Gliding Australia Training Manual

Pilot Guide

Unit 4

Orientation and Sailplane Stability

Unit 4 - Orientation and Sailplane Stability

WHAT THIS UNIT IS ABOUT

To:

- develop the knowledge and skills required to orient yourself in the three- dimensional flight environment in the local area;
- gain an awareness of the glider's inherent stability; and
- develop an understanding of terminology to be used in future training units.

WHAT ARE THE PRE-REQUISITES FOR THIS UNIT?

- GPC Unit 3 Pre-flight Preparation.

COMPLEMENTARY UNITS

- Theory Course TL1

KEY MESSAGES

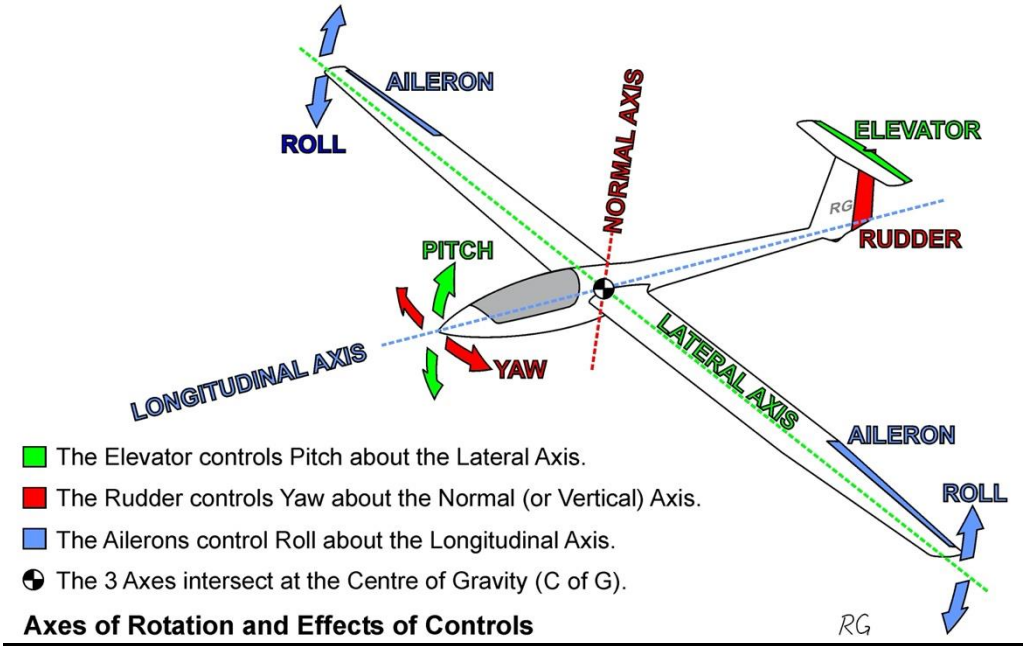
- Lookout and Visual orientation in the air is an essential skill.
- The horizon is our primary attitude reference.
- The glider is a stable platform; it will fly hands off at a particular attitude, in a straight line or shallow bank angle.

PILOT GUIDE FOR THIS UNIT

Your instructor will show you that modern gliders are designed to be both stable and controllable. Stability can be explained as follows. If a glider is in straight and level flight and the pilot takes his hands and feet off the controls, the glider will fly on by itself, and if disturbed, the glider will tend to recover automatically. If the glider is disturbed by a gust or turbulence, it also tends to return to a stable trim or speed without any input from the pilot.

Glider Stability

We now need to know how the aircraft flies and its controls. Below is a diagram of the flight controls and axes of rotation.



- There are three axes of control. We can control the glider in the pitching plane, about the lateral axis between the wingtips, where the nose goes up and down.
- We can control the glider in the rolling plane, about the longitudinal axis between the nose and tail, where the wings are banked left or right.
- We can control the glider in the yawing plane, about the vertical axis up and down, where the nose moves left or right.
- The glider has some positive stability in pitch; the nose will gradually return to a normal flying attitude.
- The glider has neutral or positive stability in roll; the wings will tend to remain at a constant bank angle until disturbed.
- The glider has strong yaw stability; the nose will move quickly back to the direction of flight.
- The glider is controlled in the pitching plane with elevator, in the rolling plane with aileron, and in the yawing plane with rudder.

Attitude

- The elevator is the only speed control on a glider. As a glider's speed changes, you may notice a change in noise level in a training two -seater but in a high-performance glider the change in air noise may be slight.
- The airspeed indicator inside the cockpit will tell how fast the glider is flying but as your flying progresses, you will notice most of your time will be spent looking outside when manoeuvring the glider so we need an alternative source of airspeed indication.
- Your instructor will show you that as the glider pitches nose up or nose down under the control of the elevator, the distance between the horizon and the nose changes very visibly. This change has a direct relationship to your airspeed.
- The position of the nose of the glider relative to the horizon, or more correctly, the angle of the glider's fuselage to the horizon is known as "Attitude".

- It is this “attitude” that glider pilots use to determine their airspeed.

See Figure 7 below.

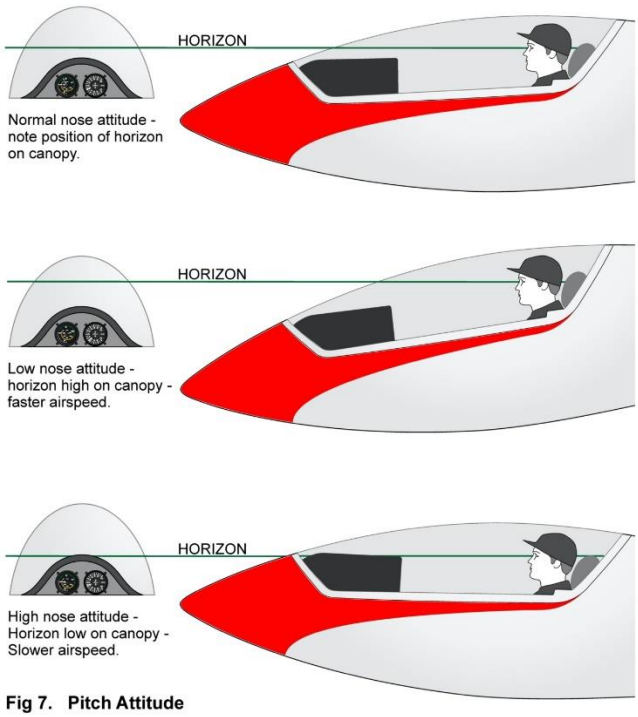
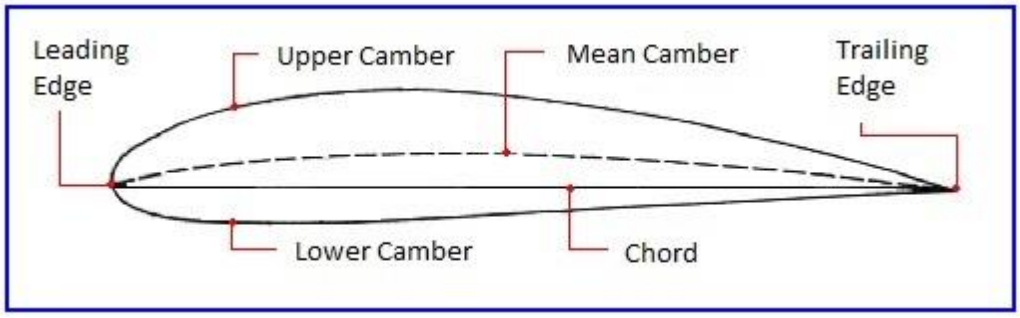


Fig 7. Pitch Attitude

Lift

The diagram below shows a cross section (aerofoil) of the wing of the glider.



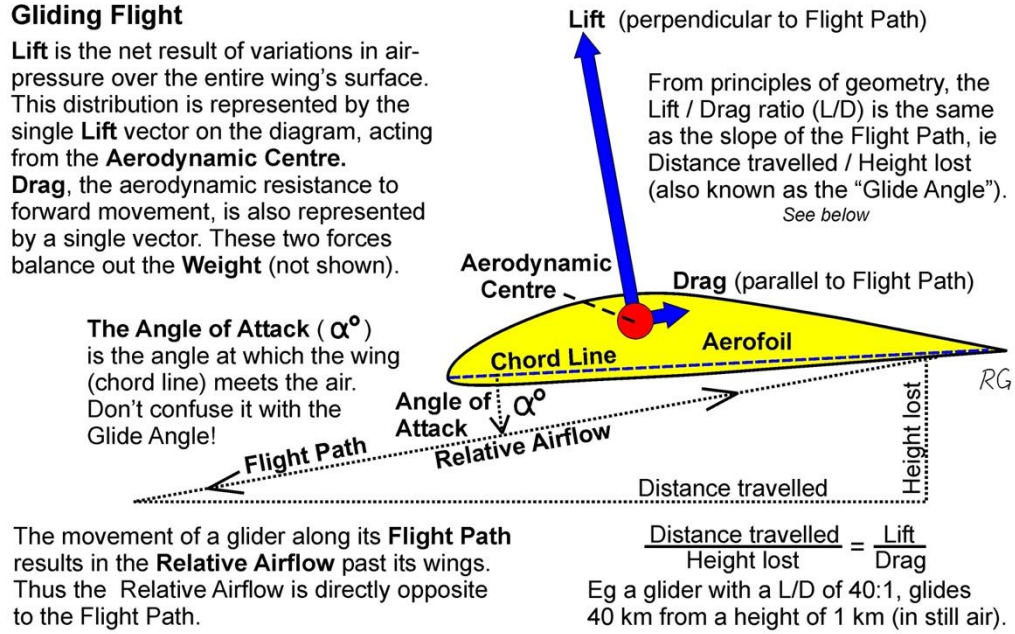
A wing produces lift in a number of different ways.

- The actual shape of the wing encourages a speeding up of the airflow over the cambered top surface. This in turn results in a lowering of the pressure over the top of the wing (Bernoulli's theory), in effect causing a “suction” upwards. Generally speaking, the thicker the wing and the more pronounced the camber, the more lift will be produced at a given speed.
- Lift is a reaction force and an aerofoil deflects the air as it passes. Since the aerofoil must exert a force on the air to change its direction, the air must exert a force of equal magnitude but opposite direction on the foil (Newton's laws of motion).

- Speed of the wing through the air is also a factor; the faster the speed, the more lift is produced.
- The angle at which the wing meets the air also plays a part. This angle, known as the Angle of Attack (AoA), has an important effect on the amount of lift produced by the wing.
- A symmetrical aerofoil will generate zero lift at zero angle of attack. But as the angle of attack increases, the air is deflected through a larger angle and the vertical component of the airstream velocity increases, resulting in more lift. For small angles a symmetrical aerofoil will generate a lift force roughly proportional to the angle of attack.

The diagram below shows the terminology used when explaining the lift and drag forces when flying.

Your instructor will enlarge on this diagram before you go flying.



FLIGHT EXERCISES FOR THIS UNIT

- As this will be your first flight your instructor will point out the local features, including the airfield. This will include the boundaries of the local flying areas which can be identified by maps and charts.
- The instructor will also show you how far the glider can travel from the airfield and safely return to give you an appreciation of the glide angle.
- It's also important to notice how stable the aircraft is when flying. You will also have your first feel of the controls but the main purpose is to enjoy the experience of glider flying.

THINGS YOU MIGHT HAVE DIFFICULTY WITH

As its your first flight and the aircraft will be turning you may lose your bearings.

To overcome this, keep your head outside the cockpit and keep track of a prominent feature such as a town or your airfield.

HOW DO YOU DEMONSTRATE COMPETENCE?

In your next few flights you will be able to identity key landmarks, and demonstrate a relaxed control of the glider.

RESOURCES & REFERENCES

Australian Gliding Knowledge pages 35-42

Theory Lesson 1 – Orientation and Stability section