Chapter 6

Incompressible Flow Around Airfoils of Infinite Span

Circulation and Lift

Potential Flow | Actual Flow
Kutta Condition - requires the flow from the upper and lower surfaces to join smoothly at the trailing edge.

Modeling the Airfoil
(Potential Flow)

Potential flow around airfoil
Vortex Flow (circulation)

Starting Vortex
Airfoil at Rest
Motion Starts
Steady State

Thin-Airfoil Theory

Theory / Experiment (Symmetrical)

NACA 0009
NACA 0012-64
**Theory / Experiment (Cambered)**

![Graph showing section lift coefficient, C_l, vs angle of attack, \( \alpha \)](image)

- **NACA 2412**
- **NACA 2418**

**B.L. and Separation Effects**

![Graph showing lift coefficient, C_l, vs angle of attack, \( \alpha \)](image)

- Geometry Only
- Geometry and B.L.

**Velocity Distributions**

![Graph showing velocity distribution](image)

- Typical Airfoil
- Liebeck Airfoil

**Liebeck Airfoil**

![Graph showing airfoil characteristics](image)

**NASA GA (W)-1**

![Graph showing airfoil characteristics](image)

- GA (W)-1 curves
- NACA std. Roughness
- O - NASA std. Roughness
Multielement Airfoils / Flaps

- Confluent Boundary Layers
- Reattachment
- Separation

Design Constraints

- Flaps must remain external to spars.
- Exposed flap surface set by airfoil geometry.

Boundary Layer Regions

- Confluent boundary layers
- Traction-free edges
- Conventional boundary-layer models

Boundary Layer Interaction

- Flap boundary layer
- Wake eddy diffusion model
- Conventional boundary-layer eddy viscosity model