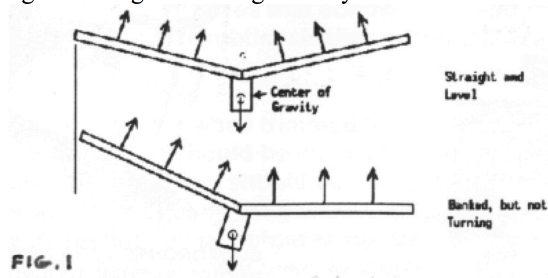


# HOW MUCH DIHEDRAL IS ENOUGH

by Clay Ramskill

*This piece is written with RC pilots in mind. The information it contains is also very useful to free flight modelers for understanding how wing dihedral affects their models - Editor.*

In general, the more dihedral an aircraft has, the more it will tend to self-right to a wings level position when upset from straight and level flight. This added roll stability makes the plane much easier to fly because the pilot doesn't have to constantly fight to maintain a wings level attitude. Note the two drawings in figure 1. Once the aircraft is no longer level, the lowered wing is effectively bit longer, and the lift forces on the lowered wing are pointed more straight up. Also, since the figure shows a high wing plane, the CG of the aircraft is offset toward the high wing. All these situations tend to force the plane to rock back to wings level attitude, before the plane begins turning or skidding sideways.



But, the conditions described above don't last long. Also note that we now have the lift forces on the higher wing pushing sideways; this will cause the aircraft to skid sideways, turn, or both. Assuming no corrections from the pilot, what now happens is largely dependent upon the size of the rudder/fin combination. If the rudder/fin area is just right, the skid continues just enough for the dihedral effect of the wing to return the aircraft to a wings level attitude. Too much area in the rudder/fin area, and the aircraft turns without skidding. Centripetal force from the turn negates all the self-righting effects, and the aircraft flies in balanced flight, but in an ever increasing wing and nose-down spiral. This is called spiral instability. Too little rudder/fin area, and the skid will continue even as the plane passes wings level, resulting in over correction, and the aircraft rolls and skids, oscillating like a drunken sailor. This is called Dutch roll.

Although the above discussion is more important to glider pilots and free flight modelers, it brings us to look at how dihedral affects a plane in skidding flight, and the good and bad sides of the dihedral effect. Note in figure 2. what happens to a plane with dihedral when in a skid, or unbalanced flight. This condition can occur with rudder deflection or when a wind gust hits the plane from the side. The large discrepancy in angle of attack between the two wings causes the plane to roll away from the direction of the skid.

The dihedral effect is definitely beneficial in self-righting, but, unfortunately, also gives us roll away from a side wind gusts. Incidentally, sweeping a wing back also gives us dihedral effect about 5 degrees of sweep being equivalent to 1 degree of dihedral. Military planes with swept back wings for speed often use negative dihedral to counter the dihedral effects from the wing sweep — the Harrier, A7 Corsair and C5 transport come to mind. How much

dihedral is enough? For most of us, then, the answer is only enough to give us the roll stability we need commensurate with our flying skills!

