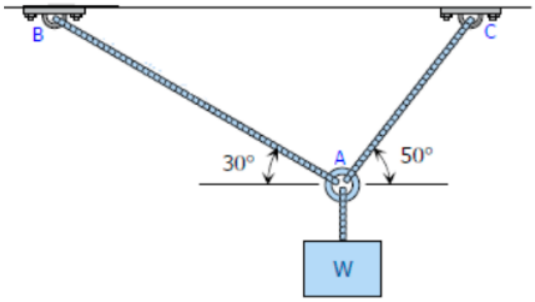
Tutorial 8: Extension and torsion

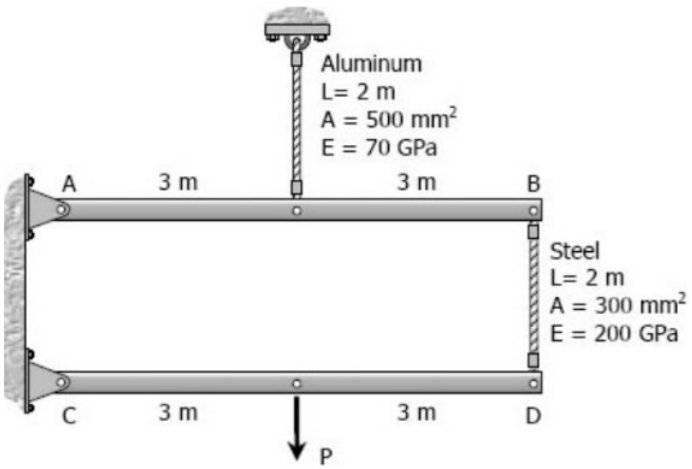
APL 108 - 2025 (Mechanics of Solids)

1. Determine the largest weight W that can be supported by two wires shown in figure shown below. The stress in either wire is not to exceed 207N/mm^2. The cross-sectional areas of wires AB and AC are 258mm^2 and 323mm^2, respectively.

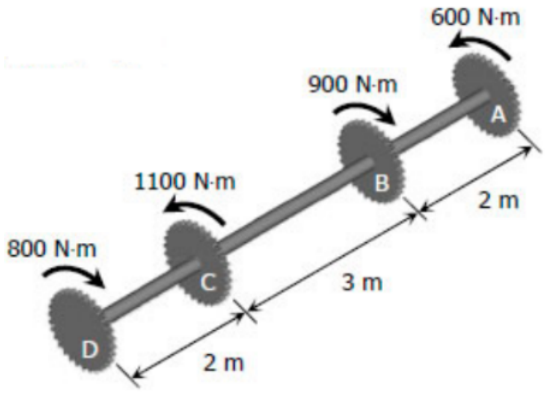


2. A round bar of length L, which tapers uniformly from a diameter D at one end to a smaller diameter d at the other, is suspended vertically from the large end. If w is the weight per unit volume, find the elongation of ω the rod caused by its own weight. Use this result to determine the elongation of a cone suspended from its base.

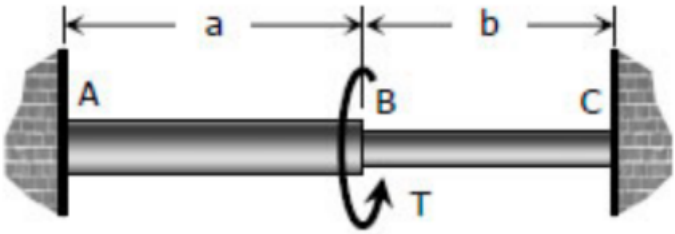
3. The rigid bars AB and CD shown in figure below are supported by pins at A and C and the two rods. Determine the maximum force P that can be applied as shown if its vertical movement is limited to 5mm. Neglect the weights of all members.



4. An aluminum shaft with a constant diameter of 50mm is loaded by torques applied to gears attached to it as shown in Fig. Using G = 28GPa, determine the relative angle of twist of gear D relative to gear A.



5. The compound shaft shown in the figure below is attached to rigid supports. For the bronze segment AB, the diameter is 75mm, $\tau_{\text{tol,B}} \leq 60\text{MPa}$, and $G = 35\text{GPa}$. For the steel segment BC, the diameter is 50mm, $\tau_{\text{tol,S}} \leq 80\text{MPa}$, and $G = 83\text{GPa}$. If $a = 2\text{m}$ and $b = 1.5\text{m}$, compute the maximum torque T that can be applied.



6. The shaft shown in figure below is made from a steel tube, which is bonded to a brass core. If a torque of $T = 250\text{N} \cdot \text{m}$ is applied at its end, plot the shear-stress distribution along a radial line of its cross-sectional area. Take $G_s = 80\text{GPa}$, $G_b = 36\text{GPa}$. (from Hibbeler, *Mechanics of Materials*, Ch 5)