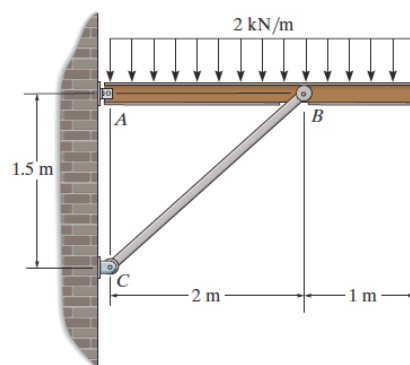


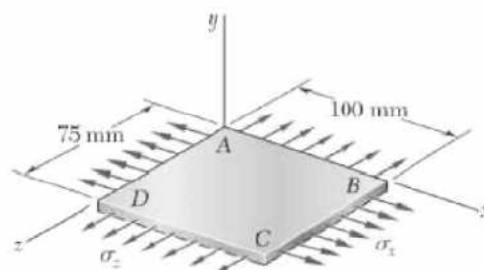
*Exam 1*  
*November 19, 2011*  
*120 minutes*

**Problem 1 (25 Points)**

- (a) Draw the shear and moment diagrams for beam AB.
- (b) Calculate the cross-sectional areas of the round steel bar BC. Given that the ultimate stress in steel is 70 Ksi. Use a factor of safety of 2.5.

**Problem 2 (15 Points)**

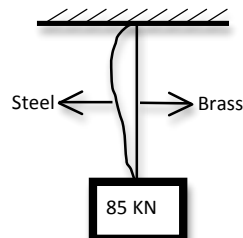
The 5mm thick plate shown in the figure below is subject to a biaxial loading that results in a normal stress  $\sigma_x = 120 \text{ MPa}$  and  $\sigma_z = 160 \text{ MPa}$ . Knowing that the properties of the plate can be approximated as  $E = 87 \text{ GPa}$  and  $\nu = 0.34$ , determine the change in length of (a) side AB, (b) side BC, and (c) diagonal AC.



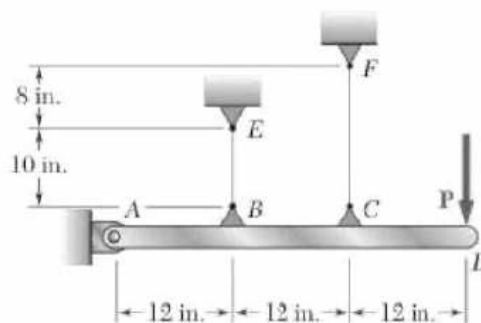
**Problem 3 (20 Points)**

In the figure shown below, the steel wire is 5mm longer than the brass wire. Find the stress and total elongation of each wire.

Given:  $A_b = 2 \text{ mm}^2$   $E_b = 100 \text{ GPa}$   $L_b = 100 \text{ mm}$   
 $A_s = 0.35 \text{ mm}^2$   $E_s = 300 \text{ GPa}$

**Problem 4 (25 Points)**

The rigid bar AD is supported by two steel wires 1/16 inches diameter ( $E = 29 \times 10^6 \text{ psi}$ ) and a pin bracket at A. Determine (a) the tension in each wire when a 220-lb load P is applied at D, and (b) the corresponding deflection at D.

**Problem 5 (15 Points)**

The concrete post ( $E_c = 25 \text{ GPa}$  and  $\alpha_c = 9.9 \times 10^{-6} / ^\circ\text{C}$ ) is reinforced with six steel bars, each 22mm diameter ( $E_s = 200 \text{ GPa}$  and  $\alpha_s = 11.7 \times 10^{-6} / ^\circ\text{C}$ ). Determine the normal stresses induced in the steel bars in the concrete by a temperature rise of  $35^\circ\text{C}$ .

