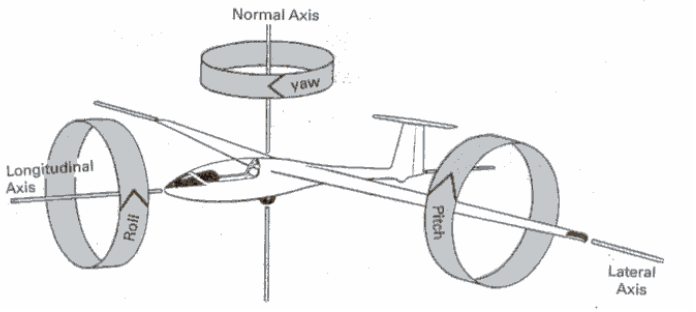
EFFECTS OF CONTROLS (PRIMARY)

Aim: To learn the primary effects of the flight controls.

Wow…our first practical, hands on, go at flying…YIPPEE. Flying is easy and fun so we shall aim to get you controlling the glider after a brief introduction to the flight controls used to fly the glider. Let's take a look at how we do it…how we fly it.

Our glider is equipped with flight controls that we as pilots use to manoeuvre and control the glider both on the ground and in the air. The glider can be controlled in 3 dimensions with movements about 3 defined axis as shown here.

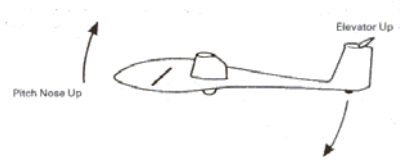


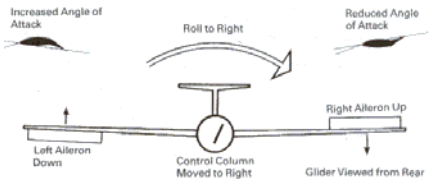
Note that each axis sits at 90° to the other 2 and all pass through the glider's Centre of Gravity (C of G).

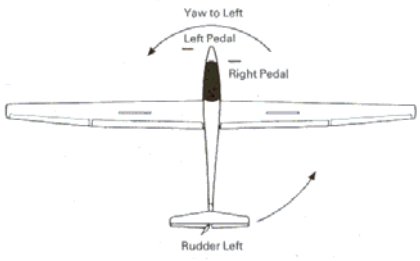
Flight Controls:
The 3 main flight controls; the Elevator, the Ailerons and the Rudder, are those used to manoeuvre and control the glider about the 3 axis as follows:

Control	Movement	Axis	Effect
Elevator CC forward / aft	Pitch Nose down / up	Lateral	pitches to a lower nose attitude, glider speeds up pitches to a higher nose attitude, glider slows down
Aileron CC left / right	Roll Bank left / right	Longitudinal	glider rolls into a banked attitude & turns left glider rolls into a banked attitude & turns left
Rudder Pedals left / right	Yaw Nose left / right	Vertical	glider yaws left and skids along sideways glider yaws right and skids along sideways

How the Controls Work:
Each control surface enables a variation in the camber of the airfoil which generates aerodynamic force over the area of the control in a particular direction. This change in the balance of forces generates the response about a particular axis as shown in the diagrams below.







Elevator **Aileron** **Rudder**

Control Feel, Responsiveness and Effectiveness:

We see from the table above the effect of each control as it is applied but there are a few other things to consider when talking *control feel, responsiveness* and *control effectiveness,* all terms used when describing handling and control of gliders. All three are influenced by the speed of the airflow over the gliders control surfaces, the rate of application and the amount of control input applied.

At low speed, the controls
- feel lighter and easier to apply inputs
- are less responsive to our input
- are less effective for the same amount of input

At higher speed, the controls
- feel heavier and require more force to apply inputs
- are more responsive to our input
- are more effective for the same amount of input

Applying the control at a slow rate
- we get a slow response

Applying the control at a quick rate
- we get a quick response

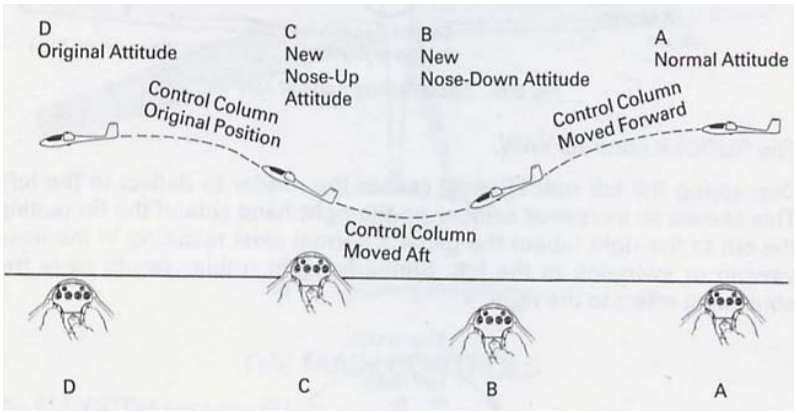
Applying a small amount of control input
- we get a small / slower response

Applying a large amount of control input
- we get a large / quicker response

The most effective control is the elevator; gliders are relatively sensitive in pitch. The ailerons make rolling the next most sensitive control and the rudder is considered the least sensitive control of the three primary controls. The manufacturers design the controls this way to give the best control feel and harmonization for the pilot.

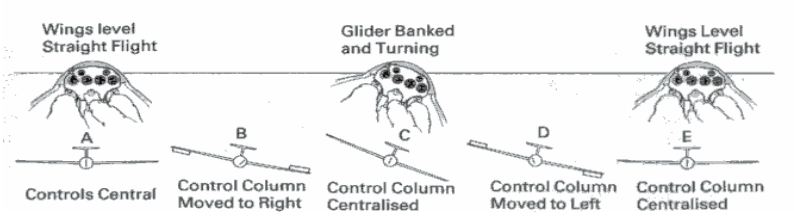
Air Exercise:
Your instructor will complete the launch and establish the glider in a steady glide at 45 knots. They will show you that the glider can fly itself in a steady glide and that we as pilots only apply a control input when we want to manoeuvre or to correct any displacement from an outside cause like turbulence. They will point out the *normal gliding attitude* for this speed by making reference to the position of the glider's nose in relation to the horizon ahead. You will be asked to *follow through* on the controls so when inputs are made, you can feel the rate and amount of control input and see the effect and response of the input.

The first demo will be controlling pitch using the elevator to vary our pitch attitude. Easing the control column forward pitches the nose down to a lower nose attitude. The glider accelerates and the noise changes as the speed increases. Note that only small inputs are required to pitch to a new attitude and once held, the glider stabilizes at this new attitude at a higher speed. Easing the control column back pitches the nose up; the glider decelerates, the noise reduces and we settle at a new attitude, a high nose attitude relative to our original normal gliding attitude.

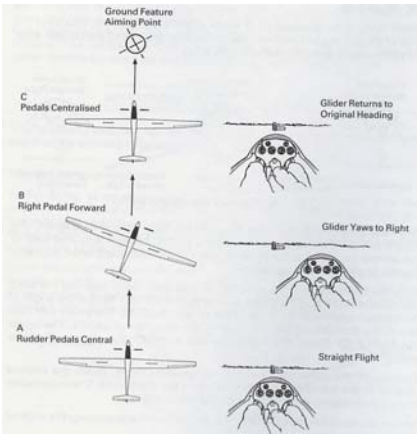


The next demo is rolling the glider using the ailerons to give us a *banked attitude*. We move the control column to the left and the glider rolls to the left; we see the left wing go down and the right wing go up to give us a banked

attitude to the left. Note that the glider will continue to roll whenever aileron is applied so to maintain a particular banked attitude, we need to return the control column to the centre. Note the angle of the horizon to the nose of the glider; it is no longer symmetrical. When the glider is banked, it turns in that direction.
Applying aileron by moving the control column to the right rolls the glider back towards the wings level normal gliding attitude. Again, we centralize the control column when we get the wings level and the glider flies straight.



Now lets see what the rudder does. We pick a point ahead on the horizon as a reference so we can see what happens. Follow through as left rudder is applied by moving the left pedal forward (allowing the right pedal to come back towards us) and see the nose of the glider yaws or swings to the left.
The glider then skids along slightly sideways while still flying towards our point. Centralising the rudder sees us yaw back to the right till we are again pointing at our reference point ahead on the horizon.



Rudder doesn't turn the glider in flight… so what does it do? We will see in following exercises that it is used to assist the primary turning control, the aileron, by coordinating its application to ensure we maintain balanced flight as we roll to a banked attitude. That mouthful will become clearer…trust me!

You will be given control of each control and asked to try some control inputs. Make control inputs smoothly and deliberately and look for the effect and response.

Horizon and Attitude
We use the horizon as a convenient reference to see the response to control inputs but it is important to understand that the controls work relative to the glider and us in it. This is best understood by thinking of the movements when the glider is banked say at 90°… pulling back on the control column pitches the nose up relative to us inside the glider… but does not move the nose up relative to the external horizon… it appears to move across the horizon. Go further to have the glider upside down…pulling back pitches the nose up relative to us inside the glider but will take it below the external horizon! But hey… we aren't into aerobatics yet… but do remember that the controls work relative to **us** and that the horizon is only a convenient reference when talking attitudes.

Other Controls:
The other controls includes things like the Trim, Airbrakes, Flaps, Undercarriage etc which all effect the gliders handling and performance will be dealt with in separate exercises.

Tips:
This is our first lesson on controlling the glider. There is quite a bit to see and take in. We will often refer back to this very basic exercise as we learn more about how to fly the glider. This is the crux of being the pilot in control and ultimately in command of the glider, determining how it is flown safely, efficiently and effectively.

We will be handing over / taking over control a fair bit…ensure you know how to do this to avoid any confusion so you can concentrate on the exercise.

During the launch and after the main lesson, take time to relax and practise your lookout and orientation. Take in the sights; ask questions… enjoy being airborne while most others are left earthbound!!…have fun.

Need To Know:

- How a control works.
- The effect of any control input.
- The terminologies and jargon used when talking about effect of control.

Further Reading:

- The Glider Pilot's Manual; by Ken Stewart. Pg 36. All about the effects of controls.