Theory Brief 4: Turning

Aim:

"To turn the aircraft with minimal height change, in balance, by the coordinated use of aileron and rudder."

Objectives

1). Maintain constant altitude whilst turning left and/or right at an angle of bank not exceeding 30 degrees.

2). Recover and / or lose height within the turn to maintain a constant altitude during the turn.

Principles of Flight

The aircraft is designed to fly in straight and level flight when properly trimmed and the aircraft is in equilibrium. In straight and level flight, Lift = Weight and Thrust = Drag.

In the turn, the lift vector is angled so that it no longer supports the full weight of the aircraft, resulting in the nose slipping sideways downwards, and if allowed to continue unchecked, would result in a Spiral Dive.

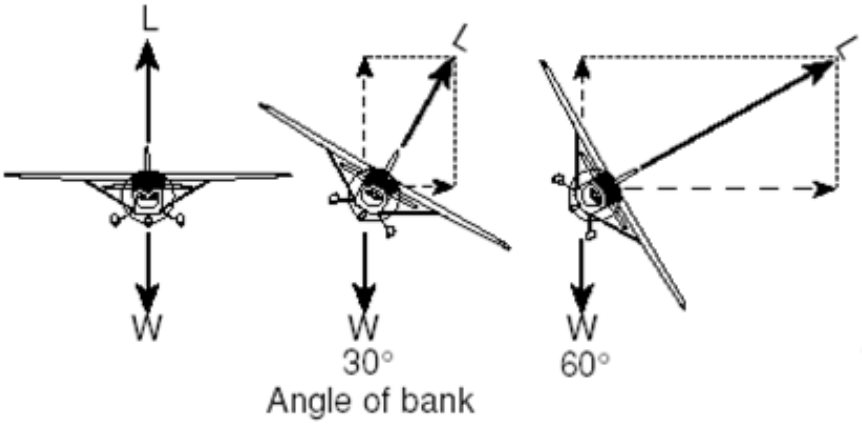
Lift is bought back into equilibrium by gently pulling on the control stick to increase the lift vector, sufficient to prevent any altitude loss.

It is imperative to conduct a lookout prior to the turn so that the pilot may maintain reference to the horizon through the turn to keep the nose at the correct attitude and the angle of bank constant.

Control Input Sequence

1. **ROLL IN TO THE TURN -** to the desired angle of bank using coordinated **AILERON** and **RUDDER**.
2. **CENTRE CONTROLS** - at the desired angle of bank and watch for the **NOSE TO SLIP** - upon noticing the nose commencing to slip downwards,
3. **SLIGHT BACK PRESSURE** - To prevent the nose from slipping further.
4. **AILERON** - To maintain a constant angle of bank.
5. **ROLL OUT OF THE TURN** - back to level flight using coordinated **AILERON** and **RUDDER**.

LIFT REQUIRED FOR LEVEL FLIGHT



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Definition of turning

1. VEERING
   - is changing the direction of the aircraft less than 30° from the current heading
   - A basic lookout is required
2. Turning
   - Is changing direction greater than 30° from the current heading
   - Mandatory Lookout (FULL)

Turning onto a new heading made simple:

1. Orientate yourself – (what direction am I?)
2. Visualise (where do I want to go?)
3. Identify a point (Find a point to turn on to)
4. Turn to a point
5. Confirm new heading with compass (Set S+L – check compass heading)
6. Adjust for minor error (veer to correct any error)

Airmanship

Make a Full and Proper Lookout prior to entering the turn.

1. Ensure stable flight in S+L.
2. Turning Left – Start on Right and when Turning Right –Start on Left
3. Scan slowly to nose of aircraft, above and below horizon (5 – 10 degrees per second)
4. Continue scan to wing tip (and beyond if possible) in the direction of the proposed turn (use a noticeably slower scan rate not more than 5 degrees per second max)
5. Once confirmed area is clear to turn into…..
6. Look over the nose and conduct the turn as trained.

Air Exercise:

1. To instil the discipline of a full lookout prior to turning.
2. To turn the aircraft at 30° Angle of Bank whilst maintaining attitude.
3. To turn onto a cardinal point using compass.

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Additional Information:

Turning onto a cardinal compass heading (N.S.W.E)

A desired compass heading is affected by errors in the compass when we turn.

A compass is only reliable in steady un-accelerated flight.

Compass Theory

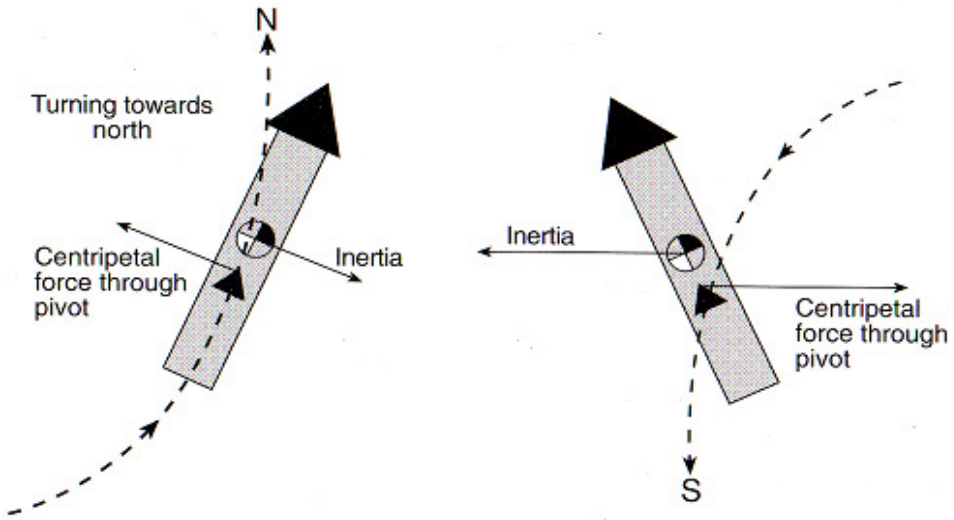

Fig. 4.29 Turning effects

Turning Errors

As an aircraft turns towards north, centripetal force acts inwards through the pivot point (Figure 4.29). Inertia tries to keep the CoG moving in the same direction. Thus the couple exerted causes the card to swing and lag behind the turn. The compass, then, indicates a larger turn than is actually occurring. Therefore, when turning onto north it is necessary to overshoot by about 30° so that when the compass settles down it will read approximately 360°. This means that, when turning from an easterly heading onto north, the turn is not stopped until the compass has passed through north and reads 30° on the other side (i.e. 330°). In turning from west to north the turn is stopped when the compass reads 030°. When turning onto south the opposite occurs and the compass card leads the turn, causing it to indicate a smaller turn than is actually occurring. Therefore it is necessary to undershoot south by about 30° in order to take up a heading of 180° (that is stop the turn at either 150° or 210°).

The need to undershoot or overshoot diminishes as turns onto westerly or easterly headings are approached.

Compass Turns made easy:

Overshoot **N**orth – **U**ndershoot **S**outh (by 30 degrees in a grade 1 turn)

East and **W**est are **OK**

ONUS - EWOK