FACULTY OF MECHANICAL ENGINEERING

BMM4873 COMPUTATIONAL FLUID DYNAMICS

Lab Exercise #2

Analysis of Flow over a Flat Plate using CFD

1. Objective

It is known that the boundary layer thickness and skin friction coefficient are highly dependent on the Reynolds number (based on the plate length).

In this exercise you will model and analyze a two dimensional laminar viscous air flow over a flat plate by using Computational Fluid Mechanics (CFD) technique.

2. Problem Description

For the analysis, consider a flat plate of length $L = 1.25\,\mathrm{m}$ as shown in **Figure 1**. The maximum velocity of the air flow is 1.5 m/sec, such that the maximum Reynolds number based on plate length will be in the laminar region.

The theory regarding laminar boundary layer can be obtained from the lecture notes I uploaded in Kalam or from any fluid mechanics book (such as, Fluid Mechanics Fundamentals and Applications 2nd edition by Yunus A. Cengel and John M. Cimbala).
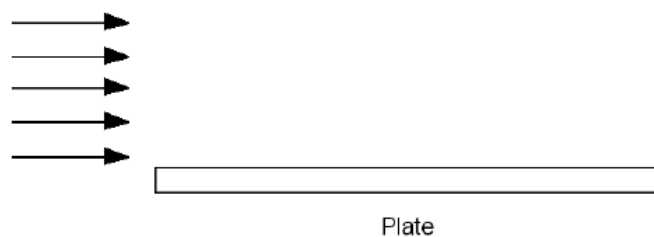

Plate

Figure 1. Schematic of flow over a flat plate

3. Expected Results

Your analysis should include the following:

- Variation of boundary layer thickness with Reynolds number,

- Variation of skin friction coefficient as a function of Reynolds number.

- Simulate the boundary layer thickness at various x locations and compare with the exact and Von-Karman approximation results,

- Change the material properties to water and compare results for laminar condition for air.

4. Report

The report should concentrate **boundary layer over a flat plate, and it should be not more than 10 pages.**

In your report, please include abstract, objective, theory, results and discussion, conclusion, and references (if any).