Thinking CAD

By Gerry Yarrish

This article is sort of open ended since I offer my basic take on designing models with Laser-Cutting of the parts in mind. It would be up to you to decide if you want to try CAD designing a try. Several years ago I reviewed the Zing 24 laser cutter from Epilog. It was an eye opening experience and it changed the way I design my models. I now look at parts differently in that everything fits more precisely together and in many places, the parts can interlock to be self aligning. If course, all of this also speeds up the building and when laying out the parts to be cut, saves on wasted material.

Getting Started

But really, buying a CAD (Computer Aided Design) program won't by itself allow you to create awesome new model airplanes. You really have to start "Old School" in that you have to be familiar with reading and drawing blue prints. I learned basic pencil & ruler drafting in both high school and while taking an advanced mechanical drafting using a correspondence course (way, way before online classes.) This was in the early to mid 70s. So basically you need to know how to draw before you can learn to use CAD. And that is another topic for another article.

So, for now let's assume you know how to draw and have a CAD program you know how to use. To fully realize the power of CAD, you need to fine tune your thinking. Using a CAD program to produce Cutting Files to produce model parts is an investment in time and money, so really you don't gain very much if you produce parts that can just as easily be made with a band saw, like solid tail surfaces and basic formers and ribs. The basic advantages I see as being, precise enough to make interlocking parts and custom assembly jigs to help with the actual building of model parts and assemblies.

Interlocking parts

For this article I am using an RC Fokker D-VII model designed by my buddy Dave Johnson. His plans were CAD so he sent them to me and I used his basic parts and added my own design elements.

For the tail surfaces, you can see by the photos that all the parts fit together to form the finished part. This design is all but impossible with a band saw or an X-Acto knife and is perfect for Laser cutting. The parts can be fitted together and hit with thin CA without even looking at the plans. Again the parts need to be drawn and then arranged so the wood grain falls in the proper direction. Even the stick stock (rib strips) for these tail surfaces were cutout with the laser. Here too is another thing to consider, when you produce the parts, you need to select the correct grade of wood. Ribs can be medium hard, while spars and Leading, trailing edges and other thin cross section parts need to cut from "Hard" grade balsa.

Once the parts are cutout, then the assembly on the building board is the same as building a kit. But this kit is of your own design.

Alignment Jigs

One of the greatest discoveries I made using CAD and Laser Cutting is how easy it is to make precise assembly jig. Take the task of bending and soldering cabane struts for a biplane. Your top wing has to be built and then held in proper alignment with the fuselage while you fabricate the struts. I can't even remember a time when I enjoyed this building task until now.

You start with the side view of the fuselage and find the common reference points that allow the top wing to be accurately positioned relative to the fuselage. I then draw the alignment jig full size and also design it to interlock while gluing the parts together. This structure is then tack glued or taped into place on the fuselage and then the wing is placed on top of it. Here I used tabs that mate with the bottom main spar and then I measure to the tail post from each wing tip, to ensure everything is in alignment.

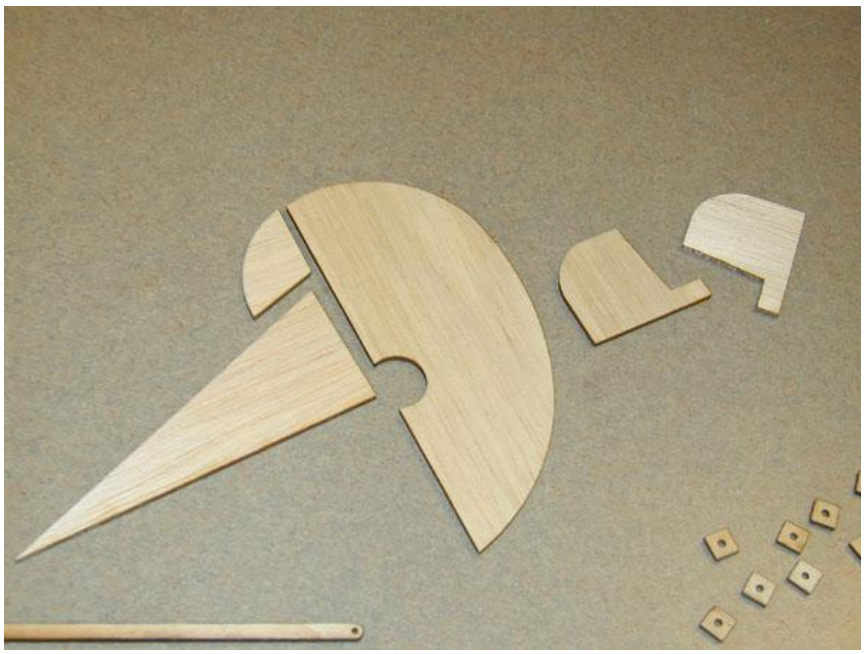
With the wing securely held in place, I flip the entire assembly upside down and go about fitting the wire parts and solder tabs into place. Check everything a few times for alignment again, and then one by one, solder the wire pieces together with the attachment tabs screwed in place on the wing.

Once everything is assembled and the solder cools down, unscrew and remove the wing and then remove the jig structure. Save the jig. It might come in handy if you build another model or need to repair the one you just built.

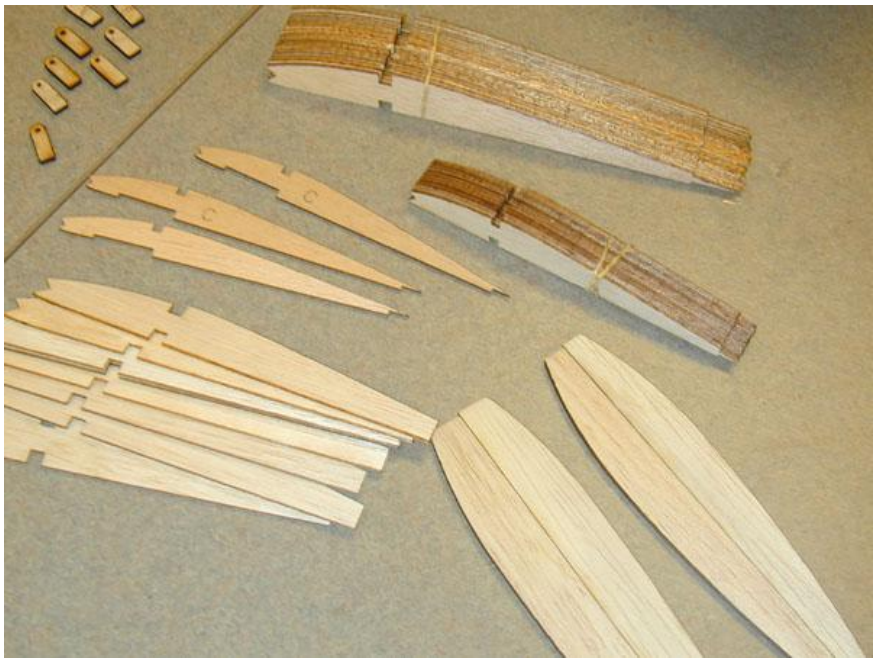
Combining/minimizing parts

Another thing CAD is great for is making models simpler with fewer parts. For my D.VII I combined the servo and battery tray and made it lightweight by removing sections so what was left was sturdy and purpose built. The servo openings fit precisely and the whole tray fit inside the fuselage exactly where is was suppose to. Rubberbands hold the battery pack and the holes for the servo screws can even be laser cut to fit your servos if you like, so no drilling was needed. Quick and simple.

So, by rethinking the way you design model parts, you can optimize your CAD drawings. Also by doing all the basic layout and producing your own cut files, you save money also, by just paying for the laser cutters time producing your cut parts, and not doing a lot of file reformatting from your original scanned plans. I think one day, the prices of laser cutters will come down to such a level that these machines will become as commonplace in modeler's shops as drill presses, bandsaws and bench grinders are today.

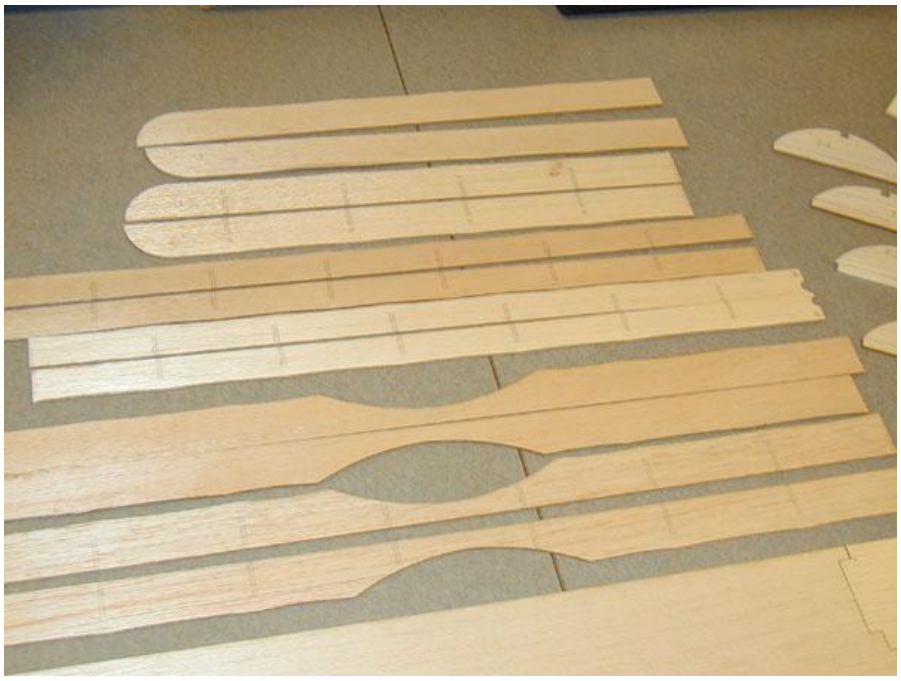


Tail parts are easy with CAD and Laser cutting but they can also be produced quickly with band saw and a belt sander.

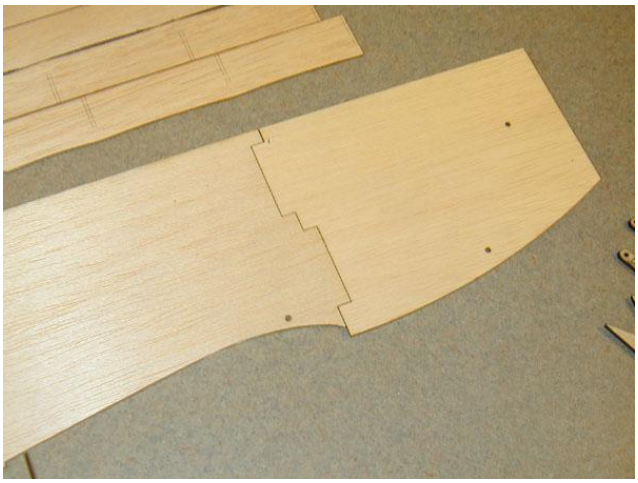


When it comes to wing ribs, laser cutting is out friend. Reproducing many identical parts is as simple as a copy and paste command in the CAD program.

These formers are also easy to make either way, but with Laser cutting you can engrave their part ID right on each part.

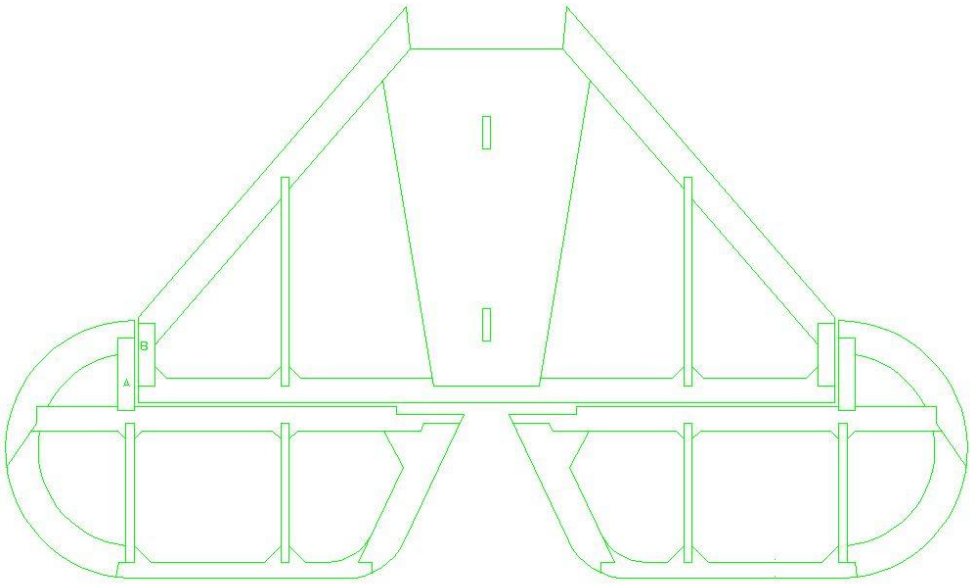


Here are wing trailing edges and sheeting. The rib locations have been engraves on them to speed assembly.

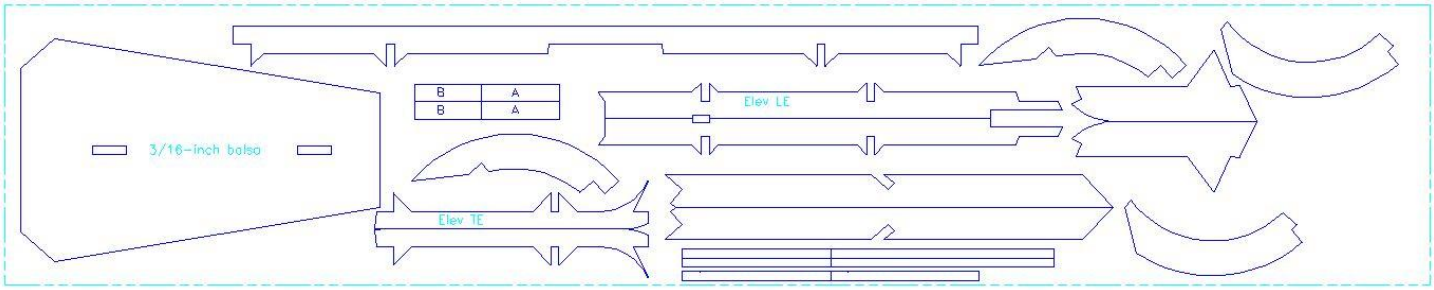


Using interlocking parts, you can make long fuselage sides with shorter pieces of sheeting that key perfectly together.

I made the double long enough to cover over the glue joint on the sides.

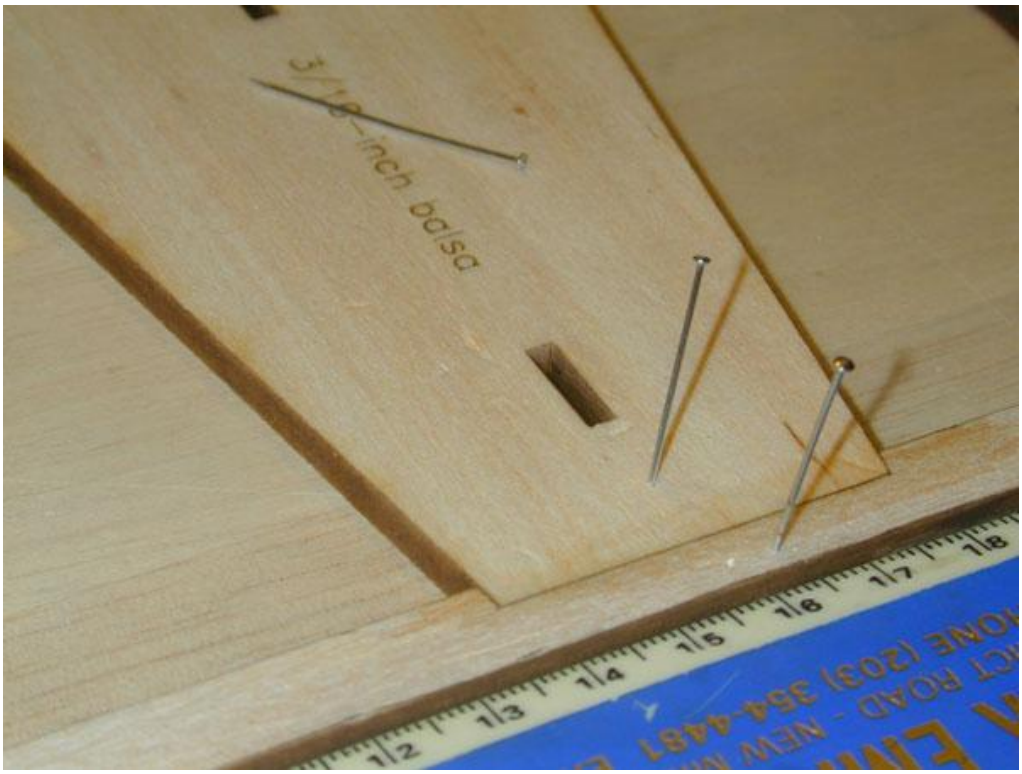


Here is the horizontal stab and elevator drawing. Notice the interlocking shapes.



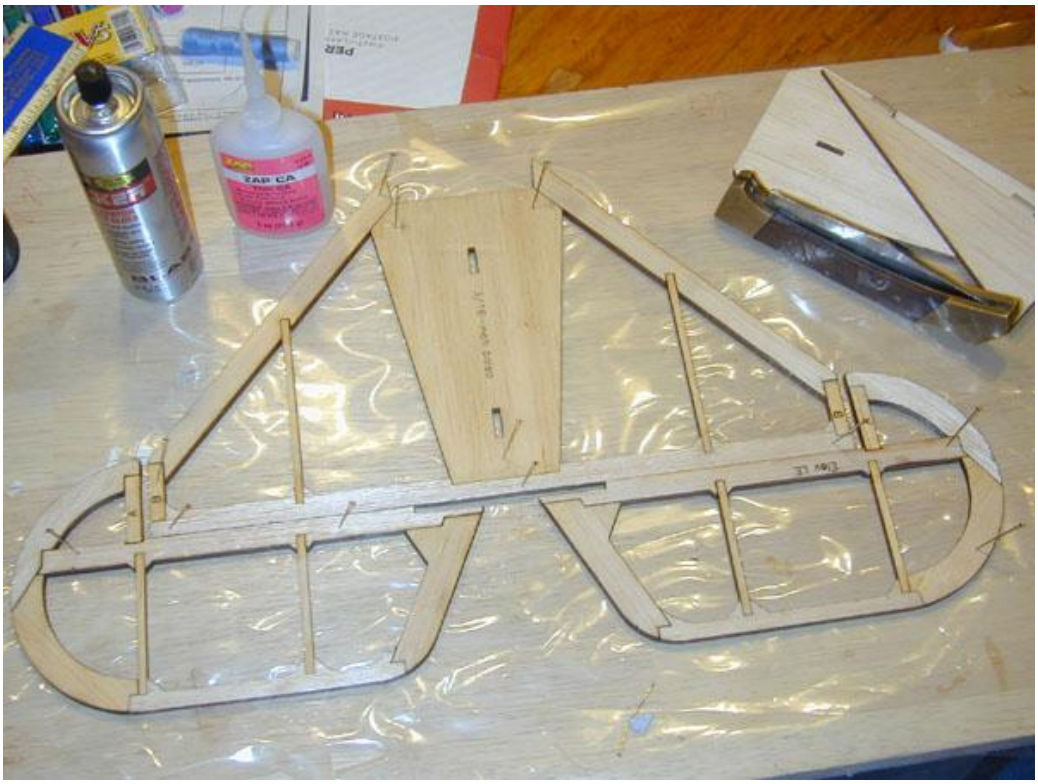
After the parts are drawn, this is what the “Cut File” drawing would look like. This gets the grain directions where we want them.

You can easily assemble the parts without the plans being used.

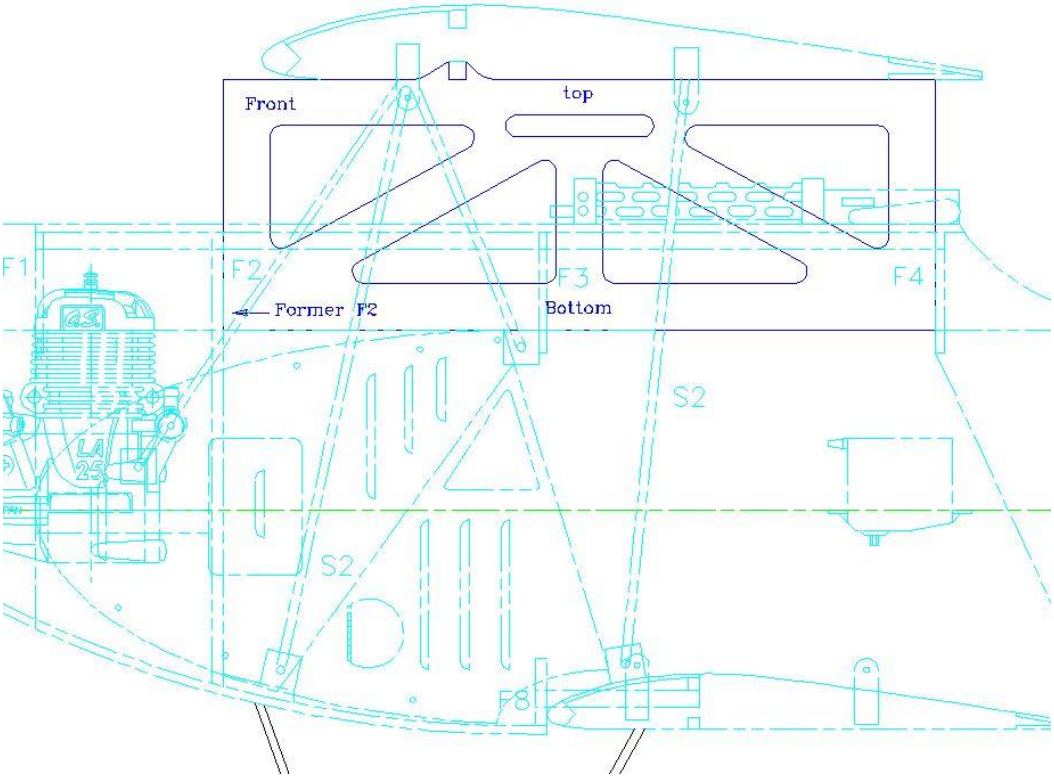


Building the parts remains the same, except the precise fit of the parts allow thin CA glue to be used in most joints.

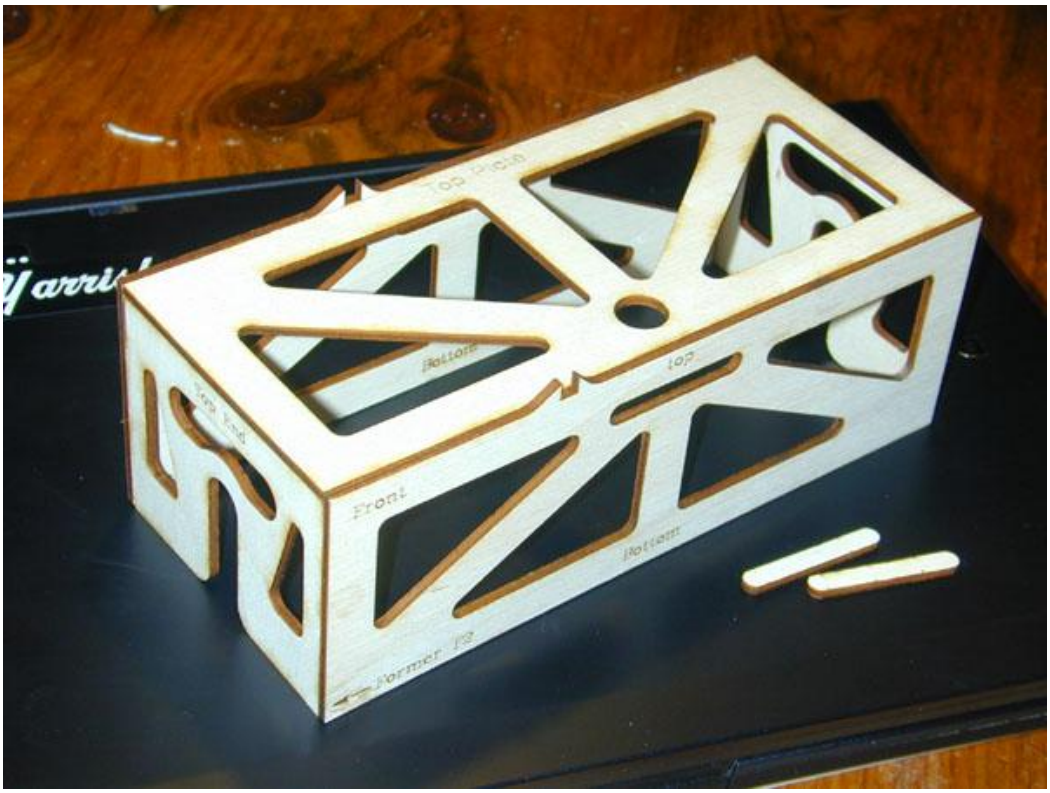
You can see the straight rib strips are also laser cut.



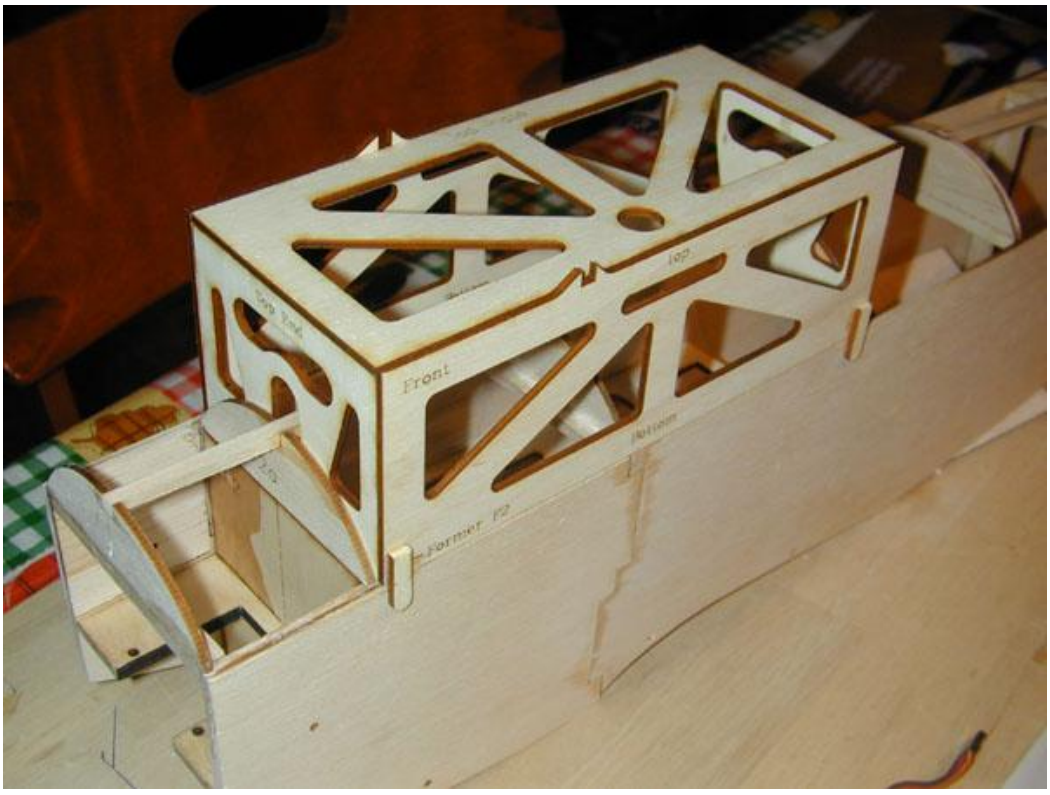
Entire tail built in about 15 minutes.



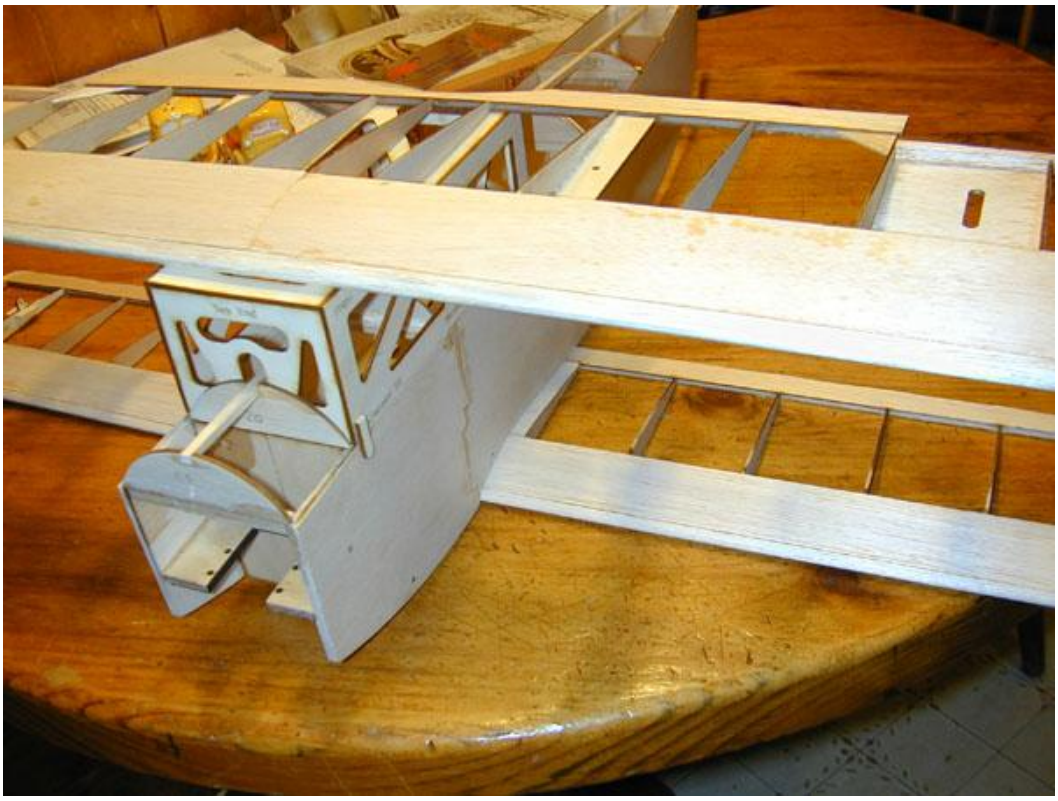
For the wing/cabane strut alignment guide, it all starts with the side view of the fuselage.



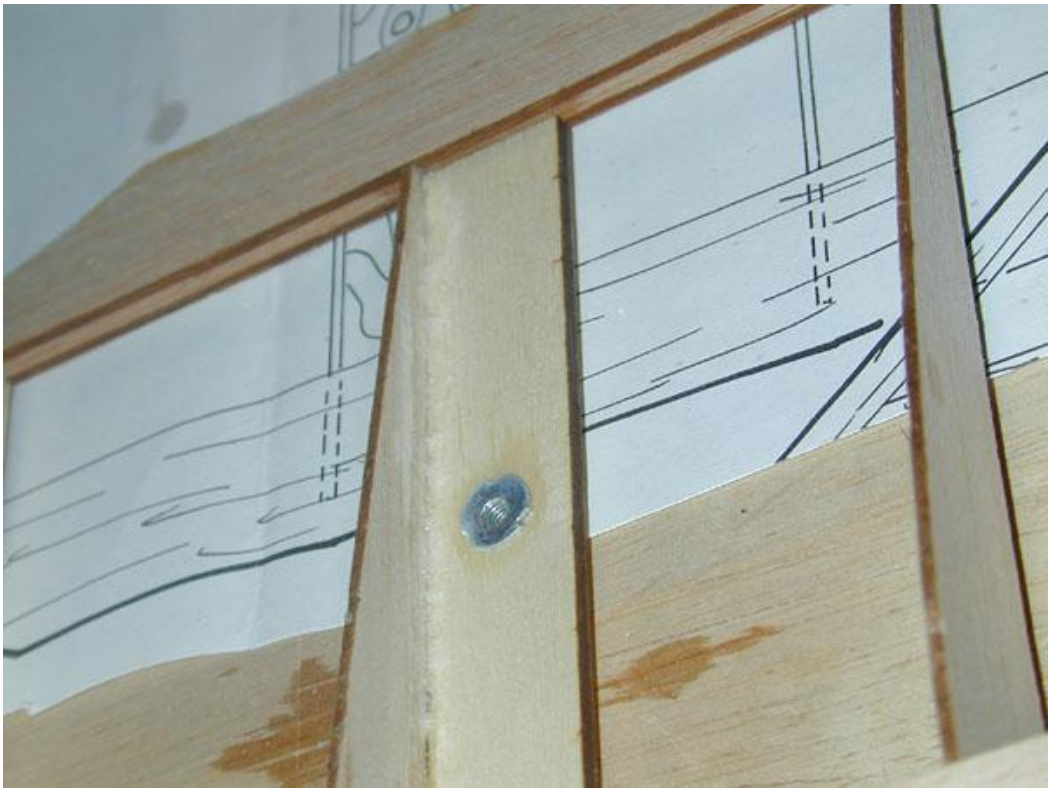
Nothing more than a box with precise measurements and cutouts.



Here the jig is tack glued to the fuselage.



Add the top wing. It can be taped into place.

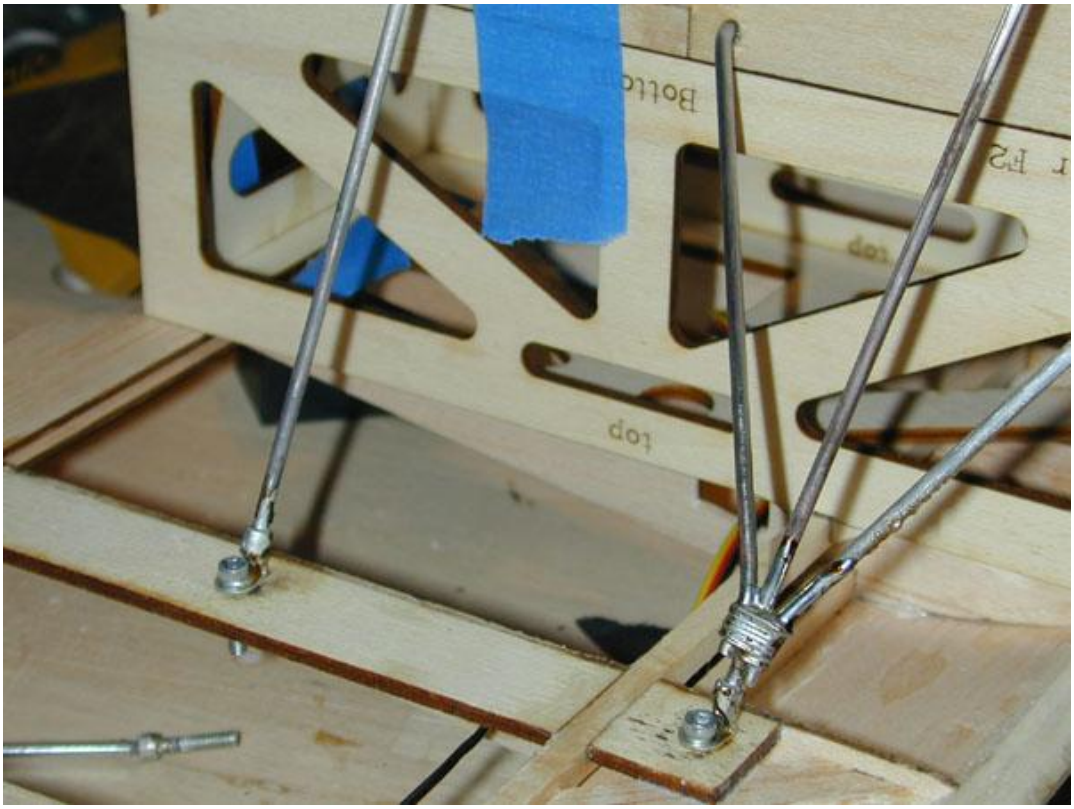


All the attachment points in the top wing have blind nuts as shown here.

An old school technique is to use solder lugs at the top of the music wire struts.

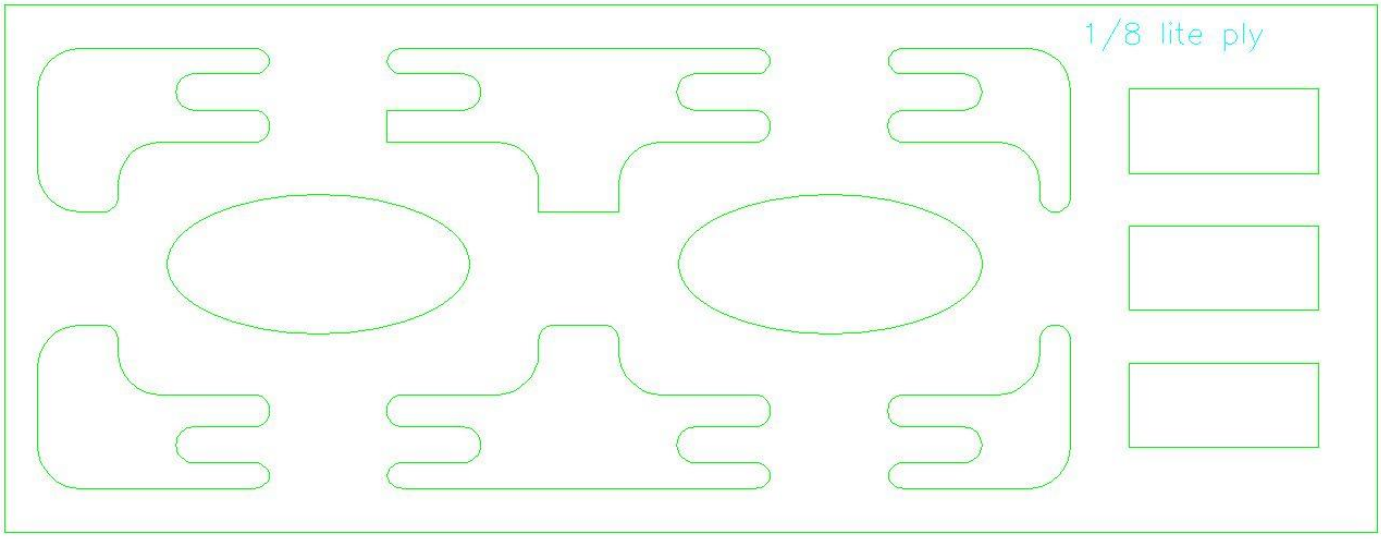
With the wing and fuselage turn up-side down, The struts are cut to length, bent to shape and positioned with the solder lug screwed to the wing.

To make the cabane struts removable, I used lock collars to secure the wires in the fuselage.

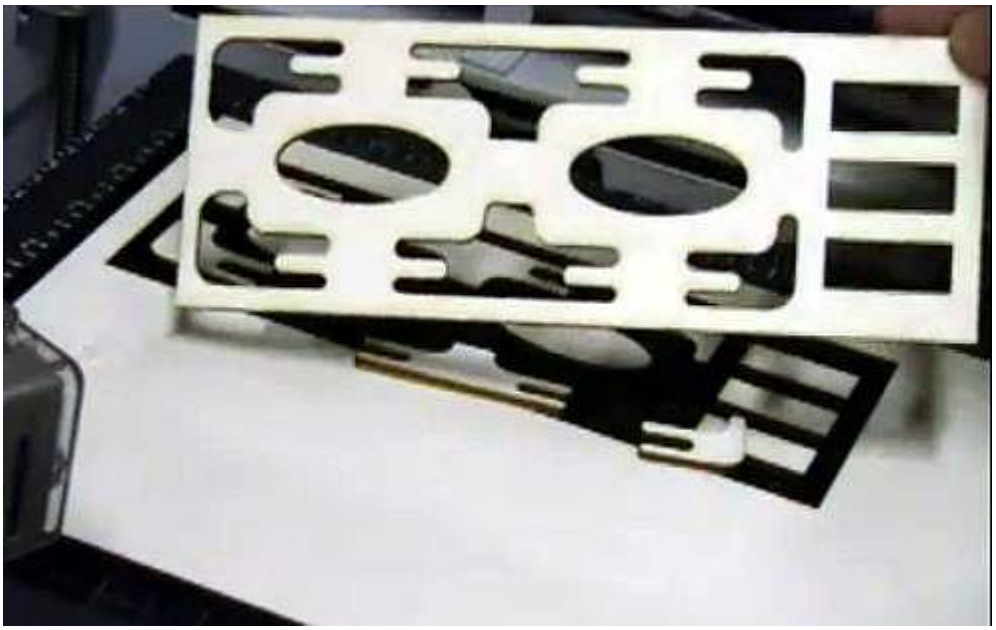


Wiring binding and soldering complete.

Alignment jig removed, the model is ready for covering.



Here’s a custom designed battery/servo tray.



Laser cut, it looks like a piece of Swiss cheese but it is very lightweight.

The shape of the openings allows the uses of rubberbands to secure the receiver battery pack.