04 – The Typical Section: from 3D to 2D

Vibraciones y Aeroelasticidad
Dpto. de Vehículos Aeroespaciales
P. García-Fogeda Núñez & F. Arévalo Lozano

ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA AERONÁUTICA Y DEL ESPACIO
UNIVERSIDAD POLITÉCNICA DE MADRID

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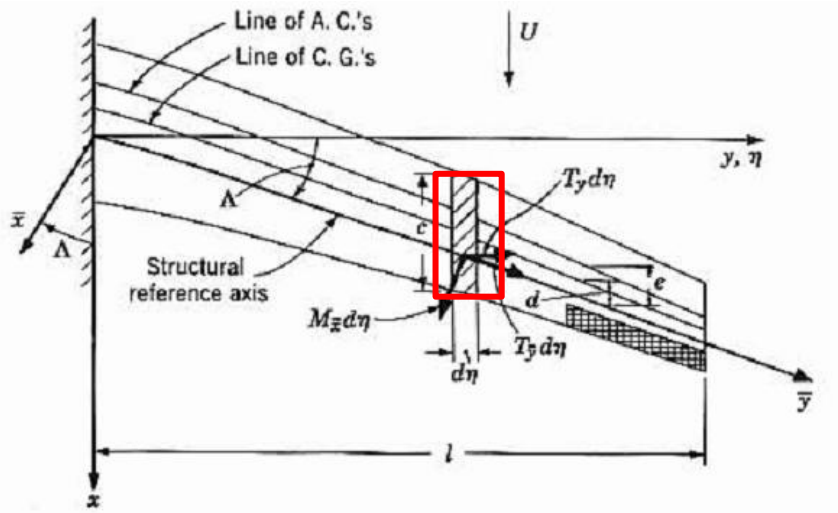
2D "TYPICAL SECTION"

Typical Section from a finite wing:

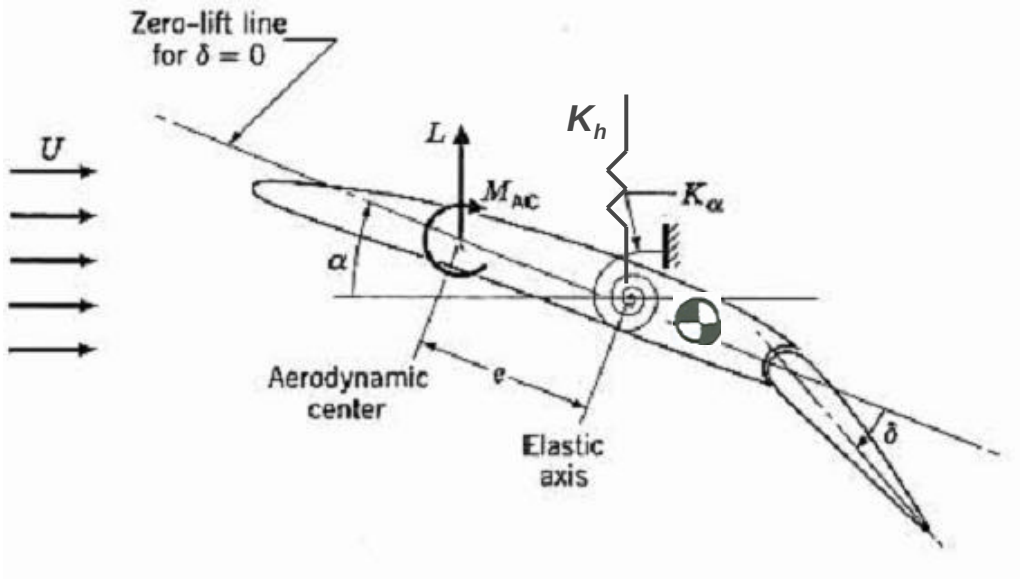
Ref: NACA Rep. 685: "Mechanism of Flutter. A Theoretical and Experimental Investigation of the Flutter Problem"; Theodorsen, T., and Garrick, I.E.

- 2D with geometry, structural, and mass properties of the 3/4 semispan location
- Span length = 1
- 2D Aerodynamics without aspect ratio corrections



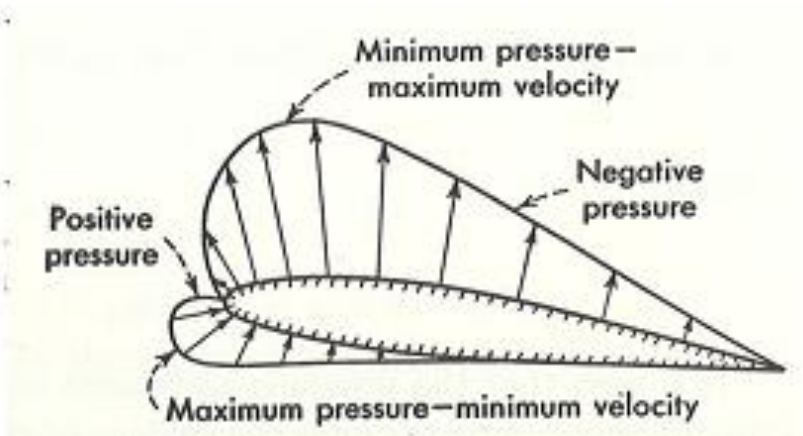
Concepts

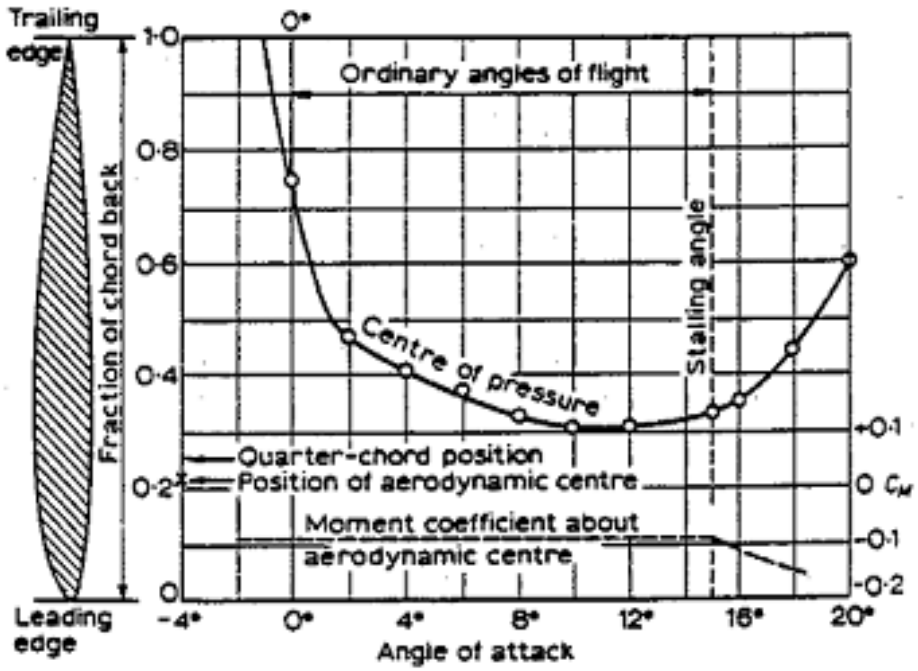
- Aerodynamic Centre (AC)
- Elastic Axis (EA)
- Centre of Gravity (CoG)
- Bending Stiffness (Kh)
- Torsion Stiffness (Kα)
- Angle of Attack (AoA)
- Control Surface Deflection (δ)



AERODYNAMIC CENTRE (AC)

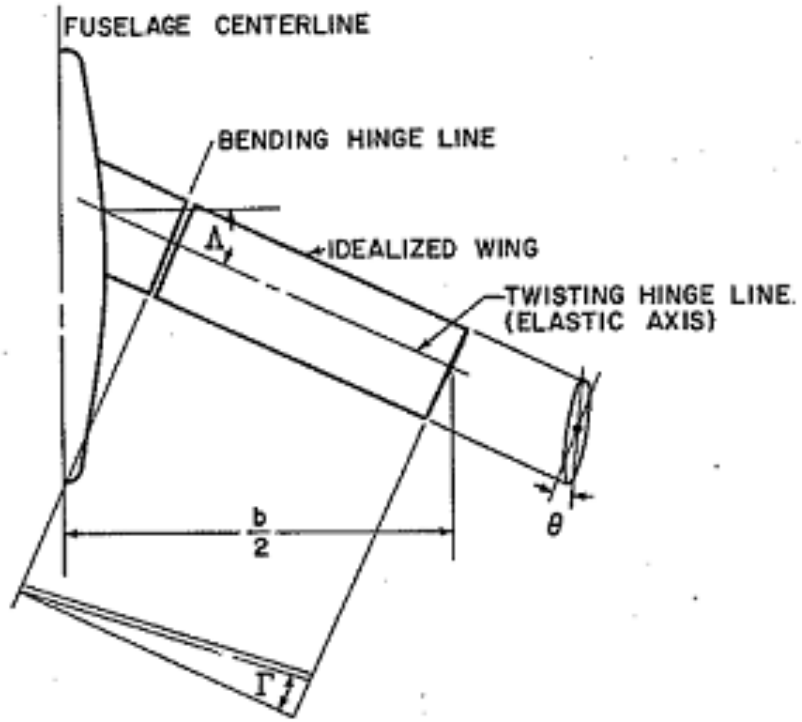
- Centre of Pressure : $C_{MCP}=0$
  - Centre of pressure moves with AoA
- Aerodynamic Centre: C_{MAC} does not change with AoA
  - Thin airfoil, incompressible flow, the aerodynamic theory places the AC at ¼ chord
  - Symmetric airfoils, the constant pitching moment is ZERO

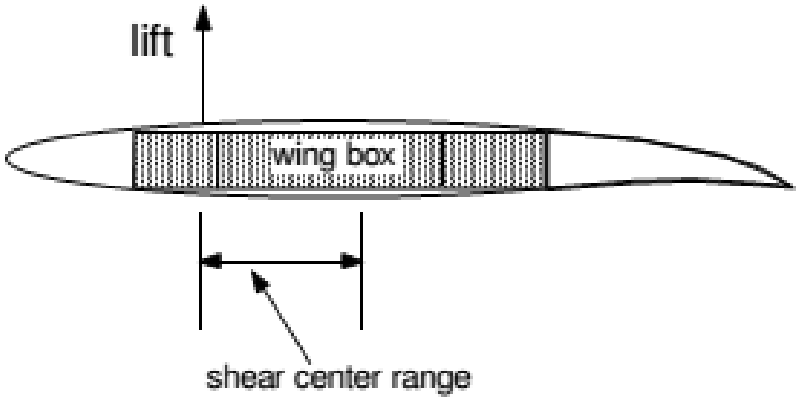




ELASTIC AXIS (EA)

- Shear Centre: a concentrated force causes only displacement
- Centre of Twist: a concentrated torsional moment causes only rotation
- Linear elastic structure: Shear Centre = Centre of Twist





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