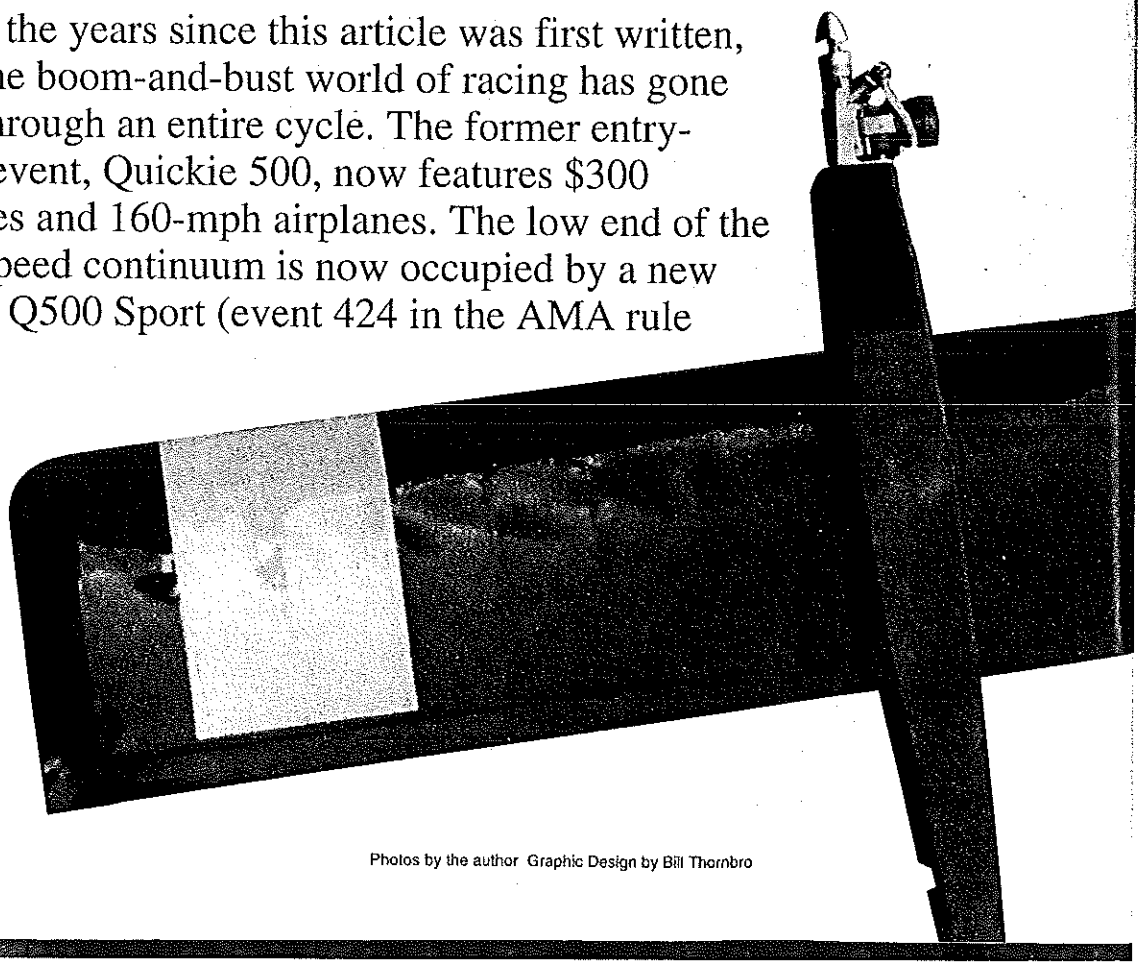
Shillelagh 500

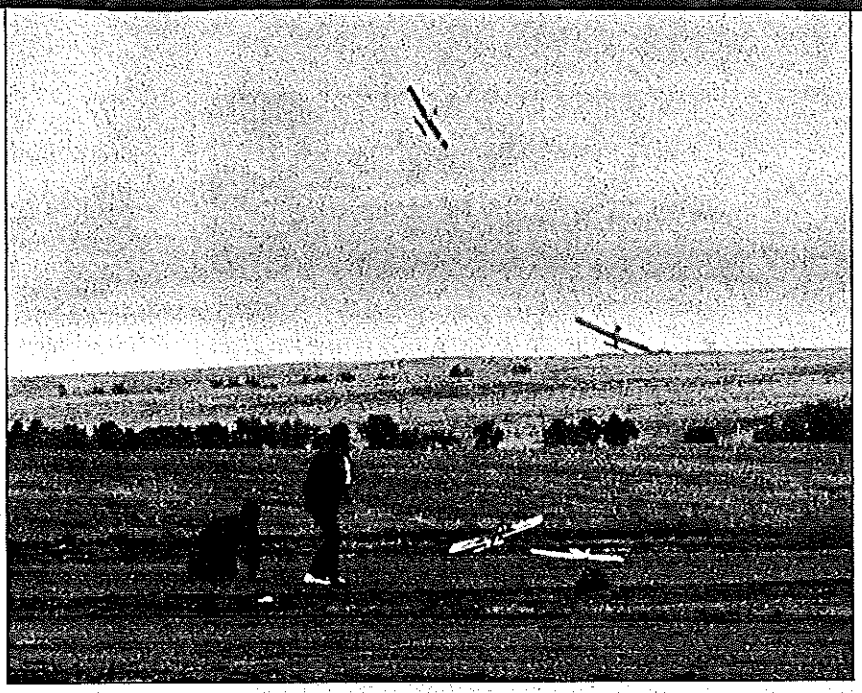
Duane Gall

Shillelagh (pronounced "shi·*lay*·lee") is an Irish word meaning *cudgel*. What better way to get into "club" racing?

In the years since this article was first written, the boom-and-bust world of racing has gone through an entire cycle. The former entry-level event, Quickie 500, now features $300 engines and 160-mph airplanes. The low end of the cost/speed continuum is now occupied by a new event, Q500 Sport (event 424 in the AMA rule



Photos by the author Graphic Design by Bill Thornbro

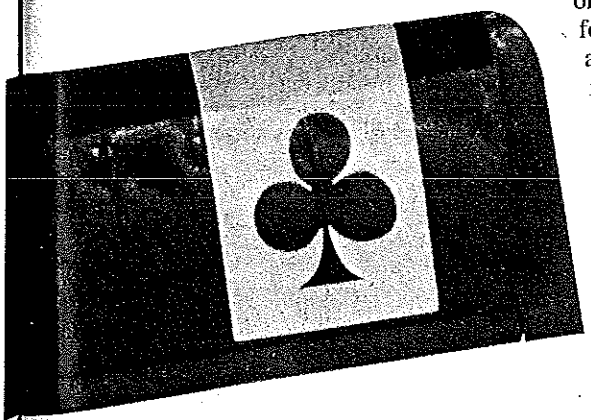


A four-model Club 500 heat. After takeoff, the launchers/"callers" scramble to join their pilot-teammates.

book). The aircraft presented on these pages may be out-of-date for the former, but it's ever-so-hip and cutting-edge for the latter.

RC Racing has undergone many permutations. Basically it involves flying two or more airplanes simultaneously over a closed course defined by markers such as flagpoles ("pylons").The currently recognized racing events call for four-airplane heats of ten laps around a triangular course. The rule variations for different events relate to the type of airplane and engine allowed, in an effort to keep everyone in the same "league" speed-wise. To be fun, racing should be fairly close, so no airplane is a hands-down winner.

The popularity of racing has waxed and waned over the years. Each new "formula" (airplane/engine class) tends to blossom for a few seasons as new pilots discover the unique thrill that racing provides. Later it declines as the airplanes get faster and the event is dominated by hard-core enthusiasts. Finally, a new, low-key event appears and a new generation of pilots goes out to do battle. In this way, Formula I begat Quarter Scale Midget which begat Sport Pylon which begat Quickie 500. Quickie (which should really be called Club 500 because the kit-built Quickie with K&B .40 is no longer the only allowable formula in most areas) has recently become very popular.



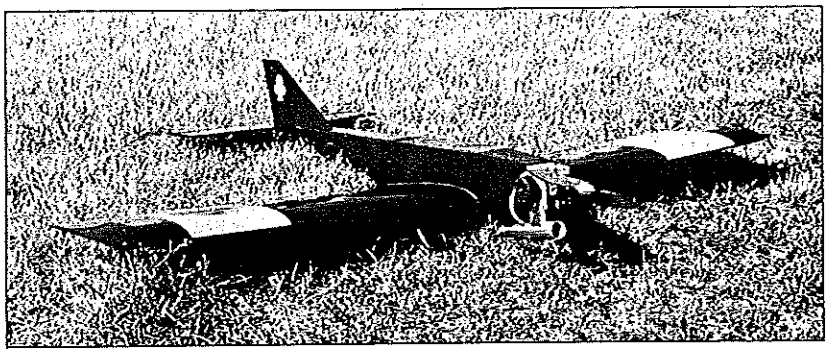
The Club 500 racers don't have the sexy curves and howling engines of the Formula Is and Quarter Midgets, but they are easy to fly, quick to build, and (depending on local rules) use engines that most sport fliers already have. They can be mass-produced for some informal racing or a club fun-fly, and they make good sport airplanes.

This design is intended for use in Club 500 racing or for sport flying with a .25 to .45 engine. Aerodynamically, it's nothing new; the finished model is indistinguishable from a kit-built Quickie, Scat Cat, Texas Outlaw, etc.

What *is* new is an ultraefficient, ultracheap method of construction. The structure makes extensive use of 3/16 foam-core board (actual thickness 7/32), available through art-supply stores (I used Foamboard™ by Bienfang.) This material is lighter than balsa, is completely uniform with no grain, and is cheap at about $4.75 per 32 x 40 sheet. I was introduced to this material by Keith Shaw of Ann Arbor, Michigan, who has been using it for years. I am indebted to him for many of the techniques shown here.

In addition to the sheet of Foamboard, the basic structure requires one 1/8 x 3 x 24 sheet of basswood; two 3/8 square x 36 balsa; six 3/32 x 3 x 36 balsa; five 3/16 x 36 birch dowels; and a small square of 1/4 plywood. Various gussets, servo rails, etc. are scrounged from the leftovers. The airplane pictured cost about $17 less covering, wheels, tank, engine, and radio.

Of course, there's no such thing as a free lunch, so there are some compromises. The Foamboard is heat-sensitive, so you'll have to use a low-temperature covering such as EconoKote. You also can't use most cyanoacrylate (CyA) glues on the foam, because the foam will dissolve; use Z



Above and right: Shillelagh makes extensive use of foam-core board. Low-temperature covering material required.

RC/56 by J&Z Products (the best), epoxy, or white glue. Water-based glues grab the Foamboard almost immediately, so you can still build fast.

If sport flying is almost (but not quite) enough for you; if you can fly a low-wing airplane without causing major property damage; if full-throttle flybys give you a secret thrill; then racing's for you. Build a Shillelagh and go race around a tree!

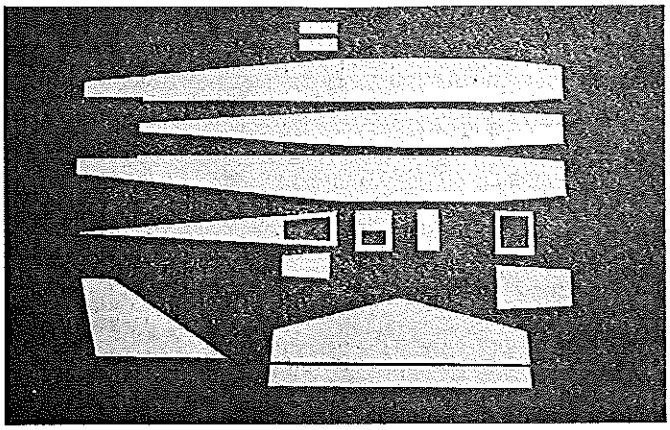
CONSTRUCTION

This airplane has a very short nose, because most ABC sport .40s are quite heavy. If you're going to use a smaller engine or a larger fuel tank, or both, extend the nose an inch or so. The prototype used a Supertigre S.40 Bluehead with Macs muffler and a six-ounce tank, and it balanced perfectly. *(Note: This design is not intended for use with the Nelson, Jett, MVVS, or other specialty engines. A Rossi .40 is about the most the airframe can safely handle.)*

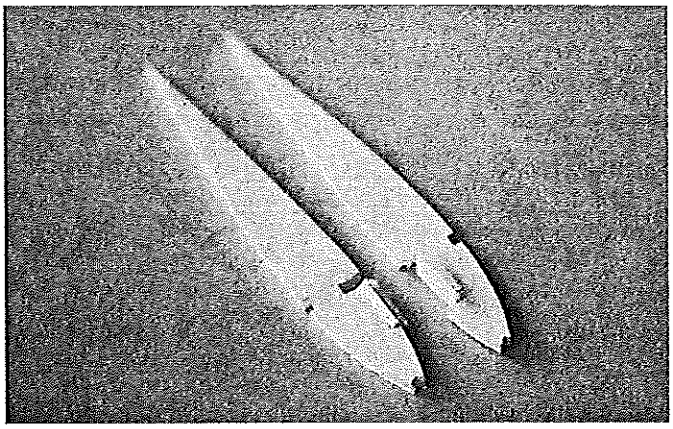
Begin construction by cutting out all the Foamboard parts using the template sheet. The Foamboard doesn't sand very well, so you'll want to cut the parts accurately and make clean joints. You can glue the template sheet directly to the board (using rubber cement or photo-mounting adhesive) and cut through the template and board, or you can stick pins through the template sheet and play connect-the-dots. Use the measurements given on the template sheet to check your work. Use a sharp #11 or razor blade, and cut over a smooth surface such as glass, vinyl, Masonite, or another piece of Foamboard.

There are only 20 wing ribs, and they come in only two flavors: "basic" and "center-section." Each center-section rib has a built-in reinforcement for the gear block area, which is created by cutting partway through the Foamboard and folding the scrap portion over (see plan). Make four "right" and four "left" center-section ribs.

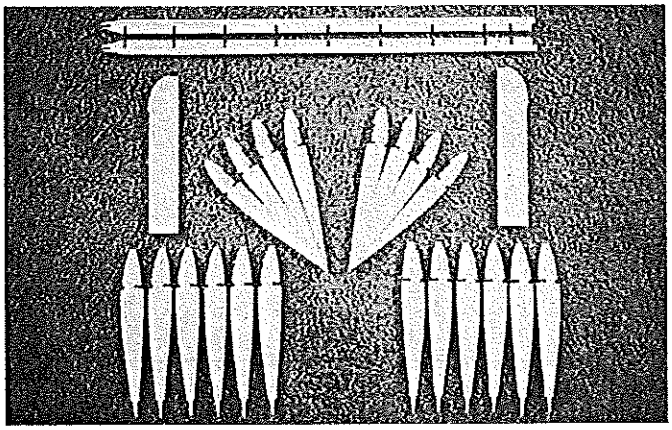
To make small, round holes in the Foamboard (such as for the receiver antenna) use a pencil point. Larger holes (such as for the fuel lines) should be started with a #11 blade or tapered reamer



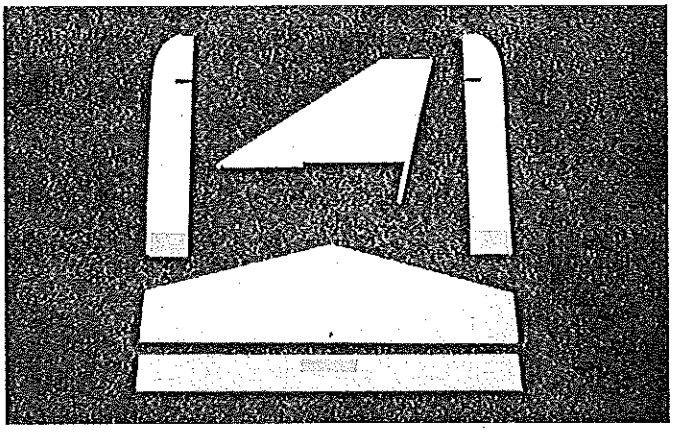
Foamboard fuselage and tail parts. Wing cutouts in fuselage sides are made after panels are complete, for a good fit.



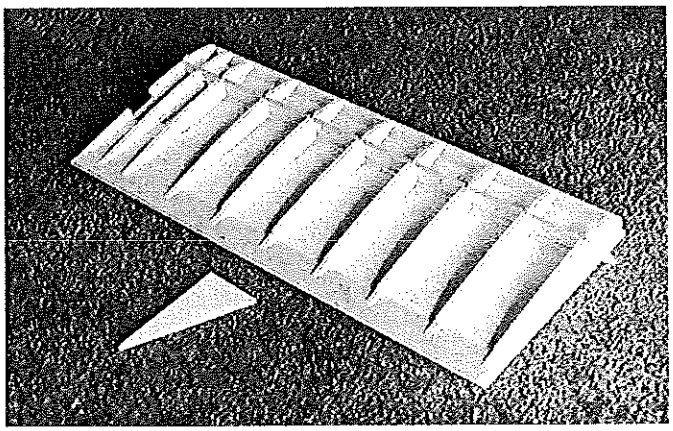
Center-section ribs have folded-over doubler to strengthen landing gear block area. Servo cutout shown on right rib.



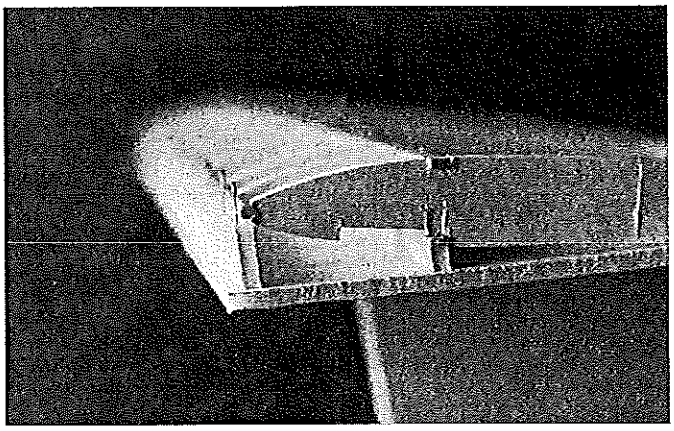
Foamboard wing parts. Material is 7/32 thick, has no grain, and is lighter than balsa. Available in art-supply stores.



Completed tail and wingtip assemblies. Tailskid assembly uses the rudder post as part of its structure.



Wing panel with top spar installed. Spar must be flush with ribs. Triangle is used to keep ribs in alignment.



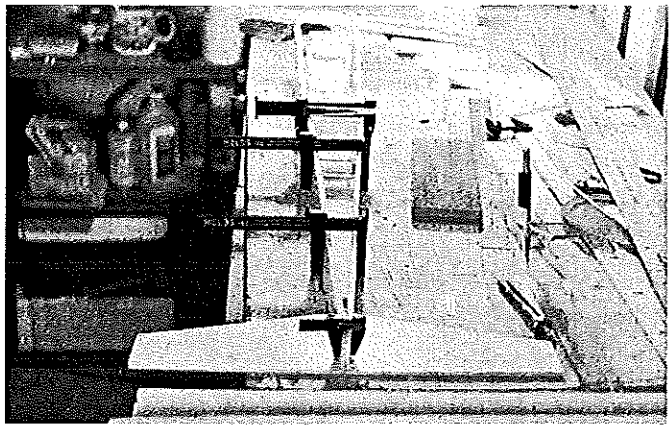
Wing leading edge is 3/16 dowel. Foamboard strips give uniform support to the leading edge and spar.

and then finished with a pencil point.

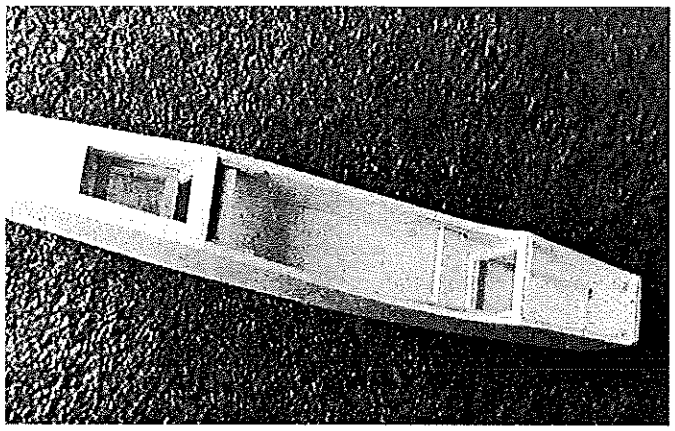
Landing gear blocks are made from the 1 x 6 basswood pieces. Use epoxy or gap-filling CyA to bond a slotted piece to an unslotted piece. The two-ply basswood wing hold-downs are made in a similar way.

For the ends of notches in hardwood and plywood parts, I use a drill to make an appropriate-size hole. For example, before cutting a ¼-inch-wide slot, I drill the ¼ hole at each end of the slot and cut out the middle with a knife or saw. This is easier than cutting square corners and produces a stronger part.

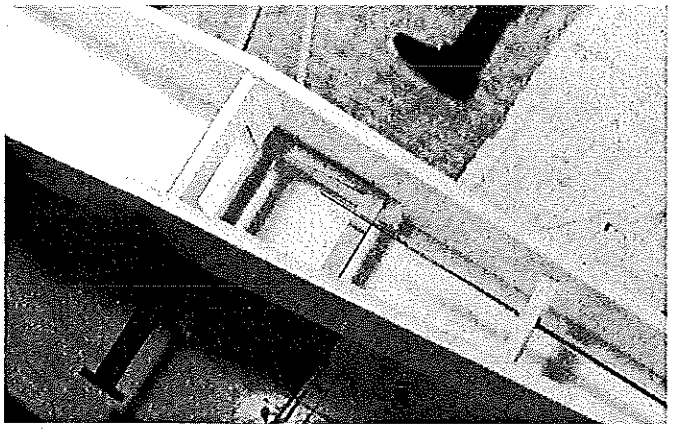
The wing leading edges are 3/16 dowel 24½ inches long. After cutting the LEs to length and putting them aside, use the remaining dowel stock to line the edges of the tail surfaces and wingtips. To do this, run the end of the dowel along the edge of



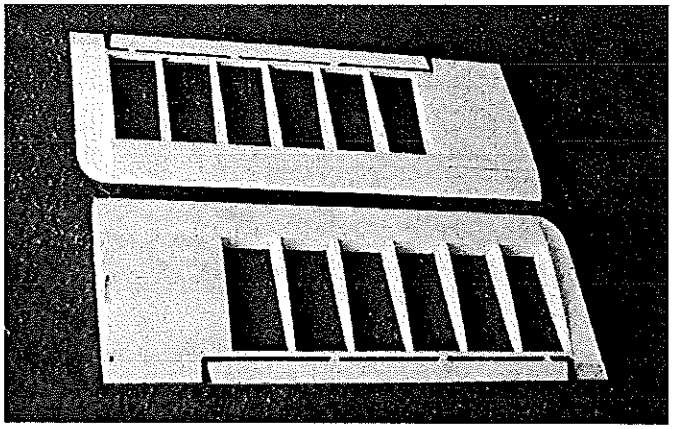
Fuselage under construction. Sides are beveled and compressed at rear to form a channel for the rudder post.



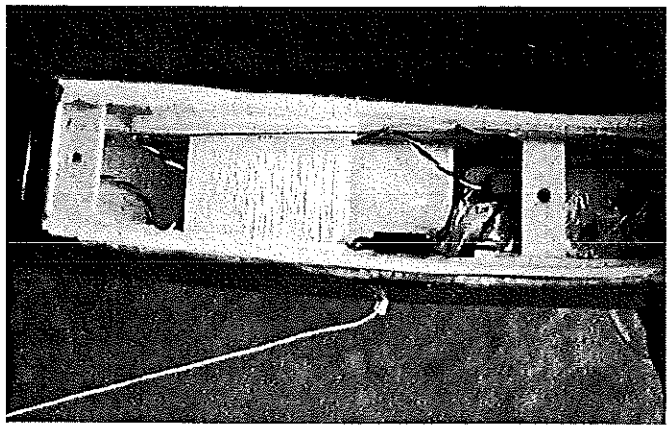
Forward portion of fuselage with servo rails, wing hold-downs, and firewall installed. Epoxy fuelproofs front end.



Servo area and elevator pushrod installation. Rudder servo may need to be added to meet some local rules.



Completed wing panels have precovered aileron hinge lines. Hinges are pinned with toothpicks.



Receiver and battery installation. Components are wrapped loosely in latex foam to dampen vibration.

Shilleglagh 500

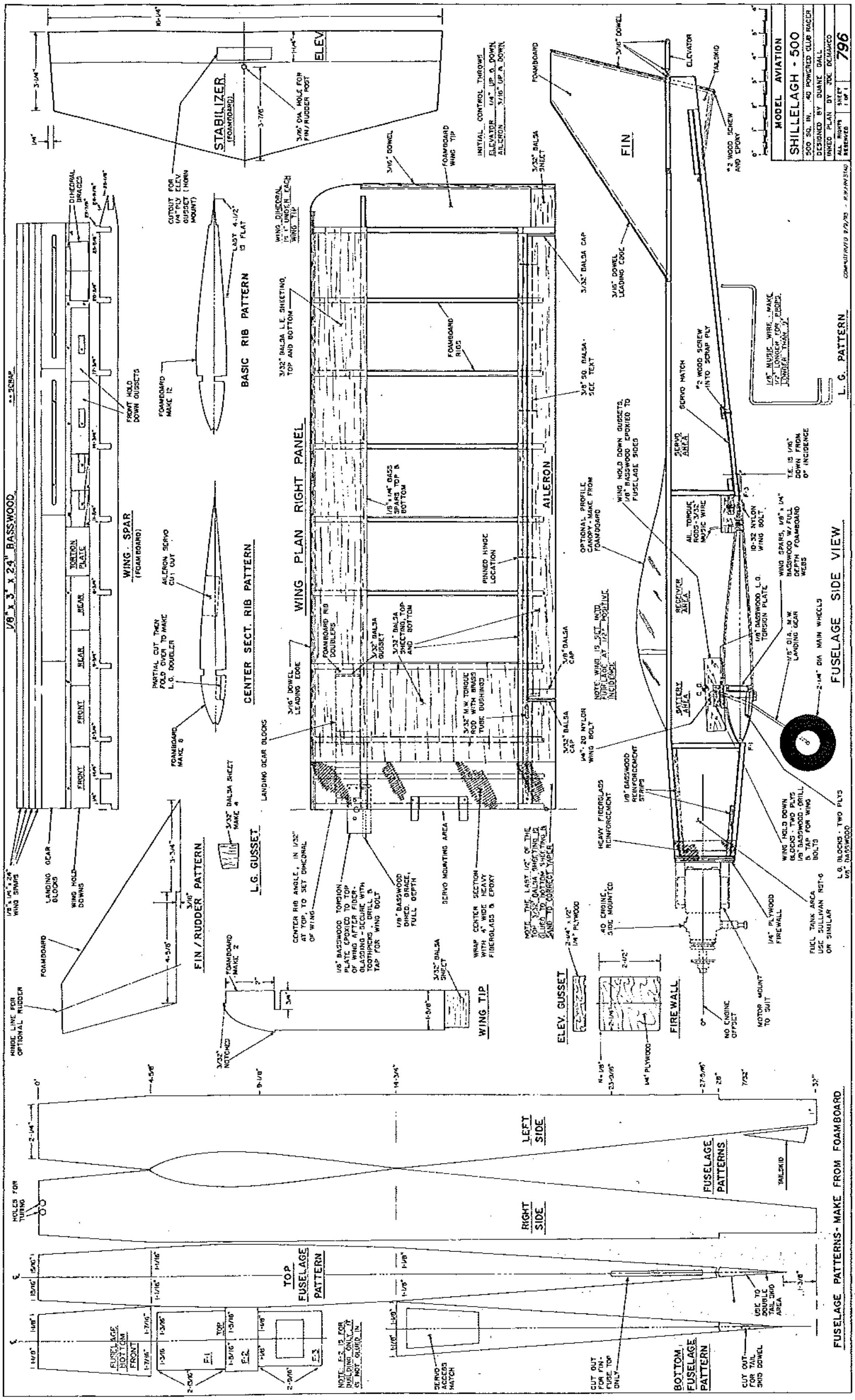
Type: RC Club Racing
Wingspan: 51¼ inches
Engine: .25-.40 glow
Functions: Aileron, elevator, throttle (rudder required in some areas)
Construction: Foamboard™ and balsa
Covering/finish: EconoKote or similar

the Foamboard several times to compress the foam into a semicircular groove, then glue a dowel of the proper length into the groove using RC-56 or epoxy.

If you find it necessary to hold assembly until it dries, lightly wrap the part with rubber bands; don't use tape, or you risk marring the paper surface of the Foamboard. Pre-groove the portion of each wingtip that will fit over the last ½ inch of leading edge dowel.

The plans call for a fixed fin/rudder and 3-channel control. In some areas of the country, racing rules require a movable rudder for ground steering, although normally the models take off so quickly there's no need to use it. If you decide to add a movable rudder, cut at the dotted line shown on the template and treat it similarly to the elevator. (You'll also probably run

Full-Size Plans Available—see page 189



out of room in the servo compartment shown. I'd suggest putting the throttle servo ahead of former 3 and using the aft compartment for elevator and rudder.)

Bend the landing gear struts from ⅛ music wire. The portion that protrudes through the top of the wing should be a bit long, to be trimmed later.

Wing: The two wing panels are built separately. Use the lighter pieces of balsa on the right panel, to compensate for the weight of the engine.

Glue the bottom spar to each spar web. While this assembly is drying, make a wing jig on your building board: at the main spar location, 7¾ inches ahead of the trailing edge, place a ¼ x 24 strip of Foamboard or balsa to block up the main spar. At the leading edge location, 9 15/16 ahead of the trailing edge, place a similar strip ¾ inch high.

Cut a 1½ x 24 piece of 3/32 trailing edge sheeting and lay it on the board. Also lay down a 3 x 6 portion of the center-section sheeting and glue it to the trailing edge sheeting. Set the spar/web assembly on the ¼-high strip and begin adding the ribs.

Install the end ribs first, then work from the center outward, using a small corner of Foamboard as a right-angle triangle to keep the ribs aligned. The fourth center-section rib should have its reinforcing doubler facing inboard.

Make sure that the ribs go down in their notches far enough that when the top spar is installed, it will sit on a perfectly flush surface. The joint between the spar, the ribs, and the upper edge of the web is the most critical part of the wing, and any gaps will greatly weaken the structure.

Install the top spar, pressing it down firmly and using pins next to (but not through) it to hold it until it dries. Add the 3/16 dowel leading edge, the trailing edge sheet, and the center-section sheeting, in that order. The rearmost ½ inch of the trailing-edge top sheeting is glued flat against the bottom sheeting; you may want to score it with a razor blade to make it bend cleanly.

When the assembly is dry, add the leading edge sheeting and weight the structure down against the jig until it is dry. If you wish, use cyanoacrylate (CyA) glue to hold the sheeting to the spar and leading edge, but be careful not to introduce any warps. The leading edge sheeting is what "locks in" the shape of the wing.

Remove the wing panel from the jig and apply a light fillet of R/C-56 on the underside of each seam. Add the bottom sheeting, landing gear blocks, balsa gear-block, gussets, and wingtips. Sand the leading and trailing edges to final shape. The top trailing edge sheeting will taper to zero thickness at the "tail" of the airfoil. When you hit the glue seam, you've sanded far enough.

Lay the panel upside down on the bench. Cut through the bottom sheeting and the ribs and install the ⅜ square aileron spar, gluing it securely to the underside of the top sheeting (see plan). Sand the spar flush with the rest of the wing, then measure and cut out the aileron.

Use a ⅛ thick Dremel grinding wheel to rout out a channel for the aileron torque rod. Cap the ends of the aileron with balsa pieces, round off the leading edges of the ailerons, and cut slots for the hinges. Before attaching the aileron, apply ¼ wide strips of covering material along the hinge line. Attach the aileron and torque rod, securing the hinges with toothpicks and CyA.

Join the panels by installing the dihedral brace in the end of the Foamboard web; dig out the foam filler with a piece of wire or a screwdriver to open up the space between the cardboard facings. Insert the dihedral brace and join the panels with epoxy, making sure the dihedral brace contacts both the upper and lower spars on each side to create a continuous I-beam through the center section.

Wrap the center section with heavy (3- to 8-ounce) fiberglass cloth and slow-curing epoxy. Make sure there are no wrinkles or bubbles under the cloth; again, the structures must be uniform for maximum strength.

Add the torsion plate and servo-mounting reinforcements. Drill through the center section for the landing gear struts and wing mounting bolts. Cover the wing and

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Shillelagh 500/Gall

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install the landing gear and aileron servo.

Fuselage and Tail: The fuselage is build upside down on a flat surface. Mark the centerline and former positions on the top plank. If there's room, lay down the stabilizer and make sure it's square with the centerline. Crease the fuselage top plank at the former #1 location and bend it, blocking it up 5/16 at the forwardmost end. Using a right-angle triangle to check the alignment, glue formers #1 and #3 to the plank. Set #2 in position, but don't glue it.

Bevel the aft ends of the fuselage sides so that when they are joined, the rear of the fuselage will be about ¼ wide. Place a scrap piece of dowel in the hole in the stabilizer where the rudder post will be. Squeeze the fuselage sides together with the dowel between them, to compress the foam into a channel for the rudder post. Remove the dowel, apply glue to all seams, and clamp the fuselage/stabilizer assembly together until dry.

Before adding the bottom rear plank, plan your servo installation. Install servo rails and cut the necessary holes for the pushrod(s).

Add the bottom rear plank and wing hold-down. Drill the firewall for the engine mount and throttle pushrod, and install the blind nuts on the backside. Glue the firewall to the nose, making sure it isn't tilted up, down, or sideways. (If you must err a little, go for down and right thrust.) Reinforce the glue joints with strips of scrap basswood as shown.

After all is dry, paint the inside of the tank compartment and firewall with slow-curing epoxy. Install the fuel tank. Paint the inside of the bottom front plank with epoxy and glue it on. If there's any epoxy left over, use it to fuelproof the wing hold-downs. Add epoxy and fiberglass tape around the firewall and paint the firewall with epoxy.

The completed fuselage will now resemble an unsanded 2 x 4. Clean it up by rounding the edges, using a knife handle or dowel to progressively squash the Foamboard into a radius with light fore-and-aft strokes. The covering material will complete the job by shrinking around the corners to make smooth, rounded contours.

Hinge the elevator to the stabilizer as you did the ailerons. Apply covering to the fin, stabilizer, and aft part of the fuselage. Install the fin, using epoxy. Add the tailskid assembly, which shares the rudder post as part of its structure. Finish covering the fuselage, drill and tap for the wing hold-down bolts, and install your engine and radio.

Check for balance, both fore-and-aft the and side-to-side. The fore-and-aft balance point, with the fuel tank empty, should be right on the wing spar.

Flying: Range-check your radio with the engine running. Check control throws: ¼ inch elevator each way and 3/16 each way on aileron to start out. Set the engine rich enough to run strong with the nose pointed straight up, and again make sure the radio is working. Point your new model down the runway, hold a little *up*, and pour on the coal!

Try some full-elevator loops at a safe altitude, to make sure the model doesn't buffet or tip-stall. If it does, reduce the elevator throw, add nose weight, or both. Your goal is to be able to turn smoothly and tightly on full elevator without losing airspeed or control.

Please don't do as some fliers I've seen, who set up their racers hair-trigger touchy and then fly by gently tickling the control stick. That's just asking for trouble. A racing airplane should be fast, but not hard to fly.

If you're flying off pavement, you may have to bend the landing gear struts back a bit to prevent porpoising on landing. It's best to land deadstick with this kind of airplane.

Whether or not you actually enter a race, the Club 500 airplanes offer lots of excitement for minimal cost. Shillelagh is one "club" racer that will deliver ... in spades! ✈