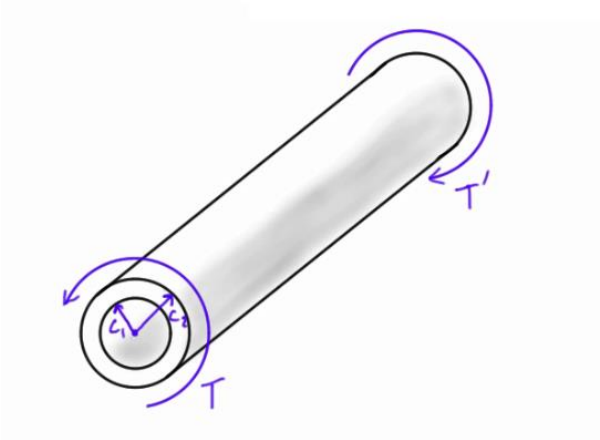
Answer on Question #80270 – Physics | Mechanics Relativity

Question:

A hollow shaft of outer radius 140 mm and inner radius 125 mm is subjected to a compressive force of 200kN and a torque. If the allowable shearing stress is 100 MPa, what is the maximum torque that can be applied?

Solution:



We have hollow shaft with outer radius $c_2 = 140$ mm and inner radius $c_1 = 125$ mm. Also we know the allowable shearing stress is $\tau_{al} = 100$ MPa. To find the maximum torque we can use equation for shear stress:

$$\tau = \frac{T \times c}{J},$$

where J is the polar moment of inertia for the hollow shaft and T is the torque. The maximum permissive stress will be observed for the outer radius c_2. So, the final formula for Torque will look like

$$T = \frac{\tau_{al} \times J}{c_2}$$

Now let's calculate J:

$$J = \frac{\pi}{2}(c_2^4 - c_1^4) = 2.2 \times 10^{-4}\ m^4.$$

Then

$$T = \frac{100 \times 10^6 \times 2.2 \times 10^{-4}}{0.14} = 1.57 \times 10^5 Nm = 157\ kNm$$

Answer: $157\ kNm$