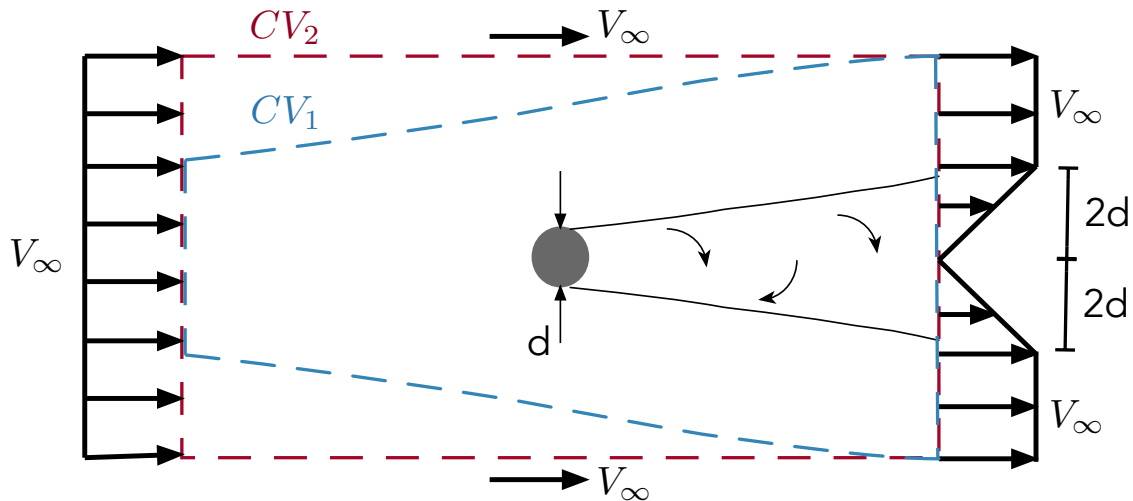


Project: What is the topic of your project? Who else is on your team?

2.1 Problem 5.46 in Munson.

2.2 Problem 5.78 in Munson.

2.3 We wish to determine the drag of a cylinder in a very large wind tunnel (so that we can ignore wall effects). Effectively the flow is unconfined. The Reynolds number is large and corresponds to case (D) in Fig. 9.21 (i.e., the wake width is reasonably steady). One approach to determining the drag is to use a force-balance measurement. However, an alternative approach is to use a wake-survey. In this approach we just need to measure the velocity profile in the wake. You should assume 2-dimensional, incompressible flow with the wake velocity profile shown below:



What is the drag coefficient of the cylinder based on projected area (i.e., $2d$ drag coefficient based on diameter)? Is this a reasonable value (why or why not)? Solve the problem **twice** using each of the two control volumes shown above: 1) a control volume that follows streamlines (blue volume CV_1), or 2) a rectangular control volume (red volume CV_2).

2.4 Open-ended: Check out this video of [flying mobula rays](#) (it seems to require Flash on the desktop but displays a non-Flash version on my mobile device). Estimate their power to weight ratio and of course show your work and justify your answer. How does your estimate compare to the power to weight ratio of humans or to other animals? Note that this is not a balance law problem, and we've not discussed drag in detail in class yet, but you should know enough from ME EN 312 to be able to come up with reasonable estimates.

2.5 CFD: Complete the "Geometry/3D-CAD: Cyclone Separator" tutorial. Think of any object you'd like to simulate in external flow. Create this object using an external CAD package. Import it into StarCCM+ then build the geometry for a fluid domain around your object (using StarCCM's internal CAD capabilities). Set the appropriate boundary conditions. You don't need to mesh or solve at this stage, but do save your file because we will use it again. Turn in a plot of your geometry and its domain. Briefly discuss how you selected the size of the domain. On our website there is a short memo on domain sizing from the StarCCM developers, which also contains references to sections in the User Guide.