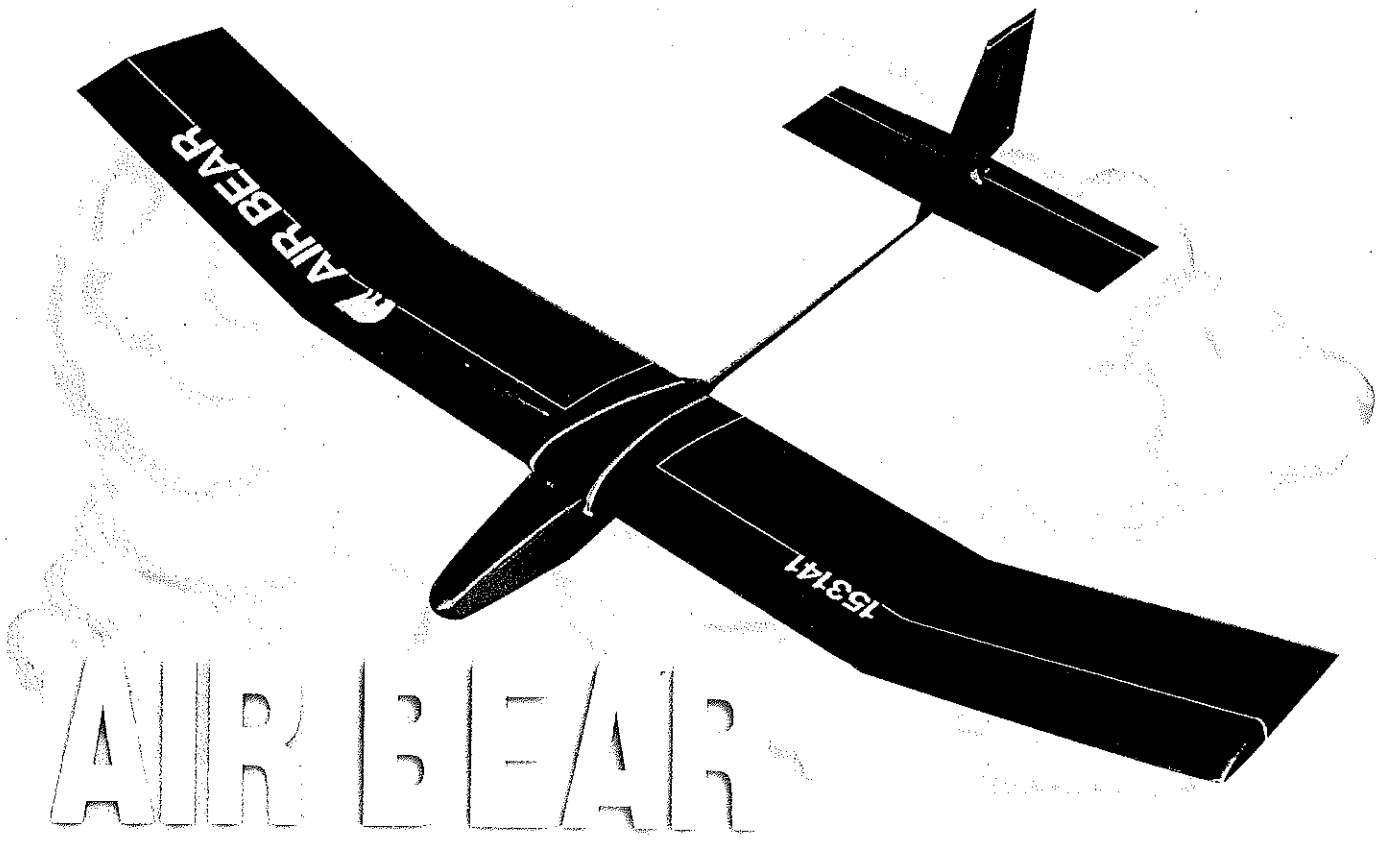
#889

■ Marcus Shimazu-Takahashi



AIR BEAR

DOESN'T COST MUCH. NOT TOO HARD TO BUILD. FUN TO FLY. GOOD REASONS TO GET A BEAR IN THE AIR!

AIR BEAR is a simple 60-inch-wingspan glider designed to introduce youngsters and newcomers to the pleasures of Radio Control Soaring. Air Bear probably won't win any Thermal Duration contests, but it does offer the first-time flier a two-function soarer that responds well to control inputs and is extremely stable and mild-mannered. The model can be hand-launched or a small hi-start can be used.

Its structure is quite conventional and would make an excellent first construction project for a young person receiving guidance from a modeler with building experience.

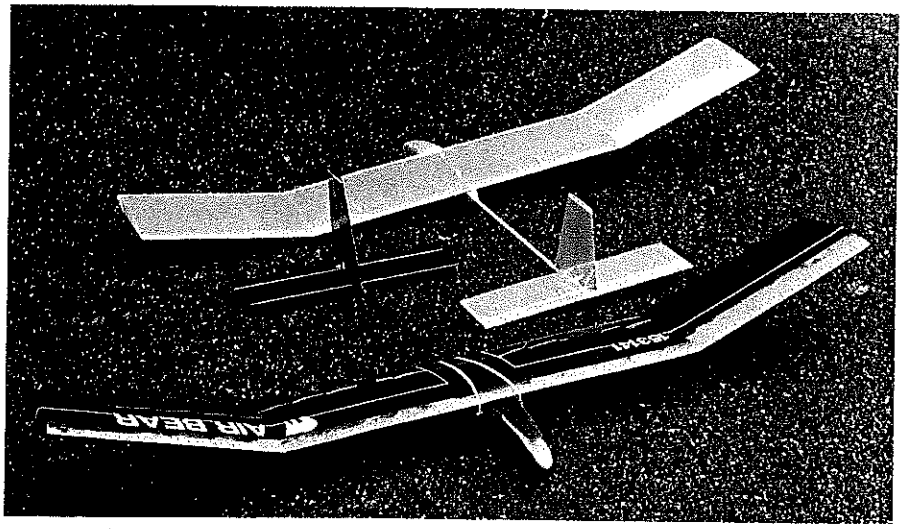
The design's origin can be traced to a conversation I had with my wife, who is a developmental psychologist, about the relative lack of children involved in model aviation. As she scrutinized the model sailplanes hanging from our ceiling (yes, she lets me hang them in our living room), she said, "You know, gliders are good because they are quiet, but maybe they are just too big, from a child's point of view."

(The name was my wife's suggestion for something that would not intimidate small children.)

Complexity is to be avoided when one is contemplating an aircraft meant to introduce youngsters and beginners to model aviation, so I sought a simple, inexpensive, reliable radio. My search led me to the Hitec Focus IISS AM two-channel, complete with a single-stick transmitter, two standard-sized servos, a two-channel receiver, and an airborne holder for four AAA batteries. With a street price of about $60, the Hitec is a fine first radio system.

The next design issue was flying characteristics. I wanted a glider that would fly slowly and smoothly. Wing loading has to be kept low while maintaining the desired short span, so a low-aspect-ratio wing was designed. I chose the Clark Y airfoil; if Charles Lindbergh trusted it on *Spirit of St. Louis,* it's good enough for me!

With a constant chord of 8.5 inches and a span of 60 inches, a respectable 510 square inches of wing area resulted. A constant-chord wing also offers the benefits



Two Air Bears ready to go. Launch by hand or use small hi-start.

of minimal tip-stalling (essential to a craft that must turn well, especially when circling in a thermal) and ease of construction.

To facilitate smooth control response, Air Bear has a relatively long tail moment, with a short nose for good stall recovery characteristics.

CONSTRUCTION

Air Bear's airframe requires only basic modeling tools (X-acto® knife, drill and drill bits, rulers, soldering iron, wire cutters, and sanding blocks) and nothing in the way of exotic materials. The only "hi-tech" part of its structure is the fiberglass boom, a stiff fiberglass tube usually employed as a pushrod in large model airplanes to connect powerful servos to big control surfaces. (Avoid pushrods made from carbon or graphite composites; they may interfere with the receiver.)

Most of the structure can be assembled with aliphatic glue. I'm particularly fond of the sandable aliphatic glue produced by Pica Products: H/D 601. It is quite strong and dries quickly. But any yellow carpenter's aliphatic wood glue will do.

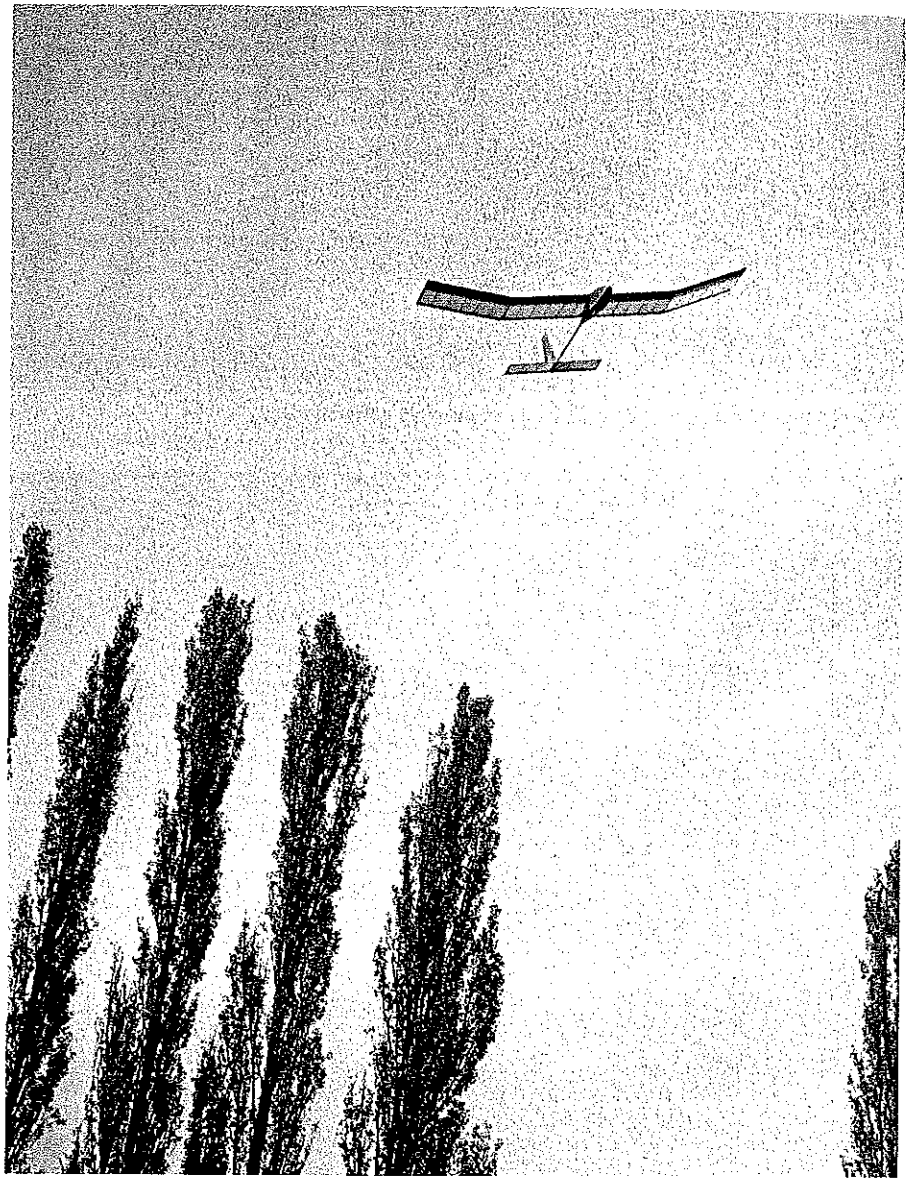
For high-stress areas, two-part five-minute epoxy can be used. (Children should not use this type of adhesive unless they have strict adult supervision, with proper ventilation and skin protection. Cyanoacrylate (CyA) glues can also be used, but with the same precautions as those noted for epoxies.)

Make a "kit" of all parts needed to construct Air Bear before beginning construction.

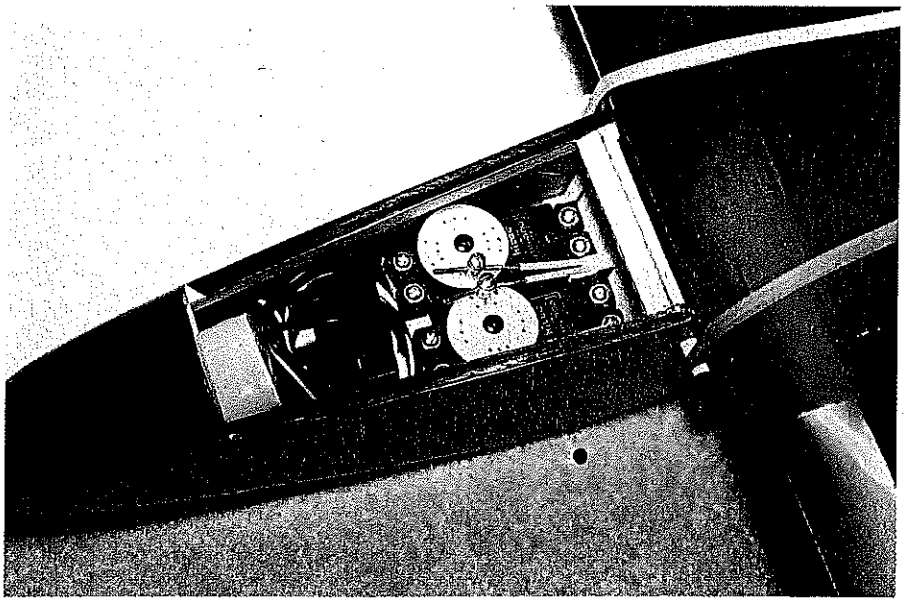
Fuselage Pod: The holes in F2-F4 need to be precise to create a tight fit for the boom. I drilled a slightly undersize hole and gradually enlarged it with an X-acto® knife.

The 3/32 hole to the upper right of the boom hole in F2 and F3 is for the receiver antenna, so that it can pass through to the aft fuselage pod and then be taped onto the outside surface of the boom.

Place the fuselage sides on the plan and mark the locations of the F1-F4 formers. Be



Air Bear is not a contest machine, but it is "extremely stable and mild-mannered."



Hitec radio is inexpensive, fits snugly into nose section. Hatch gives access.

AIR BEAR

Type: RC glider

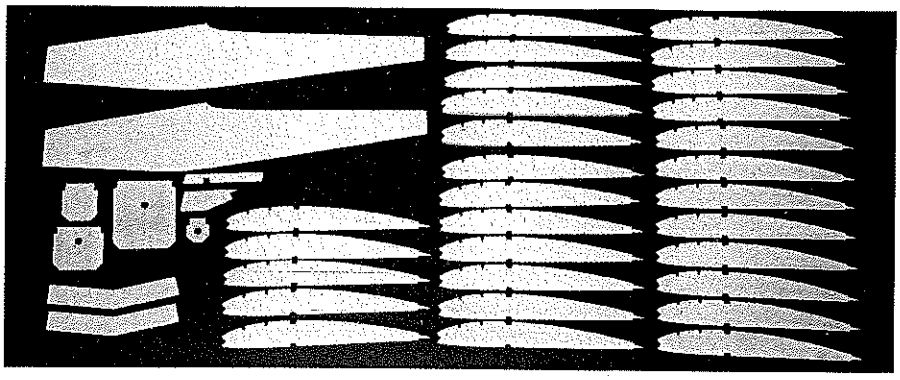
Wingspan: 60 inches

Functions: Rudder, elevator

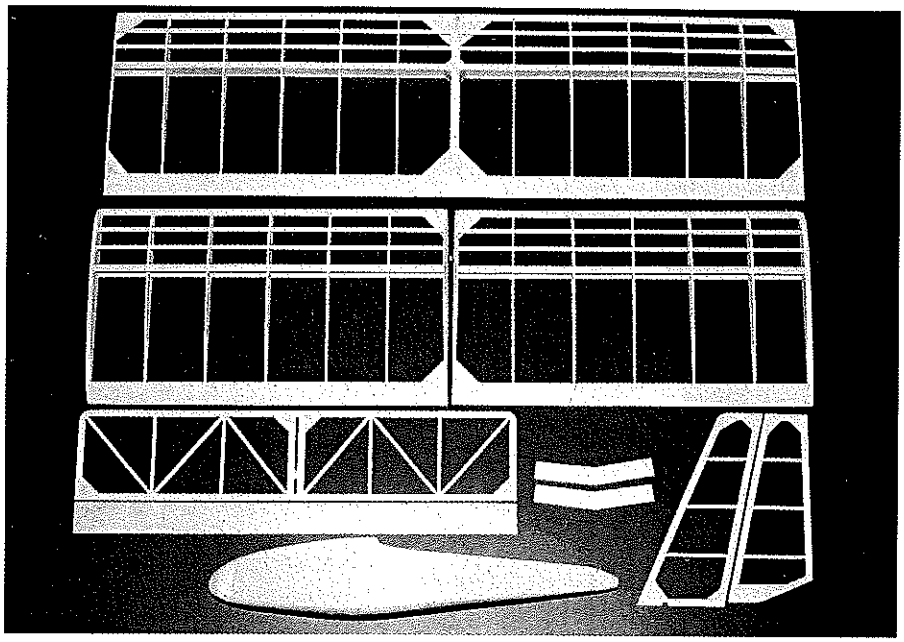
Flying weight: 18 ounces

Construction: Built-up

Covering/finish: MonoKote®



Major components are "kitted" prior to beginning construction.



Subassemblies ready for finishing. Structure is straightforward and can be accomplished with the help of an experienced modeler.

sure to make marks for left and right-hand fuselage sides. Also draw in the position of the servo rail guides. Drill the 3/16 holes for the wing retaining dowels. Add the 1/4 triangular balsa stock to the bottom edge of the fuselage side.

Glue the 1/8 x 1/4 sticks to the upper edge of the fuselage side. Once the glue holding these sticks has dried, redrill the 3/16 dowel holes. Glue the servo rail guides in place.

Use aliphatic glue to attach F2 and F3 to the right fuselage side. While the glue is still wet, position it over the top view of the fuselage. Run glue along the areas marked for F2 and F3 on the left fuselage side, bring it to the left edges of F2 and F3, and join.

Wrap masking tape around the fuselage to hold everything together; use diagonal strips if necessary to keep everything true.

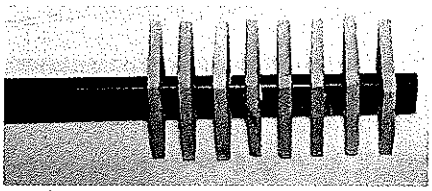
Glue in F1. Break out the masking tape again to keep everything in place. Glue F4 into position. Check the alignment of the fuselage pod by sighting down the boom holes in F2, F3, and F4. You should see three concentric holes.

Trace the bottom forward portion of the fuselage onto 1/16 plywood. Epoxy this piece to the fuselage bottom. Use masking tape to hold it in position.

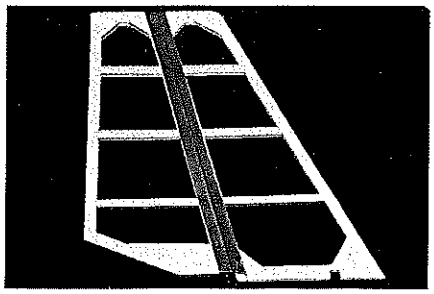
For ease of assembly, the 3/8 square spruce towhook-retaining block can be laminated from 3/16 spruce. Carefully install between F2 and F3. This part also reinforces the reverse side of F3 in its role as a finger-hole wall for hand-launching.

Sheet the bottom of the fuselage with 3/32 balsa and cut the finger hole.

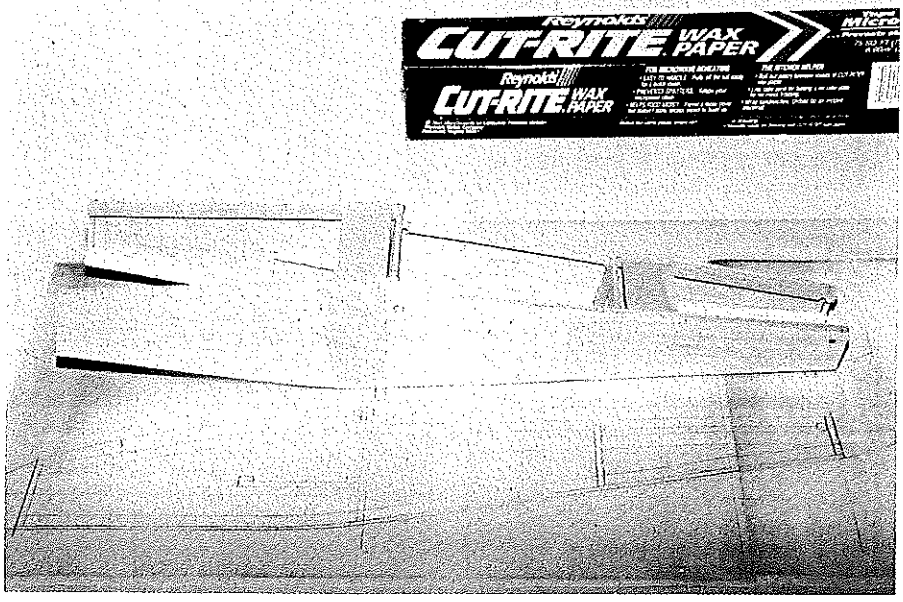
The tail cone can be laminated from crossgrained pieces of 1/8 balsa, or it can be carved from a solid block if you have access to a drill press so that a 9/32 hole can be drilled through the block.



Tail cone can be laminated from crossgrained layers of 1/8 balsa or carved from a solid block.



Rudder and fin are constructed from 1/8 balsa; text details hinging method that uses heat-shrink covering.



F2 and F3 in place between fuselage pod sides. Masking tape holds everything.

The nose block can be shaped in a similar fashion. Epoxy the nose block to F1.

The hatch has the wood grain running lengthwise. Sand the top of the nose block to follow the slope of the top edge of the fuselage. Cut through the hatch 1¾ inches behind its forward edge. Glue the smaller forward piece to the top of the nose block and forward fuselage. The remaining, longer part becomes the removable hatch. Epoxy the 1/32 plywood tongue to the lower front edge of the hatch, and drill a 1/8 hole for the hatch retaining screw.

The 1/8 x 3/8 spruce inset must now be cut to the width of the hatch. Cut a recess in the hatch and epoxy the spruce inset in place.

Cut a 1/8 x 1/4 spruce hatch rest and glue it in place next to the top of F2. Drill a small pilot hole through the 1/8 x 3/8 spruce to guide the hatch retaining screw. Place the hatch in position and drive a small wood screw in to keep the hatch in place.

The fuselage pod is now ready for sanding.

Start by rough-shaping the fuselage pod with a file, being sure to round all of the edges. Once a crude approximation of the desired shape is achieved, sand with 60-grit sandpaper on a block, then 180-grit and 320-grit. Always wear a dust mask when sanding.

Be careful shaping the tail cone; it becomes fragile as its tapered edge approaches zero thickness.

Tail Feathers: Cut all 1/8 x 1/4-inch balsa sticks to length according to the plan. Then the sticks are positioned over the plan and glued to each other, along with parts T1 and T2. Cut the 1/8 square sticks to length; shape and glue in place. Make all the necessary gussets and glue them into place.

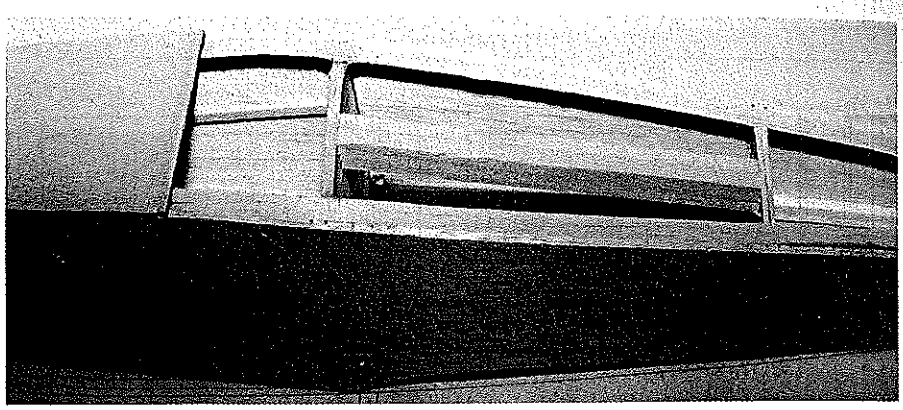
Sand a 45° bevel on the edge of the rudder that faces the fin (see section E-E on the plan). The leading edge of the fin and the trailing edge of the rudder should be sanded round.

The stabilizer is constructed in the same fashion as the fin and rudder. When positioning the two central 3/16 x 1/4 sticks, place the fin between them so that T1 fits tightly, then glue the sticks in position.

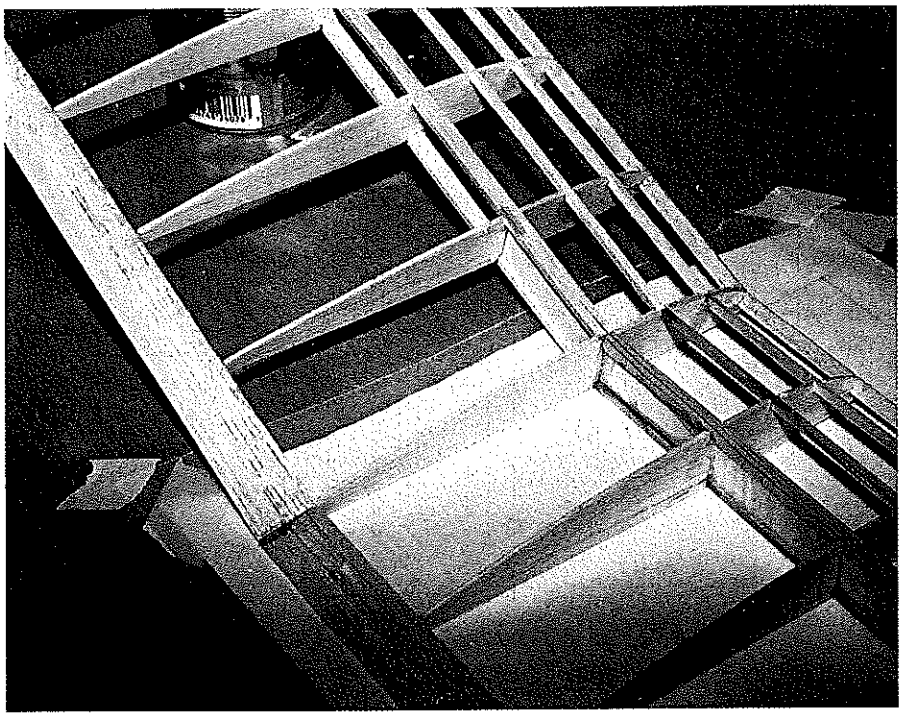
Sand a 45° bevel on the edge of the elevator that faces the stabilizer. The trailing edge of the elevator should be sanded round. Sand the leading edge and forward corners of the stabilizer round.

Wing: Make a master wing rib from 1/16 plywood. Use it as a guide to fabricate all other ribs. The W1 ribs are essentially the same as the W2 and W3, except that 1/16 inch of the top and the bottom edge of the rib has been removed.

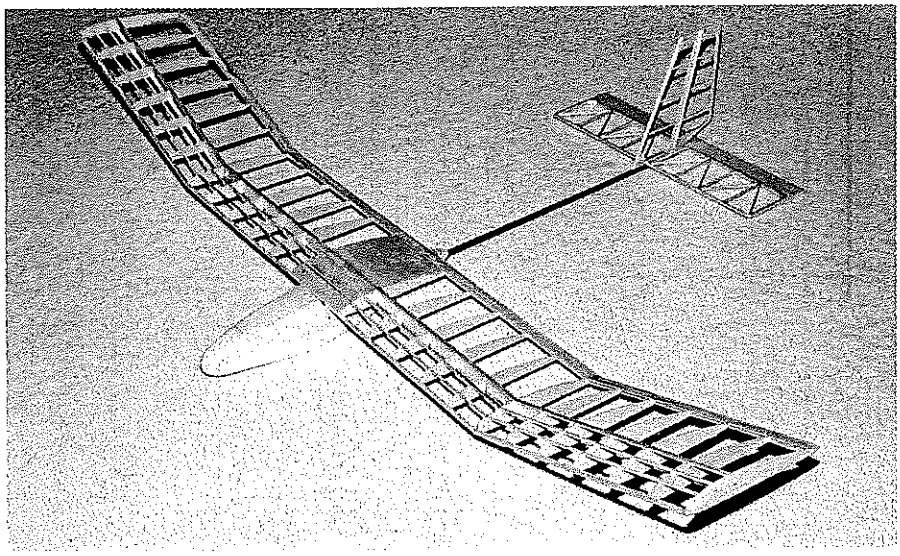
Stock trailing-edge material never seems to quite correspond to the airfoil's taper; in the case of the Clark Y, the taper is too shallow. For beginners, sanding a strip consistently to its proper slope over the entire span of a wing is very difficult. By using two strips of 1/16 x 1/2 balsa on the



Towhook block laminated from 3/16 x 3/8 spruce and epoxied between F2 and F3.

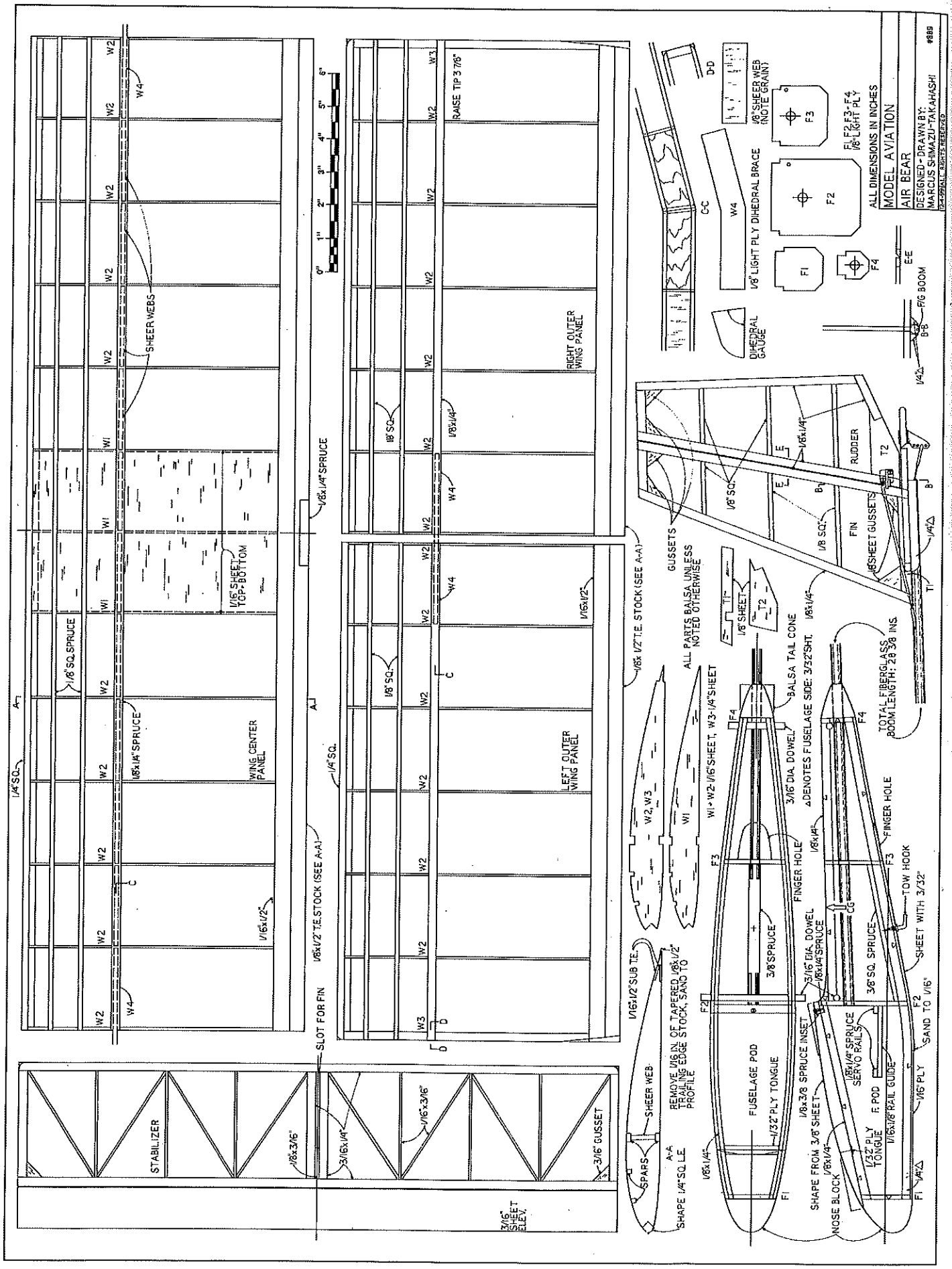


Tip panels are beveled, joined to flat center panel. Waxed paper protects plan.



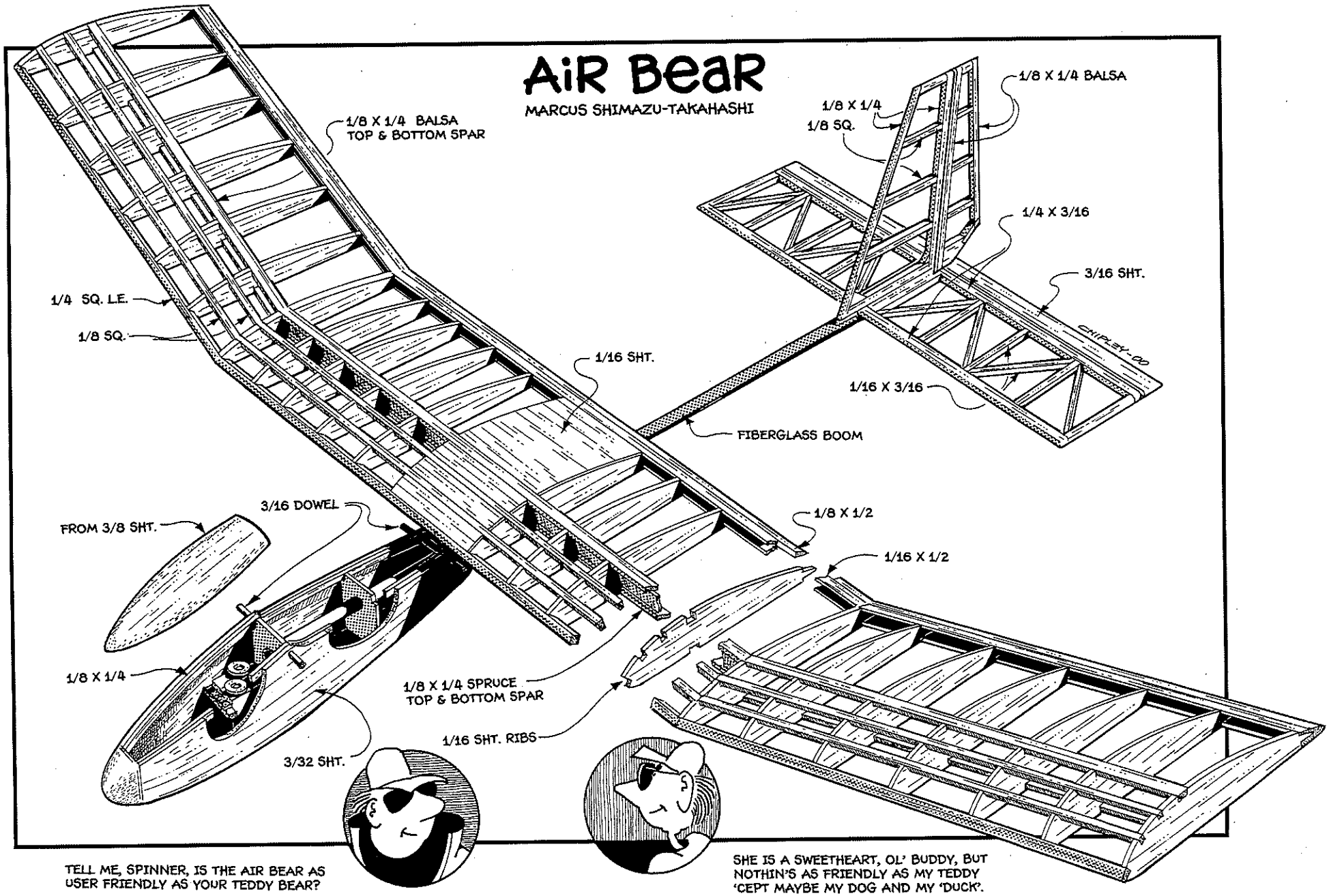
The Bear's "bones." Constant-chord wing packs 510 square inches of area into a 60-inch-wingspan model.

Full-Size Plans Available—see page 165



AiR BeaR

MARCUS SHIMAZU-TAKAHASHI



upper and lower surfaces of the ribs' trailing edge, an accurate slope is produced.

Where the two strips meet, a ⅛ edge results. Butt-joined to this edge is the smallest trailing edge stock available: ⅛ x½, with 1/16 inch of the thinnest part cut away. The end product is a strong, light, easy to build, reasonably accurate trailing edge.

Cut the ⅛ x ¼ spruce spar to length. Pin it in place over the plans of the center wing panel. Cut the 1/16 x ½ sub-trailing edge stock to length. Using a couple of ribs as spacers, position the lower sub-trailing edge.

Prepare the lower center-section sheeting by cutting two rectangles from 1/16 sheet. Position this sheet between the spar and the sub-trailing edge. Cut to size, then glue to the edge of the spar and the sub-trailing edge.

Use the remaining sheet from the spar forward. Do not cut to meet the leading edge until after the leading edge has been installed. Glue the forward lower sheeting to the edge of the spar.

Make the shear webs from ⅛ balsa. Cut them slightly long and trim to fit as the wing is constructed.

Glue the center W1 rib in place. Be certain that it is perpendicular to the spar. Trim a shear web to length and glue it in place next to the center W1 rib. Repeat this sequence out to the W2 ribs until you arrive at the second-to-last rib stations of the center wing panel.

Use the dihedral gauge to tilt the last W2 ribs toward the center of the wing.

When all of the ribs and shear webs are glued in place, test-fit the top spar. Cut it to length, and glue in place. The leading edge is added next; use pins to keep it in position until the glue dries.

The lower center-section sheeting can be glued to the leading edge by following the forward curve of the W1 ribs. The ⅛ square turbulator spars are added next. Cut the upper sub-trailing edge stock to length and glue in position.

Prepare the upper wing center-section sheeting in the same manner as the lower sheeting and glue in place.

Sand the edge where the sub-trailing edge pieces meet and glue the trailing edge stock in place. Remove the ¼ x 2 section at the center of the trailing edge noted on the plan. Cut and fit a length of ⅛ x ¼ spruce into the resulting slot and epoxy into the trailing edge. This spruce section prevents the wing retaining rubber bands from crushing the trailing edge.

Sand the trailing edge and spruce inset to the slope shown on the plan and round the leading edge (see section A-A on the plan).

The outer wing panels are assembled in the same manner as the center wing panel, except that there are no shear webs between the ribs. Note that the wingtip rib W3 is ¼ sheet balsa. Once the panels have been assembled, sand the W3 rib to the shape shown on the plan.

Now it is time to join the wing panels together into a single unit. Cut a ⅛ wide slot in the W2 ribs at the ends of the center wing section and the outer wing panels running from the top spars to the bottom spars. This vertical slot allows the ⅛ thick Lite Ply dihedral brace to slide between the spars.

Slide the brace into the center panel first, making sure that the fit is tight and accurate, then slide the outer wing panels onto the exposed brace ends protruding from the center panel. Once everything fits properly (the length of the dihedral brace may have to be trimmed slightly) and the W2 ribs of each panel butt up to each other accurately, take everything part again.

Carefully apply epoxy to all the edges of the dihedral brace and apply glue to the sides of the W2 ribs that meet, then assemble the whole unit again. Be sure that the leading and trailing edges all line up properly too. The tips of the outer wing panels should be 3⅞ inches above the work surface.

Covering: Please use an iron on covering like MonoKote®, particularly on the wings. One six-foot roll will cover all surfaces of Air Bear.

The rudder and the elevator are hinged with MonoKote®. The trick here is to cut a ¾-inch strip of covering and iron it onto the trailing edge of the fin and the

down the elevator sheath in the boom, I inserted a length of 1/32 music wire into the sheath while the CyA dried. After a while, the excess glue will run out the lower end of the boom. Just let it drip out onto a paper towel.

Apply epoxy to the ends of the boom to close it up and keep the ends of the sheaths in place. Apply a drop of epoxy to the exit point of the rudder pushrod sheath from the boom. Trim the yellow sheaths at the tail end of the boom.

Attach Goldberg mini-control horns to the rudder and elevator. Cut away the excess length of the retaining screws on the horns, then carefully file the screw ends flush with the retaining plate on the other side of the horn.

Thin cable pushrods are quite flexible; to minimize the amount of unwanted play (or slop), 1/16 OD brass tubes are soldered over the ends of the cables. Heat the end of the brass tube/cable and make a Z-bend with a pair of needle-nose pliers (see plan). Between the solder and the Z-bend, the brass tube and the cable are inseparable.

Make the little triangle-stock rails that attach to the bottom of the stabilizer; round their front ends. Cover with MonoKote® only on the long side.

Place the boom on the bottom surface of the stabilizer and center it. Position the triangle rails along the boom (see section B-B on the plan), noting that the boom stops an inch short of the elevator hinge. Remove the covering from the bottom surface of the stabilizer where it contacts the triangle stock rails and the boom. Apply glue to the bare wood of the rails, then attach to the bare wood of the stabilizer, using the boom to accurately space them.

Let the glue dry, then epoxy the stabilizer onto the boom. Be sure that the rudder pushrod sheath is in the proper position.

Cut away the MonoKote® that covers the slot for the fin on the upper surface of the stabilizer. Next remove the covering on the lower edge of the fin where it slips into the slot in the middle of the stabilizer. Slide the fin into the slot to test its fit.

Remove the fin and apply glue to the bare wood of the lower fin and slip it into the stabilizer slot. Use a right angle to be sure that the fin is perpendicular to the stabilizer.

Cut the spruce servo rails to length and epoxy them in position using the already-installed servo guides as reference. Install the servos.

Slide the boom into the fuselage pod until the end of the boom is flush with the side of F2 that faces the servos. It should be a tight fit and require a bit of effort to get the boom in place.

Accurately position the wing onto the fuselage pod, using a couple of rubber bands to keep it in place. Put the airplane on a table and position your line of sight so that you are looking directly at a front view.

Check the position of the stabilizer. Is it parallel to the center section of the wing? If not, twist the boom until it is. Once this is achieved, remove the wing and apply epoxy to all the areas where the boom contacts F2, F3, and F4.

Hook up your radio control system. Remove the servo wheel (or arm) on the servo. Connect all of the airborne components.

I like to use Goldberg pushrod connectors on servo wheels. They allow fine adjustments to be made to the pushrod's length, and hence its movement. Attach these connectors onto the servo wheel (or arm). Carefully reattach the wheel to the servo so that on the left servo (as you look from the nose of the airplane to its tail) the pushrod connector is at the 3 o'clock position. On the right servo the connector is at the 9 o'clock position.

Run the dangling yellow pushrod sheaths by the pushrod connectors. Measure half an inch from the connector back toward the boom on the sheaths. Trim the sheaths to this point.

Connect the Z-bend ends of the pushrods to the rudder and the elevator control horns, then slide the other ends into the sheaths from the back end. The rudder linkage should connect at the

second hole out from the rudder. The elevator linkage should connect at the third hole out from the elevator. The free ends of the pushrod cables will emerge next to the pushrod connectors.

Move the rudder and the elevator so that they are at their neutral positions. Now measure ½ inch past the connector toward the nose on the pushrod. Cut the pushrods at this point. Remove the servo wheels from the servos.

Cut two lengths of 1/16 OD brass tubes 5/8 long. Solder the brass tubes onto the pushrod cables in the same manner as the rudder and elevator linkage. Bend a slight kink in the brass tube for added security.

Slide the pushrod connectors onto the brass tubes, but do not tighten. Reconnect the servo wheels, making sure that they are at the correct positions. Drive the black servo wheel retaining screw back in place.

Position the elevator and the rudder neutral, straighten the pushrods, and tighten the pushrod connector retaining screw. Some Loctite® can be applied to keep the retaining screw in place.

Make a towhook by rebending a common brass cup hook to the shape shown on the plan. Drill a pilot hole through the bottom of the fuselage pod into the spruce towhook-retaining block. Screw the towhook in place.

Wrap the receiver in thin foam and put some fresh batteries in the holder. Run the receiver antenna through the holes in F2 and F3. Drill a small hole at the rear of the fuselage pod about ½ inch below the wing retaining dowel, run the antenna out, and tape it to the outside of the boom all the way to the tail.

Turn on the transmitter and the airborne system. Check for proper movement of the control surfaces.

Put the receiver and batteries back in the pod and screw down the hatch. Check the model's balance by placing your index fingers beneath the spar of the center section. If the tail tilts down, add weight to the nose. If the nose tilts down, add weight to the tail.

Place one finger beneath the nose and one beneath the end of the boom and determine if one side of the wing is heavier than the other side. Add weight to the lighter side.

Flying and Maintenance: Air Bear is quite docile, and should only be flown on calm days when the wind is blowing at less than 10 miles per hour. Check that your model is balanced at the correct spot. Always range-test your radio system before you fly. Be sure that you're using at least six new rubber bands (three on each side) to hold down the wing. Check the fiberglass boom for cracks.

Before every flight, do a complete "walkaround" of your glider, much as full-scale pilots do. Be sure your model's batteries are fresh (or fully charged, if you're using rechargeables).

Initial flights should be done over grass. A firm toss into the wind will suffice to get your little glider going. Make small adjustments to its glide angle using the trim levers on the transmitter. A small hi-start can get your Air Bear up into the sky quickly. Just a touch of up-elevator will have it climbing steeply. With practice, you'll notice the telltale waggle of the wing, which indicates that a thermal may be present.

Enjoy your Air Bear! MA

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