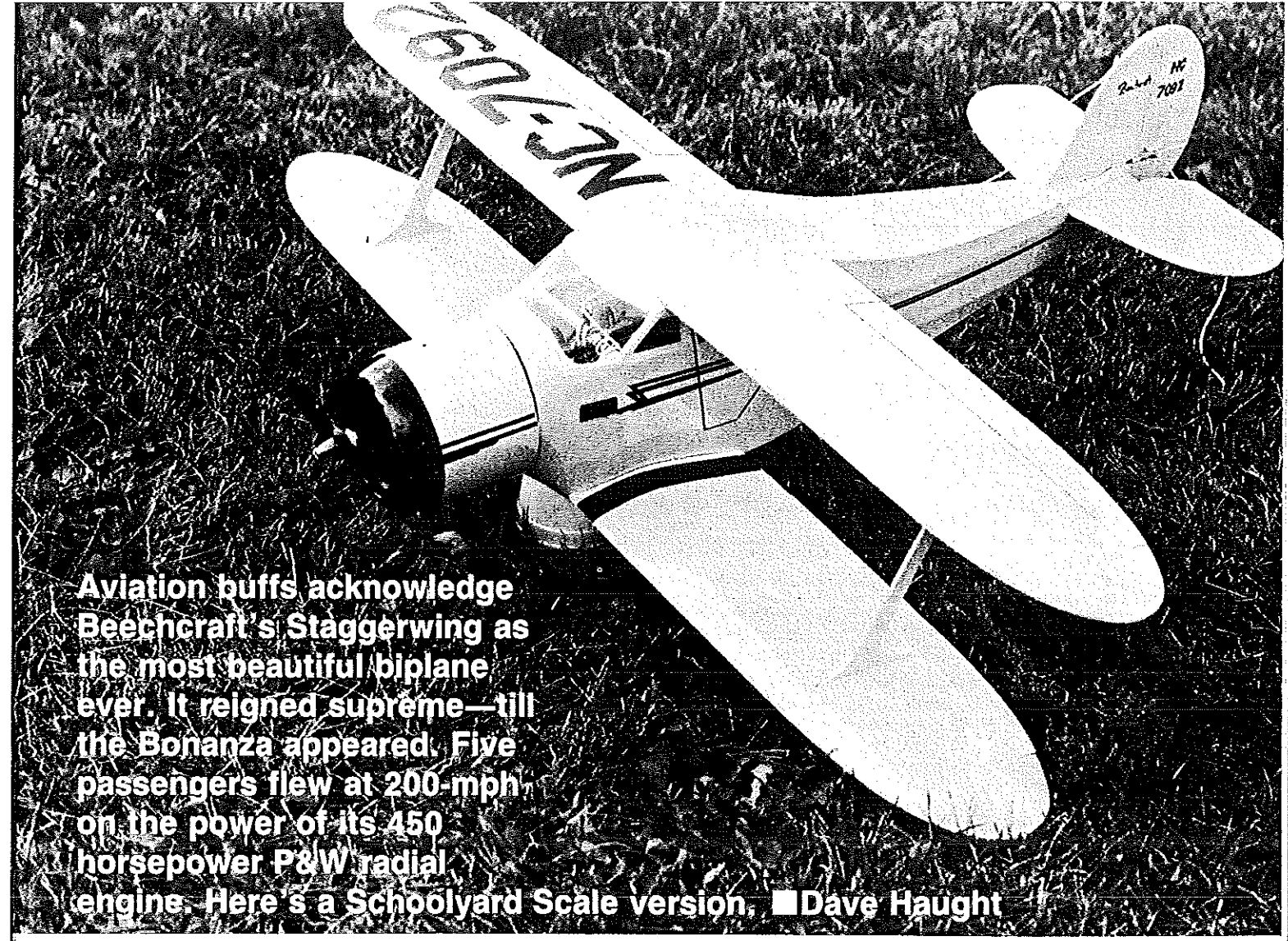

Aviation buffs acknowledge Beechcraft's Staggerwing as the most beautiful biplane ever. It reigned supreme—till the Bonanza appeared. Five passengers flew at 200-mph on the power of its 450 horsepower P&W radial engine. Here's a Schoolyard Scale version. ■Dave Haught

Staggerwing Beech

STAGGERWING! The very name brings most antique aviation buffs to their feet. Certainly one of the most recognizable and beautiful of the civilian designs of the Golden Age, the Staggerwings took to the air with grace and power and a certain mystique. The curves, angles and unusual negative rake to the biplane wings make for a distinctive aircraft. But the Staggerwing didn't just look good, it flew even better!

Even today you can see many of these icons of the Golden Age gracing the popular full-scale fly-ins around the country. Modelers have always been fascinated by the big Beech. Once you've built one you can really marvel at its design. Piece by piece it looks awkward and impossible, but when you put it all together you have the elixir of flight. One sip and you're hopelessly hooked.

So far the schoolyard Beech has won the hearts of all who've seen her. These plans were hardly drawn before members of the club started begging me for them. "Too late, lads! Send your bucks to *Model Aviation* and get your own set!" sez I. The model is irresistible in its small size and bright yellow-and-black trim. You too can have one; just follow along.

Being a dyed-in-the-tissue Free Flighter, there was only one way to build the Staggerwing this small and make it flyable. That meant stick-and-tissue-style construction. This Staggerwing is just an overgrown Peanut Scale model. It is, however, fairly accurate, since the plans were developed from James Triggs' excellent scale drawings.

Some things were adjusted to make the model simpler, but the intent was to give the model the fullest "Staggerwing impact" it could have. You'll notice that the generous wing root fairings of the full-scale machine are not there—but only if you look twice. I cheated the eyes a bit by using a few curves of my own. You can judge the results yourself. I'm quite content!

I love biplanes, but I hate building them. Two sets of wings means two sets of ribs, etc. Not quite true here! The Staggerwing offered me a lot of challenges as a designer. To keep the model light and simple meant reducing the structure and making it as strong as possible.

The first concern was how to take it apart. When you use Radio Control, you must have access to the airborne equipment. It seemed that either some sort of hatch system or removable wings were in order. With its small wingspan of only 32 in., the model did not need to come apart for transport, but somehow I knew I'd have to reach inside to install and adjust the system.

The whole matter of controls also had to be addressed. Did I want two channels or three? Should it be rudder and elevator, or

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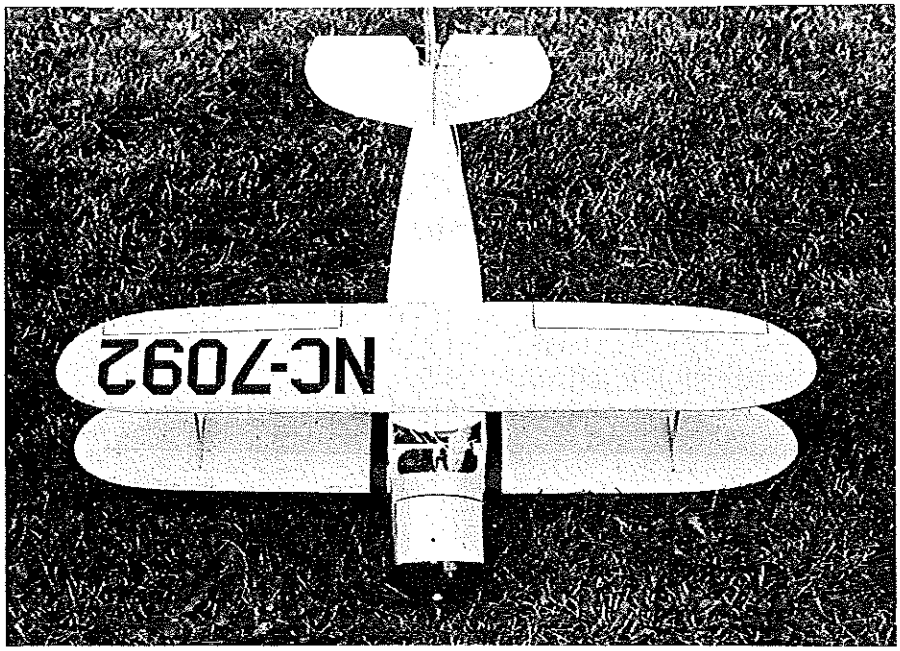


This is a fun-fly ship, not a competitive Scale model—it doesn't even have landing gear. With its reliable Cox Black Widow .049 power and light weight (10 oz.), it can really tear up the sky!

should there be ailerons? There couldn't be much dihedral, because it would not look right—and looks are the reason for building the Staggerwing in the first place.

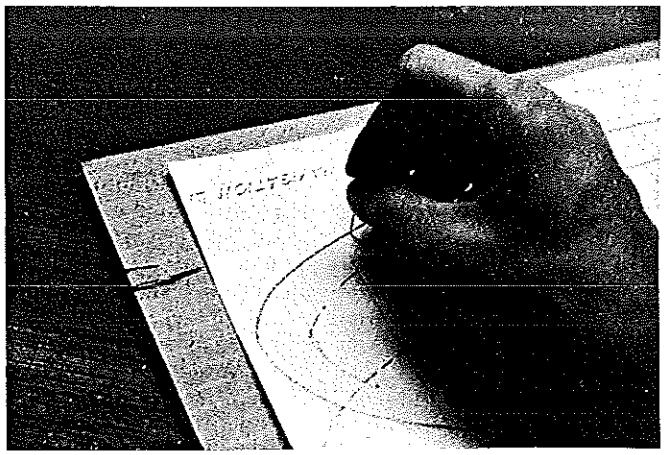
I finally decided on the ailerons, elevator, and even rudder. It just didn't look right in my mind not to have the rudder move too. You could certainly leave it out since the ailerons do the job anyhow.

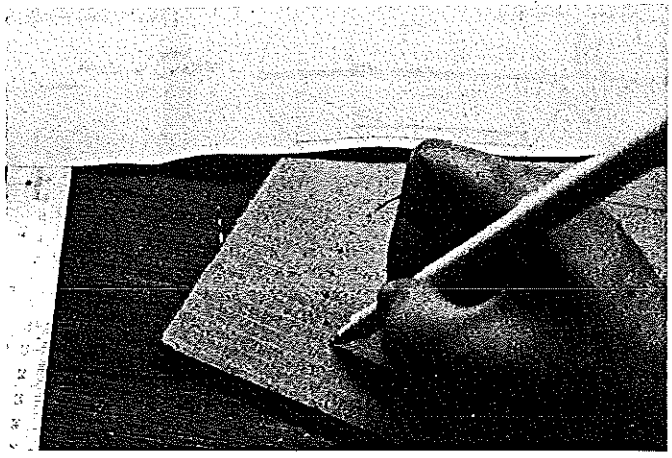
The top wing was elected to be the removable one for access to the radio, while the bottom wing would be the one permanently attached to the fuselage and carrying the ailerons. That made the most sense to me from a structural point of view as well, since the bottom wing would be the first wing to touch down in landing (the model has no landing gear) and had to have the extra structure to support the ailerons as well. One mistake I did make was in putting the aileron horns on the bottom of the lower wing. They catch on everything! I moved them to the top of the lower wing on the plans.

Building the Staggerwing is quite a project. Don't expect to throw it together in a night or two. Study the plans and pictures carefully.

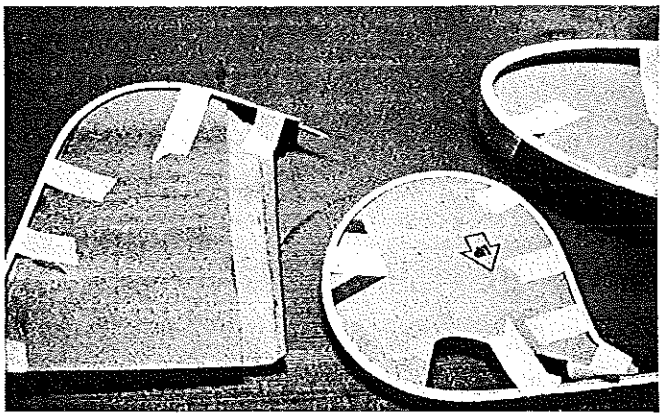
The fuselage is a good place to begin. It is basically a box with stringers and formers adding to its girth. Start with the fuselage side frames. They are made up from medium 3/16-in. sq. balsa. You should soak the lower longerons for an hour or so in hot water before pinning them in place over the plan. The wood will bend easily to the curve even when it's dry, but when it's bent into shape while it's still wet from the soaking it will retain the curved shape naturally after it dries out.

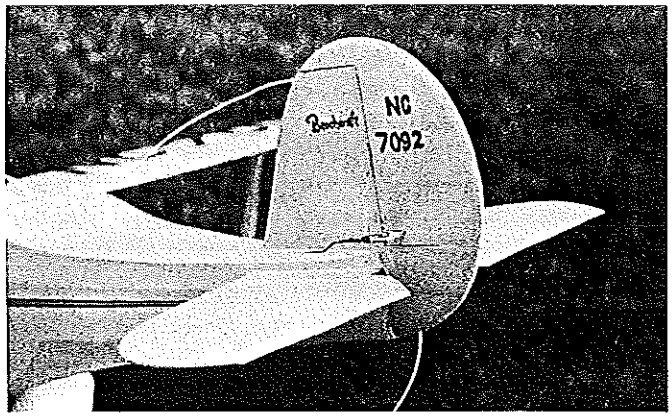
Lay down the main longerons and cut two sets of top and bottom sheet parts for the wing mounting areas. These can be cut from firm sheet balsa. The upright pieces vary in thickness from 3/16-in. sq. up in the front part of the fuselage to 1/8 x 3/16 in. towards the tail in order to keep the aft part light. Study the plans. The 1/8-in.-sq. stringers are added later, so don't worry about them now. Notice that the *interior* of the ra-



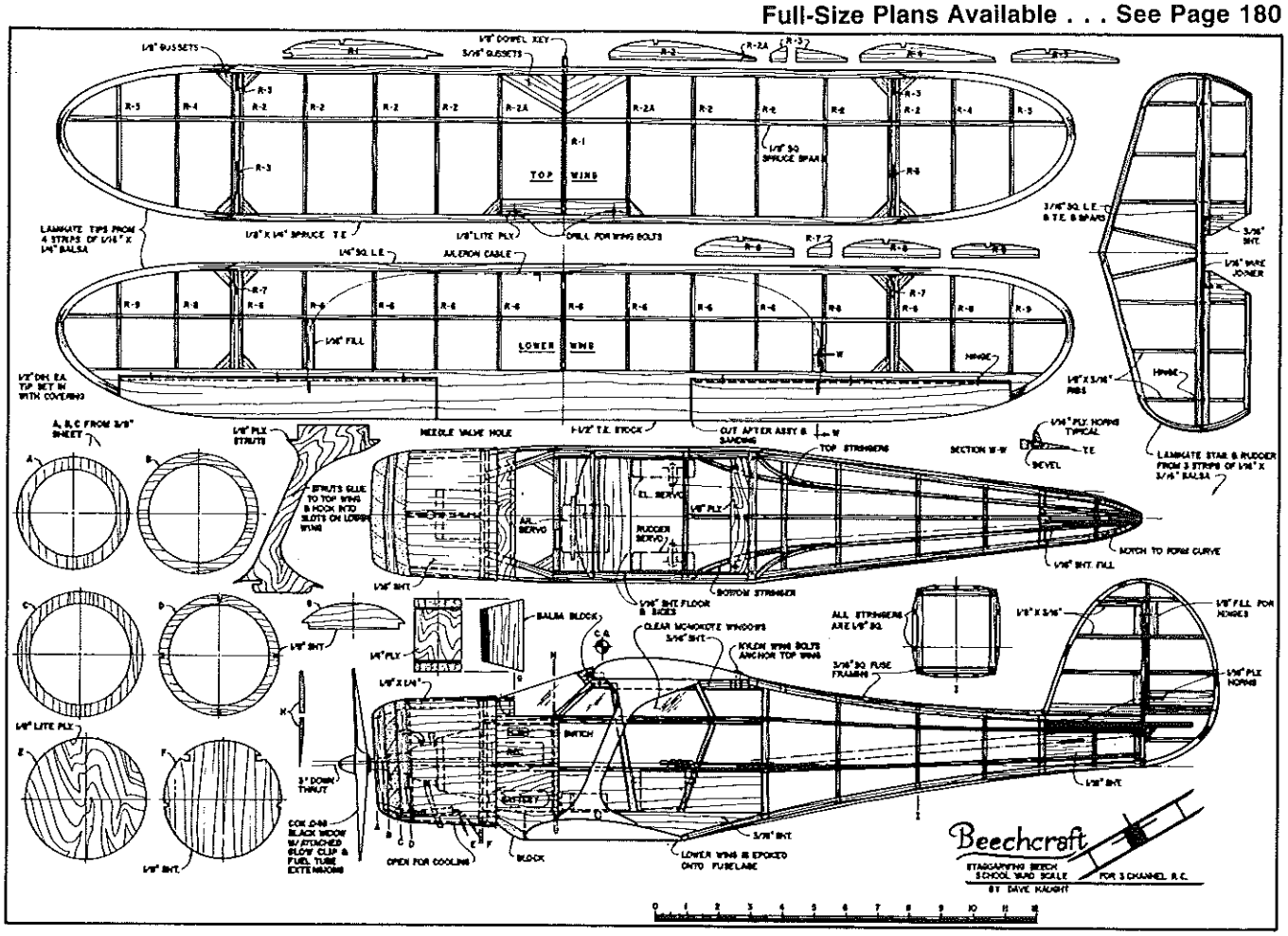


The beautifully curved tips on the Stag's flying surfaces can be made quite easily by laminating balsa strips around corrugated cardboard forms. Here's how to transfer the shapes accurately from the plan to the cardboard. There's a clear explanation of the process in the text.





Here's how the laminating goes (L). Parts will be exceptionally strong and light and will not lose their shapes over time. The result of the labor (R) is a clean, strong, graceful model. Do these photos sharpen your interest in building a copy of Dave Haught's delightful design?



dio area is sheeted after the side frames have been lifted from the plan.

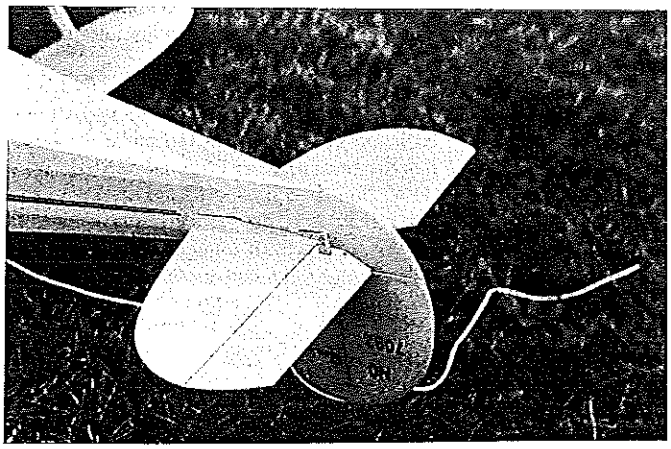
The two fuselage side frames are built simultaneously one atop the other the same way a rubber-power model's fuselage is constructed. When the glue joints are dry (and the soaked balsa longerons have dried out), you can separate them and trim off any excess wood. Now is the time to cut that interior sheeting from 1/16 sheet and glue it in place.

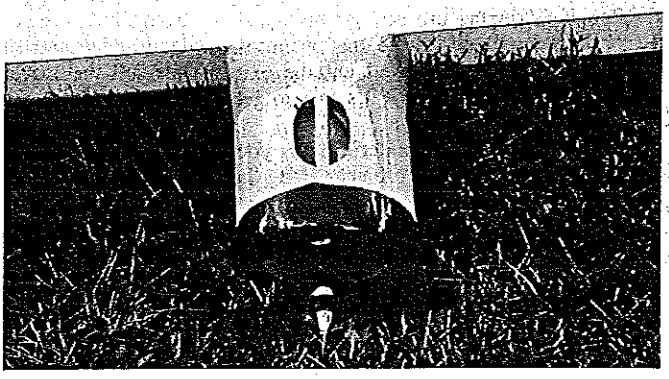
Locate former station "H" in the side view of the fuselage. From that point to the trailing edge of the upper wing the fuselage is of constant width. Cut a number of 3/16-in. cross-member sticks and connect the two sides together. After the glue has set you should carefully pull the fuselage sides together towards the tail. Cut two cross-members to the length shown in the top view just at the leading edge of the stabilizer. Glue these in next.

Notice in that top view on the plan that the rearmost longerons need to be notched and bent to form the correct curvature when viewed from above. Use a razor saw to cut almost through the longerons from the inside, then bend the wood to shape. Have patience! The result is worth the effort. As you go along, stop often to make sure the fuselage is being built square. There is nothing sadder than a neatly built fuselage that is too warped to use!

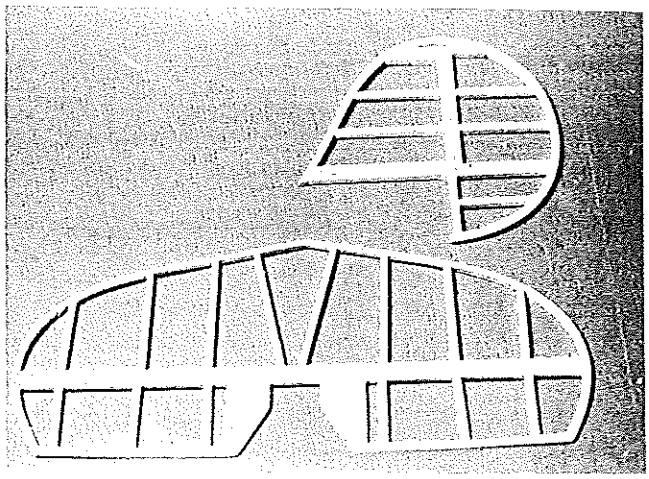
Moving to the nose, study the top view and note the way the longerons need to be cut and angled to meet the firewall. Cut out former "F" and glue the longerons into its upper notches. The space in the lower section is filled in with a balsa block of soft-to-medium hardness. This item absorbs the landing shock if all goes well and transfers the load to the wing and fuselage. Formers "G" and "H" can be cut out and glued in place. Cut and glue in the remaining cross-members, and add the stringers to the sides. Around the windows you will have to add soft balsa wedges to fair the upper wing-mount sheet into the upper stringer.

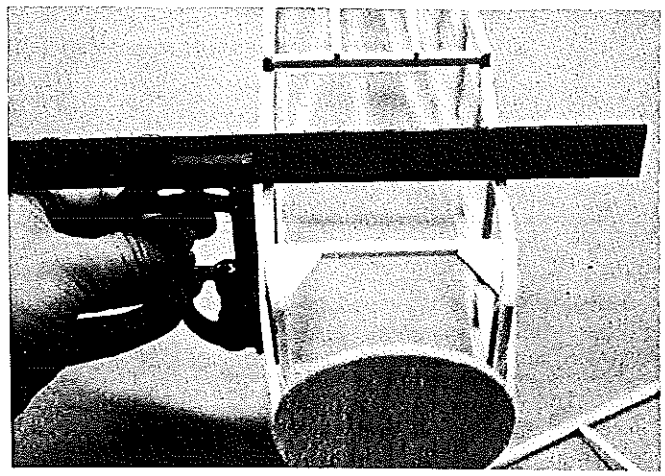
The top and bottom stringers are a bit of a challenge. These need to be soaked in very hot water for an hour before you begin in-



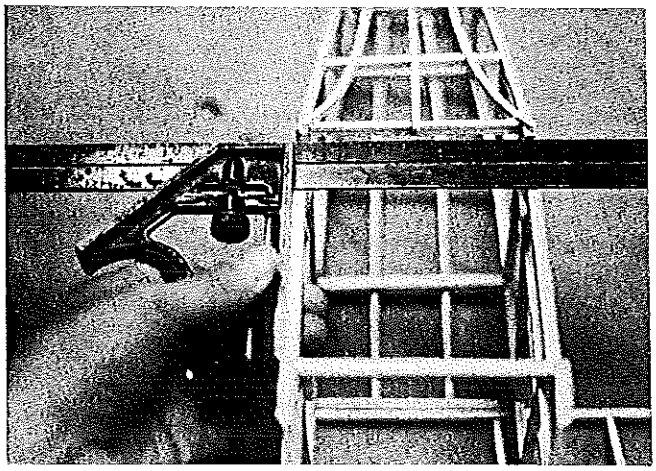


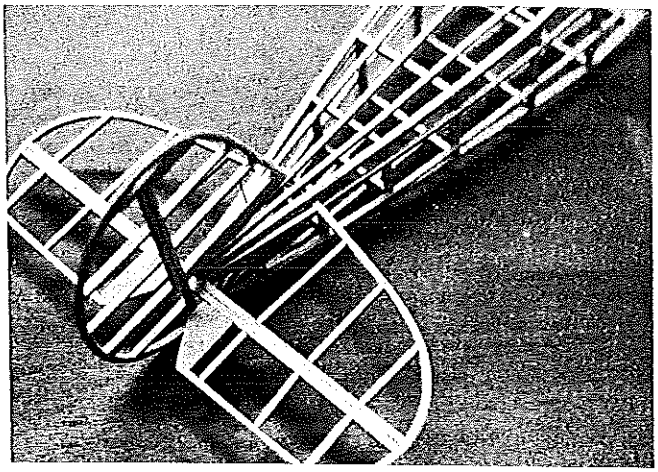
Looking at the Stag from below. You couldn't make a model of this size much cleaner than this! One of the trickiest parts of building it is in the shaping of the balsa block between the cowl and the leading edge of the bottom wing. Shape transitions from circular to rectangular.





Finished tail feathers (L) show simplicity of the structures derived from laminated outlines. You've got to make sure that the fuselage is true and square as you go along (R). A warped structure would give nothing but trouble while you try to align the wing and tail for final assembly.





More checking for true construction (L). Haste makes waste, and patience and care make for strength and good flying qualities. That looks like a lot of balsa back at the aft end of the fuselage (R), but careful selection of balsa weight and grain will still result in a light, strong model.

stalling them. Start with the top stringers at the point where they meet the trailing edge of the wing. This may sound strange, but it works better to begin with the section of maximum curvature first.

Glue the stringer to the top of the longeron with about 2 in. of wood hanging over the side. Use thin CyA glue for this job. Then begin slowly to pull and bend the stringer to the place it contacts the next cross-member. From here on the stringer is straight to the rudder post.

Repeat the operation for the other side, then do the center stringer last. The bottom of the fuselage goes the same way but is less of a problem.

After the stringers are set, go back and fill in between them where the pushrods will exit. You might as well cut the exit slots in them now, too, since it's easy to get in there at this point in time.

By now you must be wondering why you even got started on this project. Hang in there!

The wing hold-down plate can be fitted and glued in as well as the gussets around the nose. The section from the firewall back to former "H" is sheeted with 1/64 plywood—but only after the balsa chin block has been carved and sanded to shape. This area has the challenge of making the transition in the fuselage contour from the round firewall to the straight leading edge of the lower wing. Study the pictures.

The engine mount is built as a unit and then glued to the firewall. Cut out and drill the 1/4-in. plywood engine mount plate to fit your Cox Black Widow engine. Make sure the 3° of down thrust is put in, then attach the engine mount to the firewall.

The cowling is made up from rings of 3/8-in. sheet balsa glued together with the grain of each ring running at right angles to the grain of the ring it's being glued against. Make an extra copy of former "E" from 1/8-in. balsa and tack-glue four longerons made from 1/8 x 1/4-in. balsa between this "E" and former "D."

Join three 4-in. lengths of 1/16 sheet balsa edge-to-edge and soak them in hot water. Then roll them over the cowl skeleton and wrap them in place with masking tape until the wood dries. Remove the tape and use the formed sheet to make the skin of the cowl. Glue the skin to former "D" and the longerons—but not to former "E" (which will be removed later).

Next add the laminated nose section to the cowl and sand it to shape. Notice that the cowl has a distinctive amount of down thrust built into it. This is scale down thrust—and is even a bit more than is needed for the model.

Take a well-deserved break from building the fuselage and attack the tail feathers. Here there is no rest for the wicked, either. All those graceful curves that attracted us to the Staggerwing in the first place will have to be built by laminating thin strips of balsa. If you have never tried this technique, you should. It is a great way to make strong, light curved parts, and it's not as hard as you might think.

The secret to laminated parts is the use of a form to shape them. I use 1/8-in. corrugated cardboard for my forms. Transfer the outline of the *inside* of the part you are about to make to the corrugated cardboard using the method depicted in the photos. Use a jigsaw to cut out the forms.

I used a double thickness of corrugated board for this task in order to make them easier to cut. It also let me make the laminated parts twice as thick as needed. Why do it? Simple! I laminated the tip bows, and when they were dry I sliced them down the middle, and presto! I had the two tip bows I needed and only had to do the laminating once! (See, I'm not so dumb after all.)

Sand the forms carefully to eliminate any sharp corners, then take a crayon or piece of wax and rub the cardboard edge until it is well coated with wax. This keeps the laminated parts from sticking to the form.

The wood strips are then prepared from

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Beech/Haught

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medium light balsa soaked in hot water for an hour or so. While they are soaking, mix up the laminating glue. I mix carpenter's wood glue with water (with a ratio of 25% water and 75% glue being about right) and put the brew in an empty glue bottle.

The first step in the actual laminating process is to cut a bunch of 3- to 4-in. strips of masking tape and park them along the edge of the work table for easy access. The first strip of soaked wood is then taken, wiped off, and given a light coat of the laminating glue on one side.

The next step is to take a second strip of soaked wood, wipe it off, and stack it onto the first strip. The process continues until the desired number of strips have been stacked together. A film of laminating glue is put between the strips as they are layered.

While the glue is still wet, the stack must be shaped to the waxed form. Take the stack of strips and lay them onto the form starting at one end. Tape that end to the form with a strip of masking tape. Continue around the form, slowly pulling the stack against the form as you go. They should take the curvature easily without stressing and breaking. Apply strips of masking tape as needed to hold the laminated strips firmly against the form. Once you've completed this task, set the assemblage aside overnight until it is cured before untaping it.

The rest of the rudder and stabilizer assembly follows normal construction procedure. The laminated tips and outline will need to be sanded and mated to the rest of the structure as you build it. Use the same glue—but undiluted—as you used to do the laminating. I've not had good luck when trying to build things using a combination of CyA and wood glues. Some builders have good luck making laminated parts using CyA glue instead of the diluted wood glue, but I've found that the laminations made with CyA take a lot more glue and come out a lot heavier.

After the glue has cured, the gussets, hinge and control horn sheet parts need to be made and added. Join the elevator halves with a wire joiner and hinge the surfaces with light Mylar hinges. I used MonoKote hinges on my Staggerwing but did not like them in this application. I thought it was cleaner looking to use the old standbys. Give the edges a good rounding and sand the surfaces smooth before covering them.

The wings are built the same—only different! Start with the upper wing, as it's the simplest. Laminate the wing tip bows. You will need four of them (two for the lower wings, you know), so try making two at once using wider strips of wood (as mentioned earlier). While you're waiting for the laminations to dry, you can be cutting out all the rest of the parts.

The leading edge is made from hard ¼-in.-sq. balsa, and the spar and trailing edge are made from spruce. Pin the leading and trailing edges down over the plan (which you've protected with a piece of waxed paper or plastic wrap) and begin gluing the ribs in place. Make sure that the spaces between the pairs of ribs which will sandwich the wing struts are accurate and that they are true to the plan. The "R-3" ribs will help keep the space just right.

Fit the wing tip bows to the leading and trailing edges and add the gussets as shown. The center section has to be fitted with the leading edge dowel key and the light plywood hold-down plate. The spruce top spar is added last.

The lower wing is built a bit beefier. The basic difference is the preformed trailing edge and the ailerons. By using the wide trailing edge stock the wing can be built completely and sanded before you cut the ailerons out. (Look at the detail on the plan which shows the cross section through the trailing edge at the aileron station for the bevels that have to be carved into the ailerons to allow them to travel downward.) You will also see that the aileron control horns are on the top of the ailerons. This will save you having to replace them a lot. Mine (which I mentioned earlier are on the bottom of the aileron) get knocked off every other flight. Oh, well!

Don't forget the 1/16 sheet balsa pushrod exit guides. I used the smallest flex cable I could find for the aileron control cables. Depending on the servo used, you will want to sheet the area between the center ribs to provide a mounting for the servo. Do this while you can. Doing it after you mount the lower wing would make it a terrible job!

Give the wings a good carving and sanding session to get them ready for covering. Saw out the two wing struts from 1/8 in. light plywood. You will notice the odd hook on the bottom end of the struts. It's there because the struts are going to be glued into sockets in the (removable) top wing.

When the top wing is attached to the fuselage, the struts will first have to be slipped into the slots in the lower wing. The top spruce spar in the lower wing will be captured by the hook on the lower end of the wing struts, thereby locking the wings together. It took several sleepless nights to come up with that one!

Fit and pin the lower wing onto the bottom of the fuselage. Take time to make a good fit between the two assemblies, and check to assure the wing will mount level with and perpendicular to the fuselage. Next fit the upper wing on, and pin it in place. Check it to make sure it is parallel with the lower wing in both top and front views.

Also check that both wings are set at the same incidence. You do this by measuring the gap between the leading edges first, then the trailing edges. The measurements should be the same. If they're not, you'll have to do some trimming and/or shimming of the upper wing until the measurements do agree.

Drill the holes for the wing hold-down screws in the top wing, and cut a hard balsa block to form the front cabin top. Drill it for the wing dowel key, and glue the block to the fuselage. (Make sure that the top wing, with the dowel in place, is used to position the balsa block when you glue it in place.)

Finally: By now you've gotten the itch and have, no doubt, slipped the tail feathers into

place and "stepped back" to admire your craftsmanship. What? you haven't done it yet? What's keeping you? Do it now. Go over all the surfaces of the model and look for details that need to be added, trimmed or sanded. When that's done you are ready to start finishing.

Cover and finish: I was very tempted to cover my Staggerwing with silk. But in the end the high gloss of a MonoKote finish won out.

Give the engine mount area a few good coats of dope to fuel-proof it. Do it to the inside of the cowl, too.

The side windows were made from clear MonoKote and applied before the yellow overall covering. Cover the small parts first to get used to the process. I covered the wing struts, too. However, you might want to preserve your sanity and just paint them. Cover the wings and fuselage before final assembly.

The cowl was covered and then glued to the nose of the model with epoxy. With its large opening and exit holes, the cowl does not need to be removable for access to the engine.

When you cover the wings, heat-form in ½ in. of dihedral under each wing tip. This is easy to do. First shrink the bottom covering, then hold the wing down on the building board at the center section and block the tips up ½ in. Pass the hot iron over the top covering several times to shrink the covering fully. When you release the center of the wing it should retain the dihedral you set in. Repeat the process if necessary, and check the wings from time to time to make sure the dihedral is still there.

Final assembly is straightforward. Epoxy was used to make sure everything stayed put, and the relatively slow curing time will give you the opportunity to make sure that it's all in the right place. Use the following sequence for final assembly: Stabilizer, fin and rudder, and lower wing.

The real fun begins when you install the radio gear and hook up the pushrods and aileron cables. If you were sufficiently foresighted to locate and mount the aileron servo before you glued on the bottom wing, you're way ahead of me!