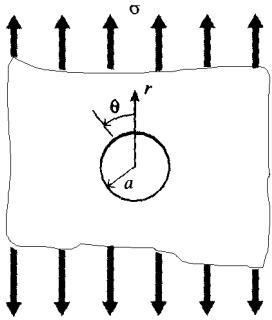


Stresses Around a Circular Hole

Uniaxial tension, hole of radius a :



Boundary conditions:

$$\left. \begin{aligned} \sigma_r &= \frac{\sigma}{2}(1 + \cos 2\theta) \\ \sigma_\theta &= \frac{\sigma}{2}(1 - \cos 2\theta) \\ \tau_{r\theta} &= \frac{\sigma}{2}\sin 2\theta \end{aligned} \right\} r \rightarrow \infty$$

$$\sigma_r = \tau_{r\theta} = 0, r = 0$$

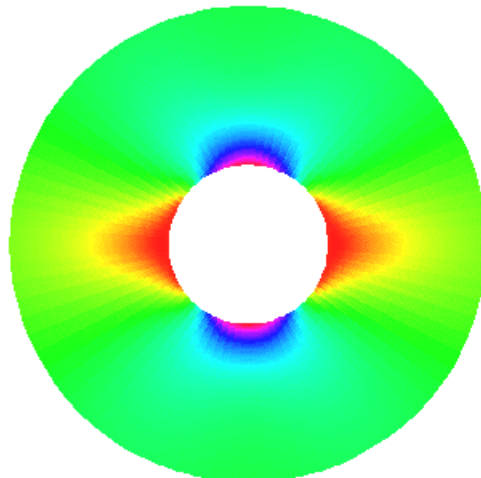
Assumed Airy stress function: $\phi = f(r)\cos 2\theta$

$$\nabla^4 \phi(r, \theta) = 0 \rightarrow f(r) = Ar^2 + Br^4 + C\frac{1}{r^2} + D$$

Evaluate constants from boundary conditions, then

$$\sigma_\theta = \frac{\partial^2 \phi}{\partial r^2} = \frac{\sigma}{2} \left(1 + \frac{a^2}{r^2} \right) - \frac{\sigma}{2} \left(1 + \frac{3a^4}{r^4} \right) \cos 2\theta$$

$$\sigma_{\theta, \max} = 3\sigma \text{ @ } r = a, \theta = \pi/2$$



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3.11 Mechanics of Materials

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