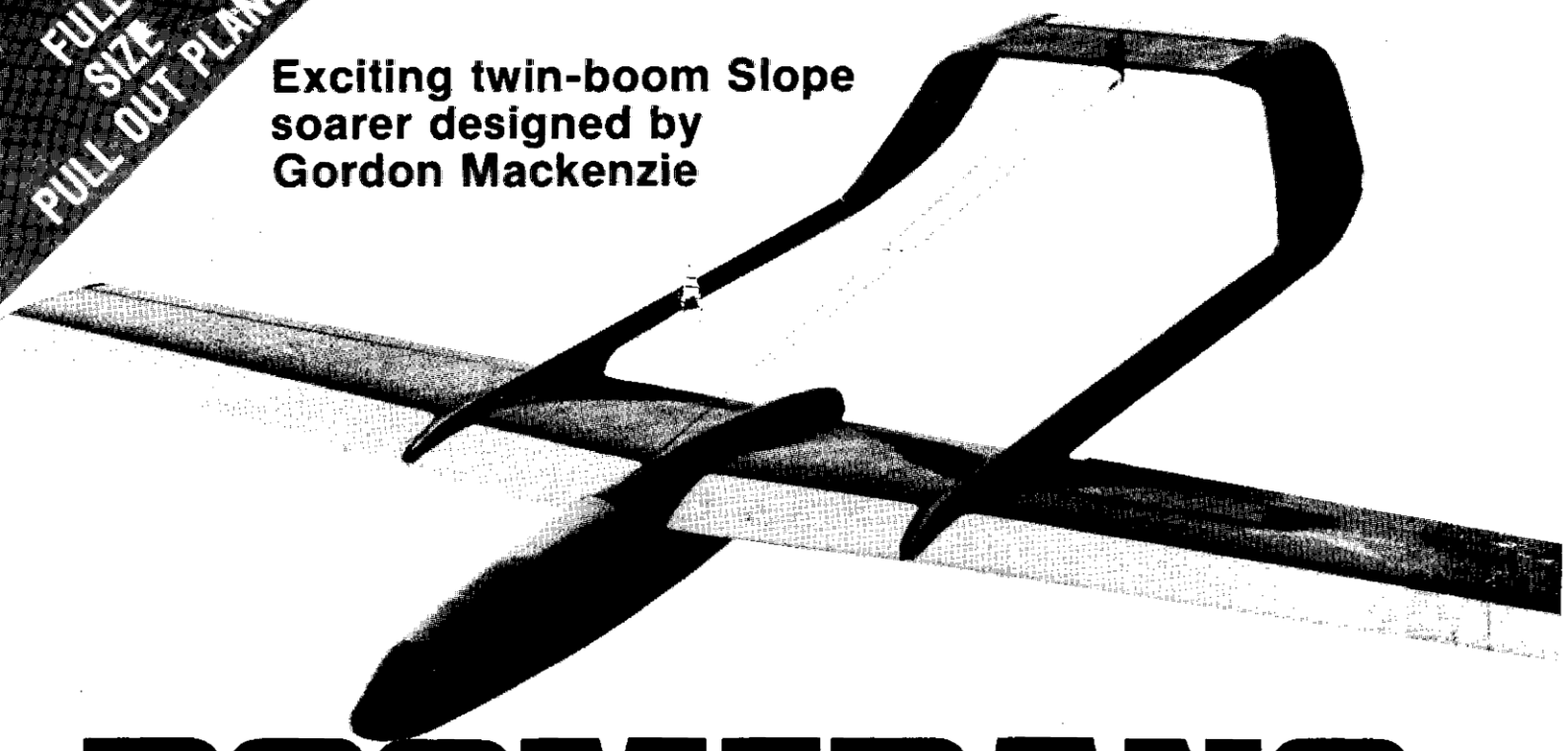
FULL SIZE PULL OUT PLANS

Exciting twin-boom Slope soarer designed by Gordon Mackenzie



BOOMERANG

BOOMERANG has many of the attributes of that famous Australian aboriginal flying device. It is launched by hand, it usually comes back to somewhere near the point of launch, it is made from wood and it originated in Australia. I only wish I could take it one step further and say that it was designed by an Aboriginal Australian, but with a name like Gordon Mackenzie I think you will realise that my racial origins are elsewhere.

I've had a lot of fun with 'Boomerang' and it has claimed more than its fair share of attention both from flyers and interested members of the public who frequent our flying site. There have also been many requests for plans over the two year period during which this machine has been flying. To these requests I have usually said: "There it is; measure it and look at it all you want and then build it your own way." This does not seem to suffice however, as most people like to have plans and instructions before they will start to build. If I think back a few years I would have been the same so I can sympathise with these conservative but discerning attitudes.

I didn't build 'Boomerang' with any particular function in mind, it's not 100% aerobatic because I simply cannot contemplate symmetrical or near symmetrical wing sections for gliders. Anybody will recognise that the Eppler 205 section is not happy upside down for long, but it has good penetration and speed range characteristics. It has become obvious to me that the role of the 'Boomerang' is in slope pylon racing because of the apparent efficiency in conservation of momentum in high rate turns and the good penetration and acceleration at low wing loadings. A pylon racing version would have to incorporate more space for ballast, however. I have entered the 'Boomerang' in a pylon race in which it came second mainly because I could not ballast it up enough. I say that anyway to save face: it's likely that my flying was at fault.

The second aeroplane of the series; which shall be nameless, had a short coupled tail, still with an all moving stabiliser and a low cambered bi-convex section. It was built purely as an aerobatic fun machine. It flew quite well but was not without vices. Most notable among these was its entry into a spin any time full up elevator was pulled. This could have been corrected quite easily by limiting the elevator movement and perhaps reducing the tail area slightly but it was fun to have a 'bag of snakes' on my hands and it was interesting to watch anybody else who asked for a fly trying to handle this slippery and mean little machine. I eventually tired of flying it in its original form and it now awaits conversion back to longer tail moments having in the interim been used as part of a canard type slope soarer ... As you can see; I'm into experimentation.

The third aeroplane in the series was an attempt to produce a compromise design suitable for pylon racing and aerobatics. It had ballast tubes in the wings which were loaded from the middle of the wings with lead slugs about 15mm diameter by 50mm long. This gave a total ballast of over a kilo which is not bad for the size of the aeroplane. Reverting back to the more understandable Imperial units, this allowed me to go from 12oz./square foot to 23oz./square foot by adding ballast. The wingspan was 60 inches and I had modified the Eppler 205 to give some inverted performance and generally cleaned up the design. This aeroplane was shaping up to be a great performer when I overcooked it on the elevator whilst it was halfway through an outside loop carrying full ballast on a very windy day. I admit that you should at least build them strong enough to withstand any aerodynamic load, but I had simply been lazy and the wings parted at the centre joint. The earth shook as the ballast slugs buried themselves and the air was filled with confetti and undeleted expletives. A lesson well learned.

Construction is, I assure you, easy because I am a naturally lazy slob and I'm always looking for the easiest way to do things. These days I wouldn't even consider a built-up wing for a slope soarer, so I hope that foam cutting is not outside your range of capabilities. The only other departures are some epoxy resin, light glass cloth, some microballoons and if you are lazy and impatient like me, cyanoacrylate and 5 minute epoxy. You don't need to build the thing my way, but here's the way I did it.

Construction methods

Start by cutting the foam cores from the root and tip templates given in the drawing. The section I used was the ubiquitous Eppler 205. No washout was included in the original machine and it does not appear to have suffered any ill effects. Fully sheet the wings and add the leading edges. Go along the inboard trailing edge joint with cyanoacrylate to add stiffness. You don't need to go beyond the point where the boom comes out of the wing as you will be fitting solid balsa ailerons outboard of the booms.

Join the wings with the top surfaces flat on the board. Use 5 minute epoxy for the joint and fibreglass tape around it later. Cut the aileron spaces out of the wings and line the wing trailing edge with hard balsa as shown. Cut the ailerons from trailing edge stock. Built up structure is also detailed.

Having shaped the ailerons, you may like to instal the torque rods. When you have fashioned these from an appropriate

gauge of wire using heat to bend them as sharply as possible at the required places (I know this de-tempers them, but what else can you do?) accurately line them up with the pivot points and cut a 3mm strip out of the wing sheeting running from the ailerons to approximately 10mm from the wing joint. (You can cut this strip from the top sheeting or the bottom sheeting depending on where you want your hinge point to be on the aileron leading edge). Using a piece of hot metal (test first on a spare piece of polystyrene) melt the polystryrene about ¾ of the way down into the groove. Cover the aileron torque rod lightly, along the pivot line only, with vaseline or grease and when you have everything lined up, drop in some 5 minute epoxy at about 50mm intervals along the wire ensuring that you have one close to each end for good support at the drive and aileron ends. Give this at least 20 minutes to set before freeing it up and making sure that the servo will be able to drive it. If stiffness persists try some WD40 or similar thin film lubricant in the pivot points. When you are sure this assembly is going to work O.K., close the gap in the wing sheeting with a thin strip of balsa and sand some balsa dust into the joints using cyanoacrylate to bond the whole. This method usually wrecks a few pieces of sandpaper but the results are well worth it.

Make the tail booms next using leading edge stock of approximately 15mm across the flat part. Bond the flats together to make an oval shaped boom. When you buy the balsa, make sure you are buying straight pieces and after you have glued them together using epoxy resin, pin them to a flat surface to let the glue set. If you are in a hurry like me you can simply join them with cyanoacrylate, just so long as they are dead straight. Slit the ends and insert the tailplane fins, building up the curved area around any suitable template such as a small bottle or can. Once again cyanoacrylate is invaluable for saving time and effort on a job like this. An alternative suggestion is to sandwich ¼in. balsa/ 1/16in. ply/¼in. balsa for the booms.

Slit the wings to accept the tail booms. The slits go all the way down to, but not through the bottom sheeting. Remember the inwards leaning angle of the tail planes when you are cutting the slits and having taped the tail assembly to a cardboard template, set the booms in the gaps with epoxy and microballoons (plenty of microballoons, not much epoxy). Ensure that the aileron torque rod is well lubricated with vaseline where the microballoons and resin come into contact with it and ensure that the booms are completely and strongly rejoined at the bottom after you have slit them to accept the aileron torque rods passing through them. This may look like a weak point, but in fact it has not proved to be so on my machine. If you are a bit cautious, however, you can beef it up some more using your own methods.

Fuselage

Construction of the canoe shaped fuselage requires no explanation. I used cyanoacrylate throughout and built it very quickly. When you have built it and sanded it to shape you can do all the glass covering in one go. Glass the whole outside of the fuselage, tape over the wing joint and glass the tail where indicated using light cloth in two or three layers. Keep the resin to a minimum consistent with complete wetting of the fibres. If you want to save yourself the trouble of finding, and the expense of buying, a commercially available canopy I recommend that you make one from fibreglass by shaping a block of polystyrene, using fine wet and dry for final finishing and applying two or three layers of cloth to the outside. Leave as much polystyrene in place as you can when you have finished and this will aid stiffness. If you are fussy you can achieve a mirror finish this way by filling and sanding before spraying black or some other suitable colour.

Having fitted the wing bolt and screwdown block, make the top decking on the wing and fit an eyelet or nonwearing recess for the elevator control wires and cut out the all-moving elevator. Fit the horns (I made mine from wire) and insert the pivot wires, beefing up the pivot wire area slightly by adding two pieces of 1/16in. balsa and shaping as shown. Insert the tubes for the pivot wires in the ends of the tail and fitting a washer to each side, spring the tail booms sufficiently to insert the elevator.

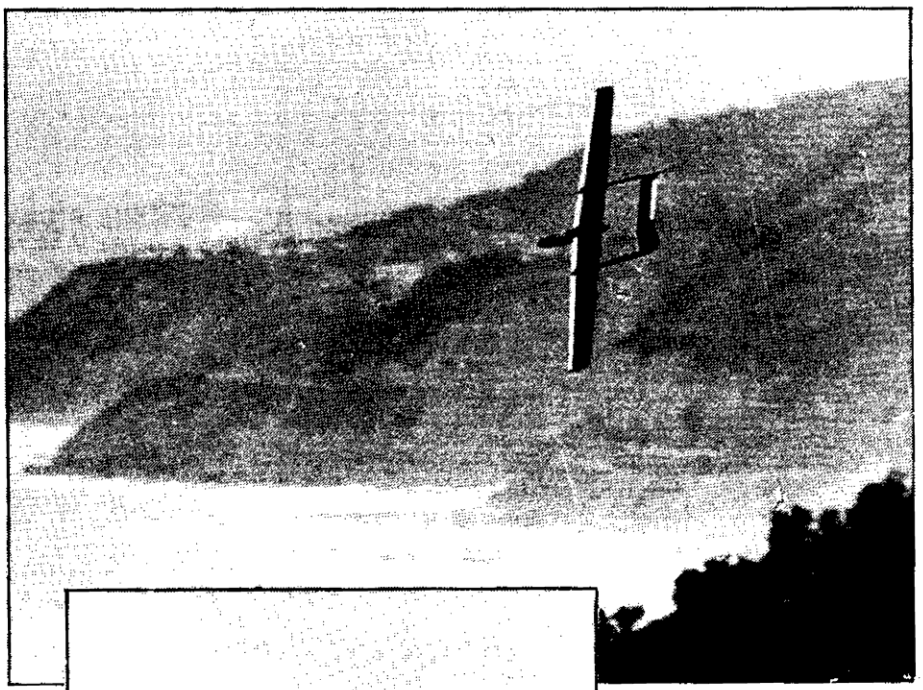
Fit the servos and the connecting links and wires. For my elevator control wires I used plastic coated stainless steel fishing trace with just enough tension to keep the wires taut. I have never had to adjust them in two years of flying.

The ailerons can be set to about 10mm of up and 4mm of down movement and the elevator to about 20mm each way from centre measured at the trailing edges. That should give you adequate initial response. After that it is up to you.

Flight tests

When you have applied your favourite finish it is time for the 'proof of the puddin'. I recommend a moderate wind for first trials, say 10 to 15 knots. You will find later that unless you have added lots of weight during the building, this model will hang around on very light lift.

First of all, a bit of confidence . . . I have flown my first model for over two years in conditions ranging from marginal to 'dearly beloved we are gathered here' and it still survives intact. Not only have you built a sound flying machine, you have also built a lucky aeroplane and that's important too. Just throw it out there and fly it.



DATA PANEL

Model type: Aerobatic Slope Soarer
Span: 51in.
Length: 35½in.
Wing area: 320sq.in.
R/C requirements: two function
Control surface movements: Elevator — 20mm each way
Ailerons — 10mm 'up' 4mm 'down'