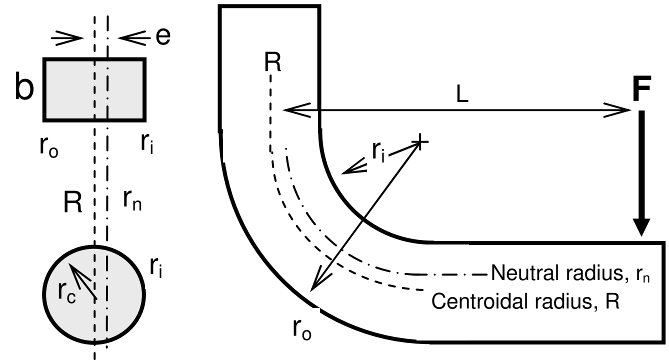
Curved Beam Stress Analysis



1) Draw a very good picture.
- Show r_i, r_o, Area
- Show the applied Force, F

2) Calculate the centroidal radius, R, based on the section type.
(Hamrock § 4.5.3)

Rectangular: $R = \frac{r_i + r_o}{2}$ Circular: $R = r_i + r_c$

3) Compute the neutral radius, r_n, based on the section type.

Rectangular: $r_n = \frac{r_o - r_i}{\ln(r_o / r_i)}$ Circular: $r_n = \frac{R + \sqrt{R^2 - r_c^2}}{2}$

4) Compute the eccentricity, $e = R - r_n$

5) Compute the moment about the centroidal radius, R. Here M = F x L, not F x R, because the force is not through the center of curvature.

6) Calculate the distances from the neutral axis to the inner and outer surfaces:
$c_i = r_n - r_i$ and $c_o = r_o - r_n$.

7) Calculate the stresses at the inside and outside surfaces:

$$\sigma_i = \frac{Mc_i}{Aer_i} \quad \text{and} \quad \sigma_o = -\frac{Mc_o}{Aer_o}$$, where A = the section area

8) Add or subtract any P/A stresses (using superposition).

Rectangular: $\sigma = \frac{F}{(r_o - r_i)b}$ Circular: $\sigma = \frac{F}{\pi r_c^2}$

9) As a check, compare the answer to MC / I for a straight beam with neutral axis on the centroid and see if it makes sense.