GLIDER BASICS

WHAT IS GLIDER ?

- A light engineless aircraft designed to glide after being towed aloft or launched from a catapult.

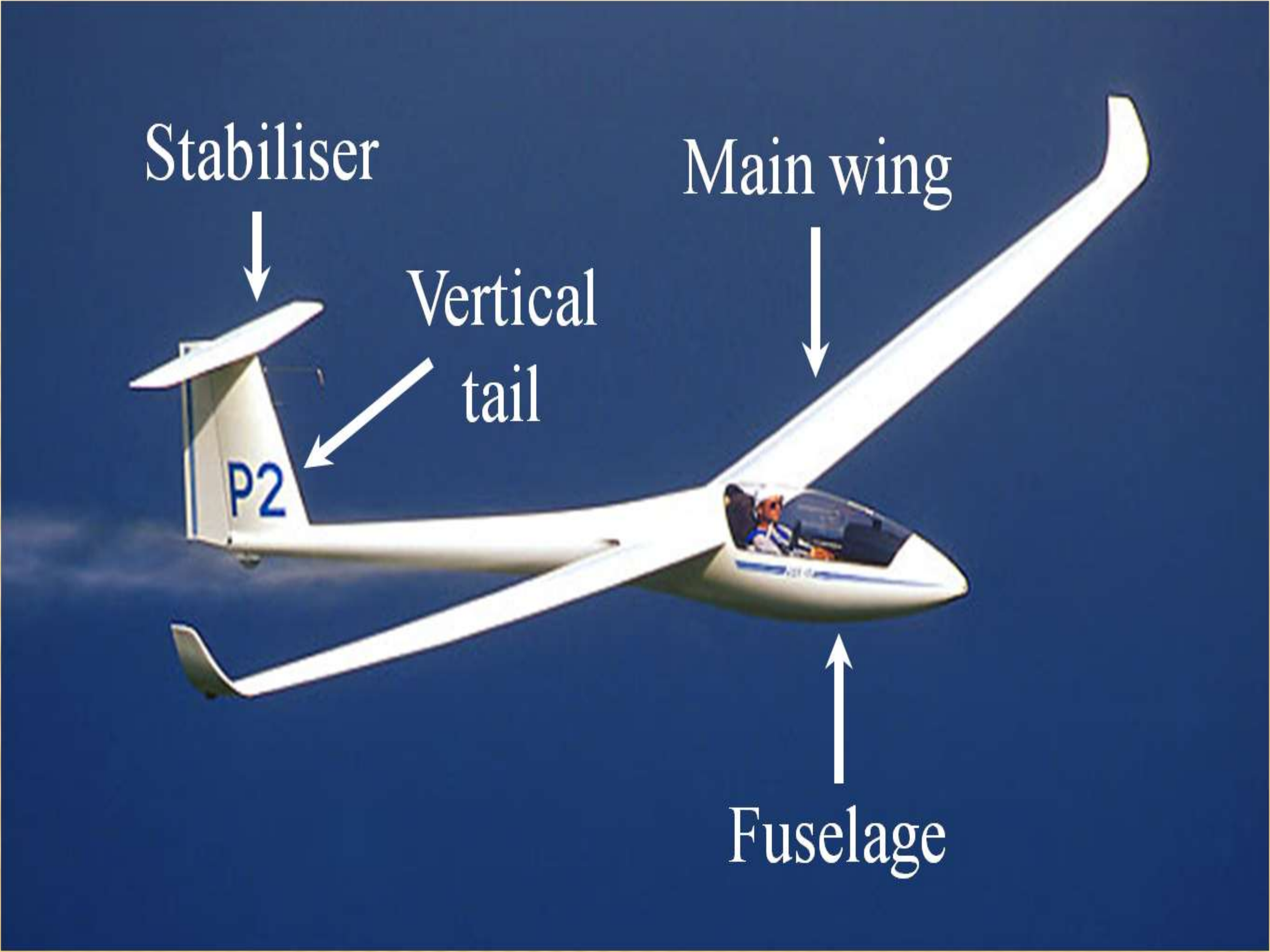
PARTS OF GLIDER

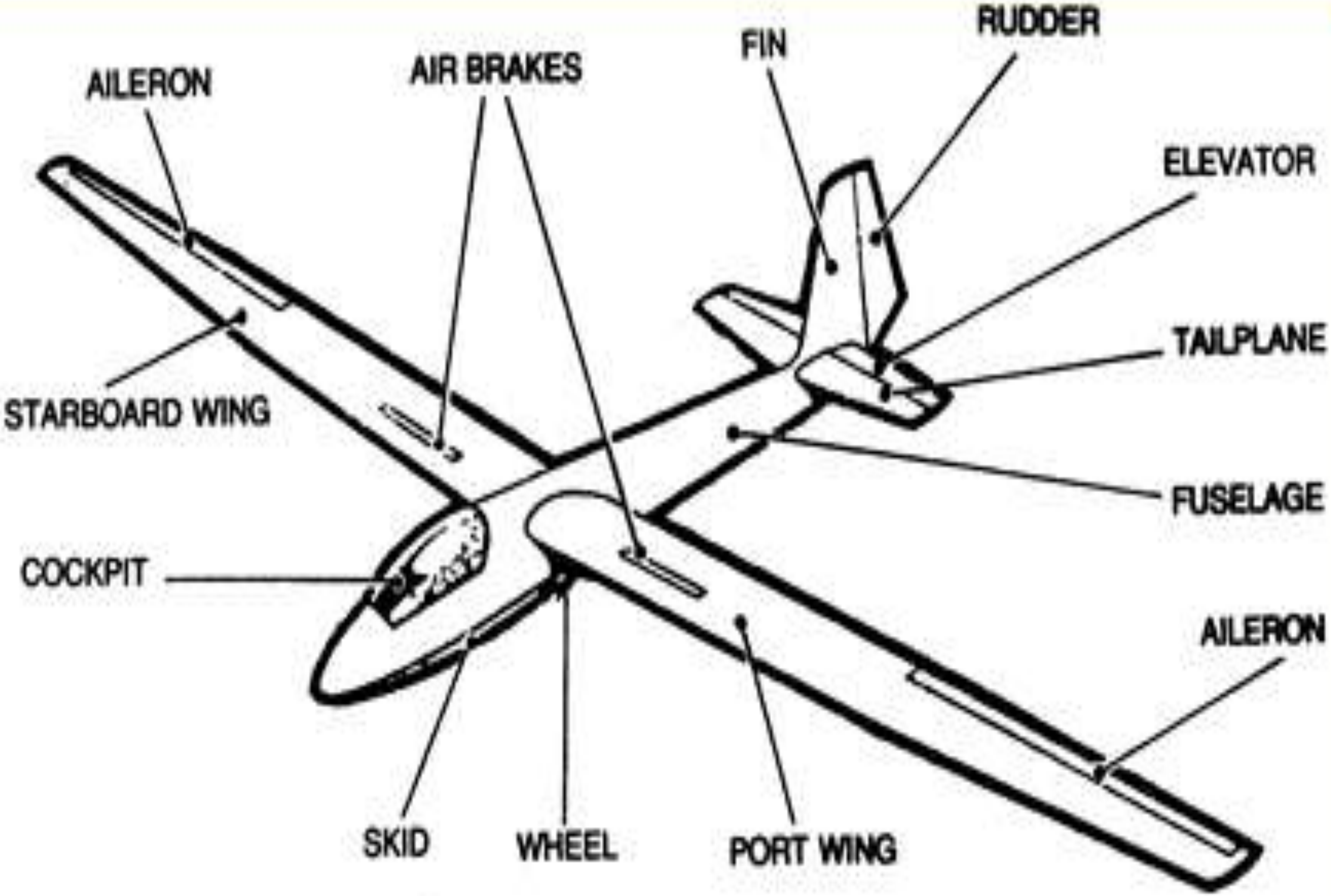
- A glider can be divided into three main parts:

  a)fuselage

  b)wing

  c)tail


Stabiliser
Main wing
Vertical tail
P2
Fuselage

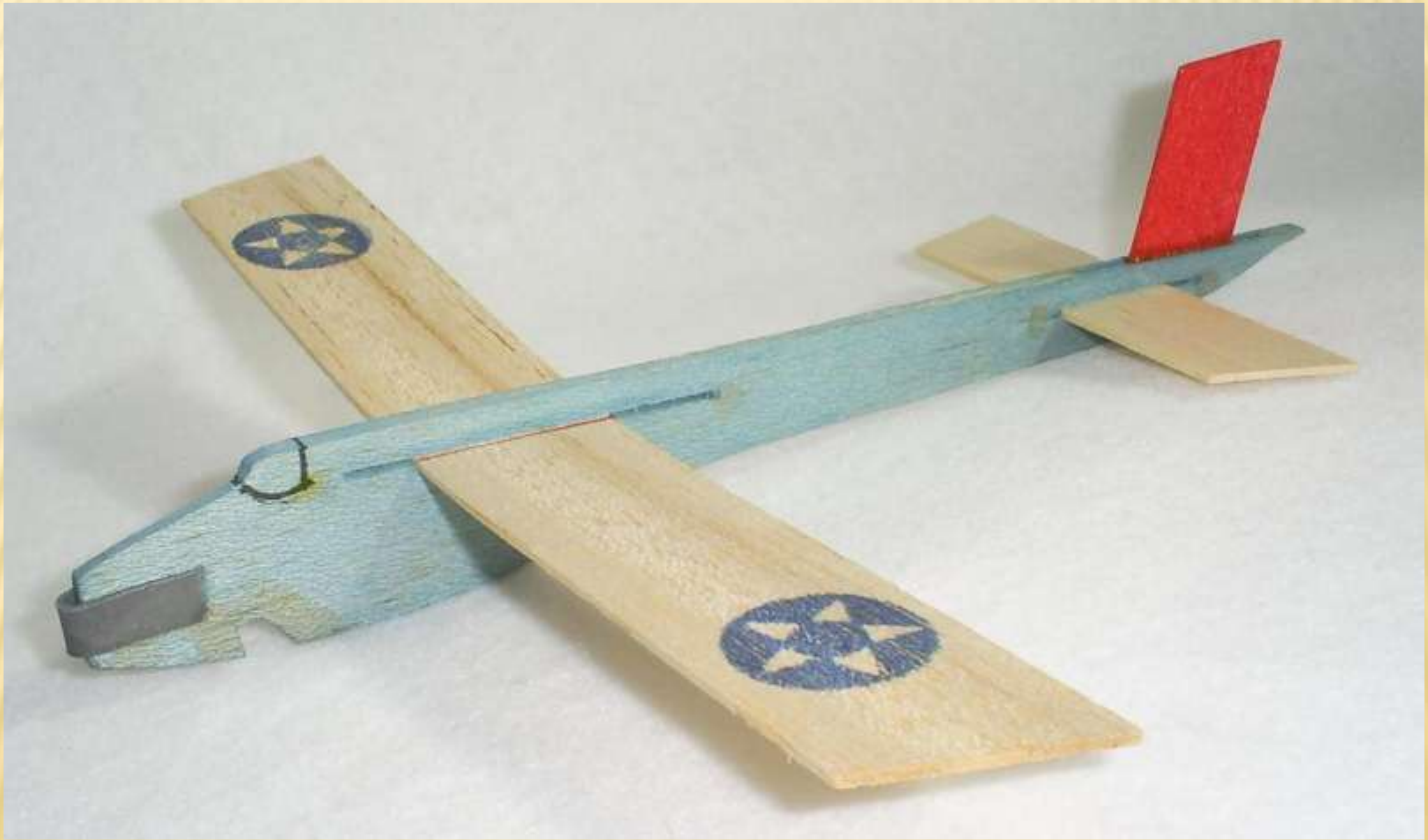


THE GLIDER AND ITS COMPONENTS

FUSELAGE

- It can be defined as the main body of a glider
- Comparing it with a conventional aircraft, the fuselage is the main structure that houses the flight crew, passengers, and cargo. Howsoever, in this case it is only a 2-D fuselage.
- It is cambered and in the middle portion, we attach the wing around the position where the camber is maximum by either making a slot in the fuselage, or by dividing in two parts and then attaching

SLOT MADE IN FUSELAGE



WITHOUT SLOT

- If we are breaking the wing in two parts then we have an advantage that we can give dihedral angle to the wing.
- But typically for first time users, it is advisable to cut a slot into the fuselage and then attach the wing.
- Since in this way the wing remains firmly attached and also since the model is of small size, dihedral is of little importance.(dihedral :explained in later slides)
- The front part of the fuselage is called nose. It is rounded in shape to avoid drag and to ensure smooth flow.

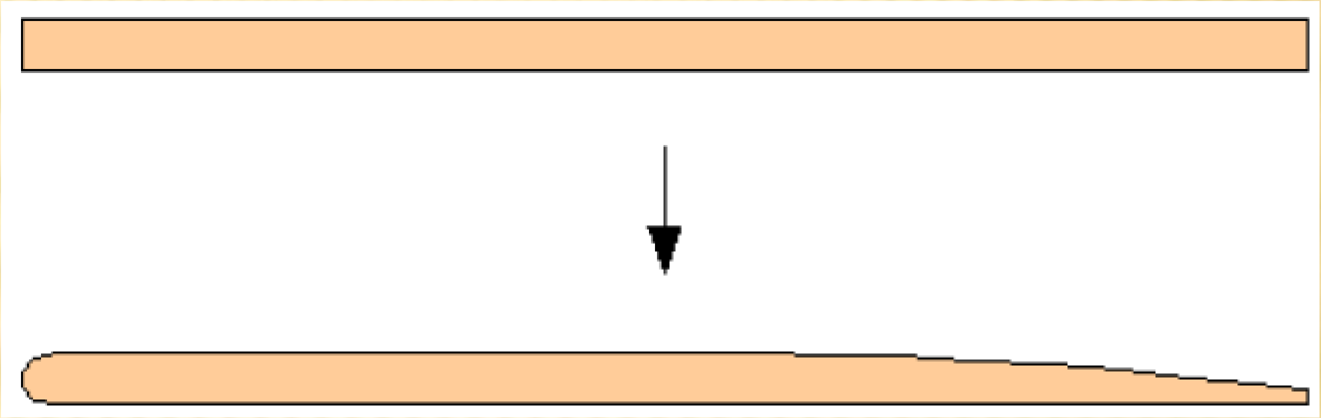
WING

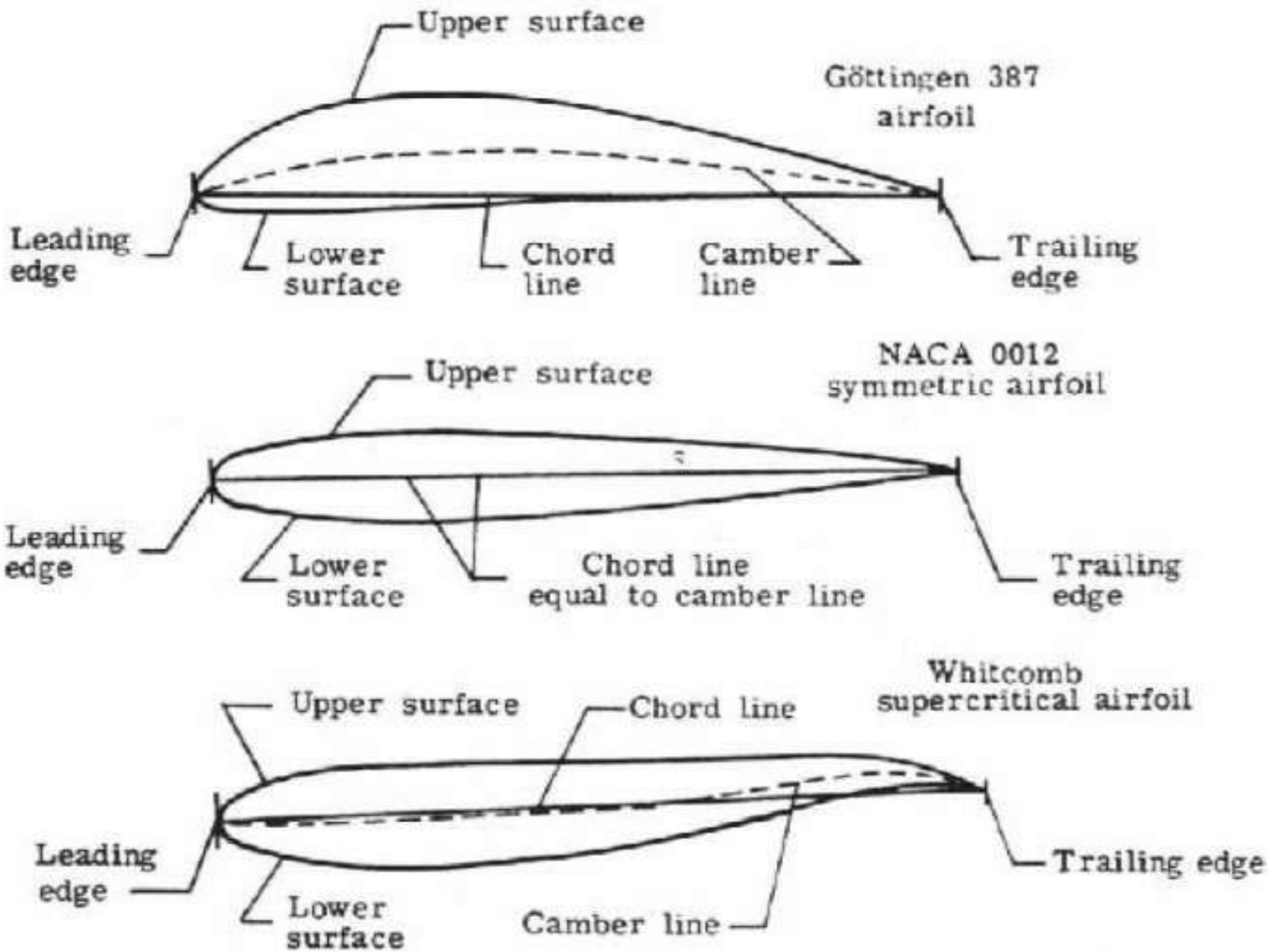
- It is the most essential part of a plane.
- When air flows past it, due to the difference in curvature of its upper and lower parts lift is generated, which is responsible for balancing the weight of the plane, and the body can thus fly.

BASIC TERMINOLOGY OF WING

- Airfoil: Cross sectional shape of a wing
- Leading Edge: Front edge of wing
- Trailing Edge: Back edge of wing
- Chord Line: Line connecting LE to TE
- Camber line: A line joining the leading and trailing edges of an airfoil equidistant from the upper and lower surfaces . High camber found on slow flying high lift aircraft.
- Camber: It is the asymmetry between the top and the bottom curves of an aerofoil in cross-section.

SHAPE OF AN AEROFOIL




Upper surface
Göttingen 387
airfoil
Leading
edge
Lower
surface
Chord
line
Camber
line
Trailing
edge
NACA 0012
symmetric airfoil
Upper surface
Leading
edge
Lower
surface
Chord line
equal to camber line
Trailing
edge
Whitcomb
supercritical airfoil
Upper surface
Chord line
Leading
edge
Lower
surface
Camber line
Trailing edge

WING

- The point in airfoil where the lift can be supposed to be concentrated upon is called the centre of pressure.
- Generally it is located at c/4, where c is the chord length.
- The point where the weight of the glider acts is termed as centre of gravity (CG).
- For weight balance, the centre of gravity must coincide with the centre of pressure.
- To bring the CG to c/4 we add some weight at the nose in the form of coins and paper clips.

TAIL

- A tail or a stabilator is attached at the rear end of the glider.
- It is composed of two parts a horizontal stabilizer and a vertical stabilizer to provide stability and control to the vertical up down movement of the nose.
- This up-down movement of the glider is termed **pitching.**

HOW AIRPLANES FLY?

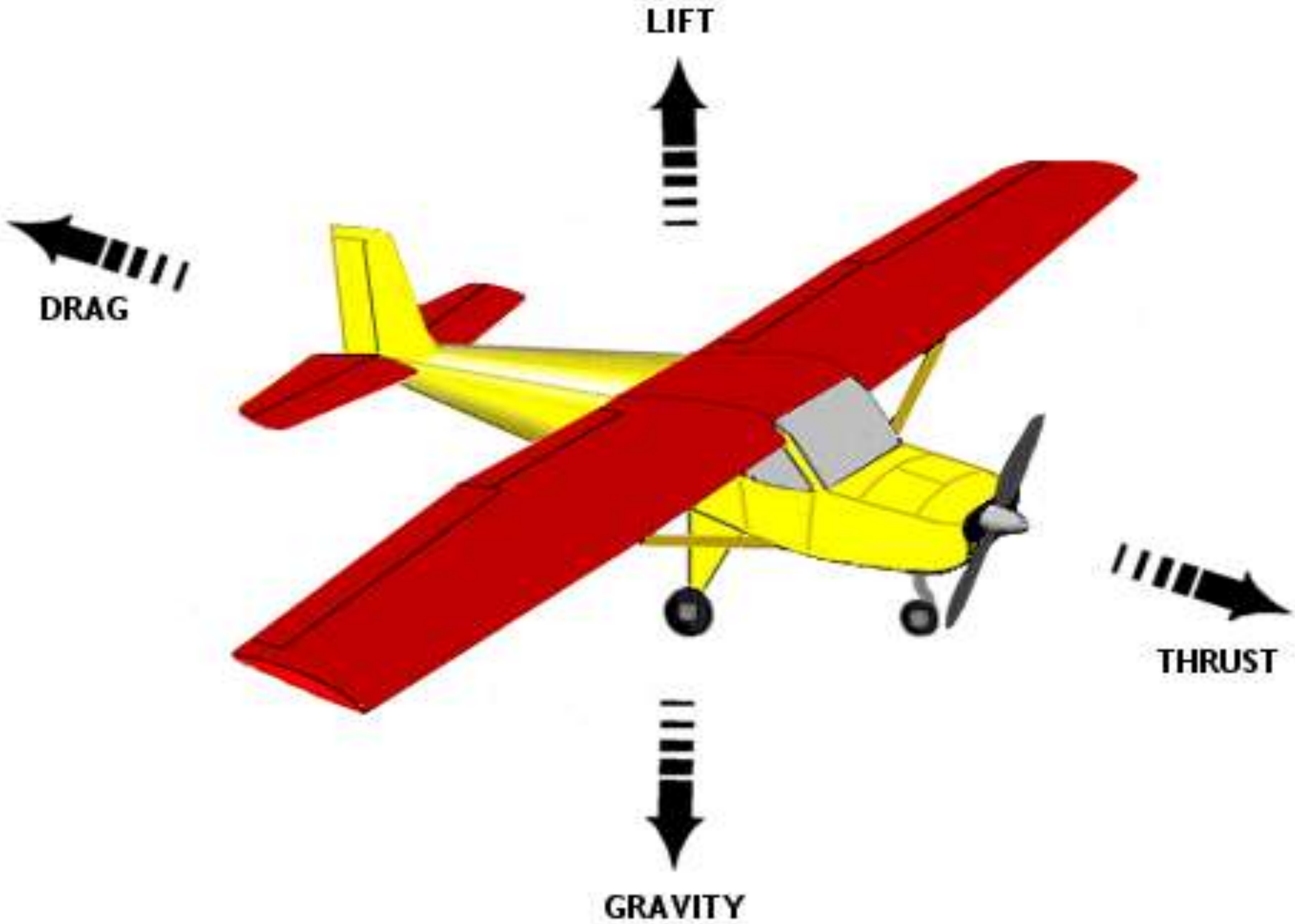
- Essentially there are 4 aerodynamic forces that act on an airplane in flight
- These are:

  a)lift: upward force(generated by wing)

  b)gravity: downward force(due to weight of the plane)

  c)thrust: forward force(power of the airplane's engine

  d)drag: backward force(resistance of air)


LIFT
DRAG
THRUST
GRAVITY

- So for airplanes to fly, the thrust must be greater than the drag and the lift must be greater than the gravity *(so as you can see, drag opposes thrust and lift opposes gravity).*

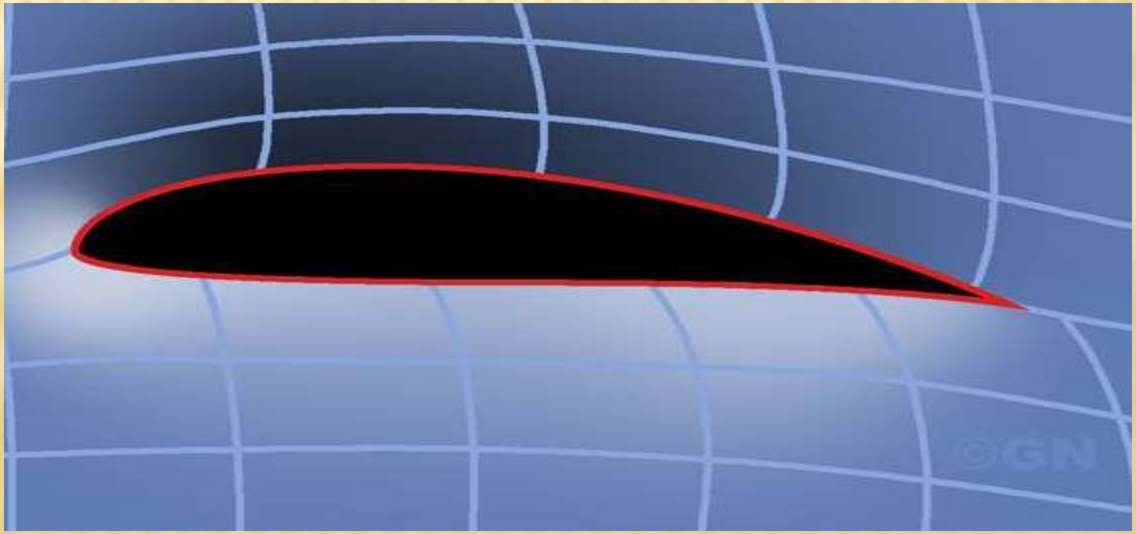
- This is certainly the case when an airplane takes off or climbs.

- However, when it is in straight and level flight the opposing forces of lift and gravity are balanced.

- During a descent, gravity exceeds lift and to slow an airplane drag has to overcome thrust.

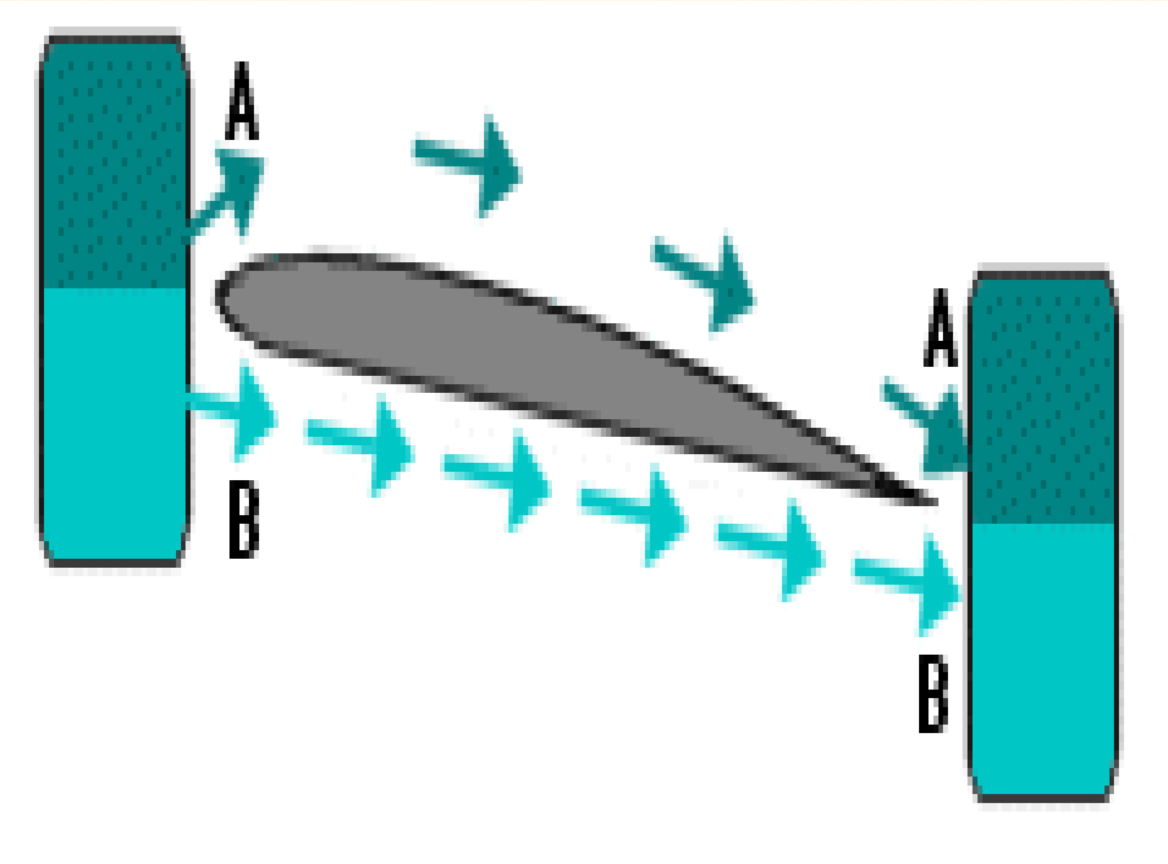
HOW WINGS GENERATE LIFT?

A cross section of a typical airplane wing will show the top surface to be more curved than the bottom surface. This shaped profile is called an **'airfoil' (or 'aerofoil').**



HOW WINGS GENERATE LIFT?

- As the fluid elements approach the wing, they split at the leading edge and meets again at the trailing edge
- As a result, the air must go faster over the top of wing since this distance traveled is larger
- Bernoulli's equation implies that pressure will be lower on the upper surface
- This net pressure difference causes lift



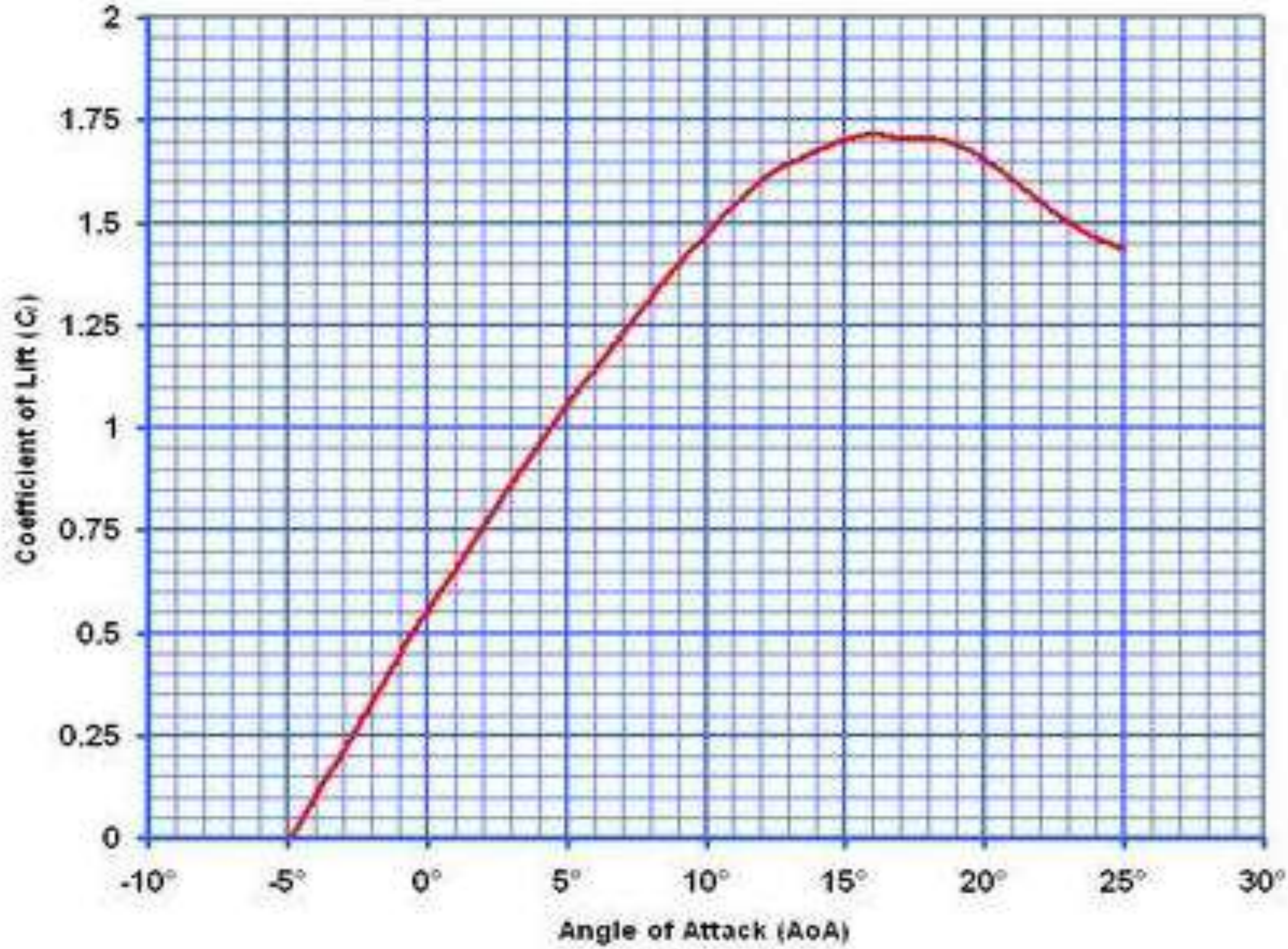
- Arrows A and B is air getting split at the same moment, and meeting up again at the same moment

SOME TERMINOLOGIES

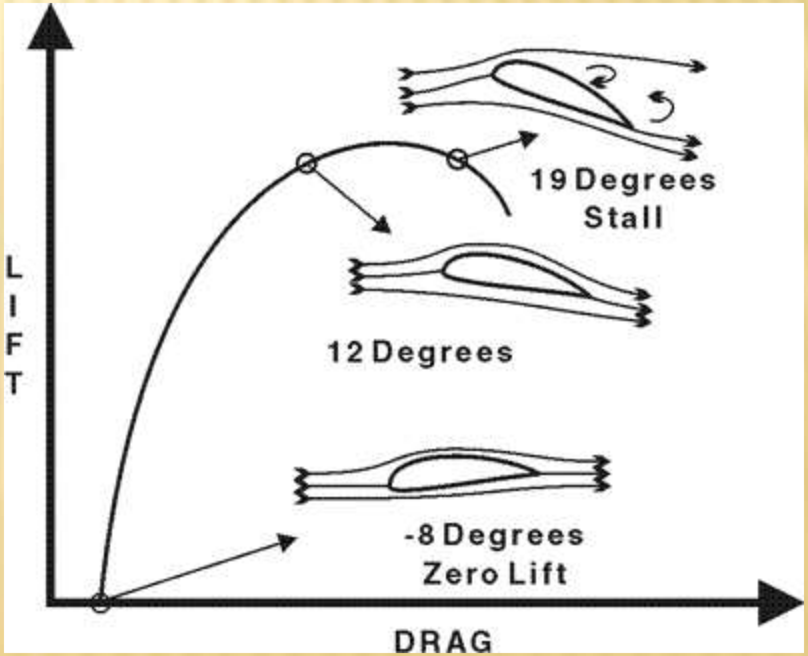
- Wing loading is defined as the weight of the aircraft divided by the wing area.
- The glide ratio is the distance travelled in a horizontal direction compared with the vertical distance dropped on a normal glide.
- A 20 to 1 glide ratio means that the aircraft would lose one foot of altitude for every twenty feet of distance travelled
- Ballast is extra weight added to a glider to help it penetrate better in windy weather or to increase its speed.
- We generally add paper clips and/or coins on the nose in balsa gliders.

ANGLE OF ATTACK

- It is the angle the wind makes with the wing (relative wind).
- As the angle of attack increases, so more lift is generated -but only up to a point until the smooth airflow over the wing is broken up and so the generation of lift cannot be sustained.
- When this happens, the sudden loss of lift will result in the airplane entering into a **stall, where the weight of the airplane cannot be supported any longer**

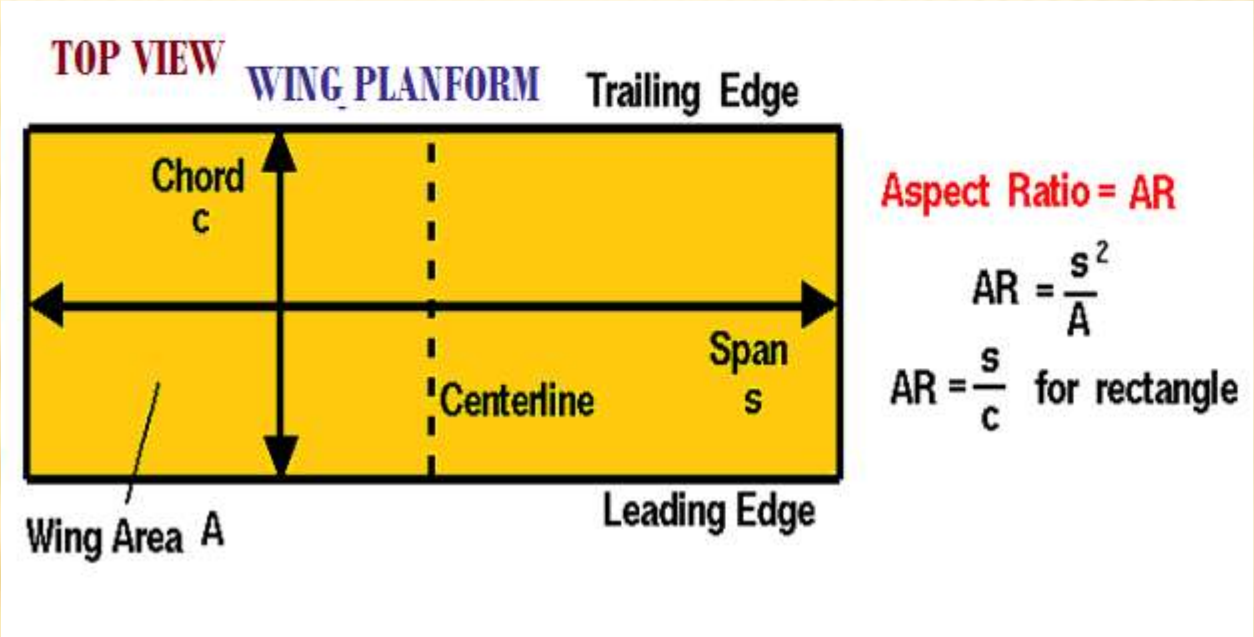

2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
-10°
-5°
0°
5°
10°
15°
20°
25°
30°
Angle of Attack (AoA)
Coefficient of Lift (C_l)

The graph below shows how lift and drag changes with the angle of attack for a typical wing design.



ASPECT RATIO

It is the ratio of the wing span to the wing's chord length(c).

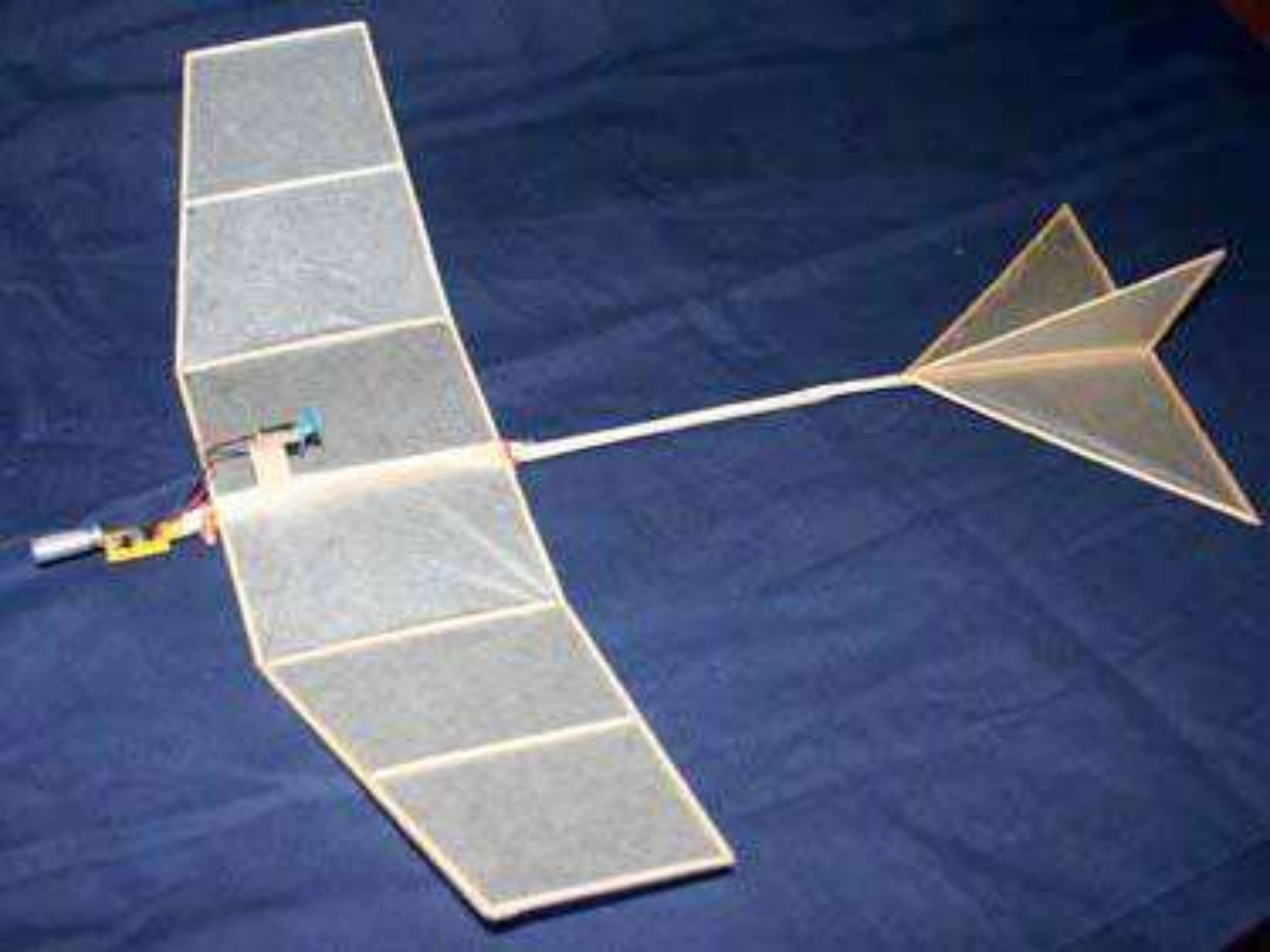


SOME USEFUL TIPS

- Try to streamline the body as far as possible, in order to reduce drag.
- The weight of the model is kept as minimum as possible. For this purpose we use balsa wood.
- The special quality of this wood is that is very light and hence adequate for our purpose along with the fact that it has good enough strength to not to breakdown away in wind.
- All the ends are rounded, again to minimize the effect of drag.

DIMENSIONING

- Aspect Ratio =9-10
- Wing span = 50-60 cm.
- Angle of attack = 3-4 deg.
- Horizontal Stabilizer = 20-25% of wing area
- Vertical Stabilizer = 40% to 50% of Horizontal Stabilizer area.
- Dihedral = 2-3 deg.
- Length of fuselage = 65%-75% of span




Thank You