

THE UNIVERSITY OF IOWA
Department of Mechanical Engineering

Fracture Mechanics
ME:5159

Computer Project #3
Total Points: 20

Assigned: March 06, 2020
Due: March 25, 2020

Consider a Polymethyl Methacrylate (PMMA) beam under three-point bending, as shown in the figure below. The load and geometric dimensions are given. *Bittencourt, Sousa, Wawrzynek, and Ingraffea* (1995) presented experimental results for this specimen which showed that based on the location and length of the original crack, the path of crack growth would either intersect one of the holes or pass between them. The experimental crack trajectories for two crack configurations are shown in the next page. For load and material properties, use $P = 1$ kip, $E = 470$ ksi and $\nu = 0.35$. Assume *plane stress* condition.

Using CASCA and FRANC2D/L at CSS (ICAEN):

- Predict crack trajectories for the following two crack configurations: (1) Configuration A: crack length $b = 1$ inch, and crack offset $a = 6$ inches, and (2) Configuration B: crack length $b = 1.5$ inches, and crack offset $a = 5$ inches. Use the maximum tangential stress theory.
- Compare your predicted crack trajectories by finite element simulation with the experimental crack trajectories for two crack configurations A and B given in Tables 1 and 2, respectively. Assume crack-length increment $\Delta a = 0.3$ inch.
- For Configuration B, study the effects of crack-length increment on the simulated crack trajectory. Try $\Delta a = 0.3, 0.2,$ and 0.1 inch.

Show all work and attach relevant snapshots. Provide comments on your results and observations.

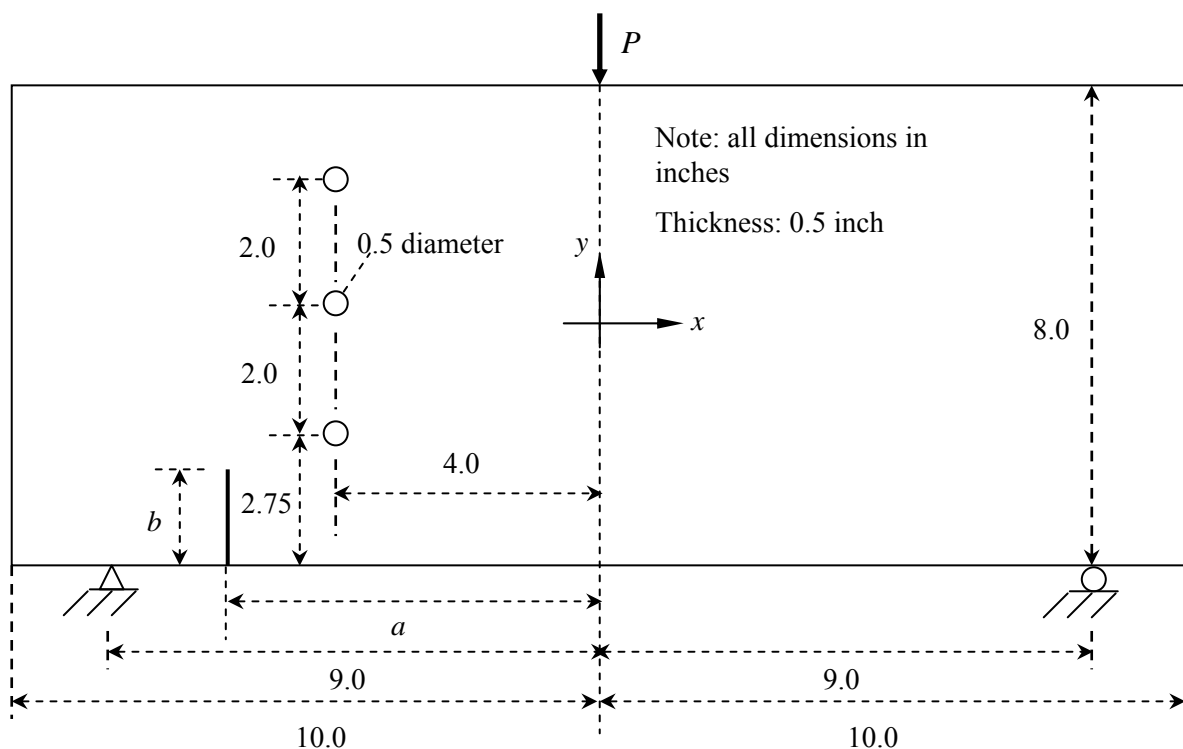


Table 1: Configuration A

x-coordinate, inches	y-coordinate, inches
-6.000	-4.000
-6.000	-3.000
-5.875	-2.627
-5.733	-2.076
-5.500	-1.600
-5.229	-1.175
-4.983	-0.708
-4.729	-0.313
-4.458	0.119
-4.167	0.551

Table 2: Configuration B

x-coordinate, inches	y-coordinate, inches
-5.000	-4.000
-5.000	-2.500
-4.850	-2.000
-4.688	-1.483
-4.458	-1.167
-4.167	-0.917
-4.042	-0.502
-3.833	0.000
-3.658	0.414
-3.658	0.560
-3.750	0.751

Note: The first two rows in Tables 1 and 2 define crack-mouth and initial crack-tip locations, respectively

