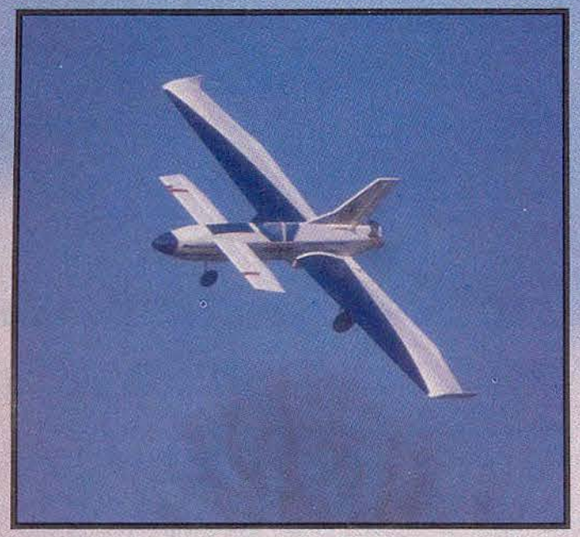
MOCKINGBIRD



ABOUT THE AUTHOR

David Pulliam (AMA 28744) was born in Joplin, Missouri, in 1930, attended Oklahoma A & M College from 1947 to 1950, graduated from Aviation Cadets at Lubbock, Texas, in 1952, is now retired from the Air Force. Interest in designing and building models began in the late 30s, during which he caused his father much concern when he was discovered lighting kerosene soaked models and launching them from the roof of the hay barn. Fortunately, this fascination with burning aircraft was of short duration, thanks at least in part to his father, and he now claims to obtain enough excitement from a successful landing of an undamaged aircraft.

Try this .19 to .30 powered canard with the option of making it a pusher or tractor powered model. David Pulliam feels that anyone who passed the totally "novice" stage should not have any trouble building this bird.

By David Pulliam

Photos by Chris L. Joiner

I have been intrigued with the Canard (which is French for "duck") configuration since my association with Charles Green of Swearingen Aircraft Corp., who assured me that a canard could be made stable. That, of course, was well before I had heard of Burt Rutan's Vari-Eze. As luck would have it though, we went our separate ways before I could glean the how-to's from him. I have subsequently attempted several canard models, none of which could be termed a success, until the Mockingbird flew.

The Mockingbird is a composite of bits of information and ideas from numerous and scattered sources; thus the name. I can't begin to give a bibliography but foremost in my mind are: the aforementioned Charles Green; Andy Lennon, author of a Model Airplane News series and correspondence; and Charles Duke of our local Columbus-Fort Benning (GA) R/C Flyers, who gave valuable theoretical and flying expertise with several of my previous models.

This model was designed to test several bits of information, to match my flying skills (or lack thereof), my economical traits (low power), and a firm desire for it to look like an "aircraft." I estimated that a sturdy structure of some four to four and a half feet span could be built that would weigh three to three and a half pounds. The wing loading would then be in the one pound per square foot range and quite flyable on a .15 to .30 engine.

After several enjoyable hours with a calculator, a few books, some ire from my wife, etc., more definite parameters evolved. The only disappointment in the model as originally sketched is the half pound of excess weight, which included 6 ounces of lead in the nose. I still haven't figured out a way to eliminate that excess without weakening the structure, except that a lighter engine mount would help. The four pound weight of the original gives a 17½ oz./sq. ft. wing loading.

I considered moving the pusher engine 1/2" forward but realized that would save only a fraction of an ounce of nose weight and would make access to the plug awkward. Incidentally, the box you see between the main gear in the pictures does not represent an omission in the plans; the plane was built for a radio with smaller servos than the Futaba now installed. A plywood servo mount had been

MOCKINGBIRD

Designed By:
David Pulliam
TYPE AIRCRAFT
Canard Sport/Trainer
WINGSPAN
51 Inches (w/o tips)
WING CHORD
9¼ Inches (Max)
TOTAL WING AREA
446 Sq. In. (Main)
WING LOCATION
Low Wing
AIRFOIL
NACA N60R (Main)
WING PLANFORM
Straight Center
Tapered Outer Panels
DIHEDRAL EACH TIP
1½ Inches
O.A. FUSELAGE LENGTH
37 Inches
RADIO COMPARTMENT SIZE
(L) 17" x (W) 2¾" x (H) 2½"
STABILIZER SPAN
20 Inches
STABILIZER CHORD (incl. elev.)
4¾ Inches (Max)
STABILIZER AREA
88 Sq. In.
STAB. AIRFOIL SECTION
NACA 63-206 (Approx.)
STABILIZER LOCATION
Top of Fuselage
VERTICAL FIN HEIGHT
6½ Inches
VERTICAL FIN WIDTH (incl. rud.)
5½ Inches (Avg.)
REC. ENGINE SIZE
.19-.30 Cu. In.
FUEL TANK SIZE
6 Ounce
LANDING GEAR
Tricycle
REC. NO. OF CHANNELS
4
CONTROL FUNCTIONS
Elev., Ail., Throt., Rud./Nose Gear
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Balsa, Ply (Glass opt.)
Wing ..... Balsa, Ply, & Spruce
Empennage ..... Balsa, Ply
Wt. Ready To Fly ..... 64 Oz.
Wing Loading ..... 17½ Oz./Sq. Ft.

securely epoxied to the ribs, dowels, and sheeting when I decided to change radios. I mounted the servo vertically rather than try to cut out the other structure. Aileron pushrods were intended to be NyRods as shown within the wing on the plans; the rods are still in my plane but are not used.

The pictures also show inverted Hoerner main wing tips, although they were not a consideration in the design. I installed them purely as an exercise to see if I could carve them as easily as friends indicated. If you want to try them, a D size battery wrapped in #100 sandpaper works well for the inside contour. First, whittle the inside to a rough approximation of the contour, then sand. Use the same procedure for the other surface. Shape them to provide a smooth airflow and to please yourself. Tips as shown are easier to make and seem to be as effective.

Before we get into the construction of the Mockingbird, let me tell you about that first test flight.

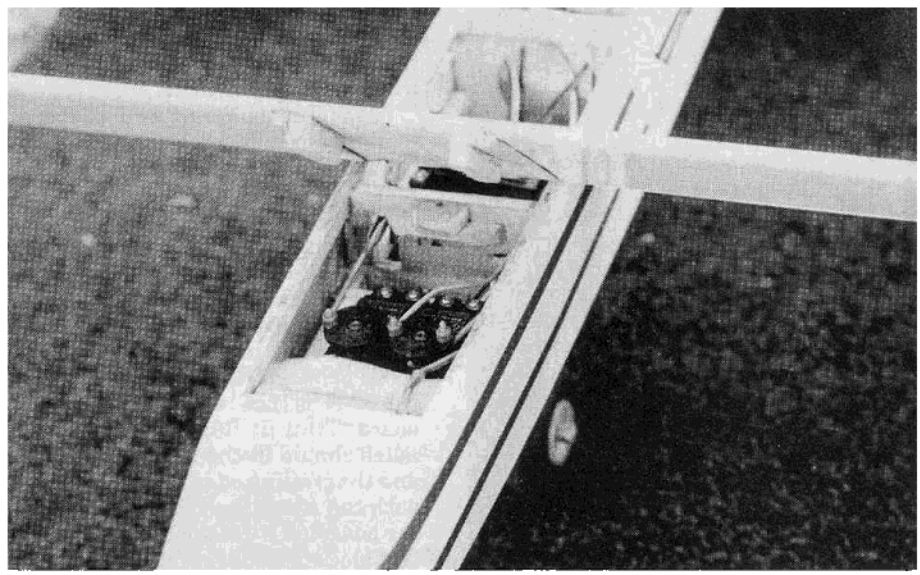
I picked a calm day when no one else was at the field for my first flight of the plane on June 4, 1984. The lack of observers was needed for my nerves as I had a great degree of apprehension after several less than satisfactory efforts with canards, both control line and R/C. I rechecked my calculations, told myself that it would work because I had already double checked the whole design. After a few taxi runs down the runway, it accelerated faster than I expected and became airborne, about three feet high. When I realized that I had gotten it back on the runway and it landed like an "airplane." I felt somewhat better and decided that "this is it." I taxied it back to the end of the runway and gave it full throttle. Acceleration seemed very slow that time (perhaps the wind shifted) and it must have been 300' down our 400' runway before giving it a slight back elevator pressure. It rotated and left the runway in a very gentle climb. Everything went as hoped for, with only minor trim required. I tried gentle turns, climbs and glides, slow flight, then acceleration as in a go-around.

With some elation, I decided to try a landing with a long, straight approach. My excitement, old man eyes, the appearance of the elevator coming at me first and a general blockage between the ears allowed me to disregard the big sweet gum tree a few yards from the approach path. When I realized that I was in trouble, it was too late. It proceeded to make it through the branches with a couple of very definite thumps, then immediately went to a perfectly flat spin. It remained in the spin from the height of the tree (80'-100') to a three point contact with the ground! So, my first real landing with my new plane was made through a tree! On-the-spot inspection indicated less than expected damage limited to cracked sheeting around the canard attachment area. That ended my flying for that session.

Thorough inspection back in the shop confirmed that the damage was indeed slight. I was able to repair it with CA and return to the field later the same afternoon. The next flights were uneventful; it handled almost exactly as I had hoped.

After the inglorius but very satisfying first day, I was able to settle down to enjoy flying the Mockingbird. It handles much like the Cowboy II with a .30 engine; i.e., not hot, but comfortable, maneuverable, and enjoyable.

During the first flying sessions with the bird, the only pusher props that I had were the old flexible nylon ones that seem to expend more energy in flopping and vibrating than in pushing the plane. Since then, I have tried several brands and sizes of props with the best results from the Master Airscrew 10 x 6. These were cut down to 8" or 8⅜" and were run on an old, tired Fox .25. Top speed may not be quite as great as with one or two of the other props but acceleration is definitely better, plus vibration is nil.



Canard raised to show rudder and nose gear servo along with elevator servo.

CONSTRUCTION

I recommend that you build the wings and canard first since they are used later for fitting on the fuselage. One point for consideration throughout your building is to keep out all unnecessary weight aft of the C.G. Any excess weight there will only require that much more weight in the nose. The design has proven to be sturdy as is but any added weight will decrease performance.

Although there aren't full sized patterns of the side or top-side pieces, these are simple enough to cut. Just allow the extra width recommended, any excess is readily sanded off.

The plans offer two basic options for the builder:

(1) Tractor versus Pusher. I built the original as a pusher and would probably do likewise on any future planes unless I wanted one specifically for fun-fly contests or such. A tractor would be more agile with the slip stream over the control surfaces, especially in slow speed maneuvers. I have not found increased responsiveness to be necessary for sport flying, however, and I enjoy the semi-jet appearance of the pusher in flight. I also enjoy the lack of goop all over the plane at cleanup time!

(2) Convex versus Slab Sides. The plans show, and the original has, slightly convex fuselage sides (7" radius). My first sketches were for slab sides but I feel that the slight additional effort necessary to make the sides convex is warranted since the fuselage will be more rigid and better looking. Appropriate cuts are indicated by dashed outlines on the former outlines for builders who may not want to bother. Note that the plan view portrays the outline of the bottom of the fuselage --- for ease of aligning parts during building.

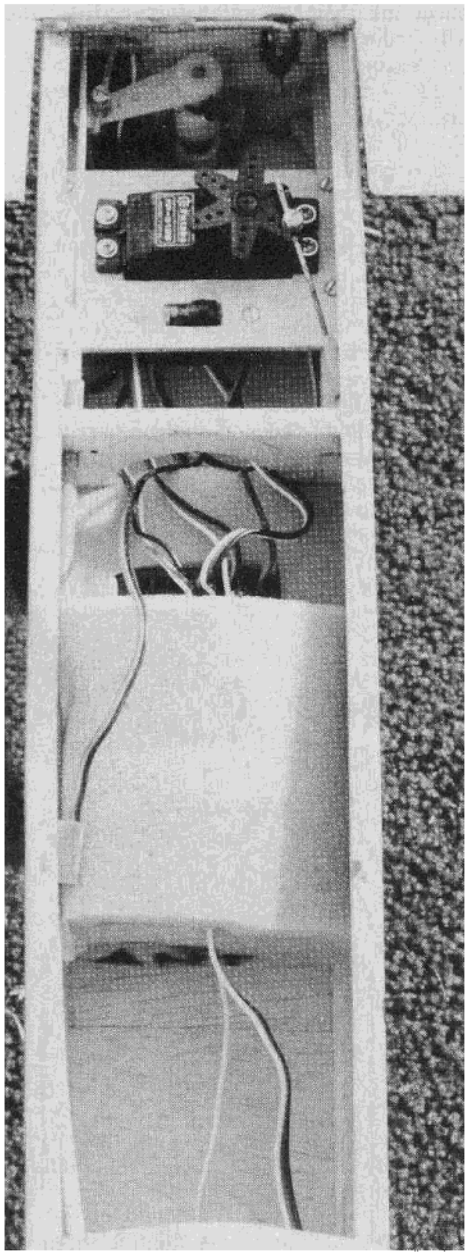
Wing:

(1) Cut ribs R1 through R6 from 3/32" sheet balsa; cut R1A ribs from 1/32" ply. Cut spar doublers from 1/16" and 3/32" ply as indicated.

(2) Cut main spar webbing from 3/32" sheet balsa. First, cut it 2-21/32" wide by about 12½" long; cut this into ten pieces 1-7/32" long.

(3) The 3/8" square leading edge may be made by gluing 3/16" x 3/8" strips together (CA, epoxy, or aliphatic resin). Pin them down until the glue is dry to assure straightness.

(4) Place the plans on your building



View of throttle servo and receiver wrapped in foam. Nose wheel steering arm shows at top of photo.

board with the wing portion toward you. Cover the wing portion with kitchen plastic wrap, discarded backing from MonoKote or other thin plastic (waxpaper isn't recommended with CA).

(5) Cut the 1/8" x 3/8" spruce spars to fit from the centerline of the wing through R6.

(6) Pin the bottom spar in position on the plans, then pin the main spar doubler (3/32" ply) in position with its centerline and end of the bottom spar aligned exactly over the centerline of the wing. Do not glue at this time.

(7) Pin the inboard R3 in position against the end of the doubler. Place a piece of the previously cut webbing in position against the rib. Glue both rib and webbing to the spar and together with CA. Do not glue to spar doubler.

(8) Glue the next R3 to the webbing and spar; install the next piece of webbing, etc., through the outboard R3. Do not install any webbing outboard of this point at this time.

(9) Add the 3/16" sq. trailing edge spar; block and pin securely, glue to all R3s with CA.

(10) Block and pin the leading edge in place being sure that the inboard end is directly over the centerline of the wing. Glue to all R3s with CA.

(11) Mark and cut a piece of the spar webbing to match the tapered end of the ply spar doubler. Set it aside for a moment.

(12) Place the upper spar in position on the ribs with the inboard end aligned with the centerline of the doubler. Glue to R3s and webbing, but not to doubler, with CA.

(13) Remove the doubler, spread a thin coat of epoxy on all mating surfaces (applicable end only), and put it back in position. Pin and clamp it to the spars and R3, making sure that the upper spar is held in position where it bends up at R1.

(14) Glue the tapered piece of webbing (from Step 11) to the doubler, top spar and inboard R3 with CA.

(15) Glue the trailing edge spar doubler (1/16" ply) in place (CA).

(16) Glue both fore and aft parts of R2 and aft part of R1 in position (CA).

(17) Weight or securely pin the wing to the building board at the outboard R3. Block the bottom spar with balsa scrap between R3 and R4 so that the tip of it is 1/8" above the building board. Trial fit R6; the leading edge notch should fit the leading edge spar and the trailing edge should be in line with the centerline of R3 (9/32" above the board). If it does not line up, adjust the block under the spar until it is accurately in place.

(18) Glue R6, R5, and R4 to the bottom spar and the leading edge spar (CA).

(19) Gently push the top spar down until it seats in the rib notches. If it fits without changing the alignment, release it and spread glue (use gap filling or slow setting CA) in the notches and reseat the spar. Hold until set.

(20) Remove the wing panel from the plans.

(21) Cut 3/32" sheet balsa webs to fit the tip ribs (about 2-13/32" wide). Beginning at the bay between R3 and R4, glue the webs in place (CA).

(22) Carefully sand the trailing edge spar to match the ribs, noting the beginning of the upward reflex on the bottom of the wing. Taper the spar from R3 through R4 to the end of it (check the plans).

(23) Cut 3/32" sheet balsa into 3/4" strips for the trailing edge caps.

(24) Cut a capstrip to match the angle at R4. Note the relative positions of the inboard and outboard parts of the caps.

(25) Pin both inner and outer parts to the underside of the trailing edge spar and ribs. Check again that all is correct and the wing is still straight. Glue all joints (CA). Trim the strip at the center and tip of the wing.

(26) Repeat #24 and #25 for the upper cap, also gluing the upper and lower caps together from R4 to R6 (CA). You will not have the reflex curvature in the trailing edge from R4 to R6, unless you bent the outer strips while gluing them, but this does not present a problem. There is sufficient wood to sand to the correct curve while thinning to a 1/16" trailing edge. I suggest that you do this sanding after both panels are completed, so you can match one against the other as you sand.

(27) Build the second panel in the same manner as the first.

a. Check the fit between the ends of each spar (trailing edge, top and bottom main and leading edge) as you place each in position. This way when you are ready to glue the panels together, you will not have any misfits.

b. Glue spar ends together when the panels are joined (#13). Use 2-7/8" dihedral block under rib 6.

(28) Glue the R1A doubler rib to the inboard side of the forward part of R1 (using gap filling CA, or epoxy).

(29) Add the leading edge spar doublers (1/16" ply) and the forward part of R1s (CA).

(30) Using your servo, determine the exact position you need the NyRod to exit R1 to match the servo wheel. Working from this position on R1, cut or drill 11/64" holes for the NyRod through each rib and the spar webbing.

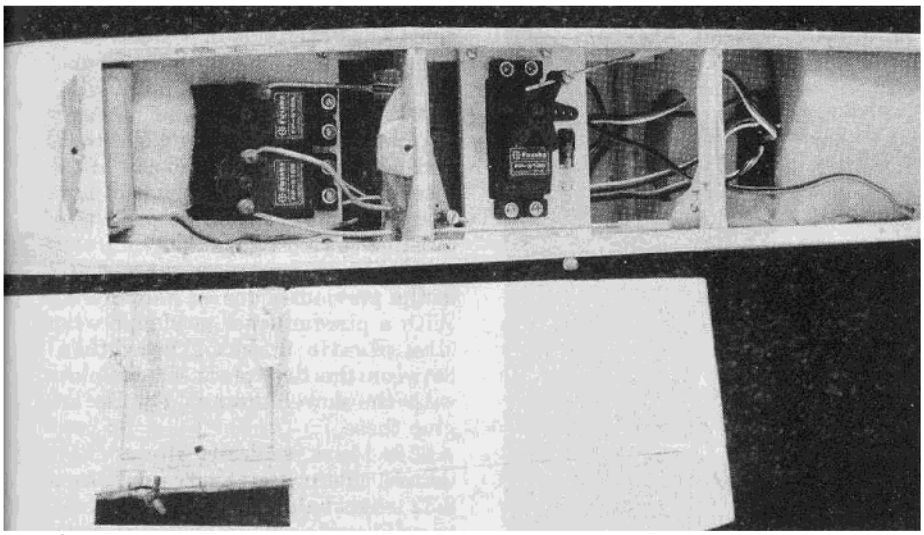
(31) Insert the outer NyRod through the holes (both panels), and re-pin or weight one wing panel to your building board to retain straightness. Glue the NyRod in place at each structure, then repeat on the other panel.

(32) Lightly sand the entire wing to smooth any uneven joints or protrusions of the spar webbing. Sand trailing edge caps to reflex contour, leaving a 1/16" trailing edge outboard of the T.E. spar.

(33) Trial fit the leading edge sheeting (3/32" x 3" x 26") on top surface only. Trim the rib notches, if necessary, to allow a good fit between the leading edge and the notch. Glue to the leading edge, main spar, and to R1 through R3 (use gap filling CA).

a. Squeeze the tip end of the sheeting down to mate with R4-R6. Trim the sheeting to fit behind the leading edge and in the rib notches. Hold in place and glue (CA).

b. Repeat on the other panel, trimming to a good butt joint at the



Canard removed — note short pushrod that connects to elevator horn.

center. Trim tips even with R6s.

c. Cut out an area between R1s for installing your aileron servo.

(34) Sheet (3/32" balsa) the rest of the top center of the wing, from the leading edge sheeting to trailing edge sheeting and from R2 to R2.

(35) Glue the six R1B ribs in place on the trailing edge. Sheet the top with 1/16" ply and the bottom with 3/32" balsa (CA).

(36) Cut and sand 5/16" sheet balsa ailerons. Remember, these are concave on top and convex on bottom. Sand the leading edge of the ailerons to a 25°-30° angle top and bottom. See sec. C-C.

(37) Cut hinge slots in trailing edge spar and ailerons. Lay ailerons aside for now.

(38) The tips are made from 1" triangular balsa.

(39) Glue the triangular piece (tip) in place on R6 with the outer corner aligned with the chord line.

(40) Carve and sand the tip to the shape shown in sections A-A and B-B.

(41) Carefully sand the tip down flush with the rib, sheeting, etc. Slightly round the edges.

(42) Repeat #39-41 for the opposite tip.

(43) The main gear mounts are made from hardwood, 1/4" x 1/2" x 8". Cut (using table saw if available) a 5/32" groove in the center of the 1/2" face of the stick for the landing gear wire. Drill 5/32" holes 7/8" from each end and then cut in the middle to make two, 4" long blocks.

(44) Epoxy the gear blocks securely to the spar doubler and ribs with the pre-drilled holes about 3/16" inboard of R2.

(45) Cut two pieces of hardwood (approx. 3/8" x 1/2" x 3/4") for a snug fit between the landing gear blocks and the top spar. Epoxy in place. Drill the 5/32" gear wire holes to a depth of 1".

(46) Drill ribs and install conduit for the antenna wire. Any light tubing may be used such as plastic drinking straws or outer NyRod tubing.

Canard (Stabilizer & Elevator):

(1) Cut 1/4" medium to hard sheet balsa to the stab outline and 3/16" soft sheet balsa to the elevator outline. Make an upper and lower template of the airfoil to check progress during sanding.

(2) Sand all three pieces to the airfoil shape with a 1/16" trailing edge on the elevators.

(3) Sand angles on the front edge of the elevators as indicated on the plans.

(4) Next, using epoxy, install the elevator coupler/control horn with the horn in line with the elevator servo arm. Note that down elevator gives a climb; "up" gives a dive . . . the opposite of conventional planes.

(5) After the epoxy has cured, cut the hinge slots and insert the hinges (but do not glue yet).

(6) Carefully sand the tips to an edge about 1/16" thick along the chord line.

(7) Glue the incidence blocks to the lower surface of the stab directly above the fuselage sides. Glue in a piece of 1/4" scrap inboard of each incidence block to align the stab.

(8) Lay the canard aside for now.

Fuselage:

The fuselage is straight former and sheet construction with the only "fitting" necessary being on the top sheeting. **Note:** Do not sheet the bottom until the wing is installed (Step #33).

(1) Cut the sides to shape, 3/32" wider (add to top) than shown on profile, from 1/8" medium to hard balsa.

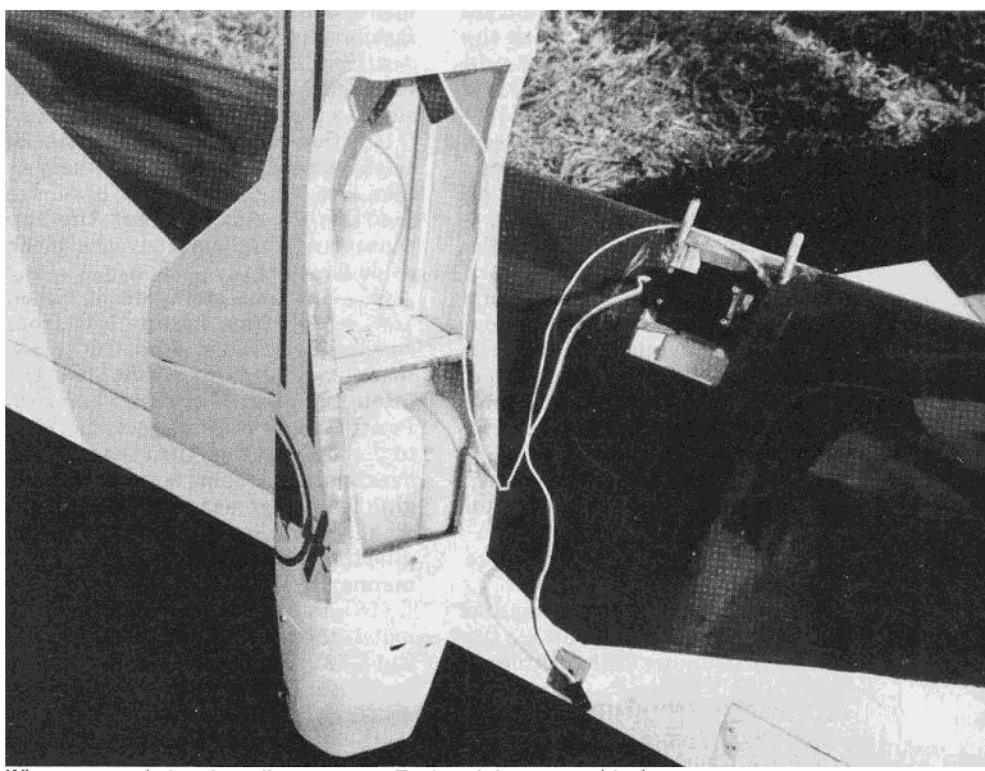
a. If you elect to make slab in lieu of convex sides, do not add the extra 3/32", i.e., cut as per outline on plans.

b. Lite plywood (1/8") may be substituted for balsa sides and will add about 2 ounces.

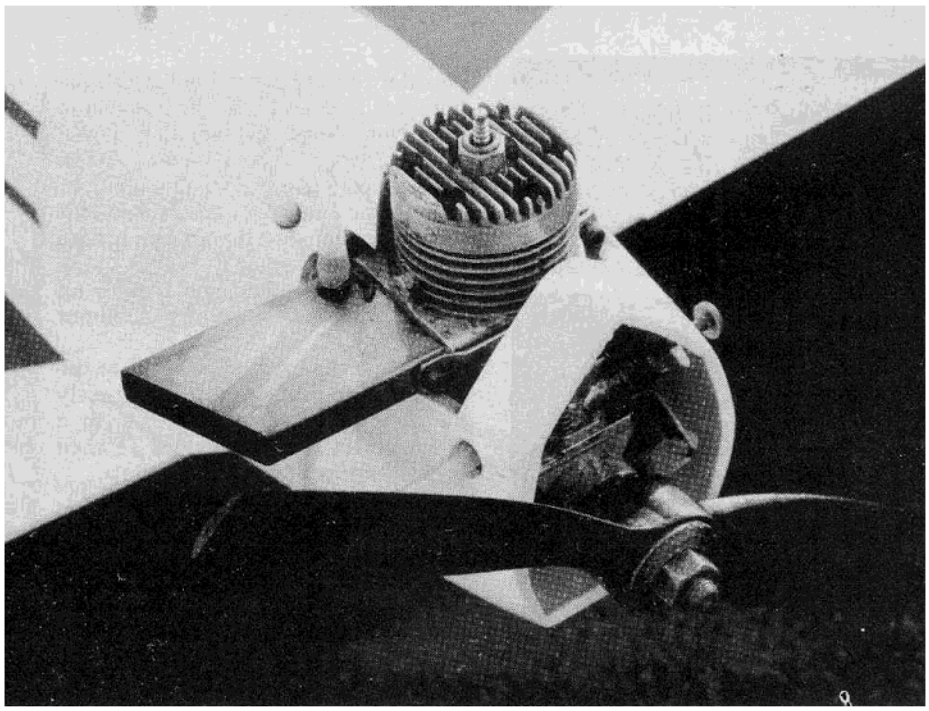
c. The shape of the nosecone is left up to the builder.

d. Do not overlook the 3/32" cut-outs for the ply plates over F1 and at the wing trailing edge.

(2) Mark the position of each former



Wing removed showing aileron servo. Fuel tank is wrapped in foam.



Pusher version shows an old model Fox .25 engine. Model can be built as a pusher or tractor version.

on the inside surface of each side piece; be sure you have one left and one right side.

(3) Cut all formers (F1 through F6, except F1a) to shape from materials indicated. Sand the edges lightly to insure good glue joints. Glue F2 to F2b and F4 to F4b, being sure that the joints match at the sides (CA). Drill 3/16" holes as shown in F4b for the wing dowels.

(4) Position F4a over F4 accurately and drill a 1/8" hole in location shown.

(5) Position your engine mount on F6 (F1 for tractor version), mark the mounting holes, fuel lines, and throttle cable position. Drill appropriate sized holes for each (4-40 screws and blind nuts are recommended for the engine mount).

(6) Position the nose gear mount on F2b, mark and drill the bolt holes.

(7) Cover the plan view with plastic.

(8) Beginning with F3 in place directly over F3 on the plans, put one side piece in place so that the bottom edge sits snugly against F3; spot glue with CA. After the glue has set for a few seconds, squeeze the side to a snug fit against the remainder of the former, taking care that it is at a 90° angle. Glue with CA and hold until set. **Note:** Take care not to get glue in the longeron notches.

(9) Glue F4 to the same side just like F3.

(10) Again, with the one side and two formers over the plans, attach the other side, beginning at the bottom of each former.

(11) Install F2 in like manner, plywood (F2b) portion down.

(12) Install F5.

(13) F1 may now be installed with epoxy. Apply epoxy freely to all mating surfaces. Place the former in position and clamp.

(14) Install F6 in the same manner as F1. If there is any tendency for the fuselage to twist, pin it securely to your building board until the epoxy has cured.

(15) Should any twist remain after the epoxy has cured, wet the fuselage sides and pin it down again, blocking to force a slight opposite twist. It should then dry straight.

(16) Starting with a block of balsa approximately 1½"h x 2¾"w x 1/2"t, fashion F1a.

a. Hold the block in position on the fuselage. Mark, then saw or carve the sides to the fuselage shape.

b. Either during or after carving the sides, cut the sides to a 45° angle as F2a, etc.

c. Do not worry about the top contour at this time; lay the block aside for now.

(17) Cut four stringers of balsa, 1/8" x 1/4" from scraps left from cutting the fuselage sides. Cut two of these to length to exactly fit along the fuselage sides and between F1 and F6. Position these two stringers, spot glue to the formers, then turn the fuselage over and, again being sure of trueness, glue the stringers to the fuselage sides along the entire length (CA). Fit and glue the bottom stringers in the same manner.

(18) Notch the top stringers to match the fuselage sides behind F1. Cut 3/32" ply to fit the notch, with the grain across the fuselage, epoxy the ply block in place.

(19) Cut two 3/32" pieces of sheet balsa to fit the top sides between F4 and the aft end of the fuselage. The lower edge is cut or sanded to a 45° bevel to fit snugly along the fuselage sides. Glue each side in position (CA). Sand the pieces flush with the front of F4.

(20) Glue F1a to the 3/32" ply over F1, then tack glue F2a and F3a to F2 and F3, and C1 to the inside of the fuselage stringers. Do not use more than a drop of glue on these as they must be cut loose later (CA).

(21) Glue a short piece of 1/8" dowel in the previously drilled hole in F4a. With a piece of kitchen plastic wrap (the plastic must be very thin) between the two, place F4a in place with the dowel through F4. Do not glue these.

(22) Mark and cut the cockpit (hatch) side pieces (F4 forward) from 3/32" sheet balsa. Trim the lower edge to a 45° angle and check the fit. Sand the aft ends (next to F4) for a tight fit against the aft side pieces. Glue the sides to F1a, F2a, F3a, C1, and F4a, making sure that they are not glued to the fuselage sides or to F4.

(23) The exact treatment you desire on the nose of the aircraft is left to your taste.

(24) Sand the top and bottom of the fuselage even with the formers and stringers. Keep the top surface between F4 and F6 flat so the fin has a solid mating surface.

(25) Starting on top at the forward end, cut 3/32" sheet cross grain, fit and glue to sides. Cut the next piece and glue it in place. Continue until you reach the windshield area. Beginning at the other end, again sheet to the windshield area. Sand the windshield area to prepare the glue surfaces. Cut the windshield piece a little large, then sand the lower edge to mate with the sheeting. Glue in place with CA.

(26) Cut 3/32" plywood, cross grain, to fit the cut-out below F6. Trial fit the ply piece to be sure it will readily bend to the contour of the sides. Score the outer surface, with the grain, every 1/8" or so to assist bending. Epoxy in place. Epoxy a 1/2" square piece of 3/32" ply inside, centered for the wing bolt as shown.

(27) Place the wing in place and check the fit. Cut two 3/8" wide strips (grain lengthwise) of 1/32" plywood to fit between the wing and fuselage, from F4 to the front edge of the wing bolt plate. Scoring the forward portion of the upper surface (cross grain) will facilitate bending to a good seat. Spread epoxy freely on the fuselage surfaces, fit the ply strips extending 1/4" outside the fuselage (flush inside). While the epoxy is wet, insert the wing; clamp in place. A couple of large rubber bands around the fuselage and under the wing will hold it on (I like sandbags for these situations).

(28) Optional but recommended: Form a fillet in the ply-fuselage

juncture with either epoxy and micro-balloons or spackling compound.

(29) Draw a line as shown on the plans to separate the canopy hatch from F1a. With a razor saw or razor blade, cut through the sheeting and F1a. The resulting bevel cut allows sufficient bearing surface for installing the screw. Drill as shown with a 1/16" bit for a #2 x 3/4" sheet metal screw, or tap for a 4-40 nylon bolt, whichever is available.

(30) Cut F2a and F3a from F2 and F3. Cut C1 from the fuselage stringers. The canopy may now be lifted off.

(31) Again, place the wing on the fuselage and hold with rubber bands. Trial fit the two 3/16" diameter x 1¾" long dowel pins through the holes in F4b, into the slots in R1. If they seat firmly, epoxy them in place.

32. Recheck wing for squareness to the fuselage. Then drill a 1/8" pilot hole as shown for the wing bolt. Remove the wing, ream a whole in the wing to 3/16" and tap the fuselage for a 10-32 screw. **Note:** If taps aren't available, file two opposing grooves on the end of a steel screw to make your own taps. These work well in wood.

(33) Beginning at F4, sheet the bottom of the fuselage with 1/8" balsa (grain crosswise).

(34) Cut scraps of 1/4" balsa to fit and epoxy them in the corners behind F1 and F2, and ahead of F6.

(35) Sand excess wood from top and bottom sheeting, slightly rounding all edges.

(36) Carve a block of soft balsa (grain fore and aft) or foam to a rough shape of your desired nosecone (tailcone on a tractor version) and glue it in place. When the glue has set, finish carving and sanding to the shape you desire.

(37) Cut a piece of hardwood (3/8" x 3/8" x 1/2"), glue to forward side of F2 as shown (CA, epoxy).

(38) Position the canard on the fuselage and drill through the stab and hardwood block on F2 with a 3/64" drill. Tap the hardwood block for a 4-40 nylon screw (use a 6-32 screw if it will make you feel better) and ream out the stab hole to 7/64". Apply a couple of drops of CA on the top, bottom and inside the hole to strengthen the area and help prevent dents in the stab caused by the screwhead.

(39) Sketch the outline of the canard stab in the appropriate location on each side of the canopy hatch. Use an X-Acto knife to remove most of the cut-out. Sand to clear canard. When it fits smoothly, extend the cut-out aft 1/8" to accommodate the elevator torque rods. When the canard is installed on the fuselage, the hatch should fit without binding and without gaps around the stab.

(40) Install the nose gear mount on the aft side of F2b. Insert a sharpened piece of 5/32" music wire or drill bit through the bearing holes and drill a pilot hole in the bottom sheeting. Turn the fuselage over and drill the pilot hole to 1/4".

(41) Install the rudder NyRod, carry the forward end well into the servo bay to allow placement of the servo wherever needed. The other pushrods are contained within the fuselage, so may be installed along with the servos.

(42) The fuselage is now ready for covering, glassing, or painting. The engine cowl should be removed from the fuselage before covering if using plastic film or painting, but if glassing, leave it intact and glass the entire assembly.

a. Before separating the cowl, measure the engine with mount to determine the proper location for the cylinder head, exhaust port, needle valve, etc., mark the outline of these 1/8" outside the actual dimensions and cut openings.

b. Cut the cowl from the fuselage with a razor saw or blade, staying immediately against the firewall.

c. Temporarily mount the engine on the firewall, trial fit the cowl and trim as necessary for easy mounting and removal.

d. Mark three of four appropriate places around the cowl for blocks to secure the cowl (hardwood blocks about 1/4" x 1/4" x 3/8" are adequate). The blocks need not be attached at this time. I recommend that you place them in the wet epoxy while installing the engine mount. They may be drilled for #2 x 3/8" sheet metal screws after the mount is affixed.

Vertical Fin And Rudder:

1. Cut the strips for the vertical fin from 3/16" medium sheet and the rudder from 1/4" soft sheet. The rudder is purposely a little thicker at the forward edge than the fin to gain the slight extra effectiveness this may give.

2. Cut the rear spar (rudder post) to length, then glue a piece of 1/32" x 3/16" ply (grain lengthwise) along the forward edge (CA). Cut the hinge slots in the post before further assembling the fin.

3. Cut the other outside pieces and glue them together on the plastic covered plans, then add interior braces being sure that you have snug fitting joints. Please resist any impulse to cut the fin from a solid sheet, as the aft weight is very undesirable.

4. Sand a radius on forward and upper edges of the fin and lightly sand the sides to insure smooth joints.

5. Sand rudder hingeline bevels (30°) and taper.

6. Cut the hinge slots as shown on the plans, drill holes in appropriate positions for your rudder horn.

7. Lightening holes, as indicated on the plans, may be cut / drilled in the rudder.

8. Finish sand with very fine sandpaper.

9. Lay the pieces aside until you are ready to cover. Install the hinges after fin and rudder are covered.

Gear:

1. Bend the main landing gear legs from 5/32" music wire. All bends are 90° so it isn't difficult, but there is a 20° sweep which I found tricky to get equal in each leg. I suggest that you begin with the axle-to-strut bend and work toward the anchoring end. That way you only have one bend where you must consider the 20° offset (sweep).

2. The nose gear is a DuBro® #154 bent to length as shown on the plans. The shock coil is outside the fuselage --- allow 1/8" to 1/4" clearance between the bottom of the fuselage and the top of the coil. File a flat for the steering arm set screw.

Author getting things ready for another flight.

Covering — Painting — Sealing:

1. Whatever your choice of covering may be, do thoroughly seal the engine and fuel tank areas with two coats of thinned epoxy.

2. Books have been written, not to mention numerous magazine articles, on finishing . . . so I won't go into details here. Besides, almost everyone I know does a better job than I do. I will point out that the glassing of the fuselage added only 3/4 of an ounce and the second coat of epoxy added another 1/4 ounce of weight. The fuselage of the original including canopy / hatch, and wing tips were painted with K & B Super Poxy®. The canard, wing, and vertical fin, including all control surfaces, were covered with MonoKote®.

3. If you have trouble getting MonoKote to adhere to any area that has epoxy on it (as well you may), try rubbing on a thin coat of Ambroid® cement and let it dry. The MonoKote will then adhere like it grew to the part.

Engine Mount And Tank:

1. Set your engine on the mount to be used. Mark and drill holes for the engine mounting bolts or screws.

2. Engine mounts seem to transmit less vibration to the structure if secured with both screws and epoxy. I have found the following procedure to be reliable (another idea from Charlie Duke):

a. Coat the engine mount attaching bolts with wax. Any paste, household or automobile wax will insure a release from epoxy.

b. Cut a piece of lightweight fiberglass or Dacron cloth slightly larger than the firewall. Cut holes to match mounting bolts, throttle wire, and fuel lines.

c. Cover the firewall, including fuselage side ends, with a thin coat of epoxy. Place the cloth in the epoxy, aligning cut-outs with the holes in the firewall; saturate the cloth with epoxy.

d. Install the engine mount, snugging — but not forcing — the screws.

e. When the epoxy is set, trim the cloth around the fuselage edges.

3. Using screws (plastic mounts), or bolts (aluminum mounts) as appropriate, secure the engine firmly to the mount.

4. Mount the tank with the fittings forward and the pickup (clunk) toward the engine. This is the same relative position as in a conventional plane. Pad the tank with foam rubber and block it securely with balsa scraps.

Final Assembly And Trimming:

1. Epoxy the hinges in the control surfaces. After the epoxy has set, epoxy in the main structure (wing, canard, vertical fin).

2. The vertical fin may be installed with CA (gap filling or slow setting) but first take a large pin and punch a series of holes along the bottom of the fin and in the mating surface of the fuselage. These holes allow the CA to penetrate, thus acting as dowels or attaching pins. Run a thin bead of CA along both surfaces. Carefully place the fin in position so that it is parallel with the horizontal axis of the fuselage and perpendicular to the lateral axis. Hold for a few seconds for the CA to set.

3. Install the main gear with metal or nylon straps and small sheet metal screws. Install the nose gear and wheels.

4. Install the aileron servo and connect the pushrods (the wing must be complete prior to balancing).

5. Mark the balance point on the fuselage with a wax pencil (it will readily wipe off).

6. Secure the wing and canard with the bolts. **Note:** Cut the wing bolt so that it cannot bear on the tank.

7. You can now set the radio in the fuselage and arrange the components to obtain the best balance. If the model cannot be balanced with the components alone, it's suggested that you install them in the most forward locations that are convenient, beginning with the batteries immediately behind F1. This is followed by the servos with the receiver in the most aft location. Add weight only after all servo rails, trays, etc., are installed.

8. Check lateral balance, also. The plane should balance when held by the nose and propeller shaft, if not, add weight to a wingtip to balance.

9. I recommend that movements as given for low rate be used for the first few flights. I have found that excess aileron movement (such as 9/16" up and 7/16" down) can result in very sudden snaps and drastic changes of direction --- which are disconcerting. If movements are within the indicated limits, the craft is very docile. I am using a dual rate radio. The figures given for low and high rates have been adequate:

Aileron:
low = 1/4" up, 1/8" down
high = 1/2" up, 5/16" down

Elevator:
low = 1/4" up, 1/4" down
high = 9/16" up, 9/16" down

Rudder:
3/4" to 7/8" either side

Flying:

If your controls are hooked up correctly, the plane's response will be the same as for any other plane. In other words, your Mockingbird will follow the same path as the plane you have been flying when the same stick movements are applied. Think in terms of elevator movement to give nose up — or nose down.

You may notice a tendency for the plane to tip towards the outside of tight taxi turns. Remember, the plane is being pushed through the turns rather than pulled through as you are used to. Don't rush your taxi around the end of the runway and you will be all right.

Take-off should be smooth as with any aircraft. Don't force too much back stick or the nose can pop up and immediately stall (the canard is leaving ground effect). Other than that, and the lack of an accelerated slipstream over the control surfaces, it will fly like a stable sport plane, probably a little faster and more responsive than a trainer, but still gentle and forgiving.

Ailerons are responsive immediately after take-off and right up to touchdown, so you have full control. If your controls are set near the maximums indicated, go easy on the ailerons the first time or so.

Go-arounds should perhaps be started a little earlier than you may be used to as acceleration is less than with some planes, although not

Bill Of Materials

8 — 3/32 x 3 x 36" balsa
3 — 1/8 x 3 x 36" balsa
1 — 3/16 x 3 x 36" balsa
1 — 1/4 x 3 x 36" balsa
1 — 5/16 x 3 x 36" balsa
or
1⅜ x 1½ x 36" balsa TE stock
1 — 1/2 x 2¾ x 1½" block
2 — 1 x 6½" balsa triangular stock
1 — 1/32 x 6 x 12" ply, or scrap box
1 — 1/16 x 6 x 12" ply, or scrap box
1 — 3/32 x 1½ x 14" ply main spar doubler
1 — 3/32 x 6 x 12" ply, or scrap box
1 — 1/8 x 6 x 12" ply, or scrap box
1 — 3/16 x 6 x 12" ply, or scrap box
1 — 3/16 diameter x 4" hardwood dowel
1 — 1/8 diameter x 1" hardwood dowel
1 — 1/4 x 1/2 x 9½" hardwood

Wheels/Landing Gear
2 — 2¾" diameter wheels
1 — 2¼" diameter wheel
1 — 5/32 x 20" music wire
1 — 5/32" nose gear

Misc. hardware and other items
Fuel tubing, engine mount, screws, epoxy, CA (regular), NyRods, wheel collars, hinges (10), aileron horns (3), wing bolts, covering material and/or paint, throttle wire, hardwood scraps for aileron mounts, elevator horn set, landing gear straps.

drastically so.

Stalls are gentle with a few degrees drop of the nose, then a return to nose up as airspeed increases. If control pressure is held, a nose up and down oscillation ensues.

The rudder is a tad slow in moving the plane, but it is adequate for coordinated turns and providing directional control during take-offs and landings. You may find that more rudder movement, up to 1" or 26° may be desirable.

Both take-offs and landings are in a nearly three point attitude. It frustrates me that I cannot get the nose up for landing, but in a greater than three point attitude, it either climbs or the airspeed rapidly drops to nearly nothing. The result of that is a "flop" type landing. So far, I accept this characteristic as typical of the breed, but if anyone has any ideas on the point, I would be happy to hear from you.

I take it that whoever builds a Mockingbird has flown R/C, however, if you haven't and can find an agreeable instructor, I feel the Mockingbird will be a satisfactory trainer with the control surface movements near the lower figures given. With surface movements toward the upper figures, I'm sure you will enjoy a different and exciting sport plane.

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Andy Lennon has a recent book published that is very interesting: "Canard, A Revolution In Flight." It's available from Zenith Aviation Books, 729 Prospect Ave., Osceola, Wisconsin 54020 at $17.95 plus $2.95 postage.

While writing this article, I also learned that he has a second book, "R/C Model Airplane Design," which includes data on canard design. This one sells for $16.95 plus $2.95 postage and should be well worth obtaining by all serious modelers. It is also available from Zenith (see ad). □

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