Fatigue Homework 5

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Gabe Morris

[ ]:
```
# Notebook Preamble
import sympy as sp
import numpy as np
import matplotlib.pyplot as plt

plt.style.use('maroon_ipynb.mplstyle')
```

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ME 8253 Homework 5 Gabe Morris
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1 Preliminary Questions

What are the expressions of the plastic zone size for plane stress and plane strain?

For plane stress:

$$2r_y = \frac{1}{\pi}\left(\frac{K}{S_y}\right)^2$$

For plane strain:

$$2r_y = \frac{1}{3\pi}\left(\frac{K}{S_y}\right)^2$$

where K is the stress intensity factor, r_y is the plastic zone radius, and S_y is the yield strength.

What are the restrictions on the use of LEFM?

The following restrictions on the use of the LEFM are:

- The plastic zone size at the crack tip must be small relative to the crack length.
- The net nominal stresses in the crack plane must be less than $0.8S_y$
- Under monotonic loading, $r_y \leq (1/8)a$
- $r_y \leq (1/8)t$ and $r_y \leq (1/8)(w-a)$
- For cyclic loading, $r_y \leq a/4$

What are the restrictions for the plane strain fracture toughness K_{IC} value to be considered valid?

In order for a plane strain fracture toughness value to be considered valid, it is required that:

$$a \geq 2.5\left(\frac{K_{IC}}{S_y}\right)^2$$

$$t \geq 2.5\left(\frac{K_{IC}}{S_y}\right)^2$$