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Teaching Maneuvers

Advanced Knowledge of the Commercial Maneuvers – The How's and the WHYs!

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Advanced Knowledge of the Commercial Maneuvers

Deep Dives Into

Steep Spirals

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Advanced Knowledge of the Commercial Maneuvers

Deep Dives Into

Chandelles

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Deep Dives Into

Lazy Eights

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Deep Dives Into

Eights on Pylons

What's Right and What's Wrong

The images in the handbooks are not quite right!

What we will cover

The descriptions of to perform the maneuvers are mostly right!

Eights on Pylons

At a particular altitude for a given groundspeed a point on the ground will appear to pivot

Eights on Pylons

The question that isn’t answered is WHY?

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What we will cover

It’s about a little geometry

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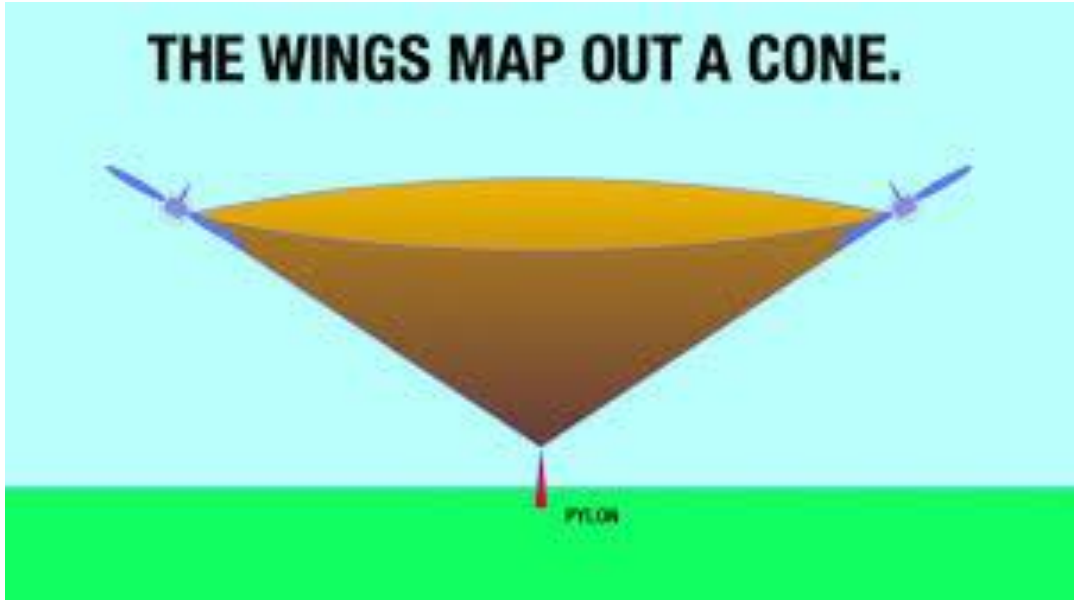
Your line of sight equates to the angle of bank – This defines a cone



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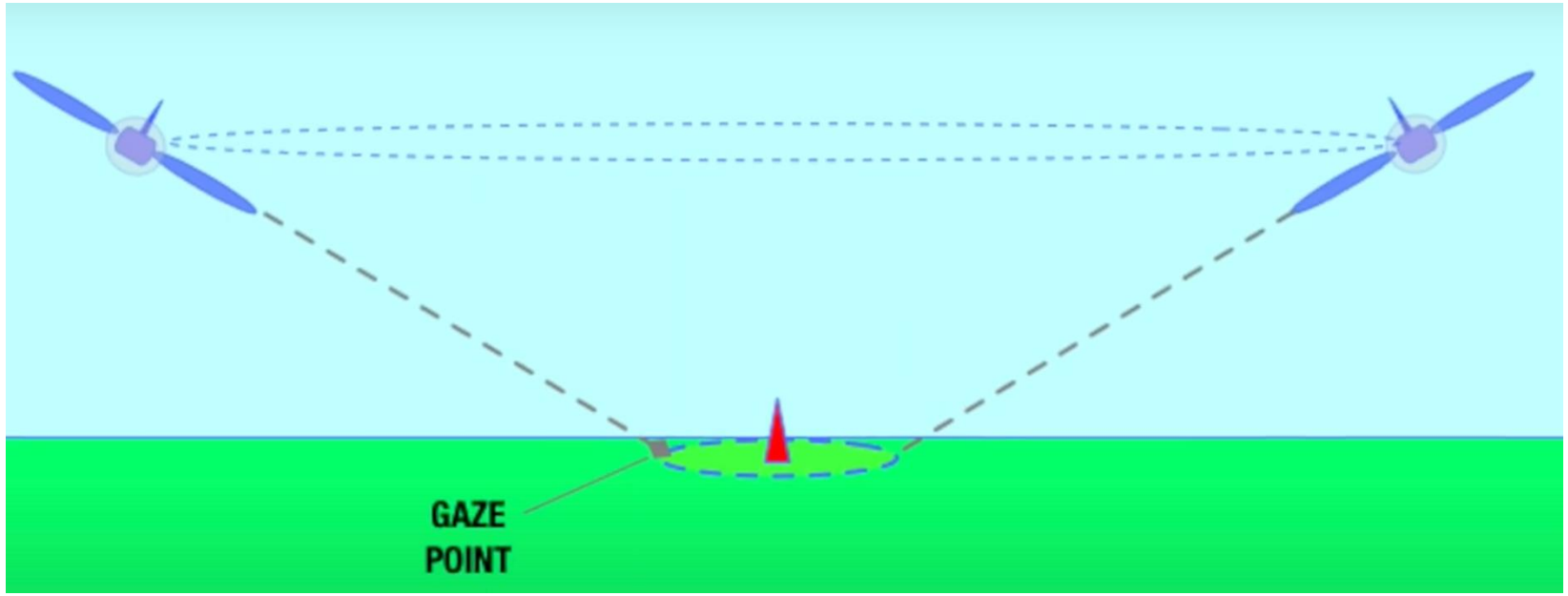
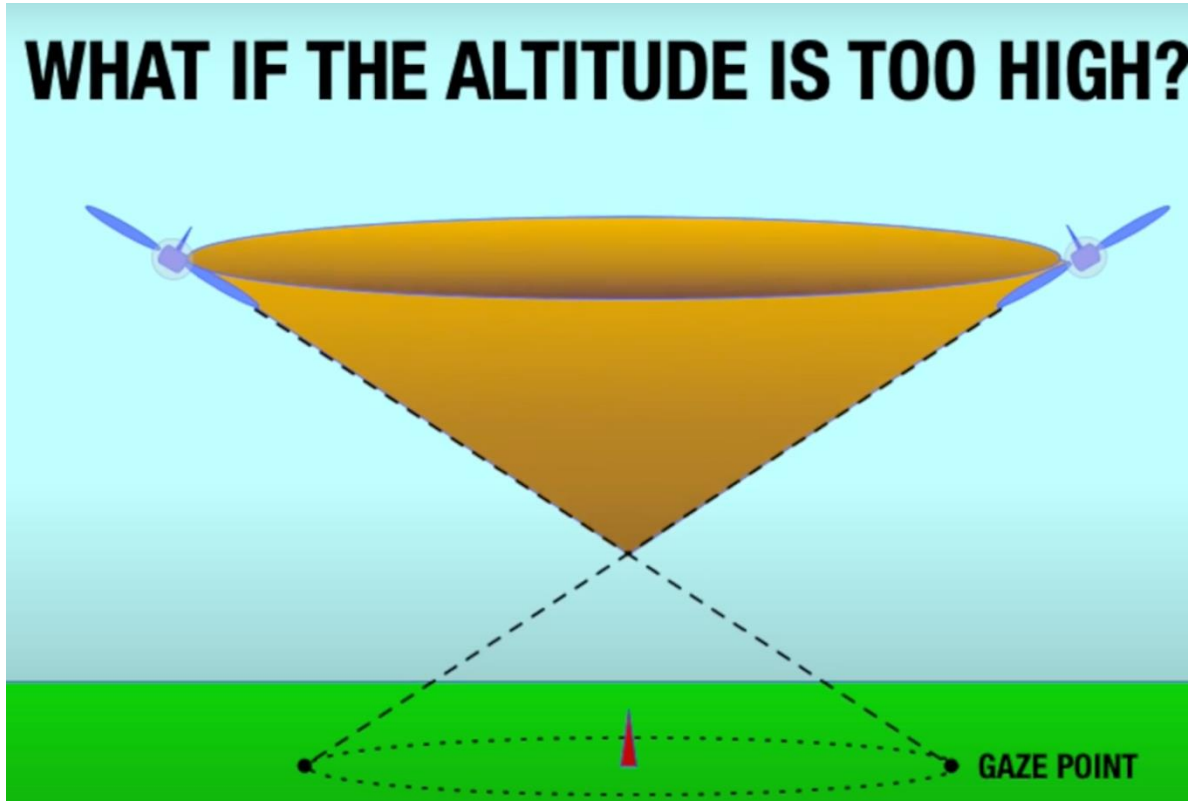
Too low – Apex of the cone is below the earth – a circle is made



Too high – a circle is also made but in a different direction



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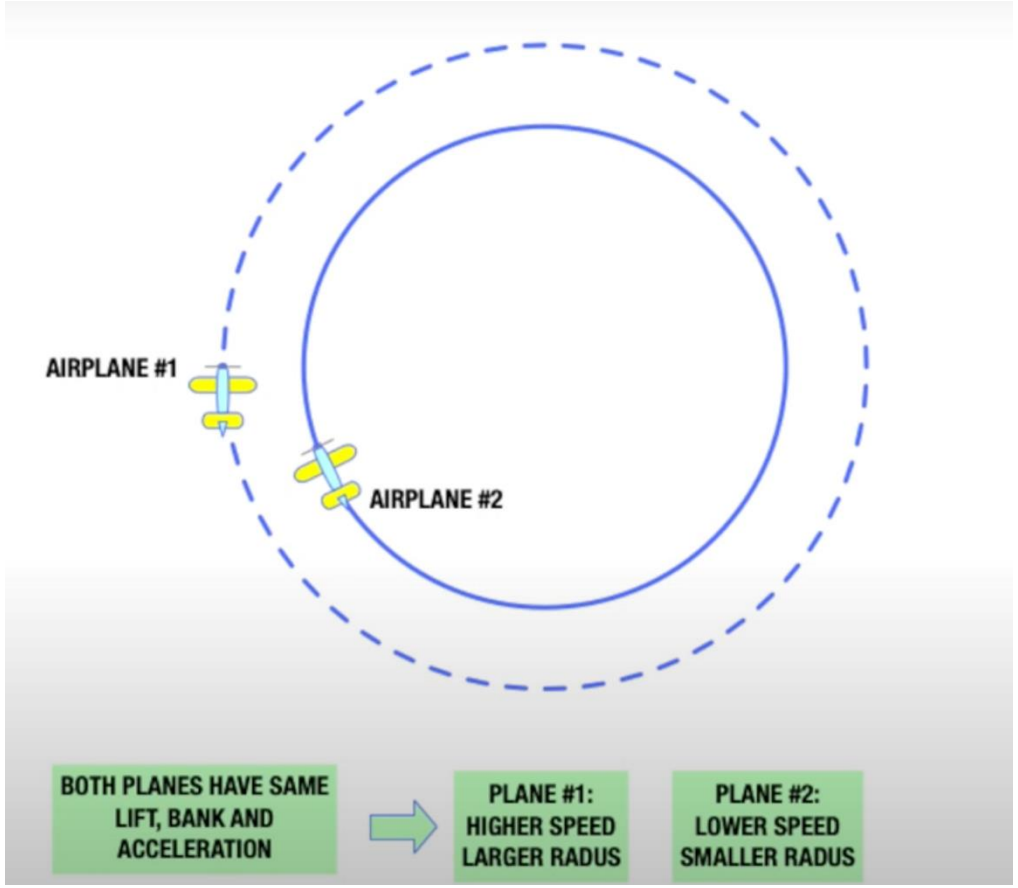
The higher the speed the larger the radius and vice versa



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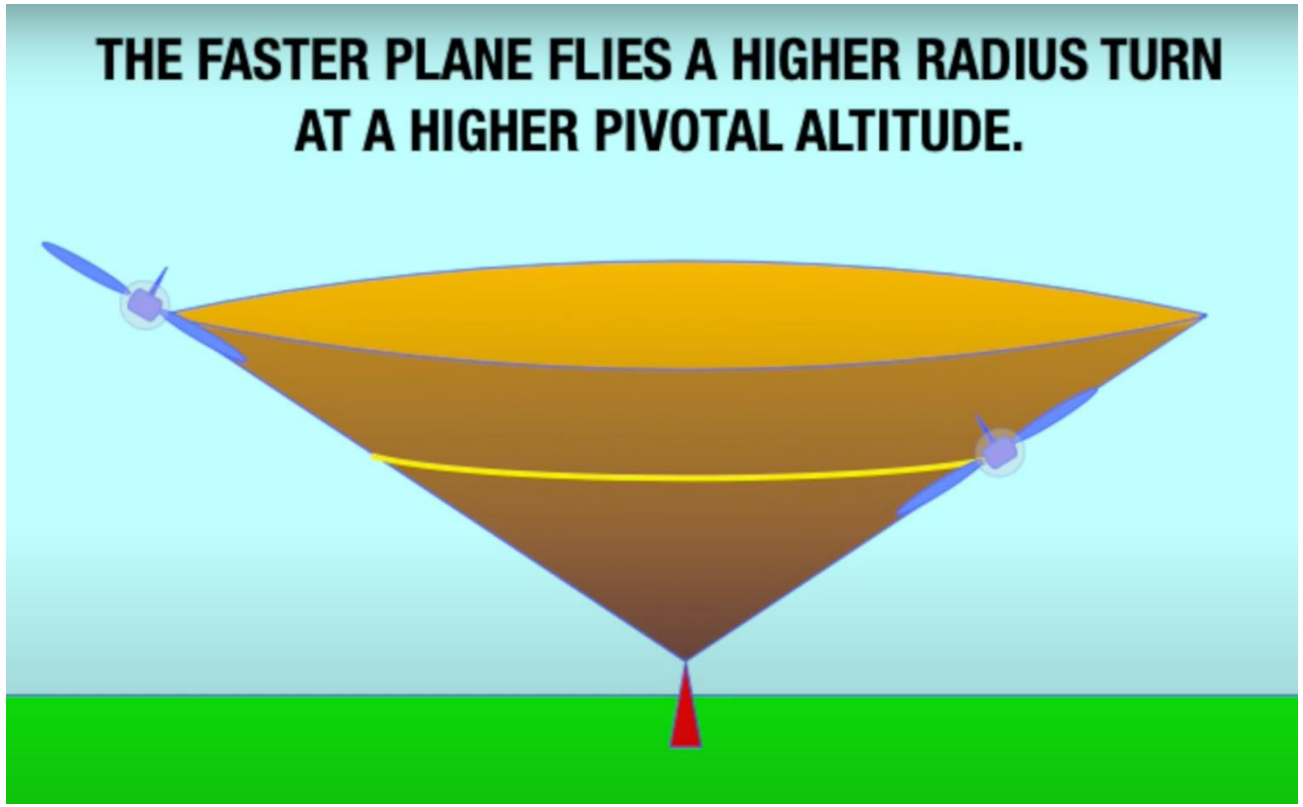

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Pivotal Altitude=$(GS)^2/11.3$

It is only necessary to calculate the highest pivotal altitude. Why not the lowest too?

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Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

PA with a 20kt tailwind is 1071 ft
PA with a 20kt headwind is 434 ft

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Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

You would only need to fly between these two altitudes if you maintained the same indicated airspeed

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Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

Indicated airspeed is allowed to vary during this maneuver

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Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

If too high – pitch forward. This lowers the altitude and increases the airspeed which in turn raises the pivotal altitude

Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

If too low – pitch up. This increases the altitude and decreases the airspeed which in turn lowers the pivotal altitude

Advanced Knowledge of the Commercial Maneuvers

Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

This is referred to as a doubling effect

Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

This is also the reason that only small changes in altitude are made

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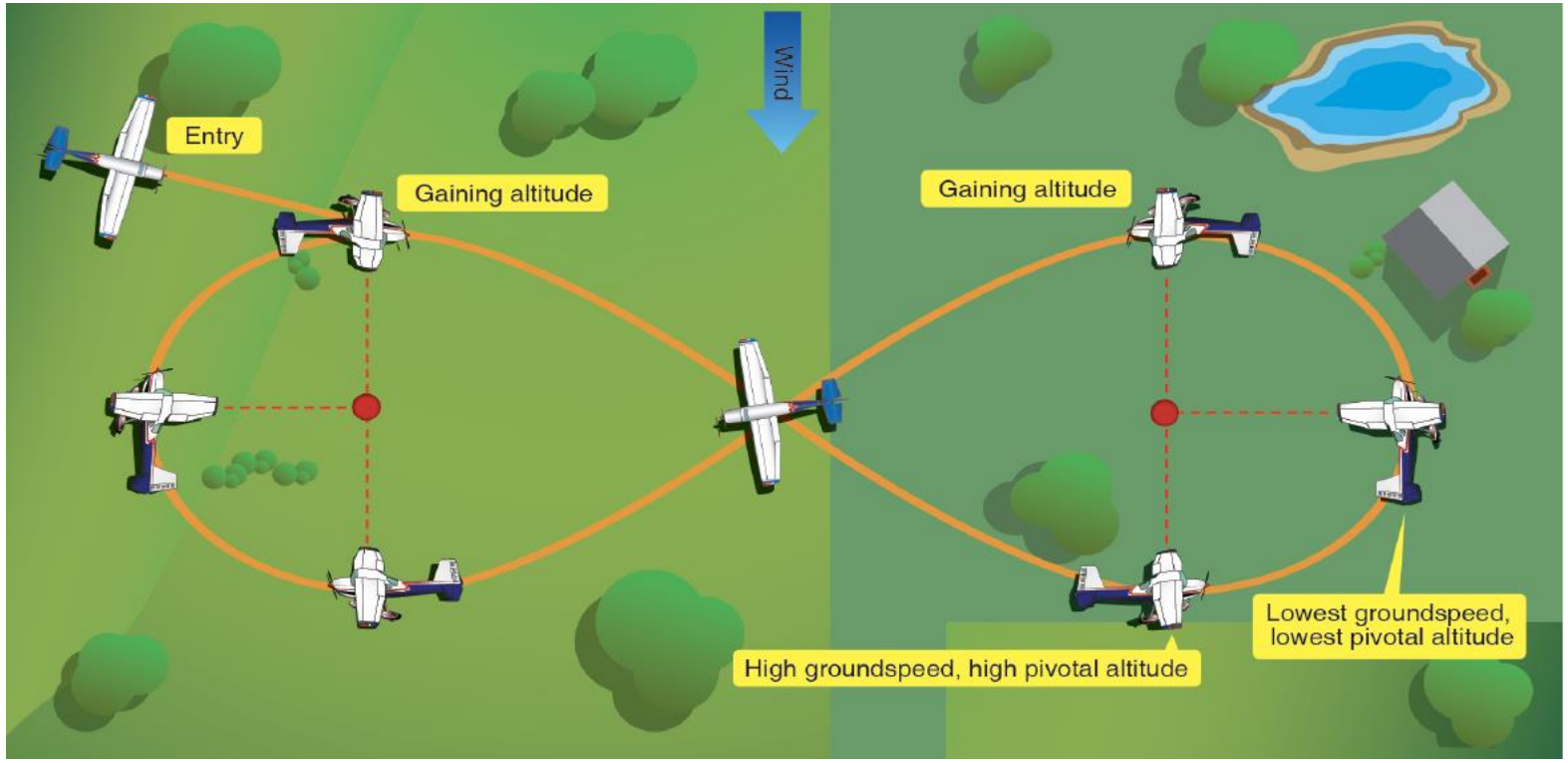
This diagram is WRONG!



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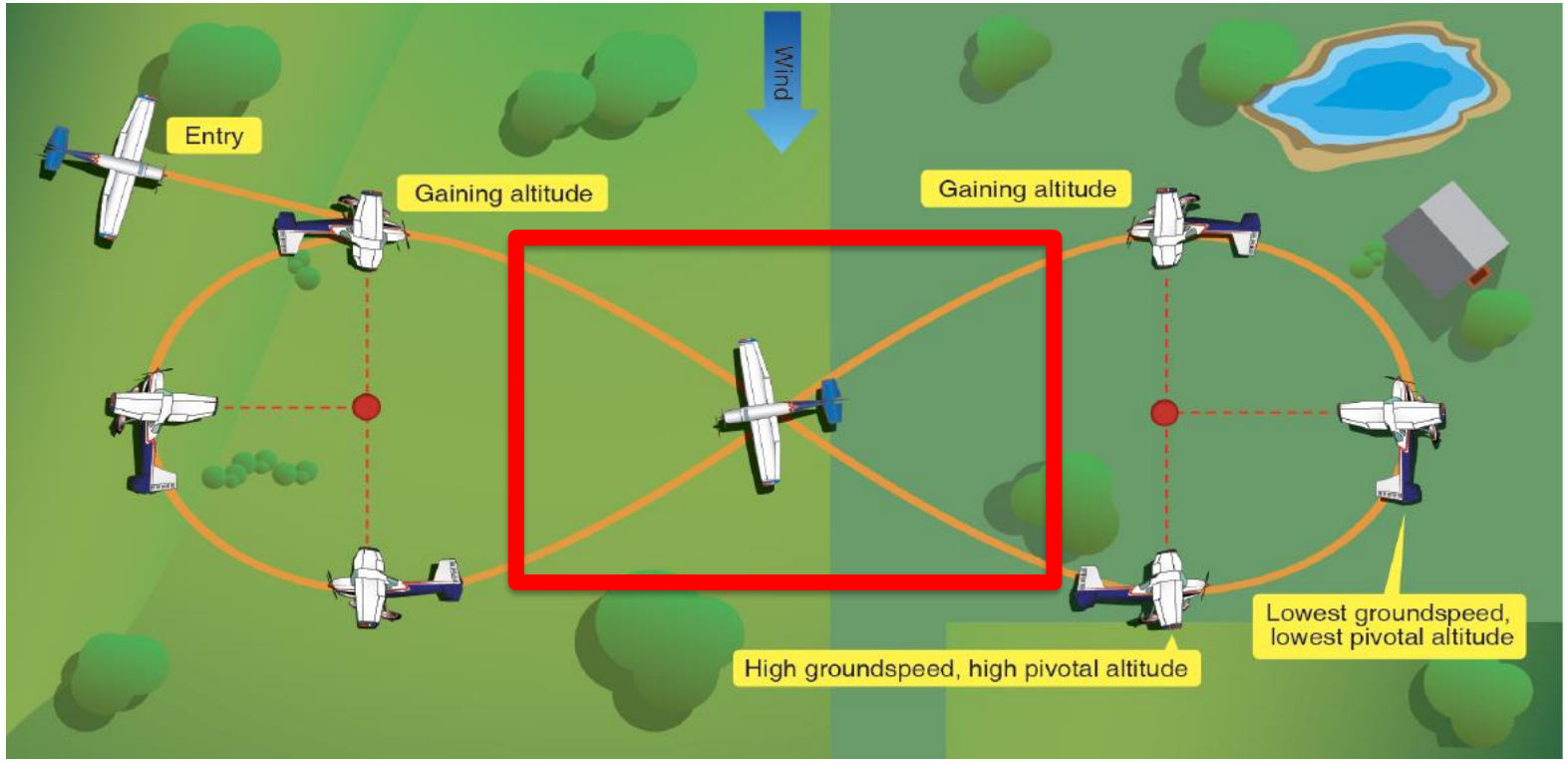
The angles between the pylons are too shallow



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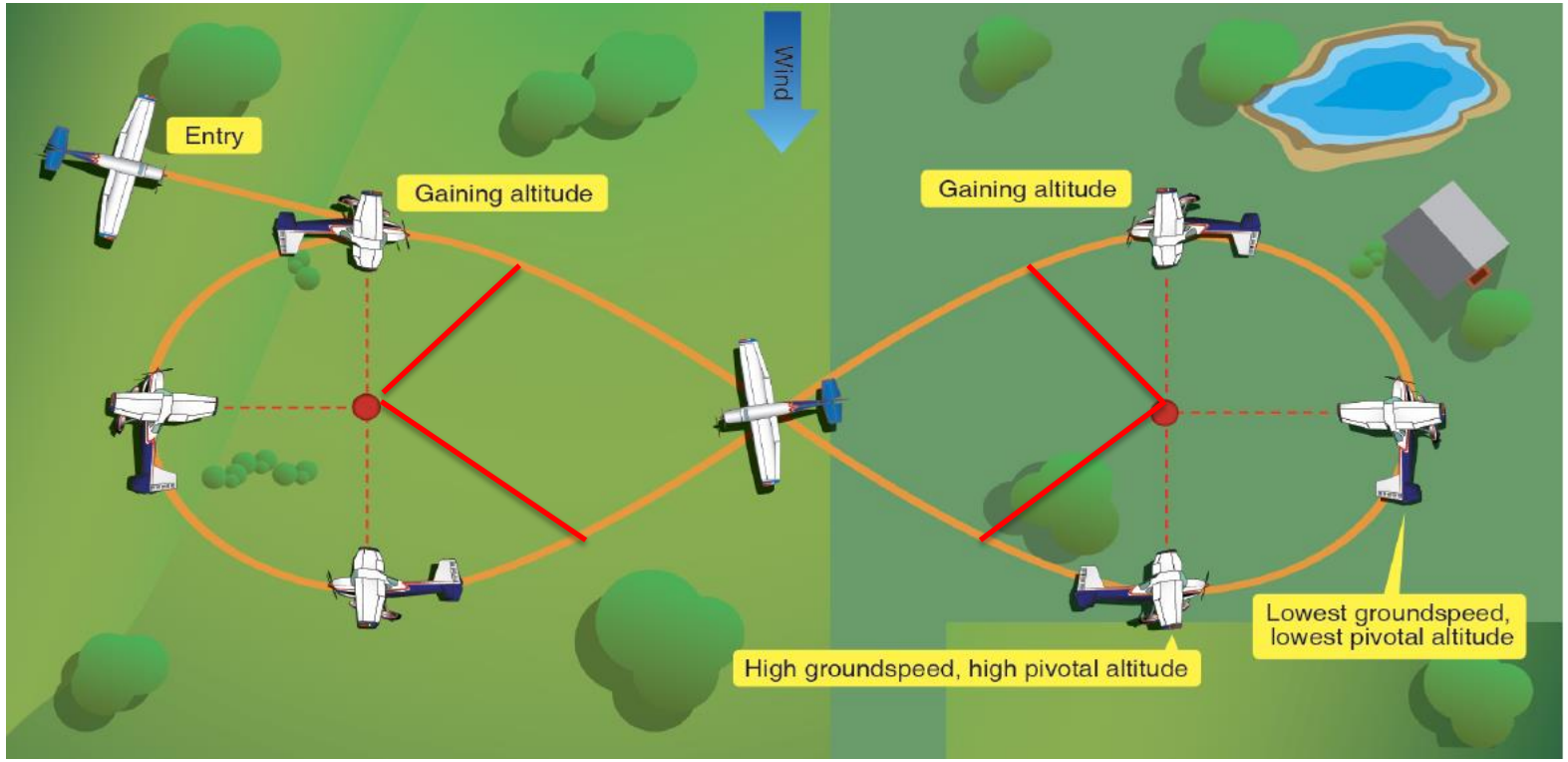
At 45° the pylon would be intercepted and left at different points



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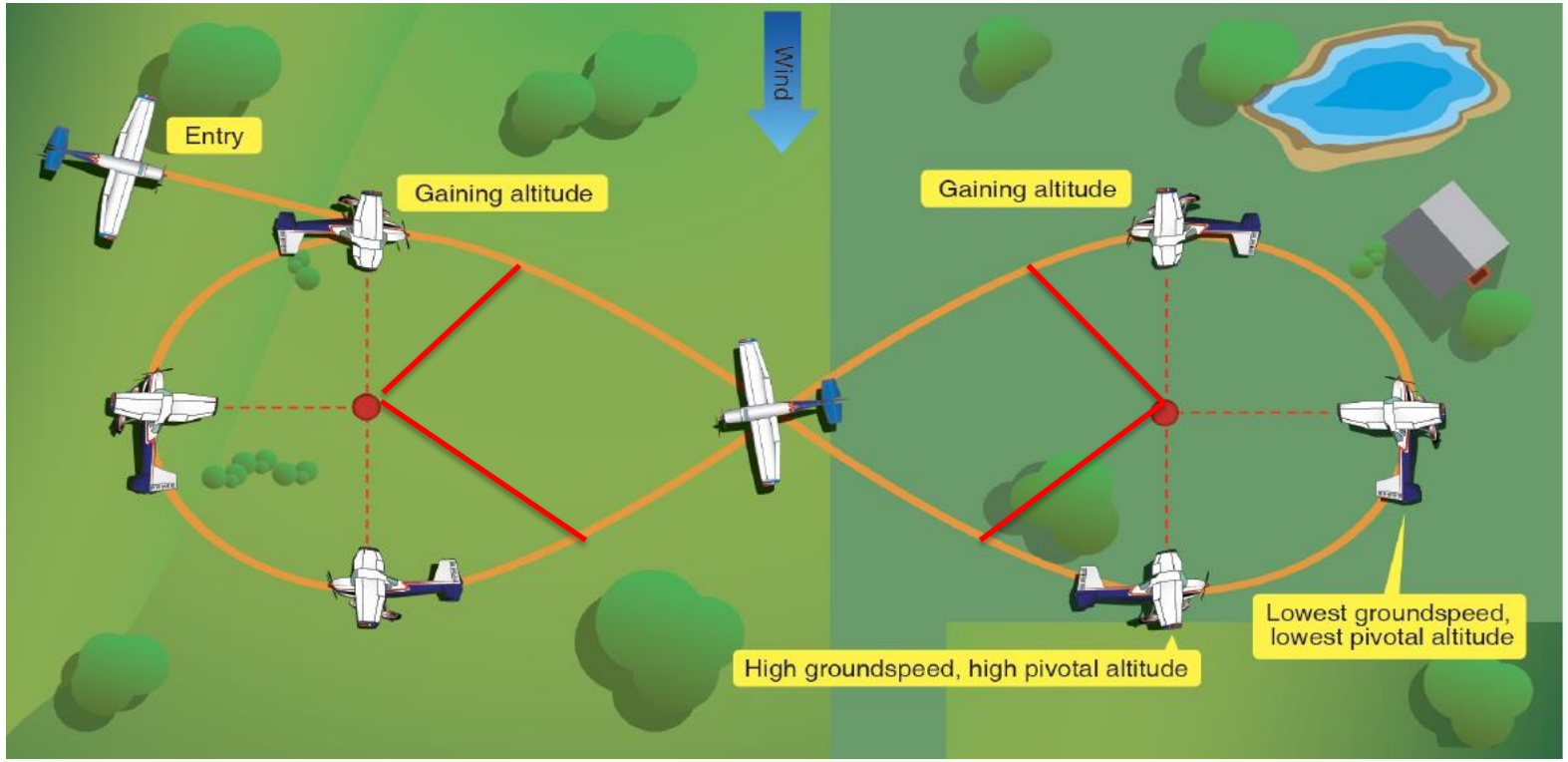
The solid red lines show where the turn would begin and stop



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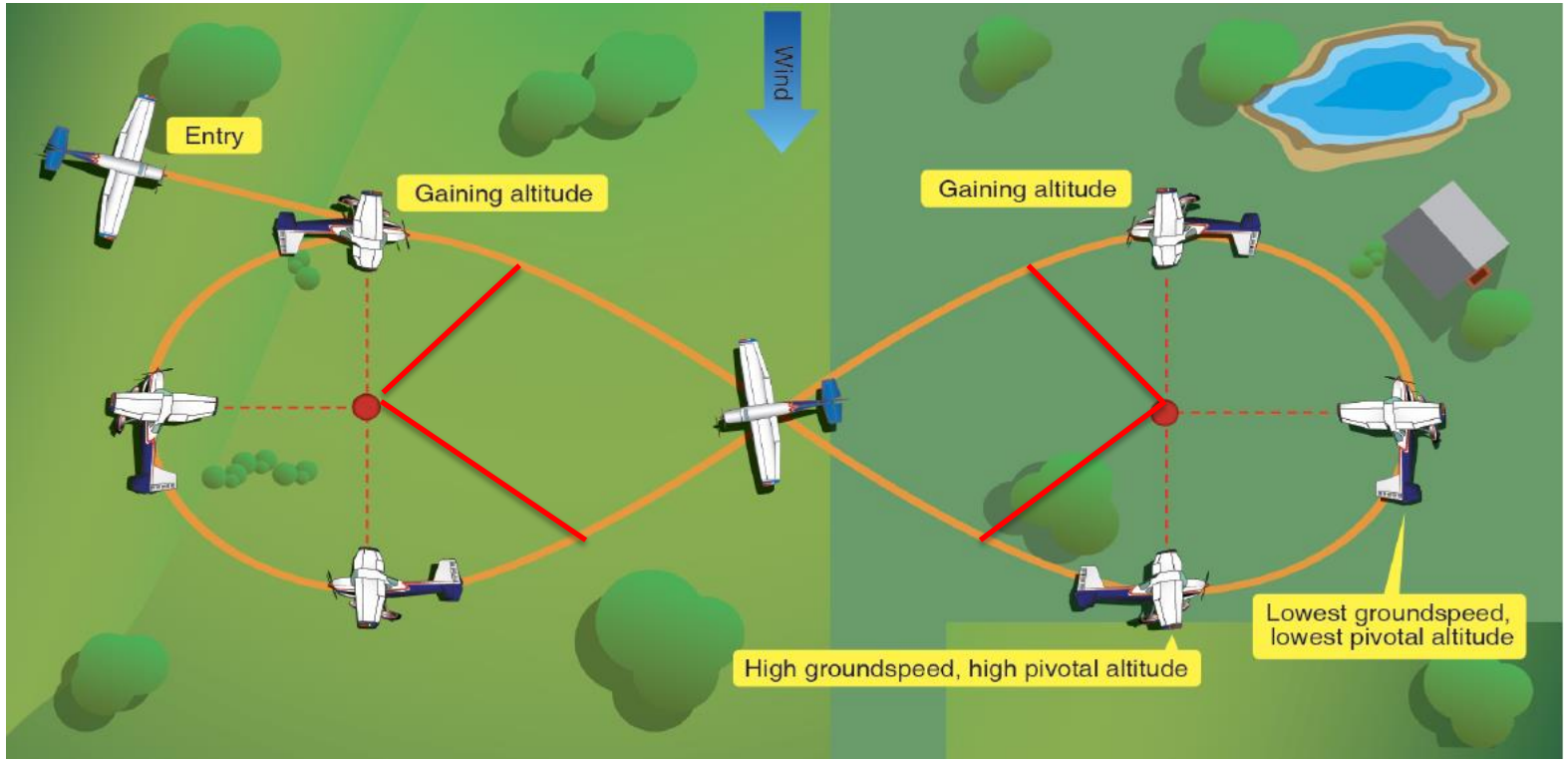
It’s sooner than they have drawn with the dashed red line



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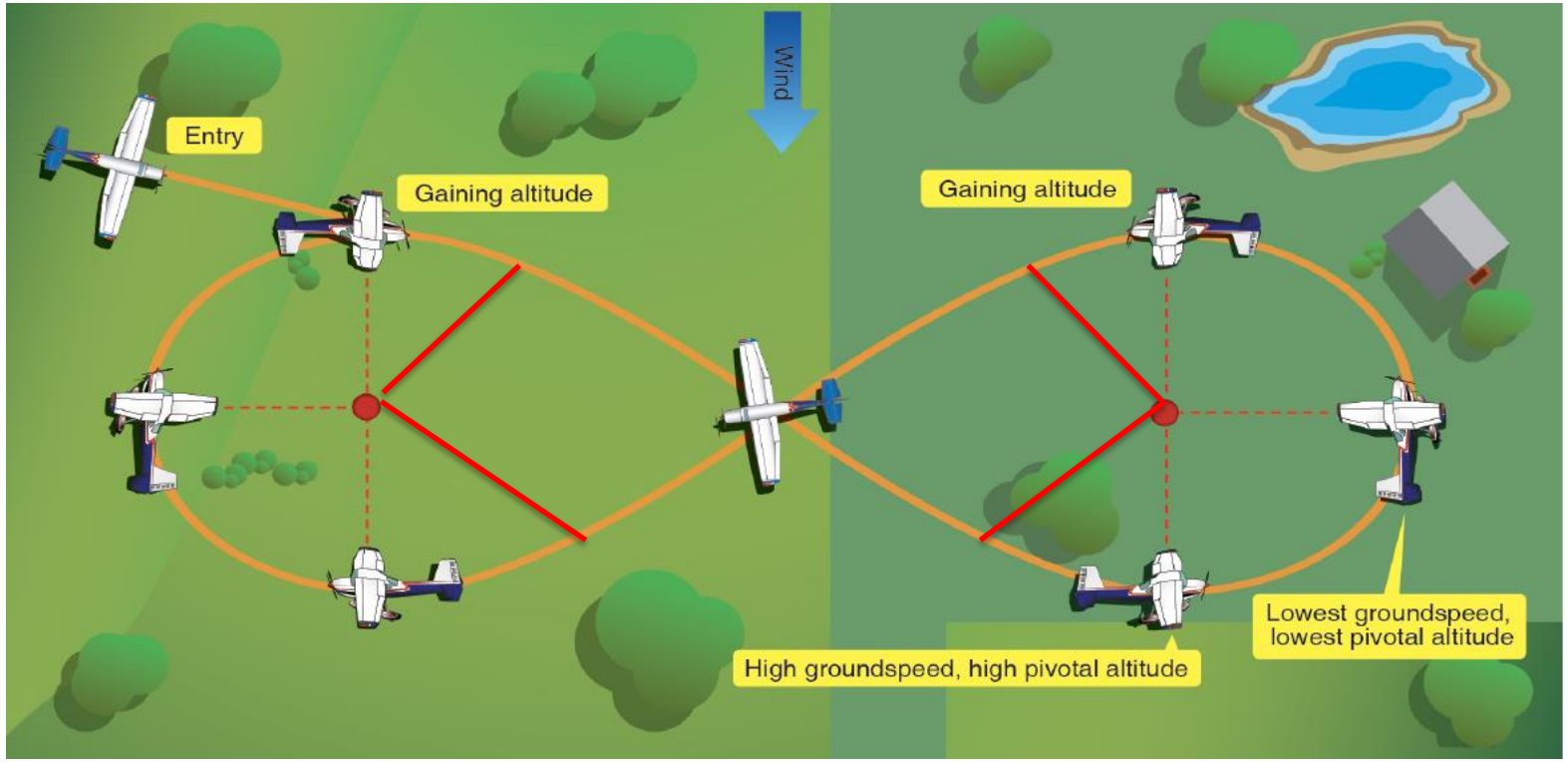
The pattern over the ground is incorrect – it shows constant radius



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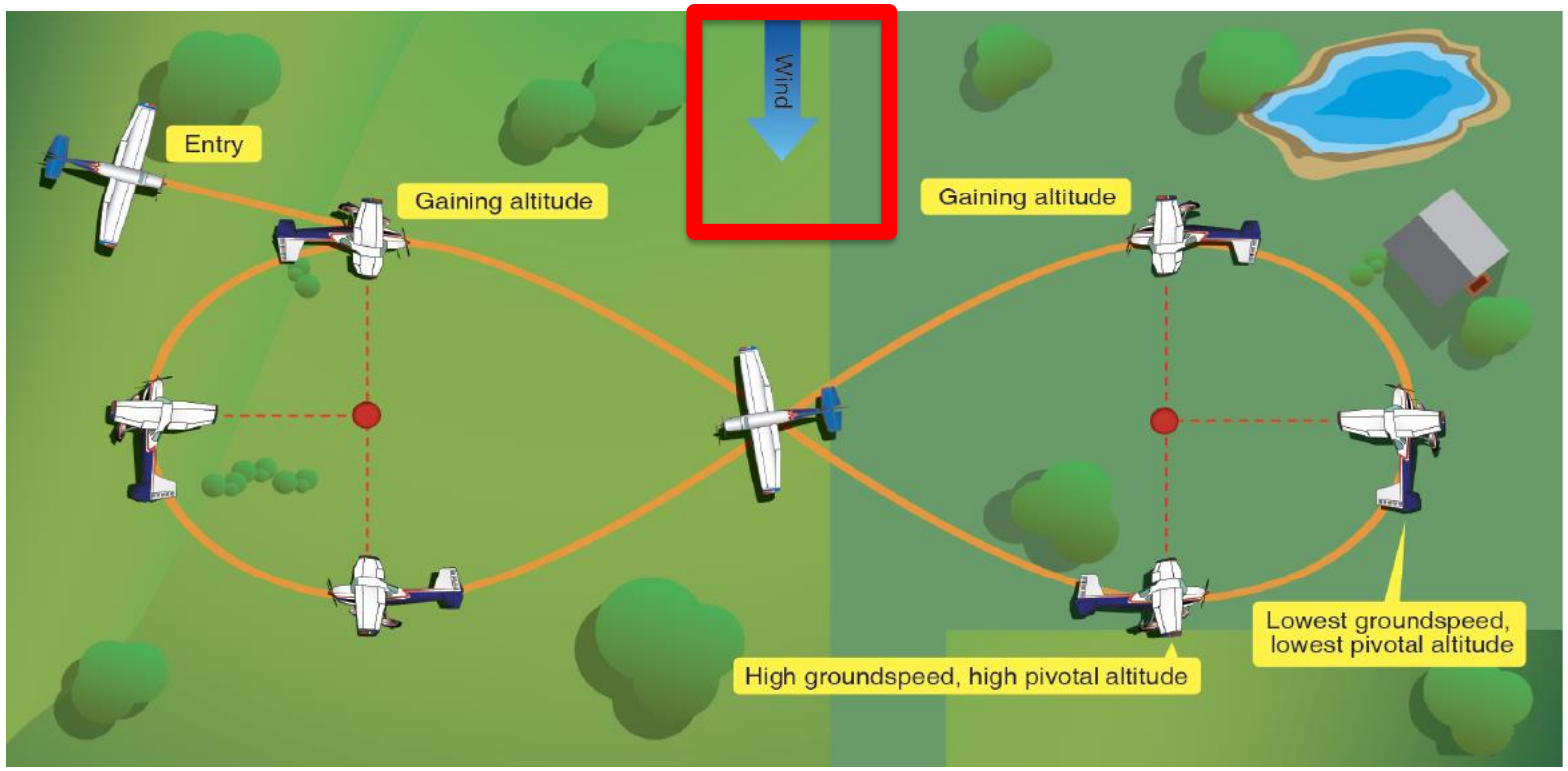
But there is wind – No correction for wind while turning can be made



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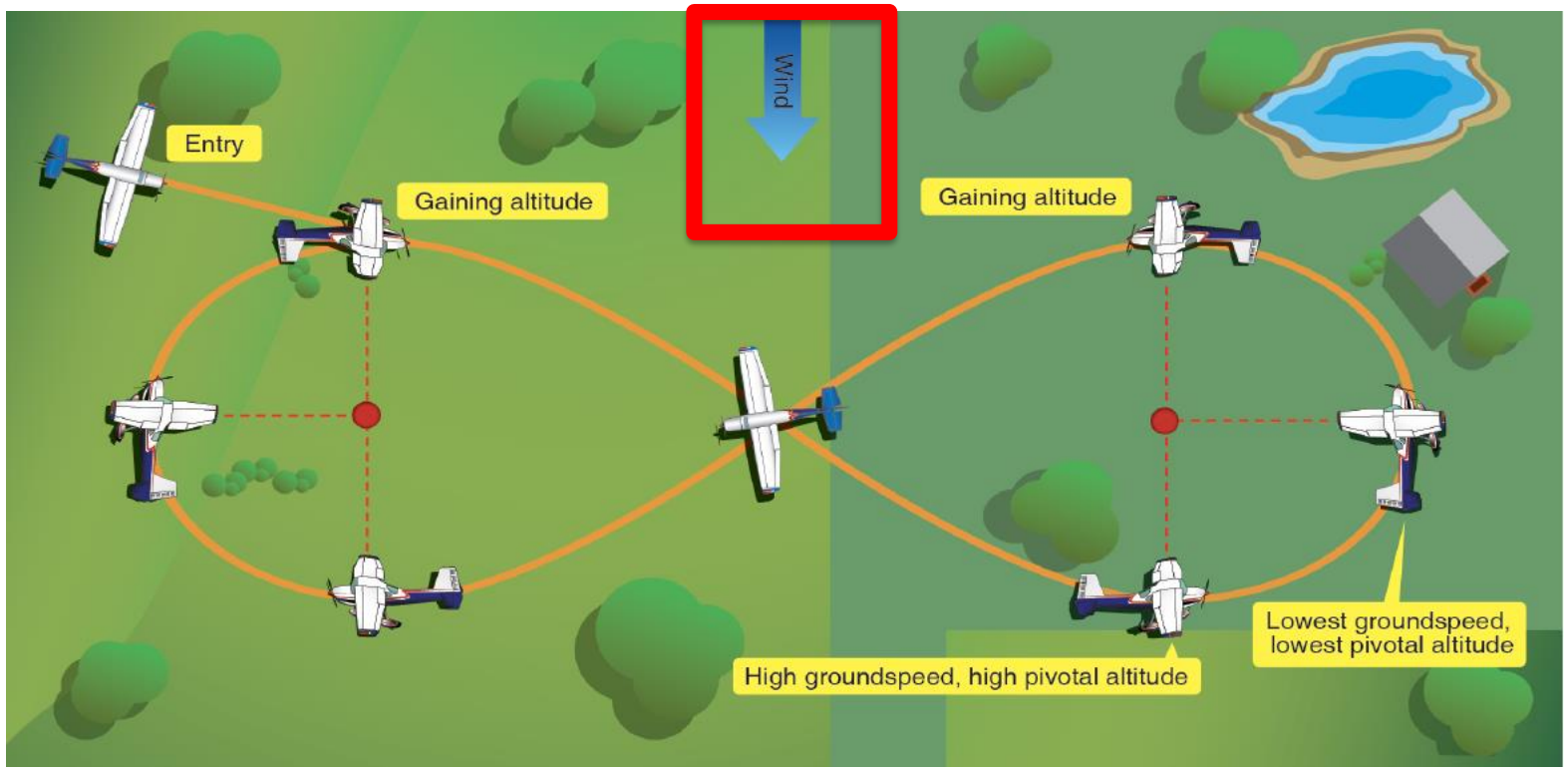
If you try to correct for wind in the turn – your line of sight will change



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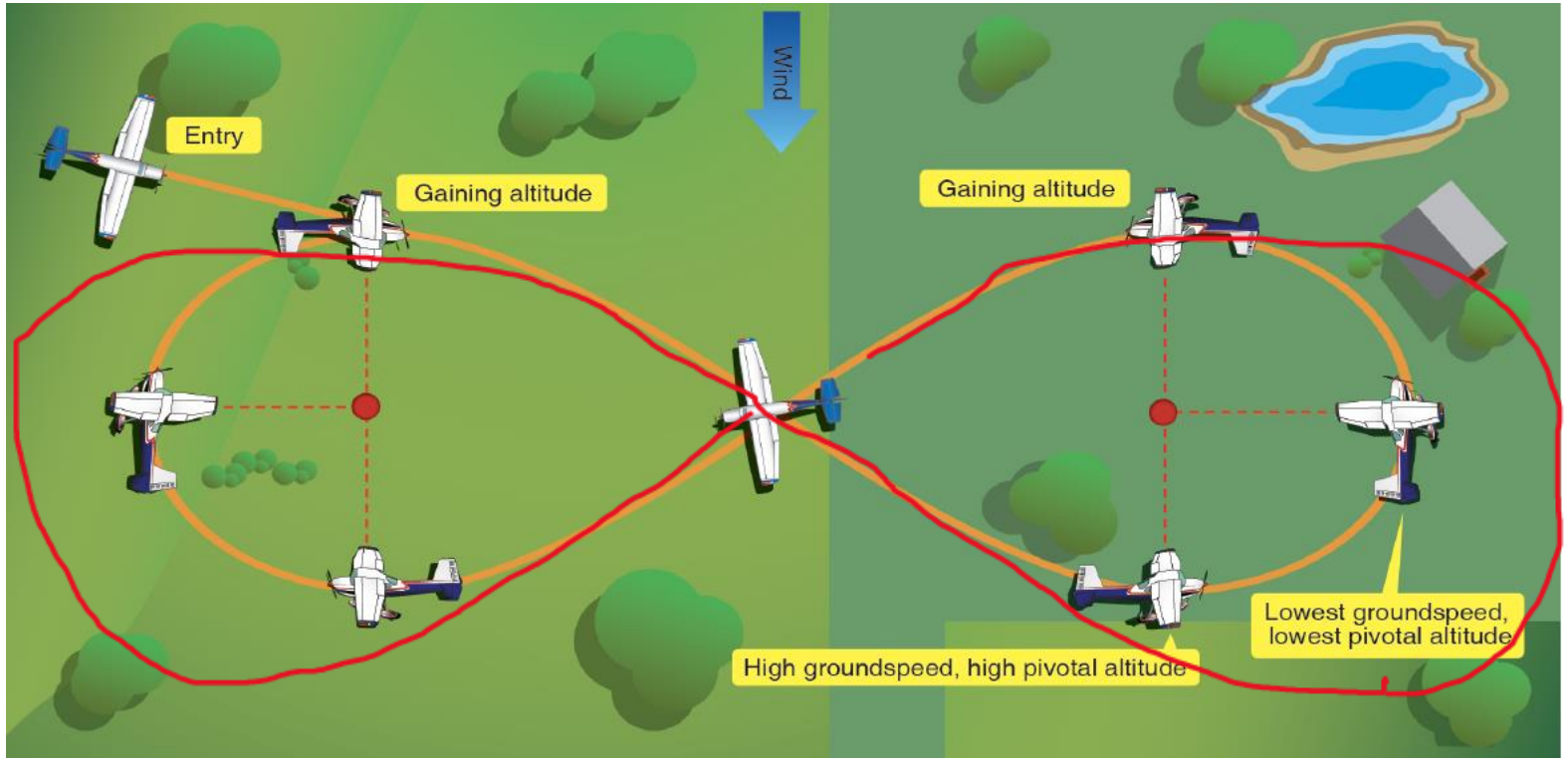
The real ground track would resemble the red line



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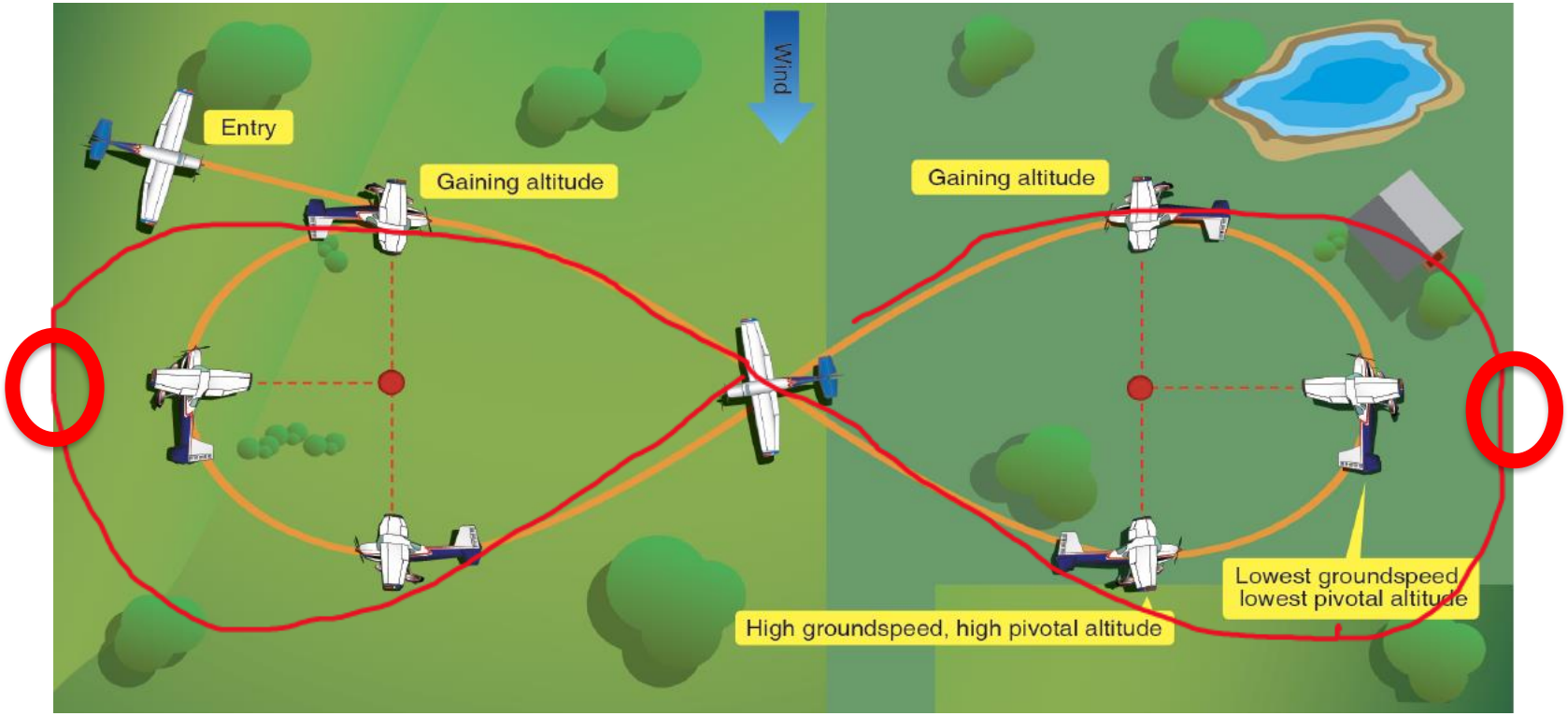
You are farthest from the pylon when no longer drifting – Red circles



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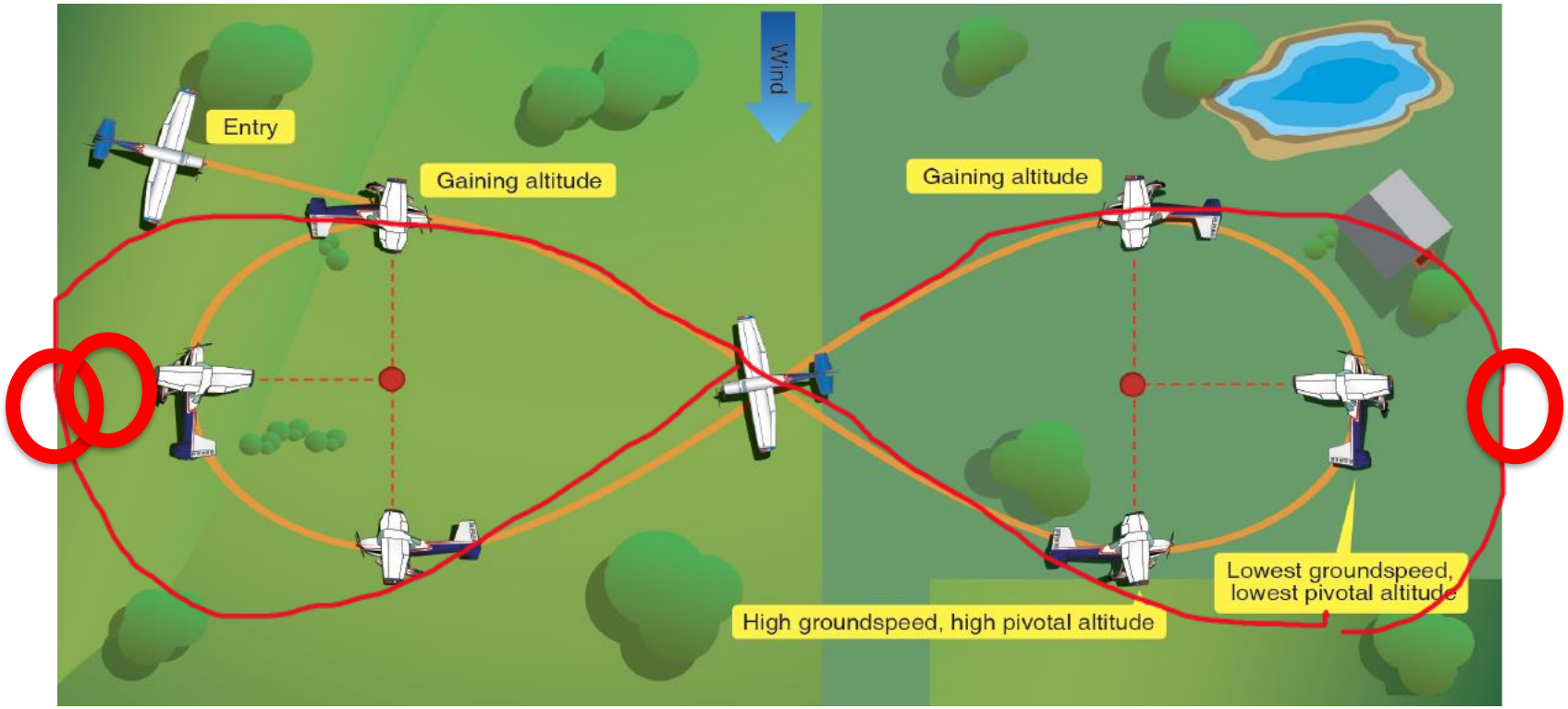
You are farthest from the pylon when no longer drifting – Red circles



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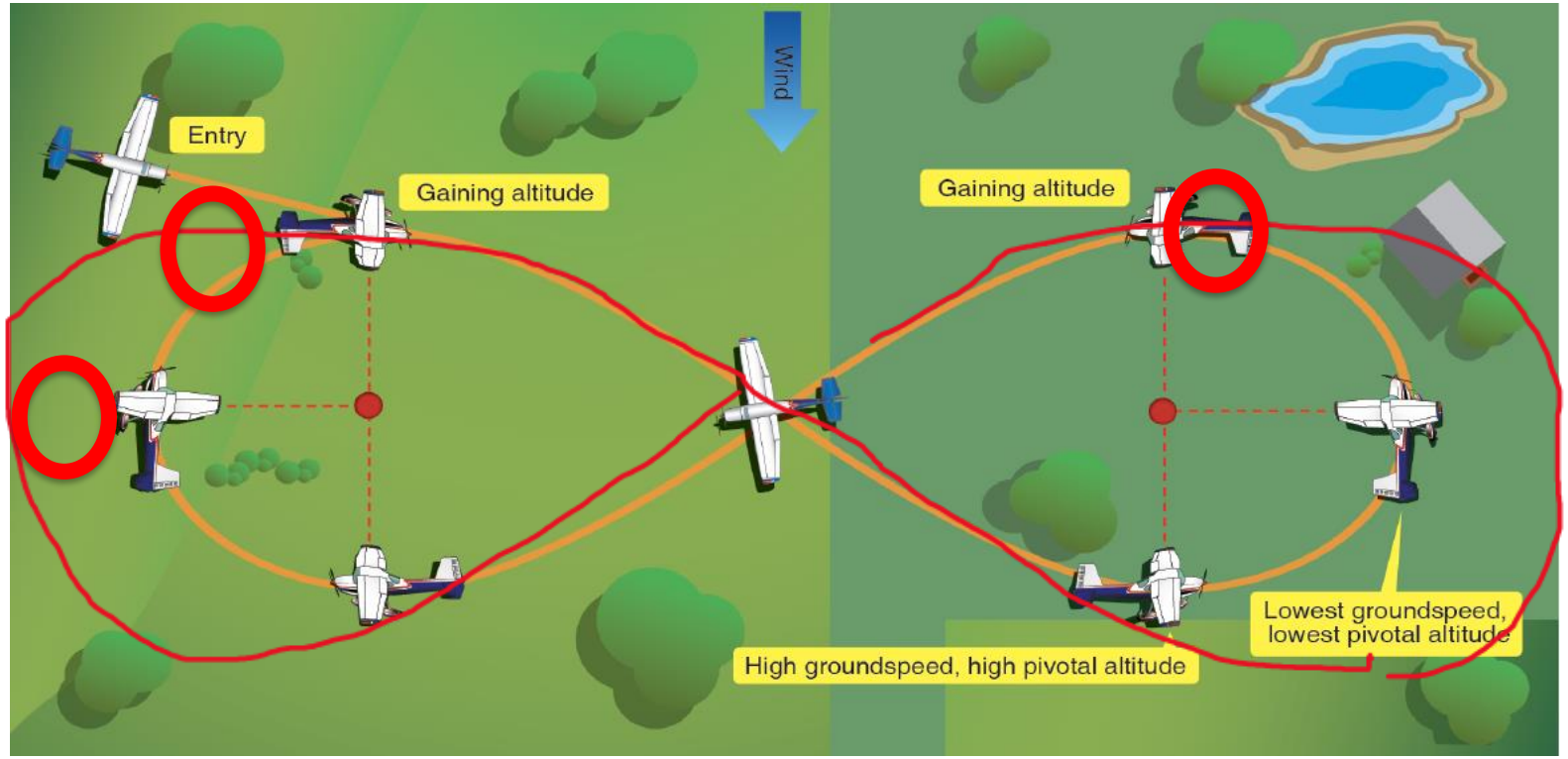
Steepest bank – red circles



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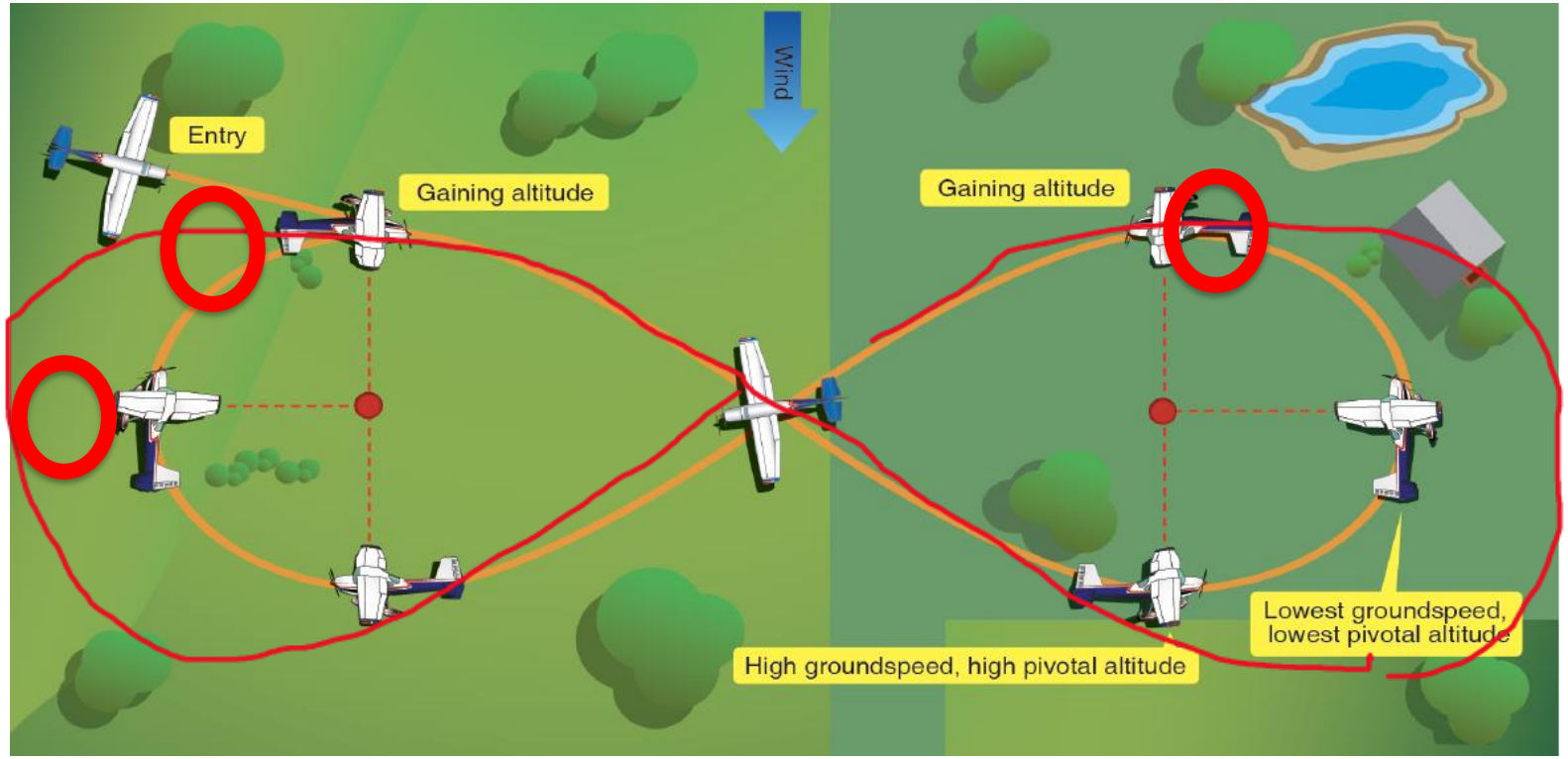
Because no correction for wind drift is done while turning – A steep turn is required here to not get blown across the pylon



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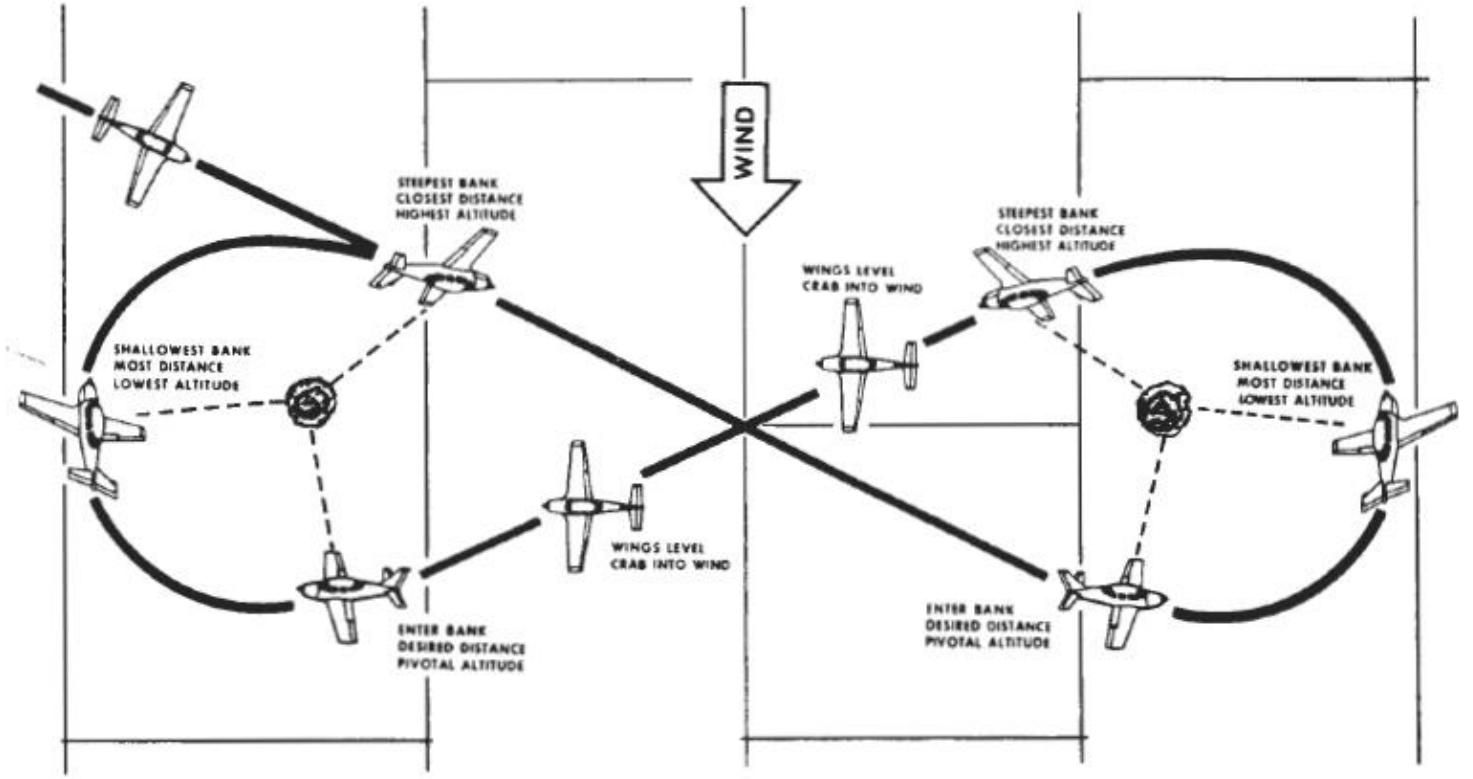
From the 1965 Flight Training Handbook



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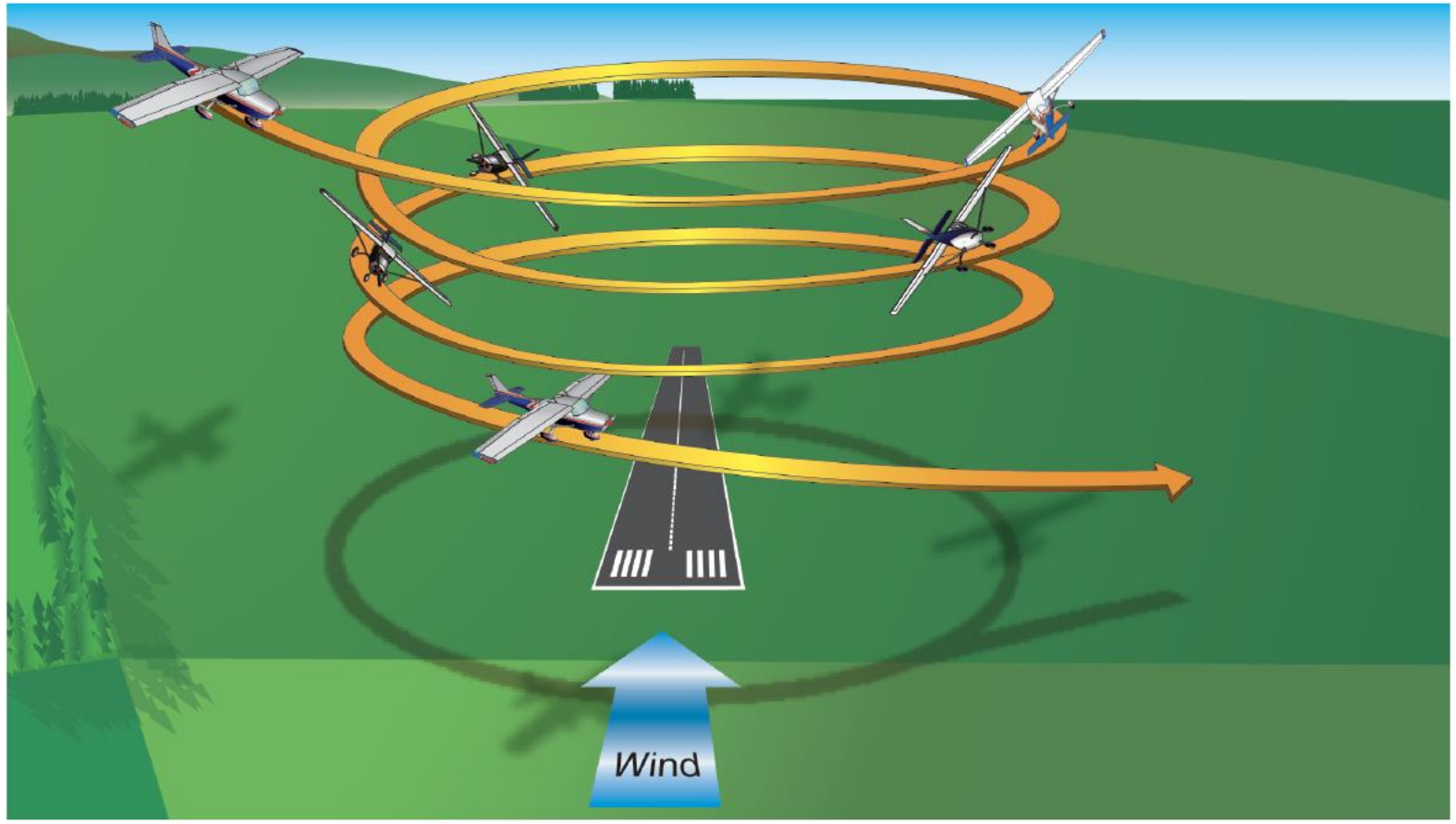
Steep Spirals



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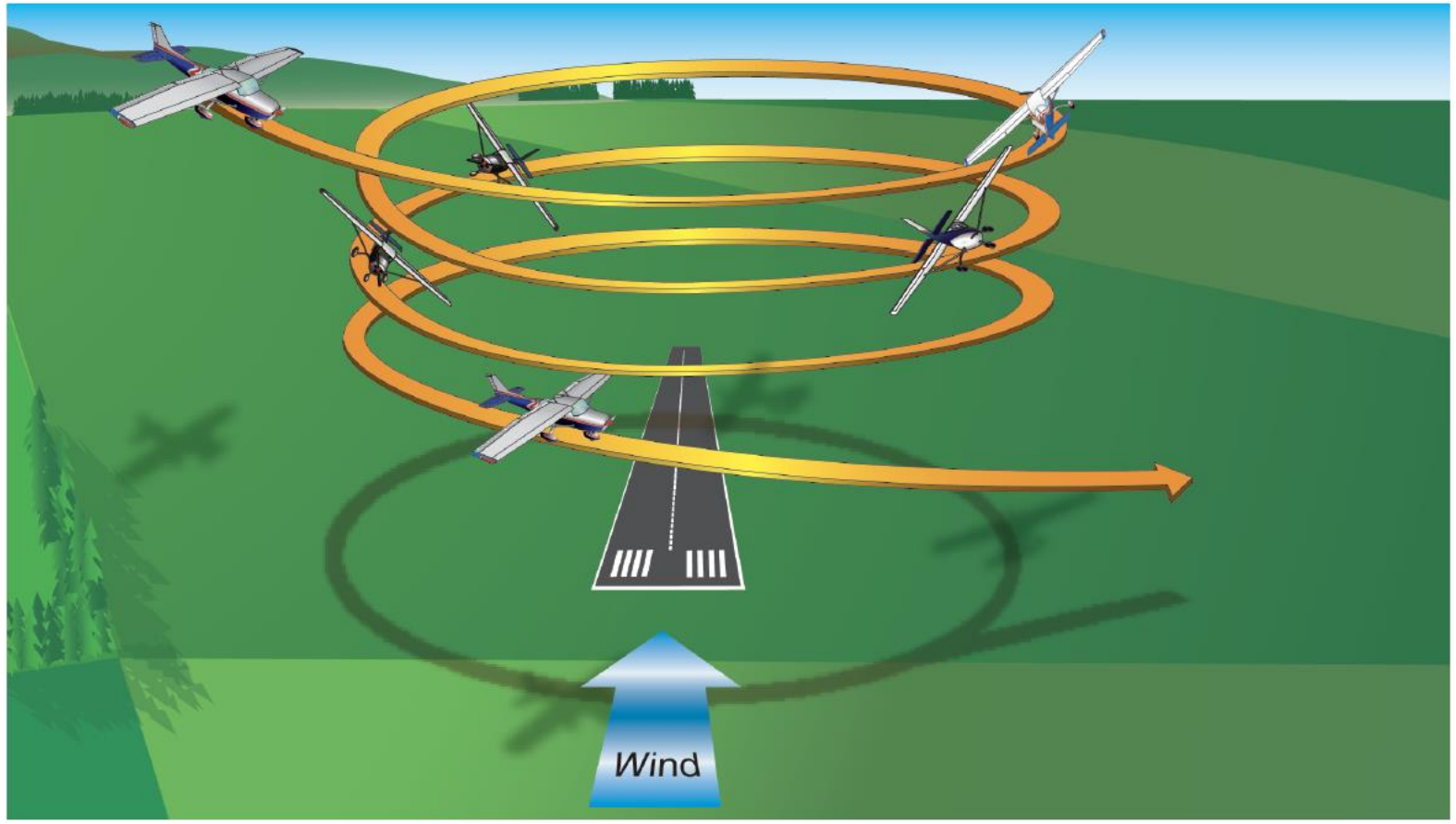
Steep Spirals



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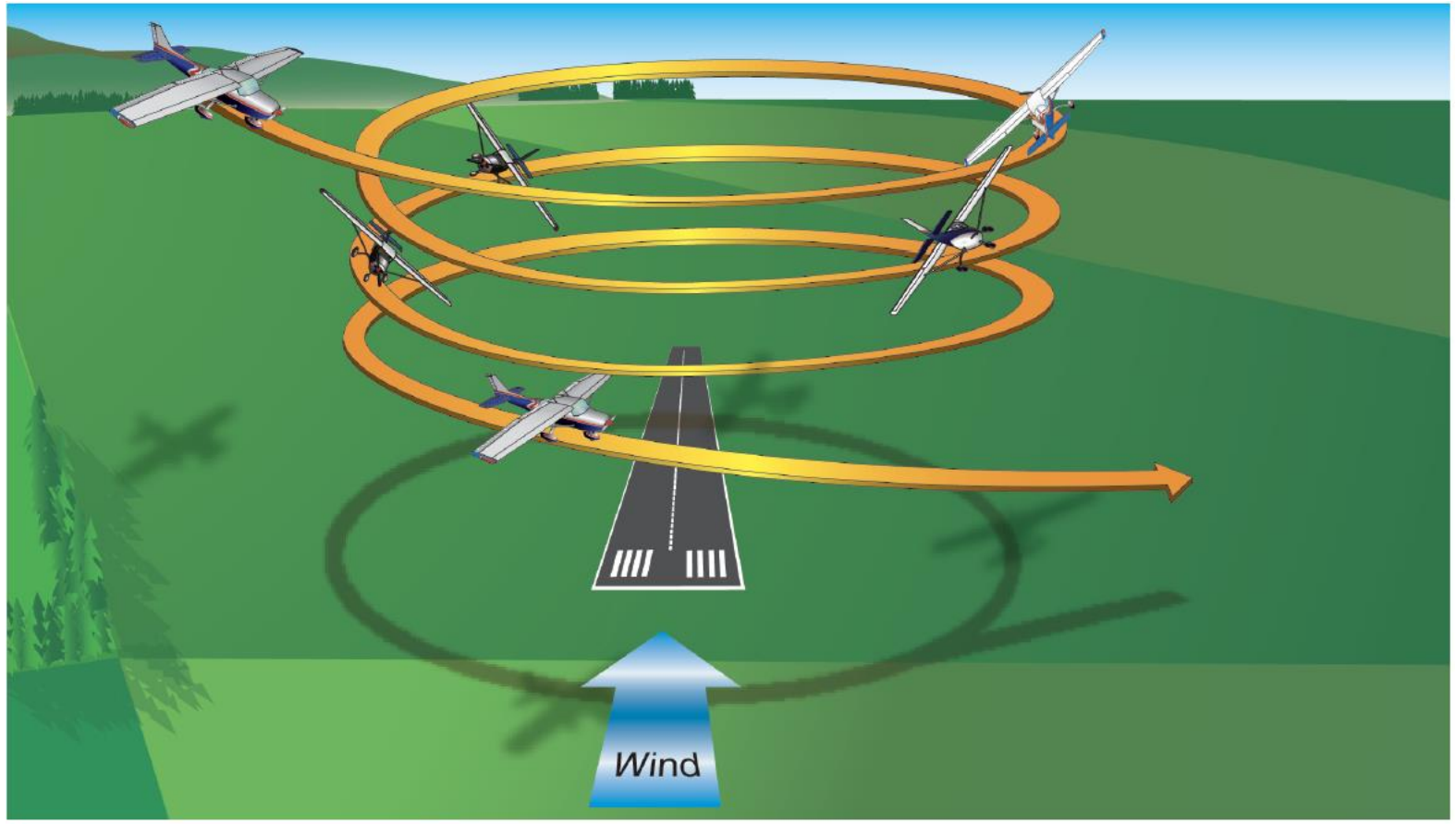
Some Lost Information – Recovered Here!



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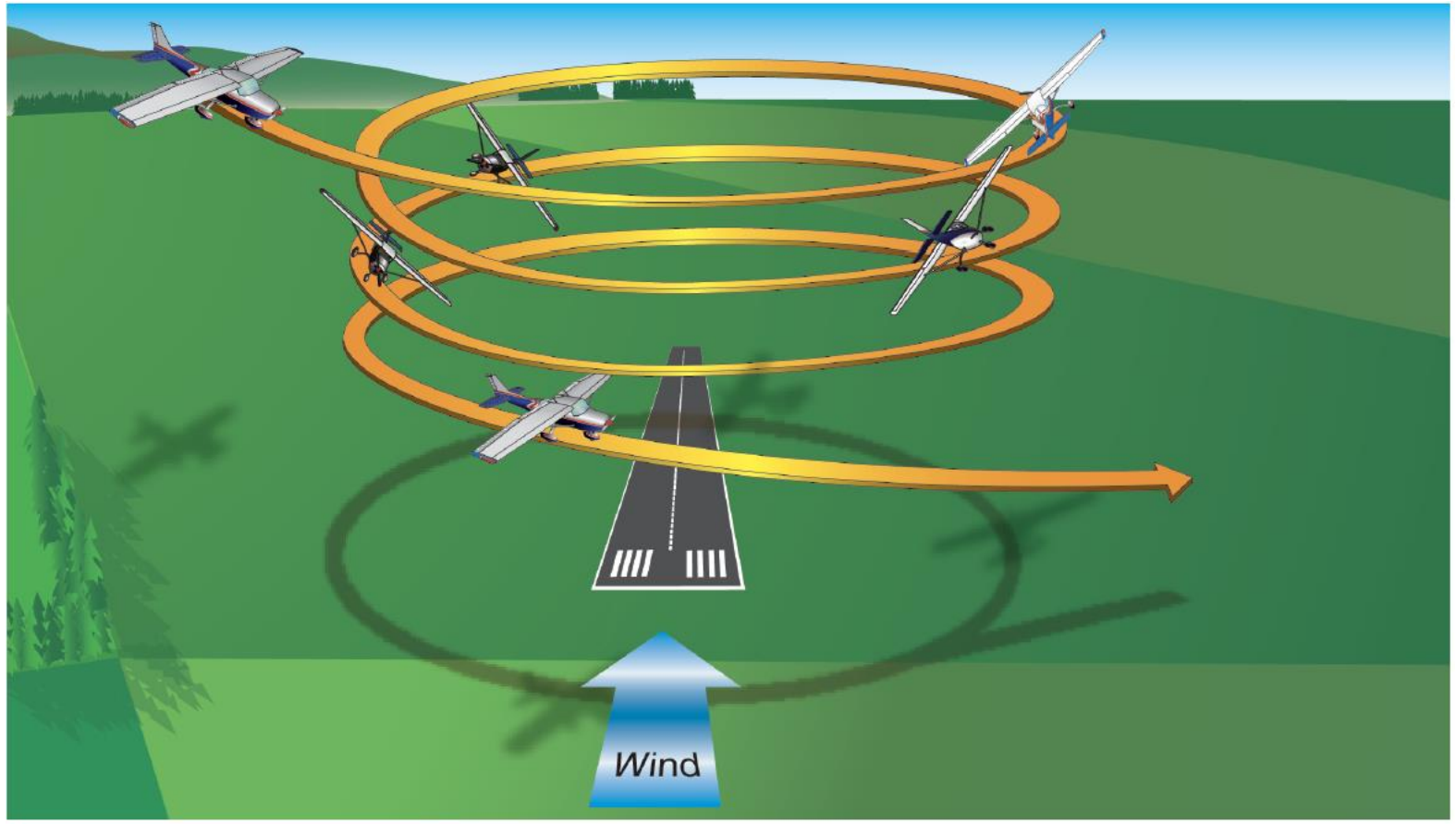
In the beginning it was over 10 turns to teach vertigo avoidance



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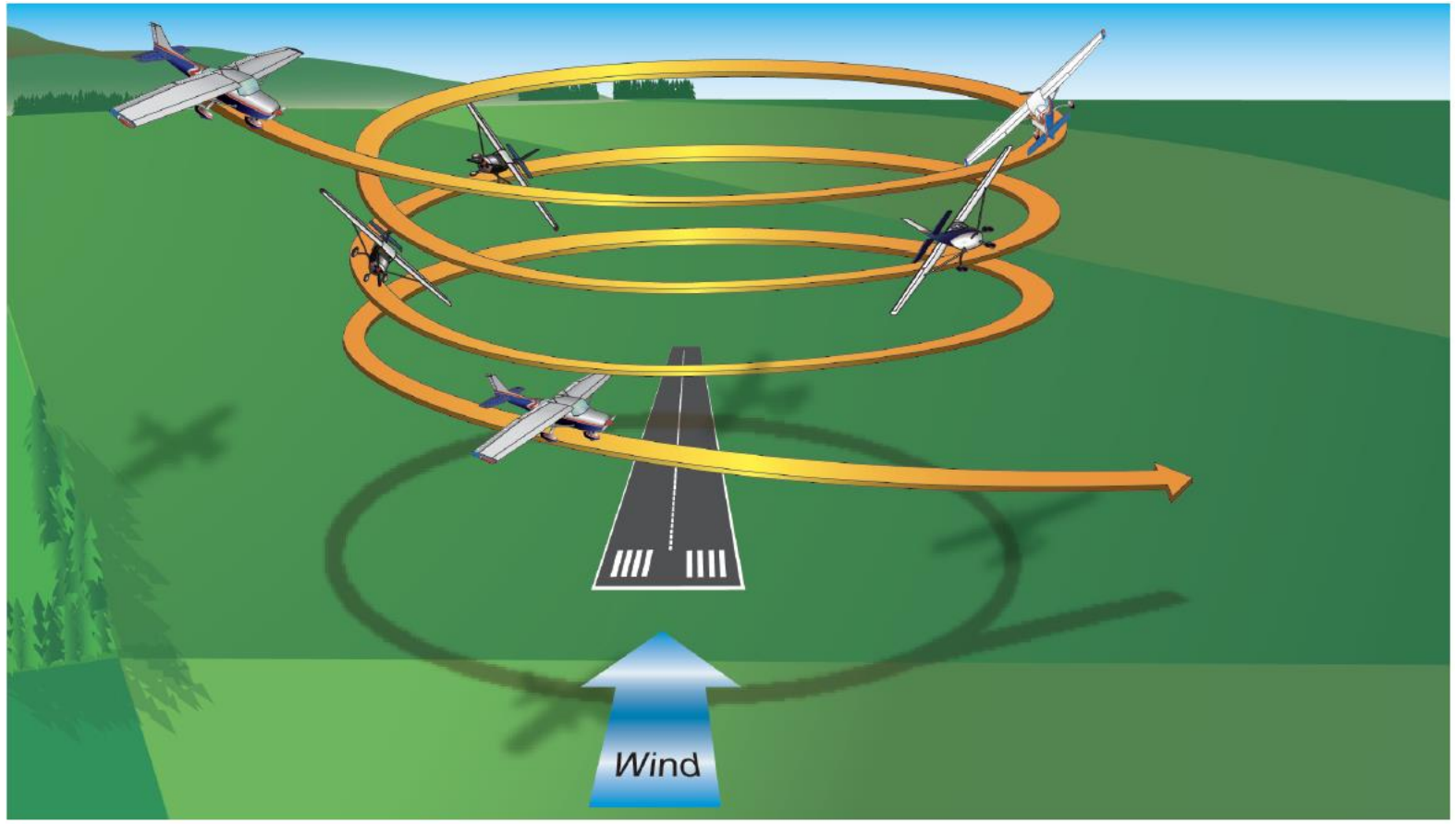
After no vertigo – a ground reference is introduced to spiral over



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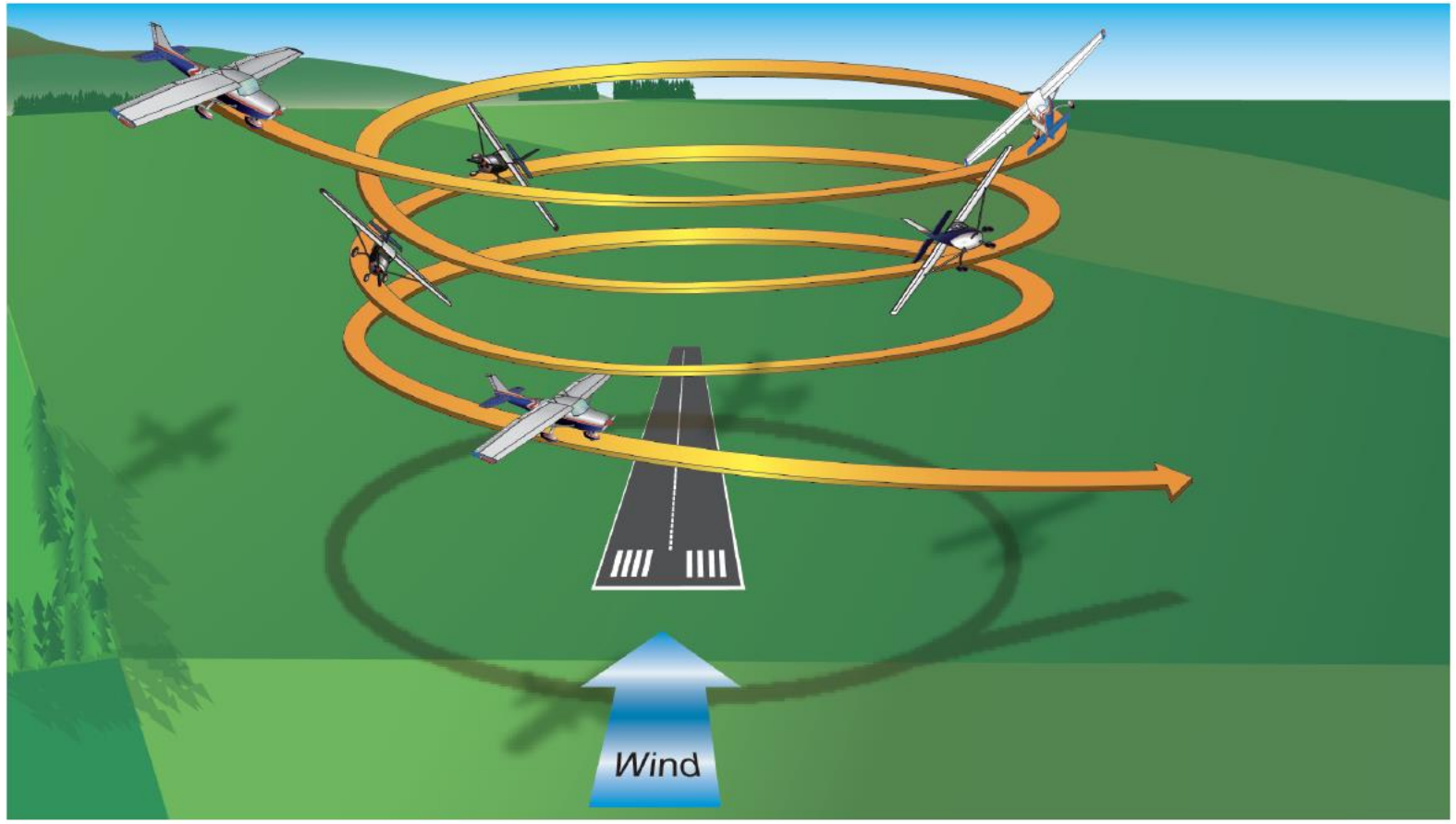
The maneuver is started UPWIND. Why?



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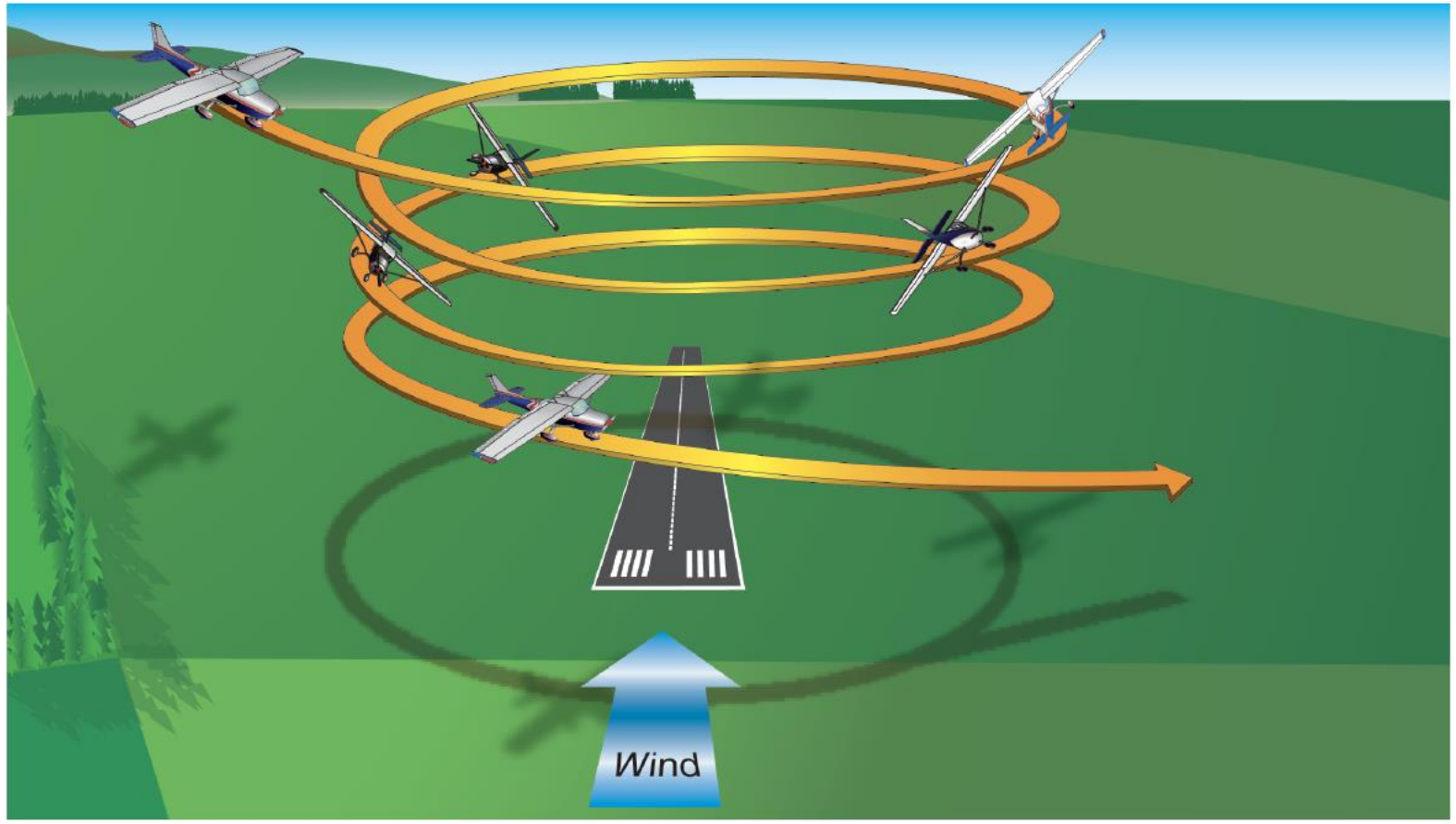
Why are all other ground reference maneuvers started downwind?



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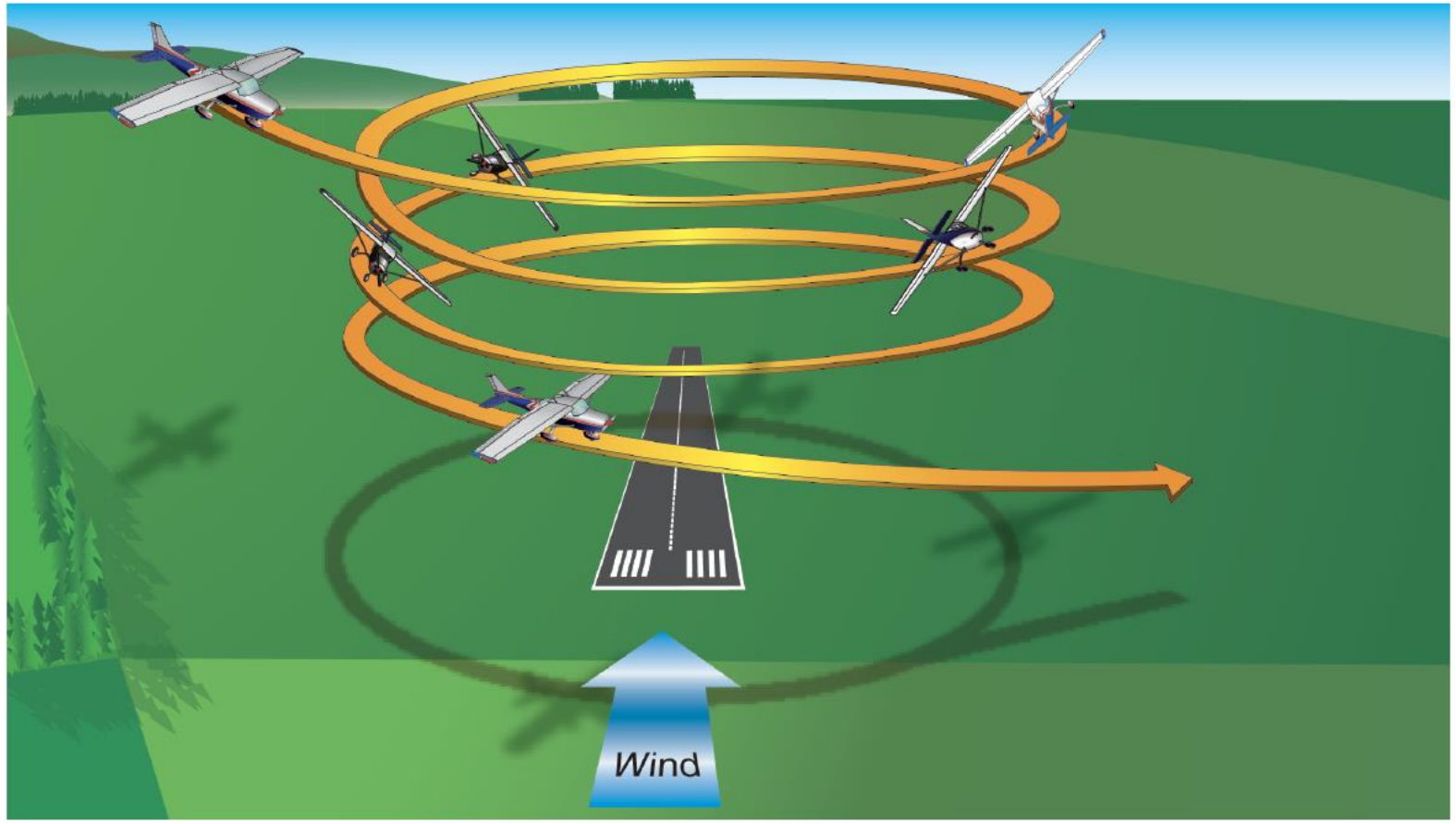
Because the max bank angle allowed is 45°



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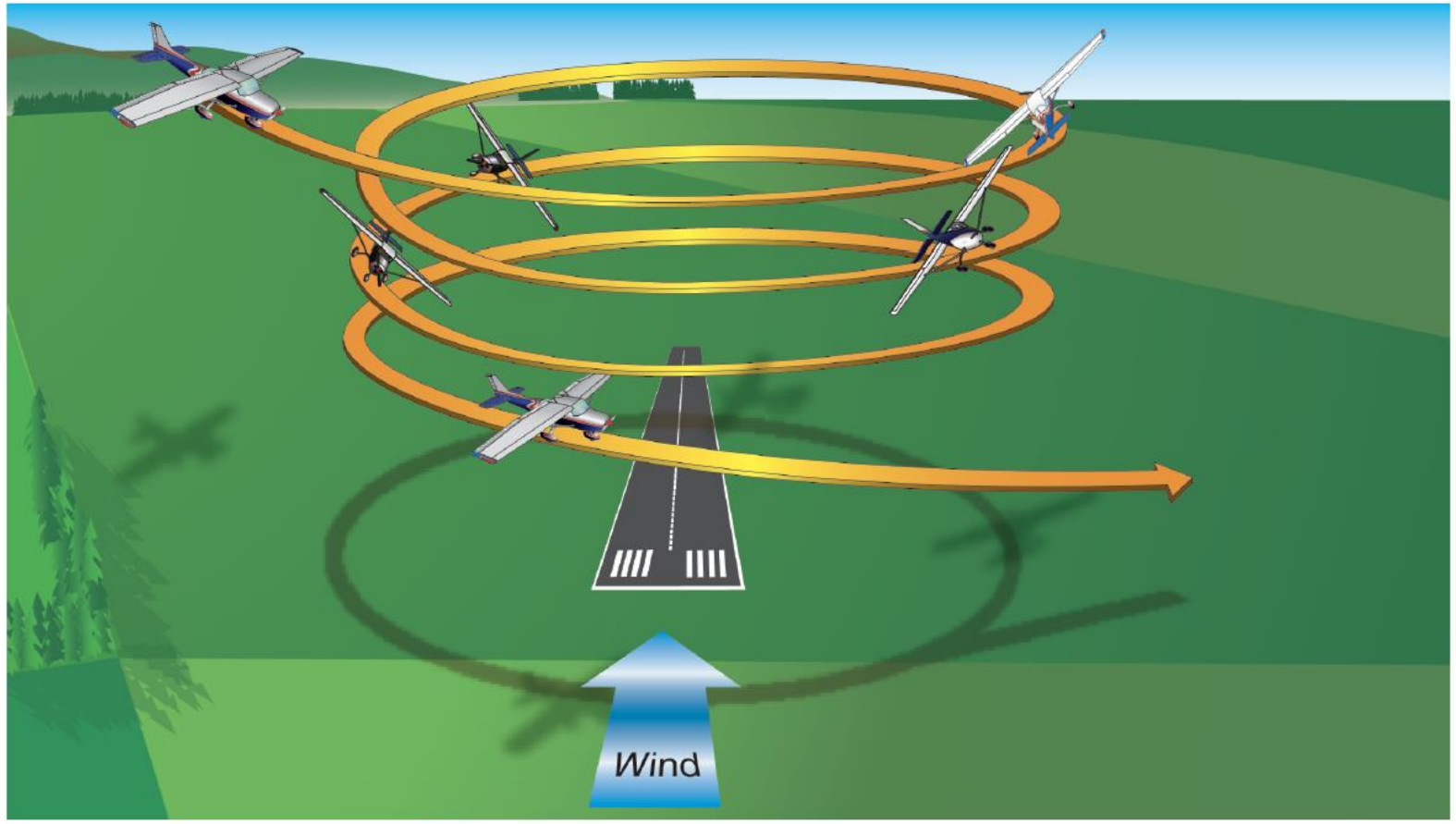
The downwind is where the steepest bank will be thus up to 45°



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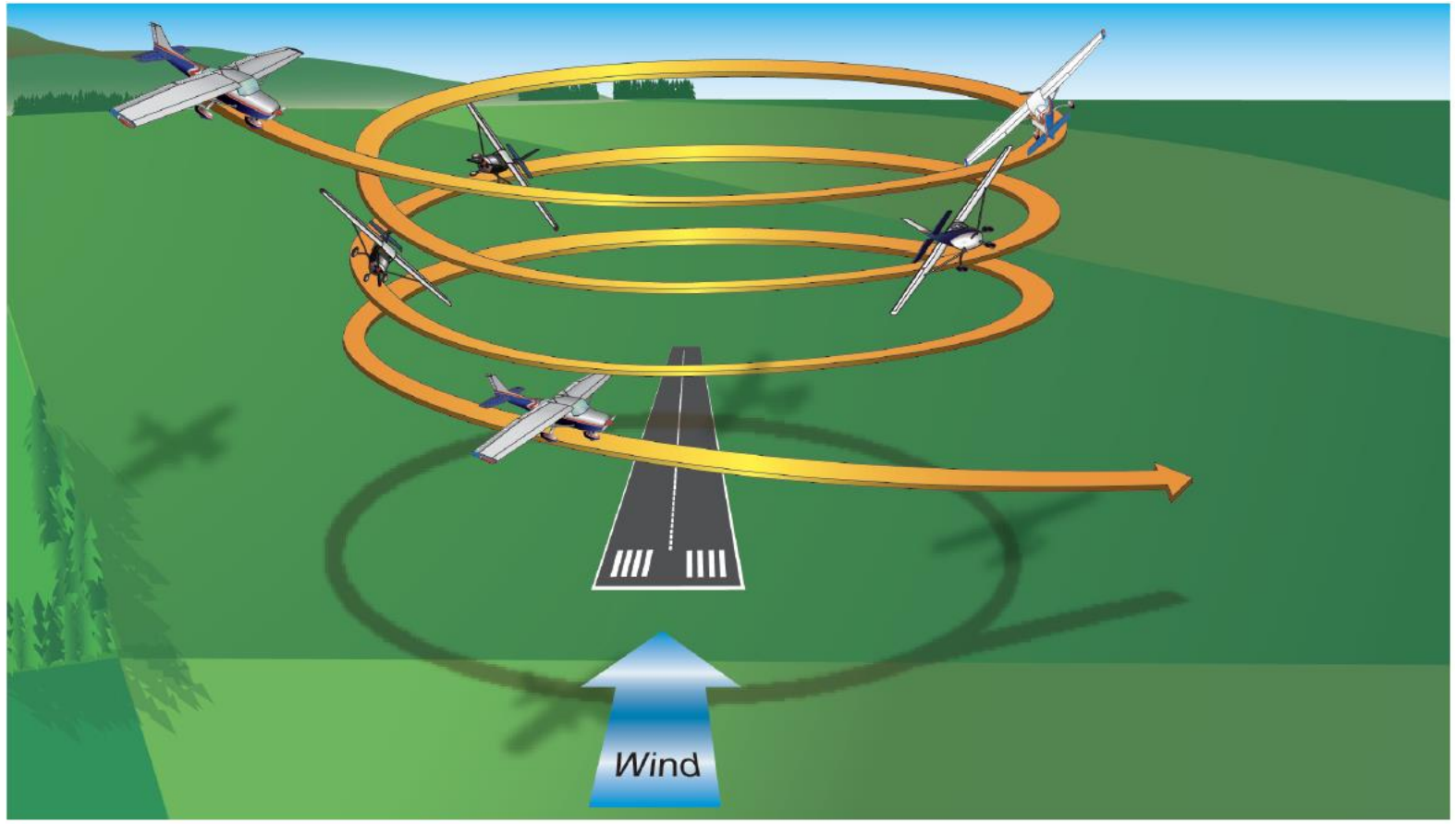
All other points during ground reference maneuvers will be under 45°



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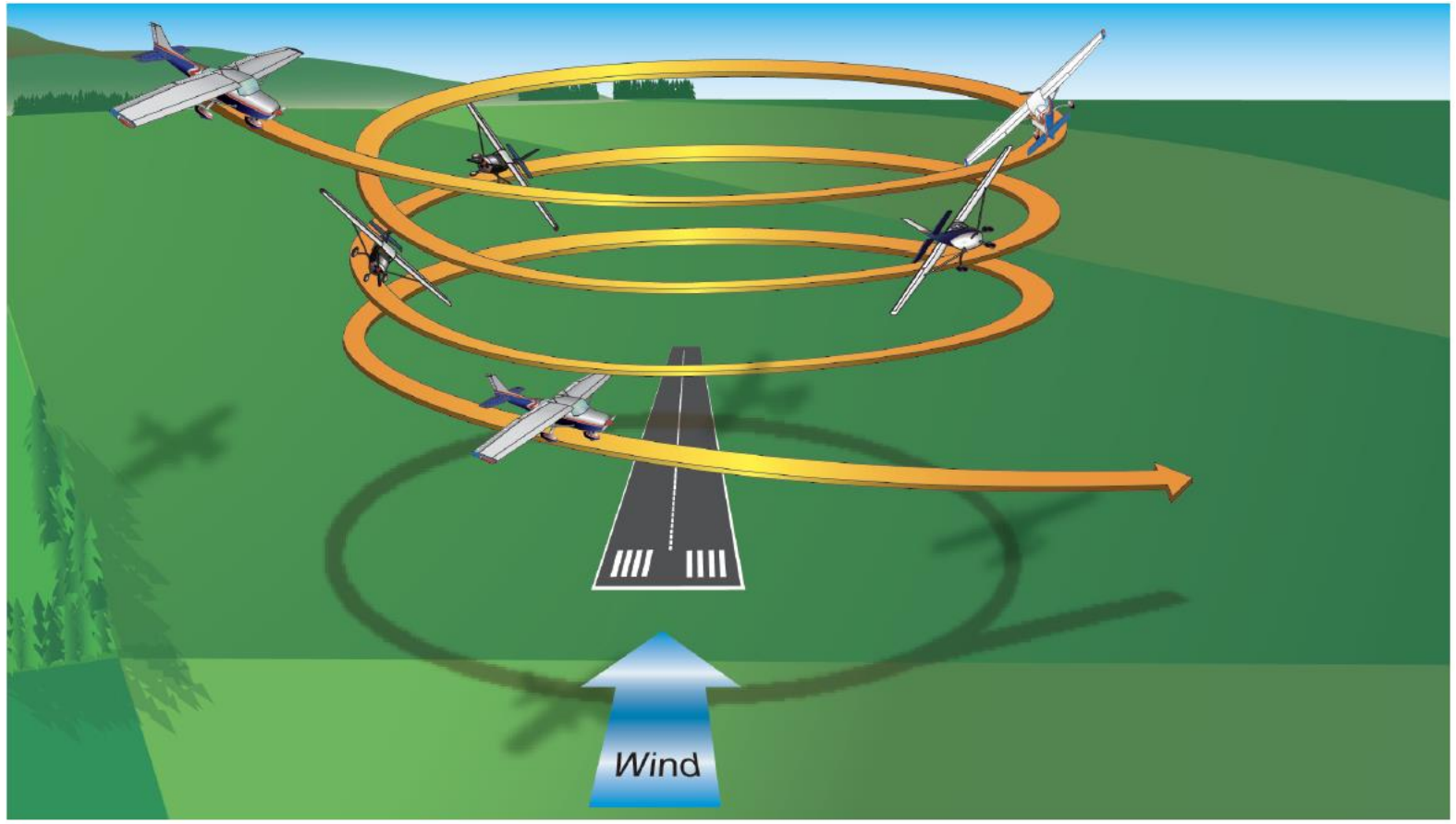
The Steep Spiral started Upwind with an allowable bank angle of 60°



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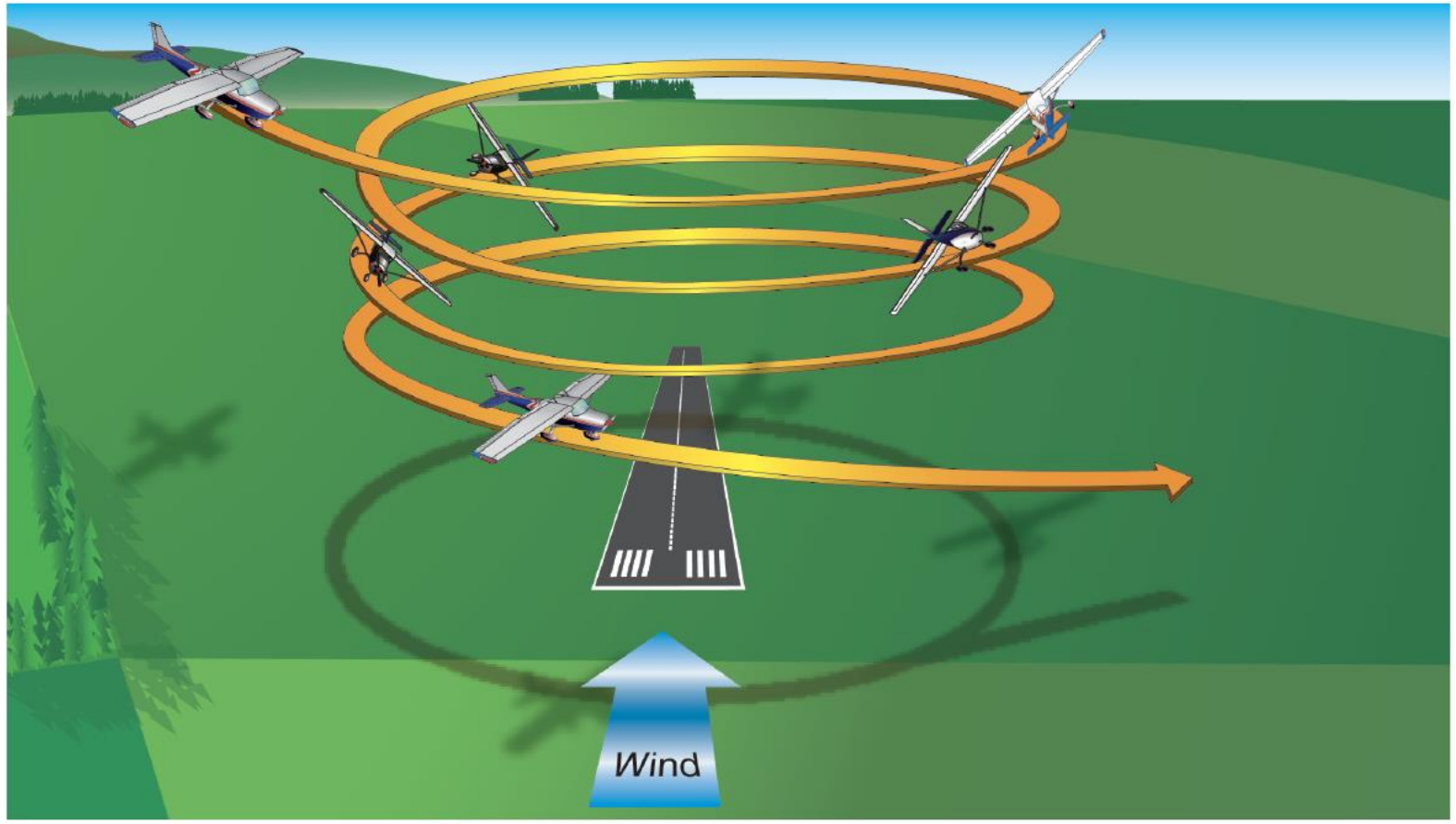
The reason is that is was supposed to be landed from



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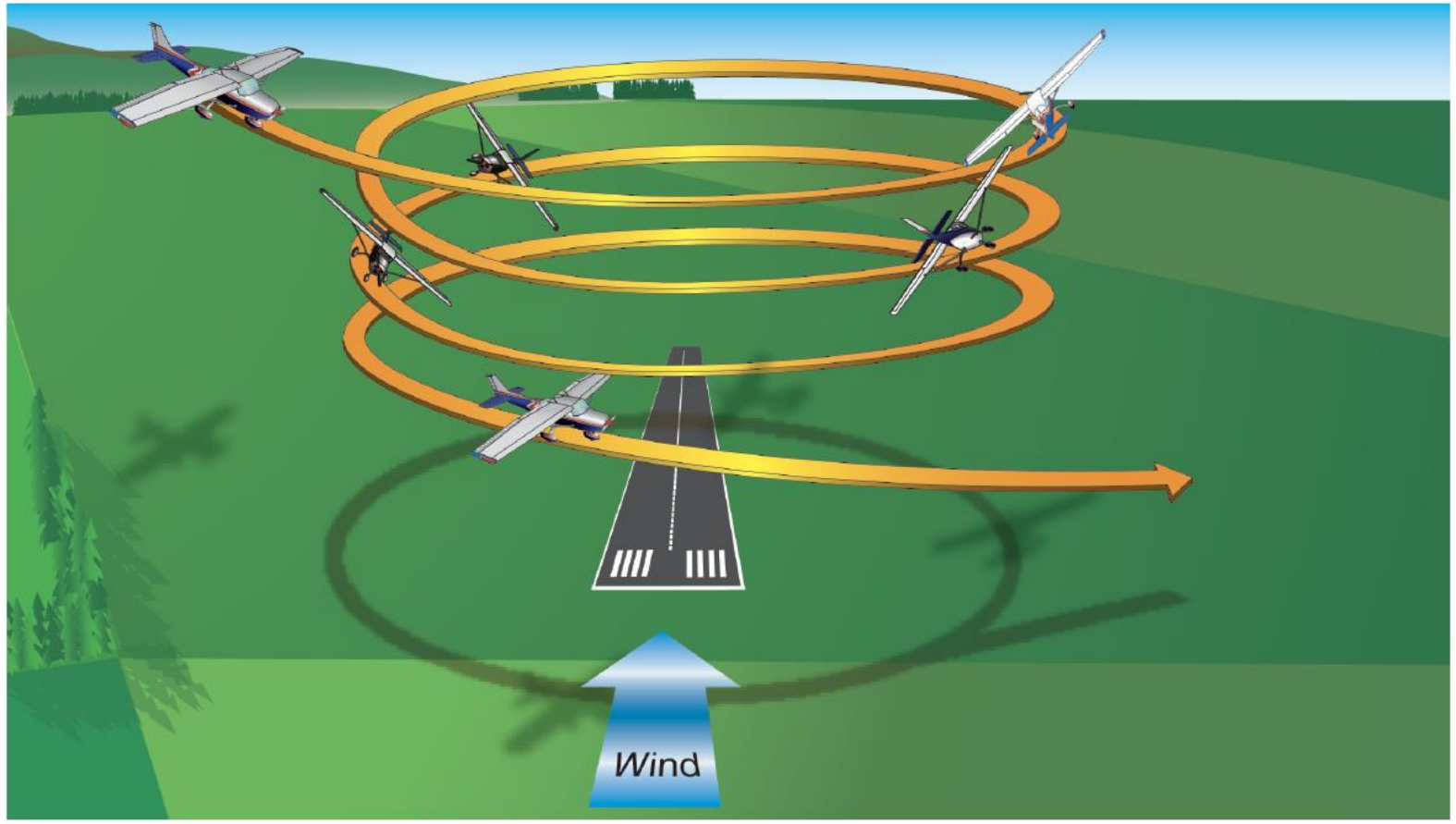
At the completion of the turns the airplane was upwind for landing



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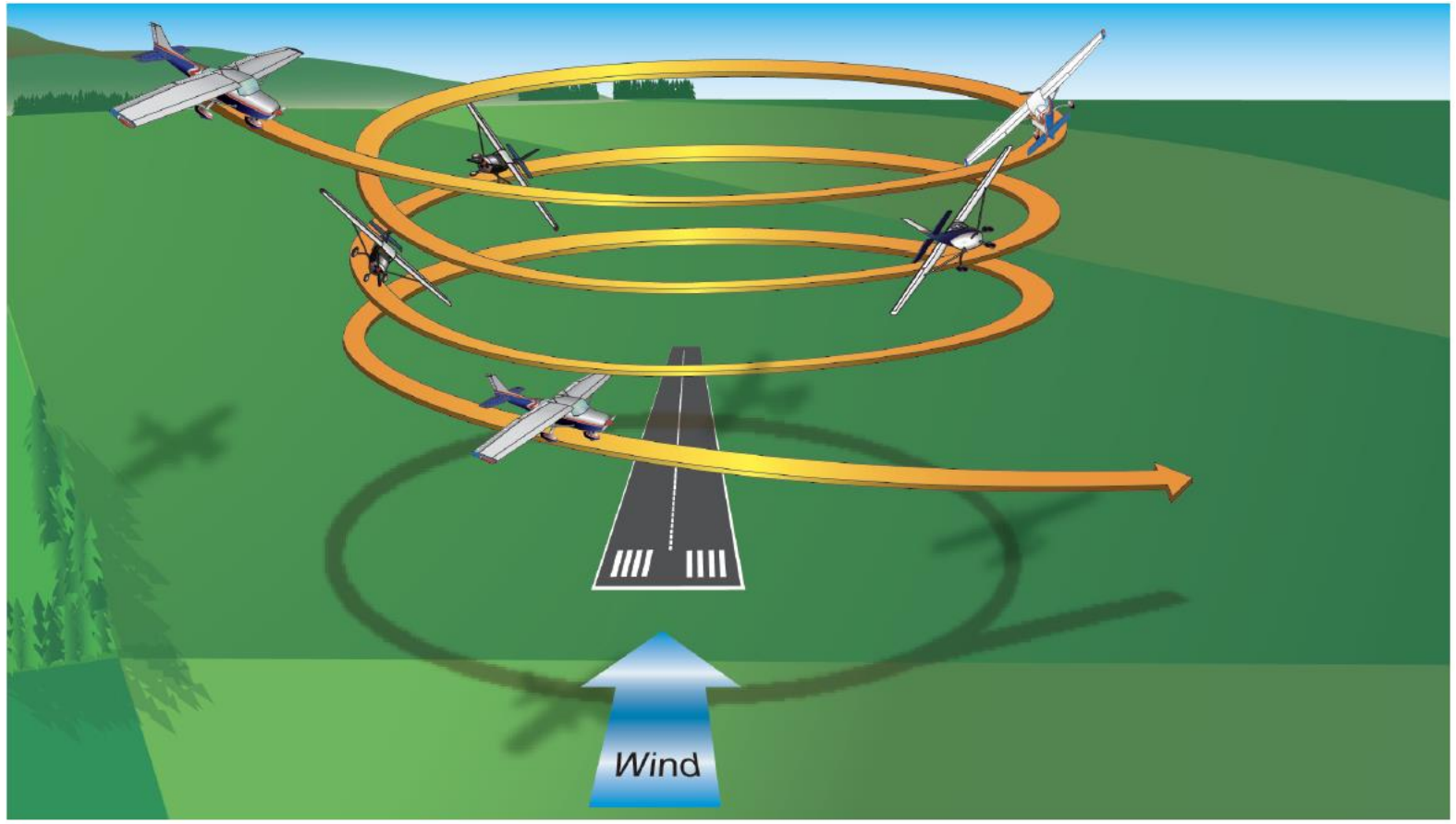
Airspeed is the first parameter to go out of standard



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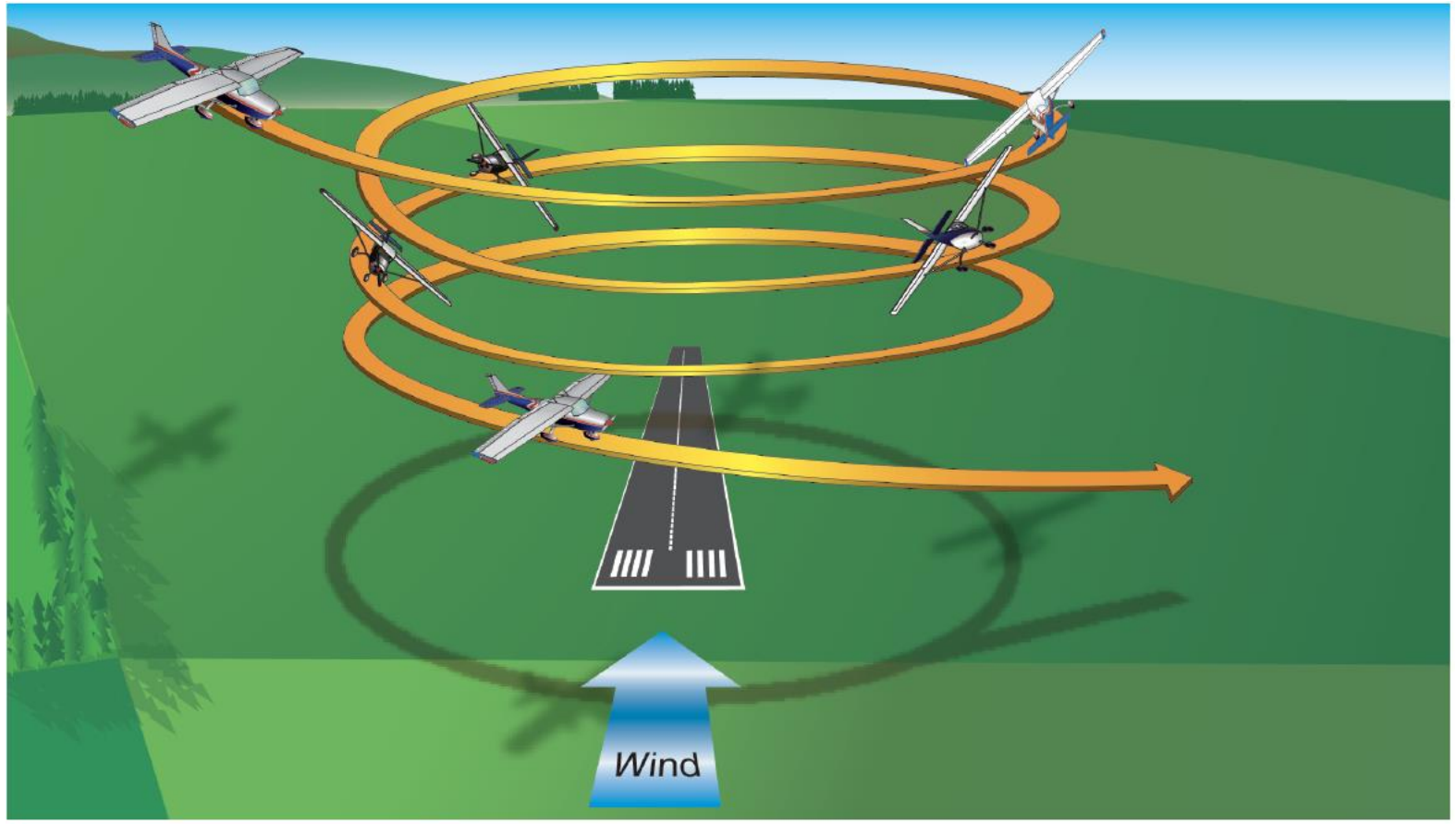
Originally the speed was 1.3-1.4 Vso – Accelerated stall avoidance



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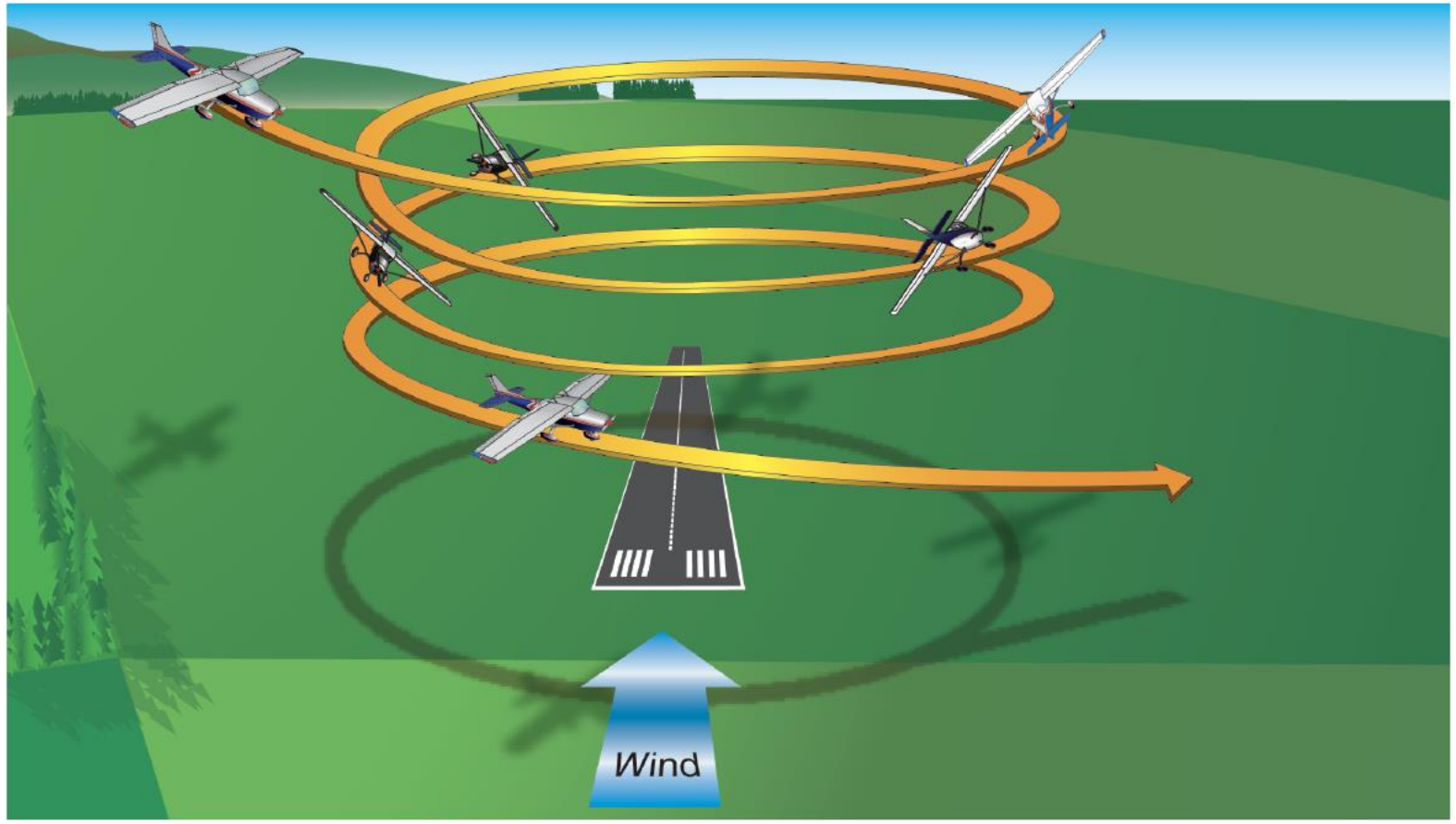
Today a “Glide Speed” is used – Typically best glide



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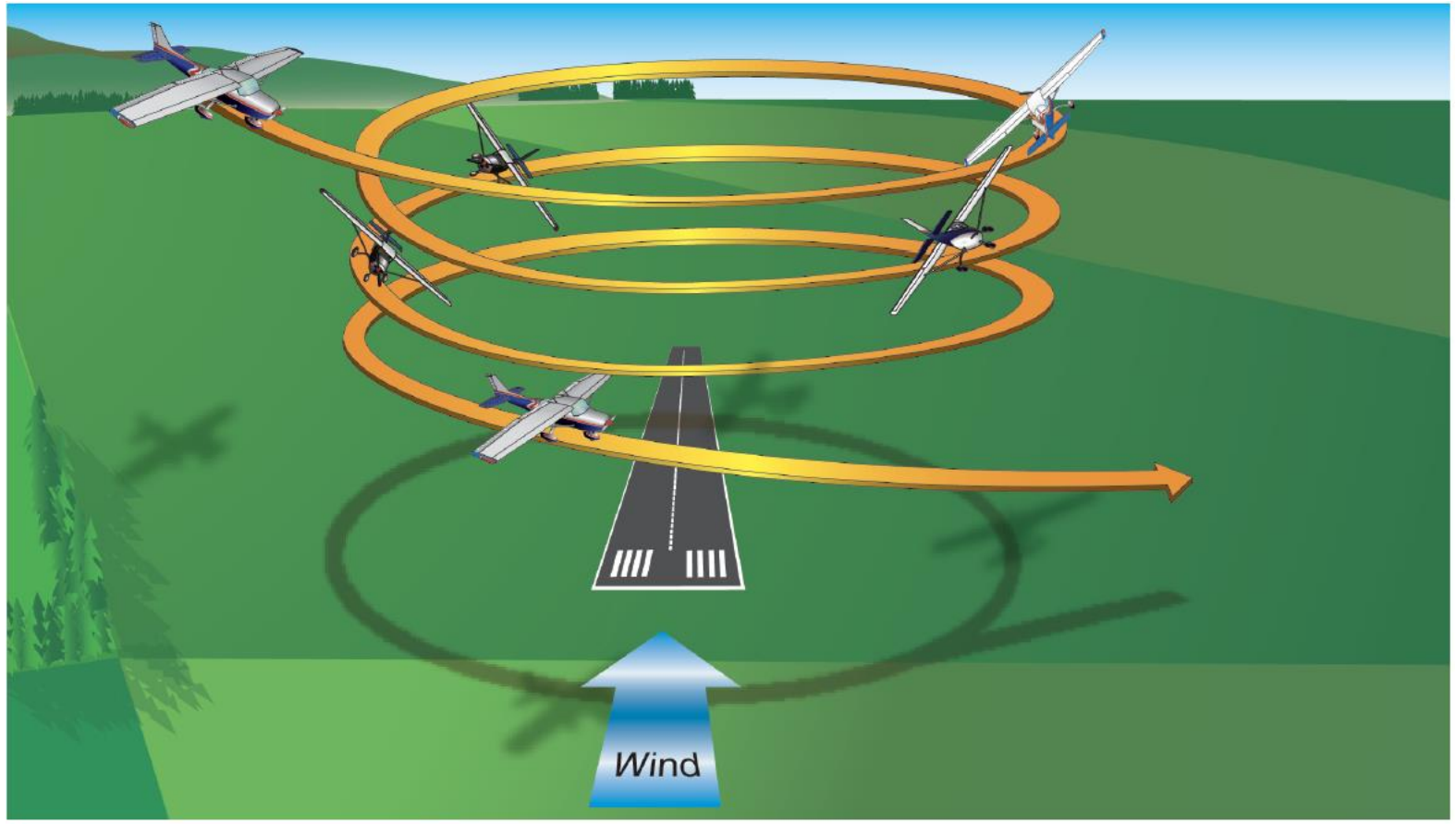
As bank angle increases, airspeed lost due to drag – Lower the nose



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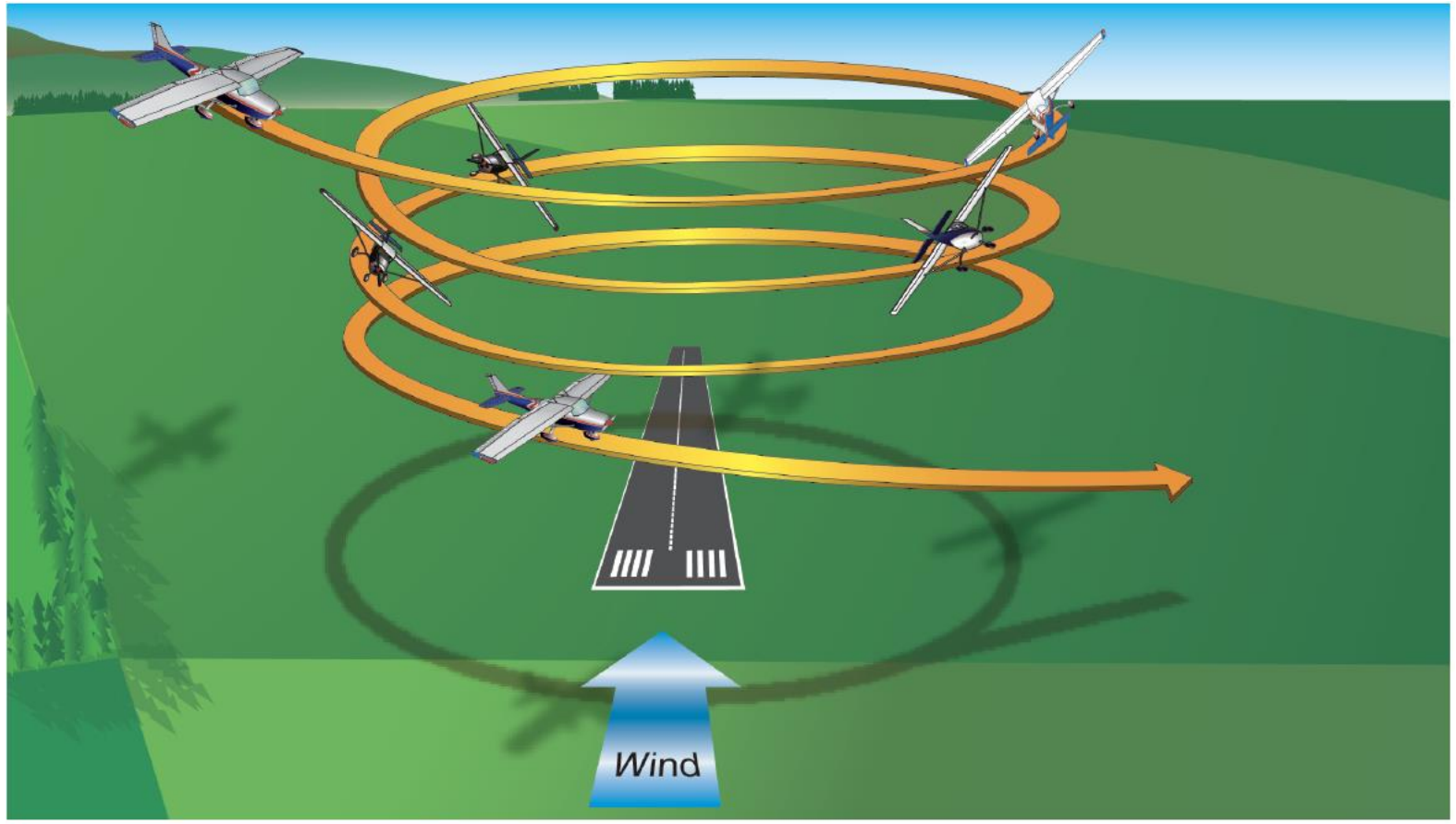
As bank angle decreases, airspeed increases – Raise the nose



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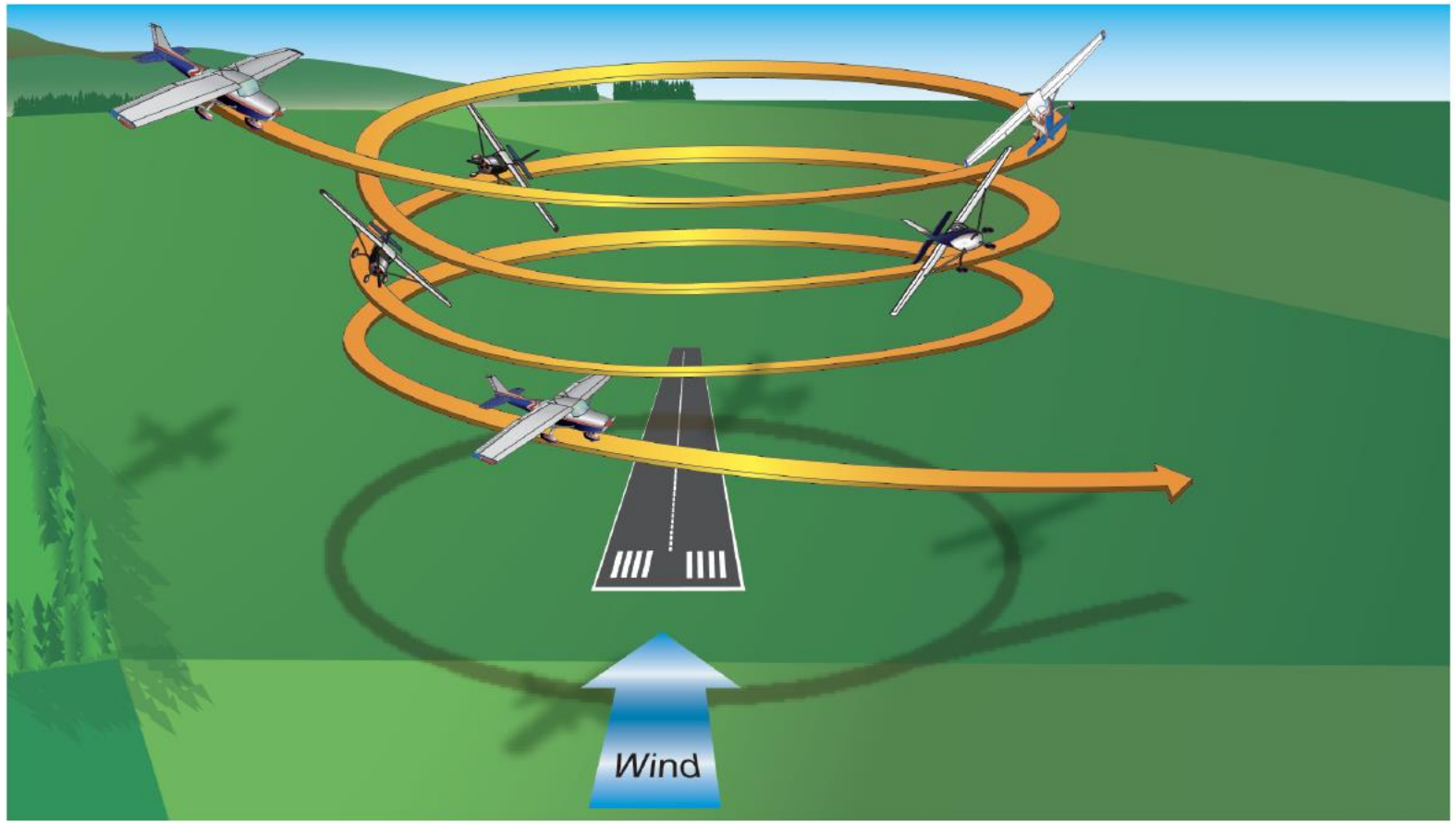
The point to spiral over must be very close to the airplane fuselage



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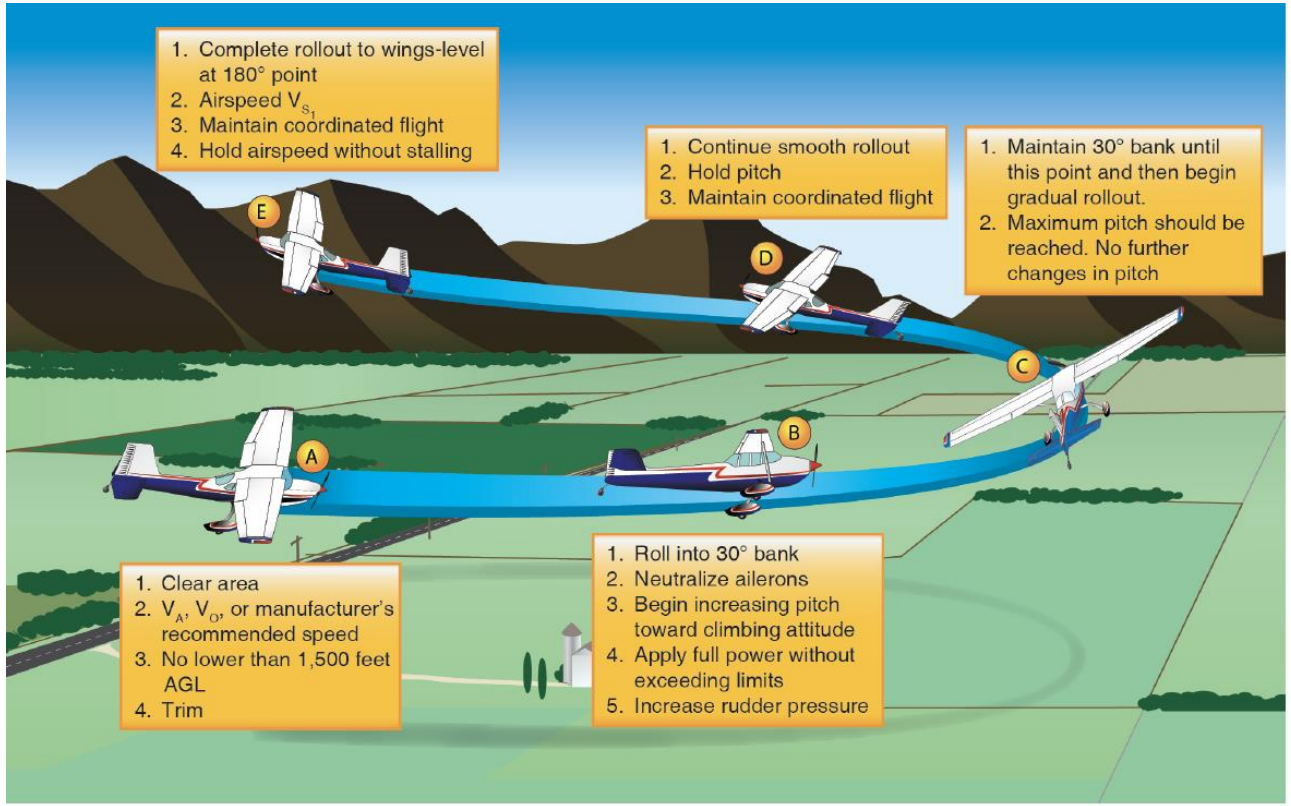
Chandelles



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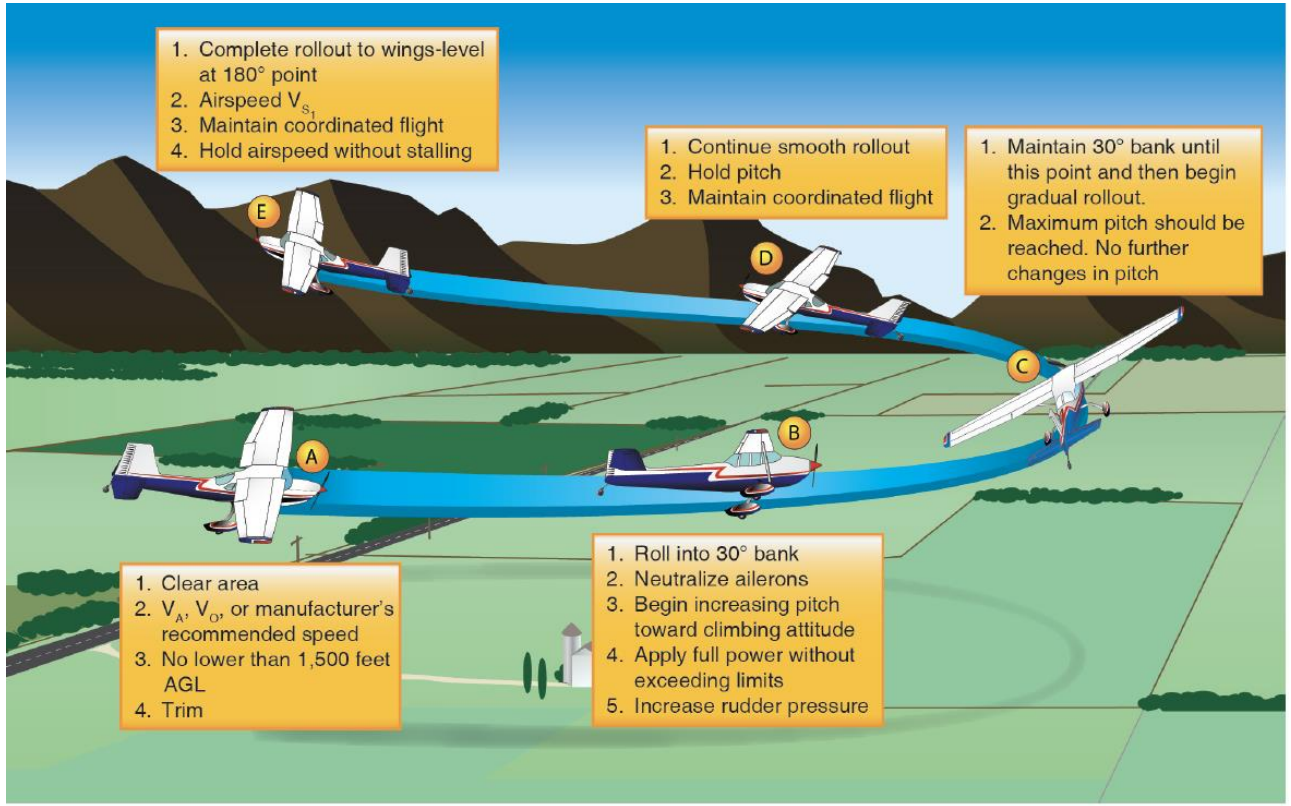
The image is not 100% correct



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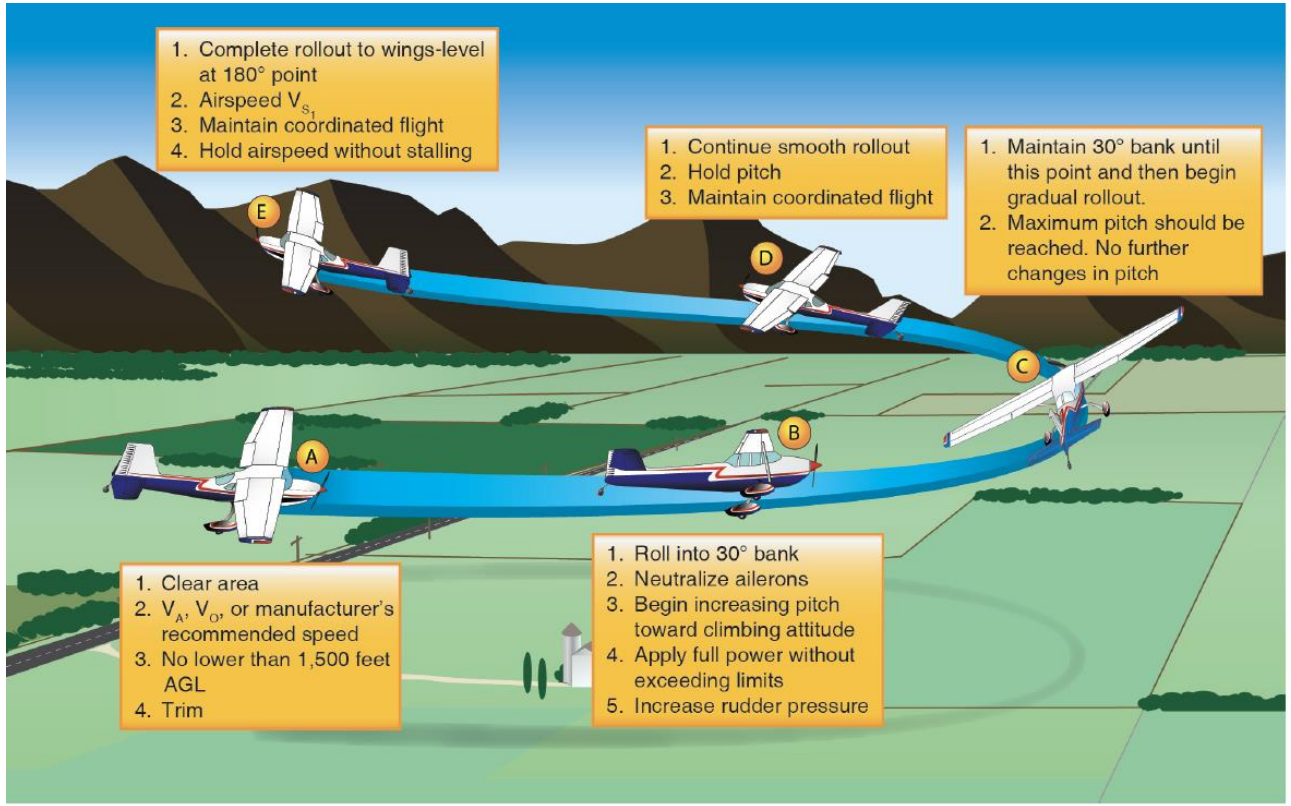
The turn radius decreases as speed is lost – It won't look like depicted



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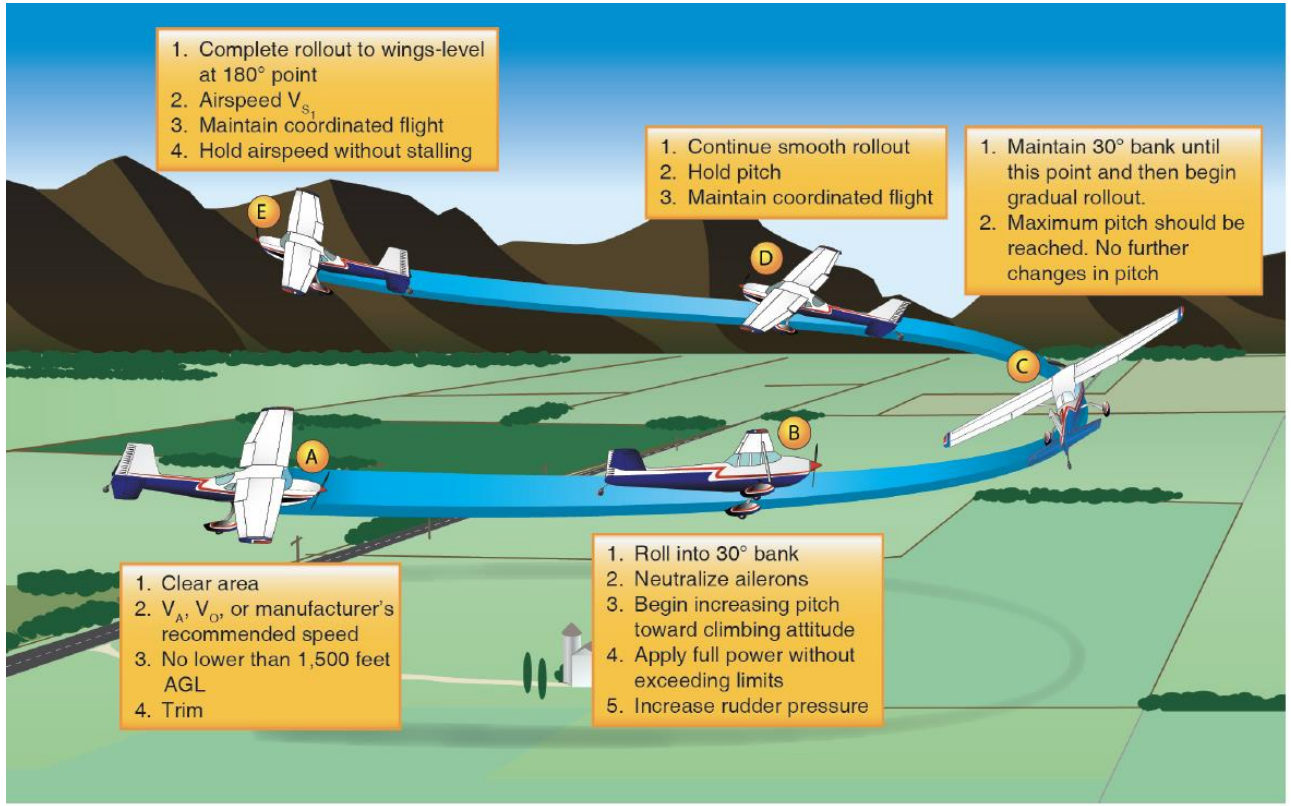
What is the pitch attitude at the 90° point?



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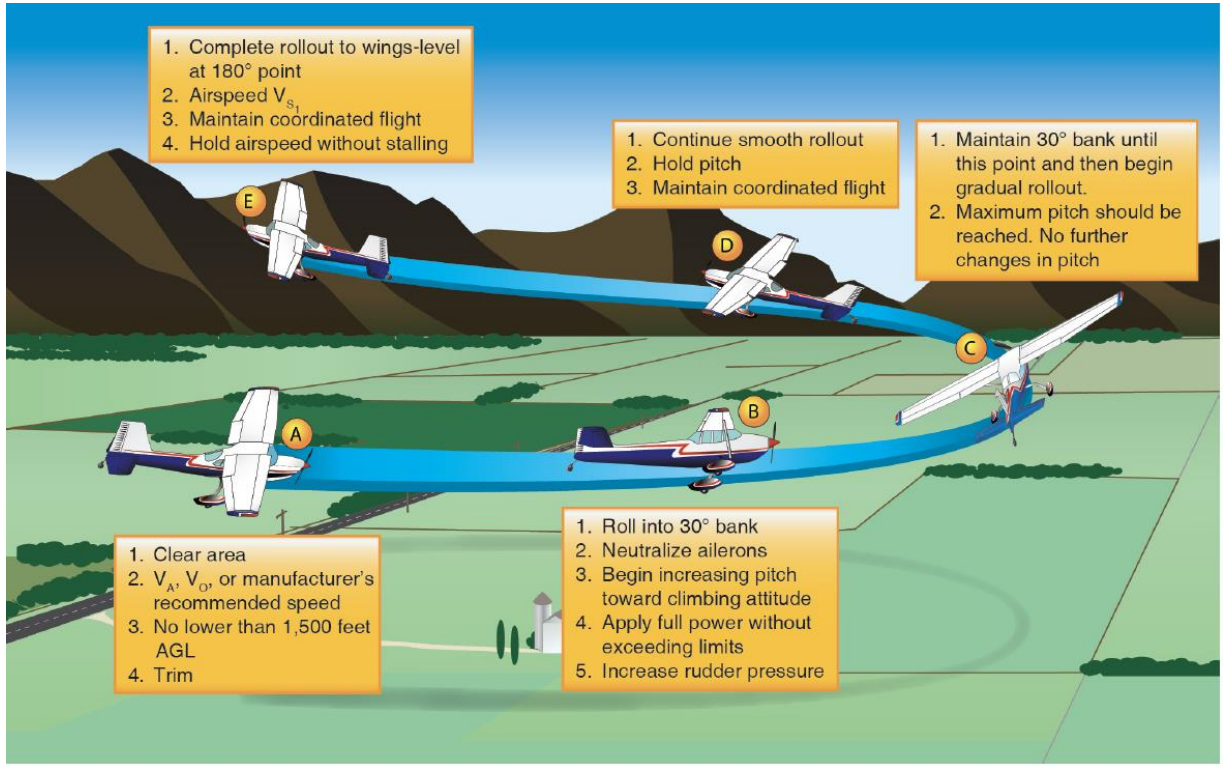
It’s the pitch attitude if held would result in the airplane being just above stall at the 180° point



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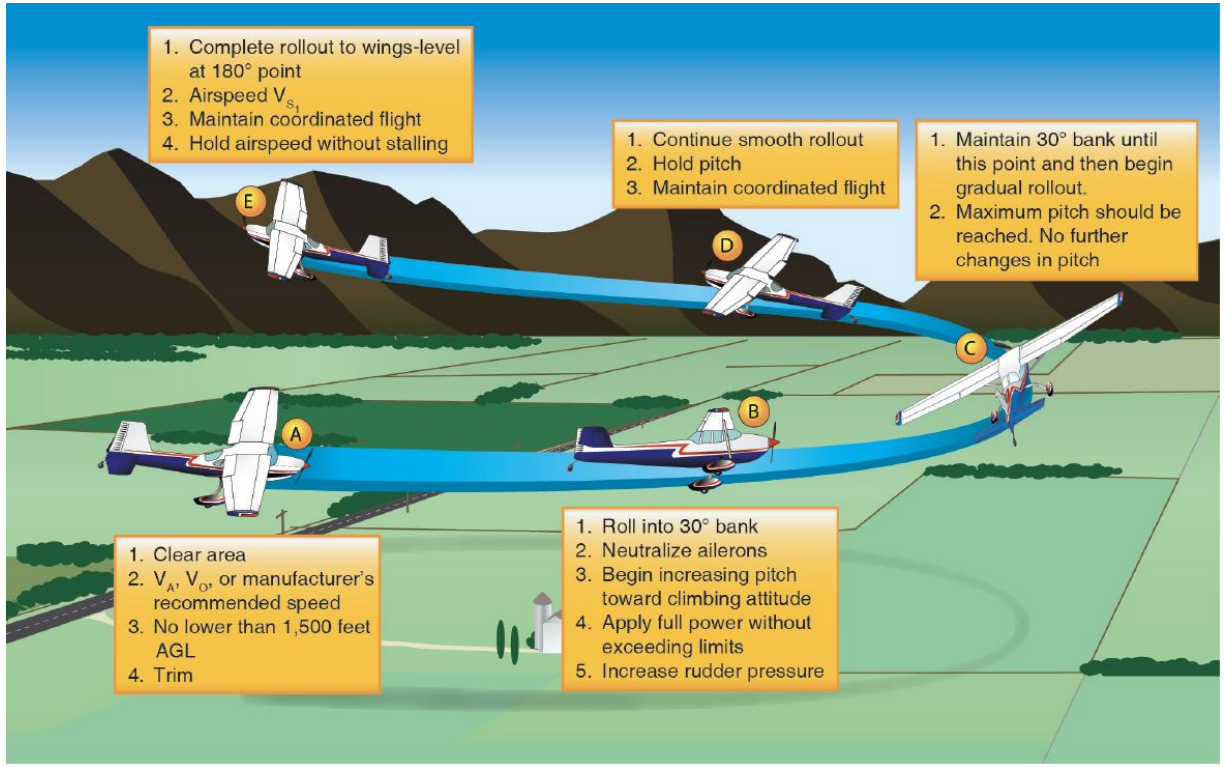
Varies with the plane, density etc.



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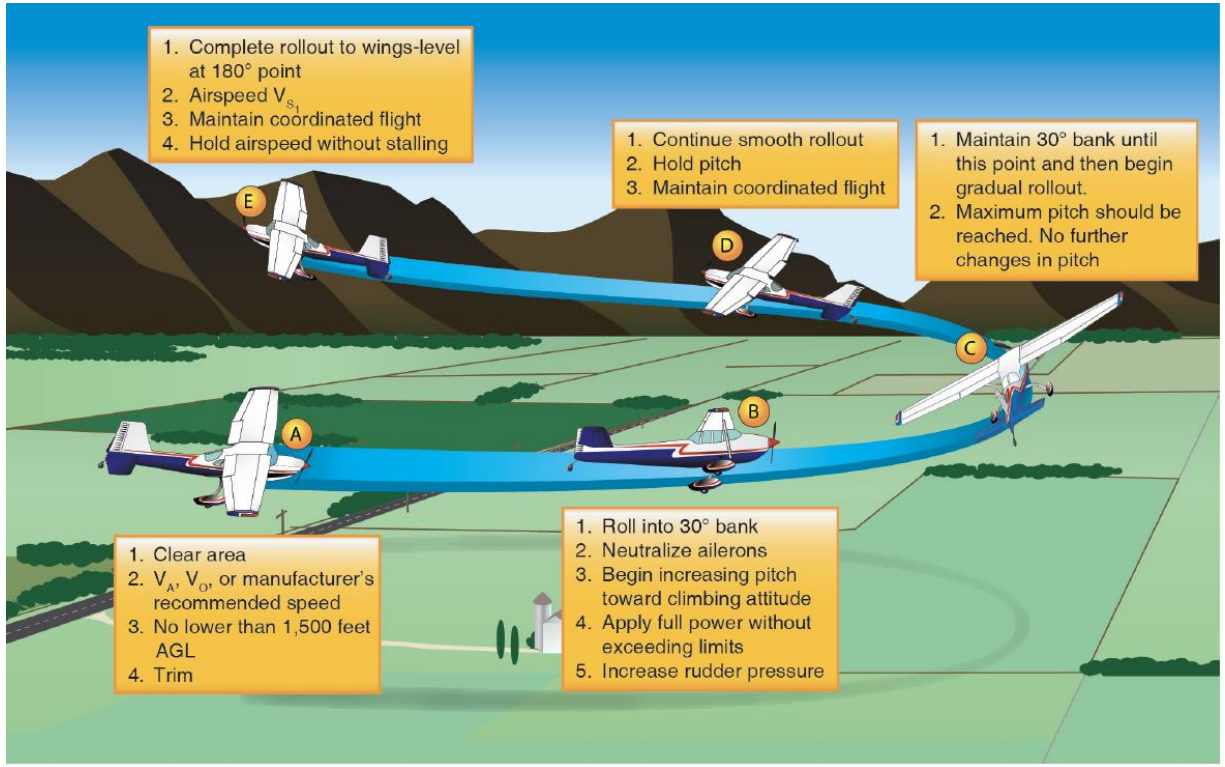
When is right rudder used less in a Chandelle - to the left or right?



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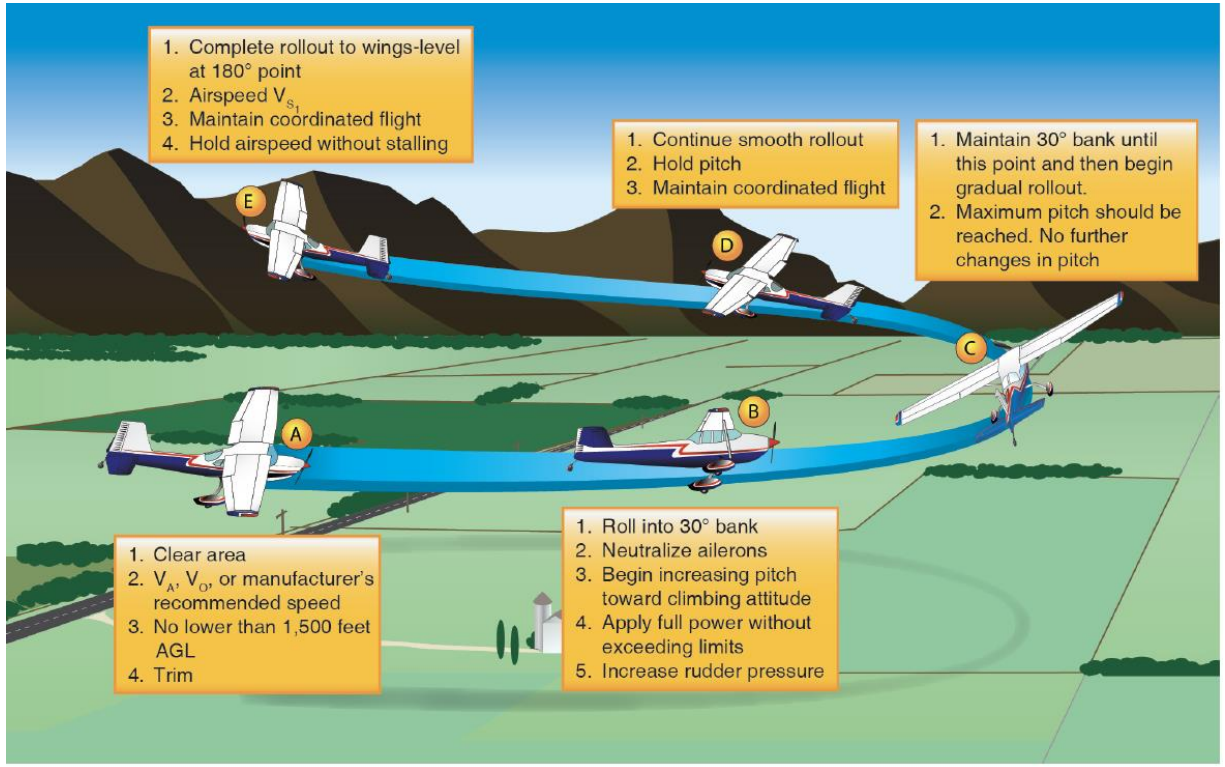
When is right rudder used less in a Chandelle - to the left or right?



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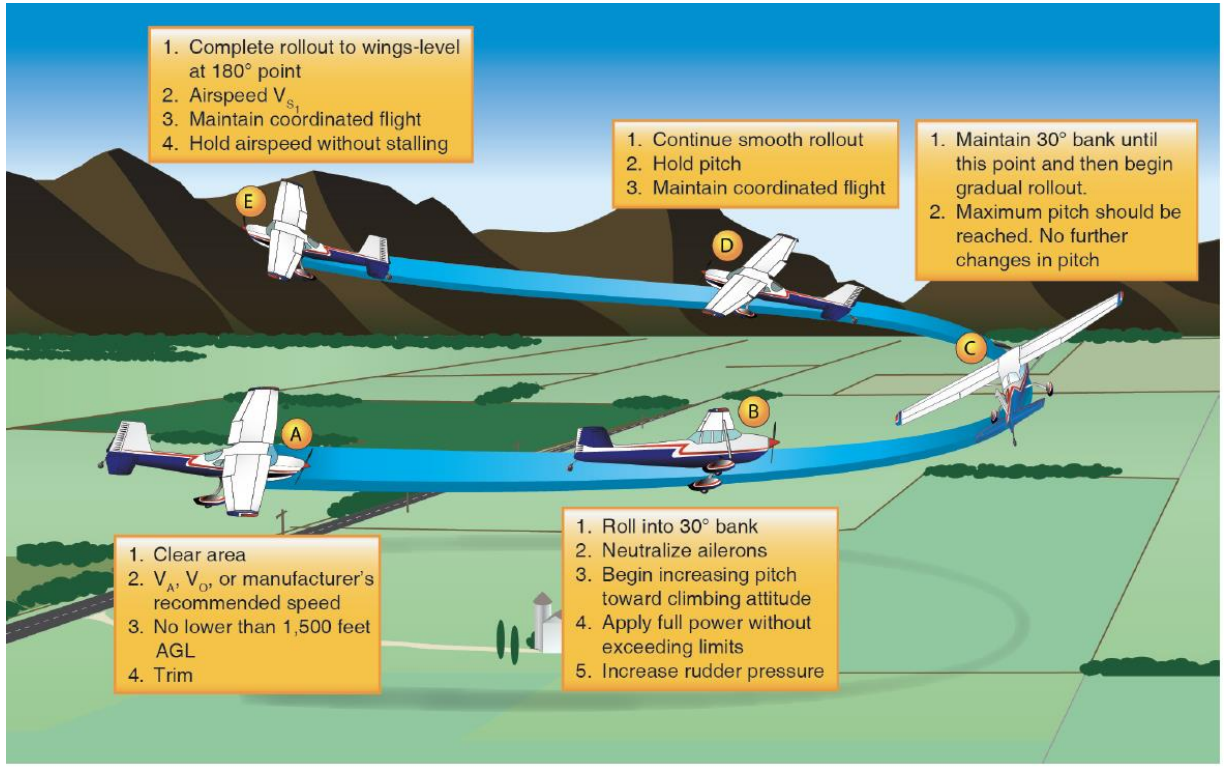
To the right during roll out – Why?



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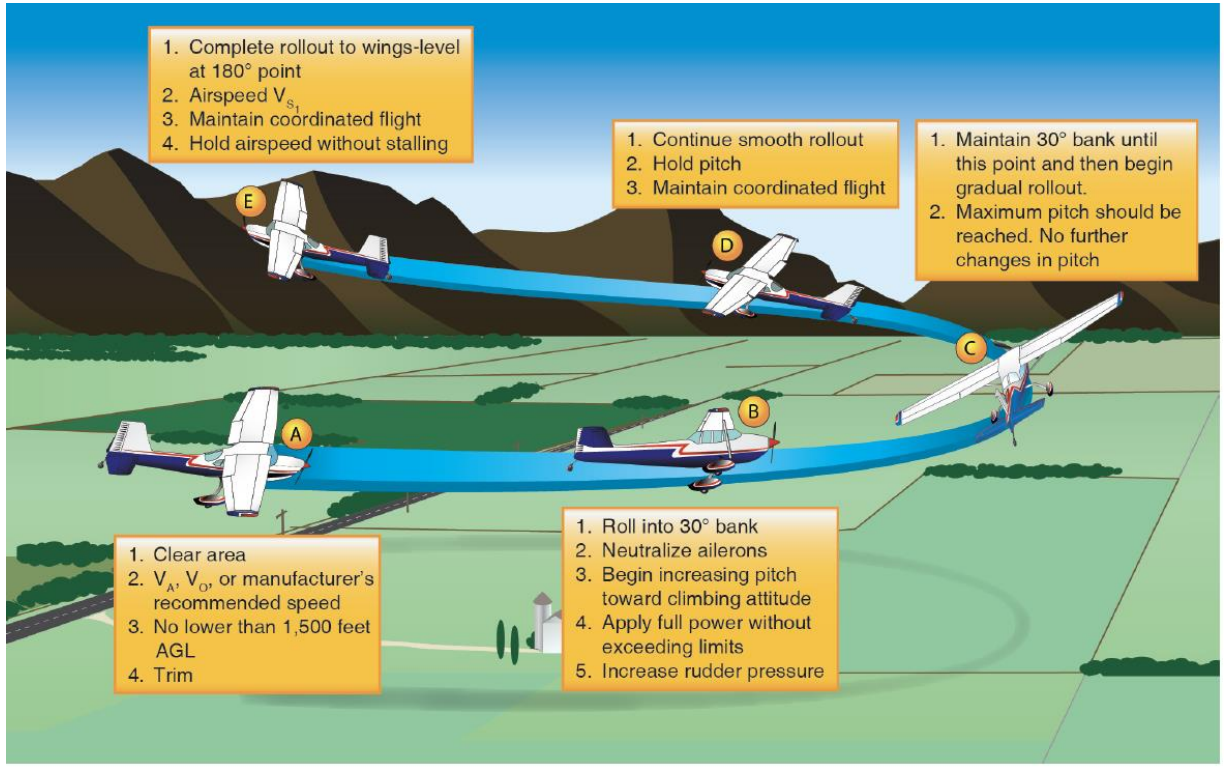
Left turning tendencies pull you left.



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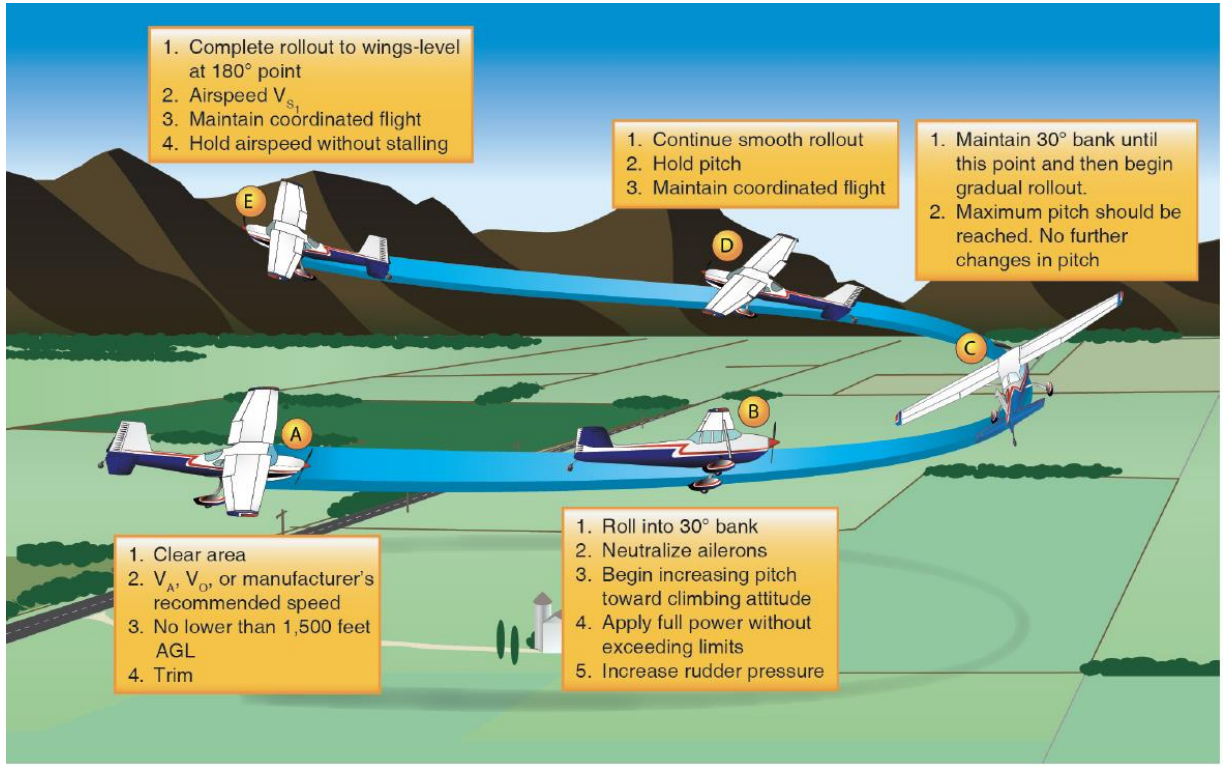
When rolling out of a chandelle to the right, left aileron is used to raise the wing.



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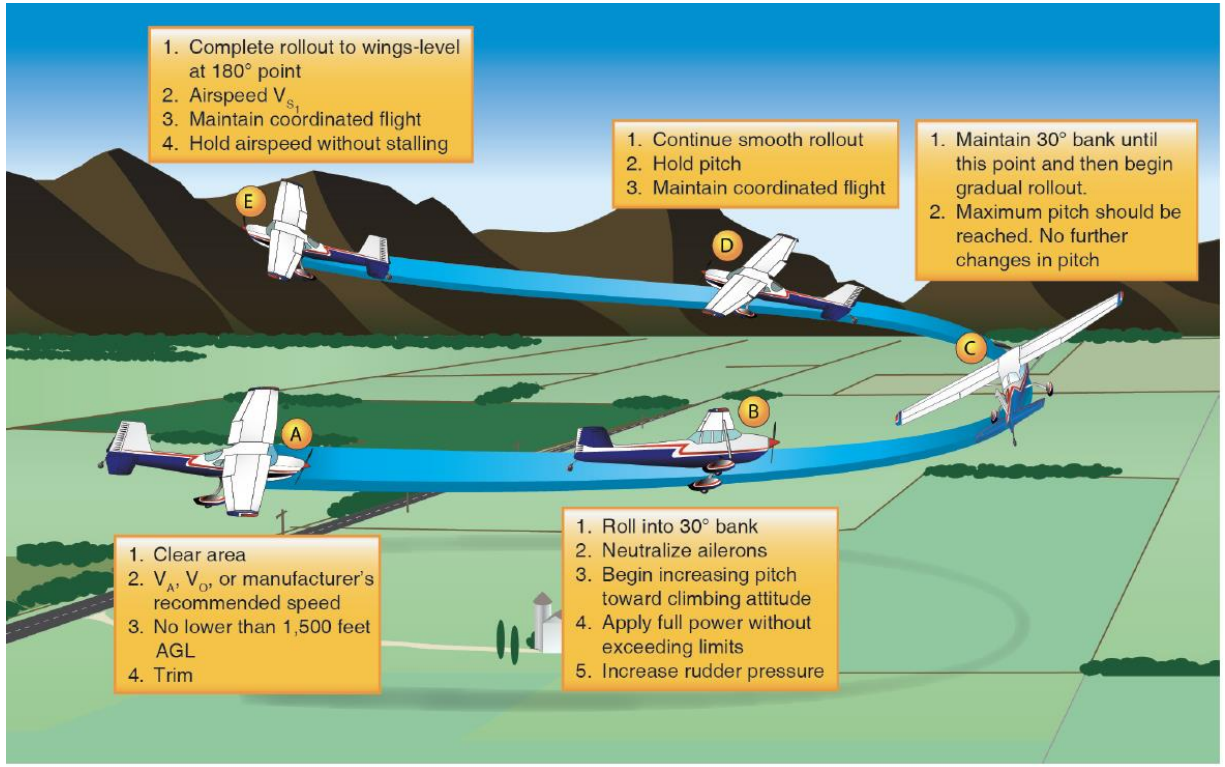
This causes adverse yaw to the right helping cancel the left turning tendencies



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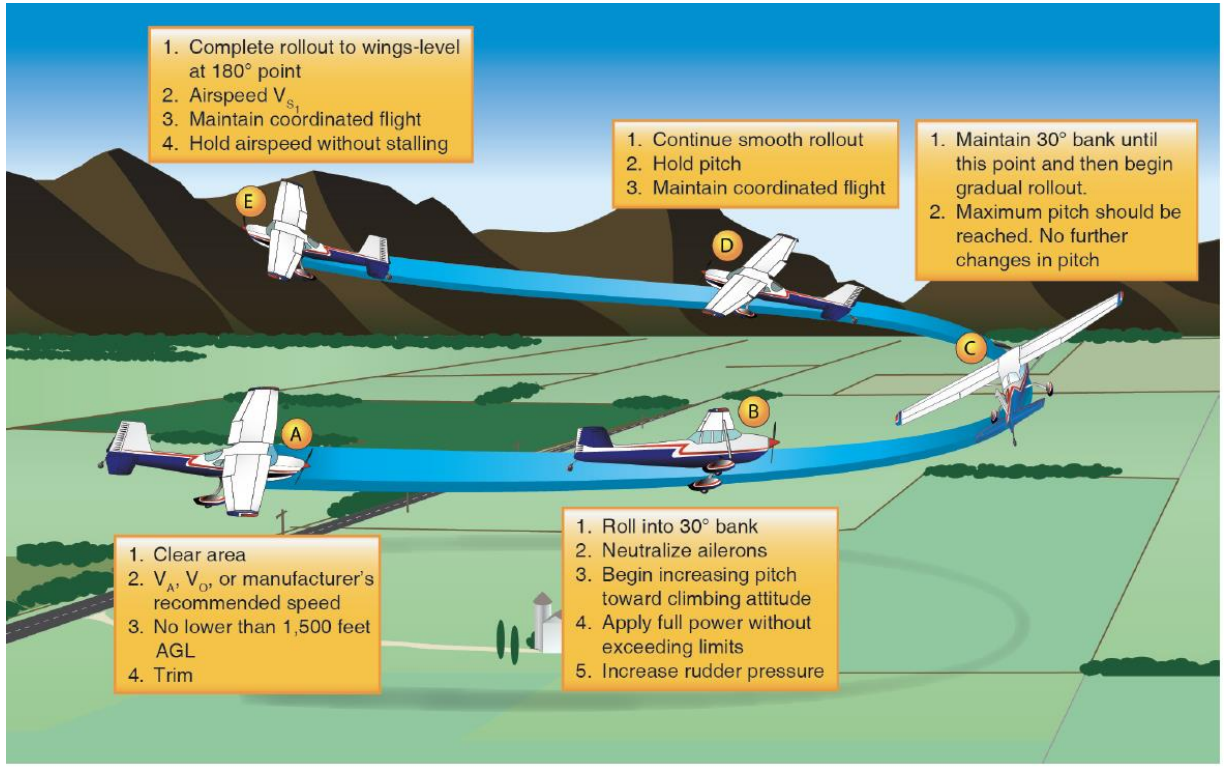
Rolling out of a chandelle to the left you use right aileron to raise the wing



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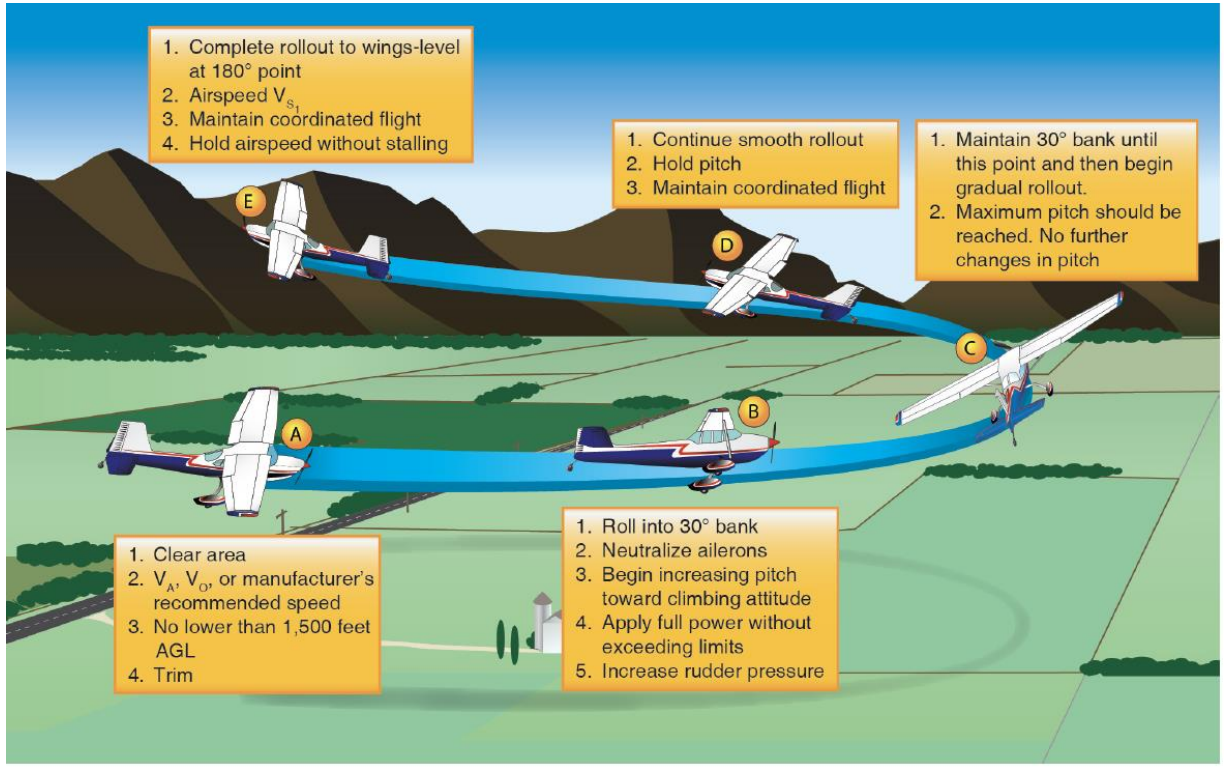
This causes adverse yaw to the left, adding to the left turning tendencies so more right rudder is needed



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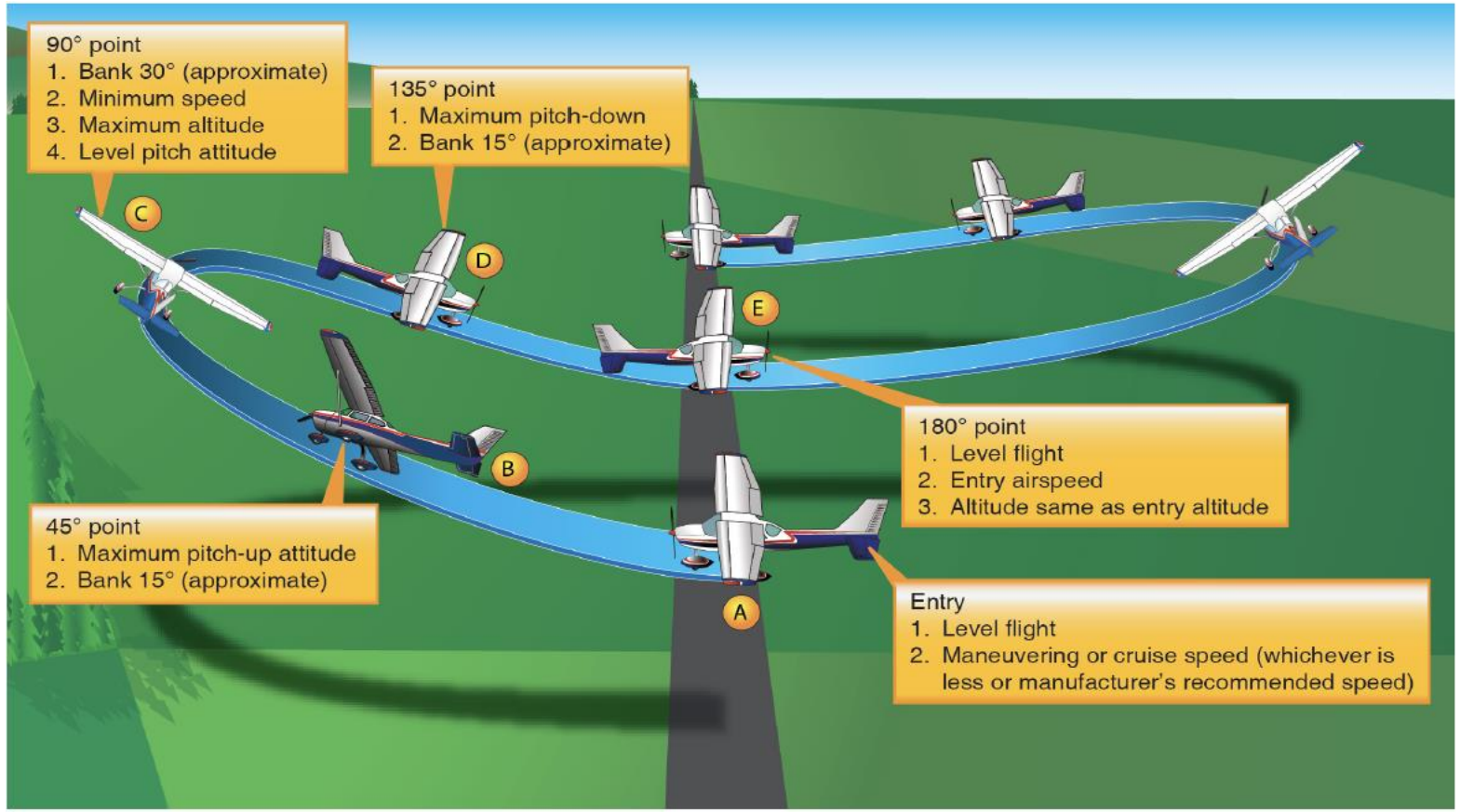
Lazy Eights



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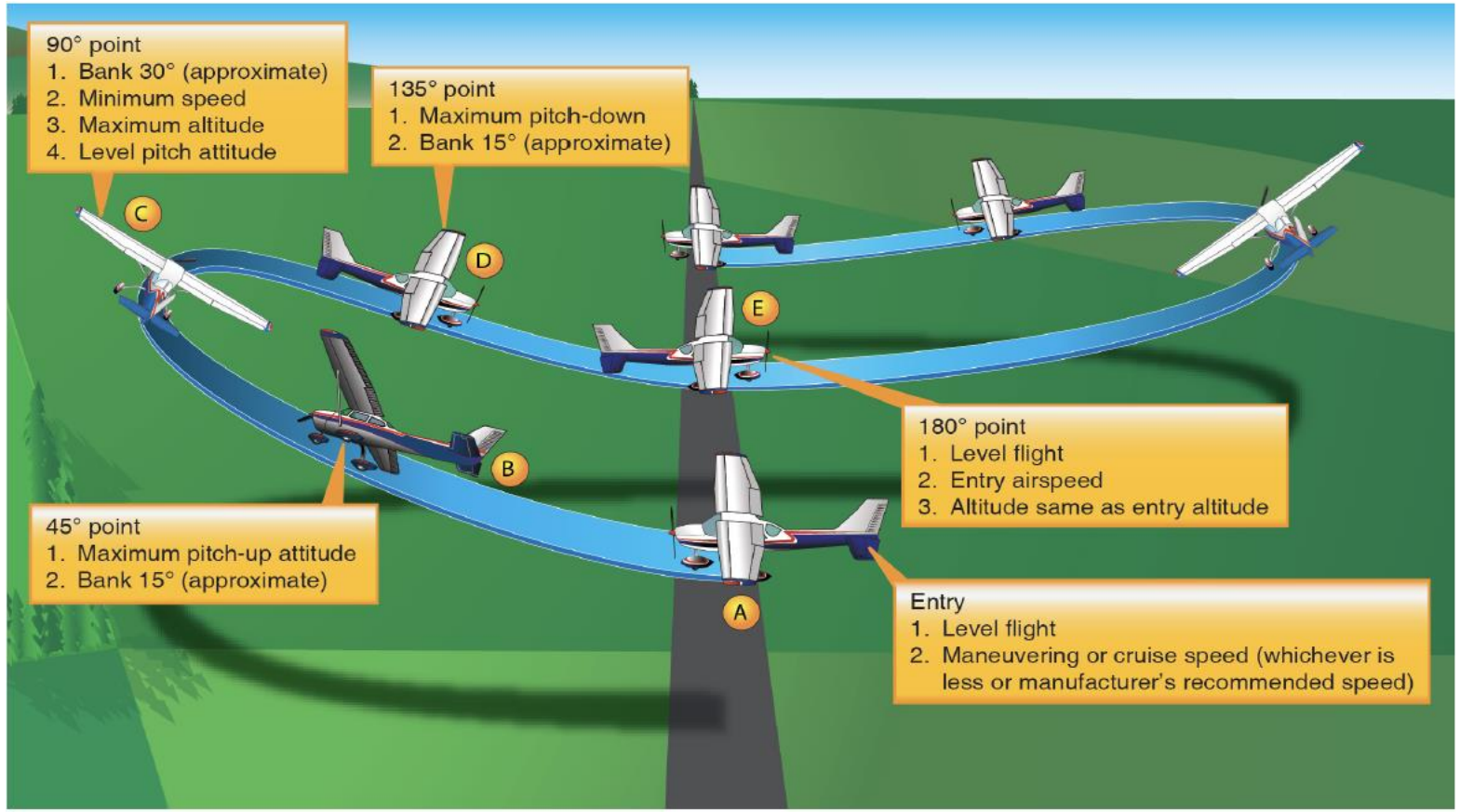
This image is not 100% correct – Similar to the Chandelles image



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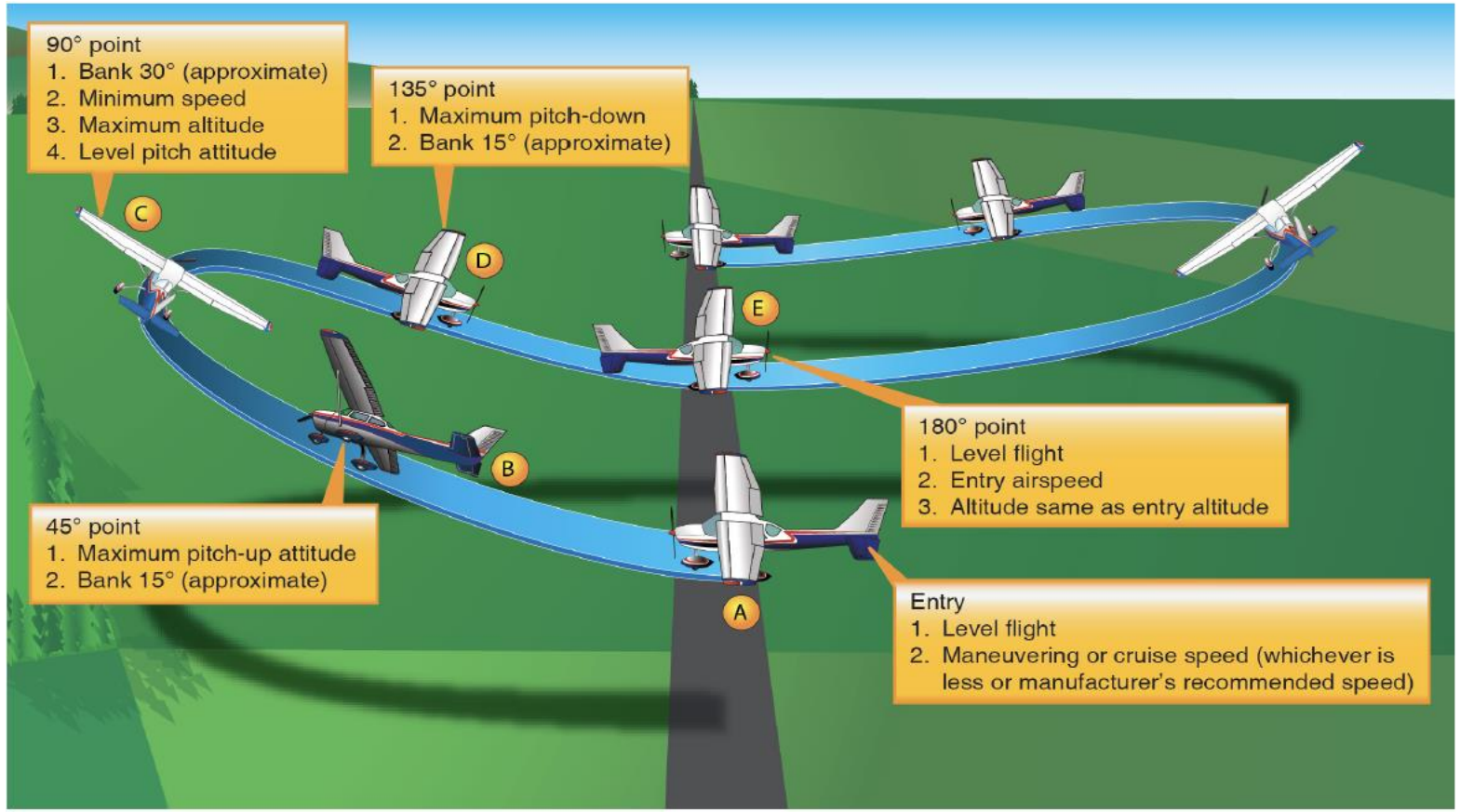
As the speed decreases the radius of the turn decreases



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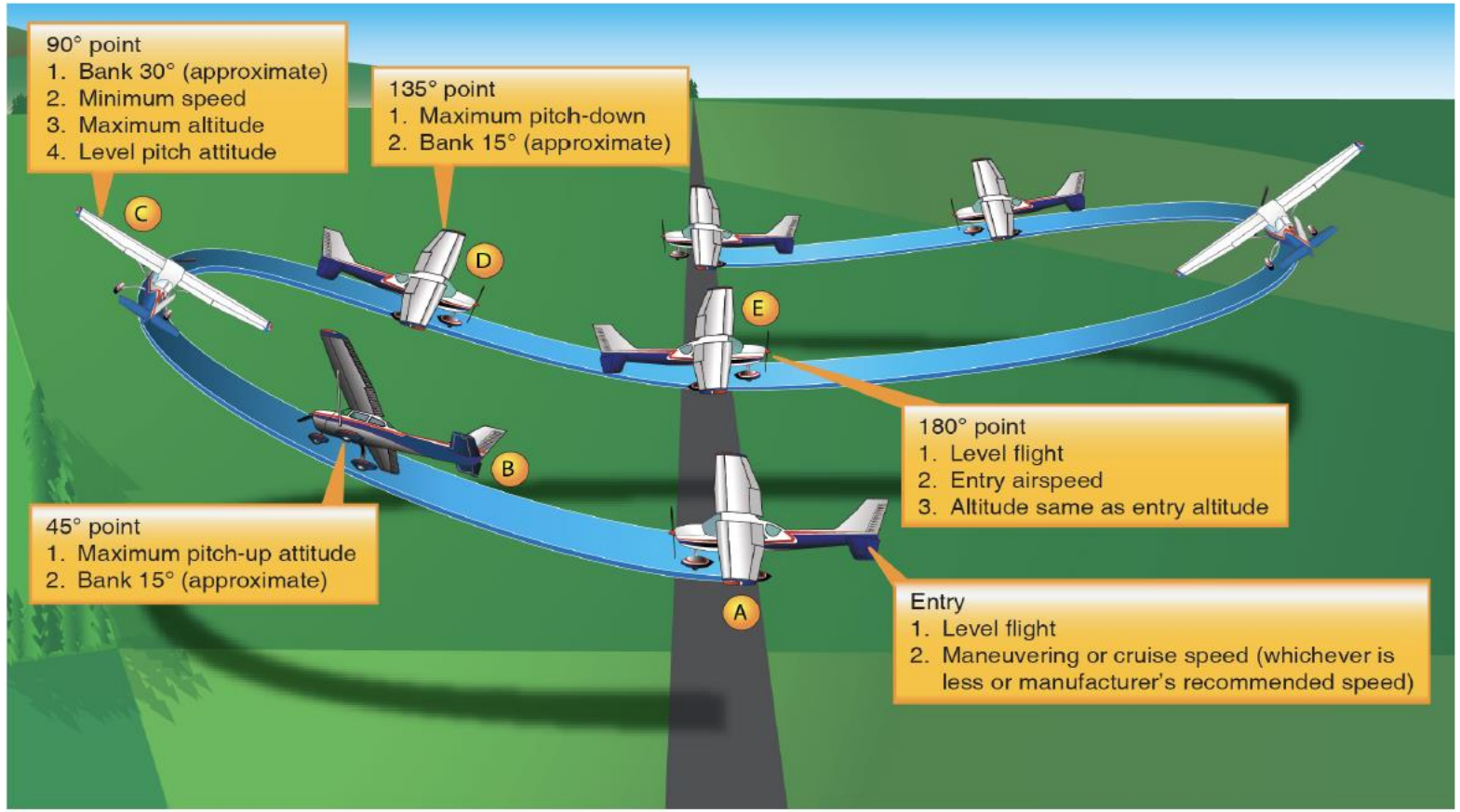
This image shows the turn radius mostly the same



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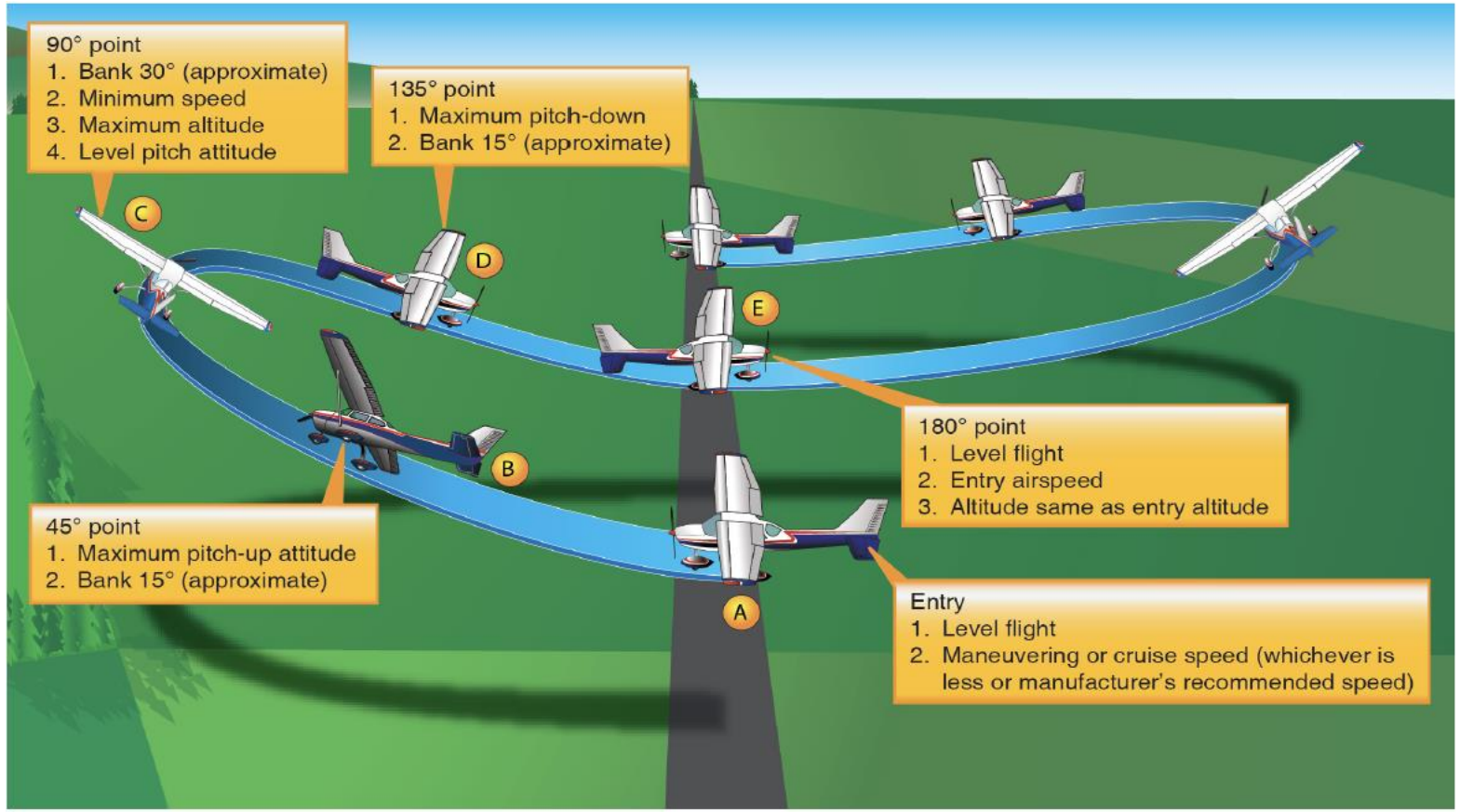
The maneuver resembles a snowboarder in a half pipe



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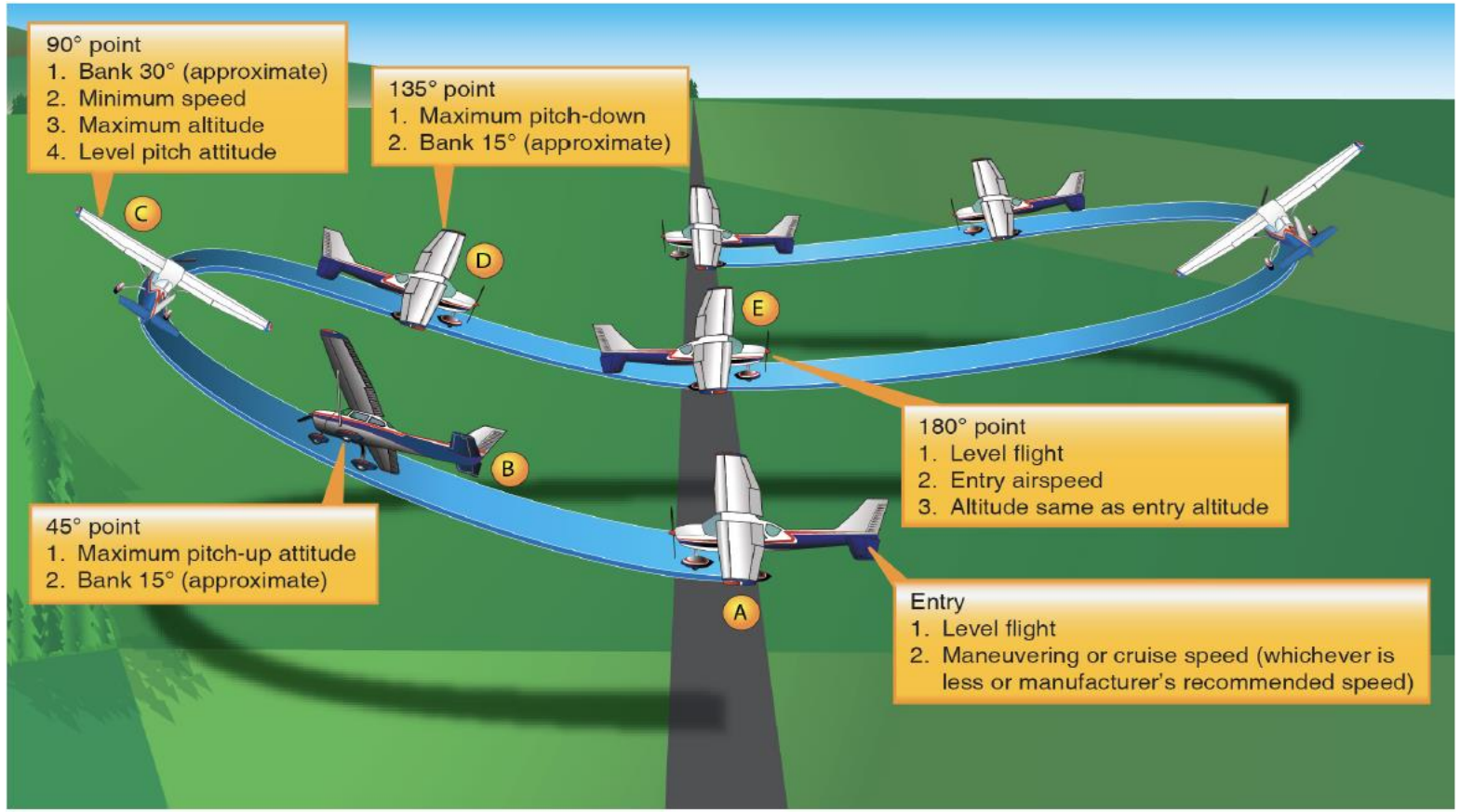
Entry speed is fast but at the top of the pipe it's slow – small radius



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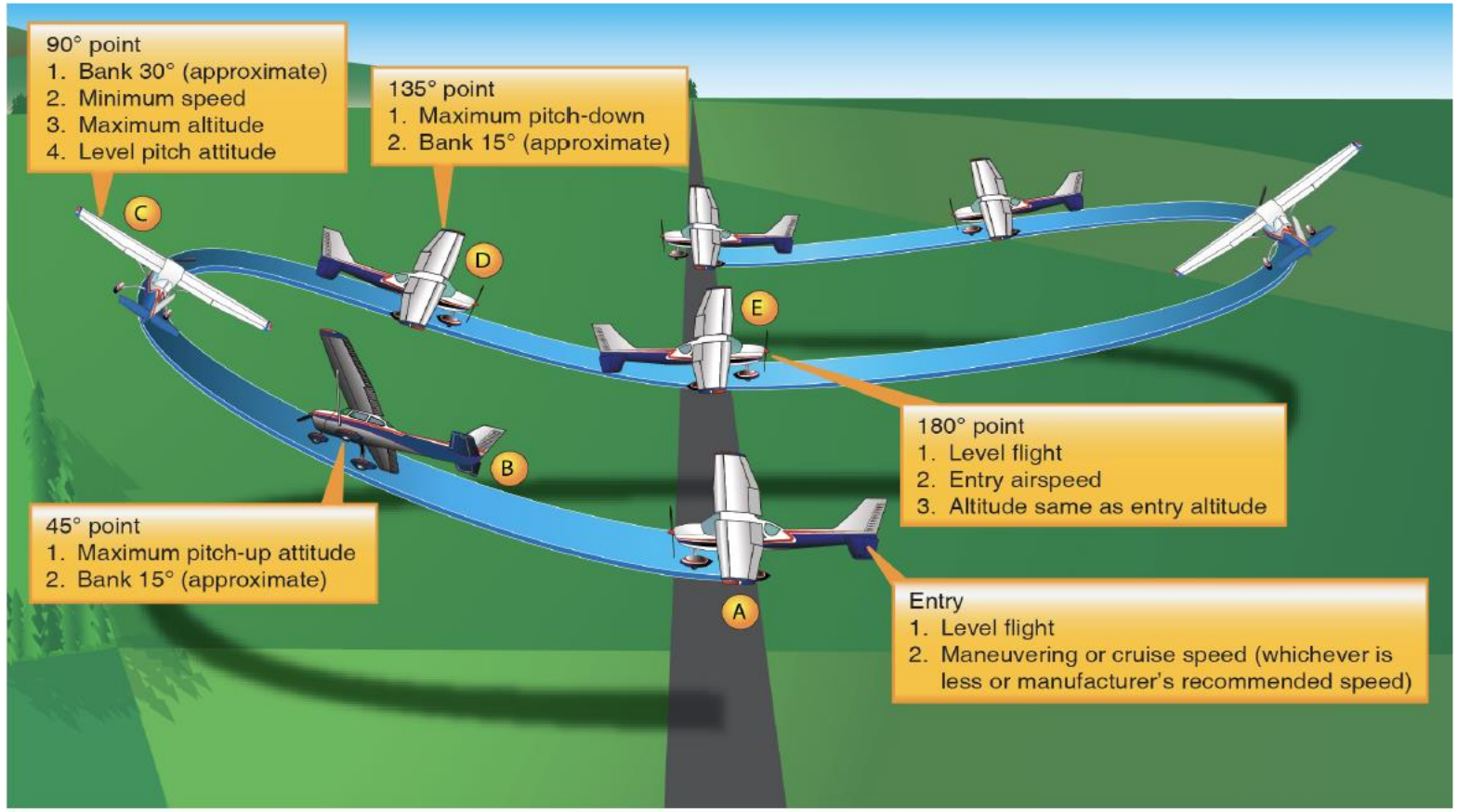
If the speed isn't slow enough at the 90° point the turn will not be completed to 180°



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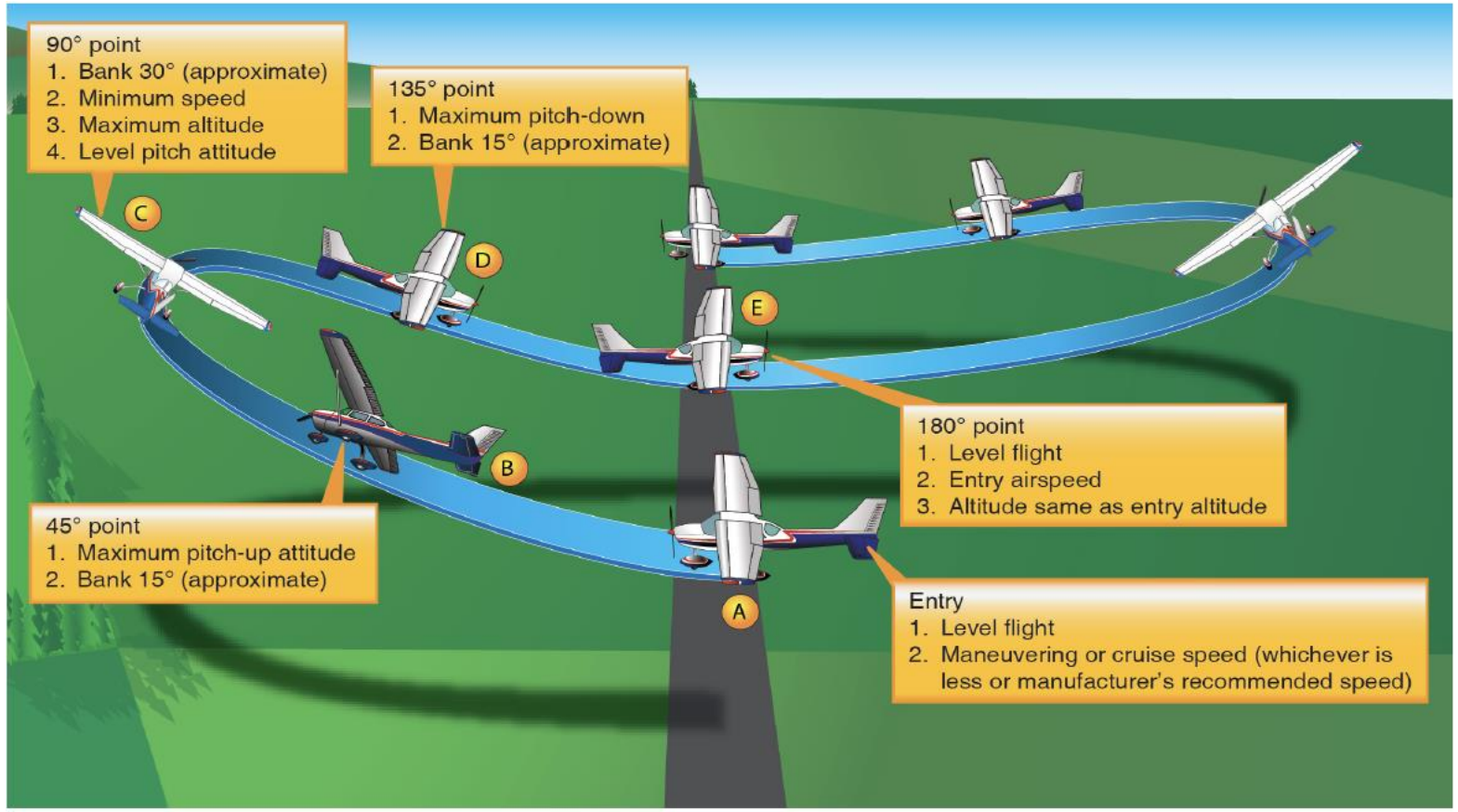
Visual references for 45°, 90°, 135° and 180° should be on the horizon



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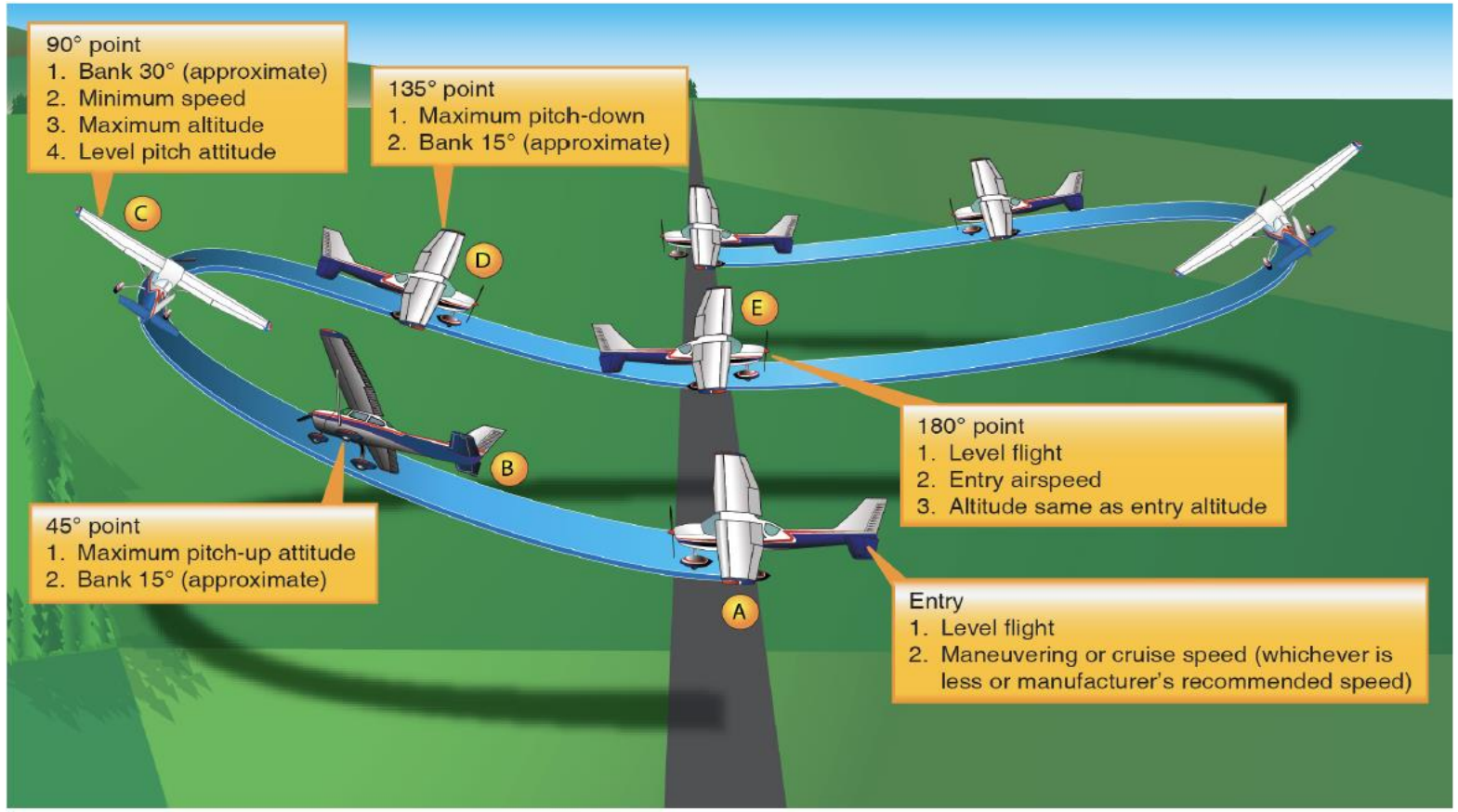
Rudder pressure – Rolling right at low airspeeds and high-power settings requires the most right rudder



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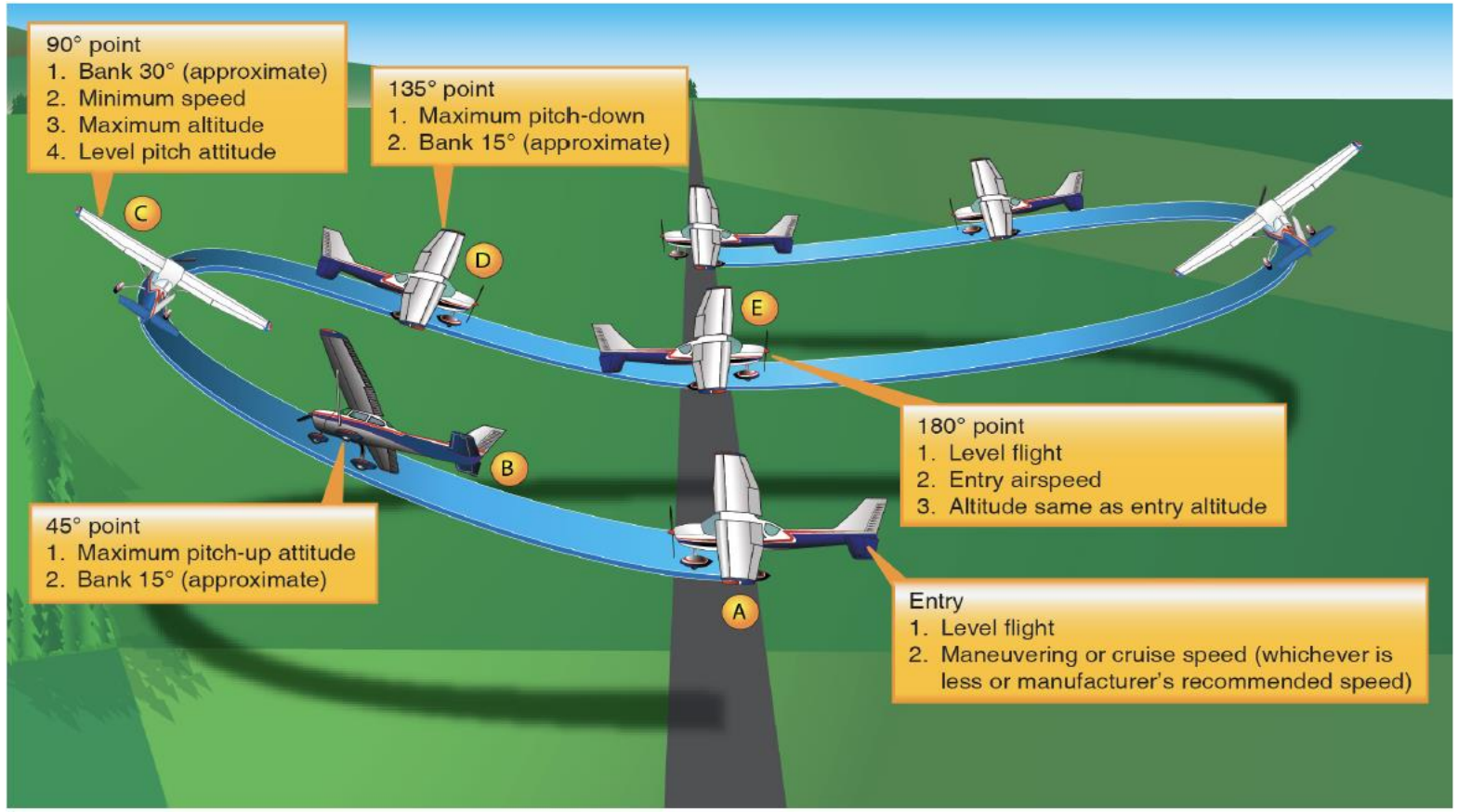
Overbanking tendency requires slight opposite aileron



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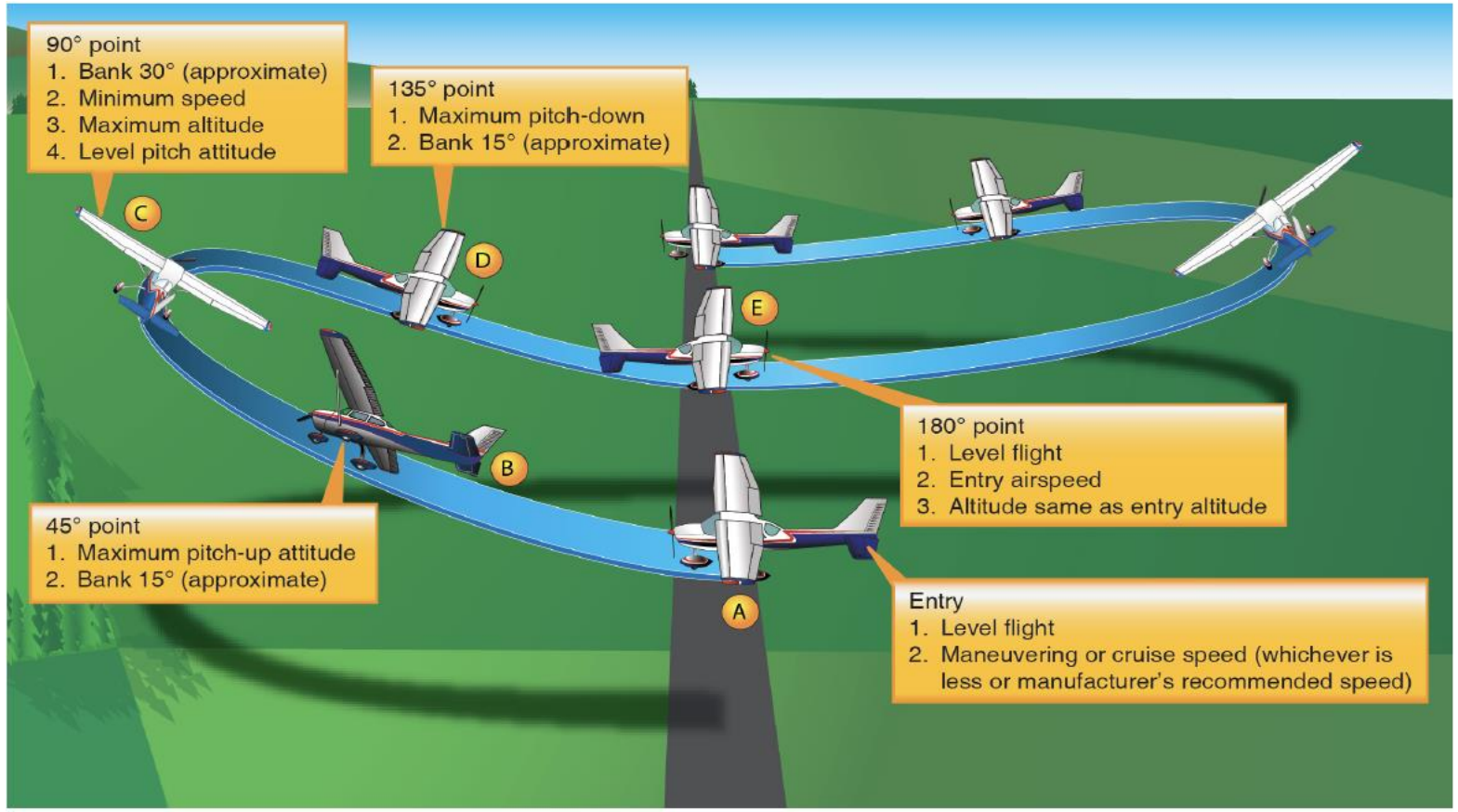
As speed decreases the outer wing produces more lift than the inside wing



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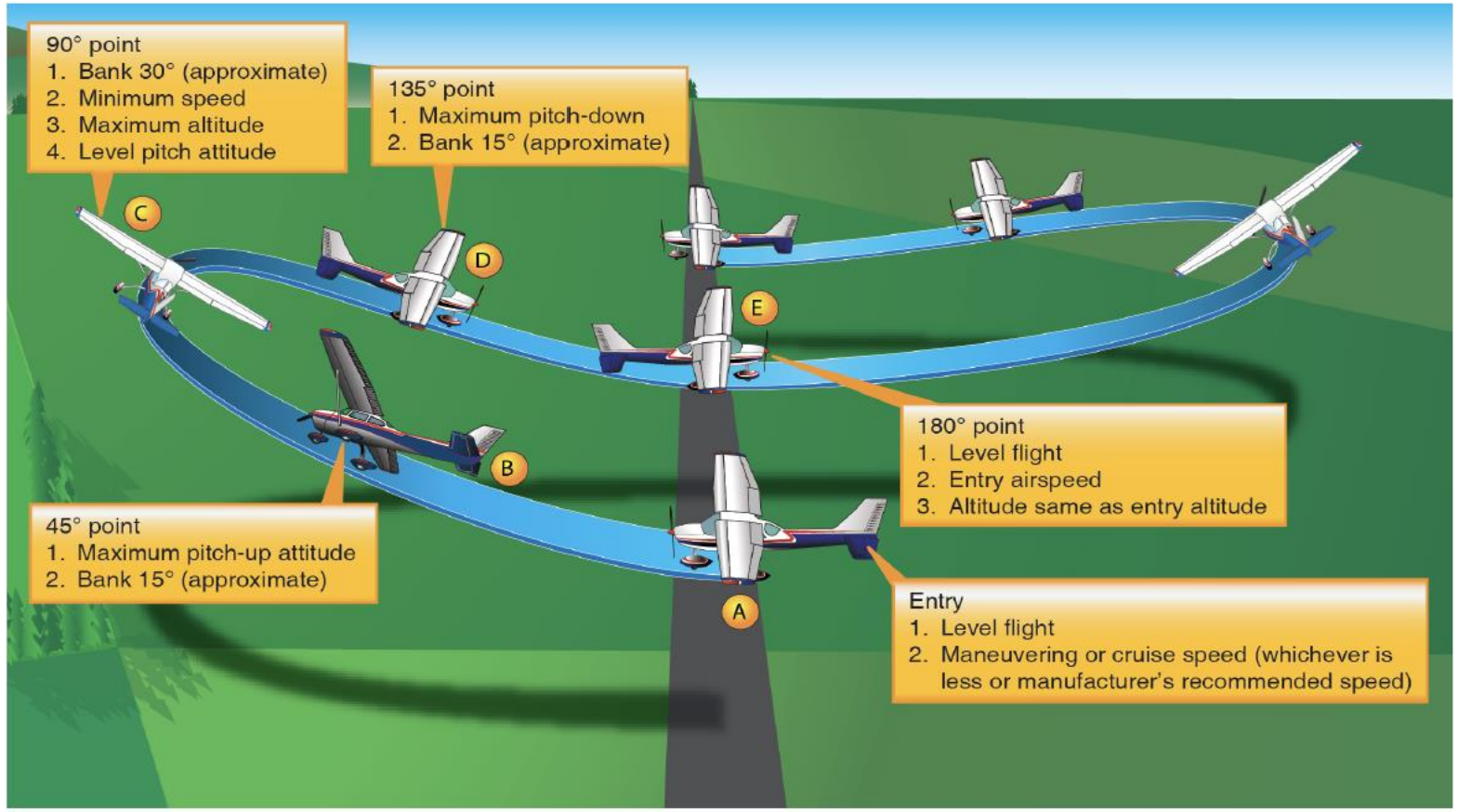
Example: At very low speeds the inside wing may be almost stationary across the ground but the outside wing is still moving causing more lift and overbanking



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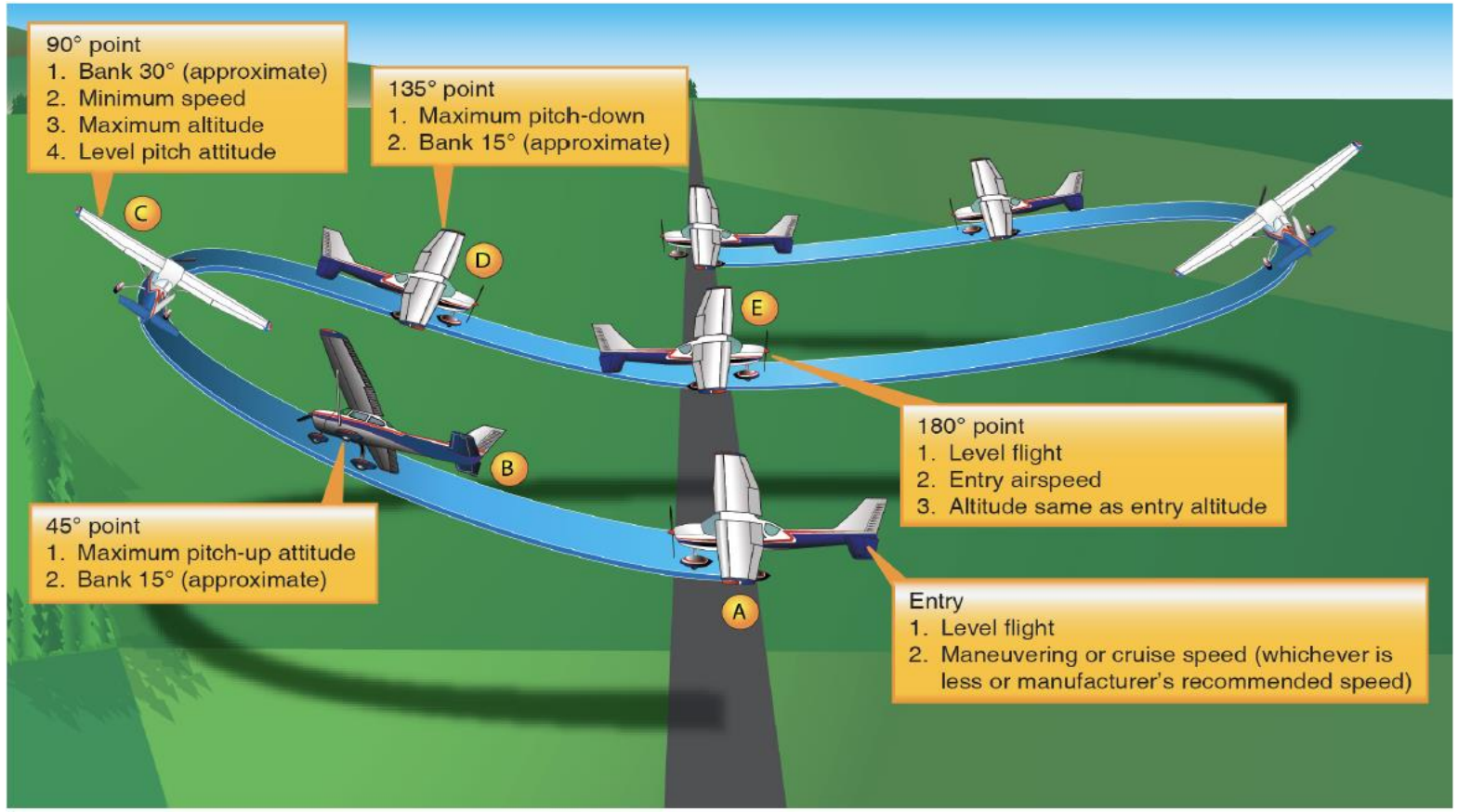
Example: The faster the airspeed, the less this happens



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