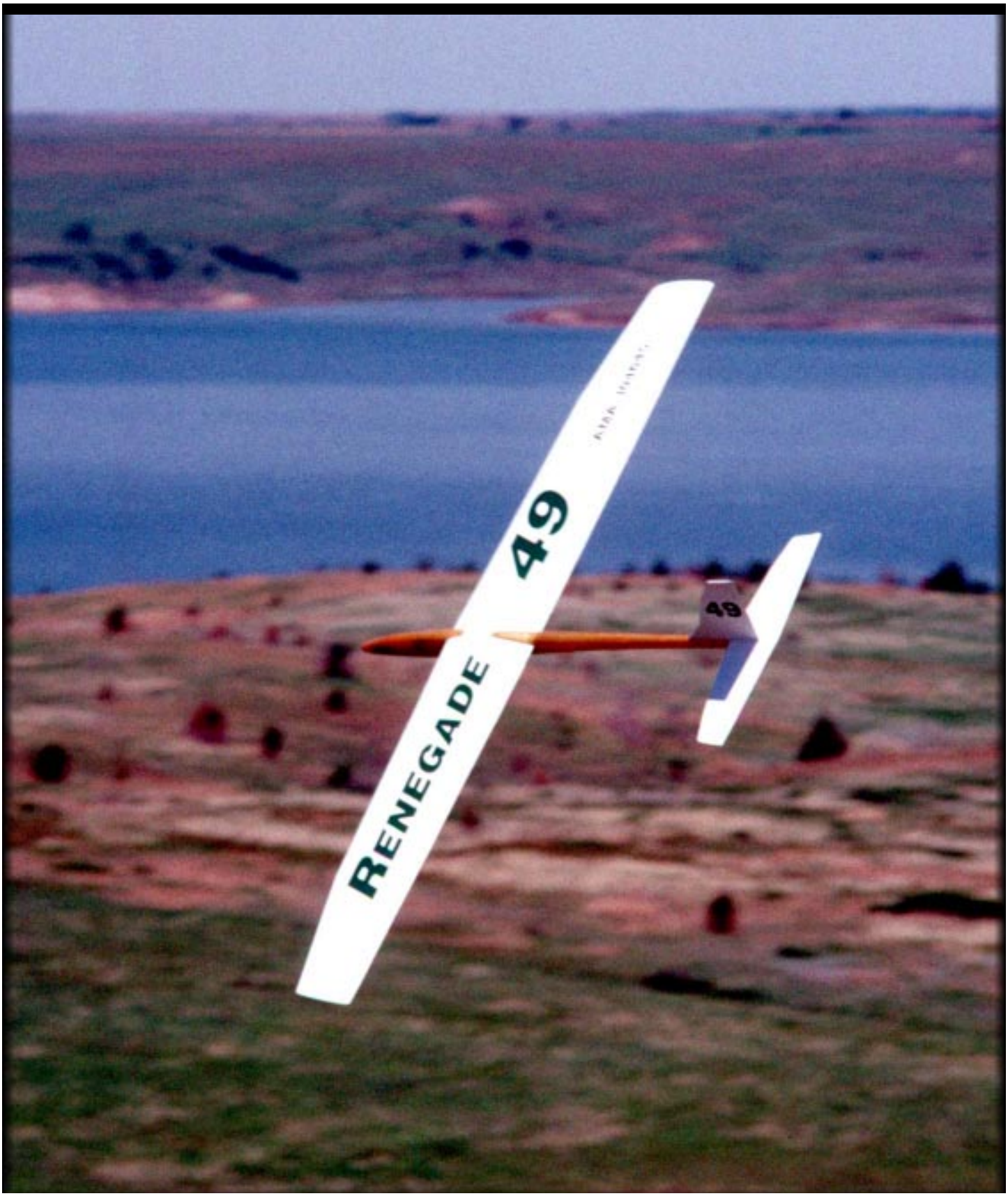
R/C Radio controlled SOARING DIGEST
THE JOURNAL FOR R/C SOARING ENTHUSIASTS
October, 2003
Vol. 20, No. 10
U.S.A. $3.50



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

F3J Team Selection Write-up

Jim Bacus, Member of the Chicago SOAR club, has done an in-depth write-up on the F3J Team Selection complete with photographs. It is available for viewing at:

http://www.jimbacus.net

SOSS Aero Tow Event Photos

Paul Naton <paul@radiocarbonart.com>, has posted some excellent photos of the SOSS aero tow event held at at Montague.

http://radiocarbonart.com/Pages/zmontepicsone.html

http://radiocarbonart.com/Pages/zmontepicstwo.html

House of Balsa

We received a snail mail request from long time subscriber, Joel Lefkowitz:

"Great article about House of Balsa 2x6! I would like to purchase kit. Perhaps you could forward address of manufacturer to me in order to do so."

Not knowing the answer to the question, we asked B^2 and received the following response in short order!

House of Balsa
10101 YUCCA ROAD
ADELANTO, CA 92301
PHONE: 760-246-6462

They went on to say:

"We did a quick check and found that Tower carries the 2x4. They should have the 2x6 as well, but it's not in their on-line catalog, at least that we can find.

"Order direct from <http://www2.mailordercentral.com/quantummodels/products.asp?dept=21&pagenumber=2. Price is $29.95.

"Joel should be able to get a kit from his local hobby shop, by special order if need be.

"There are a number of clubs which use the 2x6 as the kit in school aero courses, and it's the kit used in the Boeing intern program. Yeah, 60 teenagers running around 60 Acres, each with their own airplane and radio gear... "

Special Thanks

There's always a lot going on behind the scenes. This past month, a special thanks is in order for Dave Register, who tackled a complex editorial task for me. Thanks, Dave!

And Dave's not the only one. The *RCSD* team always seems to be there when I need them, lending their technical expertise, answering computer questions, or sending something my way that they think may be of interest to most if not all of the readers. For example, the first two items of this editorial were sent in by B^2. Thanks for all each of you do!

And, then there's Gordy. We always seem to know which state he's traveling through, next!

Happy Flying!
Judy Slates

MIDWEST SLOPE CHALLENGE 2000

CR Aircraft Renegade takes to the sky over beautiful Wilson Lake during the Midwest Slope Challenge, a special yearly event. Rich Loud is flying for the camera.

Photography by Dave Garwood, New York.

Back Cover

THE LAST FLING

An annual event in Oklahoma, the Last Fling is held by the Tulsa RC Soaring Club. Jim & Mike enjoy this special event!

Photo by Dave Register, Oklahoma.

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 5

The Horten twist distribution has been the focus thus far, but it's now time to take a look at the twist distributions formulated by Irv Culver and Walter Panknin, make some comparisons, and derive a few conclusions.

The "middle effect"

First, a small digression is necessary in order to understand one remaining concept, the "middle effect." The Hortens' later designs included geometric modifications aimed at reducing or eliminating the "middle effect." Irv Culver's twist distribution is specifically formulated to eliminate the reduction in lift near the center of a swept back wing. Interestingly, the Hortens and Culver are trying to counter two different phenomena.

As the wing moves through the air, the air coming off the trailing edge is deflected downward. This is called the downwash. As the air approaches the wing, it moves up slightly to meet the wing. This is called the upwash. We've already illustrated these two properties in previous portions of this article series, pointing out the angle of attack is directly related to the position of the stagnation point.

If you look at an airfoil traveling through the air, you'll see that the air moving over the upper surface is moving faster than the wing is moving through the air. So too, the air along the lower surface is moving slower than the wing is moving through the air. From a vector mathematics perspective, if you subtract the velocity of the wing from the two air flows, the air over the upper surface is still moving from leading to trailing edge, but the air along the bottom of the wing is moving backward toward the leading edge. From this perspective, the air "circulates" around the airfoil in a clockwise direction as a wing producing lift moves right to left. The coefficient of lift is directly proportional to this circulation. See Figure 1.

According to Prandtl's lifting line theory, you can visualize a wing moving through the air as simply a line connecting the two wing tips along the quarter chord line with horseshoe shaped vortices coming from it and extending back to infinity. In this model, both downwash and upwash are accounted for: the air inside the vortices is being deflected downward, and the air outside the vortices is being deflected upward. The actual lifting line calculations, however, are both complex and extensive. Schrenk expanded Prandtl's lifting line theory to include taper, twist and control deflections, but not sweep. Multhopp expanded this theoretical framework further, but still did not fully account for the effects of sweep.

A swept wing can be viewed as a series of connected small wings, the leading edge of each slightly behind the leading edge of its inboard partner and in front of the leading edge of its outboard partner. Each small wing has an effect on the air flow of both its inboard and outboard partner, but the effect on the outboard partner is very much greater than the effect on the inboard partner. The upwash is not equal along the span but rather tends to progressively increase over the more outboard segments. (We've illustrated this concept in previous portions of this article series.)

Schrenk's approximation does not accurately portray a swept wing, and therefore does not account for the loss of circulation and associated loss of lift at the root and the increase of circulation and associated increase of lift at the wing tips.

Multhopp's method of determining the lift distribution, which involves established "control points" based on "central difference angles," does not account for sweep either, but was used by the Hortens as the best available model at the time. The H-II was the first of the Horten aircraft to use a bell-shaped, sinx, lift distribution, an outgrowth of the Multhopp paradigm.

The "middle effect" which is so often talked about regarding the Horten designs is simply an artifact of this inability to accurately predict the sweep induced changes in circulation, specifically a loss of lift at the center. This middle effect is strictly an artifact of the computation methods and is an error in analysis. The "middle effect" is not the loss of lift in the center area of the wing, it's the unanticipated loss of lift in the center area of the wing.

Horten

The Hortens, in an effort to coordinate stalling behavior and center of gravity with other planform parameters, performed the necessary mathematical computations, but always found errors in their results. The aircraft did not behave exactly as predicted because the center of pressure was not at the location predicted. The Hortens believed the problem to be related to the intersection of the two quarter chord lines at the centerline, and envisioned colliding vortices. They constructed "bat tails" which substantially increased the root chord. Their intent in using the bat tail was to reorient the quarter chord lines of the two wings and eliminate the colliding vortices. On the H IV, the quarter chord lines meet at right angles to the centerline, while on the H VI the quarter chord lines actually bend backward. Despite these changes to the quarter chord line, the "middle effect" remained. Al Bowers has suggested that the Hortens might have realized they were looking in the wrong direction had they actually flown their Parabola design.

Despite their problems getting a handle on the "middle effect," the Horten twist distribution has the potential to reduce induced drag and allow turns to be accomplished without adverse yaw. But aircraft will operate as Dr. Horten envisioned only when all of the design parameters are utilized: moderate sweep angle, large taper ratio, carefully chosen airfoils (pitching moment), strong nonlinear twist distribution, "bell-shaped" span load (lift distribution), and outboard ailerons of defined size and configuration.

The Horten twist distribution is such that the wing twist is concentrated over the outer portion of the wing, in the area where the sweep generated upwash is greatest. Computing the

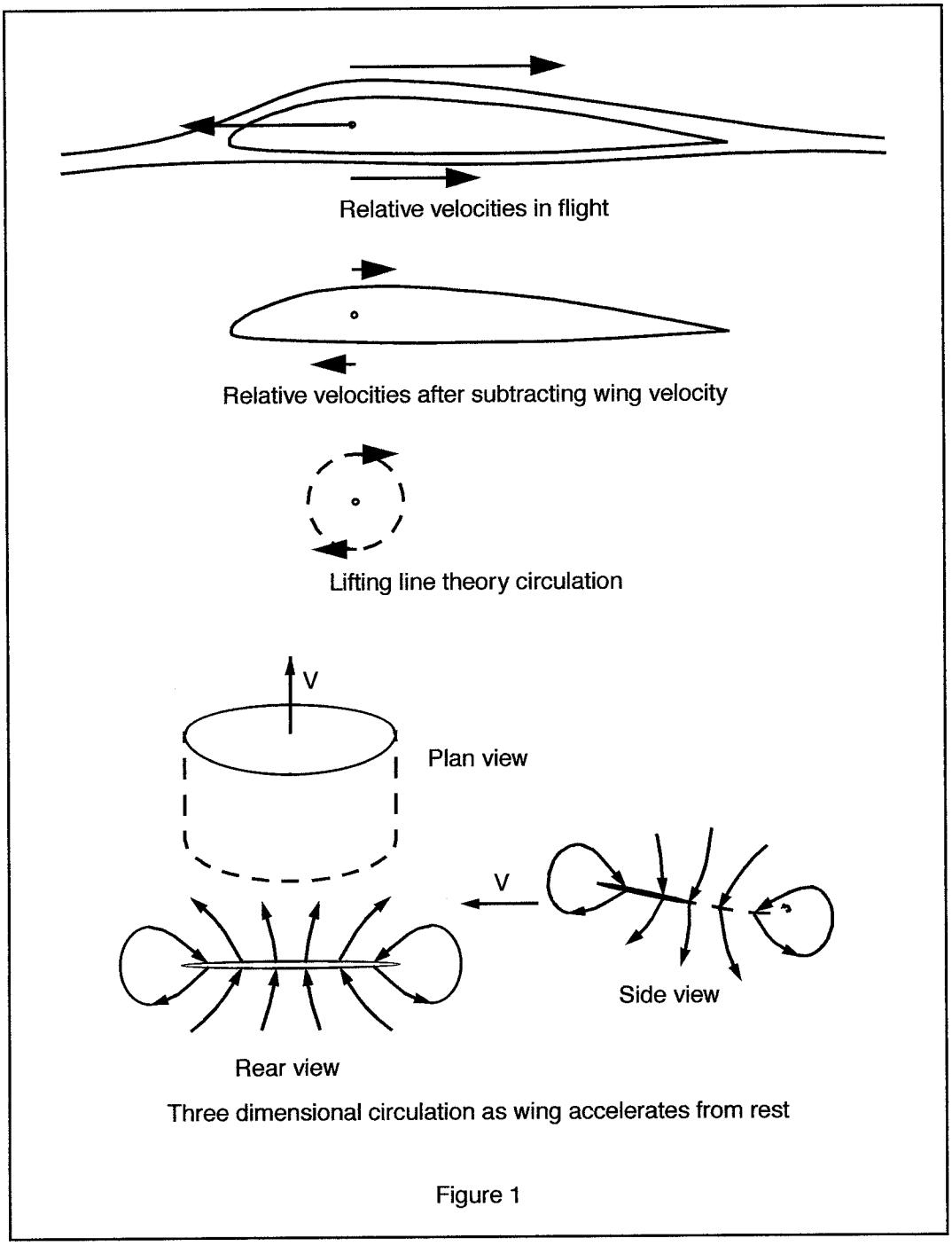


Figure 1

twist distribution is a rather complicated affair, and we've been so far unable to obtain formulae of use to modelers. Mathematically inclined readers may be interested in Reinhold Stadler's paper, "Solutions for the Bell-Shaped Lift Distribution."

Culver

Unfortunately, Irv Culver did not write a comprehensive treatise on his twist formula. Rather, his description of its use is sparse, and its derivation not explained in any detail. Still, it is possible to understand the general thoughts behind Culver's paradigm. Although Culver did not specifically mention the "middle effect," he did realize that lift of a swept wing is depressed in the area of the root. To compensate, some amount of up trim is required of the outboard elevons, depressing the lift generated by that area of the wing as well. Performance is substantially reduced as a result. In Culver's view, the ideal is to make the center portion of the wing produce more lift and thereby allow the wing tips to create more lift. At the design coefficient of lift, the lift distribution is near elliptical.

Another digression... The most simple method of creating a twisted wing is to use a single foam core and root and tip templates. Twist is then imparted by setting the two templates at the appropriate angles relative to each other. Cutting with a tensioned hot wire always creates a wing with straight leading and trailing edges. This is quick and simple, but the angle of twist does not change consistently across the semi-span. Rather, the angle changes at a more rapid rate near the root for wings with no taper, and near the wing tip if the wing is moderately tapered. As Culver uses wings with moderate taper in an effort to better achieve an elliptical lift distribution, it is the latter situation which Culver wants to avoid.

In an effort to compensate for the loss of lift in the center area of a swept back wing, Culver proposes placing most of the twist in the inboard 30% of the semi-span, say eight degrees. Three more degrees of twist are then imparted in the outer 70% of the semi-span for a total of eleven degrees. The increased angle of attack at the root increases the lift in that area. This allows the up trim of the elevons to be reduced, increasing the lift in that area as well. The Culver twist therefore requires constructing the semi-span of a foam wing in two parts rather than as a single panel.

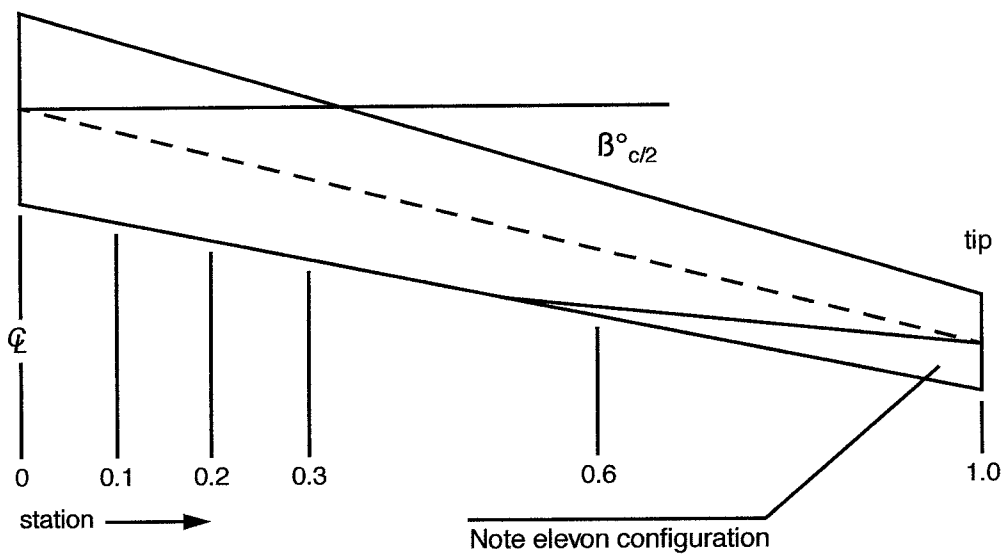
As the sweep angle is increased, the Culver twist distribution calls for more twist. As the Culver twist distribution is aimed at maintaining an elliptical lift distribution at the design coefficient of lift, this is in keeping with the increased upwash which is anticipated will occur over the outer portion of the wing.

In flight, specially designed elevons are used to trim for low coefficients of lift. As the aircraft approaches a stall attitude, the root will stall first while the wing tips remain well below their

Culver Twist Formulae:

$$\alpha^\circ_{RT} = C_{L_D} \times \beta^\circ_{\frac{1}{2}C} \times \pi \times \left(1 - \frac{1}{AR+1}\right) \times \frac{1}{\left(\frac{2\pi}{1+\frac{2}{AR}}\right)}$$

$$\alpha^\circ_S = \alpha^\circ_{RT} \times \left[(1 - station)^{\left(\frac{AR+2\pi}{2\Pi}\right)}\right]$$



Where:

C_{L_D} = design C_L for twist computation

AR = aspect ratio of the complete wing

ß° = sweep angle of the c/2 line in degrees

α°_{RT} = total twist angle of the zero lift (α_{L0}) lines from root to tip in degrees

α°_S = angle of the zero lift (α_{L0}) line at any station relative to the tip zero lift (α_{L0}) line in degrees

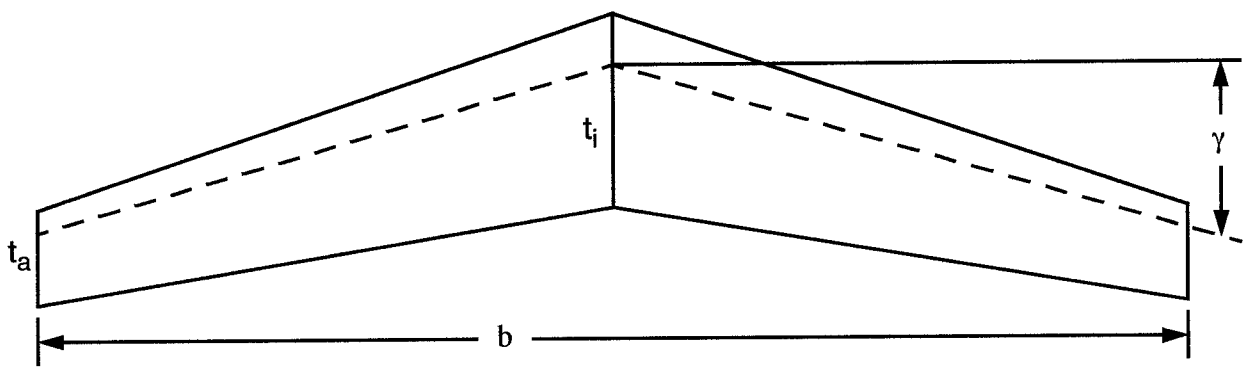
$$(1 - \text{station}) = 1 - \left\{\frac{\text{distance out from ℄}}{\text{span/2}}\right\}$$

Notes: Method works best with taper ratios which approximate elliptical chord distribution and with moderate sweep angles (around 20 degrees). C_{L_D} should be 0.8 for machines designed for speed, 1.0 to 1.2 for high performance sailplanes. Elevon configuration imposes little drag penalty when trimming for flight at lower C_L values.

Panknin Twist Formulae:

$$\alpha^{\circ}_{total} = \frac{(K_1 \cdot C_{M_i} + K_2 \cdot C_{M_a}) - (\overline{C}_L \cdot St)}{1.4 \cdot 10^{-5} \cdot \lambda^{1.43} \cdot \gamma}$$

$$\alpha^{\circ}_{geo} = \alpha^{\circ}_{total} - (\alpha_{L0root} - \alpha_{L0tip})$$



Where:

b	= wing span
t_i	= root chord
t_a	= tip chord
λ	= aspect ratio, b/t_m
γ	= angle of sweep back, measured at quarter chord
C_{Mi}	= root moment coefficient
C_{Ma}	= tip moment coefficient
$\overline{C}_L$	= aircraft coefficient of lift
St	= static margin, decimal value
τ	= t_a/t_i, taper ratio
t_m	= $(t_a + t_i)/2$, average chord
K_1	= $1/4 \cdot (3 + 2\tau + \tau^2)/(1 + \tau + \tau^2)$
K_2	= $1 - K_1$

Note: K_1 and K_2 are factors derived by Schenk and depend on taper ratio

Notes: Assures pitch stability for given static margin only. Gives designer full control over airfoil choice and other parameters. Accurate over a wide range of taper ratios and sweep angles, including forward sweep.

stall angle. This makes a full stall across the entire span very unlikely.

There are a few limitations to the Culver twist distribution: it is accurate only for wings of modest sweep and taper, and the recommended design lift coefficient is for very high compared with other methodologies, particularly that of Dr. Walter Panknin. Since the Culver twist distribution is based on maintaining a near elliptical lift distribution, adverse yaw may be noticeable, particularly around the design coefficient of lift.

There are reports stating that swept wing aircraft utilizing the Culver twist distribution are both spin-proof and tumble-proof, and there is also at least one report stating the Culver twist distribution was incorporated into the wings of a number of Boeing commercial aircraft. These reports have not been corroborated by secondary sources, and it should be noted that Boeing commercial aircraft are of conventional tailed configuration and utilize both roll spoilers and rudder to counter adverse yaw.

A six meter (236 inch) span swept wing model using an approximation of the Culver twist distribution was constructed in Germany in 1987. The Stromburg 'wing utilized the Eppler 220 for the outboard portion of the wing and the Eppler 210 at the root, and had a sweep angle of 28.5 degrees. The twist angle at the root was 11.5 degrees, going to zero degrees at station .167 and remaining at zero degrees to the wing tip. Elevons consisted of "Junkers flaps" from station .833 outboard. This model performed extremely well, and was large enough to have a movie camera mounted at the CG and directed at the center section. Films taken during flight showed no air flow separation at the root during cruise, turning, high speed flight, or landing.

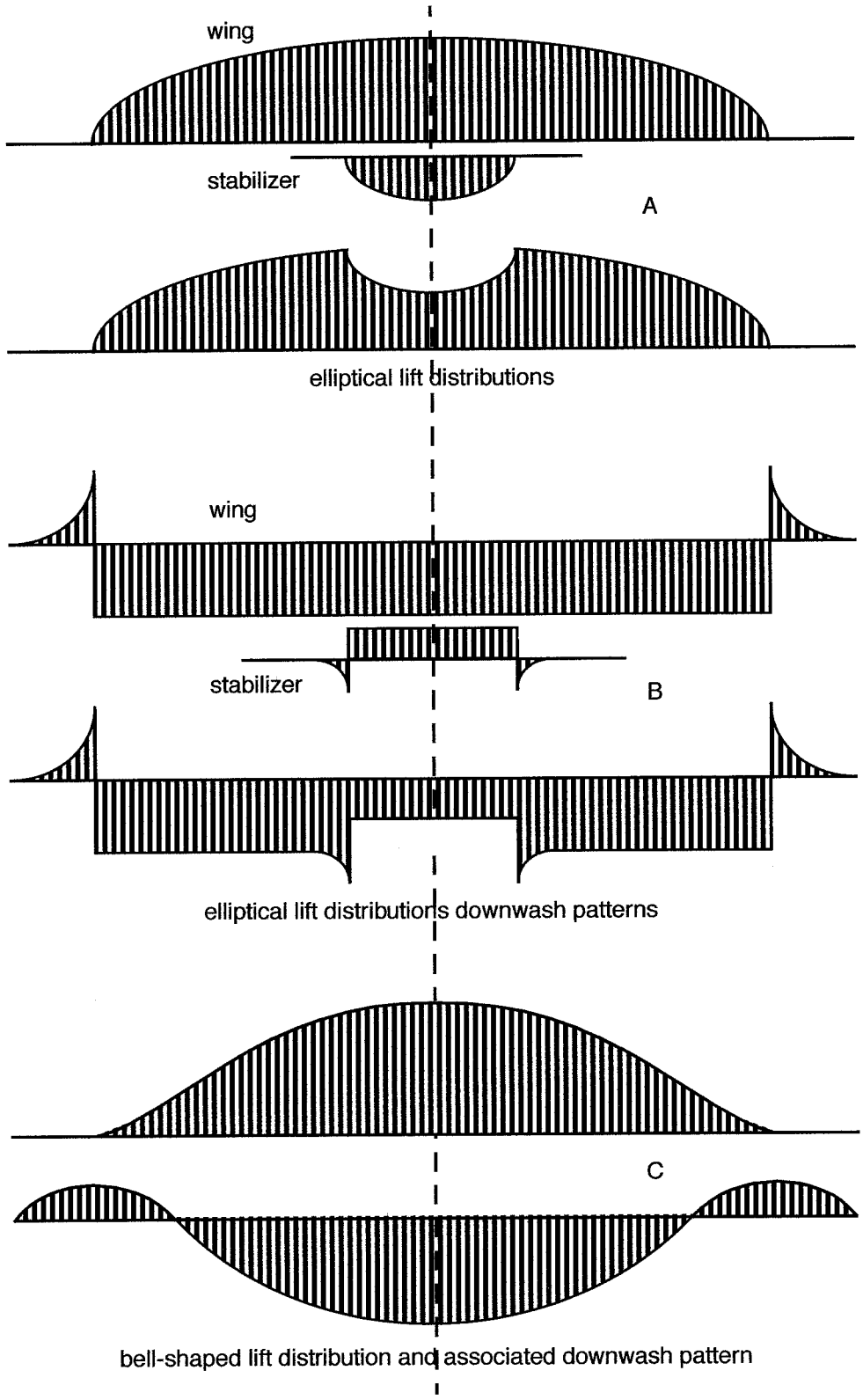


Figure 2

Panknin

Dr. Panknin derived his twist paradigm from a paper by Helmut Schenk. Using airfoil zero lift angles and pitching moments, span and chords, sweep angle and static margin, a pitch stable tailless aircraft can be assured. The method relies heavily on Multhopp's approximation of the lift

distribution, but includes a correction by D. Kuechemann so that it has good accuracy for sweep values for zero to beyond 30 degrees. (Schenk states the "middle effect" still exists using these calculations.)

The Panknin methodology provides only the total twist required for longitudinal stability for a given monolithic wing with straight leading and trailing edges and a predetermined static margin. The computed twist values have been proven in practice to be extremely accurate for sweep angles of up to 30 degrees, tapered or constant chord wing.

Like the Culver formulae, the Panknin method lends itself quite easily to both custom written computer programs and commercially available spreadsheet software. In fact, a scientific calculator is sufficient when there are no time constraints. The defined twist angle can be used on a moderately tapered wing using the foam core construction method described previously, with straight leading and trailing edges from root to tip. Successful applications, however, include planforms with constant chord in which the twist begins at station 0.5, half the semispan, placing more of the twist over the outboard portion of the wing.

All of Dr. Panknin's designs, and our own designs based on Dr. Panknin's paradigm, incorporate winglets. These vertical surfaces assist in reducing oscillations in yaw in straight and level flight and act to reduce adverse yaw at the expense of some increase in drag. As we've stated in previous columns, thermal machines seem to climb better with winglets, racers track better with a single vertical fin mounted on the centerline.

Conclusions

All three twist distributions have both positive and negative aspects.

The Horten twist distribution is based on the work of Prandtl and others, and has been supported by the more recent works of R.T. Jones and Klein and Viswanathan. The Horten paradigm has the potential to reduce induced drag and eliminate adverse yaw, but is computationally intensive and the twist distribution itself must be used in combination with a number of additional planform attributes.

The Culver twist distribution is centered on the elliptical lift distribution. This is a conservative approach which provides relatively low drag and good efficiency within a confined design point, but may be prone to adverse yaw, particularly when operating at the design coefficient of lift.

The Panknin twist distribution has proven itself over a nearly two decade period to be an accurate determiner of both required wing twist and center of gravity location. It has been used with great success by a very large number of international designers. Its major limitation is that it calculates only the twist required for pitch stability, but it can be used as a fundamental method of determining the approximate minimum twist required for a preliminary design.

Figure 2A shows the elliptical lift distribution for a conventional cross-tailed design as seen from behind. The fuselage and vertical surface have been neglected. Figure 2B shows the downwash pattern this lift distribution produces. Keep in mind the internal structure of the wing is required to support both itself and a fuselage and tail structure. Additionally, the fuselage must be strong enough to support itself and the mass and aerodynamic loads of the tail.

These factors, taken in combination, paint a picture of a relatively heavy aircraft with substantial surface and interference drag. Additionally, there is the surface and induced drag of the separate relatively low aspect ratio horizontal and vertical stabilizers. In flight, large amounts of drag are created in an effort to make coordinated turns. Given this perspective, the possibility of more efficient aerodynamics, as seen in Figure 2C, is obvious.

While a specially tailored single surface wing may be necessary to achieve this goal, a well integrated design approach for tailless aircraft is certainly very close, as demonstrated by the recent articles by Katherine Diaz in Pilot Journal and Carl Hoffman in Popular Science. It is only a matter of time before such design paradigms and appropriate construction technologies are available to modelers.

When designing a tailless planform, the type of twist distribution to be used should be one of the first decisions to be considered, and always relative to other aspects of the design such as prescribed task, design lift coefficient, and planform. There are a number of design "flowcharts" available to assist the novice designer, and we very much encourage readers to investigate their usefulness. The information presented in this series can be used to augment these resources and assist in developing viable, and perhaps cutting edge, designs.

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, complete:

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

Anderson, John D. Jr. Introduction to flight. McGraw-Hill, New York, 1985.

—. Fundamentals of aerodynamics. McGraw-Hill, New York, 1984.

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, Andy Kecskes, editor, No. 148 October 1998, No. 149 November 1998, No. 150 December 1998. TWITT, El Cajon CA.

—. Manned flight - past, present, future. TWITT Newsletter, Andy Kecskes, editor, No. 190 April 2002. TWITT, El Cajon CA.

Carmichael, Bruce. Personal aircraft drag reduction. Self published, San Clemente California USA, 1995.

Coffey, Aaron. Culver twist distribution spreadsheets. <http://www.b2streamlines.com/Culver.html>

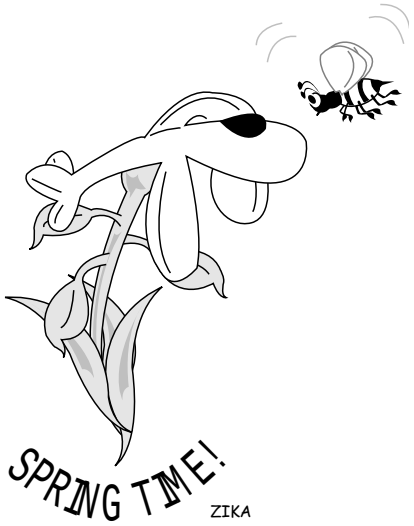
Culver, Irv. Tailless -flying wings. TWITT Newsletter, Andy Kecskes, editor, No. 201 March 2003. TWITT, El Cajon CA. (Reprint of article originally published in No. 4, September/October 1986.)

de Piolenc, F. Marc. Flying wing design flowchart. TWITT Newsletter, F. Marc de Piolenc, editor, No. 2 July 1986. TWITT, El Cajon CA.

Diaz, Katherine. The call of the wild. Pilot Journal, May/June 2003, pp. 78-87. Werner Publishing Corporation, Los Angeles.
Dommasch, Daniel O., Sydney S. Sherby and Thomas F. Connolly. Airplane aerodynamics. Putnam Publishing Corporation, New York, 1951.
Donlan, Charles J., compiler. An interim report on the stability and control of tailless airplanes. NACA Report No 796, 1944.
Eppler, Richard. Airfoil design and data. Springer Verlag, New York, 1990.
Ewald, Bernd. Will we have a Horten flying wing in the air again? VGC News No. 104, Winter 2000. Vintage Gliding Club, Somerset Great Britain
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>
Fonteneau, Glyn. Panknin twist distribution spreadsheet. <http://www.b2streamlines.com/Panknin.html>
Galè, Ferdinando. Tailless tail. B2Streamlines, Olalla Washington USA, 1991.
Harrison, Joa. Panknin twist distribution spreadsheet. <http://www.b2streamlines.com/Panknin.html>
Hoerner, Dr.-Ing. S.F. and H.V. Borst. Fluid-dynamic lift. Hoerner fluid dynamics, Vancouver Washington USA, 1985.
Hoffman, Carl. The shape of wings to come. Popular Science, October 2003 and <http://www.popsci.com/popsci/aviation/article/0,12543,483523,00.html>
Horten, Dr. Reimar. Lift distribution on flying wing aircraft. Soaring, June 1981, pp. 40-42.
Hurt, H.H. Jr. Aerodynamics for naval aviators. Published as NAVWEPS 00-80T-80 by the U.S. Navy, 1965.
Jones, Bradley. Elements of Practical Aerodynamics, third edition. John Wiley & Sons, New York, 1942.
Jones, Robert T. Notes on the stability and control of tailless airplanes. NACA Technical Note No. 837, 1941.
_. The spanwise distribution of lift for minimum induced drag of wings having a given lift and a given bending moment, NACA TN 2249, 1950.
—. Minimizing induced drag. Soaring, Oct 1979, pp. 26-29.
—. Wing theory. Princeton University Press, Princeton NJ USA, 1990.
Kermode, A.C. Mechanics of flight. Pitman, London, 1980.
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.
Kuechemann, D. A simple method for calculating the span and chordwise loading on straight and swept wings of any given aspect ratio at subsonic speeds. R.A.E. Reports and Memoranda Nr. 2935, August 1952.
Lennon, A.G. "Andy." R/C model airplane design. Motorbooks International, Osceola Wisconsin USA, 1986.
Kirschbaum, Nathan. On-the-board design progression. Aircraft Design Education Newsletter, W.H. Mason, editor, Vol. 2, No. 1, December 1, 1991. Blacksburg VA.
Masters, Norm. Correspondence within <http://www.nurflugel.com> e-mail list, 2000-2003.
Maughmer, Mark D. The design of winglets for high-performance sailplanes. AIAA 2001-2406, Washington D.C., 2001. <http://www.mandhsoaring.com/articles/Winglet_Design.pdf>
—. About winglets. Soaring, June 2002, and <http://www.mandhsoaring.com/articles/WL-Soaring.pdf> (133K)
— and Peter J. Kunz. Sailplane winglet design. The Pennsylvania State University, University Park. Presented at the XXV OSTIV Congress, Saint Auban, France. <http://www.mandhsoaring.com/articles/ostiv97.pdf>
—, Timothy S. Swan, and Steve M. Willits. The design and testing of a winglet airfoil for low-speed aircraft. AIAA 2001-2478, Washington D.C., 2001. <http://www.mandhsoaring.com/articles/Winglet_Testing.pdf>
McCormick, Barnes W. Aerodynamics, aeronautics, and flight mechanics. John Wiley and Sons, New York, 1979.
Morris, S. J. Integrated aerodynamics and control system design for tailless aircraft. AIAA-92-4604, Washington D.C., 1992.
Multhopp, Hans. Die berechnung der Auftriebsverteilung von Tragflügeln. 1938.
Munk, M. The minimum induced drag of airfoils, NACA Report 121, 1921.
Nickel, Karl, and Michael Wohlfahrt. Tailless aircraft in theory and practice. American Institute of Aerodynamics and Astronautics, Washington D.C., 1994.
Nurflugel e-mail list. Correspondence from multiple authors regarding elliptical and bell-shaped lift distributions, June 18 through June 26, 2003.
Panknin, Dr. Walter. Flying rainbows. Proceedings MARCS Symposium 1989. Al Scidmore, editor. Madison Area Radio Control Society, Madison WI, 1990.
Perkins, Courtland D. and Robert E. Hage. Airplane performance, stability and control. John Wiley & Sons, New York, 1949.
Prandtl, L. Applications of modern hydrodynamics to aeronautics. NACA Report 116, 1921.
—. Uber Tragflügel des kleinsten induzierten Widerstandes. Zeits Flugeltechnik und Motorluftschiffahrt, Vol. 24, pp. 305-306, Nov 1933.
Raymer, Daniel P. Aircraft design: a conceptual approach. AIAA Education Series, Washington, DC, 1992.
Schenk, Helmut. Laengsmomentenrechnung beim Nurfluegel-Modell. Self published, Pforzheim, Germany, publication date unknown (acquired 1996).
Schönherr, Prof. M. Das Stromburg-Prinzip — Ein versuch, 7 Nurflügelprobleme zu lösen. Faszination Nurflügel, Hans-Jürgen Unverferth, editor. Verlag für Technik and Handwerk GmbH, Baden-Baden Germany, 1989.
Schrenk, Oskar. A simple approximation method for obtaining the spanwise lift distribution. NACA Technical Memorandum No. 948, 1940.

Shevell, Richard S. Fundamentals of flight. Prentice-Hall, Englewood Cliffs NJ USA, 1983.
Simons, Martin. Model aircraft aerodynamics. Argus Books, Hemel Hempstead Great Britain, 1994.
—. Airflow. AE Press, Melbourne, 1984.
Smith, H.C. "Skip." The illustrated guide to aerodynamics, second edition. TAB Books, Blue Ridge Summit Pennsylvania USA, 1992.
Stackhouse, Don. Correspondence within <http://www.nurflugel.com> e-mail list, 2000-2003
Stadler, Reinhold. Solutions for the bell-shaped lift distribution.Self-published, 1996. <http://www.nurflugel.com/Nurflugel/Papers/h_ca_01e.pdf>
Sutherland, Alasdair. Basic aeronautics for modellers. Traplet Publications, Worcestershire UK, 1995.
Thies, Werner. Eppler-Profile, MTB 1. Verlag für Technik and Handwerk GmbH, Baden-Baden Germany, 1983.
Tucker, Chuck, J. J. Quinn, Barnaby Wainfan and Walter Boyne. Flying wings. Flight Journal, October 2003, pp. 24-44. Air Age Inc., Ridgefield CT.
Wegener, Peter P. What makes airplanes fly? Springer Verlag, New York, 1991.
The White Sheet, Spring 1986, No. 36. Sean Walbank, editor. White Sheet Radio Flying Club, Dorset Somerset Great Britain.
Wills, C. Horten - the truth. VGC News, (Part 1) No. 105, Spring 2002 pp. 40-42, and (Part 2) No. 106, Summer 2002, pp. 36-38. Vintage Gliding Club, Somerset Great Britain.
Wooldridge, E.T. Winged wonders, the story of flying wings. Smithsonian Institution Press, Washington D.C, 1988.

■



Hidden Treasure in the Balsa Dungeon

by Paula Garwood

Attention ladies, there is valuable stuff in your RC flyer's workshop.

I call my husband's workshop the "balsa dungeon." Early on, I was a little pissed because he put so much work into building the benches and putting up shelves and lights and electrical outlets, but I soon found myself down there snooping around and finding all kinds of cool supplies and tools, not to mention what an efficient work space for those tasks you want to protect your carpet from.

I am a crafter, thread bender, artist. I'm always trying out new techniques. I'm also the yardman, handyman, plumber, painter, carpenter, and maid at our house. The treasure in the balsa dungeon has made my life easier. Some of the items hidden down there were so cool or so useful to me I had to have my own - like the heat gun. I wore out three of Dave's heat guns so he finally bought me my own. I also had to have my own Dremel tool and balsa strip cutter, mini files, small plane, drill and bits, and miniature pliers set. Sharing can be over rated.

I'll list the tools and supplies I've used over the years and what I used them for, but feel I have to tell one little story about how my husband and the tools in the balsa dungeon saved my sanity.

I had broken a bone in my foot and had a walking cast. It wasn't too bad, I could get around and even drive my standard shift car. I was supposed to wear the cast for six weeks. Well, after five weeks and five days I went completely nuts. I couldn't stand the cast one minute longer. It was itchy and hot and uncomfortable and the cast was making sleep almost impossible. I was TOTALLY freaking out and had to have the cast off IMMEDIATELY. After calling the doctor and getting permission, Dave sawed my cast off with the Dremel tool and prevented my head from exploding.

Specialized adhesives:

- **Tan carpenter's glue**: fix furniture, fix broken wooden knitting needles (I break a lot of knitting needles), bind handmade books.

- **Goop®**: fix flapping soled sneakers, seal the base to the dome of handmade snow globe.

- **CA**: fix deeply torn fingernails, also keeps cuts "too deep for a Band Aid" closed, repairs broken pottery and dishes - and all in about 30 seconds.

- **Epoxy (and epoxy fillers like milled fiberglass)**: fix handmade wooden knitting swift for winding skeins of yarn (basically had to fill a worn wooden threads and re-bore so the swift could be clamped to a table). This repair saved and beautifully hand crafted wooden tool that would have been expensive to replace. Repair antique chair that had chunks of wood missing, preventing broken parts from interlocking and supporting the seat. Used epoxy and micro balloons for "creating" missing wood.

Drill – I probably drilled a thousand holes in the house and in projects over the last 20 years.

Soldering tools - fix broken jewelry, make new original jewelry, fix the wiring on the clothes dryer.

Small saws, files, X-acto® knives, pliers, large and small screwdrivers - cut and shape small, delicate items, cut out stencils, emergency orthodontia repairs. Excellent for working with polymer clay before and after curing.

Specialized tape - wrap packages, bind or repair books, seal gaps between the window frame and air conditioners. The special Mylar™ tape that the flyers use to hinge the ailerons or flaps or whatever those control panels are on the wings is also great for hinging anything. It's one of my favorites.

Heat-shrink tubing - fix circular knitting needles, encapsulate soldered or glued stuff (like knitting needles or washing machine wiring harness).

Small clamps (holding items while glue sets up) - convenient for fixing frames, book bindings, all the obvious "hold this" stuff.

Dowels - make knitting needles, curtain rods, quilt hangers, furniture repair, plugs for when you goof and "measure once and drill twice."

Heat gun - dry paint, remove paint, remove labels from boxes and envelopes so you can reuse them, remove stamps that didn't get postmarked for reuse. Shrink plastic wrap for gift baskets. For those "in the know crafters" shrink Shrinky Dink®

lighted bench in the laundry dungeon. Like I said before, sharing is over rated.

Now ladies, don't think for a minute that this is a one-way street. I showed Dave the joys of using a hot-melt glue gun, and I keep him in waxed paper and paper towels. I say support The Old Man so that he keeps buying glue and dowels and sandpaper and the stuff we need.

■

artifacts. Melt embossing powder for rubber stamping, dry the ink when rubber stamping.

Covering iron - fuse covering for book/journal making. Use with fusible web to repair wallpaper -anything you might want to use your iron for on a vertical or small surface or something you don't want to use your regular iron for since you use it on your clothes. Be careful though, it doesn't have the sophisticated temperature control that your "domestic" iron does.

Dremel® rotary tool - buff stuff, sand small places on furniture or your wooden creations, remove orthopedic casts (maybe to get your doctor's permission).

Balsa Strip Cutter - for cutting masking tape into 1/4" strips for quilting guides.

Scroll Saw - easily cut wood (dowels to 2x4s) for craft projects or home repairs.

Mini Plane - shape and rough finish polymer clay projects to save on the sanding.

Sand Paper - sanding anything or everything.

I have become such a frequent visitor to the balsa dungeon, that I started to nag a little about more "bench space" for myself. I did manage to get Dave to "light up" my side of the basement so that I now have my "own" well-

30TH ANNUAL
TANGERINE
SOARING CHAMPIONSHIPS

ORLANDO, FLORIDA

NOVEMBER 29 - 30, 2003

SATURDAY, NOVEMBER 29: UNLIMITED & RES THERMAL DURATION
SUNDAY, NOVEMBER 30: UNLIMITED & RES THERMAL DURATION

AMA Sanctioned Event

THREE CLASSES IN UNLIMITED WITH
DAILY AWARDS TO 3RD PLACE IN EACH CLASS

ONE CLASS IN RES WITH DAILY AWARDS TO 3RD PLACE

UNLIMITED OVERALL CHAMPION

RES OVERALL CHAMPION

CONTEST MEMENTOS

RAFFLE PRIZES

***** PRE-REGISTRATION PREFERRED *****

SPONSORED BY:

ORLANDO BUZZARDS
R/C SOARING SOCIETY
(http://www.orlandobuzzards.org)

“The Sloper’s Resource”

Greg’s Brian McLean Extreme crusing over Lake Michigan. Photo: Mirko Bodul.

By Greg Smith of slopeflyer.com
greg@slopeflyer.com
http://www.slopeflyer.com

Dave Garwood recently sent me a note from a guy who is just learning to fly R/C and how he found happiness at the slope after the frustrating experiences he had trying to learn to fly with electric powered R/C planes. It reminded me of my experiences learning to ski in the Midwest. FYI, I learned to fly R/C at the slope in the early ‘80s so I can only share by association the frustrations of learning to fly any other way!

Here in the Midwest we obviously get snow, and we have hills, so it seems that learning to ski should be a no-brainer. Problem is the hills are all small, 300 vertical or less, and just when you start getting the hang of it, you are at the bottom! Then, wait in line 10-15 minutes to get back to the top, forget what you just learned and do it all over again, falling most of the way. Didn’t help that the snow was really more like ice.

Out West, the scenario is totally different. Thousands of vertical feet mean you get a lot more time to ski on your way down and as you get up from each fall you find yourself being able to go longer between falls because you can get at it again right away. I learned more about skiing in two days at Heavenly Valley in California than in 3 years of face plants in the Midwest.

And so it goes with R/C flying. Sloping is like that beautiful mountain at Heavenly Valley; you get a lot of airtime without all the peripheral distractions like charging the motor battery or gassing up the plane just to be in the air for 5 minutes. Then, you have to start all over. In the 20 minutes of prep time between flights you can forget a lot! At the slope picking up the EPP wing and tossing it back out in the lift is like getting up on the ski slope after a fall with 3 more miles of run left. You’ve got a long time to learn. You can learn more at the slope over a weekend than in a whole season at the local power field.

Sure, people do learn to ski in the Midwest, it happens all the time. Just like people learn to fly R/C at the local park or at the power field. However I can’t help but think that the joy of flight is somewhat diminished by the frustration that accompanies all the hassles that go with learning to fly in an environment where the reward for all your hard work and prep time is a 3 to 5 minute flight and, likely as not, a plane you have to repair after that short period of time. It will also probably take more time than the 10-minute ride to the top of the ski hill to repair that plane and have another go.

BTW, I have a nominee for a great first slope plane: the Weasel from Richter R/C at www.flyweasel.com. It was extensively reviewed, and construction notes were reported, in *RCSD*, a couple of months back so you may have already heard of it. I have been flying one for a couple of months now. One cool thing about the Weasel is it is a great advanced pilot’s plane too. Just move the CG back and it goes from stable, predictable beginners plane to a super aerobatic performer. I have had it in winds as light as 4 and as heavy as 25. I even had a chance the DS it on a recent trip to South Dakota! It always works well. It is also one of the easiest planes to fly inverted that I own. It lets me fly when I otherwise could not and at slopes that are not suitable for any other plane. All this in a 36-inch span glider that stows anywhere! Cool!

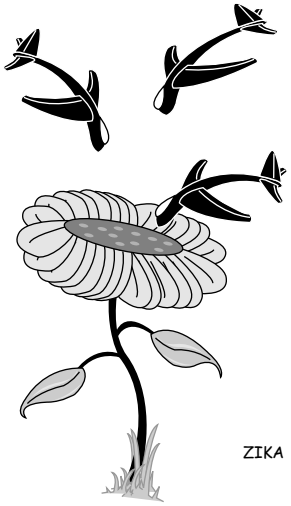
Me and my Weasel at the Big Bay slope in Mlwaukee. Photo: Mirko Bodul.

Time to wrap it up. Until next time, here is a little thought for you courtesy of the New York Slope Dogs: Talk's Cheap, Let's Fly! ■

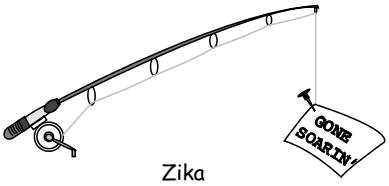
This month's links:

Richter R/C –
http://www.flyweasel.com

McLean Extreme –
http://www.mccomposites.com



The wind finally started to pick up here in Milwaukee and we have had a couple of good days at the slope recently. Besides flying the Weasel regularly, I have had some great flights with my molded McLean Extreme. Brian has a winner with this one! The new Extreme would definitely be at the top of my list if anyone ever gave me the dreadful ultimatum, "You can only have one slope plane for the rest of your life; which one is it going to be?"



GORDY'S TRAVELS

Gordy Stahl
Louisville, Kentucky
GordySoar@aol.com

Home in
- On the Range... Check!

We often have heard about how important doing a simple range check is to check up on our transmitter's connection to our sailplane's receiver and, pretty much, we all know how to do it... But that was the good old days.

I recently had one of those months, definitely a trip I hope I never experience again. Two brand new molded planes destroyed after just a few flights.

I had heard of planes having reception problems due to high carbon content in their fuselages but most of the reports were from Europe. Now I guess that makes sense, because Euro's tend to only fly molded planes with mostly carbon fuselages and, until recently, we flew mostly Kevlar fuselages.

It seems the worst signal 'blanking' problems occur in planes which use a coarse weave, sort of like burlap, cross carbon/Kevlar weave. The material seems to create a 'choke' which kills the transmitter's signal in the receiver's antenna, in effect cutting its length.

And that means lost range.

I went to the web site focused on the molded planes I had, and read the comments and articles about how it was important to route the antenna outside the fuselage... But since "I" knew so much about the hobby, I didn't really read the articles in detail. And I didn't believe their advice; more importantly I didn't do a range test... Actually I never have, not once in all my time in the hobby.

So, I lost the first model almost on the first day of flying. I was getting glitched but the plane seemed to be flying okay. Until I got a little further away and it went in hard.

I remembered something about having the antenna outside the fuse so, on the next model, I ran it outside the canopy and along the fuselage tail boom – but again, no range check.

I flew this one a few times and it had some problems, but it seemed to fly far out okay. Then finally it went in. Fortunately, it landed in a hay field and sustained pretty minor damage.

That night I went back to the web site and read the notes more carefully. The first thing I found there was this note:

> " Don't run the antenna out the canopy. It's almost as bad as running it in the fuse!"

Dup! After reading more, I found that they had done lots of real world testing, finding alternative routings for the antenna. One key factor in their success was to get the antenna not only outside the fuselage but 'away' from the fuselage.

I also heard from some other guys here who had run into the problems with range with the same model. Now don't even think it's just this particular model, because I have since heard of other models using the same weave material. Some guys in Denver had the same plane but the 'light' version which mainly had a lighter wing with only the area forward of the spar made of carbon. They had found that they could use the 9th pin of their 9 pin D connector to route the antenna into each side of the wing. They also found it didn't work on the full carbon lay-up wing that I had.

I was pretty fed up with guesses, so I decided to figure out my own 'range test'. I own a Picalario Talking Altimeter which has a glitch warning feature. That means if the servos get to jiggling, a lady announces, "Attention, Attention, Attention." This meant I had a tool to specifically gauge range loss during a 'standard' range test.

I went to the park, set up the plane in my Super-Stand, and sat down to think about the best way to perform the range test. I decided that I needed to find a benchmark to start from - a set up that would provide me with an antenna down, measured distance.

I figured that if I took the receiver out of the plane, and then plugged in 6 servos and battery, with the antenna hanging free of any obstruction, that should be the cleanest possible set up for my distance range test.

With the Picalario plugged, I paced off 350' before I got an "Attention." Wow! I had tried a test the way I had been flying it and that produced about 35'.

The web site mentioned the best they had found was to run the antenna in the fuse, exiting the fuselage top just behind the trailing edge of the wing, adding at least the amount of wire that was inside to the wire extended outside. Then, to run the wire up to the top of the vertical stabilizer, letting the rest trail behind. Uck! But better than losing the plane, so I decided to add about 20" instead of just the 10" in the fuse, then to trim back till it affected

the optimum range.

Okay, so with all of the on board stuff hooked back up, the RX in the plane, and the antenna routed in the fuse to just behind the wing to exit, extended that 20", I began my tests.

Each time I got the optimum, I would trim off an inch. I didn't want a bunch of wire flopping around the back of my plane. Sure enough, I got to where the antenna was 2" longer than the tiptop of the vertical and I still had full range.

Just to double check, having it taped to the outside of the tail boom would have a negative effect on range, I taped it along the boom, with the excess dangling. Almost all that range was lost.

The wire's total length ended up being almost exactly the same amount that was inside the fuselage.

It's not the good ole' days anymore, things have changed, definitely for the better. Those fuselages are super stiff, light and durable, but they can cause some radio range problems if not understood and measures taken to insure clean reception.

If you have one of the new breed molded planes, take the time to set up with the RX and servos outside the fuselage. If you don't own a Picalario, just have someone stand by your model to signal you when they see a problem. Move only one surface consistently, and then start counting your paces to find your system's optimum potential range. Load everything back inside, including the antenna wire as you have in the past. Then do the test again to see if you have been actually enjoying the best possible range.

Your TX antenna (top mount) should be completely collapsed, which will leave only the first segment extended. 'Inny' mount antennas, which collapse completely into the TX, leave one segment up, about 6".

The idea is to find out what the best possible range is, then to try to reach that with your antenna location.

Things like carbon or steel pushrods, powerful servos are also considerations for decreasing range. Using Torrodial Rings (iron rings), electronic chokes, etc., can cut down on jiggles caused by signal feedback from long servo leads and power wing servos; but jiggles can also be an indicator that it might be wise to get more serious about antenna placement.

PCM radios 'mask' interference and signal loss, creating a sort of ignorance is bliss situation for some modelers. Do your range testing with a non-PCM system. Then, once you have determined your best receiver antenna location, reinstall your PCM.

Our sailplanes are expensive but mostly they are hard to replace; it's worth it to take some extreme precautions to protect them. Give it a try and I think you'll be less likely to 'stumble' with your next soaring adventure.

Oh yeah, I said, "Two new molded sailplanes destroyed." The second one worked so well that I flew the battery out. I guess I still have a lot to learn.

Coming down the road is a review on a new FM, Channel Synthesized, Digital Signal Processing, Micro 8 channel Receiver, which allows you to pre-scan the frequency you are set on to see if someone else is on that frequency. It will also allow you to maintain control of your model if someone else turns a TX on your frequency!

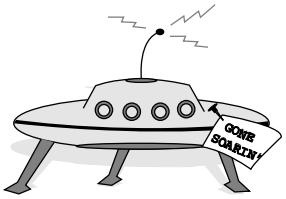
See you next trip!

■

SCHEDULE OF SPECIAL EVENTS

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

Please send in your scheduled 2004 events as they become available!



ZIKA

Please read no further unless you are interested in AMA Politics.

By Dr. Sandy Frank
- AMA Life Member #L-69
105 N. Brazos
Weatherford, TX 76086-3207
Phone/Fax: (817) 599-7131
E-mail: sfrank69@airmail.net

NOW it is Executive Council (AMA Board of Directors) election time in the AMA District VIII region.

Each adult AMA member (almost 19,000) who reside within the states of: Texas, New Mexico, Oklahoma, Arkansas and Louisiana will be sent a ballot (to save outgoing postage this ballot is enclosed within their 2004 membership renewal paperwork).

It is NOT required that you submit your 2004 membership renewal at the same time as your ballot. In fact your renewal and your vote MUST be sent to separate locations to be properly processed (AND COUNTED).

Each year literally thousands of AMA election ballots are improperly sent to the AMA Headquarters enclosed within their membership renewal.

(Some have told me that they thought that they were saving AMA postage by sending these together by enclosing their ballot within their membership renewal paperwork.)

This is NOT at all THE CASE as YOUR VOTE MUST be sent to a separate address where the auditors independently tally the votes. So PLEASE use the postage paid postcard to cast your ballot - just mark it and drop in into the mail. (It is pre-addressed and postage paid and will get to the auditors.)

IF YOU ENCLOSE YOUR BALLOT WITHIN YOUR RENEWAL PAPERWORK AND SEND IT TO AMA HEADQUARTERS IN MUNCIE, INDIANA IT WILL NOT BE COUNTED AND WILL BE DESTROYED.

The 2004-2006 term of office for the AMA Board of Directors (Executive Council) will set the course which AMA takes into the 21st Century.

Your input via your vote is needed and important!

Elsewhere you will be seeing the political rhetoric and campaign promises of all the candidates in this election!

Please read it to help you choose who to vote for... Or if you choose to, please contact the candidates directly and personally to ask any questions which you may have of them and their candidacy.

(I gladly publish my contact information and would be HAPPY to discuss this election with anyone at anytime!)

Historically only 10% to 12% of the eligible membership votes in these elections.

Many just do not BOTHER to VOTE!

So please vote! Your vote is needed and important!

It is by YOUR vote that you can express how much you really care about your AMA organization, and its mission and its goals and its objectives.

Please read no further unless you are interested in AMA Politics...

Please read no further unless you are interested in AMA Politics...

Please read no further unless you are interested in AMA Politics...

HERE is where I stand and WHAT I stand for!!!

And please consider the following...

sfrank69@airmail.net wrote:

Hello,

I am Dr. Sandy Frank of Weatherford, TX. I am seeking your vote for re-election as your AMA District VIII representative to the AMA Board of Directors. In that capacity, I will continue to insure that your thoughts, concerns, and issues are brought forward for consideration by the entire AMA Executive Council. The 2004-2006 term of office will continue to steer the course for AMA into the 21st Century.

Please vote.

I have been an aeromodeler since my earliest recollections, an AMA member since 1957, and have built, flown, competed with and enjoyed, all types of C/L, F/F and R/C model aircraft. As a child, I was taught about modeling and over the following 39 years I have learned and experienced the personal fulfillment of AMA volunteer work at the local, regional and national volunteer levels.

As a means by which to better serve the AMA members and all modelers of District VIII, in 1999 I conceived, organized, and produced the first Southwestern Aeromodeling Conference in Arlington, TX. (SWAC 2003 - Oct. 3rd - 4th) All profits will once again go to AMA projects and initiatives (within the 5 state region of AMA District VIII).

I have been successful in my personal career as a Licensed Psychologist (Ph.D.) and have owned and operated a private practice, but am now semi retired. My record on Council for the past six years is solid proof of my extensive leadership, management, and representational skills. I can, and will, continue to devote the time, energy, and effort required to represent "YOU" well to the AMA Board of Directors.

Your vote is needed and important!

I will support no dues increases or AMA instigated lawsuits. I will continue to place local modeling support (especially flying site assistance) as AMA's highest priority, and work to even further open communications between the AMA and all of its members.

Your vote for me will be a vote for progressive and dynamic representation of each and every member of District VIII, and sincerely appreciated. I am available 24 X 7 X 365 to assist you!

■

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

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