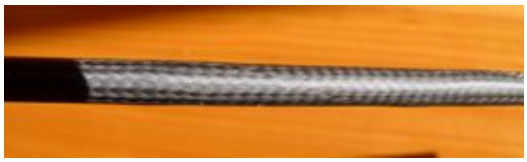
Marston Pterodactyl - Build Log - Part Three

Then get to it with the paper towel. This takes off some excess epoxy and further works the epoxy into the sock.

On with the heatshrink and out with the heat gun.



If you look at the correct angle at the finished tube you can see the weave of the CF sock.

And this is the end view of the final tube. If you look carefully the outer layer just added is visible.

Motor Test

Now that I have all the parts I have run up the motors and ESCs to make sure everything is OK.

I selected the RCer BL4-15-5 (1430 Kv) mostly by guess work based on the figures I could find on the

net, as well as Motocalc.

Static test results for a single motor with a fully charged LiPo are as follows:

APC 6x4E prop: 11.7V x 12.5A -> 140W @ 16,230 RPM
APC 7x5E prop: 11.2V x 19.7A -> 220W @ 13,470 RPM

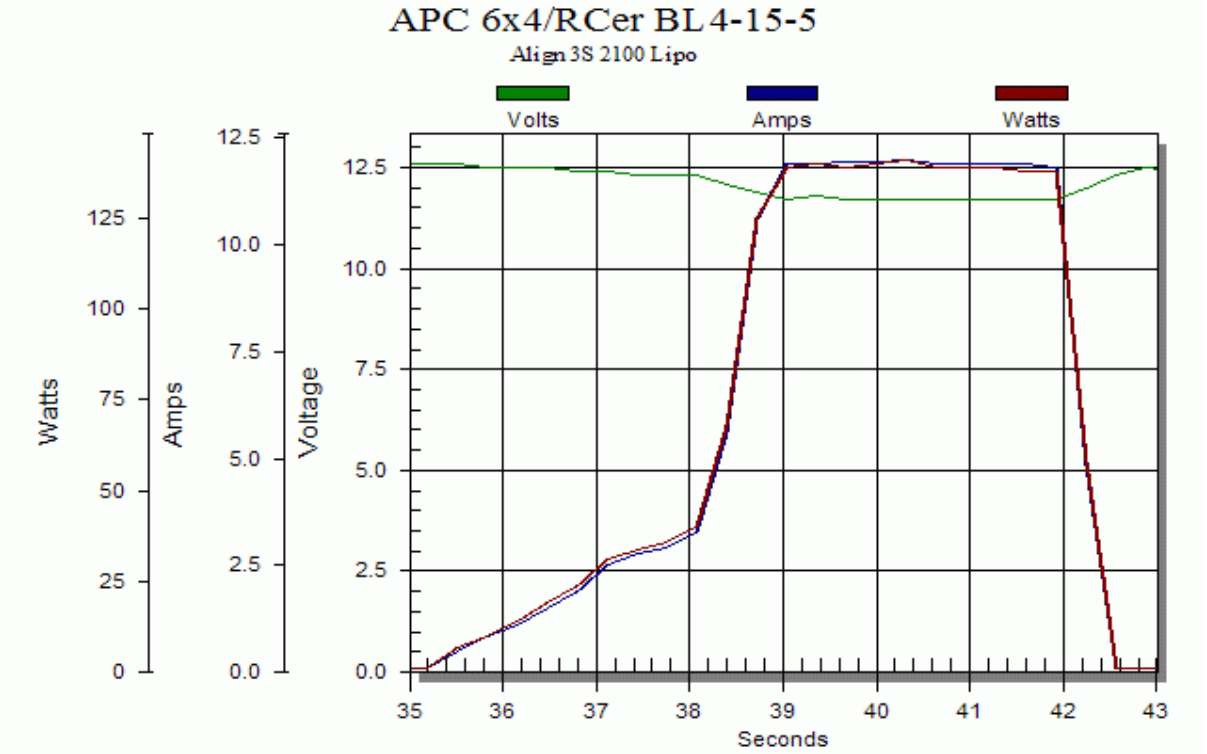
The motor ratings are
- Max Amps Continuous: 18A
- Max Power 5 minutes: 260W
- Max Amps 20 seconds: 24A

So the 6x4 props will be about 280W static with both motors and be comfortably within the motor's ratings. The 7x5 is just a fraction over the motor's continuous ratings during static testing but would probably be fine in flight.

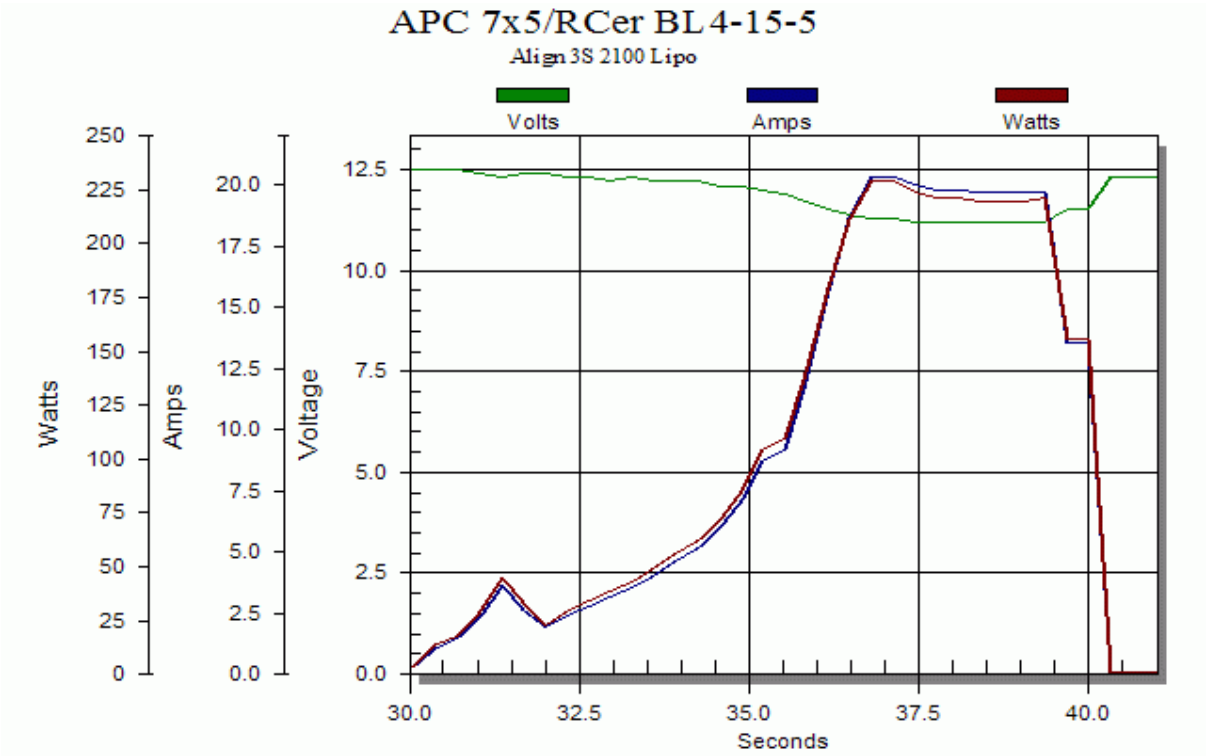
Ron Marston's configuration with Mega 16/25/3 and 6x4 props is about 20-22A per motor or about 450W total power.

I am working on trying to keep the weight down and I will probably start with the 6x4 props and see how it all goes. I am sure that for my style of flying the 6x4 props will be fine.

Anyway the main thing at this stage is that all the parts appear to be working fine.



APC 6x4E prop test data - 16,230 RPM.



APC 7x5E prop test data - 13,470 RPM.

Body: Preliminary

Most of the body parts are 1/8" ply, the exception to this are the tails and also a spacer for the rear of the body.

Actually, there are lots of the spacer type parts - and you don't need all of them. There are 2 x 1/4" balsa rear spacers, 2 x 1/8" balsa rear spacers and 2 x ply forward spacer. At this stage I think I only need 1 of the 1/4" balsa rear spacer and 1 of the ply forward spacers.

So as usual the first job is to locate the parts and give them all a good sand. I would suggest doing a good job on all the parts - this may well be the only time they will be flat and easy to handle!

Also I sanded the thin edges to remove rough patches.

Also sand the long straight edges of the 1/4" rear spacer. This will eventually be epoxied to the CF tubes and the carbon remains from the laser cut makes an excellent release for epoxy.

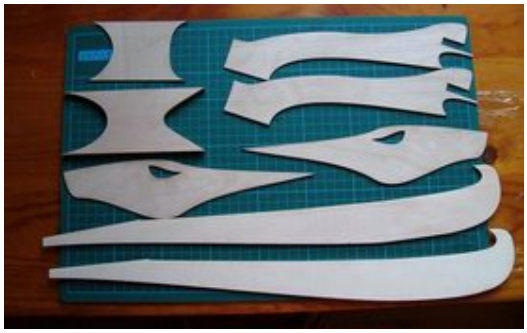
Next, use the neck parts as a template to draw the CF tube position on the inside of the left and right body sides (the big sleigh like parts). This means making a decision now about which is the left & right part - I just selected based on the 'nicest' sides. I think that this will make later assembly easier.

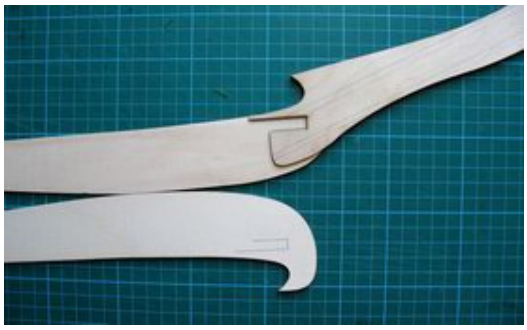
The neck of the Pterodactyl is open and carbon reinforcement of the neck is recommended. The instructions suggest CF strips or rods on the insides of the ply neck pieces.

I am going to attach two 5mm wide strips of .007 CF on each side of each neck piece - one at the top and at the bottom. I don't think having a couple of small strips showing on the outside will be too visible. These 'beams' will keep the neck nice and rigid.

Mark the position of the stips. Cut some 5mm wide strips from the CF, rough them up and epoxy to the neck.

Clamp these on firmly with even pressure. Do one side then the other.


These are all the body parts (excluding the tails and the CF tubes. Neck top right, spacers top left, head in the middle and the body sides at the bottom.


Use the neck to mark where the CF tubes should be.


Mark up the position for the neck braces. 5mm strips of CF shown above.


Glue the strips both sides.

I can't believe this - this thread is up to 129 posts and I still have quite a lot of work left to do!

Still, I think that I can actually see the end of the tunnel on the construction side. It feels like I am past the half way mark...

Tim

Tail: Step 1

The initial construction for the tail feathers, well feet actually, was covered very early in this thread.

At this stage the first thing I am going to do is to give them another sand and take off just a small amount more material. This is mainly around the center line of the main tail pieces, the rudders/elevators themselves are thin enough already.

I also enlarged slightly some of the lightening holes - this is really just adjusting at the margin, probably not a lot of point. Until I am finished I don't know how agressive I should be at this stage. When I get to the end all the rest of you intrepid Pterodactyl builders will have the benefits of knowing how light you need to get the tails at this stage.

Weight of each tail (inc control surface) 19gms

Tail: Step 2

The next step is to epoxy the tail to the CF longerons.

Cut the longerons to size and rough up where the tails will attach. *Note: it is probably a good idea to leave the longerons 1/2" oversize and trim them to the correct length* ***after*** *the location of the body sides determined later - see post #140.*

I set up the parts on the plans and made sure that everything is straight and then ran a fillet of epoxy mixed with microballons into the tail/CF joint.

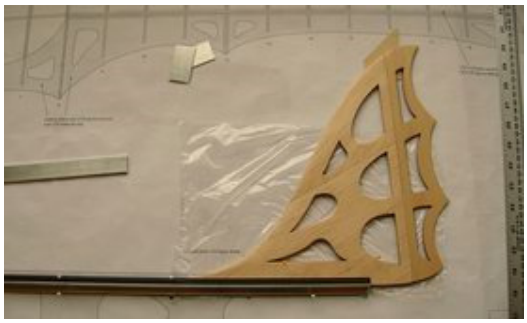
It was very convienient to have the base of the tail left as 1/4" thick, the positioning and alignment of the tail/CF was simple.

If you are using the standard 5/16" tube then the tube diameter is bigger than the tail thickness. My suggestion would be to do exactly what I did here and the tails will be 'off center' w.r.t the tube - but that will not matter. But that as they say "is left as an exercise for the reader".

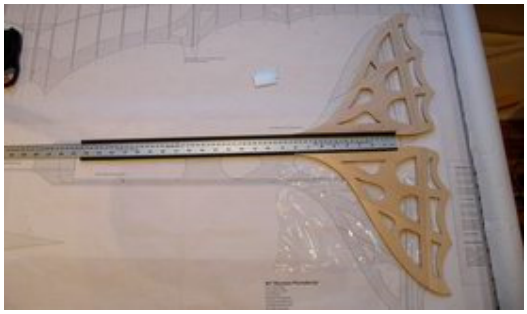
When everything is dry turn the tails over and run a fillet into the joint on the other side.

Label each tail and control surface with a left/right indicator so you know which is which.

Weight of each tail (inc control surface) with CF tube 34gms


Setup prior to gluing.

Run a nice need fillet of epoxy & microballons. I used a tooth-pick to drop the epoxy into the area and then smoothed off with a bit of scrap balsa. This was the first one I did - try to keep the epoxy off the balsa tail, it soaks in...


All done, two tails ready to label.

Tail: Step 3 - not in the instructions

Because my CF tubes are slightly smaller diameter than the plans call for I now sanded down the bottom fin of the tail where it steps over the tube. Also I shaped the bottom of the tail to fit in a bit better when the shape of the tube.

Then I cut off the rudders/elevators - they are held by three tacks of CA glue. At this point I found out that my tacks were larger than I realised - must remember in future to use only one very small drop...

The next job is to repair the slots I cut for the hinges. At first I thought the hinges would be a good idea - now I think I will go back to tape hinges. So I just put small slices of balsa in to plug the holes so that the sight of the holes doesn't annoy me.

Then a quick sand of the surface to smooth it up.


Prior to sanding.


All rounded off to match the tube.

Body: Step 1 - Glue the rear body spacer

The next step is to glue the v-tail to the rear body spacer at the correct angle (110 degrees - ignore the instructions when they say 100 degrees).

So first select the lightest of the two supplied spacers - this is a free way to save a bit of weight. As far as I can see this is going to end up exposed so I sanded an 'aerodynamic shape' to the front and back...

Then I cut a forward body spacer from scrap 1/4" balsa. I think that this can probably be temporary - once the shoulders are in place (ie. the bit that holds the neck to the body) this spacer can be removed. The forward spacer needs to be exactly the same width as the rear spacer, otherwise the body won't have parallel sides...

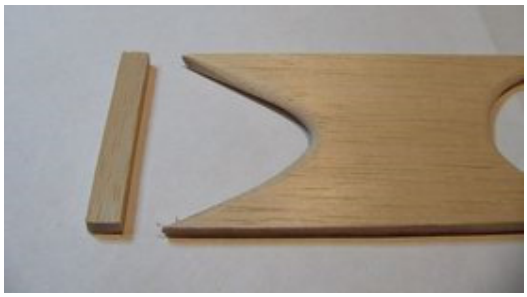
Then cut some cardboard templates for the V-tail to hold the tail at 110 degrees.

Set the whole thing up on the bench and have a look... now I understand why the build photos on the web site show this being done on some timber blocks. The bottom shaping on the tail hang down below the CF tube and the whole thing does not fit flat on the table (see pics a few posts ago). So the alternatives are to sand off the nice shape... or put some spacers under things at this stage.

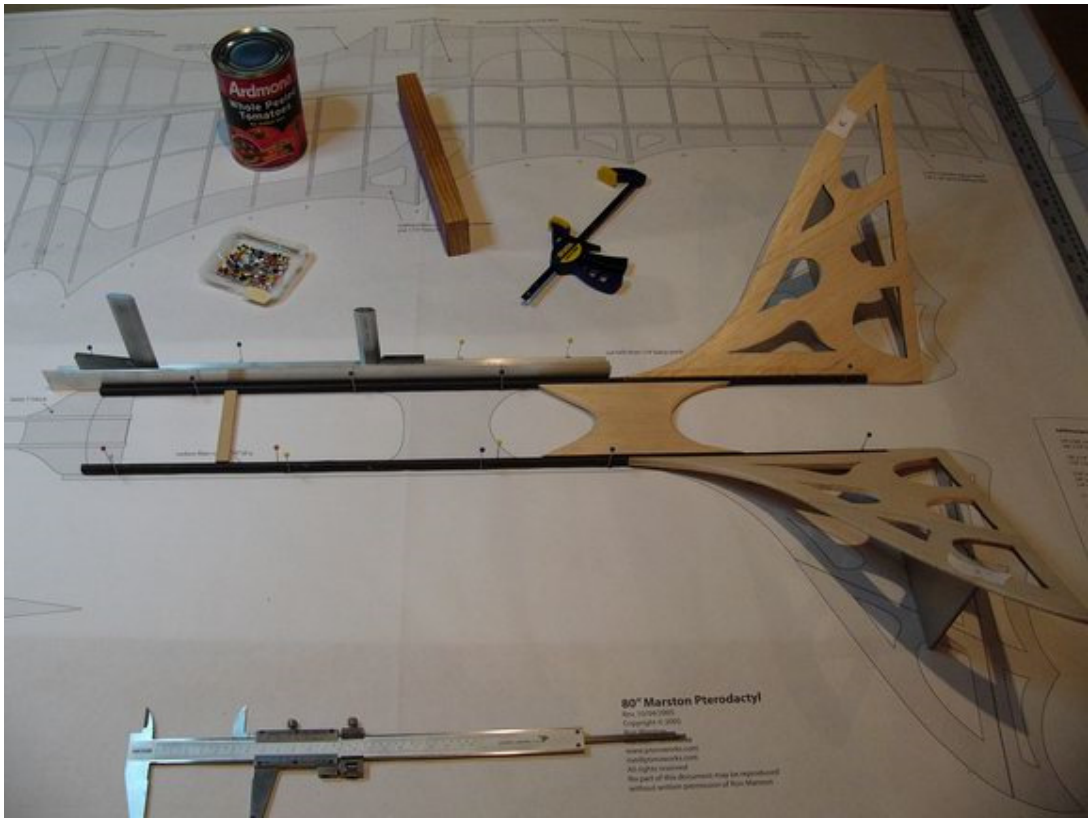
I can't bring myself to remove the curve, so all I have to do is sort out some spacers and then I am ready to epoxy the rear body space in place.

At this stage I also marked the CF tubes so that I know where to give a quick sand before gluing in place.

Late note: it looks like I only need some 1/16" balsa spacers inserted under the CF and every looks good. I left all the alignment pins in place and just slid the balsa scraps under...



Forward space and the rear spacer with the leading/trailing bits smoothed off.



Setup for checking. (Note background tin is peeled tomatoes - the soup tins appear to have all

With the balsa to allow the tails to sit correctly.

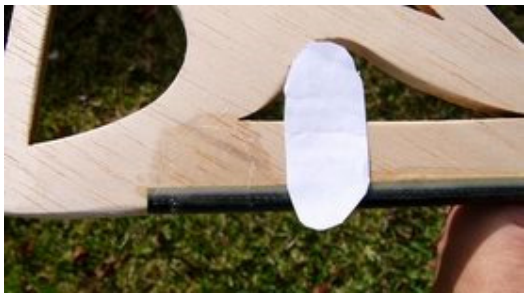
Body/Tail: extra bits

I decided to add a small glass reinforcement to the tail/CF tube join before I attached the rear body spacer. I was going to use 2oz glass - but I didn't have any and couldn't find any at short notice. So I used two layers of 0.75oz glass instead.

At this stage I put a small band of glass at the end of the CF tube. I am also going to reinforce the CF/rear spacer/tail joint once I have it in place.

Also at this stage I worked out where the CF tubes needed to go on the body sides and using a straight edge attached some temporary supports with a few drops of CA. The bottom of the CF tube should rest on these and that will set the relationship between the sides and the tube - which sets the wing incidence.

Once the CF is glued in place I will knock out these supports.


Paper template for the glass and the glass in place at the end of the CF tube.


Attaching temporary supports to the inside of the body sides.


A support...

Body: Step 1 - continued

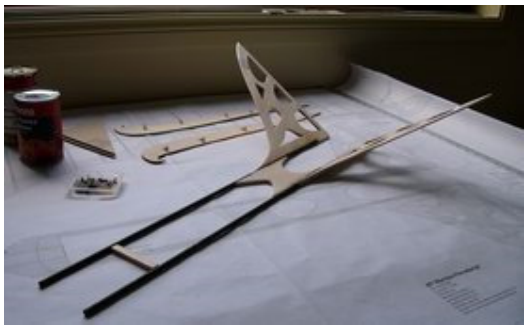
Now I have scuffed the CF tubes in the required places - as marked previously. Set them up, checked and double check
the angle of the tails, and use epoxy & microballoons to glue in the rear spacer.

I have also tacked the temporary front spacer in with some CA.

When this is dry flip it over and another fillet of epoxy & microballoons.

Weight of 'body' so far 67gms plus control surfaces 8gms = 75gms


Glue the top side - make sure everything is flat and straight.


All done.

Body: Step 2 - Glue body sides, and middle body spacer, to longerons

I am going to do the body sides first. The reason for this is that once the sides are attached I can look at the wing mounting. The middle body spacer acts as the aft screw down point for the wing - I can't glue that in until I see how that is going to work.

A quick look at the body sides and the tail assembly shows that the body needs some adjustment in the area around the v-tail. Each body side needs to have a slot cut to allow the side to sit properly round the tail.

So my first step was to cut a cardboard template to make sure that I understood what was needed here.

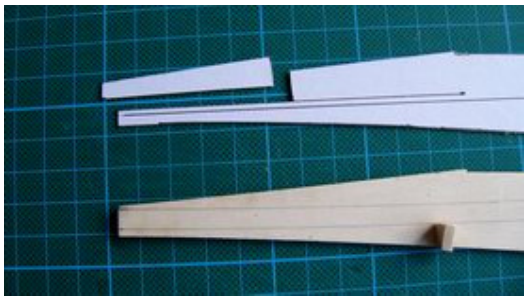
At this point I realise that I have a minor problem. The body top view, body side view and planform view of the entire model are all slightly different. I should have checked this in more detail before! However, I was just motoring along thinking that this was the easy bit!

The issue is that if you look at the planform a few posts ago you can see that the rear of the wings (and hence the 'step down' on the body side) is supposed to align with the front of the rear body spacer. When I do that my longerons are 1/2" short of the required end point as shown on the plans. The overall length of the Pterodactyl is the same on the top and side views, it looks like it is just the positioning of the parts is not quite the same...

Obviously the size of the cutout in the body sides that you need to make depend on exactly where the 'step down' on the body side is located (and hence the wing location).

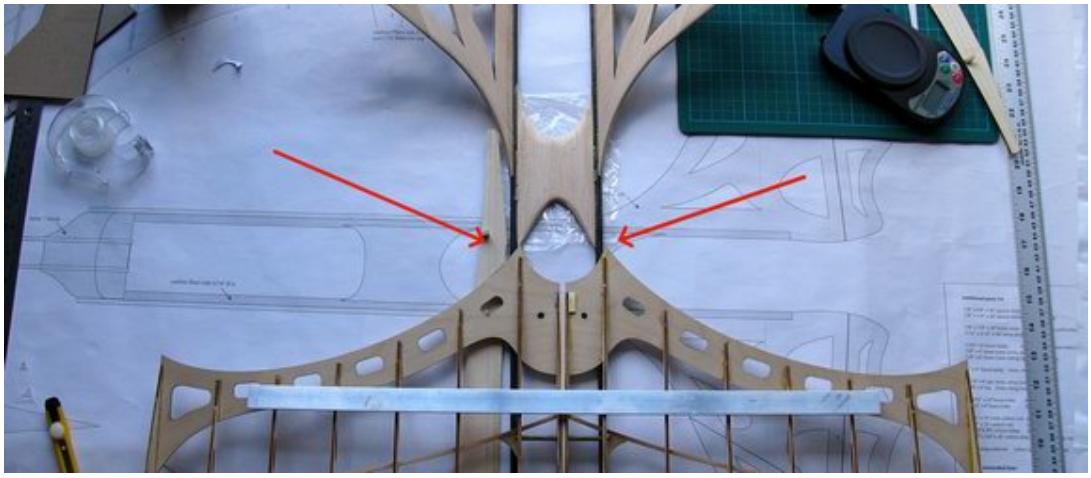
This requires a bit of thought before proceeding - I don't want to mess up the aerodynamics...

Note: I have been back to an earlier post and suggested leaving the longerons over long and adjusting at this stage to the correct length. This would probably open up more options...



Preliminary template...

Check it looks OK - then realise there is a bit more to this bit...



This is the area where things are a bit 'funny'.

Body: Step 1 & 2 - continued

Well, after a bit of thought, and discussion, I have come to the conclusion that there is no problem with the slight plan 'differences'. I am just going to continue using the body top view to construct on and use that as the reference.

So there is no problem. However when discussing all this with Salto I realised that I needed to alter the construction order slightly at this stage by adding some reinforcing before the body sides are attached. This glass reinforcing needs to wrap around the CF longerons.

So the next thing I did was add some glass reinforcement to the rear body spacer. The grain on this part is cross grain and would probably snap under any load. So I added two strips of glass diagonally on the bottom that started on the bottom front of the V-tail crossed over the spacer and wrapped round the CF longeron onto the top. Then I added some glass on the top of the spacer that wrapped round the longeron and overlapped on the bottom. This is only a few grams - but adds a lot of strength to the spacer.

Next I installed the middle body spacer - this is 1/16 ply. I centred this between the longerons, tacked the ends in place with CA and then used epoxy and microballoons along the join. (My fillets to date have been a bit 'thick' - "overkill" was the phrase used... so I tried for a finer line of epoxy here.)

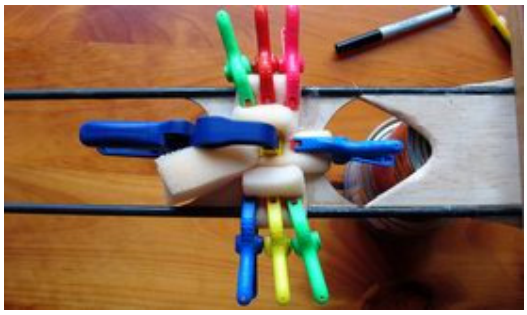
Then I determined where the screw down points were going to go and then used 4oz glass to glass a 1 inch wide strip centered on the screw down points and wrapping round the CF longerons and overlapping on the bottom. If this was left until after the body sides were installed it would be very difficult to add any reinforcing to the screw down point. I used foam and clamps to force the glass to follow the shape of the tubes while the epoxy cured. The end result is nice and strong - although my glass work could do with a bit of improvement on the appearance front...

Weight of 'body' so far 78gms plus control surfaces 8gms = 86gms


Glass reinforcement to the rear spacer.


Middle spacer glued in position.


Mark the screw down point, and a 1inch wide strip.


Apply glass and clamp to ensure glass follows the tubes.


All done.

Body: Step 2 - continued

Now back to the body sides.

My next step was to cut and shape the body to fit area around the tails. So I used the cardboard template to mark the area to cut out and cut out slightly less on the scroll saw. Then sanded/filed the body sides to fit the tails - I was aiming for a nice join around the tail so I tried to sand the body to match the 35 degree tail angle.

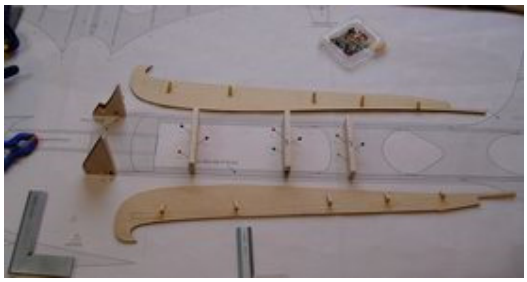
Next rough up the CF longerons where the body is going to attach.

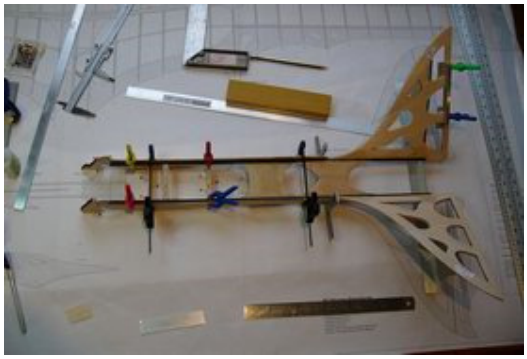
Then set it all up on the plans again and get sides in the correct place - with everything square. This is a bit tricky - I found it useful to make a few balsa spacers that I could drop in between the body sides to keep the spacing correct. I used pins to attached these to the plans with some 'front stops' to get the sides in the correct place.

Tack this in place with some CA, then use epoxy and microballons and run a fine fillet top and bottom to hold it all together. Before doing the bottom fillet I knocked off the little triangular supports I had tacked in place.

Weight of 'body' so far 112gms plus control surfaces 8gms = 120gms


Trim the ends of the body sides to go round the tail.


This was the jig I ended up using to get the alignment correct.


Setup and glued. I supported the longerons at the tail because the tails drop below the longerons.

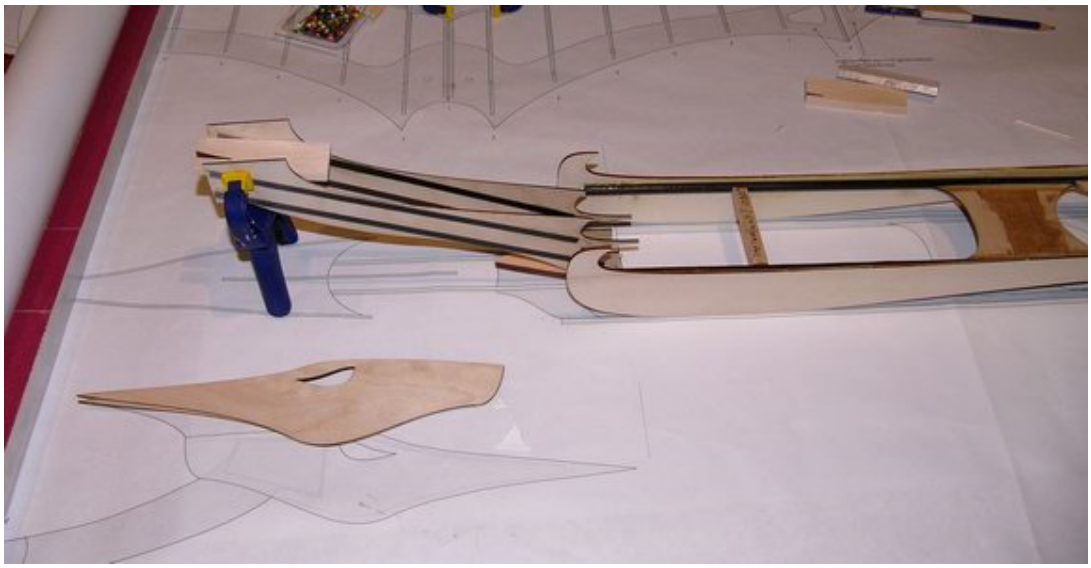
What next?

The offical instructions from here are:

Step 3: Cut outer chest pieces from 1" balsa and glue to body sides.
Step 4: Epoxy neck pieces to chest pieces, using 1" balsa in between.
Step 5: Attach head using scrap as required.
Step 6: Glue in top and bottom of head cut from 1/4" balsa.

This is going to be interesting, I am not sure my carving skills are that good! Also I am not certain exactly how to get the nose lined up exactly straight.

I think I may play with some cardboard templates to try and work out how to align the parts as I build. So there may be a bit of a delay here.



This is the next part. I have put the neck pieces in place to show roughly how this looks. The head 'sides' are also shown, the top and bottom of the head is balsa cut to shape later.

Wing: Step 22&24 - Wing sheeting

While I tinker with the body it is time to get back to the wing sheeting. I have worked out how the electronics are going to mount and I know where I want the cables to come out of the wing.

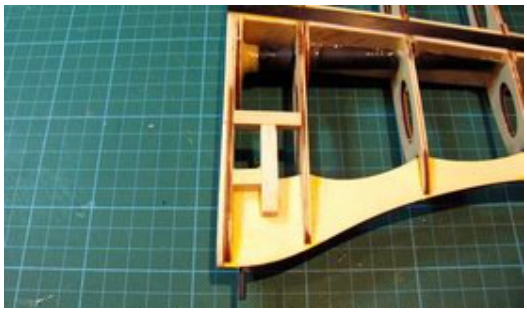
So the first step is to use some 1/4" scrap to make a "frame" around the hole where the cables will come out.

Also the front of rib 7 where the sheeting needs to be sanded so that the sheeting will fit. The front of the rib appears slightly too long over the leading edge - a little bit of adjustment and that is done.

I am also going to sheet the bottom then the top, rather than the top then the bottom as the instructions suggest. I have no idea how this is going to work out... I have only done a little bit at this stage and it is a bit tricky...

My plan is to proceed as follows:

- sheet the lower inside section up to the motor mount area
- install the servos
- sheet the lower outside section from the motor mount to the tips
- install speed controller and servo cables
- sheet the upper inside section
- sheet the upper outside section
- install the motors
- sheet the motor bay
- sheet the rear inside trailing edge
- apply cap strips


This is where the wires are going to come out of the wing.


The front of rib 7 needs some adjustment prior to sheeting.

Wing: Sheeting continued

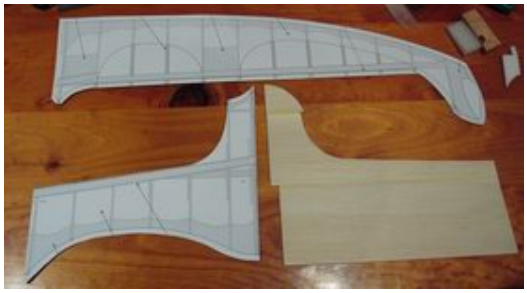
First step was to make some cardboard templates for the sheeting I will need. Then I glued together some 1.5mm light balsa to get the correct overall shape. After that I used the templates to cut a somewhat oversized shape.

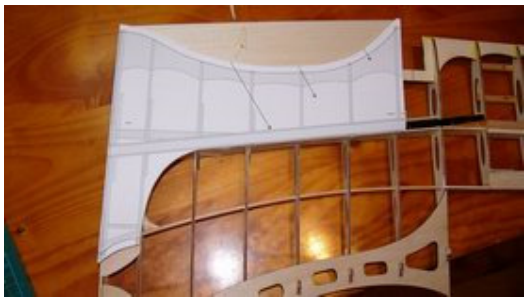
My balsa looks like it will not need to be soaked to shape for the lower sheeting - so I am just going to cut to shape, bend and glue in place. (Sounds simple doesn't it...)

Then working on the wing I trimmed the shape along the spar, then the curve down to the rear, then the shape are the rear, then the curve on the front and finally the line of the sheet to 1/2 way across rib 7. The edge at the wing join I left to hang over as it went - I can sand that off later.

I left the leading edge a bit too big on the first wing, it was really difficult to judge this. I thought on the test fit that it was correct, then when I got to gluing it was slightly too big.

Now before attaching the sheeting I used CA to attach some 1.5mm scrap to the standoffs so that the wing can be held straight on the work table while the sheeting is glued on. So I put a sheet of 1.5mm balsa under the spar and leading edge area, then put the scraps under the standoffs, held the wing down and put a few drops of CA to hold the balsa to the standoffs.


The cardboard templates for the sheeting. The outer section has not yet been trimmed. Also a preliminary sheet of material glued from 100mm wide balsa.


The spar line and the curve to the rear cut into the sheet.


Then the bit at the rear. I used tape to hold the sheet in place - I put black squiqqly lines on the tape for the photo.


Trim the front to about the right shape.


Trim the front and bevel to fit. I ended up with the material too large, probably because during the 'test fit' I did not get it quite as tight as during the gluing.


Support the front of the wing on some 1.5mm balsa and glue 1.5mm scrap to the bottom of the standoffs.


And the standoffs are now the correct height to allow for the sheeting,

Wing: Sheeting continued

I used yellow aliphatic glue to attach the sheeting - perhaps some combination of this and CA would be better. But I always end up with stuff glued in the wrong place when I use CA.

The trick/problem with the wing sheeting is to hold the sheeting on the curve over the leading edge while the glue cures.

What I did was paint the glue onto the spars/ribs/etc., then put the sheet of balsa in place and hold the edge along the spar in place with tape. Then I used tape to hold the rear of the sheet in place.

At this point I discovered that there was no way that tape was going to hold the leading edge. So then I tried clamps with pieces of scrap depron to even out the pressure and protect the balsa. Then I needed clamps along the edge of rib 1.

At this point I wanted to put the wing back onto the table and hold it flat to ensure there was no warp built into the wing - but with all the clamps it didn't look good! However, just before frustration got the better of me I realised that the wing could still be held flat if the leading edge and rib 1 were left to hang out over the edge of the table.

I slid a few scraps of thin balsa up along the ribs to ensure the sheeting was touching the ribs. The wing is flat and the sheeting looks like it is OK - except the leading edge is a bit long. I think a little sanding will fix that.

Now the long, anxious, wait until the glue dries and I can see the result. I just hope the leading edge is not too 'wobbly'

This is the glue ready to go.

And the final situation - the only way I could get it all to hold together. I have no idea how this is going to turn out.

Wing: Sheeting continued

The next day thinks look OK. After a touch of sanding to remove/shape the balsa sheet at the leading edge it looks OK. There is a bit of 'shape' to the balsa over the ribs - so the clamps were probably too strong.

But overall I am happy...

So now on to cut and shape the outer sheeting.

For the outer sheeting I started with a 100mm wide sheet of super light balsa. With the edge of the balsa about 1/2 way across the spar the width is sufficient to get to the leading edge. The arrangement suggests that it will probably be easier to do the tip of the outer sheet separately. This is actually convenient for a few reasons, including the fact that on the bottom of the wing the sheeting is going to interfere with the standoff (which I don't want to remove until the end).

I also am going to alter the sheeting slightly to cover the flap servo that I moved one bay towards the tip.

So I cut the cardboard template to the shape I need and then used the template parts to cut the two curved cutouts. Next trim the tip to 1/2 way across the rib, roughly trim the leading edge, then use the cutoff bits of balsa and glue them on to complete the shape.


This is the completed inner wing sheeting after a light sand of the leading edge.


The cardboard template cut to the required parts. Also the sheet with the two curved cutouts.


Located on the wing with the leading edge trimmed and the tip trimmed.


Use the offcuts and glue them to the sheet to make the sheet large enough.

Wing: Install servos

At this stage I need to install the wing servos. I attached the servo arms and made sure that the range of movement was correct. With the servo mounting system that I am using I am going to attach the control rods after covering the wing. So it is important to make sure that the hole in the servo arm will take the clevis - it is imposible to fix this later.

Then screw the servos into the wing. I also used a small blob of nail polish to hold the screws and provide some protection against the screws vibrating loose.

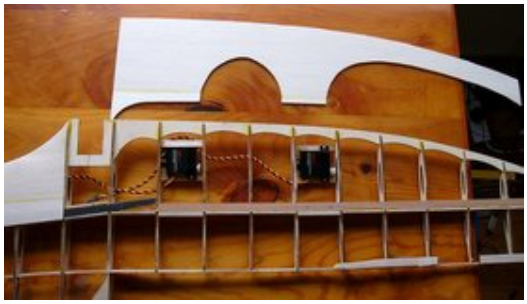
Check that the arms will not touch the wing sheeting. Mine almost touched, but not quite. Also I made sure that I will be able to route the servo cable in a way that makes it difficult to see from the outside and still does not interfere with the servo movement. This required a bit of alteration to one of the rib 'lightening holes'.

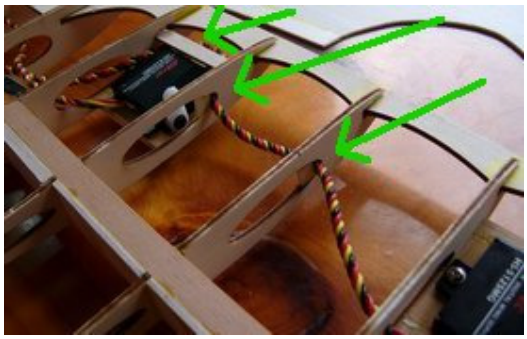
I also installed some scrap balsa to hold the servo cables in place, especially where the aileron servo cable

goes round the flap servo close to the control horn.

I also ran the servos for a couple of minutes using the servo test on the EVO to make sure the servos were running reliably over their full travel.

Let's hope I don't need to ever get the servos out, or have to repair them.


Wing servos installed, and the lower sheeting cut to shape.


This is where I installed balsa to hold the servo cable.

Wing: Sheeting continued

After the servos the outer wing sheeting can be installed.

For this I used the same method as the inner panel, however, it was a lot more fiddle because the sheeting tends to not keep to the rib shape where the cutouts are. So I used some very thin balsa (1/32) shims pushed under the sheeting to force the balsa onto the ribs.


Outer sheeting in place.

Wing: wiring

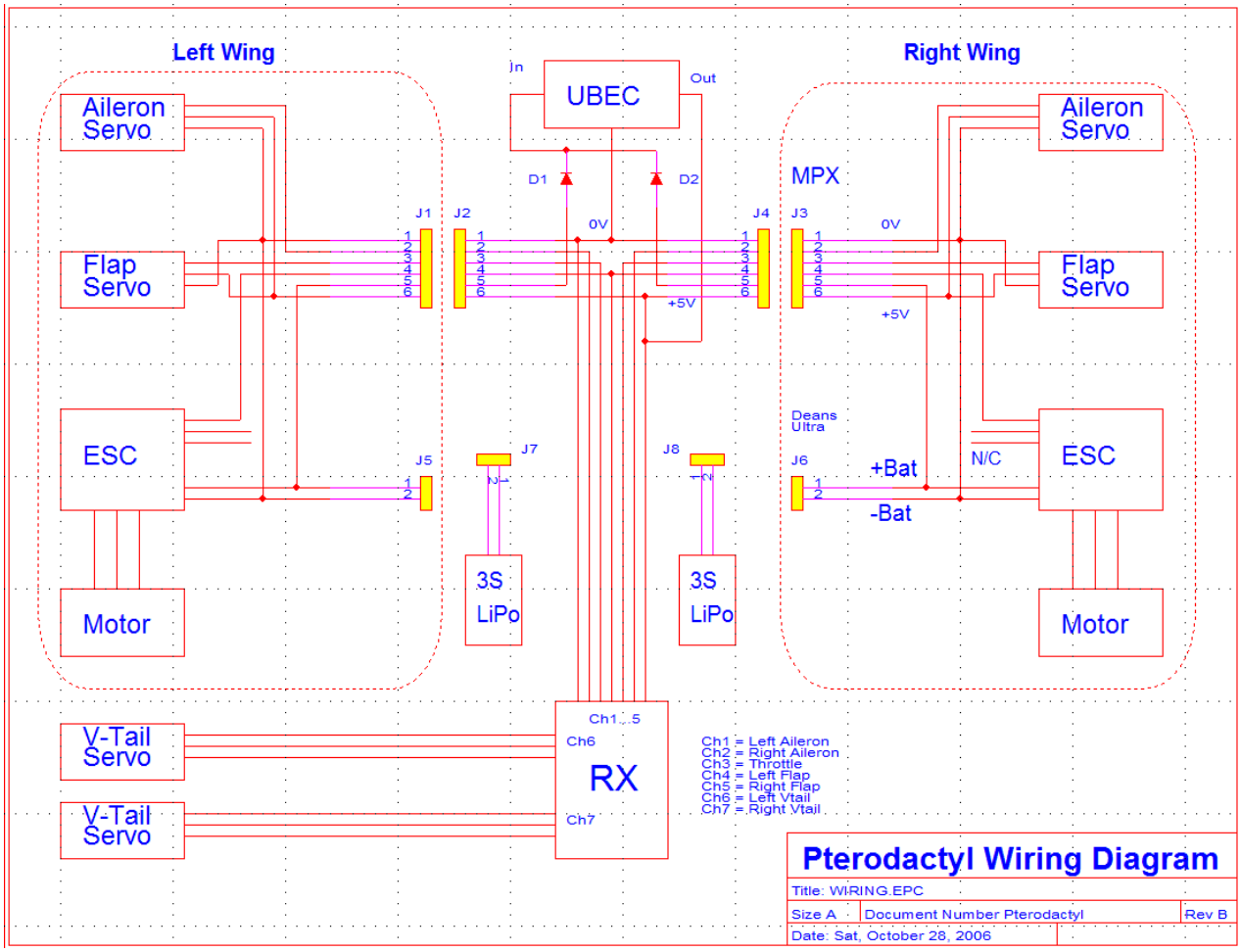
Next step is to install the ESC and make the wiring loom for the wings.

I have two 3S 2100 LiPos and I have decided not to cable them as 3S2P. The main reason for this is that I

don't want the problems of having to balance the packs every time I connect them in parallel and I want to be able to use them as single packs. What I have read about paralleling separate packs makes me a little bit hesitant to go down that path.

So instead I am going to use one pack for the left motor, and the other for the right. I am going to use a couple of diodes to grab the UBEC power from the two LiPos, so the receiver will be powered up as long as one battery is OK.

All this is shown in the attached wiring diagram. Note that I have omitted the servo cable joins in the diagram - this will become clear in a few posts time.



Wing: wiring continued

Next step is to cutout the area in the lower sheet where the wiring is going to come out.

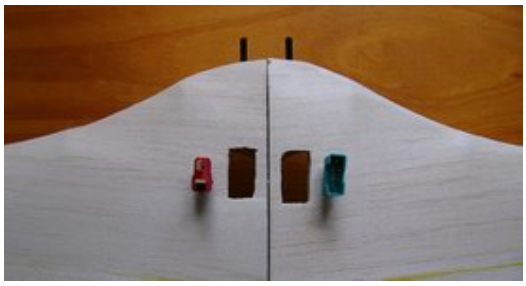
Then I added about 5 inches to the battery side of the ESC so that there is enough cable to hang out of the wing. Some of the wire will be trimmed off when the connector is added. While extending the battery side is not always recommended I don't think that this much extra wire will cause a problem - I used 14AWG wire for the extension.

Next I installed everything and worked out how long I needed all the extension cables and allowed about

3 inches to pop out the bottom of the wing.

Solder everything up and put it all back into the wing.

What I am about to do is to make sure that all the cables work correctly and also connect the motors temporarily and check that everything works. After that I will install a few balsa bits to separate the servo wires from the motor/battery wires as much as possible.

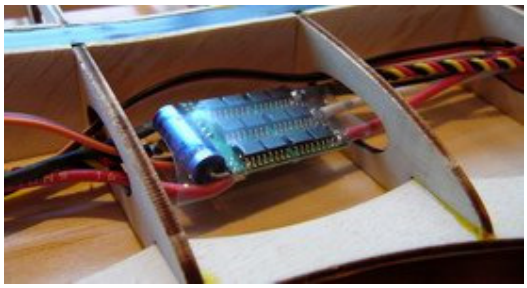

Holes in the lower sheeting for the cables to come through.


Extension to the battery leads of the controller.


Test fit all the extension cables, the cut to leave enough length for the connector.


Constructed wing cables.


Fit everything back into the wing.


Close up of ESC and cables.

Wing: ESC wiring

Some of you may be wondering about my decision to extend the battery side of the ESC cable. I am using a Phoenix 25 manufactured by Castle Creations and I decided to extend the battery side based on these two threads in the Castle Creations forum:

http://www.rcgroups.com/forums/showthread.php?t=262485 (see post #2)

http://www.rcgroups.com/forums/showthread.php?p=3858222 (see post #3)

Also locating the ESCs as shown in the Pterodactyl build pictures on the pteroworks website requires the battery side extension.

However, not all ESC manufacturers say this, for example Schulze ESCs state a maximum of 7 inches between ESC and battery:

http://www.schulze-elektronik-gmbh....de/gfutc-de.pdf

So I thought I would check out exactly how much work the input capacitor and the ESC was doing with the extended leads by checking how much heat is being generated. After all I don't want to find I have a problem after everything is inside the wing.

So I put the motor on a test mount and pushed a thermocouple heat probe between the heat shrink and the capacitor to measure the capacitor temperature. I then mounted the ESC in a small cardboard box to simulate the enclosed wing.

I attached the battery and made some measurements. All taken at about 23 degrees C ambient, with 6x4 prop, and 3S LiPo. The ESC is connected as per the wiring diagram, with a 4-cell pack powering the receiver.

First I powered the ESC up and left it to reach a stable temperature, this took about 7 minutes and was 15 degrees above ambient.

Then I ran the motor at full power, the temperature stabilised in about 2 minutes:

- standard battery cable: 17 degrees above ambient
- extended battery cable: 18 degrees above ambient

Then I attached a scope at the battery connectors and selected the throttle setting for maximum ripple voltage - this turned out to be at about 60% throttle. I then ran the motor at this throttle for 7 minutes at which point the temperature appeared relatively stable:

- standard battery cable: 32 degrees above ambient
- extended battery cable: 35 degrees above ambient

When I pulled the ESC out of the cardboard box it felt slightly warm, certainly not 'hot'.

So while my extension does cause increased heating the heating appears to be well within reasonable limits at the power levels I am using.

Wing: wiring continued

So after all the experiments I put all the wiring back into the wing.

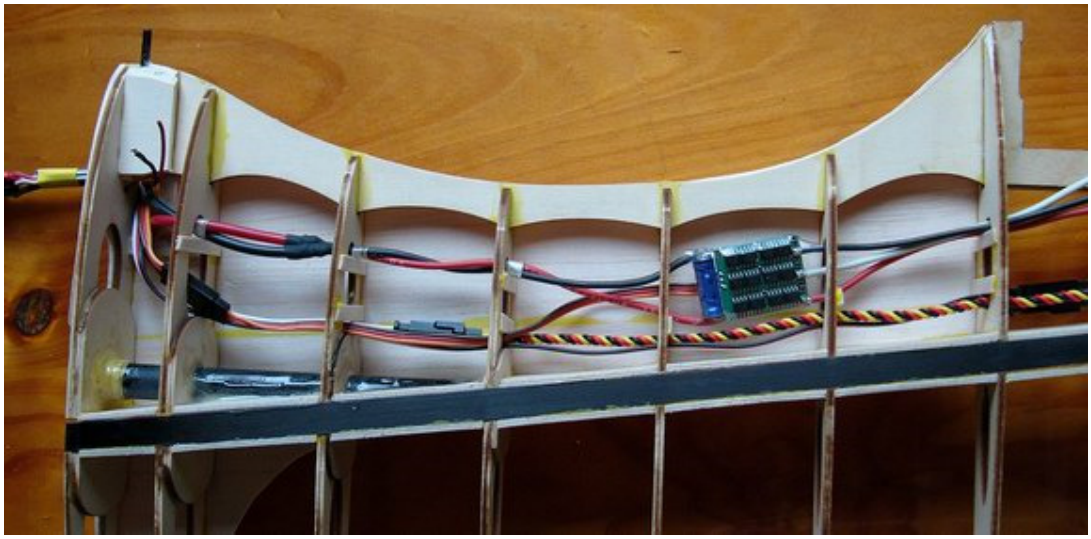
I glued in some small balsa strips to keep the servo wires as far as possible from the motor wires. I don't know if this is really required, however it does a few things:

- it keeps the wiring secure and stops fatigue;
- it holds the twist in the battery wiring;
- it serves to secure the ESC;
- keeps the servo and power wiring as far apart as possible to reduce interference, it would be preferable if the wires were not parallel to each other, but there is nothing I can do about that.

On the down side it makes it much more difficult to get anything out later...

I forgot to weigh the wiring looms before installing everything, so I have worked out their weight by subtraction. They were slightly heavier than I expected - but then I did use heavy duty cables for the digital servo extension.

Weight of wing half now 280gms - this includes servos 51gms, ESC 19gms, additional wiring 30gms



n/a

Wing: Step 22&24 - Upper wing sheeting

The next thing I am going to do the upper wing sheeting, both the inner and outer sections.

I proceeded as before to join some 100mm sheets to make the required shape. Lighter balsa on the outer section.

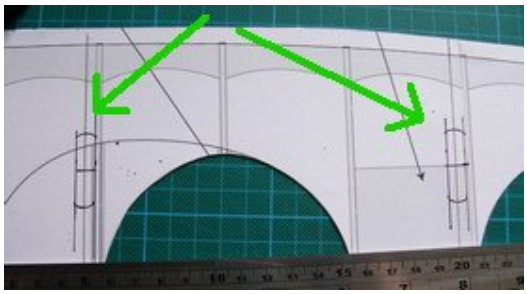
One thing that is worth noting is that I selected the position of the join line on the bottom sheeting with some attempt to ensure that it ran in a low-curve area - so on the outer section this was half way across the spar and on the inner section on the 'flat' area before the front curve. With the top sheeting the joins need to be closer to the leading edge otherwise they won't fit.

So I had marked the first set of join locations for the lower sheets on the cardboard templates and needed to make another set of join locations for the top sheeting. In the case of the outer sheets this was still on the spar (about 3mm) from the front, the inner section needed to move about 6mm forward.

Also I found very quickly that this is a good time to start with a new sharp blade on the knife...

This balsa is excellent and I don't think that I am going to need to wet the balsa to get it to shape, so I am going to try first without the soaking.

The other thing I have does is to mark on the outer wing template the position of the servo arm slots that I am going to cut later. It is easy to check at this stage that the position of the slots is correct.



Make sure that I have marked the positions of the openings required later to access the servo arms.

Wing: sheeting continued

Now I have found another use for the molds I cut to bend the upper spars. With a piece of Depron to even out the pressure, the top part of the mold can be used to hold the sheeting along the spar.

Now it is clear that the top inner sheeting is not going to work without some soaking. There is no way the balsa will bend in all the required directions at the same time. The problem area is the front of the sheet.

The outer sheet may well be fine, but I have to do the inner sheet first anyway because clamping along the spar line is easy without the outer sheeting in place.

Now, I have never tried this sort of thing with balsa, so if anyone has a better technique I would like to know.

I have soaked the front of the sheet (upto just before the glue line) in water for about 10-15 minutes. Then dried the balsa off so that it is not dripping water. Used the mold to clamp the sheet along the spar and some weights to bend the front of the sheet to the leading edge.

I have not yet done the final shape on the leading edge - because without it bent I don't know where to trim...

I suppose at this stage I leave it until tomorrow and see what the result is.

Here is the damp balsa being shaped. The timber mold holds down the sheet along the spar. Weights and scrap Depron on the leading edge.

Wing: sheeting continued

The result is not too bad, but there are a few tricks to this - so the other wing will be better...

- There is an area on the flat that needs to be held down to shape the sheeting to the ribs, otherwise this area 'sits up' (see red circle). To continue with the culinary theme I found that a 1kg bag of jasmine rice worked well to hold this area down.

- Try to avoid pushing too much on the balsa when it is wet - it is very easy to squash the balsa and then you will end up with a slight depression when the balsa dries.

- The leading edge needs to be trimmed close enough to its final shape so that when it is bent down it doesn't touch the building surface which will then stop the balsa bending to the correct shape. This is a particular problem around the motor mount and also at the middle of the inboard section where the wing chord is smallest.

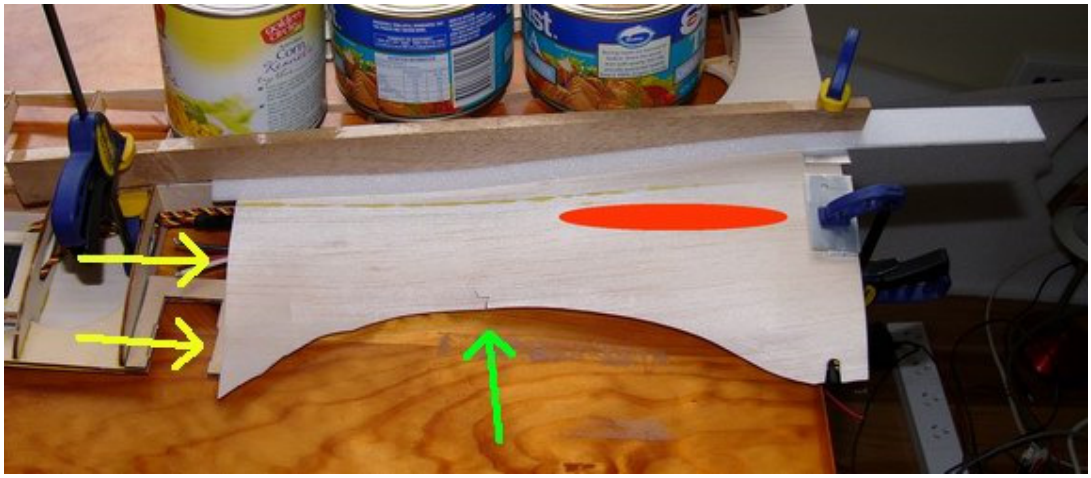
- Don't trim the outboard edge of the sheeting until after bending. If you look at the yellow arrow you can see that the bending severely alters what was originally a straight line.

- I found that the bent balsa was very brittle once bent and dried. So be carefull not to just try and bend it a 'little more' - what you will get is a crack (see green arrow). In my case this was not actually a problem because all that material had to be trimmed off anyway.

- Because the balsa appears to become brittle you need to get the shape 100% correct and dry before

glueing.

Having said all that this step was actually easier than I thought it would be and as I said there is no way the balsa would fit the shape without this step.



These are the areas to watch!

Wing: sheeting continued

So I trimmed the leading edge back so that the fit was correct, trimmed the outboard edge along the middle of the rib by the motor mount. Also trimmed the sheeting around the wing locator pins. I did this before I released the balsa from the clamps and mold. I also used a small file to try and get the edge of the sheet to the correct angle so it would touch the leading edge correctly.

Then I convinced myself that everything was installed in the wing correctly and proceded to glue the sheeting on.

- I attached lengths of good tape to the lower sheeting, I found ordinary sticky tape was useless and I used some 1/2" 3M tape with the glass reinforcing. The important thing is that the glue sticks to the balsa. I needed one piece of tape at each rib and one piece in between the ribs.

- Put the wing on a flat surface, and hold it down. This ensures that the wing is not warped or twisted.

- Then I painted the glue onto the ribs etc.

- Put the sheeting in place, put on the Depron and clamped the timber mold in place.

- Use the tape to hold the leading edge tightly in position. Put some weights on the sheet to hold it to the ribs (1kg bags of rice...). Then clamp and tape the rear part of the sheeting and also the sheeting to rib 1 join.

Now wait for the glue to dry...


This is after the weights are removed and the leading edge trimmed to shape. The clamps are very good at holding the sheet so the trimming is precise.


This is the shape you end up with - a bit difficult to photograph well, but you get the idea!

I have now completed the other wing inner sheeting. Much easier the second time - but still not perfect. Still it's all a learning process.

So at this stage I can put the wing halves together and check how it all looks. I think after a little sanding they will look fine. At this stage the whole wing, including the joiners weighs 575 gms. There are still a few bits to go (including the motors), but the weight looks good also.

Oh, one other thing I should mention: don't waste time while gueing the sheeting. This morning when I was glueing the second wing it was quite dry (low humidity) and the glue started to dry before I was finished locating the sheeting. I had no problems with the first one, but I think the combination of low humidity and going a bit slower caused the problem.

The end result was OK - but there were a few tense moments...
Then glue in place. The tape is visible and also the weights holding the sheet down onto the ribs.


Both inner sections complete.

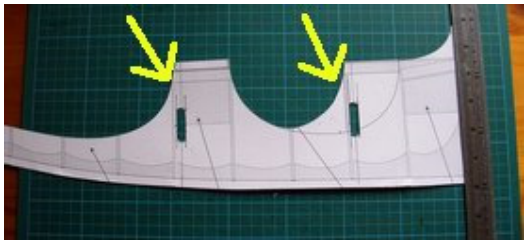
Wing: holes to access servo horns

I was going to leave this until I had the wing completely finished and covered. However, I have chickened out and decided that I will cut these holes now so that I can check everything is going to work before I complete the upper sheeting.

So I modified the outer sheeting template by cutting some holes to access the horns. I marked the holes a few steps ago and put them along the centre line for the horns, made them about 8mm wide and 30mm long.

Then I put sticky tape on the wing in the general area where the holes are to go and used a sharpie to trace the holes through the template. After checking that they were in the correct position cut along the line and instant hole! I find the tape makes it easy to mark without damaging the balsa and also makes the hole easier to cut out.

Then I can check that it will be possible to insert the control rods into the hole, through the hole in the shear web and out the top of the wing - this is how they are going to be inserted once the wing is complete.


Holes cut in the template.


Put some tape onto the sheeting and transfer the hole positions.


Cut both holes.


With any luck you will end up with the servo horn positioned in the middle of the hole.


Then test fit the control rod to make sure it will all go through correctly.

Wing: sheeting continued

The top outer sheeting can be attached without soaking (at least the balsa I am using will do this). There is only one concave section, and that is only slightly concave.

So I have attached the top outer sheeting using the same method as in earlier steps. Again, I just used weights to hold the sheeting down onto the wing and the wing flat on the table.

After attaching the sheeting I am sanding the balsa sheet near the leading edge to get a 'smooth' shape.


After all the weights are removed - the tape on the leading edge is still in place.

Wing: Leading edge shape

At this stage it occured to me that I have been sanding the leading edge area to smooth off the balsa wing

sheeting and I don't have any leading edge template - or perhaps I should say that I don't have any templates!

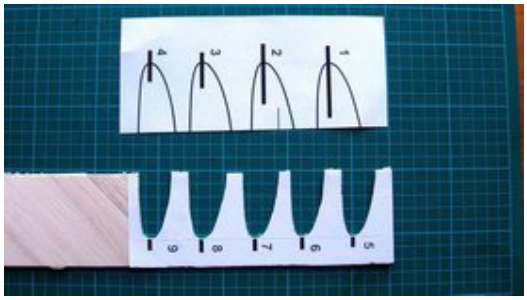
What I should probably have done early on is to use the ribs to make some templates. At this stage I used some scanned images of the ribs I made early on and use them to draw some leading edge templates for ribs 1 to 9 as a first step.

I have attached an A4 PDF with these templates - the solid red line is the wing sheeting.

I stuck these to some scrap balsa and cut along the outside of the sheeting line with scroll saw and a fine blade. I did ribs 5 to 9 as a test run.

This revealed that the leading edge shape is fine on both wings for these ribs. So with the sheeting firmly attached to the ribs and the leading edge balsa just smoothed off by eye the leading edge is fine.

So at this point I stopped worrying about this - I may make templates for ribs 10 to 19 later if I think I need them. If I do this I will attached them to this post.



Here are the front sections for ribs 5 to 9 glued and cut out.

Rib 6 template against the wing.

letemp1.pdf

These are the templates that I made for ribs 1 to 9. If you have the ribs 'loose' you could use them to check the accuracy of these...

Wing: Wing bolt area

Shortly I will need to attach the top tailing edge sheeting. This is a laser cut 1/16" balsa part.

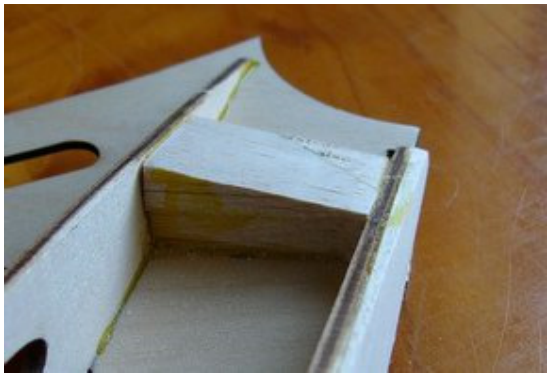
Before this is attached I am going to add some scrap balsa to build up the area between ribs 1 & 2 where the trailing edge wing bolts are located.

Once this is dry it can be sanded down to the line of the sheeting between ribs 1 and 2. I use two layers of 1/4" balsa - most of the second layer will be sanded away.

Note: this step should have been done much earlier - before any wing sheeting is attached. Probably way back before even the wing tips were attached. Once the sheeting is installed the sanding required is likely to cause minor scratches etc. on the sheeting.

This is the trailing edge, you can see the bolt hole in the lower ply sheet. The balsa top sheet is just to the left.

Cut some balsa scrap and glue in place.



After sanding to the correct profile.

Wing: sheeting continued

Now that the outer top sheeting is attached I am going to attach the tip end of the top sheeting.

So I cut the required piece using the cardboard template. I decided to alter the shape slightly and keep a thin section of the tip piece on the outside of the hole. I think that this will assist when I get to covering the wings. (Something I am not looking forward to...)

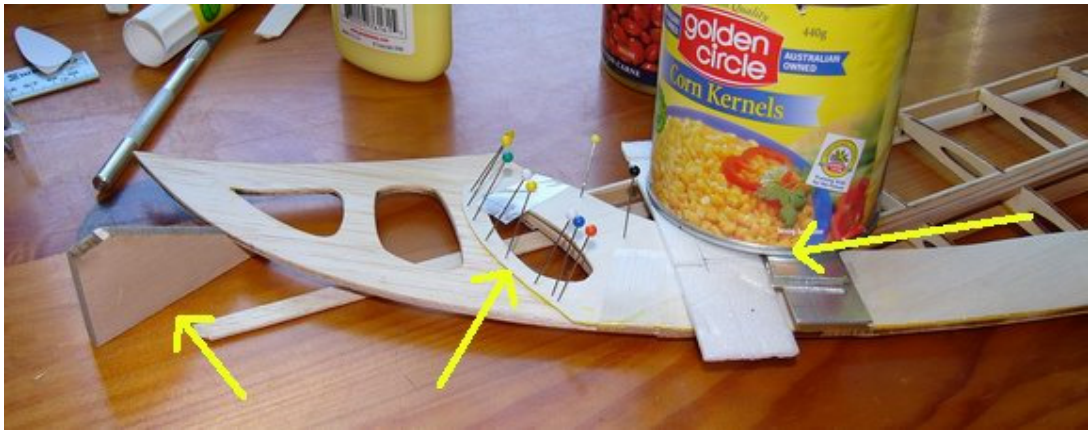
I sanded the edges of the tip sheet so that it gets as thin as possible where it hits the wing tips. Also adjust the shape slightly as required for a smooth fit.

Also I made a small chock to hold the wing tip at the correct angle so that while attaching the sheet the tip didn't get 'bent'. I just cut a notch in a bit of balsa and slid it under the tip and the point it fitted prior to glueing the sheeting.

Once the glue is dry the initial sanding can be done to remove any really rough bits and smooth out the transition to the wing tip.

Weight of wing half now 290gms - inc. servos, ESC, wiring

Cardboard template and the balsa end piece.



Glue in place with a combination of weights and pins. The rest of the wing is also held flat on the table with weights.


All done. - with a nice transition to the tip.

Hi TugBoat, thanks for all the work you have put into this thread. I have just purchased a kit and the decision was based largely on having all your hard work available as guidance. Don't stop now! I love weird stuff and this kit certainly fits the bill. Some pics below of my last effort, this Pterodactyl is certainly going to be a challenge and will require alot of patience. I was somewhat daunted by the amount of time it has taken you to get this far, but as they say "If it was easy everbody would be doing it". Thanks again, hope you don't mind if I ask some questions once I get going.

Regards

KiwiKid

Wing: top inner rear sheeting

Now for the top inner rear sheeting. There is a large 'bend' line across the top of rib 2 for this part. I suppose there are two alternatives here: either cut the part and install with a join on rib 2 or wet the balsa and bend/bruse/break the balsa and force it to the required shape. I think I will try the latter method because that should leave some wood fibres crossing rib 2 for some strength.

Sand the parts and remove the 'nibs' where the part was joined to the balsa sheet.

Mark a line about 8mm in from the trailing edge and sand a bevel for where the balsa meets the ply - this is similar to the flap & aileron construction.

Then I soaked the inboard end of the balsa for 15 minutes, installed it and bent the balsa over rib 2. I used some clamps and weights to hold the balsa to the required shape. Then it is just a matter of waiting for the balsa to completely dry.

Once the balsa is dry the sheet can be glued on. As before a combination of tape and weights worked well.

Because of the way I added some balsa for the wing join area the laser cut part was a bit small. So I added some extra material to cover the area round rib 1 after the initial part was glued on - this is really just cosmetics.

I also left the bolt 'hole' in the sheeting - if that is where the hole comes out it will be drilled out later, but I suspect that it doesn't line up with the hole in the bottom sheet.

Note: if I was doing this again I would score the back of the balsa where rib 2 is before I soaked the balsa. Just run a blunt object across the back of the sheet so that the balsa wants to bend at the right point. What happened to me is that the bend is not a uniform straight line and there was a join in the balsa (that I had not noticed) that worked against a nice straight bend.

Here you can see the line and my initial sanding towards the edge of the sheet. I actually sanded a finer trailing edge to the sheet before installing it.

Then wet the end that needs a bend and bend and clamp in place to dry.

Again a combination of tape and weights - plus the odd clamp.

The end result. This image is a bit confusing because the scrap balsa attached to the standoffs is visible.

Here are the two wing haves joined.

A top view of the entire wing at this stage of construction.

And another view. Total weight as shown is 600gms - this includes the wing joiners, servos etc.

Wing: install motors

Now the motors.

First I attached the motor mount tubes to the motors using RTV silicon sealant. I want the 'step' on the outside of the mounting tube to seat onto the ply motor mount area and the motor wires to come out as close as possible to the ply motor mount. This should permit some flow-through cooling on the motors if required.

So after working out the alignment I applied some silicon to the motor and attached the tube. This needs to be left for at least 24 hours to fully cure. To stop the silicon getting onto the outside of the tube and then stopping it glueing first apply sticky tape to the outside of the tube then once the silicon has cured

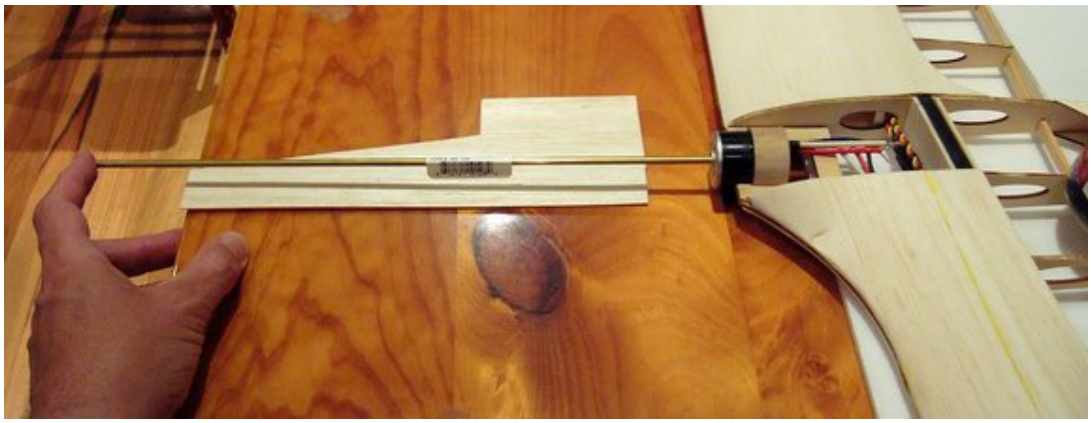
the sticky tape can be removed and the tube will be 100% silicon free.

The motors need to be aligned as well as possible so that they are both in the same position, with 1/2 degree of down thrust. I am going to use a length of brass tube to extend the motor shaft so I can see the alignment. Of course the tube is 1/8 ID and the shaft is 3mm... So I wrapped a few layers of sticky tape onto the shaft so that the tube was a good fit.

Because the motor hangs out the bottom of the wing slightly I put the wing onto a sheet of 6mm Depron so that the motor mount hangs off the front of the Depron then the motor+tube can be dropped into the already prepared mounts and the alignment checked.

Now with all that set up the next step is to work out exactly where the end of the brass tube needs to be for the correct shaft alignment... I just need to take some measurements, do a few calculations then think a bit...


The motors with the tube attached.


And this is how I am going to align the motor shaft - once I have worked out exactly what the alignment is!

Good to see your progress. Those are the Warp4 motors right?
I forgot which ones you were using. Good to see they fit though.
I really need to order one of these but I have so many other projects.

Feathermerchant: Yes, these are the Warp 4 - 5 turns. As I think I have said before these are a guess on my part... time will tell...

Now, I was about to do the motor installation, but I have just realised that I have missed one bit of wing

sheeting - so I have just done that bit - details tommorrow...

I also spent a bit of time with Salto last night going over the construction details (thanks to Graham for spending the time to help sort out some of the construction details and help me get it all straight in my own mind, the mistakes are mine and a lot of the good ideas are Graham's). So I think I have the rest of the construction planned. I am sure the odd problem is going to appear, but not too many I hope.

I am also going to do something about the 'blunt' leading edge. The ply leading edge may well give a lot of 'ding' resistance, but it is basically a 3-5mm blunt edge and that isn't good. So I have a simple way out of that.

So things are almost complete on the wing front to get them to the final sanding and covering stage. Just a few odd jobs left:

- the motors and their associated sheeting
- the leading edge
- rib caps

Once the wings are complete it's back onto the body.

Tim

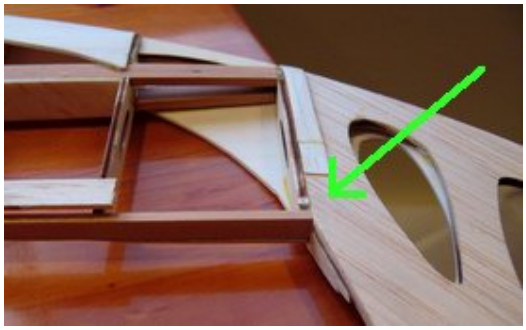
Wing: bottom tip sheeting

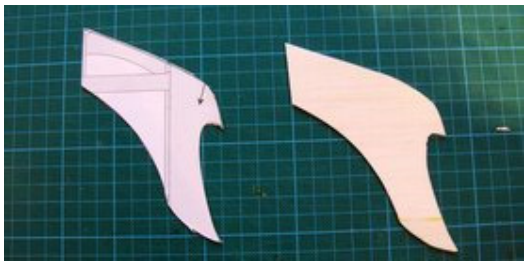
This is the bit of sheeting that I forgot. I think it is easier to do it before installing the motors because the motors will make everything heavier and more difficult to work with.

I just cut of the tip-most standoff and sanded the rib to completely remove the standoff.

Then I cut the bottom tip shapes from some balsa. I decided to use the smaller 'correct' shape for the bottom because it fitted better. So I trimmed the the cardboard template back to the smaller shape first.

Then just a matter of repeating the tape, glue, pin routine.


Remove and sand the standoff that is in the way of this bit of sheeting.


Cut the sheeting pieces. Trim and sand to form smooth transitions onto the tips.


Glue as before.


All done.

Well I am back on the job again, so there should be some more progress in the next few days. That's assuming no interruptions of course...

Tim

Wing: install motors continued

After much thought this is the best method I could come up with as an attempt to ensure the motors are installed in a similar manner as possible. There must be a better way, but I have spent the last week or so thinking about this and couldn't come up with one...

So off we go.

Give the outside of the ply tubes a good sand so that there are no reasons for a bad glue bond.

Then sand the motor bay where the mount is going to attach - I also sanded the rib next to where the tube will attached so that the balsa reinforceing will bond well.

I also marked the position of the rear of the motor (24mm from the LE in my case).

Then I made a paper alignment template by scanning and printing a section of the plans and attaching a paper extension. Then drawing the extension of the ribs and the required position of the brass tube.

Next I put this back onto the plans and marked some distances for alignment purposes so that I can measure from the wing/tip join (which is clearly visible on the LE ply) to get things square.

(Note: the front of the motor bay is not at right angles to the centre line of the Pterodactyl, however, the rear of the motor bay is. So I am using that as the reference.)

Then I soldered the motor leads to the ESC and covered the joins with heat shrink. This is easier to do when the motor is not installed. And of course I ran the motors up to check that everything is operational. (If you don't have a programmable ESC make sure the motor is turning the correct direction... stupid to mention I suppose, but to find out later would be a major disappointment!)

Next I used some 6mm Depron as a spacer and put the wing onto the building surface. Then roughly aligned the template and used stick tape to hold the template down. I then aligned the wing using the back of the motor bay and the wing/tip join point.

Weight the wing down so it doesn't move. Then I put a spacer under the motor mount tube so that both wings will have the motor at the same vertical position and I also put a weight on the top of the motor mount tube to hold it down on the spacer. (The space is a bit of scrap balsa and 1mm aluminium that together were exactly the correct height.

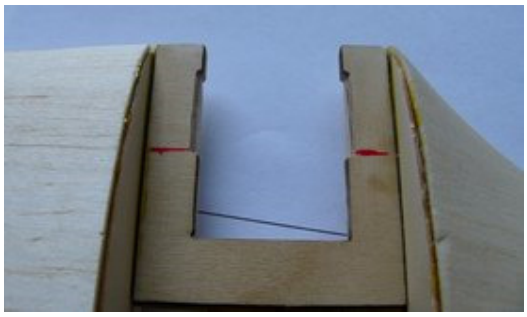
Now with the brass tube attached I used a balsa spacer to hold the tube in the correct position. There is supposed to be 1/2 degree (2.6mm in 300mm - almost nothing) of down thrust relative to the ply. As far as I can determine the standoffs ensure that the ply is parallel to the building surface so that's what I am going to work with. I suspect that the downthrust is not that important, but it is easy to drop the brass tube a couple of mm so I did. (I just used a file to notch the standoff slightly.

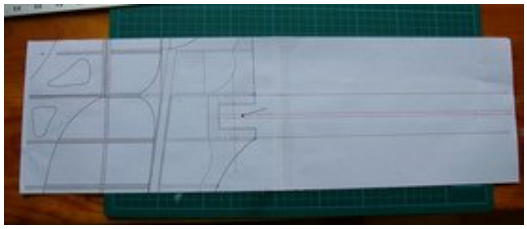
Then I used 4 drops of medium CA to hold the tube in position against the motor mount area.

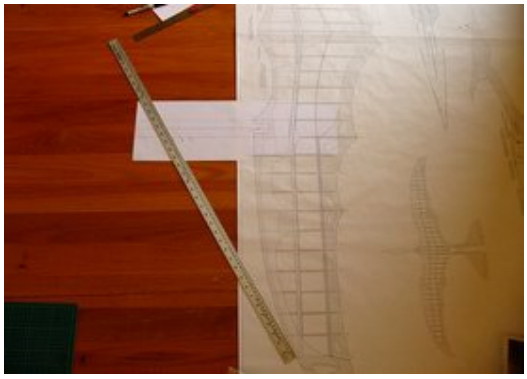
Eeek, that all sounds complex - but actually it takes much longer to put down that to do. Also the point of this is not to
actually align the motors, but rather to make you think that they are aligned. 🙂

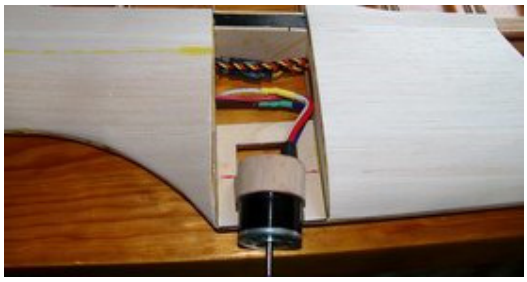
Repeat for the other motor. Note: I used the same template because I used the back of the motor bay as a reference.

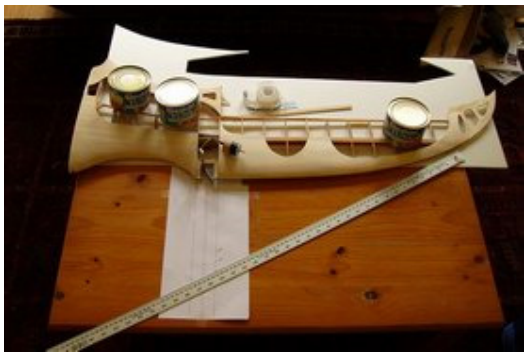

Sand the tube.


Sand and mark the bay.

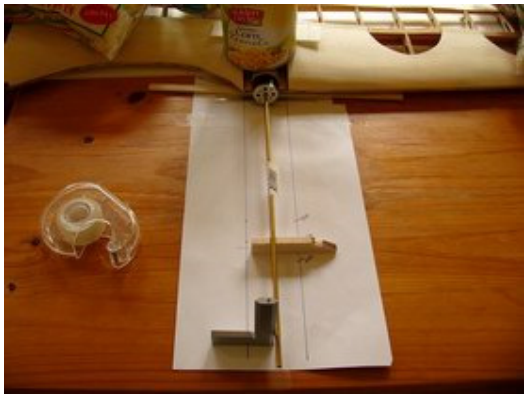

Make an alignment template.


Work out how to get it square.


Solder the motor leads.


Put the wing on the 6mm spacer and get it all square.


Put the official spacer under the motor tube.


All square and ship-shape. Tack in with CA.

Wing: install motors continued

Next I need some reinforceing for the motor tube. I purchased some hard balsa sticks: 3/8 x 1/2 and 1/4 x 1/2. The 3/8 x 1/2 is for the top reinforcement and the 1/4 x 1/4 is for the bottom.

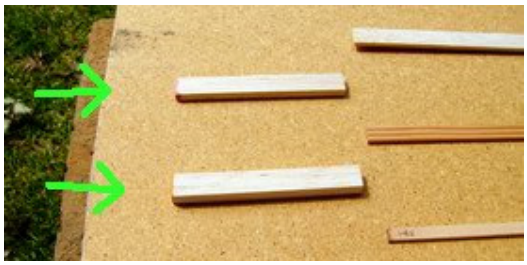
I cut a short length of each, about 100mm, and then arranged this in a stack with scrap balsa between the pieces so that the two bits of balsa I want are aligned similarly to when they are in the mount.

Next I attached some sand paper to a length of conduit that was the same OD as the motor tube and used this to sand the correct curves onto the side of the balsa.

Once this is done I cut lengths that are the same width as the motor tube and did any sanding required to get them to fit on the motor mount upto the tube and also the rib.

These can then be glued in with strong glue - I used PU, but I am sure epoxy would also be fine. Of course, PU tends to foam a lot so don't put in too much excess glue.

Once all this is completely cured I can try attaching the props and see how the mounts work.


Material for the reinforcement - and the scrap used as spacers on the right.


This is the stack of material, and the conduit used for sanding.


End result is two curved edges.


Cut to length and sanded to fit.


Glue and clamp in position.

Now, I have just noticed something that I should have probably noticed a lot earlier.

I was just sanding down the area around the motor mount and I realised that my motors had different shaft lengths! I don't know why I hadn't noticed this before. I had tested both motors/ESCs but not taken any exact measurements.

Anyway, I attached the props and powered up the wing halves using the same battery (about 50% charged) to run each side so I could get comparable measurements.

What I found at full throttle was:

Left motor (longer shaft) 15,150 RPM @ 110W (10.7V x 10.3A)
Right motor (shorter shaft) 14,300 RPM @ 90W (10.8V x 8.3A)

I suppose this is what you get with "less expensive" motors.

The right motor is 5% slower and using 18% less power!

So the question is - **do I have a problem or not**?

I suppose I am tempted to just complete the construction and find out if there is a problem in practice. If I need a better pair of motors it is going to be almost the same amount of work to replace the motor/motors now as to do it later if there really is a problem.

Also the way I have the wiring the more power hungry motor will flatten its battery faster and slow down anyway...

Any comments?

Tim

I would say you have a problem. Try swapping props.
How are the ESC's set up?

Hi feathermerchant,

I have tried swapping props - but that doesn't make any difference the APC 6x4 props must be fairly similar.

The ESC's have identical setup: Fixed Throttle range, Soft LVC cutoff. The voltage is way about the cutoff voltage. The throttle on the TX is sufficient to generate full throttle on the CC25s.

I suspect the ESCs are the same, my suspicion is that the motors are the problem/difference.

It's a bit difficult to know what to do at this stage.

Do I:

- purchase another of the Warp 4's (and hope it is close to one of the pair I already have) [only 1 motor to replace]
- purchase a pair of other motors (and find out how closely matched they are) [2 motors to replace]
- do nothing

I wonder what an acceptable match is in this situation? I could spend a lot of time searching for 'matched motors'.

My only direct experience is with a Twinstar with twin S400 motors. These are out by 5% in RPM (when run in parallel off the one ESC) and there doesn't appear to cause any problems in flight.

The more I think about this the more I am leaning towards purchasing another Warp 4 and using the best pair... but I am still uncertain...

Tim

Another thought - You can adjust the timing of the Castle controllers. Try more advanced timing on the slower motor. As long as the rpm's match you should be good to go. It will affect the efficiency, more advance=less effeciency. Where did you buy the motors?
Is 200W gonna be enough to fly this thing?

The motors came from Aircraft-world. I purchased them both at the same time - it's a bit odd really. I should probably have paid more attention when I received the motors and done more testing.

I could look at the timing - although I may be better off with better matched motors.

Is 200 W enough? Complex question - simple answer: I don't know at this stage! (Although 200W sounds a bit light on to me, see below).

a) I am aiming for an AUW of about 1500gms - I don't know if this is possible, but it is looking OK at this point. The final result will depend on how much ballast is required to get the CG correct. So I would have thought that with 200W it would fly - probably not "really fast" but perhaps a good starting point.

b) My initial motor measurements (see post #128) indicated about 140W per motor with 6x4 prop at full battery charge - so I thought I was looking at more like the 250W range. (I can only assume that was with the 'fast-left' motor...) which I thought was a reasonable starting point.

c) The motors are rated for over 200W each, so I should be able to prop up if required for a bit more power. I had a fall back position of using 7x5 props - but these were fractionally over the continuous motor current at full battery charge with the motor I measured. (Ie. I measured 11.2V x 19.7A -> 220W @ 13,470 RPM - the quoted motor limits are 260W for 5 minutes, 18A continuous and 24A for 20 seconds). I suspect that with the 'slow-right' motor I may be well under the 18A limit.

d) I was going to look for some props somewhere between 6x4 and 7x5 if I needed a bit more power - however I must admit that I have not found anything between the two. A 7x4 looks about spot on if I could find any.

e) Now that I look back at the Aircraft-world web site I see that my measured data doesn't exactly match the published data.

With 3S & APC 6x4 they show: 11.32V x 9A = 101W @ 14,670 RPM. I got 11.7V x 12.5A -> 140W @ 16,230 RPM with one of the motors (unfortunately I don't know which one).

f) Motocalc 's estimated motor performance is pretty much exactly the same as the 'slow-right' motor (ie. the slightly slower one) . Ie. Motocalc shows 10.5V x 8.45A -> 89W @ 14,157 RPM: my 'slow-right' motor is 10.8V x 8.3A -> 90W @ 14,300 RPM. And motorcalc thinks this will fly 'like a good trainer' - I know, take this with a grain of salt

All in all a bit confusing.

But I will look a the timing advance - perhaps the two ESCs are configured differently or perhaps 'automatically selecting' different settings.

I hope all that makes sense.

Tim

Yup it makes sense all right. Castle allows you to save ESC setup files so you can get one setup the way you want than save the configuration and load it into the other.

Another solution would be a pair of Mega 16/15/6 - I know 2 more motors. My experience with this motor is ~200W on an 8X6. It flies a 22.5oz Electrostreak real well. That should be right in your ballpark. They will also turn a 7X5 well enough to fly the Wattage F-22 which is about 16-18oz as I recall.

OK, I have a bit more information.

My 'faster-left' motor has 15mm of shaft protruding from the front of the motor, the 'slow-right' motor only has 11.2mm. I have email Aircraft and all their stock is the 11mm variety. They were understanding and are prepared to sell me (for a reduced price) another motor with 11mm shaft length. So I have elected to take that option and I hope/expect that it will match the 'slow-right' motor that I already have.

Thanks for the info on the Mega. When I looked at the Mega 16/15/? series they look very similar (in specs) to the Warp4... at this stage it is a lot less work to replace only one motor so I will try that route and see what happens.

Also a work mate suggested just running the motors at different throttle settings to match the speed - I don't know why I had not thought of this option. This is quite possible for me, although with any luck the new motor will be a better match.

On the subject of the motor advance on the ESC I did a lot if experimentation with this and it would appear that with these motors the power .vs. motor advance is:

High Advance: 103%
Standard Advance: 100%
Low Advance: 97%

However, motor start was slightly unreliable on High Advance with the 7x5 props.

Tim

Body: Steps 3 & 4 - attach neck

While I sort out the motor issues it is back onto the body. The instructions suggest the following order:

- Step 3: Cut outer "chest" pieces from 1" balsa and attach to body sides.
- Step 4: Epoxy neck pieces to "chest" pieces with 1" balsa between the neck pieces.

I can't work out how to get all this square during construction so I am going via a slightly different route.

My first step is going to be to construct a neck with appropriate spacers, it should be possible to get this all square on the bench.

Then I am going to shape the neck/wing join area and drill the holes for the locating tubes.

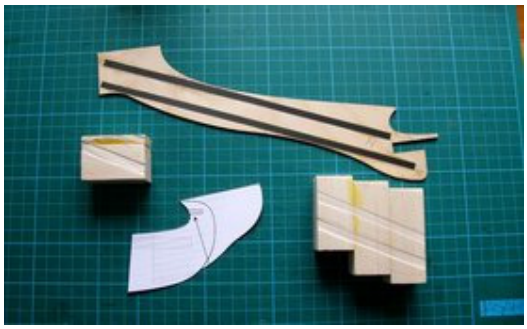
Finally attach the neck to the body.

Note: some of you may well have the bright idea of enclosing the neck to make it solid, and possibly even using it as the battery area. I did specifically ask Ron Marston about this. His comment was that the neck was specifically left open for aerodynamic reasons and he did not recommend trying this modification.

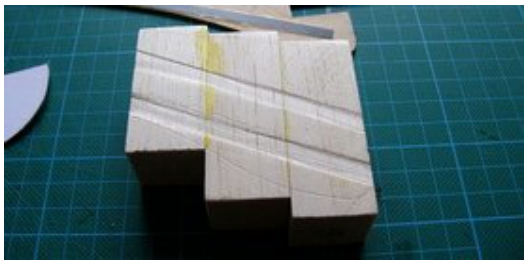
So my first step was to glue some pieces of 1" square balsa together to form the piece between the neck. When I did this I took some care to keep the large side areas as parallel as possible. Also I cut some balsa to act as the spacer in the head betwen the neck pieces.

I marked on the balsa where the carbon neck reinforcing is located. (Note that if you use a CF rod on the inside of the neck
pieces now is the time to work out where it is going.)

Then used a file to file some balsa away to allow the neck pieces to fit onto the balsa separator so that the two neck sides are parallel. These are not very deep only about 0.2mm each side is required. I also did this to the head spacer.



These are the blocks of balsa and a cardboard template of the chest area that will be used later.



Slots for the CF strips to drop into.

Body: Steps 3 & 4 - attach neck continued

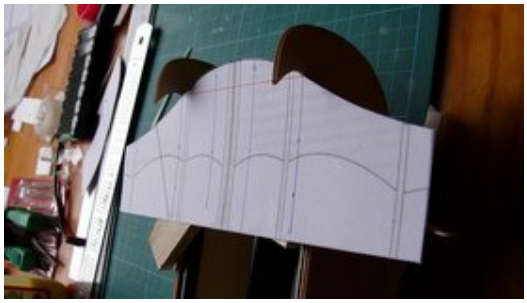
Now at this point it is worth looking at the plans carefully. The precise issue is the relationship between the body end of the neck pieces and the body sides. Naturally the leading edge of the wing is not straight and this complicated the arrangement of the parts.

As far as I can see the neck piece does not actually line up with the body sides, rather it needs to sit 11mm forward due to the shape of the wings. I suppose there are other interpretations, but that's the way I am going to approach it. (As far as I can see this also squares with the build photos on the pteroworks web site.) With the aid of a cardboard template this arrngement
is shown in one of the pictures below. This alignment is going to affect some of the balsa shapes required - so I need to
keep it in mind!

My next step is to glue the head spacer to one of the neck sides. I need a strong bond and weight is not an issue at the head end so I will use epoxy. I am doing this first because this spacer is smaller than the ply neck side and so the neck can be aligned using its edges without the balsa getting in the way.

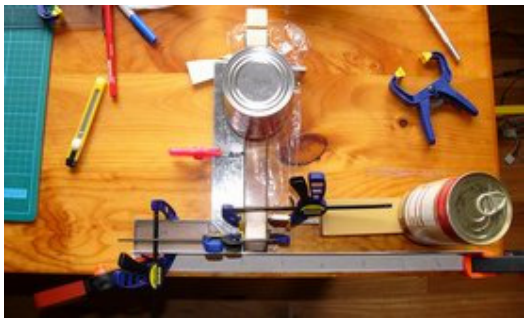
Once the first side is cured I setup a jig using some right angle section and some squares to allow me to clamp the second neck side to form the neck. The neck sides touch the bench at the front and rear and also the right angle front stop.

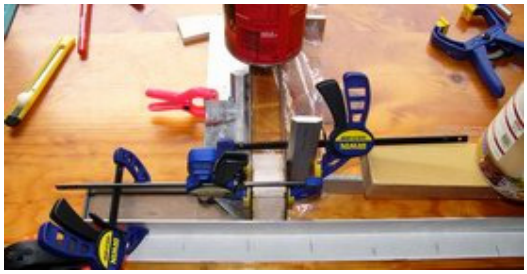
Weight of neck at this stage: 30gms



This is the wing sitting into the sides of the body. I have marked some alignment marks which are difficult to see in the photo - but you can see how the neck needs to be forward of the body sides due to the wing shape.

Attach the head spacer.


Then the other neck side. Use squares etc. to get everything parallel or at right angles as required.


A slightly different angle.


Initial stage of the neck construction.

Well the third motor has arrived (with an 11.2mm shaft) and it does in fact turn out to be the same as the other motor with the 11.2mm shaft. I have run it up and it is very closely matched for power.

So, I took removed the 'fast' motor. All I can say is that this motor mount is very strong. I had to completely remove the reinforcing blocks with a Dremel and then cut the ply and remove the motor and then cut the ply out of the motor mount area.

The next step is to make another ply tube and remount this motor - this will take a few days. After which I can get back onto finishing the wings.

I will also get back onto finishing the neck in the next few days. I am still considering the exact alignment of the neck and body. What I am slightly concerned about is that moving the neck forward will reduce the overlap between the body side and the neck and thus possibly the strength of the body/neck join.


Neck sitting in the body and 11mm forward to allow for the wing shape.