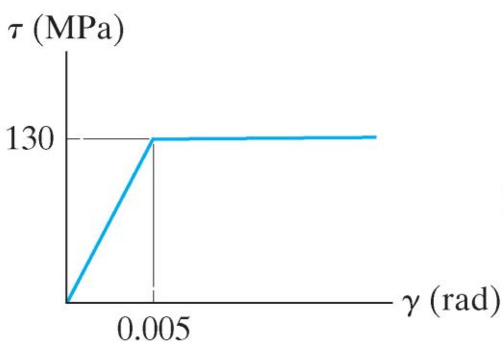
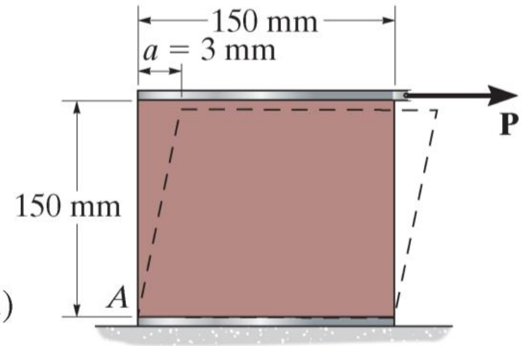
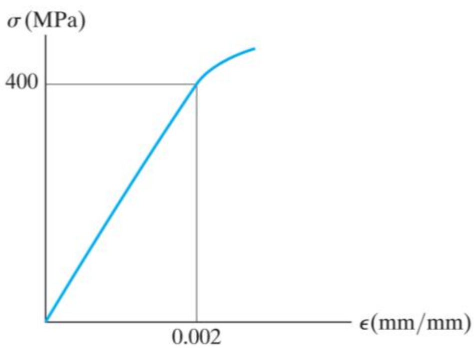
Mechanics of Materials Chapters 3 and 4 11/09/2020 by Shun-Fa Hwang

1. Please use words or figures to explain the following terms.
   (a) Yielding (b) Strain hardening (c) Offset method (d) Necking (e) Modulus of toughness [5%x5]
2. A 20-mm-wide block is bonded to rigid plates at its top and bottom. When the force **P** is applied the block deforms into the shape shown by the dashed line (虛線). If *a*=3 mm and **P** is released (釋放), determine the permanent shear strain in the block. [15%] Ans:0.015 rad

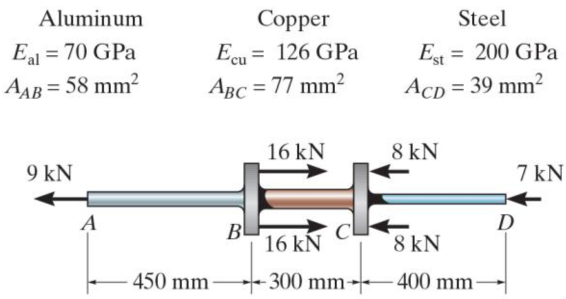




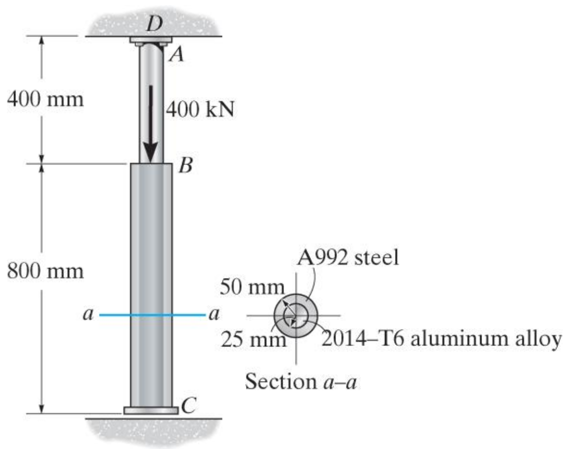
3. The elastic portion of the stress-strain diagram for a steel alloy is shown in the figure. The specimen from which it was obtained has an original diameter of 13 mm and a gauge length of 50 mm. When the applied load on the specimen is 50 kN, the diameter is 12.99265 mm. Determine Poisson’s ratio for the material. [15%] Ans:0.3



4. The composite shaft, consisting of aluminum, copper, and steel sections, is subjected to the loading shown. Determine the displacement of end A with respect to end D and the normal stress in each section. The cross-sectional area and modulus of elasticity for each section are shown in the figure. Neglect the size of the collars (領) at B and C. [15%] Ans:-0.0726 mm, 155, -299, -179 MPa



5. The 2014-T6 aluminum rod AC is reinforced with the firmly bonded A992 steel tube BC. If the assembly (組合) fits snugly (鬆緊適當地) between the rigid supports so that there is no gap at C, determine the support reactions when the axial force of 400 kN is applied. The assembly is attached at D. $E_{st} = 200\,\text{GPa}$, $E_{al} = 73.1\,\text{GPa}$. [15%] Ans:329, 35.689, 292.93 kN



6. The bar has a cross-sectional area A, length L, modulus of elasticity E, and coefficient of thermal expansion α. The temperature of the bar changes uniformly along its length from T_A at A to T_B at B so that at any point x along the bar $T = T_A + x(T_B - T_A)/L$. Determine the force the bar exerts on the rigid walls. Initially no axial force is in the bar and the bar has a temperature of T_A. [15%] Ans: $\alpha AE(TB - TA)/2$