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

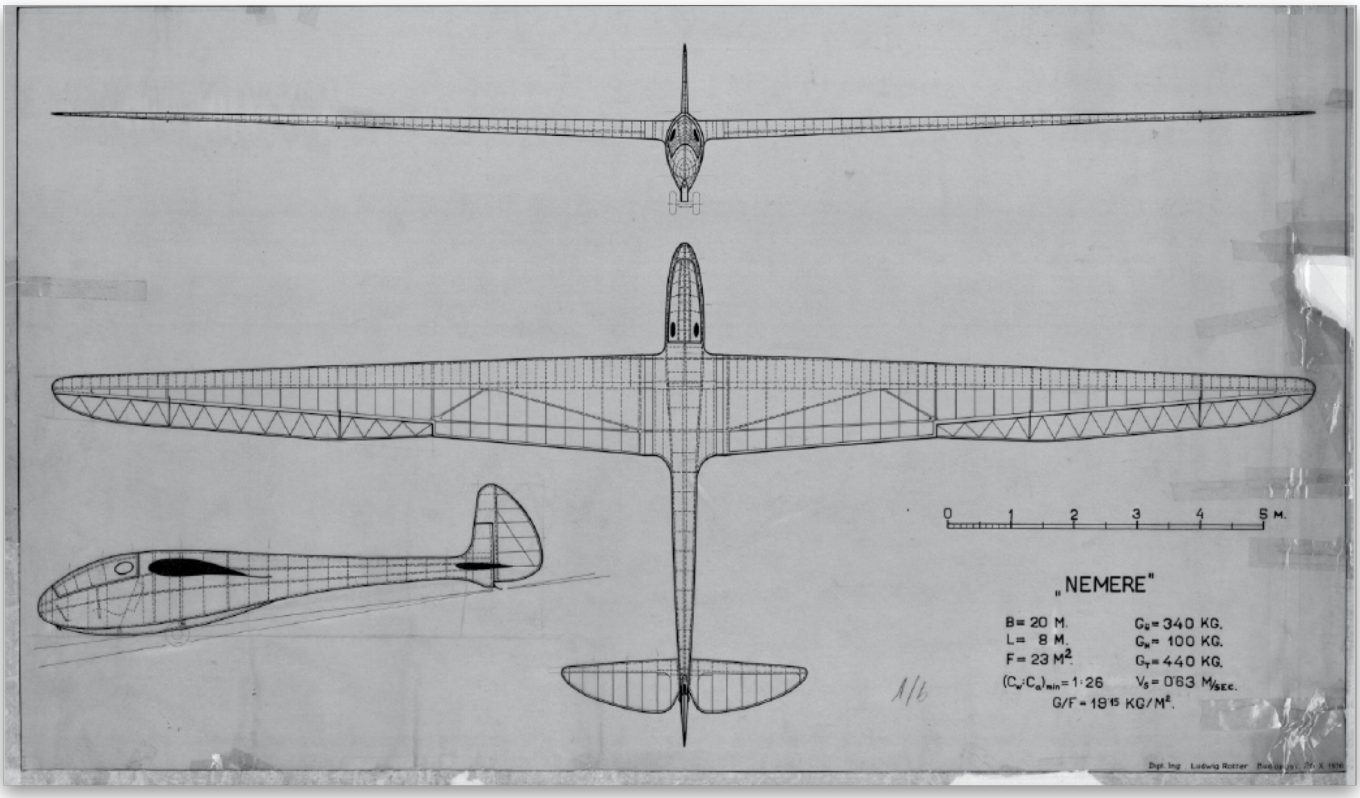
rubber powered planes. Small ones at first, later Wakefields (now F1B). Plans were not available, so I had to draw them myself and construct everything from scratch. Even the propellers were hand carved. Building such a model was quite a challenge and often they crashed, so I had to learn to repair them 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.

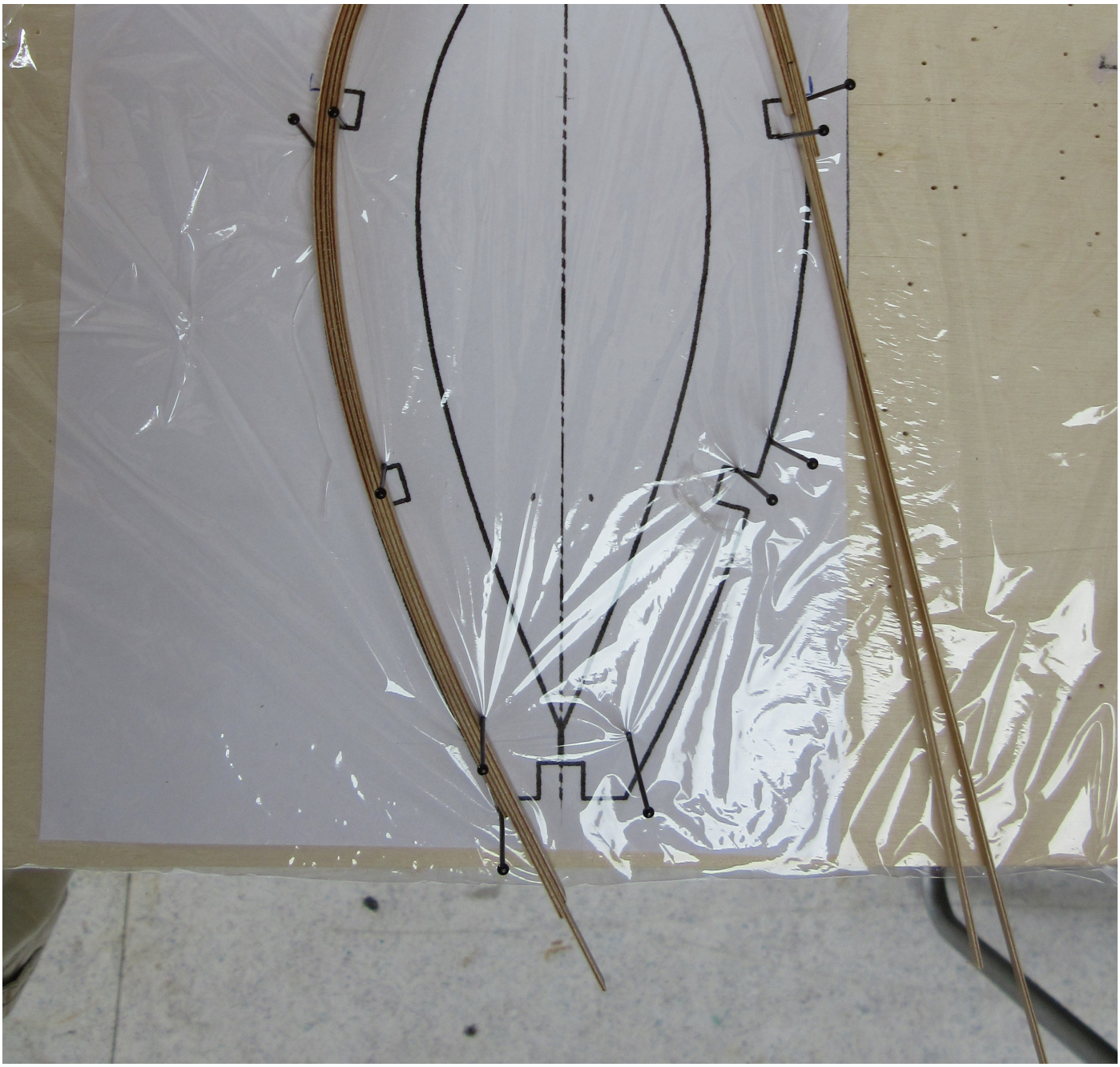
Fuselage Construction

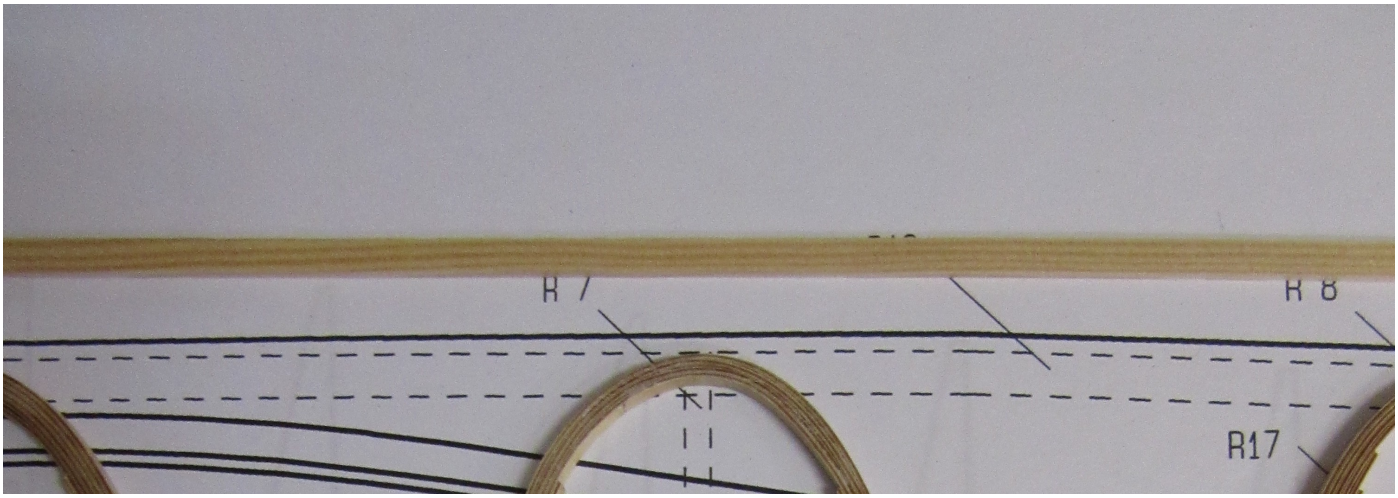
Now I could start the construction properly, beginning with the fuselage frames:

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.

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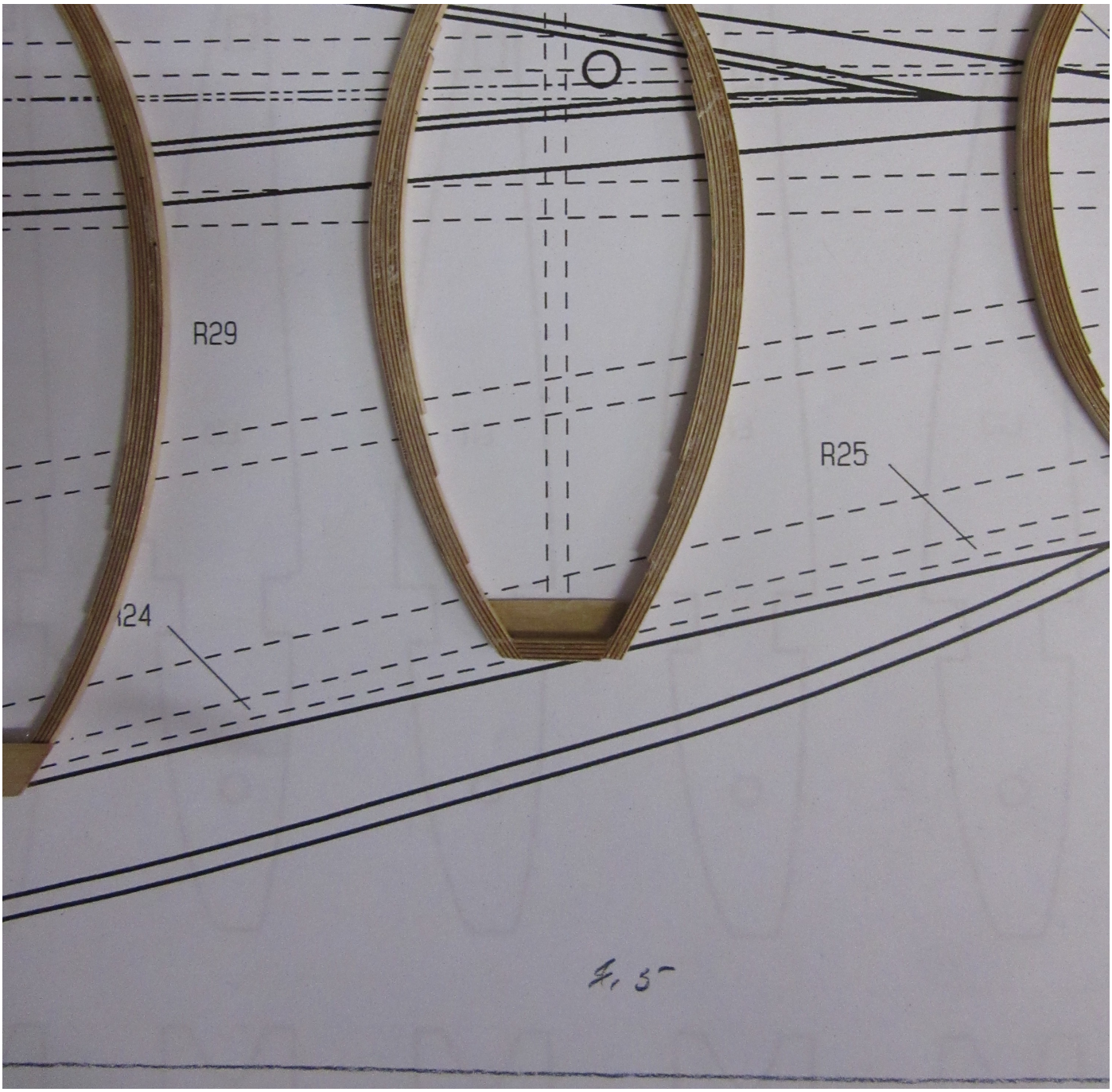
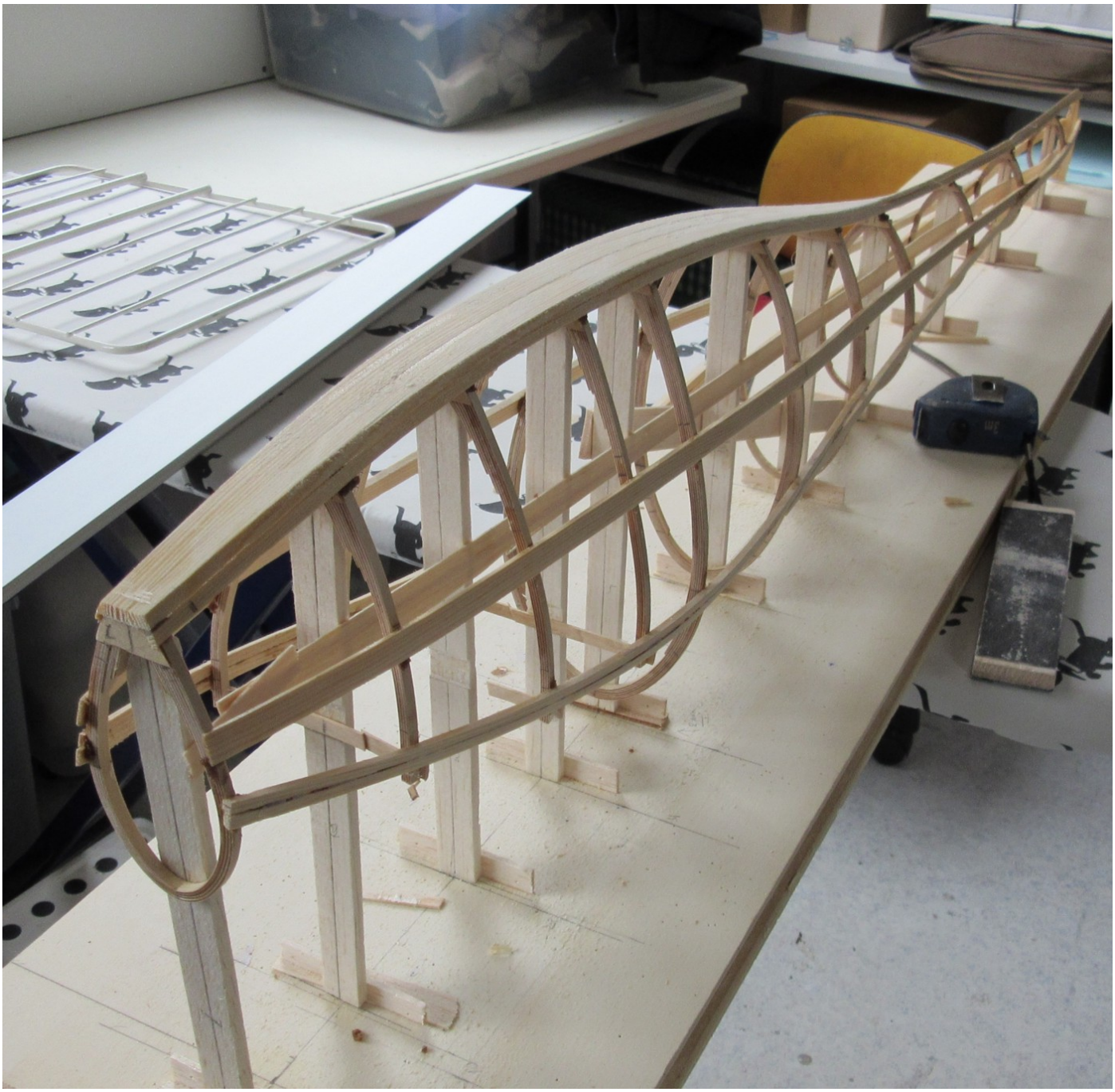


5 (left): Laminating a frame. | **6** (right): Finished frame.

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.

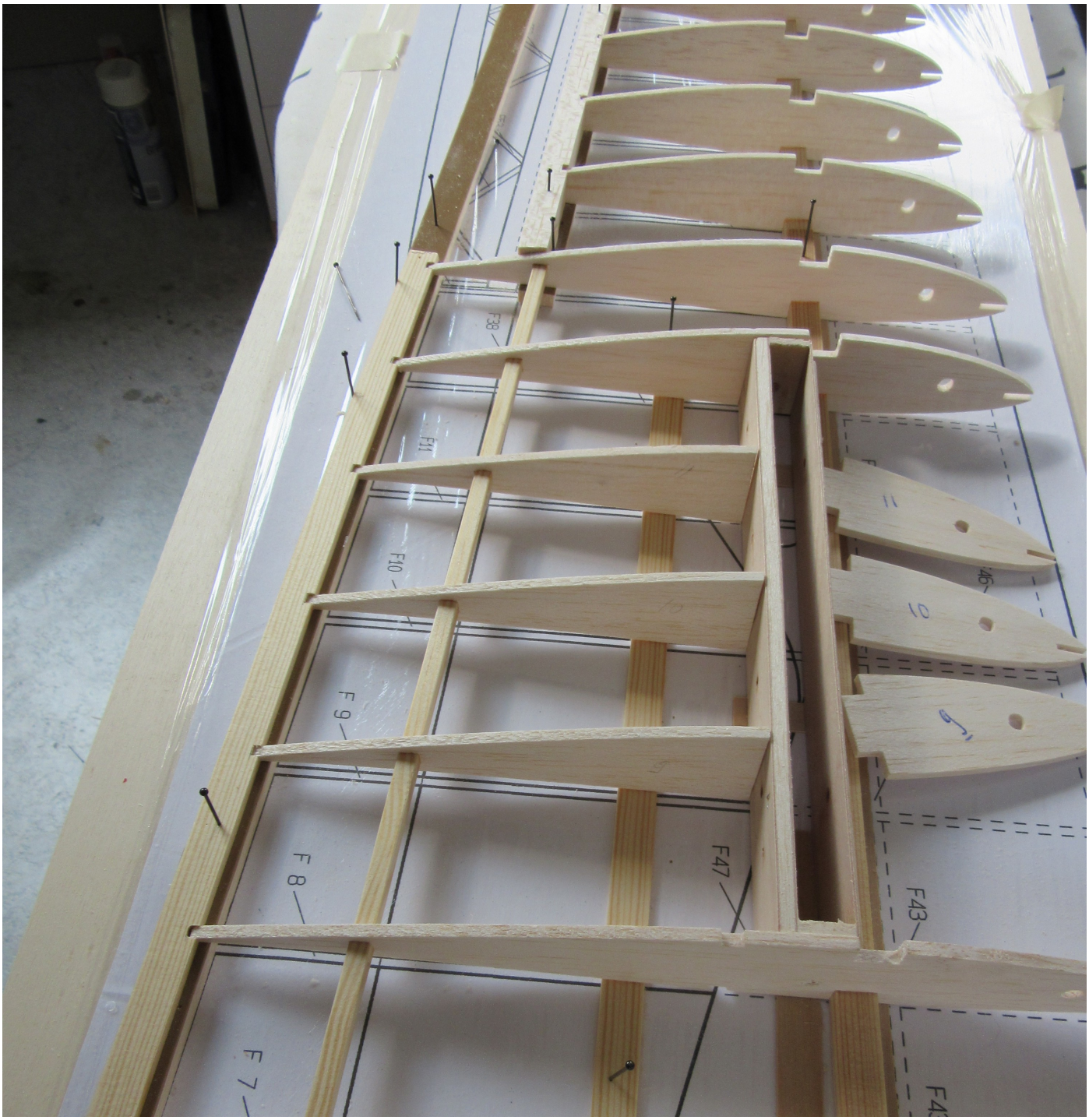
At spots where a lot of curvature was needed, I thinned the stringers. For example, at the cockpit edge where the stringer is curved in two directions, I used a couple of narrow stringers instead of one wide one. When the epoxy had set, the structure was now rigid enough to free it of the building jig (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.

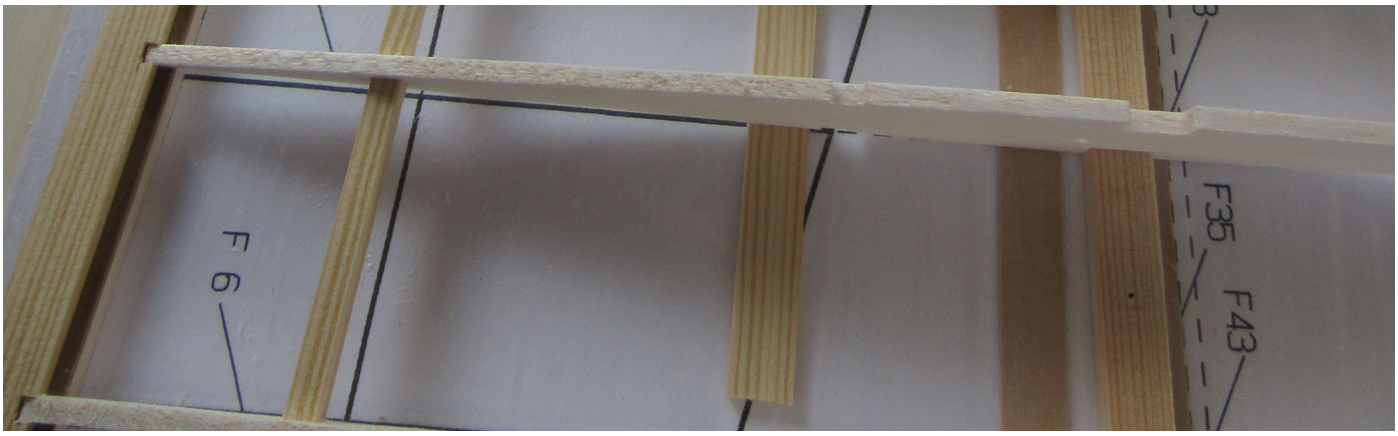
8: Lifted off the building jig.

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.





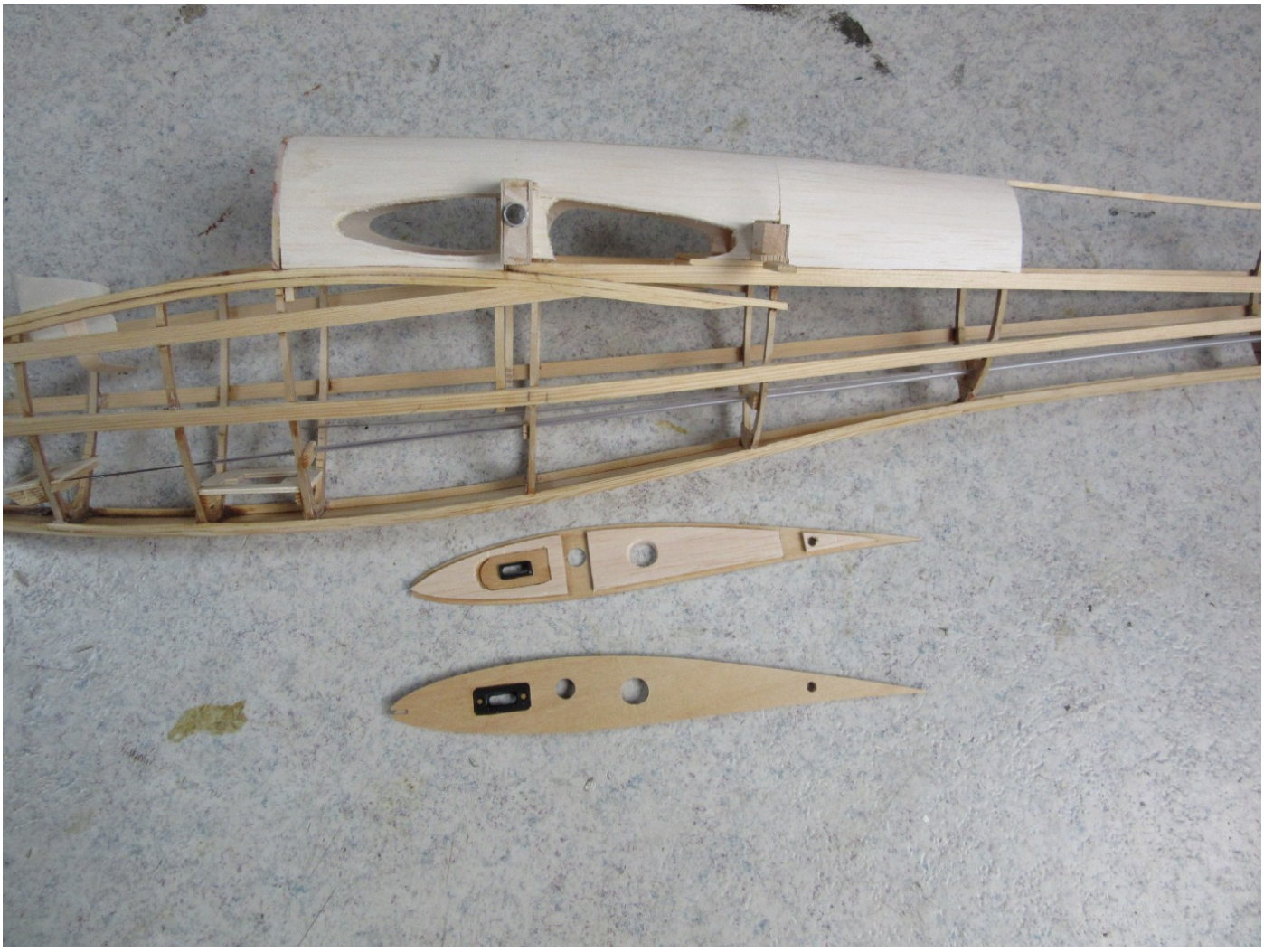
9 (left): Basic structure of the wing. | **10** (right): Balsa filling parts with ply gusset plates.

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

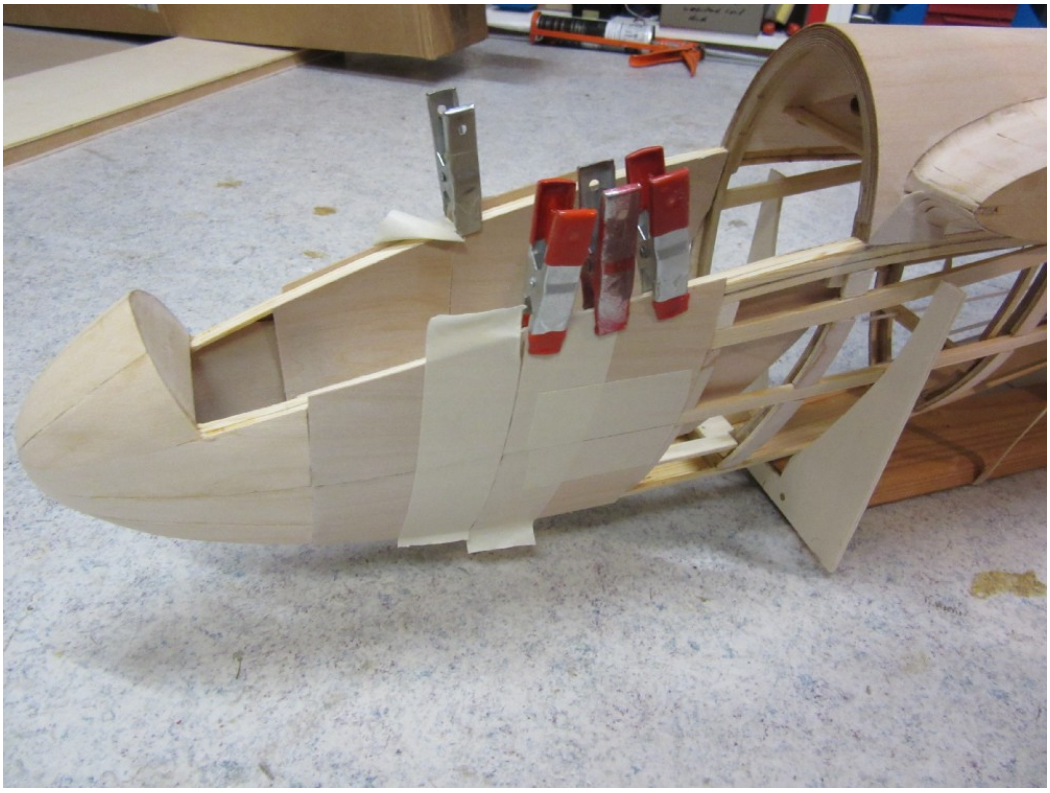
frames out with strips of balsa with plywood strips on top (which are at the same time the gusset plates for the butt joints of the ply sheeting). I used substantial stringers (3x8mm), for fear of damage, I had the impression that plywood is very stiff, but fragile.

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.

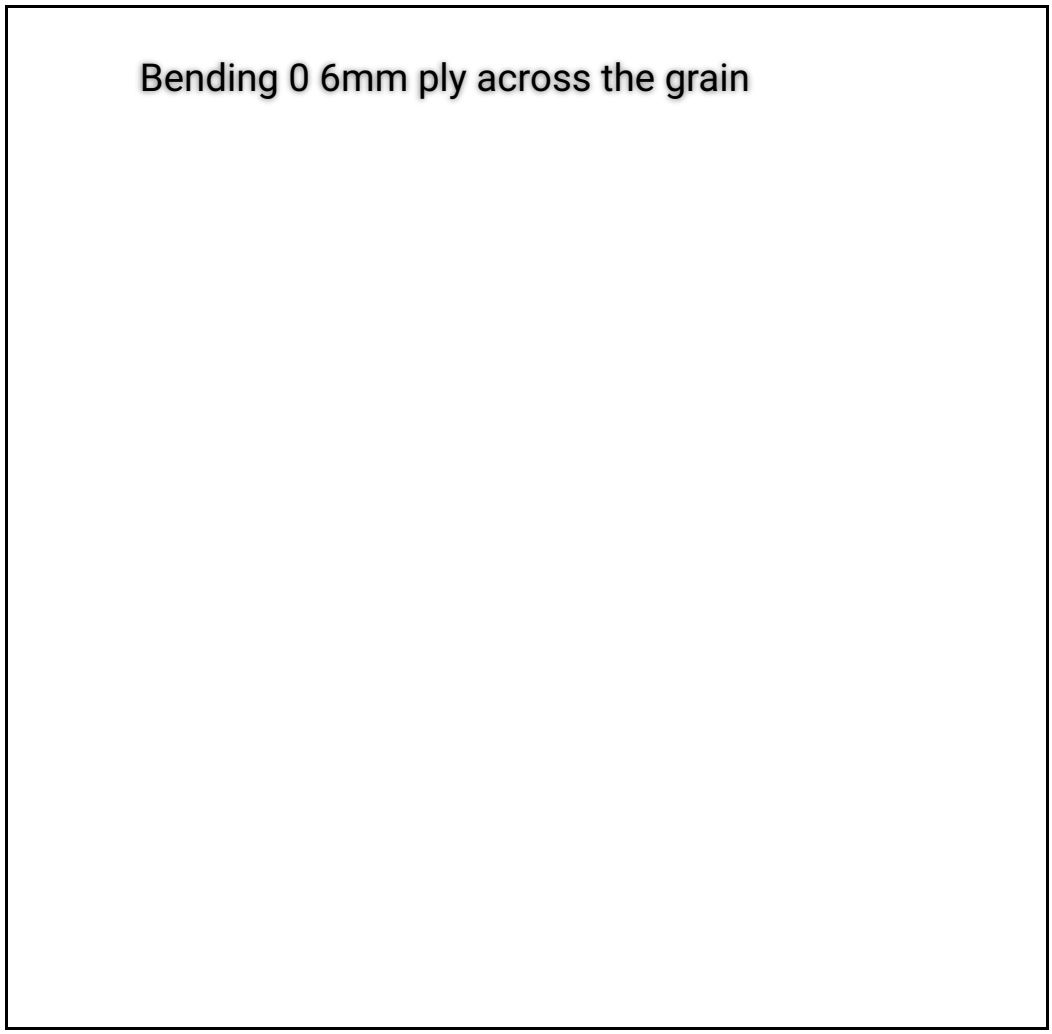


12: Gluing panels in the cockpit area.

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).

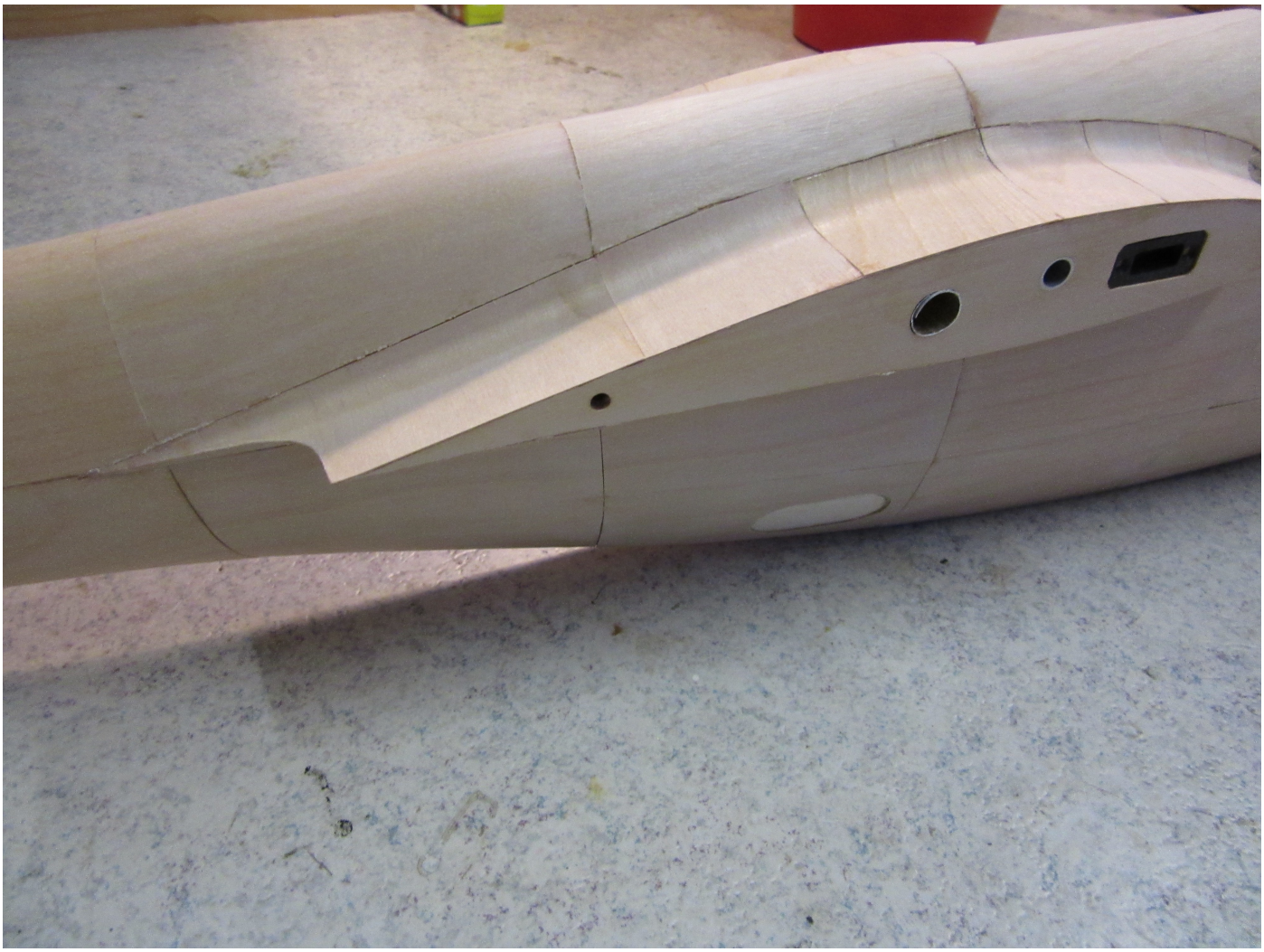
The fuselage/wing fairing was another story. First I tried veneer, then plywood, then started all over again (15). I now tried to pre-bend the plywood; laid a strip of plywood with the grain across over an aluminium angle profile, pressed it with clamps and a aluminium tube and then poured boiling water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

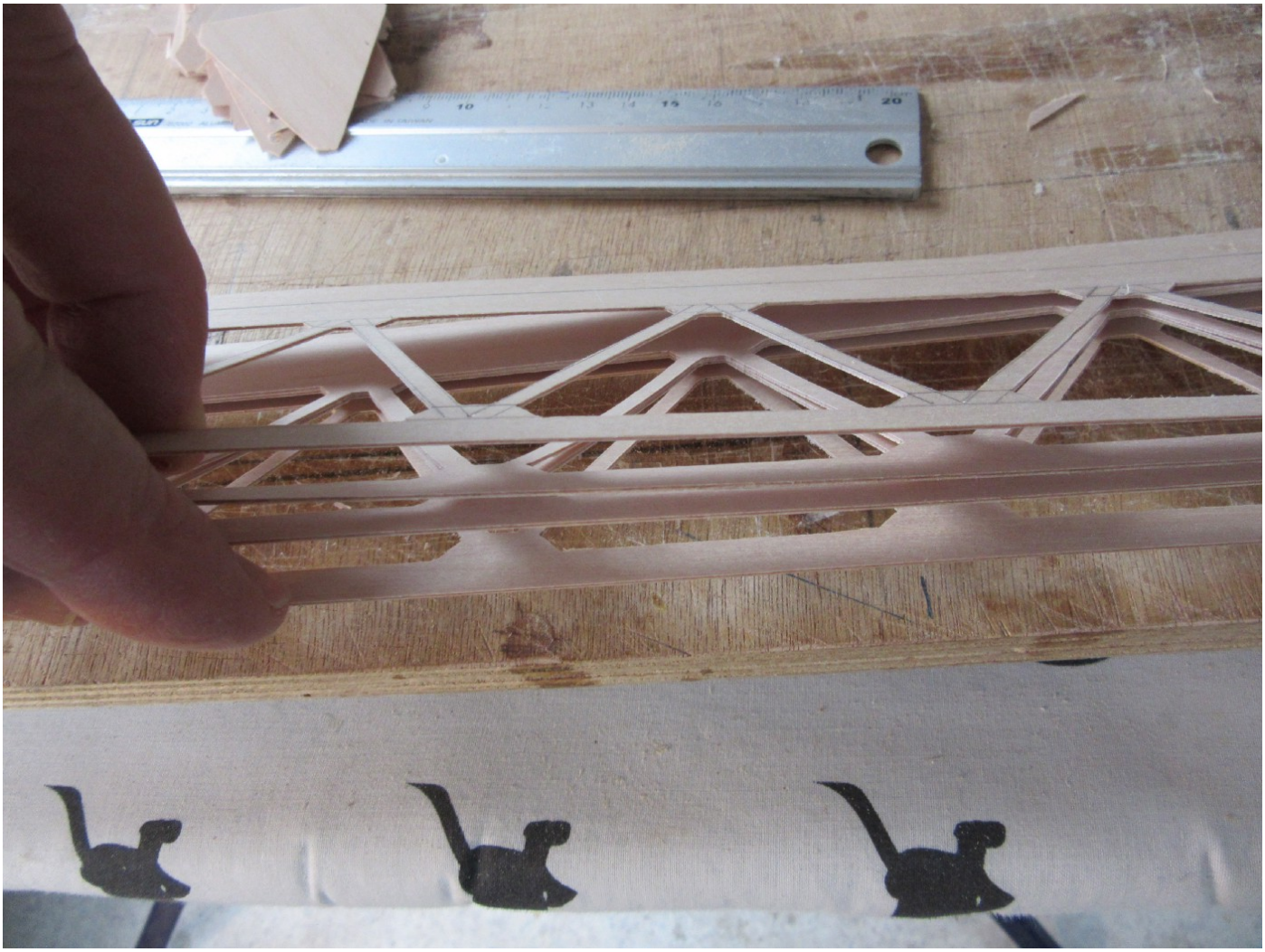


17 (top left), **18** (top centre): Bending ply across the grain. | **19** (top right): Glued in place. | **20** (bottom left): Fairing completed. | **21** (bottom right): Fuselage roughly finished.

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

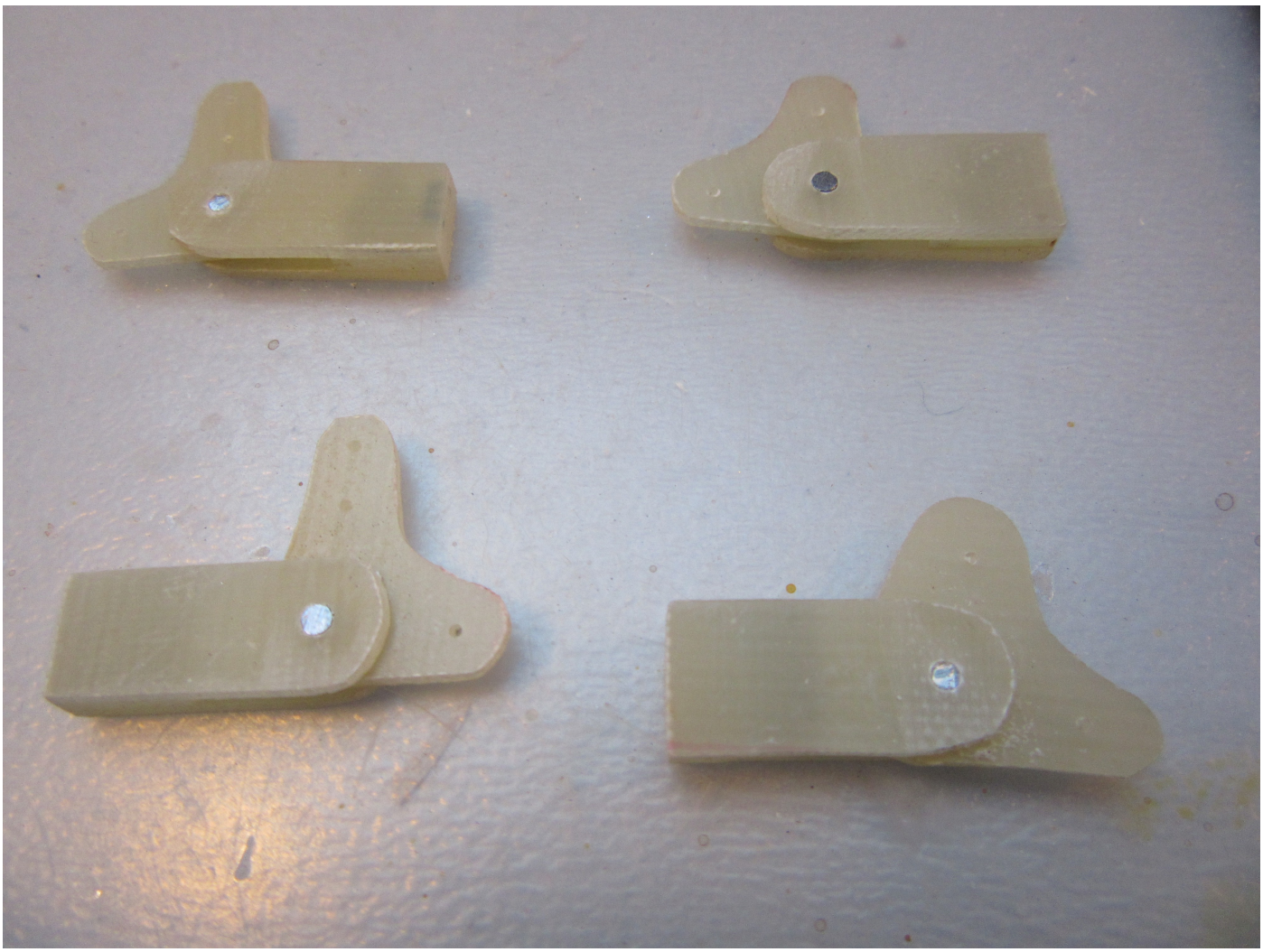
nice, one cut and you have finished all the components of the aileron in one go (22).



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.

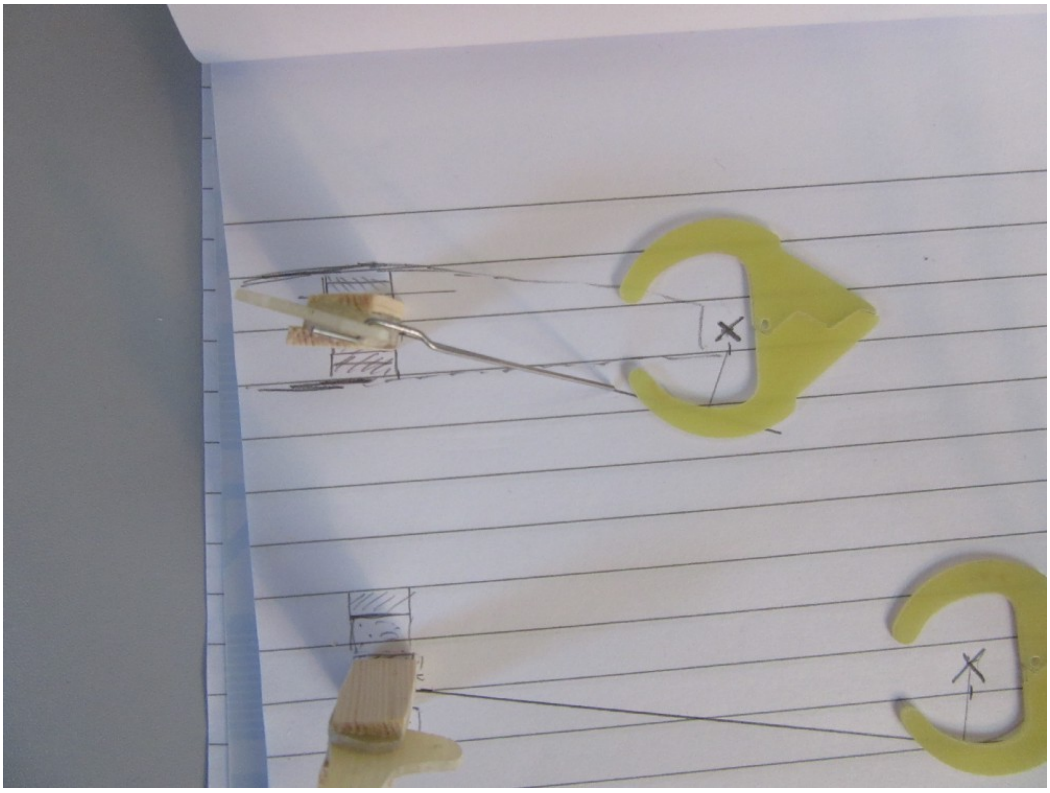


23 (left): Aileron hinges. | **24** (right): Rockers for aileron actuation.

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).

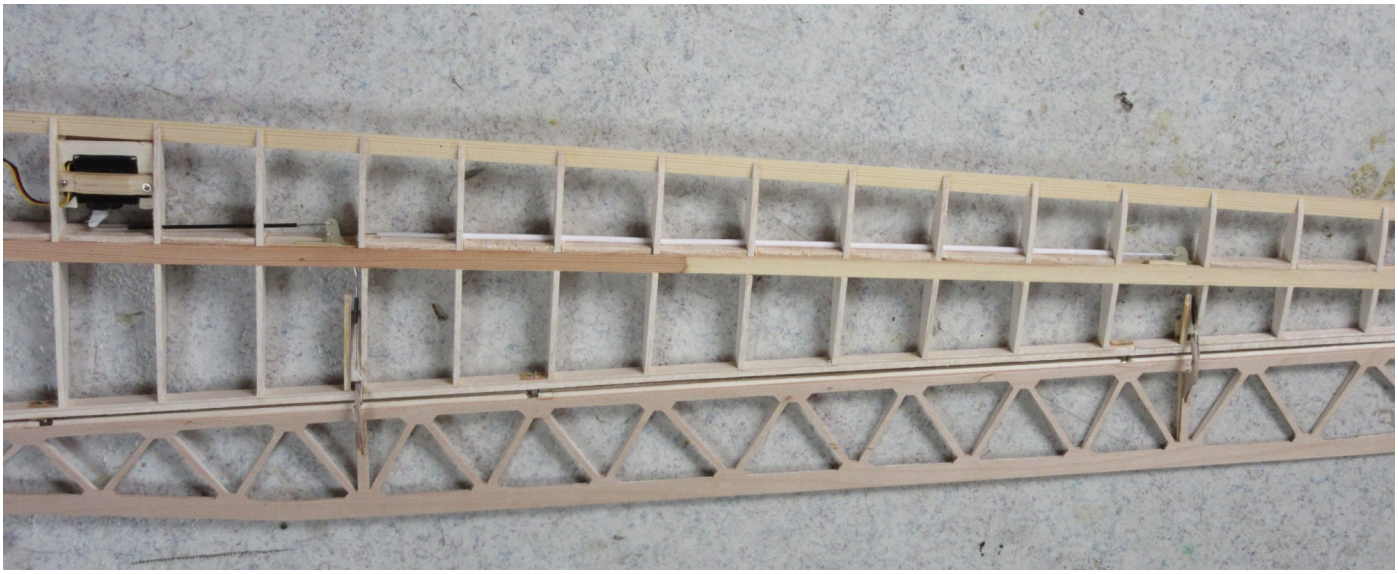


25: Rudder horns ailerons.

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.

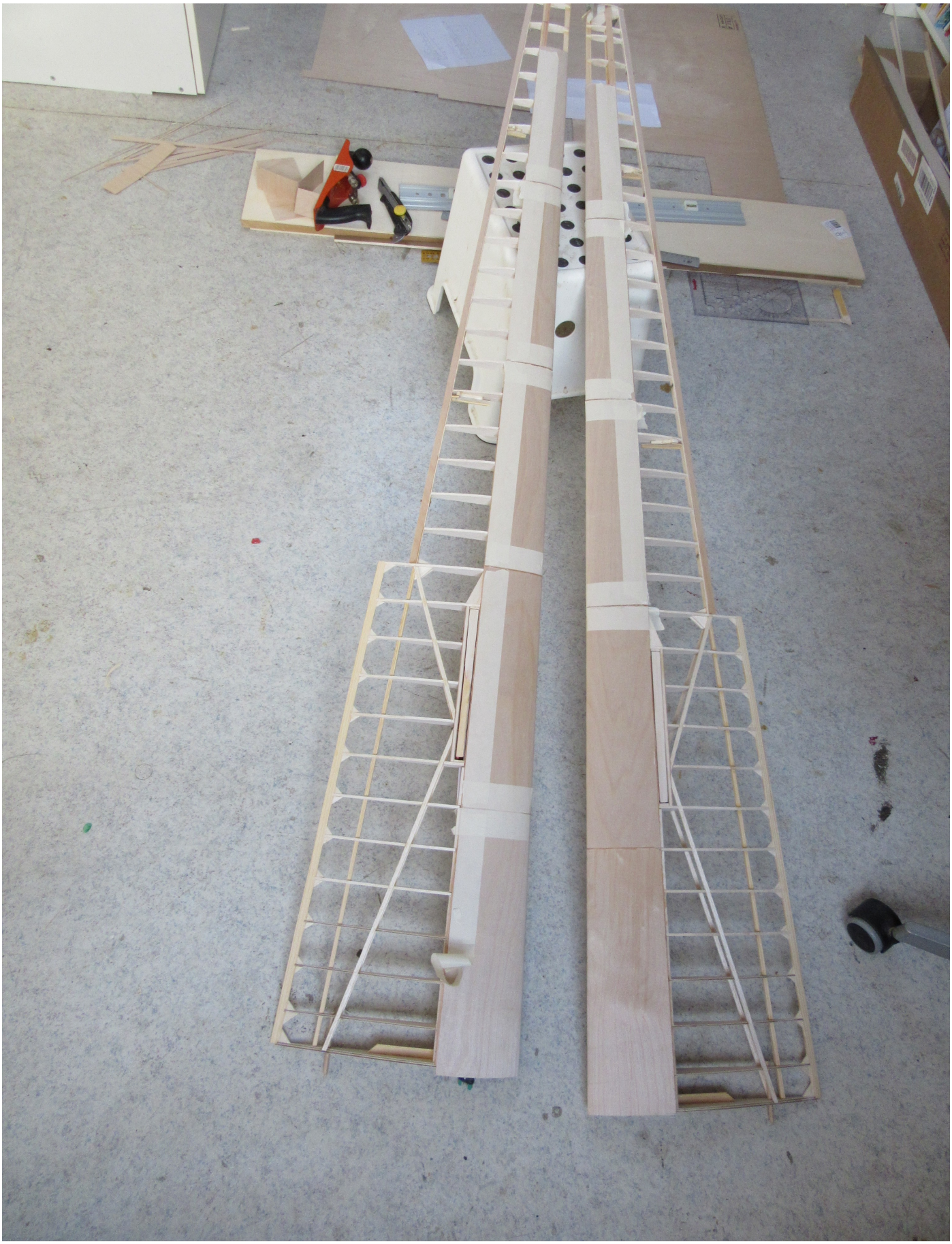


26: Aileron actuation in one picture seen from below.

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.

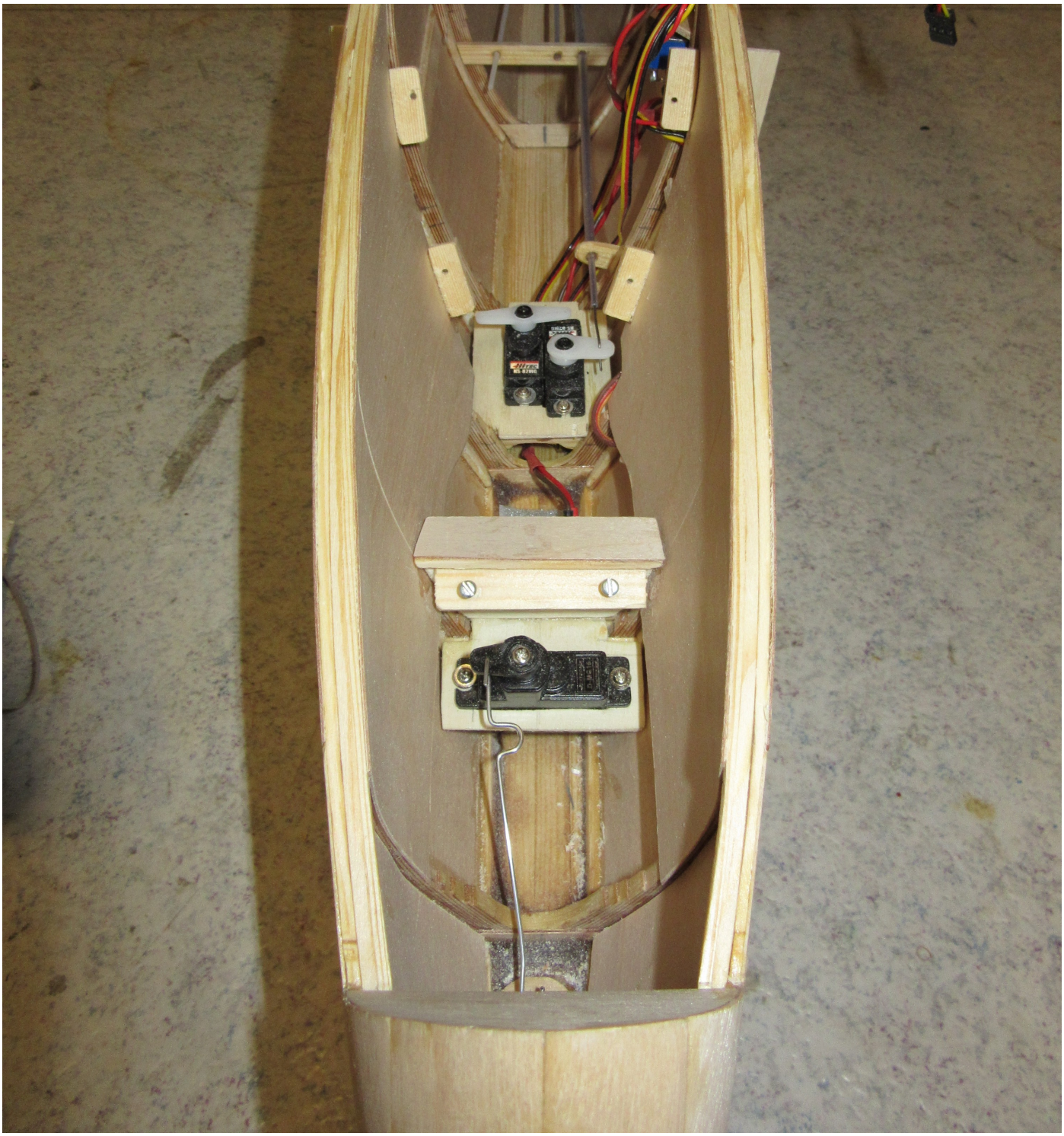
Finishing

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.

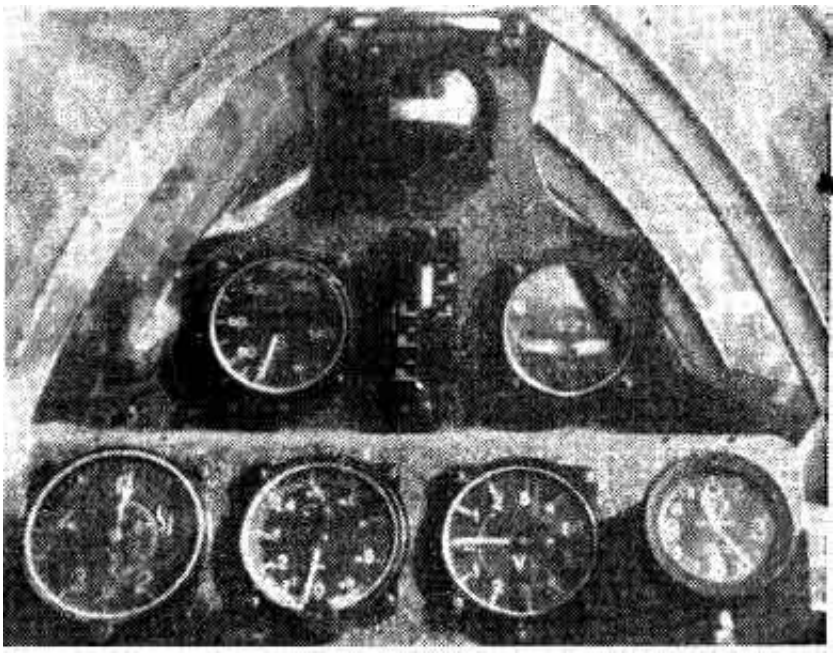
For my scale canopy I laminated the frames to have the scale 'look' and a vacuum formed canopy. I made a balsa mould, based on the dimensions of the fuselage (34).

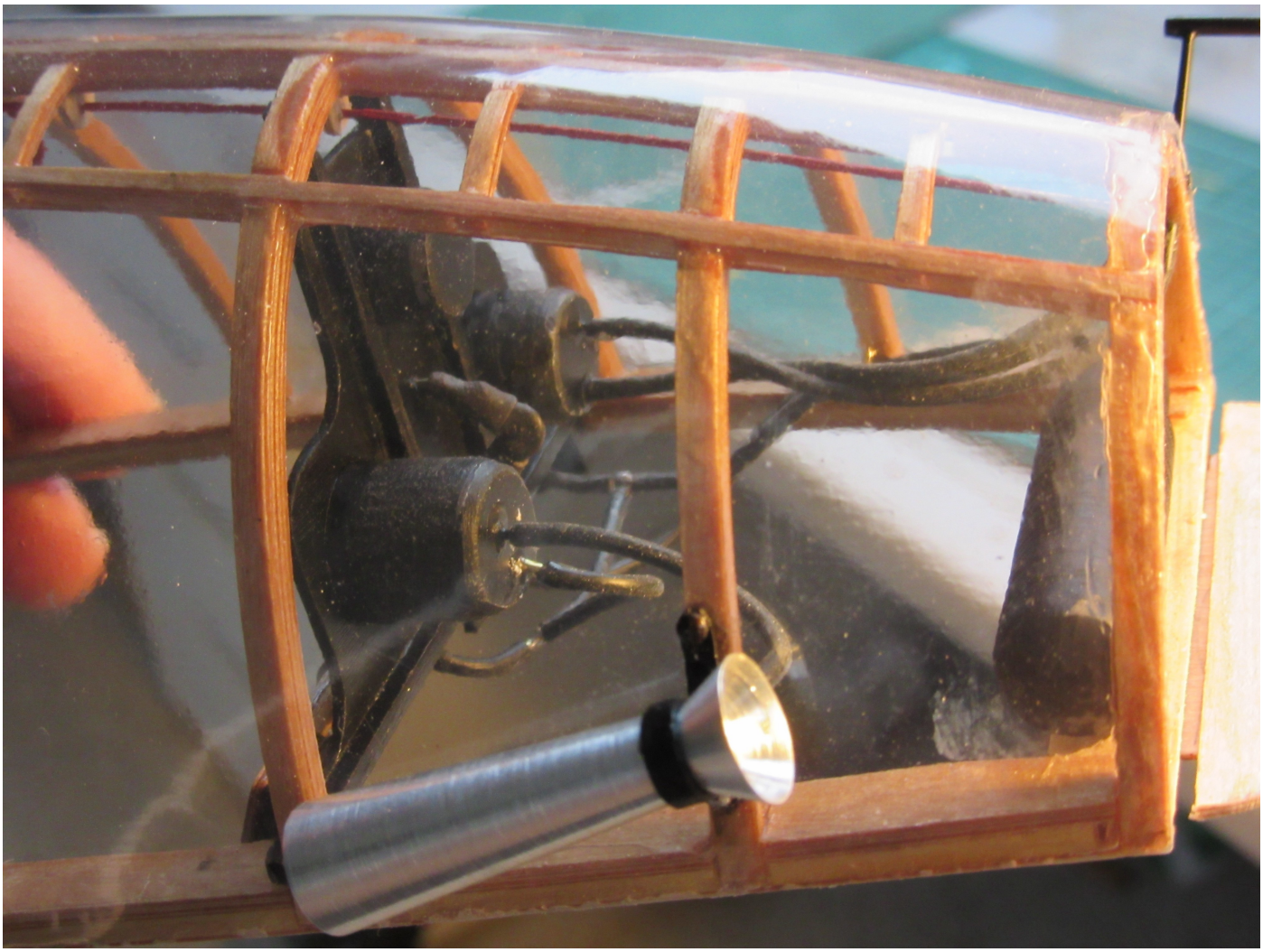


33 (left): The RC components under the cockpit floor. **34** (bottom right): All the woodwork of the canopy finished.

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!

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****.*