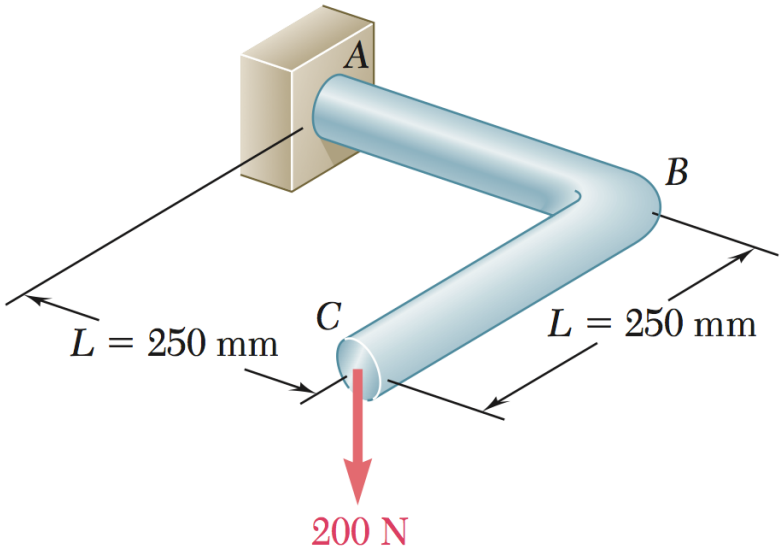
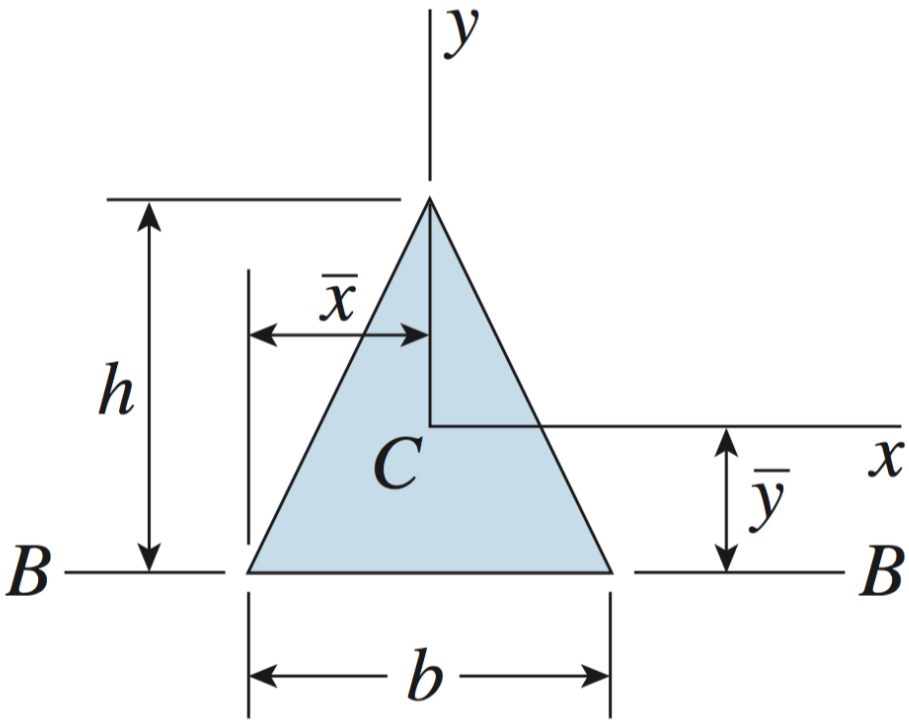
ME 202 Strength of Materials Spring 2023
Tutorial 10 13 April 2023

1. Use CT2 (Castigliano Theorem 2) to find the displacement of the point C in the direction of the applied load P = 200N. EI and GJ are respectively the flexural and torsional rigidities of the bent beam ABC.



2. A cantilever fixed at one end has an isosceles triangle cross-section shown below. Take b = 10 mm, h = 20 mm. C is the centroid of the cross-section. Consider a new centroidal system x'-y' rotated through 60 degrees anticlockwise about the z-axis with respect to the x-y system. The applied bending moments in the new system are Mx' = 10 Nm, My' = 0 Nm. Find the equation of the neutral line in the new system.



3. Refer to the triangle ABC shown above which is the cross-section of a shaft of length L fixed at z = 0 and free at z = L. An axial torque T is applied along the z-axis. Use the potential energy method to calculate the approximate angle of twist at the free end. G is the shear modulus of the shaft material.

4. A fin of an underwater vehicle is modeled as a solid prismatic shaft. The x-y cross-section of this shaft (length L, shear modulus G) is the quadrilateral region with vertices located at the points (0,a),(-b,0),(0,-a),(b,0) where 0 < a << b << L. The shaft carries an axial torque along the length (z direction). Find the approximate torsional stiffness of this shaft using the soap film/membrane analogy.