Fluent Project 2

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Due Date: July 3rd, 2025

Fluid Mechanics I EML 3701
Monday 2:00 PM – 3:50 PM

Team Number: 2

Video Link:

https://www.youtube.com/watch?v=rsjHglyT7iI

Formulas Used;

(Eq, 1) Boundary layer thickness: $\frac{\delta}{x} = \frac{5}{\sqrt{Re_x}}$

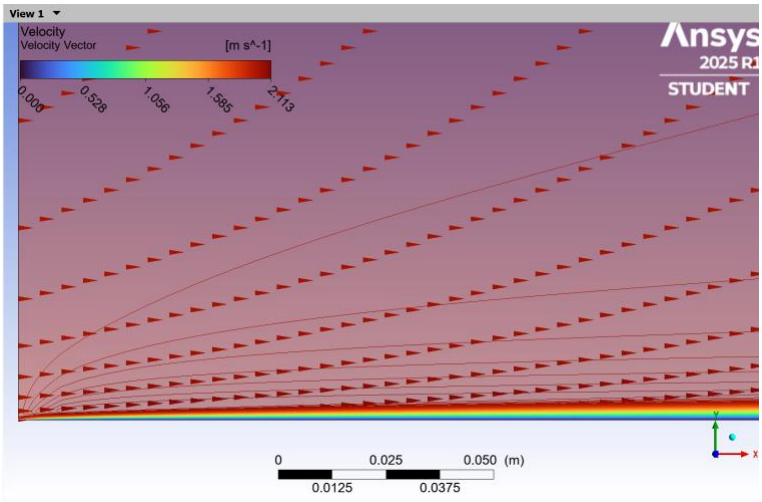
(Eq. 2) Local skin friction coefficient: $c_f = \frac{0.664}{\sqrt{Re_x}}$

(Eq. 3) Wall shear stress: $\tau_w = \frac{0.332\mu^{1/2}\rho^{1/2}U^{3/2}}{x^{1/2}}$

(Eq. 4) Drag coefficient: $c_d = \frac{1.328}{\sqrt{Re_L}}$

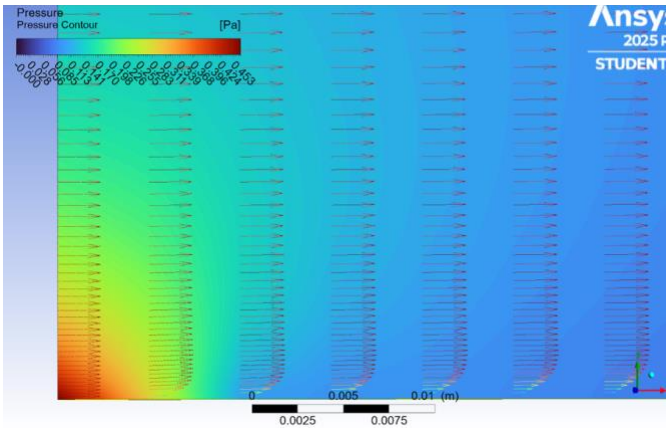
Part A

Figure 1: Velocity Vectors



To obtain the figure of the velocity vectors (Fig.1), after finishing the graph of the pressure profile, utilize the vector function in the taskbar and assign it a label. Proceed to assign it a location of “symmetry 1,” to organize the vectors on the plane, and specify the symbol and symbol size that will be used to display the vectors. For this project, “line arrow” and a size of 0.05 were selected to represent the data values.

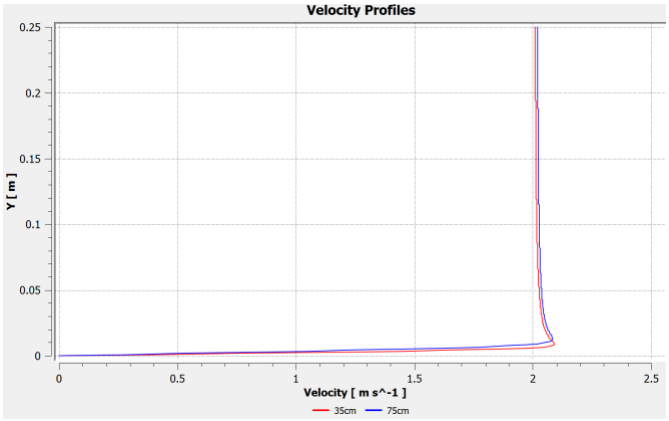
Figure 2: Pressure Contour



The pressure contour graph (Fig. 2) is obtained by selecting the contour tool in Ansys. After utilizing the tool, Ansys will fill out the contour based on the conditions given at the beginning of the project, and display the pressure regions based on the number of contours specified. In this graph, red indicates high-pressure regions, and blue indicates the low-pressure regions, which is where the wake region would be found.

Part B

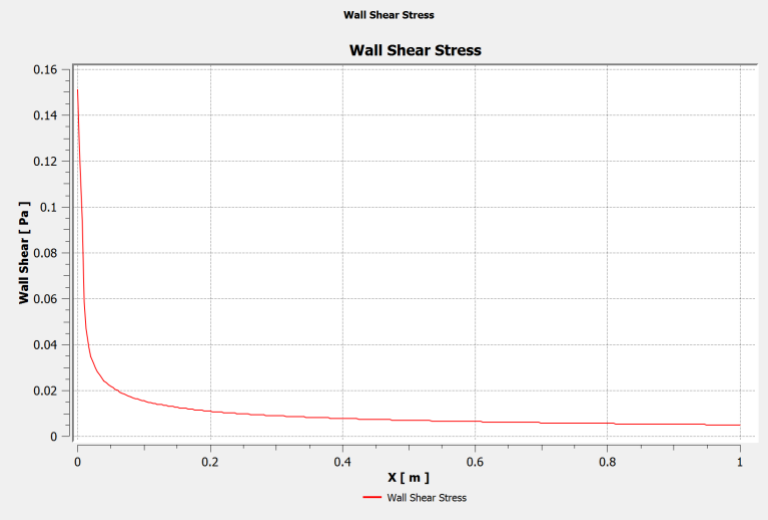
Figure 3: Velocity Profiles



In Ansys, the vertical probe can be used to identify u(y) at a given x-value, and using this information, the boundary layer thickness can be found at any point of the graph. For this project, the points $x = 35cm$ and $x = 75cm$ will be examined. Then, using the Boundary layer thickness formula (Eq. 1) and the values given for the problem, the boundary layer thickness can be solved for at both points and compared to show the increase as the fluid flows along the flat plate. However, based on the observed behavior of the graph, the boundary layer can also be seen to increase as the fluid flows and the downstream distance along the plate increases, as noted by the shift of the 75 cm line.

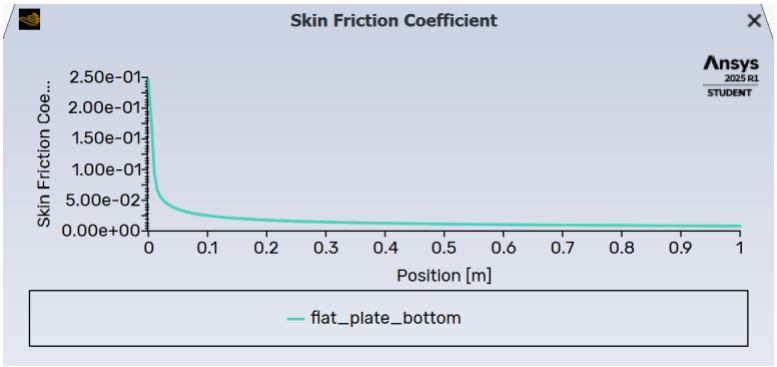
Part C

Figure 4: Wall Shear Stress



The wall shear stress can be found using Equation 3 and inputting the values given for this project; however, on Ansys, it can also be plotted by using the chart tool and importing the experiment data to generate a data series with the line showing a decreasing trend as seen in Fig. 4. Either method will demonstrate how the wall shear stress decreases as the fluid moves further downstream along the flat plate.

Figure 5: Skin Friction Coefficient



The graph for the skin friction coefficient is plotted by using the plotting tool and setting the graph's y-axis to display the wall fluxes, and the x-axis to display the direction vectors. Doing so will generate the graph seen above (Fig. 5).

Part D

Figure 6: Drag Coefficient