
Radio Controlled
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December 2021
Vol. 36, No. 12

# The New RC Soaring Digest

December, 2021
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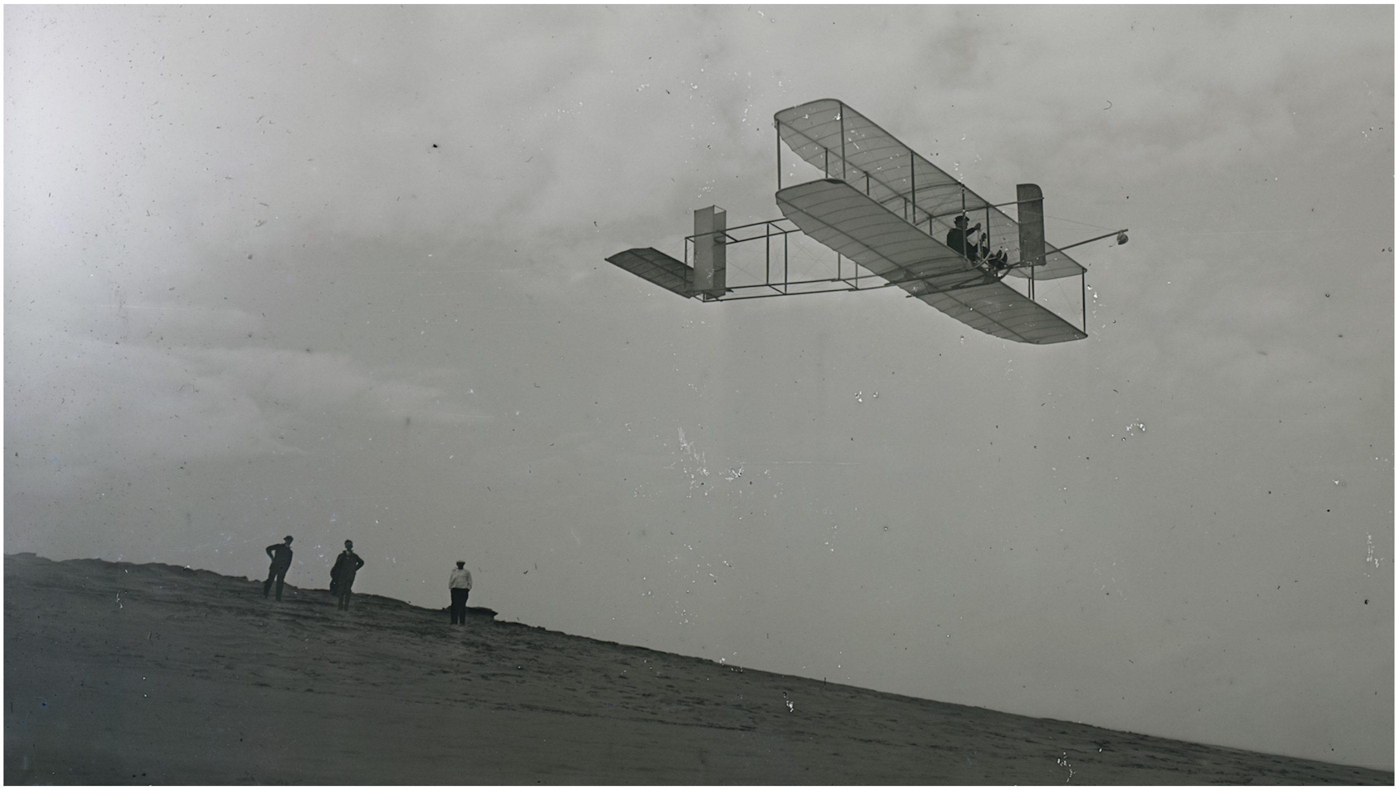
# In The Air

## December and the annual rite of Wright-mas.

Terence C. Gannon



“Orville, accompanied by his brother Lorin, his nephew Horace, and his friend Alexander Ogilvie, of England, arrived for the purpose of conducting gliding experiments with a glider resembling the Wright 1911 powered machine but lacking its motor.” — Arthur G. Renstrom. (image: Library of Congress)

Christmas was finished for me after my parents gave me a copy of *Aircraft Aircraft* by John W.R. Taylor. That would have been my sixth or seventh birthday.

Make no mistake about it, though; I was still happy to go through the motions and collect my Christmas booty from under the tree and to gorge myself on the dinner bounty my mother presented a few hours later. Not that I was really hungry. I had already demolished the Terry's *Chocolate Orange* shortly after reaching past the tchotchkes and pulling it from the toe of my Christmas stocking. It had 'magically' appeared at the foot of my bed in the wee hours of Christmas morning.

You see, after reading Taylor's book and its coverage of the early pioneers of aviation, the rather fanciful, hocus pocus festival on the 25th came in a dim and distant second place to a much more significant event occurring eight days before. On my calendar that was, of course, *Wright-mas*. It falls on December 17th each year and celebrates the Wright Brothers first successful powered flight at Kitty Hawk, North Carolina in 1903.

With the publication of the popular, acclaimed biographer David McCullough's *The Wright Brothers* in 2015, the full story of the Wrights — which extends many years both before and after the December 17th milestone — has become much more well-known. Deservedly so. I understand the film rights for McCullough's book were snapped up by Tom Hanks long before the book ever saw your nearest Barnes and Noble or Waterstones. I'm not sure about anybody else but I can't wait to see what Hanks' capable hands produce on the screen, either large or small. For those who really want to go Wright-crazy, though, I highly recommend *The Bishop's Boys: A Life of Wilbur and Orville Wright* by Tom D. Crouch. In fact, if the ship is going down and you only have time to read one, I would actually recommend the latter.

"Glider at Kitty Hawk" in 1911. Note the shadow of the photographer in the foreground. (image and quoted caption: Library of Congress)

It was Crouch's book that first enlightened me to the fact that the Wright's success could hardly be contained to a single date. However, at the time, *The Dayton Evening Herald* reported (on the 18th) the Wrights' accomplishment at Kitty Hawk on par with a story about a massive fire at the Canby Building in Dayton and Secretary McAdoo's ascendency to the post of Police Commissioner. "Dayton Boys Fly Airship" was the terse headline in modest typeface, followed by the pronouncement that the "problem of aerial navigation solved". And on to the other news of the day.

There are two things which particularly impress me about the Wrights' story as told in *The Bishop's Boys*: the first is the stunningly meticulous research program the Wrights set up in their Dayton bicycle shop. It's attention to detail and rigour would be a worthy model for any present-day technology development program. The eventual success of the Wrights was in no way guaranteed. But their approach gave them the best possible chance of succeeding. Their tenacity in the face of persistent failure is also breathtaking. During this period they strenuously avoided the spotlight — a refreshing contrast to today where apparently it's okay to be famous simply for being famous. It seemed the Wrights eventually wanted the work to speak for itself — whether it be a success or failure.

"Three-quarter left rear view of glider in flight at Kitty Hawk, North Carolina" in 1911. (image and quoted caption: Library of Congress)

The second remarkable fact about the Wrights from Crouch is their accomplishments were not immediately recognised: worldwide acclaim for what they accomplished really only came *five years* after the fact and ironically, across the Atlantic in Europe. In 1908 the brothers demonstrated a much more refined Wright Flyer at the Hunaudières race course at Le Mans, France in 1908. Yes, the Wrights actually had to *leave* the United States in order to finally receive the recognition they so richly deserved. Yet, you don't read about them complaining. Besides, the Wrights were likely too busy for any of that. During this period they were preoccupied with trying to protect the intellectual property of their invention. An effort, sadly for them and great for the rest of us, never amounted to very much.

In a complicated world full of opposing forces trying to tear us apart, I think most of us can agree the Wrights represent the very best of American creativity, ingenuity, industriousness and entrepreneurial drive delivered in a quiet, unassuming, self-effacing presentation. I would go so far as to say if your kids want to grow up to be more like the Wrights, as a parent, you could do *much* worse.

"Group portrait in front of glider at Kill Devil Hill. Sitting: Horace Wright, Orville Wright, and Alexander Ogilvie; standing: Lorin Wright, and group of journalists, including Van Ness Harwood of the New York World, Berges of the American News Service, Arnold Kruckman of the New York American, Mitchell of the New York Herald, and John Mitchell of the Associated Press" (image and quoted caption: Library of Congress)

Recently, I was reminded of the absolutely essential role gliders played in the Wrights remarkable story. Both before the fact, in order to develop their eventual powered variant, but also *after*. As late as 1911 — and perhaps even later — the Wrights were still experimenting with gliders, slope soaring to a record of nine minutes and 45 seconds aloft over the familiar dunes at Kitty Hawk, on October 24 of that year.

Knowing the Wrights as they are portrayed in their biographies, it's reasonable to assume they were still working in pursuit of incremental technical improvements to their flying machines to make them more commercially viable —hunting for a little competitive advantage in an increasingly competitive field.

But I also like to think they might have been at the top of a beach dune in that fall of 1911 for the same reason as the rest of us: because there is nothing quite like the magic of launching out over the slope and harnessing a rising column of air with a motorless aircraft under our control. In other words, they were slope soaring at Kitty Hawk that year because it was **just so much fun**.

Taking that speculation one step further, I believe if we could improbably teleport the Wrights over the space-time continuum to the present day, they might just be spotted at our favourite slope carving it up with the rest of us.

I never blanch or balk at being asked about my obsession with 'toy gliders'. I rest easy in the quiet knowledge that while what I produce out of the shed in the backyard may not change the world — as the Wrights' inventions did — 'I stand on the shoulders of giants' as I tackle my latest project and dream about what might be.

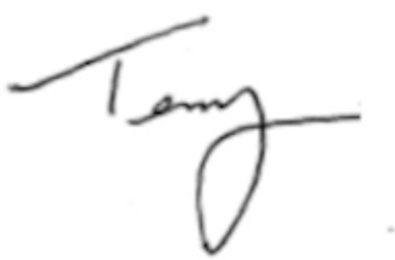
I have likely overstayed my welcome for this month, so I'll simply direct you to the links below to launch into the December RCSD. You'll be glad you did because it's jam-packed with great articles.

Before I finish though, I want to humbly thank all of you who have joined and stayed with us over the course of the first year of the relaunch of the New RC Soaring Digest. Without the steadily growing readership, RCSD is nothing. I would also like to express my deep gratitude to all who have contributed to the 12 issues so far. RCSD would also *quite literally* be nothing without you.

Finally, for the first time as Managing Editor I have to navigate the tricky minefield of year-end greetings. I realise there are any number of wonderful celebrations and cultural traditions at this time of year, both religious and non-religious in nature. At the risk of leaving anyone out and offending someone through innocent oversight, on behalf of RCSD I'll simply wish all of you all the best in whatever way you mark the season. Including not marking it at all, if that's your choice. Regardless of whatever variations in celebrations we might have, we are united in the pursuit of a decent flight and a landing that leaves us with just one piece to carry home at the end of the day.

That said, being the hopelessly lapsed son of English descendants of Irish Catholics, it is my family's tradition to personally wish all of you a very Merry Christmas. Also, given that we won't be together again 'til the New Year, also on behalf of RCSD, I'll add my wish for you that 2022 brings you the very best of health, happiness and prosperity. And, of course…

Fair winds and blue skies!



***Cover photo****: For the December issue, we're once again featuring the photography of Alexandre Mittaz, accompanied this time by his friend AlainR. This beautiful winter scene was taken near Bern, Switzerland on January 10th of this year.*

*Here's where you can find the* ***first article*** *in the December, 2021 issue. Or go to the* ***table of contents*** *for all the other great articles. A PDF version of* *this edition of* In The Air*, or the entire issue, is available* ***upon request***.

# Silent Arrow® Wins New US Air Force Contract

## Significant order placed for smaller scale, ‘swarm’ variant of the GD-2000 precision guided cargo delivery glider.

The NEW RC Soaring Digest Staff


Silent Arrow®’s GD-2000 autonomous cargo gliders rolling off the assembly line in Irvine, California.

LOS ANGELES, November 29, 2021 — In a story RC Soaring Digest has been closely following since March of this year, Silent Arrow® of Irvine, California just announced a significant new contract with the US Air Force based on a new variant of their commercially successful GD-2000 cargo delivery glider. From their press release:

> *Silent Arrow today announced the United States Air Force, through the Air Force Research Laboratory (AFRL), has awarded the company a contract entitled "Guided Bundle Derivative of Silent Arrow® for Side Door and Palletized Swarm Deployment at High Speeds and Altitudes" effective November 12, 2021.*

In order to provide more flexibility and mission effectiveness, between three and four of these smaller scale, approximately 225kg gliders will be put into a 'bundle' and deployed as a unit. Each glider is capable of carrying approximately 160kg of payload and is just one metre in length. Once the bundle has departed the delivery aircraft, the gliders will separate and each will be able to carry out their own, independent, autonomous flight plan.

While leveraging the experience of Silent Arrow's larger scale GD-2000 cargo glider, this new appoach also enables a wider range of delivery aircraft and modes: from the side door of a civilian Cessna *Caravan* ideally suited for humanitarian missions, right through to the US military's logistics workhorse, the C-17 *Globemaster* wherein the bundle will be dropped from the aircraft through the rear cargo door.

In a statement following the announcement aviation pioneer Chip Yates, founder and CEO of Silent Arrow®, said:

> *"We'd like to thank the U.S. Special Operations community, the U.S. Air Force, Navy, Army and various other organizations who signed on to support this award for a new life-saving cargo delivery drone. We look forward to an exciting flight test program in 2022 and quickly getting this new capability into the hands of the warfighter and disaster relief organizations alike."*

The new aircraft will be manufactured in the USA at Silent Arrow®'s facility in Irvine, California. Testing will occur at the Pendleton UAS Test Range in

Pendleton, Oregon.

RCSD will continue to track this exciting project — one of the few using commercialized glider technology — as it continues to evolve and will bring RCSD readers the latest, breaking news when its available.



## Resources

- Silent Arrow® Company website.
- Air Force Research Laboratory
- Pendleton UAS Test Range
- *Autonomous Glider Technology Wins Air Force Contract* RC Soaring Digest, March, 2021
- *Update on Silent Arrow* RC Soaring Digest, June 2021

*All images provided courtesy Silent Arrow®. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

# Letters to the Editor

## So what's in the ol' mailbag this month?

[The NEW RC Soaring Digest Staff](https://medium.com/rc-soaring-digest)

## Appreciates Garrison Articles

Your November issue is great and I particularly enjoyed reading about Peter Garrison, both your reminiscences and his. I passed this on to a good friend that I knew would enjoy those articles, as he and his wife did a circumnavigation in a single engined Piper Comanche a couple of years ago.

Barry Payne and I joined the Air Force on the same course in 1963 and we have stayed loosely in touch over the years. We both joined in ground trades, he as an instrument tradesman while I was engines. He went off on a different career path and became an Iroquois pilot, continuing flying both helicopters and fixed wing aircraft throughout his working life.

He told me he was delighted with the Peter Garrison stories and in return sent me a link to an article he wrote on the trip he and Sandra did. They documented their ongoing adventure on a website, posting regularly, sometimes while in the air, and that was interesting to follow at the time. They have been pretty low key about their achievement, not seeking any media recognition, but I think it was a significant event and deserving of celebration. A circumnavigation by a couple in their seventies, flying a 57 year old aircraft that Barry maintains himself is quite a feat.

Barry mentioned that his recently-published article *Around the World in ZK-BAZ* would be of interest to you. You can find it in the most recent edition of *New Zealand Sport Flying* magazine. Certainly Peter Garrison faced different problems and Cliff Tait, who Barry mentions a lot in his article, was operating at a different level again. His was a truly epic journey.

Regards,

Rex Ashwell
Blenheim, New Zealand

*It's always a good day when I hear from you Rex and thank you very much for the complements! Barry's article is **well worth** readers tracking down at the link above. For folks our age, Barry and Sandra's example truly imbues us with the notion that the best years of our lives may yet still be ahead. For readers who may have missed them, the three Garrison-related articles can be found in our November issue.— Ed.*

*Send your letter via email to **NewRCSoaringDigest@gmail.com** with the subject 'Letter to the Editor'. We are not obliged to publish any letter we receive and we reserve the right to edit your letter as we see fit to make it* *suitable for publication. We do not publish letters where the real identity of the author cannot be clearly established.*

*Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

# The Gull

## A modern take on a classic.

Thomas Martino

Test flying the Gull at the cradle of aviation: Kitty Hawk, North Carolina. This was almost 110 years (to the day!) since the Wright Brothers were there slope soaring on their 'day out at the beach'.

## Background and Inspiration

The *Gull* project began on the morning of March 30, 2021. I was talking to some friends in an RC soaring chat room when I learned there would be a scale soaring aerotow event at a field near me in one month's time. I was still furloughed from work but I had just received my COVID-19 vaccination and I was excited to finally go to a flying event. The only problem was I didn't have anything to fly. I had a handful of two or three meter thermal gliders, but nothing appropriate for a scale aerotow. I'm an avid scratch builder and it didn’t take long for my friends to challenge me to build something for the event (or maybe I challenged myself and chose to blame them). We decided that something in the four meter range would be the most practical. I was ready to get started, but what exactly should I build? The time constraint made a true scale project out of the question, and I prefer designing my own planes anyway. I decided to design something that captured the essence of a vintage sailplane, but with a more modern feel.

I had recently become fascinated by vintage sailplanes and had spent some time studying photos of them. I fell in love with gull wings and sunlight shining through cloth covering. The gull shaped wing had to be a feature of my new plane. I studied photos of gliders like the Slingsby *Petrel*, Slingsby *Gull*, and Göppingen *Minimoa*. Their subtly gull shaped wings are elegant, but I didn’t want to go through all the trouble of building a gull wing to be subtle. I wanted the wing design to be a prominent feature. I contemplated how much dihedral I could give the inboard wing sections before they became absurd. I took a few minutes to look at golden age free flight models, many of which feature exaggerated gull wings like what I envisioned. I wanted the fuselage to bridge the aesthetic gap between wooden gliders and their sleek fiberglass counterparts. The outline of my new plane was beginning to materialize in my mind. This is my favorite part of starting a new project. All the daydreaming and imagining slowly morphing into a solid idea, ready to be put down on paper and ultimately brought to life with countless bits of wood.

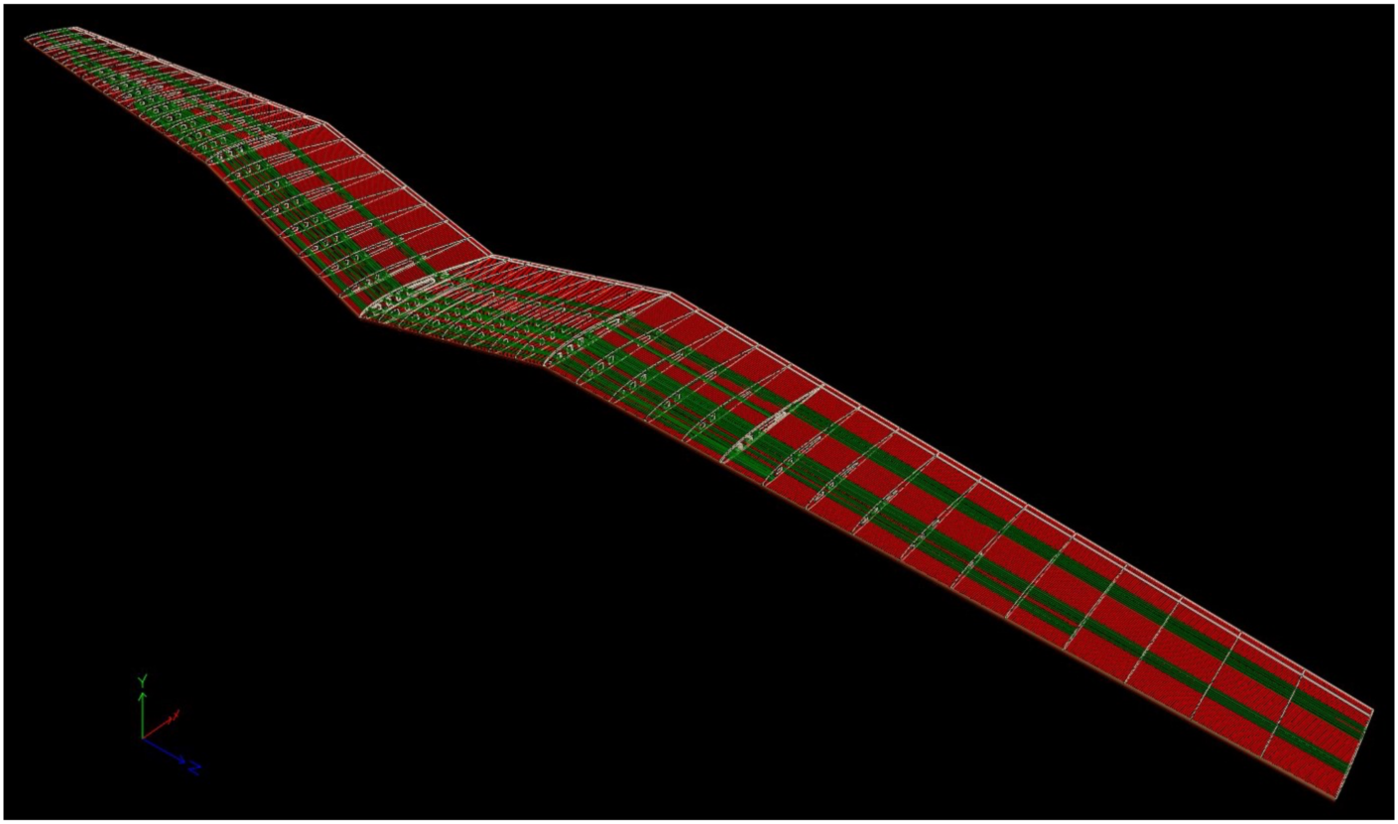
By this time I felt sufficiently inspired to sit down at the drafting board, or CAD program as it were. I was equipped with a well-stocked workshop and an abundance of free time. The race was on to build a new glider in 30 days.

155 days later it finally took flight.

# Design

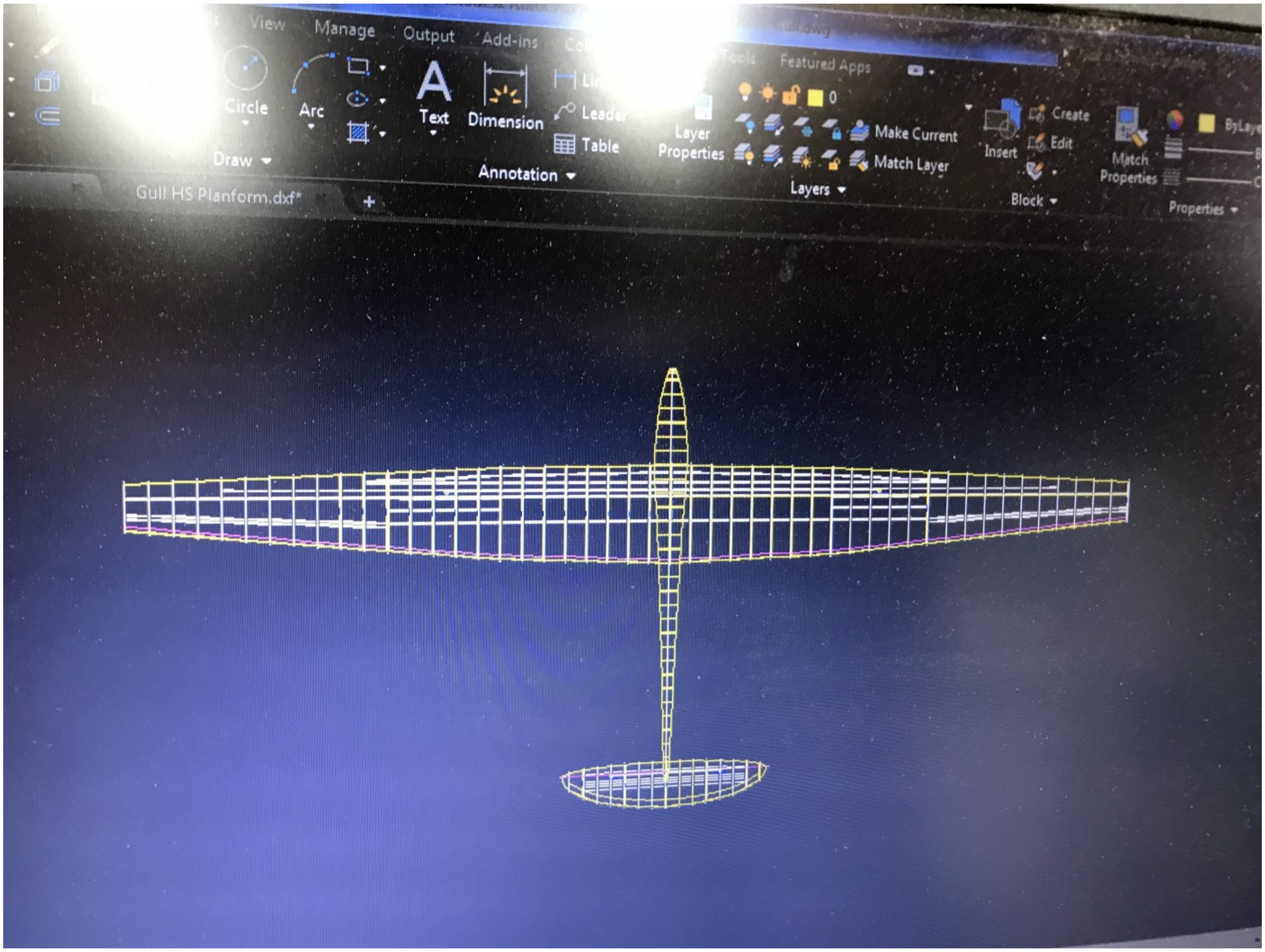
Now that I had established some broad design criteria it was time to dive into the details. I like to start with the wing and design everything else around it. Most of the design work took place in CompuFoil 3D. Step one was choosing an airfoil. I turned to Mark Drela's proven AG series. The inboard wing panel uses the AG35 airfoil and the outboard panel transitions from AG35 at its root to AG38 at the tip.

Next, I spent some time experimenting with different planform options. The temptation to build an elliptical gull wing was huge, but sanity prevailed and I settled on a simple tapered design. The inboard panel's root chord is 14″ and tapers to 12.5″ over its 24″ length. To establish the distinctive gull wing look, the inboard panels have a dihedral angle of 15 degrees. The outboard panel tapers from 12.5″ to 6″ over its 48″ length. The outboard panels have no dihedral. Small wingtips would be added later to round out the tips. With the wings mounted on the fuselage the wingspan would be 12′ 8″ or about 3.85m. The goal was to maximize wing area without sacrificing the aspect ratio too much. The wing area is 10.6 square feet and the aspect ratio is 15. I decided the wings would have ailerons and spoilers but no flaps. Once I finished defining the wing parameters I exported a planform view to AutoCAD where I could sketch out the fuselage shape and proportions.



The wing structure was designed with CompuFoil 3D.

The fuselage was the most challenging part of the design. I wanted to meld a retro looking wood fuselage with the shape of more sleek and modern composite designs. After a bit of trial and error I finally had something that looked proportional to the wing. Armed with the critical dimensions, I switched from AutoCAD back to CompuFoil to refine the profile shape and create the formers. This was a bit more of a challenge than I anticipated! After five iterations I was finally happy with the results. There are 15 formers spaced at 4′′ intervals for a total length of 60′′ not including the vertical stabilizer. The formers have jig holes so they can slide onto a metal pipe to keep everything aligned during construction.




Working out the fuselage and tail proportions relative to the wing, using AutoCad.

Lightness was a concern throughout the design process. Lightening holes were incorporated wherever possible. I planned to use balsa for everything I could and only use plywood when balsa was impractical or structural loads dictated it. I did not have a specific target weight in mind for the project; I was just shooting for less than ten pounds.

The tail surfaces were much easier to design than the fuselage. With the wing span, wing area, and fuselage length already defined, I had all the information I needed to calculate the vertical and horizontal tail volumes necessary for controlled flight. Once I knew the target surface area, I experimented with different spans, planform shapes, and chord lengths until

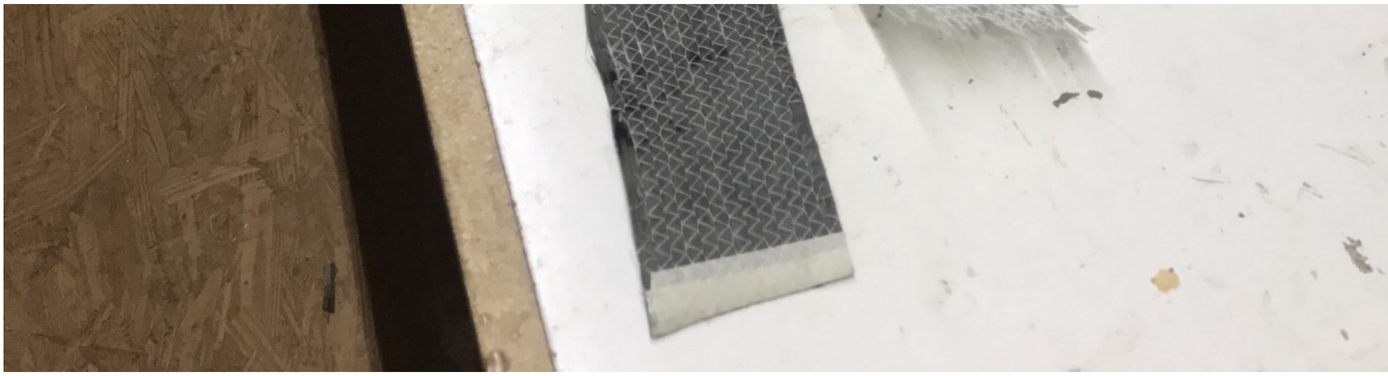
I felt like they fit the aesthetic of the plane and met the aerodynamic requirements. The horizontal stabilizer features a modified elliptical planform and uses the HT14 airfoil at the root and transitions to HT12 at the tips. The span is 30″ and the projected area is just over one square foot. The vertical stab was only loosely defined at this point. I knew how big it needed to be, but the design didn't crystallize until after construction began.

It's important to remember that I was working as quickly as possible to meet a deadline. By this point it was late at night on March 30. I went from inspiration, to design, to CAD drawings in one day. Of course, not everything had been fully thought out yet. Drawings for the vertical stab, wing mount, and landing gear mount wouldn't be done until the build was underway. It was time to get some sleep. The next day would be a build marathon.

## Construction

I walked into my shop the morning of March 31 filled with enthusiasm. Construction began with the wing spars. I had never built a gull wing before, but I knew that strong accurately shaped spars would be the key to success. The joint where the inboard and outboard panels met at a 15 degree angle would be under a lot of stress, so the spars needed to be made in one piece to effectively transfer flight loads. The spar design was pretty standard. The top and bottom caps are 1/8″ thick by 1/4″ wide made out of hard balsa reinforced with carbon fiber and fiberglass. 3/32″ thick vertical grain balsa shear webs complete the beam structure.

To accurately produce the 15 degree bend in the spar stock I made a jig out of MDF and covered it with tape and mold release wax so the parts wouldn't stick. I cut 3″ wide balsa sheets to the right lengths; then prepared 3″ wide strips of unidirectional carbon fiber and fiberglass. The composite reinforcement is thicker at the wing root and tapers to only two layers at the tip. The layup is one full length piece of unidirectional fiberglass plus four layers of unidirectional carbon fiber that start full length and get progressively shorter. The idea is to maximize strength at the wing root and minimize weight at the tip to reduce yaw inertia. The layup was vacuum bagged on the jig and left to cure overnight.



Preparing materials for the spar layup.

April 1 was a productive day. I laser cut the parts for the horizontal stabilizer and assembled it. Next, I laser cut the main wing ribs out of 3/32′′ balsa. I opened up the vacuum bag and popped the spar blank off the form and carefully cut it into quarter inch wide strips on the table saw. Wing assembly could finally begin! I used the spar form as a jig to build the wing on. Starting with the left wing, I clamped the bottom spar to the jig and glued on the ribs. Then I glued in the top spar cap, the leading edge strip, and the small 1/8′′ stringer spars that support the leading edge sheeting. By this point the wing was stiff enough to remove it from the jig and glue in the remaining stringer spars and the trailing edge pieces while being careful not to build a twist into the wing. After repeating the process with the right wing I switched my attention to the fuselage.

With nothing to support the trailing edge it was important to pay careful attention to alignment while assembling the wing.

Horizontal stab under construction.

I laser cut the fuselage formers out of 1/8′′ poplar lite ply, then slid them onto the metal tube that would act as a jig to keep everything aligned. I wanted the stringers to be full length but the Sitka spruce I had was only 48″ long. I looked through my wood stash to find something long enough and found some old growth spruce from a 1912 pipe organ that I had salvaged after a church disassembled it. The wood had tight, straight grain and its old age made it a perfect fit for my vintage inspired sailplane. I cut the spruce into 1/8″ square sticks and began assembling the fuselage. Most of the stringers had to bend pretty far to conform to the fuselage's curves. There was no good way to clamp or pin them to the formers while wood glue or epoxy cured, so I used CA. CA glue and spruce don't get along well, but baking soda can be used as a catalyst to help them bond. Balsa sheeting and trusses would be added later and would essentially gusset every joint to reinforce the brittle CA joints. Life got in the way a bit, and work continued sporadically from April 2 to April 9.

Formers jigged up and stringers partially installed.

On April 9 I took the partially completed wings, fuselage, and horizontal stab outside and set them up so I could see the plane take form.

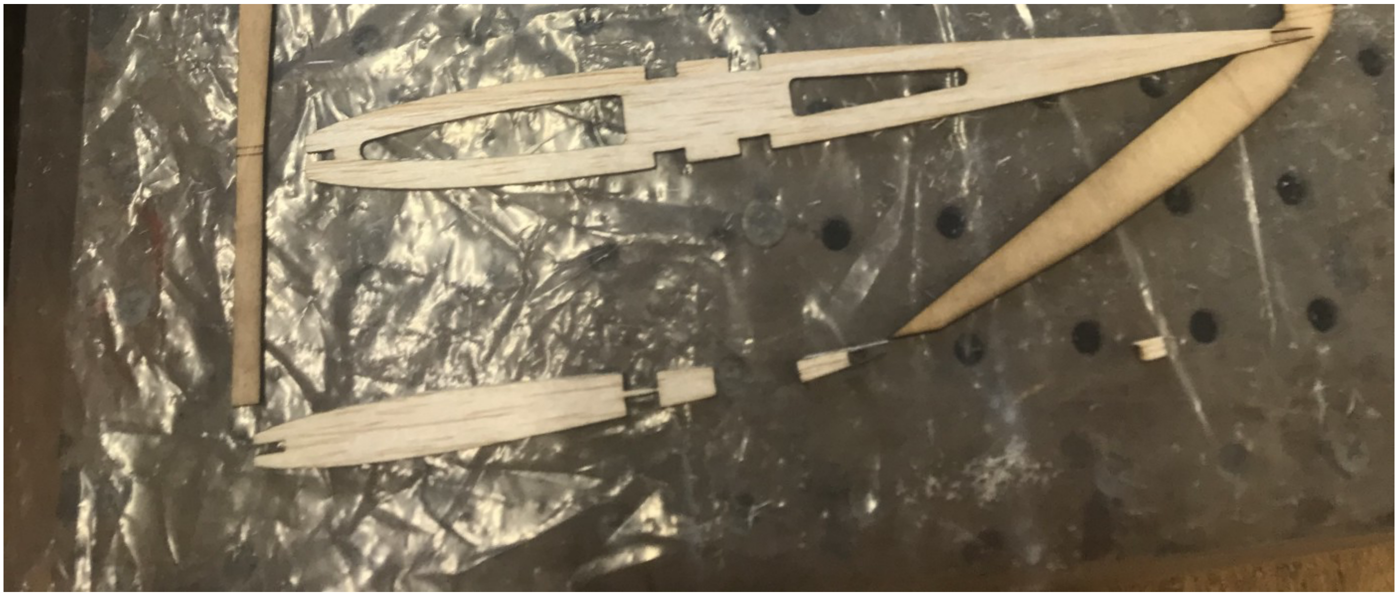
The plane's size makes it challenging to assemble inside my shop, so this was the first time I saw the wings and fuselage together.

Inspired by my progress, I continued to work diligently for the next ten days. The wing mounts were designed and built during this time. The front half of the fuselage was sheeted with 3/32″ thick balsa. The top and bottom of the aft portion were also sheeted, but the sides were left open and would later receive diagonal trusses. This was partly to reduce weight in the tail and partly because I love the look of open framed construction. The nose was shaped out of a block of balsa.

Making round parts out of balsa is always satisfying.

The plan was to use the fuselage as a form to create the canopy. My two attempts at making a clear plastic canopy failed, so I decided to move on to the vertical stabilizer and come back to the canopy later.

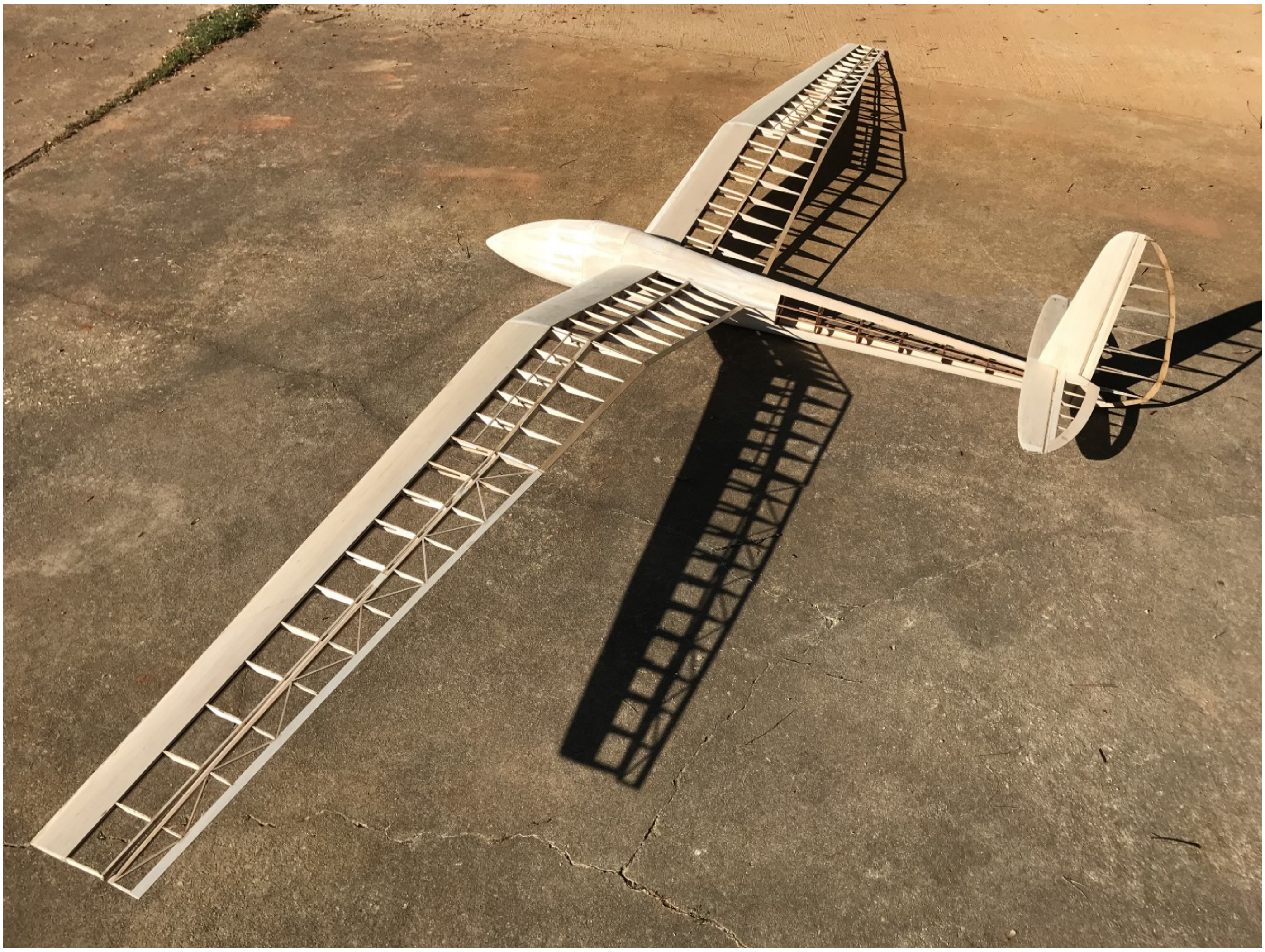
The fin features a straight leading edge with a rounded trailing edge. Laser cut leading and trailing edge pieces made assembly of this complex part fast and accurate.



The vertical stab is built as one piece, then the rudder is cut off and the gap is filled in with beveled balsa.

To finish up the wings I glued on the rest of the leading edge sheeting, taking the utmost care to prevent twisting or warping the wings as I went. I also glued in the diagonal trusses on the ailerons and cut 1/8′′ thick balsa to make the spoilers.

By April 19 the entire plane was framed up. I took it outside and mounted the wings. For the first time, I could see all the parts come together to form a complete aircraft. I spent about an hour walking around the plane admiring it and planning the next steps to complete the project.



It's really starting to look like an airplane!

That same evening I found out that the aerotow event was canceled. This came as a bit of a relief to me, as working around the clock to finish the project was exhausting. The task of completing and covering this large glider had become daunting. No longer faced with a deadline, I chose to slow down and savor the rest of the build.



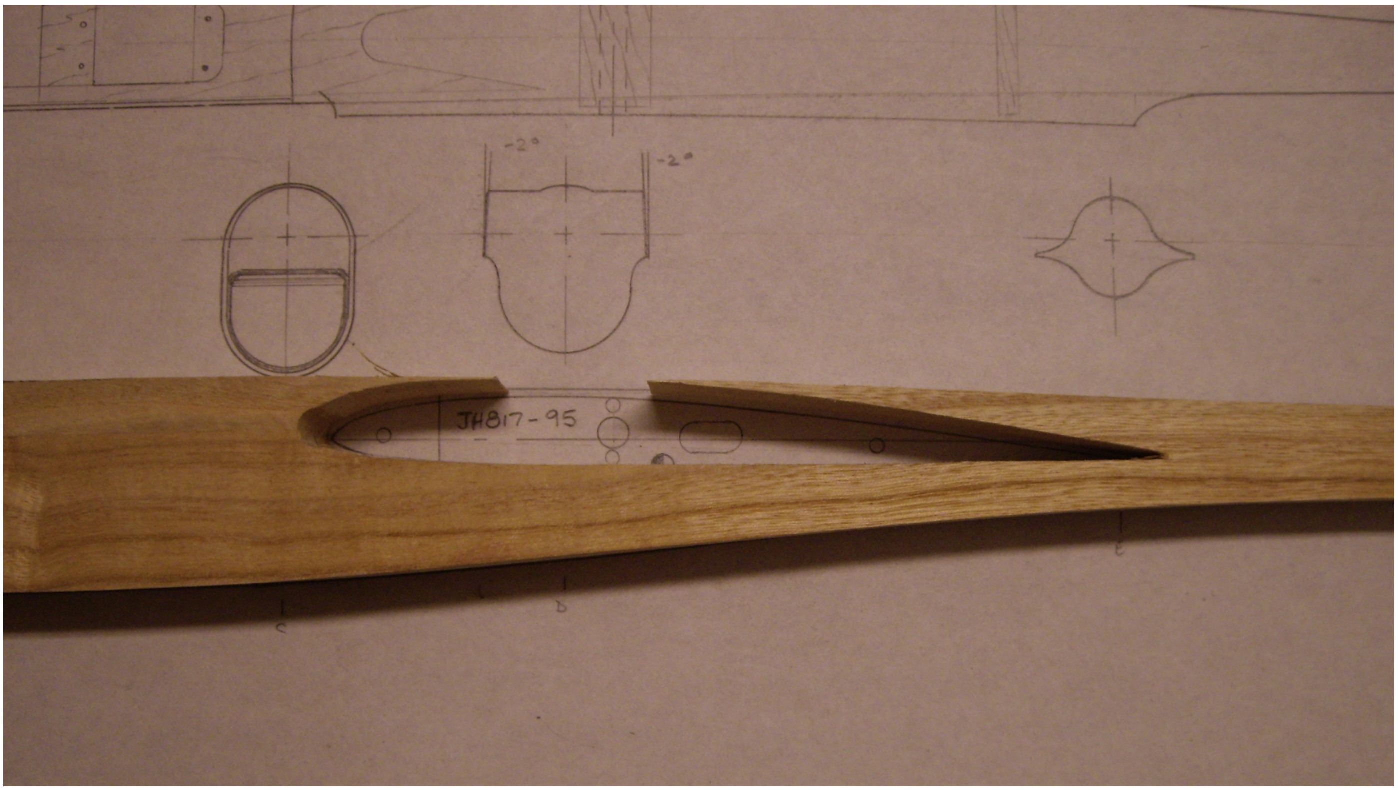
*This is the first part of a two part series. Next month, Thomas wraps up the build and talks test flying. All images are by the author. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of***

***contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

# Shinobi[1] | A Home-Grown Moulded Fuselage

## Part I: The Urge

James Hammond

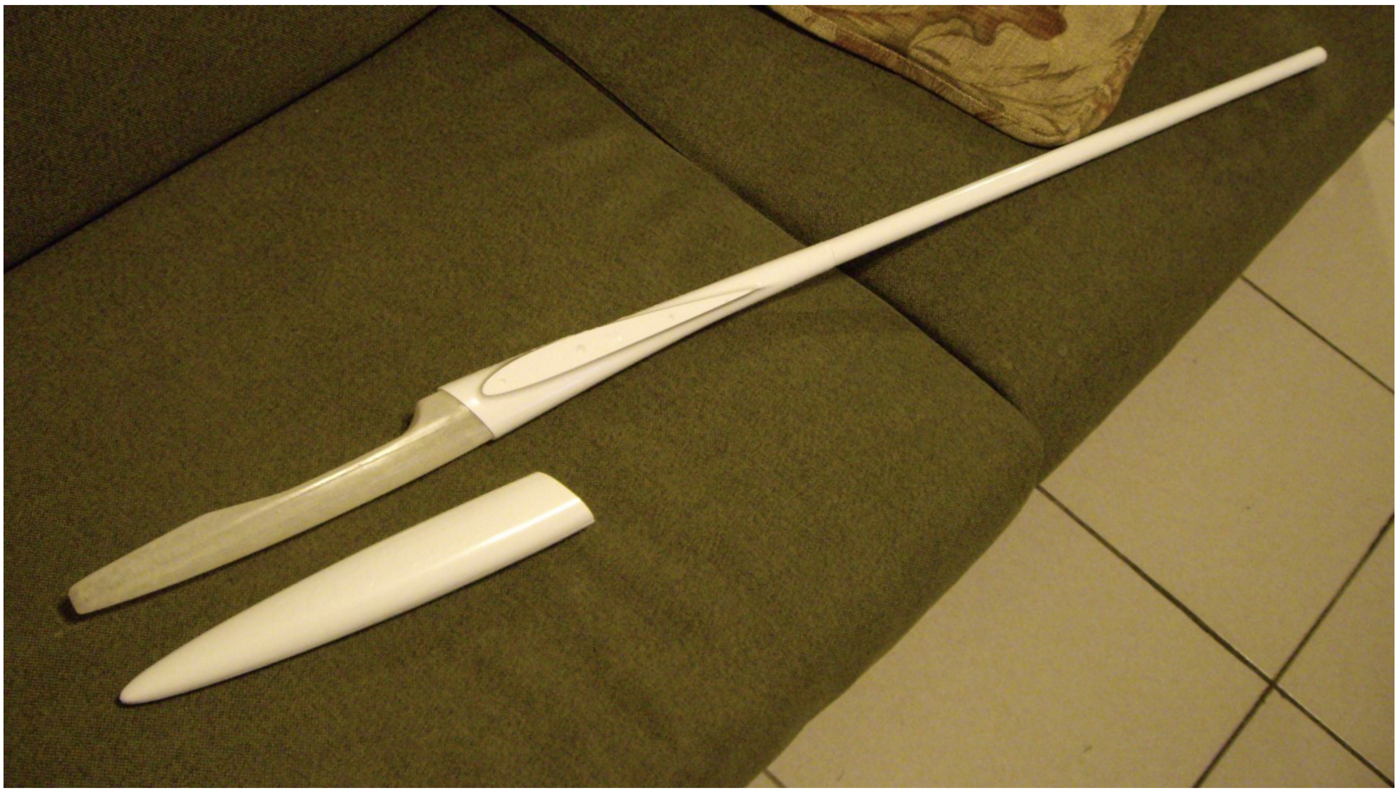



*Want to make your own fuselage? Or maybe make a replacement part for a broken model? Here's how to do it at home using the KISS[2] method. — JH*

I believe that many of you dearly beloved readers have often thought of making your own-design composite model fuselage. Looking at a model you might think: 'well if I that was a little larger to fit my radio' or maybe: 'I wish it had a really strong fuse for my Fred and Barney slope', or perhaps you just plain want to see your own work flying happily in the blue yonder — the list of reasons to embark on such a project is endless.

Well, if you do have the urge, here I will be writing a series of articles arranged as a blow-by-blow account which will tell you how I made a small fuselage plug, and then successfully manufactured the moulds with minimum tools and a very low investment. I'm not going to deal with it where processes are repeated, but I'll describe in some detail each new part and process.

Let's plug away!



Shinobi: a composite 4-part fuselage assembly for a small model of 50 to 70″ span made from a home-made plug/mould set.

## The Sketch

I'm not going to go through the procedures that I use to design the plane here (for that, see my design series in the *Resources* section below), because if you are going to make your own model then you will pretty much know what you want to make. But you'll need a drawing to work from, and ideally it should have both top and side views. I usually make a 1:1 third-angle pencil sketch of the fuselage to be made on paper — yes, I know, 'Old Skoo'l, but then I'm an old phart so what do you expect? For those of you whiz kids that are familiar with CAD, then of course you can use that medium to make your drawing, but make sure it can be printed out 1:1.

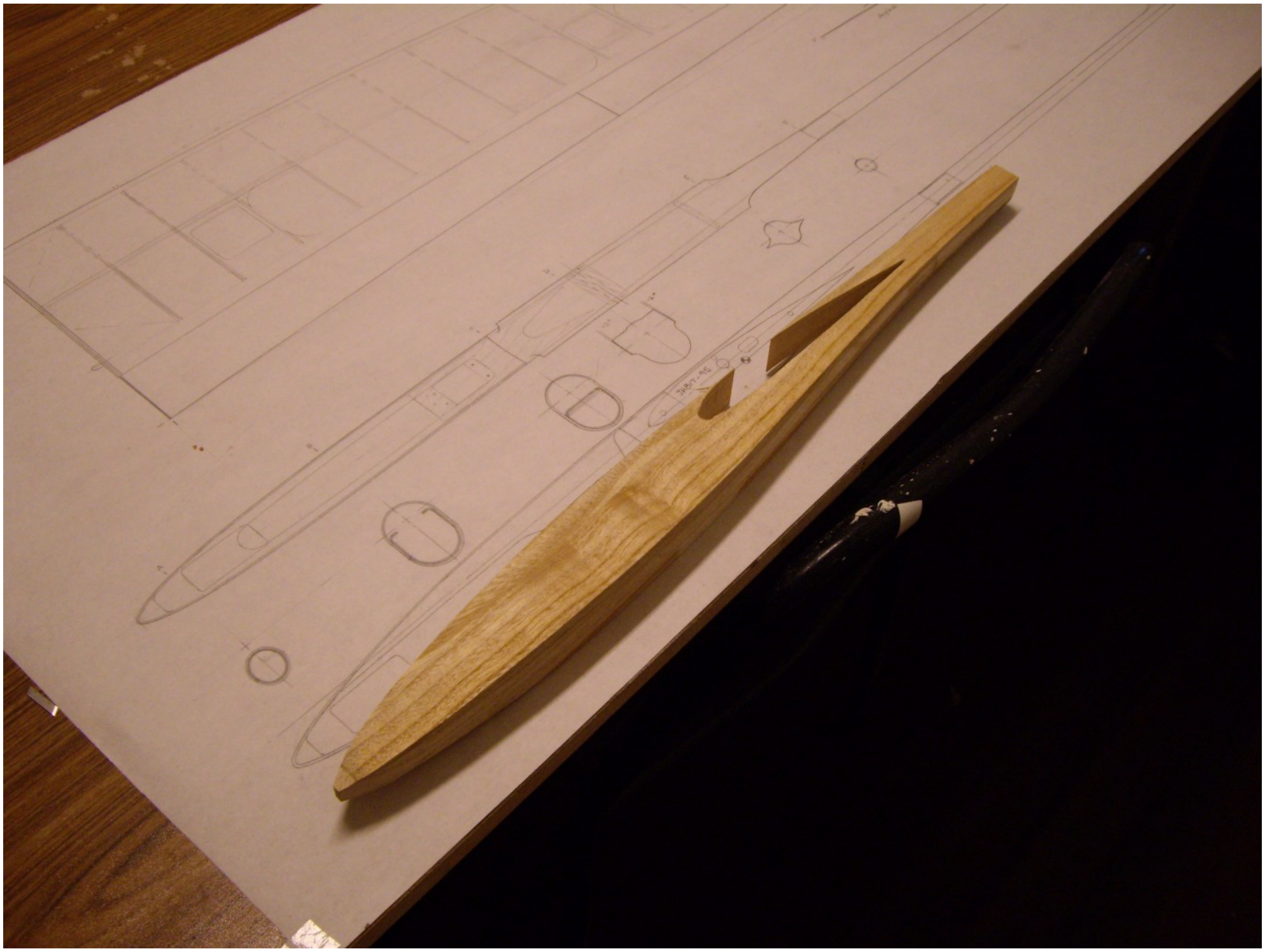
> ***Advice:*** *Before you start, take time to plan your work step by step. Things like a slip-on nose cone or a removable cap type canopy will have a big effect on what you do and when you do it in the process, but if well thought out can be easy to accomplish.*

## Keep Calm and Laminate

The first stage in the manufacture is to find some wood that is close grained but not too hard. Goodies are jelutong, and lime wood if you can find them, bass wood is OK — but it can be a bit tough to carve — while balsa is a bit too soft — and expensive. With the wood selected, you need to laminate it into a block that is slightly larger in all dimensions than the shape you want to end up with. A good idea is to use laminations each side of the vertical plane that leave one middle joint as the centre line for reference. Use a good aliphatic wood glue like *Titebond*, or epoxy and clamp the laminations tightly until the glue is cured.

> ***Advice:*** *The glued lamination lines can be a great help in carving and sanding to final shape. Comparing one side to another or top to bottom you can easily see if the carved curves are different.*

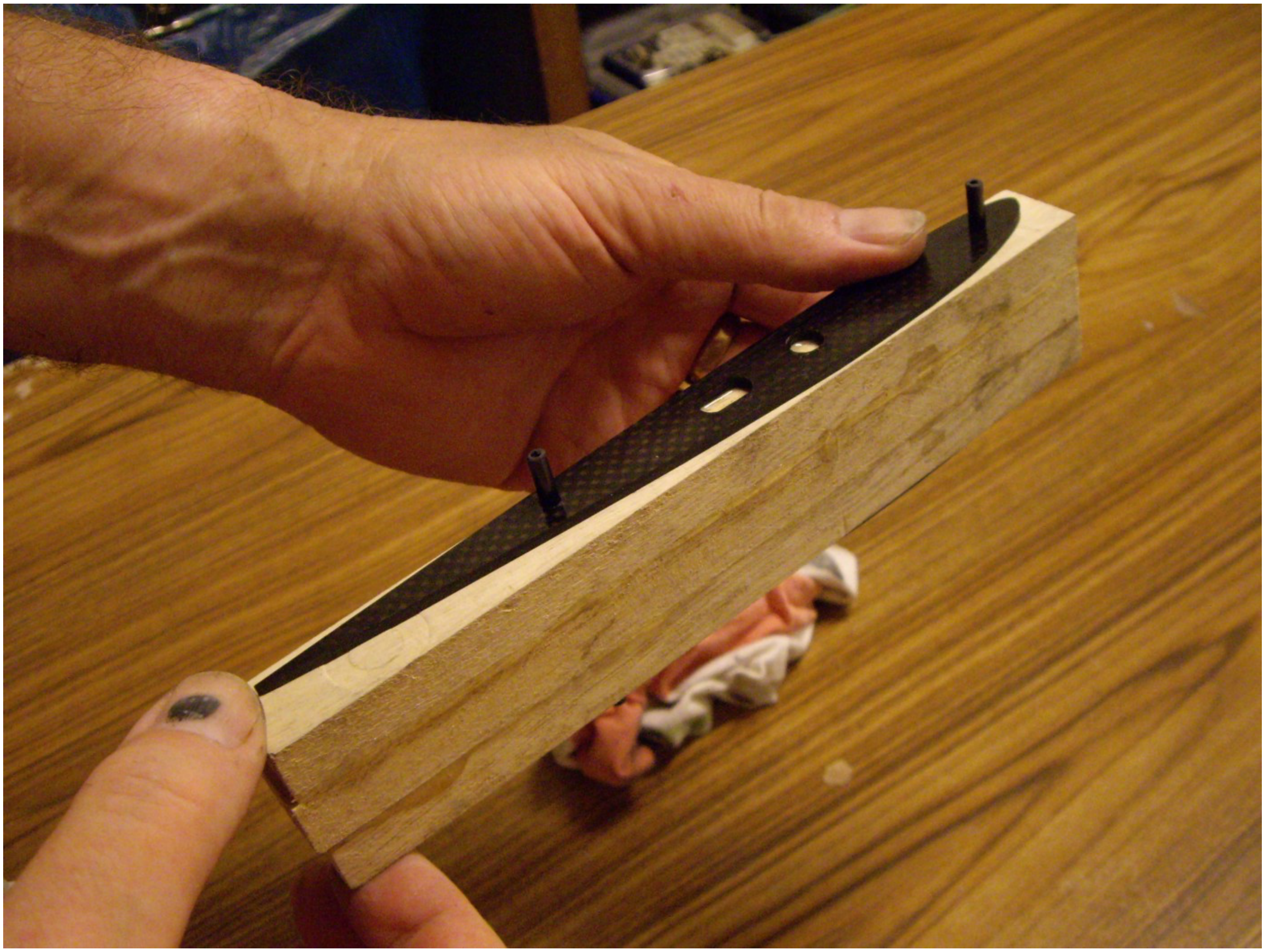
## Cutting the Outline



Fuselage side profile cut to shape. Note the pencil line 1:1 drawing.

Print out or use carbon paper to produce the fuselage side view, and then cut out and stick the cut-out shape to one side of your laminated block. When the glue is dry — I use simple paper glue or kids play glue — use a coping saw, or if you have one, a bandsaw or scroll saw to cut carefully around the fuselage shape, leaving it at least 1/8″ (3mm) larger all round. Don’t worry about cutting the top view profile to shape yet — we’ll do that later, after we have made the wing stub block. At this moment it’s a good idea to leave the plug with 90° sides to make cutting the wing stub block orifice out easier.

## The Wing Stub Block



Laminated wing stub block with carbon faces glued to both sides ready to shape. Note the extra material all round, and the wing alignment pins used to align the faces.

This step may or may not be needed depending on your design. I tend to make two-piece wings butting up to wing stubs on the fuselage a la F3F practice, but many people prefer a one-piece wing design with a wing saddle, especially in small models.

Making the wing stub block is not hard but you need to be careful to follow the aerofoil profile as closely as you can. As with the fuselage, a slightly oversized laminated block is needed and the wing profile printed and stuck to it as a guide; or if you want to make it even better, then simultaneously cut two identical wing profiles from carbon or G10 glass fiber sheet and use those not only as cutting guides but also as the actual hard moulding faces.

Use the wing alignment pin holes to line up the two facing pieces. You will also need to cut any openings that will have to be present in the win stubs such as alignment pins, joiner and MPX connector cavity outlines etc. Also remember that now is the time to arrange any dihedral you might want on the wing stub block and do it **before** you glue the hard faces on.

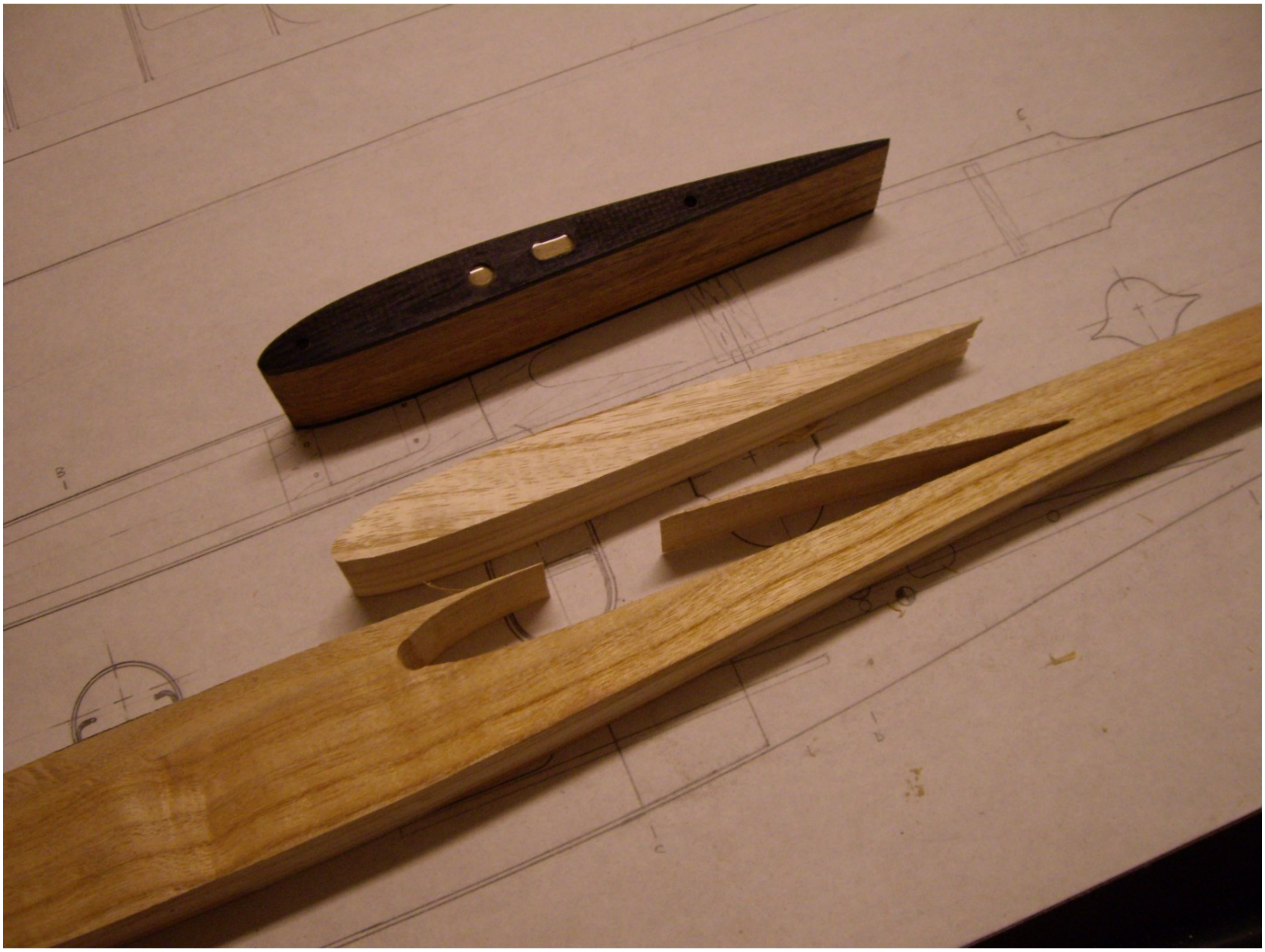
## Cutting the Wing Stub Space in the Laminated Fuselage Block

Use the accurately shaped wing stub block you have made to act as a guide to mark the cutting lines on the laminated fuselage block. Check the alignment carefully, then as with the fuselage outline, cut around the profile — only this time make the cut just *inside* the marked lines, so a tiny bit smaller than the wing stub. Then carefully remove the excess wood with a rasp followed by abrasive paper until the wing stub fits nicely, but don't fix it in yet.

Now, using just small dabs of glue, as little as possible, replace the wing stub wood that you have just cut out (not the wing stub block you have made) back into the space in the plug.

> ***Advice:*** *Be very careful and check before you cut the wing outline to make sure that the wing stub profile is correctly aligned along the fuselage blank. Is the angle of incidence (if any) correct?*
>
> ***Advice:*** *Giving the leading edge of the wing stub block a slight upwards angle will result in the model having a small nose-down flying angle — which gives an attractive predatory look when hunting up and down the slopes.*

> ***Advice:*** *Don't fix the wing stub block into the fuselage yet, instead, tack glue the part that you have cut out back into the fuselage. This part will be removed later and is only reinserted to help with the carving sanding of the fuselage plug shape, so just tack it back in — don't over glue.*

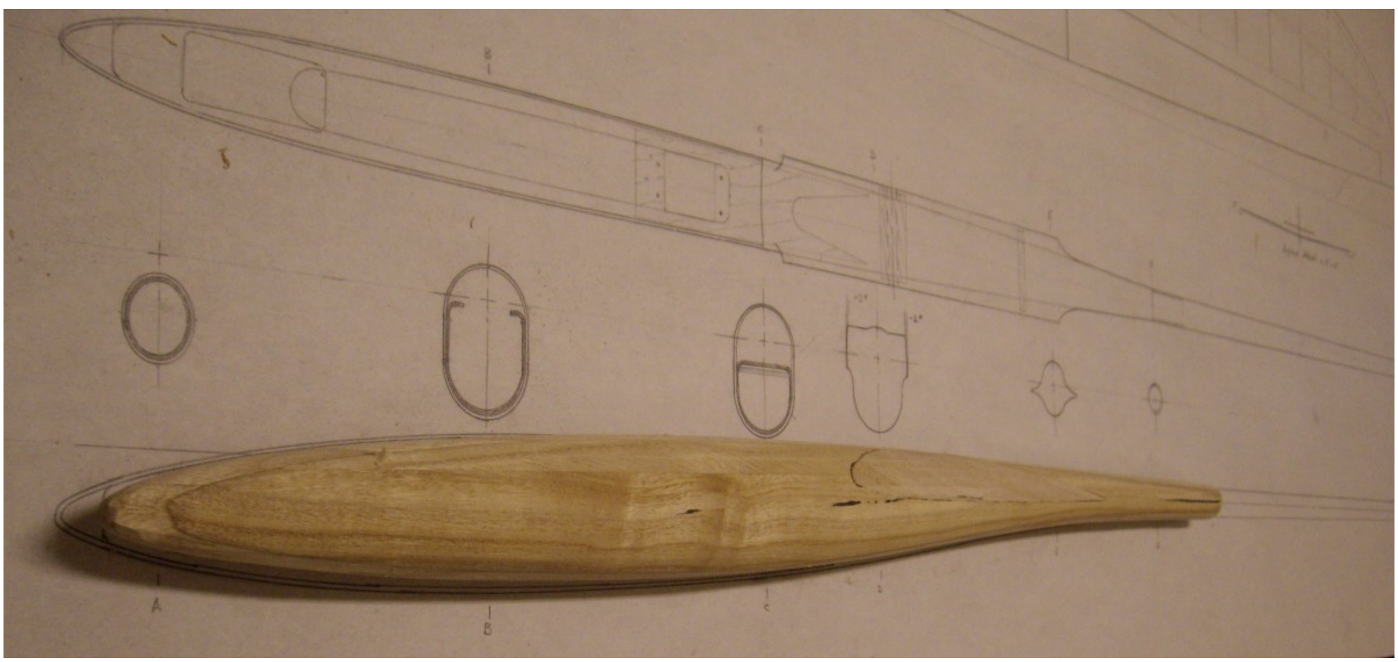


The wing profile that has been removed from the fuselage will now be tack glued back in to provide support when carving the final shape.

## Shaping the Fuselage Plug

The best way to continue now is to shape the top profile — or plan view, of the fuselage plug. First stick the paper cutout of the top view onto the top of the plug. It won't be 100% accurate as you have already shaped the side view — but it will still be a big help. Begin by using a small plane or a spokeshave to shave the plan view sides to shape. You'll see how the laminations are very helpful as a guide to how much material has been removed on both sides. Alternate between top and bottom, and work slowly as it's easy to get carried away with a nice sharp plane.

Check your work often during the shaping phase, adjusting your carving tool for finer and finer shavings as the plug takes shape. When you are happy that the profile is the correct shape in both side and plan views, begin to shave and round the corners. You can see now why we tack glued the cut-out wing blank back in and not the actual wing stub. It's now much easier to shape the fuselage block when the stub block is not in the way; the cut-out will give some meat' to allow you to shave the curves front to back and carve the shape nicely.



The fuselage positive takes shape. Note that the wing stub block profile that was cut out has temporarily been tack glued back in, thus allowing the final shape to be more easily realized.

The last part of this stage is to slowly and carefully rough sand the fuselage positive compound curves to shape. Use a sanding block and do work slowly because a mistake here is really quite hard to correct. As my father, a boat builder used to tell me, its 'glance of eye and touch of hand'.

> ***Advice:*** *Look at the lamination shapes often as you work: are they the same both sides? Top and bottom? If they are not the same then make the correction as soon as you see it. If you forget to do it you could end up with a strawberry coloured face and a banana shaped fuselage. Not recommended.*
>
> ***Advice:*** *Glance often and touch often — be critical, remember what you see, is what you get.*

## Last Caresses

Carefully carve any other features that you need. In the case of the Shinobi I wanted a tapered tubular rear end to my 'pod' design so that I could mate it with a tube to act as a boom and give adjustable length. That done, using a sanding block sand, sand, sand, constantly checking the shape side to side and top to bottom and gradually arrive at the perfect profile you want. Feel it, touch it, caress it, look at it from all angles and make it yours. Use ever finer abrasive paper until the wood has a sheen at about 320 grit. That's enough — no need to go finer than that.

> ***Advice:*** *ALWAYS use a sanding block and never, never use abrasive paper in your hand alone for shaping and finishing.*
>
> ***Advice:*** *Sometimes a block of rubber like a large eraser can be quite useful as a sanding block in taking off high spots on compound curves as it has a bit of flexibility.*
>
> ***Advice:*** *I often mark lines on the plug with a Sharpie to show that the profile is almost correct and just needs a little final sanding. This helps to*

> *eliminate the possibility of over sanding.*

The fuselage shape is rough (**very!**) carved. Note the wing cutout inserted and shaped along with the rest of the curves. You can just see the remains of marks made with a sharpie to remind me that I'm close to the final shape in those areas.

Next month— the wing stubs. Thank you for reading and if I can answer any questions, please post them below in the *Responses* section and I'll do my best to answer as many as I can.

[1]A shinobi was a covert agent or mercenary in feudal Japan whose functions included espionage, deception, assassinations and surprise attacks.Their covert methods of waging irregular warfare were deemed dishonorable and beneath the honor of the samurai. (Wikipedia)

[2]An acronym for "keep it simple, stupid" which is attributed to the one and only Kelly Johnson, one time chief of Lockheed's Skunk Works.



# Resources

- *The James Hammond Sailplane Design Series* Four articles covering all the design nuances of many of the popular RC glider configurations.

*All images by the author. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

# Spanish F5K Championships

## Taking place in Sevilla on 25th/26th of September, 2021, it was the first F5K national championships ever!

Nicolas Ridray

Juan Ramos and his refined homemade F5K version of the SuperGee.

In 2020, after approximately one year of work by Nederlander Brian van der Gouw, the introduction of F5K as an official category was approved at the CIAM plenary meeting.

## And What Is This F5K?

Its long name is *Thermal Duration Gliders for Multiple Task Competition with*

*Electric Motor and Altimeter/Motor Run Timer* (or AMRT).

It basically consists of performing several duration tasks with motor gliders of up to 1.5m wingspan, equipped with an altimeter that controls motor cut height and time.

Then the new F5K category appeared in the *Volume F5 Radio Control Electric Powered Motor Gliders 2021 Edition (*see *Resources* below for the link*)*.

In the south of Spain a great man, Luis Manuel Gonzalez, immediately expressed his interest in promoting the category.

Indeed, many contestants of the F5J electric gliders category miss some 'dynamism' in the 10 minute duration flights. Moreover, the extremely playful F3K became almost impossible for many pilots with physical limitations. The F5K seems to bring together the 'good sides' of both categories.

## A Spanish F5K Championship?

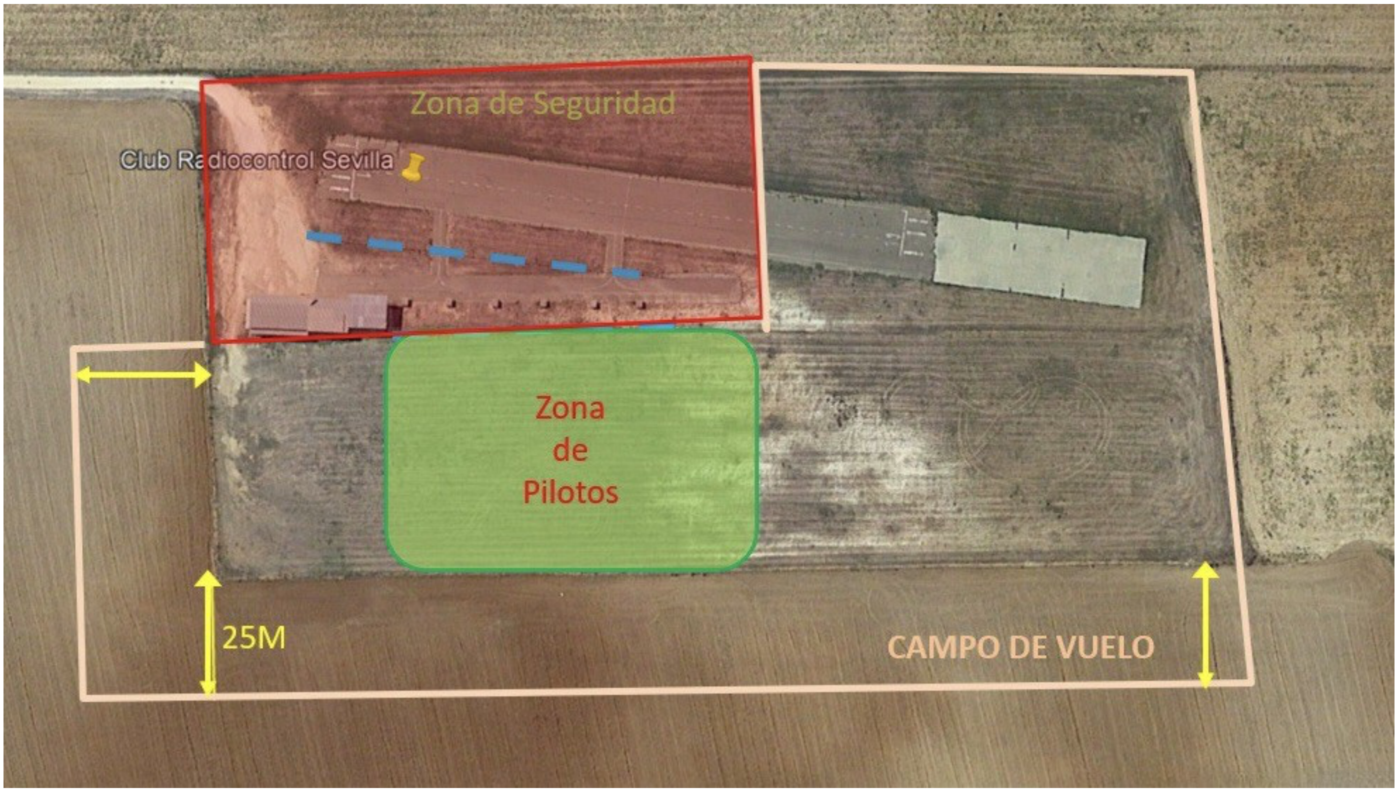
Then Luis Manuel announces it: in 2021, if the damn virus allows us, we will organize a Spanish F5K championship. Friends get ready! He is not a beginner in organizing the first national championships of a new category! Just 10 years ago he already dared with the first Spanish F5J championship — successfully!

At the beginning of 2021 Luis Manuel started a communication work on this new category, publishing several articles through the blog on the *F5J en España* website (see *Resources*, below). He explained step-by-step the rules and the tasks to be performed. In parallel, the F5 subcommittee of the Spanish Federation translated the sporting rules into Spanish.

The pilots interested in the category began to exchange about the models in the market, the homemade designs, the powertrains and the like. The date of the Spanish championship was confirmed for September 25th and 26th, organized by the *Club Radiocontrol Sevilla*, in the south of Spain.

While the pilots were building and testing their models, the organization continued with their preparation, for example, checking the correct operation of the contest management program, *Gliderscore*. It is worth mentioning that the manufacturer of the only valid altimeters to date, AerobTec, was very reactive and released a new firmware before the competition, correcting some bugs and improving the flight display.

Due to the configuration of the field, it was decided to make some concessions to the regulations for the issue of landing points. Instead of placing several hexagons as individual pilot zones, it was decided to delimit a single pilot zone, about 50m by 70m, in which the pilots chose a launch/landing point (marked by plastic spots). This allowed the organization to lighten the field preparation tasks and avoid extra work when the wind direction changed, which happened in the two days of the contest.




Pilot area in green; safety area in red. (image: Google Earth)

As the date approached, registrations were closed with 11 pilots. The entry list has perhaps been impaired by the date very close to the Spanish F5J championship. But after a first part of the year with still many limitations due to COVID-19, the 2021 calendar had to be 'tight'.

On Friday before the competition weekend, the pilots who came from further afield (Catalonia and the Balearic Islands) began to arrive to discover the field and train a bit. The day was sunny and quite windy but we were able to have a nice day of flights.

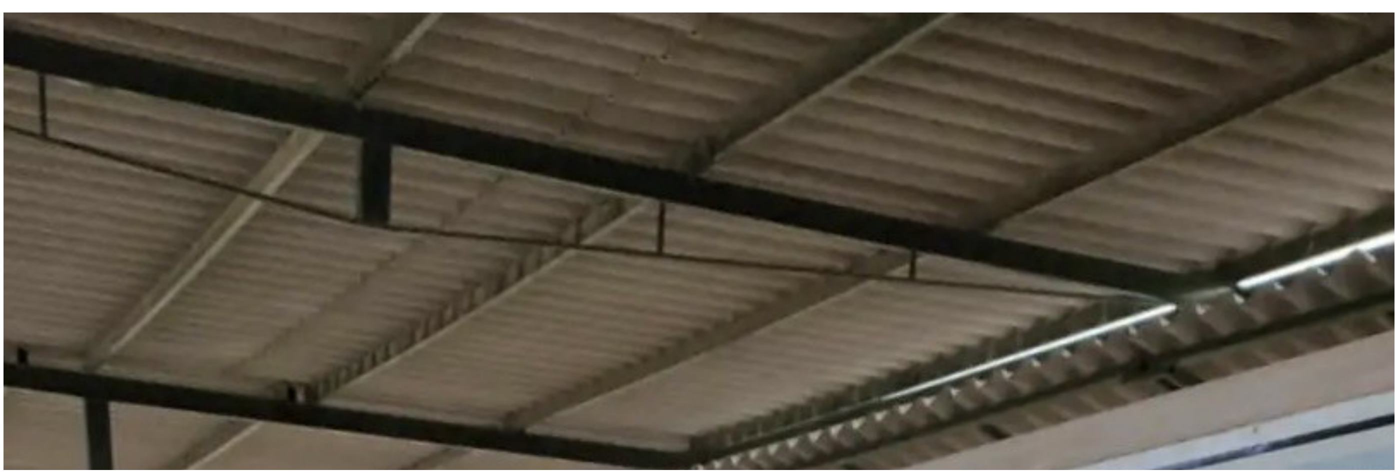
Toni Mateu from the Balearic Islands training with his GCM Hornet.

## The Competition Begins — Day 1

Then finally came Saturday the 25th, the first day of the competition. After giving the pilots time to greet each other, to mount and test their models, the contest began with a faultless briefing, explaining clearly the two-day program and clarifying any doubts that arose.


Pilots' briefing.

The organizers then proceeded to a technical verification of the models, which consisted mainly of a check of the wingspan and a measurement of the minimum weight of the model ready to fly.




CLUB RADIOCONTR
FRÁGIL

Contest Director Leticia Cobos supervising the technical verifications.

To ensure that the models had a compliant wing loading (> 12g / dm²), pilots had been asked in advance to report the FAI surface of their models. By the way, more information about each model could be collected; a table I share here:

| Pilot | Model | Type | Wingspan (mm) | Measured minimum mass (g) | Declared FAI Surface (dm^2) | Wingload FAI (g.dm^-2) | Ailerons servos | Rudder servo | Elevator servo | Motor | Propeller | Battery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juan Ramos | Super Gee | Home made | 1495 | 294,2 | 23,42 | 12,56 | Turnigy D56MG | Dymond D47 | Dymond D47 | XPOWER F2307/14 | 6x3 | Tattu 2S 450mAh 75C |
| Luis M. Gonzalez | JI-NR | Home made | 1480 | 296,2 | 23,68 | 12,51 | KS HD47MG | Graupner DS101 | Graupner DS101 | AT2206-17 1500KV 25g | 8x4,5 | Tattu 3S 220mAh 45C or Robbe EVOV5 3S180mAh 25C |
| Nicolas Ridray | Koniec F5K | Home made | 1497 | 298,0 | 23,72 | 12,56 | Hyperion DS09 | Dymond D47 | Dymond D47 | Iflight Xing2 1806 - 2500kV | CN 6x4 | Brutepower 3S 300mAh HV |
| Nicolas Ridray | Kostream | Modified F3K | 1490 | 283,8 | 22,67 | 12,52 | Hyperion DS09 | Dymond D47 | Dymond D47 | Iflight Xing2 1806 - 2500kV | CN 6x4 | Brutepower 3S 300mAh HV |
| Toni Mateu | Hornet (GCM) | Manufactured F5K | 1495 | 290,6 | 23,50 | 12,37 | KST X08H | KST X06 | KST X06 | T-Motors 1806 | CN 6x4 | Brutepower 3S 300mAh HV |
| Toni Mateu | Konite | Modified F3K | 1490 | 297,2 | 22,10 | 13,45 | KST X08H | KST X06 | KST X06 | T-Motors 1806 | CN 6x4 | Brutepower 3S 300mAh HV |
| Gonzalo Moreno | Snipe 2 El (Vladimir's) | Manufactured F5K | 1485 | 291,0 | 21,79 | 13,35 | KST X08H | KST X06H | KST X06H | 1806 | 6x3 | Tattu 2S 450mAh 75C |
| Pedro Perez | Snipe 2 El (Vladimir's) | Manufactured F5K | 1496 | 263,7 | 21,79 | 12,10 | KST X08H | KST X06H | KST X06H | LDARC XT1806 2500KV | 6x4 | Tattu 2S 300 or 550mAh or 3S 450mAh |
| Pedro Perez | Snipe 2 El (Vladimir's) | Manufactured F5K | 1496 | 271,2 | 21,79 | 12,45 | KST X08H | KST X06H | KST X06H | LDARC XT1806 2500KV | 6x4 | Tattu 2S 300 or 550mAh or 3S 450mAh |
| Jaume Roselló | TOPSKY 2.0 | Modified F3K | 1500 | 356,4 | 24,94 | 14,29 | | | | | 8x4 | |
| Javier Lara | Snipe 2/2 EL (Vladimir's) | Manufactured F5K | 1500 | 283,7 | 21,79 | 13,02 | KST X08H | KST X08 | KST X08 | LDARC XT1806 2500KV | 6x3 | Gens Ace 2S 450-550mAh |
| Antonio Coronilla | HM ACOR F5K | Home made | 1496 | 291,7 | 21,96 | 13,28 | KST X08H | KST X08 | KST X08 | XPOWER F2307/14 | 6x3 | Tattu 2S 450mAh 75C |
| Jose Enrique | OSHUN | Home made | 1500 | 292,0 | 21,88 | 13,35 | KST X08H | KST X08 | KST X08 | LDARC XT1806 2500KV | 6x3 | 2S |
| Juan Rueda | NOTOS | Modified F3K | 1496 | 344,6 | 23,56 | 14,63 | KST X06N | KST X06 | KST X06 | XPOWER F2307/14 | 6x4 | 2S 550mAh |
| Juan Rueda | ELF EL (Vladimir's) | Manufactured F5K | 1000 | 145,3 | 11,70 | 12,42 | | KST X06 | KST X06 | SUNNYSKY R1106 | 4,2x2,3 | 2S 300mAh |

According to the wind forecast, it had been decided to set the reference motor cut altitude at 70m, for the two days.

The program planned by the organization was to carry out 15 rounds, 10 on Saturday and five on Sunday. This program was carried out without any problem, with two groups of six pilots.

The five tasks of the F5K rules were then carried out three times each in the following order:

| Mng | Description |
|---|---|
| 1 | Task A - 1, 2, 3, 4 minutes in 10 minutes (any order) |
| 2 | Task B - Last flight counts; 5 min max; Max 3 flights in 7 mins |
| 3 | Task C - All up; 4 min max; 3 flights per round |
| 4 | Task D - 3, 3, 4 minute flights (any order); Max 3 flights in 10 mins |
| 5 | Task E - Poker; Pilot chooses target times; Max 3 flights in 10 mins |
| 6 | Task A - 1, 2, 3, 4 minutes in 10 minutes (any order) |
| 7 | Task B - Last flight counts; 5 min max; Max 3 flights in 7 mins |
| 8 | Task C - All up; 4 min max; 3 flights per round |
| 9 | Task D - 3, 3, 4 minute flights (any order); Max 3 flights in 10 mins |
| 10 | Task E - Poker; Pilot chooses target times; Max 3 flights in 10 mins |
| 11 | Task E - Poker; Pilot chooses target times; Max 3 flights in 10 mins |
| 12 | Task D - 3, 3, 4 minute flights (any order); Max 3 flights in 10 mins |
| 13 | Task C - All up; 4 min max; 3 flights per round |
| 14 | Task B - Last flight counts; 5 min max; Max 3 flights in 7 mins |
| 15 | Task A - 1, 2, 3, 4 minutes in 10 minutes (any order) |

The flight conditions on the first day were quite variable. We had rounds with little wind and a lot of thermal activity, but the day ended with a sustained wind breaking any thermals and forcing the pilots to fight with narrow bubbles within large sink areas.

11 pilots ready to have nice flying time!

Despite the novelty of the category, the good preparation of the pilots and the excellent briefing made the contest run without major problems. Only a misunderstanding in the sequence of buzzers in Task C (all up) caused a pilot to take off when he shouldn't…and another didn't take off on time. This problem is now fixed in *Gliderscore* with now differentiated buzzer tones.

Last instructions from Luis Manuel before starting the contest.


F5J
TEAM ARGENTINA
F5J PRO
Models

Some action at the field.

At the end of the first day, the ranking was very tight between the top seven pilots, despite observing very different strategies among some conservative guys cutting higher but 'guaranteeing' flight time, and others more aggressive with more risky cuts to win rounds, but with some failed flights.

## The Competition Continues — Day 2

The second day dawned more covered, with a bit of fog, but it dissipated before resuming the competition and we finally had very good flight conditions, with huge thermal activity, allowing to see beautiful battles with low cuts. The podium was contested until the last round.

At the end of the last flight, the organization took some time to check the results. Meanwhile the pilots were exchanging their impressions on the category in a friendly and relaxed atmosphere. The general feeling was very good. All the pilots, of any level, had had an excellent time and they all agreed on how great this new category is.

## And The Winners Are?

Finally, the official results were announced with gifts for every pilot and some beautiful trophies and medals for those on the podium.

**C España y Andalucía F5K - Resultados generales**
[Bollullos Mitación (Sevilla) 25/09/2021]

www.GliderScore.com

| Clas. | Nombre | Punt. | Pcnt | Mng1 | Mng2 | Mng3 | Mng4 | Mng5 | Mng6 | Mng7 | Mng8 | Mng9 | Mng10 | Mng11 | Mng12 | Mng13 | Mng14 | Mng15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1, 2, 3, 4 | L1 5max in 7m | AllUp 4:00*3 | 3, 3, 4 | Poker 3 in 10m | 1, 2, 3, 4 | L1 5max in 7m | AllUp 4:00*3 | 3, 3, 4 | Poker 3 in 10m | Poker 3 in 10m | 3, 3, 4 | AllUp 4:00*3 | L1 5max in 7m | 1, 2, 3, 4 |
| 1 | RIDRAY, Nicolas | 12940.0 | *100.00* | 962.1 | 1000.0 | 1000.0 | 1000.0 | 0.0 | 993.3 | 1000.0 | *0.0 | 1000.0 | 1000.0 | 1000.0 | 1000.0 | 1000.0 | 1000.0 | 984.6 |
| 2 | MORENO JIMENEZ, Go | 12727.5 | *98.36* | 1000.0 | 872.1 | 844.6 | 909.1 | 1000.0 | 1000.0 | 797.2 | 804.3 | 637.2 | *234.7 | 1000.0 | 1000.0 | 878.1 | 984.9 | 1000.0 |
| 3 | LARA RODRIGUEZ, F. J | 12105.6 | *93.55* | 952.2 | 793.2 | *0.0 | 905.9 | 1000.0 | 898.2 | 569.6 | 1000.0 | 955.8 | 1000.0 | 537.3 | 841.3 | 885.0 | 1000.0 | 767.1 |
| 4 | CORONILLA JAEN, Anto | 11566.0 | *89.38* | 877.6 | 899.8 | 821.8 | 1000.0 | 747.3 | 915.3 | 815.5 | 866.8 | 784.7 | 678.2 | *267.3 | 724.5 | 835.7 | 870.4 | 728.4 |
| 5 | MATEU BRUNET, Toni | 11469.6 | *88.64* | 931.5 | 1000.0 | 1000.0 | 934.6 | 0.0 | 1000.0 | 913.4 | *0.0 | 1000.0 | 306.5 | 859.7 | 951.3 | 592.7 | 979.9 | 1000.0 |
| 6 | RAMOS REAL, Juan | 11185.1 | *86.44* | 711.3 | 788.9 | 855.3 | 749.0 | 736.7 | 943.3 | 677.2 | 739.9 | 826.5 | 679.0 | *293.7 | 601.1 | 1000.0 | 953.5 | 923.4 |
| 7 | PEREZ RUBIO, Pedro | 11025.2 | *85.20* | 1000.0 | 364.1 | 908.7 | 808.0 | 0.0 | 858.7 | 1000.0 | 1000.0 | 980.3 | *0.0 | 549.3 | 959.7 | 716.3 | 986.6 | 893.5 |
| 8 | PALACIOS GONZALEZ, | 10665.8 | *82.43* | 873.0 | 344.9 | 599.7 | 781.4 | 934.1 | 689.7 | 775.6 | 942.9 | 852.7 | 467.4 | *287.1 | 830.4 | 776.0 | 970.1 | 827.9 |
| 9 | RUEDA MADRIGAL, Jua | 10261.0 | *79.30* | 896.0 | 852.9 | 707.9 | 688.2 | *0.0 | 672.7 | 480.3 | 839.3 | 639.1 | 298.9 | 964.2 | 888.3 | 870.4 | 759.1 | 703.7 |
| 10 | ROSSELLO PEDROSA, | 8057.6 | *62.27* | 825.8 | 212.5 | 704.0 | 219.2 | 662.7 | 971.4 | 402.9 | 630.0 | 839.6 | 0.0 | *0.0 | 508.1 | 730.7 | 681.1 | 669.6 |
| 11 | GONZALEZ GONZALEZ, | 217.1 | *1.68* | 217.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | *0.0 |

Final results.


Podium: 2nd, Gonzalo Moreno; 1st, Nicolas Ridray; 3rd, Javier Lara.

# Conclusions and Suggestions

A total of 428 competition flights were performed without observing any collision or any discomfort between pilots. Only one pilot (unfortunately myself) lost the radio link of his model at Round 8, which flew freely for 1min 30, at 900m far away from the field. It was the only incident of the weekend.

Everyone (pilots and organizers) has been enthusiastic about this first experience with the category. It allows a 'light' organization even for a contest with official timekeepers like this national championship. For local self-timing contests, a single person managing *Gliderscore* would be enough.

We also have seen that this category allows to be 100% competitive with a homemade model or an adapted F3K model (and probably better with an old generation one). This is a very positive thing because, in addition to a very low cost of the motor set, it allows an easy access to a great FAI category, without an economical barrier.

From here, I want to encourage other nations to start organizing competitions and make this F5K category takes off. You will not regret it!



## Resources

- *Volume F5 Radio Control Electric Powered Motor Gliders* (PDF)
- *F5J en España: Para los amantes de los veleros eléctricos*

*All images and figures by the author and Leticia Cobos unless otherwise noted. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

# Scheibe-Loravia Topaze 1:4.2-Scale

## Part I: The Initial Build

Chris Williams

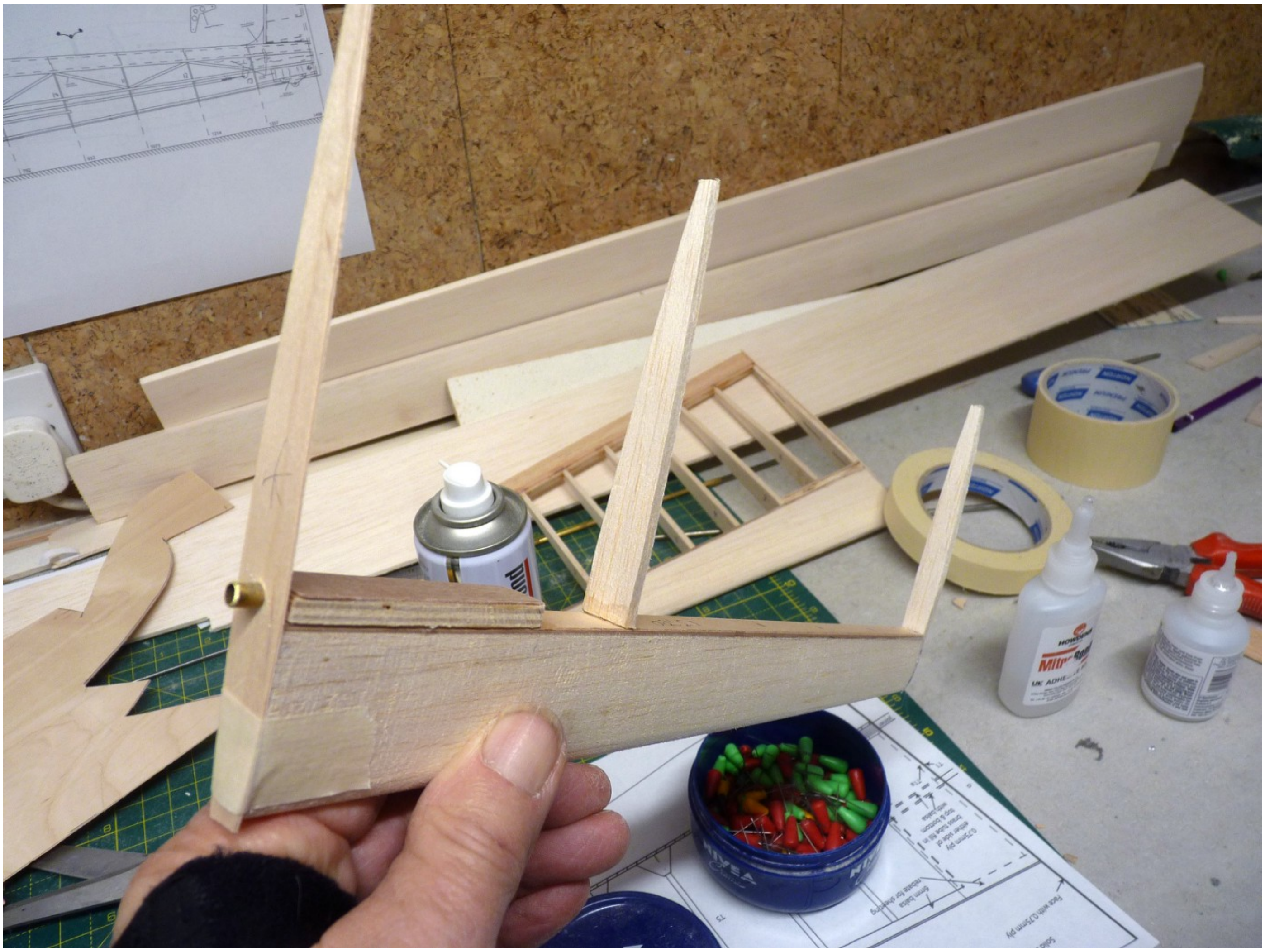
The *Topaze* was built under licence in France as a version of the popular Scheibe SF 27, and took my eye some years ago, culminating in a version scaled to 1:3.5. Three more versions followed over the years until recently, in line with my current down-sizing regime, I produced a version at an OAP-friendly 1:4.2-scale. Spanning three-and-a-half metres, and weighing in at 10lbs, this is a sweet-flying and practically-sized scale glider.

This time around we will look at the some of the building process, before finishing off with the project completion in next month's issue. You can click any of the pictures below for a higher resolution version.


**01**: First stage of fuselage construction on the 'Bridson' jig. (Alternative simplified jig would be a suitably-sized straight piece of wood)

**02**: Fuselage almost ready to be removed from the jig.

**03**: Now, the front end can be filled and sanded to shape.

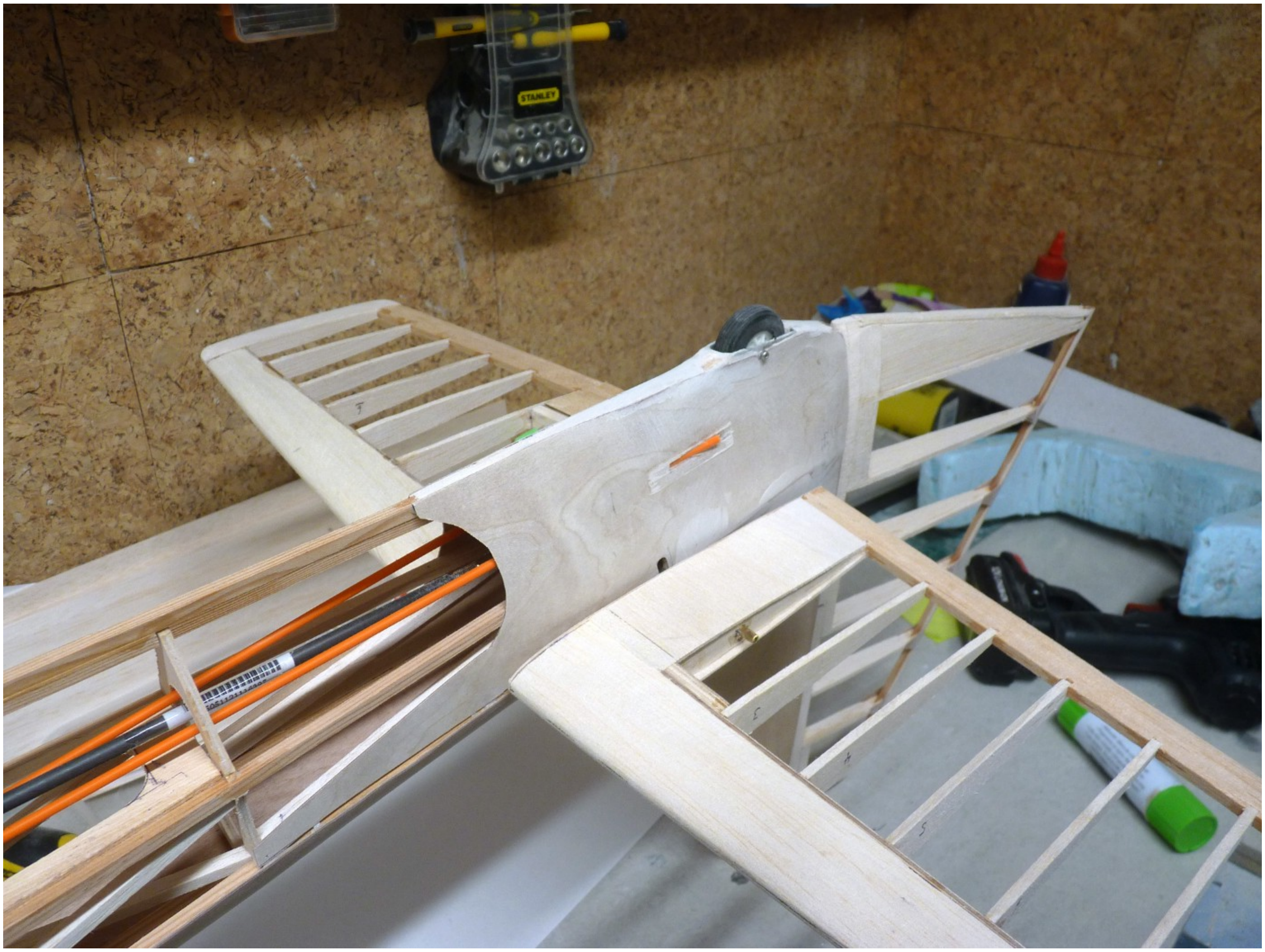


**04**: First stage of all-moving tailplane (AMT) construction.

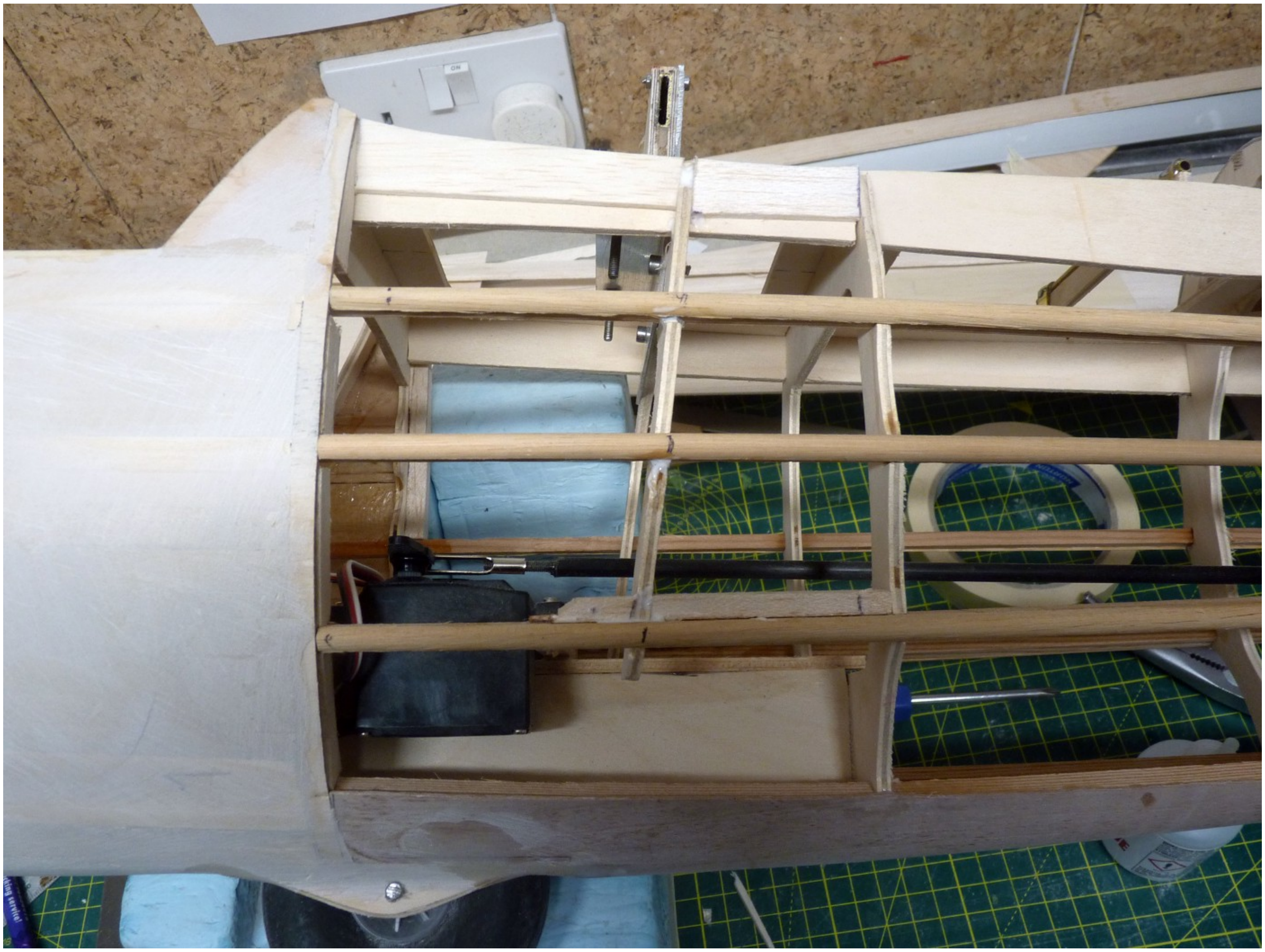
**05**: Hinging up the rudder to the fin

**06**: Tail group now completed.

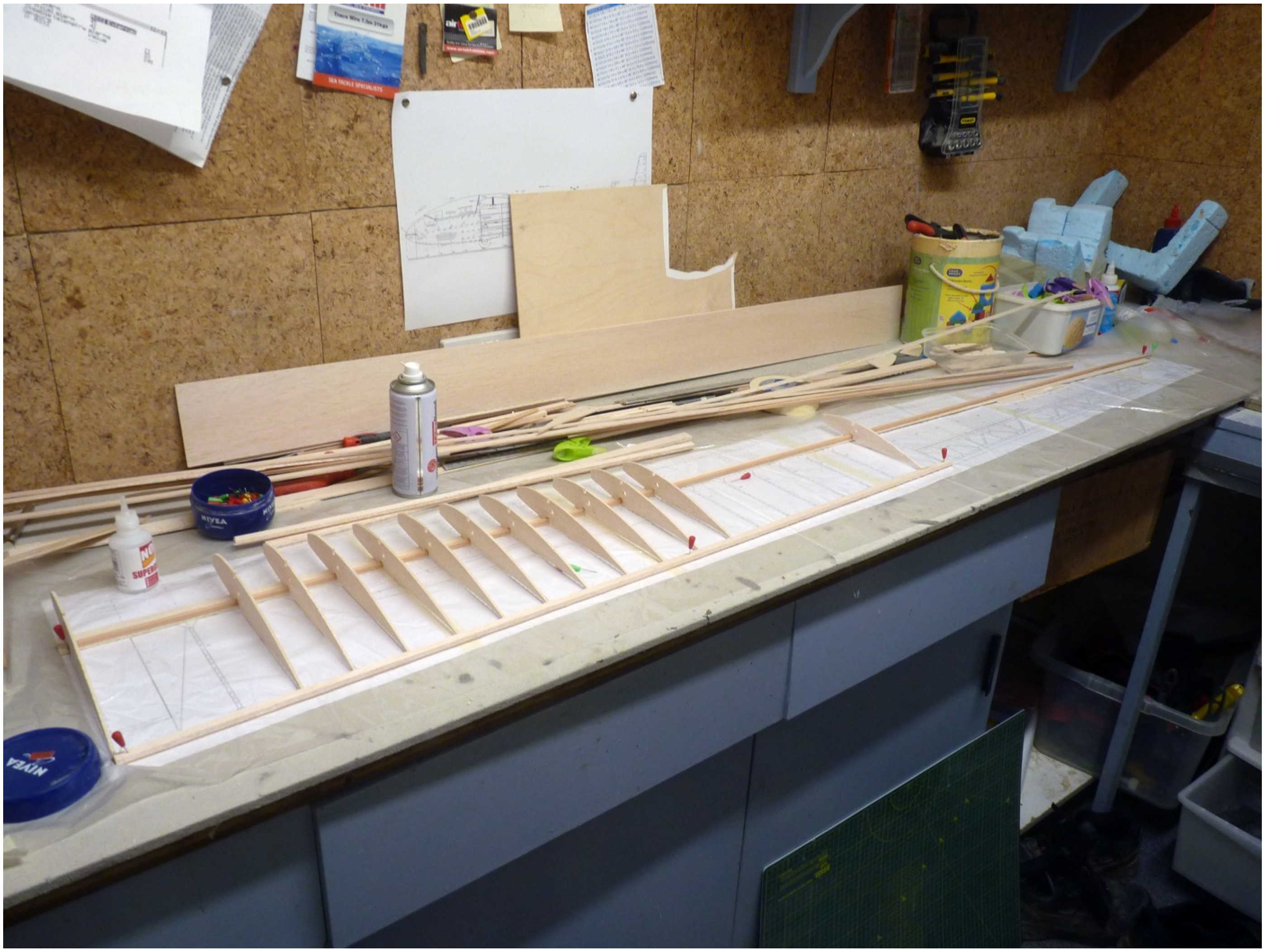
**07**: Finalising the wheel house arrangement.



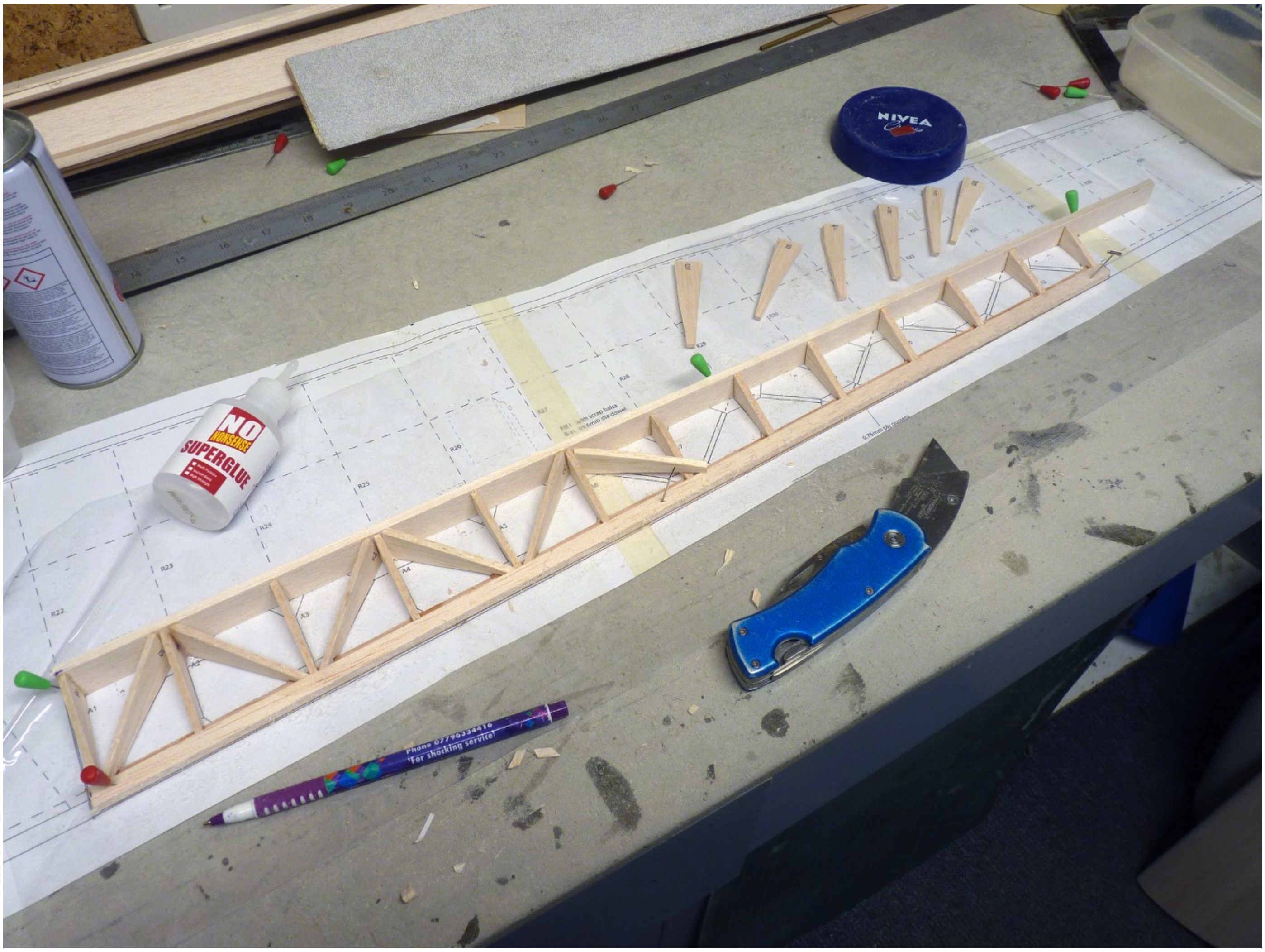

**08**: Rear end complete, including the guide tubes for the rudder cables.



**09**: The wing joiner box is anchored to its own former via two aluminium brackets.

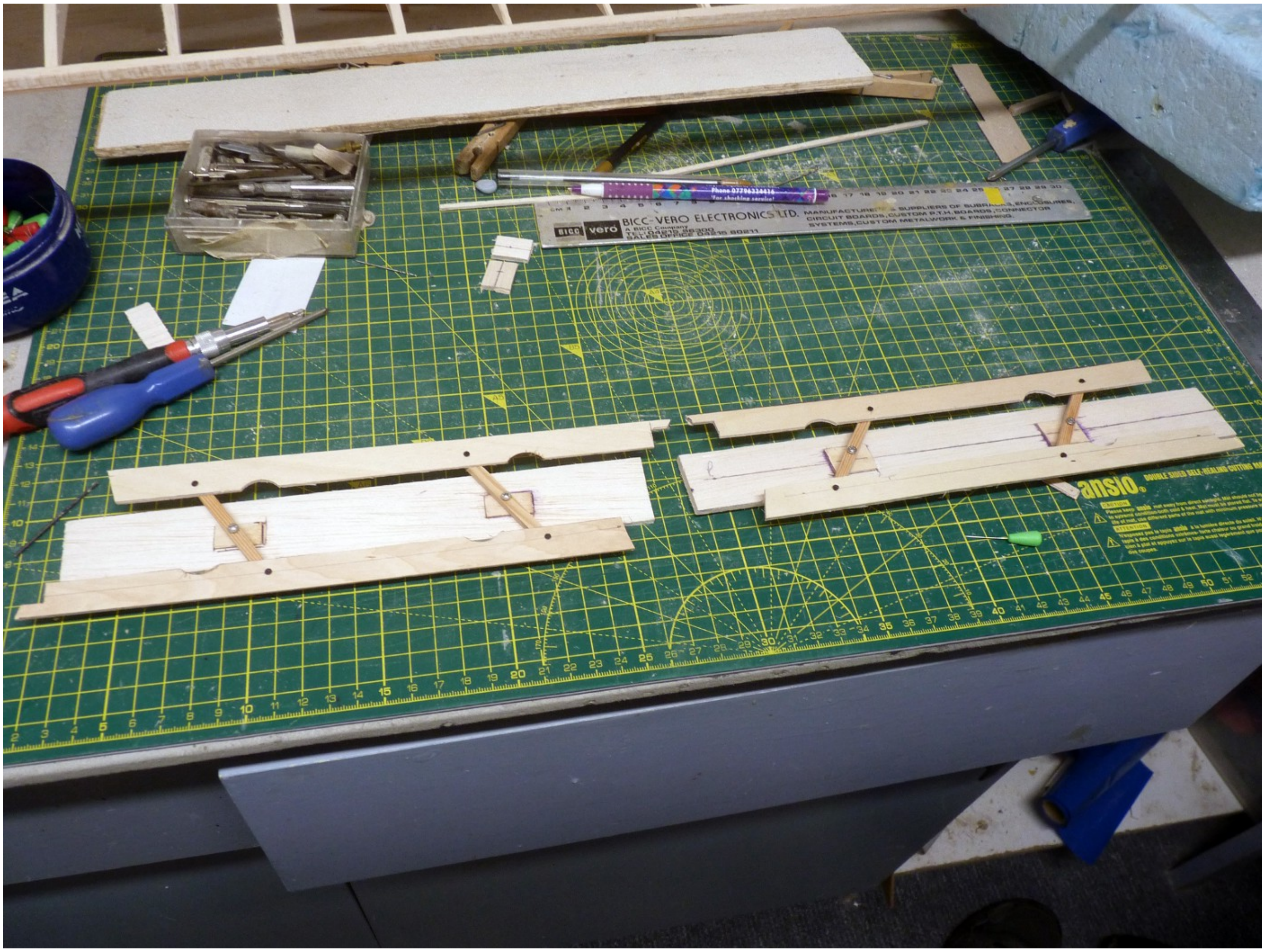



**10**: First stage of wing construction.

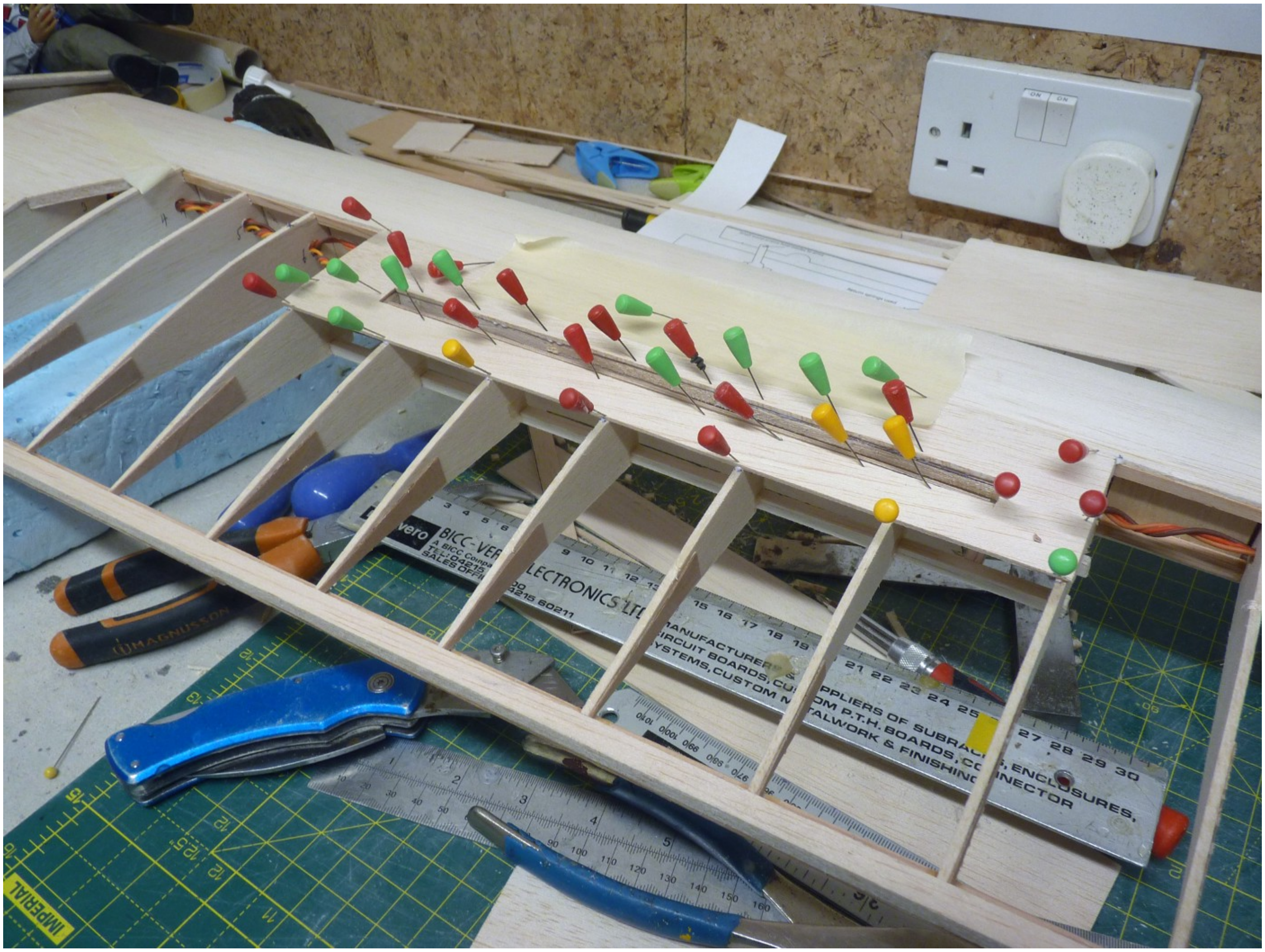



**11**: The ailerons are built flat on the board and top-hinged.

**12**: Making up the centre wing/fuselage fairing.

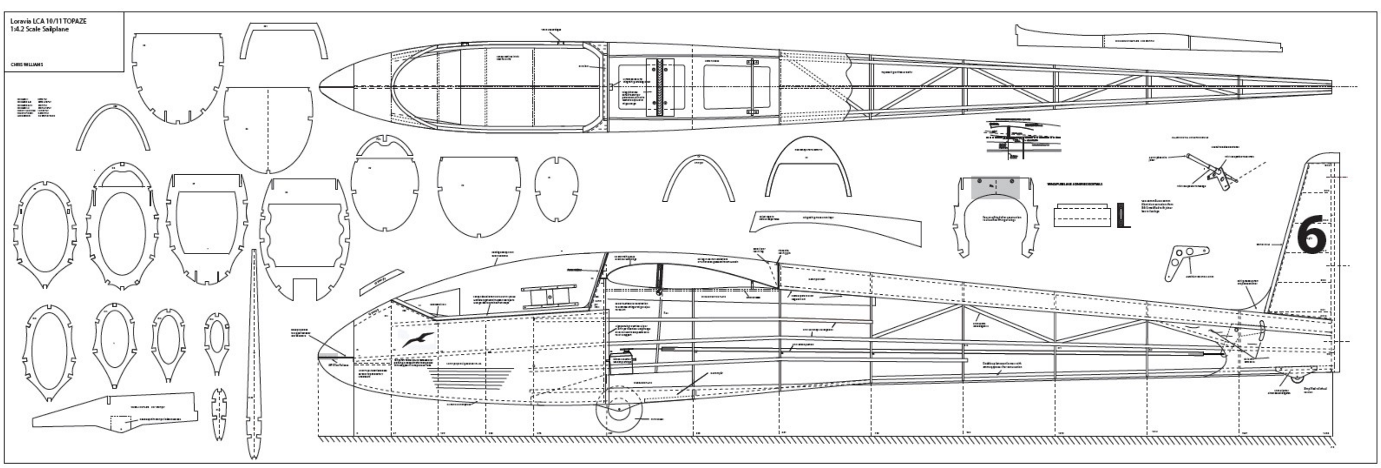



**13**: The airbrakes are best made up simultaneously to ensure they are properly ‘handed’.




**14**: Installing the airbrake assembly into the wing.

**15**: Underside view of the wing/fuselage.




**16**: Free plan available in PDF format (see Resources below).

See you next month, where I will wrap things up. In the interim, if you have any questions, please feel free to leave them in the *Responses* section, below, and I'll do my best to answer as many as I can.



# Resources

*1:4.2-Scale Topaze Free Plan (three PDFs):*

- Fuselage
- Wing
- Tailplane

*Detailed Build Photo Gallery*

- Coming shortly…watch this space!

*All images and drawings by the author. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

# Electricity for Model Flyers

## Part I: The Basics

Peter Scott


A collection of classic AstroFlight motors which went up for sale on the online auction house WorthPoint. Established in 1969, Bob and Roland Boucher's company did much to establish the viability of electric-powered aircraft, both models and full-size. Note that while they were state-of-the-art in their day, their 'brushed' configuration makes them obsolete today. (image: WorthPoint)

*This is the first part of a nine part series where regular RCSD contributor Peter Scott goes through a comprehensive explanation of everything an RC modeller needs to know on this often mysterious and misunderstood subject. — Ed.*

More and more flyers are using electric power for the motors in their model gliders and tugs. I can't think why. Can it be because it always works, never needs adjustment and doesn't cause noise problems?

Chats at the flying field tell me that many people don't know about electricity so I decided to set out the basics in good science but everyday language (the Feynmann method).

## First We Need To Understand Energy and Power

**Energy (E)** is what allows us to do things. Examples are heat and electricity. We use heat energy in our glow, gas turbine and petrol engines. We use electrical energy in motors. In both cases we turn propellors of some kind to speed up air to provide thrust. So our heat or electrical energy is turned into movement, called kinetic energy. Energy is measured in joules (J). Cells are chemical devices that store electrical energy. They have connectors labelled plus (anode/red) and minus (cathode/black).

**Power (P)** is how fast we use energy. We measure power in joules per second. This is also called a watt (W). So 1 W is the equivalent of 1 J/s.

This can be written power = energy divided by time or `P = E/t` (t is time in seconds).

Electricity is negatively charged particles called electrons. They are very very *very* tiny and light (10E-30kg). Electrical conductors are materials like carbon and metals. Some of the electrons in conductors are free to move around and constantly do so, similar in behaviour to gas in a pipe.

## How Do We Measure Electricity?

The *quantity of electricity* is measured in **coulombs (c)** and is known as **charge (Q)**. One coulomb is just over 6 million, million, million electrons. It can be trapped (static) in a conductor or forced to move through it.

If you connect a battery to a conductor, the negative cathode pushes more electrons in at one end and the same number pop out at the other (positive) end. So there is a drift of electrons through the conductor. This is called **current (I)**. Yes I know, current flows from plus to minus. This is called *conventional current* and was thought up before scientists knew about electrons. Current is measured in amperes (A or amps). One ampere is when one coulomb of charge drifts past a point in the conductor in one second. Remember that this is a huge number of electrons.

How fast do they drift? It's less than 1mm/s. That surprises people when they first hear it. It would take several minutes for an electron to drift from one end to the other of a 1 metre conductor. They might drift slowly but there is a huge number of electrons so the flow of charge (current) is still significant.

So how do electrical signal travel at great speed in a wire? It is just like particles in the kinetic theory (oh no…not that again!) The air particles as a mass move quite slowly but at the particle level they are moving randomly at the speed of sound. Free electrons move randomly at about one third of the speed of light in a conductor. It we apply a voltage at one end by throwing in more electrons, the electrons shove the next lot, which shove the next lot and so on to the far end. We call this a 'signal' and that is what travels at 100 million metres per second.

Additional detail on drift velocity and the speed of electrons can be found in *Resources* below.

How are electrons pushed? In a battery the electrons have extra energy. This is like the extra energy that an object has if you lift it, and that you get back if you let it fall. The object's energy is called potential energy. The extra energy in the electrons is called electric potential or more usually **voltage (V)**. So voltage is a measure of energy. If one coulomb of electrons is given one joule of energy it has a voltage of one volt. This is what pushes the electrons. This is shown as energy = charge x voltage (`E = QV`). Voltage is sometimes called electromotive force or EMF.

At everyday temperatures there is no such thing as a perfect conductor. Collisions (or more correctly interactions) with the fixed atoms in the conductor means the atoms take away some energy. We know this because the conductor warms. In a heater — for example in a glow plug — this is useful but in our models it is usually wasted energy. It is what warms up our batteries. The materials they are made from are not perfect conductors so they also heat up when providing electric current. This wastes energy, and as you will see later, reduces the voltage they can produce. Note that as the electrons move along the wire they lose energy and so the measured voltage falls. Perhaps in school Physics you moved a metal slider along a bare wire and saw the voltage drop.

Some conductors are better than others. We measure how bad the conductor is with an invented idea called **resistance (R)**. This is measured in ohms (Ω). If one volt is put across the ends of a conductor and a current of one amp flows the resistance is one ohm. This is shown in resistance = voltage divided by current (`R = V/I`). We will be using this later.

# Power and Electric Motors

So back to power, which is what we want from our motors. Remember that:

- Power is energy per second `P = E/t`
- Energy is charge times voltage `E = QV`
- So power is charge times voltage per second `P = QV/t`

Q/t is charge per second which you already know is current (I):

- So power is current times voltage `P = IV`

- Energy is power times time `E = Pt` (by rearranging `P = E/t`)

This means that the power of your motor relies on both voltage and current. Let's say you want 500 W of power. This is about two-thirds of a horsepower (1 HP = 746 W). If you have a lower voltage battery it will need to produce more current. More current heats both the wires and the battery more so it is good to keep current as low as possible.

For example, for the same 500W from the above:

- A three cell (3S) lipo produces about 12V. To get 500W we need 500/12 or about 40A
- A four cell lipo (4S) has about 16V so will need 500/16 or about 30A
- A six cell (6S) lipo has about 24V so will only need to produce about 20A

Note: The term 'cell' and 'battery' tend to be used interchangeably. However, strictly speaking, the term battery refers to two or more connected cells.

## What the Battery Numbers Mean

We choose our batteries using voltage, capacity and C-rating.


So what do all those numbers mean? (image: Hobby King)

**Voltage** We've covered that.

**Capacity** This is given in amp-hours (Ah) or milliamp-hours (mAh). We understand that the higher this number is, the more energy the battery holds and the longer the run time is for a given motor. Note that when you use a 6S battery you will use half the current compared with a 3S, so you can drop the capacity to half and still get the same run time, or very likely more as we will see later.

We probably don't need to know more but for completeness let's cover it:

- Earlier we learned that energy is power times time`E = Pt`
- Power is current times voltage `P = IV`
- So energy is current times voltage times time `E = IVt` (where `t` is time in seconds)

- Amp-hours give us the `It` bit so we now just need the `V`

To find the energy in the battery we multiply its voltage by its capacity. We then multiply that by 3600 to turn the hours into seconds. Phew!

For example with a 2.2Ah 3S battery, that has about 12V, the numbers are:

- Energy = 2.2 x 12 x 3600 = 95040 joules
- 1 kWh unit of electricity is 3,600,000 joules

Incidentally:

- In the UK electricity costs about 17 pence per kWh unit.
- So charging the battery will cost about 0.8 pence or 1 cent assuming 50% efficiency

**C-rating** This tells us how much current we can safely take from the battery. That is 'safely' in the sense of extending the life of the battery and getting a usable voltage from it. It can vary from 10 to 75. To find the maximum current we multiply the capacity by the C-rating. So a 45C battery of 2.2Ah capacity will safely give us up to 45 times 2.2 or 99A. Above that it will over-heat and the voltage will drop dramatically. Why? Internal resistance.

## Internal Resistance

Battery materials have resistance, called internal resistance, and so waste energy. Wasted energy means reduced voltage, so the electrons have less than the rated voltage/energy when they leave the battery. We see this as a lower voltage on the connector. As current rises the wastage goes up. If you use voltage telemetry you see the reported voltage drop as you increase the throttle and go back up when you reduce it. A high C-rating shows you that the battery has lower internal resistance. The internal resistances of lipos have improved a lot recently. Even cheap cells now give a reading of 3 or 4mΩ (milli-ohms) compared with 10 or more not long ago. Some are as low as 1. A decent charger will have a menu option to measure the internal resistances of the individual cells in a battery.

I'll discuss internal resistance in another article in this series.

## Power and Resistance

Earlier we learned that `R = V/I` (this is called Ohm's Law)

- We can rearrange this as `V = IR` (we'll call this equation 1)
- We also learned that `P = IV` (and this equation 2)
- If we put V from equation 1 into equation 2 we get $P = I^2R$
- So wasted power goes up with the square of the current

Doubling the current makes the energy wastage four times bigger. Three times means nine times. So keeping current down by using higher voltages has a strong effect on energy wastage. That's why a 6S battery of half the capacity of a 3S one will probably give a longer flight time.

Incidentally this is why electricity supply lines use very high voltages, in the UK typically up to 400kV. A lower voltage would mean higher current and stronger warming in the lines. There would be happy birds keeping their feet warm but very little energy (voltage) would get to the far end. It is also why when current is low at night in the winter, ice can build up on the unwarmed lines.

When Edison first started to power towns and cities with direct (that is, one direction) current he chose 100V because it is unlikely to kill you. However huge currents were needed from the power station and the sizes of cable needed became impracticable so higher voltages had to be used. To reduce these for use in buildings, transformers were needed so Westinghouse's alternating current (AC) systems were used instead of Edison's direct current (DC). DC is still used in some situations, for example sending electricity ashore from sea-based wind turbines or the solar cells on your roof. In a horrific but fascinating side story George Westinghouse and Thomas Edison engaged in a public battle over whether AC or DC was the safer. See *War of the Currents* in *Resources* below.

## Voltage Is Your Friend, Current Is Your Enemy

Occam's Razor is a principle that says, 'the simplest is the most likely to be true'. I have been playing with electric motors of increasing power, making mistakes along the way. I finally think I've got it in my head — simply. From above we know that power = voltage times current:

**Current**

- Each motor has a maximum current.
- Current causes heating, so too much will destroy the motor.
- Current must be kept down.
- Current is your enemy.

**Voltage**

- Voltage does no harm (unless it's enough to electrocute you).
- So to get more power out of a motor you increase the voltage, by going from 3 cells to 4, 5, 6, 7, 8 cells and beyond.
- Do not go beyond the maximum cells specified for the motor and ESC.
- Voltage is your friend.

## Now Choose a Propellor

More voltage means more RPM. A motor's kV, e.g. 500, means how many RPM for each volt.

- If you fit too big a prop the motor won't run at enough revs and the current will rise.
- So more voltage (cells) means using a prop with a smaller diameter and/or pitch.
- The choice of propellor, including the meaning of kV, is the subject of another article in this series.

You can be guided by the motor maker's suggestions but they will play safe. If you want the maximum safe power you must use a power meter that shows current and then experiment with different props at full throttle. Alternatively you can use telemetry such as a FrSky *Neuron* ESC to give you the data including power.

For two blade props a good way of comparing them is load factor which is the diameter of prop cubed multiplied by pitch. This also is the subject for another article in this series.

## What Power Can I Expect?

Some makers specify maximum power for a motor, but many do not. Remember: power = voltage times current.

- Voltage is the number of lipo cells x 4 roughly (this will be the maximum cells specified for the motor).
- For example 8S gives about 32V.

Current is the maximum specified for the motor. If the motor can take 60A:

- Maximum power = 32 x 60 = 1920 W or about 2.5 HP

And when you have done your experimenting, share your data with club members and the rest of the world. Nowhere can I find a list of motors with propellor sizes for different numbers of cells found by practical methods. I am happy to host such a list — just send me the data.

Next month I'll be back to discuss more about internal resistance and why it's important. Thank you so much for reading and I hope you found this article useful. Have a question? Please post it below in the *Responses* section and I'll do my best to answer it.



## Resources

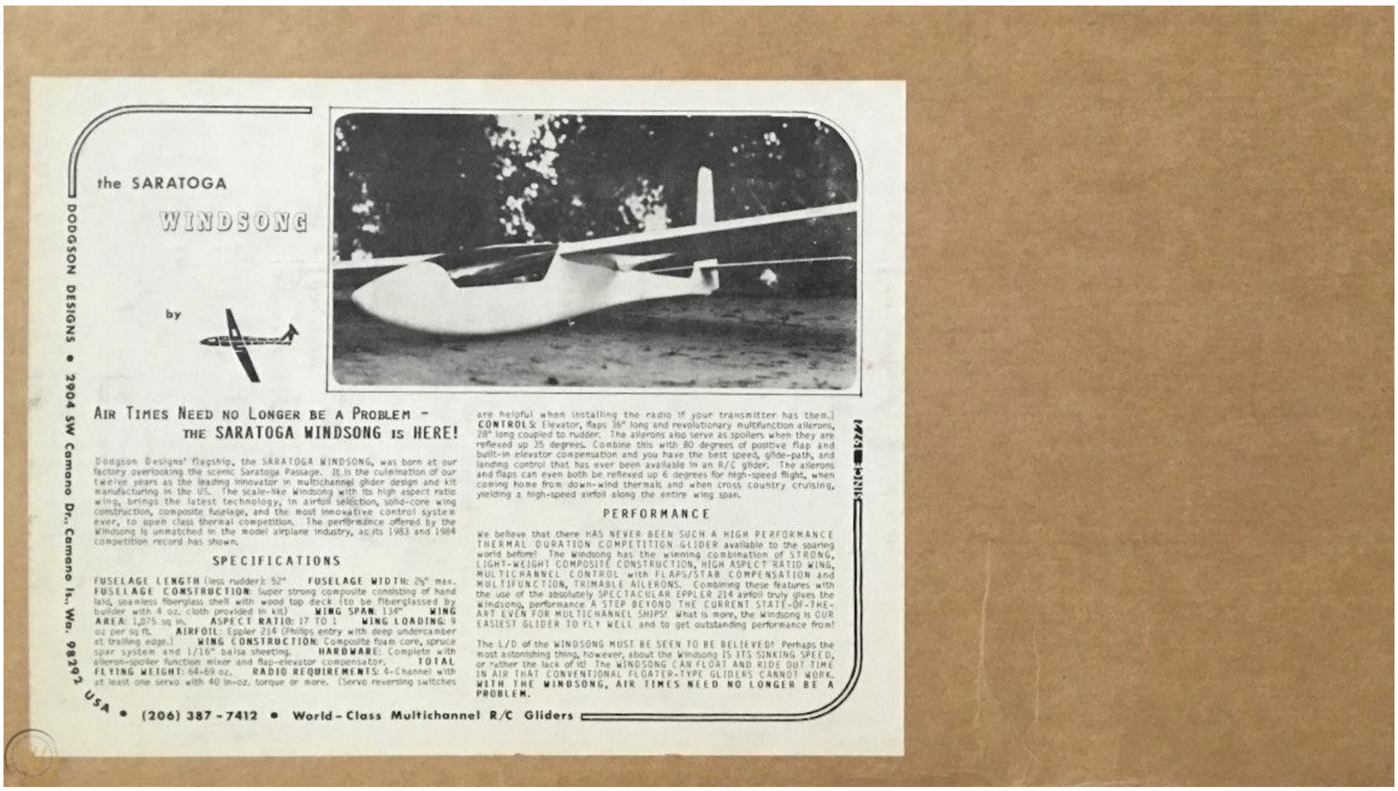
- *Drift Velocity* on Byju's (sort of like Khan Academy)
- *Speed of Electrons* on Cunningham & Cunningham, Inc.
- *War of the Currents* on Wikipedia

*Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

# From Whence Came the Windsong… and Other Thoughts

## What's with all the mullets and Phil Collins' songs? Because suddenly, it's 1982.

Bob Dodgson




"Dodgson Designs 'Saratoga Windsong' RC Sailplane 134 Inch Span New In Box! Time-capsule version of the magnificent 'Saratoga Windsong' by Dodgson Designs. This world-class multi-channel sailplane from the mid-80s…" (image and caption: WorthPoint)

After introducing the *Camano 100* kit in 1981, to replace the *Todi*, I was ready to seriously consider a replacement kit for the *Maestro* line which was first introduced in 1974. Originally I had favored using the *Maestro* fuselage with a *Camano* type control system and wing construction. My dream, beginning with our multi-channel *Todi* in 1972, had been to design and kit a glider with an undeniable performance edge over any other available kitted glider. With the *Todi*, *Maestro*,and *Camano 100*, we had offered soaring pilots the most versatile thermal competition gliders available. These planes would more than hold their own in competition against any comer in the hands of skilled multi-channel fliers. Alas, their performance edge was not dramatic enough to jar the bulk of the soaring world away from its first love, polyhedral floaters, except in pockets around the country where great fliers could demonstrate their capabilities. Where these multi-channel ships were flown well they dominated the competition scene.

I looked upon the *Maestro* replacement as the perfect chance to achieve a clear cut performance edge that none could deny. Utilizing what we had learned from our then ten year evolution in multi-channel kit design, we hoped to lock in on the perfect set of compromises for the new plane. I have long believed that the best flying glider is the one that has incorporated the best combination of compromises between structure, weight, aspect ratio, control systems, airfoil, aerodynamic purity, and handling.

It wasn't until the1982 Nationals in Lincoln, Nebraska however, that the *Windsong* design really jelled in my mind. I had driven to the Nats in my Toyota motorhome with four of the most skilled multi-channel fliers in the country: Dave Johnson, Tom Brightbill, Jack Pitcher, and Tom Neilson. The trip back home was long and soon the conversation came around to when I would be coming out with a new kit. Since I still had not made up my mind on several design variables for it, I took advantage of this captive, free, expert-flier, design team. What we got going was a think tank environment. By the time we reached the West Coast, most of the basic design parameters had been laid down. We decided to start from scratch with a third generation *Camano* concept fuselage, go with the Eppler 214 airfoil, and utilize the basic control system and wing construction of the *Camano 100*, in conjunction with the basic *Maestro* planform. It has been rightly said that "the *Windsong* was conceived in the back of a Toyota."

When I got home in August of 1982, I worked out the details, drew up the *Windsong* plans, carved the fuselage molds, made the wing core templates and constructed a prototype. During the drawing stage, I was struck with the idea of using reflexed ailerons as both spoilers and, when reflexed only six degrees, for high speed flight thus eliminating the need for typical, drag producing, spoiler bays and allow for a high speed airfoil along the entire wingspan. After all the Eppler 214 airfoil was specifically designed to perform well with camber changing capability and I was eager to see how it worked in practice. This control innovation would require no more servos than would simple, efficiency-robbing spoilers. Moreover, the concept offered the advantages of full span trailing edge camber control, full-throw inboard flaps and separate outboard ailerons that reflex as spoilers to use along with 90 degree flap throw to allow dethermalizeing in safe, steep and even vertical dives. The separate flaps and ailerons also minimize potential high-speed flutter problems, the flapped handling problems, and the performance penalty of changing the camber along the entire trailing edge every time the ailerons are deflected.

What was inside the box. (image: WorthPoint)

The prototype *Windsong* flight tested fine. It took me some time to get used to flying the *Windsong*, however, as it required more up elevator in the turn than I was used to. The *Windsong* also seemed to fly faster than I was used to but soon I was amazed at how slowly it could be flown. In the first contest that I flew the *Windsong* I didn't get many landing points. Also I was getting radio interference so I had to settle for half a tow and I could safely fly only in one little sector of the sky. In spite of this dual handicap the *Windsong* was turning in the longest flight times. From experience I concluded that these air times were just a fluke and that at the next contest I would sink like a stone. It didn't happen. It began to become evident to me that we had a real winner here. By November 1982 we had production kits on the market. In the spring of 1983 we incorporated a flap-elevator compensator 'Der Devastator' into the kit. This feature allows the safe use of up to 80 degrees of flap for very slow, steep landing approaches with excellent control. With this steep approach you never need to fall short on landing because you can remove flap (without stalling) to stretch the glide as needed.

The *Windsong* that I am still flying is the first *Windsong* prototype that I built back in 1982, The more I fly it the more I see what it is capable of doing. My contest performance has improved since I retrofitted the flap-elevator compensator to my *Windsong* which helped my landing precision. With the *Windsong* I have come to firmly believe that I have a real advantage over any other glider design especially when air times are hard to come by.

## My Views on Thermal Contest Formats

I hear people say that ‘man-on-man’ is the only fair way to hold a thermal contest. I have flown in several man-on-man contests and I do not feel that they really show much since you can’t gain on people ahead of you unless they really mess up or unless you are in the same heat that they are. The best thermal contests that I have flown in are contests that have many flights of long duration (seven minutes or more, variland, or triathalon). I mean long flights even when the air doesn’t look as if anyone will get a max. This type of contest, with as many rounds as possible and most probably no one maxing every flight, is the forum that best rewards the most skilled thermal flyer, who will rise to the top despite the ‘luck factor’ that poor thermal flyers blame for their lack of air times. Naturally, to make this type of contest work as it should, no ‘sandbagging’ can be tolerated so that thermalling skill, rather than sandbagging skill, becomes the decisive factor. This type of contest forces an aerial dual between the top thermal flyers and it is won or lost in the air rather than on the ground in spot landing points.

Having many long flights is what I enjoyed most in participating in the 1984 National Soaring Society regional contest (*Soar-In*). In fact, the 1984 NSS *Soar-In* was where the first flight was put on my own newly revised *Camano 100* which I entered in standard class. It did not take long to see that the new

*Camano 100* is to become "the *Windsong* of standard class." I hope that the NSS continues the long flight format in future years and abandons the old "3 for 15" event, in which air times are too easy, resulting in a landing contest rather than a thermalling contest.



*This article originally appeared in the November-December, 1985 issue of* Sailplane, *"the journal for RC soaring published by the National Soaring Society". It was edited and updated slightly for publication in RCSD. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request***.

# Soaring in the Rockies

## My summers of avalanche chutes, Grizzly Bears and slope soaring the Columbia Icefield.

Peter Lemieux

In the late seventies, after moving to Jasper in the Canadian Rockies, I re-discovered the joy of flying model gliders, and saw the impressive advances in RC technology (no more escapements or rubber bands!)

After building a few different, basic models, I saw an ad in an RC Modeler Magazine from Dodgson Designs. I remembered reading how Bob's designs were cleaning up at competitions, but what appealed to me most was the elegance of his aircraft compared to so much that was out there at the time. And having ailerons meant the machines flew with impressive realism.

A trip to Washington state brought me close to Bob and Sandy's place on Camano Island. I called and asked if we might stop by the 'factory'. Turned out to be Bob's garage and we were warmly welcomed! Bob's love of RC and his passion in creating great model kits shown through that day. Naturally, I had to buy one: the *Megan*.

Several months later, (and having learned a ton!), I had a fully assembled model ready to go. After a few initial flights at the de-commissioned Jasper airstrip I figured it was time to try my hand at slope soaring closer to my summer workplace: the Columbia Icefield, straddling the border between Banff and Jasper national parks. Rugged country with few landing spots.

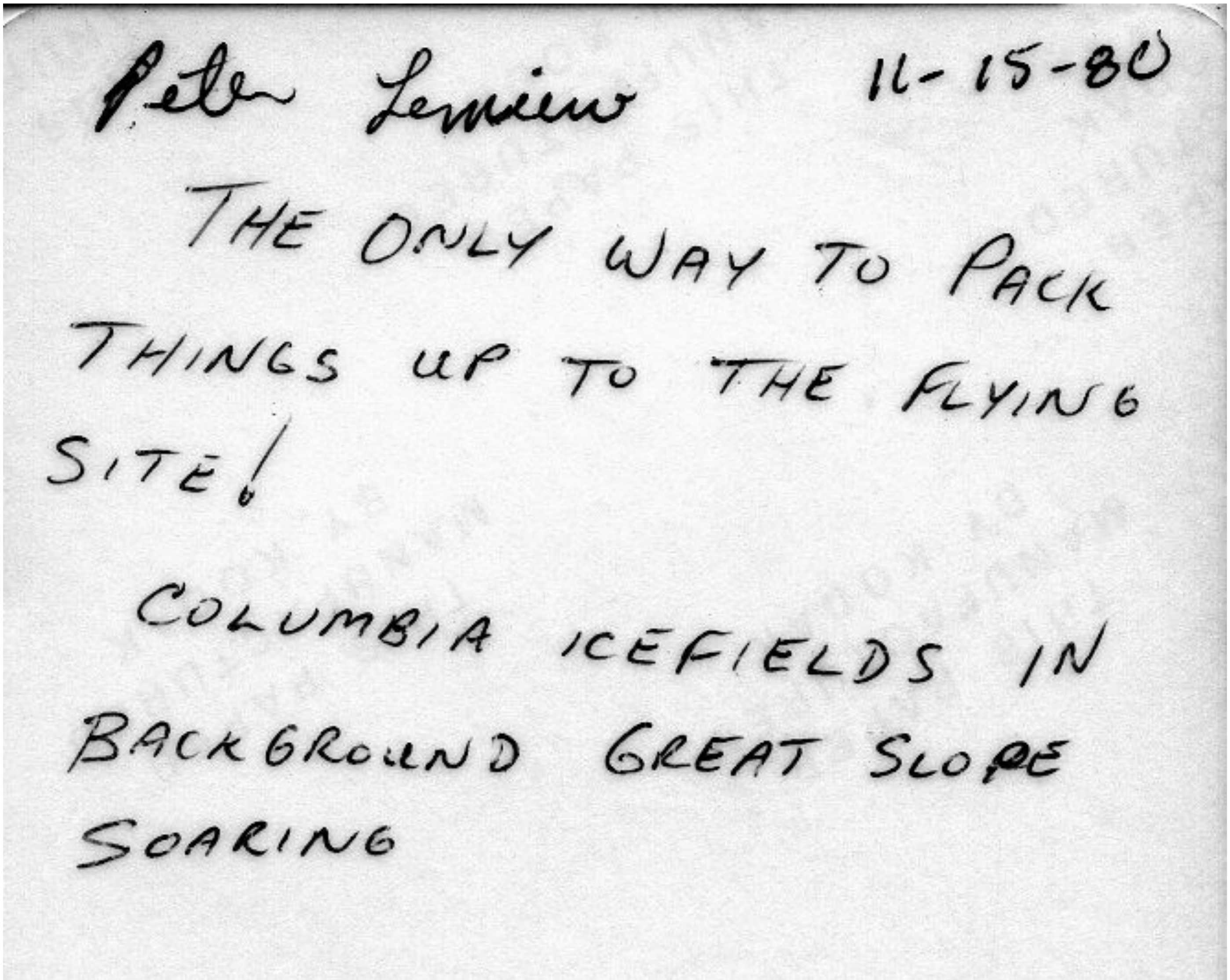
The accompanying shots illustrate the beauty of the place, but not the challenges in getting the gear to the crest of Parker Ridge, which overlooks a portion of the icefield, and has some of the few flat spots suitable to land a glider the size of a *Megan*. I had to modify a backpack and build a protective box to haul it safely to the ridge-top.

Over the next several years I added a *Camano* to my Dodgson Designs collection and successfully flew it many times from that same spot.

Two memorable flights, for very different reasons:

Near Jasper one fine spring day, I went on skis to a remote, snow-covered ridge to attempt to fly. This was late winter and snow covered the slopes. Snow that could easily avalanche.

Being very much an intermediate flyer, I never flew when the wind was too strong. On the contrary, that day the wind was light, and becoming lighter. Eventually, the glider began to sink and I dumped it into the middle of a smooth, open slope. A decent place to land but also quite hazardous for avalanches.


Peter Lemieux 11-15-80

THE ONLY WAY TO PACK THINGS UP TO THE FLYING SITE!

COLUMBIA ICEFIELDS IN BACKGROUND GREAT SLOPE SOARING

So I had the choice of abandoning my pride and joy or risking my life on a prime avalanche slope. Being young and foolish — and not willing to lose the *Megan* — I took the second option!

Another time, near the icefield, I ended up in a similar situation, with dying winds. Only this time, what awaited me on the slopes below was a sow Grizzly, about 100m from my forlorn *Camano*.

Quiet and gentle words to her allowed me to grab the aircraft and gingerly step back up the hill, none the worse for wear.

I'm only one of many who owe a great debt to Bob Dodgson — for all that I learned while assembling these amazing machines, as well as the joy I had while flying them in such amazing places.



*All images by the author. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request****.*

# 1/3rd Scale Mita Type 3 Production Notes

## The ninth part of a twelve part series.

Norimichi Kawakami

**Photo 210L:** Fairing installation

*You may want to read **the eighth part of this series** before proceeding to this article. Also if you prefer, you can read this article in its **original Japanese**.*

## Fabrication Part 39: FRP Molding for the Center Wing Fairing

Now that the plaster mold has dried, I move on to the fabrication of the FRP molding for the center wing fairing.

### *Preparation*

When the plaster mold was first made, it was cool because the water evaporated and took away the heat of vaporization, but as days went by, the coolness faded. As the mold seemed to have dried sufficiently, I applied eight coats of the mold release wax (Bonlease wax) to the surface to be coated with resin. PVA was then applied on top.

Normally, the cut lines are traced on the plaster mold after it is finished, but I am not confident I could mark it properly, so I put masking tape along the cut lines.

**Photo 189**: Preparing the plaster mold

The glass cloths and the mat were also cut to the specified size. In this way, I was ready to lay up the cloth.

### *Cloth Application*

I used two #100 (100g per square meter) micro glass clothes and one 30g per square meter glass mat. The mat is sandwiched between the clothes and laminated like a sandwich. The thickness of the #100 glass cloth is just under 0.1 mm, and the thickness of the mat is about 0.15 mm.

The resin I used is Brainy Giken's GM-6600, an epoxy resin for glass cloth.


**Photo 190**: Epoxy resin used

First, I applied a thin coat of epoxy resin to the plaster mold with a brush, then placed the first ply of the glass cloth on top of the resin and pressed it down with a resin-impregnated brush. When the resin seems to have penetrated sufficiently and the air has been released, I placed the mat on top and repeated the process. However, because I rubbed the mat with the brush here, the mat fell apart and became quite fluffy. So the mat seems to have become quite thin. I covered it with the last layer of cloth in the same way.

**Photo 191**: Finished applying the glass cloth

The resin I used was 39 grams including hardener (30 grams of main agent and 9 grams of hardener). I mixed 10g of the main agent and 3g of the hardener for the first coat, and twice that amount for the second coat. However, with such a small amount, a large part of the mixture stuck to the brush and mixing container, and the amount actually used on the FRP was probably considerably less than that.

### *Mold Release*

The less epoxy resin is used and the thinner it is spread, the longer it takes to cure. 30 minutes is the standard curing time for GM-6600, but the fairing was so thin and used so little that it was sticky even after two hours. So I left it for a day and it cured completely.

Finally, it was time to release the mold. The fairing was easy to pull because it protruded around the perimeter, but it did not release easily because it partially stuck to the mold. I carefully pulled it off from the four corners and it came off with a little force.

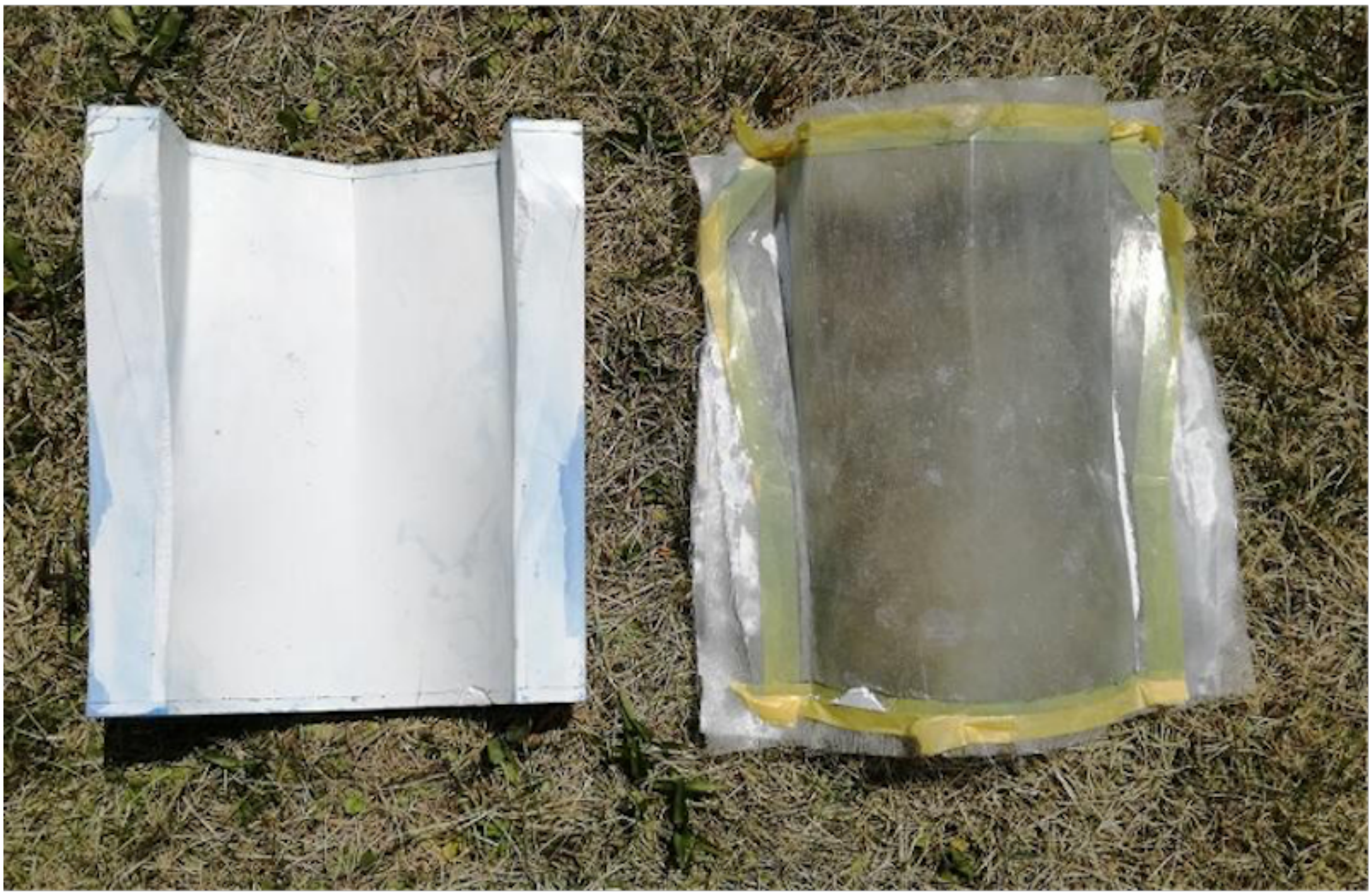


**Photo 192**: Released FRP parts for the center wing fairing

However, if you look closely at the plaster mold after demolding, you can see that some of the corners are missing, and the corresponding areas of the FRP molded product have plaster pieces stuck to them.

**Photo 193**: Chipped plaster mold

It's a shame because I didn't pull with that much force and it chipped. There is air in some parts of the inside, but the surface is relatively clean because it was adhered to the plaster mold. However, there is a little resin chipping at the corners, which will need to be repaired with putty later.

### *Cutting*

I peeled off the adhered plaster and cut off the surrounding area along the masking tape to complete the molded product. It weighed 36g and was about 0.7mm thick. It had moderate rigidity, which was a good result for my first FRP molding. I put the center wing on the fuselage and put the fairing on top of it.

**Photo 194**: Fairing installation test

It fits well. It also looks good from above. After this, the fairing will be completed by attaching the fittings and a frame for installation.

## Fabrication Part 40: FRP Molding of the Nose Cowling

Following the center wing fairing, I finally made the FRP molding for the nose cowling.

### *Preparation*

After waiting for the plaster mold to dry, I applied several coats of the Bonlease wax and then PVA. Normally, PVA is applied only once lightly, but since it was unexpectedly difficult to release the center wing fairing, this time I applied a few coats where it looked thin. After that, I applied masking tape along the cut line, and cut out the necessary amount of #100 glass cloth and 30g glass mat per square meter, the same as for the center wing fairing.

The difference is that in the case of the fairing, there was no need to divide the cloth and mat into small pieces because the entire surface could be covered with one piece, but for the cone-shaped cowling, it was not possible to cover the entire circumference with one piece without wrinkles, so I divided it into four pieces. Photo 195 shows the prepared plaster mold.

**Photo 195**: Plaster mold coated with PVA

### *Cloth Lamination*

First, 40 grams of resin and 12 grams of hardener are taken into a container, stirred, and applied thinly to the inside of the plaster mold. Then I put a glass cloth on top of it and pressed it down with a brush. I rotated the mold and finished applying the four cloths. This is the first layer, which will be the outermost layer.

There was still some resin left, so I put a mat on top of it and held it down. The mats are placed so that the center of the mat is on top of the overlapping part of the cloth, so that the thickness becomes even. When I finished applying two mats, I ran out of resin, so I took the same amount of resin and hardener in a separate container and applied the remaining two mats.

Since there was still enough resin left, the third layer of cloth was applied. This was cut to be orthogonal to the first cloth. As I was applying the second layer of cloth, the viscosity of the resin increased rapidly, and the cloth did not stretch well. The remaining resin in the container is also starting to harden. The amount of hardener might have been a little different, although the working time was not longer than the first time. I had no choice but to stop using this resin at this point, and for the third time I took 10g of resin and 3g of hardener in a separate container and stirred it. The brush also started to harden, so I changed it to a new one.

Despite these hiccups, I managed to finish putting up the clothes and mat. Photo 196 is the state where the clothes have been applied. Leave it for a day and wait for it to harden.

### *Mold Release*

Finally, it was time to remove the cowling from the mold. Based on my experience with the center wing fairing, I was prepared for some difficulty in the demolding process, but this time it was much more difficult than expected. Even the edges would not come off with a little force. I managed to peel off the straight edge with some effort, but I couldn't peel off the curved part of the upper surface that connects to the canopy. I inserted a plastic spatula and finally peeled off a little.

As the edge peeled off, I inserted a plastic spatula further inward to peel it off, but it stuck so tightly that I had to use a lot of force to get it off. While I was trying to widen the gap by inserting my fingers in between the peels, I pulled too hard inward, and the beautifully formed FRP began to have broken lines. I still haven't peeled off even 1/3 of the total depth.

It seemed that the FRP would break if I kept doing the same thing, so I decided to break the plaster mold. I placed the mold on the stone and hit it with a hammer, but it was not easy to break because the plaster was reinforced with gauze. Even so, after several rounds of hammering, the FRP began to pop out before the plaster mold was broken too much. It seems that the FRP will come off when vibrations are applied. Photo 197 shows the FRP product that was painstakingly removed from the mold and the plaster mold. The plaster mold is not completely broken.

**Photo 197**: The FRP molded nose cowling finally removed from the plaster mold

### *Cutting*

The next step was to cut off the unnecessary part along the edge of the masking tape. This is the cowling after cutting.

**Photo 198**: Cowling after cutting: the outside (left) and the inside (right)

It is very neatly done. The black line is the marking line for cross cutting, and the blue part is the attached PVA. The thickness was 0.7 mm at the thin end and 1.2 mm at the thick end. This is due to the fact that each layer was divided into four pieces of cloth or mat, resulting in overlapping areas. The overlapping areas acted as reinforcing materials, and the result was a very rigid product.

### *Fit Check*

The first thing I did was to check the fit to the body. This was my biggest concern. The result was perfect as shown in the picture below.

**Photo 199**: Fit check of the nose cowling

The weight is 114g. After this, I would repair the damaged area by forcibly removing the cowling from the mold, and attach the wooden frame to the structure side.

## Fabrication Part 41: Installation of Nose Cowling

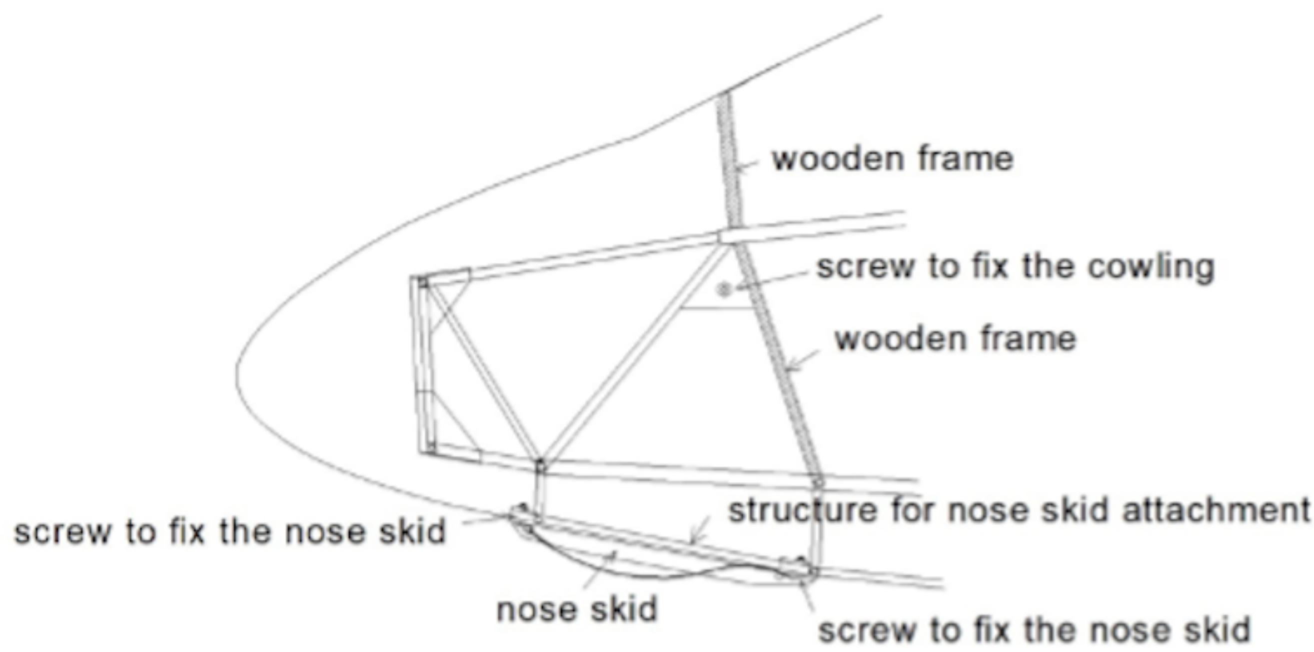
### *Mounting Method*

Initially, the nose cowling was intended to be glued to the fuselage structure, just like the 1/5 model, so that it could not be removed. Therefore, the motors and rudder servo located inside the cowling are designed to be installed and removed from inside the cockpit. However, after building this far, I changed my mind to add the release mechanism for aerotowing, although I and my club don't have any towing machines…

The release mechanism for aerotowing of the Mita is installed in the lower part of the cowling in front of the nose skid. This position can't be accessed from the cockpit. Therefore, I decided to change the nose cowling to be removable.

### *Preparatory Work*

Drawing 49 shows the cowling installation method.




**Drawing 49**: Nose cowling installation method

First, fill the gap between the rear end of the cowling and the fuselage structure with wooden frames right and left. The frames are attached on the fuselage structure side. Similarly, a wooden frame is installed on the cowling side to border the canopy. The cowling is secured by two screws on each side and the nose skid. The nose skid is attached to the fuselage structure with four screws across the cowling, so it is necessary to prepare a skid and its attachment structure to the fuselage side. Photo 200 shows the fuselage structure after the preparation work.

**Photo 200:** Cowling mounting structure

You can see the wooden frame attached to the fuselage structure, the two mounting screw receptacles on the upper left and right sides, and the skid attachment structure. If you turn the fuselage over and look at the skid attachment structure, you will see Photo 201.

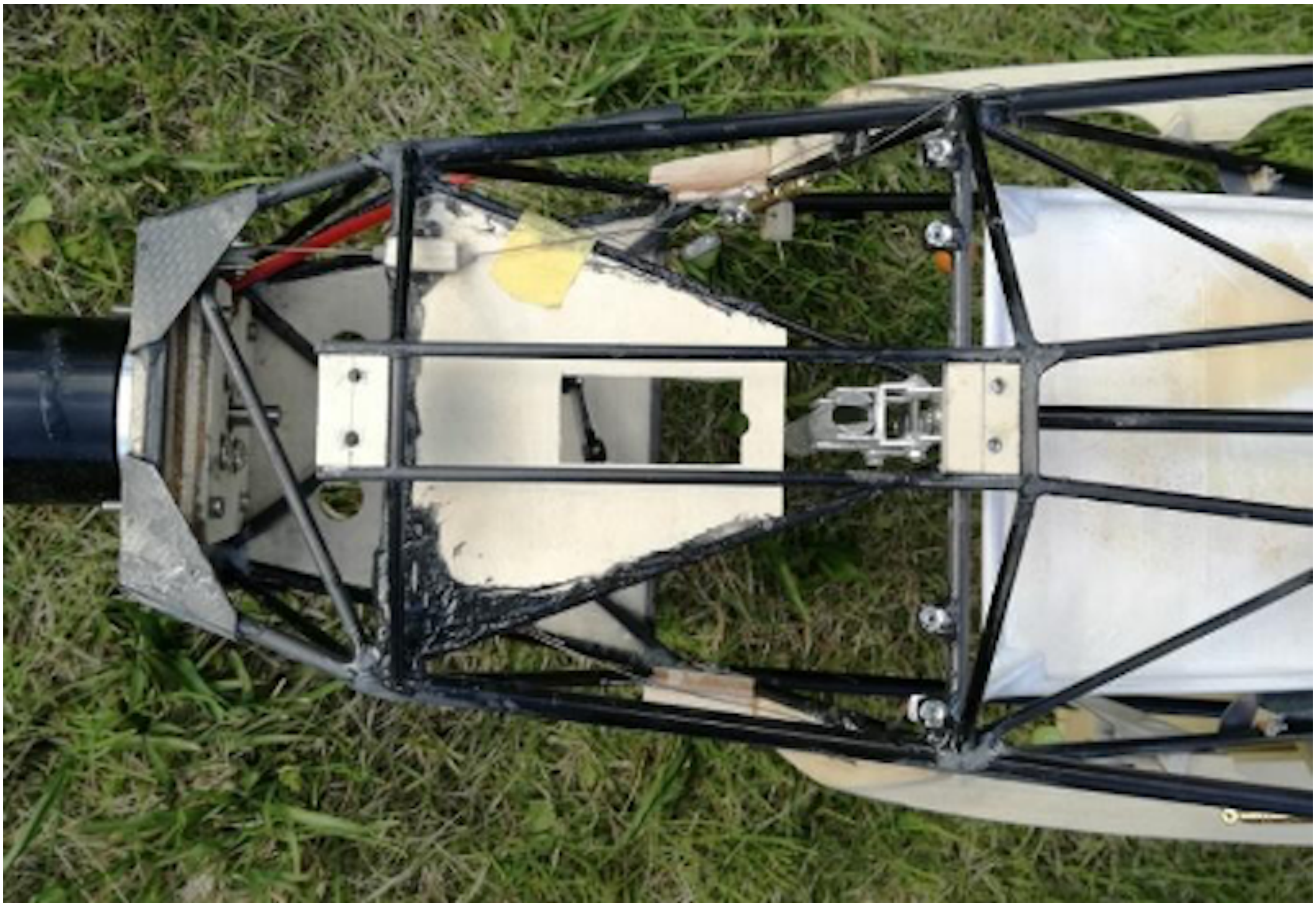


**Photo 201**: Nose skid attachment structure (left) and skid body (right)

The wooden frame that will be the boundary between the cowling and the canopy was attached to the cowling (Photo 202).

**Photo 202:** Cowling with wooden frame attached

### *Installation*

With the above preparation, the cowling was installed. You can see the two mounting bolts on the left and right.

**Photo 203**: Installation of the nose cowling

Photo 204 shows the installation of the nose skid as seen from below.

**Photo 204**: Installation of the nose skid

This is a shot taken from the cockpit side.

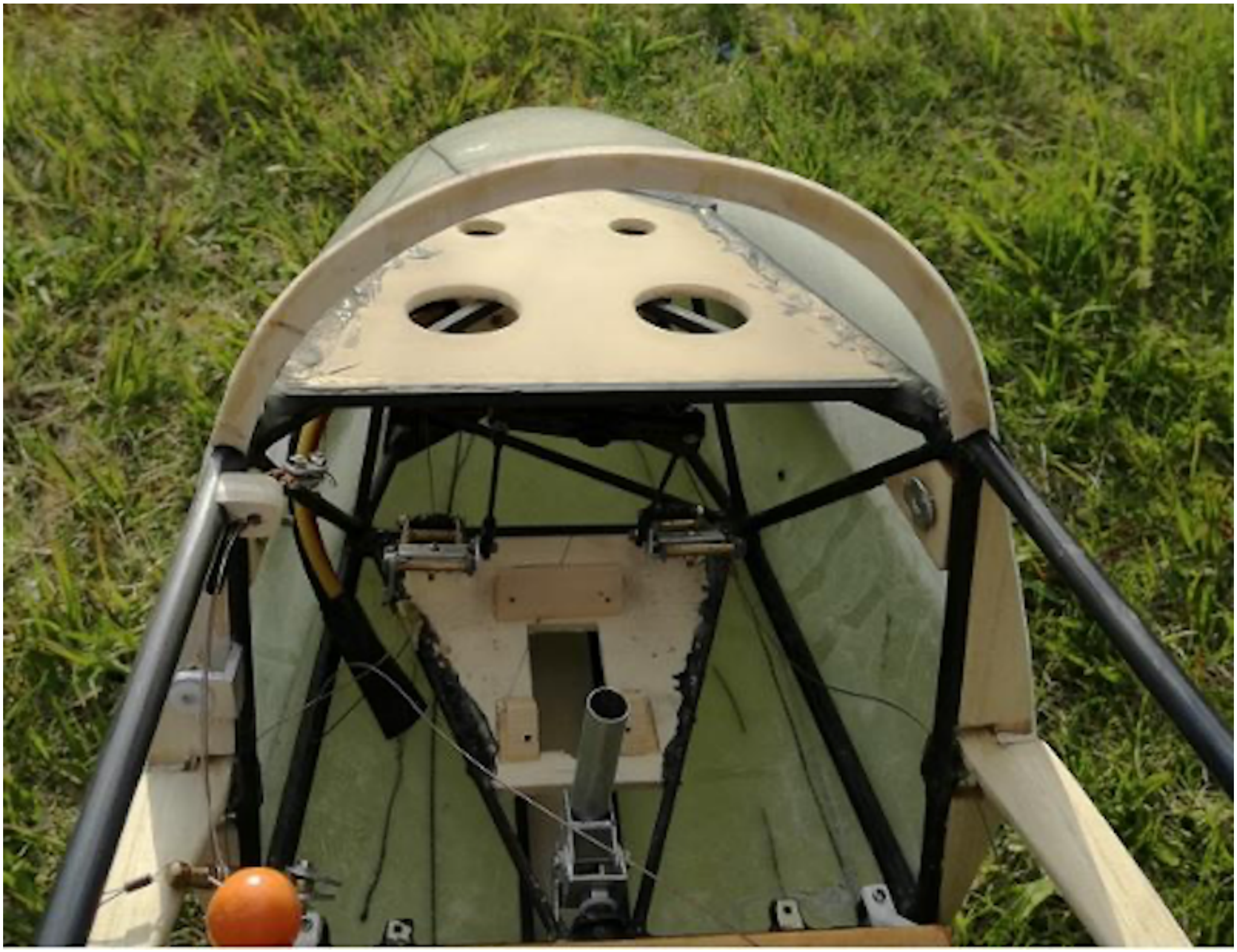


**Photo 205**: Installation of the nose cowling as seen from the cockpit side

This may sound like a smooth installation, but in fact it took a lot of time to adjust. In particular, when I installed the wooden frame on the cowling, it was not easy to fit it into the fuselage. After repeated fine adjustments with sandpaper, the wooden frame became to fit easily.

### *Trial Installation of the Folding Propeller*

I installed the propeller to check the folded state. The propeller is a Graupner 18x9. The hub is the smallest size (42mm), but it matches the nose shape and folds up nicely.

**Photo 206**: Trial installation of the folding propeller

# Fabrication Part 42: Attaching the Center Wing Fairing

Next, let's install the center wing fairing.

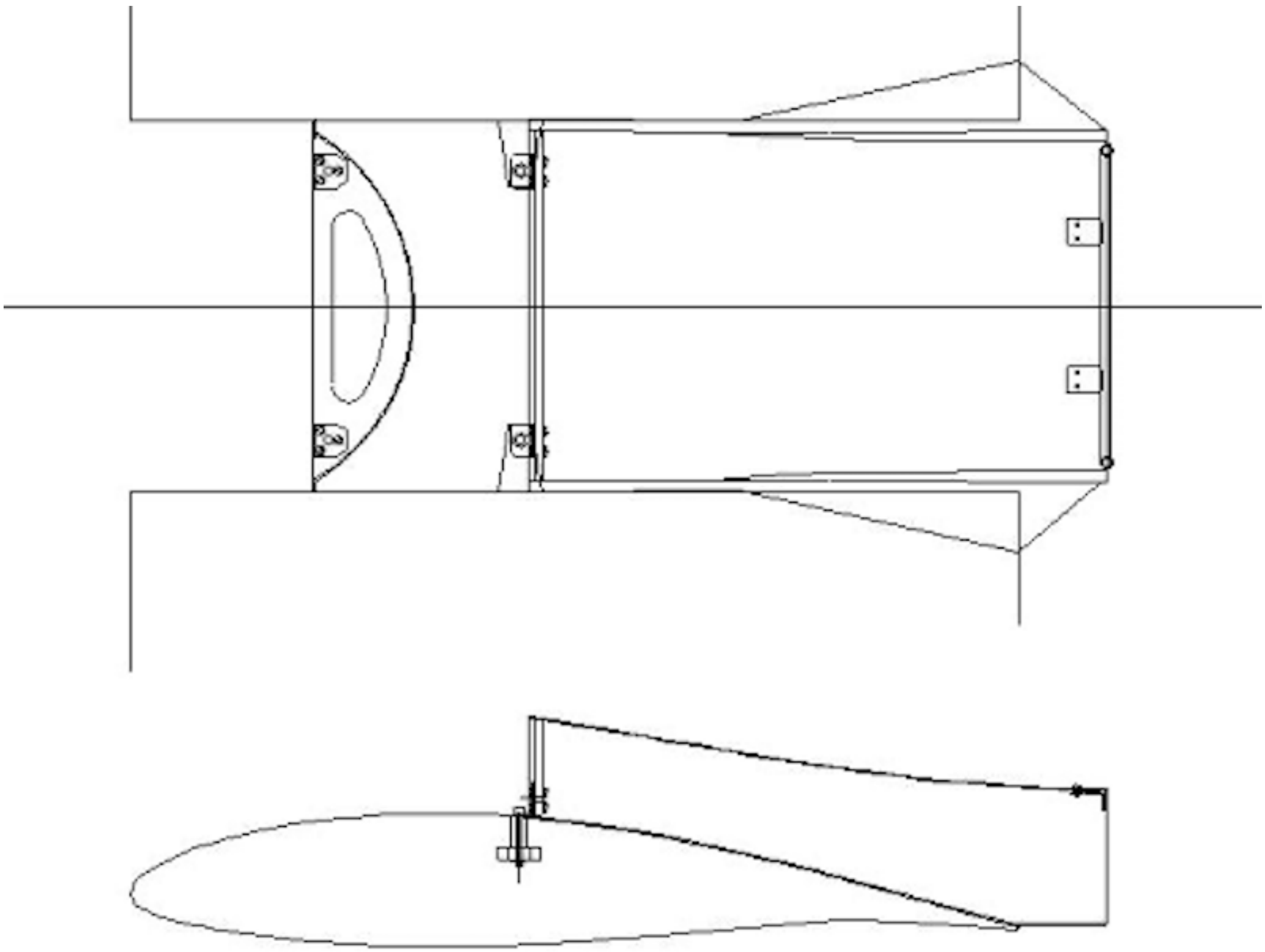
### *How to Install the Fairing*

The center wing fairing of the actual model is installed as follows,

1. Attach the fairing to the upper surface of the center wing using the front two fittings.
2. Screw the two metal fittings at the rear of the fairing to the fuselage overhang structure.
3. The center part is screwed to four locations, two on each side of the

center wing.

In the model, the fairing is relatively stiffer than the actual model, so I decided to simplify the installation method slightly. Drawing 50 shows the installation method.



**Drawing 50**: Installation method of the center wing fairing

Attach a wooden frame to the front of the fairing as in the actual model, and attach two L-shaped fittings to it. Screw the L-shaped fittings to the pillars that rise from the inside of the center wing. For the rear part, two metal fittings similar to the actual model are attached. These fittings are open at the rear by less than 1mm and they are fixed by sucking the L-shaped aluminum channel attached to the overhang structure at the top of the rear body.

### *Processing the Fairing and Center Wing*

The wooden frame and fittings are attached to the FRP fairing according to the drawing.

**Photo 207**: Wooden frame and fittings attached to the fairing

The center wing has two pillars for screwing the L-shaped fitting of the fairing.

Photo 208: Pillars for screwing the fairing

### *Installing the Fairing*

To install the fairing, first place the wing cover to hide the spoiler servos.

**Photo 209**: Wing cover; the larger hole is a mistake and will be filled later

Place the fairing on top of it and screw it in place to complete.

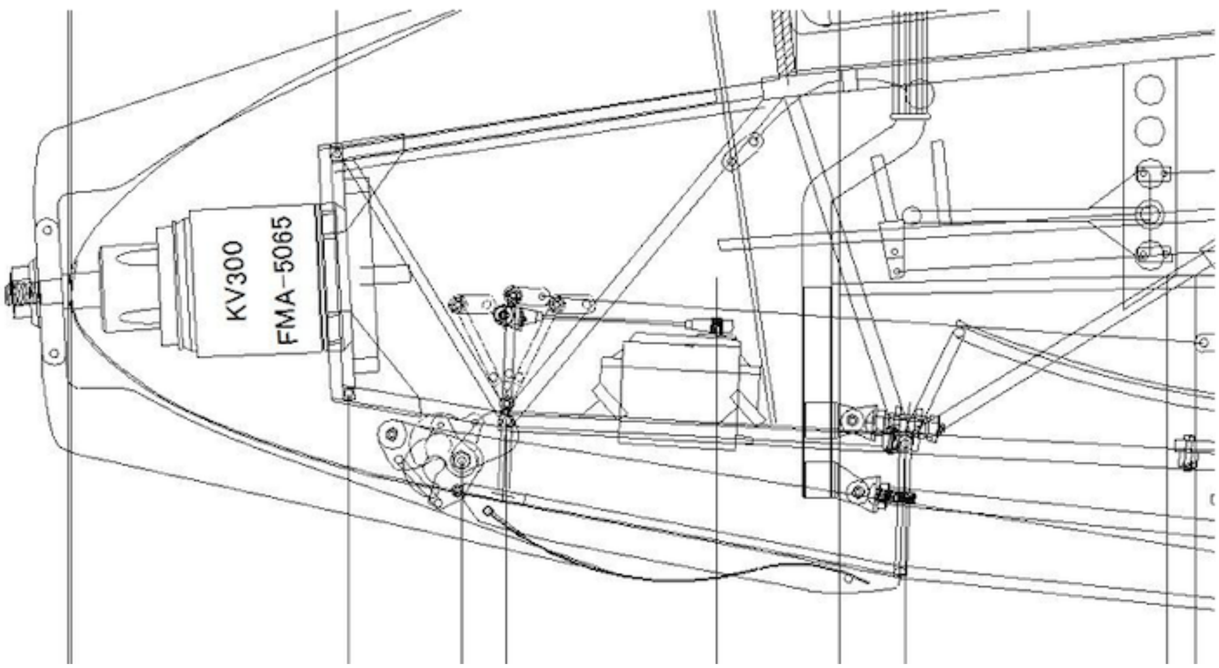
**Photo 210**: Fairing Installation

# Fabrication Part 43: Cable Release Mechanism for

# Aerotowing

### *Outline of the Mita's Cable Release Mechanism for Aerotowing*

The cable release mechanism for aerotowing of the Mita Type 3 Rev 1 is attached to the lower part of the nose cowling in front of the nose skid, and is connected to the same knobs as the release mechanism for winche towing. It is opened by pulling the knobs. The actual structure of the mechanism is difficult to understand because it can't be accessed, but I devised a simple mechanism for the model. Here is the drawing.




**Drawing 51**: Cable release mechanism for aerotowing

The simple mechanism consists of a hook sandwiched between two aluminum frames, and the hook is opened by pulling the wire attached to it. A weak spring is attached to the hook so that the hook closes when there is no wire tension. The wire is connected to the same servo as the mechanism for winch towing. This means that when the servo is activated, both release mechanisms are activated simultaneously.

### *Fabrication of the Mechanism*

This is the cable release mechanism fabricated based on the drawing.

**Photo 211**: Cable release mechanism for aerotowing; side (left) and bottom (right) views

The hook is made of 3mm thick hard aluminum plate, and the frame is made of 2mm thick aluminum plate. The rotating shaft of the hook is a 3mm bolt, and the frame is fitted with a DURACON bearing. The hook has already been fitted with wires and springs. A 20mm ring is attached to the bottom of the hook.

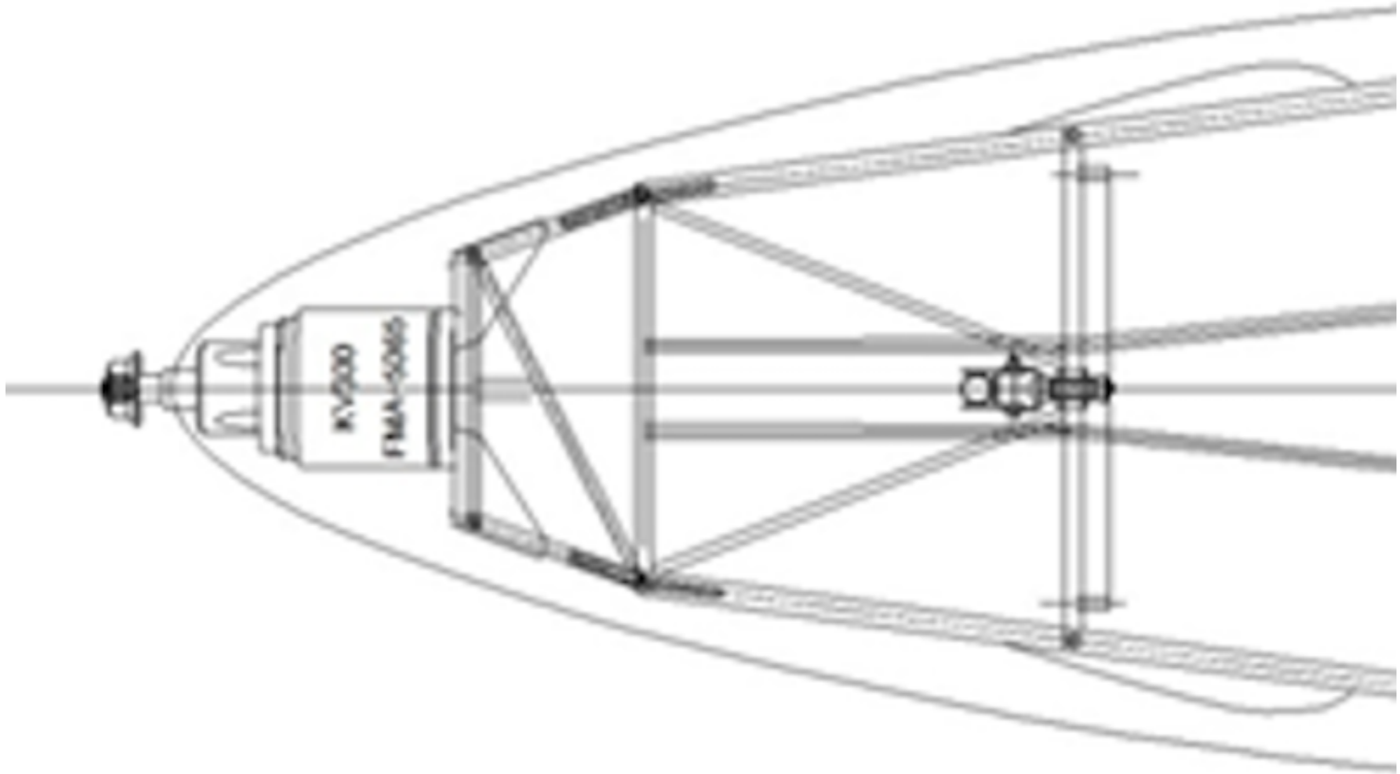
### *Installation of the Mechanism*

The mechanism was attached to the lower part of the nose.


Photo 212: Installation of the Cable Release Mechanism for Aerotowing

Two 2mm thick carbon ear-rings are attached to the rotating shaft of the hook, which is then attached to the truss bar one behind the motor mount. On both sides of the earring, two carbon rods are passed between the truss bar and the motor mount, and a small earring is attached to it to support the front part of the mechanism to hold the rotation of the mechanism.

In the beginning, this cable release mechanism was not intended to be installed, so this part of the structure was as shown in Drawing 52.




**Drawing 52**: Initial nose underside structure

Namely, there was a diagonal member running to receive the reaction torque of the motor. This interfered with the release mechanism, so I removed it and modified it as described above. To avoid any reduction in the anti-torque holding capacity, I also installed two diagonal members outside the mechanism. Photo 213 shows the entire mechanism in relation to the servo.


**Photo 213**: Overall view of the mechanism

I put the cowling over it. The ring shows a little bit.

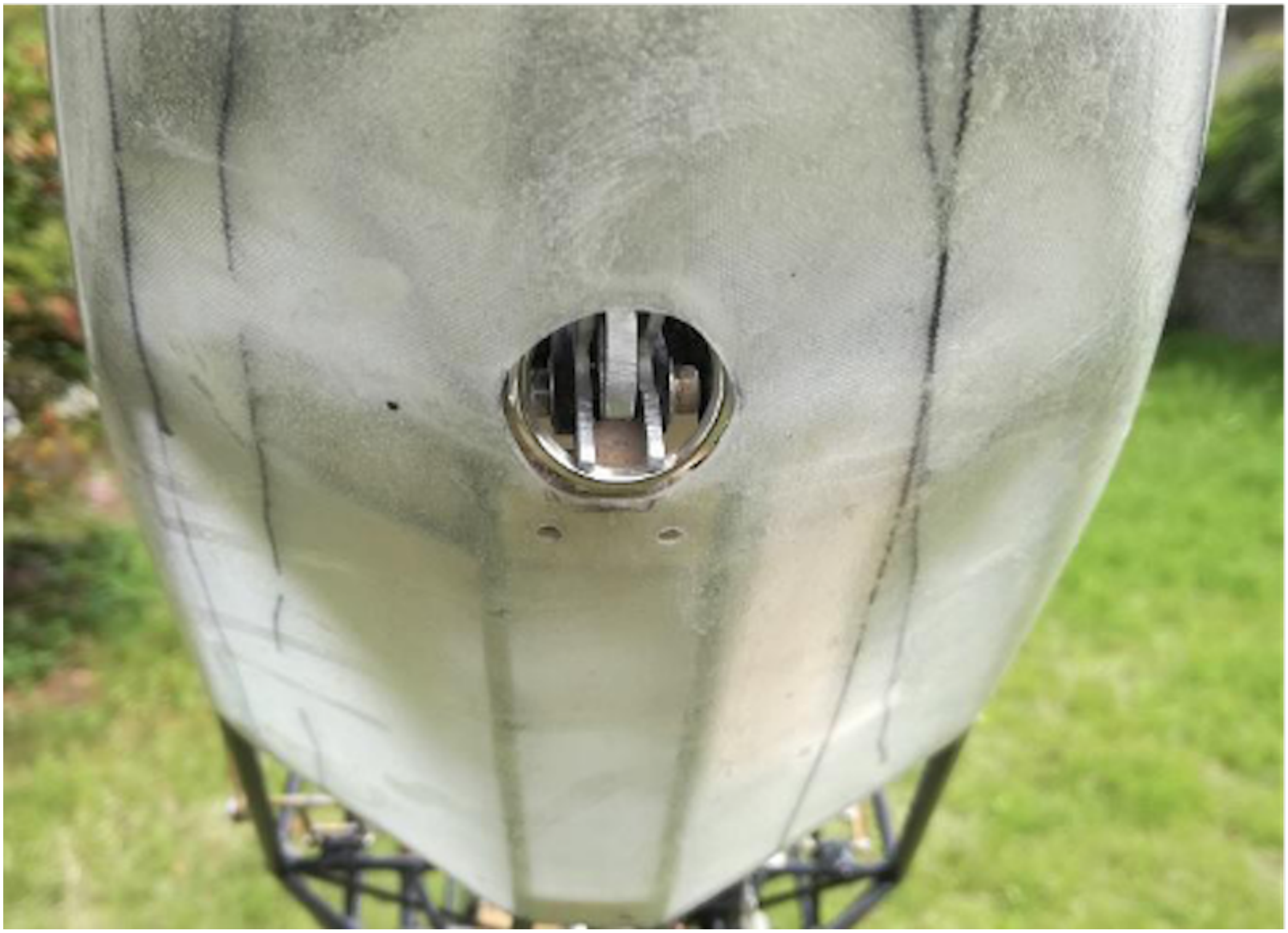


**Photo 214**: Cable release mechanism for aerotowing

I think it gives a good feeling.

The cable release knobs on the left side of the cockpit and the servo are also connected with wires. There is a spring in the middle of the knobs as shown in Photo 215, so when the hook opens, the knobs also move backward as in the real model.

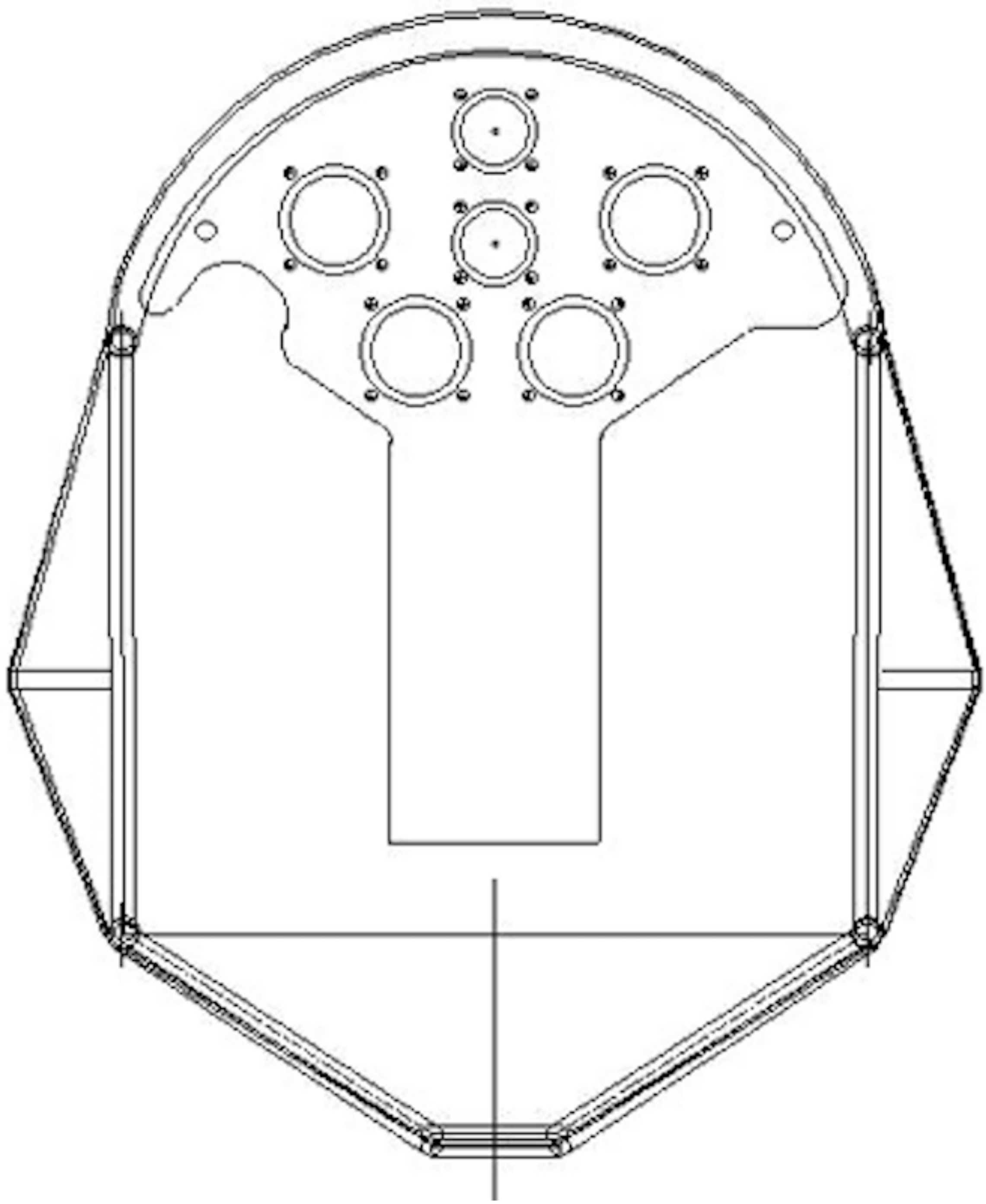
**Photo 215**: Towing cable release knob and spring

Although the fabrication of the cable release mechanisms were completed by this, I must confirm their operation thoroughly later.

# Fabrication Part 44: Instruments Panel and Its Mounting Structure

### *Instrument Panel*

The instruments panel of the Mita Type 3 glider looks like the one in drawing 53. I made it out of 1.6mm thick plywood (Photo 216). It will be painted matte black before the instruments are installed.

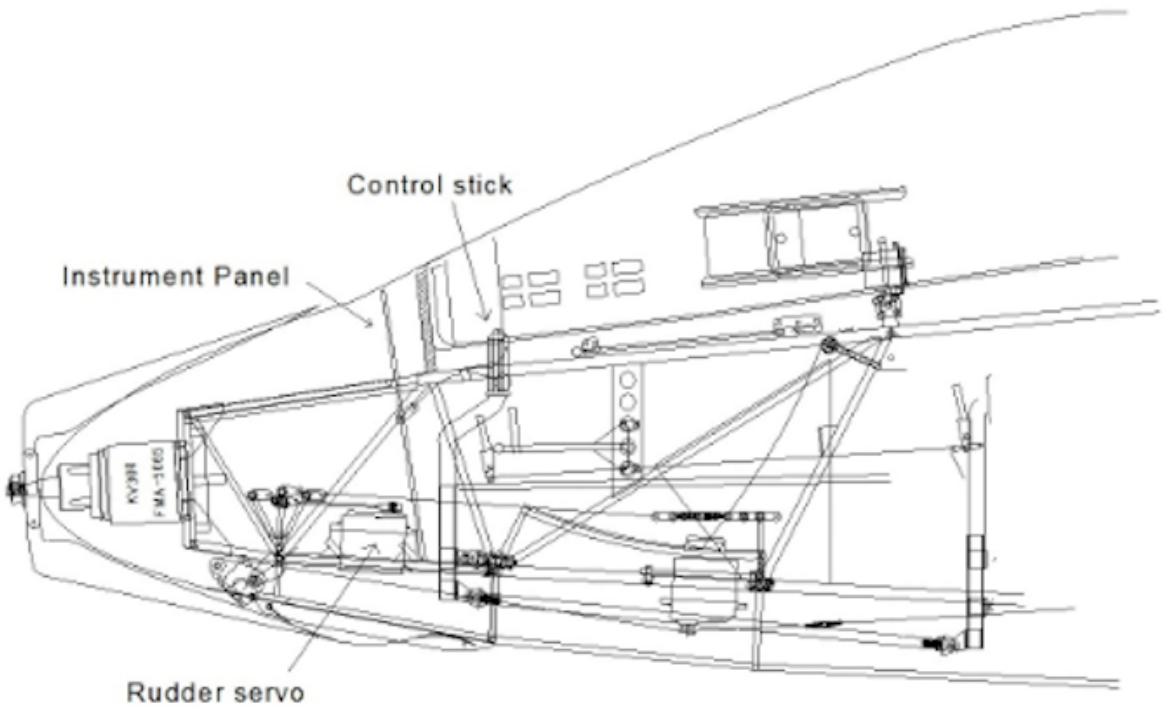


**Drawing 53** (left): The instruments panel **| Photo 216** (right): The panel made of 1.6 mm plywood

## ***Location and Mounting Structure of the Instrument Panel***

The instrument panel is located inside the nose cowling, in front of the control stick. The actual model has a curved steel tube welded to the fuselage structure along the radius of the cowling, and the instrument panel is screwed to it. However it is difficult to get a curved carbon tube in a model, so I decided to attach a wooden frame to the cowling.

The mounting method was decided, but when I put the instrument panel on the fuselage, it turned out to be a problem. It interfered with a lot of things. Drawing 54 shows the position of the instrument panel.




**Drawing 54**: Position of the instrument panel

Initially, I thought I had confirmed that there would be no interference in the drawing, but it turned out that the horn of the rudder servo would hit the instrument panel when it was rotated to the maximum angle. I had confirmed that the servo itself did not interfere with the instruments panel in the drawing, but I had not checked the interference with the horn. Furthermore, I found that the neutral position of the control stick was slightly tilted forward compared to the drawing, so the stick still hit the instruments panel when it was tilted forward the most.

I had no choice but to move the rudder servo forward by 8 mm and adjust the neutral position of the control stick to a slight backward tilt. The forward movement of the servo and the backward tilt of the control stick were beyond the adjustment range of the links connected to them, so I had to rebuild them. Furthermore I found that the backs of the bottom two instruments would hit the top plate of the nose structure.

**Photo 217**: Top plate of the nose structure

This top plate is not found on the actual model, but it was designed to hold the amplifier for the motor. The part where the instruments touch is solved by cutting out the top panel, but the problem is that the carbon square tube attached to the back end of the top platel is in the way. I had no choice but to cut it out as well.

### *Completion of the Instrument Panel Mounting Structure*

As stated above, I encountered many problems, but I solved them one by one and finally completed the installation structure. After attaching the wooden frame to the cowling, the instrument panel was mounted and checked in the aircraft.

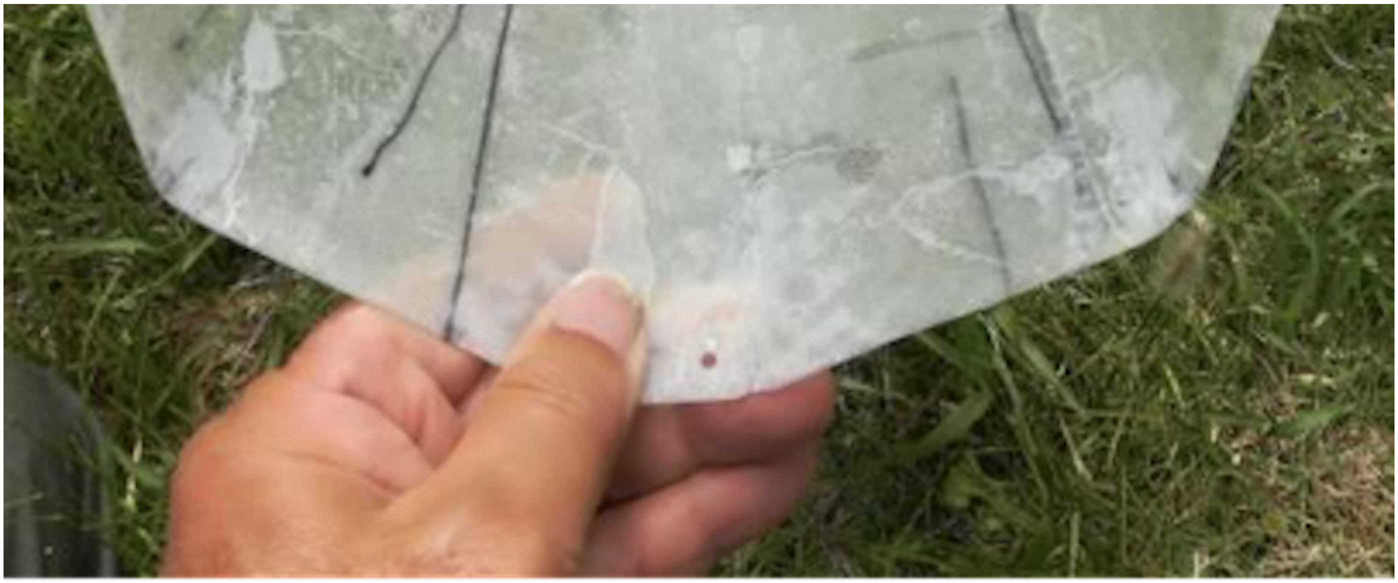


**Photo 218**: Instruments panel mounting frame (left) and panel installation confirmation

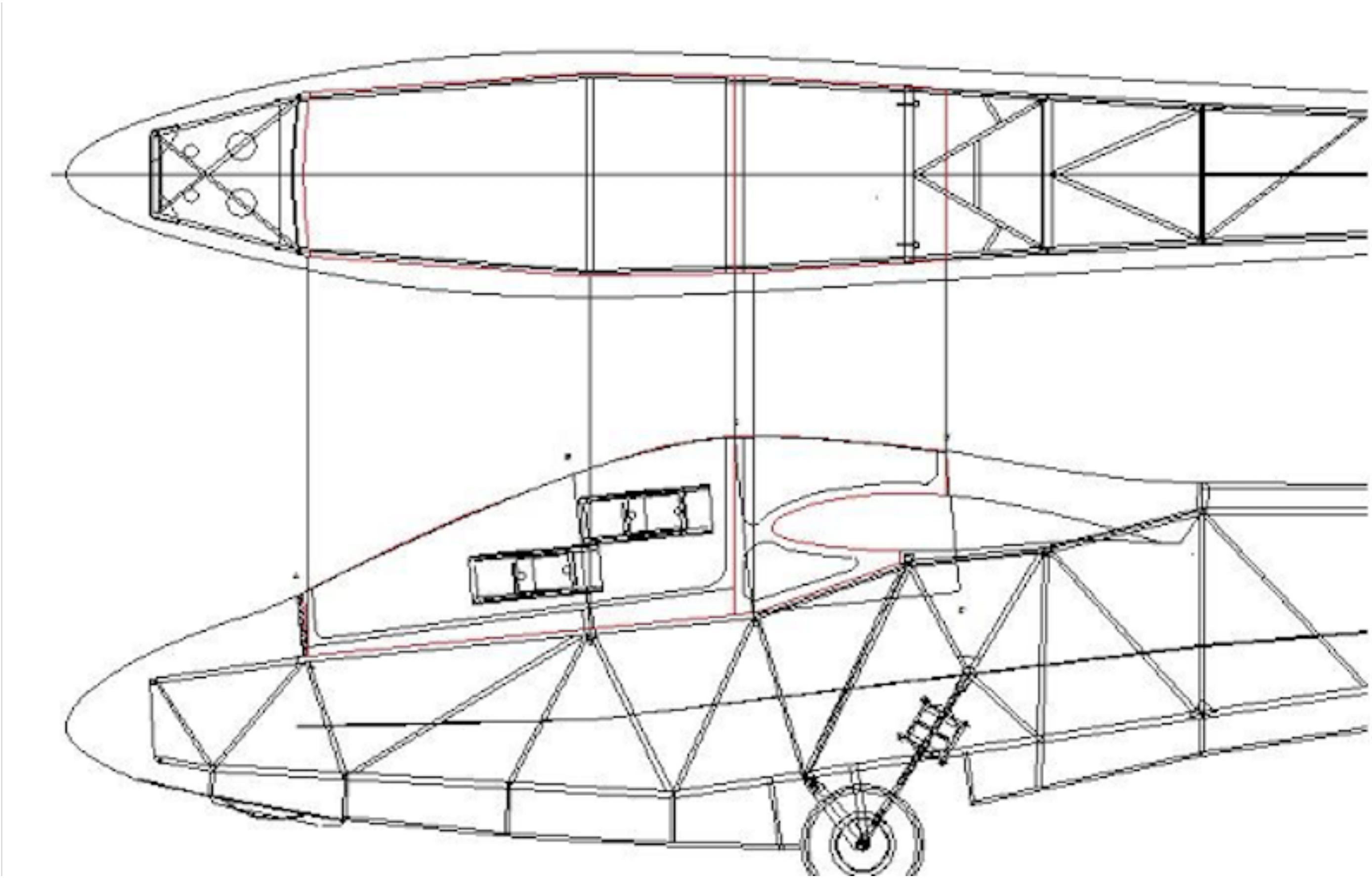
It looks pretty good. I think the actual instruments will look much better when they are mounted. After this, I asked a club member who has a mini lathe to cut the cases for the instruments. I will make scale boards and attach them to these instruments.

### *Drawing of the Canopy Wooden Mold*

There is a big task left to make the canopy. I had no experience with the vacuum method of making the transparent part. When I was gathering information on how to make the canopy, I found out that Mr. Toyama, an expert in this field, is in Nagano Prefecture and he makes canopies for many people. I immediately contacted him and he agreed to make the canopy for me. Moreover, he will also make the necessary wooden mold. So I made a drawing of the canopy mold.

### *Canopy of the Mita Type 3 Revision 1*

The canopy of the Mita Type 3 is divided into two parts, front and rear. The front canopy can be opened, passengers both front and rear seats use it to get in and out. The rear canopy is fixed to the fuselage so it can't be opened. This is what the drawing looks like. The red area is the canopy.

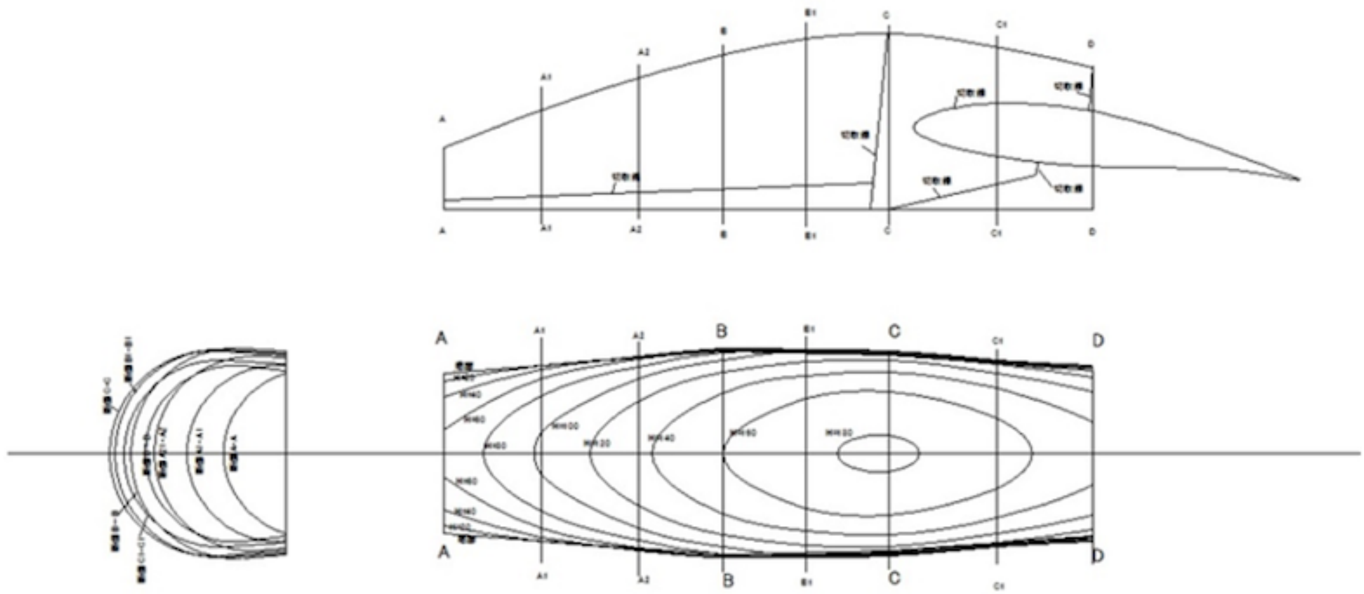


**Drawing 55**: Canopy

The rear canopy has a complex shape across the center wing. Moreover, the bottom of the canopy is not on the same plane with the front canopy. I thought about how to make the wooden mold for this canopy, and decided to use the black line in the drawing, which matches the bottom surface of the front and rear canopies. This way, the shaped transparent part can be cut and divided into two parts.

### *Wooden Mold Drawing*

Now that the scope of the wooden mold has been determined, I drew a drawing to define its 3D shape. The drawing method is the same as the nose cowling drawing.



**Drawing 56**: Canopy wooden mold drawing

Define the cross-sectional shapes of the four sections: the very front section that touches the nose cowling (section A-A), the section where the canopy sill kinks in the plan view (section B-B), the dividing line between the front and rear canopies (section C-C), and the last section that touches the center wing fairing (section E-E). Then draw the appropriate cross sections (A1, A2, B1, C1) between them.

Cut them at multiple planes of 20mm height each and draw contour lines. If the contour lines have a strange waviness, modify the cross-sectional drawing. However, there was nothing too strange, and I was able to define it in one shot.

This is a big canopy. The dimensions of the wooden mold are 670 mm in length, 210 mm in width, and 180 mm in height, and it seems that Mr. Toyama cannot cope with the vacuum equipment he has, so he will make a new large one.

I was a little worried about making the canopy, but with the support of a veteran, I was able to solve the problem.

### *Improvement of the Cable Release Mechanism for Aerotowing*

When I carefully checked the condition of the cable release mechanisms for the winch and aero towing, the condition of the aerotowing was not so good, so I improved the design and modified it.

### *Cause of the Problem*

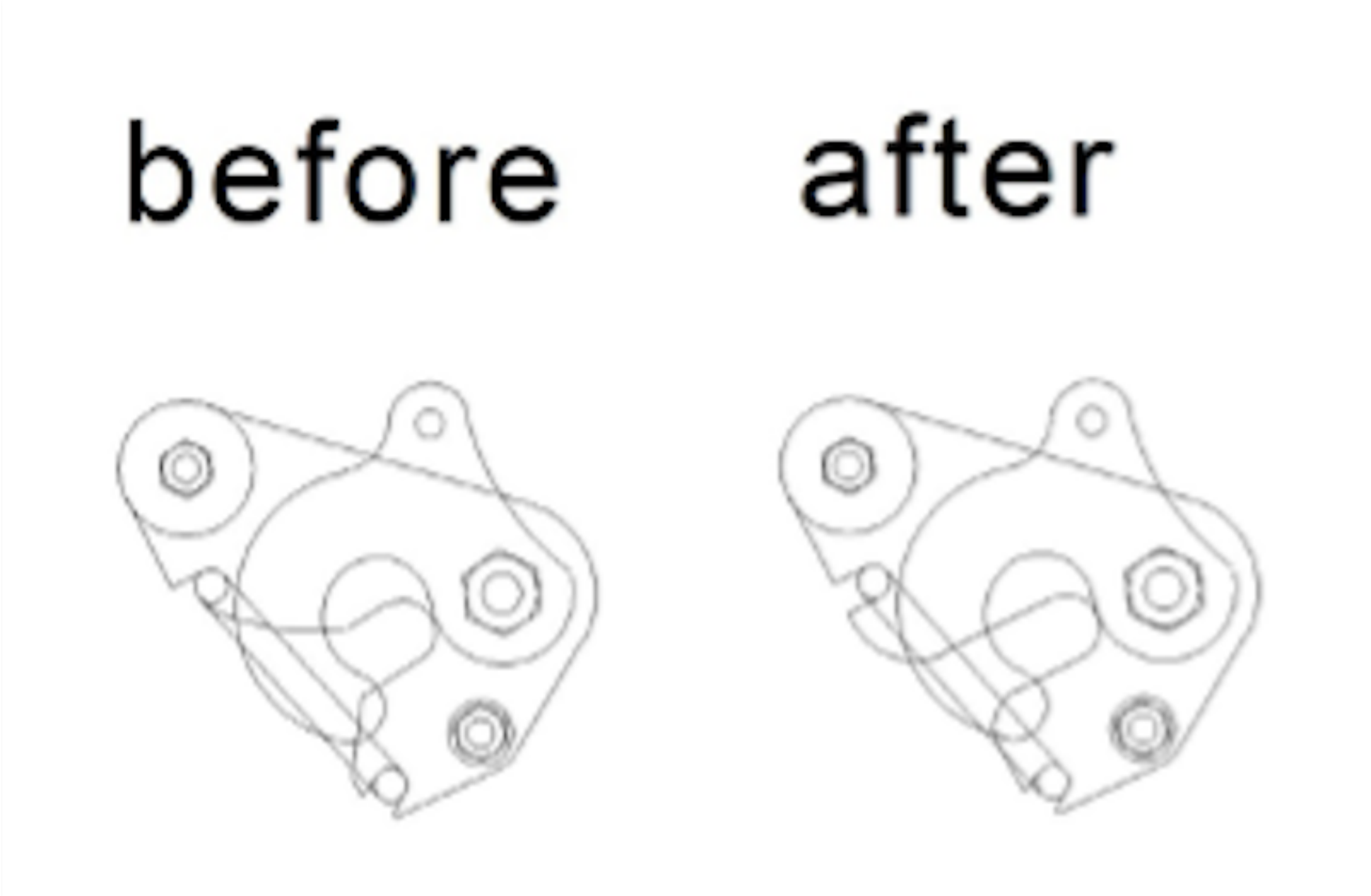
Actually, the design of the mechanism for aerotowing was made in the same way as the mechanism for winch towing, without thinking it through. However, the situation when the rope is released is very different between the two mechanisms.

In winch towing, the cable is pulled by a very strong traction force, and is released when the aircraft is near the top of the winch. In other words, the cable is positioned at a very downward angle to the aircraft axis. On the other hand, in airplane towing, the tension applied to the cable is much lower than in winch towing, and the cable is at an angle parallel to the fuselage axis when it is released.

The release mechanism that I made the other day did not take this difference into consideration, and I designed the shape of the guide that receives the ring-shaped metal fittings attached to the towing cable to be the same for both release mechanisms. When the cable was actually attached to the mechanisms and the release condition was confirmed, it turned out that the cable for winch towing was released straightforwardly, but for aerotowing it was not released well.

### *Improved Design*

I redesigned the guide for the aerotowing mechanism to take into account the release situation described above. Drawing 57 shows the comparison between before and after the improvement.




**Drawing 57**: Improvement of the cable release mechanism for aerotowing

The side plates have a different shape near the exit.

### *Rechecking the Release Condition*

I installed the redesigned mechanism and rechecked the release condition of both the winch and aero mechanisms.

Photo 219 is the ring attached to the cable.

**Photo 219**: Ring for towing cable

Connect the servo tester to the servo for the release mechanism.

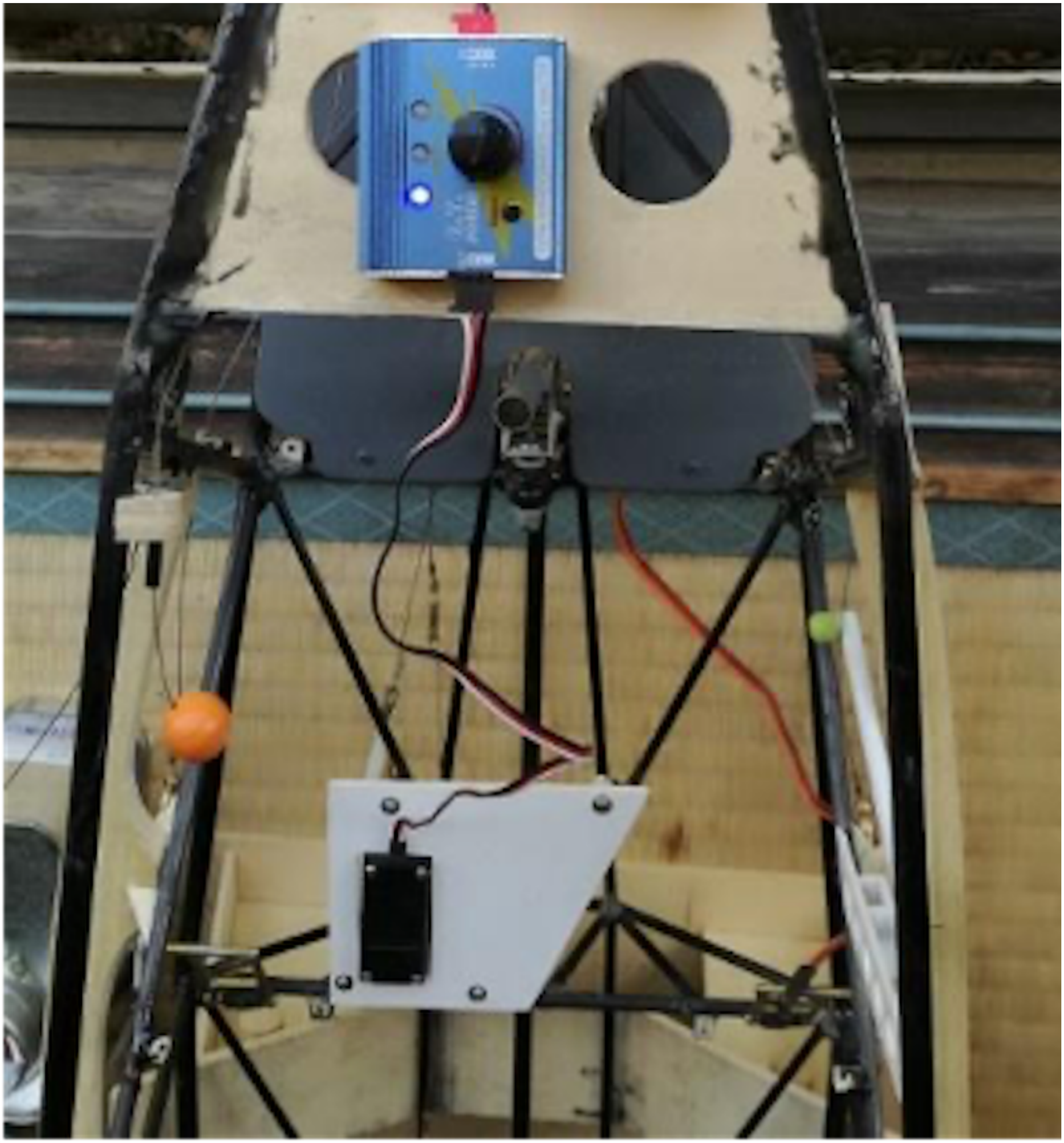
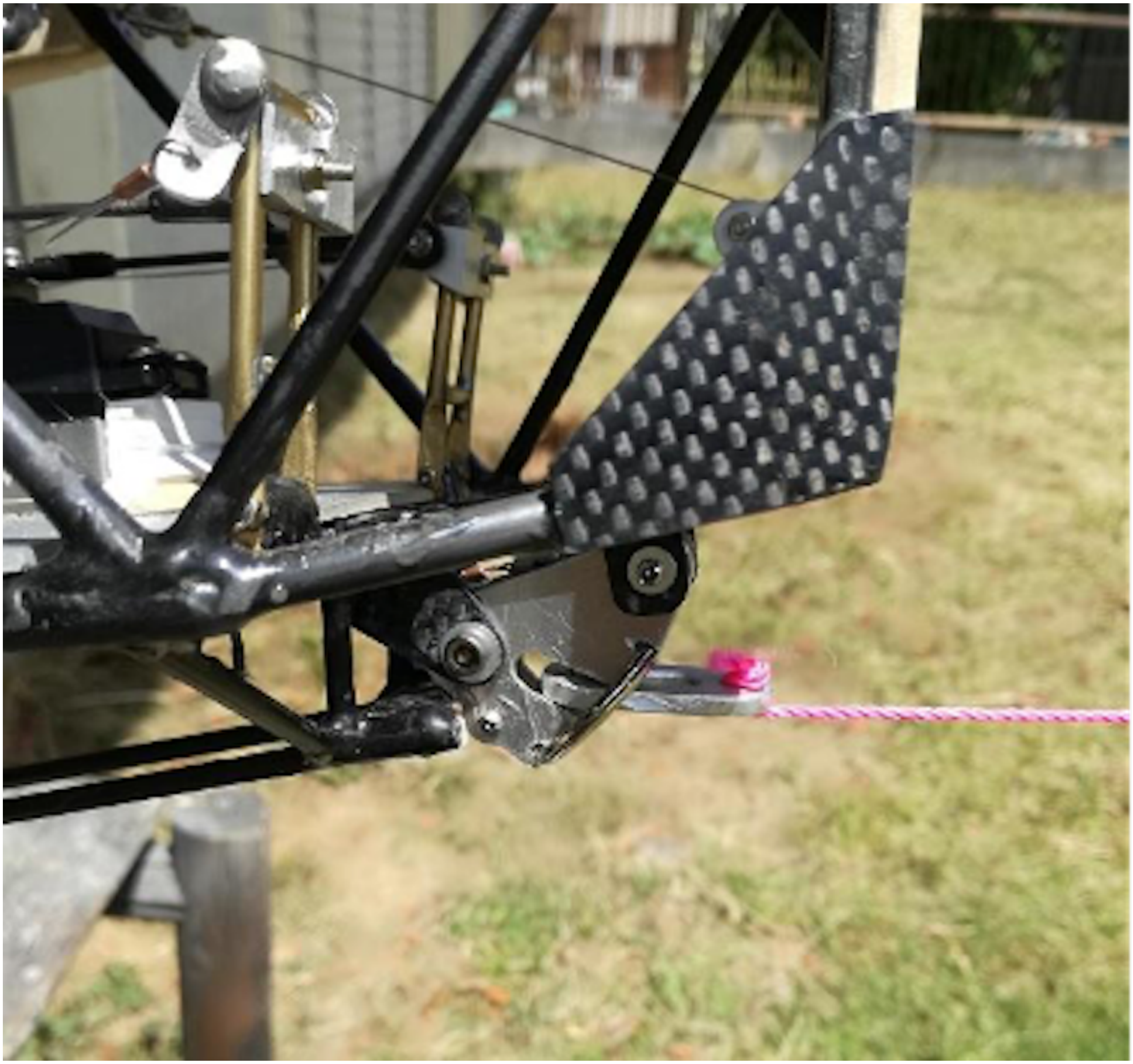


**Photo 220**: Connecting the tester to the servo for tow rope release

Then, the ring of the cable is hung on the hook of the aerotowing mechanism. In this state, I pulled the cable at an angle that seemed to be the aerotowing state, and turned the dial of the servo tester. This time, the ring came off very smoothly.

In the same way, I tested the winch towing mechanism at a deep angle to the fuselage axis, and reconfirmed that it would release straightforwardly.



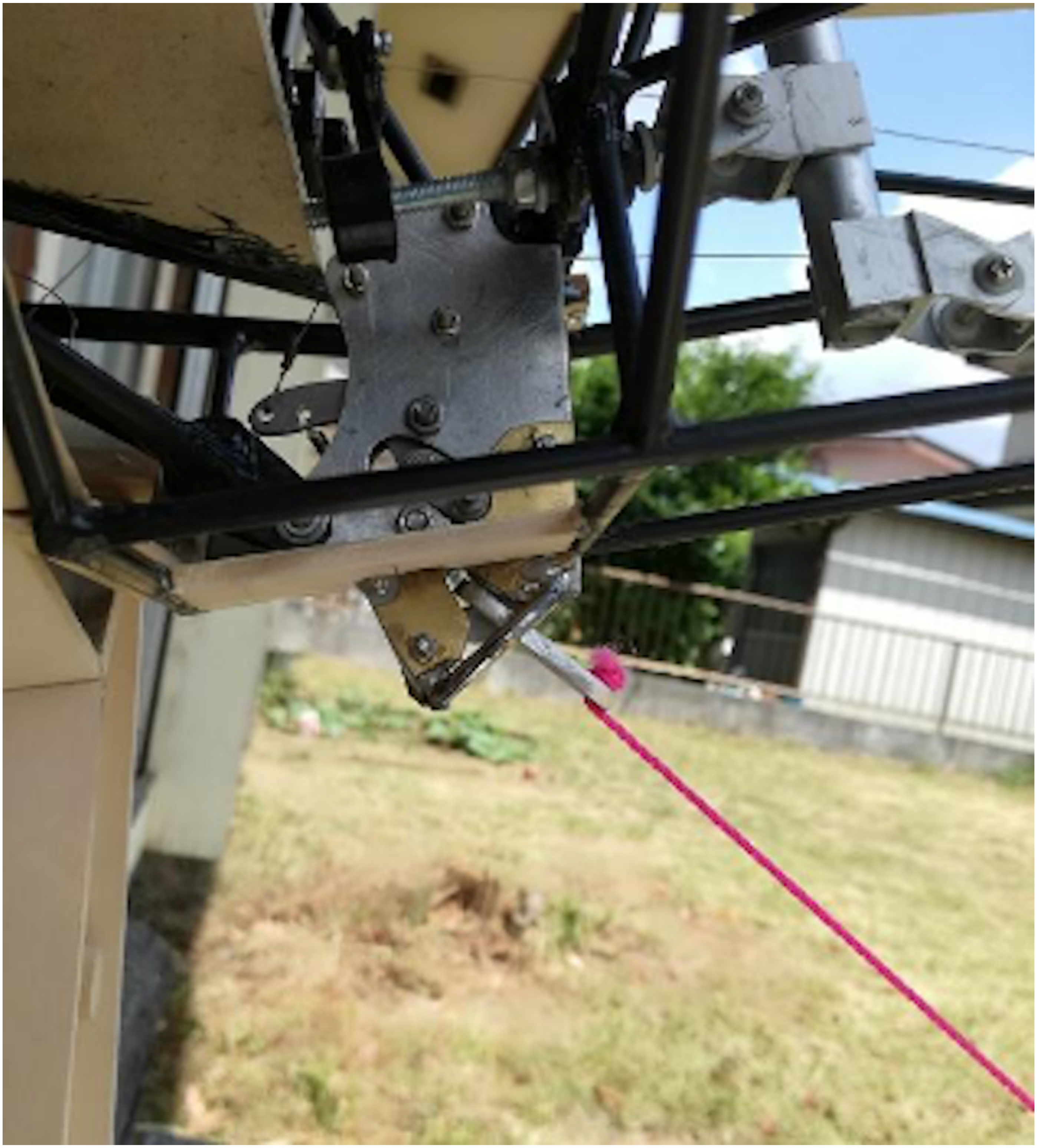


**Photo 221**: Test of tow cable release mechanisms; aero towing (left) and winch towing (right)

Now I have confirmed there is no problem in the release condition of both mechanisms.

*This is the ninth part in this series. Read the **next article** in this issue, return to the **previous article** in this issue or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*

# Get Your Plug Holes Aligned

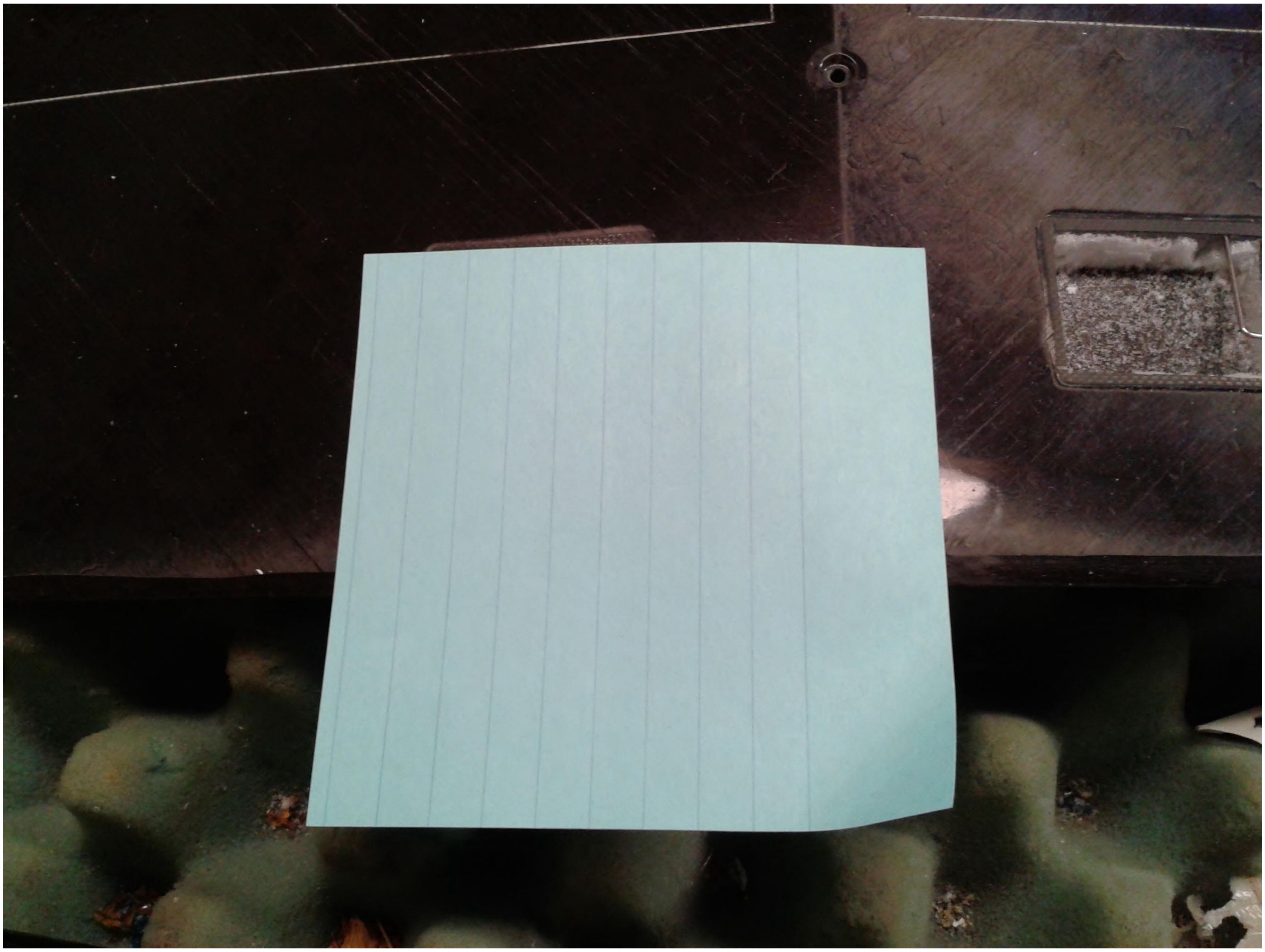
## Looked what I dreamed up.

Tom Broeski

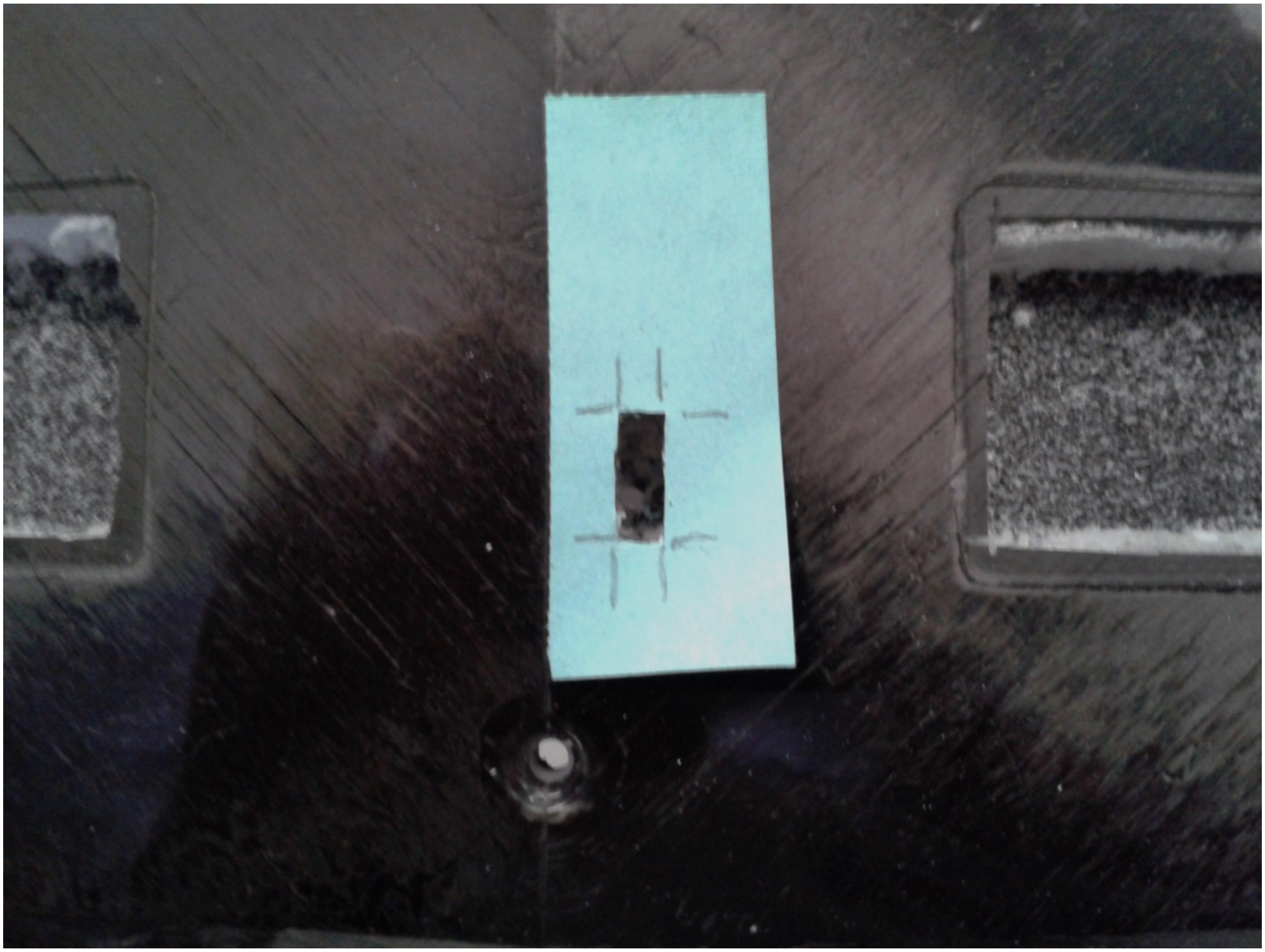
I can usually measure pretty accurately, but I was dream building (seem to do it every night) and I came up with this.

Take a Post-it® Note or a piece of paper with a very light tack glue or repositionable adhesive.


KRYLON
Easy-Tack
Repositionable Adhesive
7020
STAY TAC
CLEAR SPRAY
TEXTILE
ADHESIVE
WARNING
Scotch
Craft Stick



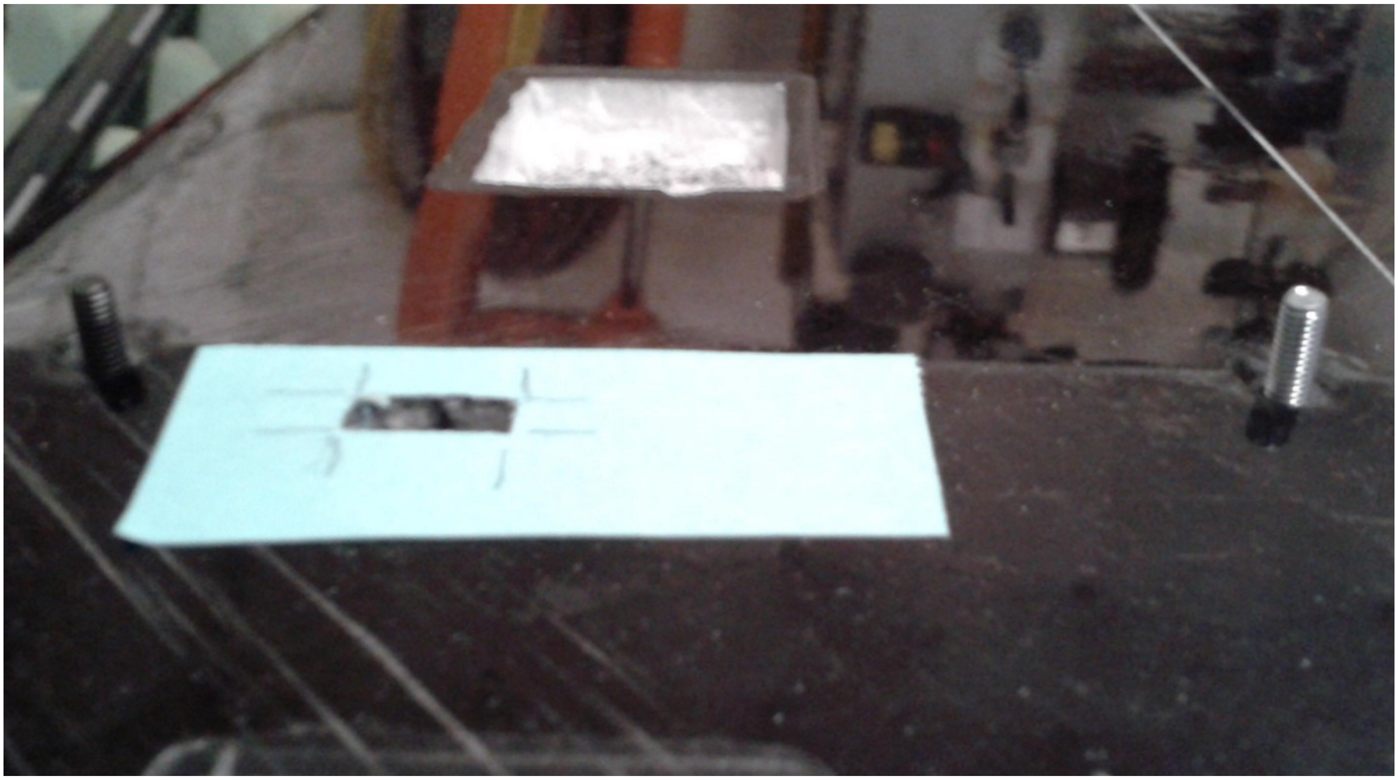
Stick it where you want to cut your hole. Measure and cut. In this case it is a Stream NXT wing.



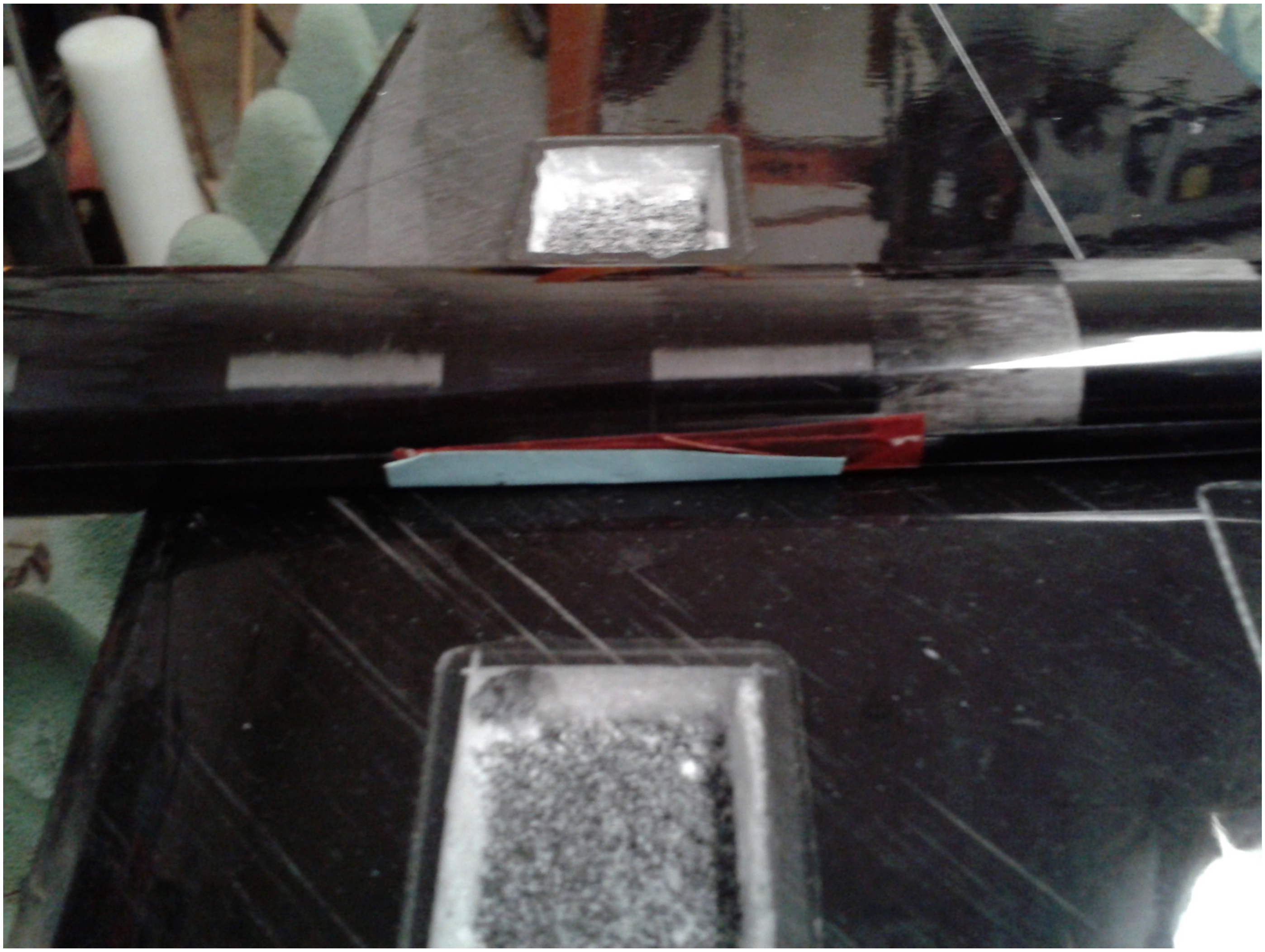
Take a piece of double stick tape (I used some red so you can see it) and put it on the fuse or other part you want to transfer the hole to.

Peel the backing off. I left a bit extra over the side.

Put your bolts in the wing (or dowels or whatever) so you can get the alignment right before pressing the wing all the way down.



Press the fuse on the wing and fold over the Post-it® Note onto the double stick to make sure it comes off easily.



Remove the wing and voila...

A perfect transfer of the hole! Cut it out, wire it up and put your plug in. If you are accurate in your cutting, it will align just right.

As always, if you have any questions, please use the *Responses* section below and I will do my best to answer them.

'Til next month!



*All images by the author. Read the* ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of contents****. A PDF version of this article, or the entire issue, is available* ***upon request.***

# The Trailing Edge

## So long 2021, it's been…well…interesting.

[The NEW RC Soaring Digest Staff](https://medium.com/@rcsoaringdigest)


We're thinking of "I Only Have Eyes for You" (the Jamie Cullum version). Have your own funny caption for this beautiful photo? ! For those who like to anthropomorphise their aircraft (like we do) you can see why we have squirrelled away this photo for next Valentine's Day. (image: Iain Medley-Rose)

It seems like yesterday we were just kicking off the New RC Soaring Digest with the January issue and here it is December already. The year 2021 has come and gone. If you were born on January 1st, 2021, that's going to seem like a lifetime. Because it is. But for the rest of us it's a frighteningly smaller and smaller fraction of our allotted span. Where does the time go?

This year started out with such promise, with the general sentiment that if it is *any* better than 2020 it will be a great thing. However that set a pretty low bar and it's nice to see that we certainly met that. But around the world we seem to be adjusting to the idea that while things may be *returning* to normal, we certainly are not there yet. In fact, it's a little disturbing to think that they may *never* be quite like The Before Days.

In thinking about the year gone by, we choose to focus on some positive things that under other circumstances would have taken decades to achieve, if they ever happened at all:

First is a profound appreciation for those who in the past were largely invisible until we needed them. Frontline workers — whether they be truck drivers, grocery store clerks, highly trained medical professionals or countless others who keep our world turning— should never be allowed to disappear into the woodwork again. We owe them a debt we cannot hope to repay, and are truly thankful for helping us get through this.

Next amongst these is the ability to both live and work at home, with that home being anywhere there is decent internet access. In proximity to great flying sites will be the primary criteria for many of us — instead of stuck an hours drive from a decent slope or field. We do realise and are respectful of the fact this is not an option for all. But for those of us for whom it is, we are truly thankful.

Finally — and yes, there are many other things that we simply can't cover in this short piece — is the isolation we have felt during this period has made us truly understand the value of community. Simply getting together with friends and family to fly our 'toy gliders' is just a little sweeter because, well, we missed it so damn much when we couldn't.

Novelty sharpens the senses and makes us pay attention. It's simply the way our DNA is wired up (as Yogi Berra might have said). If we appreciate these things in a conscious, present way for at least a little while — hopefully a *long* while — then what we've been through will have been a little more worth it.

We take great pains to find just the right sunset or other 'end of day' photo for *The Trailing Edge*. RCSD contributor Iain Medley-Rose came up with a corker for our year end issue. We'll turn it over to Iain to tell you about it:

*"The* Salto [left, is by] *Baudis… from 2008/2009. It weighs 6kg and is 4m in span. I would say that the Baudis* GP 15 *is the successor in that manufacturer's range. The plane is new to me as it popped up for sale about a month ago. I nearly bought it when the original owner sold it but couldn't justify the expenditure. It is very good to fly and doesn't exhibit the usual tail waggle of most* Salto *copies.*

*The* K 8B *is from the Flair kit and was bought a few months ago as something for me to learn how to fly slow old gliders. I am so used to skinny plastic missiles I wanted to be prepared for the test flight of my father's 1/4-scale* ASK 13 *that he has been building since 1986. It is hopefully going to be ready in spring 2022."*

Iain is also a very talented videographer — keep an eye on the RCSD Twitter feed where we are regularly featuring his work. Thanks, Iain, for all of your contributions in 2021 and we look forward to seeing more of them in 2022.

# New in the RCSD Shop


The August cover photo by Pierre Rondel features a beautiful 4.5M Jonkers *JS4 belonging to Gérard Prat*.

As regular RCSD readers know, we also carry Japanese-language articles: currently Norimichi Kawakami's magnificent twelve part series *1/3rd Scale Mita Type 3 Production Notes* presented in its original Japanese. To reflect this unique editorial principle, we have a special new feature to announce: both **English** and **Japanese** versions of our very popular *Cover Photo T-Shirts*. We are starting with the the August issue and will eventually expand the line to reflect all issues of the New RC Soaring Digest. As an added bonus purchasing one — or anything in the Shop — helps keep RCSD commercial free because **all proceeds from the RCSD Shop directly support the operating costs of the New RC Soaring Digest.**

## Make Sure You Don't Miss the New Issue

If you don't want to miss the December issue of the *New RC Soaring Digest* make sure you subscribe to our **Groups.io mailing list** or connect with us on **Facebook**, **Instagram**, **Twitter** or **LinkedIn**. And please share RCSD with your friends — we would love to have them as readers, too.

That's it for this month…and this year! Thanks to all of our contributors and above all, thank you, the RCSD reader — without you, we're nothing.

Now get out there and fly!



*Read the **previous article** or go to the **table of contents**. A PDF version of this article, or the entire issue, is available **upon request**.*