VARIOMETER

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THE UPS AND DOWNS

OF THE

KANSAS SOARING ASSOCIATION

Editor: Tony Condon

Volume LV **January 2015** **Number 1**

Matt Gontizke was 2013's Praying Mantis winner. Who will earn the trophy for 2014? Find out at the KSA Banquet January 10th!

KSA CALENDAR

January 10th - KSA Awards Banquet - Kansas Aviation Museum

February 7th - KSA Meeting - Brian Bird - Working at NASA - Cabela's

February 28th - SSA Board Meeting and Annual Membership Meeting - Greenville, SC

March 14th - KSA Meeting - Cabela's - Nate Mathews, Falconry

April 3rd - 17th - 1st Pan American Gliding Championships - Benton, TN

April 11th - KSA Meeting - Cabela's - Rafael Soldan, Safety Meeting

June 22nd - 25th - Women's Air Race Classic

June 24th - July 3rd - Sports Class Nationals - Waynesville, OH

June 24th - July 3rd - 18 Meter, Open, and Club Class Nationals - Hobbs, NM

July 4th - Kansas Kowbell Klassic

July 2nd - July 9th - 1-26 Championships - Minden, NV

August 1st - 15th - 1st 13.5 Meter World Championships - Pociunai, Kaunas, Lithuania

August 3rd-7th - Region 10 South - Waller, TX

September 28th-30th - 2015 Fly Kansas Air Tour

Parachutes

By **Paul Sodamann**

As a Senior Rigger with many years of skydiving experience I am fairly comfortable with parachutes and how they are designed to work. However, most pilots whether powered or glider only know that the parachute on their back is suppose to save their life in an emergency. Other than that they may not know much about what is actually enclosed in that harness and container system on their back.

I have a Master Rigger friend who is in the process of developing a video for pilots which should provide more information about parachutes, along with the care and use of them. To that end I am interested in getting feed back from members of the soaring community about questions and concerns pilots have about parachutes. Maybe you are not sure how a parachute is designed to open? How they are made steerable? How they should be landed if they are used? If you have any questions you would like answered relating to the parachute you own or are considering in the future please send them to me via my email address: sodie6390@gmail.com. I will not only pass on your questions to my Master Rigger friend but I will provide feedback to you about your questions.

On a parachute related note I know that many of you will be needing your rig repacked for the upcoming soaring season. I am willing to provide my rigging service if you are interested. Because I live near Manhattan I will need to get the rig(s) that you wish to have repacked in time enough to get them done and delivered either to a meeting or to Sunflower. Many of you would like to have them done in early May so that the repack cycle will carry you through the end of the official soaring season. I will be in Arizona April 15th through May 23rd training for and, hopefully, completing a double crossing of the Grand Canyon this year. This involves a forty-eight mile hike in under twenty-four hours. If you would like your parachute packed before I go please let me know. If you are willing to wait until I return that will be OK, again just allow me enough lead time to get it done and back to you.

Silver Distance

By **Matt Gonitzke**

The clouds looked great on the way out to Sunflower...

Flying high on the great soaring from the previous day, I decided to attempt my silver distance by flying from the Wichita Gliderport to Sunflower, a distance of about 42 miles one-way. The weather forecast was similar to the previous day, with slightly higher critical updraft height. However, more wind was forecast to the west, and things didn't look quite as good to the west, but certainly not bad either. Being that the forecast was better than for practically any day I had flown this year, I went for it. A welcome difference from the previous day was the widespread presence of cu. Climbs weren't particularly strong, but I made above 7000' MSL, so I felt comfortable heading for Sunflower. Due to Wichita Mid-Continent's Class C airpspace, I deviated a bit to the north. This was not a bad thing, as the clouds looked better to the north. All was well until I got to within about 8 or so miles of Sunflower. The clouds were much fewer and further between, and the usual lake-effect blue hole from Lake Cheney was working. I got to just below 7000' MSL and decided to glide into Sunflower and see what it was like. Being that it was Saturday, there would be local activity. Perhaps I could find someone getting a decent climb so I could join them, and then run back east to the good clouds. I arrived over Sunflower below 5000' MSL, and there were no decent clouds in the area. I saw the club 2-33 below me. I then saw and heard **Mike Orindgreff**, the one guy who can stay up in anything in his SZD-55, land. Usually, if he can't stay up, nobody can. I struggled around for awhile, eventually getting below 2000' AGL. I struggled back up to around 4500' MSL, and decided to just go for it. I later learned that **Steve Leonard** in his FJ-1 was below me, but could not get to my altitude, and he ended up landing at Sunflower and taking another tow to get back. If I was going to land, I was going to land closer to the Wichita Gliderport. I set off in the general direction of the Wichita Gliderport, but blew north due to the stronger winds out at Sunflower. I drifted close enough to the Hutchinson airport that I had to call them up on the radio and let them know I was there, as I was drifting north much faster than I was climbing.

I finally found a slow but consistent climb in a thermal that appeared to have been initiated by a tractor harvesting a crop in one of the fields below me. The further east I went, the better things got, and eventually I made it back to the Wichita Gliderport. Having accomplished what I set out to do, and being fairly exhausted as a result of all of the circling, I decided to land after 3.8 hours and call it a day. I now had a silver distance flight to go with my silver altitude flight the previous day, albeit at less than 30 mph average speed. I still have yet to have a cross-country flight at greater than 30 mph. My next goal became finishing my silver badge on Sunday, the last day of the regatta.

OLC Link to this flight

Friend,

I am one of two pilots who have been selected to represent the United States at the upcoming 1st FAI World 13.5 Meter Class Gliding Championships. The competition will be held in Pociunai, Kaunas in Lithuania between August 1st and 15th, 2015. I earned this spot on the team as a result of my performance flying in the Club Class at the US Sports Class Nationals in 2014.

Expenses for attending are expected to be between $10,000 and $15,000. I am not receiving financial support from the US Team, so I am asking for donations to allow me to attend the World Championships. Donations of all sizes are accepted and appreciated.

I began flying in High School, earning Flight Instructor Certificates for Single Engine, Multi Engine, and Instrument Airplane. I attended Iowa State University in Ames, IA where I earned a Bachelor's Degree in Aerospace Engineering and discovered gliders. I earned a Commercial Glider Certificate and a Flight Instructor Glider Certificate. Shortly after that I started flying cross country, eventually earning an FAI Silver Badge.

Graduation led to a job in Wichita, KS, and to soaring with the Kansas Soaring Association. I earned the Gold Badge, Diamond Goal and Diamond Distance, as well as many Kansas State Soaring Records and Kansas Soaring Association travelling trophies. In April 2014 I flew 525 miles from Wellington, KS to DeQuincy, LA earning a 750 km Diploma. Since 2011 I've flown several Regional Contests and the 2014 Sports Class Nationals, with three Top Three finishes and several day wins.

In order to prepare for the World Championships, I plan to fly in the Club Class at the 1st Pan American Gliding Championships in Tennessee the first two weeks of April 2015. This will provide a rare opportunity to fly a Category 1 FAI event, held under the same rules and organization structure as a World Championships.

Currently the paths available for a direct donation are Cash, Check, or PayPal transfer. All donors will be recognized as follows:

	<$50	$50+	$100+	$250+	$500+	$1000+
Mailed Thank You Card	X	X	X	X	X	X
Thank You Photo on the Grid		X	X	X	X	X
Team Polo Shirt			X	X	X	X
1 Dozen Homemade Chocolate Chip Cookies				X	X	X
Small Logo on Glider					X	
Large Logo on Glider						X

Day Sponsorships will be available for $75/day, during which I will wear your logo on my Bucket Hat.

To donate by Mail:

Tony Condon
911 N Gilman
Wichita KS 67203

To donate by PayPal:

abcondon@gmail.com

I thank you for your time and for your interest. If you have questions, please contact me at abcondon@gmail.com or even better, 515-291-0089, and we can talk about the best way for you to become a member of my team.

Tony London

Newbie Questions

By **Paul Sodamann**

Although I started soaring in the early 1980's I went through a long dry spell prior to joining KSA and getting back into the sport a couple of years ago. The rust is coming off, the annual is complete on my 1-35C and I am looking forward to the start of the new soaring season. However, I have a ton of questions. When I started years ago there were not all of the new fangled computers and gadgets for instrumentation. I am curious what the more experienced pilots think as to the following:

If you were going to set up your cockpit in a "new to you" glider what instrumentation would you want/need/like to have? Keep in mind a fix income from which to budget.

What would you consider for an oxygen system?

What would you consider for a parachute?

What considerations would you give to your "personal comfort" for longer fights?

What steps would you take to advance from novice to a more confident maybe even competitive pilot (at least on a local level)?

Please be as specific and detailed as possible with explanations for your decisions. This information will not only help me but I will also compile responses for a future Variometer. Send you responses to: sodie6390@gmail.com. I look forward to follow up questions in the future.

Get your KSA Banquet Tickets now! Contact **Neale Eyler** ASAP.

n_eyler@hotmail.com

316-729-0659

Notes from the President

Happy New Year KSA! I hope you all had a Merry Christmas. I must've made the Naughty List this year since I did not find a 21 Meter JS-1 with Jet Sustainer under my tree. Oh well.

I want to use my first article as President to talk about the purpose of the Kansas Soaring Association. KSA has 6 stated objectives in its Constitution. They are:

A. To educate its members in the advanced techniques of soaring and to disseminate information and ideas associated with motorless flight.

B. To support the Soaring Society of America

C. To promote flying safety by standardizing pilot training and sailplane operations and by encouraging compliance with the Federal Aviation Regulations.

D. To conduct or assist scientific endeavors related to motorless flight

E. To foster public education in matters related to soaring throughout the State of Kansas.

F. To own such equipment as may be desirable to support soaring operations.

So, how do we meet these objectives? For Objective A, we use the *Vaiometer* newsletter as well as our Soar-Kansas Yahoo! Group to educate and disseminate information. We encourage application of advanced techniques and information with our travelling trophies. The 2014 trophies will be awarded at the banquet on January 10th. Will you be there?

Objective B is primarily met by the fact that we are an SSA Chapter. When you pay your KSA dues, you are also paying your SSA dues. That reminds me, you have paid your 2015 dues, right?

Objective C? We have established a standard operation at Sunflower that works well and within with the SSA Standard Soaring Signals. KSA schedules instructors for weekend duty and holds a safety meeting each April. We have begun, and I plan for us to continue, to establish a better system of standardized training for our student pilots.

At the moment, I can not think of a good example for how we are meeting Objective D. Here is an opportunity!

Objective E is covered by our outreach activities that members do throughout the year. In 2014 alone we had the Grob at Hutchinson and Newton, with static displays backing it up (Zuni, Std. Cirrus, and Austria SH-1). **Harry Clayton** and **Sue Erlenwein** also had their Std. Cirrus on static display at the Kansas Aviation Museum for one of their open houses and I spoke to a group of kids later in the summer about soaring flight, also at KAM. **Jerry Boone**, our SSA Governor, also keeps busy promoting soaring to the public, getting us a couple of really well placed articles in the Hutchinson newspaper this season. I'm sure I have skipped over many other examples, these are just a few.

Finally, Objective E is met by the fact that we have the 182 and 175 towplanes as well as the Grob. These are the tools we use to achieve all the other objectives.

Have ideas on how we should be meeting these goals? Share your thoughts with me. abcondon@gmail.com and 515-291-0089. The board will be getting together after the banquet to chart the path for 2015 and beyond. I'm looking forward to it. In the meantime, now is the time to begin preparing for the upcoming season.

Tony

Flight Test Evaluation of Cherokee II Sailplane

By **Tony Condon**

Note: I submitted this paper as my Senior project to finish my Aerospace Engineering Degree at Iowa State University in December 2008. I presented on this same topic at the Wichita VSA Rally in 2009.

Abstract

For this report, I will present the results of glide testing that were performed on my Cherokee II Sailplane. Data was taken on altitude loss at varying airspeed, and this information was used to determine aerodynamic and stability characteristics of the aircraft. The final results present a summary of the performance of the glider.

Introduction

1.1 Motivation

The chief motivation behind the project was to quantify they glide performance of the glider. When the information of sink rate vs. airspeed is known to the glider pilot, they can use it to optimize the flight by choosing the proper speed to fly under varying conditions. This method was introduced and popularized by Paul MacCready, who used it to win several national soaring championships in the late 1940's and early 1950's. Up until this point, I had never been able to locate any reliable information on the gliders performance, so choosing proper speeds to fly was done based on what little information that I had available, as well as a qualitative idea of the performance based on experience. From that point, further motivation was to extract as much information about the aerodynamic and stability characteristics of the glider as was possible, and compare that to available information.

1.2 Outline

Section 2 will begin with a description of the Cherokee II sailplane. Calibration of instruments will be discussed, followed by the method of data collection. Details of how data was recorded, along with a description of what data was used, will be included

Section 3 describes the process that was used to determine the performance of the glider. The sink rate along with glide ratio data will be presented.

Section 4 will follow the process of determining the Aerodynamic and Stability characteristics of the Glider.

Section 5 concludes the report with a summary and thoughts on future work.

Background

2.1 Description

The Cherokee II Sailplane was designed by Stan Hall in 1956. It is a home built design, with a structure made of wood, and fabric covering. It has one seat for a pilot and is equipped with a basic instrument panel. The wingspan is 40 feet, with an aspect ratio of 12.8. The airfoil is a Gottingen 549, and is tapered at a 2.5:1 ratio. The total weight of the glider and pilot for the test was 600 lbs.

Fig 1: Cherokee II Sailplane

2.2 Instrument Calibration

The first work that needed to be performed for the project was to calibrate the instruments. The glider has four main instruments. They are an Airspeed Indicator, Altimeter, Variometer, and Compass. For the test, the Airspeed Indicator and Altimeter were the key instruments that needed to be calibrated. The instruments themselves are fairly old; I suspect they were World War II surplus when the glider was built.

To calibrate the Airspeed Indicator I constructed a water manometer. With the Airspeed Indicator connected to one end of the manometer, I applied a pressure to the other, and sealed it. I was then able to record the indicated speed, along with the height difference in the manometer. The following equation was then used to calculate the calibrated speed from the difference in water height.

$$V = \sqrt{\frac{7P_{ATM}}{\rho_{Water}}\left(\frac{\rho_{Water} g \Delta h}{P_{ATM}} + 1\right) - 1}$$

The result of the airspeed calibration is shown in the following chart. I was very pleased to see that the error was minimal, and followed a general trend. For most the speeds in the testing range, 35-75 mph, the error was usually around .5 mph.

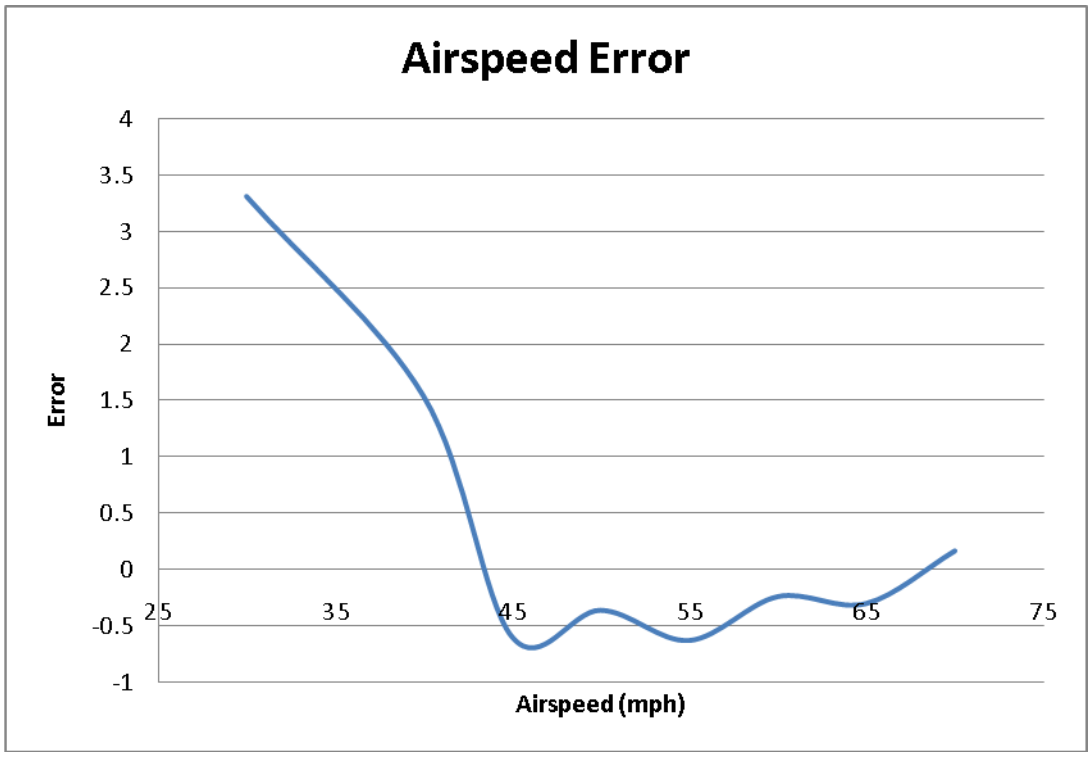

Fig 2: Airspeed Calibration

The altimeter calibration was done using a calibrated altimeter test set. The error was determined by noting the difference between the test set altimeter and the reading on my altimeter. The total error was determined by averaging the error found while climbing and descending through a particular altitude. This accounted for an hysteresis in the instrument. The following plot shows the altimeter error.

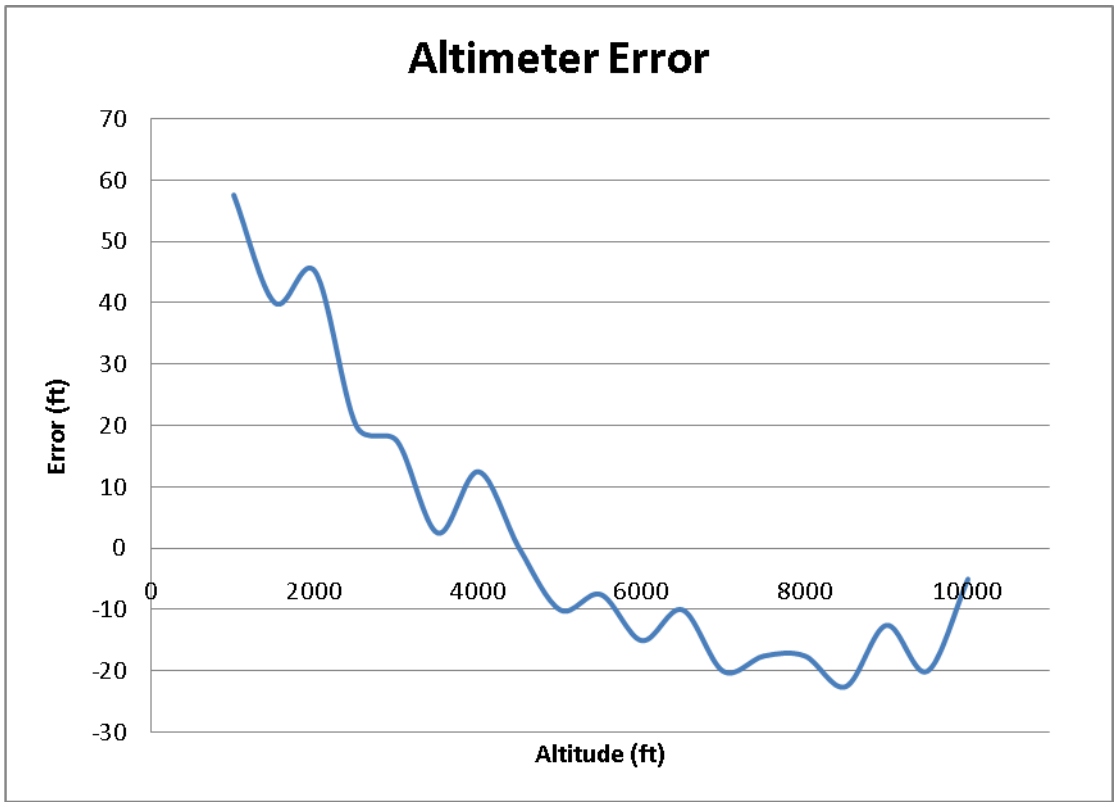

Fig 3: Altimeter Error

2.3 Data Collection

The data was collected in an analog manner. I had thought about using a GPS flight and altitude recorder to collect data, in order to get more accurate results. However, cost was quite high for the equipment. I eventually settled on using a digital video camera to record the instrument indications during flight. The field of view of the camera included the Airspeed Indicator and Altimeter, as well as a view out the canopy of the glider. Afterwards, I went back to the video and was able to collect the data from it. Data recorded was primarily altitude and airspeed. I also called out the stick position at each speed. I was able to later convert that stick position into an elevator deflection. Finally, I recorded the change in pitch attitude between each speed.

Performance

3.1 Sink Rate and L/D

The first data to be processed was the sink rate vs. airspeed. This is referred to by glider pilots as the Glide Polar. I tested at speeds varying from 35 to 75 mph indicated. For each speed I had flown for 1 minute. I analyzed the video of the flight and determined a sink rate for each portion. With this information known, I was able to plot it and determine the complete performance of the glider. I was also able to compare my glide polar with a theoretical polar that was provided by Stan Hall to Stephen DuPont for the 1974 book "Soaring by the Numbers". I digitized this theoretical data and plotted it alongside my findings.

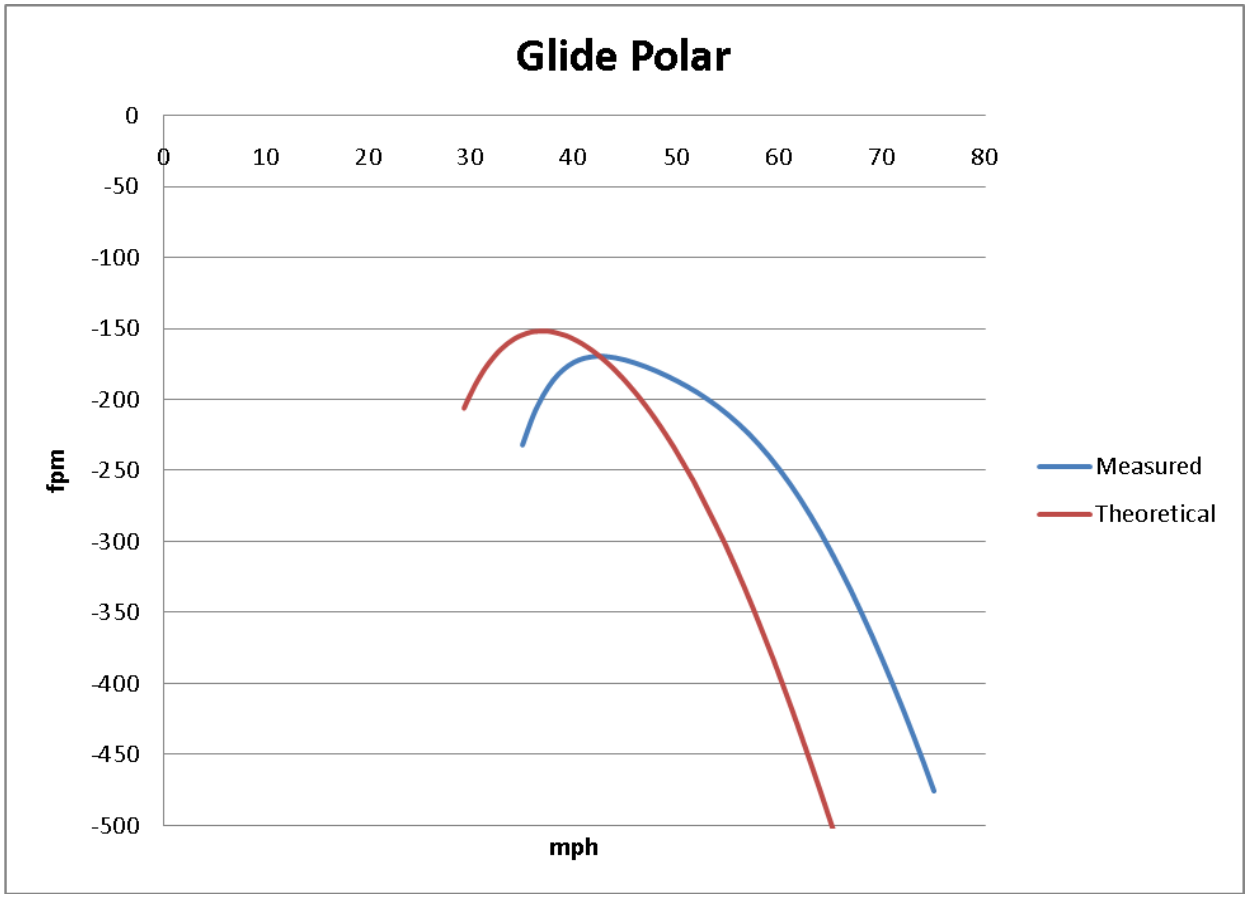

Fig 4: Glide Polar

The results matched up very well, and I was happy to see the correlation. My polar is shifted down and to the right of the theoretical polar. This was expected, as the theoretical polar was calculated at a weight of 530 lbs. The higher weight that I flew at will cause the polar to shift to the right.

I found from the data that the minimum sink rate for my glider was 165 feet per minute, which occurred at a speed of 42 mph. Also, the best glide ratio calculated to be 23.5:1, occurring at a speed of 49 mph. Stan Hall had also provided theoretical glide ratio performance for the glider in promotional material for the glider. Remember that the glide ratio is equal to the L/D ratio. I plotted L/D vs. speed and also compared that to the provided data as a comparison.

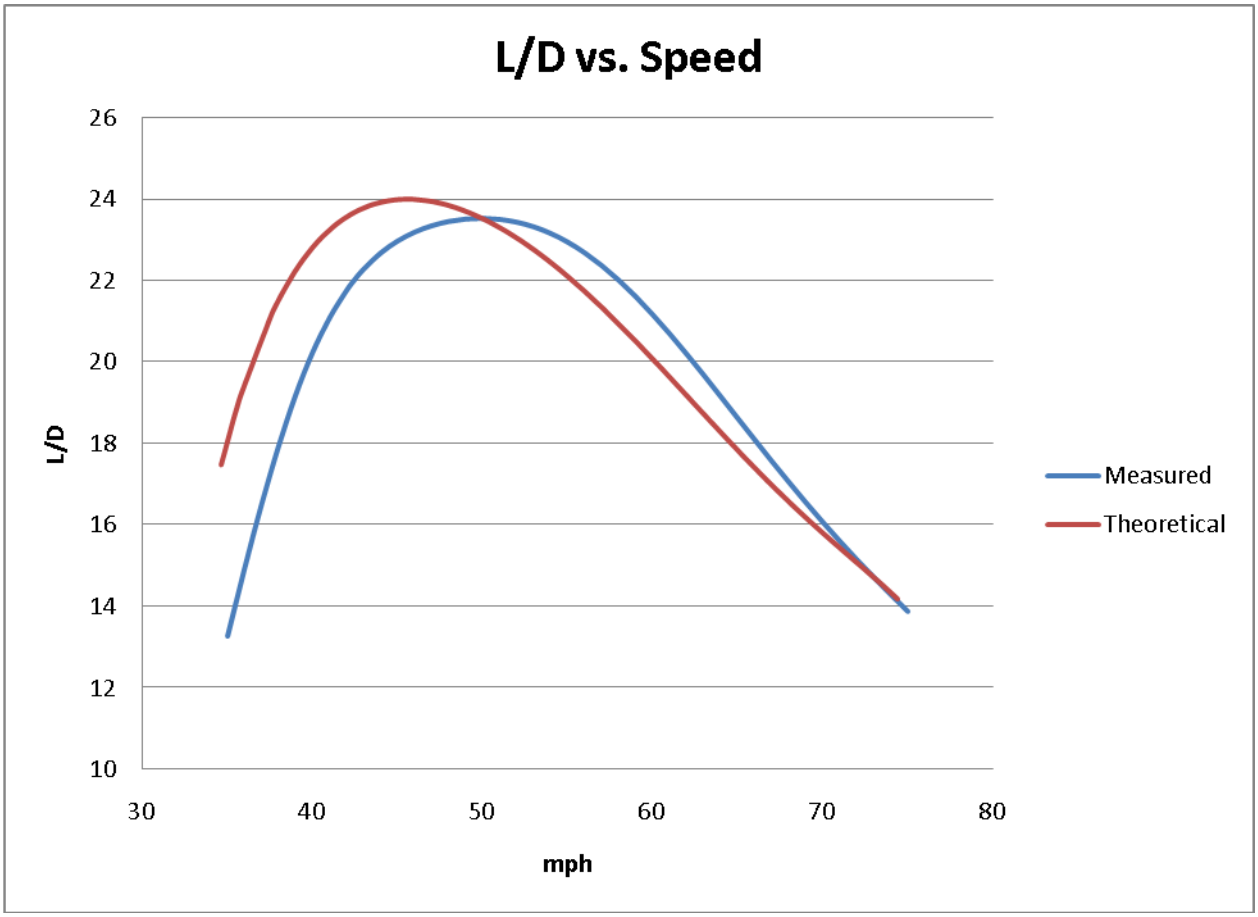

Fig 5: L/D

The best L/D ratio from the theoretical data was 24:1, which compared well with my 23.5:1 calculation. Once again, my data was shifted to the right due to higher flying weight.

Aerodynamic and Stability Characteristics

4.1 Lift

The first aerodynamic data that I worked to determine was the Coefficient of Lift, C_L. This was found using th6e following equation.

$$C_L = \frac{2W}{\rho V^2 S \cos(\gamma)}$$

All of the variables are known except for C_L, so solving was straightforward. The results are as follows.

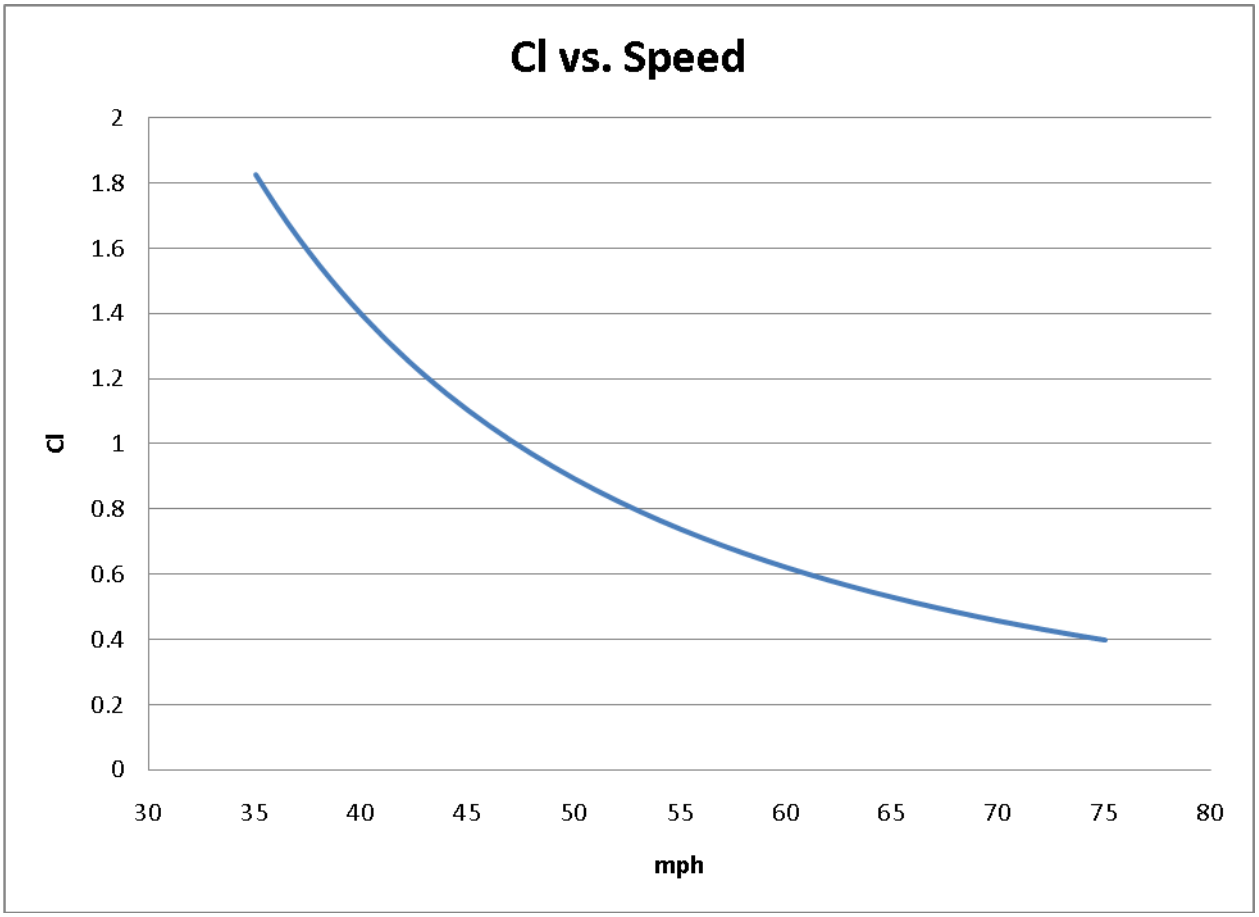

Fig 6: C_L vs. Speed

Further processing with C_L was done using the following stability equation.

$$C_L = C_{L,0} + C_{L_\alpha}\alpha + C_{L_\delta}\delta_e$$

In this case, the C_L value that was previously calculated was used. $C_{L,0}$ was taken from a 2D viscous analysis that was done on the airfoil shape using a Lockheed code. $C_{L\alpha}$ was found by using the change in C_L between airspeeds, along with the change in pitch attitude and flight path angle to find a change in α. $C_{L\delta}$ was found similarly by comparing the change in C_{L} with the change in elevator deflection. This is shown in the following plot.

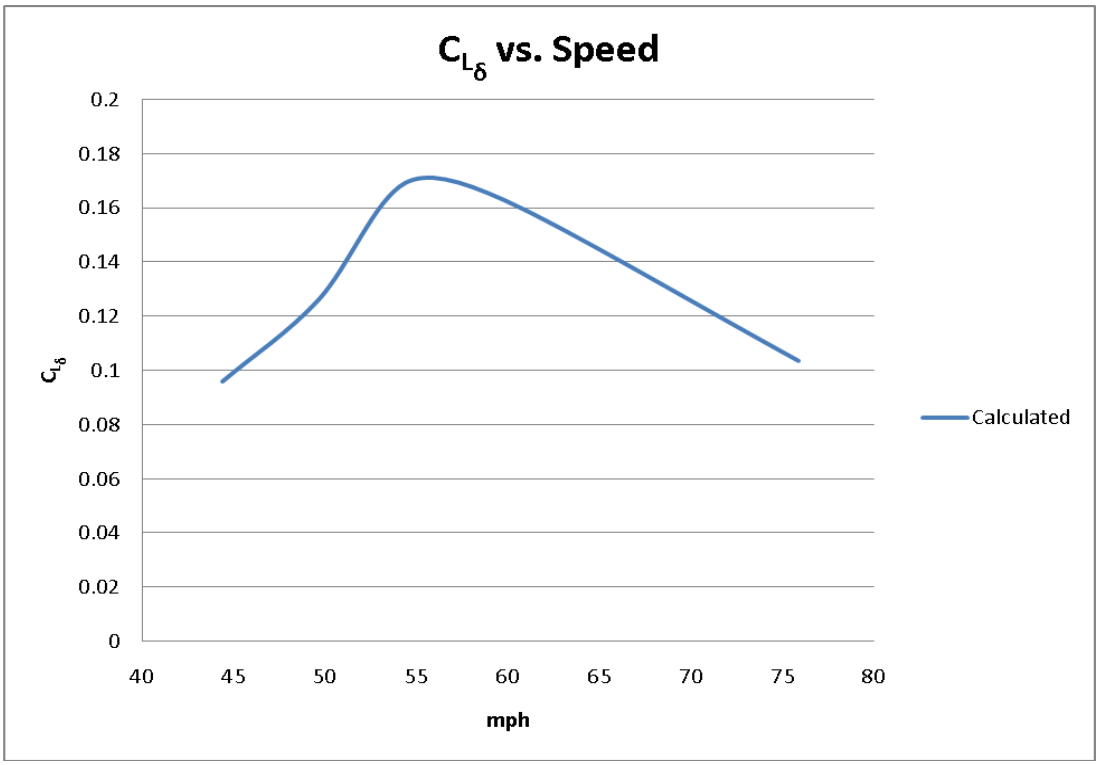

Fig 7: $C_{L\delta}$ vs. Speed

δ_e was also known for each speed. This left only α as an unknown, so solving was once again very straightforward. I came up with a relationship between speed and α, and was able to find the C_L vs. α curve. I compared this with two other sources. One was the Lockheed code results. The second comparison was wind tunnel tests that were done on the Gottingen 549 airfoil in 1926.

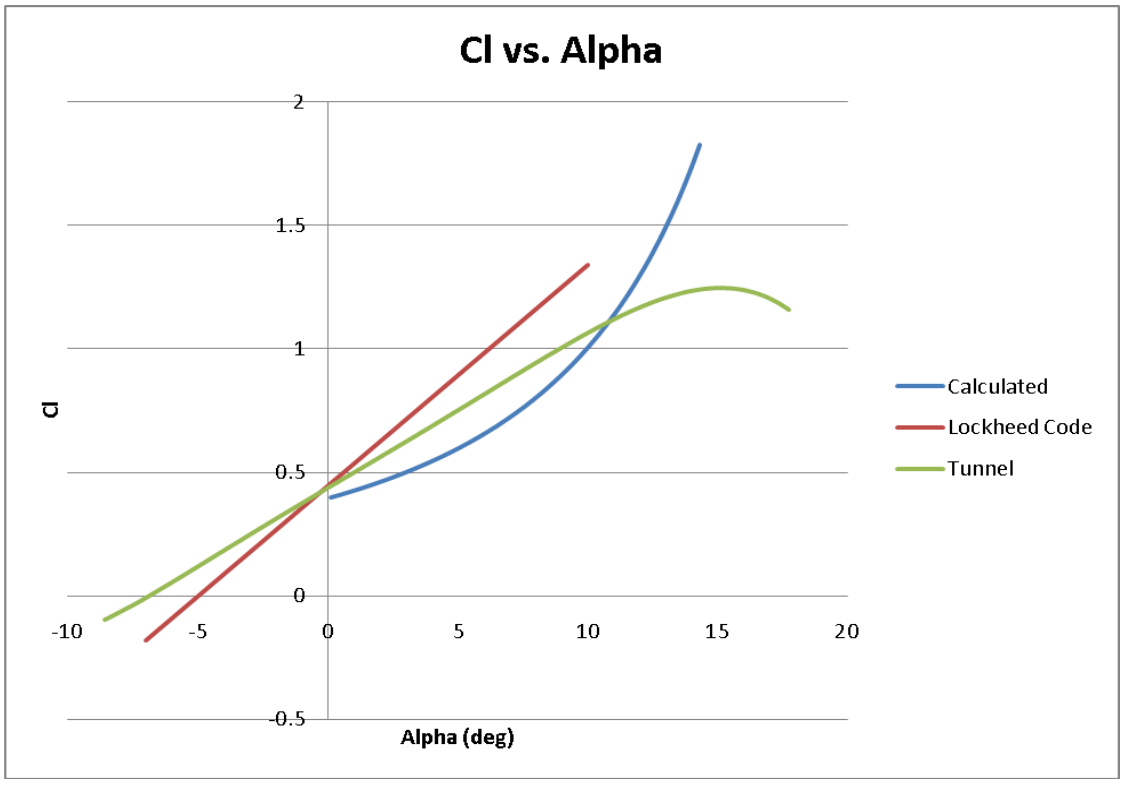

Fig 8: C_L vs. α

I felt that the comparison was pretty good. Particularly considering that the Lockheed and wind tunnel results are for an airfoil section, and my results are for a 3D wing with fuselage and tail. The $C_{L\alpha}$ values for each similar, as are the $C_{L,0}$ values.

4.2 Drag

With the L/D ratio known at each speed, the next thing to find was the Drag at each speed. This was fairly simple, as the flying weight was constant at 600 lbs, so dividing by the L/D ratio resulted in the drag force at each speed.

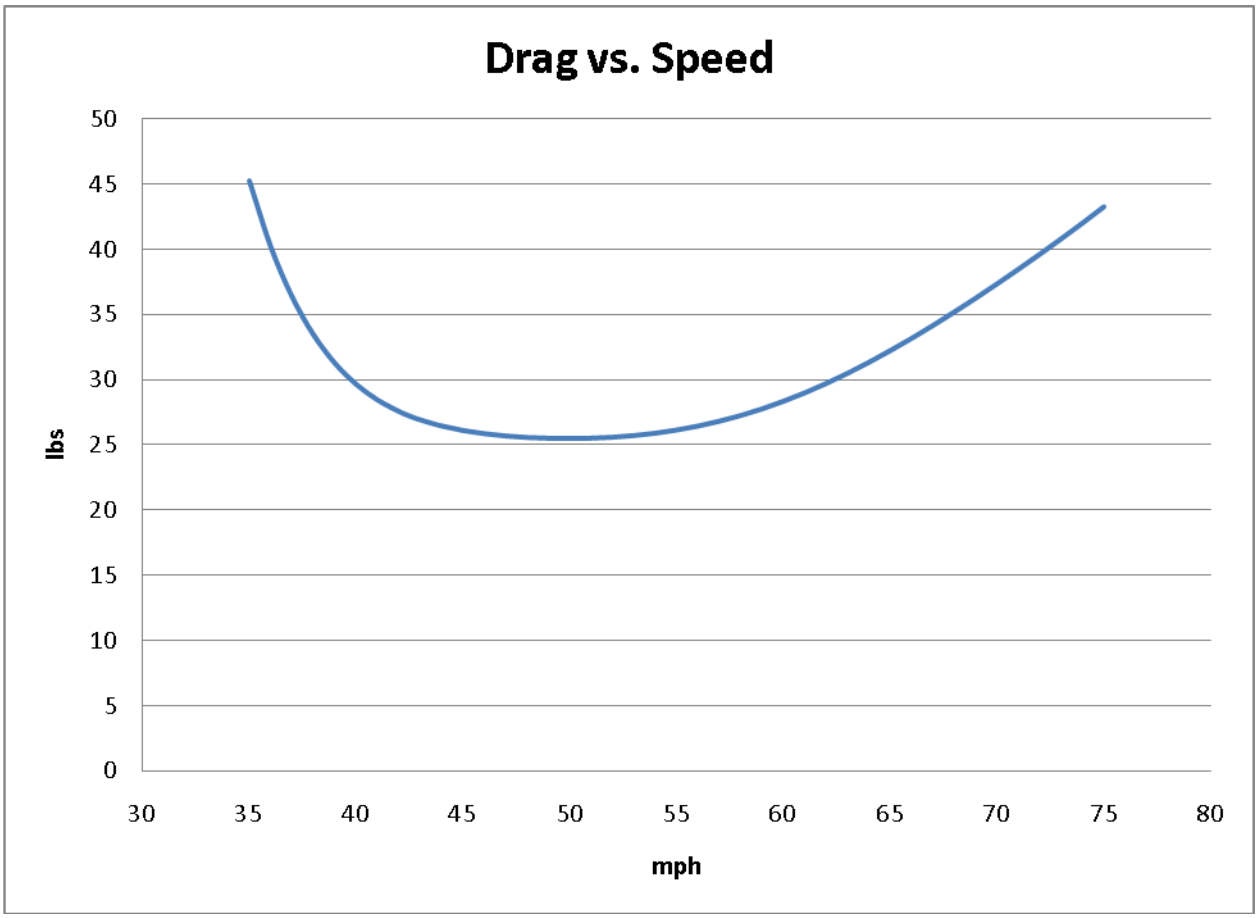

Fig 9: Drag vs. Speed

As can be seen, the drag follows an expected form. Drag is high at low speeds because of high induced drag, reaches a minimum at the best L/D speed, and increases with speed as parasite drag builds up. With the drag value known, I was able to calculate the Coefficient of Drag, C_D. Initially I found C_D by using the following equation.

$$C_D = \frac{2D}{\rho V^2 S}$$

Alternatively, C_D can be found using the following equation, which includes terms for the zero angle of attack C_D as well as induced drag.

$$C_D = C_{D,0} + \frac{C_L^{\,2}}{\pi e A R}$$

Unknowns in this equation are $C_{D,0}$ and e, the span efficiency factor. To determine these factors, I used the data from the minimum sink condition. At minimum sink, the following relationship is the case.

$$C_{D,0} = \frac{1}{4} C_D$$

I plotted $C_{D,0}$ against speed for various e values. I used this information to pick an e value that gave the proper $C_{D,0}$ value at the airspeed for minimum sink, 42 mph. The graph follows. I settled on an e value of .905.

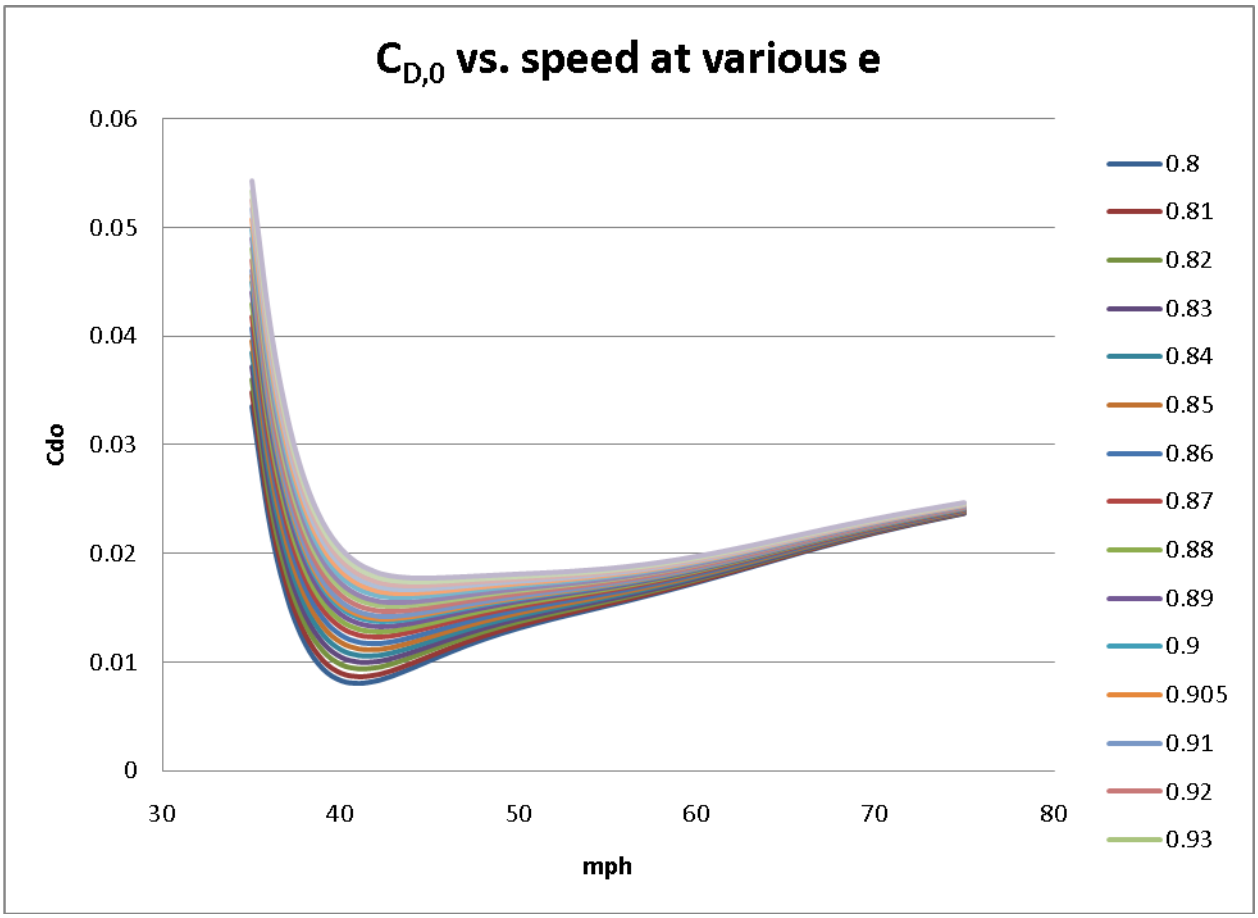

Fig10: $C_{D,0}$ vs. Speed

With the $C_{D,0}$ and e values determined, I could calculate C_D using equation 4.4. C_D vs. α is shown in the next plot, using both methods. I would consider the values to be upper and lower bounds for an actual C_D.

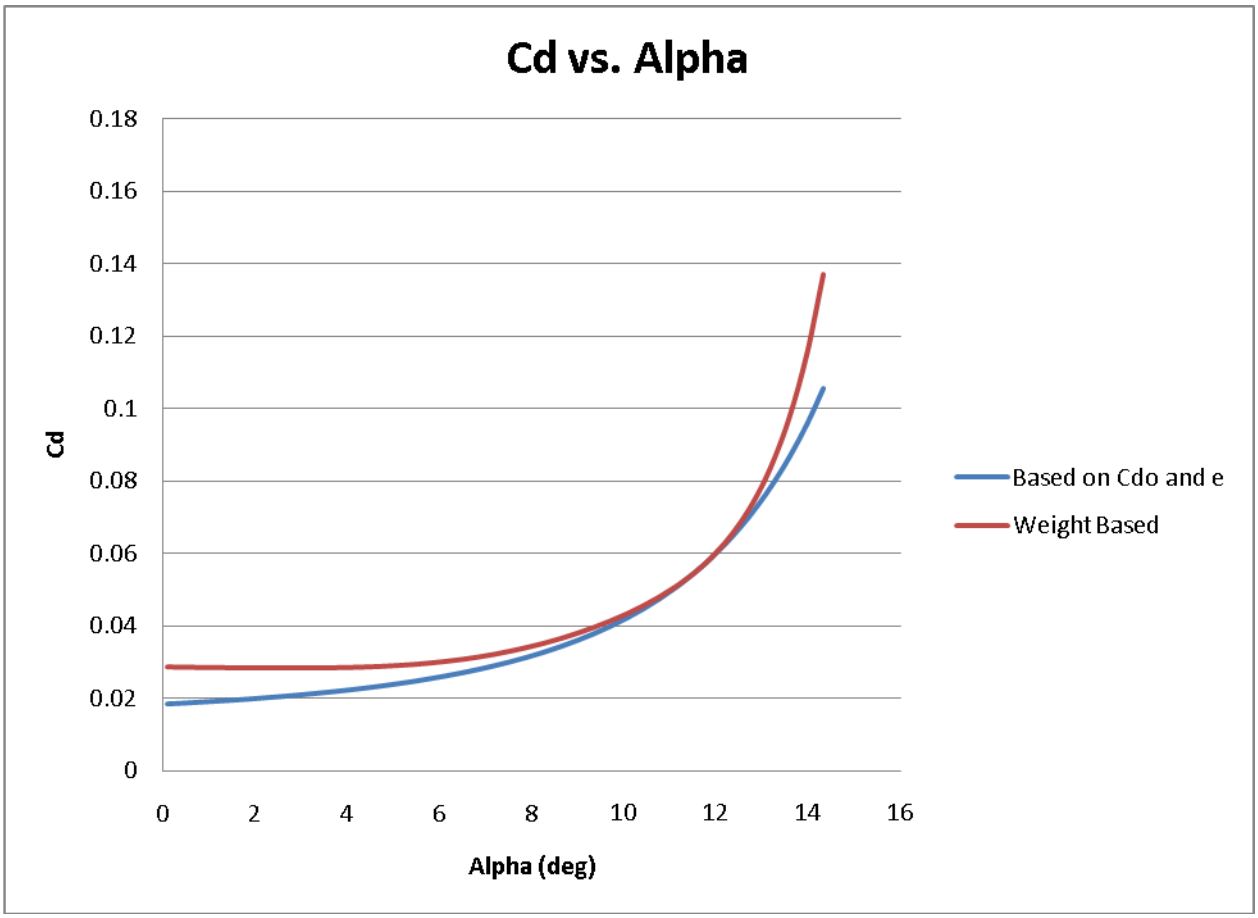

Fig 11: C_D vs. α

4.3 Moment

The final equation to consider was the C_m equation, which is as follows.

$$C_m = 0 = C_{m,0} + C_{m_\alpha}\alpha + C_{m_\delta}\delta_e$$

In this case, since the glider was flown at a steady speed, and steady elevator deflection, the total moment, and therefore C_m was equal to zero. Known values in the equation are α and δ_e. $C_{m,0}$ and $C_{m\alpha}$ were found using the Lockheed code. This left only $C_{m\delta}$ as an unknown. I plotted $C_{m\delta}$ vs. α in the following plot.

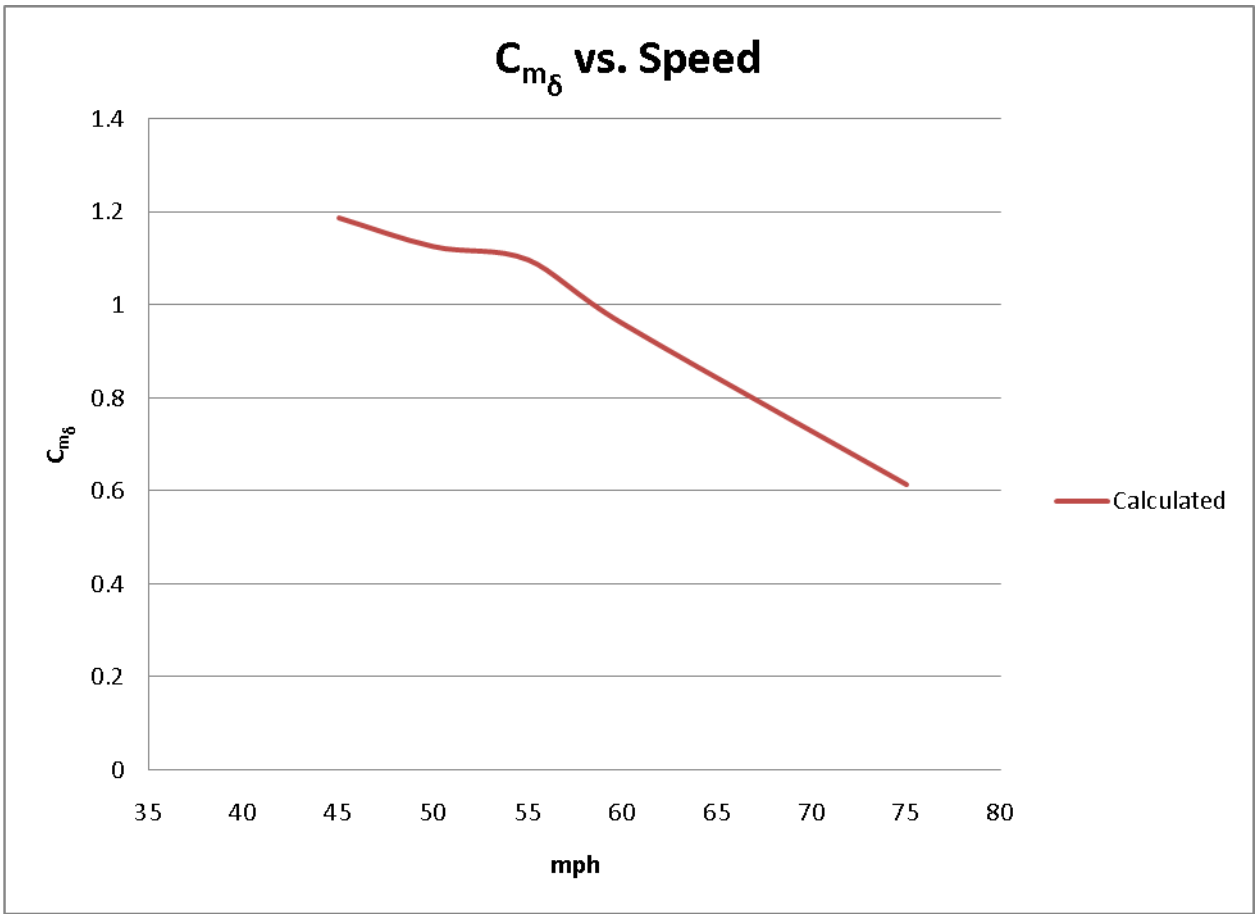

Fig 12: $C_{m\delta}$ vs. Speed

This provides a nearly linear relationship, which was expected.

Conclusion

5.1 Summary

I was very satisfied with how well I was able to determine the performance of the glider. I was particularly delighted to see how well it matched up with the expected performance. Additionally, I was able to calculate all of the major aerodynamic coefficients, and several stability derivatives. Considering how little actual data was taken during the glide test, I was happy to be able to back out so much information.

5.2 Future Work

I intend to continue with this project in the future. As I processed the data I was able to think of better methods I can employ. First would be a better camera setup. My setup left the instrument panel slightly out of focus, which made it difficult to determine the altitude accurately. Also, I would carry a digital level in the cockpit to record the pitch attitude. This should provide a more accurate measure than using the video image to try to determine an angle change. Similarly, I would like to develop a more accurate system of determining the stick position. And of course, streamlining the data processing would be a top priority in order to have a program that would take the initial altitude and time data and process all of the constants immediately. This would become particularly useful if I was doing testing on several different glider models.

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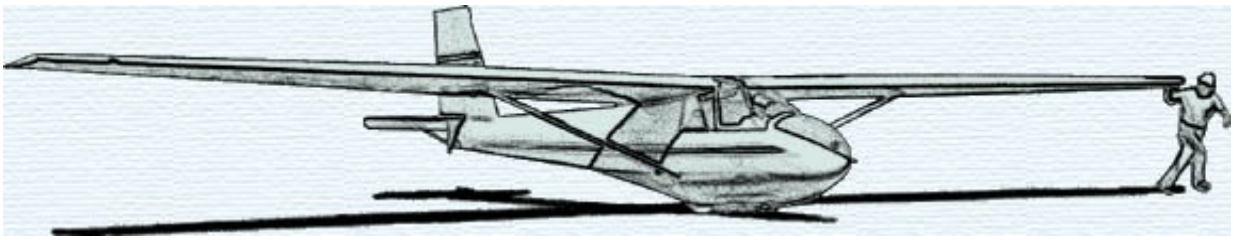

2014 KSA Awards Banquet

Kansas Aviation Museum

January 10th, 2015

5 PM Social, 6 PM Supper, Awards to follow

2015 SSA Calendars Available!

Pay your 2015 Dues!