GX510

Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway

SECOND SEMESTER EXAMINATIONS 1999

SECOND ENGINEERING EXAMINATION

STRENGTH OF MATERIALS

Professor A. Cusens;
Professor P. E. O'Donoghue;
Tadhg Kennedy, BE.

NOTE:
Repeat students who didn't sit the first semester examination, must answer section A and section B. Five questions must be answered, not more than three from any one section. (*Time Allowed Three Hours*)

Non-repeat students must answer Three questions from section B. (*Time Allowed Two Hours*)

SECTION A

1. Explain briefly the meaning of the following terms,
   - Equilibrium
   - Statically determinate beams

   Calculate the internal forces and the deformations in the members ***bc*** and ***gf*** in the pin jointed simply supported truss in Figure 1. The length of each member is 3m and they have a cross sectional area of 300mm^2. E = 200 GN/m^2.

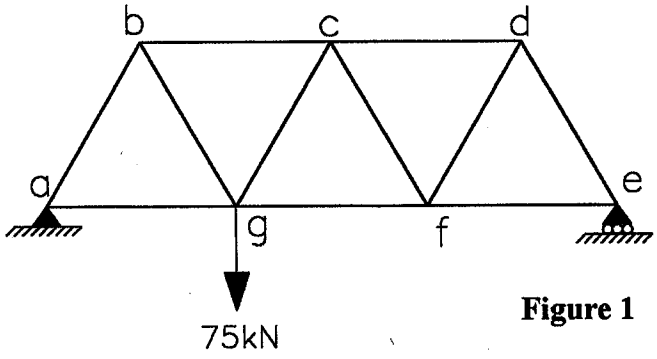

Figure 1

2. Stating your assumptions clearly and defining the symbols, derive the torsion formula for a **solid circular shaft**

$$\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{r}$$

A solid brass cylinder of radius 32mm and length 450mm is subjected to a torsional loading which results in a maximum shear stress of 80×10^6 N/m^2. Find the torsion applied to the cylinder and the relative rotation of the two ends.
$G = 38.3 \times 10^9$ N/m^2.

3. Find the position of the greatest dip and the maximum tension in the cable.

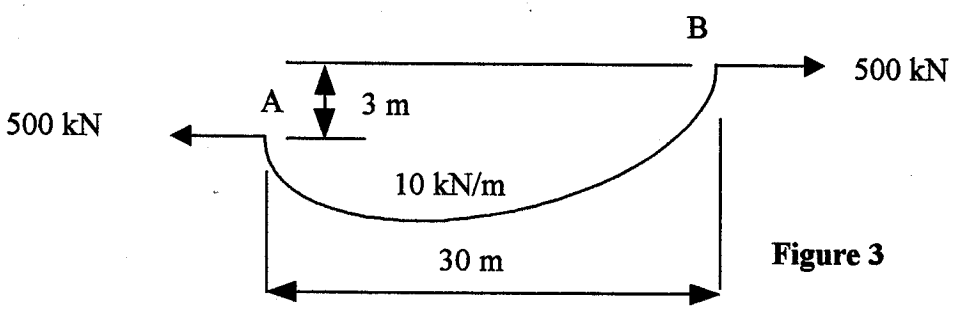

Figure 3

4. Indicate by means of neat sketches the difference between a butt weld and a fillet weld.

Determine the maximum allowable axial tensile load for the joint shown in figure 4. The main plates are 16mm thick and 200mm wide. Each cover plate is 12 mm thick and the bolts are 20 mm in diameter. The allowable stresses are 180 N/mm^2 in tension (plate), 320 N/mm^2 in bearing (plate) and 90 N/mm^2 in single shear (bolt). Assume ordinary bolts are used and that the diameter of the holes are the same as the bolts.

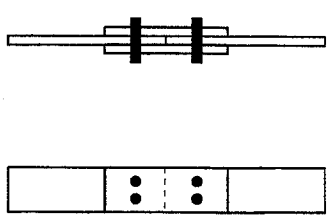

Figure 4

SECTION B

5. Figure 5 shows the vertical cross section of a beam which is subjected to a vertical shear force of 30kN. Draw, to a suitable scale, a diagram showing the distribution of shear stresses through the depth of the section.

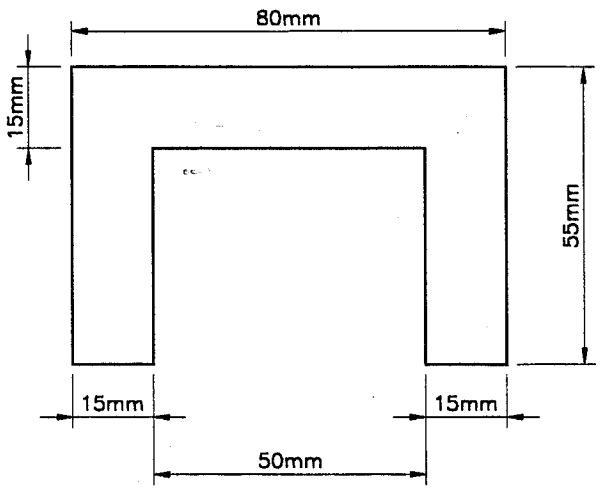

Figure 5

6. Stating your assumptions clearly, derive the bending stress formula for beams.

$$\sigma = -\frac{My}{I}$$

A cantilever beam, 10m long, has a cross section as shown in Figure 6. The beam carries a concentrated load of 1kN at the free end. Calculate the maximum bending stress in the cross section due to the applied loading. Ignore self-weight.

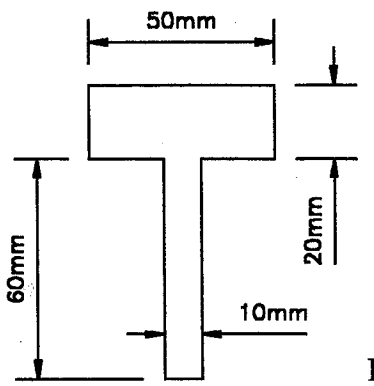

Figure 6