TWO MUCH IV

The 2-Meter class of R/C Sailplanes is a very popular event at all of the contests I have attended for the last several years and it has gained in popularity for several good reasons. They are smaller and, therefore, easier to transport. 2-Meter kits are less expensive and require less time to build, therefore, they are a logical choice for a beginning R/C glider flier. This article is presented to provide the sailplane modeler with a design that is easy to fly and yet gives performance that will satisfy those with serious competition in mind.

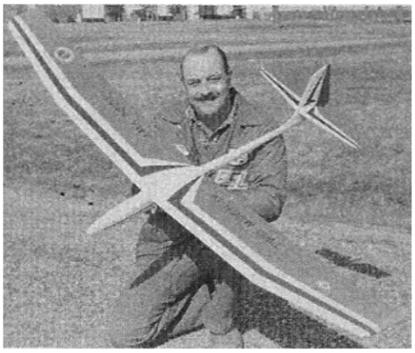
This model, Two Much, began before I became seriously competition minded, although I had flown in one sailplane contest. I had been flying power models for some time and was getting tired of just more loops, rolls, touch and go landings, and just trying to keep the model in sight. With a fast forty or sixty size model, one does not have time to relax and really enjoy just plain flying (pardon the pun), not to mention the fact that the greasy kid stuff was getting expensive. In any case, I had been flying a Wanderer 99 which is an excellent choice for a first sailplane. It is a good trainer and thermals with the best of them, but it did not have spoilers and did not have the pizzaz I wanted and thought a competition sailplane should have.

I was attending the Roanoke Valley RC Club annual auction in 1981 when a Hobie Hawk fuselage was offered for sale. I could see this as the beginning of something really snazzy with good performance and I paid nine dollars for it. Before I took to the drawing board, I called some old friends of mine in Hampton, Virginia, for some technical advice. Woody Blanchard is a retired NASA Aeronautical Engineer and Bob Champine was a NASA Test Pilot. Both are long time modelers and very serious glider competitors. Their collective advice was to use the Hobie fuselage in a 2-Meter design, because they felt it was a little too short to give me the longitudinal stability I desired. Woody sent me the ordinates of the Eppler 193 airfoil, since that was the "hot section" at that time, and Two Much I started taking shape. Other advice which has proven very good and has become one of my design philosophies is to build strong and not be too nit-picky about weight. Competition models take a real beating over a season of flying, and the extra strength will pay off in fewer nights of rebuilding. Also, since a few ounces of model weight increases the flying speed, the Reynolds Number (a measure of the effect of size and speed) increases, and sink rate performance suffers little as a result. A real plus due to the extra speed is penetration performance in the wind and the ability to cover more ground searching for thermals.

Two Much I flew pretty good but suffered from lack of yaw stability. It also tended to pitch down when the spoilers were extended. I had made a rather high aspect ratio stab and long spoilers. The inboard area of the spoilers affected about half of the stab span. The cure was to cut off 4" from the inboard end of the spoilers and 2" from the tip of each stab. The loss of stab area had no noticeable effect on pitch stability but now I could raise full spoilers and maintain good pitch control for precise spot landings.

The Hobie fuselage was discarded and a longer, balsa fuselage was built. Two Much II used the wing and stab from the previous version, but with the extra fuselage length, it became much more stable and a real pleasure to fly. Regrettably, it did not last very long. Have you ever launched your sailplane with the receiver turned off? If so, you too are on your way to becoming an expert! They (the experts) have already made all of the mistakes! The model climbed to about 75 feet and then veered off to the right. You can imagine my panic when I realized what I had done and that I had no control! The flight was terminated in a vertical dive still connected to the high start, so the impact was quite hard. The fuselage was destroyed but the only wing damage was to one outboard tip panel which hit the only rock around (Murphy's Law). The other three undamaged panels were a real surprize considering the impact, and that illustrates my point about building strong.

Two Much III was built using the same repaired wing with the addition



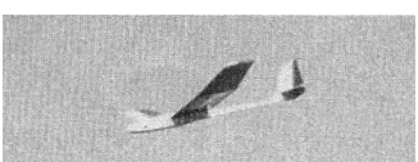
About The Author

Joe Lupton, age 42, is an Airline Transport Pilot flying a Short Brothers SD3-30 for Henson Airlines, the Alegheny Commuter serving Newport News, Virginia, where he lives. He is also rated in the Falcon 20 and has commercial ratings in gliders and helicopters. Joe soloed a Cessna 150 in 1964, and spent a year in Vietnam as an Army Huey pilot in 1967. With over 11,000 hours in flight time, he still looks forward to going to work.

Joe's first model airplane was a solid balsa B-29 which cost about 10¢ and had about an 8" wingspan. This was while he was in the fourth grade. His first income from a paper route when he was in the 8th grade went toward a Spitfire .045 and a Scientific U-Control model. By the end of high school he was designing his own combat models which he flew in competition in Winston Salem, North Carolina. He also designed several towline gliders, but there was not much interest in competition in that area then.

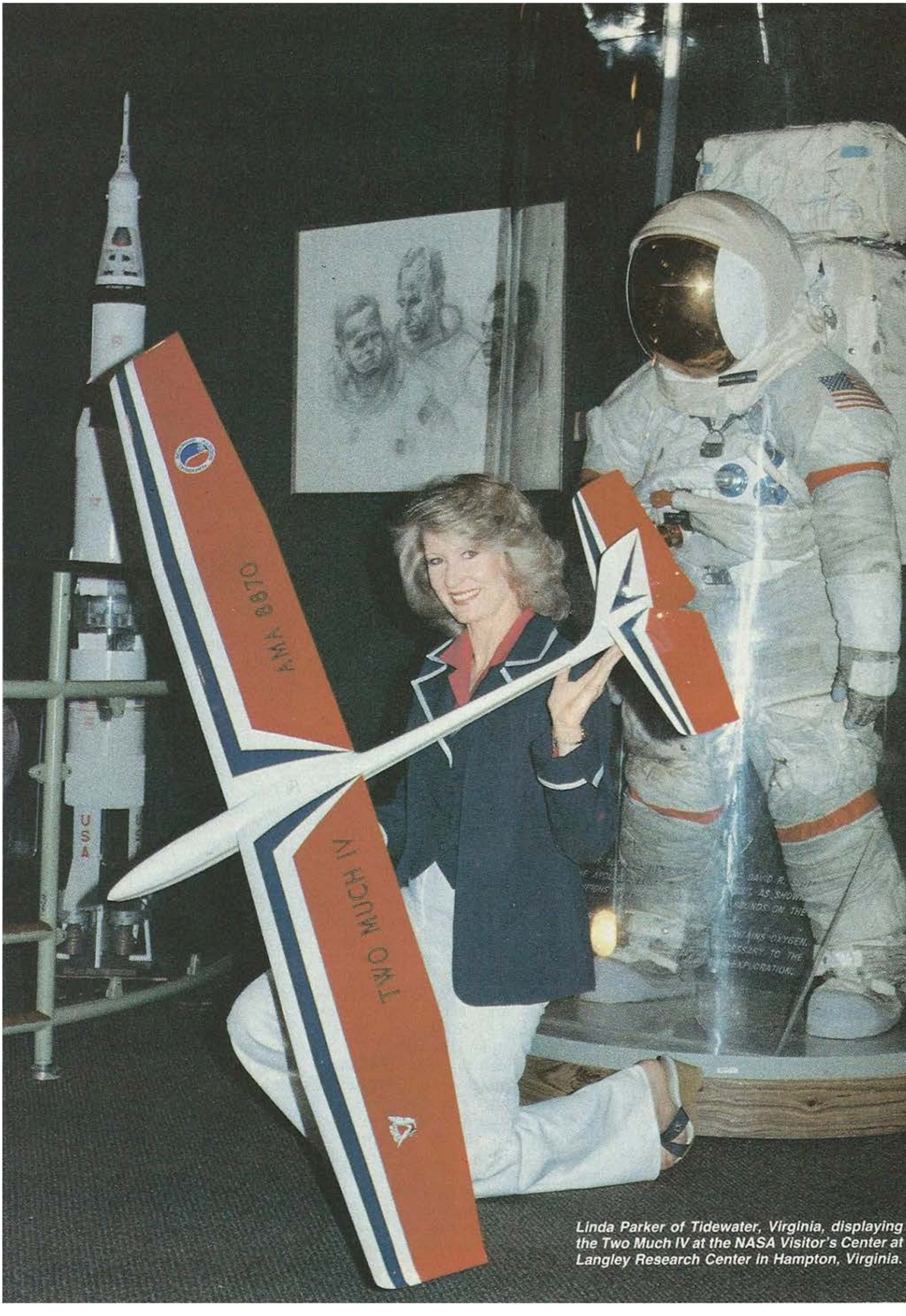
Joe spent one year in the NASA Apprentice School at Langley Field in Hampton, Virginia, where he helped build wind tunnel research models, which was "quite an education" in model building. After this, he returned to college and started taking flying lessons. College, flying, four years in the army and, finally, marriage caused him to abandon models for a few years.

He has been flying R/C models since 1978 and became interested in R/C sailplanes as an extension of full scale soaring interest about two years ago. He has designed several power models which attracted a lot of local attention and which may be the subject of future articles. Two Much IV is the outcome of his first sailplane design which is the result of over two years of testing and design improvements.



Presented here are the final results by the designer to obtain max altitude from a 12 volt winch. Altitude allows a lot of sky searching for thermals.

By Joseph S. Lupton, Jr.



Linda Parker of Tidewater, Virginia, displaying the Two Much IV at the NASA Visitor's Center at Langley Research Center in Hampton, Virginia.

Bill of Materials

All Material is balsa unless specified.

Qty.	Size	Description
Wing		
1	4 x 1/16 x 48	Firm — T.E. bottoms
1	4 x 1/16 x 48	Med. — T.E. tops
4	3 x 1/16 x 48	Soft — L.E. sheeting
1	1/4 x 1 x 36	Trailing edge — spoilers
4	4 x 1/16 x 48	Med. — ribs & stab capstrips
2	1/8 x 1/2 x 48	Spruce — inboard spars
2	1/8 x 3/8 x 36	Spruce — outboard spars
2	3/32 x 1/4 x 48	Spruce — leading edges
1	1/16 x 6 x 12	Plywood — root ribs, templates, bellcrank
2	3/4 x 1½ x 7	Soft block wing tips
1	1/2 x 80 x 2 oz	Fiberglass trailing edge reinforcing tape
1	1/4 x 3 x 36	Shear webs, wing fillet, hatch, rudder spars
1	3/16 x 2 x 12	Shear webs
1	1/4 dia x 8½	Piano wire, wing rod
1	1/4 I.D. x 12	Brass tube, wing rod tube
Fuselage		
1	1/8 x 6 x 48	Lite ply, fuse sides & fwd. bottom bulkheads
2	3/8 x 36	Triangles, fuse longerons
2	1/4 x 36	Triangles, fuse longerons
1	1/8 x 3 x 36	Med. — top & bottom, rudder — stab T.E.'s
1	1/32 (or 1/64)	Plywood — verticle stab sides
1	1/32 x 1/2 x 36	Capstrips for rudder
1	3/32 x 12	Piano wire — stab rods & wing incidence rods
1	3/32 I.D. x 12	Brass tube — stab & wing incidence tubes
1	1/8 x 12	Piano wire — tow hook material
1	1/8 I.D. x 3/8	Brass tube — bellcrank forward pivot tube
Misc.		
2	36	Pushrods: suggest braided cable
2	1/16 I.D. x 20	Plastic tubing for spoiler cables
1	1/8 I.D.	Wheel Collar — tow hook adjustment
1	small x 9"	Gapless hinge (or 4 hinges of choice)
2	5/64 I.D.	Wheel collars — spoiler pulls
1	2 x 24	Fiberglass tape — wing polyhedral reinforcing

TWO MUCH IV

Designed By:
Joseph S. Lipton, Jr.
TYPE AIRCRAFT
2-Meter Comp. Sailplane
WINGSPAN
77⅝ Inches
WING CHORD
9" Root
6¼" Tip
TOTAL WING AREA
650 Sq. In.
WING LOCATION
Shoulder Wing
AIRFOIL
Eppler 211
WING PLANFORM
Constant Chord Center
Double Tapered Tips
DIHEDRAL EACH TIP
Center Panel 1¾"
Tip Panel 2¼"
O.A. FUSELAGE LENGTH
42⅞"
RADIO COMPARTMENT SIZE
(L) 8" (W) 1⅝" (H) 2"
STABILIZER SPAN
22 Inches
STABILIZER CHORD (inc. elev.)
4¾ Inch (Avg.)
STABILIZER AREA
100 Sq. In.
STAB AIRFOIL SECTION
8% Symmetrical
STABILIZER LOCATION
Fin Mounted
VERTICAL FIN HEIGHT
8 Inches
VERTICAL FIN WIDTH (inc. rud.)
5¾" (Avg.)
REC. ENGINE SIZE
NA
FUEL TANK SIZE
NA
LANDING GEAR
NA
REC. NO. CHANNELS
3
CONTROL FUNCTIONS
Rud., Elev., Spoilers
BASIC MATERIALS USED

Fuselage	Lite Ply & Balsa
Wing	Balsa, Spruce
Empennage	Balsa,
Wt. Ready To Fly	**37 Oz.**
Wing Loading	**8.2 Oz./Sq. Ft.**

of the Horner style wingtips. The current fuselage design was employed using lite ply for the sides and has been flying now for well over a year, having won many local and regional 2-Meter events.

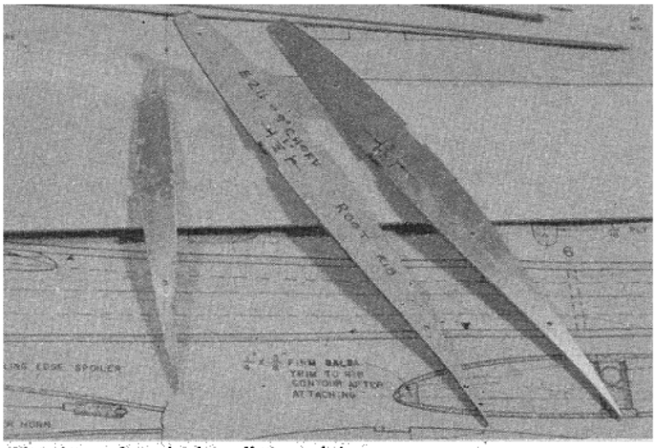
Two Much IV is a further refinement and is designed to obtain max altitude from a 12 volt winch. By "standing on the pedal" and using the "zoom launch," an additional 100 to 200 feet of altitude can be gained from the increased airspeed. The extra altitude and the superior penetration of the Eppler 211 airfoil in Two Much IV allows it to cover a lot of sky searching for thermals.

Since this design is intended for the serious competitor, I am assuming a certain degree of building competence, and I will not go into common building practices. There are several construction techniques I have developed, or learned through experience, which may be of help to others and I will try to elaborate. Let's begin with the wing!

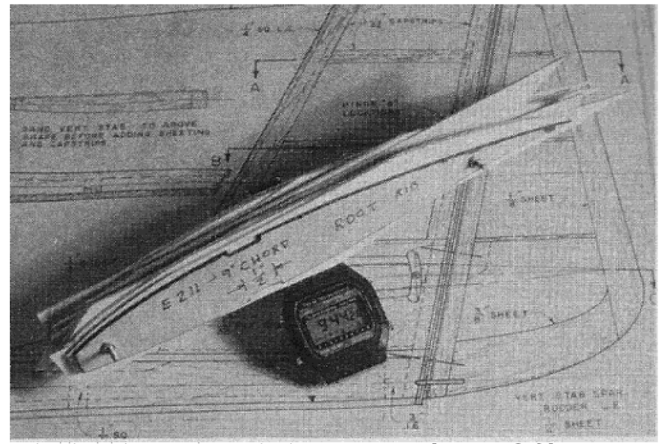
To take advantage of max winch energy, the wing must be **strong.** 1/8" x 1/2" spruce spars for the center sections with good shear webs assure this. I like to taper the spars to 3/8" wide at the polyhedral break and to 1/4" at the tip. The extra width is not needed at the tip and the weight just reduces roll response. I use plywood templates to cut the ribs and I face them with aluminum such as that used in gutters or siding. **Super!** Black the edges with a magic marker and stop sanding when you see the silver aluminum. This way each set of ribs is the same instead of getting slightly smaller per set. Three templates will be required: Inboard center section, outboard center section (which is also the inboard tip section template) and the tip rib. Cutting the notches in the ribs for tapered spars is easy this way since the center template has a 1/2" slot, the middle has a 3/8" slot, and the top a 1/4" slot. It's a good idea to make these slots slightly undersize since it's easier to enlarge a slot for a spar than vice versa. Rib material should be selected carefully since the rib is quite thin near the trailing edge and very light wood will only cause problems later.

The trailing edge technique was introduced to me by Woody Blanchard and makes a strong, lightweight structure which can be sanded to a very sharp, durable edge. The bottom T.E. sheet should be medium to firm balsa in the center section and can be light to medium in the tips. Sand the taper to as fine an edge as you dare on the bottom piece before gluing up the wing. The 3/16" square support (as shown in the **rib sections** drawing) will keep the spar surface flat on the table and properly set in the ribs. (Note that for the tip panels, this support tapers to 1/8" at the tip.)

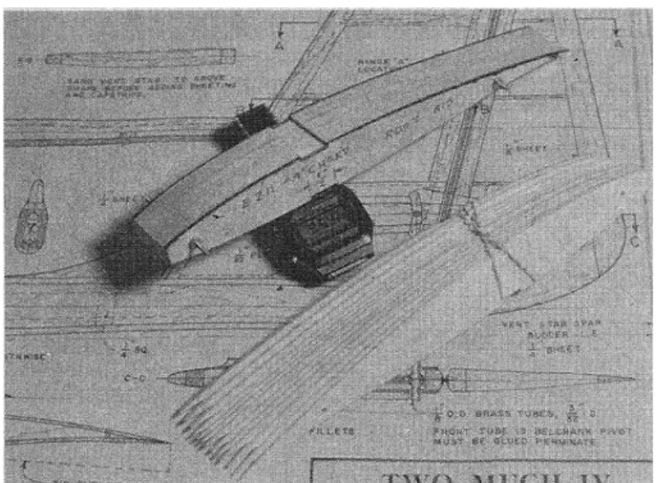
The upper T.E. is not tapered until final sanding of the wing to avoid damage during handling. The 1/2" wide fiberglass tape is the secret to this technique. This tape should be about as thick as 2 ounce cloth if you cannot locate 1/2" tape in rolls. By using a 30-minute epoxy, and holding the upper trailing edge piece in place with a wood yardstick as shown, and



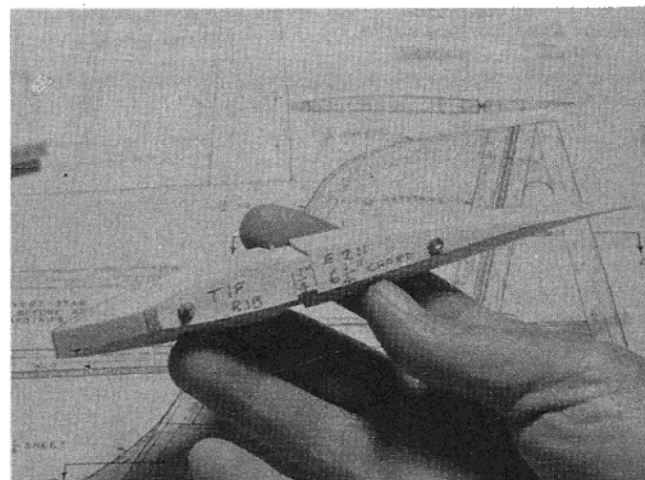
Aluminum faced wing rib templates.



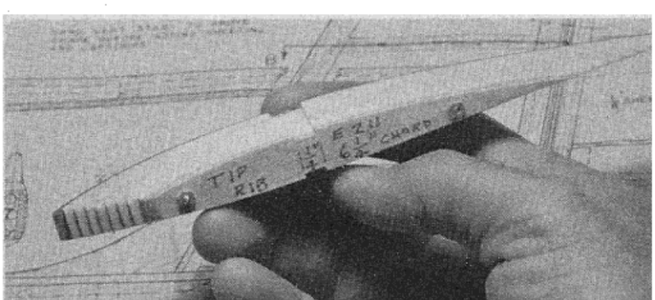
A stack of wing rib blanks between templates at 9:44.



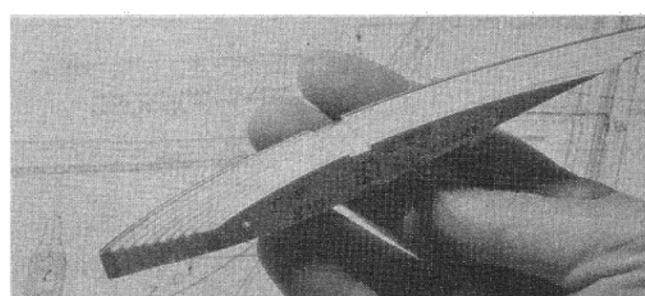
Finished ribs at 9:59, after 15 minutes, and a previous set of perfect ribs.



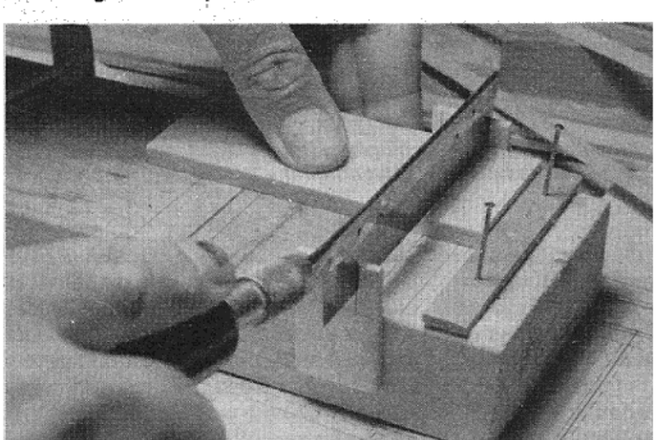
Set of tip ribs after shaping. Note bevel on outside edge of tip template only.



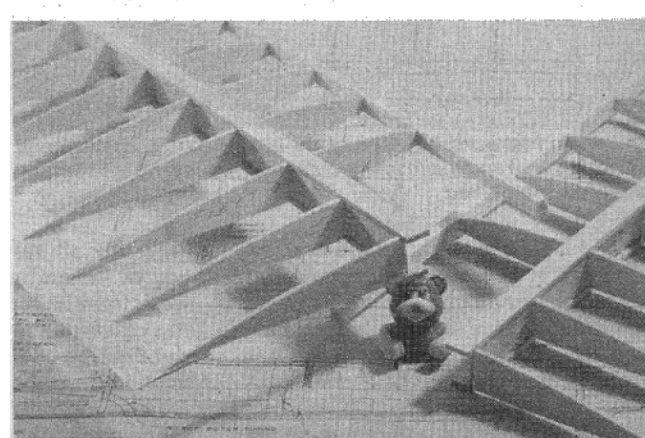
Tip ribs showing leading and trailing edge squared off before removing from templates.



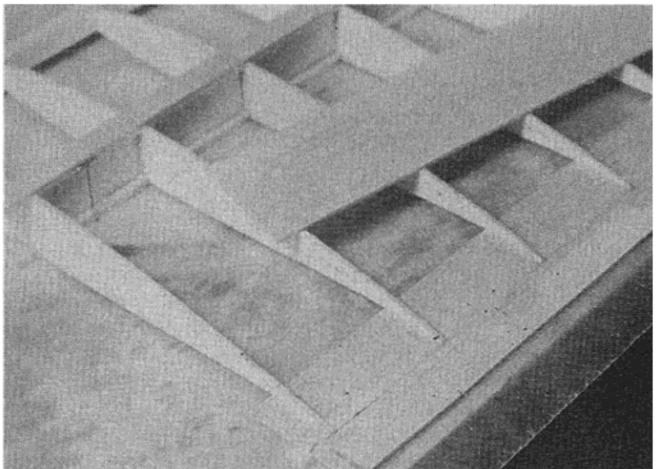
Ribs after separating from template and squaring off top and bottom edges should be very uniform when restacked.



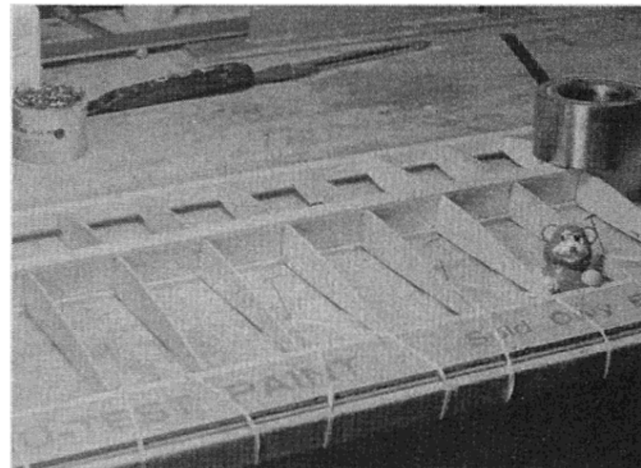
Jig made from 2 x 4 for cutting shear webs.



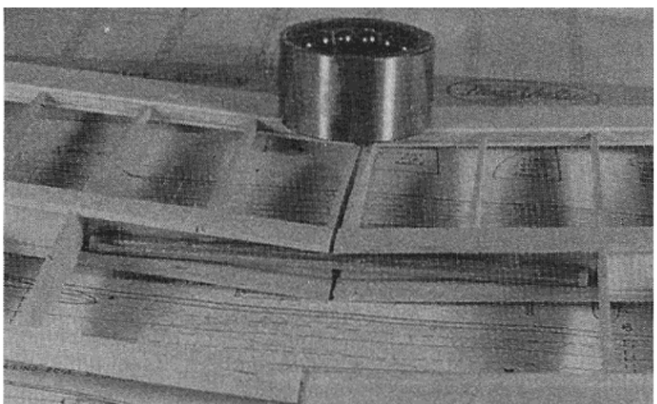
Lower trailing edge tapers to fine edge. Wing box ready for addition of tubing.



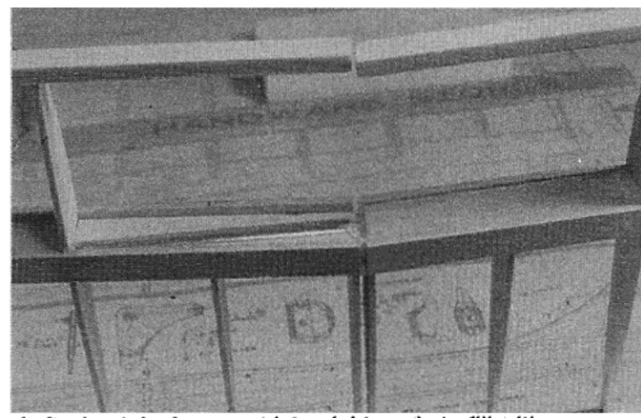
Fiberglass tape spot glued with CA prior to epoxy for top surface. Note 1/16" x 1/4" support under center of trailing edge — will preform lower surface curve.



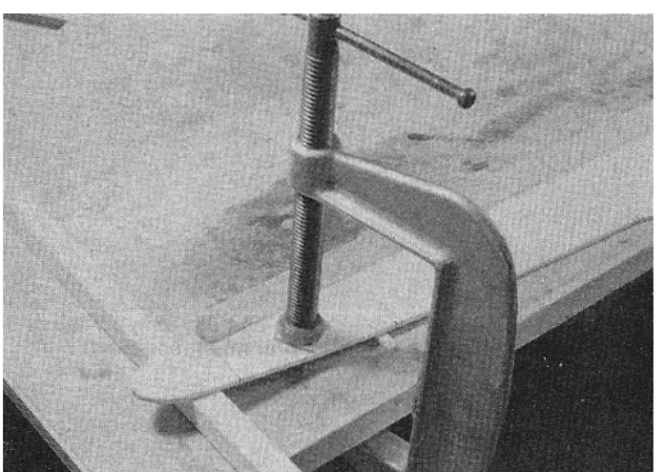
Rubber bands and yardstick apply good pressure to trailing edge while epoxy sets up and will guarantee a straight trailing edge. Upper surface then sanded to fiberglass and epoxy for a sharp trailing edge.



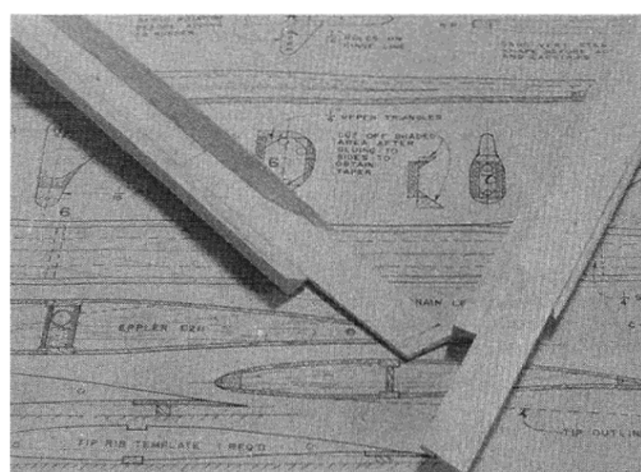
Wing panels blocked to proper dihedral and wing tube spot glued in place with epoxy. Note web in trailing edge.



Left wing tube box complete, right ready to fill with epoxy and 1/16" plywood side. Saw apart after completion.



Prebending forward fuselage sides before gluing on triangles will hold curve and make forward assembly easy. Note bulkhead locations premarked.

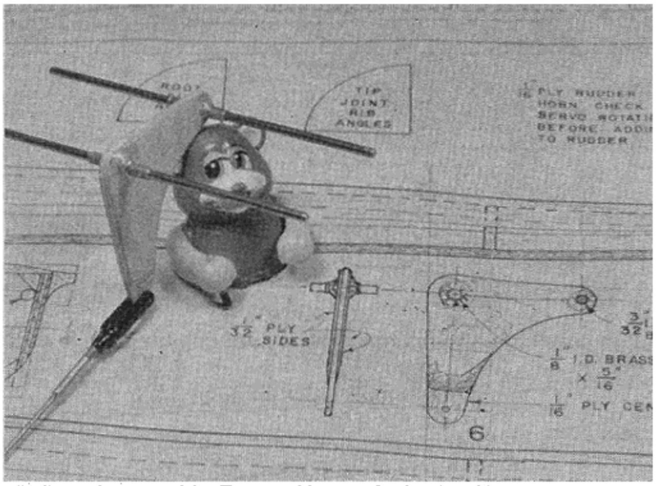


Aft fuselage showing triangles overlapping sides to cause taper when cut flush with fuselage top and bottom.

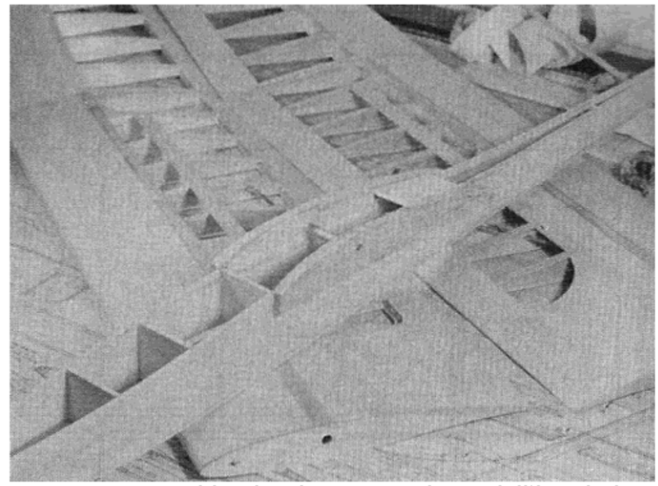
with a 1/16" strip under the trailing edge, you will produce a straightedge with the curve preset in the lower surface. (Don't forget to place waxpaper between your work and the building board.) Putting the 1/16" trailing edge web in the opening between the ribs prior to removing the yardstick is recommended and will increase the warp resistance. The 3/32" x 1/4" spruce leading edge is added last and will really protect the wing from damage from twig strikes, heavy weeds (haven't you ever missed the field?) and even small stones you may encounter.

The wing rod tube should be firmly set in epoxy with spruce or ply spacers between the spars. The wing will be no stronger than this unit, so --- 'nough said!

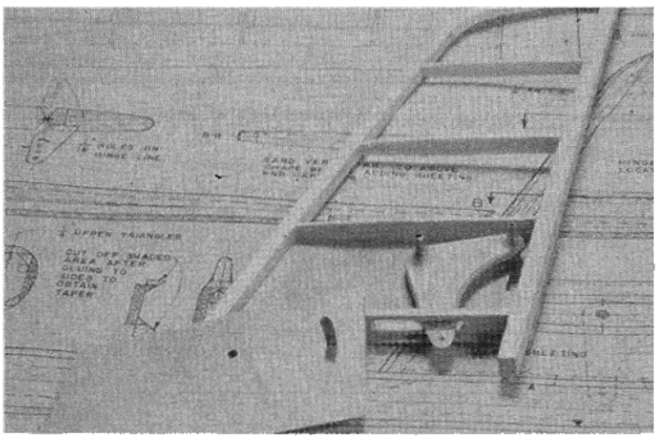
The fuselage is very conventional in structure, having 1/8" lite ply sides with medium balsa triangular corner longerons and balsa top and bottom sheeting, but a few tricks will speed up building and assure a straight structure. When cutting the bulkheads, mark the vertical centerlines on each piece. This will



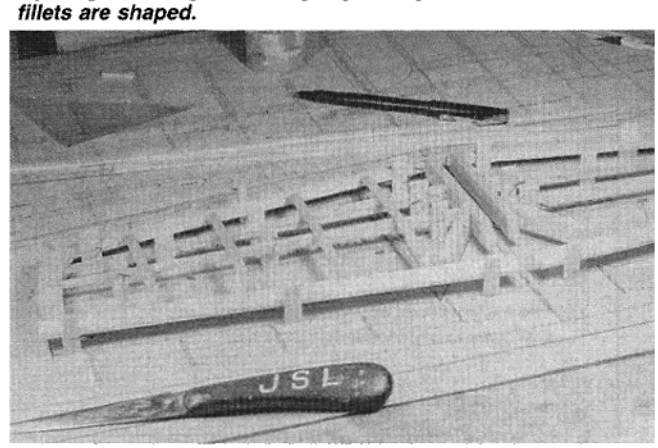
Bellcrank assembly. Forward long tube is glued into vertical stab and bellcrank pivots on it. Short 1/8" I.D. is epoxied to bellcrank.



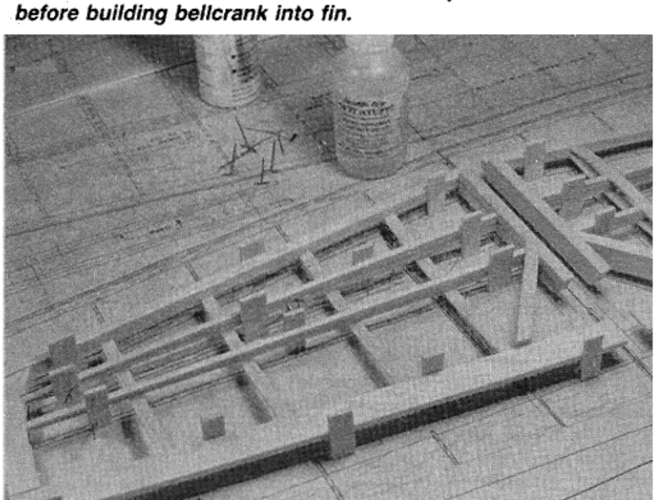
Fuselage assembly showing wing tube and fillets before tapering to fuselage at leading edge. Wing should be fitted before fillets are shaped.



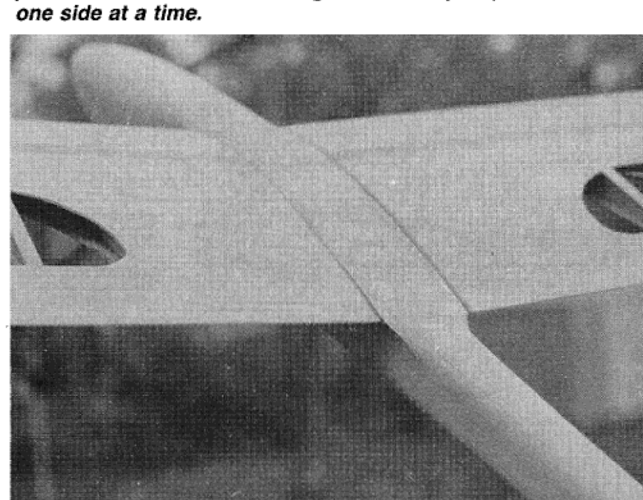
Vertical fin assembly with bellcrank in position ready for left side. Caution — assemble horizontal stab and position stab tubes before building bellcrank into fin.



Horizontal stab framed up on jigs. Centerline of stab is positioned 1/2" above building surface. Capstrips are added to one side at a time.



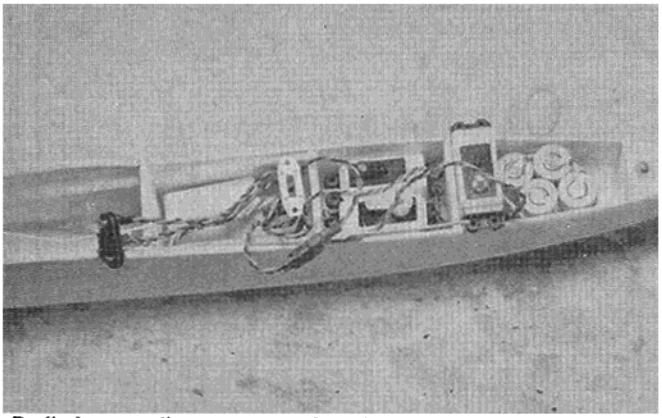
Stab has been flipped over and ready to add caps on this side. Be sure jigs are pinned down to board to assure symmetrical surface.



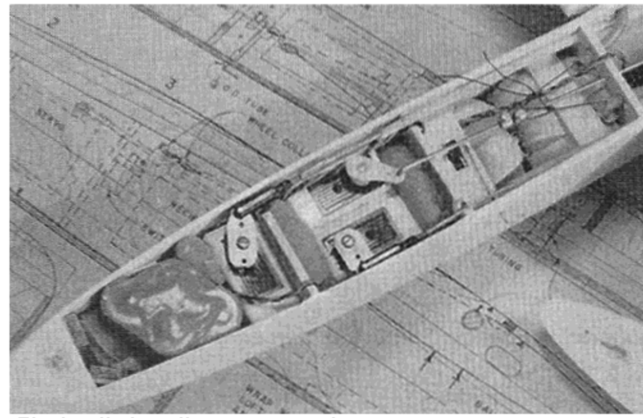
Wing and fuselage mating showing fillet contours.

help center each in position over the plan view. Also mark the bulkhead locations on the inside of each side for the same reason. The curve in the front of the fuselage will be difficult to make if the triangles are glued on the flat sides, so block up the front of each side to preform the curve and attach the longerons with CA glue flush with the edge of the fuselage back to bulkhead #5. From that point aft, move the triangle outward as you progress to the rear so that only 1/8" is attached to the sides at the rear. Be sure you don't make two of the same side. (Remember what I said about the so-called experts?) The top 1/4" longeron is treated the same way.

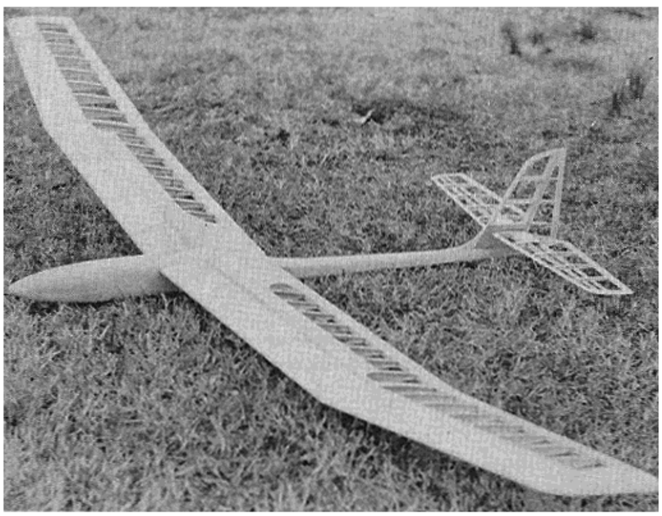
Before you trim off the triangle overlaps to create the tapered longerons, spot glue the fuselage sides together, outside to outside. Now when you trim down the triangles, you will be making the two sides match and can be sure of getting the corners square on both sides for good contact for the top and bottoms. Also, this is a good time to locate and drill the wing rod tube holes in the sides. This will allow you to use the rod in the sides

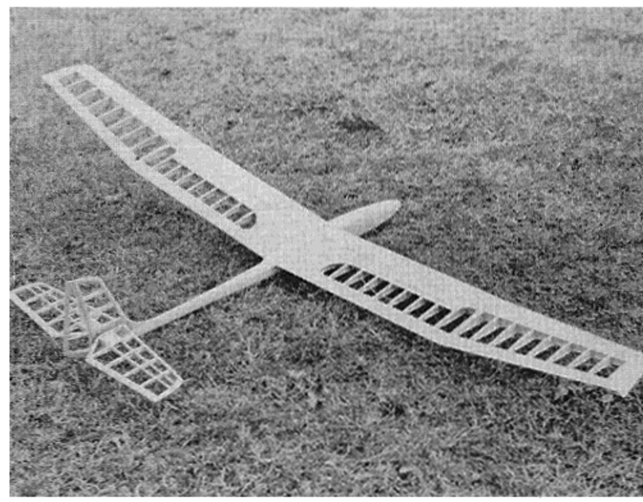


Preliminary radio component location.



Final radio installation — very tight. Note: Spoiler cable lead-in, spoiler adjustment wheel collars, switch installation, Goldberg hatch snap inlaid into forward end of hatch, much foam to cushion servos and receiver.





Completed structure ready for finish.

during assembly to help keep the sides square and the wing rod level. A good clean hole cutter for the wing rod can be made from a piece of the brass wing rod tubing about 2" long. Use a fine razor saw and cut teeth every 1/16" in the end of the tubing. Mounted in a drill, it cuts clean holes without splitting the plywood. This idea works well with balsa, also. The pushrod guides and antenna tubing (small soda straws work good for this and are light—just split one end, slip together and Hot Stuff) should be fitted and glued in before assembly. The wing fillet is just a piece of 1/4" medium balsa tapered to be flush with the fuselage sides at the wing leading edge and then is shaped with the X-Acto gouge or round blade to the lower wing surface and continues the wing upper surface across the fuselage near the trailing edge. Rounding the fuselage and shaping the fillets should be one of your last steps.

The fuselage hatch fastening method was not shown. I am using a Goldberg Nylon Snap Keeper inlaid in the top with a screw in the nose block. It would be just as easy to fit a screw in the top with a slot in plywood, ala Sagitta. Rubber bands should work well too. In any case, the hatch is fitted between the fuselage sides at the wing root and fairs into the wing.

The tow hook is designed for the strain of zoom launches. It will distribute the launch loads over a wide area in the fuselage and should be securely epoxied in place. I reinforce the entire hook area inside the fuselage by fiberglassing up both sides to the wing rod tube. After the tow hook is inserted, I epoxy glass around it. This serves to tie wing assembly and tow hook together. **Very Strong!** Try to keep the space between the hook and fuselage to no more than 1/8" so that the tow ring will not slip over the wheel collar.

The bellcrank is the next logical step as this is common to both the vertical and horizontal stabs. I like the plywood unit shown since it is custom made and is much stiffer than commercial plastic units. Most flying stabs I have seen tend to wobble — not this one. If you want to make your bellcrank out of 1/8" ply (aircraft grade) and sand it to 1/16" for the stab clevis, be my guest. However, by laminating it as shown, you can leave a large lightening hole (not shown) in the center piece between the 1/32" sides and still have a stiff bellcrank. The forward tube is 1/8" I.D. and pivots on the 1/8" O.D. tube (3/32" I.D.) which is glued into the vertical stab and fillets. Since this fixed tube and the rear bellcrank tube are both nearly 3/4" long, all wobble is eliminated.

In the vertical fin, I used some 1/64" plywood I had instead of the 1/32" ply shown on the plans for the stab mounting. If you have this available, use it in good faith. With the fillets for the stab on each side, it will be quite strong and will save some weight in the tail. If you elect to use the small hinge points which I prefer, the 1/64" ply makes a good thin capstrip for the rudder post as in Detail A for a very scale-like hinge.

The rudder may look small by comparison to other sailplanes. It is enough at the higher speeds this model normally flies at. If you're not convinced, then make it 3/8" wider. I think any more than that would have an adverse effect.

The horizontal stab structure is a little more trouble than a simple 1/4" flat stab structure but it does result in a nice strong and light symmetrical stab. If you decide to go to another type of construction, I definitely recommend an 8% thick section with good torsional rigidity. The only structural problem I had on the Two Much III was a stab which fluttered and broke both spars at the high launch speed I am attaining. This was due to using light 1/8" balsa spars and soft capstrips in an effort to keep weight down. Remember what I said earlier about strength? This model has a hard balsa front spar and a spruce rear spar and stiff capstrip ribs. This appears to have solved the problem as my best zoom launches to date have been very stable in pitch with no sign of flutter.

Although it looks complicated, it goes together very quickly. The little jig pieces which support the structure during assembly are the key and should be made from 3/32" sheet. Use a T-square or triangle and mark off 1/2" strips the width of a 3" or 4" balsa sheet and then cut it off every inch. Now you can just cut these off in 1/2" pieces and each will have a centerline. Mark the centerline on the spars, L.E. and T.E.'s and spot glue the jig pieces to them. Now, when you pin the jig supports to the board, the centerline of the stab will be exactly 1/2" above the board. Glue the capstrips to one side, flip it over and re-pin it and repeat the process. Presto — perfect! The small sheet area in the center is attached after the tubes are epoxied to the spars. Use the bellcrank with the center wires to position both tubes on the spars of each stab at the same time before you build it into the vertical fin. (Use hard sheet for this little pad as this is what you will be squeezing to push and pull the stab on and off. I have started gluing my mounting wires into the tubes of the stab.) I glue the front wire into one side and the rear wire into the other. Then after making a small bend in each wire, they will be very tight going together and should not work loose in flight.

My radio installation is very tight as you can see in the pictures. My equipment consists of a royal Vanguard receiver, Ace Bantom Midget servos and an Ace 450 ma battery pack. I have removed the batteries from the plastic case to allow a more compact arrangement. There are numerous other systems which will fit, but do plan ahead. By keeping everything as far forward as possible, I was able to keep the addition of lead for balance to less than two ounces.

Two Much IV will definitely weigh more than the typical lightweight type of 2-Meter sailplane. My uncovered and unpainted complete structure weighed about 21 ounces. MonoKote covering and the fuselage paint job added another six ounces. Total ready to fly weight was 37 ounces. The projected wing area is 650 square inches, producing a wing loading of 8.2 oz./sq. ft. This is rather low when compared to F3B types, so it is very much in line. Adding one pound of ballast raises this to 11.7 oz./sq. ft. and that really makes it penetrate.

Flying the Two Much IV with the Eppler 211 airfoil is a little different than flying the slow, flat bottom floaters. This airfoil is basically a laminar flow type and is more efficient at higher Reynolds Numbers than the flat bottom family. Therefore, you will find the best speed for minimum sink and best L/D to be much faster than you may be used to. This is what we want since we can now cover more ground without having to dive the airplane. How does it thermal? Very well, thank you! Those windy weather contests will now be something you will almost look forward to, since with ballast, you will be moving upwind when everyone has to dive just to stay over the field.

I hope you have as much success with this model as I have. I am looking forward to seeing Two Much IV in competition this year, but good luck --- I'll have mine too! □

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