BY ERROLL L. WILLIAMS
Major, USAF Retired

● Having flown as well as towed full size sailplanes, it was only natural that my first interest in RC model aircraft would center around gliders. After learning the basic skills involved in both thermal and slope soaring, albeit numerous mishaps including three near wipeouts, it was with keen interest that I welcomed the RCM series of articles on Basic Sailplane Design. Here were the needed parameters and relationship one to another that would enable me to develop my own ideas into a model that should truly perform. Then the issue of R/C Modeler arrived announcing the annual RCM Design Contest. This was the final impetus and I was off and running.

The experience I gained while constructing and flying two sailplanes from kits led to the establishment of certain criteria which are incorporated in Happy Face. These criteria include the following: provide space for a 500 mah flat configured battery pack to fit in the most forward nose compartment; reduce drag by eliminating rubber band wing attachment and attendant dowels protruding through the fuselage; minimize tail weight through light construction and minimal tail moment arm in order to keep ballast to a minimum; conventional construction and building techniques to stay within the skills of the average modeler; and, finally, the resulting model must be stable during a hi-start launch.

Let's get started with the construction.

Fuselage:

The flat bottom fuselage allows construction directly over the plan to assure perfect alignment. The 1/8'' plywood bottom gives required strength and provides for a simple tow hook installation. Bulkheads and formers 1 through 5 are constructed of 3/32'' plywood while 6 and 7 are made from 1/8'' sheet balsa. Drill 3/16'' diameter holes in bulkheads for Gold'N-Rod installation before fuselage assembly. The hole location for these will depend on the servos used. The plans show the correct location for a Hobby Lobby 5 installation.

Construct the fuselage bottom using the plan template for a pattern. Notches for the bulkheads provide for positive-lock assembly. If not desired, the bulkheads must be shortened accordingly. The fuselage sides are made from 3/32'' hard balsa and are cut to the size indicated by the heavy arrows on the fuselage side view. Glue the 1/4'' x 3/32'' spruce stringers to the fuselage sides prior to assembly as well as the 3/32'' square soft balsa longerons aft of the wing. Be sure to taper these for a close fit at the aft end to assure a sturdy structure for the tail loads. Glue the bulkheads to the fuselage bottom making certain that they are perpendicular. Next glue both sides in place making sure that they contact all bulkheads. The nose block is made from three pieces of one inch pine board cut to shape and laminated. Bore a 3/4'' hole for ballast. The nose block is now glued in place and sanded to fit. Rough shape the two balsa blocks and glue to the top of the forward nose. Glue the 1/8'' plywood aft wing attach gussets to former 4 and the fuselage sides. Do not sheet the fuselage top aft of the wing until the Gold'N-Rods are installed. Set the fuselage aside at this time.

Wing:

It is desirable to construct each wing half

A Standard Class sailplane that has logged hundreds of flights, many over an hour in duration. Equally at home on a slope or in a thermal, its structural integrity is designed to withstand virtually any maneuver or rough landing terrain.

HAPPY FACE

as a unit. This will require a folding, or improvised, building board with the outboard section raised to the correct height for the outboard polyhedral angle. This method of wing construction will assure a true wing upon completion and is well worth the slight extra effort. The ribs are 1/16" medium soft balsa except the root ribs which are 1/16" plywood. Make 1/16" plywood templates using ribs 3 and 4 as a pattern. Sandwich 7 rib blanks between the templates and sand to shape. Repeating this operation will yield the required number of ribs for both outboard wing panels.

Begin construction by pinning the lower 1/16" balsa sheeting over the plans and glue the lower main and rear 1/4" x 3/32" spruce spar caps in place. Next, glue the lower rib caps and butt glue the 1/4" x 1/2" hard balsa leading edge. All balsa ribs, except the polyhedral joint rib, are now glued into position. Use the root rib dihedral gauge to properly cant the root rib. Bevel the 1/16" upper trailing edge. The upper spar caps are now glued into position and then the 1/16" plywood polyhedral braces. Cut the polyhedral rib as required and glue. Fit the spar webs between the ribs and glue. These are 1/16" vertical grain balsa except at the wing joiners which are 1/16" plywood. Do not install the forward wing joiner webs on the main and rear spar at this time. Cut the 3/16" O.D. brass tubes for the aft wing-to-fuselage attachment and epoxy to the wing web and the 1/8" plywood doubler. Construct the opposite wing panel using the same procedure. Locate, but do not secure, the four 3/16" O.D. brass tubes. These are positioned on the lower spruce spar cap touching the rear web. Cut two 5½" lengths of 5/32" steel rod. Insert these into the front and rear tubes. Position the two wing halves flat on the workbench with the root ribs touching. Re-align the 3/16" tubes and epoxy in place. When dry, the wing halves may be separated. Fill the void around the tubes with balsa and epoxy and then close the box spar with the front 1/16" plywood web. Glue the 1/16" plywood root ribs in place. The 5/32" steel rod wing joiners are now bent to shape. Place each rod in a vise and tap with a hammer. Make certain they are bent to identical angles. Assemble the wing halves and position on the fuselage. After assuring a perfect alignment, by measuring from each tip to the fuselage tail, drill two 3/16" diameter holes horizontally through the wing leading edge, using the holes in bulkhead #3 for a guide. Drill 1/8" diameter holes through the aft wing attach gussets using the 3/16" wing brass tubes for a guide. Epoxy the forward wing-to-fuselage 3/16" attach dowels in place with the wing still positioned on the fuselage. Add the 1/8" balsa doubler to reinforce the dowels. When dry, remove the wing from the fuselage and complete the sheeting. Add the upper rib caps. Shape the leading edge and then glue and shape the wing tips. Again, position the wing on the fuselage and add the balsa filler to the top surface of the wing from the main spar forward. Shape to the outline of bulkhead 3 and blend into the wing. The wing can now be sanded and set aside.

Tail Surfaces:

The flying tail design of Happy Face gives good positive control response, yet is not over sensitive. The horizontal leading and trailing edges are medium hard balsa and the spar is spruce. Cut the ribs from 1/16" sheet medium hard balsa and slide on to the spar. The 1/16" plywood control horn is installed after completion of the horizontal and is inset into the root rib. The horizontal is constructed with three break points. This assures a rigid surface that will be free of any tendency to flutter. The hinge and aft break points are constructed from 1/16" I.D. brass tubing epoxied to the left horizontal with 1/16" piano wire aligned and epoxied to the right horizontal. The forward break points is installed after completion of the two halves in the following manner: Drill an appropriate size hole to fit the inner rod of a Gold'N-Rod in the forward section of the right and left horizontal. Cut a length of inner Gold'N-Rod to extend through both holes to the root rib. Assemble the horizontal with the Gold'N-Rod epoxied in each half making sure that the leading edges are aligned at the break. When dry, cut through the Gold'N-Rod and all break points will be perfectly aligned. Cut a 1" length of 1/16" piano wire for this joint.

The vertical is constructed of a 1/8" plywood load carrying member and 1/8" medium soft balsa to keep weight to a minimum. The lightening holes in the plywood do not affect strength. Be sure to install the 1/4" x 1/8" medium hard balsa strips to carry the hinge loads. The horizontal hinge tube is cut from 1/16" I.D. brass. It must be installed perpendicular to the vertical stab. A length of 1/16" piano wire inserted through the tube will assist in this alignment. The airfoil shaped members glued to each side of the vertical stab provide the necessary rigidity for the horizontal. The slot for the horizontal aft break point must provide for full travel without binding. Check this during control system checkout. Cut slots for the hinges but do not install until surfaces are covered.

Canopy:

The canopy framework is constructed in place on the fuselage to assure a perfect fit. Pin the canopy base to the fuselage and glue the front and rear formers in place. Saran Wrap, placed between the formers and fuselage, will prevent gluing to the fuselage. Install the two 1/8" dowels. When the assembly is dry, sand to shape. Drill a 1/8" diameter hole through the aft former using the appropriate hole in bulkhead 3 as a guide. Remove canopy and glue a 1/4" length of 1/8" dowel in this hole. After painting the inside of the canopy frame to the desired color, the clear plastic may be cemented to the frame. Duco Glue is an excellent adhesive for this purpose and dries clear. Apply glue to the top edges of the canopy formers and place the canopy frame upside down on the plastic. Weight down and let dry. Now apply glue to one side of the canopy formers and the edge of the canopy bottom. Wrap plastic around the canopy frame and fit into a 90° corner between the workbench and wall. Weight the assembly and, when dry, repeat the operation for the other side. Trim the plastic and canopy is complete.

Finishing The Fuselage:

Locate the Gold'N-Rod rudder exit hole in the right fuselage side. A small round file is an excellent tool for making this hole. Do the same for the horizontal tail surface filing the hole through the 3/16" square longeron. Install the two Gold'N-Rods, making sure that there is no binding, and then secure to the bulkheads. (Silicone sealer is an excellent product for this operation.) The top of the aft fuselage is covered with 1/16" sheet balsa. Locate the horizontal Gold'N-Rod exit hole in the sheet, then slide over the rod

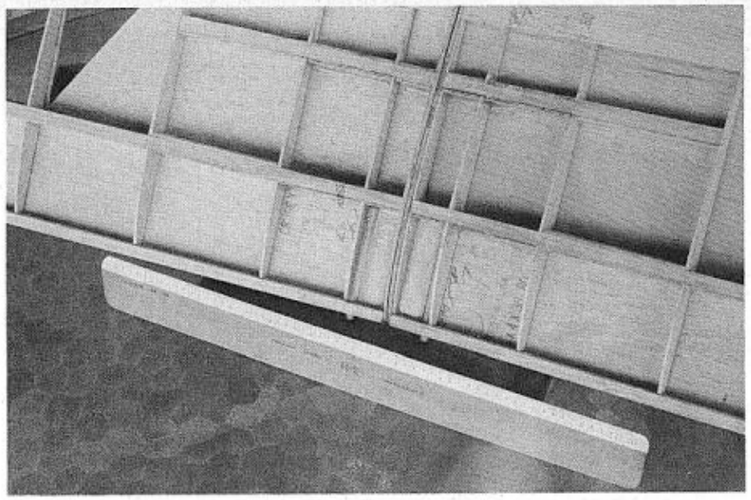
text to page 132

HAPPY FACE

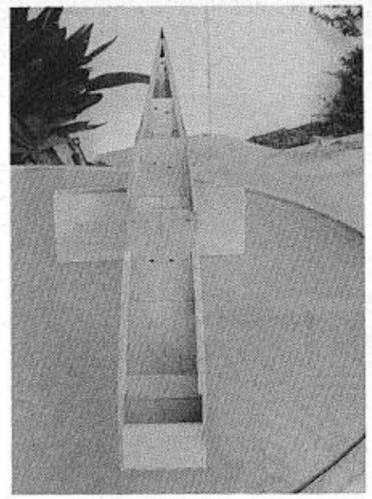
Designed By: Erroll L. Williams

TYPE AIRCRAFT
Standard Class
WINGSPAN
85 Inches
WING CHORD
7¾" Root — 5" Tip
TOTAL WING AREA
610 Square Inches
WING LOCATION
High Wing
AIRFOIL
Mod. 4309 (flat bottom)
WING PLANFORM
Constant Chord Center
Tapered Tips
DIHEDRAL, Each Tip
5 Inches
O.A. FUSELAGE LENGTH
43¾ Inches
RADIO COMPARTMENT AREA
(L) 10" X (W) 2" X (H) 1¾"
STABILIZER SPAN
22½ Inches
STABILIZER CHORD (incl. elev.)
4¼" (Average)
STABILIZER AREA
85½ Square Inches
STAB AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Mid Vertical Fin
VERTICAL FIN HEIGHT
7¾ Inches
VERTICAL FIN WIDTH (incl. rudder)
5" (Average)
REC. ENGINE SIZE
NA
FUEL TANK SIZE
NA
LANDING GEAR
NA
REC. NO. OF CHANNELS
Two
CONTROL FUNCTIONS
Elevator and Rudder
BASIC MATERIALS USED IN CONSTRUCTION

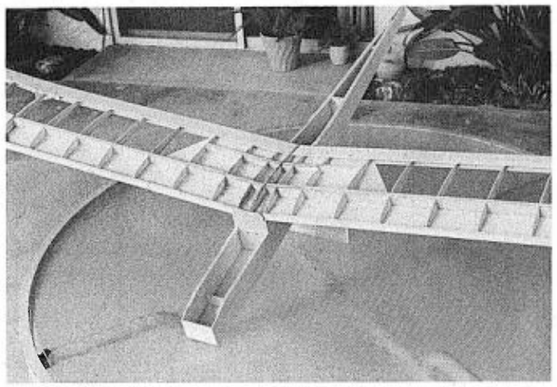
Fuselage	Balsa and Ply
Wing	Balsa, Ply, Spruce
Empennage	Balsa, Ply, Spruce
Weight Ready-To-Fly	32 Ounces
Wing Loading	7.55 Oz./Sq. Ft.



View of wing center section minus top sheeting.

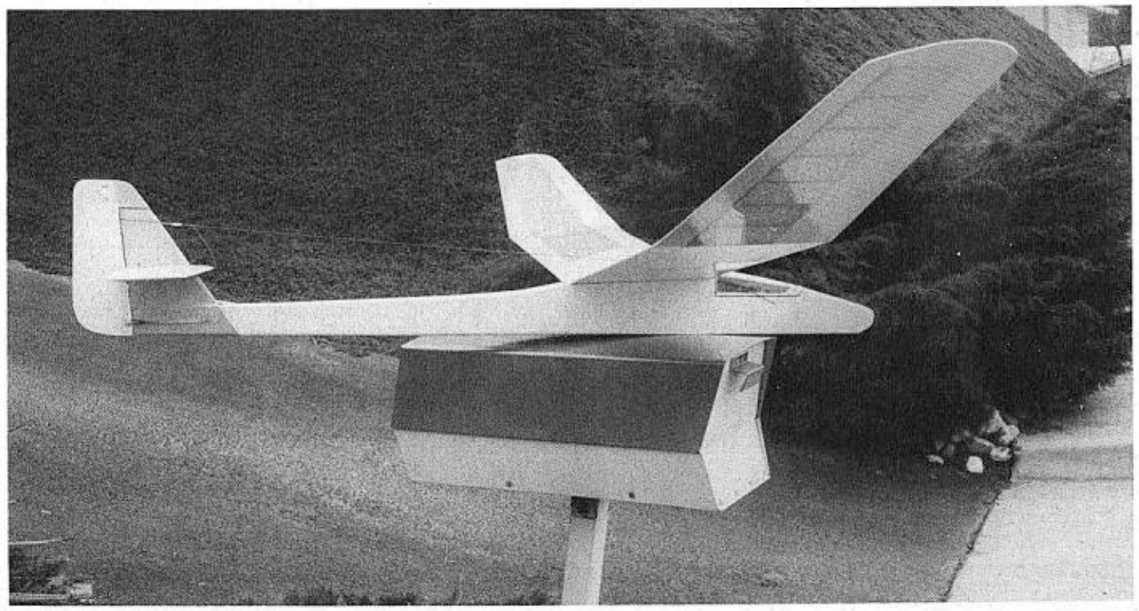


View of fuselage bulkheads.



Basic fuselage structure with semi-finished wing in place for trial fit before sheeting.

The completed Happy Face, ready for covering. Rugged, light, and easy-to-build.



from page 34/33

. . . . and glue to the fuselage. Trim the Gold'N-Rods flush with the fuselage. Epoxy two 6 x 32 nuts to the 1/8" plywood aft wing-to-fuselage hold-down gussets. These must be in line with the holes. Shape the aft fuselage as shown in Section C-C. The fuselage should now be finish sanded.

Covering:

Cover all surfaces with your favorite material. The fuselage may be covered or painted as desired.

Final Assembly:

Install the rudder hinges and attach the rudder to the vertical stab. Slide the vertical stab into the fuselage. It should fit snugly and may require shimming. Now glue the rudder into position, assuring that it is aligned with the fuselage centerline as well as being vertical. Install a rudder horn to line up with the rudder Gold'N-Rod. Install the tow hook. An Olympic type tow hook is a good choice. The forward position should be used when winds are above 5 mph. Two 8 x 32 bolts are used for the aft wing-to-fuselage attachment. A Happy Face decal is used to secure the front of the canopy to the fuselage.

Radio Installation:

The battery should be placed full forward in the battery compartment. Placement of the receiver and radio is dependent on the size of the equipment used. Size permitting, servos may be located forward of bulkhead 3. In this case, two additional holes must be drilled in bulkhead 3 for Gold'N-Rod installation. If servos are mounted under the wing, place adjacent to bulkhead 3. Rig the horizontal for 0 degrees of incidence. Check both controls for correct throw and freedom from binding.

Flying:

The model should balance as shown on the plans. With the Hobby Lobby 5 radio installed, no ballast was required. The completed model with radio installed weighed 31½ ounces giving a wing loading of approximately 7½ oz./sq. ft. The stab setting of 0 degrees was found to be a good starting point for initial trim. Several hand launches convinced me that Happy Face was ready for the acid test on the hi-start. Away she went and I was delighted to find her very stable with no tendency to weave. The glide was nice and flat with ample rudder control. Response to lift was immediate and positive, leaving no doubt when lift was encountered. The second flight was a seven minute flight on a day when lift was not readily found. No adjustments to trim settings were necessary. Stalls were straight ahead with no wing roll and recovery was positive — just relax on nose-up control.

Landing control was excellent all the way through the touch-down. Every one around was smiling upon completion of the successful first flights. When I got home and announced to my wife that my project was complete, she had the biggest smile of all. This removed any doubt in my mind — my sailplane was to be tagged Happy Face.

Good luck with yours. □