Example 2-4 A tapered bar *AB* of solid circular cross section and length *L* (Fig. 2-13a) is supported at end *B* and subjected to a tensile load *P* at the free end *A*. The diameters of the bar at ends *A* and *B* are d_A and d_B, respectively.

   Determine the elongation of the bar due to the load *P*, assuming that the angle of taper is small.

FIG. 2-13 Example 2-4. Change in length of a tapered bar of solid circular cross section
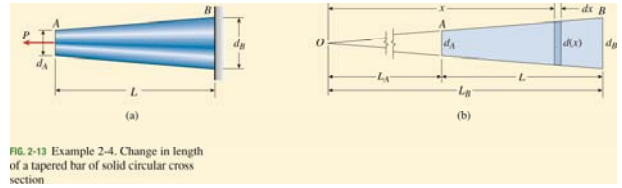
2.2-1 The L-shaped arm ABC shown in the figure lies in a vertical plane and pivots about a horizontal pin at A. The arm has constant cross-sectional area and total weight W. A vertical spring of stiffness k supports the arm at point B. Obtain a formula for the elongation of the spring due to the weight of the arm.
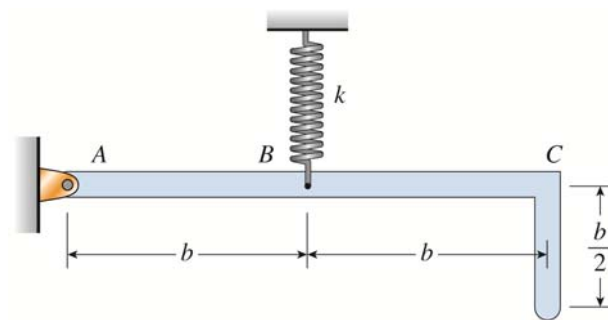
2.2-9 An aluminum wire having a diameter d = 2 mm and length L = 3.8 m is subjected to a tensile load P (see figure). The aluminum has modulus of elasticity E = 75 GPa.

If the maximum permissible elongation of the wire is 3 mm and the allowable stress in tension is 60 MPa, what is the allowable load Pmax?
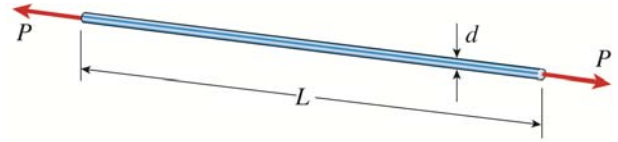
2.3-7 A steel bar 2.4 m long has a circular cross section of diameter $d1$ = 20 mm over one-half of its length and diameter $d2$ = 12 mm over the other half (see figure). The modulus of elasticity E = 205 GPa.
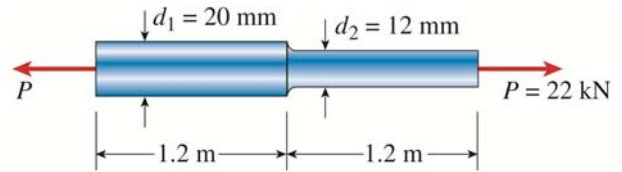
(a) How much will the bar elongate under a tensile load P = 22 kN?

(b) If the same volume of material is made into a bar of constant diameter d and length 2.4 m, what will be the elongation under the same load P?

$d_1 = 20$ mm $d_2 = 12$ mm

P $P = 22$ kN

1.2 m   1.2 m

2.3-12 A prismatic bar *AB* of length *L*, cross-sectional area *A*, modulus of elasticity *E*, and weight *W* hangs vertically under its own weight (see figure).

(a) Derive a formula for the downward displacement δ_C of point *C*, located at distance *h* from the lower end of the bar.

(b) What is the elongation δ_B of the entire bar?

(c) What is the ratio β of the elongation of the upper half of the bar to the elongation of the lower half of the bar?