
Radio Controlled
Soaring Digest
September 2021
Vol. 36, No. 9

The NEW RC Soaring Digest

September, 2021
Volume 36, No. 9

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In The Air

Whither our community?

Terence C. Gannon



This stunning image by Laurent Ducros was taken in February, 2021 and features the glider aerobatic team based in Erquy on the northwest coast of France. The three, four meter span Air 100 gliders in Hamilton livery are all built by Eric Poulain who is also one of the pilots. They are flown in precise, tight formation with musical accompaniment.

In the short time I have been Managing Editor of the NEW RC Soaring Digest, one of the things of which I'm most proud is the truly international group of authors which has assembled to bring you such outstanding material each month. In this issue alone, there are contributions from (alphabetically): Canada, France, Israel, Japan, Netherlands, Taiwan, the United Kingdom and the United States. I'm equally proud of the truly global audience that returns each month for a fresh dose of soaring journalism. We now have readers in 93 countries around the world.

I had the great honour of interviewing Canadian astronaut Dr. Robert Thirsk a number of years ago, and one of his most memorable reflections of his extensive time in space was that Earth is actually a very small place. A 'spaceship with seven billion crew members' were approximately his words. My time at RCSD and my consequent interactions with people from around the world ground-truths Dr. Thirsk's observation. The world is actually a very small place indeed. Furthermore, enabled by completely miraculous information technology, it's becoming smaller all the time.

And yet, I can't help but feel that something is somewhat amiss. One would think that this great 'bringing together' of a global community would be unifying — that is, give us a feeling of belonging to something. That is true, in one sense, but I must say that as I work with each author I am inevitably led back to the same place: I can't wait to meet them in person — to shake their hand at their flying field, kibitz about the weather and our latest gear, take the obligatory selfie and then, most importantly, **fly with them**.

In other words, there is still nothing quite like being there, in person, with other people with whom we have something in common.

These thoughts were triggered, in part, by Michael Berends' latest edition of *RC Soaring Diaries* in this issue. I won't steal any of Michael's thunder but he makes some really interesting observations about the lamentable state of competitive RC glider flying, at least in his neck of the woods. As he states, "[w]e haven't seen soaring contests in this region for over a decade". You'll just have to read Michael's excellent article to find out why he thinks that is, and what he misses most about contest flying — although you can probably guess. He also proposes some simple but potentially very effective ideas as to how the trend can be turned around. It's well worth a read and provides some important food for thought.

Phil Cooke does his usual excellent job, also in this issue, of describing what has to be the gold standard of what an RC flying community should be. Or, if in the unlikely event his Power Scale Soaring Association is *not* the gold standard, then you can at least see it from the slopes of The Great Orme. Read his *A 'Big Air' Weekend at 'The Big Rock'!* for a bit of inspiration on how to do 'community' exactly right. For my part, I can't wait to fly with them.

The Erquy Aerobatic Glider team in action. Folks, it really doesn't get much better than this. (video: Laurent Ducros)

I was chatting with Doc Hammond a couple of days ago — or what passes for chatting as conducted with nine typing fingers — and one thought we had was something currently assigned the working title of *RCSD Live*. If there has been any sort of silver lining to this infernal, seemingly unending pandemic is that the ubiquitous Zoom call has become an accepted way for communities to engage with each other in real time. To strip away the abstractions and actually see each other more-or-less as we actually are at common moment in time. It's not 'being there', exactly, but 'you can at least see it from there' and it will certainly do until teleportation is a viable option.

But I digress. What Doc has offered is to be a guinea pig for a whole new channel of communication for RCSD — a free, approximately one hour session conducted on Zoom (or equivalent) where he will talk about his series' in RCSD *and* take your questions! It will be a facilitated conversation conducted in a time slot where it will be a reasonable time of the day in most parts of the world. If that were to work out well, then other speakers could be lined up and it could become a more-or-less regular thing. Think of it as RCSD's contribution to getting closer to the spirit of community described above.

But — and it's a big but — that will all depend on whether there is sufficient interest. There's nothing worse than throwing a party only to have nobody

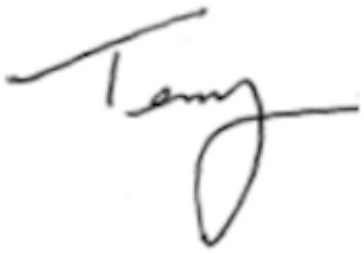
show up. If you would be interested in attending something along these lines, please drop us a line and let us know. But here's the thing to keep in mind: the whole idea will be to attend *while it's happening* as opposed to watching (or, more likely, not watching) a recording after the fact.

There are also other ideas percolating around that all core in on the notion of community building. For examples does anybody remember, or maybe even participating in a 'postal contest'? Basically, the idea was to have some sort of competition where participants, wherever they might be, take on the contest tasks in their own locale — usually on a specific day or days — and then mail in their results so they can be ranked alongside all the other entrants. Here's the takeaway: how about a 21st century version of that? Any takers?

That's enough for now. But how about this: between now and when we get together at this same place at this same time next month, consider giving your buddies a call and see if they want to hit the slopes for a flight or two.

The risk of singling out a couple of articles above is that readers may be tempted to skip right to those articles. **DON'T**. We have a ton of great material in this issue of RCSD from, as mentioned, from all parts of the world and across time as well. To get started, flip to the first story using the link below. As always, thank you so much for reading.

Fair winds and blue skies!



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***Cover photo**: For the September issue, we're featuring George Hill launching his glider during F5J competition at the recently concluded AMA Soaring Nats held in Muncie, Indiana. This particular picture was taken on August 23rd, 2021. The photographer was Matt Ruddick and is ©2021 The Academy of Model Aeronautics, used here with their permission and with our thanks.*

*Here's where you can find the **first article** in September, 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**.*

The 1/6th Scale Nemere

Recreating Lajos Rotter's classic sailplane from 1936 and intended for the 1940 Olympics.

Vincent de Bode



Sjoerd throwing the Nemere at Retroplane 2017 at Vauville, France. (image: Laco Vasek)

After writing the article about the Fokker *FG-2*, I would like to tell a bit more about the scale gliders that I built earlier and, at some point in the future, about the ones I built after the *FG-2*. I thought it might be a good thing to include all the things I tried, including my mistakes and failures.

How did it all begin? In my teens I got involved in aeromodelling, joining my older brother. It was in the late 1950's. *Oracover* didn't exist, we used silk with (cellulose?) dope. RC was a faraway dream. Even DT timers were still out of reach; we used fuses. After building an A1 glider I got involved in

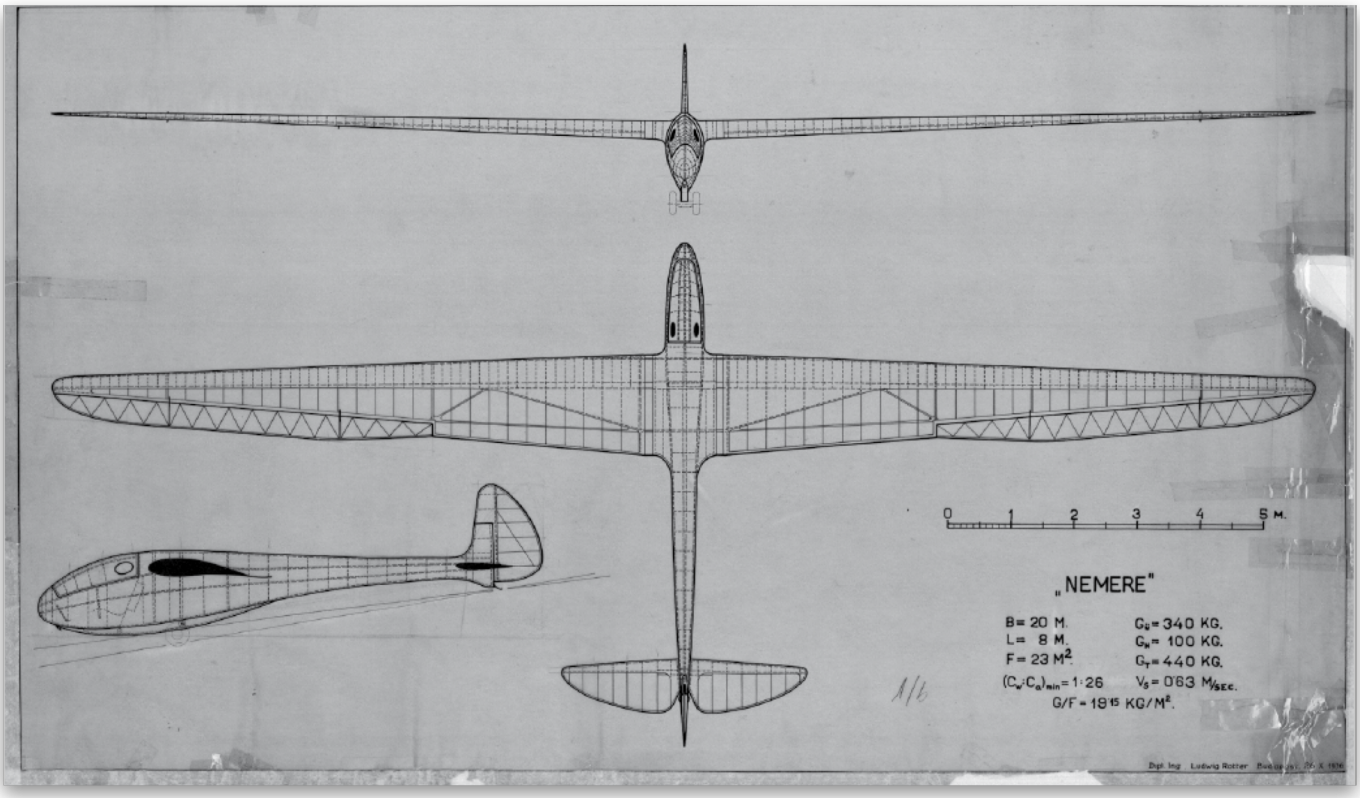
rubber powered planes. Small ones at first, later Wakefields (now F1B). Plans were not available, so I had to draw them myself and construct everything from scratch. Even the propellers were hand carved. Building such a model was quite a challenge and often they crashed, so I had to learn to repair them too. When I finally got a model flying it was very rewarding! I still remember those silent flights on windless spring evenings.

Some 15 years ago my friend Adri got me interested in modelling again. I transformed an old Wakefield into an electro glider (not the best choice!) and learned to fly with RC. I built and bought some better gliders and I enjoyed the RC flying very much.

In 2011, some of my flying buddies went to *Retroplane* in France and returned with great stories and videos about it. *Retroplane* is an event you can only join with a home built scale glider from a prototype built before 1965, mostly made from wood, steel and canvas. I liked this idea very much and it kept lingering in my mind.

Accidentally I came across an article in *Aufwind*, a well-known Austrian RC magazine, about a 1/8th scale *Nemere* with a wingspan of 2.5m. A short kit with plans was available.

The real *Nemere* was an advanced Hungarian glider of which only one was built in 1936. The info about this glider was pretty limited. Recently, original plans of the Nemere have been discovered (2), even a full scale glider is built at this moment.



2: The original Nemere plan from 1936. (image: Ludwig Rotter)

At the 1936 Olympics gliding was a demonstration sport. The *Nemere* then flew from Berlin to Kiel (326.5km). Some data of the original: span 20m, cantilever wings, adjustable ailerons for fast and slow flying. Later spoilers were added. After the war the plane was lost.



3: "The Nemere from another angle." (image/caption: iho.hu)

This plane seemed a good introduction to the world of scale gliders, so I ordered the short kit and it turned out to contain — besides the wing ribs — the fuselage frames, building plans and a CD with construction photos.

I built this model with several modifications (I always do that!) and added spoilers. It has balsa sheeting, I discovered that was difficult to stain. The original glider is sheeted with plywood and all the panels of the fuselage form a patchwork. I tried to colour the balsa sheeting on the model and the results were mediocre, but looking at it from a distance (when flying) it was acceptable.



4: Cockpit with Lajos Rotter, the Nemere designer and its pilot, at the controls.
(image: Wikimedia)

My model just met the requirements for *Retroplane* and so I was admitted to join the 2015 edition of *Retroplane* at the Wasserkuppe (that's how you get to fly there!) In the Netherlands there aren't many slopes, so I had to learn soaring. After a few fine flights I unfortunately collided in mid-air with a much bigger glider and crashed to the ground, which resulted in a pulverised nose up to the wing. The rest of the plane was still intact.

With some support from other *Retroplane* pilots and the (flying) home front, I

was able to repair the nose with some borrowed cyano and hinge tape. At the local model shop (yes, there was one!) I bought a new carbon wing joiner. So the fuselage of the *Nemere* could participate that same evening in the 'Expo Fuselage' (the fuselage show).

There, the difference between the models with plywood covering and my balsa one became very clear. Plans to build a ply covered glider started to grow. The next day I could fly again, that was great fun!

Back home I read a lot on the *Retroplane* forum. Many build descriptions can be found and although they are mostly in French (there is also a German section), I got a fairly good idea about how these planes were built.

After long consideration I decided to start building another *Nemere* with a wingspan of over three metres. At *Retroplane* there are plenty of models with a five meter wingspan, but I thought it would be wise to start a little smaller.

If I would build the model at 1/6th scale, I would end up with a wingspan of 3.33m and a weight of about 2500g. This seemed a good size to me. It was also big enough to be sheeted with plywood while keeping the weight acceptable.

Unfortunately I was not able to make a digital drawing from the analogue one, so at the local copy shop I had the 1/8th scale plans enlarged by 33.3%, thus going from 1/8th scale to 1/6th. Friend Rob offered to digitalise the wing ribs and Adri would CNC mill them for me.

Fuselage Construction

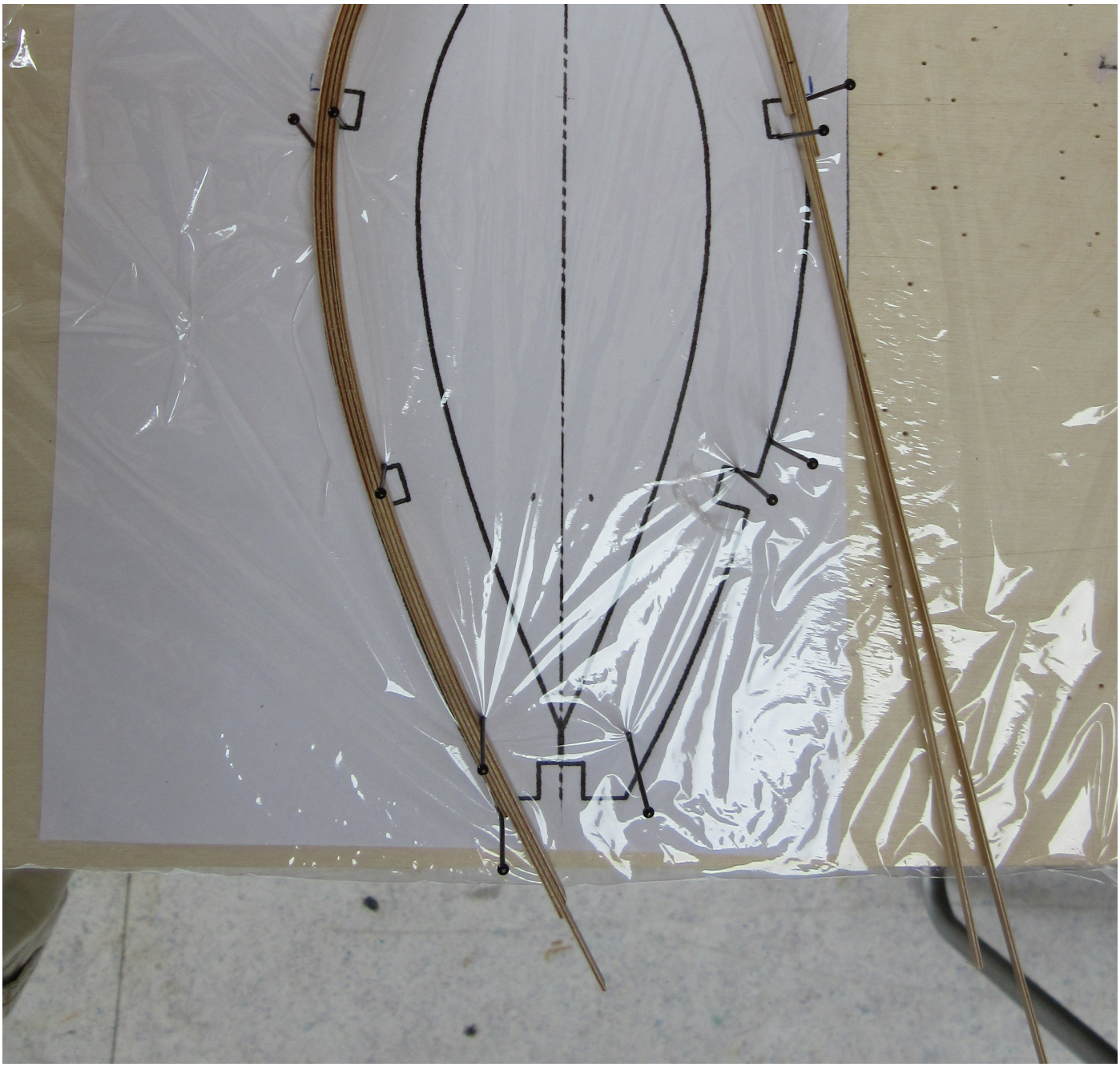
Now I could start the construction properly, beginning with the fuselage frames:

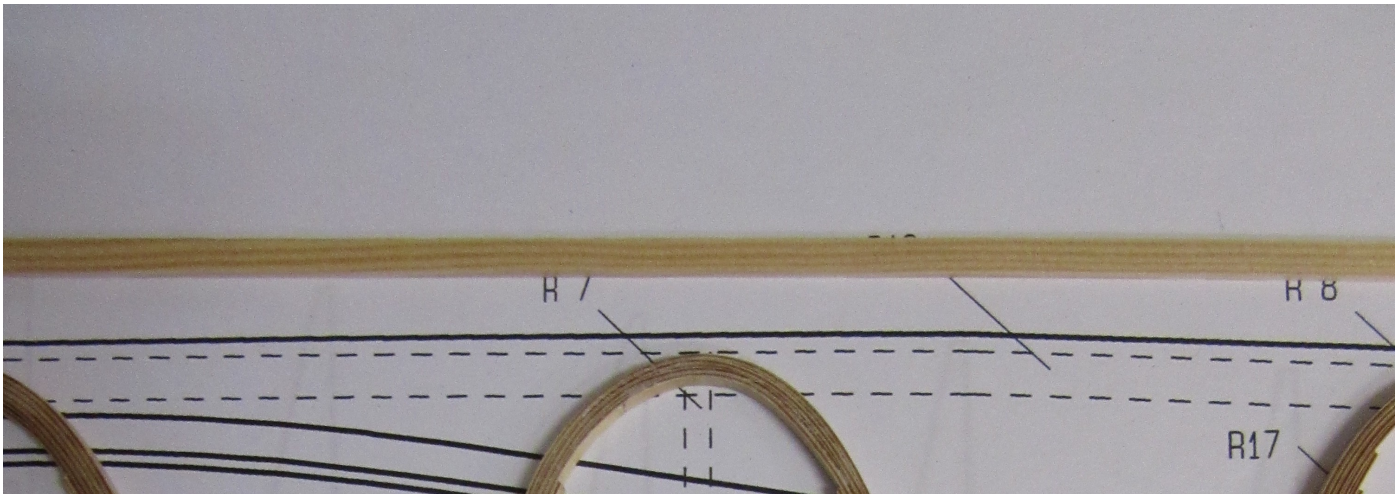
I thought of laminating the frames instead of cutting them out of ply. I'm familiar with this process from boat building (full size) and I had discovered the ins and outs of this technique. I wanted to laminate the frames from 4mm wide strips of 0.8mm plywood, which I happened to have in stock.

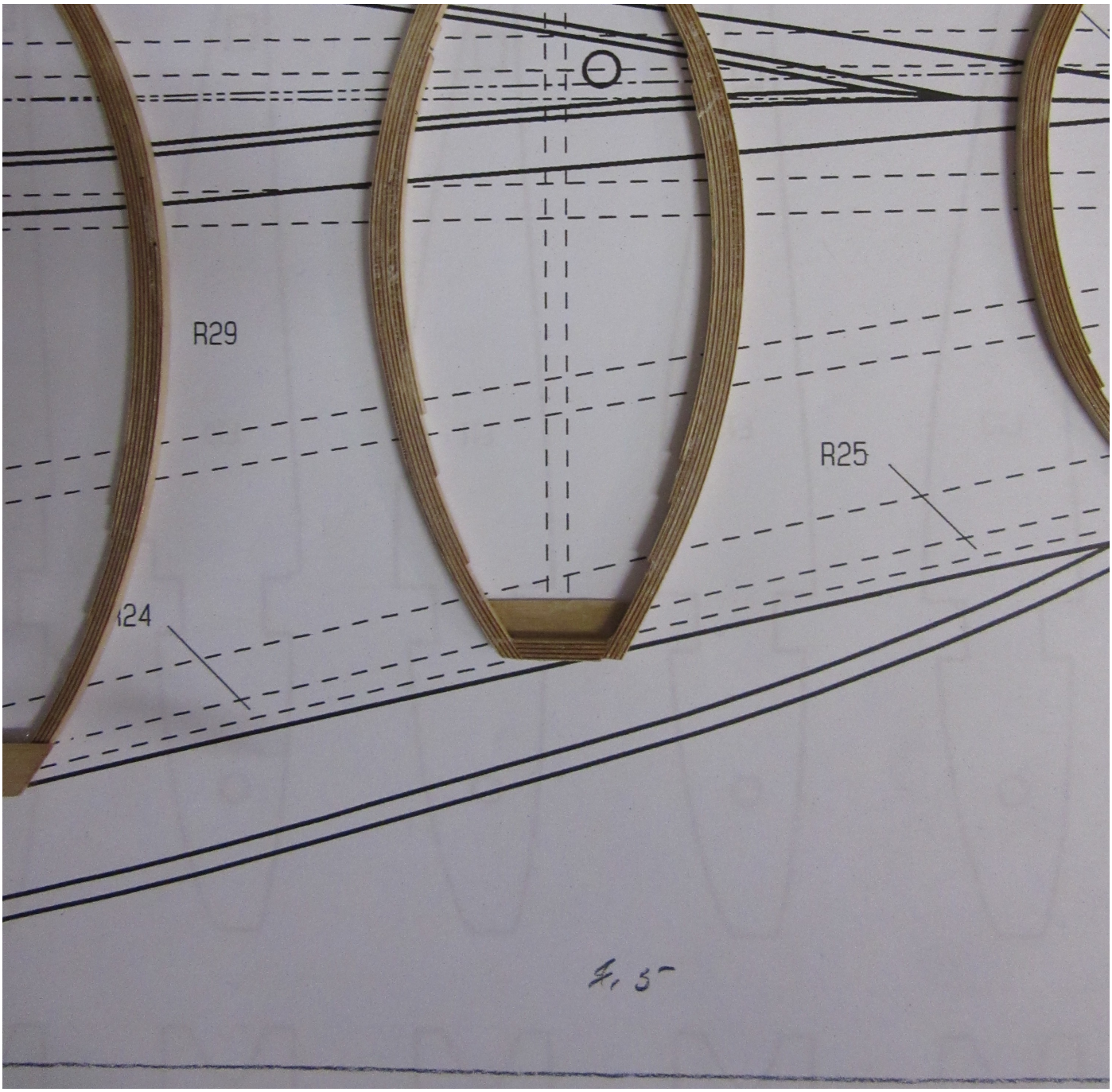
I laminated the frames in the following way: I put a paper copy of a frame on my building board and covered it with cling film stuck with painter's tape. Then nailed in some sturdy pins so that the outside of the frames matched the drawing, taking into account the thickness off the frame itself. I estimated the number of layers (usually five or seven) and after wetting the plywood with boiling water bent the whole package of ply strips around the pins, pressed them together with clamps and then drenched it with thin super glue. The wet wood seemed to glue fine. Within minutes the frame was ready.

The frames are a bit more elastic than plywood frames, but very strong. By squeezing the frames you can feel where the frames are too flexible; I then laminated additional layers on the inside. On the bottom seam of the frames I made gusset plates and/or glued in extra wood. Laminating with thin cyano is easy, because it's so thin that you don't have to apply glue to the surfaces first, but can bend the wood into shape and soak it with thin cyano.



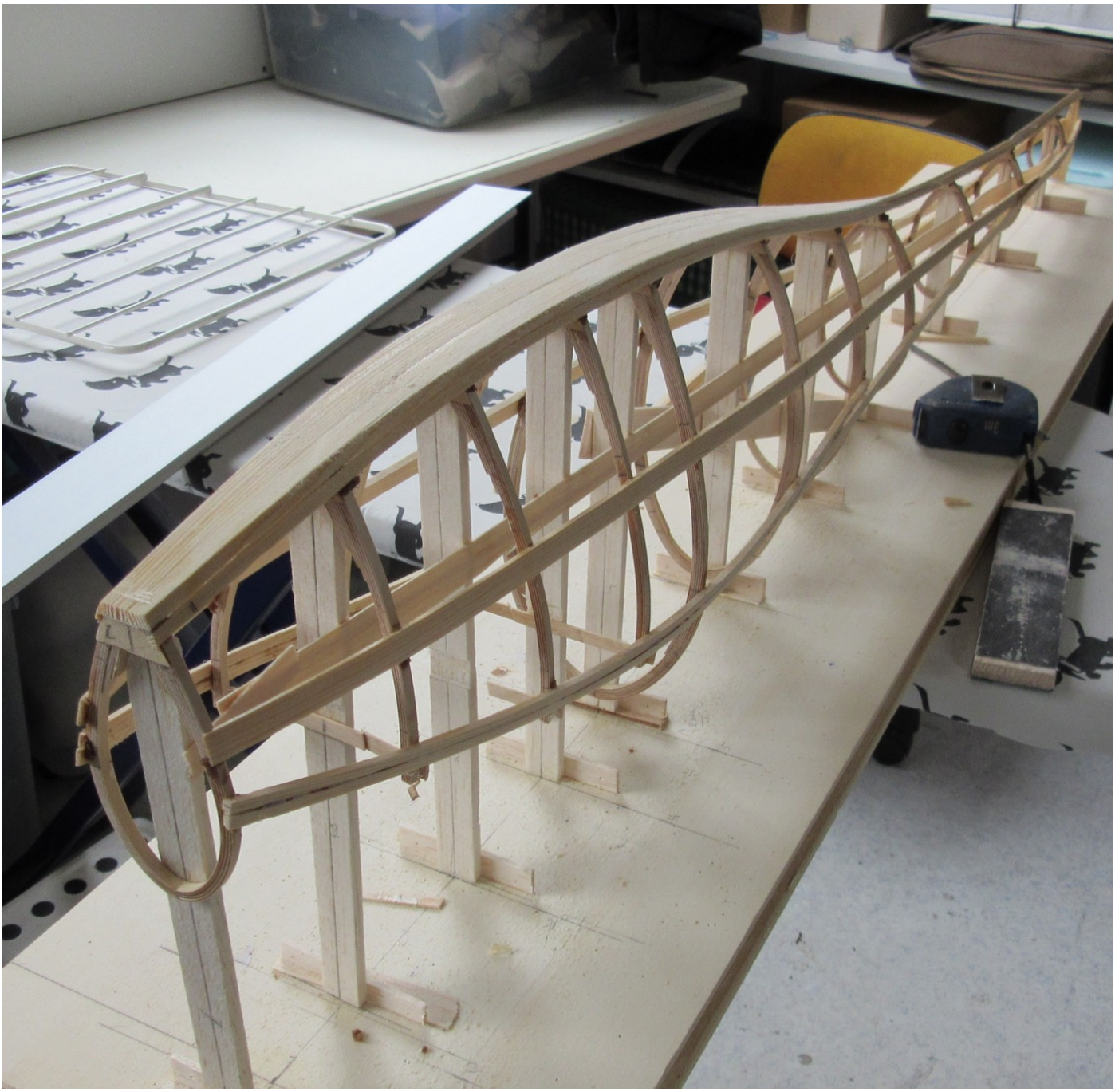



R 7
R 8
R17



5 (left): Laminating a frame. | **6** (right): Finished frame.

After finishing the frames, I glued balsa legs on them, so I could set them up on my building board. Making the frames by hand is not as accurate as CNC-milled frames, they have to be made to fit. It's an old technique I learned with boatbuilding: you bend a long, thin batten over the frames in all directions and check that it touches the frames, there are no sharp bends or flat spots and the shapes have to be gently flowing.



7: Stringers fitted.

I discovered some sharp bends in the front frames in relation to the cockpit and had to make some adjustments there. I would not be surprised if this had to be done with the real planes also. When building wooden ships (at full scale) this process (lofting) is an essential part. Then I glued the stringers on the outsides of the frames using slow epoxy with wood dust as filler.

At spots where a lot of curvature was needed, I thinned the stringers. For example, at the cockpit edge where the stringer is curved in two directions, I used a couple of narrow stringers instead of one wide one. When the epoxy had set, the structure was now rigid enough to free it of the building jig (8). I had thought about how to make the fuselage/wing fairings and I guessed it was a good idea to build the basic structure of the wing first.

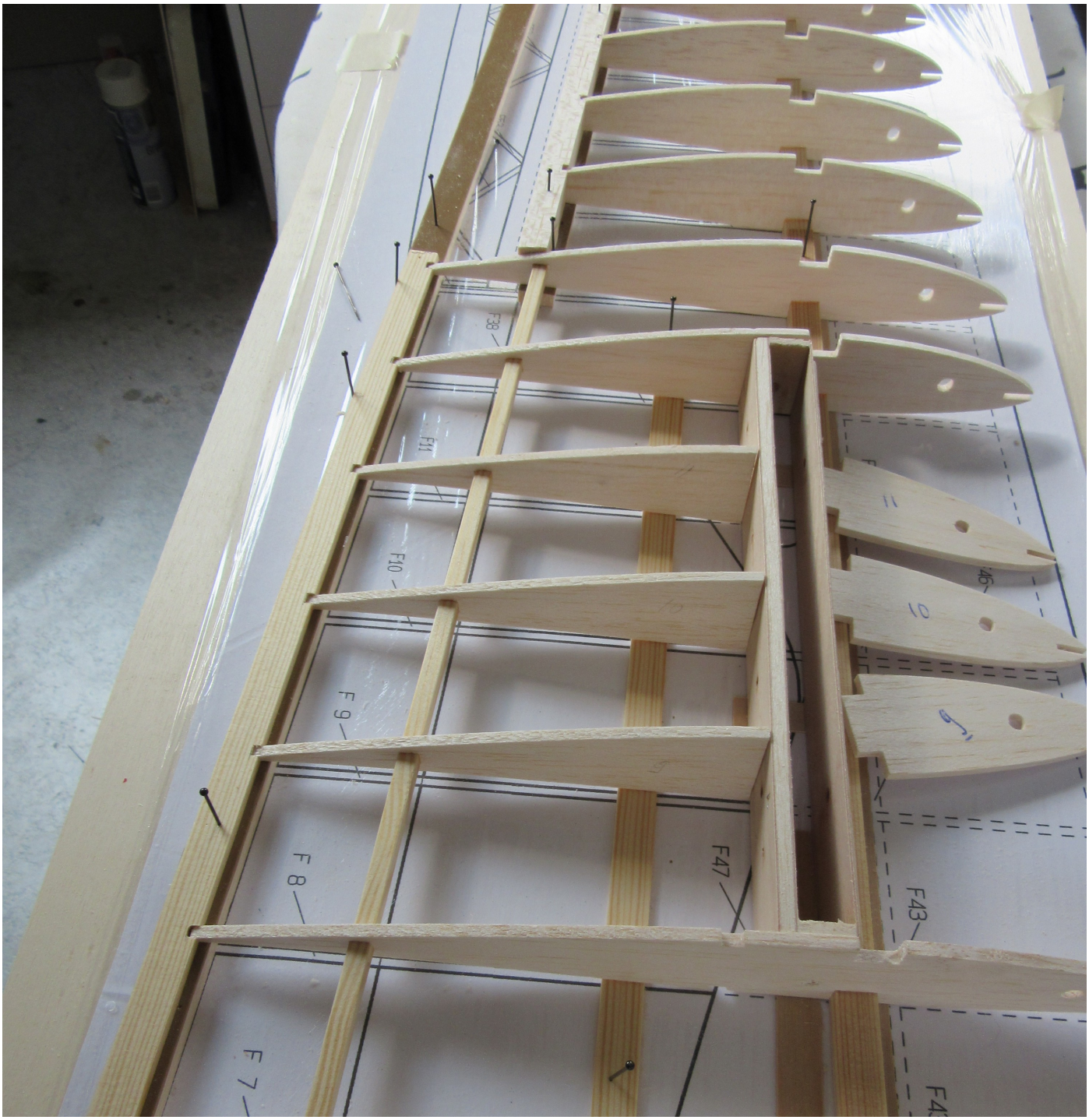


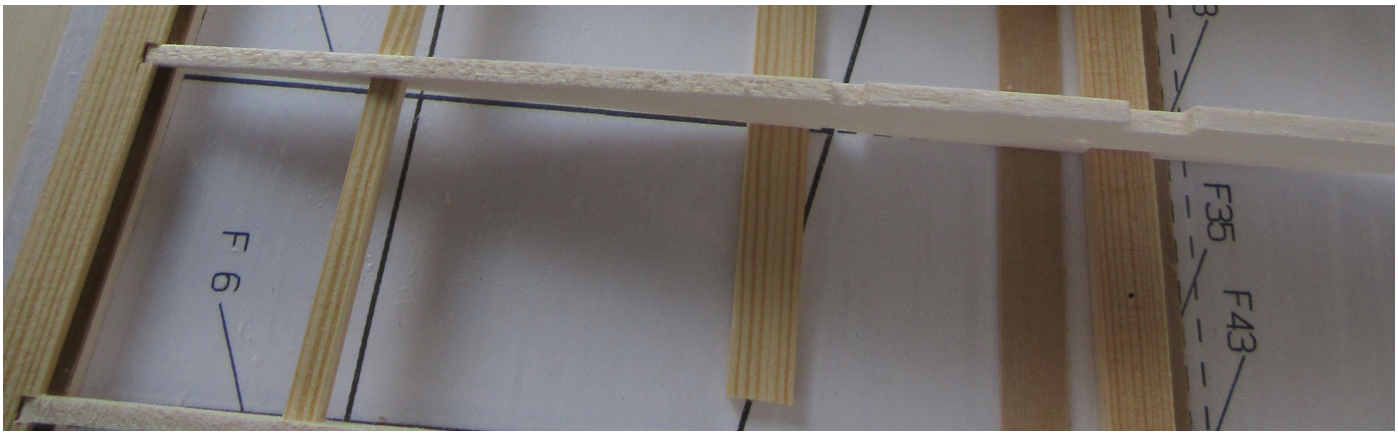
8: Lifted off the building jig.

Basic Wing Construction

In the meantime Adri had milled all the wingribs. The wings are traditionally constructed with balsa ribs and a built up spruce main spar with 3mm balsa

web plates. The main spar is constructed at the root of three layers of 2x10mm spruce top and bottom, decreasing to one layer top and bottom at the tip. Rob advised a wing joiner 10mm round steel in aluminium tubes in the fuselage and the wing. The dihedral is determined by the position of the holes for the tube in the ribs. Later I used a carbon rod, which ultimately proved not to be a good choice.







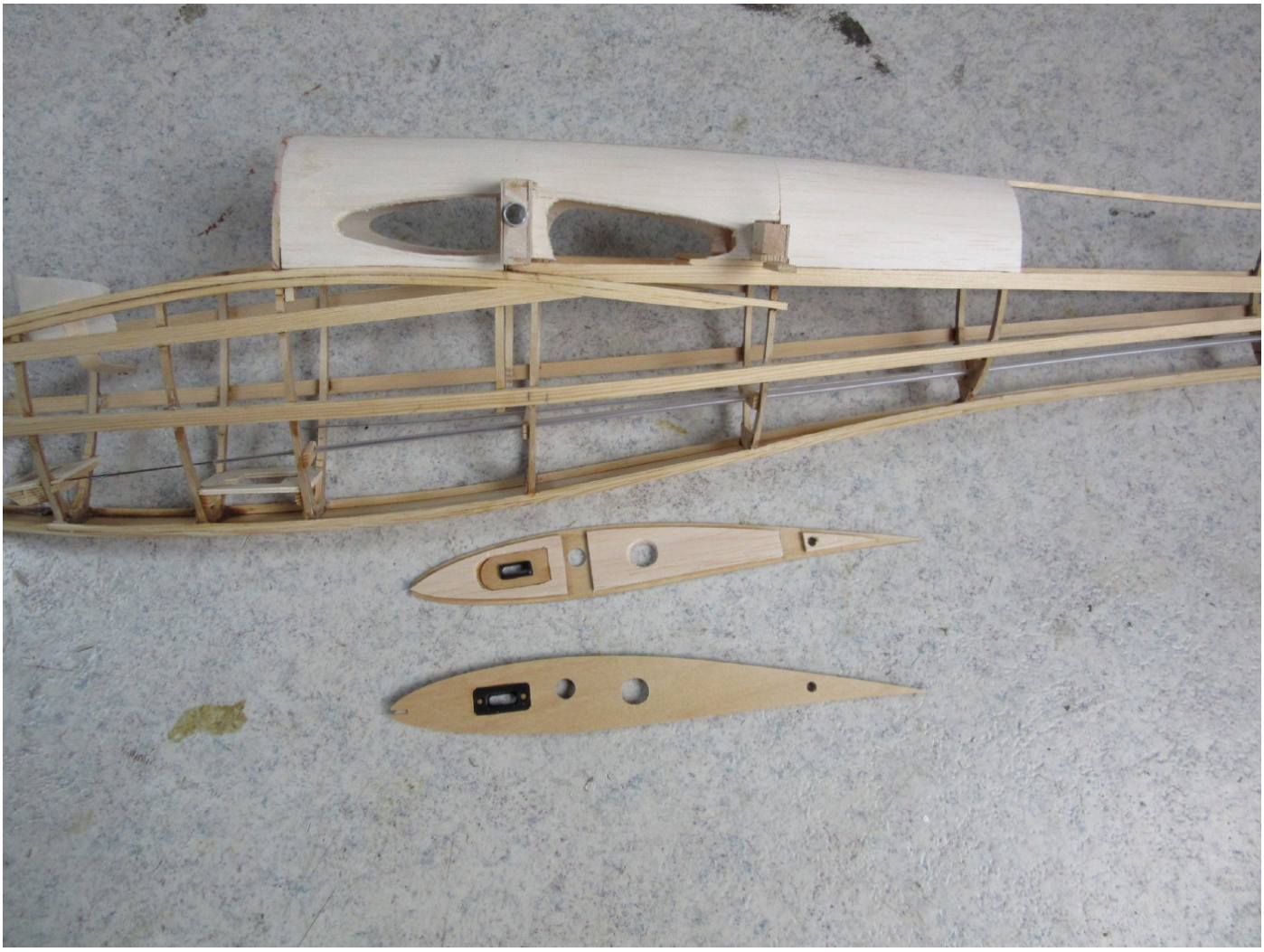
9 (left): Basic structure of the wing. | **10** (right): Balsa filling parts with ply gusset plates.

Continuing with the Fuselage Construction

After finishing the basic structure of the wings, I could proceed with the fuselage. Because the stringers are not inserted in the frames, I filled the

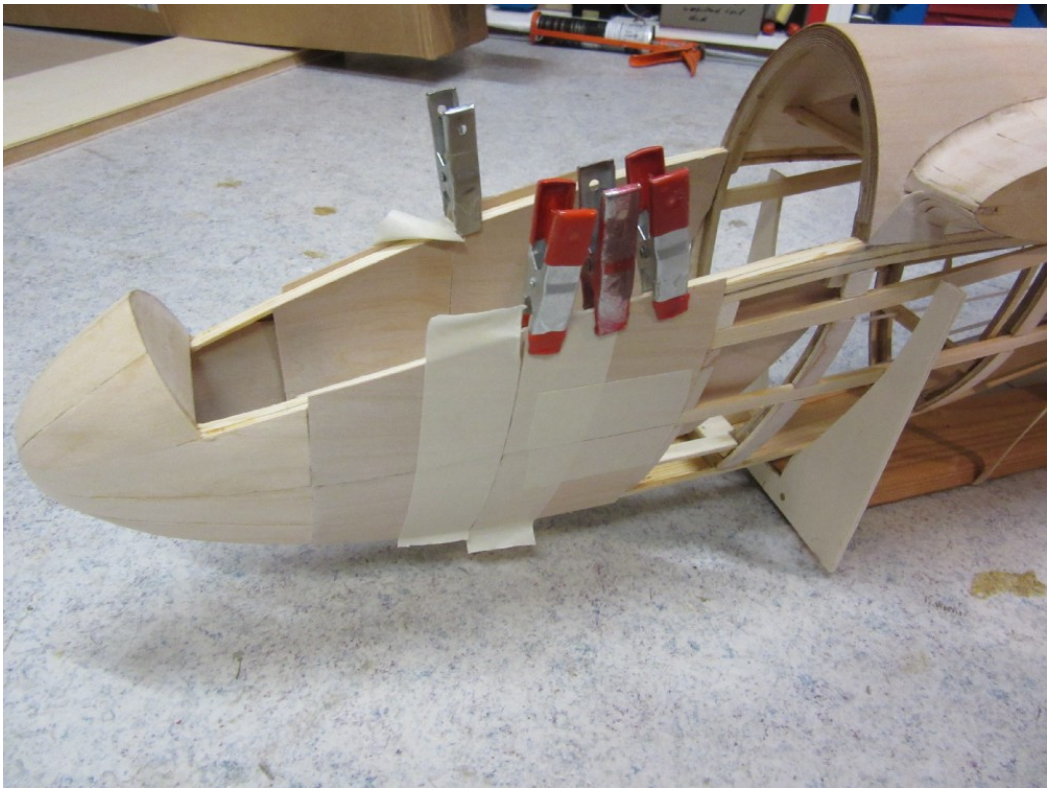
frames out with strips of balsa with plywood strips on top (which are at the same time the gusset plates for the butt joints of the ply sheeting). I used substantial stringers (3x8mm), for fear of damage, I had the impression that plywood is very stiff, but fragile.

I then made preparations for the wing fairing. I made a underlayment from 3mm balsa pieces, over which I could glue the plywood (11). Now I could start sheeting the fuselage. Because the separate layers of the 0.6mm plywood are only 0.2 mm thick, there is very little room for sanding, so it has to be built accurately.



11: Balsa under structure to support the fairing.

I planned to glue the panels with thick super glue. Before gluing I put masking tape along the perimeter on the outside of the plywood panels to avoid glue getting on, because that would spoil the staining of the plywood. I also made stops from pins on the stringers. The cyano gives about 10 seconds for corrections before it is stuck, the pins make it easier to get the panel in the right place in one go. I put glue on the frames and stringers and put the panel on, pressed it on one side with a 6x6mm spruce batten wrapped in non-adhering tape, waited a couple of seconds and wrapped the panel over the frames to the other side while pressing it. Very soon the glue sets (12). With this technique I sheeted the whole fuselage, except the nose and the wing/hull fairing.

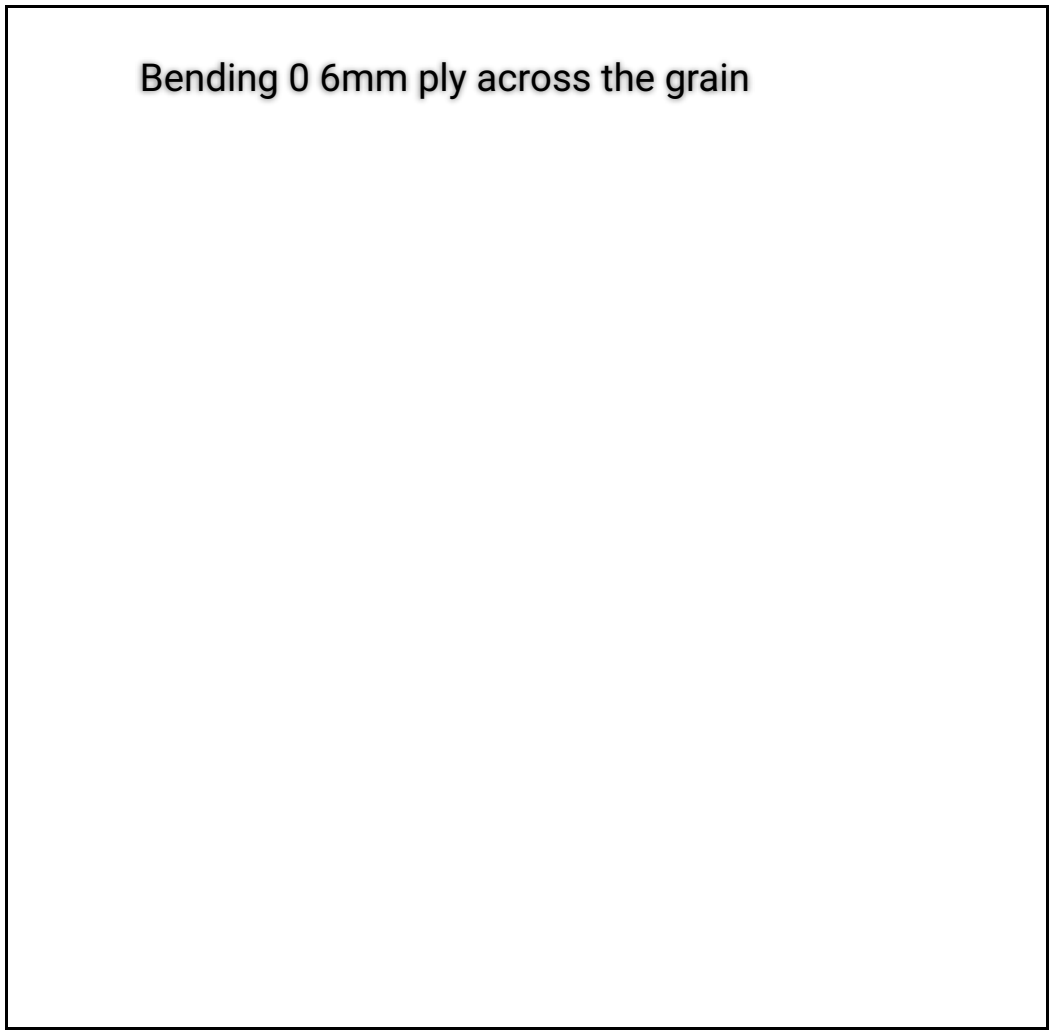


12: Gluing panels in the cockpit area.

The nose is very prominent, mistakes in sheeting here show off! After much thought and consultation with fellow builders, I chose veneer for the sheeting of the nose cone. It can be sanded without getting through the layers as with ply.

I started making a supporting structure from several layers of 10mm balsa sheet (hollowed out for the ballast), sanded it into shape, trying to approach the shape of the real plane from the photos. Veneer is, like ply, only bendable in one direction, even when it is soaked. First I sanded the round shape of the fuselage conical to a 10-angle. Then each facet made a curve to the nose. Because the balsa nose cone is built up from layers, you get nice reference lines, about where the pencil lines start is the 'turning point' for bending (13). Once I had that figured out (I had to redo that about five times), I glued the soaked veneer on quite easily (14).

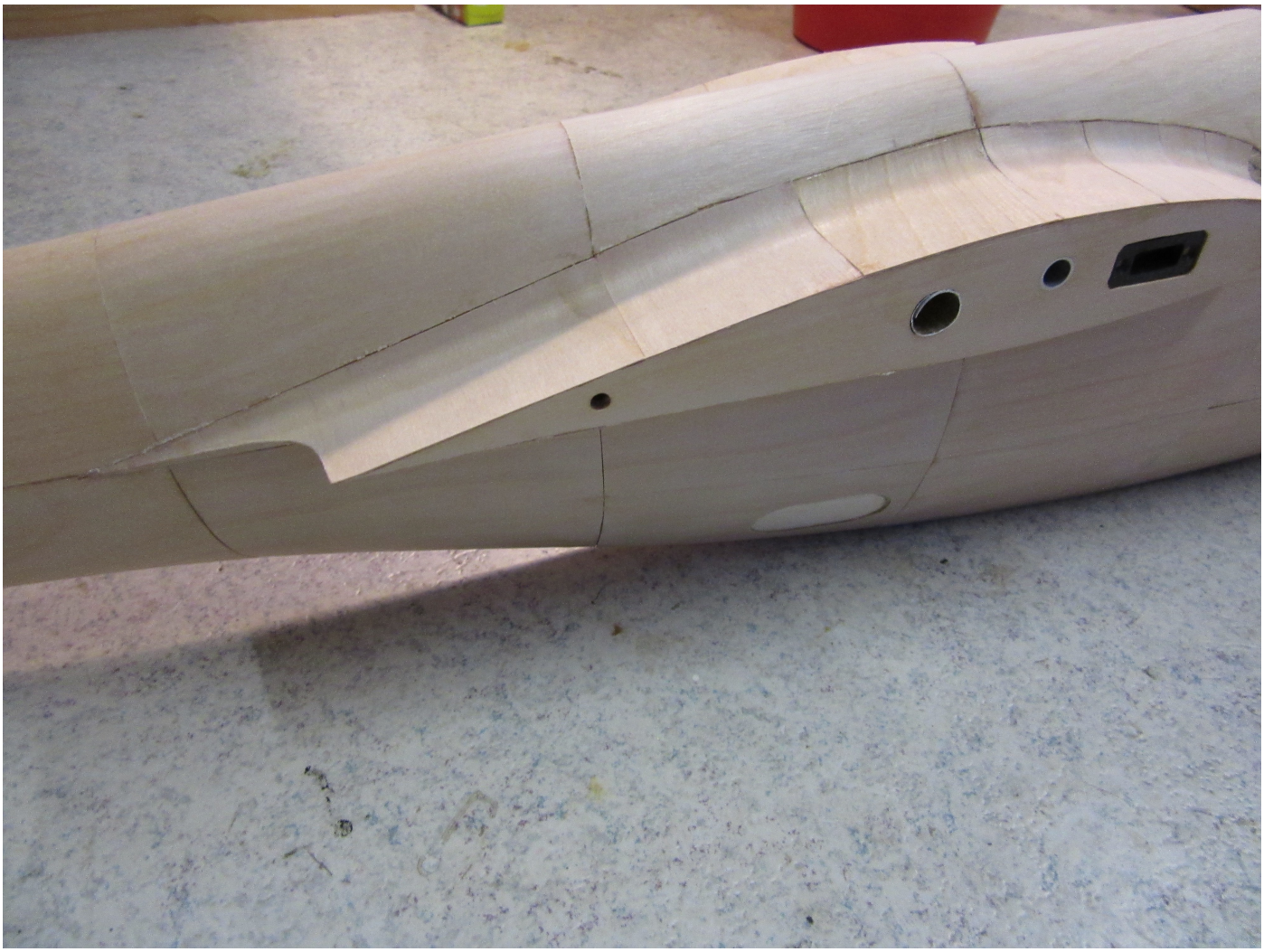
The fuselage/wing fairing was another story. First I tried veneer, then plywood, then started all over again (15). I now tried to pre-bend the plywood; laid a strip of plywood with the grain across over an aluminium angle profile, pressed it with clamps and a aluminium tube and then poured boiling water over it.



16: Bending 0.6mm Ply across the Grain

To my joy the ply immediately bent easily. I made a short video from it (16).

After drying and cutting I had some nice pre-bent pieces with which I built the fairing (17). These pre-bent pieces of plywood fitted in nicely, and I glued them to the balsa underlayment (18, 19, 20, 21). With the fuselage was now roughly finished, I went on with the wings.



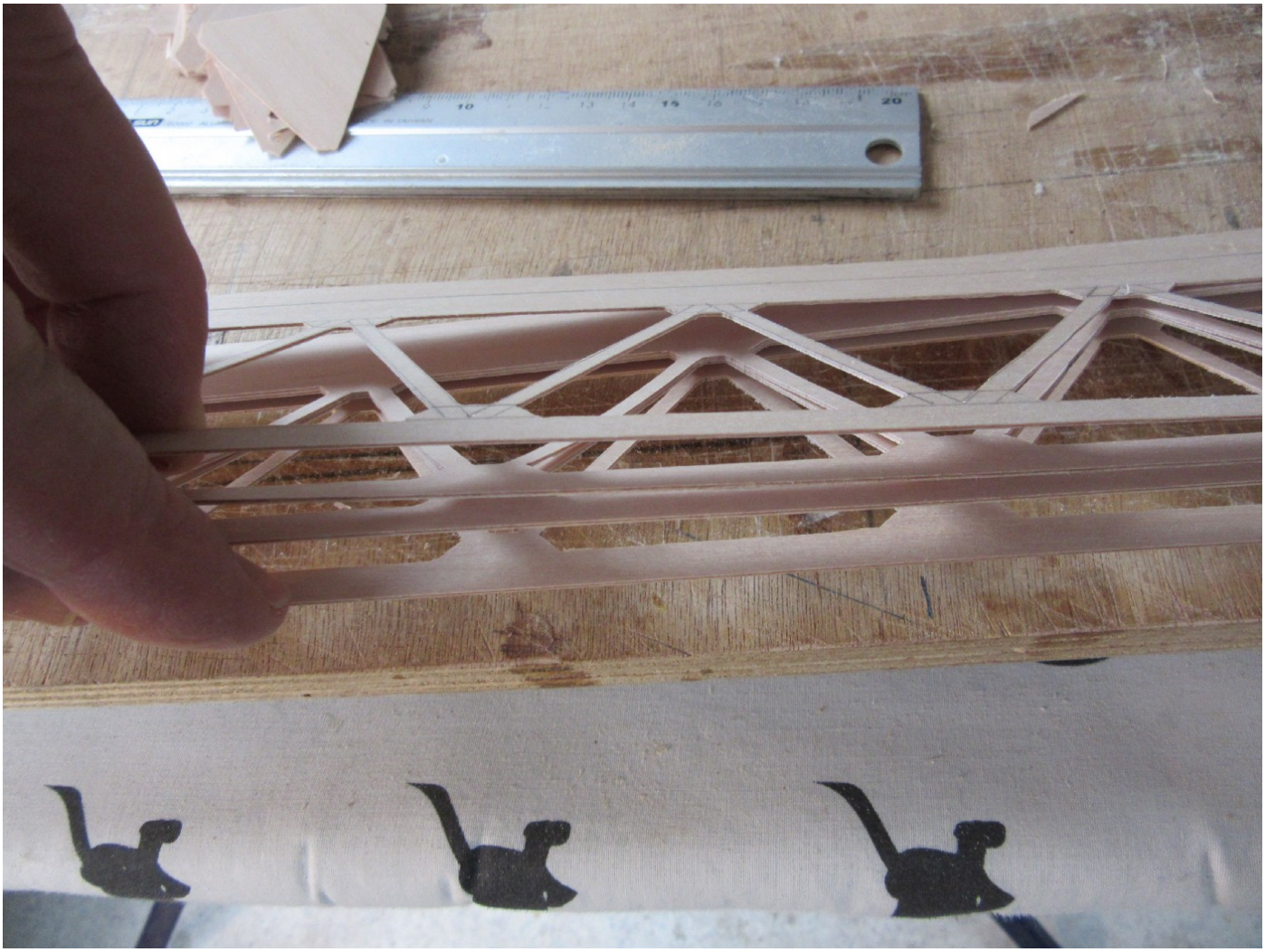


17 (top left), **18** (top centre): Bending ply across the grain. | **19** (top right): Glued in place. | **20** (bottom left): Fairing completed. | **21** (bottom right): Fuselage roughly finished.

Wings

Here too were some challenges: the ply sheeting (again) and the ailerons with their controls. First I had to build the ailerons. The real ones were completely built up with diagonal ribs and a lot of gusset plates (30 per side, 120 in total). I tried to make it easier on myself by making top and bottom panels of both ailerons in one go. I started by drawing the aileron with a pencil on an oversized piece of 0.6mm plywood. Outside the perimeter I glued another three layers of 0.6mm plywood on it with some dots of glue, so that when I cut them out, I would have four separate pieces left. This is

nice, one cut and you have finished all the components of the aileron in one go (22).



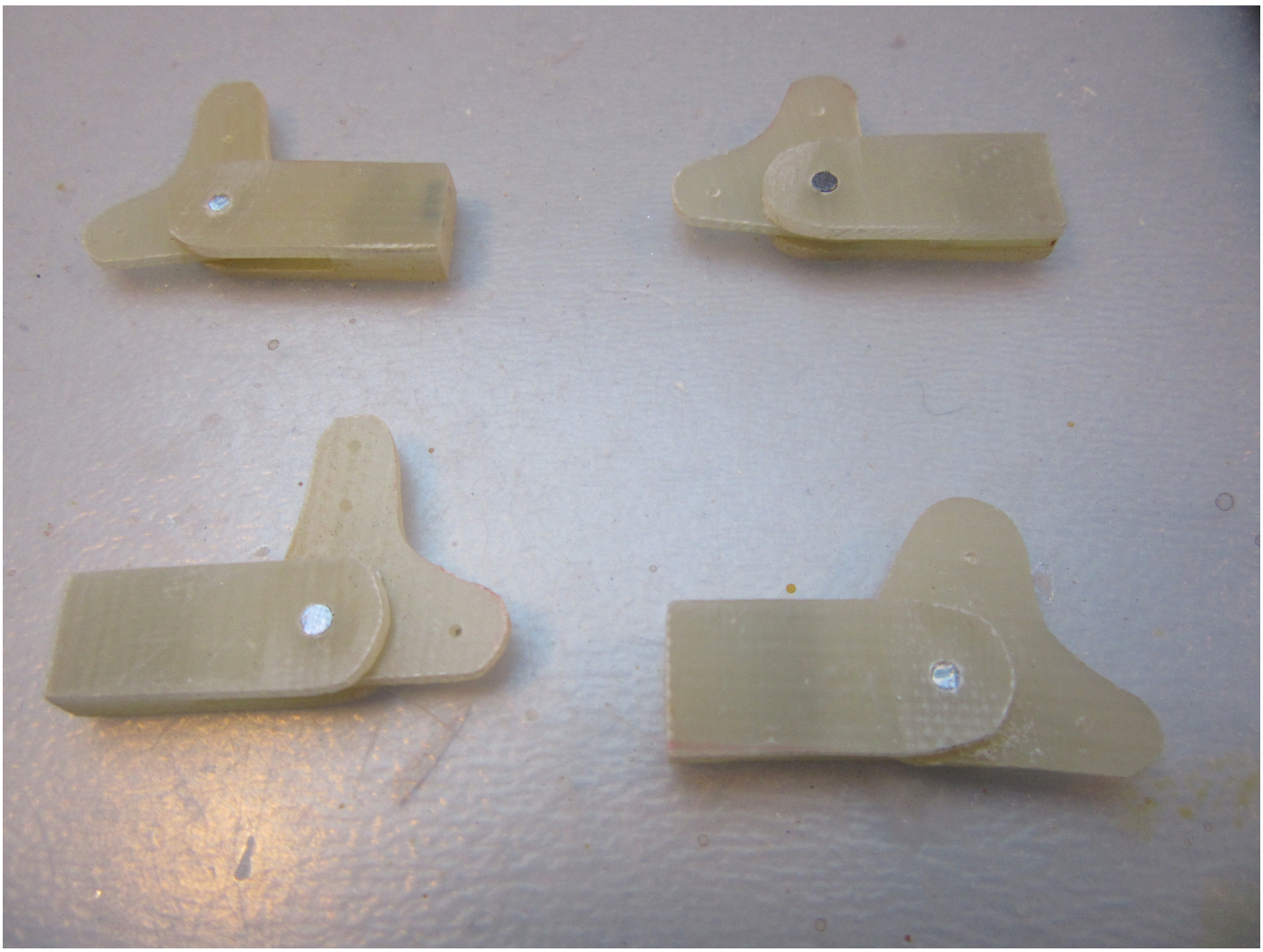
22: Parts for the ailerons.

The rest of the aileron construction is simple: a spruce nose spar and balsa strips as ribs. With a flat sanding block I sanded the top even and glued on the top panel. For the hinges I found a solution to keep them completely out of sight. By the way, when my glider was finished I came across a photo of the rudder of the big one where the hinges were visible. I made the hinges from 0.6mm thick brass strip which I had lying around, folded over 0.8mm steel wire, tightened and soldered. Per aileron five hinges that I 'threaded' on a 0.8mm steel wire (23). I could mount the ailerons after the parts were

painted and covered with *Diacov* by putting a long piece of 0.8mm straight steel wire through all the hinges in one go. I test fitted the aileron, poked the hinges through the trailing edge, unfolded and glued them. You can just see the rebate in the trailing edge where the 0.6mm plywood strip had to be glued in, so that there was no longer a gap between the wing and the aileron.





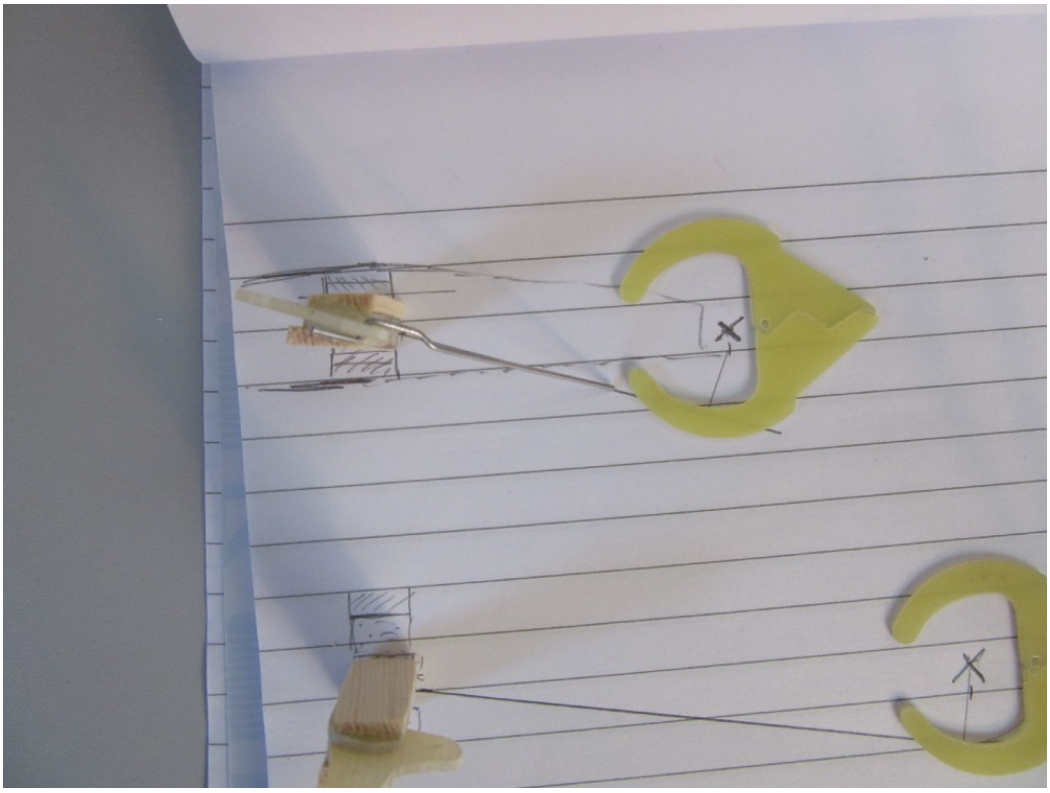


23 (left): Aileron hinges. | **24** (right): Rockers for aileron actuation.

Actuation of the Ailerons

In the real plane the ailerons were operated with a couple of cables attached to two large half circle segments per aileron. I think this was to avoid torsion and also to make adjusting the ailerons up or down during flight possible. On

some five metre models the ailerons are also actuated with cables, but on this scale I did not dare to do that. I chose to operate them with two coupled rockers and push/pull rods under the wing, using the bottom semi-circular prototypical segments as rudder horns (24).

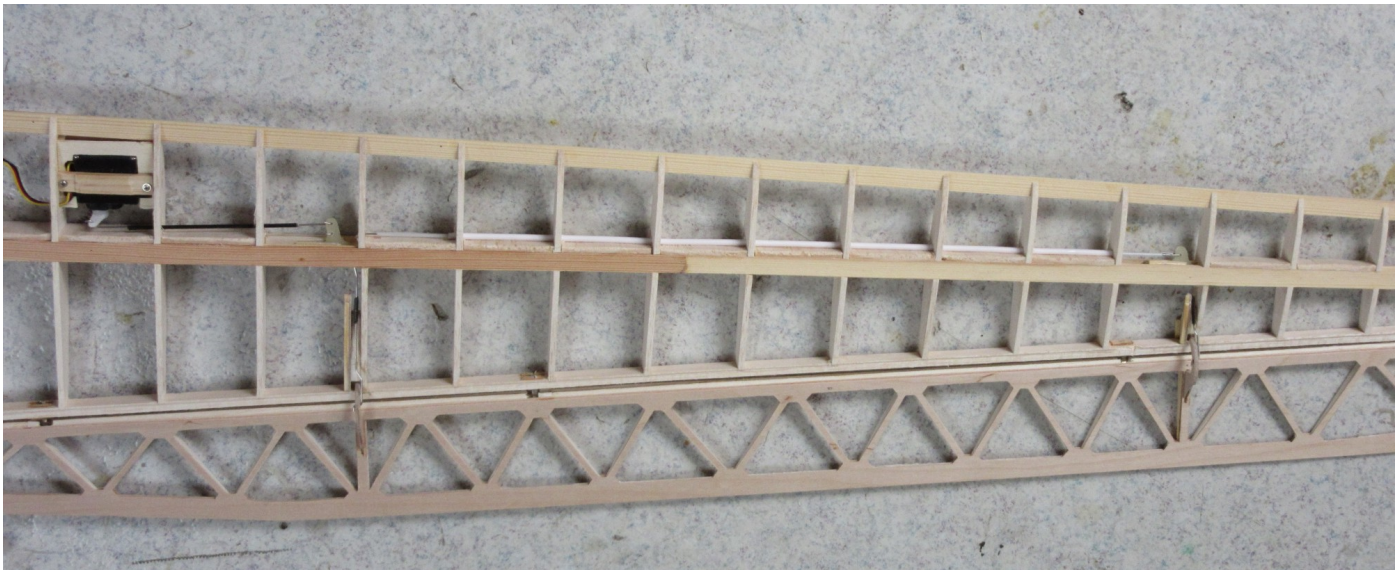


25: Rudder horns ailerons.

Fortunately, Adri still had the CNC files of these segments of my 1/8th scale *Nemere* and he could enlarge them easily. He then milled these segments from 1mm epoxy plate (25). With a jigsaw I hand-cut rockers from 1mm epoxy plate, clamped the four rockers together and drilled 2mm holes for the shaft and 1mm holes for the push/pull rods with a column drill to get identical throws.

The inner and outer rocker arms were connected with a 1mm push/pull rod. From the inner rocker arm another push/pull rod goes to the servo, which is then located even further to the centre of the wing. A picture may explain more than my text: the whole aileron control can be seen on this photo (26).

The ailerons suddenly become very stiff in terms of torsion, not because of the internal construction, but via the coupled control.



26: Aileron actuation in one picture seen from below.

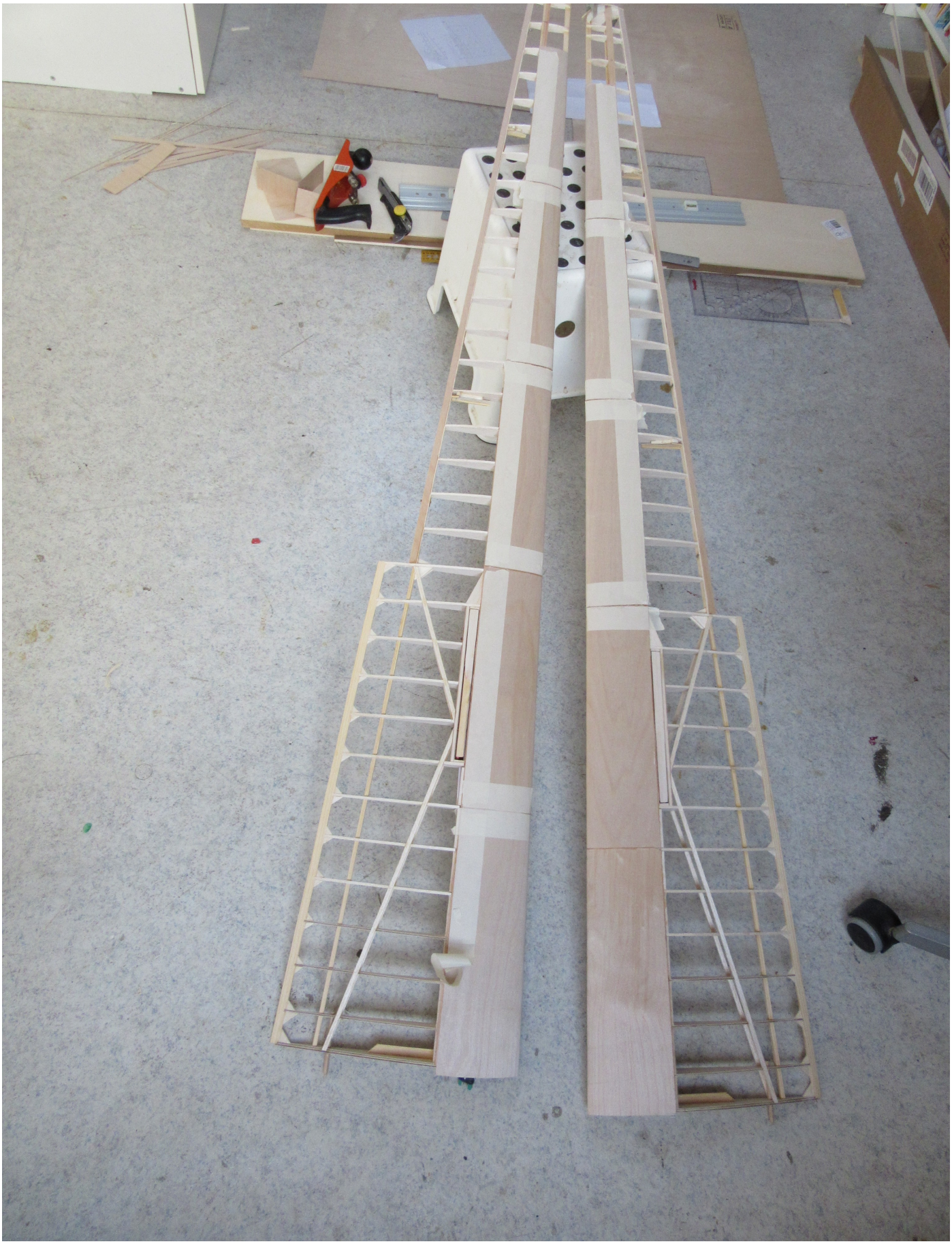
On to the sheeting of the wing. In full size the sheets were 150cm long, on scale giving about 25cm panels. I chose to make scarfed joints here. I made a template of thick paper which I transferred to plywood. I sanded one side at an angle of about 1:10. Marked where the LE sharp bend would come, bended it a little and poured boiling water through it.



27: Bending 0.6mm Aircraft Plywood

The plywood becomes soft instantly (27)! A few clamps on it and let it dry (28). Then I fitted a panel and adjusted it. I drilled two 1mm holes for 'fit pins' so that I could push the panel into its exact place in one go. I put tape on the panels, applied thick super glue to the spars, ribs and the previous panel (30). I pushed the panel along the pins onto the spar and pressed it with a batten, same as with the fuselage. Then I had to wait a few seconds until the glue had set, pressed it over the ribs and onto the other spar in one flowing movement. Putting these panels on is quite stressful! Unfortunately, gluing a panel sometimes goes wrong and, annoying as it is, it is best to pull it off right away. I hesitated with one panel and I still regret that (31, 32).









28 (top left): Bending plywood with boiling water. | **29** (top centre): Drying of pre-bend panels. | **30** (top right):

Panel ready for gluing. **31, 32** (bottom): Wings, sheeted.

Finishing

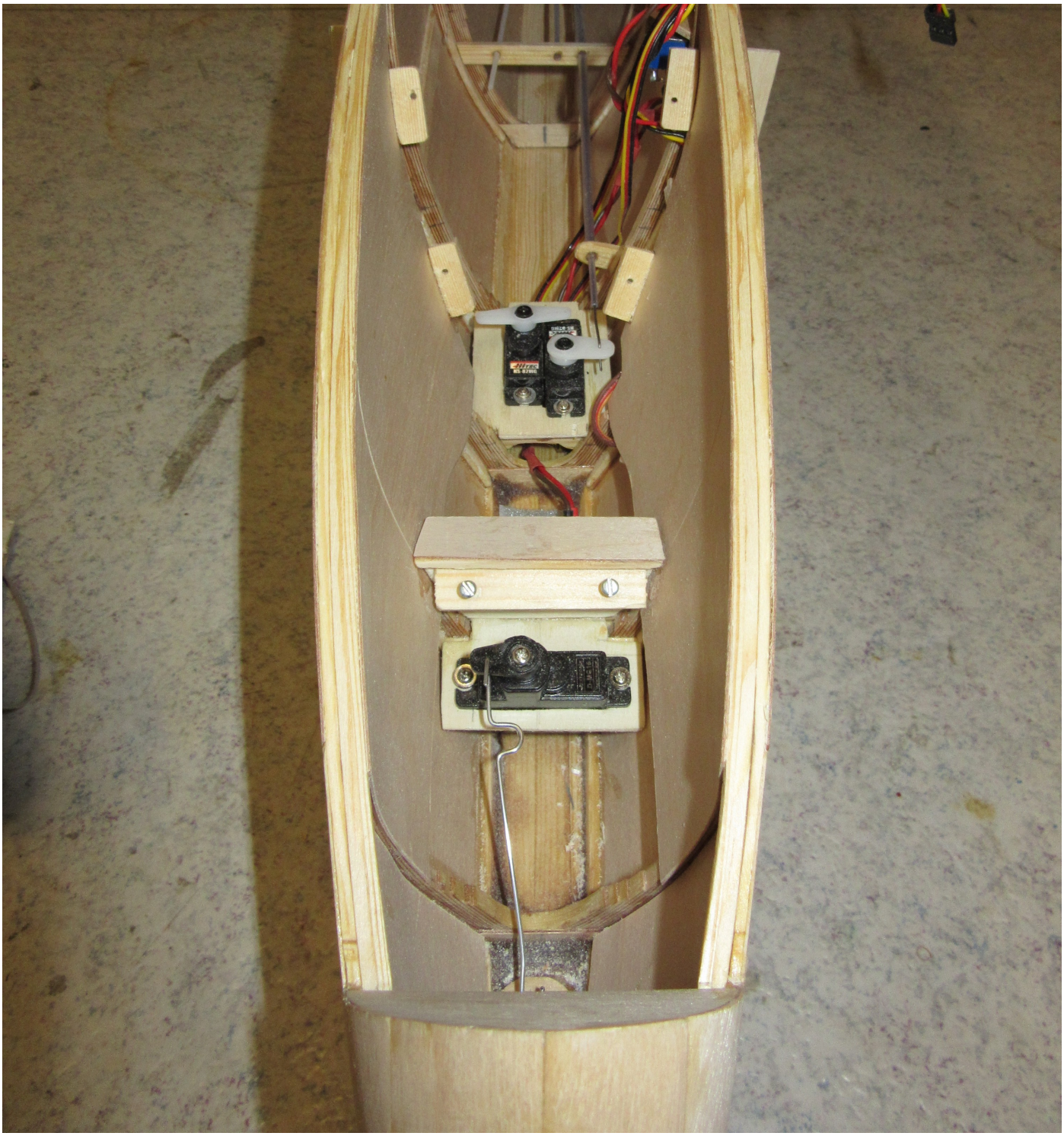
I was worried about the finishing. I had no experience with colouring plywood and with the colouring of my first balsa *Nemere* the result was not fantastic. After many experiments on scrap plywood, I finally coloured the plywood with strongly diluted bister (obtainable from artist materials shops). It's a water solvable pigment. Then I covered the wings and empennage with *Diacov*. Thereafter I applied two layers of cellulose dope with 'porenfüller' (a filler) and a rich layer of PU yacht varnish over the plywood. The colour was quite light, it could have been a bit darker, but I imagined the original plane probably wasn't that dark when leaving the workshop either.

Cockpit and Interior

During the building process I had anticipated a scale interior. The servos and battery pack just fitted under the seat and floor (33). Also the cockpit canopy is a very prominent feature of the design. It was a complicated structure, I think it was not possible to make a bubble canopy at that time. They were all bended and screwed Perspex panels, I presume.

For my scale canopy I laminated the frames to have the scale 'look' and a vacuum formed canopy. I made a balsa mould, based on the dimensions of the fuselage (34).



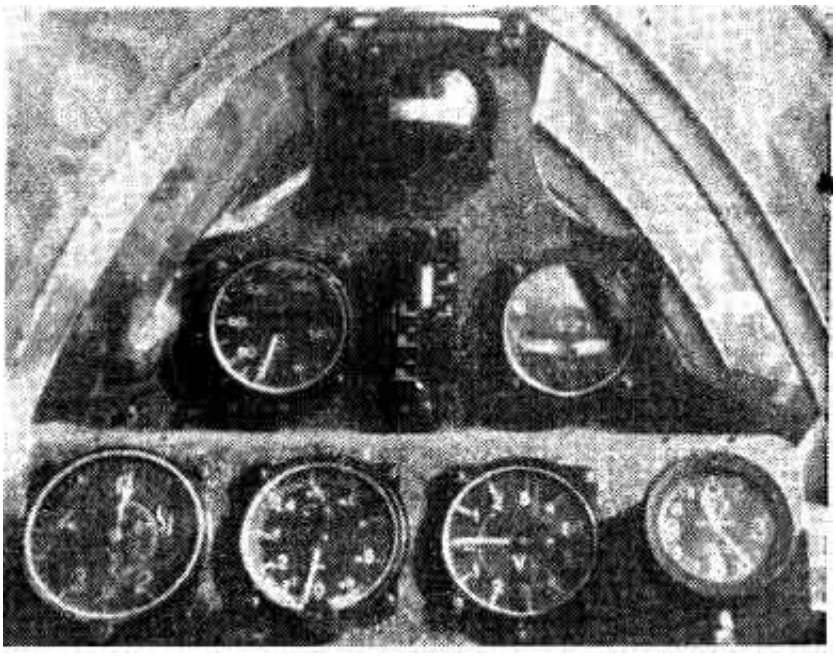


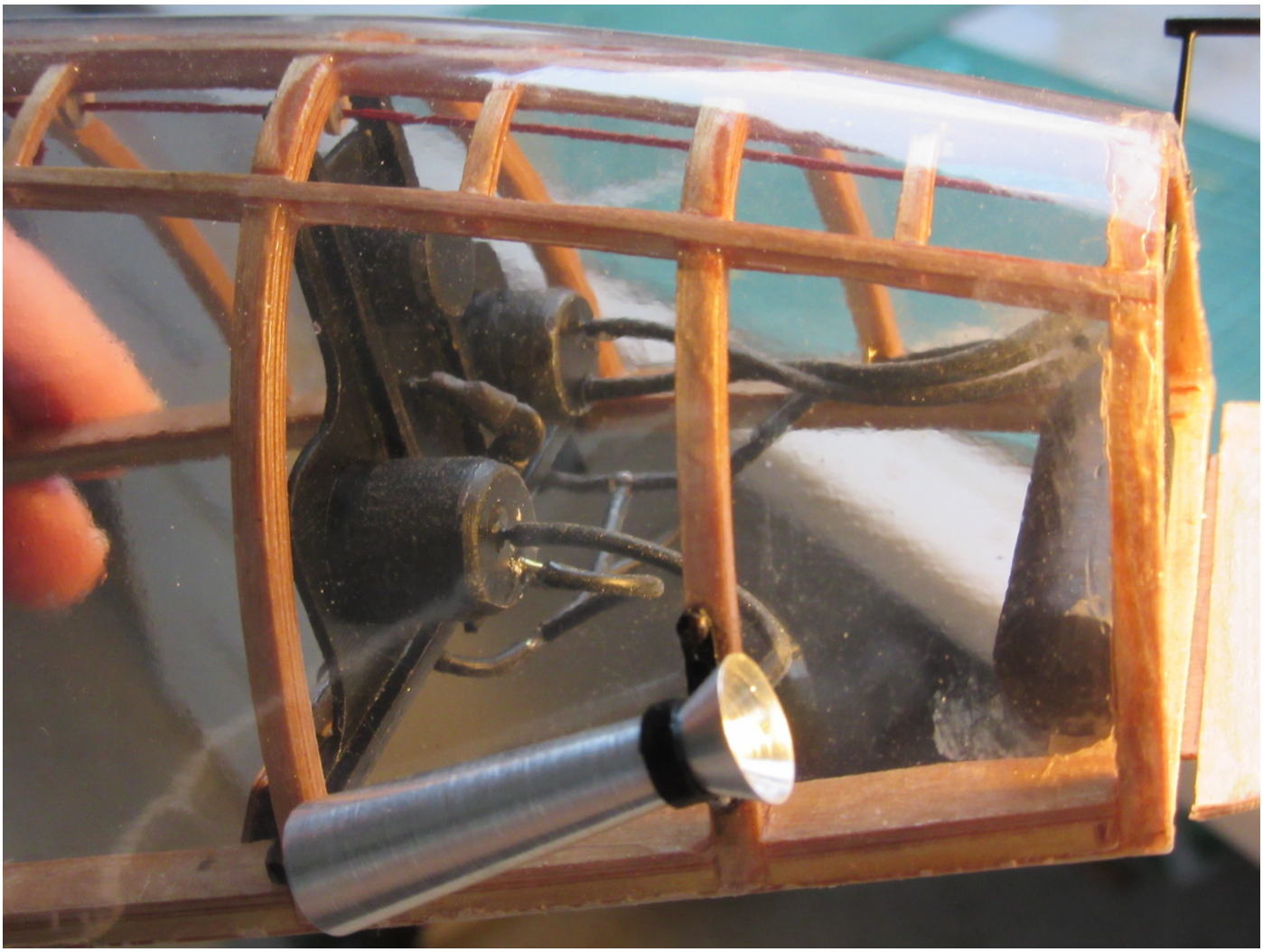


33 (left): The RC components under the cockpit floor. **34** (bottom right): All the woodwork of the canopy finished.

Instrument Panel

In the *Nemere*, all instruments are mounted in the canopy itself and both front and rear are in plain view (35). There was not much documentation about it. Searching for instruments from that time, I came across the Askania catalogue from 1937, which listed instruments for gliders, including the way they were connected to the venturi and pitot tube. The venturi was a kind of large horn used to generate vacuum to drive the gyro in the turn indicator (36).





35 (left): The original Nemere instrument panel. | **36** (right): Scale instruments and tubing.

I bought an instrument set from a German WWII fighter which I thought came pretty close. When you look very, very carefully (and only then!) you can see that the maximum indicated speed (37) is 700km/h! This kit contains only the fronts of the instruments and in the *Nemere* you also can see the rear of them. I had to create the housings. I was lucky, I had just bought an old Unimat (small lathe) and this was a nice job to practice! I turned the housings from the plastic handle of a disposable brush for the thermos bottle of the variometer. For the tubing I used black silicon insulation hose from the lead of a small old lipo battery. The venturi I turned from three pieces of aluminium from an old door handle.



37: Components of the instrument panel.

Pilot

Then, of course, I needed a pilot. I started with the head, the most difficult part I thought. I tried to remodel the head of Lajos Rotter (the *Nemere*'s designer and pilot) and made it from *Super Sculpey*, a kind of clay that can be baked at 140C and has more-or-less skin colour. I learned a lot from the *Learn to Sculpt* tutorial by Josh Foreman which you can find in *Resources*, below.



38: Lajos Rotter's likeness made of Super Sculpey.

On vacation in a holiday cottage I was playing around with *Super Sculpey* and finally I got something that looked like a head (38). I baked it in the oven (140C) and I milled quite a lot of clay out to reduce the weight. It's about 80g.

I made a basic figure from balsa with solid 1mm copper wire in the elbow, knee and neck joints. The shoulder and hip were attached with elastic material, so that the pilot could be manoeuvred into the cockpit. My sister made clothing based on patterns borrowed from an old action figure that

once belonged to my son. The balsa feet were painted twice with cellulose dope with filler and then with black acrylic, imitating black boots. He got a pair of sunglasses from bent hard brass wire with lenses cut from a pair of real Polaroid sunglasses (39).



39: Lajos Rotter, completed.

Here he is in full glory, quite a tough type, but I suppose he had to be in those days!

To finish things off I made safety belts from flat elastic band, so that they're always tight! From 0.9mm hard brass wire I made buckles for the safety belts. The central pin is from 2mm iron, soldered in a base plate from 0.8mm nickel silver. In the pin I drilled a 0.5mm hole in which a 0.3mm hard brass wire bent clip secured it all. The other buckles I bent and soldered also from of 0.9mm hard brass (40). Adri cut out the registration and the Olympic rings (41), very fiddly! That finished the *Nemere*, I had to fly it now!





40 (left): Safety belts from elastic material. **41** (right): Lajos Rotter just fits.

Into the Air

We started with hand tosses, Sjoerd gave the *Nemere* a powerful toss and it glided nicely (42).



42: Sjoerd giving a mighty hand toss.

Than it was time for a tow by Rob's Piper, an exciting moment. Seeing the plane respond nicely at the controls being towed was a great relief! It flew just great, easy in the turns, not much trimming with the spoilers (43, 44, 45).

It's a pure joy to see it calmly circling above your head. The model is responding very well on the controls. Flying scale models is a mixture of feelings, one is satisfaction and the other is fear of crashes. I learned a lot of it! Raymond made this nice video of the project (46).

46: 'Nemere' by Raymond Esveldt.

I'm grateful to Adri for all the milling work, to Rob for the drawing work and towing, to Claude and the *Retroplane* forum for all the inspiration, to Sjoerd for the great first hand toss and to my sister Hans for the pilot's clothing.

Epilogue

I flew the *Nemere* at *Retroplane 2016*, which was held in the Italian Alps. As a 'lowlander' I find it very exciting to fly in high mountain areas. Due to numerous factors I flew mostly my 1/8th scale *Nemere* at *Retroplane 2016*. Magnificent scenery, but a lack of wind on Sunday. On Sunday I flew the 1/6th scale *Nemere* and made a hard 'landing' out of sight. No damage to the plane, but the carbon wing joiner was crushed at both sides of the fuselage. With a new wing joiner I made a lot of flights back in the Netherlands and I got used to flying it.

On another tow meeting the plane was a bit stressed after the towline had hooked accidentally around the bungee hook, so I could not release. The next flight the wings spontaneously broke off at about 200m altitude. The wings, still connected with the retaining spring, also wiped off the horizontal stabiliser before separating completely, so the fuselage came down like an arrow. The flying field was quite a wet meadow with high grass. To my utter disbelief the fuselage was smashed up halfway of the cockpit, and only the feet of the pilot. I had already written off the plane in my head, but then realised it was repairable, so I went searching for the missing wings and stabilizer. The grass was high, so with help of others it took more than two

hours to find all the bits.

In fact, the tail boom of my *Nemere* was much too strong, it really should not be able to survive an accident like this. So I can construct the tailboom of a future plane lighter, with less ballast too. It's a shame that the plane I'm working on now is almost finished, so this is a lesson for the plane after that. I also ended up with a distrust for round carbon wing joiners. In a relatively short time I rebuilt the nose and canopy and got the plane flying again (47, 48, 49, 50, 51). Now I use a steel wing joiner.

After the repaired it, I flew the *Nemere* many times and it is behaving great, a very satisfying project!

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Resources

- Additional pictures and description (in English) can be found on the *Retroplane* forum
- Information on the full scale *Nemere* is being built currently can be found at *Nemere Projekt* which provided much more info than I had building my glider.
- *Sculpey 101 Class 1: Tutorial on How to Sculpt a Head with Polymer Clay* by Josh Foreman

All the photos of the build were taken by the author (unless otherwise noted). Flying pictures by Rob ten Hove and Raymond Esveldt. 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****.*

So You Want to Be a Composite RC Sailplane Manufacturer?

Part II: Inside the Devil's Fireplace

James Hammond



A nice shiny cherry Vector II awaits another launch. (image: Steve Dorling)

In this second of a new series of articles (see Resources*, below, for the first part) I am going to go on with my story, as it transpired, and use my experiences to lead you along the crooked path and across the many pitfalls that you may encounter. They are all part and parcel of the frustrating process of realising your own moulded glider. — JH*

1998 — The First Obstruction

If you remember in the first instalment of this gripping, wildly exciting, edge-of-the-seat tale, I'd decided to make my own fully moulded model; I was looking for a suitable partner, and I thought I'd found one. Well, that all went west; it didn't work out at all how I had hoped.

Out of the four European moulded glider manufacturers I got replies from, three said that they had never heard of me, so they weren't interested, and one looked at least to have some promise as they asked for a sketch. A few software compatibility problems ensued as the company in question — located in (just) post-communist Eastern Europe — had a version of Windows that was probably issued when the predominant European language was Latin. But we soon had that sorted, and the dialogue progressed quickly to how much it was going to cost and what business model was to be used. I was teetering, white knuckling it on the edge of my chair to say the least.



The late, great Steve Dorling heaves his second Vector II off The Great Orme, Wales. (image: Steve Dorling)

After a good deal of — in hindsight — utterly pointless dialogue exchange it

was apparent that the dream I had was to come to naught. In the *OEM* business model, I would have paid about six thousand euros for CNC work and production mould manufacture, with a transfer price of about six hundred euros per airframe — which, even today for that model would have been far too much. So that was scuppered. Or the second, *Royalty* business model, whereby I sign over the design and all intellectual property rights, and the manufacturer — now design owner — would pay me a royalty of around 10 euros per model sold. Of course, they swore on a stack of bibles and several aged relatives that they would be very honest in letting me know how many models had been made, and how they'd be sure to pay the royalties regularly.

Really? Even I was not that naïve. Damn — my McLaren was retreating again. Yep, I was forced to admit that I was listening to the proverbial fat lady sing — and I didn't even know the language. Without doubt the tin hat was securely on the commercial idea. Again. Or so I thought.

Takeaways:

Contact several potential manufacturers, not just one or two.

Have a good idea which business partner best suits you — are they making similar models already?

Have a good idea beforehand which business model will best suit you.

If the manufacturer responds, then carefully consider their proposals.

Try to pre-qualify any potential manufacturer as much as possible by asking questions first by email.

A Beautiful Golden Beam of Light

For a while I was doing as well as could be expected. I was in full gepissedoff, uber-sulking mode and ready to heave all of my toys out of the stroller at the slightest provocation. My carefully laid plans had been dashed to smithereens on the sharp rocks of reality, and possibly over-ambition. So, I put the entire idea to sleep, sternly told myself that it wasn't to be, gritted my teeth and cancelled the McLaren 720. Then I made a few more models for myself and my friends and concentrated on generally enjoying the flying.

Am I one to give up so easily? Nah! Soon it was back on with the chase! The search around the planet began. And then?

One crystal clear day, a beautiful golden beam of light shone down from the heavens. A model shop owner friend of mine told me that he had done business with a couple of companies in China, and he had heard from one of them that there was a firm somewhere in that yawning vastness, that had started up making moulded models, possibly for a year or more. Could it be? Damn, that was like offering the equivalent of free crack cocaine to an addict. Hooked again, I'm afraid.



LP Hao's yellow Vector II — notice the missing rudder. (image: LP Hao)

China Beckons

I soon found who the aforesaid startup was: *Great Huge Flying Raptor Model Enterprises* — or something akin to that — and where they were: Henan province, China. And so, I contacted them or tried to. After a rather confusing stream of duck soup emails and equally befuddling telephone calls by SWMBO to the owner's assistant, no good information was forthcoming. So being the tenacious cove I am, I decided to visit the factory for myself. Sounds like quite a commitment but at the time it wasn't, due to the fact that I was over in China every couple of months for my engineering consulting business anyway. A visit to the factory was really just a side trip.

Although still highly skeptical but ready to be surprised — pleasantly, I

hoped, I arrived at Jinan 'International' Airport, one sunny but cool autumn morning after a flight from Shanghai. Then, after quickly completing the formalities — no baggage to collect, only a small backpack as it was best to travel light in those days, I sauntered out to the greeting area to be met by a crowded sea of identically smiling faces. I was waved at and then picked up easily, me being the only foreign face emerging, further aided by a sign with my picture and "JMAESHAMOND MODEL" (sic) emblazoned on it. *Wot, me*? I remember thinking.



Blast-from-the-past: me in Taiwan in September 1991 with a Greengrass/Hammond MOM Sigma Racer. Dayum — what a skinny handsome dude! Note the elephant grass — try and find your model in that stuff — its six feet high down the slope. (image: James Hammond)

We were soon speeding along the wide roadway towards the city of Jinan at a fine clip, in our limousine — an old and dilapidated van that had an exhaust leak which made it sound like a couple of badly adjusted through-pipe Harleys. My compadres, who turned out to be the owner and his able assistant, both managed to smile and grinned reassuringly throughout the rather nerve-shredding journey. I'm not sure it helped.

GHFRME Co. Ltd. — The Final Frontier

Within a half hour we had swerved off the high-speed carriageway and were blaring through the countryside at the deafening and to me dangerous pace we had been doing on the highway. My companions did not seem worried at all, so I reassured myself that the van was actually self-announcing and that anyone who was not actually stone deaf would be adequately warned of its imminent arrival — and get out of the way. After a mercifully short time, the van careened into an unpaved parking lot surrounded by an eclectic jumble of low buildings of various sizes, ages, and persuasions. I later found out that it had originally been a pig farm. A discouraging sign was that I noticed a lot of small offcuts of carbon and glass cloth that had been blown into corners by the wind — not an encouraging sign.

Later, seated in the second floor *VIP Meeting Room* — according to the sign on the door — having completely forgotten to inform them I could actually speak and understand Mandarin, I managed to filter out from the broad Henan-accented discourse, that my hosts were experiencing a bit of conflict as to whether or not to allow me to peruse the top-secret facility. The factory manager was forecasting a wide-ranging fallout of doom and gloom that would certainly ensue when I had cunningly gleaned all their production secrets and transferred them to party or parties unknown. You can't trust these espionage-trained foreign devils, you know. In the end common sense prevailed, and after a smiling announcement in English, off we went traipsing round the connected buildings that formed the work spaces.

Le Tour de Factory (Après Moi Le Deluge)

I have to say that my initial impression of the place was about what I had expected, or at least imagined — a series of average-sized mildly untidy and grubby rooms arranged with working surfaces and equipment according to

function: cutting, painting, layups, curing, finishing, packing and storage. The curing *room* — no, it was not just an oven, it was a whole damn room — in particular would not have been out of place as an important feature of Dante's inferno. Three open braziers filled with yellow-hot charcoal dominated a space that was otherwise occupied by angle iron push trolleys, but I could not see any actual curing going on, though I did not comment on that. To say it was hot in there was a gross understatement. It was like the Devil's fireplace and had to be close to 150 degrees — skin burning heat. So much for temperature-controlled curing.



A Vector II, most likely at The Slot near San Francisco. (image: [tbd])

The layup room was actually more interesting as a three metre DG 600 scale sailplane layup was being conducted by a couple of young guys — in fact the only two workers I saw, who were working with the only mould set I saw. After a few minutes of observation, it soon became apparent that these guys had only the most rudimentary idea of how this process should be conducted. The moulds weren't much good due to very loose alignment methods, the halves were over-polished to the extent of losing sharp edges,

and the numerous mistakes they were making were obviously not corner-cutting, but in fact due to lack of knowledge. *Yahhhh!* A look at a finished model soon had me shuddering in fear, as, to put it bluntly, it was rubbish. I felt I'd been drenched with cold water once again, bugger it!

Or Maybe Not?

Yes, the factory tour had been quite disappointing, except for a couple of gleams of hope:

1. There was a new looking laser cutting machine that was actually working — cutting servo mounts — none of your plastic moulded trays back then.
2. Cunningly concealed in a new prefab building that stuck out like a sore thumb among the old farm barns, was a pretty large — at least three metre table — brand spanking new CNC routing machine.

Takeaways:

Make sure that you can gauge the capability of your potential partner.

Don't be daunted by the seemingly rather primitive production facilities.

Ask them by email before any face-to-face meeting about years in business, in-house skills, customers and other relevant facts.

> *Ask for pictures of moulds, and the models they have produced.*
>
> *Remember that typically ANYTHING you ask for will be NO PROBLEM! — take that with a pound or two of salt.*

Frankly, those last two pieces of equipment at GHFRME and the general potential of the place were the only things that stopped me from requesting to be returned to the airport there and then. Where I'd thought that this would be an open or shut case — basically a yes or no deal — I now found myself faced with a predicament. What would happen if I taught this crew the correct way to make moulded airframes? If I did, they could. If I didn't, they couldn't. A rare juxtaposition. What did I want the outcome to be? The question rolled around my brain.

A little inspiration: the Vector III in action. (video: Mike Evans)

Deciding not to decide on that gristly quandary until I had gleaned more information, I produced my rolled-up drawing of the *Vector II*, then sat down with the ever-grinning owner and the factory manager to see how much they knew about converting a line drawing to CAD. Then we moved on to CNC programming, and thence to making a mould or master on the CNC machine. The owner's assistant was the 'translator'. I soon found to my surprise and hidden joy that the dynamic duo were surprisingly knowledgeable on the CAD side, using the ubiquitous if a bit dated AutoCAD programme, and were confident on the CNC machine as well.

> *Takeaways:*
>
> *If you have the chance then do visit the factory — if not, ask for pictures.*
>
> *If an actual visit is not possible, then arrange a Skype or similar face-to-face meeting.*
>
> *Have a list of important questions prepared.*
>
> *Make sure you have a translator handy, and make sure you discuss the questions with them first.*

My visit to the GHFRME factory was encouraging, so I started to become encouraged. But, the nagging question was, how had they survived until now?

That was soon to be revealed but for that, you will have to rejoin the odyssey in Part III.

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Resources

- So You Want to Be a Composite RC Sailplane Manufacturer? Part I: The Road to Perdition Awaits
- James Hammond Sailplane Design Series
- The Aeroic Sine Wave Spar

The third part of this series coming up in the October issue of the NEW R/C Soaring Digest. *Signed up for the **RCSD mailing list** to be notified when that's out. 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**.*

A ‘Big Air’ Weekend at ‘The Big Rock’!

Phil Cooke



PSSA member Steve Kemp awaits final instruction from Harry Twist before he launches his new F-4 Phantom!

It’s been some time since a PSSA ‘Fly-for-Fun’ event has seen such a vast array of models — both old *and* new — being flown over the course of a single weekend. Phil Cooke reports on all the event highlights.

Blessed both days with 25–35mph SW winds, this well attended meet on August 7th and 8th, 2021 really came to life and despite some challenges with torrential rain showers on the Saturday at the Great Orme at Llandudno, North Wales delivered once again as the scene for this memorable weekend.



The authors Hawker Sea Hurricane ‘Nicki’ at rest between flights as the sun breaks through!

Saturday’s wet forecast drove a bigger attendance on the Sunday, but the rain proved showery for most of the day and the 15 pilots who flew on Saturday just had to pick their moment in between the weather fronts. In reality this proved quite easy, the inclement weather was clearly visible as it approached from the horizon meaning you could land out just before the rain commenced and sit in the car as it passed through. As a pilot you are spoilt at the Great Orme’s ‘Tank-track’ site with easy access to the car park just 75m from the flying site. ‘*No back pack required!*’ — you simply walk to and from the car for tools, food, drink — or in this case shelter — as and when required throughout the day. Admittedly the morning session was a little stop/start due to the rain, but just after midday there was a really good band

of clear sky with sunshine, the event was uninterrupted for a good three hour slot during which time a serious amount of flying was achieved by all.



Dave Worron’s large P-47 Thunderbolt gets away on another ground attack sortie!

Dave Worron was on site with a couple of large World War II types he’d converted to PSS from power kits. We’ve seen his well proven P-47 *Thunderbolt* at events before, impressively bulky at around 65″ span and nicely detailed for a big foamie, built for slope use from the old Max Thrust kit. This model flew numerous times in between the showers and looked to handle the conditions well, with good penetration and energy retention throughout the flight. Dave’s other type was something we rarely see on the slope, again another power kit conversion from Flair Models in the form of the Messerschmitt Bf-110. At 66″ span this model also flew very well, the types slender cross-section and general arrangement lending itself well to a slope model — but my attention was drawn to the colour scheme and finish.

Dave has currently finished the model in a wrap-around polished silver with high visibility RAF markings applied directly over the original German identification, representing an aircraft captured and used for allied flight test during the war. Dave explained to me that he sees this as an interim scheme and that he has intentions to produce a battle worn finish with brown paint sprayed over the silver and then sanded back to create the weathered look. We look forward to seeing this model in that new guise sometime in the future!



Hawker Typhoon flown early on the Saturday by Andy Meade.

Second World War fighters were well represented during the Saturday morning session. Andy Meade was seen putting in some good flights once again with his little Hawker *Tempest* and the larger *Typhoon*, both of these models clearly becoming ‘go-to’ favourites for Andy this season. Since it’s last outing at the Bwlch event in July, Andy had manufactured and fitted

some impressive ‘tank-busting’ cannons to the leading edges of the *Typhoons* wing and he’d also got the models lighting system to work properly too, elevating this already impressive scale model up another notch!



Bob Jennings with his new P-51B built from the Janssens plans.

Bob Jennings test flew his latest new creation in the shape of a little North American Aviation P-51B *Mustang*, built using balsa clad foam and glass from the Paul Janssens’ plans issued free with QFI magazine. Again, it was finished in a rare guise I’d not seen before on a Mustang — a very attractive silver and red Swiss Air Force scheme. Bob explained the colours represent a ‘neutrality scheme’ hastily applied to a USAAF aircraft which diverted and landed out at Dubendorf airfield in Switzerland during a bomber escort mission having suffered engine problems.

Great to have a bit of history behind this rare colour scheme and aircraft combination! Built from a well-proven plan, the model flew as well as it looked from the off, Bob clearly enjoying the flight in the high-octane conditions that were being enjoyed by all!

It was good to see Jez Billington flying his lovely De-Havilland DH-108 *Swallow* again, a model we’ve not seen in action for a couple of seasons now, but still looking extremely smart in its all-silver scheme with the yellow ‘P for prototype’ and RAF markings.



DH-108 Swallow grooving through the landing zone on another superb low-level pass!

I was very impressed with some of the flowing curved lines and low flypasts Jez put this large flying wing through, particularly considering the turbulent compression zone just ahead of the launch area — Jez flew very confidently and the model seemed to handle this with no problem at all. Some superb ‘Farnborough’ passes were witnessed and enjoyed by all who were watching! Steve Kemp was seen flying a number of models during the first day including his big Airbus A380 and BAe *Hawk*, but his most flown model must be the 150% scale *Jet Provost* built from the Andy Blackburn plans and finished very nicely in an early silver and orange RAF trainer scheme. Again this large, stable airframe seems to build a level of confidence in Steve not typically seen with other PSS models, allowing him to put on a real show with low, jet-like flypasts through the landing zone and when required, some really impressive, pin-point sliding landings. There are a few more of these large *Jet Provosts* in build, indeed, I have one ‘half baked’ on my own desk at

home — I must complete it this year and start to enjoy the same spoils clearly evident whenever Steve and Peter Garsden fly theirs!



Jet Provost looking good on finals built and flown by Pete Garsden.

Despite the relatively high wind speeds, many smaller models were being flown successfully too. John Hey flew his well proven Hawker *Hunter*, a model originally built by his dad and impressively now 40 years old and still going strong! Steve McLaren enjoyed a good flight with his New Zealand Air Force A-4 *Skyhawk*, and there was a pair of RAF *Tucanos* being flown to good effect by Martin Pope and Harry Twist. As always, the smaller *Jet Provosts* dominated at times too, an ever popular model with this group, and good for all conditions from the lightest of PSS days yet still fully capable in the higher wind speeds like we were enjoying — myself, Steve Kemp, John Hey and Steve McLaren all enjoyed some lengthy airtime with these small scale vintage jets.

Before the rain returned and settled in for the remainder of Saturday afternoon, Andy Meade elected to rig his newly completed Boeing C-17 *Globemaster III*. This is an impressive own-design model which Andy has been building and finishing in parallel with all his other work over the past few seasons, it’s now ready to fly and was seen here at the slope for the first time. It’s built from ply and white foam, the wings, tailplane and fin are all veneered, the fuselage is covered in brown paper and PVA prior to the entire airframe being glassed ready for paint. At 1/15th scale, this is a large model with a span of 134″ and an AUW of approx 35lb. The wings are particularly impressive with huge drooping flaps and flap guides just like the full size. Like the well proven system employed on the PSS B-52 and An-225, the four engine nacelles are hollow ABS vac-forms mounted to the robust wing pylons with a ‘knock off’ system should that be needed on landing.



Andy Meade’s impressive C-17 Globemaster III is brought forward to the launch zone.

With all checks complete, the model was readied for launch. All the navigation lights were working and everything was go with a coordinated team of helpers moving the model to the launch point — which proved somewhat of a challenge in the high winds. With the scene all set, and in hindsight with extremely fortuitous timing, a member of the launch party suddenly noticed one of the flaps begin to droop and then seconds later some white smoke was seen coming from within the airframe. Andy worked quickly through a well positioned access hatch to kill the power and isolate the source of the electrical failure, thankfully without any apparent damage to the airframe. After a little investigation it became clear that a flap servo had failed and created the short circuit which overheated and melted the wiring loom associated with that panel. We were all extremely relieved that this failure occurred during the initial launch phase and not seconds later when the model could well have been airborne! Andy will no doubt replace the damaged hardware and have this impressive model back ready for the slope at a future event.

From 4pm on Saturday afternoon the rain and clag became persistent and reluctantly we halted play for the remainder of the day, having all had a good fly in between the showers. Later that evening there was an organised group meal booked at a fantastic pub in town, 16 people in total allowing us to relax and recap on some of the days events — great to re-instate a little more social activity within the boundaries of the recently relaxed UK COVID rules!

Sunday morning dawned with a forecast much dryer than Saturday, still overcast but with the promise of improvement as the day wore on. Most importantly there was no rain, and this brought with it the increased attendance on the Sunday with over 20 pilots present at the 10am brief.

Mike Cavey had travelled across from Wigan and brought with him his lovely little Beechcraft *Bonanza*. All foam in construction from the DuraFly EP kit

and with an AUW of less than 2lb, it handled the conditions superbly and must have been one of the most flown models throughout the Sunday! Mike explained he chose the subject for PSS use as (apart from the obvious v-tail) he saw so many similarities between it and the little Jet Provosts he’d seen us fly successfully at previous meets. It’s certainly a pretty little aircraft, which put on an impressive performance considering it’s low AUW and the wind speeds we were flying in!

Rich Henderson was flying not only his own-design Hawker *Hurricane* but also his Mitsubishi A-6 *Zero* built for PSS from the Tony Nijhuis plans a few years back — again a model we’ve not seen flying with us at a PSSA event for a few seasons now. Both of these models were of a size and weight ideally suited to the conditions and Rich enjoyed some lengthy flights with both airframes throughout the day. At one point Rich was seen dogfighting his *Hurricane* with Tim Mackey who was flying his little Me-163 *Komet* fighter — excellent stuff chaps!



Rich Henderson’s O/D Hawker Hurricane about to mix it up with the Komet fighter!

With the PSSA’s Sabre Mass Build running in September (see *Resources* below) after a number of deferrals, there are more and more finished airframes being test flown and refined prior to the eagerly anticipated event. I had flown my Yugoslavian Air Force example for only the second time on the previous day, its first flight in booming lift, and today, with the lift just as favourable, Steve McLaren and Chris Barlow both decided it was time for their new creations to get airborne. Steve’s example has come out with an impressive AUW below the 4lb target weight, and is finished in an attractive silver and orange scheme of the Alaskan Air National Guard. Chris has finished his Canadian-built *Sabre* F-4 in the glossy camo scheme of 112 (F) Sqn based at RAF Bruggen, it’s fitted with a working rudder, flaps and a wing-tank release system giving it an AUW of 5lb.



Steve McLaren’s ANG F-86 seen at launch on its maiden flight.

Both aircraft got away smoothly from launch and performed very well, Steve’s example I think needing a little less weight in the nose than was fitted to bring the CoG rearward a few millimetres to improve the elevator response. In the lift both aircraft put on a good turn of speed, Chris ably demonstrating some very smart aerobatics with his, before they thankfully both returned home unscathed! Time now to make any final adjustments based on that learning then wrap these models up ready for the competition in September!

Steve Kemp was seen arriving in the pits with a large new *Sea Fury*, bought second hand and converted to PSS from an old Seagull I/C power model. It spanned 66″ and had an AUW of 13lb, it certainly looked the business finished in the classic Royal Navy two-tone grey scheme with the invasion stripes.



Hawker Sea Fury converted to PSS and flown by Steve Kemp.

Once everything was checked over Andy Meade provided the launch and it soared away very gracefully without any apparent need for trim change. Very impressive! Having flown for a few minutes Steve started to explore the models envelope a little more and commenced some circuits around the back. Sadly a turn back cross wind from the downwind leg appeared to result in a tip stall which saw the model come in quite heavy, causing some damage around the front of the wing seat. I’m sure we will see more of this impressive model once some repairs are carried out!

One of the real highlights of the Sunday for me was witnessing Bob Jennings and Andy Meade flying their Sukhoi Su-27s *Flankers* together in close formation. Both models are built from the Andy Conway PSS plans, and both are finished in three-tone camo schemes representing airframes from the Ukrainian Air Force. These models require a certain amount of lift to really

get going so they are not seen that often at our events, but the slope conditions were perfect and from launch it was obvious we were about to witness something a little bit special!



Sukhoi Su-27 Flanker duo flown by Bob Jennings and Andy Meade.

Bob’s airframe, originally built by Matt Jones, is fitted with LED afterburner rings mounted in chrome thrust tubes which look superb when activated! They are mixed to the (otherwise redundant) throttle stick on Bob’s Tx and are programmed to pulse and flicker into life as the throttle is pushed forward, just like the real thing! Andy and Bob thrilled the spectating crowd for a good 10 minutes before each aircraft was safely circuited into a consecutive landing one after the other. A brilliant PSS display!



Tim Mackey poses with his newest slope model the Gulfstream G550.

Mid-afternoon Tim Mackey unveiled his latest PSS model, a Gulfstream 550 private jet built for PSS from the HobbyKing EDF kit. The model spanned an impressive 74″ and looked superb in its gloss white finish with blue and grey trim. Tim had also fitted a high intensity flashing strobe on the upper fuselage spine which looked great both on the ground and in the air! Bob Jennings provided a perfect launch on this, the model’s first outing, and after applying a little corrective trim on the elevator Tim soon settled into what was a great flight. We don’t see too many private jets flown as PSS models, but these latest types in particular, designed for high altitude, long range

flight all lend themselves ideally to our sport — they have smooth, low drag profiles with huge slender wings and elegant wing tips. They would all make ideal PSS subjects!

At 4pm, as a few folk started to think about travelling back home in readiness for the working week ahead, models were landed out temporarily and a short prize giving ceremony was held for winners (voted by the pilots throughout the day) in the categories of *Best Flown Prop*, *Best Flown Jet* and *Model of the Event*. **Rich Henderson** won the *Best Flown Prop* category with his Mitsubishi *Zero*. **Steve Kemp** took the *Best Flown Jet* award for his large *Jet Provost*. And **Tim Mackey** won *Model of the Event* with his impressive Gulfstream 550 — for which he also took home the coveted Alan Hulme Memorial Trophy. Well done to each of the winners!



The Great Orme's South West facing slope really does provide a magnificent setting!

Just as forecast the weather improved as the day matured, it was clear we might be in for some glorious end of session conditions, as so often happens when flying at the Great Orme. Slowly the clouds dispersed and we were left with an impressive blue sky for the final few hours of soaring which turned golden as the sun started to set over the North Wales coast. Harry Twist took advantage of this moment and test flew his Royal Navy F-4 *Phantom II*, newly restored from an old Howard Metcalfe kit — commonplace in the late 1980s but now a very rare bird indeed! Steve Kemp (also a F-4 Phantom

pilot!) provided the launch and Harry very quickly started to enjoy the model as it soared gracefully up and down the South West face.



Harry Twist with his newly finished MD F-4 Phantom II built from the HM kit.

After a 15 minute maiden flight Harry brought the *Phantom* through for a couple of practice circuits before dropping her effortlessly into the soft grass — the beaming smile on his face upon retrieving the model back to the pits said it all! What a lovely way to end this busy weekend’s flying!

The remaining few pilots flew on until dusk, which came far too quickly in the glorious conditions with which we were seeing the weekend out. John Hey was last to land with his fabulous MB-339 which looked stunning in the golden light we were now being bathed in. Another successful PSSA weekend on The Orme had drawn to a close.



John Hey’s MB-339 enjoying every last moment of sunlight on the Sunday evening!

More photos from this superb PSS event can be viewed using the link in the *Resources* section immediately below. Well done to all who attended the event and stuck at it through the difficult weather on Saturday — I think Sunday’s flying was more than enough reward for one weekend!

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Resources

- Additional photos of the Llandudno PSSA Fly-In August 2021 can be found on Flickr
- Power Scale Soaring Association website
- The PSSA’s Sabre Mass Build event coming up in September 18–19, 2021

*All photos are by the author 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**.*

RC Soaring Diaries

Let's make soaring contests fun again!

Michael Berends



Some of the happy participants after their first soaring contest. (image: Glynis Hern)

After being involved in RC soaring for close to 40 years now, I've witnessed it evolve through so many things both good and bad.

The development of the gliders themselves has been amazing to watch and the performance of the ships have just gotten better and better. Unfortunately the downside of this is that I've also watched the contest participation in my part of the world (Canada) decline to the point where it's almost non-existent with but a few small patches of diehard glider competitors in a few regions of the country.

Through the 80s and 90s we had quite large club gatherings and contests every year in multiple cities. Some of my best soaring memories are from these events. Everyone working together running winches, retrievers and timing each other with such friendly rivalry. Most of the ships were built by the pilots and they flew them proudly, seeing their craftsmanship and efforts gracing the sky. It was always a great day of flying and camaraderie with all the participants.



Everyone getting ready for the day's events (image: Michael Berends)

I actually started seeing the decline when composite ships first started showing up at the flying fields. They performed so much better than what everyone else was flying and were hard to beat as they could 'work' the air

for every little bit of lift far better than their built-up counterparts. Quite a big step in performance but it came with a price. All of a sudden the cost of having a contest ship increased dramatically! Often putting it out of the budget for the normal hobbyist. This started creating a bit of a problem as doing well at a contest turned into a bit of a money game instead of hobbyists building affordable planes and enjoying competition on a fairly level playing field.

It also created a bit of embarrassment for those that were in a situation where they couldn't justify or afford the substantial sum of money for a competitive ship. It was like showing up to an Indy Car race with your old souped-up VW Beetle! You knew that you had to work twice as hard as everyone else, lacked tons of performance and were almost looked down upon even though you had a ship that was considered fairly high performance and a good contest winner just a few years before.

I knew this situation first-hand as I was in my late 20s at the time trying to raise a family and there was no way that I could possibly afford an empty composite airframe that cost twice as much as one of my built-up ships ready to fly with electronics.



Everyone ready and waiting to see what's in store (image: Glynis Hern)

As I watched the trend grow I saw more composite ships show up at the field, I also watched the clubs getting smaller and the attendance at contests start to drop dramatically until it became almost non-existent. Eventually, only a small handful of the elite still remained in the soaring club. We haven't seen soaring contests in this region for over a decade now.

Please don't get me wrong in thinking that I'm opposed to high performance composite gliders as I'm not and have a large number of them in my fleet. I'm just trying to describe what I have found to be some of the reasoning behind the declining participation in contest flying.

The big question is, what happened to the ability for an average RC soaring hobbyist to participate in contests? The majority of thermal duration contest

flying is F5J, F3J and F3K which are all world class levels of competition. The entry level costs to simply participate in these and even get a taste can be thousands of dollars. Even the fairly new F3RES class has some pretty specific gliders and strict set of rules to abide by making it a little difficult to get the 'normal' hobbyist involved.

All types of competitive sports have multiple tiers of participation, with the majority of them falling within the amateur realm and not using the premium equipment available. Why should RC soaring be any different? Why should the only available options be nothing but the most advanced, world class flying ships in the world? What about all the hobbyists out there that might like some new challenges?

After thinking about this for a few years I decided to finally do something about it. It was a bit of an experiment to confirm some of my thoughts and also had hopes that it might ignite some interest in thermal duration contests again.

I extended an invitation to quite a number of RC aviation enthusiasts that I know for an introductory thermal duration contest. It was a mix of powered pilots, glider pilots who had never flown in a contest before and some fairly new people to the hobby. All held on my friend's property, where we had lots of room.

The contest format was to bring any glider you have whether it was a pure glider or electric with no restrictions on size or wingspan. We also supplied a winch and hi-starts for launching which somewhat regulated their launch height. For the electrics the plan was to figure out the specific motor run time for each glider before the first round using a simple range finder to gauge their height so it was the same as the other launch systems. The task was set at three minutes with a spot landing task in a 15 meter circle.



Tom Link assessing the sky for the next round (image: Glynis Hern)

The response was better than I expected! Lots of guys had questions and some of them started dusting off old gliders that they've had sitting in the rafters for years with some even scooping up old gliders that people were selling.

The day finally came and we had around 10 excited guys show up ready to see what this was all about!

After getting everyone sorted and explaining what the tasks were and what they had to achieve, my friend Chris and I — who were the only experienced RC soaring contest pilots — then started getting everyone comfortable with the launching equipment. Most had never flown from a winch or even knew what the heck it was all about. I also talked everyone through some landing

strategies and some thermal tips.

Then it was time to start the rounds. We set the duration task fairly low so the group could make the task with just a little effort and have the ability to have the challenge of the landing points too. I could see that there was a few things that the guys had to workout during the first round but that was to be expected.

As more rounds were being flown they just got better and better. Amazingly enough the best round of the day was flown by a pilot that had never thermalled a glider before, never flew off a winch or hi-start and flies mostly power. With just a little verbal guidance he was able to stay in some lift, make the task and also the best landing points of the day.

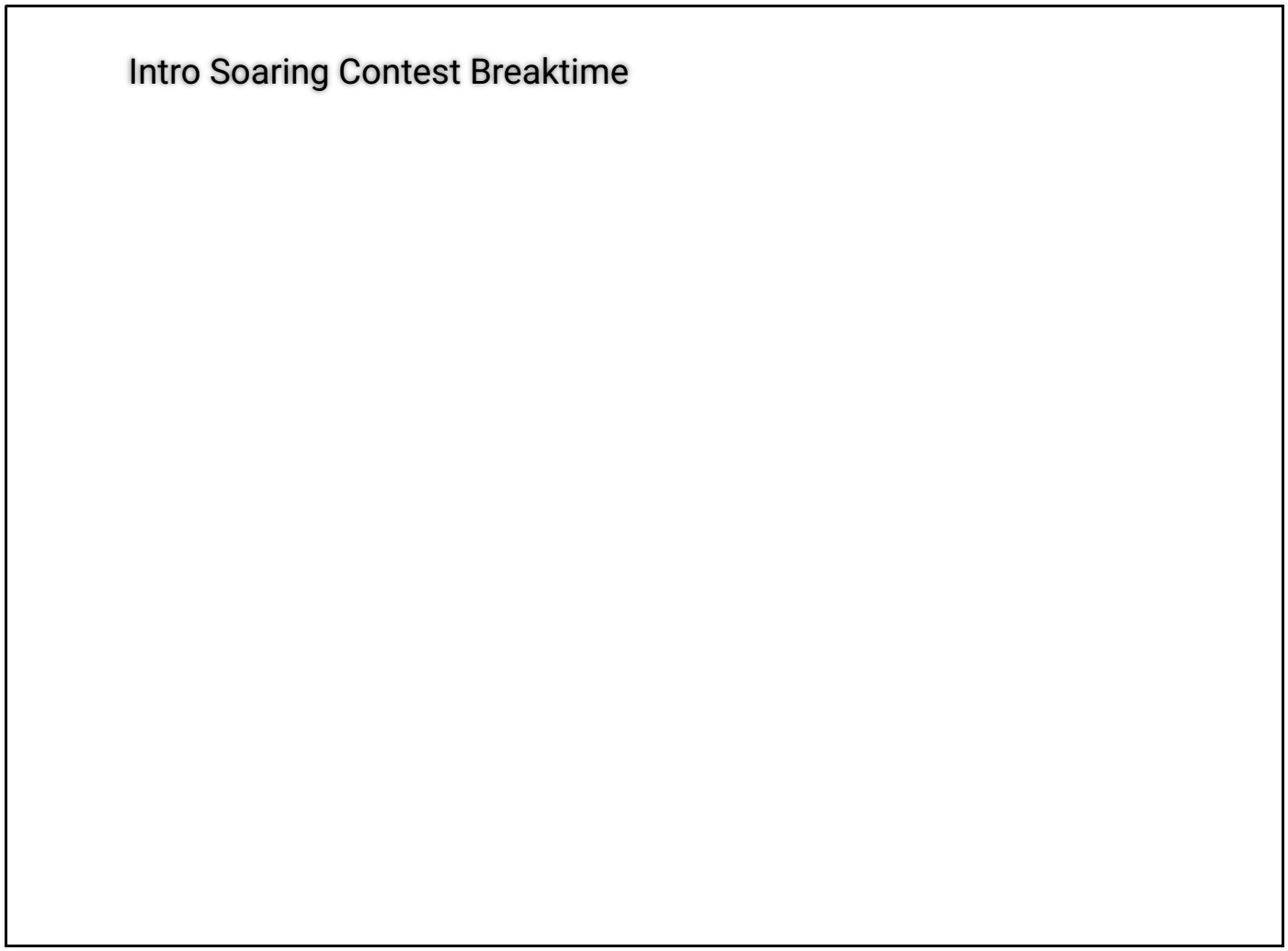


Phil Dessureault with the best score of the day (image: Michael Berends)

The lift got better as the day progressed and we decided to increase the duration task challenging everyone that much more. Some were getting their first real thermal flights circling in lift climbing like homesick angels. They then faced with the new challenge of getting their glider down in time so they didn't lose any points exceeding the duration.

The best part of the day was seeing this group of guys with ear to ear grins, timing for each other and helping their friendly competitor do the best they can, the playful banter that was constantly in the air and the cheering that was heard when someone was coming into the landing circle! What a great thing to witness. In all honesty I found myself in a few emotional moments as it reminded me so much of the contests I attended in my younger years.

We also had some breaktime fun flying a variety of different things from DLG gliders to some electric foamies. I was able to capture some FPV footage of the action along with the beautiful place that my friend Chris let us use to host the event in the following video.



Breaktime FPV footage (video: Michael Berends)

It really turned out to be an amazing day and was well worth the effort. Chris Gregg did manage to get first place for the day. He was the only other experienced contest pilot and a great friend that I used to fly with in those contests back in the day. Second place went to Carey Keating who has been involved in RC for decades and has always had a love for soaring but had never flown from a winch or been in a contest before. Third place went to Tom Link who has also been involved in RC for decades but had never flown a contest before either.

I do have to give an honorable mention to my friend Christian Minardi who's enthusiasm for RC flying always brightens my day. His excitement knowing he made the duration task with everyone cheering him on as he approached

the landing circle was my best memory of the day, and gave him a 5th place standing overall. Congratulations to all of them!



Chris Gregg launching his Legion Air showing everyone how it's done. (image: Glynis Hern)

The amazing part of all of this is that before the day was half over, there was already a buzz in the air with people talking about how much fun they were having and the question of when I'm scheduling the next one?

The experiment worked! Average hobbyists were once again interested in contest flying which confirmed my thoughts. I knew that once they were able to try it that there would be interest. Not only were they interested but in the following weeks I was able to see what this introductory contest started in motion.

A couple of pilots are already getting F3RES ships. Some others are

modifying what they currently have to be better for contests. It also started a bit of a fever in a few others practicing the tasks in anticipation for the next contest. The word got out to other RC aviation enthusiasts in the area who have reached out also wondering when the next contest will be?

With the help of my friend Tom we decided to hold another contest before the season is over. We did put a cap on the amount of participants we could accommodate and we were quickly surprised by how many people were interested and wanted to participate which surpassed our limits. The idea is for this to grow so we have increased our capacity to accept all.

We went from no contests for over a decade to two contests within a couple of months with the interest and attendance escalating rapidly. I also have to add that none of the participants are from an RC soaring club. They have mostly come from powered flying clubs which means that the amount of local glider pilots is also increasing because of these contests.

With all this being said, I'm so happy to see this amount of interest has been sparked because I decided to see if there was still a place for basic contest flying. I strongly encourage you to host a small introductory contest in your area and get more people interested in this great way of flying! Friendly competition just makes everyone better pilots as it makes you fly with intention and challenges your skills.

Let's make it fun again and get more people involved. I'm sure that some of them will enjoy it so much that they will want to pursue it further and advance into the higher levels of competition helping the FAI participation blossom also. Lets change the trend and help competitive RC soaring grow.

That's it for this month. Wishing you nothing but good lift until next time!

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The Micro Bird of Time

A full build-and-fly write-up on the J&H Aerospace kit.

Rene Wallage



The J&H Aerospace Micro Bird of Time (image: J&H Aerospace)

Ask anyone, I have a very soft spot for the *Bird of Time*. Back in the early 2000's I seriously looked into building one from a kit. Lacking room and skills, I decided not to. Years later I discovered the ARF version, and got two. One for me, and one for a friend. No, really!



1: One for me (left) and one for my friend.

I flew mine for a few years, recovered the wing, and promptly crashed her after specking out and probably over-speeding her, resulting in a spectacular one point landing on the nose, without wings. Bits of the wings came fluttering down slowly.

After a suitable mourning period, I managed to lay my hands on another one. I flew that one for several years, until the point where I had to decide: remove the covering, give the frame some serious TLC, and re-cover. Or give her to

someone who will do that, and than enjoy her again. As I had entered the F5J world, I opted for the latter. So I've been without a *BoT* for over a year now.

And then, about six months ago, a post on Facebook caught my eye. A *BoT* kit. Following the link (see *Resources*, below) brought me to J&H Aerospace. They have a very nice collection of glider kits. Nothing but good things have been written about the *BoT* kit (or any of their other kits for that matter). The price was very reasonable, and it was possible to put a tiny motor on the nose. So what was keeping me from ordering one? Nothing really, so I ordered one.

What's in The Box

A very well protected kit arrived, with plenty of bubble-wrap, to survive the vagaries of throw-happy postal services (2).



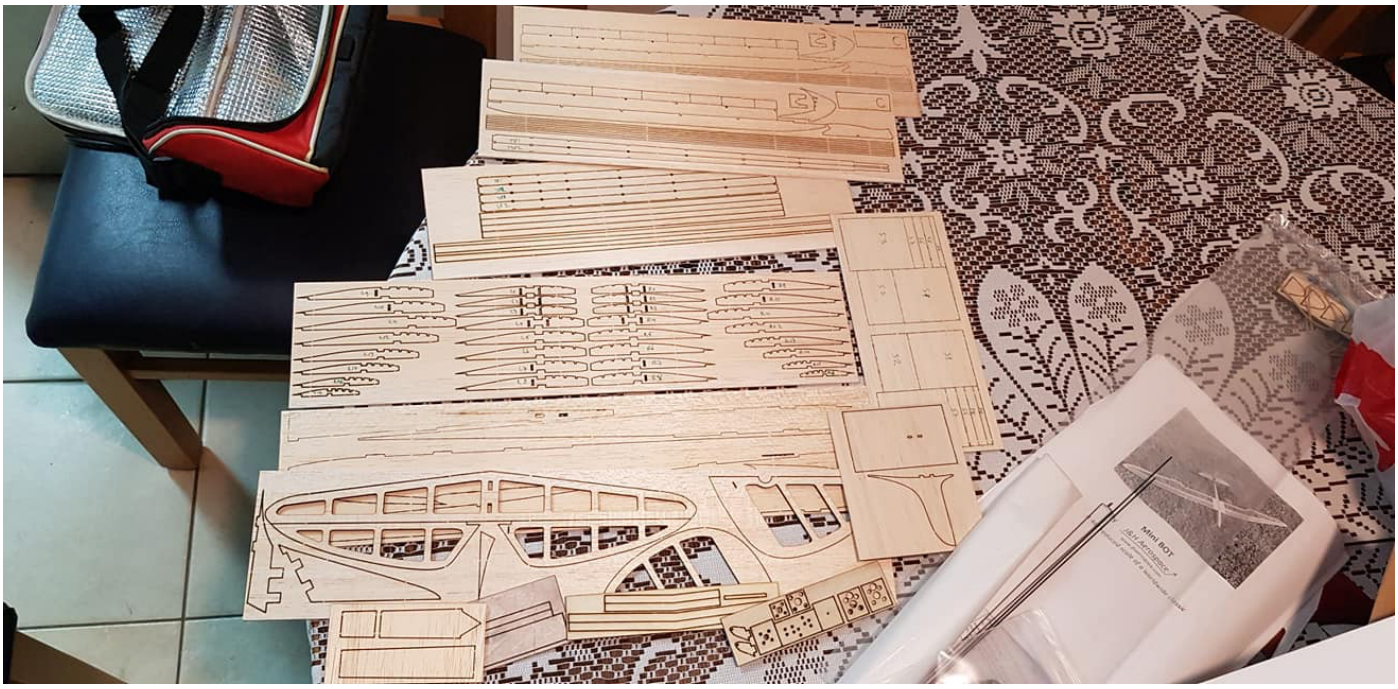


2 (left): As it arrived, wrapped in bubble-wrap. **3** (right): What the bubble-wrap contained.

Once the wrappings were removed there was a lovely little flat pack (3). To take the guessing out of the electric power set up, I had also ordered the motor and 2S lipo. I still had a 10A ESC in my spares drawer.

Opening the little pack, I discovered a surprisingly large amount of laser cut

sheets of mostly balsa, with a few bits of lite ply, and a bag of assorted bits ‘n pieces (4). Closer inspection of the various sizes of balsa showed good quality balsa, without any blemishes or knots. First impressions and all that.



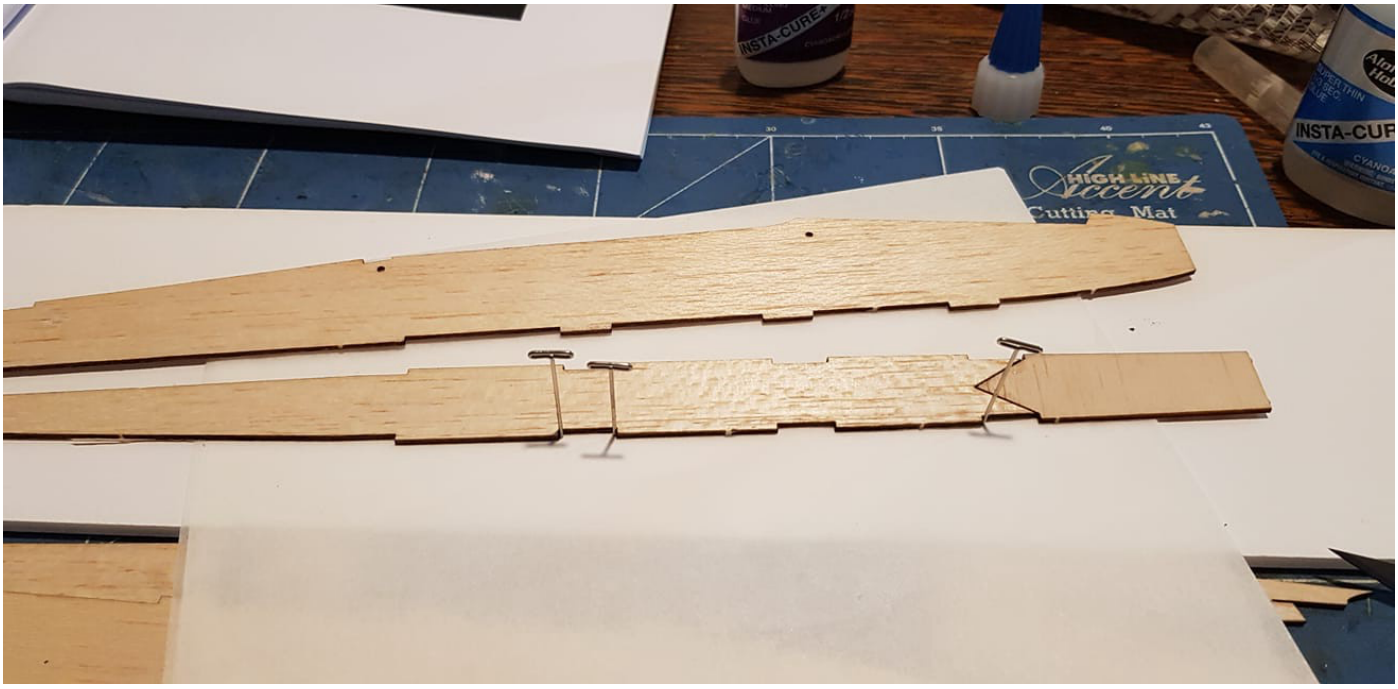
4: What the flat pack contains.

Also included was a roll of (what I later discovered was) *Doculam*. I had never used it to cover a model, but I was told it is not dissimilar to *New Stuff*. And an A4 sized printout of the instructions. These are printed in black & white, but a colour version can be found on the J&H Aerospace website. I read the instructions several times (actually, I downloaded them and had read the instructions a few times before I even had the kit in my hands). If any of the B&W pictures were somewhat puzzling, I had a look at the coloured ones and all became clear. Most of the time.

There’s no plan. You don’t need one, as the parts fit together like a well made jigsaw puzzle. As the manual says, just follow the instructions — we’ll see!

Fuselage Construction

The manual starts with the fuselage, so I did too. Using the supplied *Depron* plate as a building board, I went from this:



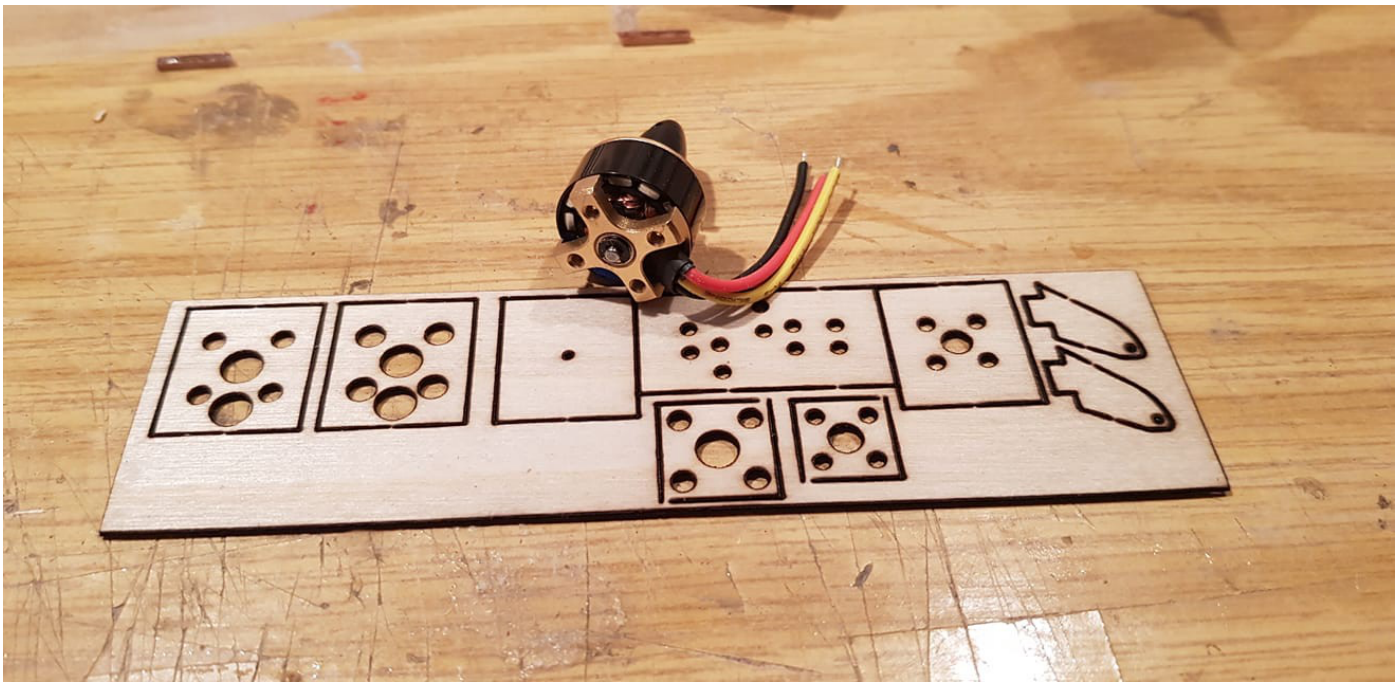
5: Fuselage construction underway.

To this, in about 1.5 hours:

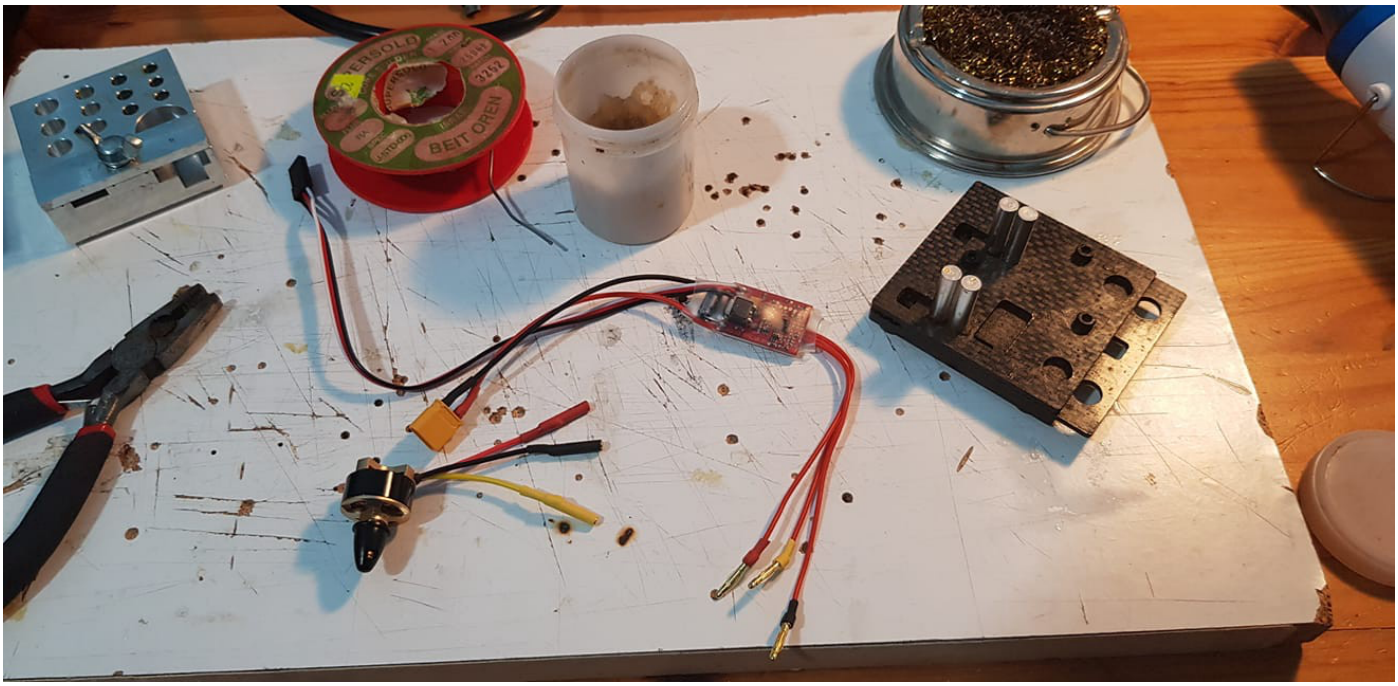


6: Fuselage, basically framed up.

As I will be putting a motor on the nose, I did not shape the nose cone. Instead I found a suitable firewall for my motor (7) and glued that in place. While fiddling around with the motor, I took the opportunity to also sort out the cabling and connectors for the ESC (8). I also connected it all to a receiver and checked the motor direction. I even made a hole in the firewall for the cables to feed through (9).



7: Should you not have the standard motor, there are several firewall options, including a blank one.





8 (left): Sorting out the cabling and connectors for the ESC. **9** (right): Cabling hole in the firewall.

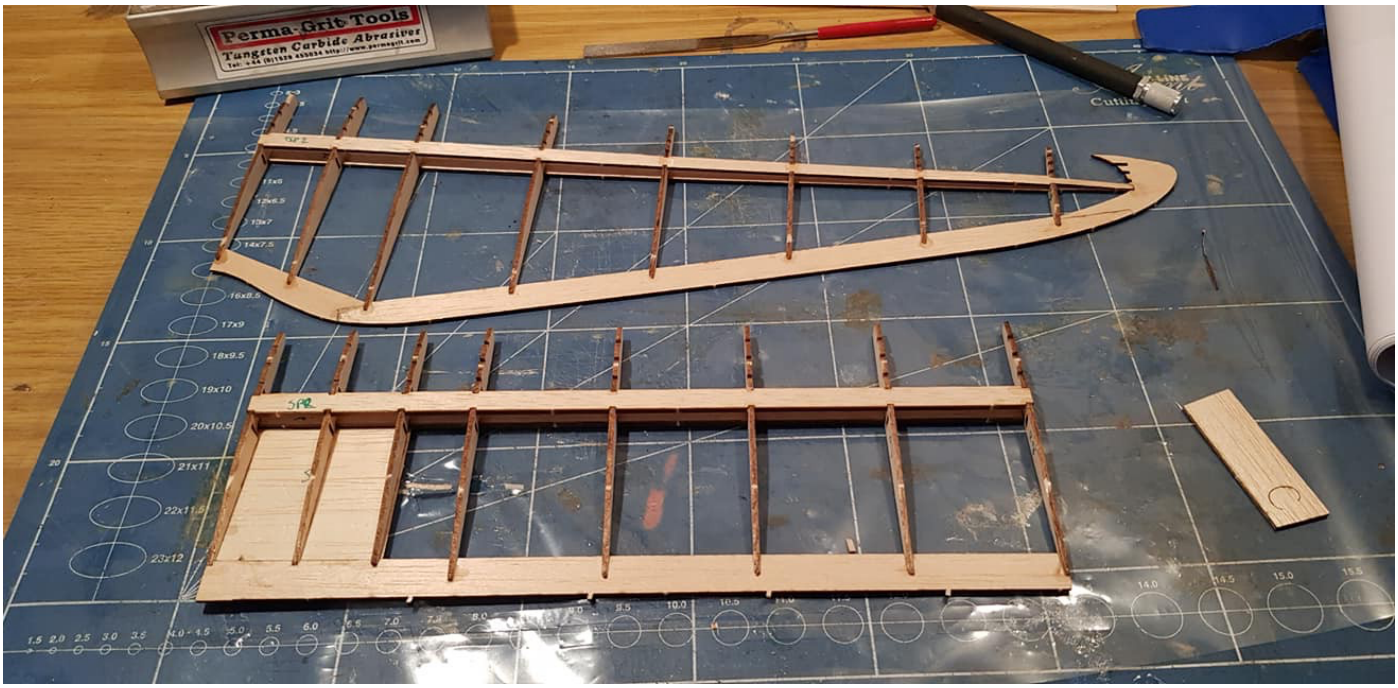
Maybe I should mention that this build coincided with our third lockdown, so this build was especially pleasant. Now onto to the wing!

Wing Construction

Before starting on the wing construction, I marked all the pieces with a fine

marker. I found this necessary because the parts for both wings are identical, so it will be easy to get them ‘confused’. I do a very good confused. Ever build two left wings? Sure you did. But twice on the same project?

So following the instructions, counting all marks and slot locations I started with one mid-section (the wing is build in four separate sections), which again went pretty quick, aided by the numbers. This seamlessly flowed into the build of the outer panel. The leading edge turbulators followed, after which I could add the centre top balsa covering. Up until now, I have done hardly *any* sanding! The sanding block you see is used to sand the little bits after taking parts out of the parts sheets.

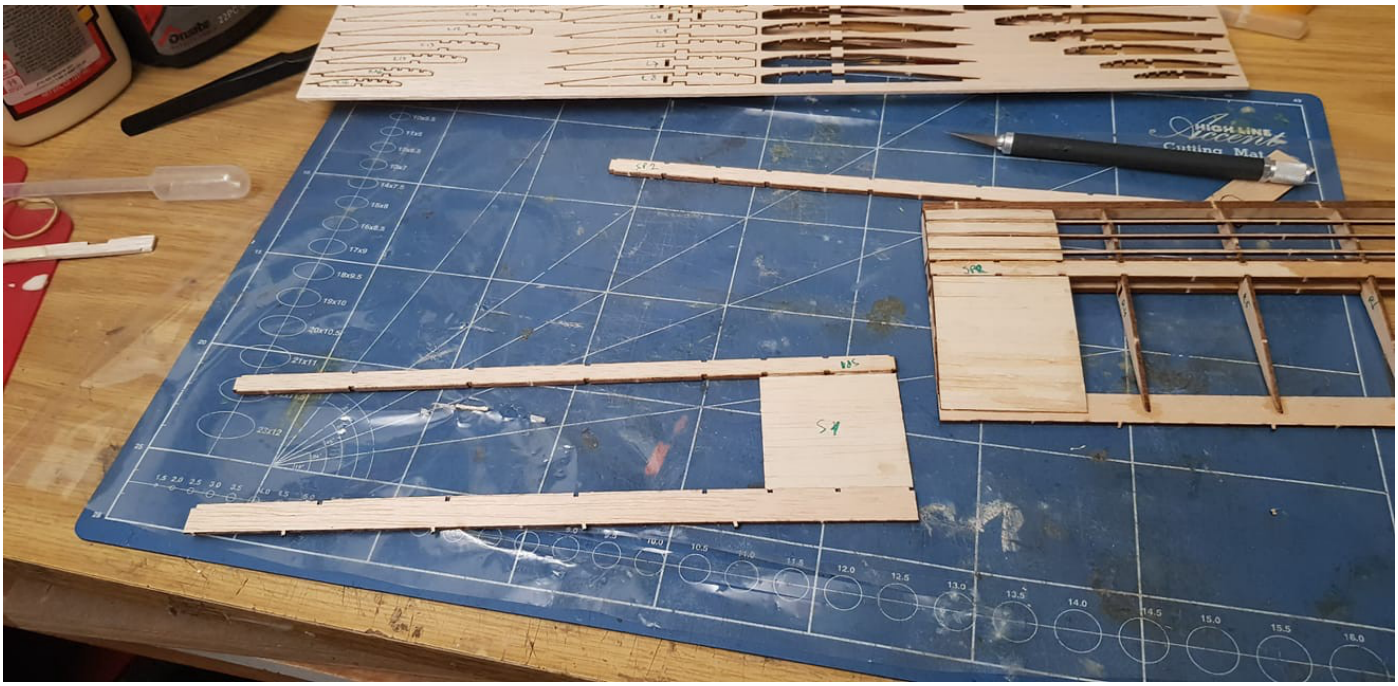




10 through **17**: The basic build sequence for the wing. The leading edge is added on later.

Now I could glue the leading edges in place. To keep it all in line, I used some rubber bands to keep a gentle pressure on the parts while curing.

To prevent my traditional mistake, before setting the right wing halves aside, I made a start on the left one (18). Just to make sure I am not falling for it again.



18: Starting the left wing just to make sure I don't make two right wings.

And than put the completed parts out of harm's way.



19: Best to get the finished part up and out of harm's way.

In no time I had two more panels done. To sand the leading edge, J&H supplies a handy little profile template. So using that, and my trusty

Permagrit sanding blocks, I got all four panels done. Still in lockdown, so I did the sanding in the morning, on our balcony, before the heat hit.

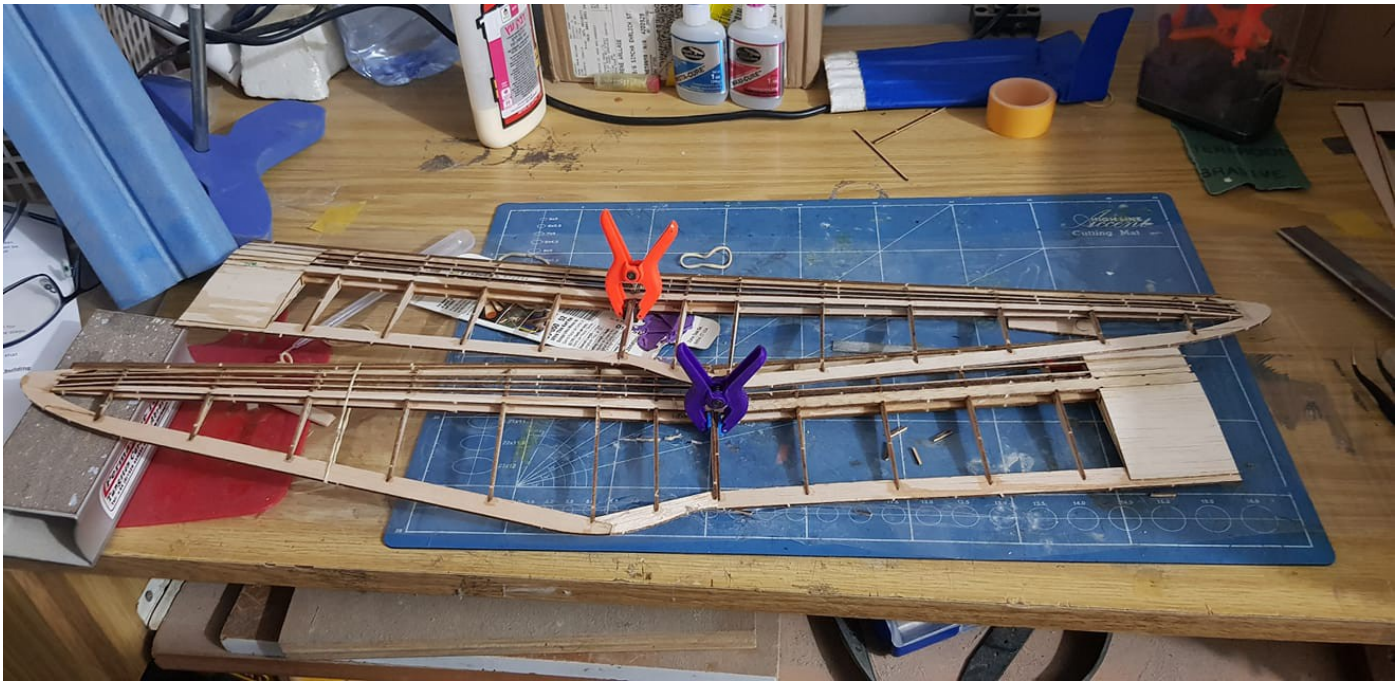




20, **21**: Took my time doing this. The structure is strong, but the individual ribs aren't. So if you hold too tight, something will snap…(I found out)

Deep breath — making two wing halves. I followed the manual, so the outer ribs have the correct dihedral angle (I used the supplied angle indicator).

Sand both sides flush, trial fit, and when all looks good, spread some aliphatic glue, and clamp together. Easy, peasy.





22, **23**: Joining the wing panels.

It must be noted that due to the design of all the parts, and the way they fit together, the two panels (together with their lite ply dihedral spars) fit together perfectly. So when that was done, some more trial fitting, first

without, and then with the main spars, again aliphatic glue was spread, and the wing halves were joined. I used masking tape to keep them tightly together. The next morning I found this:



24: The completed wing, ready for convering.

Covering and Finishing Details

With both the wing and fuselage ready, I had to proceed with the covering job. As I am not very good at it, I hate covering.

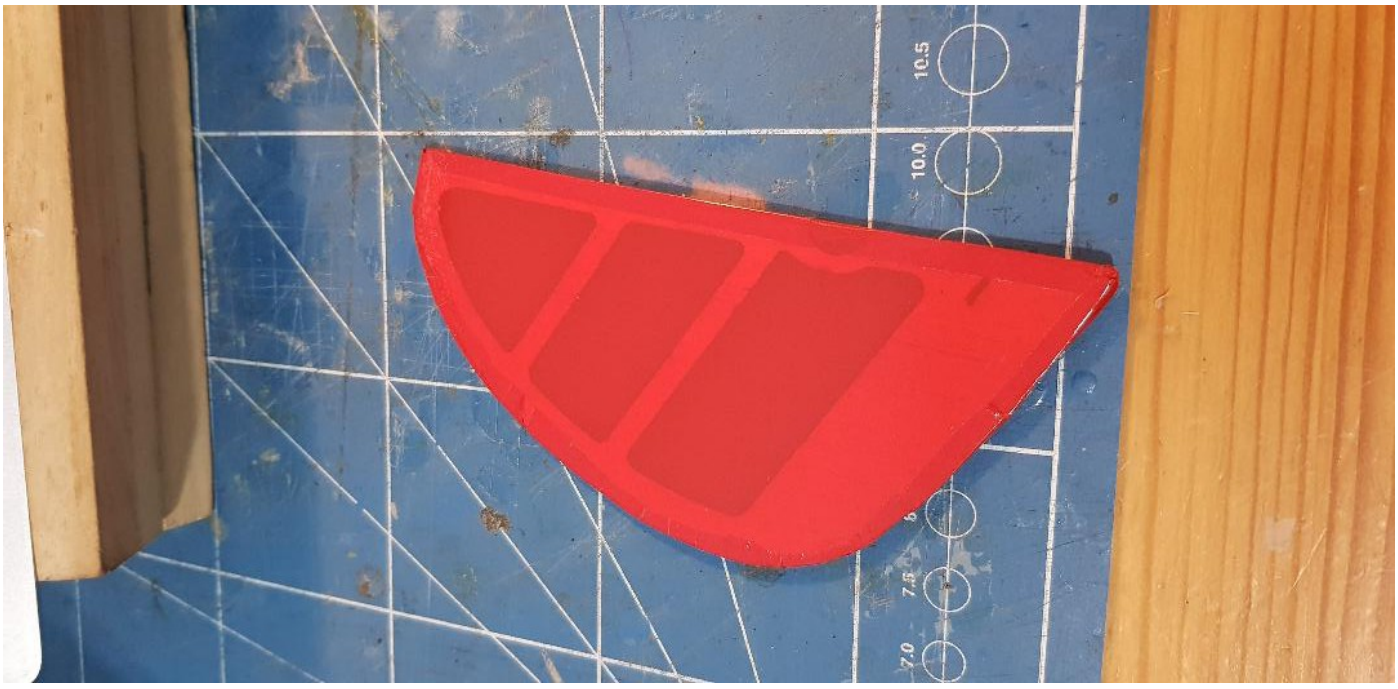
I knew I was going to use the supplied *Doculam* on a large part of the wing, but needed some colour to aid my 60+ eyes to orient the model. Rummaging through my collection of heat shrink I found two unused flat rolls of *Solite*. I think the colours are just right for a *BoT*.



25: Covering materials, ready to be employed.

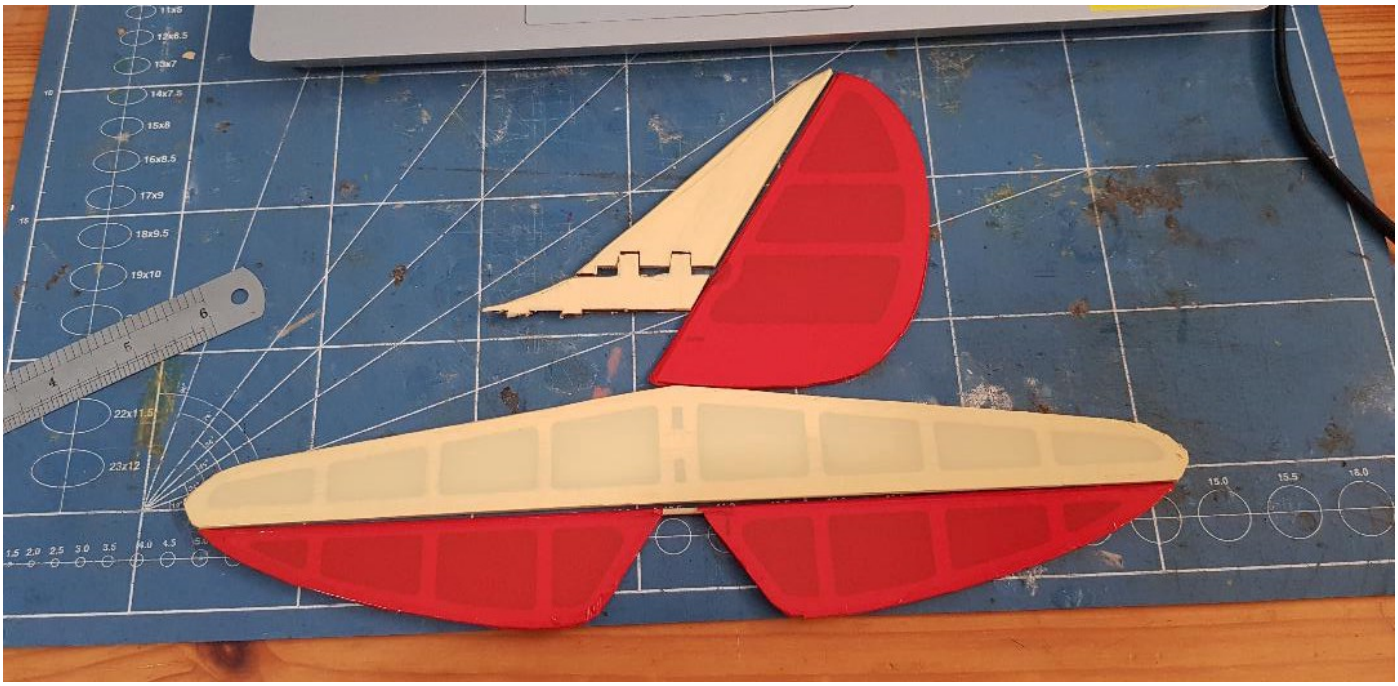
Anybody who has ever used this covering knows, it's ultra-light and ultra-*ultra*-sticky — to itself. Removing the backing sheet is in itself a battle. Then, once the backing sheet *has* been removed, you need to prevent the material from folding onto itself or you can start all over again. So do not have a fan on (ceiling or otherwise) and move the AC airflow away from your work table. Also, an absolutely clean and dust free table is a must. To get the hang of this material I started with the tail group. Some choice unprintable words were used, and I invented some more in the process.





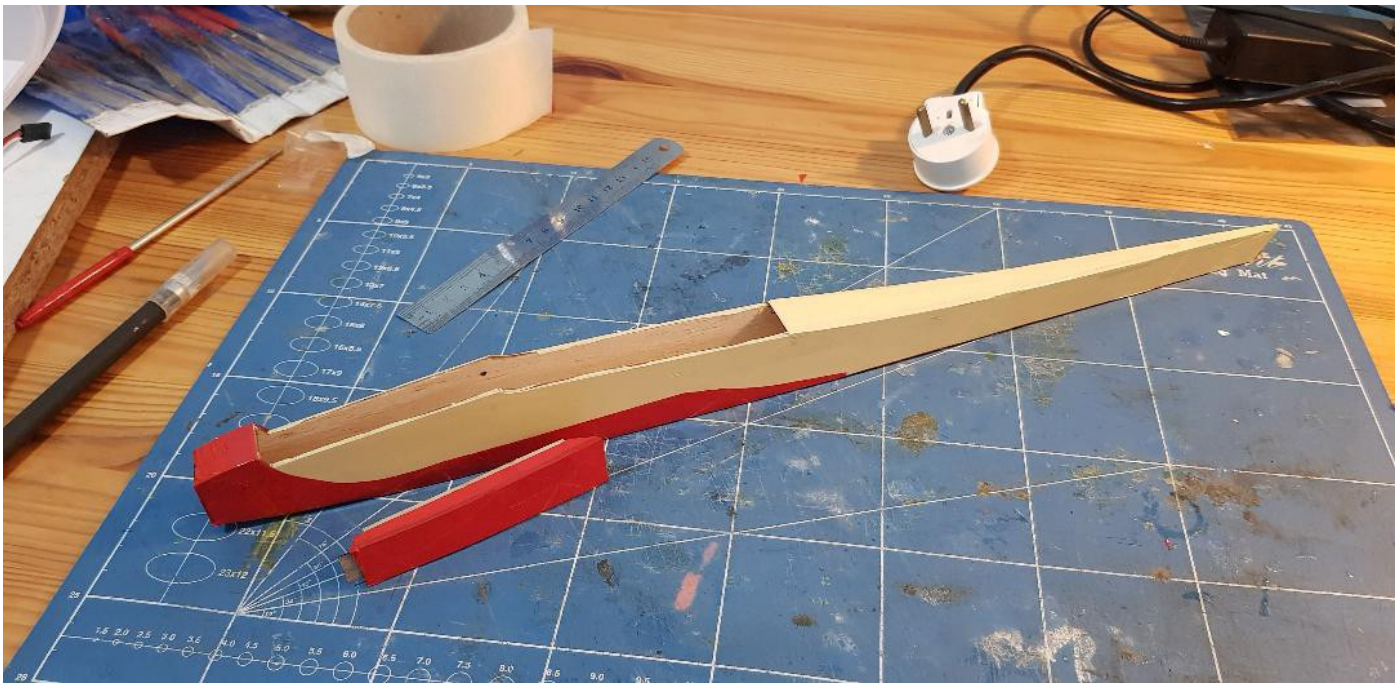
26, **27**: First experiment; covering the rudder in one piece. Do-able.

I found it best to tack the material with medium heat, than tighten the covering with high heat, and than to use a heat gun at a distance to shrink the wrinkles away. Ta daaaah:



28: The finished covered tail group.

Once that was done, I felt comfortable enough to tackle the fuselage:



29: Covering the fuselage.

Removing some of the covering, to open up the pushrod holes etc, I always find it easiest to use a warm (not hot!!!) soldering iron.



30: Opening up holes with a **warm** soldering iron.

Procrastinating a bit, because I really don't want to cover that wing. I found some itty bitty things to do. Like re-enforcing the fuse, where the wing hold down rods go. I glued in four tiny pieces of 1mm lite ply. Sticking a thin piece of carbon fibre flatrod to the tail skid. And adding some decoration to the fuse's sides. Most of my models have the Israeli Air Force insignia on them, so there was another reason not to start covering the wing yet.

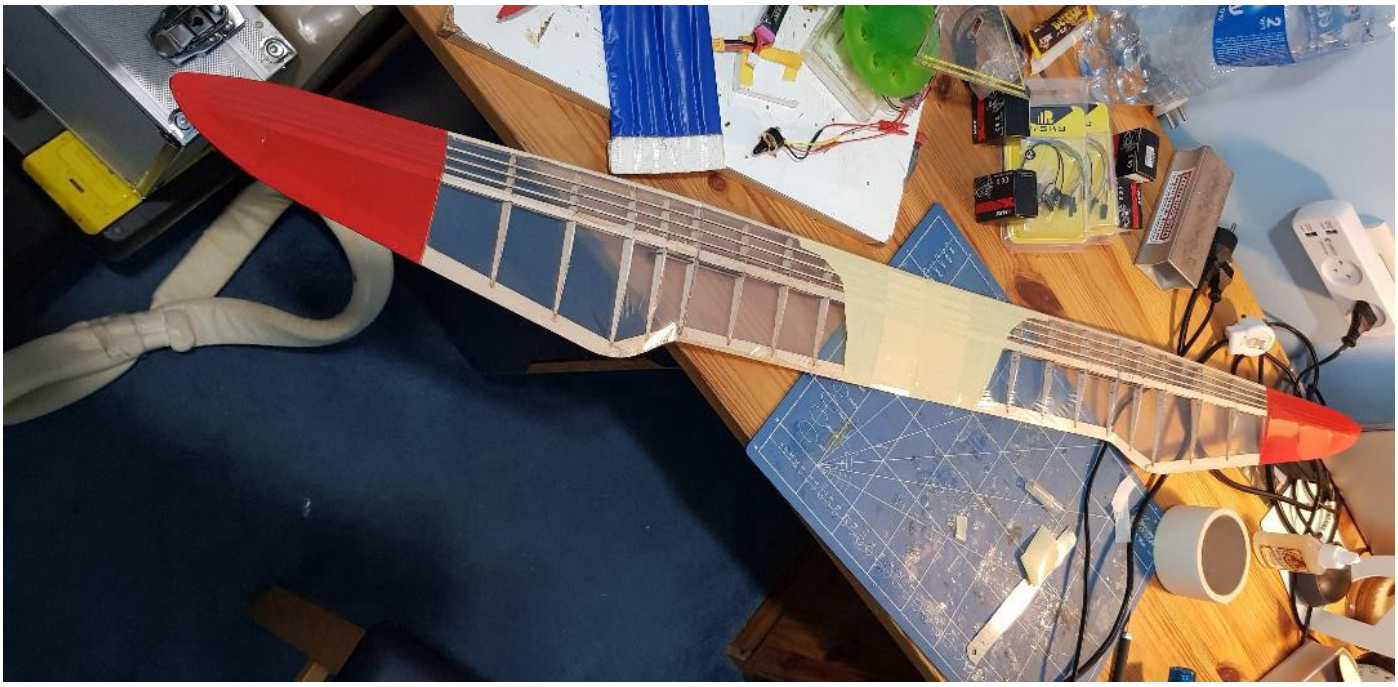
Next came another little head scratcher: fitting the motor. As I mentioned, the motor was ordered together with the kit. I've never held a motor that small! It came with the motor backplate installed, and four small Allen bolts to install it onto the fuse's motor mount. However, the fuse is so tiny and narrow, it was nearly impossible to get a small Allen driver and my sausage fingers inside, to tighten the four tiny Allen bolts into the motor mount. Looking it all over, while dunking biscuits in my coffee, my eye fell on a handy multi Allen driver set from a well known Chinese website. I taped the right sized rod to a pencil — presto! — I had a usable Allen driver that fitted inside the fuse. I could even bent it a little so I didn't need to fit my fingers inside

the fuse.



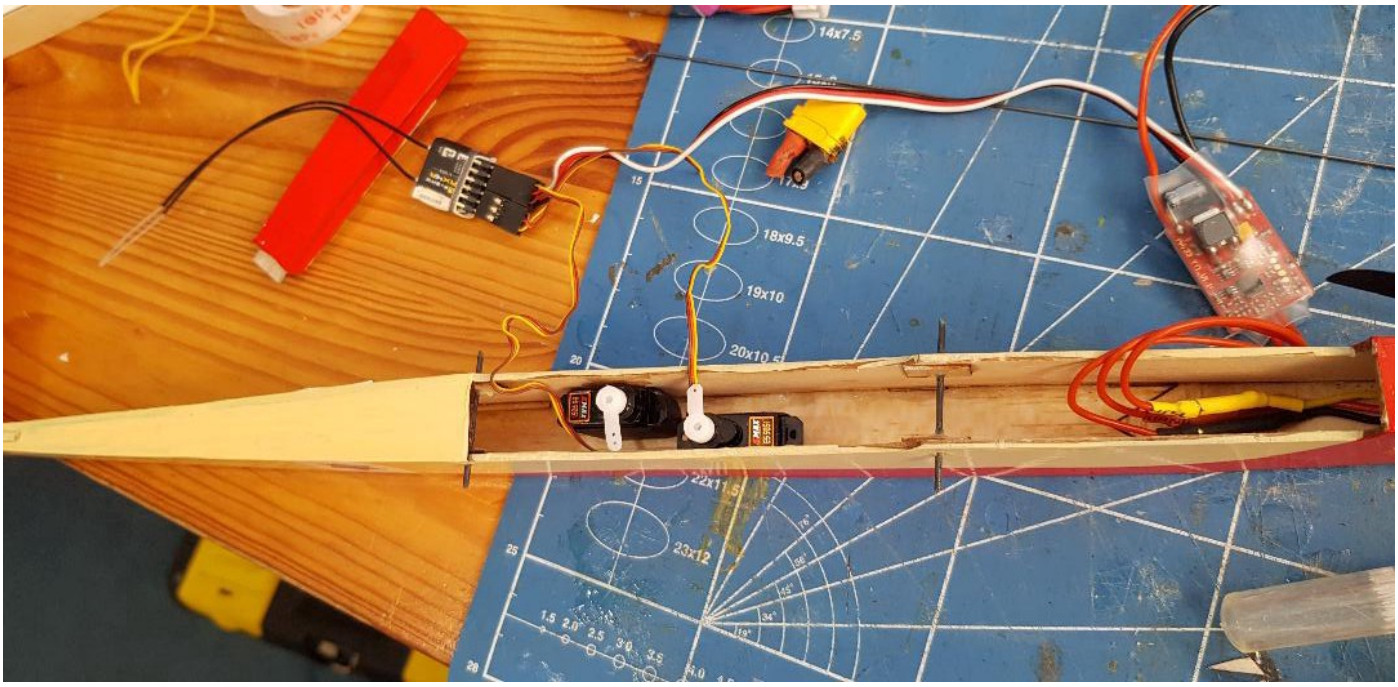
34: Fitting the tiny motor into the even tinier fuselage. My custom, ‘extended reach’ Allen driver is in the foreground.

No more excuses — onto the wing. I knew more or less what scheme I wanted, so started with the neutral, transparent *Doculam*. I covered the wing in eight sections: four top, and four bottom. The *Doculam* went on really well. After the *Solite* experience, it was a joy to use. Didn’t shrink very well with the iron, but I found later, after adding the *Solite*, careful use of the heat gun got rid of any wrinkles. I took two afternoons for the wing covering, with plenty of breaks, so as not to get frustrated. It was all worth it in the end.



35: The finished, covered wing.

Next came the servos. Now, as I have that little motor on the nose, I installed the servos towards the back of the fuse. This would cost me dearly later on. I wrapped the servos in heat shrink, roughed up the sides somewhat, and glued them in place.



36: Installation of the servos in the tiny fuselage.

Attaching the tail group was a no-brainer, I just had to make sure that the covering was removed wherever wood had to be glued to wood, and make sure it's all at the correct angles while curing. I used aliphatic glue here, as it gave me more time to get things right. As the design assures you of a straight fuse, there was very little chance I could get this wrong.

Next came the pushroddery. The pushrods that are in the kit are genius in their simplicity. Two carbon fibre rods, four pieces of 1mm piano wire with a z-bend, and four pieces of heat shrink. I fed the carbon fibre pushrod into the fuse, cut the piano wire to the required length (I did the tail end first), insert the z-bend into the control horn. Then comes a slightly fiddly bit, if your hands are as big as mine. Slide the heat shrink over the piano wire on one side, and the pushrod in the other. Hold them together, and hit it with some heat. I used my little heat gun. For some extra security, I added a drop of cyanoacrylate. With 20/20 hindsight, it would have been easier if I had NOT glued in the control horns previously, so it would have been easier to trial fit, and put it all together outside. On the servo side, I cut down the servo arms as per the manual, centred the servos, and repeated the procedure.

I had two sets of little folding props with spinners from the aforementioned Chinese supplier, that fit the recommended size. While trying to fit one on the motor I broke one. There's a saying here: "if it doesn't go with brains, use brute force. If it doesn't go with brute force, use more brute force…". I put the saying aside and used some more brains instead. The spinner is a bit oversized, and it's not streamlined as an F5J, but it'll do.



40: The finished motor installation.

All that still needs doing is balancing her. With the motor, ESC, receiver, and 2S Lipo all in front of the servos, she ways very nose heavy. Try as I might, I couldn't get anything to fit inside the fuse behind the servos, because I had glued in the wing rod. In the end, I removed the rod by cutting of the protruding bits inside and outside and re-drilling the holes. It was either that, or removing the servos and repositioning them further forward. Which would include re-doing the pushrods.

Than it was just a matter of trial fitting, balancing, trial fitting, balancing…you got the picture. In the end I found the best way to balance was to push the receiver as far back as possible, and add a 2g piece of lead just in front of the vertical stab.

Flying

And just like that, I had run out of excuses! Now I just had to maiden her. So the next Friday morning (our weekends are Friday/Saturday), I arrived at the patch bright and early, and setup my *Enigma* and *BoT* ready for launch. To calm my thumbs, and 'sniff' the air, I had a 10 minute flight with my *Enigma* first.

For the first flight, I gave my transmitter to our resident test pilot, all things RC mentor and general good guy, Israel Ofek. The launch at full throttle had the *BoT* jumping out of my hands like a scalded cat! Israel did a very short flight, just to make sure it all worked, and after a dive test the CG was declared fine. I had set up the elevator throws too high, so upon landing I toned that down and got ready to launch again. This time with the transmitter in *my* hands.



41: The happy pilot with his just-flown Micro Bird of Time. The smile says it all.

Half throttle was more than enough power to see her of at a brisk pace. Once at altitude I cut the motor and tried the glide. I needed a few clicks up

elevator trim, and that was it; hands-off flat glide. And that says more about the kit design than my building abilities. Because of the light weight (139g) lift is indicated very well. Imagine your glider going “wheeee” and jumping up. Once my thumbs had calmed down, and I relaxed, I started to get a good feel of her. When slowed down, she flies very much like my big *BoT* did, although with the Micro edition I did fly some loops.





42, **43**: Proof of flight pictures. (images: Eyal Radomski)

A lovely little glider. A very enjoyable build, she flies like a much bigger glider, looks great, and gets plenty of attention at the patch. I keep her for low wind/low lift days, or early in the morning.

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Resources

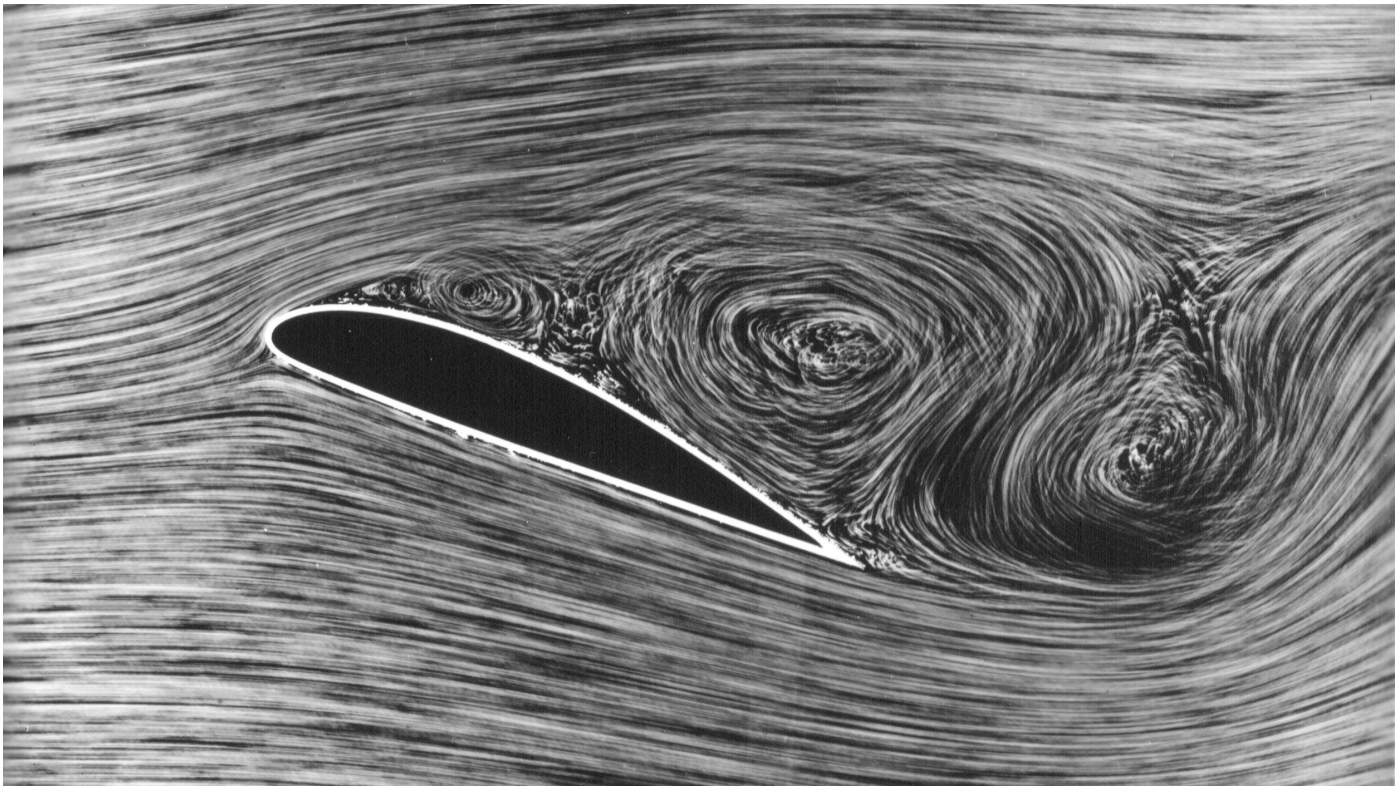
- *Micro Bird of Time* from J&H Aerospace
- *Doculam* from Adlam Films
- *New Stuff* from Aloft Hobbies
- *SoLite* from Solarfilm Sales

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Kinetic Theory and Lift

Every once-in-a-while it's helpful to return to first principles.

Peter Scott



Photograph of an airfoil in a wind tunnel showing separated flow over the top surface, taken in 1915. (image: Deutsches Zentrum für Luft- und Raumfahrt via Wikimedia under Creative Commons Attribution 3.0 Germany [CC BY 3.0])

On page 63 of the February 2017 issue of the UK magazine *Aeromodeller* I found an article by Stuart 'Supercool' Sherlock about Isaac Newton and aerodynamics under the heading *Fluid or Molecules*. It was very thought-provoking. On the UK BBC Radio 4 channel there was a comedy series about civil airline flying called *Cabin Pressure*. In the first episode, the hapless young man Arthur tells the crew that no-one really knows how planes can fly. They all tell him he's wrong but don't explain why. In the end, to shut him up,

Arthur is given the classic explanation involving air speeding up over the longer upper surface causing a pressure drop and hence lift. He then says "so 'planes can't fly up-side-down then?" Let's try to answer Arthur's question.

Kinetic Theory of Gases And Impulse

For those who are not familiar with the theory here is a brief summary: all gases are made up of tiny particles that we call molecules. At sea level the volume of the particles is about one thousandth of the volume of the gas. They move at random, on average at the speed of sound. They bounce off each other and solid objects. The hotter the gas the faster the particles move. Gases store heat energy in the form of this kinetic energy which increases with the square of their speed. The particles do not stick to each other but adhere a little to a solid surface. Hence the boundary layer on a wing. They bounce perfectly elastically, so no energy is lost that way.

Lift is a force. Stuart's idea was to analyse lift in terms of molecular motion as Isaac Newton apparently did. I started to wonder if this would help us understand lift better. Newton was fond of particles. He also said that light was made up of particles, which made everyone fall about laughing until the discovery of photons.

Newton showed that force is the result of a change in momentum. Momentum is mass times velocity mv. When a particle bounces off a solid boundary it imposes an impulse on it. An impulse, according to Newton, is a change in momentum and is equal to force times the time of contact. Newton's equation therefore is impulse Ft = mv. Divide through by t. As v/t is acceleration we get to the modern version of Newton's Second Law which is F = ma. A force, like all vectors, can be resolved into two (or three) components at right angles to each other.

The Atmosphere

We are at the bottom of a roughly 20km deep sea of air. At sea level the forces from the air particles are high, though our bodies are adapted to it so we don't notice it. A cubic metre of air has a mass of about 1kg. So a one square metre column of air 20km high has a mass of 10,000kg assuming the density steadily drops to zero. So each square metre has a pressure of about 100,000 pascals on it due to this air piled up on top of it. Each pascal is a newton per square metre. A newton (N) is the weight of a 100g medium apple (nice!) A kilogram weighs ten newtons. So each square metre has 100,000 apples on it or 10,000kg as suggested above. You can see that you only need a small change in this to create a large force. To generate a lift force of 1kg (10N) on a surface area of one square metre you only need a pressure difference between the upper and lower surfaces of 10/100,000 or a hundredth of one percent. A 5kg model with a wing area of 0.5m² will only need a 0.1% difference.

Yes, I had to check the data for that percentage figure again when I calculated it. So I tried again in older units where atmospheric pressure is 14 lb/square inch. There are 1550 square inches in a square metre. So there are 1550 x 14 or about 22,000lb force. There are 2.2lb in a kg so the answer is again about 10,000kg and 100,000N.

Phew!

It's All Particles

From now on we will only think in terms of particles not pressure. Does this help our understanding? Each wing surface has a force on it from the sum of the particle impulses. Some particles hit vertically but most bounce at an angle. In this case a proportion of the force acts vertically on the surface,

called a component. When stationary the upward and downward forces are the same so there is no lift. If there is to be lift the sum of these components acting down must be less than those acting up. This can be both from the number and the size of the impulses.

Particles in a hotter gas move faster. They can be speeded up by being hit by a surface moving towards them so increasing their speeds. That is how a diesel engine works. The rising piston hits and speeds up the particles. This heats the gas until it reaches the ignition temperature for the fuel vapour. As the hot gas pushes the piston down the piston surface moving away means the particles bounce back more slowly. This lowers the gas temperature and the piston absorbs the kinetic energy. It is also why the skin of a fast moving aircraft heats up.

Of course a wing has a thin stationary boundary layer attached to it. However it would seem logical to treat this layer as the surface of the wing as any impulses will be passed on at the speed of sound. This is similar to the fact that a surface that feels hard is actually mostly empty space made to feel hard by the repulsion between the outer layers of electrons on the surface and the finger pushing down on it.

Impulses on the Wing

Let us look at the impulses on the lower surface. When it moves forward with an angle of attack there will be a small rise in the size of the force from the impulses. The particles will crash into the lower surface harder as the wing hits them. For an incidence angle of say four degrees the upward component will be about 7% of the force (sin 4°). For a surface with a drooping trailing edge the effect will be larger. Flaps will make it larger still. We notice that when we lower flaps and the model's nose starts to rise. If it didn't also slow this would be fine. In fact we have to lower the nose to keep up airspeed as

the horizontal component of the impulses increase drag. There must also be a similar effect on the upward curve on the underside of the leading edge. Remember we only need a tiny change to generate lift.

What about the top surface? Classic theory from Bernoulli says that when a fluid, in this case air, is speeded up its pressure drops. Using kinetic theory this true fact can be viewed differently. The upper surface is longer. Therefore the particles are more spaced out. Therefore the impulses per unit area will be fewer and so will be the force per unit area, also known as pressure. Are there other effects at play? As a gas expands it cools. That is why you get condensation mist when you pop the cork from a champagne bottle. Perhaps the air above the wing is cooler than that below? The particles would then move more slowly and produce smaller impulses.

What about symmetrical aerofoils? Here clearly we have no lift due to the longer upper surface. All lift must be the result of angle of attack as described above. Extremely thin wings must rely on a modest angle of attack coupled with high forward speed. No doubt the air is heated below the wing as well, which will increase lift.

Gliders sometimes use turbulators in the form of a thread just in front of the leading edge, or shapes sticking out of the wing surface. These cause controlled turbulence over the whole surface instead of only behind the point where laminar flow breaks up. Does turbulence reduce impulses? It is neither more nor less random than normal flow. Perhaps the only advantage of turbulence is that it is predictable so the glider can be trimmed to fly closer to stall without unpleasant surprises if its flight is disturbed. I can't get my head round this so maybe someone else can suggest ideas based on kinetic theory?

Conclusion

So after thinking about kinetic theory it seems that lift is not caused by a single pressure effect. It is the result of many different effects. The proportion of each in the total lift will depend on airspeed, wing cross-section including camber and leading edge, angle of attack and possibly even temperature changes. But all are the result of the frequency and magnitude of the vertical components of the many particle impulses.

And the answer to Arthur's question (which isn't in the radio programme) is that when an aerofoil is inverted it loses the effect of the curvature of the upper surface. In fact there will be some negative lift from that effect. The changed angle of attack and the forward speed produce higher impulses on the new under surface which more than compensate for this.

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This is the first part of a two part series. Stay tuned for the October, 2021 issue of RCSD where you will find the second part Kinetic Theory and Drag. *Don't want to miss it? Join our* ***mailing list*** *and we will let you know when it's out. Now, 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****.*

Finding Lift

Some advice is timeless and universal.

Bob Dodgson



Outside my kitting shop on Camano Island, Washington in the early 1980s. (image: Bob Dodgson).

How many times have you heard someone at a thermal contest say, “I always get all the sink. Every time it’s my turn to fly, there is no lift.” Then, there are other people who seem to get their air times most of the time. What are the secrets that enable some flyers to find ‘lift’ nearly every time they fly? This article assumes that the contest is properly run so that sandbagging, the deplorable crutch of the small-minded and unsportsmanlike competitor, is not allowed. After all, anyone can max every flight if he only goes up on tow after seeing someone else spot the lift.

Without a doubt, great thermal flyers have a gift. Most of the skills involved,

however, can be learned. The four basic ingredients in thermal flying are:

1. Being decisive and knowing the most probable areas to look for lift at any given time and having the guts to go for it.
2. Being able to recognize workable lift, no matter how weak, when your plane passes through it, while not being seduced by turbulent air that is not workable.
3. Having a plane and the flying skills necessary to work the lift as efficiently as possible.
4. Knowing when to leave a dying thermal and when to push the stick forward and reflex the flaps to force the plane to quickly fly out of a bad area rather than to aimlessly flounder around in down air as the less decisive flyers are often seen doing.

Knowing where to look for lift is a lot like playing cards. The best players are the ones who keep track of what cards have been dealt so they can know what the odds are at any given time. A good thermal flyer watches the sky and the other flyers very carefully, trying to establish probable patterns in the lift cycle. This enables him to figure about what part of the sky is due to kick off a thermal when it is his time to fly. Sometimes if there is a massive sink cycle that is killing everyone, just trying a different part of the sky is about the best you can do. In general, unless you have sure knowledge of a thermal do not do your thermal searching way down wind. If you find a thermal downwind, you cannot ride it for long because your plane will soon be blown to the limits of vision. This is assuming that you have a good multichannel glider, sporting an airfoil with a good L/D (ideally with camber changing capability) so that you can get home from most downwind situations. If you do not find a thermal while flying downwind you can find yourself in big trouble very quickly. It is much safer to search for lift upwind or off to the sides.

Under most circumstances, it is best to fly the search pattern at or near the maximum L/D of your glider. This is usually about 3 or 4 MPH above stall speed and 1 or 2 MPH above the minimum sinking speed. Your maximum L/D speed is increased with ballast. For an unballasted *Lovesong* for example, the maximum L/D is about 20 MPH, for a *Lovesong* with 20 oz. of ballast the maximum L/D would be about 23 MPH. The maximum L/D is near but slightly above the minimum sinking speed so if you keep your glider searching at speeds that fall within the range of the minimum sinking speed and the maximum L/D, you will get the most possible air time if you do not find lift and you will cover the most possible sky, thereby affording you the best chance of encountering lift during the flight.

In strong winds, you may have to adjust your strategy. However, in many windy situations there are no standard thermals and you can get better times by flying slowly into the wind and doing a little dynamic soaring by altering your trailing edge (TE) camber at the right instants to gain energy from changes in the wind speed. In these situations, flying fast at a high sink rate in a vain effort to find a thermal is a losing strategy. On other occasions, when there is thermal activity in a windy situation, ballast up and put the TE in the 'move out' position and search the likely thermal spots. With this strategy, you are gambling on finding workable lift. Good flyers will usually make the best choice as to which strategy to use in a particular windy situation.

Watch closely for tell-tale signs of lift within a half mile radius of the field. We all know that a circling hawk, eagle, buzzard or even seagulls can be a dead give-away as to the existence of lift. Small birds like swallows can be just as reliable. They feed on small insects which can become air-born by thermals. When these swallows are darting around in a small section of the sky, they are probably defining the boundaries of a thermal for you. Sometimes you may even be able to spot a column of dust or even debris such as paper or

thistle-down in the air as a thermal indicator. If you suddenly find yourself climbing out on tow higher than is usual for the wind condition, you have probably encountered a thermal on tow. Go for it!

Wind shifts are another thermal indicator. A sudden temporary shift in the wind direction can indicate that a thermal is nearby and is sucking the air toward it. If the air suddenly warms and the wind dies, you may be standing in the 'eye' of a thermal. Sometimes you can see wind patterns in nearby tall grass that indicate multiple or circular wind directions, another thermal indicator.

Look for variations in ground cover and terrain. Areas that are dark will absorb heat faster than surrounding lighter colored areas and so will be likely areas to kick off thermals. Ridges can also help thermals break loose if there is a little wind. A slope facing the sun is another possible thermal generating area. We all know about the old standbys such as: parking lots and dark roofed buildings. If nothing else you can always try to slope soar off of the windward face of the buildings or a well defined tree-line.

Two of the most difficult things to learn in thermal flying are being able to recognize what lift is workable and then how best to work it. In general, as you all know, thermals start at the ground and spread out as they go up in a funnel shape. Then, the funnel goes down wind as it rises. The wind also blows the entire funnel down wind usually including the base of it. When you are climbing out in a small thermal at low altitude and following it down wind and it suddenly disappears, if you cannot re-center in it, try flying back to the spot that you first picked it up. The generating spot may be producing a thermal that breaks off down wind while the original spot is sending up another column.

If other planes are in a thermal and they are higher than you are, you should

look for the thermal upwind of the higher planes. You will normally have to follow the thermal downwind or else it will blow past your plane and you will end up on the down side of it. You'll want to get out of the down air fast. When you are high, or when working thermals that do not seem to have a noticeable core or 'hot spot' it is usually best if you work them in flat efficient gentle circle turns. Some thermals have tiny areas of strong lift that can best be worked by standing the glider on its wing tip while doing tight, fast 16 foot diameter circles centered in the "hot spot". This is the only way that you can climb out on some thermals, particularly at very low altitudes. Some gliders perform more efficiently than others in tight circles (this is one of the many aspects of performance that gets top priority in the kits I design). Other thermals seem to require that you fly an upwind climbing leg slowly and on the verge of a stall (not quite letting the plane stall) while whipping around the downwind turn quickly at a faster speed. At low altitude one stall or false move can spell the difference between a max flight and a premature landing. How you fly a multichannel glider through the turn is of utmost importance.

If you know that you are in lift but you are not climbing or you are not satisfied with your rate of climb, try varying your thermal technique to find one better suited to that particular thermal. also, be quick to re-center if your climb rate decreases. At altitudes under 30 feet, you can't afford to waste a move. So if you are not losing altitude with a thermal turn, you should probably stick with it. Many times if you fly out of a bubble, you can't find it again even if you have the altitude to try. Don't leave a productive thermal turn, especially at low altitude but you can try shifting the center of the turn slightly while you circle to find the 'hottest spot' for maximum climb. Keep in mind that some thermals disappear quickly so it is important that you concentrate all of your efforts to climb to a safe altitude as rapidly as possible. Don't relax just because you have found a thermal. This is not the time to start BS-ing with your timer or to casually saunter over to the landing

circle. Climb fast! You may only have one chance and a few precious seconds of good lift. Take advantage of it while you have it.

In general, a thermal will try to turn the plane away when it encounters lift so be quick to force the plane to turn into the lift. You may have to try several different circle locations before you are centered in the thermal. Some thermals even seem to have centers that shift, requiring you to re-center your plane several times during a flight. If you stop climbing, try to find a more productive area of the thermal while being careful not to lose the thermal. If you can't do better in that thermal, then get out of the dying thermal quickly and find another one while you have the altitude to do so.

There are some occasions when a fixed area is generating lift which you can't work well by any type of thermal circle. Sometimes these may be called 'waves' and they may be produced by wind after it has blown over a hill or ridge in a harmonic of the original air pattern caused by the hill. At any rate, smooth gentle flying with minimal control input is the best way to fly this type of lift if it is weak and smooth. Fly large flat turns and figure 8's to stay in the lift area but make as few turns as possible.

The best type of plane for thermal flying depends upon the skill level of the flyer. For beginners, a self-neutralizing polyhedral floater like a *Gentle Lady* is a good choice. As skills increase, then more versatile and higher performance gliders are called for. The top flyers and soon-to-be top flyers will find more room for growth and more possibilities in difficult situations if they are flying a high performance multichannel glider. This is how I felt when I came out with the *Todi* in 1972 and this philosophy has guided my designing right up to the design of our new *Saber*. With so many great flyers flying good multichannel machines now, you are really handicapping yourself if you stick with your polyhedral type glider too long. One theory is that if you fly polyhedral for more than two seasons, your brain atrophies and you then

are unable to make the jump up to serious multichannel flying (I said it was only a theory come on — lighten up!)

Having the best plane, however, will do you little good if you have not mastered the ship. The more sophisticated the glider is, the better you the flyer must be in order to harness the added capability. Become so familiar with it that your glider feels like an extension of yourself, and you don't even have to think about the mechanics of flying it. This frees your mind to help you fly each lift opportunity almost on instinct as your thermal skills increase.

One of the most important things to remember is that altitude is time and distance in the bank. Practice your tow technique until you are getting the highest tows that you can possibly get. Use a Casio altitude watch to compare how high you get with various launching techniques and stick with the launch technique that gives you the most height. You have all seen great last ditch saves where a flyer thermals out from a 30 foot high final approach. You may call this good flying but in most cases, if the flyer had flown the early part of his flight better he would not have had to rely on a last minute save. The most important part of a flight is the first minute, when you are the highest and your options are unlimited. Have a plan of action before you launch, based on your skilled observations over the half hour prior to your flight. Come off of tow aggressively. Don't give up a foot of altitude unnecessarily. When you are high and just off of tow, do not get sloppy! Fly as if you were only 30 feet off the deck. Do not waste this important part of your flight worrying about getting to the landing area. After you launch, move quickly away from the winches and then stop and concentrate on your flying and on your pre-decided strategy for finding lift.

Pick a timer who understands finding and working thermals. He should not try to fly your plane for you but he should concentrate on watching the entire sky and all the other gliders and signs of lift. You want a timer who knows

thermal flying well enough so that if another glider flies through lift (even if the other pilot doesn't know that he has flown through lift) your timer knows it and can tell you about it. It is important that your timer knows your capabilities as a flyer as well as the performance range of your glider. Several times, I have found myself timing for a polyhedral flyer and have spotted a thermal for him within easy reach. To my chagrin, he made too many turns before heading for the lift or his glider just did not have the sky covering ability that I was used to or he chickened out just before he reached the lift and so my advice only messed him up. I knew that my glider and I could have easily reached the lift without a second thought but I learned that when I am advising someone else, I must take their skill level, flying style and glider performance into account if I am to help them. A good timer is a most valuable asset, but some top flyers become so dependent on their timers and advisers that you begin to wonder if they could actually even fly without their entourage. Thermaling 'by committee' is one way to do it but I have more respect for flyers who can do it on their own even if their groupies are not with them and even if they have an unfamiliar timer.

Perhaps the one thing that really separates the great thermal flyers from the okay thermal flyers, is the ability to immediately recognize when to stay with a thermal, when to leave it and when to re-center in it. How many times have you seen a gaggle of flyers slowly circling down to the ground in what was a thermal only minutes before. The smart flyer left the thermal as it was breaking up and quickly and decisively went in search of another thermal while still high enough to do so, thus saving his flight. If a great thermaler encounters sink he will recognize it immediately and will not waste precious altitude floundering in it. One of the hardest things to do, when in sink, is to reflex the wing trailing edge and pour in down elevator and thus increase your apparent sink rate to get the plane moving fast so you can fly out of the sink as quickly as possible. Fly anywhere just get out of the down air.

Whatever you do, do not retrace your flight path and fly through the same down air that you have just flown through. Anything is better than that!

Great thermal flyers are decisive, smooth and attentive. They can work any air within a range of half a mile or more, speeding out of sink and maximizing any form of lift. The great thermal flyer expects to get his time whenever he goes up and he doesn't give up until he is on the ground. Climbing out at 15 feet of altitude is not an uncommon feat for the skilled thermaler be it on final approach or elsewhere. It is a common sight to see great thermalers like Dave Banks thermal his *Lovesong* or *Saber* out from a hand toss.

If you have the basic skills and the best thermaling machine to fly, you can spend a lifetime improving your thermaling skills, learning to work lift that you could not work the year before or even the week before. You will find your decision making improving so that you can now salvage 'max' flights out of air that is eating everyone else alive. The thrill of thermal competition flying is that there is no end to how far you can go, each flight is a totally new challenge to be optimized. The person who best optimizes each flight opportunity is the one who wins the most contests. This personal growth in thermaling skill is to me the ultimate and ever-new thrill and joy in soaring.

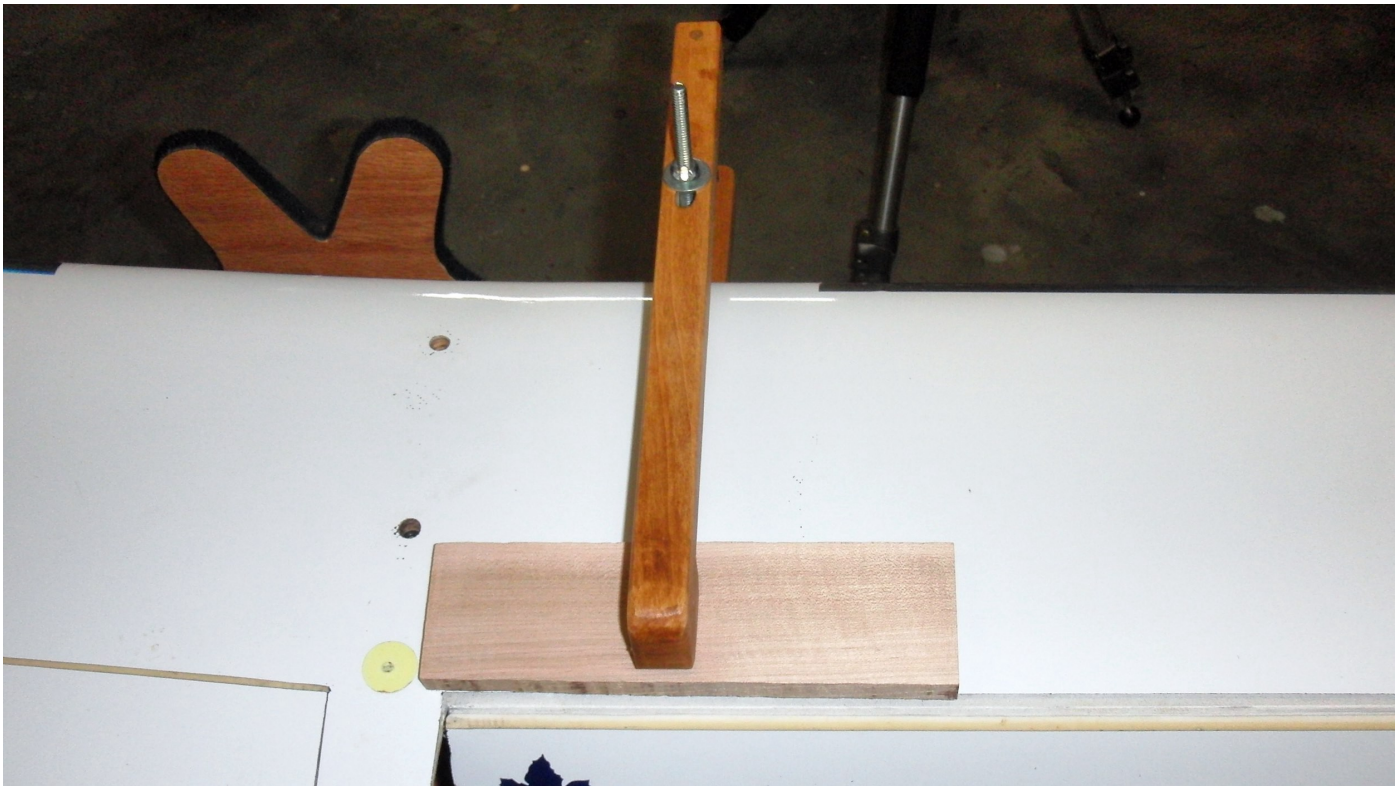
©1990

As part of RCSD's arrangement to publish Bob Dodgson's autobiography in a series of article, he kindly afforded us the opportunity to publish (or in some cases, re-publish) his past articles. This will be the first of many. Read the ***next article*** *in this issue of RCSD, 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****.*

Long Reach Clamp

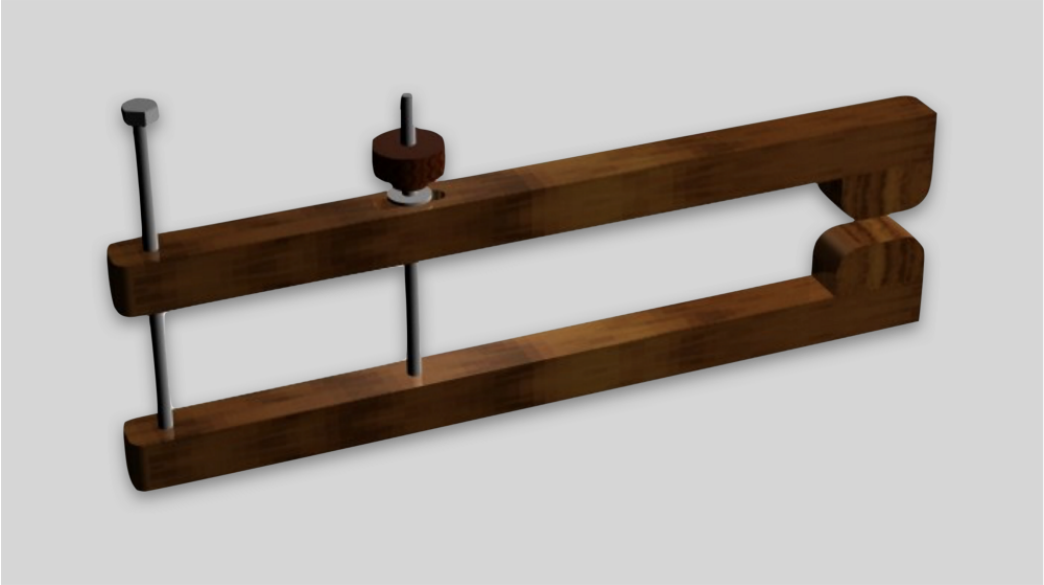
When the reach of an ordinary C-clamp simply won't do.

Tom Broeski



The Long Reach Clamp works great on a trailing edge spar, for example.

It started when I needed to glue a trailing edge spar and wanted full access to the inside of the flap space. There have been many times I have had need of a deeper clamp than I had access to.

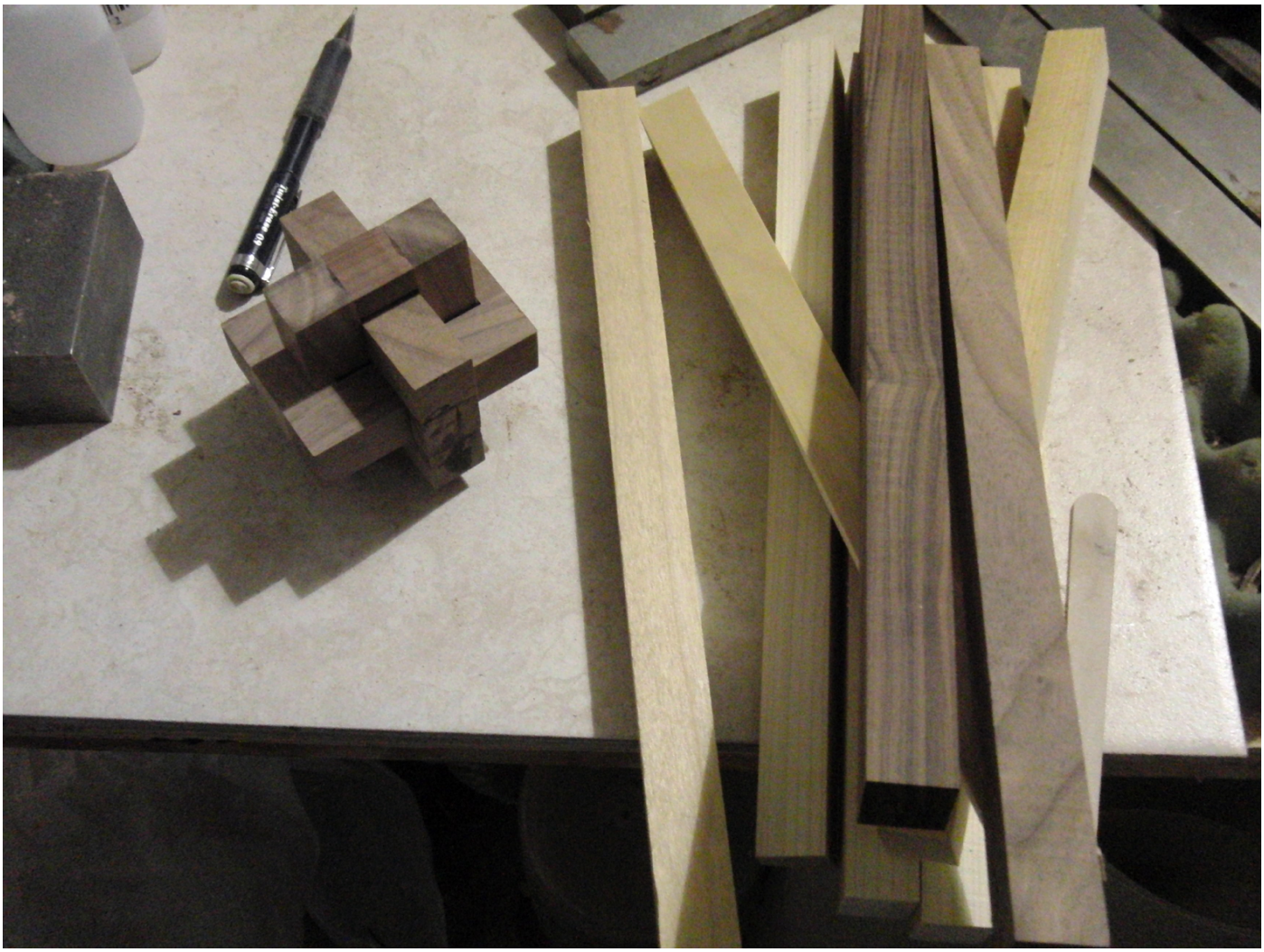


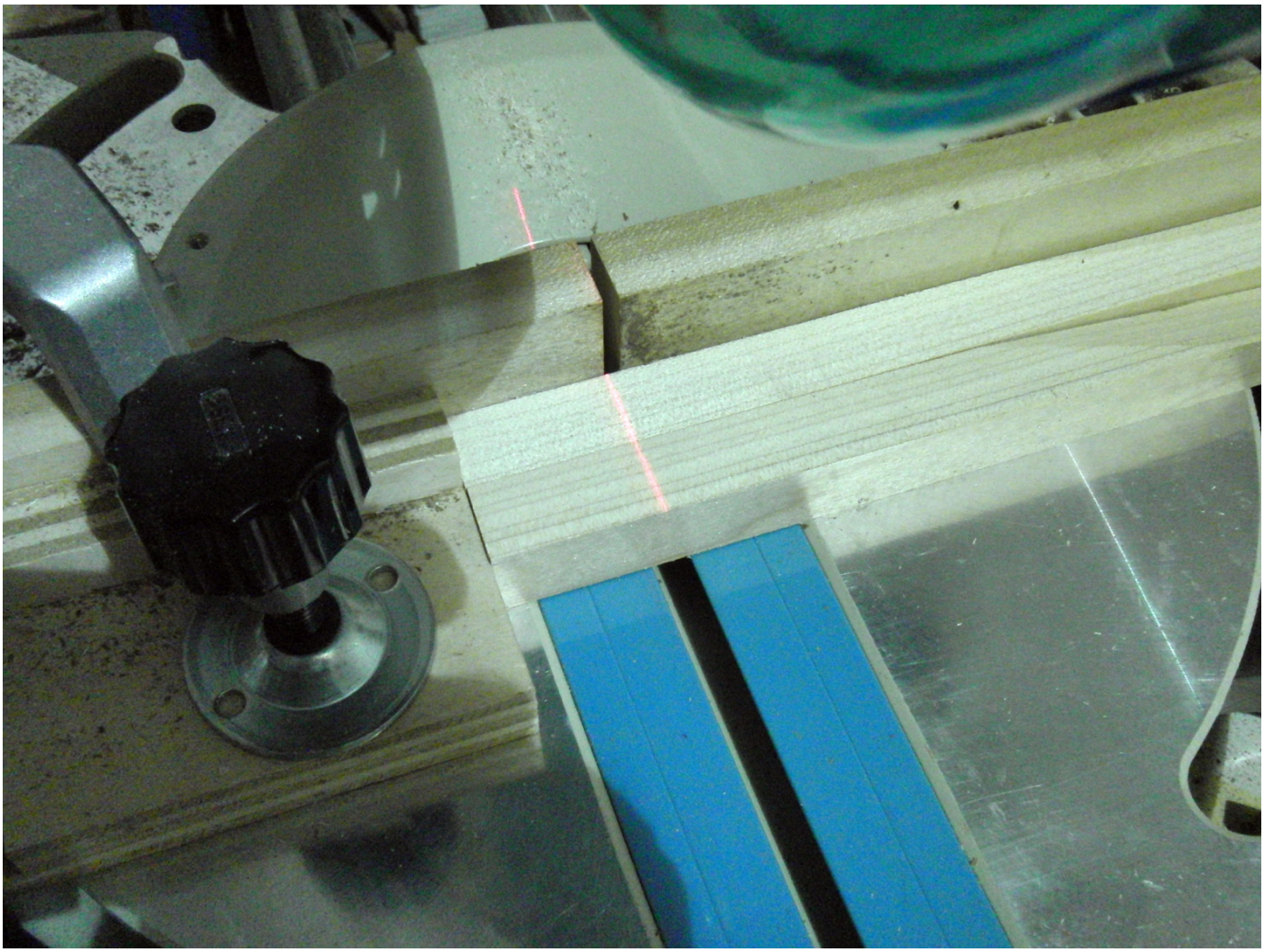
So…I came up with this very simple, easy to make clamp. A bit more versatile than the standard wood or fiddle clamp. The size can vary depending on how you want to use the clamp. I made 12" clamps because that was the material length I already had left over from making a bunch of wooden puzzles and it would suit my purpose.

Materials List

- 2 — 3/4" x 3/4" wood what ever length you prefer
- 2 — blocks 3/4" x 3/4" x 1 1/2" (optional)
- 1— 1/4–20 hex head machine screw fully threaded (4" to 6" or longer)
- 1— 1/4–20 carriage bolt fully threaded (4" to 6" or longer)
- 1 — 1/4–20 wing nut or knob
- 1 — washer

First cut the stock to length and cut the jaw blocks:





Mark the center bolt holes. The rule of thumb would be 1/3 of the stock length for leverage. I made one 1/4 of the length and it worked fine also. I easily got over 20 lbs of pressure from both. Drill 9/32" hole through the base piece as shown. I made multiple clamps to experiment with, so you can ignore them if you only want one.


Choicewood
POPLAR
1 x 8 x 6



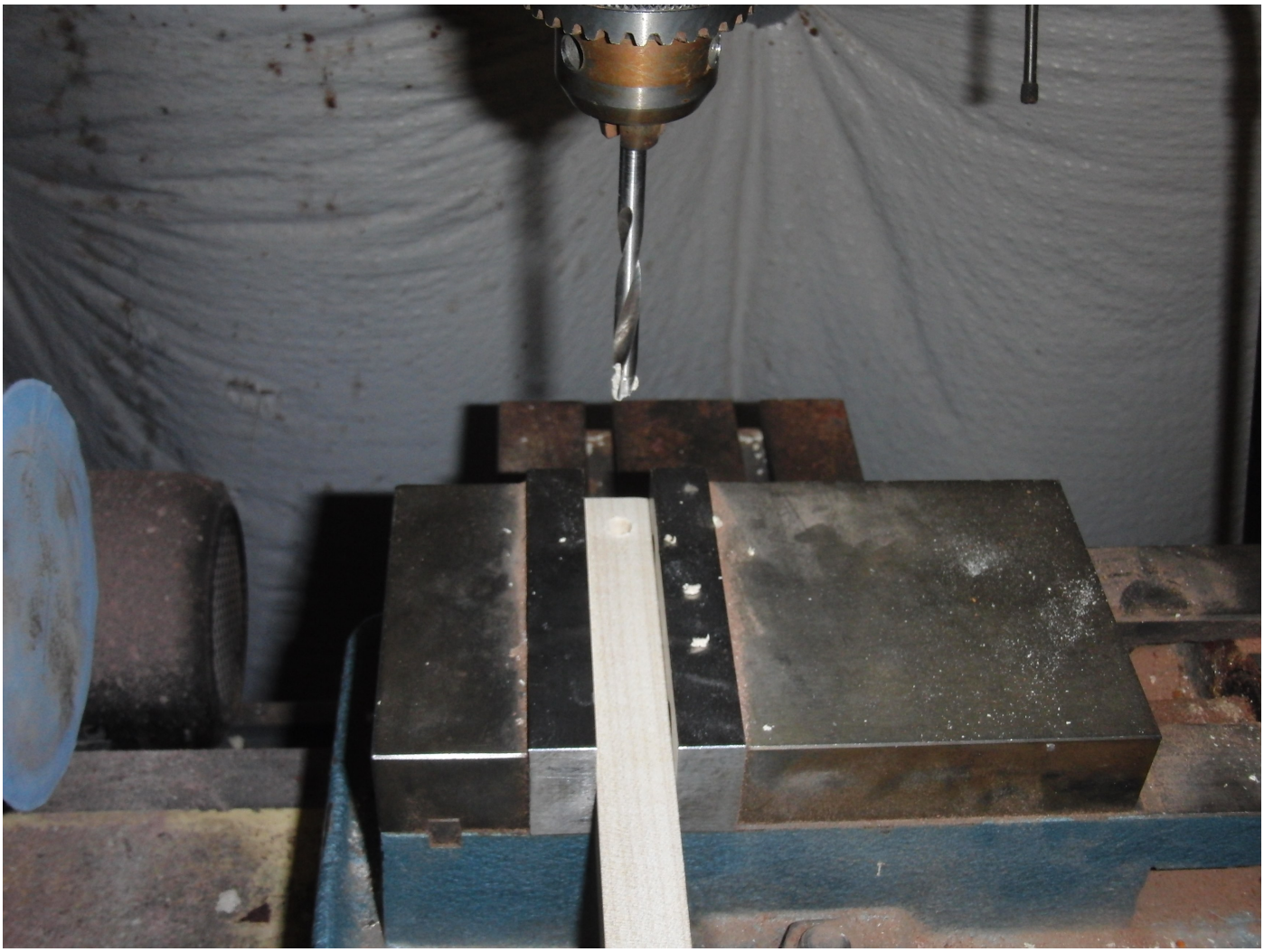
Mark for the slot — 3/4" to 1" wide. This helps keep the screw from jamming when at different angles during clamping. Drill a 5/16" hole at each end of the slot. Drill out the stuff in between. It is cleaner if you use a knife and score down the sides between the holes.

Mark for the end holes. By the way, I used the center finder (from a previous tip — see *Resources* below) a lot.



Stack the two pieces and drill a 7/32" hole through the top piece and deep enough to mark the bottom piece. Remove the top piece and drill the bottom piece half way through with a 9/32" bit. Thread the top piece with 1/4–20 tap. You can use the bolts if you don’t have a tap. Harden the wood threads with CA. If you only have soft wood, you can use 1/4 -20 threaded inserts, but I did not find it necessary with the wood I had.

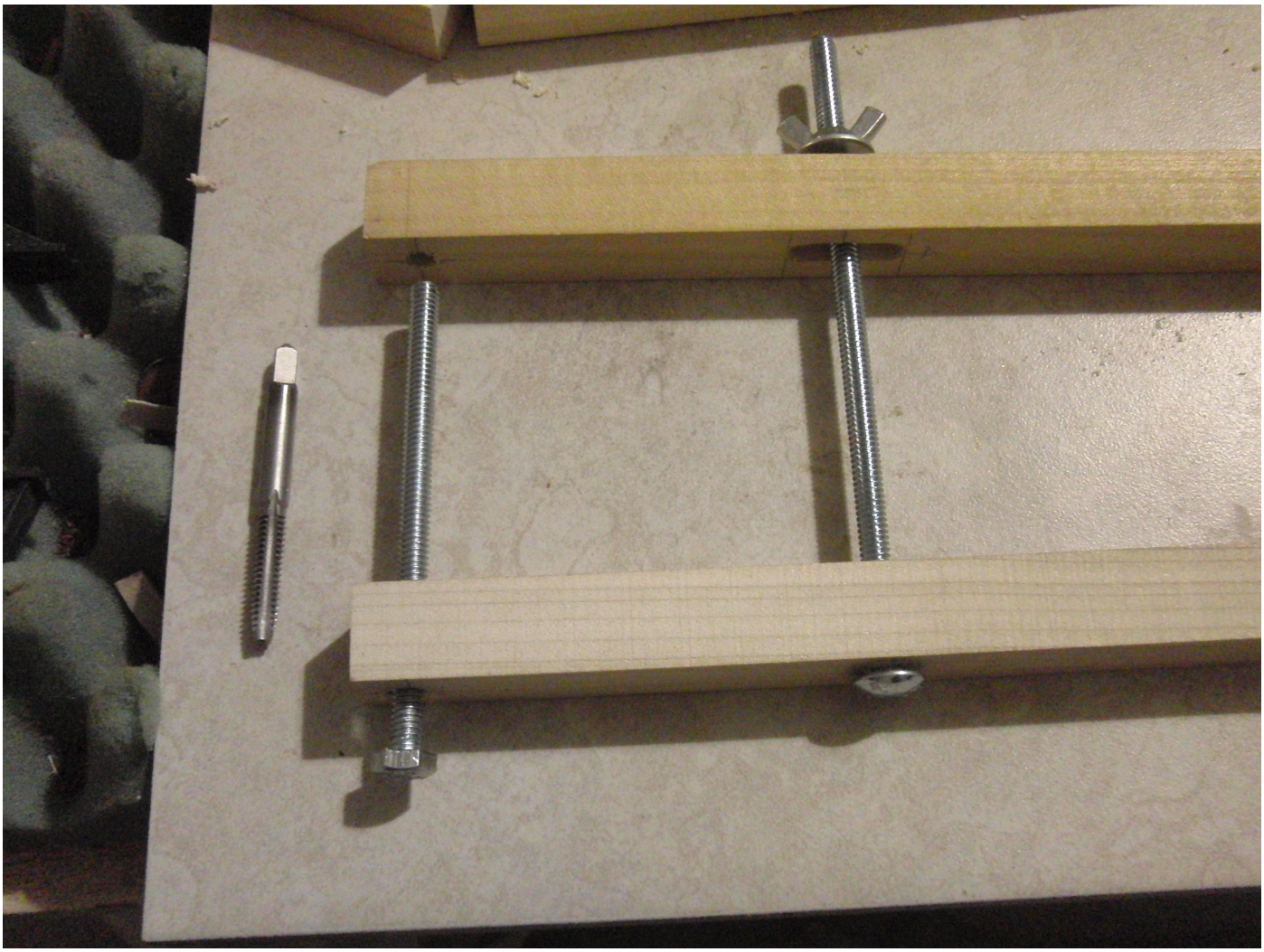






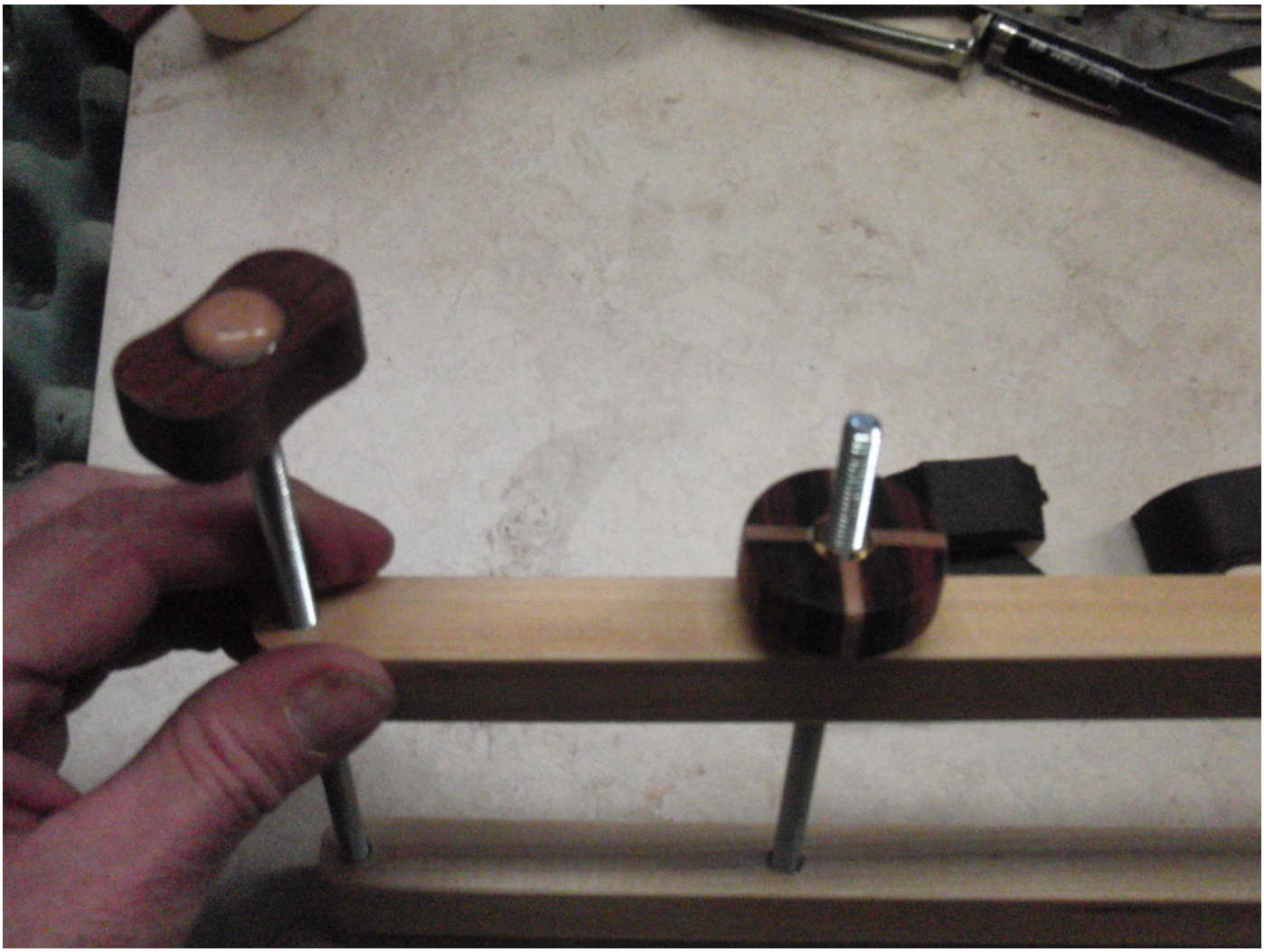


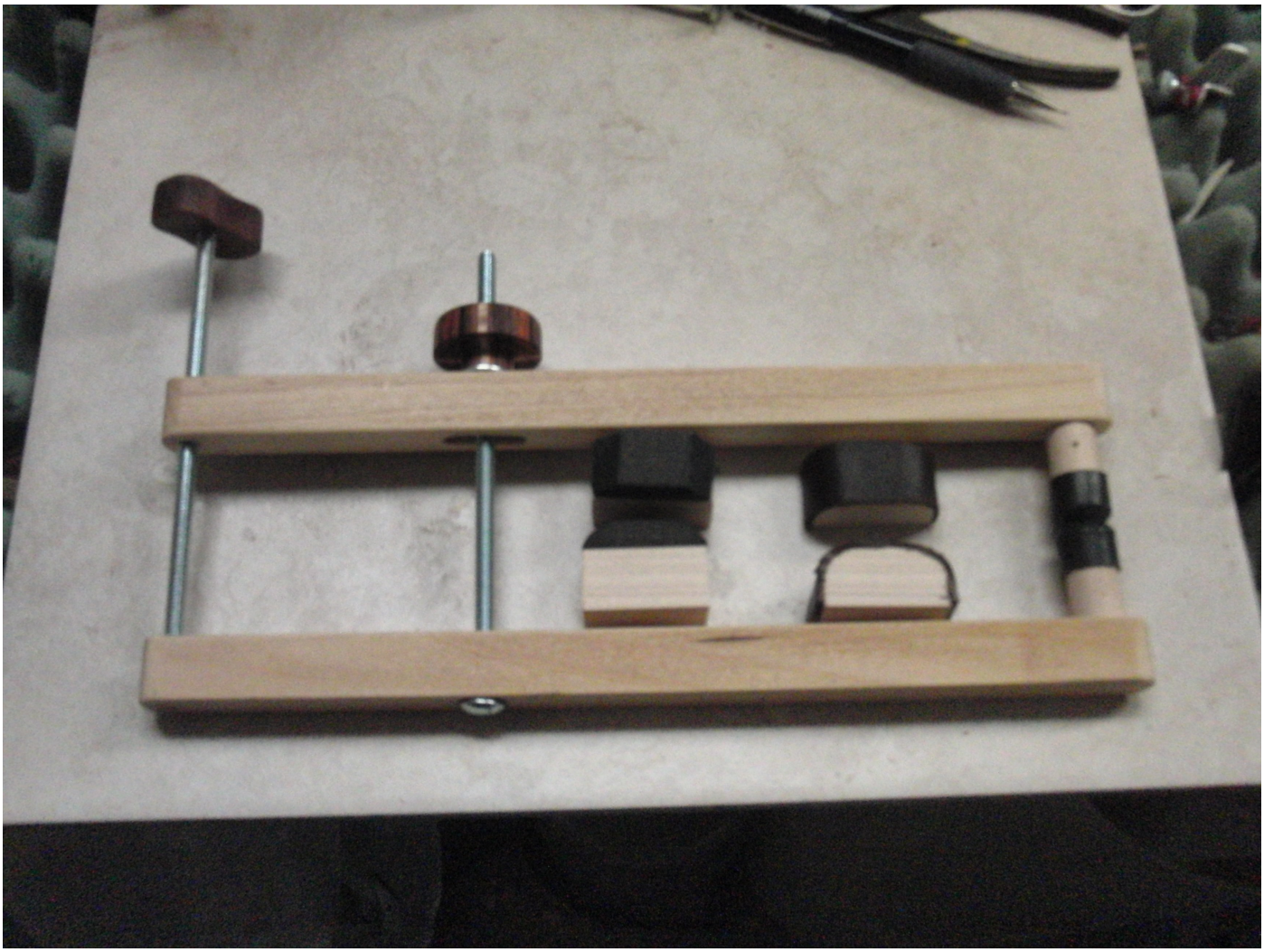
Assemble the clamp. Threading in the hex bolt, sliding in the carriage bolt, adding the washer and wing nut. The total time to make the first clamp was about a half hour. The first one I threaded the base hole putting the knobs on opposite sides. This was similar to a machinist clamp I made 25 or so years ago. All the rest, I put the threads on the slotted bar, so the knobs were on the same side.



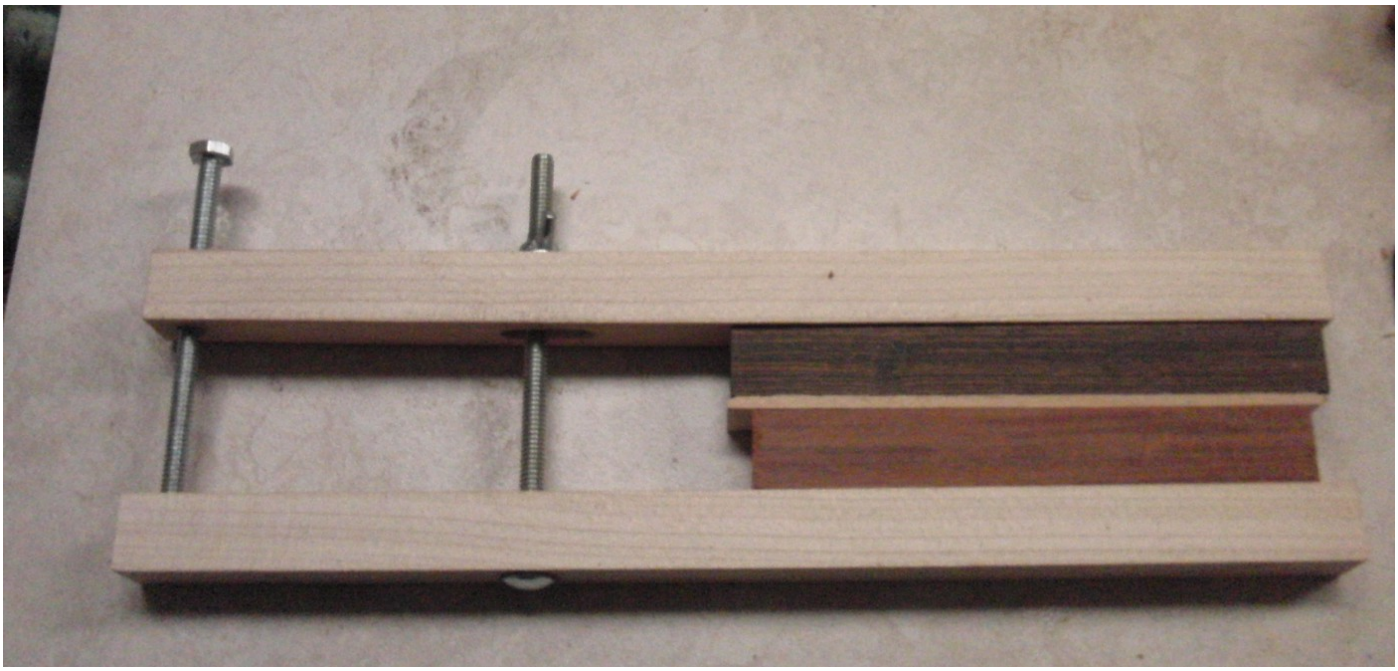


You can go crazy with all the options as far as knobs and jaws go. Foam blocks, leather blocks — whatever works best for you and the application you have in mind.

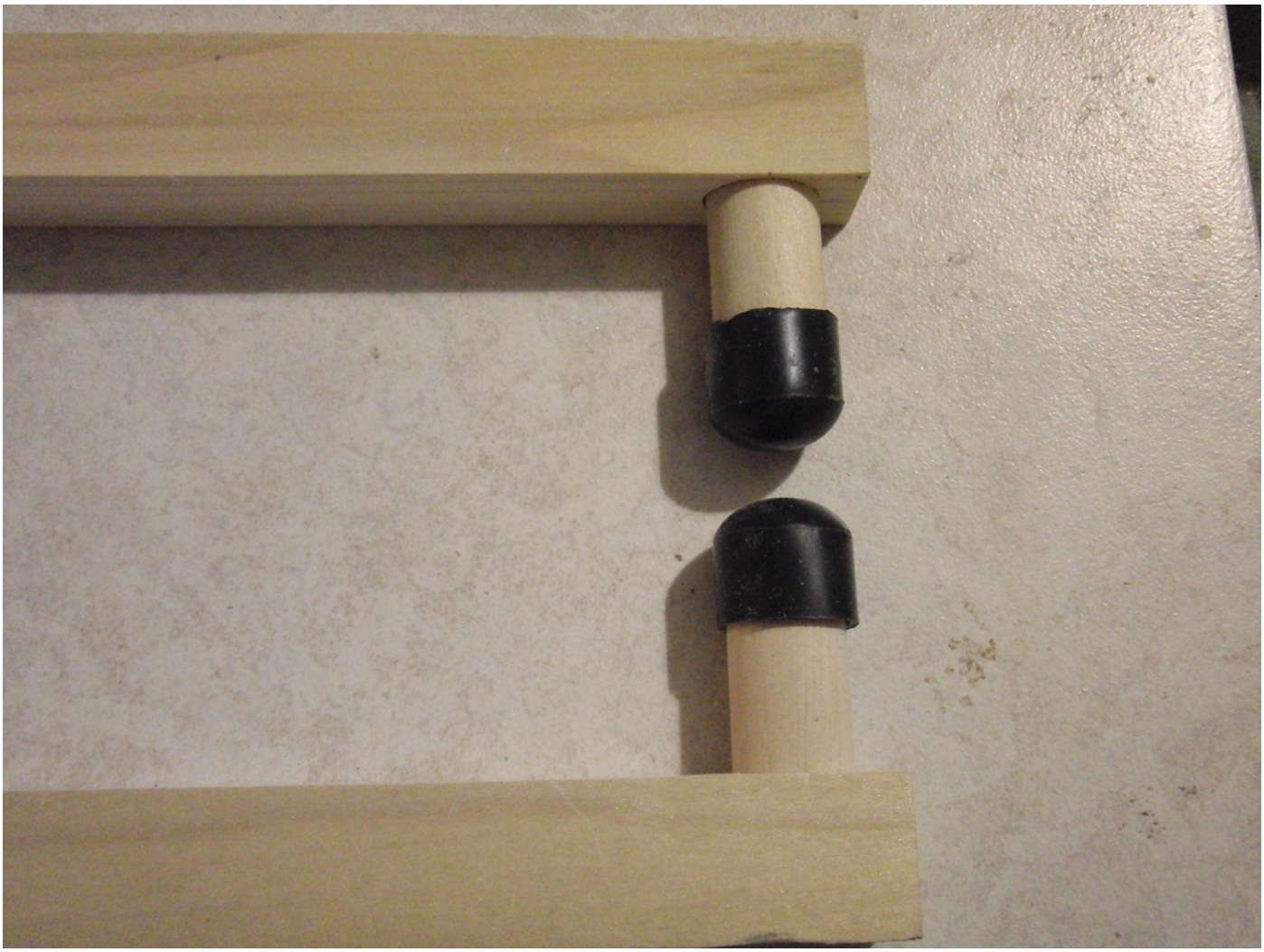




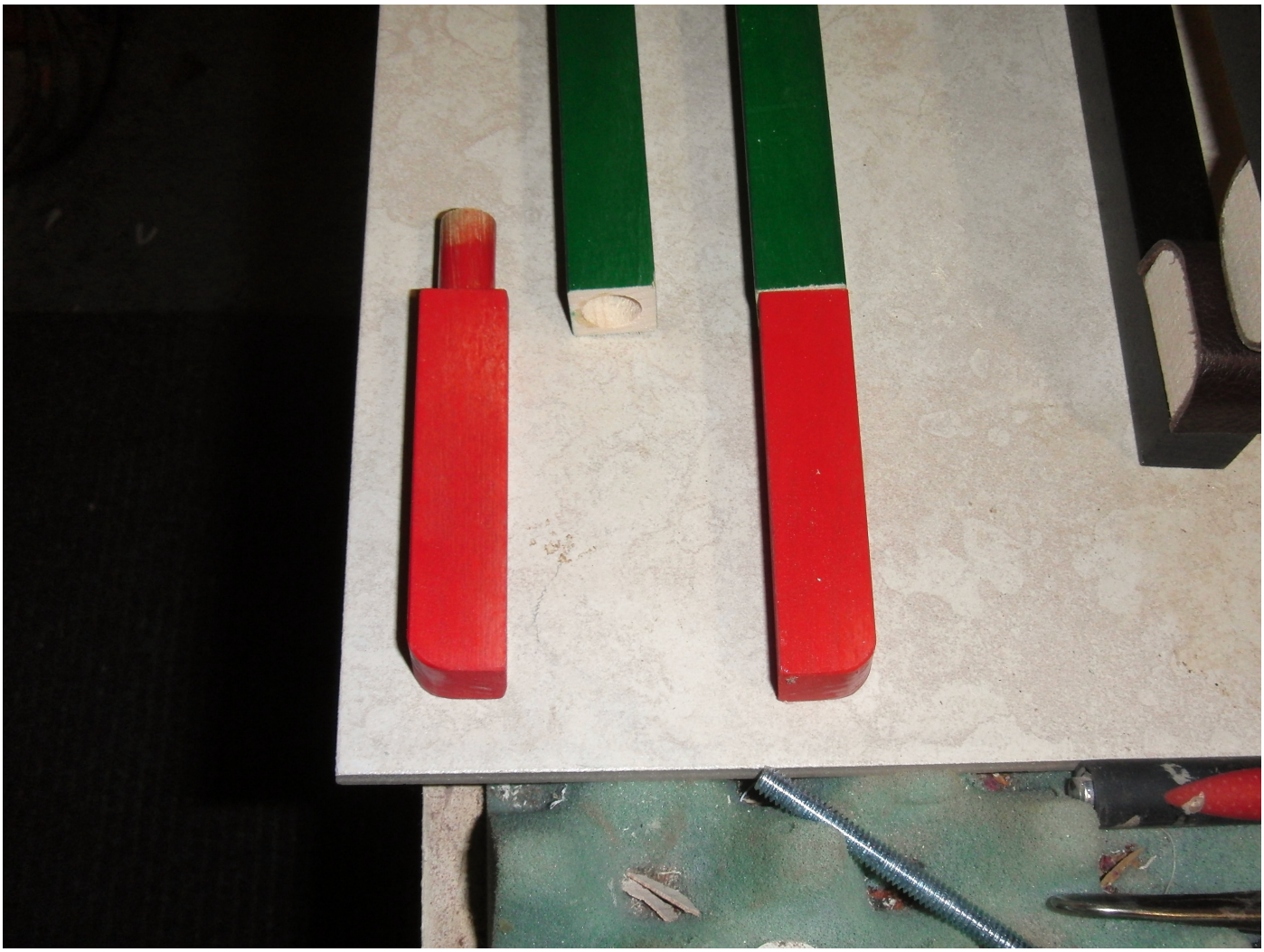
A simple flat clamp came in handy for gluing puzzle blocks and strips together.

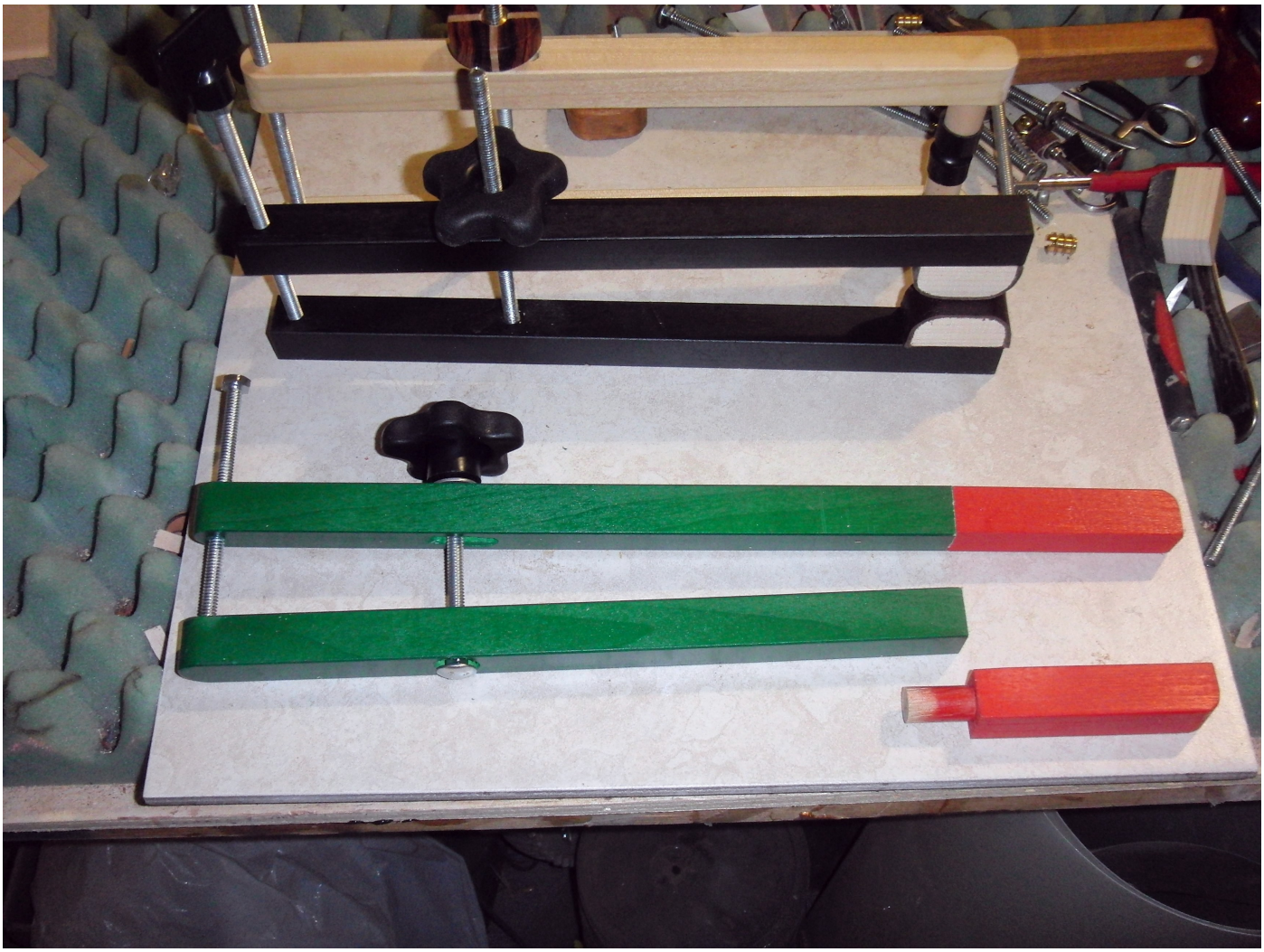


Dowels with rubber caps worked great, as well.



At Christmas I decided to see if I could do some extensions to make a longer clamp for occasional use when needed. I used 1/2" oak dowel and drilled in an inch into each piece. Glued the dowel into the extension. Since the clamp is hardwood, it worked great. Got 20 lbs on the scale. Still CA'd the hole to add that extra bit of strength.





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

As always, have at it and feel free to share your ideas or improvements by leaving a comment below.

'Til next month!

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Resources

- *Center Finder* from the June, 2021 issue of RCSD.

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

1/3 スケール三田式 3 型改 1 製作記

マルチパートシリーズの第6部。

Norimichi Kawakami



*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5部** を読むことをお勧めします。*

製作その19 垂直尾翼の完成

垂直尾翼は2018年6月に木地完となっていましたが、その後実機写真を良く見ると垂直安定板下部の形状が製作したものと若干異なることが判明したので、修正を施した上でカバーリング・塗装・マーキングを行って完成させま

した。

カバーリング、塗装及びマーキング

絹目調のオラカバ（オラテックス）でカバーリングしました。その後全体を艶消し白色のアクリル塗料で塗装し、ラダー上部は赤に染めました。JAナンバーは参考にした元東海大学が所有していた実機と同じJA2103としますので、尾翼には末尾２桁の03のシールを作成して貼りつけました。

こうして、垂直尾翼が完成しました。（画像111）


03



画像111 完成した垂直尾翼

かなり実機感があります。完成重量は胴体への２本の取付ボルトを含めて222ｇでした。予想重量を10ｇ超過しました。因みに木地完状態での形状（画像21 第2部）と比較すると安定板の下部形状の違いがわかるかと思いま

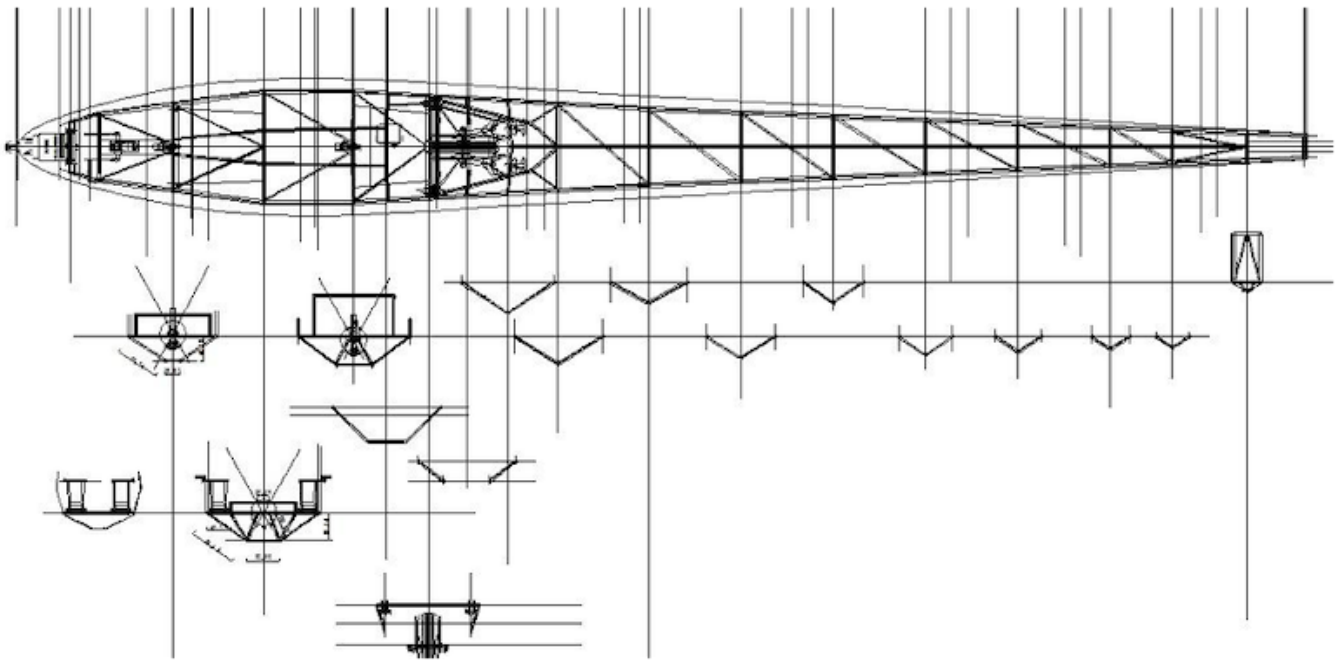
す。実機では、新たに取り付けた部分に水平尾翼との交点に跨る樹脂製のフェアリングの後部を挿しこむようになっています。

製作その20 胴体下部張出構造

胴体下部張出構造とは

三田式3型改1の胴体は断面形が矩形の主要構造の上下に、細い鋼管で張出構造が取り付けられています。その内今回は下部張出構造を製作しました。図面29に示します。前胴の下部は前後席間の操縦桿連結棒や主車輪が取り付けられますので、それらをカバーする為に張出構造は台形形状をしています。これに対して後胴部分の張出構造は単なる三角形状です。この張出構造は強度部材ではなく、単なるフェアリングの役割しか持ちませんので、当初これらはΦ4mmの木製の丸棒で製作しようと考えました。木製ならば電波障害の心配も無い上に軽量且つ低コストだからです。

しかし一部部品を作り取り付けてみると、剛性が不足することが判明しました。これではカバーリング時に表皮の張力で丸棒が撓んでしまう恐れがあります。そこで同径のカーボンパイプで製作することに変更しました。



図面29 胴体下部張出構造

製作

カーボンパイプでの製作となると、胴体主要構造の製作と同じ手順を踏むことになります。まず、前胴下部用の台形部材の一部となる部品を、下のような治具を作ってその上で製作しました。



画像112 前胴下部構造用部品

この部品は一見すると平面形状ですが、中央付近で折れ曲がっていますので、治具が必要だった訳です。写真では判りにくいですが、治具は山形をしており向かって右側が下り坂になっています。

この部品と後胴張出構造の組立は中心線を正確に出す必要があるので、簡単な組立治具を作りました。組立治具の上で張り出す構造を組んでいる状況が画像113です。胴体をひっくり返して下部を上にしています。写真では簡単な作業に見えますが、数十本の部材をカーボンパイプから切出して長さを合わせ、端面を組み合わせ形状に加工するのは意外に面倒な作業でした。



画像113 胴体下部張出構造の組立

下部張出構造の完成

何とか全部品を切り出して組立を完了しました。





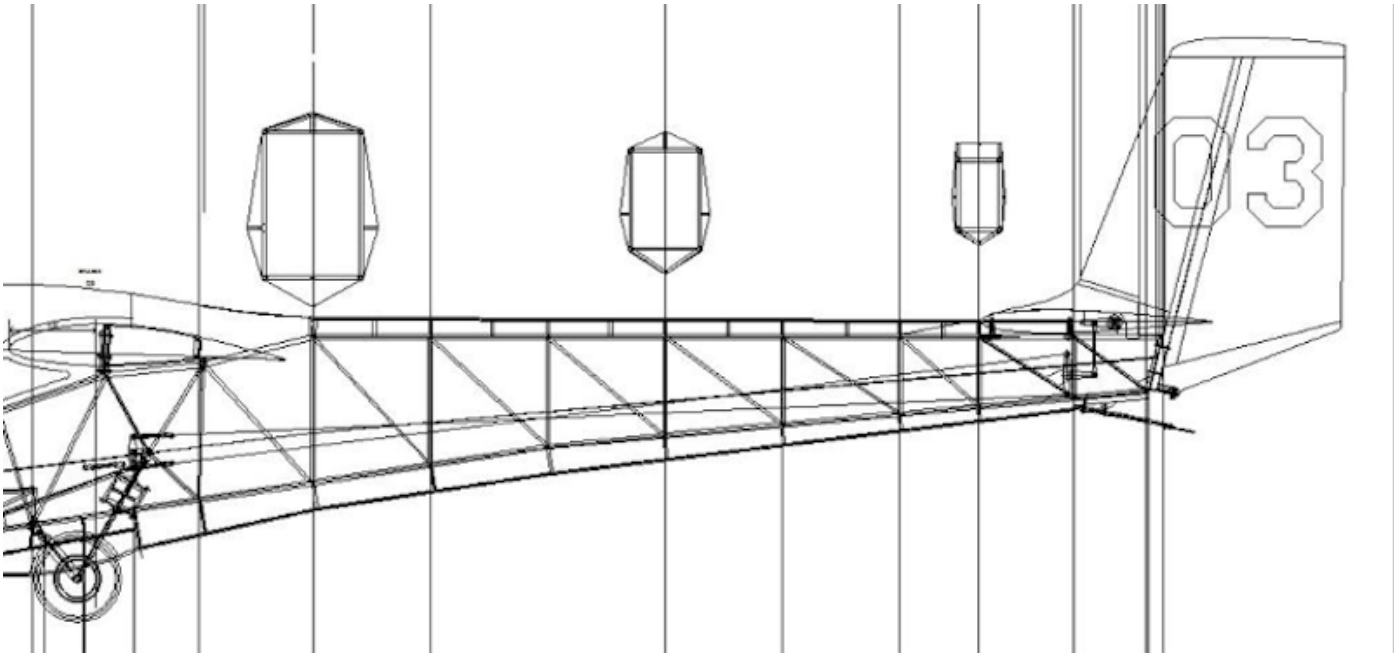
画像114 完成した胴体下部張出構造 左＝前胴 右＝後胴

実は主車輪周りの構造は未だできておりません。この部分の構造の詳細が良く判らず図面が書けない状態だからです。静岡航空資料館に支援を依頼して詳細写真を送っていただくお願いをしました。

製作その21 胴体上部張出構造

胴体上部張出構造の図面

前胴にはコクピットが在りますので、上部張出構造は後胴にしかありません。構造は下部張出構造に比べてずっと単純です。



図面30 胴体上部張出構造

羽布を被せた完成形では下部張出構造と同じように三角形を形作りますが、下部構造が前後に走る梁を胴体主要構造から伸びる2本対の斜め部材で支えているのに対して、上部構造は一本の垂直な柱で支えるだけです。但し、梁の先端はL型チャンネルで組んだ山形のトラスに支えられます。中央翼に被さるフェアリングの後部がこのL型チャンネルに挿しこまれて固定されます。

また後端は、水平尾翼にきれいに繋がるように形状が三角形から矩形に変化します。そのため梁の後端は木製の矩形形状フレームで支えられます。三角形状から矩形形状へ連続的に遷移させるために、この矩形フレームの前には胴体主要構造の上部2本の梁上に三角形の木板が前後方向に載せられています。

製作した上部張出構造

先端の山形トラスはアルミのL型チャンネルで作りました。



画像115 胴体上部張出構造の前部

後部の木製矩形フレームと三角形の木板は4mm厚バルサで作りました。ついでに水平尾翼と胴体の間を塞ぐ板も作って取り付けました。



画像116 胴体上部張出構造の後部

前後に走る梁は下部構造の製作と同じように位置決め治具を作って梁の位置を正確に保ちながら柱を建てました。こうして上部張出構造が完成しました。



画像117 完成した胴体上部張出し構造

治具のお陰で梁が真っ直ぐに通りました。張出構造を付けると一段と実機形状に似てきてテンションが上がり、側方張出構造の製作が楽しみになりました。

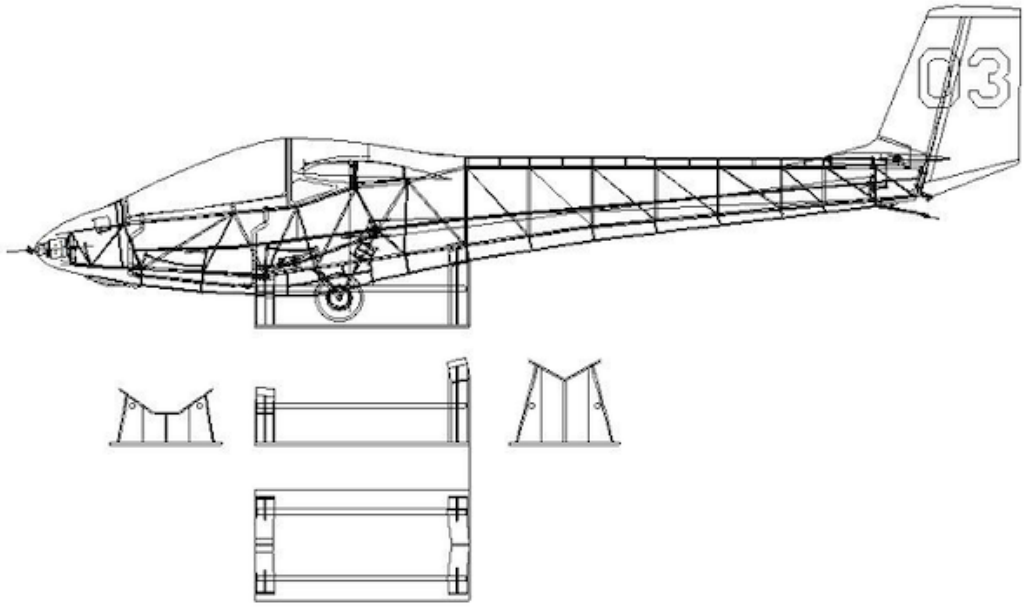
製作その22 胴体架台

三角形状をした下部張出構造を取り付けた為に胴体が自立できなくなりました。このままでは側方張出構造の製作がやりにくいので胴体を支える架台を作りました。

胴体架台の設計

架台は今後の作業に使うだけではなく完成後の保管や運搬にも使えるよう

に、主脚を取り付けた状態でも胴体を支えられるように設計しました。



図面**31** 胴体架台

前胴と後胴の2か所を支える構造です。前胴下部は台形、後胴下部は三角形なので受け構造の形状を変えてあります。できるだけ軽く且つ充分な剛性を有する構造様式になるように配慮しました。また、架台に載せた状態で機体が水平になるように設計しました。材料は主に4㎜厚のシナベニアで、持ち上げ易くするために15Φの丸棒の取っ手を長手方向に付けました。

完成した架台

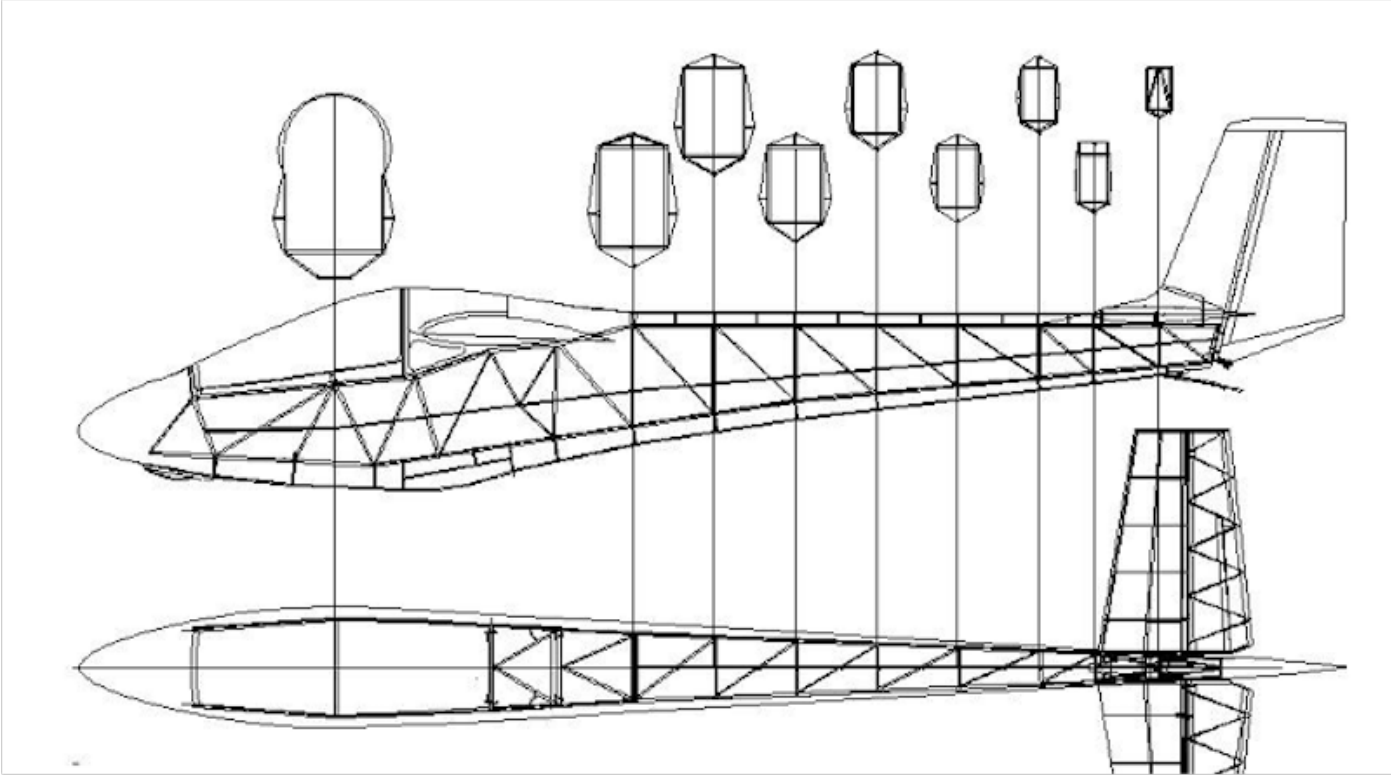
構造が簡単なので容易に部品切出しや組立ができました。こんな感じで胴体を載せます。



画像118 完成した胴体架台

製作その23 胴体側方張出

三田式3型改1グライダーには胴体の側方に木製の細い張出部が在って、一つのアクセントになっています。張出は機首のFRP製カウリングの直後から胴体最後尾まで、左右各一本づつ通っています。上から見たときは前胴部分は曲線を描き、後胴では略直線形状をしています。側面図では二か所で折れ曲がった3本の直線形状です。因みに厚さは4㎜程度を想定しました。



図面**32** 胴体側方張出

側方張出の製作

製作にあたって材料を何にするか迷いました。当初はシナベニアを考えましたが重いのが難です。一旦はバルサに決めましたが、張出なのでぶつけることも覚悟しなければなりません。バルサでは凹んでしまう恐れがあります。ホームセンターの木材売り場を物色していたら手ごろな材料を見つけました。桐の集成材です。30×6×900のものが一本100円程度で売っていました。これならば軽く適度な硬さもあり、何よりも安いです。只、若干厚いのでこれをカンナで削って4㎜強に仕上げることにしました。

図面から型紙を作って桐板に貼りつけてカッターナイフで切出しました。胴体構造に貼りつけるのに少々手古摺りました。正確な位置決めがやりにくいのです。そこで簡単な位置決め治具を作ってその上に張出構造を載せてから、瞬間接着剤で胴体トラス構造に貼りつけました。（画像119）



画像119 簡易位置決め治具による側方張出の取付作業状況

このようにして胴体左右に貼りつけて完成！と思ったのですが、そうは問屋がおろしませんでした。張出構造は薄板で且つ長いので直線に通すことがかなり困難です。位置決め治具は両端の位置を決めているだけで、中央付近はフリーです。後胴部分に取り付ける部分は幅が10㎜にも満たないのに、長さは900㎜近くあってどうしても曲がってしまいます。出来上がったものを後から透かしてみると、直線であるべきところがカーブを描いています。仕方がないので折角作ったものを取り外して、今度は糸を張ってそれに沿って取付直しました。

完成

手間取りましたが何とか完成させました。（画像120）



画像120 胴体側方張出の

4㎜厚の張出板をカーボンパイプに突合せ接着しただけでは少々不安なので、バルサの小さな三角材で上下から押さえています。尚、大きな三角材が見えるところはアクセスドアが付くところです。胴体左側の中央翼直下にアクセスドアがあって、内部の整備点検ができるようになっています。後日ドアの製作を行います。これが2018年最後の工作になりました。

動力システム再考

以前検討し一旦結論を出して購入も済ませていた動力用モーターについて、検討不足が気になり再検討しました。

パワー対重量比

先に動力システムを検討した時に必要なパワーを重量1Kg当たり130Wとしました。しかしもう少しこの値について調べてみると少々不安になってきました。サイトでいろいろ調べてみると国内には余りデータが見つからないのですが、海外では沢山の報告があります。しかし、サイト毎に微妙にデータが異なります。或るサイトAでは次のように述べています。

Rule of Thumb for power weight ratio （パワー対重量比の目安）

- 25 Watt/lb = minimum for level flight, with a reasonably clean plane.（55Watt/Kg = 充分抵抗の少ない機体の水平飛行に必要な最低値）
- 50 Watt/lb = Trainer/Casual/scale flying（110Watt/Kg = 練習機/カジュアルな機体/スケール飛行）
- 75 Watt/lb = Sport flying and sport aerobatics（165Watt/Kg = スポーツ飛行およびスポーツアクロバット飛行）
- 100 Watt/lb = aggressive aerobatics and mild 3D, effortless loops from level flight（220watt/Kg = 果敢なアクロバットおよび穏便な３D飛行、水平飛行からの容易な宙返り）
- 150 W/lb = all out performance.（330Watt/Kg = 全性能を発揮できる）
- 200 Watt/lb = Unlimited high-speed vertical flight（440Watt/Kg = 無制限、高速、垂直上昇飛行）

他のサイトBでは次のように述べています。

- 50–70 watts per pound; Minimum level of power for decent performance,park flyer/slow flyer models （110–150Watt/Kg,

パーク飛行機/低速飛行機がまともに飛べる最低レベル）

- 70–90 watts per pound; Trainers and slow flying scale models（150–200Watt/Kg,練習機および低速飛行のスケール機）
- 90–110 watts per pound; Sport aerobatic and fast flying scale models（200–240Watt/Kg,スポーツアクロバットおよび高速飛行のスケール機）
- 110–130 watts per pound; Advanced aerobatic and high-speed model（240–290Watt/Kg,高等アクロバットおよび高速機）
- 130–150 watts per pound; Lightly loaded 3D models and ducted fans（290–330Watt/Kg,低翼面荷重の3D機およびダクテッドファン機）
- 150–200+ watts per pound; Unlimited performance 3D and aerobatic models（330–440Watt/Kg超,無制限3Dおよびアクロバット機）

グライダーについて直接の言及はありませんが、サイトAによれば110〜165Watt/Kg程度で良さそうに見えますが、サイトBによると少なくとも150〜200Watt/Kgが必要に見えます。つまり、サイトAに従えば先に設定した130Watt/Kgで良いが、サイトBでは不足と言うことなります。重量も当初の目標重量よりかなり増えることが確実なので心配になり出しました。

所有するグライダーのパワー重量比

そこで、私が所有するグライダー等のうち、比較的大型の1/5スケールクラスの機体のデータを纏めたものが下表です。

	1/5三田式3型改1	1/5MDM-1 FOX	1/5Minimoa	1/5ASK-18	1/6Grob G109	Grob G109A 実機
重量 W 〜Kg	2.765	2.797	3.2	2.167	3.555	850
翼幅 b 〜m	3.2	2.8	3.4	3.2	2.77	16.6
モーター	FSD FC4250-7T	OS OMA-3820-960	FSD FC4250-7T		OS OMA-3825-750-W	Limbach Engine
KV値	710	960	710	910	750	2,400cc
重量 g	198	160	198	110	195	90hp
LiPo セル数	4	3	4	4	4	
容量 〜mAh	2,600	2,650	3,300	1,800	3,300	
プロペラ 直径×ピッチ 〜in	14×8	14×8	14×8	13×6	12×8	
消費電流 〜A	35.9	50.1	39.82	22.65	41.91	
電圧 〜V	14.43	10.77	15.15	15.41	14.64	
消費パワー 〜Watt	518	540	603	349	614	67,000
比パワー 〜Watt/Kg	**187**	**193**	**189**	**161**	**173**	**79**

表**9** 所有するグライダー等の搭載パワーデータ

概ね160〜190Watt/Kgのパワー重量比（比パワー Specific Power）にあります。これらの機体はパワー的に問題なく、一番パワー重量比の少ないASK-18が若干弱めの上昇率ですが、他はGrob G109を除いて実機のウインチ曳航のような離陸が可能です。

因みに参考のために実機モーターグライダーのGrob G109Aのパワー重量比も載せました。実機モーターグライダーは非常に非力で、80Watt/Kgを切ります。当然、離陸も穏やかな上昇でグライダーのウインチ曳航のような上昇率は望めません。

これらのデータから、静穏な大気での離陸に限れば130Watt/KgでもOKであろうことが予想されます。先に選定し既に購入済みの動力システムは1300Watt級なので全備重量10Kg程度までカバーできそうです。今のところ全備重量は9Kg程度が見込まれますから、140Watt/Kg程度となります。しかし、RC機では風の中での離陸や、前方障害物の回避、旋回中の翼端失速による急激な姿勢変化からの回復等では、モーターを廻して対処する必要があり、充分なパワー余裕が欲しいところです。問題は140Watt/Kgで十分なパワー余裕があるか否かということです。

余剰パワー(Excess Power)と比余剰パワーPs (Specific Excess Power)

実はパワー余裕とは余剰パワー(Excess Power)と称し、航空機の場合は利用可能な最大パワーと水平飛行に必要なパワーの差分を言います。単にパワーの差分だけでは、同じ差分でも重たい機体と軽い機体では余裕感が異なり同一に評価できないので、重量で割って1Kg当たりどれだけの余剰パワーがあるかを用います。これを比余剰パワー(Specific Excess Power)と言いPsと記します。単位はWatt/Kgで、正に上で検討しているパワー重量比と同じです。パワー重量比から重量1Kg当たりの水平飛行に必要なパワーを差し引いたものがPsです。

比余剰パワーPsが0では水平直線飛行しかできませんが、Ps＞0ではパワー余裕が生じて、加速や旋回、上昇等の運動が可能になります。Psが大きければ大きいだけ激しい運動が可能になります。

比余剰パワーPsの単位はWatt/Kgですが、1 Watt＝0.102Kg・m/secですからPsの単位は実はm/secとも書けます。これは上昇率の単位と同じで、実際Psが上昇率を表します。実際には余剰パワーを上昇に変換するのに航空機の効率が100%では無いので、Psの80〜85%が実際の上昇率として実現されます。

つまり、パワー余裕とはPsで表すことが妥当で、どの程度のPsがあれば良いのかと言うことが興味の対象になりす。

1/3三田式のPs予想

Psを求めるには水平飛行に必要なパワーを知る必要がありますが、それは性能予測で得られた降下率（沈下率）から略算できます。

降下飛行では、降下による位置エネルギー（ポテンシャルエネルギー）の減少率即ち、降下率×重量がその速度で降下飛行をするのに必要なエネルギー（パワー）を供給しています。沈下率に等しい上昇率を与えれば水平飛行になりますから、降下飛行に必要なパワーにその上昇率を与えるパワーを加えれば水平飛行に必要なパワーが求められます。上昇に必要なパワーは位置エネルギーの増加分ですから、上昇率×重量で求められます。上昇率と降下率が同じですから、結局水平飛行に必要なパワーは降下率×重量の2倍で略算できます。実際にはプロペラやモーターの効率がありますから、上記で計算されるパワーを効率で補正した値が必要なパワーになります。

以上のことを用いて、1/3三田式の比余剰パワーPsを計算したのが下表です。

速度	Km/h	32.5	35	37.5	40	45	50
降下率	m/sec	0.418	0.441	0.469	0.499	0.578	0.681
降下による位置エネルギーの減少率	Kg･m/sec	4.18	4.41	4.69	4.99	5.78	6.81
降下率に等しい上昇に必要なパワー	Kg･m/sec	4.18	4.41	4.69	4.99	5.78	6.81
水平飛行に必要なパワー	Kg･m/sec	8.37	8.83	9.38	9.98	11.56	13.61
同上	W	82.0	86.5	92.0	97.8	113.3	133.4
重量1Kg当りの水平飛行必要パワー	W/Kg	8.20	8.65	9.20	9.78	11.33	13.34
モーター＆プロペラ効率 η		0.5	0.5	0.5	0.5	0.5	0.5
パワー重量比が180W/Kgの時のPs	W/Kg	81.8	81.4	80.8	80.2	78.7	76.7
同上	m/sec	**8.3**	**8.3**	**8.2**	**8.2**	**8.0**	**7.8**
パワー重量比が140W/Kgの時のPs	W/Kg	61.8	61.4	60.8	60.2	58.7	56.7
同上	m/sec	**6.3**	**6.3**	**6.2**	**6.1**	**6.0**	**5.8**

表**10** 1/3三田式3型改1の比余剰パワーPs

重量は10Kgを、プロペラ＆モーターの効率を0.5と仮定しました。流石に揚抗比の良い機体なので、水平飛行に必要なパワーも82～133W程度と極めて少ない値です。Psはパワー対重量比が180W/Kgの場合と140W/Kgの場合で計算しました。180W/Kgの場合にPs=8.3m/sec程度、140W/Kgの場合にPs=6.3m/sec程度と見込まれます。

必要なPs

6.3m/secのPsは有人機では充分大きな値ですが、RCグライダーではどのように感じるものでしょうか？これを確認するために、手持ちの1/5三田式でパワーを落として実験してみました。1/5三田式は4セルで通常は36A程度を流して520W程度で飛ばしていますが、これを電流制限して400Wまで落として飛ばしてみました。Psは520W時で8.6程度、400W時で6.4程度と計算されますので、上に述べた1/3三田式の検討条件にほぼ一致します。
尚、テストパイロットはクラブのベテランSさんにお願いしました。

520W（Ps=8.6m/sec)ではいつも通りウインチ曳航のような離陸上昇をしますが、400W(Ps=6.4m/sec)ではずっとマイルドで恰も飛行機曳航のような上昇です。ドーリーを用いての試験も行いましたが400Wでもドーリーを引っ張って離陸は可能でした。Ps=6.4m/secでも通常は何ら問題が無いように思え、更にパワーを落とした飛行を試みようと思いましたが、Sさん曰く「これがパワーの下限」とのこと。これよりパワーを落すと何か異常が発生した時の対処に不安を感じるようです。

結局1/3三田式は1300W級の動力システムで飛ばすことは可能だが、異常時の対処に余裕が少ないという結論が得られました。折角作った機体がパワー不足で緊急操作ができず墜落！と言うような事態を避ける為に、もう一回り大きなモーターに変更することにしました。

再選定したモーター

上記の検討結果によれば1/3三田式に適当なモーターは1,700〜1,800Wクラスとなりますが、同クラスの適当なモーターが見つからないので、大は小を兼ねるの精神で2,000WクラスのFUTABA FMA-5065 KV300を選定しました。

このモーターは8セルで2,000W程度が得られます。手持ちのESCは6セルまでしか対応しないので、このモーター用の12セル、100A迄対応したESC（アンプ）と、同アンプ用のプログラマーユニットも購入しました。これが購入した3点セットです。



画像121 再購入した動力システム

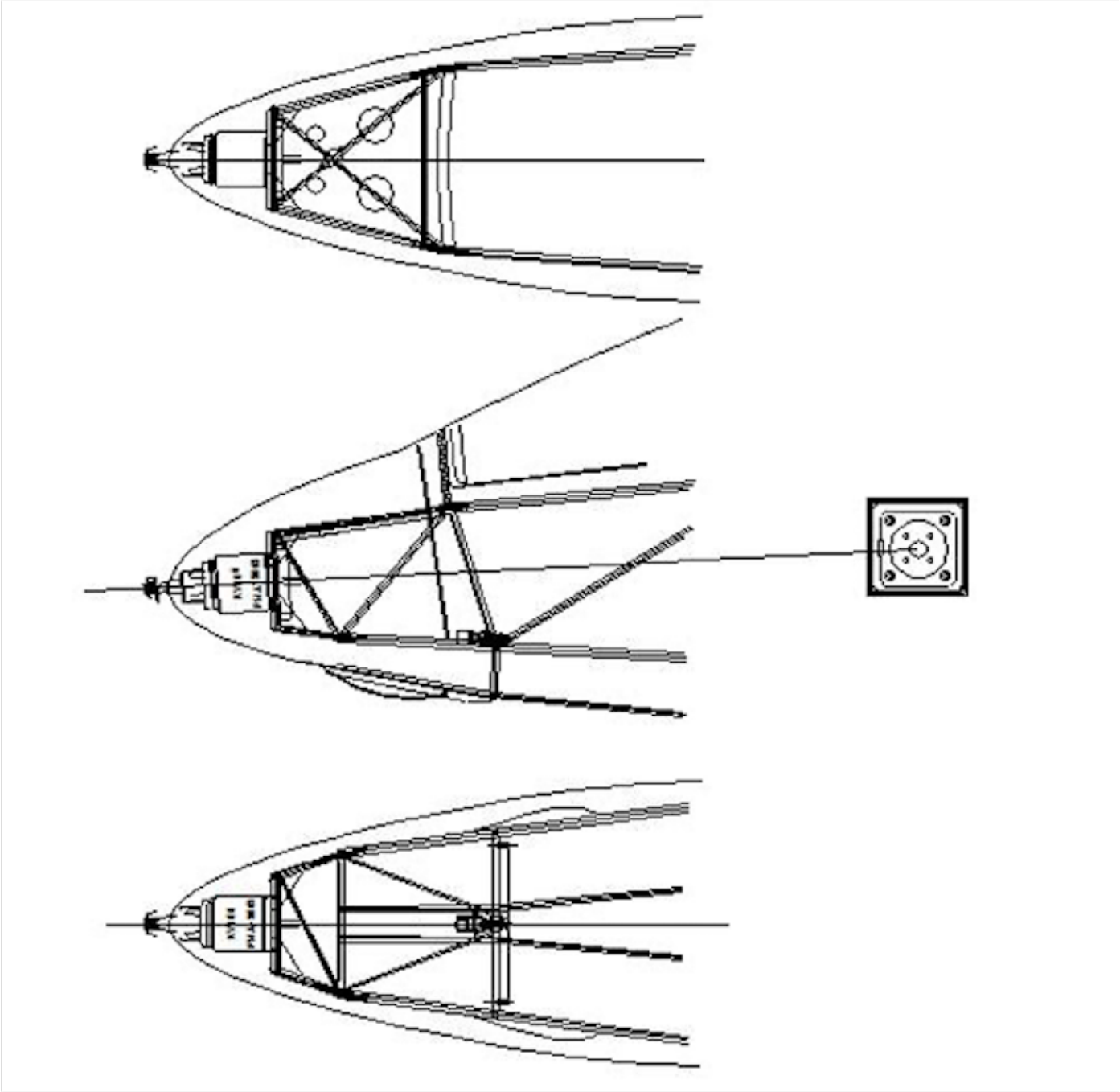
これでパワー不足の心配も無くなりました。実はこの検討で動力システムのパワーアップを図ったことが初飛行での危機一髪を救ってくれました。それは初飛行のところで改めて説明します。

製作その24 モーターマウント

早速、同モーター用のマウントを設計・製作しました。

設計

図面はモーター再検討前から検討していたものの小改修で済みました。



図面33 モーターマウント

モーターはバックマウントで搭載します。胴体主構造である4本の7mmΦ縦通材の先端に5mmΦの支柱を張出し、その前面に4mm厚シナベニアを2枚重ねてエポキシ樹脂で接着したモーター取付板を設置します。縦通材と支柱の内部は長さ50㎜の3mmΦ鉄棒をエポキシを塗って挿しこんで止めます。上面支柱の間には4㎜厚シナベニアを渡してあります。この上にESC（アンプ）を載せる予定です。支柱とモーター取付板との間には斜めに補助支柱を

通してあります。これらの補助支柱がモーターの反トルクを受けます。更に、支柱先端とモーター取付板に渡って8枚の1㎜厚カーボン板製の3角形補強板をエポキシ樹脂で取り付けて、トラス構造の剛性を確保します。

モーターは保守点検の為に胴体内部方向へ取外しができるようにしました。このため、モーター取付板には直径50㎜のモーターより若干大きい直径52㎜の穴が開けてあります。モーターの取付は付属の十字マウントでは52㎜の穴に対して長さが足りないので、8.5㎜厚シナベニアで製作した四角形のベッドをモーター後部に取り付け、そのベッドを3mmボルト4本でモーター取付板に後方から取り付けます。

モーター取付板とベッドをシナベニア製にしたのは、マウントや胴体構造がカーボンパイプの接着構造の為に構造減衰が殆ど期待できないからです。プロペラやモーターが発生する振動を減衰させるために厚いシナベニアにしました。

製作

モーターマウントは製作済の胴体主要構造から突き出して取り付けるので、組立治具が無ければ正確に取り付けられません。そこでまずこの写真のような治具を作って胴体に取り付けてみました。



画像122 モーターマウント組立治具

治具の最先端にある板にモーター取付板を取り付けて、胴体構造との間をカーボンパイプで繋ぐ構想です。しかしこの治具を取り付けた段階で大きな問題が発生しました。治具が素直に胴体構造に取りつかないのです。無理に取り付けるとモーター取付板が斜めに曲がってしまいます。原因をいろいろ調べているうちにどうやら前胴右側パネルが正確に取りついていないようです。2本の上側縦通材の先端間の距離が図面より微妙に長い様ですし、右側パネルの上下縦通材間を繋ぐ部材の取付角度が、若干開き気味のようです。胴体構造は組立治具を用いて組んであるのでそれなりの精度は確保されているものと思っていましたが、思わぬ不具合の発生です。

実はこの部分は数か月前、床に置いてあった時に誤って踏みつけてしまい、

部材が数本分解してしまったことがありました。そのとき治具に載せずに外れた部材を再組立した経緯があります。このことが原因の一つであることは間違いないと思いますが、それだけでは説明がつかない狂いがあります。

仕方がないので、原因究明はそこまでとして、右側パネルのトラス構造をバラして組み立て直すことにしました。

しかし、トラス構造は既にエポキシ樹脂で固めてあるので分解するのも大変でした。エポキシ樹脂にはラジコン仲間に使わせて貰っている下の写真にあるカーボン繊維を含んだパウダーを混ぜ込んであるので、非常にガッチリ固まっています。



画像123 カーボントラス構造の接着用エポキシ樹脂に混ぜたカーボンパウダー

何とか苦労してトラスを分解しましたが、せっかく作った側方張出構造は割れて使えなくなってしまいました。再製作が必要です。次にもう一度正確にトラス構造を組み立てなければなりませんが、前回使用した胴体組立治具は、胴体下部張出構造を取り付けてしまった今となっては使用できません。そこで次のような、部分治具を作って形状確保を図ることにしました。



画像124 簡易組立治具

前側治具がコクピット前部の幅を正確に押さえると共にモーターマウントの位置を定めています。後側治具はコクピット中央部の幅を正確に決めるために設けました。前側治具には既にモーター取付板とそれを支える4本の支柱が取り付けられています。胴体右側パネルの部材も仮組立されていますが、コクピット中央上で前後席の間にあるべき台形部材や、右側側方張出は未だ取りついていません。モーター取付板もまだ4㎜板が一枚取りついただけです。この前にもう一枚をエポキシ樹脂で貼りつけます。

モーターマウントの完成

このような苦労をしましたが、何とかモーターマウントを完成させることが出来ました。（画像125）



画像125 完成したモーターマウント

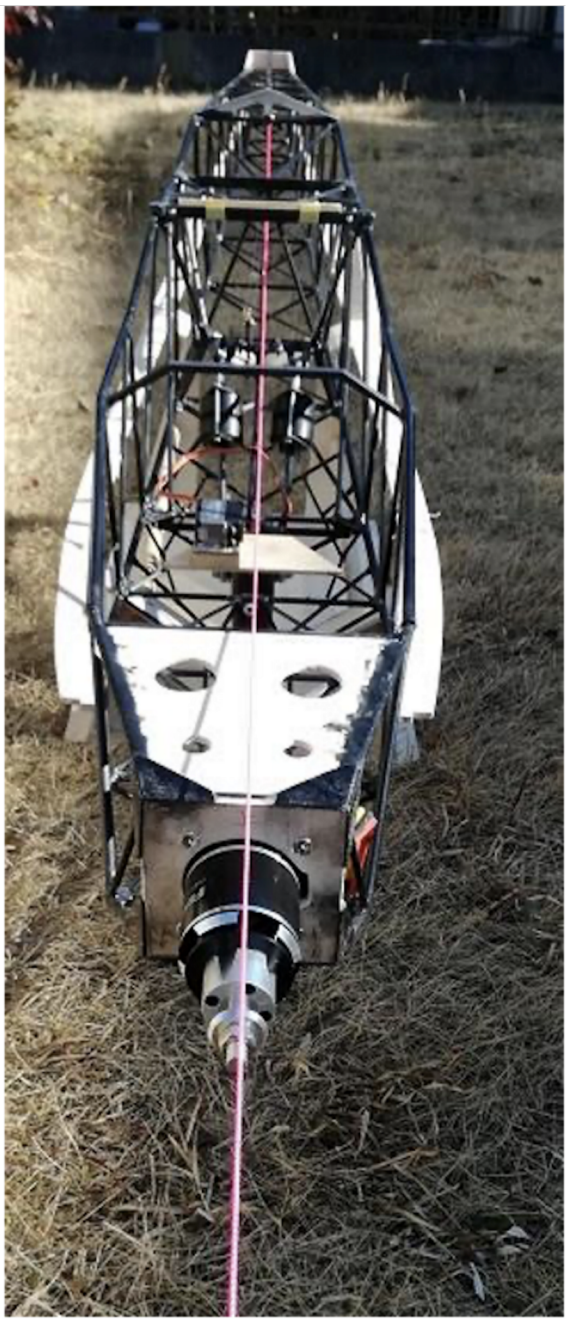
ひっくり返すとこのようになっています（画像126）。モーターはこのように取りつきます（画像127）。



画像126 モーターマウントの裏側



画像127 マウントへのモーター仮取付



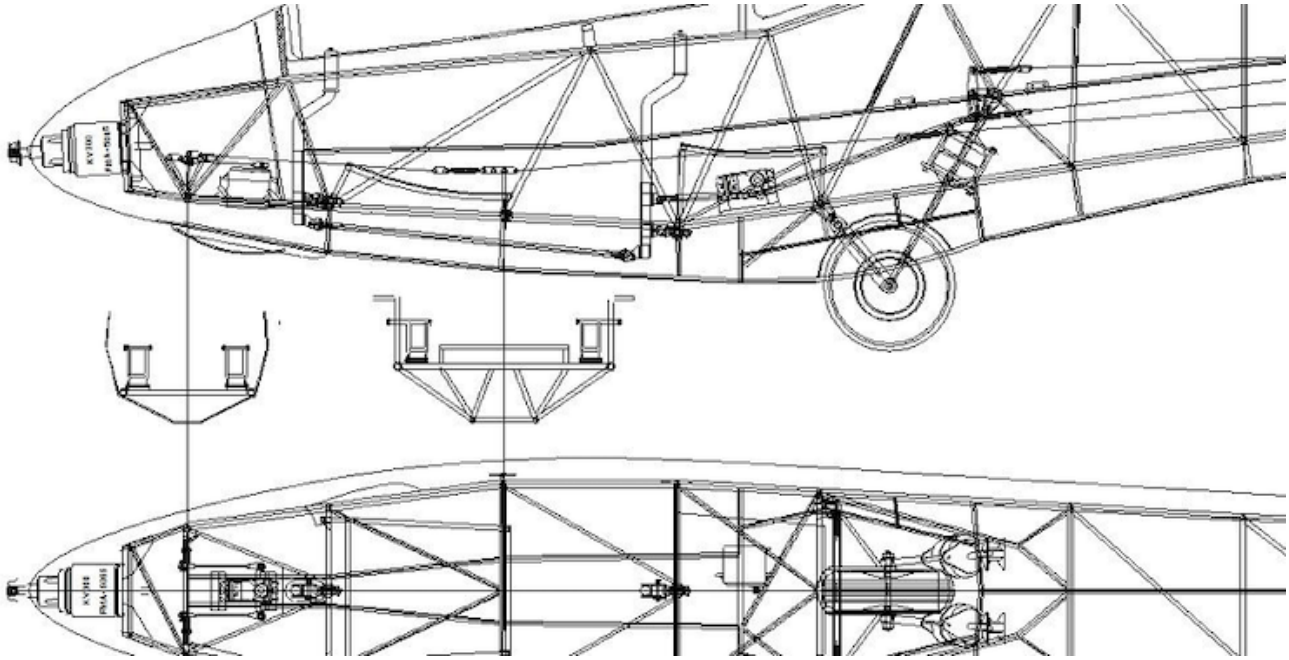
画像128 モーター軸位置の確認

一番気にしたモーターシャフトの機体中央軸上への配置も略上手くいきました（画像128）。斜め部材と三角形の補強板のお蔭で、非常に剛性の高いマウントが完成しました。

製作その25 ラダー操縦系統

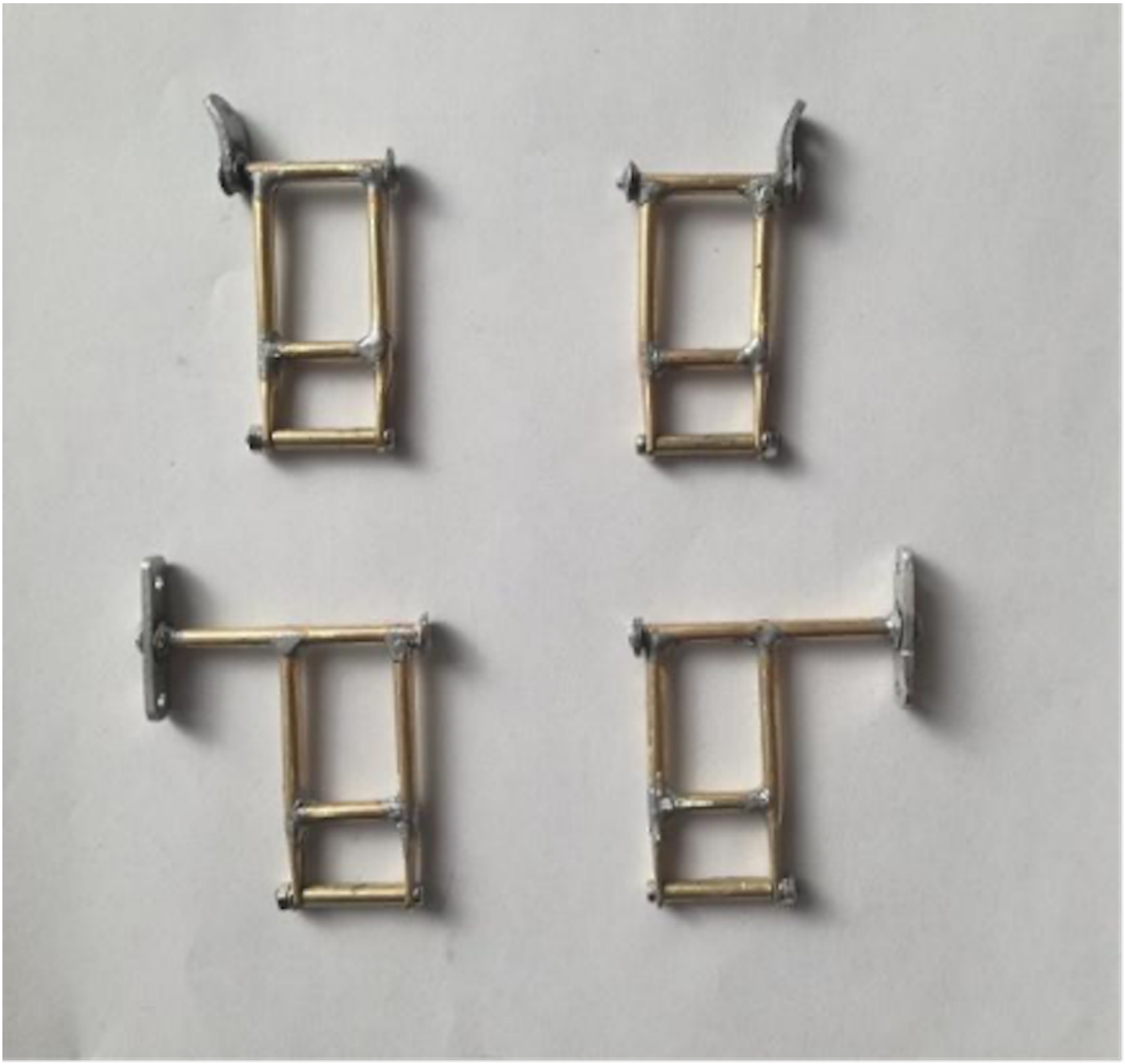
三田式3型のラダー操縦系統

三田式のラダーはその最下部にあるラダーホーンを、前後操縦席のペダルから伸びる両引きワイヤーで操作します。ワイヤーの長さ調整用に後席ペダルの前側と後席ペダルとラダーホーンの間の2か所の左右に合計4個のターンバックルが装着されています。前者は前後席間の長さ調整に、後者は後席ペダルとラダーホーン間の調節に使われます。図面はこのようになります。



図面**34** ラダー操縦系統

まずペダルの製作から着手しました。実機のペダルは短い鋼管を溶接して作られていますので、模型では3mmΦの真鍮パイプを半田付けして製作しました。



画像129 製作したラダーペダル

上の2つが前席用、下が後席用です。前後席間のワイヤーは胴体基本構造鋼管の外側に張られますので、後席用ペダル上部のワイヤー取付部が外側に伸びています。実はこのペダルは再作したものです。実物の大きさの実感がつかみにくく、当初は勝手に長さ15cm程度と考えてその1/3大のものを製作して取り付けてみると、如何にも大きすぎることが判りました。それで当初の2/3の大きさに作り直したものです。実機を見たときにその大きさが予想

より小さかったことに驚いた経緯があります。どうもボリューム感のある機体イメージから、全てのものを実物より大きめに想像してしまうようです。

取付

ペダルを所定の位置に取り付けて、ワイヤーを張りターンバックルも取付けました。





画像130 ペダルの取付 左＝前席用 右＝後席用

後席用ペダルにはターンバックルが取り付けられています。このターンバックルはエレベータ操縦系統で用いたものと同じで、金属加工の得意なクラブ仲間に製作して貰ったものです。後席より後方の主輪近くにはもう一つのターンバックルが取り付けれれています。

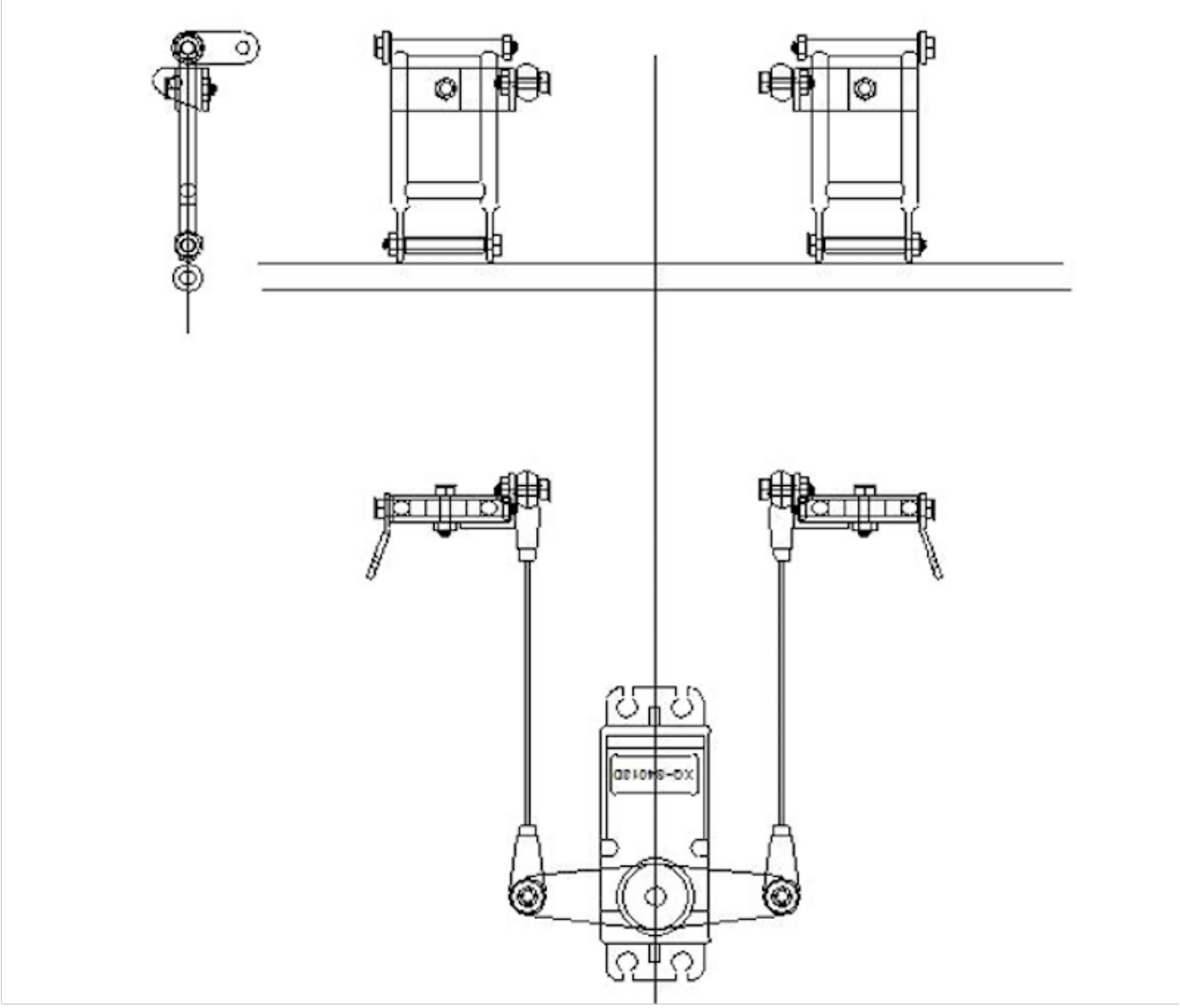


画像131 後部ターンバックル

このターンバックルから後ろに伸びるワイヤーがラダーホーンに繋がりますが、胴体の表皮を貼る邪魔になりますので未だホーンとは繋いでいません。ワイヤーを張っているときに、胴体構造とワイヤーが交差する部位が意外と多いことに気が付きました。私はもっと注意して構造にぶつからないようにワイヤーを通す場所を設計するものと思っていましたが、三田式ではその辺は割り切って、構造と交差する場所にはプーリー状のもの（詳細不明）を取り付けて擦れを避けています。模型でプーリーは面倒なのでノイズレスチューブを当該場所に貼りつけて擦れを避けました。

ラダーサーボの取り付け

ラダーサーボは機首に設置しました。サーボで前席ペダルを動かす構造です。コクピット側から見てサーボの手前には計器盤が取り付く予定ですので、サーボは大半がその陰に隠れて見えないことが期待されます。



図面35 ラダーサーボリンケージ図面

ペダルに取り付けた板とサーボ間をリンクで結んでいます。これが謂わばパイロットの足になります。

サーボの取付方法は一工夫しました。最先端にモーターが取り付いた機首はFRP製のカウリングで覆われ、モーターはコクピット側からしかアクセスできません。その際サーボが邪魔になります。そこでサーボに足を付けて斜め45度方向のネジで固定しました。これが完成したラダーサーボ機構です。



画像132 ラダーサーボの搭載

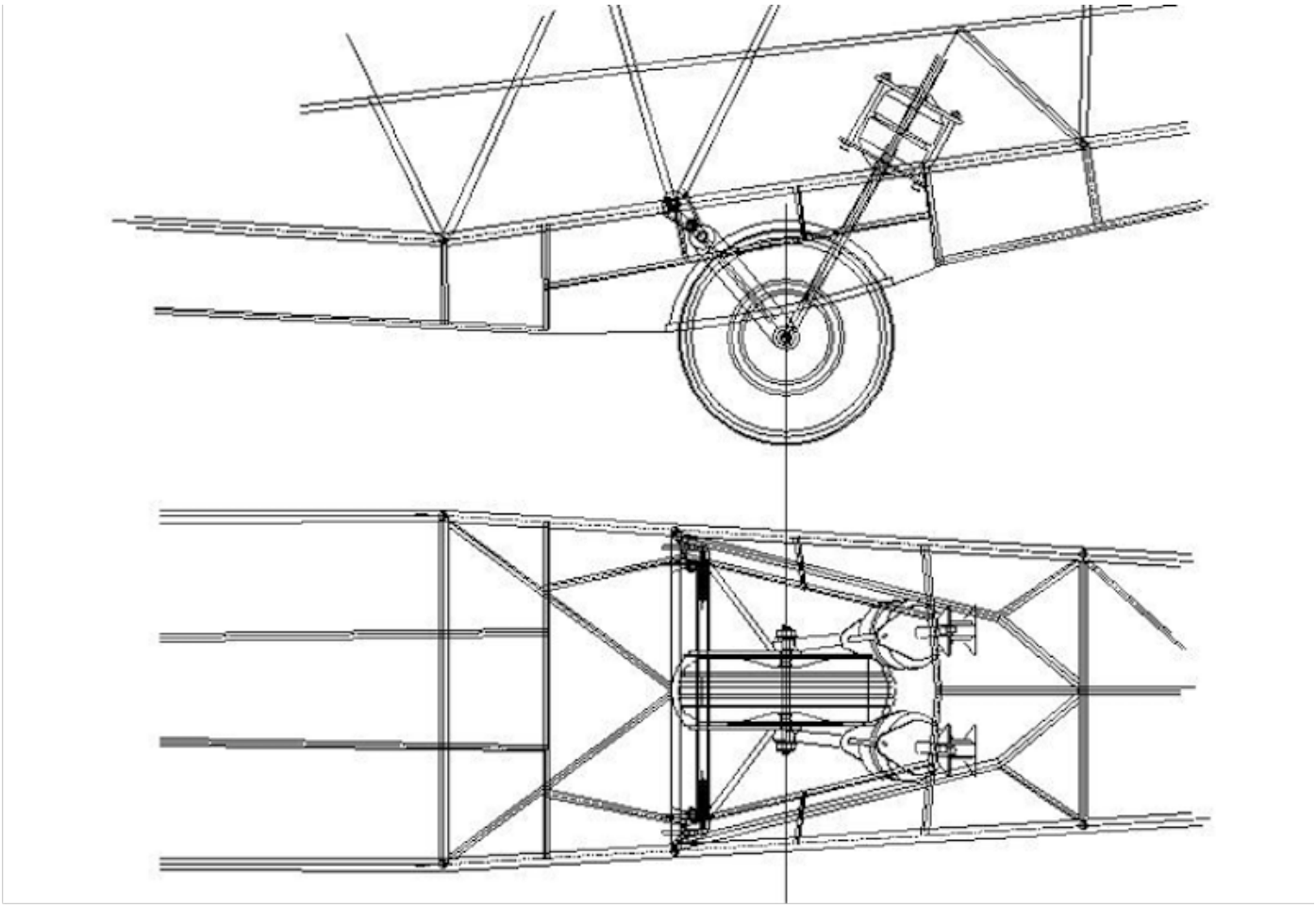
（注）この時点では機首のFRP製カウリングは1/5模型と同じように取り外しできないものに考えていたため、このようなラダーサーボの取付方式にしました。しかしその後カウリングを取り外し可能に変更したので、結局その必要はありませんでした。

因みにサーボはラダー、エレベータ、エルロン共同じサーボを用いています。サーボの仕様は下記です。

型式	XQ S4013D	デジタルサーボ		
トルク	12.5Kg-cm	(@4.8V)	14.5Kg-cm	(@6.0V)
スピード	0.13秒	(@4.8V)	0.11秒	(@6.0V)
重量	56 g			
大きさ	40×20×39㎜	(L×W×H)		
モーター	コアレス			
ギア	チタン			
軸受	二重ベアリング入り			

製作その26 主脚周りの胴体下部構造

胴体下部張出構造を製作した時に、その構造形状が判らないために放置してあった主脚周りの構造について、静岡航空資料館にお願いして写真を送って頂きました。その写真を元に構造を想像して設計しました。



図面36 主脚周りの胴体下部構造

この構造は台形形状の前胴下部張出構造の中央付近から出て、三角形状をした後胴下部張出構造の中央付近に繋がります。側面から見ると一直線ですが、平面図でみると大きく「く」の字に曲がっています。これは横幅が大きい主脚の前方取付部材を覆うために、その部分だけ横幅を広くしているためです。

この構造より下側は布製の車輪カバーが取り付けられます。今回はトラス構造部分を作りました。

製作した構造

4㎜Φのカーボンパイプで前後に走る「く」の字部材を作りました。治具上で2本のパイプを正確な角度で繋ぎました。つなぎ目にはステンレス線を中に入れエポキシ樹脂で固めてあります。それを位置決め治具で左右対称性を確保して胴体に取り付け、支え部材を接着しました。このようにして出来上がった写真が画像133です。



画像133 主脚周りの胴体下部構造

「く」の字に大きく曲がって飛び出していることが判ると思います。しかしここで大きな不安が生じました。前胴下部から後胴下部に渡って形状変化が余りに激しいのです。前から透かして見るとトラス部材の傾き角度が急変しています。これでは胴体に羽布を貼った時に皺が生じるのではないかと不安になりました

羽布の試し貼り

そこで、形状変化の激しい部位に羽布を試し貼りしてみました。使用したのは絹目調のオラカバであるオラテックスです。結果は画像135のように心配無用であることが判明してホッとしました。







画像134 前から見た主脚周り構造 | **画像135** 羽布の試し貼り

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。

The Trailing Edge

What else do you want to accomplish in 2021? Whatever it is, you had better get busy.

The NEW RC Soaring Digest Staff



We end where we began: at the F5J competition on August 23rd, 2001 at the AMA Soaring Nats held in Muncie, Indiana. Here Wally Adasczik launches during F5J competition. (image: Matt Ruddick, ©2021 The Academy of Model Aeronautics, used here with their permission and with our thanks.)

With 2020 being what it was, many people resolved that 2021 was going to be the year when all the ills of the turbulent, recent past were put to rest and we would all start with a fresh, clean slate. We certainly thought that way and it was with that cheery idea in mind we launched our first issue of the NEW RC Soaring Digest way, way, *way* back in January of this year. It seems like ten years ago. Candidly, we simply cannot believe that we're now at the end of our **ninth** issue which means that 2021 is already three-quarters over.

Wow, all the things we intended to do that remain steadfastly and stubbornly on the to-do list — are we still going to be able to accomplish them? If we are, we had better get busy getting busy or we'll be carrying at least some of that baggage into 2022. Perish the thought.

Then again, we are pretty pleased as to what *has* been accomplished in 2021, particularly when there is enough of it left that there really is some opportunity to put a few more dents in the universe. Our Managing Editor rolled out a couple of interesting facts in his *In The Air* editorial. Thousands of readers scattered across 93 countries around the globe is really nothing to sneeze at. But before we get a bit too tipsy celebrating our success, we must once again acknowledge — and be thankful for — the running start we had, what with a great email list, a robust followership on Facebook and the goodwill of the legacy RCSD of Bill and Bunny Kuhlman. However, we think we can at least take credit for not squandering the opportunity — not yet, anyway.

For our part in 2021, we would still like to get the ball rolling toward RCSD's financial sustainability. There is an opportunity for you to help out in that regard: we have new merch in the store (see below) and have new products in the works all the time. We would also like to launch the *Friends of RCSD* program. This is where corporations which have aligned interests with the RCSD readership provide longer term financial support with the objective of keeping RCSD free. Forever. If you know of such a company, or maybe even own or work for one, which fits this profile we would be thrilled if you would get in touch. Thanks, in anticipation, for your help with this.

Of course, we hope we continue to bring you the very best articles that will both enlighten and entertain. Once again, we need your help with this. Have a great story idea? We want to hear from you! Your next opportunity to have your magnum opus appear in our pages is coming up very quickly. The

deadline for the October issue is **2021–10–03**. Based on the head-spinning speed at which 2021 is going by so far, that date will be here in less time than it takes the guy behind you to beep the horn when the light turns green. Okay, maybe not quite that fast. But really, *really* fast.

New in the Store



Just out, this is the **May** edition of the quickly-becoming-very-collectible *RCSD Cover Photo T-Shirt*. It features a gorgeous photo by Laurent Ducros — who also provided the picture and video for this month's *In The Air*. Laurent took the May cover photo at Ménez-Hom in the Brittany region of northwest France on May 13th, 2021. The aircraft is a Polish *Mucha* design which was built by pilot Quentin Philippe and his father Paul. Or, if you prefer, you can order the **January**, **February**, **March** and/or **April** editions of the *RCSD Cover Photo T-Shirt* in the Store.

Note that the **RCSD Store** is gradually swinging its manufacturing over to a

new partner who maintains production in a number of locations around the world. That means lower shipping costs and faster delivery while maintaining the same high quality of the end product. We ship worldwide.

By the way, if you're super keen to be the first to add June, July, August or this month's edition of the *RCSD Cover Photo T-Shirt* to your collection, please don't hesitate to let us know and we'll make sure there is one in the store on a very tight turnaround. Not a big fan of black t-shirts? We can fix that, too: just let us know what colour you prefer and we'll put one in the store especially for you.

Make Sure You Don't Miss the Next Issue

If you want to be absolutely sure you don't miss the October issue of the *NEW R/C Soaring Digest* make sure you subscribe to our **Groups.io mailing list** or connect with us on **Facebook**, **Instagram**, **Twitter** or **LinkedIn**.

That's it for this month. Thanks to all of our contributors in this issue and above all, thank you, the RCSD reader for making us a part of your day.

Now get out there and fly!

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The NEW RC Soaring Digest Staff

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