Escape

A 1600mm span EPP slope soarer

Escape ? Named simply because it provides an excuse to get away from the family for a while and the pressures of work and go and have some fun on windy hillsides !

The techno stuff

I recently found a picture of a very young looking me flying a Chris Foss'Phase 6 when the kits were first released. Since then there have been long periods when I did no RC because of work commitments. Of late I have been flying and designing large scale electric powered aircraft and EPP and depron foamies, and then a friend re-introduced me to slope soaring and I designed a flying wing for him (see Streaker on RCGroups). This stirred my slope soaring interest once again.

I love rolling along the top of a ridge or cliff face and doing close up aerobatics in slope lift. This requires a model with an ability to float, good penetration and good control even at lower speeds – my lifetime mantra has been build them light reduce drag and make the control surfaces large! All of this formed the background to my design thoughts – oh and yes EPP is very forgiving I have got several beaten up foamies to testify to its durability. I made a depron slope soarer recently and it flew well enough, but a couple of firm landings quickly exposed depron's brittleness.

With a 2300maH 6volt NiMh pack, my Hitec Optima7 receiver and 4 servos the prototype weighed 19oz, and with a wing area of 610 sq ins (4.24sq ft) the loading starts at 4.5ozs/sqft. The AUW could be further reduced by using a smaller 4.5v battery, a lighter receiver, and lighter servos. I prefer to

have short pushrods so the tail servos are mounted very rearward and this is happily balanced by the 150gm battery, this arrangement would have to be altered if a lighter pack was fitted. I have marked the servo and battery positions on the fuselage plan as a guide.

By coincidence I had a 60mm thick 800x500 block of EPP and Escape's design was aimed at getting the whole model out of this and the fuselage shape was intended to provide side area to help with knife edge.

I hate plug in anything on models – they always come apart or get damaged, and since I tend to travel to fly in a camper van (the family have got used to sharing the camper with a scratch 34% electric Pitts S1C!) moving around with a complete model is no problem, so Escape's design is based upon a complete one piece build. (It actually fits into our small 5 door Vauxhall Corsa so isn't huge) The wings are joined using internal CF tube braces top and bottom glued in with my very favourite ultra strong and sticky Gorilla glue, and then the whole section is glued into the fuselage for additional support. The wings could be made so they can be removed if you prefer.

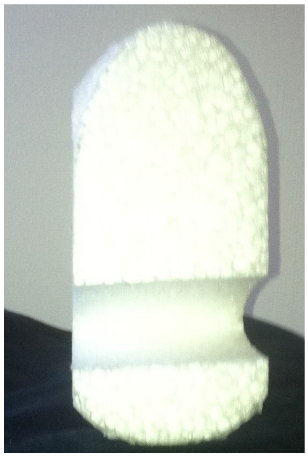
I have always fitted rudders to my models, how can you turn without adding a bit of rudder and anyway I like spinning, flick rolls and blenders so the design includes a fin & rudder. I decided to use airfoils rather than flat plates for both fin and tailplane, I am sure more orthodox flat plates or other airfoil sections could be used for both if you prefer.

After a long period of research I decided to use an Eppler 374 for the wing root and by removing the camber using the same section as a symmetrical tip but increasing its depth very slightly. This resulted from two write ups by sloping pilots extolling their virtues and Ive been flying a ¼ scale scratch Sukhoi SU-31 recently. It has a naca 0018 root and 0012 tip sections, both quite thick. It needs very little power in horizontal flight and can be a real pain to land because it glides for ever without any prop power loosing very little height. So I am a fan of thicker section airfoils, they can be very low drag. I know the Re no is higher on this scale plane but even so knowing how rough slopes can be on landing planes section depth can sometimes be an advantage.

Buiding it
EPP
I printed the plan and made card templates for each part to be hot wired from the EPP block. Ive made a bench hot wire system from designs shown in RCGroups. The EPP sits on a large flat surface with the wire vertical. It is easy to attach the template on the top of the EPP and then move the foam slowly to release each block.

I use 2mm Tufnol (phenolic resin reinforced with fibres) for my hot wire templates. Its easy to cut with a fret saw (one day I will buy a scroll or band saw) and sands easily so the wire doesn't stick. I haven't added lead in/out to the sections believing that most people have their favourite methods.

Fusalage



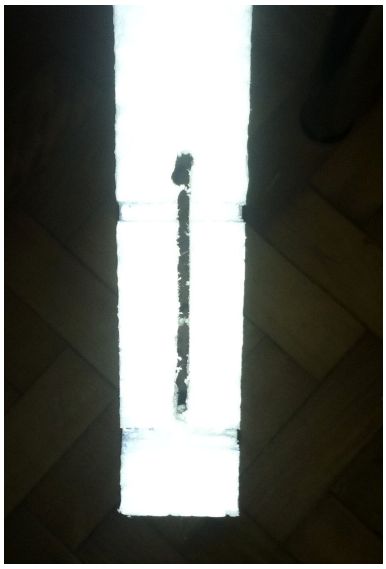
Once the two EPP lumps are available its time to shape the fuselage sections. I made a template for the vertical airfoil shape of the front section of the fuselage (up to the joint) – its based upon naca006 thinned a little and then with the tail widened to support the tailplane. The fuselage rear shape was cut with straight edge templates.

Again I made a template for the cross section of the fuselage at the joint and then used it as a guide to roughly shape the front profile.

The tail section profile I cut with a wire using the template at the front and a second one for the tail. These are both shown on the plan The top remains

flat at the back so some care is required so as not to damage this area with the hot wire. We used aluminium foil to provide a guard to protect the foam.

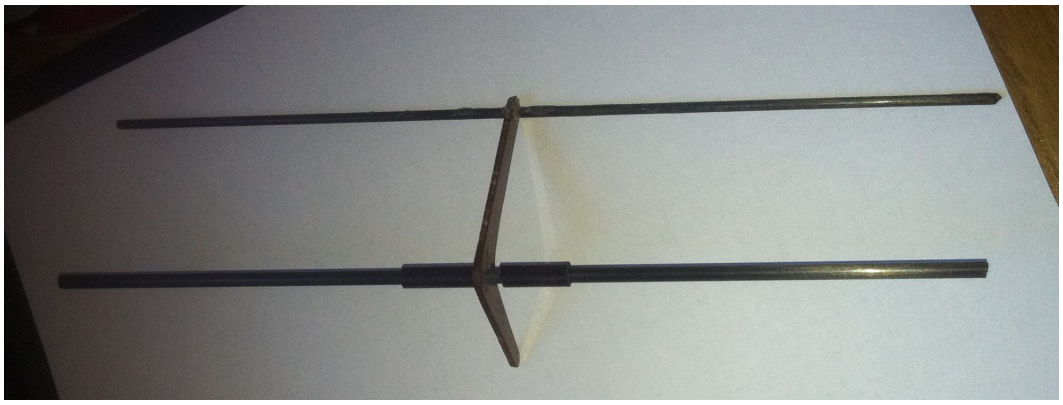
I tacked the 2 halves together and then got out the sandpaper to produce the final smooth shape.



Mark out and cut the pivot cut out for the all moving tail and the radial shaped path for the rear 3mm tube.. I actually used a template top and bottom with a 3mm wide slot to hot wire cut out the vertical slot for the tailplane mechanism, boring a small hole to feed the wire through first.

I glued two vertical pieces of 1x6 CF strip inside the slot at the free end to act as guides and to prevent any sideways movement. These have to extend up into the fin so make some provision for them before gluing on the fin.

I made the bellcrank for the tailplane from 2mm Tufnol, its tough and doesn't wear so the small hole for the pushrod remains the same size and round. Its worth checking with your servo that you get +/-15 deg of elevator movement with the bell crank arm hole positions shown on the plan.



250mm long 4mm OD tube and 3mm rod make up the moving support beams, with 2 sections of 6/4tube making up the bearings. I used my favourite Gorilla glue with a splash of water to secure the tube & rod into the bell crank making sure that all was square. When dry I cleaned up the excess glue and chamfered the inner bore of one end of each of the bearing tubes, just to give some clearance on the glued area. I put Vaseline on the 4mm tube where the bearings are running to prevent that embarrassing sticking of all moving tails !

Tailplane.

The section I chose was Eppler 474, quite thick at 14% with max thickness at 21.5% but this was an experiment to see whether this purpose designed aerobatic foil would give better elevator control than the ubiquitous Naca009. The target low wing loading was never going to make this glider a flying bomb and I have had success with thicker sections in the past. The root chord is 150mm and the tip 100. I have added my sketches for each airfoil template showing how I fixed them to the 60mm thick block ends.

I am afraid I went for the quick and easy method of securing the rods into the tailplane halves. I

marked them from the plan onto the EPP and then slotted right through the foam, removed the rectangular slices and cut out a slot in each for the rod and tube. I then glued the whole assembly back in the tailplane halves using Gorilla glue with both halves supported on the EPP outer shells that they were cut from to keep them at the correct angle..

Putting shrink film on both tailplane halves has mixed blessings it gave me some colour for orientation and also helped to reduce friction between the airfoil ends and the fuselage walls, but had to be put on cool else the trailing edge gets warped very easily.

I also opted for an easy pushrod removal system just in case and used a clevis with a screw up clamp for the pushrod.

Once dry and covered with film glue the bearings ad the whole assembly into the fuselage with UHU Por. Don't forget to fill in the top of the bearing slot

Fin and rudder

You will need to tack the two pieces cut from the EPP block together before setting up the 2 templates to cut the airfoil. I have used a naca1034 for this – max thickness aft to give the rudder some authority, and the top of the fin some strength.

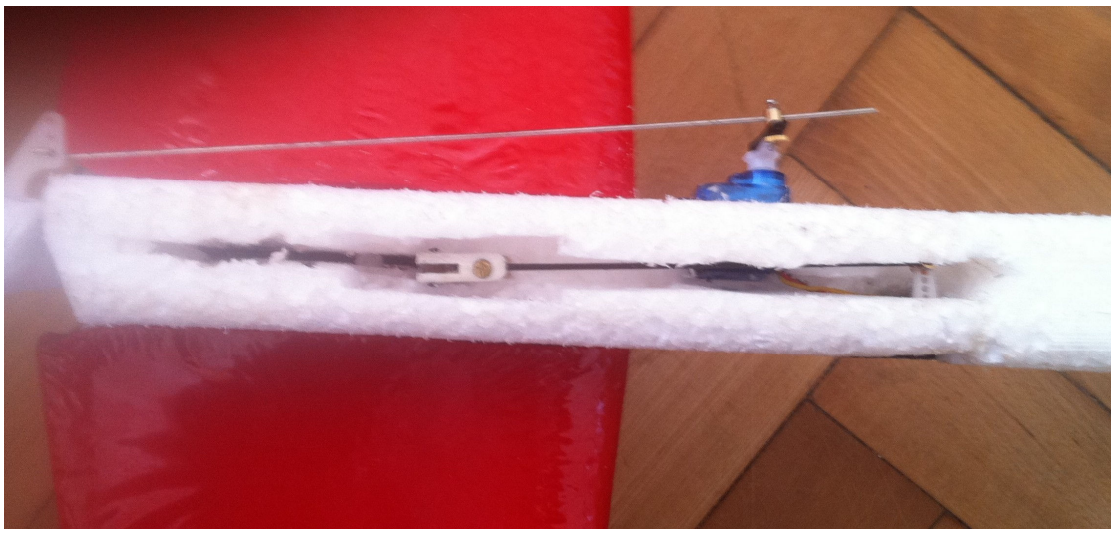
Once cut you can separate fin from rudder trimming the fin to height to fit on top of the fuselage and the rudder for some ground clearance.

I chose on this one to hinge with tape along the right hand side of the rudder and fit a hinge made from one side of an anti-static bag between the rudder and the fuselage aft section.

I wanted to see if a sealed rudder gave better response and to provide good support to the lower rudder.

I tend to extend servo wires myself, cutting off the plug and using 3 fine individual coloured wires soldered onto the originals at both ends. These wires can then be hidden/protected in shallow slots cut into the EPP. Small amounts of Por can be used first as a lubricant to gets the wires into the slots and later to close up the slots by pressing both edges together. On this model I did this for all 4 servos, leading the rudder servo wire through to join the elevator one in a common slot back up the fuselage.

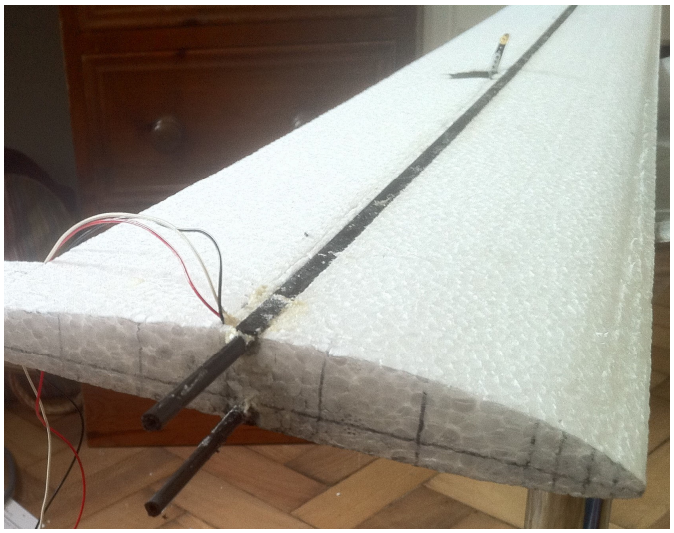
I used fibre reinforced tape to secure the outside face of the elevator servo to the fuselage, and to close up the bottom of the elevator system slot.



Wings
The tip section was set mid height of the root, and this is the layout used in the block drawing on the plan. I did not build in any washout, the tip section is 1% thicker than the root which has in my experience the same benefit. The wing has not displayed any horrible tip stalling yet when flying.

Initially I built the ailerons from EPP, with diagonal fibre tape and laminating film. These worked ok but I am currently trying several different aileron build techniques; at the moment they have an EPP foam core with 1.5mm balsa skins with diagonal fibre tape bracing and laminating film seem light yet really stiff. Next move will be to try light balsa planed to shape and covered with light glass cloth and CA, and then laminating film. Use your own preferred technique.

A hang over from large scale power I suppose but I prefer to have the aileron servos operating at mid span to minimise aileron twist under deflected load. The 2 servos were mounted directly into lined pockets in the wing, the wires extended & back to the fuselage in a small slot. I used some light weight carbon horns cut down – just because I had them.

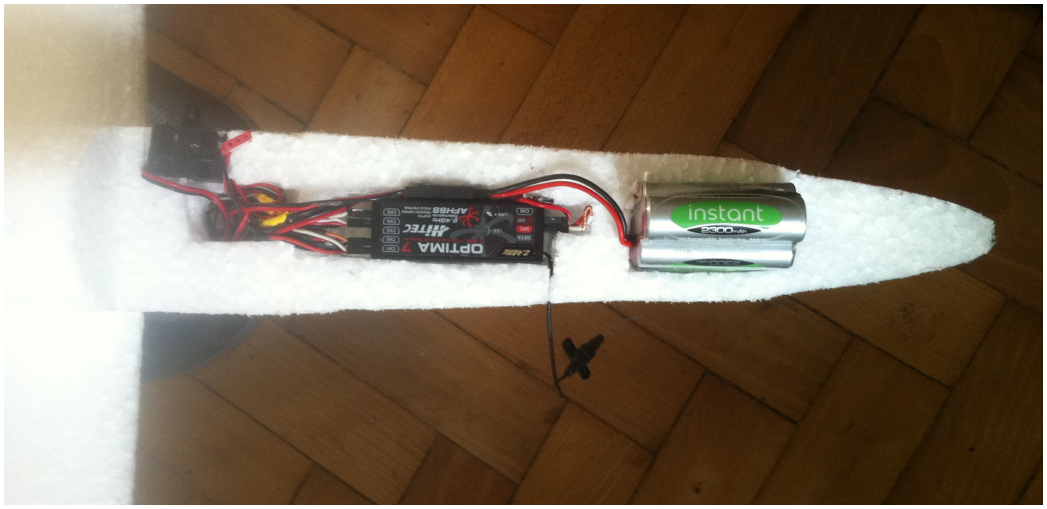


The 6x1 CF strip was glued into hot wired slots top and bottom of the wing using Por. Once both wings were assembled I fitted some 100mm long 4mm OD tube across the joint and glued one side in with Gorilla glue and water.

I used Por to join the 2 wing halves together and at the same time Gorilla glue to secure the 4mm tubes to the two 6x1 CF strips.

I decided that the easiest option to fit all the gear was to create a space at the nose. I cut a horizontal line to remove a section of the nose and created a cradle inside for the receiver and battery pack.

A short tunnel rearwards joined this location to the wing slot and allowed me to run the 2 aileron servo wires up to the Rx.A switch and pack charging lead were installed and then I closed up the front, glued it all together and added some fire reinforced tape to top and bottom for strength and something to land on.



Ailerons individually run from ch1 & 5 so I can try flapperon function

Gear
Servos
Calculated servo torques @ Wind speed = 45mph

Elevator	+/-15deg	9.7ozin	0.70kg cm
Aileron	+/-30deg	19.3ozin	1.39kg cm
Rudder	+/- 35deg	6.13ozin	0.44kg cm

Simply because I had them I used 3 x 14g Hextronic MG14 metal geared servo, 2.5kg/cm, 0.10sec/60degree at 6 v for elevator and aileron. The additional 15gm is offset by guaranteed power and speed. Personally I think metal geared servos are essential

The rudder is driven by a 9g ,1.6 kg-cm, 0.12 sec/60

I have been using a 2.4MHz Hitec Aurora9 recently and Ive fitted my Optima7 receiver so that I can develop flapperon function

The battery I used is a 6v 2300 NiMH 5 cell pack weighing in at 150gm, I hate being on a slope in a great breeze with lots of lift and worrying about when its going to run out of receiver and servo power, and I like the additional grunt provided by 6v. A smaller 4.5V battery would save about 80-90gms, but would require longer tail pushrods because the two servos would need to be further away from the tail, so it is as always a balance.

CG
I have a rather individual flying style, honed over many years of practice, crashing and model abuse. I tend to use big control surfaces, large movements supported by dual rates when more précis flying is required, no expo and I like the response from a responsive CG. I am not the greatest aerobatic pilot but I do have a lot of fun trying !

The plan shows a range of CG positions , the rearward one provides 5% static margin and it seems to fly ok at that balance point (121mm rearwards from the wing leading edge)

I have not explored the complete envelope of this beast and I am sure there will be further modifications and changes as time goes on please try it out see what you think.

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