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The New RC Soaring Digest

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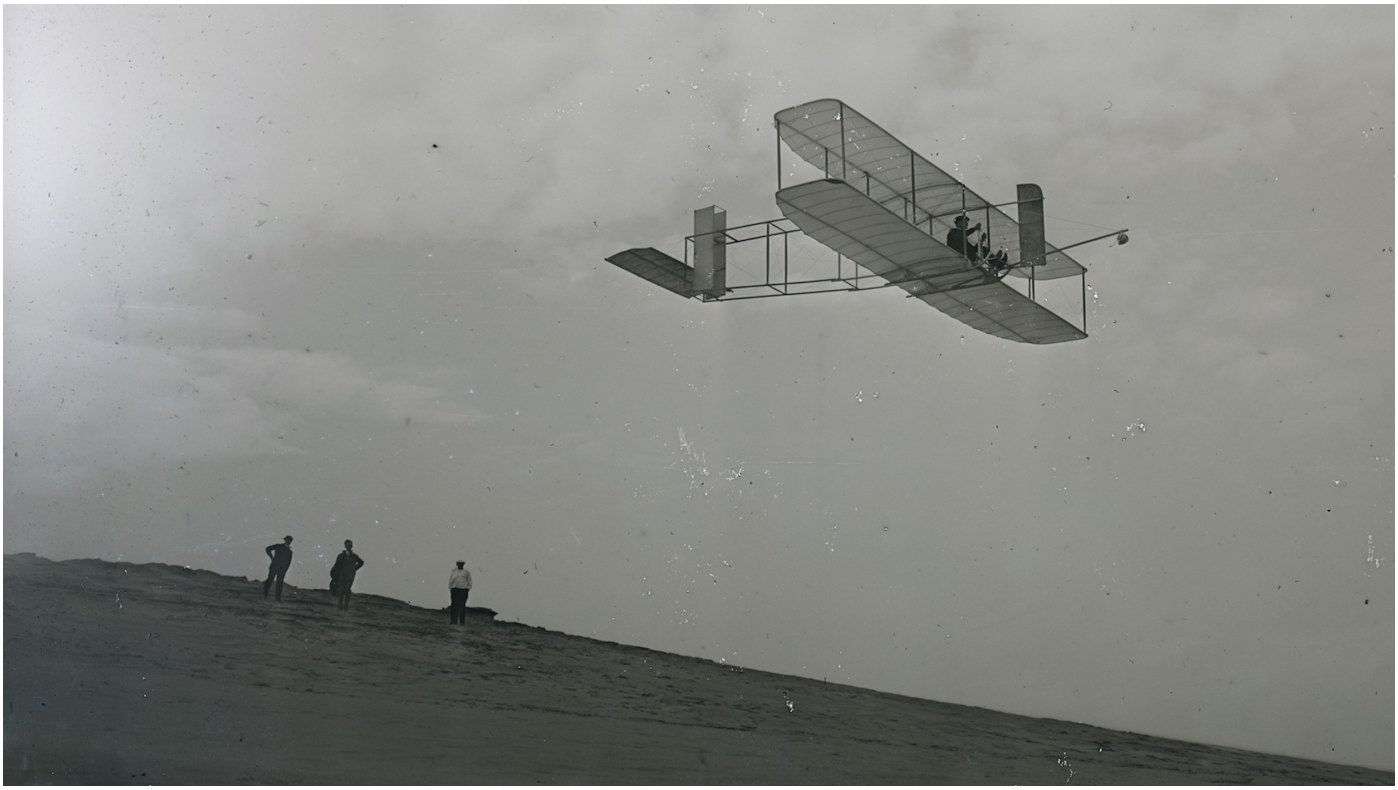
In The Air

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.

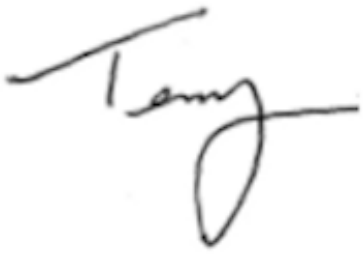
I have likely overstayed my welcome for this month, so I'll simply direct you to the links below to launch into the December RCSD. You'll be glad you did because it's jam-packed with great articles.

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.

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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

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.

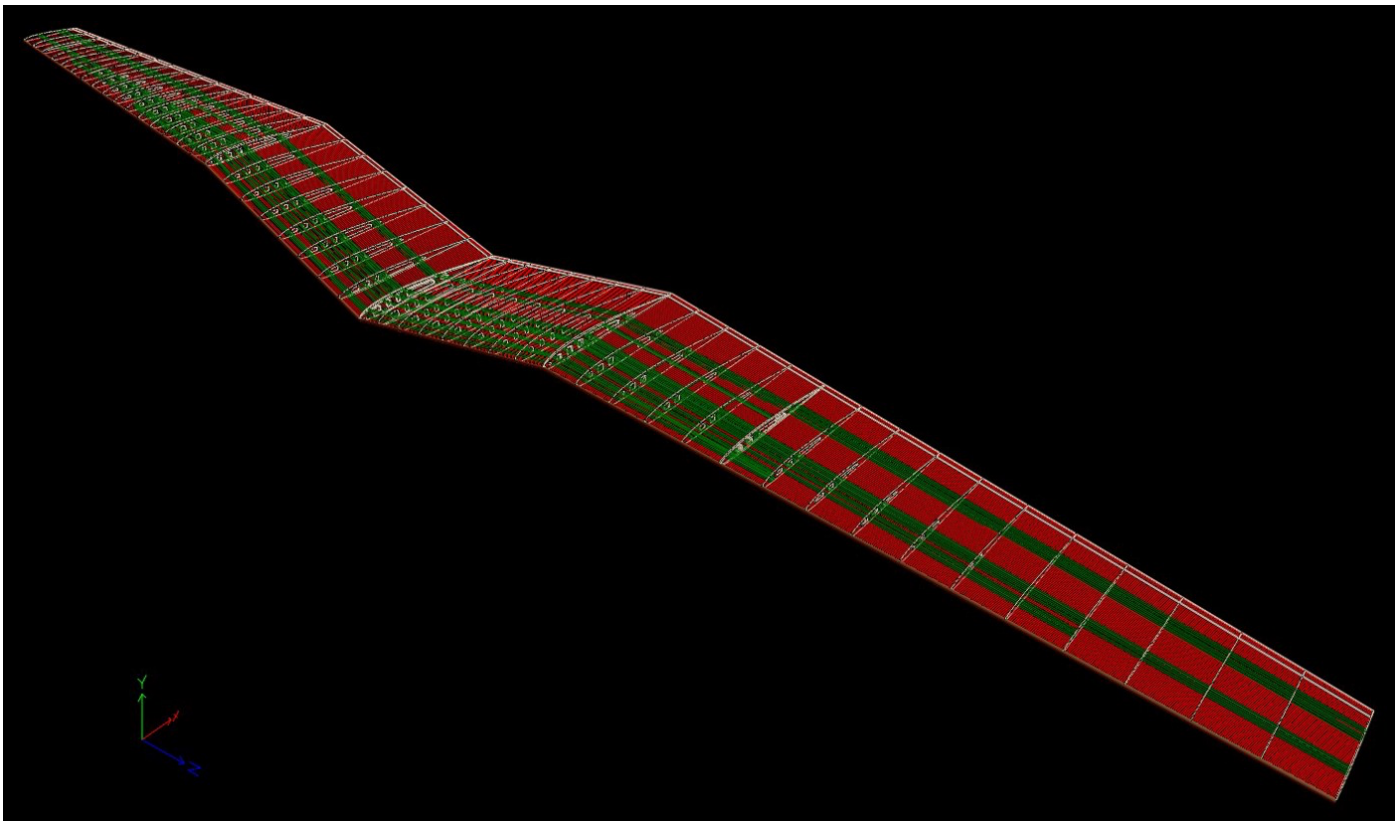
By this time I felt sufficiently inspired to sit down at the drafting board, or CAD program as it were. I was equipped with a well-stocked workshop and an abundance of free time. The race was on to build a new glider in 30 days.

155 days later it finally took flight.

Design

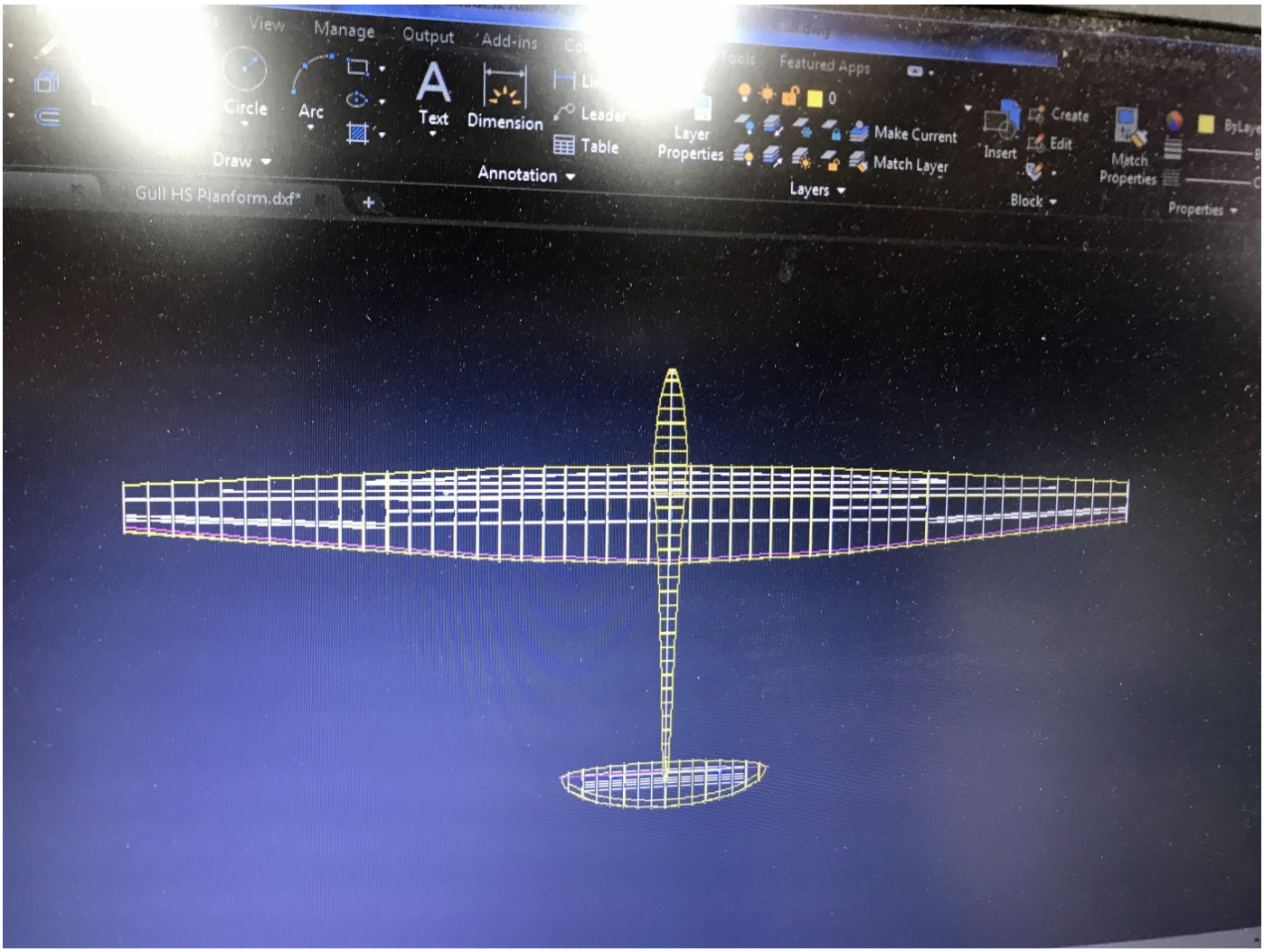
Now that I had established some broad design criteria it was time to dive into the details. I like to start with the wing and design everything else around it. Most of the design work took place in CompuFoil 3D. Step one was choosing an airfoil. I turned to Mark Drela's proven AG series. The inboard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

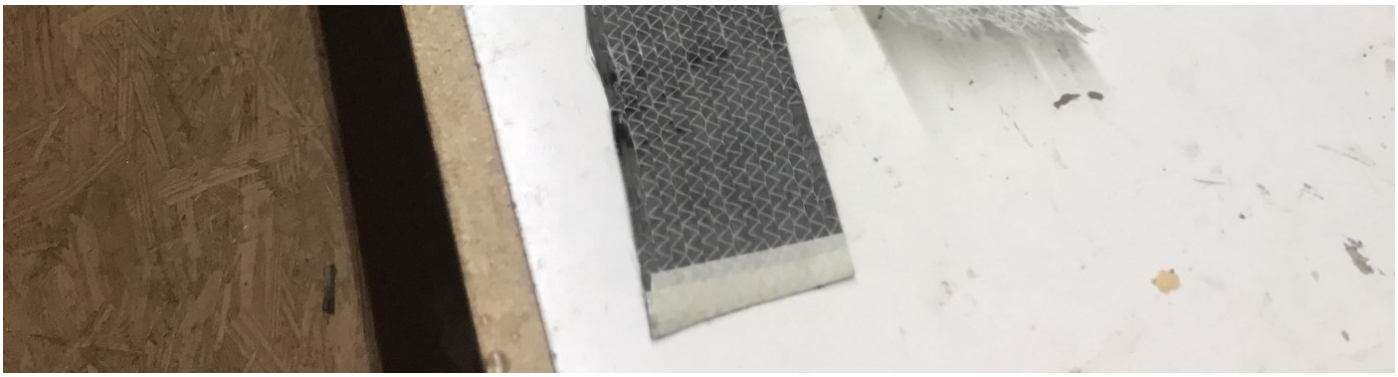
It's important to remember that I was working as quickly as possible to meet a deadline. By this point it was late at night on March 30. I went from inspiration, to design, to CAD drawings in one day. Of course, not everything had been fully thought out yet. Drawings for the vertical stab, wing mount, 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.

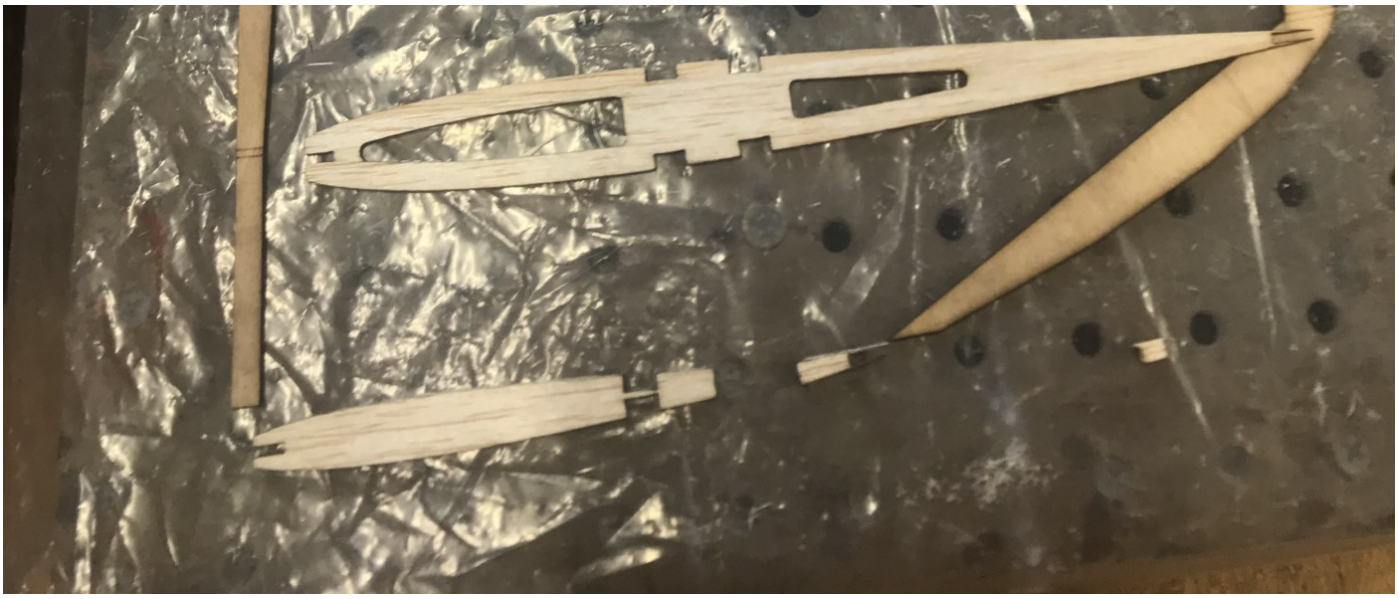
The plane's size makes it challenging to assemble inside my shop, so this was the first time I saw the wings and fuselage together.

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.

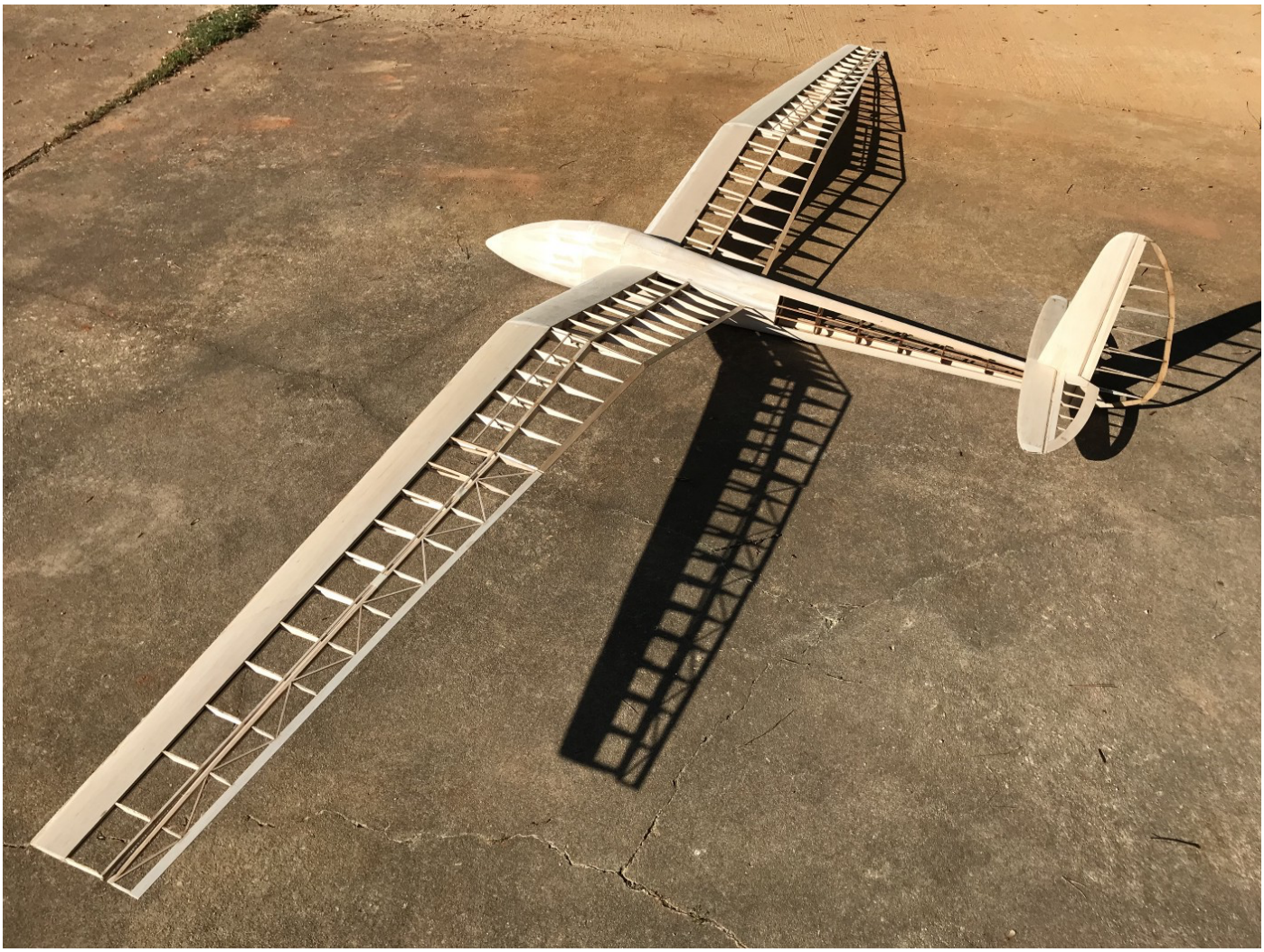
The fin features a straight leading edge with a rounded trailing edge. Laser cut leading and trailing edge pieces made assembly of this complex part fast and accurate.



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.

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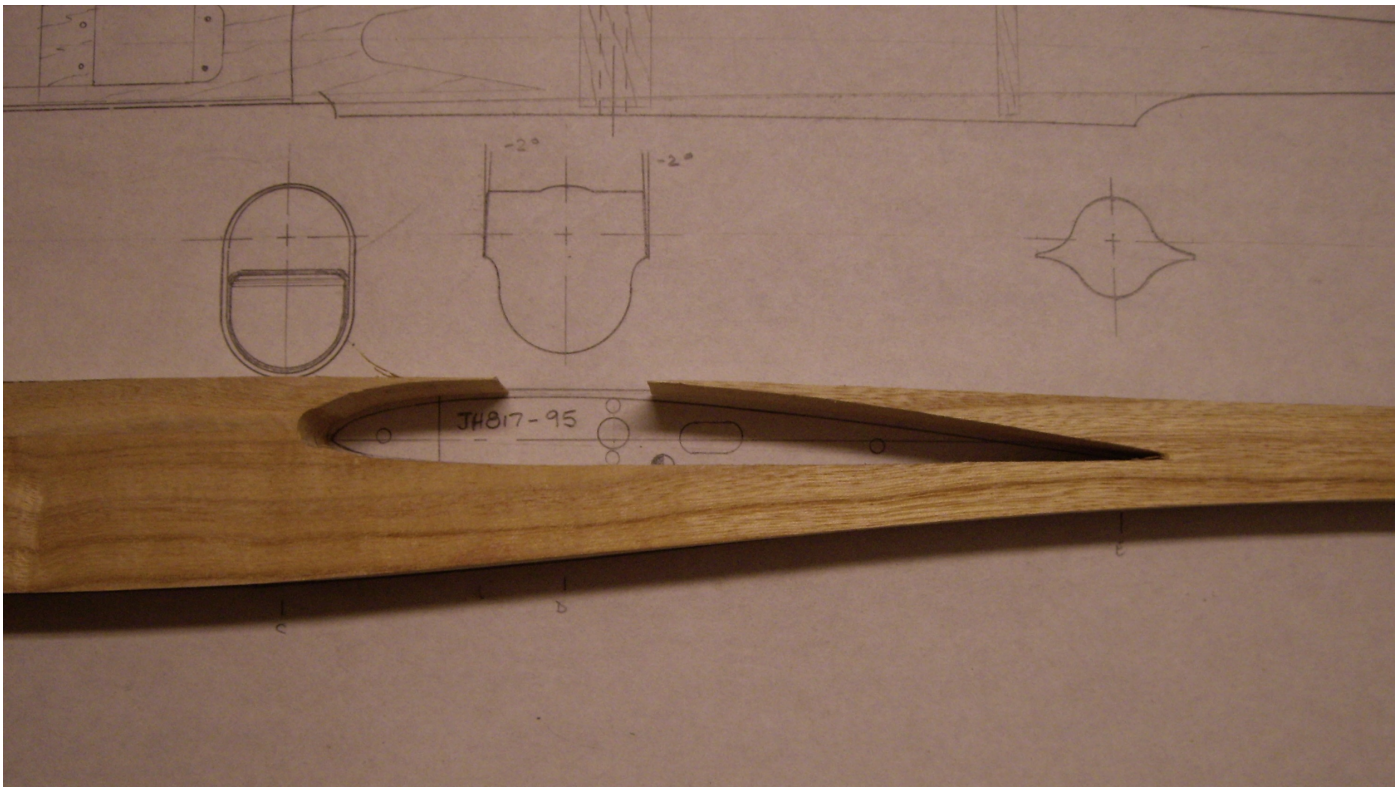
This is the first part of a two part series. Next month, Thomas wraps up the build and talks test flying. All images are by the author. Read the ***next article*** *in this issue, return to the* ***previous article*** *in this issue or go to the* ***table of***

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

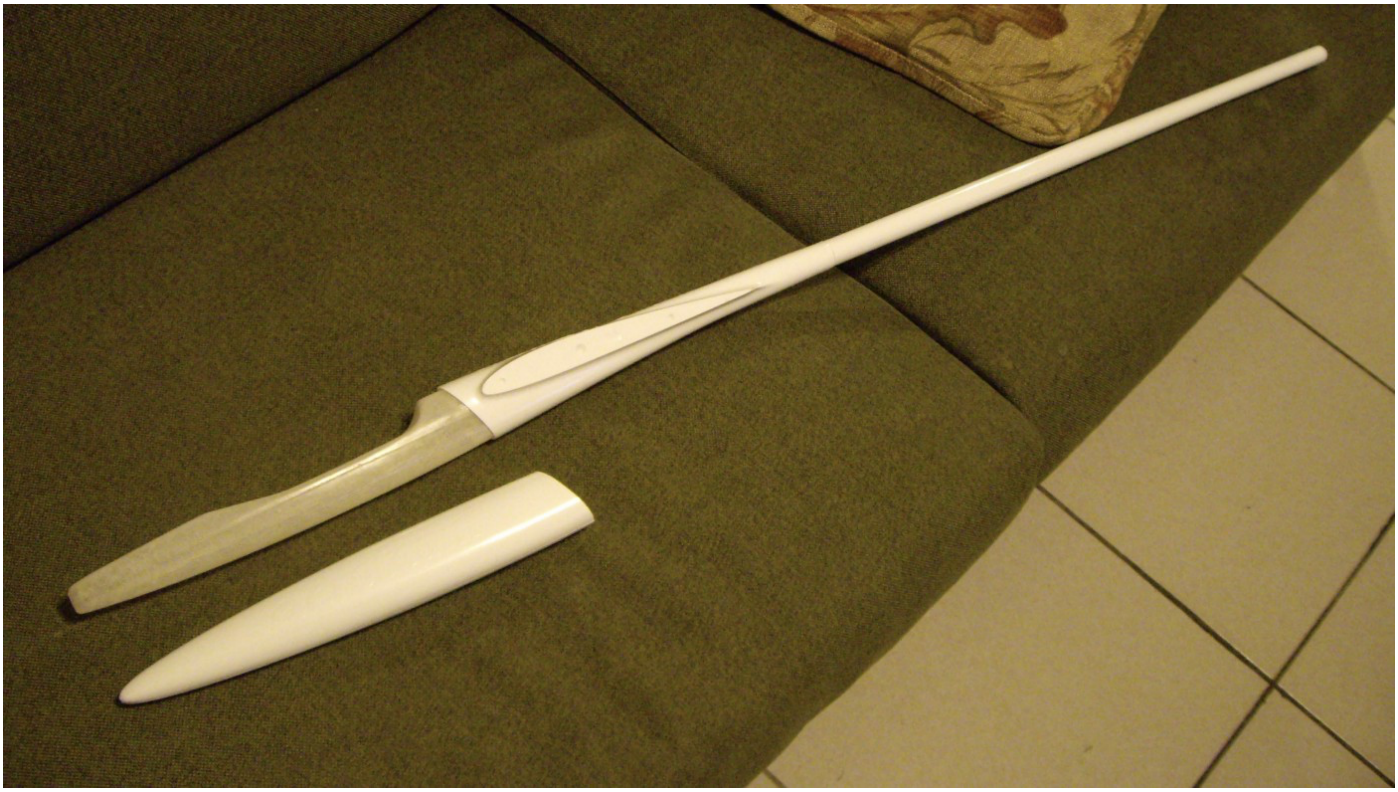


Want to make your own fuselage? Or maybe make a replacement part for a broken model? Here's how to do it at home using the KISS[2] method. — JH

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.

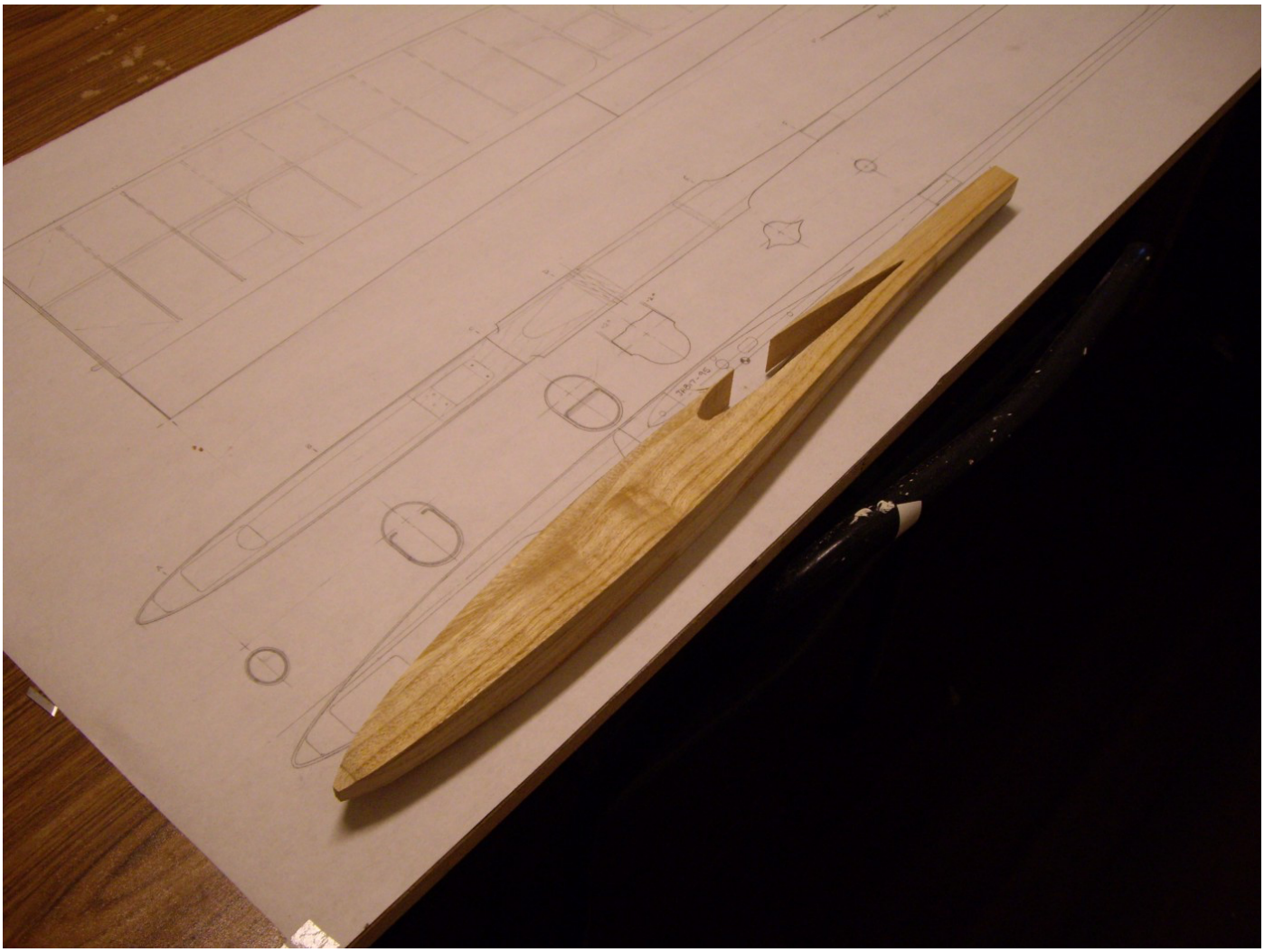
> ***Advice:*** *Before you start, take time to plan your work step by step. Things like a slip-on nose cone or a removable cap type canopy will have a big effect on what you do and when you do it in the process, but if well thought out can be easy to accomplish.*

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.*

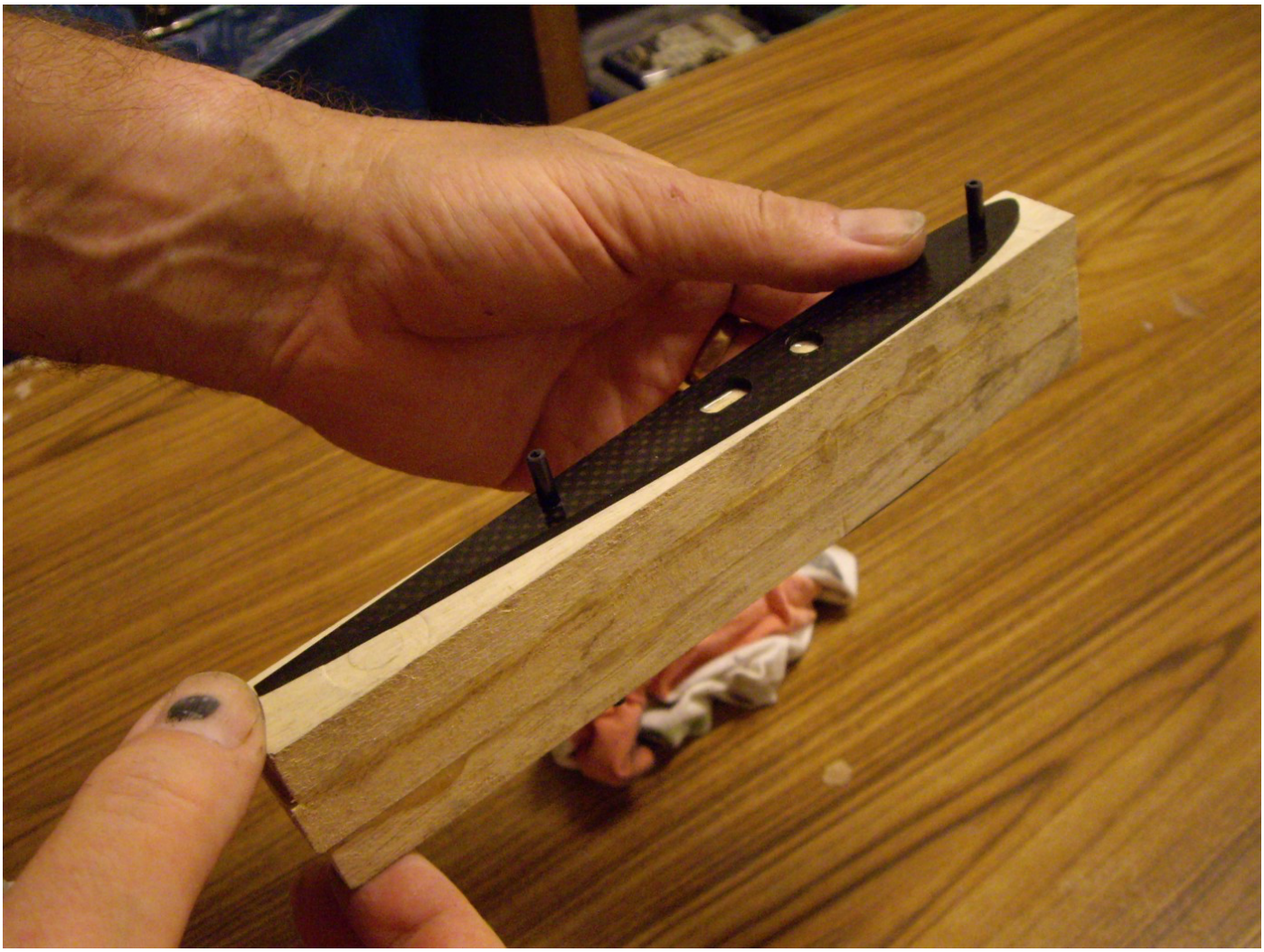
Cutting the Outline



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.

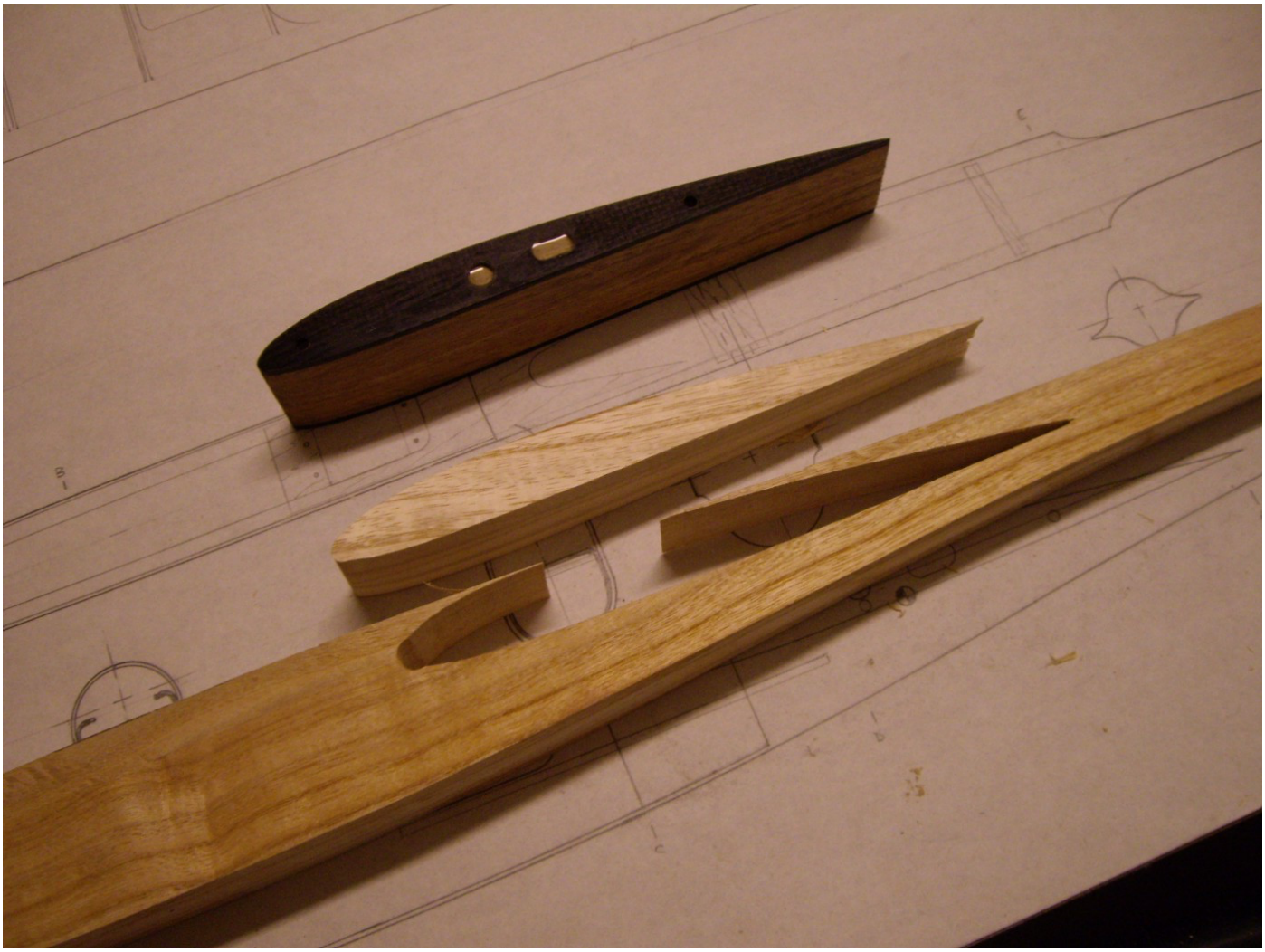
Cutting the Wing Stub Space in the Laminated Fuselage Block

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.*



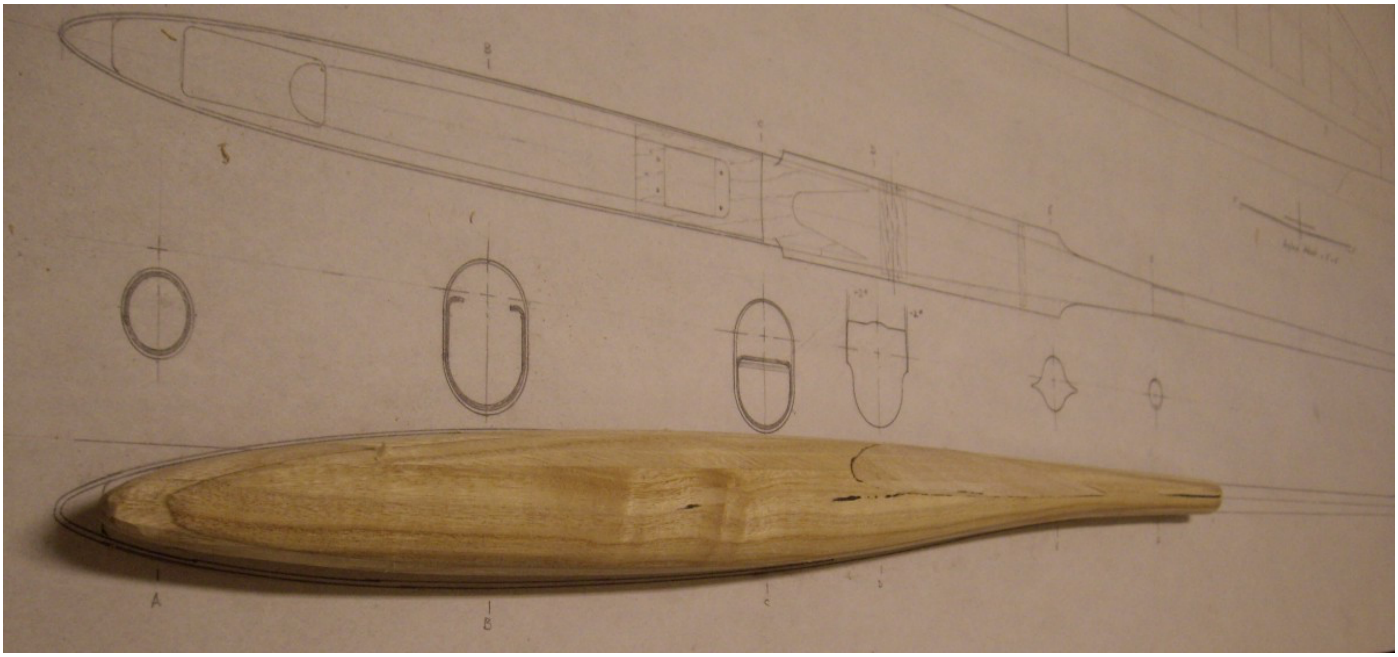
The wing profile that has been removed from the fuselage will now be tack glued back in to provide support when carving the final shape.

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'.

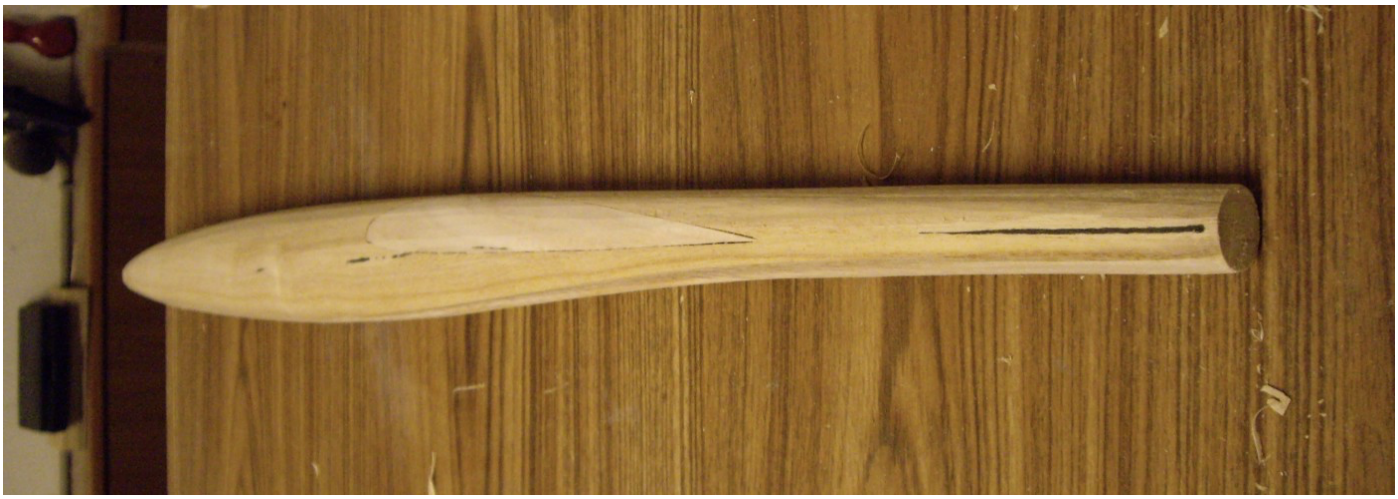
> ***Advice:*** *Look at the lamination shapes often as you work: are they the same both sides? Top and bottom? If they are not the same then make the correction as soon as you see it. If you forget to do it you could end up with a strawberry coloured face and a banana shaped fuselage. Not recommended.*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

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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?

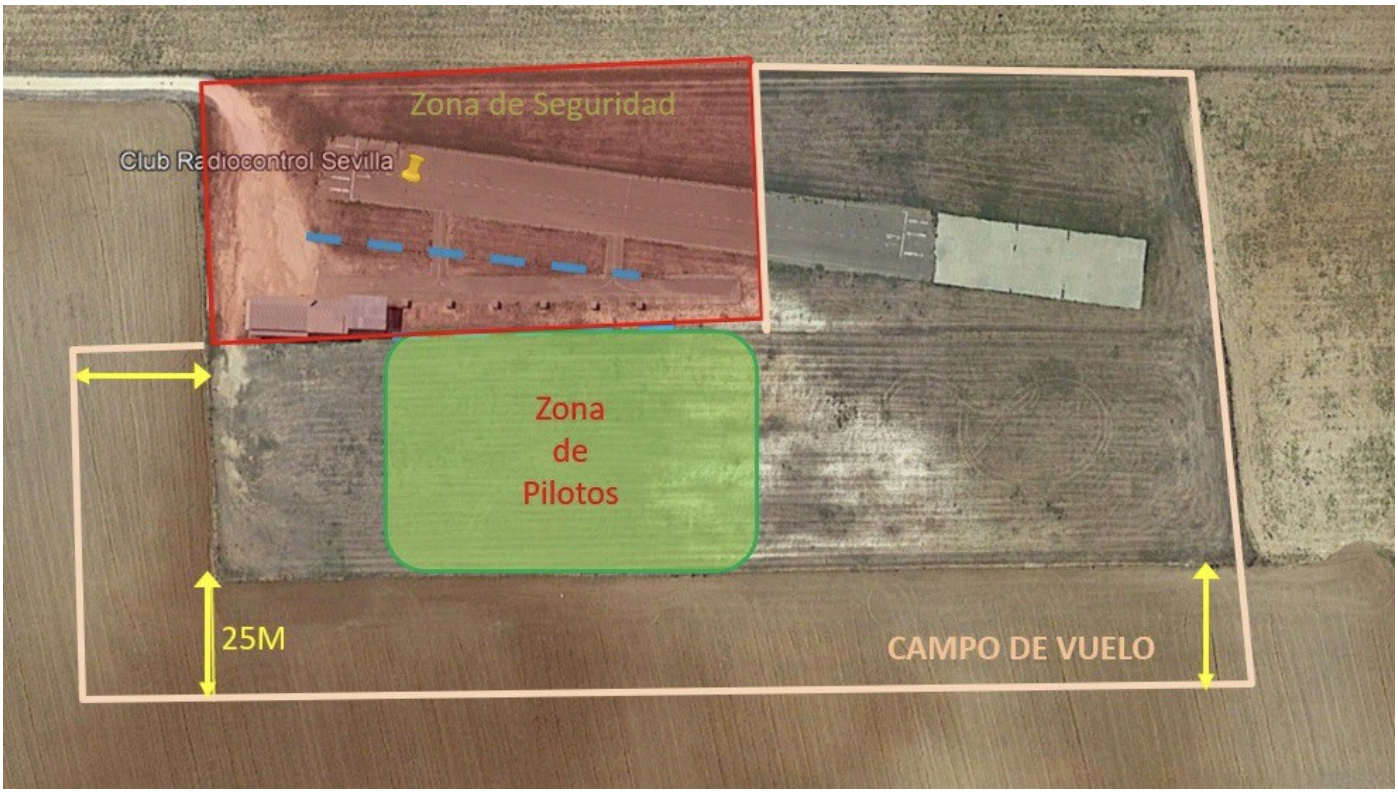
Then Luis Manuel announces it: in 2021, if the damn virus allows us, we will organize a Spanish F5K championship. Friends get ready! He is not a beginner in organizing the first national championships of a new category! Just 10 years ago he already dared with the first Spanish F5J championship — successfully!

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 RADIOCONTRO
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 EI (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 EI (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 EI (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:

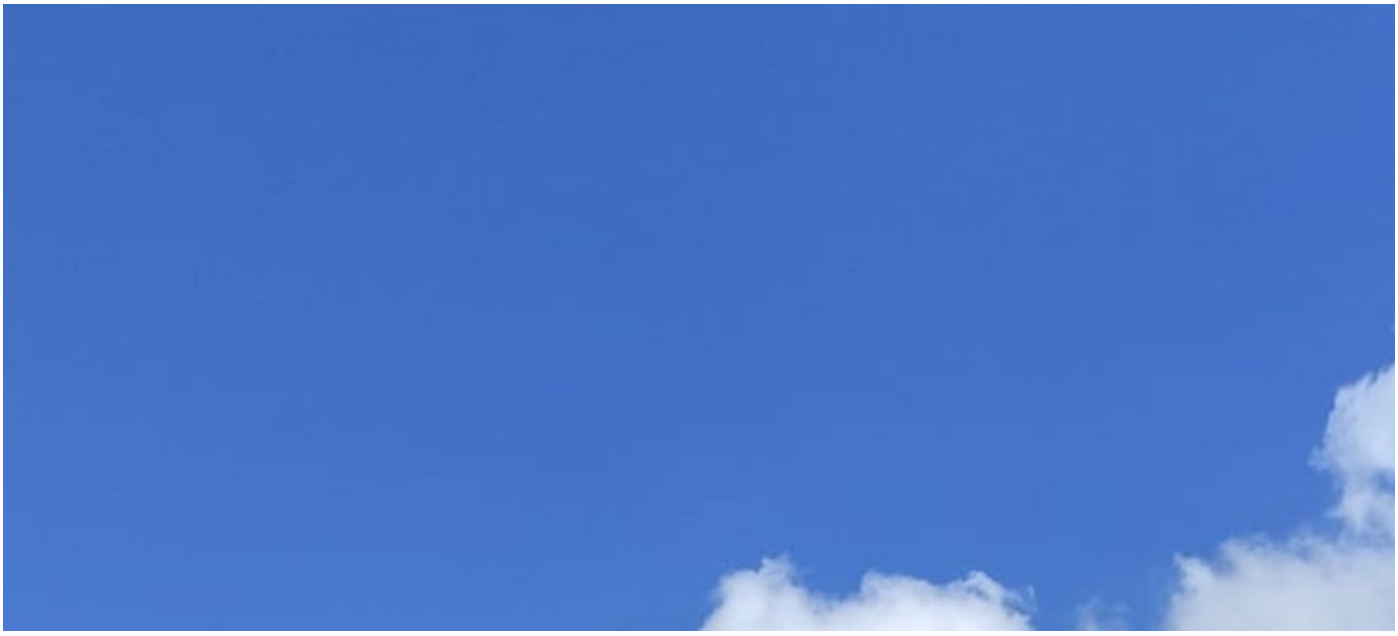
Mng	Description
1	Task A - 1, 2, 3, 4 minutes in 10 minutes (any order)
2	Task B - Last flight counts; 5 min max; Max 3 flights in 7 mins
3	Task C - All up; 4 min max; 3 flights per round
4	Task D - 3, 3, 4 minute flights (any order); Max 3 flights in 10 mins
5	Task E - Poker; Pilot chooses target times;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

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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

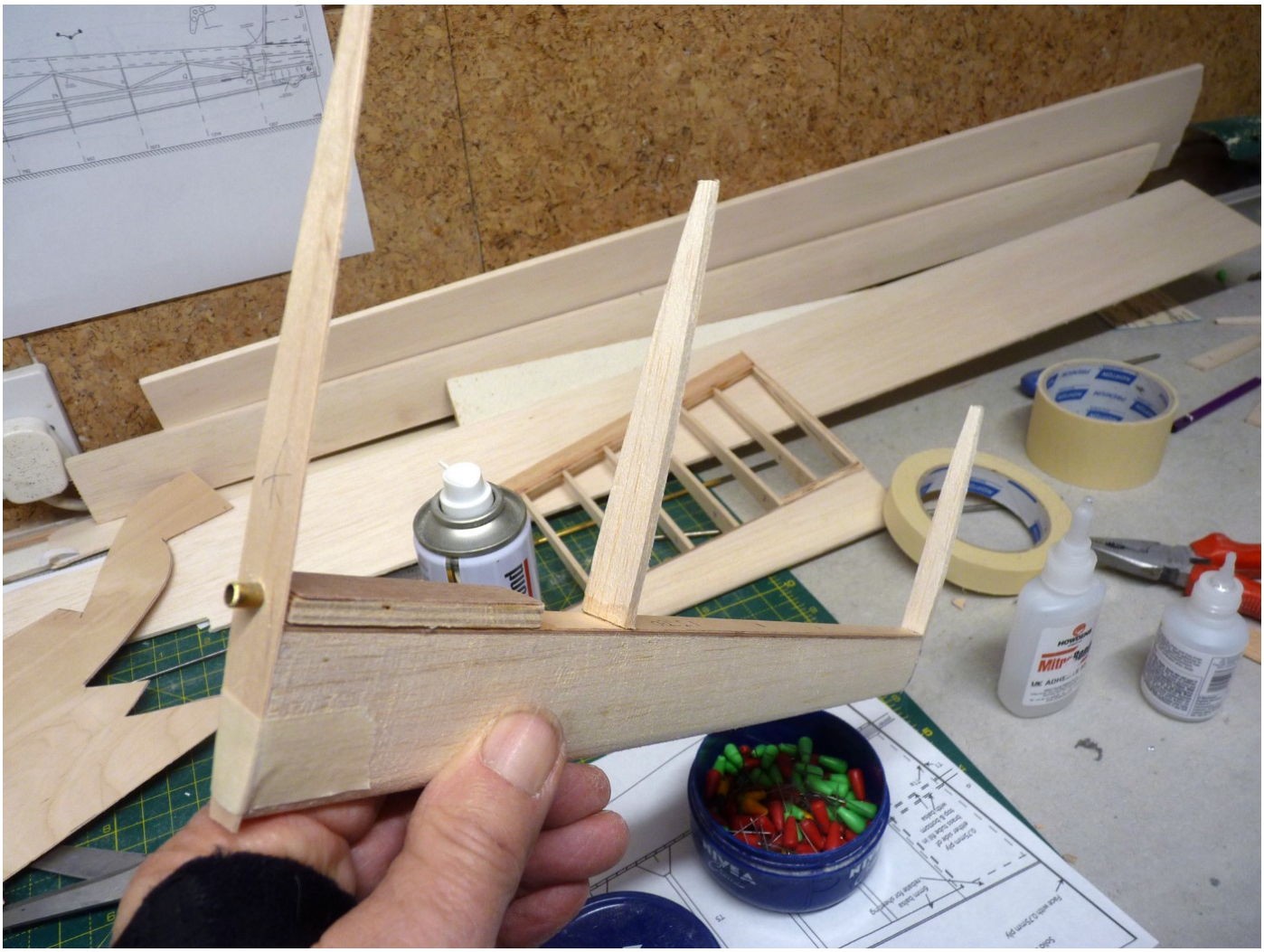
The *Topaze* was built under licence in France as a version of the popular Scheibe SF 27, and took my eye some years ago, culminating in a version scaled to 1:3.5. Three more versions followed over the years until recently, in line with my current down-sizing regime, I produced a version at an OAP-friendly 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.

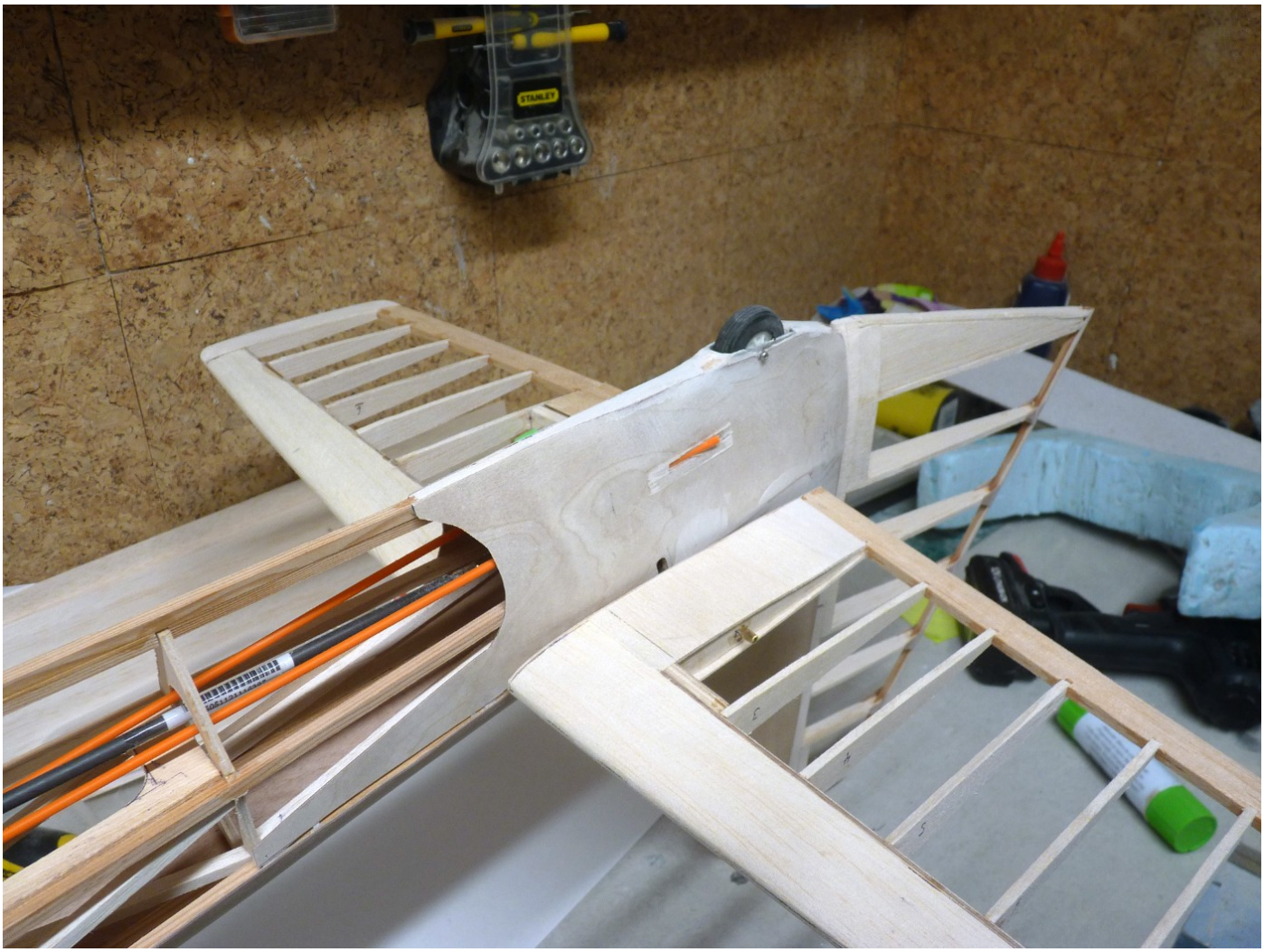


04: First stage of all-moving tailplane (AMT) construction.

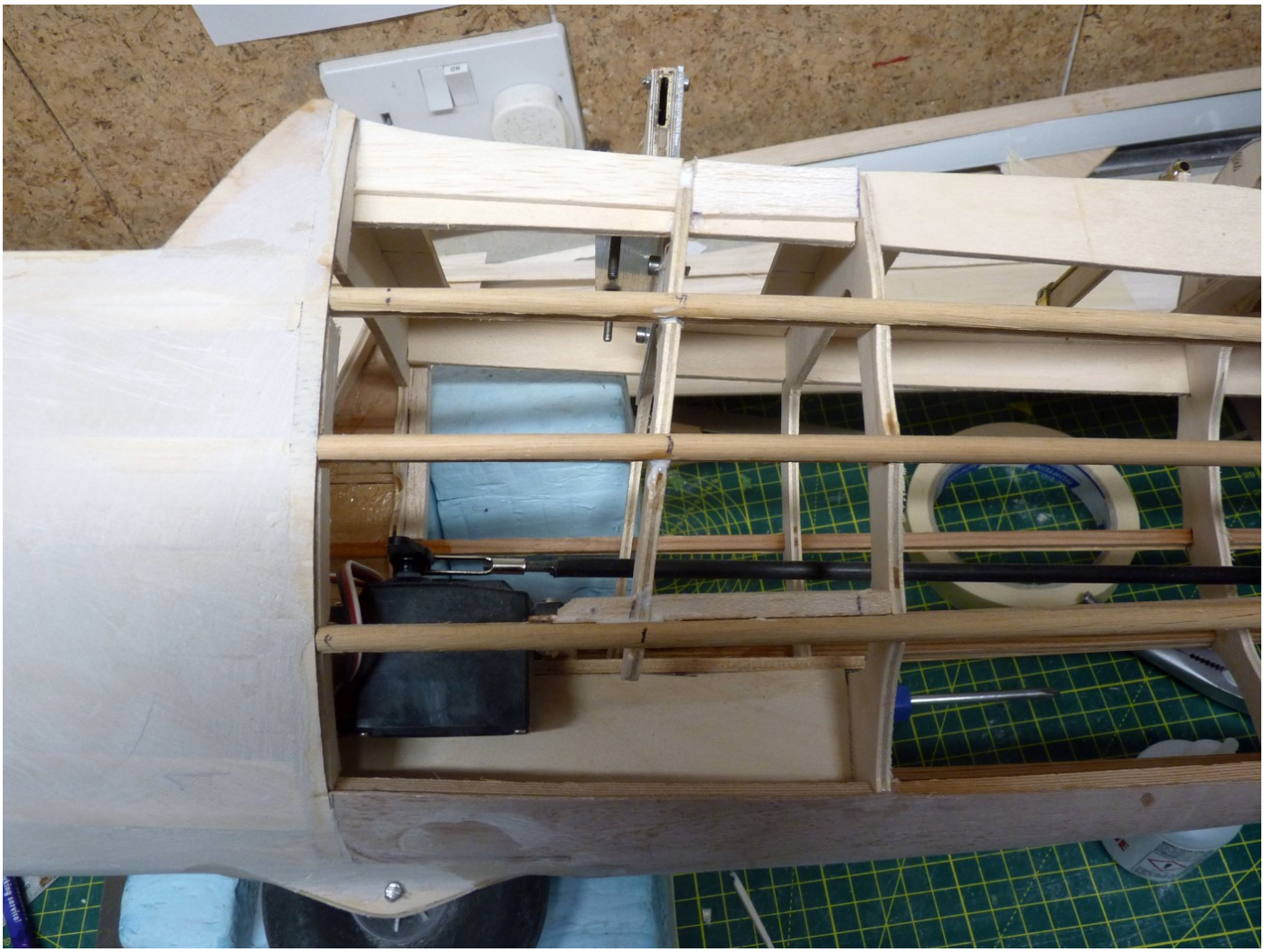
05: Hinging up the rudder to the fin

06: Tail group now completed.

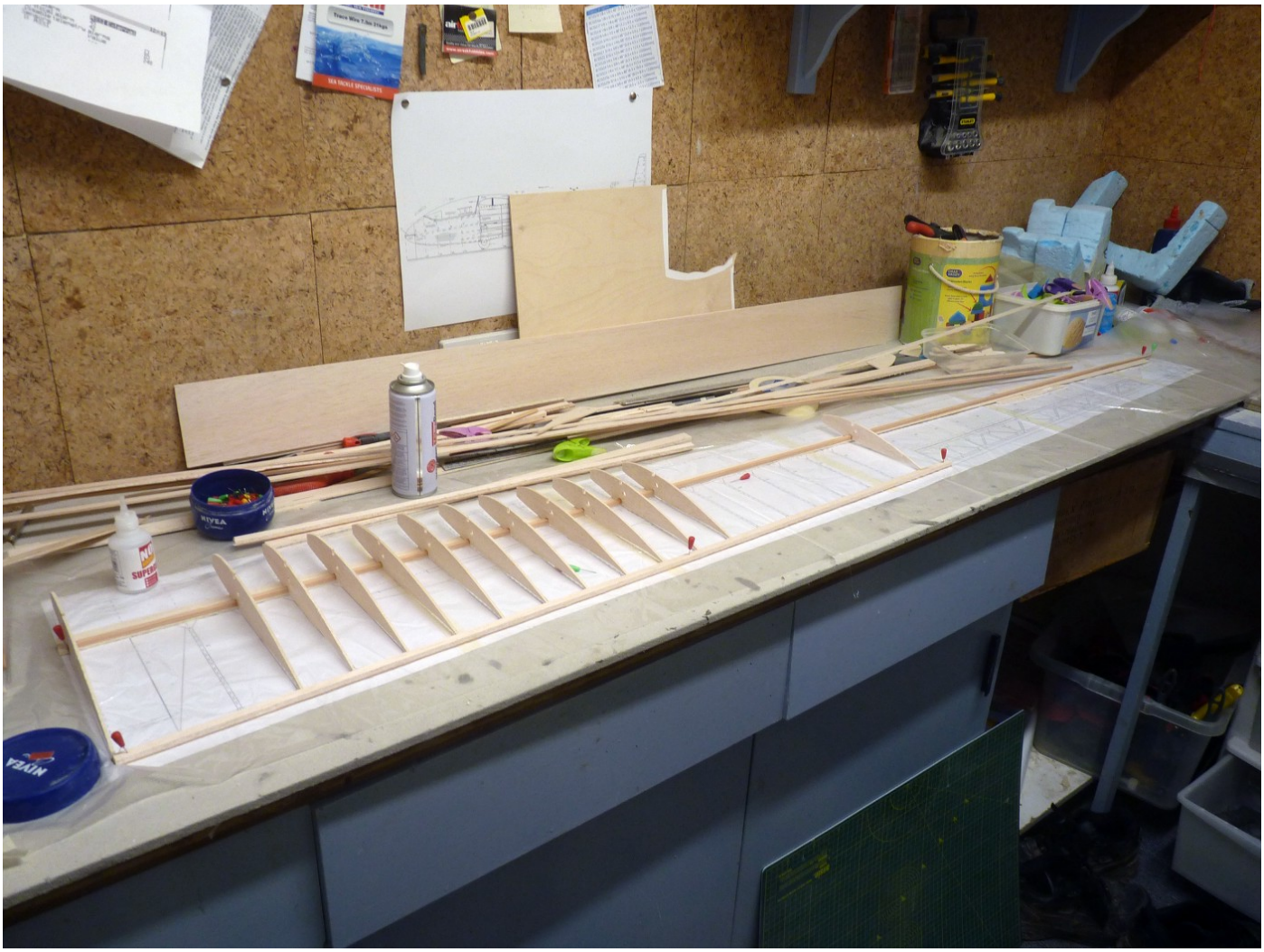
07: Finalising the wheel house arrangement.



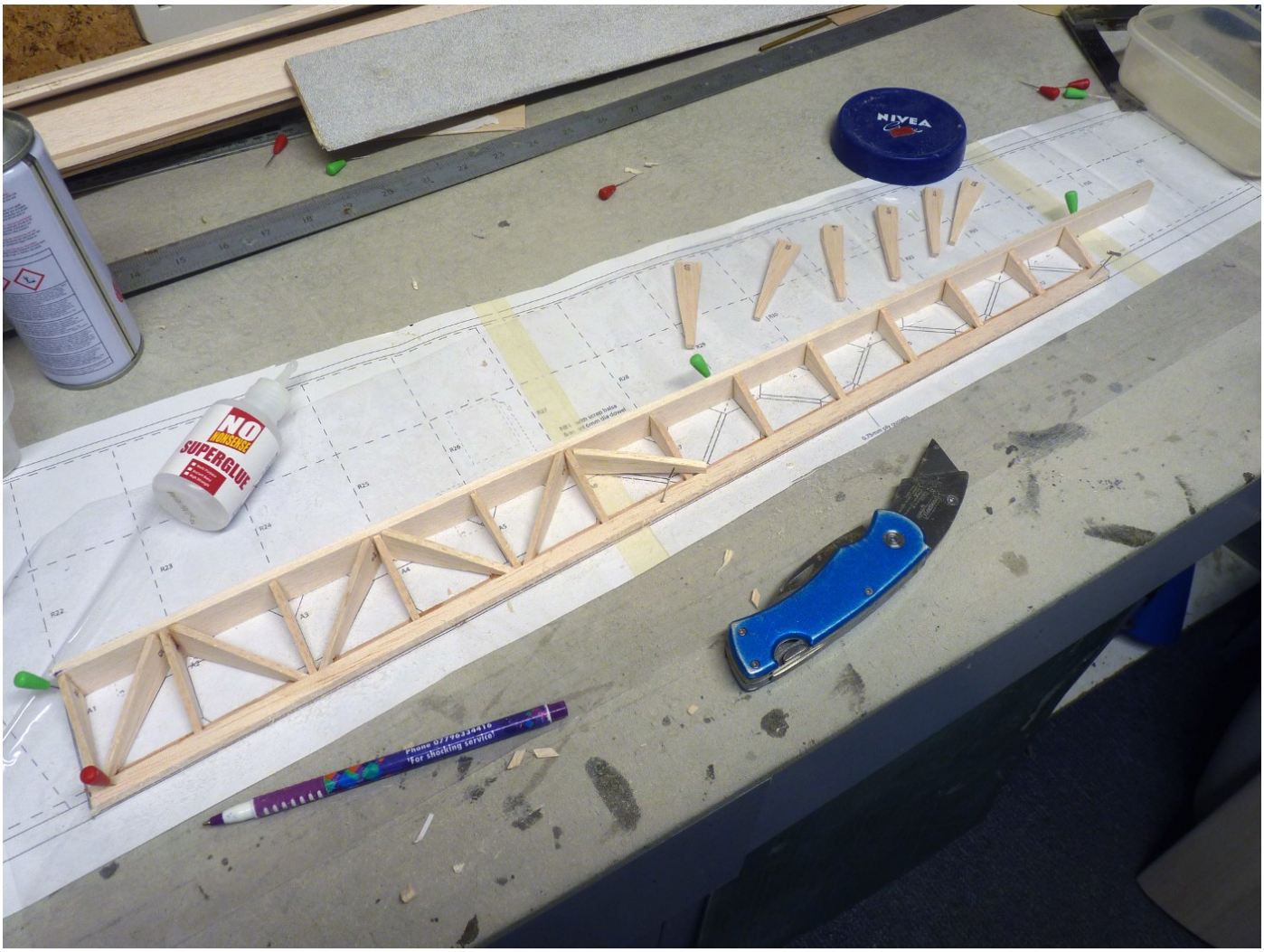
08: Rear end complete, including the guide tubes for the rudder cables.



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

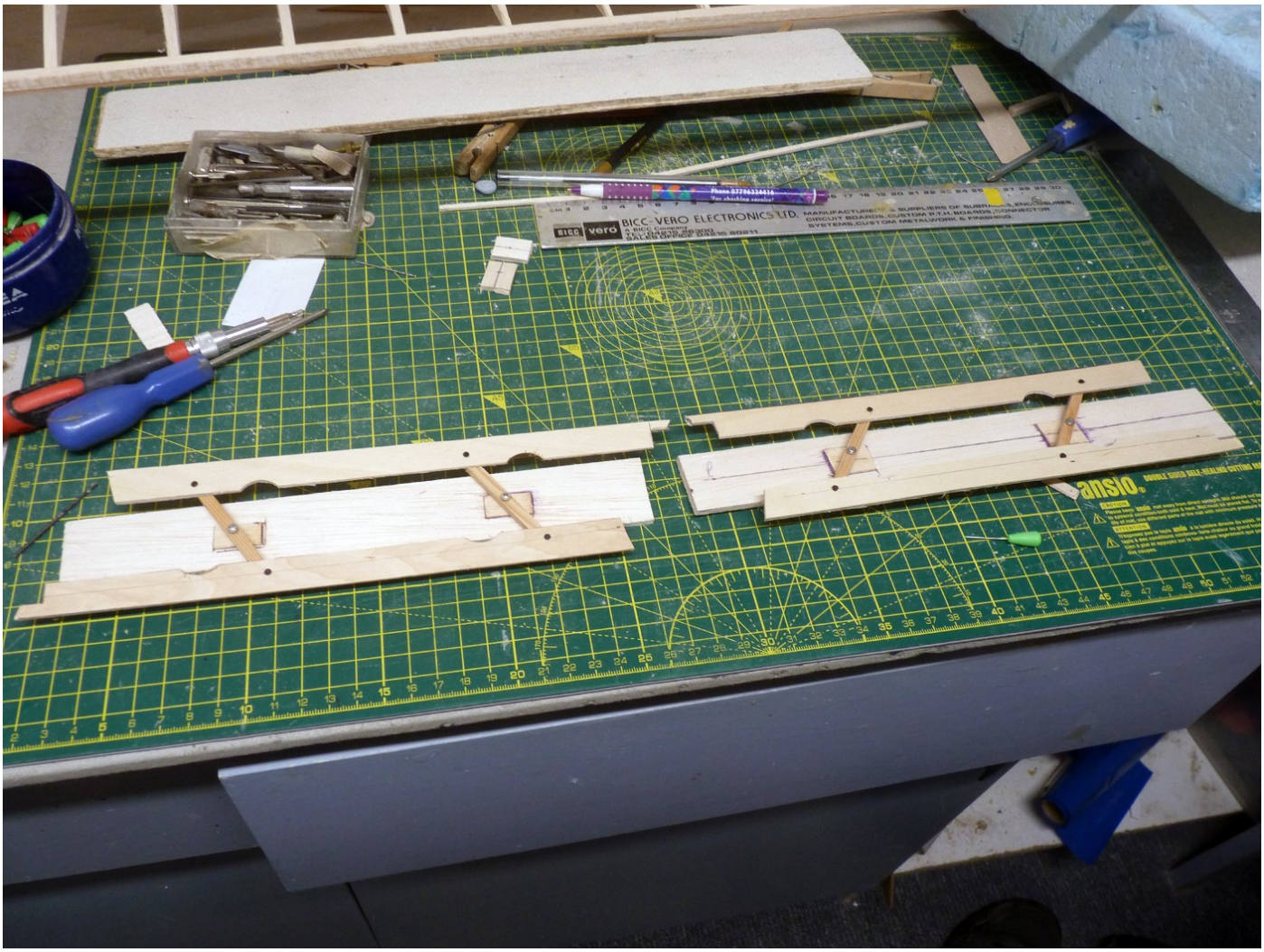


10: First stage of wing construction.

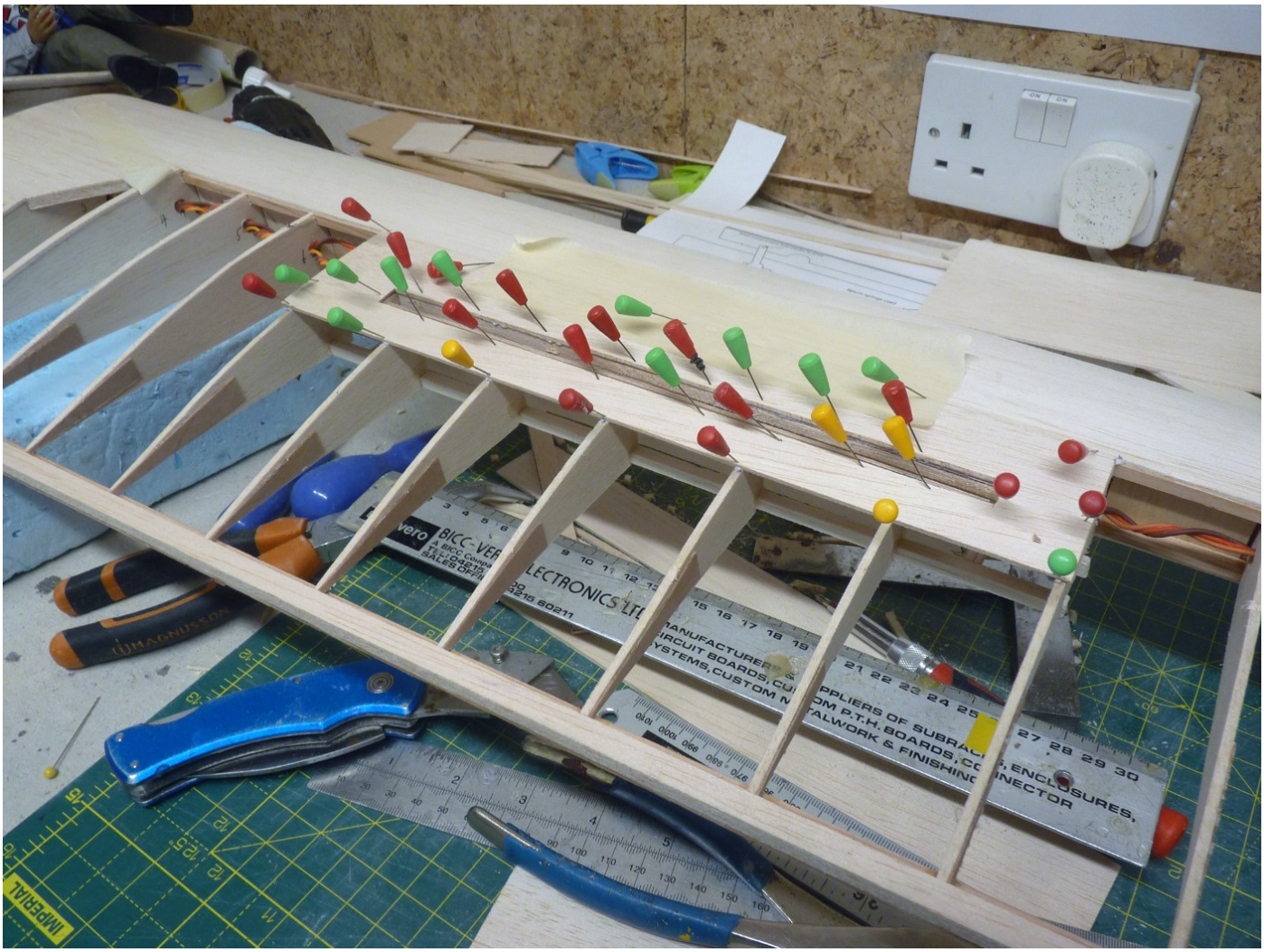


11: The ailerons are built flat on the board and top-hinged.

12: Making up the centre wing/fuselage fairing.

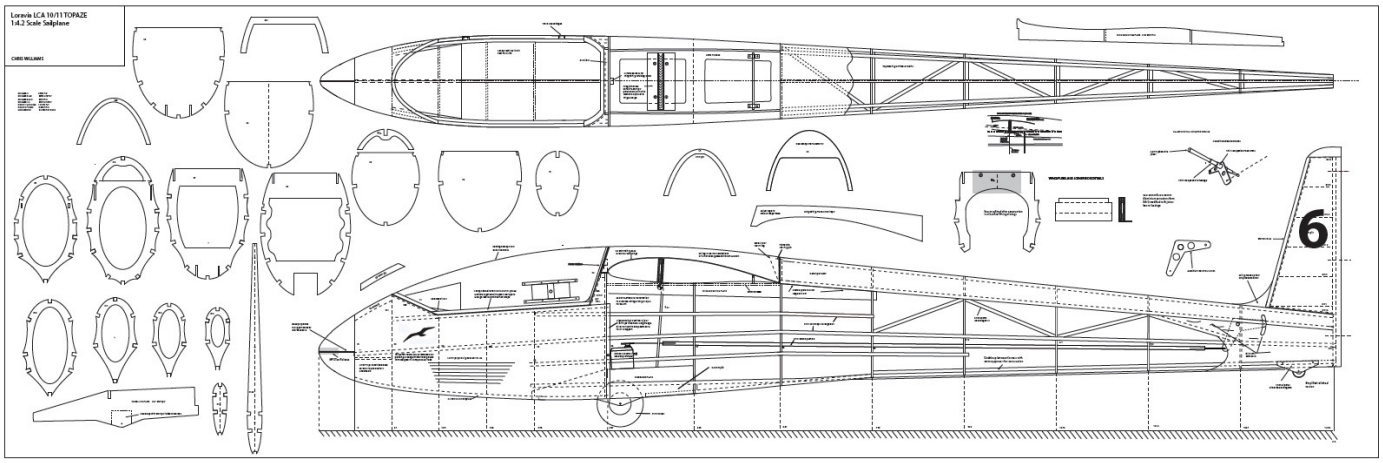


13: The airbrakes are best made up simultaneously to ensure they are properly ‘handed’.



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.

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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.

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Resources

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

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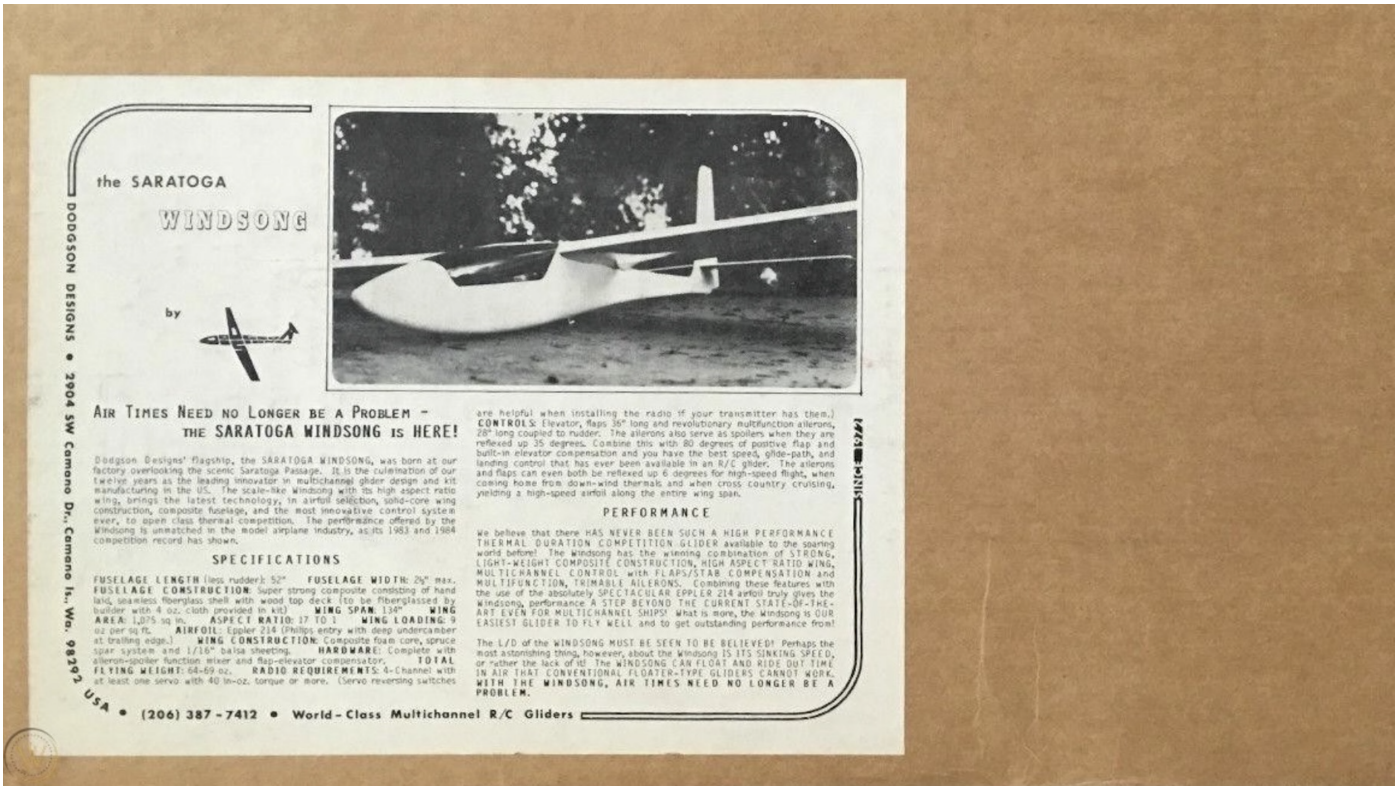
From Whence Came the Windsong… and Other Thoughts

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.

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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.

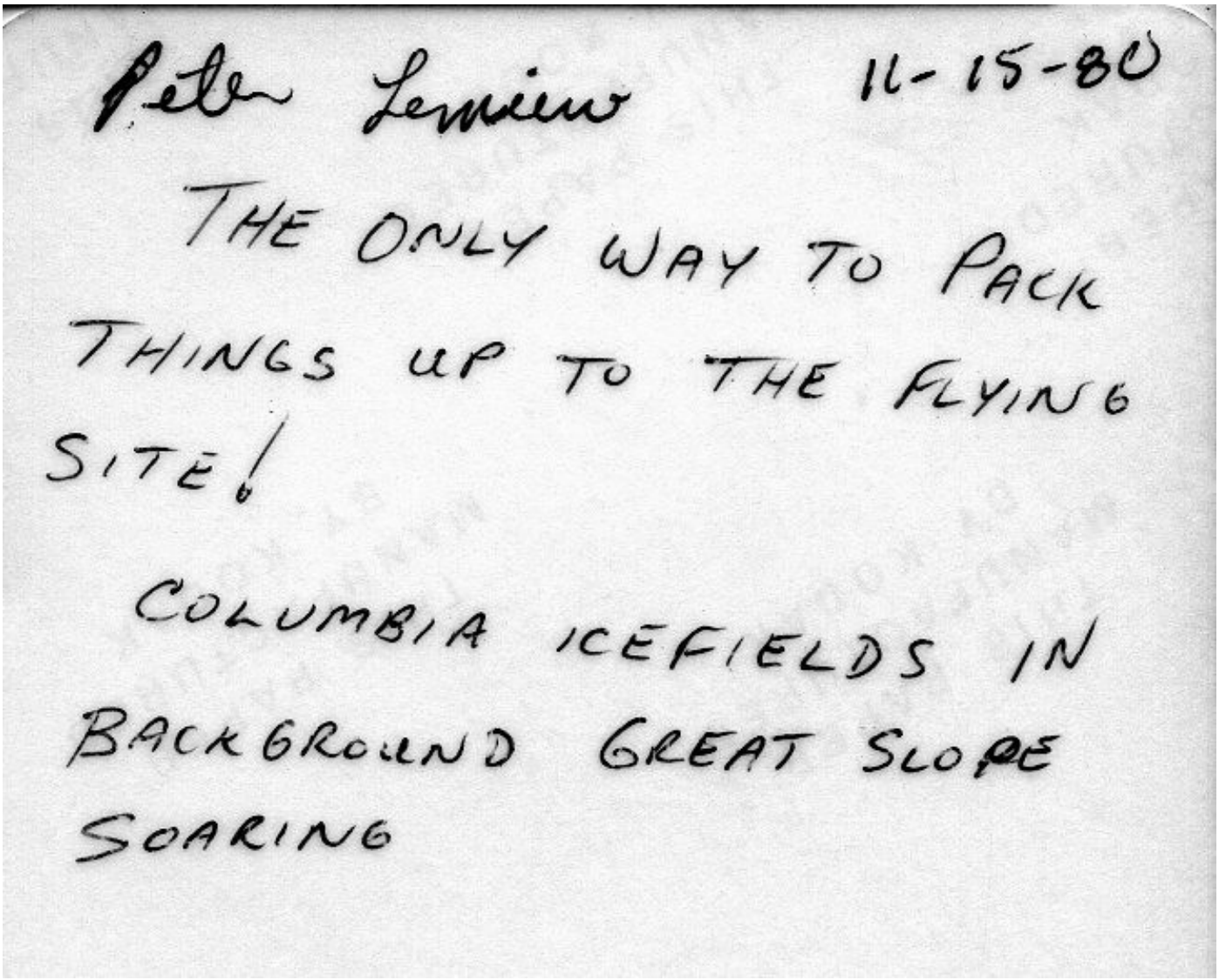
The accompanying shots illustrate the beauty of the place, but not the challenges in getting the gear to the crest of Parker Ridge, which overlooks a portion of the icefield, and has some of the few flat spots suitable to land a glider the size of a *Megan*. I had to modify a backpack and build a protective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



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.

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*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**.*

1/3 スケール三田式 3 型改 1 製作記

12部シリーズの第9部

Norimichi Kawakami

画像210L フェアリングの装着

*If you prefer you can read the **English translation** of this article, which was provided by the author. この記事に進む前に、このシリーズの **第8部** を読むことをお勧めします。*

製作その39 中央翼フェアリング用FRP成形品

石膏型の乾燥が終わりましたので中央翼フェアリング用FRP成形品の製作に移ります。

準備

石膏型は作った当初は水分が蒸発して気化熱を奪うのでひんやりと冷たいのですが、日が経つに従って冷たさが薄れてきました。十分乾燥したと思われたので樹脂を塗る面に離型ワックス（ボンリースワックス）を8回塗りこみました。その上にPVAを塗布しました。

通常は出来上がってから切り取る線を石膏型にケガくようですが、上手くケガく自信が無いので、切り取り線に沿ってマスキングテープを貼りました（画像189）。

画像189 石膏型の準備

またガラスクロスとマットも所定の寸法に裁断しておきました。こうしてクロス貼りの準備が整いました。

クロス貼り

ガラスクロスは＃100（1平方m当たり100ｇ）のマイクロガラスクロス2枚と、1平方m当たり30ｇのガラスマット一枚です。マットをクロスの間に挟んでサンドイッチ状に積層します。＃100ガラスクロスの厚さは0.1㎜弱、マットの厚さは0.15㎜程度です。

使用した樹脂はブレーニー技研のＧM-6600というガラスクロス用のエポキシ樹脂です（画像190）。

画像190 使用したエポキシ樹脂

最初に石膏型に刷毛でエポキシ樹脂を薄く塗ってその上にガラスクロスを1枚載せて樹脂を付けた筆で押さえます。樹脂が十分に浸透して空気が抜けたと思われる頃にマットを載せて同じことを繰り返します。しかしここで筆を擦った為にマットがバラケて随分毛羽が立ってしまいました。そのためマットは相当薄くなったようです。その上に最後のクロスを同様の要領で被せました。

画像191が積層を終えた状態です。

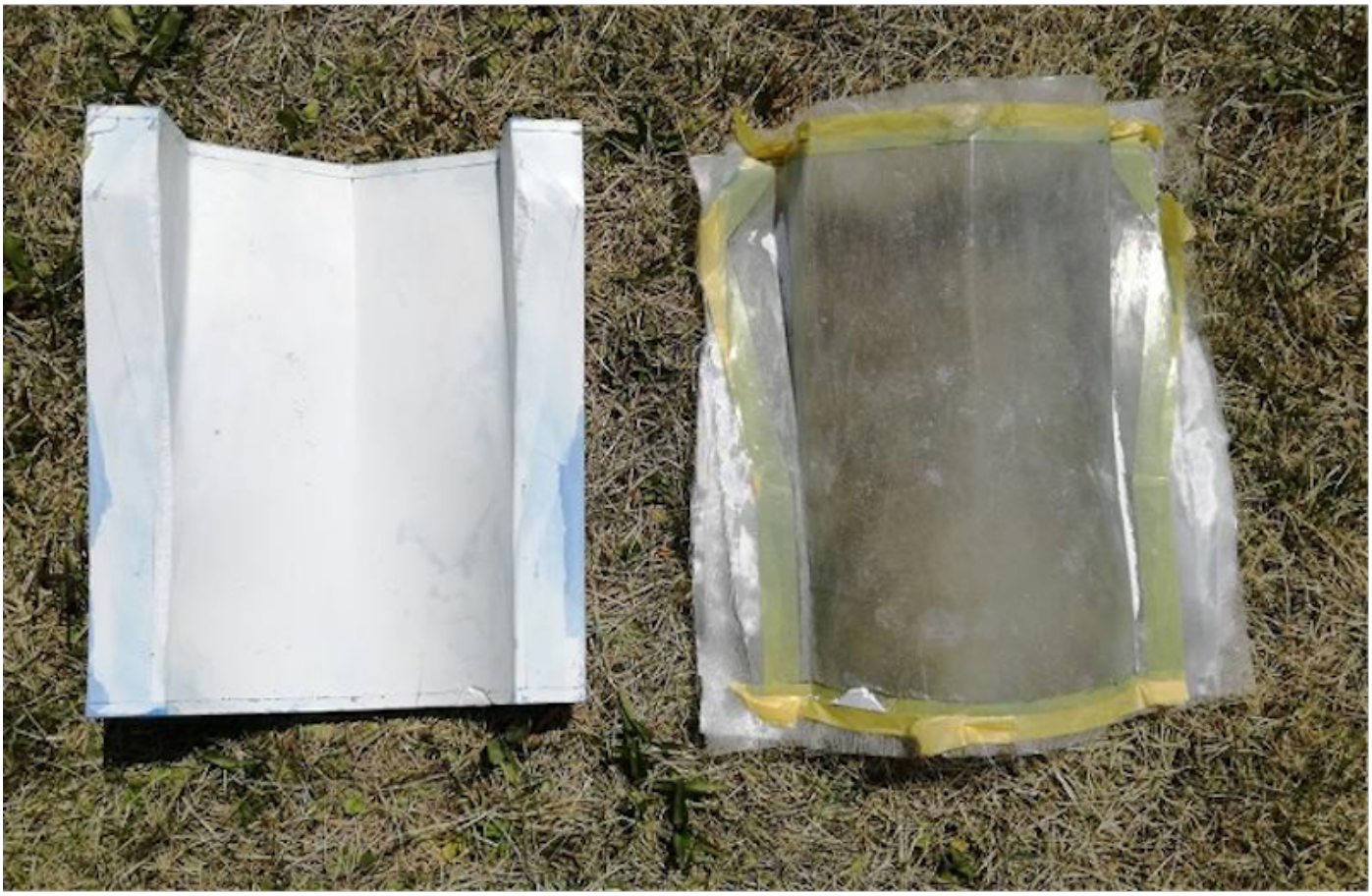
画像191 ガラスクロスを貼り終えた状態

使用した樹脂は硬化剤を含めて39g（主剤30g、硬化剤9g）でした。最初様子を見る為に主剤10ｇ、硬化剤3ｇを、二回目はその倍を混合して塗りました。しかし、この程度の少量では、かなりの部分が刷毛や混合容器にくっ付いてしまい、実際にFRPに使われた分はそれより相当少ないと思われます。

離型

エポキシ樹脂は使用量が少なく且つ薄く伸ばす程硬化するのに時間がかかります。ＧM-6600の硬化時間は標準で30分程度ですが、フェアリングは薄く且つ使用量も少ないので2時間経ってもべとつきました。そこで一日放置して置いたところ完全に硬化しました。

いよいよ離型です。今回のフェアリングの形は周囲がはみ出しているので引っ張ることは容易ですが、部分的に型にくっ付いてスンナリとは離型してくれません。慎重に4隅から引き剥がすとそれ程力を入れなくても離形しました（画像192）。



画像192 離形した中央翼フェアリング用FRP整形品

しかし離型後の石膏型を良く見ると角が欠けている部分があります。ＦＲＰ成形品の対応する個所には石膏片が貼りついています（画像193）。

画像193 石膏型の欠け

それ程力を入れなかったのに欠けてしまったので残念です。内側の一部に空気が入ってしまったところがありますが、表面は石膏型に密着していたために比較的綺麗です。但しコーナー部分は少し樹脂欠けがありますので後でパテで補修する必要があります。

カッティング

付着した石膏を剥がし、マスキングテープに沿って周囲を切り落として成形品が完成しました。重量を計ってみると36ｇ、厚さは凡そ0.7㎜程度でした。適度な剛性があって初めてのＦＲＰ整形としては、まずまずの出来栄えです。早速中央翼を胴体に載せてその上にフェアリングを被せてみました。

画像194 フェアリングの装着テスト

良い感じにフィットします。上から見ても良さそうです。これで中央翼フェアリング用のＦＲＰ成形品が出来上がりました。このあと機体に取り付ける為の金具やフレームを取り付けてフェアリングとして完成します。

製作その40 機首カウリングのFRP成形

中央翼フェアリングに続いていよいよ大物の機首カウリングのFRP成形品を製作しました。

準備

石膏型の乾燥を待ってボンリースワックスを複数回塗りその上にPVAを塗布しました。通常PVAは軽く一回塗るだけですが、中央翼フェアリングの離形が意外に困難だったので今回は薄く見えるところに2,3回塗り重ねました。その後、切り取り線に沿ってマスキングテープを貼ったこと、＃100のガラスクロス、平米30ｇのガラスマットを必要量切出したことは中央翼フェアリングの場合と同じです。

違いはフェアリングの時はクロスもマットも一枚で全面が貼れるので小分けの必要がありませんでしたが、円錐状のカウリングを一枚で皺無く全周を覆うことはできないので4枚に小分けしました。

画像195が準備完了した石膏型です。

画像195 PVAを塗布した石膏型

クロス貼り

最初に樹脂40ｇと硬化剤12ｇを容器に取り、撹拌して石膏型の内部に薄く塗りました。その上にガラスクロスを載せて筆で押さえます。型を回転して4枚のクロスを貼り終えました。これが一番外側になる第一層です。まだ樹脂が残っているのでその上にマットを載せて押さえました。マットはクロスの重ね部分の上に中央が来るように載せて厚さが均一になるようにします。マット2枚を貼り終えた段階で樹脂が無くなりましたので、更に同量の樹脂と硬化剤を別容器に取り残り2枚のマット貼りました。

未だ十分樹脂が残っているので第3層のクロスを貼りました。これは最初のクロスに直交するように裁断してあります。クロスの2枚目を貼っているうちに樹脂の粘度が急激に増してきて、上手くクロスが伸びてくれません。容器に残った樹脂も固まりかけています。一回目より作業時間が長いわけではないのですが、硬化剤の量が多少違っていたのかも知れません。仕方がないのでこの樹脂の使用はここで止めて3回目として樹脂10ｇ、硬化剤3ｇを別容器に採って撹拌しました。刷毛も固まりだしたので新しいものに変えました。

このようなハプニングがありましたが、何とかクロスとマットを貼り終えました。

画像196が貼り終えた状態です。このまま一日放置して硬化を待ちます。

画像196 クロス貼りが完了した状態

離型

いよいよ型から外す段階です。中央翼フェアリングの経験から離型は多少の困難を覚悟していましたが、今回はその比ではありません。縁部分ですら多少の力では剥がれません。何とか力をいれて直線状の縁部を剥がしましたが、キャノピーに繋がる上面の湾曲部分が剥がれません。プラスチックのヘラを挿し込んでようやく少し剥がれました。

縁部が剥がれたので更に内部に向かってプラスチックヘラを挿しこんで剥が

しましたが、ピッタリと貼りついて相当の力を入れないと剥がれません。剥がれた間に指を入れて隙間を広げる作業を行っているうちに、余りに強く内側へ引っ張ったので折角綺麗に出来ているFRPに折れ線が入るようになってしまいました。未だ全体深さの1/3も剥がれていません。

これ以上同じことをしているとFRPが壊れてしまうと思われたので、意を決して石膏型を壊すことにしました。石の上に型を置いて玄能で叩きましたが、石膏にガーゼを入れて補強してあるので、簡単には割れません。それでも何回かハンマーを打ち付けていると、石膏型が余り割れないうちにFRPが飛び出してきました。どうやら振動を与えると剥がれるようです。画像197が苦労して型から外したFRP成形品と石膏型です。石膏型は完全には割れていません。

画像197 ようやく石膏型から外した機首カウリング用FRP整形品

カット

次いでマスキングテープの縁に沿って不要部をカットしました。カット後のカウリングです。

画像198 カット後のカウリング 左＝外側 右＝内側

割合綺麗に出来ています。尚、黒い線はクロス裁断の為に引いたマーキング線で、青い部分は付着したPVAです。厚さは薄いところで0.7㎜、厚いところで1.2㎜程度でした。これは1層につきクロスやマットを4枚に小分けしたことで、重なり部分が生じる為です。重なり部分が補強材の役目をしてかなり剛性が高いものに出来上がりました。

フィットチェック

何はともあれ胴体に上手く嵌るか否かのフィットチェックです。これが一番の心配毎でしたので。結果は下の写真（画像199）が示すように略完璧です。

画像199 機首カウリングのフィットチェック

因みに重量は114ｇです。この後は無理に型から剥がそうとして傷ついた部位を補修し、胴体との境界線に付ける木製枠を構造側に貼りつけます。

製作その41 機首カウリングの取付

取付方法

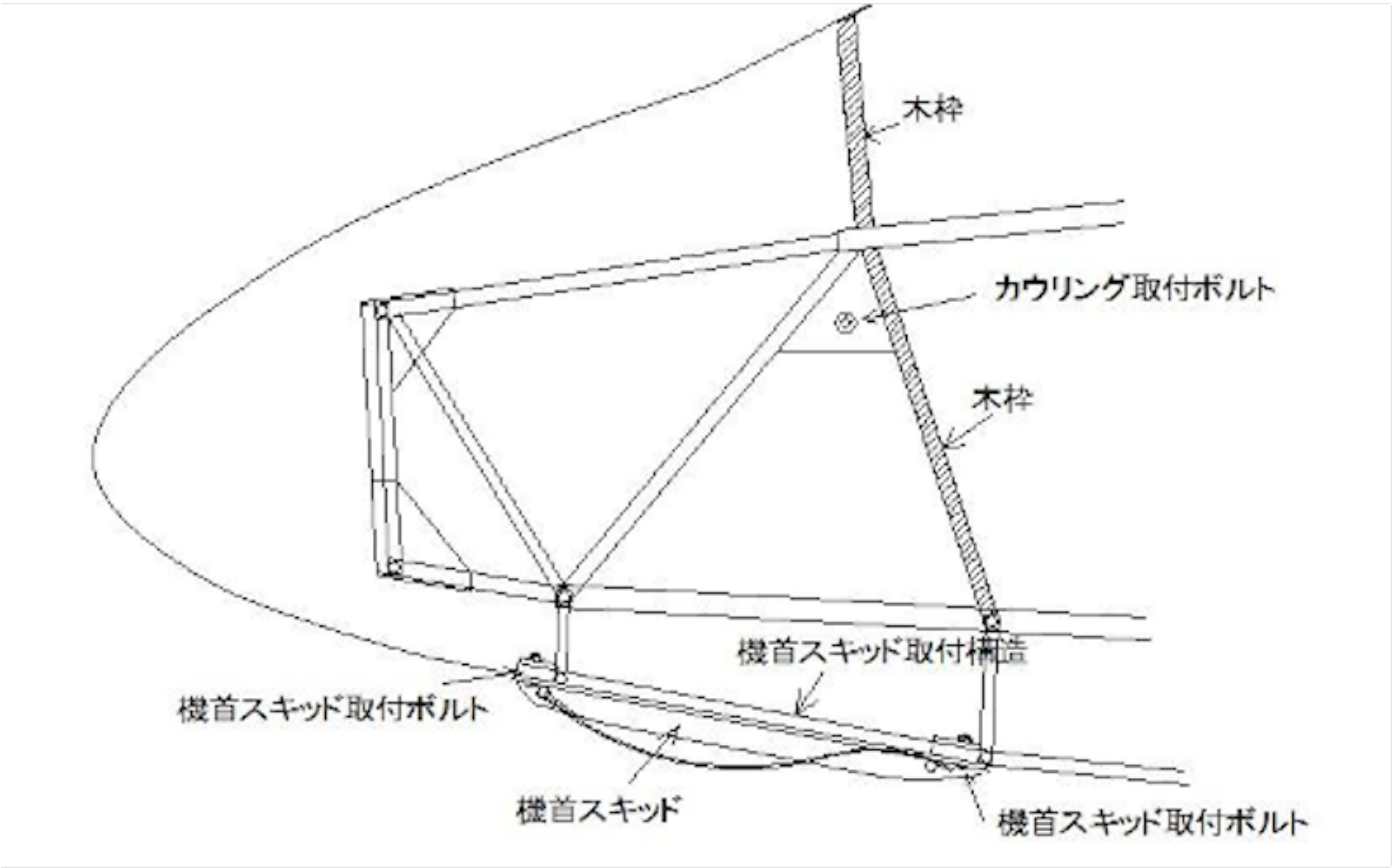
当初、機首カウリングは1/5模型と同じように機体構造に接着して取外せない取付方式にする予定でした。その為カウリング内に配置されるモーターやラダーサーボはコクピット内から取付・取外しができるように作られています。しかし、ここまで作ってくると実機にある飛行機曳航用索リリース機構も付けたくなりました。私や私の所属するクラブには曳航機は無いのですが・・・・。

三田式の飛行機曳航用索リリース機構は機首スキッドの前、カウリング内の下部に装着されています。この位置はコクピットからは手が届きません。そ

こで、機首カウリングは取外し可能な取付に変更することにしました。

準備工作

図面49がカウリング取付要領図です。



図面49 機首カウリング取付要領

まずカウリングの後端が胴体構造に繋がる部分のトラス構造との隙間を木枠で埋めます。木枠は胴体構造側に取り付けます。同様にキャノピーとの境はカウリング側に木枠を取り付けます。カウリングの固定は左右２か所のボルトと機首スキッドです。機首スキッドはカウリングを挟んで胴体構造に４本のボルトで取り付けられます。そのため構造側にスキッドを取り付ける構造を設けることと、スキッド本体を準備する必要があります。画像200が準備工作が完了した機体構造です。

画像200 カウリング取付構造

胴体構造に取り付けた木枠、上部左右２か所の取付ボルト受け、スキッド取付構造が見えます。機体をひっくり返してスキッド取付構造を見ると画像201のようになります。

画像201 機首スキッド取付構造（左）とスキッド本体（右）

カウリング本体にはキャノピーとの境界になる木枠を取り付けました。

画像202 木枠を取り付けたカウリング本体

取付

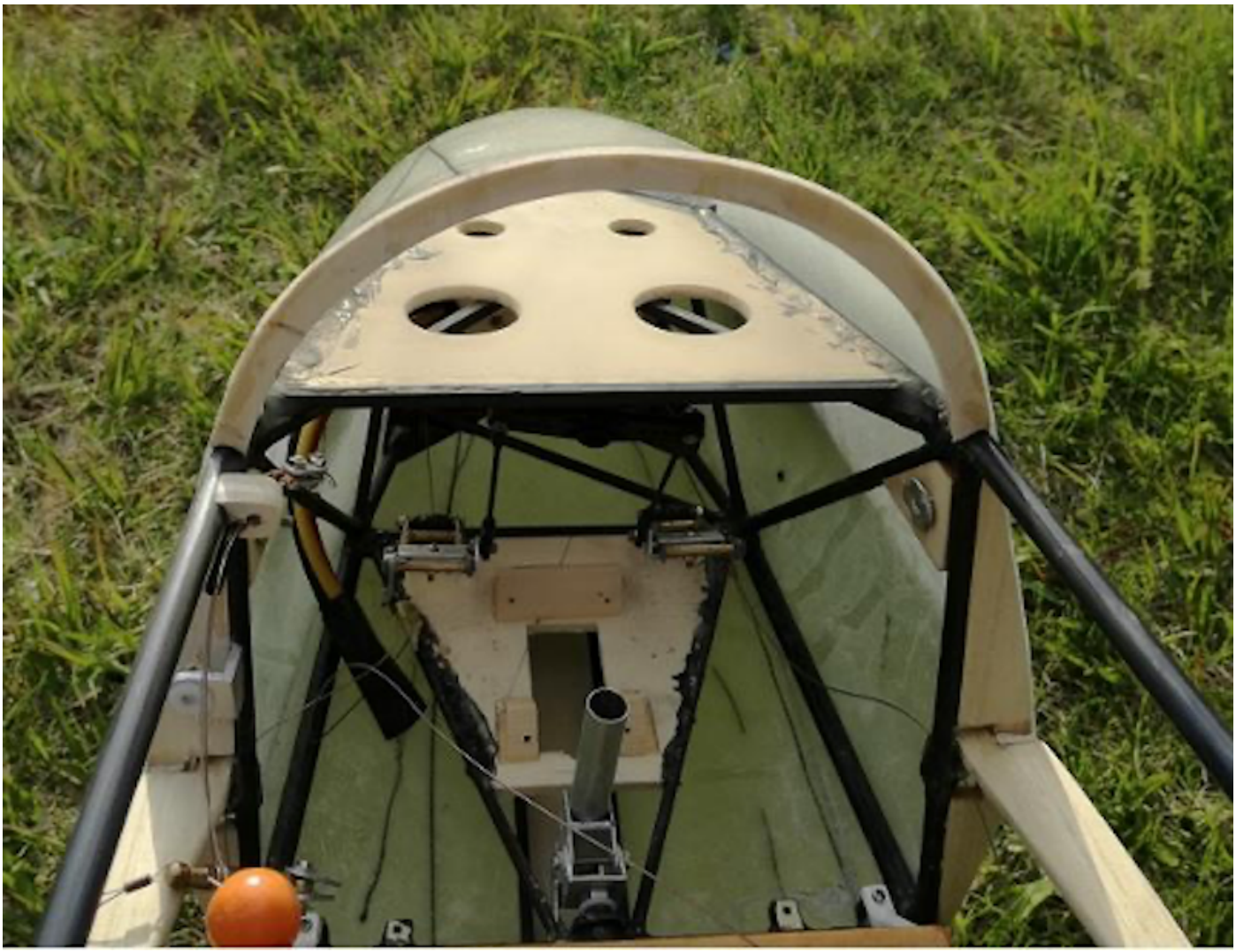
以上の準備をしてカウリングを取り付けました（画像203）。左右２か所の取付ボルトが見えます。

画像203 機首カウリングの取付

画像204は下から見た機首スキッドの取り付け状況です。

画像204 機首スキッドの取付

最後はコクピット側から見た状態です（画像205）。



画像205 コクピット側から見た機首カウリングの取付状況

このように書くといかにもスムーズに取付けられたように思われますが、実際は調整に手間取りました。特にカウリングに木枠を取り付けると中々すんなりと胴体に嵌りません。何度も木枠を紙やすりで削って微調整を繰り返した結果すんなりと嵌るようになりました。

折りペラの試装着

折りペラを試しに装着して折り畳み状態を確認しました（画像206）。折りペラはグラウプナー製18×9です。ハブは一番小さい42㎜サイズのものですが、機首形状に丁度マッチして綺麗に折りたためることが確認できました。

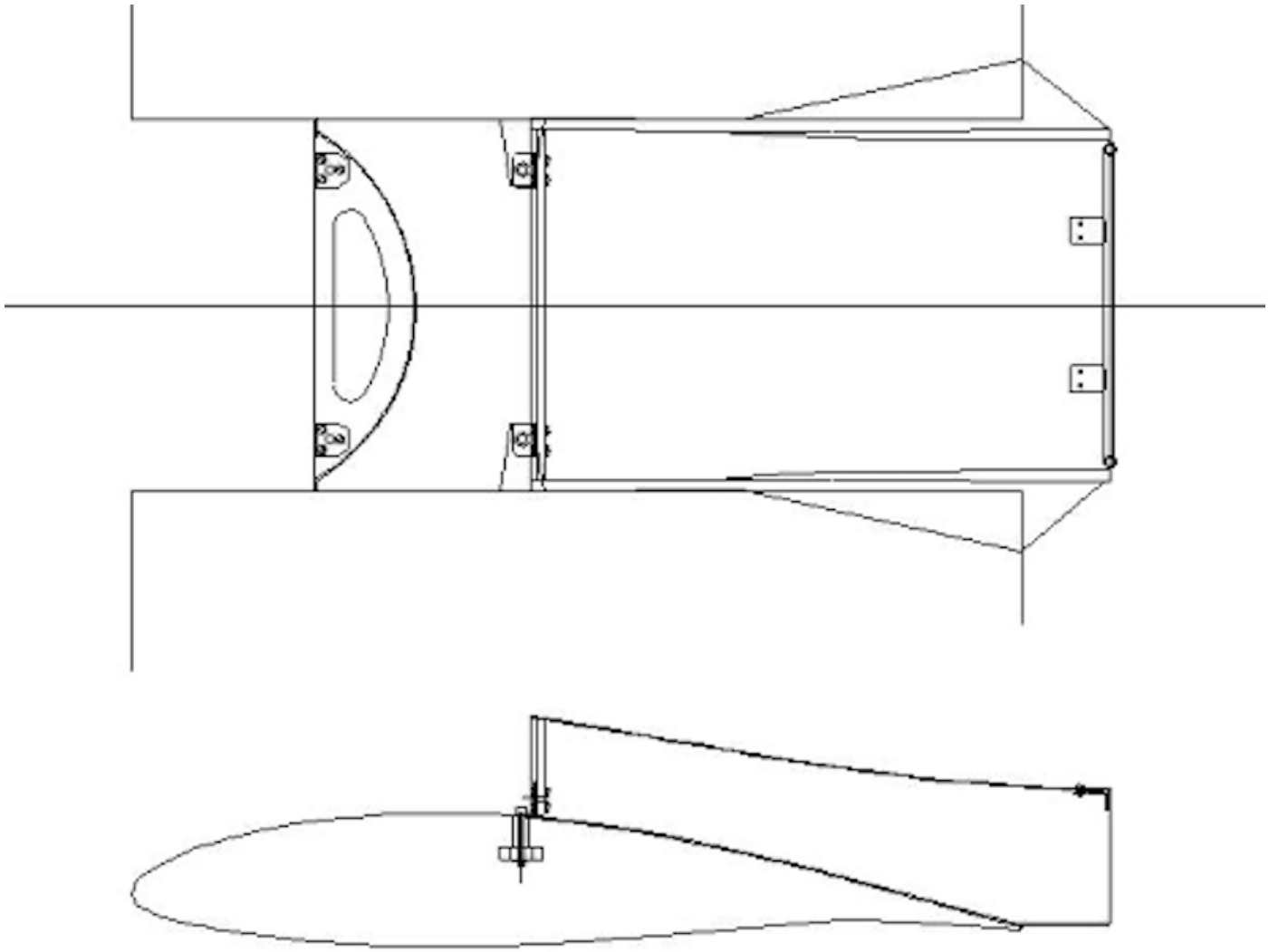
画像206 折ペラの試装着

製作その42 中央翼フェアリングの取付

続いて中央翼フェアリングを取り付けます。

フェアリングの取り付け方

実機の中央翼フェアリングの取り付け方は、フェアリング前方2か所の金具で中央翼の上面にある金具に引っ掛け、後方２か所の金具で後胴上部の山形張出構造にビス止めした上で、中央部分を翼の左右２か所ずつ計4か所にネジ止めしています。模型では実機に比べて相対的にフェアリングの剛性が高くなっているので取付方法は若干簡略化することにしました。図面50が取り付け要領図です。



フェアリングの前部に実機同様の木製フレームを取付けて、それにL型金具2個を付けます。L型金具は中央翼内部から立ち上がる座にビス留めします。後部は実機同様の金具を２か所に取り付けます。この金具は後部が１㎜弱開いていて、後胴上部の山形張出構造に取り付けられたL型アルミチャンネルを咥えて固定されます。

フェアリングと中央翼の加工

図面に基づいてFRPフェアリングに木製フレームと金具を取り付けました（画像207）。

画像207 フェアリングに取付けた木枠と金具

フェアリングのL型金具をネジ止めする座を設けました（画像208）。

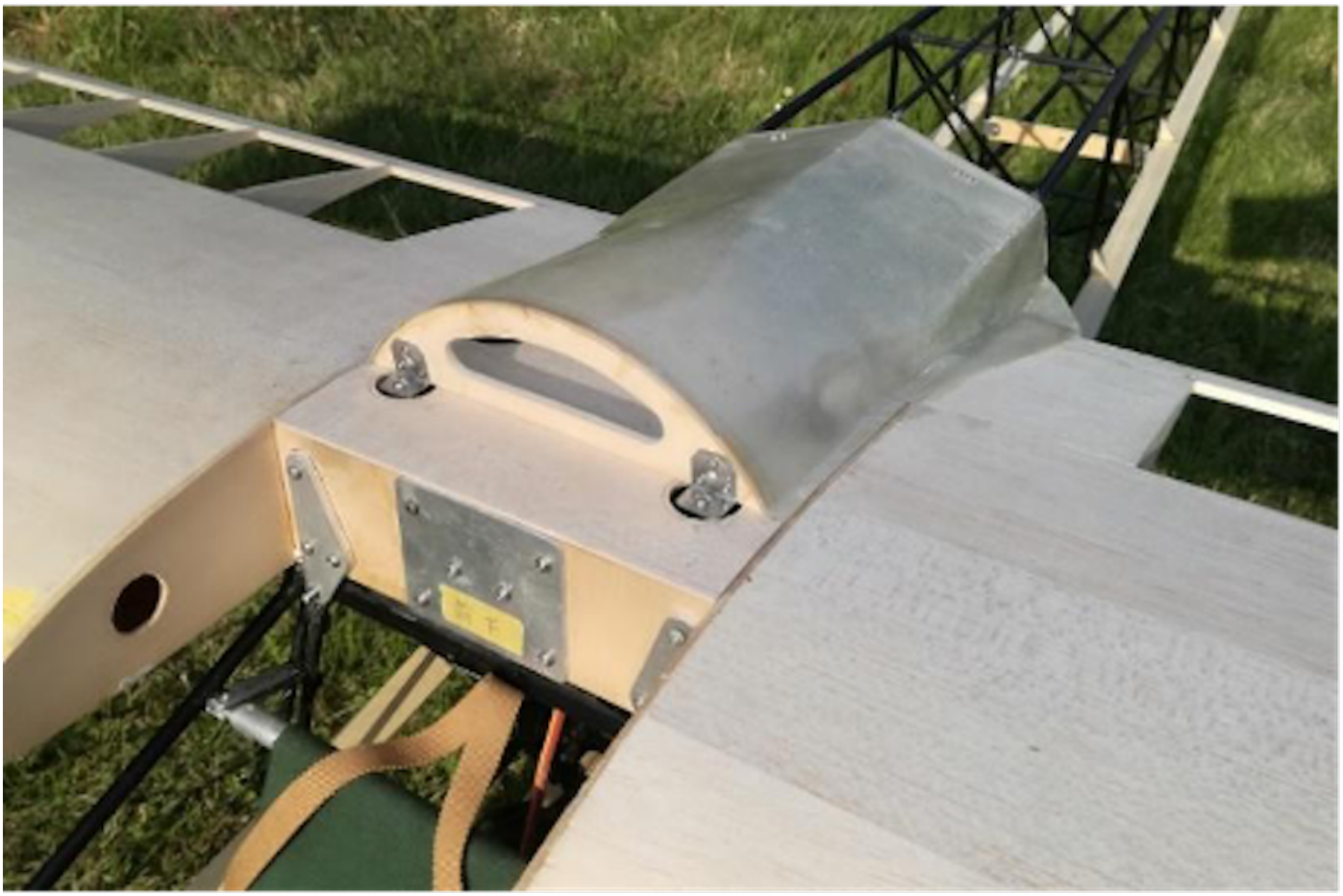
画像208 フェアリングネジ止め用の座

フェアリングの取付

フェアリングを取り付けるにはまず翼カバーを被せてスポイラーサーボを隠します（画像209）。

画像209 翼カバー（大きい方の穴は間違いで後で埋めます）

その上にフェアリングを載せてネジ止めして完成です（画像210）。

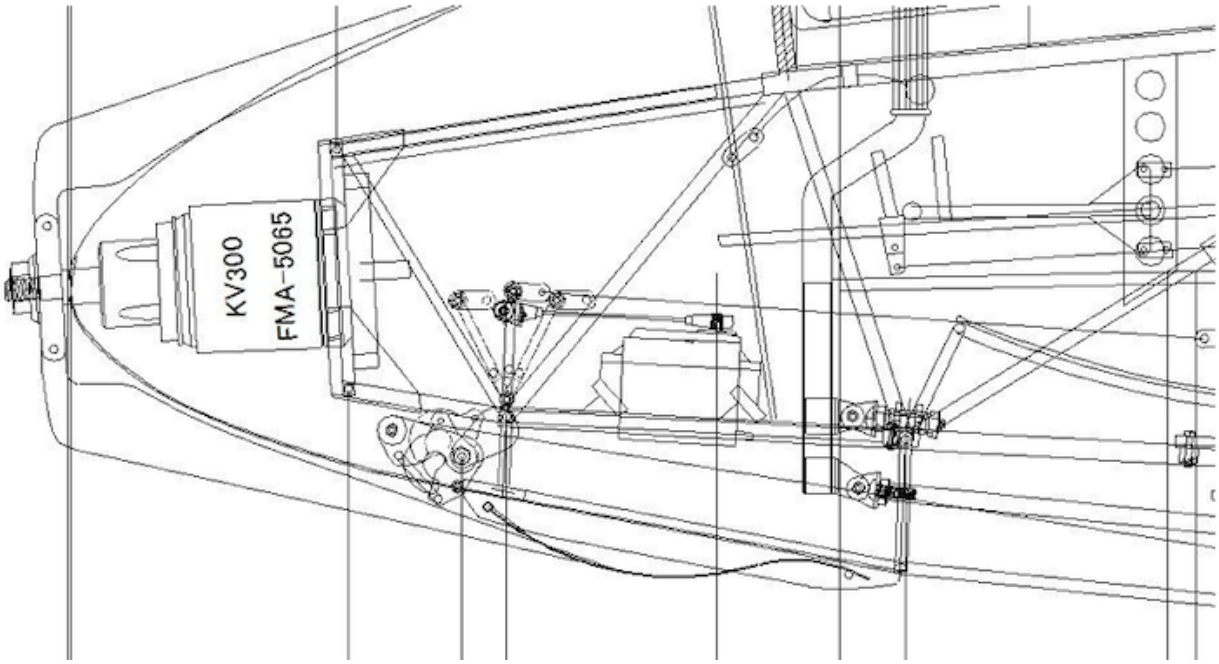


画像210 フェアリングの装着

製作その43 飛行機曳航用索リリース機構

飛行機曳航用索リリース機構の概要

三田式３型改1の飛行機曳航用索リリース機構は、機首スキッドの前のカウリング下部に取り付けられていて、ワイヤーでウインチ曳航用索リリース機構と同じノブに繋がっています。ノブを引くことで開錠します。実際の機構の構造はアクセスが難しいので良く判りませんが、模型用に簡単な機構を考案しました。これがその図面です。

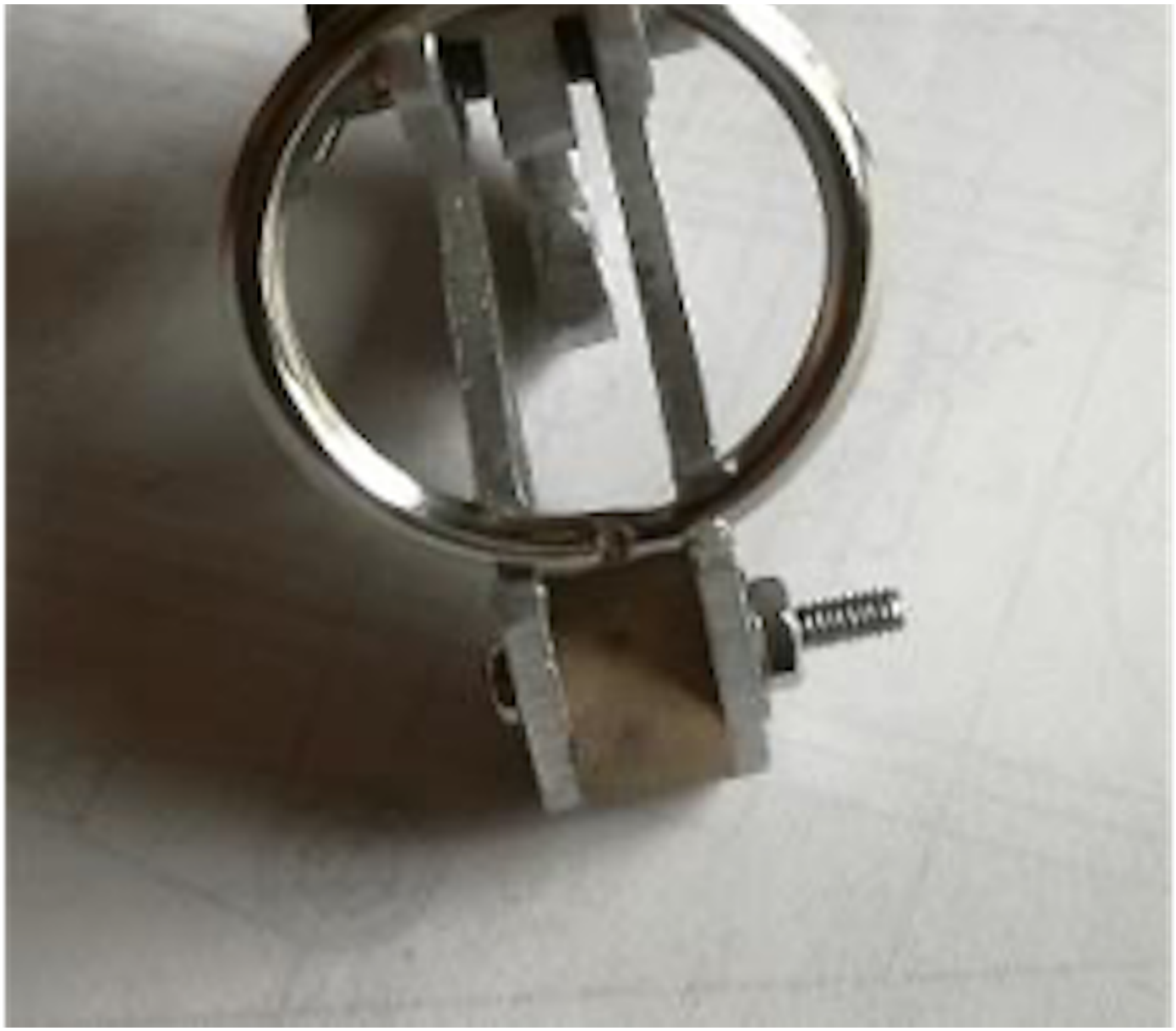


図面51 飛行機曳航用索リリース機構

フックをアルミ製の２枚の枠で挟んだ簡単な機構で、フックに取り付けたワイヤーを引けば開錠します。フックには弱いスプリングを付けてワイヤー張力が無い時にはフックが閉じます。ワイヤーはウインチ曳航用索リリース機構と同じサーボに接続されます。つまりサーボを作動すると両リリース機構が同時に作動します。

機構の製作

図面に基づいて製作した索リリース機構です。



画像211 飛行機曳航用索リリース機構 左＝側面 右＝下面

フックは３mm厚の硬質アルミ板で、枠は２mm厚のアルミ板で作りました。フックの回転軸は３mmボルトで、枠にジュラコン製の軸受を嵌め込んであります。フックには既にワイヤーとスプリングを取り付け済みです。最下部には20Φのリングを取り付けてあります。

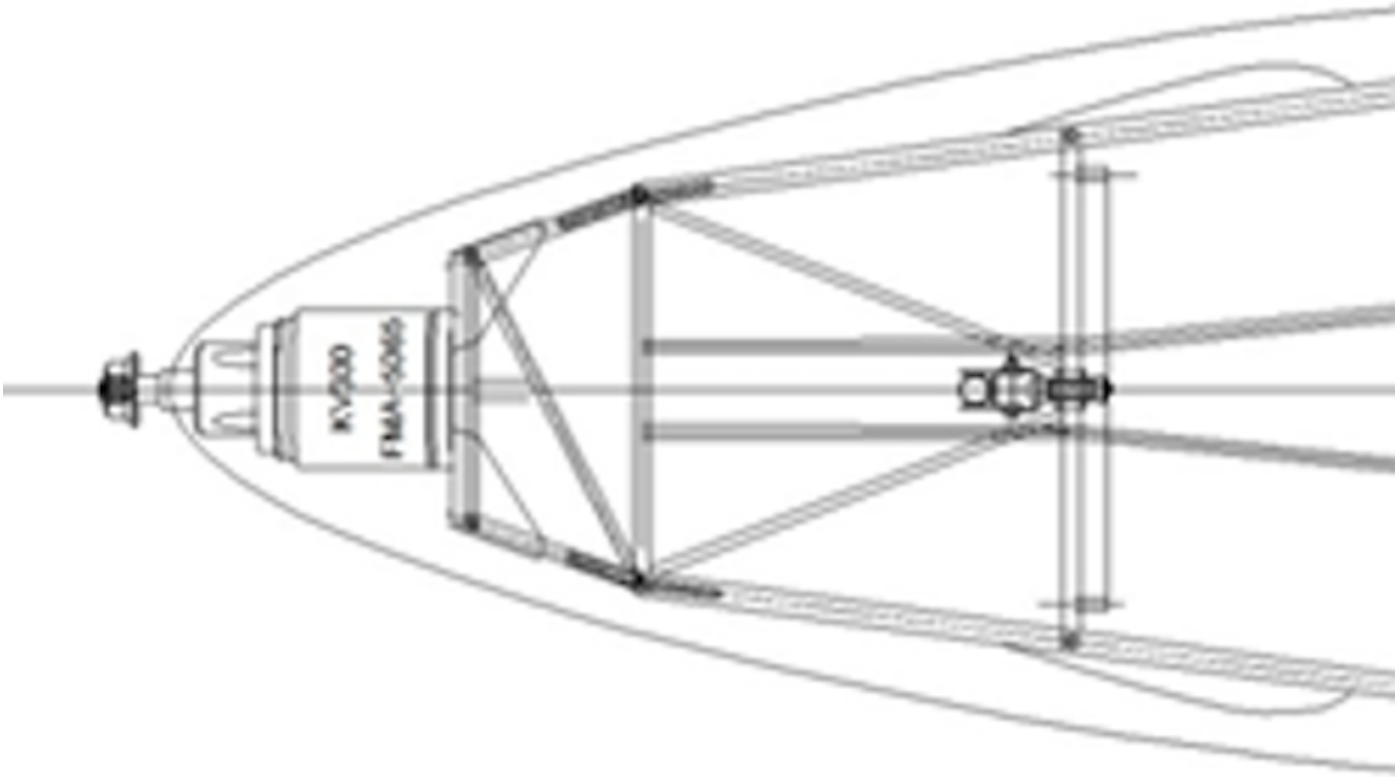
機構の取付

機構を機首下部に取り付けました（画像212）。

画像212 飛行機曳航用索リリース機構の取付状況 左＝側面 右＝下面

フックの回転軸に2枚の2mm厚カーボン製耳金を取り付け、それをモーターマウントの一つ後のトラスに取り付けています。耳金の両脇にはトラスとモーターマウントの間に2本のカーボンロッドを渡し、それに小さな耳金を付けて機構の前部を支えることで機構の回転を押さえています。

当初は本索リリース機構を設けない積りでしたのでこの部分は図面52のようになっていました。

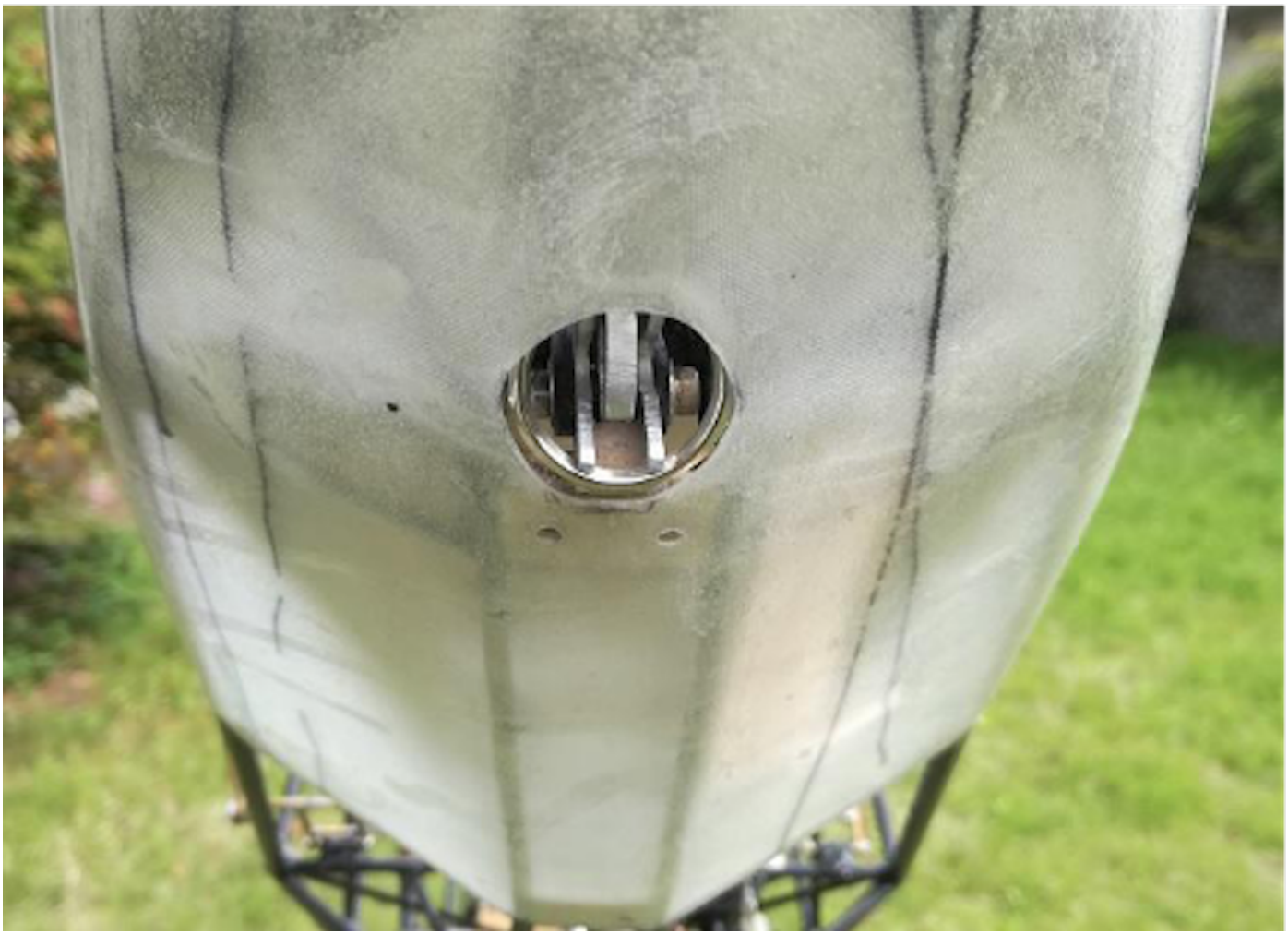


図面52 当初の機首下面構造

即ちモーターの反トルクを受ける斜めの部材が走っていました。これがリリース機構と干渉するので取り外して上述のように改修したのですが、反トルク押さえ能力が減少することを少しでも避ける為に、機構の外側に２本の斜め部材も取り付けました。画像213がサーボとの関係が判る全体取付写真です。

画像213 機構全体像

カウリングを被せてみました。リングが少しだけ顔を出します（画像214）。



画像214 飛行機曳航用索リリース機構

感じが出ていると思います。

尚、コクピットの左サイドにある索リリースノブとサーボもワイヤーで繋ぎました。途中には画像215のようなスプリングを設けたので、フックが開錠する時にノブも実機同様に後ろに動きます。

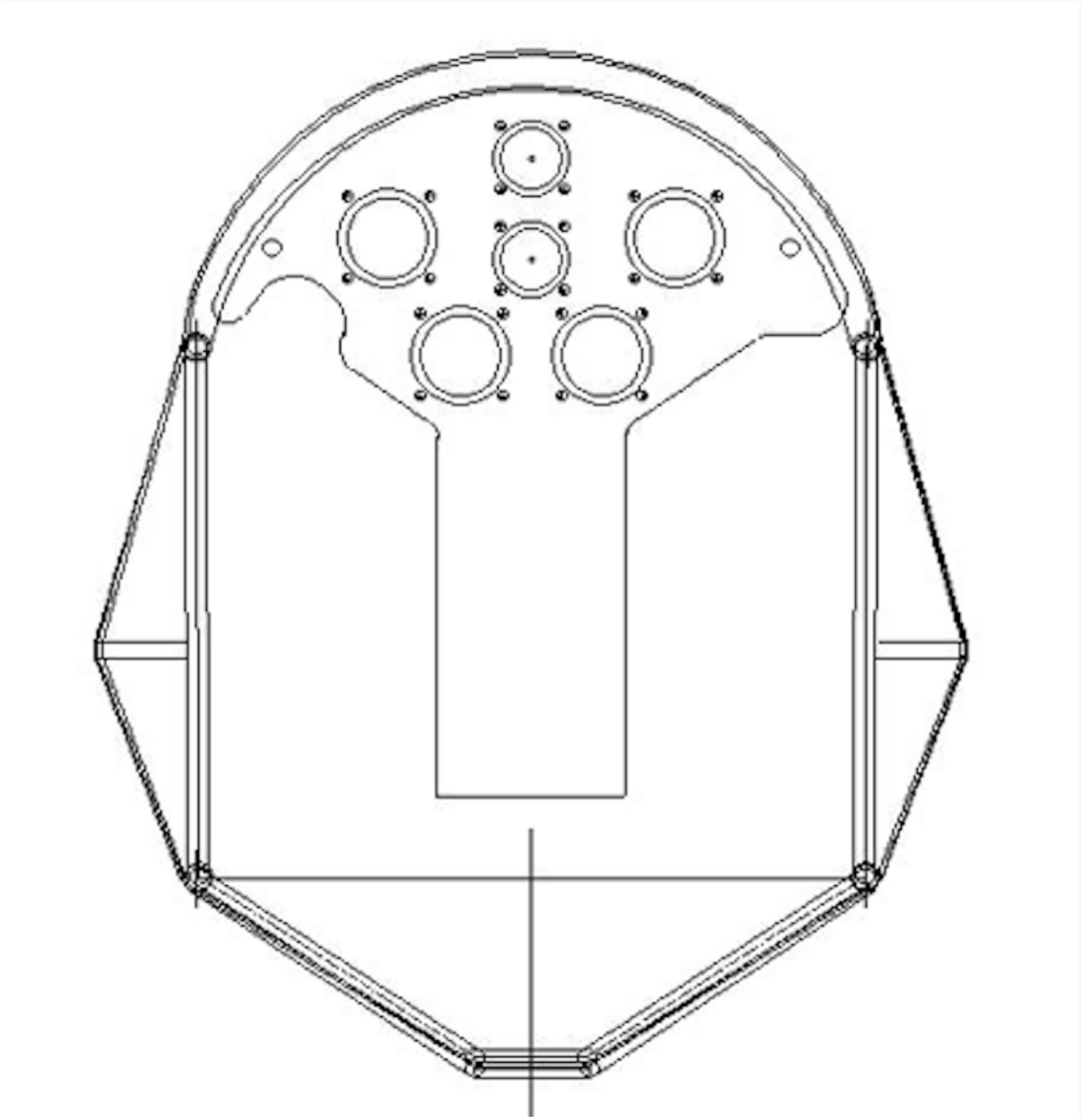
画像215 曳航索リリースノブとスプリング

これで索リリース機構の製作は一応完了しましたが、ウインチ曳航用機構を含めて良く作動確認をしたいと思います。

製作その44 計器盤とその取付構造

計器盤

三田式３型改1グライダーの計器盤は図面53のような格好をしています。これを1.6㎜厚のシナベニアで製作しました（画像216）。計器を取り付ける前に艶消しの黒色塗装を施します。

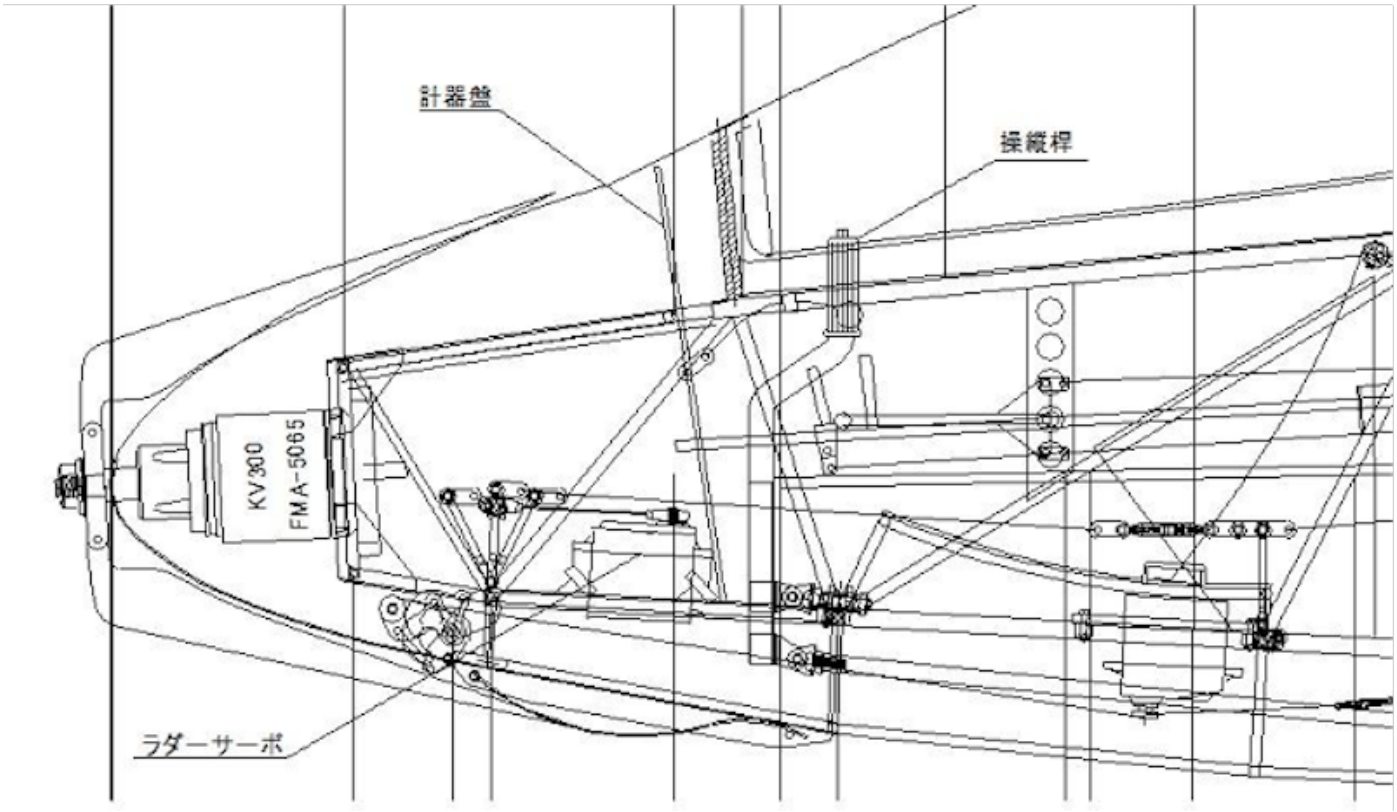


図面53 (左) 三田式3型改1の計器盤形状 | **画像216** (右) 1.6㎜シナベニアで作った計器盤

計器盤の位置と取付構造

計器盤は機首カウリングの内側で操縦桿の前方にあります。実機はカウリングのRに沿ってカーブした鋼管を胴体構造に溶接し、それに計器盤をネジ留めしていますが模型では剛性のあるカーブした管が得にくいので、カウリングに木枠を貼りつけ、それに計器盤をネジ留めする構造にしました。

取り付け方は決まりましたが、計器盤を実際に機体に載せてみると問題があることが判明しました。いろいろなものと干渉してしまうのです。図面54が計器盤の位置を示します。



図面54 計器盤の取付位置

当初この図面を書いて干渉しないことを確認した積りでしたが、ラダーサーボのホーンが最大角度に回転した時に計器盤に当たることが判明しました。図面ではサーボ本体とは干渉しないことを確認していたのですが、ホーンとの干渉までチェックをしていなかった罰です。更に操縦桿の中立位置が図面より若干前傾気味であることから最前傾位置でやはり当たってしまうことも発見しました。

仕方がないので、ラダーサーボを８mm前進させ、操縦桿の中立位置も若干後傾気味に修正しました。サーボの前進と操縦桿の後傾はそれらに接続した可変長リンクの長さ調節範囲を超えるので、作り直しを余儀なくされました。更に計器を付けると計器盤の後側に飛び出しますが、一番下の2つの計器が機首構造の上面に設けた天板（画像217）に当たる事が判りました。

画像217 機首の天板

この天板は実機には無いものですが、モーター用のアンプ等を搭載するために設けたものです。計器が当たる部分は天板を切欠くことで解決しますが、問題は天板の後端に貼りつけたカーボン角チューブが邪魔します。仕方がないのでこれも切り取りました。

計器盤取付構造の完成

このように色々問題が発生しましたが、一つずつ解決して漸く取付構造が完成しました。最後にカウリングに木枠を貼りつけた上で計器盤を取付けて、機体に搭載・確認しました（画像218）。

画像218 計器盤取付木枠（左）と計器盤の取付確認

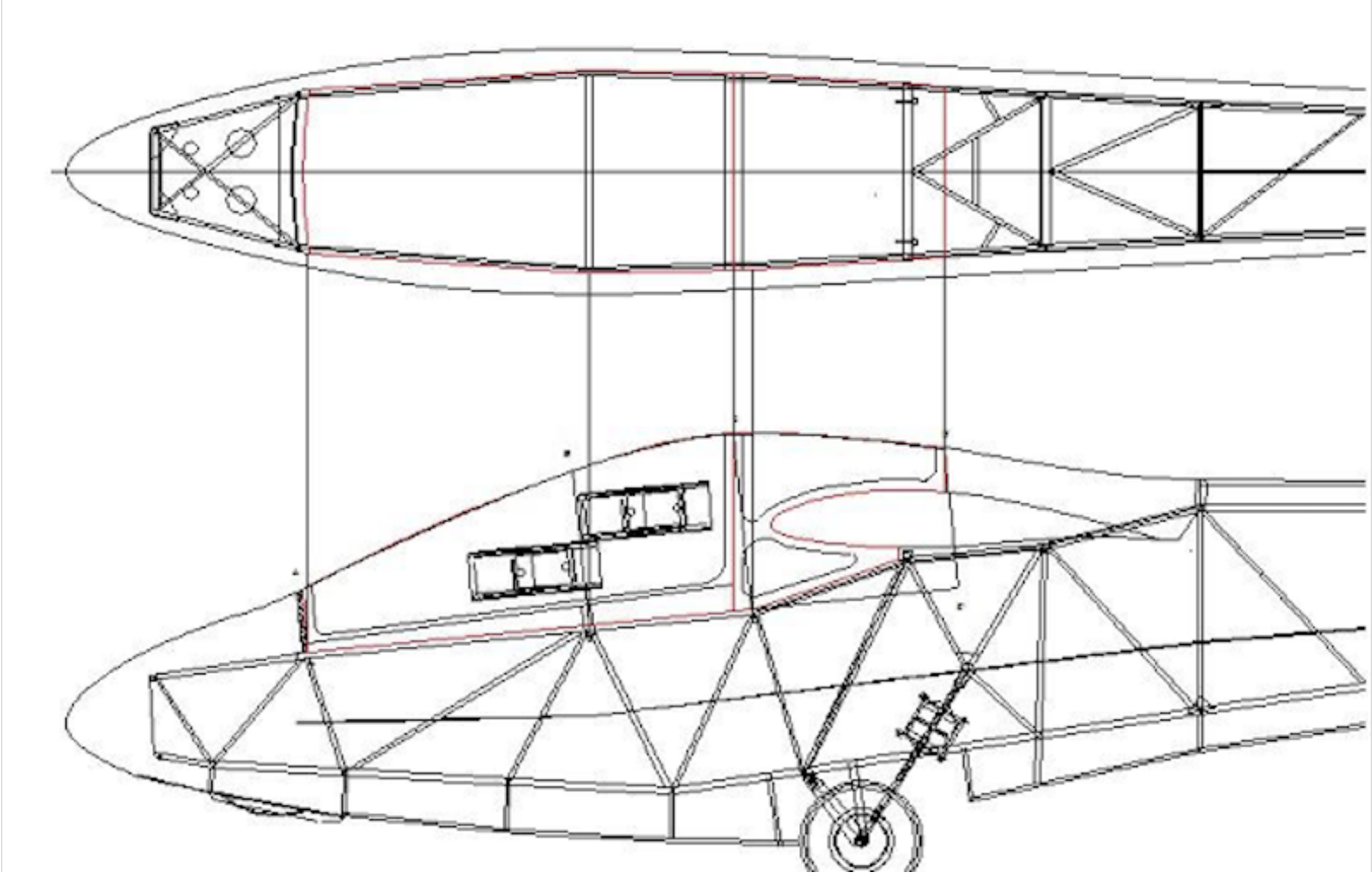
なかなか良い感じです。実際に計器が嵌ると実機感がグッと上がると思います。この後ミニ旋盤をお持ちのクラブ仲間に計器のケースを削って貰ってから目盛盤を製作してこの計器盤に取付けます。

キャノピー木型図面の作図

製作には大物のキャノピーが残っています。バキューム方式で製作する透明部は私には未経験で、どのように作るか情報を集めていたらその達人Tさんが長野県にいらっしゃることを知りました。しかも色々な人のキャノピーも製作しているようです。早速連絡を取ると快く製作して頂けることになりました。しかも製作に必要な木型も製作して頂けます。そこでキャノピー木型の図面を作図しました。

三田式3型改1のキャノピー

三田式のキャノピーは前後2つに分かれています。前部は開閉可能で前後席搭乗者がそれを開けて乗り降りします。後部キャノピーは機体に固定されて開け閉めできません。図面にするとこのような形です。図の赤線範囲がキャノピーです（図面55）。

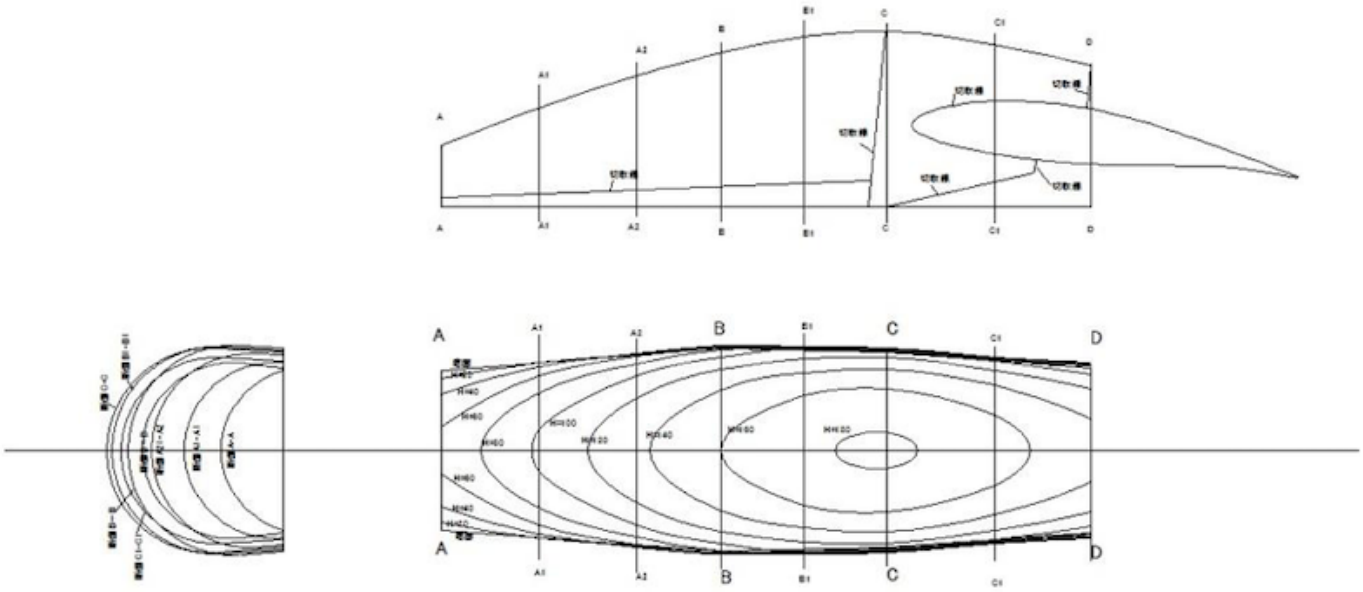


図面55 キャノピー

後部キャノピーは中央翼を挟んで複雑な形状をしています。しかも底面が前部キャノピーと同一平面にありません。このキャノピーの木型をどのように作るか考えましたが、底面を前部、後部で一致させた図の黒線にすることにしました。これで整形した透明部を切断して2つに分ける方式です。

木型図面

木型範囲が決まったのでその3次元形状を定義する図面を書きました（図面56）。作図法は機首カウリングカウリング図と同じです。



図面56 キャノピー木型図面

機首カウリングに接する最前部（断面A-A）、平面図でキャノピーシルがキンクする場所（断面B-B）、前後キャノピーの分割ライン（断面C-C）および最後部で中央翼フェアリングに接する部分（断面E-E)の4か所の断面形状を定義して、それらの間の適当な断面（A1、A2、B1、C1)を仮に作図します。

それを高さ20mm毎の平面で切断して等高線を描いてみます。等高線に変なウネリがあれば断面図を修正します。しかしそれほどおかしなことがなく、一発で定義できました。

それにしても大きなキャノピーです。木型の寸法は長さ670㎜、幅210㎜、高さ180㎜あります。Tさんも手持ちのバキューム装置では対応できず、大きなものを新製されるようです。

キャノピー製作には一抹の不安があったのですが、ベテランのサポートで課題がクリアーされました。

飛行機曳航用索リリース機構の改良

先に製作したウインチ曳航用と飛行機曳航用索リリース機構の索リリース具合を入念にチェックしたところ、飛行機曳航用機構の具合が余り芳しくないので改良設計して作り直しました。

不具合の原因

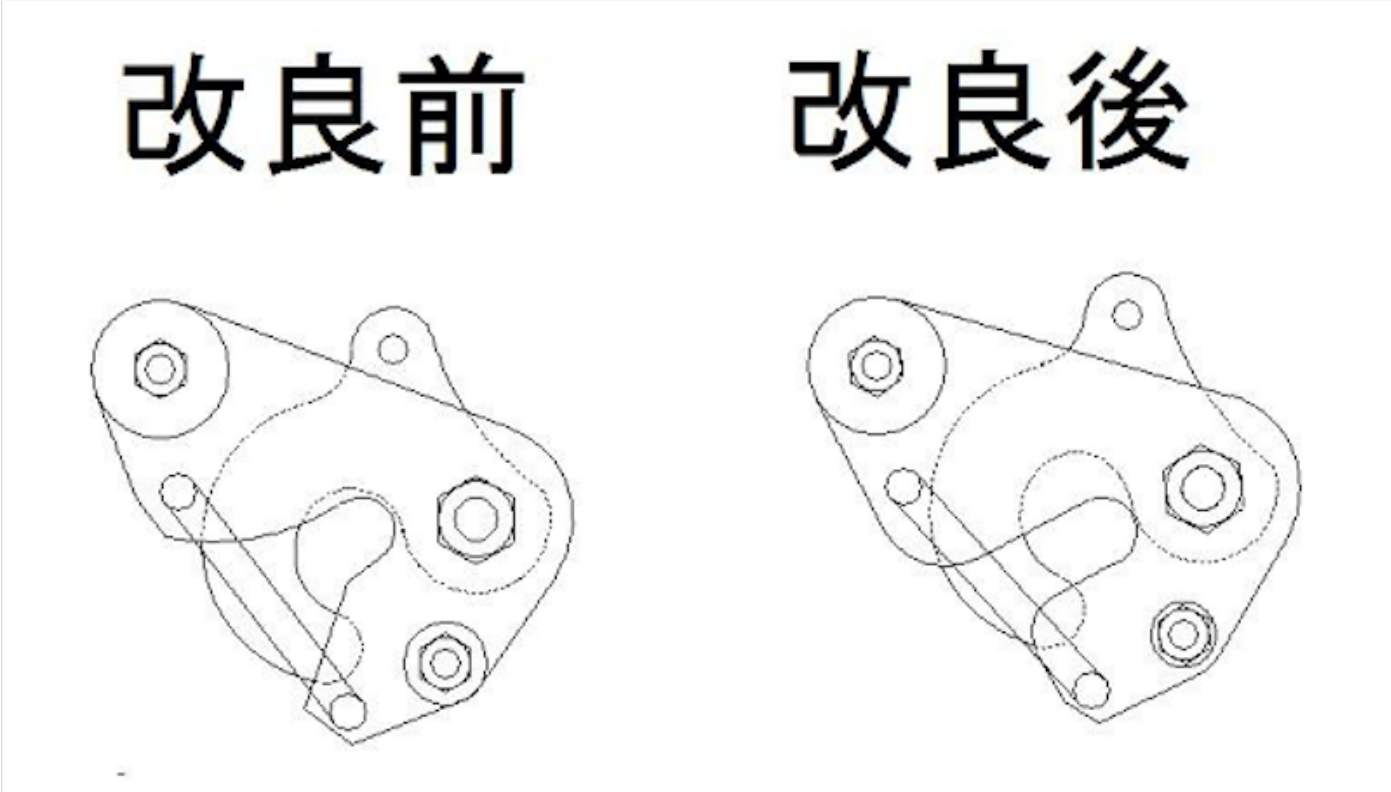
実は飛行機曳航用機構の設計は余り深く考えもせず、ウインチ曳航用機構と同じように作ったものでした。しかし、両機構の索リリース時の状況は大きく異なります。

ウインチ曳航ではかなり強力な牽引力で索を引き、機体がウインチの真上近くに来たときにリリースされます。即ち、機軸に対して索はかなり下向きの角度に位置します。一方、飛行機曳航では索にかかる張力はウインチ曳航に較べて遥かに小さく、リリースする時の索は略機軸に並行の角度です。

先日作った索リリース機構はこの違いを考慮せず、曳航索に取り付けたリング状の金具を受けるリリース機構のガイドの形状を、ウインチ曳航用と飛行機曳航用で同じ設計としました。両機構に実際に索を付けてリリース具合を確認してみると、ウインチ曳航用は素直にリリースしますが、飛行機曳航用は上手くリリースしないことが判明しました。

改良設計

そこで上に述べたリリース時の状況を考慮して飛行機曳航用機構のガイドを再設計しました。改良前と改良後の比較が図面57です。



図面57 飛行機曳航用索リリース機構の改良

側板に設けたガイドの出口付近の形状が違います。

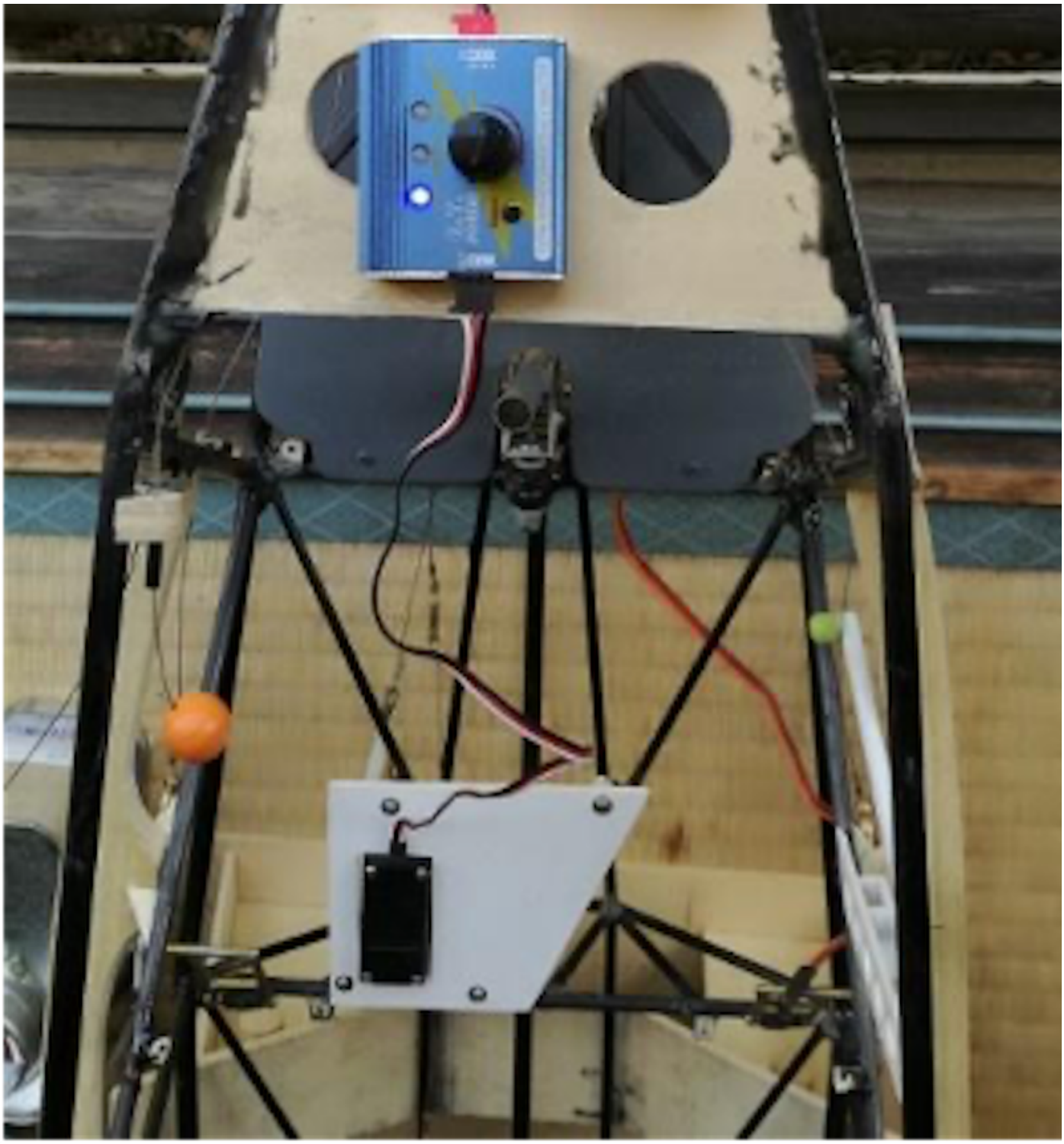
リリース具合の再チェック

再設計した機構に取り換えてウインチ用と飛行機用の両機構のリリース具合を再チェックしました。

画像219が索に付けたリングです。

画像219 曳航索用リング

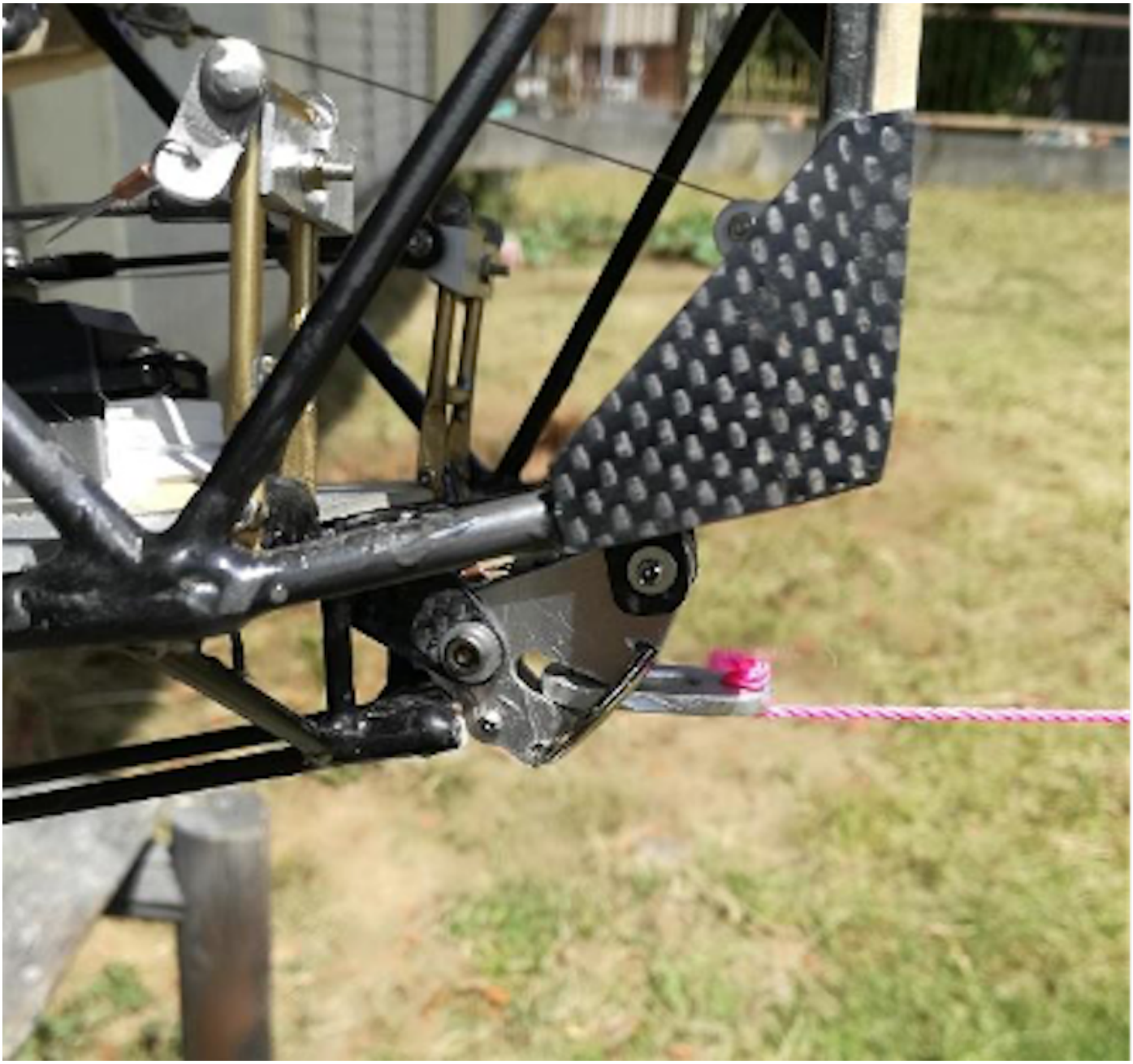
リリース機構用サーボにサーボテスターを繋ぎます。

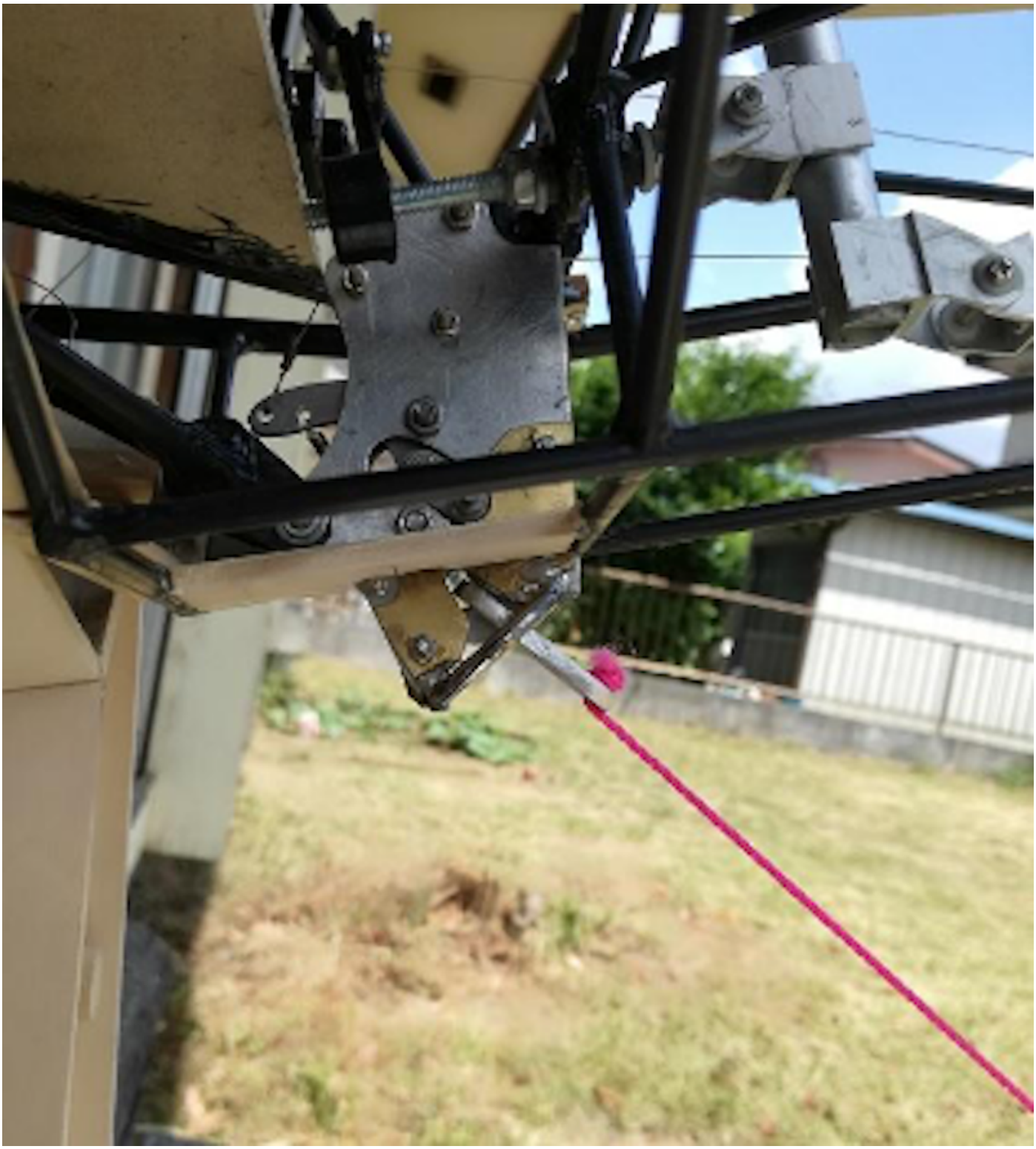


画像220 曳航索リリース用サーボにテスターを繋ぐ

その後索のリングを飛行機曳航用機構のフックに掛けます。この状態で索を飛行機曳航状態と思われる角度で引っ張って置き、サーボテスターのダイヤルを廻しました。今度は極めてスムースにリングが外れました。

同様にしてウインチ曳航用機構も基軸に対して深い角度をつけてテストして、素直にリリースすることを再確認しました。





画像221 曳航索リリース機構のテスト 左＝飛行機曳航用 右＝ウインチ曳航用

これで両機構のリリース具合に問題の無いことが確認できました。

次の記事を読む | *前の記事を読む* | *目次* | この記事または他の記事のPDF

をご希望の場合、または問題全体のPDFをご希望の場合は、*お問い合わせください*。

Get Your Plug Holes Aligned

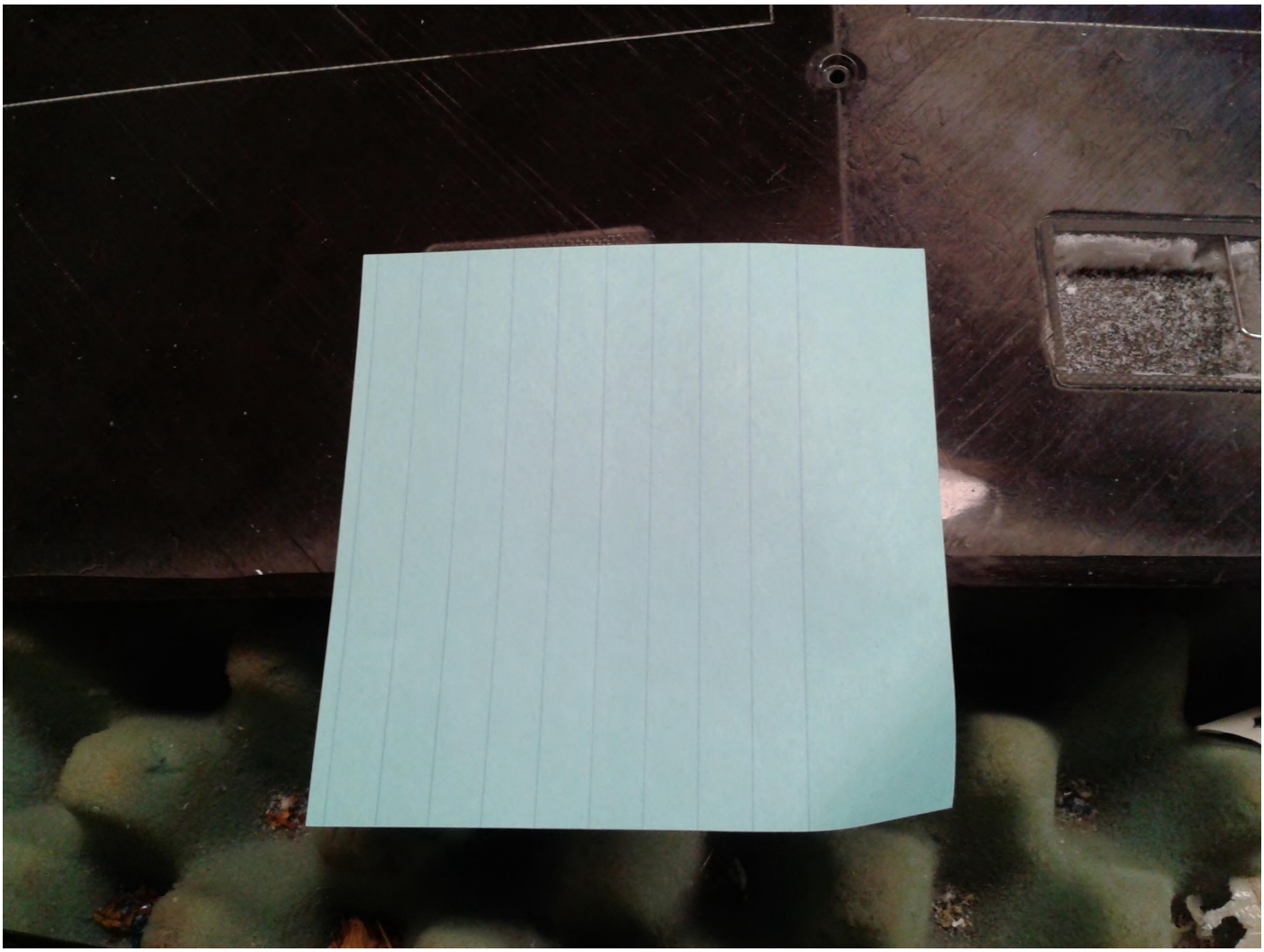
Looked what I dreamed up.

Tom Broeski

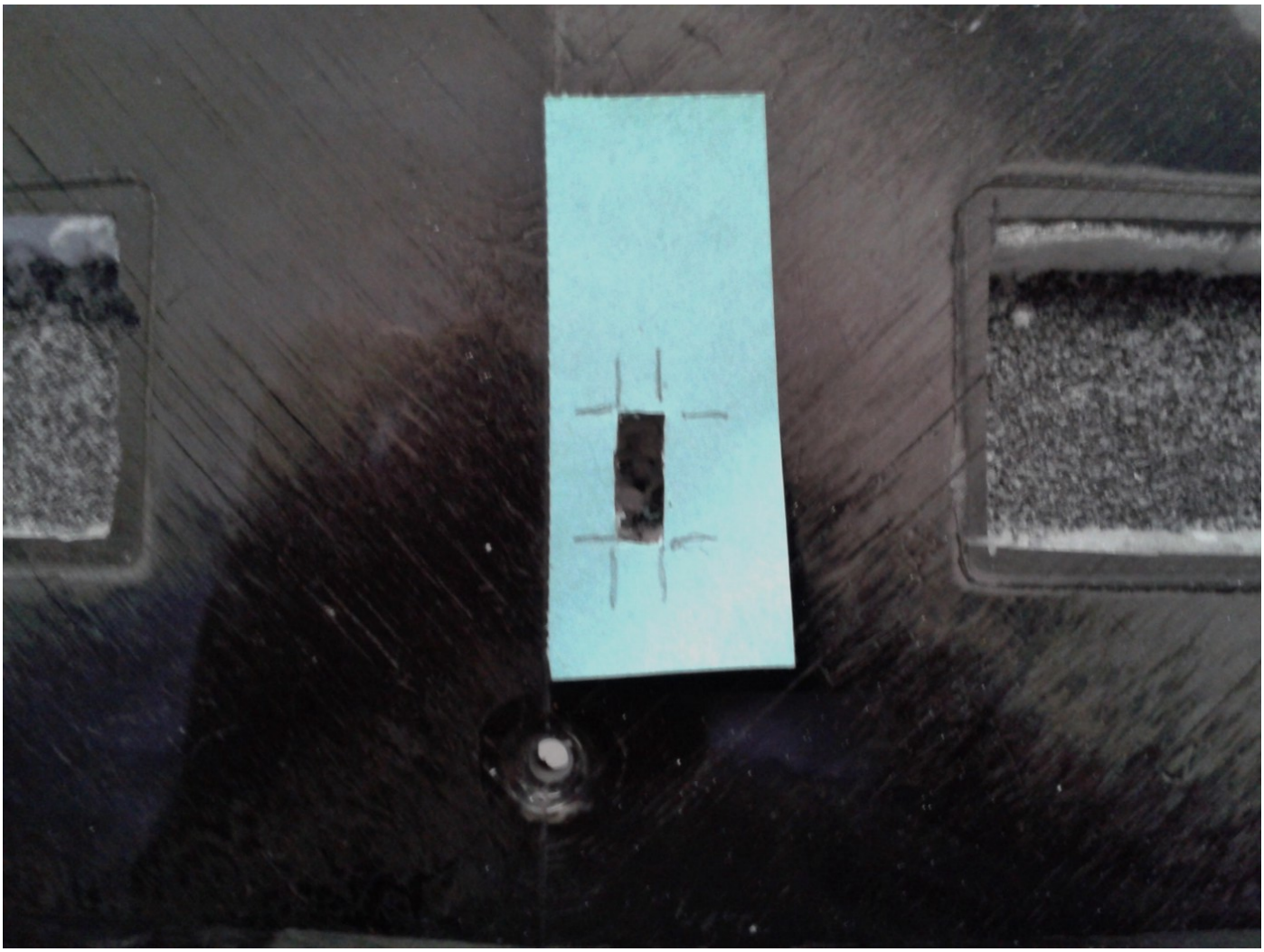
I can usually measure pretty accurately, but I was dream building (seem to do it every night) and I came up with this.

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
Scotch
Craft Stick
STAY TAC
CLEAR SPRAY
TEXTILE ADHESIVE
WARNING
DISTRIBUTED BY
advanced



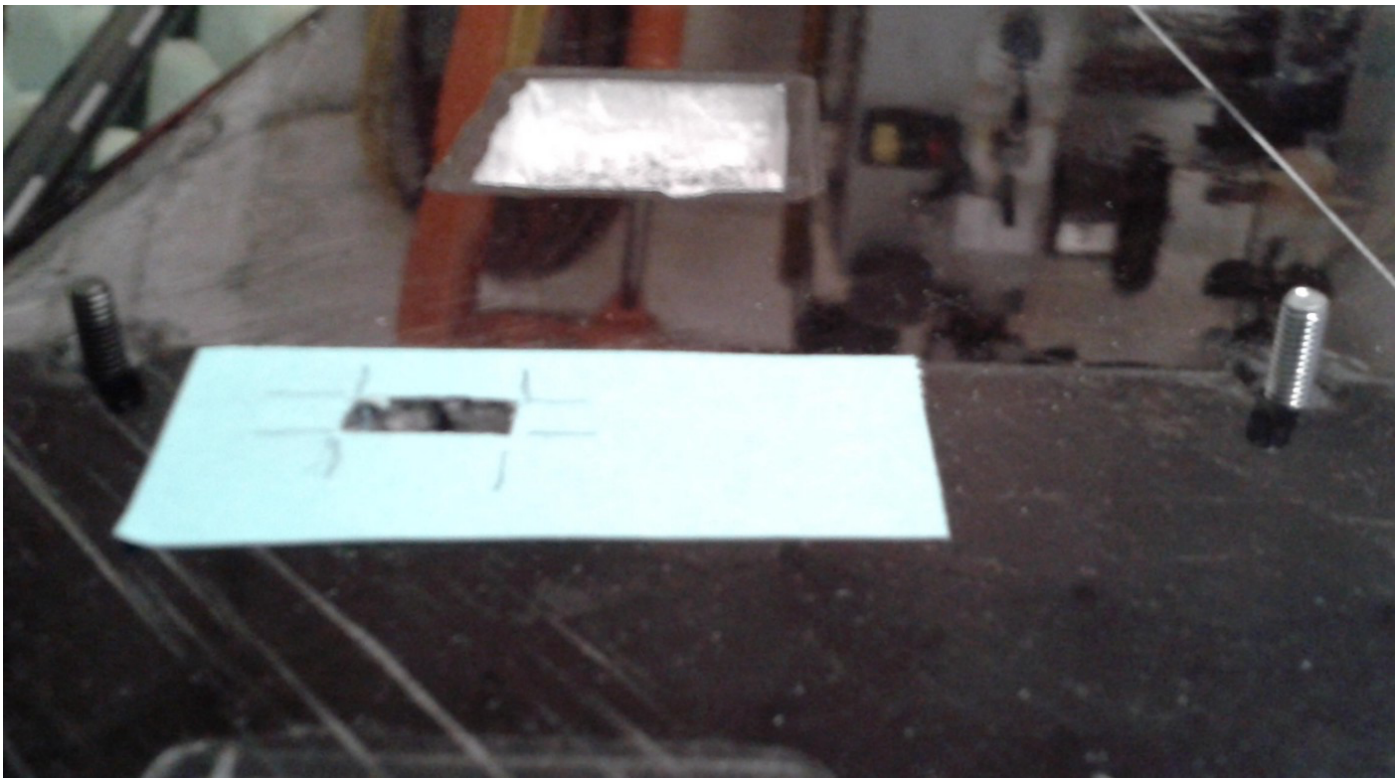
Stick it where you want to cut your hole. Measure and cut. In this case it is a Stream NXT wing.



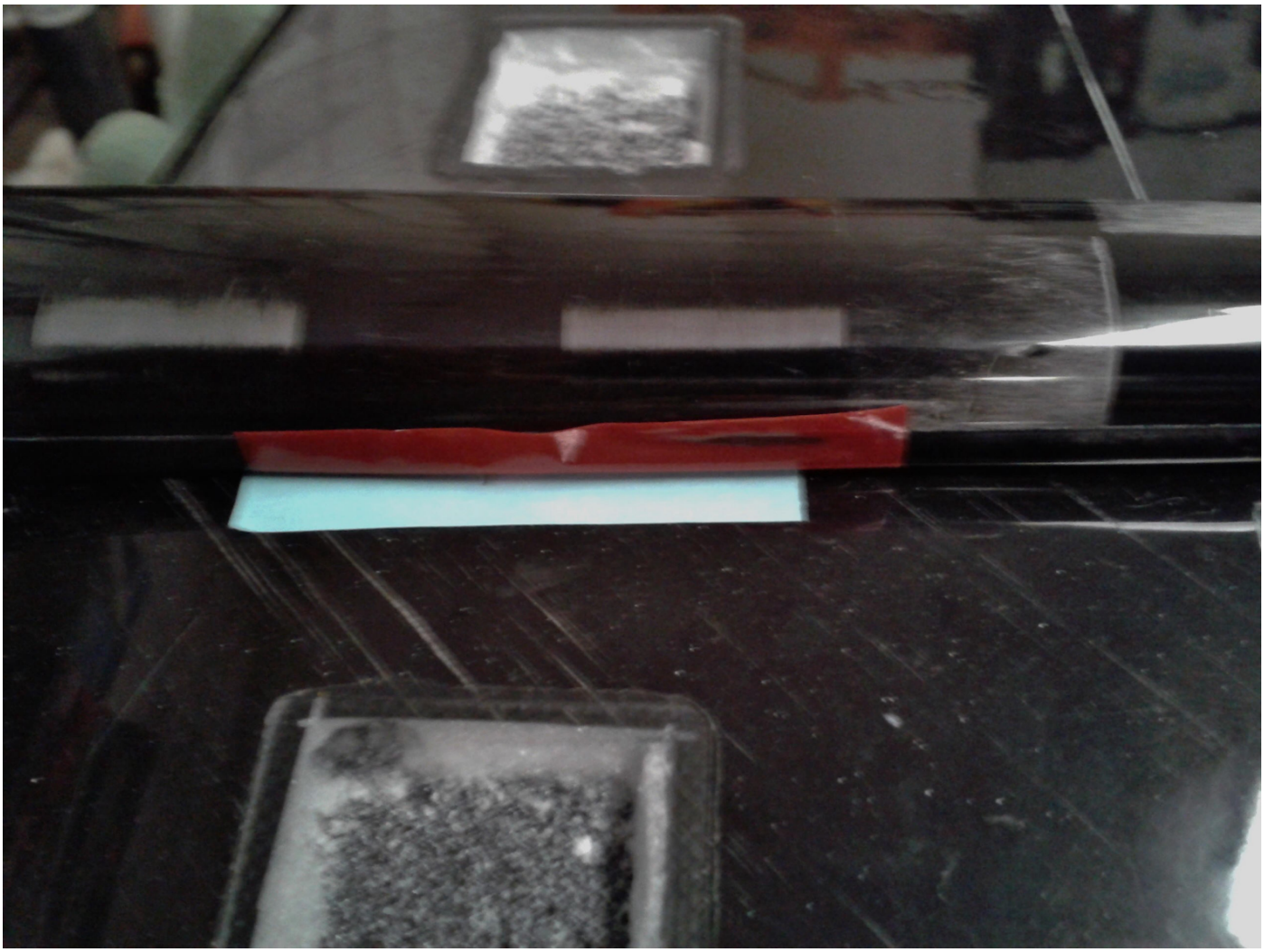
Take a piece of double stick tape (I used some red so you can see it) and put it on the fuse or other part you want to transfer the hole to.

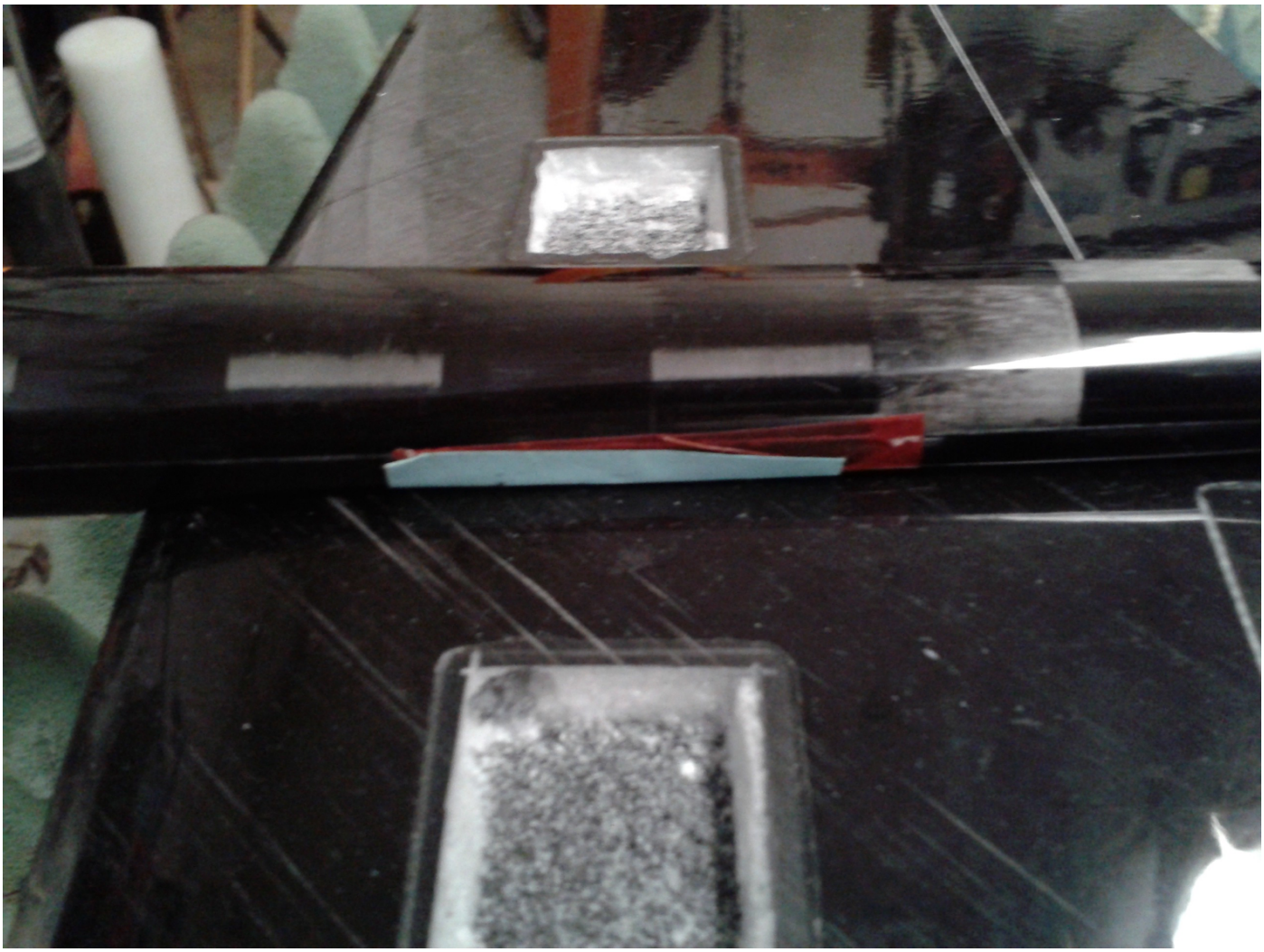
Peel the backing off. I left a bit extra over the side.

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!

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The Trailing Edge

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

The NEW RC Soaring Digest Staff

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!

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The NEW RC Soaring Digest Staff

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