THAPAR INSTITUTE OF ENGINEERING AND TECHNOLOGY, PATIALA
UES 017: SOLIDS AND STRUCTURES

B.E. – Second Year (CIE, MEE, MP) **Session: 2020-2021**

Tutorial Sheet No. 5 **(Torsion in circular shafts)**

1. A solid steel shaft 5 m long is stressed to 80 MPa when twisted through 4^0. Using G = 83 GPa, compute the shaft diameter. What power the shaft at 20 Hz can transmit?

2. What is the minimum diameter of solid steel shaft that will not twist through more than 3^0, in a 6 m length when subjected to a torque of 12kN-m? What is the maximum shearing stress developed? G = 83 GPa.

3. A steel shaft has to transmit a mean power of 100kW at 250 rpm. The allowable shear stress is 75MPa and the maximum power transmitted exceeds the mean power by 30%. Determine

a) The suitable diameter for a solid shaft
b) The suitable diameter for a hollow shaft whose inside diameter is 0.8 times the outside diameter
c) Percentage saving in weight when solid shaft is replaced by hollow shaft.

4. A steel shaft ABCD having a total length of 4.8 m consists of three lengths having different sections as follows

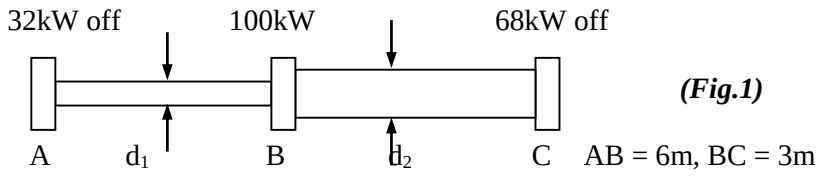
AB	Hollow	d_0 = 12 cm	d_i = 10.2 cm
BC	Solid	d = 12 cm	
CD	Solid	d = 9.6 cm	

If the angle of twist is same for each section, determine the lengths of each section.
Find the value of applied torque and total angle of twist if maximum shear stress in hollow section is limited to 50MPa, G = 84GPa.

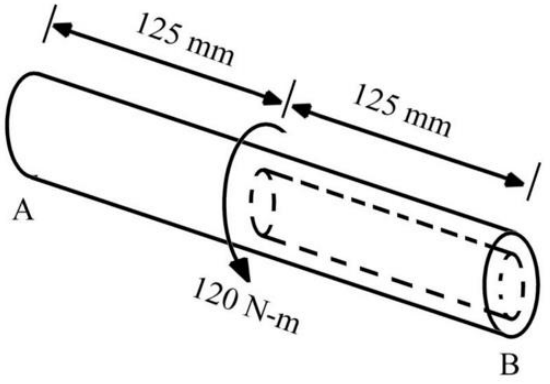
5. A 100kW motor at 40 rpm is driving a line shaft at B *(Fig.1).* Determine d_1 and d_2. Also determine the angle of twist in AB and BC.
Allowable shear stress is 50MPa and G = 80GPa. (Bending is avoided)

6. A circular shaft AB consists of a 250 mm long 20 mm diameter steel cylinder, in which a 125 mm long, 16 mm diameter cavity is drilled from end B (Fig.2). The shaft is attached to fixed supports at both ends, and a 120 Nm torque is applied at its mid-section. Determine the torque exerted by the shaft on both supports.

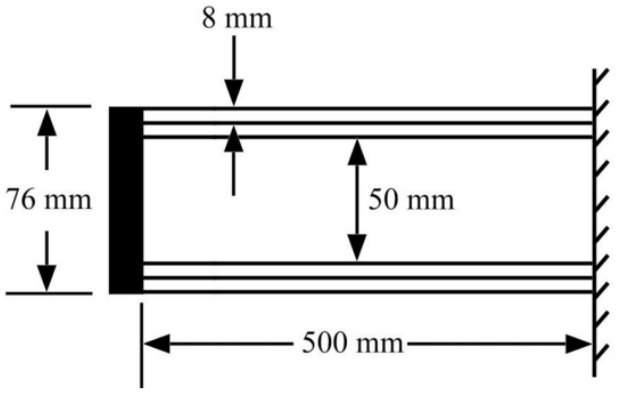
7. A steel shaft and an aluminum tube are connected to a fixed support and a rigid disc as shown in Fig.3. Determine the maximum torque which may be applied to the disc without exceeding the shearing stresses of 120 MPa and 70 MPa in steel and aluminum tube respectively. Take G = 80 GPa for steel and 27 GPa for aluminum.



(Fig.1)



(Fig.2)



(Fig.3)