
Fluids - 2

A 0.5 m-radius cylinder is fixed in air flow. To determine the drag experienced by the cylinder, an engineer set up a control volume shown as the dashed box below. The engineer measured the velocity at a cross-section downstream and the velocity profile is shown in the figure. It was also found that

- The horizontal velocity of air at any position outside the dashed box is 50 m/s.
- The pressure on the four surfaces of the dashed box is 1 atm

The density and viscosity of the air are 1.2 kg/m^3 and $2 \times 10^{-5} \text{ Pa}\cdot\text{s}$, respectively. Do the following:

1. **(15 points)** Determine the air's mass flow rate through boundary AB per unit length of the cylinder.
2. **(70 points)** Building upon your results in Question 1, determine the direction and magnitude of the drag experienced per unit length of cylinder.
3. **(15 points)** Sketch representative streamlines to illustrate the features of flow around the cylinder and explain why these features exist.

