Area of Operation **VIII** - Task **C**

Straight Climbs and Climbing Turns

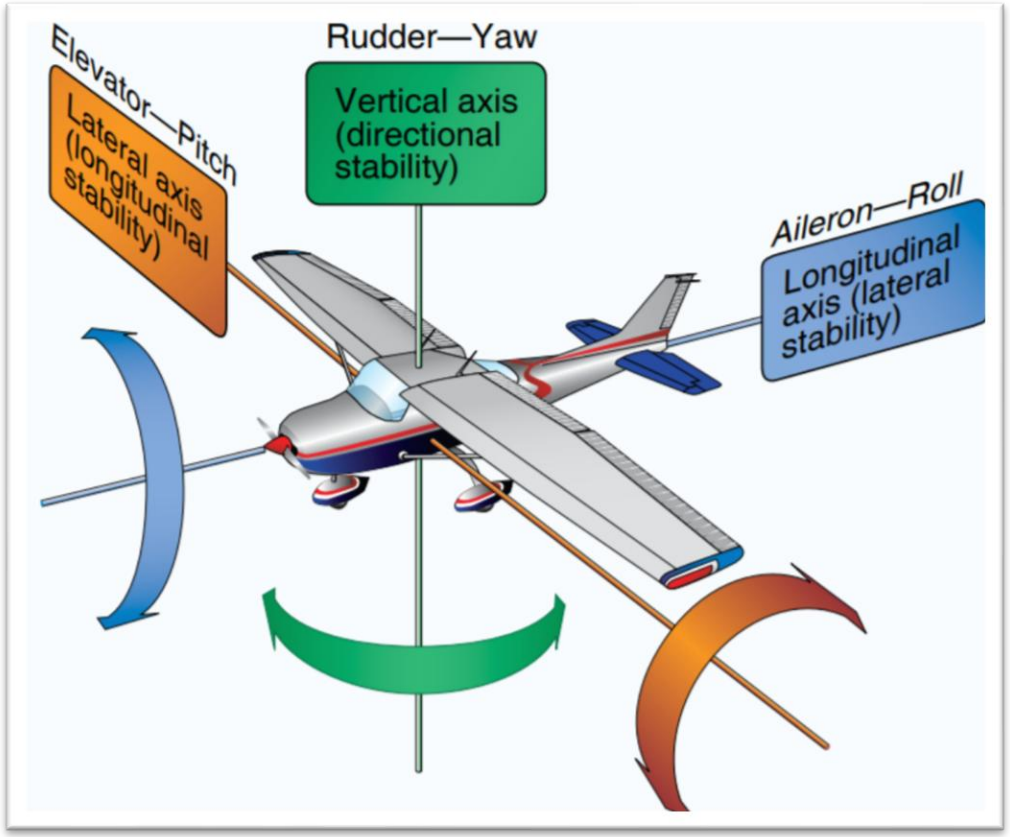
westflying

Key References:
- Airplane Flying Handbook

Content

1. Introduction

- **What**: The airplane is put into a climb attitude and power settings in order to gain altitude
- **Why**: Part of the fundamentals, basis for all flying and maneuvers
- **Primary Flight Controls**:
  - Pitch – Controlled by the **Elevator** (Yoke)
    - *Back pressure pitches up*
    - *Forward pressure pitches down*
  - Roll – Controlled by the **Ailerons** (Yoke)
    - *Right roll → Right aileron deflects UP*
    - *Left roll → Left aileron deflects UP*
  - Yaw – Controlled by the **Rudder** (Pedals)
    - *Right pedal → Rudder deflects to the Right*
    - *Left pedal → Ruder deflects to the Left*



➡ **Standard (ACS):**

- PPL(*): Level off Alt ~~**±200ft**~~ *100*, Hdg ~~**±20⁰**~~ *10⁰*, Airspeed ~~**±10 kts**~~ *5*

* Basic Instrument

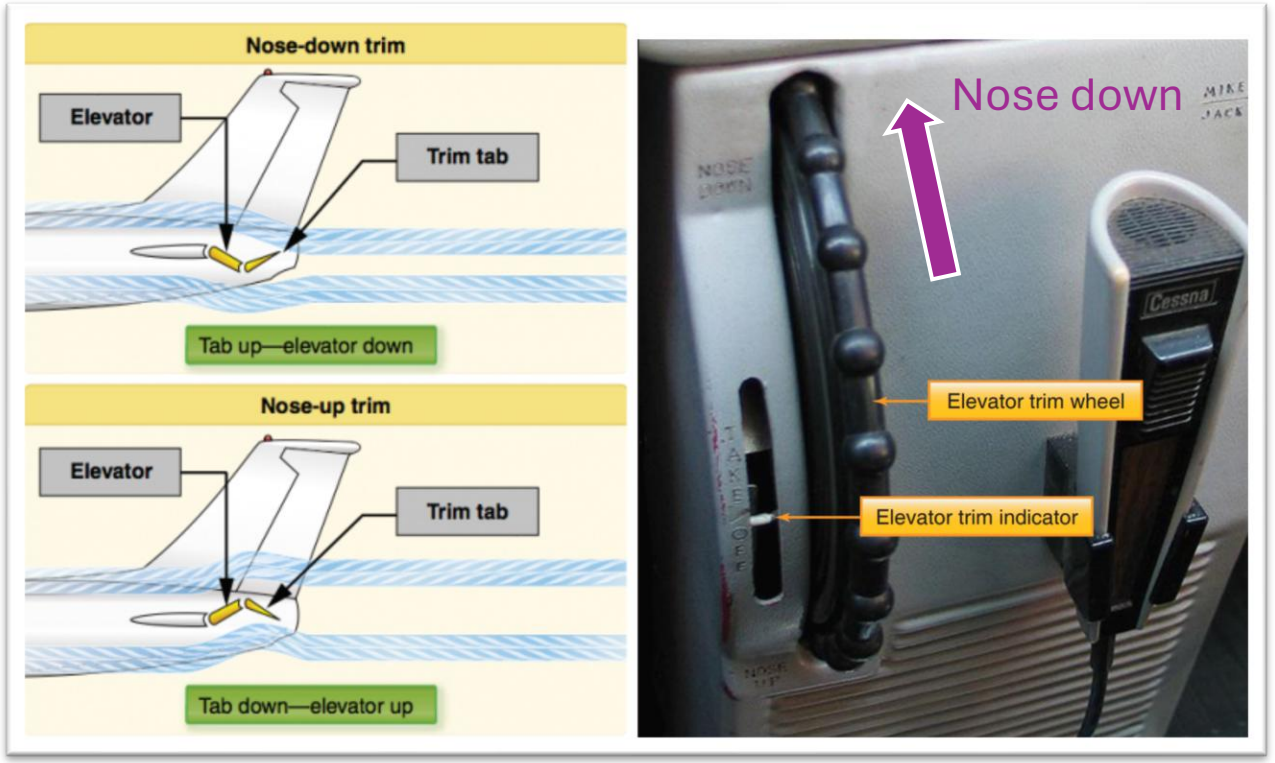
2. Control Pressure

1. **Control should be smooth, light pressure (no jerky movements)**
    - Airplane is stable, require small control inputs → Feels more like “Guiding” versus “Piloting”
2. **Overcontrolling:**
    - White knuckle death grip (overall nervousness)
    - Large flight control movements
    - Tendency to react briskly to any natural disturbance in the aircraft movement
    - How to prevent: **fly with your fingers** and toes, deep breath, relax

3. Trim Technique

1. **Once stable, set pitch and power and let airspeed stabilize**
2. **Add Trim to relieve control pressure**
   - Verify desired performance and repeat/correct it until almost no control inputs are needed
   - If multiple axis → trim Rudder first, then elevator, then aileron
   - Do not attempt to control pitch using trim, use yoke first, then add Trim to release pressure

3. Types of Trim
   - Servo: moves opposite to elevator (helps deflect the surface) → C172
   - Anti-servo: moves same direction (decrease sensitivity)

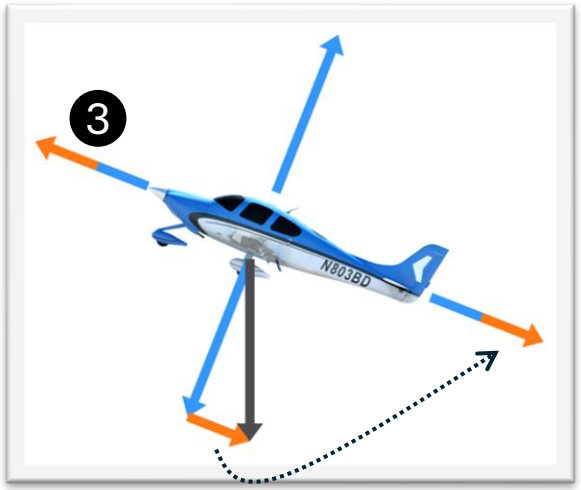


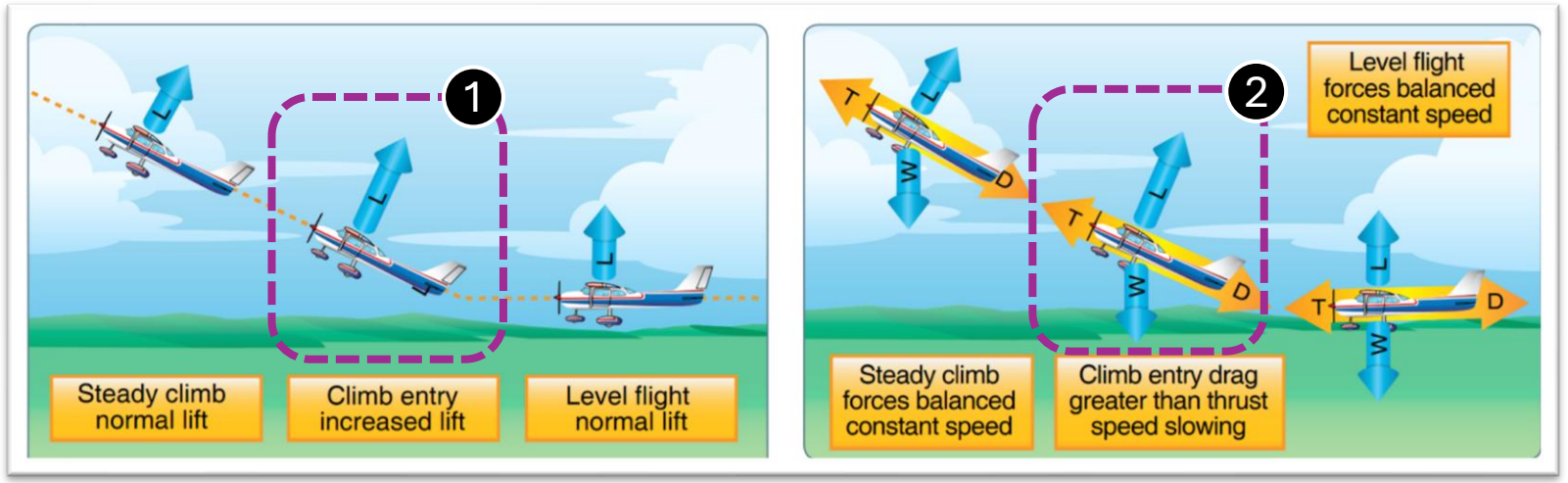
4. Integrated Flight Instruction

- Use **Outside References + Flight Instruments** to obtain and maintain desired performance
- **Basics**
  - 90% Outside, 10% Inside
  - Use outside references to fly
  - Validate the airplane's attitude and performance inside on the instruments
- **Corrections**
  - When a correction is necessary, apply it in reference to the natural horizon
  - Verify the new attitude and performance on the instruments
  - Trim the controls to maintain the new attitude and continue crosschecking

5. Physics of the Climb

- **Establishing the Climb**:
  - Pitch up: AOA and lift increases, drag also increases ❶, airplane starts to slow down and gain altitude ❷
  - Power is added: "reward component" of the weight in compensated by the excess trust ❸
  - Once the climb is established, AOA and lift return to level flight values and forces are again in equilibrium
- **Higher Power = Higher Left Turning Tendencies**
  - Must be countered by right rudder
  - Note: Large fast increase in power also causes the airplane to pitch up (C172)



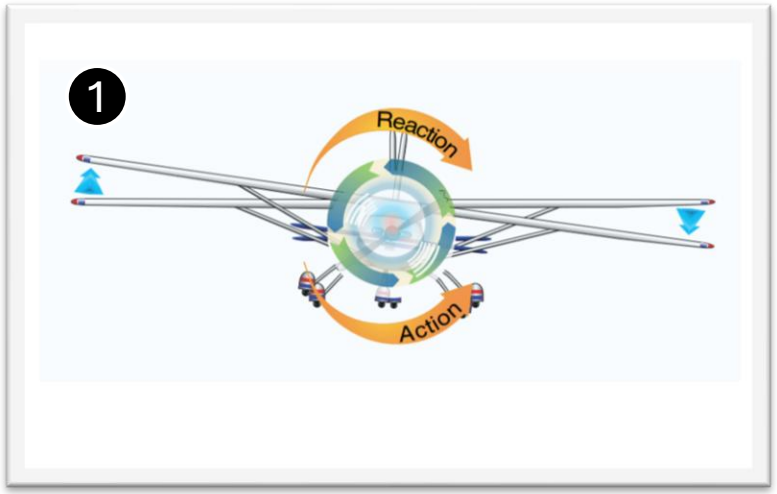


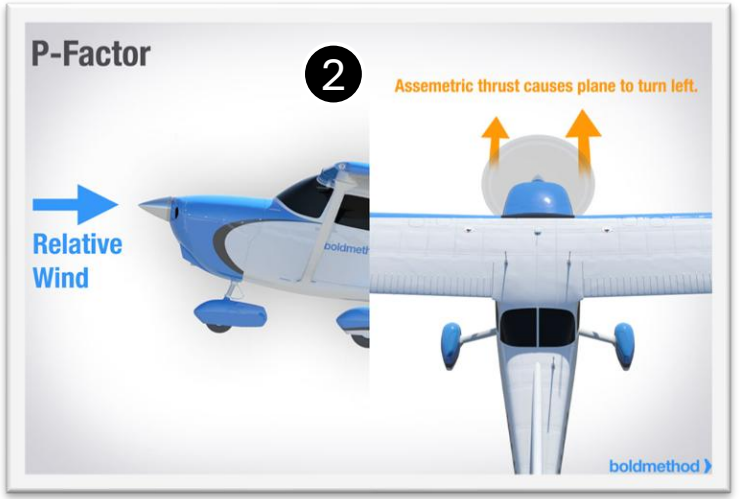
5. Physics of the Climb

- **Left Turning Tendencies in a Climb**:

  1. Torque: Propeller rotates clockwise → Airplane try to rotate counter-clockwise (bank to the left, Newton's 3rd law)
  2. P-Factor: in high AoA, trust at the right side of the prop is higher ("bites" more air) → Yaw to the left
  3. Corkscrew: slipstream hits the left side of the vertical stabilizer → Yaw the nose to the left

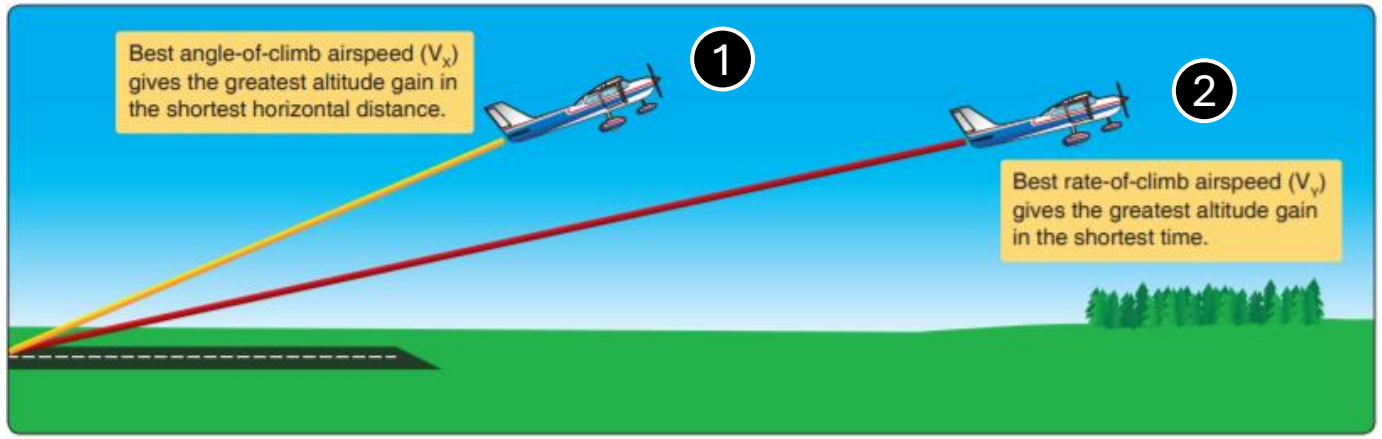
- **To counter left tendencies** → Right rudder must be applied to keep coordination





6. Types of Climb

- **Cruise Climb** – *85kts in the C172*
  - Airspeed published by the manufacturer
  - Faster than the best rate and angle of climb speeds to provide better airspeed, cooling, control & visibility
- **Best Rate of Climb (Vy)** – *74kts in the C172*
  - Most altitude gained in the shortest amount of time (maximum feet per minute) ❶
  - Airspeed where the most excess power (horsepower) is available
- **Best Angle of Climb (Vx)** – *62kts in the C172*
  - Most altitude gained in the shortest distance (slower than Vy) ❷
  - Airspeed where the most excess thrust (force) is available



Note:
Power = Thrust x Airspeed

7. Climb Procedure

- **Entering a Climb**
  - Simultaneously establish the pitch attitude and power setting for the climb
    - **If Climbing Turn** ➔ establish bank in relation to the natural horizon while increasing power
  - Establish with visual references, verify with the instruments
  - Maintain coordination with right rudder and Trim to relieve the control forces
- **Maintaining a Straight Climb**
  - Power is constant, Ailerons keep the wings level (to maintain heading) or proper constant bank (if climbing turn)
  - Airspeed is controlled with elevator pressure (pitch up to slow down, pitch down to speed up)
- **Returning to Straight-and-Level Flight**
  - Initiate the level off at approximately 10% of the rate of climb (500 fpm = 50' prior to desired altitude)
  - Smoothly and slowly lower the nose and bank to the level flight **while keeping power** (crosscheck with the instruments)
  - Once level, maintain climb power to accelerate to the desired cruise speed
  - Reduce power, verify straight-and-level site picture, trim the airplane

8. Particularities of a Climbing Turn

- **Climbing Turns and Pitch**
  - Turning reduces vertical lift ➔ more back pressure is necessary than straight climb or straight turn
- **Bank Angle**
  - Shallower bank angles provide for a more efficient rate of climb
  - Medium or steep bank turns can significantly degrade or eliminate climb performance
- **Adverse Yaw and Torque Effect**
  - **Left turn**: Less right rudder pressure is required than in a straight climb (left tendencies helps counter adverse yaw)
  - **Right turn**: More right rudder pressure is required than in a straight climb
    - *To counter **both** the left tendencies AND the adverse yaw*

9. Common Errors

1. Failure to cross-check and correctly interpret outside and instrument references
2. Application of control movements rather than pressures
3. Improper correction for torque effect
4. Faulty trim procedure

Questions?