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Editorial

Tailless Aircraft : An Overview

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EDITORIAL

Apart from its main wing, it lacks a tail assembly and any other horizontal surface. The main wing incorporates aerodynamic control and stabilisation functions in both pitch and roll. A tailless design might nevertheless feature a rudder and a vertical fin (vertical stabiliser). Low parasitic drag, similar to the Horten H.IV soaring glider, and strong stealth qualities, similar to the Northrop B-2 Spirit bomber, are theoretical advantages of the tailless configuration. The tailless delta has proven to be the most successful tailless layout, particularly for combat aircraft, albeit the Concorde airliner is the most well-known tailless delta.

A horizontal stabiliser surface separate from the main wing is present on a traditional fixed-wing aircraft. Because of the larger surface area, there is greater drag, which necessitates a more powerful engine, especially at high speeds. The stabiliser can be deleted and the drag lowered if longitudinal (pitch) stability and control can be obtained using another approach (see below). There is no separate horizontal stabiliser on a tailless plane. As a result, the aerodynamic centre of a conventional wing would be ahead of the aircraft's centre of gravity, causing pitch instability. To relocate the aerodynamic centre rearward and make the aeroplane stable, another mechanism must be applied. The designer can accomplish this in one of two ways.

Sweeping the leading edge of the wing back, either as a swept wing or a delta wing, and lowering the angle of incidence of the outer wing section allows the outer wing to function as a traditional tailplane stabiliser. Tip washout occurs when this is done in stages along the length of the outer part. Dunne achieved this by curving the upper surface of the wing in a conical shape.

This affects the wing's overall efficiency, but for many designs - notably for high speeds - the savings in drag, weight, and cost over a traditional stabiliser outweigh this. The broad wing span also limits manoeuvrability, which is why the British Army rejected Dunne's design.

Low or null pitching moment airfoils, as seen in the Horten family of sailplanes and fighters, provide an alternative. These have a unique wing segment with reflex or reverse camber on the back or entire wing. The flatter side of the wing is on top, while the steeply curved side is on the bottom, resulting in a high angle of attack in the front part.

Fitting large elevators to a standard airfoil and trimming them considerably upwards can approximate reflex camber; the centre of gravity must also be moved forward from its normal position. Reflex camber tends to cause a tiny downthrust due to the Bernoulli effect, thus the wing's angle of attack is increased to compensate. This, in turn, adds to the drag.

This approach, unlike sweepback and washout, allows for a greater range of wing planforms, including straight and even circular (Arup) wings. However, the drag associated with a high angle of attack is typically viewed as inefficient, and only a few production types have used it, such as the Fauvel and Marske Aircraft series of sailplanes.

A simpler option, as in the paraglider, is to overcome the instability by placing the aircraft's main weight a large distance below the wing, where gravity will prefer to keep the plane in a horizontal attitude and therefore counteract any aerodynamic instability. However, in practise, this is rarely enough to ensure stability on its own.

The Rogallo wing hang glider is a classic example, as it uses the same sweepback, washout, and conical surface as Dunne. Stability can also be achieved through artificial means. Stability and manoeuvrability are mutually exclusive. A low level of stability is required for maximum manoeuvrability. Aerodynamically, certain modern high-tech combat aircraft are unstable.

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