Real VFR

Lessons In
Visual Flight Rules Flying For Flight Sim Pilots.... The Real Pilot's Way

By Professor Fred Calfior

In this second lesson plan of visual flight rules flying for Flight Sim Pilots, we will takeoff from Ballarat Aerodrome (approaching dusk) and proceed to the airports at Maryborough, Bendigo, Shepparton, and finally make a night landing at Wangaratta Aerodrome. This particular regional area of Victoria, Australia has a wealth of beautiful lakes and rivers that will make this a very pleasurable and landmark rich flight. In addition, I will be sharing with you how to perform climb and cruise calculations using a Cessna 182RG Pilot's Information Manual.

Using your Mega Scenery CDROM, place yourself at Ballarat where you'll be resting at the approach end of runway 05. Let's get all this setup stuff taken care of, and then we can pause the program and roll up our sleeves for some aeronautical tinkering!

Surface winds: 030 degrees at 6 knots
Altitude winds: 330 degrees at 23 knots
Visibility: 20 miles
Time: 1815
Scenery Complexity: Very dense
Options - Preferences - Instruments: Display indicated airspeed

Now pause your simulator, so that your time doesn't run away from you and it gets dark before you takeoff! I would like to get into some fundamental issues regarding time, fuel, and distance to climb calculations using the Cessna 182RG information manual.

We will assume standard temperature in our calculations, just to keep things simple. At sea level, standard temperature is 15 degrees Celsius, and for every one thousand feet above, it'll always be 2 degrees colder. Take a look at the Time, Fuel, And Distance To Climb (Maximum Rate of Climb) page in this article. The second column is pressure altitude and the following third column has each altitude's corresponding standard temperature. See, I don't lie to you! Two degrees colder for each thousand feet - neato!

Since we're traveling northwestward at first, let's choose a cruise altitude of 6500 feet. I'm interested in determining how much time it'll take to climb to cruise altitude, the fuel burned to do it, and the ground distance flown. The airport elevation at Ballarat is 1433 feet. For this exercise, we'll set the altimeter setting at 29.92 so that pressure altitudes will be as given. For the climb out of Ballarat, we'll approximate a departure pressure altitude of 1500 feet. Here is what I do when setting up my table of numbers for time, fuel, and distance from 1500 feet to 6500 feet. The numbers for 1500 and 6500 feet are interpolated between corresponding whole

TIME, FUEL, AND DISTANCE TO CLIMB

MAXIMUM RATE OF CLIMB

CESSNA MODEL R182 PERFORMANCE

NOT FOR USE IN REAL WORLD NAVIGATION

CONDITIONS:
Flaps Up
Gear Up
2400 RPM
Full Throttle
Mixture Full Rich
Cowl Flaps Open
Standard Temperature

NOTES:
1. Add 2.0 gallons of fuel for engine start, taxi and takeoff allowance.
2. Mixture may be leaned above 3000 feet for increased power
3. Increase time, fuel, and distance by 10% for each 10°C above standard temperature
4. Distances shown are based on zero wind.

WEIGHT LBS	PRESSURE ALTITUDE FT	TEMP °C	CLIMB SPEED KIAS	RATE OF CLIMB FPM	FROM SEA LEVEL		
					TIME MIN	FUEL USED GALLONS	DISTANCE NM
3100	S.L.	15	88	1140	0	0	0
	1000	13	86	1065	1	0.4	1
	2000	11	85	995	2	0.8	3
	3000	9	84	920	3	1.2	4
	4000	7	82	850	4	1.6	6
	5000	5	81	775	5	2.1	8
	6000	3	80	705	7	2.6	10
	7000	1	78	630	8	3.1	12
	8000	-1	77	560	10	3.7	15
	9000	-3	76	485	12	4.4	18
	10,000	-5	74	415	14	5.1	21
	11,000	-7	73	340	17	6.0	25
	12,000	-9	72	265	20	7.1	30

thousand feet intervals.

The numbers for time, fuel, and distance at 6500 feet are those calculated to climb from sea level to 6500 feet altitude. The numbers at 1500 feet are from sea level to 1500 feet. Since our airplane is not a subway and cannot travel below ground level, we must get rid of the influence from sea level to 1500 feet. To do this, we subtract the two set of numbers in order to arrive at the time, fuel, and distance to climb from 1500 feet to 6500 feet. Magic, right?

Flight Plan

Route Segment	Alt	TAS	Course	Wind	Hdg	GS	Dist	ETI	Fuel
									86
Ballarat	↑6500	90	342	330/23	328	68	71	6	3 83
TOC	6500	154	342	330/23	329	132	26	12	3 80
Maryborough	6500	154	059	330/23	039	147	35	15	4 76
Bendigo	6500	154	070	330/23	051	156	56	22	5 71
Shepparton	↓1000	154	089	330/23	071	164	45	17	4 67
Wangaratta							169	72	

Legend
Alt: Altitude TAS: True Air Speed Hdg: Heading
GS: Ground Speed Dist: Distance ETI: Estimated Time interval

Notes
Fuel measured in gallons

	Time	Fuel	Distance
6500 ft	7.5	2.9	11.0
~~Subtract~~ 1500 ft	1.5	0.6	2.0
Result	6 mins	2.3 gal	9.0 nm

Because we're taking off from a 1,500 ft airport, we need to subtract that altitude in our climb performance calculations

CESSNA MODEL R182 PERFORMANCE

NOT FOR USE IN REAL WORLD NAVIGATION

CRUISE PERFORMANCE

PRESSURE ALTITUDE 6000 FEET

CONDITIONS: 3100 Pounds
Recommended Lean Mixture
Cowl Flaps Closed

NOTE:
For best fuel economy, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

RPM	MP	20°C BELOW STANDARD TEMP -17°C			STANDARD TEMPERATURE 3°C			20°C ABOVE STANDARD TEMP 23°C		
		% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2400	22	...	...	...	75	154	13.6	73	155	13.1
	21	73	148	13.2	71	150	12.7	68	151	12.3
	20	89	145	12.3	66	146	11.9	64	147	11.5
	19	64	140	11.5	61	141	11.1	59	142	10.8
2300	23	...	...	...	77	155	13.9	74	156	13.4
	22	75	150	13.5	72	151	13.0	70	152	12.6
	21	70	146	12.7	68	147	12.2	66	148	11.8
	20	66	142	11.9	63	143	11.5	61	144	11.1
2200	23	76	151	13.7	74	152	13.3	71	153	12.8
	22	72	147	12.9	69	148	12.5	67	150	12.1
	21	67	144	12.1	65	145	11.7	63	146	11.4
	20	63	140	11.4	61	141	11.0	59	141	10.7
2100	23	72	148	13.1	70	149	12.6	68	150	12.2
	22	68	144	12.3	66	145	11.9	64	146	11.5
	21	64	141	11.6	62	142	11.2	60	142	10.8
	20	60	137	10.9	57	137	10.5	56	138	10.2
	19	55	132	10.1	53	133	9.8	52	133	9.5
	18	51	128	9.4	49	128	9.1	48	128	8.8

Now, these numbers are based upon zero wind, as it says in note 4 of your Time, Fuel, Distance to Climb chart. So a distance of 9.0 and a time of 6.0 gives a no wind speed of 90 knots. The next target is to determine our climb course so that we can use the planned winds and determine our ground speed in the climb. There are two lakes east of Ballarat. Draw a line from runway 05 on the WAC chart until you're abeam the northernmost lake, then proceed direct to Maryborough. See the figure given. Your measured true course should be 342 degrees to Maryborough. Now, since most of the climb will be at this course, we can use 342 degrees as our climb course. The climb winds will be our set altitude winds since that's how we're setting up this flight. But in actuality, you would choose forecast winds at 2/3 climb altitude. Trust me!

Without teaching the details, you would now perform a wind problem with an E6B or CR mechanical computer, or an elec-

tronic flight computer. The groundspeed in the climb will be 68 knots with a wind correction angle of 3 degrees left. That wind correction angle is how far off of your course do you need to point your nose in order to track your course! With a true course of 342 degrees in climb, to hold that track you will need to move your nose 3 degrees to the left and fly a true heading of 339 degrees. Last but not least, that 9.0 miles distance was the distance you would go if there were no winds. Since the groundspeed is 68 knots, use that speed with your time of 6.0 minutes in the climb to calculate the ground distance to climb. That becomes 7 nautical miles. So where will our planned level off point be when we arrive at 6500 feet altitude? It'll be 1 nautical mile after our abeam lake turnout. Now in actuality, we'll see where it occurs. Let's fly, and then we'll pause again to work on cruise performance.

Note your takeoff time, flaps 10 degrees, go full power and climb out at about 80 knots as seen on the "Climb Speed KIAS" column of your climb chart. Raise flaps at 500 feet AGL, maintain runway heading until abeam the lake and then turn to a heading of 339 degrees. Do your 20 degree left and right clearing turns every 500 feet of altitude or so for collision avoidance, remember? As you arrive at 6500 feet altitude, level off and press "P" to pause the simulation. Don't worry about accelerating just yet to cruise speed.

From the planned level off position, the town of Crestwick should have been in front of us and just off the right side. It looks to me like we passed Crestwick before we leveled off! Makes sense since it took almost 9 minutes to climb, rather than the calculated 6 minutes. So our distance to climb was a bit longer than planned, and there could be dozens of reasons for that. Most likely it's hard to keep an optimum maximum rate climb when you're distracted by all the beautiful scenery around you!

For this flight, cruise calculations will be based upon 2400 RPM and a manifold pressure of 22 inches. We'll rely upon the Cruise Performance chart for 6000 feet pressure altitude, which is closest to our cruise altitude. We need to calculate our cruise true airspeed, ground speed, and fuel flow from this chart. Refer to the appropriate figure. There are three temperature parameters to consider - 20 degrees below standard, standard, and 20 degrees above. We've assumed standard temperature and will proceed in that direction.

For 2400 RPM at 22 inches of pressure, KTAS for cruise is 154 knots with a fuel flow of 13.6 GPH. Doing another wind

problem with altitude winds of 330 degrees at 23 knots, and a true course of 342 degrees, ground speed in cruise is calculated as 132 knots. Wind correction angle is 2 degrees left. From the planned level off point to Maryborough is 26 nautical miles, therefore the ETI to Maryborough is 12 minutes. Twelve minutes at 13.6 GPH gives us a planned fuel burn of 2.7 gallons. You can now see where the Flight Plan numbers are coming from! Each leg is calculated in preflight in this very same fashion.

One further educational point, before it's time to simply give an uncontrolled bloodcurdling scream of pent up excitement and just firewall the throttles and hit the Cessna 182RG afterburners for an impressive display of 100% acrobatic insanity! From the WAC chart, we see that the variation in this area of Victoria which we're flying in is 11 degrees east approximately. From this area, that is the angular difference between a line from a point in this area to the true north pole and that same point to the magnetic north pole. Now in case you're wondering, Santa Claus lives at the true North Pole rather than magnetic North Pole. Those two poles are separated by around 1300 nautical miles - so it'd be ridiculous to commute from one to the other! A choice had to be made!

Anyways, with a true course of 342 degrees to Maryborough, an 11 degrees east variation will result in a magnetic course of 331 degrees. The ditty used in America is "EAST IS LEAST AND WEST IS BEST WHEN GOING FROM TRUE TO MAGNETIC." Now our airplane is not flying course, it's flying heading - and that's a factor of wind correction angle. With a 2 degree left wind correction angle, true heading is 340 degrees, and magnetic heading is 329 degrees. So true to magnetic is affected by magnetic variation, while course to heading is affected by winds. Get it? Got it? Good!

I lied! That was the next to last point. This is the last point. To compare your actual aircraft performance to planned performance, it's important to calculate your cruise indicated airspeed. Cruise true airspeed is 154 knots - you know that already. Now using again your mechanical or electronic flight calculator, for 6500 feet altitude and 2 degrees Celsius (standard temperature assumed), you find calibrated airspeed is 140 knots. This correction is necessary because of the changes in pressure and temperature from standard sea level, to which the airspeed indicator is referenced. Refer now to the "Airspeed Calibration" chart shown for the normal static source. The difference between cali-
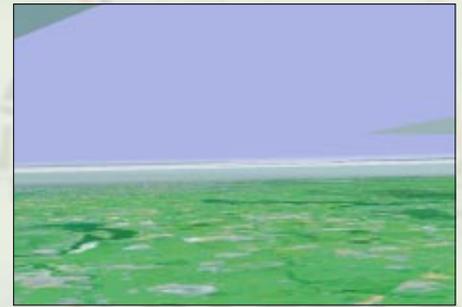

Fig 1. Right front quarter view. Tullaroop Reservoir in foreground Cairn Curran Reservoir in further right background

Fig 2. Bendigo far ahead. Tullaroop Creek in foreground

Fig 3. Map picture of between Laanecoorie Reservoir and Cairn Curran Reservoir. Loddon River connects.
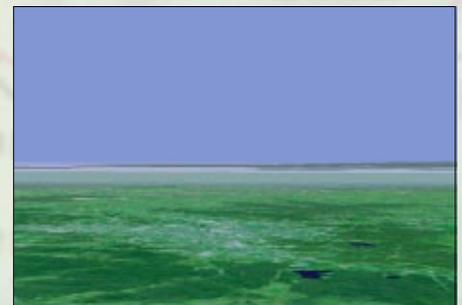

Fig 4. Bendigo - two lakes in view. Airport should be past the city

brated and indicated airspeed is based upon the placement of the pitot tube and static source for each airplane. With flaps up, since our KCAS is 140 knots, it's closest to the KCAS in the chart of 137 knots. See it? 137 KCAS gives an indicated airspeed of 140 knots - or three knots increase. Use that same 3 knots increase and apply it to 140 KCAS to get our KIAS in cruise of 143 knots. That's it! Now we're armed, locked, loaded, and full of powder!

Fig 5. Waranga Basin - foreground, Tatura - middle, Shepparton - further ahead

Fig 6. Follow Broken River. Notice the left wind correction angle! Lake Mokoan distant.
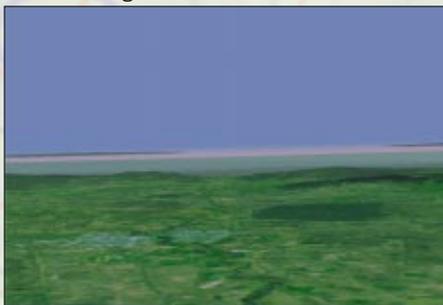
Fig 7. Right wing view. Benalla and mountain ridge line. This is the descent point.

Fig 8. What a landing!

Let's fly!

Press "P" to continue your flight. You can see the city of Maryborough already in the distance in front of you. The airport there is slightly left of it, so point your nose. You might want to try a magnetic heading as you calculated of 329 degrees and see what that does for you as the leg progresses. In front and to your right, you'll eventually see **Tullaroop Reservoir** *(Fig 1)*, and as you arrive close to its south-

ern pointing tail, on your left side you'll see Talbot Reservoir. Since you're established at cruise, look at your indicated airspeed. Is it 143 knots as you calculated it should be? Nope! It's much less, about 130 knots, and that tells us something. The aircraft performance is the Cessna 182RG in the Microsoft Flight Simulator program is a tad less than what the actual aircraft is capable of. That's one small reason why our times will be a little bit longer than planned. Remember the climb increase? You'll see this for all of your cruise legs also. This flight will be somewhat longer than what's given in the Flight Plan because of the minor disparity between simulator modeling and actual aircraft features. Benchmarking the rest of this flight will show you that and it's not a major issue in the least. Just an interesting difference.

About 6 nautical miles out, you'll see the airport at Maryborough. Fly overhead and then turn right to a magnetic heading of 039 degrees. That comes from a measured true course of 059 degrees, 11 degrees east variation, magnetic course of 048 degrees, TAS - 154 knots, GS - 147 knots, 9 degree left wind correction angle, resulting in 048 - 9 = 039 degrees MH. Distance to Bendigo is measured as 35NM, so ETI is 15 minutes, fuel burned is 3.4 gallons. Note the time over Maryborough - rather than the planned 12 minutes at cruise, it took almost 11 minutes, and that's with the three extra minutes to climb thrown in! So from takeoff to Maryborough, it has taken us 20 minutes, in comparison to our planned 18 minutes! Piece of cake, huh? In another lesson, we'll go from this step and recalculate the actual groundspeed, and re-flight plan the remainder of the flight while in cruise. For now, we'll keep our preflight planned numbers. Also, let's be reprobates and remain at 6500 feet altitude. Even though the CASA rules say we should be at an even plus 500 foot altitude - there are times when it's appropriate to bend the rules. Rather than bending, let's get real radical and out and out disregard this one!

The town of Bendigo is big and can be seen in the distance. Hold your magnetic heading of 039 degrees. You like the warm fuzzy feeling of the town being right off your nose, but this heading will allow the wind to keep your airplane on the desired track so that it (not your nose!) will overfly the town! Lots of water to reference! Cairn Reservoir is to your right. You'll cross Tullaroop Creek *(Fig 2)* and Laanecoorie Reservoir is on your left. Loddon River is an excellent reference right in the midst on your track between those two reservoirs. *(Fig 3)* See the two

lakes on the southern side of Bendigo? Slide right by the left side of those two, *(Fig 4)* and in the distant right you'll see Lake Eppalock. Go through the town of Bendigo and at its outskirts you'll find the Bendigo aerodrome. Note the time. Planned was 15 minutes - actual ETI is 16 minutes. Coolness!

Now overhead Bendigo Aerodrome, turn right to a magnetic heading of 051 degrees. Again, refer now to the Flight Plan chart to see where the numbers come from. We're going to Shepparton Aerodrome. We'll cross Campaspe River, and right away we see Waranga Basin in the distance which needs to be hit on its left corner. Along the Colbinabbin Ridge on your right, you'll see Mount Camel. Continuing eastward, Lake Cooper (told you there're a lot of lakes!) and other puddles of lakes are on your left. After passing Waranga Basin, note how you should be to the right of the town of Tatura. *(Fig 5)* Notice how Shepparton Aerodrome is before the town on the right side. Midland Highway is on your left side rolling into town, and you'll be pretty much abeam Mooroopna on your left side. Right next to it is the aerodrome. The Goulburn River system runs right between the two towns. Just past the river you'll find the airport. Planned ETI was 22 minutes - actual ETI of 23 minutes. WOW!

And last but not least, let's turn right to a magnetic heading of 071 degrees to the Wangaratta area. You've noticed, haven't you, that it's getting to be dusk, and that wonderful pink hue of sky is inspiring me to write a couple more pages worth of this flight plan! Lake Mokoan is immediately in view - and hey! That's our friend from the previous lesson when we took off from Benalla Aerodrome, right? Follow Broken River eastwards *(Fig 6)* - it's an easy trail. Mount Major slides by our left side, and in the distant right we can see the mountain line where it begins. Look to your right side and say hello to the town of Benalla! When abeam Benalla, this would be a good time to begin your descent into Wangaratta Aerodrome. (Fig 7) Go ahead and be brave - and rashly descend at about a 1000 feet per minute descent to a traffic pattern altitude of 1500 feet. The descent profile is about 1800 RPM at 14 inches manifold pressure. The Wangaratta Aerodrome is south of the city. Mount Warby is a great reference on your left as well as the northern tip of Lake Mokoan. Adjust yourself to enter on a left base to final and land with pride right on the numbers of runway 36 at Wangaratta! (Fig 8)

Planned ETI was 17 minutes - actual ETI of 21 minutes. It's been a privilege to be with you once again. See you next time! ✈