UNIVERSITY OF CALIFORNIA, BERKELEY College of Engineering

Introduction to Solid Mechanics (ME85/C30)

Mid-term Examination (Fall 2013)

Problem 1. A truss structure is shown in Figure 1. Use the method of section to find the internal forces in bar JI and bar JC. (30 points)

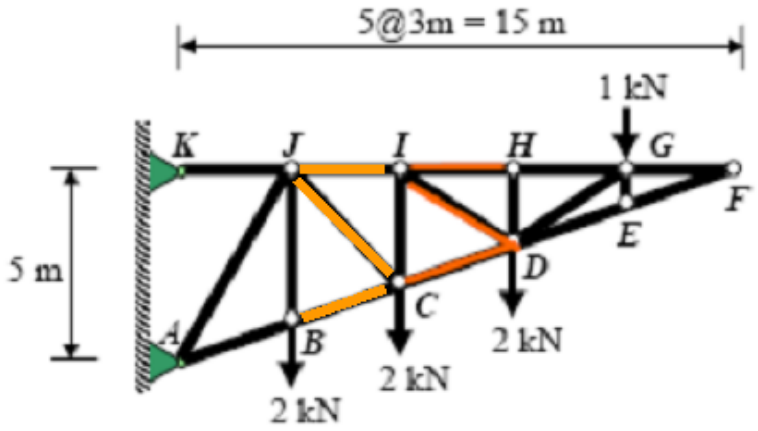

Figure 1: A truss structure under multiple loads

Problem 2. A planar structure consists of two bent bars as shown in Fig. 2. Determine the reaction forces at A and B caused by the application of a vertical force P at C.

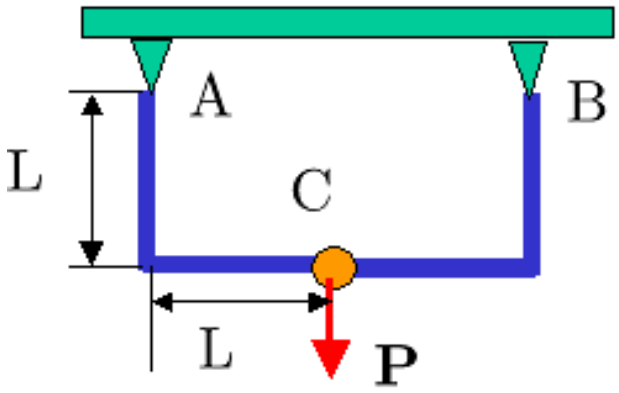

Figure 2: A three-hinge arch truss system

(25 points)

Problem 3.

For a two-bar system shown in the figure, determine: (a) the flexibility constant for each bar, (b) the compressive force in the bars after a temperature rise of 100^oC, and (c) the stress in each bar.

Hints:

First write down the displacement compatibility condition. Thermal strain: $\epsilon_T = \alpha \Delta T$; $\Delta = \frac{L}{EA} P = fP$. (25 points)

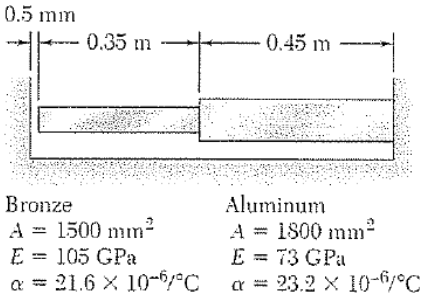

Figure 3: An axially deformed bar with two different cross sections and two different materials.

Problem 4. Multiple Choose Questions (Each question 5 points):
A. Which of the following stress states are possible equilibrium stress state ?

$$(a): \begin{bmatrix} 5 & 3 \\ 3.01 & 4 \end{bmatrix}, \ (b): \begin{bmatrix} 5 & 3 \\ 3 & 4 \end{bmatrix}, (c): \begin{bmatrix} 0 & 2.99 \\ 3 & 4 \end{bmatrix}, \ (d): \begin{bmatrix} -5 & 3 \\ 3 & -3 \end{bmatrix},$$

B. Which of the following statements are incorrect: The shear strain

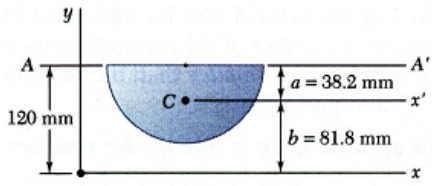

Figure 4: Second moment for a semi-circle.

(a) is a relative elongation;
(b) is the change of angle;
(c) has nothing to do with temperature;
(d) has something to do with change of shape;
(e) has something to do with change of volume.

C. The semi-circle shown in Fig. 4 has the radius r, and area $A = \pi r^2/2$, and the moment of inertia with respect to axis $AA^{'}$, $I_{AA'} = \pi r^4/8$. The centroidal axis is x'-axis. Which of the following is the moment of inertia w.r.t. x-axis for the semi-circle shown in the figure:

$$(a) I_x = \frac{\pi r^4}{8} + (a+b)^2 A; \ (b) I_x = \frac{\pi r^4}{8} + a^2 A; \ (c) I_x = \frac{\pi r^4}{8} + b^2 A; \ \ (d) I_x = \frac{\pi r^4}{8} - a^2 A + b^2 A; \ (e) I_x = \frac{\pi r^4}{8} + (a^2 + b^2) A \, .$$

Hint: Parallel axis theorem:

$$I_x = I_{Cx} + d^2 A$$

(**D**) For the structure shown in Fig. 1, which of the following members are not zero-force member ?

$$(a) GF; \ (b) HD; \ (c) IC; \ (d) DE; \ (e) EF; \ (f) GE \, .$$

(20 points)