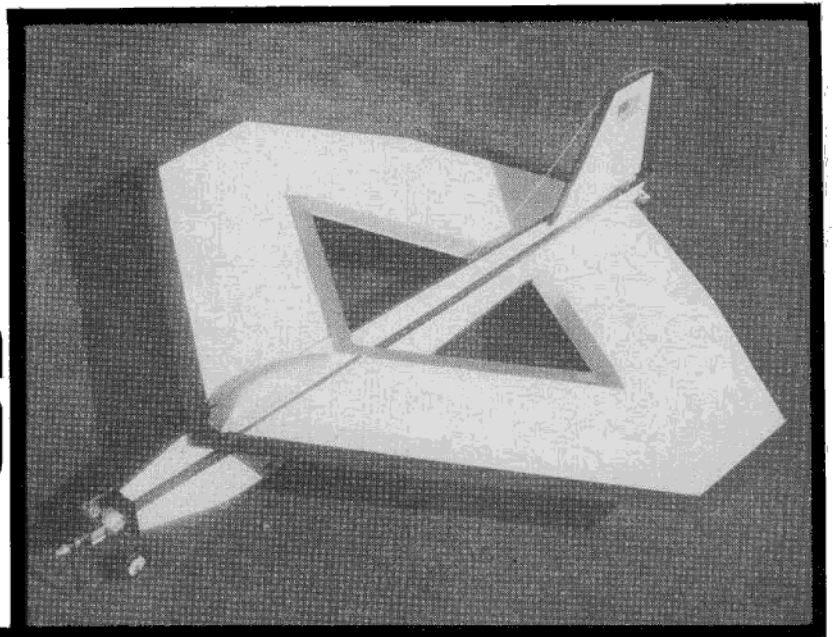


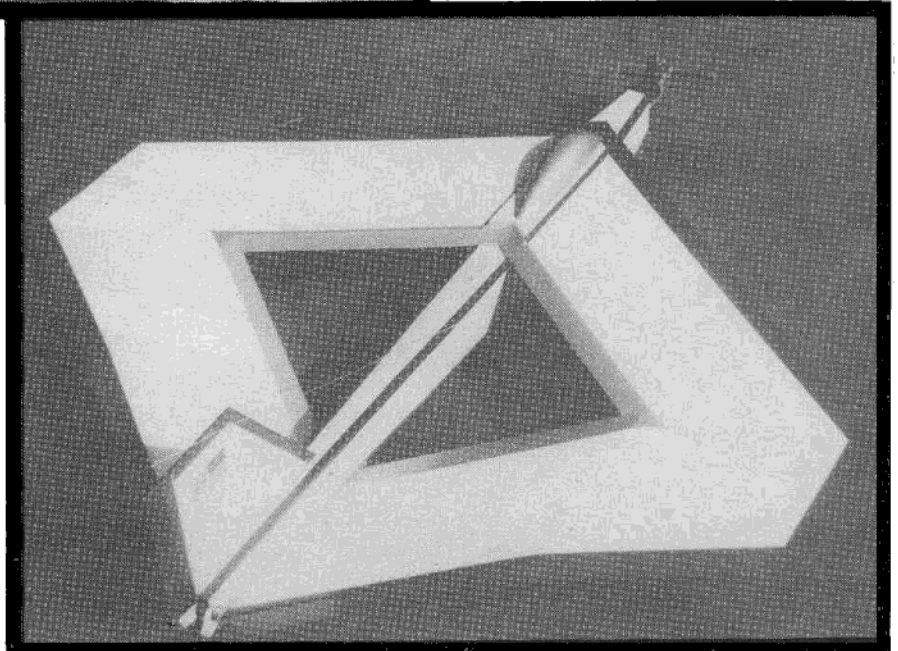
ROAMIN' HOMBUS



As the saying goes, "Someone is always reinventing the wheel." That tendency is especially true in the field of aviation, where "new" concepts keep springing up regularly. As an example, look at all the ultra light airplane designs. The designers claim, "This concept is quite new, and has many advantages over conventional designs." But a look at the historical efforts shows that there are virtually no really new designs --- just variations on old concepts.

The diamond wing concept is one of the best examples. Consider this; the original diamond wing was conceived in 1926 by Norman Hall-Warren, an English experimenter. He patented the concept in 1937, but never was able to get enough money together to build anything but flying models.

This diamond wing concept is new to many modelers, however, it was first conceived in 1926. Ken designed an .049 powered model that proved to be not only an excellent flier but also very stable.



By Ken Willard

In 1974 the United States Air Force released information regarding an "Advanced Aircraft Design." It was a variation on Hall-Warren's basic layout. More recently, Burt Rutan came out with his "Predator," a rhombus wing aircraft with some added wingspan at the tips. All new --- and all old insofar as the basic concept is concerned.

Rhombus wing models have been published before. In August 1969, RCM published a scale model of the "Skycar," which was designed by Normal Hall-Warren. A small .010 powered free flight variation was published in another periodical in 1976. Both models were excellent fliers.

About a year ago, Jim Moynihan came out with Aerolite foamboard. It

entirely comprised of Aerolite? The rhombus shaped wing, or "flying diamond," is an ideal subject. So, the "Roamin' Rhombus" was designed to take advantage of Aerolite's characteristics. Only a few tools are required, and the framework will take longer to dry than it does to cut out. Here's the simple step by step sequence.

Aerolite foamboard is available from Aerolite Products, Inc., 1325 Millersport Hwy., Buffalo, N.Y. 14221, Tel. (716) 634-4042. It comes in 16" x 48" sheets, in various thicknesses. For this model, the wing is cut from a sheet of 3/16" x 16" x 48" (minimum order is three sheets of any of their available sizes. Call or write for prices). The layout is shown in Photo #1. To cut the panels out, use a



CONSTRUCTION TOOLS AND MATERIALS

Tools:

- Single edge razor blade
- Needle nose pliers
- Small screwdriver
- Masking tape
- Adhesive — FasTac, Titebond, Elmers or epoxy. Hot Stuff (or similar cyanoacrylates) can be used some places

Materials For Basic Structure:

- (1) sheet Aerolite 3/16" x 16" x 48"
- (1) sheet Aerolite 1/8" x 16" x 48"
- (3) 3/16" x 36" dowels
- (3) 3/4" x 3/16" x 36" balsa trailing edge stock
- (1) 1/4" x 1/4" x 36" balsa strip
- (1) 3/8" x 2" x 1 1/4" hardwood block (basswood or pine)
- (1) 1/16" x 14" steel wire
- (3) wheels, 1 1/2" diameter
- (5) wheel collars
- (1) 3/16" x 3" x 12" balsa sheet stock
- (1) MonoKote "Trim Strip" (color optional)
- (1) plastic canopy, cut to fit as shown on plans (optional)

differs from other foamboard material in that the inner styrofoam core is covered with .004" thick ABS plastic. It is fuelproof and waterproof, roughly equal in weight to medium grade balsa, and can be painted if you use a polyurethane base paint. Jim also came out with a special adhesive, called FasTac, which works very well. The material can also be bonded with Titebond, Elmer's Glue, and epoxy. Cyanoacrylate "instant glue" can be used to bond the outer surface, but care must be used not to let the instant glue come in contact with the inner core, since the glue will dissolve the core.

This new material, Aerolite foamboard, can be used in many ways when building a model, but how about building a model which is almost

single edge razor, and cut along the straight lines using a steel ruler as a guide. Photo #2 illustrates the method. Be sure to keep the razor perpendicular to the foamboard.

Next, place the two panels together on a flat surface so they form the rhombus shape. At the forward apex, put some waxpaper under the joint, and butt glue the two panels together. At the same time, cover the joint with a piece of 1/8" Aerolite, 2" wide at the front and 1 3/4" wide at the rear, and glue it in place along the centerline. When dry, trim it to the angles of the front and rear of the panel. **Do not glue the rear apex together.**

Now look again at the plans. You will note a "score line" extending from the inner angle where the "front wing" trailing edge meets the "rear wing"

ROAMIN' RHOMBUS

Designed By: Ken Willard

TYPE AIRCRAFT

Rhombus Wing

WINGSPAN

33 1/2 Inches

WING CHORD

7 1/4 Inches

TOTAL WING AREA

490 Sq. In.

(includes all surfaces)

WING LOCATION

Top at Front

Bottom at Rear

AIRFOIL

Flat Section

WING PLANFORM

Rhombus (truncated at tips)

DIHEDRAL, EACH TIP

0°

O.A. FUSELAGE LENGTH

34 Inches

RADIO COMPARTMENT SIZE

(L)6" x (W)2" x (H)3"

STABILIZER SPAN

Included as part of rhombus

STABILIZER CHORD (incl. elev.)

7 1/4 Inches

STABILIZER AREA

Included as part of rhombus

STAB AIRFOIL SECTION

Flat

STABILIZER LOCATION

Bottom rear of Fuse

slanting up to Tip

VERTICAL FIN HEIGHT

6 Inches

VERTICAL FIN WIDTH (incl. rudder)

6" (Avg.)

REC. ENGINE SIZE

.049 Black Widow

or Dragonfly

FUEL TANK SIZE

Integral with engine

LANDING GEAR

Tricycle

REC. NO. OF CHANNELS

3

CONTROL FUNCTIONS

Rud., Elev., Engine

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage Foamboard & Balsa

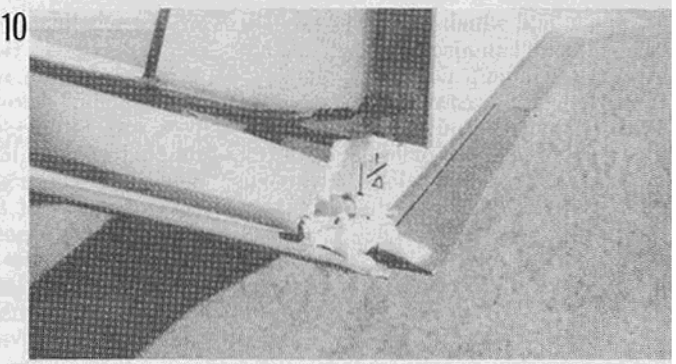
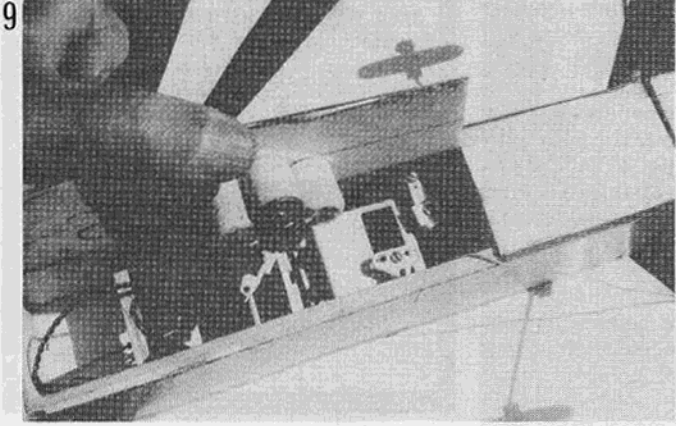
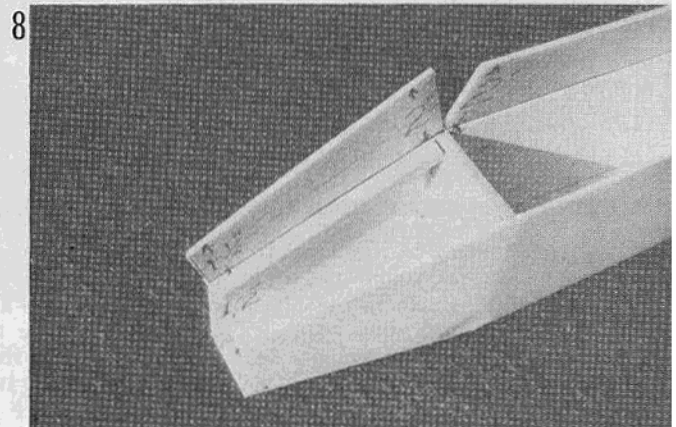
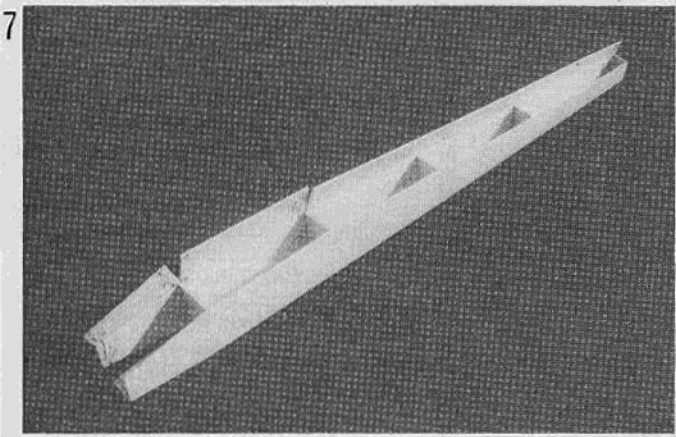
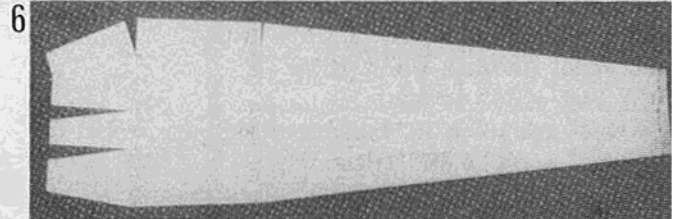
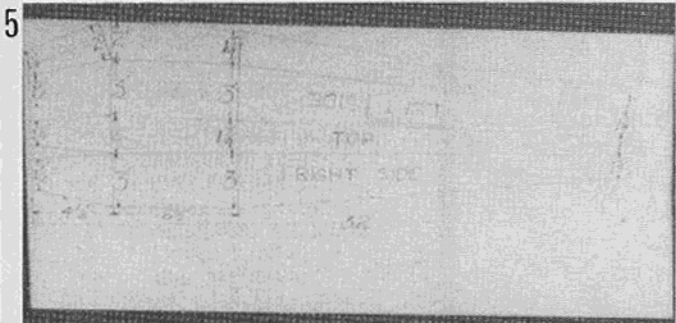
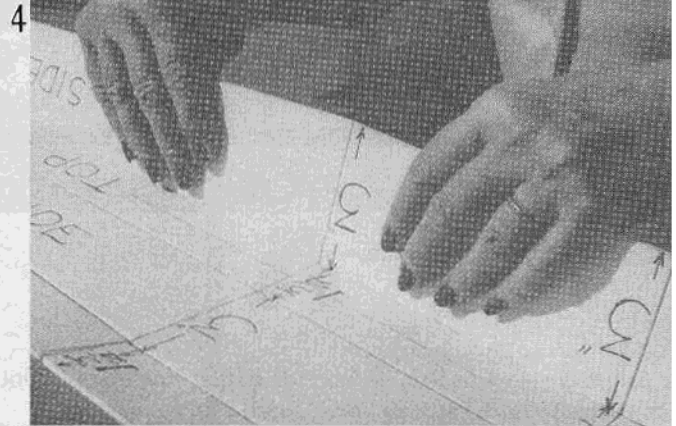
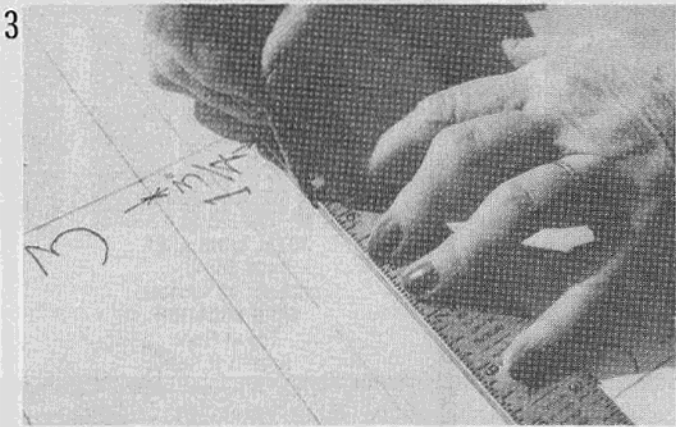
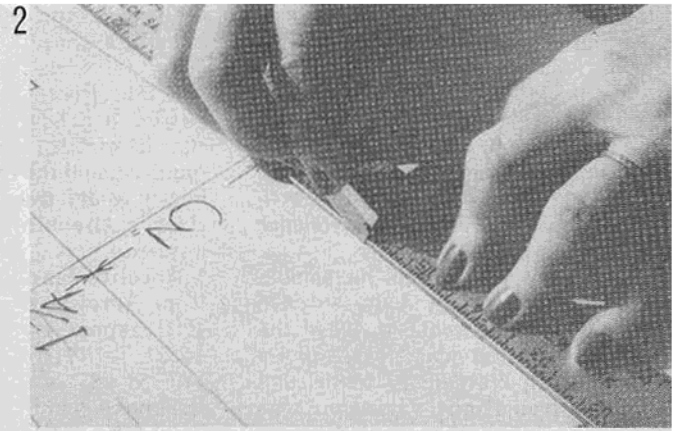
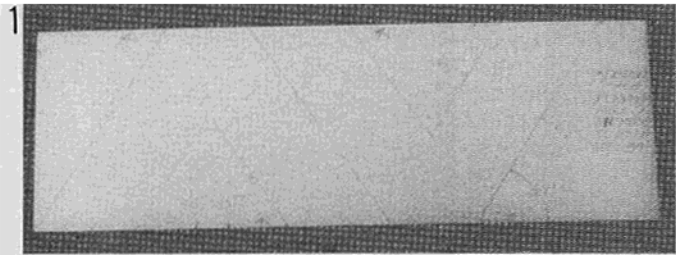
Wing Foamboard & Balsa

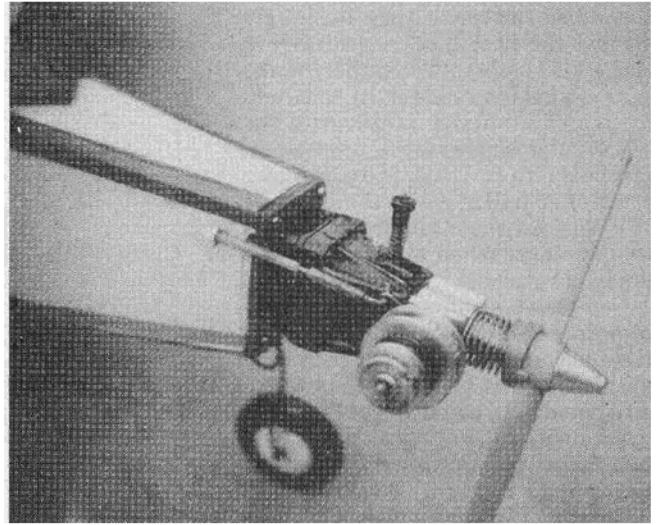
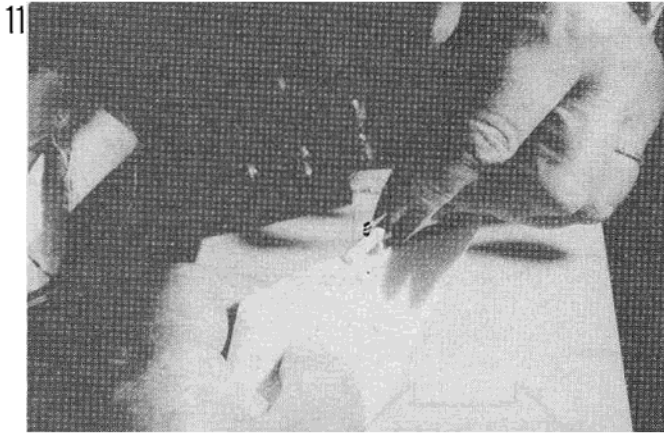
Empennage Foamboard & Balsa

Wt. Ready To Fly 15 Oz.

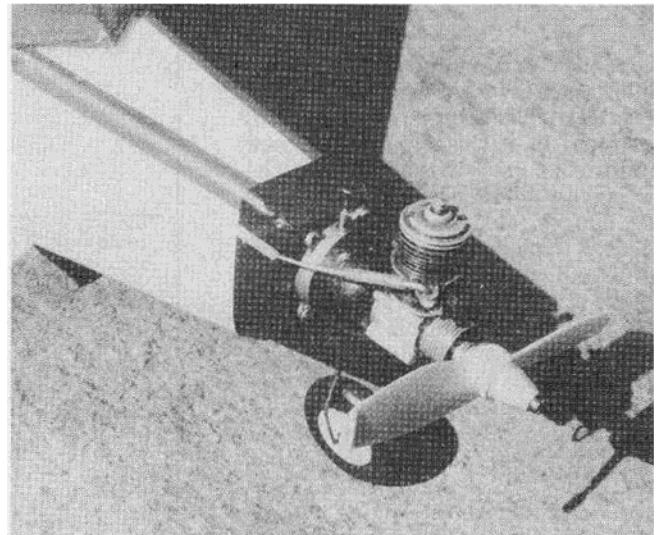
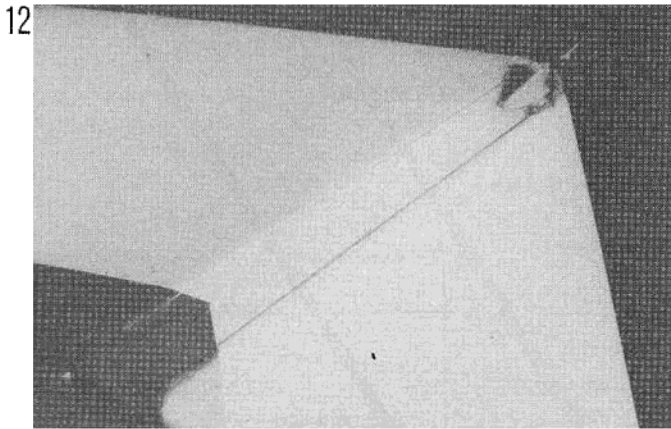
Wing Loading ± 5 Oz. (incl. all of rhombus surface)



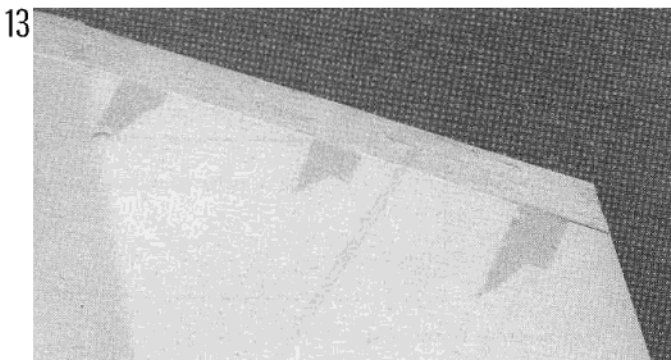




Cox newest .049 Dragonfly engine installed on Rhombus.



Rhombus with Cox .049 Black Widow and Ace R/C sleeve throttle.



leading edge, back to the trailing edge of the rear wing. The score line is parallel to the centerline. That is the line where the wing is bent so that the rear section can be attached to the lower side of the fuselage at the back end.

To "score" the Aerolite, use a soft pencil (No. 2) and run it gently along the line, using a steel ruler as a guide. Press just hard enough to indent the outer covering, without going through to the inner foam. Practice a bit on some scrap material first. Photo #3 shows how it's done. Next, carefully bend the material along the score line. The inner foam will compress slightly, and the bend will be structurally intact. Photo #4 shows the bending action; it's the same on both the wing score line and on the fuselage lines.

At this point, set the wing panels aside and make the fuselage. The fuselage is made from a sheet of 1/8"

x 16" x 48" Aerolite sheet. The plans show the lofting lines to make it, and Photo #5 shows the layout on the Aerolite sheet.

Cut out the fuselage as shown in Photo #6, and then score the straight lines which separate the top section from the side sections, and the straight line which separates the bottom panel from the left side.

Now bend the side panels up, and the bottom panel over, thus "wrapping" the surfaces around into a box-like section. Let the panels spring back slightly, mark the locations where the bulkheads are to be, measure the inside width of the top panel, and cut out the bulkheads which are rectangular and fit snugly against the sides, bottom and top, as shown in Photo #7. The bulkheads can be made from 3/16" balsa, or from the 3/16" Aerolite. I used balsa, because then, since the joint between the sides

and the bulkhead were balsa to the ABS skin, the bulkheads could be instantly stuck in place using Hot Stuff, Jet, or any of the cyanoacrylate adhesives. If you use the Aerolite bulkheads, you have to use FasTac, Titebond, white glue, or epoxy, since the edges of the bulkheads expose the inner core.

Secure the bulkheads in place as shown in Photo #7, but don't close the bottom down just yet.

Add the 1/4" x 1/4" braces to the nose section as shown in Photo #8.

The next step is to epoxy the nose block in place. Leave the bottom open, bend the two sides inward until they press against the forward top section, which must be bent slightly downward, then epoxy the top of the sides to the edge of the top panel, and epoxy the nose block to the forward end of the fuselage. Before applying the epoxy, gently sand the ends of the

1/4" x 1/4" braces so they fit snugly against the nose block. Also, as you epoxy the assembly together, make sure you hold the ends of the sides and top pieces so they are flush with the rectangular shape of the nose block. One way to do this is to pin the surfaces together while the epoxy is still wet, get them aligned, and then let them dry. When dry, pull out the pins.

Note that two different types of nose blocks are shown. The original installation on the prototype used a piece of 3/8" hardwood block, to which any one of the older model Cox reed valve .049s with integral tank could be attached by screwing the backplate to the block with 1/2" wood screws.

Shortly after the test flights, which were originally made with a Black Widow engine, Cox Hobbies sent along one of their newest designs, the "Dragonfly." This engine has several new features --- larger ports, more fuel capacity, and a clunk tank which allows for inverted flight. Since the Roamin' Rhombus is capable of inverted flight, this feature on the new engine is very attractive, so the Dragonfly was installed. Because of the longer tank, plus the long bolts needed to hold the tank together and also to the nose block, a different nose block was installed. First the nose of the fuselage was cut off 1/2" shorter, then the piece of 1/8" plywood was cut to fit the nose shape. Before epoxying it to the nose, the mounting holes for the Dragonfly were drilled and the mounting nuts epoxied to the back of the nose plate of the fuselage. Thus, you could remove the engine without having to get at the back of the nose plate on the fuselage. And you will have to, at times, clean out the fuel line, and even replace it. The fuel line is short, and very flexible --- it has to be so the clunk can flop around during maneuvers. So be careful when you install it.

At this point in the construction, it's time to make the radio installation. Since there are several small radios --- Cannon, Futaba, Airtronics, and World, to name some --- which have very small servos, the choice is yours. Keep in mind that light weight is desirable. The plans show a typical installation of three servos, a battery pack (100mA is best from the standpoint of weight), and a receiver. Photo #9 shows a variation, in which a Cannon "brick" with receiver and two servos is one unit, and the third servo is just ahead of the brick; the battery pack is attached to the hatch cover with servo tape.

The plans show two servos in a separate compartment. The reason is that with the servos further forward, the model is nose heavy.

The nyrod going back to the rudder is a conventional installation, with a clevis attachment to the base of the rudder where the control horn is located.

The nyrod going to the elevators is conventional at the forward end, but you can readily see from the detail drawing and Photo #10 that a special "Mickey Mouse" fitting is used on the prototype. A threaded rod is screwed into the inner nyrod, and at the other end a crossbar wire is soldered to the threaded rod, using a small piece of thin brass sheet. The ends of the crossbar slide through the elevator horn holes and, as the elevators move up and down, the bar permits the inward and outward movement which exists at the holes due to the angles at which the elevators slant forward and up when in the neutral setting.

The engine servo is mounted to the bulkhead with servo tape, and the throttle wire inside the plastic tube comes out the side as shown in the top view and connects to an Ace throttle sleeve on the engine. This feature is optional, in case you do not have the throttle fitting. You just have to land "dead stick."

With the radio units in place, it is now time to close up the fuselage bottom. Leave that portion of the bottom sheet which covers the opening to the radio compartment, and the servo compartment, open. This gives access to the units. When you are ready to fly, these surfaces can be closed and held together using clear plastic tape. Permanently glue the rest of the bottom in place, using FasTac or epoxy. Again, check to make sure that the fuselage closes "square" in line and that there is no twist in the sides from the front to the rear.

Now is as good a time as any to make the main gear attachment. Note on the plans how a 3/16" dowel goes transversely through the fuselage and is glued to the bulkhead. The ends stick out about 1/2" on either side, and the wire landing gear is held on with rubberbands. Don't snug it up too tight, or it will crush the bottom where the gear goes across. Even if this happens, don't worry; just put a reinforcing piece of 1/16" plywood over the crease and epoxy it in place.

The nose gear is installed later, and for the time being, don't strap on the main gear. It will get in the way as you handle the fuselage while mounting the wing, which is the next step.

You may wonder why the wing sheets are mounted even before the leading edge dowels and trailing edge pieces have been attached. The reason is simple; you can fit those pieces better after the wing is mounted. There is, however, one thing you can do before mounting the wing, and that

is to prepare the leading edge of the Aerolite sheet to accept the leading edge dowel. To begin with, when you cut the sheet out, the edges are straight up and down, but you want them to be concave so the dowel will fit well, as shown in the section A-A. To get that shape, take a piece of dowel and run it along the edge of the sheet as shown in Photo #11. Press it in and compress the foam to the curved shape. Then the dowel will lay in the cup as shown in Photo #11, and this will give a good gluing surface.

Now let's mount the wing. Mark off the location on the top of the fuselage where the wing sheet goes.

Bend the rear sections of the wing down at the score lines, then locate the wing on the fuselage at the forward apex, with the rear sections bent down so they are at the bottom of the fuselage. Now you can see why the rear was not glued together. Where they meet the bottom of the fuselage, there is a gap. Don't try to pull it together; it will distort the wing.

Glue the forward section of the wing to the top of the fuselage and let it dry. When dry, glue the aft sections to the bottom of the fuselage along the edges. You'll have to twist the rear section of the wing slightly, and that is necessary for the wing not only to fit the bottom of the fuselage, but it is a stabilizing factor for good flight. It yields the right angular difference between the forward wing and the rear section. When the joints are dry, you can fill in the gap with a piece of scrap Aerolite, as shown in Photo #12.

It's beginning to look like the "Roamin' Rhombus" now, but there's still a bit of work ahead. Let's finish the wing.

Since you have already pressed the leading edge to the concave shape, you can now glue the dowel into the leading edge. Cut the dowel to the right length for each section, run a bead of FasTac or Titebond along the cup shaped leading edges, press the dowel in place, and hold it there with short strips of masking tape. Of course, the ends of the dowels have to be cut off at the right angle so they butt together at the apex of the leading edge of the forward wing, and at the inner apex of the rear section where it meets the trailing edge of the forward wing.

Next glue the 3/16" x 3/4" trailing edge stock to the rear of the wings, and at the tips. Note that the bottom of the trailing edge stock is in line with the bottom of the Aerolite sheet, except that it is reversed at the tips, as shown in section B-B on the plans. Use masking tape to hold it in place while drying. Photo #13 shows how. Also note that the trailing edge stock at the rear of the aft wing section which slants downward is not glued to the

From RCModeler Sep. 1982

Aerolite sheet. Instead, it serves as the movable elevator, and is hinged to the sheet. Hinge it at the top surface, using either clear plastic tape, or alternatively, a strip of MonoKote Trim Strip in a color of your choice. Before attaching the elevator, make sure that there is a gap at the bottom surfaces of the Aerolite sheet and the trailing edge stock so there is room for down elevator action. It doesn't need to be much, just sand the trailing edge of the sheet to a slight angle, so there is a gap as shown on the plans.

Now you have the wing and fuselage assembly finished, and it's time to add the fin and rudder. Cut the fin out of 3/16" Aerolite (there's plenty left on the original sheet) and butt glue it to the top of the fuselage with FasTac, Titebond, or epoxy. Glue the 3/16" dowel to the front and the top, per plan. Make sure that it is right in line with the centerline of the fuselage, otherwise you'll have problems when it comes to flying. Next attach the rudder with either cloth hinges or MonoKote Trim Strip secured to the sheet. Install the control horns, connect the nyrods, and all that's left is putting the engine on the front, and the canopy on top. The canopy is optional, but looks good. Just Hot Stuff it on.

Before installing the engine, drill the hole in the nose block where the end of the nose gear is inserted, and cut a groove vertically from the hole to the bottom. The wire gear fits in the groove, and is held in place by the backplate of the engine.

Attach the 1/2A engine to the nose block with four wood screws, connect up the throttle control, strap on the main gear, charge up your batteries, close the hatches, and go fly!

Oh, yes; one more thing before flying. Check that the Roamin' Rhombus hangs level when you support it at the center of balance. Small variations in the balance can be compensated for by adjusting the elevator. The odds are that the model will be slightly nose heavy if anything, and a small weight at the tail may be needed.

Control surface movements are a matter of your choice, but a good point to begin with is about 3/8" travel to right and left with rudder, and the same amount of up and down for the elevators.

When you go out to fly, be ready for lots of attention and various comments. The Roamin' Rhombus never fails to attract lots of attention. But keep your eye on it --- sometimes it's hard to tell whether it's coming or going, turning right or left, or upside down if you do maneuvers.

It's as easy to fly as any sport plane --- and more fun than most.

So have fun.