MASSACHUSETTS INSTITUTE OF TECHNOLOGY
13.10J/1.573J Structural Mechanics
13.014 Materials and Structures
1.052 Mechanics of Structures
Problem Set 4

Assigned : September 27, 2000
Due : October 4, 2000

1. Undergraduate students (1.052) : 4.9, 5.33, 5.62, 5.64

2. For undergraduate students (13.014) : 4.9, 5.62, 5.64 and

   Consider the superficial hardness test (load 15kg on a spherical indentor) on flat steel specimen. The gauge reading on the Rockwell aparatus was 70. Using the chart the corresponding hardness is $H = 660N/mm^2$. Calculate the flow stress from the above hardness value. And calculate the hardness directly from its definition and measured reading of a circular indentation. Compare the above values with the stress-strain curve measured in the tensile test (Laboratory 1).

3. For graduate students (13.10J/1.573J) : 4.11, 5.55, 5.64, 6.20,

4. A problem for all students (13.10J/1.573J, 13.014, 1.052)

   A homogeneous plate $ABCD$ (See Figure 1) is subjected to a biaxial loading which results in the normal stresses $\sigma_x = 150MPa$ and $\sigma_z = 100MPa$. Knowing that the plate is made of steel for which $E = 200GPa$ and the Poisson's ratio $\nu = 0.30$, determine the change in length of (a) edge AB, (b) edge BC, and (c) diagonal AC.

5. A problem for graduate students only (13.10J/1.573J)

   A long rod hanging vertically in a well supports a load P at its lower end as shown in Figure 2. The material has the bilinear stress-strain

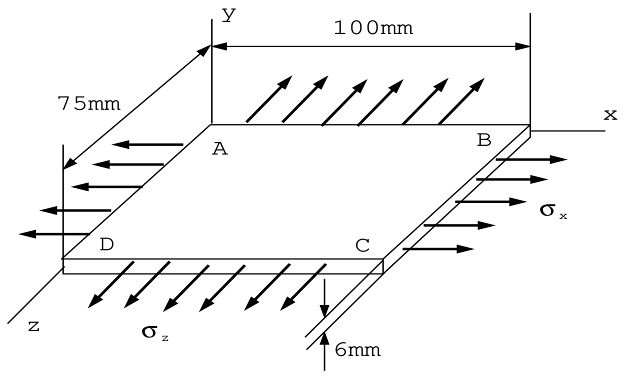

Figure 1: A plate ABCD under stresses

curve shown in the figure, in which E_1 and E_2 represent the slopes of the two parts of the diagram. Find the elongation δ of the bar due to its own weight and the force P if the unit weight $\gamma = 28kN/m^3$, the cross-sectional area $A = 960mm^2$, the length $L = 360m$, and the load $P = 92kN$.

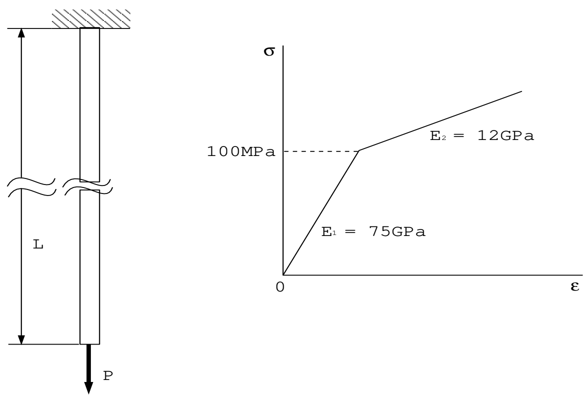

Figure 2: A rod and its $\sigma - \epsilon$ graph

Problem sets are available also in the course homepage.