Radio Controlled
Soaring Digest

April 2012 Vol. 29, No. 4

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Front cover: Phil Pearson captured this image of Ken Lies' DLG at a contest in Pasco Washington last year. Ken built the airframe using a Zone wing. Valspar paints for coloring; red color down first then light layer of yellow over the entire bottom mylar. The tops are solid red which gives the thinner flaperons the orange hue.
Nikon D300S, ISO 200, 1/125 sec., f5.3, 230mm

Back cover: Thomas Truffo's Supra soaring over the gentle slopes of Pianoro, Bologna, Italy. Photo by Francesco Meschia
Nikon D70s, ISO 200, 1/800 sec., f7.1, 170mm

R/C Soaring Digest

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RC Soaring Digest is published using Adobe InDesign CS5

In the Air

Marco Testi was a tremendously creative designer and builder of flying machines. Well known within the nurflugel and xfoil Yahoo! groups, Marco's messages under the name karenfuxia were always worthy of note. He was also an influence within the X-Plane forums. Marco held a Bachelor's degree in Physical Technologies and a Master's degree in Cognitive Sciences and was a self-taught aerodynamicist. He held patent US 6,273,371

Marco Testi's Article 07-XS utilized huge flaps for very slow speeds.

and had two other patents pending. He was a private pilot, trained in aerobatics, and had 200 hours flying hang-gliders and paragliders. He was working on a rather small electric manned flying wing and just finished a line of flying wing RC planes. Marco was killed in November of 2011 while bicycling in France. He was 41 years old. Marco leaves his young son, family and friends and the aerodynamic community. Marco's web site, Aerial Creatures & Cognitive Integration <http;//www.karenfuxia.com>, is still on-line and deserves your extended visit.

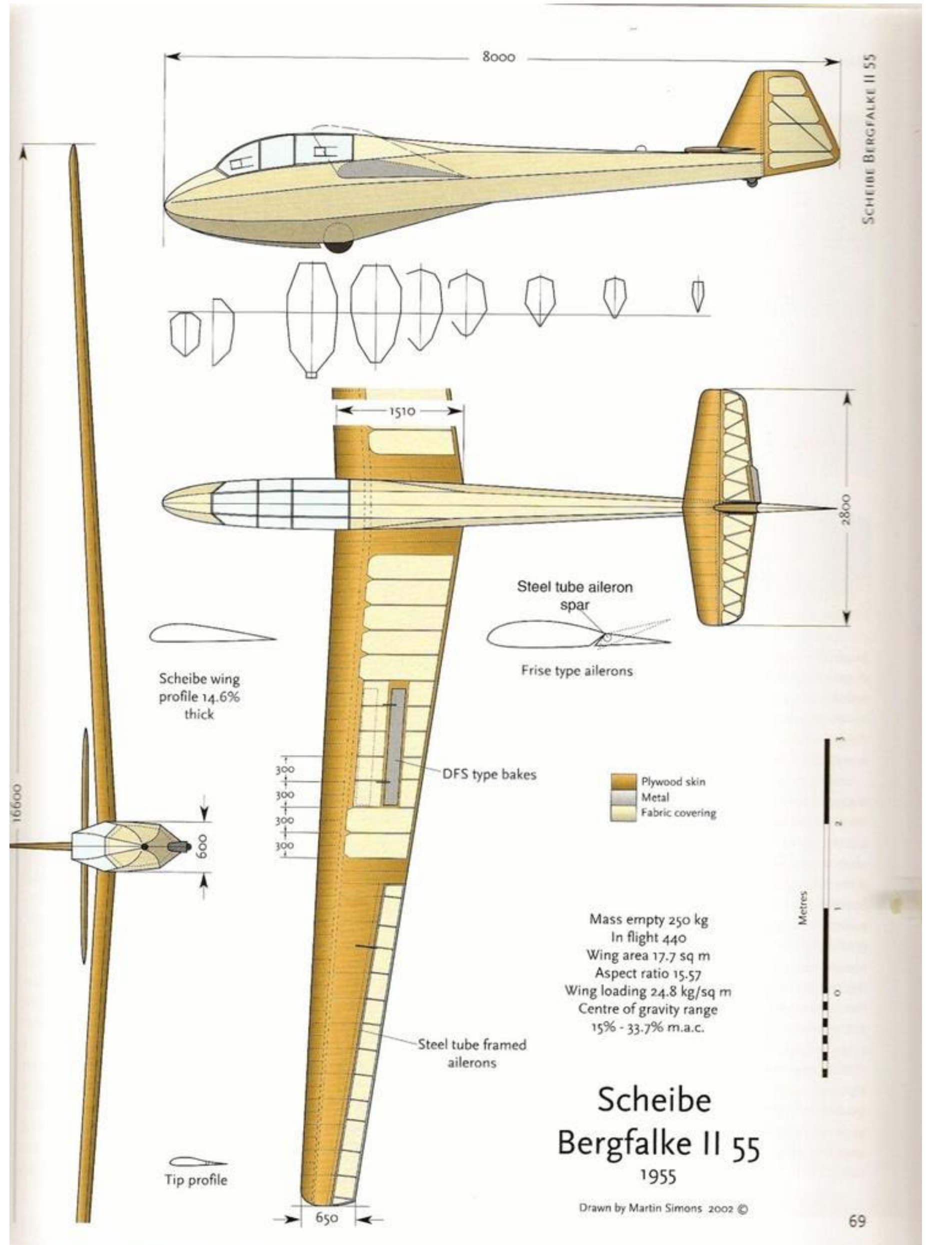
Time to build another sailplane!

B²

Bergfalke II Freestyle

Gino Alongi, ginoalongi45@gmail.com

Photo 9 IMG_5838
Marco Benincasa/*Modellistica International*



Scheibe Bergfalke II 55 3-view from Sailplanes 1945-1965 by Martin Simons © 2006, published by EQIP <www.eqip.de>. Used with permission.

Photo 9 SDC15797
Marco Benincasa/*Modellistica International*

From the Editors

Followers of *RC Soaring Digest* from its beginning in 1984 have been introduced to an astounding array of sailplane designs. There have been one-off quick-builds of foam, creations of fiberglass and carbon destined for sale through commercial outlets, and intricate airframes using wood as the primary building material.

The methods of design and construction of the latter type have evolved over the intervening time, from the die-cut parts of available kits to the use of hand-drawn plans and hand-made templates in the home workshop.

The use of computers during the design and parts fabrication processes is relatively new and improving rapidly, and there is a decline in the cost of the laser cutting of wood parts.

Gino Alongi has utilized all of these modern techniques in the development of his Berfalke II Freestyle, and his comprehensive documentation of the journey from initial concept to flying model should serve as an inspiration to other scratch-builders and potential scratch-builders around the world.

— Bill & Bunny Kuhlman

Introduction

It is my opinion that talking about modelling techniques is not easy at all. If the presentation is addressed to the most expert modellers, there is a fear of not saying enough to meet the high level of their knowledge, but if it is addressed to a less experienced modeller, concern is even greater because everything is to be explained very clearly in order to allow them to follow the topic all the way through.

The consumed reader will excuse me if sometimes we focus on some aspects that he would prefer to skip, as perhaps a richer explanation will capture the attention of a larger number of fabric and wood's new friends.

I confess that I have only recently approached silent flight. It was perhaps inevitable to bump into a turning point after years of exasperated Heat Racing. I don't want to now repudiate the activity which awarded me gold medals at 11 National Champs and two World Champs under our association Federazione Italiana Motonautica. The fact is that one door has been opened - a new world which fully involves me.

RC soaring is made of well defined theoretical bases and unexpected sophisticated techniques. Flying a glider draws you to moments of rare serenity, close to nature, in good company with your friends. I have plunged into that with the enthusiasm and renewed skill of which the Bergfalke II Freestyle is the result.

It's strange to note how many things we must learn before we understand how little we know. Nevertheless, today, when things are done, I feel myself ready to show you, with pride, the result of my work.

According to all friends present at the first flights, I'm enjoying a valuable glider with uncommon flight potentiality.

Read the e-mail from Geppi Frattali, the tow plane pilot, which refers to the test flight:

> ... it strikes me a few factors which are essential for a gliding enthusiast:
>
> ... the incredible efficiency that made me gape when, at 15 meters, I saw you make three 360 ° turns with virtually no loss of altitude, the slow majesty of flight makes it virtually impossible to distinguish whether it is a model or a real glider. Flight is tight and clean, with no unexpected problems or critical issues, no changes of speed, that we often see in models...
>
> Marco Benincasa, habitual competitor at Top Gun Lakeland, FL, was also present at the test. His impressions:
>
> It was a real pleasure to attend the launch of Gino's Bergfalke. I was taken from my job as a photographer, but this did not stop me from admiring the obvious majesty of the flight and cleanliness of the flight path. What particularly struck me is the relatively slow speed and the complete naturalness of the flight. Gino has done some turns into a real handkerchief, always without losing speed and elegance.
>
> The Bergfalke seemed to rotate around its own wing tip. The landing approach with the brakes extended is a pleasure for the eyes. So congratulations to Gino Alongi for a realization of high-level which rewards him for the long work done.

I like thinking that you desire to share the motivation and the development of this project. I have noted the first steps up to the analysis of flight features in the virtual wind tunnel.

Even if we cannot really say that this glider affects you for its aesthetic quality, I first chose the Bergfalke II instinctively for its sculpted lines which are simple to replicate and at the same time exhibit a pleasing and strong overview which absolutely fits with so an impressive binding name: Mountain Hawk !

Egon Scheibe's glider

The full-size MU-13 Scheibe Bergfalke II/55 is a two-seat glider that represents the construction set belonging to the designer Egon Scheibe (1908-1997), one of the pioneers of German soaring. The fuselage is a structure of welded steel tubes, wings are of wooden structure covered with canvas.

It is derived from two gliders of identical DNA: MU-13 Merlin and MU-13 Atalante. These gliders were celebrated for their achievements in the Rhön competitions up to the '40s.

The company Scheibe Flugzeugbau was born immediately after the war. This factory produced from 1951 to 1978 the Bergfalke II, III and IV for a total of about 700 specimens.

The version II 55 of the project became reality with the inaugural flight of March 15, 1954. The next few years involved some aesthetic variations, intermediate to version III dated 1963. 1969 saw the version IV being born. Unrecognizable! While retaining the fuselage frame of steel, the wing planform loses the negative sweep, replaced by a straight leading edge perpendicular to the longitudinal axis. The profile is substituted with the laminar Wortmann FX S 02-196, the wing aspect ratio goes to 16.95 and the aerodynamic fineness changes from 28 to 34.

In 1978, after only 70 specimens, the production of version IV stopped, buried by the advent of fiberglass construction. Don't cry, now: sixty years after the prototype, some real Bergfalke relics of the past are still flying all around the world. Monographs are available on the web with lots of photos. Even YouTube shows some flights.

<http://www.sailplanedirectory.com/scheibe.htm>

<http://www.retroplane.net/bergfalke/bergfalke.htm>

<http://a60planeur.free.fr/monsiteweb% 20BF/>

<http://a60planeur.free.fr/monsiteweb 20A60/Reportages/2004%%% 20Les 20Alpilles.htm>

Back to the model now. Looking for more information in the network, I was fascinated by the flight of Chris Williams' Bergfalke II sloping over the smooth English hills <http://www.youtube.com/watch?v=6Q6tAOZU-zY>.

I've watched this video with open mouth a hundred times, until I was definitely pushed to switch on this project.

Here I am, after less than two years, to tell you the whole story from my point of view, and while I cannot stay in my skin waiting for the next takeoff.

The Project

The reproduction of this glider dated 1955, was recently developed by expert modelers, Chris Williams and Vincent Besancon, who used traditional techniques to obtain two models of excellent performance, both for thermal and slope flight. These movies will give an idea:

<http://www.youtube.com/watch?v=6Q6tAOZU-zY>

<http://www.retroplane.net/html/videoaccueil.htm>

My ¼ scale plan is a freestyle drawing.

Yes, I am not proposing again a copy, more or less faithful to the original. I love the Scheibe Bergfalke to the point that I cannot deny to provide the newborn sailplane with all the best of today's technical knowledge, both in terms of construction technology and in terms of aerodynamics. I have been measuring each individual contribution with the attention and sensitivity of those who dare not distort Mr. Scheibe's superb work.

I have re-styled the fuselage, preserving the original character, with a more penetrating slim section, rounded top and sides, as also happened to the full size glider only a few years later with new releases of Bergfalke III and IV.

My drawing proceeded step by step without ever losing sight of the real target: performance to be optimized by the careful choice of the airfoil, its thickness and pitching moment. I almost imperceptibly increased the chord, so as to achieve the wing aspect ratio of 14.14 against 15.6 of the original, to the benefit of both wing loading and Reynolds number with which we will have to come to terms with flying performance. Stabilizer and rudder are re-sized to have the best control in any flight condition.

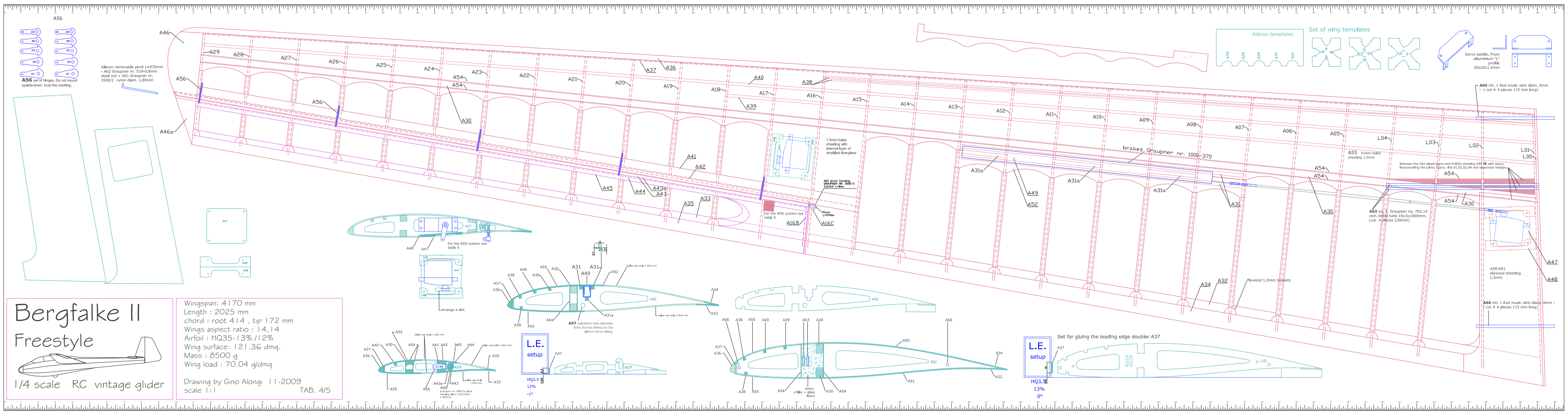
All the moving flight control surfaces, such as ailerons, elevator and rudder, at any range of their motion, are hinged to avoid the corruption of the airfoil profile. For maximum aerodynamic cleanliness, a concrete contribution is assured by the absence of levers and links outside of the airfoil sections. (Direct, powerful and invisible, the Rotary Driver System for the aileron control is suggested as an option to the traditional system, but please note: it's highly recommended.)

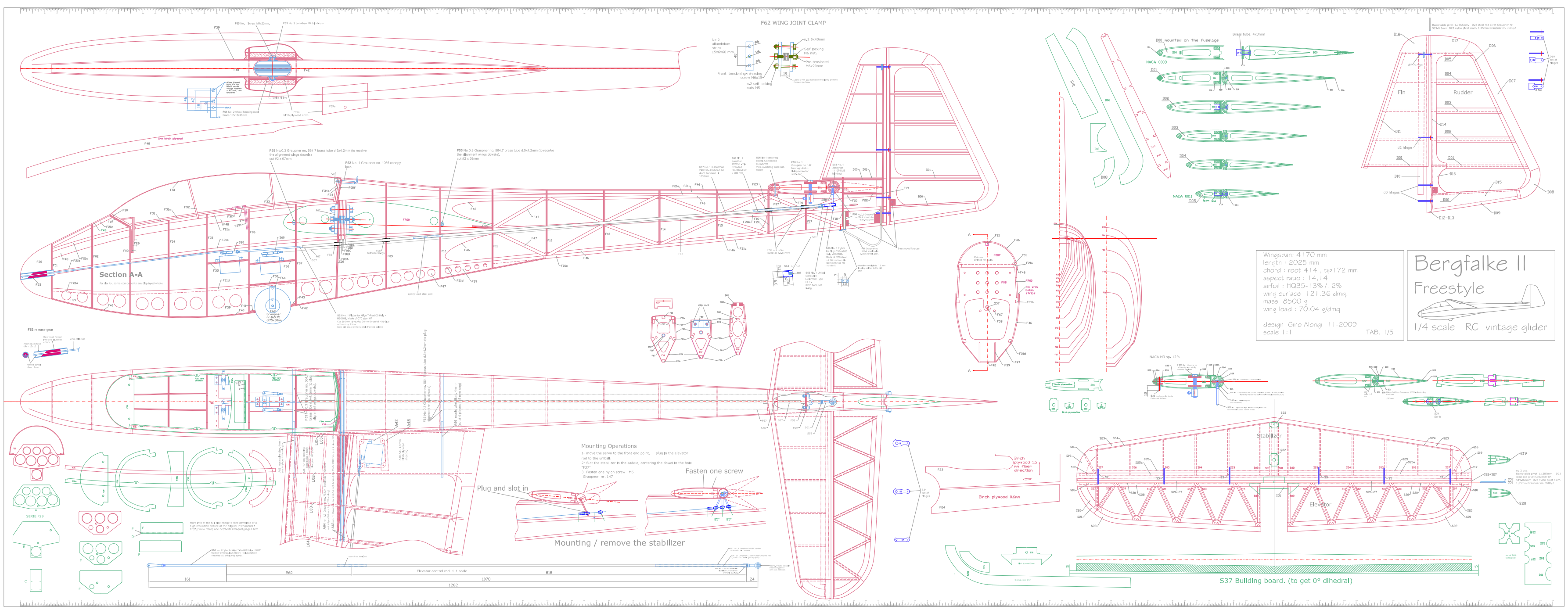
Paying the utmost attention to simple design and functionality, some additional elements, such as the air brakes, are simplified by adopting those in commerce. At the same time, where the original design offers the best solution, as the quick fix for mounting the stabilizer and its control lever to the fuselage for example, this has been fully reproduced.

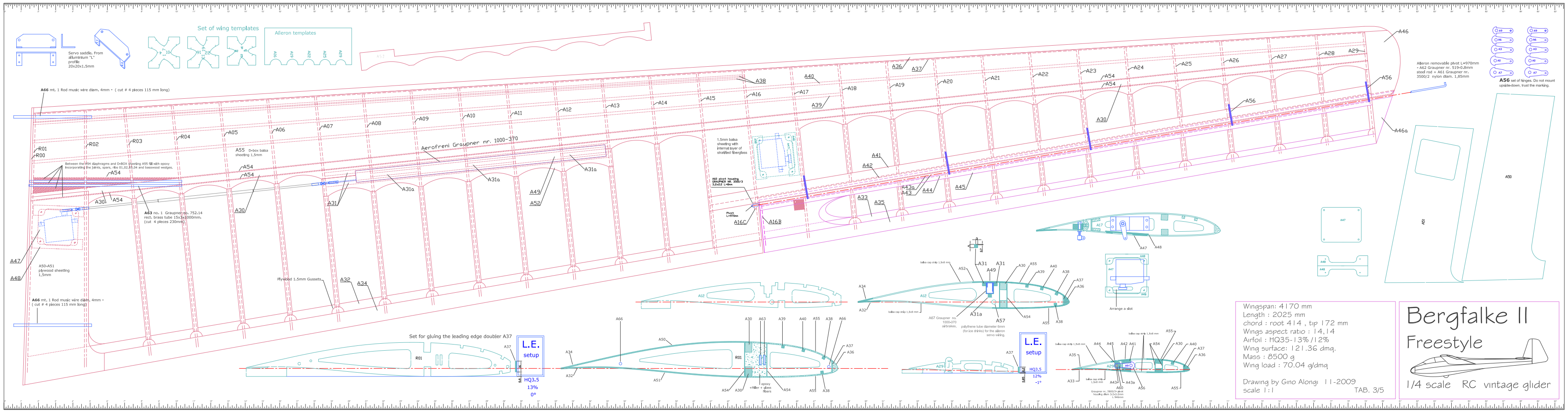
At first glance you will immediately recognize my Bergfalke II and this compensates my work, but the careful observer will find much more. Photo 8 DSC00990

Photo 8 DSC00990

Plan set for Gino Alongi's Bergfalke II Freestyle

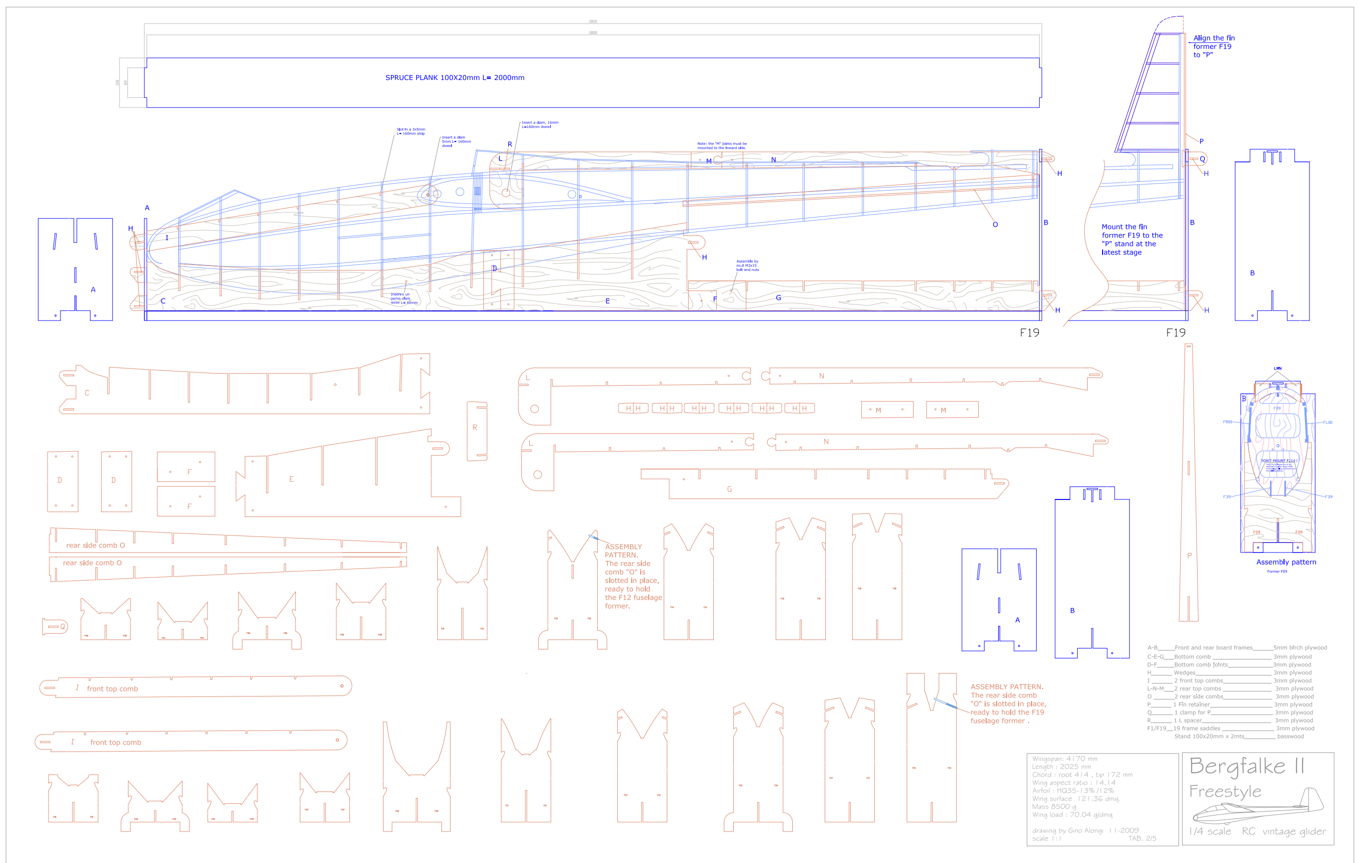






Shown on these pages are thumbnail versions of the full size plans for the left and right wings, fuselage and tail assemblies, and the fuselage building board. Also available are enlarged plans for the RDS linkage installation, a list of the required materials, a description of the wing retention system, and complete building directions which include roughly 300 photos taken during the construction of Gino's model.

See the last page of this article for links to all of the files mentioned in the text.



Features comparison

Name: Scheibe Bergfalke II/55	Name: Bergfalke II Freestyle
Construction: 1955	Construction: 2010
First flight: 1956	First flight: 04/01/2011
Wing span: 16.60 m	Wing span: 4,170 m
Length: 8 m	Length: 2,025 m
Fuselage height: 1.40 m	Fuselage height: 0,292 m
Fuselage width: 0.60 m	Fuselage width: 0,148 m
Chord root: 1.50 m	Chord root: 0,414 m
Chord tip: 0.62 m	Chord tip: 0,172 m
Wing area: 17.70 m^2	Wing Area: 1.21 m^2
Weight in flight: 440 kg	Weight in flight: 8.5 kg
Aileron surface: 1.95 m^2	Aileron surface: 0,131 m^2
Surface stab. + Elevator: 2 m^2	Surface stab. + elevator: 0,155 m^2
Surface of the rudder: 1.09m^2	Surface of the rudder: 0.062m^2
Wing aspect ratio: 15.6	Wing aspect ratio: 14:14
Dihedral: 3.5°	Dihedral: 3°
Root to tip sweep: -4,8°	Root to tip Sweep: -4,98°
Wing Profile: MU 14% relative thickness	Wing Profile: HQ 3.5 13% root - 12% tip
Stabilizer Profile: MU symmetrical	Stabilizer Profile: NACA M3 sp. 12%
Media CG location: 15%-33.7% MGC	Media CG location: 36% MGC
Aerodynamic fineness: 28	- -

The Drawing

In June 2009 I started importing into Autocad the 3-view of the full size sailplane found at <http://www.retroplane.net/bergfalke/plan.htm>.

This created a preliminary draft with the data and size that were afterwards used within Profili2, the airfoil program by Stefano Duranti <http://www.profili2.com>. Profili2 simplifies the choice of the airfoil most suitable for our model. You can filter a rich airfoil database by parameters, select and compare two or more polars. (For a sample application, see the article by Giuseppe Ghisleri in Settimo Cielo #1, developing the aerobatic glider Manta Ray.)

Once the choice of the profiles was determined for the Bergfalke wing: HQ3,5 / 13 at the root, +1.5 ° incidence; HQ3,5 / 12 at the tip, +1 ° incidence; NACA airfoils for the tail. The Profili2 program generated the wing and tail panels. All the ribs are already prearranged to slot together to the spars, to the leading and the trailing edges, and the shape for lightening holes is suggested, the sheeting thickness is considered, and the root/tip incidence angles can be fixed.

Not bad, eh? If this is not enough, Profili2 gives you the chance to export all these tables in DXF format files for further management within Autocad. The design of the fuselage, the “ladder” assembly and other details proceeded within the Autocad environment and were concluded in November 2009.

The first prints of the 1:1 scale drawing shown to friends received interest and an inquisitive feedback, especially two of them, Ing. Bruno Tomei and Geppi Frattali, who gave me complete confidence for which I am very grateful. With great enthusiasm these two have become available for prototyping the model, therefore the Bergfalke Freestyle will be born as triplets!

In December 2009 we received three laser-cut kits and the construction of the three models started.

Checking the project with XFLR5

In recent months, that I employed mainly for spreading glue and scraping wood, a fascinating article by Francesco Meschia (*RC Soaring Digest*, February 2008) came back to mind. The subject was a simulation program for the analysis of the performances of a model airplane, XFLR5 by Andre Deperrois.

It seemed to me convenient to have in advance the Bergfalke II Freestyle’s theoretical performance data in order to approach the upcoming test in a calm and well aware way. So I found the site <http://sourceforge.net/projects/xflr5/> that offers free download of the latest version.

The XFLR5 program interface turns out to be not really intuitive and requires all your attention, but it was not so difficult to perform the 3D modelling of the wing and tail surfaces. The fuselage was deliberately skipped because, as Giuseppe Ghisleri suggested, “It is irrelevant in the analysis we need.”

I got initial results, but I had to admit my lack of preparation, which I couldn’t quickly fill in. Consequently, I consulted Francesco and Beppe asking them to develop the analysis of my file and I received their immediate availability, for which I thank them again. After a few days, Francesco returned the file enriched with a huge collection of data. Especially appreciated is the description of the procedures needed to elaborate the analysis by XFLR5. My objective now is to summarize all this information.

The analysis of the model is very powerful and it gives us detailed information useful in determining performance, efficiency, balance and stability.

Preliminarily, the program should be provided a set of 2D polars representing the Reynolds numbers at which the airfoils used for the wing and the tail will fly. We must also consider that in the tapered Bergfalke wing, the Reynolds numbers change based on the local wing chord. As a result, not just one 2D polar is needed for each profile, but many of them… “a mesh” as elucidated by Francesco… who created a mesh for each profile and the relevant polars at Re 50k, 100k, 200k, 500k and 1M.

Now the type of analysis that we require, among those proposed, is to be defined. For this study of a glider, we choose “fixed element” and the balance of lift and weight; the type of analysis that the program defines “Type 2.”

Two more data are needed: the Mass and Centre of Gravity position. By these new inputs, XFLR5 can now calculate the final polar of our model at a sequence of incidence angles for the range we have selected — between -2° and +9° at step 0.25°.

Once these calculations are made, the display of a few standard graphics are immediately available, and through some options we can customize the creation of many other diagrams.

The introduction chart of the Bergfalke features is visible selecting “View - 3D.”

See Illustration 0.

I’m providing this image only to document the program’s features. The overlap of lift and drag vectors, moment and pressure coefficients are giving a chaotic view. Actually, running the program, each of them are activated separately, so you can choose what to observe and from what point of view.

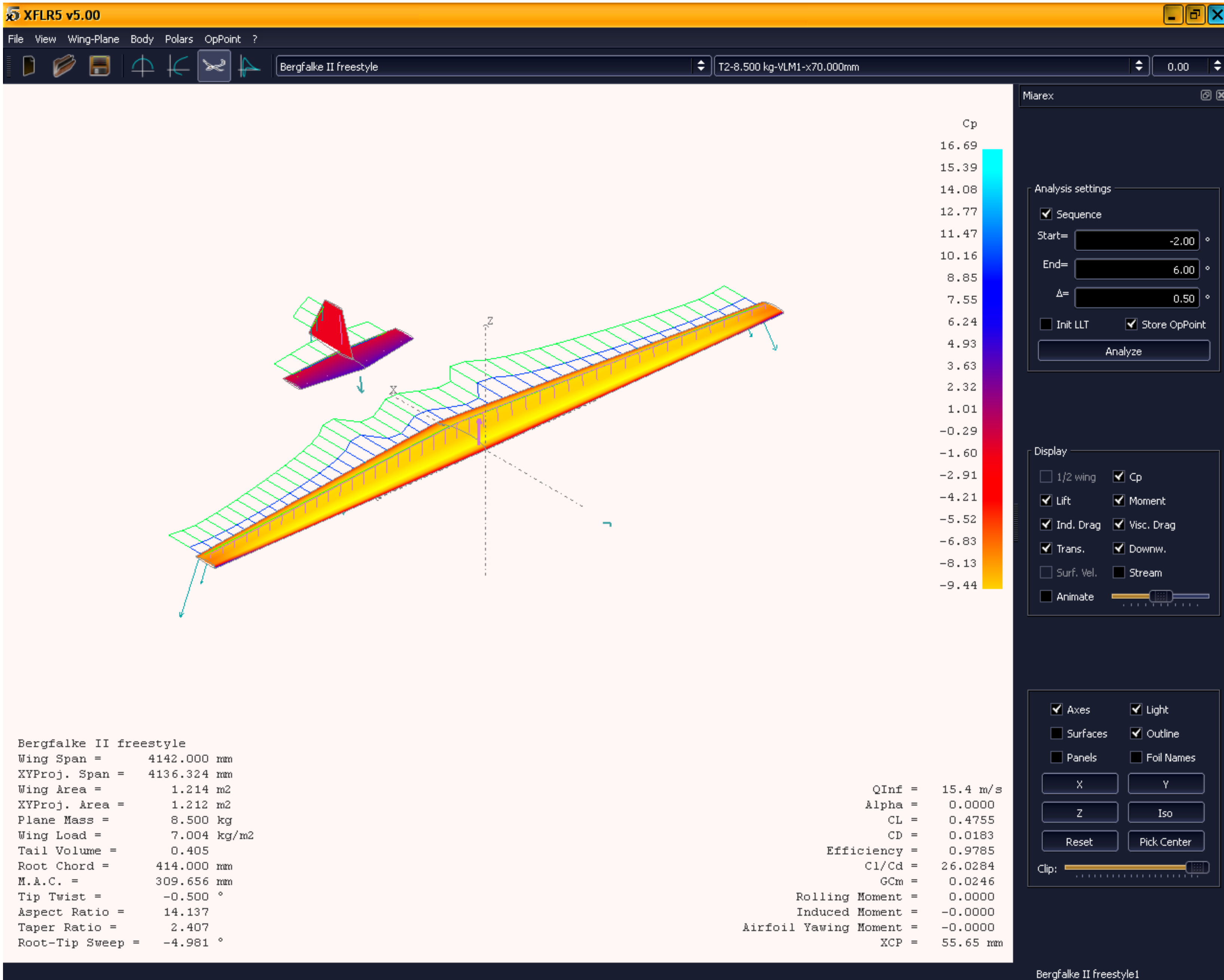


Illustration 0

Moreover, the values and vectors which are shown will vary as we modify the angle of attack of the model. This helps to become familiar with the unexpected amount of information we receive.

Back to Bergfalke II Freestyle. A preliminary study of the stability was provided by Francesco emailing me this first chart (Illustration 1) and relevant description. That enables us to choose which CG position matches the conditions of stable equilibrium.

The analysis goes like this: Once a location for the CG is fixed, you must run a VLM analysis and go to find the chart Cm/alpha. This diagram represents the pitching moment coefficient the model “feels” for different incidence angles. The angle of attack corresponding to Cm = 0 is the angle at which your model will fly with the pitch and the CG you have fixed.

This diagram gives also information on the stability: If the slope of the curve is monotonously decreasing with alpha, it indicates that the configuration is stable. When the model, for whatever reason, finds itself at an angle of incidence lower than that for Cm = 0, it will receive a nose-up moment.

Vice-versa, at a higher angle of incidence, a nose down moment will be manifested. If the curve is flat with one end in the rate of interest, the configuration is neutrally stable. Lastly, if the vector is increasing with alpha, the

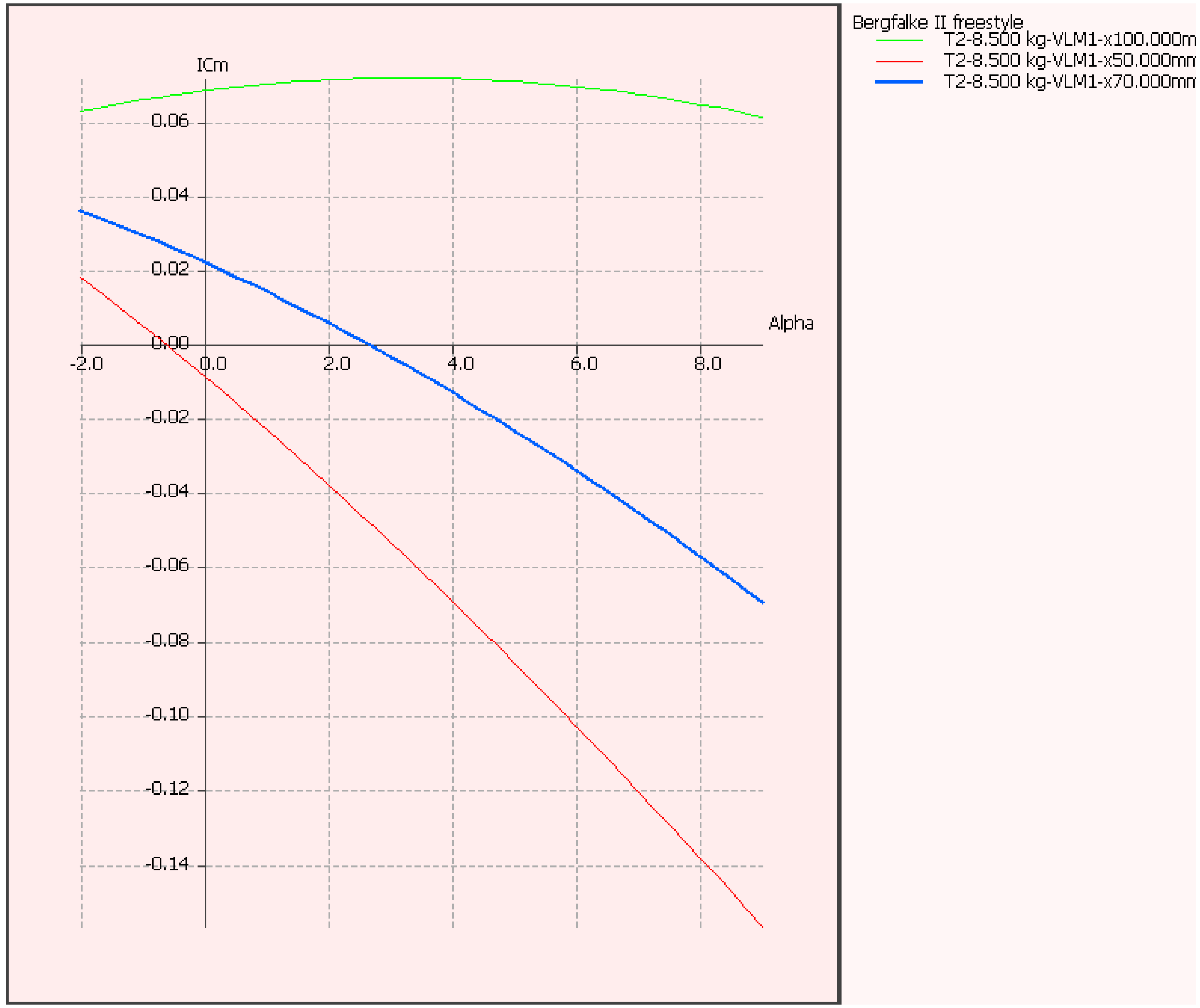


Illustration 1

configuration would be unstable.

Let's now have a closer look to the Bergfalke Cm/alpha diagram (Illustration 1). It contains three configurations: one with CG at 100 mm from the leading edge (green curve), a second one with CG at 70 mm (blue curve) and a third one at 50 mm (red curve).

The green curve tells us that, by the pitch you set, the configuration with CG at 100 mm is not balanced, but it would be neutrally stable, meaning that the rear limit for the CG is located at around 100 mm.

The other two curves tell us that the model is stable and reaches balance in a case with an incidence angle of about zero degrees (CG 50 mm, red curve), and in the last case at an angle of incidence of around three degrees (CG 70 mm). Looking at that information, I would choose to put the CG at 70 mm — the model will be stable and will tend to fly with the elevator trim at zero, at an incidence angle between the best efficiency and the minimum sink rate. Thank you Francesco, I've got it.

The file I received contains all these analyses and the data are stored for future production of new diagrams. Click here to download the .WPA file.

How can we get a new graph, Efficiency versus Alpha? Simple! Just open the file and arrange it by a few simple steps.

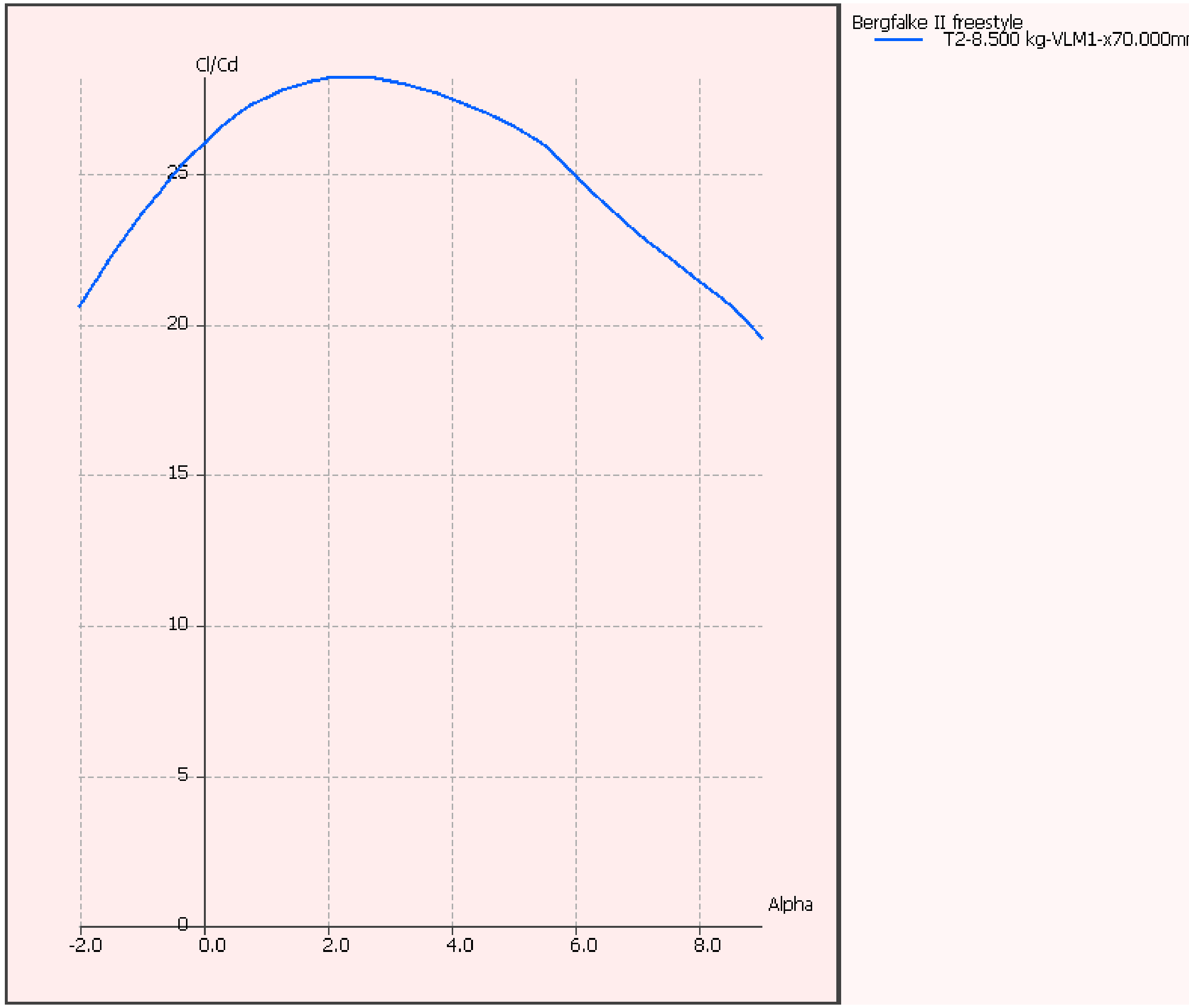


Illustration 2

In the menu "polars," select the view of a single graph: Graphs / Polar Graph (1) (2) (3) (4). A right click on the blank graph opens a new menu where you must select "Current Graph / Define Graph settings." A new window lists all the variables to be represented on the Y and X axis.

For this graph the choice is glide ratio Cl/Cd on the Y axis, Alpha on X axis. And here's the output of the new chart (Illustration 2)

The highest Cl/Cd ratio (best efficiency) is found at 2.5 degrees of incidence, close to the wing incidence set for the model.

Can we find the minimum sink rate? Yes! Apply the same procedures described in the previous paragraph and use the variable Vz m/s on the Y axis, and the variable Alpha on the X axis (Illustration 3)

This diagram shows the minimum sink rate (0.4 m/sec) at about 5 degrees of incidence. We guess the Bergfalke pilot will trim to this incidence to slow the airspeed as for the final stage of the landing procedure.

A well known and useful diagram is the one which relates the airspeed with the sinking speed. This is definitively the picture of a glider performance. Select the sinking speed Vz to the Y axis and the airspeed Vx to the X axis in order to get the following graph (Illustration 4).

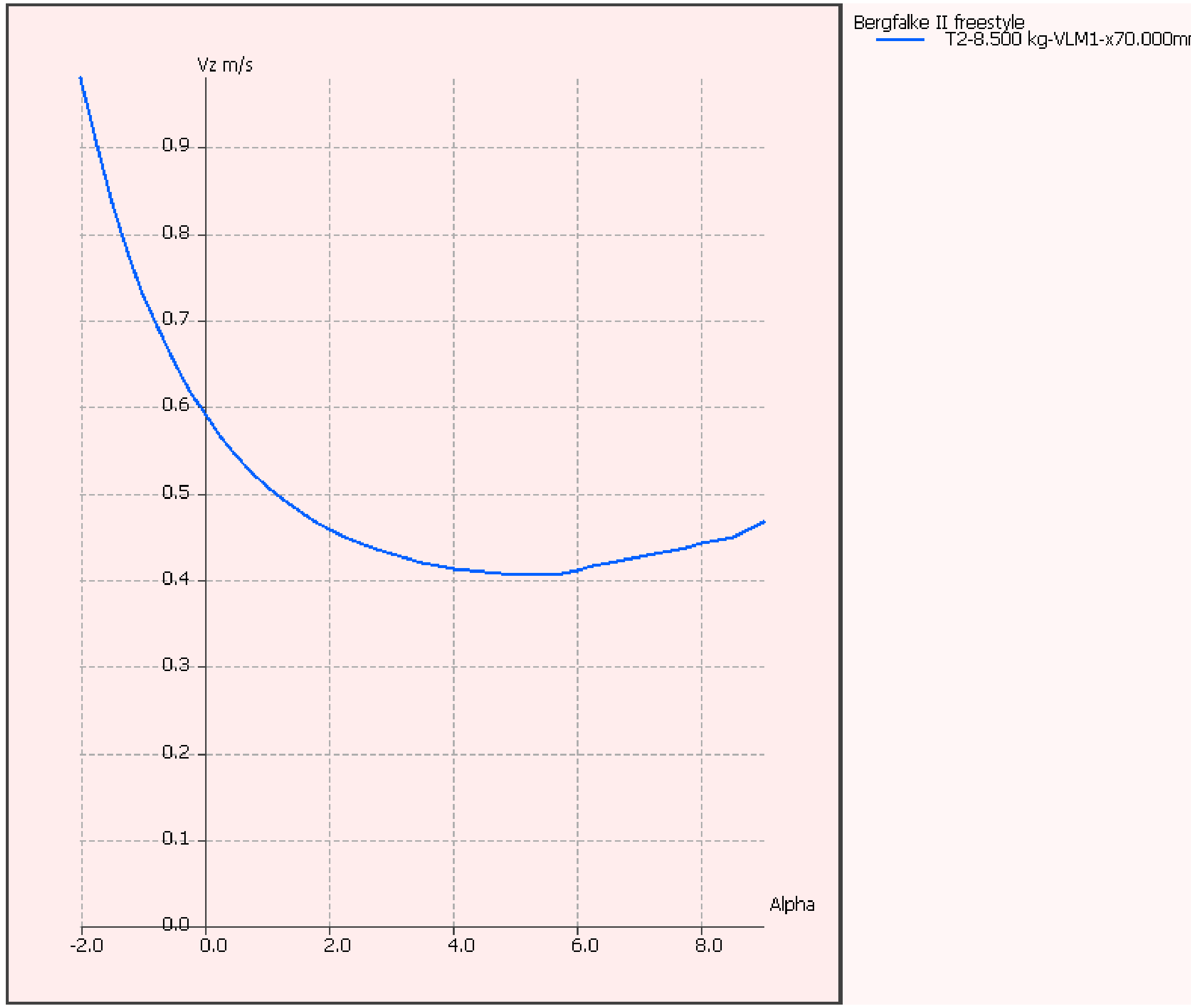


Illustration 3

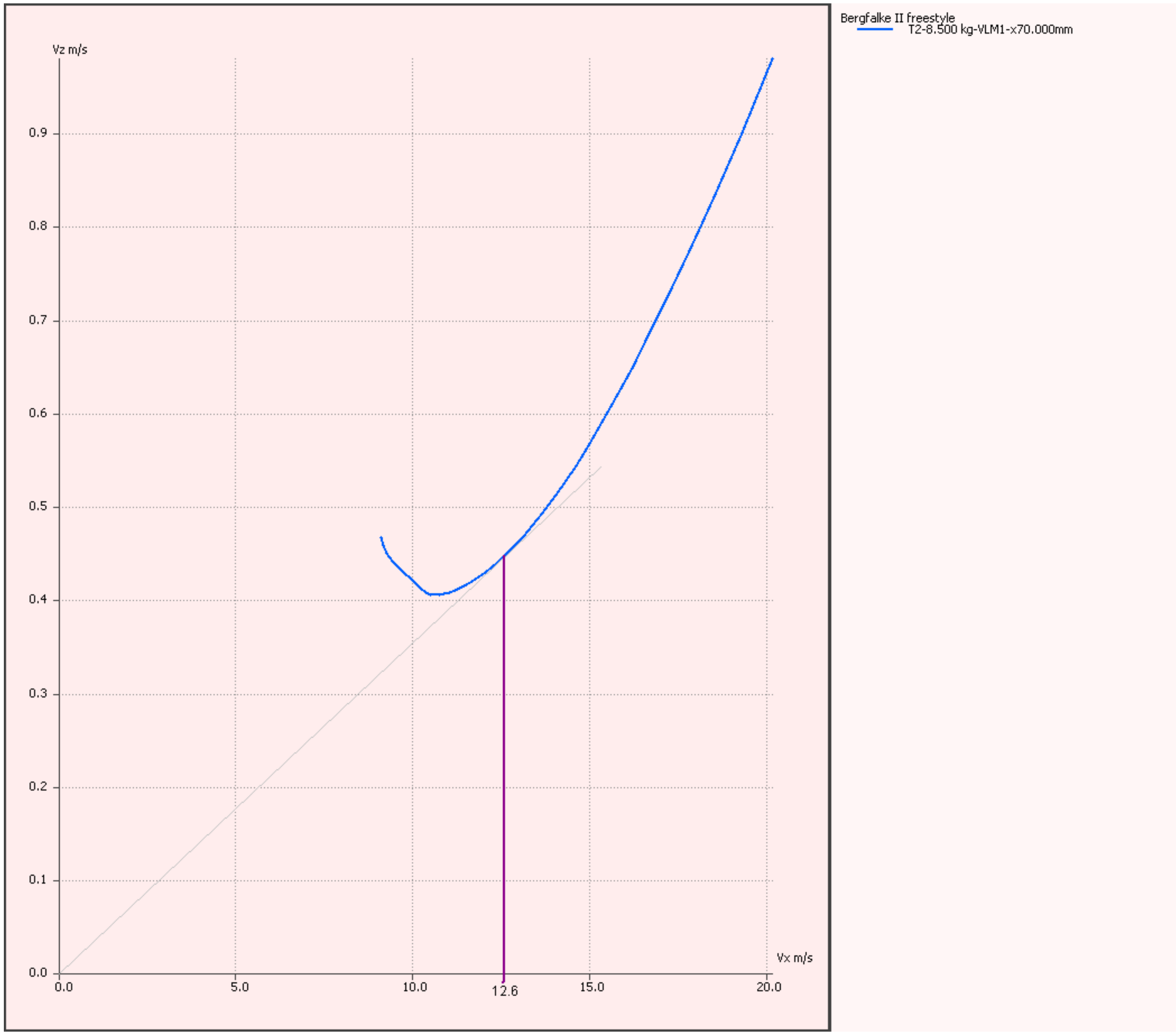


Illustration 4

The Bergfalke minimum sinking speed (a little more than 0.4 m/sec) is shown at an airspeed of 10.5 m/sec or 38 kmh. The pilot who wants to fly in calm air for as long as possible must trim the sailplane to keep this airspeed.

To estimate the airspeed of the Maximum Glide Ratio (Cl/Cdmax), draw a line through the origin of the axes and the tangent to the polar (see the grey line). At the point where the line touches the polar, the speed of maximum efficiency is found at 12.6 m/sec or 45 kmh. The Bergfalke pilot who needs to cover the longest distance must trim for Cl/Cdmax.

This data is immediately confirmed by the following graph (Cl/Cd versus Vx m/s, see Illustration.5, next page), where the maximum efficiency, which is the best Lift/Drag ratio, occurs precisely at that speed.

Let's now ask XFLR5 to plot the Pitching Moment PM versus Airspeed Vx m/s diagram (Illustration 6, page after next).

We see that the curve intercepts the horizontal 0 axis at an airspeed of 12.2 m/s, very close to the maximum efficiency (12.6 m/sec), as it is shown in the previous graphs.

This point is the balance point for all flight capabilities belonging to our glider. At this speed it does not feel any pitching moment, neither upward nor downward,

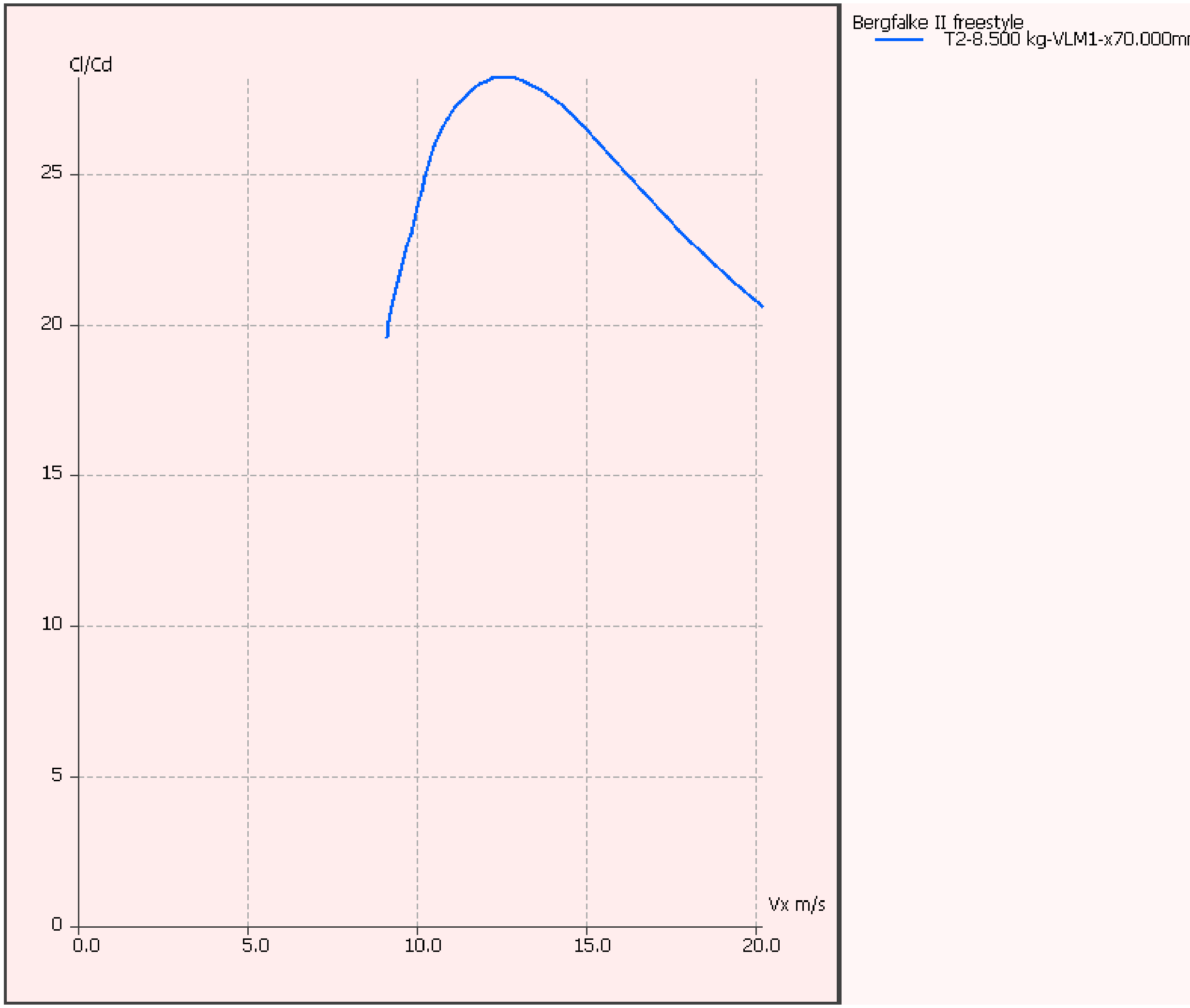


Illustration 5

and the model flies balanced at 12.6 m/s with neutral stabilizer trimming.

The curve reports that any higher speed would cause the model to pitch up and decelerate back to that speed, any lower speed would make it pitch down and accelerate again. This means the project's settings assure a stable equilibrium to the Bergfalke.

Well, I can go back to work now, spreading glue and scraping wood, as the XFLR5 simulations have me eagerly looking forward to the Bergfalke II Freestyle test flight.

Design Strong Points

This model requires a commitment greater than other kits on the market. It is not directed to a beginner, although, thanks to the adopted construction technique and the good documentation, may be attractive to the modeller who has developed a medium-level skill and wants to take a stab at a qualifying project.

We must not be intimidated or be suspicious of some of the unusual details as proposed. They have been tested in building more prototypes and designed to achieve the desired result, without any discount to the effectiveness and reliability.

The laser cutting technology offers solutions to complex problems with precision and repeatability of processes.

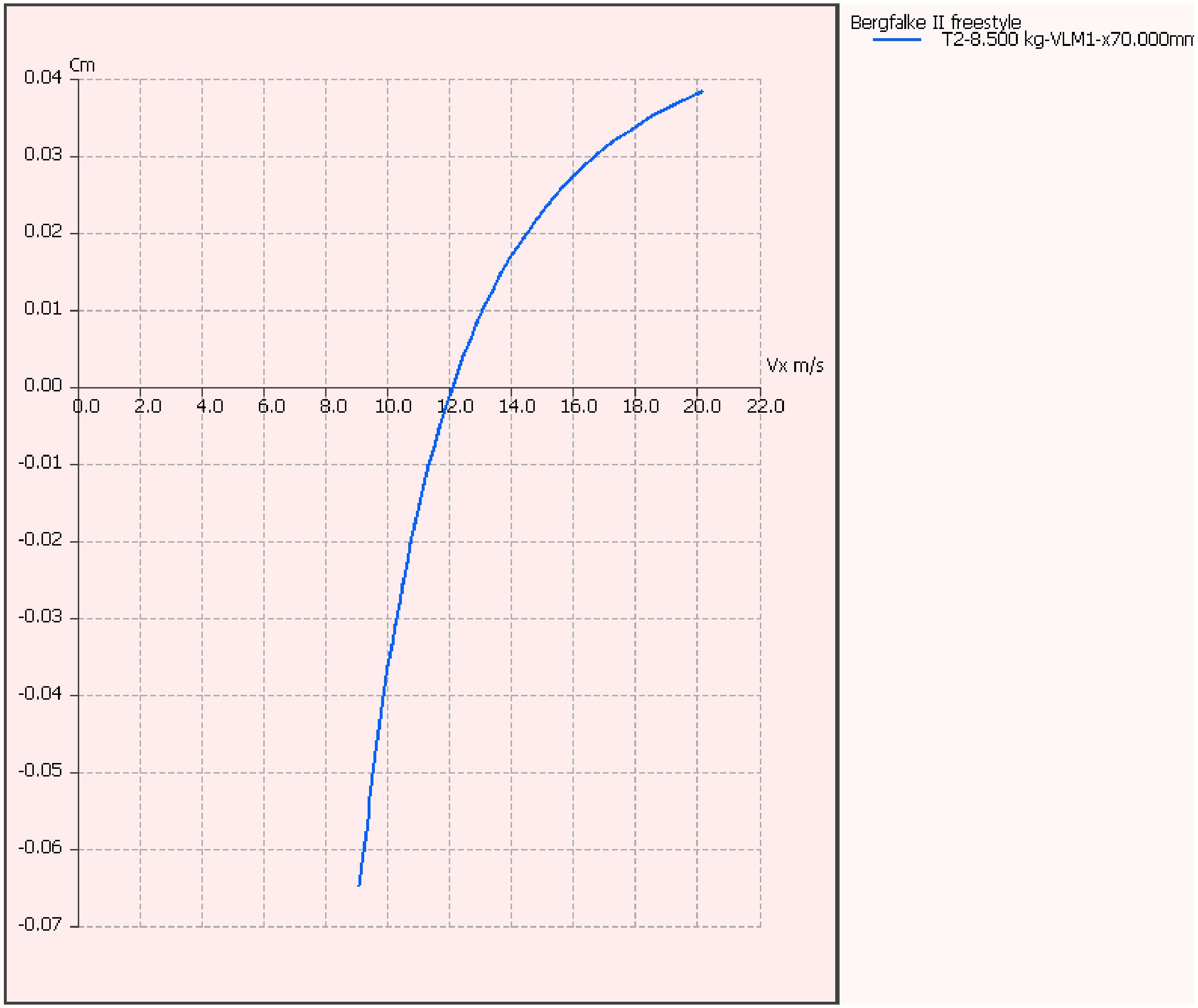


Illustration 6

Let us make good use of it to avoid the long boring jobs, and why not to also free up our creativity. Creativity which in my case has been leading to a few innovative solutions, the real strong points of the model:

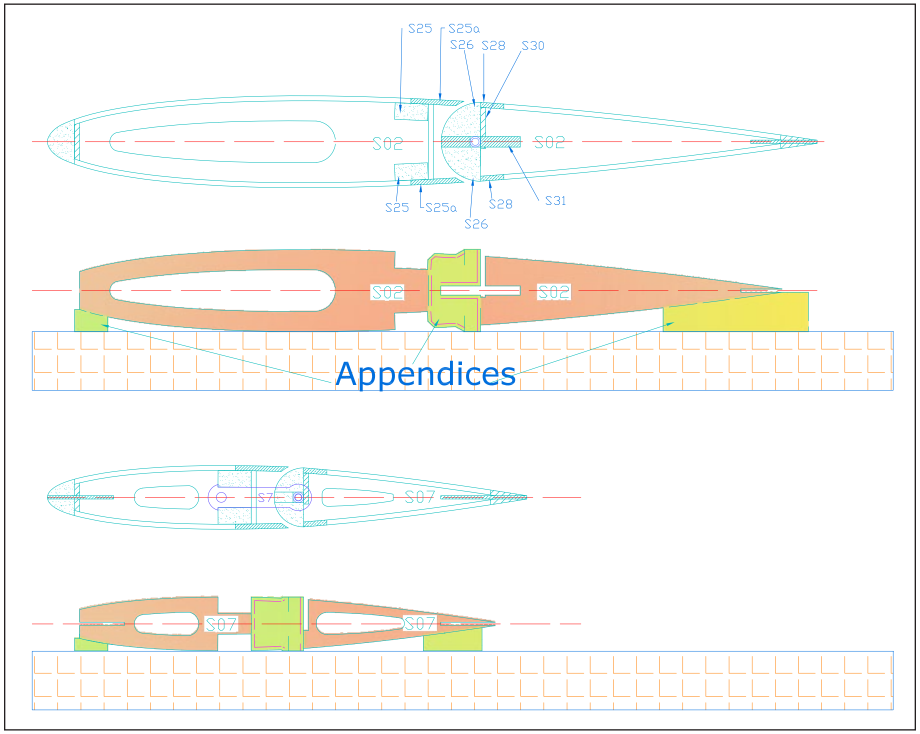
Centering components with appendices and micro-joints

The ribs are provided with "appendices" set by micro-joints that serve only to keep them upright, aligned and with the spacing between the components on the ladder assembly (spars, trailing edges, etc.) before the glue fixes them to each other. Once the assembly is complete, the appendices will be separated from the ribs and eliminated. The sides of these appendices, sure enough, must not come into contact with the glue. The ribs have an attention mark by the areas at risk. The drawing 1/ Stab_ribs_ appendices_S59 shows some typical rib sections.

The advantage we have, in return, is the most accurate positioning of the components to be assembled.

Composite D Box and Bias diaphragms

The vintage look of wood and canvas wings should not lead us to imagine them delicate and fragile. The balsa panels covering the D-box have their underside coated with 180g/mq fibreglass. They have been placed on the ribs, leading edges and spar while the resin is still wet.



Stab_ribs_appendices_S59

Photo 4 W-13

In full respect for the classic wood wing aspect, the stratification of the glass cloth is made under the skin of the balsa panel, invisible. Photo 4_W-13

To avoid the weaknesses of the traditional wooden structure subjected to hard shear loads, I used a double diaphragms between the spars with bi-axial -45° +45° 300g/mq glass cloth. Photos 4_W-19... 24

For a D-box having a closed-section made of composites, 500g of extra weight seem to be well spent.

<u>Moving surfaces - Clean aerodynamics</u>

Ailerons, elevator, and rudder are removable by pulling the hinge pin (as it is used routinely for the rudder in a glider). Photo 2_D-28 They are arranged so as to avoid altering the profile at any point in the range of their movement, thus preserving the maximum clean aerodynamics. Photo 8 DSC00985.

<u>RDS aileron control</u>

Again, clean aerodynamics, ensured by the absence of servo levers and rods outside the surfaces. (Direct, powerful and invisible, the Rotary Driver System for the ailerons is not only suggested as an option to the traditional system, but it’s highly recommended).

The RDS system mounted in the Bergfalke is home-made. Those who possess the basic equipment can reproduce it following the design and the instructions documented by photos. Drawing 7 Controls-ailerons_RDS, Photo 7 Controls-ailerons_RDS_57

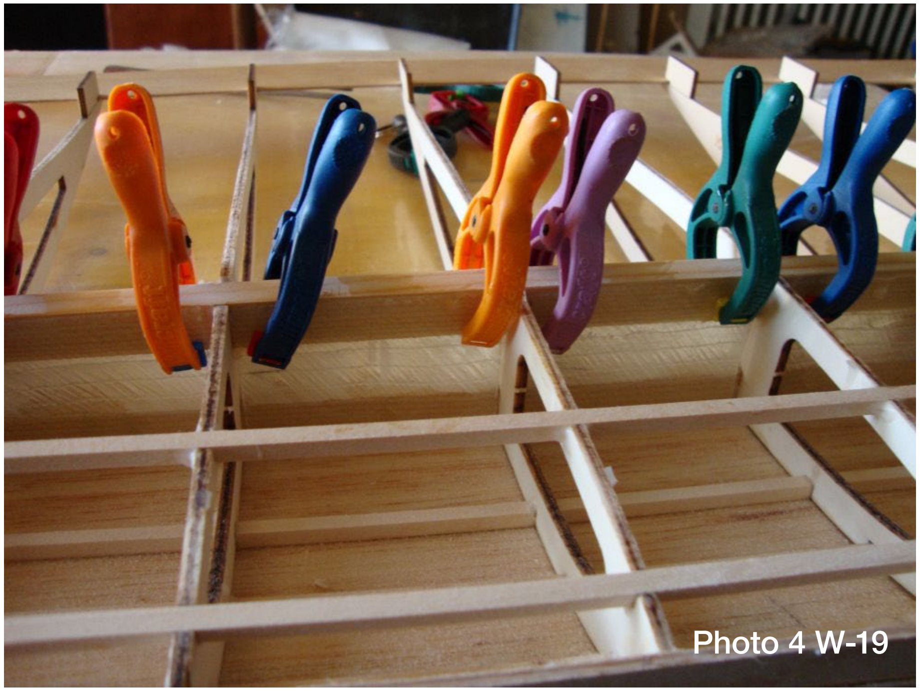


Photo 4 W-19


Photo 4 W-20


Photo 4 W-21

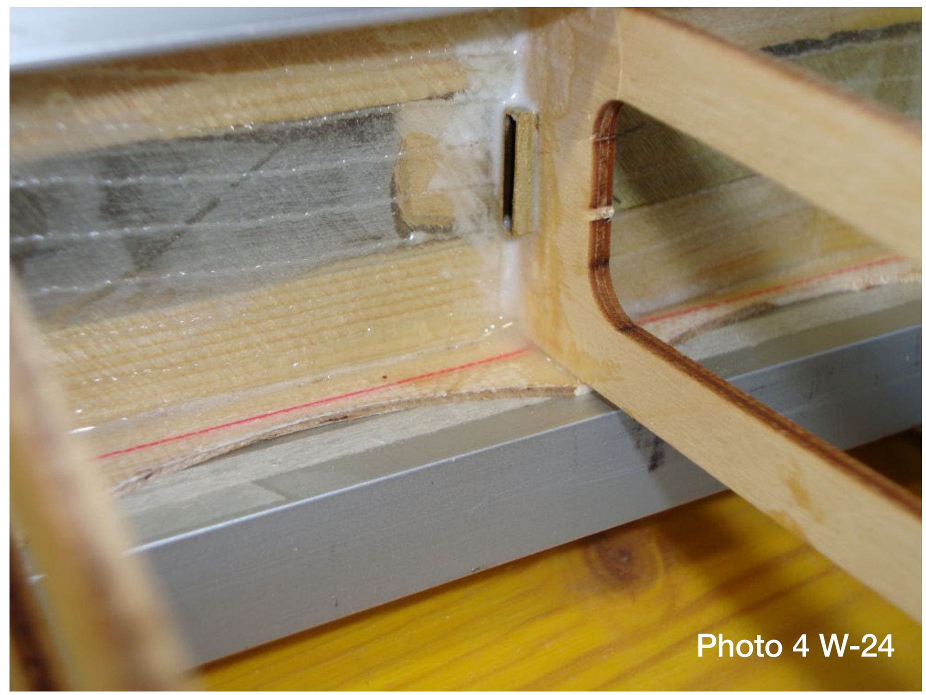


Photo 4 W-24

Photo 2 D-28

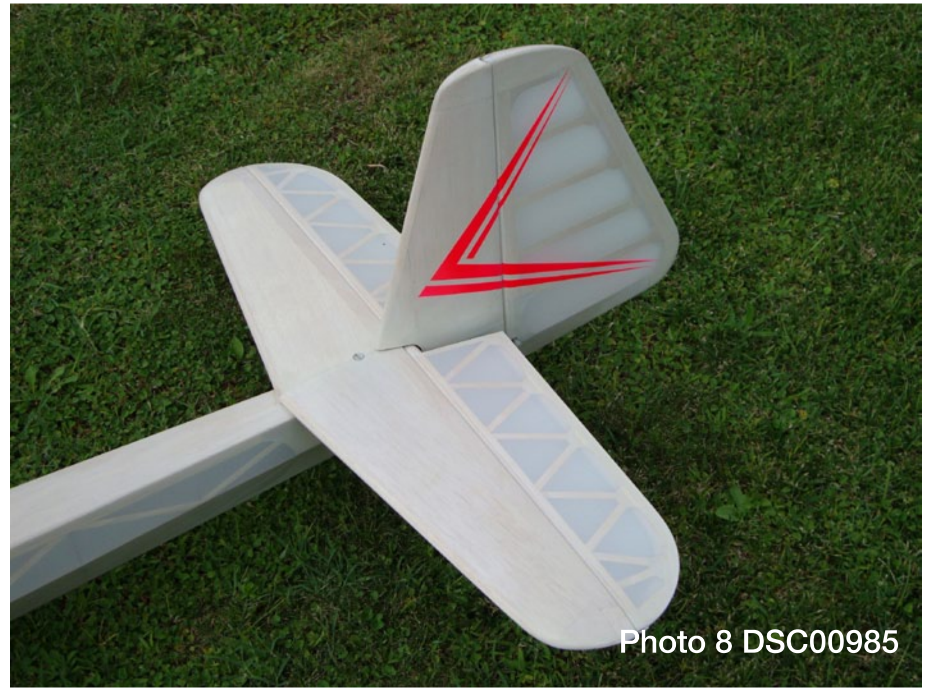
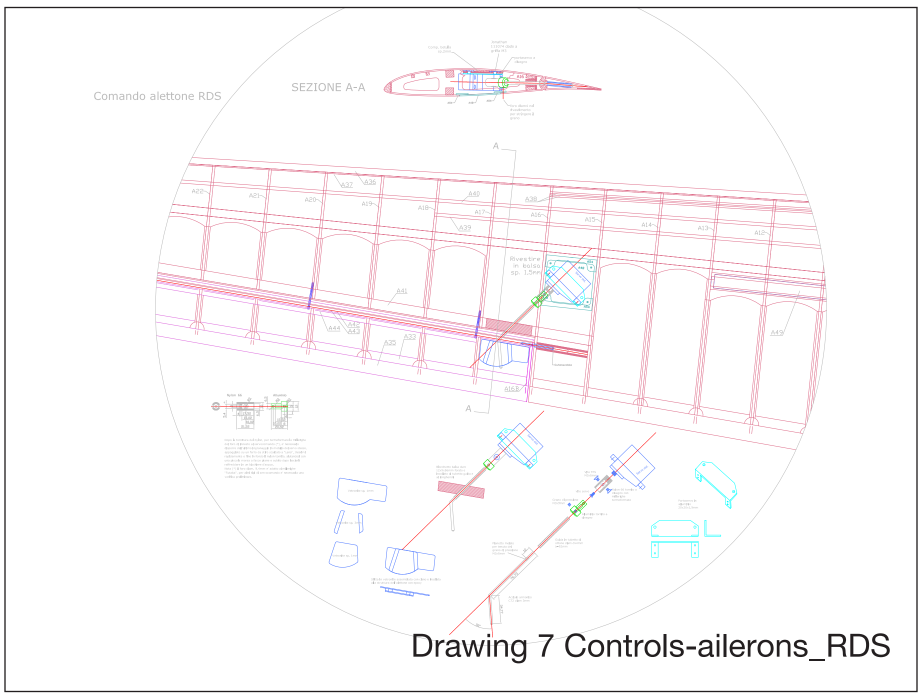


Photo 8 DSC00985



Drawing 7 Controls-ailerons_RDS

Photo 7 Controls-ailerons_RDS_57

Command for elevator – removable stabilizer

The elevator control system, unusual for model gliders but widespread among “full size” of the times of Begfalke II, is actually very strong and as reliable as clockwork. The components are commonly available in model shops and technical stores, so why not replicate it?

The carbon tube that transmits the movement along the longitudinal axis of the fuselage runs inside several Teflon bushings. On the end stop, a uniball is mounted. Its sphere transmits the rotation to the elevator lever (removable). Photo 3_F-055

This lever is obtained by cutting 60 mm from a helicopter flybar by the rod terminals. This has two important features: 1 - the tough material, very close to steel springs, and ground with the precision required by our joint uniball, and 2 - The rod already has a tapped M3 terminal (difficult to achieve without special equipment).

Assembly and disassembly of the stabilizer is made possible in a very short time. Photo 1 Stab_fast_assembling_S-60 The repositioning of the stabilizer into place is accomplished with a single screw (a dowel pin preassembled). Photo 8 DSC15826.

Another feature of no small account is that the reconnection of the control levers and the system automatically maintains the trim that had been set. Photos 8 DSC15829 and DSC15830

So, speed and reliability for this operation which facilitates the transport of a large model, something to be appreciated when placing the model in the garage.

Pre-tensioned hooks for mounting of the wings

I have always appreciated the system “Carrera” of the ’80s but impossible to find today. Thanks to a couple of days of rain, those days that you feel better staying in the garage, I equipped

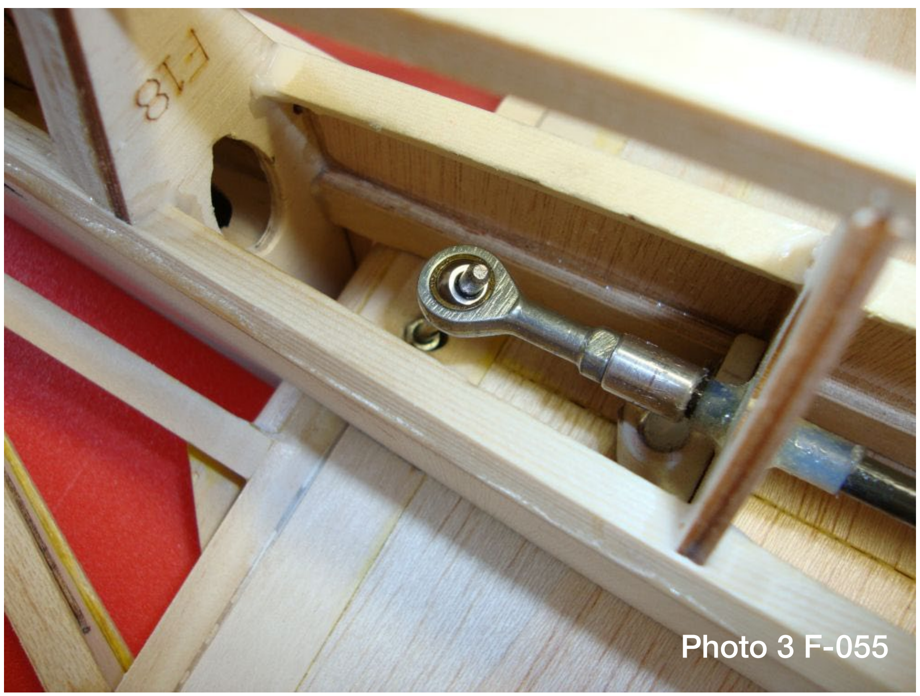


Photo 3 F-055

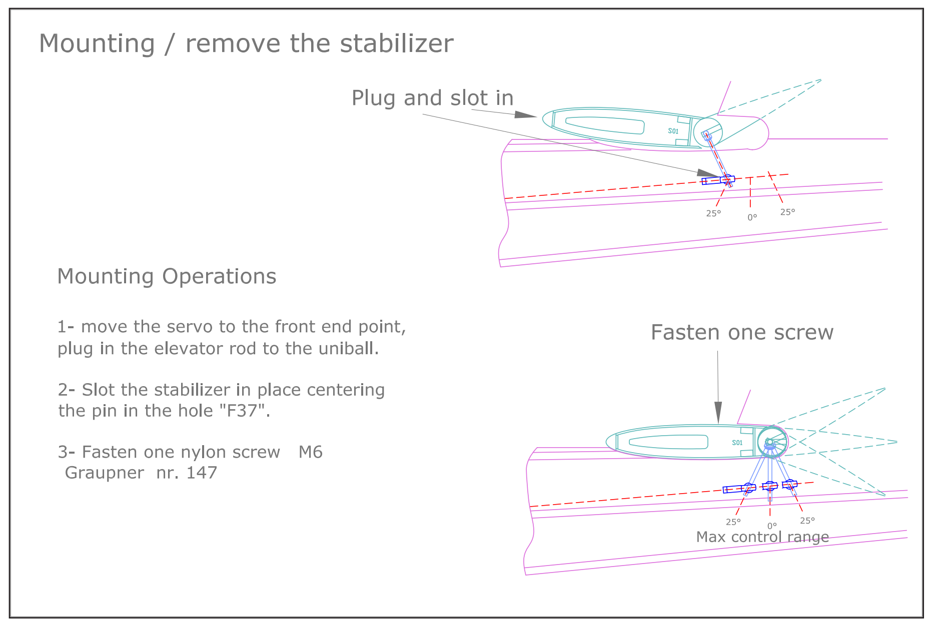


Photo 1 Stab_fast_assembling S-60

Photo 8 DSC15826

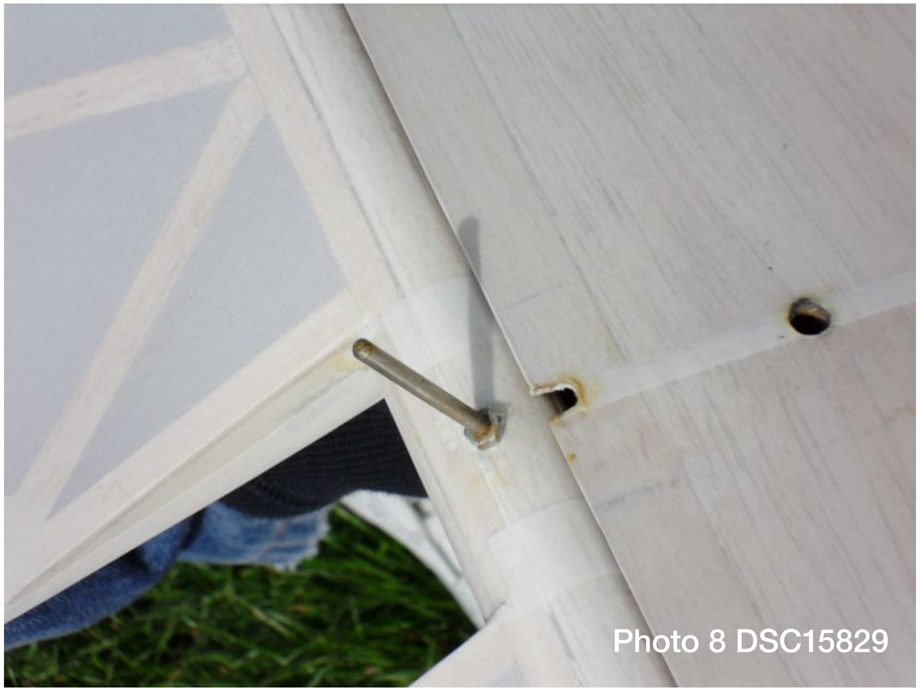


Photo 8 DSC15829

Photo 8 DSC15830

Photo 7 Device-WingRetainers_02

Photo 7 Device-WingRetainers_04

my lathe and reproduced it. Photo 7 Device-WingRetainers_02. What a joy to see it working at first try-out, it really was a stroke of luck. Photos 7 Device-WingRetainers_04 and Device-WingRetainers_05, Photo 6 Oratex_14

The details for DIY lovers, such as the technical drawing, is in Folder 7 Device-Wing retainersDWG with more details in the file 7 Devices-WingRetainers_how_they_work.

Availability

The project Bergfalke II Freestyle is free to the modelling community, except the costs of copying, mailing, etc., as decided by the builder.

For the experience that I can provide, having already developed the model, I am at the disposal of anyone who has questions or suggestions to send to my email <ginoalongi45@gmail.com>.

The drawing is divided into five 1:1 scale ensemble plans:

1 fuselage+rudder+stab/elevator, 2 fuselage building board, 3 right wing, 4 left wing, 5 optional RDS aileron control.

Due to the large sizes, splitting in more tables enables the printing and utilization.

Each drawing is linked to a list of components and materials from commercial sources.

Once again, the project will be close to the needs of the modeller. The optional guideline of materials to be used is suggested. A detailed list of components, their characteristics and specificity can be download as well.

All the cut wood components have a code which refers to the ensemble plans. They can be cut by laser or by hand. Email me for the 1:1 file: DXF for laser cutting, PDF for hand cutting.


Photo 7 Device-WingRetainers_05

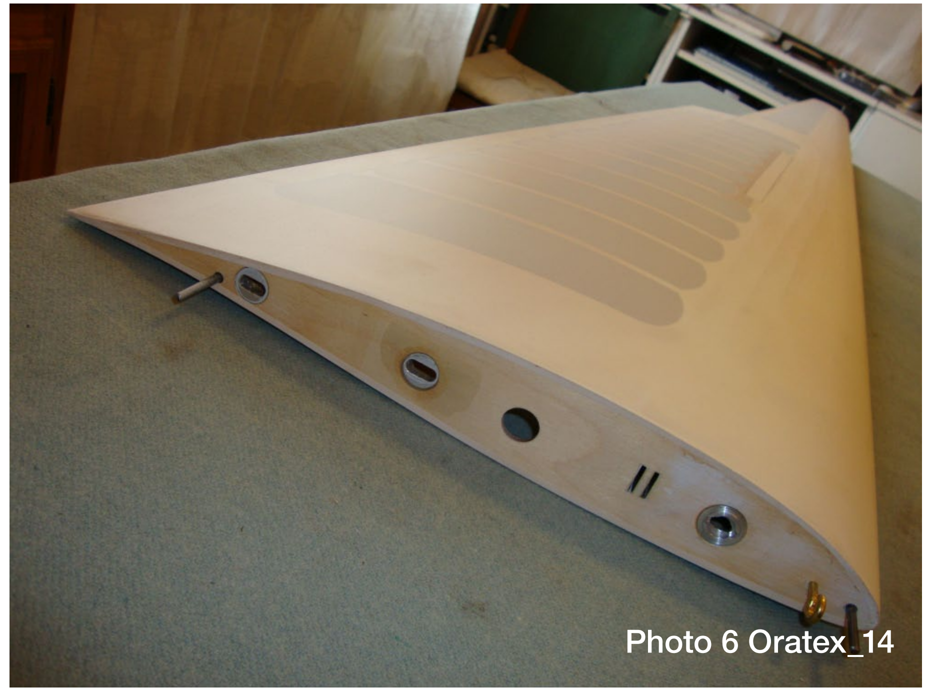


Photo 6 Oratex_14


Photo 5 Ready_to_cover_0

Building Instructions

The building instructions can be downloaded here. XXXXXXXX

They are accompanied by about 300 photos and some drawings that will lead you step by step up to this point. Photo 5 Ready_to_cover_0

These photos are presented by a high resolution photo gallery that is viewable online. This is the link : XXXX

Search the files by the blue notes you meet in the following text:

Folder no. / namefile no.

More information are given about the covering, the electronics and the final settings for the test flight.

The Bergfalke II Freestyle is designed for thermal and slope flights including the simplest aerobatic manoeuvers. Its structure is such as to withstand the stresses of this magnitude.

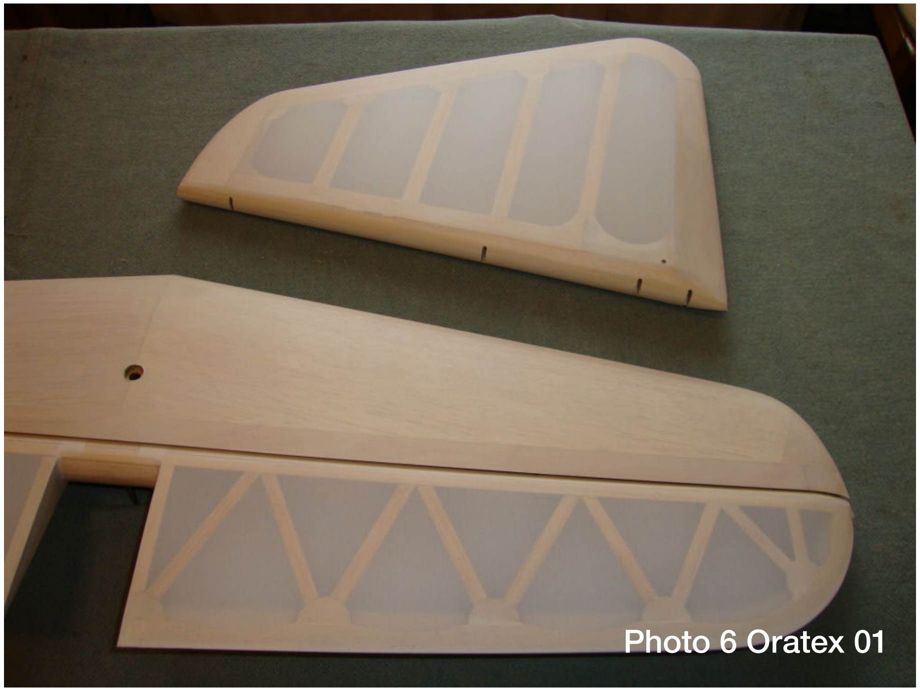


Photo 6 Oratex 01

Photo 6 Oratex 17

If you plan to use it for a more aggressive flight conditions with strong dynamics, landings in rough terrain as often found in slope soaring, an adequate reinforcement of those areas subject to high stresses is expected.

<u>Notes to the building</u>

One flat surface perfectly levelled at least 2.2 x 0.6 meters is absolutely essential. When you have chosen to begin a serious and significant project, the first steps must always go in that direction.

A ¼ scale model requires a precise implementation faithful to the project. The structure must be straight, strong, well-made. The utmost attention must be paid to the quality of materials, to the execution of the details and bonding the components to each other.

Wherever the term "bond" appears, you'd better use your own expertise to decide which type of adhesive is to be used. Those I think are the most indicated for each phase of assembly have been suggested from time to time.

In beginning each new phase of the construction, you should read all of the paragraph of instructions related to it. Often, at the bottom of the information, may appear the notes you really need to know before starting.

There are several phases of construction for which it is preferable to test a dry assembly (without glue) of the components and perhaps chamfer the joints for a perfect set up. This procedure applies to all components to be assembled at angles other than 90°. The joints made by laser cutting are precise and perfectly perpendicular to the cut surfaces and so they have a tendency to hold the assembly in that position.

Warning! Some photos may differ from the design and instructions. The

Photo 6 Oratex 07

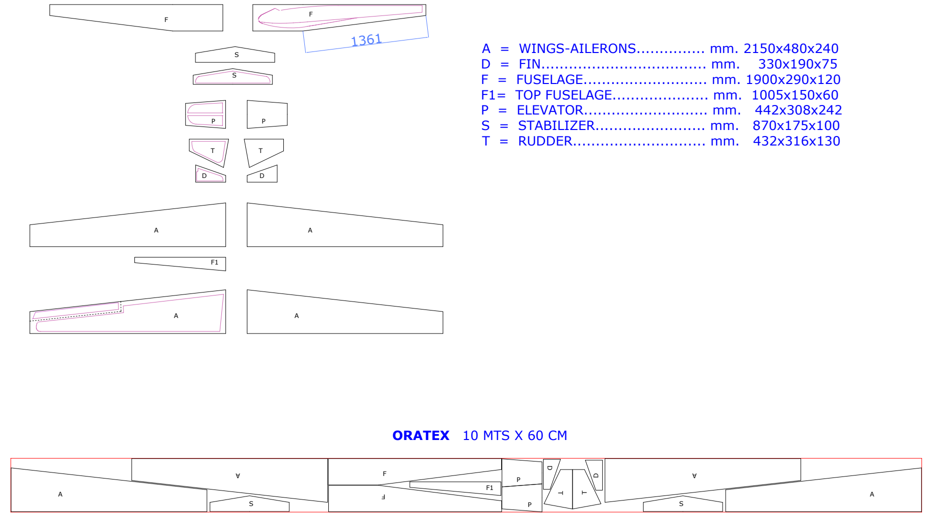


Illustration 6 ORATEX_CUTTING

changes suggested by the construction of prototypes have been documented by updating the design and instructions.

Covering

Oratex of course! I believe there doesn't exist a fabric to apply easier than this. The only condition to satisfy the requirements for a brilliant covering job is the perfect smoothing of the wood surface. That's all.

I have nothing to add to the Oracover instructions apart from confirming that the covering obtained is absolutely among the best I know. Photo 6 Oratex_01.JPG, Photo 6 Oratex_17.JPG,_ Photo 6 Oratex_07.JPG

On the concave surfaces (the wing bottom) it is suggested to impregnate the wood with Oracover filler diluted with Oracover thinner. This is a heat-sensitive preparation to which the fabric will adhere more tenaciously.

A 1:1 scale drawing of the cutting pattern can be useful to employ the 10 meters (60 cm width) of covering needed. Illustration 6 ORATEX__CUTTING.pdf

Electronics and adjustments

This is my equipment:

- Two LiFe batteries of 2300mAh and dual-supply circuit control unit with safety switch, voltage controlled from 5.0V to 6.0V.
- Receiver 9-channel (7-channel is enough)
- No. 2 aileron servos; Futaba S3050 digital MG 6.5 kg / cm
- No. 1 elevator servo; Futaba S9255 Digital MG 9 kg / cm
- No. 1 rudder servo; Hitec HS 645 MG 9 kg / cm
- No. 2 brakes servo; Futaba S3004 BB 4 kg / cm
- No. 1 Tow release servo; Multiplex Profi MG 5.6 kg / cm

_____

Control ranges:

Ailerons
+22/ -40 mm, +22 / -40 mm (*)
60% Reduction
Expo 40%
Differential 60%

Elevator
2 x 35 mm 2 x 30 mm
60% Reduction
Expo 20%

Rudder
2 x 110 mm 2 x 110 mm
60% Reduction
Expo 50%

(*) “+” down, “-” up

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Center of gravity

I did not want to use the XFLR5 calculation indicating the location of the CG at 70mm from the leading edge at the root. For the test flight I decided to move it to 57mm which means 36% of the Mean Geometrical Chord (MGC). This setup was already experienced in the past by Vincent Besancon with good results. A very simple calculation program can be downloaded for free at: http://tracfoil.free.fr/cm/.

This is the report of the results: 10 MC Bergfalke_II_freestyle.pdf

To achieve this balance I used 650 g. of lead, if I had in advance the means to evaluate it, I could have done better lightening the structure of the stabilizer and the tail boom.

Weight of the model ready to fly

Fuselage	**Weight g.**	**Wings**	**Weight g.**
Fuselage	2,082	No. 2 wings	3,750
Ballast	650	Bayonets - pegs	260
Undercarriage	60	Wing retainers, rubber	60
Cowling	180	No. 4 servos & wiring	240
Stabilizer, elevator	317		
Rudder 88			
No. 3 servos & receiver	185		
Power system interface & wiring	140		
2 LiFe batteries 2300 mAh	326		
Total Fuselage	**4,028**	**Total Wings**	**4,310**
Total weight ready to fly	**8,338**		

Flight

Finally the big day! April 1, 2011 . In spite of all caution and superstition, (in Italy this is the day when jokes and tricks are to be accepted) we met at our club Lucca Delta Team for the test flight.

Marco Benincasa, Geppy Frattali, Bruno Tomei, Vinicio Triglia and myself had been rewarded with good weather. We

Model : Bergfalke II freestyle

Data : 31/03/2011 (c)cm V. 2.8.0

Data (mm)

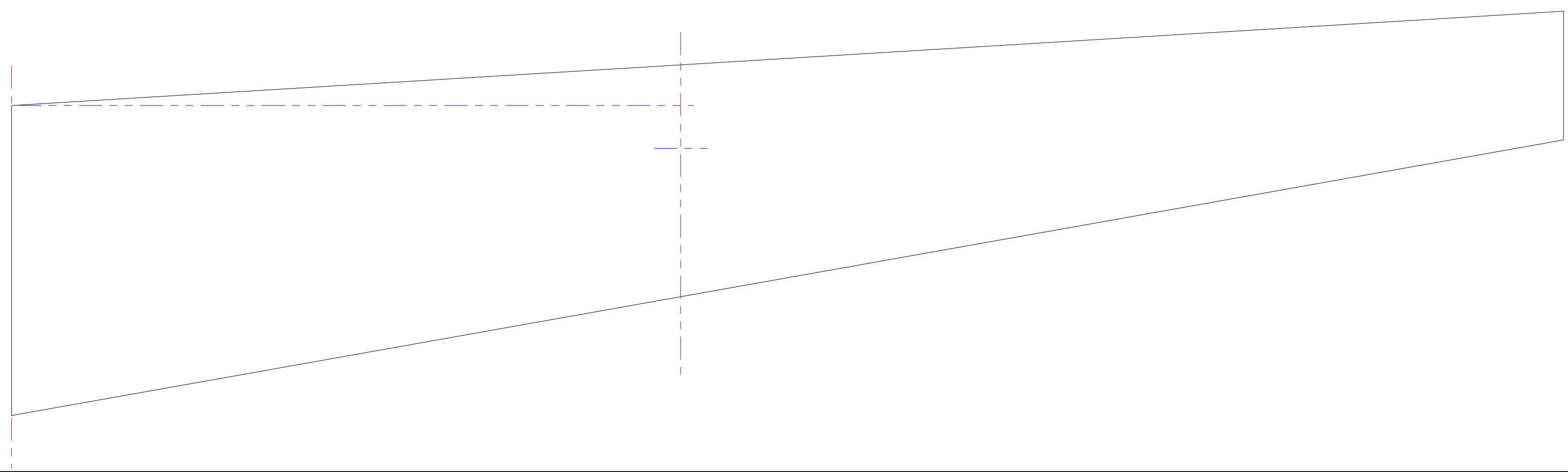
	Trapezoid 1
Max Chord :	414
Min. Chord :	172
Length Trapezoid :	2071
Root to tip sweep +/- :	-126
CG location :	36 %

Weight : 8500 g Wing load : 70,04 g/dm²

Results

Wingspan :	4 142,0(mm	Distannce X :	892,96 mm
Surface :	121,36 dm²	Mean Geom. Chord	309,66 mm
Aspect ratio :	14,14	CG distance from LE :	57,15 mm

Scale : 1/10



10 MC Bergfalke_II_freestyle

Photo 9 IMG_5838
Marco Benincasa/*Modellistica International*

Photo 9 Trims =0
Marco Benincasa/*Modellistica International*


Photo 9 IMG_6012
Marco Benincasa/*Modellistica International*

waited for the mist of the morning to dissolve and after the last inspection, fire the tow engine and go! This time, people with his nose up and open mouth, were five. Photos 9 IMG_5838, 9 Trims =0, and 9 IMG_6012.

Efficiency is the most significant characteristic that could be appreciated at the first flight of this model. The aerodynamic solutions adopted revealed their value. Bergfalke unmistakable silouette flying at a surprisingly slow pace, stable and constant, offers a suggestive and majestic picture.

As mentioned earlier, the Bergfalke is stable but definitely not dull. The responsiveness to its control surfaces is immediate, fluid and effective, thus capable to provide an unsuspected agility when needed.

The Bergfalke II Freestyle offers the medium experienced pilot a relaxing flight, inspiring immediate confidence in performing the simplest aerobatic maneuvers, provided by the best energy return of its 8.5 Kg (8.338 g actual) mass.

When a fast dive is induced, the Bergfalke maximum speed is restrained thanks to the greater thickness of the wing profile (HQ 3,5 -13% at the root,12% at the tips).

The prototype did not suffer from unwanted behaviour patterns. Its stall is predictable and well under control.
Landing deceleration is good down to an impressive minimum speed. This is made possible by an average chord measuring 310 mm that gives the model

Bruno Tomei's model, ready to fly, behind Gino's

Gino Alongi's Bergfalke II *Freestyle*

Introduced in the April 2012 issue of RC Soaring Digest.

Photo collections:
- Stabilizer and elevator construction 1_STAB+ELEVATOR.zip (5.7MB)
- Vertical fin and rudder construction 2_RUDDER.zip (3.7MB)
- Fuselage construction 3_FUSELAGE.zip (15.7MB)
- Wing construction 4_WINGS.zip (6.2MB)
- Completed airframe, ready for covering 5_Ready_to_cover.zip (10.7MB)
- Airframe with covering applied 6_Covering.zip (14.4MB)
- Electronics installation, RDS, elevator quick-connect, and wing retention hardware 7_Controls+Devices.zip (27.7MB)
- Completed model 8_Ready_to_fly.zip (52.8MB)
- Initial test flying via aerotow (All photos in this folder are courtesy of Marco Benincasa/*Modellistica International*) 9_Flying.zip (358.7MB)

Graphs depicting results of software analyses, and Bergfalke *Freestyle* "stickers" 10_Graphs.zip (1.1MB)

Construction directions, overview of the model, full size plans (pdf), RDS details, list of materials, how the wing retainers work, Oratex cutting patterns, and details for the stabilizer quick-connect 11_Documentation (4.4MB)

Items in Folder 11_Documentation can be downloaded individually:
- Bergfalke_Freestyle_construction_directions.pdf
- Bergfalke_II_freestyle_1FUSELAGE&TailSurfaces.pdf
- Bergfalke_II_freestyle_2FuselageBuildingBoard.pdf
- Bergfalke_II_freestyle_3rightWING.pdf
- Bergfalke_II_freestyle_4leftWING.pdf
- Bergfalke_II_freestyle_5_RDSaileron_control.pdf
- Bergfalke_II_Freestyle_List_of_materials.pdf
- Devices-WingRetainers_how_they_work.pdf
- ORATEX__CUTTING.pdf
- Stab_fast_assembling_S60.pdf

<http://www.b2streamlines.com/BergfalkeFreestyle/>

profile high Reynolds numbers, even at moderate speed.

The ailerons in this condition remain effective to keep the wings parallel to the ground until the last meter of taxiing.

I suggest a movie of the firsts test flights available on YouTube. At that time the model still needed balance adjustments, but it was nevertheless promising enough to fulfill me and touch the sky with one finger.

<http://youtu.be/rsJ7T7K1K4A>

I sincerely thank all those who have collaborated in my project and gave their help for the Bergfalke II Freestyle test flights.

One more Bergfalke is now ready for the test flight. It has been realized by Ing. Bruno Tomei, mentioned previously. Additionally, there are two more work-in-progress Bergfalke Freestyle models at the moment.

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The *RC Soaring Digest* web page devoted to Gino Alongi's Bergfalke II Freestyle, shown at left, is located at <http://www.b2streamlines.com/BergfalkeFreestyle/>. Links to the various photo albums noted in the text are located on the web page, together with links to the full size plans and various other illustrations.

High-Speed Dynamic Soaring

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Abstract

Dynamic soaring uses the gradient of wind velocity (wind shear) to gain energy for energy-neutral flight. Recently, pilots of radio-controlled gliders have exploited the wind shear associated with fast winds blowing over mountain ridges to achieve very fast speeds, reaching a record of 487 mph in January 2012. A relatively simple two-layer model of dynamic soaring was developed to investigate factors that enable such fast speeds. The optimum period and diameter of a glider circling across a thin wind-shear layer predict maximum glider airspeed to be around 10 times the wind speed of the upper layer (assuming a maximum lift/drag of around 30). The optimum circling period can be small ~1.2 seconds in fast dynamic soaring at 500 mph, which is difficult to fly in practice and results in very large load factors ~100 times gravity. Adding ballast increases the optimum circling period toward flyable circling periods of 2-3 seconds. However, adding ballast increases stall speed and the difficulty of landing without damage. The compressibility of air and the decreasing optimum circling period with fast speeds suggest that record glider speeds will probably not increase as fast as they have during the last few years and will probably level out below a speed of 600 mph.

1. Introduction

In April, 2011, I watched pilots of radio-controlled (RC) gliders at Weldon Hill California using dynamic soaring to achieve speeds up to 450 mph in wind gust speeds of 50-70 mph. One almost needs to see and hear these fast gliders to believe their amazing performance. These observations raised questions about how gliders could fly so fast and led me to try and understand the relevant dynamics. The motivation was the possibility that the technology of these gliders and the experience of the pilots could be used to help develop a fast robotic albatross UAV (unmanned aerial vehicle) for surveillance, search and rescue, and rapid scientific sampling of the marine boundary layer and ocean surface.

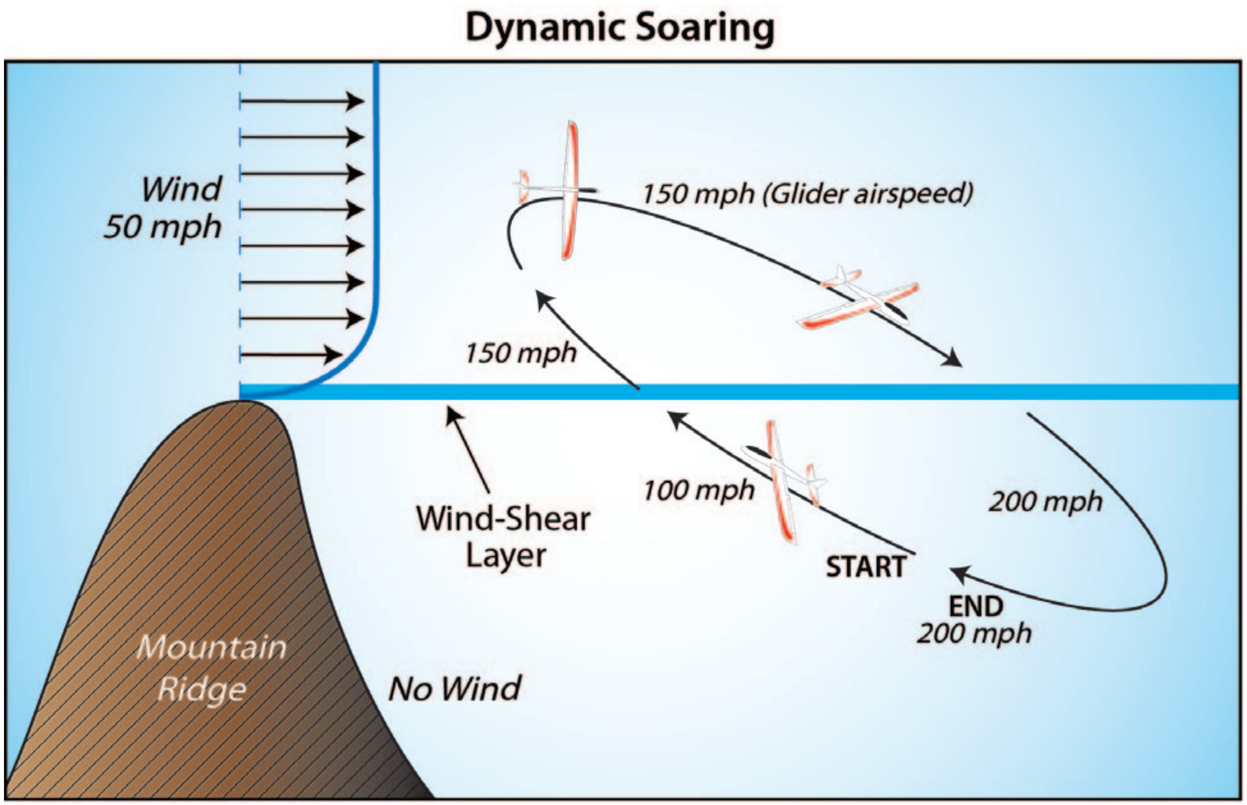

Figure 1. Idealized example of the increase of airspeed of a dragless glider soaring through a thin wind-shear layer in which the wind increases from zero below the layer to 50 mph above. This example shows how a glider could use dynamic soaring in the region downwind of a ridge crest as observed at Weldon. Starting in the lower layer with an assumed airspeed of 100 mph, a glider climbs upwind a short distance vertically across the wind-shear layer, which increases glider airspeed to 150 mph. The glider then turns and flies downwind with the same airspeed of 150 mph. During the turn, the glider's ground speed increases to 200 mph in the downwind direction and consists of the 150 mph airspeed plus (tail) wind speed of 50 mph. The glider descends downwind a short distance vertically across the wind-shear layer, which increases the glider's airspeed to 200 mph. The glider turns upwind flying with airspeed of 200 mph. Thus, one loop through the wind-shear layer increases the glider's airspeed from 100 mph to 200 mph (two times the 50 mph wind speed in the upper layer). The nearly-circular flight modeled in this paper is shown as an ellipse in this schematic figure.

Recently, I developed a fairly simple model of dynamic soaring to help understand how albatrosses use this technique to soar long distances without flapping their wings (Richardson, 2011). This present paper uses this model but concentrates on much faster glider airspeeds, which are more than ten times the typical wandering albatross airspeed of 35 mph. Specific questions explored are: 1) what are the key parameters of the flight that allow such high speeds to be achieved, 2) how can the flight be optimized for fast speeds, 3) what are the maximum airspeeds that can be achieved with realistic winds.

2. Observations of RC glider soaring

The RC dynamic soaring I observed at Weldon exploited the wind shear caused by fast wind blowing over a sharp-crested mountain ridge (see rcspeeds.com). The RC gliders flew in approximately circular loops lying roughly along a plane that tilted upward toward the wind direction and extended above the ridge crest. From the windy region above the ridge, the gliders descended headed in a downwind direction into the low-wind region below and downwind of the ridge crest. They then turned and climbed in an upwind direction back into the fast wind in the upper layer above the ridge crest. The gliders flew in fast steeply-banked loops with a loop period of around 3 seconds. The wings looked like they were nearly perpendicular to the plane all the way around a loop, implying very large accelerations. An accelerometer on one of the gliders recorded a maximum acceleration of 90 g, the accelerometer's upper limit (Chris Bosley, personal communication). At times the gliders were perturbed by turbulent wind gusts, and the pilots needed to quickly respond in order to prevent the gliders from crashing into the side of the ridge. High-speed crashes totally destroyed five gliders that day. Glider speeds up to 300-450 mph were measured with radar guns, usually after a glider had reached its lowest point on a loop and was climbing upwind again. This suggested that the recorded speeds are representative of typical speeds in the loop and could be somewhat slower than peak speeds. Wind speed gusts of 50-70 mph were measured on the ridge crest by holding a small anemometer overhead at a height 7 feet above ground level. Anecdotally, maximum glider speeds are around 10 times the wind speed, although this seems to be more realistic at lower speeds (< 350 mph) than at higher speeds (> 350 mph) (S. Lisenby, personal communication). However, there are generally very few wind velocity measurements with which to compare the glider speeds.

The gliders had ailerons and an elevator to control flight and a fixed fin in place of a moveable rudder. Flaps were used to reduce the stall speed when landing.

3. Inferences about the wind field

Wind velocity over a ridge crest generally increases with height from near zero velocity at the ground level. The largest vertical gradient of wind velocity (largest wind shear) is located in a thin boundary layer located within several feet of the ridge crest. Fast wind blowing over a sharp-crested ridge usually forms an area of weaker wind or a lee eddy just downwind of the ridge crest and below the level of the crest. Located above this region of weak wind is a thin wind-shear region, a wind-shear boundary layer that separates from the ridge crest, and

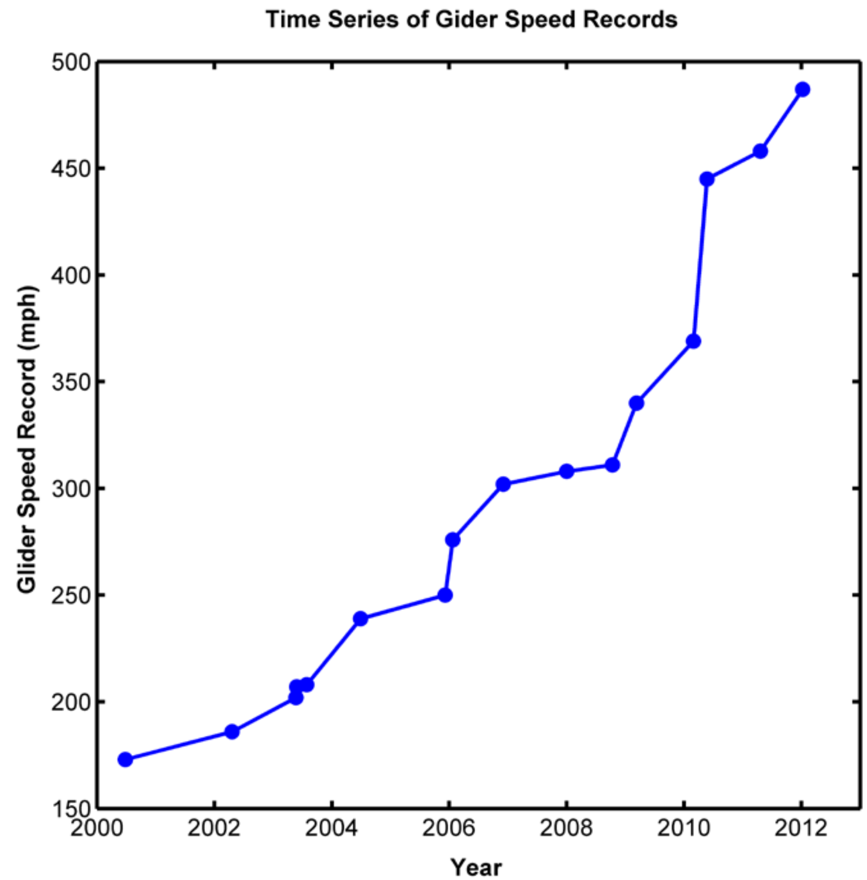

Figure 2. Time series of maximum recorded speeds of RC gliders using dynamic soaring as listed in the website rcspeeds.com. Each value represents an unofficial world record as measured by radar gun. The charted record holder is Spencer Lisenby who flew a Kinetic 100 (100 inch wing span) glider at a speed of 487 mph in January 2012. On 06 March 2012 Spencer flew the Kinetic 100 to a new record speed of 498 mph. <http://www.rcgroups.com/forums/showthread.php?t=1609281>

above that a layer of stronger wind and reduced wind shear. The wind-shear layer is inferred to extend nearly horizontally downwind of the ridge crest and gradually thicken with distance downwind. The glider loops crossed the wind-shear layer where it was thin just downwind of the ridge crest (see Figure 1).

4. Schematic illustration of dynamic soaring

The technique of dynamic soaring illustrated by the glider flight is to cross the wind-shear layer by climbing headed upwind, to then turn downwind, and to descend headed downwind (Figure 1). Each crossing of the wind shear layer increases the airspeed and kinetic energy of a glider. The rate of gain of airspeed and kinetic energy can be increased by increasing the frequency of the loops. Several things tend to limit a glider's airspeed including increased drag associated with both faster airspeeds and steeply-banked turns. When the gain of energy from crossing the wind-shear layer equals the loss due to drag, a glider reaches equilibrium in energy-neutral soaring.

Temporal wind gusts, in contrast to the structure gusts encountered by crossing the wind-shear layer, can be used to gain additional energy. A faster-than-average wind-speed gust contains greater-than-average wind shear, through which a glider could extract a greater-than-average amount of energy. The trick of soaring in gusts is to maximize time in the gusts and minimize time in the lulls.

5. Brief history of dynamic soaring

Interest in dynamic soaring began in the late 1800's as mariners watched albatrosses soaring over the ocean without flapping their wings. Observers tried to understand and model the birds' soaring techniques in order to adapt them for human flight. Two theories were suggested to explain how an albatross could extract energy from wind. The first theory, which has gained prominence, proposed that an albatross uses wind shear, the increase in wind velocity with height above the ocean surface, to gain energy (dynamic soaring). The second theory proposed that an albatross uses updrafts over waves to gain energy (wave-slope soaring). Albatrosses probably use both techniques, depending on the local wind and waves, but dynamic soaring is thought to provide most of the energy for sustained soaring. Albatrosses appear to exploit the thin wind-shear layer located above lee eddies, which are located downwind of ocean wave crests, as described by Pennycuick (2002).

The concept of dynamic soaring was first described by Lord Rayleigh in 1883, and the phrase "dynamic soaring" was used as early as 1908 by F. W. Lanchester. Over the years dynamic soaring has been discussed and modeled by many people, although only quite recently were the aerodynamics correctly developed (see Lissaman, 2005; Sachs, 2005). A problem for non-aerodynamicists is that the aerodynamic differential equations describing the accelerated twisting, turning, swooping flight of gliders in wind shear are very complex, which makes it difficult to understand the relevant dynamics. This note is an attempt to try to express the physics of dynamic soaring in a simpler framework and apply it to fast glider flight.

A little over a decade ago, pilots of RC gliders began using dynamic soaring and have been exploiting it to fly gliders downwind of mountain ridges much faster than had been previously possible. During the last 12 years, dynamic soaring speeds increased remarkably from around 170 mph in year 2000 up to 487 mph in 2012 with no sign of leveling off (Figure 2).

Speed gains have been achieved with the development of high performance airfoils, stronger airframes, better servos, and increased pilot experience. Along with these developments, pilots have flown gliders in progressively faster winds and larger wind shears. Along the way were many structural failures due to the large accelerations associated with fast highly-banked loops. Numerous crashes were caused by trying to fly fast gliders close to the ground near ridge crests. Maintaining control of gliders in quick loops and in wind turbulence is challenging and requires fast and accurate reflexes. In addition, large stall speeds of high-performance gliders make them tricky to fly at slow speeds and to safely land on top of a mountain ridge.

6. Model of dynamic soaring

The approach here uses the characteristics of observed glider loops to develop a simple model of dynamic soaring based on Rayleigh's (1883) concept of soaring across a sharp wind-shear layer and on the flight dynamic equations of motion (Lissaman, 2005). The modeled flight pattern is referred to as the Rayleigh cycle because he was first to describe the concept of dynamic soaring. The model provides a relatively easy way to understand the essential physics of dynamic soaring and provides predictions of soaring airspeeds, which agree well with more complex simulations of albatross flight (Lissaman, 2005; Sachs, 2005, Richardson, 2011). The Rayleigh cycle, which uses two horizontal homogenous wind layers, is the most efficient way for a glider in nearly-circular flight to gain energy from a wind profile and thus indicates the maximum amount of airspeed that can be achieved using dynamic soaring in energy-neutral flight.

When a glider soars in wind, the glider's airspeed (speed through the air) is different from its ground speed (speed relative to the ground). This should be kept in mind because airspeed, and not ground speed, is the quantity most relevant to flight. Aerodynamic forces on a glider depend on its airspeed not ground speed. Sufficient airspeed must be maintained to avoid a stall, which could be fatal at low altitude. The analysis of airspeed and ground speed leads to different conclusions about where kinetic energy is gained in dynamic soaring. An increase of glider airspeed comes from crossing the wind-shear layer. Most increase of ground speed occurs as a glider turns from a direction headed upwind to a direction downwind; during the turn wind does work on the glider and accelerates it in a downwind direction. Radar measurements of glider speed are relative to the ground and can be significantly different from glider airspeed.

Over time, gravity and drag relentlessly force a glider downward through the air. In balanced flight the glider's sinking speed through the air represents the glider's rate of energy loss. In order to continuously soar, a glider must extract sufficient energy from the atmosphere to counter the loss due to drag. For many years gliders exploited updrafts along ridges to gain energy from the wind and continuously soar, but recently gliders have used the vertical gradient of horizontal winds to gain energy; the exceptionally fast speeds achieved using wind gradients suggest that dynamic soaring is an effective way to gain energy.

The Rayleigh cycle of dynamic soaring as shown in Figure 1 was used to model a glider soaring in nearly-circular loops along a plane tilted upward into the wind similar to the glider observations at Weldon. The essential assumptions are that 1) the plane crosses the wind-shear layer at a small angle with respect to the horizon so that vertical motions can be ignored, 2) the average airspeed and average glide ratio can be used to represent flight in the circle, and most importantly, 3) conservation of energy in each layer requires a balance between the sudden increase of airspeed (kinetic energy) caused by crossing the shear layer and the gradual loss of airspeed due to drag over half a loop, resulting in energy-neutral flight. The motion during each half loop is somewhat similar to a landing flare when a glider maintains constant altitude and airspeed is slowly dissipated by drag. This study assumes that the lower layer has zero wind speed and that the increase of wind speed across the wind-shear layer is equal to the wind speed in the upper layer.

The glide polar for a particular glider is given by values of the glide ratio V/V_z, where V is the glider airspeed and V_z is

V (mph)	200		300		400		500		600	
V_c (mph)	45	55	45	55	45	55	45	55	45	55
t_{opt} (sec)	2.9	4.3	1.9	2.9	1.5	2.2	1.2	1.7	1.0	1.4
d_{opt} (feet)	270	400	270	400	270	400	270	400	270	400
W_{min} (mph)	20		30		40		50		60	
Bank angle (deg.)	87.1	85.7	88.7	88.1	89.3	88.9	89.5	89.3	89.7	89.5
Load factor	20	13	44	30	79	53	123	83	178	119

Table 1. Optimum loop period (t_{opt}) and diameter (d_{opt}) and the minimum wind speed (W_{min}) required for different glider airspeeds in energy-neutral dynamic soaring. V is the average airspeed (speed through the air) of a glider circling in a Rayleigh cycle. V_c is the assumed cruise airspeed (45 mph) of the glider corresponding to the airspeed of maximum lift/drag, which was assumed to equal 31.4 in this example. Cruise airspeed increases to 55 mph by adding ballast of around 50% of the original glider weight. The optimum loop period t_{opt} corresponds to the minimum wind speed W_{min} in the upper layer required for dynamic soaring at the listed glider airspeeds (Eq. 6). Optimum loop diameter d_{opt} corresponds to the optimum loop period (Eq. 9). Bank angle is for balanced circular flight. Load factor is equal to $1/\cos\varphi$ and is the total acceleration of the glider, including gravity plus centripetal acceleration, normalized by gravity.

V (mph)	500					600	
t (sec)	1.0	1.5	2.0	2.5	3.0	2.0	3.0
d (feet)	230	350	470	580	700	560	840
W_{min} (mph)	51 (58)	52 (51)	58 (53)	66 (53)	78 (58)	77 (63)	103 (77)
V/W_{min}	9.9 (8.7)	9.6 (9.9)	8.7 (9.9)	7.6 (9.4)	6.7 (8.6)	7.8 (9.5)	5.8 (7.8)
Bank angle (deg.)	89.6	89.4	89.2	89.0	88.0	89.3	89.0
Load factor	143	95	72	57	48	86	57

Table 2. Minimum wind speed (W_{min}) required to fly at 500 mph (and 600 mph) using different loop periods (t) and the associated loop diameters (d) in energy-neutral dynamic soaring. The maximum L/D is assumed to equal 31.4 at a cruise airspeed V_c of 45 mph (no ballast). V is the average airspeed of a glider circling in a Rayleigh cycle, t is an assumed loop period, and d is the corresponding loop diameter. W_{min} is the minimum wind speed in the upper layer required for dynamic soaring at the listed glider airspeed. Values in parentheses are for a cruise airspeed V_c of 55 mph (added ballast). V/W_{min} is the ratio of glider airspeed to wind speed and, when multiplied by the wind speed, indicates the maximum airspeed. Values in parentheses are for a cruise speed of 55 mph (added ballast). Bank angle is for balanced circular flight. Load factor is equal to $1/\cos\varphi$ and represents the total acceleration acting on the glider, normalized by gravity.

the glider's sinking speed through the air. The glide ratio is closely equal to lift/drag (*L/D*) for *L/D* values >> 1 typical of glider flight. Values of V/V_z for circular flight were modeled using a quadratic drag law, in which the drag coefficient is proportional to the lift coefficient squared, and the aerodynamic equations of motion for balanced circular flight (Lissaman, 2005; Torenbeek and Wittenberg, 2009). The equation for a glide polar can be specified by using a glider's maximum *L/D* value and the associated cruise speed V_c. In balanced circular flight the horizontal component of lift balances the centripetal acceleration and the vertical component of lift balances gravity. A more complete discussion of glide polar model and derivation of relevant equations are given in the appendix. Equation numbers below refer to the equations derived in the appendix.

For a given wind speed in the upper layer, the maximum possible glider airspeed coincides with an optimum loop period (t_{opt}) and the associated optimum loop diameter (d_{opt}). For fast glider speeds, > 150 mph, t_{opt} is given by

$$t_{opt} = \frac{2\pi V_c^2}{gV}. \qquad (6)$$

V_c is the glider cruise speed, V is the glider airspeed, and g is gravity. Equation 6 indicates that t_{opt} is inversely proportional to glider airspeed. The optimum loop period decreases with increasing glider airspeed because drag increases with airspeed, which requires more frequent shear-layer crossings to achieve a balance and energy-neutral flight.

The optimum loop diameter d_{opt} is given by

$$d_{opt} = 2V_c^2/g. \qquad (9)$$

Equation 9 reveals that the optimum loop diameter is independent of glider airspeed but is proportional to cruise airspeed squared.

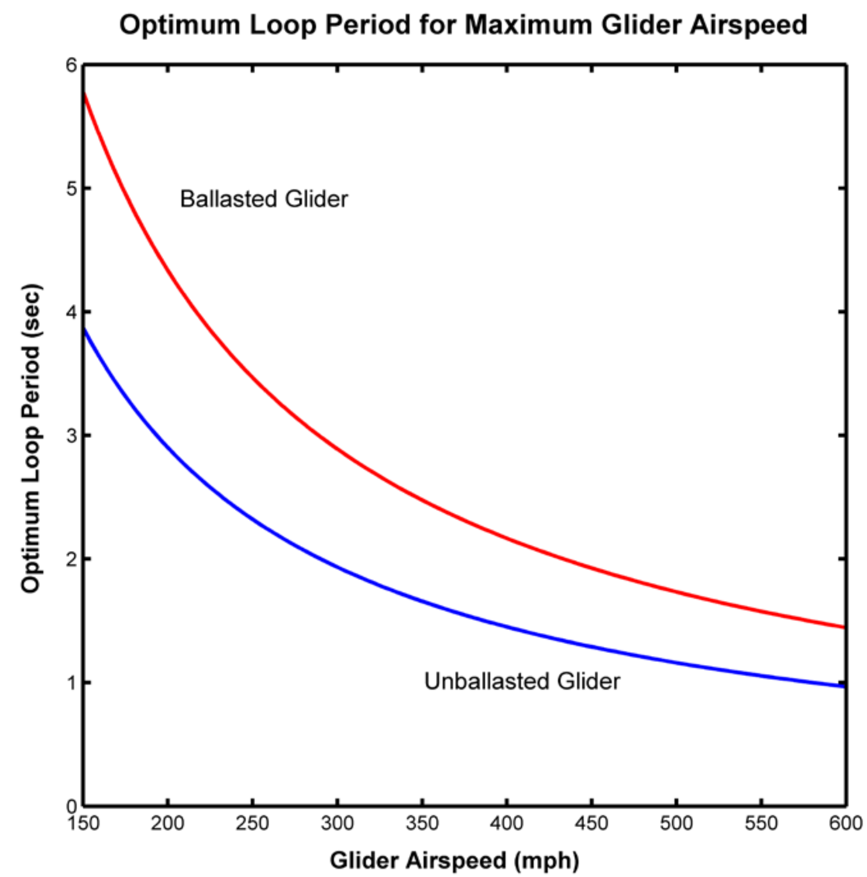

Figure 3. Optimum loop period t_{opt} required to achieve the maximum glider airspeed in a Rayleigh cycle plotted as a function of glider airspeed. Curves are shown for the unballasted (V_c = 45 mph) and ballasted (V_c = 55 mph) gliders. Ballast is around 50% of the unballasted glider weight.

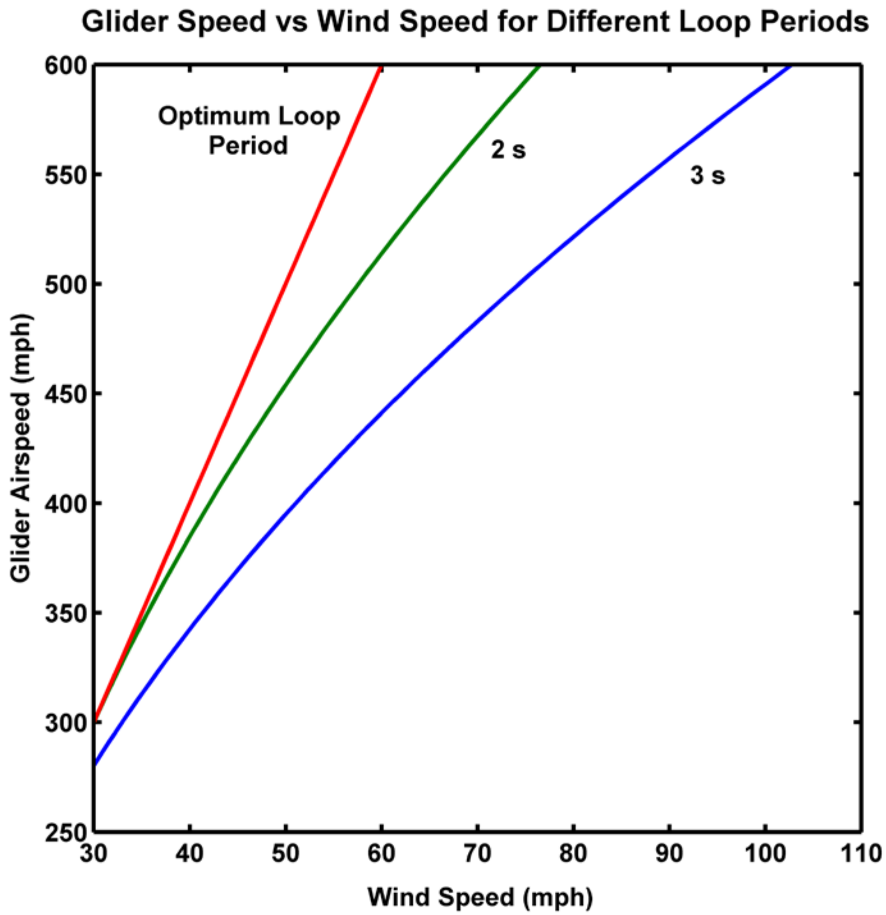

Figure 4. Maximum glider airspeed as a function of wind speed using a Rayleigh cycle and the unballasted glider (V_c = 45 mph). Curves are shown for the (variable) optimum loop period (see Figure 3) as well as for constant loop periods of 2 s and 3 s.

t_{opt} was used to calculate the maximum glider airspeed V_{max} for a given wind speed W

$$V_{max} = \frac{(V/V_z)_{max}}{\pi}(W). \qquad (8)$$

Equation 8 indicates that for fast flight (> 150 mph) the maximum average airspeed in a Rayleigh cycle is proportional to the wind speed W in the upper layer. For a high-performance RC glider like the Kinetic 100, $(V/V_z)_{max}$ is around 30 (S. Lisenby, personal communication), and the maximum possible (average) dynamic soaring airspeed is around 10 times the wind speed of the upper layer. Consider a glider with a maximum L/D of around 30 soaring with an optimum loop period and with an upper-layer wind speed of 50 mph. Equation 8 predicts that the maximum possible average glider airspeed would be around 500 mph (10 times the 50 mph wind speed). A glider flying in a loop would increase its airspeed by 50 mph on crossing the wind-shear layer from 475 mph just before the crossing to 525 mph just afterward. Between shear-layer crossings airspeed would gradually decrease back to 475 mph due to drag. At these fast speeds the variation of airspeed due to vertical motions in a loop is much smaller than that due to crossing the shear layer.

The total acceleration of a glider includes centripetal acceleration and gravity and is given by the load factor, which equals $1/\cos\varphi$, where φ is the bank angle (Eq. 3). For fast dynamic soaring, the load factor is approximately equal to $2\pi V/gt$.

7. Results

The main results are the derivation of equations for the optimum loop period (Eq. 6), the optimum diameter (Eq. 9), and the maximum glider airspeed V_{max} (Eq. 8), which predicts that maximum glider speed equals around 10 times the wind speed for fast flight and $(L/D)_{max}$ around 30. It is helpful to explore these results by using values for a typical glider, so the values of the flight characteristics of a glider dynamic soaring at different airspeeds were calculated. The examples assume a high-performance glider $(L/D)_{max}$ value of 31.4 at a cruise speed V_c of 45 mph, similar to a Kinetic 100, the present world speed record holder (see dskinetic.com). The 31.4 $(L/D)_{max}$ value was chosen so that V_{max} = 10.0 W. Adding ballast was assumed to maintain the same $(L/D)_{max}$ and to increase cruise speed V_c to 55 mph. V_c is proportional to the square root of glider weight, and (approximately) a 50% increase of glider weight increases V_c from 45 mph to 55 mph.

Figure 3 shows that, as glider speeds increase from 150 mph to 600 mph, the optimum loop period t_{opt} for the unballasted (V_c = 45 mph) glider decreases from 3.8 s to 1.0 s (t_{opt} is inversely proportional to V). Over this speed range the optimum loop diameter is 270 feet (Table 1). Small loop periods of around 2 s, or smaller, are difficult to fly in efficient dynamic soaring and stressful for the glider. More typical flyable minimum loop periods are between 2-3 s with 3 s being easier to fly and more common than 2 s, which is rare (Spencer Lisenby and Chris Bosley, personal communications). Thus, to fly at 500 mph, say, it is necessary to use flyable loop periods ~ 2-3 s, which are larger than the optimum loop period of 1.2 s and correspond to larger loop diameters of 470-700 feet (Table 2). The downside of these flyable loop periods is that the minimum wind speed required for a glider to reach an airspeed of 500 mph increases over the minimum wind speed required at the optimum period and diameter (as predicted by Eq. 7) (Figure 4). For example, the minimum wind speed W_{min} required for dynamic soaring at 500 mph (Eq. 4) increases from 50 mph for a 1.2 s loop (at t_{opt}) (Table 1) up to 78 mph for a 3 s loop (Table 2).

Therefore, a major difficulty in trying to fly at glider airspeeds of 500 mph (or faster) is that by using flyable loop periods of 2-3 s the minimum required wind speed increases substantially over that at the optimum loop period and diameter (Figure 4). In

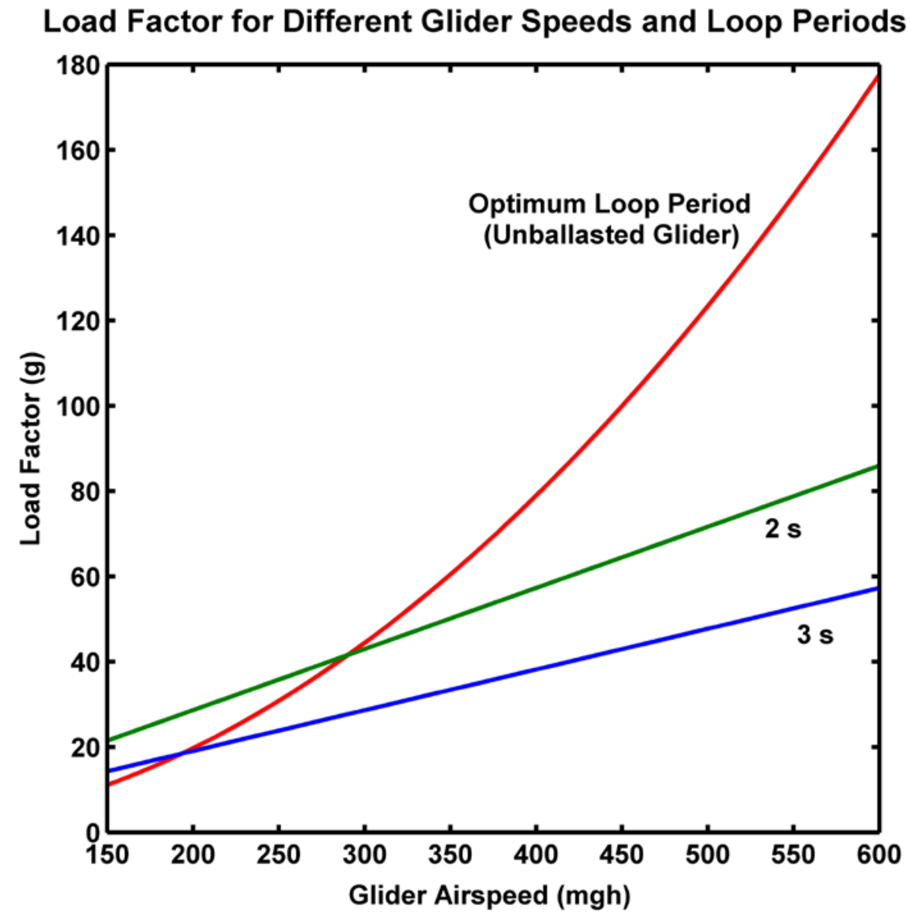

Figure 5. Load factor plotted as a function of glider airspeed and different loop periods for the unballasted glider (V_c = 45 mph). Load factor is equal to the total acceleration of the glider in terms of the acceleration of gravity (g).

other words, the glider's maximum airspeed for a wind speed of 50 mph (say) decreases from values predicted by $V_{max} = 10\ W$ (Eq. 8), which is based on the optimum period. In order to take advantage of $V_{max} = 10\ W$ one needs to fly close to the optimum period, and this becomes increasingly difficult at fast airspeeds of 500 mph (Table 1). This suggests that it will be difficult to continue to achieve such fast speed gains as seen in the last few years.

The effects of flying with and without added ballast are shown in Tables 1 and 2 and Figure 3. At a glider airspeed of 500 mph, adding ballast increases the optimum loop period from 1.2 s to 1.7 s (optimum loop period is proportional to glider weight), which is still difficult to fly but closer to flyable loop periods. A benefit is that at a flyable loop period of 3 s the minimum required wind speed decreases to 58 mph (ballasted glider) from 78 mph (unballasted glider) (Table 2). A main benefit of adding ballast is to increase the optimum loop period and to reduce the minimum wind speed required to fly at 500 mph from that obtained without ballast, assuming a flyable 3 s loop period. Table 1 and Figure 3 show that the optimum loop period of the ballasted glider falls below 3 s near an airspeed of 300 mph, indicating that at airspeeds greater than 300 mph V_{max} will be below values predicted by Eq. 8. This is in accord with the anecdotal evidence of $V_{max} = 10\ W$ being more realistic at glider speeds below 350 mph.

Another way to interpret the effect of ballast is to compare maximum glider airspeeds achievable with a wind speed of 50 mph (say). At the optimum loop period (1.2 s) and optimum diameter (270 feet) an unballasted glider could reach 500 mph (Table 1). With a loop period of 3 s, maximum airspeed of the unballasted glider would be 370 mph (loop diameter 520 feet) and that of the ballasted glider 450 mph (loop diameter 630 feet) (Eq. 4). Thus, adding ballast increases the maximum glider airspeed over that possible without ballast (for $t = 3$ s and wind speeds > 30 mph).

Figure 5 shows the load factor (total acceleration) of an unballasted glider at airspeeds of 150 mph to 600 mph. At a glider airspeed of 500 mph and optimum loop period of 1.2 s, the load factor is 123 g. Increasing the loop period to 2 s at 500 mph reduces the load factor to 72 g, and increasing the loop period to 3 s reduces the load factor to 48 g. Table 1 also shows that the ballasted glider has a smaller load factor ~ 83 g than the unballasted glider ~ 123 g due to the larger optimum loop periods of the ballasted glider. (Load factors are similar for ballasted and unballasted gliders when using the same constant loop period). Therefore, adding ballast and increasing V_c from 45 mph to 55 mph reduces the load factor, and that seems beneficial. However, for a given glider airspeed, the lift force on a glider's wings is the same for both the unballasted and ballasted glider. This is because lift force equals the glider weight times the load factor, and the glider weight is larger with ballast.

Values of load factor in the tables are for average airspeeds in a loop. When a glider crosses the wind-shear layer, the airspeed suddenly increases ~ 5% over the average airspeed and that can cause a ~ 10% jump in load factor and lift force over average values given in the tables.

8. Speed limits for dynamic soaring

At a critical aircraft speed of (roughly) Mach 0.7 ~ 540 mph (or greater) the flow of air past the aircraft can increase locally and reach, in places, the speed of sound, Mach 1 ~ 770 mph (see Torenbeek and Wittenberg, 2009). The aircraft speed at which this occurs depends on the wing shape, the angle of attack, and the particular configuration of the aircraft. Some modifications that have led to a higher critical speed are a supercritical airfoil, swept wings, and a smooth variation from nose to tail of an aircraft's cross-sectional area and a small maximum area (area rule). At the critical speed, shock waves begin to form due to the compressibility of air, and the aerodynamics of incompressible flow is no longer valid. The lift coefficient drops, drag coefficient increases, and lift/drag decreases enormously. The linear relationship V_{max} = 10 W fails, since maximum lift/drag (Eq. 8) decreases, even when flying at the optimum loop period and diameter for incompressible flow. This suggests that an increasingly large wind speed would be required to obtain a particular glider airspeed, larger than predicted by V_{max} = 10 W.

At an airspeed of 600 mph, the optimum loop period of the Rayleigh cycle is 1.0 s for the unballasted glider and 1.4 s for the ballasted glider, and the wind speeds required to fly with loop periods of 2-3 s increase substantially over 60 mph (Table 1). The minimum required wind speed of an unballasted glider is 103 mph for a loop period of t = 3 s (Table 2). Adding ballast decreases the minimum required wind speed to 77 mph for t = 3 s (Figure 3). Thus, adding ballast could help gliders reach 600 mph, assuming that loops could be flown with periods of 2-3 s and that wind speeds of 77 mph are available and flyable. Of course, reaching 600 mph using these wind speeds is based on a glider flying a nearly-circular loop in a two-layer Rayleigh cycle, which gives the maximum amount of energy possible from wind shear. In practice, somewhat less energy would be gained than from a Rayleigh cycle, and thus a larger wind speed would be needed to achieve the airspeeds predicted using the Rayleigh cycle. For example, flying a nearly-circular loop through a linear wind shear would result in around 80% of the maximum glider airspeed achievable in the two-layer case, assuming a similar increase of wind velocity over the heights flown. Additional limits to speed are the structural strength of the glider, which is subjected to very large accelerations and lift forces, and the glider's ability to control flutter at high speeds.

In summary, although record glider speeds have increased rapidly during the last few years up to 487 mph (Figure 2), and the shape of the curve in Figure 2 looks like it could continue upwards to much higher glider speeds, the limits mentioned above—the decreasing optimum loop period at higher speeds, the effects of the compressibility of air, and the larger wind speeds required to reach a particular glider airspeed--suggest that maximum speeds in dynamic soaring will tend to level out near between 500 and 600 mph. Further modifications of gliders for high-speed flight might help increase maximum speeds somewhat, but these modifications would probably make it difficult to fly at slower speeds and land safely. The addition of an autopilot might possibly help to fly a glider at small loop periods.

9. Conclusions about how to soar at 500 mph

The following conclusions about how to soar at 500 mph were derived from the analysis of the Rayleigh cycle model of dynamic soaring:

1) Fly a high-performance and strong glider with a large maximum L/D and large associated cruise airspeed (V_c). A larger maximum L/D results in a larger glider airspeed for a given wind speed (Eq. 8). A larger cruise speed results in a larger optimum loop period (t_{opt}), closer to flyable airspeeds of 2-3 s (Eq. 6).

2) Fly in fast wind ~ 50-70 mph (or more) and large wind shear (Table 2).

3) Fly as close to the optimum loop period (Eq. 6) and optimum loop diameter (Eq. 9) as possible because that increases the maximum glider airspeed to be around 10 times the wind speed (V_{max} = 10 W) and results in the fastest airspeed for a given wind speed (Eq. 8). However, fast flight at optimum loop periods results in large accelerations and large lift forces and requires very strong gliders. Flyable loop periods (~ 2-3 s) are significantly larger than the optimum loop period ~ 1.2 s of an unballasted glider at 500 mph and increase the minimum required wind speed to reach 500 mph (Table 1).

4) Add ballast to increase the cruise airspeed V_c because that increases the optimum loop period toward flyable loop periods and tends to reduce the minimum wind speed and

shear required for flight at 500 mph (Tables 1 and 2). However, increasing V_c leads to higher stall speeds and difficulties in safely landing a glider on a ridge crest. For this reason, S. Lisenby, (personal communication) limits ballast to around 25% of the weight of his unballasted Kinetic 100 glider.

5) Fly at high altitudes and warm temperatures where air density is lower, which has effects similar to adding ballast. Warm temperatures tend to keep the critical airspeed high.

To further investigate the dynamic soaring of gliders, it would be helpful to add instruments to measure at high resolution, positions, orientations, velocities and accelerations over the ground and through the air, as well as information about the structure of the wind interacting with ridges. It would be useful to continuously monitor glider airspeeds and groundspeeds in order to more accurately document maximum airspeeds. With this information one might be able to refine glider performance and achieve faster airspeeds. Numerical modeling could be used to further investigate high-speed dynamic soaring in more realistic conditions (wind interacting with a ridge) and help refine high-performance glider design.

Acknowledgements

Chris Bosley and Spencer Lisenby helped with my visit to Weldon to see fast dynamic soaring and explained and discussed glider dynamic soaring techniques. Don Herzog flew us down to Bakersfield in his “high-performance” Trinidad airplane at 200 mph (much slower than the RC gliders) and joined in the trip up to Weldon. Paul Oberlander drafted Figure 2. Steve Morris and Pritam Sukumar read an earlier version of this paper and provided helpful comments about how to improve it.

Appendix

Modeled Rayleigh cycle

In the modeled Rayleigh cycle the loss of potential energy over a half loop ($t/2$) is given by $mg(t/2)V_z$, where m is mass, g is gravity, t is the period of a loop, and V_z is the glider's sinking speed through the air due to drag. Conservation of energy for energy-neutral soaring requires that this energy loss must be balanced by the sudden gain in kinetic energy (airspeed) from crossing the wind-shear layer, which is given by $m(V_2^2 - V_1^2)/2$, where V_1 is the airspeed before crossing the wind-shear layer, and V_2 is the airspeed after crossing the layer. In this latter term, $V_2^2 - V_1^2 = (V_2 - V_1)(V_2 + V_1)$. $V_2 + V_1$ is assumed to equal twice the average airspeed ($2V$) in the nearly-circular flight, and $V_2 - V_1$ is the increase of airspeed ΔV of a glider crossing the wind-shear layer, which is assumed to equal the vertical increase of wind speed (ΔW) across the layer and also the wind speed W of the upper layer, assuming zero wind speed in the lower layer. Conservation of energy and the approximations given above indicate that

$$\Delta V = \frac{gt}{2(V/V_z)}, \quad (1)$$

where V/V_z is the glide ratio averaged over a half loop and over ΔV. Values of V/V_z define the glide polar for a particular glider and indicate values of its sinking speed V_z through the air as a function of airspeed V. The glide ratio is closely equal to lift/drag (L/D) for L/D values >> 1 typical of glider flight. Lift $L = Cl(\rho/2)V^2S$, drag $D = Cd(\rho/2)V^2S$, Cl is the lift coefficient, Cd the drag coefficient, ρ the density of air, and S the characteristic area of the wings.

The decrease in airspeed at the assumed nearly-constant height during a half loop was obtained by balancing the rate of change of airspeed (kinetic energy) with dissipation due to drag. This balance indicates that $dV/dt = g/(V/V_z)$. Since V/V_z is nearly constant in the relevant glider airspeed range ΔV centered on a particular average airspeed, airspeed decreases nearly linearly in time. (The variation of V/V_z is around 10% of the average V/V_z in an energy-neutral loop.) Therefore, the total decrease of airspeed ΔV in a half loop ($t/2$) is equal to $gt/2(V/V_z)$ as derived above (Eq. 1).

Values of V/V_z for circular flight were modeled using a quadratic drag law, in which the drag coefficient is proportional to the lift coefficient squared, and the aerodynamic equations of motion for balanced circular flight (Lissaman, 2005; Torenbeek and Wittenberg, 2009). In balanced circular flight the horizontal component of lift balances the centripetal acceleration and the vertical component of lift balances gravity. Specifically, V/V_z was modeled by

$$V/V_z = \frac{2\,(V/V_z)_{\max}}{(V/V_c)^2 + (V_c/V\cos\varphi)^2}, \tag{2}$$

where $(V/V_z)_{max}$ is the maximum glide ratio at V_c the associated cruise airspeed (airspeed of minimum drag) of a representative glider in straight flight, φ is the bank angle, and $\cos\varphi$ is given by

$$\cos\varphi = \sqrt{\frac{1}{(2\pi V/gt)^2 + 1}}. \tag{3}$$

Combining Equations (2) and (3) with (1) indicates that

$$\Delta V = \frac{gt}{4\,(V/V_z)_{\max}}\left[(V/V_c)^2 + (V_c/V)^2 + (2\pi V_c/gt)^2\right]. \tag{4}$$

The $(2\pi V_c/gt)^2$ term is due to the centripetal acceleration and bank angle. Equation 4 indicates that for a particular glider in energy-neutral soaring, the glider airspeed (ΔV) gained by crossing the wind-shear layer (and the gradual loss in a half loop) is a function of both the loop period t and the average airspeed V.

A minimum ΔV (and also minimum ΔW and minimum W) for a given glider airspeed occurs at an "optimum" loop period t_{opt} coinciding with minimum energy loss in a loop (minimum $V_z t$). The optimum loop period (t_{opt}) was obtained by setting the derivative $d(\Delta V)/dt$ of (Eq. 4) equal to zero and solving for t.

$$t_{\text{opt}} = \frac{2\pi V_c/g}{\sqrt{(V/V_c)^2 + (V_c/V)^2}}. \tag{5}$$

At fast glider speeds >150 mph and for V_c ~ 50 mph, $(V/V_c)^2 >> (V_c/V)^2$ and $(V_c/V)^2$ can be neglected. This simplifies Eq. 5 to

$$t_{\text{opt}} = \frac{2\pi V_c^2}{gV}. \tag{6}$$

Equation 6 indicates that t_{opt} decreases with increasingly large V. Substituting Eq. 6 into Eq. 4 provides an expression for minimum ΔV (and minimum ΔW and minimum W) for a given V. The minimum wind speed W_{min} needed for a given glider airspeed V in energy neutral dynamic soaring is

$$W_{\min} = \frac{\pi V}{(V/V_z)_{\max}}. \tag{7}$$

This equation can be rearranged to provide the maximum glider airspeed V_{max} for a given wind speed W

$$V_{\max} = \frac{(V/V_z)_{\max}}{\pi}(W). \tag{8}$$

Equation 8 indicates that for fast flight (> 150 mph) the maximum average airspeed in a Rayleigh cycle is proportional to wind speed. It is important to note that this linear relation depends on flying with an optimum loop period. Other loop periods result in a smaller maximum airspeed for a given wind speed.

The diameter of a loop is given by $d = Vt/\pi$. Substituting into this equation the expression for optimum loop period t_{opt} in fast flight (Eq. 6) gives the optimum loop diameter d_{opt}

$$d_{opt} = 2V_c^2/g. \qquad (9)$$

Equation 9 reveals that the optimum loop diameter is proportional to cruise airspeed but is independent of glider airspeed squared.

The total acceleration of a glider includes centripetal acceleration and gravity and is given by the load factor, which equals $1/\cos\varphi$ (see Eq. 3). For fast dynamic soaring $(2\pi V/gt)^2 >> 1$, and the load factor is approximately equal to $2\pi V/gt$.

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Calling all F3J pilots

We are planning the pre-contest for the World Championships in August.

The pre-contest will be held on Friday 3 August and Saturday 4 August 2012. The contest will be limited to 150 pilots including anyone of the international competitors that would like to enter. Additional information will be sent to interested parties along with the bulletin for the event.

This pre-contest event will include as many qualifying rounds as we are able to fit in and three fly-off rounds as per normal F3J regulations.

This is a great opportunity to compete against international pilots and remember, not all of them are WC pilots.

The preliminary World Champs schedule is as follows:

Friday 3 August	Pre-contest day 1
Saturday 4 August	Pre-contest day 2
Sunday 5 August	Model processing and opening ceremony
Monday 6 August through	World Champs rounds
Thursday 9 August	World Champs rounds
Friday 10 August	WC final fly-off rounds
Saturday 11 August	Tour and banquet

Kind regards, Michelle Goodrum

Rethinking 2.4 GHz

Pete Carr WW3O, wb3bqo@yahoo.com

It’s been a warm winter here in the Northeast so I’ve had the chance to fly. The other week I was out at the school yard testing a new 1.5 meter two channel sailplane and it spiraled into the ground. Fortunately, it just snapped off the nylon wing hold down screw and cracked the stab so it was an easy fix.

Once the repairs were done I was left with that nagging doubt about the radio. The sailplane had been passing overhead going upwind at about 50 feet. I was going to turn around and set up for the landing and all appeared normal. The ship went into full right rudder and stayed that way until the ground interrupted the flight. I had instinctively slammed the stick hard left but the ship didn’t respond.

In these situations I do what most all red blooded sailplane pilots do... check the internet!

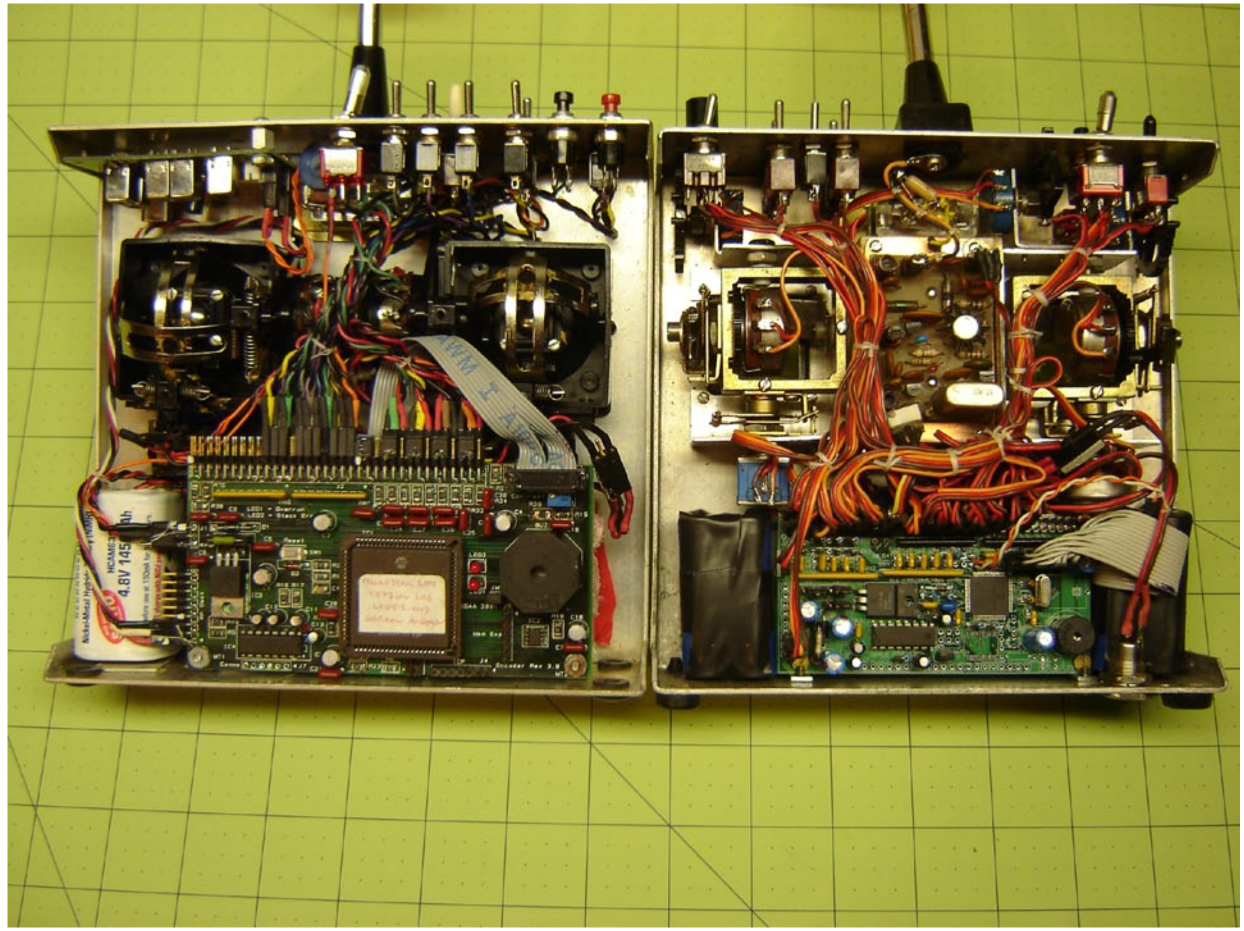
Actually, there’s a Yahoo Group devoted to the Ace MicroPro 8000 R/C transmitter and I subscribe. These are geeks of the finest kind. They have converted transmitters of every type and vintage to use the M*2K encoder and then changed them to operate with the new 2.4 GHz transmit modules. I posted the circumstances of the crash on the Group web page and sat back to gather information.

The response was amazing! At one time or another all the responders had been in a similar situation with a crash and a radio that was quite functional afterward. Their advice ran the well worn road of checking batteries, wiring, servos and such. Then I read a message from Dan WB4GUK who is also moderator of the Group. He had the same experience and had done an after-action analysis on the work bench. The radio worked okay laid out of the table until Dan moved the transmitter. At that point the LED on the face of the receiver went out for several seconds and he lost control of the flight gear.

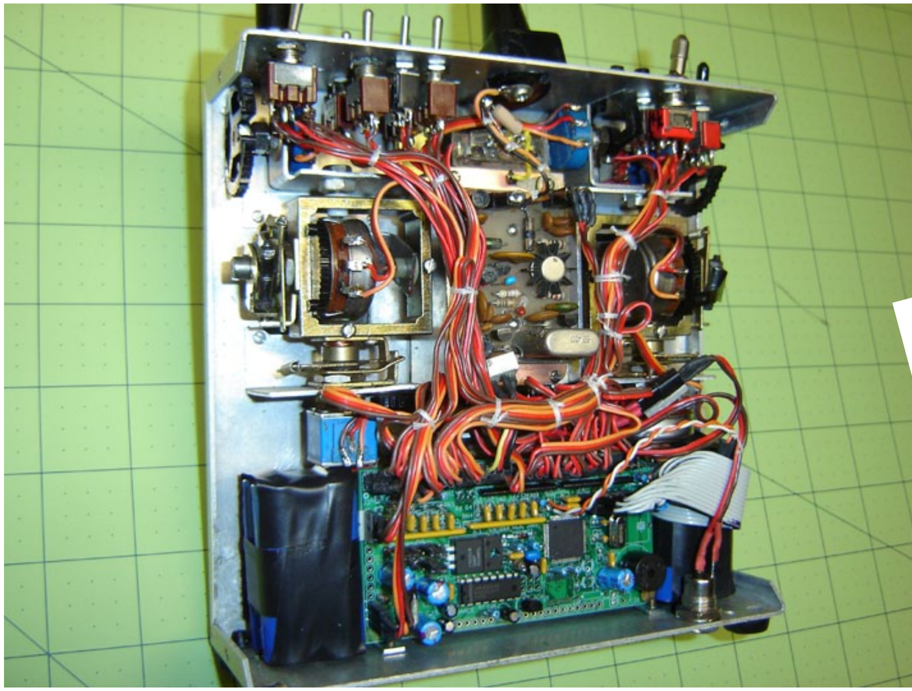
Dan is quite knowledgeable about software code, to the point where he designed an updated microprocessor for the Ace MicroPro 8000 transmitter. I’d installed one of his chips in my MP8K and loved it. For that reason major alarm bells went off when he wrote that he scrapped the receiver. His opinion was that the code in the receiver that restores operation after invalid packets was not good enough to handle flight conditions.

There are several reasons for an invalid packet as picked up by the receiver. One is interference where other signals cover the packet or corrupt it enough to make it worthless. The second is multi-path reception where a signal is reflected off nearby metal objects and arrives later than the original signal at the receiver. Since the original signal and the late one are valid, only the time difference confuses the receiver which then discards all of it. There can be other problem sources such as WiFi signals, fading of the desired signal and static inside the aircraft from servo motor noise. However, Dan felt that, after several successful flights, the trouble was probably in the software of the receiver. The fact that it happened on the work bench was also a major factor in reducing the variables.

At various times I've opened up a 2.4 GHz transmitter to have a look and see what the latest and greatest technology is like. The entire innards are machine produced and not supposed to be serviced by the user. Guys like those who are Yahoo M*2K Group members can solder, use test equipment and read a schematic. We also know enough not to mess with stuff that isn't easily repaired! For that reason we usually just close up the transmitter case and hope that it doesn't ever break!



*The ProLine is on the right while the original MicroStar 2000 radio is on the left. The latest version of the M*2K encoder is considerably smaller than the hand wired unit that first was produced.*



The ProLine case and sticks are a tight fit for the electronics. This requires very careful planning during installation of the various components. For example, the 8-cell NiCad battery is split into two 4-cell packs to fit either side of the encoder board. The Ace RF deck fit very well between the stick assemblies with the on-off switch underneath. The LCD screen is mounted to the inside of the case under the encoder board.

The face of the ProLine shows the LCD screen installation. A hole is cut with a knibbling tool and a bezel surrounds the screen to dress up the hole edges. I used Sharpy Magic Marker with the very fine tip to letter/label the various knobs and switches. The top of the transmitter case is very crowded. This is made slightly easier since the RF deck is not located along the top as with the Ace MicroPro 8000 transmitter. Still, those switches such as aileron/rudder coupling or flap/elevator mixing should be at the case edge if possible.

The receivers are the same way. If a servo connector pin breaks there is little chance of replacing it since the space is incredibly tiny and the circuit board is extremely fragile. Crash damage that was an easy fix with FMA, Futaba and all the ACE receivers is a life-ending event for these 2.4 GHz units.

I had reflown the flight of the little sailplane over and over again in my mind. I was looking for some small detail that would lead to a solution to the problem. The ship was wood with only a small bit of carbon in the wing main spar. The two receiver antennas were well removed from servo wiring and oriented at 90 degrees from each other. The flying field is a school yard with some chain link fencing nearby but the ship had flown several times out of that field without incident. Finally, the airborne pack and transmitter battery tested in excellent condition. I also looked at the well known “brown-out” problem, but the 2-channel glider couldn’t drag the flight battery down enough to make that happen.

I finally gave up on the quest to find the answer and changed out the radio for one in the Ham band. Yes, it’s AM, not FM, and yes, the receiver is slightly larger. However, I know that radio is reliable and would fly it anywhere, anytime, in any sailplane from this 2-channel ship up to and including a

*The Kraft/M*2K and the Proline/M*2K are shown. The number of switches and controls of the newer transmitter reflect how experience has led me to develop the design. While the LCD display is a gem, I still like the warm, fuzzy feeling of seeing the iron needle RF meter above the on/off switch.*

thousand dollar F3J machine. It ignored carbon, has out-of-sight range and is very easy to maintain and service.

I stuck an Ace Silver Seven receiver, stripped of the plastic case, into the sailplane and dug out a ProLine transmitter that had a MicroStar 2000 encoder installed. The encoder is the latest generation of the board which started out as a kit that I soldered together about ten years ago. The ProLine can be updated to the latest software version via the internet where earlier versions required an IC chip swap. The encoder is separate from the RF module which means that it's possible to look at the pulse train from the encoder on a cheap scope and check individual data channels for stick/switch defects. Similarly, the RF deck can be tuned to match the impedance of the rod-type antenna for maximum RF radiation and range. The receiver has inductor cans that can be tuned using a multimeter. The Ace tuning sequence is simple and precise. Finally, all the items mentioned are large enough to be serviceable by the average R/C modeler.

At left is the original Ace MicroPro 8000 transmitter that started it all. Everything in that case was hand soldered from kits so the larger size was needed. With surface mount technology used on current circuit boards the overall size of the transmitter can be safely downsized.

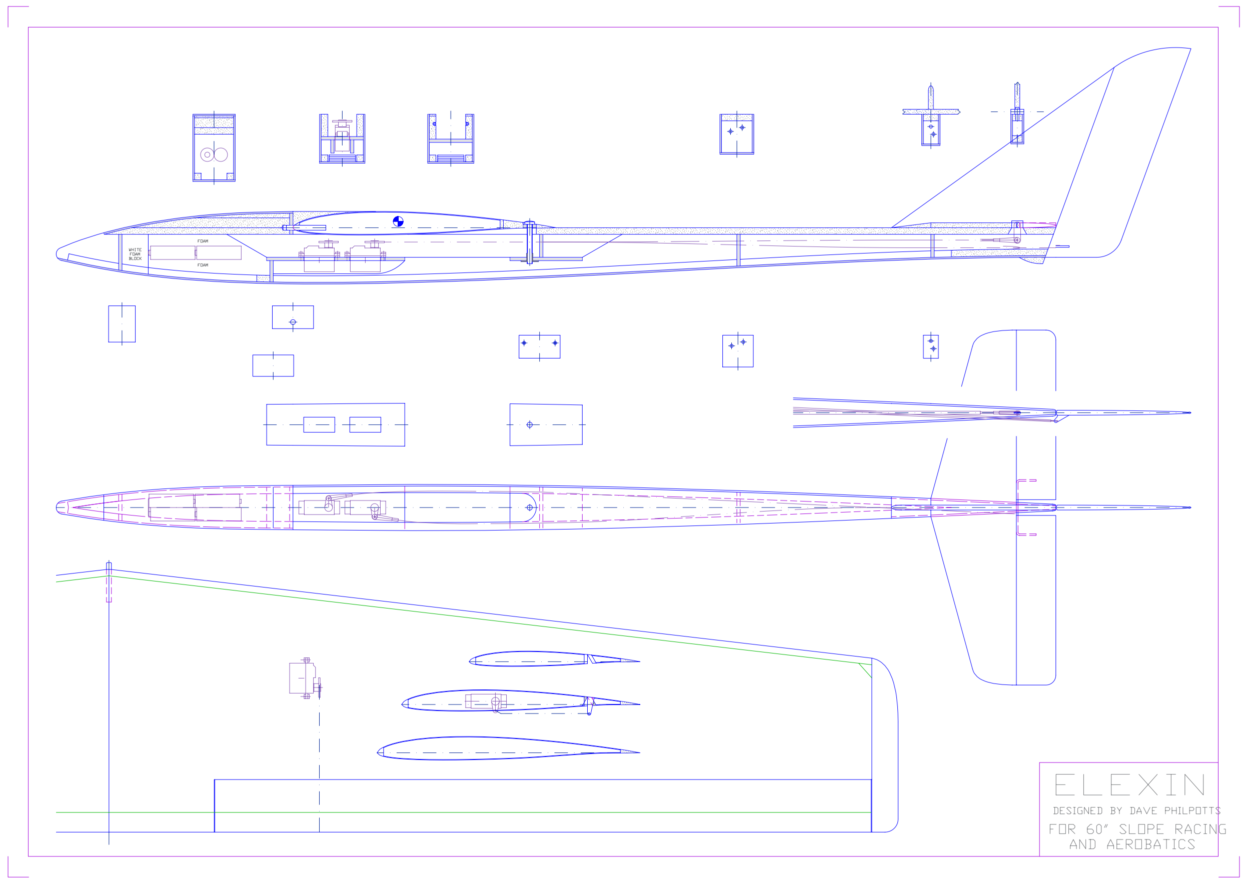
There are sailplanes such as the current crop of hand launch ships, and some of the F3B/F3J types, with the very small fuselages that would be a poor fit for these radios. Still, for the majority of sailplanes the old 72/50 MHz radios are a good deal. I'll gladly remember to use a frequency pin if that gives me a reliable control system. There is a tradeoff between size and reliability.

For now, and until I gain some confidence in the 2.4 GHz equipment, I'll use the older low-frequency gear in my sailplanes. Most of us have an old sailplane that is used for radio and equipment testing and there is one here in the shop as well. This ship will be the test bed for any further experiments on 2.4 GHz. I'll also watch the Yahoo Group for further information on the problem and talk to the guys at various flying events over the summer.

I've not mentioned the brands of the problem equipment since it's not specific to a single manufacturer. If you ask around, you'll hear war stories of just about every brand that has had trouble at one time or another. Some very smart people are working on the problem so I'm willing to wait and be patient until it's solved. Meantime, I've dusted off the old stuff and gone out to enjoy some stress free flying.

Resources:

The Yahoo user Group for the Ace MicroPro transmitter.
<http://www.yahoo/groups/MP8K>



ELEXIN, *designed by Dave Philpotts for 60" slope racing and aerobatics*

Full size PDF plans (34" x 44") are available from the web site of:
Associação de Planadores Radiocontrolados de Belo Horizonte/MG
<http://www.planabh.com.br/elexin.pdf>

FAI 2012 RC Soaring Proposals

On the following pages are reproductions of the FAI 2012 RC Soaring Proposals. These proposals will be formally voted on at the next CIAM (Commission Internationale d'Aero-Modelisme) meeting, to be held 20-21 April 2012.

The first four pages relate to the general rules for International contests, clarifying the role(s) of the Team Manager and establishibng a Team Manager assistant, defining the type and size of identification required to be affixed to models, and mandatory fire extinguishing equipment at eachoperational flightline.

The last five pages describe rule changes specific to RC soaring.

Changes to F3F (slope racing) include removing the F3B towhook from the nose radius template, elimination of the minimum wing loading, a prohibition of certain electronic devices from the contest field, and sighting of models during flight.

Rules changes for F3J include a prohibition of certain electronic devices from the contest field, the number of allowed helpers, re-flights, and the shortening of towlines from 150m to 100m.

F3K proposals include unintentional jettisoning (current rules give an incorrect reference), the landing window, flight testing time (response to a previous change).

Thanks to Terry Edmonds for making this information available through the USA_FAI_Soaring Yahoo! Group <http://groups.yahoo.com/group/USA_FAI_Soaring/>.

12.2 Volume ABR, Section 4B
(General Rules for International Contests – page 40 (2011 Edition))

b) B.3.6. Team Manager — **F3 Soaring Sub-committee**

Amend the second paragraph as follows:

The team manager may assist the competitors. He is the only person allowed to deal with the Jury or the Organiser in the case of disputes, complaints or protests and must be obligatory for World and Continental Championships. Any member of the officially entered national team may be nominated as team manager.

For Free Flight, Control Line, **<u>RC Soaring,</u>** Scale and Space Model competitions, the team manager may have an assistant, registered with the organiser, who will have the same duties as the team manager except that the assistant will not be allowed to deal with the Jury or the Organiser except to deliver protests.

<u>Reason</u>: In fly-off very often competitors of one team fly simultaneously on distant spots. Then it's difficult for the team manager to serve all of his competitors.

c) B.3.6. Team Manager — **Germany**

Amend the paragraph as follows:

For Free Flight, Control Line, **<u>F3J – RC Thermal Duration, F3K – RC Hand Launch</u>**, Scale and Space Model competitions, the team manager may have an assistant, …

<u>Reason</u>: The F3J- and F3K-rules offer full junior teams of three competitors their own classification alongside of the senior's event. One team manager is not able to care sufficiently for two teams, so informal solutions had been agreed, stressing the rules. Assistant team managers eligible for all classes with full junior teams fulfil the actual demands of international championships and of the Sporting Code.

Agenda Item 12 Sporting Code Proposals — Page 6 — Volume ABR Section 4B

q) B.17 Processing of Model Aircraft <u>for International Competitions</u> **Bureau**

Amend the paragraphs as follows:

B.17.6. **<u>Model aircraft</u>,** except for Indoor Free Flight and Scale, must bear the nationality abbreviation of the International Olympic Committee **<u>followed by the FAI licence number</u>.** The letters or figures must be at least 25 mm high and appear at least once on each model ~~(~~on the upper surface of a wing for Free Flight models). See Annex B.1 for examples and Annex B.2 for the list of nationality abbreviations. (Re-located from 17.10)

B.17.**<u>7</u>**. Each NAC shall process every model aircraft entered for a World or Continental Championships and shall issue for each model aircraft a model aircraft specification certificate, provided by the FAI. A sticker, also provided by the FAI or marking to the pattern of this sticker, shall appear on each model aircraft (except for Indoor and Scale model aircraft). Examples of how to fill out and handle the Model Aircraft Specification Certificate and Sticker are shown at Annexes B.1.a and B.1.b. (Was 17.6)

B.17.**<u>8</u>**. Model aircraft not properly processed by their NAC, with FAI certificates and stickers, must be processed by the organiser at a cost of 8 Euro for each model. (Was 17.7)

B.17.9. Indoor free flight duration models must be processed before each flight to confirm that the model meets the dimensional and weight requirements of the class. Rubber motors are to be weighed before or after the flight to confirm that these are within the specification.

B.17.**<u>10</u>**.Except for Indoor **<u>Free Flight</u>** and Scale, each model ~~s~~hall carry a model identification code (letters and/or numbers). The identification code is to appear on each part of the model aircraft (wing(s), tail, front and rear fuselage if detachable) so that the individual parts of a competitor's different models may be separately identified. The letters and/or numbers must be at least 10 mm high and clearly visible. The identification code of the nominated models will be recorded on the score card **<u>and for World or Continental Championships</u>** this must be recorded on the model specification certificate. (Was 17.8)

~~B.17.10. Except for Indoor and Scale, each model must bear the nationality abbreviation of the International Olympic Committee and for Free Flight models the FAI license number or National Identification Number of the competitor. The letters or figures must be at least 25 mm high and appear at least once on each model (on the upper surface of a wing for Free Flight models). See Annex B.1 for examples and Annex B.2 for the list of nationality abbreviations.~~ (Re-located to 17.6)

<u>Reason</u>: To clarify, harmonise and resolve anomalies throughout the paragraphs.

r) B.17. Processing of Model Aircraft **France**

Modify paragraph B.17.8.

Note: if the proposal is adopted, it will be necessary to do the corresponding changes on the annex B.1.b.

B.1.8. Except for **<u>Free Flight</u>** Indoor and Scale, each model shall carry **<u>FAI model sticker(s)</u>** with **<u>mention of the FAI licence number, national identification mark, competitor name and</u>** ~~a~~ model identification code (letters and/or numbers)~~on the and this must be recorded on the model specification certificate. The identification code is to appear on each part of the model aircraft (wing(s), tail, front and rear fuselage if detachable) so that the individual parts of a competitor's different models may be separately identified. The letters and/or numbers must be at least 10 mm high and clearly visible. The identification code of the nominated models will be recorded on the score card.~~ **<u>The letters and numbers on the FAI model sticker must be at least 10 mm high and clearly visible.</u>**

<u>A FAI model ticker will be put on each part of the model aircraft so that the individual parts (wing(s), tail, front and rear fuselage if detachable) may be separately identified.</u>

<u>The model identification code must be also recorded on the model FAI specification certificate and on the score card of the nominated models.</u>

<u>Reason</u>: Clarification of the way to mark the model with FAI model sticker. Regarding Indoor exception, limitation to Free Flight Indoor classes (and not Radio Controlled).

s) B.17. Processing of Model Aircraft **France**

Modify paragraph B.17.10.

Note: if the proposal is adopted, it will be necessary to do the corresponding changes on the annex B.1.b.

B.17.10. Except for Indoor **<u>Free Flight</u>** and Scale, each model must bear the **<u>national identification mark (</u>**nationality abbreviation of the International Olympic Committee**<u>)</u>** and ~~for Free Flight models~~ the FAI license number or National Identification Number of the competitor. The letters or figures must be at least 25 mm high and appear at least once on each model (on the upper surface of a wing for Free Flight models). See Annex B.1 for examples and Annex B.2 for the list of nationality abbreviations.

<u>Reason</u>: Clarification of the way to mark the model with the national identification mark (nationality abbreviation of the International Olympic Committee) and the FAI license number (or National Identification Number) of the competitor.

Regarding Indoor exception, limitation to Free Flight Indoor classes (and not Radio Controlled).

Reintroduction (except for Indoor Free Flight and Scale) of the mark the FAI license number (or National Identification) Number of the competitor in all classes and not only for Free Flight as actually mentioned.

v) B.19.7. Flying Sites **F3 Aero Sub-committee**

Add a new paragraph four as follows:

At each operational flightline an appropriate fire extinguishing equipment shall be available.

Reason: Modern electric drive systems, such as for model aircraft propulsions or winches, as well as turbines, etc. or flammable substances in use in or near the competing model aircraft and the persons around are subject of fire risk, which may require a sudden and quick action of fire fighting.

Eg at the 2011 World Championship F3A an ESC exploded during the sound test on ground causing the model aircraft to catch fire. If fire extinguishing equipment would have been available on spot, the damage to the model aircraft could have been significantly reduced. Luckily no personal injury resulted from the accident.

12.6 Section 4C Volume F3 - RC Soaring

F3F

a) 5.8.2. Characteristics of Radio Controlled Slope Gliders **Germany**

Insert the relevant template without the gap for the tow-hook

Characteristics of Radio Controlled Slope Gliders

Maximum surface area (St) 150 dm2

Maximum flying mass . ... 5 kg

Loading on St .... between 12 and 75 g/dm2

Minimum radius of fuselage nose………………..7.5 mm in all orientations ~~(see F3B nose definition for measuring technique).~~ **(see template)**

Template for nose radius to be inserted here.

Reason: By adding the relevant template the reference to F3B is no longer necessary.

b) 5.8.2. Characteristics of Radio Controlled Slope Gliders **Germany**

Eliminate the lower limit of the wing-loading

Characteristics of Radio Controlled Slope Gliders

Maximum surface area (St) 150 dm2

Maximum flying mass . ... 5 kg

Loading on St .... ~~between 12 and~~ **≤**75 g/dm^2

Minimum radius of fuselage nose 7.5 mm in all orientations (see F3B nose definition for measuring technique).

Reason: Specifying a minimum wing loading is senseless and irrelevant for F3F model aircraft

c) 5.8.2. Characteristics of Radio Controlled Slope Gliders **Germany**

Add a new final paragraph:

Any transmission of information from the model aircraft to the competitor is prohibited, with the exception of signal strength and voltage of the receiver battery. Any additional/other use of any kind of transmission (sending or receiving data of any kind e.g. height, climb or decline, temperature, wind speed, humidity, etc.) and telecommunication devices (including like transceivers, and telephones, headphones, earphones, etc) in the field by competitors, helpers or team managers is not allowed. If an infringement to this paragraph occurs the flight will be penalized with 1000 points. The penalty of 1000 points will be a deduction from the competitor's final score and shall be listed on the score sheet of the round in which the penalisation was applied.

Reason: With the technological impact of the possibilities of modern transmission not only devices like transceivers, telephones, headphones, etc. shall be banned from the competition airfield. Any kind of data transmission other than the necessary data for piloting the model aircraft should be prohibited. Especially at competitions with any kind of gliders any means of technological support to facilitate detection of thermal activity and the supply of data of the conditions of the surrounding air should be prohibited.

d) 5.8.6. Cancellation of a flight **Germany**

Amend paragraph h) as follows:

h) the model (ie ~~the centre of gravity~~ **any part of the model aircraft)** fails to pass above a horizontal plane, level with the starting area, within five seconds of exiting the course.

Reason: The speed of the models is nowadays very high, that the helpers at the sighting device are not able to decide which part of the model aircraft has crossed the plane, especially not the centre of gravity.

On the other hand, the wording should be equal to the wording when a model aircraft crosses the Bases A and B and safety plane.

e) 5.8.9. The Speed Course **Germany**

Removal of three words and addition of six words in 5.8.9.

The speed course is laid out along the edge of the slope and is marked at both ends with two clearly visible flags. The organiser must ensure that the two turning planes are mutually parallel and perpendicular to the slope. Depending on the circumstances, the two planes are marked respectively Base A and Base B. Base A is the official starting plane. At Base A and Base B, an official announces the passing of the model aircraft (ie ~~the fuselage nose~~ **any part of the model aircraft)** with a sound signal when the model is flying out of the speed course. Furthermore, in the case of a signal announces the first time the model is crossing Base A in the direction of Base B.

Reason: The speed of the models is nowadays very high, that the officials at the sighting device are not able to decide which part of the model aircraft has crossed the plane.

On the other hand, the wording should be equal to the wording when a model aircraft crosses the safety plane and horizontal plane after leaving the speed course.

F3J

f) 5.6.1.3. Characteristics of Radio Controlled Gliders **Germany**

Amend paragraph c) as follows:

Any transmission of information from the model aircraft to the competitor is prohibited, with the exception of signal strength and voltage of the receiver battery. **Any additional/other** use **of any kind of transmission (sending or receiving data of any kind eg height, climb or decline, temperature, wind speed, humidity, etc) or** devices **such as** transceivers, telephones, **headphones, earphones, etc)** in the field by competitors, helpers or team managers is not allowed. **If an infringement of this rule occurs, the flight will be penalized with 1000 points. The penalty of 1000 points will be a deduction from the competitor's final score and shall be listed on the score sheet of the round in which the penalisation was applied.**

Reason: With the technological impact of the possibilities of modern transmission not only devices like transceivers, telephones, headphones, etc. shall be banned from the competition airfield. Any kind of data transmission other than the necessary data for piloting the model aircraft should be prohibited. Especially in thermal duration soaring any means of technological support to facilitate detection of thermal activity and the supply of data of the conditions of the surrounding air should be prohibited to keep emphasize of the competitors 'air reading' skills.

g) 5.6.1.4 Competitors and Helpers **USA**

Amend paragraph b) as follows:

b) Each competitor is allowed three **four** helpers. ~~When a team manager is required, he is also permitted to help the competitor~~. When a team manager is available he is considered one of the four helpers. A maximum of two helpers are permitted for towing during the launch as described in 5.6.8.2. **During the flyoffs any four helpers are permitted.**

Reason: At the 2008 WC there was a discussion that the current rule penalizes smaller teams where the team manager is also a pilot. In that case the TM is only allowed 3 helpers. The rule is also unfair in the flyoffs if more than one team member (or the TM makes the flyoffs) allowing differing numbers of helpers. Some previous WC events have ignored this rule for the flyoffs. The simple solution is to allow 4 helpers at all times. This also clarifies the helper rule for non-WCh contests where there is no team manager "required". This makes the rule consistent for all contests and all team sizes.

h) 5.6.4 Re-Flights **USA**

Amend sub-paragraphs of the fourth paragraph and replace the final paragraph in its entirety:

The new working time is to be granted to the competitor according to the following order of priorities:

1. if the event causing the reflight occurs in the first 30 seconds of the slot, the entire group will be called down and a new prep and working time will be started. No results from the aborted slot will be recorded.

~~1~~ **2**. in an incomplete group, or in a complete group on additional launching/landing spots;

~~2~~ **3**. if this is not achievable, then in a new group of several (minimum 4) re-flyers. **The reflight group can be completed by accumulating pilots requiring reflights from multiple flight groups and flown at a time chosen by the CD**. Other competitors **may be** selected by random draw to the number of 4 **if required**. If the frequency or team membership of the drawn competitor does not fit or the competitor will not fly, the draw is repeated;

~~3~~ **4**. if this is also not achievable, then with his original group at the end of the ongoing round.

~~In priority case 2 and 3, the better of the two results of the original flight and the re-flight will be the official score, except for the competitors who are allocated the new~~

~~attempt. For those the result of the re-flight is the official score. A competitor of this group who was not allocated the new attempt will not be entitled to another working time in case of hindering.~~

Scores for randomly selected pilots will only be used to calculate the group scores for the competitors who are allocated the new attempt. For competitors who are allocated the new attempt the result of the re-flight is the official score. A competitor of this group who was not allocated the new attempt will not be entitled to another working time in case of hindrance.

Reason: The current process for allocating reflight groups has 2 problems – 1) it slows down the contest as every round with a reflight requirement requires a new reflight group. 2) Selecting pilots at random to participate in the reflight and awarding them the better of their 2 scores provides an unfair luck factor – it is the “reflight lottery”. This proposal can speed up the contest as you can group multiple reflight pilots into a single group. This group might be flown at the end of the day or other CD selected time. It would require fewer pilots to be selected at random to participate. It may require more than one group to be flown as a result of frequency or team conflicts, but then would be no worse than the current process. This proposal also eliminates the reflight lottery. Pilots can no longer be saved from a bad flight by being selected in the lottery. Pilots who choose to fly in the reflight group are flying as “spoilers” in order to provide competition for the reflight pilots. This is no different from a current competitor that has a 1000 already and chooses to fly as a spoiler. This proposal attempts to limit the luck factor in reflight selection. Since the majority of reflights result from mishaps at the start of the slot, this proposal provides a fair restart with no advantage for pilots that are randomly selected to participate in the reflight.

i) 5.6.8.7. Towlines b) **Bulgaria**

Amend paragraph b) as follows:

The length of the towline shall not exceed ~~150~~ **100** metres when tested under a tension of 20 N.

Reason; Short lines will make more difficult to reach 10 minutes in no thermal or hi wind conditions. One more step to separate tight results.

F3K

j) 5.7.2.2. Unintentional jettisoning **F3 Soaring Sub-committee**

Amend the paragraph as follows:

If the model glider suffers any unintentional jettisoning during the flight, then the flight shall be scored zero ~~according to 5.3.1.7~~. If, during the landing, any unintentional jettisoning occurs (ref. 5.7.6.) after the first touch of the model glider with ground, any object or person, then the flight is valid..

Reason: Wrong reference. Reference not necessary.

k) 5.7.9.3. Landing window **F3 Soaring Sub-committee**

Delete the last sentence of the first paragraph in article 5.7.9.3 Landing window.

5.7.9.3. Landing Windows

No points are deducted for flying over the maximum flight time or past the end of the working time. Immediately after the end of the working time, or after each attempt for the task “all-up-last-down”, the 30 seconds landing window will begin. Any model gliders still airborne must now land. ~~If a model glider lands later, then that flight will be scored with 0 points.~~

The organiser should announce the last ten seconds of the landing window by counting down.

Reason: The proposed change corrects conflict of penalties. In article 5.7.9.4 there is already stated a penalty for flying outside the testing time, working time or landing window. With the present wording it is not clear whether the 100 points penalty should be also applied.

l) 5.7.9.4. Flight testing time **F3 Soaring Sub-committee**

Amend the fourth paragraph as follows:

5.7.9.4. Flight testing time

After all the model gliders of the previous group have landed, the competitors flying in the next group receive at least 2 minutes of flight testing time, which is part of the preparation time. During this flight testing time the competitors are allowed to perform as many test flights inside the start and landing field as necessary for checking their radio and the neutral setting of their model gliders.

Each competitor has to ensure that he is finished in time with his test flights and is ready to start when the working time of the group begins. The last 5 seconds before the start of the working time have to be announced by the organiser.

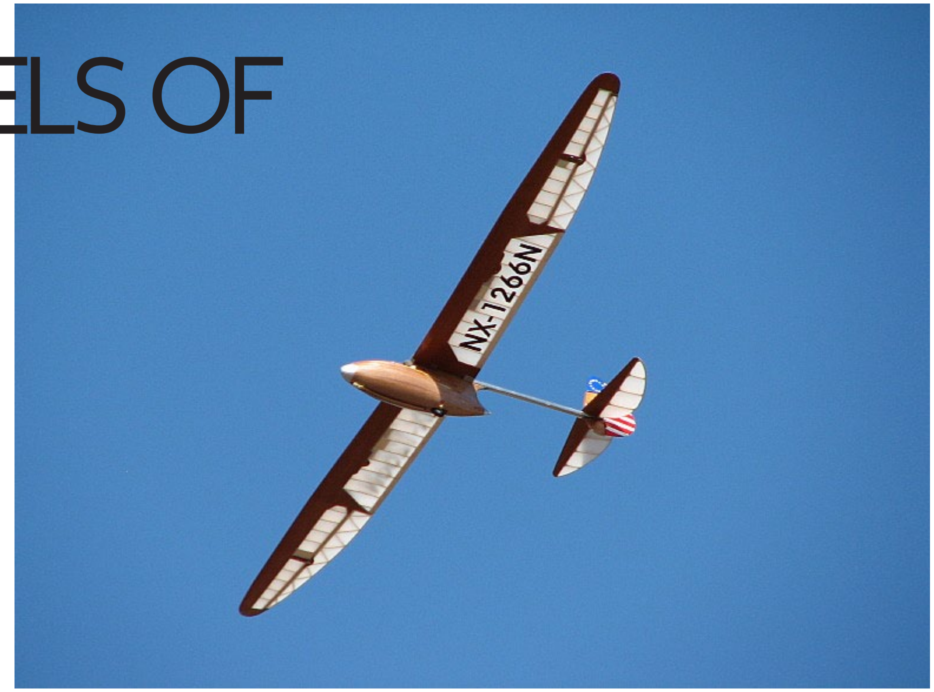
A competitor will receive a penalty of 100 points if he starts or flies his model glider outside of the working **time,** ~~and preparation~~ **flight testing** time **and landing window** of his assigned group.

Competitors may test fly before the transmitter impound and after the last working time of the day.

Reason: Consequent change. In 2008 the flight testing time was introduced. The fourth paragraph of the article 5.7.9.4 didn’t reflect this change.

THE BOWLUS MODELS OF DAVID ALCHIN

David Alchin, ddalchin@comcast.net



The article from Brazil about the 1/2 scale Super Albatross *(RCSD* Feb/Mar 2012) absolutely fascinating for this scale nut and admirer of Hawley Bowlus sailplanes. The attached pictures show my 1/4 scale Baby Albatross flying above the lake at Los Banos Creek Reservoir in 2007. The next photo shows my 1/3 scale Super Albatross landing at Visalia on maiden flight 2009.

John Raley translated the Super Albatross plans I received from Earl into 1/3 scale drawings. The fuselage mold came from a turned piece of blue foam. Wing spars consist of five laminations of 1/8" x 5/8" x 6' spruce, reducing down to one at the tip.

My Albatross is identical to the one in the San Martin museum, previously owned by Earl Menifee, and sports full working cockpit controls in conjunction with surface movement.

RC Soaring Digest readers are welcome to have copies of the drawings from me. Contact me through the email address noted above for information.

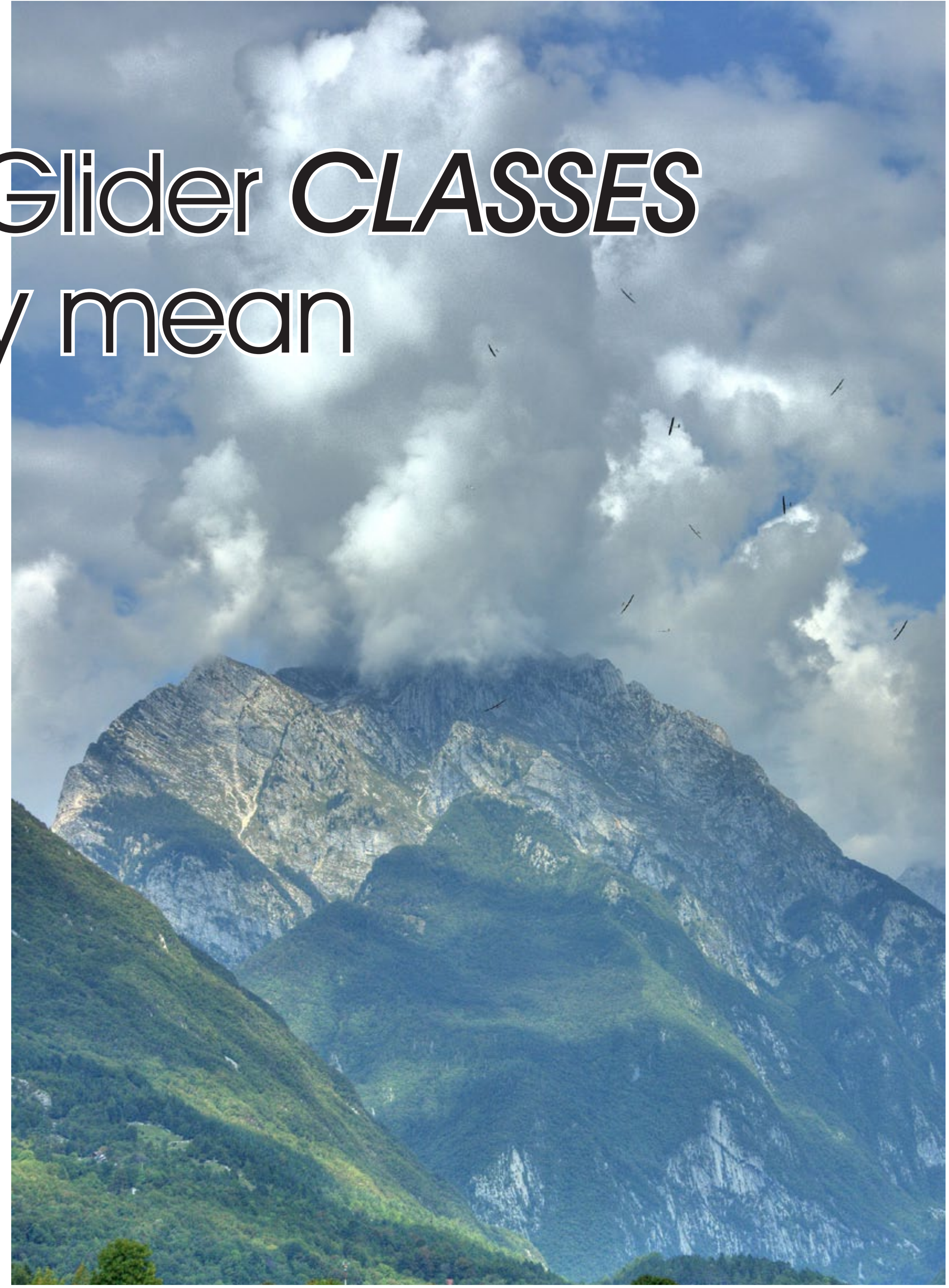
Glider *TYPES*, Glider *CLASSES* and what they mean

Ed Anderson, aeajr@optonline.net

Like most of what I write, this is for the new guys who are little confused about some of the terms we glider guiders use. I am not going to try and tackle the whole special language of gliders. Instead I am just going to focus in on some of the terms used around thermal duration gliders and contests.

If you are an experienced glider pilot, have been flying contests for years and know all there is to know, stop now and go to the next article. Otherwise, read on, you might pick up a tidbit or two of useful information. Or you might find this would be helpful to the new guy in your club who is just getting started.

Context – how we use terms can vary based on context. Are we talking about a style of flying, aircraft design or contest formats? It matters.



Eleven sailplanes climbing in a thermal during the fly-off rounds of the 2009 Alpine Cup F3J Eurotour competition in Bovec, Slovenia. Photo by Francesco Meschia

Using radios as an illustration, my 9-channel radio is using six channels to control my Supra and is transmitting in channel 40. Here I am using the word "channel" in two completely different contexts in the same sentence. You are being told about the radio's ability to control the surfaces when I say it is a 9-channel radio. (Context – aircraft controls). If it is on 72 MHz and I speak of channel 40 I am talking about the transmission frequency. (Context - frequency control).

Style of Flying

TD, thermal duration soaring is a style of flying based on using warm rising air to keep the ship aloft while the aircraft is gliding, producing no thrust of its own. Slope soaring is a different kind of glider flying using wind hitting a hill to keep the plane aloft while the glider is producing no thrust of its own.

Power flying is a style of flying that uses a motor/engine to spin a prop, a rotor or some other means of producing thrust to keep the aircraft aloft. Power planes can glide and gliders can have motors but it is the intent of the design and the optimization of that design that distinguishes power planes from gliders and TD gliders from slope gliders.

TD, thermal duration gliders are designed for TD style flying. They do not use an engine or motor to sustain flight. The Supra, the AVA, the Radian, the Blaster DLG are all thermal duration type ships. They are designed to ride thermals. You could also fly them on the slope but that is not their primary design. They can have motors for launch purposes but they are not intended to have the motor on all the time so they are not power planes.

From this point on I am going to focus on thermal duration gliders and thermal duration contest formats.

Contests –Terms and Formats

Thermal Duration contests have a thermal duration task as the major part of the pilot's score. The pilot's task is to keep the glider in the air for a stated period of time using his launch height to hunt for thermals to sustain the glider aloft. All of the contests described below are variations on thermal duration soaring contests. But only one is typically called TD. This is as much for historical reasons as anything else.

Thermal Duration — In the US, in general use, a TD contest is a winch or hi-start launched contest and TD gliders are gliders designed for that kind of launch. It is unfortunate that we are not more precise in our terms but that is the common usage. A Supra, a Bird of Time, a Gentle Lady or an Easy Glider (no motor) would be considered examples of TD gliders in this context.

Hand Launched — This includes all TD gliders that are launched by hand throw and have a wing span of less than 1.5 meters, about 60 inches. Typical hand launch methods are javelin throw, SAL or side arm launch, and discus launch. SAL is really a subset of DLG in that it is done the same way but SAL is typically a half circle as opposed to the full spin of DLG. SAL gliders typically don't have wing pegs and DLGs do. I have never seen wing controls or wing span sub classes used in hand launched contests though I suppose you could. However they are often used in other TD formats.

Wing Span Classes

Why have wing span classes? Simply put, the larger wing span gliders can be flown higher and farther in the pursuit of thermals. This can give an edge to larger gliders over the smaller wing span gliders. In addition many pilots feel larger wing span gliders fly better. So grouping gliders by wing span is intended to more evenly match the gliders.

Not all contests have wing span classes, but if they do, they will likely use these classifications. Note that wing span, in this context, is the projected wing span that would be measured by a string pulled tight from tip to tip, not the linear length as measured along the surface of the wing. This may also be called the projected wing span.

Bruce Kimbel with an early Encore DLG. Bruce airbrushed water-based acrylic paint on the foam core before bagging to get the color trim. Photo by Phil Pearson

The wing span classes define the top wing span permitted in that class. Later I will also talk about sub classes so watch the context of where I use them.

2 Meter – Gliders with a wing span of up to 2 meters (about 78 3/4”) can be flown in this class. An Easy glider has a 71” wing span but for contest classification it would qualify to fly in 2M class.

Standard – Gliders with wing spans of up to 2.5 meters (100 inches) are Standard Class. Note that Standard Class is not used much today, but was popular in the past. If you have an Easy Glider, a 2M Gentle Lady or a Spirit 100 you could fly them all in standard class, but the 2.5 meter Spirit 100 glider could not fly in 2M class.

Unlimited - Over 2.5 M is called Unlimited Class. Anything can be flown in Unlimited winch/HS launched TD contests. Easy Gliders, Supras, Radians with the props removed, even a DLG glider that can be winched can be flown in Unlimited. Notice I have said nothing about wing controls so far.

Wing Controls

Why have wing control classes?
Again, it is felt that some wing control combinations may offer an advantage over other combinations. As such it is possible to have contests divided by wing controls to more evenly match the gliders. This will not always be the

case, but if it is done it may be good to understand the various classifications of wing controls.

Full House – These are gliders that have rudder, elevator, ailerons and flaps, REAF. This is typically not a class but the term is so common I felt it should be defined. Some people may imply full house gliders when they say unlimited as most of the gliders at the typical unlimited contest will likely be full house.

Aileron Gliders - Ailerons but no flaps or spoilers. Again, this is not typically a distinct class. This is common configuration in DLGs and slope gliders, but not as common in winch launched TD gliders.

RES – RES is a very popular contest class. Here you can have rudder and elevator controls or you can have R/E and spoilers. Flaps and/or ailerons are not permitted in RES class contests. The AVA, Bird of Time and Gentle Lady are all RES gliders.

Classes and Sub-Classes – Mixing and Matching

Now we mix it up. We can have different combinations of wing span and controls to further subdivide the pilots at a contest or to attract pilots of a particular type of glider.

You could have a RES TD contest and within RES you can have 2M, standard and/or unlimited as sub-classes. The various wing spans may fly separately or they can all be flown together but scores tracked by class, depending on how you are doing the scoring.

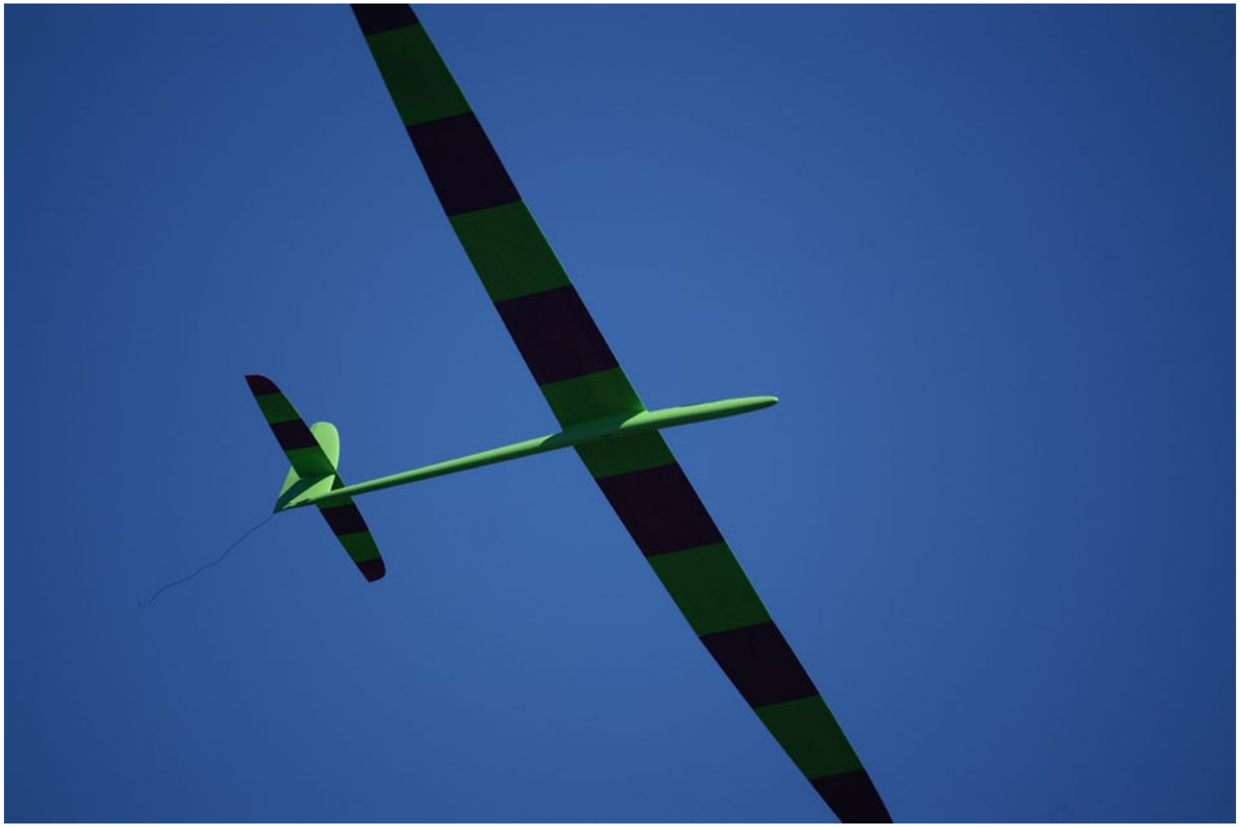
As another example, you could fly an unlimited TD contest, in which all glider types and sizes are permitted, but have RES as a sub class. RES might fly separately or it may fly with the full house planes but the score could be tracked separately.

Many TD contests are simply designated as Unlimited. That means you can fly any wing span and any controls you like. Everyone is welcome!

Mark Nankivil's Soprano RES — rudder, elevator, and a single spoiler (the black rectangle just behind the carbon/Kevlar wing leading edge D-tube). Photo by Mark Nankivil

Electric Launched TD Soaring

Electric TD contests differ from TD contests in that a motor replaces the



Jim Laurel's Pike Perfect, an Unlimited Class 'ship, soars over 60 Acres South, Redmond WA. Photo by Bill Kuhlman

winch, hi-start or hand launch as the means to get the glider to altitude so thermal hunting can begin. You can also have wing span and wing control sub groups in any of these electric formats.

LMR – limited motor run – Everyone gets the same motor run time, then you power off with no restart permitted. At the end of the motor run, the pilot begins the thermal duration task.

Within LMR you can have classes based on the motor size. Examples would be Speed 400, 35 mm, etc. Or you can have classes by battery pack size such as seven NiCd or NiMh cells. In all LMR formats launch heights can vary by quite a bit.

ALES, altitude limited electric soaring – This is a fairly new contest format. In this electric launched contest format a device is placed between the motor and speed control that cuts the motor at a preset time limit and/or a preset altitude limit. Once the motor is turned off it cannot be restarted.

The main difference between ALES and LMR is that in ALES all pilots will launch to the same height, and then the thermal soaring task begins. Again you can have wing span sub categories or control surface sub categories or you can fly unlimited which means all controls and all wing spans are permitted and fly together.

Other classes you may hear mentioned

Nostalgia class – This is for gliders designed, published or released prior to 1/1/1980, as defined in the AMA Nostalgia contest rules.

Woody – This is not an AMA class but some clubs run contests for wood wing gliders in order to promote the building of wood gliders. The Bird of Time would be an Unlimited TD RES woodie, for example. That one glider fits 3 categories. The Woodcrafters events, sponsored by Skybench models is probably one of the best known major woody events

Andy Page's Astro Jeff, a beautiful representative of the Woody Class. Photo taken during one of the SASS Wood Wings contests. Photo by Bill Kuhlman

Builder of the Model – This is a format that requires the pilot to build the aircraft from plans or a kit. ARFs and RTFs are not allowed. There may also be a requirement that the model be made of wood. So you could have a Builder of the model, 2M, RES contest for example and only kit or plan built 2M RES gliders could be flown.

One Design – In this format everyone is flying the same model of glider. The goal here is to minimize the difference between the gliders in order to make the skill of the pilot the real winning factor. Typically One Design contests are flown with lower cost models so that the greatest number of people can join it. Our club had a Bird of Time One Design contest last year that was based on a club build project where many of our members built Bird of Time kits. The Radian, Easy Glider, Vista and Gentle Lady are often used for one design events.

Foamy – This is not a real competition class in any AMA rule book. However, some clubs use it to separate the foam gliders from other gliders. This is based on the assumption that only the newest, greenest pilots are flying foam gliders or that foam gliders are disadvantaged compared to other constructions. I bring this up because I have seen this cause confusion among new pilots who believe this is an actual, nationally recognized competition class. It isn't. However, clubs can do whatever they like when putting on contests. Whatever encourages participation and enjoyment of the club members is just fine.

Summary

The goal of this discussion was to clarify some of the terms you hear during club meetings, may read in magazines or hear at the field. Sometime the terms being tossed around can be confusing if you don't know the context of the discussion. Hopefully this article helps to put some of those terms in a context that will help you understand what is being discussed.

Clear Skies and Safe Flying