

# Attitudes and Movements

In this exercise you will learn the range of attitudes through which the aircraft will normally be operated and how the movements necessary to achieve and maintain the desired attitudes of flight are produced and controlled. Some of these matters may appear complicated on paper, but you will gain understanding very quickly when they are demonstrated in the air.

## Look-out

Now that flight training has begun in earnest, start observing this rule: *look around*. For safety in flight, *keep alert for other aircraft*. Look continually. Realize that there is a blind spot beneath your aircraft and never assume that others see you. Be especially alert during periods of nose-up attitudes of your aircraft, when the blind spot enlarges due to a decrease in forward visibility.

A pilot must be constantly on the look-out for other aircraft and must keep up a continuing search of the sky. It is commonly believed that the eye sees everything in its field with equal clarity. This is not so. Fix your gaze about 5 degrees to one side of this page, and you will no longer be able to read the printed material. Studies have revealed that the eye perceives very poorly when it is in motion. Wide sweeping eye excursions are almost futile and may be a hazard, since they give the impression that large areas of sky have been examined. A series of short, regularly spaced eye movements is recommended for maximum efficiency in searching the sky.

## Transfer of Control

During flight training there must be a clear understanding, between the student and the flight instructor, of who has control of the aircraft at a given moment. Whoever is handing over control should say in clear

tones, "You have control." This should be immediately acknowledged by the words, "I have control." When the flight instructor wishes to take over control of the aircraft, the instructor does so and at the same time says, "I have control." The student acknowledges immediately by saying, "You have control."

## Attitudes

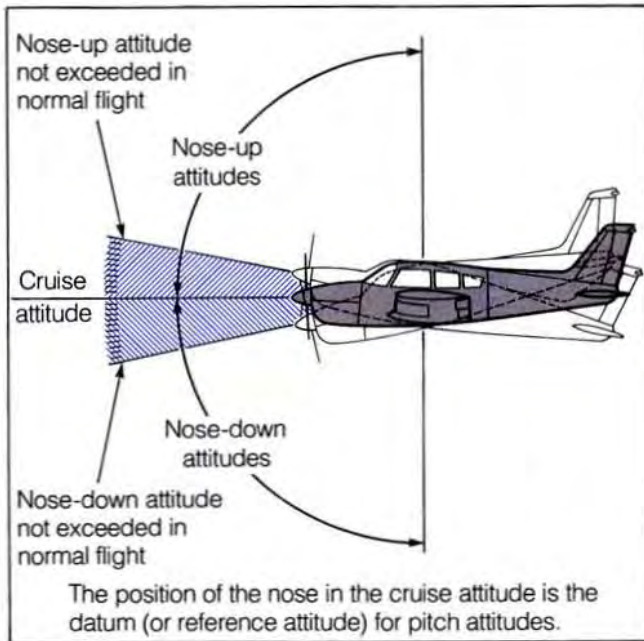
The basic attitude of an aircraft is termed a *cruise attitude*. Cruise attitude is the datum (reference point) to which all other attitudes of flight are related. It can be defined as the aircraft attitude for level flight at a constant altitude and airspeed, using a recommended cruise power setting, with the wings parallel to the horizon. All attitudes are considered as being relative to the horizon.

The attitudes of flight may be broken down into two groups:

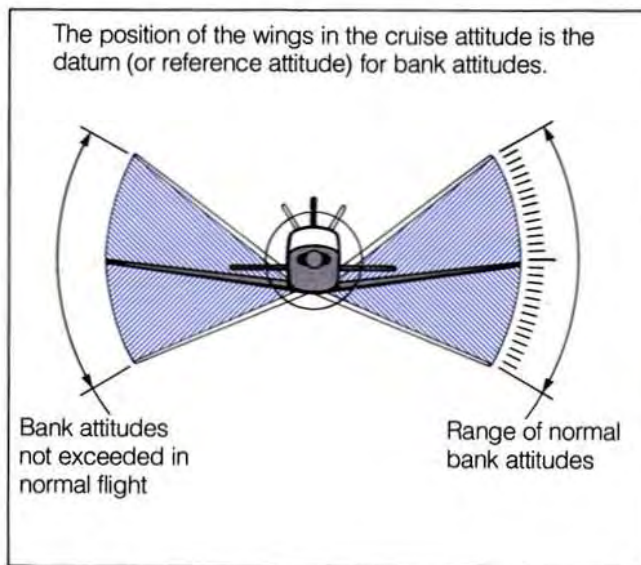
**Pitch Attitudes.** Any attitude of the nose of the aircraft above or below the reference datum. Fig. 2-7 illustrates a range of pitch attitudes above and below the reference datum and indicates the approximate attitude limits for this stage of training. The attitudes above the datum are termed "nose-up attitudes," and those below, "nose-down attitudes."

**Bank Attitudes.** Any attitude of the wings of the aircraft when inclined relative to the datum. Fig. 2-8 illustrates a range of bank attitudes relative to the reference datum. The illustration indicates the approximate bank attitude limits for this stage of training.

The airspeed for flight in the cruise attitude selected should be noted, as it will be referred to when nose-up and nose-down attitudes are demonstrated. The other flight instruments will be referred to frequently. If you have an appreciation of the performance of your aircraft by reference to flight



**Figure 2-7 Pitch Attitudes**



**Figure 2-8 Bank Attitudes**

instruments, as well as by outside reference, you will develop from the start the habit of monitoring your own and the aircraft's performance continuously.

### Handling the Controls

During the air exercises the position of the feet, when applying pressure to the rudder pedals, should be comfortable, with most of their weight supported by the heels in contact with the floor, thus allowing a fine sensitivity of touch with the toes. The control column should be held firmly but lightly with the fin-

gers, not grabbed and squeezed. Apprehension and tension may result in a tendency to choke the control column. Developing such a habit destroys "feel".

### Control Response

The amount of control movement required to achieve a desired flight response depends to a great extent on the speed of the air flowing over or past the ailerons, elevators, and rudder. The cruise attitude airspeed may be considered the design datum for control effectiveness; at speeds above cruise speed, the controls become firmer, and there is a greater reaction to equivalent control movement. At lower cruising airspeeds, the controls become more yielding and less effort is needed to move them, but relatively more control movement may be needed to achieve an attitude change. The ailerons, being outside of the propeller slipstream, react consistently with airspeed changes, but the elevators and rudder do not (except in a power-off descent). Since the elevators and rudder are in the propeller slipstream, they will remain sensitive to control movement. This sensitivity increases with increase of power more or less independently of airspeed in the low ranges, until the cruise attitude airspeed is reached. In a power-assisted descent at a low airspeed, the aileron control will require relatively coarse movement, whereas elevator and rudder control movements will remain relatively fine to achieve the desired control response.

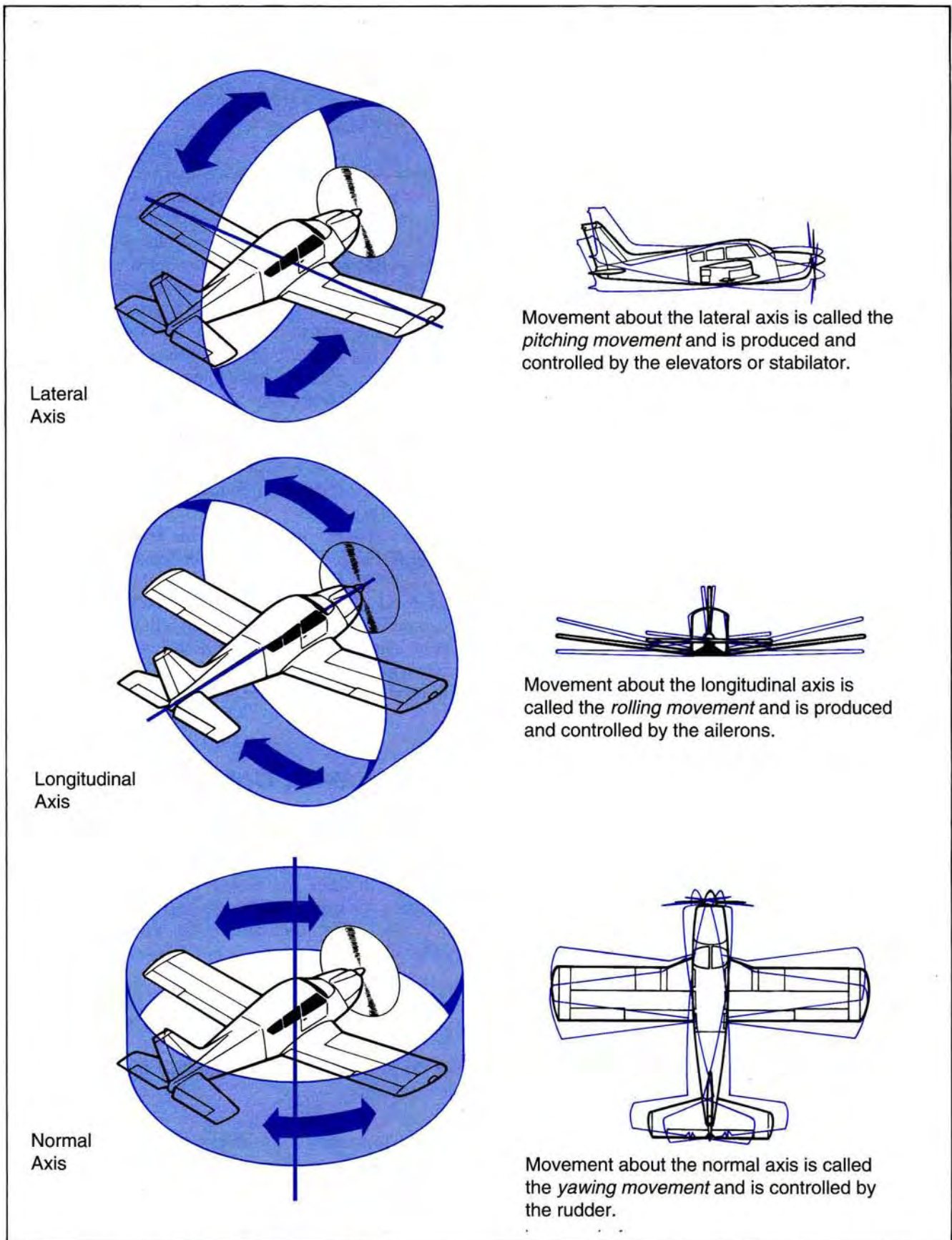
## Movements, Controls, and Axes

The fundamental consideration is the method of control of the three movements of the aircraft. In any aircraft all three movements are around one central fulcrum, the Centre of Gravity, and they can be defined relative to the pilot and/or the aircraft as follows (Fig. 2-9):

1. **Pitching:** any movement around the lateral axis.
2. **Rolling:** any movement around the longitudinal axis.
3. **Yawing:** any movement around the normal (vertical) axis.

These movements are always relative to the aircraft and the pilot, regardless of the aircraft's position relative to the horizon. This may be difficult to visualize here but will become apparent in flight.

The three movements of an aircraft (Fig. 2-9), pitching, rolling, and yawing, are governed by the



Lateral Axis

Movement about the lateral axis is called the *pitching movement* and is produced and controlled by the elevators or stabilator.

Longitudinal Axis

Movement about the longitudinal axis is called the *rolling movement* and is produced and controlled by the ailerons.

Normal Axis

Movement about the normal axis is called the *yawing movement* and is controlled by the rudder.

Figure 2-9 Aircraft Axes and Movements

three controlling surfaces — elevators, ailerons, and rudder. The elevators are used to produce and control the pitching movement required to achieve and maintain the desired pitch attitudes. The ailerons are used to produce and control the rolling movement required to achieve and maintain lateral level and bank attitudes. The rudder is used to control yawing movement.

Yaw may occur adversely for many reasons: turbulence, power changes, or misuse of rudder. Failure to control yaw may cause the aircraft to slip or skid and ultimately roll; therefore, control of yaw is very necessary to maintain co-ordinated flight.

The following statements concerning the flight controls will be true regardless of the position of the aircraft relative to the earth.

1. When backward pressure is applied to the control column, the nose pitches up.
2. When forward pressure is applied to the control column, the nose pitches down.
3. When the aileron control is moved to the right, the aircraft rolls to the right.
4. When the aileron control is moved to the left, the aircraft rolls to the left.
5. When the left rudder pedal is pushed, the nose yaws to the left.
6. When the right rudder pedal is pushed, the nose yaws to the right.

## Inertia

An aircraft possesses inertia. It tries to continue on its original path even when forces are introduced to change that path. Thus when the controls are moved there may be a slight lapse of time before the flight path changes, even after the attitude has been altered. The attitude of the aircraft is always referred to as relative to the horizon. The horizon referred to is the earth's natural horizon, but the inference also includes the horizon bar of the attitude indicator.

## Flight Instrument Indications

During the pitch and bank demonstrations, the instructor will ask you to observe the indications of certain flight instruments.

When the aircraft is pitched into a nose-up attitude,

1. Airspeed decreases.
2. The miniature aircraft will be above the horizon bar of the attitude indicator.

When the aircraft is pitched into a nose-down attitude,

1. Airspeed increases.
2. The miniature aircraft will be below the horizon bar of the attitude indicator.

When the aircraft is rolled into a banked attitude for a turn,

1. The miniature aircraft will indicate a bank in relation to the horizon bar on the attitude indicator.
2. The heading indicator shows a change in direction.
3. The turn-and-bank indicator needle will be deflected in the direction of the turn; if the turn is co-ordinated, the ball will be centred.

When the aircraft is pitched up or down while banking left or right, the instrument indications will be a combination of those indicated during the individual attitude demonstrations. For example, should the aircraft be pitched into a nose-down attitude while in a co-ordinated bank to the left:

1. The airspeed will increase.
2. The miniature aircraft will be below and banked to the left in relation to the horizon bar of the attitude indicator.
3. The needle of the turn-and-bank indicator will be deflected to the left, and the ball will be centred.
4. The heading indicator will show decreasing degrees of heading.
5. The altimeter will show a constant decrease in altitude.

This is your first real training exercise. Many new and relatively strange events seem to be occurring rapidly. Even after the exercise has been demonstrated in the air, there are bound to be things you do not fully understand. This is perfectly natural, so do not hesitate to question your flight instructor concerning areas that still appear vague to you.

At a certain stage you may feel that you cannot do anything right, that you lack co-ordination and comprehension, that you aren't learning anything. All students go through this stage. Stay determined and you will discover that learning comprehension and co-ordination will sharpen as you become more familiar with the aircraft and the environment in which it operates.