SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)

Department of Aerospace Engineering

23AST101-Fundamentals of Aerospace Engineering

UNIT-2:
AERODYNAMICS

CENTER OF PRESSURE AND AERODYNAMIC CENTER

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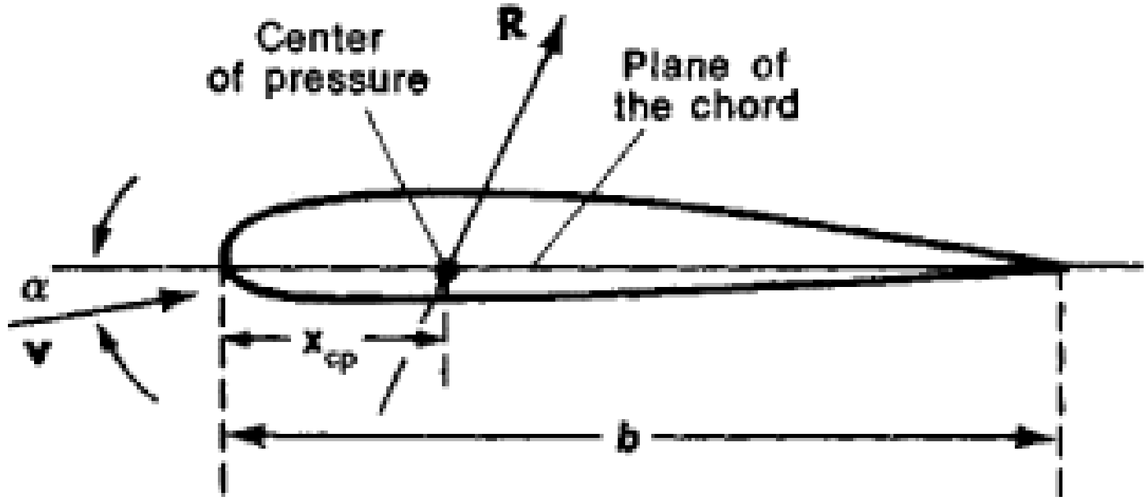
1. Center of Pressure (CP)

Definition: The center of pressure is the point on an airfoil or wing where the resultant aerodynamic force (lift and drag combined) can be considered to act.



Characteristics:

- The CP is not fixed; its location changes with the angle of attack (AoA).
- At low angles of attack, the CP is typically located closer to the leading edge of the airfoil.
- As the angle of attack increases, the CP moves toward the trailing edge.
- For symmetric airfoils at zero angle of attack, the CP coincides with the aerodynamic center.

Importance:

- The CP is critical for understanding stability and control. If the CP moves too far forward or backward, it can cause pitching moments that affect the balance of the aircraft.

2. Aerodynamic Center (AC)

Definition: The aerodynamic center is the point on an airfoil or wing where the pitching moment is constant and independent of the angle of attack.

Characteristics:

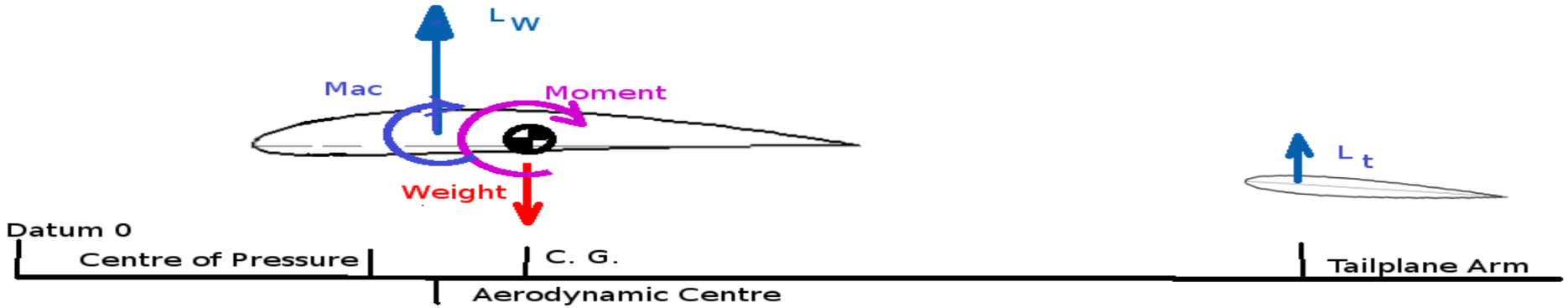
The AC is a fixed point for a given airfoil or wing, typically located around **25% of the chord length** from the leading edge for subsonic flow.

At the AC, the pitching moment does not change with the angle of attack.

The AC is important for analyzing the stability and control of an aircraft, as it provides a reference point for calculating moments.

Importance:

The AC is used in aircraft design to ensure stability. For example, the center of gravity (CG) of an aircraft is usually placed slightly forward of the AC to ensure natural stability.



Relationship Between CP and AC

- The CP and AC are related through the pitching moment. If the CP moves, it creates a pitching moment about the AC.
- For stable flight, the aircraft's center of gravity (CG) is typically placed near the AC to minimize unwanted pitching moments.

Practical Implications

- In aircraft design, the AC is used as a reference point for stability calculations, while the CP is monitored to ensure it does not cause excessive pitching moments.
- For symmetric airfoils at zero angle of attack, the CP and AC coincide.

Key Differences Between CP and AC

Aspect	Center of Pressure (CP)	Aerodynamic Center (AC)
Definition	Point where resultant aerodynamic force acts	Point where pitching moment is constant
Dependence on AoA	Changes with angle of attack	Independent of angle of attack
Location	Moves with AoA	Fixed (typically at ~25% chord for subsonic)
Importance	Affects pitching moments and stability	Used as a reference for stability analysis


THANK YOU!