# Stability

## Objective

To understand the effects of design choices on the stability of an aircraft along its three axes.

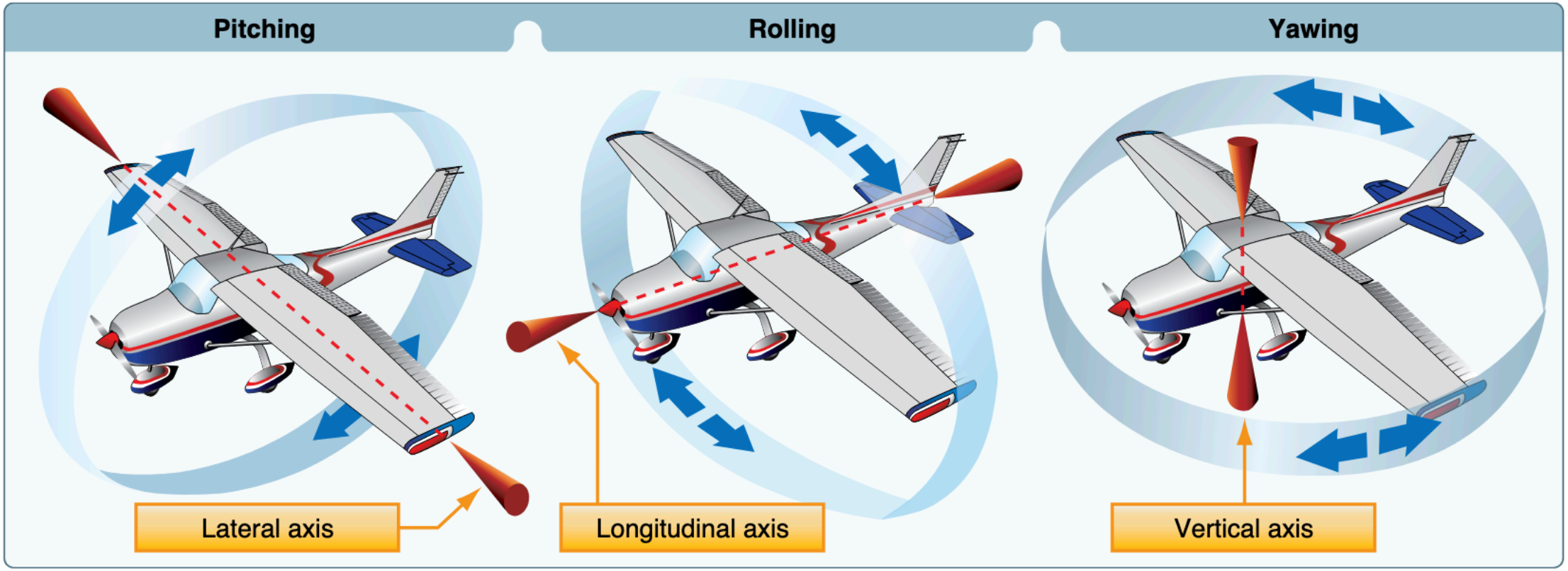
## Motivation

Helps a student develop an intuitive understanding of stability and controllability that they can use to make sense of the control inputs as they fly in different conditions.

# Overview

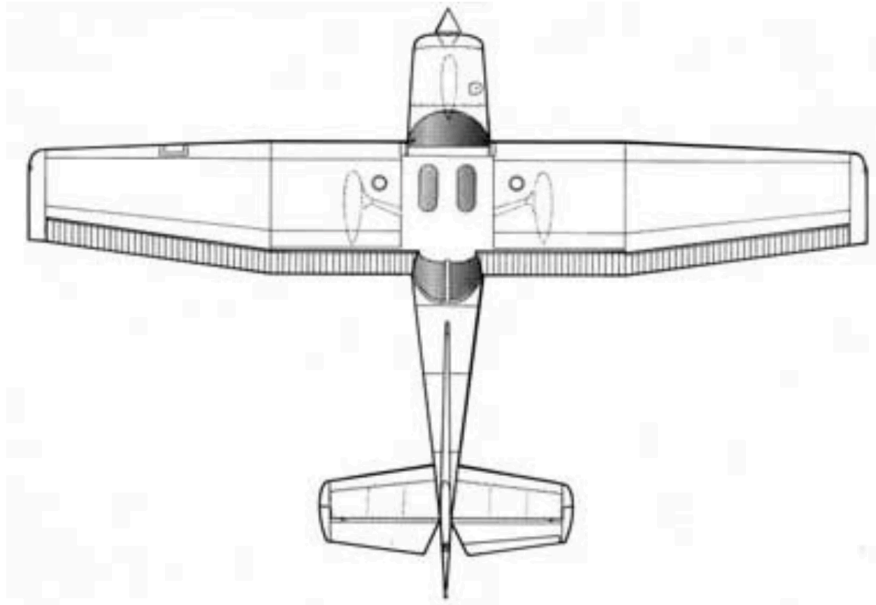
- Airplane Axes
- Static Stability and Dynamic Stability
- Yaw / Directional Stability
- Longitudinal / Pitch Stability
- Lateral / Roll Stability
- Maneuverability vs Controllability

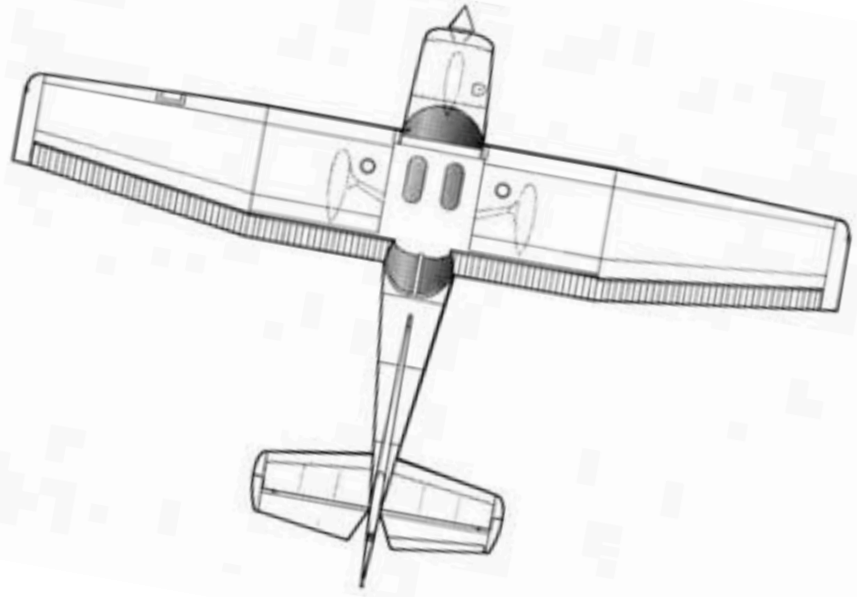
# Airplane Axes



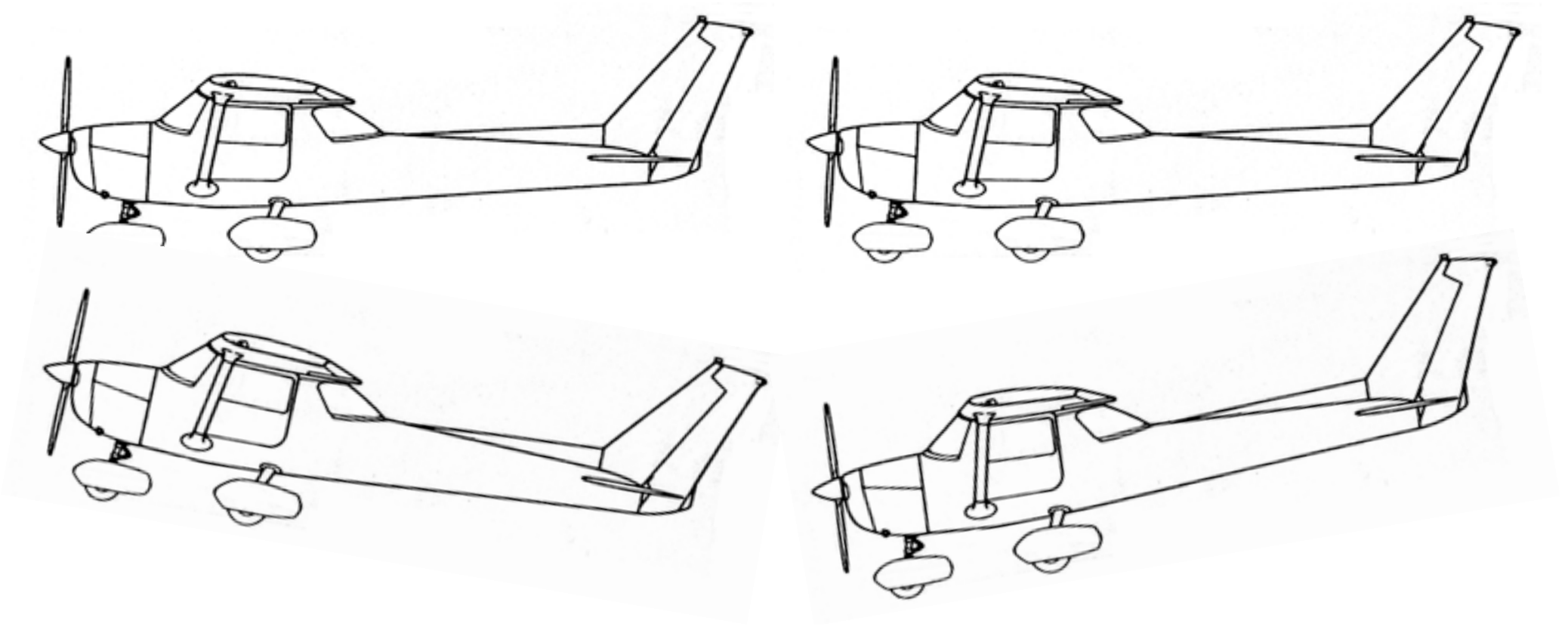
# Static Stability and Dynamic Stability

# Yaw / Directional Stability



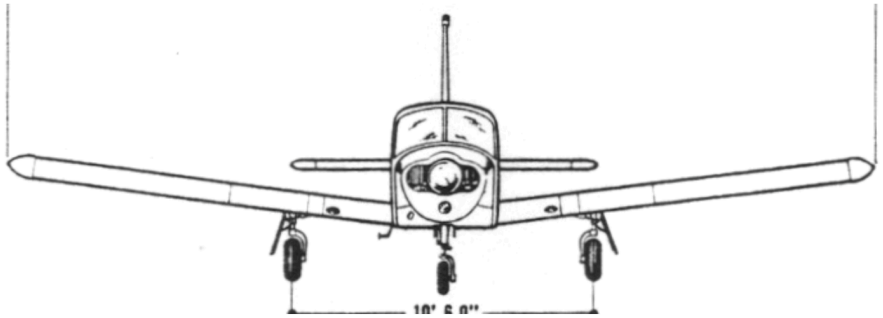


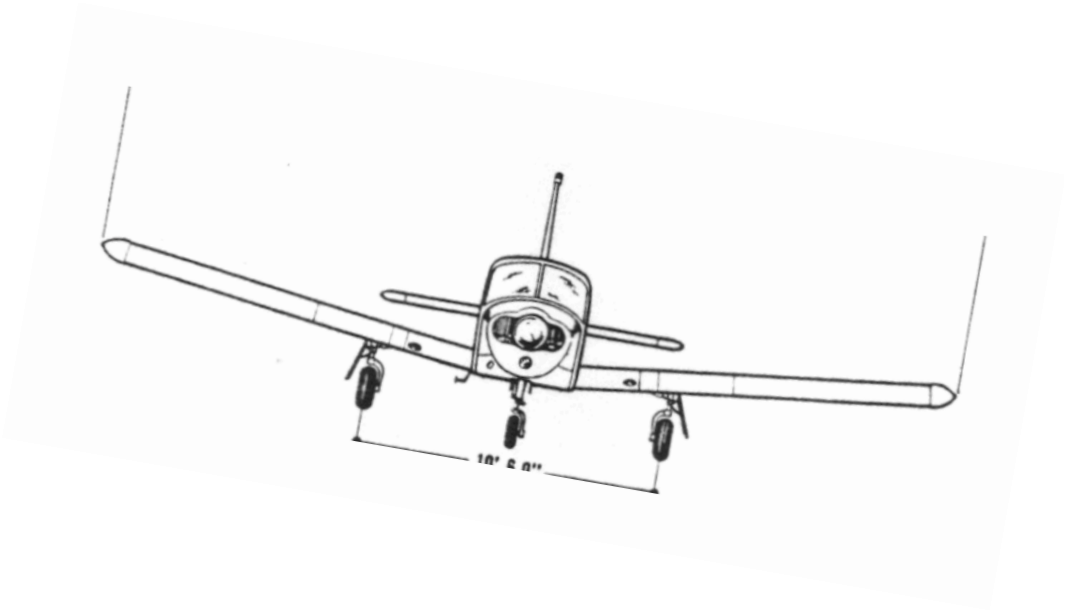
# Longitudinal / Pitch Stability



Pitch dampens over time

# Lateral / Roll Stability

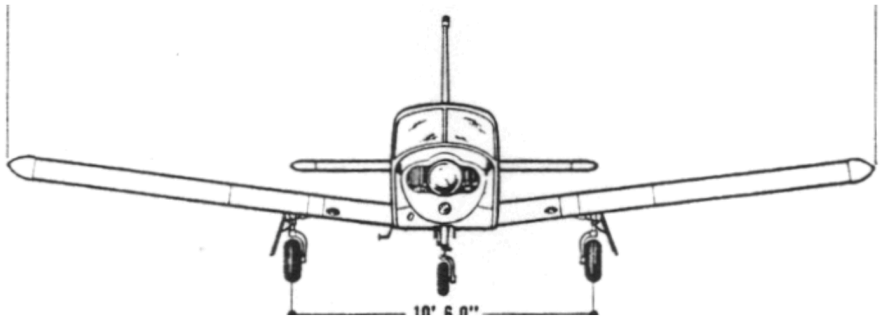


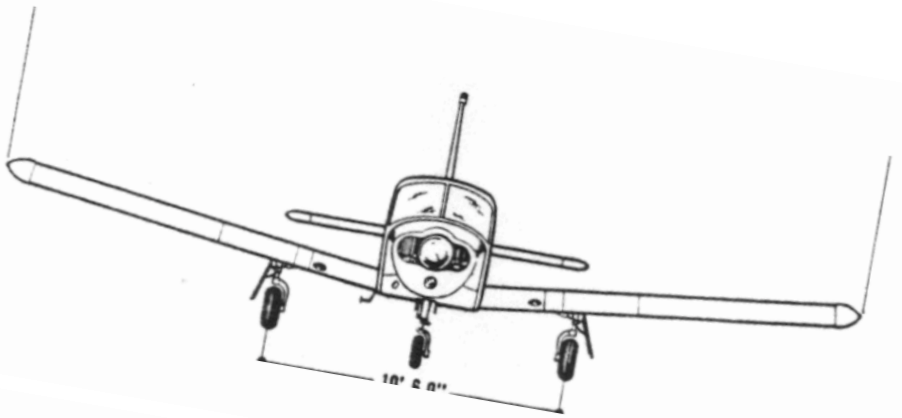


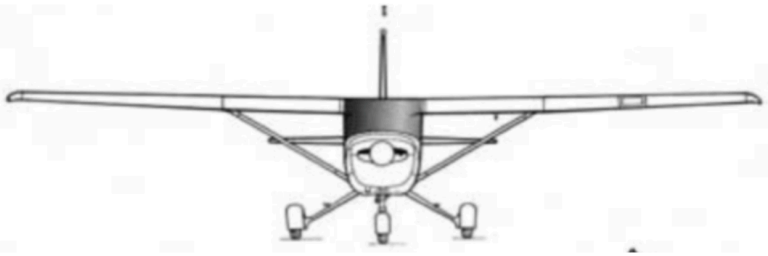
Dihedral angle make large AoA on down wing, raising wing

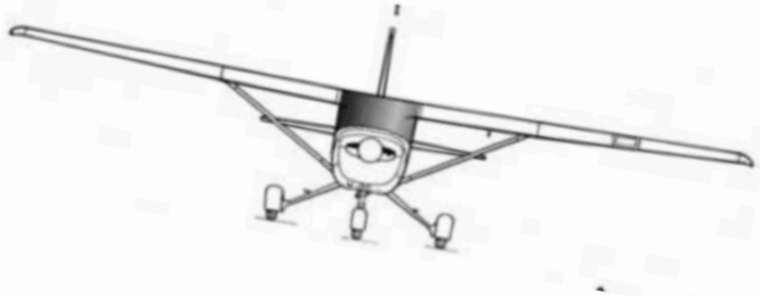
# Deeper, Commercial-Level Discussion

# Lateral / Roll Stability - High vs Low Wing

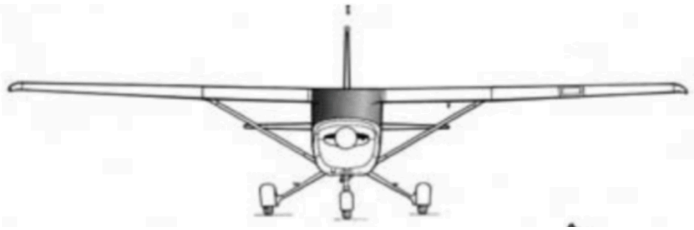


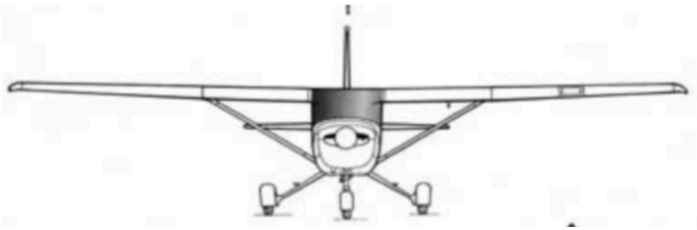


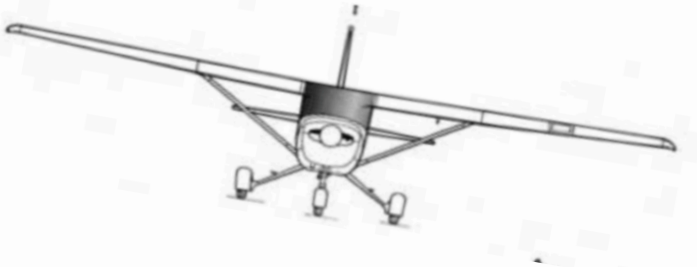




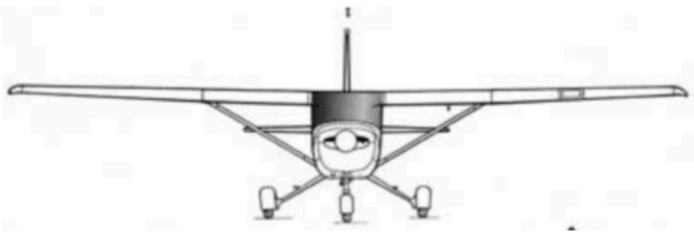
# Spiral Instability - Strong directional (yaw) stability and weak lateral (roll) stability

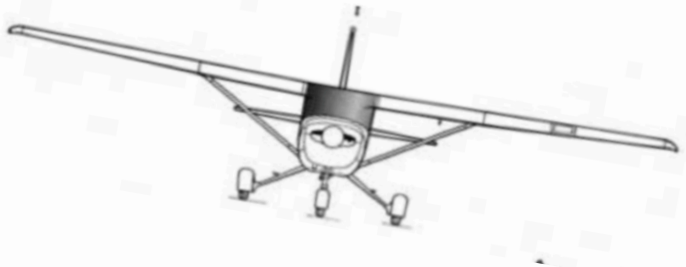


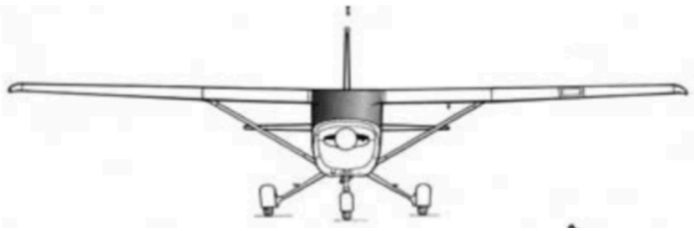


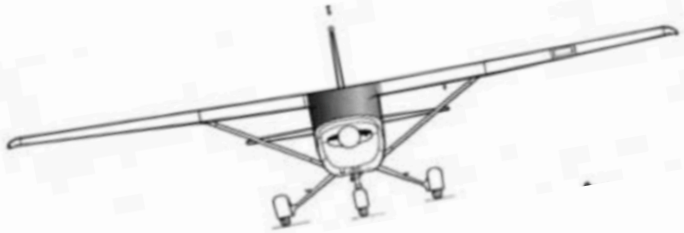


# Dutch Roll - Strong lateral (roll) stability and weak directional (yaw) stability

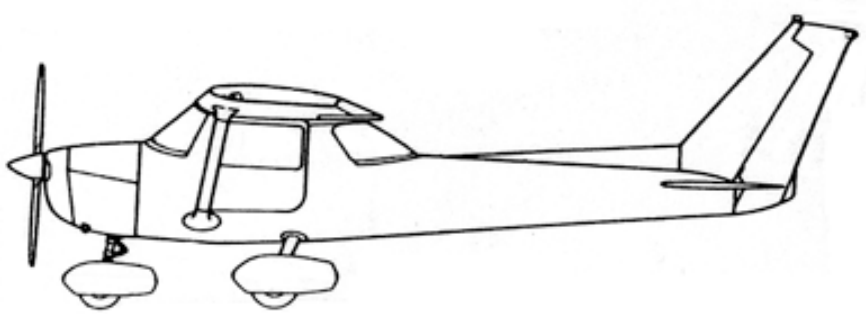




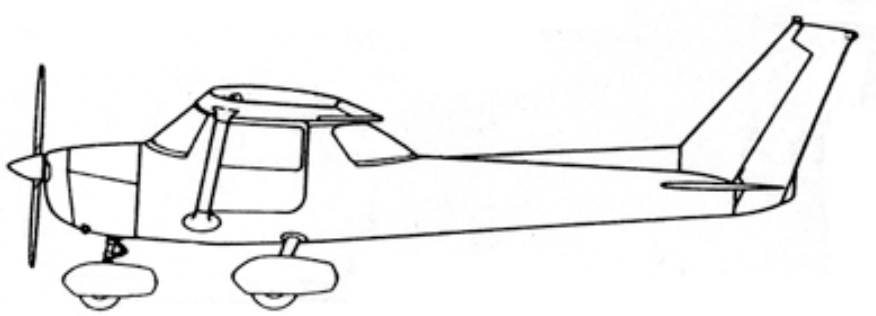




# Maneuverability vs Controllability

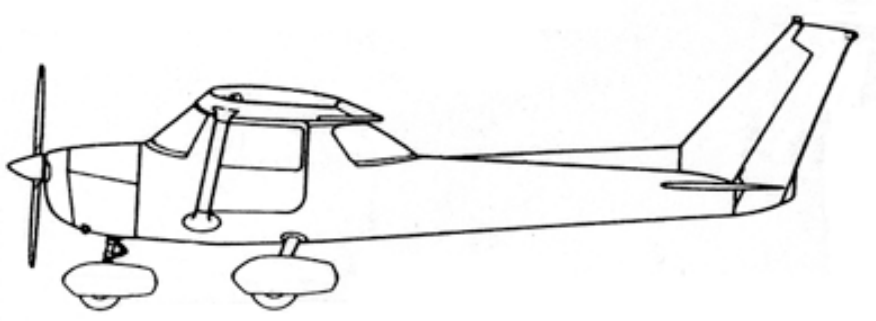


# Maneuverability vs Controllability - Forward CG



Nose heavy, more stable, higher stall speed, lower cruise speed, more drag

# Maneuverability vs Controllability - Aft CG



Tail heavy, less stable, sensitive controls, lower stall speed, higher cruise speed, less drag

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