Last Updated: April 8, 2020 at 11am

Name:

Homework 8

Due 21 Apr 2020

1. A wide, center-cracked specimen with Paris law parameters $C = 10^{-9}$ and $n = 4$ has an initial crack length of $2a = 2$ in. The specimen is subjected to an $R = 0$ cyclic stress such that $\sigma = 3.4a^{-1}$, where a is the current crack length. How many cycles will it take for the crack to reach $2a = 8$ in?

2. An edge-cracked specimen with Paris law parameters $C = 10^{-9}$ and $n = 4$ has an initial crack length of $a = 0.5$ in. The specimen is subjected to an $R = 0$ cyclic stress such that $\sigma = 3.0$ ksi. What will the crack length be after 50,000 cycles?

3. While flicking the clip on his pen, Dr. Smith (with his eagle vision) notices a 0.01" edge-crack. Assume that Dr. Smith's flicks are generally about 3 in-lbs, with one strong, 5 in-lb flick for every 10 regular flicks. If the pen clip is 0.25" wide, 0.05" thick and made from 7075-T6 (with $K_c = 70$ ksi$\sqrt{\text{in}}$), use the Boeing-Walker growth rate equation with $p = 3.5$, $q = 0.6$, $\mu = 0.1$, and $m_T = 24$ to estimate the number of cycles remaining for Dr. Smith's pen.

4. Consider a wide, center-cracked panel with an initial crack length of $2a = 0.5$ in. Use the Boeing-Walker growth rate equation with $p = 3.5$, $q = 0.6$, $\mu = 0.1$, and $m_T = 24$. Compare the expected crack growth rate for the expected load ($\sigma_{min} = 5$ ksi and $\sigma_{max} = 20$ ksi) with a situation where an unexpected overload ($\sigma_{min} = 5$ ksi and $\sigma_{max} = 40$ ksi) occurs after 5,000 cycles
   (a) Using the Wheeler retardation model with $m = 1.5$ and a plane stress plastic zone for $\sigma_{ys} = 68$ ksi
   (b) Using the Willenborg retardation model with $S_{OL} = 2.0$ and $K^{th} = 3$ ksi$\sqrt{\text{in}}$.
   (c) Using the closure retardation model with $C_{f0} = 0.3$