BUILD RECORD FOR AN IVAN PETTIGREW MOSQUITO 600

PART 2 – WINGS AND NACELLES
By Martin Hardy

INTRODUCTION

This article is intended to assist builders of the Ivan Pettigrew designed Mosquito 600.

Due to the size of the file, Part 2 has been sub-divided into:

- Part 2A – Wings
- Part 2B - Nacelles

Photos are of an actual build. Where this deviates from the original plans, I will endeavour to make this clear in the text. Main changes are in the method of driving retracts, the use of brushless motors and associated Electronic Speed Controllers (ESCs), and Li-po flight battery.

Photos are placed below the associated text.

Further information is available in the instruction sheet given out by Ivan with the plans, and wing building notes on the plan itself.

May I suggest that you take your pristine plan to a local copy shop and get a couple of working copies from it. Use one copy to build the model over, and the other to cut out the component outlines. These can then be lightly glued (I used Spraymount or similar cheaper spray glue) onto the sheet balsa etc. then cut around the outlines to make the components. At the end of the process you can bin your wrecked copies and retain the original for any future repairs!

Build start 14 March 2014

WINGS

The wing build started by making a kit of parts as shown below. As the plan was hand drawn, there was a certain amount of 'guesstimation' involved where lines had become thickened on the drawing. This is normal with older drawings, so I erred on the generous side – it is easier to sand a bit off later than to try to add it on!

It is worth noting at this stage that the wing rib drawings do not include:

- Holes for aileron snakes;
- Cut-outs for the secondary spars.

I decided to make oversize holes for the aileron snakes in one wing only so see if this was easier than cutting them later. As it turned out, either method works alright.

Next I made up the main spar. I tried using fairly hard balsa sheet that had been stored for some time. Although the sheets were straight and true before I cut them out, very soon after cutting they took on a bend and resembled a banana. These were binned and re-made with newer balsa which remained true.

The plan needed to be very carefully secured to the building board. The spar is so long that it was necessary to use a long straight-edge to check that the lines on the plan were in fact straight and not pulled out of true by the length of the paper.

The balsa components were aligned, glued and pinned over the plan and then the strips were added to the rear face. I used straight grained spruce here, as it was successfully used for years in full size glider construction. PVA glue was used as the spar needs to be able to take bending loads without the glue cracking up. This was left to dry overnight, the spar was then unpinned and checked for straightness. The strip was then glued to the front face, clamped in position and again left to dry overnight

.
The spar was lightly sanded top and bottom to remove any extruded glue from the joints, before it was pinned it vertically over the plan ready for attaching the ribs.

Any dimensional vagaries in the sizes of the ribs were left alone at this stage, to be sorted later with a long sanding block.

Also noted here was the need for adjustments to some cut lines for the ailerons, as shown below.

The upper and lower trailing edge (TE) components for both wings were cut out from sheet balsa. Stock trailing edge section was cut down to make the 1/8 x 3/8 tapered insert.

The lower TE sheet was placed in position and raised to the height of the ribs with packing pieces. The ribs were then glued to the TE sheet….

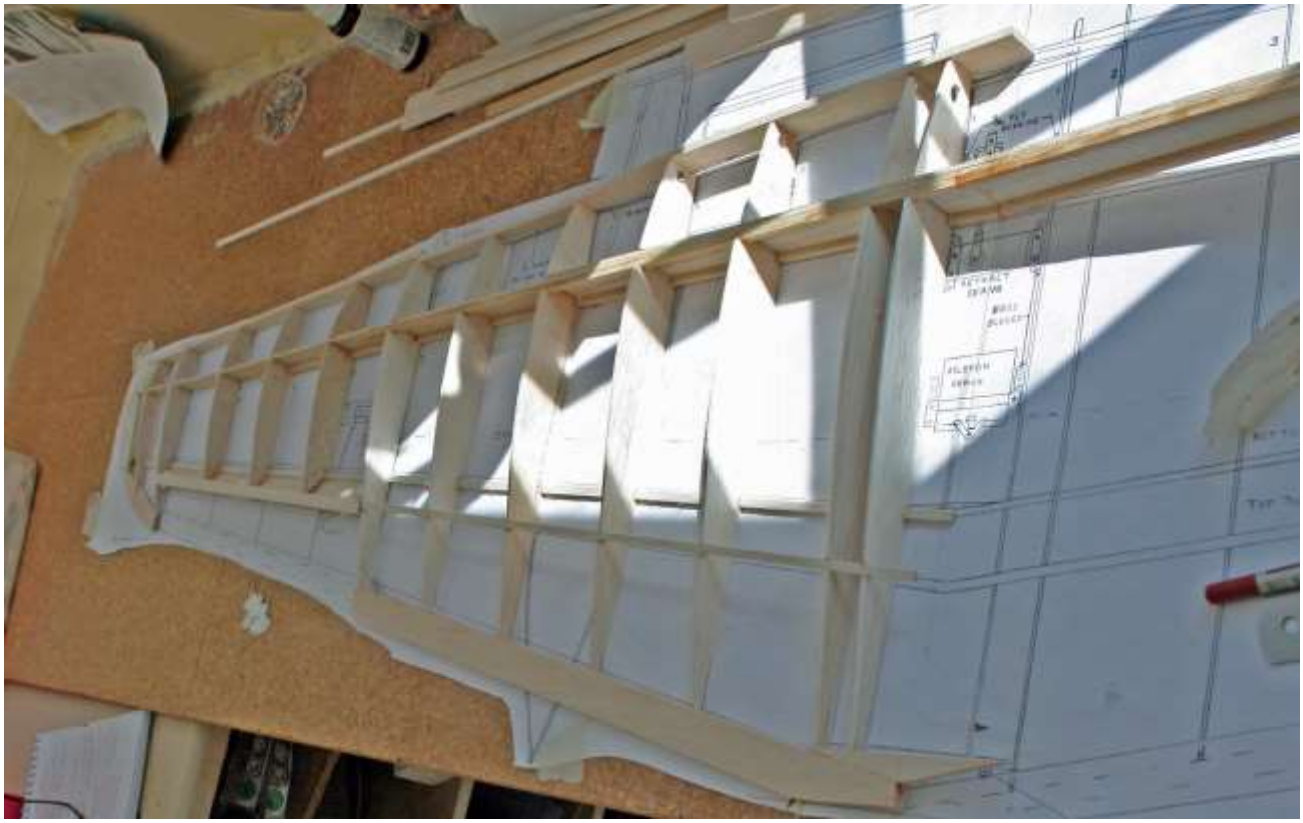
… followed by the tapered strip.

At this point it was noticed that the lower TE sheet needed to be champhered to allow the top TE sheet to follow the curve of the ribs. This entailed the unpinning of the wing from the plan and placing it over the edge of the bench before sanding with a block.

After repositioning the wing on the plan, the aileron was cut free.
Note: it was found to be easier to build up the aileron as shown later.

The sub spars were then added, followed by the sheet at the aileron cut-out. The depth of cut for the sub-spar slots was marked onto a razor saw using masking tape, to make accurate cutting easier.

The following photo shows the wing with sub-spars and aileron cut-out sheet added.

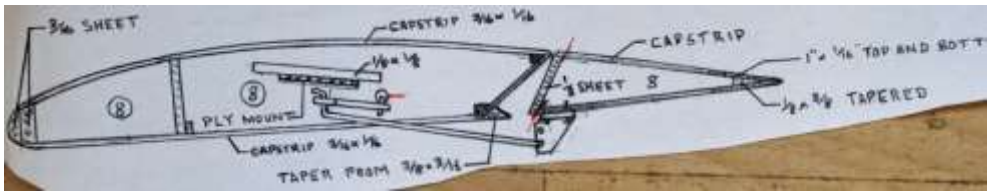


Aileron hinges were then inset into the top spar, aligned with piano wire and straight edge and epoxied in position.

The inner leading edge (LE) sheet was then shaped and fitted. Note the difference in height between the wing inboard and outboard of the nacelle position. Also note the step where the NACA cuff starts.

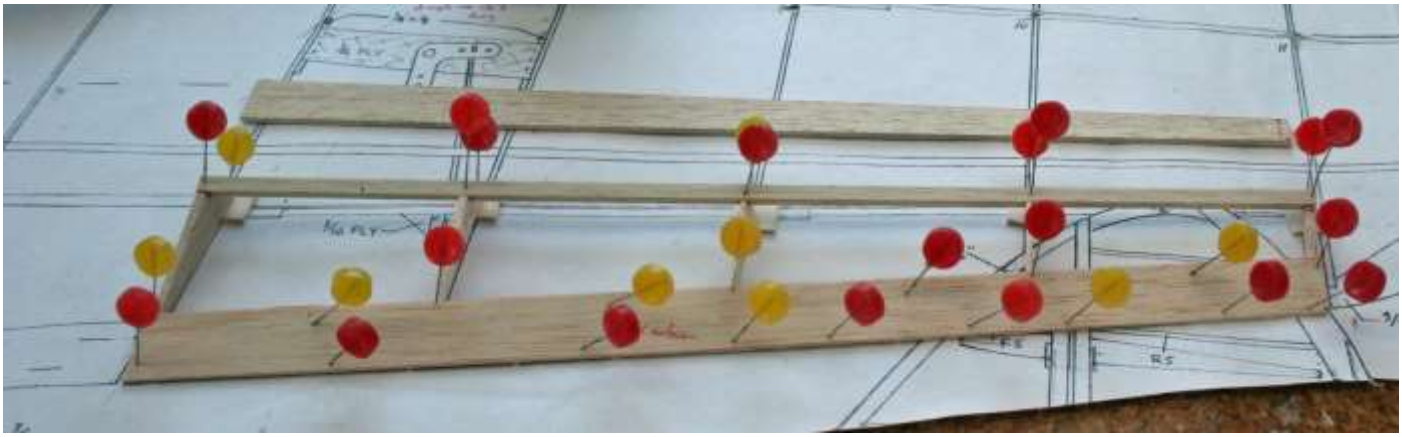
Ailerons

Aileron components were made next, with the aileron rib size derived from the Rib 8 drawing (below) and the main wing drawing.



Components were then pinned over the plan with packing pieces under the front of the ribs, and glued.

A top strip (not shown on the plan) was added to match the sub-spar on the wing to make hinge attachment easier.



Then the front sheeting was shaped and glued in place.

Finally the hinges were assembled, the hinge points protected from glue with a film of oil and the aileron attached with epoxy.

When the epoxy had set, the aileron hinge pins were withdrawn and the aileron removed to a safe place.

Wing Fettling

Wing ribs and LE were then lightly sanded to shape using a long sanding block (150 grit sand paper held onto a flat wood board with double-sided tape). Ribs heights were checked with a straight edge.

Both wings were carefully examined for anomalies and these were sorted before the D-box was sheeted.

The following photo shows the wing awaiting front sheeting.

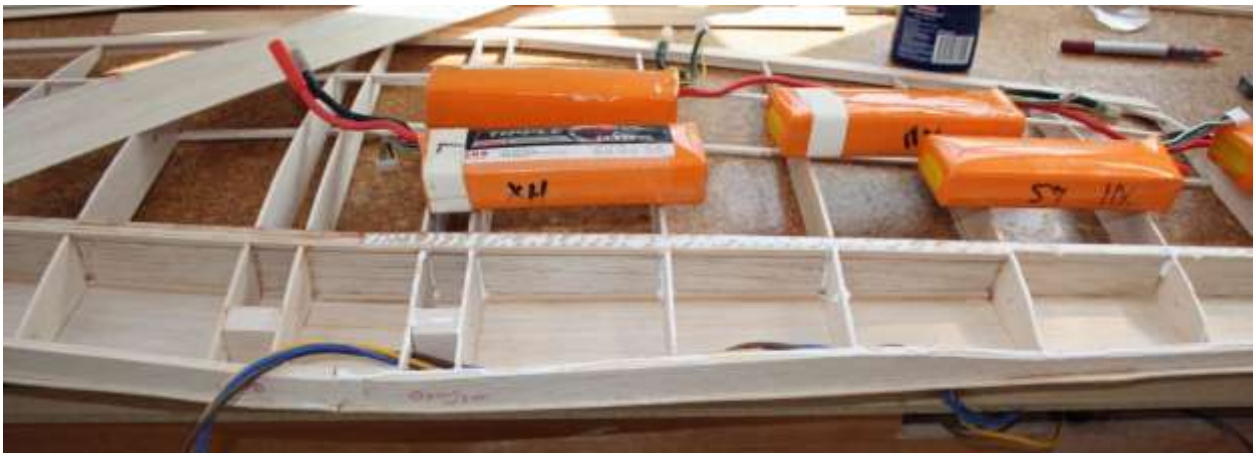
Front Sheeting
The lower front sheeting was marked up for a cut at the step in Rib 7.

The LE sheeting was attached using PVA glue, with occasional tacks of cyano to hold it in place while drying. TE section stock from the spares box was used to support the sheet under the LE.

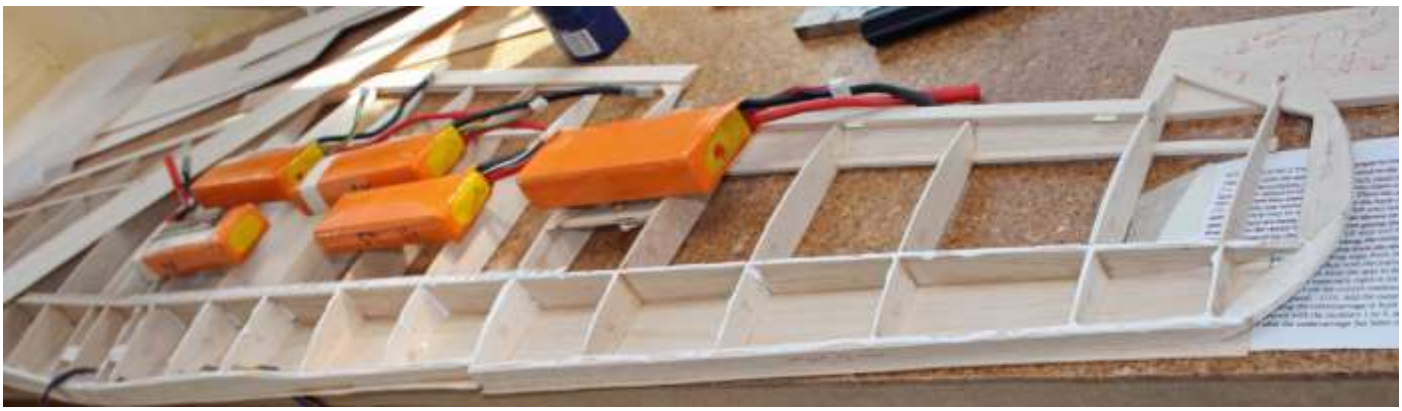
The cut in the LE sheet is seen here, allowing the sheet to follow the different curvature of adjacent ribs.

The lower LE sheet was fitted to the second wing, then three motor wires were fitted from the centre section to the nacelle positions on each side.

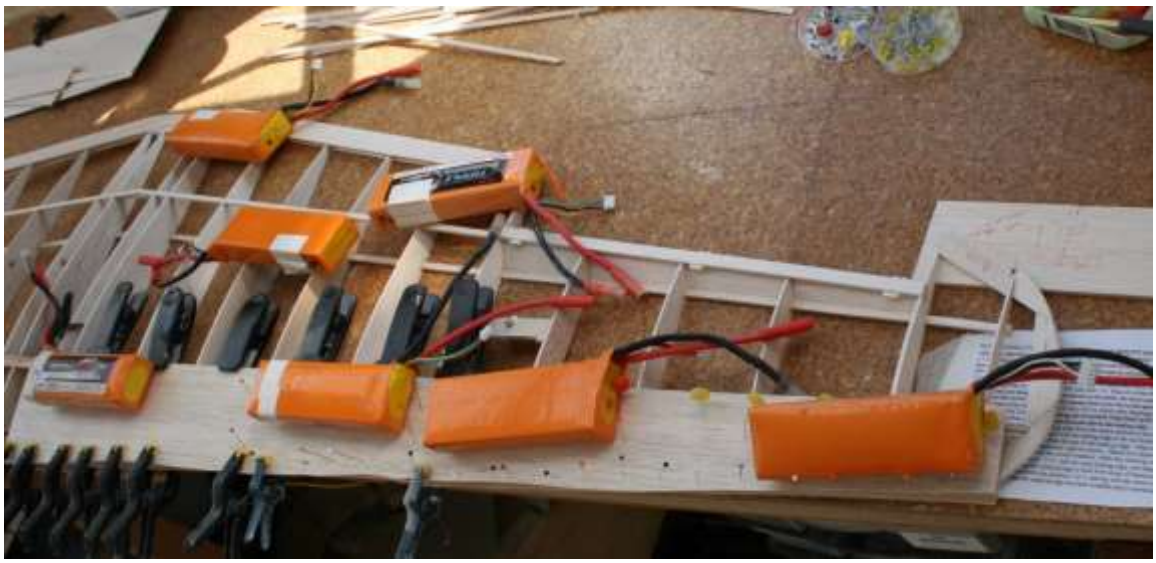
Balsa blocks were added between Rib 1 and Rib 2 at the front end to support the wing mounting dowels. Holes will be drilled for the dowels after the LE is completed and the wing offered up to the fuselage. The blocks are needed to support the dowels as with the top sheet already added it will be difficult to align the dowels with Rib 1 and apply glue as shown on the plan.



The wing was weighted down and the tip trailing edge raised to give the required washout…..



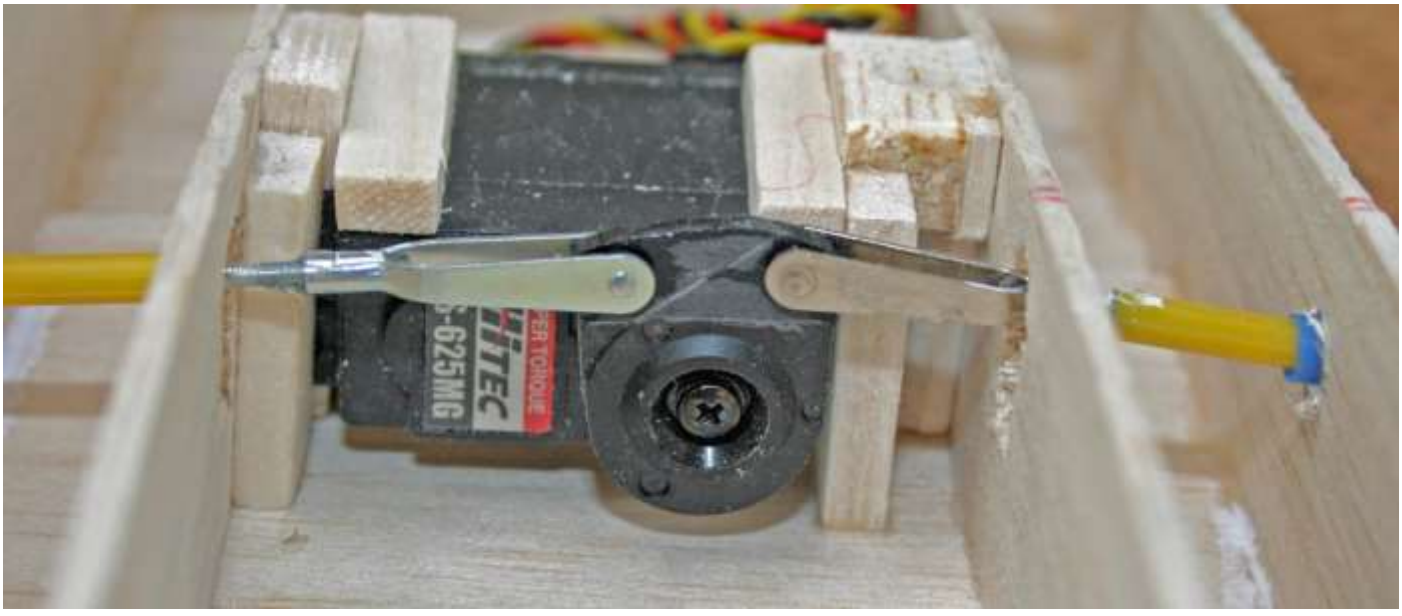
….. before the top LE sheeting was added. Spring clamps liberated from trouser hangers were useful here.



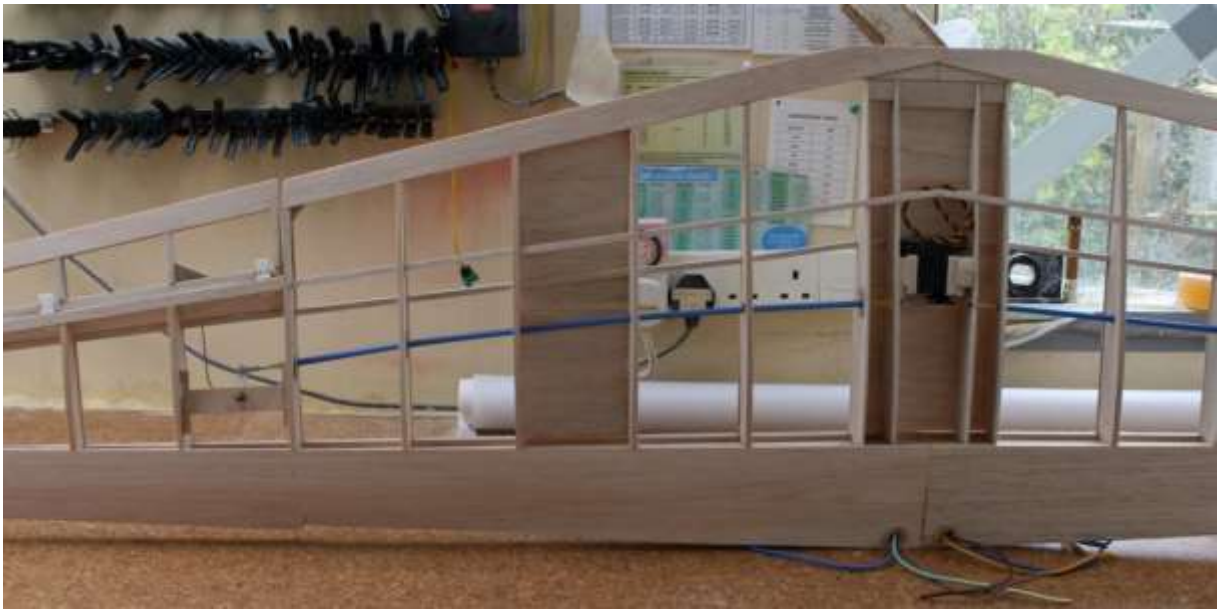
A hole was added in the centre section sheeting for the motor wires to exit upwards and at the nacelle position for the motor wires to exit downwards.

This was repeated for the other wing, resulting in the wing as shown below.

Aileron Servo and Connections
The aileron servo arm was cut from the large disk supplied with the servo, so as to give differential movement at the ailerons. The servo was fitted in position and slots were cut in Rib 1 to accommodate the vertical movement at the snake ends. I tend not to use the anti-vibration grommets when fitting servos to electric models – I don't expect them to vibrate!

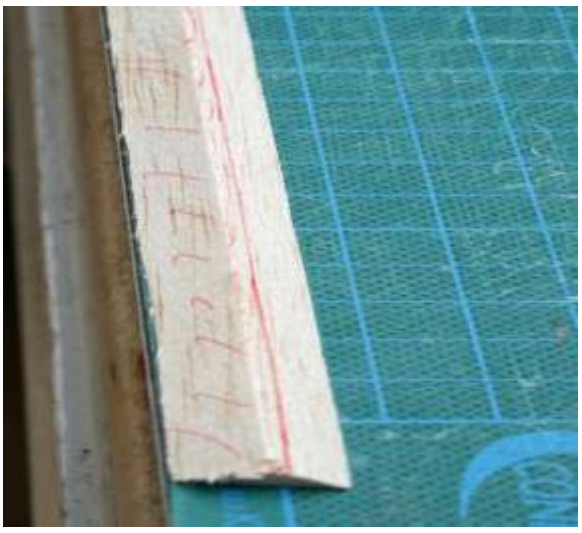


Snakes were fitted in position, using squares of 0.4 mm ply at each rib to support the snake outer. Each snake outer was bonded to two of the ribs, using epoxy.



The ailerons were then fitted and hinge pins inserted. Cocktail sticks were epoxied into holes drilled through the aileron hinges to pin the hinges in place. These were then cut off and sanded flush.

The shaped strip under the aileron hinge line was made up from triangular strip and glued in place. Clearance with the aileron was checked over the full aileron movement.



Aileron linkages were adjusted to give correct deflections at full servo travel.

Wing to Fuselage Fittings
The wing was then offered up to the fuselage and minor adjustments made to the wing seat. When this was completed, the wing was clamped to the fuselage and checked for alignment. Holes were then drilled for the wing securing dowels, taking care not to drill beyond the rear face of the wing LE as this could damage the motor wires.

As the holes turned out to be below the centre line of the LE, an extra reinforcing plate of 1 mm ply was added to the LE, extending out 10 mm beyond the dowel holes.

Lengths of dowel were then cut and checked for a tight fit in the wing LE holes. One end of each dowel was then sharpened (with a pencil sharpener) to a point, so that when the dowel was finally inserted it could be pressed into the balsa block between Rib 1 and Rib 2 (added earlier). This was in lieu of the glue joint to Rib 1 shown on the plan.

PVA glue was applied to the LE holes and to the pointed end of the dowels. Dowels were then inserted into the wing and pressed firmly so the pointed end entered the balsa block, thus supporting the rear of the dowel and preventing it from twisting.

Finally, the dowels were cut to length in front of the LE and chamfered (with the pencil sharpener) to ease insertion into the fuselage fitting.

At the TE of the wing, the holes for the wing securing screws were drilled and captive nuts (T nuts) fitted and secured with epoxy.

The intention is for the aileron servo and retract wiring to connect automatically as the wing is fitted, using a fixed Multiplex (MPX) 6-pin connector. I have used this method regularly on other models and it has proven fuss-free and reliable. Two further free (i.e. not fixed) MPX connectors will be used at the front of the wing to connect the motor wires to the Electronic Speed Controllers (ESCs).

Wiring Diagram
I decided to dispense with my normal Eneloop 2000 mAH receiver battery to save weight, and to use the port ESC's battery elimination circuit (BEC) to power the receiver. The receiver then supplies power to the rudder, elevator and aileron servos.

The retracts are powered by the starboard ESC's BEC. This ensures that if the retracts become jammed, the receiver and flying controls will not suffer a loss or reduction in voltage. This is especially important should the model hit a bump and have its undercarriage bent during take-off.

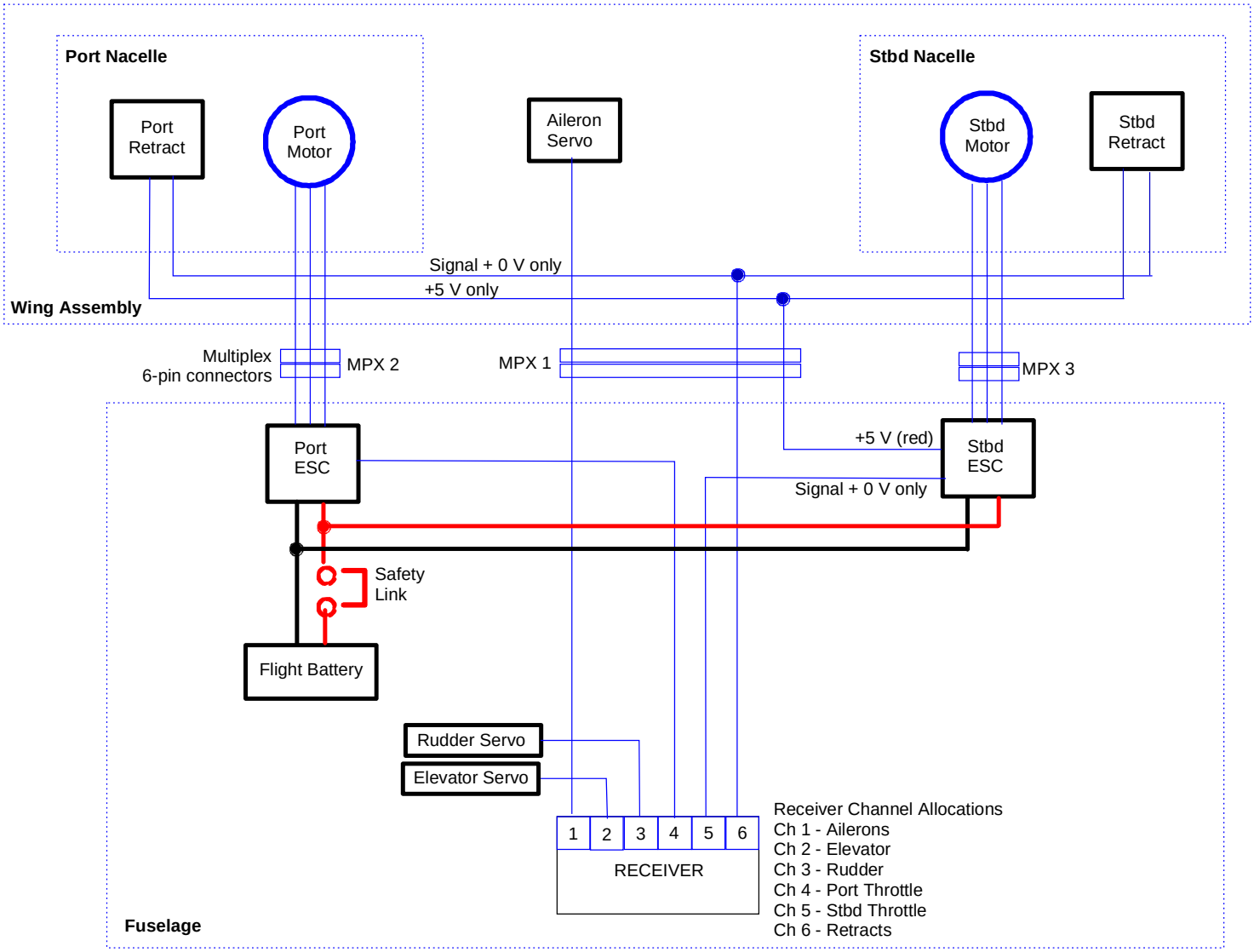
The above is achieved as shown in the wiring diagram:

- The port ESC is connected to the receiver as normal.
- The starboard ESC has the red wire removed from the receiver connector.
- Retract servos have the red wire removed from their receiver connectors.
- The red wires of the starboard ESC and retract servos are connected together to provide the power to these servos.

The important point to note here is that all common (black –ve) wires connect directly back to one common point i.e. the receiver –ve bus bar. It is imperative that the black wires are not connected in a loop, as this could result in a 'ringing circuit' with unpredictable and very undesirable results for the control of the model.

The principles outlined above can be expanded still further in models with long wiring runs between receiver and servos. My HP42 (four engine 1930s biplane airliner) has the ailerons in the upper wings powered from the adjacent motor's ESC, the receiver from an NiMH battery and the opto-isolator from a second NiMH battery. This model has been operating for years on initially 35 MHz and then 2.4 GHz with no glitches.

MOSQUITO WIRING DIAGRAM



Multiplexer Connector Pin Allocations

MPX 1

Pin 1 - Retract Signal
Pin 2 - Retract 0 V
Pin 3 - Retract +5 V
Pin 4 - Aileron Signal
Pin 5 - Aileron 0 V
Pin 6 - Aileron +5 V

MPX 2 & MPX 3

Pin 1 & 2 - Motor 1
Pin 3 & 4 - Motor 2
Pin 5 & 6 - Motor 3

NOTE:
Red wire (+5V) is removed from the stbd ESC receiver connector.

Stbd ESC +5 V output powers retracts - wire removed from receiver connector provides Retract +5 V at MPX 1 Pin 3.

Receiver is powered from the port ESC.

Flight battery for initial flight testing will be a 3S 4500 mAH lipo.

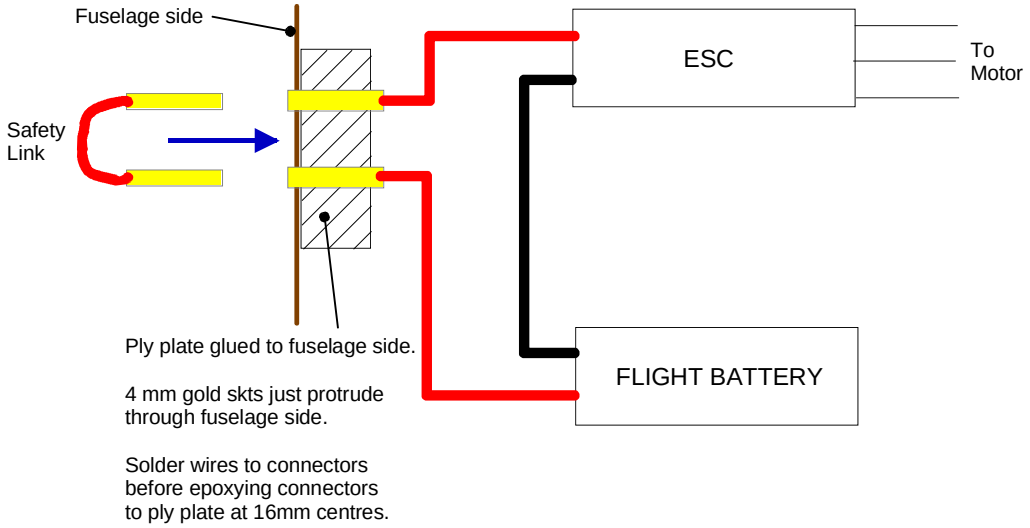
Safety Link

The Safety Link shown in the wiring diagram (and below) comprises two 4 mm gold sockets mounted into the side of the fuselage, and a link made from two 4 mm gold plugs and a short length of battery wire. . One 4 mm socket is connected to the positive wire to the ESC, the other 4 mm socket to an additional red wire and connector going to the flight battery positive.

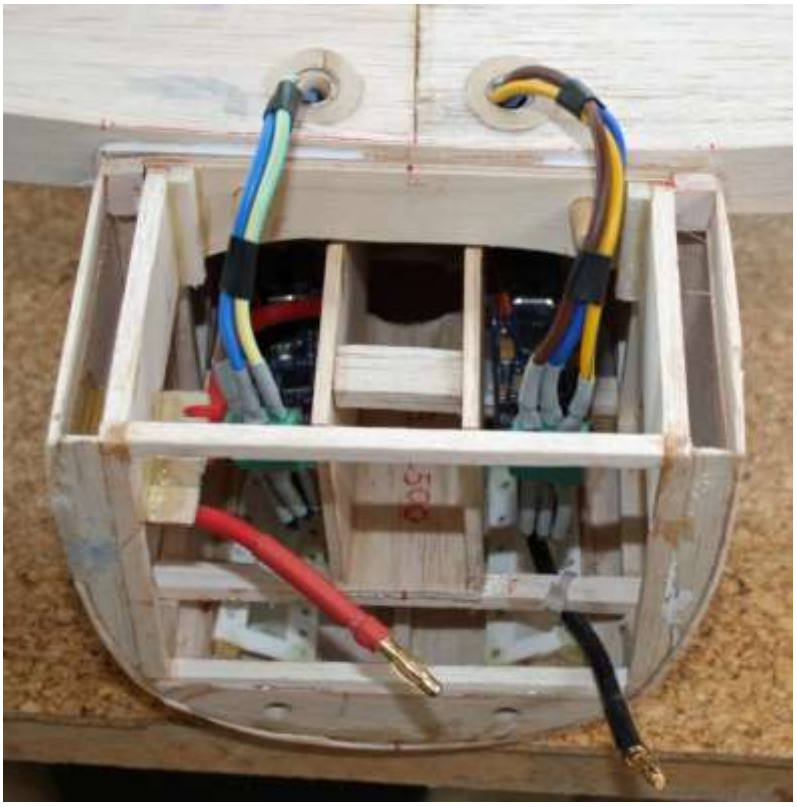
This arrangement allows the flight battery to be fitted and connected to the model without the ESC becoming live until the link is fitted. It is especially useful in models where a wing (or in this case a nose section) have to be fitted after the flight battery is connected up.

In use, the model can be carried to the take-off position in complete safety, even with the Tx switched on. The Safety Link is then fitted, powering up the ESC.
On landing, the Safety Link should be removed, rendering the model safe to carry back to the pits.

Provided you always set the 4 mm sockets the same distance apart, one link can be used for many models. My links have the 4 mm plugs spaced at 16 mm centres and are made in a jig comprising two vertical 5 mm holes drilled in a wooden block. This holds the 4 mm plugs in the correct position during soldering.



ESCs Positioned in Fuselage
The battery position (centre) and port and starboard ESCs are shown below. The ESCs are placed above the air intakes for maximum cooling. The MPX connectors between the ESCs and wing wiring to the motors are partially obscured by the balsa cross-piece – sorry.



The red (positive) battery lead connects to a 4 mm gold connector of the Safety Link assembly. The link plugs in to the fuselage side from the left of picture.

Rear MPX Connector

The MPX connector for aileron and retract connections at the rear of the wing is shown below. It is secured by epoxy between two ply cross-pieces and protrudes slightly below the underwing sheeting.

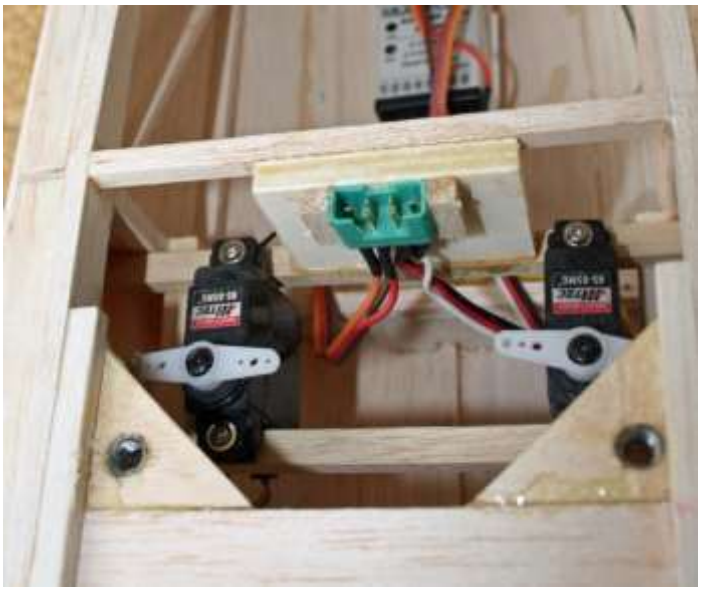
The fixed plug in the fuselage is epoxied onto a piece of liteply fitted to a servo rail and existing balsa cross-piece.

To obtain the correct alignment, the plug was mated with the wing socket, the wing fitted in place and the liteply plate aligned as closely as possible. When the liteply was glued in place, aluminium foil was used between the wing and liteply plate to ensure the wing did not get glued to the fuselage.

A small amount of epoxy was then spread onto the (roughened) surface of the MPX plug facing the liteply, and also onto the liteply. The wing socket surface was protected from the glue with a thin smear of oil. The wing was then secured in position until the epoxy had cured.

The wing was then gently removed, leaving the MPX plug glued in the correct position. Two short lengths of square section hard balsa were then epoxied at the ends of the plug to reinforce the joint (as shown below).

Finally, a sharp knife was used to round off the square internal edges of the plug's plastic shell to make connection with the wing socket easier.



Wing Leading Edge Extensions
The wing was re-fitted to the fuselage and used as a jig for fitting riblets 2N.

The riblets seemed to be the wrong size – much smaller than the height of the LE they were to be attached to. I then realised that they were to be sheeted top and bottom, with the sheeting flush to the top and bottom surfaces of the existing LE. A piece of 1/16 balsa sheet was used to ensure the correct spacing between the top and bottom of the rib and the existing LE.

Riblets 3N and 4N were then fitted aligned with ribs 3 and 4 (red marks in photo).

The wing was removed from the fuselage and the inner leading edge and lower sheeting fitted…..

…followed by the top sheet and outer leading edge. The outer leading edge was made from LE stock.

Cockpit and Canopy

With such a large canopy, some token effort was called for to fill it. The bought-in Traplet canopy (details in Part 1) fits well after trimming and was of good quality.

The position of the canopy was determined from the plan, centre lines were drawn and the canopy placed in position over the nose section. A line was drawn around the outside of the canopy and the canopy removed. A cut-out was then made for the cockpit 3 mm inside the canopy shape to give a good glue area.

The wing was fitted to the fuselage, then the nose section adjusted to fit snugly over the wing. Positions of motor and battery wiring were noted, as space has to be left for these underneath any cockpit detailing.

A 1/16" balsa cockpit floor was fitted as low as possible, from the rear of the cut-out forward to just short of the instrument panel position.

Google images provided lots of cockpit layout information. This was used to position two 1/10 scale WW2 pilot figures (from Kings Lynn Models £5.99 each – bargain). The pilots' legs dangle over the front of the cockpit floor – the navigator was not so lucky! A bit of surgery with a junior hacksaw was necessary to make him fit.

Seat backs were made from litho plate. Radio and instrument details were downloaded from the internet and re-sized. The radio is a block of blue foam, painted and with the front panel detail pasted on.

The canopy edging and framing was made using adhesive backed aluminium tape (ex B & Q), which was then painted to match the fuselage colour.

Paints were Hobby Flight enamels sourced from Kings Lyn Models. This paint is easy to apply by brush (or can be sprayed), covers well and dries in minutes. Recommended.

Details of the nacelle build and any adjustments or alterations needed to set the C of G etc before flight will be covered in the final instalment – Part 2B.