
Module-2

Lecture-4

Introduction to Performance of Flight and Experiments

Performance of flight

Module Agenda

- **Aerodynamic nomenclature used for flight performance**
- **Definition of forces, in steady and symmetrical straight line flight**
- **Cruise flight**
 - Thrust and power required*
 - Thrust and power available*
 - Maximum flight velocity*
 - Altitude effects on power available and power required*
 - Range and endurance.*
- **Climb performance**
 - Maximum angle of climb*
 - Maximum rate of climb*
 - Altitude effects on power available and power required*
- **Estimation of profile Drag coefficient (C_{D_o}) and Oswalds efficiency (e) of an aircraft from experimental data obtained in steady and level flight.**

Aerodynamic nomenclature used for flight performance

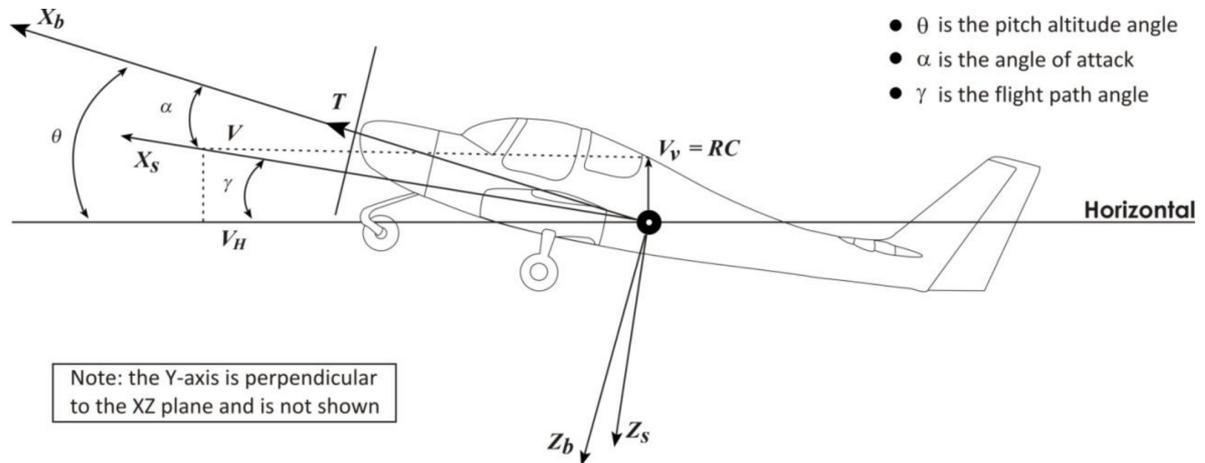


Figure 1: Definition of angles, axes and velocities in steady, symmetrical and straight line flight

V	Air relative velocity of airplane
X_b	Body fixed X -axis (Along fuselage reference or chord line)
X_s	Stability axis X -axis (X_s -axis align along the air relative velocity)
Z_b	Body fixed Z -axis
Z_s	Stability axis Z -axis
α	Angle of attack, defined as the angle between X_b and the horizon
θ	Airplane pitch attitude angle, defined as the angle between X_b and the horizon
γ	Flight path angle, defined as the angle between V and the horizon
V_v	Vertical-velocity component, also known as the rate-of-climb
V_h	Horizontal-velocity component
ϕ_T	Thrust force inclination, defined as the angle between X_b and the thrust line of action (ϕ_T is Zero in Figure 1)
RC	Rate of Climb

Definition of forces, in steady and symmetrical straight line flight

In flight an airplane, can be said to be under the influence of four main forces:

1. The Lift, L , acting vertically upwards and is perpendicular to the air relative velocity.
2. The Weight of the airplane, W , acting vertically downwards through the centre of gravity.
3. The Thrust T , delivered by the engine or engine(s).
4. The Drag, D , acting in the direction opposite to the air relative velocity.

These forces are depicted in Figure 2.

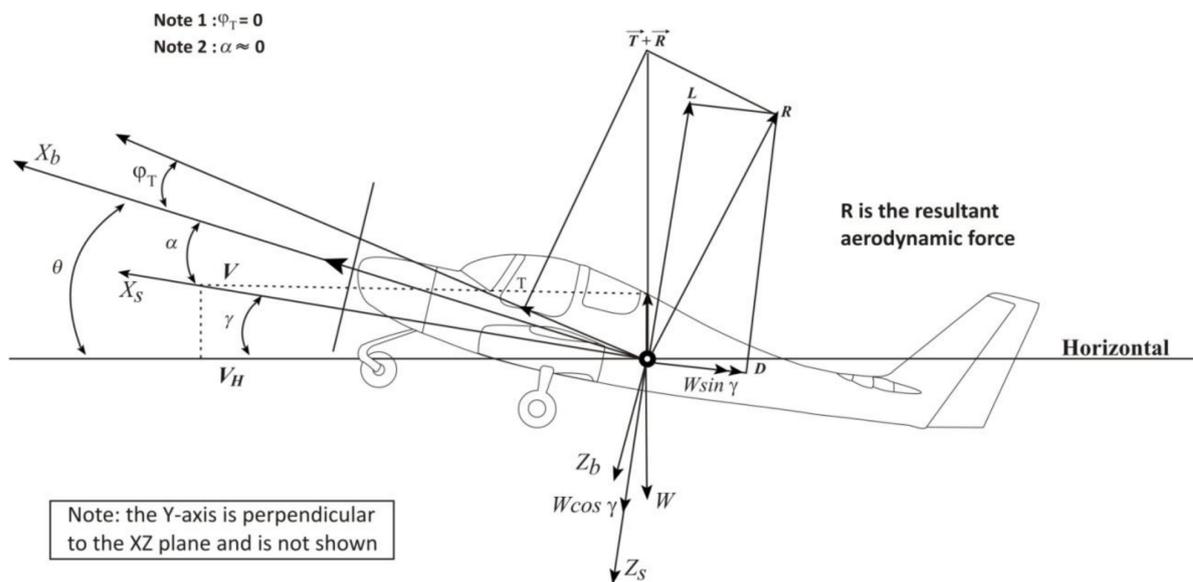


Figure 2: Definition of forces in steady, symmetrical and straight line flight