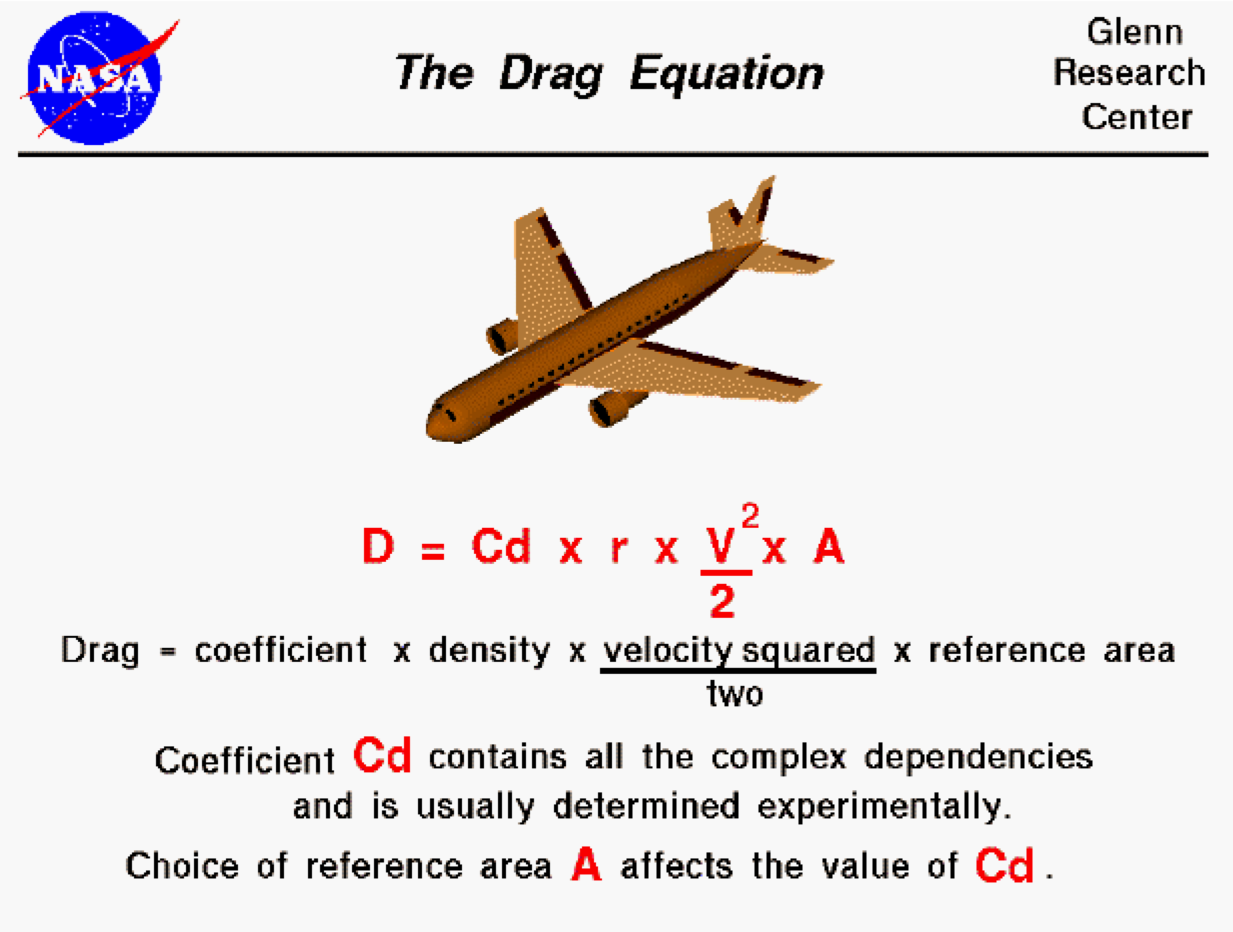
Capítulo 4. AERODINÂMICA



Factors That Affect Drag

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The Object : Shape and Size

The Motion: Velocity and Inclination to Flow

The Air : Mass, Viscosity, Compressibility

Shape Effects on Drag

The shape of an object has a very great effect on the amount of drag.

$$Cd = \frac{D}{r\ A\ V^2/2}$$

A = frontal area

All objects have the same frontal area.

Size Effects on Drag

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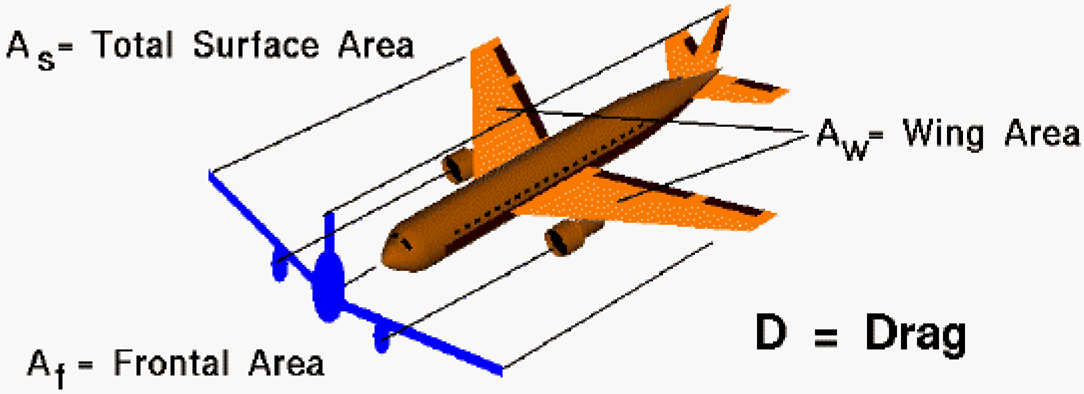


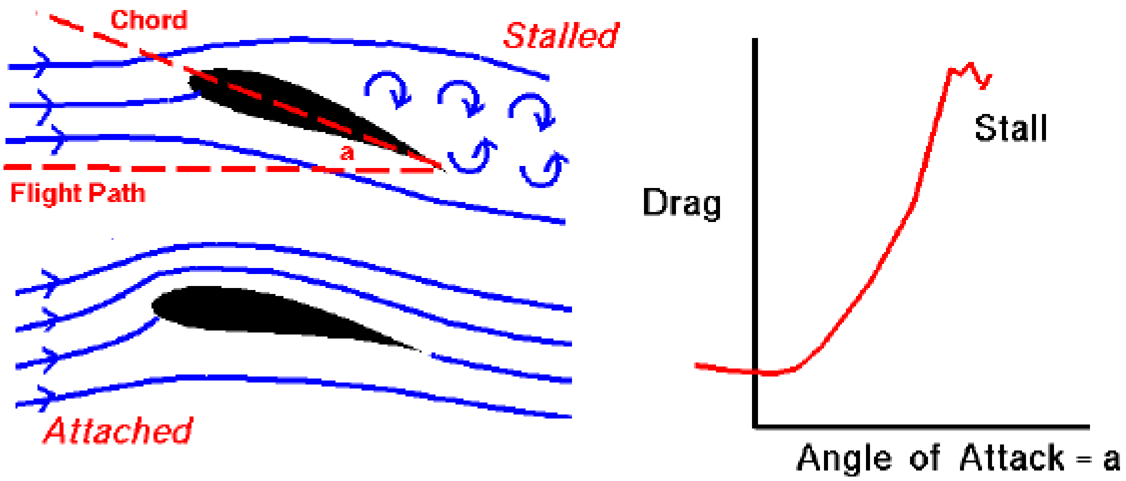
$$A_s \sim A_f \sim A_w$$

Drag is directly related to reference area

$$D = \text{Constant} \times A_{ref}$$

Double the Area --> Double the Drag

Inclination Effects on Drag



For small angles, drag is nearly constant.

As angle increases, drag increases.

Greater Angle = Greater Drag

After stall, relationship is quite complex.

Included in Drag Coefficient

Induced Drag Coefficient

Drag due to Lift

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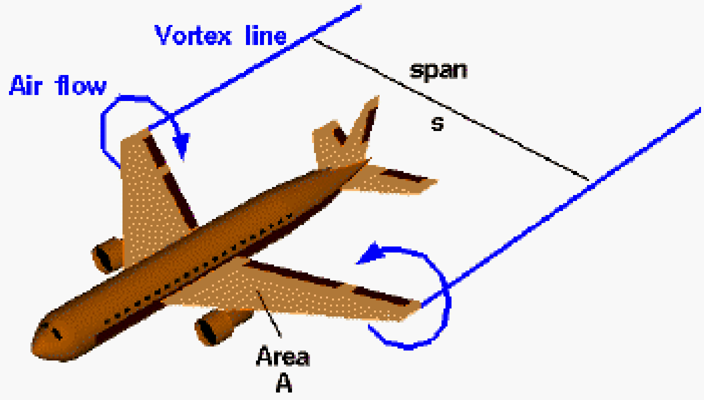

Aspect Ratio = AR

$$AR = \frac{s^2}{A}$$

$$Cd_i = \frac{Cl^2}{\pi \, AR \, e}$$

efficiency factor = e

for an ellipse e = 1.0

in general e < 1.0

Pressure difference across wing surface causes spillage around the wing tips.

Downwash causes a local induced angle of attack with additional induced drag on a finite wing.