Name:

Exam 1

1. (25 pts.) Estimate the stress intensity factor with

$$d = 1.0 \text{ in.}$$
$$D = 2.0 \text{ in.}$$
$$r = 0.2 \text{ in.}$$
$$t = 0.125 \text{ in.}$$

where r is the fillet radius and t is the thickness for

(a) $c = 0.05$ in.

(b) $c = 0.25$ in.

(c) How accurate do you expect each estimate to be? What could you do to further check their accuracy?

NOTE: Express all answers in terms of the load, P and β for some known panel configuration (such β is not given in the exam, but you may assume it is known, do not calculate it)
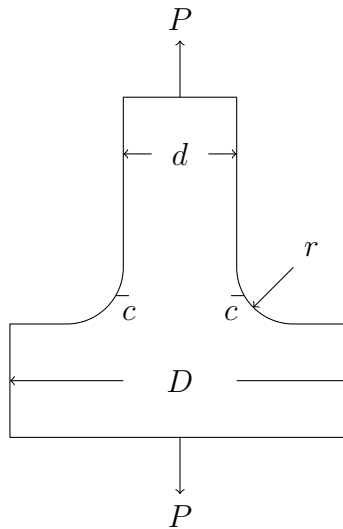

Figure 1: Cracks near a fillet

2. (25 pts.) For the following panels, determine the plastic zone size and indicate whether the panel is considered in Plane Stress, Plane Strain, or neither.

   Note: If iteration is necessary, indicate it but only perform the iteration once.

   (a) Center-cracked panel, $2a = 6$ in., $W = 9$ in., $\sigma = 12$ ksi, $\sigma_{YS} = 75$ ksi, $t = 0.125$ in.

   (b) Center-cracked panel, $2a = 6$ in., $W = 9$ in., $\sigma = 12$ ksi, $\sigma_{YS} = 50$ ksi, $t = 0.125$ in.

3. (25 pts.) A large sheet of some new metal alloy (2.5 in. thick) containing a center-crack with length $2a = 3$ in. fractures under remote tensile stress of $\sigma = 55$ ksi. This material has a yield strength of 150 ksi.

Note: If you feel you cannot answer any of the following questions with the given data, explain why not. Also, as before, any time iteration is necessary, indicate it but only perform the iteration once.

(a) What is the fracture toughness for this sheet?

(b) What is K_{IC} for this material?

(c) What remote stress, σ will fracture an identical plate with a 4 in. crack?

(d) What is the failure stress for a 3-in. long center crack in a 2-in. thick plate?

(e) What is the failure stress if the original 2.5 in. thick panel contains a 1 in. center crack?

4. (25 pts.) Analyze the residual strength curves for the stiffener, panel and rivet shown below. Indicate, on the graph, the critical crack length, residual strength and identify regions of unstable and stable crack growth. Under what conditions (if any) will an unstable crack arrest?

Stiffened Panel Residual Strength