

This article is about a model building technique that should fire up your imagination for that pet project you have had stored in the back of your mind just waiting for a way of building it. This combination of foam and fiberglass, along with small amounts of balsa and plywood, can be modified to allow you to easily build anything that your mind can envision. It can be used to produce simple shapes, but it really shines when you find that you can produce a very complex fuselage with ease. Well, enough of the why of the technique, let me tell you a bit of the why of the model that is the subject of this construction article.

The first Styros was born 8 years ago when I was an Air Force F101B VooDoo pilot at Tyndall Air Force Base, Florida. I wanted a model that resembled the F101 without needing to be a scale project and one that would have good acrobatic performance. The first attempt at a nearly all-foam model was very successful from both an appearance and performance standpoint in spite of a near disaster on the first flight. This model even won honorable mention in the first RCM Design contest. The near disaster I mentioned came shortly after I advanced the throttle for take-off on my well used set of reeds. Many hours of vibration wear on my none-too-good solder joints finally parted the positive lead to the switch, shutting off all power to my radio. That first command was the last command for that flight and my shiny, new bird increased speed across the concrete and lifted off by itself due to the up elevator trim that was applied prior to the throttle advance. The aircraft climbed out like a homesick angel until at about 200 feet where it had become nearly vertical and out of enough horsepower to take it up any farther. The bird rolled over to the left, presumably because of engine torque, and headed for the dirt beyond the lip of the taxiway at Tyndall AFB picking up speed all the way because of the combined effects of gravity and full engine power. It hit the ground in two foot high grass, dead vertical and I knew that was the end of my sleek "TEE" tailed beauty. I didn't hurry over to sweep up the pieces because I knew they would be all there in one small heap whenever I arrived.

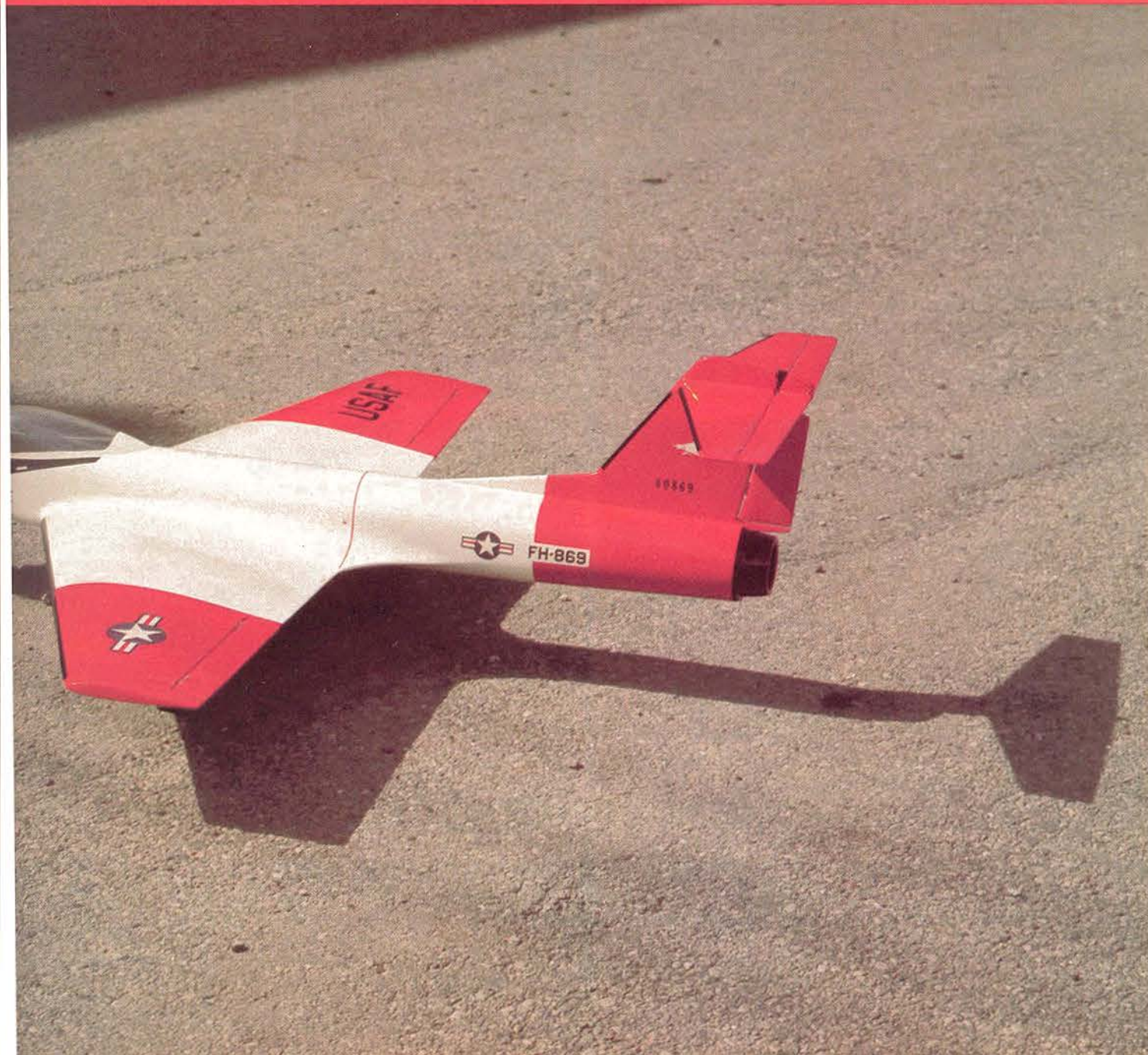
to page 26



STYROS XV

Following his three part series on the use of foam as one of today's best ways to build a model aircraft, John D. Woods puts it all together in this jet-like .15 powered pattern ship.

Photos by Monroe Pinkleton.



To my surprise, however I found the model intact. The total damage consisted of one broken prop, one smashed Veco spinner, one split maple motor bearer and one crack vertically on the left side of the fin about 1 1/2" long. Unbelievably, that was the sum total of the damage. Granted the ground was damp, but the nose only dug an 8" hole and I would venture to say that a conventionally constructed model would have been a complete wipe out in a similar crash. I went through this complete story only to illustrate the other attribute of the foam, balsa, plywood and fiberglass model—**strength**. If the model had not hit the ground exactly vertical the damage would certainly have been more extensive, but even considering that, no other type of construction offers the kind of strength-to-weight ratio that foam does.

Now that you know how Styros was born, let's get into the model and how to build it from block foam, sheet balsa and epoxy, and fiberglass cloth. Let me caution the novice not to attempt this model and recommend that even the accomplished modeler have some foam wing cutting experience. Also, the airplane itself is no trainer. It does not exhibit any vicious characteristics, but it is an active, responsive bird that will go just where you point it. Strangely, landings are slow and docile with the nose proudly pointed skyward. All-in-all it is a rewarding model for the accomplished flyer.

The design has gone through many changes over the 8 years since its inception in 8 separate airplanes. Each new model incorporated changes that improved it over the one that preceded it. All were .40 powered except this one. The idea with this size model was to see if the slightly heavier construction method could be applied to a small airplane without degrading the extremely good performance of the design. Happily, it can, and the results justified my confidence in the wide range capabilities of this radical airframe. If you are ready to start after this windy sales talk, follow the steps religiously and your Styros 15 should be a rewarding modeling experience for you.

The pictures accompanying the article should clarify each major construction step for you and ease your way through the project. By the way, the Styros was one of the design winners at the 1975 Toledo Conference.

Let's start with the fuselage. First cut two 3/4" x 3 1/2" x 13 1/2" foam blocks making certain that they are squared up and that all opposing faces are parallel. I cut these blocks with a hot wire cutter using 1/8" x 3/4" balsa strips pinned along carefully measured pencil lines on the foam. Allow the strips to extend a couple of inches outside the foam blocks on each side to enable you to lead the wire into the foam.

Next, cut 1/16" plywood templates for cutting out the hole in each side of the foam blocks. Pin these templates on each end of one block at a time and cut out the hole keeping in mind that the desired hole diameter is 1/16" shallow to allow for the 1/8" balsa strips that will be glued between the two foam blocks, top and bottom. Cut these 1/8" strips from medium balsa and epoxy in place on one side. Mark the intersection of the fin leading edge on the top and bottom strips and cut out the areas to allow the fin to key through the center of the aft portion of the fuselage.

Cut out the fin leading edge from 1/8" balsa, 3/8" wide, and use a marking template. Cut the fin trailing edge from 1/8" balsa, 3/8" wide, and mark the

slot for the T.E. to slot into the top strip. Cut the rear slot 1/4" longer than required for the T.E. strip to slip the rudder arm through later on in construction. Cut the front and rear rings from 1/16" plywood. Glue both halves together, aligning carefully and tape together — glue the front and rear rings on making certain the front ring aligns perfectly with the vertical center line of the aft fuselage. Shape the rear section using a coarse wood rasp cutting in one direction rather than rubbing back and forth. Rubbing back and forth will roll out the foam beads. Shape the section down to about 1/8" from the desired size using the ply rings and the longitudinal balsa strips as sanding templates. Finish down to the final shape using 80 grit garnet paper on a sanding block. Construct the vertical fin using 1/8" x 3/8" balsa strips surrounding 1/8" foam sheet and cap both sides with 1/16" sheet balsa with the grain on both sides running vertical.

Allow the 1/16" sheet sides to extend forward of the 1/8" leading edge 1/8" of an inch making a channel to accept the nylon tube for the elevator push cable. Construct the horizontal stab using the same procedure as the fin. Glue the stab to the top of the fin and fillet the underside with 3/8" triangular stock sanded to shape. Cut the foam "Horseshoe" that forms the center of the fuselage from a 10 1/2" x 3" x 3" single foam block. Use the same cutting template on the front and rear to cut out the hole that continues on toward the front from the previously constructed rear fuselage section. Use the foam piece just cut from the center section to sheet the cavity with 1/32" balsa. Simply wrap the balsa sheet around the cut out piece and brush 5 minute epoxy into the cavity. Tape across the bottom with enough pieces of tape to hold secure until cured. Make the inside sheet 1" too long in the rear and 3" oversize in the front. These extensions will help key the front and rear sections of the fuselage to the center section. Cut the rear extension to one-half the diameter of the hole across the top so it will key into the rear hole. Epoxy the center and aft sections together, align carefully, and hold together with masking tape until cured. Cut the center section crutch from 1/16" ply using the template from the plan and epoxy in place across the bottom of the horseshoe. Install a 1/8" x 3/4" balsa tripler on the inside of the center section, both sides, and allow to extend to the front of the 1/32" balsa inside sheeting. Install two 1/2" x 3/4" balsa cross pieces on top of the ply cross members. Cut two 3/32" balsa full size wing root ribs using the ply wing cutting template and glue to the sides of the fuselage. Be sure to align carefully at 0° incidence.

Next cut two (2) 3/8" x 5/16" x 14" balsa longerons and epoxy along the underside of the crutch, one on each side. Cut two 3/8" x 3" x 1" balsa filler blocks and epoxy above the front of the longerons and flush against the extended inside sheeting and butted against the front of the center foam block on both sides. Cut three (3) 1" half rings and carefully fit and epoxy in place over the top of the extension of the inside sheeting that extends out in front of the foam center section. Now razor saw off all projecting pieces that extend beyond the front block and sand smooth in front.

Note: If you glue two of the half round pieces that came out of the three half rings together and saw on a 5° bias inside and outside you will have the balsa extension of the aft portion of the tail pipe. Epoxy in place about 1/4" inside of the end of the foam tube.

STYROS

Designed By: John D. Woods

TYPE AIRCRAFT

Sport

WINGSPAN

35 Inches

WING CHORD

12" Root / 4 1/4" Tip

TOTAL WING AREA

306 Square Inches

WING LOCATION

Fixed/Low

AIRFOIL

Semi-Symmetrical

WING PLANFORM

Modified Delta

DIHEDRAL, EACH TIP

1"

O.A. FUSELAGE LENGTH

35 Inches

RADIO COMPARTMENT AREA

(L) 10 1/4" (W) 2 3/8" (H) 2 1/4" (Avg.)

STABILIZER SPAN

15 Inches

STABILIZER CHORD

4 1/4" Root / 2" Tip

STABILIZER AREA

46.87 Inches

STAB. AIRFOIL SECTION

Symmetrical

STABILIZER LOCATION

Top of Fin

VERTICAL FIN HEIGHT

5 3/4 Inches

VERTICAL FIN WIDTH (incl. rudder)

7" Bottom / 4" Top (not incl. dorsal)

REC. ENGINE SIZE

.15 Cu. In.

FUEL TANK SIZE

4 Ounces

LANDING GEAR

Tricycle

REC. NO. OF CHANNELS

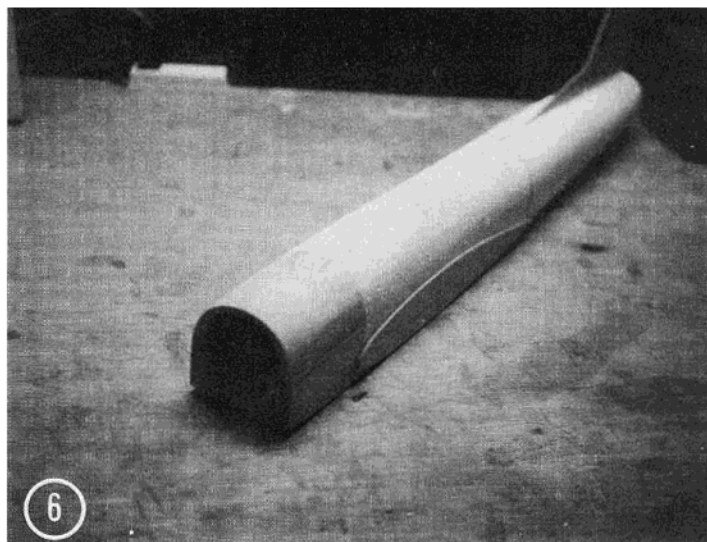
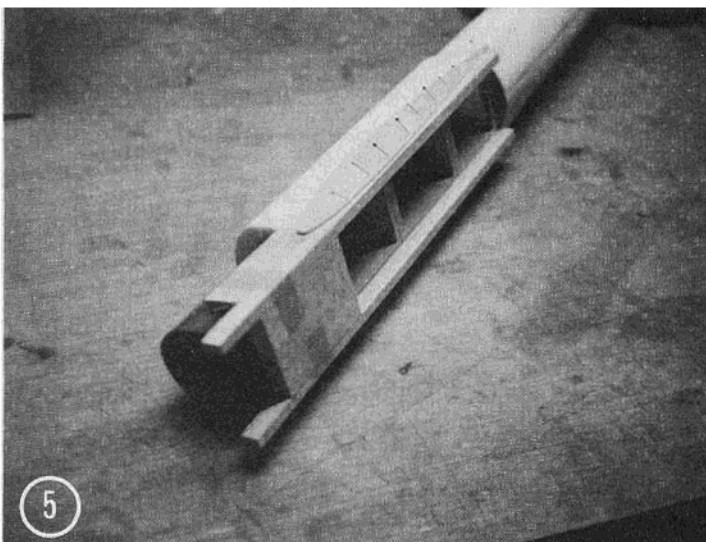
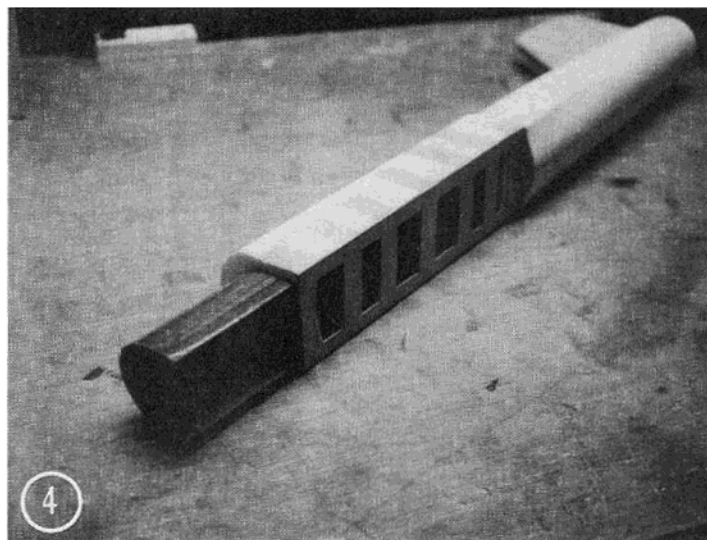
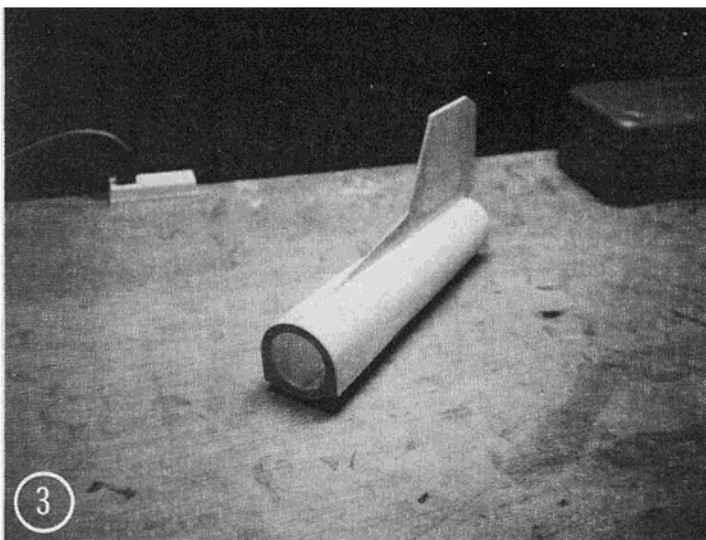
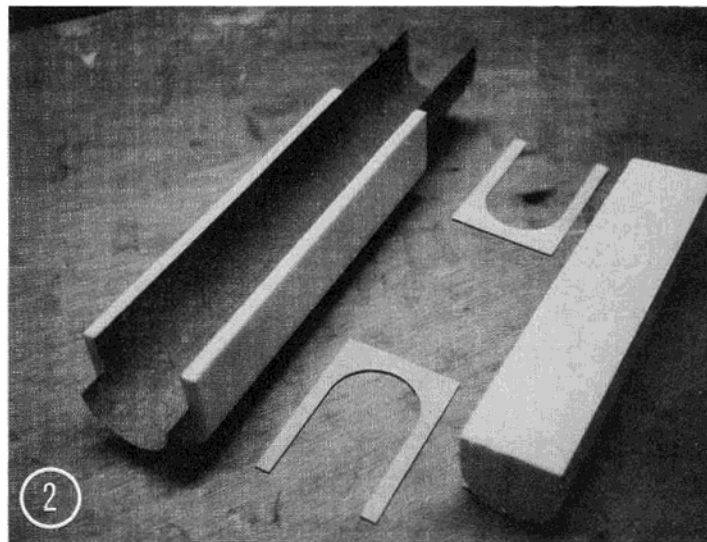
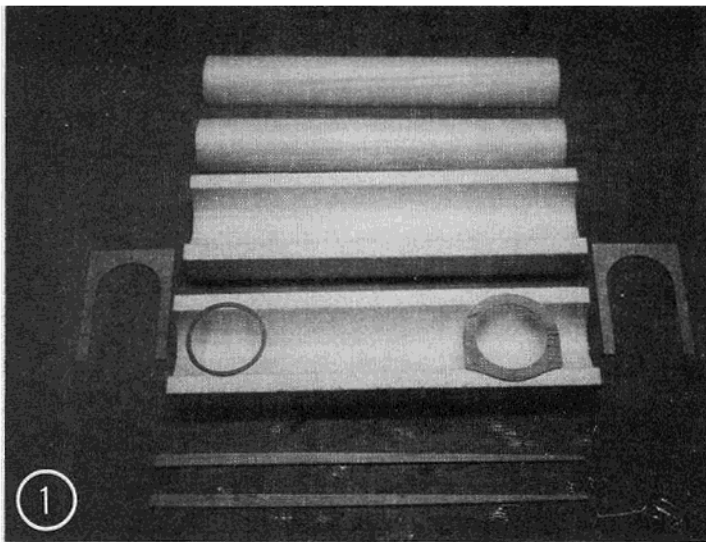
Four

CONTROL FUNCTIONS

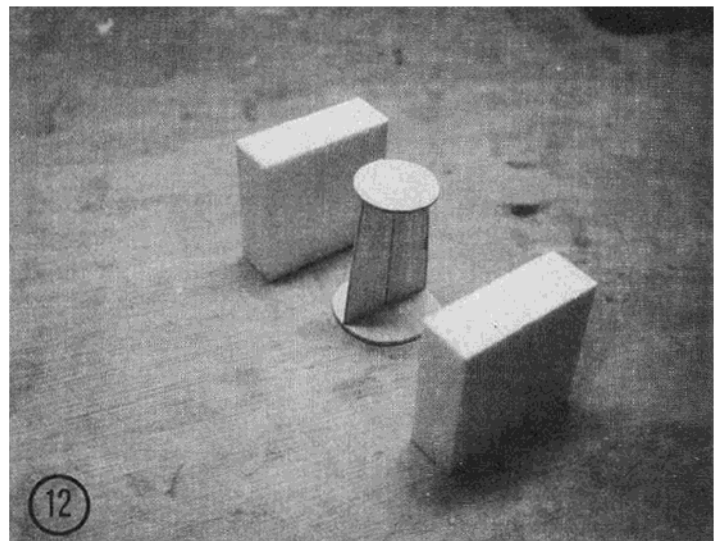
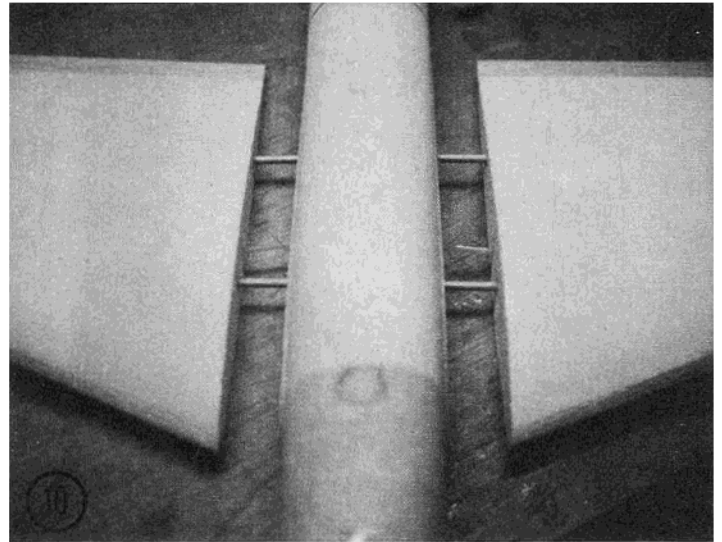
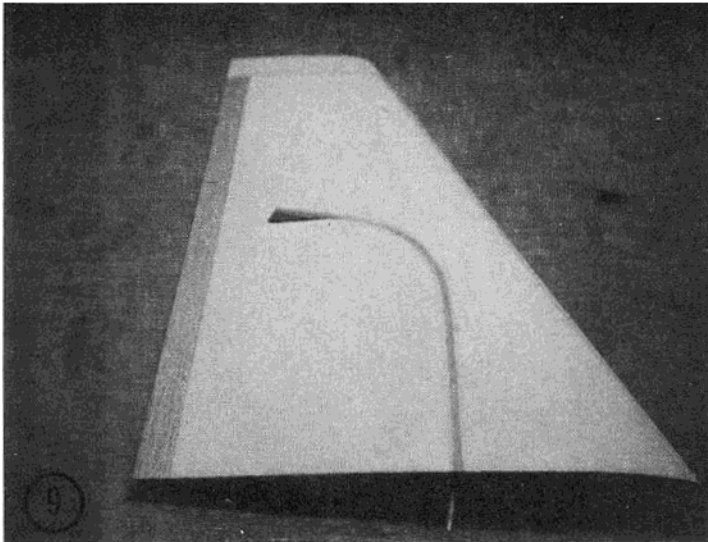
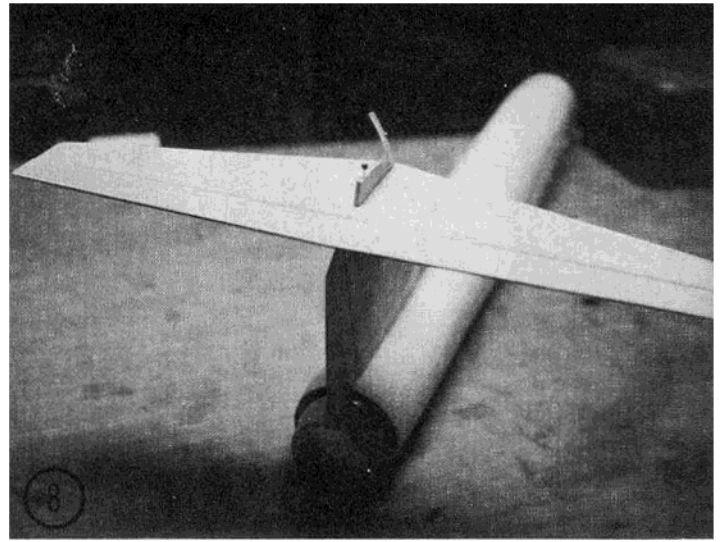
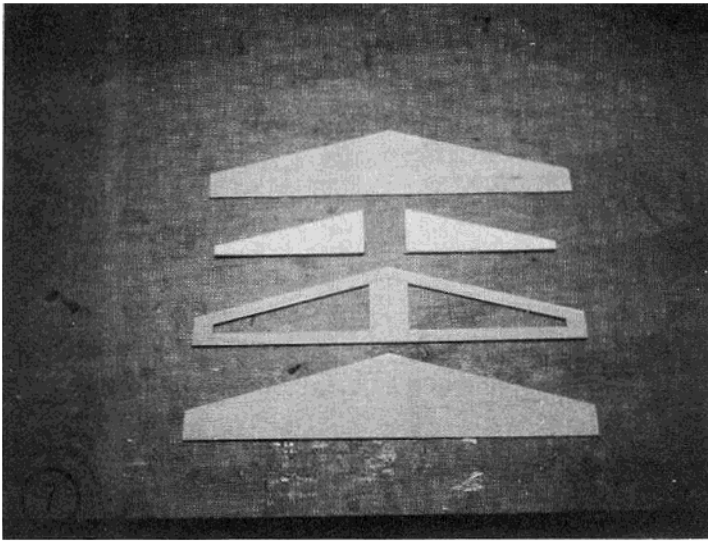
Rudder, Ailerons, Elevator, Throttle

BASIC MATERIALS USED IN CONSTRUCTION

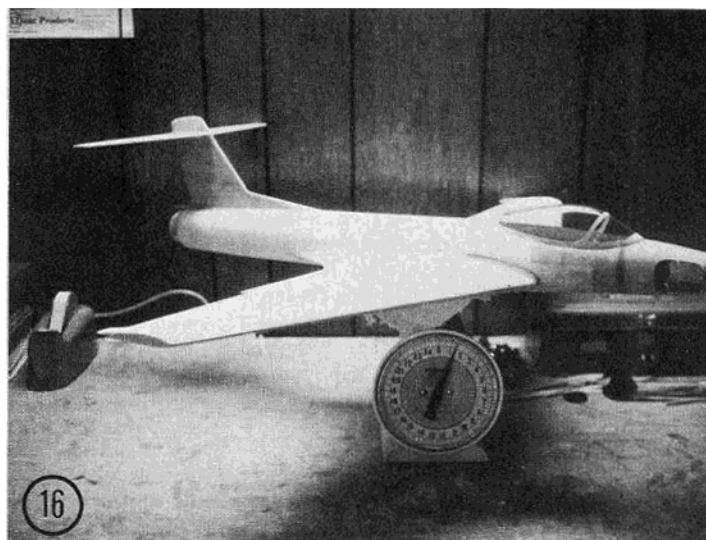
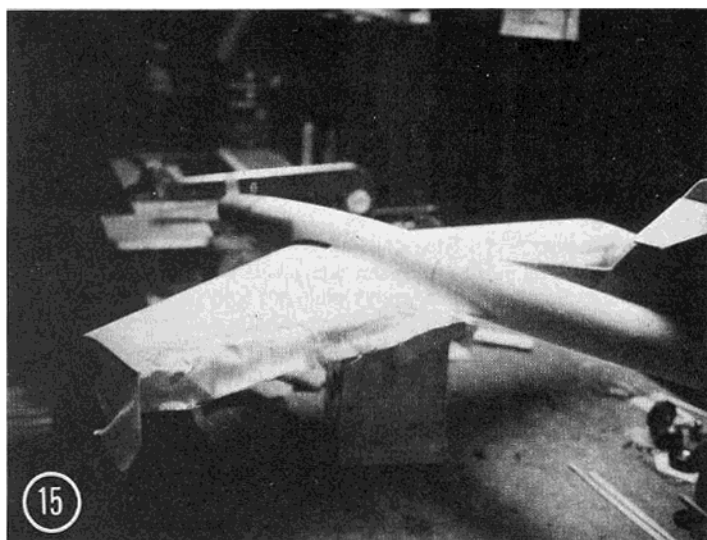
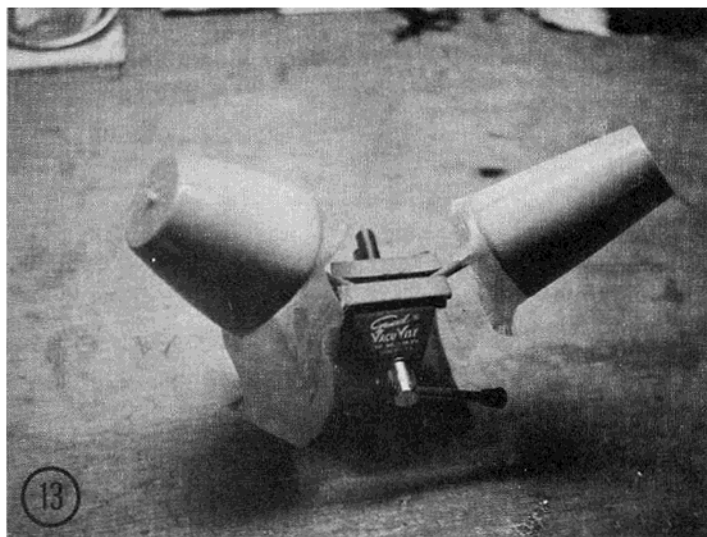
Fuselage	.....	Beaded Styrofoam
		Balsa, Ply, Fiberglass
Wing	....	Beaded Styrofoam, Balsa, Fiberglass
Empennage	....	Balsa, Styrofoam, Fiberglass
Weight Ready-To-Fly	.....	48 Ounces
Wing Loading	.....	22 Oz./Sq. Ft.



(1) Aft fuselage assembly showing foam halves, bulkheads, balsa longerons and cutting templates. (2) Center fuselage assembly including inner fuselage sheeting, cutting templates and foam core. (3) Aft fuselage assembled with fin and rudder in place. (4) Center and aft fuselage sections joined with 1/16" ply crutch in place. Note tape holding center section foam member and ply crutch together and correct angle on aft extension of fillet/fuselage line. (5) Forward extension of balsa fuselage members and balsa wing root members epoxied in place. (6) Sanded foam center section and forward balsa section.



(7) Component parts of the horizontal stab prior to laminating. (8) Empennage detail showing nylon cable housing and support prior to addition of upper fin cap. Note: Balsa exhaust tube glued in place. (9) Wing detail showing aileron cable detail and balsa edging prior to aileron cut out. (10) Wing assembly detail. Note: Nylon aileron cable housings projecting from wing roots. (11) This picture shows both foam fillets in different stages of completion. (12) Component parts of the foam/balsa cowl mold.



(13) Cowl mold with first layer of fiberglass cloth epoxied to balloon over mold. The one on the right is the Styros mold. (14) Completed fiberglass cowl and balsaply insert combine to form the complete nose section of the model. Notice that the nose wheel steering, throttle and tank holes are pre-drilled prior to the assembly being glued on the front of the fuselage. (15) Fiberglass applied to both upper surfaces of the wings. (16) Completely fiberglassed and sanded model ready for spraying. (17) Rear view of completed model. (18) Side view of completed model.

Glue the triangular strips into the lower edges of the tank compartment. Next, sand the balsa front and the foam center section to shape back to the trailing edge of the wing template, being careful not to sand a cup in the foam either side of the ply bulkhead that separates the center and aft foam sections. This is easily done using 80 grit garnet paper on a sanding block and sanding slowly in one direction. You will find that the foam quickly comes down to the desired shape. Do not sand the balsa bottom of the center section under the wing ribs that were glued to the fuselage sides. Also, be sure to leave the sides of the center section and forward part of the aft section flat and vertical so the fillets can be glued against a flat surface. Cut the 1/8" O.D. nylon tube to length and epoxy into the groove in the leading edge of the fin and cap the slot with 1/4" square balsa and sand to shape. Add the forward fin to the top of the fuselage and sand the complete empennage to a shallow airfoil shape. Saw a 3" square, 1" thick block of balsa to the outside shape of the front of the fuselage. Saw out the inside of this block on a Dremel saw using a 5° taper from back to front. A paper pattern can easily be made to simplify this job. Place a piece of bond paper on the front of the fuselage and rub the inside edge and outside edge with the side of a pencil; cut out the pattern and glue it on the balsa block and saw around the paper pattern. Note that only the inside cut-out is sawn with a 5° taper — the outside is sawn straight and sanded to shape after it is glued to the front of the other three balsa blocks. Cut the firewall from 1/8" ply and epoxy in place on the front of the 4 balsa blocks. Now finish sand the front to shape.

Next make a styrofoam and balsa mold 1/16" undersize to the shape indicated on the plan. Epoxy the balsa sanding templates and the vertical separator together and allow to cure. Cut 2 foam blocks to fit between the front and rear balsa bulkhead templates and epoxy in place. Hold together with tape until dry. Push a 6" length of 1/4" dowel into the center of the rear of the mold and clamp in a vice at about a 45° angle. Blow up a small Hobbyoxy balloon and run it down over the projecting mold until the rear of the mold captures the advancing inside of the balloon, then slowly let the remaining air out of the balloon. Cut the neck of the balloon off and pull the top layer of the balloon to the back of the mold leaving just one layer of rubber over the mold. Brush on a thin coating of Hobbyoxy II glue and wrap a layer of fiberglass cloth (2 oz.) around the mold, patting and smoothing the wrinkles out as you go. Overlap the cloth about 1/4". Cut the excess cloth off from the front leaving approximately 1/2" sticking out and snip all the way around the front toward the front cowl ring at about 1/2" intervals. Fold these 1/2" strips in toward the center, lapping each over the last until the cloth is stuck to and saturated with the Hobbyoxy II glue. Allow to cure overnight. Sand any lumps, blobs, etc., from the first layer and apply a layer of Hobbyoxy cloth in exactly the same

manner as you did the fiberglass layer. Allow to cure overnight. This second layer will look and feel like coarse sandpaper when cured and must be sanded nearly smooth before the next step. Now apply the third layer, again using 2 ounce fiberglass cloth and the same method as the first, allowing to cure overnight.

Sand this layer as smooth as you can without fuzzing up the fiberglass cloth using 80 grit garnet paper. Brush on a "gel" coating of Hobbyoxy II glue and allow to cure. Sand smooth using 80 grit garnet, then 180 silicon carbide "No Fill" paper. Trim the projecting cloth from the rear of the mold-block sand the rear face until the balloon is cut away by the sandpaper and remove the cowl from the mold by cutting a 1/4" to 3/8" hole in the front and pushing the mold out with a 1/4" dowel. Next build the balsa and ply insert that goes inside of the mold that includes the front cowl ring, nose gear block and motor mount. Sand to shape until it fits inside of the fiberglass mold and glue the two together using Hobbyoxy II. Next, epoxy the whole assembly to the firewall and finish sand the front of the fuselage.

Cut the wing cores with a hot wire and install the landing gear blocks, nylon tubing for the aileron cable, and cap all the way around with balsa as indicated on the plan. Cut out the aileron cut outs using a razor saw and an X-Acto knife and cap the cut-out with balsa. Cut the ailerons to size from 1 1/2" trailing edge stock and bevel the front to a 30° angle.

Drill 1/4" holes in the balsa wing seat in the position indicated on the plan — three on each side. Two are for positioning dowels and one is for the aileron cable to go into the equipment compartment. Drill 1/4" holes in the foam in the proper place to accept the wing joiner dowels and epoxy glue the wing in place over the dowels. Stick masking tape over the fuselage/wing joint on the underside of the fuselage to keep the glue from running out and prop up the wing tips with 1 inch blocks. **Make certain** that the wings are even, and straight on the fuselage longitudinally — that the fuselage is held flat against the table and the horizontal stab and wing are properly aligned. Now allow to cure.

Install the triangular wing fences/aileron cable housings on the underside of the wing. Notice that these are a 3 layer sandwich of 1/8" balsa center and 1/16" balsa on each side.

Place 2" masking tape over the foam on the bottom of the wing right up to the edge of the balsa of the fuselage to protect it while sanding the hatch area to shape. Build the 1/2" balsa 1/16" ply laminate for the bottom hatch 1/16" smaller than the hatch hole all the way around and wedge into the hatch hole with 1/16" balsa strips. Place 1/16" balsa under this hatch to allow for later addition of a wing saddle tape seal. Sand the hatch and fuselage to shape.

Next, cut the two fillet blocks of foam 15" x 2 1/2" x 1 3/4". The 2 1/2" dimension is the height. Use the wing root cutting

template and mark the lower edge of the block with a pencil following around the top half of the template to form the shape of the lower edge of the fillet. Notice that the fillet sweeps up from the end of the trailing edge of the wing. Your block should look like Figure 1.

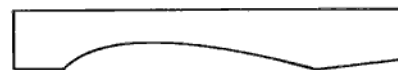


FIGURE 1: SIDE VIEW



FIGURE 2: SIDE VIEW

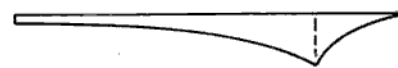


FIGURE 3: TOP VIEW

Next, mark the top outline of the foam blocks with a pencil. Cut out the fillets on the Dremel saw to the side profile and what you have left should look like Figure 2.

Now mark the top of the fillet to the plan view of the fillet and saw out on the Dremel. See Figure 3.

Glue the fillets into the upper wing fuselage joint using a very thin layer of 5 minute epoxy glue and hold in place until cured. Roll a piece of 80 grit garnet paper around a short length of 1" dowel or broomstick and sand the fillet to shape. Note: Protect the fuselage and the wing from damage during sanding by placing a 1" strip of masking tape along these joints, just as you did on the bottom of the wing.

Make the fin cap from a 1/8" and 1/16" balsa laminate and glue in place on top of the horizontal stabilizer. Be sure to align carefully. Also, make sure that you do not allow glue to fill the holes in the nylon tube when installing the fin cap and the wing fence/aileron housing.

Build the aileron horns and the elevator horn from 1/16" phenolic and 1/32" balsa and glue in place with 5 minute epoxy.

Now, apply a layer of 2 ounce fiberglass cloth over the whole airplane including the fiberglass cowl. Start with the fin and horizontal stab and apply the cloth by brushing the Hobbyoxy II glue on one surface at a time as thin as possible, i.e., one half of the top of the horizontal stab, one side of the fin, etc. Apply the glue first then lay the fiberglass cloth on it, gently smoothing the wrinkles with your index finger. Most wrinkles can be eliminated by laying the cloth on carefully in the first place. Two people work best for this step. Smooth out the edge of the cloth along the fin lower edge and fuselage. Allow the cloth to overlap the fuselage about 1/4". Allow the empennage to cure at least 12 hours before proceeding with the fuselage. The top of the wings can be done while the empennage is curing to speed the covering step. Allow the glue to cure, then trim off

... the cloth around the edge of the stab, fin and wing. Next, cut a piece of cloth large enough to go completely around the fuselage and long enough to extend about 1" beyond the front and rear of the fuselage ends. Cut a slit in the aft center, long enough to go around the vertical fin and lay in place over the fuselage with the fuselage resting on a box to raise it off the table about 6" or more. Make 2 cuts in the cloth along the leading and trailing edge of the wing so the cloth will hang down along the front and rear fuselage sides. Trim the excess cloth around the fillet allowing a 1/2" overlap with the upper wing surface fiberglass. Pull the cloth from the aft fuselage and lay it over the front half and apply glue to the rear half of the fuselage. Carefully lay the cloth back over the glue and smooth out the wrinkles with your finger, moving them to the edge and end. Pick up the front half and lay it back over the just applied rear half and complete, using the same procedure. Overlap the cloth along the bottom of the fuselage about 1/4". Allow to cure, then fiberglass the bottom of the wings. Trim off all excess cloth using an X-Acto knife and sand the edges using 180 grit silicone carbide paper to finish the edge. Brush on a thin coating of Hobbypoxy II glue over the tail surfaces, fuselage, and top surface of the wings, and allow to cure. Brush a coating on the bottom of the wings and allow to cure with the model upside down. When dry, wash the entire model with a mild solution of Ivory liquid before sanding with 100 grit garnet paper. Be careful not to sand into the glass cloth or the balsa wood on the ailerons, elevator and rudder, and hatch.

Glue the 8" canopy on the fuselage at the location indicated on the plan with Hobbypoxy after finishing the area under it with flat black enamel. Tape and sand the canopy outline and the glue edge around the canopy/fuselage joint.

Brush on the last (thin as possible) coat of Hobbypoxy II as thin as possible, using the same procedure as you did the first and allow to cure at least 24 hours at 70° minimum temperature. Sand the entire model smooth using 100 grit garnet paper followed by 280 silicone carbide No-Fil paper.

Finish with brushed or sprayed Hobbypoxy White Trim as indicated with International Orange and apply appropriate decals to fit your color scheme. Install equipment, tank, engine, spinner, landing gear, and wheels. Hook up the linkage as indicated on the plan and stand back and take a good look at a "new generation" model airplane. If the .15 size model is too small for you, scale up the full size plan 25% and go for a .40.

Here are a few last minute hints that will help you through your Styros project. First, when you mix the Hobbypoxy II glue, warm the tubes by placing them next to a 100 watt bulb or shining a heat lamp on them. Bring the temperature up only enough to allow the glue to flow through well, **do not get it too hot**. If you get it too hot, you will reduce the curing time too much. Mix the glue in small quantities. This makes for a lot more mixing, but it also allows you to brush the glue more easily, while the viscosity is down because of the heating, without the glue starting to set on you. Mix the Hobbypoxy II glue in pot pie tins and brush it on with a stiff bristle flux brush usually obtainable at hobby shops or hardware stores. Finally, when you are sanding, if the glue balls up or sticks in the sandpaper it hasn't cured long enough. Your sanding should leave a heavy white powder. Also, to avoid excessive weight build-up, sand as much of the glue off as possible without sanding into the glass cloth or the balsa parts.

Flying the Styros is a real pleasure. She's got a good speed range, handles well fast or slow. It's active enough to be satisfying, yet docile on

landing — and it doesn't look like everyone else's model. It is a real standout in the pit and in the air.

Once you master the foam and fiberglass technique you can apply it to any other model you would care to build from pattern to sport to scale.

Good luck with your Styros. I hope you enjoy yours as much as I have enjoyed the eight that I have built and flown. Plans for the Styros 15 are available from R/C Modeler Magazine Plans Service. If you prefer the larger, .40-powered Styros, the plans are available from the author John D. Woods, 2947 Persimmon Dr., Xenia, Ohio 45385 for \$5.00. □

From RCModeler July 1975