AerE 344: Undergraduate Aerodynamics and Propulsion Laboratory

Lab Instructions

Lab #01: Flow Visualization with Smoke Wind Tunnel

Purpose: Use of Collins 690A-1 smoke tunnel to visualize the flow patterns as the airflow passes 2-D and 3-D models for studying the aerodynamic characteristics of bluff and streamline bodies.

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First   Last

NOTE: On all sketches **(for all questions)**, label areas of the highest and lowest pressure. If a lift force exists, draw a vector to represent it.

1.   Sketch the flow pattern over a symmetrical airfoil for the following conditions:

(a). "No Lift" condition, α=0 °;

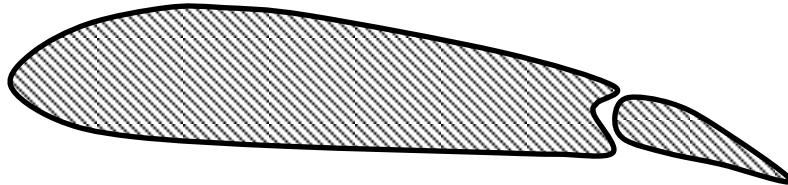(b). A positive angle of attack;

(c). Stalled condition.

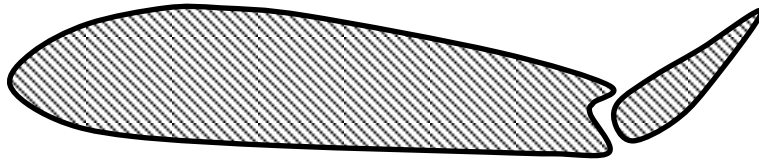2.   (a). Sketch the flow pattern around a cambered airfoil at zero angle of attack.

(b)   Discuss the difference in the flow patterns around a symmetrical airfoil and a cambered airfoil at zero angles of attack.

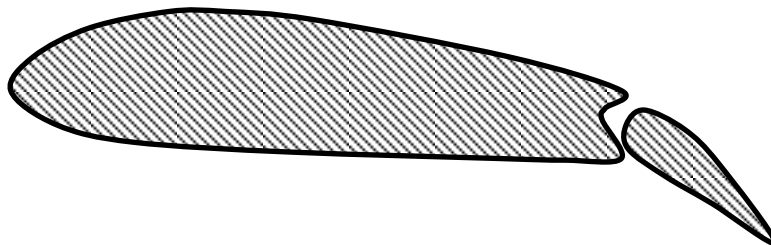3. Sketch the flow pattern around the airfoil and flap with the flap deflection specified.

(a)   No flap deflection



(b)   Upward flap deflection

(c).   Downward flap deflection

(d).   Considering only the flow pattern around the airfoil state which of the above three conditions produces the greatest lift coefficient. Based on your observation of the <u>flow pattern,</u> state how you arrived at this solution.

4. Describe the effects on a C_l vs. angle of attack plots of the symmetrical airfoil (Problem 1), cambered airfoil (Problem 2) and cambered airfoil with flap (Problem3).

5. (a). Using the smoke tunnel, sketch the flow pattern around the five shapes tested.
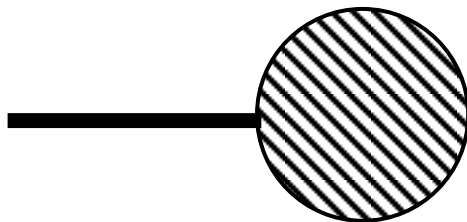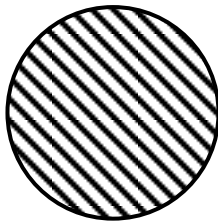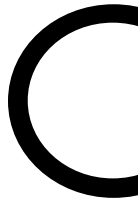
(b).   Discuss the relative magnitude of the drag of the different configurations in consideration of the streamlines and the wake width.

6. (a)   Sketch the flow pattern around the tip of a finite wing.

(b)   Explain how this difference (compared to the 2-D cases) gives rise to another form of drag known as 'induced drag'.