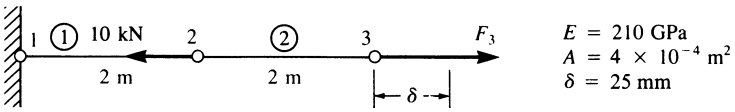


**Figure P3–9**

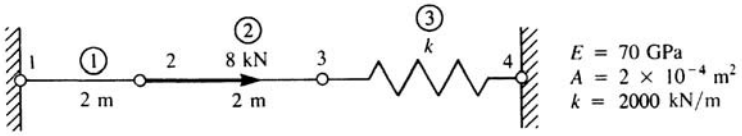


**Figure P3–10**

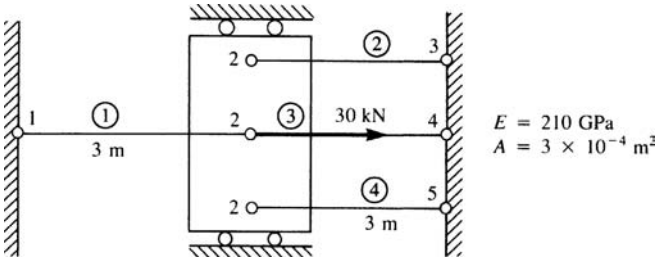


**Figure P3–11**

**3.12** Solve for the axial displacement and stress in the tapered bar shown in Figure P3–12 using one and then two constant-area elements. Evaluate the area at the center of each element length. Use that area for each element. Let $A_0 = 2$ in$^2$, $L = 20$ in., $E = 10 \times 10^6$ psi, and $P = 1000$ lb. Compare your finite element solutions with the exact solution.

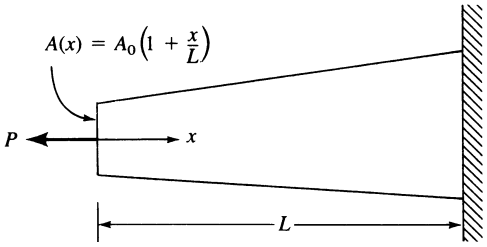


**Figure P3–12**

**3.13** Determine the stiffness matrix for the bar element with end nodes and midlength node shown in Figure P3–13. Let axial displacement $u = a_1 + a_2x + a_3x^2$. (This is a higher-order element in that strain now varies linearly through the element.)

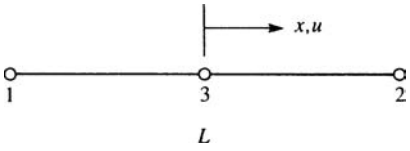


**Figure P3–13**