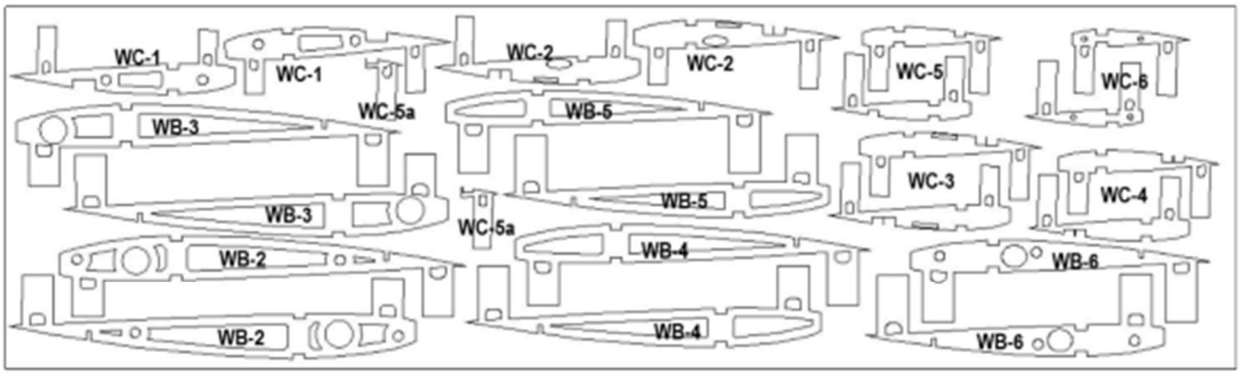
Beechcraft Starship Build Description

I was contacted by a flying club friend who has asked me if I would be interested in building him a new kit he was looking to purchase. Even though this is not a scratch build, I was very interested in this kit because I feel I can use the AMTN wing and fuselage design to aid me in coming up with plans for a JetZero Blended Wing Body RC model.

Well, the kit and retracts have arrived, and were brought to me on 5 April 2024. So, this model is now my build project. A Callie-Graphics package has been ordered and will arrive well before we will need it. Below is an image of the balsa and plywood RC model in discussion. A unique aircraft indeed. You can see more images and information @: https://www.amtn.nl/starship-s/. There also is a multi-part video Build Log that Saul at Plane Fun R/C Channel has put a great deal of work and excellent information into, and you can view @: https://www.rcgroups.com/forums/showthread.php?4148453-AMTN-Burt-Rutan-Beechcraft-Starship/ .

The first thing we did was unpack everything and checked out all the various light plywood and balsa sheets, and there are a LOT of them as you can see in the image below. I then took the AWESOME instruction manual AMTN provided and labeled all the individual pieces to ensure I would know which were which once they are removed from the large sheets. A couple of the instruction manual sheets can be seen below, or you can download the entire instruction manual @: https://balsaandglass.com/Balsa_Builds.html.


INSTRUCTION MANUAL
BEECHCRAFT STARSHIP


WC-1
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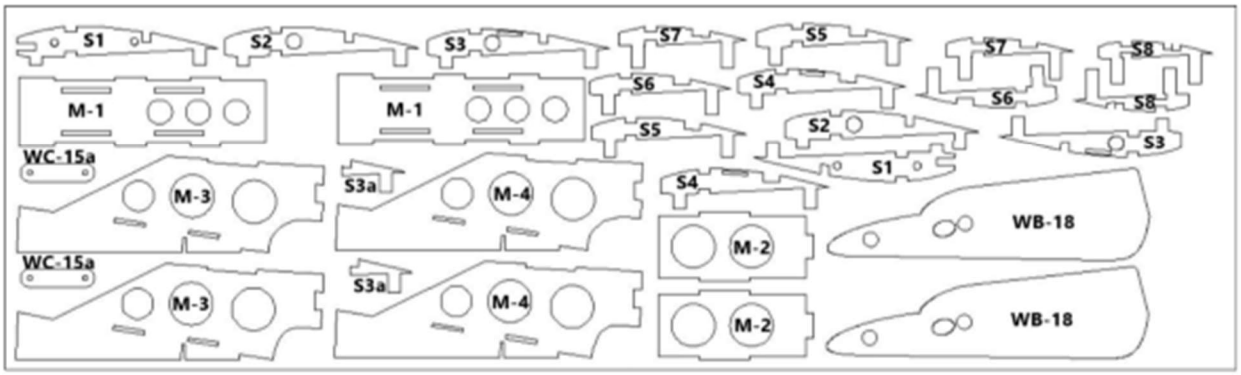
S1
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M-1
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S1
WC-15a
S3a
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WB-18
WC-15a
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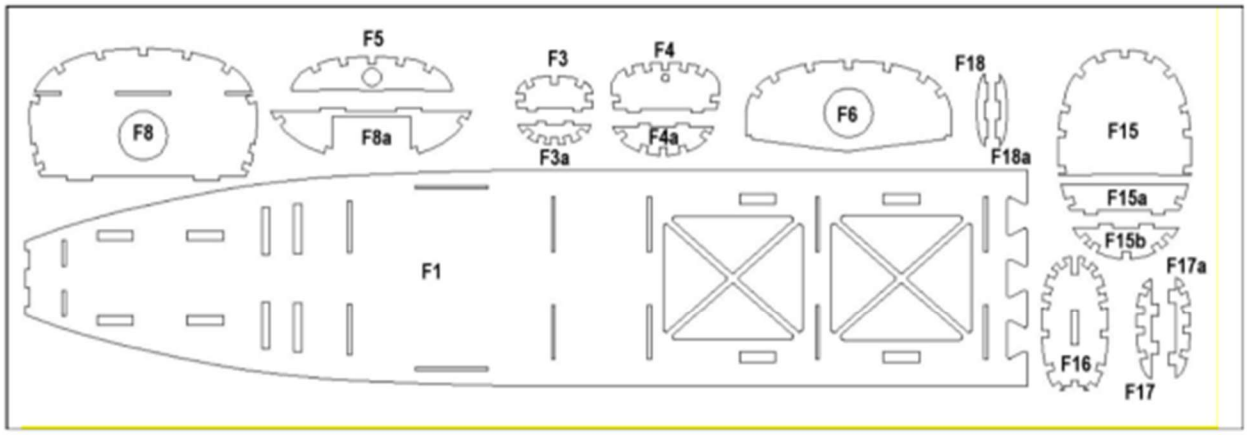
WB-18


F5
F3
F4
F18
F8
F8a
F3a
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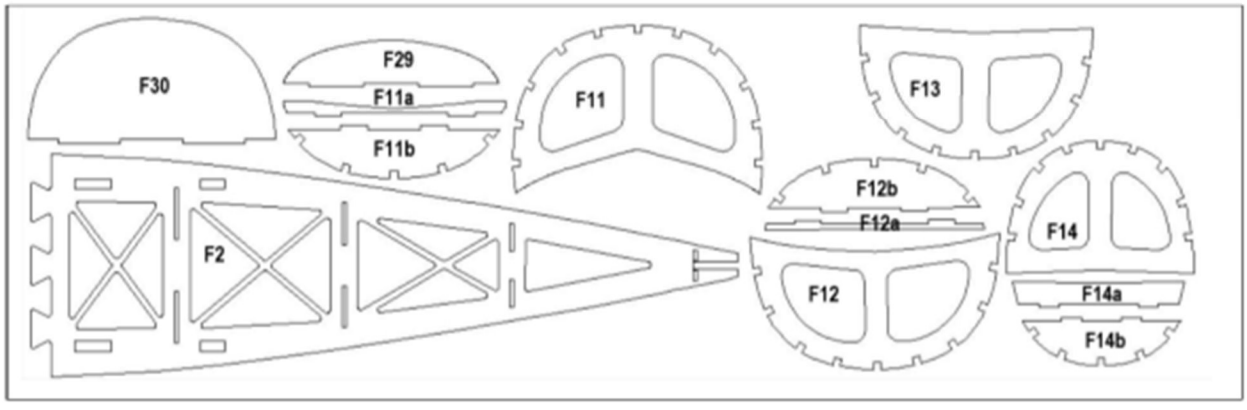
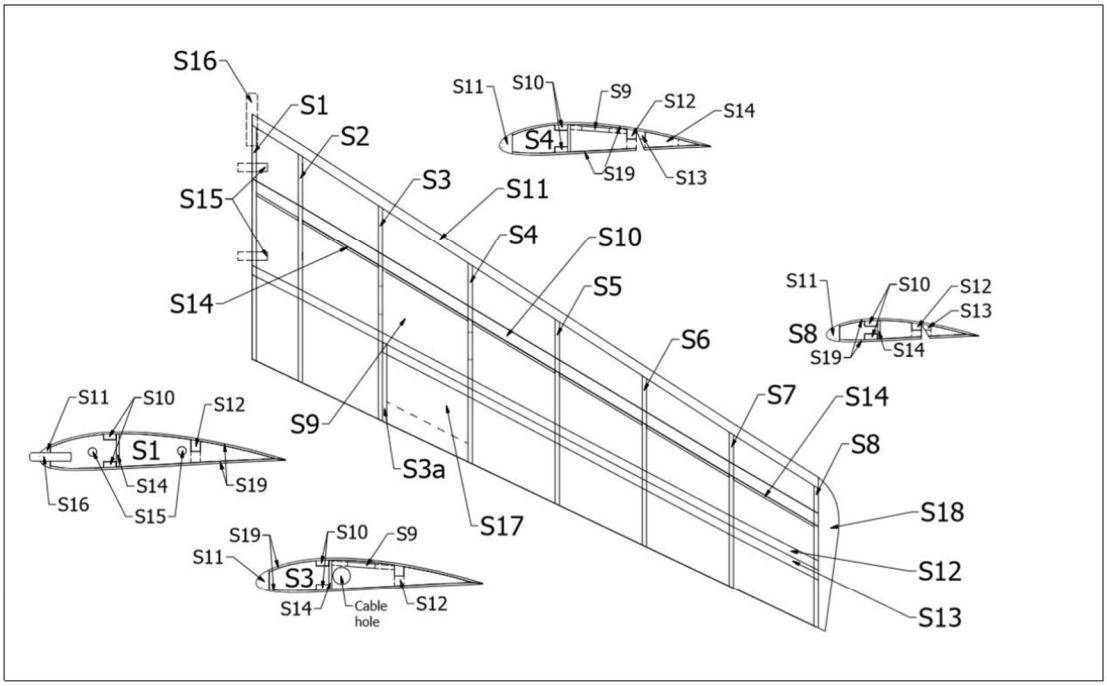
F6
F18a
F15
F15a
F15b
F17a
F1
F16
F17


F30
F29
F11a
F11
F13
F11b
F12b
F12a
F14
F2
F12
F14a
F14b

My next task was to remove all the parts required to assemble the front wing (or canards) from the Lite ply sheets, sanding the outside edges and interlocking cutouts to help make that assembly go smoothly.

FRONT WING



In general:
The front wing will be built by using template "S". In this template there have been made cut-outs for placement of the ribs, there for the correct angle of attack of the front wing can be guaranteed. Because the front wing has to be built in an angle of attack it is important to prepare the leading edge, main ribs and back list in an angle. They must be reworked slightly.

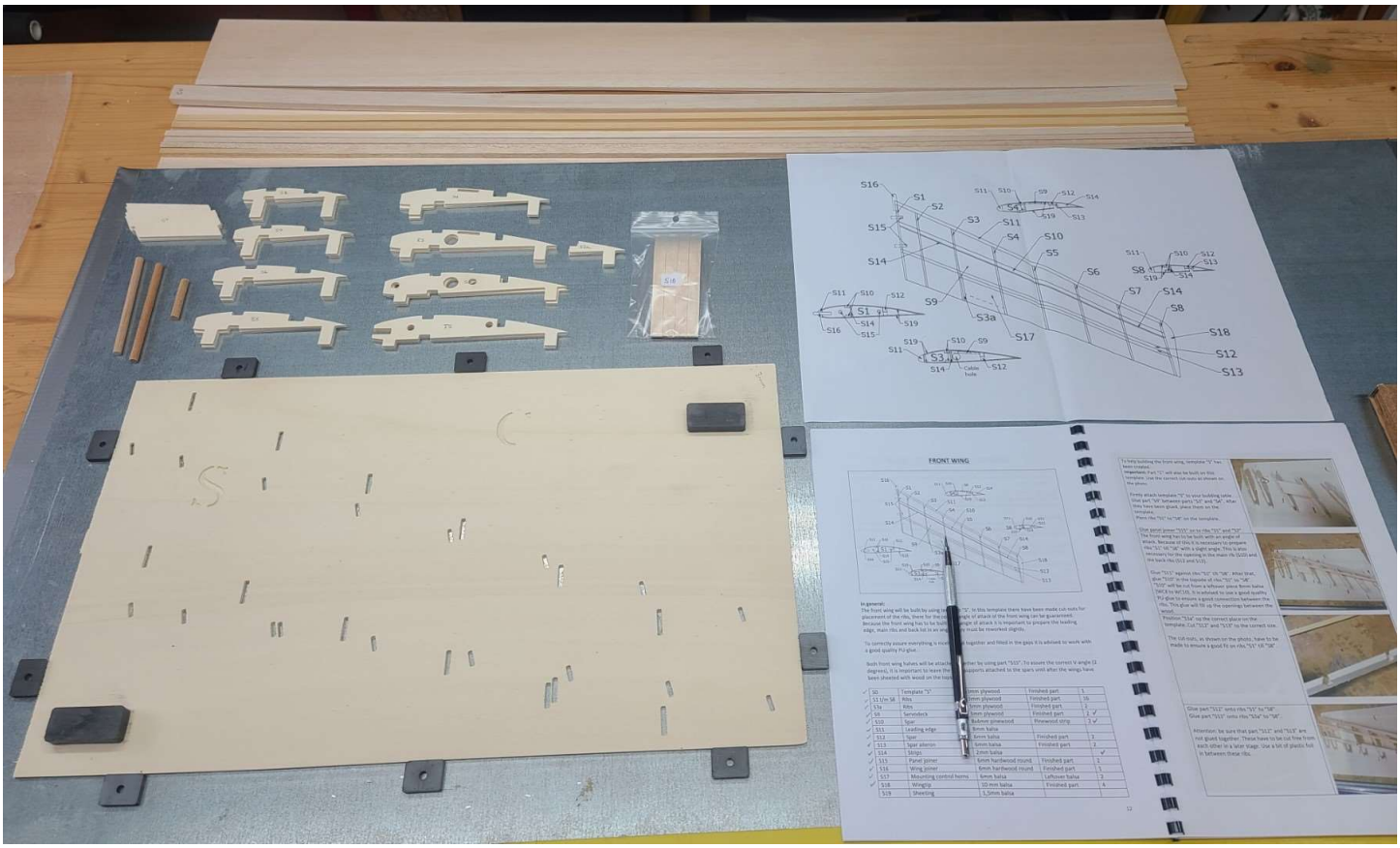
To correctly assure everything is nicely glued together and filled in the gaps it is advised to work with a good quality PU-glue.

Both front wing halves will be attached together by using part "S15". To assure the correct V-angle (2 degrees), it is important to leave the build supports attached to the spars until after the wings have been sheeted with wood on the topside.

S0	Template "S"	3mm plywood	Finished part	1
S1 t/m S8	Ribs	3mm plywood	Finished part	16
S3a	Ribs	3mm plywood	Finished part	2
S9	Servodeck	3mm plywood	Finished part	2
S10	Spar	8x4mm pinewood	Pinewood strip	2
S11	Leading edge	8mm balsa		
S12	Spar	6mm balsa	Finished part	2
S13	Spar aileron	6mm balsa	Finished part	2
S14	Strips	2mm balsa		
S15	Panel joiner	6mm hardwood round	Finished part	2
S16	Wing joiner	6mm hardwood round	Finished part	1
S17	Mounting control horns	6mm balsa	Leftover balsa	2
S18	Wingtip	10 mm balsa	Finished part	4
S19	Sheeting	1,5mm balsa		

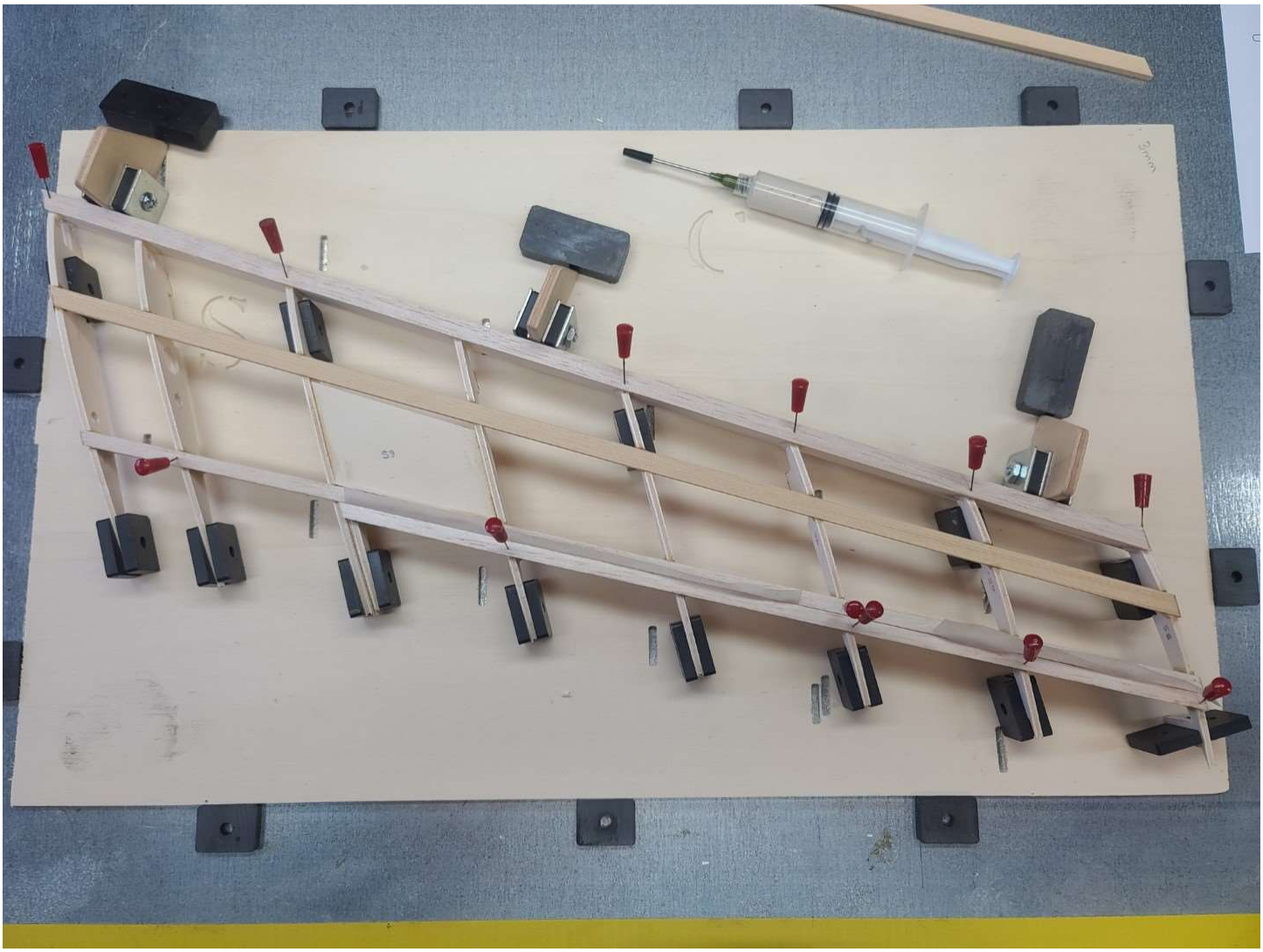
Below you can see all the finished parts and other materials needed to assemble the front wing (canards), including the plywood template “S”. I used a Dremel tool with a small fine saw blade to remove the various pieces from the Lite ply sheets.

Two Builders Notes – 1) Ribs S2 did not have holes to accept the S15 panel joiner 6mm hardwood dowels. Determine the correct location for these holes and drill them in both S2 ribs prior to starting the front wing build. 2) Use a S9 servo deck part to make a paper template (minus the two side tabs) for the elevator servo hatch covers needed later in the build.



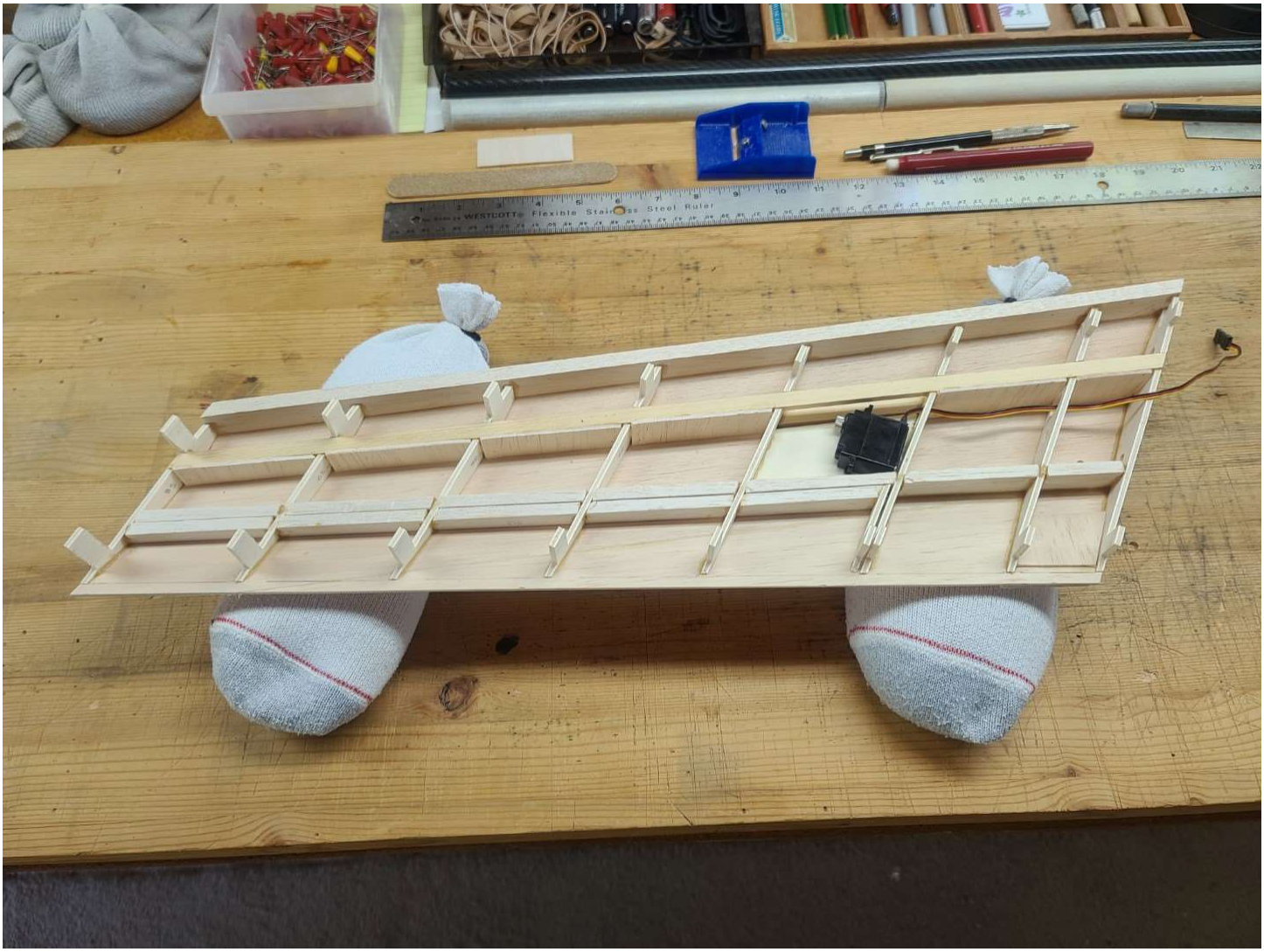
This next image shows the start of the right canard build. Magnets are used to keep all the ribs in place and perpendicular to the ply template. I use Titebond III Ultimate wood glue for all the joints, and after parts have been initially glued in place, I go back and put a small bead of glue along all joints using the syringe you can see in the image. Once the glue had dried, I removed some magnets to allow for the installation of another S10 pinewood main spar along the bottom of the eight ribs. I also glued two 1.5mm balsa sheets together (edge-to-edge) to sheet the tops of each canard.

Builders Note – In order to get the top cover sheets for both canards out of these two 1.5mm balsa sheets, you need to stagger the ends of the sheets by 63.5mm, otherwise you cannot get the lengths needed to cover both canards.

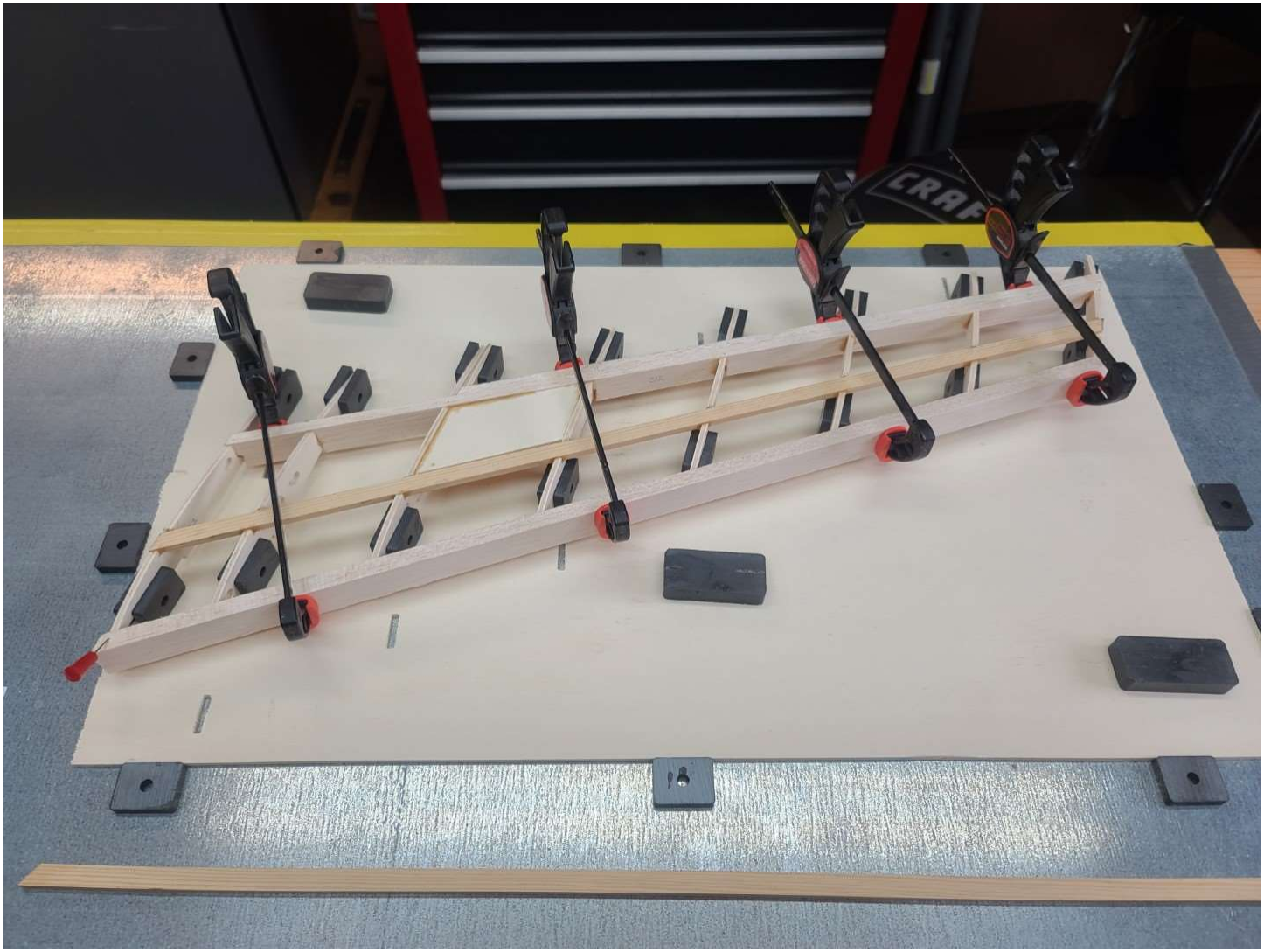


After a complete sanding of the canard to the final top airfoil profile of the ribs, the 1.5mm balsa sheeting was applied. The image below shows the gluing of this top balsa sheeting on the right canard. I use old socks filled with lead shot to apply weight evenly over the surface while the glue dries. These work great!

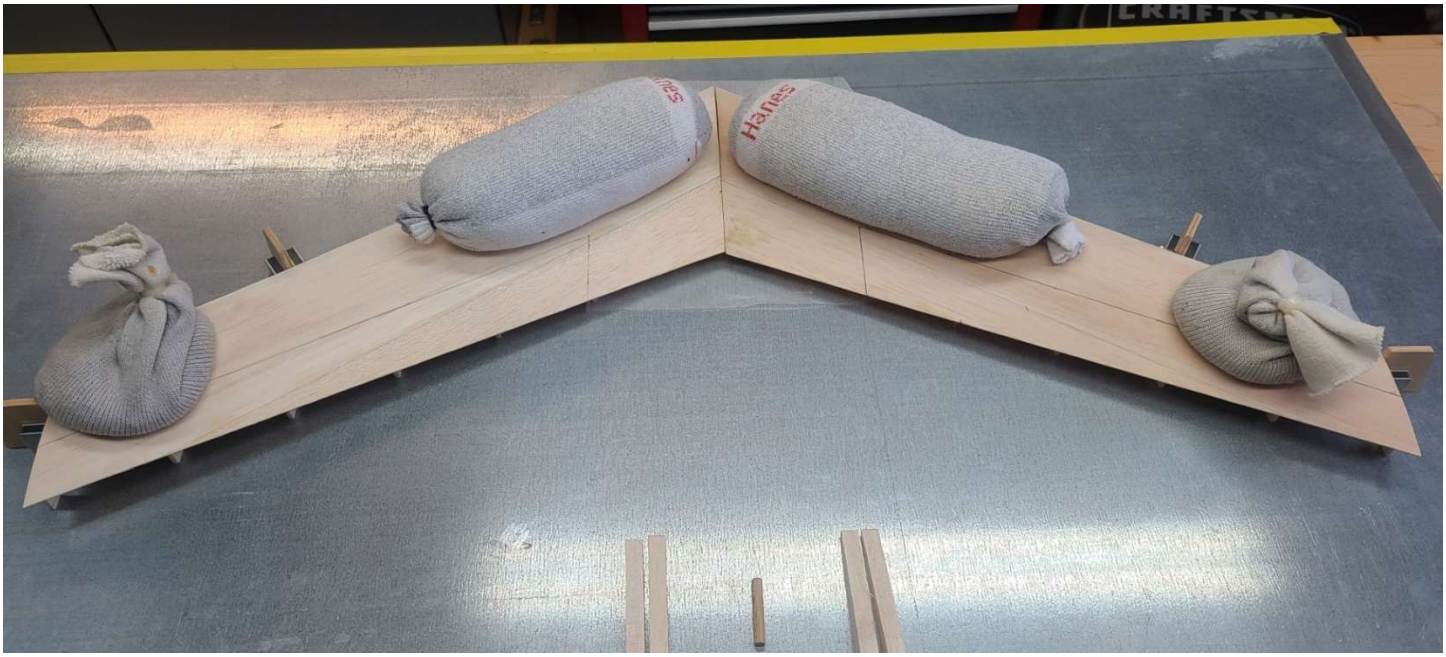
The image below is the right canard removed from the plywood build template “S”. You can see the 2mm vertical grain balsa shear webbing has been cut and installed along the aft side of the main spars. I temporarily set the elevator servo in place for a fit-check, only to find that it is too thick to allow for proper fitting of a 2mm ply hatch cover. Looks like we will need to see about getting a couple thin wing servos.



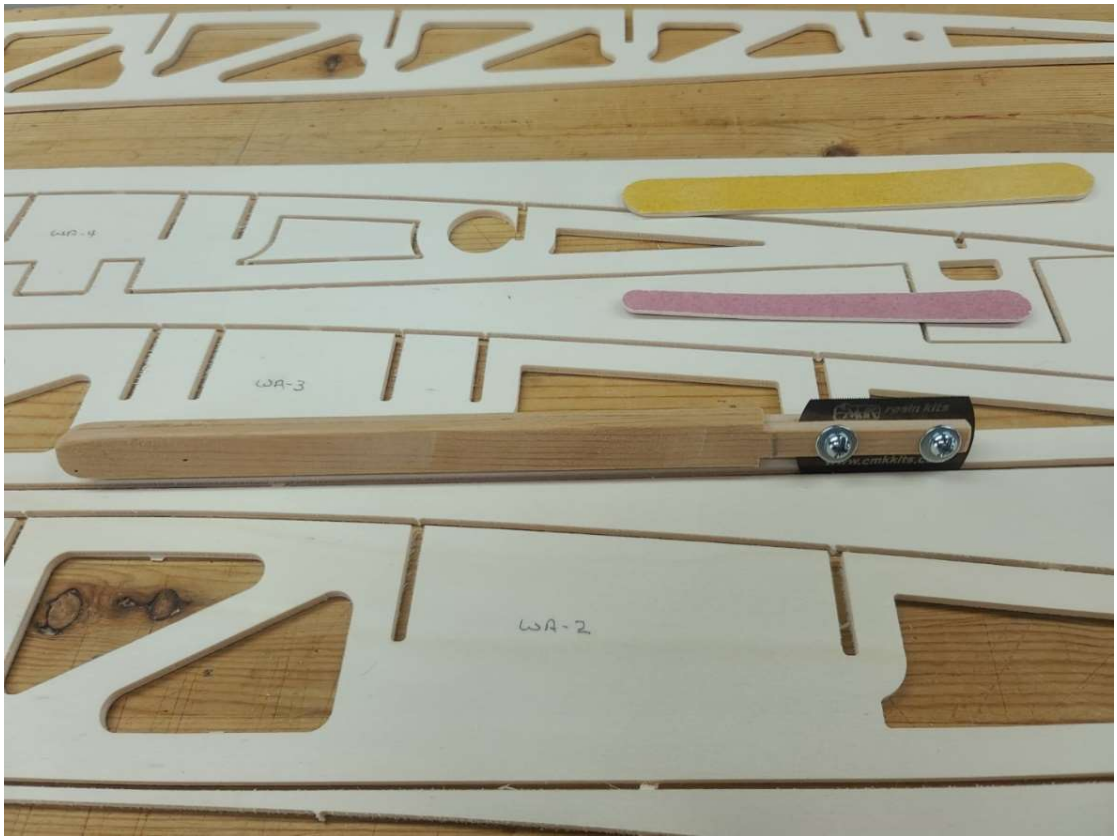
After flipping the plywood template “S” over, I started the build of the left canard. The image below shows that build in progress. Those mini bar clamps are one of the best purchases I have ever made. Over the many years, I’ve used them on all my scratch builds. I just wish Craftsman was still making them. I jointed two more 1.5mm balsa sheets and then cut out the top and bottom sheeting for the left canard.



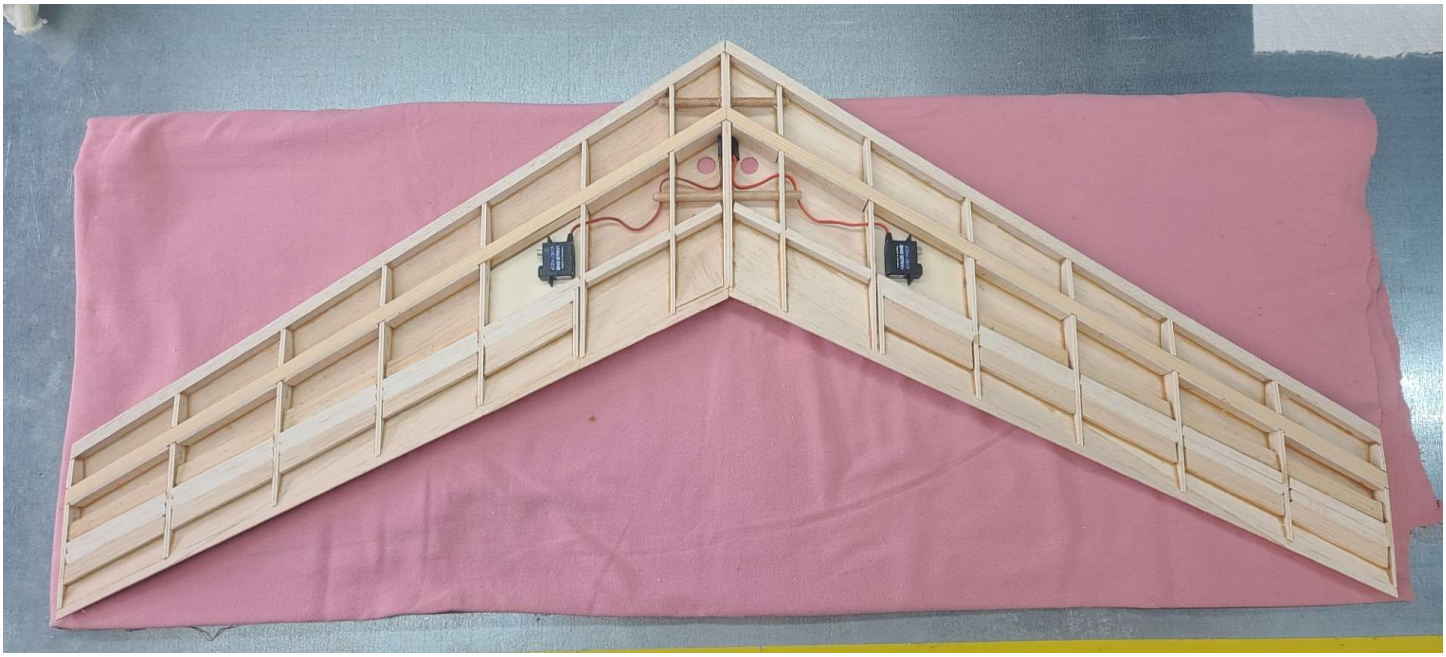
This next image is the canard wing in what we use to call in the C-17 program "a major join". After inserting the two S15 6mm hardwood dowls into ribs S1 and S2, the two front wing halves are joined together using 30-minute epoxy, and to ensure all the rib tabs remain in contact with the building board during the cure, I once again use my trusty sock weights.



While the canards were in-join, I decided to start the prep for the build of the Main Wing Part A by removing all the required pre-cut parts from the Lite plywood sheets. The image below shows a nifty little tool I made to cut the small ply tabs holding each of the parts in the sheets. This is a very sharp and very thin razor saw blade sold by Micro-Mark Tools @ https://www.micromark.com/mini-hand-tools/knives-and-cutters?page=4&mini-hand-tools%25252Fknives-and-cutters=. After each part is removed from the larger Lite ply sheet, I take the large tongue depressor sanding bar covered with 100 grit sandpaper to clean up the outside edges of each part, and the small fingernail file to clean out each of the interlocking notches.



Once the canard epoxy has completely cured, you can remove all the rib tabs; install balsa fillers between the ribs for the elevator control horn and the four hinges; cut the holes in the top sheeting to run the elevator servo leads; plane the leading edge; and then sand everything until you get a nice flat surface across the entire front wing that matches the rib profiles. You can see all this completed in the image below, along with the two elevator servos that will be mounted on the servo bay hatches. They are Blue Bird BMS-127WV+ servos from https://www.bluebirdservousa.com/product-page/bms-127wv/ and these little things give us a torque of 4.7 kg-cm / 65.3 oz-in at 7.4 volts. Next, I will run some temporary cord from the servo bays out thru the top surface holes, and then sheet the entire bottom side of the front wing using the two 1.5mm balsa sheets I cut earlier.

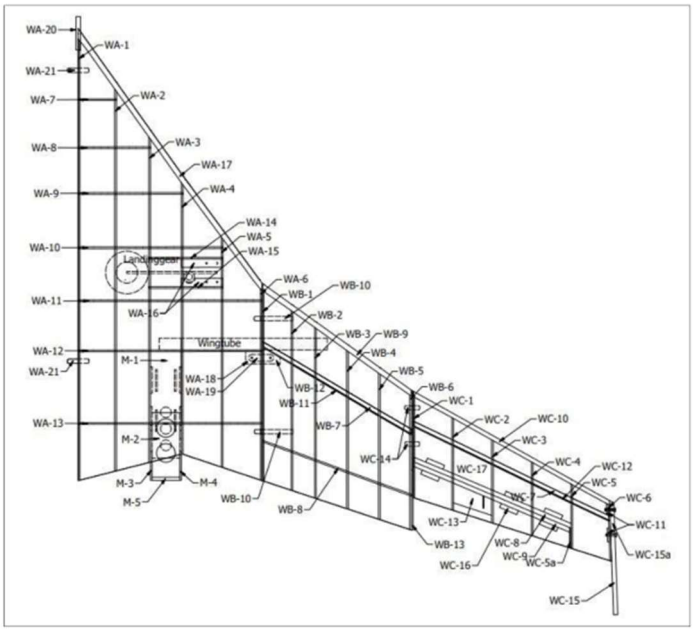


With the front wing bottom side sheeting installed, the S18 soft balsa wingtips are attached and sanded to match the S8 rib/elevator profile. The leading edge is then planed and sanded to the final shape; elevators are cut-out from the front wing and their leading edges beveled to provide clearance for deflection; elevator servo bay openings are cut-out; and the S16 nose 6mm hardwood dowel gets installed. The results of all this are shown in the image below which is the bottom side of the front wing.

This completes the front wing build for now, so let's see about building the Main Wing.

The first task in the build of Main Wing Part A (or inboard-wing panel) is to remove all the finished parts required for assembly from the Lite ply sheets, sanding the outside edges and interlocking cutouts to help make the assembly go smoothly. The bottom image shows all the parts needed for both inboard-wing panels.

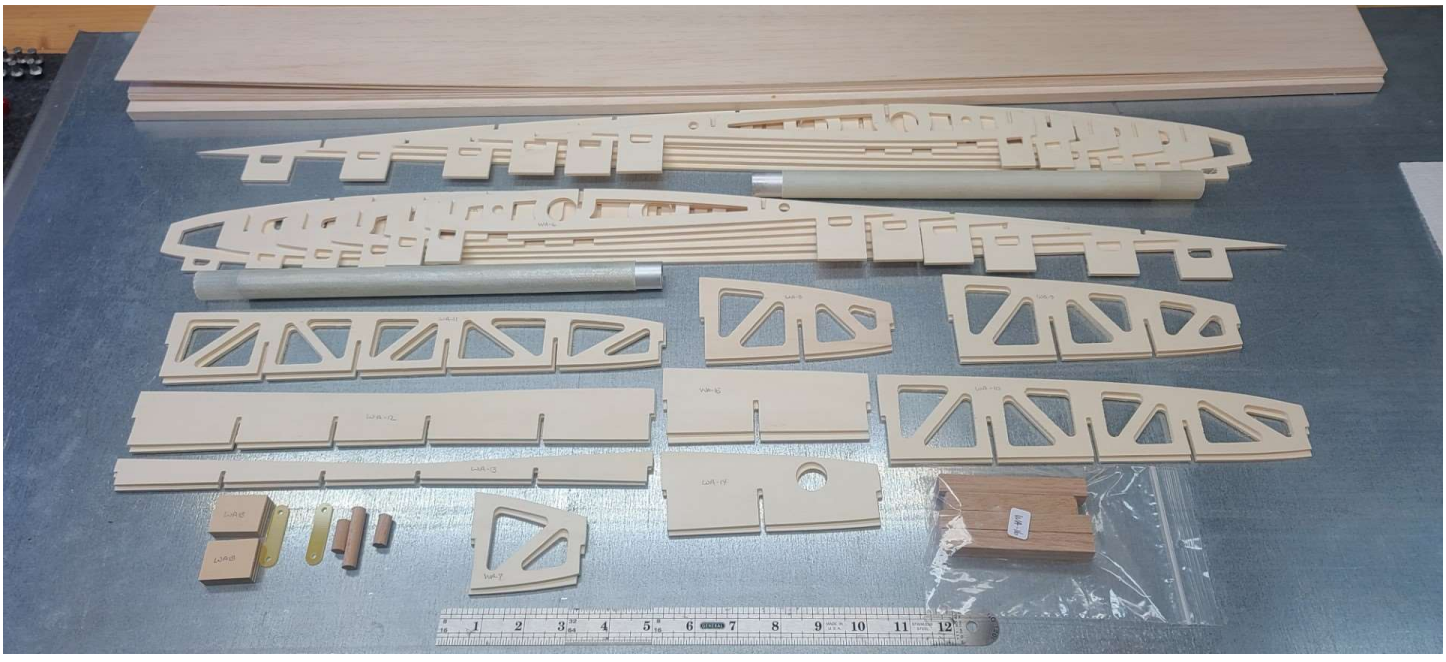
MAIN WING.



In general:
The main wing consists of 3 parts: A, B and C.
Part A will be glued in the fuselage. Part B and C will be glued together. Note that part B/C will be connected to part A with a wingtube.

To assist in the build of part B and C there is a template supplied in the kit. The ribs for part A are constructed in a way there will be no need for a template.

Part C has a negative angle of 1,5° relative to part B. Because of this negative angle the topside of the wing will be aligned with the topside of part B. This is needed to provide enough lift to the airplane during flight. If not, the airplane will not have enough lift and will dive to the ground. To increase the stability, part C has a washout of 1,5° negative to part B. It is also to be noted that the most outer rib of the wing is placed under an angle of 2° to the inside. It is also placed that the tip has a angle of 6°.

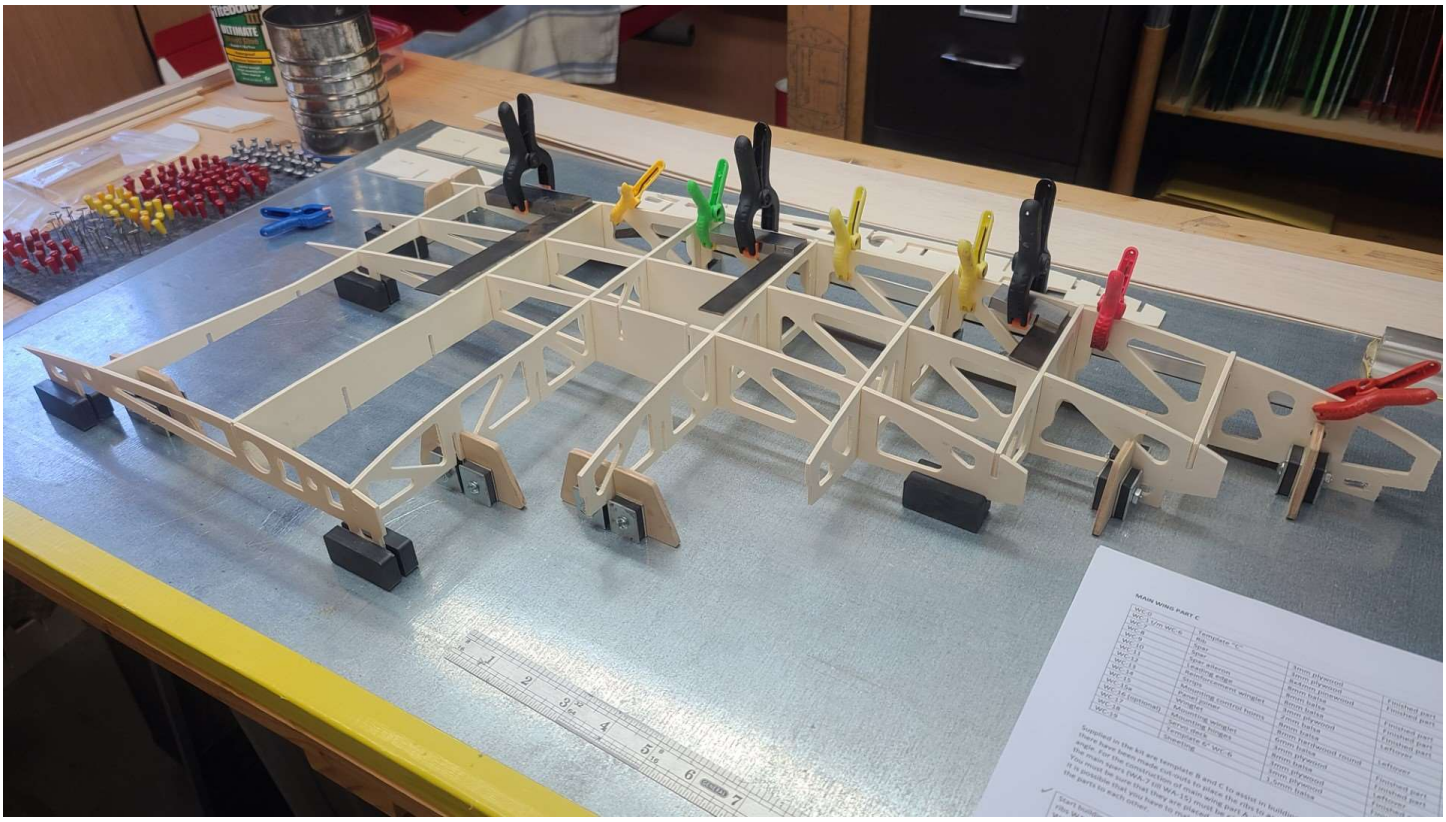


Builders Note – If you plan to install the WA-20 8mm hardwood dowel in the nose of the Main Wing, now would be the time to cut 8mm notches in both WA-1 ribs for the dowel to fit into.

In this next image you can see my magnetic board jig set-up and a dry-run test fit of ribs WA-1 through WA-3, and main spars WA-7 through WA-13. Various magnetic fixtures are used to hold the ribs perpendicular to the building board, and to ensure each of the seven spars are positioned 90 degrees to rib WA-1. This AMTN kit is awesome. The Lite ply parts fit together like no other kit I have ever built. With the jig and test-fit verified, each main spar can be lifted out, one at a time, to apply the Titebond III wood glue to each joint, and then set back down into the ribs. Just as I did in the assembly of the front wing, I take my glue syringe and put a small bead of glue along all the interlocking rib/spar joints, and there are a lot of them.

Builders Note – I clamp a small aluminum "L" bar along the length of rib WA-1 to ensure it is kept straight during the panel assembly.

Once WA-7 through WA-13 are all glued in place, this partial assembly is allowed to set overnight before I proceed any further.

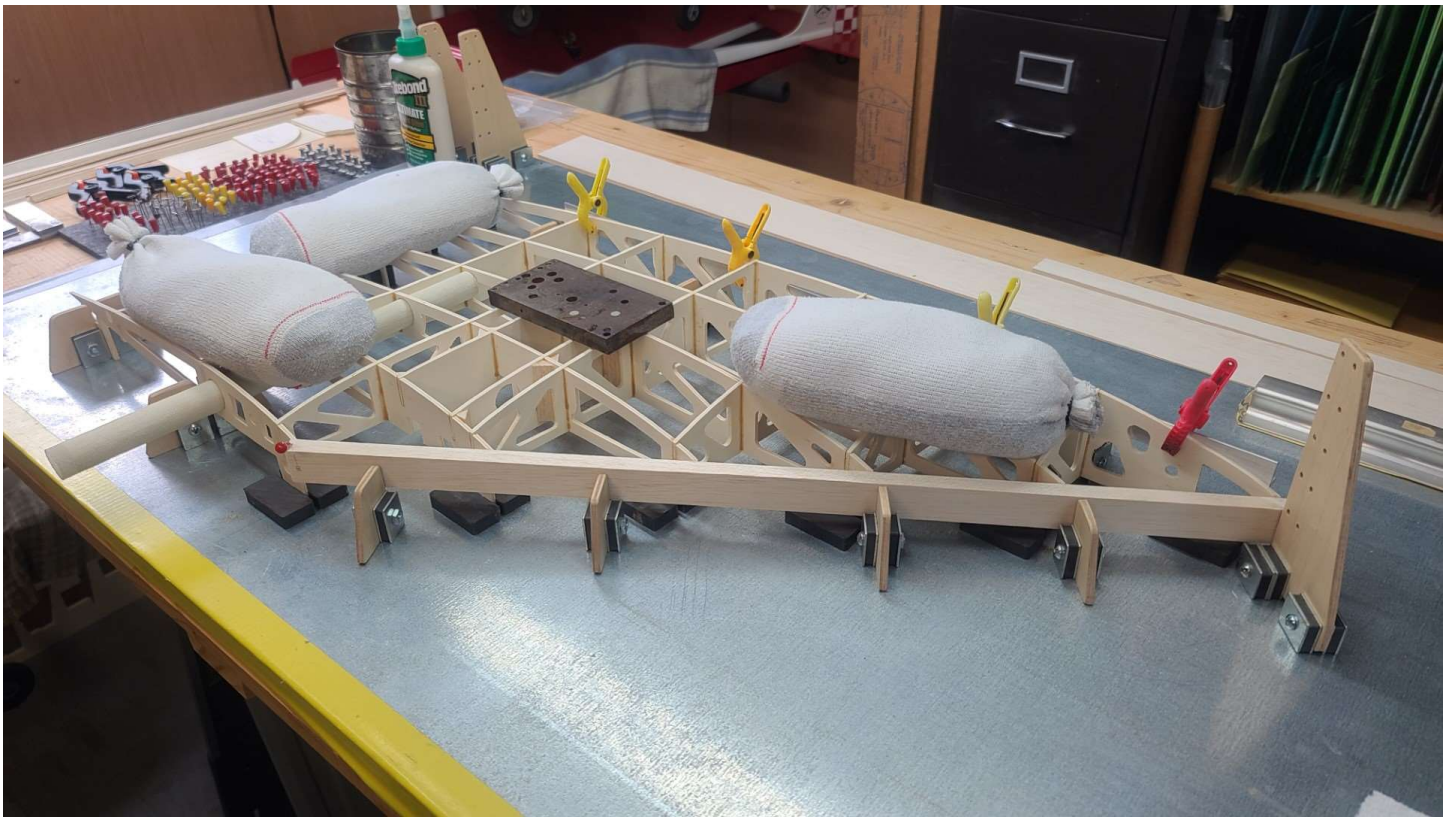


Next, this partial assembly of the right inboard-wing panel is temporally removed from the mag fixture jig and flipped over so ribs WA-4 thru WA-6 can be glued into the wing spars WA-9 through WA-13. With these three outer ribs initially glued in place, flip the panel back over and reinserted it into the mag fixture jig. Place some more mag fixtures along the outer three ribs to ensure they are held in their correct positions while the glue dries. Now glue spars WA-14 and WA-15 into the interlocking slots of ribs WA-3 through WA-5. This forms the bay for the main landing gear (MLG) retract. Again, I used my sock weights to keep all ribs resting on their support tabs.

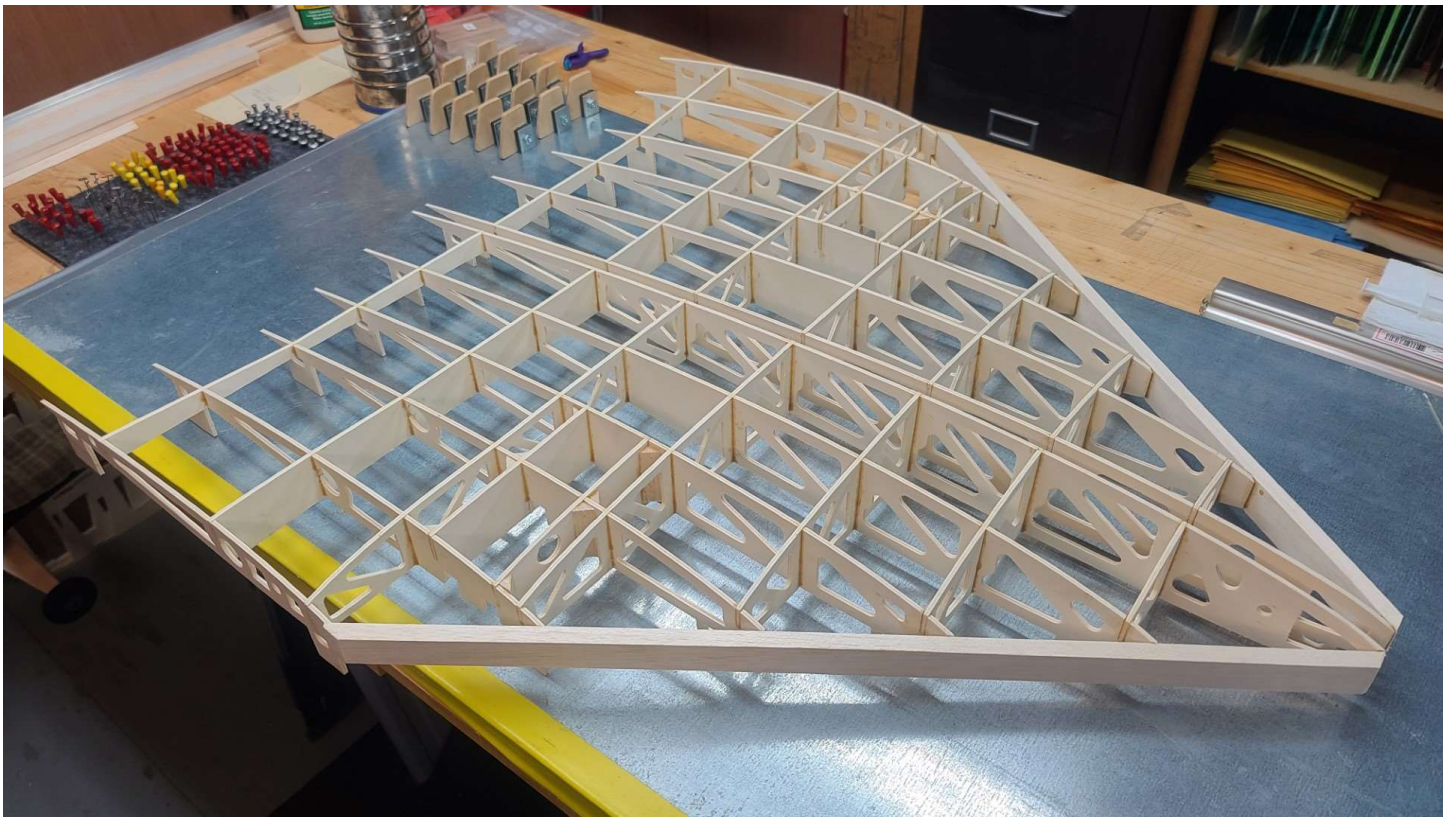
Three Builders Notes – 1) This is a good time to verify the fit of the fiberglass wing-tube sleeve through ribs WA-4 thru WA-6. 2) To help strengthen the MLG bay, I glued some 10mm balsa triangle stock in the outside corners of the rib/spar joints. 3)Finally, it is critical that ribs WA-1 and WA-6 are perpendicular to the building

board surface. This is to ensure a good joint between the inboard-wing panels and the mid-wing panels, and the joint of the two inboard-wing panels.

Now I cut-out the WA-17 leading edge of this panel from a 10mm balsa sheet and glued it to ribs WA-1 through WA-6. Make sure you grind an angle to the ribs leading edge to improve the glue joint between the WA-17 leading edge and six ribs. The image below shows the right inboard-wing panel at this stage of the build.

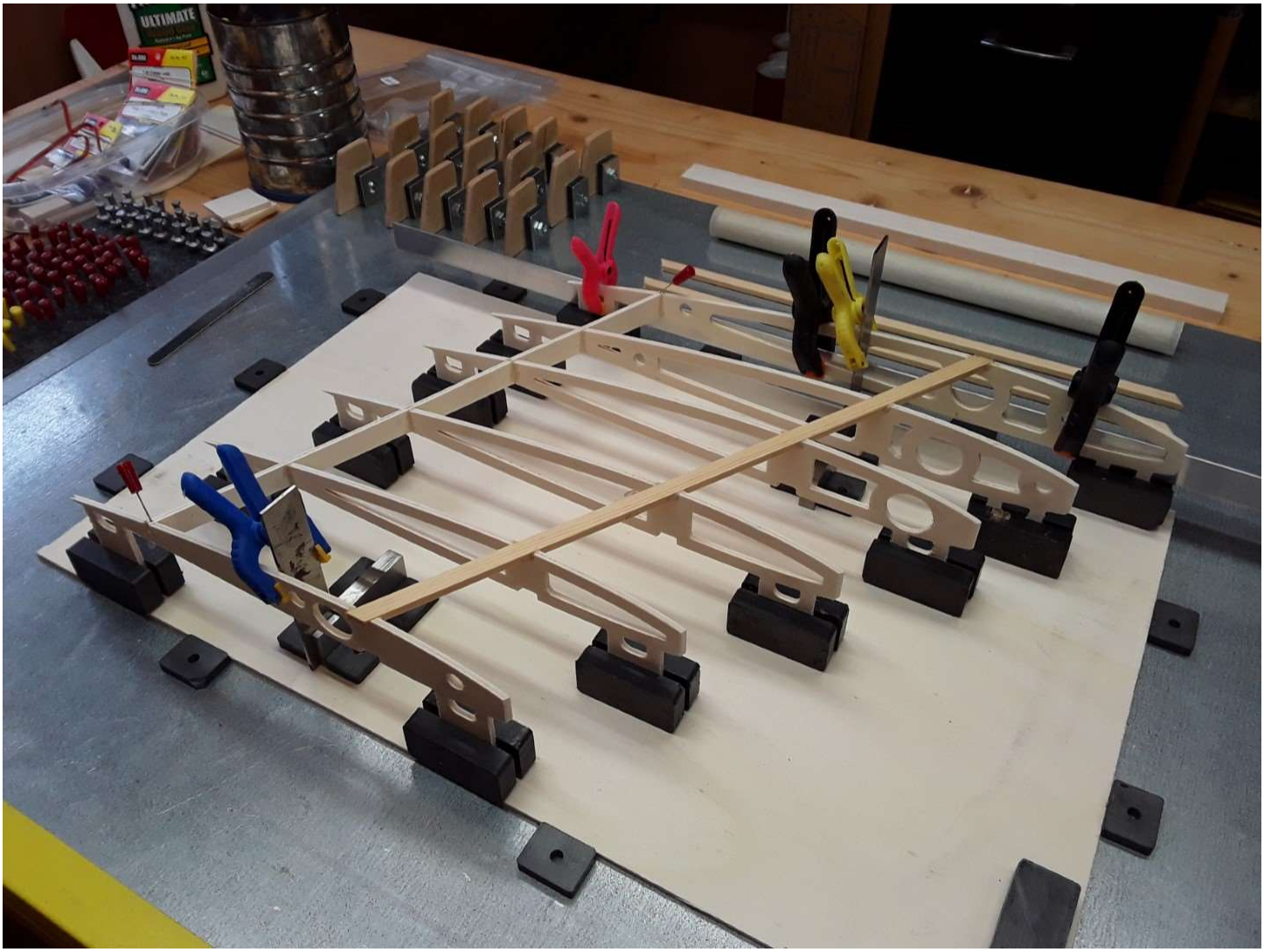


After going through all the same steps again to build the left inboard-wing panel, I pulled that panel from the mag jig and as you can see in the image below, we now have both panels needed for the Main Wing inboard section. Next up is to start the build of a Main Wing mid-wing panel.

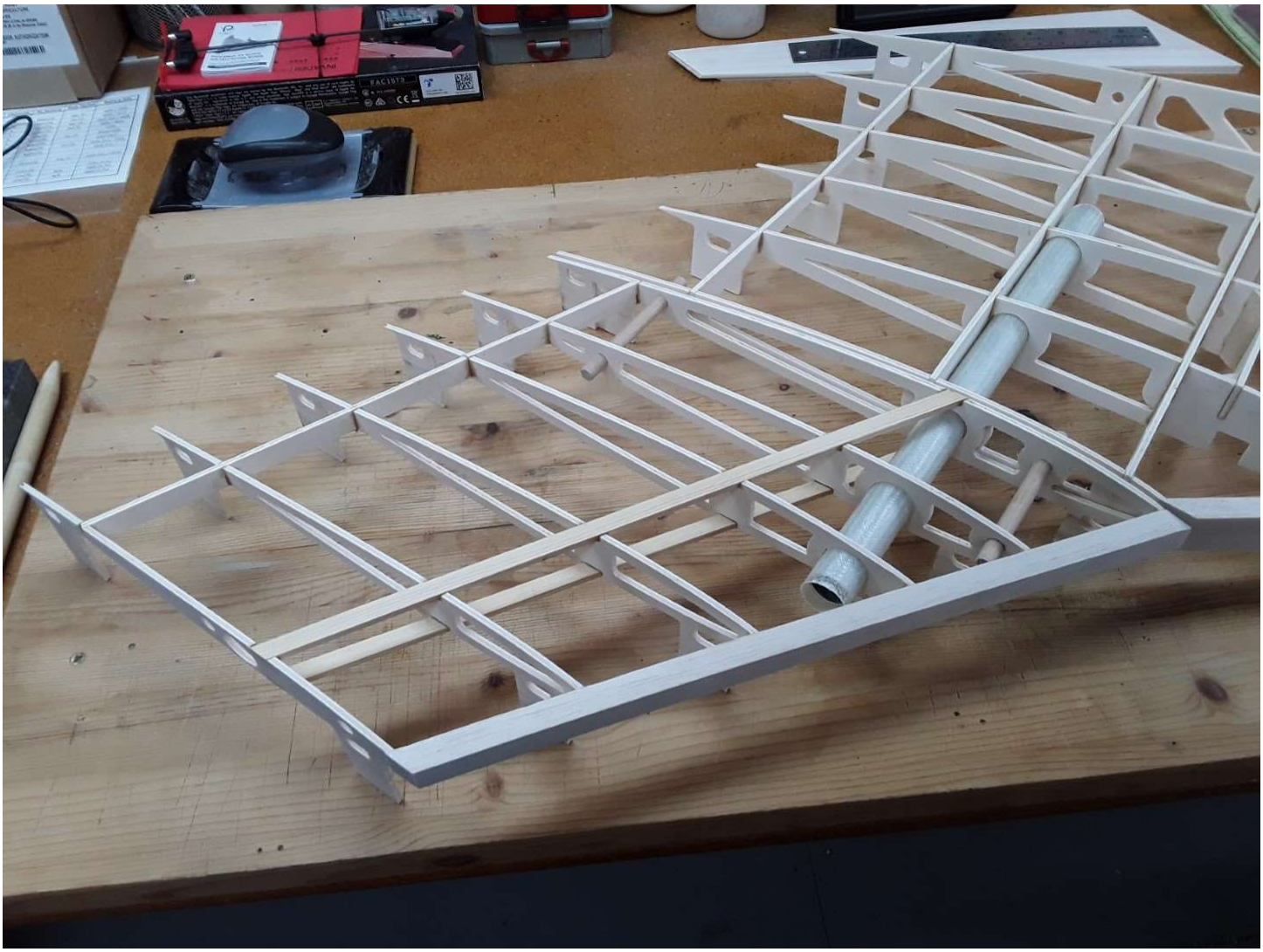


With the inboard-wing panels completed per the instruction manual, we now move on to removing all the parts from the 3mm Lite ply sheets that are needed to build the mid-wing panels. These are sanded along the outside edges, and the notches that accept the top and bottom WB-7 main spars and WB-8 aft spar are sanded to match the required angle. The leading edge of ribs WB-1 through WB-6 also require a slight angle sanding. The build of each mid-wing panel is accomplished using the supplied 3mm Lite ply template "B". The next image below is the start of the right mid-wing panel build.

Builders Note – I clamp a small aluminum "L" bar along the length of rib WB-1 to ensure it is kept straight during this panel assembly.



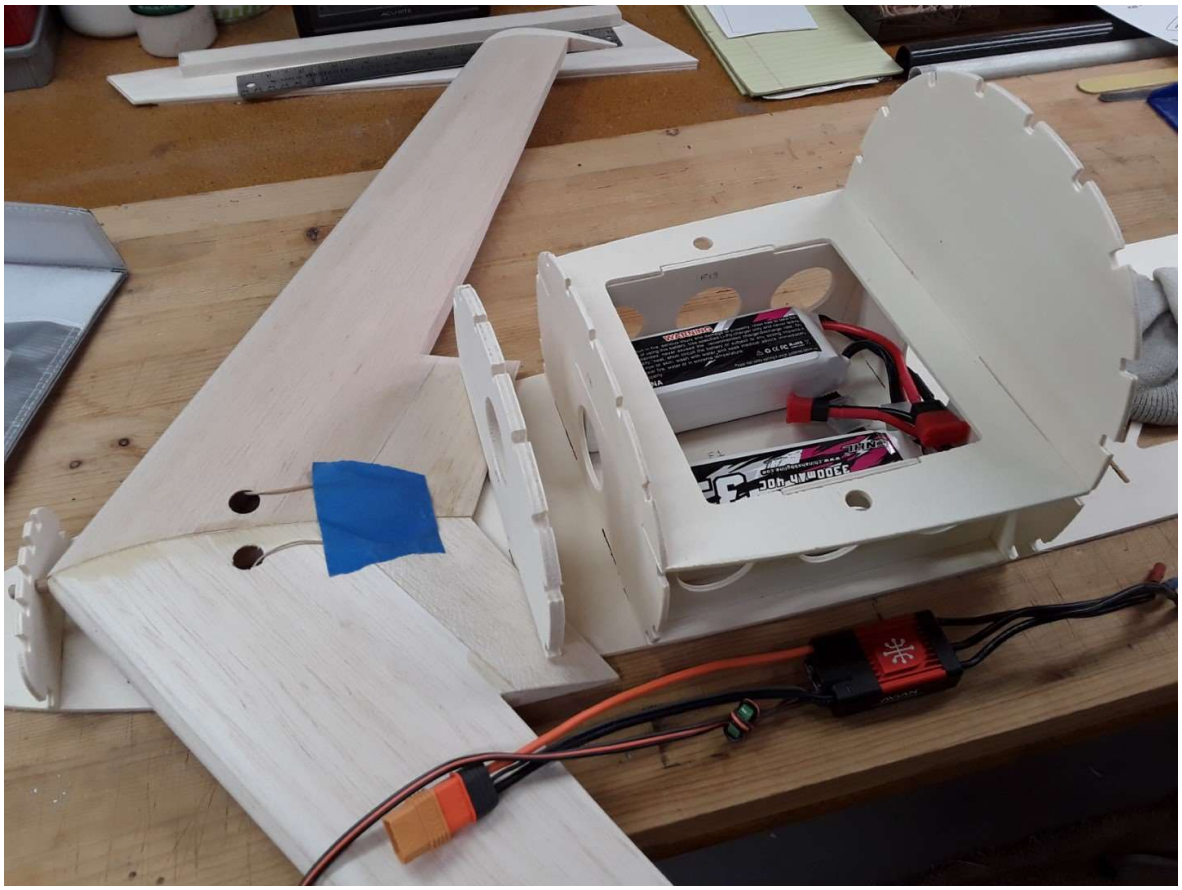
Finally, the bottom WB-7 main spar and WB-9 leading edge are glued to all the ribs and this panel is allowed to dry overnight. The image below shows test fitting of the completed right mid-wing panel to the right inboard panel before the two WB-10 8mm hardwood dowels and wing tube sleeve are mounted using epoxy.

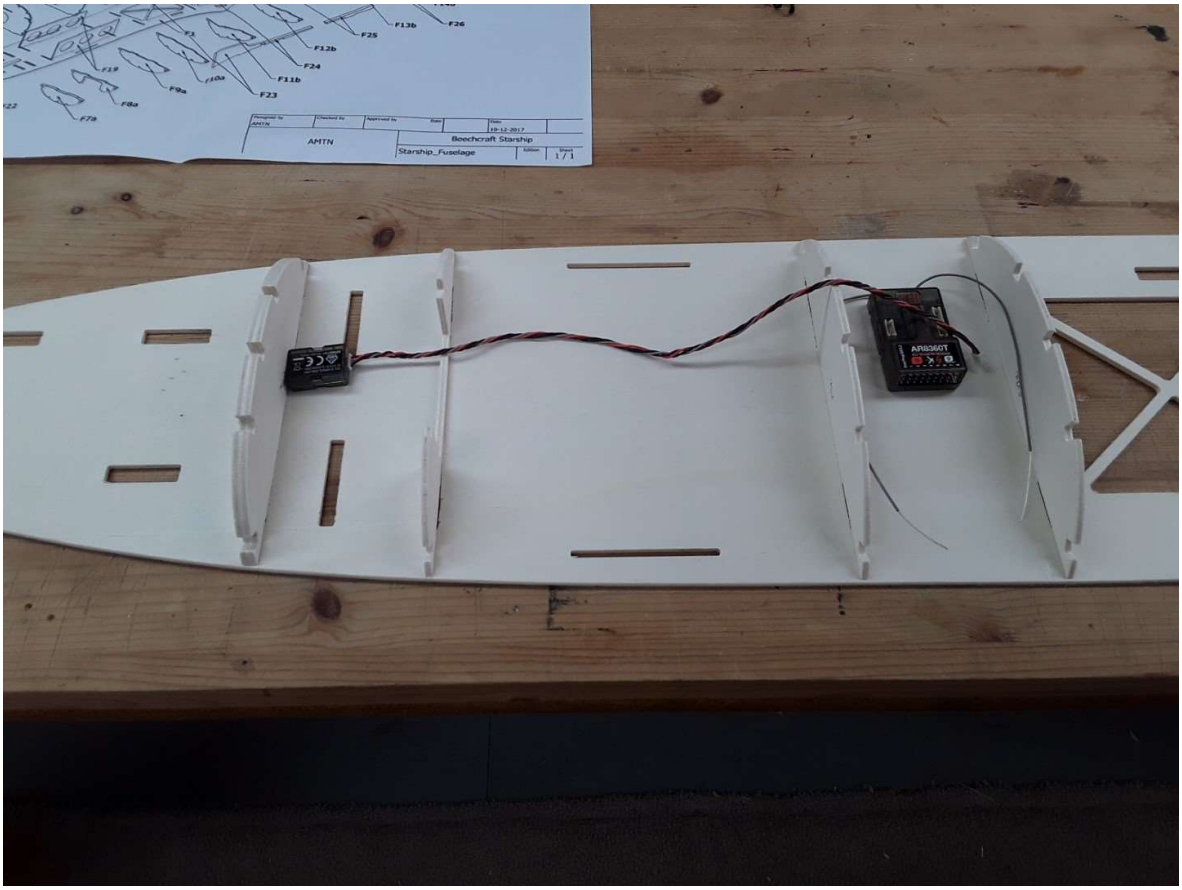


Alright, finally finished the left mid-wing panel. One item we wanted to investigate was how we could reduce or even eliminate having to add weight to the nose of the fuselage to obtain the required center of gravity (CG) location. One way to do this is to move the batteries and electronic speed controls (ESCs) from the motor mounts forward to the large bay area below the canopy between formers F8 and F9. So, I removed some of the fuselage pieces from the Lite ply sheets to try and get some idea as to how this idea would work out. The next image below shows the two 5S 3300mah battery packs we plan to use positioned in the lower bay, and one of the ESCs next to the bay. Based on a suggestion from David, putting the two batteries on their edge in the center of the bay will allow enough room for the two ESCs to be mounted along the sides (with the three large holes) of the bay. We could also put the ESCs in the upper bay under the plastic canopy provided we painted the clear canopy and could find some way of getting cooling air into that bay. Otherwise, the ESCs will go in the motor mounts as originally designed.

Additionally, we now must fine somewhere to mount the receiver since that was originally intended to go in the lower bay. The second image below is the bottom side of the fuselage main plate F1. The bay area between fuselage formers F9a and F10a will work to mount the receiver, and the small remote antenna unit can be placed forward of the nose landing gear (NLG) bay. I will need to put wire routing holes in F1 and F9a,

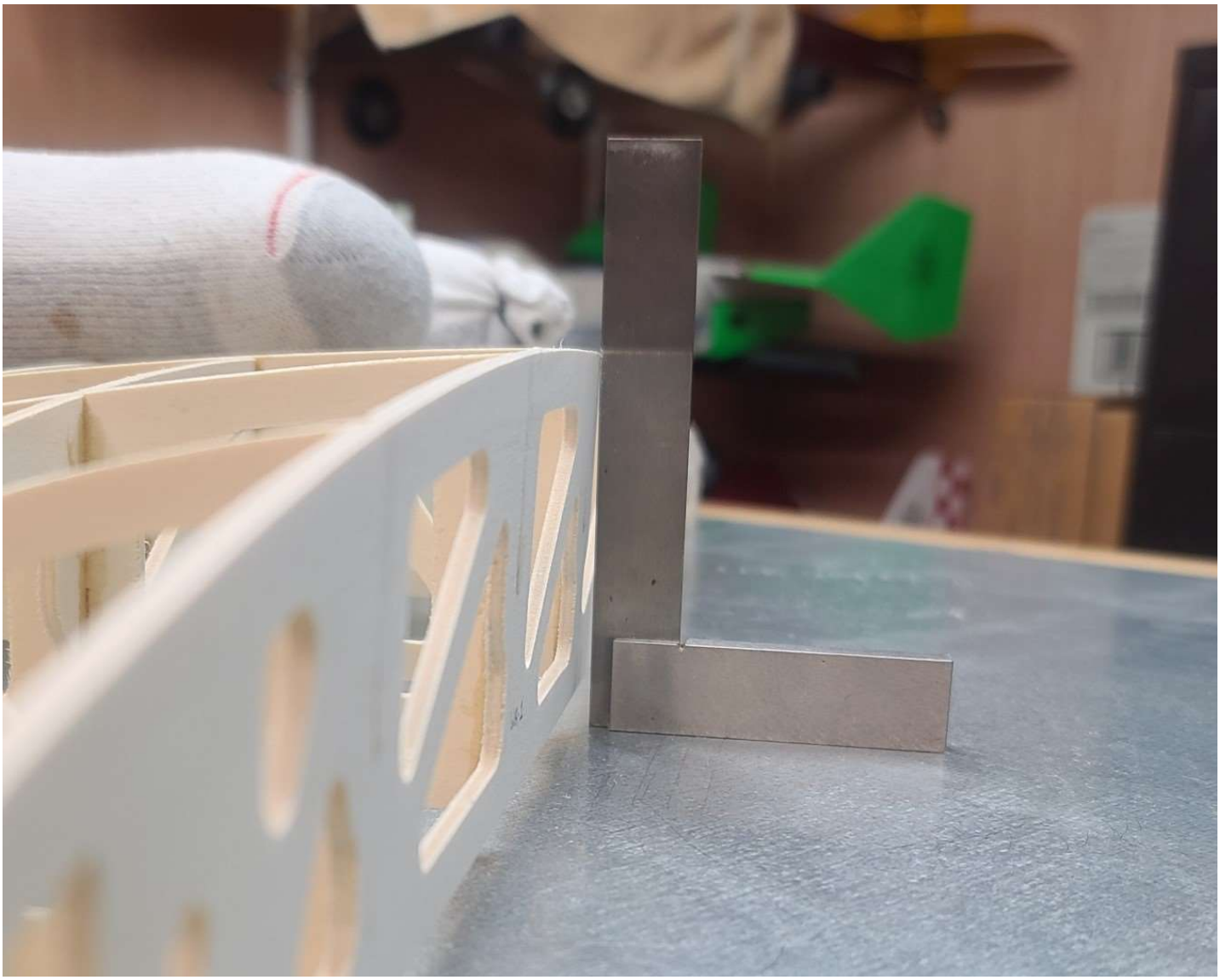
plus make photocopies of F9a and F10a to use as templates to make a receiver bay access hatch. More on this modification later when building the fuselage.

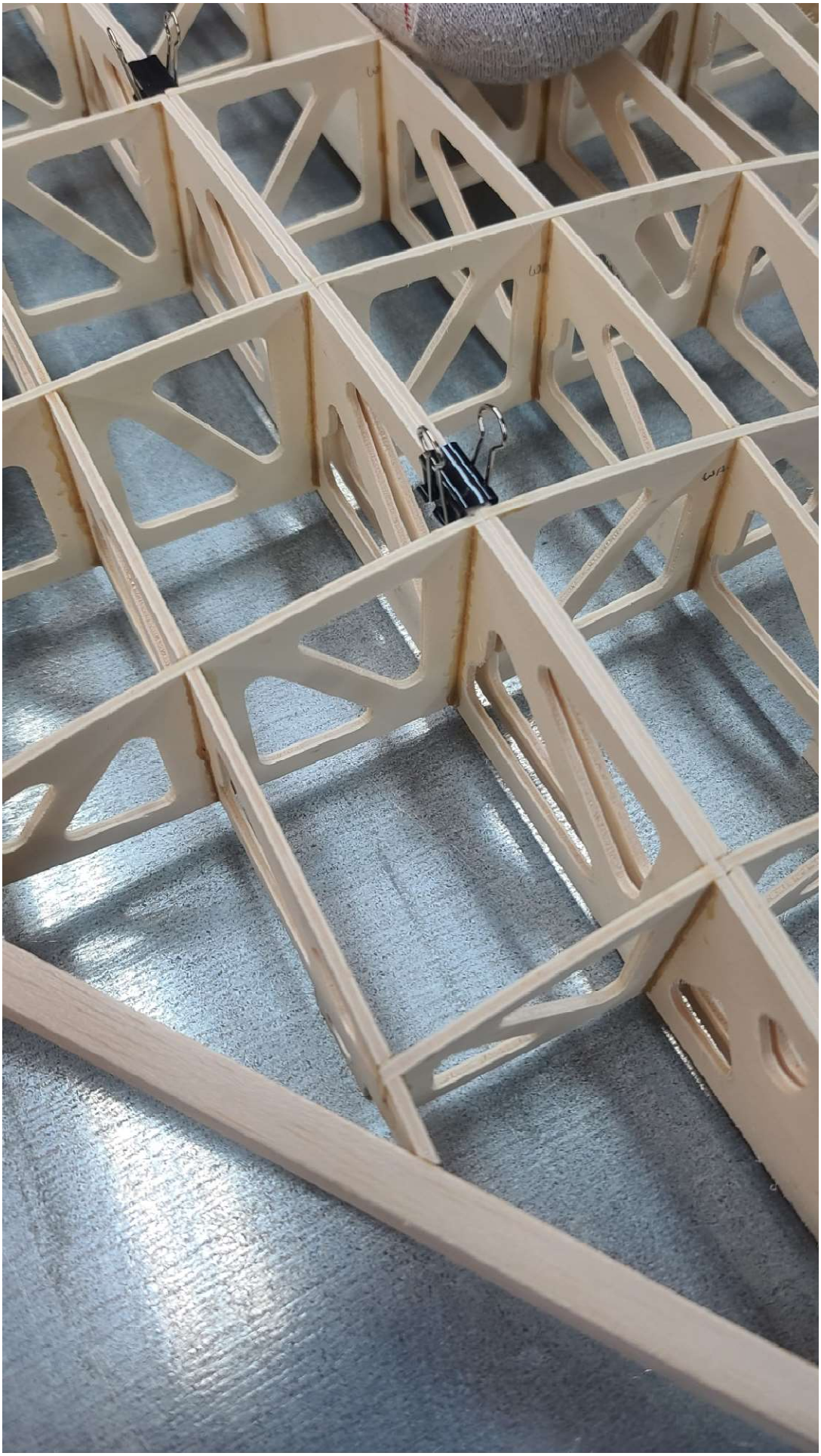




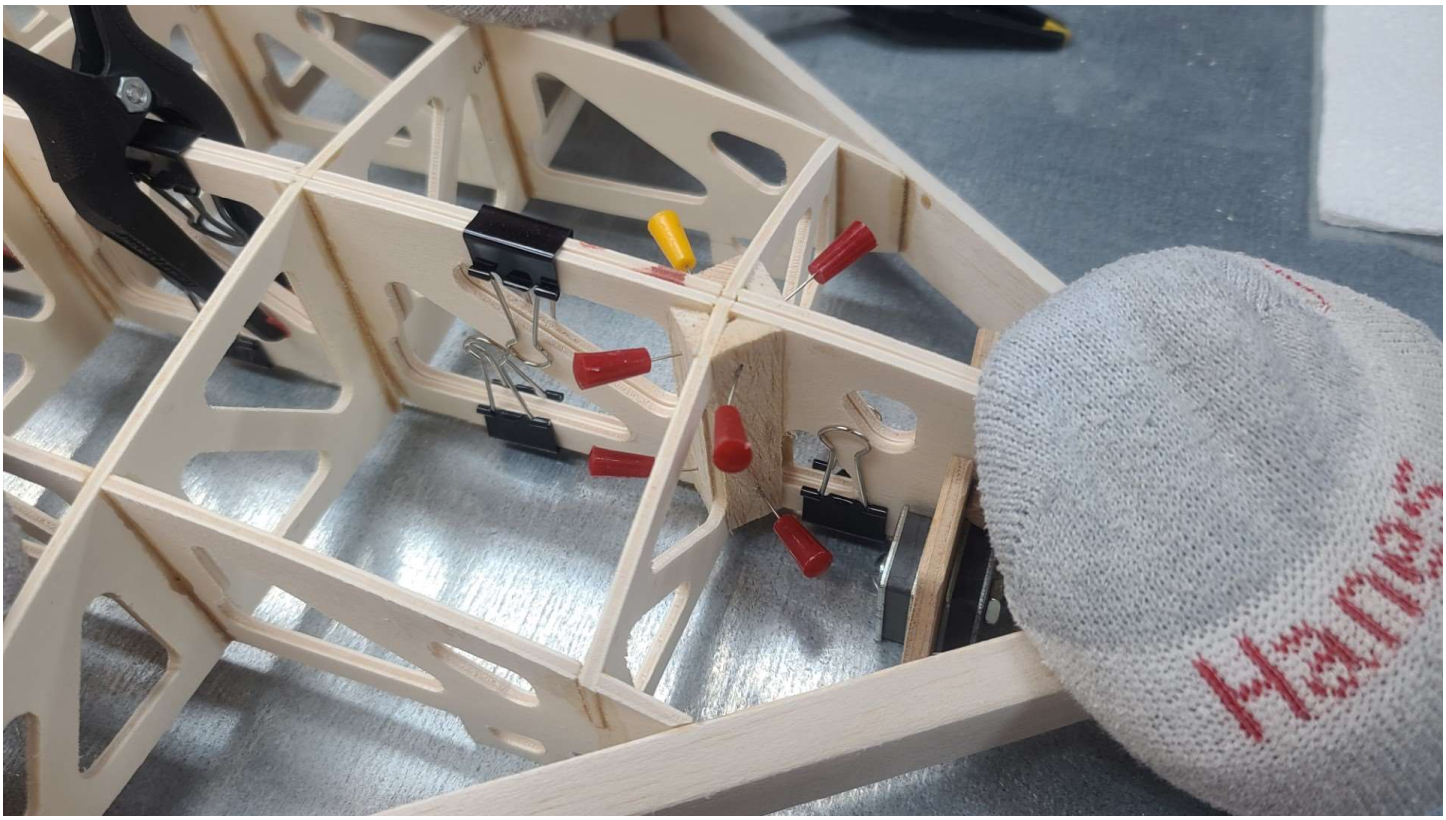
While checking the fit and alignment of the mid-wing panels to the inboard-wing panels I discovered a problem with the two WA-1 ribs. While they are nice and straight lengthwise, they turned out **NOT** to be perpendicular to the building board surface as shown in the first image below. When building the inboard-wing panels I noticed WA-1 not touching the lower spar areas, and assuming the spars were cut as to ensure a perpendicular rib, I used my mag fixtures to push the rib up next to the spars when gluing the panels together. ***This was an incorrect assumption on my part.***

When you place the two inboard-wing panels together and put weights on them to ensure all the rib tabs are flat on the building board, you get a gap between the bottom of the two WA-1 ribs as you can see in the second image below. One might think this is no big issue since when you go to join the two inboard-wing panels together, you just clamp the two WA-1 tightly together, which will work to get a tight fit, **BUT** unfortunately will also introduce a large negative dihedral in the inboard-wing panels. **NOT GOOD!**



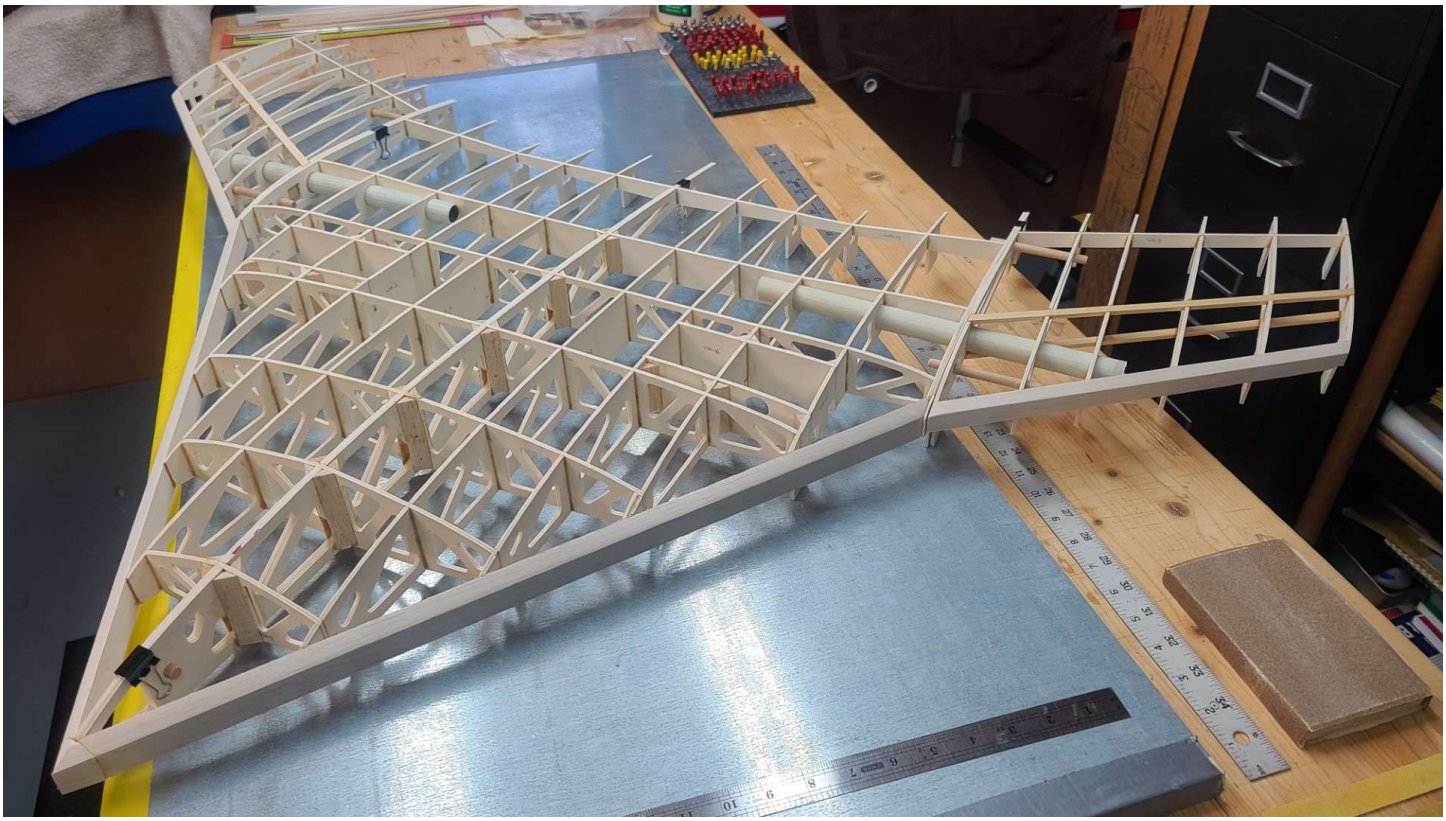


So, I needed to come up with a solution to this problem. You could put a filler between the bottom of the two WA-1 ribs during the inboard-wing panels join, which may work, but I feel it would greatly reduce the overall bounding area between the two WA-1 ribs. After doing a little more head scratching I finally decided to cut the glue joints between the WA-1 ribs and spars WA-7 through WA-12 (only the lower half of the joints), and then re-glue all those joints with the two inboard-wing panels clamped together along the top and bottom edges of the two WA-1 ribs, plus have both panels held flat on the building board using my sock weights and mag fixtures. To ensure a good joint between each spar and the WA-1 ribs, I decided to add 10mm balsa triangle material on each side of the joints. The image below shows the re-gluing in progress, and *yes that is some of my DNA on the WA-1 rib*. Once all the spars are re-glued to the WA-1 ribs, this will result in a good flat fit and strong joint between the two inboard-wing panels without introducing any dihedral changes.

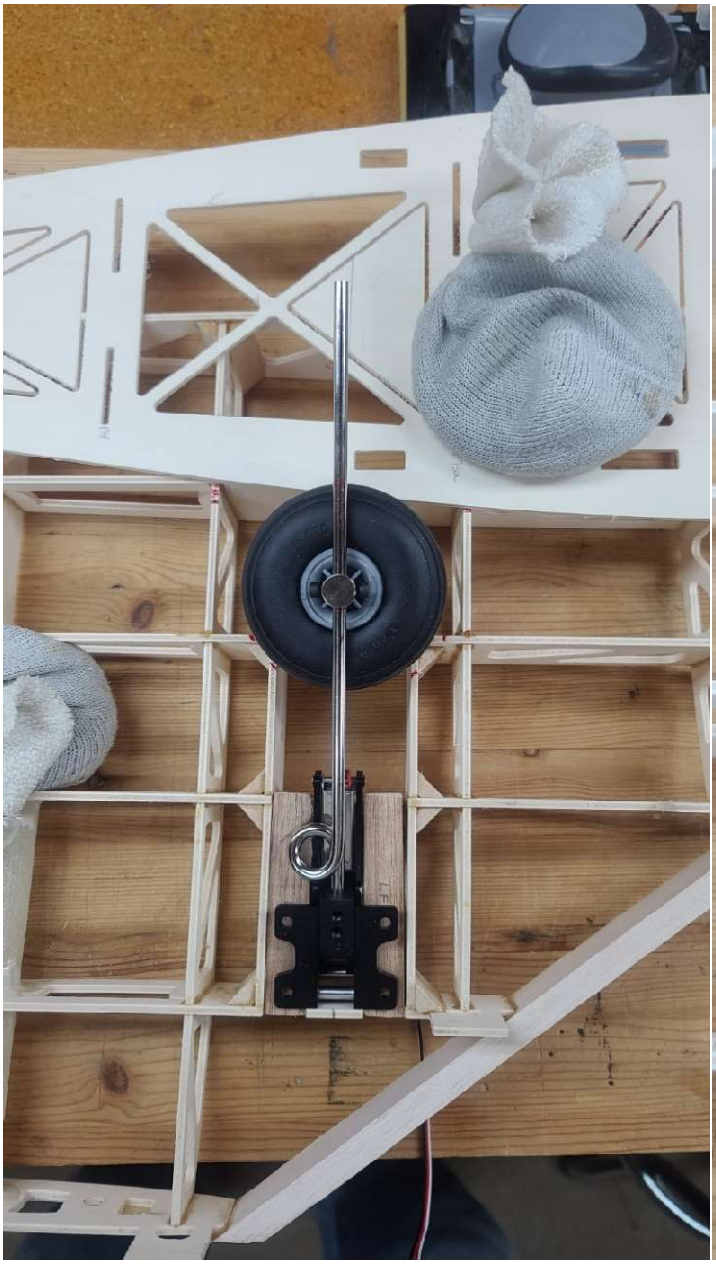


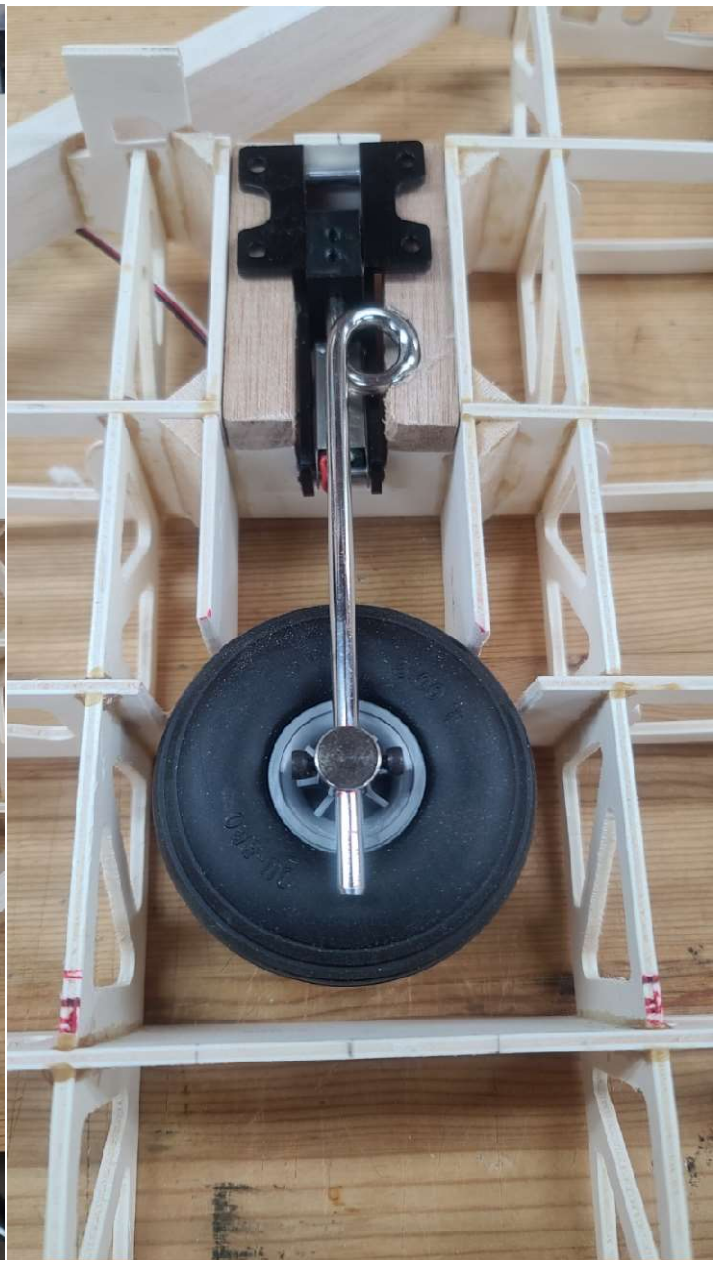
With the inboard-wing WA-1 ribs issue resolved; we can now get back to building again. As you can see in the next image below, everything now lines up very nicely with all rib tabs flat on the building board surface and this is starting to look like a pretty good size model, *and we still have the outboard-wing panels to add.* Next up is to epoxy both wing tube sleeves in place.

Builders Note – When epoxying the wing fiberglass tubes to inboard-wing panel, have the aluminum tube inside the fiberglass tube. Also, initially epoxy the fiberglass tube **ONLY** to the inboard-wing panel, not to the mid-wing panel. When cured, separate mid-wing panel from the inboard-wing panel and remove the aluminum tube, then cut the fiberglass tube flush with outer rib WA-6. Put the aluminum tube back in fiberglass tube, clamp inboard-wing panel and mid-wing panels together, now epoxy the fiberglass tube to the mid-wing panel. Use micro-bubbles in the 15-minute two-part epoxy for these steps.



Ok, with the wing tube sleeves epoxied in place, the AMTN instruction manual says we should now sheet the top surface of the inboard-wing panels. ***Well, I want to do a couple other things first.*** After viewing Saul's build videos, I felt it would be better to work on installing the MLG retracts and the inboard to mid-wing joiners with both surfaces of the wing panels open for better access to the internal structures. First the MLG mounts and wheel wells. In the left image below you see the rear fuselage template F2 positioned over the bottom of the left inboard-wing panel, the MLG mounting blocks placed in the slots in ribs WA-4 and WA-5, and the left retract sitting on top of them. This setup allows me to see where I need to place the wheel on the retract shaft so the tire will not hit the side of the fuselage, and where I need to remove material from the ribs and spars so the retract and MLG wheel will fit down inside the inboard-wing panel. With this established I removed the mounts and retracts and then use my Dremel tool to open up the area for the wheel well. Having both the top and bottom of the wing panel open really makes this easier than how the instruction manual suggests. The right image shows the left retract sitting as it will when finally installed. Now I epoxy the retract hardwood mounts in place. I won't install the wheel well sides and floor until I can verify the final position of the MLG wheel on the retract shaft with the wing mounted to the fuselage.

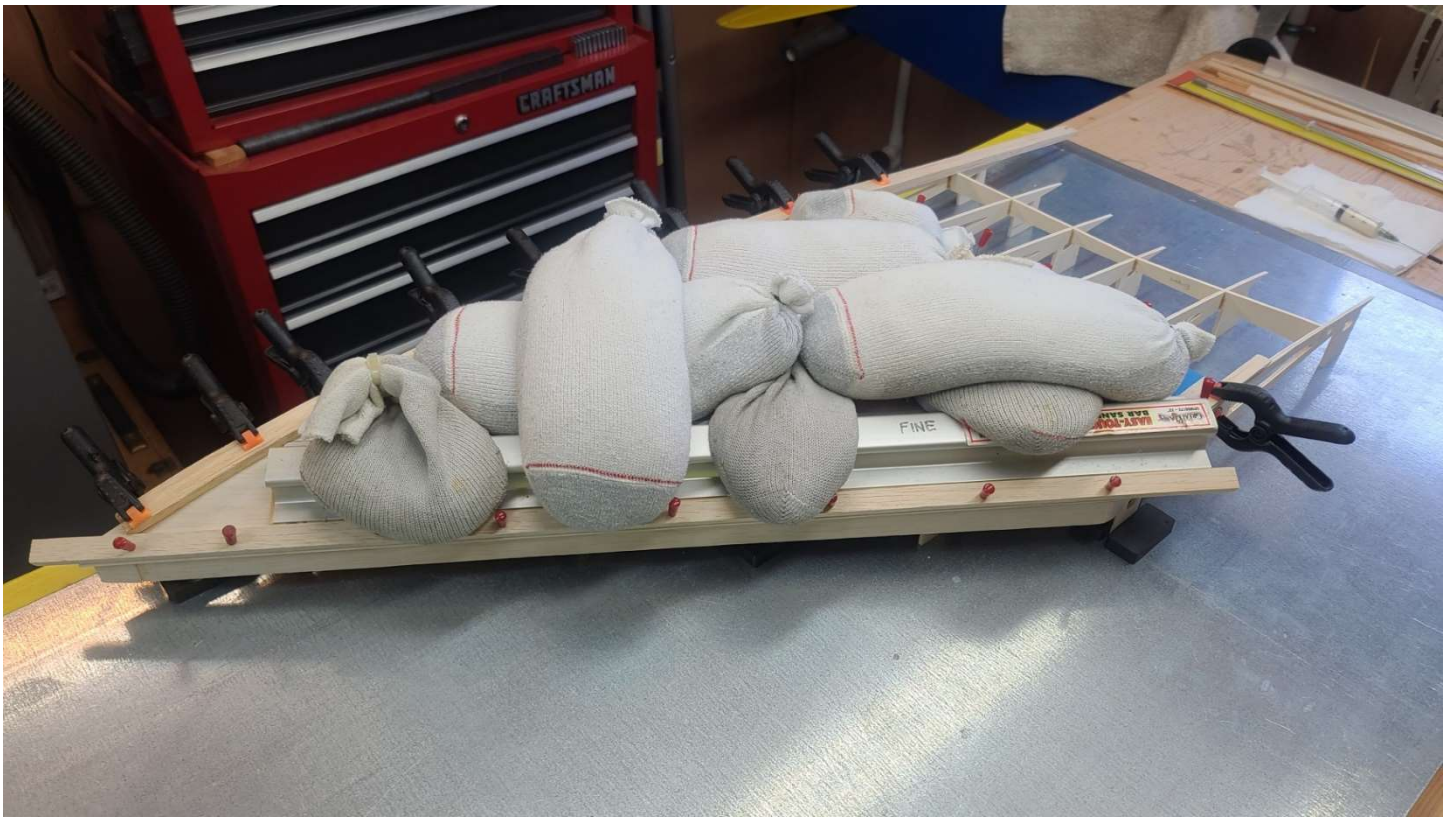


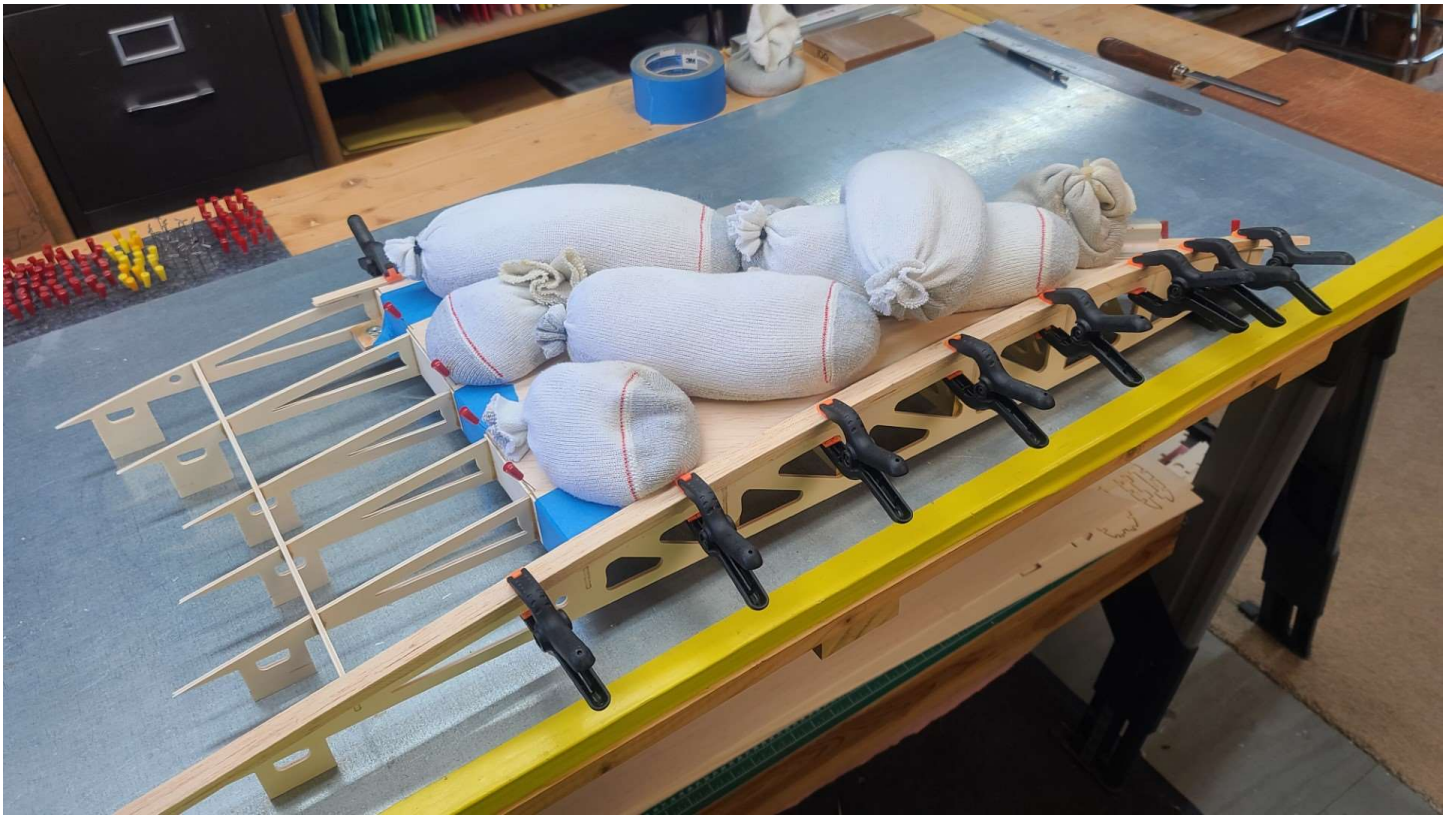


Now for the wing joiners. As per the instruction manual WA-18 and WB-12 hardwood joiner blocks get epoxied in place, and then holes drilled for the M3 mounting screws blind nuts. Having the top side of the wing panel open makes installing the blind nuts very easy and allows me to lock them in place using epoxy. You can see in the image below that I also added some 10mm triangle stock along the top side of the MLG mounting blocks and applied epoxy over the entire area to ensure a good secure mount for the retracts. With these items completed I can now return to the instruction manual and start to sheet the top surface of the inboard-wing panels.

The first step in sheeting the main wing inboard panels is to glue together four each 1.5mm thick balsa sheets. **Builders Note** – Place the four balsa sheets together with a 135mm stagger at the ends (as seen on the right in the image below). This way you will be able to get the sheeting cut-outs (one for the left panel is on the left) for the tops of both inboard-wing panels from these four joined balsa sheets.

I lightly sanded the entire top surface of both inboard-wing panels to obtain a smooth transition across all the ribs/spars intersections. Next, I lined up the aft edge of the forward sheeting cut-out along the centerline of spar WA-12, then double checked the sheeting alignment along the length of the leading edge and rib WA-1. Once satisfied with the fit, I used some wide blue painters' tape to form a hinge along spar WA-12, flipped the top sheeting back, run a bead of Titebond III Ultimate glue along the tops of all the ribs, spars, and leading edge, then flipped the top sheeting back over on the forward section of the panel. You can see in the next two images how I used scrap balsa strips to hold down the sheeting along the leading edge and rib WA-1, and all my old sock lead-shot weights to ensure a good contact between the balsa sheeting and all the wing panel substructures.


CRAFTSMAN
FINE



Once the sheeting on the forward portion of the panel was set, I then sheeted the aft portion of the panel using 1.5mm balsa sheets. I did this using single pieces of sheeting and some scrap pieces left over from sheeting the forward wing. **Builders Note** – As you can see in the image below, to ensure the aft tips of ribs WA-1 and WA-6 remain straight during the sheeting, I clamped them to hardwood strips running along the outside of the panel. Also, because the center area of panel is lower at rib WA-4, start pinning of the sheeting at WA-4 and work outward to each side. Again, I used the good old sock weights.