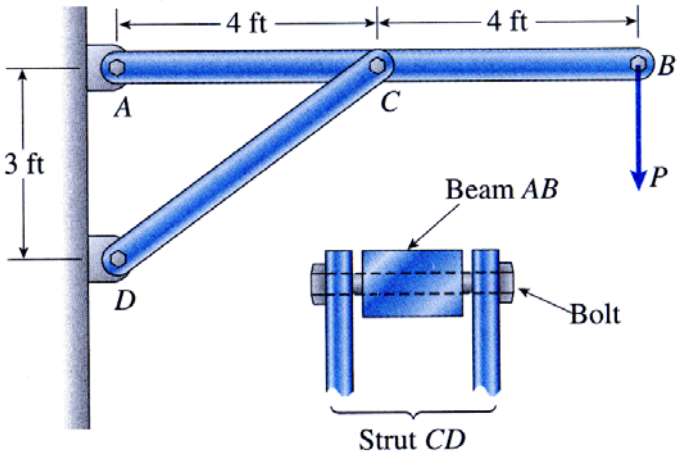
BE 110 - Mechanics of Materials - Winter 2004

Name:

Exam 1 – Stress; Strain; Axial Structures; Torsion Structures

Section: D

1. A horizontal beam *AB* supported by an inclined strut *CD* carries a load $P = 2600$ lb. The strut, which consists of two bars with cross-sectional area of 2 in^2 each, is connected to the beam by a bolt passing through the three bars meeting at joint *C*. **(a)** What is the compressive stress in the two bars of the strut? **(b)** If the allowable shear stress in the bolt is 13,500 psi, what is the minimum required diameter *d* of the bolt?



Write legibly – box answers
Include proper units

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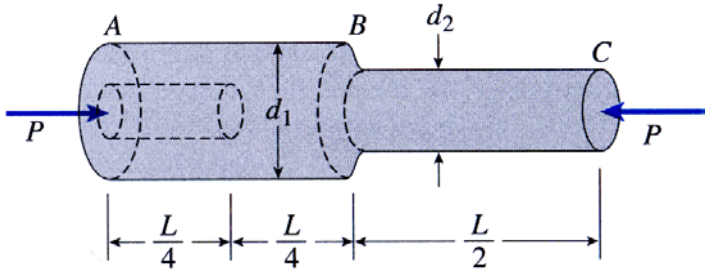
2. A bar ABC of length $L = 1.2$ m consists of two parts of equal lengths but different diameters. Segment AB has diameter $d_1 = 100$ mm and segment BC has diameter $d_2 = 60$ mm. A longitudinal hole of diameter d is drilled through segment AB for one-half its length ($L/4 = 0.3$ m). The bar is made of plastic having modulus of elasticity $E = 4$ GPa. A compressive load $P = 110$ kN acts at the ends of the bar. If the shortening of the bar is limited to 8 mm, what is the maximum allowable hole diameter d?



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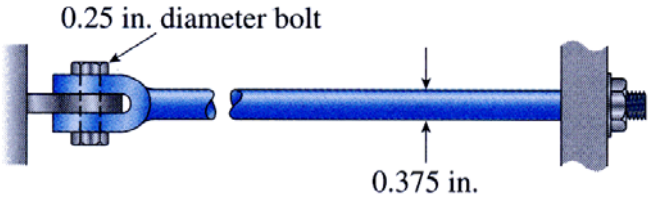
3. A steel rod of diameter 0.375 in. is held snugly (but without any initial stresses) between rigid walls by the arrangement shown. Calculate the temperature drop ΔT (in degrees Fahrenheit) at which the bearing stress between the 0.25 in. thick connecting bracket and the 0.25 in. diameter bolt becomes 7000 psi. Use $\alpha = 6.5 \times 10^{-6}/^{\circ}F$ and $E = 30 \times 10^{6}$ psi.



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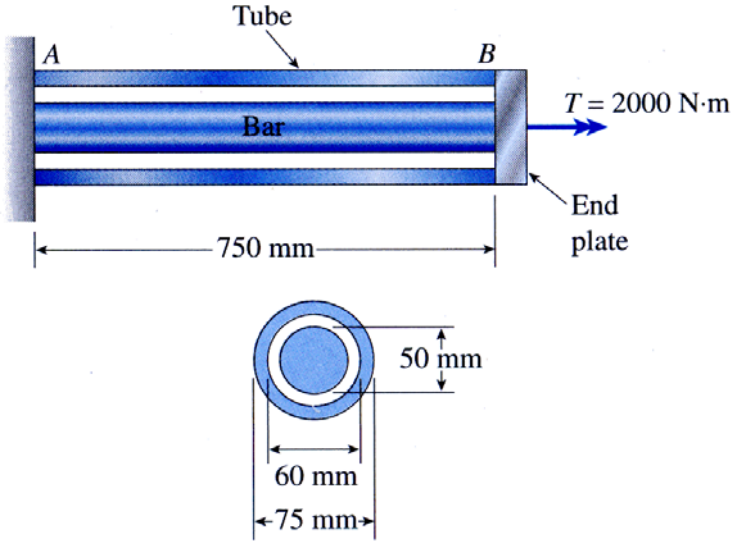
4. A solid steel bar of diameter 50 mm is enclosed by a steel tube of outer diameter 75 mm and inner diameter 60 mm. Both bar and tub are held rigidly at end *A* and joined securely to a rigid end plate at *B*. The assembly, which is 750 mm long, is twisted by a torque $T = 2000$ Nm acting at end *B*. **(a)** Determine the maximum shear stresses τ_t and τ_b in the tube and bar. **(b)** Determine the angle of rotation ϕ of the rigid plate, assuming that the shear modulus of the steel is G = 80 GPa.



Write legibly – box answers
Include proper units