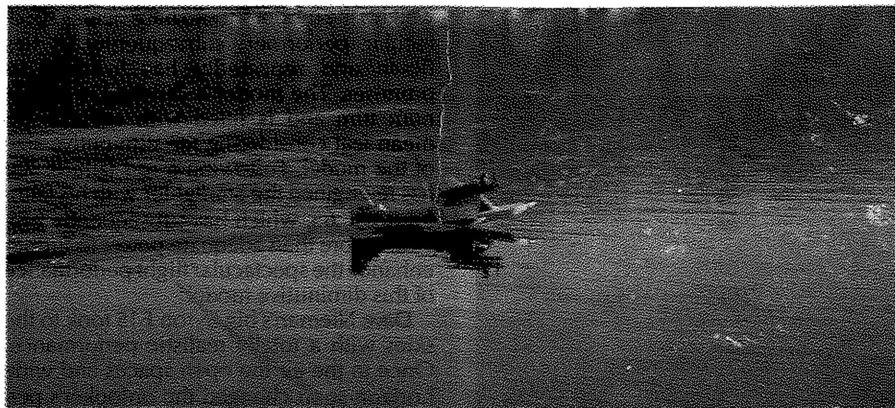

SEA FLI XI

A .60 to .90-powered R/C flying boat of foam/fiberglass composite construction

• In my regular column, "Model Design & Technical Stuff," we have been studying composite structures and also seaplane design. This month the column examines the design of the all-composite R/C flying boat which is being presented here to the scratch builder. The author's prototype contains no balsa wood. If you have any curiosity about design, I encourage you to read the column, but whether you do or do not, there are certain things you need to know about this model before deciding to build it.

First, it is not a model for the beginner. The drawings look quite simple, because composite construction requires very few separate parts, but the techniques will be new to the modeler who has built with wood only, and some of the processes require a bit of practice. There have been a few construction articles on all-composite R/C models, but the field is still pretty new and definitely experimental. Also, it takes longer to build than one might suspect. In other words, if you want a seaplane model to fly right away, buy an ARF, but if you are an innovative person interested in working with advanced materials and processes, join me, and let's both learn.

When I read a construction article I always turn to the end of the article first, to see how it flies. I will save you that trouble. The model performs very well in the air and on the water. It is light for its size and quite aerobatic. My prototype carries a four-stroke .60, but it turns out to be a bit underpowered for the way I like to fly, therefore, the plans have been changed to show a four-stroke .90 or two-stroke .60. It tracks well in loops, axial rolls (not very axially), flies inverted easily, snap rolls and spins, but is sometimes a bit slow in getting into and coming out of spins.

On the water it is a sweet dream. It gets off at partial throttle, lands beautifully, and does easy touch-and-go's. It is fun to do high-speed figure eights at zero altitude on the step. I have never succeeded in flipping it, and there is seldom any spray in the prop.

Since you modelers who will be building Sea Fli XI have some experience, I do not need to tell you to glue stick A to stick B, etc. That wouldn't be applicable to this model anyway, since there are no sticks. But speaking of sticks, if you like the configuration but don't want to work with foam and fiberglass, you can design and build a conventional balsa structure inside the outlines shown.

Some writers of construction articles warn the reader not to make any changes from the design as presented. In this case the opposite is true. This is an experimental model and I encourage you to experiment along with me. There is much room for improvement in this and all other models. Further, using the head and the hands in model building is a lot more fun than hands alone.

If you look closely you will find some areas where the photos of the prototype aren't exactly like the drawings, because as a result of the building and flight testing, I have made changes to improve it and incorporated them into the drawings. These changes have also been made on the prototype and tested, so you are buying few, if any, untried "improvements." I had a boss once who said, "Don't improve it until it doesn't work." I'm pleased to report that most of these changes also improved the appearance of the model over what you see in the photos. Speaking of looks, there were design reasons for the unusual step between the lower and the upper part of the fin. I also like the looks of it, but if you don't, broaden the upper fin. It will fly just as well.

WEIGHT SHEETS

For the past twenty years or so I have been doing something that I highly recommend. For every model I build, I make a tabulation of the weights of all the parts and subassemblies of the model as I build it, as well as the total weight. This is a tool that helps me get smarter so I can build lighter on the next model. I keep a permanent file of these weight sheets so I can go back and look at the weight of any part on any previous model and see how it compares with the weight of the equivalent part that I am currently building on another airplane. For instance, how much should a finished stabilizer without elevators for a .60-size R/C model weigh? From my weights records, I can tell you that a good stab should weigh between 2-1/2 and 3 ounces. If it weighs more than that you can do better with lighter materials, smaller cross sections, or a different design. If it weighs less than that, maybe you are doing very well on strength-to-weight ratio, but better examine it. Is it going to be strong enough and stiff enough for flight and rugged enough for handling?

MATERIALS

The foam cores for the hull and most of the model are hot-wire cut from Dow Styrofoam type SM blue foam. This is available in four-inch thick planks from retailers who stock insulation materials. Don't use white beaded foam for anything but the wing cores; it doesn't have enough compression strength to adequately support the fiberglass skin. The blue foam is heavier (2.5 lbs./cu. ft. versus 1.0 for the white), but its strength more than makes up for the added weight. If you haven't used it before, you will find the blue foam much nicer to work with than the white. Blue foam is more rigid and sands much easier. It can also be carved with a sharp knife or worked down with a rasp much more easily than white foam. It cuts with a hot wire very smoothly, but at a slightly higher temperature than the white.

I used three different weights of fiberglass cloth in the construction of the prototype; .75 oz. (or .6 oz.), 1.5 oz. and 6 oz. You could get by with 1.5 oz. only, but glass cloth is cheap, and you can do a better, lighter, and stronger job with a selection. The hobby shops usually carry Sig fiberglass in these three weights in handy packages. Dan Parsons sells the very light .6 oz. cloth. Speaking of cost, you will probably spend less for materials to build this model than for a balsa model and have a lot of material left over for the next one.

We are going to bond the fiberglass cloth to the foam cores with epoxy. Polyester resin can't be used here because it dissolves the foam. I used some 5-minute and 15-minute model epoxies, but mostly I used a slower-curing epoxy which I bought at a Standard Brands paint store called "Envirotex 1 to 1 Polymer Coating." Let me repeat the warning about epoxy. Some people are allergic to it or develop an allergy from exposure to the material itself or its fumes. This can be quite serious. Avoid breathing the fumes and wash it off immediately if you get it on yourself. Wear rubber gloves if you have a problem.

You are also going to need a little more plywood, 1/8-inch regular and 1/8 Sig Lite-

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ply in particular. You won't be using much, if any, ordinary CA glue, because it dissolves both blue and white foam. (I have just tried the new foam-friendly "UFO" CA by Satellite City. It is wonderful, but beware, too much accelerator will soften foam temporarily.) Although I didn't use any balsa in the prototype, I don't forbid you to, especially on the wings and for control surfaces.

Use only reinforced nylon props on seaplanes. The spray which sometimes gets into the prop eats wooden ones.

PROCESSES

We have been discussing the methods for using foam and epoxy/fiberglass in my MD&TS column in *Model Builder* since last fall. If you haven't read them, I recommend that you do, since space here doesn't permit repeating all the details of the use of composite materials that I covered over those months. Of special importance to you, as a builder of this model, is MD&TS for January of this year, where we covered epoxy thinning and how much foam and fiberglass to use, and February, with a description and instructions for the pivot-point foam cutting method, tapered-wire cutting, and soldergun foam cutting. The March/April column covered the equally important techniques for fiberglassing and the "miracle method" of fiberglassing. If all of this scares you away, there is always balsa.

HULL

As the drawings show, the hull consists of hollowed blue foam cores covered with epoxy/glass. On my prototype, the core for the part of the hull aft of the step (the aft fuselage) was originally cut with the conventional two templates and a hot-wire bow. It worked, but was difficult and had flaws. I then made myself a tapered wire, rediscovered the single-point or pivot-point foam cutting method, and tried again. What a world of difference! It was a cinch and the result was beautiful. Only one template, no helper needed, and I got the proper wall thickness along the full length with no excess melting at the small end.

The February column describes the pivot-point method of pinching the rudder hinge line area of the fuselage into its narrow vertical section. Figure 1 illustrates the technique. We simply attach two vertical guide strips for the cutting wire to the back end of the foam block. As you can see, it works for both the external and the internal or hollowing cut.

The fin below the stab is done with a wire cutter, inside and out, plus a sharp rasp and sandpaper to contour it to the fuselage. The forward part of the hull is mostly cut with a bow, with the wire riding against parallel straightedges attached to opposite sides of the foam block. The curved parts of the hull are again contoured with rasp and sandpaper. The forward hull is hollowed out using a wire loop set in a soldering gun. The March/April MD&TS column tells how to join the sections of the hull without glueline ridges.

For the planing bottom on my prototype I used a sheet of 1/4-inch Artcore foamboard and fiberglassed it inside and out. If you don't have Artcore, a piece of 1/16 plywood will make a good bottom. The March/April column also tells how to stay out of trouble in putting the structural bulkheads in the foam cores.

WING

The wing foam cores are pivot-point or single-point tapered-wire cut from white beaded foam. Do use the pivot point method of cutting. It is much easier, faster, and better than the two-template method! Don't use solid blue foam for the wing cores; it is too heavy. I said don't use "solid" blue foam, because I think there are good ways of making a wing with a blue foam core with major cut-outs, but I don't have a tried and true design to offer you yet. You try it and give me a report.

On my prototype I covered the white foam wing cores directly with epoxy fiberglass, but I don't recommend it. It took too long and it was difficult to get a good smooth finish. One half of the wing was glassed and filled and sanded and primed and sanded ad infinitum. In an attempt to get a better job in less time, the other wing panel was glassed by the miracle method (March), which transfers the ultra-smooth high-gloss finish of a sheet of Mylar to the fiberglass covering. This is a wonderful method, but I haven't learned all the tricks yet. My main problem was that I tried to do it without vacuum bagging. Don't.

Noal Rossow of Composit Aircraft Engineering & Supply phoned me the other day. He routinely uses the "miracle method" in making sailplane wings, but uses a vacuum. Noal's company sells a simple vacuum setup called the "Sucker Kit," which was described on pages 41 and 42 of the January issue of *Model Builder*. And Ron and Karen Wagner of Hi Performance Sailplanes and Supplies paid me a visit yesterday. They showed me some beautiful wings made by the miracle method and vacuum. HPS has all kinds of composite materials for sale. They can be reached at (206)487-1721 and are located at 17902 N.E. 156th St., Woodenville, Washington 98072.

If you have or can get a vacuum setup, go for a miracle wing on Sea Fli XI. But, lacking vacuum, I recommend you build a conventional 1/16 balsa-sheeted foam-core wing and cover it with .6 or .75 oz. glass to keep out the water. Another good choice is 1/64 plywood over white foam cores. The ply is hard enough that it can be primed and painted without covering it with glass, reducing both weight and building time.

WING MOUNT

This is one of the unusual features of XI. If you have been following my column you will recall that I believe that wings should be mounted so that in a crash they can come forward, be driven back, or pivot, without damaging either the wing or the fuselage. The wing mount shown was so designed. The 8-32 nylon screw near the trailing edge keeps the wing at right angles to the fuselage, but is designed to shear and let the wing pivot if a wing tip hits something. The single 1/4-20 nylon screw in the center of the wing supports the entire weight of the airplane. If that scares you it is only because you have been looking at too many models where the wing mount was far stronger than it should have been for crash separation. The main reason for using nylon screws is that they are weaker and will shear. But then too many designers put in too large or an excessive number of screws and defeat the purpose. Which is worse, broken nylon screws or a broken wing and/or fuselage? If you still don't believe one 1/4-20 nylon screw is enough to hold the wing on, consider the numbers. One such screw has a shear strength of 343 pounds and a tensile strength of 317 pounds! Not convinced? My prototype has had many aerobatic flights plus some hard landings and hasn't lost the wing once.

TAIL

The empennage shown on the drawings is fiberglass over blue foam. Again, vacuum and Mylar would be the way to go. On the prototype I used stripped Artcore foam board for the cores of the tail, since it was already smooth and flat. The control surfaces were tedious to make of foam and glass, therefore I recommend well-sealed balsa control surfaces.

WING FLOATS

Quite simple, really. The blue foam cores are sanded smooth and fiberglassed. To bore the holes in the foam of the floats and the wing, sharpen the end of a piece of brass tubing and use it like a drill. Note the plywood washers built into the wing and into the top of the wing floats. These are necessary to distribute the load out into the foam and fiberglass. Pre-drill the washers before installing them. The struts are epoxied in place after the wing and the wing floats are all painted. I could see through the fiberglass where to cut the holes in the skin to match the holes in the washers. With a balsa covered wing you will have to accurately measure and record the locations of the washers prior to sheeting.

NACELLE

The pattern for the nacelle on the prototype model was turned on the lathe from blue foam. Several layers of epoxy/glass were laid up and cured on the foam pattern, then the foam was dissolved out, leaving a hollow fiberglass nacelle. If you are going to turn a foam pattern, put a half-inch dowel through the foam and glue it in first. The foam is too flexible to turn without it. The hold R/C-56 glue. R/C-56 is not truly waterproof, so don't use it for seaplane structural joints, but it resists water long enough to be fine for radio sealing. Also, put the receiver in a small plastic bag and tie the open end around the servo leads. Water in the servo connectors can short out the signal enough to cause trouble. I have at least one good crash to prove it. Water in the battery connectors and switch will not short the power out, but if it is not dried out after the flying session the presence of the voltage will cause electrolytic corrosion which will soon ruin the connectors and switch. If there is any chance of water in the plane, disconnect the battery from the switch, shake any water out of the battery connector and dry it. Once the voltage is removed from the rest of the system, it will dry safely without corrosion.

Again, seaplane flying is an increasingly popular form of R/C, but don't choose this special model as your first seaplane unless you are interested in composite construction. •

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