FEM and CFD Theory (ME3180)
Department of Mechanical and Aerospace Engineering
Assignment 2
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Due Date: 25/11/2023 (11:59 PM)

2D Steady State Heat Conduction Equation

Consider a case of steady heat conduction in a long square slab in which heat is generated at a uniform rate of q''' W/m^3 as shown in Fig 1. The top and right sides are maintained at $T = T_\infty$, the temperature of the surrounding fluid. The other two sides are insulated. Solve the steady state 2D heat conduction equation numerically and plot the steady state contour of the temperature distribution within the slab. Use a second-order central difference scheme to discretize your governing partial differential equation.

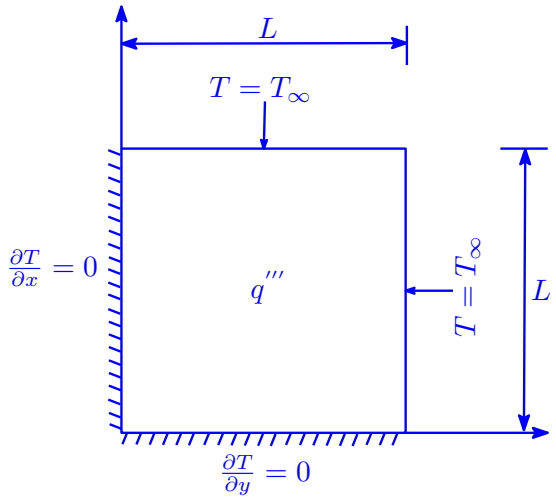

Figure 1: Computational Domain

Make a note of the following points:

- Use Gauss-Seidel, Gauss-Seidel with Successive over-relaxation, and Line-by-Line methods to solve the system of equations you obtained after discretizing the governing PDE.
- Perform a grid independence test to show that your numerical solution is not dependent on your grid size. You may consider only a uniform grid for your computations.
- For the grid independence study you may consider any one of the linear solvers of your choice.
- Compare the center line velocity distribution along the x and y directions to perform the grid independence study.

*** Please prepare a clean report and submit it on the due date. The report should contain the Governing equation, the complete discretization of the governing equation, the derivation of the analytical solution, and all the results (as asked). Please append your code at the end of your report. Upload your report and the code as one Zip file in the Google Classroom. Kindly note that the submission date will not be extended, and no late submission will be accepted.

**********Best Wishes**********