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

June, 2003
Vol. 20, No. 6
U.S.A. $3.50

R/C Radio controlled SOARING DIGEST

THE JOURNAL FOR R/C SOARING ENTHUSIASTS

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.

RCSD should not be considered to endorse any advertised products or messages pertaining hereto. An advertising rate card is available for businesses, and clubs.

R/C Soaring Digest
556 Funston Drive
Santa Rosa, CA 95407
phone: (707) 578-7871
e-mail: rcsdigest@aol.com
http://www.b2streamlines.com/RCSD.html

TABLE OF CONTENTS

Don't forget to check out the *RCSD* web pages each month. Cover photographs are always available for viewing, and usually available for downloading, as well. Special article .pdf files are frequently available for a limited time, and of course our web masters update the highlights and status information of each issue as it becomes available.

Advertiser Index

RCSD ON THE WEB

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

Monthly Feature Photography & Web Version of the Printed Article (where appropriate)
Highlights & Mailing Status of the Current Issue
About RCSD
.... **Subscription Information**
.... **Advertising Rate Card** (Adobe Acrobat PDF format)
.... **RCSD Feature Columnists, Reporters, and Editors**
.... (E-mail/web addresses, plus general information about their areas of interest)
"Getting Started in RC Soaring" .... Getting started guide - Adobe Acrobat PDF format
Links to Organizations, Special Interest Groups & Clubs
On-Line Articles - Great articles originally written for the printed version of *RCSD*.
.... "Trimming Your Sailplane for Optimum Performance" by Brian Agnew
.... "Flys Faster" by Dr. Michael Selig
.... "The Square-Cube Law and Scaling for RC Sailplanes" by Dr. Michael Selig
.... "Modifying & Building the MB Raven (Parts 1-4)" by Bill & Bunny Kuhlman
.... "Butterfly and Moth Airbrushing Tutorial" by Joedy Drulia
Bookshelf Listings - A listing of recently published books of interest to aeromodelers.
Complete RCSD Index, 1984-2002

The Soaring Site

RCSD Web Pages Downloadable Files

How does one get the word out quickly for upcoming events? And, of course, since *RCSD* is printed in B&W, how does one share the full impact in beautiful color of past events? Or, if a special article needs to be showcased, so one can see the detail better, how should we go about doing that?

Well, most of you know the answer to that, as many of you visit the *RCSD* web pages frequently. But for those of you that don't, this is just a simple reminder.

The status & highlights of each issue are posted monthly. Most cover photography is usually available for downloading as poster size pdf files.

Last month, there were 2 poster size photos available, one for the front cover and one for the back. Additionally, the article associated with the cover (Blackbird XC.3 by Bill & Bunny Kuhlman) was available as a pdf file, and the article for Oc-Tow-Berfest 2002 (by Mark Nankivil) associated with the back cover was also available in pdf format.

This month, there will be front and back cover poster size photographs, as well, covering the MWSC 2003. The event coverage, written by Loren Blinde is available for downloading as a pdf file, and will replace the MWSC 2002 coverage pdf.

In regards to events, we recently made available detailed documents covering the Sailplane Builders 2003 Eastern Workshop and the JR Aero Tow events. Since the events have already been held, they have, of course, been removed. Should any of you have an upcoming event that you'd like to make available, don't hesitate to let us know!

Yes, we take a great many 'hits' every month. So, we try to make sure that all the links are working properly. Should any of you note that a link is not working properly, please, please, let us know!

Our web masters have also reformatted the web pages to make it easier to navigate. Our thanks to them for all their hard work and dedication to the hobby!

Happy Flying!
Judy Slates

SCHEDULE OF SPECIAL EVENTS

July 19-26, 2003
AMA/LSF NATS — Muncie, IN

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

November 29-30, 2003
Tangerine Soaring Championships — Orlando, FL
www.orlandobuzzards.org

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

Midwest Slope Challenge

Larry Blevins' and Duane Jenkins' Magnum Models ODR Cobras over Wilson Lake. These planes are made of EPP foam.

Photo by *RCSD* columnist Greg Smith.

Back Cover

Midwest Slope Challenge

Mike Bailey's new large scale EPP-foam MDM Fox. Mike will be making kits for these planes.

Photo by Dave Garwood.

on the Wing

B2

P.O. Box 975
Olalla, Washington
98359-0975
bsquared@appleisp.net
http://www.b2streamlines.com

Twist Distributions for Swept Wings, Part 4

This installment will be devoted to just two items: the interrelationship of lift distribution, aileron configuration, and adverse and proverse yaw, and how the bell-shaped lift distribution can be utilized to reduce induced drag.

Defining lift distributions

Before describing research results related to lift distributions, another look at the elliptical lift distribution is in order.

In Part 1, the elliptical lift distribution was defined by means of a geometric construction. Figure 1 illustrates this methodology. Simply stated, vertical lines are dropped from a semicircle to the baseline. The center of these verticals are then determined and a curve drawn which connects the determined points. The curve thus defined is an ellipse. This shape is then used as a basis for the lift distribution across the span. The result of such a lift distribution is a constant downwash across the entire span and a minimization of induced drag.

As an extension of the description in Part 1, there is another method of defining the elliptical lift distribution which involves trigonometric functions. In this construction, the point P is defined by its X and Y coordinates as determined by the following formulae:

$$YP = b/2 * \cos \xi$$
$$XP = K * \sin \xi$$

For the construction of the semicircle, K = b/2, the semi-span. For the construction of an ellipse, K can be any value less than one. In the illustrated case, Figure 2, K = 1/2 in keeping with the geometric construction explained previously.

Table 1: Sin^n values for the construction of lift distributions

ξ	90°	78.75°	67.5°	56.25°	45°	33.75°	22.5°	11.25°
$\sin \xi$	1.0000	0.9808	0.9239	0.8315	0.7071	0.5556	0.3827	0.1951
$\sin^2 \xi$	1.0000	0.9619	0.8536	0.6913	0.5000	0.3087	0.1465	0.0381
$\sin^{2.5} \xi$	1.0000	0.9526	0.8204	0.6304	0.4204	0.2301	0.0906	0.0168
$\sin^3 \xi$	1.0000	0.9435	0.7886	0.5748	0.3536	0.1715	0.0560	0.0074
$\sin^4 \xi$	1.0000	0.9253	0.7285	0.4780	0.2500	0.0953	0.0214	0.0014

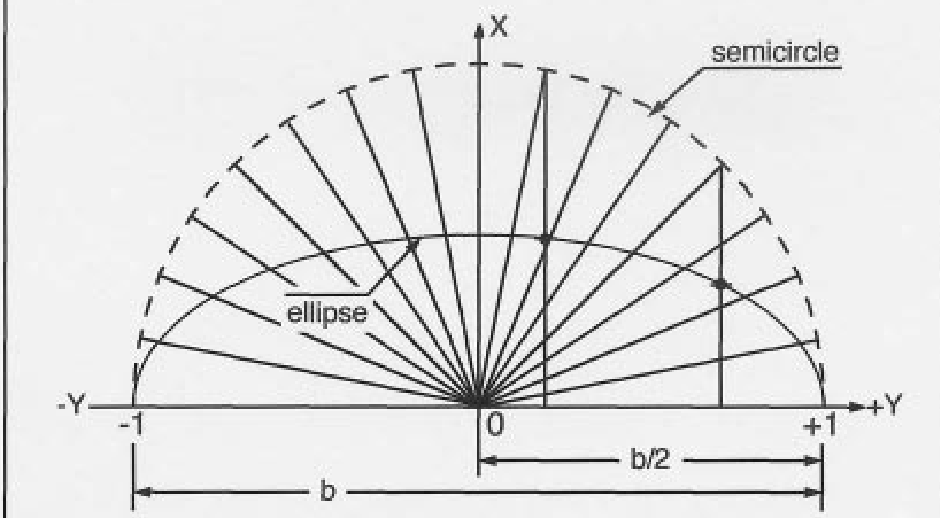


Figure 1. Geometric construction of elliptical lift distribution

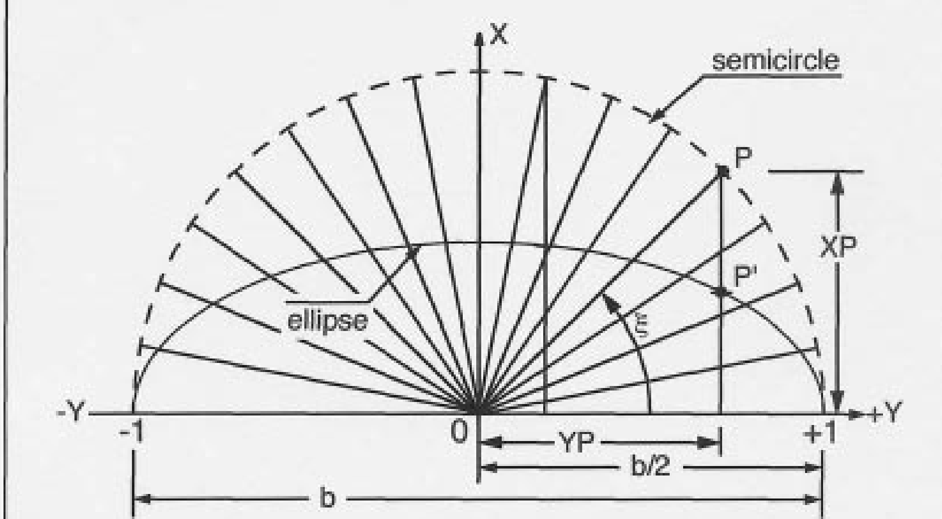


Figure 2. Trigonometric construction of elliptical lift distribution

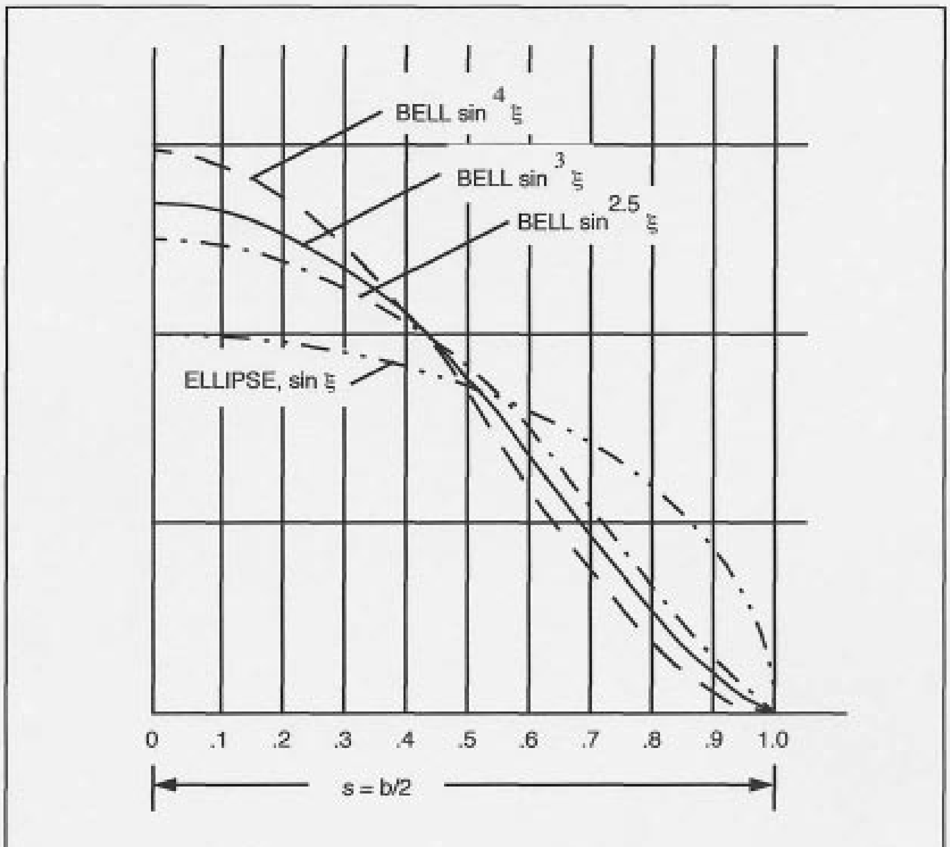


Figure 3. Lift distributions for $\sin^n$ functions.

It should be noted at this point that each point P' defines the lift generated by that wing section, the coefficient of lift times the local chord. One way of visualizing this is to consider an elliptical lift distribution and an elliptical wing operating at a coefficient of lift of one. Remember, the lift coefficient is constant across the span; that is, the local coefficient of lift for each wing segment will be one. In this case, the wing chord is directly proportional to the height of the lift distribution curve at that point along the Y-axis.

Taking this trigonometric methodology one step further, we can modify the trigonometric function by adding an exponent n. For example, rather than using sin ξ, we use $\sin^n \xi$. See the included Table for an idea as to how various exponents affect the resulting points P'.

Figure 3 shows the elliptical lift distribution, sin ξ, and three other distributions, $\sin^{2.5} \xi$, $\sin^3 \xi$, and $\sin^4 \xi$. Because the aircraft weight is held constant, the area under each curve is identical. The latter lift distributions which utilize the 'n' exponent are termed bell-shaped for obvious reasons.

When the bell-shaped distribution is applied to moderately swept back wings, the following generalizations apply: When the exponent n is two, the lift distribution is bell-shaped but there is no induced thrust at the wing tips. When n = 2.5, the adverse yaw disappears and proverse yaw begins to appear. As n approaches three, the induced drag begins to increase rapidly. The designer should therefore use the lowest value of n in keeping with his/her objectives. The Hortens used n = 3 for most of their designs, but n = 2.5 may be sufficient for use on models where both adverse and proverse yaw are undesirable and induced drag should be as low as possible.

Yaw moment, lift distribution, and aileron configuration

Dr. Edward Udens analyzed the yawing moment of two swept wing planforms with differing lift distributions and control surface configurations. Figure 4 shows the various configurations, notes their lift distributions, and presents the yaw moment for each. The elliptical and $\sin^3 \xi$ bell-shaped lift distributions were evaluated. Negative yaw moment values indicate adverse yaw, positive yaw moment values indicate proverse yaw.

Both of the wings with elliptical lift distributions demonstrate adverse yaw regardless of control surface placement. Proverse yaw can be generated by using the bell-shaped lift distribution and by keeping the elevon control surface well outboard.

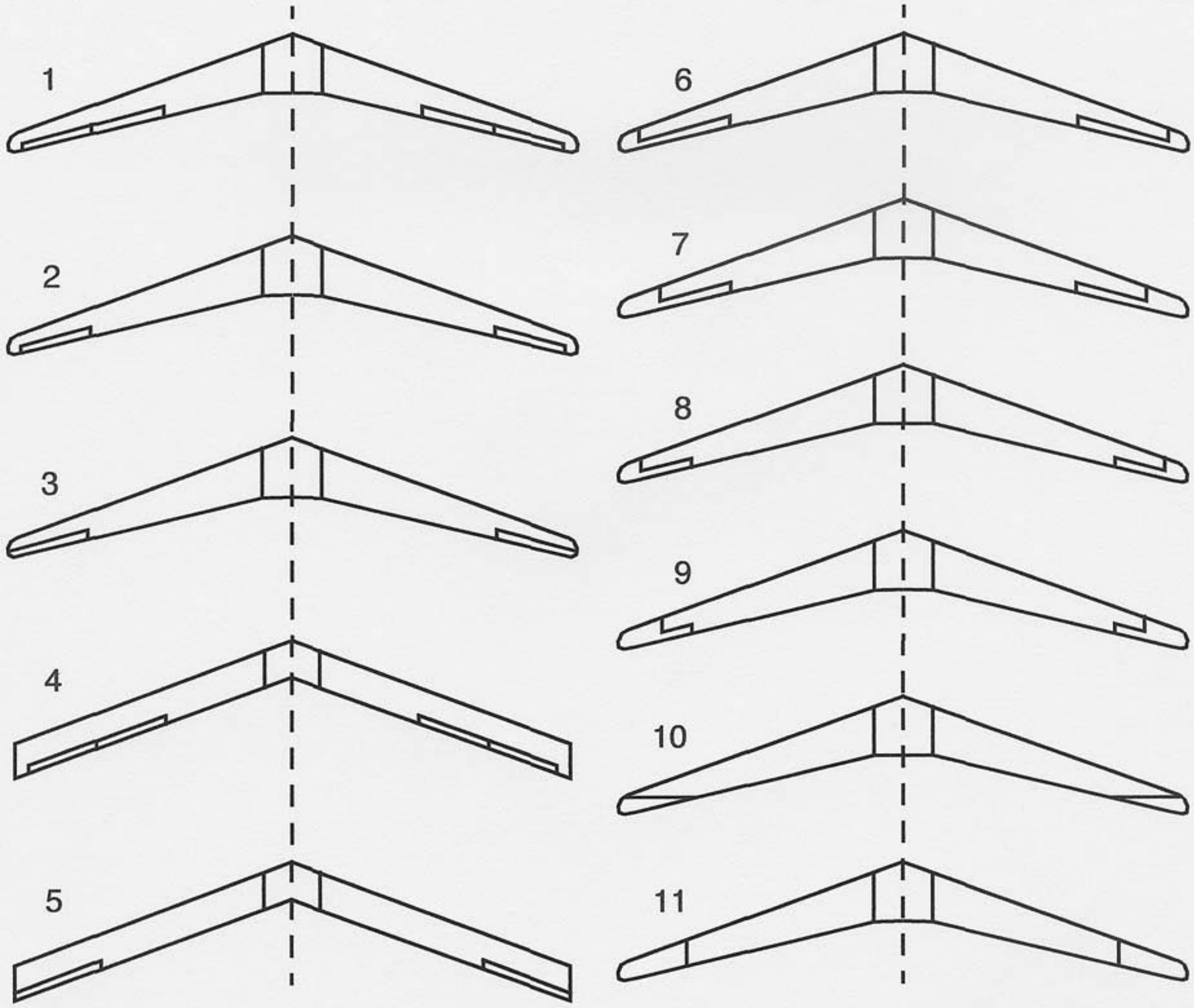
Dr. Udens' results demonstrate an increasing adverse yaw moment as the elevon control surface is moved inboard. This is an important consideration. The roll control surfaces must be placed in the area of the wing which has a concave lift distribution curve; that is, outboard in the case of the bell-shaped lift distribution. Although the Hortens used the $\sin^3$ lift distribution, they included inboard elevons which may have significantly reduced the proverse yaw moment and in fact created an adverse yaw moment.

A relevant example

There are a number of readers who at this point desire some sort of practical example of the bell-shaped lift distribution generating proverse yaw as elevon control surfaces induce a roll moment. Ideally, we would look for a swept wing tailless model without winglets which exhibits very strong adverse yaw as an example. Those who have built and flown a Klingberg wing know well this model meets the ideal. Don Stackhouse of DJ Aerotech had the following to say about his Klingberg wing:

> "My stock Klingberg, with its horrible adverse yaw and a yaw-roll coupling that essentially negates the roll response to any but the smallest elevon deflections, is essentially unsafe to fly in any place with maneuvering space restrictions or in any kind of turbulence."

Don goes on to say that the addition of any aileron differential severely affects the aircraft in pitch. The application of down elevator to inhibit the nose up pitching reduces the differential, so it's



Elevon Configuration	Cn∂a	Span Load
1	-0.002070	bell
2	0.001556	bell
3	0.002788	bell
4	-0.019060	elliptic
5	-0.015730	elliptic
6	0.001942	bell
7	0.002823	bell
8	0.004529	bell
9	0.005408	bell
10	0.004132	bell
11	0.005455	bell

Figure 4. Relationship of control surface configuration, span load, and yaw moment.

a Catch 22 situation. Don has not flown his Klingberg wing in several years, and in fact only takes it out of storage to serve as an exhibit model.

Michael Allen, a student at Embry-Riddle Aeronautical University and an intern at NASA Dryden Flight Research Center under Al Bowers, decided to build a Klingberg wing using a bell-shaped lift distribution. The taper ratio and other planform parameters of the two meter Klingberg wing closely match those of the Horten Xc, an advanced ultra-light glider designed by Reimar Horten while he was living in Argentina. Al was able to get the twist values for the modified Klingberg wing from Reinhold Stadler, and Michael built the model using the defined twist distribution.

Additionally, Michael used an elevon planform, illustrated in Figure 5, in keeping with the results of Dr. Udens (Figure 4 No. 6). This elevon planform is calculated to give a small amount of proverse yaw, $C_{n\partial a} = 0.001942$.

Al says the wing looks very "organic" in the air, and while flying directly overhead and giving full right or left stick, there is not even a hint of adverse yaw in evidence.

Reducing induced drag

"The elliptical lift distribution is the most efficient." We have heard this statement often over the years. Recently we've come to discover it is not entirely true simply because it is incomplete. More accurately, "The elliptical lift distribution is the most efficient for a wing of given lift and span." The qualifications may not seem to be of much importance at first. But consider a wing of a given span with an elliptical lift distribution. Is there a way to reduce the induced drag of this wing, making it more efficient, while keeping the root bending moment the same?

If you simply add span and maintain an elliptical lift distribution, the wing will be more efficient because you've increased the aspect ratio. But the spar will need to be strengthened because the bending moment at the root will have been increased with the larger span. So the question becomes a matter of finding a means to increase the span without increasing the load at the wing root. Enter the bell-shaped lift distribution.

Ludwig Prandtl came up with the elliptical span load around 1908, but did not formally publish his work until 1918. In 1933, Prandtl published his paper "On the minimum induced drag of wings" in which he presented the bell-shaped lift distribution. Prandtl's solution provided an 11% reduction in induced drag with a 22% increase in span and no increase in the root bending moment. In 1950, Robert T. Jones looked at the same problem and, unaware of Prandtl's work, came up with a similar solution by a different means.

Jones' computations show a 15% decrease in induced drag with a 15% increase in span when using a bell-shaped span load. Figure 6 illustrates Jones' planform, a comparison to the standard elliptical lift distribution, and the trapezoidal shape of the produced downwash.

Also included in that illustration is a diagram showing the lift distribution for a wing with a span ratio of 1.30 and a root bending moment identical to the span ratio 1.0 elliptical wing. Jones states that while the span can be increased further, the near maximum benefit comes with a 15% increase in span.

Other investigators, notably Klein and Viswanathan, have looked at the same constant root bending moment problem but also included other constraints, such as shear. The results point to a bell-shaped lift distribution and similar reductions in induced drag.

Back to winglets

In Part 3, we described how winglets can be a source of induced thrust. We also drew a parallel between the action of winglets and the effects of generated upwash on the outer portion of a swept wing. Consider a wing with a bell-shaped lift distribution which is producing induced thrust at the wing tips to be equivalent to a wing with winglets which is operating at its design speed.

While researching this series of articles, we ran into a document produced by Boeing as part of their publication *Aero* dealing with blended winglet design for various passenger and cargo aircraft. Briefly, the addition of properly designed winglets which extend the wing between ten and 16 percent can substantially increase payload and range and decrease takeoff runs, particularly near maximum gross weight. This is parallel to the effects predicted for the span extension proposed by Jones.

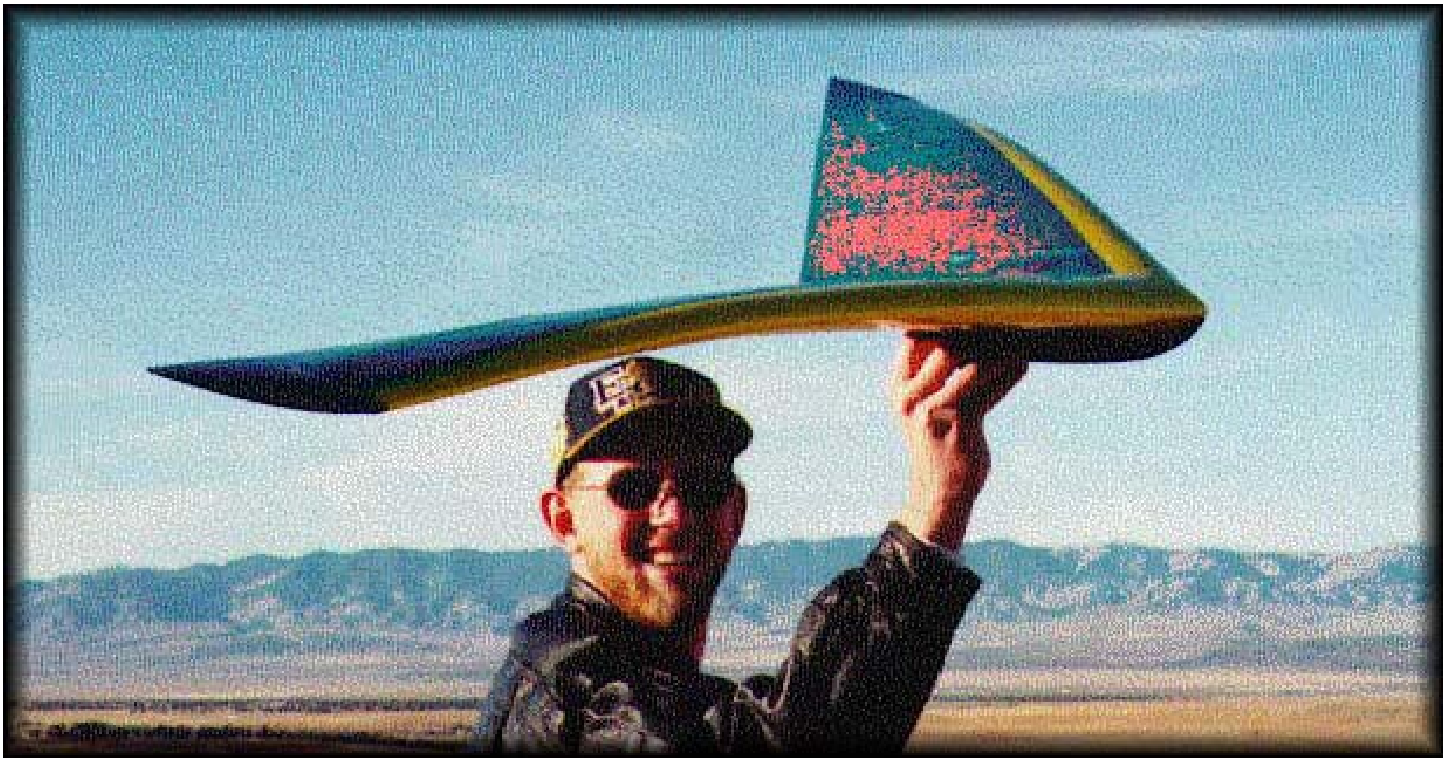
According to the article, maximum payload increases, takeoff runs are shortened, cruise drag is decreased by four to more than five percent, and range is increased by approximately four percent. This is evidence that, when properly designed, winglets can improve performance over a wide speed range. Additionally, blended winglets improve directional and pitch stability and longitudinal and lateral trim stability. There is no change in stall speed or Dutch roll damping.

One of the interesting points covered in the article involved the toe angle of the winglet. Initially, the toe out angle was set for zero degrees. While this minimized induced drag, it imposed very high loads on the wing. A toe out angle of two degrees reduced the bending loads on the wing but did not adversely affect the drag reduction except in the flaps down position. Boeing determined this was an acceptable trade-off for reducing required structural modifications.

It's important to realize that commercial aircraft have span limitations based on constraints imposed by airport architecture, so vertical winglets are a much more attractive option than increasing the wing span. Boeing's blended winglets aerodynamically increase the wing span without imposing a greater root bending moment and without increasing the actual wing span.

Discussion

The following discussion recently took place on the nurflugel e-mail list. We think the exchange may be enlightening, particularly for those readers with some doubts as to the efficacy of the bell-shaped lift distribution as applied to reducing induced drag. Al Bowers is Chief of Aerodynamics at NASA Dryden Flight Research Center.



Michael Allen and his “Hortenized” Klingberg ‘wing.

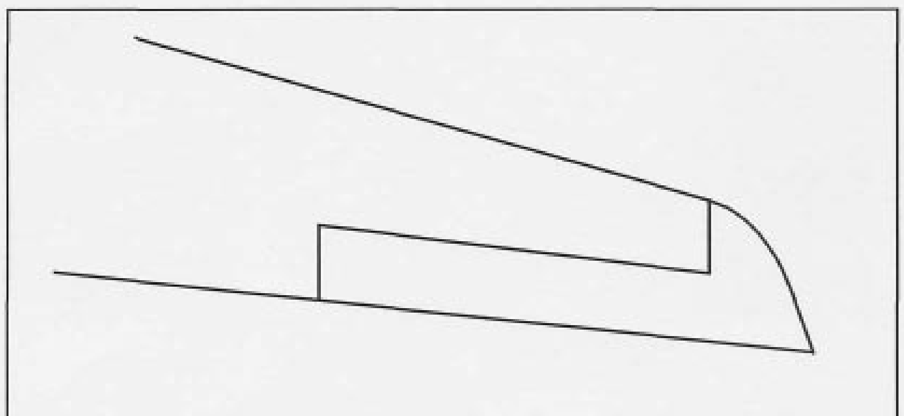


Figure 5. Elevon planform for Michael Allen's "Hortenized" Klingberg 'wing.

From: Al Bowers
<al.bowers@dfrc.nasa.gov>
Date: Wed, 18 Jun 2003 07:58:24 -0700
Subject: [nurflugel] NASM and Hortens...

Just a quick FYI: Russ Lee is in a blurb about the Hortens at:
<http://www.airandspacemagazine.com/ASM/Mag/inthemuseum.html>

The blurb is mostly right. The part about a drag penalty isn’t quite true (but I made that mistake in the past, so I can’t complain too much). Nice photos...

Al

From: Russell Lee
<russlee_99@yahoo.com>
Date: Tue, 24 Jun 2003 10:37:51 -0700 (PDT)
Subject: Re: [nurflugel] Digest Number 1143

Al, when the author of the A & S piece asked me about Horten’s bell distribution, I recalled that you had reported finding less drag than with the elliptical distribution. I wanted to mention that fact but I have no idea how this occurs, so wanting to err on the cautious side, I recited the standard litany about the drag penalty with bell. Would you have time to explain why the bell drag is less? I would sure like to give Reimar full credit when people ask about his work.

Russ Lee

From: Al Bowers
<al.bowers@dfrc.nasa.gov>
Date: Wed, 25 Jun 2003 15:33:46 -0700
Subject: Re: [nurflugel] Digest Number 1143

Hey Russ,

The question is actually pretty complex. But the problem boils down to one issue: is span constricted or not? If span is constricted, then the lowest drag is elliptical (unless winglets are allowed). If span is not constricted, then the bell shaped is lower drag.

Let’s assume we design a wing elliptical. Now, given that wing, what is the size of the spar we have to build to support that load (this is the wing root bending moment, hereafter the WRBM). Now, as a thought experiment, ask the question:

Is there a span and a span load that results in SAME WRBM but has less drag? If the answer is yes, then what is the optimum span and span load for the same WRBM? (This was Prandtl’s question in 1933.)

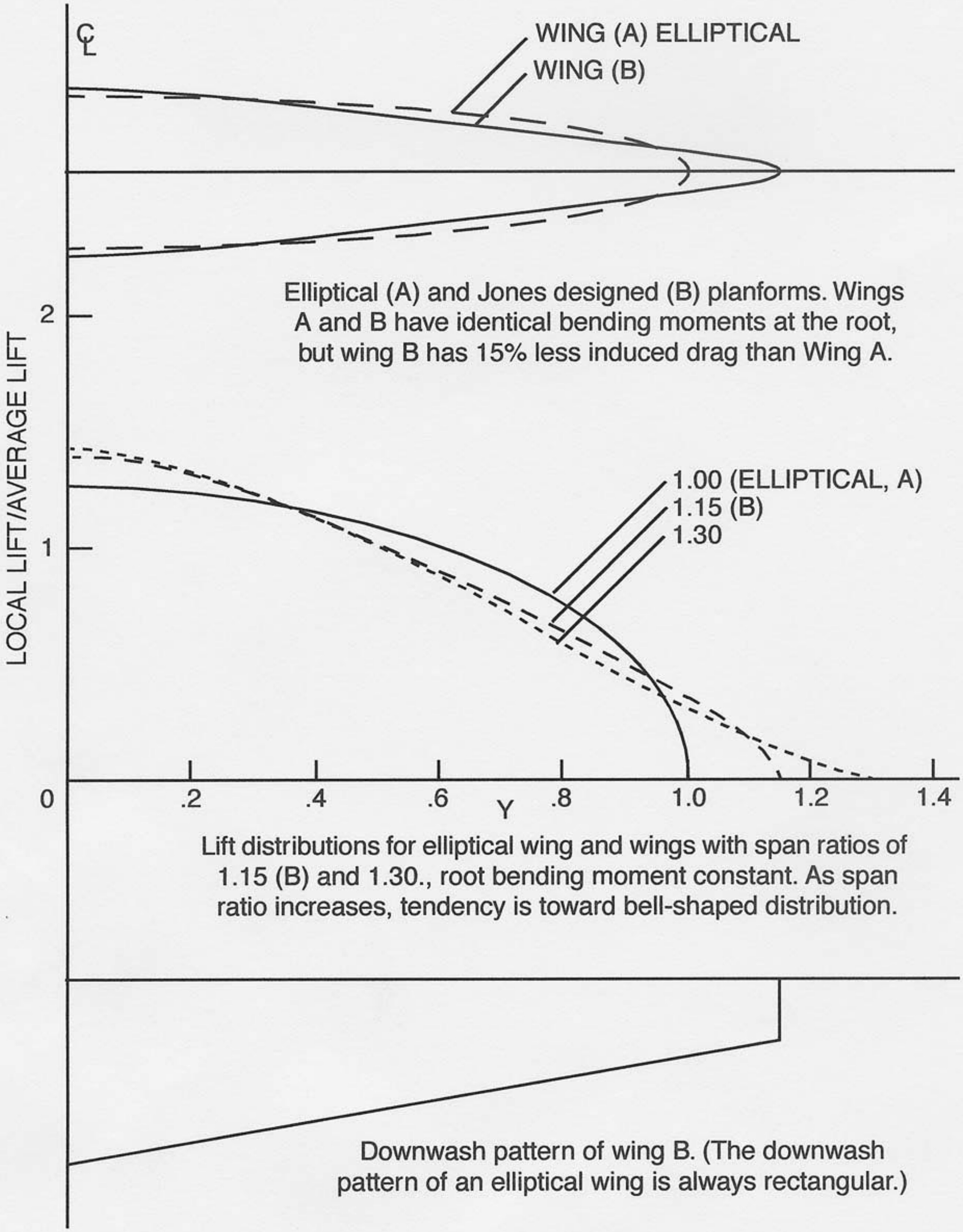


Figure 6. Comparison of various aspects of Jones' low induced drag planform to an elliptical wing.

The answer is yes, it is the bell shaped load distribution. The BSLD has the same WRBM as the elliptical and the same lift (so the same wing spar), but it has 22% MORE span and 11% LESS drag. It's the optimum drag for a given wing spar (which makes it of interest to birds; why haul around more bio-mass than necessary?).

By the way, this is also the subject of R.T. Jones 1950 paper, as well as being developed a bit more with Klein and Viswanathan's 1975 paper.

The other piece of the puzzle is the induced thrust at the wing tips (ala winglets). This allows the defeat of the adverse yaw part. But that's another story.

Does that help?

Al

From: "DavidRSw" <DavidRSw@bdumail.com>
Date: Wed, 25 Jun 2003 16:57:18 -0700
Subject: Re: [nurflugel] ESLD vs. BSLD

Hi Al,

So after listening to you give at least three lectures on this subject, talking to you in person an equal number of times, and reading your posts here, finally I may be beginning to under-stand what you are saying. ;-)

So, if we take two aircraft with the same weight = same lift = same WRBM = same wing spar, then we have two aircraft with different spans and different drags?

One hang glider with an elliptical lift distribution (ESLD) wing that weighs 245 lbs. ready to fly, has a 40 ft. span and a glide of 22:1. Does the other hang glider with the bell shaped lift distribution (BSLD), weigh 245 lbs. ready to fly, have a 48.8 ft. span, and a glide of 24:1? Have I got it right yet?

Disregarding the weight, what would the glide be of a 48.8 ft. span hang glider with an ESLD?

If we have two hang gliders of 48.8 ft. span, the one with the ESLD will have a better glide but weigh more? About how much more?

Thanks,
Dave Swanson
Glendale, CA

From: "Albert Robinson" <arobins1@midsouth.rr.com>
Date: Thu, 26 Jun 2003 02:34:47 -0500
Subject: Re: [nurflugel] ESLD vs. BSLD

Or with the BSLD are we are driven to a longer span to make up for the losses incurred? How else would you have the same WRBM with a greater span? I thought one premise of BSLD was an increase in stability but with a small loss in total efficiency. Would not ESLD for a given span have to be more efficient? For that matter, were any of the Horton designs ever tested and demonstrated as "pure" BSLD? Or perhaps a blend of both.

Sorry, just old and stupid, I don't understand.

A-n-P

From: Al Bowers <al.bowers@dfrc.nasa.gov>
Date: Thu, 26 Jun 2003 08:28:46 -0700
Subject: Re: [nurflugel] ESLD vs. BSLD

>So, if we take two aircraft with the same weight = same lift = same WRBM =
>same wing spar, then we have two aircraft with different spans and different
>drags?

RIGHT!

>One hang glider with an elliptical lift distribution (ESLD) wing that weighs
<snipped>
>ready to fly, have a 48.8 ft. span, and a glide of 24:1?

Close, it's only the INDUCED drag we reduced a bit (~11%), we didn't do anything to the profile drag (remem-ber, we changed the wing area, so the balance of drag would be different, but profile drag changes would be "insig-nificant"). So the "real" L/D max would probably only go up to a little over 23:1 (not quite to 24:1). And I would imagine the weight would rise a little as well (we did not consider the shear required to carry that load further out, Prandtl's original solution didn't consider shear, but Klein's & Viswanathan's solution DID).

> Or with the BSLD are we are driven to a longer span to make up for the
<snipped>
> and demonstrated as "pure" BSLD? Or perhaps a blend of both.

BSLD gets less drag than ESLD, that's not a "making up for losses" in my mind. The reason BSLD has the same Wing Root Bending Moment (WRBM) as ESLD is because BSLD carries less load out near the tips as ESLD.

It's like trying to pick up a 40 lb. tool box and turn it around vs. picking up a 40 lb. ladder and turning it around. The ladder has more mass out further away than the tool box, so you have to apply more load to turn it. BSLD is the tool box and ESLD is the ladder.

There is no loss in efficiency, BSLD is BETTER than ELSD. It minimizes the structure to carry the load (or you carry more payload as a fraction of total weight), it gets less drag, and it also solves the adverse yaw problem (you don't NEED a vertical tail, for even less weight).

It is the bird flight solution.

> Sorry, just old and stupid, I don't understand.

No, I'm just not explaining it well enough. When you get this one, a HUGE light bulb will turn on in your head and you'll suddenly get it, in a BIG way! I get chills just thinking about this, it is so completely right, elegant, and simple.

It HAS to be the bird flight solution.

From: Al Bowers <al.bowers@dfrc.nasa.gov>
Sent: Thursday, June 26, 2003 10:28 AM
Subject: Re: [nurflugel] ESLD vs. BSLD

OK, OK, I think I am getting it now, but one more pass for us "aerodynami-cally impaired":

So to get simplistic (it's more than this, I am sure) the BSLD it is a function of airfoil selection and of course washout (type and style of twist). You said that the WRBM would be less with BSLD because the tips are carrying less load than if it were ESLD. (Am I doing OK so far?) In order for it to be "less" something had to go away, i.e.: total lift in the wing tip sections correct? But the trade off is worth the loss in that the lift vector at the tips is now forward (from the washout and the airfoil selection) and provides yaw stability plus less bending moment. Hooowee, do I got it?? :) or maybe a little??

From: Al Bowers
<al.bowers@dfrc.nasa.gov>
Date: Thu, 26 Jun 2003 10:07:45 -0700
Subject: Re: [nurflugel] ESLD vs. BSLD
Albert Robinson writes:

> OK, OK, I think I am getting it now, but one more pass for us
<snipped>
> I got it?? :) or maybe a little??

BSLD is a function of twist, design point (lift coefficient & wing sweep), and airfoil. But ESLD is also a function of airfoil selection as well. And we traded the lift at the wing tips and moved it inboard a bit relative to ESLD.

	ESLD	BSLD
center load:	less	more
tip load:	more	less
total load:	equal for both	

I think you've got it now...

Al

The bell-shaped lift distribution and tailless RC sailplanes

For AMA RC models outside of the Unlimited class (RC-HLG, 2M, Standard), span is limited. Designing a tailless model with a bell-shaped lift distribution in an attempt to improve performance beyond that of a conventional tailed aircraft of the same span is therefore problematic, as Al Bowers explains.

Still, for the Unlimited class, where the only limitations are wing area (2325 sq. in.), mass (5 Kg., 11.02 lbs.), and wing loading (3.95 - 24.57 oz./sq.ft.), a competitive swept wing tailless model is certainly in the realm of possibility, and in fact, may be the best choice.

A tailless model utilizing the bell-shaped lift distribution is a particularly enticing proposition when such considerations as ground handling and construction costs are removed and modern low Reynolds airfoils, vortex-lattice computer codes, and high-tech materials and fabrication methods can be so easily added to the design and construction processes.

Our sincere appreciation goes to Al Bowers for providing substantial guidance and positive reinforcement, as well as a number of printed references, for this installment. Thanks are also due to the members of the nurflugel e-mail list for their informed questions regarding the elliptical and bell-shaped lift distributions.

The next and final installment in this series will provide a summation of the Horten, Culver, and Panknin twist distribution methodologies.

Ideas for future columns are always welcome. *RCSD* readers can contact us by mail at P.O. Box 975, Olalla WA 98359-0975, or by e-mail at <bsquared@appleisp.net>.

References:

Allen, Michael. <http://pr.erau.edu/~allenm/wing.html>

Bowers, Al. Correspondence within <http://www.nurflugel.com> e-mail list and private correspondence, 2000- 2003.

—. The Horten H X series: ultra light flying wing sailplanes. TWITT Newsletter, October, November, December 1998.

—. Manned flight - past, present, future. TWITT Newsletter, April 2002.

Faye, Robert, Robert Laprete and Michael Winter. Blended winglets for improved airplane performance. AERO 17, pp. 16-31. Available at <http://www.boeing.com/commercial/aeromagazine/aero_17/winglets.pdf>

Galè, Ferdinando. Tailless tale. B^2Streamlines, Olalla Washington USA, 1991.

Horten, Dr. Reimar. Lift distribution on flying wing aircraft. Soaring, June 1981, pp. 40-42.

Jones, Robert T. Minimizing induced drag. Soaring, Oct 1979, pp. 26-29.

—. The spanwise distribution of lift for minimum induced drag of wings having a given lift and a given bending moment, NACA TN 2249, 1950.

—. Wing theory. Princeton University Press, Princeton NJ USA, 1990.

Klein, Armin and Sathy P. Viswanathan. Approximate solution for minimum induced drag of wings with given structural weight. Journal of Aircraft, Feb 1975, pp. 124-126.

Masters, Norm. Correspondence within <http://www.nurflugel.com> e-mail list, 2000-2003.

Nurflugel e-mail list. Correspondence regarding elliptical and bell-shaped lift distributions, June 18 through June 26, 2003.

Munk, M. The minimum induced drag of airfoils, NACA Report 121, 1921.

Prandtl, L. Applications of modern hydrodynamics to aeronautics. NACA Report 116, 1921.

—. Uber Tragfugel des kleinsten indezierten Widerstandes. Zeits Flugeltechnik und Motorluftschiffahrt, Vol. 24, pp. 305-306, Nov 1933.

Stackhouse, Don. Correspondence within <http://www.nurflugel.com> e-mail list, 2000-2003.

■

Midwest Slope Challenge 2003

Larry Blevins' Northrop F-5 Tiger, a new design this year that will be kitted by Magnum Models. Photo by Dave

Alden Shipp to Rich Loud on Saturday: "Now even though it's technically a slope race, we never said there would be any wind..." Photo by Dave Garwood.

By Loren Blinde,
Event Director
Lincoln, Nebraska

Photography by David Garwood, Joe Chovan, and Greg Smith

In my mis-spent youth, which shows signs of ending any day now, I had this thing for Grateful Dead concerts. A peculiar fascination with living in a parking lot for three days, at the mercy of Mother Nature, all in search of that elusive moment when the band doesn't forget the words and the music is magic.

Lately it's occurred to me that the Midwest Slope Challenge isn't all that different. You still sleep wherever a bed is to be found, the drug of choice is 3.2 beer at Linda's Café, and it's all held together by the determination of like-minded people to have fun in their own little world. The 2003 MWSC tour was indeed a long strange trip...

ODR race. Photo by Dave Garwood.

Foamie Warbird Racers display their planes to far-end turn judges. Photo by Dave Garwood.

Two original design Foamie Warbird Racers new this year: Mike Bailey's Sea Fury and Joe Chovan's Me-109. Photo by Dave Garwood.

And here's the story:

The reviews will say something like four days of weather frustration followed by one exceptional day and mood swings to match. Plus lots of positive feelings from the local community (okay, that part is different). 54 registered pilots was down slightly from last year, but the number of class entries was the largest ever, including a new combat class.

It seems that every year, more flyers are arriving sooner, some as early as the preceding Sunday. Yes, you can spend a fun-filled week in north central Kansas and top it off with a slope contest. Word has it that the early birds had some exceptional air, one even heard to say he could have gone home happy after Tuesday.

Wednesday, about 25 flyers used Airport Hill, mostly for light planes, electrics and bungees in barely noticeable S-SW breezes. There were more jaws flapping under the awning than wings flapping in the air.

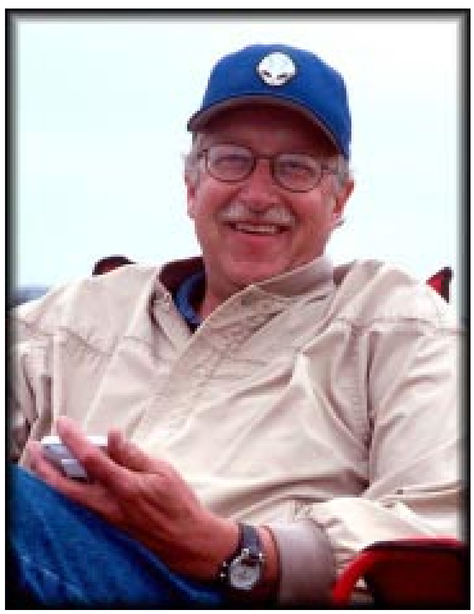
Thursday, the "official" fun-fly day, began with a decent East wind blowing up the far side of the main hill and there was a lot of flying until a late-morning rain interruption. When the action resumed around 3:00, the breeze stiffened and the fun flying crowd was out well into the evening.

Combat day Friday was a total rain out. The ever resourceful group managed to get the Lucas Theatre to

Full Contact Combat can be hazardous to your airplane. Wayne Rigby's DAW FoaMe-109 heads for terra firma with a broken aileron. Photo by Dave Garwood.

Joe Hosey launches Dave Garwood's DAW Ka-6 in the Unlimited Race. This plane is made of EPP foam. Photo by Joe Chovan.

Student Pilot Marley Palmer and Instructor Pilot Alden Shipp at the Friday evening Air Show. The MWSC 2003 week also saw high school graduation for Marley. Of the 17 seniors in the Lucas-Luray Cougars graduating class, those who are college-bound had already been awarded $125,000 in scholarships.



Contest Director Loren Blinde. Photo by Dave Garwood.

(L) Joe Hosey from Topeka KS and Doug Barry from Charlotte, NC. Doug is the Chairman of the AMA Soaring Competition Committee. Photo by Dave Garwood.

open for a special matinee movie. In keeping with the spirit of the day, the movie wasn't very good either, but that wasn't the point. A movie at a slope contest? You just know it's going to get stranger...

Lucas, Kansas, population 436, has been our headquarters and hang out for 10 years so far. In keeping with the anniversary spirit of the event, George Voss had the inspiration to suggest a model air show for the city of Lucas at the local airport. George made the arrangements, did the paperwork, recruited the "acts" and emceed a first rate show for 150 spectators. The weather even cooperated with clearing skies and light winds. Slope on a rope, a hotliner electric, park flyers, winch launches and Mr. Clean's U-Control aerobatics wowed the crowd.

The grand finale was five "slope guys with a dark side" flying two rounds of powered, cut the streamer, combat. Considering the role our friends in the Radio Control Combat Association had in keeping slope combat alive, this was a great way to say that we're all model aviation enthusiasts, no matter what we fly. Judging by the cheers of the crowd, even audible over the engine noise on the flight line, it was entertaining as well.

Start of a heat in the Foamie Warbird Race. Jack Nicholson, er, I mean Randy McCleave launches Erik Eaton's SR Hobbies MiG-3 and Mile Bailey launches Greg Smith's DAW Foam-51. Photo by Dave Garwood.

Joe Falconer's 2-meter EPP-foam MDM Fox. Joe makes this and other kits at Falcon Air Models. Photo by Dave Garwood.

There was an abundance of local publicity during the week (fortunately, no arrests involved), including radio interviews, TV spots and a great feature article in the Salina Journal. The air show alone may have elevated our group to cult status in Lucas.

As bad as things had been at the hill so far, Saturday was the cruelest day of all - light winds, slowly moving from north to south. And enough occasionally seductive gusts and approaching lake waves to make us think things would get better. They didn't. We set up the One-Design race course for an east wind and subjected the competitors to a less than memorable slope race. Out of 20 heat races, only two had all four planes actually complete the course. This was really disappointing considering we had an all-time high of 40 entries in the class.

After two rounds of flying, there were four flyers in the lead, we decided a merciful end was in order and ran the final. There must have been some skill involved in this process as there were still first-rate flyers in the final. Todd Martin, with a Fun-1 on the heavy side of the official scale, repeated as the king of ODR.

If you're really depressed, one proven solution is excellent food in extreme quantities. The Saturday night banquet couldn't have come at a better time. We're looking at 78 faces, most of whom have endured four really crappy days of flying, and they are smiling! This is indeed a family.

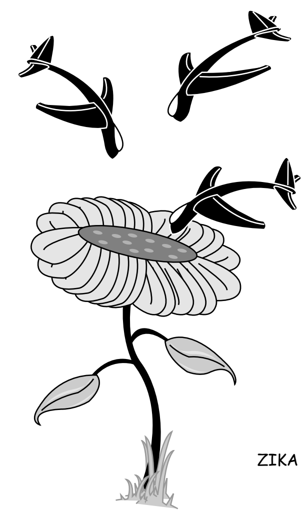
Foamie Warbird Race. "The Big Pole." Photo by Dave Garwood.

The K-18 Cafe crew put on another fantastic prime rib feed and the prize sponsorship was unprecedented. Dave Garwood was presented with the Lifetime Achievement award and we even got a slide show on the history of

MWSC. But the highlight of the evening was a recitation of the Sunday forecast: 20 knots at 170! The Sunday pilot's meeting was moved up to 8 am and the crowd hustled off to charge some batteries.

Sunday was probably the best and busiest day in the history of MWSC; yes, the band finally remembered the words. Unwavering 20 mph winds SSE all day long; the perfect direction at Wilson Lake. Our patience and perseverance were about to be rewarded.

First items on the agenda were two combat events: Flying Wings and "Tails". With all the attention paid to slope combat by the AMA this past year, running a safe and successful combat event was especially important. And that we did, with three qualifying rounds and a fly-off in each class; 38 Wings and 25 Tails. This year's combat event used a marked safety zone which effectively enforced safe flying away from the crowd. A one-point bonus for completing a round without landing kept the competition interesting and helped spread out the scores from the usual 14 man tie.



Roger Brining was the Wing winner. Considering last year's results, the Great Bend/Holyrood, Kansas guys, including Rob Koch and Randy Mohr, will hereafter be known as the "Sultans of Wing" and are already next year's designated targets.

The Conventional ("Tails") class was won by Joe Chovan. Yes, the suggestion last year to separate wings and tails was a good one and is here to stay. It made for fairer competition and was more fun to watch, especially for the photo-journalists who were out in force. Highlight was Alden Shipp's Corsair delivering a 'center-punch' flat spin to an unsuspecting victim that would have made Pappy Boyington proud!

After combat, the race course was set up for double-elimination Unlimited racing. When you hold a race on the usual "go-home" day, brackets are a nightmare, but despite the temptations, the hill at MWSC proudly remains a generator and printer free zone. 20 pilots remained and showed some of the best man-on-man Unlimited flying ever seen in Kansas. Jim Porter, temporary German and Iowan forever, was the winner in the final over Greg Smith.

Okay, we'd done enough for one day by any reasonable standard... But the crowd was holding up cigarette lighters and clapping, so an encore was in order. The Warbird race has somehow gained stature and popularity beyond belief. Not running it would have meant the event director riding down the main street of Lucas on a rail, so the course was set up at 3:30. But there was a catch... Your CD resigned so he could fly and left it up to the crowd to run the event.

Doug Barry graciously volunteered to take over and others quickly manned the other key positions. Since Doug is the chair of the AMA Soaring contest board, this was like having Emeril cooking a meal or Hugh Hefner running a party... No, there were no stuffed shrimp or bunnies, but Doug & company did a first rate job! Since this was my first time flying at MWSC in 5 years, let's just say that I'm better at inventing events than flying in them, having experienced first hand the "clank" of the "Pole of Doom". Greg Smith is the 2003 "Ace of the Base" for winning the four-man fly-off.

The Lincoln Area Soaring Society roadies did another exceptional job of keeping things moving. Jim Baker, Steve Dworsky, Tom Neill, Tom Wild, Jack Barry and Mark Blinde even set up the race course two straight days, above and beyond the call of duty. Alden Shipp (the Bill Graham of Lucas, Kansas) did a superb job with local publicity and hospitality. And Ms. Kelly Neill (seamstress for the band) did an amazing amount of work, not only with the T-Shirts and slide show, but was hauling batteries and equipment down the hill and served as line judge during the Unlimited race.

If you'd like to see complete results and links to our wonderful sponsors, go to home.alltel.net/mwsc. And mark your calendar; tickets for the 2004 show go on sale February 14th. ■

GORDY'S TRAVELS

Gordy Stahl
Louisville, Kentucky
GordySoar@aol.com

New Developments in Receivers Coming Down the 'Road'

My travels keep me in synch with the latest developments in equipment and one of the most exciting is what's coming and here already in Receivers!

Polk's Hobby has long been offering a most amazing 8 channel Rx, the Seeker ll. The Seeker uses no crystals! It is a total chameleon for both shift and channel. That means that it has the ability to 'lock' onto the signal from any TX and match it.

Here's how it works, first it's synthesized and, in order to get it to 'lock' onto your TX, it has a button which you hold, then turn on the RX power. If you have a servo plugged into channel #1 (aileron) it will begin cycling back and forth. If not, there is also a blinking LED light located on the face of the Seeker. It actually has the option of using one of two buttons; one button is supplied with the RX and is on a servo lead that plugs into the servo slot named 'SET'. Plugged in, you hold it down and turn on the RX power to begin the TX 'lock' procedure. OR, and this was pretty brilliant of the designer, there is also a button inside a small hole on the face of the RX also marked 'SET', just in case you were to forget or lost the remote switch.

Once the RX is in the search mode, looking for the TX signal, the LED light flashing and or the aileron servo cycling, you simply hold the TX antenna (with power on) near the RX

TRACKER II INSTRUCTION MANUAL

The SEEKER II is compatitble with<u>ANY FM</u> transmitter

(no crystal matching needed or required)

For the past 2 decades there has not been any radical improvements in hobby radio technology. Mismatched combinations of different brands can possibly result in damage to your model. The receiver is an extremely important part of your system, because of posible radio interference such as mirror image, 3 im, or pager swamping are caused by the receiver. All receivers must be narrow band, but there is a tolerance +/- 10ppm (+/- 7khz), which requires the need for replacement crystals to be tuned by the same maker. The SEEKER II has innovated a breakthrough, which changes the "old" relationship between the transmitter and receiver. The SEEKER II automatically adheres to any type or brand of FM transmitter within the narrowest of possible settings (typ. +/- 5ppm).

SEEKER II with its auto setup means that you do not have to remember what your model setting was. ***THE RECEIVER NEVER FORGETS***

IMPORTANT CAUTIONS BEFORE SETUP

Do not setup with other transmitters within 10ft.
During setup all CH-1 levers (trim, dual rate, ect.) must be at neutral

SETUP

1. Connect the SEEKER II as shown in the diagram.
2. Hold set button , turn on receiver power switch (not supplied). CH-1 servo will move back and forth in small amounts.
3. Turn on transmitter with antenna fully extended and within 2-6 inches of the SEEKER II antenna.

WHEN SERVO (LED) STOPS MOVING YOU ARE NOW CONFIGURED.

The SEEKER will keep the data even when the battery is removed.

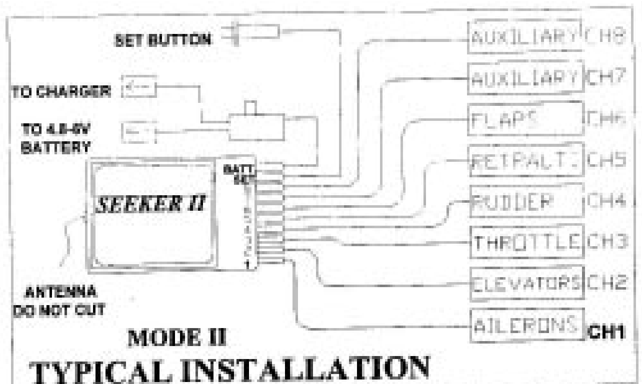
To change frequency, repeat the procedure

SEEKER II

5 year limited WARRANTY

POLK'S HOBBY / LMP inc.
698 South 21st. ST.
Irvington, N.J. 07111

POLK'S



72 MHz PLK13101
72 MHz PLK13102
35 MHz PLK13103
40 MHz PLK13104

MODE II

TYPICAL INSTALLATION

POLK'S HOBBY 698 S. 21ST STREET, IRVINGTON, NJ 07111

22

antenna, moving the aileron stick back and forth. Shortly the RX will lock onto the signal, the LED light will go out, and the servo will begin following the aileron stick movements.

Understand this... It doesn't matter if your TX is Futaba/Hitec/Airtronic/JR/Robbe/MPX... Any FM, any channel on 72mhz, the Seeker ll doesn't care, it finds it and locks on - forever. Regardless if you keep it in a drawer for a year or whatever, until you reprogram it, it is now on that channel, matched to that TX.

A prominent electronic wizard, most respected in RC by all who count, did some personal testing on the Seeker ll and found that it is by far one of the 'tightest' and 'best' in every category available. That was good enough for me to switch!

The Seeker ll also gives you the ability to preset 4 'failsafe' programmed servo positions in case of a lost signal; just an added value to the already amazing RX! The Seeker ll matched with the Hitec Spectra module in your TX, gives you the ability to chose any open frequency, instead of the annoying and dangerous 'sharing' freqs.

The Seeker ll is slightly smaller than a standard 8 Channel RX and slightly smaller than say a Hitec Slimline 8. Small enough to fit the current trend of slim fuselage noses of Euro-moldies. In some, it may be necessary to remove the case from the Seeker ll to fit, but no worries, as the inside components don't look at all fragile and the end load servo plug block makes shrink wrapping it an easy task.

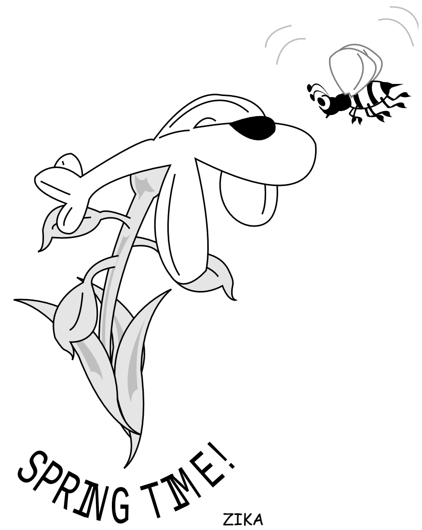
Actual size is 2.25"x 1.50"x .75".

I have been using the Seeker in my Thermal Duration plane 'My Compulsion' and it has been rock solid. Current consumption seems about the same as the Hitec Slimline I had been using. I like the fact that I don't get 'single flap syndrome' glitches or 'swamping' glitches when my TX is close by. This is a really outstanding addition to our hobby, and you guys need to give them a try!

Pricing is a little more than a standard crystal RX but when you consider Xtals are about $10 each, having to keep them with you, the hassles of changing etc., and the rock solid electronics of the Seeker ll, it's a total no-brainer value-wize.

You can find the Seeker ll at
www.Polkshobby.com
Polk's Hobby/LMP, Inc.
698 S Irving Street
Irvington, NJ 07111
973-351-9800
Sales@polkshobby.com

■



Classified Advertising Policy

Classified ads are free of charge to subscribers provided the ad is personal in nature and does not refer to a business enterprise. Classified ads that refer to a business enterprise are charged $5.00/ month and are limited to a maximum of 40 words. *RCSD* has neither the facilities or the staff to investigate advertising claims. However, please notify *RCSD* if any misrepresentation occurs. Personal ads are run for one month and are then deleted automatically. If you have items that might be hard to sell, you may run the ad for 2-3 months.

For Sale - Business

PARACHUTES: $12.50 (includes S&H U.S.A.) Send check or money order to Dale King, 1111 Highridge Drive, Wylie, TX 75098; (972) 475-8093.

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>.

BBS/Internet

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

T.W.I.T.T.

(The Wing Is The Thing)

T.W.I.T.T. is a non-profit organization whose membership seeks to promote the research and development of flying wings and other tailless aircraft by providing a forum for the exchange of ideas and experiences on an international basis. T.W.I.T.T. is affiliated with The Hunsaker Foundation which is dedicated to furthering education and research in a variety of disciplines. Full information package including one back issue of newsletter is $2.50 US ($3.00 foreign). Subscription rates are $20.00 (US) or $30.00 (Foreign) per year for 12 issues.

T.W.I.T.T., P.O. Box 20430
El Cajon, CA 92021

www.twitt.org

Sailplane Homebuilders Association (SHA)

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).

Sailplane Homebuilders Association
Dan Armstrong, Sec./Treas.
21100 Angel Street
Tehachapi, CA 93561 U.S.A.

The League of Silent Flight (LSF) is an international fraternity of RC Soaring pilots who have earned the right to become members by achieving specific goals in soaring flight. There are no dues. Once you qualify for membership you are in for life.

The LSF program consists of five "Achievement Levels". These levels contain specific soaring tasks to be completed prior to advancement to the next level.

Send for your aspirant form, today:

League of Silent Flight
c/o AMA
P.O. Box 3028
Muncie, IN 47302-1028 U.S.A.

http://www.silentflight.org

The Vintage Sailplane Association

Soaring from the past into the future! The VSA is dedicated to the preservation and flying of vintage and classic sailplanes. Members include modelers, historians, collectors, soaring veterans, and enthusiasts from around the world. Vintage sailplane meets are held each year. The VSA publishes the quarterly BUNGEE CORD newsletter. Sample issues are $2.00. Membership is $15 per year. For more information, write to the:

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.

Continuing with the 20+ year tradition of extremely enjoyable flying, the 1999 season will include 14 weekend competitions in HLG, 2-M, F3J, F3B, and Unlimited soaring events. Come on out and try the ESL, make some new friends and enjoy camaraderie that can only be found amongst R/C Soaring enthusiasts!

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