FIREBIRD II
Designed By:
J.M. Mergen
TYPE AIRCRAFT
Big Sport
WINGSPAN
100" to 60"
WING CHORD
15 Inches
TOTAL WING AREA
1448 sq. in. to 848 sq. in.
WING LOCATION
Parasol
AIRFOIL
Clark Y
DIHEDRAL EACH TIP
3½ Degrees
O.A. LENGTH
57 Inches
RADIO & CARGO VOLUME
316 Cu. In.
STABILIZER SPAN
28 Inches
STABILIZER MEAN CHORD (inc. ele.)
8 Inches
STABILIZER AREA (inc. ele.)
220 Sq. In.
VERTICAL FIN HEIGHT
12 Inches
VERTICAL FIN CHORD (inc. rud.)
8 Inches
REC. ENGINE SIZE
.40-.60 Cu. In.
FUEL TANK SIZE
16 Ounce
LANDING GEAR
Conventional (5" wheels)
REC. NO. RADIO CHANNELS
3
CONTROL FUNCTIONS
Rud., Elev., Throt.
BASIC MATERIALS USED
Fuselage ..... Balsa, Ply & Spruce
Wing ..... Balsa, Ply & Spruce
Empennage ..... Balsa & Spruce
Wt. Ready To Fly ..... 176 Oz. (100")
165 Oz. (60")
Wing Loading ..... 17.5 Oz./Sq. Ft. (100")
28.0 (60")

FIREBIRD II

The Firebird II is a two times larger version of the original Firebird (RCM, June 1981). Powered by a good .61 engine, the Firebird II, with two sets of wings, can match whatever type of flying you enjoy.

by Joseph M. Mergen

Firebird II is a big airplane. In fact, it is twice as big as the original Firebird which was the subject of my "design and build" article in the June 1981 issue of R/C Modeler. All dimensions of the original have been substantially doubled giving Firebird II a wingspan of 100" or 60" or anything in-between which the builder chooses.

Like the first Firebird, this airplane is a mixture of the characteristics of the Heath Parasol, the Corbins, the Pietenpol Sky Camper, Sky Scout, etc. Based on those airplanes, the 100" wing is approximately 1/3 scale and a 75" wing is 1/4 scale. The fuselage has been designed to be in-between and if the airplane is built with an 85" wing it will match the fuselage exactly and be a stylized 3.53 scale model of the Heath.

Using the 100" wing, the airplane flies nicely between 20 and 25 mph. remembering that the full scale airplanes cruised at between 60 and 75 mph, Firebird II can be flown at exactly scale speed. Of course this is a slow cruise. With the K & B .61 engine used in the prototype, and the 100" wing, the airplane has been timed at 44 mph at full throttle and will do 58 mph with the 75" wing.

Although it has not been built as yet, a 60" wing would match the clipped wing of the original Firebird and provide a pretty fast airplane.

Using the 100" wing the airplane is slow and docile. With the 75" wing you have a well-balanced sport airplane which seems to do just about everything right.

To try to overcome the transportation problems and tedious assembly at the flying field associated with most 1/4 Scale or larger models, Firebird II has been designed with a quickly demountable wing as in the case of the original. Assembly can be accomplished in less than one minute after arrival at the flying site. Disassembly can be achieved equally fast. The longest job seems to be wiping the castor oil off the stabilizer. Note the easily removed stabilizer and landing gear which make packing for shipping pretty convenient.

Because the airplane is light (160 oz. empty) and the wing loading is relatively low for a large airplane, the .61 C.I.D. engine has more than enough power with the wings tested. It should be entirely adequate even with a 60" wing. Based on flight testing, the writer would not hesitate to use a .40

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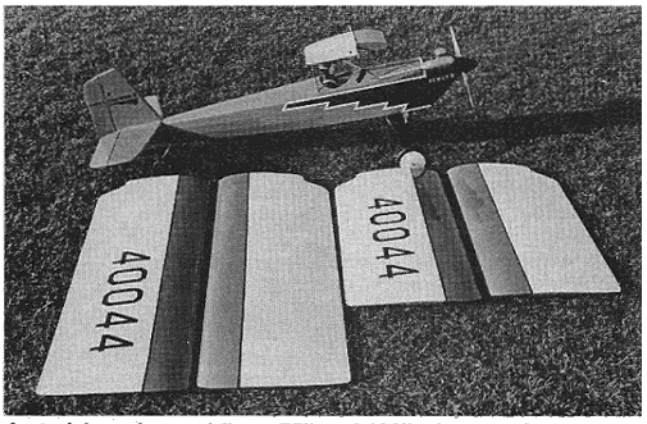
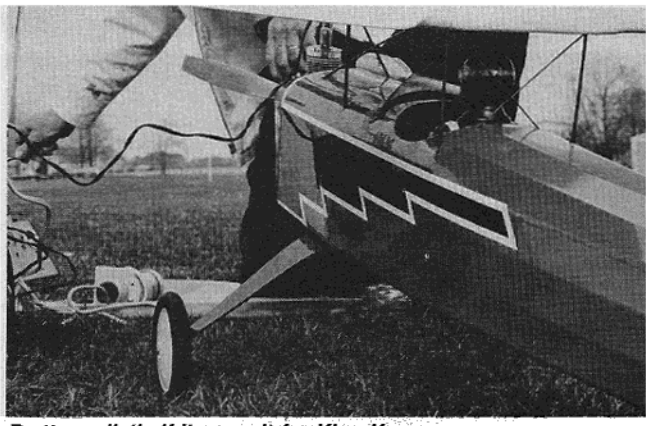
Bill Of Materials

(13) — 1/4" x 1/4" x 36" balsa — fuselage longerons, struts, braces.
(14) — 1/8" x 3" x 36" balsa — cowling, fuselage bottom, ribs, wing plank, trailing edge, cockpit bottom.
(3) — 1/8" x 6" x 36" balsa — wing plank, leading edge (inner).
(1) — 3/16" x 6" x 12" balsa — turtle bulkheads.
(2) — 3/32" x 4" x 36" balsa — spar webs.
(1) — 3/8" x 4" x 36" balsa — cut into strips for fin, rudder, stab, ele., rudder post (lower).
(3) — 3/8" x 3/4" x 36" balsa — leading edge (outer).
(1) — 3/4" x 7/8" x 6" balsa — center section T/E.
(1) — 1/4" x 7/8" x 6" balsa — center section block.
(5) — 1/8" x 5/6" x 36" balsa — rib caps.
(1) — 1/4" x 3/8" x 48" spruce — fin and stab spars.
(2) — 1/8" x 1/4" x 48" spruce — stringers.
(4) — 1/8" x 1/4" x 36" spruce — stringers.
(4) — 3/16" x 3/8" x 48" spruce — spar caps.
(1) — 1/8" x 12" x 28" plywood — hatch fwd., fuse bottom, F1A, F3, F7, NR1, W1, center section doubler.
(1) — 3/32" x 6" x 6" plywood — center spar webs.
(1) — 1/32" x 2" x 1" plywood — doubler at center section clip.
(2) — 1/4" x 6" x 12" plywood — F1, F2, tail skid support, eng. mt. blocks, NR2, servo rails, hatch opening support, C/section blocks.
(1) — 5/16" x 5/16" x 9" hardwood — cowl blocks.
(1) — 1/2" x 1" x 3" hardwood — top cowl block.
(1) — 1/2" x 3/4" x 6" hardwood — center section block.
(1) — 5/32" dia. x 36" music wire — fwd. cabane struts.
(2) — 1/8" dia. x 36" music wire — cross cabane struts, aft cabane struts, tail skid, wing incidence rod, stab carry through rods.
(1) — 1/16" dia. x 16" music wire — aft cross cabane wires.
(1) — 5/16" dia. x 16" 200K T.S. temp — wing carry through bar, steel bar.
(1) — 3/64" dia. x 8" music wire — clips.
(1) — 3/8" O.D. x 11/32" I.D. x 18" brass tube — wing carry through tube.
(1) — 11/32" O.D. x 5/16" I.D. x 18" brass tube — wing carry through tube.
(2) — 5/32" O.D. x 1/8" I.D. x 20" brass tube — wing incidence tube, stab carry through tube.
(1) — 1/8" O.D. x 3/32" I.D. x 1¼" brass tube — fuel filler.
(1) — 17/32" O.D. x 1/2" I.D. x 8" brass tube — muffler extension.
(1) — 16" fuel tubing — fuel line, filler, vent.
(1) — .025" x 1/2" x 2½" brass plate — cross cabane strut clips.
(1) — 1½" x 16" x 2 oz. fiberglass — cabane strut reinforcement cloth.
(1) — .010" dia. x 48" soft wire — cabane bindings.
(1) — #B106-6 Hallco landing gear.
(2) — 5" dia. "Golden Age" wheels
(2) — 3" Sig engine mounts.
(1) — 3" dia. Du-Bro spinner or equivalent.
(1) — .015"-.018" x 9" x 13" alum. — cowling, stab strap.
(1) — 1/32" x 3/4" x 8" alum. — landing gear straps.
(3) — #2 x 3/8" flat head screws — hatch.
(4) — #6 x 3/4" screws — landing gear.
(4) — #4 bolts, washers, nuts — cross cabane struts.
(7) — #1 x 1/4" flat head screws — cowl at NR2.
(10) — #1 x 3/8" flat head screws — cowl at fire wall, stab strap.
(4) — #6 T nuts — engine mount.
(4) — #6 x 1½" bolts & lock washers — engine mount.
(4) — #6 x 3/4" bolts & lock washers — engine.
(2) — #8 x 1" round head screws — wing root.
(2) — #8 x 1" flat head screws — center section block.
(1) — 1/8" x 3/16" x 4" soft rubber — vib. isolator at NR1.
(1) — 1/16" dia. Du-Bro nylon/steel throttle cable assembly.
(3) — #2 x 12" threaded control rods.
(2) — 24" NyRod elevator & rudder pushrods.
(2) — #2 x 1" threaded control rods.
(2) — Large nylon control horns.
(5) — Steel clevises — threaded — elevator & rudder.
(1) — Small nylon clevis — throttle.
(1) — Small steel clevis — soldered — throttle.
(1) — .020" x 6½" x 3½" windshield mat'l.
(1) — 16 oz. Sullivan fuel tank assembly.
(2) — Vent tube clamps.
(4) — #1 x 3/8" screws — vent tube clamps.
30 sq. ft. MonoKote (as desired).
.60 cu. in. engine, propeller & radio equipment of your choice.
Epoxy, cyanoacrylate, aliphatic cements. Sta-Brite solder, Epoxilite, foam wrap for Rx & battery, as required.

Firebird II with original Firebird (RCM Plan #838) under wing.

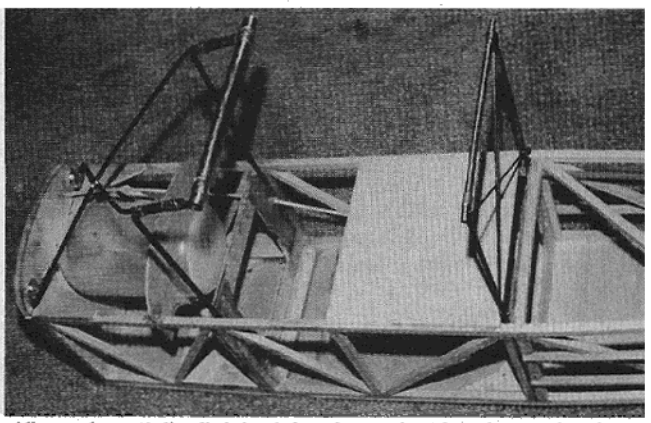


Just pick a wing and fly — 75" and 100" wing panels.

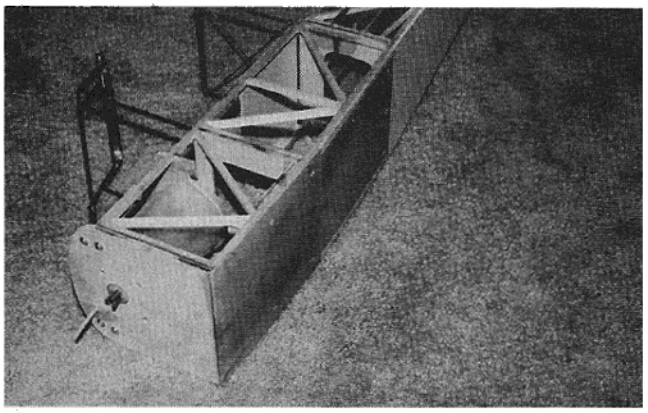


Pretty realistic if it weren't for King Kong.

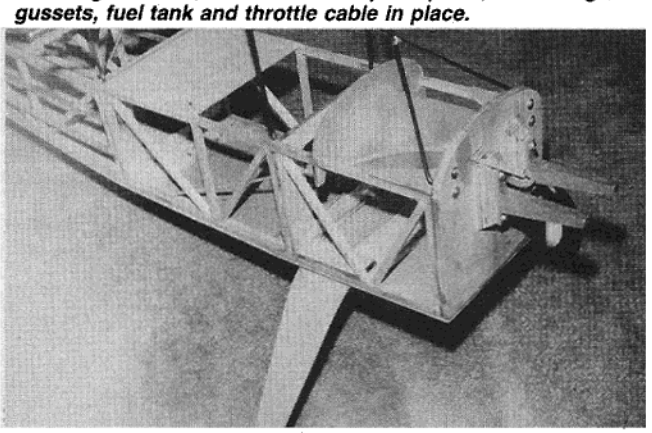
Joe shows what to do for a cold spinner. He failed to tell us if it helped.



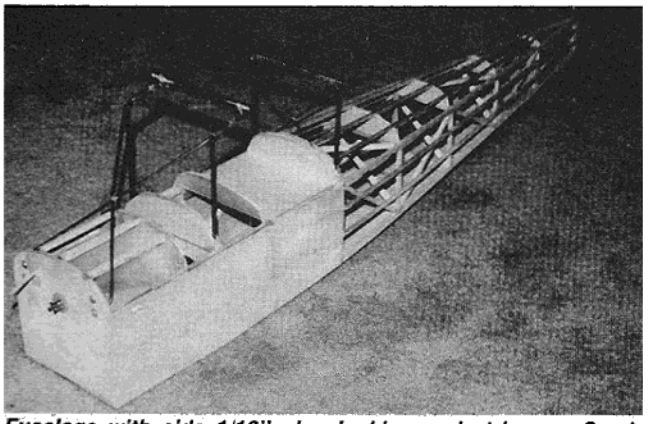
View of partially finished fuselage showing forward cabane struts "glassed in," cross brace clips in place, F1 to longeron gussets, fuel tank and throttle cable in place.



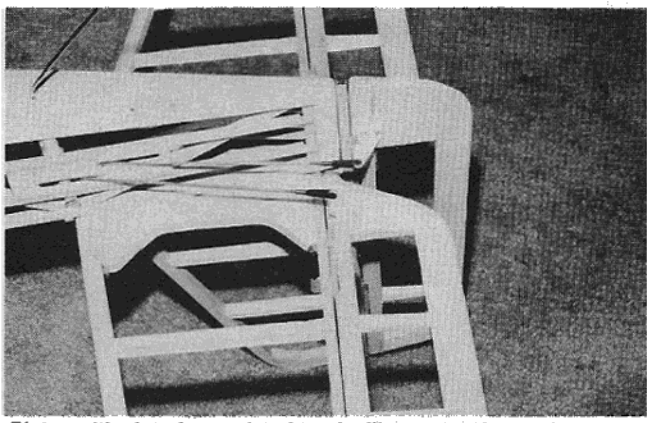
View of fuselage with aft cabane struts "glassed in."



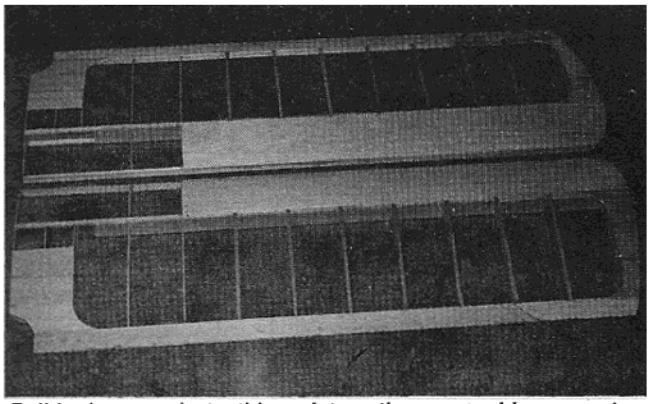
Details of engine mounts and landing gear supports.



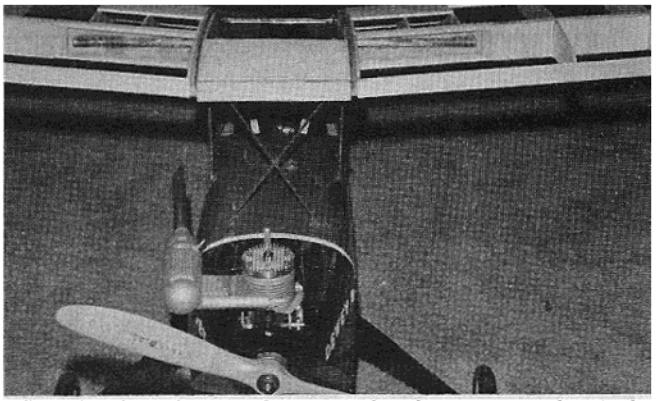
Fuselage with side 1/16" ply planking and stringers. Sand everything smooth and flush where stringers meet side planking.



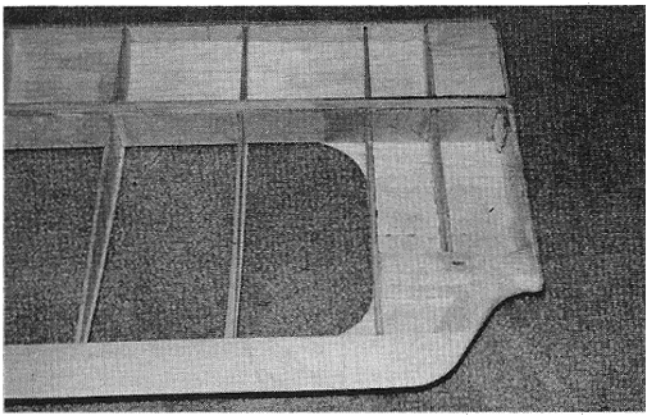
Plates with slots for pushrods to facilitate covering and support rod eyelets.



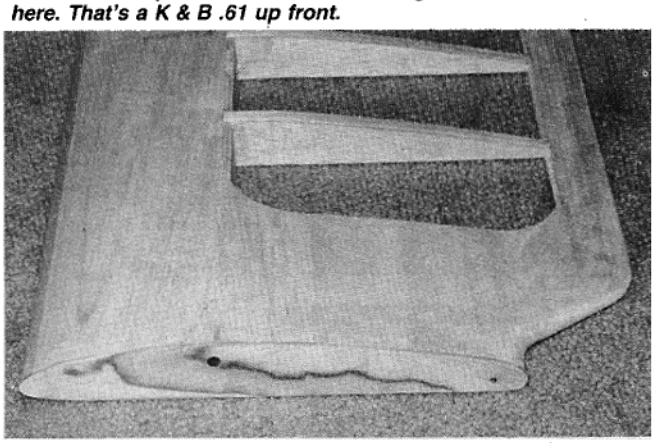
Build wing panels to this point — then assemble on center section. Note that spar web is left off first bay so that carry-over tube can be fitted.



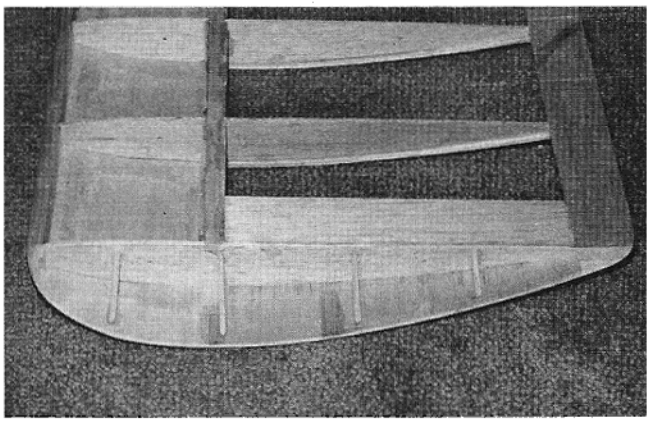
View showing wing panels mounted and carry-over tubes tack cemented to spar web. Dihedral and alignment is established here. That's a K & B .61 up front.



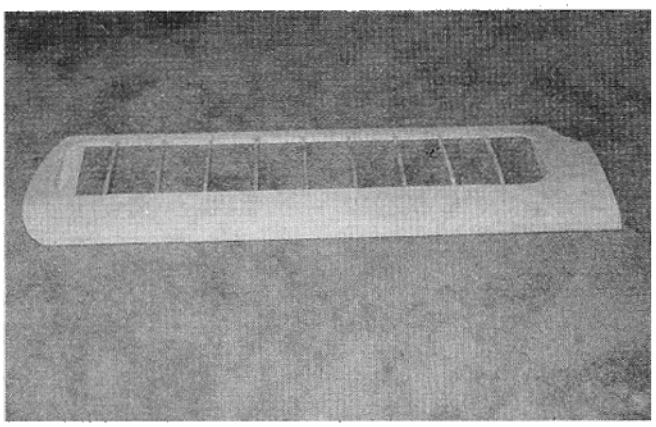
Bottom view of inboard end of finished wing panel.



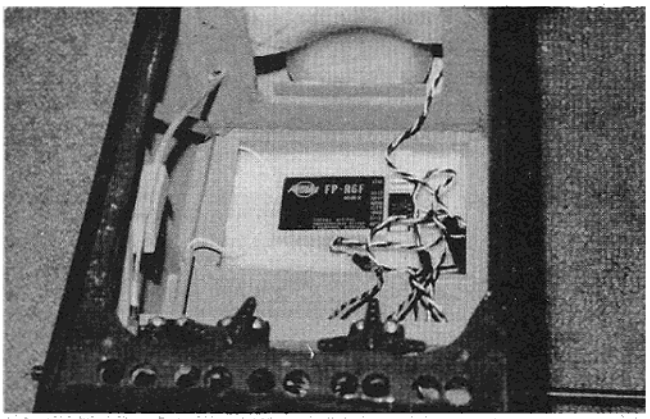
Top view of inboard end of finished wing panel. Retaining screw not shown.



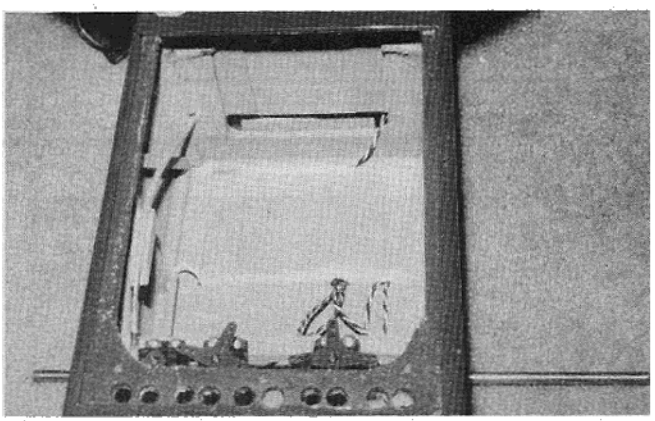
Bottom view of wing tip.



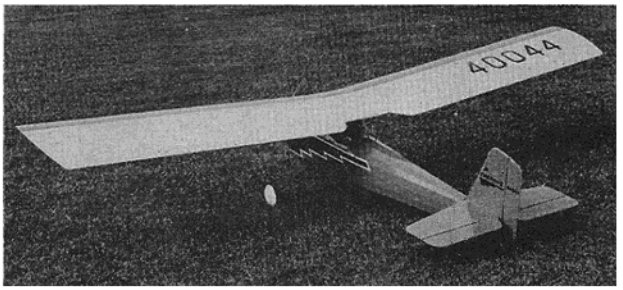
Finished wing panel ready for covering.



Bottom view of fuselage with hatch removed to show RX location, antenna tube, throttle cable, servos and fuel tank. RX is above top longerons in forward cowling.

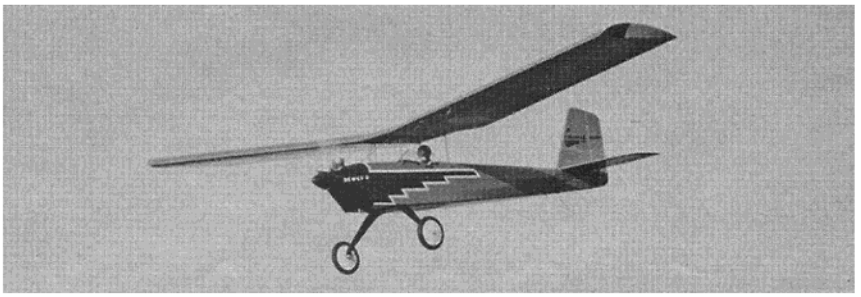


Simple snap in hatches to keep things in place can provide substantial clear cargo space. Room for two more servos to drop cargo or perform other tasks is provided.



in all but the shortest wing versions.

So, if you would like a versatile, low cost, easy to build, easy to transport, big airplane --- why not build Firebird II.



CONSTRUCTION

The construction of Firebird II is conventional and relatively simple throughout. All materials and parts can be bought at the local hobby shop or hardware store with the exception of the wing carry-through bar which will have to be procurred from a specialty steel warehouse or industrial supplier.

The finished empty weight with the 100" wing should be no more than 160 oz. using a .60 C.I.D. engine and standard radio gear.

Almost any size fuel tank can be used. The writer chose the 16 oz. tank to provide almost a half hour of flying between fueling sessions.

Since the construction is conventional, and the usual builder will have no need of step by step details, the discussion will cover the sequence of operations with an occasional explanation of a convenient way to accomplish a particular phase.

Fuselage:

Start the fuselage by building two identical sides using 1/4" square balsa for longerons, struts, and braces. Next, cut out F1, F1A, F2, F3, F3A, F3B and the turtleback formers at F4, F5, F6, F7 and the bulkhead at F7 which supports the tail skid.

Start assembling by attaching the sides to F2 and F3. Then square up the forward end of the fuselage frames with the top longerons and install F1. The 1/4" plywood landing gear supports can be put in next.

The bottom plywood planking from F1 to just beyond F2 can now be added. Note that it extends beyond F2 to take the aft landing gear screws and provide a lip for the hatch tab. Install the shaped 1/4" plywood stiffener between the longerons near F3. This contains the servo screw access holes. This planking includes the 1/8" and 1/4" square balsa strips which frame the hatch shown in section A-A. Also add the cockpit bottom on the upper longerons.

Now draw the fuselage together, sand to fit and install the balsa tail post and cross struts. Diagonal braces are added next to the top longerons and across F4, F5 and F6. Stiffness of the bottom is supplied by the 1/8" planking which can be installed now, stopping short of F7.

Bend the 5/32" music wire forward cabane struts using the drawing as a pattern. The 3/8" O.D. brass tubing can be added next by wrapping with fine wire and silver soldering to the music wire. Since 3/8" O.D. x 5/16" I.D. tubing is hard to obtain and every hobby shop has 1/64" thick brass tubing, the writer used an 11/32" O.D. by 5/16" I.D. tube inside a 3/8" O.D. by 11/32" I.D. tube sweat soldered together at one end to prevent slipping out when installing the carry-through bar.

Next, bend the 1/8" music wire aft cabane struts as shown and wrap and solder the 5/32" O.D. by 1/8" I.D. tubing to the music wire. Add the 1/16" cross braces and solder as shown, making sure of a good fit inside the longerons.

Tack cement the two cabane strut assemblies to the fuselage at F2 and F3 so that the flat bottom of the wing center section is exactly parallel with the two upper longerons. Make sure that the sides of the struts are parallel with the centerline of the fuselage and the tubes perpendicular since the whole positioning of the wing depends on the squareness and accuracy of the center section.

Bend the crossed 1/8" forward cabane braces as shown and fit to the brass clips which are bolted to F1. Before assembling, tin the clips and wire ends with Sta-Brite or equivalent low melting joint solder. When assembling to the firewall, slip a piece of 1/16" scrap plywood between the clip and the firewall to protect F1 while soldering. Solder the clip to the wire. Remove the 1/16" plywood and secure both clip and wires in place with the #4 bolts. Carefully fit the tops of the braces by bending so that they lie against the 5/32" cabane strut wires. Wrap and solder. This completes the cabane strut assemblies except for "glassing in" with fiberglass and epoxy cement as shown. Recheck all alignment dimensions before "glassing in."

F1A and the fuel tank can now be installed as well as the throttle cable. Fit and epoxy two 1/8" plywood gussets between the top longerons and F1 as shown on the photos.

Larger engine mounts could be used but the writer was successful using 3" Sig mounts on plywood spacers to obtain the desired engine position.

Using 1/8" music wire, form the tail skid and attach to F7 with a #4 bolt and wire wrap. Install the bulkhead in the fuselage and add the 1/4" plywood stiffener between the longerons as shown. Finish the 1/8" balsa planking.

Fairing strips and planking for the fuselage are added next along with the instrument panel. The 1/8" x 1/4" strips along the longerons are very important to stop the covering material from tucking in and spoiling the appearance.

Fit the 1/8" plywood hatch as shown, cement the tab in place and secure with three #2 screws.

Shape four W1 and four W2 ribs together drilling the 3/8" and 5/32" holes for the cabane tubes at the same time using the flat bottom of the ribs for incidence reference. Use two W1 and two W2 ribs to form the center section. The hardwood center brace, the 1/32" plywood wear plates, the leading and trailing edges, and the planking complete the center section. Make sure that the flat bottoms of the ribs are parallel to and equidistant from the tops of the longerons and the faces of the ribs parallel to the fuselage centerline.

Rework a Hallco B106-6 landing gear by flattening and rebending to fit the 6" wide fuselage. The landing gear is attached by 1/32" soft aluminum clips and #6 screws. The aluminum clips are meant to shear in a hard landing to protect the screw threads in the fuselage. This will eliminate the need to remove a broken nylon screw which happened to break just below the surface in the conventional screwed-on landing gear. Install 5" Golden Age wheels.

The aluminum engine cowl is begun by adding the hardwood blocks to F1. NR1 and NR2 are next roughly formed making the hole in NR1 a tight fit on the engine nose. Laminate the two and, after installing the engine, push the assembled nose rings on the engine nose. By laying a straightedge between the blocks on F1 and the nose ring assembly, the variable angles required at the nose ring are fairly easily determined and can be sanded to conform with the cowl angles.

Trace the cowl pattern on the drawing on vellum, or other stiff paper, approximately 1/8" oversize. Cut out and tape on to the blocks at F1 and nose ring. Establish a bottom centerline and adjust and trim until satisfied with the fit. Then use the pattern to cut out the aluminum cowl. Starting at the bottom centerline, shape the cowling up to the top longerons and the centerline of the nose ring. Install two screws on each side at F1 and one at the bottom, one part way up and one at the centerline of both sides of the nose ring. Remove the cowl and engine. Reinstall the cowl and finish forming and fastening as shown with a screw at each end in the top wood block at F1 and screws equally spaced to the top edges at the nose ring. Trim at F1 and the nose ring. Reinstall the engine and cowl and mark the clearance you like around the engine and muffler boss. Remove and trim. Sand the aluminum and NR1 flush. Open the hole at the engine nose to accommodate a 1/8" rubber ring as shown. A 2¾" Goldberg or 3" C.B. Associates spinner can be fitted with slight changes in NR1 and NR2. The cowl pattern will fit with trimming changes.

Seal the exposed wood and fuelproof the inside of the nose ring parts. Lightly sand and spray paint with polyurethane.

The small piece of cowl behind the cylinder is cut to size, joggled to match the edges of the main cowl, and finished in the same manner. It is retained by two screws in the upper hardwood block on F1.

Set the fuselage aside. Controls and covering will be added after the empennage is fitted.

Empennage:

3/8" sheet balsa is used for the empennage since the widths vary considerably and stripping your own pieces seems much more economical. All stabilizer, elevator, fin, and rudder balsa stock is 3/8" thick. Note that stab and fin spars are 3/8" x 1/4" spruce. Build the center blocks of the stab in one piece by slotting for the tubes and tack cementing. The writer used Klett aileron bearings for hinges but any large size hinge will do. MonoKote hinges would be very satisfactory and provide a sealed gap. Don't forget the aluminum keeper strap on the stabilizer.

Large nylon horns are used and the prototype was rigged with steel clevises and threaded steel pushrods. In the case of the elevator, the two rods were joined in a "Y" with a short length of threaded rod soldered on. This was threaded into a NyRod to connect in the conventional way to the servo. The single rudder rod was treated in the same manner.

Clamp the empennage on the fuselage for control rigging and then remove for covering. After both the fuselage and empennage parts are covered, the stab center section and fin can be cemented in place. If you want an internal antenna, run a 3/16" NyRod tube from F3 and bring it out ahead of the tail skid.

Wing:

The toughest part of building the wing is to pick the span. As discussed earlier, a very docile, slow floater is obtained with the full 100" wing. An 85" wing will be substantially true scale with the fuselage and will turn out to be a lady-like sport and trainer airplane. Experience with the 75" wing has shown it to provide an all-around well-tempered machine with good maneuvering capability and excellent handling qualities. Try the 60" wing if you want speed and quick response. Having more than one size on hand seems desirable. Any size is a very simple structure to build. With its flat bottom Clark Y section, no jig is necessary so just clear the table, tape the drawing down, cover with waxpaper, and go ahead.

A word about mounting is about all the help that can be given or needed. Before planking the inboard ends, and before adding the webbing to the forward side of the spar at the inner bay, slip in the carry-through tubes and, after clamping roughly in place, assemble the panels on the center section with the carry-through rod. When satisfied with the dihedral and alignment, tack cement the tubes in place with epoxy. When cured, remove one panel and set the incidence of the other by aligning the flat bottom surfaces of the inboard rib and the center section rib. With a long 1/8" drill or sharpened 1/8" wire, bore the incidence rod hole in the wing block using the aft center section tube as a drill guide. Remove the panel and enlarge the hole to 5/32". Epoxy in the brass tube. Repeat this process on the other panel and the wing is mounted. All that remains is finishing the webbing and planking, covering, and installing the retaining screw. Of course, both panels must be sanded with the center section for a good match.

Flying:

There is nothing unusual or different about flying Firebird II. With the 100" wing it will take off smoothly at less than half throttle and climb beautifully. Taxiing is what you would expect with a tail skid only. Steering must be done with rudder and throttle. In this maneuver Firebird II handles just like its full scale ancestors and is, in the writer's opinion, great fun. However, if you don't want this challenge, a tail wheel can be added.

The airplane has been designed with a slightly forward C.G. location so that construction of the rear of the fuselage and empennage will not require extreme weight consciousness to prevent that old "tail heavy," lots of "ballast in the nose," airplane. However, keep the C.G. pretty much as shown — 28% with full fuel and 32% empty — to achieve a super handling machine. As in most models, and full scale airplanes as well, a C.G. too far aft will make the controls over-sensitive and variable; too far forward will make this parasol type power pitch trim sensitive. In any event, you should have many happy flying hours ahead if you build Firebird II.

From RCModeler May 1983