

ME 5339

HOMEWORK SET NO. 11

All of the problem will be graded.

Due April 24, 2008

Problem 11.1

Consider a thin plate 12 in. by 12 in. with a center crack being subjected under a tensile load. The plate has Young's modulus $E=30 \times 10^6$ psi, Poisson's ratio $\nu=0.3$, and the material ultimate strength $\sigma_f=380$ Ksi. The ultimate applied stress for the plate is 30 Ksi if the crack size is 4 inches long.

Determine:

- the ultimate strength of the plate with a crack size, 8 inches
- the strain energy release rate for the plate with 4 inches crack size under 30Ksi
- the maximum crack opening displacement on the crack surface

Problem 11.2

A large thin steel plate is loaded as shown below in each case. The material properties of the plate is given as

$$E = 30 \times 10^6 \text{ psi} \quad , \quad \nu = 0.3 \quad , \quad S_{ult} = 82 \text{ ksi}$$

$$S_y = 47 \text{ ksi} \quad , \quad K_c = 110 \text{ ksi} \sqrt{\text{in}}$$

A 4" crack is located at the center of the plate.

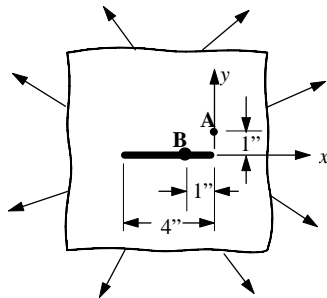


Figure (a)

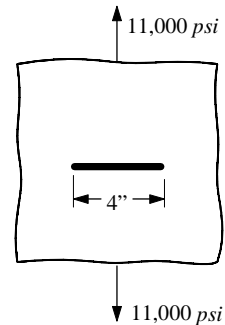


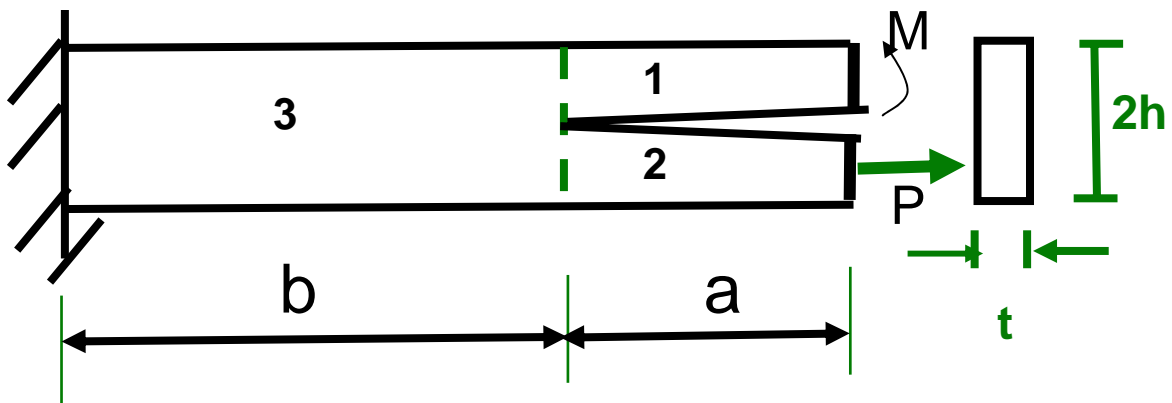
Figure (b)

- If the stress measurement at Point A is given as $\sigma_x = 4,000$ psi and $\sigma_y = 16,000$ psi. Find K_I and K_{II} , crack opening displacement at Point B.
- If the same plate shown in Figure (b) is subjected to 11,000 psi, estimate the size of the plastic zone near the crack tip.
- Determine the max. permissible crack length of the same plate under 55,000 psi (tensile load).

Problem 11.3

Find the total strain energy release rate for a slit beam loaded as shown in the following cases.

a) M and P are given the applied load and moment, respectively.



b) a couple forces with equal magnitude but opposite direction, P as shown

