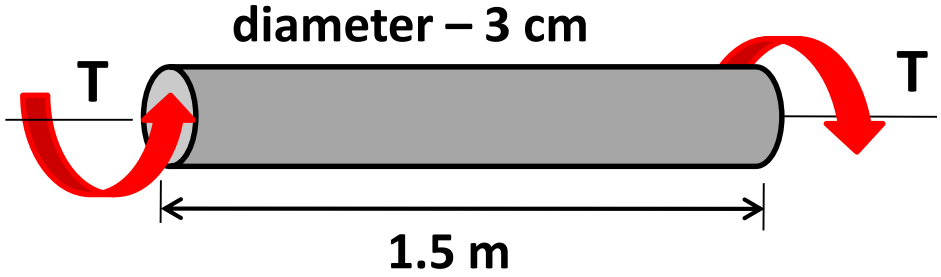
# Module – 4 Mechanics of Materials

- Torsion
  - shear stress, angular twist
- Columns
  - Euler's formula
- Elastic Strain Energy
  - Uniaxial loading

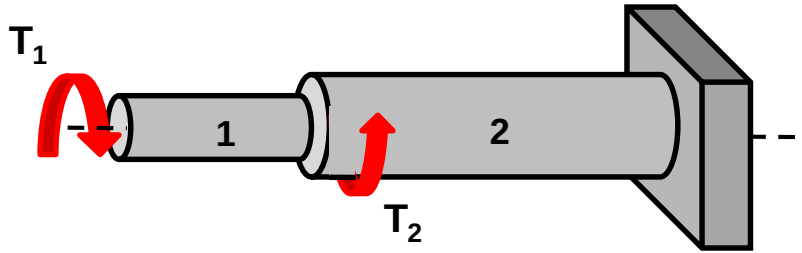
# Problem – 21 Shaft Torsion




The steel shaft shown is subjected to a twisting torque T. Find the largest value of T such that the maximum shear stress will not exceed 100 MPa and total twist will not be greater than 4 degrees. Choose an answer from those listed closest to the actual value. G = 8.27 x $10^4$ MPa

(A) 299 Nm (B) 300 Nm (C) 400 Nm (D) 500 Nm

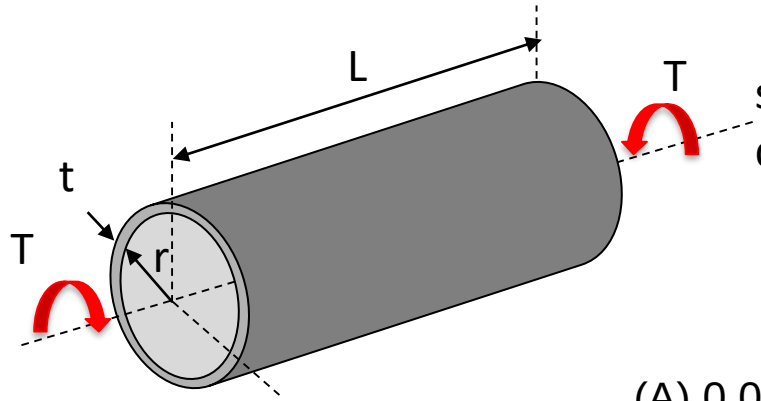
# Problem 22 – Stepped Shaft




A stepped shaft fixed to a wall is loaded with two applied torques. $T_1$ has a magnitude of 100 Nm and $T_2$ is 500 Nm in the opposite direction applied at the left end of section 2. Determine the ratio of the diameter of section 2 to section 1 so the maximum shear stress in both sections is equal.

(A) 1.2 (B) 1.4 (C) 1.6 (D) 1.8

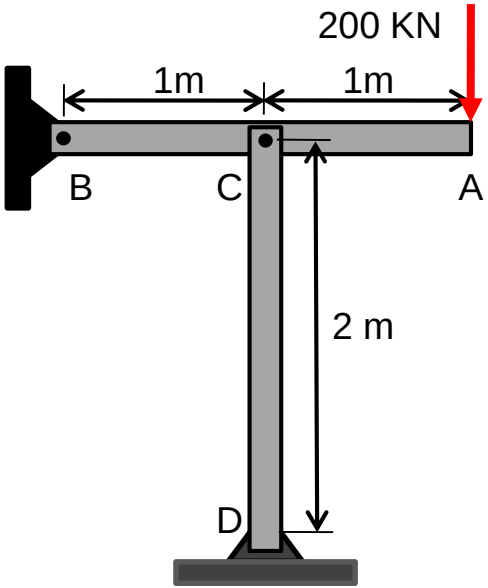
# Problem 23 - Thin Wall Tube




A 45 cm long section of copper tubing is subjected to a torque of 40 Nm. The inside diameter is 16 cm and the wall thickness is 3 mm. Determine the resulting total twist in degrees. G= 45 GPa

(A) 0.02 deg (B) 0.04 deg (C) 0.4 deg (D) 4deg

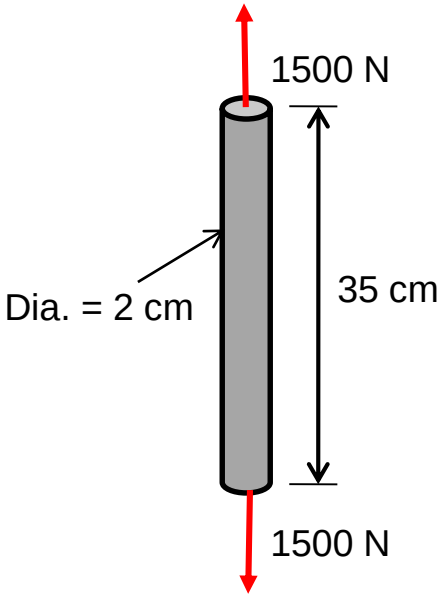
# Problem 24 – Column Design




Determine the minimum safe diameter for the solid Aluminum member CD in the system shown to prevent buckling by a safety factor of 3. The column is pinned at C and fixed at D. E = 72 GPa.

(A) 8 cm (B) 9 cm (C) 10 cm (D) 11cm

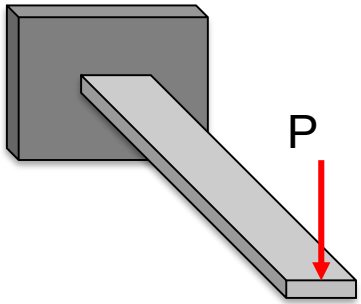
# Problem 25 – Tension Strain Energy




A circular steel rod in tension is subjected to a tensile load P of 1500 N. For the dimensions given in the figure calculate the strain energy stored in the rod due to the work done by the force P. E= 200 GPa

(A) 1.2 Nm (B) 0.62 Nm (C) .12 Nm (D) .062 Nm

# Problem 26 – Bending Strain Energy




Determine the bending strain energy stored in the cantilever beam in Problem 20 by the work of the concentrated end load P.

(A) 1.2 Nm (B) 0.62 Nm (C) .12 Nm (D) .062 Nm

***Thanks for watching***

***and***


***on the exam !***