MASSACHUSETTS INSTITUTE OF TECHNOLOGY
13.10J/1.573J
Problem Set 8

Assigned : October 24, 2002
Due : October 30, 2002

- From your book : 11.72

1. A bending couple of magnitude $M_0 = 3.5kN \cdot m$ acting in a vertical plane is applied to a beam having the Z-shaped cross section as shown in Figure 1. The moments and product of inertia of the section with respect to the y and z axes have been computed and are $I_{yy} = 3.25 \times 10^{-6}m^4$, $I_{zz} = 4.18 \times 10^{-6}m^4$ and $I_{yz} = 2.87 \times 10^{-6}m^4$. Find (a) the principal axes ξ, η orientation and $I_{\xi\xi}$, $I_{\eta\eta}$(with $I_{\xi\eta} = 0$), (b) the stresses (normal and shear) at point A and (c) the angle that the neutral axis forms with the horizontal plane.

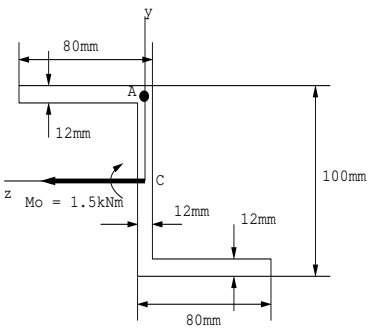

Figure 1: A diagram for problem 1

2. A steel beam, with Young's modulus E_s, and an aluminum beam, with Young's modulus E_a, where $E_s = 2E_a$, are joined together continuously to form a cantilever beam as shown in Figure 2. The individual beams have the same width, W, and height, H, and $W = 3H$.

   (a) To minimize the end deflection using configuration (A), does it matter whether the steel is on the top or bottom? Justify your answer.

   (b) What is the shear stress the joint must be able to withstand if the beams are oriented as in configuration (A)?

   (c) Where is the shear center if the beams are oriented as in configuration B? Assume the steel is on the left.

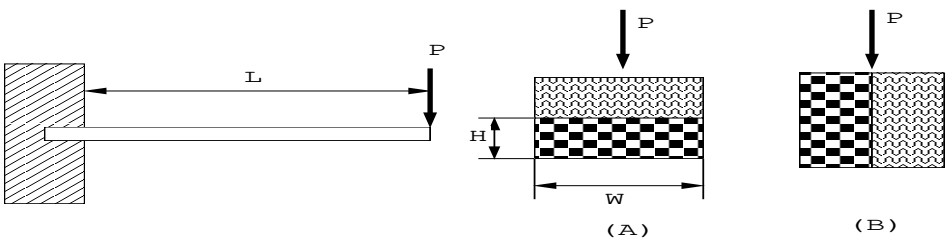

Figure 2: A diagram for problem 2