

Tails you win

Do you have the Wright stuff?

Dick Reynoldson

WHEN Wilbur and Orville Wright began to design and build gliders in 1899, their first breakthrough was the realisation that birds in flight change direction by inclining or banking their wings. All other contemporary aircraft experimenters had either ignored the problem or tried to emulate ship design and incorporate a rudder for turning, without realising the need for bank. Needless to say, trying to turn an aircraft with the rudder while keeping the wings level was an extremely unsuccessful means of aircraft control.

The Wright brothers therefore devised a wing warping mechanism to induce the bank required for turning and achieved a degree of control far ahead of anything envisaged elsewhere. The Wright brothers' discovery became, of course, the basis for controlled flight and the principle remains the same on modern aircraft, even though Glenn Curtiss in 1908 replaced the wing warping mechanism with ailerons. (The Wrights subsequently brought a successful lawsuit against Curtiss for patent infringement of their principle).

The Wrights' first experiments established the success of this method of turning to a degree that they considered a moveable rudder unnecessary and did not include it in their first glider designs. However it was not long into their flying programme before they discovered that while the method worked well in gentle turns, when they tried to bank sharply, the nose of the aircraft would yaw uncontrollably in the opposite direction. This is what we now call adverse yaw. This became a major problem for them to overcome in terms of maintaining aircraft control.

They were forced to modify their design to include a rudder which was interconnected with the wing warping mechanism and which automatically yawed the aircraft in the direction of roll and prevented the adverse yaw. Some aircraft designs still incorporate a degree

of interconnection between rudder and aileron for similar reasons.

The interconnected rudder worked well for controlling yaw while turning, however the brothers later encountered another even more unnerving phenomenon, when at low airspeed, a wing drop would induce a roll and yaw in the same direction and which the wing warping mechanism was unable to prevent. This resulted in total loss of control and several crashes. Luckily these crashes occurred from only a few feet above the ground and the brothers escaped serious injury.



Today, of course, we all know that it's not wise to pick up the downgoing wing with aileron in or close to a stall, because this only increases the angle of attack and initiates or deepens the stall condition on the downgoing wing. The brothers eventually realised that they could avoid this problem by maintaining adequate airspeed while turning, but they also recognised the need to change their design to incorporate a rudder with which the pilot could directly control the yaw. This added feature of a pilot operated rudder completely solved the problem of aircraft control and the principle has remained largely unchanged in aircraft design to this day and is just as vital now as it was then.

Modern aircraft have design features which minimise adverse yaw when turning and generally have ailerons which remain effective well into the stall. For this reason it is possible to fly

around in a reasonably satisfactory fashion most of the time without worrying much about the rudder. Unfortunately many pilots seem to be quite happy with this state of affairs and fail to recognise the importance of the correct use of rudder for directional control.

The lack of proper rudder control usually manifests itself most dramatically during the final stages of the landing when the aircraft is approaching the runway, particularly if a crosswind is present. During the landing the rudder should be used to align the aircraft in the landing direction. Ailerons are not effective for

this purpose and any attempt to use them for directional control usually results in wild gyrations as the pilot frantically applies aileron first one way and then the other in a vain attempt to keep the aircraft straight. Using the rudder to keep the nose aligned with the runway, on the other hand, is very effective and easy.

Even though modern aircraft are designed to have very little adverse yaw, gentle rudder pressure in the direction of roll is still essential to keep the aircraft properly balanced when entering and leaving turns.

The application of opposite rudder to prevent yaw is also an essential part of the standard stall recovery procedure. On the other hand, kicking in too much rudder in an attempt to tighten a turn, particularly at low airspeed and altitude, can induce a savage stall and wing drop with disastrous results.

The message is that from the very first days of flight the rudder has been an essential means of aircraft control. Modern aircraft, through good design, can lull pilots into a false sense of security and a feeling that those pedals on the floor are only there to serve as brakes and footrests. How confident are you that you have the "Wright stuff" when it comes to rudder control?

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