

# Force 5

Frail birds and high winds don't mix too well. Here's a machine for those less than perfect days/Howie Applegate

PHOTOGRAPHY: TRACY APPLGATE



**F**orce 5, described by the "Beaufort Scale" as a fresh breeze of 19-24 miles per hour, or 16-20 knots. Although some of us sailplaners don't feel too comfortable flying in Force 5 winds, this ship is designed to take it, and handle well to boot.

This aircraft is designed around a wing with an aspect ratio of 11.19, which is quite normal for machines of this size. The airfoil is a Göttengen 609 which is blended at the tips. The wing outer panels are washed out approximately 2-1/4 degrees, which gives very desirable stall characteristics. Let's get on to building:

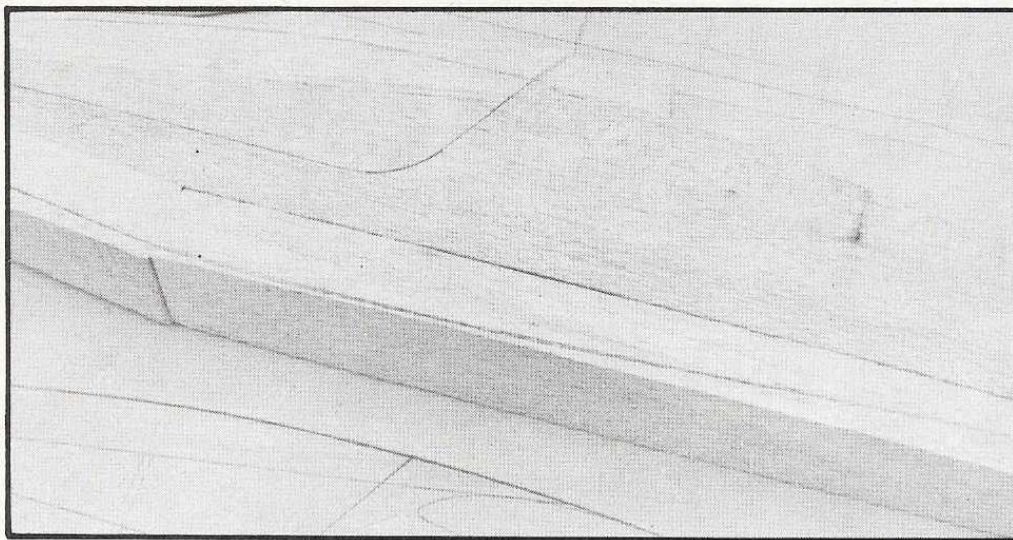
## Tail Structure

The horizontal tail is flat in lower camber so it can be built directly over the plans. Pin down the lower trailing edge 1/16" x 1", the lower leading edge 1/16" x 1/2", the 1/16" sheet lower center-section (leave a 1/8" wide gap in the lower center-section for the spar which will be added later). Insert the 1/16" x 5/16" lower tips and all the 1/16" thick ribs and install the 1/16" x 1/2" upper trailing edge. Now add the 1/8" x 1/4" spruce leading edge. (This lays flat on the 1/4" face). A 1/16" x 1/4" balsa cap goes over the 1/8" x 1/4" spruce. Install the 1/4" x 5/16" tips and the 1/4" thick leading edge gusset, and tip gussets. You may want to install the 3/32" x 1/8" diagonal braces in the three bays outboard of the spar ribs. Install the 1/8" x 1/4" spruce spar after securing the 5/32" O.D. brass tubing to it. This tube is what holds the stab onto the airplane, so wrapping the thread on them to hold them in place is a good idea. Epoxy is not necessary to use if the thread is smeared with Ambroid or Tite Bond. If you do use epoxy, however, make sure the inside of the tubing is free of it as it will really be a job to remove it after curing.

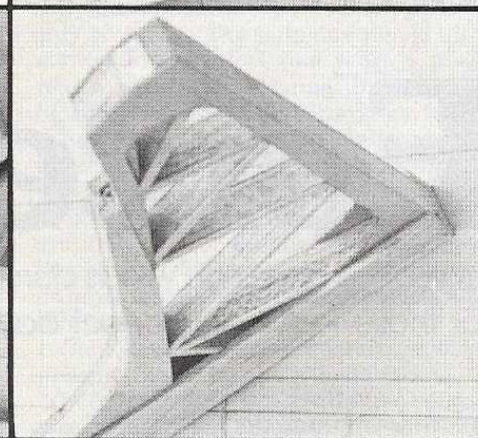
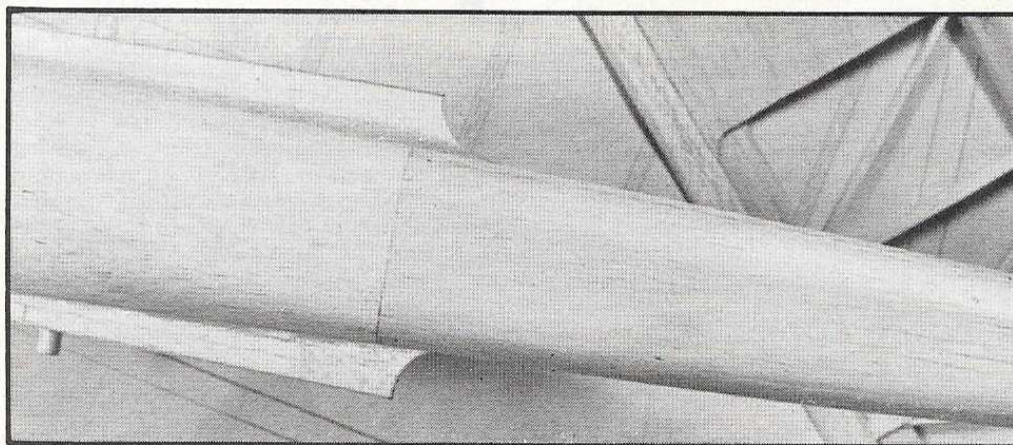
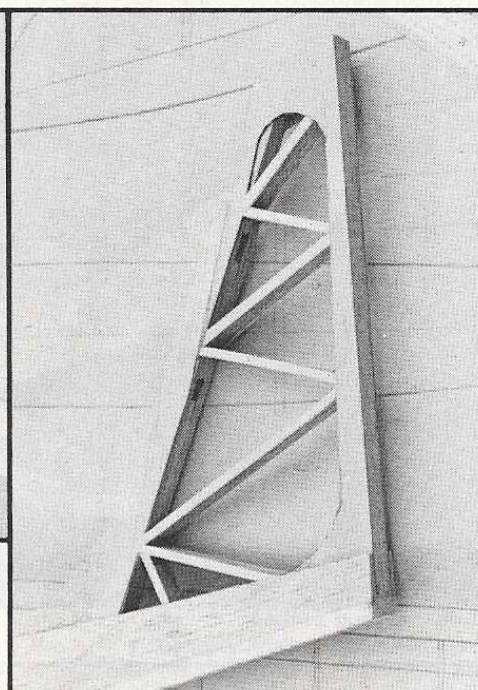
Install the remaining diagonal braces, upper center-section sheet, and 1/16" x 3/16" capstrips. The stab is now ready for sanding.

The rudder is framed out in 1/4" x 1/2" balsa with 1/16" x 1/2" ribs. The trailing edge should be shimmed up with 1/8" thick scrap balsa to centralize it during the build-up. Install a control horn seat of a build-up to 1/2" or a piece of 1/2" sheet.

The vertical fin is a sandwich, consisting of a 3/16" thick balsa core, a 1/8" thick doubler on either side of a core, and a 1/32" plywood outer cap. The 3/16" leading edge core has a piece of Gold'n Rod inner tube bound to it



The fuselage blocks are seen here ready for the shaping. It is best to trace the outline on both sides. **At right top:** The fin showing thread binding which holds Gold 'N Rod control cable sheath in position. **Below:** The fillets are small, but functional. A build-up of plastic wood kept the sanding to a minimum. **Lower right:** The fin is an inch thick, a rugged airfoiled stab mount, an integral part of the fuselage.



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with thread. The tube is the path for the .030 flex cable, which flies the stab. Use 1/32" thick balsa sheet to make up the thickness where the plywood caps end. The ribs are 1/8" x 1/2" balsa. After the fin is finished, sand it in profile only. The fin will be an integral part of the body.

## The Fuselage

While it may look complicated, it is quite straight-forward in construction. Start by cutting the two sides out of 1/8" medium balsa, splice at the tail if you use 36" long wood. If you are really good with a modeling knife, you may be able to use the canopy sides that you cut from the fuselage sides. The sides are laminated with 1/32" ply doublers from the nose to just aft of bulkhead 5. The rear part of the sides take 1/64" ply doublers from aft of bulkhead 5 all the way back.

Bulkheads 1, 2, 3, 4 and 5 are 1/8" ply; all the others are 1/8" balsa. After contact cementing the plywood doublers to the inside surfaces of the fuselage sides, glue the two sides to the vertical fin. Install the bulkheads starting at the rear, working forward.

Add the lower 1/4" balsa triangular strips and glue on the 1/4" thick balsa aft belly, and belly blocks. Now is a good time to install the rudder control Gold'n-Rod and the outer sheath of the stabilvator cable and Gold'n-

Rod combination. These two rods will terminate just forward of bulkhead 5, the rudder rod on the right side approximately as shown on plans. Glue the upper 1/4" triangular pieces in place and add the 1/4" balsa top. The grain is widthwise from bulkhead 8 to the notch in the fin and length-wise from 8 forward to 5. Glue a second thickness of 1/4" balsa on the top from bulkhead 5 to 6.

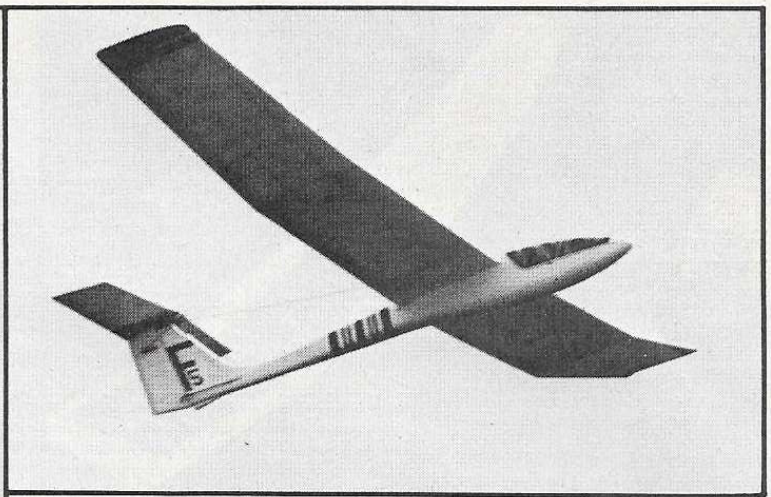
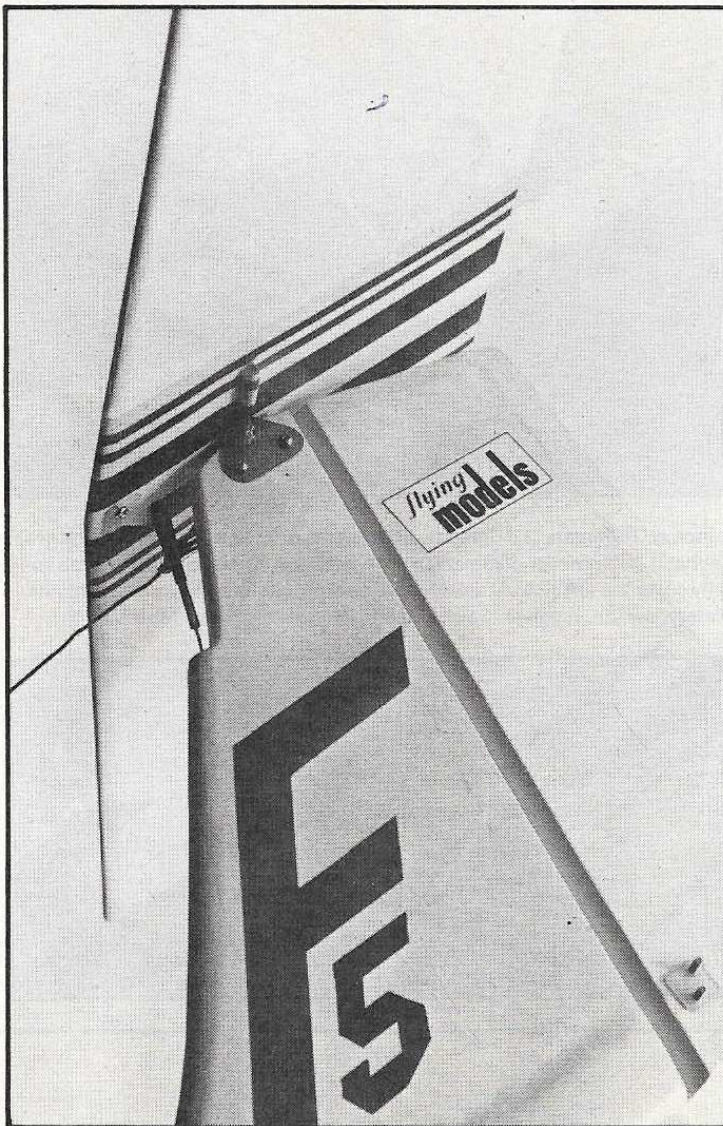
The canopy sides should be placed in position next and the balsa bulkheads installed. Be careful not to glue the canopy to the fuselage sides. Bevel the canopy top block as shown on the plans and notch it to fit into the fuselage sides between bulkheads 4 and 5. Please note that this block must have another piece glued to the bottom of it between bulkheads 4 and 5. When you are satisfied with the fit of the canopy top block, glue it to the canopy sides. Fit the triangular filler block to the nose and the canopy block. This should have a piece of 1/32" plywood glued to the back face of it. When you are satisfied with the fit, glue it to the fuselage, not the canopy. Now sand the front belly block and the filler block flush to bulkhead 1. Drill a 3/16" dia. hole through filler block into the canopy block. Glue a piece of 3/16" dia. dowel into the hole in the canopy block. This dowel will act as a key to hold the canopy in position. Note the end of the dowel should be

somewhat rounded and protrude about 1/8" into the filler block. Now glue the nose block (grain lengthwise) in position. After trimming the belly, nose, and canopy blocks to the planform of the fuselage, trace the profile of the fuselage on them and whittle or bandsaw to shape. Install the sub-rudder (two thicknesses of 1/8" balsa) and set the fuselage aside.

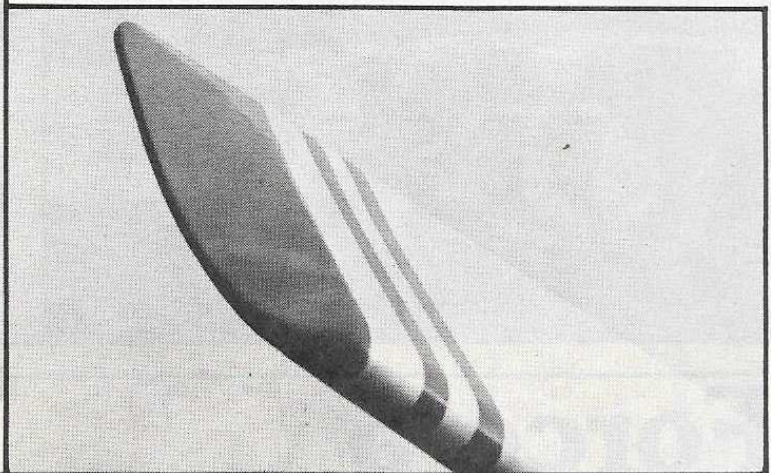
## Wing Assembly

The wing is conventional, but should be constructed carefully. The main spar consists of two 1/8" x 3/8" spruce members and a shear web of 1/16" balsa.

Start with the inboard panels first. Shim up the 1/16" x 1-1/4" balsa lower trailing edge and pinning down the 1/4" x 5/16" leading edge. Glue all the ribs in place and add the upper spar member. (The outboard rib should be angled to agree with the setting template). Now install the upper spar member and trailing edge stiffeners. Unpin the wing panel and install the lower spar member and 1/8" x 1/4" spruce rear spar. Remove the wood between the spars at the first two ribs and insert the 1/16" plywood members to form the wing joining box. These plywood pieces are bevelled on the outside edges to provide for a good epoxied joint. Insert some 1/4" square scrap in the wing join-



You can so fool with Mother Nature. It's a real kick to core into a thermal and ride free. Solar energy! **At left:** Close-in look at the rugged fin, huge rudder and stab pivot fitting, cable attachment. **Beneath:** The underside of the wingtip, carved to a slightly concave contour, lessening the tip weight.



ing box and apply epoxy to the seam between the plywood and the spar members. Hobbyepoxy-4 is fine for this operation. Do not get epoxy inside the box.

Sand the upper surface of the lower trailing edge to a fine taper and install the upper trailing edge. Bevel the upper leading edge and install the upper 1/16" balsa sheeting. Fill in the upper inboard bay with 1/16" balsa sheeting also.

The outboard panels are almost the same as the inboard, but 1/4" wash-out is built in at the tips. Start by shimming the lower trailing edge sheet 1/4" at the inboard rib and 1/2" at the tip. You will have to use various thicknesses of shims in between. Pin down the leading edge and install the ribs. At this point you may have to make some adjustments in the twist of the trailing edge sheet. Use the setting template to angle the inboard rib. Install the upper spar member (1/8" x 3/8" spruce), and the trailing edge stiffeners. Install the upper trailing edge (this one goes out to the tip), upper spar, and rear spar. The leading edge will have to be tapered as well as bevelled to accept the upper 1/16" sheeting. The upper spar cap will need some bevelling too.

Install the 1/16" shear webs to the front faces of the spar to both inboard and outboard panels. The wing joining boxes do not need

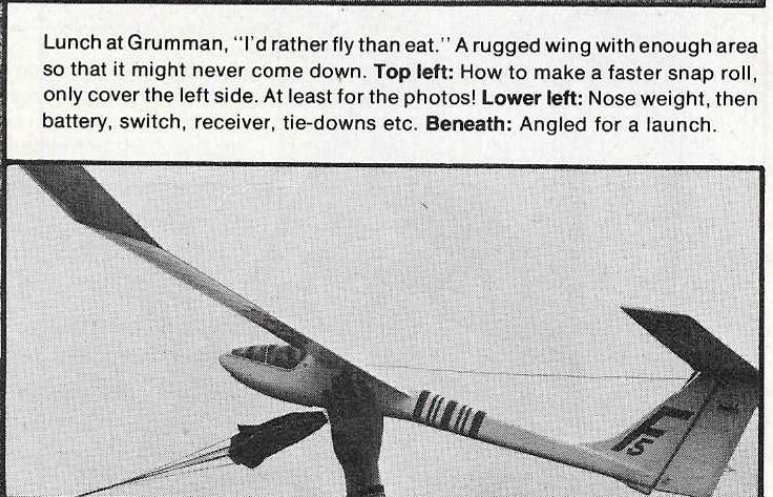
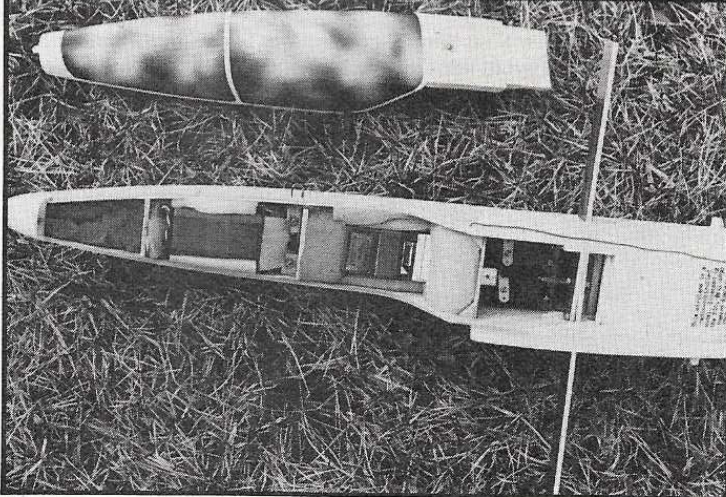
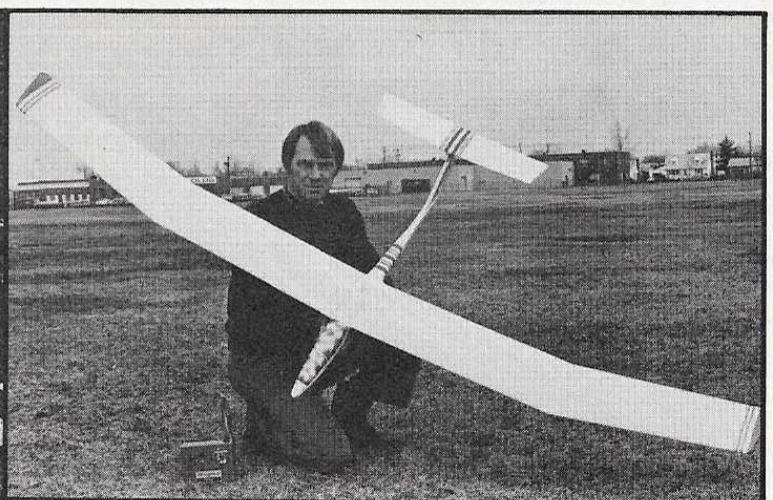
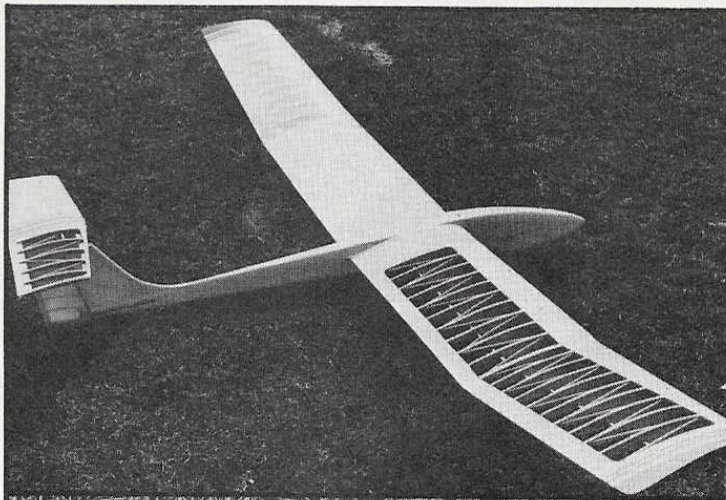
any webs, so skip these and continue out to within the last three or four bays of the outboard panel. Remove 1/16" of wood from the ribs behind the spar where the inboard and outboard panels join; attach the two panels and install the 1/16" ply dihedral joiner. Notch in back and in front of the rear spar and add the 1/32" dihedral joiners. Bevel the lower leading edge and install the lower 1/16" sheeting.

Add the 1/16" sheeting fill to the bottom of the inboard bay, the last two bays on the upper outboard panel, and the lower bay between the last two ribs. The optional cross braces can be now added and then the 1/16" x 1/4" capstrips (top and bottom). A 1/4" thick piece of balsa should be glued to the bottom of the upper trailing edge sheet at the tip. Also glue a scrap balsa block to the bottom of the upper tip sheet. Trim the tip sheet to form the tip outline. The bottom of the tip is formed by gluing a piece of 1/16" sheet (grain chordwise) to the edge of the lower rib bay sheeting and the bottom surface of the upper tip sheet. This process will tend to form a slightly hollow lower surface, which is the effect we want to achieve. The lower leading edge and trailing edge blocks can be trimmed to meet the contour of this lower surface.

Trace the inboard root rib outline on a piece of 1/32" plywood. Add the wing joiner

box cut-out, the aligning dowel holes and the wing tensioner holes and glue it to the root rib. Sand this plywood rib to be smooth and flush with the wing root. Drill out the aligning dowel and wing tensioner holes in the balsa rib to which the plywood is glued. The wing is now ready for sanding; we will now get back to the fuselage.

The wing fillets are next. If you are going to use the 1/4" thick plywood wing joiner, insert it in the fuselage now, as it will be captive when the fillets are built. If you use the 1/8" thick aluminum wing joiner, it can be installed after building the fillets. Notch the fuselage sides to accept either the plywood or the aluminum joiners. Note, the aluminum joiners overlap each other so the fuselage notches will be staggered by 1/8" inch. Trace the wing root outline on 1/32" thick ply; make sure the joiner cut-outs, aligning dowel holes, and the wing tensioner holes are also cut out. Glue these plywood ribs to a piece of 3/8" thick medium balsa. Carefully cut the 3/8" thick balsa to the plywood rib outline (make 1 left, and 1 right); leave about 1/2" protruding beyond the trailing edge (this will become part of the fillet). Sand a bevel on the back of the balsa fillets to agree with the wing dihedral, and cut out the wing joiner holes. Now glue the fillets to the fuselage, add a balsa wedge between the fil-



Lunch at Grumman, "I'd rather fly than eat." A rugged wing with enough area so that it might never come down. **Top left:** How to make a faster snap roll, only cover the left side. At least for the photos! **Lower left:** Nose weight, then battery, switch, receiver, tie-downs etc. **Beneath:** Angled for a launch.

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let and the fuselage to fill in the gap where the fuselage curvature starts. These wedges do not have to fit perfectly, as the filler material will take care of this. Sand the trailing edge to the shape shown on the plans. Now blend the wooden part of the fillets to the fuselage with your favorite filler material. I used plastic wood built up in thin coats to form these blends (a wet finger tip keeps the P. W. from sticking to it while forming contours). If Micro Balloons is your thing, by all means use it. After the filler material has hardened, sand, as required, to the desired shape.

Epoxy 1/8" ply wing joiner doublers to the inside of the fuselage sides. These doublers are very important in strengthening the cut-out at a highly stressed area.

The canopy top must be relieved to clear these doublers. Drill through the fillets to provide for the wing aligning dowel (this dowel is one piece). Also drill out for the wing tensioner holes. Next, carve the cross-sectional shape into all the fuselage and canopy blocks, round all the side, top, and bottom sheets and sand the fuselage.

## Miscellaneous Parts:

The tail fitting is simple to make. Start by sticking a piece of 3/4" wide masking tape to the .016 thick brass sheet. Draw the fitting outline on the tape and mark the hole locations. Drill all the holes first through two thicknesses of brass, then cut the brass to shape. Cut a piece of 5/32 O.D. tubing to length shown (this must fit between the two

tubes on the stab). Use steel wool or fine sandpaper to clean the brass sheets and tube where they are to be soldered. Drill a piece of scrap 1/2" balsa sheet to agree with the three holes on the brass sheet. Assemble the fitting on the balsa using two #2-56 round head machine screws with nuts and insert the tube (centralize it please). Use paste flux or lemon juice at the joints, solder the fitting together. Remove the screws and cut the scrap balsa away and the fitting is ready.

Bend a tail skid out of .030 or .040 dia. wire to the shape shown on plans. Bend three tow hooks of 1/16" dia. wire and bind them to the 1/8" thick ply hook mount. Smear glue on the thread bindings as this will keep the hooks in place. The belly skid is made of 1/8" x 1/4" spruce. Soak the wood in water for a few minutes, then bend it to agree with the belly contour. Use some 1" long brads driven into your building board along the belly profile shown on plans and bend the spruce to the brad contour. Use a few more brads on the outside face of the wood. Let the spruce dry overnight and the contour should remain.

Bend two wing tensioner hooks out of 1/16" dia. wire and epoxy them to 1/8" ply discs (these discs should be slightly smaller than the holes in the wing root ribs).

## Finishing

After final sanding prepare your model for covering. I used two coats of clear dope on the fuselage, wing tips, vertical tail and stab center-section, then covered them with Silkspan. The covered wing tips and stab

center-section got four more coats of clear, then sprayed with white butyrate dope. The vertical fin got two layers of Silkspan, but the rudder only got one. The fuselage got two coats of clear and several of filler (sanded between coats) until all the seams and laps of the covering disappeared. The vertical tail received four coats of clear, the fuselage one coat, then sprayed white. The remainder of the stab and the wing was done in white Super MonoKote. I did my trim painting before the MonoKote was applied, but it can be done after.

Now that all the sanding, painting and handling is over, inlet the fuselage belly and install the two hook assembly. Touch up the gaps and grooves with filler and spot spray this area. I painted the canopy to simulate glass with the black streaks, over white patches, over blue (nearly covering the black), over black technique. See "How to Paint Solid Canopies" Sept. '78 Flying Models for more detailed information. Now spray a clear dope overcoat on the fuselage to keep it clean.

## Flying Notes

After you are happy with some hand launched glides, go to it, fly it. You may want to be a trifle nose heavy for your first few flights to see if she has any bad habits. Continue to take out nose weight until you can achieve the sink rate for your weather and field conditions. It won't take long to fall in love with this lady, so get started.

May the Force be with you.