<u>THE GREAT CIRCLE LANDING APPROACH</u>

The Great Circle is the most commonly seen RC landing approach. Visit any RC flying field and note the landing approaches each pilot makes. Probably somewhere near 75% of them will be the Great Circle in one form or another. As you watch these approaches, also note how many aircraft land on, or at least near, the runway's centerline; with the touchdown point somewhere near the pilot's latitude. You will find that most of these landings are either "long", well past the pilot's position, or close to the opposite runway boundary, or maybe both.

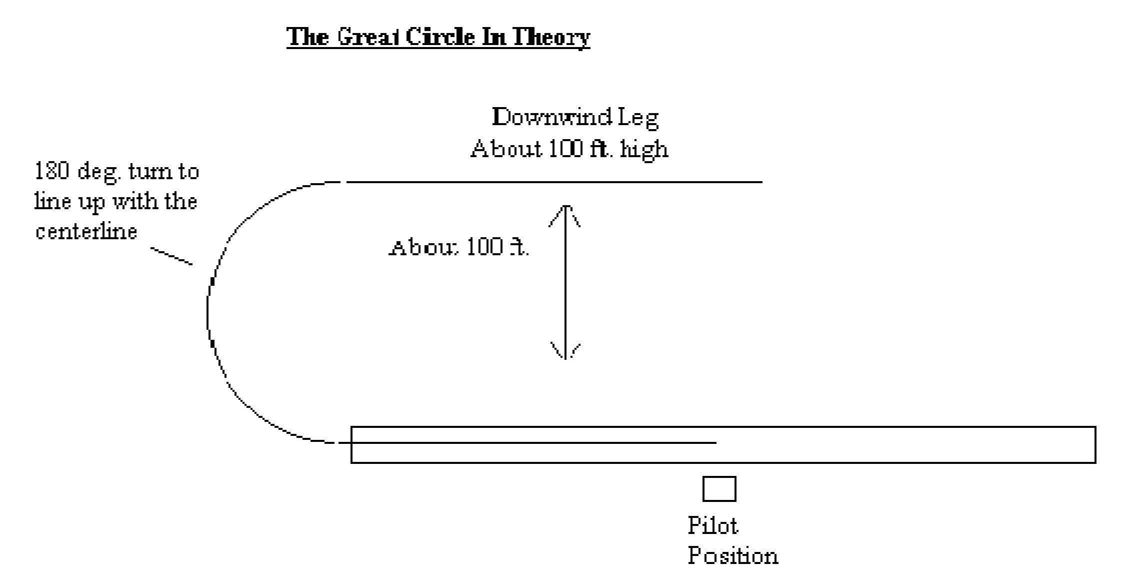
Why? Because, although the most common RC landing style, the Great Circle approach is the most difficult RC landing approach to master. During this style approach, the pilot must *simultaneously* adjust the aircraft's descent rate, airspeed, runway centerline position and touchdown point while the airplane is in a *spiraling descending turn*. These are too many tasks to manage while the airplane is in an unfavorable position.

Most RC pilots don't realize they are trying to accomplish so many tasks at once because the Great Circle has one major advantage that *seems* to make it the easiest approach to use. During this approach, the aircraft is usually *closest* to the pilot of any approach and easy to see. The Great Circle affords excellent visual references because it is flown close in to the field. This makes the approach *appea*r easy to accomplish when it is not in reality. But a few approach modifications do help to simplify this approach without losing it good visual references advantage.

While as old as powered flight itself, the Great Circle was perfected in the 1920's by pilots trying to land on a moving aircraft carrier. Biplanes do not afford the pilot good visibility, as the wings and struts always seem to be in the way. Things didn't improve much when carrier pilots switched to low wing WW II fighters with cockpits located right over that broad wing. These wide wings were also always blocking just where the pilot wanted to look.

Landing while in a constant turn kept the moving carrier always in sight. Since there was only one turn, the downwind could be flown close to the carrier affording a good situational view. The Landing Signals Officer (LSO), the man with the flags you see on deck in the old movies, kept track of the airplane's speed and descent rate allowing the pilot to concentrate on aligning the aircraft with the centerline of that tiny deck. The pilot was sitting in the airplane, where he could both feel and see the approach unfold, and had the LSO to help manage the simultaneous tasks. In this situation, the Great Circle approach worked well.

But the RC pilot has none of these advantages. He is alone and in the position of the LSO with no "feel" for the aircraft through the control system. The perfect Great Circle is shown in Fig. 1.



The RC pilot flies the Downwind Leg about 100 ft. high and 100 ft. out from the runway centerline. At about the end of the runway, the aircraft begins a descending, 180 deg. turn to align with the centerline about 20 ft. high over the end of the runway. From there, the airplane lands in front of the pilot. Sounds easy, doesn't it. Let's see just what is happening in this approach.

First the airplane must start to turn and begin to descend at the same time. There is little time to establish the descending glide before making the turn. Therefore the pilot must establish to proper descent rate that will leave to airplane with 20 ft. of altitude just over the runway's edge. At The same time, the pilot must also establish the correct turn diameter to be sure the aircraft is aligned with the centerline when the turn is completed. Again at the same time, the pilot must control the airspeed so that the airplane is not traveling too fast, or too slowly, to land in the middle of the runway. This is a lot or work.

What usually happens is different from theory. The pilot starts the turn and cuts the engine. Usually, the turn is too gentle resulting in the airplane's passing the centerline while still in the turn as in Fig. 2. Seeing this, the pilot increases the bank angle and adds more up elevator. This causes the aircraft to turn more quickly and to lose airspeed. But the sharper bank angle and reduced airspeed causes the nose to drop and the airspeed to quickly increase. The airplane drops quickly, the airplane speeds up, the pilot adds power, the airplane accelerates even more in the descending turn and arrives at the runway's end traveling fast enough to glide beyond the horizon. The approach looks like Fig. 2 when seen from above.

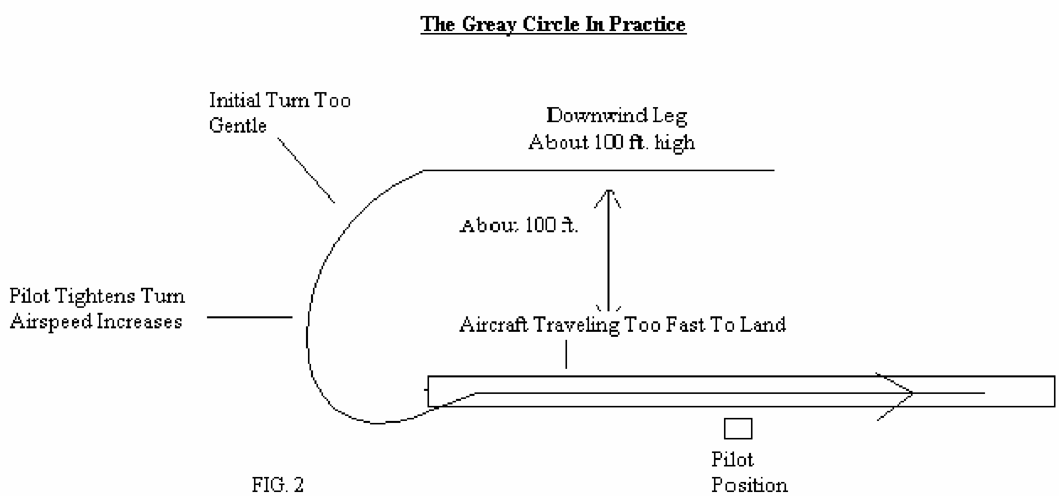


FIG. 2

Seen from the side, the increased descent rate is obvious in Fig. 3.

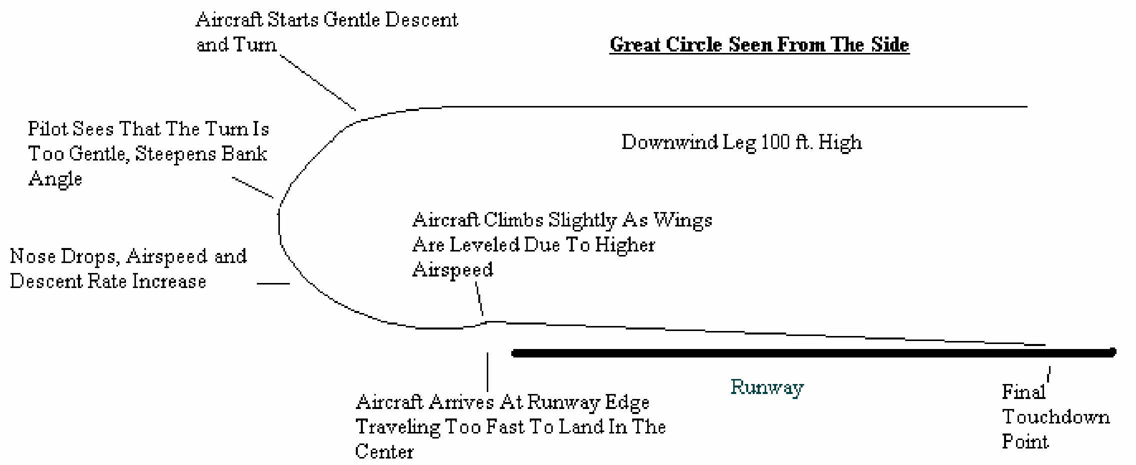


FIG. 3

Many times the initial turn rate is too sharp. In this case the pilot sees that his aircraft is going to end the turn far outside the runway centerline. The pilot decreases the bank angle to compensate. But this decreases the descent rate and the aircraft arrives over the runway too high as in Fig. 4. Many times the pilot will stop the turn and fly directly towards him/herself as in Fig. 4A. The descent rate almost stops or the aircraft even climbs. The airspeed slows dramatically and the pilot ends up dragging the aircraft to the runway with power; makes a final turn at low altitude to line up with the runway and then "plops" the aircraft on the ground, somewhere.

Great Circle In Practice II

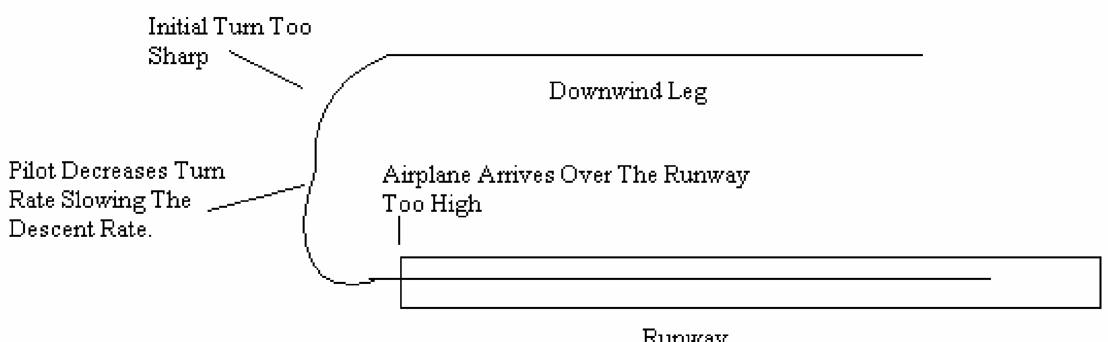


FIG. 4

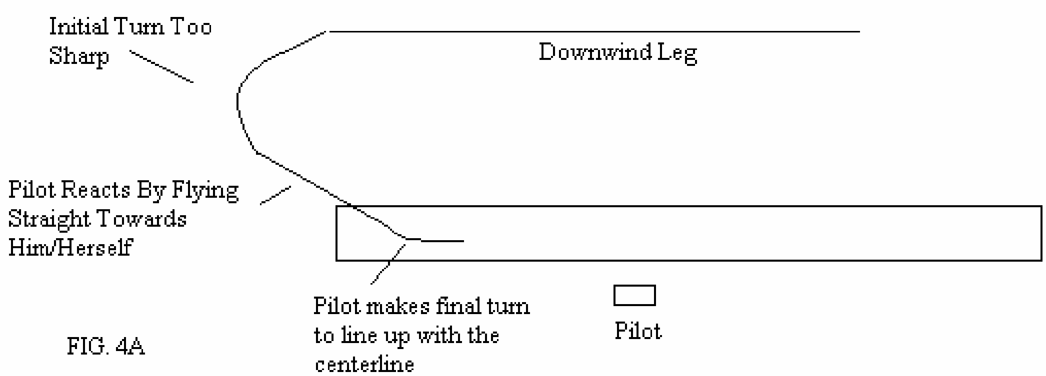


FIG. 4A

If you watch the landings at your flying field, you will see all these variations of the Great Circle, and others as well, along with the corrections. Aircraft are landing all over the runway, long, short, wide, close in and combinations of these positions. Add a crosswind and the approaches deteriorate even more. But it needn't be so difficult. A few adjustments make this landing approach easier to do.

Basically, the Great Circle just requires key extensions to space out the pilot's task management. Adding two 75 ft. extensions, one to the Downwind Leg and one to the Final Approach allows the pilot to separate airspeed, descent rate and turn rate tasks as shown in Fig. 5.

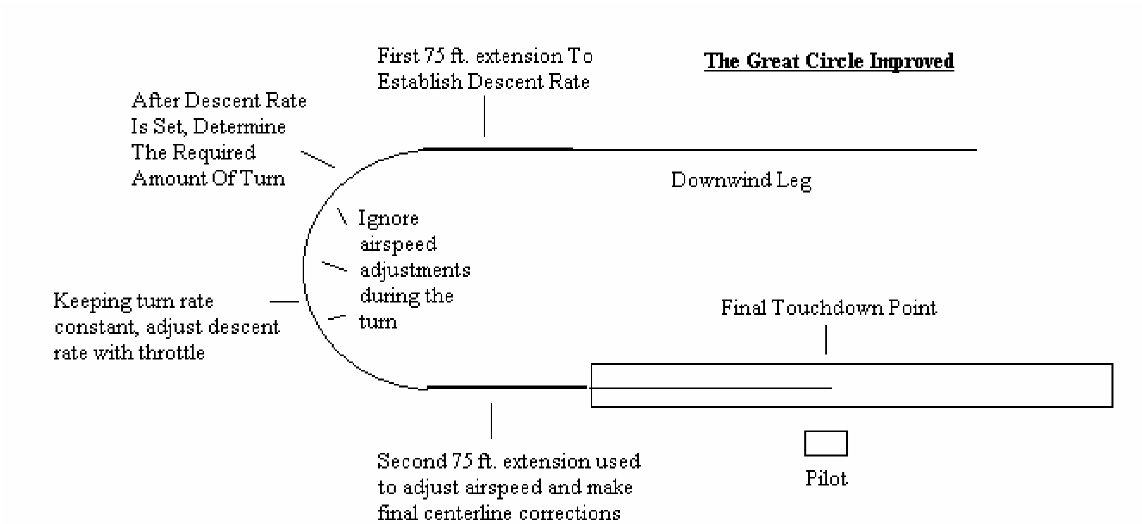


FIG. 5

When the aircraft is even with the runway's end, continue flying straight, but reduce the throttle to 3-4 clicks above idle and then adjust the descent rate, using the throttle as mentioned in Basic Landing Techniques. Once the proper descent rate is set, begin the turn. Add a little throttle to maintain the proper descent rate in the bank. Adjust the bank angle to achieve the correct turning rate. Do not worry about airspeed at this time.

Once the turn rate is set, control the descent throughout the turn using the throttle. The elevator is actually controlling the turn rate and airspeed during the turn. It should not be varying much as the airspeed is not being managed at this time and the *bank angle* should be used to control the turn rate. If a slightly steeper bank is required, add throttle to maintain altitude, not the elevator. If the bank angle needs to be shallower, reduce the throttle to manage the descent rate. Do not reduce elevator to reduce the turn rate, as that will increase the airspeed, changing the end point of the turn.

Once the aircraft rolls out near the centerline, reduce the throttle back to 3-4 clicks above idle and adjust the airspeed, using the elevator during the second 75 ft. extension added to the Final Approach. The aircraft enters this extension about 20 ft. high and usually traveling slightly too fast. Allow the aircraft to lose airspeed during this strait flight while maintaining the 20 ft. altitude. Make any final centerline adjustments during this extension as well.

Once the runway is reached, begin the final landing descent using throttle to control altitude and elevator to manage airspeed. The touchdown should be right in front of the pilot.

Just two simple extensions remove the Great Circle's task management complications. Keep the extensions as short as practical in order to maintain the Great Circle's only true advantage – Good visibility. We have found 75 feet to be about right. This landing approach requires a bit more practice to fly well than does the square landing pattern in Basic Landing Techniques. But the airplane is always easier to see and it is pretty to watch.

Please excuse a few words of caution here. Do not use this landing technique when flying scale aircraft with high wing loadings. Since the airspeed is not managed in the turn, heavy scale aircraft may lose enough airspeed during the turn to stall. Remember that stall airspeeds increase with bank angle. At bank angles of 45 degrees, the stall speed increases about 20%.

Be careful when flying high-drag aircraft, such as biplanes, as these airplanes can slow dramatically in a turn. Using extra throttle and reduced elevator helps with these aircraft, but then the pilot is back to simultaneously managing airspeed and turn rate. The regular square landing pattern is recommended for these two aircraft types.

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