DEPARTMENT OF AEROSPACE ENGINEERING

AIRFOIL NOMENCLATURE

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AIRFOIL NOMENCLATURE

Airfoil Nomenclature :

1. Naming system for categorizing airfoil shapes.
2. Typically includes parameters like camber, thickness, and maximum thickness location.
3. Represented in a standardized format, often using a combination of letters and numbers.
4. Facilitates easy communication and identification of specific airfoil designs.

IMPORTANCE OF AIRFOIL DESIGN IN AERODYNAMICS

- **Efficiency:**
  - Well-designed airfoils can maximize lift while minimizing drag, leading to improved fuel efficiency and performance.
- **Control:**
  - Airfoil design influences an aircraft's control and stability.
- **Performance:**
  - Optimal airfoil design can enhance the overall performance of aircraft, allowing for higher speeds, better maneuverability, and increased payload capacity

IMPORTANCE OF AIRFOIL DESIGN IN AERODYNAMICS

Applications:

- Airfoil design is crucial in various applications such as aircraft wings, helicopter rotor blades, wind turbine blades, and hydrofoils.

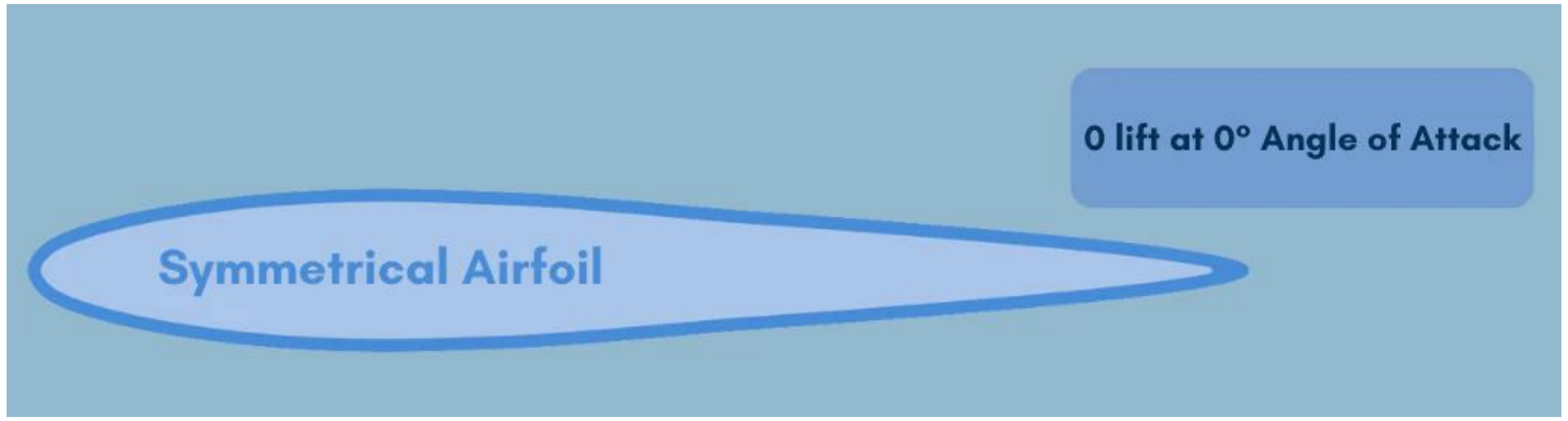
Safety:

- Proper airfoil design ensures safe and stable flight by controlling airflow over the aircraft surfaces.

SYMMETRIC AIRFOIL

A symmetric airfoil is an airfoil shape that has the same curvature on its upper and lower surfaces.

- Shape:
  - Upper and lower surfaces have identical shapes when viewed from the side.
- Zero Lift Angle of Attack:
  - Generates no lift at zero angle of attack.



- Applications:
  - Commonly used in applications where lift is not the primary concern, such as tail surfaces of aircraft and rotor blades of helicopters.
- Characteristics:
  - Provides equal lift and drag characteristics at positive and negative angles of attack.
- Examples:
  - NACA 0012 is a widely used symmetric airfoil in aerospace applications.

CAMBERED AIRFOIL

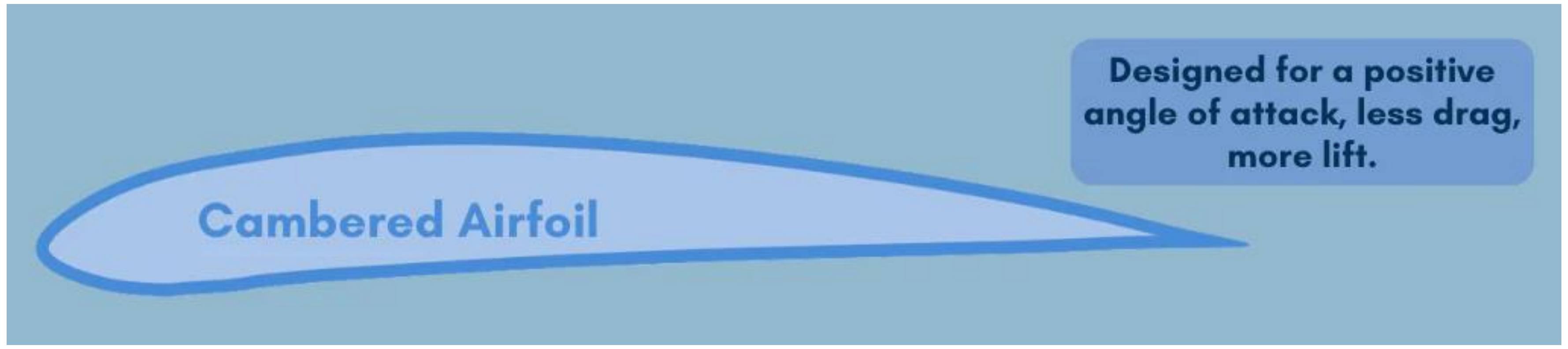
A cambered airfoil is an airfoil that has a curved shape, resulting in a difference in the curvature between its upper and lower surfaces.

Curvature:

- Upper surface has a greater curvature than the lower surface, resulting in a camber line.

Lift Generation:

- Generates lift even at zero angle of attack due to its camber.



Optimization:

- Camber can be optimized for specific flight conditions to enhance lift and reduce drag.

Examples:

- NACA 2412 is a commonly used cambered airfoil with 2% camber and 12% thickness.

Variations:

- Cambered airfoils can have various camber and thickness distributions optimized for specific applications and performance requirements.

COMPONENTS OF AN AIRFOIL

LEADING EDGE

The leading edge of an airfoil is the foremost edge of the wing or blade, where the airflow first encounters the surface.

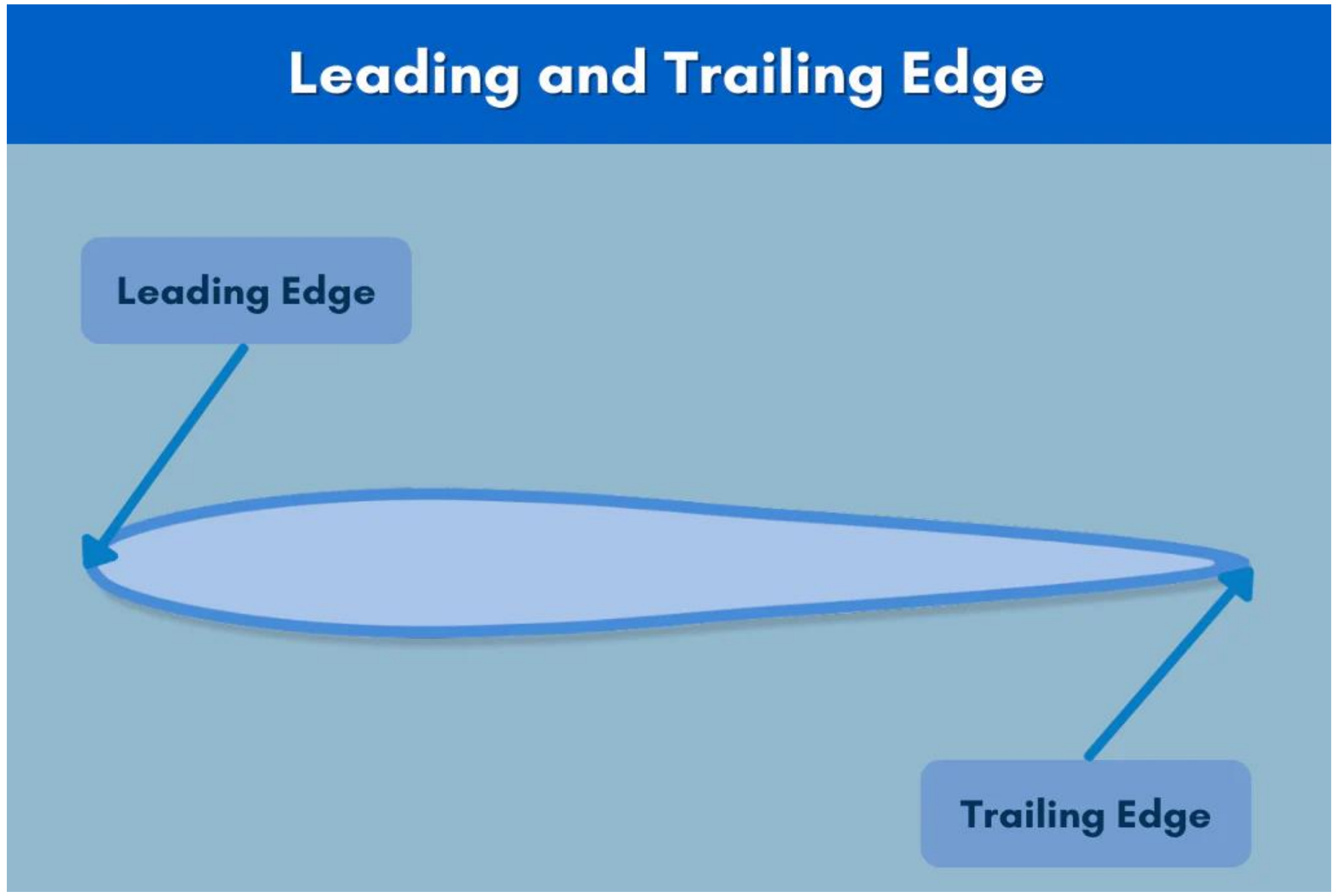
- **Shape:**
  - Can be rounded, sharp, or have various other shapes depending on aerodynamic requirements.
- **Aerodynamic Importance:**
  - Leading edge shape influences how air flows over the airfoil.
- **Boundary Layer:**
  - Plays a crucial role in the formation of the boundary layer, affecting lift and drag.
- **Design Considerations:**
  - Leading edge design is crucial for optimizing aerodynamic performance and stall characteristics.

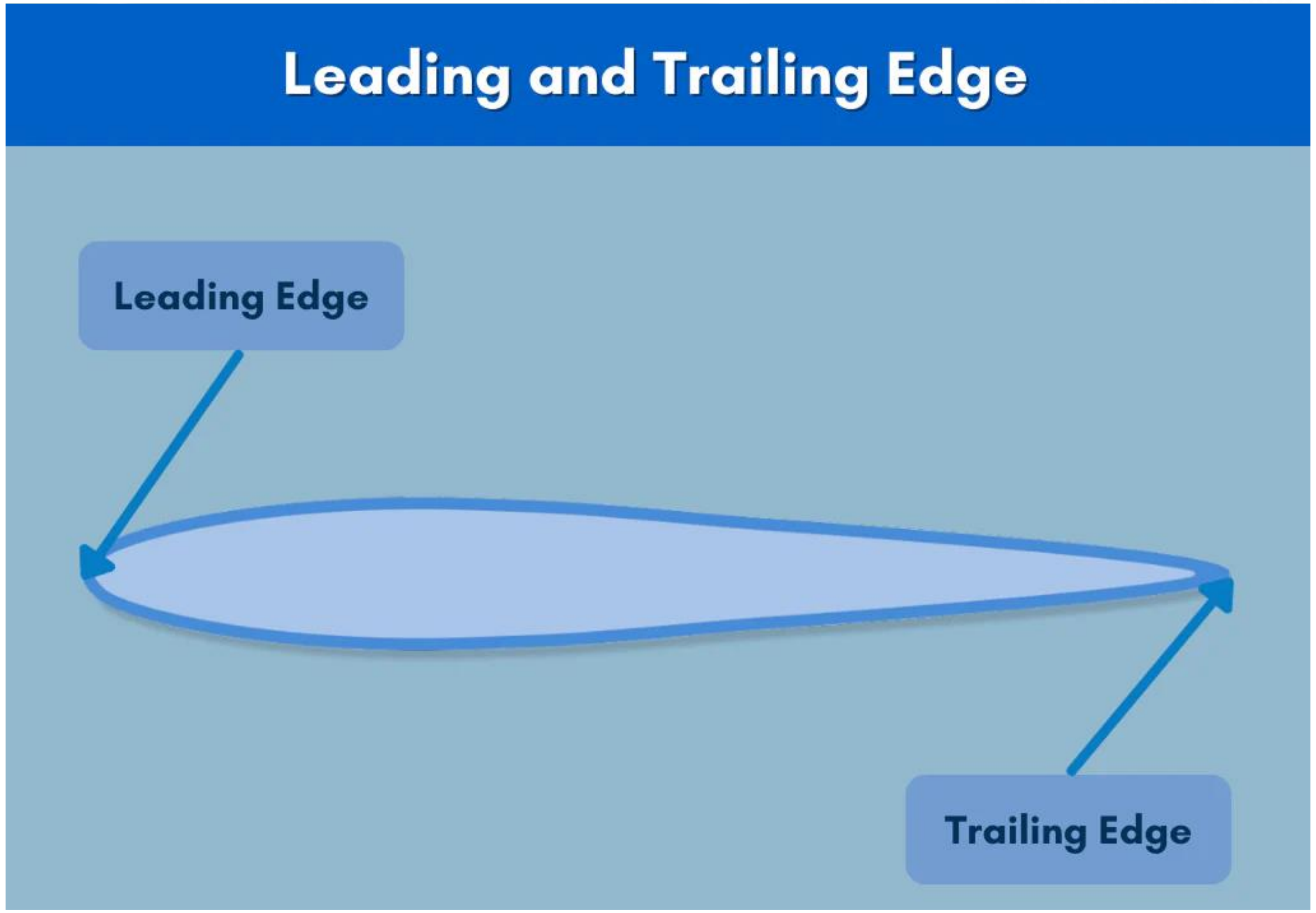
LEADING EDGE

- The leading edge marks the front most point of the airfoil, where it first encounters the oncoming airflow.

- The shape of the leading edge is a critical factor, and it's tailored to suit the airfoil's intended function.

- For high-speed airfoils, as found on modern fighter aircraft, the leading edge is razor-sharp, designed to efficiently slice through the air. In contrast, airfoils intended for greater lift at lower speeds, such as those on certain small-engine aircraft, sport thicker, more substantial leading edges.





Trailing Edge

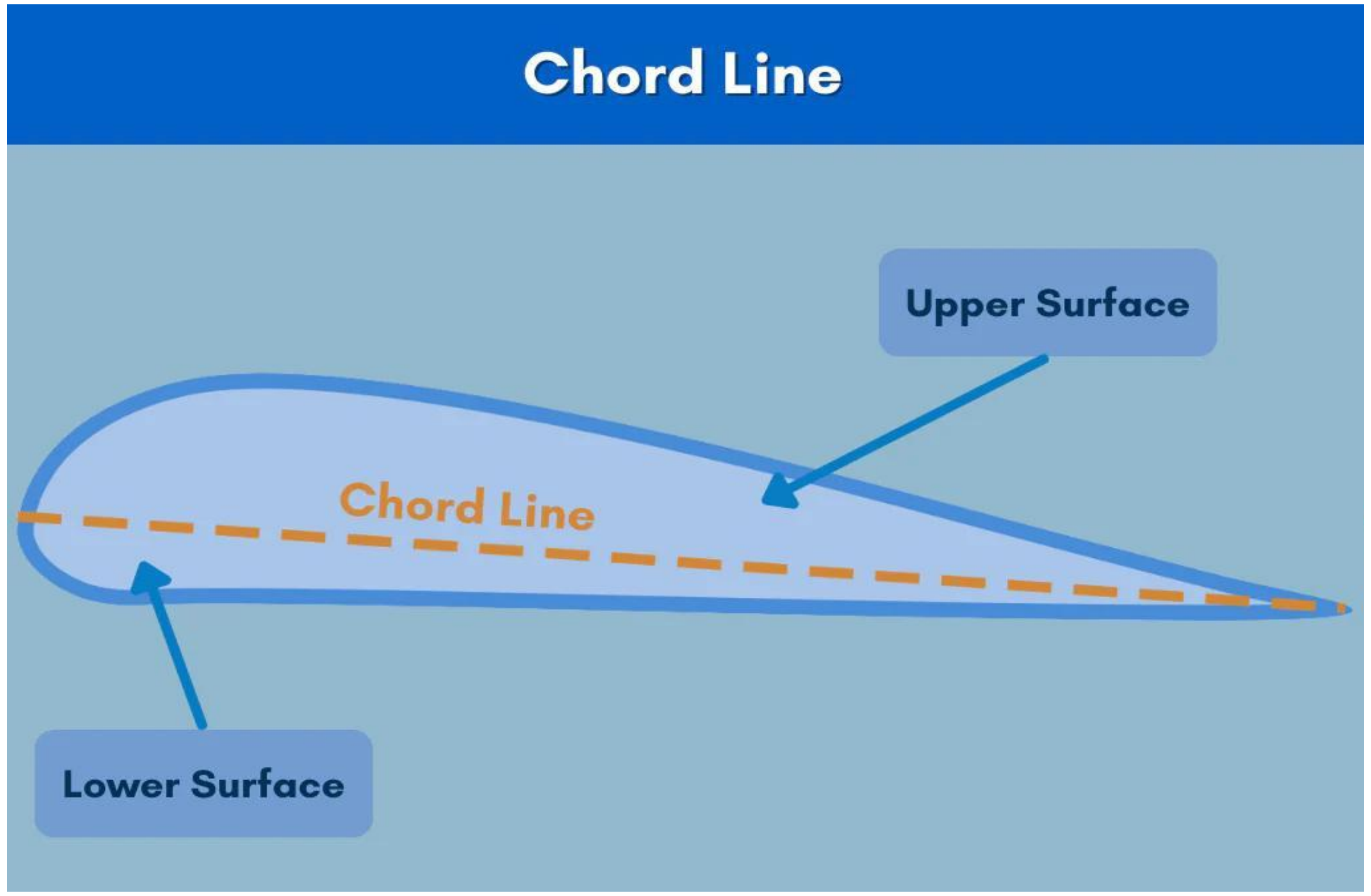
1. The trailing edge is the rearmost edge of the airfoil.
2. It's where the airflow recombines after passing over the airfoil.
3. Shapes and angles at the trailing edge influence lift, drag, and other aerodynamic properties
4. Situated at the rear of the airfoil, the trailing edge represents the point at which the airflow over the upper surface converges with the airflow beneath.
5. The design of this portion of the airfoil is just as vital as that of the leading edge. Its purpose is to ensure that the two airflows meet with minimal turbulence.

CHORD LINE

The chord line is a straight line connecting the leading and trailing edges of an airfoil

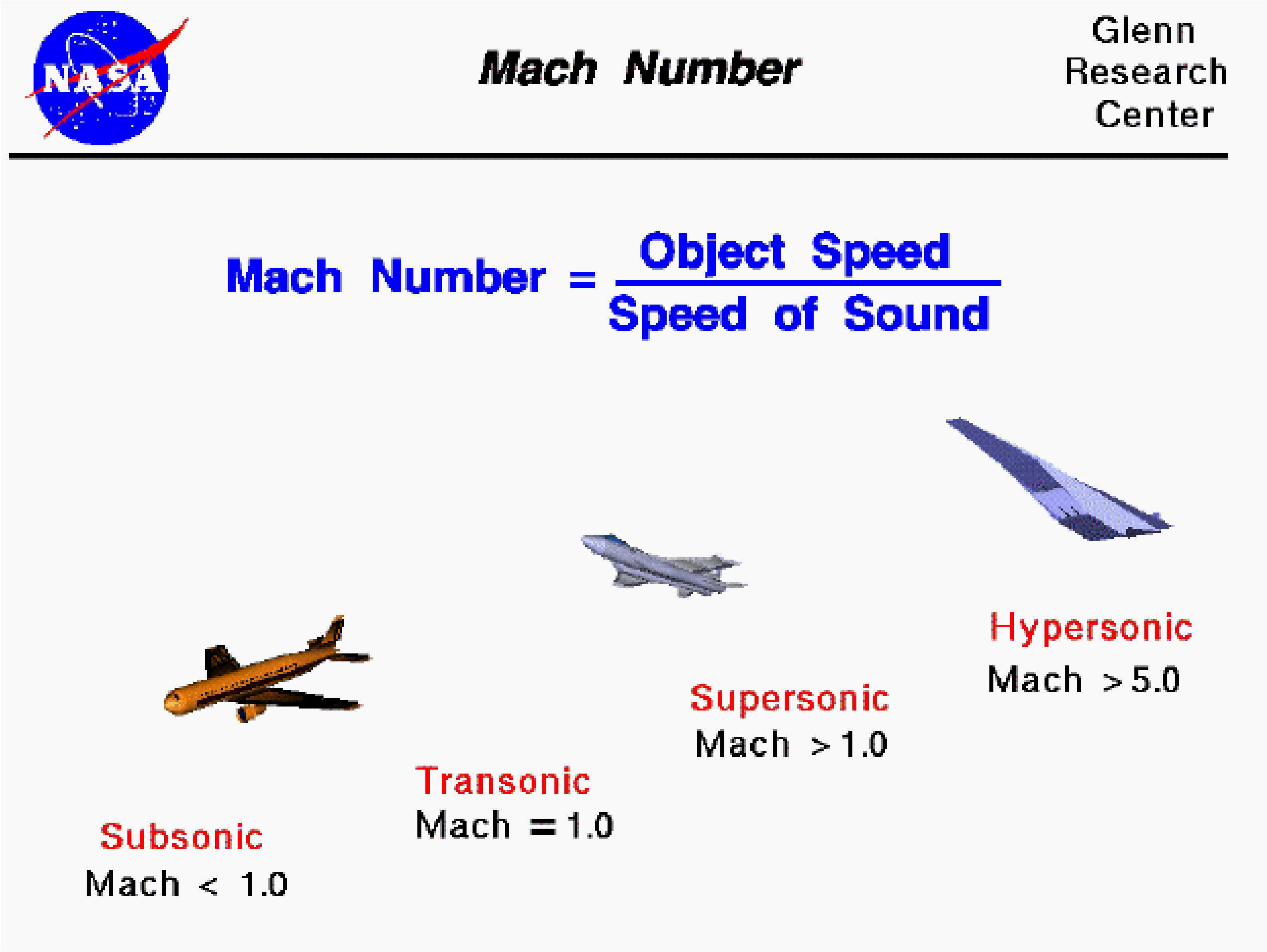
- The chord line serves as an imaginary straight line. The chord length extends from the leading edge to the trailing edge of the airfoil section, connecting these two critical points. This line forms the basis for measuring various angles and dimensions crucial to airfoil design.

- The area above the chord line is the upper surface, the area below is referred to as the lower surface. Both the upper and lower surfaces are divided by the chord line.



TRANSONIC AND SUPERSONIC

A transonic that is just a bit below or above the speed of sound, brings some unique challenges. To keep air moving efficiently, supercritical airfoils work best in this situation.

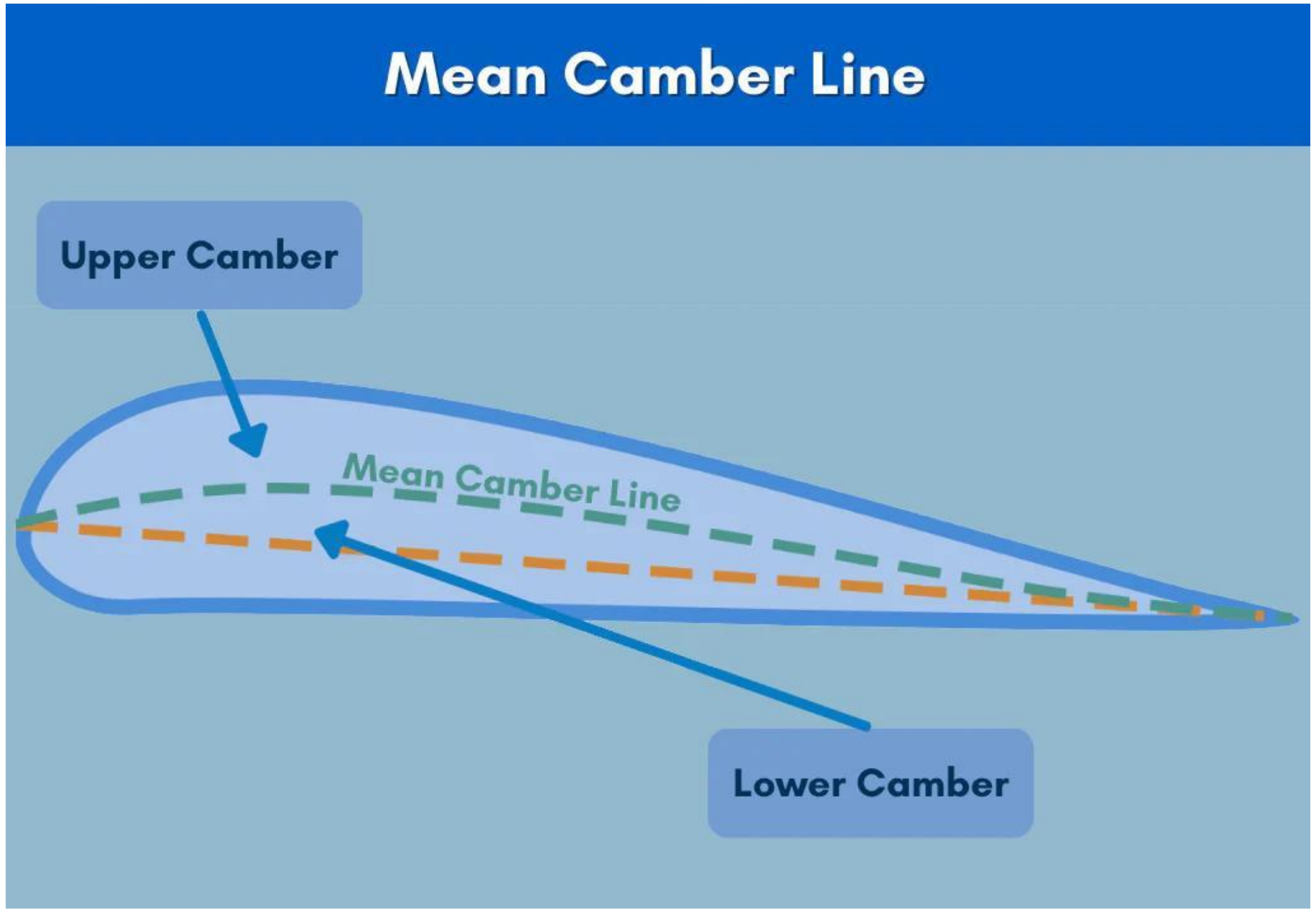


- The design of these supercritical airfoils is meant to limit the wave drag so they can perform better at transonic and supersonic speeds.

- When compared to more traditional subsonic foils, such as bi-convex and double-wedge camber designs with thin leading and trailing edges, you may notice that they have a thinner profile and sharper leading edge. All of this helps optimize performance for faster flights

MEAN CAMBER LINE

The mean camber line is an imaginary line drawn midway between the upper and lower surfaces of the airfoil. In a symmetrical airfoil, the mean camber line is merged with the chord line.



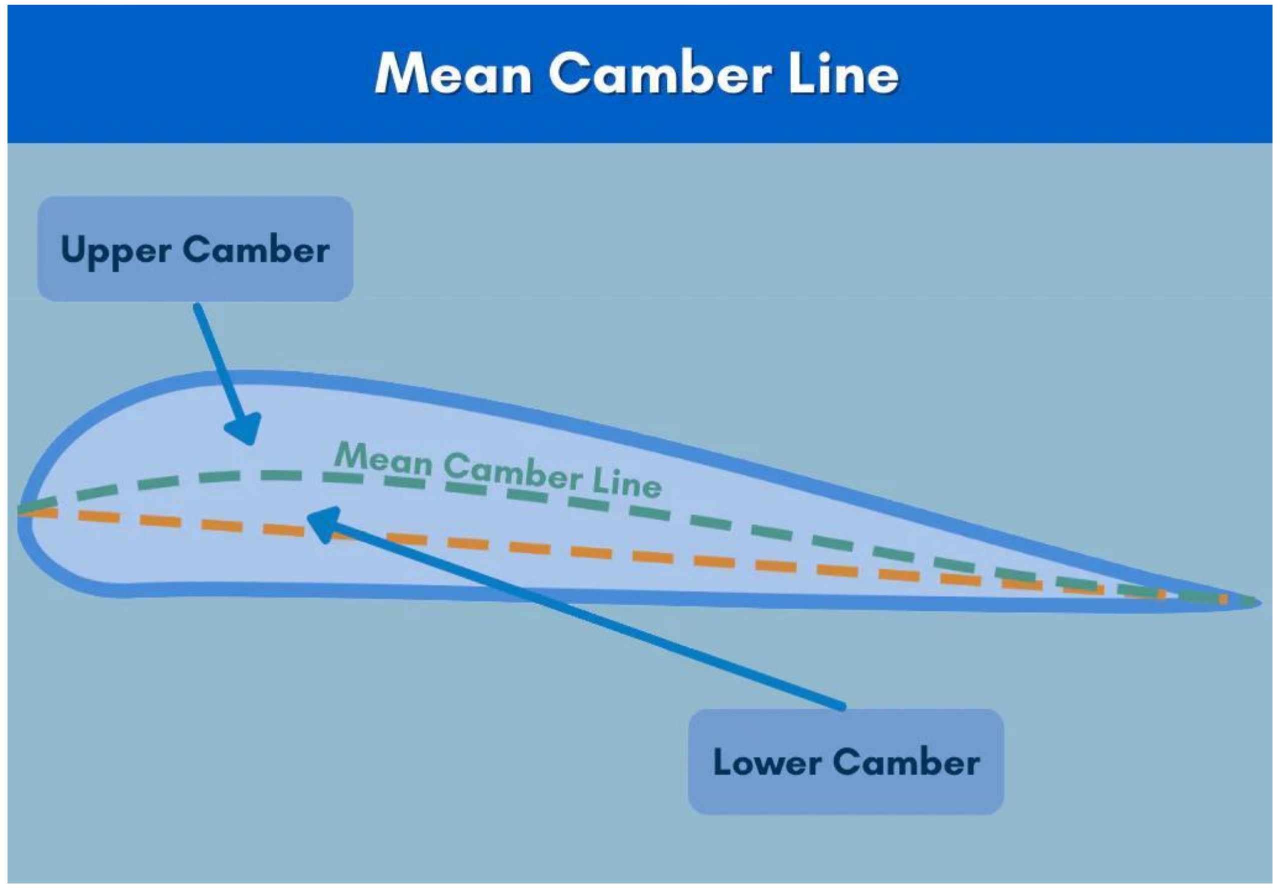
- This line plays a pivotal role in quantifying the airfoil's curvature, a fundamental parameter for lift generation.
- Much like the upper and lower spaces for the chord line, ıne mean camber line has an upper camber and a lower camber.

MAXIMUM CAMBER

It represents the maximum curvature of the airfoil.

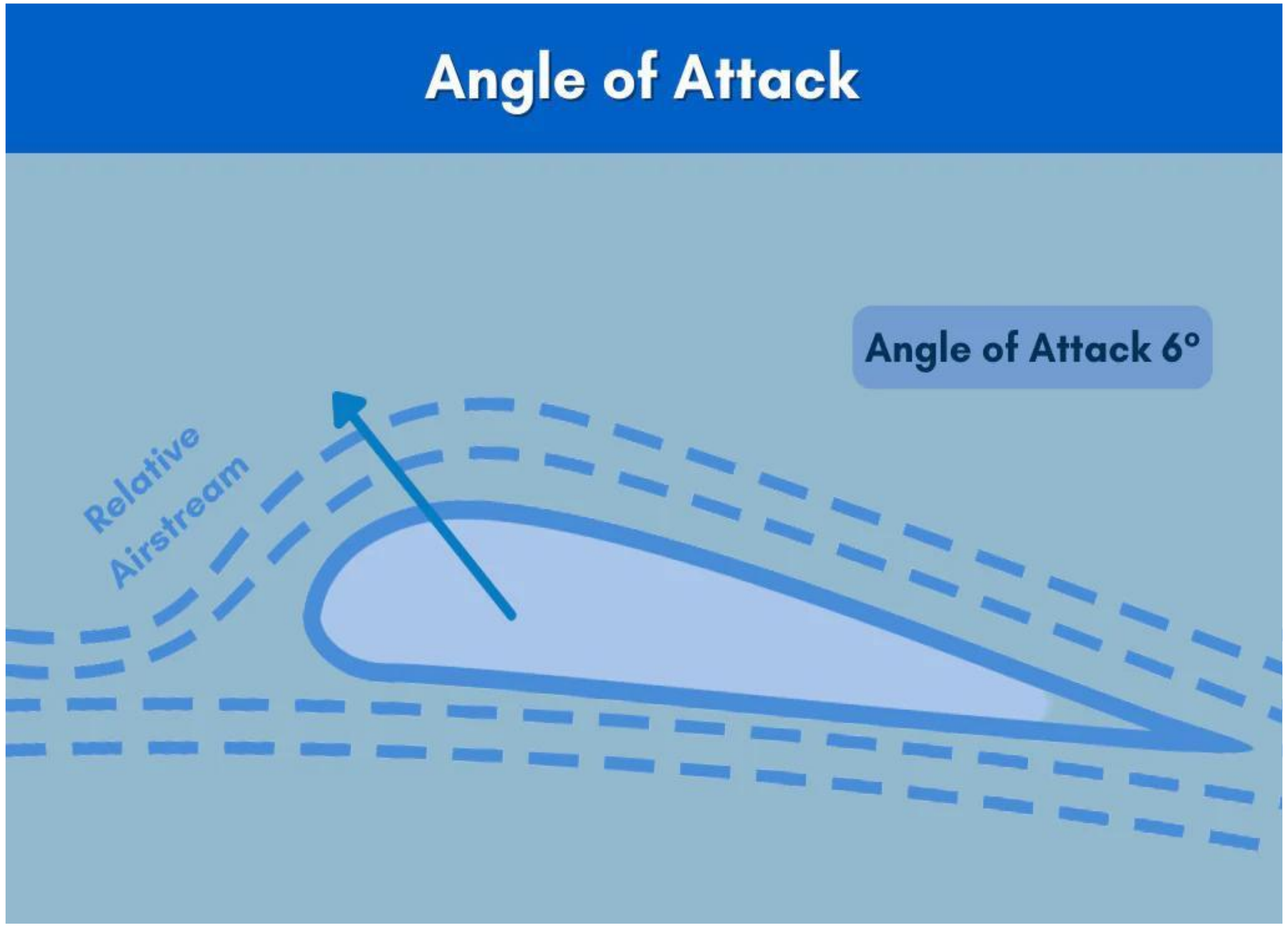
- The part of the wing where the mean camber line and chord line have the greatest distance is known as the maximum camber point.

- For optimized airflow, the maximum camber within the front of the airplane wing gives off an ideal pressure distribution, which is preferred by most aircraft designers.



ANGLE OF ATTACK

the angle of attack is a fundamental parameter in aerodynamics, crucial for understanding and optimizing the performance and behavior of airfoils and aircraft.



- The angle of attack is a central concept in aerodynamics, representing the angle formed between the airfoil's chord line and the direction of the relative airflow.

- This angle wields significant influence over the airfoil's performance, affecting both lift and drag.

THANK YOU