#793

Delilah

This twin-.020-powered flying boat is at home in the air and in the water

■ David Boddington

If you are looking for a model that's versatile, small, maneuverable, exciting, and different, I'm sure that Delilah will fit the bill. Delilah's a 38-inch-span twin-engined flying boat, powered by Cox Tee Dee .020s. Delilah's a flighty piece of work, but still handles like a thoroughbred.

It had been some years since I had built a model with a rolled-plywood fuselage. It was this type of structure that came to mind while I was looking at an old copy of *Radio Control Models and Electronics* (*RCM&E*). In it was a photograph of a model I designed called the Seastormer. Although the Seastormer handled very well in the air, it was not at ease on the water.

Being new to flying boats at the time I had not made the fuselage wide enough, or sufficiently extended at the nose. I realized that combining several elements—a parasol wing arrangement (with engines in close to the centerline), a rolled-plywood fuselage, a wider beam fuselage, and longer nose moment—might produce a pleasant flying boat. Water airplanes have always fascinated me.

Designers of radio control model aircraft have the challenge of producing an airplane that is structurally sound and flies well. Meeting these criteria gives an enormous amount of satisfaction, but it is seldom won without some problems, or without a few changes along the way. I like to have everything drawn-out and organized before commencing building, including the location of the radio equipment, linkages, fuel tank, engine installation, and so on.

However, it is probable that during construction there are parts of the structure or building that I would do differently if I was starting again. This is the advantage of modelers who build from plans and instruction printed in magazines. Improvements can be incorporated in the final drawings to avoid the mistakes made on the prototype.

> "Just the sound of two Cox .020s in-beat makes it all worthwhile."
> -David Boddington

There are some restrictions with rolled-plywood structures, particularly with regard to changing widths of the fuselage and the design of supporting framework. However, once completed the resulting structure is extremely strong and quite light. In view of the experimental nature of the project I decided to build a small-scale version of the flying boat before moving on to the larger version(s).

CONSTRUCTION

Already with Delilah (to the larger Samson) a few improvements have been found during building, and these have been incorporated on the drawings. As these changes will be slightly different to some of the construction photographs, I will note them:

1) Constructing the fuselage framework at the front end, as originally designed, was somewhat akin to building sand castles in the air. By provisionally extending the spine and the top to formers F1 and F2 (spot-cemented in place) it's much easier to construct the framework inverted over the board. Pinning a flat-topped temporary former to the end of F10 also helps to make the framework rigid on the building board.

2) Fitting the front wing struts to the undersides of the engine nacelles was a little fiddly, requiring the installation of bolts

from the tank bay to secure the nylon saddles. As the fuel tank bay area was also fairly "tight" I have extended the engine nacelles slightly, and moved the front strut more upright so the nylon saddles could be screwed directly into the underside nacelle plywood (without fear of piercing the fuel tank).

3) One near-clanger occurred with the rudder cables for the closed-looped control linkage. The wing struts are fitted after the fuselage has been constructed. However, on the early drawing I had routed the cables through the 'V' center, where the struts are housed. As the cables have to be fitted before the completion of the fuselage, it would have been impossible to fit the rear strut! Rerouting the cables (and routing them in small-bore tubing) cured this potential disaster.

General Comments: Prepare for construction by cutting out all of the parts and forming the struts. You may think that 1/64 plywood is not very strong (even for a model of this size) but believe me, it is more than strong enough. Adhesives should be of the waterproof variety. Cyanoacrylate (CyA) glue and epoxy can also be used.

Waterproofing must be thorough. Seal the elevator pushrod exit with silicone rubber sealant (apply petroleum jelly to the metal rod when the sealant is positioned to prevent sticking) and pay special attention to the front hatch.

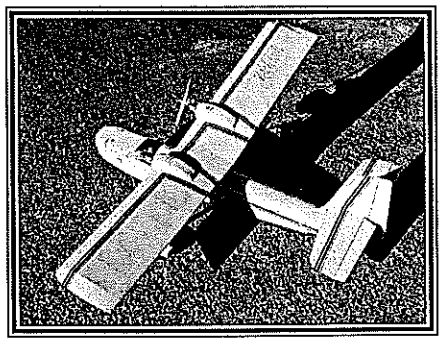
"Do a thorough job of waterproofing, as Delilah is going to the water."

Wing: Design for the airfoil allows for building the wing panels directly over the drawing. Start by pinning down the lower trailing edge, rear spar and lower main spar, followed by the wing ribs. In the photographs you will notice that the 1/16 plywood nacelle plate was fitted at this time; it should *not* have been. It should only be glued in position *after* the wing panel has been shaped.

Glue the top trailing edge, top main spar, and leading edge strip to the ribs. (The root rib is angled for dihedral). Add the vertical webbing, leading edge, and center-section sheeting. Leave these to dry before removing them from the board.

Sand the leading edge to section, and carefully cut away the leading-edge section back to the main spars at the engine nacelle position. Glue the 1/4 nacelle sides to the wing panel, plus the 1/16-inch plywood underside, 1/16 front sheet, 3/8 triangular, 1/4 x 5/8 top reinforcement, and then the 1/8 plywood engine bulkhead. To improve single-engine performance it is advisable to include 3-4° right thrust to the starboard engine.

Sew the 3/32 tubing to the 1/16 rear strut mounting plate and epoxy (or CyA) around the tubing and sewing. Glue to the wing panels, reinforcing with strips of balsa. File holes in the front of the engine nacelles for the fuel-feed tubing and fuel proof inside the tank bay. When dry, fit the 1/2A fuel tanks, with fuel feed fitted, and wedge them in position with balsa scrap. Fix the top 3/32-inch sheeting and rear fairing, and shape the nacelles by rounding off the corners.



Floats are held in position by bolting the float legs between two nylon 90° brackets. This way the degree of friction can be adjusted to secure the floats but allows them to knock back if they hit something. Float brackets are screwed to Lite Ply pieces glued to the wing ribs and spars.

Wingtips are formed from sheet and gussets. Check the root ribs of each panel for a true fit and then cut the slots in the rib underside for the dihedral braces. You can join the panels by fitting the braces, pinning the center ribs together and propping each tip up by 1 7/8 inch or, as I did, by positioning the braces and holding the panels together with clothespins. Be warned, however, it is easier to introduce a misalignment of panels in this way. The wing is now ready for a final sanding and covering.

Floats: Construct these on one side panel, ensuring that each former is at 90° to the side. Add the second side, followed by the laminated strut (round off the corners). Cut a slot in the top sheeting, slide it over the strut, and glue to the formers and side. Glue the 1/64 plywood to the undersides and add and shape the nose block.

Tail Surfaces: Select light, medium-grade balsa for the fin, rudder, and tailplane. Use a slightly harder grade for the elevators. Glue the tips to the tailplane and sand them, rounding off the edges and tips. Taper the rudder and elevators, drill and slot for the piano wire joiner, which should be epoxied in position.

Fuselage: Now to the interesting bit! Although the idea of using a rolled-plywood structure would result in a strong fuselage, there was the problem of how to fix the wing struts, which I wanted make from music wire. There was no way of 'feeding through' the struts in holes in the sides and then sewing to the formers. In a flash of inspiration—I get one about every five years—the answer came. By making composite formers at the strut positions of plywood/balsa core/plywood, it would be possible to leave a 'V' shape in the top of the core. After completion of the fuselage, a slot would be cut at the strut positions, the struts inserted, epoxied and held by balsa 'V' pieces glued into the remaining slot.

I am pleased to say that the method has proved to be very successful and results in a rigid structure. It is also a simple operation to bend the struts. Top fixings are tubing at the rear and nylon saddles at the front.

Mark the location of the formers on the spine and keel pieces, and pin the spine, upside down, onto the drawing board using a straight line as a guide. As mentioned previously, formers F1 and F2 have temporary extensions to reach the extended spine (these are cut away later). Use a slow-drying adhesive to glue the formers to the spine, followed by keel

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Type: RC Sport

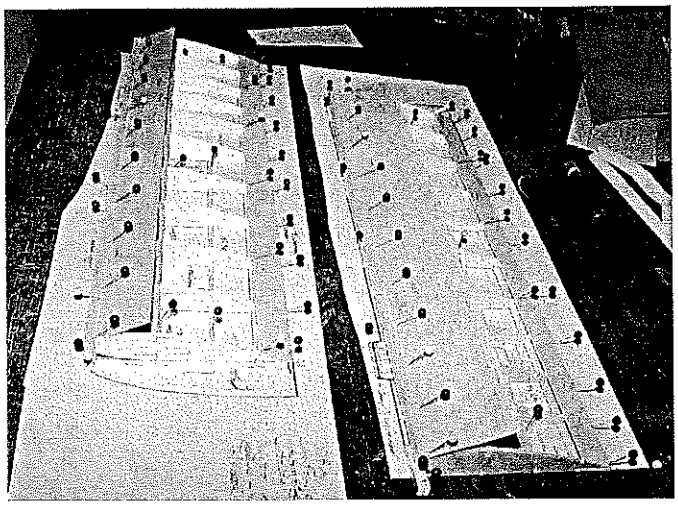
Wingspan: 38 inches

Engines: Two Cox TD .020s

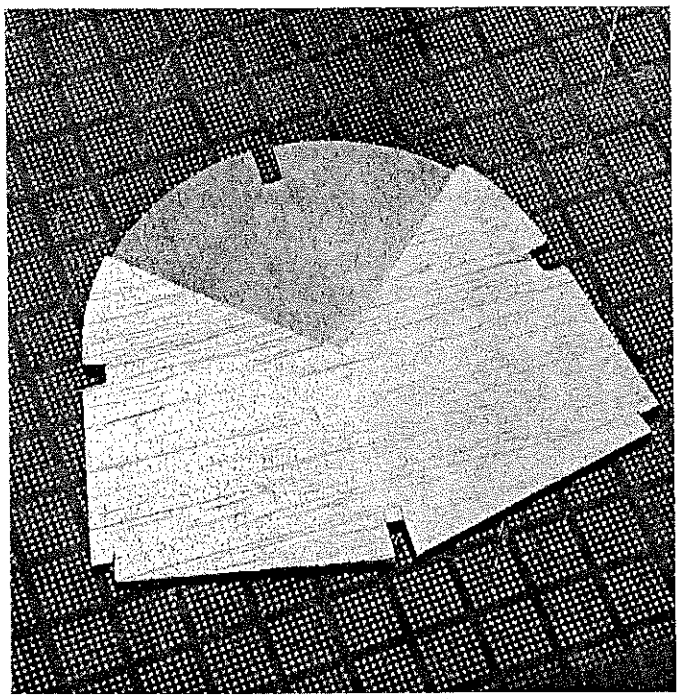
Functions: Elevator, rudder

Construction: Built-up

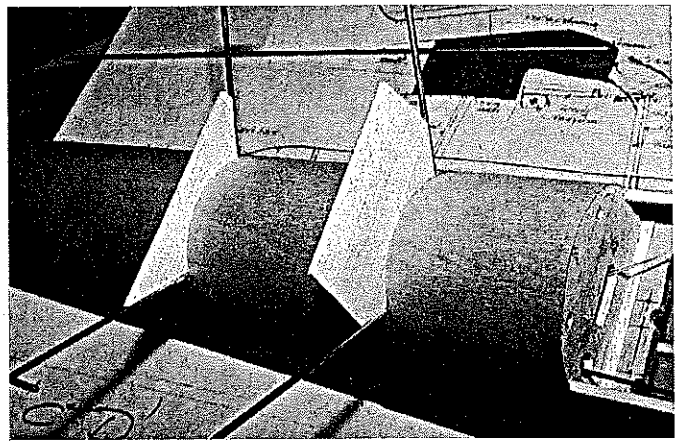
Covering: Film, fabric, or tissue



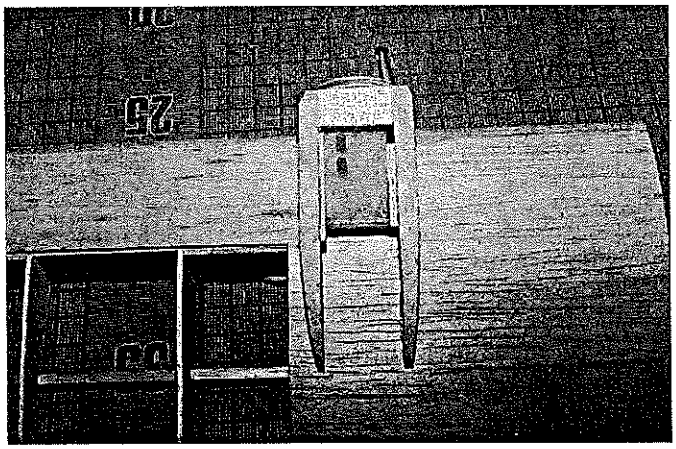
After the top-front spar and leading edge have been installed, add the 1/16 leading-edge balsa sheeting.



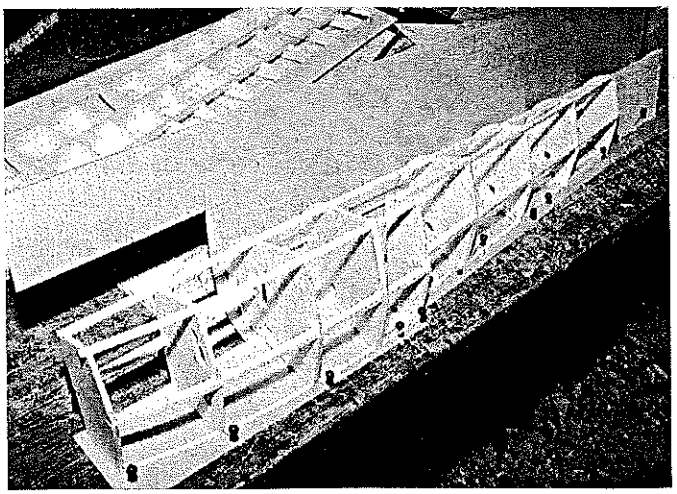
The music-wire wing strut seats in the center V of the fuselage former, trapped by 1/32 plywood outer laminate.



Cut slots at the strut positions, then epoxy the struts in place. Filler plugs will be sanded flush with the fuselage.

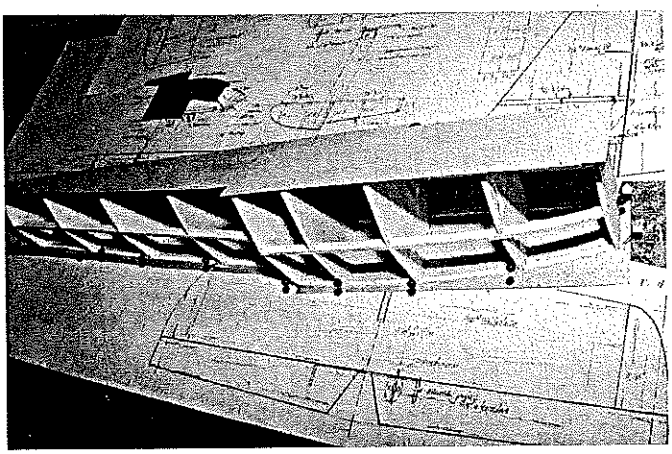


A ½A fuel tank is installed in each engine nacelle. Top sheeting is then added and sanded to the rounded contour.

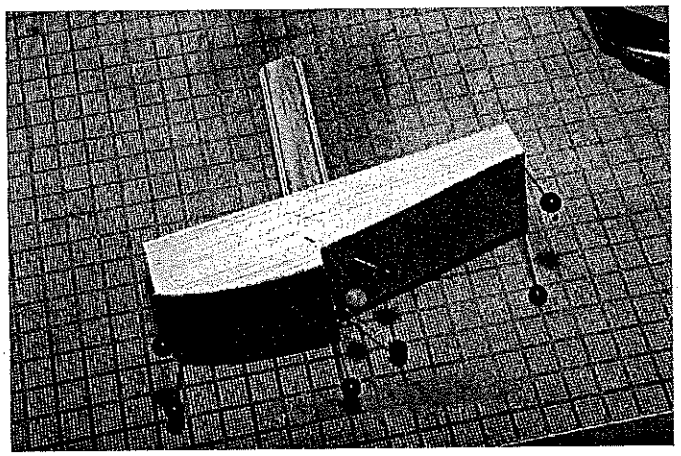


Wet the outside of the plywood skin ½ hour before adding it to the fuselage. This will help curve the wood.

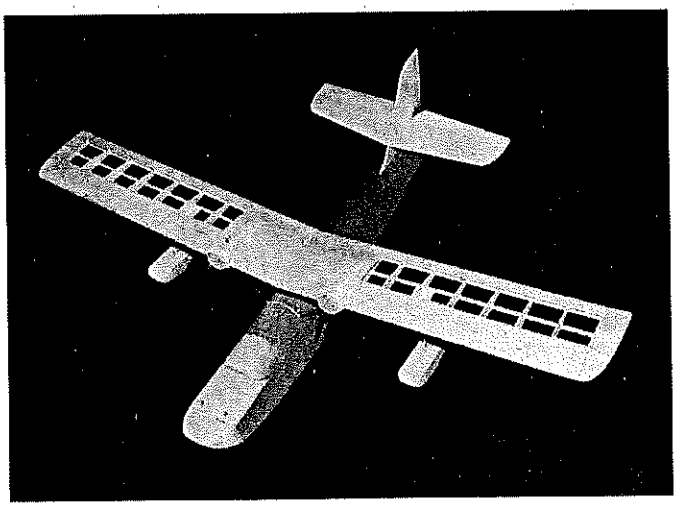
Delilah



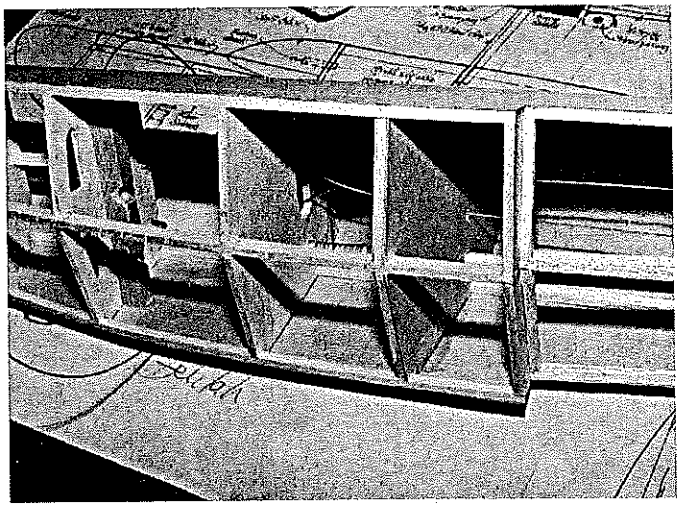
When one side is dry, roll the water-softened plywood around the fuselage, attaching it with slow-drying cement.



Glue formers to one side of the float, then add the second side, strut, and top sheet. The plywood bottom is added last.

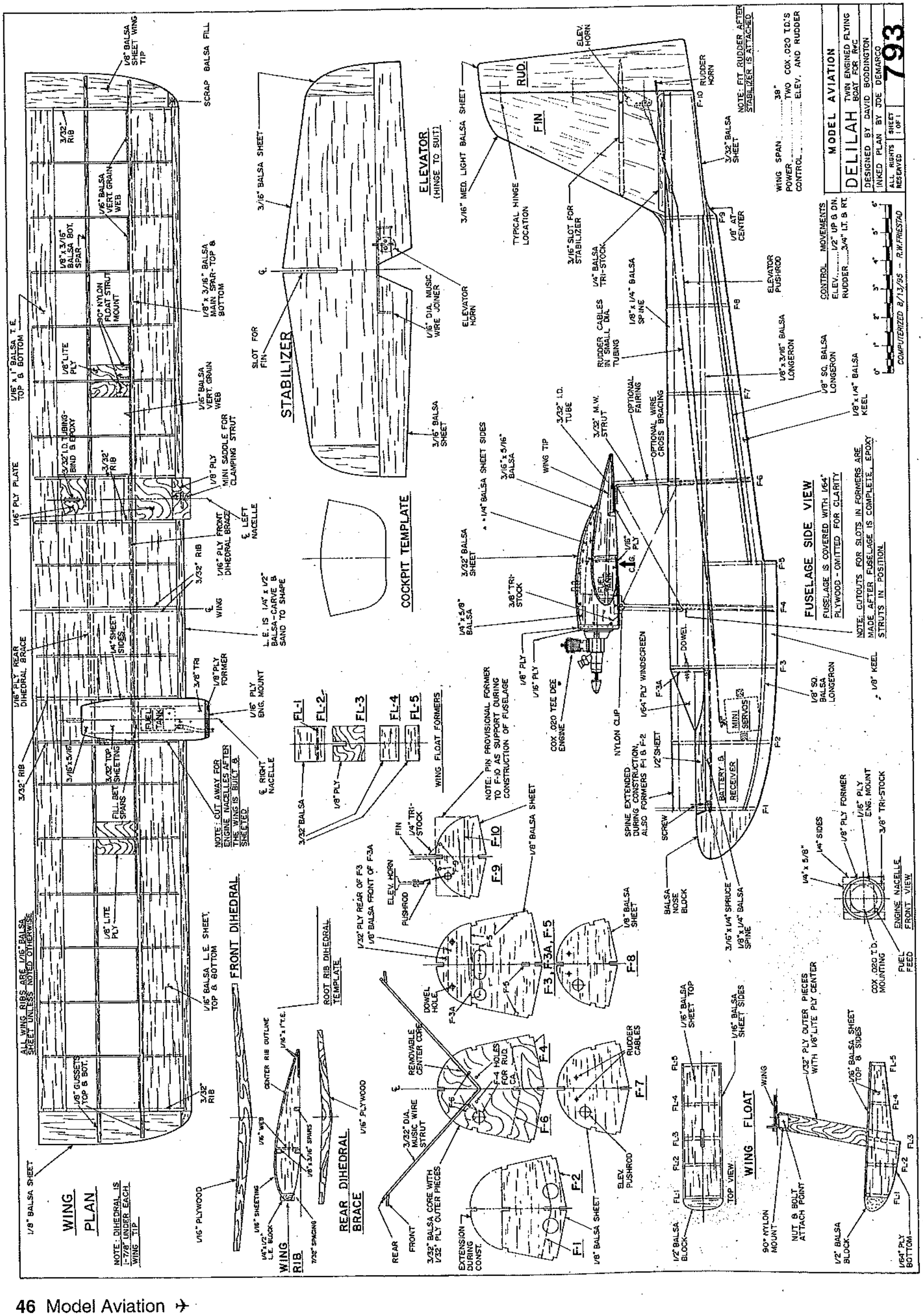


Delilah is suitable for film, fabric, or tissue covering. Do a thorough job of waterproofing before covering.



Before the bottom plywood is attached, trim and sand the sides, then install the rudder and elevator linkages.

Back to the drawing board: Delilah met her end in a mid-air collision with a .40-powered model. On to Samson!


MODEL AVIATION
DELILAH TWIN ENGINED FLYING BOAT FOR R/C
DESIGNED BY DAVID BODDINGTON
INKED PLAN BY JOE DEMARCO
793
WING SPAN 38"
POWER TWO COX .020 T.D.'S
CONTROL ELEV. AND RUDDER
CONTROL MOVEMENTS
ELEV. 1/2" UP & DN.
RUDDER 3/4" LT. & RT.
COMPUTERIZED 8/13/95 - R.W.FRIESTAD
WING PLAN
NOTE: DIHEDRAL IS 1-7/8" UNDER EACH WING TIP
ALL WING RIBS ARE 1/16" BALSA SHEET UNLESS NOTED OTHERWISE
FRONT DIHEDRAL
REAR DIHEDRAL BRACE
WING RIB
ROOT RIB DIHEDRAL TEMPLATE
STABILIZER
ELEVATOR (HINGE TO SUIT)
COCKPIT TEMPLATE
WING FLOAT FORMERS
FUSELAGE SIDE VIEW
FUSELAGE IS COVERED WITH 1/64" PLYWOOD - OMITTED FOR CLARITY
NOTE: CUTOUTS FOR SLOTS IN FORMERS ARE MADE AFTER FUSELAGE IS COMPLETE. EPOXY STRUTS IN POSITION.
NOTE: FIT RUDDER AFTER STABILIZER IS ATTACHED
NOTE: PIN PROVISIONAL FORMER TO F-10 AS SUPPORT DURING CONSTRUCTION OF FUSELAGE
NOTE: CUT AWAY FOR ENGINE NACELLES AFTER THE WING IS BUILT & SHEETED
ENGINE NACELLE FRONT VIEW
WING FLOAT
TOP VIEW
FIN
RUD.
F-1
F-2
F-3, F-3A, F-5
F-4
F-6
F-7
F-8
F-9
F-10
FL-1
FL-2
FL-3
FL-4
FL-5

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pieces and the 1/8 x 3/16 side stringers and 1/8 square longerons. Check the angles of the formers. Note that F10 has a flat-topped support pinned to the outside, to prevent it from moving on the board. Glue the 3/32 sheet between F1 and F10.

When the framework has dried, remove it from the building board and sand it so that the former sides are flush with the stringers, longerons, and spine. Cut a piece of 1/64 plywood 26 inches long (grain lengthwise) and 9 inches wide. At one end (at the center) cut out a panel 5 1/4 inches long and 4 inches wide. This is the position of the hatch and cockpit. Mark a 1/8 line down the center of the plywood and glue the spine to this, the front edge of F3 lining up with the cutout. Leave this assembly to dry.

Again using slow-drying adhesive, glue one side of the plywood to the framework—wetting the outside of the plywood half an hour before fixing will help with the curving. When you are satisfied that the side is attached to the framework at all points except the nose from F1 to near F3 (this is glued later), pin the side to the building board and leave to dry. Do the same to the other side. Then the plywood can be glued and pinned to the front formers.

Before the bottom plywood is attached, the lower edges of the sides have to be trimmed and sanded, and the rudder and elevator linkages have to be installed. The rudder closed loop (20-pound-test nylon-covered fishing trace line) should be routed through narrow-gauge nylon tubing. I used a standard pushrod for the elevator linkage; you could use a "snake" but try to select on that is reasonably small in diameter—3/16 O.D. tubing looks wrong exiting a small model. With the bottom sheet in position the nose block can be fitted and the hatch and cockpit formed.

Now is the time to cut those slots for the

struts. Positions can be ascertained from the drawings, and once the knife has located the slot it is easy to follow the plywood sides of the formers. Dry-fit the struts and check the fit of the wing to the struts. Once you're satisfied, leaving the wings fixed and epoxy the struts in the slots. Add the 3/32 balsa filler and sand it to profile with the fuselage.

Finishing: Whichever covering method you use, (and Delilah is suitable for film, fabric, or tissue) do a thorough job of sealing and waterproofing, as she is going to take to the water. Cover the fin, rudder, tailplane, and elevator separately, before joining the fin and tailplane. Hinge the elevators first, followed by the rudder. Glue the tail assembly to the fuselage, supporting the fin with triangular gussets.

Radio: Although Delilah is quite petite there is still ample room in the bays between F1 and F2, and F2 and F3 for standard-size equipment. I forgot to include a tube to route the antenna to the rear of the model, and had to take it to the top of the fin. The switch should be positioned *internally* and remote operation of the toggle arranged.

Flying: All standard checks for balance, radio operation, and correct direction of control movements should be made. For first flights I would certainly suggest hand launches—water flying can come later. Although the model will fly with either engine dead (it has quite a respectable glide) it's better if the starboard engine cuts first, to minimize the torque effect. Always start the starboard engine first, and top-off the port fuel tank before launching.

Completing a flying boat just as winter

is approaching does not, perhaps, suggest the best of planning. Our winters tend to be rather cold and damp, and are definitely not the conditions for "messing about with boats." However, we had a nice, crisp four-inch layer of snow this year. This coincided with a delightfully sunny afternoon the temptation was really too great. A telephone call to fellow modeler Jeff Barringer didn't find him at the office; he had gone home with exactly the same thought that I had: Let's go flying!

Neither of the Cox TD .020 engines had been run before, so it was a little unkind to expect them to roar into life in just-above-freezing temperatures. Surprisingly, this is exactly what did happen—within a few minutes both engines had been given a quick run (thanks to a small electric starter—details later).

The tanks were topped off, and both engines were started. Needle valves were adjusted so both engines were running really rich. Jeff gave the launch. Power, at these settings, was just not enough—the model was not gaining height. With a hedge rapidly approaching, I decided to "dump" the model—but I forgot that the snow would not provide any braking force! Delilah skipped once and ended up in a thorn bush.

Careful extraction revealed only a few puncture holes. The starboard float had been knocked back, proving the effectiveness of the friction-bolt fitting.

The next attempt was made with the engines almost at full song—away she went as prettily as you'd like. Despite what I consider to be a forward center of gravity, the elevator position was only slightly up, and the handling was responsive. With no throttle it's a little difficult to carry out low runs for the camera—it's not difficult to perform the

flybys, but they are a little fast, and the model is small.

Shortly after one flyby, the starboard engine cut, and I found out what asymmetric flying was going to be like. Fortunately nothing dramatic happened; Delilah was quite happy on one engine, except that turning to port (into the live engine) was rather marginal. Putting the rudder trim all the way to the left solved that problem.

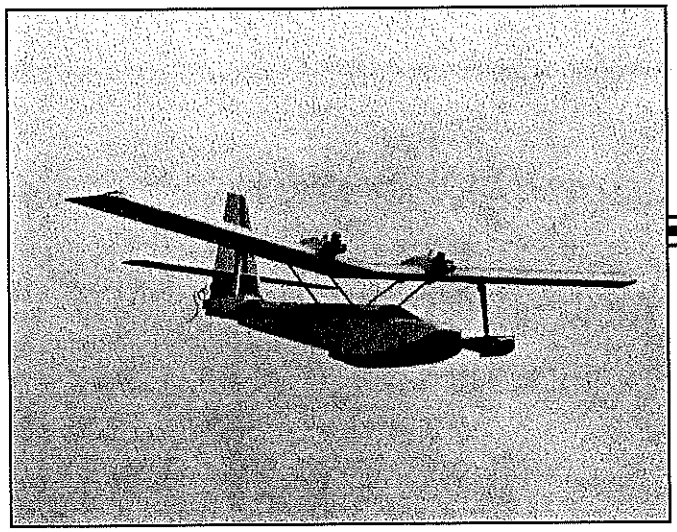
In fact, handling qualities were so good that I carried on with the photo session on the one remaining engine. With the single engine two-stroking smoothly away it was easy to carry out circuits without losing altitude; in a straight line Delilah climbs quite steadily on one engine. After a few flybys it was time to think about landing, so I gained some altitude and waited for the port engine to cut—which it did at distance. The touch-down was fine, and the maiden flight was successful.

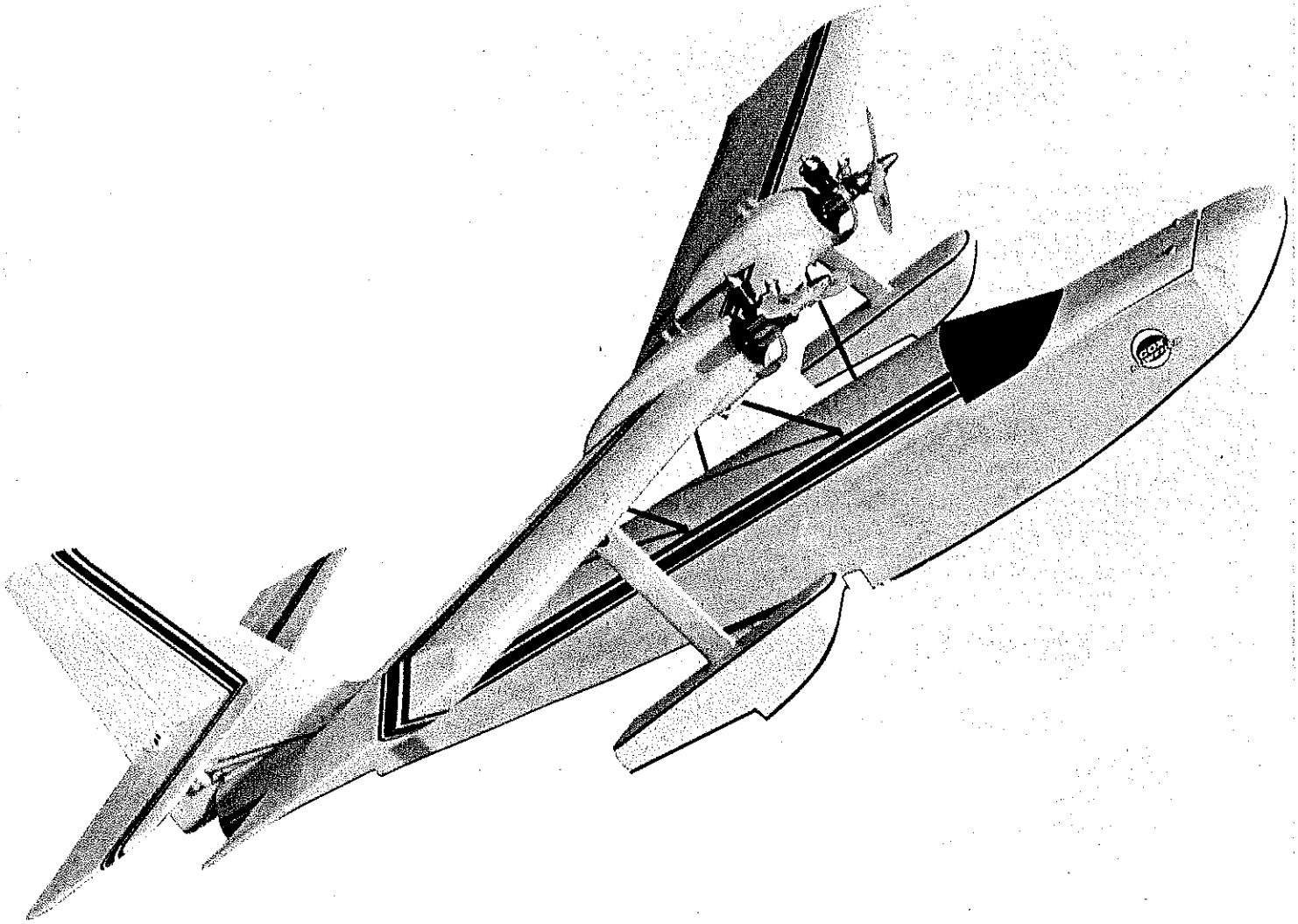
Water flying must wait a while, but the action so far is too exciting for this article not to go ahead. Just the sound of two Cox .020s in-beat makes it all worthwhile.

Finally, a word about control movements. For Delilah's maiden flight there was barely ⅜-inch of elevator movement up and down, and this proved to be suitable. Rudder movements were just over ½-inch left and right, and as stated before, this was barely sufficient with just one engine flying.

I would recommend that with rates on you should have ½ inch of movement each way; with rates off you should have ¾ inch of movement left and right. This will give ample rudder movement, regardless of which engine cuts out as soon as the rates are switched out. It may be possible to safely move the CG further rearward, but I did not bother to change it as the model flies well with the indicated position. (I hate adding nose weight, and I absolutely *detest* having to ballast to the tail.)

After numerous excellent flights, Delilah met her fate in a full-frontal midair collision with a .40-powered model during an Old Warden Fly-In. It was really cut-up about the whole proceeding, and to make matters worse one of the delightful Cox TD .020 engines flew off, never to be seen again. At least the accident will act as a spur for me to commence building Samson!✈





Photos by the author Graphic Design by Heather Erdahl