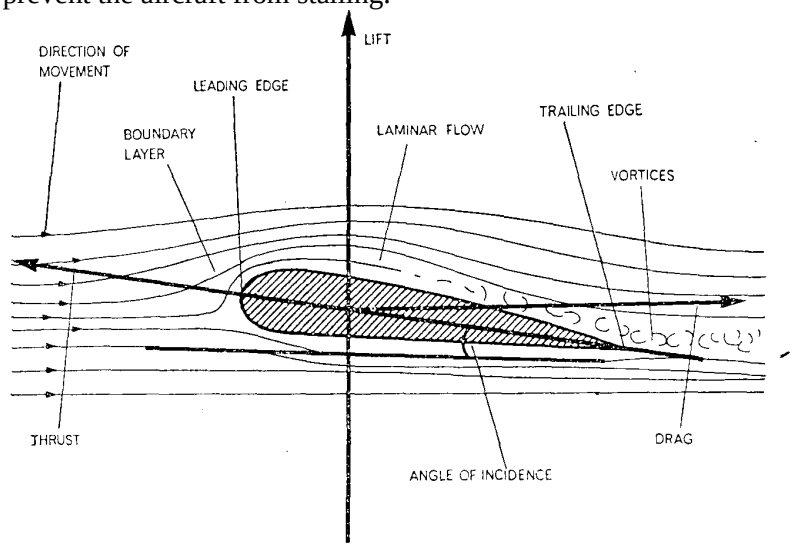
AEROFOILS

Apart from the fuselage and the engines, the most important parts of an aircraft are the surfaces known as aerofoils. These include the rudder, elevators and ailerons, whose function is to control the aircraft in flight; and the wings which provide the lift necessary to overcome the weight of the aircraft and lift it through the air. A substantial horizontal thrust, provided by the jet or the propeller, drives the aircraft through the surrounding air, while the wing deflects downwards the mass of air *flowing* on to it. This produces a reactive force *acting* in the opposite direction, which lifts the wing upwards. Without some means of horizontal propulsion, no lift can be produced by the wing. Modern aircraft are **so heavy that** the wings must develop a very large lift force in order to sustain the aircraft.

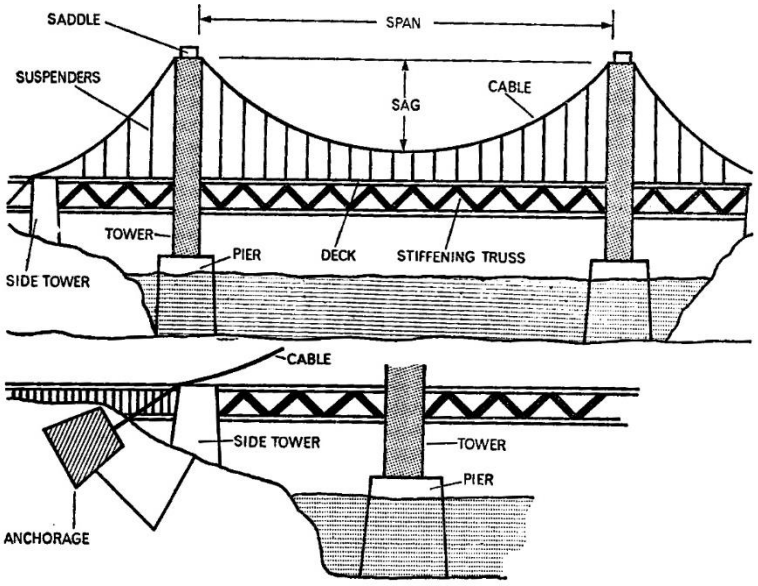
The design of the wings is therefore very important, and various factors have to be considered. Wind-tunnels *reproducing* flight conditions are used to examine the behaviour of air *flowing* over different types of wings at different speeds. The lift produced by a wing will depend on, among other factors, the wing area, its profile, and the angle of incidence - that is, the angle at which the wing is inclined to the direction of motion. Air *flowing* over the top of the aerofoil should flow smoothly and without turbulence. This laminar flow is achieved by streamlining the profile and by making the skin of aerofoil smooth. As a result, the air-flow will follow the contour of the wing, except for a narrow boundary layer of stationary air on its surface. However, above a certain angle of incidence, which varies with the type of wing, the air-flow is liable to break up and become **so turbulent as to** destroy the low-pressure region above the wing. This causes **such a rapid loss of lift that** the aircraft may stall. To counteract this, slots are sometimes fitted to the leading edge of the wing, *guiding* the air-flow more steadily over the aerofoil. Since low speeds are essential for landing, extendable flaps are also fitted to the trailing edge. These extend the effective area of the wing, and thus prevent the aircraft from stalling.



Cross-section of aircraft wing

The force exerted by the deflected column of air beneath the wing has a vertical component called lift, and a horizontal component called drag. Drag in its various forms represents a loss of the energy available to provide lift, but it always accompanies lift. It can never be entirely eliminated, since the wing itself offers resistance to the air through which it moves. A laminar flow over the wing, *reducing* drag to a minimum, is the optimum condition. But around the wing-tips and on the trailing edge, some turbulence is inevitable. The air, *flowing* through a region of higher pressure under the wing, swirls up at these edges into

a region of low pressure above the wing and produces a vortex, which may be **so violent as to** produce vapour trails at the wing-tips.



Suspension bridge and anchorage