Arab Academy for Science, Technology & Maritime Transport.
College of Engineering & Technology,
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Stress analysis (ME 276)
Sheet No. 3.

(1) A shaft 50 mm diameter and 0.7 m long is subjected to a torque of 1200 N.m. Calculate the shear stress and the angle of twist. Take G = 90 GPa.

(2) A hollow circular cross-sectional shaft 50 mm outer diameter and 30 mm inner diameter and 0.7 m long is subjected to a torque of 1200 N.m. Calculate the shear stress and the angle of twist. Take G = 90 Gpa.

(3) A shaft 40 mm diameter is made from steel and the maximum allowable shear stress for the material is 50 MPa. Calculate the maximum torque that can be safely transmitted by the shaft. Take G = 90 GPa.

(4) A shaft is made from tube 25 mm outer diameter and 20 mm inner diameter. The shear stress must not exceed 150 MPa. Calculate the maximum power that should be transmitted at 500 rev/min.

(5) A steel shaft 5 m long, having a diameter of 50 mm, is to transmit power at a rotational speed of 600 rev/min. If the maximum shear stress is limited to 60 MPa, determine the following:

(a) The maximum power that can be transmitted by the shaft.

(b) The corresponding angle of twist.

Assume the modulus of rigidity for steel is 80 GPa.

(6) A hollow steel shaft with a diameter ratio of 0.75 and a length of 4 m is required to transmit 1 MW at 120 rev/min. the maximum shear stress is not to exceed 70 MPa nor is the overall angle of twist to exceed 1.75. Determine the following:

(a) The necessary outside diameter of the shaft so that both the above limitations are satisfied.

(b) The actual maximum shear stress and the actual angle of twist.

Assume the modulus of rigidity for steel is 80 GPa.

(7) For the shaft/gear assembly shown in Figure 1, the shaft is driven by Gear at **C**. Gears at **B** and **D** are driven by the shaft. It turns freely at **A** and **E**. T_2 = 450 N.m, T_1 = 275 N.m, T_3 = 175 N.m, d = 30 mm, L_{BC} = 500 mm, L_{CD} = 400 mm, and G = 80 GPa. Determine the maximum shear stress and the angle of twist between gears **B** and **D**.

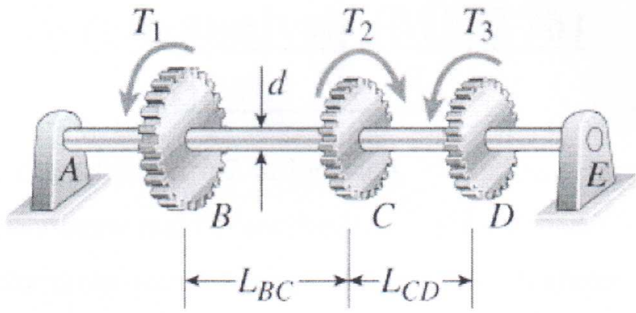

Figure 1.

(8) Solid steel shaft in torsion shown in Figure 2. The motor transmits ***50 kW*** to the shaft ***ABC*** of ***50 mm*** diameter at ***10Hz***. The gears at **B** and **C** extract ***35 kW*** and ***15 kW*** respectively. Calculate the maximum shear stress in the shaft and the angle of twist (□***AC***) between the motor and the gear **C**. Use **G** = 80 GPa.

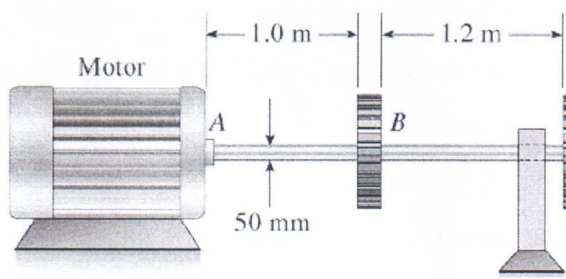

Figure 2.

(9) The horizontal shaft ***AD*** is attached to a fixed base at ***D*** and is subjected to the torques as shown in Figure 3. A 44 mm diameter hole has been drilled into portion ***CD*** of the shaft. Knowing that the entire shaft is made of steel for which ***G*** = 77 GPa, determine the angle of twist at end ***A***.

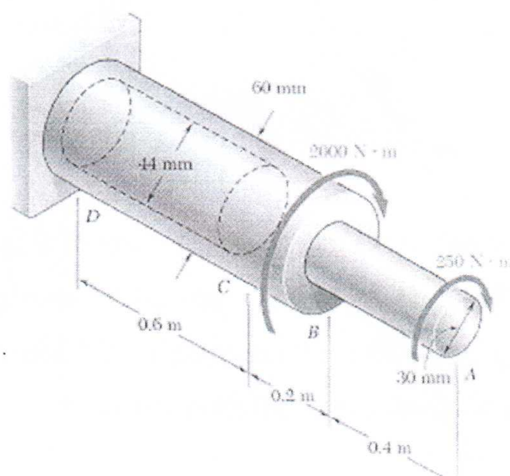

Figure 3.