UNIVERSITY OF CALIFORNIA, BERKELEY College of Engineering

# (C30/ME85) Fall 2014

## The Midterm Exam Problems

**Problem 1**

Find: (1) The global centroid of the composite shape (T-beam) by using the formula,

$$\bar{y} = \frac{\sum_{i=1}^{2} y_i A_i}{\sum_{i=1}^{2} A_i};$$

(2) The moment of inertia of $I_x$ for the T-beam shown in Figure 1, in which $H = 10mm$ and $B = 100mm$. Note that for the rectangular shapes shown in Fig. 1, the moment of inertia with its local centroidal axis is either,

$$\bar{I}_x = \frac{BH^3}{12} \text{ or } \bar{I}_x = \frac{HB^3}{12}.$$

(25 points)

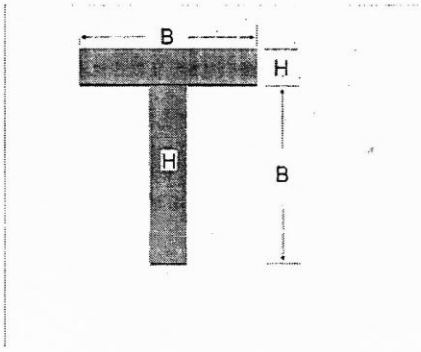


Figure 1: A T-beam

**Problem 2.**

An external force P is applied at the joint (C) of two circularly bent rods AC and BC. Both points A and B are connected to the wall with hinges as shown in Fig. 2. Find the reactions at the point A and B.

Hint: Use method of joints. (25 points)

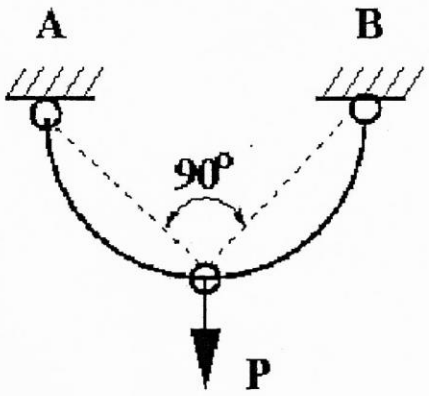


Figure 2: Two circular shaped bars

**Problem 3.**

Consider a two elastic bar system with an external force acting at the connecting point of the two bars. The dimension as well as material constants are given in Figure 3. Initially, there is a gap between the tip of the bronze bar and the wall (0.5 mm). There is a temperature rise, $\Delta T = 50C^o$, so that under the thermal expansion as well as the applied load the bronze bar may (or may not) contact with the wall, and the system becomes statically indeterminant.

First, find the flexibility of each bar shown in Figure 3. Second, find the reaction forces $R_1$, $R_2$.

Hint: The thermal strain can be calculated by the formula $\epsilon_T = \alpha \Delta T$.

(25 points)

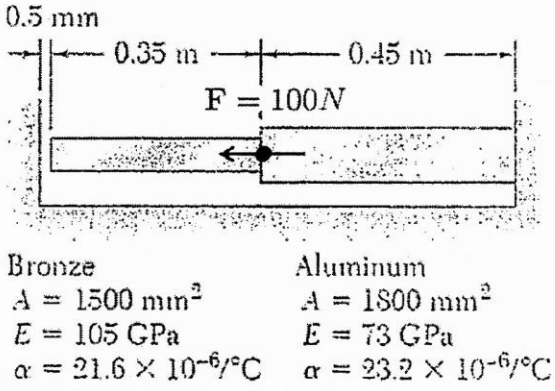


Figure 3: A two-bar system with an external force

**Problem 4.**

A steel bar is fixed on the ground at point B. At the top of the steel bar, there is a rope that exerts a tensile fore $F = 100N$ on the bar at the point A.

Find the moment that the tensile force $\mathbf{F}$ generated at the point B.

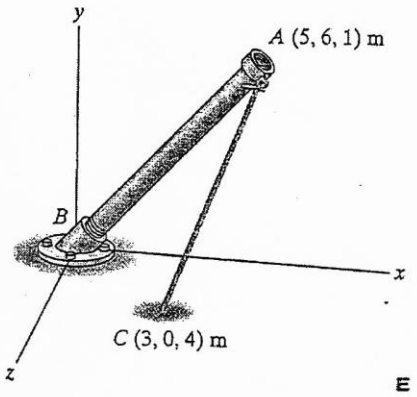


Figure 4: Problem 4.

The moment may be calculated by

$$\mathbf{M}_B = \mathbf{r}_{BA} \times \mathbf{F} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix}$$

(25 points)