

LEVERAGE

The personal airplanes we fly are designed to place the wing's center of lift (CL) aft of the center of gravity (CG). This makes the aircraft "nose heavy," and requires the horizontal tail surfaces to generate downforce (D) to balance the aircraft and keep the nose up. To help, the horizontal tail surface usually is mounted at a slightly negative angle of attack (AoA).

As the FAA's *Pilot's Handbook of Aeronautical Knowledge* (PHAK, FAA-H-8083-25A) tells us, it's as if the line described in the image at right, CG-CL-D, "were a lever with an upward force at CL and two downward forces balancing each other."

The PHAK continues: "In aircraft with fixed-position horizontal stabilizers, the aircraft manufacturer sets the stabilizer at an angle that provides the best stability (or balance) during flight at the design cruising speed and power setting.

"If the aircraft's speed decreases, the speed of the airflow over the wing is decreased.... In turn, the characteristic nose heaviness is accentuated, causing the aircraft's nose to pitch down more. This places the aircraft in a nose-low attitude, lessening the wing's AoA and drag and allowing the airspeed to increase." If the aircraft's nose-low attitude is maintained, its speed will increase, creating greater downforce and raising the nose.

