0045

Ollscoil na hÉireann, Gaillimh

National University of Ireland, Galway

Semester 1 Examinations, 2005/2006

Exam Code(s)	3BE121, 3BV121
Exam(s)	3rd Civil and Environmental Engineering
Module Code(s)	CE320
Module(s)	Solids and Structures I
Paper No.	
Repeat Paper	
External Examiner(s)	Professor M. O'Mahony
Internal Examiner(s)	Professor P. O'Donoghue
	Dr. P. D. Rodd
Instructions:	Answer Four Questions, Two from Section A and Two from Section B Answer Sections A and B on separate answer books
Duration	3 Hrs.
No. of Answer books	2
Requirements:	
Handout	
MCQ	
Statistical Tables	
Graph Paper	Yes
Log Graph Paper	
Other Material	
No. of Pages	
Department(s)	

Ollscoil na hEireann, Gaillimh
National University of Ireland, Galway
SEMESTER 1 EXAMINATIONS, 2006
Third Civil and Environmental Engineering Examination
Solids and Structures I
Professor M. O'Mahony
Professor P. O'Donoghue
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Time allowed: Three hours
Attempt *Four* Questions, *Two* from Section A and *Two* from Section B.
Answer Sections A and B on separate answer books.

Section A. Mechanics of Solids

1 (a) Assuming linear elastic behaviour, plot the stress distribution over cross section A-A of the offset link shown in Figure Q1 under the action of the 15 kN forces shown. (8 marks)

(b) If the link were made of material with a yield stress of 250 MPa, what increase in the 15 kN force would cause full plasticity at the section? (12 marks)

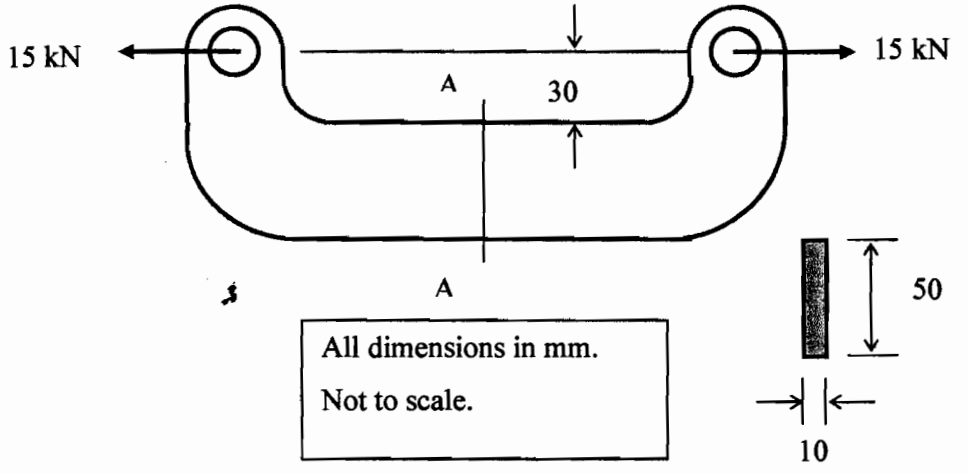


Figure Q1

Section AA

2 At a point on the surface of an aluminium component a 45° rosette strain gauge, orientated as shown in Figure Q2, indicated strains of ε_A=400 με, ε_B=300 με, and ε_C= -200 με. Determine:-

(a) the principal strains at the point (10 marks)

[Graphical solutions should be plotted on graph paper]

(b) the principal stresses at the point (6 marks)

(c) the orientations of the principal planes (4 marks)

Young's modulus of elasticity for aluminium E = $70x10^3$ MPa and Poisson's ratio ν=0.3

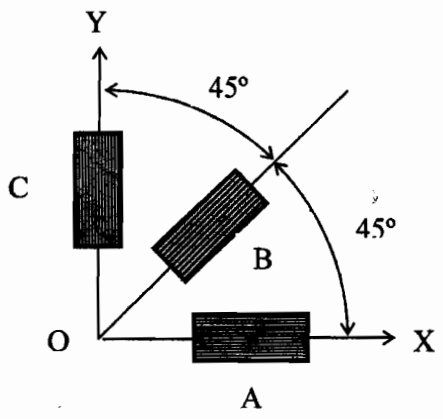
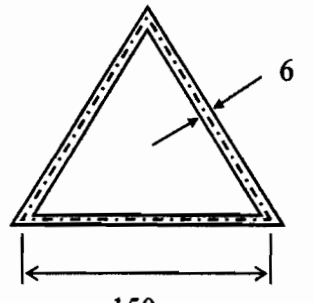


Figure Q2



Dimensions in mm

Not to scale

Figure Q3

3 (a) For a two-dimensional stress system show that the strain energy due to shear is given by $U = 1/2 \int \tau_{yx}^2 \, dV / G$ (10 marks)

(b) The cross section of a thin-walled tube is in the form of an equilateral triangle as shown schematically in Figure Q3. The length along the median line is 150 mm and the wall thickness is 6 mm throughout. Use the Bredt Batho formula $T = 2 q Ⓐ$ to determine the maximum torque that the section can carry for a limiting shear stress of 60 MPa. (5 marks)

(c) If a torque of 5 kNm is applied to this section determine the angle of twist over a 3 m length. (5 marks)

Assume linear elastic behaviour and a shear modulus G = $80x10^3$ MPa.

Section B. Theory of Structures

4. (a) Briefly comment on the following:

(i) The role of superposition in structural analysis. (3 marks)

(ii) The difference between flexibility and stiffness coefficients. (3 marks)

(iii) The importance of influence lines. (3 marks)

(b) For the beam shown in Figure Q4, draw the influence line for (i) bending moment at section A and (ii) shear force at a section just to the left of section B. (11 marks)

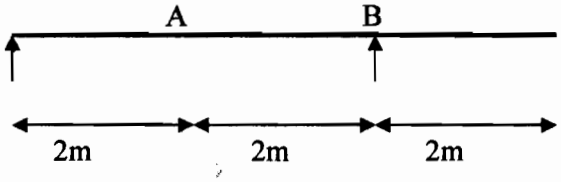


Figure Q4

5. (a) Provide qualitative assessments of the structures shown in Figures Q5(a) and Q5(b). Note that a full analysis is not required. (8 marks)

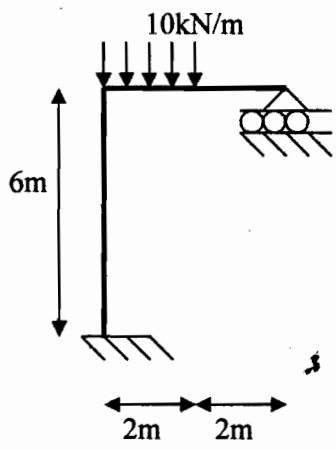


Figure Q5(a)

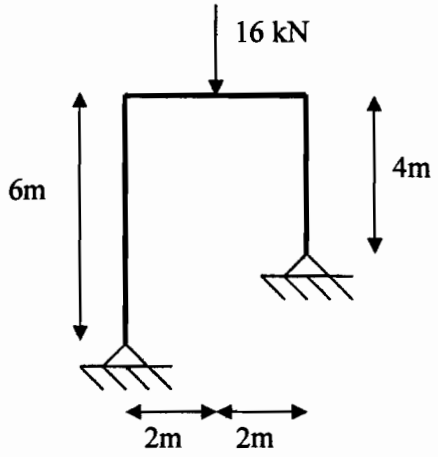


Figure Q5(b)

P.T.O.

(b) Use the Principle of Virtual Work to analyse the frame shown in Figure Q5(c). Draw the bending moment diagram. (12 marks)

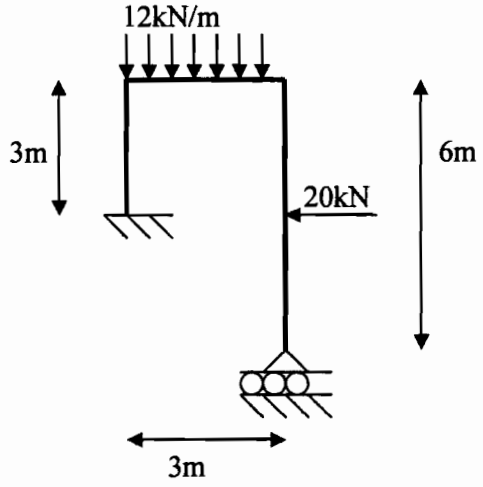


Figure Q5(c)

6. (a) In relation to the use of the method of moment distribution

(i) What are distribution factors at a joint? (2 marks)

(ii) How are distribution factors calculated? (2 marks)

(iii) Why is the carry over factor necessary? (2 marks)

(b) For the beam, EI constant, shown in Figure Q6, use moment distribution to draw the bending moment diagram. (14 marks)

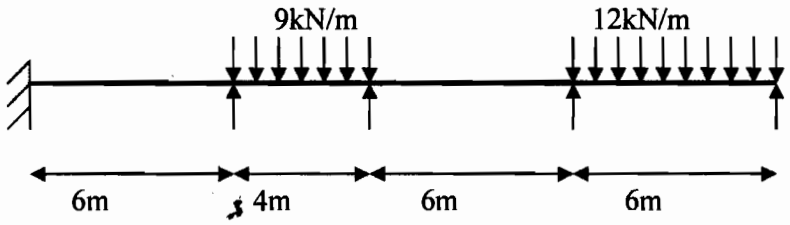


Figure Q6