**Lesson 8**

**Aircraft Stability**

Read: FTGU pages 31, 32

1. Definitions
   1. Stability
      1. How an aircraft reacts to disturbances while in flight
   2. Types of Stability
      1. Dynamic Stability
         1. The overall tendency of an aircraft, when disturbed, to return to its original position
         2. Positive: airplane will return to its position
         3. Negative: airplane will tend to move further away from its position
         4. Neutral: airplane will neither return to its position nor continue to change
      2. Static Stability
         1. The initial tendency of an aircraft, when disturbed, to return to its original position
   3. Inherent stability
      1. Built in characteristics to enable the airplane to be either stable or unstable
   4. Stability may be built into each aircraft axis
2. Longitudinal Stability
   1. Stability of the longitudinal axis *around the lateral axis*
   2. Also known as pitch stability
   3. Affected by:
      1. Size and position of the horizontal stabilizer
      2. Position of the C of G
         1. Too far forward
            1. Required loading on the horizontal tail surfaces to maintain angle of attack increases
            2. Overall weight of the aircraft increases
            3. Stall speed increases
         2. Too far aft
            1. Decreased longitudinal stability because C of G is behind C of P
            2. Violent stall characteristics
            3. Poor stall recovery (very dangerous!)
            4. Stall speed decreases
3. Lateral Stability
   1. Stability of the lateral axis *around the longitudinal axis*
   2. Also known as roll stability
   3. Affected by:
      1. Dihedral
         1. The angle that each wing makes with the lateral axis of the aircraft
         2. The lowered wing will produce more lift due to having a greater angle of attack than the raised wing, and will roll back into place
      2. Keel effect
         1. When disturbed, the weight of the aircraft acts like a pendulum to swing the aircraft back into position
         2. Natural feature of high wing aircraft
         3. Centre of Gravity is below Centre of Pressure
      3. Sweptback wings
         1. Leading edge of the wing slopes backward
         2. When one wing is dropped, the lowered wing produces more lift than the raised wing and the original position is restored
4. Directional Stability
   1. Stability *around the vertical axis*
   2. Affected by:
      1. Vertical tail surface
         1. Airplanes have a tendency to fly directly into the relative airflow due to the vertical tail surface
         2. When disturbed the relative airflow will hit the side of the vertical tail surface and push it back into position
      2. As one wing moves forward, it presents itself at a more perpendicular angle while the other wing presents itself at a less perpendicular angle
         1. The increase in lift also produces an increase in induced drag, reversing the yawing motion

Confirmation:

1. Match the axis with the stability property
   1. Longitudinal Stability
      1. C of G
      2. Horizontal Stabilizer
   2. Lateral Stability
      1. Sweep Back
      2. Keel effect
      3. Dihedral
   3. Directional Stability
      1. Vertical Stabilizer
      2. Sweepback
2. What is the difference between dynamic stability and static stability?
   1. Dynamic stability is the overall tendency of the airplane to return to its original position, while static stability is only the initial tendency
3. How does dihedral affect lateral stability?
   1. The dropped wing has an increased angle of attack and produces more lift
4. How does the vertical stabilizer affect directional stability?
   1. When disturbed, the relative airflow will hit the side of the vertical tail surface and push it back into position