Answer on Question #50069, Engineering, Other

Why is an aerofoil shaped as it is?

a) Why is it rounded and not pointed at the front

b) why is it thicker in the middle

c) Why is it tapered at the rear

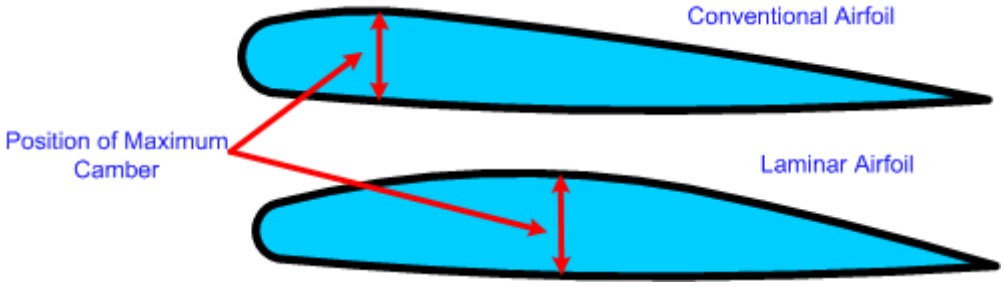
d) Why is it flatter underneath, with a camber making it curve on top?

Answer:

a) Why is it rounded and not pointed at the front

Air divides smoothly around a wing's rounded leading edge, and flows neatly off its tapered trailing edge. You might think a sharp leading edge would be better. However, air cannot turn a sharp corner, so tilting a sharp wing even slightly would disrupt the smooth airflow over the wing. This would cause a loss of lift and increase drag. A rounded leading edge divides the airflow smoothly, even as the wing is tilted up or down.

b) why is it thicker in the middle



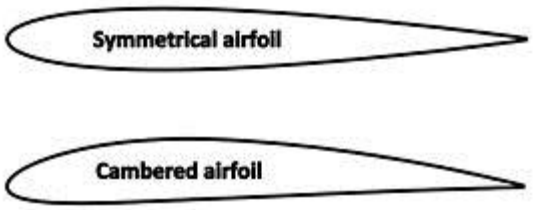
Two types of airfoils commonly used are the laminar and conventional airfoils; as a rule, the laminar foil is faster, but the cost is more adverse stalling characteristics. The two types differ with respect to location of the maximum camber—while the maximum camber on a conventional airfoil is located 25% behind the leading edge, the laminar maximum camber is located at 50% chord.

A laminar flow wing has a maximum thickness in the middle camber line. Analyzing the Navier–Stokes equations in the linear regime shows that a negative pressure gradient along the flow has the same effect as reducing the speed. So with the maximum camber in the middle, maintaining a laminar flow over a larger percentage of the wing at a higher cruising speed is possible.

c) Why is it tapered at the rear

If the trailing edge were rounded, the higher-pressure air flowing along the lower side would try to follow the rounded surface and spill upward into the lower-pressure air above the wing. A sharp trailing edge prevents this upward spill, because air cannot make a sharp turn. Instead, the air flowing off the top and bottom surfaces rejoins smoothly.

d) Why is it flatter underneath, with a camber making it curve on top?



The lift force depends on the shape of the airfoil, especially the amount of camber (curvature such that the upper surface is more convex than the lower surface, as illustrated at right). Increasing the camber generally increases lift.

Cambered airfoils will generate lift at zero angle of attack. When the chordline is horizontal, the trailing edge has a downward direction and since the air follows the trailing edge it is deflected downward. When a cambered airfoil is upside down, the angle of attack can be adjusted so that the lift force is upwards. This explains how a plane can fly upside down.