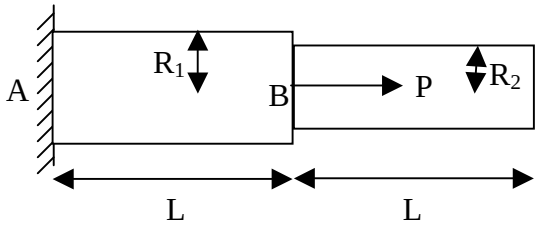
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Department of Mechanical Engineering
2.001 Mechanics and Materials I
Fall 2006

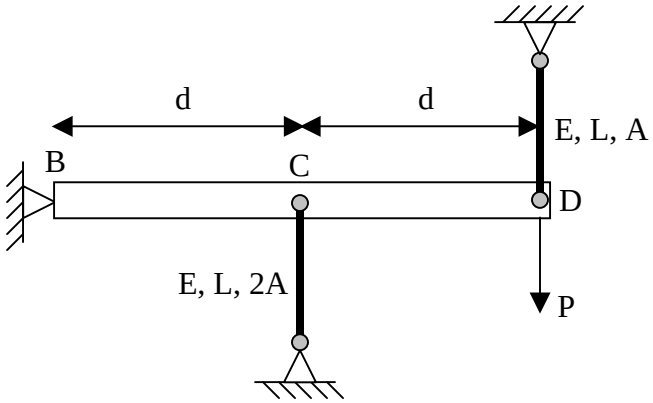
Problem Set 4

Distributed: Wednesday, October 4, 2006
Due: Wednesday, October 11, 2006

Problem 1: A structure is attached to a wall by a fixed support as shown in the diagram below. From point A to point B, the structure is a cylinder with radius R_1. From point B to point C, the structure is a cylinder with radius R_2. Before the structure is loaded at point B with the force P, the length of each cylinder (AB and BC) is L. The entire structure is made of the same material, which has a Young's modulus of E. Find the strain $\varepsilon(x)$ and the displacement $u(x)$ of each point x along the length of the structure, and plot them vs. x. What is the total deformation δ_{AB} of cylinder AB when the load is applied? What is the total deformation δ_{BC} of cylinder BC when the load is applied?



Problem 2: A rigid bar is supported by a pinned support at point B and by two deformable bars at points C and D as shown in the diagram below. Each deformable bar has a Young's modulus of E and a length L. The bar attached at D has a cross-sectional area of A, and the bar attached at C has a cross-sectional area of 2A. What is the displacement of point D and what are the forces in bars C and D when the load P is applied?



Problem 3: Do Hibbeler's problem 3.16. (E = 200 GPa for steel.)

Problem 4: Do Hibbeler's problem 4.27.

Problem 5: Do Hibbeler's problem 4.21.

Problem 6: Do Hibbeler's problem 4.33.

Problem 7: A cylinder is attached to a wall at point A by a fixed support as shown in the diagram below. The half of the cylinder from point A to point B is made of steel (E = 200 GPa) and has a length of 1 m and a diameter of 1 cm; the half of the cylinder from point B to point C is made of aluminum (E = 70 GPa) and has a length of 1 m and a diameter of 1 cm. Before the cylinder is loaded, the free end (point C) is separated from a second wall by a distance of 0.5 mm.

a) At what value of the load P does the cylinder first touch the second wall?
b) At what value of the load P does the strain at the points between B and C equal 0.1%? (That is, what is P when ε(inside the Al) = 0.1%?).