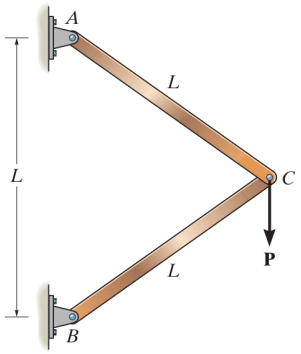
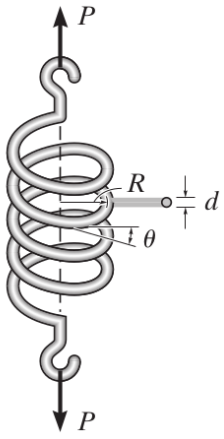
Tutorial Sheet 10: Energy Methods

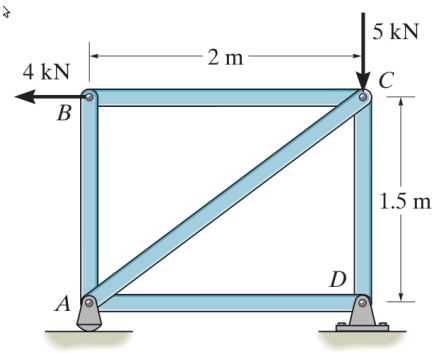
1. Determine the vertical displacement of joint C. The value of EA is constant. $[2PL/(EA)]$



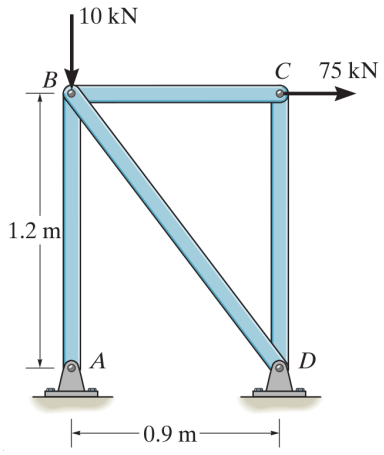
2. The coiled spring has n coils and is made from a material having a shear modulus G. Determine the stretch of the spring when it is subject to the load P. Assume that the coils are close to each other so that $\theta \approx 0^\circ$ and the deflection is caused entirely by the torsional stress in the coil. $[\frac{64nPR^3}{d^4G}]$



3. Determine the horizontal displacement of joint B of the truss. Each steel member has $E = 200$ GPa and $A = 400$ mm^2. [0.367 mm]

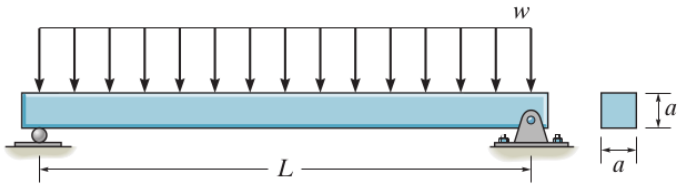


4. Determine the horizontal displacement of joint B of the truss. Each steel member has $E = 200$ GPa and $A = 1935$ mm^2. [0.753 mm]

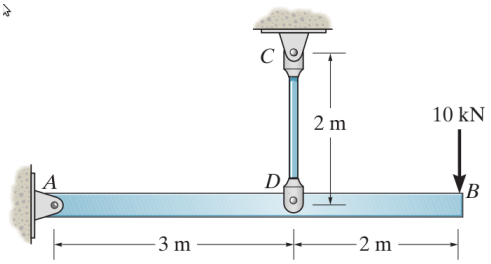


5. The simply supported beam having a square cross section is subjected to a uniform load w. Determine the maximum deflection of the beam caused only by bending and caused by bending and shear. Take $E = 3G$. Compare the two values as a function of L/a.

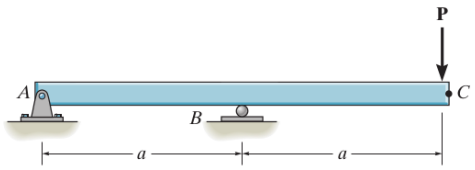
$$\left[\frac{5w}{96G}\left(\frac{L}{a}\right)^4 ; \left(\frac{w}{G}\right)\left(\frac{L}{a}\right)^2\left[\left(\frac{5}{96}\right)\left(\frac{L}{a}\right)^2 + \frac{3}{20}\right] \right]$$



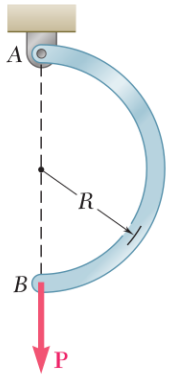
6. Beam AB has a square cross section of 100 mm by 100 mm. Bar CD has a diameter of 10 mm. If both members are made of steel ($E = 200$ GPa), determine the vertical displacement of point B and the slope at A. [43.5 mm, 0.00530 rad]



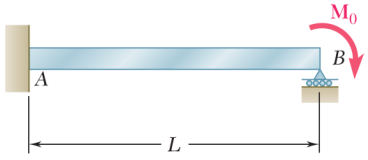
7. Determine the displacement at point C and the slopes at C and A. $[\frac{2Pa^3}{3EI}, \frac{5Pa^2}{6EI}, \frac{Pa^2}{6EI}]$



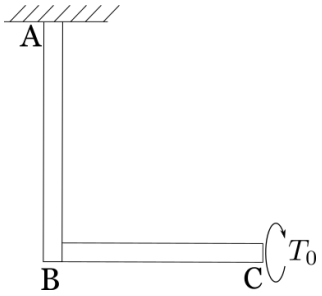
8. For the uniform rod and loading shown, determine the deflection of point B. $[\frac{\pi PR^3}{2EI}]$



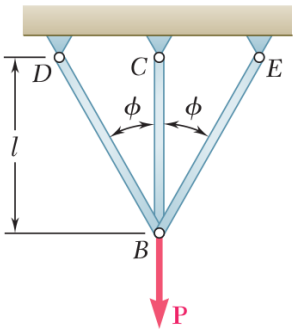
9. Determine the reaction at the roller support. $[\frac{3M_0}{2L}]$



10. A shaft BC (length: 1.2 m) of circular cross-section (diameter 60 mm) is welded to a beam AB (length 1.5 m) of rectangular cross-section (70 mm × 50 mm). A torque $T_0 = 2.50$ kN·mis applied at C as shown. Determine the rotation of the end C. Both the shaft and the beam are made of steel ($E = 200$ GPa; $G = 77.5$ GPa). [0.0523 rad]



11. Three members of the same material and same cross-sectional area are used to support the load P. Determine the force in the member BC. $\left[\frac{P}{1+2\cos^3\phi}\right]$



12. A thin circular ring of radius r is subjected to two diametrically opposite loads P in its own plane as shown in the figure. After obtaining an expression for the bending moment at any section, determine the change in the vertical diameter. $\left[\frac{Pr^3}{EI}\left(\frac{\pi}{4}-\frac{2}{\pi}\right)\right]$