Radio Controlled Soaring Digest

March 2014

Vol. 31, No. 3

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Front cover: Apis on tow at Livno. A tour of the Livno RC soaring site and a collection of photos captured at the site begins on page 4 of this issue. Photo by Andrej Novak.
Nikon D90, ISO 500, 1/4000 sec., f5.6, 150mm

Back cover: Roland Stuck's 5 meter ASW15 diving before starting some aerobatic maneuvers at Corps, France).
Photo by Pierre Rondel </www.planet-soaring.com/>
Canon EOS 650D, ISO 125, 1/2000 sec., f5.6, 300 mm

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In the Air

Welcome to the March 2014 issue of *RC Soaring Digest*! This month there are articles covering a wide range of interests, so we're sure you'll find something appealing.

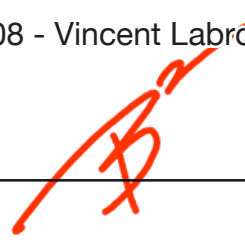
In other news... FAI has recently ratified the following Class F (Model Aircraft) World records:

Claim number: 16929
Sub-class:F5 Open (Radio Control Flight) Category: Aeroplane
Group: Electrical Motor Solar Cells
Type of record: Distance to goal and return: 188
Course/location: Kara-Goz (Russia)
Performance: 1000 m
Pilot: Valery Myakinin (Russia)
Members: Alexander Vasilyuk (Russia)
Date:09.09.2013
Previous record: no record set yet

and:

Claim number: 16889
Sub-class:F5 Open (Radio Control Flight) Category: Aeroplane
Group: Electrical Motor Rechargeable Sources
Type of record: Duration: 171
Course/location: Norris Field Liberty, Indiana (USA)
Performance: 18h 6min 13sec
Pilot: Andre Mellin (USA)
Members: Dave Brown (USA); Joe Mekina (USA)
Date:05.08.2013
Previous record: 12h 36min 46sec (30.07.2008 - Vincent Labrouve, France)

Time to build another sailplane!



Livno
soaring paradise

Author: Uros Sostaric
English translation: Gorazd Pisanec
Photos: Klemen Korosec, Andrej Novak, Uros Murkovic, Uros Sostaric

It's been four years since my friends and I were talking about where to go for a soaring vacation. I then remembered about Livno (Bosnia and Herzegovina, BiH) and the famous Livno flying field. When I was a young modeller I was listening to stories about the great Livno flying field and excellent soaring conditions told by my older friends. The dream to fly there was growing in me for years.

Because the first aero tow camp in Livno four years ago was a great success we are now organizing the fifth trip to Livno this year. This year's aero tow camp, organized by Alpine hobby club, will be held between the 7th and 14th of June.

Livno flying field has been well known for its superb soaring conditions for over 50 years. Summer flying camps for exploring thermal soaring as well as wave soaring were organized in the sixties and then slowly died until 1984 when the Aero Club Livno was born.

Aero Club Livno celebrates its 30th anniversary this year. Aero Club organized several national competitions (1984) for free flight models in ex-Yugoslavia. They also organized European and world championships (1985) for free flight models (F1A, F1B and F1C). The world championship was remembered for excellent weather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Apis fly-by

conditions and organization among competitors. Flying activities were put on hold when the civil war started in ex-Yugoslavia at the beginning of 1990s. Luckily, Livno survived without any damage.

At the end of the 1990s the aero club was revived again. On the place where summer camps were held they built a new hangar and started working on airport infrastructure. They built a completely new and bigger hangar (30 x 15) with the help of European funds last year. They offered more space in the first hangar to us modellers. They plan to build paved runway along existing grass runway, headquarters and a camp site in the next two years. This will improve the quality of accommodation.

Why does Livno have such great weather conditions? Livno field generates excellent thermals called “the Livno thermals” in spring and summer. The climate is mountain-mediterranean and makes great weather conditions.

The weather in summers is very stable because the Adriatic Sea is only 50 km away. Livno field lies 750 m above sea


foto: Klemen Korošec


Andrej Novak

level and is 50 km long and 15 km wide. This is a typical kasrt terrain surrounded by mountains which are from 1500 to 2000 m high. All of these make the so called Livno boiler in which the air heats up and generates excellent soaring conditions.

Late springs and early summers are well known for their cumulonimbus clouds. Summers have very stable weather and strong thermals which last till evening. With the south west wind blowing, model pilots can take advantage of wave soaring. Evening thermals are special and they appear when the surrounding mountains start cooling down. The Livno field starts to emit the heat that was collected during the day. It only gets better if the sky is covered with decaying clouds.

Late spring and early summer are the best times for thermal soaring which is why aero tow enthusiasts like myself go to Livno at the beginning of June. Usually we take at least two tow planes in sizes 1/3 to ¼ (Piper Super Cub, Bellanca Decathlon, Hektor, Pilatus Turbo Porter) and 15 gliders in sizes 1/3 to 1/2,5 (DG 1000S, Ventus 2c, Ventus 2ax, Arcus, Discus 2b, ASK 13, Ka6, Pilatus B4, Salto, Apis, MDM-1 Fox, Cirus). Of course we shouldn't forget about the additional equipment which usually takes more space than the model planes.

The locals give us a warm welcome and ensure us excellent conditions for aero tow. They offer us two hangars for model storage, work shop, bedroom with 10 beds,


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two separate rooms, kitchen with dining room, bar with pool table and a bathroom. Camping area for tents and motor homes is available near the hangars. Price per person is only 7€ ($10) for accommodation. Food is very good and typically Balkan and we look forward to it every year. That is why Livno has become our favourite soaring destination since it offers great hospitality of the locals, excellent soaring conditions, infrastructure and Balkan food.

The airport itself is very nicely organized, maintained and on a perfect location. It is in the middle of the field with no obstacles. Tranquility and freedom are guaranteed.

We use one of the runways close to the hangar. There is very little air traffic. Only sailplanes fly there therefore air space is free and there are no obstacles for R/C model planes. One can fly there throughout the day starting early in the morning till evening. In the mornings there are light thermals and most suitable planes are F3K or F5J gliders which are fun to fly catching first weak thermals. If the weather is stable, there are no strong winds that could break the strong thermals. That is why soaring at low altitudes and then gaining heights over 1000 m are very common.

Because the airfield is very spacious and without obstacles you can afford soaring with bigger models at low altitudes anywhere and you don't have to worry about landing.

Thermals are strong with lift ranging from 4 to 5 m/s and can even reach 7 m/s which literary shoots the model in the sky. Sometimes storms with hail can happen due to strong convection in the middle of the day. Convection clouds disappear in the afternoon and if there is sun light thermals appear again in calm atmosphere. Evening thermals are also very delightful when the sun goes down. Thermals begin to work above 400 m and can go

Behind the Cirus HS-62 we can see Dinara mountains

to 1000 m. This is a great soaring experience in very calm atmosphere with the model at certain height shining from the setting sun.

In spring and early summer cumulonimbus clouds often appear and offer exceptional soaring experience and a few moments later seeking shelter in hangar.

The town Livno is 10 km away from the airport and is the center of this region. It is an old town on the edge of the field situated by the river Bistrica. It offers everything you need for a pleasant stay, from entertainment to good Balkan food. There are two hotels in town and also several private accommodations. Prices are around 15€ ($20). You can take a family trip and visit the Makarska Riviera on the Croatian coast which is about an hour of drive time away. Road connections are very good. Main highway Zagreb – Split is only 50 km away.

On this year's expedition we also plan to visit Kupres and its surrounding slope sites. Kupres is about 40 km north-east from Livno and is 1120 to 1150 m above sea level. Its grassy slope sites offer amazing opportunities for slope soaring. More to come when we return.

More info about airfield and Aero Club Livno can be found at this address: <http://www.aeroklub.livno.org>

You can read more about our expeditions at: <http://www.aerozaprega.si> and ask me questions at: info@aerozaprega.si.

Linkage 101

Chuck Anderson, chucka12@outlook.com

I sometimes think that the modern computerized transmitter has been a mixed blessing. All too many modelers install the servos in a model and hook them to the controls without any consideration of proper linkage installation and then depend on transmitter programming to give the desired control response. A much better method is to design the linkage to give the correct control deflections and then use the transmitter program to fine tune the controls. This article discusses the fundamentals of linkage design.

A typical linkage to connect a servo to a control surface uses a pushrod to convert the rotary output of the servo to the desired angular deflection of the control surface. The linkage arrangement should use the maximum amount of servo arm rotation to give the desired angular deflection of the control surface in order to minimize the effects of slop in the servo gears. Mixers must be considered when defining the limits of servo travel.

Control surface deflection is then controlled by the lengths of the servo arm and control horn. The longest possible servo arms and control surface horns that can be fitted inside the model should be used to minimize the slop produced by wear in the connection to the pushrod. Z-bends for pushrod connections should be avoided because oversized holes in the horns and servo arms are required in order to insert the Z-bend. Clevises or 90-degree bends in the pushrods used with a keeper are much better solutions.

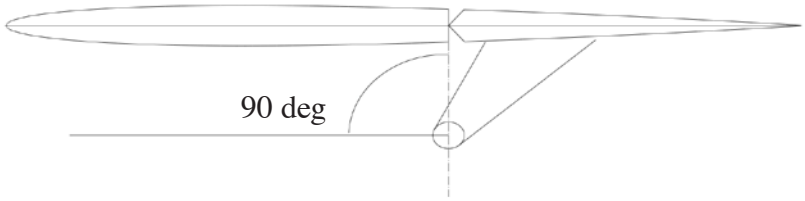


Figure 1

Let's begin by looking at a typical rudder or elevator installation. The pushrod must be connected to the control horn and servo arm at a 90 degree angle from a line between the hinge line and the pushrod attachment point to avoid unequal movement either side of neutral. In the "good old days," we adjusted the angle between the pushrod and aileron horns or control horns to provide aileron differential but that isn't necessary with modern computer radios.

Figure 1

It is easy to install the control horn when the pushrod is parallel to the surface. If the pushrod is not parallel to the control surface, then the location of the pushrod connection to the control horn must be determined. The location of the pushrod connection can be found by drawing a circle around the hinge

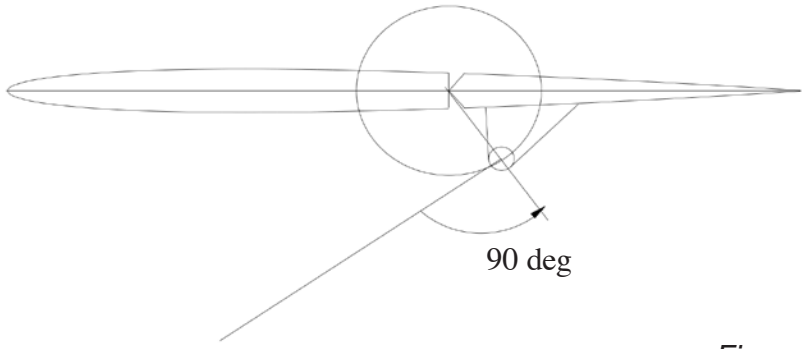
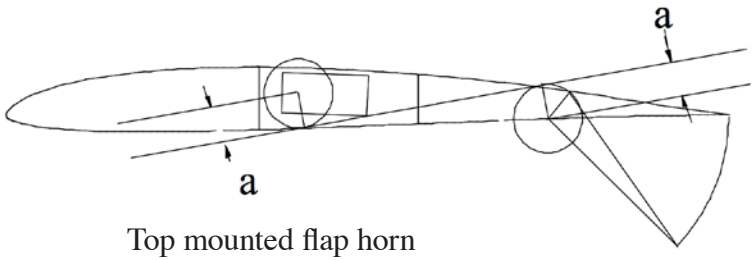


Figure 2



Top mounted flap horn

Figure 3

line with radius equal to the distance from the hinge to the pushrod connection. Then draw another circle around the servo shaft equal to the length of the servo arm and draw a line tangent to the circles. Where the line touches the circles is the correct locations of the pushrod connections to the servo arm and control horn.

Figure 2

Rudder and elevator servos are normally far enough from their servos that the angle between the pushrod and horns/arms are close enough to 90 degrees that no special effort is normally required to get a good installation. Wing servos often require a little more work. The following examples illustrate the use of circles to locate the servo arms and control horns for flaps and ailerons.

It is difficult to get full flap throw when the flap horn is on the top of the flap. This is the method I use. Flaps with bottom horns are much easier but I still use the circles to locate the pushrod connections.

Figure 3

Begin by drawing a circle with radius equal to the control horn length centered on the flap hinge line. Then draw another circle of the same radius around the center of the servo horn. Set the servo at mid travel and deflect the flap to 45 degrees. A line tangent to the two circles will locate the points to connect the pushrod. A slot may have to be cut in the leading edge of the flap so that the pushrod will clear the flap when the flap horn is located on top. The servo arm should be shifted as necessary to provide a pushrod attachment as close as possible to the desired location. The flap horn is then attached to the flap where required to place the pushrod attachment point at the correct location. It may be necessary to fabricate a special flap horn to get the pushrod connection at the desired location.

This method will give 90 degrees of travel if the hinge allows the flap to move 90 degrees and if there is no binding in the servo arm or pushrod. Final adjustment can then be made using the transmitter's programming capabilities.

Aileron linkage is similar to flap linkage except that both up and down deflections are required and the deflections are smaller. The aileron linkage becomes more complicated if ailerons

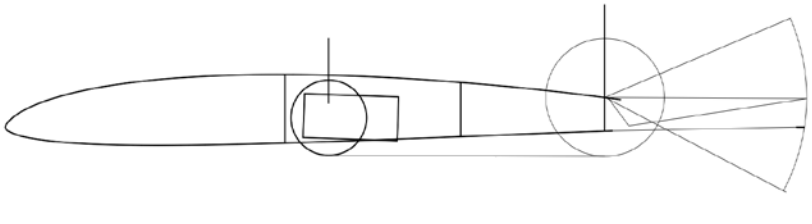


Figure 4

are drooped to provide additional lift or are raised to provide additional drag in crow mode. The circles are still used to define the pushrod attachment points, however different size circles will be required to reduce the angular deflections from the 90 degree total rotation of the servo to the deflection desired for the aileron.

Figure 4

Do I really draw all those circles when installing the servos in my model? Of course not! The circles were for illustrations but I do go through these steps without doing the drawing for most of my installations. I go through the complete routine including drawing the circles for installations that require unusual pushrod and servo positions. The last time I did a full layout was the first time I installed flaps with the horn on the top surface of the flaps. I had heard other modelers complain of the difficulty getting full flap deflection with this setup so I drew the airfoil with servos and circles with a CAD program. The illustration showing flaps with top mounted horns was the result. When I decided to write this article, the first thing I did was to search my computer files to find that drawing.

Most of the time, I install the servo, deflect the control surface to the mid point of travel, and install the servo arm on the servo in a position that gives the angle between the arm and the pushrod as close to 90 degrees as possible. The control horn is installed to give a 90 degree angle between the pushrod and the line from the pushrod to the hinge. This sometimes requires fabrication of a special horn but I can usually manage to install a standard control horn to give the desired 90 degrees between the pushrod and the line to the hinge. Final adjustments are then programmed into the transmitter.

Calculating Servo Arm And Control Horn Lengths

It may be necessary to calculate the lengths of the servo arms and control horns in order to lay out the linkage. The calculations can be made using any calculator that has sine and cosine functions. If the distance from the center of the servo shaft to the pushrod connection is R, we can calculate the length of the control surface horn (L) to give the desired control surface deflection angle.

I will illustrate the steps necessary to calculate the length of the elevator horn to give an elevator deflection angle of plus or minus 20 degrees for a servo arm length of 0.5 inches. I prefer to limit servo rotation of 45 degrees either way from neutral to reduce the non-linearity of the control response. In the figure, R is the length of the servo arm and X is the distance the end of the pushrod moves. The other end of the pushrod moves the same distance so we need to calculate the length of the elevator horn (L) to give the desired elevator deflection angle of 20 degrees.

First, we need to calculate the distance X for 45 degrees of servo rotation. This is simply the length of the servo arm multiplied by the sine of 45 degrees. Enter 0.5 on your calculator, press the multiply key, enter 45, press the SIN key, press the equals key, and the distance the pushrod moves is displayed in the calculator screen. In this case, the value displayed is 0.3535 plus some more digits.

Figure 5

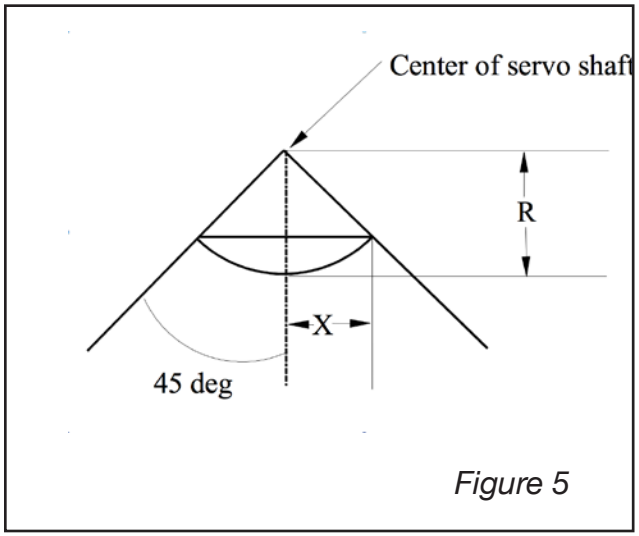


Figure 5

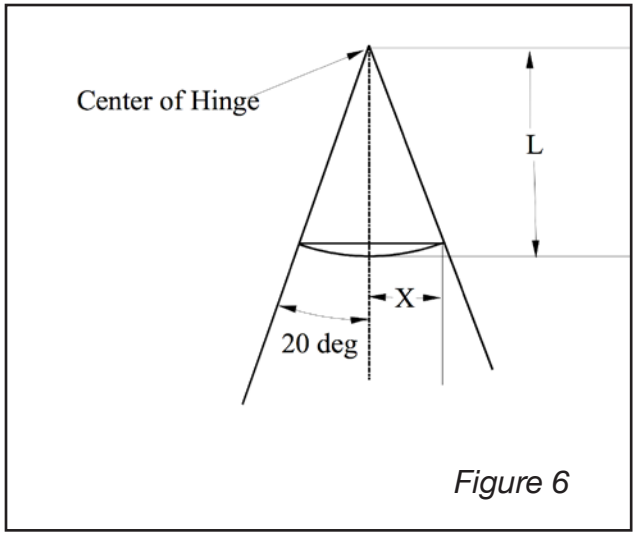


Figure 6

Now we need to calculate the length of the control horn that will give am elevator deflection angle of 20 degrees. This is simply the distance the pushrod moves divided by the sine of the elevator deflection angle. With the value of the pushrod movement still displayed on the calculator screen, press the divide key, enter the elevator deflection angle (20), press the SIN key, press the equals key, and the calculator screen reads 1.0337. This is the length of the elevator horn required to give an elevator deflection of 20 degrees for a servo rotation of 45 degrees. Easy wasn't it, and you don't even have to be a math whiz.

Figure 6

In equation form, this is:

L=Rsin45/sin20

By simply rearranging the equation, we can calculate the length of the servo arm necessary to provide the desired surface deflection using a specified control horn length.

R=Lsin20/sin45

For older modelers who have forgotten their high school math and more recent high school graduates, these are the steps necessary to calculate the servo arm length required to give a 20 degree control deflection using a one inch long control horn. Enter the length of the control horn (L), press the multiply key, enter the control surface angle (20), press the SIN key, press the divide key, enter the servo angle (45), press the SIN key, press the equals key, and read the servo arm length (0.4836). The servo arm closest to this value is 0.5 which is what we started with.

Some people prefer to specify control surface deflection by the distance the trailing edge moves at full throw. The control horn length required to move a specified distance with 45 degrees of servo rotation can be calculated with a few more steps. If C is the distance from the hinge line to the trailing edge of the surface and H is the distance the trailing edge moves from neutral to full deflection, then the sine of angle the surface moves is simply the distance the trailing edge moves divided by the distance from the hinge line to the trailing edge. (This is getting a little deep, but just bear with me.) Substituting H/C for the sine in the equation for calculating the stab control horn length gives:

L=Rsin45/(H/C)

which is the same as

L=RCsin45/H

If the distance from the hinge line to the trailing edge is 1.25 inches and the trailing edge moves up .2 inches from neutral, then calculating the control horn length with a calculator is easy.

Enter the distance from the servo shaft to the pushrod (R), press the multiply key, enter the distance from the hinge line to the trailing edge (C), press the multiply key, enter 45, press the SIN key, press the divide key, enter the distance the trailing edge moves (H), press the equals key, and the horn length (2.21) is displayed.

These are the basic steps necessary to set up the controls for sport, sailplane, simple scale models, and pattern models. Complex scale and 3D models are more complicated but the same basic steps apply.

Summary: The steps necessary to calculate control horn length using a calculator with sine and cosine functions are:

Calculating Control Horn Length Using Control Deflection Angle

1. Enter servo arm length
2. Press the MULTIPLY key
3. Enter servo arm rotation angle
4. Press the SIN key
5. Press the EQUALS key
6. Press the DIVIDE key
7. Enter the control surface deflection angle
8. Press the SIN key and read the control surface horn length

Calculating Control Horn Length Using Trailing Edge Travel

1. Enter servo arm length
2. Press the MULTIPLY key
3. Enter the distance from the hinge line to the trailing edge
4. Press the MULTIPLY key
5. Enter the servo rotation angle
6. Press the SIN key
7. Press the DIVIDE key
8. Enter the distance the surface trailing edge moves
9. Press the EQUALS key and read the control horn length.

RCSD

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Tom's Tips

Long Reach (Deep Throat) Clamps

Tom Broeski, T&G Innovations LLC, tom@adesigner.com

It started when I needed to glue a trailing edge spar and wanted full access to the inside of the flap space. There have been many times I have had need of a deeper clamp then I had access to. So I came up with this very simple, easy to make clamp. A bit more versatile than the standard wood or fiddle clamp.

The size can vary depending on how you want to use the clamp. I made 12" clamps because that was the material length I already had left over from making a bunch of wooden puzzles and it would suit my purpose.

Material list:

(2) each 3/4" x 3/4" wood what ever length you prefer.

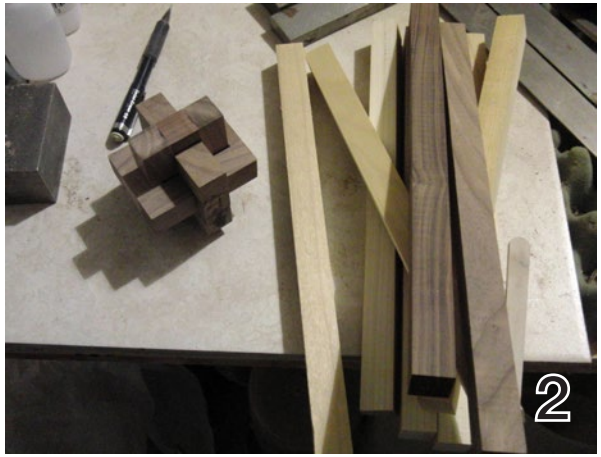
(2) blocks 3/4" x 3/4" x 1 1/2" (optional)

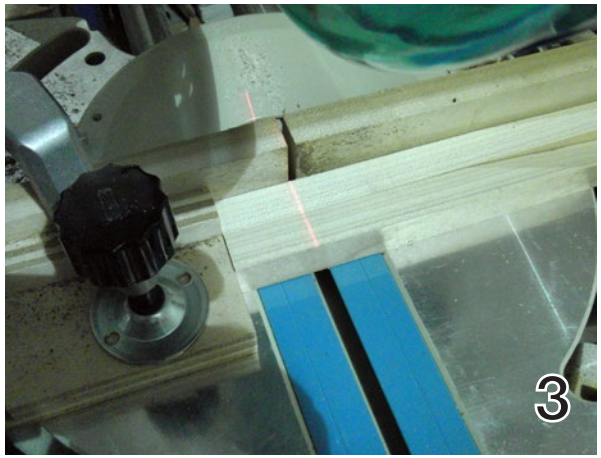
(1) 1/4 - 20 hex head machine screw fully threaded (4" to 6" or longer)

(1) 1/4 - 20 carriage bolt fully threaded (4" to 6" or longer)

(1) 1/4 - 20 wing nut or knob

(1) washer





First cut the stock to length and cut jaw blocks. See Photos 2 and 3.

Mark center bolt holes. The rule of thumb would be 1/3 of the stock length for leverage. See Photo 4.

I made one 1/4 of the length and it worked fine also. See Photo 5.

I easily got over 20 lbs of pressure from both. See Photo 6.

Drill 9/32" hole through the base piece as shown. See Photos 7 and 8.

I made multiple clamps to experiment with, so you can ignore them if you only want one.

Mark for slot. 3/4" to 1" wide. This helps keep the screw from jamming when at different angles during clamping. See Photo 9.

Drill 5/16" hole at each end of slot. See Photo 10.

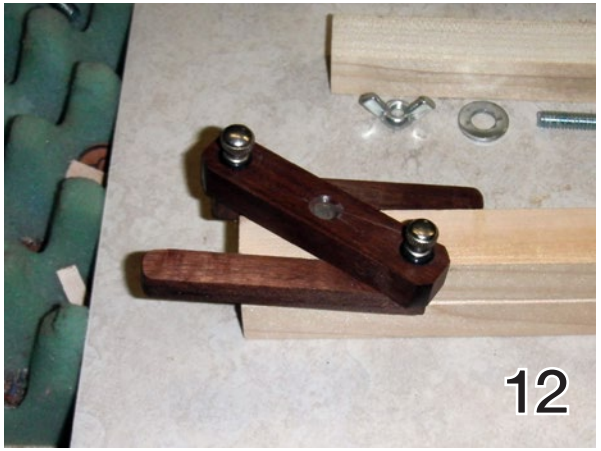
Drill out the stuff in between. It is cleaner if you use a knife and score down the sides between the holes. See Photo 11.

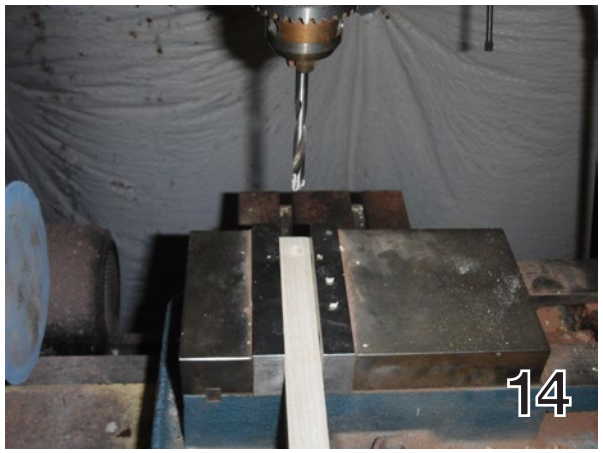
Mark for end holes. By the way, I used the center finder (from a previous tip) a lot. See Photo 12.

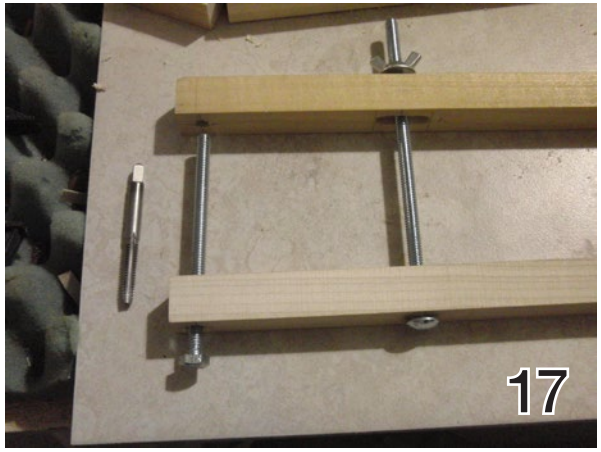
Stack the two pieces and drill a 7/32" hole through top piece and deep enough to mark bottom piece. See Photo 13.

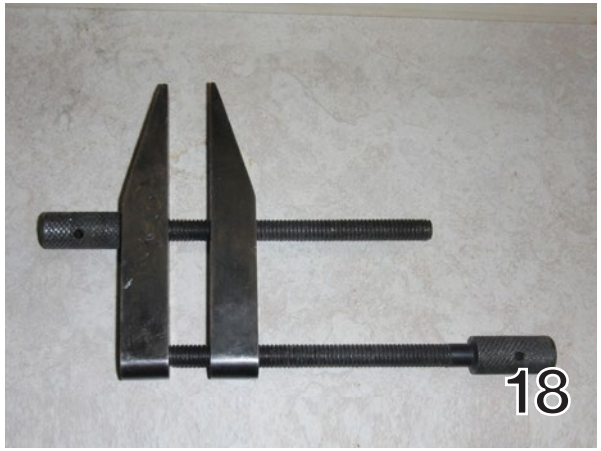
Remove top piece and drill bottom piece half way through with 9/32" bit. See Photo 14.

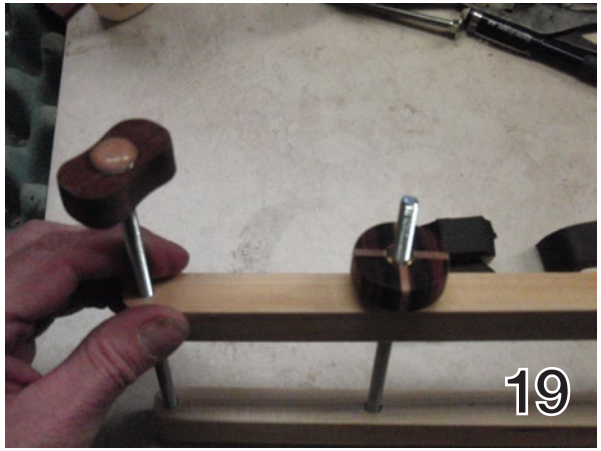
Thread the top piece with 1/4 - 20 tap. You can use the bolts if you don't have a tap. See Photo 15.

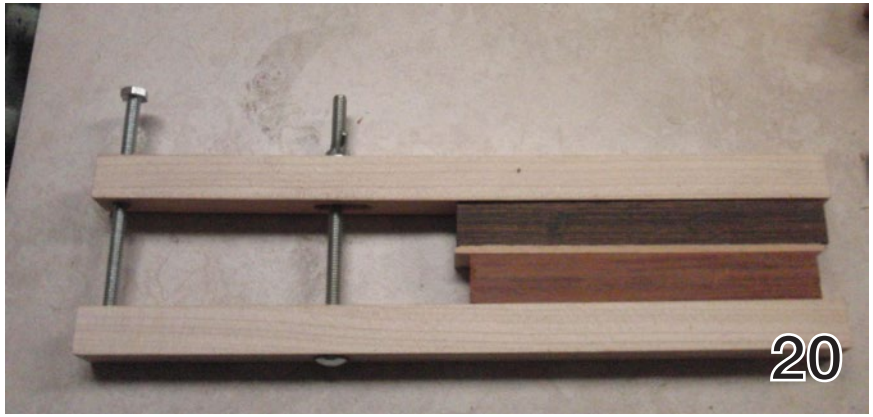












Harden the wood threads with CA. If you only have soft wood, you can use 1/4 -20 threaded inserts, but I did not find it necessary with the wood I had. See Photo 16.

Assemble the clamp. Threading in the hex bolt, sliding in the carriage bolt, adding the washer and wing nut. See Photo 17.

The total time to make the first clamp was about a half hour. The first one I threaded the base hole putting the knobs on opposite sides. This was similar to a machinist clamp I made 25 or so years ago. All the rest, I put the threads on the slotted bar, so the knobs were on the same side. See Photo 18.

You can go crazy with all the options as far as knobs and jaws go. See Photo 19.

A simple flat clamp came in handy for gluing puzzle blocks and strips together. See Photo 20.

Dowels with rubber caps worked great. See Photo 21.

Foam blocks, leather blocks, etc. See Photo 22.

Oh... and it worked great on the trailing edge spar. See Photo 23.

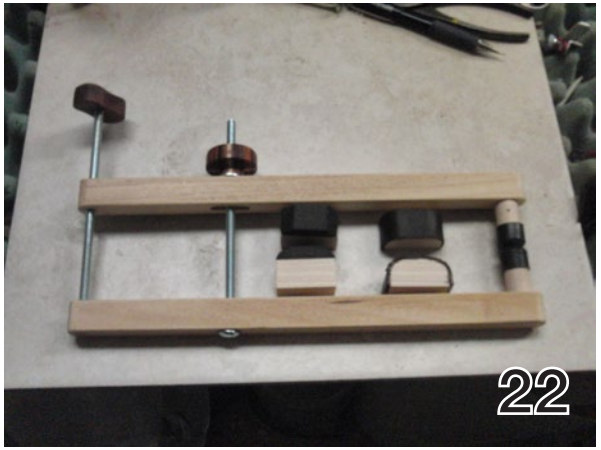
At Christmas I decided to see if I could do some extensions to make a longer clamp for occasional use when needed. I used 1/2" oak dowel and drilled in an inch into each piece. Glued the dowel

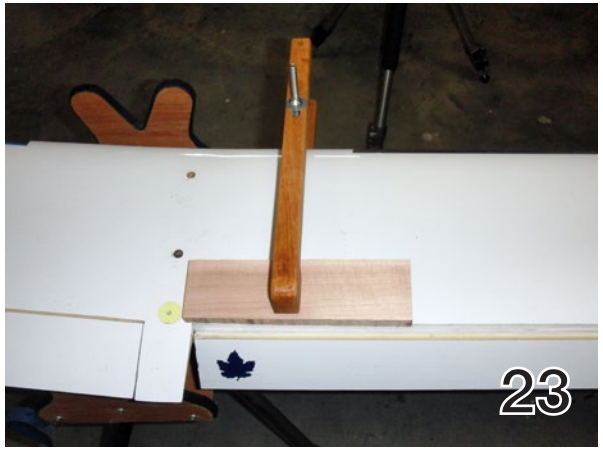
into the extension. Since the clamp is hardwood, it worked great. Got 20 lbs on the scale. Still CA'd the hole to add that extra bit of strength. See Photos 24 and 25.

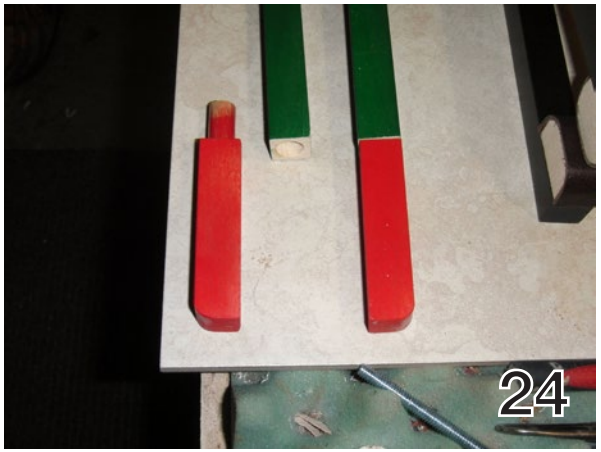
I was working on a badly crashed SBXC and had to push out and hold the cockpit area while glassing. I drilled and through tapped the base end hole. (It needs to be held fixed) and put a nut on the carriage bolt inside. I then added a washer and wing nut (upside down). It was exactly what I needed. See Photos 26, 27 and 28.

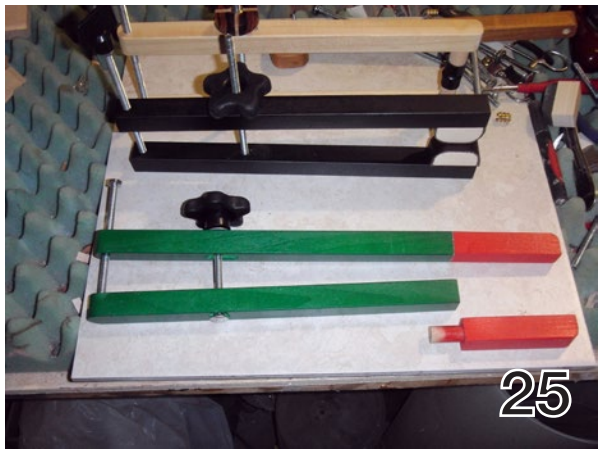
As always, have at it and feel free to share your ideas or improvements.

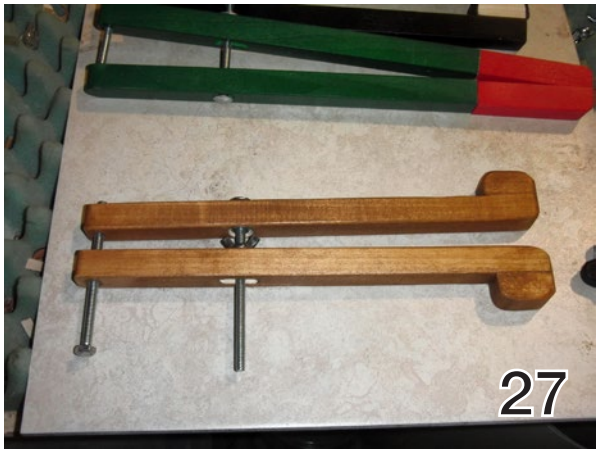
You can email me at <tom@blueridgesoaring.org>.

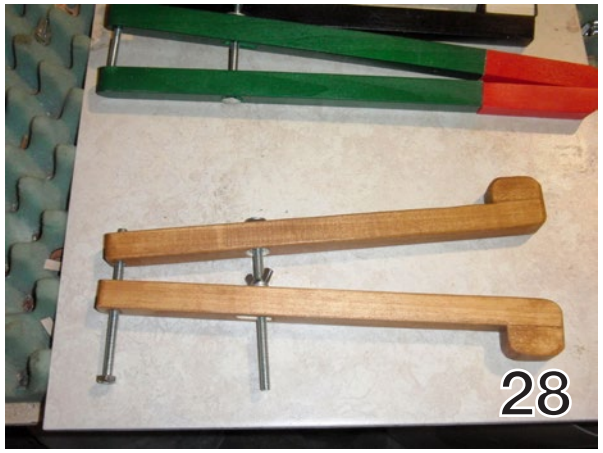












Taking the SiGh flying wing to thermal heights

Part 1

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Photos by Peter Brüel, pet4bru@gmail.com

Less is more.

- Mies Van Der Rohe (Architect)

What inspired me to do the BullSiGh

Like Mies Van Der Rohe, I have always had a love for simple and elegant lines. Hence, since I first saw the first flying wing, I have been forever lost to these simple and elegant creatures of the sky. Also the coveted better performance over a traditional planform due to the lack of drag and weight of a tail has inspired me over the years. In this endeavor I set out to test this paradigm with the best analysis programs, materials and general information at my disposal.

I hope to beat the traditional planforms in the Danish F3J Nats in September employing the BullSiGh as my weapon of choice – and leaving my Supra on the bench!

In *RCSD* 4/2013 I read about the outstandingly beautiful F3F SiGh. I fell in love with that planform immediately and wanted to make my own F3J/TD version of this glider. So I started to analyze the possibilities in XFLR5 and eventually thought that performance in this planform would become outstanding with my design. So I jumped in and started construction of a bagged swept flying wing – the BullSiGh! This is my story.

This article will be the first of two articles. This first installment describes the design, construction and building, up until the first two flights. After that winter came and I thought I would publish what I had and then return with an update after more experience is gained with the BullSiGh.

Contact with the SiGh designers

I contacted both Simone and Ghisleri – the original designers of the SiGh, and got some initial tips for making a thermal version of it. Among other things, they pointed out to me that I should keep the wingtips light. I didn't get this at first - but learned later what they meant by this! My friend Peter Wick, a renowned airfoil designer of model-airfoils, also chipped in some thoughts on winglet and airfoil choice parameters for me.

What's in a name

I first wanted to do a SiGh slightly altered and optimized for F3J, but quickly appreciated that this would be a completely new design that would take me far away from the initial design of the SiGh. Aspect ratio and all angles have been optimized to thermal well. Only what resembles the original SiGh outer visible planform remains. Hence I had to think of a new name for my model… I'm a Taurus and was building a SiGh – So it could only be named the BullSiGh! I hoped it would be a Bullseye at least…

Initial considerations – Designing for F3J and F3B

Thermal duration is my main interest, and the design was therefore aimed at getting maximum height on the winch as well as maximizing the maximum glide ratio and minimizing the minimum sink rate for best performance in thermals.

The plane should be able to do hard winch starts so high strength around the middle section and the wing joiners where my two towhooks are placed is critical and hence this section is beefed up to take the stresses at 160 km/h or 100 mi/h. This has worked flawlessly on my R-2 flying plank glider (rib construction described in RCSD-2009-02). This plane happily takes the "pedal-to-the-metal" during hard launches.

Many much brighter heads than I have lived to tell the tale of the "flutter ghost." My friends have said time and time again during initial design – beware of the flutter ghost. And I second their heed, so this is my secondary design goal to achieve a wing with stable high-speed potential that will not flutter. I have taken extreme precautions in all structural solutions to maximize strength and lightness towards the tips to minimize any chance of hitting self-resonance/flutter.

When we talk about winch-launching and F3B and F3J, speed is really important because in the zoom you convert your builltup speed to altitude, hence the wing was purposely made as clean as possible for max speed. The Rotary Drive System (RDS) was therefore chosen to keep all linkages safely and cleanly inside the wing to prevent any bulges on the surface of the wing stealing speed at the top end of the speed-regime.

So my design goals can be summed up in this prioritized list:

1. Great thermaling in floating conditions with no or weak wind. Calls for light weight construction.
2. High launches from winch.
   a. High design Cl.
   b. High strength required.
3. Best competition performance in F3J/F3B as possible.
   a. Best glide ratio and minimum sink is required – hopefully beating the Supra's performance in these aspects.
   b. Calls for high speed, so ballasting is built-in.
4. Resistance to flutter – as much of the above is achieved only through extreme speed at launch and on high-speed legs of F3B.
5. Ultimately I could live with lower launch height than a normal planform – if the wing suffers in this respect, which they usually do.
6. I need to be able to take the wing apart for transportation.

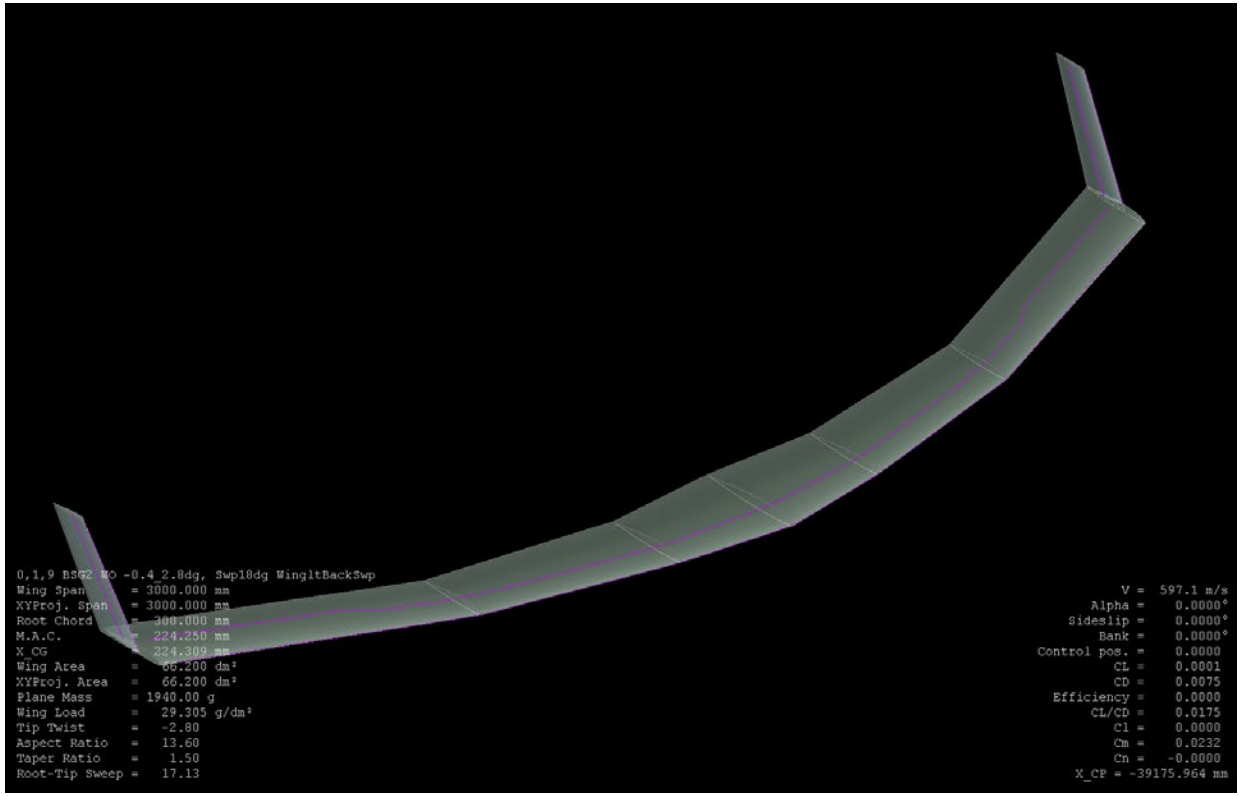
It could be speculated that I am a speed-freak! But everyone who has ever seen me fly knows that this is not the case. I am just aware that speed is imperative to acquire some or all of the above design-goals in a high-performance glider design. Fortunately, a flying wing has great versatility and should be adequate to offer all of the above in a transport-friendly package.

Design

XFLR5

Using wing analysis programs like XFLR5 and FLZ_Vortex to optimize performance

Starting out with XFLR5 was a long and interesting journey filled with great fun and learning. At first I took the first steep learning curve reading a great XFLR5 tutorial. It was a great help reading the fine tutorial in *RCSD*. See the References section at the end for a link. With this tutorial I jumped out with XFLR5 and Wow! have I come to love this piece of software. It is tremendous what it will make you realize in few minutes when you get to the point where you actually know what you are doing with it. I will not delve into XFLR5 much, because excellent tutorials for this software has already been written and published on the internet, but I will just tell you that if you are adventurous and practical, and you from time to time want to know "What-if..." with your existing model, or like me, you have a whole new design you want to visualize and predict performance about, XFLR5 is the tool to use. Naturally you would of course like it to fly like a dream. Well then XFLR5 is your dream come true… If you are interested, it will come easy. I struggled at first getting airfoils into XFLR5 – the way to do it is so simple, you just open the airfoil file… Quite embarrassing to not know this. But I spent some time figuring that out.



BullSiGh in XFLR5

Wing airfoil selection

I read a very interesting article about a flying wing, the SD4, an F3B swept flying wing with no washout built-in, inspired by the Co(x) series from Hans Jürgen Unverferth's hand. The SD4 had a new airfoil, that from the author's words was incredible, and allegedly was very good at high speed. I quickly took note of this airfoil for analysis with my BullSiGh. I ran the SD4 airfoil (HQs 1.64) through XFLR5 and it impressed me with its maximum glide ratio in the BullSiGh planform. Maximum glide ratio was in the 27 region. However, my reference is my Supra glider from Dr. Mark Drela. I wanted to surpass the Supra with its maximum glide ratio of 30 (main wing AOA 1,5deg, and stab @ 1deg as I fly mine). I later learned that the Pike Perfect has a glide ratio of approximately 20, and in another wing analysis program, FLZ:Vortex, the Supra showed 22,9. So I

am convinced that XFLR5 is too positive on normal planforms – maybe also on flying wings.

Conventional tailed planform (Supra) analysis in both programs was without fuselage, which in reality makes this number a tad too positive, as the fuse will have a detrimental effect on performance in real-life. But it is advised in XFLR5 to leave the fuse out of the performance analysis, so I only took into account the Supra's fin, elevator and wing.

Among all the other airfoils I analyzed; the HS522, PW51, -54 (used in my R-2 plank), -98, -106 by Peter Wick, TL54, the RS004A by Hans Jürgen Unverferth's team (This airfoil is used in the Co8, which supposedly is hard to trim to a specific trimspeed, this airfoil probably has an edge in launch height, but suffers in stability), BW 05 02 09 smoothed that I read so many great things about in this very magazine. Of all these Cm stable airfoils, the HQs 1.64 section developed for the SD4 was by far the most suited when I took Cl/Cd and the different speeds I would fly at into account. This airfoil has an incredible performance for swept flying wings. See the link at the end for reference to the used airfoil.

Final optimization to take performance unmistakably beyond the Supra

To surpass the Supra's performance, I knew that I was in for some hefty tweaking of all major components in the design. But I was bitten by the bug, and scrutinized the details to finally succeed in this goal.

First I optimized the aspect ratio and found that tips would be 200mm chord, and center section should be 300mm. I iterated with small adjustments of sweep and washout angle until I thought I had the optimum solution. Actually, most of my design findings, I later discovered align closely with Hans Jürgen Unverferth's Co8 v2. See references for link to this article. It is a very powerful cocktail. My wingspan is 3m. Washout: 0 degrees at the root, through -0,4 degrees at the wing joiner, and -2,8 degrees at the tips.

I went on tweaking the angle (AOA) of the winglets to find the best performance, and had read about a term "induced thrust" and could not believe the things I read about it. But finally I saw it with my own eyes. With slight toe-in of the winglets, performance was boosted 1,5 points in maximum glide ratio. I was stunned.

Winglet sweep was also under scrutinization – and I found another 1,2 in maximum glide ratio here. So I was on the right path. Winglets are swept 15 deg.

With this lesson learned, I went back to the main planform of the wing, and wanted the sexy curvy planform of the SiGh, but for thermal performance reasons I had to increase aspect ratio or it would not be competitive in climbing or launches. So after several weeks of iterations I landed at a planform with just the right combination of sexy curves and extreme performance. And I was happily seeing maximum glide ratio of 32,4!!! If this performance is realized in real-life it is a complete and utter success of modern wing airfoil analysis software, as without it, I would or could never have taken on a project like this, let alone been able to make the hundreds of math calculations for the necessary iterations.

Stability

With XFLR5 I have yet to learn how to analyze stability of wing design. So my solution in the planform resembles closely what the SiGh designers implemented in their design. A swept wing gets some additional effective dihedral from aerodynamic forces I cannot explain. But suffice it to say that I knew I had to implement slight anhedral (negative dihedral), to get a wing that would behave harmonically during turns. I hope I have the right combination of winglet size, anhedral and sweep to make it a joy to thermal and avoid the dreaded Dutch-roll effect. I have opted for the simplest anhedral I could

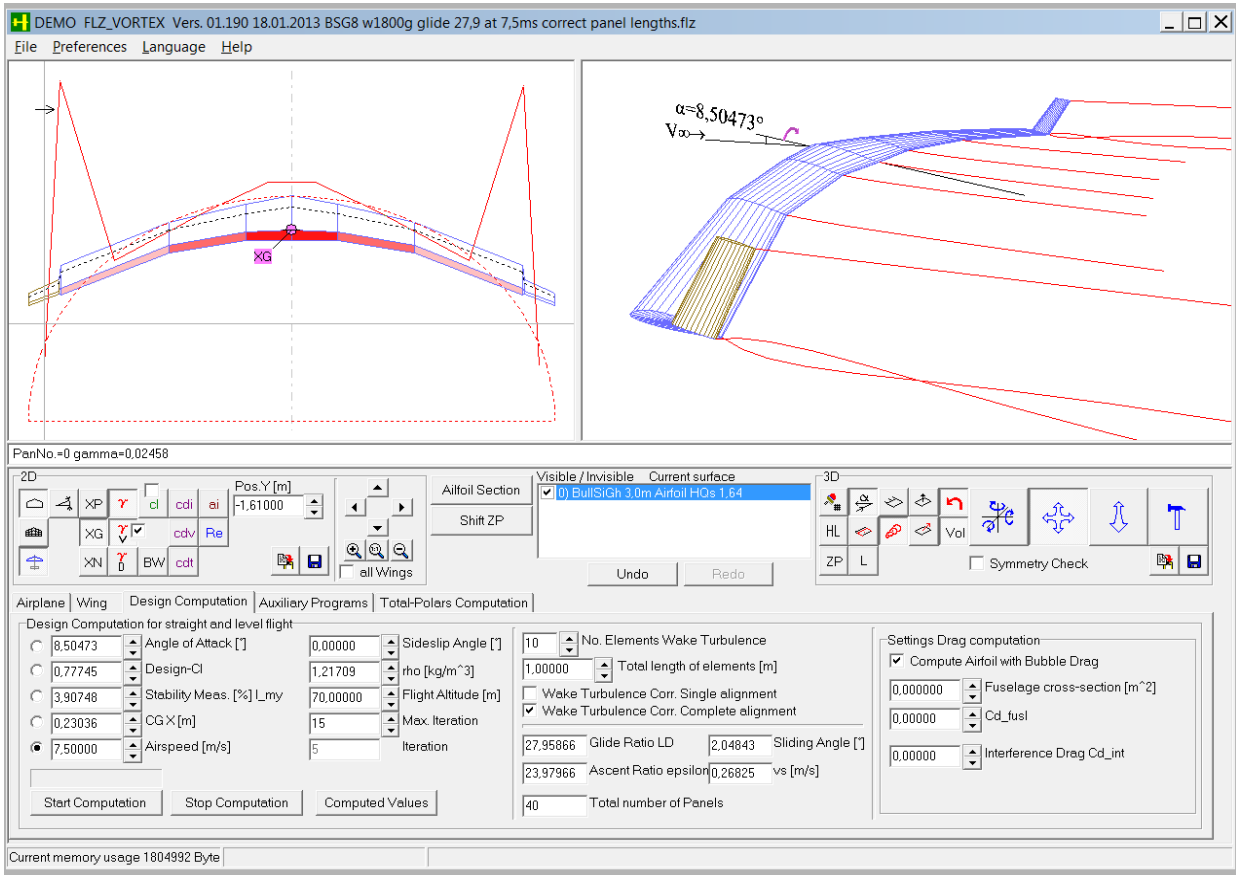
implement. In the center section, where the root-sections mate with the middle-sections, I have implemented one degree of anhedral. This anhedral is laminated in at the time of curing the center-section. This makes my wing joiner dihedrally straight (and much simpler to construct), so the tip-sections continue the one degree anhedral from the root section.

I was startled to learn that performance plummeted when I designed anhedral into the wing. The maximum glide ratio went from 32,4 to some 27, and this by only one degree of anhedral! I think this must be a design flaw in XFLR5. It seems really counter-intuitive. If some of the readers would like to mail me about this phenomenon, or even better, write an article about it – I would be grateful.

FLZ_Vortex – Time for a Sanity Check

I got anxious and requested additional tips regarding the aerodynamics and performance of the BullSiGh as I contacted both my friends Peter Wick, designer of the PW airfoils, and Niels Sørensen, who works as an aerodynamic analyst at Risoe Airfoil Science center, where they develop new wings for wind generators. Niels helpfully crunched my numbers and came out on the other end with a maximum glide ratio of approx. 25-30. This made me believe that XFLR5 is a tad positive.

Prudently I thought that trusting only



BullSiGh in FLZ_Vortex

one wing analysis program for analysis would be risky, and I could end up like a fool if real-life performance was too far off. Hence I employed another program, the FLZ_Vortex by Frank Ranis, who also made Nurflügel. This program is quite more advanced than Nurflügel in that it handles dihedral (winglets) and multiple wings (traditional planforms). So I felt that I could somewhat rely on some form of average between the XFLR5 and FLZ_Vortex results.

BullSiGh Performance in FLZ_Vortex

To get 'in the air' quickly, I followed a tutorial here: http://www.rcgroups.com/forums/showthread.php?t=1898646

I entered the planform and all my optimized angles for wash-out, winglet AOA, and anhedral, and was happy to

see that I actually obtained a maximum glide ratio of about 27,95. I also entered the Supra and could see that it scored about 22,9. So I was now full of confidence about my design and its stellar performance.

A word of caution though, in the first analysis, I put in mass both in the plane tab and the wing tab, so I ended up getting a mass of 3,6 kg! This was much heavier than anticipated. But gave me a glide ratio of 37! But that success was shortlived as I realized my flaw in the computed numbers where weight was calculated twice. So be very careful when scrutinizing your analysis from any wing analysis program. A proper log-readout is of crucial importance.

A word of caution about trusting software code in comparison to the real thing

From different people I have been warned about trusting the analysis that any computer-code (in this case Dr. Drela's X-Foil) predicts about a virtual design plane. But the XFLR5 tutorial mentioned above actually measures real-life performance and compares it to predicted polars from XFLR5. And they are very close. But obviously at this time of writing I have not seen the plane in real life – and am eager to measure its real life performance. So XFLR5 and FLZ_Vortex simulations are all I have to go by. Time will tell if I can really trust the positive predictions. However, in the update article about the SD4, the author mentions that he has had company of a Supra one still morning, where there was no thermal activity, to gauge actual minimum sink. This pilot flew his Supra at minimum sink between 0,35 – 0,45 m/s. So I can say that my analysis which indicates a min sink of 0,26 in XFLR5 for my Supra must be a tad too positive. The Supra in FLZ_Vortex indicates a min sink of 0,42 m/s which is really close to actual measured minimum sink. And my BullSiGh greeted me with estimated min sink rate of 0,27 m/s… The BullSiGh started to look really promising at this point.

This way I believe that it would be prudent to actually bias analysis of gliders in XFLR5. This performance looks a little too positive. I have no idea how to modify the analysis to match real life performance more.

Structural considerations

Light tips to make the BullSiGh flutter-resistant was a major concern. I have used less skin thickness in the outer parts of the tip-sections to cater to this prerequisite. And the winglets are only covered with one straight layer of 49g/m^2 glass-weave. So winglets are very fragile. Only time will tell if too much so. Weight is of utmost importance in the very slightly swept wing, as I have no proper nose to counteract the weight behind the CG.

Another issue that I spent much energy contemplating was the location of the two tow-hooks. These should be placed slightly in front of the CG. I knew the location of the CG from XFLR5. So I drew a full size plan of the plane. And on this I could place the ballast compartments and the tow-hooks. Both need to be close to the CG.

Torsional and bending strength considerations made me opt for many layers of 100g/m2 carbon-weave. The exact number of layers was completely unknown to me when I set out on this project, as this is my first bagged epoxy laminated wing. I searched high and low – and fortunately also asked my bright friends in my club. Adam Rogalski came to the rescue with a link to the great worksheet of Joe Wurts and many others who designed and tested this worksheet for assessing bending and torsional stiffness requirements in a wing, and illustrates how much each component is stressed during flight.

I read in the SD4 article and the following update article that the SD4 was prone to damage during spot-landings in the front assembly where the two L-R wing halves are held together. I wanted my BullSiGh to be able to take this stress without damaging the structure. So because of this and for the added transportability, I opted for a 3-piece wing. My center section only sweeps between 9-13 deg, so 160cm with only slight sweep is pretty

easy to transport.

Joe Wurts laminating sheet – load estimations

This sheet is an invaluable tool (link at the end in References), and has definitely made my first project much less “hit or miss.” I am confident that the structural integrity of my wing will withstand all the muscle that I intend to throw at it during hard winch launches.

You simply enter the dimensions and proportions of your design, and define how many layers you will be doing of each weave thicknes, and the sheet works out in the bottom if you are stretching the material and design structurally or is home-safe with your structural design. It even graphs the anticipated loads under winch-stress, and calculates weight and price of materials used! Internet giving and sharing at its best. Wonderfull – thanks goes out to all who contributed to this sheet. I am in awe of your skills!

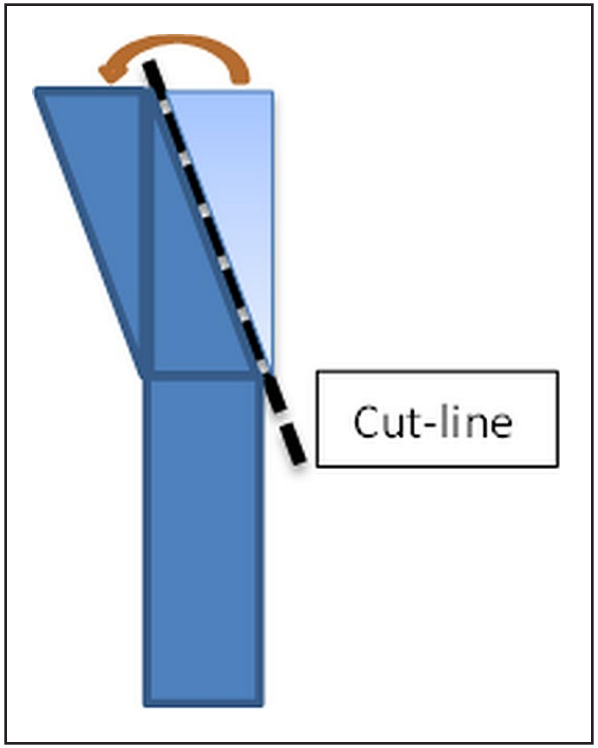
I ended up deciding on one layer of straight 100g/m^2 carbon-weave on both buttom and top of the wing, and one layer of 100g/m^2 carbon-weave diagonally also on both sides out to about half of the tip sections. The rest of the tip and winglet is only covered with straight carbon to save weight.

What is really interesting and only a few people know I think, is the fact that from these four layers, the straight two layers carry 95% of the bending and stress load! The diagonal layers have only 1/6th the strength in both bend and stress, but is important for torsional stiffness – so it cannot be left out entirely.

This calculation of course does not take into account that I applied a main spar of the following construction. I found no way of describing this in the laminating sheet. Only a capped spar is selectable. I did not look at the strength of my main spar. But I am confident that my construction will be strong enough, as the four skin layers of 100g/m2 unidirectional carbon at the leading edge will carry the loads under flight.

To beef up the structural construction to withstand winch-start stress and combat flutter, I opted to make a spar like those Drela uses in his designs. This spar reuses part of the airfoil core and wraps 100g/m2 carbon-weave around it in two sections of the front part of the wing, making it very rigid and light at the same time. So with this construction I hope to have a preemptive defence against flutter on my swept wing design that would otherwise be highly prone to flutter.

The aft part of the main spar (mid-secion of the wing core) takes the form of a large rectangle (40x19mm), so I used this to double as the reception point (and actual wing joiner) for my wing joiners, but this joiner will have to follow the wing sweep at the joiners. I managed to get the sweep I need by cutting the joiner



Basic main spar construction. See text for details.

(cut in foam, and divided into three parts lengthwise and covered with 3x100g/m^2 carbon-weave – so the wingjoiner also has some shear-web strength to it), and flip the smaller triangular part over to the other side of the joiner, in effect giving me the sweep that I need. After this the joiner is laminated like the wing. Anhedral at the large root wing section is built in while curing in its beds.

Construction

At the end of May I finished the major design and started cutting cores for the wing and winglets. I anticipated that building would take far less time than the design and analysis part.

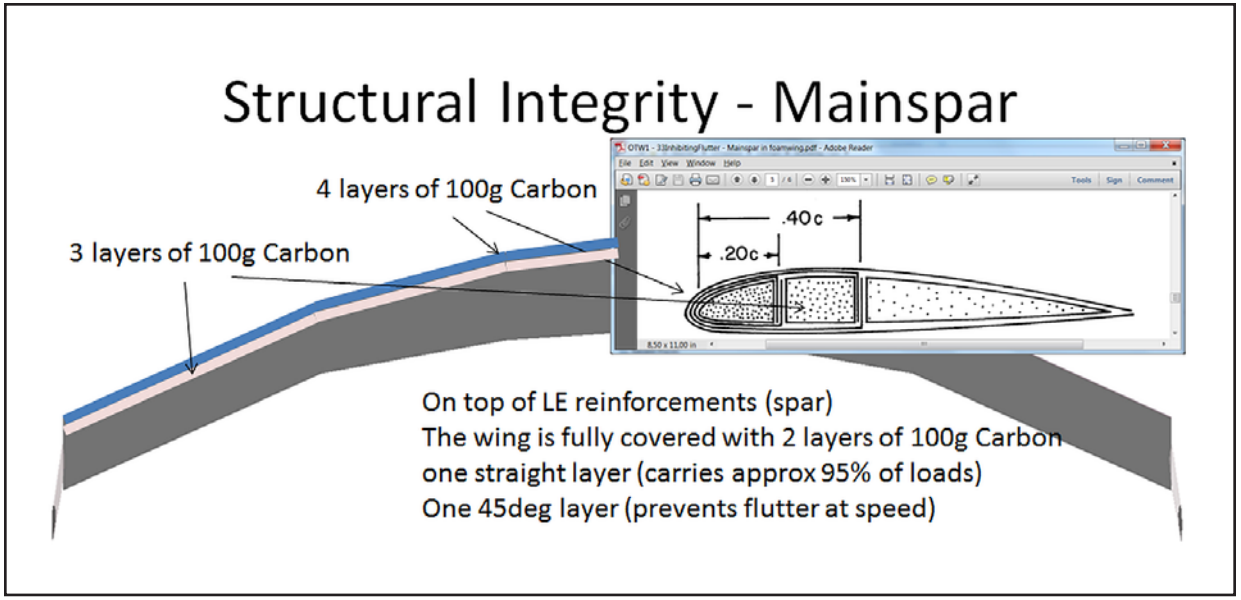
Cutting foam

My friends got me started with a CNC foam cutting machine based on the MX2001 board and GMFC Pro cutting software and I quickly got good results with cutting my cores. It took only one evening/night. Because of the big sweep in the outer panels and winglets, I had to go another route via Profili Pro. Here I could set an option to align the leading edge with the cutter string and it would then compensate for the sweep in interpolating the airfoil coordinates. Then I could export this cut in a .CUT file that could be imported into GMFC and all was well. I cut a slot along the wing cores to guide the servo-wires.

The center panel root and mid-sections was cut with the desired anhedral, so I could glue the wing-cores and the respective beds together and laminate the center section's four panels as one section.

Preparing for bagging wing sections

End ribs where made from 1,5mm plywood and glued to the ends where foam would otherwise be exposed to make sure that end stiffness would not suffer at these locations, and also this provides maximum stiffness to the parts that need to be held in place in the height of the wing end - mainspar, alignment dowel, hole for wires to the servo in the outer panel. I even considered placing plywood ribs in the joining place between the cores that would bond together, but finally reverted from this. I do not feel that it is needed.



I prepared the winglet assembly thoroughly, and made preparations for the servo-wire extensions. But most importantly I thought that I could obtain a super light wing joiner employing the actual middle of the wing core (see illustration of the cut-through wing lamination in the Joe Wurts laminating sheet – load estimations section). I opted to first cut all cores at 20% and 40% X of chord. I then got a leading edge, middle and a trailing edge section from each core panel.

Bagging wings

I assembled the center section leading edge, middle and trailing edge respectively with spray-glue 3M-77. These would be laminated like this:

1. Paint was applied to the mylar in my patterns and logos was put down in their positions
2. First on both the top and bottom mylar I prepared applying epoxy to the full layers to go on the outer panels: one layer of 100g/m2 unidirectional carbon straight along

the span

3. And one layer 100g/m2 unidirectional carbon diagonally at 45 degrees.
4. When this was ready I applied 80g/m2 Kevlar to the hinge areas on the mylar.
5. I then placed the bottom mylar in its bed(s). The center section was glued from four parts, as was the center portion of the wing.
6. Then back to the 3-part spanwise separated cores for the main-spar.
7. The leading edge got a full roll of straight 100g/m^2 unidirectional carbon along the span of the sections and was then placed on the wax-prepared mylar in the beds.
8. The mid-section was placed tightly against the leading edge. Another layer of 100g/m^2 unidirectional carbon was then rolled around both these sections like before – now effectively giving me a sandwich of two carbon tubes around the leading edge and one layer around the mid-cores.
9. Then I placed the traing edge section tightly against the LE/mid sandwich
10. And finally placed the top mylar with its straight 100g/m^2 unidirectional carbon layer, and its diagonal 100g/m2 unidirectional carbon.
11. Vacuum was then slowly applied to almost 500 bar vacuum.
12. Everything was checked and carefully aligned before leaving to cure.

It was a difficult process as I was working wet-in-wet with epoxy and things slide around when I work.

Hinges – and RDS

I ended up making the foam cores without the hinge lines, and simply dremel them out afterwards. I made a mistake in one hinge line. But this was easily fixed afterwards by filling in epoxy with micro balloons.

Assembly

The only assembly involved is fitting the three parts of the wing together with a wing joiner. The hardest part was fitting the RDS system in the wings. This took some time.

Radio Control – Advanced Mixers for Flying surfaces

A swept flying wing will fly with only one mix – Delta, or elevon mix, but to make it really competitive and agile I decided to look at other advanced swept flying wings out there and copy as much of their control surface control as possible. Control would be like the SB13 Arcus full size glider and the model flying swept wing Taborca, both with six control-flaps. My BullSiGh would have a single center flap instead of two, because I purposely drew the planform to get a straight hinge line here. So I would save the weight and the cost of a sixth servo.

So I developed my radio-model in my Multiplex Royal Evo 9 and finally ended up with some pretty amazing mixes that I hope will give me an edge in competition. And also it makes me feel that I have perfected not only design and construction of the model, but also the actual flying. Nothing is left untried to squeeze maximum performance out of this flying wing.

Mixers used in BullSiGh

1. Delta control on the outer elevon.
2. Active camber control to adjust camber on root- and mid-flap during thermal flying.
3. When aileron is applied the mid-flap goes adverse the elevon surface on the inner wing, so it actually serves as a drag-rudder. During test flights I can adjust the ratio of drag-rudder on the fly on a digi-adjuster wheel. Drag-rudder can also be switched off entirely by flicking a switch during competition flying where I believe I will not want to sacrifice drag in steering for height loss… My winglets are stationary and offer no steering.
4. Spoiler where mid- and root-flap goes down to about 80 degrees for full breaking – with pitch compensation on the outer elevon, actively giving the model extra wash-out for landing.
5. During thermaling I control pitch with both the elevon and the root-flap to keep maximum lift on major parts of the airframe at all times during circling

in lift. This also reduces the required radius of the circle – and should enable tighter turns will less drag than otherwise possible.

So the simple and elegant look of the BullSiGh is deceiving. Much thought and work has gone into making it fly and handle like I need it to.

Flying

Maiden flight

Finally I was ready to let the Bull rip. So one fine day only 14 days prior to the Danish Nats in F3J, I went with a couple of buddies to the field and set up everything. Apparently all was well so off the Bull shot skywards. I felt that there was too little tension on the winch-line, and I was right! So the BullSiGh shot forward faster than the winch could pull… To make things worse, the line was not at all taught, so I had very little to work with. And I had no other option than to get away from the winch, even though I was too low for my own taste with an untrimmed wing. Fortunately, I had built up some speed momentum from the winch, so I could slowly stabilize the glide from somewhat upwards into a gentle turn to the right so I could better see the speed I was flying at. The wing stabilized at an impressive glide out to the right where I wanted to do a gentle turn until I could come in on final on my right. But as soon as I turned slowly right, the right wingtip stalled, and it went into a spin, which I was too low to get out of. So it crashed with minor damage to the winglet mounts as the only injury.

A link to the video of the maiden flight:
<http://tinyurl.com/m444x82>

I am quite certain that this crash indicates that the winglets are too small, and hence need to fly somewhat faster than I am used to flying my Supra. The somewhat higher wing loading of the BullSiGh at

34 g/dm in comparison to my Supra's 28 g/dm probably also has some effect at the lowest airspeeds, where this video is taken. This will be investigated in a later article when I have had the time to further test the wing under various conditions.

Adjustments and refinements

The next flight showed another obstacle that has to be tackled before flying the BullSiGh. I was starting the wing with good tension on a properly accelerating winch this time. But the bridle is made from nylon winch-line, and the tension from the two tow hooks is very strong. Apparently this line has a lot of friction with this large load and the wing cannot adjust its trajectory under full winch load So I could only watch as it went fine on the first eight meters on the line, until speed was built up, and then it started a slow left roll on the line, which I tried to compensate for, but could not. In order to fix this obstacle I must find a very small pulley that can be attached to the bridle so the winch-line can run freely from side to side as I adjust left-right aileron attitude of the wing on its

way up the line for straight tracking. If anyone have some idea of where to get such a micro pulley please let me know.

Wrapping up the first article about the design of BullSiGh

I have not had the opportunity to finally make the adjustments to the parameters that I need to actually fly the wing as of this time. But as soon as I get the final verdict I will let the readers of *RCSD* know in a new article. If you have any questions about any of my experiences, please just let me know at <skjorten@gmail.com>.

References

My first inspiration for the BullSiGh came when reading RCSD 4/2013

Airfoil coordinates found in the article about the SD4 flying wing by Stephane De La Haye – RCSD 04/2007 <http://www.rcsoaringdigest.com/pdfs/RCSD-2007/RCSD-2007-04.pdf>

Joe Wurts and many others have contributed to a great worksheet, that calculates stresses in your plane, and suggests how many layers you use for skinning your wing-cores. <http://www.rcgroups.com/forums/showthread.php?t=1213427>

XFLR5 – Free WING ANALYSIS software for analyzing wings and performance of planes – <http://www.xflr5.com/xflr5.htm>
XFLR5 Tutorial – fine tutorial in *RCSD* 02/2008

Nurflügel by Frank Ranis – <http://www.zanonia.de/ranis.php>

FLZ_Vortex the new wing analysis program from Frank Ranis – <http://www.flz-vortex.de/flz_vortex.html>

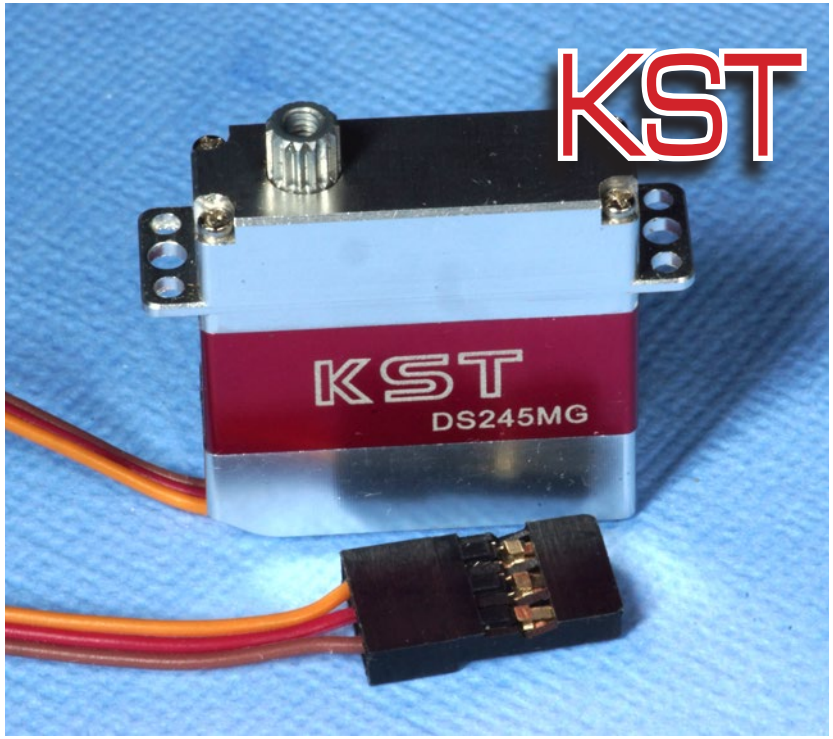
I mention my other flying wing plank, the R-2, described in *RCSD* 6/2009 – <http://www.rcsoaringdigest.com/pdfs/RCSD-2009/RCSD-2009-06.pdf>

Many “On the Wing...” articles from *RCSD* – for structural and mechanical tips

OTW1 – 33 Inhibiting Flutter – main spar construction from which I was inspired to create my main spar. I’ve attached the relevant screen-dump in the Structure section. <http://www.rcsoaringdigest.com/OTW/on-the-wing1/33InhibitingFlutter.pdf>

Theory of Effective Dihedral on swept flying wings: <http://www.aerodesign.ufsc.br/ipa/08_stability/Effective%20Dihedral.pdf>

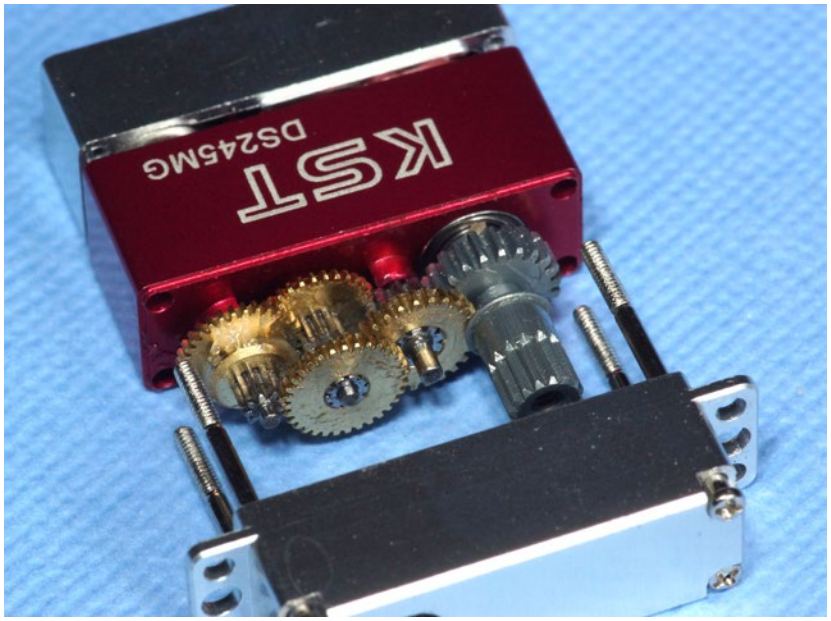
General angle geometry of my design match the Co8,2 described here: <http://www.glide.net.au/flyingwing/co8.htm>



KST DS245MG servo

8mm wing servo

Bill & Bunny Kuhlman, bsquared@centurytel.net



The KST DS245MG is a very thin (8mm), metal gear, digital servo designed for use within the wing of DLG and HLG machines. The mounts for the DS 245MG are those of a servo for "vertical" mounting, as within a fuselage for controlling rudder and elevator. For mounting within a wing, this makes the DS245MG less accessible than a horizontal mounting system. Luckily, KST also makes this servo in a horizontal mount configuration, the DS245H. The latter version may be a better choice for some situations.

Our sample was provided by Hobby Club <http://www.hobbyclub.com> and arrived in the usual retail cardstock box with the mounting screws, control arm retaining screw and a single control arm in a small plastic bag. The control arm has three holes, all are slightly undersize and are too small for the usual clevis.

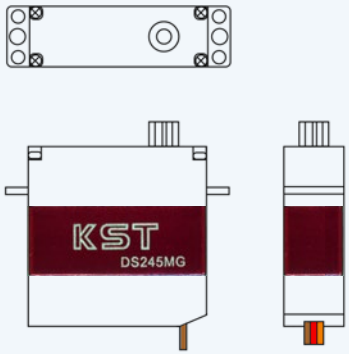
The body of the DS245MG is machined aluminum. Contrary to the DS125MG, the 7mm diameter coreless motor in the DS245MG is completely enclosed. (The DS245H has a truncated case which is less tall, and the motor base with wiring extends slightly from the case. The weight of the DS245H is 9g, 0.317oz.)

All of the gears in this servo are metal. There is no play in the linkage and the sound in operation reflects the smoothness of the geartrain. The measured travel with signals from 1.00μsec to 2.00μsec was 90 degrees.

In our testing, centering was consistently right on with no load, and any measureable deviations under load were due solely to bending of the nylon arm.

KST DS245MG

Dimensions	23.5mm x 8mm x 23.7mm
W x T x H	1.185" x 0.395" x 1.332"
Frequency	1520µsec/333Hz, 900µsec-2100µsec
Rated torque	1.5 Kg.cm, 20.8 oz·in @ 4.8V
	2.0 Kg.cm, 27.8 oz·in @ 6.0V
Operating speed	0.09 sec/60° @ 4.8V
	0.08 sec/60° @ 6.0V
Case material	3-pc. machined aluminum
Weight	10g, 0.35 oz. (servo only)
Bearings	Dual ball bearing
Gear material	Steel and bronze with steel output shaft
Retail price	$33.00, 4/$120



<http://www.hobbyclub.com/product_info.php?cPath=24_43_229&products_id=1446>

The DS245H sports horizontal mounting tab positioning and a truncated case which partially exposes the 7mm diameter coreless motor. The DS245H shares the same gear train as the DS245MG and performance specifications are identical.

23.5mm x 8mm x 20.3mm

Our test equipment:

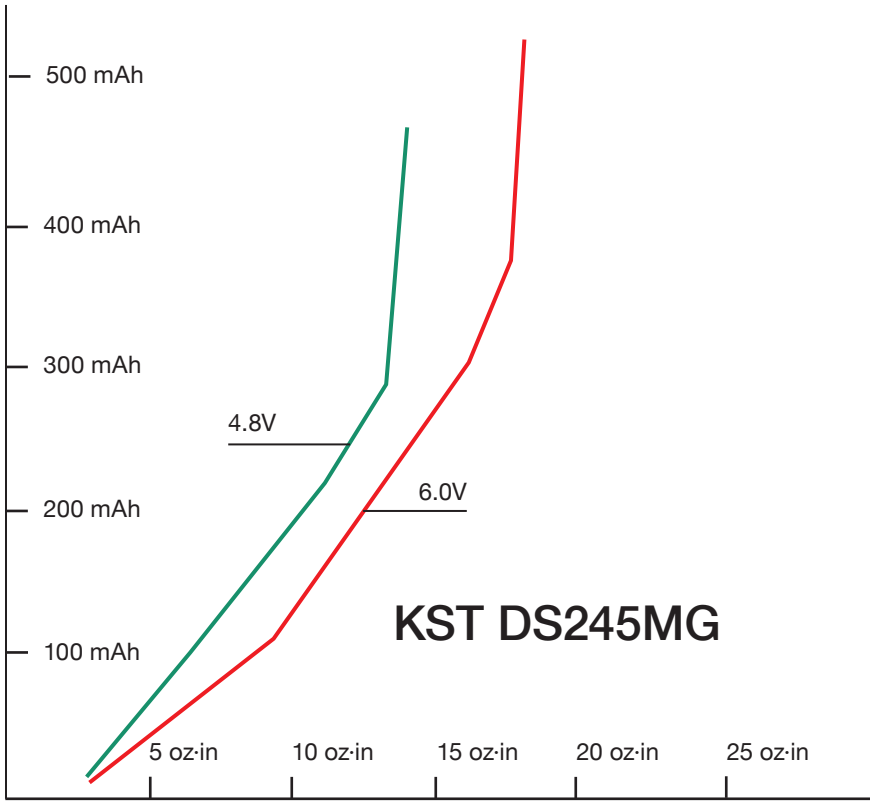
Hewlett-Packard Agilent 6024A
DC Power Supply, 0-60V / 0-10A, 200W
<http://www.hpl.hp.com/hpjournal/pdfs/IssuePDFs/1981-08.pdf> pp.11-17

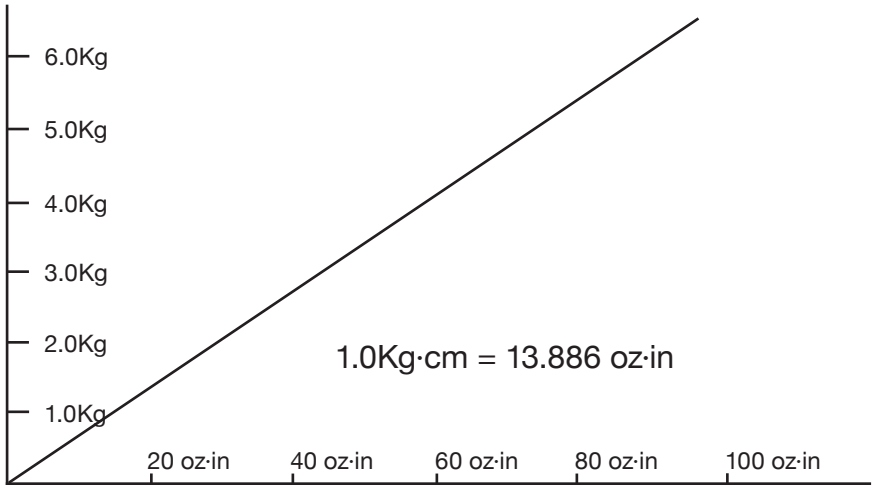
Servo Driver/Tester
Milli-S-Meter - Digital Pulse Width Meter
<http://www.emsjomar.com>

Pelouze PE5 Digital Postal Scale

Cen-Tech Digital Multimeter (V)

Gardner Bender GDT-190A Digital Multimeter (mA)





We tested the DS245MG with 4.8V and 6.0V. The accompanying charts show the torque and current as related to the position signal being received by the servo amplifier, 1000µsec-2000µsec, 1500µsec neutral.

Some comments regarding the performance of the DS245MG:

We measured the torque using the middle hole on the servo arm, 0.5" from the rotational axis. The measured torque at 4.8V maxed out at 15 oz·in and 430mA, 18 oz·in and 530mA at 6.0V. These torque values are slightly lower than the ratings indicate, but the holding power of this servo is extremely high, measuring more than 40 oz·in (about double the data sheet torque rating) on 4.8V while drawing 500mA. There was substantial bending of the servo arm under this condition.

The character of digital servos is to put out significantly more power initially than their analog equivalents as they move from one position to another. This is especially noticeable over small increments. Our samples showed definite increases in torque with a signal change of 0.01µsec., increasing to 2/3 maximum torque at 0.05µsec and maximum torque with a signal change of 0.07µsec.

This is a very thin lightweight servo with more than sufficient torque for use in a DLG or HLG. The vertical mounting of the DS245MG may not be suitable for some installations, but the DS245H, with identical performance and pricing, and also available through Hobby Club, is a ready alternative.

Sources:

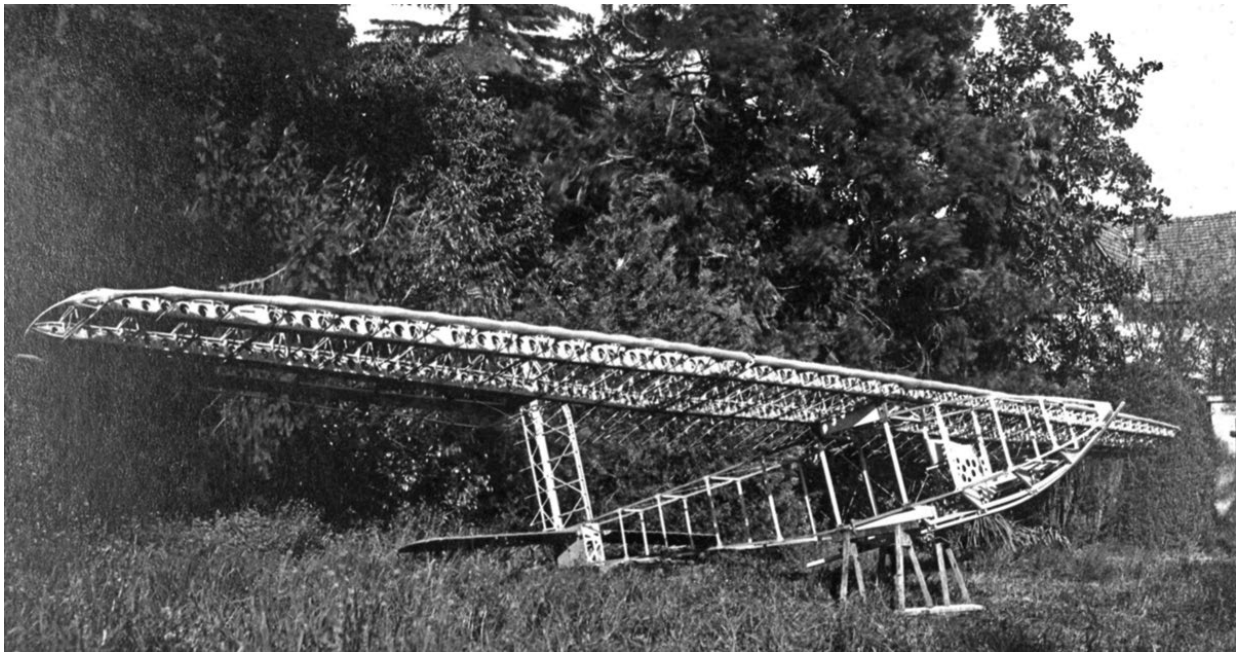
Hobby Club: <http://www.hobbyclub.com>
KST: <http://www.kstsz.com>

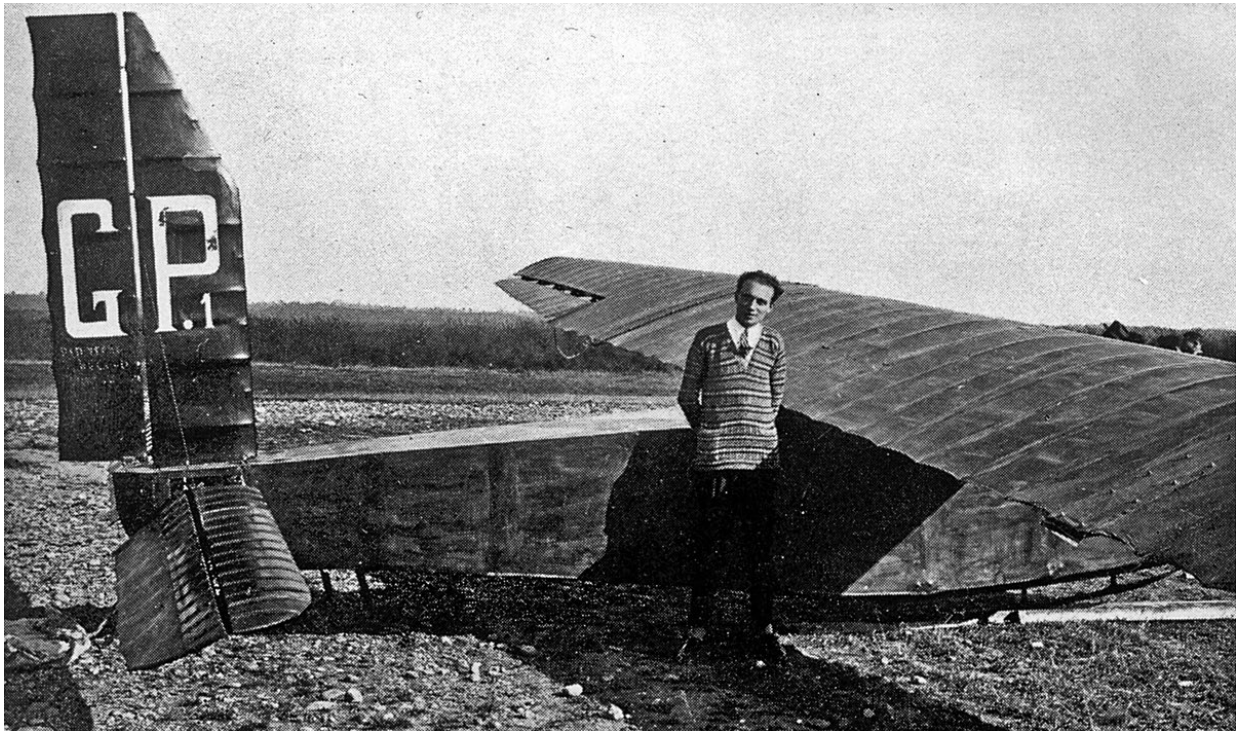
Ettore Cattaneo from the University of Pavia demolished two national records and established a world record

(From an article of "La gazzetta dello Sport" of December 1926)

Vincenzo Pedrielli, vincenzopedrielli@gmail.com

The GP1 at Campo Dei Fiori





The enthusiasm, courage and determination of Pavia university students finally reaped it's deserved reward on Saturday, 16th December 1926.

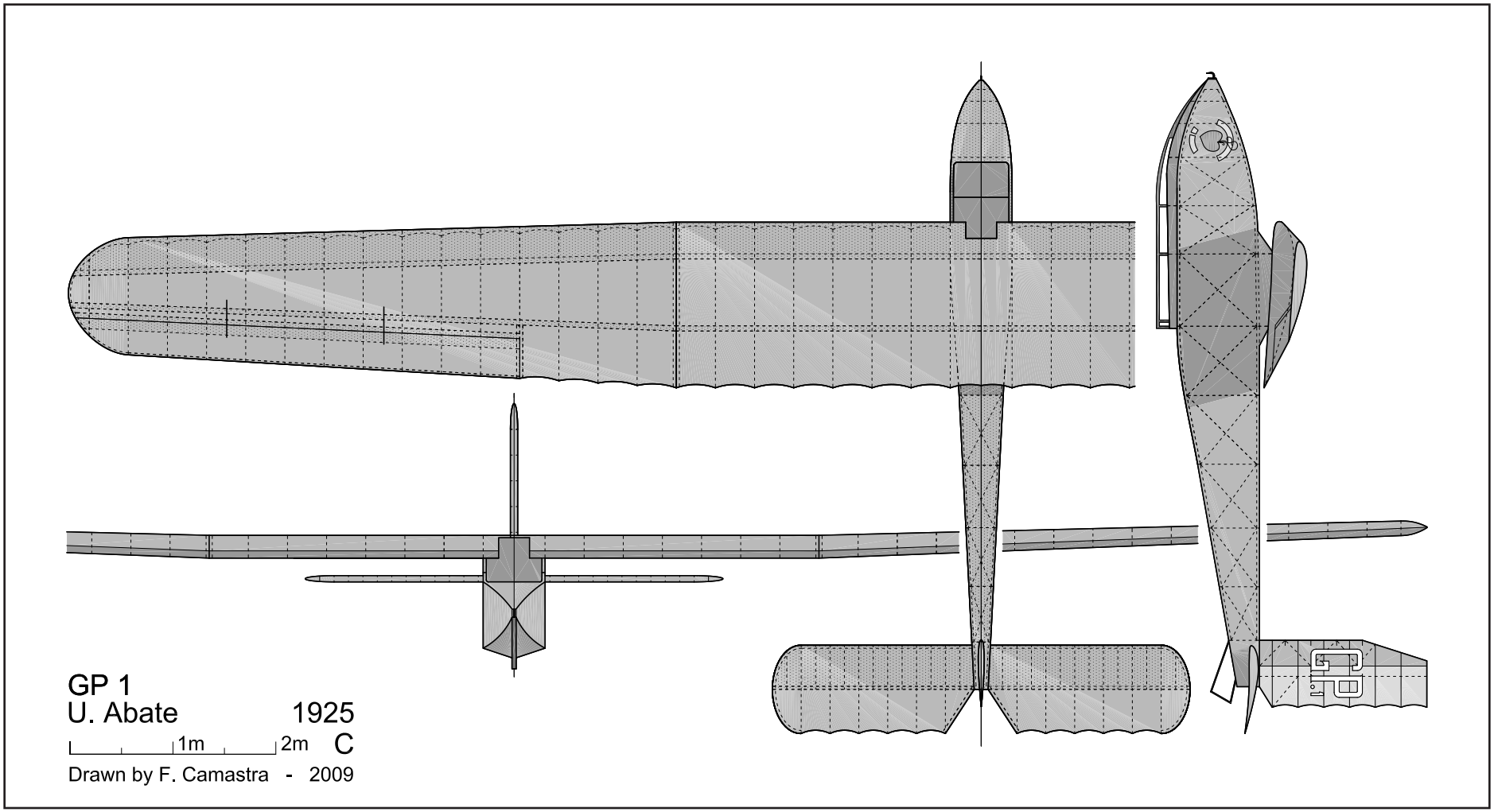
Ettore Cattaneo flew from the top of mount Campo dei Fiori down to the plains knocking out two national records and setting a new world one.[1]

The first two records belonged to Franco Segrè, a student from Pavia who, launched from Mount Mazze a few months after the Asiago Competition and flew 6.2 km in 12 minutes. The world record for distance at that time belonged to Lieutenant Thoret who, on 25th August 1923 in Vauville, had flown 8.1 kilometers. All these records were largely exceeded by Ettore Cattaneo with his monoplane "GP1," designed by Ugo Abate and built by the Visco Brothers. He made a flight of 11.5 km, remaining in the air a little less than 16 minutes.

1 At that time (1926) information was not spread as quickly as nowadays.
The journalist of "La Gazzetta dello Sport" obviously did not know that the world record of Thoret had already been passed in 1923 by the German Albert Bosch with 18.7 km and, in October 1924 Arthur Martens had yet established a new record covering a distance of 21.2 km.

Above: GP1 under construction

Left: EttoreCattaneo with the GP1



This first great success was achieved in spite of unfavorable wind conditions. In fact, in the early afternoon, when all was ready for taking off, the wind blew intensively from North, the most unfavorable direction to fly. The pilot was forced to fly with a constant tailwind.

Taking off or flying with a tailwind obviously presents some difficulties on the plains, imagine in the mountains! Blowing from the north, the wind was beating against the North side of the Campo dei Fiori, deflecting upwards after the impact against the slope. On the opposite side a significant depression was then formed, which created vortices and down drafts of considerable intensity. Undertaken to attempt the challenge, already postponed twice due to bad weather, Ettore Cattaneo however wanted to take off at any cost.

Ettore Cattaneo ready to take off

About the GP1 logo: "Non ti fidar di me se il cuor ti manca," which means "Do not trust me (GP1) if you miss the heart."

In fact, at 13 and 37', 29", in the presence of the Commissioners of the Aeroclub of Italy and the timekeeper Mr. Pirovano, the flight had its happy start. Running for a few meters on the small wooden track, pulled by the launching team, the “GP1” took off smoothly and hovered in the sky. Soon after, however, it was caught between the vortices and lost significant altitude, giving a lot to do to his pilot, who thanks to the great sensitivity of the machine, could continue the flight, losing the lowest possible altitude.

Having moved away from the slope a little, the sailplane met an area of greater calm and continued its flight relatively smoothly. It passed in front of the big hotel Campo dei Fiori, and flew over Induno and Sant Ambrogio, then, making a small detour, aimed for Varese. Overflying Varese and its surroundings, Ettore Cattaneo threw bundles of leaflets, thanking the citizenship of Varese for the kind hospitality offered to the students of Pavia, and a message from the Rector of the University of Pavia. Passing the foothills to the north east of this beautiful city, the brave pilot flew over and came to the area of Belforte, still having fifty meters altitude.

Here he found himself facing a hill. There was no way to fly over it so the pilot, after literally avoiding a telephone line, landed on a narrow lawn, aiming to stop against a hedge of large locust trees.

GP1 on the launching track

The flight was over. The landing had occurred in the locality of “Fuga Della Rocca,” north-east of Belforte at an altitude of about 300 meters. It was 15:53.

Since it started from about 1100 meters above sea level, the “GP1” had flown approximately 11.5 km with a vertical drop of 800 meters.

With a gliding ratio of more than 1:13, despite the very unfavorable aerological conditions and Ettore Cattaneo’s lack of knowledge of the machine, the “GP1” had given proof of its good gliding qualities.

Walk-around

Slingsby T-31B "Tandem Tutor," N12065

Serial No. WT-902, manufactured June 1960

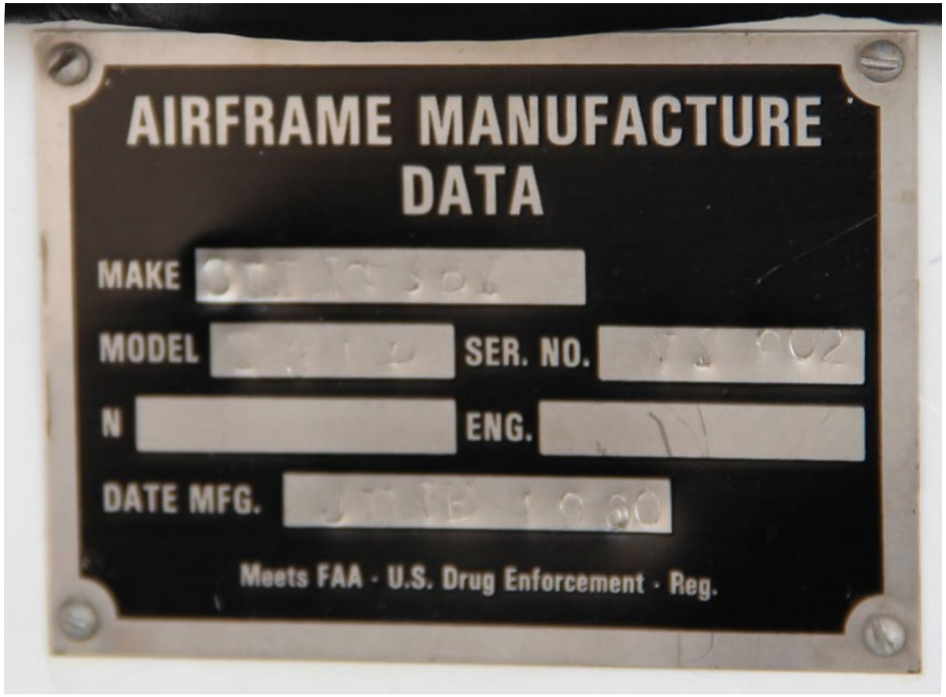
Mark Nankivil, nankivil@charter.net

Owned by Dennis Barton of Gainesville, Georgia, this T-31B "Tandem Tutor" was photographed by Mark Nankivil at the 2012 Wabash Valley Soaring Association Vintage/ Classic Sailplane Regatta held at the Lawrenceville-Vincennes Airport in Lawrenceville, Illinois.

The T-31 Tandem Tutor is the two-place development of the single-place T-8 "Tutor." It uses the same wings but has additional bracing. There were 200 T-31s built. Early production T-31s had no means of glide-path control, and spoilers were added to later models and retro-fitted to most of the earlier machines. The Royal Air Force used 131 T-31Bs, known as the Kirby Cadet T.X. Mk. 3, in its air cadet organization from 1950 to the mid 1980s. There are currently three T-31s in the United States.

Slingsby T-31B “Tandem Tutor,” N12065

Span	13.2 m / 43' 3.5”
Length	7.1 m / 23' 3.5"
Wing area	15.8 m^2 / 170 ft^2
Aspect ratio	11.1
Wing profile	Göttingen 426
Empty weight	176 kg / 388 lb
Payload	200 kg / 442 lb
Gross weight	376 kg / 829 lb
Wing loading	23.8 kg/m^2 / 4.88 lb/ft^2
Structure	Wood and fabric
L/Dmax	18.5 @ 73 km/h / 41.6 mph
Minimum sink	1.05 m/s / 3.48 fps / 2.06 kt
Designer	F.N. Slingsby, Great Britain
No. of seats	2

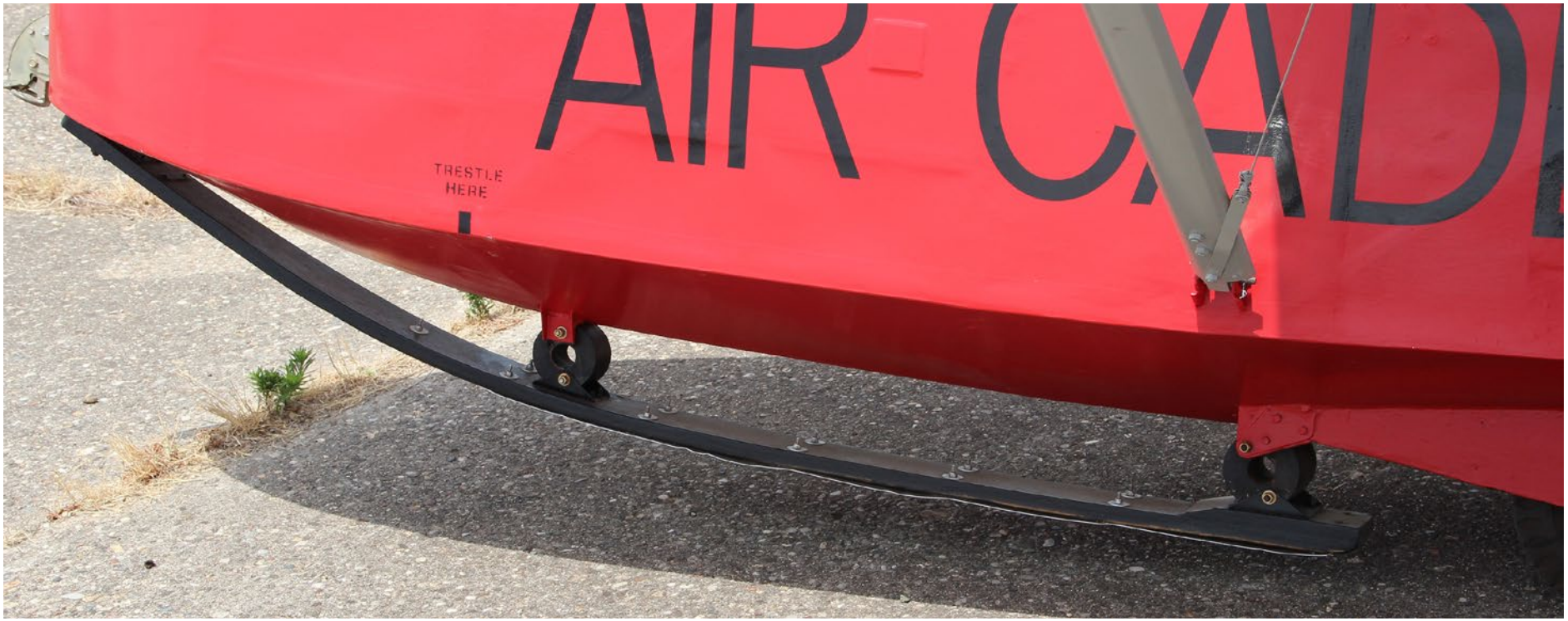



WABASH VALLEY SOARING
AIR CADETS


AIR CADETS
WT902


WT902


AIR CADETS


TRESTLE
HERE


CADETS
WT90


NO HANDLING ON


T-31B
NO HANDLING ON
N12885


TRESTLE
HERE
065


T-31B

Resurrection

Waid Reynolds, waid@waidreynolds.com

Thirteen long years after its uncontrolled vertical dive from high altitude into an apple tree in Redmond during a thermal duration soaring contest at 60-Acres Park, my (now ancient) Laser 3-Meter RC glider, originally built by Doug Buchanan, has returned to flight. Shortly after that crash I lost interest in RC soaring, and dropped out of the hobby. The Laser was such a beautiful soaring machine that I hung onto its remains in spite of major damage that would ordinarily have resulted in a one-way trip to the dumpster. I just couldn't bear to part with it.

For some reason, last Fall (2013) I felt like getting the old bird back into the sky. Down here in the southern Utah desert they call that "a hankerin'." There's no explanation for it. It just happens.

I dug the bits and pieces out of storage, and was surprised that after more than a decade which included two moves all of the vital parts had survived. Many hours at the work bench, combined with small quantities of epoxy, foam, filler, glass cloth, and carbon fiber finally got all the major pieces stuck back together and more or less smoothed out.

There are still some minor cosmetic repairs needed on the leading edges of the wings. I figured those could wait until I found out whether or not the now somewhat heavier bird would fly well enough to make any further repair effort worthwhile.

Luckily, none of the six servos that actuate the control surfaces on the wings and tails were damaged in the crash. All they needed were new universal connectors soldered onto their wires.

The installation of a new Spektrum receiver and battery pack got all the servos re-energized. Thanks to the yellowed pages of rocket scientist Don Edberg's good ol' book describing in detail how to setup my ancient Futaba 8U transmitter (equipped with a Spektrum RF module) I was able to get the control surfaces moving in the right directions at about the right throws. Isn't this new (to me) technology great -- no frequency boards needed!

A trip to a local park for some hand-launched test glides showed the Laser to be in surprisingly good trim. Only the elevator needed a bit of adjustment. The old bird appeared to fly like new -- long, flat, smooth glides. Now, my problem is finding a way to launch it to thermalling altitude.

Unfortunately, there is no RC glider activity in this -- St. George, Utah -- area. So, I have no one to lean on to borrow their winch. My aged heavy-duty high-start has barely enough oomph left to get a 2-meter glider into the air. I may have to ferret out the pieces I once bought to build an electric winch, and try to complete that job. In the meantime, perhaps my wife will tow the glider behind her bicycle.

First launch of Laser 3M after completing repairs.

Happiness after the Laser 3M actually flew!

Two days after the above was written, I rashly sent the Laser up on the ancient high start, now more aptly named, “low start.” At least it held together. Optimistically, the glider may have topped out at 75 feet of altitude on the third and highest launch -- a headwind would have helped. Not long after leaving the parachute behind, the Laser unexpectedly started showing signs of light lift. A couple of lazy circles confirmed that a weak thermal was indeed working on this calm, cool, late afternoon in February. The Laser started gaining altitude slowly as it circled, then more rapidly until it was specked-out almost directly overhead.

Half an hour and a fun series of aerobatics later, I brought the glider in for a soft landing on the grass. What a pleasant surprise after all these years -- totally unexpected, and most satisfying. In spite of my rusty thumbs, the Laser flew even better than I remembered.

I was well-rewarded for the effort that went into resurrecting this vintage competition sailplane.

If an inexpensive, old tech (carbon & glass-over-foam wings & stab; glass fuse) glider like the Laser flies so well, I can’t help but wonder how the current generation of much larger, fully-molded, multi-thousand dollar gliders perform. They must be truly amazing!


15
F-CAPM