GX480

Ollscoil na hÉireann, Gaillimh

National University of Ireland, Galway

FIRST SEMESTER EXAMINATIONS, 2000

Third Civil and Environmental Engineering Examination

Solids and Structures I

Professor R.A. Falconer

Professor P. O'Donoghue

Dr. K. McNamara

Time allowed: *Three* hours

Attempt *Four* Questions – **two from each section**

Use separate answer books for section A and section B

SECTION A

1. ***ANSWER only one part of this question (PART I or PART II)***

PART I

The strains at a point on a linear elastic material are ε_{xx} =300με; ε_{yy} = 600με and γ_{xy} = 900με. Young's modulus for the material is E = 68.9x10^3 MPa and Poisson's ratio ν = 0.3.

a) Find the principal strains at the point.
[Graphical solution should be plotted on graph paper.]

b) Find the principal stresses at the point.

c) Describe how electrical resistance strain gauges may be used to measure strains at a point in a two-dimensional strain field.

Or PART II

a) Find the principal axes and principal second moments of area of the unequal leg angle section shown.

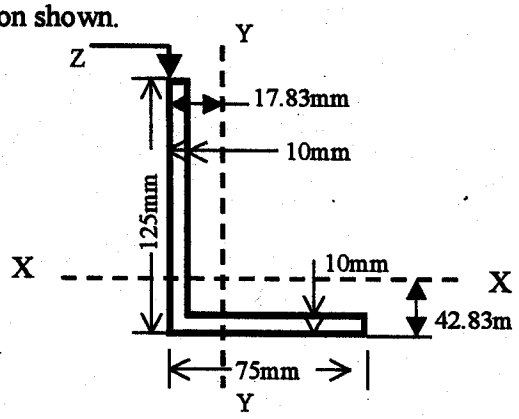

Fig. Q1

X&Y are centroidal axes

I_{xx} = 3.047x10^{6}mm^4
I_{yy} = 840x10^{3}mm^4
I_{xy} = -922x10^{3}mm^4

b) If a bending moment of 10 kNm is applied about the X-X axis find the stress at point z.

PTO

2. I) Derive Mohr's first and second theorems for the Moment Area Method.

II) One end of a fixed-fixed linear elastic beam rotates through an angle θ as shown in the figure. The self-weight of the beam may be neglected.

a) Using the Moment Area Method or otherwise find:

i) The fixed end moments M_A and M_B

ii) The reactions R_A and R_B.

b) If the span L is 5m, EI = 6069 kNm^2 and θ = 1°, plot bending moment and shear force diagrams on graph paper for the beam shown.

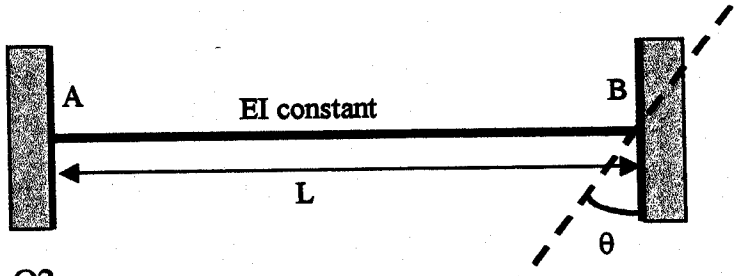

Fig. Q2

SECTION B

Answer any two questions

3. (i) Distinguish between

(a) Statically determinate and statically indeterminate structures

(b) A bending moment diagram for a beam and the influence line for bending moment

(c) Work and complementary work

(ii) For a cantilever beam of length, ℓ, draw the influence line for

(a) bending moment at mid span

(b) the reaction force at the support point

4. Explain the Principle of Virtual Work.

Use the Principle of Virtual Work to determine the support reactions for the frame in Figure Q5. Draw the shear force diagram for the frame. (**EI** constant)

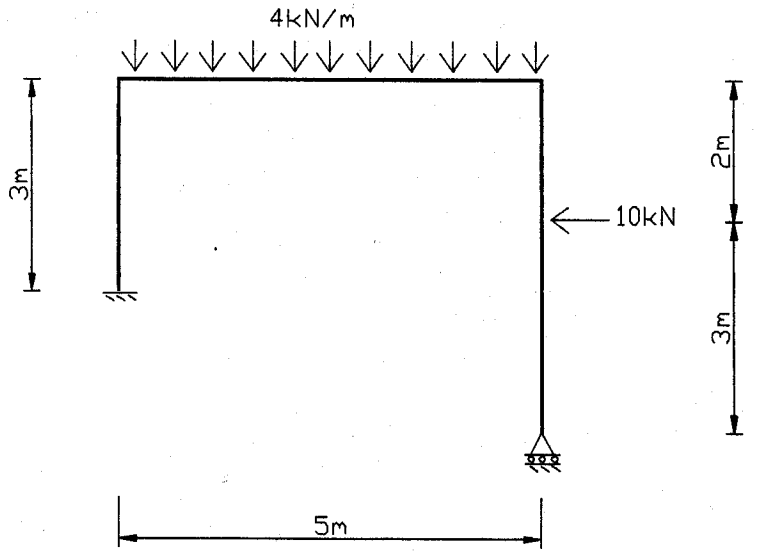

Fig. Q5

5. Compare the use of the method of Moment Distribution and the Principle of Virtual Work as approaches to determine the bending moments in continuous beams.

Use the method of Moment Distribution to draw the bending moment for the continuous beam shown in Figure Q6. (**E** constant throughout, Moment of Inertia **2I** in left hand bay and **I** in remaining bays.)

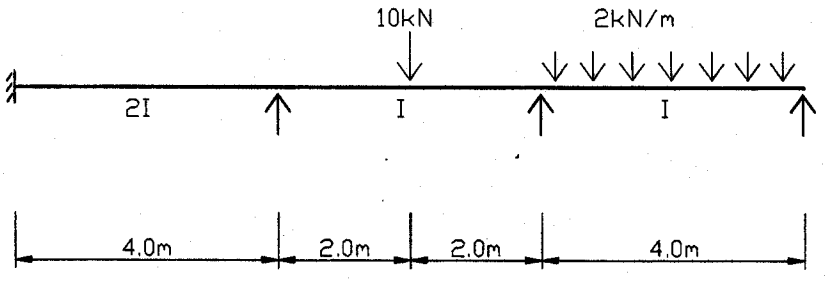

Fig. Q6