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Name:

Homework 4

Due 20 Feb 2020

1. A large steel sheet (0.1 in. thick) containing a center-crack with length $2a = 4$in. fractures under remote tensile stress of $\sigma = 30$ksi. This material has a yield strength of 100 ksi. If you feel you cannot answer any of the following questions with the given data, explain why not.
   (a) What is the fracture toughness for this sheet of steel?
   (b) What is K_{IC} for this material?
   (c) What remote stress, σ will fracture an identical plate with a 9 in. crack?
   (d) What is the failure stress for a 4-in. long center crack in a 1-in. thick plate?
   (e) What is the fracture stress if the original 0.1 in. thick panel contains a 0.1 in. center crack?

2. Consider a panel with an edge crack $a = 2$ in.. Predict the failure stress for the following conditions
   (a) The panel is Aluminum 2024-T351 (L-T direction), 1.5 in. thick, 8 in. wide, and $\sigma_{YS} = 50$ ksi, at room temperature.
   (b) Consider an identical panel, but with a crack in the transverse direction (T-L).
   (c) The panel is Aluminum 7075-T6 (L-T direction), 0.5 in. thick, 8 in. wide, and $\sigma_{YS} = 72$ ksi at room temperature.
   (d) Consider the same (7075-T6) panel, at -65°F.
   (e) The panel is Steel 15-5 PH, 1.0 in. thick, 8 in. wide, with $\sigma_{YS} = 140$ ksi

3. The data file HW4-3.txt contains load-displacement data (P vs. v) for an aluminum alloy of an M(T) specimen. Assuming the specimen had a thickness of 0.1", a yield stress of $\sigma_{YS} = 48$ ksi, a width of 50", Young's Modulus $E = 18$Msi, Poisson's ratio of $\nu = 0.33$ and half-span displacement measurement points at $Y = 0.75$":
   (a) use the secant method to calculate the effective crack length throughout the test and plot the K_R curve
   (b) find K_C using the tangent curve method

   Note: Use the finite width center-cracked panel formula to calculate K_I.