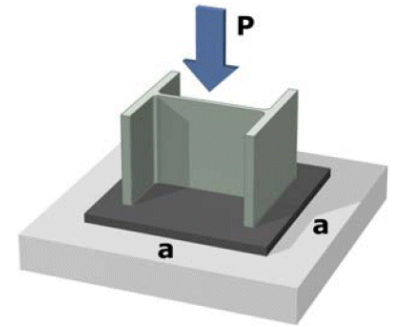
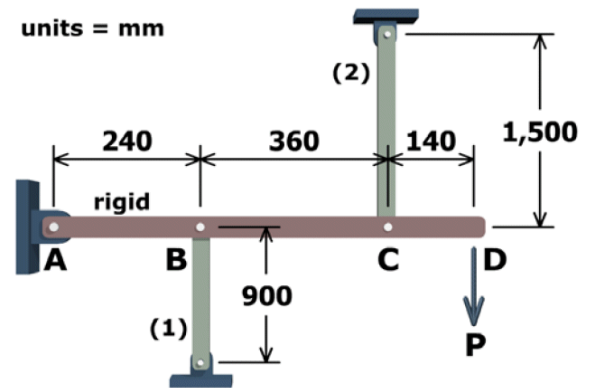


1. An axial load  $P$  is supported by a short steel column, which has a cross-sectional area of  $11,400 \text{ mm}^2$ . If the average normal stress in the steel column must not exceed  $110 \text{ MPa}$ , determine the minimum required dimension " $a$ " so that the bearing stress between the base plate and the concrete slab does not exceed  $8 \text{ MPa}$ .

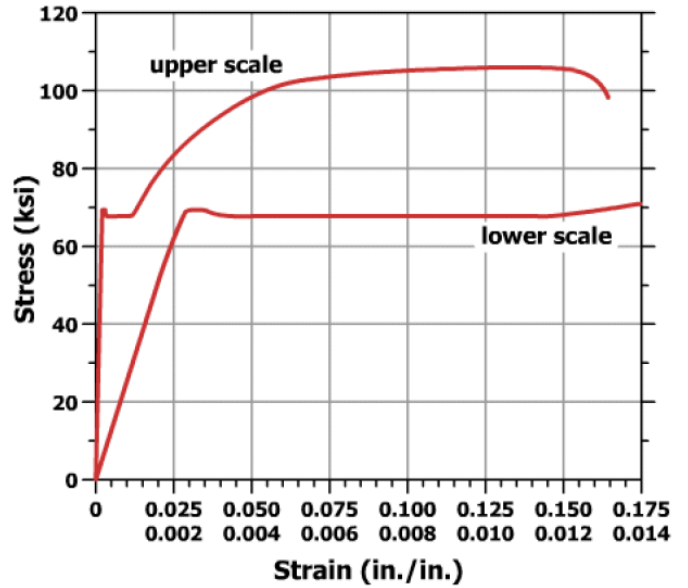


2. A rigid bar ABCD is supported by two bars. There is no strain in the vertical bars before load  $P$  is applied. After load  $P$  is applied, the normal strain in rod (1) is  $-1,200 \mu\text{m/m}$ . Determine the normal strain in rod (2).



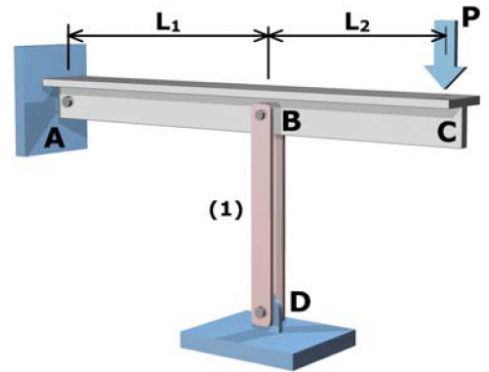
3. A tensile test specimen of 1045 hot-rolled steel having a diameter of 0.505 in. and a gage length of 2.00 in. was tested to fracture. Stress and strain data obtained during the test are shown. Determine:

- (a) the modulus of elasticity.
- (b) the proportional limit.
- (c) the ultimate strength.
- (d) the yield strength (0.20% offset).
- (e) the fracture stress.



4. A steel [ $E = 200$  GPa] rod with a circular cross section is 6-m long. Determine the minimum diameter  $D$  required if the rod must transmit a tensile force of 30 kN without exceeding an allowable stress of 180 MPa or stretching more than 5 mm.

5. Rigid tee-beam  $ABC$  is supported at  $A$  by a single shear pin connection and at  $B$  by a strut, which consists of two 50-mm-wide by 10-mm-thick steel bars. The pins at  $A$ ,  $B$ , and  $D$  are each 16 mm in diameter. The yield strength of the steel bars in strut (1) is 250 MPa, and the ultimate shear strength of each pin is 500 MPa. Determine the allowable load  $P$  that may be applied to the rigid bar at  $C$  if an overall factor of safety of 3.0 is required. Use  $L_1 = 1.4$  m and  $L_2 = 1.7$  m.



6. A solid aluminum [ $E = 70 \text{ GPa}$ ,  $\alpha = 22.5 \times 10^{-6}/^\circ\text{C}$ ] rod (1) is connected to a solid bronze [ $E = 100 \text{ GPa}$ ,  $\alpha = 16.9 \times 10^{-6}/^\circ\text{C}$ ] rod at flange B. Aluminum rod (1) has an outside diameter of 40 mm and bronze rod (2) has an outside diameter of 120 mm. The bars are unstressed when the structure is assembled at  $30^\circ\text{C}$ . After the 300-kN load is applied to flange B, the temperature increases to  $45^\circ\text{C}$ . Determine:

- (a) the normal stresses in rods (1) and (2).
- (b) the deflection of flange B.

