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| The CIX VFR Club | Flight Training Notes | Exercise 4b |
| For Simulation Purposes only. Not to be used for real World flight | SECONDARY EFFECT OF CONTROLS | Issue 1.1 13/05/07 |

1 INTRODUCTION

This series of tutorials for the CIX VFR Club are based on real world flight training. Each document focuses on a small part only of the necessary skills required to fly a light aircraft, and by echoing real world training, you will be a better Flight Simulator pilot and get more enjoyment out of the hobby as a result.

These tutorials are written specifically for the Flight Simulator Default Cessna 172. Some details will be different for other aircraft.

You should read Exercise 4a before continuing with this tutorial.

2 A TILTING SITUATION

When an aircraft changes its attitude relative to one axis, the forces acting on it are no longer acting in the same direction as when it is flying straight and level. In a bank, for example, – the normal axis is no longer vertical, but inclined at the same angle as the angle of bank.

2.1 The Secondary Effect of Ailerons

When the aircraft banks, it will turn (yaw) in the direction of bank because the lift, which remains perpendicular to the wings, is now not equal and opposite to the weight of the aircraft. There is now a component of the lift which is acting horizontally. The aircraft therefore “sideslips” in the direction of this horizontal component. In this sideslip, the air moves across the fuselage and the large area of the tailfin and rudder. The area affected is far greater behind the centre of gravity than in front and the aeroplane will behave like a weathercock. The nose will turn towards the left wing – the aircraft will yaw – in the direction of the bank, although the rudder is held in the central position.

As the aircraft turns about its normal axis (see Exercise 3, paragraph 1.1) the nose will be lowered and the aircraft will tend to descend. In addition, the lift acting vertically to counteract the mass is now less, so the aircraft descends unless prevented by some control input.

The primary effect of ailerons, as we saw in exercise 4a, is roll, and we can now see that the secondary effect of Ailerons is yaw.

2.2 The Secondary Effect of Rudder

If the left rudder pedal is pressed, the primary effect of the rudder will be that the aircraft will yaw left, as we saw in exercise 4a. Under this effect alone, the aircraft would continue to fly in the same direction, but the longitudinal axis would not be aligned along the flight path.

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Now consider a column of marching soldiers turning a corner. The outer troops have to lengthen their stride and travel further than the inner men in order to maintain straight ranks. Similarly with the aeroplane, where, as a result of this left yaw being applied, the right wing will travel further than the left wing, and so the speed of the airflow over it will be greater. The right wing will therefore generate more lift, and the aircraft will bank left. The effect of bank as we have seen above is that the aircraft will turn. Press the right rudder pedal, and the aircraft will yaw right and bank right, and thus turn right.

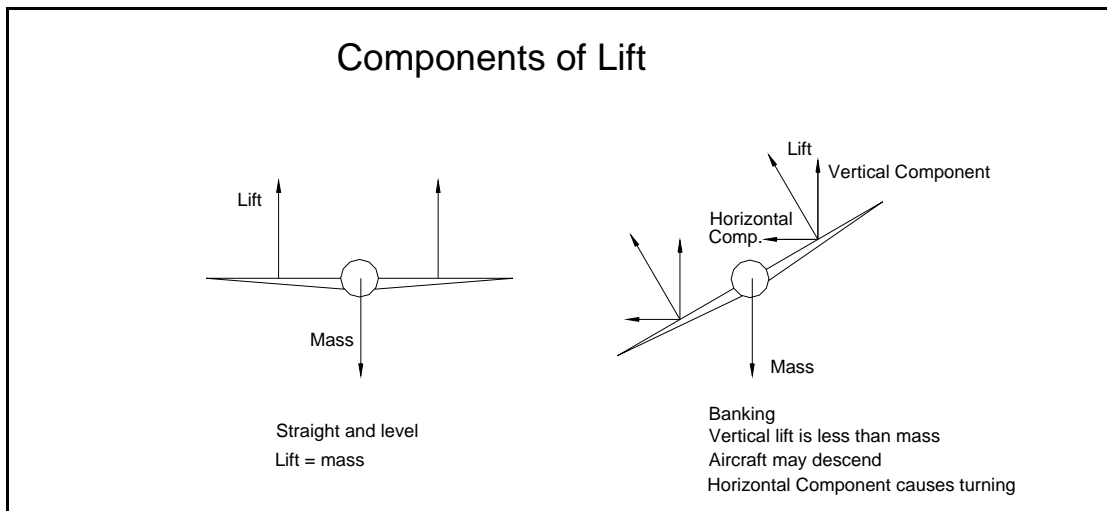


Fig. 1

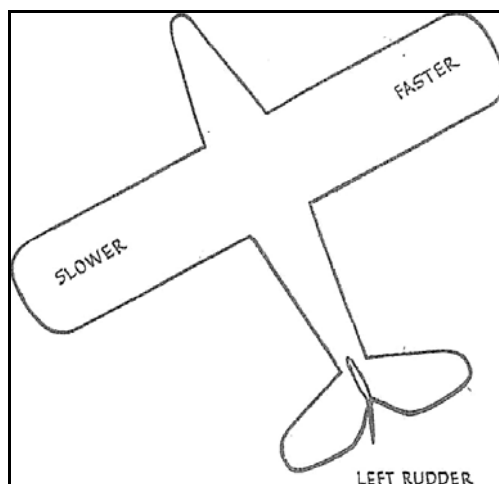


Fig. 2

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The primary effect of rudder, as we saw in exercise 4a, is yaw, and we can now see that the secondary effect of rudder is roll (Fig 2). The turning effect induced by the roll can be used in flight. Small changes of direction can be made using rudder alone, keeping the yoke in its neutral position. The effect is limited, and if too great an angle of bank results, rudder alone will not recover the wings to level.

In Flight Simulator the amount of turn possible using rudder alone is less than in real life.