ME 326 **FLOW SIMULATION PROJECTS** **Spring 2024**

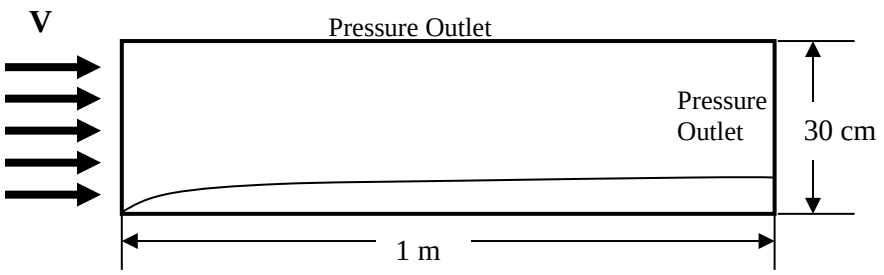
Project 1: Duct Flow

Develop a grid and analyze the developing airflow in a 2 cm wide and 10 cm long channel. a) For an air velocity of 0.1 m/s, Evaluate the velocity profile and wall shear stress. (Evaluate the Reynolds number and verify that the flow is laminar). Determine the solution's sensitivity to the grid size and compare the numerical velocity profile with the exact laminar flow solution for a fully developed steady parallel flow profile. Also, discuss the nature of the developing flow.

b) For an air velocity of 5 m/s, evaluate the velocity profile using the k-ε turbulence model and study the developing flow conditions. Discuss the differences between laminar and turbulent flows. For the air velocities of 0.1, 0.5, 5, and 10 m/s, find the friction coefficient and compare the results with the Moody diagram or the empirical equation.

Project 2: Boundary Layer Flow

Evaluate the boundary layer growth over a flat plate. The boundary conditions for the top surface and the outlet are constant pressure. Determine the features of the boundary layer velocity profile for the case of laminar and turbulent flows. Evaluate the velocity contours, velocity profiles, boundary layer thickness as a function of distance, and C_f and C_D.



a) Use an inlet velocity of 0.02 m/s and assume the flow is laminar.

b) Use an inlet velocity of 2 m/s, assume the turbulent flow, and use the k-ε model.

Compare your findings with the theoretical predictions.

Reports and Due Dates: The pdf project reports should include an abstract, introduction, results, figures with captions, a discussion of the results, conclusions, and references. Copies of the case and data files and the electronic copy of the report should be uploaded to Moodle. The due date for Project 1 is March 7, 2024, and for Project 2 is April 11, 2024. Groups of three (or two) students can work together and submit joint reports.