From Norway, the Cirrus RC-Flyklubb

KLUBBENS 2-METER

By KÅRE SCHANCHE . . . Norwegian and English Two-Meter Class rules restrict controls to rudder/elevator only. Within those rules comes this highly refined, competitive thermal glider developed by the Cirrus club.

INTRODUCTION

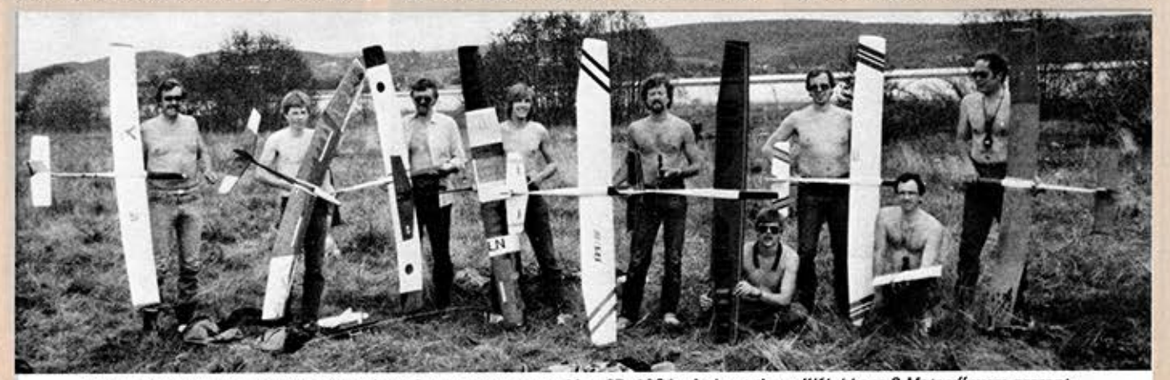
The model has been designed at several club meetings of the CIRRUS RC club in Oslo, Norway during the autumn of 1982 and winter of 1983. We have used this opportunity to give our members a simple schooling in model airplane design, aerodynamics, and practical construction work.

The design manager has been Thorbjorn Jespersen, also known as one of the *KITT-193* designers. (See **MB** February 1984.) The drawings were made at late nights and early mornings by the author.

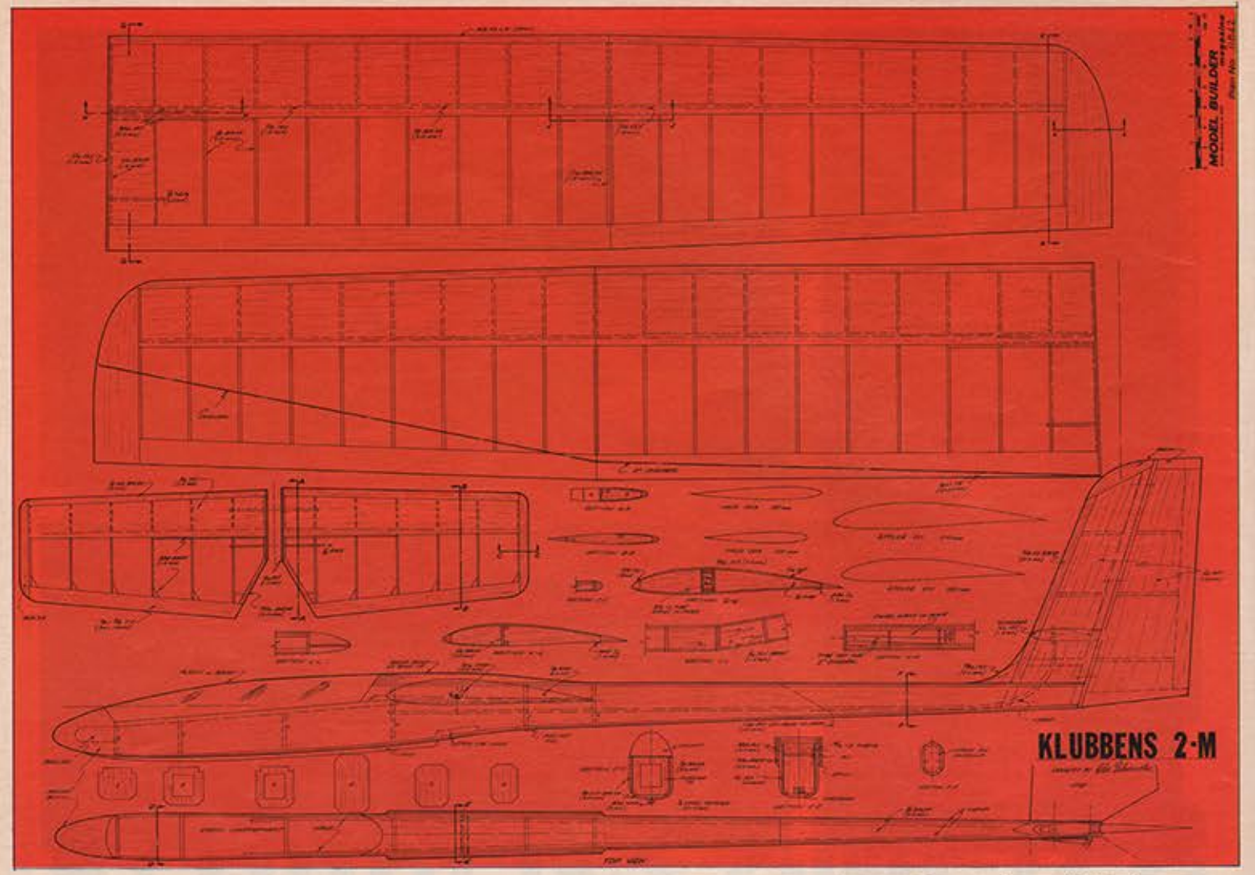
The appearance has been a compromise between an easy-to-build model and a good-looking model. Our philosophy has been that the Two-Meter Class ought to be a schooling class only, and an introduction to the F3B tasks.

The soaring background in Norway is too small for two competitive programs. In our opinion, a two-meter model ought to be easy-to-build, easy-to-fly and at the lowest possible cost. That is why we have chosen only two functions: stabilizer/rudder or V-tail. We have used parts which can be bought in even the smallest modelshop. The standard design has wings made of balsa and fuselage laminated with plywood. Some of our members make foam wings and some cover the fuselage with epoxy/glasfibre to achieve a more resistant surface.

When you are going to build a model from scratch, you have to make all the parts. A lot of model builders become apprehensive at this point, particularly the airfoil ribs terrify



Cirrus RC Flyklubb members gather for a 2-meter contest on May 27, 1984. At least three *"Klubbens 2-Meters"* were present.



blanks between the templates and keep the stack together with some long needles or screws. First you make all the ribs (two wings at a time) from the root to the polyhedral break, then you make the ribs for the outer panels. For the forming, you will need a knife and one or two sheets of sanding paper.

We have not numbered the ribs, so you have to ensure that they will be placed correctly.

If you like to take care of (or protect) the drawings, you have to cover the plan with clear plastic wrap.

You start by cutting the spruce spars and the lower sheeting to length. The spruce spars taper from 3x10 mm at the root to 3x5 mm at the wing tip. For all wing sheetings, we use 1.5 mm (not too weak) balsa. Cut the trailing edge 3x15 mm to length. Put the lower sheeting on the drawing and glue the lower spruce spar to the sheeting. Below the rear end of the ribs and front of the trailing edge you have to place a 1.0 mm shim. Then you can glue the ribs (not the root rib and the ribs in the polyhedral break) to the spruce spar and lift the sheeting up to the ribs with shims and glue it to the ribs. Then glue the trailing edge to the ribs. Now it's time for the upper spruce spar. Glue it to the ribs. Then you put shear webs between the ribs. As you can see from the drawing, we have 2.0 mm plywood on both sides between ribs no. 1 through 3 (no. 1 = root rib), then 1.5 mm plywood between ribs no. 3 through 5 and 3.0 mm balsa for the rest with exception of the polyhedral break where we use 1.5 mm plywood at both

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Wing joiner pins may be stored under canopy block. Snug fit for large R/C gear. Note LSF!

Ballast compartment hatch. Neat idea!

The author and codesigner, Kare Schanche, poses with the *Cirrus Klubbens 2-Meter* in the backyard of his home in Oslo, Norway.

Wings are constructed rather conventionally. Airfoil is slightly curved on the bottom, so shims are needed at LE and TE for flat surface.

sides. Do not glue the rear webs between ribs no. 1 through 3 yet! The wing joiner which is a 5 mm inside diameter brass tube, will be installed and glued when the wings are ready to be mounted to the fuselage. The rear wing joiner, 3 mm ID brass tube, will also be glued later. Now it's time for making the polyhedral joint. Cut and adjust the spruce spars to the proper angle (11–2=9 degrees). Then raise the outer panel to the angle shown on the plans and glue the polyhedral braces on both sides of the spruce spars. Use epoxy! The braces are made of 1.5 mm plywood.

Glue the ribs in the polyhedral break and also the balsa wing root (two degrees). I prefer to glue the 2.0 mm plywood root rib to the wing later (see fuselage construction). Then you cut and adjust the upper sheeting and glue it first to the inner and then to the outer part of the wing. Be sure that you don't get any distortion. As weight when gluing the sheets use some volumes of **M.B.** or other model airplane magazines. Cut the 8x8 mm balsa leading edge to length, and glue it to the wing. We have laminated the wingtip with 1.0 mm plywood.

When you assemble the wings to the fuselage, you can adjust the wingspan by cutting the wing tips to achieve exactly two meters. If you think the work with the first wing has gone well, it's just to start with the other. But, be sure that you make the opposite one! Many model builders have been shocked when they discover that they have made two left or right wings. If you prefer to build both wings at the same time, you are guaranteed not to get a problem like this. For gluing the wing joiners and root rib (plywood): See fuselage construction.

STABILIZERS

We have chosen the symmetrical airfoil NACA 009. You can form the ribs just like you did for the wings. To get the stabilizers as light as possible, we have used the upper spruce spars only and they taper from 2x7 mm at the root to 2x4 mm at the tip. The ribs are made from 1.5 mm, the trailing edge 3x15 mm, the leading edge 6x6 mm and the sheeting 1.0 mm, all balsa. Rib no. 2 from the root has to be laminated with 0.6 mm plywood. As joiner tubes, we use two 2.0 mm ID brass tubes.

You start by cutting the spruce spars and the upper sheetings (just like the lower) to length. The stabilizers should be built upside down and both at the same time. Put the upper sheeting on the plan and glue the spruce spars to the sheeting. Before you glue the ribs to the spruce spars, you have to shim them up at the rear end 5 mm (not shown in the drawing). Glue the ribs to the sheeting and then the trailing edge to the ribs. Be sure that the airfoils are symmetrical! Then raise the sheeting up to the ribs.

Then you form and glue the bracing of 4.0 mm balsa between the root rib and the trailing edge. You now adjust holes for the brass tubes and glue them to the ribs with epoxy in both stabilizers at the same time. Be sure that they are glued straight and on the same level. Press the inner end of the tubes together, otherwise the joiners will perhaps take a trip through a couple of ribs sometime. Then, you glue the lower sheeting to the ribs. Finally, you glue the leading edge, the wing tip, and the 1.5 mm balsa webs in place.

FUSELAGE

First, you have to form the main parts of the fuselage such as side, top, and bottom sheetings and 5x5 mm triangle stock. Use the drawing to get the right shape. We use 3.0 mm balsa laminated with 1.0 mm plywood from the nose block to the middle of the tail boom. For laminating, you will achieve the best result in the shortest time using glue of contact cement type. We place the laminating plywood inside the fuselage due to the fact that balsa is easier to form later on. In all inside corners we glue in place 5x5 mm triangle stocks.

As you already have observed, the top sheeting is straight before gluing the contour balsa between the wing shoulders. Pin the top sheeting to the board and glue the sides to the top. Then you glue the triangle stock in place. Like the building of the stabilizers, the fuselage must be built upside down. Be sure that the sides are glued at right angles to the top sheeting. I use two aluminum angles for this purpose. Be exact! A distorted fuselage is almost as bad as distorted wings. The bottom sheeting is not glued in place until all the installations in the tail and rear part of the fuselage are carried out.

For the tail fin, we use balsa only except for the stabilizer shoulders. Be critical when choosing the materials. Use only the lightest and be stingy when using glue. One gram too much in the tail has to be compensated with several grams of lead in the nose. The leading edge 10x10 mm balsa and the rear spar 10x15 mm balsa have to be joined properly to the fuselage. But first make the whole vertical fin separately. The width of the rear spar tapers from approximately 12 mm at the bottom to approximately 8 mm at the top. The airfoil is identical to that of the stabilizer, NACA 009. We make ribs from 2 mm balsa, and for sheeting we use 1 mm balsa.

When one side is sheeted, you can install the Nyrods, with the Ball Link and the 2 mm brass tube. Remember to glue in place holds for the hinges. You will need them because the rear spar is to be carved out to make place for the movable rudder. The Nyrods must be attached at two or three points inside the tail boom.

We have mounted one extra Nyrod tube for the antenna inside the fuselage. It looks much better this way, and the antenna itself is better protected against damage. Then, you make sure that everything works properly before you sheet the opposite side and glue the vertical fin in the right position. The 2 mm plywood fairing in front of the fin you adapt and glue in place.

The next step is critical to proper fuselage alignment. Make the 2 mm plywood shoulders and root ribs for the wings. Drill 5 mm and 3 mm holes through all four ribs at the same time. If you want to make the shoulders wider, you make additional fairing ribs of balsa and of somewhat larger size than the root rib. Then, you trace the root rib onto the fuselage sides and make the necessary holes for wing joiner tubes. You then put the balsa fairing ribs between the plywood and the fuselage and glue it in place. Be sure that the prescribed 2 degrees angle of attack (angle between fuselage center line and airfoil center line) becomes the same at both sides. Make a jig to assure this. Use epoxy for all gluing in connection with the wing joiners. When the shoulders and brass tubes are fastened, you glue in place the 2 mm plywood brace behind the 5 mm brass tube. Make it an extra strong joint! Don't be stingy with the epoxy.

Then you glue in place the fuselage formers no. 4 through 6 and the "ceiling" in the ballast compartment. All fuselage formers are made of 3 mm balsa laminated with 1 mm plywood on both sides. Between the shoulders you place a balsa block to achieve a nice, aerodynamic fuselage.

Now it's time to glue in place the bottom sheeting including the hardwood stock as hold for the tow hook. Before gluing in the formers no. 1 through 3, you must check the

size of your RC equipment to insure that the fuselage will have sufficient space. If needed, make the formers a little wider and/or replace them. Thereafter, you adapt the noseblock, canopy, landing skid and tow hook. The noseblock is hollowed out for nose weight if necessary.

Inside the canopy, I have made slots for the 3 mm and 5 mm wing joiner pins for safekeeping when not in use. The landing skid is made of 2 mm plywood with 5x5 mm triangle stocks on both sides. To achieve a fairing between wings and fuselage, I use epoxy with "micro-ballons" and sand it after hardening.

Now it's time to carry out the remaining wing work. Put the fuselage on a table. Assemble the wings to the fuselage and glue the 5 mm brass tubes in correct position. Be sure that you achieve the described two degrees dihedral. After hardening, you glue in place the 3 mm brass tube. Now, it's very important that you build in the correct angle of attack in both wings. The best way to discover any misalignment is to look at the wings from the rear. Raise and lower the fuselage slowly by the tail and sight along it. The undersides of both wing halves should appear or disappear simultaneously. If not, the wings are out of alignment (relocate the 3 mm brass tube). When the brass tubes are fixed in the right position, you cut some hard balsa blocks to fill out the space around the brass tube between the spruce spars. Fill the remaining space with epoxy and press the balsa block in place. Then you add the 2 mm plywood webs. Be sure that the epoxy doesn't enter the inside of the brass tubes. Finally, you glue in place the root ribs and then the wings and fuselage should be ready for sanding.

RUDDER

The rudder is made in the same manner as the vertical fin. The front spar tapers from about 12 mm at the bottom to about 8 mm at the top, and it has to be rounded off to fit the slit in the vertical fin. The ribs are made of 1.5 mm balsa while the sheeting is made of 1.0 mm balsa. Remember the holds for the hinges and control horn. Hinges and control horns are glued in place after finishing and covering.

FITTING, SHAPING, AND COVERING WINGS/STABILIZERS/RUDDER

Firstly, you have to make a template to achieve the correct form of the leading edge. After rough working with knife or planer, you first sand with a coarse sanding paper, later on you use a finer one. Line up the model with the wings mounted to the fuselage. Then assure that the wingspan is correct. If not, cut the necessary part from the wing tips. Thereafter, you can start the final sanding. After sanding, I usually dope once to reinforce the balsa fibres. Then I have to sand once more with a very fine sanding paper.

Covering is the next step. You can use any of the known coverings, paper, nylon, Solarfilm, Monokote, etc. This time I chose Solarfilm just because I had some at home. It's an advantage to use light colour on top and dark colour under the wing. When you turn the model, this colour scheme makes it easier to see if the plane turns away from you or towards you.

FUSELAGE

Now you have come to the final shaping of the fuselage. We all want a nice and well-shaped model, so we have to round the fuselage a little bit. See the drawing! Now you will realize the advantage of laminating the fuselage with plywood inside! The leading edge of the vertical fin must also be rounded. Due to the balsa outside the fuselage, we have to make a hard surface to protect against damage. I have chosen epoxy/glassfibre: two or three layers from the nose to the rear of the wings and only one layer for the rest. After sanding with very fine sanding paper, I finally finish with one coat of car enamel.

RADIO EQUIPMENT INSTALLATION

The fuselage formers 2 and 3 are, of course, glued in place to fit your radio equipment. Install from the front, the battery pack, the receiver, the switch, and the two servos. Push the receiver antenna down the Nyrod tube in the fuselage. Assemble the completed model and check the control surface movements for proper direction. The stabilizers should have a total throw of about 17 mm measured at the leading edge, and the rudder should deflect about 23 mm each way.

BALANCING THE MODEL

This requires great care, because the performance and flying characteristics of the model are governed mainly by the proper positioning of the center of gravity. If you have used lightweight materials and possess normal radio equipment, you should not have to put much lead in the nose block.

As shown in the drawing, we have three different places for the center of gravity. For the two-meter competitions, we use only two of them. For duration, we place it 68 mm behind the leading edge of the wings, and for the speed task, 81 mm behind the leading edge.

Now, when you first balance the model, balance it for the speed task. Then add a little piece of lead to the nose to achieve the correct center of gravity for the duration task. When changing from one task to another, you have to trim the stabilizer a little on the transmitter to achieve the correct angle of attack. For duration: two degrees. In speed task, we reduce the angle a little to achieve less drag.

For windy days and for the speed task, we have installed a ballast compartment with a capacity of 800 grams of lead. When filling the compartment, assure that you don't move the center of gravity. The weight of the model should be within 1000-1100 grams (35 to 39 ounces,) depending on the builder giving a wing loading of 25-28 g/dm² (8.2 to 9.2 oz/ft.²) with the ballast compartments filled with lead we will achieve a total wing loading of 45-48 g/dm² (14.7 to 15.7 oz/ft.²)

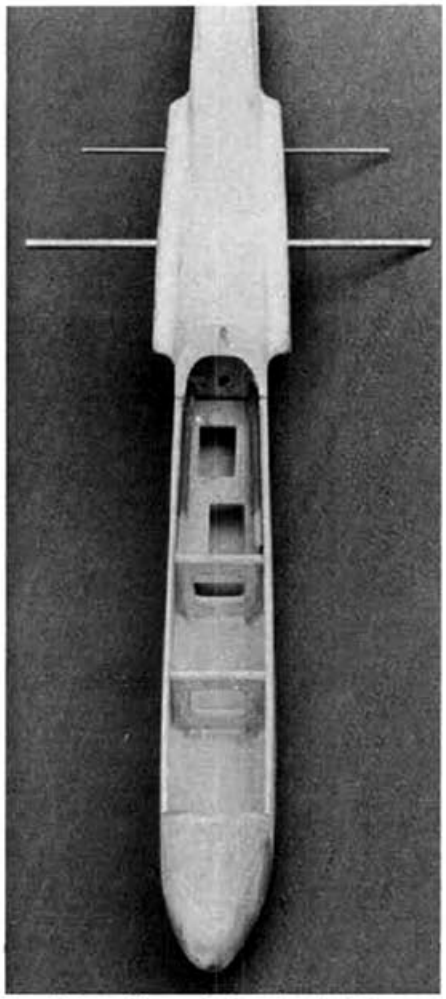
FINAL CHECKS

Be sure that all flying surfaces are without warps. Warps can be removed by reheating the film covering. It's OK with a small amount of washout in the wings as long as both tips are equal.

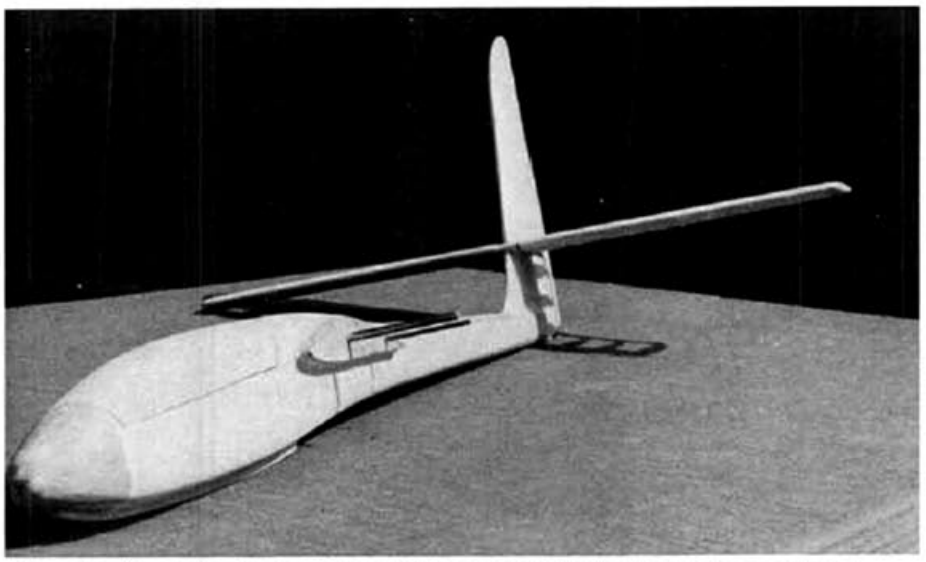
Check the control functions and make certain once more that the moving surfaces move in the proper direction. (It's my experience that you never can check it too often.) Be sure that batteries are fresh, and if you use Ni-Cds, be sure that they are fully charged. At this point, I am sure you can't wait any longer. After a couple of hand launchings to see if the model climbs or dives too much, or turns left or right, you take it up on the line for the first time. Try to find the way of flying which gives best results for the two-meter tasks.

Fly the model in a proper manner! Don't take unnecessary chances! It often ends with a very second-hand kit.

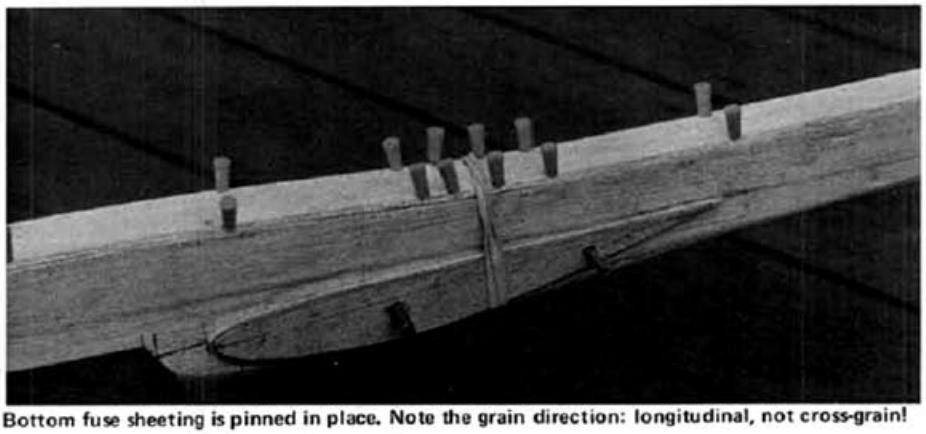
Congratulations with your new two-meter! Have fun, K8re Schanche. •



There's lots of space in there for the biggest servos. Clean design is very obvious.



Completed fuselage and empennage. Hardwood skid would be advisable for rough fields.



Bottom fuse sheeting is pinned in place. Note the grain direction: longitudinal, not cross-grain!

them. It's easier to buy a kit and just put it together. Believe it or not, most of the parts can be made by simple methods!

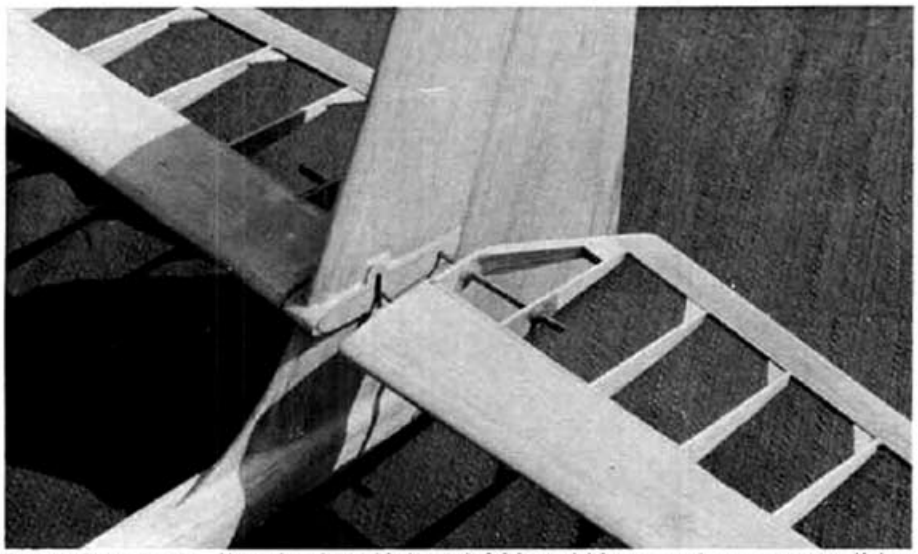
As you see from the drawings, we have not solved all the problems in building this model. We have left some details to each builder's own choice.

Now, let us start with the construction!

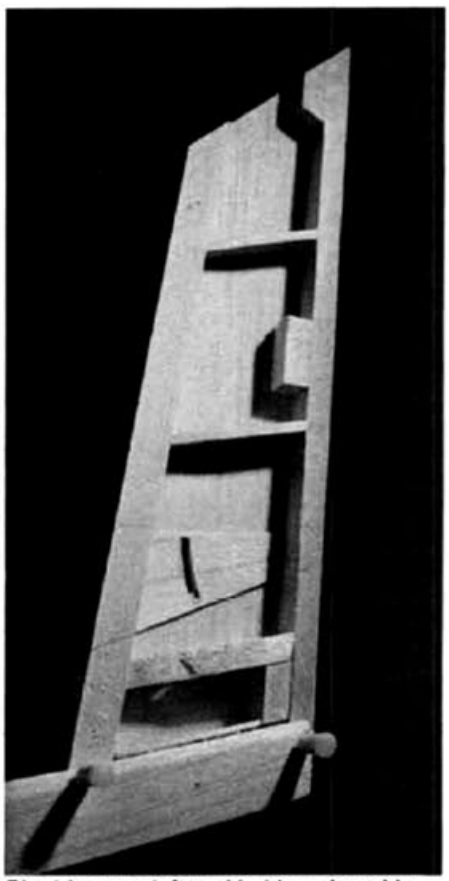
WINGS

Firstly, you have to make the ribs. We considered airfoils like E193, E201, and E205 for this model. We chose the E201, an airfoil not so very much used, even though its capability is not far from the E193. Besides, it will give us a thicker and therefore a *stronger* wing. When you make the templates for rib fabrication, you will get the most correct airfoil from an airfoil book. The airfoil shown in the drawing is not guaranteed 100% correct, but it is good enough to use for making the templates. Use ply or aluminum for templates. Work exactly, and be sure that you will get all sheetings and spars inside the airfoil contour. You have to make templates of the root rib, the rib in the polyhedral break, and the wing tip rib.

You then put the necessary numbers of rib



Shaped fin and stabs. Note the ply and balsa stab fairing: yields strong pivot area, streamlining.



Fin sides are reinforced inside and outside with thin plywood where stab mounts. Firm! Small blocks are for hinge support.