VOYAGEUR II

Introduction

One August day I sat down to build a new wing for my primary sailplane which over the past three years had taken a fair number of tree and post landings. I had somehow convinced myself that the rest of the plane was airworthy even though its battle damage was only slightly less than that of the wing. Since this new wing was to be a rather simple project, I decided to make a few modifications to the existing design in hopes of improving the plane's overall performance. Nothing major, since the design of original R/C aircraft was still an area I knew only enough to talk about staying away from.

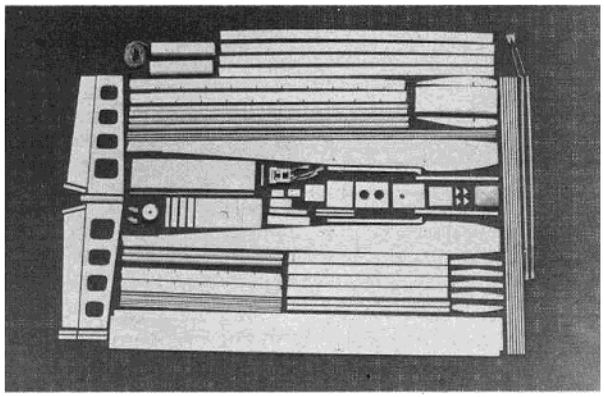
Then RCM ran an article on sailplane design principles; just what I needed to bring model designing out of the closet. I guess Mother Nature (in cahoots with RCM) was at work here, preparing me for this new dimension in radio control. As the idea of flying an aircraft that was entirely my own creation began to grow, those mentally suppressed dings and dents in my old sailplane began to stand out like gravy stains on a white formal coat. "After all," I told myself, "the plane really didn't fly that well anyway." I collected the plane's salvageable parts, put the rest in the bone yard, and sat down at the drawing board with a large sheet of drafting paper and the RCM article.

ABOUT THE AUTHOR

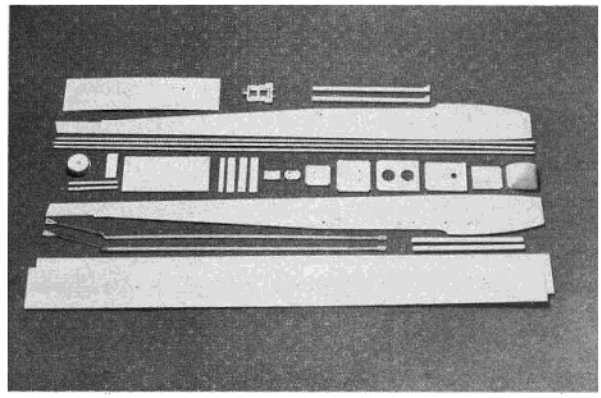
Terry Alan Blake is 28 years old and has 6 years in R/C with a primary interest in sailplanes, although he maintains a couple of powered trainer types. His bread is buttered by Uncle Sam as a DC-9 instructor pilot in the U.S. Air Force at Scott AFB, Illinois. Alan is currently acting vice-president, instructor, and safety officer in the "Buzzards" R/C club at Scott AFB. His home is Columbus, Ohio where he crashed his first control line plane and later graduated from Ohio State University. He enjoys playing the guitar, stamp collecting, Don McLean's music, Eric Sloane's art, Angie and Scooter (the family cats), his wife Rosalee, and all kinds of flying.

Fourteen months, and four prototypes later, I had a successful flying ship. I must confess that I adopted several proven concepts into this, my first "original" design. Specifically, I incorporated into one airframe many of the construction and performance features I have enjoyed from those sailplanes I have built and flown. I christened her the "Voyageur II" as the final design differed considerably from the original prototype. Actually, 11 major and minor modifications were necessary before the plane, presented here, achieved the stability and thermaling performance I sought.

I chose a V-tail design for four main reasons: They're practical for landings in tall grass, reduce drag, build easy, and usually attract an eye or two at the flying field. (From some of the looks I get, I suspect that some folks doubt their flyability.) Don't let this or the idea of control mixing scare you away from an elevon design. The plane flies beautifully, and the Voyageur's large radio compartment is adaptable to many



Start with a self-made kit.



The fuselage pieces – notches in the bulkheads are cut after the cross braces have been installed.

MATERIALS LIST FOR THE "VOYAGEUR II"

The $35.00 price tag is based on the purchase of all required materials with nothing on hand.

Balsa:

1 — 1/32" x 2" x 36" . . . Tip panel shear web.
3 — 1/16" x 3" x 36" . . . Fuse. top & bottom sheeting, wing center sheeting.
3 — 3/32" x 4" x 36" . . . Fuse. sides, bulkheads, ribs, gussets, empennage mount, and bulkhead cross braces.
1 — 1/8" x 4" x 36" . . . V-tail, anti-warp strips, and wing tube mounting.
3 — 1/8" sq. x 36" . . . Fuse. longerons.
1 — 1/4" sq. x 36" . . . Fuse. longerons.
1 — 1/4" x 3/4" x 36" . . . Wing saddle.
1 — 1" sq. x 12" . . . Tip blocks.
1 — 2¼" sq. cube . . . Nose block.
3 — 1/2" x 1/2" x 36" L.E. . . . Wing leading edge.
3 — 1/4" x 1" x 36" T.E. . . . Wing trailing edge.
1 — 3/4" x 12" triangular stock . . . V-tail mount.

Spruce:

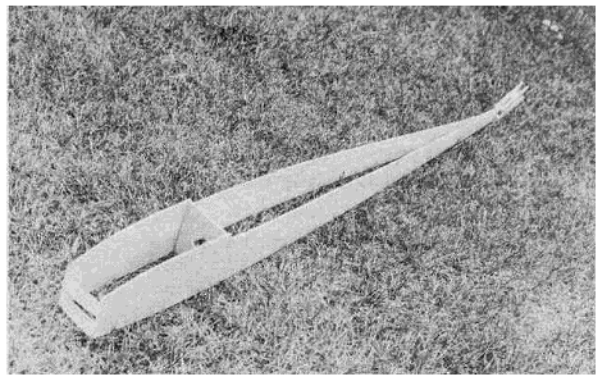
3 — 1/8" x 3/8" x 36" . . . Wing spars, tow hook mount.
9 — 1/8" sq. x 36" . . . Turbulator spars.

Ply:

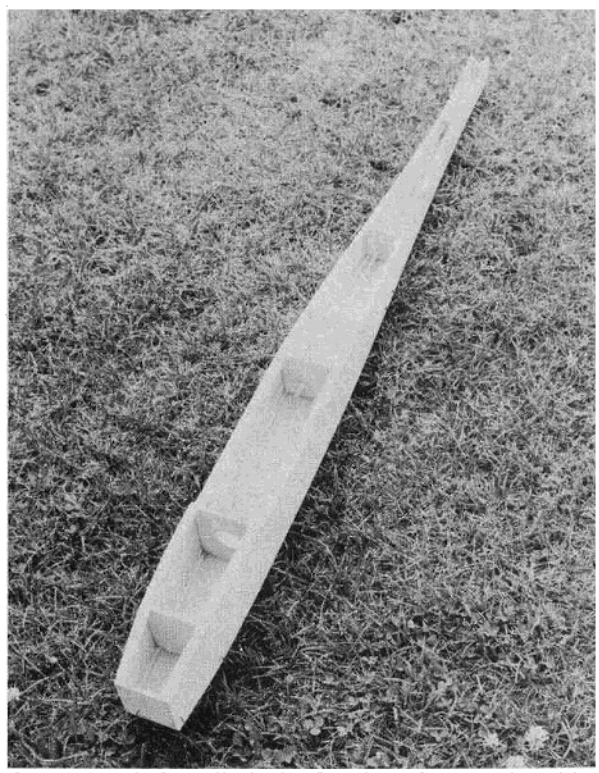
1 — 1/32" x 12" x 36" . . . Wing panel shear web.
1 — 1/16" x 6" x 12" . . . Hatch, skid plate, tow plate, and wing & dowel braces.
1 — 3/32" x 6" x 12" . . . Rib templates.

Miscellaneous:

1 — 3/16" diameter x 36" dowel.
2 — NyRods plus 6 extra control clevises.
2 — Small control horns.
1 — Tow hook.
1 — 1/16" diameter x 6" wire.
1 — 3/16" I.D. x 12" tubing.
1 — 3/16" x 12" steel rod.
1 — Control mixer.
2 — Rolls covering film.
1 — Box #64 rubber bands.
1 — Roll glider sup'r skid.
1 — 2-channel radio.
1 — Hi-start or winch.
6 — Nylon hinges (if used).
1 — Trim tape (if needed).



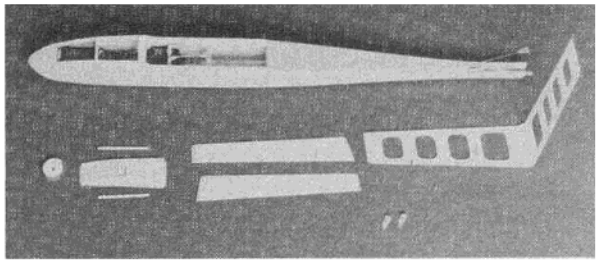
Clothespins and tape align and set the first bulkhead.



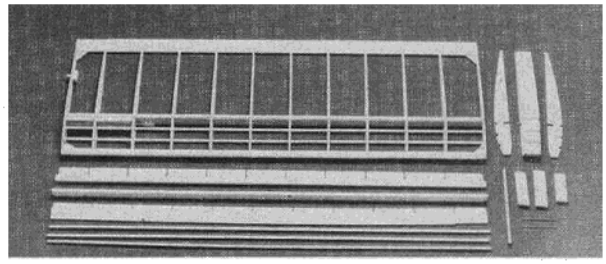
Control rods installed; the fuselage is completed by adding the top sheeting and the nose block.

If you are looking for a first scratch-built thermal sailplane, the Voyageur II is for you. This V-tail conception will please both the beginner and experienced pilot.

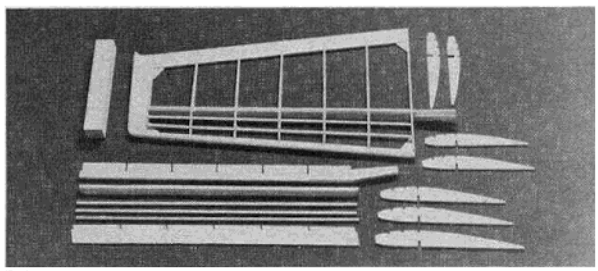
Designed & Built By Terry A. Blake



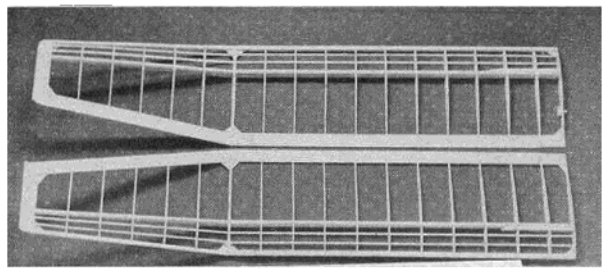
Having built four Voyageurs, I knew my radio would balance as shown here. Don't install yours until final construction. Holes in the elevons are optional.



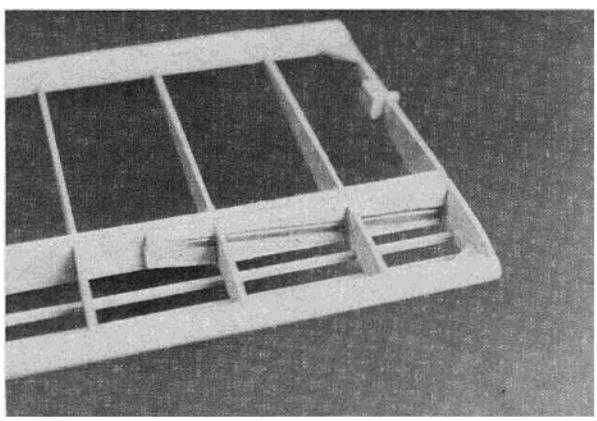
One main wing panel completed and the pieces for the other.



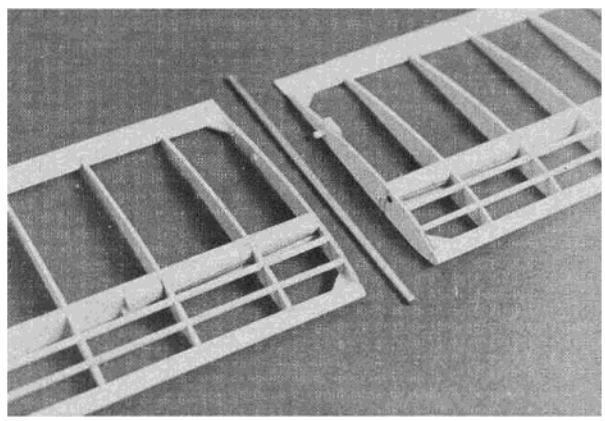
This tip panel shows an early airfoil design which proved unstable due to the upsweeping lower front edge.



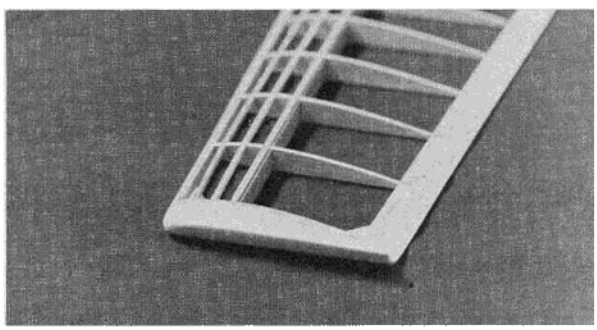
Wing panels ready for covering.



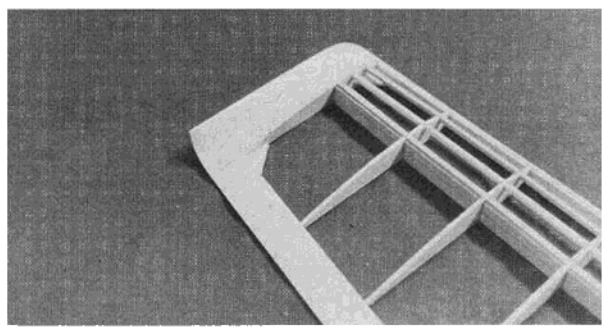
Rough-up the outer surface of the wing brace tubing and use plenty of epoxy to set the tube.



The steel bar aligns the wing mounted tubing for proper main panel dihedral.



The wing tips are easier to build than they seem. These three views will help simplify the details on the plan sheet.

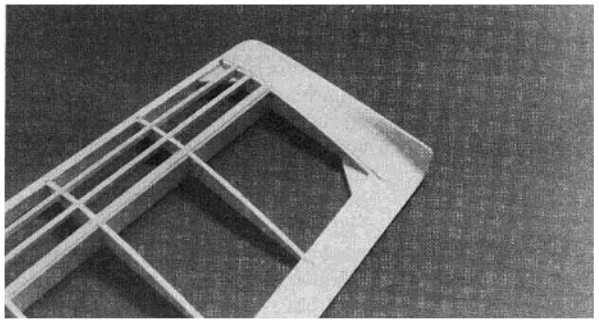


Paint the tips to avoid the problem of covering the concave upper surface.

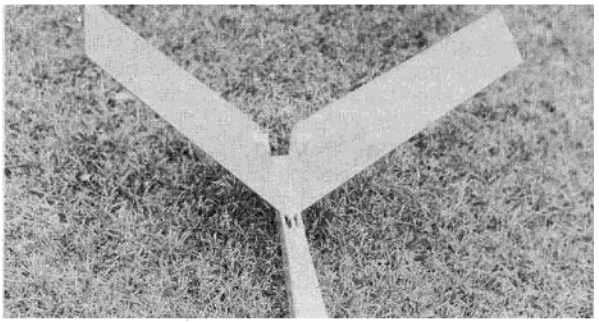
commercially available or homemade control mixers. If this is your first scratch-built project, you will find the plans and construction sequence easy to follow. If this is your tenth project from plans, you'll appreciate the clean design and tight, flat turns inherent to V-tails. Good luck!

Pre-Construction:

Begin by stockpiling your materials in a homemade Voyageur kit. Before starting any unit assembly, your kit should include the following: (1) Cut and matched fuselage sides which have been marked for the bulkhead locations and drilled for the wing dowels. (2) All bulkheads with the cross braces attached (notch the appropriate bulkheads for the 1/8" sq. balsa longerons). (3) A nose block which has been pre-shaped to the top and side



A hobby knife and plenty of sandpaper are all the tools needed for the tips.



Even the control linkage is up out of the grass, but they may be run under the V-tail.

view contours. (4) Both wing dowels and the four 1/16" ply dowel braces. (5) A completed tow hook mounting block (marked, but not drilled, for the tow hook locations). (6) Completed empennage halves (i.e., the fixed and movable portions finished, but unhinged). (7) A complete set of wing ribs (see the special section for construction details). (8) All spars and turbulators cut to length. (9) Wing leading and trailing edges cut to length and notched for the wing ribs. (10) Pre-shaped 1/16" ply tip panel braces (4 required). (11) All other wood and R/C accessories listed in the materials list. You should also pre-form the shear webbing by first cutting the strips to the proper length, observing the angles at each end of all 8 pieces. Mark the rib locations on one piece of the center panel webbing and one piece of tip panel webbing. Stack all 4 of each type webbing, being careful to align the end angles. The marked strip should be on top of each stack. Run each set through a jigsaw to notch the rib locations identically across each shear web. The notches are cut from the top of the webbing and bottom-out 3/8" from the bottom surface of the strips. This continuous strip shear web is considerably stronger than typical construction involving individual pieces of shear webbing inserted between each rib of a completed panel.

Do not pre-cut or pre-shape the following: (1) The five 1/16" ply hatch pieces. (2) The 1/16" ply skid plate. (3) NyRods and 1/16" wire control links. (4) Fuselage top and bottom sheeting. (5) Fuselage longerons. (6) Wing saddle or forward top fuselage longerons (1/4" sq. balsa). (7) Center wing joint tubing or 1/8" balsa tube bracing. (8) Wing tip blocks. Do not join the V-tail halves to the triangular stock or slot the elevon hinge line just yet.

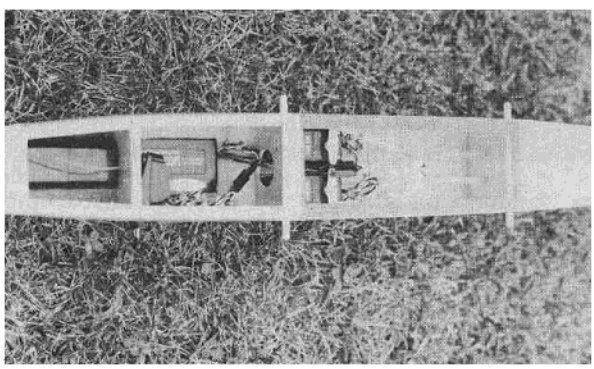
You will need standard modeling tools: pins, clamps, masking tape, electric drill and bits, jigsaw, sandpaper, and some 5-minute epoxy. For the other gluing, I recommend some cyanoacrylate or aliphatic resin. A small amount of contact cement is needed for the skid plate. If you complete the above preparations, your Voyageur should go together in a couple of days, ready for covering and, most importantly, flying.

Making The Wing Ribs:

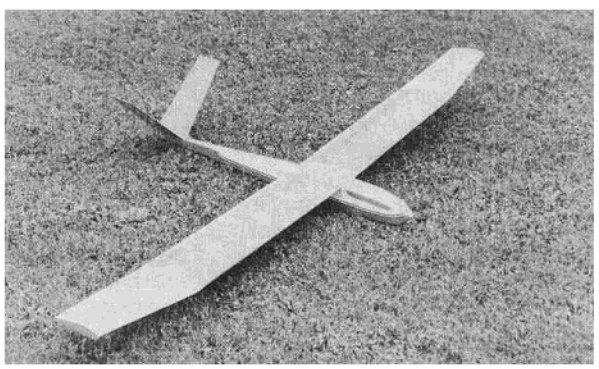
Making a uniform set of wing ribs for any model may seem difficult at first, but by using the "sandwich" technique described here, you can form an accurate, matched set of ribs for both constant chord and tapered panels. Begin by tracing and cutting two 3/32" ply WP-1 templates. You can insure their similarity by stacking two ply pieces and cutting both templates at the same time. The measurement across the bottom spar gap should be 3/16". You may also drill the 1/4" hole for the brace tubing. Measure and drill **carefully**. Next make a tip rib template in the same manner (1 required).

Using one of the WP-1 templates, rough out 24 rib "blanks" from 3/32" sheet balsa. Do not notch the blanks for any of the spars. (Note: The whole job will be easier if you form each rib "blank" from a piece of balsa that has a perfectly flat bottom surface.) As you cut each rib, mark the bottom at the front corner of the main spar notch. Place all ribs between the two WP-1's, aligning the marks with a square. Insure that all ribs rest flat on the work surface. Place the "sandwich" in a vise and carefully sand the package to the size and shape of the two end templates. Use a sanding block and do not over-sand as you will change the basic rib contour. Since you will have to turn the sandwich many times in the vise, be careful that none of the pieces slip out of alignment. The spars are notched with a small square file, and the main spar may be vertically notched with a zona saw; then filed. You now have a complete set of 22 main panel ribs and two more for the root ribs of the tip panels. Mark, but do not drill, 4 ribs for the approximate location of the 1/4" wing tube to be installed later.

The tip panel ribs are formed in essentially the same manner as the main panel ribs, but since they decrease in size, your "blanks" will be less accurately pre-formed. Use one WP-1 and the tip rib template for the sandwich ends. You will need 6 rib blanks plus one of the two extra main ribs in your sandwich. Once again align the marks at the forward spar notch and sand from template to template. Each set of tip



Plenty of room for even the bulkiest of radios.



Voyageur II: Clean lines, simple construction, and pure flying pleasure.

panel ribs must be made separately, and all 14 ribs will have a slightly greater than necessary cross angle on the rib tops. You may leave the ribs in this manner or sand them lightly after they are firmly cemented in place over the plans. Use a large sanding block for this and accomplish the job prior to installing the tip blocks. Do not enlarge any of the ribs at the joint of the center to tip panel for the 1/16" ply dihedral braces. These are modified during panel construction. Now add the rib sets to your kit.

Empennage:

Start actual assembly of your Voyageur II by completing the V-tail. First hinge the control surfaces as indicated on the plans or utilize the following steps to form a sealed hinge line with the aircraft covering material. By sealing the gap between the fixed and movable portions of the tail surfaces, you eliminate the added weight of the hinges and the unsightly gap and, more importantly, you reduce drag in this area making the control surface 20% more efficient. Start by sanding the hinge line of both pieces of each elevon half as shown in "step one" on the plans. Next, cover one side of both the fixed and movable portions of each elevon half leaving a 3/16" gap at the hinge line between the balsa pieces. Fold the structure at the hinge line and iron the covering onto the beveled surfaces you sanded previously. Open the pieces and cover the other side of the structure, being careful not to shrink the covering directly over the hinge line. Now carefully iron the covering into the hinge working from one side to the other as necessary. As the material shrinks, the two balsa pieces will draw together uniformly and swing freely. The finished product should look like "step two". This method is quite strong.

Whether you use nylon or sealed hinging, I have found it easier to cover each empennage half separately prior to joining them at a right angle with the triangular stock. Study plan section E-E to join these pieces. Don't install the control horns until you're sure of their alignment with the 1/16" wire links from the NyRods.

Fuselage:

Mark the vertical center of each bulkhead. Align and clamp the fuselage sides together at the tail, then cement in F3. To get the proper bond, use some tape at the nose to pull the sides in to the proper fuselage shape — let dry. Next, glue in formers F1, F4, and F5. Position this assembly over the fuselage top view to aid in true alignment. F2 may be positioned to suit your particular radio installation, but remember to keep the bottom of this former flush with the bottom of the fuselage sides. When thoroughly dry, unclamp the tail and add the rearmost F6. Pull the fuselage sides in to secure the other F6 — clamp until dry. Next, install the two bottom full length longerons, gluing them from the tail to former F3. These 1/8" square balsa strips fit into the notches pre-cut into the bottom of each bulkhead. When dry, check that the strips will fit easily through formers F1 and F2, but do not cement them as yet. Sand the fuselage bottom square from the tail to F3.

Now mark the long centerline of a sheet of 1/16" balsa. Cement the fuselage assembly to the sheet from the tail to former F3, matching the centerline marks on the bulkheads with the centerline on the sheet. Allow to dry, then bend and glue the sheet up to F1, trapping the longerons in their respective slots in each bulkhead. Trim the excess bottom sheet away and lightly sand the entire fuselage bottom to shape as shown in section C-C or D-D on the plans.

VOYAGEUR II
Designed By: Terry A. Blake

TYPE AIRCRAFT
R/C Sailplane
WINGSPAN
85 Inches
WING CHORD
Center 8 ⅞" - Tips 5½"
TOTAL WING AREA
710 Square Inches
WING LOCATION
Shoulder Wing
AIRFOIL
Flat Bottom
WING PLANFORM
Tapered Tip Panels
DIHEDRAL, EACH TIP
2" Center panel - 3½" Tip panel
O.A. FUSELAGE LENGTH
40 Inches
RADIO COMPARTMENT AREA
(L) 14⅝" X (W) 2½" X (H) 2⅝"
STABILIZER SPAN (VEE TAIL)
13⅜" (Projected)
STABILIZER CHORD (incl. elev.)
5 Inches (Avg.)
STABILIZER AREA
86½ Sq. In.
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Top of Fuselage
REC. NO. OF CHANNELS
2
CONTROL FUNCTIONS
Elevons
BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa, Spruce & Ply
Wing	Balsa, Ply & Spruce
Empennage	Balsa
Wt. Ready-To-Fly	30 Oz.
Wing Loading	6.1 Oz/Sq. Ft.

Control rod placement is next, and the routing of the cables may depend to some extent on the type of control mixer you choose. I utilized a molded plastic unit distributed by North American Model Enterprises, 7639 Grapevine Highway, Ft. Worth, Texas 76118, at a cost of $3.98 plus $1.00 handling. The mixer resembles a small handle switch, and fits nicely just aft of the tow hook mount. (P.S. . . . While you're ordering the mixer, get a captured, releasable tow hook at $4.95. Both items are sold under the brand name of Radio Sailplanes.)

When the outer shell of the control rods are in position, add the aft, top longerons and sand this area square with the fuselage sides. Then add the 1/16" cross grain sheeting — trim and sand as you did the bottom. The small area where the pushrods exit is left open until the wire pushrods are formed and in place.

Next, form the wing saddle from a piece of 1/4" x 1/4" balsa. Trim away the excess wood from the rear of the saddle to a point 1/2" from the front end prior to installing this piece to the inner fuselage side. When the piece is firmly set, remove the remaining scrap balsa carefully with your knife and fine sandpaper. You will need a slight angle across each saddle to match the center wing panel dihedral. While in this area, epoxy the pre-made tow hook mount just aft of former F3. Then add the 1/16" ply dowel braces; drill out when dry.

Using the forward fuselage bottom as a guide, carefully trace the skid plate outline onto a 12" piece of 1/16" ply. Cut and install using contact cement. Then sand the skid plate to blend smoothly with the fuselage bottom as shown in plan view section B-B. Now you may drill the tow hook mounting holes through the fuselage bottom. Next, add the 1/4" square forward, upper longerons.

Begin the forward hatch construction by installing one 1/2" x 2⅛" x 1/16" ply piece at former F1, and one 1/2" x 2¾" x 1/16" ply strip at F3. Now sand the forward, upper fuselage side edges as you did the bottom edges. Contouring the sides prior to actual hatch cutting will result in less overall sanding to the hatch area as the hatch can be more accurately traced and cut to final contour. Cut the hatch from 1/16" ply and epoxy a 1/2" x 1/16" ply strip to each end of the hatch. Make each strip just long enough to fit easily under the ply strips at stations A-A and B-B between the fuselage sides. Each of two ply pieces epoxied to the hatch form a "tongue" which slips under the fuselage mounted ply strips. By flexing the hatch in the middle, it can be quickly installed or removed as needed. When all pieces are dry, install the hatch and sand it

smooth with the curving fuselage edges.

The fuselage is now completed by attaching and contouring the nose block; then complete the empennage attachment. This last step starts with addition of the 3/32" x 1/4" balsa tail mounts just forward of the rearmost F6. Epoxy your completed V-tail assembly to the fuselage by first notching the last F6 with a 90° "V" cut of the proper size. Run a square sanding block on edge in the mounting area to "square up" the mounting surfaces. Trial fit the empennage often during this process to assure that each tail fin is equal height above the work surface. (See plan section E-E during this entire process.) Form and install (temporarily) the pushrods, and then add the two mini-horns to the elevons. The fuselage top sheeting around the pushrods may now be formed from a scrap of 1/16" ply or balsa, but do not cement it in place until the pushrods are permanently in place. Now take a break.

Wings:

Study the wing plans carefully and you'll probably **not** build two left wings or end up with one wing longer than the other. And remember that your wing panels will be only as straight as the surface they are built on.

Begin wing panel construction by forming the lower wing spar assembly. First, re-check your spar lengths, shear webbing end angle accuracy and alignment and, above all, insure that you lay out all pieces correctly to form one each left and right center panel spar. Next, firmly cement the webbing to both sides of the 1/8" x 3/8" main (bottom) spruce spars. The small cross section drawing on the plans will aid you in this step. Clamp with plenty of spring type clothespins, and sight along the spars to insure they are not setting up with a span-wise warp. When dry, you can position the left main spar over wax paper covered plans. Then pin down the left main panel trailing edge. Before installing the wing ribs, mark and drill both WP-1's for the 3/16" alignment pin. Slide the 11 main panel balsa ribs into position, and add one WP-1 to the center root. Note how the pre-cut angles on each end of the spar supply the proper slant to the end ribs for the dihedral breaks. Cement all ribs in place and allow to thoroughly dry before continuing. Position and install the left main panel leading edge stock, followed by the three turbulator spars. Use plenty of cement and clamp securely the turbulator which fits between the shear webbing. When the unit is thoroughly dry, remove the excess material from each end of the left center panel and install the four 3/32" gussets. Complete the right center wing panel in the same manner.

The tip panels are completed in a similar pattern as that used for the main panels. Study the plans and photos for completion of the wing tip blocks. (Note: The 1/16" wire at the trailing edge of the tip block is optional.) You will have to enlarge the root rib of each tip panel to accommodate the two 1/16" ply tip dihedral braces.

When all four wing panels are completed as described above, you may attach the tip panels to their respective center panel section. Once again, enlarge the dihedral joint rib at the main spar to clear the tip ply braces. You should have 3½" under the tip with the main wing panel resting on the work surface. When both wings have been joined, sand the leading edge, if needed, to the blunt contour shown on the plans. You may also notch the center panel trailing edge of both wings for the 1/16" wire. This 2" wire protects the trailing edge from crushing when the wing is rubber banded to the fuselage. Epoxy the wires into the notches. Next, add a 3/16" pin and block to the left center panel WP-1.

The wings are joined with a 3/16" diameter steel or music wire rod which is inserted into 3/16" I.D. tubing mounted in each wing half. Study the wing center section spar detail on the plans before proceeding. Sharpen the end of the aluminum/brass tubing with a file, and use it to bore through the two wing ribs in each panel where the tubing will eventually rest. Be as accurate as you can; it is better to have a greater angle on the tube than less than that indicated on the plans. This will result in slightly more than 2" of main panel dihedral which is considerably better than having less than 2". When both wings have been drilled for the tubing, cut the tubing to length and position each piece in a wing section. Add the 1/8" balsa tube bracing and the 1/4" square tube plugs. Trial fit the wing panels with the rod in place to insure that the proper dihedral is achieved. When you are satisfied, rough-up the outer surface of the tubing with sandpaper, and epoxy the tubes in place. **Use plenty of epoxy**, but do not allow any adhesive to get inside the tubing. When dry, add the 1/16" balsa cross grain sheeting to the two center bays of each wing half; top and bottom.

Finish & Covering:

Cover using your favorite material. Warps in the wing panels can be manipulated during the shrinking process, but remember that they can be put into the wing just as easily. Be sure to take your sealing iron over each rib and spar, as the covering material is an integral part of the wing structure. Take a little extra time during the covering process, as the effort will be rewarded many times over at the flying field. The colored trimming tape available at most hobby stores adds a nice accent to most finishes and is very easy to apply. Be sure to include the canopy outline for a finishing touch. After covering the fuselage, punch in the tow hook holes from the bottom. Add the glider super skid, and install the wing dowels.

Next comes your radio gear. Balancing is no problem, but start with your battery in the forward compartment. Pack the battery and your receiver in foam for protection, and route the antenna through the leading edge of the hatch. Secure the other end with a rubber band between the empennage halves. Set your control throws for 1/4" on the elevator travel each way and 3/8" to 1/2" on the rudder each way. If this is your first V-tail, remember that for a right turn, the **right** elevon goes down and left one goes up. Up is up and down is down as usual.

Flying:

If you've built your Voyageur carefully, it will fly right off the building board. Try a few hand launches in deep grass to gain a feel for the craft's speed and control response. Do not launch it like a spear, but rather, let it glide gently from your hand from an easy, nose low release. Go easy on the elevator, as it is better to land a little hot than to plant the nose from a stall.

On the first hi-start launch, you'll find that she tracks fast and true all the way up with only minor corrections for the wind. If the launch is a good one, the transition from tow to glide is automatic, and you're soaring without touching the sticks. Normal glide is medium slow with the nose about level with the horizon. The first flight will give you some idea of the sharp control responsiveness to both pitch and trim. I have yet to observe any fishtailing, even at slow speed. Loops are tight, stall turns are quick if started with plenty of airspeed, and rolls are possible, though somewhat dished-out. Since you're bound to have a stall or two, you can rely on them being straight ahead and easily recoverable. Landings are routine, hand catches are easy.

The Voyageur II is no twelve foot monster, but she will thermal on light to moderate lift. A little weight is nice on the windier days, and it is here that she is really "at home". I have had longer flights on days when the wind hit 15 knots than I have experienced with my other kitted sailplanes.

I hope you'll enjoy your Voyageur, and can some day experience the thrill of launching your own sailplane design.□

From RCModeler Aug. 1978