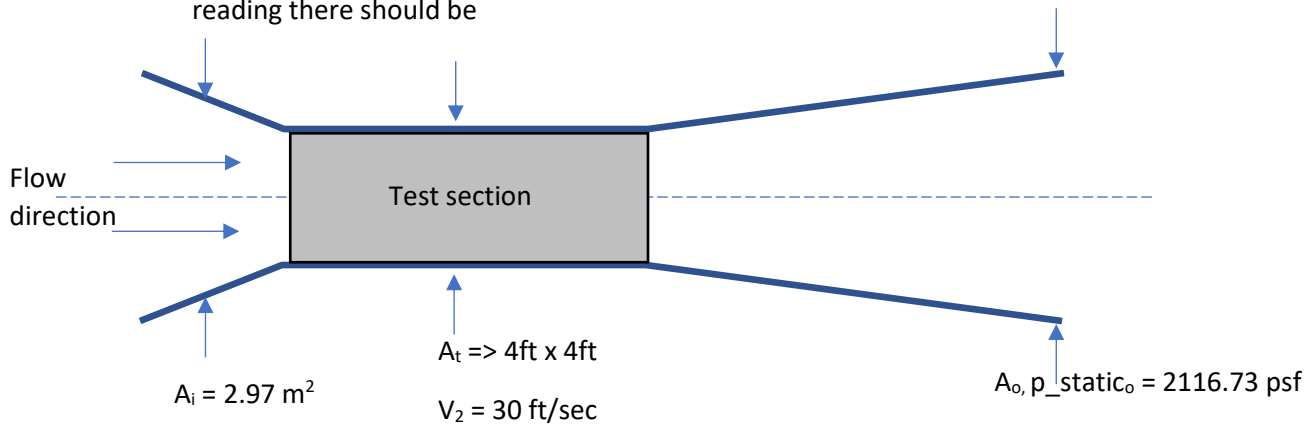


## Homework #2

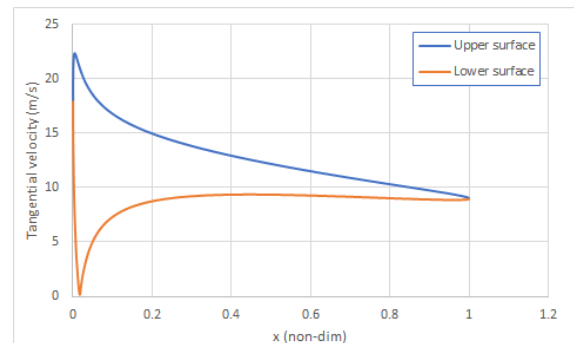
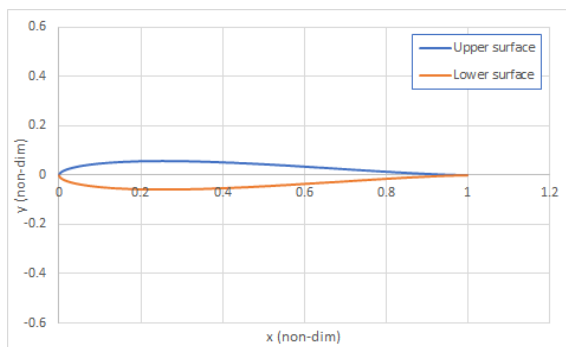
MEAM 5450 - Fall 2022

Assigned: 10/04/2022, Due: 10/12/2022

- 1.) You are working on testing an airfoil in a wind tunnel at sub-sonic speeds (see figure). There is a static pressure port at the inlet, test section and outlet. You know the test section and inlet dimension, test section velocity and the static pressure at the outlet. Your lead engineer has asked you to calculate the following, (you use your engineering judgement to assume that the flow in the tunnel is incompressible and that you are operating on a standard day at sea level,  $p_{\text{tot}} = 14.7$  psi):
- The tunnel speed at the inlet
  - An estimate of the cross-section area of the outlet
  - You don't trust the static pressure port at the inlet, what is your estimate of what the pressure reading there should be

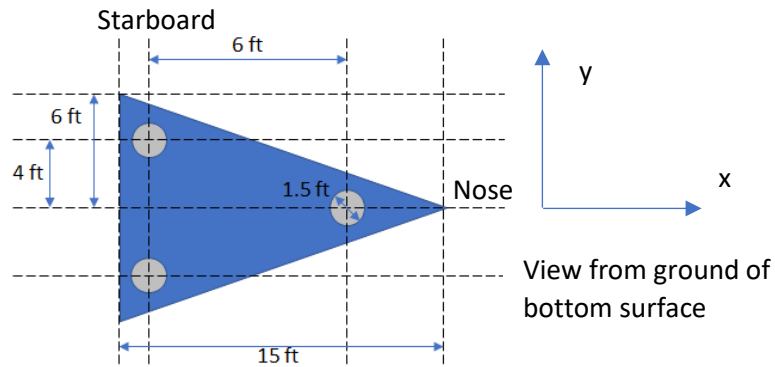


- 2.) You are at the wind tunnel getting ready to test an airfoil design your team had come up with. One of your colleagues noticed an error in the calculation of the expected pressures on the upper and lower surface of the airfoil (measured by the static ports on the test article). She believes that the solver predicted the velocities tangential to the surface of the airfoil correctly but not the pressures. Your lead engineer is asking you to calculate the pressure (in psi) that you are expecting to see in the test. Your colleague mentioned that the aero analysis software was run at the tunnel speed (10 m/s; you can safely assume a standard day). The data file generated by the analysis code is labeled airfoil\_data.txt



A senior engineer in your group recommended that as part of your reporting to write down a few sentences on the trends you observed in the data you calculated/started with.

3.) You have been assigned to work on this awesome new VTOL aircraft with three jets.



When on the ground the bottom surface of the vehicle is designed to sit 1.5 ft above the ground (when level). If you were to assume that all the jet exhaust (at exit 40 ft/sec, ambient temperature) is to fill the volume under the vehicle, your manager wants you to analyze (calculate and critique):

- An estimate of the flow pattern under the aircraft (show plot, state assumptions/equations) in i) zero wind condition, ii) 10 knots from the nose, i.e. head wind iii) 10 knots from starboard side
- Assuming standard sea level atmosphere, an estimate of the suction force on the aircraft due to the jet exhaust only in all three wind conditions from (a)