R/C
Radio controlled
Soaring Digest
THE JOURNAL FOR R/C SOARING ENTHUSIASTS

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The Soaring Site

RCSD on the Web

With the March 2004 issue of RCSD, we transitioned to web publishing, which most of you reading this already know by now. Thanks to a lot of last minute teamwork on the part of our authors and their wives, we said that transition would not have happened if not for them. But there are others who share in that transition effort: the subscribers who no longer receive a postal delivered copy each month. Their last copy was mailed March 11th, only one week ago.

When offered the opportunity to have the balance of their subscription refunded or contribute that balance towards our electronic publishing efforts, many have already asked to contribute.

We also had no way of knowing how many of our subscribers could download pdf files, or would even consider doing so. One by one, we're finding out, and helping anyone who has questions, comments, or concerns.

In just one week, special thanks go to the following sailplane enthusiasts for their subscription contributions in support of the hobby:

Douglas Barry, VA
Anker Berg-Sonne, MA
Alex Cormack, CA
Gregory Ciurpita, NJ
Mark Dennis, KS
John Dvorak, CA
Jim Ealy, PA
Browne Goodwin, TX
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Ron Sneddon, CA
Herk Stokely, VA
Jon Stone, AL
Mike Stoneman, Canada
John Thayer, CA
Gregory Vasgerdsian, CA
Jess Walls, CA

Thanks to all! Your support of the electronic conversion and understanding are very much appreciated! If we missed anyone, we'll say, "Thanks!" next month!

Judy Slates
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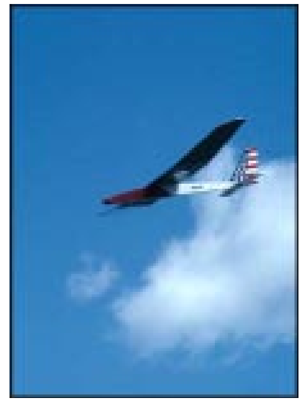
http://www.b2streamlines.com/RCSD.html



Easy Eagle

An Easy Eagle on a perfect soaring day - deep blue sky with puffy cumulus fair-weather clouds. Built from an Ace R/C lit, this two-meter span full-house sailplane carries six servos for ailerons, flaps, rudder and elevator. The fuselage is painted and the flying surfaces are covered with Ultracote heat-shrink covering.

Built by Dave Garwood and flown here by Bob Powers, this photograph was taken on Kodachrome 200 slide film with a Minolta SRT-201 camera using a 90-230 mm lens by Dave Garwood.

on the Wing

B²

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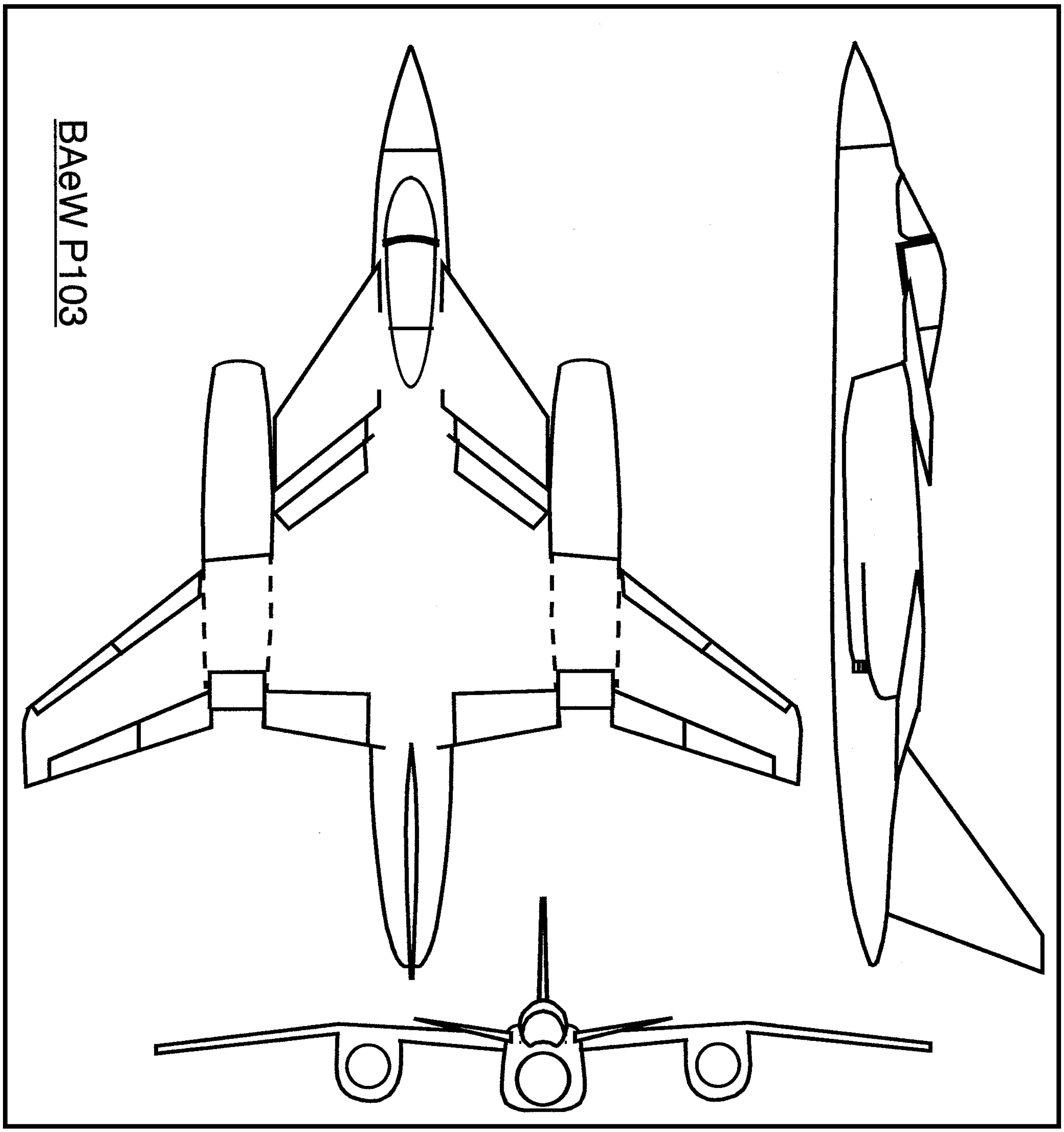
British Aerospace at Warton BAeW P.103

Always on the lookout for full scale aircraft with a unique style, especially tailless and canard planforms, we'd like to pass along the British Aerospace at Warton BAeW P.103 as a good candidate for power scale slope soaring.

The most well known STOVL (Short Take Off Vertical Landing) aircraft is the Harrier. From the deck of a small aircraft carrier, a fully loaded Harrier takes off by accelerating down the flight deck and up a curvilinear ramp to essentially leap into the air. Upon returning to the carrier, a vertical landing is performed. STOVL makes best use of available engine power and fuel supply.

The Harrier is designed to operate with a fixed engine supplying vectored thrust. That is, there are nozzles on either side of the aircraft which rotate to direct engine

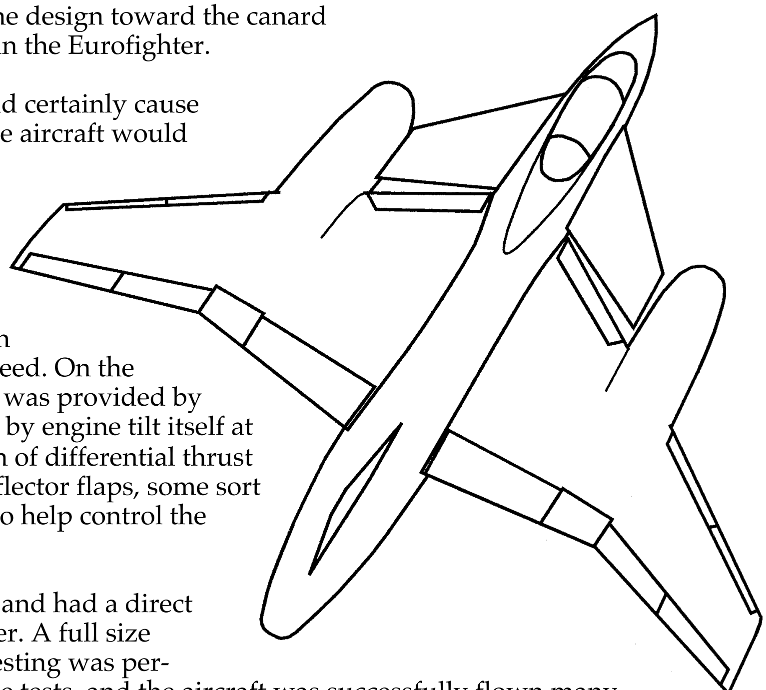


thrust downward, forward, or toward the rear. Designed in England, built in both the U.K. and the U.S., and used by the U.S. Marine Corps and several other military forces, the Harrier is tremendously maneuverable and can be used from either sea based or land based sites. Despite its various advantages in combat situations, it does have one disadvantage other than its relatively high operating cost — it is not a supersonic aircraft.

British Aerospace, with the availability of new engine technology, in 1977 began working on a preliminary tilt-engine design for a twin engined supersonic fighter type aircraft with STOVL capability. While that preliminary BAe Warton design looks to be derived from the Eurofighter, the P.103 project actually began six years earlier.

The BAeW P.103 was made possible by engines of much shorter length, and a new afterburner system called PCB (Plenum Chamber Burning) which doubled the exhaust pressure of the engine used in the Harrier. The engines could be tilted, and because of their short length the engine tail pipes were always a reasonable distance above the ground.

The critical part of any tilt-engine design is the balance between the center of gravity and the thrust line. This drove the design toward the canard configuration, one of the traits retained in the Eurofighter.



Two engines placed well outboard would certainly cause problems if one engine failed because the aircraft would immediately flip to the side, making egress of the pilot extremely difficult or impossible. BAe apparently worked out a solution to this problem, but details are lacking.

Of more importance perhaps, is the pitch maneuverability of the aircraft at any speed. On the BAeW P.103, this pitch maneuverability was provided by deflector flaps just aft of the engine, and by engine tilt itself at slower speeds. Because of the interaction of differential thrust from the engines, engine tilt, and the deflector flaps, some sort of computerized system was necessary to help control the aircraft in all flight regimes.

The P.103 took shape over several years and had a direct influence on the design of the Eurofighter. A full size P.103 mock-up was built, wind tunnel testing was performed, along with a multitude of engine tests, and the aircraft was successfully flown many times on a simulator. A prototype was never constructed.

Aside from being a canard, the P.103 has a couple of interesting points which make it attractive to the slope scale modeler. First, the original aircraft had no rudder, so a control system using only outboard ailerons and inboard elevators would be very easy to design and construct and be accurate to the original. Second, the canard surface is fixed and acts to direct the airflow over the leading edge of the wing at the root. This should improve the stall characteristics in comparison to a similar planform using the wing alone. Keep in mind, a model of larger size is called for because of the relatively narrow canard-wing gap. A rendition with a six foot wing span or larger would look truly exceptional skimming along the slope at high speed.

We'd very much appreciate hearing from any *RCSD* reader who designs, builds and flies a model of the BAeW P.103.

Suggestions for future On the 'Wing... columns are always welcome. Contact us at P.O. Box 975, Olalla WA 98359, or at <bsquared@appleisp.net>.

Resources:

Boot, Roy. From Spitfire to Eurofighter. Airlife. England, 1990.

Buttler, Tony. British Secret Projects - Jet Fighters since 1950. Midland Publishing. England, 2000

Eurofighter Typhoon web site. <http://www.eurofighter.com/>

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HAVE SAILPLANE, WILL BABBLE!

Sloper Headgear

By Tom H. Nagel
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RC Sailplane pilots almost always wear a hat when flying. The reasons are obvious — eye shade and sun protection. Styles run toward big floppy hats with wide brims, everything from straw hats to Tilley caps to coolie hats to Lawrence of Arabia neck veils and, of course, a few die hard dilberts with black baseball caps worn backwards.

When operations move to the slope, considerations change. The new factors are high wind, air temperature, wind chill factor, and combat protection. The range of Darwinian responses to these conditions is truly amazing. Let's have a look.

Wind is the constant. Slopers don't fly when it is calm. The slope pilot who wants to wear a hat has to devise some means of keeping it on his head in winds that may range from 5 or 10 mph to more than 45 mph. (For those of you struggling to covert meters from teaspoons, that is about 60 kph.)

Option 1A:

Friction fit. This flyer screws his hat on tight and relies on friction between his hat and his furrowed brow to keep his headgear in place.

Tom Nagel in baseball cap.

Option 1B:

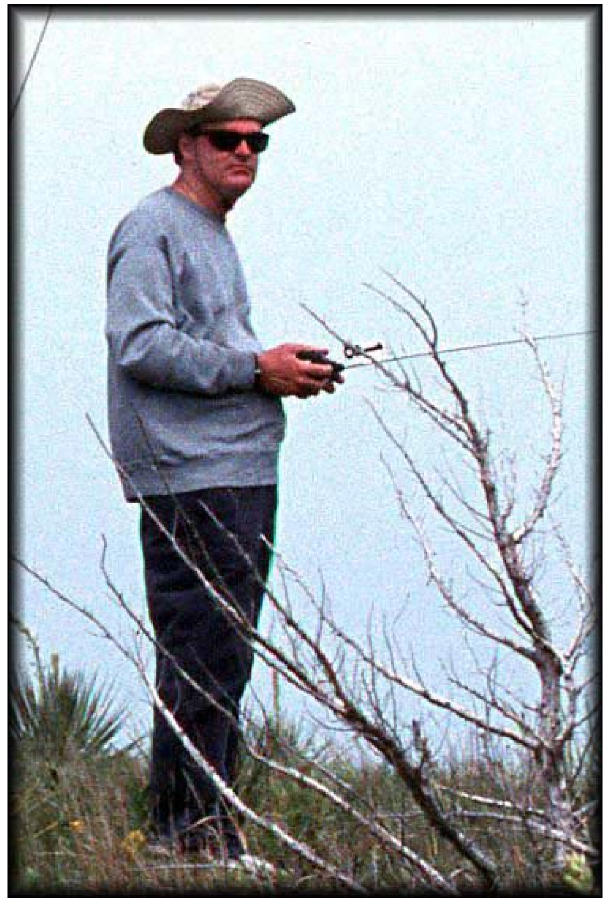
Reverse Friction Fit. See also "Dilbert" supra. Unless you are a welder, don't go there.

Andy Litsky in dark baseball cap, reversed.

Option B:

Negative Angle of Attack. This pilot never flies above the crown of the slope and spends his day staring down into the gulch in order to maintain a negative angle of attack with his hat brim. Well, why not? Every new slope pilot is instructed to add a few clicks of down elevator.

Tom Nagel riding the range.



Option C:

Chin Strap. The flyer with a chin strap risks looking like Sgt. Preston of the Yukon, and the chin strap undoubtedly gives him a goofy look. Fortunately, most spectators only see the slope pilot from the rear. The Tilley Hat and the Ultimate Hat have both front and rear chin straps, for those of us who are double chinned I guess.

Wayne Rigby at the race flight line MWSC 2003. Dave Garwood photo.

Option D:

The Red Green Solution. Duct tape. This is a possible approach for hats with no chin strap. Duct tape adhesive may be hard to remove from some fabrics. On the upside, it is a remarkable depilatory. Duct tape is also preferable to such alternatives as thumb tacks, staples or cyano-acrylic glue.

Steve Staley in deer hunting hat with duct tape.

Slope headgear styles also vary according to the individual taste and style consciousness of the flyer. Weather conditions and style of flying also come into play.

Here is a brief field guide to the identification of slope dawgs:

The Yuppie

Steve Staley in Hawaiian shirt and white sun hat.

The Recovering Ski Bum

Paul Wiese in ski cap and goofy expression.

Sherlock Holmes meets Lawrence of Arabia

Skye Malcolm and son with strange tan hat with earflaps and chin strap.

The North American Doofus (goober Americanus)

Bert Olson with goggles, orange hat, blue jacket and sort of "Oliver Hardy Goes Sloping" look about him. Photo courtesy Greg Smith at <Slopeflyer.com>.

The Combat Pilot

Skye Malcolm in motorcycle helmet
and with slope jet.

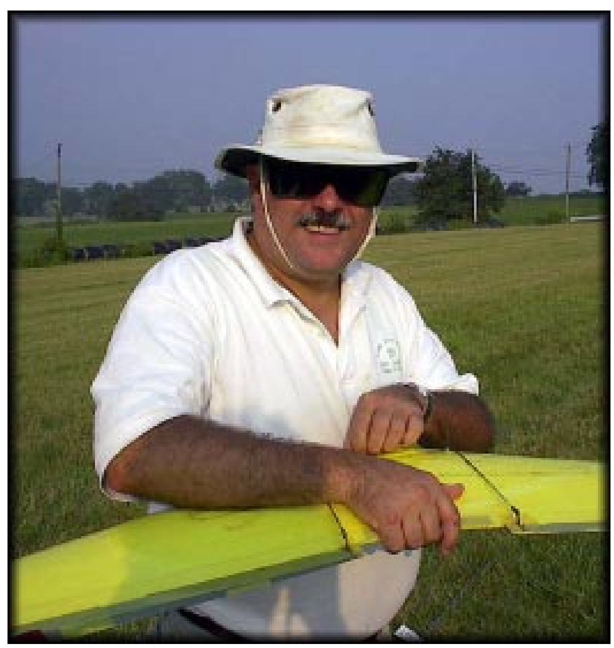
The Really Serious Combat Pilot

Tom Nagel in Viking helmet.

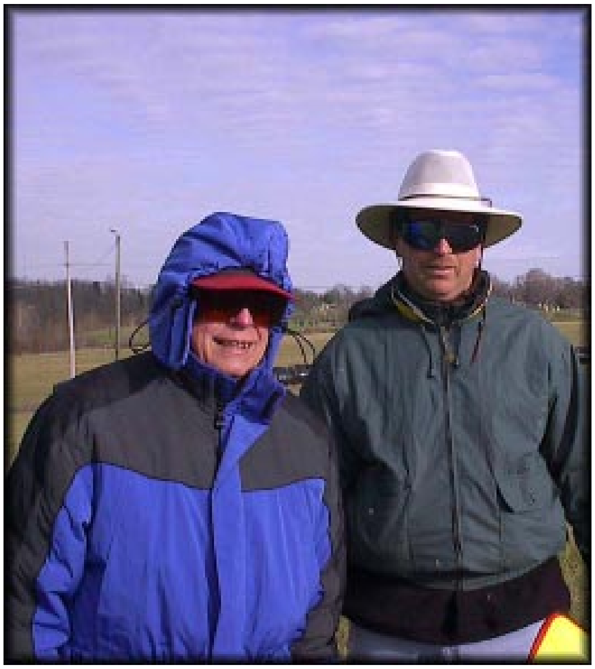
The REALLY Serious Low Drag Coefficient Combat Pilot

Skye Malcolm in fore-and-aft Viking Helmet.

My personal preference for slope flying is a Tilley hat for general use, the Red Green Deer Hunter cap for winter operations, and the Viking Helmet for combat. I really can't say enough about the Viking Helmet. You can buy one for a few bucks at any costume store. I once almost made Don Harris fly into a tree when I launched and then walked up next to him at the slope while wearing the Viking Helmet. And if you wear it while driving, you can cause people to drive right off the road next to you. You'd have to almost be Carmen Miranda to beat that reaction.



Tom Nagel in Tilley hat with Zagi.



Don Harris and Steve Staley - Don has his hat on UNDER his jacket hood.

I'd like to thank Moss slope flyers Steve Staley, Andy Litsky, Skye Malcolm, Paul Wiese and Don Harris for letting me take silly pictures of them. Viking Helmet available at Yankee Trader or your local costume store. Thanks to Dave Garwood for the Bert Olson's photo. Thanks to Greg Smith at slopeflyer.com for the use of the North American Doofus photo from his web site.

Hey! Don Harris found another way to keep his hat on!

If you have a good digital photo of sloper headgear that deserves to be added to this rogue's gallery, send it to HSWT, at tomnagel@iwaynet.net with information about getting a model release.

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HLG Incidence Angles

Mark Drela

Q: I am designing a HLG and want to know what you might suggest for wing incidence and tail incidence. My understanding is that you want a slightly positive angle of attack for the wing and a slightly negative AOA for the horizontal stabilizer, relative to a "level" reference line.

A: The relative angle (decalage) is the most important thing to get right. You also want zero elevator deflection in the climbout for low drag and low control linkage stress.

The wing's CL will be small over most of the climb, say CL = 0.05. For this CL, the unflapped MH32 airfoil is at $\alpha = -1.0$ degrees, and has CM = -0.055. The tail will have to exert a negative lift to balance this nose-down wing CM.

The required tail CLt is roughly

$$CLt = CM * (wing\_chord / tail\_arm) * (wing\_area / tail\_area).$$

Let's say CLt = -0.15 in your case. A typical tail with aspect_ratio = 4 will have a lift slope of about

$$\Delta(CLt)/\Delta(\alpha_{tail}) = 0.075 \text{ / degree,}$$

so the tail's incidence will have to be

$$\alpha_{tail} = -0.15 / 0.075 = -2.0 \text{ degrees.}$$

The wing is at -1.0 degrees, and the tail is at -2.0 degrees, so the wing incidence relative to the tail (the decalage) is about +1.0 degrees. Your design may have a different decalage depending on your particular CLt calculation above. Also, if you are using flaps on launch, the wing α and wing CM will be different, and a different decalage may be necessary.

Some tweaking may be necessary during testing, but this is a good starting point.

TECH TOPICS

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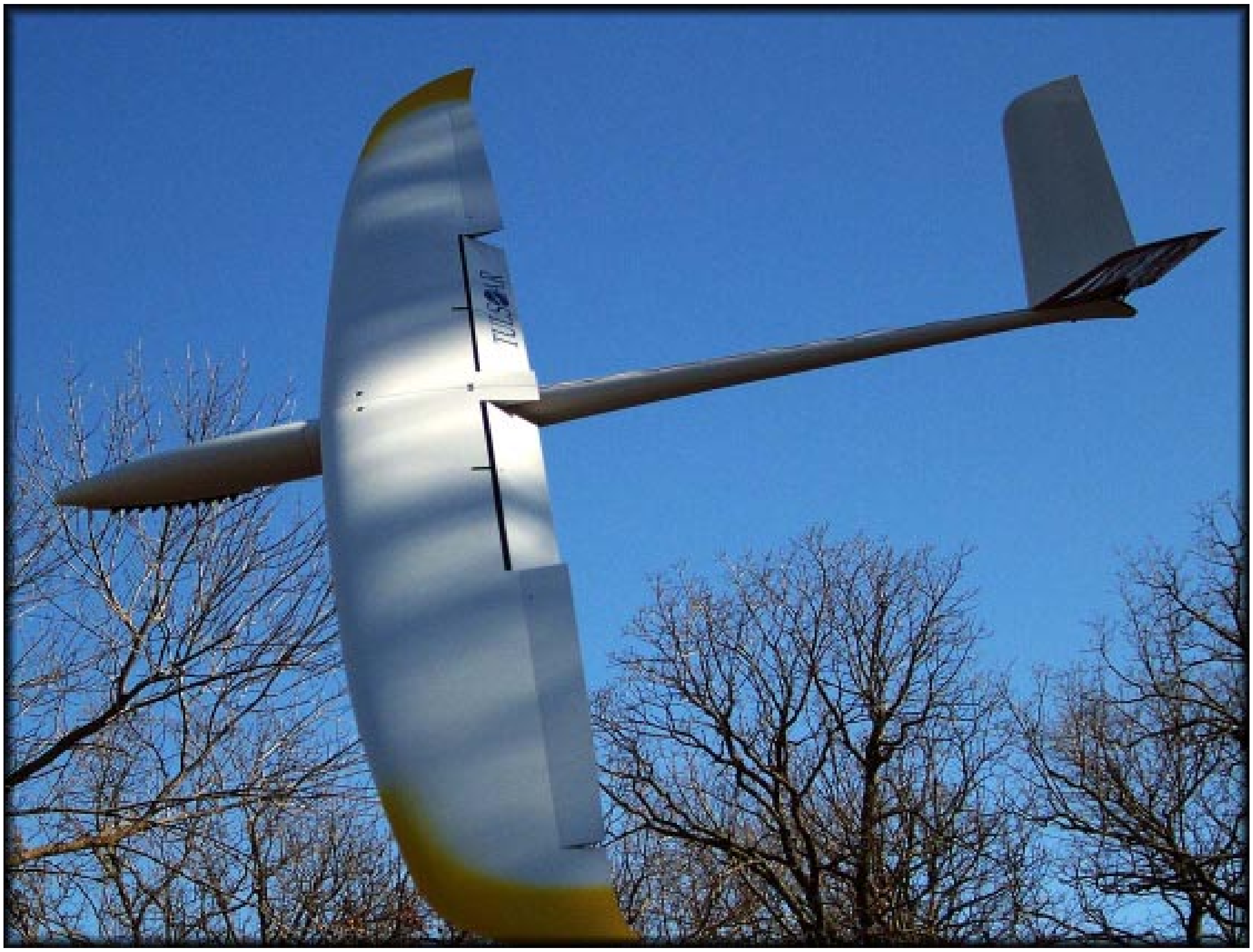
2 Meter Design: Mini Graphite Review



Previously, we discussed general planform, airfoil and weight considerations for a 2-meter design. A summary of that analysis includes:

> An aspect ratio in the range of 8 to 10 optimizes Max L/D and MinSink,
>
> An all up weight of ~ 44 oz should be a practical target with a wing loading in the range of 10 to 11 oz/sq.ft.,
>
> A higher lift airfoil such as the SA7038 may be preferred.

A number of assumptions were made regarding part density (for size scaling), equipment weight and volume coefficients. These assumptions provided input for our polar calculation that gave the above conclusions.

Before continuing down the path of further analysis, let's pause and look at a recent entry into the 2M-sailplane class to see how it compares with these estimates.

MINI-GRAPHITE

The Mini-Graphite is a new, molded 2M class sailplane (75 in. span in this case) available from Barry Kennedy (Kennedy Composites):
www:kennedycomposites.com

Barry is the importer for a series of very high quality planes by Vladimir's Models (Ukraine). You can read more about their construction methods and design concepts at:
http://www.airplane-model.com/glider.html

Vladimir's designs are rapidly gaining a reputation as planes with very solid flying capabilities and excellent construction and mold quality. At last year's TNT, Barry had prototype parts for the MG available. Randy McCleave and I were both hooked by the potential of this ship.

When my MG arrived in late December, the quality of the finished product exceeded any expectations I had dreamed up while waiting for it to get to my door. Overall, the molded parts are as good as anything I've seen. The basic construction uses generous amounts of carbon and Kevlar fabric. The gelcote is essentially flawless. The fit and finish on the wing is great. The hinges and wipes for the control surfaces are as good as it gets.

First impression? If this plane flies half as good as it looks, it's going to be a real keeper!

A general technical analysis of the MG is summarized in Table 1. The final weight comes in at 44.5 oz but could be a bit lower (~ 42 oz) using the optional 2-piece tail. More on that later.

With regard to the overall design, the deviations from our analysis last month are in the stabilizer volume coefficients, airfoil selection, wing dihedral angle and wing area distribution. Most of these are subtle and are matters of personal choice. The efficacy of this particular combination can only be assessed at the flying field.

Looking at the volume coefficients, the horizontal value ~ 0.40, is at the low end of the range I'd prefer. However, the MG uses a very nicely molded stabilizer airfoil. If the deadband and downwash blanking have been minimized, then this value should work fine. The vertical value is also at the low end of where I usually design but the slightly lower dihedral angle (~ 3.5 degrees) should allow good yaw response and turn coordination.

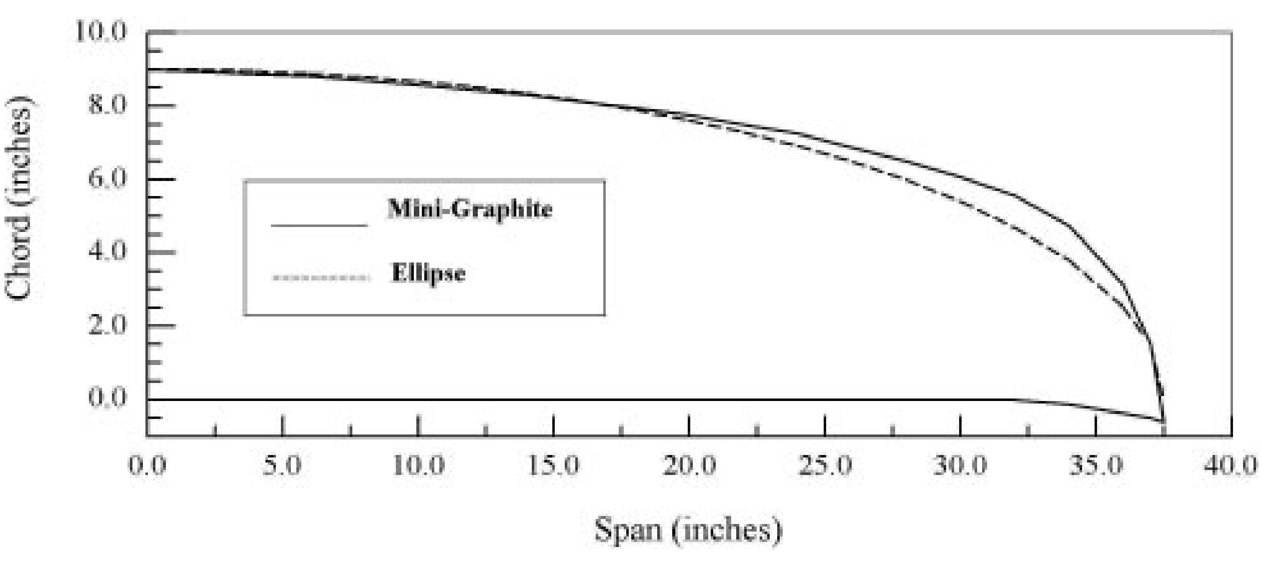
The Mini Graphite uses the MH32 airfoil. In many respects the MH32 is similar in performance to the SD7080 and the SA7035. I like both of these airfoils – they seem to take camber rather well – so the MH32 looks like a good choice. As compared to our 'optimized' design with the SA7038, we might expect the MG to require a bit more velocity at MinSink and Max L/D.

An issue encountered on another molded 2 meter I built recently was a 'wash-in' warp in the left wing. Launch and tip stall problems with this ship were pretty severe. So the MG got a VERY close look for wing alignment and warpage. After an hour or so of measuring everything in sight, the entire wing is as true as anything I've seen. There is NO detectable spanwise twist of any sort in this wing – excepting the slight upsweep at the tips.

A careful measurement of the wing profile indicates that the lift distribution is close to elliptical (Figure 1). The deviation from elliptical indicates more relative chord in the tips than the root. Since Re decreases with local chord, this is an appropriate correction. Given the good alignment of the wing, I would also expect this planform to initiate stalls at the wing root rather than the tip. This is by far the preferred design approach.

Using the numbers we've gathered, the estimated polar performance for the MG is shown in Figure 2. This is compared with

Figure 1: Mini-Graphite Wing Distribution



the 'optimized' 2-meter design from the last time. As can be seen, the results are very close. The primary offsets are due to the slightly higher wing loading of the MG and the use of the MH 32 airfoil.

However, this overall design is so close to where I was going with my design series that there may not be a need for construction work when we're finished with this series!

There's not much to say about building the Mini Graphite. I'll offer a few points that worked out for me. Hopefully the pictures tell the story.

The only real issue I encountered was a slight misalignment of the V-tail mounting screw. The fit of the one-piece tail into the V-slot is so perfect that any offset here will cause the parts to bind. The solution was to twist out the aluminum tube in the fuselage, egg out the holes in the fuse a little and then re-install the tube. With the V-tail screwed down correctly, the tube was re-glued with Goop (filled epoxy would work well also).

I would suggest changing out the socket head metric screws for mounting the wing. I used pan heads in the front holes (4mm X 25mm) and oval head in the rear (4mm x 20mm). The front holes accept a pan head and this helps spread out the load a bit. The rear holes are chamfered to accept an oval head. Using a socket for the rear mounts will introduce a stress concentration at the thinnest part of the wing.

Table 1 - Design Parameters

Plane	2M Design	Mini Graphite
Span	78.5	75
Aspect Ratio	10	10.3
Cavg	7.85	7.28
Area	616	546
TM*	28	27
VVc**	0.045	0.038
HVC***	0.5	0.4
Area (Per V-Stab)	63	44
Angle	112	110

* quarter chord wing to quarter chord stab
** vertical stab volume coefficient
*** horizontal stab volume coefficient

Also for the wing construction, Randy and I agreed that the flap linkage should come out the bottom of the wing (conventional US linkage). We've both had experience with Euro designs that run the flap linkage through the wing to the top surface. With a lower surface hinge, you can't get more than ~ 30 degrees of flap deflection. For slope soaring, that's fine. For the precision landings we use in US contests, 90 degrees of flap is a nice advantage.

One handy addition I'd also recommend is gluing in a sealed bulkhead in the nose ahead of the battery. With molded, tapered fuselages, there's always an inch or so ahead of the battery that you can't use. I glued in a 0.25 inch thick piece of balsa and then slathered it with Goop to seal it. Drill a hole in the top of the fuselage ahead of the bulkhead and pour in lead shot for balance. Put some tape over the hole when you're done.

My calculations suggest a conservative location for the CG is 5 inches (127mm) ahead of the TE of the wing at the root. The adjustable tow hook is also centered at the same point. Getting the ship to balance required 3 oz of lead shot in the nose.

Randy ordered the optional, built-up, two-piece V-tail. This is better for traveling and definitely lighter. My one-piece V-tail weighed 2.5 oz while Randy's two-piece was 1.7 oz. All else being equal, the two-piece tail may require ~ 1.5 oz of lead in the nose which would give an all up weight of ~ 42 oz.

Well, the proof is at the field. Time to stop talking and start flying. Preliminary settings for control throws and couplings were programmed into my trusty Futaba 9CH-FM. The 'short-start' was tossed in the truck and off we went.

Conditions at the field were interesting. About 28 degrees, wind out of the NW at 10 mph, a couple of inches of snow on the ground and ice providing a nice top dressing over all. But the skies were blue and no more precipitation was expected for another 12 hours.

Test glides indicated that the CG and general setup were just about right. First hi-start launch was amazingly predictable – straight and true with no tendency to stall in any direction. About all that was needed were 4 clicks of up trim to get it flying beautifully.

Over the next several flights, things just kept getting better and better. Although launches on my 'short-start' are relatively low altitude

(< 100 ft), the MG had no problem grabbing low level thermals and specking out. Each of the flights this day could have easily been 10 minutes or longer. The limiting factor was when I lost the feeling in my fingers!

Turns were initiated in both directions. I detected no difference in handling either way. A few shallow dives suggested that the CG could be pulled back a bit. 5 inches ahead of the TE at the root has proven to be a conservative place to start and you can work it back from there.

Camber seems to work very well for both slowing down and tightening up thermal turns. Although the lift was light and spotty this day, the MG had no problem finding it, centering in it, and cranking up on a wing tip and specking-out. Each flight ended with a pilot's decision to come down and warm up.

'Butterfly' or 'Crow' is extremely effective with the 90 degree flap setting. I wound up using about 60% down elevator coupling to get it to track properly. At that point, adding 'Crow' gives no nose-up pitch, just a significant increase in glide slope while maintaining reasonable speed. When 'Crow' is removed, the plane seems to fly right out of it with no hesitation – a nice feature if you've undershot your glide slope on approach.

With the somewhat lower than normal dihedral angle (3.5 degrees as compared with the usual 5 degrees) it may take a little time to really dial-in aileron differential and rudder coupling. I got pretty close before needing to warm up. Right now it looks like about 40% differential and 50% rudder coupling is working pretty well. I did find that a little opposite aileron is helpful after establishing a tight thermal turn.

Pitch control and tracking are excellent - so much for the concern about a slightly low volume coefficient. I saw absolutely no tendency for the MG to 'hunt' in pitch. The V-tail control surface throw is about +/- 0.25 in and that seems to be quite sufficient.

At about this point in the day a few thoughts finally penetrate the euphoria – say dumbie, you're about 2 months past a major heart attack, you're standing ankle deep in frozen snow, you can't feel your fingers any more, your toes are tingling pretty bad, and the wind is making your eyes tear up so much that you can hardly see that tiny little speck of a plane up there. Maybe you should think about going home now?

Although logic finally prevailed, it was a helluva lot of fun. Based on the experience so far, I'd say Barry and Vladimir have a winner here. Also, based on the analysis so far, do the numbers validate the design or does the design validate the numbers?

Hard to say. But I find it curiously coincident that a ship that flies this well is so very consistent with an analysis that says this is right about where the 'sweet spot' for a 2M design should be. At the very least, it's worth pushing on with this analysis a bit longer.

See you next month – assuming my fingers start working again soon!

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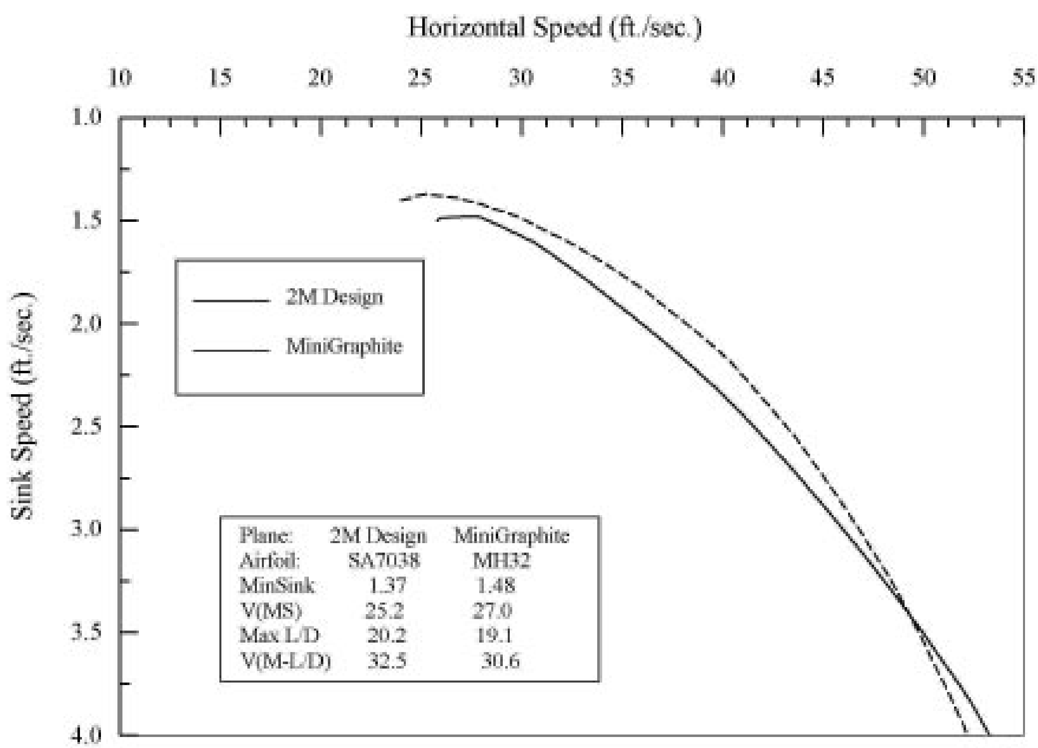

Figure 2: Polar Analysis Comparison, MiniGraphite Vs. 2M Design

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Hooked Up My Camber and Headed... UP!

EVERYONE uses launch camber on their full house sailplanes for launch. However, some folks may not be sure why or how much to use. Or, perhaps some folks don't know that too much is just as bad as too little! So on this trip, I slow down to let everyone get a clear understanding that every part of soaring is about using the available energy to get the best flights possible.

The reason for camber during launch

The ONLY reason to camber a wing during launch is to have enough wing lift to literally lift the winch line. But there is a cost to camber: winch battery, which should be used to THROW the sailplane as fast as possible in order to get as high as possible.

The simplest components

Let's say the wing can 'lift' 10 lb. un-cambered, clean as can be. But the winch line weighs 15 lb. While you might get a shotgun shot release at the end from airspeed, the line, say 400' long from the hook to the turnaround at the top of the launch, is bowed and bent from the wind and its weight. So, at release, the plane is only 300' high. If a ping release gives you another 100', you are at a total of 400'.

Let's say, for example, you don't have any drag from camber. The release airspeed is at optimum 100 mph.

If you were to camber the wing so that the wing can lift 15 lb. then, at the apex of the launch, the release height would be 400'. Good stuff.

Keep in mind, the extra lift is not free. Every motion uses energy and the only place we get energy from during a launch is from what is stored in the winch battery.

So, with 3/8" wing camber, the wing could lift 15 lb.; the camber costs you speed. Now while you have more altitude, the release speed is only 95 mph, so your 'ping' altitude is also reduced some.

(Don't get wrapped up in numbers cuz that ain't me... This is only to get you all thinking about energy, cost and result, in the context of set up and why.)

Okay, so IF 3/8" full wing camber gets that line lifted, but costs some in release speed, what if you have 1/2" full wing camber? Will the apex altitude before release be higher than the line length available? Not too likely, since we can't get 5 lb. of stuff from a 4 lb. bucket.

No, you can't be any higher than your line length (from the turnaround to the tow hook), but what about the airspeed at release? Will it be faster or slower with more than the right amount of camber? Will it allow you to throw the plane higher than before with only 3/8" full wing camber? The answers are, of course, slower and lower.

So to sum things up, camber on launch is to let a wing that can lift a 10 lb. winch line, lift a 15 lb. winch line. And if you have enough camber to lift a 20 lb. winch line you are wasting winch energy that you could have used to throw your plane off the line a little faster and higher.

Tow Hook Placement

So where is the 'right' spot for the tow hook?

Let's look at where the energy from the winch is going; which direction compared to where the tow hook is placed on the sailplane. If the tow hook were at the balance point, then the force of the winch line would be pulling the tow hook (and bottom of the fuselage!) directly toward the turnaround. That puts the sailplane moving belly forward about 3' off the ground, for awhile.

The idea is to again use the winch battery energy as efficiently as possible to 'throw' the sailplane as high as possible from the point of release - that is at the apex of the launch radius (vertical over the turnaround). If the tow hook is back at the balance point of the sailplane (assuming you have balanced the sailplane and not measured some CG mark), the sailplane's bottom will be plowing ahead and up, eating up any airspeed you might have used to throw your plane off the line.

Imagine discus launching a DHLG while holding the bottom of the plane forward, instead of the nose. We're not likely to get much of a launch altitude.

So the goal is to use the airfoil and wing to take up the line, and that only happens with airspeed. That's why you set the tow hook by launching with no camber. And it's best done with downwind launches. If the tow hook is set just right, then instead of plowing toward the turnaround for a lousy launch on a downwind wind change, the model can be catapulted up for a good launch.

Set the tow hook where you normally do, then launch down wind. If the model flounders belly forward, move the hook

Bruce Davidson (Past Nats DHLG Champ) and Gordy, wearing USA F3J Team Fund Raiser Shirts, holding the amazing WindRider.com.hk EPP DS Bats. Their club bought about15 of them as a Dynamic Soaring Foamie Club Project - fully molded EPP kit that comes complete! Photo taken by Ken Marks, official photographer for the Louisville Area Soaring Society.

forward 'til the nose shoots forward on a launch; somewhere between the first case and the fast no altitude launch is the sweet spot for the tow hook.

Once you find that spot, then put in about 3/8" full span camber and launch. Don't look so much at the model, rather listen to the winch motor. If you are not making the winch 'work' you are not using its power and the sailplane's lifting power to get all you can from the stored energy in the winch battery. IF you are lugging the winch and the plane is sluggishly fighting the launch, you have too much camber.

The sailplane needs to be traveling forward for air to empower the airfoil and the wing. In order to get it to move forward, you have to 'pull' it forward, NOT DOWN. A too far forward towhook pulls the nose down, and one that's too far back pulls the back of the plane down; one that's in the middle pulls the middle of the sailplane DOWN.

The goal is to pull the sailplane as fast forward and up as is possible, then add in some camber to straighten the line dragging in the wind.

Wind is launch energy, too! But it changes. Let's say you have no wind. Camber will likely be increased in order to lift the line up. Line speed/toss speed will be burned up in the effort to pull the line up to apex, keeping it as straight as possible and resulting in very little toss energy left. Dramatically, all of the above is so that, in a down wind launch, you have sort of negative launch energy.

In a strong wind, a lot less camber is needed to lift the wing and less line speed/toss speed is burned up getting to apex. That means you don't have to use winch battery energy, you get a boost from the wind energy.

Yep, it's not only okay to change the amount of launch camber, it makes great sense! No camber is good camber in a down wind condition, however cambering a little immediately after the 'toss' is a good idea, because you have energy that can be used for lift; but just a tiny amount is the right amount - vertical airspeed is the ideal goal.

Recap!

Camber is for helping the wing lift the winch line straight.
Too much camber wastes launch energy trying to lift more weight than the line weighs, reducing 'toss' power on release.
Tow hooks in the 'dead-on the neutral balance' point of a 'balanced' sailplane pull the belly down.
Tow hooks located forward pull the nose down.
Tow hooks located behind the balance point pull the back of the sailplane down.
The optimum spot for the tow hook pulls the plane forward so that the wing/airfoil can do its job taking the winch line to apex with the least amount of drag on launch speed.
Set the tow hook first without camber.
Add camber to hear the winch motor working.
Reduce camber if the winch is lugging, killing launch speed.
Reduce camber for good into the wind conditions.
Use no camber for downwind launches.

EXPERIMENT!!! It's fun! BUT don't change tow hook location AND camber at the same time. Set the tow hook first. Your launch should be steep but FAST. Then add camber. Your launch should make the winch sound like it's working. Then you will have all the height of the length of the winch line, and a "TOSS" at the end that lets your model pierce the sky.

Don't go for impressive release rotations, rather go for optimum launches. Impressive rotations at release puts you at the height of the turnaround during downwind launches.

This is a 'trip' worth taking yourself! I appreciate thoughts on all my soaring revelations but mostly let me know if you learned something!

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Low-Speed Stability

Gregory Ciurpita
March 9, 2004

An aircraft can be stable at higher speeds but unstable at low speeds. While a more rearward center of gravity (CG) may cause instability, it not only reduces the lift force and induced drag produced by the tail, but makes airspeed more sensitive to elevator trim setting. Adding ballast may make an aircraft more unstable, but a ballasted aircraft is normally flown faster. First a review of an airfoil's moment coefficient (Cm). Then, an analysis of an aircraft's pitching moments over a range of CG positions.

Airfoil Moment

Figure-1 shows a typical airfoil measurement from the UIUC database. It shows curves for the lift (Cl) and moment (Cm) coefficients for various angles of attack (AOA). The lift coefficient (Cl) varies significantly, steadily increasing until stall occurs. It is common for an airfoil moment coefficient (Cm) to be constant and negative.

The actual lift (*L*) and moment (*M*) are determined from the following well known equations, where *Q* is the *dynamic pressure*, *rho* (0.002378 slugs/ft^3) is air density, V is airspeed (ft/sec), *S* is the wing area (ft^2), and *C* the chord length (ft):

$$Q = 0.5\ rho\ V^2$$
$$L = Q * S * Cl$$
$$M = Q * S * Cm * C$$

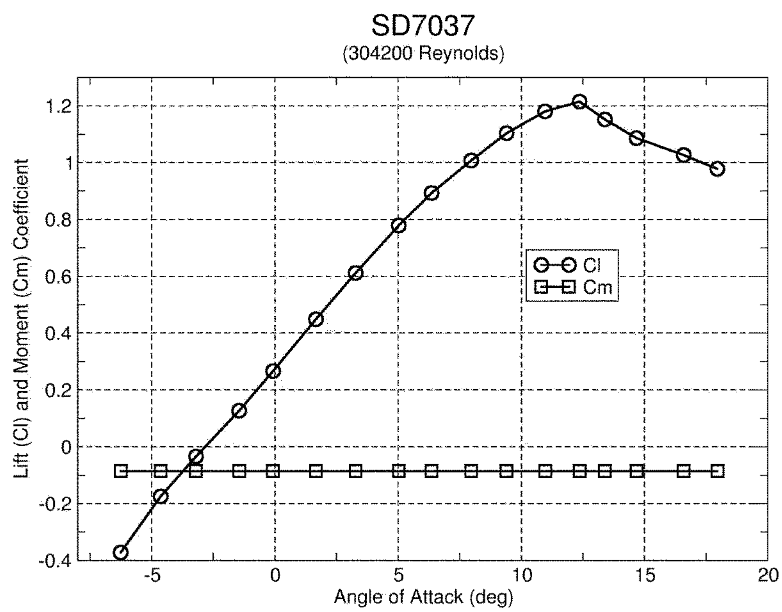

Figure 1

The resultant of the lift force (L) is generated through the *aerodynamic center* (AC) of the airfoil, typically 25% of the chord. The moment (M) is a rotational force measured in foot-pounds or newton-meters. A wrench applies a moment on a bolt; a motor generates a moment around a shaft. A negative coefficient indicates a nose-down direction, forcing the leading edge of the wing down and the trailing edge up.

The relationship between pitching moment and the *total* lift of an airfoil can be confusing. As figure-1 indicates, the Cl and Cm coefficients are independent. Consider a *typical* wing in a wind tunnel at a constant airspeed. As the angle of attack is increased, the lift will increase as predicted by the equations. However, the moment will remain constant, even when the lift is zero. Also consider that the moment does not change direction when the lift coefficient becomes negative.

Aircraft Moments

Four forces affect the overall pitch of the aircraft: the airfoil pitching moment (Cm), the lift produced by the wing, the lift force produced by the horizontal stabilizer, and drag. Lift only affects pitch when the CG is not located at the AC of the wing. Likewise, drag produces a moment when its center is either above or below the CG. The moment produced by drag will be ignored in this article.

The horizontal stabilizer and wing lift forces produce moments determined by multiplying each with their respective *moment arms*. Their moment arms are the distance between the aircraft CG and AC of the tail and wing respectively. The sum of all three moments must balance (equal zero) for the aircraft to maintain its pitch. Otherwise, it will constantly rotate upward or downward.

Balanced pitch does not mean that the pitch angle will remain unchanged. For stability, there must be some mechanism to maintain the pitch orientation of the aircraft. This orientation may be affected by tubulence or a change in airspeed. A conventional approach to maintain stability is to have the horizontal stabilizer generate negative lift (a downward force). As the airspeed increases, the tail lift increases pushing the tail down and slowing the aircraft.

Figure-2 plots the three moment forces vs airspeed for a CG located at 30% of the chord length (10"). The lift and its moment are constant since it must balance the weight (38 oz) of the aircraft. The lift moment produces a nose up force, and is therefore positive.

The airfoil moment (M) is dependent on airspeed, wing area (900 sq.in.) and chord length. Cm is negative as well as its moment (M). It produces a nose down force. As the airspeed increases it produces a greater negative moment.

The tail moment must balance (equal but opposite) the sum of the lift and airfoil moments. In this example, the horizontal stabilizer always produces a nose up force. Even though the horizontal stabilizer produces a negative (downward) lift force, the moment is positive (nose up).

The aircraft becomes unstable in pitch if the tail is required to produce positive (upward) lift in order to balance the sum of the airfoil and lift moments. This would be indicated by a negative (nose down) tail moment, and is most likely to occur at low airspeeds.

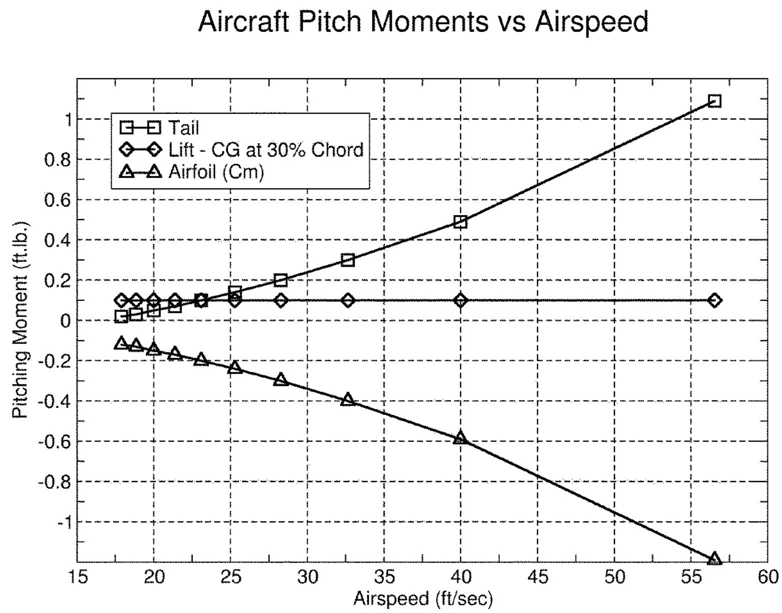

Figure 2

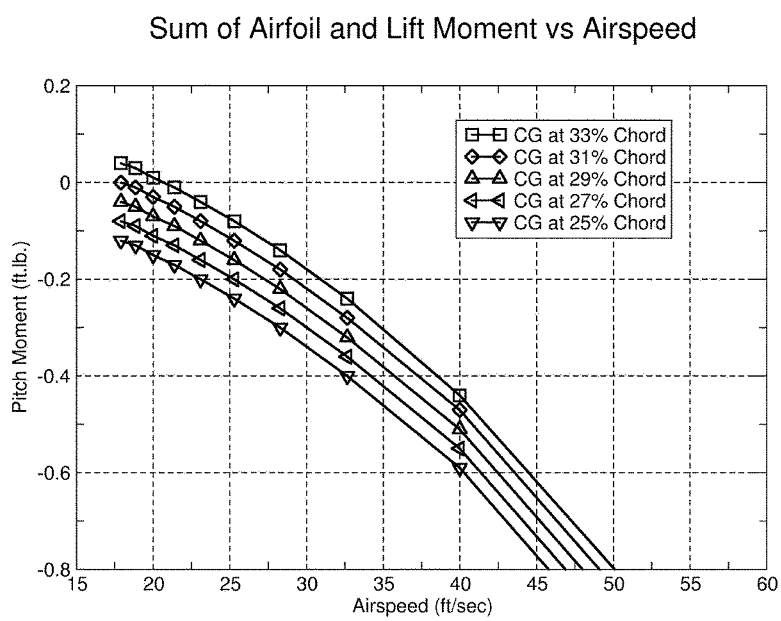

Figure 3

Low-Speed Instability

Figure-3 plots the sum of the airfoil and lift moments versus airspeed, for CG ranging from 25 to 33% of the chord. For all cases, the airfoil moment contribution is the same as in figure-2. As the CG is moved more rearward the lift moment arm and its moment increase.

The lowermost curve is for the case where the CG is at the AC of the wing and the lift moment arm is zero. Therefore, the lift moment is zero, and this curve is purely the airfoil moment. The uppermost curve is for the case where the CG is at its most rearward position. At each CG position, the lift moment is constant with airspeed, and simply shifts the airfoil moment curve upward the same amount at all airspeeds.

As the CG is moved rearward, it is more likely to cause an unstable situation at low speeds. As the 33% case shows, a negative tail moment is required below an airspeed of 20 feet per sec. A negative tail moment requires a positive (upward) tail lift, which no longer provides a pitch correcting mechanism.

Airspeed Sensitivity

Figure-4 shows the corresponding tail lift coefficients for the cases shown in figure-3. The lift coefficient is calculated from the required tail moment. The plot for the 33% case clearly shows that the lift coefficient becomes positive at low airspeeds, producing an unstable, non-correcting situation.

When the CG is at the AC and the lift moment is zero, the horizontal stabilizer and wing pitching moment must balance one another (the lowermost curve). Both are equally affected by airspeed. There is only one trim setting where they both balance one another, and will do so at all airspeeds.

For all other curves in figure-4, when the lift moment is not zero, the aircraft will be balanced at only one airspeed depending on the tail lift coefficient. The lift coefficient depends on the elevator trim setting.

The figure also shows that as the CG is moved rearward there is a greater change in lift coefficient per a change in airspeed. This means that for a more rearward CG, there will be a greater corrective force for a smaller change in airspeed. In other words, stable airspeed will be more sensitive to elevator trim setting.

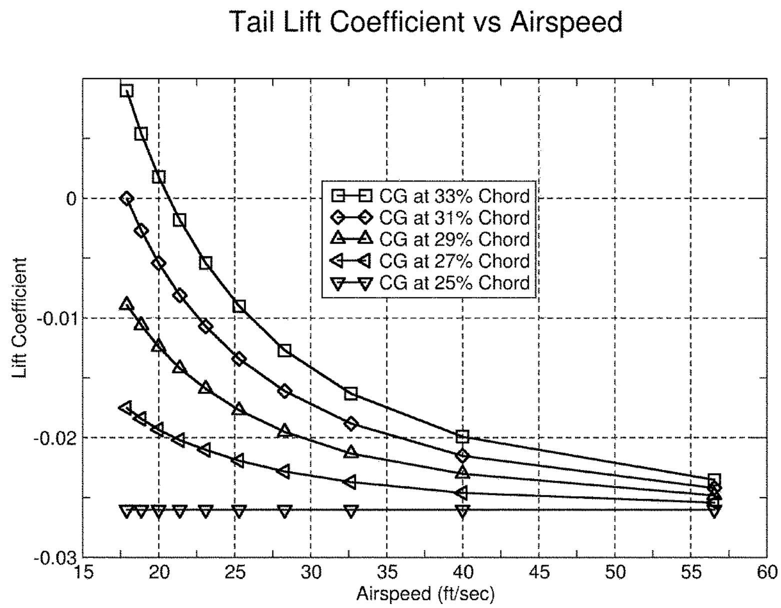

Figure 4

Summary

1. The pitching moments of an aircraft can be balanced with a horizontal stabilizer that provides positive lift, but negative (downward) lift, producing a positive moment, is required to provide pitch stability.
2. Because the lift moment is constant but the airfoil and horizontal stabilizer moments are airspeed dependent, a negative tail moment may be required at low airspeeds. This is more likely to happen as the CG is moved more rearward. The aircraft can therefore be unstable at low airspeeds, but stable at higher speeds.
3. A more rearward CG results in a corrective force more airspeed dependent, making the stable airspeed more sensitive to elevator trim setting.

Adding ballast is more likely to cause low-speed instability, but a ballasted aircraft is flown faster. In flight camber adjustments will also affect balance and stability.

This article came about after studying tail lift forces and CG position. The analysis helps me understand why a seemingly stable aircraft can behave poorly at low airspeeds. Unlike other technical articles dealing with aircraft design, CG position is something every pilot must consider. I hope others will contribute articles on this and other technical subject. My sincere thanks to Dave Register for his review and discussion of this article.

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International Hand Launch Glider Festival 2004

The Torrey Pines Gulls and ***Airtronics***, the host sponsor, invite you to participate in the 11th annual International Hand Launch Glider Festival (IHLGF) on June 5-6, at the TPG Poway Flight Center, located in Poway (San Diego), California.

This should be another very exciting IHLGF further contributing to its short but dynamic history. The caliber of pilots seems to get better every year witnessed by the fact that perennial champ Joe Wurts was outscored last year by an "Easterner", Oleg Golovidov. We fully expect this year will be another heated battle between the East, the West and the International pilots. We invite you to join in the fun of this great event.

The continuing goal of the IHLGF Committee is to further enhance the world-class reputation of the IHLGF. We believe that we have come up with a set of tasks and rules that will make the IHLGF 2004 a fun and challenging event. Enclosed you will find the IHLGF 2004 tasks and rules. Please review them, practice them and feel free to use them in contests you may be sponsoring. *(Tasks and rules may be obtained from the web site. Ed.)*

While there have been a few changes, a number of things remain the same. There will be three classes of pilots this year: Open, Junior (15 and under) and Eagle (55 and better). Each class will have their own set of awards. Open class will have awards through 10th place and the Junior and Eagle classes will have plaques through 3rd place. Only Open Class pilots will be eligible for the Championship Fly-Off. There will be no separation of the Junior and Eagle classes from the Open classes. In short, all pilots will have the opportunity to compete against each other during the ten rounds of open competition. As such, each pilot must launch his/her own plane. If you qualify (age) and wish to fly in a class other than Open, you must register as such on the entry form.

Once again we will have a "throw-out" round. Your best nine out of ten rounds will be used to calculate your score. The top ten Open Class pilots will be in the Championship Fly-Off and will carry their adjusted scores into the Fly-Off.

One of the things that make the IHLGF so special is the social aspect. We begin Friday evening with a "Post Practice Social" which will be held at the Hamburger Factory. Saturday evening we have an old fashioned "all you can eat" Pizza Party planned at Round Table Pizza in Poway.

The field will be available beginning Thursday, June 3, for practice. Toilet facilities will be available beginning Thursday. RV parking is allowed at field; however, there are no hook ups.

For complete information on the IHLGF, local hotels, car rentals, maps, and a wealth of other information, please visit the TPG web site at **www.torreypinesgulls.org**. If you have any questions please give me a call at (858) 668-2804 ext. 122 or e-mail me at Scharck@kw.com

Ron Scharck
IHLGF 2004 Registrar

Please do not mail your completed entry form and check before April 1.

The Torrey Pines Gulls

in cooperation with

AIRTRONICS

invite you to attend the

International Hand Launch Glider Festival 2004

June 5 and 6

TPG Poway Flight Center - West Garden Road, Poway, California

(15 miles north-northeast of San Diego)

Ten Rounds of Competition — Three Fly-Off Rounds for Open Championship

Awards through 10th place — Open Class; 3rd place — Eagle & Junior Class

Pilot Check-in: 7:00 a.m. Pilots Meeting: 8:30 a.m. First Round - 9:00 a.m.

Entry Fee: $50 (Includes lunch on Saturday and Sunday). ***No Entry Fee Refunds***

Pizza Party Saturday evening at Round Table Pizza — Poway $10 per person

Lodging: LaQuinta 858-484-88OO / Ramada 858-748-7311 / Country Inn 858-748-6320

RV Parking at field - no hook ups

CD: Don Richmond - (619) 988-1710 or e-mail - highlaunch@aol.com

Entry limited to 90 Pilots - Entries must be postmarked no earlier than APRIL 1

Please complete the following information, together with your ***check made payable to TPG****, and return to*

Entries must be postmarked APRIL 1 or later

Name: ____________________
Address: ____________________
City: ____________________ State: _______ Zip: _________
Phone: (_____)____________________ *AMA #:*____________________
E-mail : ____________________

Class: Junior (_) Senior (_) Eagle (_) Age: ____
Frequency: 1st _____ *2nd* _____ *3rd* _____
*Tee-Shirts: M*____ *L*____ *XL*____ *XXL*____
Polo Shirts: M____ L____ XL_____XXL_____

Ron Scharck
13520 Evening Cr. Dr. N
Suite 160
San Diego, CA 92128
(858) 668-2804 Ext. 122

Entry Fee	*$50.00*
T-Shirts ($15 x ____)	_______
Polo Shirts ($30 x ____)	_______
Pizza Party ($10 x ____)	_______
Total Enclosed	$______

Golden State X.C. Race

May 1 & 2, 2004
California Valley, CA

SPECIAL ANNOUNCEMENT

With the cooperation of C.V. Lodge owner Ken Tab, we have moved the start finish line and launch area next to the C.V. Lodge. This will allow pilots to setup and launch within walking distance to the lodge and restaurant. In addition, the course has been expanded to a 50K or 31 mile course and most of the course is on pavement. The course still offers an unobstructed flight path as far as trees and other vehicle traffic. The new course has all the features which can develop the world famous lift that Cal.Val. is known for.

We are excited to announce that the South Bay Soaring Society is sponsoring the Golden State X.C. Race, May 1st & 2nd 2004. This race is the ultimate challenge in cross country soaring. It is 3 days of fun and competition for all levels of X.C. Soaring. April 30, Friday, will be a course practice day. We will also offer LSF levels 3,4,&5 task goal and return markers set on course. Level 2 witnesses will be available to sign off your completed tasks.

California Valley is located at the northern tip of the Carrizo Plain Natural Area Preserve. The preserve is predominately shrub and grassland which provides an arid basin allowing wide open spaces for the best thermal activity. It is bordered by the Tremblor Mountains to the east and the Caliente Mountains to the west. The central feature is Soda lake. One of the largest undisturbed alkali wetlands in the state. In May, the lake may have evaporated leaving behind a glistening expanse of white salts which illuminates your sailplane as it is crossing.

The South Bay Soaring Society would like to welcome any and all pilots to participate in this fun and challenging event. If you have any questions or want additional information, Please feel free to call me: (408) 683-4140 or Gervais@garlic.com

Thank You for your interest and hope to see you there.

C. D. Mike Gervais