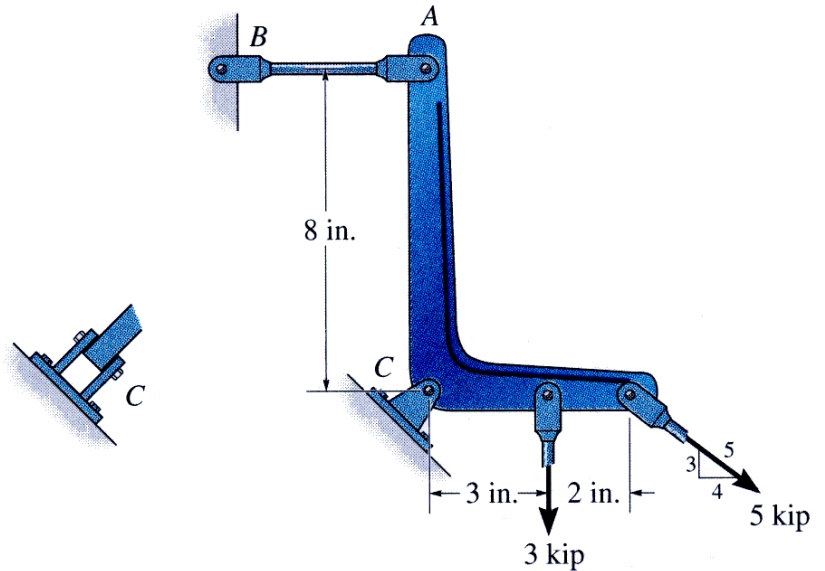# BE 110 - Mechanics of Materials - Fall 2003
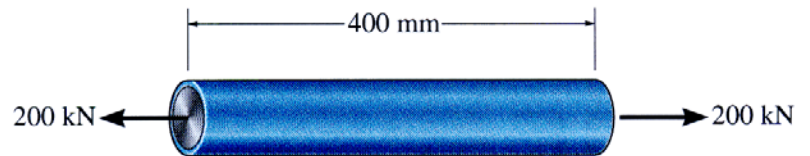
Exam 1 – Stress; Strain; Axial Structures; Torsion Structures

Name:

Section: C

1. The control arm is subjected to the loading shown. Determine the minimum diameter of the steel pin at C if the allowable shear stress for the steel is τ_{allow} = 8 ksi. Note in the figure that the pin is subjected to double shear.

2. The A-36 steel (E = 200 GPa) pipe has a 6061-T6 aluminum (E = 69 GPa) core. It is subjected to a tensile force of 200 kN. Determine the normal stress in the aluminum and the steel due to this loading. The pipe has an outer diameter of 80 mm and an inner diameter of 70 mm.
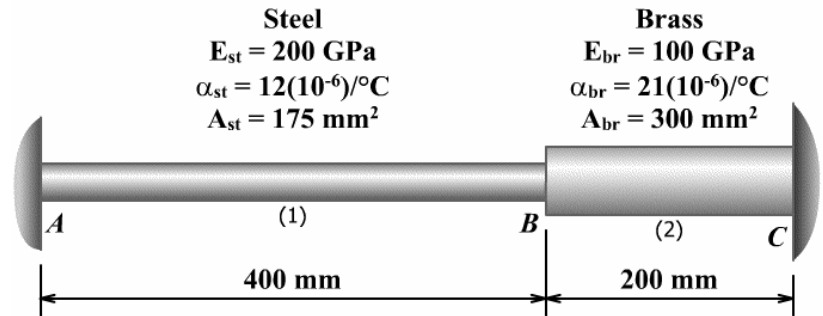

400 mm

200 kN

200 kN

3. Two bars, each made of a different material, are connected and placed between two walls when the temperature is $T_1 = 15°C$. Determine the force exerted on the (rigid) supports when the temperature becomes $T_2 = 25°C$. The material properties and cross-sectional area of each bar are given in the figure.

Steel
$E_{st} = 200$ GPa
$\alpha_{st} = 12(10^{-6})/°C$
$A_{st} = 175$ mm²

Brass
$E_{br} = 100$ GPa
$\alpha_{br} = 21(10^{-6})/°C$
$A_{br} = 300$ mm²

A   (1)   *B*   (2)   *C*

400 mm   **200 mm**

4. The 304 stainless steel (G = 75 GPa) shaft is 3 m long. When it is rotating at 60 rad/s, it transmits 30 kW of power from the engine E to the generator G. Determine the minimum diameter of the shaft if the allowable shear stress is τ_{allow} = 150 MPa and the shaft is restricted not to twist more than 0.08 rad.