BOXER

Design By
Chris Pinchbeck
& Bill Burkinshaw

Second part of a construction series on cardboard and foam featuring 'BOXER' for .19 size motors and 3 function R/C

LAST month I covered the possibilities, techniques and practicalities of using cardboard as a structural material for model aircraft. Hopefully that article has gone some way towards dispelling the myth that any such model will suffer not only from a 'droop snoot' but a droop everything else. If there are still doubts in your mind, perhaps because last month's model was basically a trainer with a slow, steady and stable performance, I hope to dispel them this month.

'Boxer', has been designed as an aerobatic model for three function operation on rudder, elevator, and engine only.

The plan presented here is for the fourth version of 'Boxer'. Previous versions have all been of built up construction and utilising the wings from a Ripmax Superbipe (one at a time of course). The first model in the series featured a radial engine mount which could be readily un-bolted and replaced with a streamlined nose block for slope soaring. The throttle servo was then utilised to operate a release system for some early attempts (highly successful I might add) at aero-towing.

Boxer No. 1 proved quite aerobatic but a more positive rudder control was felt to be necessary. Mk II incorporated an underfin and full depth rudder, also reduced tailplane area. These modifications together with slightly reduced dihedral transformed the performance of the model. Consecutive axial rolls, flick rolls, full power spins and 'rudder reversal' when inverted, all combined to produce a model which completely fulfilled the design parameters. Many who inspected the model on the ground after witnessing its violent aerobatics were amazed at the lack of ailerons, the aerobatic performance particularly in the rolling plane was to say the least sparkling.

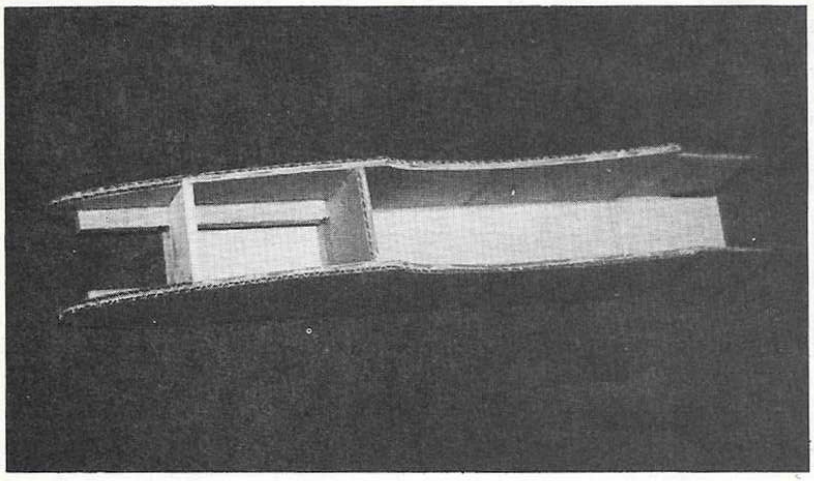
This is not a R.E.M. model for the novice. It is a 'fun' model for 2 or 3 function R/C suitable for someone who has quite a few 'solo hours' on a basic trainer.

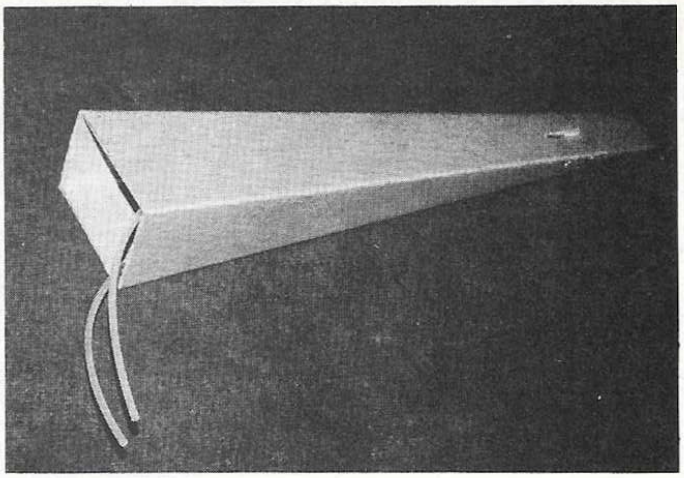
Construction

I recently obtained a few pieces of a new (to British modellers) material called 'Rohacell', which I believe to be a rigid acrylic foam. The opportunity was taken of using this material for the tail surfaces and other 'block' areas of Boxer since it is very light but quite strong. It may be remembered from last months article that the all cardboard tail used was too heavy and several ounces of nose-weight were required to achieve the correct balance point.

In addition to the 'B' flute 1/8" corrugated board, this time I have also used plain 1/16" solid card.

For the construction of Boxer then, a





Front and rear fuselage sections before assembly. Note long overlap tongues on rear end of the nose section.

number of different materials have been used in an attempt to optimize the performance of each one for a specific application, whilst maintaining the basic advantages of ease and speed of construction at minimal cost.

Fuselage

With the flat underside and slab sides the obvious constructional method is a straight forward 'cut and fold' in two sections plus a doubler, the join being just behind the wing trailing edge position. The plan includes the development, or opened out shape, of the three pieces of cardboard which make up the basic fuselage. These can be marked out by pricking through the plan directly onto the board. As far as possible ensure the grain is vertical on the rear fuselage section. Cut out the three fuselage developments.

If tube and cable control runs are to be used they must be fitted at this stage.

Fold lines are scored on the inside and the rear fuselage formed by bending. Use a blunt knife or similar implement for scoring since you do not need to actually cut into the facing of the board, only crush it, 1/4" sq. strip of balsa wood was fixed to the edge of the underside before finally closing and glueing the rear fuselage. Finally the joint was sealed with brown gumstrip paper.

The front fuselage outer should have the 'flute graining' vertical and the doubler grain must be horizontal. Flaps for joining front and rear fuselage sections are drawn in as extensions to the underside and sides of the inner doubler.

Formers should now be cut out, F.1. from 1/4" ply, F.2. from two laminations of corrugated board (with grain at right angles) and F.3. fabricated from 1/2" × 1/4" strip balsawood. Engine bearers are also now prepared from hardwood.

Below: Trial assembly of front and rear fuselage sections note control tubes already installed. Below right: U.C. Torque loads are well spread by ply re-inforcement. Raw edges yet to be covered with gum paper strip.

Stage one in the assembly of the front fuselage section is to glue the engine bearers to the inside of the doublers. The outer sides and inner doubler are then bonded together with contact adhesive. Care must be taken at this stage to ensure that the composite will still fold and form the front fuselage section. Complete formers F.1. and F.2. may be fitted and glued into position.

When both fuselage sections are finished they should be joined by liberally smearing the joining flaps and inside of the rear fuselage half with contact adhesive and sliding one into the other before the surface of the glue gets too dry. It is most important that a 'dry fit' is practised first in order to ensure a good snug final join. F.3. may now be fitted, and masking tape used to cover what would otherwise be an unsightly join in the fuselage sides.

A tank hatch was rough cut from 'Rohacell' then shaped using a balsa plane and glass paper. The material could be worked easily by either carving, planing, or sanding in exactly the same way as block balsa.

Wing band retaining dowels were fitted and noseleg bolted to F.1. The main undercarriage is of the torque rod variety and is set into a series of laminated 1/8" ply plates which effectively spread the load.

Fin and tailplane

From the previous cardboard model I have learned of the inherent weight penalty when using laminated corrugated board for these surfaces.

Before actually making the units I decided to experiment to see how Rohacell foam could be shaped and glued. It works in a similar way to medium hard balsa and can be cut, sanded and planed (with normal modelling tools). It has a brittle strength but needs to be flexed further than wood before breaking, however, it has the advantage of being without grain. All normally used modelling adhesives were tried, including polyester resin and successful results were achieved in all cases. I have yet to find a solvent.

The tailplane and fin are made up from Rohacell with 1/4" balsa framing added. The assembly was glued to the underside of the fuselage, the join being strengthened by keying in the under fin tail skid.

Rudder and elevator were both made from Rohacell, and when completed the tail surfaces were carved and rounded to an aerofoil shape.

Wings

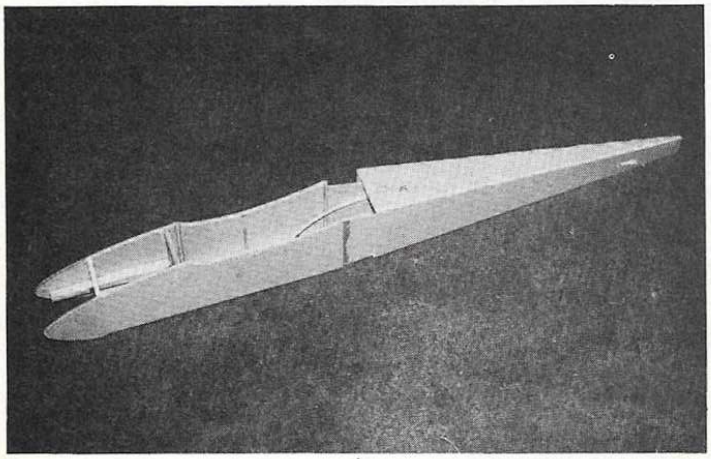
Previous all-cardboard wings had proved effective but somewhat heavy, so in an effort to achieve a lighter structure this time I used a combination of Rohacell, balsawood, and plain card.

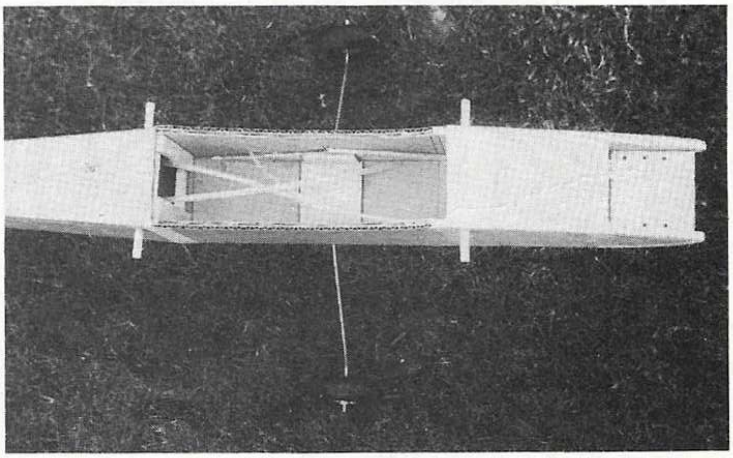
Ribs were cut from 1/4" Rohacell, 1/4" sq. balsa was then used for top and bottom main spars and also shaped as a leading edge section. The main spar was 'webbed' along its full span with plain card. This resulted in a strong but light core for each wing.

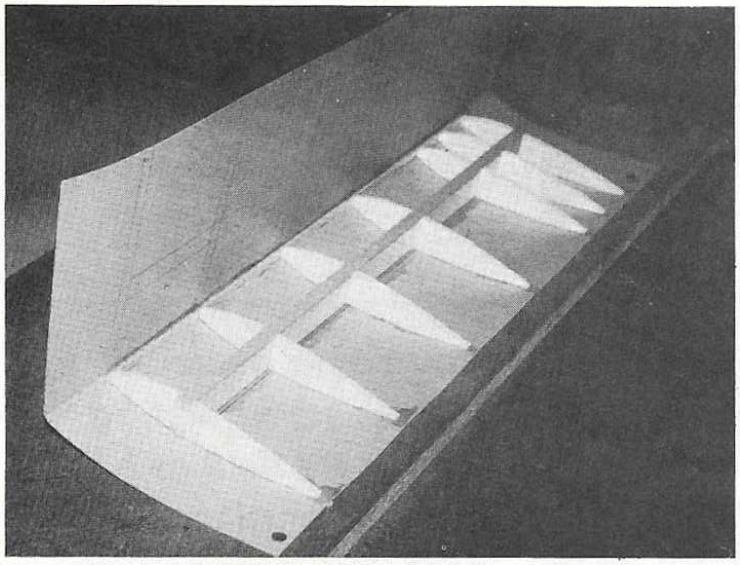
Plain card was cut to size to enable complete envelopment of this core, but before proceeding further the leading edge area of this piece was soaked in water then 'rolled' to give a smooth radius for the leading edge. Once this stage had been completed the positions of main spar and ribs was marked out and contact adhesive painted on the underside of the wing cover and rib/spar assembly. The two pieces were bonded, and adhesive painted on the inside of the upper surface which was in turn bonded.

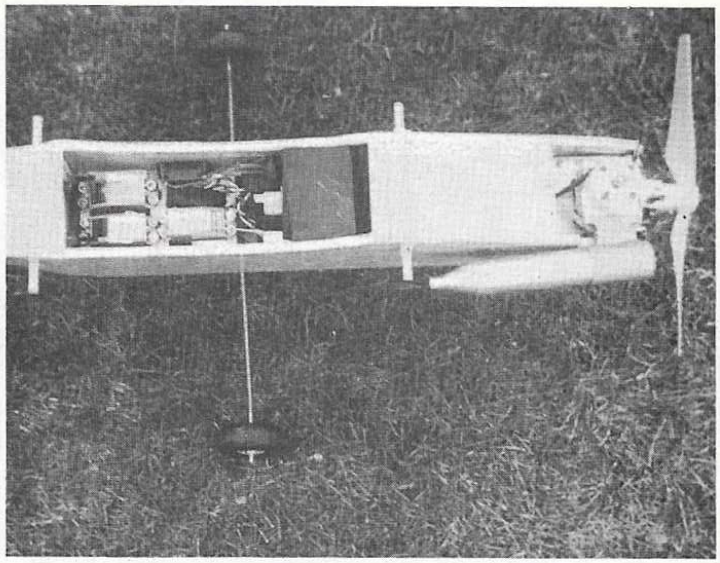
A small gap was left along the trailing edge between top and bottom skins which was sealed with strips of 1/8" × 1/32" balsa, the join finally being covered with masking tape.

Having completed both wing panels, the root ribs were chamfered, 1/8" plywood dihedral braces inserted at leading edge and main spar positions, and joined with five minute epoxy resin. Finally a glass reinforced polyester bandage was placed around the root section and Rohacell tip blocks added. *(A confirmed belt and braces man Ed.)*









Above: Wing core about to be hidden for ever more. Card skin is rolled around the Rohacell/balsa core and fixed with contact glue. Above right: plenty of space for three Futaba 'M' series servos, etc. Ni-cad is below the tank up front.

Covering

A standard heat shrink film was used and this 'took' extremely well over both types of cardboard and over Rohacell surfaces.

Trim was applied, cut from the same material, and transfers fixed. All joins, transfers and trim edges were sealed with Tufkote, as were the engine and tank bays.

Weights of the model before and after covering were:-

	Before	*After*
Fuselage and Tail	20.5	27
Wings	*15.5*	*18.25*
Total	*36.0 ozs*	*45.25 ozs.*

Engine and Radio Installation

This seemed to be an ideal opportunity of evaluation of the Cippola 25 engine performance. Manufactured in Italy by Motori Cippola of Milan it is well made, with twin ball race crankshaft bearings. At first I was a little concerned, because the prop driver only has a small locating stud for the propellor which is retained by a 5mm bolt, however, in practice this has proved entirely suitable and has withstood some quite 'vigorous' handling. The choke tube (venturi) orifice seems rather small for this size of engine, but is adequate in practice. Sufficient power is generated for any general sport flying and the engine has proved responsive to throttle and very quiet when fitted with manufacturer's standard silencer.

A 9″ × 4″ glass reinforced nylon propellor was used and the engine was mounted on hardwood bearers using an alloy plate.

My trusty Futaba gear was transferred, yet again, from another model and installed without difficulty on ¼″ sq. ramin servo rails supported by ½″× ¼″ balsawood bearers glued to the fuselage sides. Nylon/polyethylene rod in tube control runs were used for rudder and elevator with a Bowden cable linkage for throttle. Control deflections at the trailing edge were set up as follows:

Rudder ± ⅝″
Elevator ± ¼″

The completed model weighed 4lb 3½ ozs ready for flight.

Flying (by Bill Burkinshaw)

With the engine on full song, the model was released across our patch only to come to an abrupt halt when it reached the long grass at the edge, still attached to terra firma. Muttering imprecations about the unreliability of those club members whose turn it was to cut the grass, we picked up the model and returned to base for a re-start. Two obvious solutions were a hand launch or a mower. A hand launch was chosen. Chris accordingly flexed his arm muscles, picked up Boxer, paced a few brisk strides and away Boxer flew. After a few steady circuits making the very minor trim adjustments necessary a few tentative aerobatics were attempted. Despite the pre-flight confidence, those cardboard wings produced a feeling of caution I have not felt whilst flying for quite some time. As confidence was gained more ambitious manoeuvres were attempted and I soon found myself flick-rolling and full-power spinning Boxer in just the same way as with the original balsa version.

The model handles in a very positive manner right down to stalling speed. The stall is positive and good stalled turns can be achieved with ease. Flick rolls need a little practice and are best performed by firstly initiating a slight turn then immediately giving full opposite rudder and full elevator. If the controls are not neutralised before the model has fully rotated there is a strong possibility that Boxer will enter a 'power-on' spin. This is easily stopped if sufficient height is available by neutralising the controls. By entering the flick roll whilst climbing a violent horizontal spin results with the model flailing around the sky in a most impressive, and safe, manner.

Conclusion

A quick build model in either cardboard or balsa versions, this one took a week-end to build, plus a few evenings to finish off and cover.

The performance is much more aerobatic than first appearances may lead you to believe and would be a good design for anyone with only three function gear, wanting to enter this side of our hobby, or as a fun machine for the more experienced club flier.

All-in-all, a most enjoyable model to fly; but not for the novice. The model is aerobatic at the expense of stability, and whilst it will dawdle round the sky on tick-over, heavy handling will result in a spin. Do not exceed the stated control throws, and when making the first flight remember, the name of the game is *Proportional Control*. Only move those control sticks as much as necessary!

Below left: Cipolla 25 provided adequate power for BOXER, quiet too. Below: Chris Pinchbeck prepares to fire-up BOXER for the maiden flight. Grass probed too long for the take-off, however.