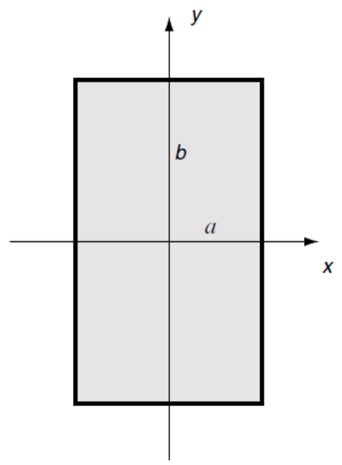
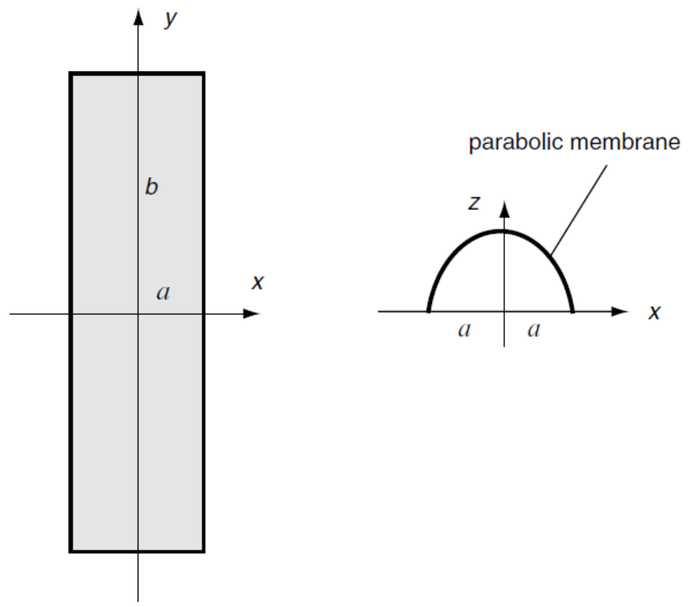
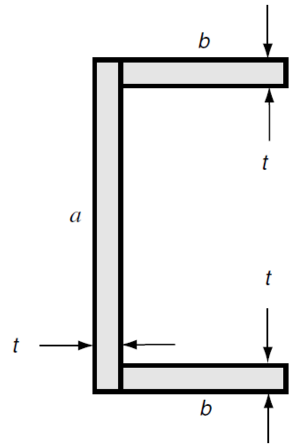
1. Attempt to solve the torsion of a rectangular section shown in below by using the Boundary Equation Method. Show that trying a stress function created from the four products of the boundary lines $x = \pm a$ and $y = \pm b$ will not satisfy the governing equation.



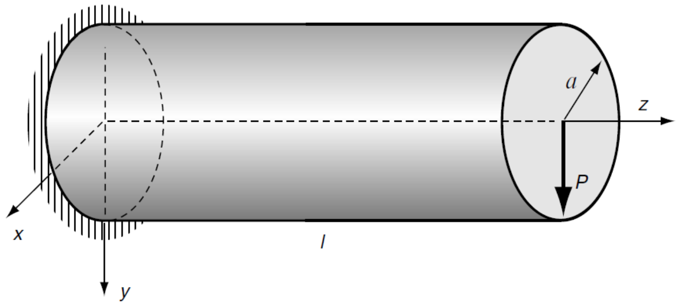
2. Employing the membrane analogy, develop an approximate solution to the torsion problem of a thin rectangular section as shown. Neglecting end effects at $y = \pm b$, the membrane deflection will then depend only on *x*, and the governing equation can be integrated to give $z = \psi = G\alpha\left(a^2 - x^2\right)$, thus verifying that the membrane shape is parabolic. Formally compute the maximum membrane slope and volume enclosed to justify the results of the torsion of a thin rectangular section, as developed in class.



3. Using the results from the torsion of sections composed of thin-rectangles, develop an approximate solution for the load-carrying torque of the channel section shown.



4. Determine the displacement field for the flexure problem of a beam of circular section shown below. Starting with the stress solution developed in class, integrate the strain-displacement relations and use boundary conditions that require the displacements and rotations to vanish at the origin. Compare the elasticity results with strength of materials theory. Also investigate whether the elasticity displacements indicate that plane sections remain plane.



5. Using the torque relation $T = \dfrac{16G\alpha a^3 b}{3} - \dfrac{1024G\alpha a^4}{\pi^5}\sum_{n=1,3,5\cdots}^{\infty}\dfrac{1}{n^5}\tanh\dfrac{n\pi b}{2a}$ for the rectangular section, compute the non-dimensional load-carrying parameter $T/G\alpha b^4$, and plot this as a function of the dimensionless ratio b/a over the range $1 \le b/a \le 10$. For the case where $b/a \to 10$, show that the load-carrying behavior can be given by $T = \dfrac{16}{3}G\alpha a^3 b$.