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REDBIRD FLIGHT SIMULATIONS

HARTZELL ENGINE TECHNOLOGIES
MONTGOMERY, ALABAMA USA

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MINDSTAR AVIATION

The Beginner’s Mind

The Basics

Revisiting the Basics

- Feel your butt
- Center the ball
- Control torque, precession and P-factor
- Watch the nose
- Aim for the runway numbers
- Nail your airspeed
- Stay on the centerline
- Kill the drift
- Point the nose
- Get it down in the 1st 3d of the runway

The Problem

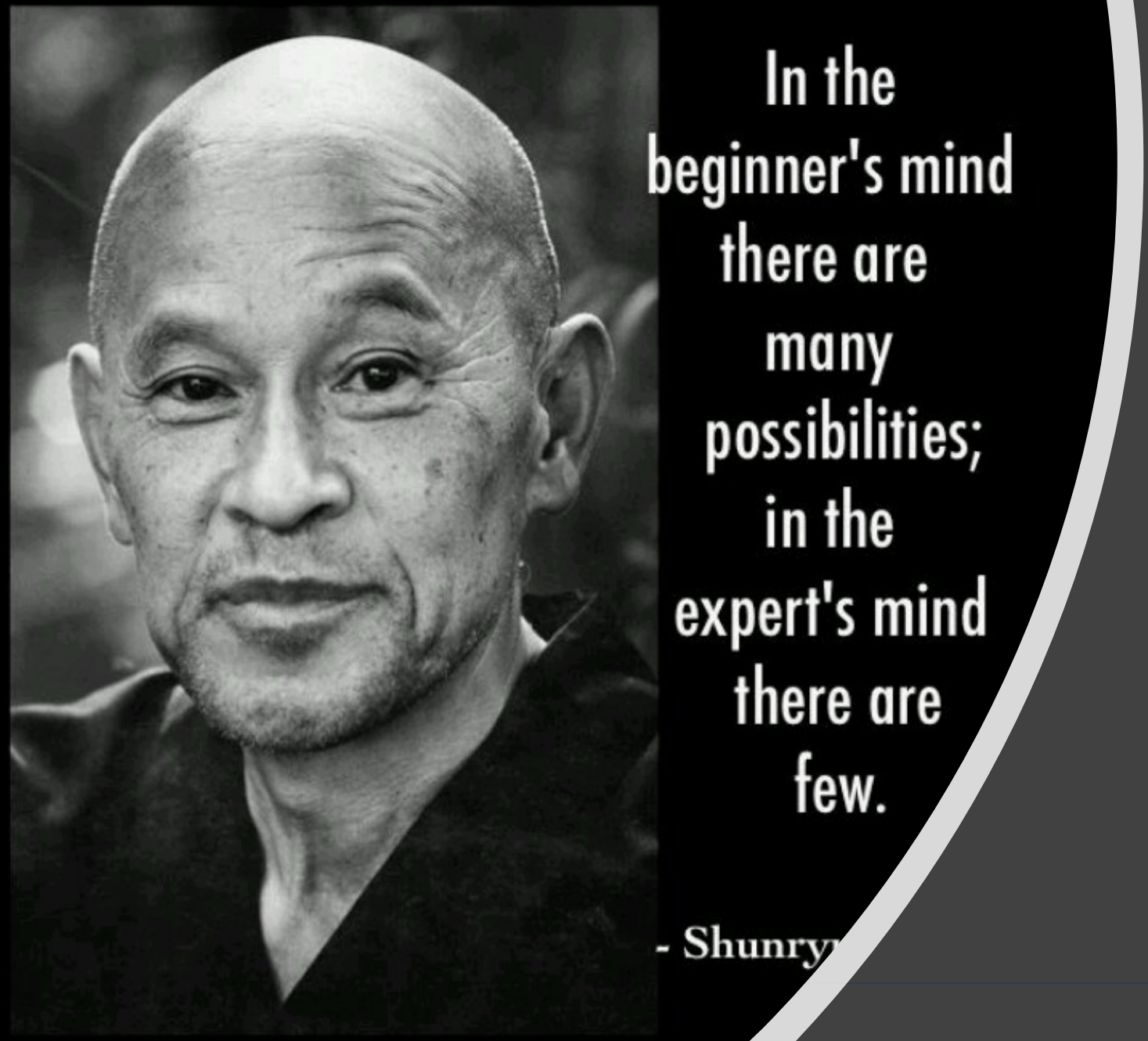
- The last time they were mentioned was that 1st 10 hours of initial flight training…do you remember?
- Not consistently taught throughout training.
- Not high on a check-ride pilot's "bust 'em list.
- Gee wiz avionics are more exciting.
- Daily operational environment is very forgiving.
- We're creatures of habit.
- ___ % of all accidents are skill-based accidents.

Total Control

- Being able to visualize your touchdown point.
- Being able to control your airspeed.
- Being able to control your glideslope.
- Foundation of all flight.
- Allows you to extrapolate.

What is a Stick and Rudder Pilot?

A stick and rudder pilot is someone who flies the airplane, primarily by looking outside the cockpit paying attention to the physical sensations of flight!



Have a Beginner's Mindset

Explain the Flight Controls?

- Ailerons – control the angle of attack along the outer portion of the wings.
- Elevator – controls the angle of attack of the main wing.
- Rudder – controls the angle of attack of the fuselage.
- Power – change in rate of climb; changes in torque, P-factor, slipsteam and airspeed
- All can be perceived through: Sight – Sound - Feel

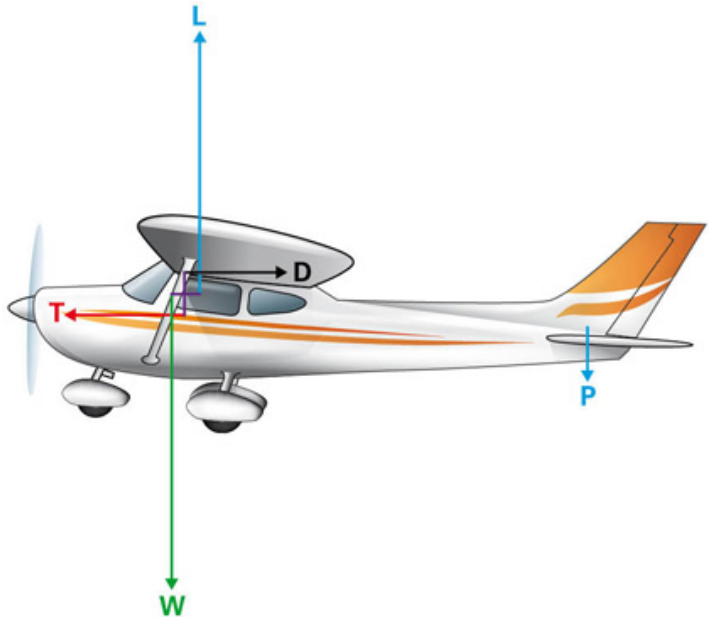
"Control…is the ability of the pilot to change the airplane's flight conditions. It is brought about by the use of devices that alter the lift force on the surface to which they are attached."
Theodore A. Talay Introduction to the Aerodynamics of Flight

What is Straight & Level Flight

- 90% of flying is straight and level
- Fundamental to all other flight regimes
- It is…steady state/un-accelerated flight.
- Requires:
  - constant airspeed
  - constant direction
  - constant altitude

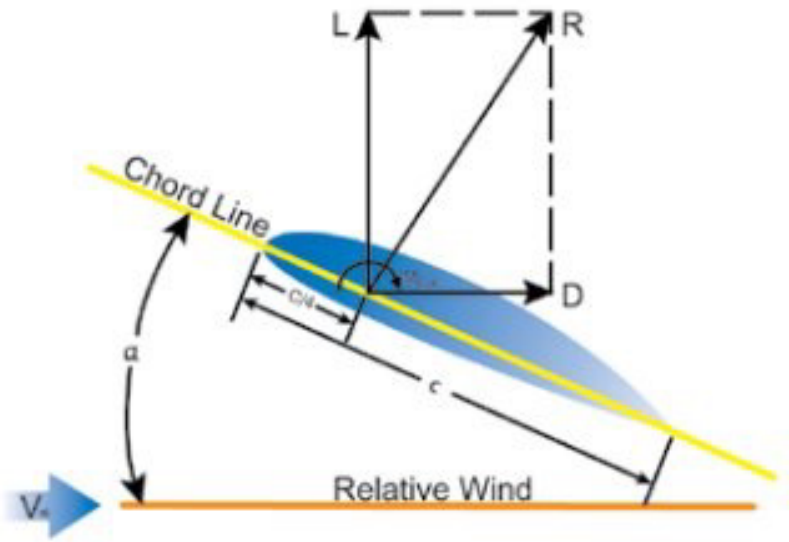
Maintaining Straight & Level Flight

- In VFR flight, accomplished with reference to the outside i.e. the horizon.
- PRIMARY reference is the natural horizon; cross-check altimeter
- How to establish?
  - Pitch
  - Power
  - Trim
- Stay In Balance:
  - Wings level
  - Ball centered
  - GOAL - Keep drag at a minimum!!!



What Does Trim Do?

- At the primary level it relieves control pressure and holds at airspeed.
- It actually sets the aircraft's angle of attack.
- Once set the aircraft, no matter the power setting, will be at that angle of attack.
- Each trim setting has a corresponding speed that the aircraft will seek and hold.
- Trim input is equivalent to elevator input…more on this later

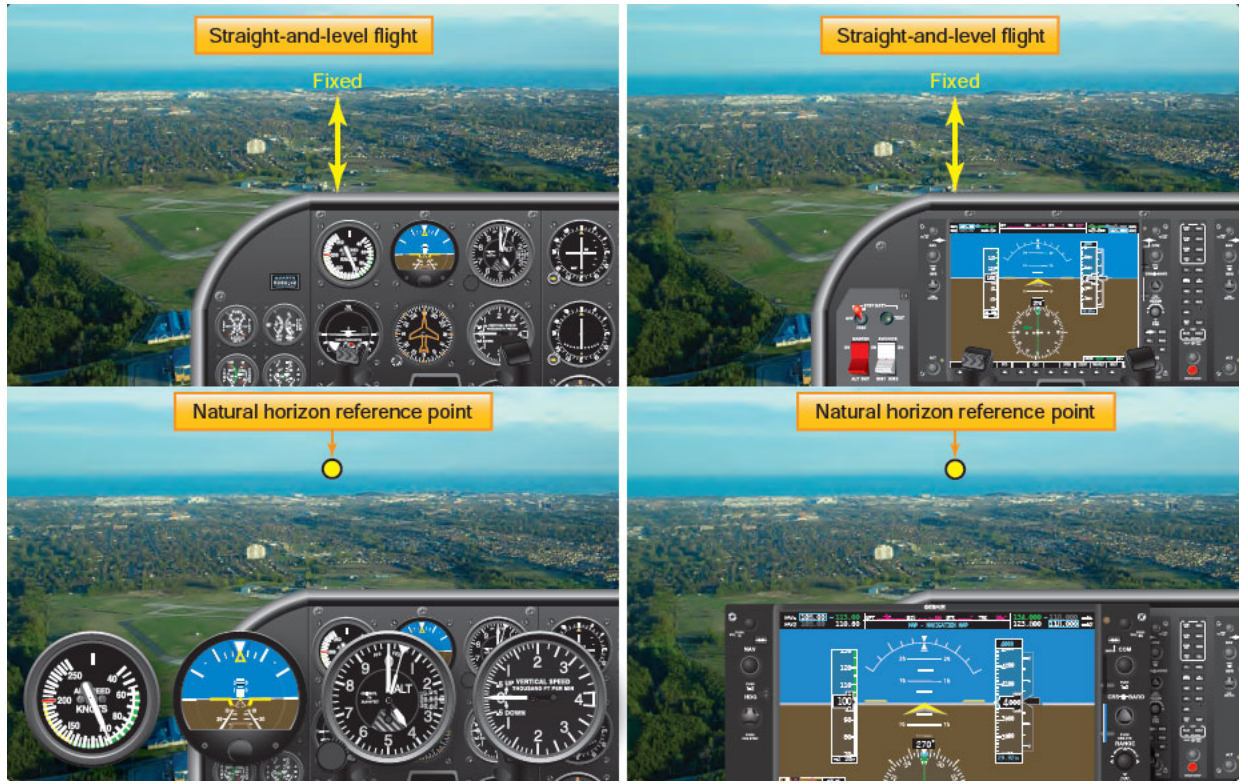


$$L = 1/2 \rho C_L v^2 S$$

AoA

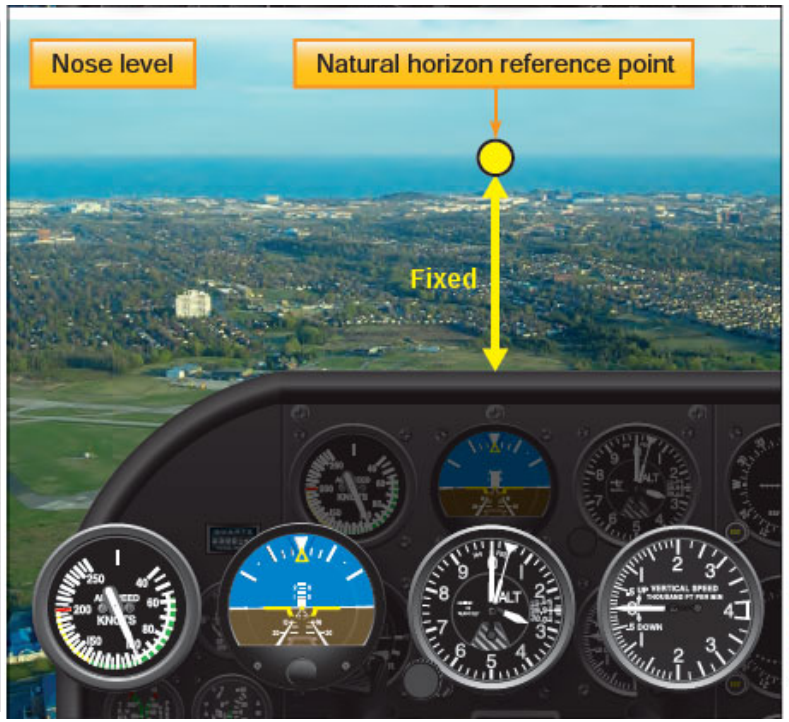
- The angle between the chord line and the relative wind.
- Control lift via:
  - Change your AoA
  - Changing your airspeed
  - Changing the shape of the:
    - Chordline
    - Camber
    - Surface Area
- Think of lift as acting along your torso.

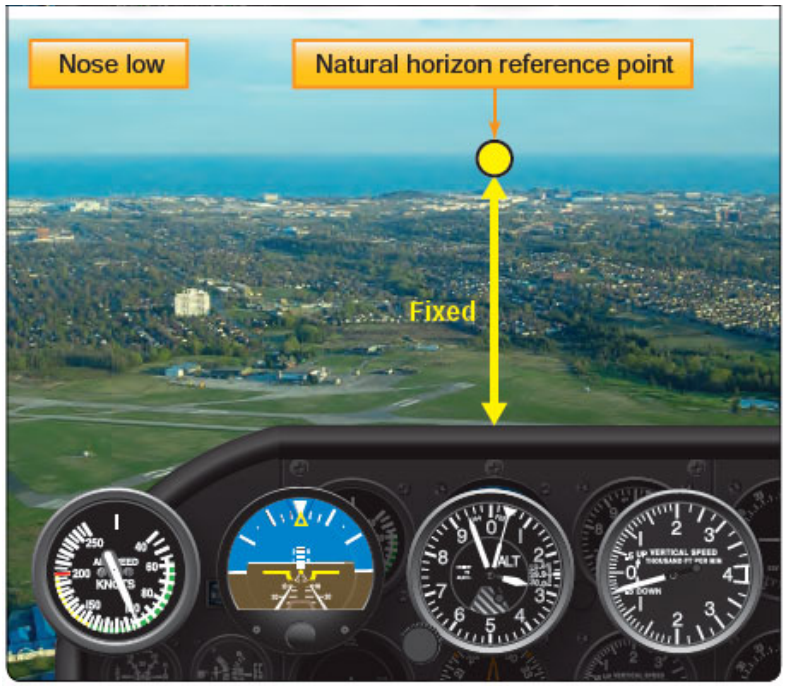
Straight & Level Flight Sight Picture



Maintaining Straight Sight Picture

Maintaining Level Sight Picture





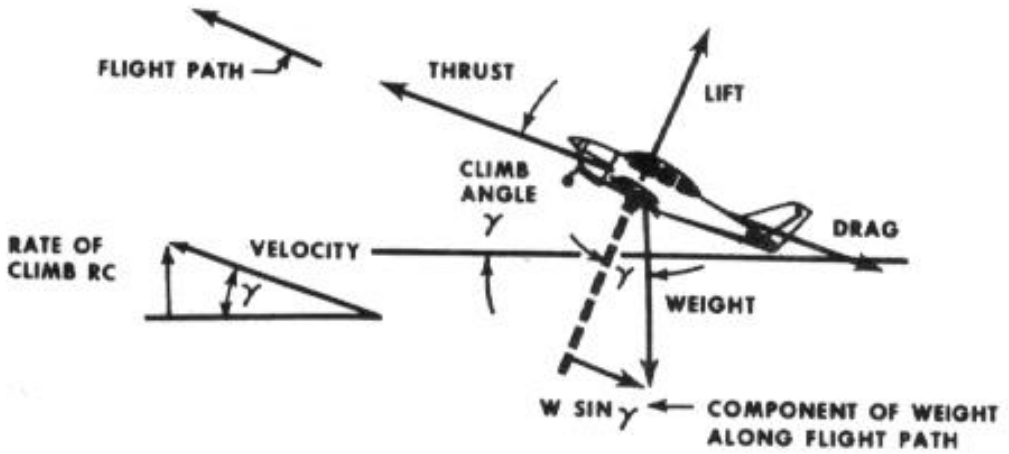
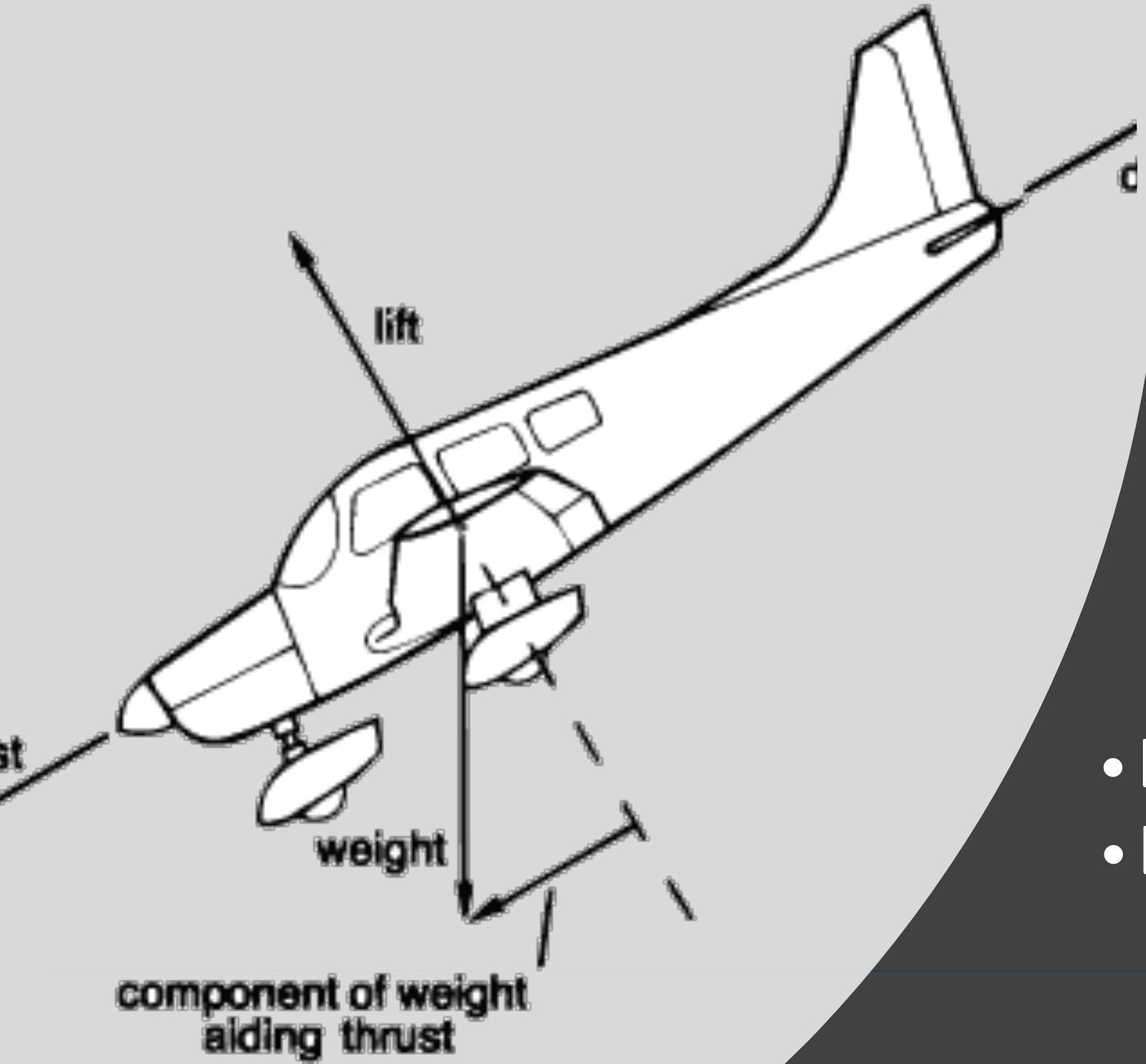


Figure 17–55 Weight Has Rearward Component

What Climbs an Airplane?

- **Excess thrust!**
- **High AOA = increase in torque, P-factor & asymmetrical loading =**

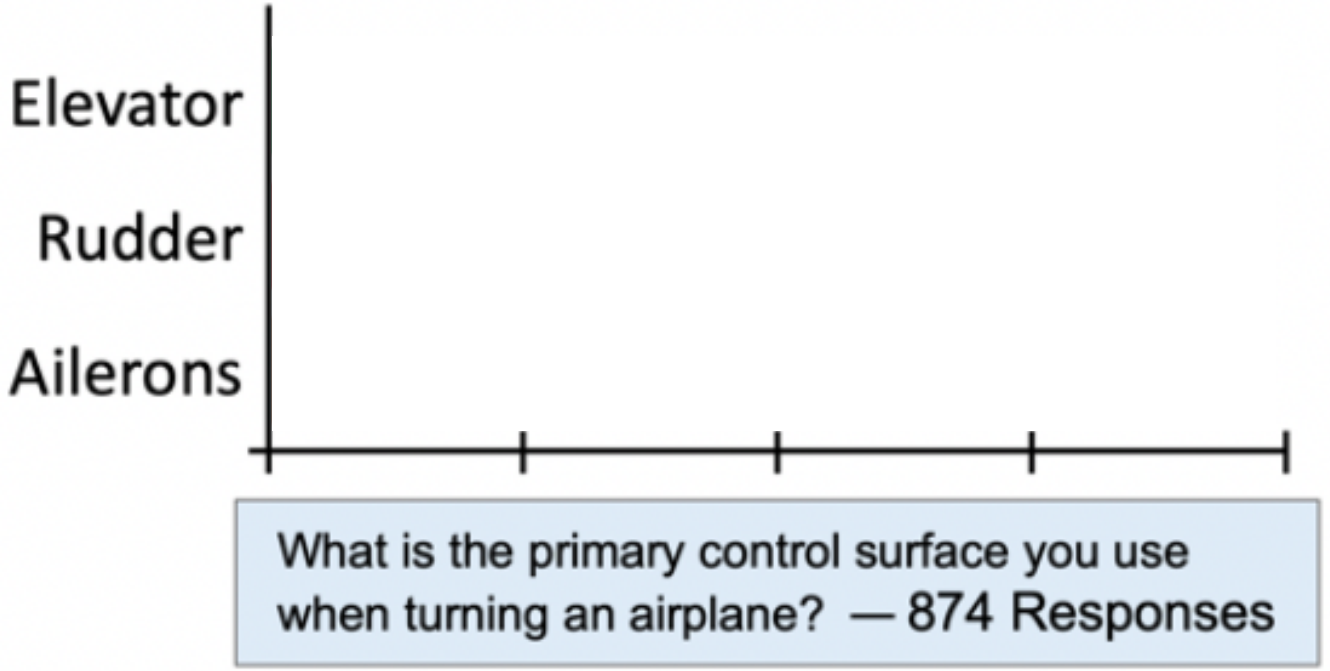
RIGHT RUDDER!!!!



How Does an Airplane Descend?

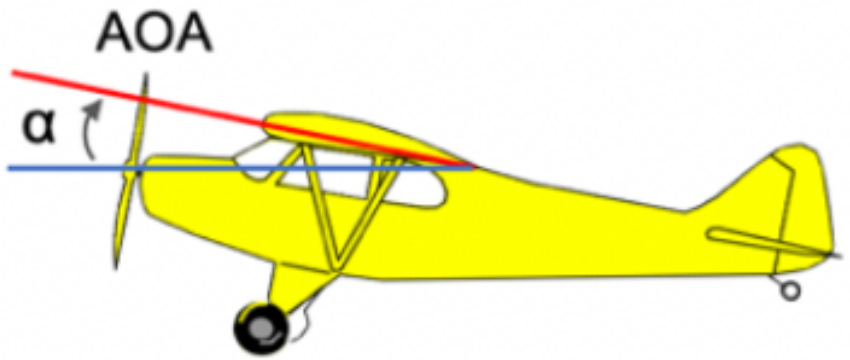
- Let Gravity to the Work!
- LEFT RUDDER!!!!

What is Primary When Turning an Airplane?



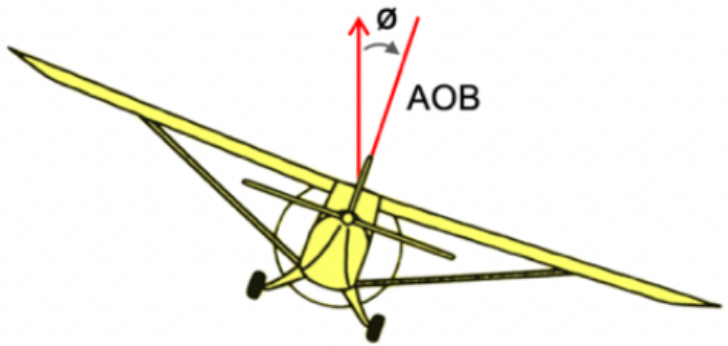
The Elevator is Primary for Controlling:

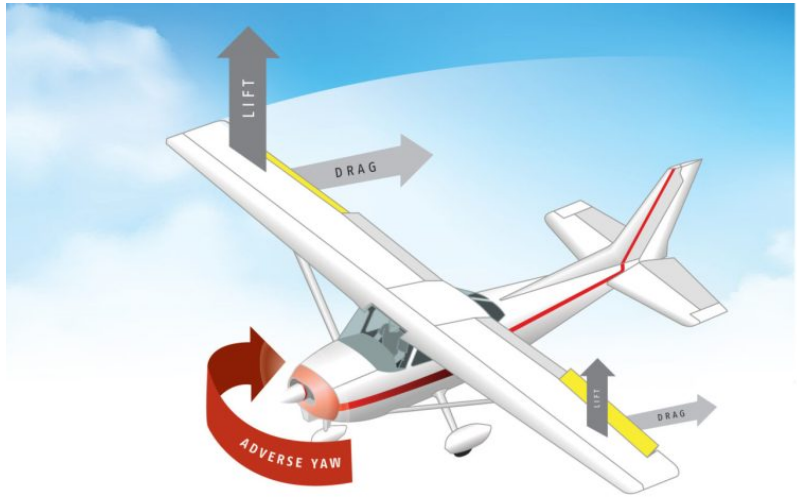
- Angle of Attack (of the main wing)
- Airspeed
- G-Loading
- G-load & tightness of a turn & nearness to the stall & back pressure on the stick = the elevator



What do the Aileron's Do?

- Control the angle of attack along the outer portion of the wings (AOB).
- Down aileron : increases AoA = increases lift = increases drag
- Up aileron : decreases AoA = decreases lift = decreases drag

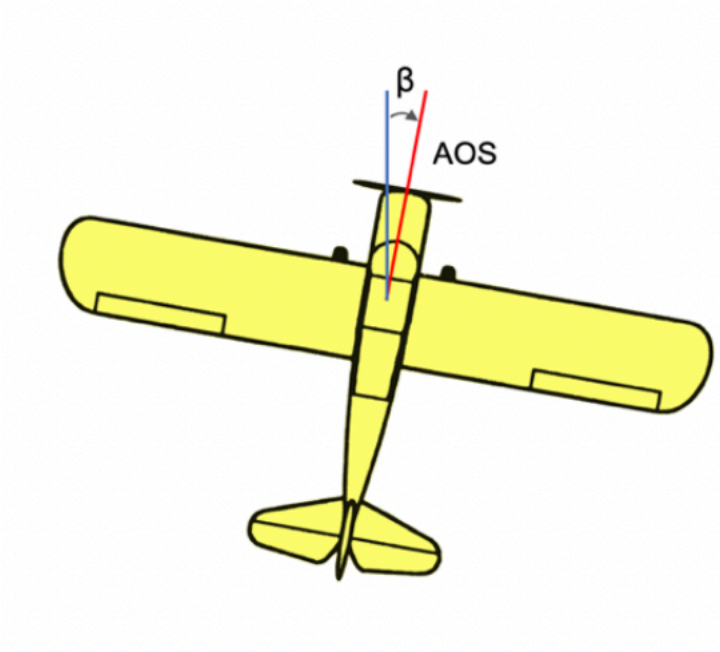




- Adverse Yaw - the tendency of an airplane, when turning and banked, to go the opposite direction

What is the Rudder Use For?

- Primary purpose of the rudder is to cancel Yaw.
- Rudder controls the fuselage's AoA i.e. Angle of Side Slip (AOS)



Proper Rudder Use

- When Turning
  - Slipping Turns
  - Skidding Turns
- Take off
- Slow Flight
- Power on/off stalls
- Forward/Slid Slips

How to Turn an Airplane

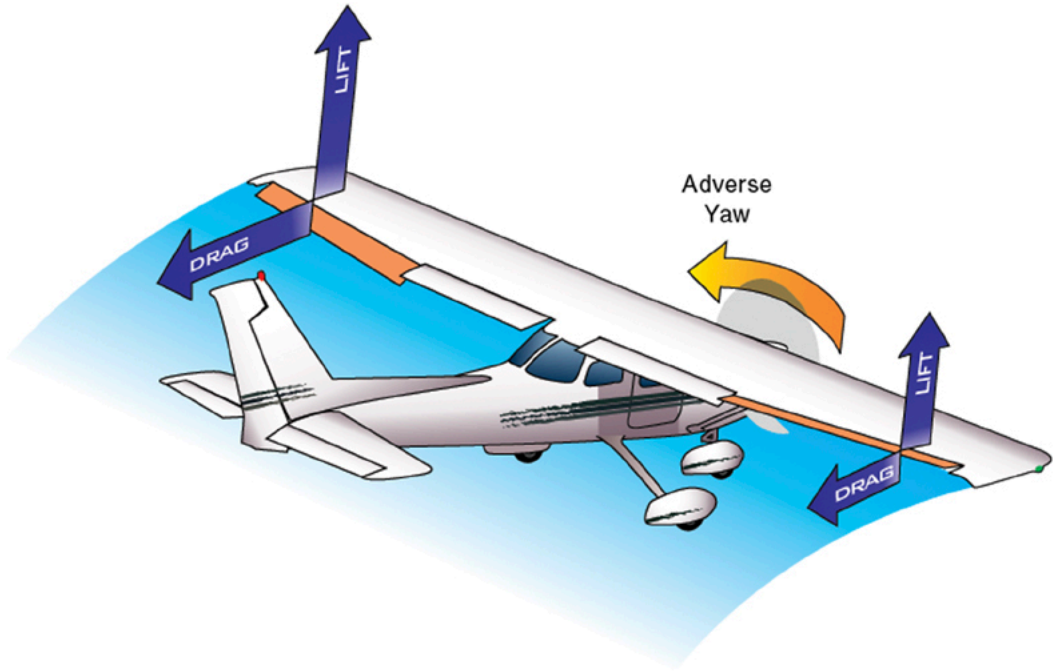


FIG 03-63

Guided Flight Discovery Private Pilot Manual

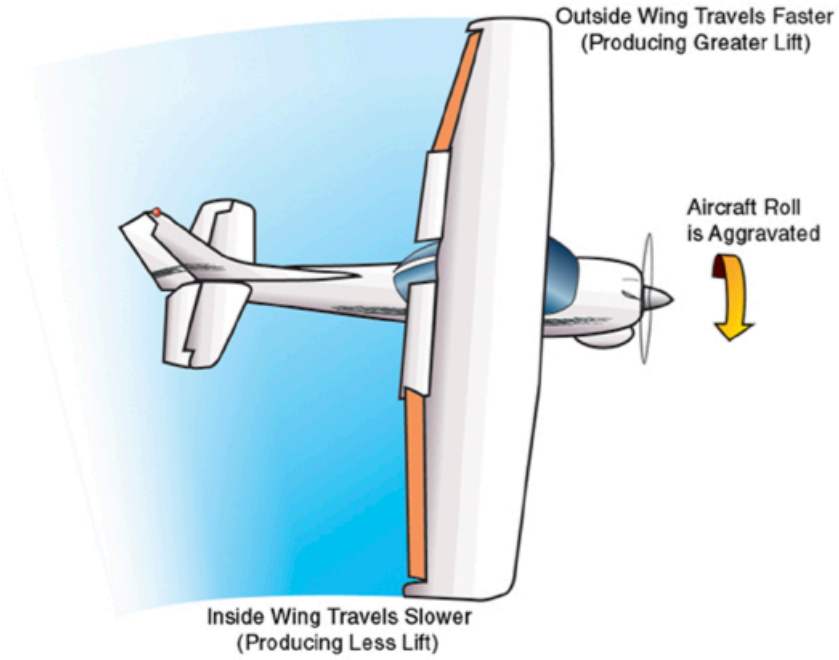


FIG 03-64

Guided Flight Discovery Private Pilot Manual

How to Turn an Airplane

- Pick a point directly ahead
- Roll right or left - simultaneously apply enough rudder pressure to keep the nose from yawing in the opposite direction of the turn
- Same for rolling into and out of a turn
- Once in the turn, look over nose to see if it points along the curving flight path.
- “Cheek check!”

Rudder Training

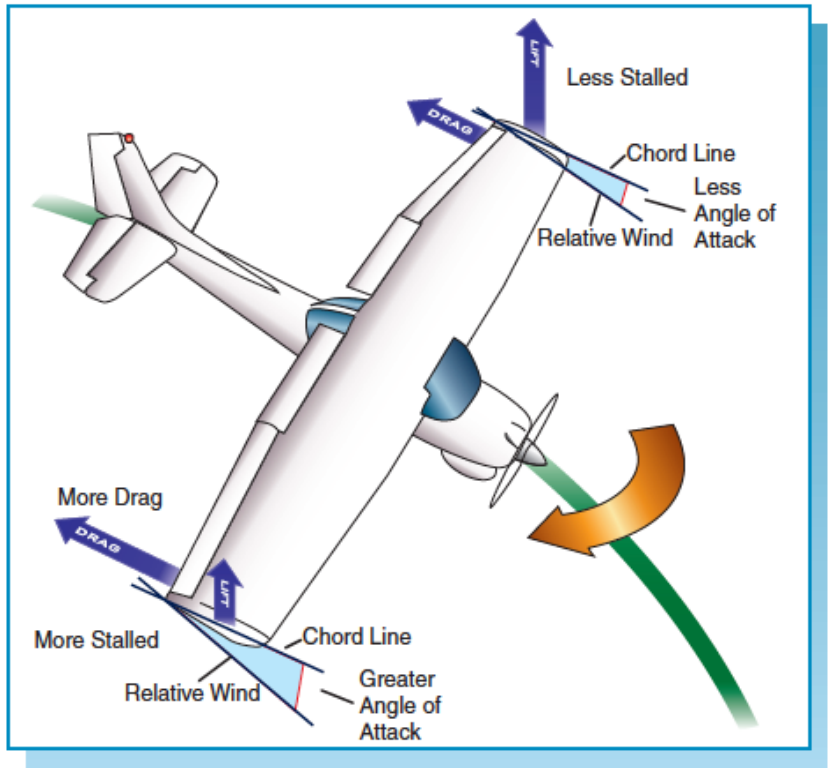
Where can we use rudder to raise (or lower) a wing?

- Climb out after takeoff
- During slow flight
- Practicing power off (landing) & power on (takeoff) stalls
- When a wing suddenly lowers due to a wind gust
- Unusual attitude
- Spins

Raise a Wing

Why is rudder preferred when attempting to raise a wing in a high AoA situation?

- Lowering its aileron increases a wing's AoA, possibly beyond the critical angle at which it stalls.

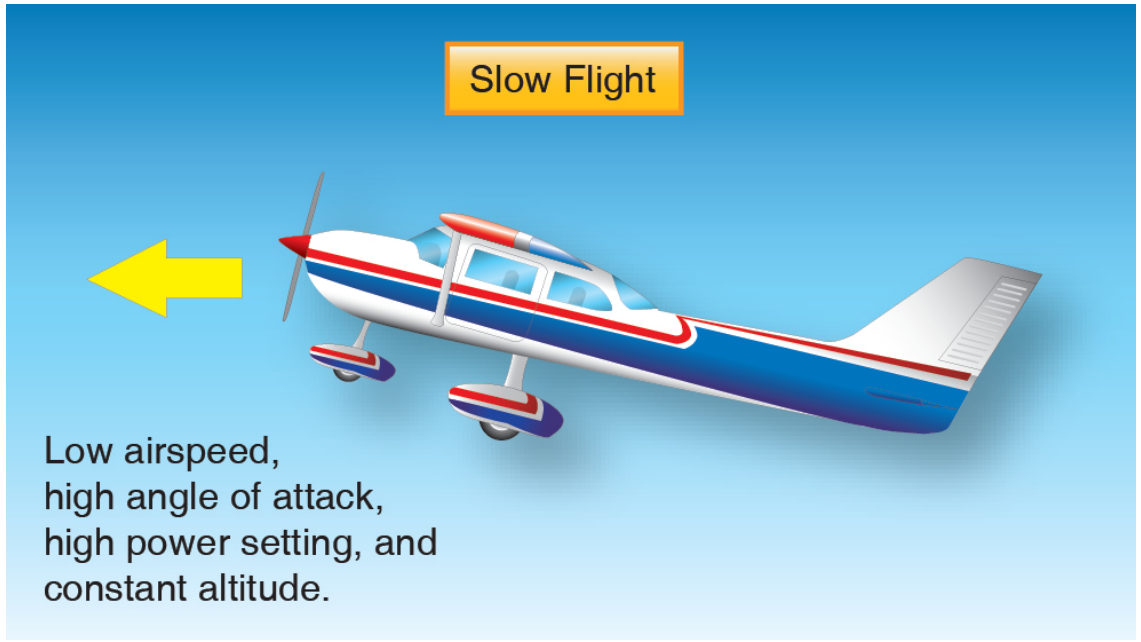


Slow Flight

- Takeoff
- Landing
- A go-around
- Missed approach (IFR)
- For spacing
- Canyon Turns
- You need to loiter over an area for an extended period

What is Slow Flight

- Controls feel mushy
- Controls less effective
- Need larger inputs
- Left Turning Tendencies
    - P-factor
    - Torque
    - Slipstream
- Backside of Power Curve



It is an aerodynamic condition, NOT a speed. Each aircraft has a specific speed.

Angle of Attack

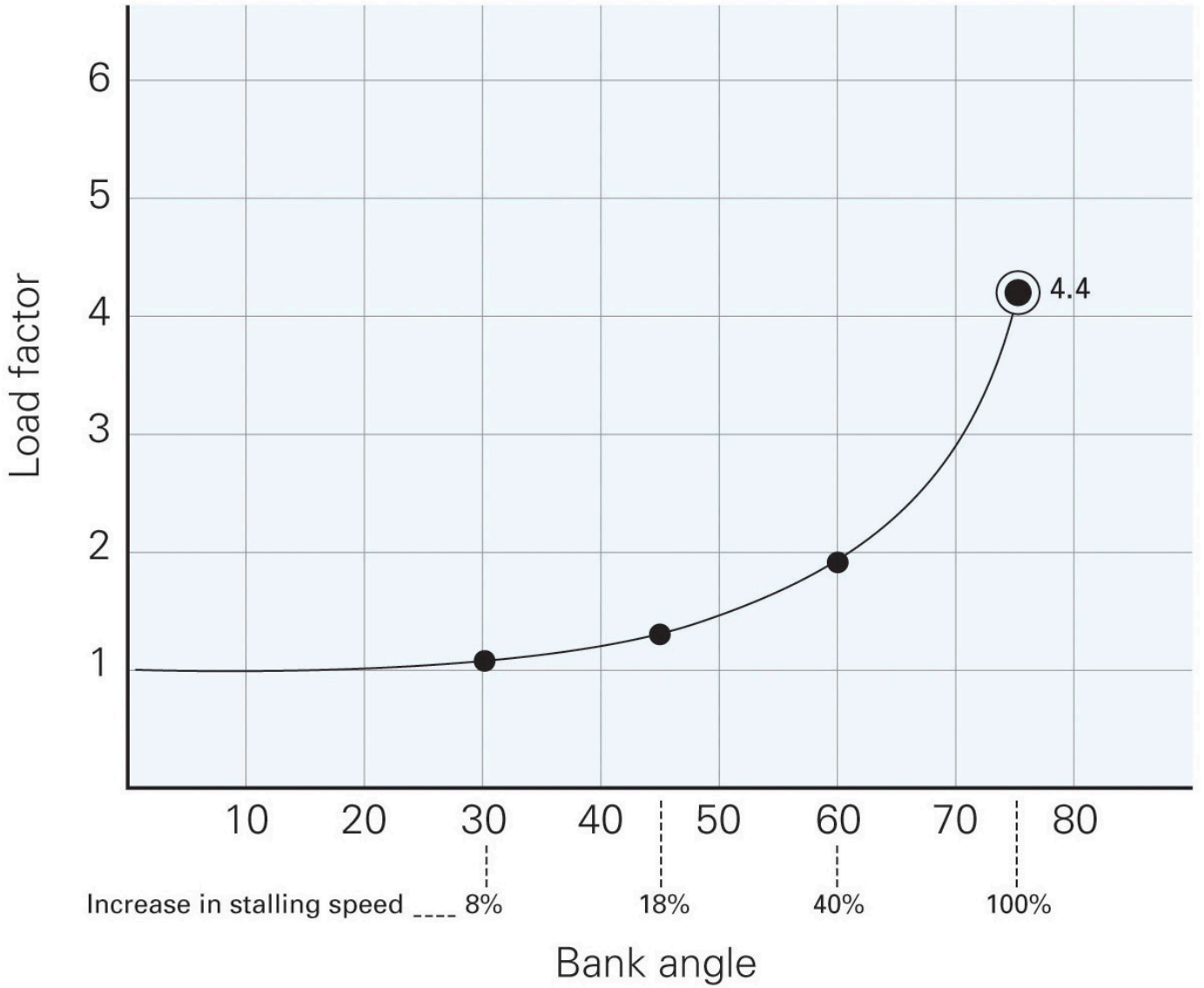
Is it dependent upon speed or pitch?

No!

What factors affect a stall?

Load
Configuration

Load Factor


Load factor
6
5
4
3
2
1
4.4
10
20
30
40
50
60
70
80
Increase in stalling speed
8%
18%
40%
100%
Bank angle

Stall

What single factor is necessary for a wing to stall?

EXCEEDING
CRITICAL ANGLE OF ATTACK!

Stall

What single factor is necessary to recover from a stall?

REDUCING
ANGLE OF ATTACK
BELOW CRITICAL

Are We Stalled?

WHEN ARE POWER OFF STALLS LIKELY?

- Base to final turn
- Stretching a glide
- Flaring too high
- Wind shear on final
- Engine failure on T.O.

WHEN ARE POWER ON STALLS LIKELY?

- Too high AoA > Ground Effect
- Go Around
- Clearing an Obstacle
- Trim Stall
- Practicing Maneuvers
- Lee Side Sink

Spins

What two things must occur for an airplane to spin?

STALLED

&

YAWED

Base to Final Stall/Spin

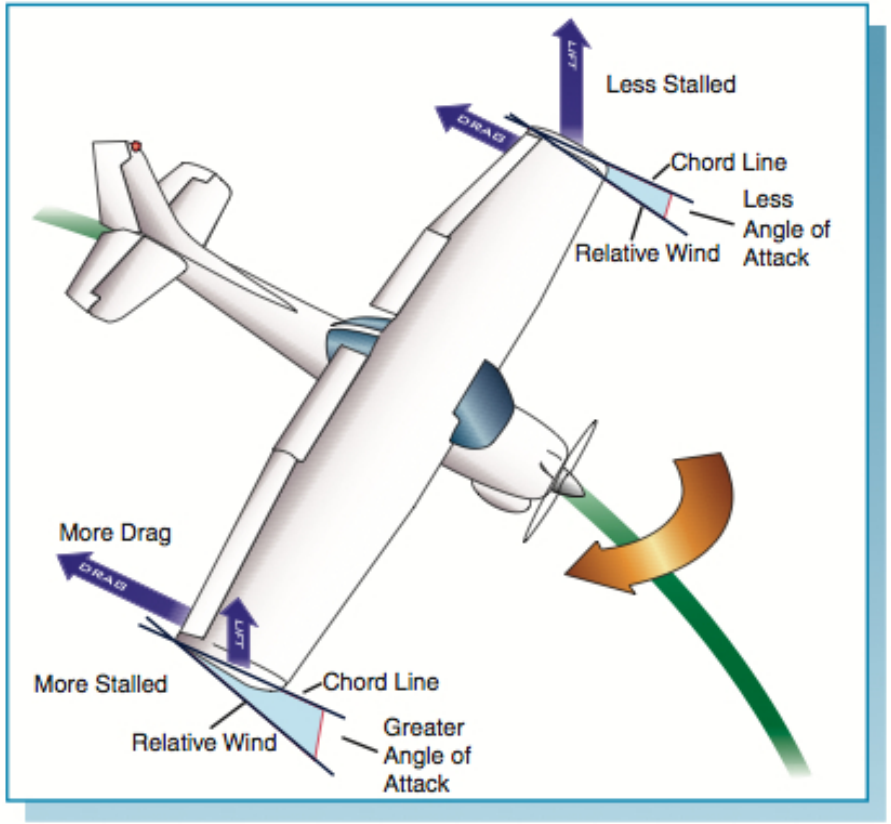
DEADLY SEQUENCE INITIATED BY THE PILOT:

1. Overshoots runway centerline
2. Elects not to execute a go-around
3. Believes ailerons turn the airplane, but advised not to exceed “X” in the pattern
4. Tries to tighten the turn with inside/bottom rudder instead
5. Nose yaws below the horizon
6. Pulls back on yoke, believing “elevator = up”
7. Turn tightens, G’s increase, speed decreases – increasing AOA cues!
8. Consequence: Yaw + Stall = LOC-I, i.e., Stall/Spin at low altitude

Base-to-final spin:

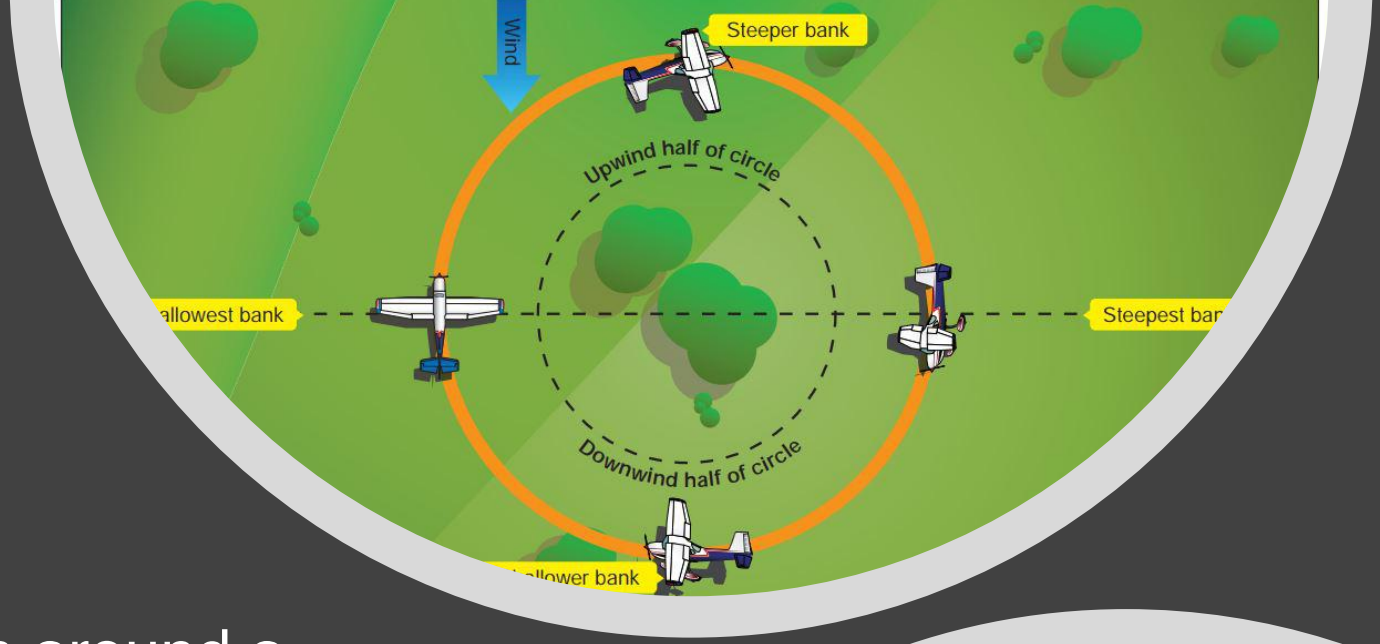
Sources of Yaw?

- Improper rudder use
- Adverse yaw from aileron
- Engine/prop efects:
  - Torque, p-factor, slipstream,
  - Gyroscopic precession
- Wind shear



Turns Around a Point

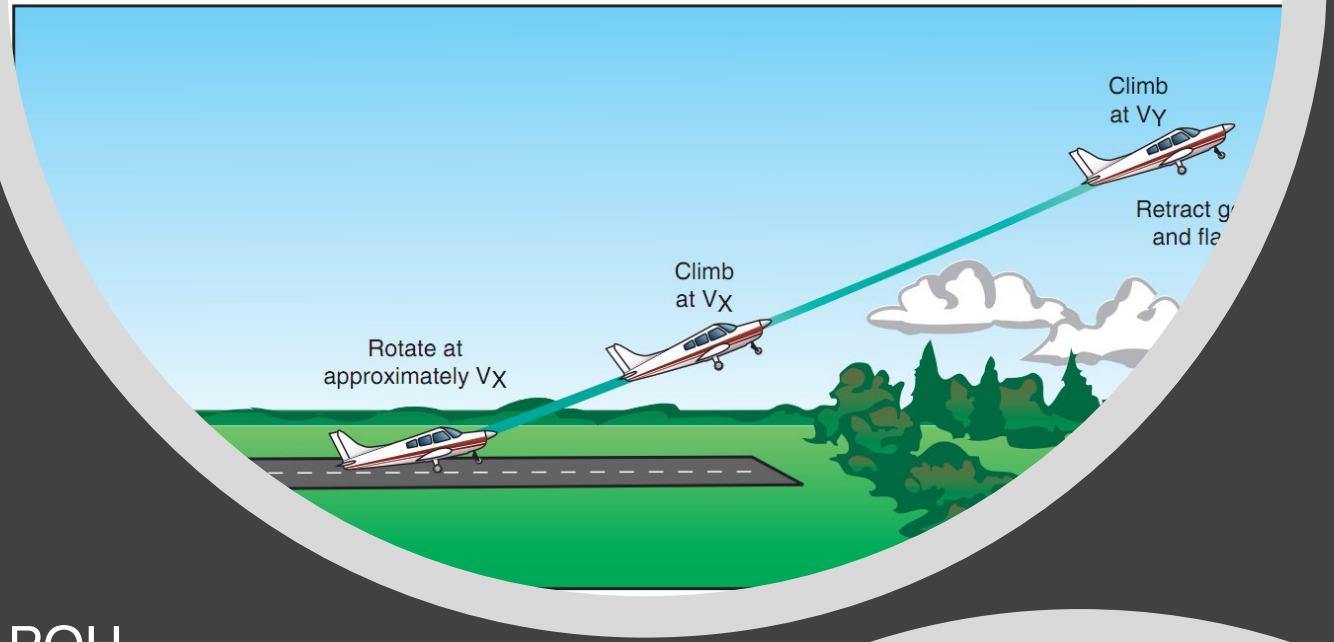
To fly a constant radius turn around a reference point while maintaining altitude.



What Constitutes a Stabilized Approach?

- On Speed
  - Fast or slow?
- On Spot
  - High or low
  - On centerline
- Airplane Configured
- Checklist completed
- Starts downwind a-beam touchdown point

Short-field Take-off



- Do some math - check the aircraft's POH
- Atmospheric Considerations
- Use of Flaps (following the POH)
- Use all available runway
- Sounds good – looks good
- Maximum Performance Climb
- Left Turning Tendencies
- Use of Trim

SHORT FIELD

...hnique as specified in Section 4.
...eoff from fields above 3000 feet elevation, the mixture should be leaned to give maximum ...
...up.
...distances 10% for each 9 knots headwind. For operation with tailwinds up to 10 knots, increa...
...h 2 knots.
...peration on a dry, grass runway, increase distances by 15% of the "ground roll" figure.

GHT BS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C	
	LIFT OFF	AT 50 FT		GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEA 50 FT OB
2300	52	59	S.L.	720	1300	775	1390	835	1490	895	1590
			1000	790	1420	850	1525	915	1630	980	1745
			2000	865	1555	930	1670	1000	1790	1075	1915
			3000	950	1710	1025	1835	1100	1970	1185	2115
			4000	1045	1880	1125	2025	1210	2175	1300	2335
			5000	1150	2075	1240	2240	1335	2410	1435	2595
			6000	1265	2305	1365	2485	1475	2680	1585	2895
			7000	1400	2565	1510	2770	1630	3000	1755	3245
			8000	1550	2870	1675	3110	1805	3375	1945	3670

Short-field Landing

- Starts at beam point
- Visualize glide path
- Stabilized at 1.3 V_{so} (~3-5 kts slower)
- Manage energy (both horizontal & vertical)
- Touchdown firmly
- Aerodynamic Braking

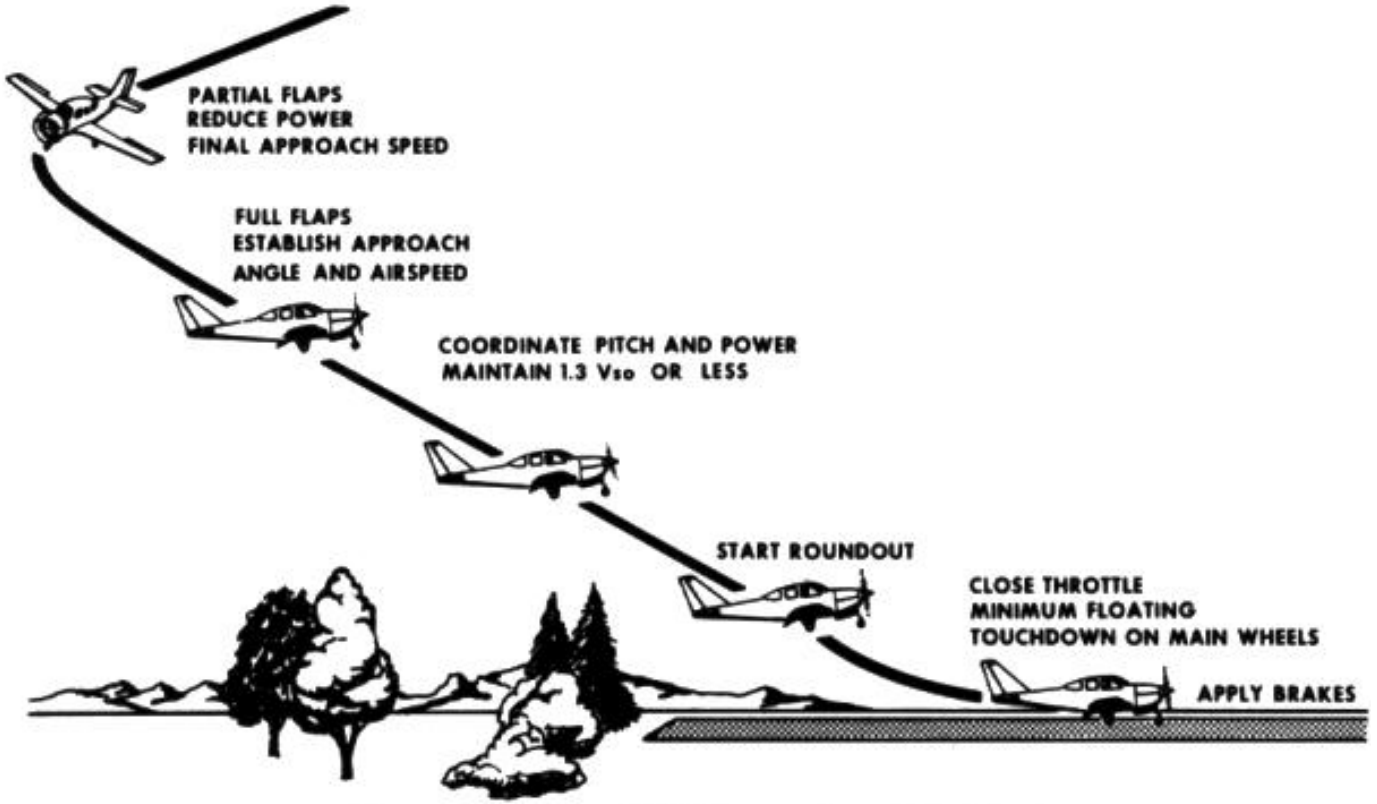
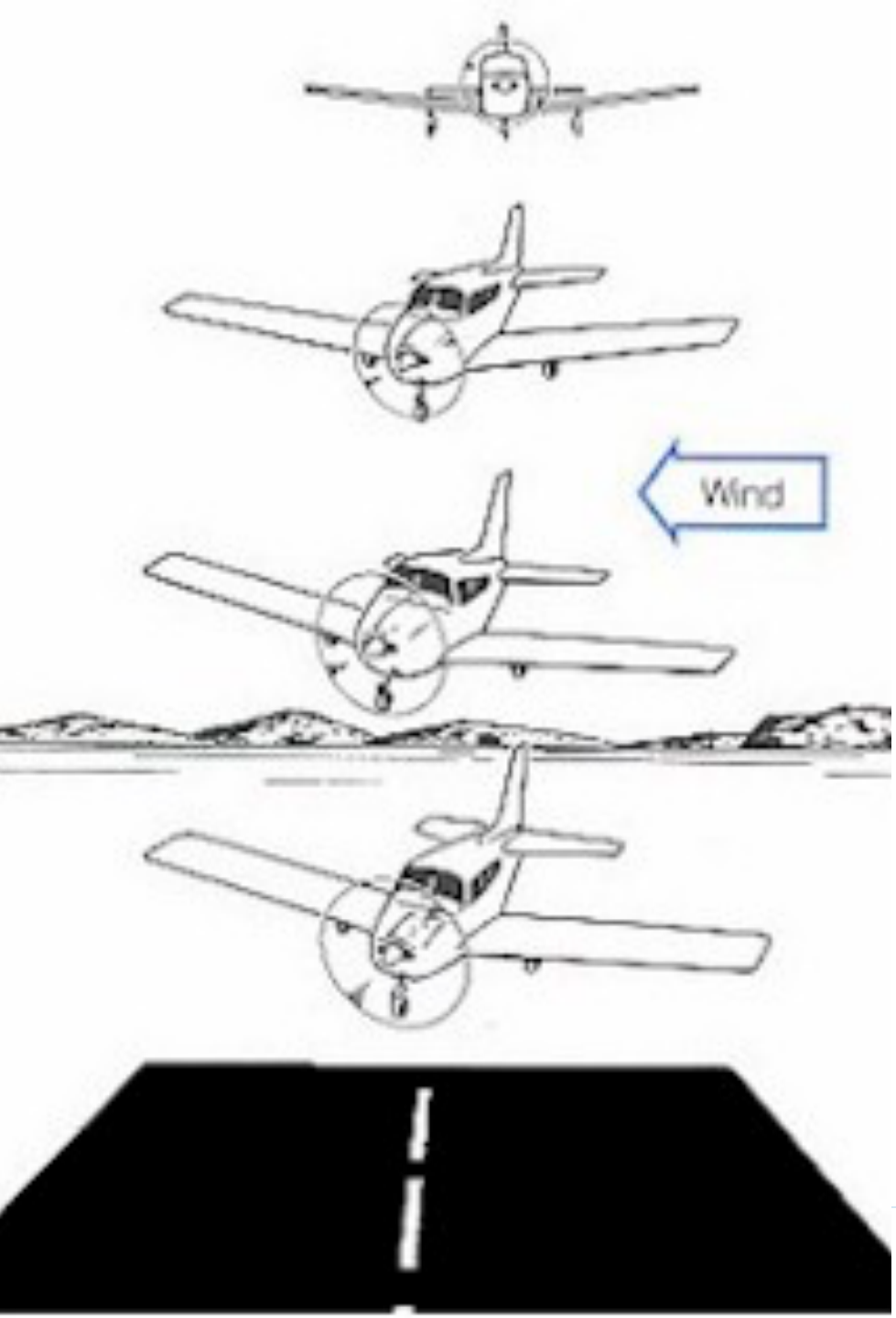


Figure 9-16 Short Field Approach and Landing



Forward Slips

- The ability to dissipate altitude without decreasing airspeed.
- Bank angle determines rate of descent
- Ground track controlled by rudder
- Slip into the wind

Key Takeaways

- Visualize the Flight
- You Take the Airplane for a Ride, Not the Other Way Around
- Eyes Outside
- Feel the Airplane
- Train for the Basics

The Beginner’s Mind

Practice, Practice, Practice

“The goal of practice is always to keep our beginner’s mind.”

— Shunryu Suzuki, Zen Mind, Beginner's Mind: Informal Talks on Zen Meditation and Practice
Second level

Thank You!

Jason T. Archer
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Berkshire Aviation, LLC
www.BerkshireAviation.com

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