"Ahead of," or "in front of...."
The Avanti is a .60 powered full pattern ship for the advanced Sunday Flyer.

By Donald A. Grassi

avanti

"Avanti" translated means "ahead of," or "in front of." I'm not quite sure just what this creation is ahead of or in front of, but the name seemed to have a nice ring to it, so "Avanti" it is.

The design presented here is the result of a four year labor of love that started with a compulsive desire for a good looking "groovy" model that I could call my own, capable of doing the full pattern, with good low speed landing characteristics. The "Avanti," which is the fourth in a series, has, in fact, turned out to be all these things and it is with great satisfaction that I dedicate this article to the 'Sunday Flier.'

At the outset, many of the then current designs were studied both on paper and at the flying field. The "Kwik Fli" was chosen as the point of departure, consequently the first version in the series was a modification of the "Kwik Fli," but as the design evolved the similarities all but disappeared.

The original versions had rectangular wing planforms which, ultimately, evolved into the current tapered wing. While the rectangular planform was more forgiving in the round maneuvers, such as loops and Figure Eights, the tapered wing reacts better in the rolling maneuvers. Besides, the tapered wing just plain looks

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better. The earlier versions had a symmetrical airfoil of 18% constant chord to thickness ratio. The present design uses a symmetrical progressive airfoil, 17% thickness at the wing root and 18.5% at the tips, which enhances the wing tip stalling characteristics. No, that doesn't mean the tips stall better – it means they stall last! The wing is set up with 1/16" positive incidence, the engine with 1½ degree downthrust. This setup, coupled with the progressive airfoil, makes possible truly low speed approaches with a minimum of attention required on the elevator, and landings that flare out beautifully.

CONSTRUCTION

Before getting into the details of construction, several comments are in order. All four versions of this design were covered with silk and dope and weighed in at 6¼ to 6½ lbs. when new. As each of the previous versions grew older and heavier with successive repair jobs (due mostly to running out of air and the inevitable sudden stops) each became less responsive and generally more difficult to handle on low speed approaches.

The most recent version weighs 100 oz. (6¼ lbs.) which seems to be ideal, so keep it light. If you plan to cover with one of the heat shrink materials you can build a little heavier, but if you plan to silk and dope, select your balsa carefully. Use soft balsa blocks and planks and medium/soft on all sheets. The use of hard balsa should be restricted to the wing spars and leading and trailing edges, to the fuse keel and stringers, and a few other selected places, as noted on the plans.

Regarding the non-controversial science of gluing, I'd like to say that while I'm not a member of the cult that goes around demonstrating with placards stating "Help Stamp Out Epoxy," I do believe that its indiscriminate use produces a model that is unnecessarily heavy and with the advent of the five minute stuff its use has gotten somewhat out of control. It does, however, have its undisputed place such as in and around the motor compartment, installing the firewall bulkhead, the motor mounts, the landing gear mounts, and other high stress locations. On all other balsa to hardwood, or balsa to plywood joints I use white glue. On all balsa to balsa joints I use Ambroid (double glued) with the only exception being gluing up the fuse doublers to the fuse sides where contact cement works quicker.

A flat working surface is mandatory. One that works quite satisfactorily and is relatively stable can be made by contact cementing together two pieces of 3/4" x 18" x 48" particle board which is available at your local lumber yard.

WING

To obtain a "true" tapered wing the best results are obtained by using a wing jig, or as I prefer, a dihedral board that permits building both wing panels simultaneously. However, for those who have neither a jig nor the building space required for the one piece construction, the following procedure will provide very satisfactory results.

Tape one of the wing panel plans to your work surface, the right one first if you're North of the equator, and the left one first if you're South of the equator.

Start construction by cutting out two each of all ribs to the outlines shown, sanding them in pairs. While both R1's are still clamped together jig drill two 1/4" diameter holes (as shown) through both of them, preferably on a drill press. These will be used later for accurately joining the wing panels. Make one each of the jig blocks shown on Ribs R2, 5, 8, and 11, from 1/4" or thicker balsa. The bases of these jig blocks should be square with the sides. Pin them down firmly, centered under their respective

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ribs. In order to prevent gluing the wing to the jig blocks, line the interface with small pieces of wax paper. Cut out the trailing edges to the shape shown – they have a constant cross section and therefore can be cut on a table saw.

Put your glue guns away for awhile and start by pinning the trailing edge to the jig blocks. It should be **straight** and directly over the location shown on the plan. Double check this with a square before proceeding. Locate and pin ribs R2, 5, 8, and 11, to the jig blocks and to the plan just forward or aft of the spar notches. You should now be able to lay in the upper wing spar and the 3/8" square leading edge and, if all has gone according to plan, the leading edge should be straight and in contact with all the rib notches. If not, send a strong letter to Don Dewey – otherwise proceed by pinning the leading edge to the ribs. Locate and pin the rest of the ribs in the same manner. When all is go, remove the wing spar. Remove R2 only and glue it to the leading and trailing edge repinning it to the leading edge and to the jig block. When pinning the rib down to the plan, make sure that it is in contact and square with the building surface. Proceed in the same manner, one at a time, with ribs R5, 8, and 11, then all the others. Glue R1 to the leading and trailing edge at an **angle** to the building surface using the wing dihedral jigs shown on the plan.

Glue in the upper wing spar doubler and the upper main spar making sure it's flush with the top surfaces of the ribs.

When dry, sand away any projections and carefully sand the upper surface of the leading edge flush with the ribs to the shape shown on the rib outlines. Glue on the 3/32" trailing edge sheeting and after wetting the external surface of the leading edge sheeting, glue it in place. Do not sheet the center section yet. Add all the upper capstrips to R5 through R11 and let dry thoroughly.

Remove the wing panel from the building surface, saving the wing dihedral jigs and jig blocks for the opposite panel. Turn the wing over and, using epoxy, install the landing gear mount so that it protrudes 3/32" above the ribs. Then install the 1/16" ply reinforcements and the maple landing gear torsion block.

Following the same procedure as in the three previous paragraphs, install the leading and trailing edge sheeting and the capstrips to the bottom of the wing. Trim the sheeting overhang flush with R1 and R11 and, after **rough cutting** the tip block, hollow it out and glue it on.

Build the opposite wing panel in the same manner.

JOINING WING PANELS AND AILERONS

Place the bottom of the wing on the work surface and block up the tip rib 1". Using a square sanding block, sand across R1 so that it is square with the work surface. After doing both wings, check for a good fit and, using epoxy, align and join the two panels using two pieces of 1/4" diameter dowel (well vaselined for later removal) inserted in the jig holes in R1.

Remove the center section of R1 by cutting vertically along the forward faces of the main spars and at the rear of the servo compartment, which is shown for a Kraft KPS-10. Vary the loaction of the rear cut to suit your servo. Glue in the two 1/4" thick balsa gussets from R2 to R2 between the

spars then add the 3/16" rear servo compartment gusset. Using R1 outline, Cut out and install the 3/16" servo compartment side walls. Add the servo mounting rails and complete the top and bottom center section sheeting.

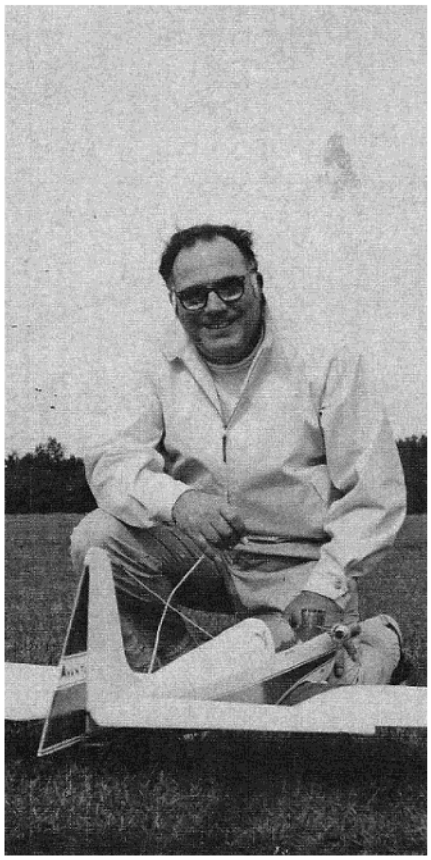
Cut out the ailerons slightly thicker than required but to the correct taper angle. Install the aileron horns using epoxy, make 1 left and 1 right hand. Cut the hinge slots in the ailerons and the wing panels and, using flat hinges, install them on the wing panels without glue. Notch the wing trailing edges as shown to allow forward movement of the horns.

Cut out a piece of hard balsa 3/4" thick to fit between the ailerons and slot it out for clearance with the aileron horns and notch it to allow rearward movement of the aileron horns. Check both ailerons for freedom of motion. Then **tack glue** it onto the trailing edge (for later removal when covering and finishing). The wing is now ready for final sanding. Using lots of masking tape, lock the ailerons in neutral position and sand them, the wing tip trailing edges, and the wing center section trailing edge assembled. After final sanding is completed, apply brush-on epoxy to the wing tips as shown and fiberglass the center section of the wing, top and bottom, about 6" wide and sand smooth when dry.

TAIL GROUP

This is pretty straightforward; however, a few words are in order. When locating the two center ribs on the stab, make sure they are perfectly vertical, square with the trailing edge, and spaced apart for a snug fit with the 3/8" fin. After sheeting top and bottom, sand flush with the tip rib faces and add the tip blocks, then cut out the top sheeting **only** between the center ribs and the leading and trailing edges for the fin extension. Glue up the two elevator halves and while still pinned to the plan, connect them with the 3/32" dia. music wire horn using epoxy.

Prior to contouring the fin and rudder and, likewise, the stab and elevator, cut the hinge slots in all pieces and, using flat hinges, assemble the fin to the rudder, and the stab to



the elevator without glue. Sand to shape and contour as shown. Do not contour the portion of the fin that fits into the stab. Fit and glue the fin into the stab making sure that the fin is square with the stab and that the fin trailing edge is perpendicular to the stab.

FUSELAGE

Cut out the fuse sides, fuse doublers and wing seat stiffeners making sure they're identical. Glue them up, one left hand, one right hand, using contact cement on the fuse doublers and fuse sides. **Accurately** mark all bulkhead locations on the inside surface of both assemblies, and pin them down to the work surface. Make the two motor mount assemblies from 3/8" thick maple and the balsa wedges as shown on the detail, then epoxy them into the slots in the fuse doublers. Cut out and install the 3/16" engine compartment spacers and the 3/16" x 1-5/8" wedges. Now cut out and install all the various pieces of triangle stock with the exception of the vertical 1/2" and 3/4" triangle pieces at F1 and F2. Install the 3/16" x 1/2" longerons to the aft fuse section, the 3/4" trailing edge pieces at the fin and add the 1/16" doublers back there. Using white glue, install the 3/32" thick plywood dowel reinforcements (undrilled) making sure to allow for the thickness of F3 and F5.

You now have a pair of paddles that don't remotely resemble an airplane fuselage – and heavy? – but have faith – mush on!!! At this point, clamp, pin, or tape the two assemblies together accurately, outside surface to outside surface, and sand the outer edges so that they are straight, square-edged and identical. Stay away from the wing seat curve for now. While the two assemblies are still clamped together, drill them out for the 3/8" wing dowels. Cut out bulkheads F2, 3, 5, 6, 7, and 8. Make sure that F2 and F3 are **exactly** the same width and F5 is 3/8" wider than F2 and F3. This is important since these bulkheads will determine the parallelness of the assembled fuselage. Drill F2 and F3 for the throttle and landing gear linkages and F2 for the fuel lines and nosegear block. Bolt it on now. Glue a couple of 1/4" x 1/4" spreaders to F3 to maintain its width dimension during assembly. These will be removed when the fuse is all built up. Add the 1/8" x 1/2" doublers to the rear of F5, 6, 7, and 8, as shown on the plan.

Pin one of the sides down to the work surface and, using **no glue**, place F2, F3, and F5 in their respective places, then place the other fuselage side on and check for alignment and fit. The two sides should line up and be parallel and square with the building surface. Check the bulkheads for perpendicularity with the sides. When you are satisfied that all is O.K., liberally apply **slow curing** epoxy and Ambroid, as required, to all the flying surfaces of F2, 3, and 5, and the fuselage sides. Reassemble and align everything to make sure they are square and parallel and add a flat weight to the upper fuselage side from forward of F2 to beyond F5. Jig F2 so that it is perpendicular to the fuselage sides. Double check for alignment, squareness and perpendicularity, and let dry overnight. Remove the assembly from the building surface and, using the plan view as a template, taper the mating surfaces of the longerons and the 1/2" x 1/2" triangles at the rear of the fuselage to the

required angle. Place the fuselage assembly (from F5 aft) on the plan (right side up) with the centerline of F5 coincidental with the centerline on the plan. Check the fuselage sides for perpendicularity with the building surface and jig the forward fuselage section so that it is centered over the plan. Now glue the aft end of the sides together, jigging them perpendicular to the work surface. Install bulkheads F6, 7, and 8, making sure the fuselage curvature follows the outline and let dry.

Remove the assembly from the work surface and add the 1/8" sheeting (crossgrain) to the bottom of the fuselage. Cut out F4B **without notches** and install it with the 3/16" aft deck piece. Next, glue together the 3/8" and 3/16" planks that make up the forward top deck; then make the 60 degree angle cut at the rear for F4B. Hollow it out for the fuel tank as shown, and glue it to the fuselage, then cut out F4A (oversize) and **tack** glue it to F4B for later removal when fitting and installing the canopy. Check the spacing between the motor mount with your motor. If you have to do any filing to fit, do it now. Cut out the side nose blocks and epoxy them to the motor mounts and F2, after determining which side the one that's slotted for the steering gear arm goes on. Fit the bottom nose block and glue it in place between the side nose blocks, then add the 3/8" balsa battery compartment block to the fuselage. Square off and sand the front face of the fuselage to the 1½ degree downthrust angle. Cut out F1 and, using your spinner as a gauge, taper it as shown, and temporarily install it with the motor, using 1½ degree shims. Drill out the mounts and bolt the motor down and, with the spinner and prop in place, locate and glue F1 to the fuselage (not the motor). Let it dry this way; then remove the motor, prop, and spinner. Now, add the 1/2" and 3/4" triangles (trimmed to shape) to the rear of F1 and to the forward face of F2 and F5.

You can now get out your old World War II machete, or your favorite ax, and start chopping away at this 10 pound crate. Sand the fuselage to the contours shown on the plan. Go slowly at F1 and where the canopy joins the fuselage, especially at the forward end.

For a neat canopy installation, set it in flush with the turtledeck and with the sides of the fuselage. Remove bulkhead F4A which was supposed to be only tack glued – remember? Sand it down so that it's smaller than F4B by the thickness of the canopy material, then glue F4A on permanently. Likewise, undercut the 3/16" thick fuselage flat deck by the canopy material thickness.

FINAL ASSEMBLY

Carefully sand the wing seat to fit the wing contour. Then install the 3/8" wing dowels and assemble the wing to the fuselage, aligning for squareness, equal distances from ribs R11 to fuselage, and from the tips to the centerline of the fuselage at the rear and all those good things. While still assembled, cut out and fit the balsa wing fairing block and glue it to the wing, then sand it to the fuselage contour. With the wing still accurately located, add the tail group to the fuselage, again, checking for all those good things. Double gluing **this joint** is mandatory if you're not a believer. Add the fin fairing blocks to both sides of the fin and sand to shape.

FINISHING

There have been so many words written on this subject and there are so many options I won't go into details. However, some general instructions regarding the hidden aileron horns, are in order.

Detach the wing center section trailing edge that was tack glued on and remove the ailerons. Then tack glue it on again and cover and COMPLETELY finish the wing. After covering and finishing the ailerons, white glue or epoxy the hinges to them. To install the ailerons, NEATLY slit the top covering only of the wing center section trailing edge at the wing trailing edge and hinge it out of the way. Vaseline the aileron horn slot liberally, install both ailerons and epoxy the center section trailing edge to the wing.

BALANCING

Install all flight equipment except the elevator, rudder, and motor servo tray. Turn the bird upside down and tape the servo tray with servos to the wing at the approximate position shown. The balance point should be on the line of the landing gear wires where they run along the wing. Move the servos until this balance point is reached and, if necessary, move the battery pack in its compartment. When the proper balance point is reached, install the servo mounting rails and install the servo tray. Check for side to side balance and, if necessary, add the required tip weight.

FLYING

The control surface movements shown on the plan are "as measured" from my bird and were derived by adjusting until they suited me. As specified, they afford more than adequate control and even if such is not your preference, it is desirable on initial flights to have a reserve for trimming.

All versions of the "Avanti" were powered with Enya .60's, the first three with the .60 II and the current one with the .60 III. The increased power of the .60 III, coupled with the 100 oz. (6¼lb.) flying weight of the current version, produces a delightfully lively bird that goes through its maneuvers in a manner that can best be described as graceful. It can be flown slowly without "falling out of the sky" and, conversely, will climb vertically until practically out of sight.

While the Winter evenings devoted to designing and building are an important part of the hobby to me, the gratification of flying a unique model is really where it's at. The "icing on the cake," however, will come from knowing that the "Avanti" has given some enjoyment to those of you who decide to build it. I will be happy to answer your questions and sincerely look forward to your comments. Have fun!!! □

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