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R/C Soaring DIGEST

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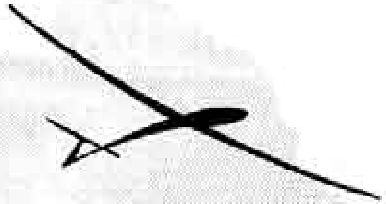
R/C Soaring Digest

A publication for the R/C sailplane enthusiast!



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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 submitted 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. He can be reached at: 210 East Chateau Circle, Payson, AZ 85541; (602) 474-5015.

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The Soaring Site

Well, this issue finds us in Texas, knee deep in boxes. We are receiving mail that is being forwarded from the old address in California and it appears that most of the mail is finding its way to us. Our move was relatively smooth with only a 1 1/2 hour delay in leaving California and moving into our new residence!!! A big thanks goes to some special people who made this happen: Craig Sparks (Texas RE/MAX Real Estate), Pete Torrey (California Century 21 Real Estate), Allied Van Lines driver Rick Lawrence, and Gordon Jones who dropped everything at the last minute to fly out to California to help us move and was rewarded with a long three day drive back to Texas. Of course, there were a lot of other folks who deserve a special thanks, as well. With this writing we realize that this issue of *RCSD* may be mailed a week later than usual, but we hope you understand. A special thanks to those of you who have been patiently waiting to hear from us! Our new phone numbers are included in this issue.

About the Cover

We received a note from Jim Bonk of Farmington, Connecticut. He says, "Us Easterners have fun and pretty sunsets, too! This photo was taken at the Seascape Motel on Cape Cod in October. Yes, the same Seascape that Sal DeFrancisco mentioned in a past issue of *RCSD*. Pictured left to right: Mark Lowell, Tony Benson, and myself."

Looking for Scale Pilots?

Lee Murray of Appleton, Wisconsin, says, "I contracted with a lady selling hand painted scale pilots to make me a 1/6 scale pilot for the ASW-20. He will have a blue jump suit and have a sailplaner's cap. The sailplaner is a little different than what she normally sells, but I specified size, eye color, hair color, clothing, clothing colors, glasses, etc. She can even make larger scale pilots with glass eyes that really look like people. Her business is Handpainted Pilots, 2911 Sunray Lane, Green Bay, Wisconsin 54313; (414) 434-6263."

Vacuum Bagging & Composites Workshops

Gail Gewain of Composite Structures Technology dropped us a note about new workshops that are in the mill. She says, "We are planning to hold vacuum bagging and composites workshops this summer at our facilities in Lancaster. The first one is scheduled for the first Saturday in May and once per month thereafter. We are limiting the size of the group so they must call for reservations! We will cover both the use of composites in modeling applications and actually wet out and vacuum bag a part. There is no charge for the workshop. Please pass the word along if you would please." Gail Gewain can be reached at P. O. Box 4615, Lancaster, CA 93539; (805) 723-3783 (phone/FAX).

Do You Have a Merlin?

Charlie Levasseur, 82 Healy Crescent, Winnipeg, Manitoba, Canada R2N 2S1 is looking for Merlin owners. He says, "Through *RCSD* I was introduced to Mr. Frank Weston of WACO in Maryland. I purchased a Merlin from him, have built it and flown it. I am extremely impressed with it and so are members of our club who tried it. I would greatly appreciate it if you printed an ad in the digest to let me hear from other Merlin owners out there in gliderland. I use a JR347 radio for my Merlin and am pleased with it. I would like to write an article for *RCSD* re the Merlin based on owner reports throughout North America. I believe this would make for a good article on high performance standard class sailplanes, which would be of interest to the readership. So let me hear from Merlin owners out there!"

Lots of Ideas

Nathan Phillips of Vancouver, B.C., Canada says, "Have been working on lots of ideas, lately; the hotter topic: vacuum bagging, of course. Good success with strong, light stabs by using one layer of 1/4 oz. carbon fiber mat (for larger size stabs use 1/2 oz. mat) full width and span, and one layer of 2 1/2 oz. glass on the bias (for wings use two layers, one on the bias and one straight across). Produces a very strong and light structure at a reasonable cost! Also, one coat of wax or mold release on the mylars, then a couple of light coats of paint (spray cans of enamel or 'acrylic' enamel work fine); let it dry and proceed with bagging. The wet epoxy bonds to the paint and actually interacts with the paint giving a smooth, almost scratch-proof finish! No covering required, no paint primer needed, and very little weight added. If you are using florescent paint or bright colours, mix a little white pigment into the epoxy. This gives a nice base or backing to the paint and the colours come out quite bright."

F.Y.I. - Model Flight™

Don Edberg is working on his new book and has written to say, "I am in the process of collecting data for my new book, **F.Y.I. —Model Flight™**. This is a book following in the spirit of F.Y.I.—Quiet Flight™, with its intensive lists of radio control, construction supplies, tools, hobby supplies, soaring and electric kits and accessories, and miscellaneous products. **F.Y.I. — Model Flight™** has broadened its scope to ALL flying models, including R/C, FF, and U/C. It will list as many of the current model aircraft manufacturers and sources that I can get my hands on. There will be a "yellow pages" containing sources by category, white pages of alphabetical company listings with product and ordering information, detailed tables and lists of model airplane products, as well as lists of hobby shops and model clubs. I would appreciate if you could inform your modeling industry readers and advertisers that a mailing was made in February to all the sources on the database, which currently contains **over 1,500** of these manufacturers and sources! However, it is possible that some have evaded that list. Please inform those readers that if they did **NOT** receive any such mailing about **F.Y.I. — Model Flight™**, and would like to be listed free-of-charge, that they should send their catalog and/or price list to the following address: Dynamic Modelling, Attention: F.Y.I./New Sources Dept., 4922 Rochelle Avenue, Irvine, CA 92714-2941. I would like to repeat that there is no charge for being listed in **F.Y.I. —Model Flight™**, so a manufacturer has nothing to lose and everything to gain by responding to this request! The deadline for inclusion in **F.Y.I. — Model Flight™** is June 1, 1992. ■

One of Those Days

...by Brian "Tink" Tinkler
Westminster, California

Ever have one of those days? I did on Saturday.

I was flying my Quicksilver at Bluff Cove when the wind changed direction and the lift died. No problem, I confidently said to myself. Just turn her around and head back to the top of the ridge. Wait a minute. I'm sinking, FAST! Don't panic! To maintain airspeed just fly into that nice big bush just below the ridge line. OK! She's down! I walk over to where I last saw my beloved Quicksilver but, wait! Where the heck is she? I look high; I look low. I wiggle the control stick to see if I can hear the servos working. Spotted, she was slowly sliding down the ridge in one of those ravines of loose stuff. DARN! I get out my trusty slope ship grapple hook (a bicycle hanger hook on the end of a 4" length of 2x2 attached to a string), and start the recovery process. DARN, again! She just slid another 50' down the ravine.

After about an hour of this, and another 50-75' slide downward, I decide to bag the grappling hook and go down to the bottom of the hill and climb up to get her. So, I packed up my gear, hopped on the bike (Yes, I ride my motorcycle to the slope with my planes strapped to the seat.), and head out to find the base of the slope.

No sooner than I arrive at the base when I look up and there, traversing the side of the hill, is some guy and he's just about to pick up my airplane. I wave my hand (happen to be holding my Scooter in it at the time) to let him know, THAT'S MY AIRPLANE! He waves back and indicates he is going to climb back to the top.

About this time I've kissed my nice Futaba flight pack good-bye. No one in this day and age is going to wait until some idiot climbs back up the path to the top. Nooooo! I'm thinking, he's half way home with MY AIRPLANE!

But, wait; I come around the corner. No cars. My heart sinks. My plane is gone, I think. But, wait. There she is just sitting there on a rock waiting for me. The good Samaritan (notice how quickly my attitude has changed) is nowhere in sight. I can't even thank him.

I survey the damage; it's fairly extensive, but repairable. I strap her back on the bike and head home. Hope I don't do that again, or at least not for a couple of weeks. ■

Flying in Wind and Weather

...By Martin Simons

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South Australia 5069

Fallacies and forces in flight

Some grey bearded modellers who have been flying successfully for many years and who's advice on other questions is greatly respected, go completely wrong when they write or talk about flying in the wind. Far too often these people pass on their strange notions to beginners and the mistakes persist. Once a false notion has entered a pilot's mind, it makes the whole business of learning to fly, and soar, a sailplane very much more difficult. I suspect that many of the new comers who give up in despair, do so because they have been misled by someone who should know better.

From time to time erroneous articles are published in some of the most widely read modellers' magazines. This even applies occasionally to full-scale aviation journals but errors in such places are invariably corrected speedily by official bodies concerned with the safety of pilots and passengers. In model magazines the fallacies often tend to pass uncorrected. The misinformed will very possibly become upset when their long-held beliefs are challenged. However, we are not dealing with matters of personal opinion, but with well established and demonstrable fact. If required, I can supply, for anyone who is anxious to improve their understanding in this area, ample authoritative literature to support the arguments presented.

Nothing in what follows contradicts or in any way ignores what was said in previous articles about wind gradient effects, and gusts. All such matters have to be remembered and allowed for. A model at any time, in straight flight or in a turn, may be upset to some extent by rough air, and if flying near the ground will be within the wind gradient and subject to all the problems associated with this. If neglected, these effects will cause accidents but do not change in any way whatever the basic principles of flight.

Airspeed and groundspeed

Fatal accidents in full-sized aviation are sometimes caused by pilots on windy days judging airspeed by looking at the ground. One of the classic accidents in sailplane flying, indeed in all flying, is to stall and spin at the end of a downwind leg, or on the final turn, when approaching to land. It is natural at such times for the pilot in the cockpit to be looking at the ground, to judge position relative to the intended landing spot, rather than attending to the sound of the airflow, the feel of the controls and the attitude of flight, or the airspeed indicator. The ground moves by below quite fast and as it comes closer it seems to move even faster. The inexperienced pilot subconsciously eases back on the stick. When pilots of full-sized aircraft behave like this, they stall and crash. Fortunately, those who have been well trained know better and **do not judge airspeed by watching the ground.**

The difficulty for model fliers is that we stand on the ground. Assessment of airspeeds is more difficult than for the pilot who is actually in the aeroplane. Mistakes by us are rarely fatal but many crashed models result. **Do not judge airspeed by the model's motion over the ground.**

What the ground-based observer sees is not disputed. It is in the interpretation that people go wrong, and the bad advice that is given that causes crashes. As Figure 11 indicates, when flying downwind the speed of a sailplane (or any other aircraft whatever) over the ground is the airspeed plus the wind speed. Heading the other way, against the wind or, as we

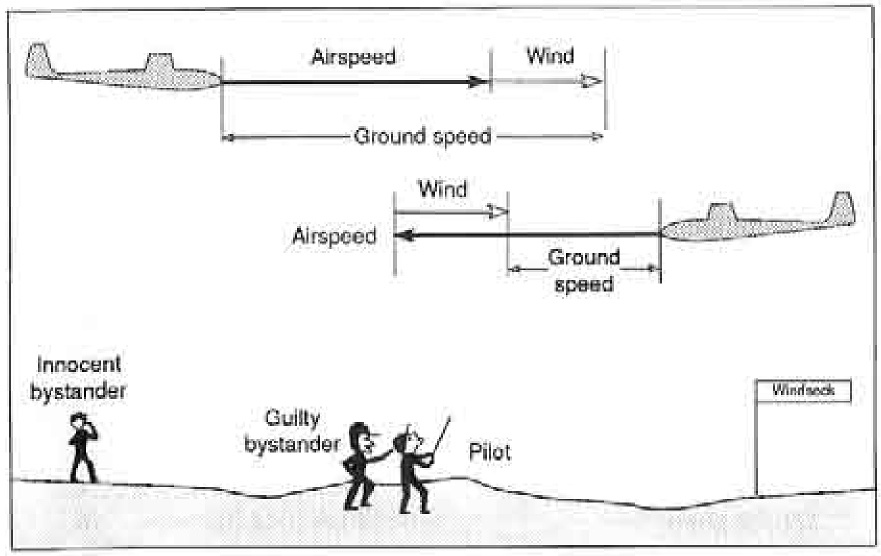


Figure 11 Airspeed and groundspeed

say, upwind, the speed of the model over the ground is the airspeed minus the wind speed. Since the pilot is standing on the ground, inevitably the sailplane moves **relative to this standpoint** faster if it is flying downwind, and slower if it is going upwind. Everyone sees and agrees that the model, viewed from a fixed position on the ground, moves fast in the one direction and slower the other. This is not an illusion. If the wind is blowing at a steady 5 m/s, then if the model is trimmed to fly at 10 m/s **airspeed**, when heading downwind the glider will have a **ground speed** of 10 + 5 = 15 m/s, which looks fast. With no change of trim, when going into wind the same model will have a speed **over the ground** of 10 - 5 = 5 m/s, which will look slow from the ground.

If the wind speed happens to equal the airspeed, when facing into wind the model stands still or 'hovers', which slope soaring sailplanes frequently do. If the wind is 10 m/s and the flight speed is 10 m/s, the model will not move forward relative to the ground when flying upwind, but will travel at 20 m/s if it turns the other way. Any aircraft may do the same on a day if it happens that the wind speed is the same as the selected and trimmed airspeed.

But airspeed is **airspeed**. Groundspeed is not airspeed.

Flying across the wind direction.

In Figure 12, the effects of wind when flying crosswind are shown. This might be a sailplane 'crabbing' along a soaring slope, or a model flying on the base leg of a circuit before landing. Viewed from the ground, the model appears to move somewhat sideways and some people are confused by this, thinking that there is actually a sideways flow of air over the model. I have even heard a modeller of long experience say that he would not turn his sailplane to fly across wind if he could possibly avoid it, because the air blowing sideways across it would create a lot of drag. If the model is correctly trimmed and controlled, there is no such cross flow. The airflow remains always from nose to tail unless the pilot deliberately or accidentally causes a slip or skid. Viewed in plan, as the diagram shows, the wind merely causes the track **relative to the ground** to slant. The air in which the model is flying is moving as a whole across the landscape at the speed of the wind, but what counts is the air-

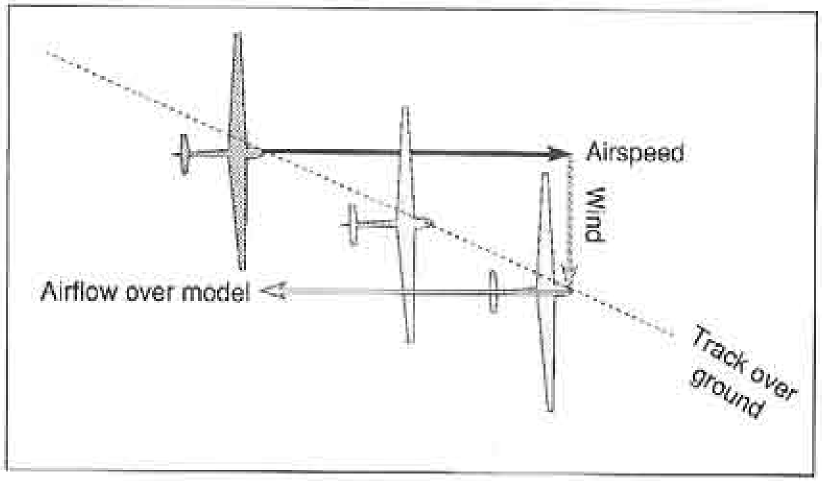


Figure 12 Flying in cross wind

speed of the model within this package of air. More follows with respect to slope soaring, in a later article.

All these effects are very like those affecting a motor boat in a river. The speed of the boat through the water is determined by the engine power setting. Going upstream against a current, those on the boat see the river bank passing by more slowly than when they are going downstream at the same **water** speed. If we are in the boat, we do not confuse water speed with ground speed because we can see or even feel the water flowing past whatever the river bank seems to be doing. At a certain power, a boat can match its speed upstream to that of the current, and then, relative to the bank, it stands still, which is equivalent to the 'hovering' glider. But the water still flows past the hull from bow to stern. Going downstream, with the same engine power, the boat's water speed is the same but because the current is also present, the river banks go by faster.

Turning across the stream, the current drifts the boat so that it does not arrive at the place the bow is pointing. The navigator has to allow for this by offsetting the course. The screw drives the boat through the water and the flow of water is from bow to stern, not sideways, even if the current and the consequent offset is quite pronounced. Certainly the landlubber watching the boat sees it moving at a somewhat sideways angle relative to the river banks, but this view from the shore does not make the water flow sideways past the boat.

So with aeroplanes and gliders. If a correctly trimmed model is flying across wind, the flow is from nose to tail just as it is at other times. To make a certain track over the ground, such as along a soaring slope, or from point A to point B in a cross country flight, the pilot must lay off the heading, like a boat crossing a flowing stream, but the airflow still remains from nose to tail.

What often happens is that the pilot of a radio controlled model is very conscious of the wind felt on the face, is possibly terrified by misleading advice muttered by the guilty bystander, so starts fiddling with the controls and sometimes thereby induces the very thing it is hoped to avoid. The **groundspeed does not inform the pilot of the airspeed or the direction of flow over the wings.**

Turning upwind and downwind

When the matter of turning in wind arises, those who misunderstand often begin to talk with pseudo learning about inertia and momentum, potential and kinetic energy, suggesting that the model flying downwind has excess momentum so that when it turns the other way, this causes a marked pitching up, due to a sudden transfer of kinetic into potential energy, speed into height.

Certainly one often sees a sailplane come out of a turn when coming in to land, surge upwards, very probably stalling at the top of this upward movement, and then crashing. The correct explanation of this common event has a great deal to do with airspeed in turns and coming out of turns, but has nothing whatever to do with the wind. (The true explanation appears below. Of course, some crashes are caused by turbulence, as has already been discussed.)

A pilot who thinks that turning from downwind to upwind is going to produce a sudden gain of height because kinetic energy, is going to crash because there will be no such gain.

Yet it has been claimed in some articles, loaded with formulae and tables of figures and long words, in more than one otherwise respectable and widely read model magazine, that if an aircraft turns from the downwind direction into wind, it will gain something like a hundred feet, even in a fairly gentle breeze. The corollary was also claimed, that turning downwind will cause a sailplane to come down a similar amount. This is simply untrue. It is hard to understand how anyone who has ever actually flown a model, could make such a claim. Anyone who has ever flown an aeroplane or glider through a complete 360 degree turn knows perfectly well that, if properly trimmed, it does not swoop upwards scores of feet and down again, as it goes round. It would hardly be possible to fly any kind of aircraft, and certainly not a model sailplane, if anything of this kind happened. The mathematics sometimes used to bolster up such strange claims, are demonstrably, misapplied and preposterous. There is danger in using equations if these are based on fundamental misunderstandings.

Equally hard to comprehend, it is quite often claimed that certain wing sections, especially the Clark Y and all its relatives, exaggerate the effect. Such ideas are totally mistaken.

The purveyors of the false information should ask themselves, or be asked, why no qualified flying instructor uses these strange ideas, why no professionally trained pilot learns or applies them in flight, why no reputable aeronautical engineering of flying textbook anywhere includes them. Why do they form no part in any examination for airmen and flying licences or gliding certificates? The reason is, **they are wrong and dangerous.** How likely is it that the entire world of professional aeronautics remains ignorant on such important matters as making turns on windy days, while the strange article in a modelling magazine, or the muddled model flier whispering into the beginner's ear, has the right story? Are the professionals ignorant, blind and stupid? If so, there would be huge heaps of wreckage on the downwind side of every aerodrome and gliding field in the world, every day!

If a turn is correctly flown at the appropriate angle of bank and with the model in suitable trim, the direction of the wind makes no difference whatever. Accidents happen when the model pilot thinks that the elevator should be moved this way or that according to the wind felt on the face and the groundspeed, rather than airspeed, of model. ■

Winch Line

...by Gordon Jones

Gordon Jones, 214 Sunflower Drive, Garland, Texas 75041; (214) 840-8116

Foam Wing Construction - Part 5

Now that the wing has been sheeted it is time to do all the trimming, cutting and fitting. Now is the time to proceed carefully and do your best work. More mistakes are made hurrying at this stage than any other, because you can see the light at the end of the tunnel. Care and forethought is the name of the game.

Carefully sand off the excess sheeting material back to the foam core along the root, tip and leading edge. This is best accomplished with a large sanding block using heavy grit paper. Be sure to sand straight so as not to sand into the foam. I generally use the edge of my work table, which is a door with a nice straight edge. I also mark a line along the edge I wish to sand, using the foam core as a guide, as a reference so I don't go too far.

To make a nice straight trailing edge measure the length of the root of the wing panel to the correct length and do likewise with the tip. Mark both locations on the wing panel. Do the same thing with the other panel and then butt the panels together to be sure that they match. (Be sure to butt the tips together so that these match, as well.) You should have a straight line across both panels that are at the correct angle to the root. This will depend on the sweep of the trailing edge of your planform. If the planform calls for a straight trailing edge simply use a T square to ensure a straight line from both wing roots and align the panels so that the straight trailing edge is achieved.

If there is a forward sweep to the trailing edge, measure the angle of sweep in inches forward. Stand the two panels root end down and measure the points of the two tip trailing edge locations to ensure that they match. Mark this location on the wing panel tips. Next, lay a straight edge along the inside of the two points that you have; draw a reference line between the root and tip reference marks.

Once the reference lines have been marked on the two panels and they match, lay the straight edge on the inside of the reference line. Then, cut the excess trailing edge material off. When this is accomplished measure the two panels to ensure they match (either straight or forward sweep). After you are satisfied with the trailing edge alignment, sand the trailing edge reasonably sharp. Don't sand them to final shape until you are ready to final sand the wing so you eliminate some hanger rash.

After the edges have been sanded back to the foam (except the trailing edge), measure and cut the spruce, or balsa if that is what you will use, leading edge pieces to length for each wing panel. Glue the leading edge pieces in place on the wing panel.

When the leading edges have dried, sand them to the airfoil shape. Be careful not to sand into the sheeting material on the wing. A neat little trick here is to place a piece of masking tape along the sheeting just inside the leading edge. This will allow you to sand the leading edge and when you start sanding the masking tape you know it is time to slow down and be careful.

Now it's time for the ailerons and flaps. There are several theories as to the size of ailerons and flaps, and most of them make sense. Some designers use a percentage of the wing cord to figure the aileron/flap line, while others use a straight dimension across the entire trailing edge. Either system works well and it boils down mostly to individual preference or building style. If you are using the percentage theory, the most used percentage is 20 to 22% of the wing chord. Just figure 22% of the root and mark it; then figure 22% of the tip and mark this point. Then draw a line on the wing joining the two points and you have your

aileron/flap line.

Measure the aileron and flap line on the wing panels. Tape a metal straight edge along the opposite side of the aileron/flap line and carefully cut the ailerons and flaps from the wing panels with an X-acto knife. Or you can be lazy like me and set up the table saw and run the wing through the saw. This method has the advantage that if you use the right blade you will not have to trim for the caping material.

Measure the length of the aileron or flap and cut the aileron/flap section to the required lengths. This is another of those stages where there are many people with many ideas on aileron and flap lengths. Some use the 50/50 method and some insist that the flap should be larger. I have tried both and either will work very nicely. One method of obtaining equal size control surfaces is to cut them both at the same time. Use masking tape to hold them together while you do your cutting.

Next, carefully cut or sand the required angle into the facing of the ailerons. I have found it easiest to set up a block on the work table and use the edge of the work table as a guide to get the same angle into the ailerons. Also, it doesn't take much to get the angle in there as you really don't have to have much. The illustration below is a fair representation of what you need in the way of an angle. Be sure to allow for the capping material when you trim the ailerons.

Trim the control surfaces and/or wing panel as required to allow for the two pieces of 1/16" capping material. Be sure to do a little measuring here so that the gap is equal along the entire span before you put on the capping strips. Measure and cut the 1/16" capping material for the ailerons, flaps and wing panels. Remember to provide a little extra material on your cap strips as the control surfaces are angled. Glue the capping material on the ailerons, flaps and wing panels. When this is complete use light sand paper and sand the caps to the shape of the wing and control surfaces as depicted above.

If you are going to use balsa tip blocks, glue the balsa tip blocks on the wing tip panels. A nice idea that I got from Mark Allen is to lay a piece of 1/64th plywood on the bottom of the tip block so that it protects the tips from landing damage. Mark and lightly sand an area for the 1/64" plywood bottoms of the tip blocks. Cut the bottom plywood pieces to shape; then glue them to the bottom of the tip blocks. When the tip blocks have dried, sand them to shape.

Measure and cut 1/16" plywood control horns for the aileron and flaps. You can use the control horn off a set of plans for the size of the control horns; but remember that part of the horn will be imbedded in the control surface so it will be a little longer. Locate the position of the control horns for the flaps and ailerons in relation to where the servo wells will be located. Cut a 1/16" notch to accept the control horns at the proper locations. Install the control horns in the control surfaces with microballoons and epoxy.

Measure the location of the aileron and flap servos on the bottom of the wing panels. Mark this location and then make a cavity in the wing panel to accept the servos and mounting devices. A couple of hints/tricks here; you can use a Dremel Tool with a router attachment set to the correct depth to make some nice looking servo wells. First, make an outline of the servo well and if you desire you can even go so far as to make a template for the Dremel Tool to ride. Be sure to measure the depth of this cavity and take your time; you don't want to punch a hole in the top wing skin now. Also, if you are using a fairly thick airfoil, you can leave some of the foam at the bottom of the cavity and glue a 1/32 plywood plate on the bottom of the cavity for support.

At this point I want to introduce a neat method of making the troughs for the servo wires. I use an aluminum arrow shaft approximately 32 inches long to make the holes for my servo wires. I set the sheeted wing on a flat surface upside down and place weights on the panel to hold it in place. I check to see that the panel is level with the table. I then mark a line with masking tape on the panel as a guide for alignment. Next, I chuck the arrow shaft in the drill and carefully set the depth of the drill in relation to the wing using blocks. Once the alignment and depth are set I slowly drill through the end of the panel and on into the wing. While you are doing this you need to watch the arrow shaft for alignment with the wing. If you plan the line the drill will follow, you can make your holes at the top of each servo cavity thus allowing for a little extra room for any excess wire.

Trial fit the servo extension wires through the troughs in the wing panels. Make sure that you have enough wire to make any solder joints, if required. I have gotten in the habit of using aileron extension wires so that I don't have to do any soldering. This makes the job a lot easier and even though you may have excess wire you are assured of a good connection (one less thing that can go wrong with radio installation).

Mark two root ribs on 1/8 inch plywood using the sheeted cores as a guide, and then cut out the root ribs again leaving a little extra wood so that you sand to a perfect fit. Next, mark the location of all the exits (servo wire, carry through, etc.) on the root ribs. Then, carefully cut out the exit holes and check for alignment with the desired exits on the wing.

Using the 1/8" plywood root rib as a guide, mark the locations of the carry through, the servo wire exit, wing holding hook and alignment pin locations of the fuselage. Insure that the locations of each is the same on both sides of the fuselage. This is very important for alignment of the wing and fuselage. Now is a good time to install the carry through in the fuselage so that proper alignment can be achieved and you can get a good tight fit between the wing panels and the fuselage.

Lightly sand the wing root to provide a smooth flat surface that matches the fuselage. Trial fit the root ribs on each wing panel to insure the location of the exits is correct. Also, trial fit the wing panels against the fuselage to insure a good fit there, as well. Now is the time to make all these adjustments.

Measure and mark the locations of the blocks for the alignment pin block and the wing holding block on the root of the wing panels. Cut out a recess for each of these blocks in the foam of the wing panel. Trial fit each block to insure a good fit. Epoxy the alignment pin blocks and the wing holding blocks on the root ribs at the correct locations.

Carefully epoxy the root ribs to the wing panel roots. Insure that the root ribs are flush against the wing panels. An easy way to obtain a super fit is to use Saran Wrap between the fuselage and the wing panel and glue the root rib on with the root rib butted against the fuselage. Fill any gaps between the root ribs and the wing panels with epoxy and microballoons. When the root ribs have dried, carefully sand the root ribs to match the wing panels. Fill any dings or cracks with spackling compound and let dry. Then final sand the wing, the ailerons and flaps for covering.

Guess what guys; you are done except for the covering and installation of the servos, etc. As you can see it is not that hard to sheet a foam wing. Most of the steps take very little time and once you get the hang of it the entire process will zip along. There are other methods and sequences that other builders prefer; I have tried to give one view of these processes. If you can find shortcuts or methods you like better, use them; after all each builder has his/her own way of doing things and processes that he/she is most comfortable with. If you have any questions give me a call; I will be happy to help.

Happy Sheeting. ■

What are Good Rules for Flying Safely?

...by Doug Gilbert
Victoria, B.C., Canada

I'm writing from Victoria B.C. on the west coast of Canada. R.C. Sailplanes are very popular here and the enthusiasm is growing rapidly. We have a problem that I'm sure is common to other areas and I'd like to describe what we're doing about it and get some advice from some of the readers on what they're doing. The best site for cliff flying here is in a very popular park and is shared by joggers, tourists, sun bathers, kite fliers, hang gliders, dog walkers, and spectators. I've seen so many near catastrophes that I refuse to fly there any more, and as president of the local club try to influence others to do the same. This makes me really popular and makes for very heated debate. We are trying to solve the problem but it's not obvious how. Our approach is to consider a solution in two steps, the pilot and the plane.

We don't have the power to enforce any rules but for those who want to listen, we suggest a training program based on the LSF principal of "do it if you want to". The tasks we would specify would be something like this:

- A minimum of 10 flights on a cliff or from a field recognized as safe by MAAC or AMA totalling at least 200 minutes of air time.
- Landing 8 times out of 12 within a 20 ft. diameter circle.
- Demonstrating basic flight control such as figure eights and circles.

The pilot should also have at least one million dollars of personal liability insurance other than MAAC or AMA. We also recommend flying with a spotter to advise the pilot of people movement.

But, of course, cliff flying just isn't much fun unless we're pushing our flying abilities to the limit once and awhile, and when you throw in the odd wind shift and radio failure we have to conclude that we're going to crash now and again so our planes have to be able to hit people without serious injury (to the people). Is this possible to do with a plane that's fun to fly, ie. aerobatic and reasonable penetration? These are the specs we came up with but I don't want to redesign the wheel if someone else has already been through the process.

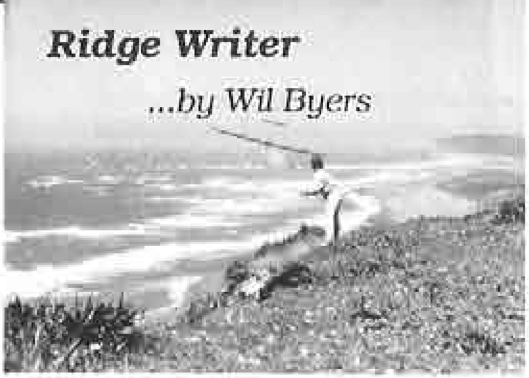
- Maximum flying weight of 24 oz.
- Maximum wing loading equal to the airfoil thickness in oz. (example: 10% thick airfoil = 10 oz./ft. wing loading)
- Wing must be held on with elastics.
- Nose must be made of soft rubber.
- Nose must be rounded to a minimum radius of 3/4".
- Leading edge of wing must be "crushable" or made of soft rubber.

Has anyone worked out a program like this that they feel comfortable with and made it popular enough to be effective? If we're experiencing this problem up here in our little city, surely you cliff dwellers down there in the "big crowd" who always seem to do things first worked all this out years ago.

Please write, or send an IBM compatible disk to: Doug Gilbert, 953 Arden Rd., Victoria, B.C., Canada V9B 5B4; ph. 604 474-4442. ■

Ridge Writer

...by Wil Byers



RT. 4 Box 9544, W. Richland, Washington 99352; (509) 627-5224 (7:00 PM - 10:00 PM weekdays, after 9:00 AM weekends)

Last month's column discussed pre-flight evaluations for landing a model successfully in a slope environment. The conclusion was reached, I think, that pre-flight assessments are essential if your R.C. glider is going to survive slope landings.

This month the focus is on the landing approach and the final touch down. So, let's assume you have already launched your aircraft and are cruising the model about the face of the hill. As an extra you are controlling it through world championship aerobatics. Finally, you will tire and be forced to land the model. The question then arises, "What is the best way to perform this crucial landing maneuver?"

Begin by realizing there is no absolute right way or perfect solution to the question of landing technique. The simple reason there is no perfect answer, is that the environment is constantly changing from minute to minute. There are even instantaneous changes which can toss the model about violently a fraction of a second before landing. I have had a model virtually flipped inverted while making a final approach and just twenty feet from the ground. In this instance the wind was blowing over 50 mph and the model had moved back into the rotor zone where the turbulence was vicious, making the glider uncontrollable. Nonetheless the experience serves as an example of the energy stored in the wind.

For those who don't know what a rotor zone is let's detour for a moment. A rotor is a condition that exists on the lea side of a hill or an obstruction to the air's flow. In the case of slope soaring it is usually associated with the down wind side of the slope. It may even be likened to the area of laminar separation on an airfoil. At any rate, when the air flows over a hill it separates and becomes turbulated. In this region of turbulence the air is moving in all directions. Sometimes it is moving down, then up, then back, and even forwards. As such, it can seriously effect the flying characteristics of the model. It can make the ship fly slow, or faster, or rise and, of course, sink. It is important to know that all of these effects are going to influence the model's relative airspeed. So, in this type of environment experience is a tremendous asset because it aids one in understanding what mode of flight the model **MAY** be in next.

Even though there are no absolutes in this business of landing, there are landing methodologies that work well for different conditions. And, because we have to start somewhere in this tutorial, we best start by defining the hill conditions. So, we'll start by saying the hill is reasonably good. Reasonably good meaning, it has a rounded face, an incline of ≈ 60 degrees, no trees or obstructions, and grass on the face (no rocks). In front of the slope the terrain is smooth and flat. Therefore, the river of air arriving at the hill is not turbulated. However, the wind is blowing from the left at ≈10 degrees with respect to face. As a result, the lift produced is traveling at a sheer angle, adding another dimension for the model to deal with. Also, this site does not have a landing zone on its lea side, forcing the pilot to land the model on the face of the hill.

Landing an R.C. sloper on the face of a hill is no small task. It can be tricky. This type of approach is multifaceted and requires skill and timing. One reason it is tricky landing in this fashion is because the model is landing in a region of lift. It would be easier if the model were flying in no lift or in the sinking air that is found on the lea side of a slope site. However, in this example, the model must land where air is rising up and over the hill and is consequently trying to keep the model aloft.

Another reason this style of approach and landing is difficult is because the wind velocity is working against the model rather than for it. Therefore, as the model approaches the hill it will have excess ground speed that is undesirable. Notice the term was ground speed. This is to say that a model flying down wind has a higher ground speed than one flying up wind or in still air. For example, suppose the glider has a flying speed of 20 mph and is flying in a wind of 20 mph. If it were to fly into the wind it could potentially have a ground speed of 0 mph. However, if the model was to fly down wind it would have to have a ground speed of 40 mph to maintain an airspeed of 20 mph. In other words the airspeed and the wind speed are additive. So, 20 mph airspeed plus 20 mph wind speed is equivalent to 40 mph in ground speed.

This is a very ticklish concept for any beginning slope pilots to understand because visually the model appears flying at the proper speed. However, all too often the pilot will fly the model slower than stall speed resulting in a down wind stall. And, a down wind stall can be characterized by lack of aileron, elevator, and rudder control. It may even result in the classic stall break where the aircraft's nose eventually drops. The stall is also often times accompanied by spin tendencies. Consequently, the pilot must control the model such that it is flying fast enough to allow good control response. Further, he should not fly it so fast that it stores a great deal of kinetic energy. Because if the glider is full of energy, that energy must eventually go somewhere; and that somewhere very well could be into the glider structure on touchdown, resulting in damage. So, manage the model's airspeed for the best controllability.

I would suggest you start the model's approach by flying it away from the slope. Next, get it below the location where you want to land. This may only be a few feet or a hundred feet; you will have to get a feel for this part because each slope is, of course, different. But, getting the model below the landing spot will allow it maneuvering room to establish that all important approach. Don't, however, get the model so low that it falls out of the lift band, thereby forcing you to walk to the bottom for a retrieve. Do get it low enough that it can climb the slope while riding the lift and establishing an accurate glide to the landing spot. This is important because if the model is higher than the landing spot it must dive to the landing spot (sounds like a thermal landing) and as such will carry extra speed and energy.

So, very importantly, keep the model flying at a normal flying speed. Don't dive the model down below the landing spot and then force it into a landing while still not having bled the speed generated from dive. Also, if the model has excess velocity, it could zoom or balloon up the face of the hill aided by the lift zone. As a result, it will become increasingly difficult to target the glider to the landing zone. Also, should the model encounter any object in its path, it will most likely cause damage. Therefore, get the model down below the slope and slow it down. You may have difficulty performing this feat at first, but practice controlling the model's airspeed is a very good R.C. glider fundamental. A suggestion to aid in this maneuver may be to spin the model to scrub altitude and then pull out gently. If done properly the model will exit the spin at a near normal cruising speed. Remember though to fly the model under control, with **you** in control.

Keep in mind while guiding this sleek beauty about the slope that the reason it is able to fly, in a slope environment, is the rising river of air flowing up and over the hill. Note also the glider must land while riding this buoyant mass of air. However, if you position your model low and slow you can use this rising air to advantage. After positioning the model comfortably low and slow, begin by guiding it towards the face of the hill and somewhat towards the landing spot. Use an approach such that the model is coming towards the hill and landing zone at ≈45 degrees and from the direction opposite the wind sheer. Flying at an angle opposite the wind sheer will help reduce the model's ground speed somewhat. While the model is flying its approach you must pay close attention to the direction of the wind. Watch for wind drift changes with respect to how the glider approaches and continually correct to any movement off the glide path.

Continue to fly the model along this predetermined path until it comes within approximately 50 feet of the face and the landing target zone. Begin implementing a turn such that the glider turns somewhat across the face of the hill. Reference the height of model with respect to the landing area. If the model rises too high for a safe and controlled landing, you should abort the landing attempt and go ahead with a fly bye and then try again. Importantly, don't force the landing which can result in increased speed and possibly damage to the model. Just utilize the lift and go around for another shot at the landing.

If all goes well, keep flying towards the landing spot until model is roughly 10 feet from touching down. Now begin to increase the ship's angle of attack. This will slow the model down as it approaches the hill. The ideal situation here would be to have the model stall just as it touched the hill. Keep pulling up elevator to bring the model into an angle of attack such that it is flying exactly parallel, with respect to wings and fuselage, to the hill just at touch down. If this is accomplished the glider should land with minimum speed while still under control, thereby escaping damage or worse.

This landing technique is based on timing and coordination ability of the pilot. He/She must judge all the environmental conditions and then control the model within them. This is the kind of technique that must be developed. It is also a style of landing that gives the pilot the option of going around for another pass. But, it is as well a landing that can be hard to perform, especially if the lift is strong and the wind is blowing hard. It is lastly a technique that can benefit greatly from some tall grass growing on the face of the hill. Grass that can act as a cushion to any high impact landings.

Slope Scene

I got a call from a Mr. Jess Walls the other day. He tells me and all of you via *R.C.S.D.* that his club in Arcata, CA is having a slope fun fly. The event is based around the KISS (Keep it Simple Stupid) principle. They are planning to host any type of model that one should want to enter. So, if you have a slope model and want to get together with a good bunch of guys, I suggest you contact them for a FUN day of slope flying. The C.D. is Daryl Pfaff and he can be reached by telephone at 707-445-3538. The event is named the King of the Bluff and is scheduled for May 16, 1992. ■

A One Design Slope Plane

...by Steve Savoie
Gorham, Maine

This is the first of three articles devoted to the development and construction of a club, one design, slope plane [Sea Hawk] by the Downeast Soaring Club of Portland, Maine. This article will be composed of the planning, design and ordering steps. The second and third articles will describe the mass production steps, group building efforts, and lessons learned.

This plane was the second, class plane produced by the club. The first plane, DSC1, was a high performance variant of the Southwind. The DSC1 introduced club members to foam core cutting and balsa sheeted vacuum bag wing construction. Other benefits from the DSC1 were the introduction of a fast airfoil [SD7037] and flaps to many of the club's fliers. Many lessons were learned during the planning and building process of the DSC1 and were implemented on the Sea Hawk.

The Sea Hawk was designed to give the flier an aileron plane for entry level slope that would develop flying skills for moderate slope lift and leading to one class slope racing. The plane needed to be very durable to withstand the sometimes tough landings experienced during the learning stages of slope soaring. It had to have an airfoil with a wide speed range to allow the flier to improve his/her flying [speed] skill and still be somewhat competitive for Club racing.

Introducing club members to new building techniques was another goal of the plane's design, and since some of the best slope winds occur in the winter building season it was felt that construction should be quick and not a long drawn out process. The building steps were planned to allow the builders to complete many of the construction steps at home on their leisure while requiring the group meetings to focus on the new construction techniques.

Another benefit of group construction is savings. The DSC1 with its Schuemann balsa sheeted 100" wing, balsa over ply fuselage, two rolls of covering, all hardware, and necessary adhesives cost each of the eleven builders $65. The cost of the Sea Hawk is estimated at approximately $50, minus electronics.

The design was based around a one piece 2 meter glass bagged wing with full strip ailerons. The wing cores were fitted with a simple 3/8" balsa spar extending 18" out from the root. Spectra [2 oz.] was selected for the leading edges and for wing half assembly. Nylon break away wing bolts [2] allow for quick reassemble if the wing were separated from the fuselage. The horizontal stab and vertical fin were constructed from 3/16" balsa inserted with a spruce spar.

A Bob Martin Durelene Fuselage [complete] was used to cut down both construction and repair time. Durelene is similar to the material used for wiffle bat construction but is a lot tougher and is guaranteed for up to one year after purchase for normal use and accidental crashes. The fuselage can be easily configured for either rubber band or bolt down wing attachment. The canopy is not raised above the wing and therefore not a target for a break-away wing.

To keep things simple, a fixed vertical fin was used instead of a rudder. One servo per aileron kept construction simple, reducing slop and allowing flapperon use, if desired, for landings. Because the plane was designed for intermediate slope, the wings did not have to be winch-proof; nor was a tow hook installed, though a molded recess was provided on the fuselage. Two airfoils were offered: S3021 and SD6060; most of the novices selected the SD3021 for its slower speed range.

We found it best to have just one person organize a project like this. It keeps confusion to a minimum and precludes overlaps or voids in material requirements. The first step was to get firm commitments from the club members to develop a final plane count. Once the final estimate per plane was developed, we added a few dollars to the individual plane cost for those small items that sometimes get overlooked. Any remaining balance can always be returned after the project is completed.

One of the toughest aspects of a project like this was the consolidation of materials to optimize bulk order prices and to keep the number of suppliers to a minimum, which reduces shipping and handling costs. Patterns were developed for sheet plywood and balsa orders. Material needs were developed by components group, such as wing bagging needs, tail group, control group, etc. The group needs were then consolidated together to minimize waste, and this is where the patterns came in handy.

The next task was to develop a building sequence and schedule. Three group building sessions were needed, along with separate groups which meet independently to bag the wings. The wing cores were all cut by two members to keep wing sets consistent and reduce the number of building sessions. Club members were previously exposed to making templates and cutting cores through the construction of the DSC1 so it did not appear to be advantageous to have each person cut their own wings.

Well that's about it for the planning stages. The next two articles will deal with the actual building of the plane itself. ■

Electric Falcon

...by Ed Slegers
Route 15, Wharton, New Jersey 07885

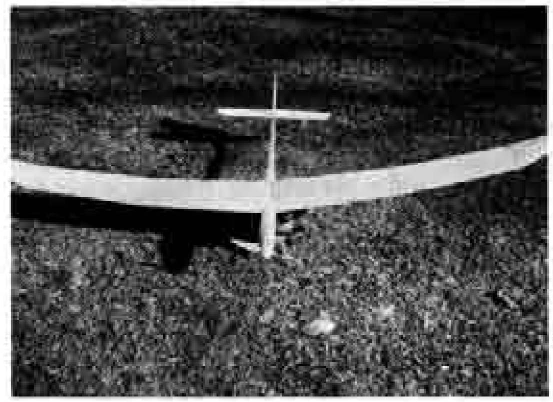
Two months ago I talked about a prototype electric sailplane from Flite Lite Composites. Now, it is available as a kit.

The electric Falcon (That's what I call it because it has no name yet.) is much like Flite Lite's other planes. The Falcon has foam wings covered in Obechi, a fiberglass fuselage and built-up tail.

There will be two kits available. One is an Obechi covered wing with aileron cutouts, capped leading edge, installed and sanded. The servo wire cutouts are in the wing, but the servo cutouts are left up to the builder because of the many different sizes of servos. The typical Falcon style tips are complete and sanded. All that has to be done is to join the center of the wings, add the tips and install the servos. Because of the higher weight of an electric sailplane, make sure to do a good job on glassing the center joint. I use a one inch wide strip of heavy cloth, then a two inch wide strip of medium cloth at a 45 degree angle and then another two inch wide strip of medium cloth at an opposite 45 degree angle. You could also use carbon fiber cloth. This may sound like a lot of work, but it sure beats watching a wing fold. Then, clear lacquer the wing. The fuselage needs very little work. Flite Lite's glass work is some of the best available. I left mine as is. The fiberglass and Kevlar look too pretty to cover with paint that just adds more weight. The motor mount and wing holddown plates are installed. All that has to be done is to install the servo in the rear of the fuselage. The tail is already built but has to be covered. The last thing to do is install the motor, speed controller, receiver and battery pack. Once everything is installed, slide the battery pack forward or rearward to get the proper CG. Once this is done put some scraps of foam around the battery to keep them from shifting.

Inside of .15 10 cell fuselage. White foam block behind batteries can be removed. Photo shows how much room there is for more batteries...as in F3E.

.15 10 cell aileron version



.05 7 cell polyhedral

The other version gives you more work, but costs less. The wing is covered with Obechi, but that's it. You have to install the leading edge and cut out the ailerons and cap them. Add the wing tips and build the stabs and rudder. The rest is the same as the deluxe kit.

Another kit should be available by the time you read this. This kit will have a polyhedral wing with the rudder and elevator servo in the fuselage. See photos of the polyhedral version. What makes this a great floater is that it will have an 80 inch wingspan and a total weight of 38 ounces with an Astro .05 FAI on 7-cell. The flight performance of this plane is excellent. This is the plane that I plan to fly at the NATS this year. I think for 7-cell thermal duration, it's about as good as you can get.

Another picture shows the aileron version. This weighs 40 ounces with an Astro .15 on 10 cells. As you can see from the picture, there is lots of room for more batteries. Mark Allen has one with 28 cells for F3E. The picture should answer some of your questions. If not, call Flite Lite at 707-792-9174. Tell them you read about it in *RCSD*.

It was lots of fun doing the building and flying of the prototype electric Falcon. Now I'm going to get another project to do. Northeast Sailplane Products and Mel Culpepper are designing an electric Chuperosa to be flown on a .035 and 6-cell. This could make an excellent small field electric sailplane. We'll let you know how it progresses.

Good flying! ■

on the Wing

B²

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Pitch stability for swept flying wings is the focus of many of our readers' questions, and a fundamental knowledge of pitch stability must be acquired before formulae and computer programs can be used in a sensible way to design a high performance flying wing sailplane.

It is probably best to think of a swept 'wing as nothing more than a highly modified conventional tailed aircraft. Start with a conventional sailplane and assume it requires a horizontal stabilizer of 15% of the wing area for stability. (See Figure 1.)

If we choose to move the horizontal stabilizer closer to the wing while keeping the incidence angles constant, we must increase the stabilizer's area to maintain the same level of pitch stability. (See Figure 2.)

From this point it is a simple matter to move the horizontal stabilizer to the wing tips. (See Figure 3.)

What's nice about this design is that there is no downwash to adversely affect the stabilizer. On the negative side, however, realize the increased size of the "horizontal stabilizer" due to the shorter moment arm.

The overall pitching moment of the conventional tailed sailplane's wing dictates several aspects of the horizontal stabilizer and its placement. A larger negative pitching moment means (1) a more negative angle must be applied to the horizontal stabilizer, (2) the airfoil of the stabilizer must be changed to produce a larger downforce, (3) the stabilizer must be made larger, or (4) the tail moment must be increased. A combination of two or more of these measures may also be used, so long as the aerodynamic downforce produced by the tail can offset the pitching moment generated by the wing.

Projecting these four options to a swept flying wing, we would anticipate finding that as the pitching moment of the root becomes more negative a larger downforce will need to be applied by the wing tips. Again, there are four options: (1) retain the same tip section and build in more washout, (2) keep the twist the same and change the tip section to one capable of more down force, (3) reduce the taper to increase the area of the stabilizing wing tips, (4) increase the sweep angle and hence the stabilizing moment. (Note these four points are precisely parallel to those listed above.) The trick is to pick the method(s) which least increase (or, better yet, decrease) drag while maintaining stability around the other two axes.

The goal when designing a swept 'wing is to reduce the twist required to just one or two degrees. More twist, while offering greater stability, will reduce performance due to the forward CG required and the increased drag created. As well, it's very easy to create a situation where the lower surface of the wing tip is stalled. But too little twist courts full span stalling at high angles of attack, a very dangerous occurrence. Sweep angles greater than 20 degrees have a great potential for causing control problems, particularly at low speeds and/or high angles of attack (read "launch").

While it may be tempting to utilize a reflexed section across the entire span, the experiences of others show this not to be a viable alternative. Best to stay with the Eppler 222 - 230 planform, or use an airfoil with a pitching moment very close to zero across the span. For the latter, try one of the EH series of sections.

Swept flying wings have substantially better flight performance than planks because of their greater speed range and higher L/D. With a basic understanding of how pitch stability is achieved the modeler can manipulate airfoils, sweep, twist, and other variables to achieve a very efficient planform.

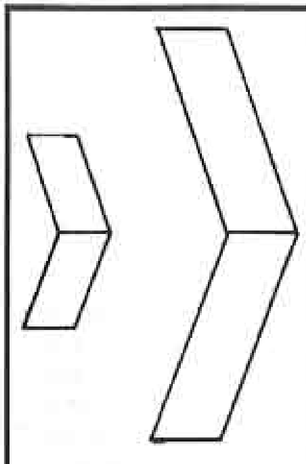


Figure 1

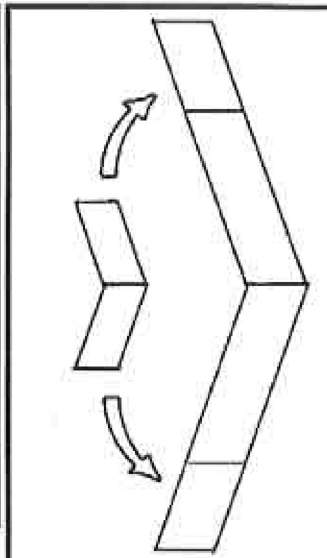


Figure 2

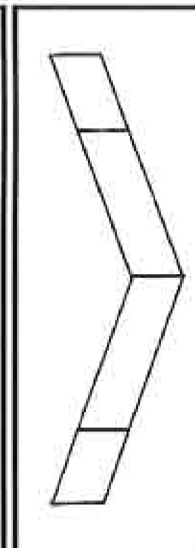


Figure 3

Suggestions for further reading

Gale', Dr. Ing. Ferdinando; "Radioguided Sailplanes." One chapter devoted to the aerodynamics of tailless designs. Text is in both Italian and English.

Lichte, Dipl. Ing. Martin; "Nurflugelmodelle." A German text book, published by VTH, devoted to tailless sailplanes and electrics. A twist formula mathematically identical to that of Thies is presented.

Panknin, Dr. Walter; "Flying Rainbows." Text of Dr. Panknin's presentation at the 1989 MARCS Symposium, complete with diagrams and formulae for computing required wing twist. Available as part of Symposium Proceedings.

Thies, Werner; "Pfeilung - ja- aber wie gross?" Four page article explaining derivation and use of Thies' twist formula. Diagrams, graphs, and step by step directions are included. German text originally printed in the February 1984 issue of *FMT*.

CG, Elevator Trim and Decalage

Part 3- The Utility

...by Frank Deis
Colorado Springs, CO
Pikes Peak Soaring Society (PPSS)

(This three part series originally appeared in the Journal of the Pikes Peak Soaring Society, *The Spoiler*, and is reprinted with the permission of Frank Deis.)

We have to start flight testing some place so let's assume the elevator trim is in the minimum sink position, the sailplane is high, just off the winch, settled down and flying straight and level. It should "feel normal". The airspeed will be what you are used to unless you recently set the CG and decalage. In this case the sailplane may feel a little " slippery " and will fly a little faster than you are used to. Spend some time in this trim and get used to the feel.

When you are ready to experiment with minimum speed (stall speed), start easing the elevator trim lever back toward the minimum speed setting you located with the incidence meter. Do this slowly the first few times because you will have to help the sailplane find the new equilibrium point. As you increase the up trim the sailplane may pull up into a stall. If so use some down elevator to recover from the stall as you would normally. When you get it flying straight and level again add some more up trim and stabilize it again. Keep going until the trim lever is in the minimum speed position. The sailplane will fly very slowly, sink faster than you will like and feel very mushy on the controls. Practice pulling the trim lever all the way to the minimum speed position and feeding in a little down elevator stick as the sailplane climbs 10 feet or so, slows down, and goes directly into minimum speed flight. Practice until you can do this very smoothly.

Now that you have found minimum speed trim, it is fair to ask why you should care! This trim is a good way to back up in a high wind. It can be much better for short distances than turning down wind and then trying to turn back into the wind again. Just go to minimum speed and backup! It is also useful if you are too high on the final approach. If you nose over you will pick up too much speed. If you go into minimum speed trim instead, you slow down and increase the glide slop at the same time. This is one technique you can use for getting spot landings if you don't have spoilers or flaps, for example. (If you are in a dog fight with the enemy on your tail, you can go to minimum speed trim and he will fly right past you and you can gun him down..... But I digress....) The point is, once you learn how to get into and out of minimum speed trim you will find lots of uses for it.

Coming out of minimum speed trim back to minimum sink trim is easy; just push the trim lever back to where you started and wait. As before, it takes about 5 seconds for the sailplane to stabilize in the new trim. It will nose over in a shallow dive, then kind of "zoom" out of the dive and level off about 10 feet lower than it started and fly a little faster. Some sailplanes will over shoot the minimum sink trim and climb back as though they are going to stall. If this happens, use the elevator stick as necessary to get it leveled off again and then get off the controls. It should fly itself. Holding the stick forward or back defeats all of this trim work.

Because the sailplane can be a little touchy flying on the verge of a stall, you may want to go just to the low speed end of the useful speed range. The process is the same as going to minimum speed trim. It just uses a little less up trim.

The next thing to try is going from minimum sink to maximum L/D trim.

MINIMUM SPEED	SLOW END OF SPEED RANGE	MINIMUM SINK	MAXIMUM L/D	HIGH END OF SPEED RANGE	MAX SPEED
• LANDING WITHOUT SPOILERS • BACKING UP (FADING) DOWN WIND WITH OUT TURNING	• IMPROVED CONTROL RESPONSE IN MODERATE LIFT • BACKING UP (FADING) DOWN WIND WITH OUT TURNING	• THERMAL SOARING • MAXIMUM DURATION • MAXIMUM DURATION IN VERY LIGHT LIFT • FLYING IN LIGHT TURBULANCE • FLYING IN LIGHT WAVE LIFT	• ROUTINE SEARCHING FOR THERMALS • IMPROVED HANDLING IN STRONG LIFT • DISTANCE COMPETITION • STREACHING A GLIDE TO GET BACK HOME • FLYING IN MODERATE TURBULANCE • FLYING IN WAVE LIFT	• FLYING IN WAVES • FLYING IN HEAVY TURBULANCE • FLYING IN HIGH WINDS • BURNING UP EXCESS ALTITUDE ON THE DISTANCE COURSE • LEAVING SINK	• SPEED COMPETITION • COMING HOME FAST TO AVOID OVER SHOOTING THE TARGET TIME IN DURATION

TABLE 4 SUMMARY OF APPLICATIONS OF THE KEY TRIM SETTINGS

THE DIVE TEST IN DETAIL

This is very similar to going from minimum speed trim down to minimum sink trim except the altitude drop is usually greater (20 to 30 feet), and the speed increase is much greater. In Maximum L/D trim the sailplane is very close to neutrally stable, so this transition can look a lot like the dive test. Some sailplanes may start to level off after the initial dive only to nose over again and keep picking up speed. If this happens, give it a touch of up elevator stick to level it off and watch it run! It is a lot of fun to fly in this flight trim because the flight path is very flat (only a degree or two down), and very fast compared to the minimum sink speed. This is the trim to use for cruising around the sky. When you get where you are going, move the trim lever back to minimum sink. The sailplane will climb about 30 feet, slow down and go back to being its old self.

The last conditions to try are the high speed end of the useful speed range and the maximum speed trims. Investigate these with some caution because you can easily go so fast that the wing will flutter on a typical sailplane and even explode in mid air - pretty impressive but not recommended. The risk is increased if the wing loading is high so be extra careful if you add ballast. This is why the F3B wings are so strong. We will discuss flutter in a later article. The other problem is that the sailplane may be slightly unstable if you set the trim lever to either of these settings. It will initially go into a 10 to 20 degree dive and accelerate rapidly. It may start to nose over steeper and dive. If so, correct it with a touch of up elevator stick. As discussed in the section on speed flying, a dive angle of 35 degrees or so is optimal for covering ground, so keep the sailplane in the vicinity of this glide slop. Soon (5 seconds or so), the sailplane will reach maximum velocity and you can stabilize it in the 35 degree dive. If it insists on either pulling out or tucking under by itself, make the appropriate correction in the elevator trim settings. At these speeds and dive angles, the center of pressure (center of lift) is moving around, the Reynolds Number is changing and the downwash angle is changing so the estimate of the maximum speed trim setting may be off a degree or two either way. Remember the sailplane will be neutral to slightly unstable so it is not likely to seek its own glide path angle as it does in the other trims. You will have to hold it on the glide path you want - anywhere between about 20 degrees and vertical; the steeper the faster!

When you decide to come out of these trims, gently level the sailplane out with the elevator stick and ease the up trim in over a few seconds; too much up elevator input too fast can cause the sailplane to pull so many g's the wings will fold - not a pretty sight. Expect to gain a lot of altitude as the speed diminishes and it returns to maximum L/D or minimum sink trim. Normally it will climb back up surprisingly near where you first made the trim change unless you raced for a long distance.

As you master the use of the elevator stick to assist the sailplane's natural transition from one trim setting to another, you will begin to think of the elevator trim as the throttle control on the sailplane. The six discrete trim points we have been discussing are good to keep in mind, but as a practical matter you can now fly at any trim position between the extremes as the situation demands. Table 4 gives a summary of situations where particular trim settings are especially useful.

For those of you who are still awake and aspire to become dive test experts, let's discuss it in a little more detail. What the dive test approach to pitch trimming does, in my opinion, is drive the angle of attack of the stabilizer to zero thus minimizing the drag produced by the stabilizer. This is why I believe it leads to trimming for max L/D. If the CG is too far forward, the stabilizer must generate some down force to hold the nose up. Instead of flying at zero angle of attack, it settles in at a slight negative angle of attack and generates some "negative lift". (See the left hand portion of Figure 6.) Fortunately for the dive test, this turns out to be a speed sensitive trim condition. If the sailplane slows down the stabilizer loses some of its negative lift and the sailplane noses down. If it speeds up, the reverse occurs. This is what causes stalling.

If the sailplane is trimed so that no up or down force is produced by the stabilizer (See the center portion of Figure 6.) then, in theory, the trim would not change when the speed changes - i.e., the way my Falcon behaves, for example. On most sailplanes, however, the water is muddied by the fact that the center of pressure moves aft as the speed increases. This small movement of the center of pressure with speed changes makes it impossible to eliminate the lift force on the stabilizer for all flight speeds and produces the behavior seen in the dive test. (The dive test results force me to assume there is very little CP (center of pressure) shift on the Selig 3021 airfoil.) At low speeds the center of pressure is at its forward limit and there is usually a slight down force on the stabilizer if the sailplane is positively stable in pitch. As the speed increases the down force on the stabilizer increases and the nose starts to come up. However, as the speed increases further, the center of pressure moves back along the wing airfoil a little bit which makes the sailplane slightly more nose heavy. As the nose heavy condition overcomes the down force on the stabilizer, it steepens the dive causing the effect shown previously in Figure 4 and in Figure 6.

Thus the dive test only indicates that the horizontal stabilizer is flying at an angle of attack as close to zero as it can get. Please note that this is pretty good but may not be the same as having the sailplane flying at either max L/D or minimum sink rate.

If it is not theoretically related to maximum L/D or minimum sink rate, why should the dive test be useful in adjusting the pitch trim anyway? There are several reasons. Because the stabilizer is so small, it must fly at relatively large angles of attack if it is to generate much down force. This means high parasitic drag and high induced drag. Furthermore, remember the rule of thumb developed by Eric Lister in his "Drag Reduction Handbook" that says if the air must turn through an angle of more than 6 or 7 degrees relative to the free stream direction as it heads toward the trailing edge of a surface it will separate from the surface effectively causing a stall on that side of the surface. Thus an angle of attack of 3 or 4 degrees combined with an airfoil slope of 3 or 4 degrees at 60 % to 75 % of the stabilizer cord could result in separation and a major increase in drag. Finally we have the Reynolds number to worry about. Because the stabilizer cord is small the local Reynolds Number is small and the flow is even more likely to separate. All of this indicates that you want the stabilizer to generate little or no lift - either positive or negative - most of the time and none of it appears in the theory we have discussed. (This comes under the heading of " other important considerations to keep in mind".) The drag effects generated by the stabilizer can be so strong that they dominate the wing L/D considerations; i.e., it may be better to have the wing at the wrong angle of attack and have the stabilizer at zero angle of attack than to have the wing at the correct angle and have a load on the stabilizer. This, I believe, is why the dive test works so well. (The perfect sailplane would be designed to fly at max L/D for the wing with no load on the stabilizer!) Once the model is built, the dive test is a pretty good way to set the pitch trim to maximize performance. Keep in mind that the drag increases on the stabilizer are small if you can keep the angle of attack small (less than a degree or so), so there is some room to optimize the performance (i.e., adjust the decalage angle) about the point indicated by the dive test. Be careful however and don't get too far away unless you are certain you are on the right track.

A final note of caution, as always. Theory is great but no one should be intimidated by it. What works, works, whether the theory agrees or not! Theory can help one understand the principles underlying the behavior observed and this is always very useful. Places where the theory does not explain the behavior are very interesting, as well, because they focus our lack of understanding and force us to think - you know about thinking, right - "A time consuming and error prone strategy of last resort". So keep all of this stuff in its proper perspective and have fun! ■

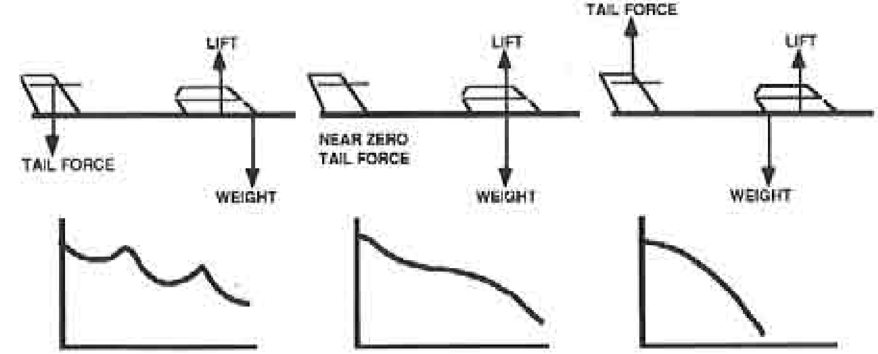


FIGURE 6 FORCE BALANCE FOR TYPICAL TRIM CONDITIONS

The Anthem Kit Review

...by Craig Aho
Mountlake Terrace, Washington

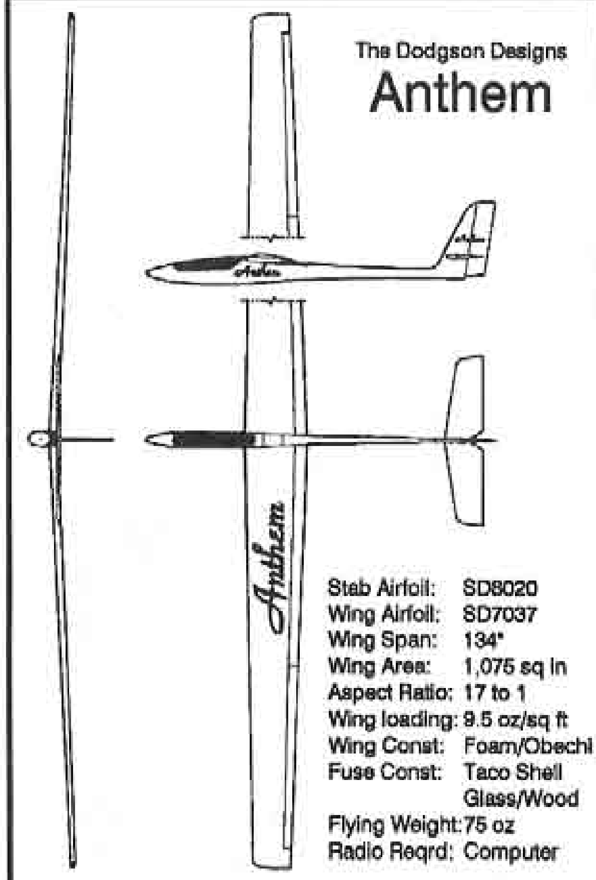
When Bob Dodgson announced that he was interested in updating his Lovesong with the same SD7037 airfoil, Obechi sheeting, unique dual pushrod and the new spar system he was using in his fabulous Saber, I knew I had to have one. Moreover, I volunteered to build the prototype so that Bob could get one in the air as quickly as possible. Bob agreed and six days later I had it ready to fly!

I am one of those fliers who believes that the Windsong/Lovesong is one of the best looking and flying sailplanes around. When it comes to quality of materials and packing, Dodgson Designs is hard to beat. I personally enjoy opening a kit and finding neatly machined and sanded wood parts all bagged, with everything of top quality. For me, I give this kit two thumbs up. It is very complete with all hardware items, wood, foam, fiberglass and the most complete set of instructions and drawings that you will find anywhere.

The fuselage utilizes a composite fiberglass taco shell integrated with spruce and plywood longerons. It also features a wood top deck that the builder must glass over using materials supplied in the kit. This may all sound time consuming, but I found it quite easy to do. If you have ever built a Sagitta or other simple wood fuselage, you'll have no trouble completing the Anthem fuselage. The end result is a fuselage that is strong and very lightweight while sporting smooth contours and very graceful, scale-like lines.

The flying surfaces all utilize foam cores and Obechi sheeting which saves a lot of building time since it is not necessary to splice sheeting materials together. The wings employ a composite box spar which is made up of spruce reinforced with .021 carbon fiber (top and bottom) along with plywood and balsa shear webs. The first sixteen inches of the spar root is wrapped with dacron thread to reinforce the joiner box area. The total spar construction took me only about two hours and they are the single most time-consuming element in the wing construction. Once the spars are complete, you just have to glue them into the main cores, align and glue the tip cores in place and install the sandable spar cap, the sub leading edge and the alignment pin receivers. Final sanding is all that is left and you are ready to apply the Obechi sheeting to the panels.

I chose to use the transfer tape method to sheet my wings. I've used epoxy and 3M-77 adhesive on other projects but it is hard to beat the simplicity, lightweight and foolproof application of transfer tape. I highly recommend that you fiberglass-reinforce the trailing edge (TE) of the wings with the supplied 3/4 ounce cloth as is explained in the instructions. The TE is thin and the glass



Anthem Kit Prices

The kit is available as a deluxe full kit for $279.00. The Anthem with optional pre-built CF/Rohacell spars is $345.00. The Anthem with all flying surface pre-sheeted is $430.00.

will insure you have a sharp, rigid and warp-free surface. The stabs have spar and alignment pin slots pre-cut and they are very straight forward and simple to construct, as is the rudder. In all, the kit is very fast and easy to build.

The radio used in my Anthem is the Ace Micropro 8000 computer driven transmitter and the Ace 810 receiver. For aileron control, I installed separate Futaba 133 servos in the wings. I opted to use a single servo in the fuselage for flap actuation (as per the Lovesong) using the HDL-2 flap linkage from Dodgson Designs, rather than putting two expensive, metal-geared, micro servos in the wings. This flap device works great in my Anthem with no sign of flutter on tow or at high speed. The flap servo is a Futaba 131-S. For elevator, I chose the JR NES-4031 servo. The control surface deflections are set at: Ailerons - 1/2" up and 1/8" down, elevator LE - 3/8" up and down, Rudder - 1-1/2" left and right, Flaps - 3 degrees up and 90 degrees down. If you don't happen to have a computer radio, it would be a practical option to use a simple radio in the Anthem. (You could easily add the computer transmitter and receiver later, if you wished.) All that would be required is to "Y" the two aileron servos together so that they operated from a single channel and you could use the flap-elevator compensation system used on the Lovesong. There is plenty of room in the fuselage and you would only be giving up aileron reflex capability and only until you upgraded to a new radio. (You probably would not miss the lack of reflex, anyway, because the top-end speed range of the Anthem with neutral flap is so good.)

The ready-to-fly aircraft weighs in at 74 ounces which I feel is about ideal for the Anthem. Initially, I set my center of gravity (C.G.) at 3-1/2" from the wing LE at the root, visually set the stab incidence and gave the bird a hand toss at the flying field. She flew straight and level so I knew she was ready to winch aloft. After a couple of flights, I decided to put another quarter ounce of ballast in the nose and I haven't touched the C.G. since.

Well, it has been six months of flying now and I can tell you, the performance is awesome! The Anthem displays excellent handling with a very crisp roll rate. I especially like the way you can change turn directions quickly without altitude loss and the way that the Anthem will core up tight enabling you to work tiny thermals low to the ground. The speed range is extremely wide. Once off tow, you can push the nose down slightly and she moves out like a bungee jumper with a broken cord. The Anthem covers great distances in a hurry. Fortunately, the long, slender wings and stately, scale-like fuselage of the Anthem make it easy to see at extreme distances where other planes are fading from sight, increasing the effective range over the competition. The Anthem tows straight and zooms off the winch like a Patriot missile with the scent of scud in its nostrils. Remarkably, its stall characteristics are exceptionally gentle and mild. Landing the Anthem is by far the best of all the competition aircraft that I own. When you drop the flaps, the Anthem slows down to a crawl without any noticeable loss of roll response. It tracks superbly, is predictable in its approach and most telling of all, it has greatly improved my spot landing performance.

I also own a Lovesong and have flown at least four Sabers. My opinion is that the Anthem has the same fine landing and thermalling qualities as does the Lovesong, but it has a noticeably quicker roll rate and it can move out faster between thermals. I think that the Anthem is the equal of the Saber in all respects except I feel that the Anthem has a slight advantage in light lift conditions.

The Anthem truly delivers the performance and quality for your dollar spent. I highly recommend this kit and if you're like me and love the classic lines and thoroughbred pedigree of the Windsong/Lovesong, you won't be disappointed in the Anthem. The Anthem is available from Dodgson Designs, 21230 Damson Road, Bothell, WA 98021; (206) 776-8067. ■

Sophisticated Lady

...by Dan Morrison
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I have been toying with a Goldberg "Sophisticated Lady" as a development aircraft and have now begun to wonder if such a thing as a "Development Class" might not be a good idea for our sport. The following are my constraints, presuming the use of the above aircraft kit, which is recommended by its low cost and high availability.

a. Use the fuselage design as it appears on the plans, glassing the wood or alternate wing mounting system is allowed, but the distance from the wing trailing edge to the tail feathers may not be increased.

b. The rudder must remain the same size and shape as on the plans, the vertical stabilizer cord must stay the same at all positions, but the height may be changed slightly to accommodate various elevator arrangements.

c. The horizontal stabilizer and elevator must not exceed the size shown on the plans, slabs or elevators are allowed within the total outline.

d. Wing cord must be the same as the plans at the fuselage and not exceed this dimension at any other point on the wing. Other than this, no limitation on wing design.

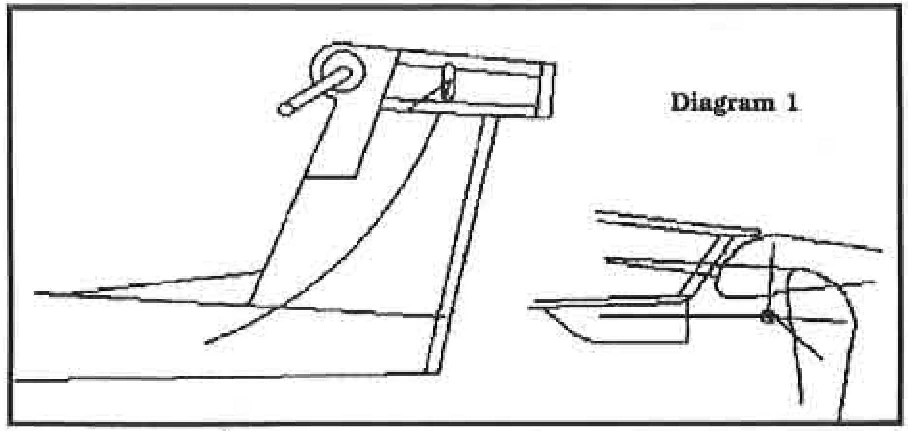
e. You have to build it yourself.

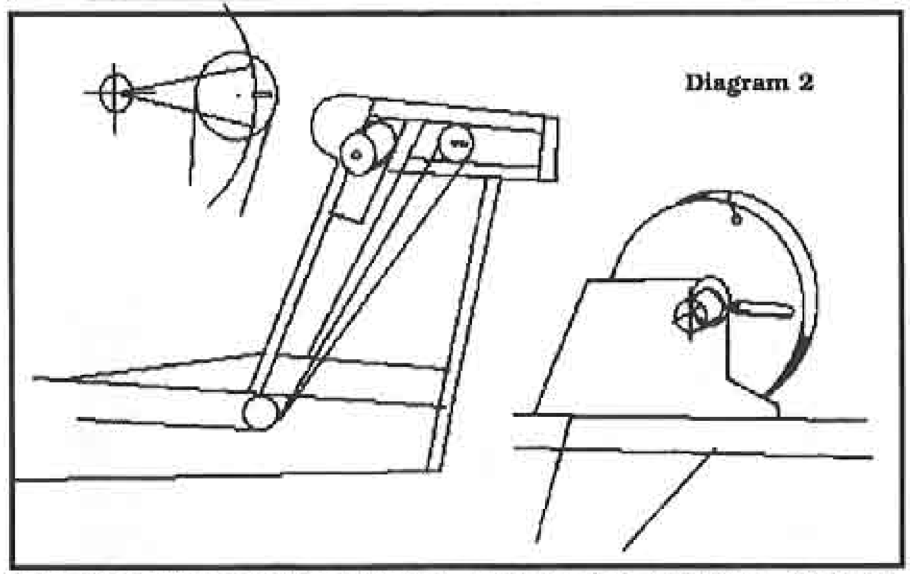
And that's it. The result is a nice problem in design and building, that should be within most budgets, as well as a chance to show your stuff at the field. So far, I have converted mine to a slab elevator. (See det.1) I added a pull-pull rudder system and have the ribs cut for a S-7032 airfoil wing with ailerons and flaps and a higher aspect ratio than the original.

It might be nice to contest these aircraft. Other development classes could be devised; this formula would provide good exercise in scratch building, investigating the aerodynamic effects and the characteristics of structures affected by design changes, all at a very reasonable price.

I wanted to mention another design detail I tried recently - slotted flaps. (See other part of diagram 1.) The main benefit of flaps of this design seems to be that they cause only a small amount of trim change when they are lowered and are quite effective. Mine are easily controllable with the elevator trim, and would not require a programmable radio to compensate for the induced pitch change. There is some loss of rudder effectiveness for the particular bird I'm using, a 120" span polyhedral design, but this is to be expected and is not severe. The next set of wings I build for this plane will have ailerons and only normal dihedral, which should improve handling and ease the guidance problem. I'll find out if I'm right with the Sophisticated Lady's new wing before proceeding.

Diagram 1 shows that the bottom of the airfoil curves smoothly up into the flap slot, with the rear spar angled aft at the top at about 30-45 deg. from the vertical. The upper sheeting is extended aft to make a small slot tangent to the flaps upper surface when the flaps are raised. Enough space can be left here for a little reflex for those who want it. The flap should be a true airfoil in its own right, first preserving the main foil when up, but approximating a foil which can stand high angles of attack and not stall when down. This is one case where drag is welcome. I only run my flaps down 45 degrees rather than the 90 shown. I may try more later but I'm happy with my present results. The flaps stay clear of the ground as the small pylons which are shown for the hinge mounts also protect the flaps. They are 1 oz. glass and resin over balsa. There are three, steel jointed, round pin hinges on each 30" X 2.5" flap; there have been no structural problems.





The servo motion opens the slot as the flaps are lowered by the wing enclosed pushrod which acts above the hinge pivot near the center flap hinge. The servo is buried in the wing. I used .6 oz. glass and resin to reinforce and fine the upper trailing edge of the main wing at the slot. I find this finishing technique as light or lighter than films and much stronger, smoother, and accurate. After wetting the glass I squeegee out as much resin as possible with a playing card and finish with primer and lacquer. It gives one more chance to make the wing surface and airfoil correct and it's easily repairable if you don't consider this type of work too time consuming. Hope the readers find some of these ideas fun. I would be glad to talk or correspond in regard to them.

An Update...

I have done more toying with the Goldberg "Sophisticated Lady" as a development aircraft. I have changed the elevator drive to a pull-pull system and the airfoil to something symmetrical close to a NACA 64A-10. The results at the field have been quite good.

The mounting for the drive wheel is two pieces of 1/64th ply holding a short piece of brass tube which is carefully glued to them, so as not to stop the drive wheel. The tubing is then finished flush with their outer surface. The assembly is glued to the outer skin, which covers the whole top of the vertical fin except the slot at the drive wheel for the elevator drive wire. The geometry for the slotted wheel drive wire arrangement is at the left of diagram 2.

The drive wheel is the diameter of a small Futaba servo wheel and was turned out of aluminum. Two small holes were drilled from the drive wire slot to the side flange of the wheel on top, where the drive wire never leaves the wheel, and the wire led through and CA'd there once the system is set up and working. I use plastic coated stainless steel leader wire, 25 lb. test, and crimps that the tackle stores sell. This is like the stuff Proctor puts in their kits and it works fine.

I have also turned a fitting in light metal to replace the plywood elevator pivot. This is wide enough and tight enough to allow the through tube to be removed for travel and provide a bearing for it to rotate on when flying. This will allow the through tube to be fastened to the elevator halves and rotate with them in flight and also save some weight.

Work on the new wing progresses...

More Green Air to All!

1. The forward part is a 3/32" plywood insert in the rudder structure which is covered with 1/64" ply above the reinforced rib all the way to the trailing edge. External 1/16" ply buttons on each side help to stabilize the shaft for the slip on tubes in the elevator halves and are let into them. The pushrod supplied with the kit is soldered to a bit of tubing which is flattened, drilled and soldered to the elevator drive wire. The pushrod sleeve is firmly glued into the rib. The elevator is set up never to interfere with the rudder at full down. ■

Alan Ball
Boston, Massachusetts

Vacuum Feed-Through Fitting

...by Lee & Jim Murray
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I had seen a feed-through vacuum fitting advertisement in *Advanced Composites* magazine and had thought that I might buy one. The advantage of this tool is that you don't have to struggle making a seal over the vacuum line in the end of the bag. My experience is that making a seal around a tube takes some puttering at a time when you want things to go smoothly. The conventional practice also generates expensive waste if you are using butyl rubber window sealant. Inexpensive and easily obtained packaging tape can be used to make the bag seal. You must have a towel or porous material under the bolt and along the side of the part so the bag doesn't seal off the vacuum to the whole part.

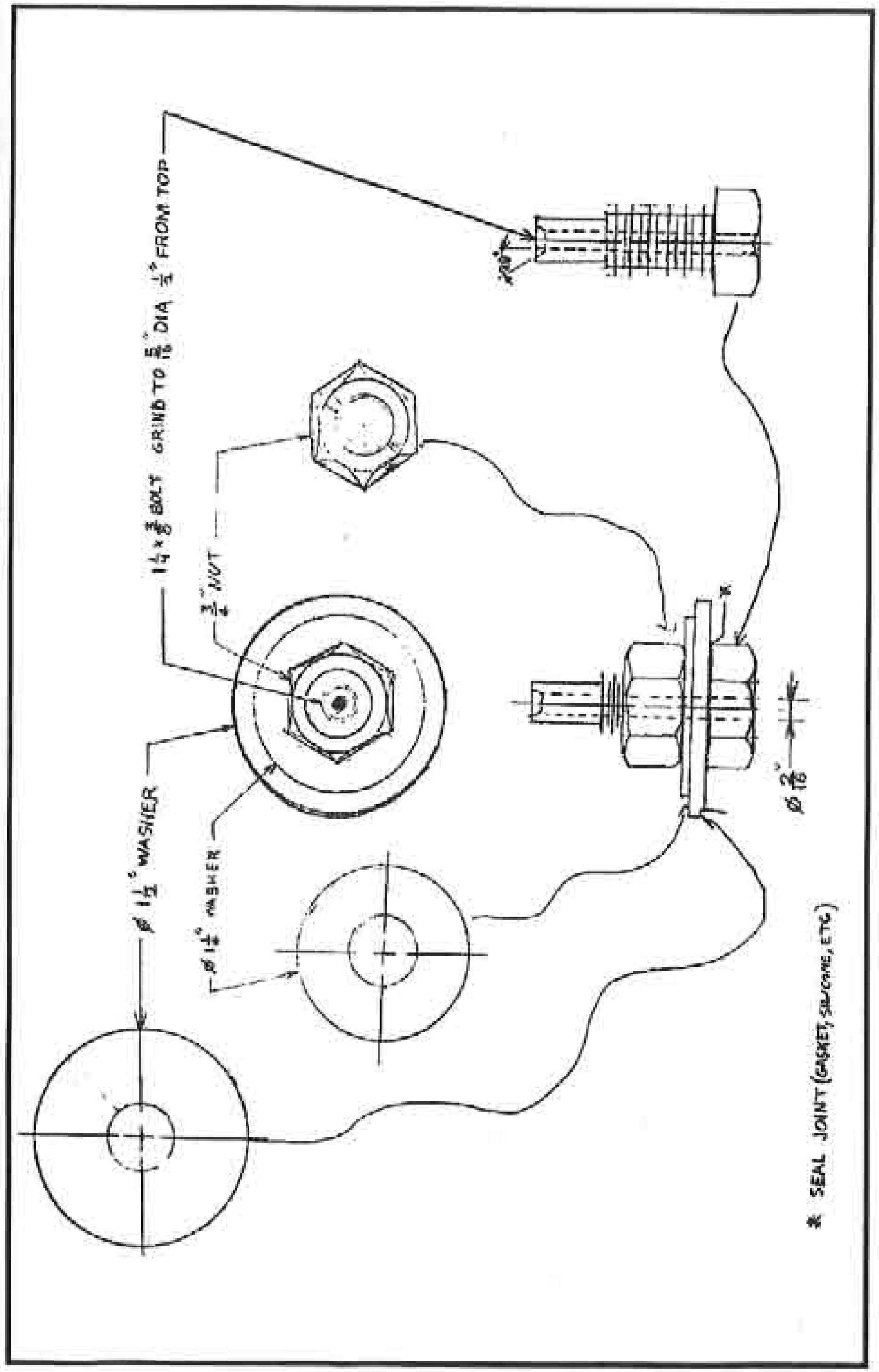
After thinking about how simple the vacuum feed through was, I decided to make one myself. The construction was very simple and can be accomplished by anyone with a lathe (see my son's drawing). I took a .5" * 1.5" bolt and had the threads cut off the last 0.5" of the bolt to make a smooth 0.167" (5/16") end. A little smaller would made a 0.25" (1/4") I.D. vacuum tubing easier to install. I also had a 0.125" (1/8") hole drilled through the center of the bolt to make the air/vacuum passage. A large washer was bonded to the head of the bolt using silicone rubber to make a seal. Keep the threads of the bolt past the washer free of the sealant. Some kind of soft gasketting material such one soft rubber is then adhered onto this large washer.

In using the vacuum feed-through make a 0.5" hole in the vacuum bag and insert the bolt into the hole from the inside of the bag. A brass tube with a sharpened edge works well. The free washer is placed on the bolt, and then the nut is placed on the bolt and tightened. The wings or whatever you would be vacuum bagging would be inserted into the bag and the end closed with tape, a mechanical seal, or some other easy method. If you tape, you must do so without wrinkles. Using a longer bag than you otherwise might, will make this last requirement easy.

I've made a few fiber glass - epoxy parts now and things are working well. I have a vacuum system with a vacuum ballast made from a Freon tank and a vacuum switch so the vacuum pump runs less than 20 percent of the time. A spring loaded check valve was found to be a requirement to keep air from running through the system in reverse when the pump was idle. With this system the bag seal does not have to be perfect.

The fitting which created my idea is from an ad in *Advanced Composites*. I see that the supplier is Torr Vacuum Probes and Hoses, 1-37th St. NW Unit E, Auburn, Washington 98001-1715. Perhaps one of the readers has been using one of the devices and can comment on the effectiveness of the original unit which I believe to cost about $30. ■

Sailplanes at Valley Aero Modelers show.



Spirit 100 Construction Tips

...by Ed Jentsch, 2887 Glenora Lane
Rockville, MD 20850; (301) 279-7611

I read with interest Pierre Julien's article on the Spirit 100 in the February issue of *RCSD*. I am in the last stages of building the same model and was pleased to learn my time and effort will pay off with a plane that performs well.

Also being without a computer radio, I elected to modify the plane, but only slightly, by moving the flap servo inside the fuselage where it could be coupled to the elevator servo using a mechanical linkage (ala Bob Dodgson's Lovesong). Other than that, my Spirit 100 will be a stock plane using the S7037 wing.

Unlike Pierre, I found several areas in the plans and instructions that were either incorrect or improvable. Great Planes has a copy of my notes. Whether they will use them or not remains to be seen. I've also made them available to other Spirit 100 builders in our local club, and Pierre's article suggested an even wider audience may exist.

Except for the first one, my notes are sequenced and titled to match the table of contents in the Spirit 100 instructions. They cover only those things I judged to be quirks of this particular model and its instructions.

Fuselage and S7037 Wing

Do not glue the S7037 Wing Root Cap in place until after you have completed the fuselage. The wing saddle of the fuselage is shaped for the S3010 wing. The S7037 wing has a drooped TE and a more tightly curved lower LE. When the fuselage is finished, the wing saddle should be trimmed and sanded to match the contour of the S7037 airfoil. The Wing Root Cap makes a good template for marking the necessary changes on the fuselage.

With this mind, you may also want to slightly build up the section of the trailing edge directly over the fuselage to recover the smooth transition from wing to fuselage.

Join The Outer And Inner Wing Panels

The Outer Panel Upper Spar should be 1/16" above the Inner Panel Upper Spar when the two panels are joined so that the Outer Panel Upper Spar will be flush with the Top Leading Edge Sheeting when it is added to the Inner Panel. (The photos in the instruction book show these spars joined together flush, which is incorrect.)

A better method of making the 5/8" hole in the Top Leading Edge Sheeting, one that will result in a neater hole with no tear-out, is to:

- hold the top sheeting in place on the wing.
- insert a 13/64" drill from below the wing and twist it gently by hand to mark the center of the hole.
- remove the sheeting and push a pin through the center of the mark made by the drill.
- place the sheeting, top side up, on a piece of scrap wood for backing and drill the 5/8" hole with a sharp brad-point or a Forstner bit, using the pin hole to center the bit.

Install Aileron Servos - S7037 Wing

Consider mounting the aileron servo extension socket inside the servo bay (e.g. glue it to a scrap piece of 1/8" balsa which is then glued to W3B). If installed as shown in the instructions, it will interfere with one of the hatch mounting screws and be somewhat difficult to access after the wing is covered.

Install Flap Torque Rods and Aileron/Flap Assembly

To avoid binding in the flap mechanism and distortion of the flaps when they are raised or lowered, the flap torque rod must be positioned differently than shown in the instructions and plan. In effect, the torque rod must be positioned 5/32" closer to the TE and 1/32" further from bottom flap surface than it is if the instructions are followed.

Read the instructions and the changes below carefully and make sure you understand them completely before starting any work.

- cut the notch for the Flap Torque Rod in the 2 1/4" stationary TE piece, NOT IN THE SUB-TE as instructed. Glue the stationary TE piece in place. Place the torque rod in the notch and check for proper fit. The nylon bearing should be flush with the wing surface and its end nearest the flap should be just at the outer edge of the stationary TE. The unthreaded torque rod arm will extend about 17/32" into the area that will be occupied by the flap.

  Cut relief notches in the sub-TE and stationary TE so that the threaded torque rod arm rotates through the proper range of angles. DO NOT glue the torque rod in place at this time.
- shorten the brass tube about 1/4" using a fine file.
- drill the 1/8" hole for the brass tube 1/32" below the bottom surface of the flap, NOT "touching the bottom surface". Its depth should be 1-3/16" to 1-1/4".
- cut a 5/32" by 5/32" deep notch along the front edge of the flap between the tube hole and inner edge of the flap, parallel to and 1/32" from the flap lower surface.
- round the corner where the notch meets the hole to accommodate the curve in the torque rod arm.
- insert the brass tube so its end is slightly below the notch cut in the step above.
- install the torque rod and flap (tape the flap to the sub-TE with masking tape) and check for proper positioning and operation of the flap. (Note: you may have to push the brass tube slightly deeper into the flap to accommodate the bend in the torque rod).
- if the mechanism works smoothly, glue the torque rod and brass tube in place. (To glue the brass tube, make several pin-holes in the flap lower surface by the tube and apply thin CA glue.)

Frame Up the Fuselage

Depending on your radio installation, you may need notches in formers BB1, BB2, F5 and F4 for pushrod tubes, the antenna tube and/or wiring. Cut these BEFORE assembling the fuselage.

Consider making a small former from scrap 1/4" balsa and installing it in the tail section of the fuselage to provide added support for the elevator pushrod outer tube. Drill holes in this former for both the antenna and pushrod tubes and install it when installing the pushrod tubes.

Don't forget that fuselage former F5 needs to have a V shape trimmed and sanded in their upper edge to match the wing dihedral. The Wing Joiner makes a good template and sanding for block doing this.

If you will be installing standard servos in the compartment between formers F3 and F4 (e.g. the S148's shown on the plan for the spoiler set-up), DO NOT install the triangle braces in the bottom of the fuselage between these two formers. The braces will prevent the servos from being positioned correctly in this compartment.

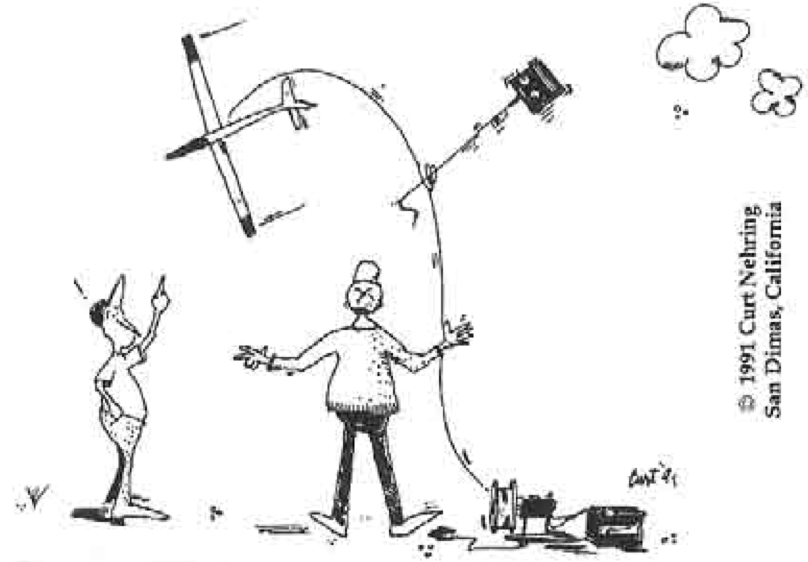
Assemble The Cockpit/Canopy

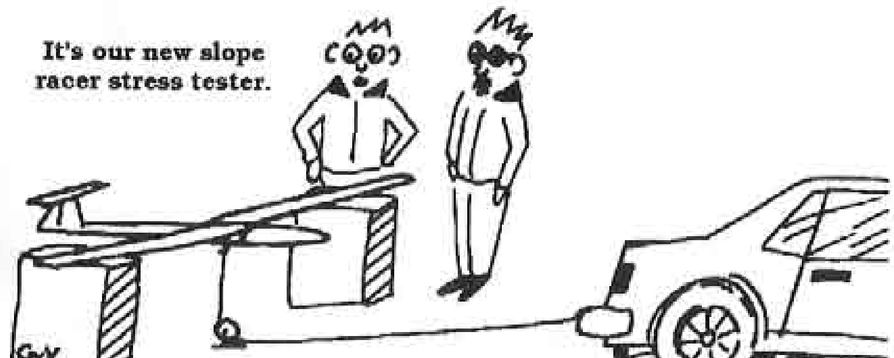
The 1/8" plywood Cockpit Back may not be correctly shaped. Before doing any assembly, place it in position on the fuselage to see if there will be a smooth transition between the canopy and fuselage. If not (e.g. if more than about 1/32" would have to be sanded off the fuselage for a nice fit), cut the shape a new Cockpit Back from scrap plywood.

Conclusion

Overall, I found the Spirit 100 to be a good kit. The materials provided were of good quality and assembly was no more difficult than other built-up kits.

If you encounter other problems with this kit, or with my corrections/suggestions, please drop me a line. I'm interested in collecting various experiences with the Spirit 100 and, if there is enough material, sharing it in a future article. ■





Greg Vasgerdsian
Concord, California

R/C Soaring Resources

Do you hold seminars and workshops? Would you like to be included as a contact to answer questions on soaring sites or contests in your area? If so, please contact *RCSD*. Our address and telephone numbers are on page 1.

Seminars & Workshops

Free instruction for beginners on construction and flight techniques. Friday & week-ends (Excluding contest days) Bob Pairman, 3274 Kathleen St., San Jose, California, 95124; (408) 377-2115

Free instruction for beginners on construction and flight techniques. Sunday - Thursday. Bob Welch, 1247B Manet Drive, Sunnyvale, California 94087; (408) 749-1279

Fall & Winter 1 day seminars on composite construction techniques. Free with purchase of Weston Aerodesign plan set ($35.00) or kit. Frank Weston, 944 Placid Ct., Arnold, Maryland 21012; (301) 757-5199

Reference Material

Madison Area Radio Control Society (M.A.R.C.S.) *National Sailplane Symposium Proceedings*, 2 day conference, on the subject and direction of soaring. 1983 for $9.00, 1984 for $9.00, 1985 for $11.00, 1986 for $10.00, 1987 for $10.00, 1988 for $11.00, 1989 for $12.00. Delivery in U.S.A.is $3.00 per copy. Outside U.S.A. is $6.00 per copy. Set of 8 sent UPS in U.S.A. for $75.00. Walt Seaborg, 1517 Forest Glen Road, Oregon, WI. 53575

BBS

BBS: Slope SOAR, Southern California; (213) 866-0924, 8-N-1

BBS: South Bay Soaring Society, Northern California; (408) 281-4895, 8-N-1

Reference listings of *RCSD* articles & advertisers from January, 1984. Database files from a free 24 hour a day BBS. 8-N-1 Bear's Cave, (414) 727-1605, Neenah, Wisconsin, U.S.A., System Operator: Andrew Meyer

Reference listing is updated by Lee Murray. If unable to access BBS, disks may be obtained from Lee. Disks: $10 in IBM PC/PS-2 (Text or MS-Works Database), MacIntosh (Test File), Apple II (Appleworks 2.0) formats.

Lee Murray, 1300 Bay Ridge Road, Appleton, Wisconsin, 54915 U.S.A.; (414) 731-4848

Contacts & Special Interest Groups

California - California Slope Racers, John Dvorak, 1638 Farringdon Court, San Jose, California 95127 U.S.A., (408) 259-4205.

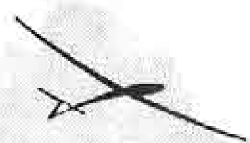
California - Northern California Soaring League, Mike Clancy (President), 2018 El Dorado Ct., Novato, California 94947 U.S.A., (415) 897-2917

Canada - Southern Ontario Glider Group, "Wings" Program, dedicated instructors, Fred Freeman (416) 627-9090 or David Woodhouse (519) 821-4346

Texas - Texas Soaring Conference (Texas, Oklahoma, New Mexico, Louisiana, Arkansas), Gordon Jones (Contact), 214 Sunflower Drive, Garland, Texas 75041 U.S.A., (214) 840-8116.

Maryland - Baltimore Area Soaring Society, Steve Pasierb (President), 21 Redare Court, Baltimore, Maryland 21234 U.S.A., (410) 661-6641

Washington - Seattle Area Soaring Society, Waid Reynolds (Editor), 12448 83rd Avenue South, Seattle, Washington 98178 U.S.A., (206) 772-0291.



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T.W.I.T.T.

(The Wing Is The Thing)

T.W.I.T.T. is an organization of engineers, scientists, pilots, sailplane enthusiasts, model builders and many other persons having an interest in flying wing/tailless aircraft technology. Write to T.W.I.T.T., P.O. Box 20430, El Cajon, CA 92021 to find out how you can participate.

Send SASE for membership application and flyer: "What is T.W.I.T.T." or, send $2.00 for full information package including one back issue of our newsletter, postpaid. Full membership is $15.00 per year and includes twelve issues of the newsletter. Back issues of newsletter are $.75 each, postpaid.

The Vintage Sailplane Association

VSA is a very dedicated group of soaring enthusiasts who are keeping our gliding history and heritage alive by building, restoring and flying military and civilian gliders from the past, some more than fifty years old. Several vintage glider meets are held each year. Members include modellers, pilot veterans, aviation historians and other aviation enthusiasts from all continents of the world. VSA publishes the quarterly magazine BUNGEE CORD. Sample issue $1.-. Membership $10.- per year. For more information write:

Vintage Sailplane Association
Route 1, Box 239
Lovettsville, VA 22080

NEW PRODUCTS

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

Contender

...from C.R. Aircraft Models

My new 2 meter slope kit will be available in late May of this year. It is a wood kit with blue foam wings sheeted with 1/32" ply top and 1/64" ply bottom skins with a ply wing spar. It is a double taper wing with the tip section swept back so the trailing edge is parallel to the point of wing rotation. The 7.5% to 7.0% thin wing section, along with a full wing aerodynamic washout going from 2.0% to 1.5% at the tip make this sloper very fast in the straights, and tight turns at high speed are made easy. Impressive speed runs and fast dives are free of wing flutter or wing tuck. It is a three channel pivoting wing plane in which the rudder can be mixed with the wing rotation or operated separately. The flying weight is 50 ounces but there is a large space for ballast in the fuselage where up to 20 ounces can be placed on the C.G. This would make the wing loading over 24 oz./sq.ft. At the standard weight of 50 ounces, the Contender is very fast and will still fly great in winds averaging as low as 5 mph. The estimated list price is $95.00. C.R. Aircraft Models, 205 Camille Way, Vista, CA 92083; (619) 630-8775. ■

Contender

- High speed, aerobatic, 2 meter slope plane.
- 7.5 to 7.0 percent thick/2.00 to 1.5 percent camber, transisted S3016 airfoil.
- Wing Area: 415 sq. in.
- Flying Weight: 50 oz. unballasted.
- Wing loading: 17.4 to 24.0 oz./sq. ft.
- 3 Chan. wingeron, rudder and elevator.

A Revolutionary New Control Surface Actuating System

...by George G. Siposs
2855 Velasco Lane, Costa Mesa, CA 92626

There is one thing that bothers me about the looks of a very slick, well-finished R/C glider: the control horns. No matter how realistic the rest of the model is, the control horns and the pushrod ends sticking out in the breeze destroy realism. They also add tremendously to induced and parasitic drag.

My idea completely hides the control system inside the surface to be actuated. It is basically a very simple idea but the execution must be flawless; otherwise, the control surface either binds or is too loose.

To illustrate the idea, take an ordinary paper clip and bend out the outermost leg of it so that it is at a 45-degree angle (Fig. 1). Hold the bent leg gently between your left index and thumb while, with the right hand, you rotate the rest of the clip (Fig. 2). You will notice that the left hand, which represents the control surface, such as rudder, will have a tendency to move as you rotate the paper clip which represents the control rod.

Let's discuss the rudder installation only; the other surfaces are very similar whether they are elevator, aileron, flap, etc.

The rudder is hinged conventionally. A slot is made in the rudder in the appropriate location, preferably near a hinge (Fig. 3). The slot should be lined with thin plywood or plastic (Teflon is best.), or thin metal such as shimstock, to prevent wear. The most important thing is that the slot has to be exactly as wide as the actuating rod; otherwise, the rudder will be sloppy.

The control rod may be 1/16 dia. steel wire or thicker, depending on model size. The wire is bent to an approx. 45-degree angle. The bent part is about 1 inch long, again depending on your model size (Fig. 4). The long part of the wire runs inside the fuselage and must be supported every six inches or so with a 1/2 inch long piece of close-fitting aluminum tubing epoxied to the structure. The end of the wire is connected to the servo in some way such as a crank. This depends on you. I suspect as time goes by we will see standard methods developing. The object is to make the servo causing the long control wire to rotate inside the fuselage.

It is most important to ensure that the 45-degree bend is precisely located at the hinge line, to prevent it from moving fore and aft. Otherwise, the system will bind. You can use small "wheel" collars on either side of one of the guide tubes.

Remember that the control wire must be closely supported, the 45-degree bend must be in the hinge line, and the slot in which it slides must be the same size as the wire diameter.

I am planning to patent the system, and would be very interested in hearing from you re. your experience with it. ■

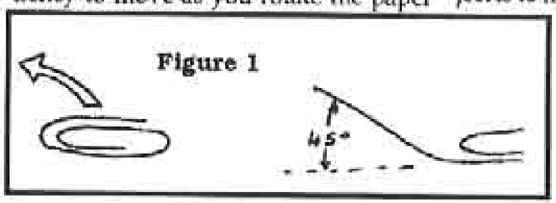

Figure 1

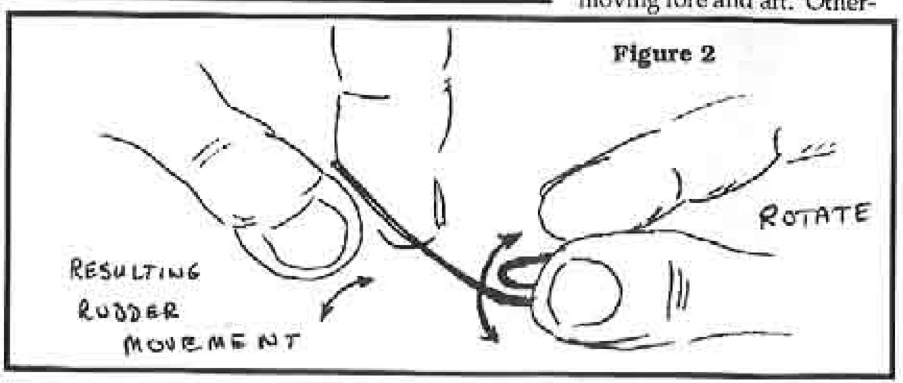

Figure 2

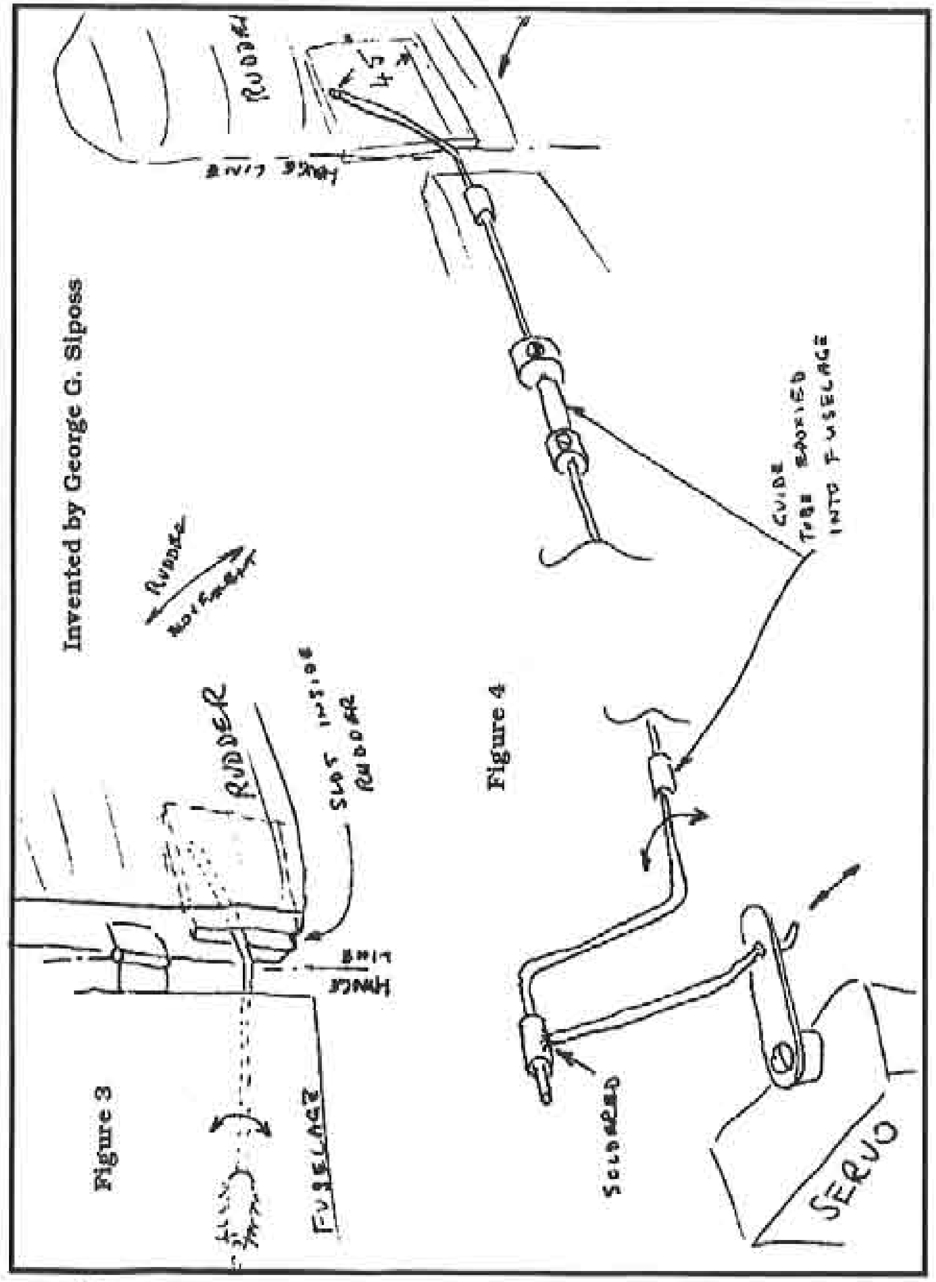

Figure 3

Figure 4

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"Tailless Tale"

Written by Dipl. Ing. Ferdinando Galé
...Review by Jim Gray, Payson, Arizona

What a splendid book for the tailless (flying wing) aircraft enthusiast jam-packed with tables, charts, graphs and reams of technical data for historians, designers, engineers, and - yes, modelers; especially modelers! After you have seen the Galé book, you can't resist thinking: "How come this hasn't been available before? What a great contribution to the literature of "flying wing" material."

Those who have a copy of "NURFLUGEL" - the Horten brothers' book about their tailless aircraft designs of the 30's and 40's - will feel a real need to have the Galé book in their collection. It covers the history of designs other than the Horten ones in countries other than Germany, as well as in Germany itself. It also covers the design and construction of flying wing models in great depth and gives thorough discussions and performance data on powered and un-powered tailless model aircraft.

"Tailless Tail" - provides a super "read" but won't be the kind of book you'll whip through in an evening or two while waiting for your favorite TV program. Instead, it will more likely be the book you sit down with for serious study. However, if you're a "browser" like me, then you'll do a lot of skipping here and there to find subject matter to come back to later.

"Ferdi", as he prefers to be known among his friends, states that there are "simplifications" and "over-simplifications" throughout his work, yet for the person who is neither a trained engineer nor scientist, this is all to the good and makes the book all the more understandable to the layman.

If any of you who may be reading this review have seen sketches, alleged photos, or other interpretations of Unidentified Flying Objects, then you'd better have a close look at some of the tailless creations designed, developed and flown before and during WWII . . . which leads one to speculate, "What about developments after the war?" You will find sickle-shaped, ovoid, disk-shaped, cusp-like, and other interesting and strange planforms abounding in this book...many, if not all, of which were flown successfully...As early as 1876!

Who is Ferdi Galé?

Dr. Ing. Ferdinando Galé, a retired aerodynamics engineer, resides in Italy but still serves as a consultant to major aircraft firms. His first love is R/C sailplanes, and he has authored a book entitled "Aerodynamic Design of Radio Guided Sailplanes". This work, a dual language publication was very well received by the modeling community, and nearly 1000 copies sold here in the United States.

Dr. Ing. Galé has been accumulating information about the aerodynamics, design, and construction of tailless model aircraft for many years. He is a member of the EAA (150382) and #17 SAM Italia, Chapter 62.

The publication of "Tailless Tale" marks the fruition of over a year of research, writing, editing, and drawing. Directed to modelers, it serves as a general guide for those intrigued by the history and potential of tailless aircraft and as a source of technical information for those designing their own models.

What Ferdi Says About His Book

"Design of model aircraft is both an art and a science. As a science, it requires knowledge of the basic laws of applied aerodynamics, as well as the rules of correct structural dimensioning.

As an art, designing, constructing and flying model aircraft requires ingenuity, enthusiasm and perseverance.

Almost all aviation pioneers investigated their ideas by building and flying models of their dreamed-up flying machines. Flying models flew much earlier than their full-size counterparts, although seldom is this mentioned in high-brow aviation literature.

Also the tailless configuration has been investigated by aviation pioneers in many countries of the world in order to arrive at a pure wing configuration with superior qualities. Exactly the same was done by model builders in the past six decades.

Quite differently from conventional crosstail 'craft, tailless ('craft) are based on diversified theories and principles which often contradict each other. The relevant information is scattered in a variety of books, reports, publications, and magazines as well. Thus it is not easily available to model builders.

In these pages the author has tried to select and synthesize ideas, theories, practical tailless examples which can be useful for the design and the construction of all-wing value, several well-proven rules of thumb are mentioned in the text. Adequate warnings are given when necessary.

From a strictly scientific point of view, this book contains many simplifications and over-simplifications. It assumes model builders are not, necessarily, technical persons. Therefore, this book is far from being a scientific treatise on tailless (aircraft). Instead, it should be considered a low-key approach to the tailless configuration, written by an aeromodeler for aeromodelers.

Consequently, instead of elaborate theoretical considerations which often can be challenged one way or another on strictly scientific ground, practical rules and considerations are presented. In this way, model builders have enough information available to draw their own conclusions.

When it comes to flying models, it is definitely more exciting and rewarding to learn from one's mistakes, rather than simply to draw from somebody else's experience and without any personal contribution.

Of course, experience is indispensable in the recipe of success, provided one contributes with some inventiveness. Progress is made in this way.

After decades of model building activity (since 1934), the author still considers the learning curve to be asymptotic...there is no limit.

Hopefully this publication will be of interest to those aeromodelers who share the author's beliefs, as well as to aviation fans who are interested in tailless (designs)."

The Format

"Tailless Tail" is usefully divided into chapters including: Historical notes; Basic considerations; Tailless flying models; Static longitudinal stability; Lateral and directional stability; and Control and maneuverability.

The Appendix includes Airfoils; Bell-shaped lift distribution; Wing loading conversion chart; Trigonometric tables; and Selected tailless design dates.

An outstanding feature of this book are the drawings and plan views of tailless designs created and flown in various countries of the world including France, Germany, Great Britain, Italy and the United States...all the way back to the mid-1800s. The dream of an efficient, workable, and often bird-like flying wing aircraft has captured the imaginations of searchers throughout history and legend, and probably pre-history as well if only the information had been saved.

When confronted by a soft-cover, spiral-bound book of some 258 pages, one is tempted to leaf through quickly, looking for specific items of interest and attraction. I tried that, but 'stuck' no matter where I had landed at the moment. There is just too much interesting information wherever you turn to permit quick dismissal. For example, I landed at Fig. 2.16 and saw a chart of sweep angle and aspect ratio of untwisted wings. Sure enough there is the expected curve of data, but what's more, each point on the curve is illustrated by tiny drawings of machines that fit the data. The chart illustrates the effect of sweep and aspect ratio on instability at high angles of attack.

Here's another gem: Figs. 3-32, 3-33, and 3-34 contain three-views of 44 tailless craft from the U.S., Germany and Poland, among others. How about a page-size three-view of a fine Polish sailplane called the IS-16 Nietoperz? It features a "cranked" wing (double sweep-forward and back), a span of 12 meters and a NACA 23012 airfoil. So what, you ask? Here's what: it was designed for speeds up to 300 Km/hour!

You'll find that the equations are mostly of the simple algebraic variety with single terms — easy to use and apply to your design.

Have you wondered exactly what a "bell-shaped lift distribution" means, how it is achieved, and its effect on performance? Here it is, all explained in a very simple and easy-to-understand manner. Using the information set forth, you can design your own flying wing to achieve the following results: adequate directional and longitudinal stability, limited throw of elevons for satisfactory maneuverability and limited drag increase upon deflection, and reduced risk of flutter due to torsional forces.

Many of us are aware of the Horten brothers' influence on tailless design, but how many know of the tremendous advances contributed by Alexander Lippisch - the man responsible for the design of the Me-163 rocket-propelled fighter? Pages 8, 9, 10, 11, and 12 give small three-views of his many, many designs..including the 1942 twin-engine "fast bomber" proposed for construction by Germany during WWII...a pusher-puller arrangement of engines and fairly long fuselage mounted to a crescent-shaped wing. Mind you, that was 1942!

Dr. Lippisch came to the USA to work in aircraft design following the end of WWII, and contributed greatly to the success of several U.S. tailless aircraft.

The Me-163 Komet had a single fin-rudder centrally mounted, whereas the Storch and Delta designs had tip-mounted yaw control devices. To quote Dr. Lippisch: "...To fly models is a lot of fun, but be always aware that many achievements in large-scale aviation made their way through aerodynamic childhood as models." (From the May 1950 "Air Trails Pictorial".) Isn't that phrase "aerodynamic childhood" a delightful expression - and so apt?

In any review it is difficult to pick the particular subject likely to please all modelers, but I'm sure that this book will please just about everyone through its diverse and important subject matter and its practical effect on the design, construction and flying of successful tailless model aircraft. One can ask no more of a book than inspiration, and the Galé book gives that in full measure.

You may obtain your copy for only $33.00 (postage and handling included) until June 30, 1992 from B² Streamlines, P. O. Box 976, Olalla, WA 98359-0976. Orders postmarked July 1, 1992 and later will be $38.00, postage and handling included. My copy resides on my aeronautical bookshelf, right next to "Nurflugel" and "Airfoils at Low Speeds" by Selig, Donovan and Fraser. ■

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Schedule of Special Events

Date	Event	Location	Contact
May 16	Slope Fun Fly	Arcata, CA	Daryl Pfaff (707) 445-3538
May 16-17	Electric Contest	Memphis, TN	Bob Sowder (901) 757-5536
May 16-17	CSS May Memorial Contest	Cincinnati, OH	Chuck Lohre (513) 731-3429
May 29-31	Mid Columbia Scale Int. Fun Fly	Richland, WA	Roy (509) 525-7066 Gene (509) 457-9017
June 6-7	Unlimited & 2M 11th Annual Rose Bowl Soaring Festival	Pasadena, CA	Noel Brooks (818) 796-9929 HM
June 7	9th Annual Hand Launch	Riverside, CA (After 6:00 P.M.)	Ian Douglas (714) 621-2522
June 13/14	S.O.A.R. Great Race	Osewego, IL	Lee Sheets (708) 748-8934
June 27-28	MASS-NASF Mid-South Soaring Championships	Memphis, TN	Bob Sowder (901) 757-5536
July 18-19	CSS Mid-Summer Contests	Cincinnati, OH	Chuck Lohre (513) 731-3429
July 18-25	LSF R/C Soaring National Championships	Vincennes, IN	Mike Stump (616) 775-7445
July 25/26	World Inter-Glide 92	Fairlop, London	Les Sparkes 81-505-0191
Aug. 22	MASS Soaring Unlimited	Memphis, TN	Bob Sowder (901) 757-5536
Oct. 3-4	CSS Pumpkin Fly	Cincinnati, OH	Chuck Lohre (513) 731-3429

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Contact Noel Brooks for inf. at (818) 796-9929 HM.

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MODEL Sailplane Clearance: 4 meter DISCUS - "KRAUSE", incl. wing servos, ready to fly...$595.00; 4 meter LS4 - "ROWING", all glass, ready to fly, Liscomb retract, incl. wing servos...$899.00; 1/4 scale ASW 20 - "WIK", all glass, ready to fly, Liscomb retract...$899.00; ASW 22, 6.25 meter - "FIBERGLASS FLUGEL", all glass, new kit w/retract or ail. mixer...$1450.00; LS4, nearly 1/2 scale! 8 meters (26') wing span! Unbelievable German craftsmanship, brand new kit, flying wt. approx. 40 lb. Entire airframe in gleaming white...$2700.00; LS4, nearly 1/2 scale fuselage, canopy frame, canopy, beautiful white gel-coat, brand new...$950.00; DC 500 - "THERMOFLUG", 3.5 meters, beautiful scale 2 seater, ready to fly...$345.00. Some prices flexible. All prices cash & carry. All models brand new or like brand new. Call Dan Troxell (714) 831-8013 CA.

JR X347, NIB, without servos...$300.00; With 4 used 4001...$400.00. Money back guarantee. Nat Penton, (318) 786-3871, Louisiana.

Airtronics GRAND ESPIRIT...$200.00; Airtronics AQUILA GRANDE...$150.00; Airtronics Sagitta 900...$70.00; LEGIONAIRE 140...$160.00; Bob Smith SUNDANCER II...$100.00; M.H. Manufact. ALBATROSS...$80.00; Midwest SOARER...$40.00; Gold Coast VORTEX Deluxe...$125.00; ACCIPITER XL...$125.00; PHOENIX...$200.00; Bob Sealy LUMINA...$65.00; Prices do not include shipping and/or C.O.D. All kits NIB. Call after 7:00 P.M. CST (414) 367-2419 WI, Tom Gressman.

MAGIC, 138" span, T-tail w/bellcrank, beefed up wings and fuse, finished & flying...$425.00 w/out servos, $500.00 w/wing servos; Multiplex FIESTA, 127" span, w/spoilers, excellent condition, good flyer...$250.00; 100" electric sailplane, fiberglass fuse w/motor, finished & flying...$200.00; SWIFT 800, slope racer, carbon fiber fiberglass, finished & flying...$500.00. Call Ray Franz, (714) 363-7633 CA.

Wanted

Information on any available software for "Amiga 500" for sailplane design or wing rib plotting. Ray Gadenne, 93 Headley Drive, Ilford, Essex 1G2 6QL, U.K.

Replacement canopy for 1/6 scale Reiher 2, Triton kit. It was a victim of the Killer Winches at the '91 NATS. Bob Harold, 519 N. Youlon St., West Salem, WI 54669.

Supplier for bungee rubber in quantity. For example, 20-30 off X 100 ft. X 3/8" bungees. Brian Scott, 81 Victoria Road, Netherfield, Nottingham, NG4 2NN, U.K.; 0602-870243.

Product Review

C.R. Aircraft Models "Turbo" S and ST High Performance Wingeron Sailplanes

...by Paul Naton

A new and extraordinary plane is now dominating the slopes of California; if you slope flyers have not yet seen the Turbo series of planes from C.R. Aircraft Models tear up the skies at your site, you soon will. It has been awhile since anything this hot has come on to the commercial slope plane kit market.

I have been flying the Turbo for about 6 months and have seen my flying skills improve dramatically. It is the first plane I have flown that gives you the feel of a direct brain-to-plane interface; this is due to the wingeron control and the clean efficient design. If you want a plane that will challenge your skills to the limit and a plane that will out fly almost anything from light to extreme conditions, Turbo is the plane you must have.

Designer and very experienced pilot Charlie Richardson (other designs include the Savage and Savaron) spent two years developing and refining the wingeron concept and testing a variety of wing and airfoil designs. The resulting Turbo series proved so successful that he decided to get back into the kit business full time. In one year, with only word of mouth advertising and a few hobby shops selling the kits, over 500 Turbos are now flying around the country.

The Turbo comes in two versions. The 'S' model has a 52" span, 31" length, a Selig 3016 section, two channel wingeron and elevator control, and a flying weight of 13-18 ounces. The Turbo 'ST' is larger with a 60" span, 34" length, a Selig 3021 section, and a flying weight of 15-20 ounces. The 'ST' is large enough to add a third channel with a rudder. The 'S' was designed for slope flying only and is extremely fast and agile. It is safe to say it will out perform anything flying today.

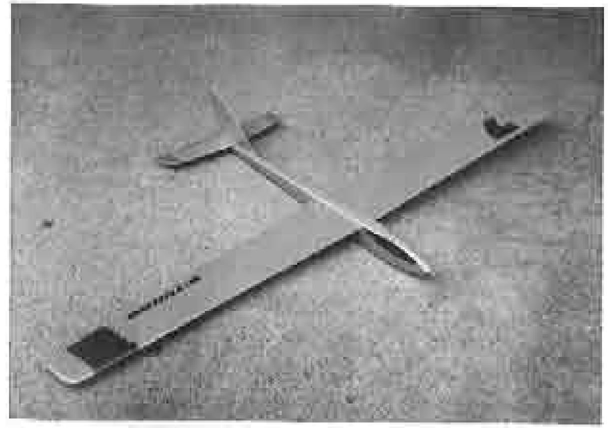
The 'ST' is more of a general purpose design that will fly in very light lift conditions and performs well off a winch or high start. The ST is no cruiser however, with a very high roll rate and excellent speed range. You can buy an optional wing kit for the ST with the Selig 3016 section which greatly enhances its slope flying speed and acrobatic ability. The interchangeability of the wings gives you a plane that can excel in any conditions you might encounter.

The kit quality is simply outstanding and very complete. All you need to get to complete the kit is the recommended Sullivan cable for the elevator. The wood was of good quality and the foam cores were very accurate. A nice feature is that the wingeron linkages are included saving a lot of building time. The Turbo was the first kit I built that had foam cores. All of the parts matched the well drawn plans unlike many kits I have built. Even a rookie builder like myself should have no problem assembling the Turbo, and the foam cores were a snap especially when you did not have to install and align a complicated aileron linkage.

The Turbos can take standard servos though a 250 mamp battery should be used. Make sure that a high quality servo drives the wings! This is the heart of your plane so don't skimp here. I opted for the Airtronics 141 high torque mini servo though the new Futaba high torque mini would work too. You need the speed and extra torque for those high speed runs.

The Turbo is very sensitive to extra drag so take the time to round the fuselage and make sure the flying surfaces are done to perfection. The elevator and tail need to (be) dead straight or you will get yaw effects. The difference in speed between a 'clean' Turbo and one hack built is 20-30%. Try too keep the plane light as possible and use ballast to adjust the wing loading.

You should have some aileron experience before trying to fly the Turbo. For first flights, set the CG a little ahead of the plan location and put the wingeron push rods on the inside holes to reduce wing throw. If you have a dual rate radio, set the slow rate to 50%. The Turbo is actually easy to fly once you get used to the sensitivity. Because there is no lag time in control movements, you can actually fly out of bad situations that a regular plane couldn't. Try to get off the 'training wheels' as soon as possible.



My personal set-up is the ST with both the 3021 and 3016 wings. With famous Torrey Pines being my primary flying sight, I usually fly with the 3016 wings and use the steel wing rod included in the kit. Use the carbon rod in light conditions and thermal situations. The trick to really making your Turbo cruise is using ballast to adjust the wing loading.

For maximum acrobatics in up to 15 kts. of wind, use the steel rod only. If you want speed and energy retention, build your Turbo with a ballast compartment (just bolt in lead at the CG), and add weight up to 8 ounces.

In good lift with the extra ballast, the Turbo can out climb and out speed planes 2-3 times its size. I have even raced against a heavy slope racing Swift and came in dead even! I have pulled off 9 vertical rolls, 4 horizontal rolls in 1 second, and maneuvers only a wingeron plane can do.

The Turbo S and ST are inexpensive and easy to build kits that don't rely on exotic materials or computer radios. They allow the slope pilot to fly without envelope limitations and without extensive maintenance, cost, and repair. I have flown most of the slope planes on the market, and none of them come close to the performance of the Turbo. After flying the Turbo for awhile, pilots complain that their other planes seem like sluggish 'bricks'. I recommend you build or test fly a Turbo no matter what kind of planes you already own. ■