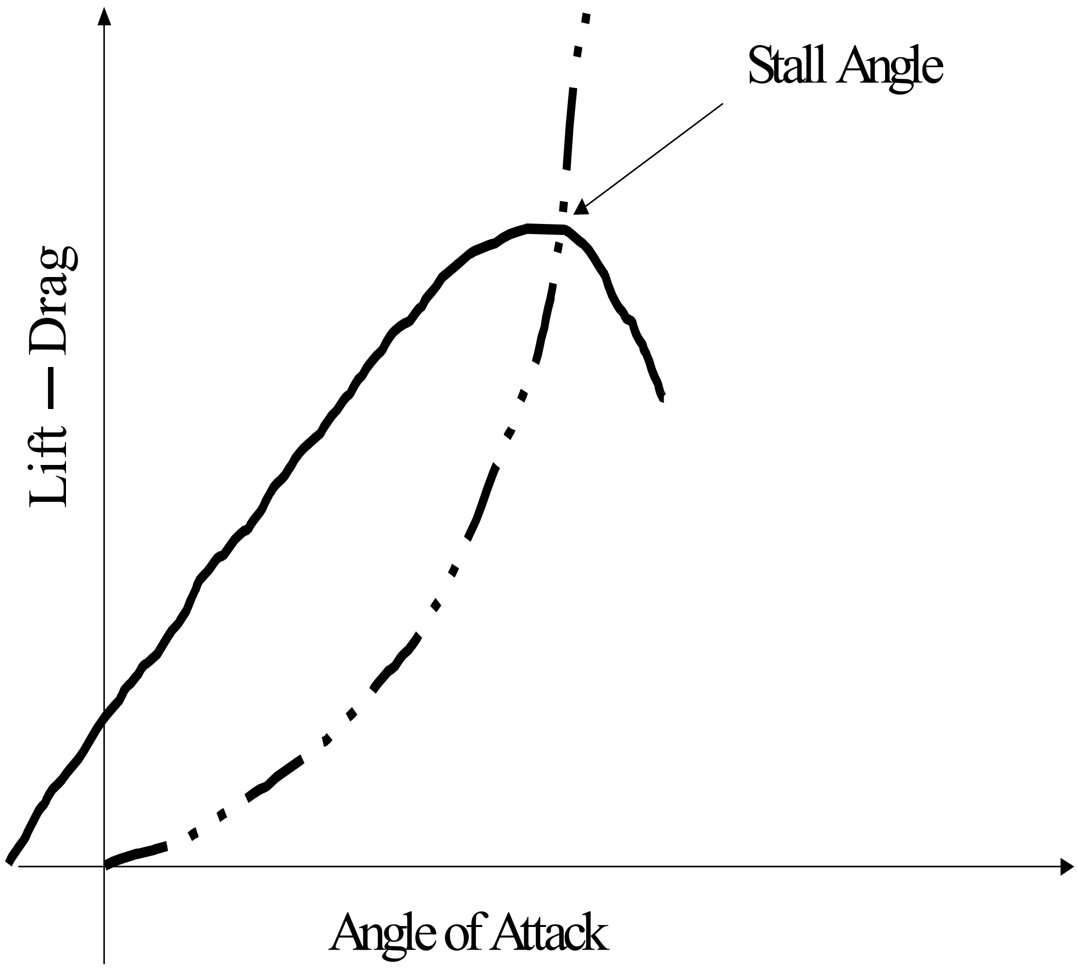

Stall Angle
Lift — Drag
Angle of Attack

(DATA FROM NACA REPORT NO. 824)

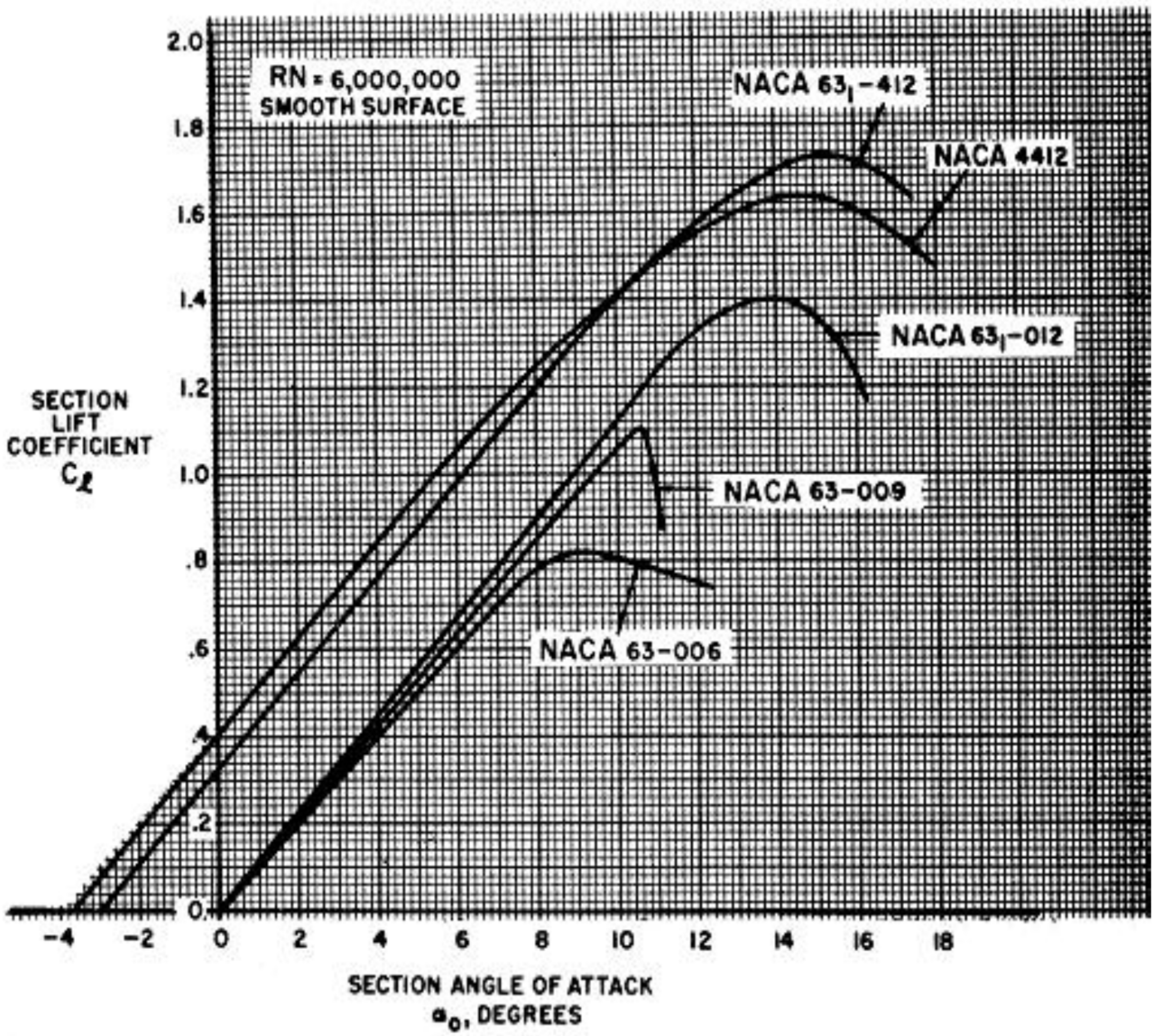


Figure 1.12. Lift Characteristics of Typical Airfoil Sections

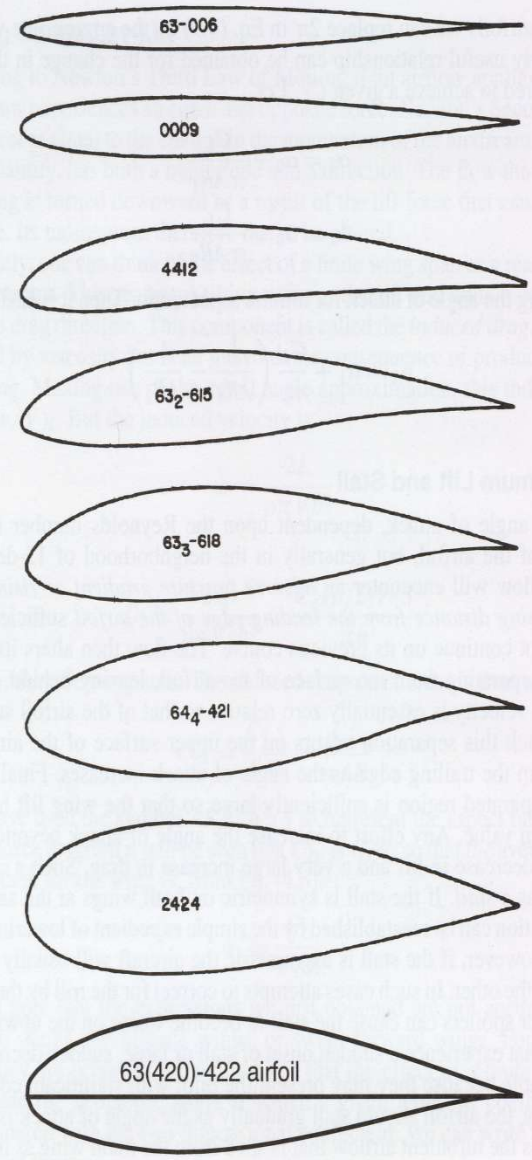


Fig. 4.1 Tested airfoils.

Aerodynamic Coefficients

$$L = L(\rho_\infty, V_\infty, S, \alpha, \mu_\infty, a_\infty) \quad \textbf{[2.2a]}$$

$$D = D(\rho_\infty, V_\infty, S, \alpha, \mu_\infty, a_\infty) \quad \textbf{[2.2b]}$$

$$q_\infty = \frac{1}{2}\rho V_\infty^2$$

Dynamic pressure

$$M = M(\rho_\infty, V_\infty, S, \alpha, \mu_\infty, a_\infty) \quad \textbf{[2.2c]}$$

$$C_L = \frac{L}{q_\infty S} \quad \textbf{[2.3]}$$

Reynolds number (based on chord length): $\text{Re} = \dfrac{\rho_\infty V_\infty c}{\mu_\infty}$

$$C_D = \frac{D}{q_\infty S} \quad \textbf{[2.4]}$$

Mach number: $M_\infty = \dfrac{V_\infty}{a_\infty}$

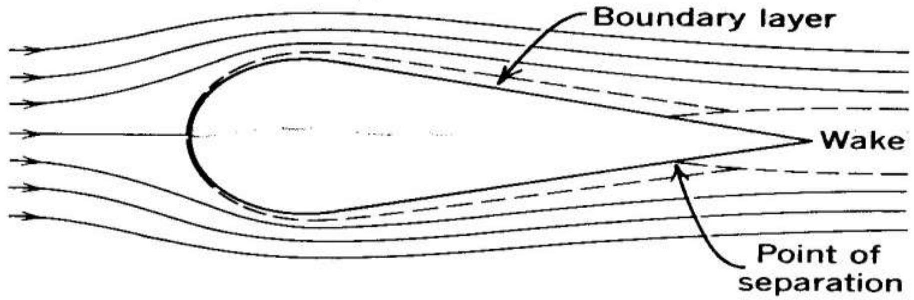
$$C_M = \frac{M}{q_\infty S c} \quad \textbf{[2.5]}$$

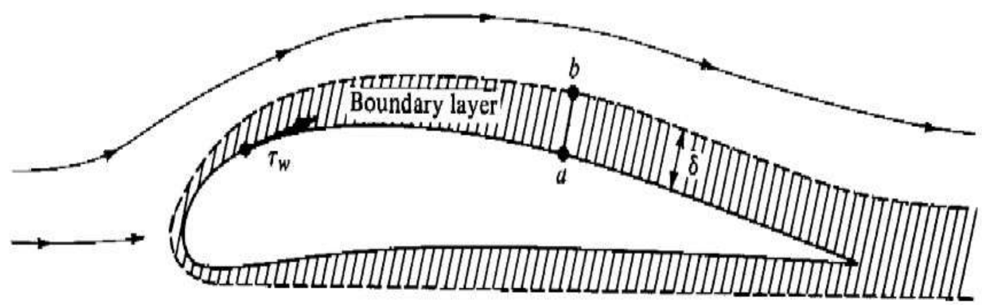
$$C_L = f_1(\alpha,\ \text{Re},\ M_\infty)$$

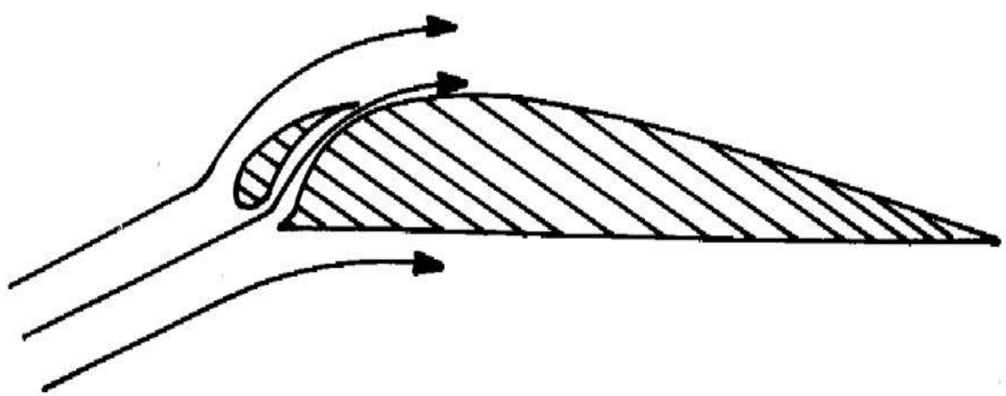
$$C_D = f_2(\alpha,\ \text{Re},\ M_\infty)$$

$$C_M = f_3(\alpha,\ \text{Re},\ M_\infty)$$

Boundary Layer







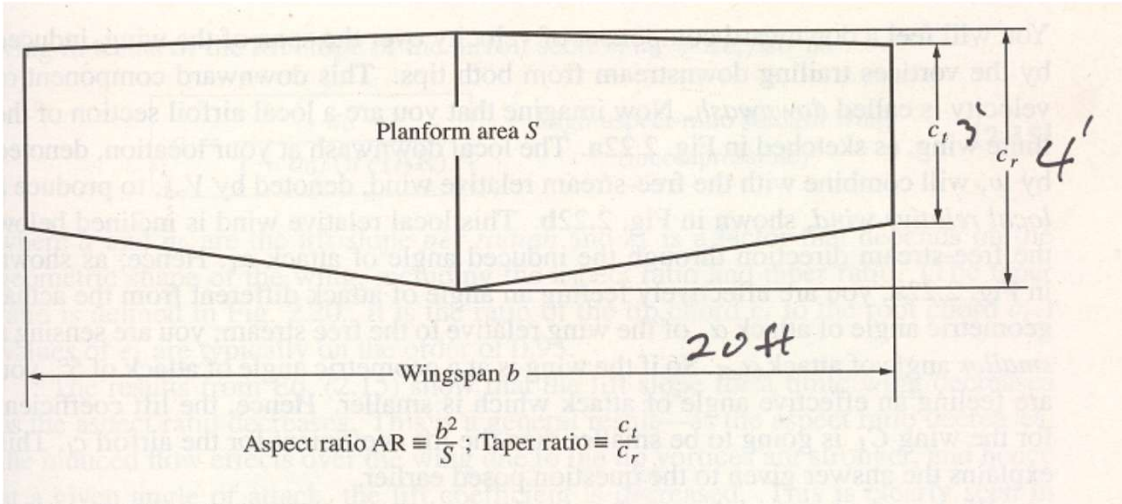


Figure 2.20 Finite-wing geometry.

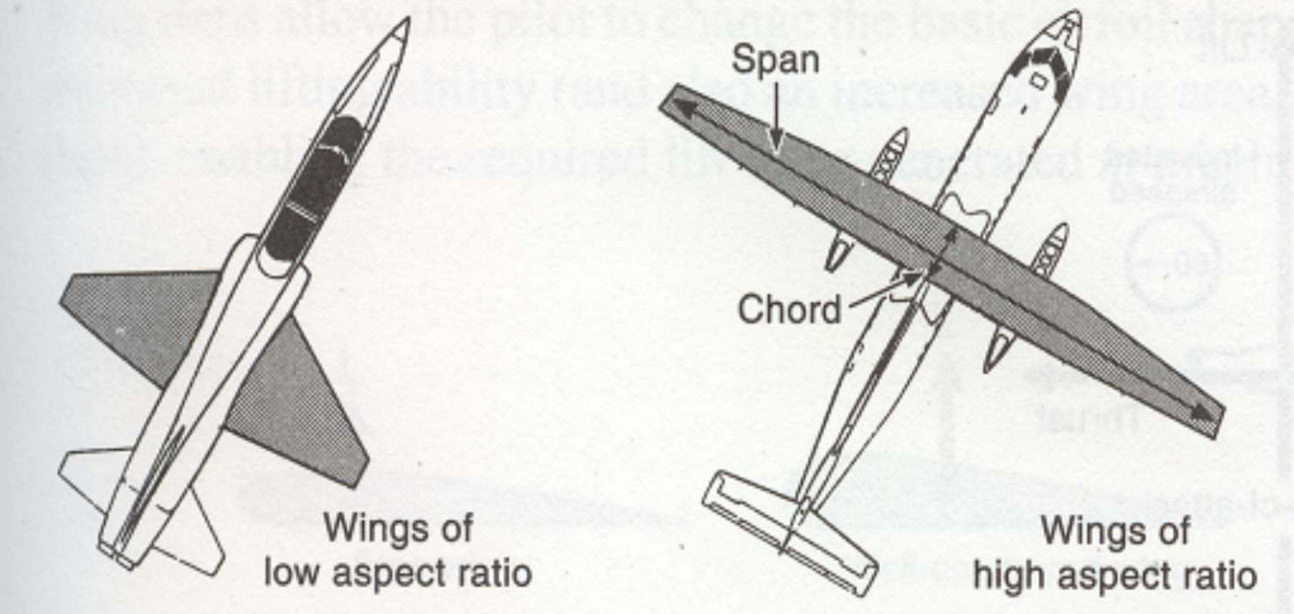
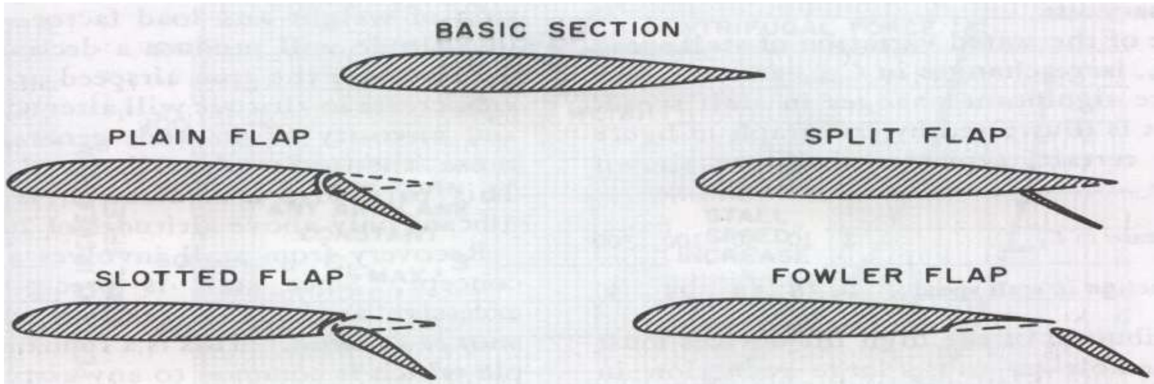
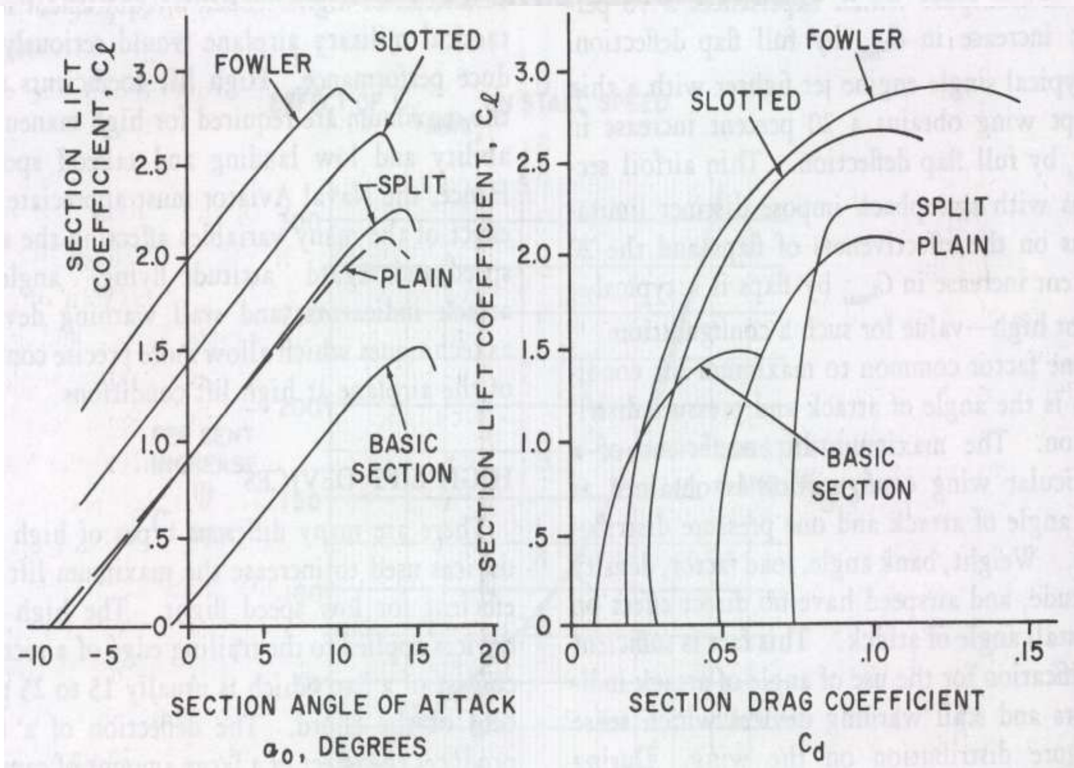


Figure 1-38. Aspect ratio



Flaps also improve Boundary Layer Performance

EFFECT ON SECTION LIFT AND DRAG CHARACTERISTICS OF A 25% CHORD FLAP DEFLECTED 30°



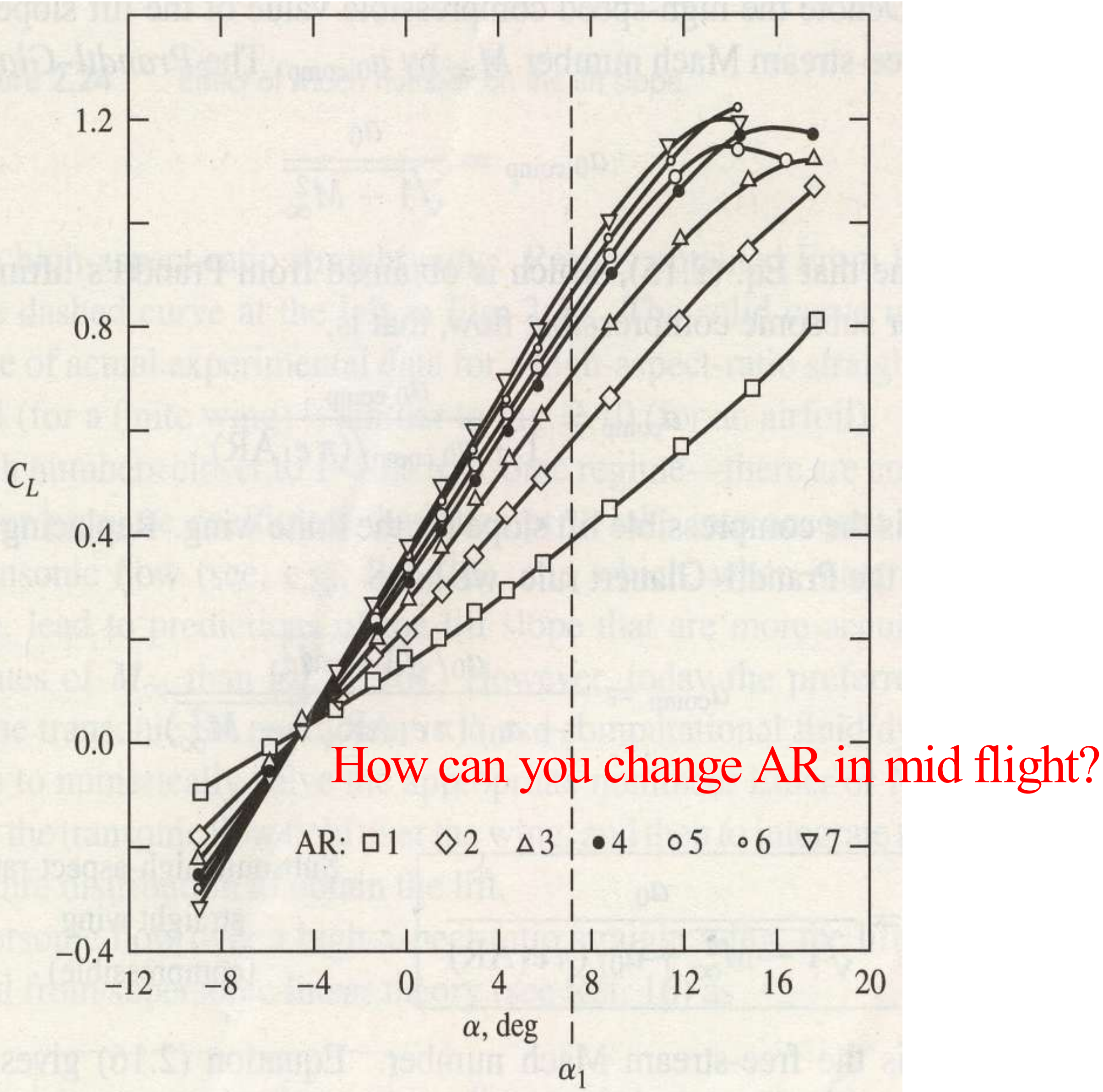
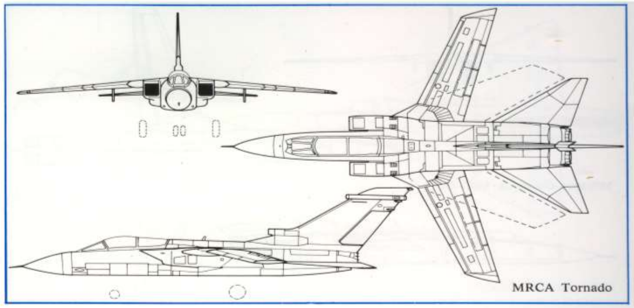
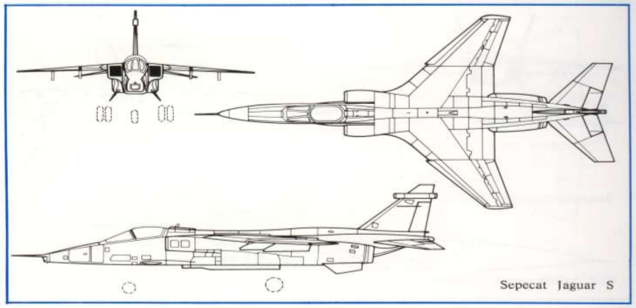


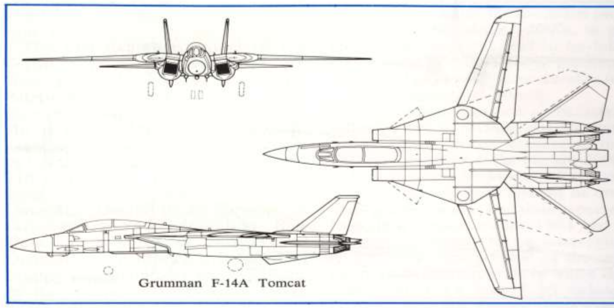
Figure 2.23 Effect of aspect ratio on the lift curve.



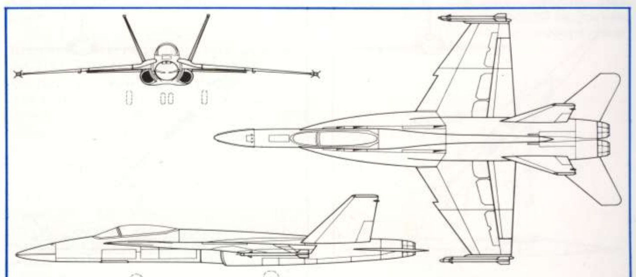
MRCA Tornado



Sepecat Jaguar S



Grumman F-14A Tomcat



McDonnell-Douglas F-18 Hornet

Types of Drag

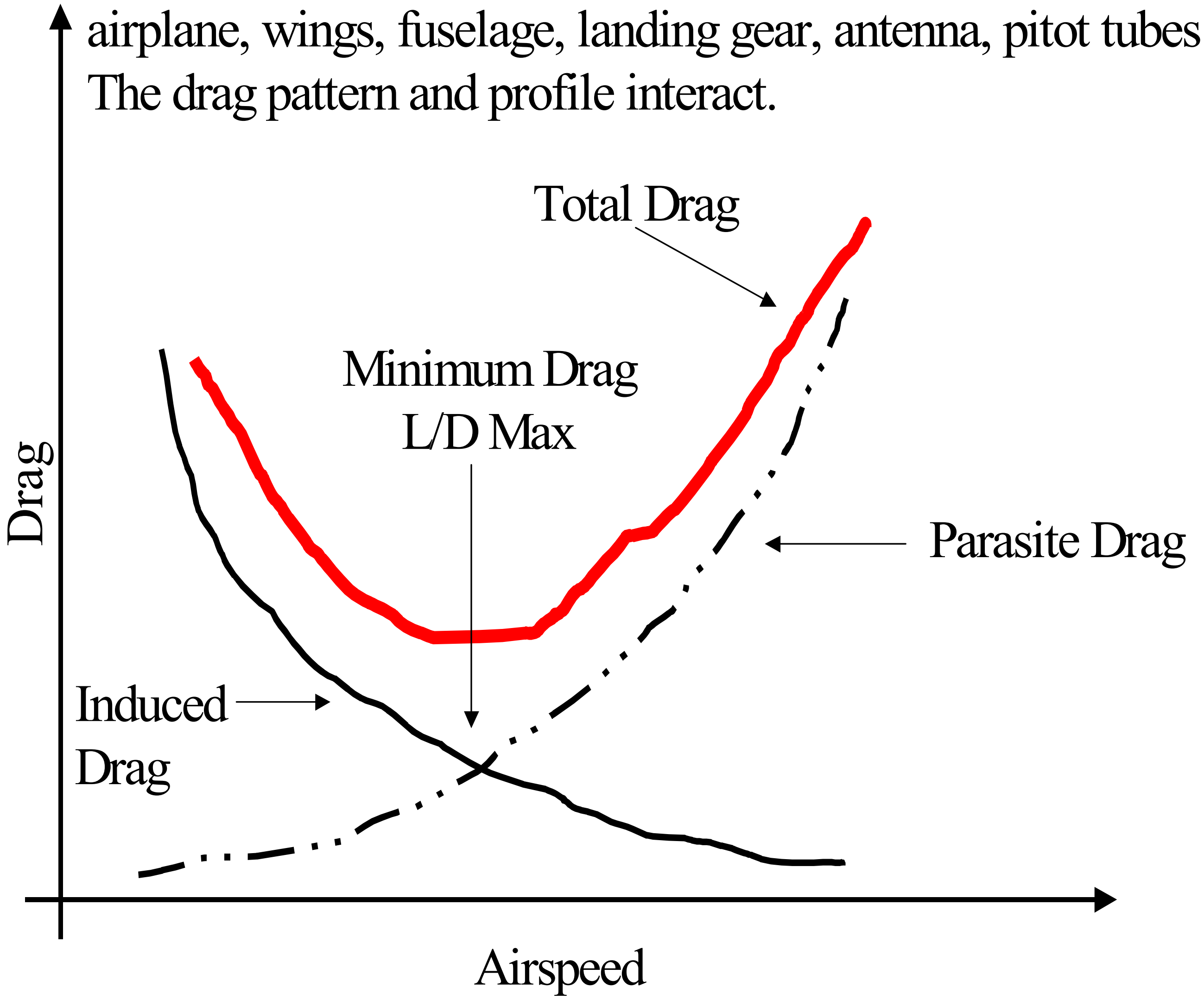
Skin-friction Drag- Drag due to frictional shear stress integrated over the surface i.e. all surfaces in the flow stream. (wind tunnel)

Parasite Drag – Drag due to items that are in the flow stream yet don't not provide any lift i.e. pitot tubes, antennas, position light, Ordnance etc. (complete airplane)

Induced Drag – Drag due to the downwash associated with the vortices created at the tips of the finite wing. (page 79) (wind tunnel and complete airplane)

Interference Drag – Drag due to mutual interaction of the flow fields Around each component of the airplane. (complete airplane)

Drag is a systems issue it involves everything external on the airplane, wings, fuselage, landing gear, antenna, pitot tubes etc. The drag pattern and profile interact.



In class quiz:

How would you re-design this aircraft to reduce or avoid
The impact of stall turbulence on the horizontal stabilizer or
elevator?

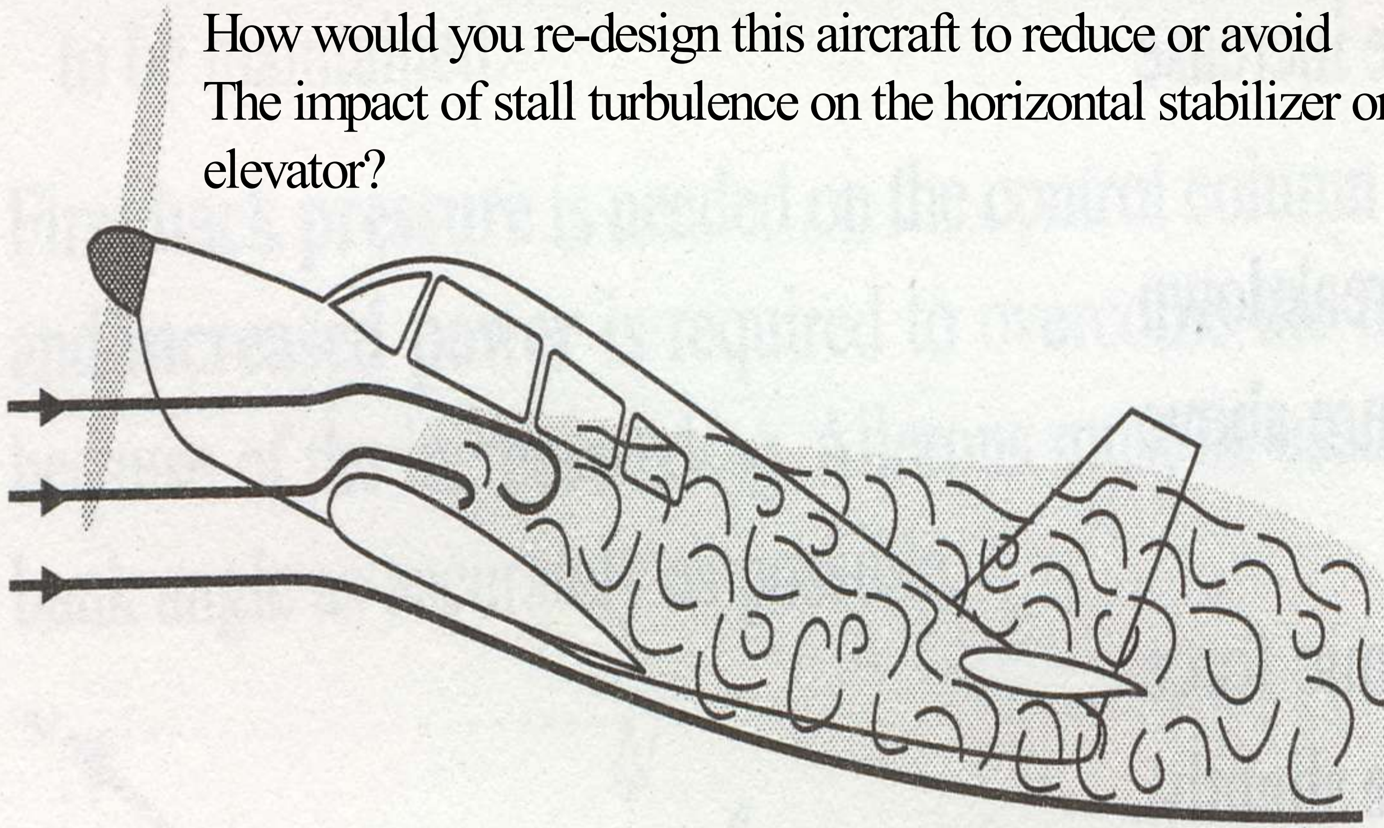


Figure 3-30. Turbulent flow over the horizontal stabilizer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