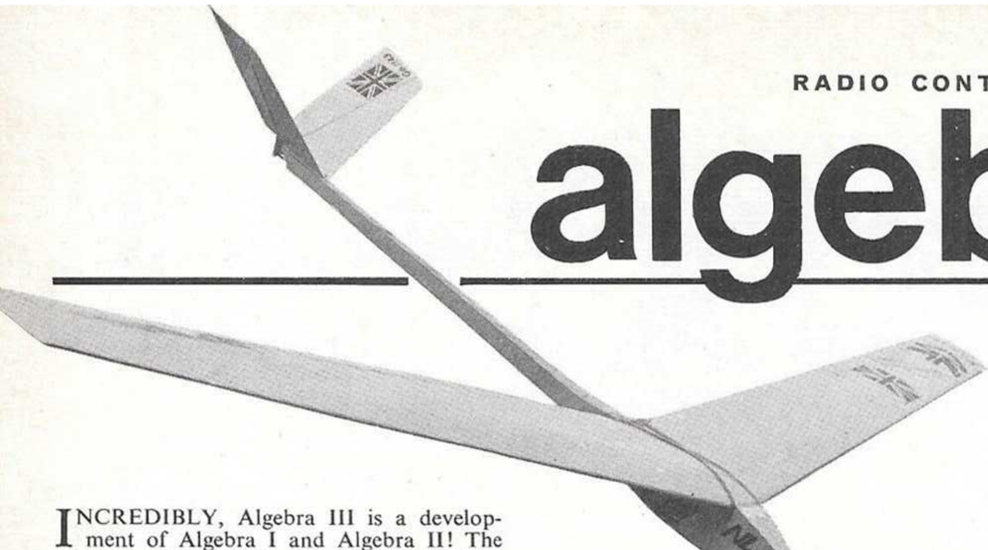


algebra

A 96 in. span sailplane

INCREDIBLY, Algebra III is a development of Algebra I and Algebra II! The Algebra phenomenon started as a high aspect ratio (20:1) power assisted glider, 96 in. span, open structure, flat bottom wing, with an .049 up front. This model was fast, good in lift but came down faster than desired out of lift.

Algebra II followed with more wing area, lower aspect ratio (14:1) and an open structure wing incorporating an Eppler 387 wing section. The wing loading was lighter at 6½ oz. per sq. ft. and ballasting this up to 8 oz. increased the speed range without reducing the endurance. I must sincerely thank a friend for kindly testing this model to destruction last Boxing Day by towing the model to 600 ft. in a 300 ft. cloud base! (Yew is der man on der box, Squire – Ed.)

Algebra III has a smaller tail surface area, all sheet wing, altered Eppler 387 wing section and wing loading of 8 oz. per sq. ft. It is interesting that the all sheet wing weighs 16 oz. complete, only one ounce heavier than the previous open structure wing. I am a slow builder but can get Algebra III in the air after only two weeks of evening building. Some measure of the design's potential as an all-round performer can be gauged from its performance at the first U.K. Soaring International Meeting at Halton. Algebra III placed 5th in both the model and pilot's first venture into soaring competition.

Wings

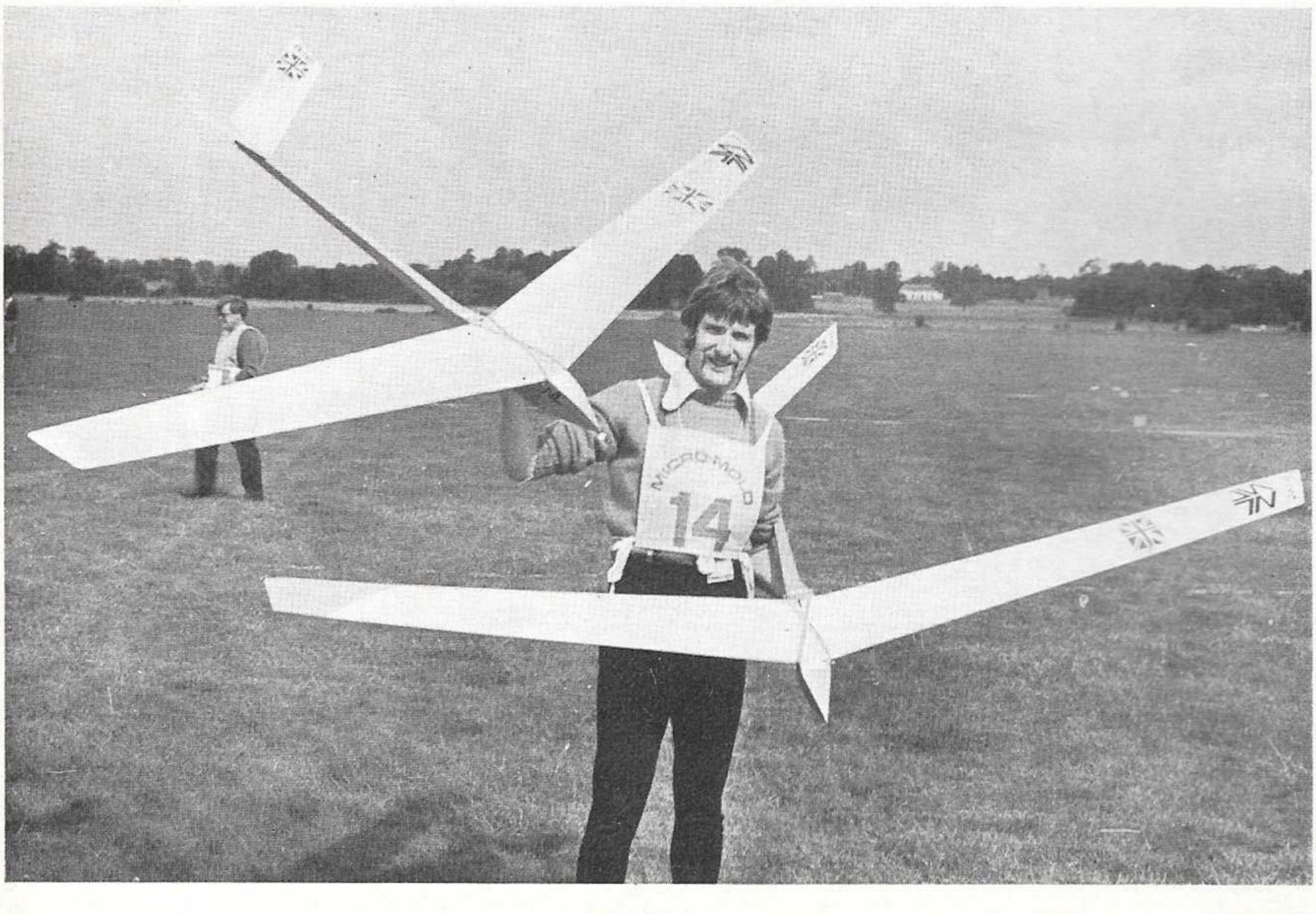
Cut the leading and trailing edges from a sheet of medium soft ½ in. x 4 in. x 48 in. Razor plane the trailing edge to an oversize shape to enable ease of locating the top sheeting at a later stage. Select five sheets of medium 1/16 in. x 4 in. x 48 in. for the wing sheeting. One of these sheets is cut down the centre and each half is again cut from corner to corner, giving four triangular sheets. The sheeting pieces are now joined and sanded before assembly of the wing.

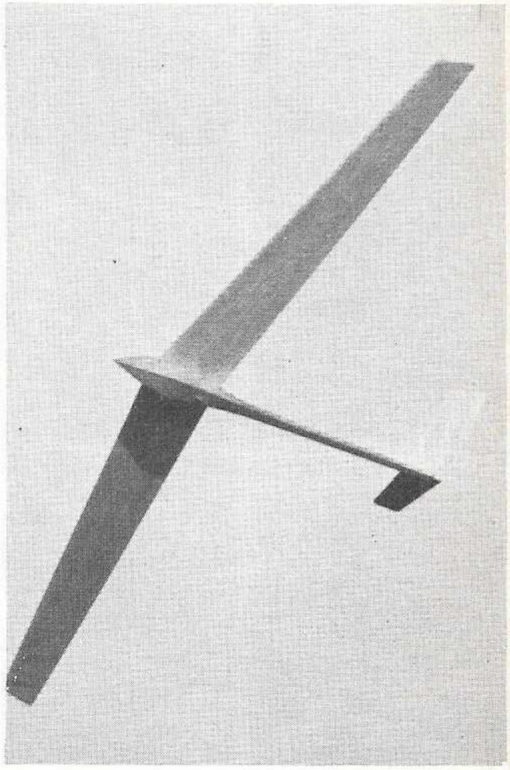
Now cut twenty five 1/16 in. medium balsa rib blanks and place them in sandwich fashion between the two rib templates. Hold this assembly together with rubber bands and drill two holes for the retaining bolts from the smaller template through the sandwich. I use 15 swg. bicycle spokes bent over at one end and retained with 8 B.A. nuts to hold the sandwich together. Having carved and sanded the sandwich to shape, discard the three largest ribs as these will be replaced with the three ⅛ in. ply root ribs.

Having prepared the pieces, they may now be stuck together. Commence by pinning the L.E. to your building board, then add the bottom sheeting and trailing edge.

It will be found that the ribs are slightly too long but this enables the chamfer at the end of each rib to cut off providing a square joint at the leading and trailing edges. Now remove the two complete wing panels from the building board minus the three ⅛in. ply root ribs and top sheeting. The two wing panels are now placed together with 6 in. dihedral under one tip to enable accurate alignment of the ⅛in. ply root ribs, 8 swg joining wires and brass tubes. White glue is used to place the ribs and epoxy resin for the rib/brass tube joint, remembering to tilt the two root ribs W.1 for a flush joint. When the glue has set, the two panels may be parted for final construction. The panels are again pinned to the board and the ⅛ in. sheet balsa webs are added, remembering to run the grain in a vertical direction. Finally, the top sheeting is trimmed to fit and glued in position. Impact adhesive is used for this operation, marking the rib/sheeting joint on the underside of the sheeting and smearing a thin strip of impact adhesive along this line. The impact adhesive is also applied to the ribs and left to dry as per maker's instructions. Balsa cement is still used though for the leading and trailing edge joints but only applied immediately before sticking. It is most important that the ⅛ in. balsa web is also stuck to the top sheeting and I find white glue most suitable for this operation.

The wing is now ready for final shaping





ith novel construction BY SEAN BANNISTER

and the addition of the 1/16 in. ply root facing ribs. The facing ribs are cut well oversize and holes drilled to permit passage of the 8 swg wing joining wires. The ribs are now glued in position and the two wing panels placed together to provide a perfect fit but separated with a sheet of polythene to avoid the two panels remaining together permanently! Finally, the facing ribs are trimmed to the adjacent wing shape giving a flush joint.

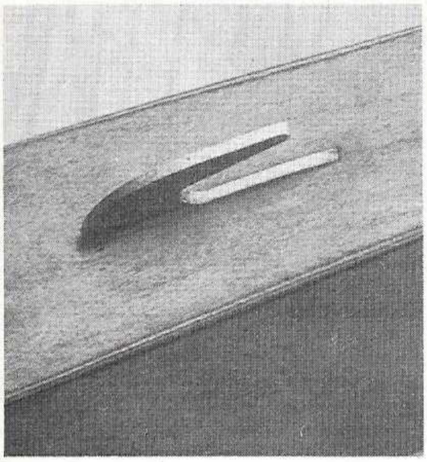
After the doping operation, a $\frac{1}{4}$ in. of washout is added to each tip progressive from half span, by holding the wing over a steaming kettle and twisting until the required washout is incorporated.

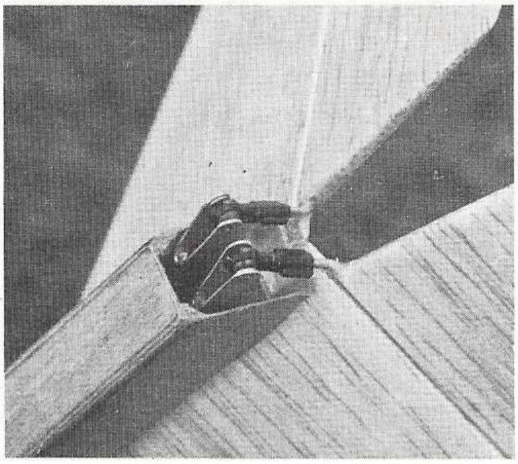
Fuselage

From the plan it can be seen that the fuselage is constructed entirely of hardwood and it is therefore essential that white glue be used to ensure ample working time.

Start by cutting out the 1/32 in. ply fuselage sides and pinning these to your building board, taking care to make one right hand side and one left hand side! The $\frac{1}{8}$ in. sq. spruce longerons and $\frac{1}{8}$ in. x $\frac{1}{4}$ in. spruce wing seating pieces are now glued to the ply sides securely pinned at a minimum of 2 in. centres. Next, the $\frac{1}{8}$ in. x $\frac{1}{4}$ in. and $\frac{1}{8}$ in. sq. spruce spacing pieces are added and the two assemblies removed from the board when set. At this stage, the two complete sides can be placed together and sanded top and bottom giving two identical fuselage sides. As there are no formers, temporary spacing pieces have to be placed between the sides while the $\frac{1}{8}$ in. x $\frac{1}{4}$ in. and $\frac{1}{8}$ in. sq. spruce spacers are positioned. A chamfer is sanded on the inside of the fuselage sides at the front, providing a flush pointed nose, before the sides are placed together. Note that the fuselage is $\frac{1}{4}$ in. narrower at the bottom over the wing seating section, reducing to $\frac{1}{8}$ in. narrower at the bottom along the main rear section and make allowance for this taper when placing the spacing pieces. The fuselage sides and spacing pieces are held together with rubber bands with a large paper clip at the nose while the assembly is trued up over the plan. The spruce spacing pieces can now be glued in position and the rubber bands and temporary spacing pieces removed when the assembly is dry. The top and bottom may now be sanded flat before the 1/32 in. ply top and bottom sheets are added. The bottom sheet is first glued in position and held with rubber bands. When this sheeting is dry the top 1/32 in. ply sheeting can be glued in a similar fashion. The basic fuselage is now ready for final shaping, the four corners being sanded until the corners of the $\frac{1}{8}$ in. sq. spruce longerons are just visible.

A slot may now be cut in the fuselage bottom to locate the 3/32 in. dural towhook.





This is stuck in with epoxy resin projecting ⅛ in. inside the bottom 1/32 in. ply sheeting. The space between the towhook and ⅛ in. sq. spruce longerons is now filled with scrap ⅛ ply and a piece 1/16 in. glued over the whole assembly. Finally, the 3/16 in. dia. dowels are added for the wing retaining rubber bands.

Tail Surfaces

One piece of medium soft 3/16 in. x 4 in. x 36 in. balsa is sufficient to provide the four tail surface blanks. The ruddervators are first cut out, keeping as close to one end as possible. The remainder of the sheet can now be cut approximately from corner to corner, providing the tail surface blanks.

Using a razor plane, the blanks are planed to the flat bottomed airfoil shown on the plan and sanded to final shape. 1/16 in. sq. slots are now carefully cut in the ruddervator roots and a 1/16 in. dia. hole drilled to accommodate the 15 swg bicycle spoke ruddervator horn as shown on the plan. The horn is now epoxied in place and a piece of heavyweight tissue doped around the whole assembly for reinforcement.

Radio Installation

The battery and receiver are well surrounded in foam rubber and placed as far forward in the nose as possible. Next, the servos can be positioned remembering to leave enough room for removal of the receiver and battery. I am fortunate enough to have the micro-mini World Engines servos, giving ample room for removal of the receiver when I want to go pylon racing. As there is a lot of room in this section of the fuselage much larger servos can be accommodated but the receiver removal facility will be lost. For neatness, an internal on/off switch is preferable and the aerial is also mounted along the inside of the fuselage. I find no range problems mounting the aerial internally and in fact, my World Engines radio has functioned perfectly at maximum visible range for countless long flights:

Having decided the exact servo positions, the ¼ in. sq. hardwood servo rails may be glued in position remembering to position the rudder servo centrally on plan in the fuselage and the elevator servo offset an amount equal to the servo output arm length.

Mixer Assembly

With the servos fixed in the fuselage, the ruddervator mixer assembly can now be put together, starting with the longer 1/16 in. paxolin arm which is held to the rudder servo output arm with two 10 B.A. nuts, bolts and washers. The 10 B.A. pivot is now firmly bolted to the elevator servo output arm with two washers and a 10 B.A. nut. On top of this is added a washer, one of the 1/16 in. paxolin arms, another washer, the other 1/16 in. paxolin arm, yet another washer and finally two 10 B.A. locking nuts. The 10 B.A. locking nuts must be tightened allowing the two paxolin arms freedom of movement, but without any vertical float. Linkages with adjustable clevises can now be made up in the normal fashion between the front and rear paxolin arms as shown on the plan.

Finishing

Most modellers have their own ideas about finishing but nevertheless I will describe what is most suitable for this model. I much prefer the traditional dope and tissue finish, this method being used on three of the four prototypes. One of the prototypes was finished in plastic film and although this was adequate, the film added no rigidity to the tail surfaces resulting in tail flutter in very fast dives. Be warned!

Before the tail surfaces are glued on to the fuselage top, a 60 degree chamfer is sanded along the root to provide a perfect butt joint as can be seen from the tail assembly detail on the plan. A small amount of 5 minute epoxy is now mixed and the two tail halves joined, setting the 120 degree 'V'. The tail is now ready to be glued to the fuselage. To ensure true alignment, the wing is first placed in position as a reference for the tail. The tail is now epoxied to the fuselage, aligned from the rear until true and left to dry. Epoxy fillets are now added as shown in the tail assembly on the plan. This method of fixing has proved to be more than adequate on the four prototypes built.

Before any dope is applied to the wing surface, the root leading edge area is reinforced with fibreglass resin over the rubber band fixing area. The wing is then finished in dope and lightweight tissue, with the 1/16 in. ply trailing edge reinforcing pieces added after the first coat of dope over the top of the tissue. The tail surfaces are finished in a similar manner with the hinges epoxied in position after the final coat of dope.

As the fuselage is plywood, it looks very attractive in its natural finish with two coats of clear polyurethane added to bring out the grain and seal the wood. While the final coat is drying, the 3/16 in. dia. dowel pushrods may be made up with adjustable clevises at each end. Ball and socket swivels are added to complete the ruddervator horn assembly. With the push rods linked up the control surface movements may be checked with elevator throw at ½ in. each way and rudder throw double this with 1 in. each way. Take care to hook up the rudder function the correct way round, a right turn requiring the left ruddervator up and the right ruddervator down.

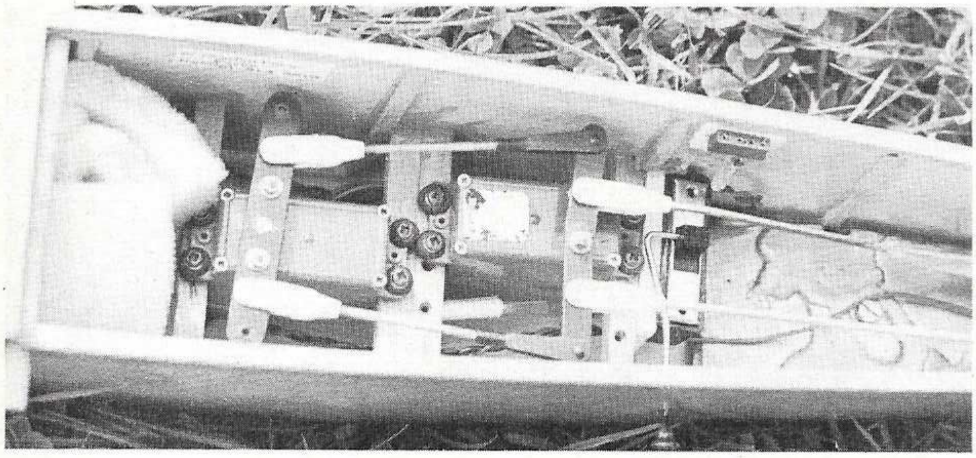
If medium soft balsa has been used throughout the construction, the centre of gravity will be very near the point shown on the plan, but one or two ounces of lead may be required on front of the battery to obtain perfect balance.

The finished model should weigh 36 oz., the same as both Algebra III prototypes. This gives a wing loading of 8 oz. per sq. ft., but this is best increased to 10 oz. per sq. ft. by the addition of ½ lb. of ballast at the C.G. for flying on windy days or at the slope.

Flying

Test glide Algebra III before towing and make any necessary adjustments. After the model is trimmed from a gentle tow you will be ready to 'give it the gun'! Allow the tension to build up before releasing and be careful not to blink or you will miss the first 200 ft. of rocket-like climb. As well as being fast, the climb is perfectly straight and both my towing assistants Arthur and Wal insist that the wing has carbon fibre spars! Consecutive loops and other minor aerobatics can be performed without danger to the structure and it will only be a matter of time before a lucky Algebra III owner beats the best thermal time of 59 minutes! Have fun.

Top: the metal tow hook used on the prototype, and a view of the tail cone showing the simple yet effective ruddervator linkage with adjustable links.



Left: the radio installation showing the linkage arrangement used to drive the ruddervator control system on the butterfly tail. The linkage is illustrated on the plan.