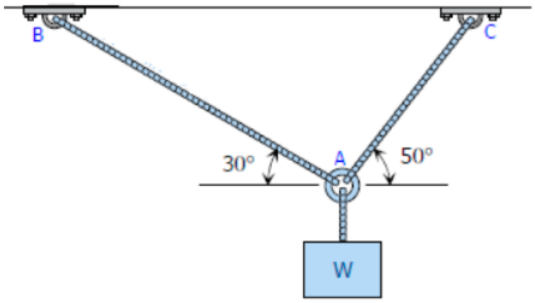
Tutorial 8: Extension and torsion of cylinderss

APL 104 - 2022 (Solid Mechanics)

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.

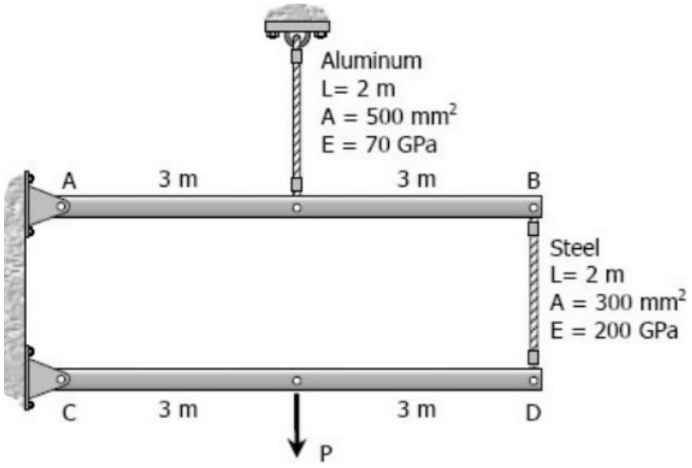


   (a) Find the relation between normal stresses in x and y directions in this problem.

   (b) Find the volumetric strain.

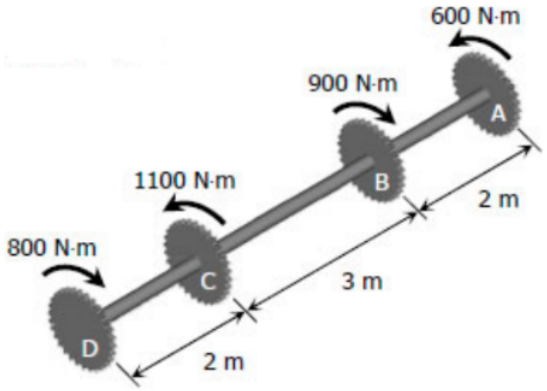
2. A round bar of length L, which tapers uniformly from a diameter D at one end to a smaller diameter d at the other, is suspended vertically from the large end. If w is the weight per unit volume, find the elongation of ω the rod caused by its own weight. Use this result to determine the elongation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



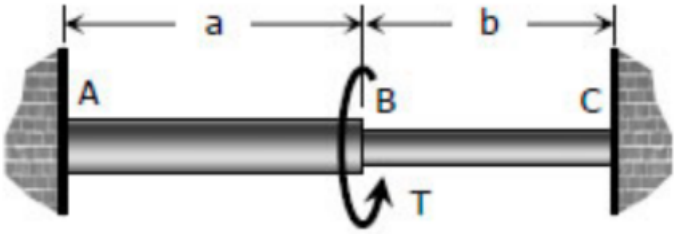
4. A 50.8mm diameter steel tube with a wall thickness of 1.27mm just fits in a rigid hole. Find the tangential stress if an axial compressive load of 1424kg is applied. Assume ν = 0.30 and neglect the possibility of buckling.

5. 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.



6. A hollow bronze shaft of 76.2mm outer diameter and 50.8mm inner diameter is slipped over a solid steel shaft 50.8mm in diameter and of the same length as the hollow shaft. The two shafts are then fastened rigidly together at their ends. For bronze, G = 7kN/mm^2, and for steel, G = 12kN/mm^2. What torque can be applied to the composite shaft without exceeding a shearing stress of 55N/mm^2 in the bronze or 82N/mm^2 in the steel?

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



8. A composite shaft is clamped at both its ends. It is composed of three sub-shafts as shown in figure below. The first part is made up of bronze (shear modulus G_B) and has length L_B and radius R_B. The second part is made up of aluminium (shear modulus G_A) and has length L_A and radius R_A. The third part is made up of steel (shear modulus G_S) and has length L_S and radius R_S. There is a torque T_1 acting at the interface of aluminium and bronze parts and a torque T_2 acts at the interface of aluminium and steel parts. Both T_1 and T_2 act along $+\underline{e}_1$ direction. What is the maximum shear component of traction in each of the three shafts?