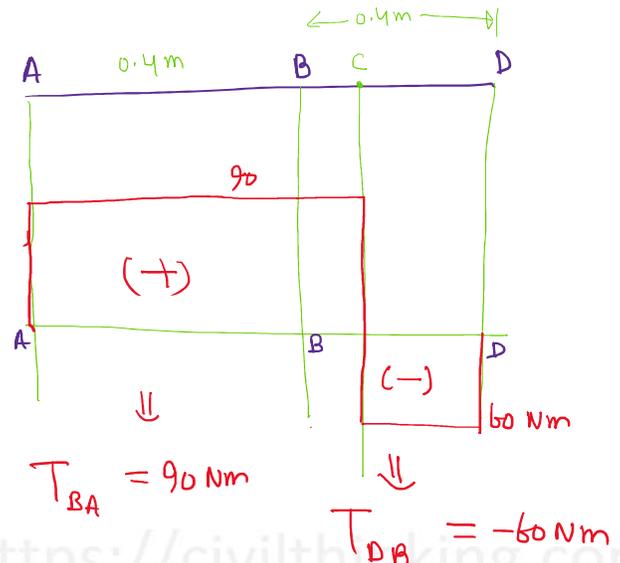
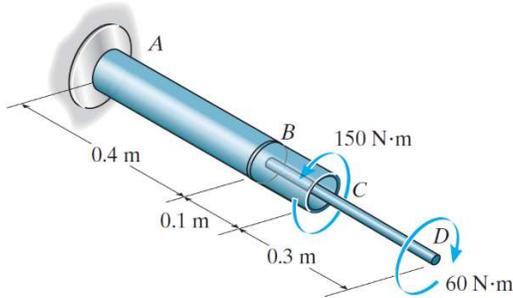


5-54. The assembly is made of A-36 steel and consists of a solid rod 20 mm in diameter fixed to the inside of a tube using a rigid disk at B. Determine the angle of twist at D. The tube has an outer diameter of 40 mm and wall thickness of 5 mm.

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$$\theta_{D/A} = \theta_{D/B} + \theta_{B/A}$$

we know:  $\frac{G\theta}{L} = \frac{T}{J} \Rightarrow \theta = \frac{TL}{GJ}$

$$= \left(\frac{TL}{GJ}\right)_{DB} + \left(\frac{TL}{GJ}\right)_{BA}$$

$$= \frac{-60 \times 0.4}{75 \times 10^9 \times \frac{\pi}{2} (0.01)^4} + \frac{90 \times 0.4}{75 \times 10^9 \times \frac{\pi}{2} (0.02 - 0.015)^4} = -0.01758 \text{ rad} = \left| 1.01^\circ \right| \text{ ANS.}$$

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