Lift and Drag
- Horizontal Wind Tunnel AF100

UTD Mechanical Engineering
Fluids Lab (MECH 3115)
Dr. Hui Ouyang

How to?

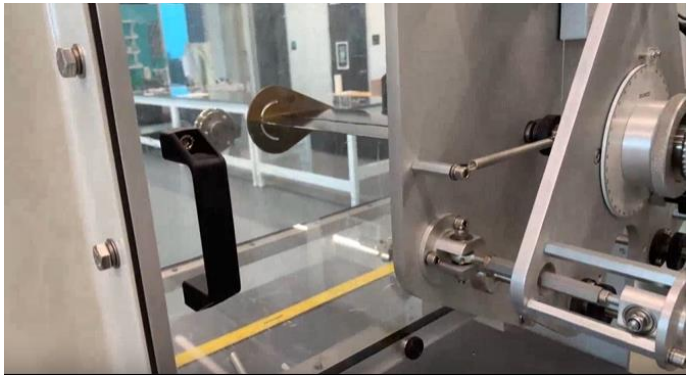
To complete your report, you need to:

- Water the presentation video.
- Watch the experiment video
- Complete the quizzes about this experiment.
- Perform data analysis
- Perform a discussion about your results/findings
- Assemble your work and complete the report

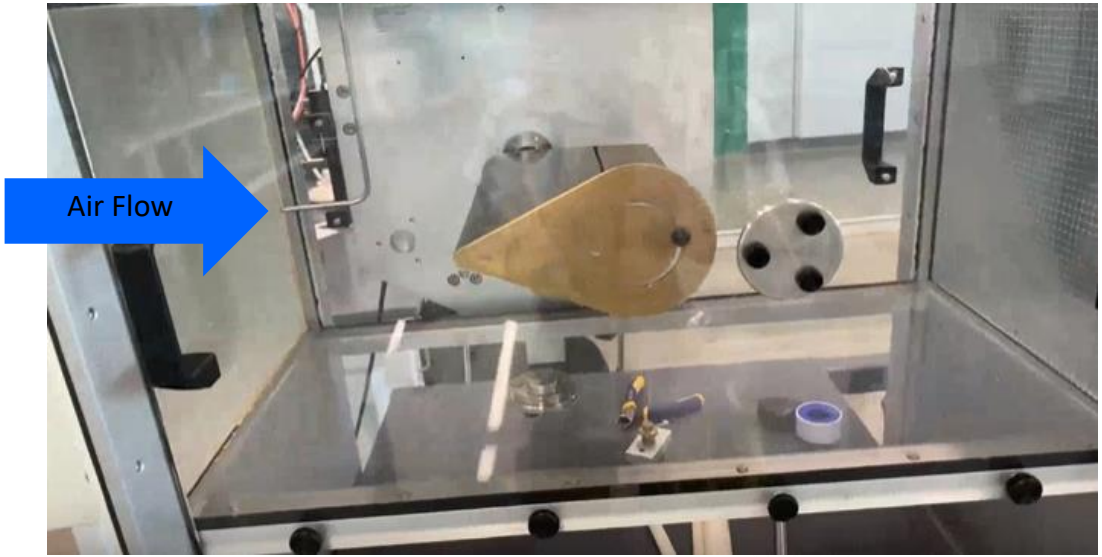
Experimental instruments/apparatus

AF 100

- AF 100 can expose an object with various geometry to air flow, ultimately to measure drag / lift / moment.
- In your experiment, you will use NACA2412 aerofoil, not a golf ball.



Fan sucks air from the funnel area



Theory

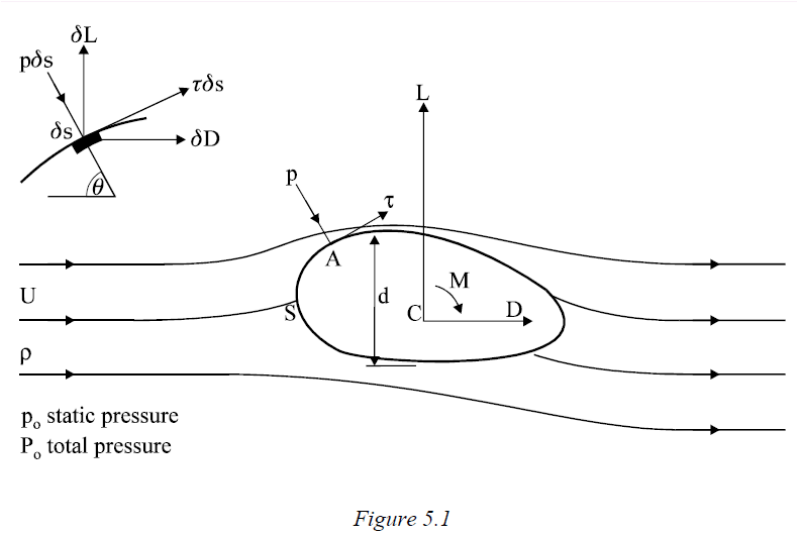


Figure 5.1

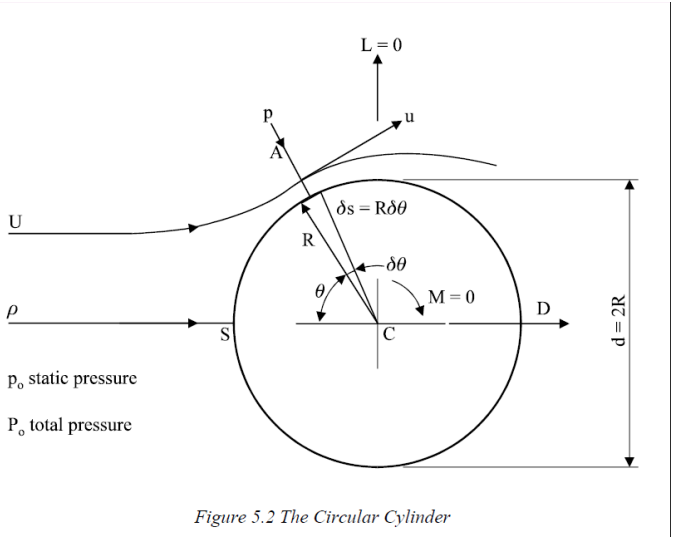
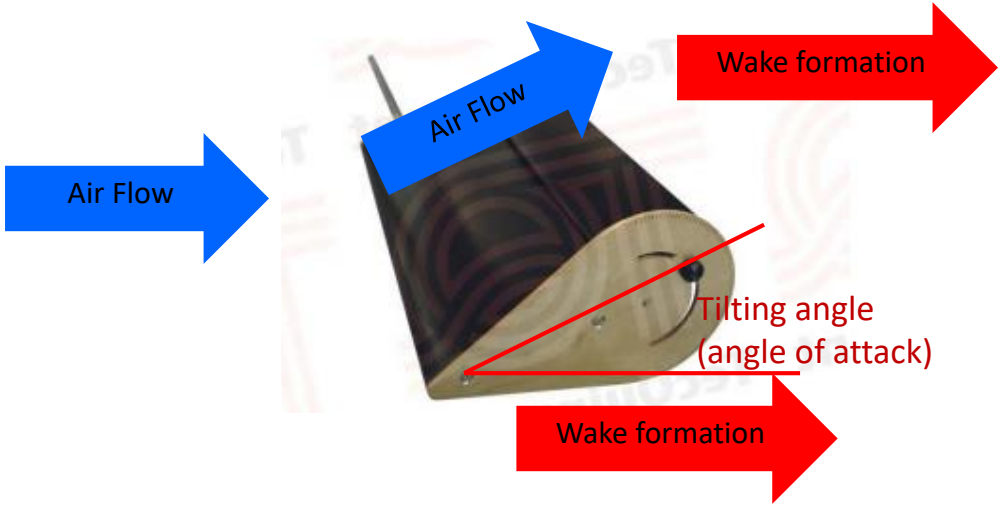
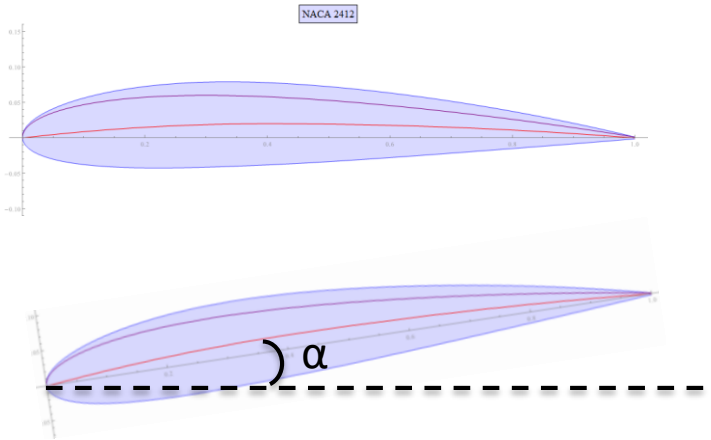


Figure 5.2 The Circular Cylinder

NACA 2412 Aerofoil

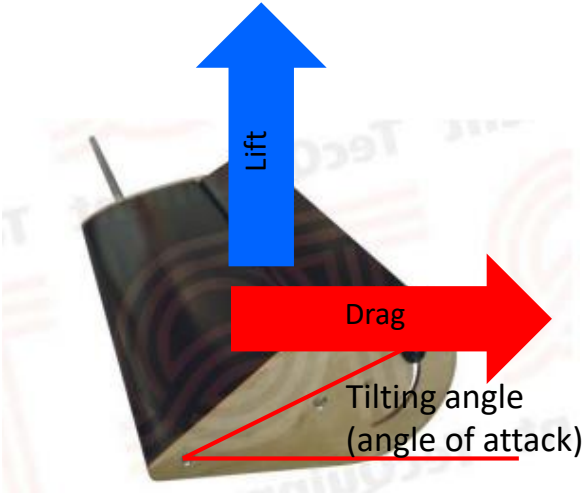
This experiment measures drag and lift coefficients at multiple different angles of attach, to recognize the relationship among noted variables.

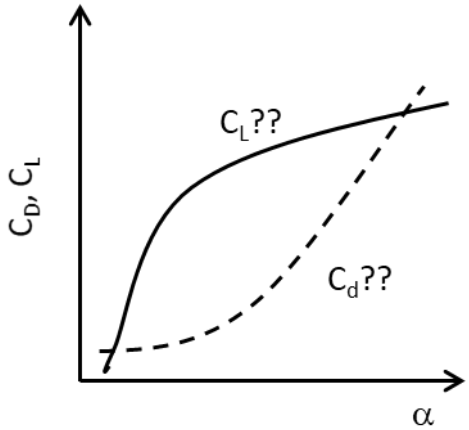




NACA 2412 Aerofoil

Measure α, and measure F_D and F_L, and calculate C_D & C_L





Coefficient Calculation

Equations used to determine coefficients:

- Drag Coefficient, C_d:

$$C_D = \frac{F_D}{P_D * A_p}$$

$A_p = chord * span$

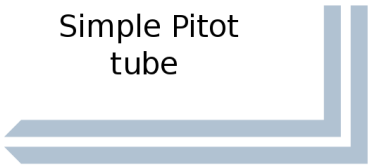
(NACA2412 Airfoil)

chord length = 0.152 *m*

span = 0.3 *m*

- Lift Coefficient, C_L:

$$C_L = \frac{F_L}{P_D * A_p}$$



Experimental Objective

- Determine the drag and lift coefficients for an airfoil as a function of angle of attack.

- Determine the angle of attack corresponding to the onset of stall.

Experimental Procedure

1. Switch on the power.
2. Lock the AFA3 Three Component Balance (Force Balance) strings (rotate the levers to extreme clockwise end).
3. Change angle of the aerofoil. Start your experiment from zero degrees.
4. Place pitot tube aligned to leading edge of aerofoil.
5. Release the lock of Force Balance strings by rotating the levers half to one turn in anti-clockwise direction.
6. Zero the force and pressure measurements if needed.
7. Start wind tunnel.
8. Note down forces and pressure values from display board/computer.
9. Stop wind tunnel.
10. Repeat steps 2-9 for every 5 degree increment in angle.
11. Switch off the power.

Data Collection

α	0	5	10	15	20	25	30	35	40	45	50
P_D											
F_D											
F_L											

Data Analysis

α	0	5	10	15	20	25	30	35	40	45	50
P_D											
F_D											
F_L											
C_D											
C_L											

Results and Discussion

- Plot angle of attack vs coefficients C_L and C_D
- "Stalling" phenomenon is marked as a decrease in lift coefficient for an increase in angle of attack

Results and Discussion

- Does an increase in angle of attack lead to an increase in drag indefinitely? Lift?

- At what angle should an airplane try to lift off at to generate maximum lift for minimum drag?

The end.