ME354
Autumn Quarter 2002

Hmwk 3

From the Dowling Text: Problems 4.12, 4.18, 4.29, 4.30, 4.35

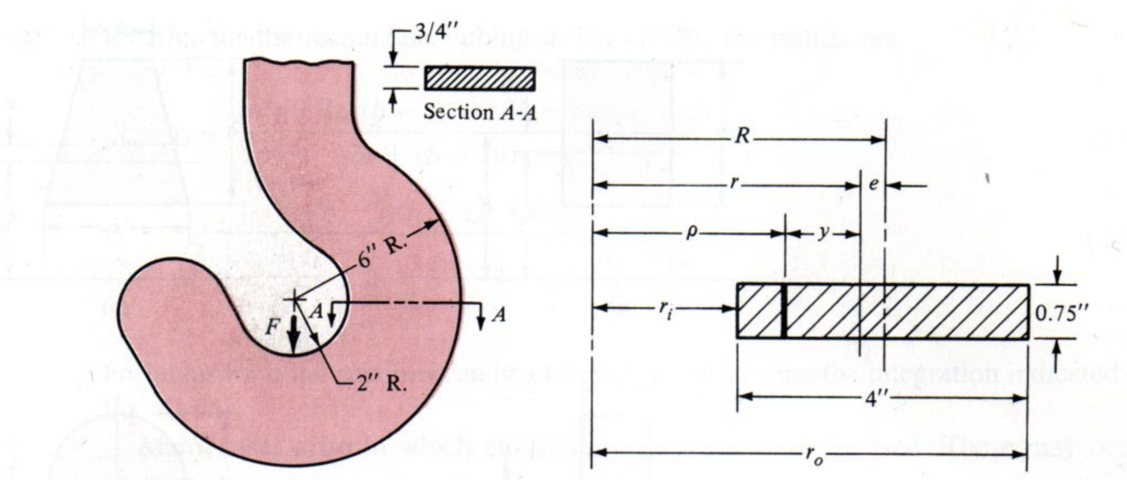
For the crane hook shown, determine the following.

a) Plot the <u>total</u> stress distribution of stress across section A-A of the crane hook shown. The cross section is rectangular with b=0.75 and h=4 in. The load is F=5000 lbf.

Note that the curved beam bending formula is $\sigma = \dfrac{My}{Ae(r_n - y)}$ where M is the applied moment (in this case F •R where R is the radius of the centroid such that $R=(r_o+r_i)/2$ in which r_o and r_i are the outer and inner radii, respectively), y is the distance from the neutral axis to the point in question such that $y=(r_n-r)$, A is the cross sectional area of the section, e is the "eccentricity" such that $e=R-r_n$, and r_n is the radius of the neutral axis which is $r_n = \dfrac{A}{\int \frac{dA}{r}}$ but for a rectangular cross section is $r_n = \dfrac{h}{\ln(r_o / r_i)}$. Note that in this case an additional tensile stress component (F/A) from the axial loading of the applied force needs to be included with the bending component to determine the total stress.

b) Compare the maximum and minimum bending stresses calculated using the curved beam equation to the maximum and minimum bending stresses calculated using the flexure formula for straight beams. Are there large differences? Explain discrepancies based on the rule of thumb that the straight beam equations are not appropriate if R/h<5.

c) Which way does the "neutral axis" shift from the centroid? Does this make sense?



(a) (b)