November, 2002
Vol. 19, No. 11
U.S.A. $3.50

R/C Radio controlled Soaring Digest

THE JOURNAL FOR R/C SOARING ENTHUSIASTS

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ABOUT *RCSD*

R/C Soaring Digest (RCSD) is a reader-written monthly publication for the R/C sailplane enthusiast and has been published since January, 1984. It is dedicated to sharing technical and educational information. All material contributed must be exclusive and original and not infringe upon the copyrights of others. It is the policy of *RCSD* to provide accurate information. Please let us know of any error that significantly affects the meaning of a story. Because we encourage new ideas, the content of all articles, model designs, press & news releases, etc., are the opinion of the author and may not necessarily reflect those of *RCSD*. We encourage anyone who wishes to obtain additional information to contact the author. *RCSD* was founded by Jim Gray, lecturer and technical consultant.

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Special Event Schedules

For those of you that have club schedules in hand for 2003, we'd sure like to hear from you so that we can add them to the listing in *RCSD*.

B2Streamlines

Bill & Bunny Kuhlman have been providing fellow modellers with information and the results of their in-depth research for many years, now, and we really appreciate their efforts! Regretfully, as I'm sure most of you have noted with their new ad, they will no longer be offering their speciality books commencing with the New Year.

The good news is that they will continue to write their "On the 'wing..." column for us and plan to continue the web site work that they started several years ago, which includes the *RCSD* pages.

Our thanks to them for all they do! And, for all of you, Happy New Year, 2003!

Happy Flying!
Judy Slates

SCHEDULE OF SPECIAL EVENTS

February 1-2, 2003
Southwest Classic — Phoenix, AZ

March 15-16, 2003
The Classic Mid-Winter — Southern California
Torrey Pines Vintage Sailplane Regatta
http://www.agcsc.org

October 10-11, 2003
Texas National Tournament (TNT) — Dallas, TX
www.SLNT.org

Lunch or Launch?

The cover of this issue was created by Phil Bauer, Fremont, California.

Please send in your scheduled 2003 events as they become available!

TECH TOPICS

Dave Register
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It's funny how a random conversation can trigger a 'Tech Topics' column. Especially one that didn't really sink in at the time.

THE PROBLEM

While wrapping up the HLG event at our Last Fling of Summer this year, a couple of the contestants commented that the planes they were flying 'just didn't carry enough wing area to be able to compete successfully'. Those comments were made by good pilots who are capable of winning on any given day. Based on the evolution of the airfoils and structures needed for DLG, do these fellows have a point we might have missed?

About two years back, we ran a series of articles looking at optimizing the planform for a 2 channel HLG using the SD7080 as the reference airfoil. The MH82 and several other sections were also evaluated. These sections are all around 8.5% to 9.5% thick with camber in the range of 2% or so. This was fairly typical of the airfoils being used at that time for HLG (the S6063 was identified in that analysis as a section of potential interest and had been flown successfully at the IHLGF about that same time).

The overall conclusion was that an aspect ratio in the 8 to 10 range looked advantageous. Based on those results, a 2 channel polyhedral HLG (later converted to DLG) was developed. This plane, called the Tahlequah, pushed the AR to the high end of the proposed range (~10). I've had a lot of fun with this design for the past several years. 50 second dead air flights with DLGs are pretty common and it's not at all difficult to ride even very light thermals to fairly decent times. I'm not sure this ship would be highly competitive but some of that is limited by the age and vigor of the pilot. Not too long after that work was complete, I noticed several commercial HLG designs had moved to the higher AR range. So I think the trend was valid.

What's changed lately that could affect the planform optimization? Well, with Dr. Drela's X-Foil code we now have higher performance airfoils that are thinner with lower camber. The strength requirement for DLG has added structure (and weight) to the wings. The larger vertical stabilizer/ sub-rudder requirement has also added mass. And even if you're flying a two channel radio, you're probably now using a piezogyro. Bottom line - weight is up and low speed capability (due to the lower Cl-max of the airfoils) is not as favorable. So a lower wing loading (more area for a given flying weight) seems like a reasonable outcome.

With that in mind, let's re-optimize a DLG planform taking into account the structural changes and additional weight requirements of today's equipment. Let's also try and see how airfoil evolution may have affected the optimized planform results.

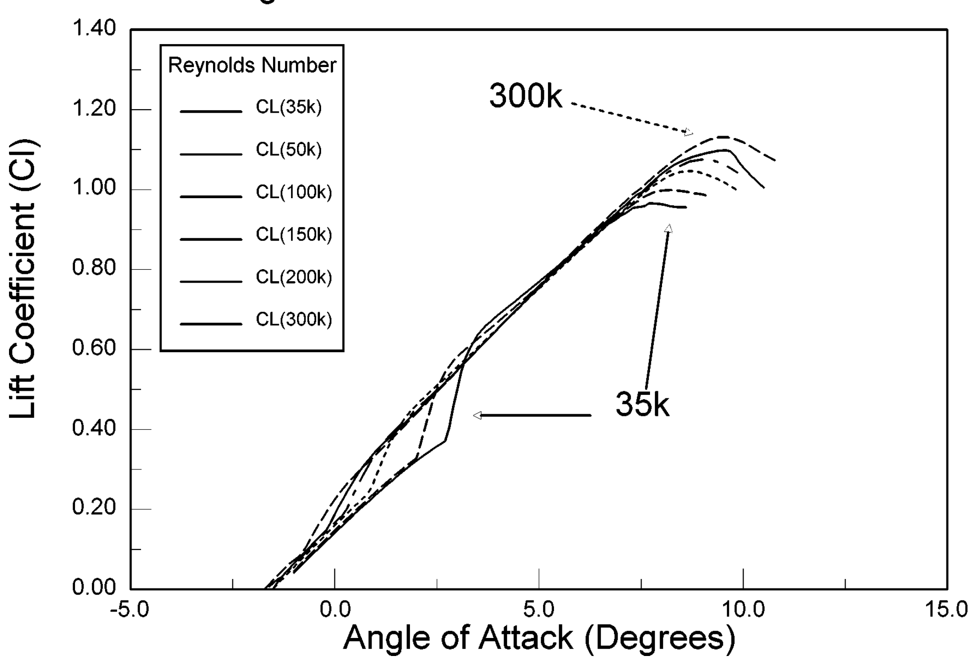
X-FOIL CALCULATIONS

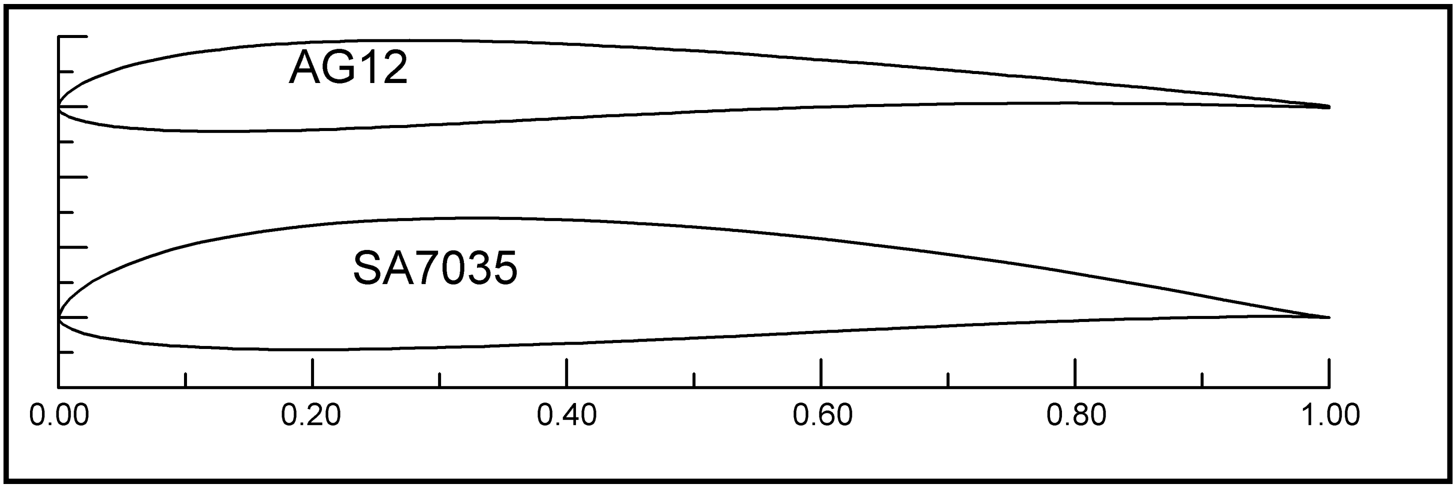
To carry out this analysis, we'll use synthetic airfoil data. For the most recent Drela airfoils, wind tunnel data is not yet available. We'd also like to have lower Reynold's number data than is currently available experimentally. Since X-Foil will be the information source for the Drela airfoils, we'll put the older section through the same analysis.

Once those analyses are complete, we can use the planform model developed in this column to compare planform changes with these airfoils. Given the demands of modern DLG structures, let's see if a suggested optimal configuration is different from what we learned a few years ago.

The assumptions for the planform analysis will be provided in next month's column. For now, we'll calculate the required coefficient data

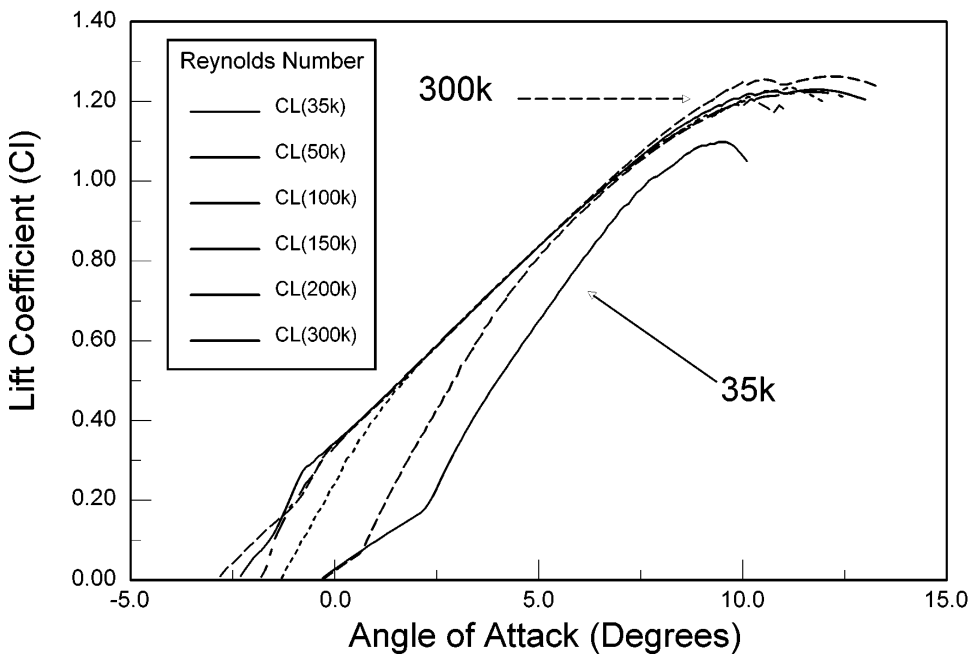
Figure 1: Cl vs AoA: AG12 - X-Foil Data





and see what it tells us about the evolution of airfoil performance over the past several years. Recall that we compared X-foil output against wind tunnel data in this column earlier in the year and the agreement was remarkably good.

Figure 2: Cl vs AoA: SA7035 - X-Foil Data



Our first question is the Rn range we'll need for the analysis. Assuming a limiting average chord ~ 5" (12:1 AR) at a low speed of ~ 15 ft/sec, our lower Rn limit will be ~ 35,000. For the high speed end, we'll allow a maximum launch velocity of 90 ft/sec for an upper Rn limit of around 200,000. The polar analysis code requires a range of Rn curves so we'll calculate results in X-Foil for Rn of 35k, 50k, 100k, 150k, 200k and 300k.

The sections chosen for comparison are the SA7035 (a re-optimized version of the original SD7080) and Prof Drela's AG12. These represent the 'big airplane' airfoils originally applied to HLG and then the general class of low Rn optimized sections that Prof Drela (and others) have developed for DLG.

For general considerations, the AG12 is 6.2% thick with 1.84% camber. The maximum thickness occurs at 21.4% of the chord while the maximum camber is found at 43.1%. The same numbers for the SA7035 are 9.2% thick at 29% of chord and 2.55% camber at 40.4% of chord.

For the X-foil users, the AG12 was run with default parameters throughout. Ncrit was set to 9 (default). No additional paneling of the section was made from the original coordinates. The SA7035 coordinates were too coarse for reliable convergence so it was run through the GDES/CADD routines and then re-paneled with default values (140 surface points). In both sections stable solutions were found throughout the Rn and angle of attack (AoA) range of interest. In certain regimes (near transitions) small step sizes in the solution were required but no other problems were encountered. For the SA7035 at 35k, a slight numerical instability is found in the solution. Consequently, this one data set uses a 5 point smoothing average for the final results.

It's important to note that the data ranges of keen interest for this type of analysis are high AoA for low Rn (flying near minimum sink) and low AoA for high Rn (launch and high speed cruise). The latter case does not present a problem but the former does. At high AoA and low Rn, the AG12 solutions are noticeably more difficult to converge than the SA7035. When converged above stall, the drop off in Cl is noticeable. Since the low Rn sections are optimized for extended laminar flow, a sharp onset of stall is the price you pay for laminar separation at high AoA. The older sections (SA7035) are aimed at turbulent separation and the stall characteristics are less abrupt.

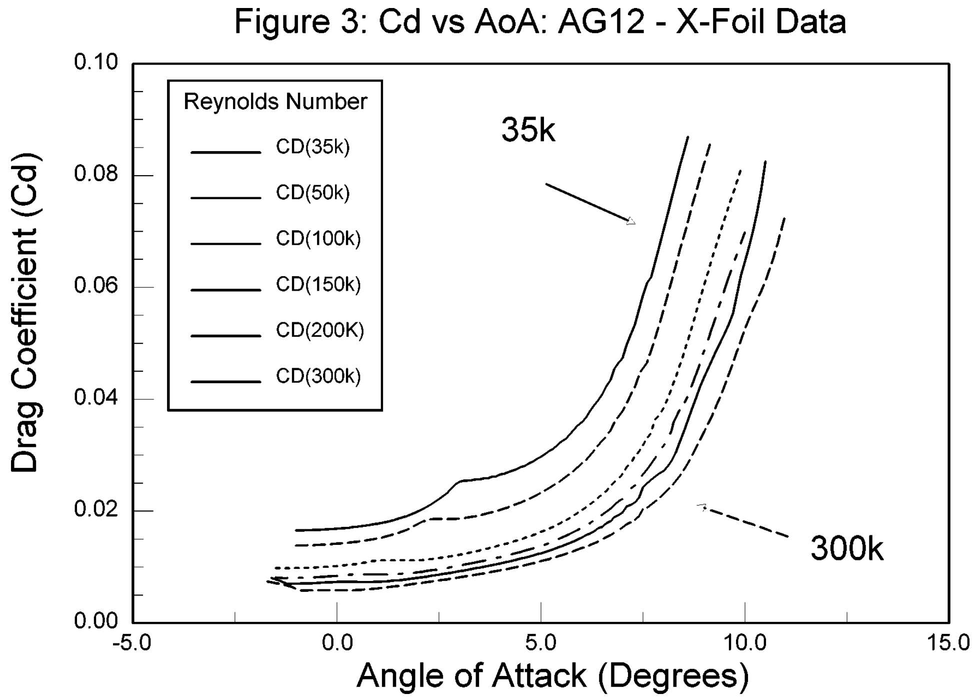
This tells us that the overall wing planform (not just the aspect ratio but the lift distribution) is critical for a good DLG using modern airfoils. The last thing you want is a tip stall due to poor load distribution. A root stall is far more desirable. Tools such as the Lift-Roll spreadsheet and the

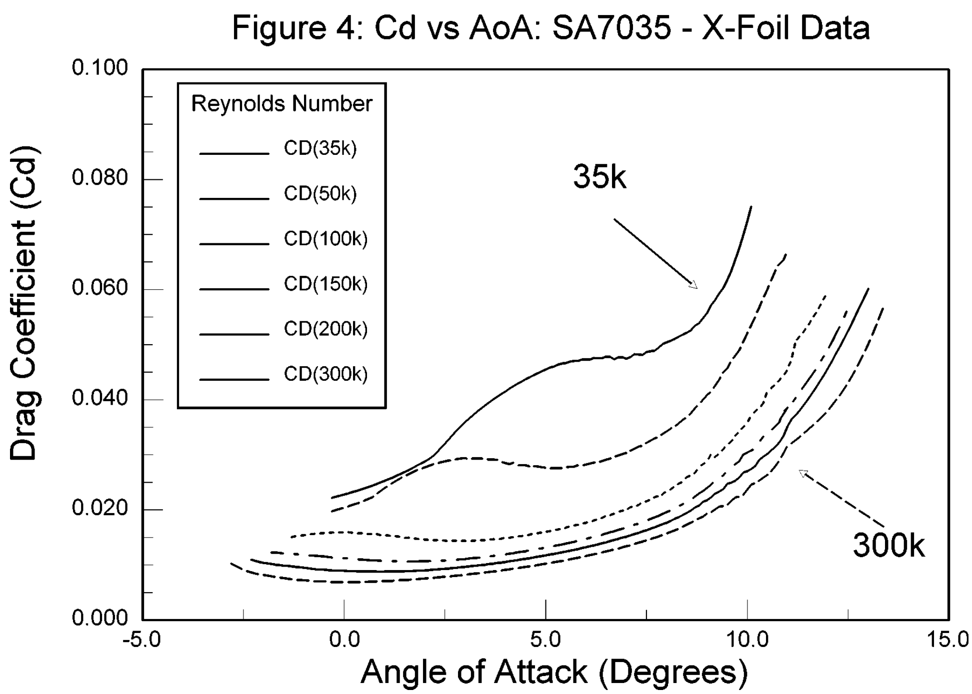
Schuemann-Ellipse planform fitting routine developed in this column are necessary to optimize the spanwise wing load profile. Airfoil blending is another approach, which is why you see the most recent designs using sections like the AG12 but blending to the AG13 and AG14 for appropriate spanwise load distribution.

A particularly graphic example of a transition effect was reported at a conference at the former Solar Energy Research Institute (SERI) I attended about 7 years ago. A wind power generator airfoil had been developed for low drag at high AoA and had been installed in the Golden, CO area. To achieve low drag, the section was designed for extended laminar flow. After being in service for ~ 2 weeks, the generator efficiency dropped off ~ 30%. Being a model airplane guy, it was immediately obvious what had happened. Bug splats on the LE of the airfoil caused an early trip of the boundary layer which quickly pushed the blades to turbulent flow. In this mode the airfoil had much higher drag. I can't recall the appropriate academic term used to describe 'bug-splats' but that was acknowledged to be the problem.

The solution (short term) was to send a graduate student out to clean the blades every few days. The long term solution was to redesign for a low drag turbulent flow section. This was not as efficient overall as the laminar flow design but almost no change in efficiency was noted with time and the graduate students went on to less mundane tasks. Those are the trade-offs the real world sometimes forces us to deal with.

So much for serendipity. Let's take a look at our X-Foil results.





LIFT AND DRAG COEFFICIENTS

The calculated lift coefficients for both sections are shown in Figures 1 and 2. As expected, the SA7035 has a higher maximum lift coefficient throughout the Rn range of this study. The curves also suggest a somewhat more gentle stall than the AG12. However, the response to Rn change of the slope and offset - Cl(Alpha=0) - is much more sensitive with the SA7035, especially at low Rn. This is where the optimization for low Rn using X-Foil has created a significant advantage with the newly designed sections.

When we look at the drag coefficients (Figures 3 and 4), Comparable conclusions can be made. The low Rn drag is lower but the width of the drag bucket is narrower with the AG12 as compared to the SA7035. The SA7035 also shows a pronounced excursion in the middle of the drag range at low Rn presumably due to poor transition stability and re-attachment. At 100k and above, the differences drag values are not significantly different.

This suggests that the SA7035 has an advantage with a larger planform (3 meter range) while the AG12 carries the advantage for smaller airframes such as DLG. Obviously these are the design principles behind both of these

Figure 5: Cd vs Cl: AG12 - X-Foil Data

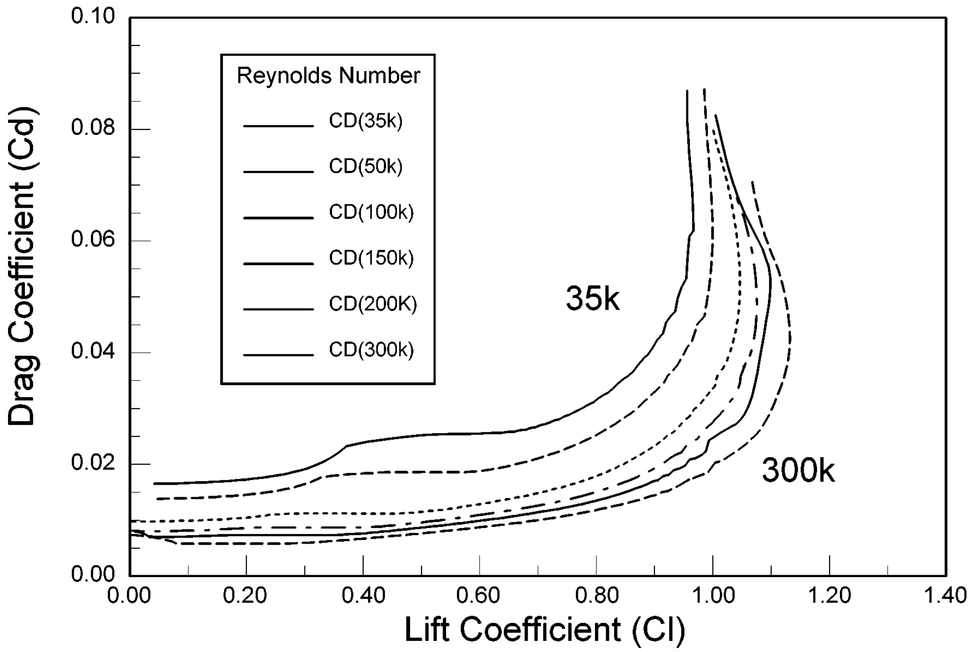
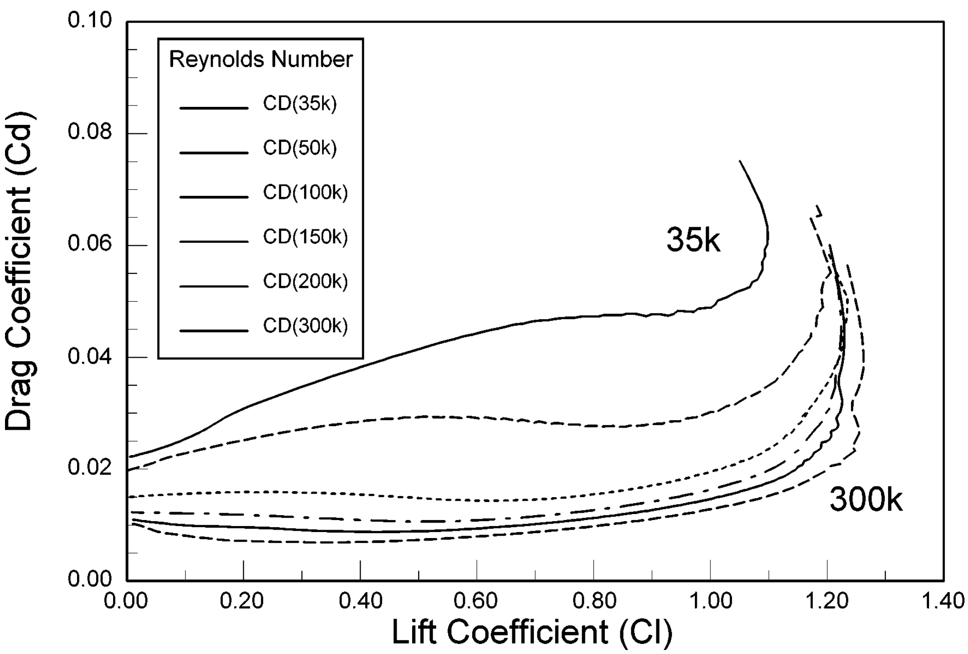


Figure 6: Cd vs Cl: SA7035 - X-Foil Data



sections but it's reassuring to infer these results from the calculated data.

In Figures 5 and 6 we plot the more conventional Cd vs Cl plot and again the overall drag bucket for the SA7035 is typically wider but the AG12 has a significant drag advantage at low Rn values.

As originally suggested, the AG12 will be a much cleaner airfoil at low speeds but not as capable of generating high Cl under AoA conditions. Which is precisely where we need to be for low speed (minimum sink) flight. The high drag of the SA7035 under these conditions suggests a somewhat poorer minimum sink even though the Cl capability is a bit higher.

For the launch phase of the flight envelope, (low Cl at high Rn) the Cd of the AG12 may be slightly lower but the advantage here seems pretty subtle.

Without running the polar calculation, my suspicion would be that launch heights would be quite comparable with these two airfoils but the AG12, with an optimized planform (probably lower AR), should have better minimum sink. Thus the complete flight envelope (launch and glide) should be more favorable. Next time, we'll run the planform and polar calculations in detail and see if the 'gut feel' pans out.

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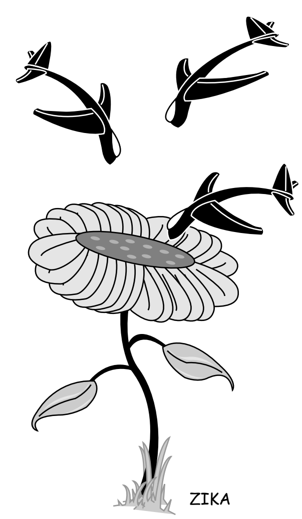

GORDY'S TRAVELS
A Return to the Land of Trim and Balance

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In my previous trip to the land of trim and balance, I talked about the fact that terms like 'CG' are the arch enemy to getting our planes optimized.

As I have said many times in my column, I am fortunate because I get to meet and discuss stuff like this with guys who really know things. Recently, I chatted with one of the youngest, foremost brilliant free flight modelers (and RC Sailplaner) Russ Whitford of the Slopeflyer.com Whitfords in Milwaukee, Wisconsin.

Russ and I go way back, and while we seldom see each other or even talk, when we do, it's like we were just together yesterday.

Russ had read my article on trim and balance, and pointed out that where I stated that Rudder Elevator ships of the past were always balanced at 30% with lots of up decalage in the horizontal stabilizer, because the kits were designed by ex-free flight guys who had added radio control to their planes, in fact, the opposite was true - that free flight planes were actually balanced way back to sometimes 50% of root chord.

So as we discussed that line, an epiphany came to me as to why poly ships had evolved in such a goofy manner.

It was actually something Russ said as he was discussing the rationale of free flight trim and balance, where he used the phrase, "trimmed for a particular speed."

And THAT was it, whether consciously or unconsciously, or maybe as a result of 'task'. Kits prior to full house planes (let's say pre-1980ish) were (for the most part) all set up with some decalage and lead in the nose to 'balance' the crookedness of the wing to stab alignment.

Setting those planes up like that made them very difficult to fly fast for one thing, plus pilots learned which speed was optimum for their setup. Diving them down from a thermal caused their destruction. Often, when at cloud base, it's near impossible to tell if your plane is flying across the sky or speeding down from the sky, down being the bad thing.

Keep in mind that very few modelers alive actually 'know' why they did what they did in designing a model for Thermal Duration flying, mostly they did what was the norm for the day. We actually still see it in many of the Euro-Moldy V-tails (fixed stabs) which, if balanced like a full flying stab plane, have to be either flown with 1/16" down elevator trim or have the stab assemblies leading edge shimmed up that amount.

Try to forget applying judgment terms like 'good thing or bad thing'. There are lots of ways to skin a cat but there are some that are faster than others... The cat is skinned in the end in either case.

Now here's the reason's it's been a dumb idea for years!

With mass quantities of lead in the nose of a sailplane, once airspeed is lost, so is the stab's ability to support the nose against gravity. That's why, on a hand toss, sailplanes that are set up crooked first balloon, then drop their noses like javelins... With a really nice glide in the middle.

It's why so many newbies end up in trees or watch their planes heal over on launch, crashing into ground and shredding their way to the turnaround. It explains the REALITY of what some call the 'deadly down wind turn'.

A sailplane balanced at 30% of root chord has lots of lead in the nose. Only the elevator can make that nose lift. The more lead, the more strength (or authority) the elevator needs to get that nose to come up in a turn.

So, when a newbie gets down low and slow, let's say he decides to try to bring his plane around in that down wind turn; but, since his airspeed is reduced, his sailplane's elevator has lost its strength to pull the nose through the turn. Centrifugal force, mass and inertial come into play, forcing the nose to drop or fade down, away from the turn. Same as a piece of lead swung at the end of a string wants to fly away from the center, the lead in a sailplanes nose wants to fly out and away from the direction of the turn!

When a newbie sees his plane is not responding (coming around), he pulls more elevator. Since there was barely enough air on the elevator as it was, raising it more causes the air, that was passing over it, to 'baffle' against it, rendering the elevator 'gone'... And a SNAP ROLL results — NOT A *TIP STALL* (Don't get me started on that topic!!) that lead to the nose rushing toward the earth... And we have planes in trees, or with a crumbled wing tip first into Terra-firma.

So, why don't poly ship guys 'get it'?

Because they don't understand what 'IT' is. When they see a newbie's plane porpoising, they advise him to, "Add some lead to the nose!"…Not taking into account that it takes real thumb experience to 'learn to fly' a crooked airplane. If the newbie had mastered flying his crooked airplane at its specific speed, it wouldn't be porpoising in the first place.

AND THAT'S WHY poly flyers have so much trouble transitioning to full house planes. Anyone who flys full house will always argue that they are sooo much easier to fly, 'fly' being the operative word. As in, the pilot controls every movement of the ship, every attitude change, where the crooked planes resist most input control and hate, to the point of getting crazy, speed request changes.

Poly guys are told, by other poly guys, that full house ships are ‘for experts thumbs’. So, they ‘learn’ to fly their particular crooked-unbalanced poly ships. Since no other model flies like their personalized speed-specific poly ships, they have lots of trouble flying anyone else’s sailplanes, crooked poly or full house balanced ships.

When asked to help a newbie with his poly ship, that guy will always start adding lead to get the newbie’s ship to fly *like* the plane he is used to… his own.

Now the same is true for a full house sailplaner who understands trim and balance. He will always start pulling lead and adjusting the full flying stab until all the decalage is out, so that at any speed the plane flies the same attitude. That way it allows the pilot to be able to range further away and not wonder what his plane is doing. It allows him to spend more time reading air, and less correcting attitude for speed.

Too often, those club experts flying crooked-unbalanced planes will hold their trophies up, or proclaim their hours long flights, as a justification of their set up. In spite of the fact that houses fly in the right air.

That they have mastered *their* model well enough to beat guys with full house ships is a testament to their skills, but also a condemnation to only being able to enjoy that particular model.

A balanced plane doesn’t need lots of elevator in that low, slow downwind turn, to get its nose to come around, so you seldom see them tip first into the ground (don’t confuse balanced and trimmed with full house, a crooked-unbalanced model still has to fight the same physical forces). It’s why so many of the ‘pros’ are seen hand tossing 120”+ full house composite models, circling and catching, or putting then up into the clouds from the same toss. A trimmed and balanced plane doesn’t waste what little energy is available. They land slower, not because of flaps, or computer radios, but rather because they are not following the masses of lead found in unbalanced models noses. They need less of all control surfaces to make them do what we want and are ‘set-up’ to fly the same at any speed, under any pilot’s thumb.

Our sailplanes have to fall forward to fly right. Trim & Balance is a trip that is tremendously interesting once you get your head beyond the aerodynamic jargon that causes us to dismiss the common sense factors. I’ll be on this road for awhile; hope you can come along!

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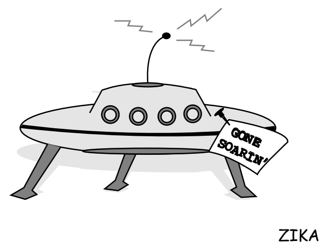

R/C Radio controlled Soaring Digest

THE JOURNAL FOR R/C SOARING ENTHUSIASTS

A MONTHLY LOOK INTO THE WORLD OF SAILPLANE ENTHUSIASTS EVERYWHERE

R/C Soaring Digest (RCSD) is a reader-written monthly publication for the R/C sailplane enthusiast. Published since 1984, *RCSD* is dedicated to the sharing of technical and educational information related to R/C soaring.

RCSD encourages new ideas, thereby creating a forum where modelers can exchange concepts and share findings, from theory to practical application. Article topics include design and construction of RC sailplanes, kit reviews, airfoil data, sources of hard to find items, and discussions of various flying techniques, to name just a few. Photos and illustrations are always in abundance.

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HAVE SAILPLANE, WILL TRAVEL!

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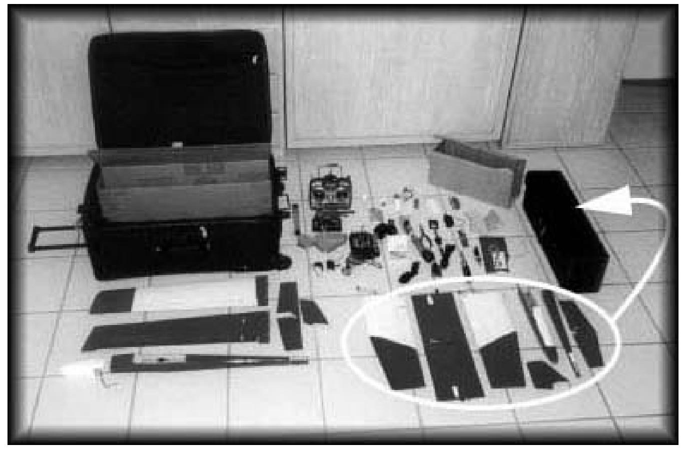


Suitcase with 2 travel planes and gear. The Nomad MP is circled and the arrow points to the small box it fits into. This photo shows 2 travel planes, radio, charging gear and repair supplies. There was still space left in the suitcase.

This month's travel saga is written by Kurt Dumas. Kurt lives in Burbank, California and works for Warner Bros Animation as a story artist. He is a private pilot as well as a hang glider pilot. This was his second trip to Maui to fly sailplanes.

Hawaii 2002

by Kurt Dumas
Burbank, California

Many things led to the develop ment of a practical RC travel glider but I believe that my trip to Venezuela was the proverbial last straw. I was traveling to an island off of the coast of Venezuela for a friend's wedding and learned that the conditions might well be favorable for flying RC sailplanes. Not certain of the wind or landing conditions, I decided to take two planes, a foam Zagi and a CR Fun-1 with a two-piece wing. Taking these two planes required a 14x11x37.5 inch box for transporting. I emphasize, BOX. And it just so happened, unbeknownst to me, there was a box embargo.

I don't know why there was an embargo on the container rather than the contents, but the Venezuelan security officers decided that my box must be opened and searched, perhaps for more boxes. For me this was a huge inconvenience. I don't speak Spanish save for "Dos huervos por favor. Donde esta les banos?" and "Cervesa con manzanas, gracias." You can't hold a discussion of RC sailplanes with said vocabulary. Thankfully, they understood hand waving and looks of confusion and eventually I was allowed to repack my airplanes and underwear to search for my bilingual friends that had long since vanished. The trip itself is the subject of another travel article but for now I will focus on the convenience or lack thereof when traveling with sailplanes and how to make things a whole lot easier on yourself when flying for fun by building a plane that will fit in your regular suitcase.

There are several ways one might travel with model sailplanes, each of which has its advantages and, unfortunately, its disadvantages, as well.

Shipping ahead:

Shipping ahead makes things simple at the airport but adds expense and time at the post office. It also requires more planning. You do, after all, need a place to ship this large peculiar box to, some place where it will be held for you safely and out of the rain. You really don't know for sure. Then at the end of the trip of course you need to ship it back.

Packing in an over size luggage container:

Some pilots pack their planes in golf or bow cases and claim it costs no more than flying with regular luggage. It's possible to get it past the steward but it is oversized and therefore subject to added airline charges, if the airline feels like it. The golf or bow cases are bulky and you need to consider this when hiring a car, train or rickshaw.

Custom making a box for your planes that doesn't look like a standard piece of luggage can lead to problems when there's a crazy box embargo, even if the box fits within the size restrictions. Silly.

If you're thinking of packing your radio as a carry-on consider the added security at airports these days. Taking your radio and odd shaped battery packs through the x-ray machines and metal detectors often will subject your bag to search more often than before.

If you're entering an international contest and must have that 20 foot span scale sailplane that requires shipping then deal with it, but if you're a sport flyer that is taking the airplane along as an afterthought than my vote is a portable/packable travel plane that is designed to be flown in a variety of conditions.

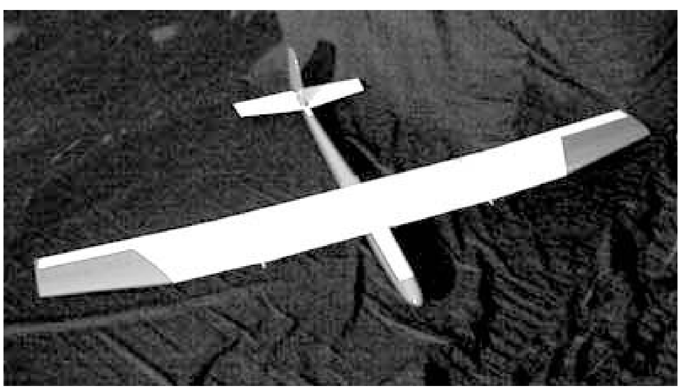
Voila, the Nomad Sailplanes MP. The MP stands for multi-purpose. It is a 2 in 1 travel
plane.

The MP is a super-modified 55" Dynaflite Skeeter. When disassembled it will fit into a box with dimensions of 5"x7" x22". The tail is removable, the fuselage separates into two pieces, and the wing into three.

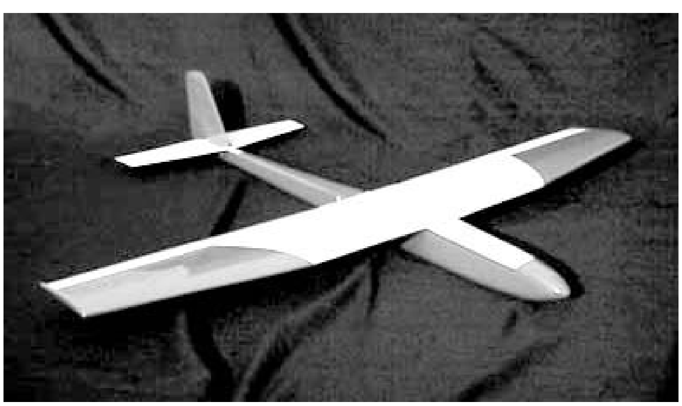
Each outer panel of the wing has an aileron with its own servo. When assembled the pilot has the option of flying the plane with the wing's center section in place as a thermal sailplane or without the center section for sloping.

This column is dedicated to soaring vacations. If you have a favorite sailplane saga, consider writing it down for *RCSD*. If you are planning a vacation that includes your plane and transmitter, consider making notes as you go, and working up an article later. Take photos. Collect maps. And send your story to Tom Nagel at tomnagel@iwaynet.net for gentle editing and suggestions.

Tom



Poly config. and slope config.



The Travel plane in its box easily fits into a medium sized suitcase, with room for radio gear and charger and still extra room for enough clothing for a week on the islands.

It was with this new sailplane that I traveled to Maui to fly once again with members of the Maui Island Soaring Organization.

FLYING IN POLY CONFIGURATION FOR HLG GOLF

I contacted Duane Asami through the MISO web site and made plans to meet him at the Glider Golf contest they have once a year. It was held on the foothills of the Haleakala volcano at Poli Poli. (For directions to the Maui flying sites go to http://groups.msn.com/SoarMauiRC and click on FLYING SITES.)

The flying conditions had been poor at best during the previous week. The day before the contest the site was completely socked in. Apparently most of the regular pilots were apprehensive about the possibility of flying in instrument conditions so there was a low turnout as the sky cleared on the day of the contest. The pilots that did show up were good. Really good. They had many more hours of flying time than I had. One claimed to fly over six hours a week at this spot. Yet, still with my little travel plane, I managed to place third with a score of a 19, just one "stroke" behind the first and second place pilots whom both scored 18.

The travel plane performed very well. The ailerons allowed me adequate control in the turns as long as I kept the speed up and the plane clearly indicated what little lift there was. I was flying faster than I expected but the plane is 2 oz. heavier than the Skeeter recommends. In addition, the cg may have been off. But over all it flew great.

FLYING THE SLOPE CONFIGURATION AT MALUHIA

With a successful day of flying at Poli Poli complete, the next test was to fly the travel plane in its slope configuration at Maluhia, an exceptional thermal and slope lift flying site about twenty five minutes from the Kahului airport.

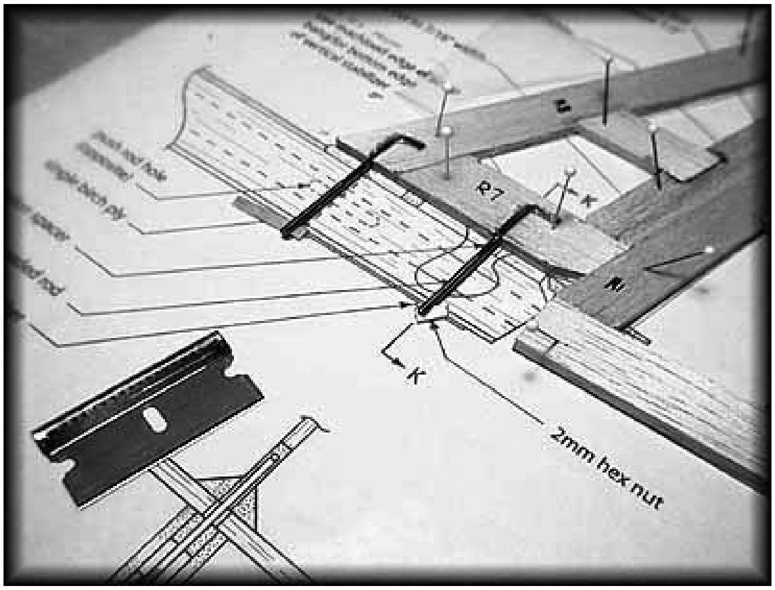
It was about 4:30 p.m. and the wind was averaging 15 miles per hour. I held the travel plane up to feel the wind and it was obvious I was going to need lead to keep control as I flew out past the turbulent air and to penetrate into the wind. I added three ounces to the belly and gently tossed it into the wind. With a few unsettling dips she was above the tree line and climbing. Six ounces would have been better but even with it being a bit too light it was solid in flight. I was used to the slow roll rate of the thermal wing, which requires a generous up aileron differential throw to counteract the adverse yaw, so the roll rate of the shortened wing with full aileron along the span was quick to say the least. The landing was relatively uneventful in the field of freshly mowed grass behind the ridge.

Over all I was pleased with the performance. The short wing doesn't provide much of a silhouette at great distance but it flies great and is very responsive to control inputs. Overall, the plane I designed and built flew great. The overwhelming response to the Nomad MP was, "Man, you've got too much time on your hands."

Here's an abridged explanation of the structural modifications beginning with the fuselage:

Fuselage:

There are a number of planes with removable tail designs and wings built in multiple sections are common. These features help make a model easier to transport but, to make it truly portable, the fuselage must also pack small. The fuse on the MP breaks down.



Building the removable tail over the modified plans.

The fuselage is built similar to the original except that it separates just aft of the wing's trailing edge. Brass and aluminum tubes glued into the lower longerons form connecting rods which provide lateral support and keep the fuselage from twisting. Strips of plywood bolted into the upper longerons keep the fuselage from separating in flight.

Tail:

The original Skeeter is designed with a solid balsa tail. To keep the weight down I cut the stock into strips and built the tail over its planform.

Adding ailerons meant adding weight. I eliminated the rudder to help offset this weight. To counteract adverse yaw, I added the aileron differential adjusted to provide greater throw in the up position.

There is an option to add a rudder servo under the trailing edge of the wing.

Wing:

The wing is built into three sections. Ailerons, each with its own servo, are added to the outer port and starboard wing sections and aileron servo wires with connectors run through the center section.

The basic idea of this modification is that the outer wing thirds, or wing tip sections of the full thermal wing, are built to remove from the center section and then connect to each other forming a wing suitable for slope soaring. The wing is aligned using a basic male/female tube system at the spars. The 3/8-inch thick ribs at the ends provide strength for the connection.

Packing tape may be used to hold the wing tips on. However, I chose to bolt them to the center section by screwing a nylon bolt horizontally through the end ribs. This requires an access hatch that can be covered with tape prior to flight.

For more photos and information on how to order the 32 page detailed construction manual with complete plan modifications, photos and step by step instructions for building the Nomad MP (AKA 2 in 1 travel plane), go to:

nomadsailplanes.com

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GORDY'S TRAVELS

Gordy Stahl
Louisville, Kentucky
GordySoar@aol.com

RC Soaring... It's Not About Flying!

So often I get asked,"Why sailplanes versus helicopters or powered planes, or even electrics?"

To start at the beginning, I started with glow powered planes like so many of us. I had a ball with it but it always left me just a little bit short of being satisfied with my hobby. I did build a new model, fly it and began looking for something faster, bigger or fancier.

When I got into RC soaring, it was the same thing all over again; before I had the latest and greatest model finished and flown I'd be looking and lusting after the next new sailplane. From balsa to bagged to molded, from E214, 3021, 7037, 7035, to MH32, it was a mistaken quest.

It took a lot of miles of soaring in order to understand the answer to the question, and that it was misguided to think that some new 'gimmick' would give me an edge toward 'enjoying' my hobby.

The answer? Simple... Or maybe I should say, it is now, after all these years in the hobby. The difference between flying power planes and sailplanes is that one is about building and flying, and one is about building and HUNTING... with the emphasis on HUNTING.

It really came to me the other day while flying with Bruce in Nashville at the Percy Priest Dam site. The wind was slightly sideways to the dam; Bruce had one of Dave's Aircraft's amazing 60" EPP Schweizer 1-26's, a foamy suited for rough landing sites. But I only had my Fred Sage 126" Compulsion Thermal Duration contest ship so, needless to say, I wanted to make sure conditions would warrant launching.

I watched Bruce's launch closely, but it was his comment that gave me that sort of Zen realization. He tossed the plane and headed out along the dam face, but what he said was,"I think the lift will be right over that corner." THAT WAS IT!

Thinking back over every launch I made or watched with sailplanes, slope or thermal, it was always about *finding* air... It was about the HUNT.

When we step on a field, we scour the area for clues signaling lift. When we come off the winch our thoughts are, "Where is the air, which way to turn?" Never about 'the flying'.

RC soaring is about the hunt for lift, because we don't have a motor. Sure we can do rolls and loops and virtually all the stuff the powered planes can do, but because there is no motor or fuel tank, finding more energy to fly is a huge part and in fact the primary goal of each flight.

We all can think back (and remember vividly!) to that first huge thermal that sky'd us out... And it's that memory that drives our yearning each morning of a flying day, and our day dreams on those rainy days.

The Hunt, that's what separates RC soaring from all the other variations of RC (well maybe not so different than RC sailboats)!

Good luck on your next 'hunting' trip! I'm off on another of mine...

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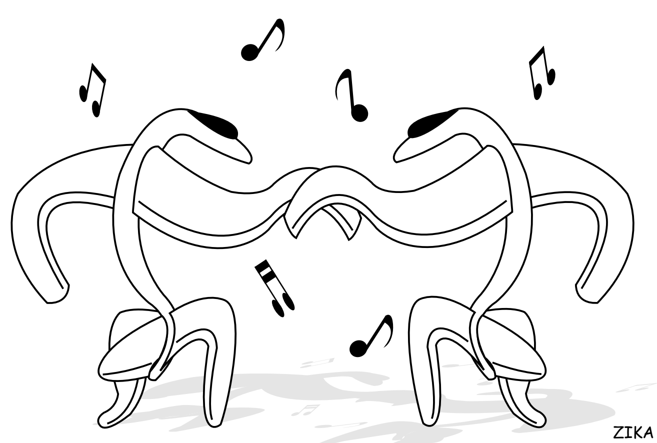

Center-of-Pressure, Again

Greg Ciurpita
Somerset, New Jersey
http://ciurpita.tripod.com/rc

"As the forces approach zero, the center of pressure moves to infinity. For this reason, the center of pressure is not always a convenient concept in aerodynamics."

- Fundamentals of Aerodynamics,
John Anderson Jr

The total pitching moment about the center of gravity (CG) is

$$C_{Mg} = C_M + C_{Lw} x_{wg} - C_{Lt} x_{tg} S_t / (S_w c)$$

where

- C_{Mg} is the total moment of the aircraft about the CG,
- C_M is the moment coefficient of the wing (nose-up is positive),
- C_{Lw} is the lift coefficient of the wing,
- x_{wg} is the distance between the aerodynamic center of the wing and the center of gravity,
- C_{Lt} is the lift coefficient of the stabiliser,
- x_{tg} is the distance between the aerodynamic center of the stabiliser and the center of gravity.
- S_t is the area of the tail.
- S_w is the area of the wing.
- c is the average wing chord length.

Figure-1 illustrates the primary forces affecting pitch. The wing is shown on the left, with an upward arrow indicating lift, represented by C_{Lw} in the equation. The lift is shown originating at the *aerodynamic center* (AC) of the airfoil. An arc is shown at the AC indicating the moment created by the wing in the direction caused by a negative C_M. The stabiliser is shown on the right, with a downward arrow indicating the force it creates, due to a negative C_{Lt}. The circle with a cross in it indicates the center of gravity (CG). Both moment arms between the CG and the lift generated by the wing, X_{lw}, and lift created by the stabiliser X_{lt}, are shown.

The total moment of the aircraft, C_{Mg}, must be zero for an aircraft to remain in level flight, otherwise the aircraft will either nose up or nose down. The elevator setting affects the lift produced by the tail, defined by C_{lt}, and is adjusted to neutralize the total moment, making it zero.

This equation is fundamental to understanding pitch stability. It identifies the key forces and moments of the aircraft. Inherent in this explanation is the fact that the lift is stationary at the location described by x_{wg}. This equation accounts for the fact that a wing produces lift and a moment, and because the moment is separate from the lift, the location of the lift (center of pressure) is stationary and does not move as the lift changes.

Pitch stability is determined by the location of the CG. I continue to be impressed by experienced flyers that can so easily see that my model is nose heavy by the way it flies. I've seen them use various methods: the dive test, flying upside down and seeing how much elevator is required, observing how the plane turns, and observing that a plane is thrown out of a thermal. (I sincerely wish someone would write an article on these.)

In the 3rd edition of Aerodynamics for Model Airplanes, Martin Simons shows two polar diagrams for the Clark-Y airfoil. The first, from 1924, shows a center of pressure measurement. The second, from 1931, shows separate lift and moment measurements. In this article I show the equations that relate the center of pressure curve from the 1924 measurement, to the C_M curve in the 1931 measurement. This is not an article on pitch stability. I've shown the equation above to emphasis that a wing can produce both a pure moment, C_M, and lift which also produces a moment around the CG.

A review of moments seems an

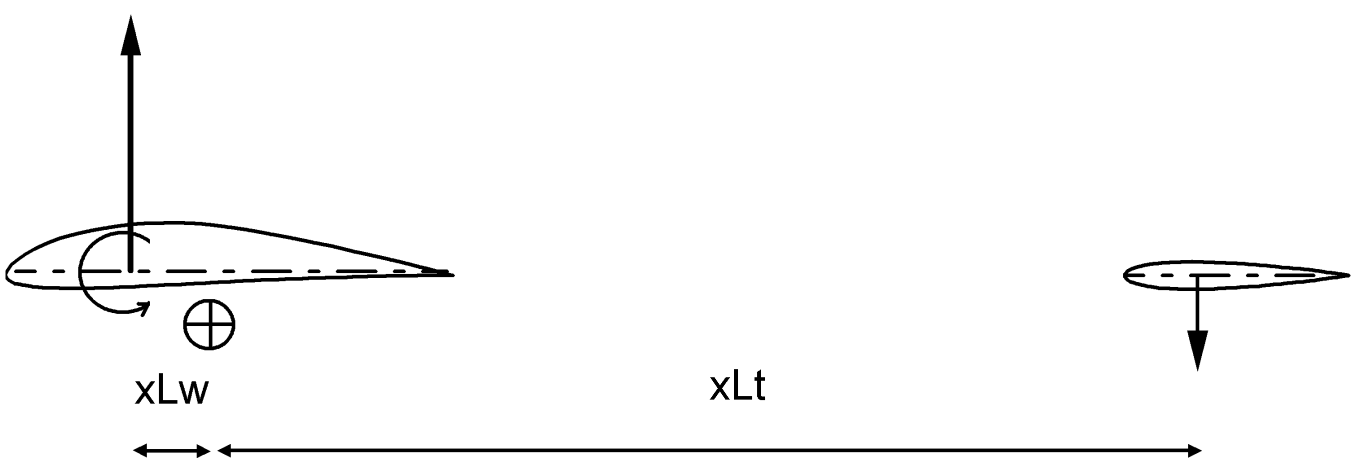

Figure 1 - Primary forces affecting pitch.

appropriate place to start. A moment, or torque, is a twisting force such as that created by a wrench twisting a bolt. The magnitude or size of the moment is the force times the length of the moment-arm. The moment can be increased by either increasing the force or moment arm.

$$M = F * d$$

where M is the moment, F is the force, and d is the moment arm.

A *translational* force, F, would normally push an object in the direction of the force. But if the force is applied off center of the center of gravity of an object, the object rotates, due to the resulting moment. A translational force can create a moment, but a common rotational motor is an example of a device that only produces a moment and no translational force.

Most *cambered*, or non-symmetrical airfoils produce both a translational force, lift, as well as a rotational force described by C_M, as shown in figure-1. The exception being those with a reflexed trailing edge used for flying wings. The *aerodynamic center* (AC) of the airfoil, typically 1/4 chord location, defines the center of lift.

The moving center-of-pressure concept assumes that an airfoil produces a single force, lift, and that the moment is the result of the lift force. But since the moment of many airfoils is fairly constant even though the lift changes, this concept implies that the moment-arm, d, changes, as the lift changes. To maintain a constant moment, the moment arm must increase as the lift decreases, moving the center of pressure rearward.

What becomes difficult to believe is that as the effective AOA and the lift becomes small, a point is reached where the lift is actually behind the trailing edge, and ultimately goes to infinity as the lift becomes zero. Then, as the lift decreases infinitesimally and becomes negative, the center-of-pressure moves an infinite distance in front of the leading edge.

Center-of-Presure vs. Moment Measurements

The center-of-pressure curve on the 1924 airfoil plots from Simons' indicate a most forward chord position at maximum lift, and more rearward chord position as the lift decreases.

Figure-2 illustrates typical curves for a moving center-of-pressure as in the 1924 plot from Simons'. A typical curve is close to the 1/4 chord location when the lift is near its maximum on the right hand side of the plot. Moving to the left, the lift decreases. The center-of-pressure decreases slowly, at first, but then falls very quickly. The center-of-pressure, on all three curves, has moved to ~60% of the chord as the lift decreases to 0.25.

Consider using the previous equation, to calculate the center-of-pressure (CP) on an airfoil knowing the aerodynamic center and a constant moment coefficient, C_M. The CP location must be some distance from the aerodynamics center (AC) so that the moment arm, d, is sufficiently large to produce the required moment for the available lift, L.

$$CP = AC + d$$

The moment arm can be determined by dividing the moment by the lift

$$CP = AC + M / L$$

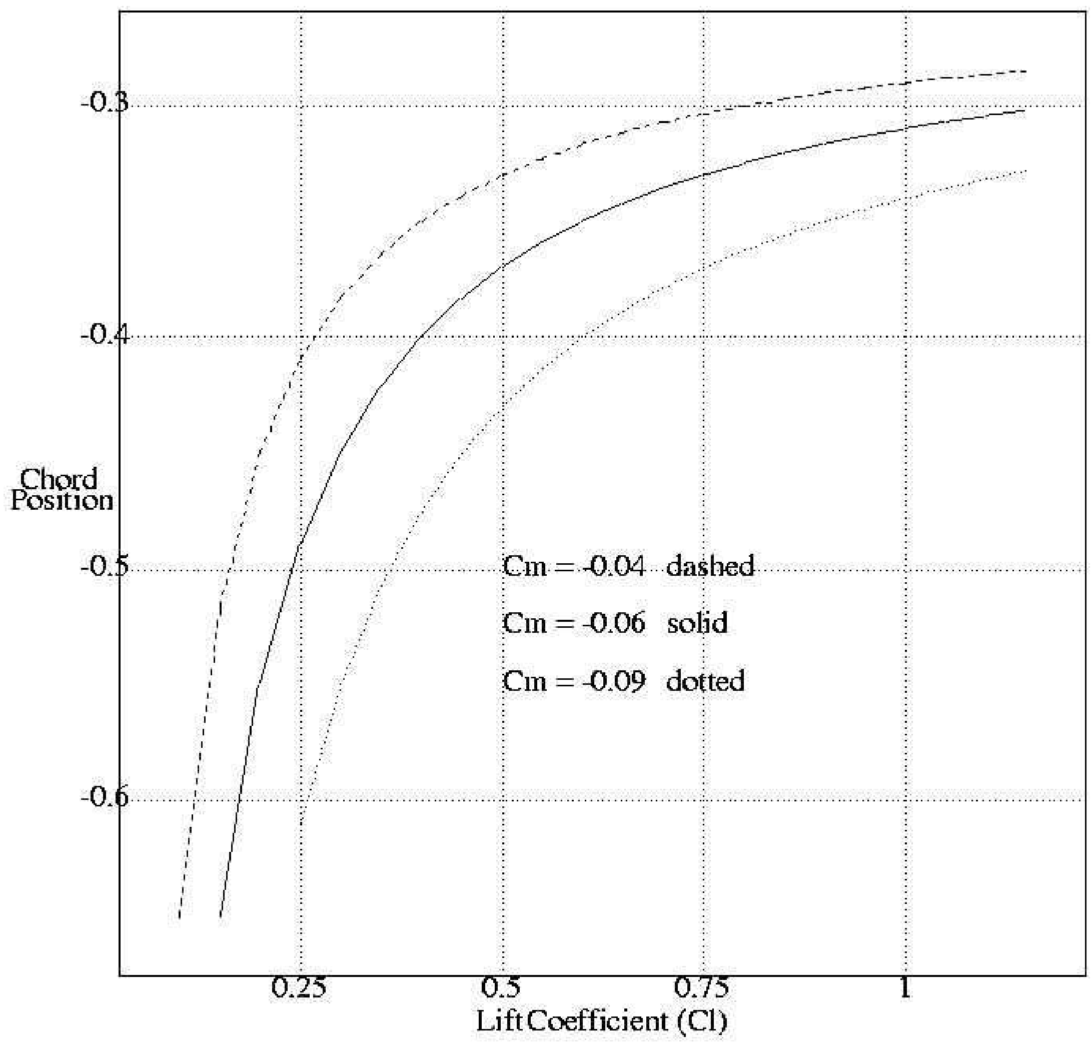

Figure 2 - Center-of-pressure curve for a few C_m values.

We should all be familiar with the lift equation

$$L = 1/2\ r\ V^2\ S\ C_L$$

where r is air density, V is airspeed, S is the area of the wing, and C_L is the lift coefficient. A similar equation is used to calculate the total moment, given a moment coefficient, C_M, as indicated on the more modern 1931 plot from Simons'

$$M = 1/2\ r\ V^2\ S\ C_M$$

These two equations provide values for the moment and lift produced by the wing, and can be used to replace M and L

$$CP = AC + (1/2\ r\ V^2\ S\ C_M) / (1/2\ r\ V^2\ S\ C_L)$$

Fortunately, since the lift and moment equations are so similar, many terms cancel out, and the result is simply

$$CP = AC + C_M / C_L$$

This equation relates the moment coefficient on modern airfoil measurements to center-of-pressure on pre-1930 airfoil measurements. Figure-2 illustrates this by reproducing the center-of-pressure measurement for three constant moment coefficients, assuming an aerodynamic center at the 1/4 chord position.

While both the lift and moment depend on airspeed, it is very common for the moment coefficient to be relatively constant while the lift coefficient varies with AOA. It appears to be standard practice for airfoil measurements to be made and plotted with respect to the 1/4 chord location. A moment coefficient that is not constant but varies linearly (in a straight line) with AOA indicates an airfoil where the aerodynamic center is slightly different from the 1/4 chord location. In these cases, the measurements account for the aerodynamic center not being at the standard 1/4 chord location, that the moment arm between the actual aerodynamic center and standard 1/4 locations is not zero, and therefore that the lift contributes to the moment that determines C_M. There are, however, (less desirable) airfoils where the moment coefficient varies non-linearly with AOA similar to the way lift varies non-linearly near stall.

Working out these equations and seeing the resulting plots helps me see that ... *"the center of pressure is not always a convenient concept in aerodynamics."* With this understanding, I can understand why some people would say the center of pressure is behind the wing, but I don't think this helps me understand pitch stability.

My sincere thanks to Dave Register and Lee Murray for their review on this article. Their comments very significantly shaped and improved this article. Thanks to Dave for help with the graphics.

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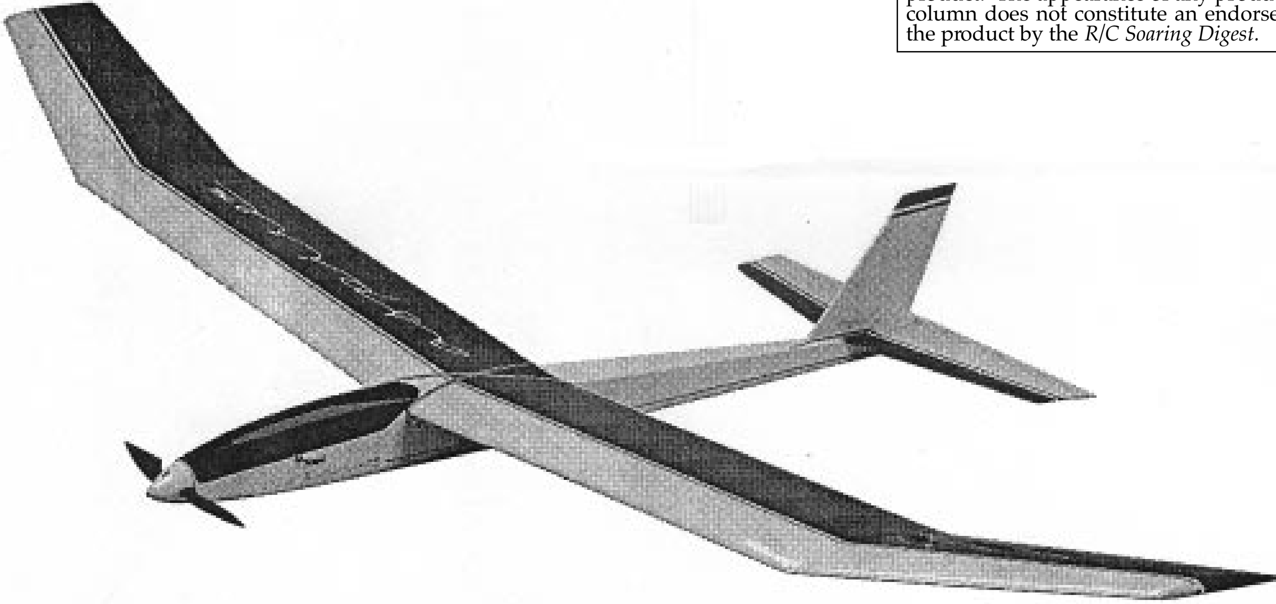
NEW PRODUCTS

The information in this column has been derived from manufacturers press releases or other material submitted by a manufacturer about their product. The appearance of any product in this column does not constitute an endorsement of the product by the *R/C Soaring Digest.*



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The Aspire EP RTR features an excellent balsa/ply structure and is covered with an UltraCote® trim scheme. Control is provided by Hitec's reliable Focus 3 single stick RC system. The same 550-type electric motor and folding prop combination that's found on the standard Aspire EP is included in the RTF. Power to the motor is regulated by a sophisticated proportional electronic speed control. Hangar 9 has included a 6-cell sport battery pack AND charger. Everything is in place and ready to use. There is practically nothing left for the modeler to provide other than 8 "AA" batteries for the transmitter.

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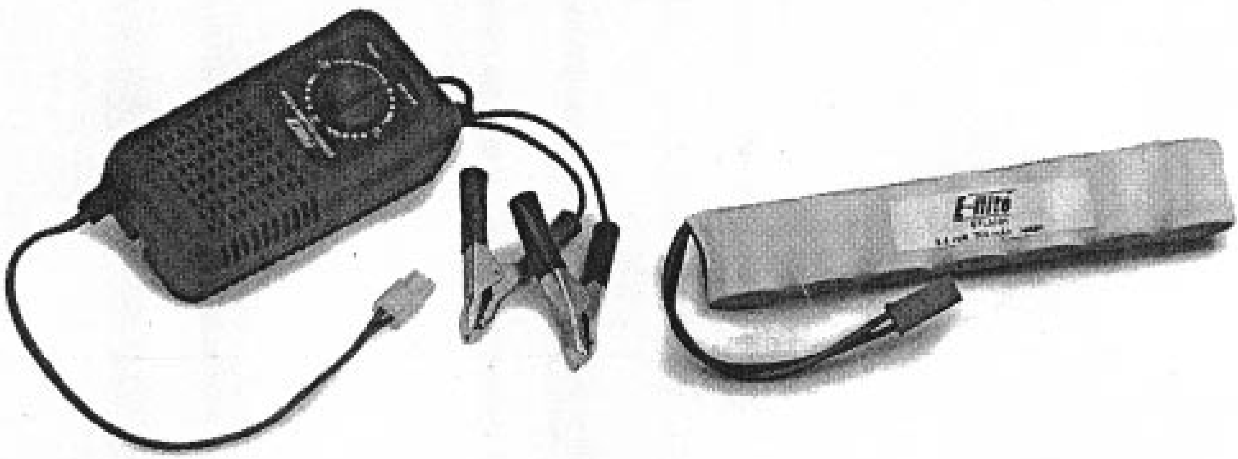

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Reference Material

Summary of Low-Speed Airfoil Data - Volume 3 is really two volumes in one book. Michael Selig and his students couldn't complete the book on series 3 before series 4 was well along, so decided to combine the two series in a single volume of 444 pages. This issue contains much that is new and interesting. The wind tunnel has been improved significantly and pitching moment measurement was added to its capability. 37 airfoils were tested. Many had multiple tests with flaps or turbulation of various configurations. All now have the tested pitching moment data included. Vol 3 is available for $35. Shipping in the USA add $6 for the postage and packaging costs. The international postal surcharge is $8 for surface mail to anywhere, air mail to Europe $20, Asia/Africa $25, and the Pacific Rim $27. Volumes 1 (1995) and 2 (1996) are also available, as are computer disks containing the tabulated data from each test series. For more information contact: SoarTech, Herk Stokely, 1504 N. Horseshoe Circle, Virginia Beach, VA 23451 U.S.A., phone (757) 428-8064, e-mail <herkstok@aol.com>.

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Internet soaring mailing listserve linking hundreds of soaring pilots worldwide. Send msg. containing the word "subscribe" to soaring-request@airage.com. The "digestified" version that combines all msgs. each day into one msg. is recommended for dial-up users on the Internet, AOL, CIS, etc. Subscribe using soaring-digest-request@airage.com. Post msgs. to soaring@airage.com. For more info., contact Michael Lachowski at mikel@airage.com.

International Scale Soaring Association

There is a growing interest in scale soaring in the U.S. We are dedicated to all aspects of scale soaring. Scale soaring festivals and competitions all year. Source for information on plans, kits, accessories and other people interested in scale. For more information:

web site: www.soaringissa.org

Books by Martin Simons: "World's Vintage Sailplanes, 1908-45", "Slingsby Sailplanes", "German Air Attaché", "Sailplanes by Schweizer". Send inquiries to: Raul Blacksten, P.O. Box 307, Maywood, CA 90270, <raulb@earthlink.net>. To view summary of book info.: http://home.earthlink.net/~raulb

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A Division of the Soaring Society of America

The purpose of the Sailplane Homebuilders Association is to stimulate interest in full-size sailplane design and construction by homebuilders. To establish classes, standards, categories, where applicable. To desiminate information relating to construction techniques, materials, theory and related topics. To give recognition for noteworthy designs and accomplishments.

SHA publishes the bi-monthly **Sailplane Builder** newsletter. Membership cost: $15 U.S. Student (3rd Class Mail), $21 U.S. Regular Membership (3rd Class Mail), $30 U.S. Regular Membership (1st Class Mail), $29 for All Other Countries (Surface Mail).

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Vintage Sailplane Association
1709 Baron Court
Daytona, FL 32124 USA

ESL

The Eastern Soaring League (ESL) is a confederation of Soaring Clubs, spread across the Mid-Atlantic and New England areas, committed to high-quality R/C Soaring competition.

AMA Sanctioned soaring competitions provide the basis for ESL contests. Further guidelines are continuously developed and applied in a drive to achieve the highest quality competitions possible.

Typical ESL competition weekends feature 7, or more, rounds per day with separate contests on Saturday and Sunday. Year-end champions are crowned in a two-class pilot skill structure providing competition opportunities for a large spectrum of pilots. Additionally, the ESL offers a Rookie Of The Year program for introduction of new flyers to the joys of R/C Soaring competition.

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ESL Web Site: http://www.e-s-l.org

ESL President (99-00): Tom Kiesling (814) 255-7418 or kiesling@ctc.com

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2 Meter Class: YES	NO (circle one)	Junior Cup YES NO	Large		
Entry Fee:	$ 35.00		X-Large		
BBQ: ___ x $15.00	$		XX-Large		
Shirt Order (fill in form)	$		XXX-Large		
TOTAL ENCLOSED	$				