ME 202 Strength of Materials Spring 2023
Tutorial 02 17 Jan 2023

1. A. Watch the posted video of the torsion pendulum and derive a formula to determine the shear modulus of the steel wire by measuring the period of oscillation. B. The torsional pendulum shown in the figure below consists of a horizontal circular disk of mass M = 60 kg suspended by a vertical steel wire (G = 80 GPa) of length L = 2 m and diameter d = 4 mm. Calculate the maximum permissible angle of rotation of the disk (that is, the maximum amplitude of torsional oscillations) so that the stresses in the wire do not exceed 100 MPa in tension or 50 MPa in shear. Use g = 10 N/kg.

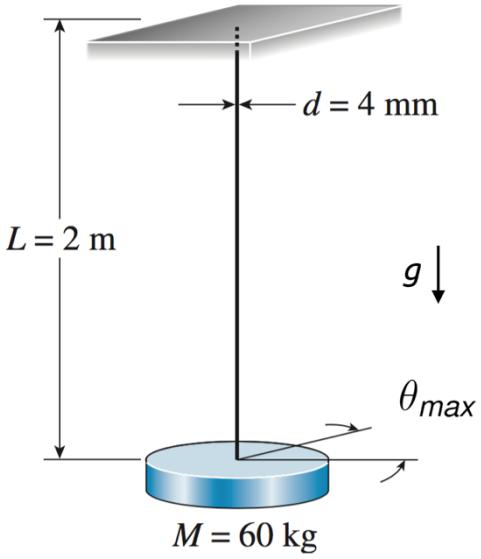

Fig.1

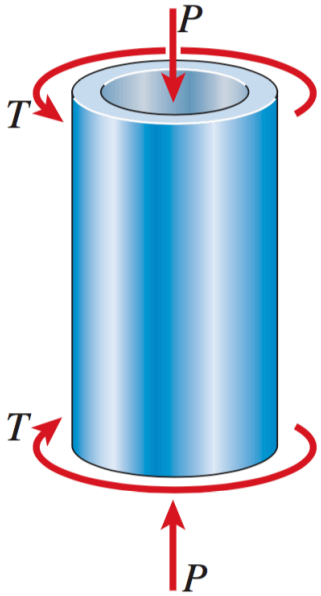

Fig. 2

2. A segment of an electrical generator shaft is subjected to a torque T and an axial force P, as shown in figure above. The shaft is hollow (outer diameter d_2 = 300 mm and inner diameter d1 = 250 mm) and delivers 1800 kW at 4.0 Hz. If the compressive force P = 540 kN, what are the maximum tensile, compressive, and shear stresses in the shaft? Shear modulus G = 75 GPa = 75 kN/mm^2

3. A solid steel shaft ACB of diameter 50 mm is held against rotation at ends A and B. Horizontal forces P are applied at the ends of a rigid vertical arm that is welded to the shaft at C. Determine the allowable value of the forces P if the yield stress in a tensile test is measured to be 90 MPa. Use G = 75 GPa for the shaft material. Assume that the shaft material fails as per the maximum shear stress theory of failure.