# UMaine Wind Tunnel

## The need:

Wind tunnels are tubelike structures or passages in which wind is produced, usually by a large fan, to flow over objects such as aircraft, engines, wings, rockets or models of these objects. A stationary object is placed in the test section of a tunnel and connected to instruments that measure and record airflow around the object and the aerodynamic forces that act upon it. From information gathered in these observations, we can determine the behavior of an aircraft or its components at takeoff, while cruising, and during descent and landing.

Wind tunnels also help us determine the performance of, and eliminate "bugs" in, new designs of civil and military aircraft without risk to a pilot or costly aircraft. Responses to flight condition of new materials and shapes for wings, ailerons, tails, fuselages, landing gear, power systems and engine cowlings can be assessed before these designs are incorporated into aircraft. Today, no aircraft, spacecraft or space launch or reentry vehicle is built or committed to flight until after its design and components have been thoroughly tested in wind tunnels. Every modern aircraft and space rocket has made its maiden flight in a wind tunnel. [From http://www.nasa.gov/centers/langley/news/factsheets/WindTunnel.html]

UMaine owns an open return low speed wind tunnel in Crosby lab. The tunnel has not been operated in a number of years, and no quantitative data regarding the flow quality (velocity distribution across the test section and turbulence intensities) exist. In order to advance aerodynamic design capabilities of capstone and research projects, an operational wind tunnel with known flow characteristics and appropriate measurement instrumentation is needed.

## The key project design objective:

This team will provide at the end of the year a flow map of the tunnel in its current form, a design (including CFD analysis) and construction of airflow improvements and cross sectional adjustments that adapt to current experimental needs at UMaine, and a subsequent experimental characterization and verification of the selected tunnel modifications and instrumentation. The redesigned tunnel functionality will be demonstrated by carrying out two standard aerodynamic experiments: the measurement of the pressure distribution and lift of a known airfoil using pressure taps, and a flat plate boundary layer velocity profile measurement using a hot wire anemometer.

## Who is the final customer for this device?

The customer for this project will be the UMaine air flow lab. In particular, the project will develop critical infrastructure for both capstone and other design and engineering science classes.

## Who will be supervising and evaluating the outcome of the project:

Daily supervision of the project will be done by Professor Peterson with technical direction done by Professor Friess. Additional insight may be available from Dr. Urbina and Mr. Cameron, both of whom have been involved in the wind wave facility design and are in the mechanical engineering department.

## UMaine Mechanical Engineering technical contact point:

Professor Peterson will provide primary oversight on the goals and objectives of the project. Additional technical support will come from other faculty in the other relevant technical areas, most notably Professor Friess.

## Core Mechanical Engineering classes required as background:

- Controls
- Thermodynamics
- Design I and II
- Fluids
- Aerodynamics

## Resources available:

Extensive build and test facilities are available in Crosby Lab. Fabrication and assembly areas are available. Basic software is available for analysis

## End of year deliverables:

Complete characterization data of original and modified tunnel, accompanied by a design report outlining the redesign of the tunnel and test results for demonstrator cases including comparison with reported results. Oral presentation of the results as well as other deliverables related to the class activities.