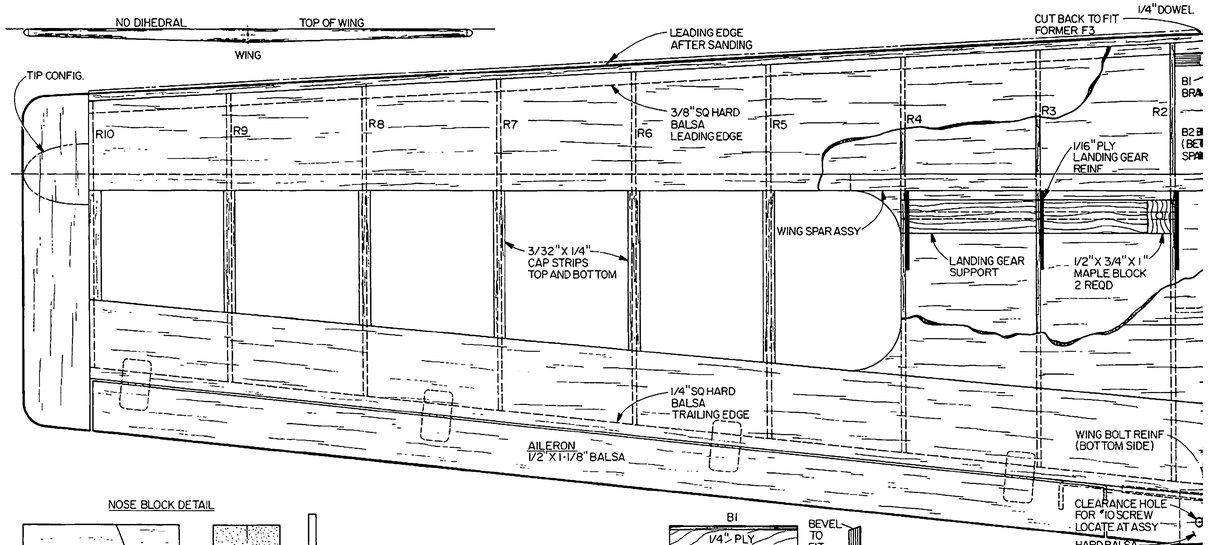

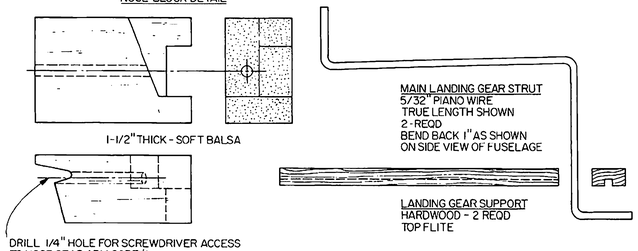

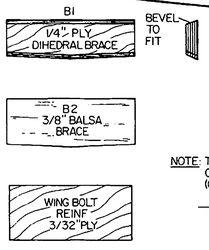

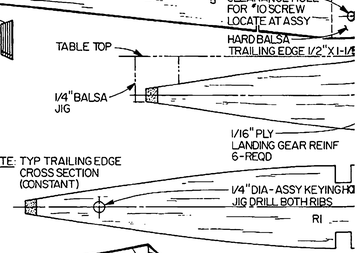

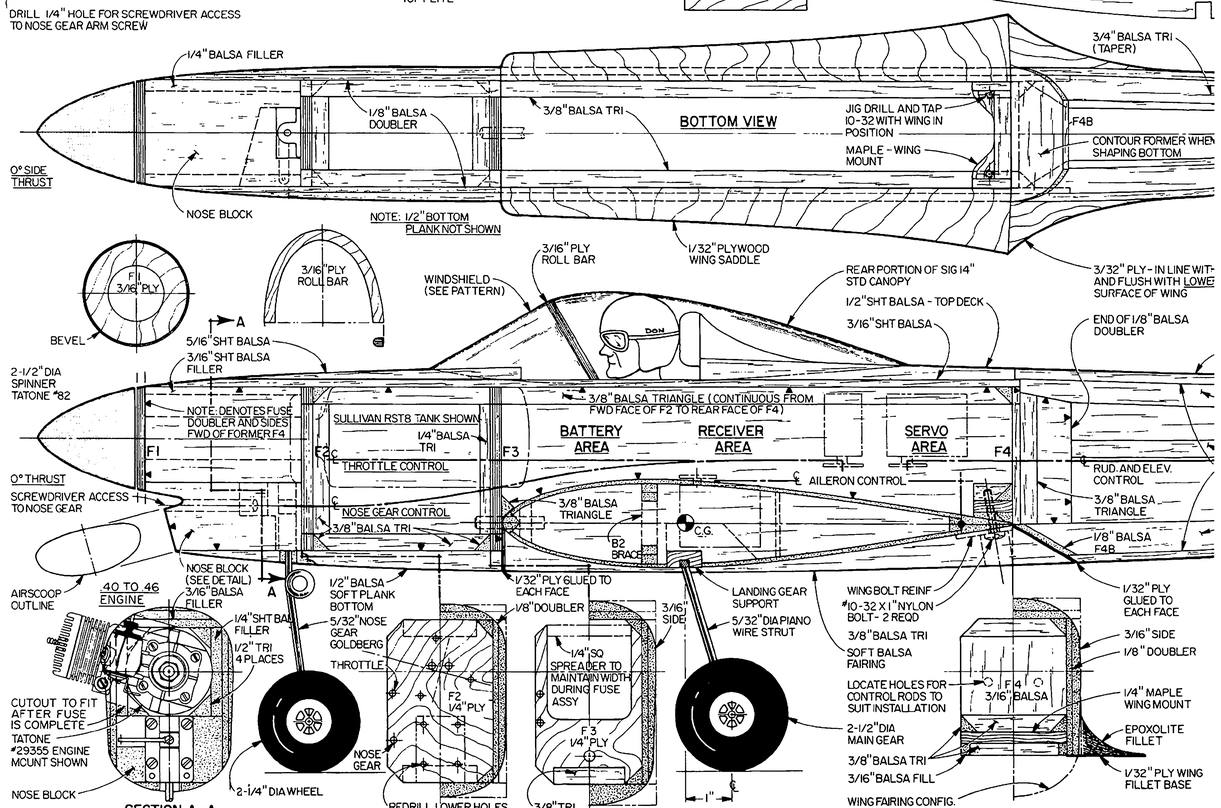

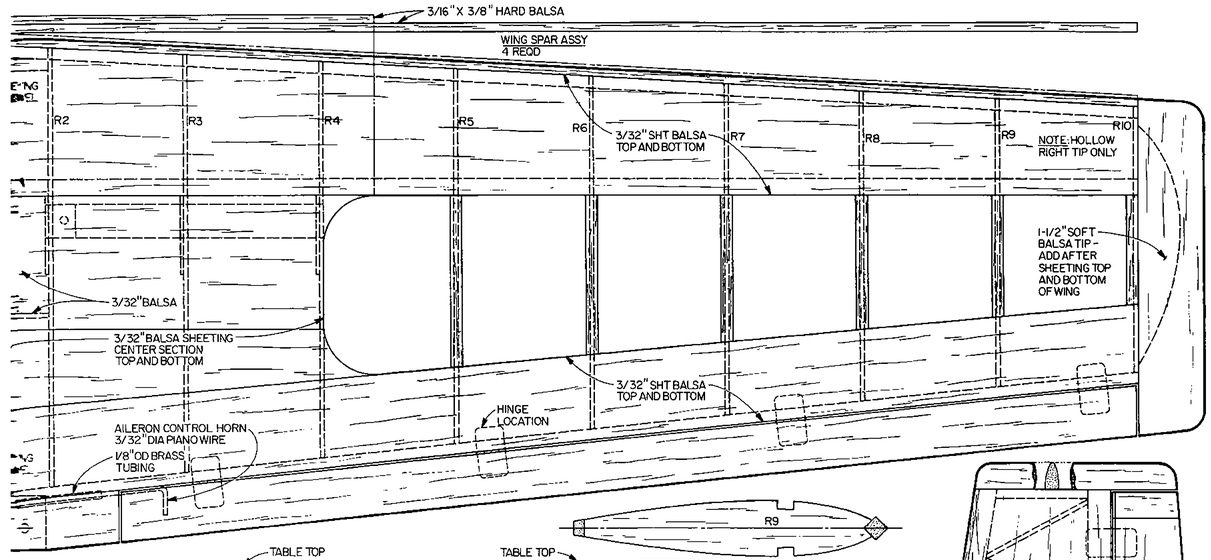

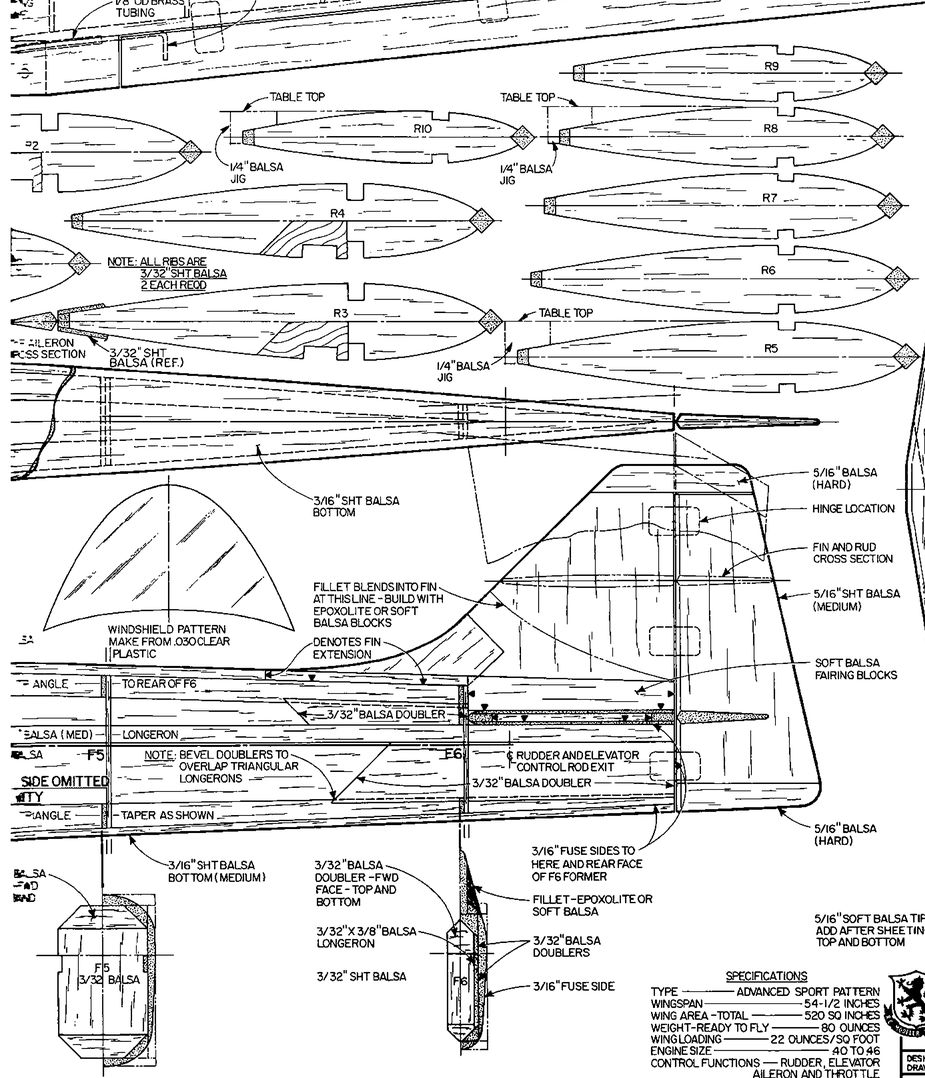

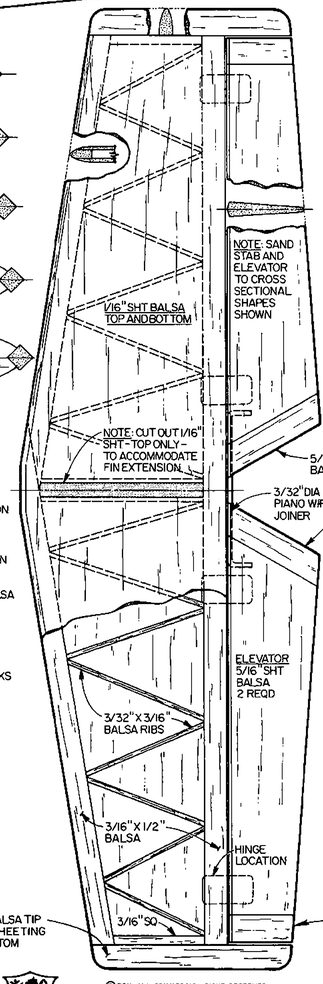

AVATAR

SPECIFICATIONS

TYPE	ADVANCED SPORT PATTERN
WINGSPAN	54-1/2 INCHES
WING AREA - TOTAL	520 SQ INCHES
WEIGHT-READY TO FLY	80 OUNCES
WING LOADING	22 OUNCES/SQ FOOT
ENGINE SIZE	40 TO 46
CONTROL FUNCTIONS	RUDDER, ELEVATOR AILERON AND THROTTLE

DESIGNED AND DRAWN BY: DON GRASSI / ARRANGED AND INKED BY: JERRY SMITH

0 1 2 3 4 5 6

PLAN NO. 765

AVATAR

Don Grassi's .40 sized machine has it all put together in one package. At 5 lbs., it's alive and eating up the sky.

Avatar — "A Variant Phase/A version of a Continuing Entity." The design presented here is exactly that --- it didn't start out that way, however. It started out simply as a "scaled down" .40 sized version of my Avanti. (See the May 1974 issue of R/C Modeler Magazine.) But being a compulsive designer, "slight modifications" to update the design were impossible to resist. So --- the dominoe theory took over, resulting in a bird that doesn't really resemble the Avanti in outward appearance even though it is essentially the same aerodynamically, since the force arrangement, relative areas, and wing and power loadings are quite similar.

The attitudes that prevailed when I undertook this project to "scale down" the Avanti, were that .40 sized pattern ships are just not smooth and groovy, lack penetration and act badly in crosswinds. I sort of refused to accept what I was hearing and proceeded on the basis that "all generalizations are false" and specifically that a good clean design with sufficient power, having about 520 square inches of wing area and weighing about five pounds, would perform satisfactorily.

For starters, the horizontal tail surface was lowered and placed on the thrust line; the rationale being to improve the appearance of the rolling maneuvers, if not the actual maneuver itself. Then the fuselage lateral area was modified and redistributed for improved knife edge characteristics. Having made those two "slight modifications," any resemblance between this bird and Avanti would not be purely coincidental.

The Avanti wing planform was retained and simply "scaled down" since it worked well and looked just fine. However, the dihedral was deleted to improve inverted flight stability. The progressive airfoil concept used so successfully on Avanti (17% thick at the root and 18.5% thick at the tips) was also retained; however, on Avatar the tip thickness was changed to 18% (the racer's edge?). Except for a slight amount of positive incidence built into the wing seat (only to preclude the possibility of an inadvertent negative angle of incidence) the design features a zero/zero set-up.

The motor chosen for both versions was the HP .40 with a Super Semco expansion muffler. This combination was more than adequate and, though I have not tried a conventional .40 (not Schneurle ported), I am sure that any good .40 would do the job quite handily. The motor was side mounted on a metal mount fifteen degrees above horizontal. The side mount was chosen over the more conventional upright since it gives a cleaner looking model from above and from the left side, while tucking in the muffler closer to the fuselage. The choice of fifteen degrees above horizontal was necessary for muffler clearance with the fuselage without unwanted extensions, and actually turns out to be a very neat and compact installation.

Avanti did not use wing fillets, so the first version of Avatar was built without them; however, wing fillets were added on subsequent versions.

The performance difference was surprisingly noticeable to say nothing of the aesthetic improvement, making the

ABOUT THE AUTHOR

Donald A. Grassi was born in 1924, in Fairfield, Connecticut. He majored in aircraft design at the Academy of Aeronautics, N.Y., and is presently Manager of Engineering, Raytheon Co., Missile Systems Division, Lowell Plant, Lowell, Massachusetts.

He has been designing and building model airplanes since he was 9 years old and has dabbled in just about every phase of the sport/hobby through the years.

In the post-World War II years, he was a serious free-flight competitor with a very enviable record in the Northeast. He currently limits his modeling activities to sport flying radio control models of his own design, both pattern and Stand-Off Scale.

He is a Past President of the 495th Radio Control Squadron, Chelmsford, Mass., and has held various other offices in that active Massachusetts Club.

AVATAR

Designed By : Donald A. Grassi

TYPE AIRCRAFT
Advanced Sport Pattern
WINGSPAN
54½ Inches
TOTAL WING AREA
520 Square Inches
WING LOCATION
Low Wing
AIRFOIL
Symmetrical
WING PLANFORM
Double Taper
DIHEDRAL, EACH TIP
None
OVERALL FUSELAGE LENGTH
46 Inches
RADIO COMPARTMENT AREA
(L) 11⅜" x (W) 2½" x (H) 2"
STABILIZER SPAN
21⅝ Inches
STABILIZER CHORD (incl. elev.)
5½" (Avg.)
STABILIZER AREA
120 Square Inches
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Mid-Fuselage
VERTICAL FIN HEIGHT
7¾ Inches
VERTICAL FIN WIDTH (incl. rud.)
7" (Avg.)
REC. ENGINE SIZE
.40-.46
FUEL TANK SIZE
8 Ounces
LANDING GEAR
Tricycle
REC. NO. OF CHANNELS
4
CONTROL FUNCTIONS
Rud. Elev., Throt., Ail.

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa, Ply & Hardwood
Wing	Balsa & Ply
Empennage	Balsa
Wt. Ready-To-Fly	80 Ounces
Wing Loading	22 Oz./Sq. Ft.

effort well worth the little extra building time required. Along the same vein, the fin was smoothly faired into the fuselage to clean up that turbulence generator.

The resultant design is a groovy .40 sized machine that eagerly goes wherever it is pointed and sort of slips through the air effortlessly with a responsiveness and silky smoothness that is truly reminiscent of a .60 sized pattern ship. All of this, while still retaining the excellent low speed stall characteristics of the Avanti --- it really leaves very little to be desired.

CONSTRUCTION

My versions of Avatar weigh five pounds (80 ounces) resulting in a wing loading of 22 oz./sq. ft., consequently they are extremely lively and flair out beautifully on landings. I am sure the design can support a little higher wing loading, but I would recommend you keep it light by carefully selecting your balsa. Use **soft** balsa blocks and planks, and soft/medium sheets. The use of hard balsa should be restricted primarily to structural members such as wing spars, wing leading edges, and to those places as noted on the plans. Where there are two or more of any piece required, cut them at the same time and

sand them stacked to ensure that they are identical. This holds especially true for the wing ribs and fuselage side panels. Since hand cutting is not as precise as die stamping, it generally pays to temporarily assemble things and check for good fits before gluing.

WING:

A "true" tapered wing can be best achieved by the use of a jig that permits the building of the wing in one piece. However, for the benefit of those who do not use a jig, the folowing procedure in conjunction with a **flat** work surface will produce very satisfactory results.

In essence, each wing panel is built separately, upside down or "bottoms up," then joined by the use of short pieces of dowel keys at the center ribs.

Cut out all ribs and stack and tape both R1's together and jig drill (preferably with a drill press) two 1/4" diameter holes, as shown, through both of them. Identify each rib "top" to take care of any non-symmetry realized in the drilling.

Make one each of the trailing edge jig blocks from 1/4" thick balsa, as shown on ribs R2, 5, 8, and 10, and pin these to the plan, at their respective locations. Since the trailing edge has a constant cross-section, it can be cut out on a table saw. Pin the trailing edge to the wing jig blocks after lining the interface with wax paper. With the use of a straight edge and square, make sure that the trailing edge is straight and directly over its position on the plan.

As discussed earlier, fit all parts before gluing. Pin all the ribs to the plan and to the trailing edge. Since the wing is being built upside down, pin ribs R2, R3, and R4 to the plan with the landing gear support notches **up**. Next make the wing spar assemblies as shown and test one of them in the rib notches. It should lay in there straight and flush with the rib top surfaces. Place the leading edge in position. It should be straight and in contact with each rib notch. Make any corrections as required before proceeding. Before gluing anything, check all ribs for location and squareness to the work surface. When you're stisfied with everything, glue away.

Assemble the landing gear rib reinforcements to their respective location and insert the hardwood landing gear support into the notches. The landing gear support should protrude 3/32" above the ribs to allow for sheeting. When all is "go," apply epoxy liberally, clamp everything together and hang out to dry. The torsion block (undrilled) should be installed next.

After sanding away any surface projections, add the 3/32" bottom sheeting and cap strips. It usually helps to wet the exterior surface of the leading edge sheeting to help form it to shape. Let this assembly dry thoroughly while still pinned down. Remove the wing panel from the work surface (save the wing dihedral jigs for the opposite wing panel) and install the upper wing spar assembly.

Build the other wing panel in the same manner.

JOINING THE WING PANELS AND AILERONS:

When both panels are at the above stage of completion, they should be joined together sort of like the way procupines make love — very carefully. This is one operation that can make the difference between a bird that "flies right off the board" and "instant kindling wood." Check R1 for squareness with the top surface of each wing panel by placing the panel "bottoms up" the way you built it onto the work surface. If it is not square, sand R1 perpendicular to the work surface using a square sanding block. Put the two panels together and insert a piece of 1/4" diameter dowel about 1/4" long through each of the keying holes in ribs R1. The surfaces and all edges of both panels should be flush and even. When satisfied, glue the two panels together with the dowels in place.

Install the center section gusset between the upper and lower spars. Install the 1/4" thick plywood leading edge gusset and fill in with micro-balloon loaded epoxy between the wing leading edge and the gusset.

Make the servo compartment to suit your servo; the one shown is for a Kraft KPS-10. After sanding away any projections, add the top sheeting and cap strips. Cut out the wing tips slightly oversize and glue the left one on permanently. Tack glue the right one only for removal and hollowing out after shaping to the proper contour.

Add the aileron control horn assembly to the wing panels by epoxying the outer tube only to the trailing edge centered on the hinge line. Cut out the ailerons slightly thicker than shown to allow for final sanding and assemble them to the wing with hinges but without glue. Glue the hard balsa center section trailing edge block between the ailerons checking for freedom of motion with the ailerons and the control horns. Lock the ailerons in "neutral" with tape and sand the complete assembly to final shape. Remove the right wing tip and hollow it out, then glue it on permanently. In sanding the leading edge radius, a smaller radius at the center section, that progressively becomes larger towards the tips, will improve the tip stalling characteristics of your wing.

TAIL GROUP:

Only a few words are required since this assembly is rather straightforward. When locating the center stabilizer ribs, make certain they are square with the trailing edge and spaced apart for a snug fit with the fin. After top and bottom sheeting is complete, add the tips and then cut out the top sheeting only between the two center stab ribs to accept the fin extension. Glue up the two elevator halves and, while still pinned to the work surface, connect them with the 3/32" diameter music wire using epoxy.

Prior to contour sanding the fin/rudder, and stab/elevator, cut all the hinge slots and assemble them without glue. Then sand to shape as shown. Do not contour sand the portion of the fin extention that protrudes below the fuse top planking. Glue the fin into the stab checking for squareness and perpendicularity.

FUSELAGE:

The typical pattern ship box fuselage consisting of two slab sides, separated by bulkheads, closed up with top and bottom planking and contour sanded to shape, is employed on Avatar.

Glue up a pair of fuselage slab side assemblies (one right, one left) including **all** doublers, longerons and triangular stock as shown on the plan. After these have dried thoroughly, tape them together accurately paying particular attention to the wing seat and aft fuselage portion. Sand the outer edges so that they are identical. In cutting out the bulkheads, note that F2, 3, and 4 are exactly the same width and, at this point, drill all the required holes in them. Install the blind nuts to the aft face of bulkhead F2 for the motor mount and the landing gear mounting block. Note that the lower two holes in the landing gear mounting block are not used since they are too close to the edge of F2. Re-drill them as shown, and install it **now**.

Add all the required cross pieces and doublers to the bulkheads as shown. In some cases, these are of triangular stock and, in others, rectangular stock.

If you don't have a fuselage building jig, the following method will produce very satisfactory results. Pin one of the sides down to the work surface and, without glue, fit F2, F3, and F4 in their respective locations; then put the other side on and check for fits, squareness, and alignment. When all is okay, liberally apply slow-curing epoxy to all interfaces, reassemble, realign, and add a flat wieght to the upper fuselage side from forward of F2 to aft of F4. Jig F2, F3, and F4 so that they remain perpendicular to the work surface during the curing cycle. When the assembly is fully cured, plan and install **all** control rod outer tubing. Sand away any projections and add the lower nose block and all required filler blocks and triangular stock to the engine compartment. Glue the 1/2" thick balsa plank to the underside of the fuselage at F2 and F3. Add the 3/16" sheet top deck and, when dry, trim it flush. Using the plan view as a template, pin the fuselage assembly "bottoms up" (always "bottoms up" — must be a message in there somewhere) to the plan directly over F2 through F4 and weight it down so that it can't move. Glue the aft end of

the fuselage sides together and jig them perpendicular to the work surface directly over the plan. Install bulkhead F5 and F6 and jig the sides so that they are vertical and follow the curvature of the plan. Add the lower bulkhead F4B and the 3/16" bottom sheeting. When dry, remove the assembly from the work surface and add the remaining top fuselage planking.

Drill out the motor mount allowing 3¾" from the rear of the spinner to the mounting face and install the mount to F2. Cut out the motor access opening in the fuselage side to fit your motor/muffler combination. Square off the front face of the fuselage and epoxy F1 to the fuselage when you have the correct clearance all around (about 1/16" between the rear face of the spinner and F1).

Go ahead; you're entitled, start chopping away at this (Ugh) heavy box and sand to the contours and cross-sections as shown.

FINAL ASSEMBLY:

Install the maple wing bolt block to the fuselage (undrilled), and add the wing bolt reinforcement plate to the underside of the wing as shown. Accurately locate and drill the wing for the 1/4" diameter dowel and insert it allowing for the 1/32" plywood wing fillet base. Assemble the wing to the fuselage and measure the distance from each wing tip to a point at the rear of the fuselage and, when the wing is accurately positioned, lock it in place and drill through both the wing reinforcement plate and the maple wing bolt mounting block in the fuselage with a #10-32 tap drill. Disassemble, englarge the holes in the wing for both clearance and tap the wing bolt mounting block.

For a real neat wing fillet, try this: wrap the wing center section with Saran Wrap or the backing from Super MonoKote that you've been saving for something. Cut out and glue the 1/32" plywood wing fillet bases to the fuselage wing saddle using a relatively slow drying glue (such as white glue) and pin or tape them in place. Then bolt the wing to the fuselage. Next, add the 3/32" thick plywood rear fillet piece to the fuselage flush with the under surface of the wing and let dry. Disassemble and, with a spatula, make a fillet with Epoxolite to the approximate shape shown. Let this firm up for awhile, then, using your fingers as a radius tool (wetted with dope thinner), form the radii of the fillet removing any excess material. With this method, I've achieved fillets with almost no sanding required.

Reassemble the wing to the fuselage and add the fairing block to the lower wing surface using real **soft** balsa. After sanding the fairing block to match the fuselage contour and cross-section, I usually glue a piece of 1/32" thick plywood to each face to keep them neat and free of nicks.

We can now add the tail feathers to this peacock. Reassemble the wing to the fuselage and add the tail group. This step is another of those "if you don't do it right, there won't be a second flight." So — measure, re-measure, then glue it on. After it is dry, measure again and, if it isn't right, saw it off and do it again. Add the fuselage fin fairing blocks and sand to shape to match the fuselage, then fair in the intersection of the fuse/fin with Epoxolite using the same method as used in making the wing fillets.

At this point, you should "side to side" balance your bird. (You do want a balanced bird, don't you?) with a side mounted motor and muffler hanging off it, the imbalance is significant. I suspend the plane with string under the prop shaft and under the top rudder hinge, and add steel wood screws as required to the outer rib (screwed through the rib and into the left wing tip block).

FINISHING:

Since there are so many choices and each is worthy of a separate article, I won't go into great detail here except to say that all my versions of Avatar were covered with a combination of Super MonoKote and Superpoxy.

The wings, ailerons, elevators, and rudders, were covered with Super MonoKote. The fuselage and fins were hysol resined, primed with Super Poxy Primer and sprayed with Super Poxy for the final finish. The wing tips and elevator tips were also finished with Super Poxy. This combination is a really good compromise between ease of application/durability and weight.

Just one of the reasons for the choice of a Super Poxy finish on the fuselage was to get a "super clean" canopy installation, and it goes like this --- hysol resin the complete fuselage and fin using lightweight glass cloth for added strength, if you prefer; then wet sand the entire assembly. Add the roll-over bar to the cockpit and completely finish the cockpit area under the canopy only. After trimming and fitting the canopy and windshield, completely mask the outside surfaces of both pieces with masking tape except for about 1/16" all around where they attach to the fuselage. Clean the inside surfaces of each piece with detergent and tape the rear canopy portion to the fuselage in a couple of places. Then glue (Wilhold R/C 56 works great) the unmasked portion of the canopy to the fuselage all around and let dry. Do the same with the windshield, gluing it to the roll-over bar also. Run a fillet bead of Hobbypoxy "Stuff" all around the unmasked portion of the canopy and windshield and lightly sand smooth. With the masking tape still in place, completely finish priming and painting the fuselage.

Remove the masking tape and you should have a canopy that looks like it "grew" out of the fuselage.

BALANCING:

Since the model is already "side to side" balanced, we only have to balance for fore and aft CG location. My versions of Avatar handle beautifully with the CG as shown on the plan and there was no difficulty in achieving this balance point with the equipment located as shown. However, different choices of motor, muffler, airborne pack and finish will affect this. The servos can be moved forward from where they are shown and there is room for the battery pack under the fuel tank, if needed, and, of course, there is always the option to (Ugh) add lead as required when all else fails.

FLYING AND TRIMMING:

My versions of Avatar are set up with 5/16" up and the same amount of down on each aileron; 3/8" up and the same amount of down on the elevator and "all I can get" on the rudder, just short of interfering with the elevator when hard-over. This amount of travel is more than required for the pattern maneuvers so that, in the case of a "good" loop or roll, full stick throw is not required, but it's there for the "hot dog" maneuvers which really turn me on.

If built relatively true and with the CG close to where it's shown on the plan, your bird should require only minor trimming to bring it "right on." However, if you experience any real difficulties, I suggest you **study** Chapter One of RCM's Flight Training Course, Vol II. □

From RCModeler June 1979