Division of Engineering
Brown University

EN0310: Mechanics of Solids and Structures

Homework #4: Stress and Strain

Due on Friday, 10/09/09, 4pm outside Dr. Gao's office (BH610) in a box labeled EN 31.

Problem 2.87. A vibration isolation support consists of a rod *A* of radius R_1 = 10 mm, and a tube *B* of inner radius R_2 = 25 mm bonded to an 80-mm-long hollow rubber cylinder with a modulus of rigidity *G* = 12 MPa. Determine the largest allowable force **P** which can be applied to rod *A* if its deflection is not to exceed 2.50 mm.

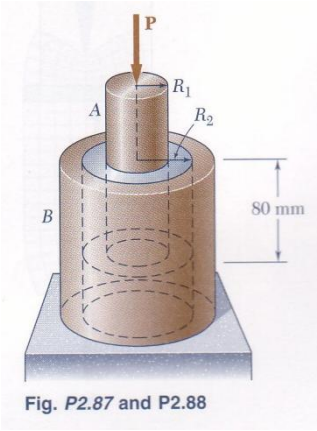
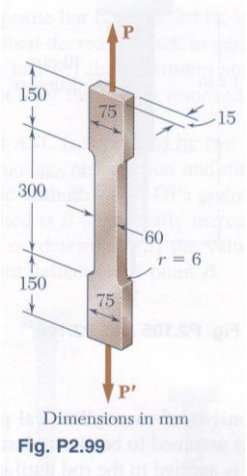


Fig. *P2.87* and P2.88

Problem 2.99. The aluminum test specimen shown is subjected to two equal and opposite centric axial forces of magnitude *P*. (*a*) Knowing that *E* = 70 GPa and σ_{all} = 200 MPa, determine the maximum allowable value of *P* and the corresponding total elongation of the specimen. (*b*) Solve part *a*, assuming that the specimen has been replaced by an aluminum bar for t he same length and a uniform 60 × 15-mm rectangular cross section.



Dimensions in mm

Fig. P2.99

Problem 2.101. Rod *AB* is made of a mild steel that is assumed to be elastoplastic with $E = 29\times10^6$ psi and $\sigma_Y = 36$ ksi. After the rod has been attached to the rigid lever *CD*, it is found that end *C* is 3/8 in. too high. A vertical force **Q** is then applied at *C* until this point has moved to position *C′*. Determine the required magnitude of **Q** and the deflection δ_1 if the lever is to snap back to a horizontal position after **Q** is removed.

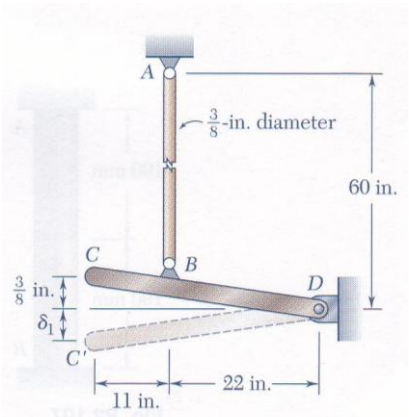


Fig. P2.101

Problem 2.104. The 30-mm square bar *AB* has a length $L = 2.5$ m; it is made of a mild steel that is assumed to be elastoplastic with $E = 200$ GPa and $\sigma_Y = 345$ MPa. A force **P** is applied to the bar and then removed to give it a permanent set δ_p. Determine the maximum value of the force **P** and the maximum amount δ_m by which the bar should be stretched if the desired value of δ_p is (*a*) 3.5 mm, (*b*) 6.5 mm.

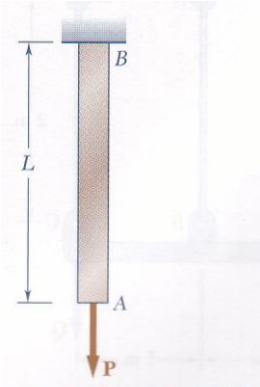


Fig. *P2.103* and *P2.104*

Problem 2.135. The uniform rod *BC* has a cross-sectional area *A* and is made of a mild steel which can be assumed to be elastoplastic with a modulus of elasticity *E* and a yield strength σ_y. Using the block-and-sprint system shown, it is desired to simulate the deflection of end *C* of the rod as the axial force **P** is gradually applied and removed, that is, the deflection of points *C* and *C′* should be the same for all values of *P*. Denoting by μ the coefficient of friction between the

block and the horizontal surface, derive the expression for (*a*) the required mass *m* of the block, (*b*) the required constant *k* of the spring.

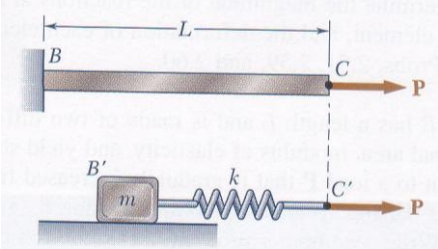


Fig. P2.135

Problem 3.2. Determine the torque **T** that causes a maximum shearing stress of 80 MPa in the steel cylindrical shaft shown.

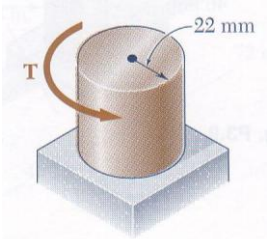


Fig. P3.1 and P3.2

Problem 3.9. The torque shown are exerted on pulleys *A* and *B*. Knowing that each shaft is solid, determine the maximum shearing stress (*a*) in shaft *AB*, (*b*) in shaft *BC*.

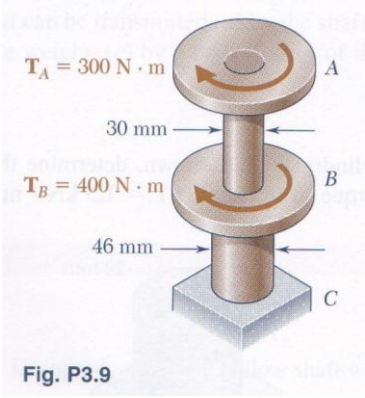


Fig. P3.9