

Construction

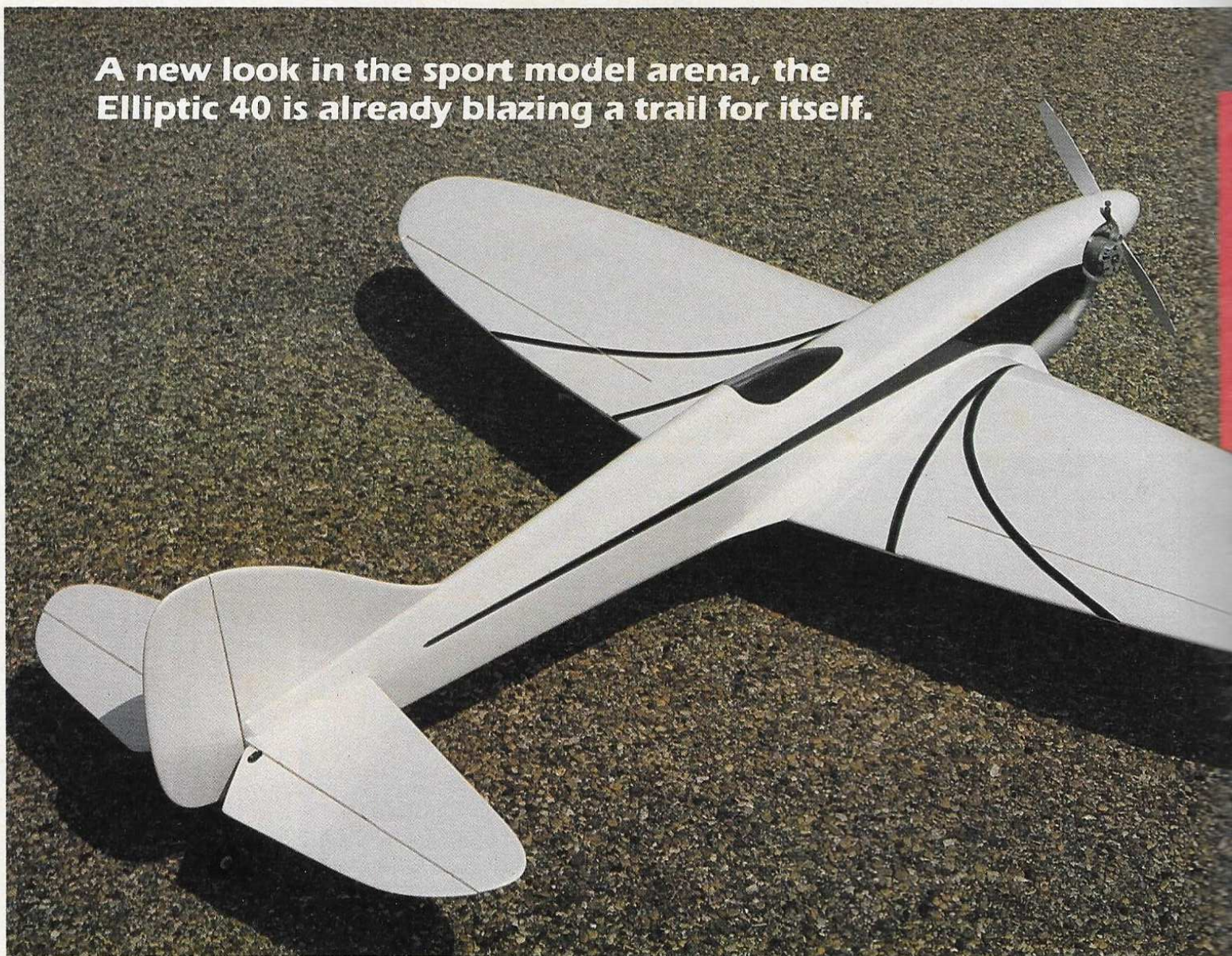
ELLIPTIC 40

by ALEX BOUKNIGHT

Type: Sport Fun-Fly
Wingspan: 58 inches
Wing Area: 653 square inches
Channels: 4
Engine: .40 to .51 two-cycle
.60 four-cycle
Weight: 5½ to 7 pounds

DOES AN airplane have to be ugly to fly well? My friend Paul Wood and I have been pondering this question for some time now. Most of the aerobatic airplanes I've seen have been designed with the emphasis on functional aerodynamics and ease of construction, with the aesthetics of the ship somewhat of an

A new look in the sport model arena, the Elliptic 40 is already blazing a trail for itself.



afterthought. Could an aircraft be designed with good flight characteristics and pleasing lines? Could we achieve this goal using standard construction techniques? These questions brought us to the design of the Elliptic.

The version presented here is the .40-size of our design, a size popular with most sport fliers. The .40-size ship offers the best compromise between fuel economy and flight performance; big enough to see the flight attitude in the air during maneuvers, yet small enough for easy storage and transport. The key to any good flying aircraft is to keep the weight down, which reduces the wing loading and gives better vertical performance. This size aircraft coupled with a hot .40-.45 two-



cycle engine will give you plenty of performance and meet the light weight requirements desired. Adding a pipe only increases the effect. If you are a four-cycle fan, a .60 four-cycle will give greater torque at a lower rpm and swing a larger prop. Some modification to the fuselage will have to be made to accommodate the added weight of this engine to get the CG in the right place.

The obvious starting point of any design is the wing and what better way to

get away from the straight-style wings than with the ellipse. This shape is pleasing to the eye and offers some real advantage in terms of aerodynamics. The elliptical wing produces a constant downwash at all speeds and near perfect load distribution over the entire surface area, something not easily achieved by any other platform shape. The effective angle of attack is the same along the entire span. There is a simultaneous stall over the entire surface with no tip-stalling tendencies. This reduces induced drag and the tip vortex effect. An 18% airfoil section was chosen to give a high lift coefficient and a constant airspeed through maneuvers.

The problem was how to build this desirable shape with simple construction techniques. An all-balsa wing was chosen to have the lightest weight possible, without sacrificing the strength requirements of an aerobatic aircraft. It uses the standard open-frame with ribs and partial sheeting used on most model aircraft today. Since most of the curve in the ellipse is at the tip, the tip block does most of the shaping. The leading edge is deceiving in that there is only one break to achieve the curve. The rear of the wing gets most of its curve on the trailing edge of the aileron, which is made of an easy-to-shape thin pine strip. One servo in each wing panel drives each aileron individually, which gives precise control with no slop in the linkages and is easier to install than torque tubes. This cuts down the chances of flutter on the control surface. The two servos are connected with a Y-chord and run off of the aileron channel of the receiver. The weight difference between two servos versus one and the savings of not using the torque tubes comes out about even.

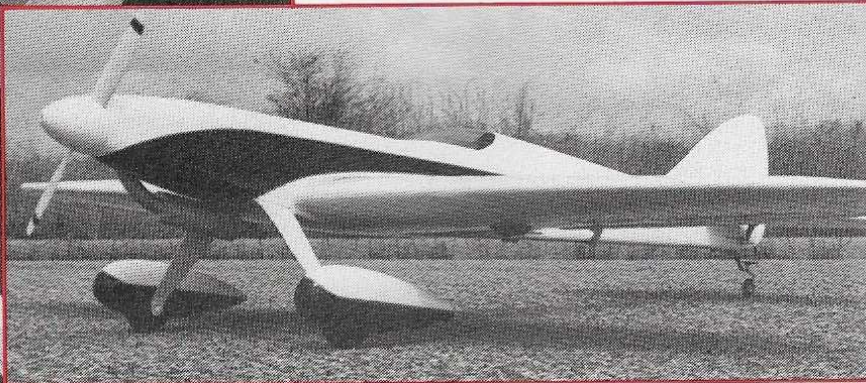
The fuselage uses the standard box-type construction rather than the built-up type to achieve the curved contours. The trick is to use thick top and bottom



ELLIPTIC 40

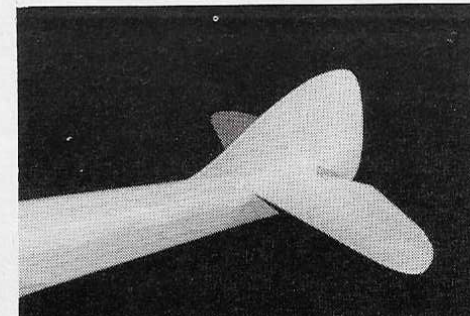
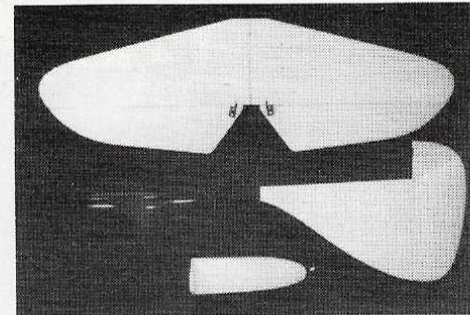
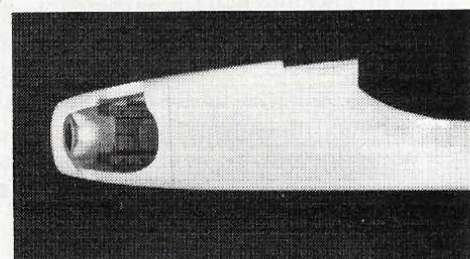
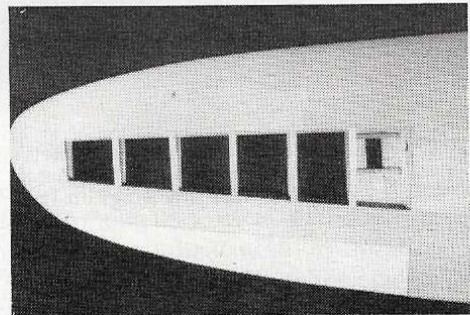


Although the Elliptic 40 has pylon racer lines, don't let that scare you as it's a docile airplane.



sate for the carburetor mounting on the rear and the longer engine mount beams.

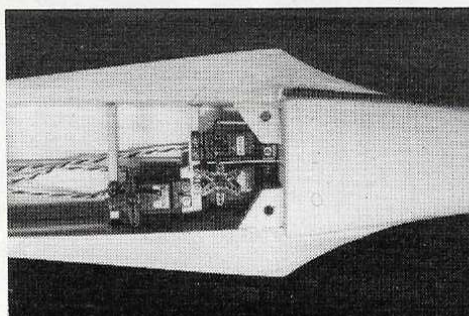
All of the incidence lines are set at 0° to give the same performance in the standard attitude and inverted flight. The right thrust will have to be varied depending on the engine and prop you use. The wing is flat on the top, with the dihedral built into the bottom surface because of the taper. I think you'll find this design very easy to build and you'll end up with a finished product you'll be proud of. I had a lot of fun building the prototypes. Well, let's get started.



sheeting with large corner triangles. This allows you to sand the contour you want and retains the mass necessary to dampen the engine vibrations. The rounded contour makes the fuselage clean aerodynamically and produces low parasitic drag figures. This method builds strong and light—and allows you the freedom to make it as round as you like—while keeping the construction simple. The tailfeathers are sheet balsa with ply plates for the control horns. Long nose and tail moments give the aircraft a smooth feel through maneuvers instead of the twitchy feel you get with a short-coupled plane.

As I mentioned, the plans were drawn for a .40-.45 two-cycle engine, but modifications can be made to accept a .60 four-cycle. Simply stretch the tail moment—the distance from bulkhead 4 to the tail—3 inches, to accommodate the heavier weight of the four-cycle and to get the CG in the right place. Keep the backplate of your spinner in the same location so the mass of the engine is at the same balance point. This could involve moving the firewall aft to compen-

CONSTRUCTION. The best way to begin this project is to cut out all of the needed parts before you begin the actual construction, so that it will build just like a kit. Take your time during this phase. The more accurate the parts are, the better your glue joints will be, and less glue means less weight. Save the wood scraps because you can make other parts from them. For example, the wing sheeting scraps make the center section sheeting.



Construction photographs above show no secrets, just good techniques.

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IN SOUTHERN MAINE

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Edge-glue the fin pieces together on a flat work surface. Epoxy the ply plates to the rudder. Temporarily install the hinges and sand the fin and rudder to final shape. Apply the same process to the stabilizer and elevators.

Mark centerlines on the firewall, bulkheads, main gear plate, and inside of the top block and top sheet. Cut the corners

off the bulkheads to allow for the triangles which are used to achieve the curved shape on the fuselage. Drill pilot holes for the wing dowels in bulkhead 2. Plan your radio and tank installation and cut away the necessary clearance from the bulkheads. Lay out your mount installation on your firewall and drill the necessary holes. Be sure to allow for the necessary right thrust and offset your mounting holes to have the nose of the

spinner on the centerline. Fuel-proof the firewall and epoxy in blind nuts. Use the same technique on the landing gear plate.

Glue spacer strips to the fuselage sides. Add triangles to the inside of the sides; make one right and one left. Glue ply doublers in place using epoxy. Epoxy the firewall, bulkheads 2, 3, 4, to the top block. Make sure that everything is 90° and square. The slow-drying epoxy gives you more time to get the alignment right and is stronger. When this is dry, add the sides and tail post to make one unit. Take your time and get the alignment right. A straight fuselage is much easier to fly than a crooked one.

Epoxy the wing bolt blocks together, and taper to fit against bulkhead 4. Add triangles and epoxy in place. Trim the wing to fit between bulkheads 2 and 4. Fiberglass the center section of the wing with glass cloth and resin or Hot Stuff. Mark a centerline on the wing bolt plate and cut partway through to make a bend to match the lower surface dihedral. Epoxy to the wing. Align the wing from the tips to the fuselage tailpost. Sand the wing saddle until you get equal tip height from the workbench. Set the fillet plates in place for spacing and mark the leading edge of the wing through the pilot holes in bulkhead 2 for dowels. Check the wing incidence to be sure you have 0°. Remove the wing and drill for dowel holes. When the wing fits everything accurately, glue the dowels in place. Drill undersized holes through the wing and the wing bolt blocks. Tap for a 1/4-20 wing bolt. Protect the wing with waxed paper and glue the fillet plates to the fuselage. The wing will give the exact contour and help hold the plates until they're dry.

Fuel-proof the tank compartment. Make up your pushrods for the elevator and rudder. Add your antenna tube if you plan to run an internal installation. Cut to size and epoxy the spruce gear triangles and add the main gear plate. Fuel-proof and add the tank bottom block.

Build the nose cowl separate from the fuselage, and use a square to get all sides 90°. Add the triangles to the inside corners and let dry. Attach a full sheet of sandpaper to a flat surface and sand the firewall side of the cowling until it fits flush with the fuselage front. Permanently mount your engine mount at this time. The mounting bolts will be hard to reach after the cowling is glued in position, so make sure the bolts are tight.

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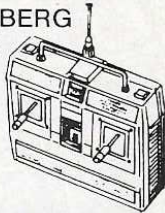
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Nothing can spoil your day more than losing your engine in mid-flight. You might want to drill your pilot holes for the engine mounting screws before you install the mount. Using the engine as a guide, cut out the cowling so that you can remove the engine through the cut-out. Sand to length to fit the engine and glue the nose ring in place. When you're satisfied with everything, glue the cowling to the nose of the fuselage. Using the spinner as a guide, sand the entire nose area to a streamlined shape. Fuel-proof the entire inside area of the cowling.

Epoxy blind nuts to the inside of the ply tail-gear plate. Epoxy to the fuselage. Lay out your rudder and elevator servos and use pushrods to determine the exit holes needed in the fuselage. It's much easier to lay this out now before the area is sheeted. Nyrod pieces make nice exit holes if they are glued in and then sanded flush with the side. Add cross-grain sheeting to the bottom rear section of the fuselage. Construct the wing belly pan and sand the entire bottom contour of the wing and rear fuselage to a nice flowing shape. Cut out for wing bolt holes.

Construct the turtledeck separately from the fuselage with top, sides, and ribs. Sand the bottom surface flat and glue to the fuselage. Using the fin for spacing, glue the fin support blocks in position. Remove the fin before the glue sets. Set the canopy in place and mark the outline. Glue the canopy bulkhead and the canopy baseplate in place. Sand the entire fuselage, avoiding the canopy area.

Check the alignment and glue the stabilizer in place. It should be at 0° incidence and 90° from the centerline. Glue the fin in place and check for 90° from the stabilizer. The fin should aim

directly down the centerline of the fuselage.

Use balsa triangles to begin filling the fillet area. Use your favorite filler to finish the process. I used Model Magic* Filler and it seems to work very well. You may want to treat the entire area with a thin layer of Hot Stuff before you start so that when you sand to shape, you don't end up with as many gouges in the adjacent wood surfaces.

Trim the canopy at the bottom to fit the turtledeck and fuselage. Finish the interior of the canopy area as you like and glue in place. Use filler to fill all of the seams, fillets, and any other areas that need work. Cover and tape off the canopy if you plan to paint the fuselage. Give the whole model a good final sanding.

I chose to cover the wing with Mono-Kote and paint the fuselage and bottom center section of the wing. I sealed the wood with two or three coats of resin, sanding between each coat. I then applied three coats of K&B primer, sanding between each coat. The secret is to sand off almost all of the material so that you are sealing the surface imperfections and removing most of the weight. It takes lots of work but sanding is good therapy and makes for a good finish. I then sprayed the base and trim color coats, and sprayed the trim colors on the wing.

Build the wheelpants per the instructions. Install the remaining hardware, engine, fuel tank, radio gear, landing gear, and tail gear. Check for proper control surface movement; both in direction and amount of throw. The throws given on the plans are good trim flight settings. They are not too sensitive and yet offer enough movement to get you out of trouble if necessary. Adjust to your personal taste after the trim flights. Check the CG location and shift the gear

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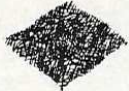


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as necessary to start with the correct location, which is over the main spar. You may want to change this position after the first few flights, since CG location is a matter of personal preference. If you're fairly new at this, you may want to decrease the throws slightly, and use the forward portion of the CG range for more stability. Seal your aileron hinge gap with MonoKote to increase the effectiveness of the control surface.

I mentioned that I got a wing jig (\$8) from U.S. Eagle, and they also sell .040 ASA wheelpants (\$7), and an .030 canopy (\$5).

FLYING. Now comes the fun part, the flying. You've spent the time and effort to build a beautiful aircraft, so take a little extra time now to check everything out now before you fly. Be sure that your engine is completely broken-in and properly adjusted. Pressure-test your tank for leaks. Do all the necessary radio tests, range checks, etc. You don't want to plant your new pride and joy about a foot in the good Mother Earth. If there is any kind of problem that needs fixing, fix it now before you fly. The problem will not magically go away in flight.

You'll find the ground handling for this tail-dragger nice, due to the height of the tail, with no tendency to tip over. The rudder is effective on takeoff and a little right input is all that's needed to compensate for the torque effect. Use a shallow climb-out and gain enough altitude to trim for straight-and-level flight. Pull the ship into a straight, vertical climb to check the right thrust. It should pull straight up without much rudder input for 4 or 5 seconds. If not, adjust your right thrust or change the pitch of your prop to give a nice straight vertical climb. As an example, 2° right thrust seemed to be about right for a Super Tigre .45 ABC (from Great Planes Model Distributors*) with a 10x6 prop. Try some inside and outside loops. Adjust your rudder and aileron trim to give nice straight tracking through the loops. Try some inverted flight. It should track as straight either way.

The aircraft exhibits very nice slow speed characteristics and has a very slow stall speed. Make several slow speed passes to get the feel of the landing approach. Fly a shallow approach because the ship is so clean aerodynamically that it will not bleed off airspeed

ELLIPTIC 40

very fast. Just cut the power a little before you're used to doing so and let her lose altitude. Make a nice slow flair before touchdown. Make all of your trim adjustments to give a neutral setting in your transmitter. If you want a more crisp snap or spin, shift the CG slightly aft, a little at a time.

After you get used to the flight characteristics, try any maneuver you like. It will fly them with a slow grace and constant airspeed. Fly safe and enjoy!

**The following are the addresses of the companies mentioned in this article:*

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