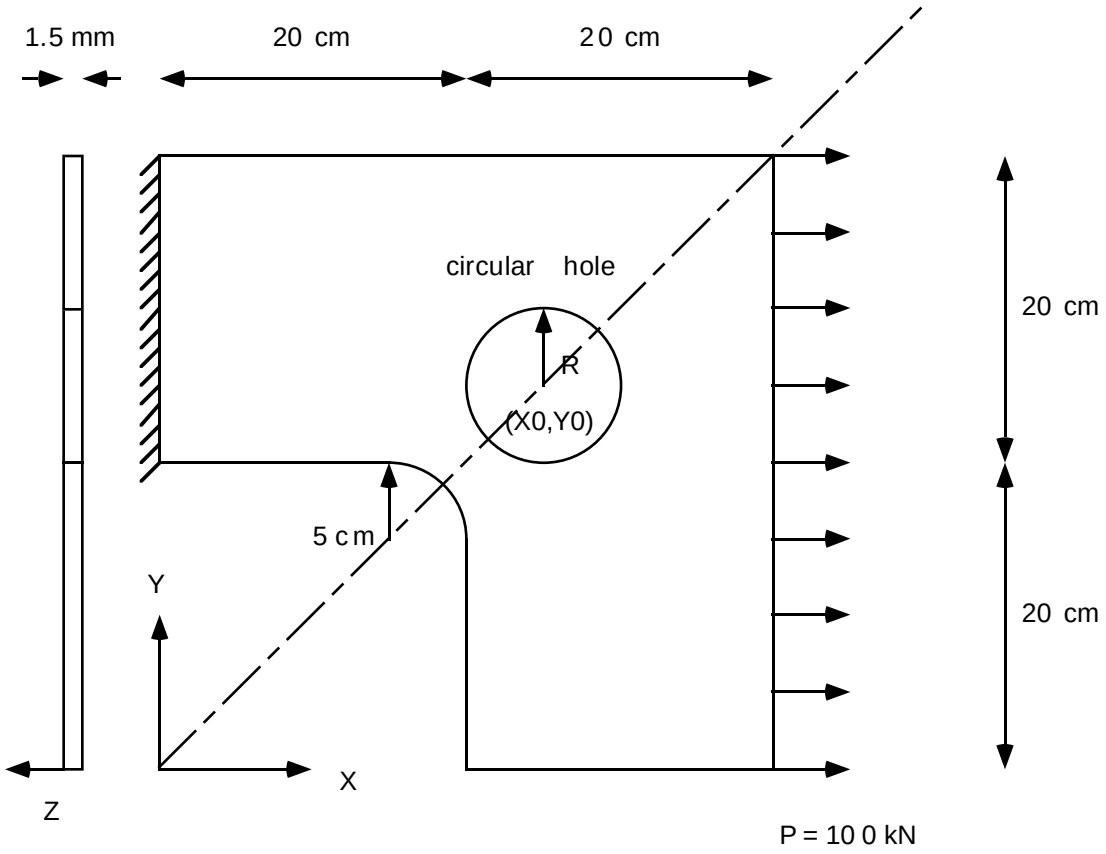
Homework #2 (March 12,1997)
MEAM 305 Introduction to Finite Element Methods

97W

Consider a thin flat plate-like solid structure shown in the following figure with a circular hole inside and a circular fillet whose radius is 5 cm. Assuming the thickness of the plate-like solid structure is 1.5 mm, and that the dimensions of the geometry are as in the figure. Using the material constant specified in the first homework, solve the following problems by using HEXA8 elements, that is, by making a finite element model by HEXA solid elements. To do so, at least two elements must be assumed in the thickness direction.



(1) Assuming that the center of the circular hole is located at (X,Y)=(25,25) cm, and its radius R is R=5 cm, find the maximum Mises equivalent stress in the structure, together with the maximum displacement in the X direction. Please submit the plots of the Mises equivalent stress, the deformation of the plate-like structure, and the finite element model you have created. In this homework, data files need not be submitted.

(2) By changing the location of the center of the circular hole with the same radius, say, shifting to (25.5, 25.5) cm and (24.5, 24.5) cm, find the maximum Mises stress, and calculate the "design sensitivity"

$$\left.\frac{\partial \overline{\sigma}_{\max}}{\partial (X,Y)}\right| \approx \begin{cases} \dfrac{\overline{\sigma}_{\max}\big|_{(25,25)} - \overline{\sigma}_{\max}\big|_{(24.5,24.5)}}{0.5} \\ \dfrac{\overline{\sigma}_{\max}\big|_{(25.5,25.5)} - \overline{\sigma}_{\max}\big|_{(25,25)}}{0.5} \end{cases}$$

where $\overline{\sigma}_{\max}$ is the maximum Mises stress in the structure. Using this information, guess the "best" location of the hole in the sense that $\overline{\sigma}_{\max}$ becomes the minimum. In order to describe change of the stress distribution, please submit the plots of the Mises equivalent stress.

(3) Repeat the same question by changing the radius R of the circular hole while the location of the center of the hole is fixed at (25, 25) cm. Change the radius to 4.5 cm and 5.5 cm.