ASSIGNMENT 9

1. If a twisting moment of 1100 Nm is applied to the end of 50 mm diameter steel shaft, what is the maximum shearing stress in a 1.5 m length of the shaft.

   44.81 MPa

2. In problem 1 find the angle of twist in a 1.5 m length of the shaft. Take G = 80 MPa.

   1.925˚

3. A 4130 HT steel shaft of 3 cm diameter and of length 1m transmits a torque just below that which causes plastic deformation. Calculate the angle of twist between the ends of the shaft. Take yield strength as 1400 MPa and G = 80 GPa. Use maximum shear stress criteria.

   33.43˚

4. A hollow steel shaft of 5 cm outside diameter is made of 4130 HT steel. What is the maximum internal diameter of the shaft which will just allow it to transmit without any yielding a torque of 3750 Nm. Take yield strength as 1400 MPa and G = 80 GPa. Use maximum shear stress criteria.

   4.7 cm

5. A hollow steel shaft of 8 cm outside diameter is made of 4130 HT steel. What is the maximum internal diameter of the shaft which will just allow it to transmit without any yielding a torque of 7500 Nm. Take yield strength as 1400 MPa and G = 80 GPa. Use maximum shear stress criteria.

   7.77 cm

6. Two shafts AB and BC of the same material but different diameter are welded together at point B. Ends A and C are fastened securely so that the shafts cannot rotate at these points. An external twisting couple Mo is applied to the shafts at point B. Find the twisting couples exerted on the end of the shaft at A in figure 1.

$$M_A = \frac{M_o}{1 + \frac{L_1}{L_2}(\frac{d_2}{d_1})^4}$$

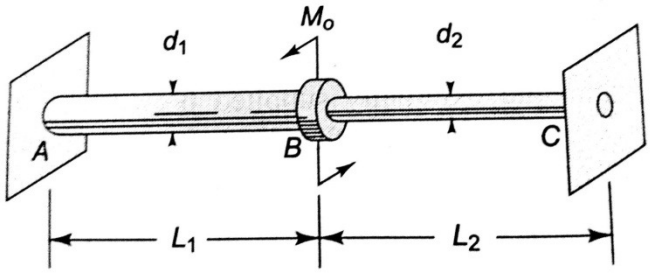

Figure 1

7. Find the twisting couples exerted on the end of the shafts at C in figure 1.

$$M_C = \frac{M_o}{1 + \frac{L_1}{L_2}(\frac{d_2}{d_1})^4}$$

8. In figure 1 assume that the two rods are made of different materials. It is found that the twisting couples at A and at C are equal. What relation must hold between the diameters, lengths, and moduli of the two materials.

$$\left(\frac{G_2}{G_1}\right)\left(\frac{L_1}{L_2}\right)\left(\frac{d_2}{d_1}\right)^4 = 1$$

9. For a hollow shaft whose outside diameter is twice it's inside diameter, derive the relation between the horsepower that may be transmitted, the rpm, the maximum allowable shear stress and the outside diameter d_o. Use relationship $H_P = (M_t \times w)/ 76$. where w is the angular velocity. $w = (2 \times \Pi \times (rpm))/60$

   $H_P = 2.54 \times 10^{-4} (rpm) \times (\tau_{max}) \times (d_o)^3$