



## AEE 464 · Application of Finite Element Analysis in Aerospace Structures

### Term Project

Date: July 16, 2021

- Q1.)** Consider the two-dimensional heat conduction problem over a thin square plate with a square central hole. The temperature of outer and inner edges are prescribed as shown in Fig. 1. The conductance matrix is given as

$$k = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$$

Write a finite element program in Matlab that is able to solve the temperature field  $T(x, y)$  and evaluate the heat flux  $\mathbf{q}(x, y)$ . The code should use 4-node quadrilateral elements with full and reduced integration. Use the given coarse and fine meshes and graphically present and comment on your results. You should present temperature contour  $T(x, y)$  and heat flux contours  $\mathbf{q}_x(x, y)$ ,  $\mathbf{q}_y(x, y)$  in the report. Conduct the same analysis using Abaqus with fine mesh and compare both results.

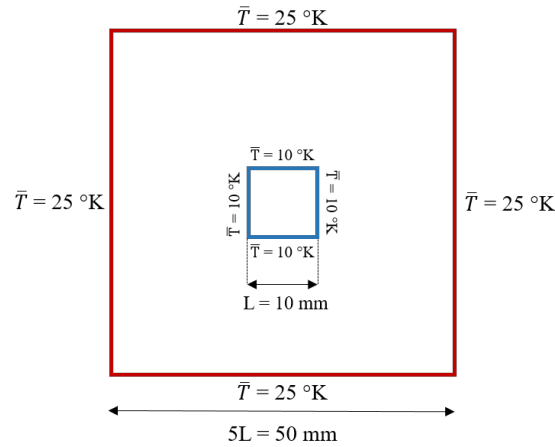


Figure 1: Geometry and boundary conditions of Q1 and Q2

- Q2.)** Consider the previous problem as shown in Fig. 1. This time the conductance matrix is given as

$$k = \begin{bmatrix} 40 & 0 \\ 0 & 2 \end{bmatrix}$$

Obtain the temperature field  $T(x, y)$  and evaluate the heat flux  $\mathbf{q}(x, y)$ . Use the given coarse and fine meshes and graphically present and comment on your results. You should present temperature contour  $T(x, y)$  and heat flux contours  $\mathbf{q}_x(x, y)$ ,  $\mathbf{q}_y(x, y)$  in the report. Conduct the same analysis using Abaqus with fine mesh and compare both results.

- Q3.)** Consider the two-dimensional heat conduction problem over a thin square plate with a square central hole. The temperature and the heat flux boundary conditions are prescribed as shown in Fig. 2. The conductance matrix is given as

$$k = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$$

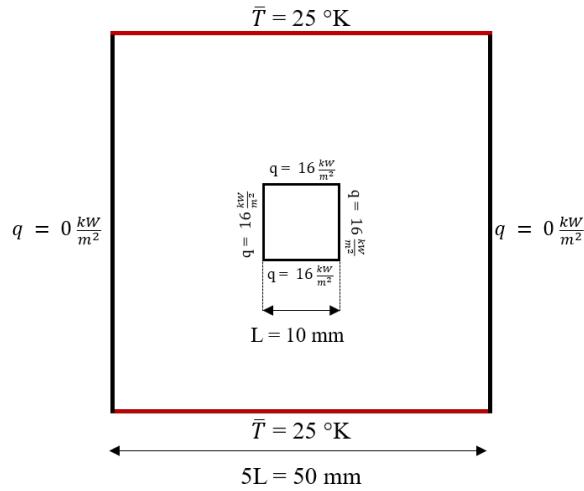


Figure 2: Geometry and boundary conditions of Q3

Obtain the temperature field  $T(x, y)$  and evaluate the heat flux  $\mathbf{q}(x, y)$ . Use the given coarse and fine meshes and graphically present and comment on your results. You should present temperature contour  $T(x, y)$  and heat flux contours  $\mathbf{q}_x(x, y)$ ,  $\mathbf{q}_y(x, y)$  in the report. Conduct the same analysis using Abaqus with fine mesh and compare both results.

- Q4.)** (Bonus) Consider the two-dimensional heat conduction problem over a thin square plate. The temperature of edges are prescribed as shown in Fig. 3. There is a body heat source, which is expressed as

$$s = s_0 \frac{1250 - x^2 - y^2}{1250} \quad \text{and} \quad s_0 = 5$$

The conductance matrix is given as

$$k = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$$

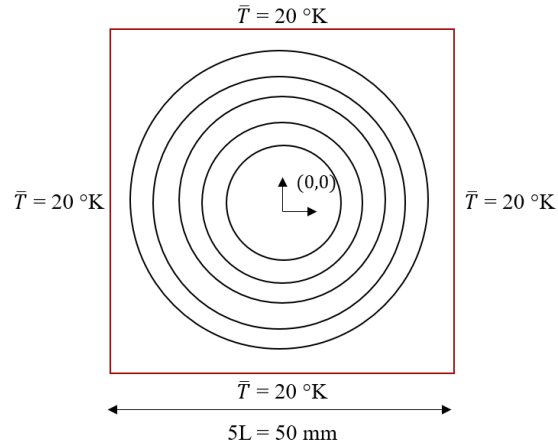


Figure 3: Geometry and boundary conditions of Q4

Obtain the temperature field  $T(x, y)$  and evaluate the heat flux  $\mathbf{q}(x, y)$ . Use the given coarse and fine meshes and graphically present and comment on your results. You should present temperature contour  $T(x, y)$  and heat flux contours  $\mathbf{q}_{\mathbf{x}}(x, y)$ ,  $\mathbf{q}_{\mathbf{y}}(x, y)$  in the report. Conduct the same analysis using Abaqus with fine mesh and compare both results.

**Note:** Please submit your codes with the report.