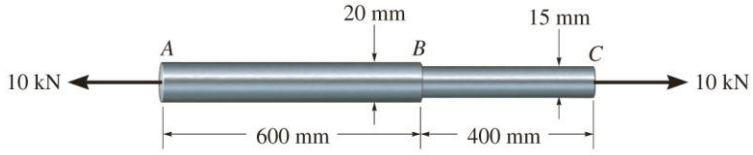
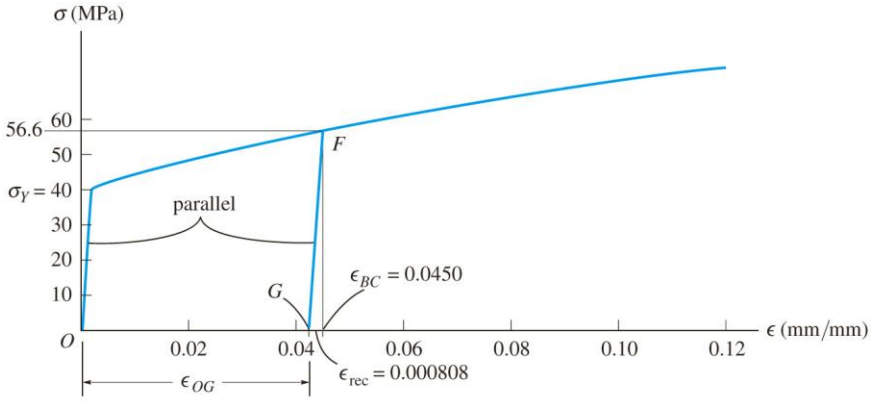
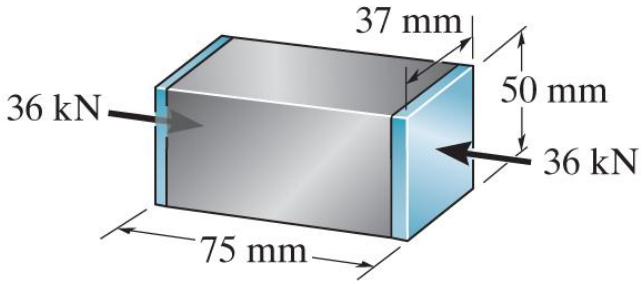
Mechanics of Materials Chapters 3 and 4 11/06/2017 by Shun-Fa Hwang

1. Please use words or figures to explain the following terms.
   (a) Yielding (b) True strain (c) Strain energy (d) Offset method (e) Necking [5%x5]
2. An aluminum rod shown has a circular cross section and is subjected to an axial load of 10 kN. If a portion of the stress-strain diagram for the material is shown, determine the approximate elongation of the rod when the load is applied. If the load is removed, what is the permanent elongation of the rod? Take $E_{al} = 70\,\text{GPa}$. [15%] Ans:18.3 mm, 17.7 mm

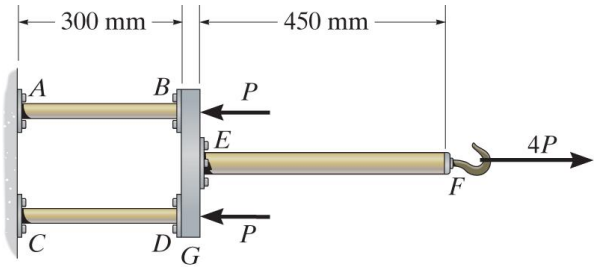




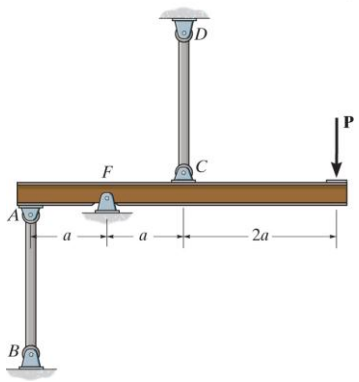
3. The aluminum block has a rectangular cross section and is subjected to an axial compressive force of 36 kN. If the 37-mm side changed its length to 37.5033 mm, determine Poisson's ratio and the new length of the 50-mm side. E_{al}=70 GPa [15%] Ans:0.321, 50.000178 mm



4. The assembly consists of two 10-mm diameter red brass C83400 copper rods *AB* and *CD*, a 15-mm diameter 304 stainless steel rod *EF*, and a rigid bar *G*. If *P*=5 kN, determine the <u>horizontal displacement of end *F* </u>of rod *EF*. $E_{cp} = 101$ GPa, $E_{st} = 193\,\text{GPa}$. [15%] Ans:0.453 mm



5. Two identical rods *AB* and *CD* each have a length *L* and diameter *d*, and are used to support the rigid beam, which is pinned at *F*. If a vertical force *P* is applied at the end of the beam, determine the <u>normal stress developed in each rod</u>. The rods are made of material that has a modulus of elasticity of *E*. [15%] Ans: $6P/\pi d^2$



6. The assembly has the diameters and material make-up indicated. If it fits secure between its fixed supports when the temperature is T_1= 20 ^0C, determine the <u>average normal stress in each material</u> when the temperature reaches T_2=40 ^0C. $E_{al} = 74.2$ GPa, $\alpha_{al} = 23(10^{-6})/^0C$, $E_{br} = 105$ GPa, $\alpha_{br} = 17(10^{-6})/^0C$, $E_{st} = 196$ GPa, $\alpha_{st} = 17(10^{-6})/^0C$. [15%] Ans:15, 33.75, 135.03 MPa