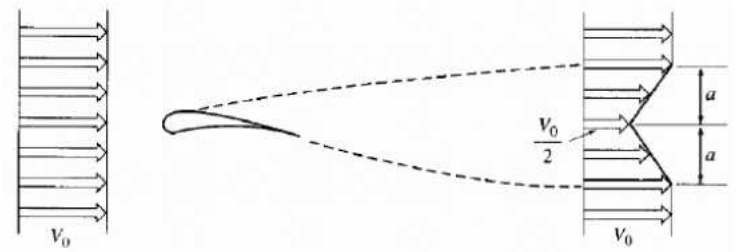
2.20 Marine Hydrodynamics Homework #3(a)
Due: October 6, 2009

Question 1: Control Volume

Problem 4.31, from "Fluid Flow, a first course in fluid mechanics", SAH, 4th Edition

An airfoil is tested in a large wind tunnel. The velocity upstream is uniform over the cross secition and equal to V_0. At a cross section downstream, Pitot tube measurements show a distorted veolcity profile as shown in the figure below. The pressure at both cross sections is the same and constant. Find the drag of the airfoil (per unit depth normal to the surface of the paper). The air may be considered incompressible.

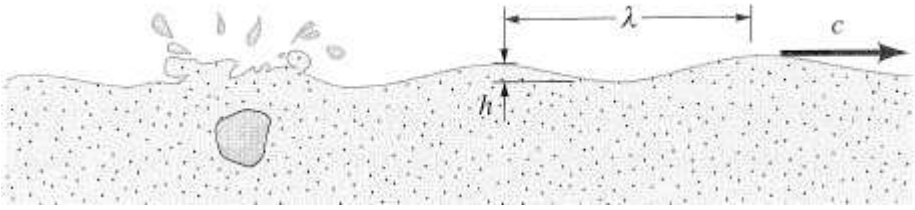


PROBLEM 4.31

Question 2:

7.7 from Fund. of Fluid Mech. by Munson, Young, and Okiishi (5^{th} Ed.)

When a small pebble is dropped into a liquid, small waves travel outward as shown in the figure below. The speed of these waves, c, is assumed to be a function of the liquid density, ρ, the wavelength, λ, the wave height, h, and the surface tension of the liquid, σ. Use h, ρ, and σ as repeating variables to determine a suitable set of pi terms that could be used to describe this problem.



Question 3:

7.14 from Fund. of Fluid Mech. by Munson, Young, and Okiishi (5^{th} Ed.)

A jet of liquid directed against a block can tip over the block. Assume that the velocity, V, needed to tip over the block is a function of the fluid density, ρ, the diameter of the jet, D, the weight of the block, W, the width of the block, b, and the distance, d, between the jet and the bottom of the block.

1. Determine a set of dimensionless parameters for this problem
2. Use the momentum equation to determine and equation for V in terms of the other variables
3. Compare the results from first and second part