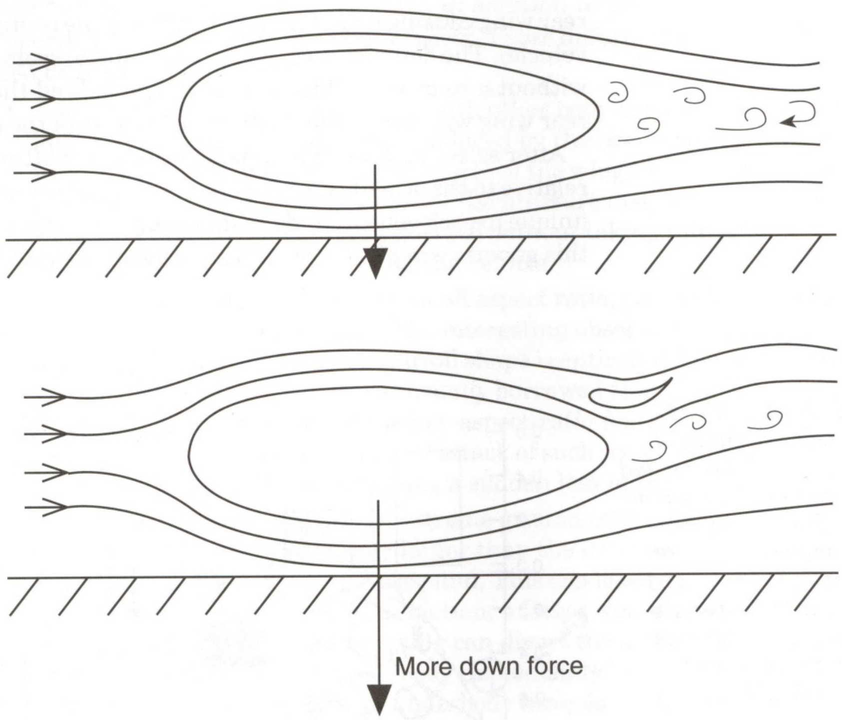
MECH 4430-15F
Aerodynamics

Ref.: Katz, J., *Race Car Aerodynamics*, Bentley, 1995.

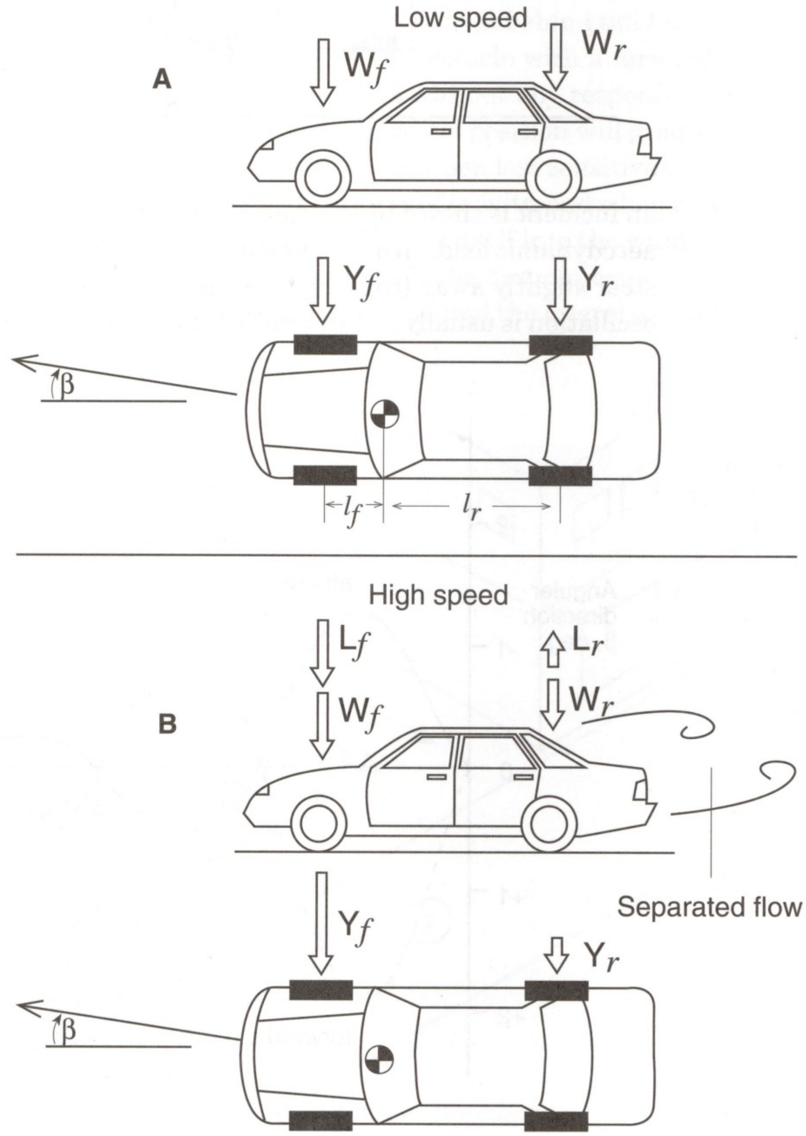
Lift

Fig. 6-64. *Schematic description of the effect of a rear wing on the streamlines nearby a generic body.*



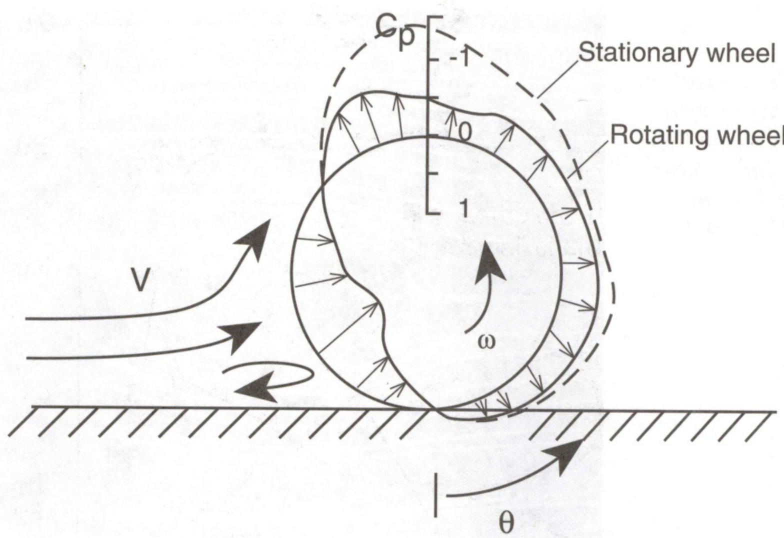
Aerodynamic force coefficients

Fig. 5-25. Lateral forces created by the tires during side slip: without aerodynamic effects (A) and with aerodynamic lift at the rear axle (B).



Action of wheel

Fig. 6-24. Schematic description of the centerline pressure distribution on a stationary and a rotating isolated wheel.



Action of diffuser

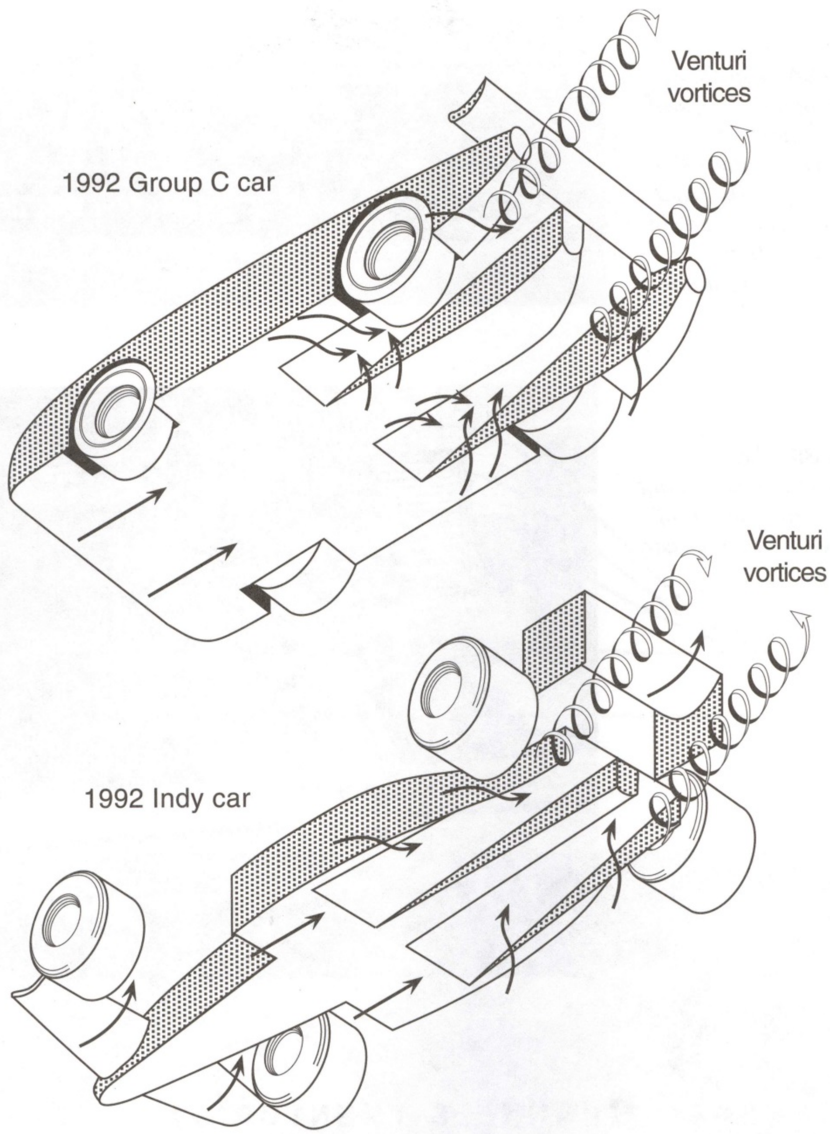


Fig. 6-36. *Typical underbody channels on two types of race cars.*

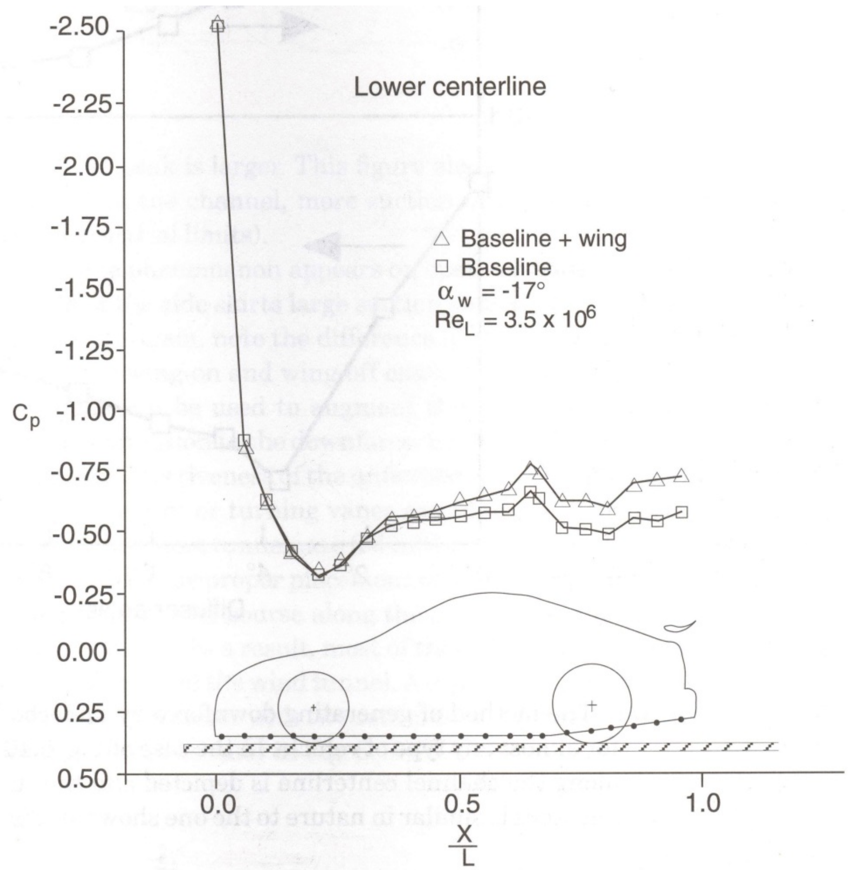


Fig. 6-38. *Effect of rear wing on a vehicle's slanted lower surface, centerline pressure distribution (wing height above rear deck = 0.75c). Reprinted with permission from Ref. 2.7.*

Action of spoiler

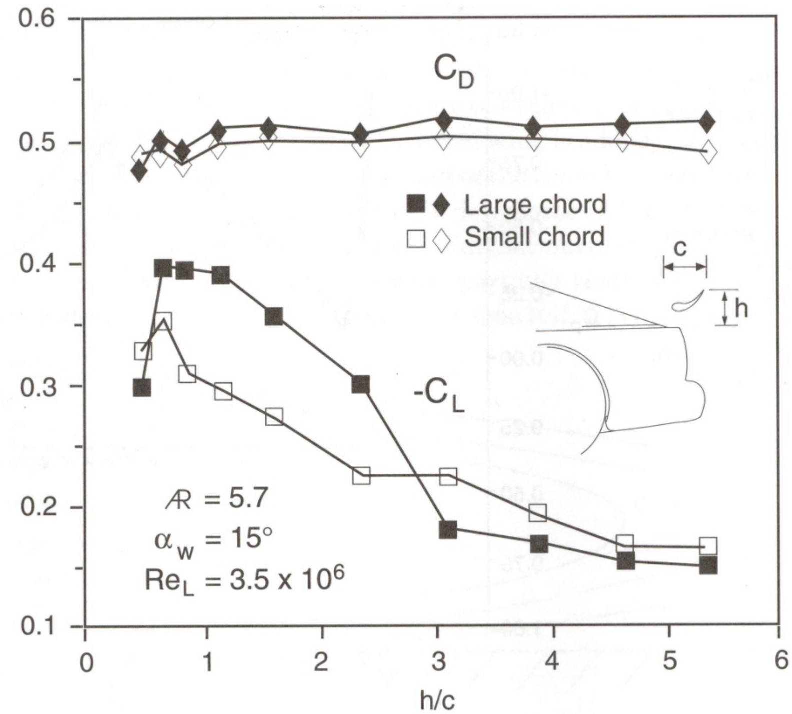


Fig. 6-67. *Effect of rear wing proximity to vehicle's body on lift and drag (for a generic sedan-based race car). Reprinted with permission from SAE paper 920349, Copyright ©1992 SAE, Inc. (Ref. 4.11).*

Airfoils

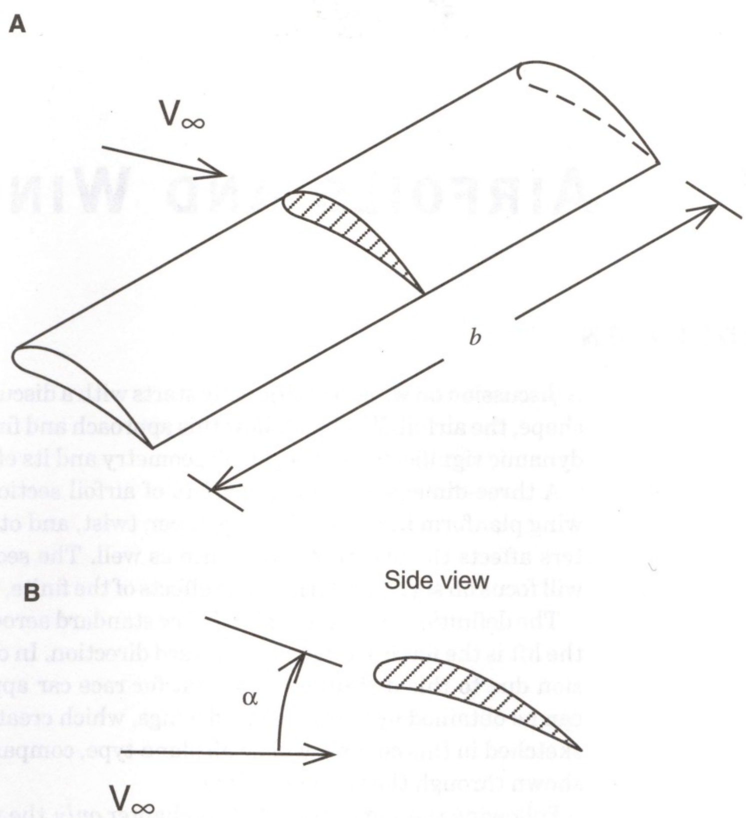


Fig. 4-1. *The airfoil is the shaded shape shown on the wing* ***A****. In the case of a rectangular wing,* ***B*** *shows the two-dimensional airfoil.*

Fig. 4-2. Basic nomenclature used to describe an airfoil.

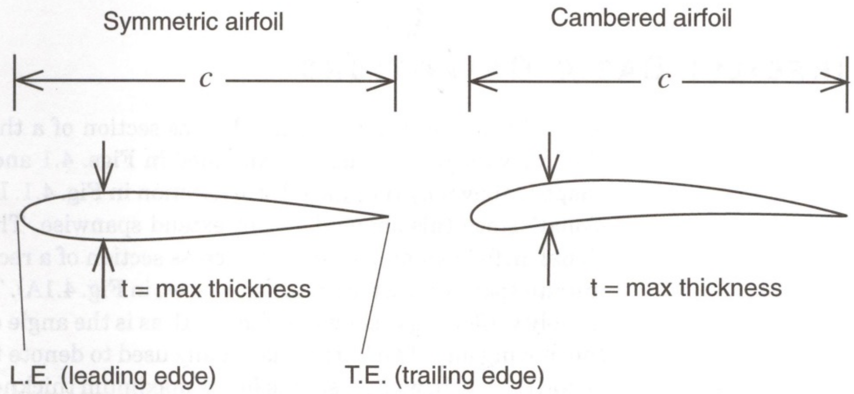
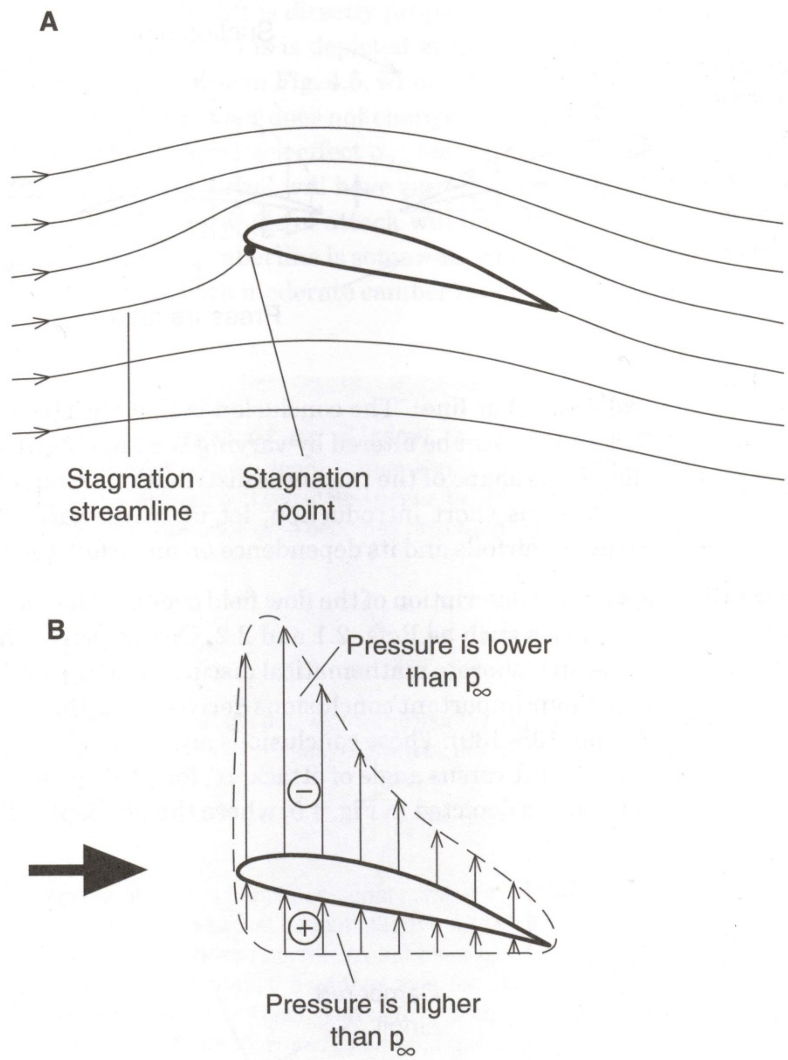
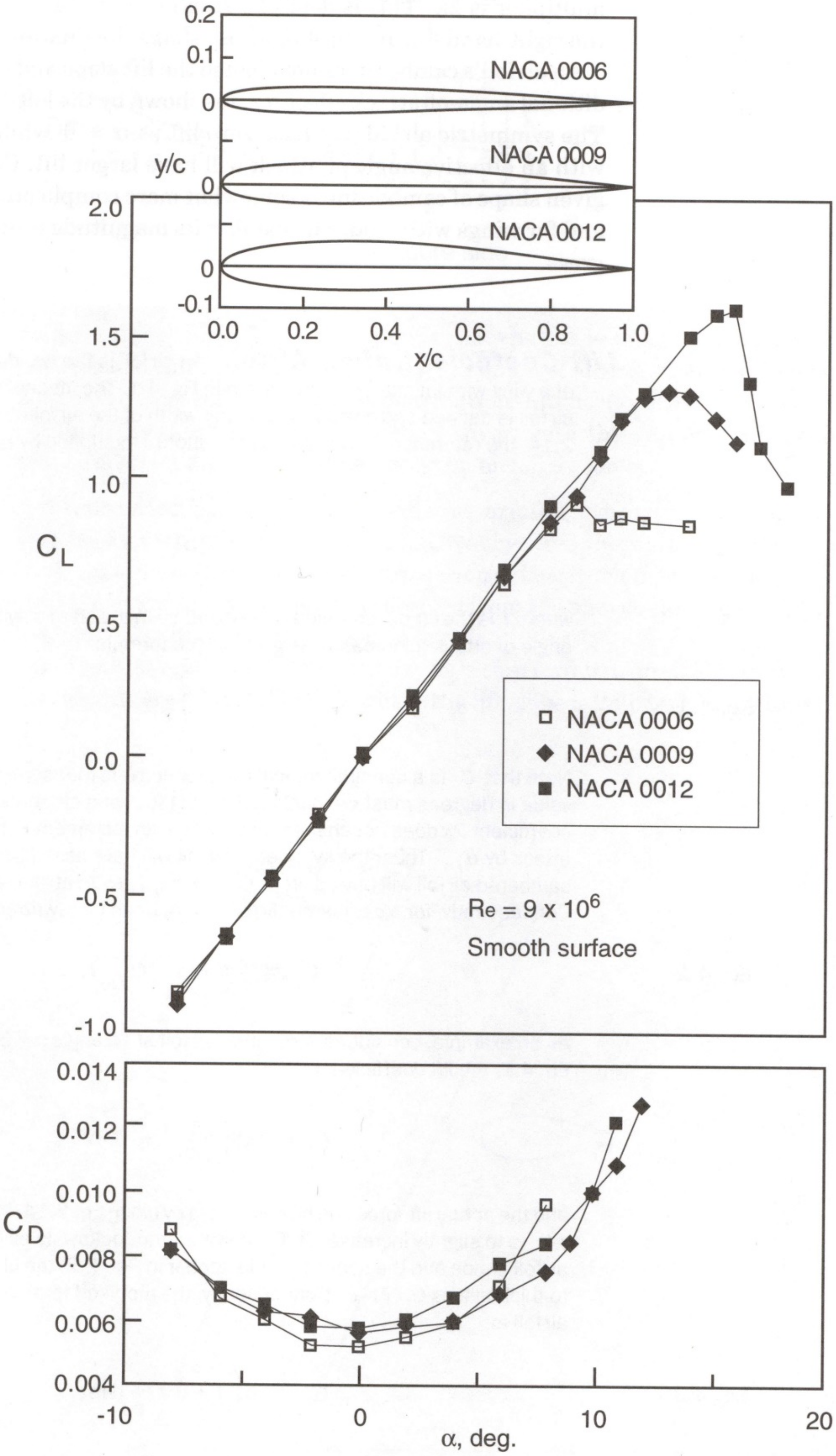


*Fig. 4-3. Streamlines near an airfoil (**A**), and the resulting pressure distribution (**B**).*



Effect of thickness

Fig. 4-6. Effect of thickness on the aerodynamic coefficients of symmetric NACA airfoils (based on data from Ref. 4.1). Note that the thickness of the 0006 airfoil is 6%, of the 0009 is 9%, and for the 0012 is 12%.



Stall

Fig. 4-7. *Schematic description of the streamlines near an airfoil with attached flow and with separated flow.*

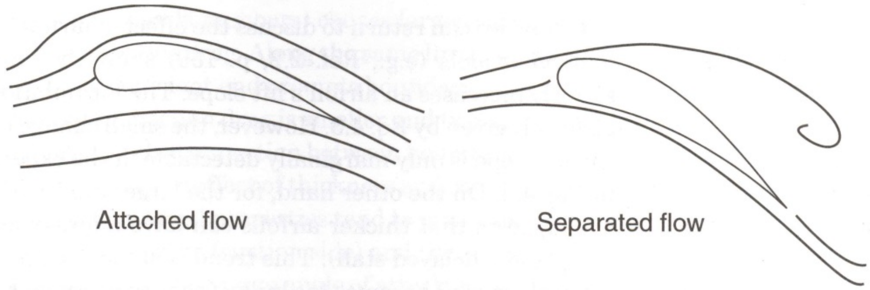
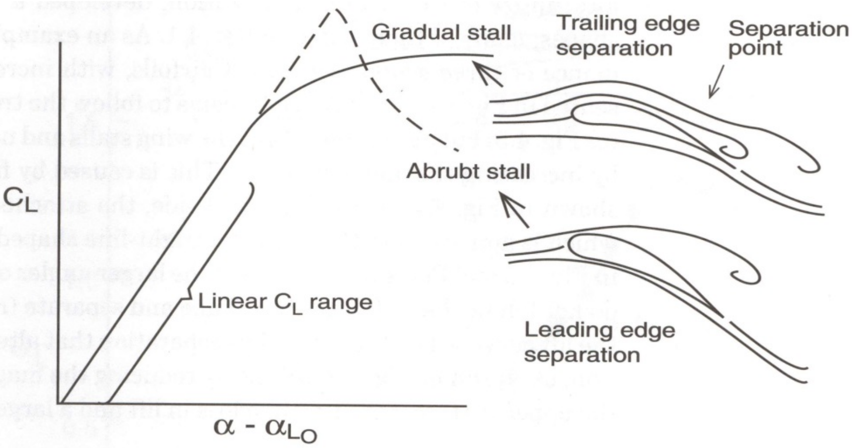
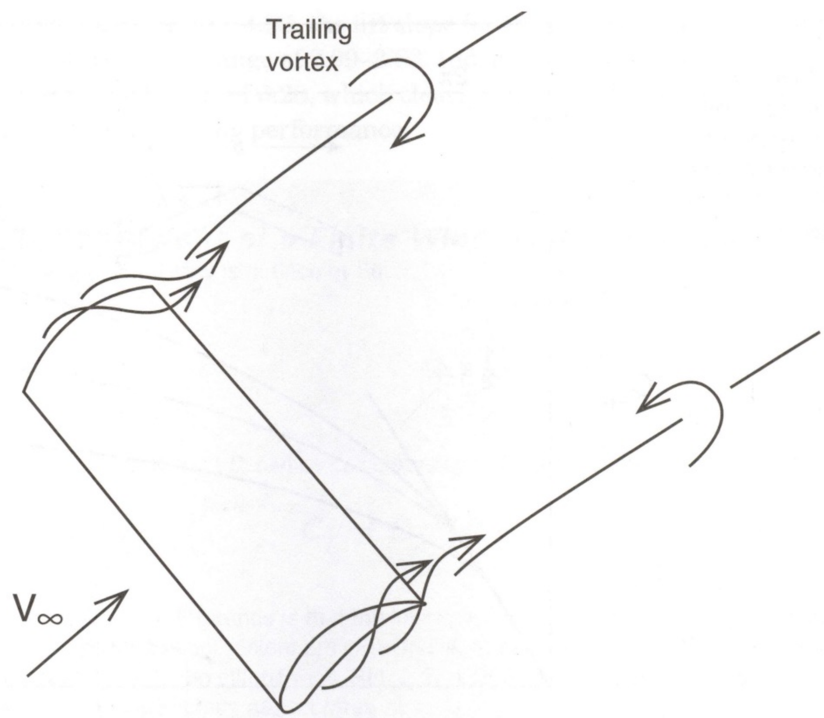


Fig. 4-9. *Effect of stall on the lift versus angle of attack curve, for two airfoil types.*



Effect of span

Fig. 4-21. *Trailing tip vortices behind a finite wing.*



Effect of end plates

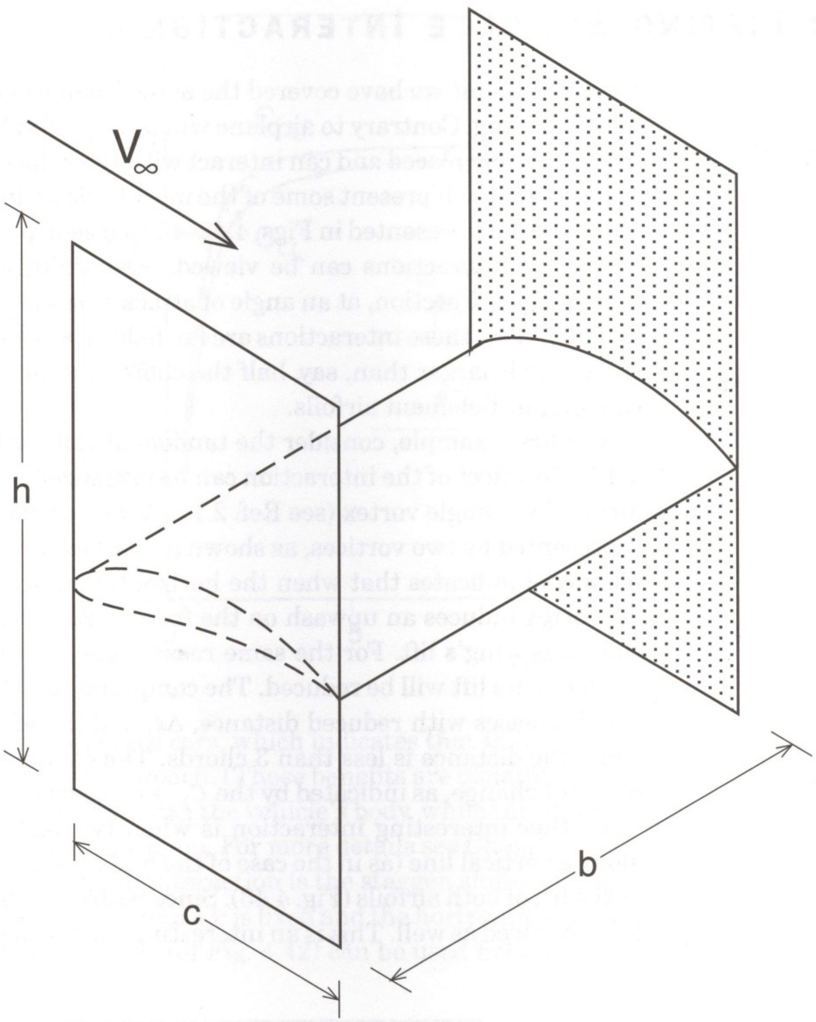


Fig. 4-41. End plate parameters affecting the performance of a rectangular wing.

Effect of ground

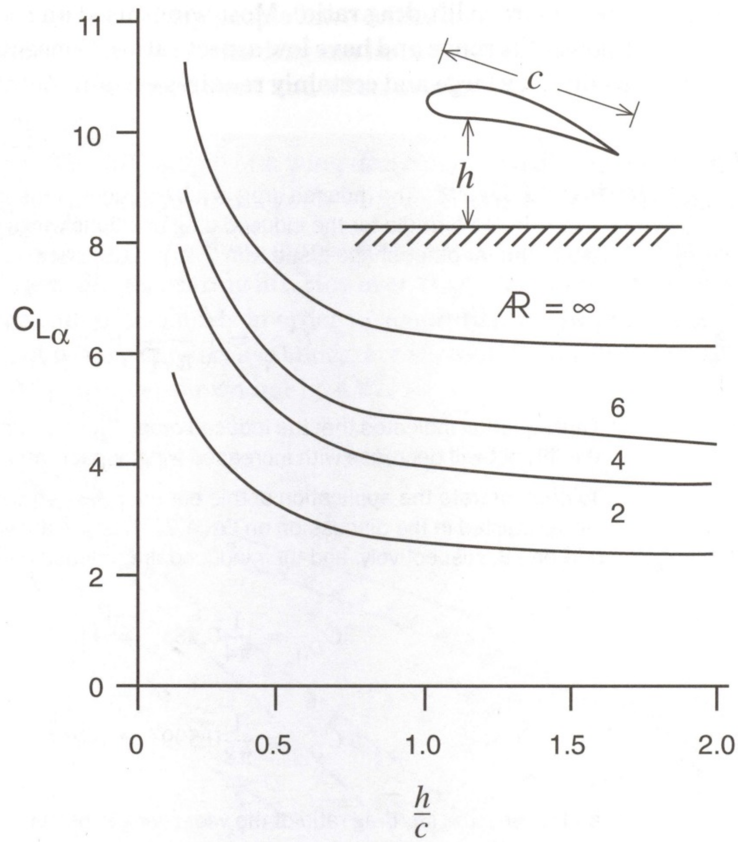


Fig. 4-25. *Effect of ground proximity on the lift coefficient slope of rectangular wings. Reprinted with Permission of ASME, from J. Fluids Eng., Vol. 107, Dec. 1985, p.441.*

Drag on airfoils

Multi-element airfoils

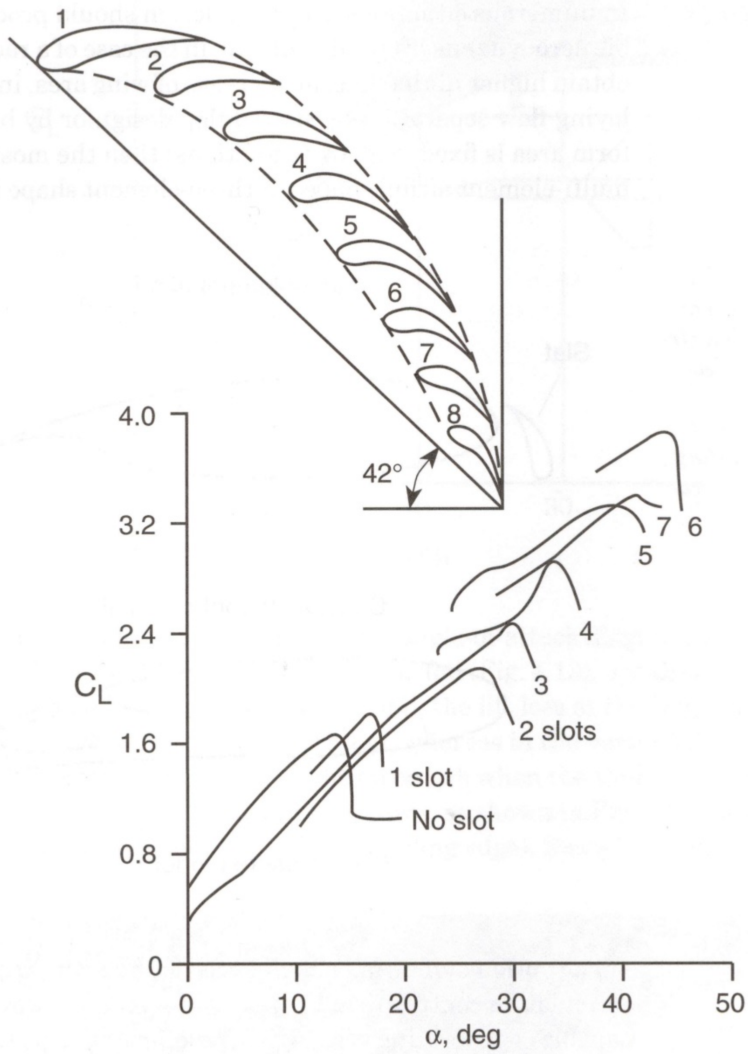


Fig. 4-33. *Lift coefficient versus angle of attack for the RAF 19 airfoil broken up to different numbers of elements (note that a two-element airfoil has 1 slot, a three element airfoil has 2 slots, etc.) (From Smith, Ref. 4.5, Copyright ©1975 AIAA, Reprinted with permission).*

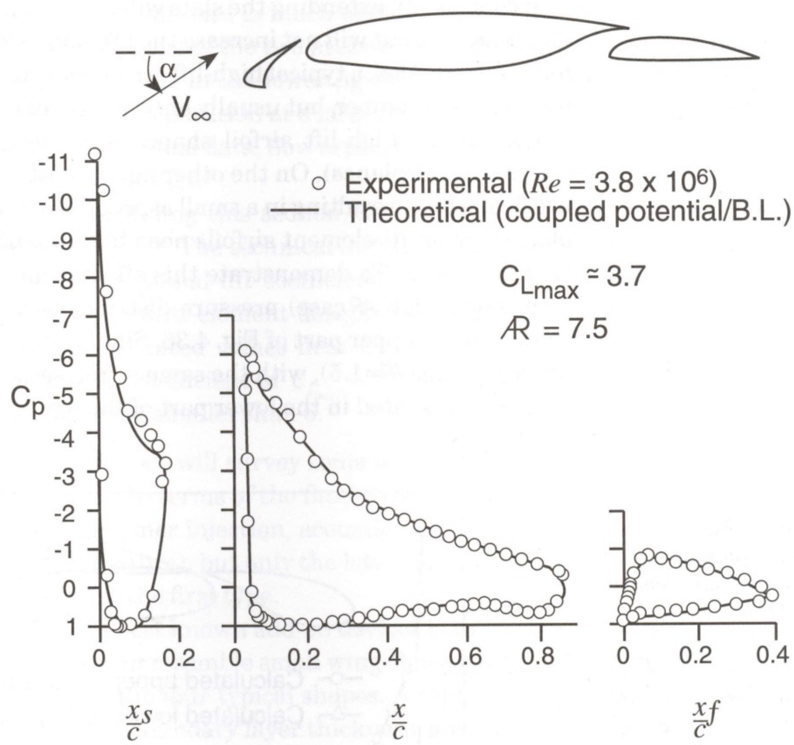


Fig. 4-34. *Pressure distribution close to the maximum lift coefficient on a three-element wing. Slat angle is –42°, trailing edge flap angle is 10°, and section lift coefficient is 3.1 at Re number = 3.8 x 10^6.*

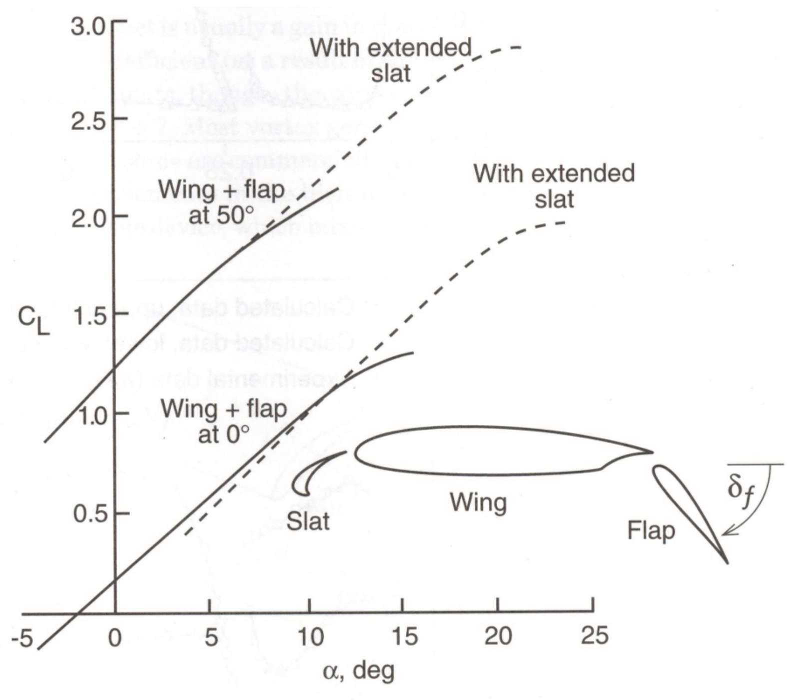


Fig. 4-35. *Generic trends showing the effect of leading edge slats (used above α = 5°) and trailing edge flaps on the lift curve of a high-aspect-ratio, airplane-type wing.*

Gurney flap

Fig. 6-47. Schematic description of the streamlines in the vicinity of a wing's trailing edge with a normal flap.

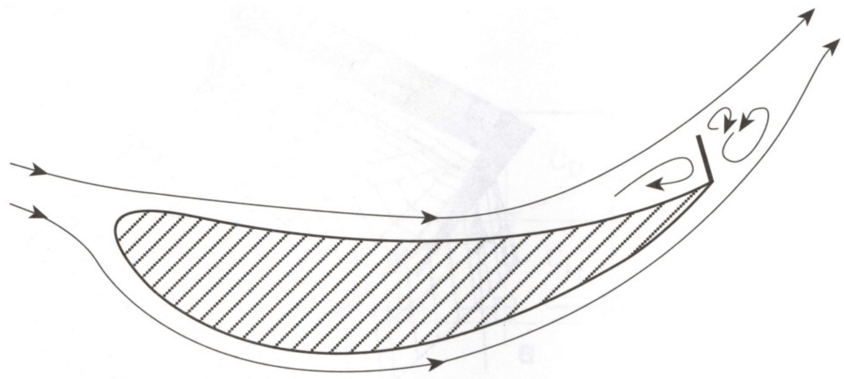


Fig. 6-48. Effect of 90° flap length on the lift and drag increments of a sedan-based race car.