AMA BETA

WING DIHEDRAL ACTIVITY & TEACHERS NOTES

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WING DIHEDRAL/POLYHEDRAL

You have likely noticed that the wings on the ALPHA and BETA aircraft are not perfectly level. In the case of both aircraft, the saddle connecting the wing to the fuselage tilts the wing at an angle above the horizontal, while the wingtips are tilted up further still. In the case of the BETA, the wingtips tilt up twice! Why would the wing be designed this way? What effect does it have on the aircraft's performance?

The "tilt" in the wings is called the dihedral angle, and it imparts what is called the dihedral effect (these two terms should not be confused or used interchangeably), which is that the aircraft will have a natural tendency to return to straight-and-level flight. As the dihedral angle increases, so does the dihedral effect. On full-scale aircraft, greater dihedral angles can be found on airliners and smaller personal airplanes to make them safer. Conversely, military-like fighter aircraft, which need to be extremely maneuverable (at the expense of stability), do not use dihedral to this extent.

Why does tilting the wing have this effect? Simply put, the lift force generated by an aircraft's wings always acts perpendicularly from the wing's surface itself. This means that when a craft with angled wings is in straight-and-level flight, a small component of the lift force is directed "inward" toward the fuselage, and thus wasted. When the aircraft rolls, however, the lift generated by the lowered wing will be directed completely vertically, raising the wing back up and restoring the aircraft's straight-and-level flight. This means that, although an increased dihedral angle goes a long way toward improving an aircraft's stability and safety, it comes at the cost of a proportionate percentage of both lift and agility.

There are multiple ways in which dihedral angles can be implemented into an aircraft's design, depending on the dihedral effect that is desired. For example, the BETA utilizes polyhedral angles, meaning that the dihedral angle changes along the length of the wing from root to tip. This is an attempt to optimize both the stability of increased dihedral angle and the greater lift from a level wing. You might also come across the term anhedral, which is typically used to refer to a dihedral angle below the horizontal. As you may intuit, the effect here is to make the aircraft more dynamically unstable, increasing its maneuverability. As a result, this design features most commonly in military aircraft such as fighter jets.

If so inclined, the dihedral angles of the BETA's wings can be modified by attaching a string between the wingtips to hold them under tension, as illustrated in the following picture; however, this will create permanent creases in the foam of the wing roots where they meet the saddle, and it might be difficult to return the wings exactly to their original dihedral angles. If you want to give students the option to modify dihedral angles in this way, please keep this constraint in mind, because repeated creasing of the wing roots may reduce the kit's reusability and might even necessitate its replacement.

Here the wing is being held under tension by the string connecting the tips... Possibly helpful for studying the dihedral effect, but probably not particularly good on the wing!

NOTES

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