

Author poses with his Petrel at the NYSA Scale event where he was placed second. He was first with another of his designs - the Condor.



A winning vintage 1:3.5 scale soarer designed by Chris Williams

# Slingsby Type 13 Petrel 1

**T**his whole project came into being via an innocent inquiry from Rick Briggs in California, who was looking around for a plan for the Slingsby Type 13 Petrel. Alas, none were forthcoming, but in the process I took a closer look at this machine via the pages of Martin Simon's excellent book on Slingsby Sailplanes. The first thing that one notices is that the Petrel's wings have a very pronounced taper, perhaps it is for this reason that most designers have left her alone. Before I knew it I was hooked and the pencil sharpener was well and truly in business.

Only three examples of this type were ever built, the first crashed, killing the pilot Frank Charles, this accident being caused by a jammed up winch cable and being credited with leading to the invention of the Ottfur safety release. Of the two remaining Petrels, which still exist today, they differ mainly by the fact that one (BGA 651) has a conventional Tailplane/Elevator set up, and the other, (BGA 418) had an all-moving tailplane. Due to the usual ironies of life, work commenced on the building of one, but I was only able to get photographs of the other, so, what else is new?

This then is the plan for BGA 418 which is detailed on the assumption that both

sailplanes share the same major construction features, but of course, if you wish to make a serious job of it, you will no doubt want to obtain your own documentation.

There have been some minor profile changes to the wings; you will find that the tips have been widened slightly, and the Quabeck 3.5/12 section has been used throughout the wing. In order to retain the appearance of the thick wing root of the full-size, the Quabeck has been expanded at the root to a matching thickness and tapers back to 12% at the gull-break.

Thanks must go, by the way, to Graham Saw, owner of BGA 651 who supplied some fifty or so photographs of the machine that he has recently restored to such an amazingly high standard.

## HORIZONTAL STABILISER

The all-moving stab is built up from a solid balsa 'D' section with full depth 1/8" ribs. The idea is that it should be built off the board, with the ribs slightly oversize, and the whole thing sanded to shape with a flat sanding block. Start by fabricating the 'D' section from sheets of 1/2" and 1/4" balsas sheet laminated together. Make up the joiner box from 1/4" spruce, 6g brass tube and 1/32" ply.

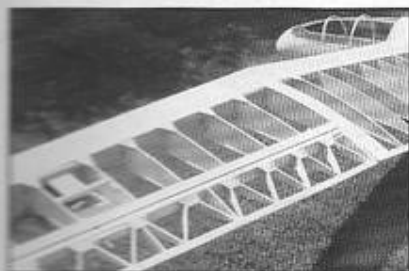
Glue in place the 1/16" ply spar. Make up the TE's from 1/16" spruce sheet with 1/8" balsa either side.

Measure up the ribs from the plan and cut them out slightly oversize. Cyano the root rib in place ensuring that it is at right angles to the spar. Now cyano the TE in place, eyeing it up from all angles to ensure that it is parallel and true to the spar. Add the remaining ribs and then fill in between them with 1/8" balsa sheet to lock them into place. Sand the whole assembly flush and then cut out recesses for the 1/64" ply gussets and cyano them into place on the top surfaces only. Face the two root ribs with 1/32" ply and glue in place the 8g tube for the actuating rod.

## FUSELAGE

The fuselage is built up over a 1/4" balsa/ply crutch. The crutch is pinned flat over the plan and the formers cyanoed vertically to it. Once the outer longeron K5 (notched, to accurately line up the formers) is glued in place and a few strips of 1/16" ply planking white glued to the front formers, the fuselage half is rigid enough to remove from the plan and the other half built up similarly. From there, the rest of the front planking between F1 and F6 is added and the outer surface filled and sanded.

# PlanFeature



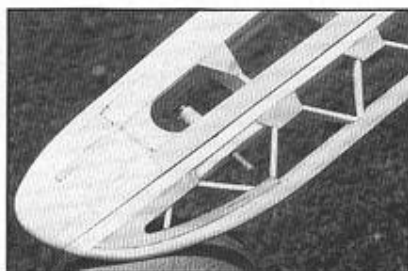
Half wing outer panel shows D box construction and servo construction. Elevator servo position with 1/65" ply triangular webbing braces on ribs.

Using 1/16" ply planks is a slightly difficult but ultimately very strong process. It would be tedious in the extreme to cut out and glue in all the planks individually, but fortunately there is a quick way to do it. If you cut out the equivalent of four or five planks at a time from one piece of wood, it is a simple matter to partially cut out the individual planks, and bend the piece of wood in the radial plane to match the curve of the formers. If you then reverse it and rub the back of your Stanley knife hard along its surface whilst holding it bent, you will achieve a bend in the longitudinal plane. It is then very quick and simple to trim and glue the ply into place, but remember to do each side in turn as you go along to avoid uneven stresses distorting the fuselage shape. Once the front planking is finished, the balsa formers F2-F4 are removed, the edge of the cockpit aperture lined with two strips of 1/16" ply, and the entire inner surface glassed with chopped mat and resin. This allows you a smooth fuselage interior to which you can add as much detail as you like.

I must put in a quick word here for the use of car body filler. In the old days this stuff used to set like concrete and you needed to be Arnie Shwartzeneiger to rub it down, but times have changed. These days it is much lighter and easier to render smooth and is ideal for our purposes here. Not only does it make quick work of filling and smoothing the planking, it is also used to fill-in either side of the nose profile and to enclose a fair amount of lead, which needs to be right up front where it has the most gravitational leverage. Did I mention that the stuff is cheap, too?

The rear of the fuselage is sheathed longitudinally in three pieces with 1/32"

fill in with scrap balsa.



Wing tip details. Note spars protrude into solid balsa wingtip.

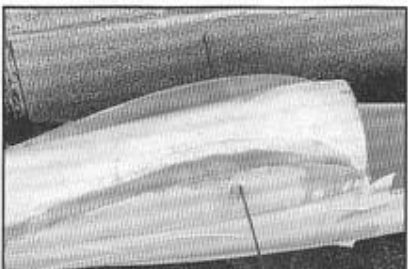
ply; once again this makes for a very strong fuselage. One piece of ply rolls over the top, and the other two are glued to the sides, with the join running along K5.

It will become necessary to fill in between the formers rear of F6 with diagonals of 1/4" balsa to keep the rear of the fuselage rigid when it is time to add the top sheeting. If, like me, you can only get your 1/32" plywood sheeting in 48" by 12" lengths, you will find that it will extend only as far as F18 (on the 3.5 scale model). Also, you will need to extend it down the sides between F6 and F8 by adding a triangle of ply with glass-cloth reinforcement on the inside. When you come to glue the top decking in (with white glue) you will first need to make up a paper template to get the rough size. Make several dry runs by using masking tape to hold the ply to the fuselage (you will probably need to pre-steam some curve into it). Use the tape to pull the ply on to the formers, and when fully satisfied with the fit, glue in place properly.

## ALL-MOVING TAIL MECHANISM

Make up the bellcrank from dural and cut away the lower longeron for easier access. The bellcrank pivots on the brass tube that joins the AMT and activates the stab via the actuating rod. Line the inside of the fin with balsa to prevent the bellcrank from moving from side to side. The bellcrank is actuated by a length of Bowden cable which is taped to a 1/2" square balsa spar running through the centre of the fuselage. The rudder cables are also guided through two lengths of Bowden cable outer which will need to be installed before the lower fuselage ply sheeting can be glued in place.

Glass-in with glass mat and resin.



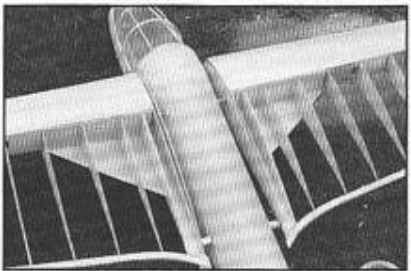
## CANOPY

There are three types of canopy to choose from depending on what example and from what period you are building. Mine is based on BGA 418, but from an earlier period in time as I don't think the current canopy to be representative. This means that you don't have to find or make a moulded canopy, and you end up with a wooden framework that is as good to look at as it is satisfying to make, although be warned, there's a lot of work involved. (BGA 651 features at the present day a modern blown canopy, with the frames simulated.)

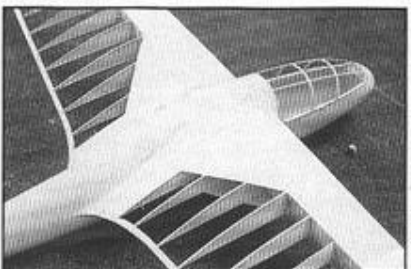
Construction begins with the lower rails that sit on the cockpit aperture. Place a suitable piece of 1/16" ply over one edge and draw the shape of the aperture side on to it. Cut out two pieces, glue them together and tape them to the aperture to set in the correct shape. Repeat for the other side and cut out C1 from two pieces of 1/16" ply and tape to the front of the aperture to dry also. Use the same procedure for C2, then trim up the various joints and glue the assembly together by taping in place in the aperture. (Remember to allow for the thickness of the acetate). Reinforce the corners with suitable wedges of hardwood.

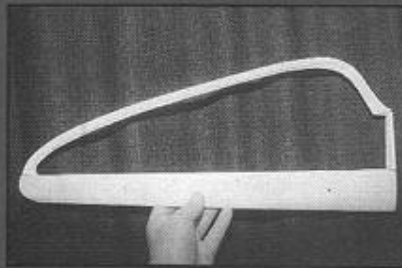
Make up the laminated hoops C3 and C4 from 4 lengths of 1/32" ply, cut across the grain. On the prototype, two rovings of carbon fibre were added between each layer of ply for added strength. Trim the hoops to size and cut a slight rebate in the lower frame for each hoop to sit in. Temporarily jig the hoops in place with tape and clothes pegs and lay two strips of 1/32" ply lengthways to mark out the positions of the longitudinal stringers. Notch the outside of the hoops to a depth of 1/32" and then glue them in place using the template to ensure their correct positioning.

Wing root fairing detail. Space out wing root fairing ribs with the wings in place, ensure that wings are 180 degrees.

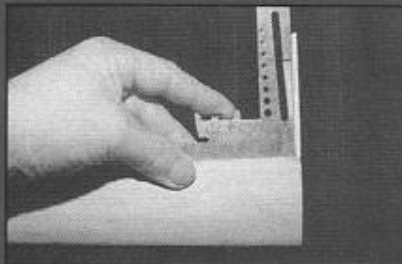


Achieve final shape with car body filler.

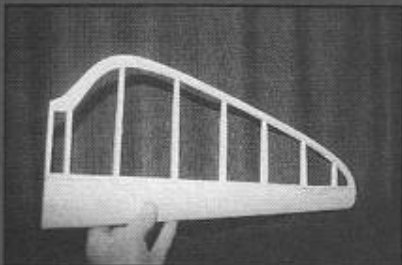




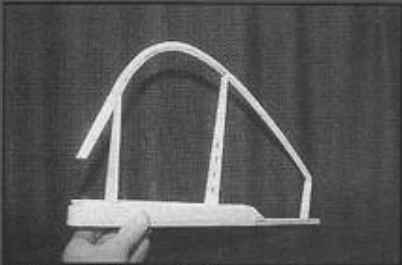
First stage of tailplane construction.



Ensure that tailplane ribs are cyanoed at 90 degrees.



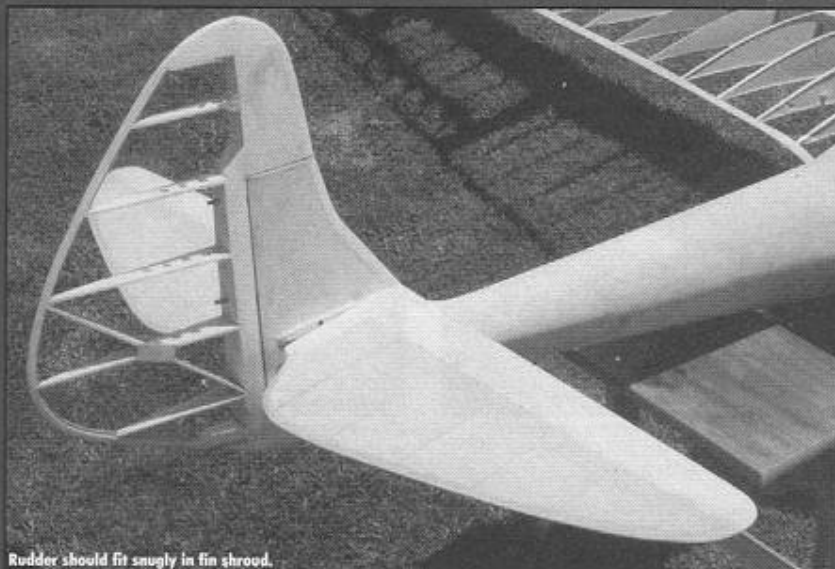
Tailplane sanded, ready for 1/64" ply webbing plates



First stage of rudder construction.

#### FIN

The fin is constructed in place on the fuselage. First the fin post must be glued to the rear of the fuselage in a vertical position. If you support the fuselage so that it is vertical by using a set square to align the nose profile, you can then use it to similarly check that the fin post is also vertical (assuming that your building bench is flat). Cyano in place the three ribs and the 1/16" false LE, ensuring all the time that the ribs are in line with the fuselage. (The best way to check this is to draw a centre line down the top of the fuselage and through the ribs and eye them up for continuity.) Fill-in between formers 18 & 19 with block balsa and sand to follow the fuselage profile. Make up the ply skins for either side with the grain vertical, and white glue into place, checking all the while the fin stays in alignment. Don't forget to leave the ply protruding at the back of the fin to make the rudder shroud.



Rudder should fit snugly in fin shroud.

#### RUDDER

This is built on the same lines as the tailplane, top and bottom ribs glued to R1 at right angles, followed by the T.E. and the remaining structure. Be sure to eye the rudder up for trueness, especially during the initial phases of construction.

#### WINGS

Although at first sight the wings may look a little complicated, in fact the building sequence is quite simple. For the purpose of retaining as much scale fidelity as possible, the Quabeck section at the root has been thickened to match the scale section, with normal thickness being restored at the gull joint.

The spars need to be fabricated first from suitable hardwood, spruce or Ramin etc. For the prototype, the wood was bought from a DIY store in 8ft lengths to avoid too many fiddly joints. If you can't obtain the exact specified size, something similar will no doubt do, simply adjust the rib notches to suit. Either way, check the wood for knots and splits etc. before choosing to buy. The spars taper from root to tip, and the gull-joint is reinforced each side with 1/32" ply. When cutting out the ribs, remember that they were drawn in the first place by running a fine pen around the actual rib, so cut to the line, and sand the line away carefully afterwards.

Make up all of the major pieces before starting the assembly sequence; the 1/4" sheet aileron mounting spar will need a joint in it, as will the false 1/16" LE. Make up the inner TE from 1/16" spruce sheet and 1/4" balsa by gluing them together and taping and clamping to J4 to build in the gull angle.

Construction commences by pinning J4 and the pre-laminated TE to the board. Pin the lower spar in place, supporting it to a height of 2 1/2" (64mm) at the gull joint. Glue in place all the full-length ribs from 4 to 11. (Cyano the TE's, but leave the spar joints dry). Cyano in place ribs 11a and 28, and add the aileron mounting spar. Fit remaining ribs 12-27 and then fit the top spar. Cyano in place the false LE and fiddle

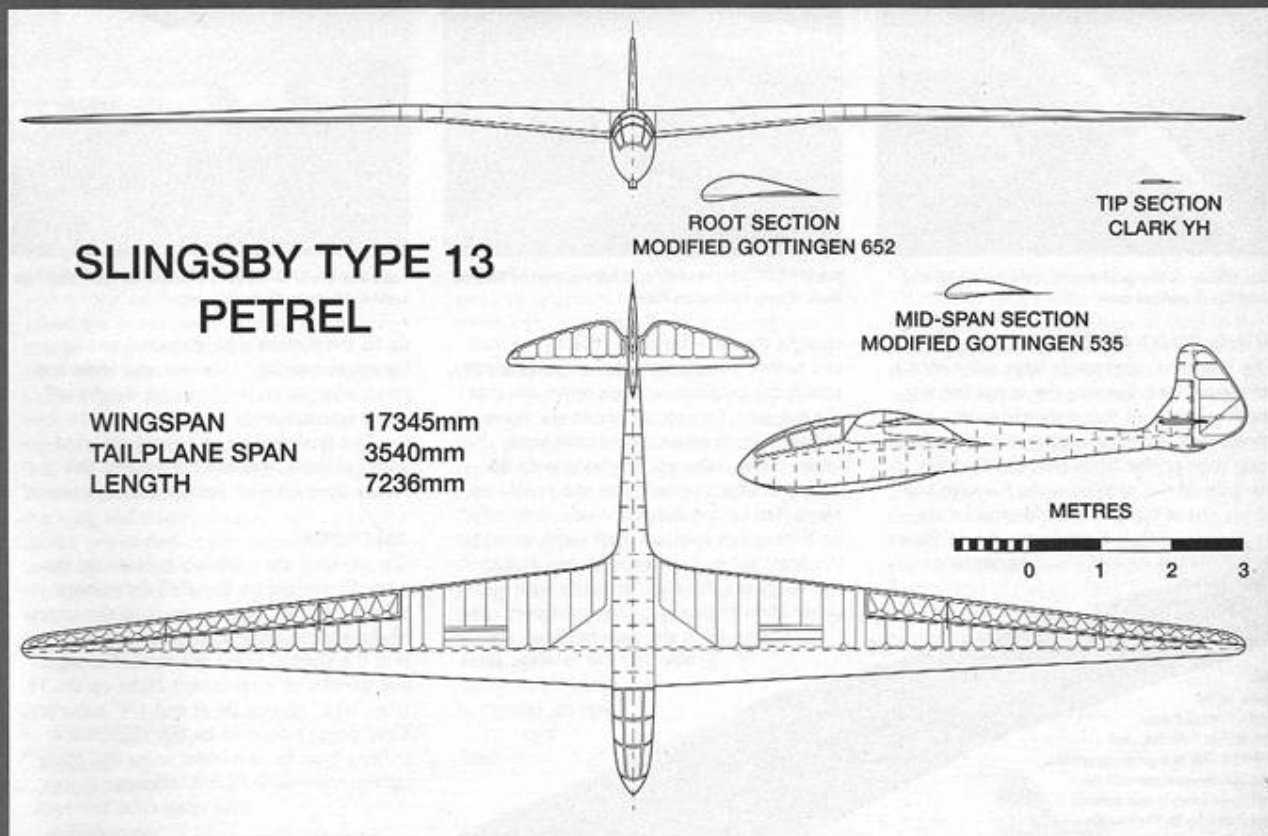
with the rib-spar joints until everything lines up satisfactorily and then glue in the remaining joints with white glue. Lay a straight-edge along the top outer spar to check that it is straight; if not, support as necessary, and then add 5 or 6 1/32" ply spar webs to lock the spars together.

Fit 1/32" ply plates to the rear of ribs 4-11 to reinforce the joint between them and the TE.

The next job is to make up the wing joiner boxes: cut out the 1/32" ply plates and the angled hardwood in-fills and epoxy and clamp the assembly together until the glue has set. Repeat for the second box, noting that one brass strip is shorter than the other in order to taper off the flight loads and prevent a sudden change in strength along the spar. Glue one box to the spars, (leaving enough of each spar proud to accept the root rib) and then the second, being careful to insert the steel joiner bars in each box to enable you to make sure that they are exactly parallel to each other. You can now glue in place the remaining ribs and riblets. At this stage it is advisable to go over the entire wing with a flat sanding block of reasonable length to smooth out the inevitable slight differences between each of the ribs, and between the ribs and the leading and trailing edges. Also, there will probably be a bit of waviness to the false LE; don't worry too much about this as its function is to support the sheeting, simply cut the balsa sheet to overlap slightly, and when the wing is fully

Open cockpit with scale pilot - what a finish! Note the airbrakes are just visible on the inner panels.





sheeted, sand it to a straight edge with a long block.

Next, make up the lower 'D' box sheeting and glue in to place with white glue. This can be done off the board, but be careful that the spars remain in a reasonably straight line during this process. (If you cut the sheeting with dead straight edges, you can align the spars along the straight edge). Now pin in place on the board the jiggging pieces J1-J3 (remember to pack up J3 at the junction between the wing TE and J3 to allow for the fact that the 1/16" sheet strip has yet to be fitted to the wing) and lay the wing on to them and weigh it down snugly. (It is a good idea to cyano in place a cross-piece in each jiggging template to help it sit firmly on the board) Glue in place the top sheeting, remembering that this will lock the wing into its final shape, so sight everything up carefully ensure that the wing

Lining the cockpit interior with 1/32" ply.



is straight. (This should be reasonably easy to see, as the wing has no washout and if you lay the wing on the board with the TE facing you). By far the simplest way to hold the sheet to the wing is to use masking tape wrapped around the LE and the spar.

Check the aileron hinging spar for undulations and sand or trim straight. Offer up a suitable length of 1/4" sheet and mark out for the aileron LE. Make up aileron

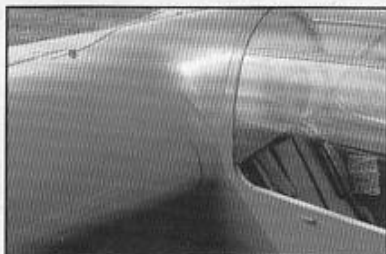
shrouds from 1/16" balsa strip and 1/64" ply and glue into place, making sure that the edges are as flat and true as possible. Repeat for the lower shroud. Add the wiring looms for the aileron and spoiler servos at this stage. (I prefer to leave the end of the loom inside the first rib bay and to drill a reasonably sized hole in the root rib at the end of construction and pull it out with a wire hook).

Completed cockpit interior.





Long aileron on the outer panels make the model very scale-like in performance.



Petrel 1 (BGA 651) recently superbly restored by Graham Shaw. (Photo by Graham Shaw)



Some way has to be found to simulate the thick wing root section. (Photo by Graham Shaw)

### WING ROOT FAIRINGS

The Petrel has extremely large wing root fairings, indeed, the way the wings fair into the fuselage contribute greatly to its appearance. Start by cutting out a full-size wing root profile from 1/8" Liteply. Mark the position of the profile on the fuselage and cut out the slots for the 14mm brass joiner boxes. Pass something

straight through the slots, (the 1m of steel rod before you cut it is the obvious choice), attach the tailplane and eye up to see that the tailplane, fin and bar are at the correct angles to each other. Insert both brass joiner boxes, offer up one wing with the Liteply profile and tack-glue the profile in place. Repeat for the other side, then offer up both wings and tack-glue (with epoxy) the brass tubes in place after ensuring that the wings are lined up correctly with each other and the fuselage. The procedure now is to fill in the gaps between the profile and the fuselage sides with scrap block balsa, leaving enough of a gap to finish

up to the surface with glass mat and fibreglass matting. If, like me, you leave too much of a gap to be filled, the weight will creep up alarmingly, so beware.

The final shaping up is best achieved with car body filler, but be warned, this is a messy business with lots of dust and waste!

### AILERONS

The ailerons are made up in place on the wing. First make up the 1/4" sheet initial aileron LE and spot - cyano it to the edges of the aileron shrouds on the wing. (Ensure that the shroud edges are sanded straight and parallel to each other). Make up the TE from 1/16" spruce sheet and 1/4" balsa (the balsa doesn't need to be this thick, but it stiffens it up for the initial lining up). Make up the root rib from 1/4" sheet to match the wing. Glue the root rib and TE in place, and add the

This could be the real thing! Airframe finished in Solartex, and painted with two-pack car paint and lacquer to represent the sailplane when it was entered and flown by M. Watt in the 1939 Nationals.



Even more realistic in flight than on the ground. Author enjoys another winning flight.



right-angle ribs using them to line up the TE edge until it is straight. Eye up the wing from behind; you should see that the TE is parallel with the lower aileron shroud. If you can't get the TE straight at this stage, add more parallel ribs until you can, they can always be removed later. If you want to be certain that things are lined up correctly, use the templates to check. Cut out and glue in the diagonal 1/8" ribs now, without worrying too much about profile accuracy, as the whole lot will be sanded flush to the wing with a long sanding block afterwards. For speed, the prototype's ailerons were cyanoed together, then reinforced afterwards with white glue. Once the glue has set, sand the aileron flush to the wing with 80 grit paper on a flat block, and separate the aileron from the wing. Add the final 1/4" sheet LE edge and sand roughly to a round profile. Mark out the points where the wing and aileron hinges are to go. Make up the pre-drilled dowel pieces, which are to be cyanoed to the wing and glue them in place. Make sure that the holes are lined up in the centre and that the dowel protrudes by only about 1/16". The hinges themselves

are of the large Robart type. Sand the shrouds back to the 1/64" ply to give a sharp, crisp edge, hollow out the tips to follow the shrouds and push the aileron into place. You should now find that the ailerons are once again oversize; this time when you sand them flush to the wing you will end up with a perfect fit with the hinges in place. (Which is far easier than getting a fit first, and then hinging up whereby inaccuracies are far harder to remedy). A certain amount of fettling will be required to get everything working properly, but the result should be a perfect fit between aileron and wing/shroud.

## COVERING AND FINISH

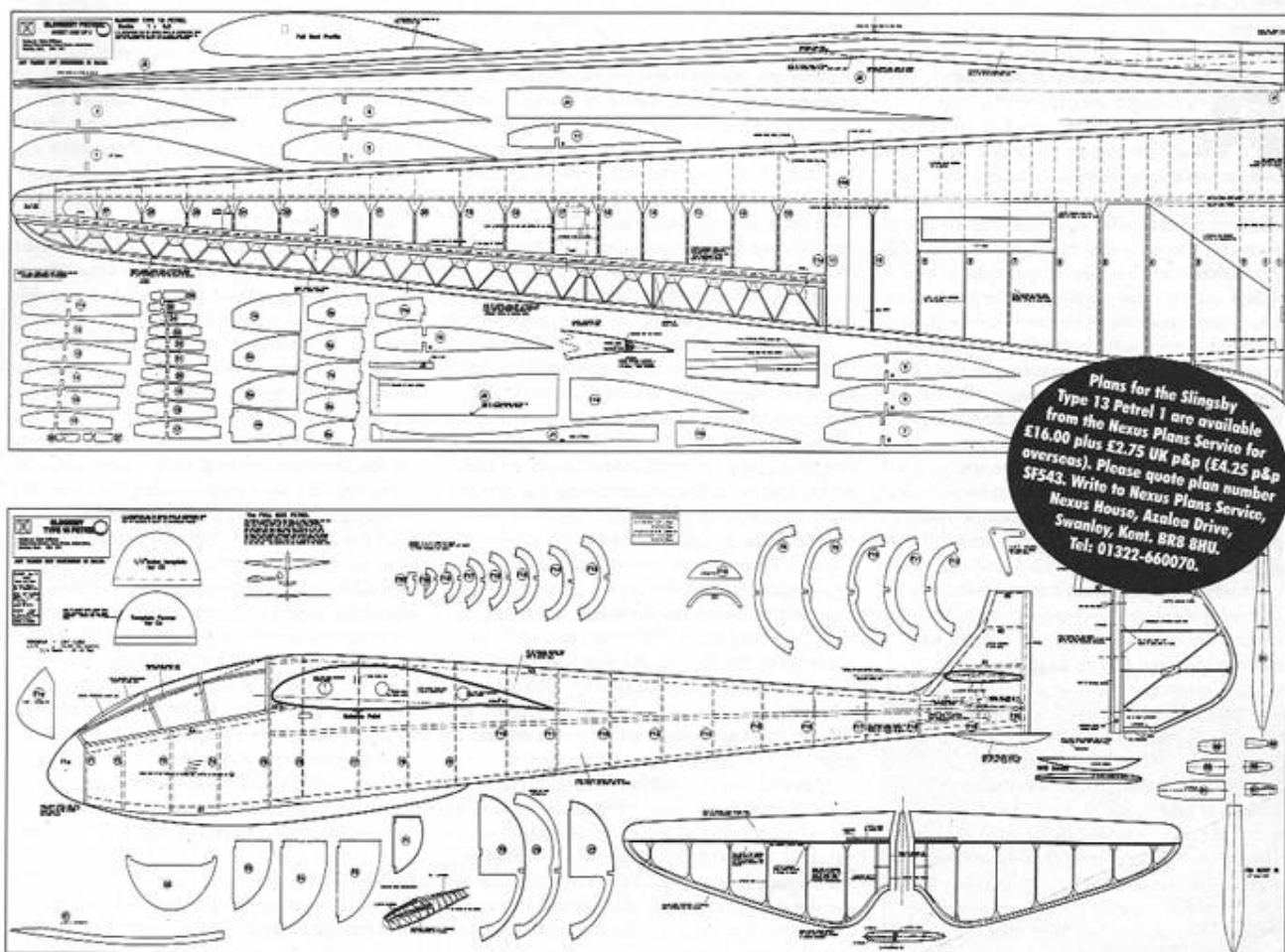
The prototype was covered entirely in Solartex, including the fuselage, and painted with two-pack car paint and lacquer to represent the sailplane when it was entered and flown by M. Watt in the 1939 Nationals. Frame lines were simulated with strips of Solartex under the covering, and the Slingsby logo scanned and printed on to glossy photo quality labels. The convex areas around the wing root and AMT fairings were left uncovered, the Solartex

edges sealed with cyano and the areas painted with copious amounts of two-pack primer and wet-flatted until the edges disappeared.

The CofG should be on or around the area of the front wing joiner.

## FLYING

Early test flights with the prototype in light winds showed that the model displayed all the usual characteristics associated with this Quabeck section: efficient use of minimal lift, nice turning ability, with no undue loss of height, safe stall and bags of float in the landing phase. With the spoilers coupled to the ailerons, glide path control is good, but what of the penalties induced by the thick root section? Later flights in much stronger winds showed a slight but noticeable decrease in penetration, which means you shouldn't go too far back in the landing circuit when the wind gets up. In the air, the Petrel is a truly beautiful machine, bearing more than a passing resemblance to the Reiher and although not a project for the faint-hearted brings its own rewards once completed.



Plans for the Slingsby Type 13 Petrel I are available from the Nexus Plans Service for £16.00 plus £2.75 UK p&p (£4.25 p&p overseas). Please quote plan number SF543. Write to Nexus Plans Service, Nexus House, Azaloe Drive, Swanley, Kent. BR8 8HU. Tel: 01322-660070.