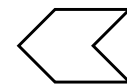




Airplane Flight Controls

THE BACKSEAT PILOT



1

Overview

- **What**
 - Primary flight controls - Ailerons, Elevator, Rudder
 - Hinged movable surfaces attached to the trailing edge of the wings, vertical stabilizer, and horizontal stabilizer
 - When deflected, the surfaces change the camber and AOA of the wing or stabilizer and thus its lift and drag
 - Trim controls – Used to relieve control pressures
 - Flaps – Secondary flight control, creates a compromise between high cruise speed and low landing speed
- **Why**
 - Understanding the effects each control input leads to an understanding of how to control the airplane
 - Understanding how the airplane works results in a much more proficient pilot

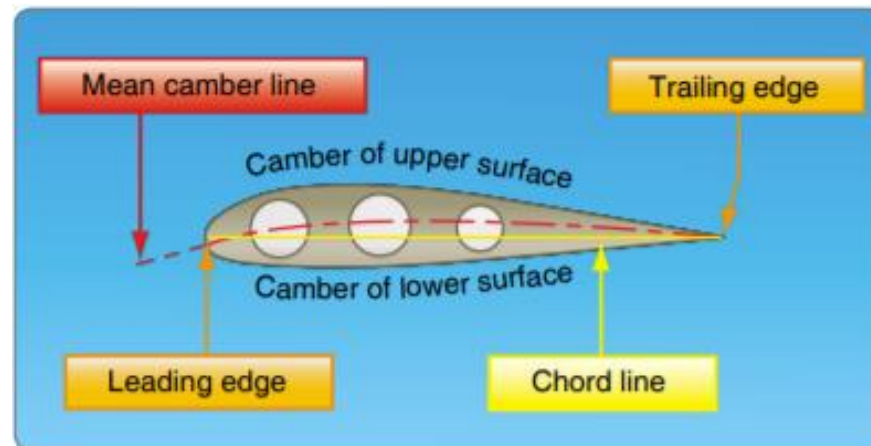
Content

- Terms
- Ailerons
- Elevator
- Rudders
- Flaps
- Spoilers
- Trim



Terms

- **Chord Line**
 - Imaginary straight line joining the leading and trailing edges of an airfoil
- **Camber**
 - Curve of an airfoil's upper and lower surfaces
 - Generally, the more curved the upper surface, the more lift is generated



Ailerons

- Control roll about the longitudinal axis
- Operation
 - Outboard, trailing edge of each wing; move opposite each other
 - Right turn: right aileron up, left aileron down (opposite for a left turn)
 - Upward deflected aileron decreases camber, decreasing lift, lowering the wing
 - Downward deflected aileron increases camber, increasing lift, raising the wing
 - Difference in lift causes the airplane to roll
- Adverse Yaw
 - Downward deflected aileron produces more lift which results in increased drag
 - Yaws the airplane in the direction of the raised wing
 - Rudder is used to counter and maintain coordination
- Types of Ailerons
 - Differential
 - Frise-type
 - Coupled
 - Flaperons

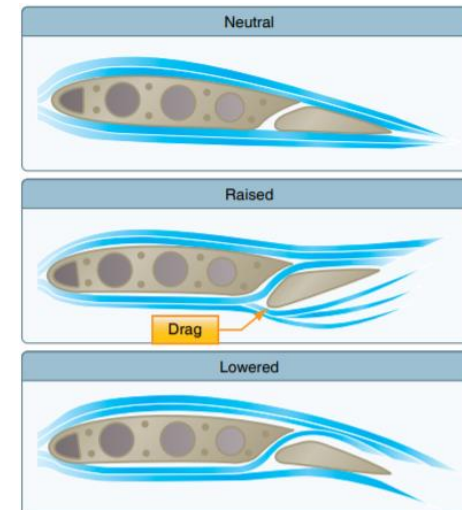
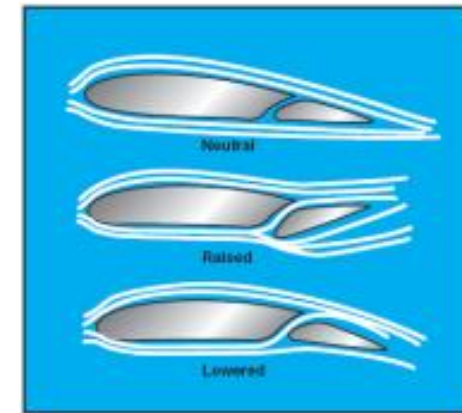
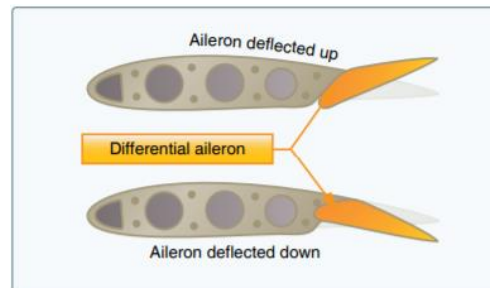
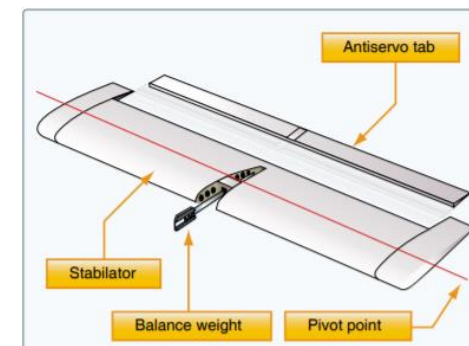
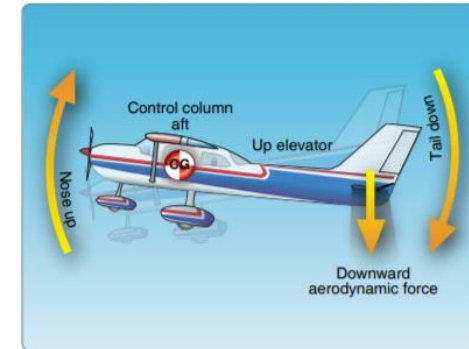


Figure 6-7. Frise-type ailerons.

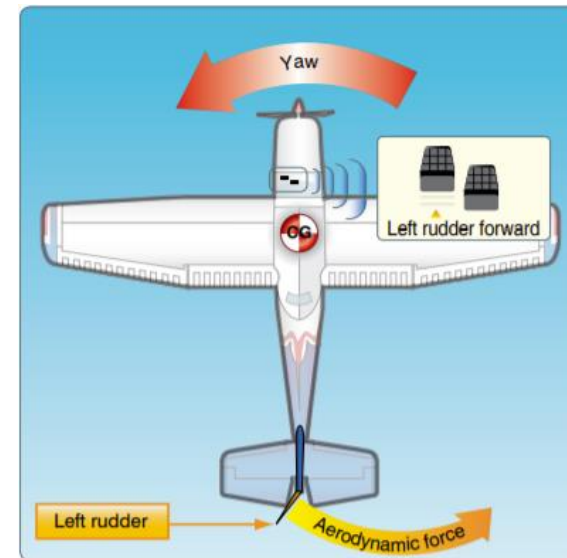
Elevator

- Controls pitch about the lateral axis
- Operation
 - Pulling the control backward deflects the elevator up
 - Changes the camber of the horizontal stab, creating a downward aerodynamic force
 - Tail moves down, nose moves up
 - Pushing forward deflects the elevator down
 - Changes the camber of the horizontal stab, creating an upward aerodynamic force
 - Tail moves up, nose moves down
- Types of Elevators
 - Conventional
 - Elevator is located at the trailing edge of the horizontal stabilizer
 - T-Tail
 - Elevator is above most effects of downwash and airflow around the fuselage
 - More susceptible to a deep stall
 - Stabilator
 - All moving tail. One piece horizontal stabilizer



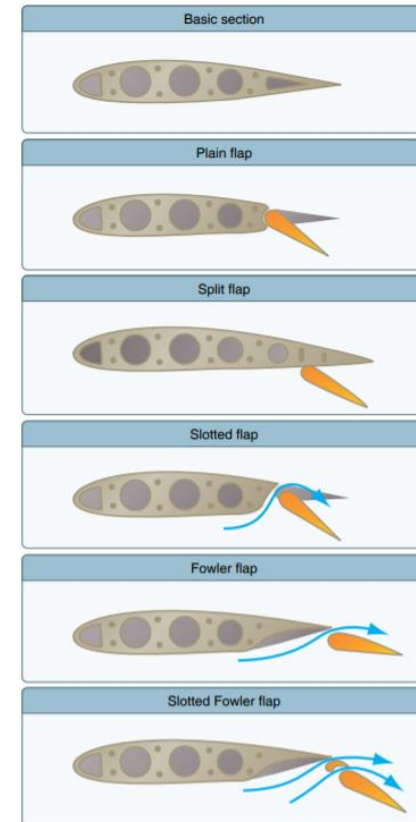
Rudder

- Controls yaw about the vertical axis
- Operation
 - Left pedal moves the rudder left / Right pedal moves the rudder right
 - When the rudder is deflected into the airflow, a horizontal force is exerted in the opposite direction
 - Increased camber
 - Rudder is pushed into the relative wind
 - Yaws the nose in the direction of pedal pressure



Flaps

- **Basics**
 - Most common high lift device
 - Attached to the trailing edge of each wing
 - Increase lift and drag
- **Benefits**
 - Shorter takeoff and landing distances
 - Improved climb capabilities
 - Slower and / or steeper approaches
- **Types of Flaps**
 - Plain – Simplest type, increase lift and drag
 - Split – Deflect from lower surface, slightly higher lift than plain flaps
 - Slotted – Duct between the flap and the wing provides significantly more lift
 - Fowler – Type of slotted flap, slides out on tracks increasing area of the wing



Spoilers

- **Basics**

- High drag devices
- Deploy from the wings
- Reduce lift and increase drag

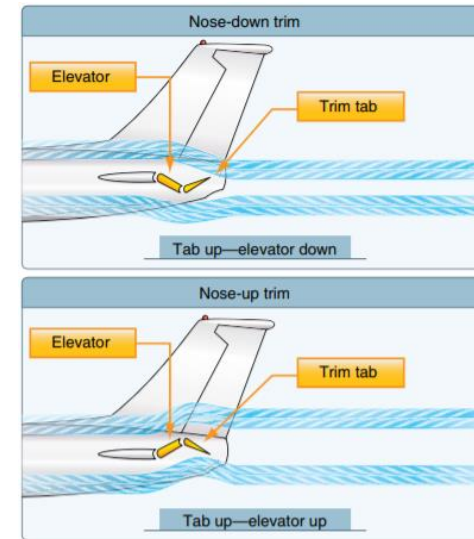
- **Uses**

- Reduce Airspeed – faster loss of speed in flight and on the ground
 - Decreases ground roll during landing
- Increase Descent Rates – higher descent rates without increasing speed
- Roll Control – spoiler on one wing is deployed, lowering the wing and turning the airplane
 - Eliminates adverse yaw



Trim

- **Basics**
 - Relieve the need to maintain constant pressure on the flight control(s)
- **Operation (elevator trim tab)**
 - Pilot uses a control wheel to set the desired trim
 - Trim tab moves in the opposite direction of the elevator
 - Nose Down: Tab moves up, forcing the elevator down
 - Nose Up: Tab moves down, forcing the elevator up
- **Trimming**
 - Once established and stable, trim to relieve control pressure
 - Re-trim for changes
- **Types of Trim Tabs**
 - Balance Tab – Just like trim tabs, but coupled to the control rod, moves with flight control movement
 - Servo Tab – Small portion of a flight control that helps move the entire control surface
 - Antiservo Tab – Decreases sensitivity of stabilator and acts as a trim device
 - Ground Adjustable Tab – Metal tab that can be bent to apply a trim force (trial and error)
 - Adjustable Stabilizer – Instead of elevator trim tab, can adjust the entire stabilizer



Questions?

