ALTO

Easy to build and a real all-weather performer. That's Tony Mellor's latest

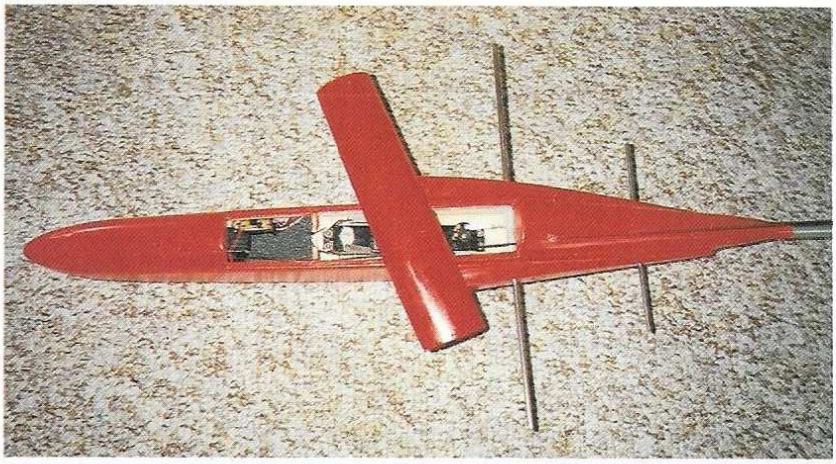
Have you ever arrived at your local slope only to find the wind too strong for the lightweight floater you have just carried to the top, or too light for your aerobatic model? At this point most of us wish for a good, all-round model which will fly in all conditions and have to either risk flying a model unsuitable for the conditions or pack up and go home!

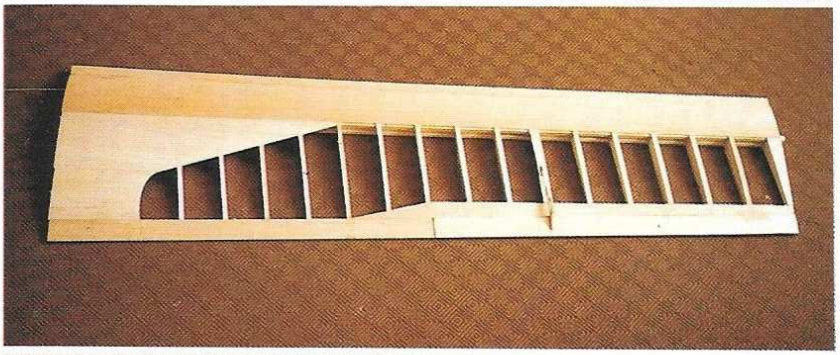
After several years of such frustrations I decided it was about time to design the all-round model that I needed. This need was also partly brought about for me by the fact that the locally available slope sites are quite small both in height and length! This means that, at low wind speeds, lift is very light and thermal assistance is always welcome, while at wind speeds around 15-20mph and above the lift becomes fragmented and unable to sustain a smooth area of slope lift.

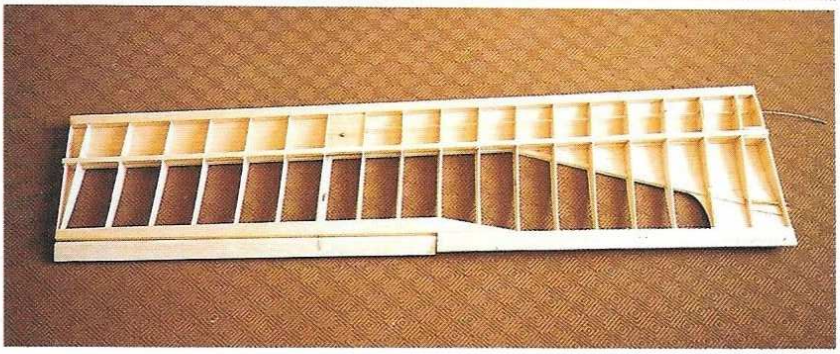
So the model needed to cope with these conditions would have to be a good thermal climber to make use of all light lift, yet still be able to penetrate into stronger winds and punch through turbulence. The design criteria were further complicated by the fact that I wanted the model to be able to perform at least mild aerobatics to liven up my flying time in light or rough weather!

'Alto' is the result of my deliberations to try to produce such a model and has lived up to all my expectations with performance to spare. Thermal performance is excellent; this model has often overtaken 100S models in the same thermal, and penetration is all that could be asked for, ballast seldom being required. Although only mild aerobatics were envisaged when designing the model, this is one area where she really excells. Loops, stall turns (yes, even with coupled rudder!) and rolls, though not the twinkle variety, are all easily accomplished. Loop/roll combinations are also quite easy providing plenty of speed is built up first. But to really stretch her out try a bunt from inverted (upwards) or level flight (that's downwards) or fly towards

The man and the model! Tony gives scale to 74" span 'Alto' and pic at right illustrates efficient lines and neat pod and boom fuselage which really is simplicity itself to make. Tailplane is of the all-moving variety and model features coupled rudder and ailerons.







'Alto' is easily transportable and breaks down as shown at top left; designer claims he can fit three into this Metro boot! Fuselage consists of balsa pod with aluminium tube boom. Wing construction is entirely conventional and should present no difficulties. Amount of dihedral can be at your discretion; that shown on the plan makes 'Alto' a fine first aileron model capable of a wide aerobatic repertoire.

yourself, push the stick forwards for a half bunt and roll off the bottom over the slope edge, if you have the nerve! In good lift inverted flight is easily maintained and if you are well up in a thermal there is no need to worry, just dive away or perform aerobatics on the way down – the wings won't fold on this one!

The thermaling capability is taken care of by the E 193 wing section which works well over a very good speed range plus having good low drag characteristics, and seems, on this aircraft at least, to vary very little in handling from high to low speed flight. The rest of the aircraft is designed to maximise on the aerofoil performance by keeping to a reasonable wing loading of between 9-10 ozs per square foot. I have found in the past that this section performs better with a little load rather than lightly (6-8oz per sq foot) loaded when it tends to lose its performance edge compared with less sophisticated aerofoils, like the Clark Y for instance. (That ought to rattle a cage or two!)

The fuselage is a pod and boom type as this seems to offer the least surface area and therefore less drag, and with the aluminium tail boom lots of strength. Using 1/32in ply to make a sub fin wrapped round the tube, produces a very neat, light and strong tail end, again with little drag.

By sweeping the wing back I have found that washout becomes unnecessary, the model stalling straight with no wing dropping tendencies. An added bonus to this set-up, is that when the model is flown inverted extra stability is gained by the reflex action of the undercambered section plus the sweepback, as on a flying wing! I found this out a few years back when flying a broad chord (15in) low aspect ratio model on this section. At about 1,500ft in a thermal I decided to half loop to inverted and begin a descent (no air brakes). After about 10 seconds of this the tailplane suddenly disintegrated into a shower of small pieces, however the rest of the model continued to fly as if nothing had happened and eventually made a perfect landing under rudder control only, still inverted and perfecly stable, some three or four minutes later!

Well that seems to have explained the reasons for building the model and some of the design philosophy. Controls are two-function working coupled aileron rudder plus all-moving tailplane – she *will* go alright without the rudder coupled but the turns are much smoother and efficient with it! An all up flying weight of around 40ozs and, with the centre of gravity as indicated, she should go perfectly first time. Finally, if you like your models to whistle and howl at speed I'm afraid in this case you will be disappointed. Efforts to keep down drag seem to have worked well and very little energy is wasted making noise on 'Alto'!

Fuselage

Begin by cutting two sides from fairly hard, springy 1/8in balsa sheet. Pin to the building board and add the 1/8in x 1/4in hard balsa outer framing, splicing the joints for maximum strength. Don't forget to make a pair! Whilst this is setting cut all formers F1-F5 and servo mount S1; you will find it easier to drill or fretsaw the 1/2in dia holes in F4 and F5 before cutting from the parent sheet. The servo mounting plate S1 will need holes cut in it for your servos. Position of the front elevator servo is not critical, but take care with the rear one as this must line up with the aileron snakes in the wing to operate smoothly!

Now glue F2-S1-F3 to one of the sides and leave to set, then add the other side to form a strong central box. When set draw in the nose and glue in F1, repeat for the rear end, glueing in F4 and F5 and put aside to thoroughly set.

Next comes something a little different. The tail boom is from 1/2in x 16swg high tensile (dural) aluminium tube some 25.1/2in long. Mine came from a local aluminium stockholder who just happens to supply a microlite manufacturer, but it is fairly easily obtained from a number of sources, model shops included. This has to have the sub fin from 1/32in plywood securely epoxied to it, and needs a little preparation to ensure success. First cut your 1/32in ply to the developed shape shown on the drawing. Now furnish yourself with either a G clamp and two sturdy small pieces of wood, a largish vice or some other arrangement to hold the ply in its bent shape once around the aluminium tube. You will also need a piece of 3/8in thick balsa sheet or something of similar size to clamp between the sub fin sides.

Now take your flat sub fin and steam it

over a boiling kettle until pliable, wrap it round the tube (position is not important at this stage) place your 3/8in sheet between the sides and clamp up tight with side and top edges aligned. The shape should now look like the sectioned drawing of the sub fin, leave till the ply is completely dry and back to its normal state before releasing. Next roughen the contact area of the tube and the inside of the sub fin with medium sandpaper and repeat the clamping operation only this time with epoxy glue on the contact surfaces.

When all is cured fit and glue the 1/8in x 3/8in false leading and trailing edges, drill the pivot tube hole for the all-moving tailplane A.M.T. horn and cut the curved slots to the rear of this for the rear wire. Drill two 1/4 in. holes approx. 1.1/4in. apart as drawn, through the bottom of the sub fin and tube and elongate into a slot with a file to allow the A.M.T. end into the tube and aid assembly. Also drill two holes for the rudder cable guide tubes through the top front of the sub fin and tube. You will need to carefully 'lean' the drill to elongate these holes so they lie in line along the tube, epoxy in scrap outer snake or similar size tube and file off flush when set.

Now tape your A.M.T. snake to a length of 3/8in x 1/8in balsa and push it into position in the tube. Pull the inner snake through the bottom slot and attach a quick-link. Pop your A.M.T. horn through the top of the sub fin and through the slot and connect up with the quick link. Push the horn back into the sub fin, place the pivot tube in position and check for free and correct movement. When satisfied all is well epoxy on the ply washers to fix all in place and glue in the top 1/8in x 3/8in balsa 'rib'. Finally feed your rudder cables down the tube leaving sufficient at each end for connecting up, and epoxy guide tubes in the front end for outlets.

The fuselage pod and aluminium tube boom can now be assembled together and holes drilled in F2 for the elevator snake and rudder activating rod. If all seems OK epoxy together, checking that the sub fin is truly vertical before leaving to cure. Also epoxy in the wing joiner tubes making sure there is enough length to go through the wing stubs later. I like to reinforce these areas with Plastic Padding, P38 or similar filler paste, by smearing a generous fillet into all corners where tubes, formers and sides meet. Do the same with the aluminium tube to fuselage pod joints for a really strong job. Fit the small crank, and its mount for rudder operation and attach the rudder cables. Make up the activating rod from servo to this crank, fitting a threaded quick link for adjustment and check operation.

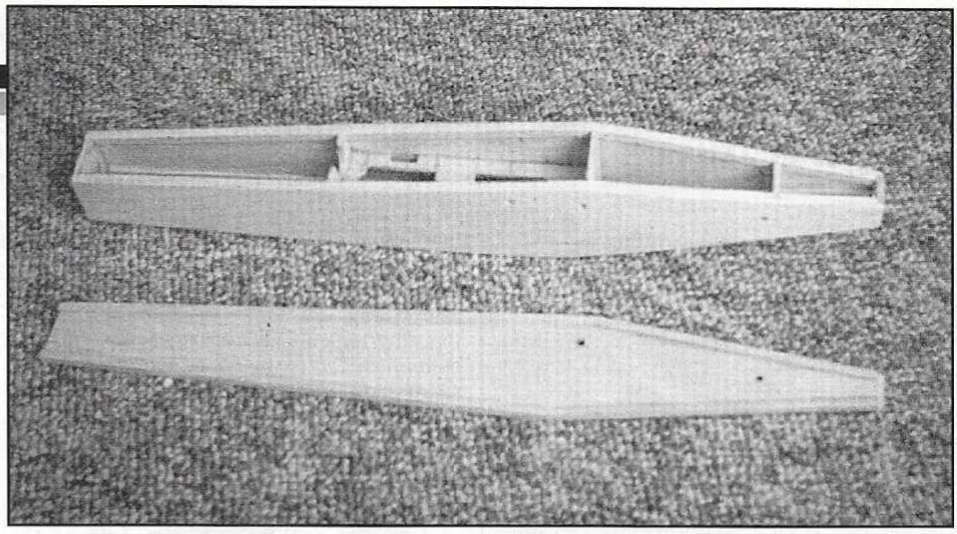
All the top and bottom sheeting can now be tackled, starting with the bottom rear fuselage, and working forwards round the nose, then rearwards along the top. This ensures the noseblock is firmly held between the top and bottom sheeting and the bottom rear joint faces rearwards. The hatch should only be tack glued in position of course, so that it can be removed after carving and sanding! Use medium to hard sheet for this end as hard as you like underneath, the weight won't matter here and the model will be much stronger and 'ding' resistant!

Finally get to work with knife, razor plane and sandpaper to produce a nice streamline shape. This leaves just the wing stubs to complete the fuselage, but for these the wings are needed to check angles and fits, so these are the next job to make.

Wings

Construction of the wings is entirely conventional with quite a lot of wood of fairly small sections. Because the wing is of swept configuration a short diagonal spar is used to take twisting loads back to the rear locating dowels. Main spars are from 1/4in square hard balsa stiffened with webs between. Try for good fits here to make a very strong structure. I am sometimes asked why I don't use spruce spars in my models. The main reason is that I don't like mixing materials of different stress limits. This generally means that when failure of structure does occur it is complete rather than gradual and can lead to dangerous situations. This is because when the stronger materials in the structure reach their breaking point, the other materials are usually already well past their limits and complete breakup then follows. I feel that a well-designed balsa spar coupled with wing joiners that allow a little flexing, i.e. not too rigid, is a better option. Anyhow I have yet to fold a wing and my models are pushed pretty hard at times!

Begin construction by cutting R1-2-3 from 1/8in plywood and cut an R19 in similar material or sheet metal for a template. Make R4-R19 by the sandwich method using R3 and the R19 template rib and cut two extra R19 ribs for the tips. Note that R10 is from 1/8in balsa to strengthen the aileron start area and the rest are from 1/16in balsa.



Pin down the bottom 1/4in square spar to the plan, cut and splice the bottom trailing edge from 1/16in balsa sheet and pin this in position also. Now add all ribs using the angle template for the root rib R1 and fit all spar webs as indicated, note all grain is vertical on these. Fit and epoxy in place the joiner tubes and fill the space between R1 and R2 webs with plastic filler of some type. The top 1/4in square spar can be glued in place now, and slots cut in R3 to R7 for the 3/16in x 1/8in hard balsa diagonal top spar. Also make up the 1/16in sheet balsa doubler gusset between R1 and R2 in the rear tube and glue this and the spar in place. Next glue in place the 1/2in square balsa leading edge ensuring that it is central to the rib edges.

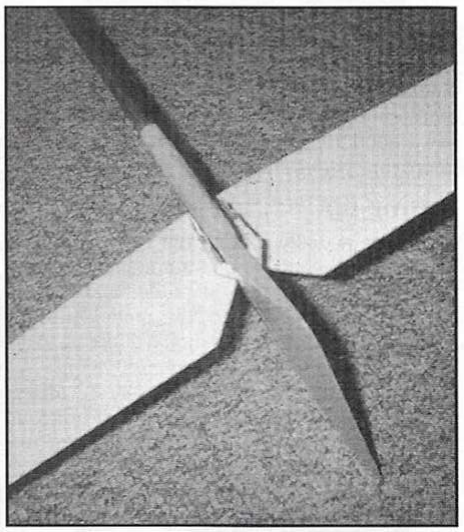
You now need to fit the control snake (choose a cable type if possible) and the right-angle crank and pushrod for aileron operation. I made my aileron, too, at this stage so that it could be used to check the pushrod shape and length. A little time spent on this will ensure good, free operation – remember the servo has to drive both ailerons and rudder on this aircraft!

All the top 1/16in balsa sheeting leading edge to spar, root, tip and all 1/4in x 1/16in balsa cap strips can now be prepared and glued in place. Leave at least 24 hours to dry out thoroughly before removing from the building board and inverting. Pack up level and true and secure to the building board. Now check all joints and add extra glue or epoxy as necessary. Cut slots for the bottom 3/16in x 1/8in balsa diagonal spar and glue this in place. When you are satisfied all is correct prepare and glue in place all 1/16in balsa sheeting and cap strips as for the top. Again leave for at least 24 hours before removing from the building board to ensure a true warp free structure. Next sand root and tip areas, cut out and glue in place the 1/16in plywood root facing rib and the 1/2in balsa sheet tip. Time now to make dust! Carve the leading edge and tip to shape and sand the entire wing smooth to profile all over; remember every fault is a little less performance when flying. Finally trim tube ends flush with the root facing rib and the snake outer about 1/4in beyond the rib, and this should complete one wing. The other wing is built in exactly the same manner.

It is a good idea to balance the completed pair of wings at this stage by joining with wires and balancing about the centre join. Add weight to the light wing tip if necessary – a small point this and often overlooked. This completes the wing structures and these can now be used to aid the fitting of the fuselage stubs.

Fuselage wing stubs

First assemble wings to fuselage (one at a time) and trim back the fuselage tubes to leave approximately 1/4in between the wing extreme trailing edge and sides. Select a piece of hard 1/2in balsa sheet wide enough to accommodate the wing section and long enough for the wing chord. Drill two holes through this at an angle to take the fuselage tubes, and a larger one at the front end for the aileron snake. This needs to go through the fuselage side too, so check the position carefully. Now offer the wing again and



Fuselage construction of the basics (top) and rudder linkage detail (above). Tailplane is AMT type and rudder function is coupled with ailerons for smooth flying. Give 'Alto' a try for flat field thermal hunting or conventional slope excitement!

measure the gap at the front tube, take this amount off of the *inside* face at the trailing edge, tapering off to the front tube and reassemble.

If you got everything right the wing root rib and the embryo stub outer face should now be a fit – if not sand the inside of the stub until a good fit is made. Next mark the wing section onto the stub from the wing while still assembled. Remove wing and stub and cut to shape, finally sanding to a perfect profile using the wing to check progress. When satisfied all is as good as can be made, glue the stub in position; this will leave a tapered gap at the front to be filled by another piece of 1/2in balsa sheet. Again get the taper correct first then the profile and finally glue in place. A facing rib from 1/16in plywood will complete the stubs, leaving the aileron snake hole to be enlarged to take the ball link connector and another hole to be drilled for the wing retaining band or spring. Flush off the mounting tubes now and reassemble the wings to check fits, dihedral should be approximately 1.1/2in under each tip.

If you temporarily fit the ailerons with masking tape or similar, the ball links can now be fitted to the servo end of the snakes and correct and free movement checked for. If you found that a rather difficult and trying job to do you are not alone, it is one of the few jobs in model building that I dislike! But well fitted stubs really do look good and add quite a lot to performance by cutting down on drag.

Fin and rudder

After the stubs this will come as a bit of light relief! The fin leading edge, and rear post are simply 3/8in x 1/2in medium balsa cut to length and tapered to 1/4in at the top. After filing or sanding a radius to match the tube at the leading edge bottom, glue both of these to the sub fin using epoxy. Cut the small filler piece from 1/4in sheet balsa and glue this in place also, plus its two 1/16in balsa gussets. Finally add the 1/8in balsa ribs and sand all over to streamline section when dry.

Before putting the fuselage aside the small underfin fairing to cover the slot and protect the rudder can be made and fitted. This is from 1/2in balsa sheet radiused to fit closely round the tube, sanded to shape and epoxied on to the tube. Be careful not to get glue inside the slot or onto the controls though!

The rudder is also of quite simple construction, but because the hinge post is tapered; is difficult to build flat. To get round this I usually build mine upright, standing on the hinge post and use a small square to check everything is truly vertical. The end of a piece of balsa sheet will do just as well for this if you haven't got a small square. So pin down the hinge post, make the 1/2in balsa price for the bottom of the rudder to the drawing and to the same with the 1/4in balsa piece for the top. Glue both of these to the hinge post and cut a piece of 3/8in x 1/8in balsa for the trailing edge, glueing this in position also. When the glue is set add the 1/8in balsa ribs and the 1/16in balsa gussets to three corners and leave to thoroughly set. Next make the control horn and the two gussets which support it from 1/16in plywood. Fit these in place and when the glue is set sand the whole rudder carefully to section and angle the front face of the hinge post to allow movement.

Hingeing is largely a matter of preference and virtually any type of commercial hinge will suffice. However as we are aiming for maximum efficiency, a sealed gap is preferable and this is most easily achieved by using a stitched, Solartex type. This also has the advantage of being cheap (you were going to cover the structure weren't you?) and very free moving. Simply take two pieces of Solartex each large enough to cover one side of both fin and rudder and run a line of stitching down the hinge line position with adhesive faces together. After that cover first the rudder with the stitch line stuck tightly down the hinge post centre

line and then the fin, thus covering and hingeing all in one go. A small dab of cyano glue at the top and bottom will make sure the stitching stays put and if you seal the Solartex after covering, this will do the job anyway.

Tailplane

Both tail blades are identical and are cut from medium fairly light 3/16in balsa sheet 4in wide. The mounting tubes can be fitted in a variety of ways, most of which have been covered in **R.M.** from time to time. My method is to mark the positions from the A.M.T. crank onto the end of each blank, then carefully bore out the holes with a piece of 14 s.w.g. tube sharpened at one end. At the outboard end of the tube holes I then drill through approximately 3/16in dia. Now epoxy the tubes to be used and slide into place in the holes, fill the 3/16in hole with epoxy also, a piece of tape either side will stop this running out. This strengthens the outer mounting of the tube and also stops the wires disappearing into the tailblade. The root end is reinforced with a 1/32in ply facing rib also epoxied on. Just for good measure I then like to soak cyano into the wood surrounding the tubes by flooding some onto the area round the tubes and pricking the wood with a pin. This hardens the wood and makes a very strong job of the tube mounting area.

Now carefully sand each blade section, not forgetting to taper the thickness to approximately 1/8in at the tips. Finally sand smooth all over ready for covering.

Covering

With such a wide range of materials available these days we really are spoilt for choice here. I chose Solartex for the fuselage and fin/rudder assembly for its toughness, then clear doped this to a high gloss finish, very strong and looks good too! Tail blades are covered with Solarfilm as this is light, has a good surface finish and no extra strength is required for the covering in this area. For the wings I used Solarspan, again because of the very good surface finish but also for its strength. The covering may as well contribute a little to the overall strength of the wings as these are the most highly stressed parts of the aircraft.

The ailerons are also top hinged with Solarspan. If you cover the bottom of the aileron and the front face first, leaving about 1/2in extra above the aileron, this can then be attached to the aileron wing spar with the aileron lying on the wing top surface. Now cover the entre bottom surface of the wing, fold down the aileron and cover the top surface. If the top covering goes right over the aileron joint line this plus the film already applied to the aileron forms the hinge.

All the foregoing are my personal preferences and are based on previous use of these covering materials; I have no doubt others will do just as well. With the covering complete, give the whole aircraft a polish with spray furniture polish. Apart from smelling good it does make the model a lot more slippery and therefore efficient and will put a good 10mph on the top speed plus improving penetration.

Setting-up

Before actually putting the model into the air, check all controls operate smoothly and in correct directions. Also rudder and ailerons are trying to turn the model in the same direction! Ailerons should have approximately 3/8in up travel and 1/4in down, the differential coming from the offset servo ouput location and a little horn rake. Rudder should have about 1in to 1.1/2in movement each side of centre. You may need to experiment with the amount of movement here to suit your particular style of flying. This amount gives me just enough yaw to enable smooth turns at thermalling speed without making rolls 'barrelling' at speed. The A.M.T. should have approximately 3/8in to 1/2in movement at the trailing edge either side of centre, again adjust to suit your style of flying.

Make sure the centre of gravity is to plan position or a little forward for initial flights and all should go well. I like to trim my 'Altos' almost to neutral stability, that is, the model will only pull out of a shallow dive very gradually by itself. This means of course, that the model has to be flown all the while. If you like to relax and let the model sort itself out rather more, simply add weight to the nose. This has the effect of making the tailplane work harder, thus automatically pulling itself out of a dive.

Flying

At normal flying speeds 'Alto' is a relatively easy aircraft to fly. Providing you take time to get used to her she would probably be a good first aileron model to learn on. However with speed built up a little, control becomes very light and responsive and she will quickly roll past the vertical if you are not careful! Built with the amount of dihedral as drawn, she will almost fly hands off, but not quite. Once a turn develops there is not enough dihedral to correct it therefore you are on duty all the time the model is in the air.

Flight speed can be varied a great deal, the model accelerating quite fast when commanded. Stall speed is very low and is no more than a gentle nose drop to recover speed. My 'Altos' refuse to spin and, unless absolutely stopped dead by turbulence, never drop a wing. One of my favourite tricks with 'Alto' is to hover motionless overhead then either dive forward for aerobatics or ease in a little more up and fly backwards! Indeed landings can be made this way without ever turning downwind, simply by flying backwards into the sink then making a normal controlled landing at your feet!

When thermalling 'Alto' usually needs a touch of opposite aileron once established in the turn. Height gain is usually quite rapid in thermal lift, 'Alto' being quite capable of overtaking 100S models in the same thermal.

All the normal aerobatics are possible, rolls, loops, bunts, roll loop combinations, inverted flight, stall turns, chandells and so on. Manoeuvres like Immelmans require a fine judge of entry speed as they are two figures in one. Too little speed at the loop top and you will find aileron power fading and the model usually comes out sideways, I wonder if that's a new manoeuvre? This is one of the easiest models I have ever flown inverted, the combination of seep back and undercamber making the aircraft very stable in this attitude. In good thermals she will even climb inverted and has proved this several times. Bunts can be attempted from both inverted or normal flight, however from normal flight don't forget to start with a dive to gain speed or you won't get over the top. Stall turns are possible because the ailerons seem to die out before the rudder. A full stick of turn just before the model stops flicks her over and a full stick of opposite before speed starts to build too much straightens her up, but without the roll. If you like to race up and down the slope, this model will turn vey tight at the ends, just roll to 90° and pull in the up, she comes back as if on a bungee!

Flat field flying is just as good as slope though a good fast tow is necessary – I always use a bungee as I am a lazy sort. On full stretch 'Alto' goes up like an arrow and will make good extra height in wind if up elevator is held in to re-stretch the bungee prior to diving for a 'ping' launch.

So there she is; 'Alto' is still my favourite aircraft after some four years of flying her, and is taken out on flying sessions most weekends. She will fly in a light breeze or up to 20-25mph of wind without ballast and although I have fitted ballast tubes to a foam winged version I made, they are usually left empty. This model also breaks down well; with wings and tailblades removed, my Metro boot will take three with ease and still have a little room left.

Right, that's enough said. I'm off to fly my 'Alto'. Why not join me?

And then ther were two! Tony Mellor's so pleased with 'Alto' he builds them by the batch.