

UNIVERSITY OF SOUTH AUSTRALIA  
SCHOOL OF NATURAL AND BUILT ENVIRONMENTS

STRUCTURAL ANALYSIS EXAMINATION, NOVEMBER 2005

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**GENERAL INSTRUCTIONS TO CANDIDATES:**

1. Attempt ALL questions.
2. Marks for questions are shown in brackets.
3. The following material may be taken into the exam:
  - 1 x double-sided A4 sheets of student notes

Lecturer: Y .Zhuge

Course: LBMI / LBMP/LBEC

Reading Time: 10 mins

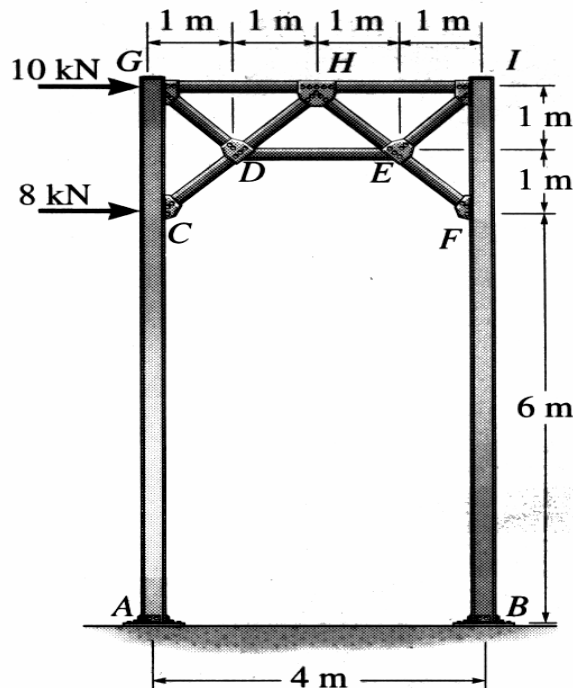
Exam Duration: 2 hours

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**QUESTION 1**

Determine (approximately) the reaction at the fixed column support **A**. Also find the force in truss members **CD** and **GD** of the portal frame. Draw the moment diagram for column **ACG**. Assume all members of the truss are pin connected at their ends and the supports at A and B are fixed.

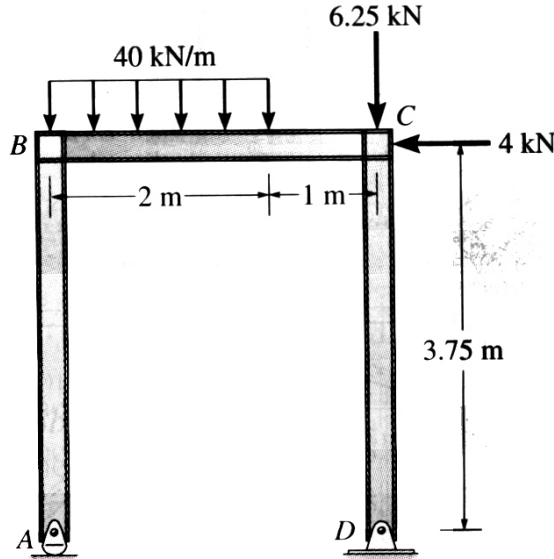


[12 marks]

Contd/...

**QUESTION 2**

Find out the support reactions at **A** and **D** and then draw the shear force and bending moment diagrams for the whole frame. Assume joints **B** and **C** are fixed connected (rigid joints). Also assume the support at **A** is a roller and **D** is a pin.



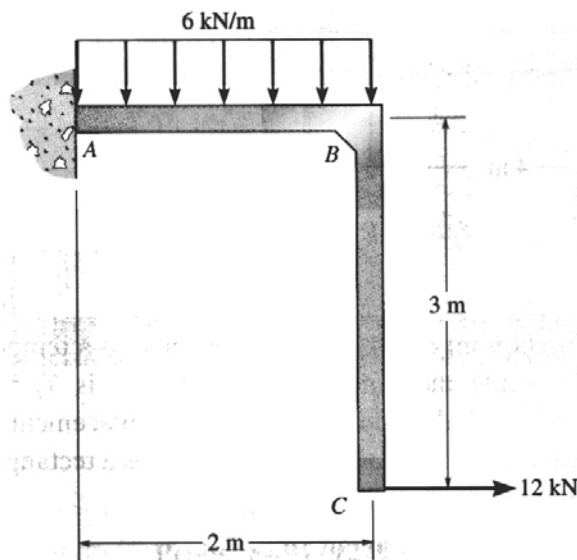
[12 marks]

**QUESTION 3**

Determine the horizontal displacement at **C**:

(a) using the table; (b) by integration.

Take  $E = 200 \text{ GPa}$ ,  $I = 90(10^6) \text{ mm}^4$  for each member. A table for evaluating the integrals is attached.



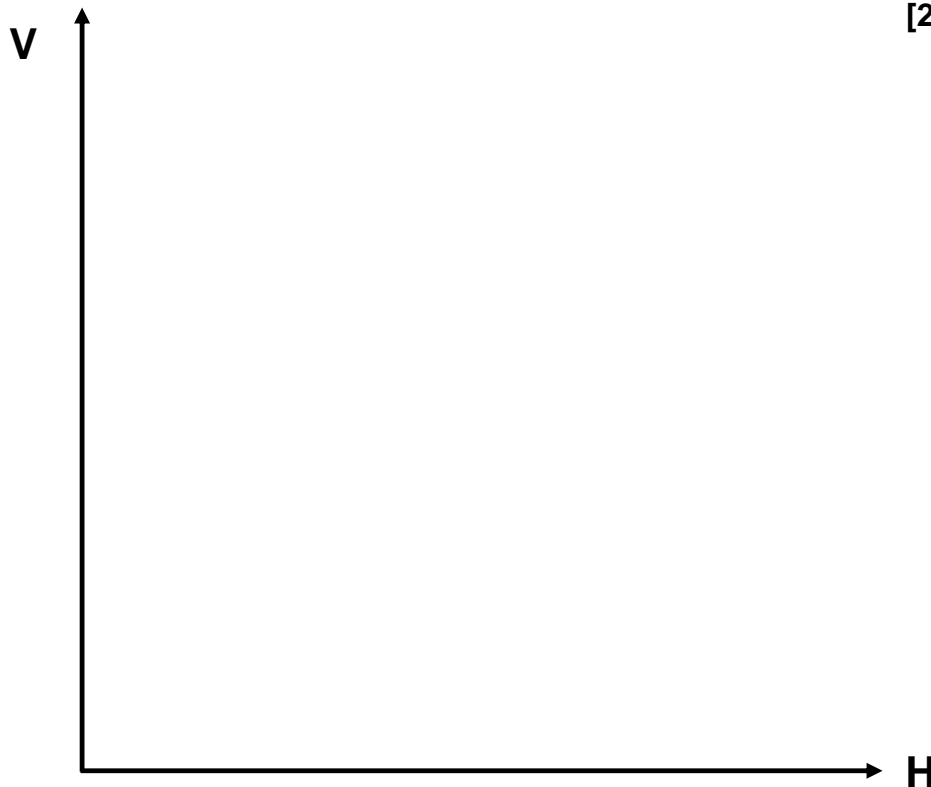
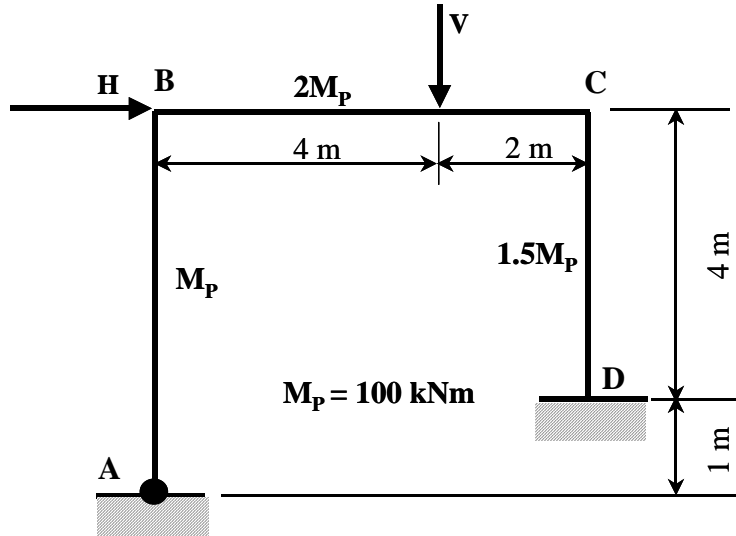
[16 marks]

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**QUESTION 4**

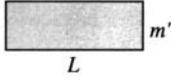
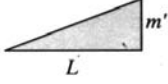
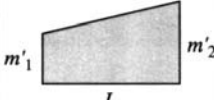
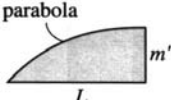
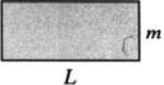
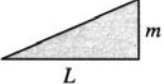
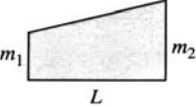
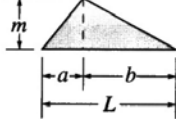
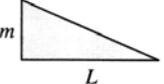
The portal frame carries the vertical (**V**) and horizontal (**H**) load.

- a) Assume that **V** and **H** vary independently of each other. Draw the interaction diagram (ID) (use the graph sheet below) and shade the permissible loading region.
- b) What are the collapse loads and corresponding collapse mechanism when  $V=2.5H$ ?
- c) Find the reactions at the supports and draw the bending moment diagram (BMD) for case under b)



[20 marks]

Table for Evaluating  $\int_0^L m m' dx$

$\int_0^L m m' dx$				
	$mm'L$	$\frac{1}{2}mm'L$	$\frac{1}{2}m(m'_1 + m'_2)L$	$\frac{2}{3}mm'L$
	$\frac{1}{2}mm'L$	$\frac{1}{3}mm'L$	$\frac{1}{6}m(m'_1 + 2m'_2)L$	$\frac{5}{12}mm'L$
	$\frac{1}{2}m'(m_1 + m_2)L$	$\frac{1}{6}m'(m_1 + 2m_2)L$	$\frac{1}{6}[m'_1(2m_1 + m_2) + m'_2(m_1 + 2m_2)]L$	$\frac{1}{12}[m'(3m_1 + 5m_2)]L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'(L + a)$	$\frac{1}{6}m_1[m'_1(L + b) + m_2(L + a)]$	$\frac{1}{12}mm'\left(3 + \frac{3a}{L} - \frac{a^2}{L^2}\right)L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'L$	$\frac{1}{6}m(2m'_1 + m'_2)L$	$\frac{1}{4}mm'L$