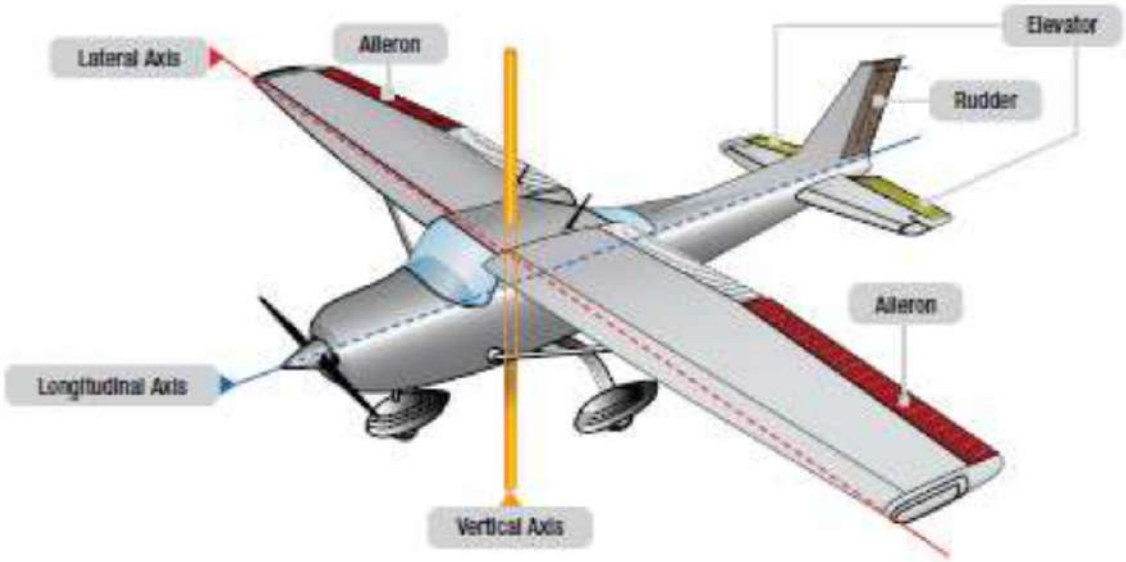
Sub module 8.4 – Flight stability and Dynamic

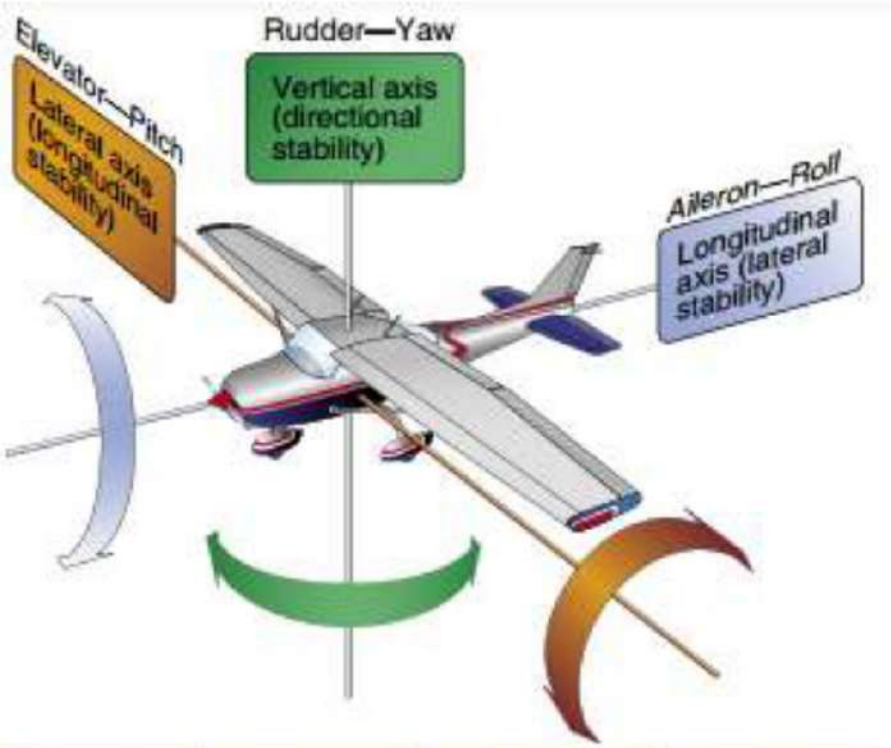
✓ Content

1. Stability

1.1 Introduction

Three axis of an aircraft





Primary Control Surface	Airplane Movement	Axes of Rotation	Type of Stability
Aileron	Roll	Longitudinal	Lateral
Elevator/ Stabilator	Pitch	Lateral	Longitudinal
Rudder	Yaw	Vertical	Directional

✓ Stability

- The stability of an airplane means its ability to return to some particular condition of flight (after having been slightly disturbed from that condition) without any efforts on the part of the pilot.

✓ Instability

- An oscillation which steadily grows worse. Even this is not so bad as the case when an aeroplane makes no attempt to return but simply departs farther and farther away from its original path. That is complete instability.

✓ Stick fixed condition

- stick-fixed means that the elevators are held in their neutral position relative to the tail plane,

✓ stick-free conditions

- stick-free means that the pilot releases the control column and allows the elevators to take up their own positions.

1.2 LONGITUDINAL STABILITY (PITCHING)

- Longitudinal stability is the quality that makes an aircraft stable about its lateral axis.

- We shall start with **longitudinal stability**, since this can be considered independently of the other two.
- In order to obtain stability in pitching, we must ensure that if the angle of attack is temporarily increased, forces will act in such a way as to depress the nose and thus decrease the angle of attack once again.

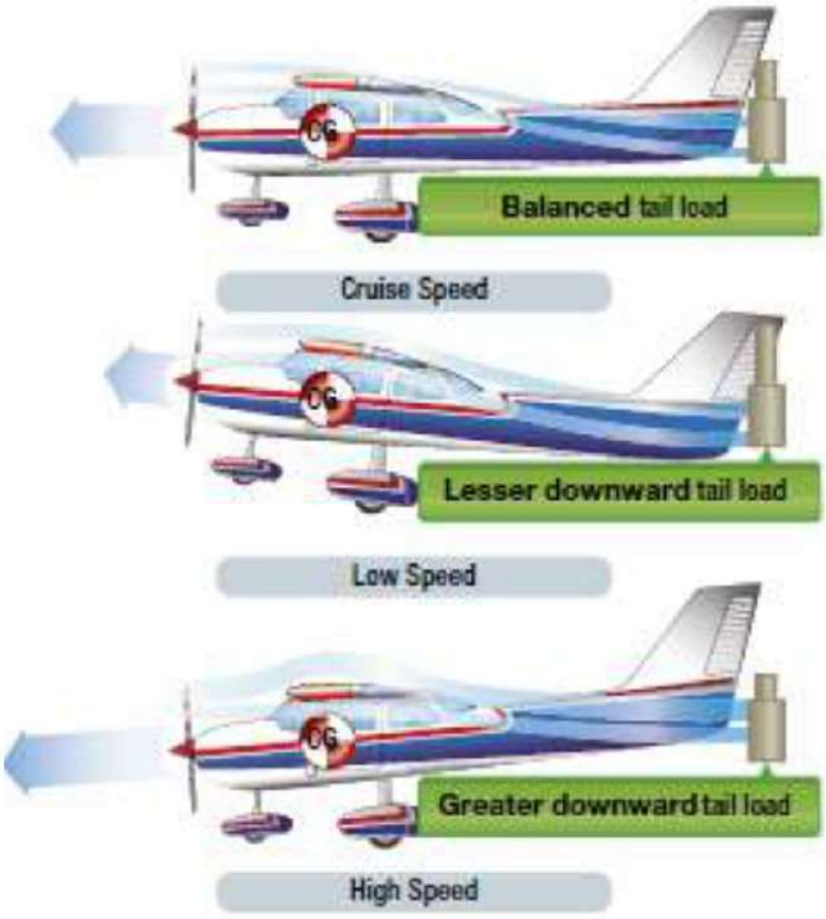
- The position as regards the wing itself can be improved to some extent by **sweepback**, by **wash-out** (i.e. by decreasing the angle of incidence) towards the wing tips, by **change in wing section** towards the tips (very common in modern types of aircraft), and by a **reflex curvature** towards the trailing edge of the wing section.

- But it is not only the wing that affects the longitudinal stability of the aircraft as a whole, and in general it can be said that this is dependent on four factors –

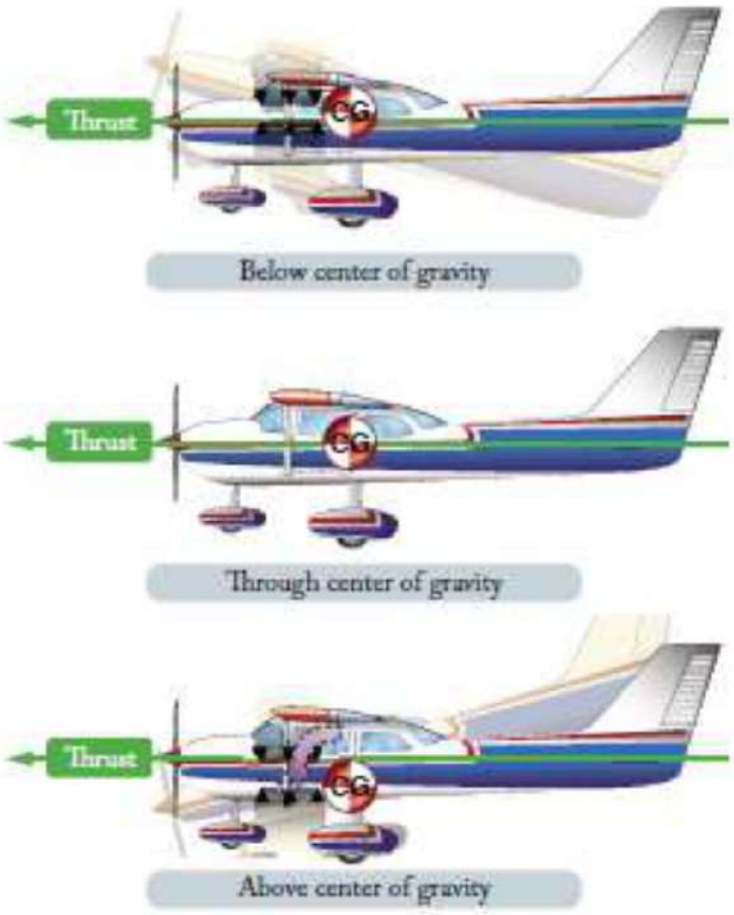
1. **The position of the Centre of gravity**,
2. **The pitching moment on the main planes**
3. **The pitching moment on the fuselage** or body of the aeroplane
4. **The tail plane**

- Most aircraft are designed so that the wing's CL is to the rear of the CG. This makes the aircraft "nose heavy" and requires that there be a slight downward force on the horizontal stabilizer in order to balance the aircraft and keep the nose from continually pitching downward.

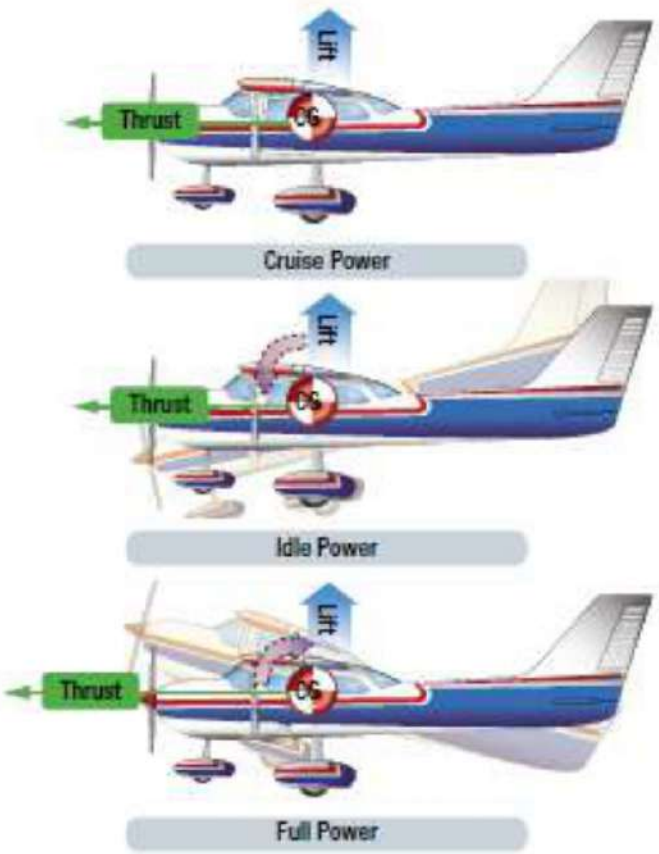
Effect of speed on downwash.



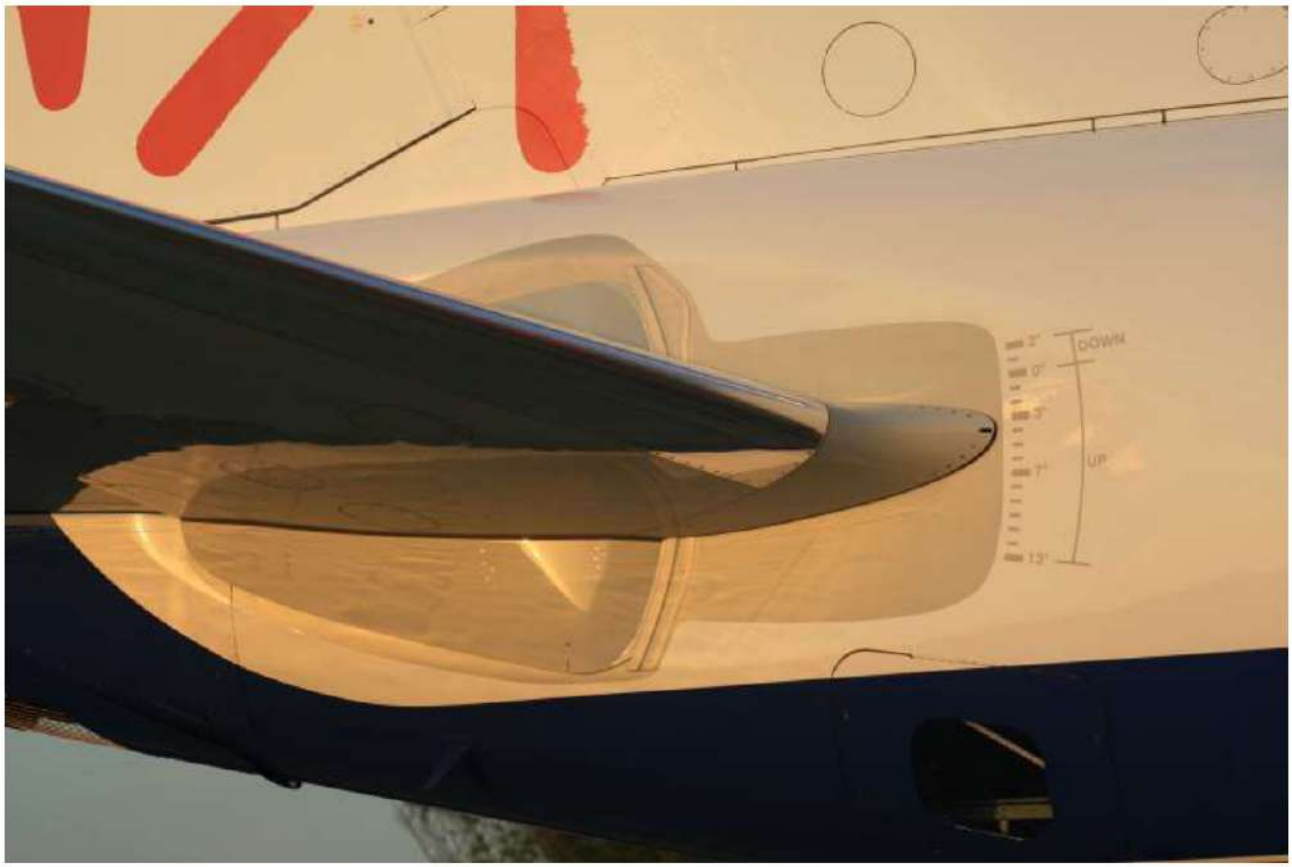
Thrust line affects longitudinal stability.



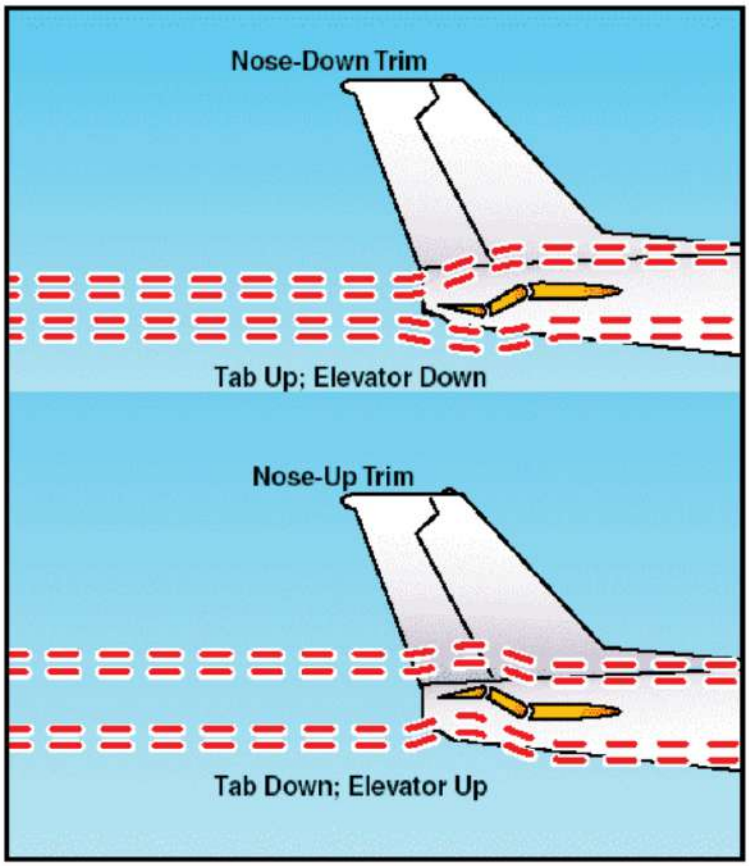
Power changes affect longitudinal stability.



Adjustable H. stabilizer



Trimming


Nose-Down Trim
Tab Up; Elevator Down
Nose-Up Trim
Tab Down; Elevator Up