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[Courtesy of Chris Kaiser, [Chris "at" Kaiser.net.nz](#), July 2001]

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First - what in the world is a "Kahu"?

The name Kahu (pronounced CAR-who) is the Maori (indigenous people of NZ) name for the native Harrier Hawk.

Design Philosophy and Plans [\[top\]](#)



Kahu at rest! (click on small thumbnail images for larger pictures throughout this page)

This model is optimised for launch height using the discus throw technique. The long tail moment, large fin, stiff tail boom, and forward positioning of the throwing peg all contribute to a very clean, dead straight launch with very little yaw - it literally goes up like it's on rails. Unlike many other DLG's that will launch okay but need a gyro to get the best out of them, this model launches so cleanly that a gyro actually makes no improvement.



The first real launch of the Kahu - up!

To take maximum advantage of the clean launch a thin (6%) and low cambered (1.6%) section is used. This in turn means the weight must be kept down to minimize the sink rate. 45 degree biased kevlar wing skins are used to provide the required strength, stiffness, and flutter resistance while keeping weight to a minimum. They're also much tougher than equivalent glass skins which adds to the longevity of the model. The kevlar

isn't cheap, but it's well worth it in my opinion.

- [Kahu DLG 3-view drawing](#) (15 kB Adobe Acrobat PDF file)
- [Kahu DLG wing layup details](#) (21 kB Adobe Acrobat PDF file)



Chris with a ready to throw Kahu

Fuselage Pod [\[top\]](#)



Fuselage molds Completed fuse The whole fuselage and tail group assembled

The fuse pod is moulded from 2 layers of 60g (1.7oz) kevlar cloth with carbon tow reinforcing along the shoulder of the wing saddle and around the canopy cutout, and also lengthwise lower down in the fuse. The canopy is moulded seperately from 1 layer of 200g (6oz) carbon cloth.

I am not going to supply fuse pods so please don't ask - I'm not a manufacturer. However if you want to have a go at moulding a pod like this is an ideal start as it's quite small and simple in shape. There are plenty of websites out there with info on moulding so have a go! Failing that any similar sized pod from a manufacturer or your local guru will work fine, or for a one-off the best option is probably the lost-foam technique. The only thing to watch with this model is the nose length, as the CG is only 58mm (2.25") back from the LE at the wing root so the radio gear has to be a fair way forward to avoid the need for nose weight. The 3-view shows rough locations for the radio gear - 110mAH nicad in the nose, Hitec 555 Rx behind this, followed by two 9g (0.3oz) GWS Naro servos.



Not much space in there, but it will fit if you are careful!

Try to keep the fuse pod weight to 28g (1oz) or less. My kevlar pod with carbon canopy weighs around 23g (0.8oz) but is probably a bit too light - the wing/tail mount area is fine but it flexes a little around the canopy cutout on launch.

Tail Boom [\[top\]](#)

The booms used on this model are very stiff and contribute greatly to the launching ability. They come from the free-flight community, but unfortunately my local supplier is out of stock and having trouble getting more made. There are numerous on-line suppliers who should be able to supply something similar.

The basic specs are: 950mm (37") long, 12mm (0.5") diameter tapering to 6mm (0.25"), and weight is 14g (0.5oz). The length is obviously more than enough and gets cut down to around 650mm (26") depending on how you mount it into the fuse pod.

As an example of the required stiffness, with my fuse pod secured to a bench and a 900g (2lb) weight suspended 600mm (24") out I've measured the deflection at around 40mm (1.6").

Tail Surfaces [\[top\]](#)

These are cut from 3mm (1/8") 6lb contest grade balsa and the TE's sanded to a thin edge. I generally mark the hinge line on the blank and then sand a linear taper from there back to the TE.



Tail group components



Here they are assembled



And here is a close view of the tail pull-pull mechanism

When installed the elevator will require a cutout at the center TE to clear the fin and boom when deflected downward. To provide a solid connection between the elevator halves insert a 30mm (1.23") length of 3mm carbon rod spanwise about 12mm (0.5") behind the hinge line before bagging.

25g (0.75oz) glass skins are then vac-bagged on, and I usually trap a carbon tow between the skins along the TE - this squeezes out under the vacuum and gives a tough carbon TE. Once out of the bags I sand the LE to a rounded section then seal and harden it with thin CA.

To mount the fin to the tail boom, first wrap a few turns of kevlar thread around the boom 25mm (1") in from the end and secure with CA - this will prevent the boom from splitting. Now slot the end of the boom up to this wrapping to accept the fin, noting that the forward part of the subfin projects ahead of the wrapping and butts up against the bottom of the boom. Glue the fin in place and reinforce the joint with small pieces of 25g (0.75oz) cloth and CA.

The stab mount is simply a piece of 6mm (0.25") square balsa sanded to fit snugly onto the tail boom. Glue it in the appropriate position and again reinforce the joint with 25g cloth and CA. I inbed a small piece of fibre-glass circuit board into the stab mount and then drill and tap it to take a 3mm nylon bolt. An alternative is to drill an oversize hole into the balsa stab mount, fill it with epoxy, and then drill and tap into this once it's cured. A small piece of 0.4mm (1/64") ply is glued to the stab top surface as a washer to prevent

the bolt head crushing the balsa. I also CA a piece of 1mm (1/32") carbon rod to the bottom of the stab each side of the mount to act as locators and prevent the stab twisting around the single bolt. Or just use two bolts.

Control horns are cut from 1mm (1/32") ply and CA'd into slots cut in the surfaces. On my prototype I used closed-loop pull-pull spectra lines on both rudder and elevator. While this worked fine the elevator connection was a bit messy. A better solution is to retain the pull-pull on the rudder, but use a 1mm (1/32") carbon pushrod for the elevator. The pushrod should exit the side of the boom about level with the front of the stab. CA a small patch of light glass to the boom before cutting the slot to help prevent it splitting. Put a 90 degree bend in the end of a short length of thin wire and attach to the end of the carbon pushrod using a couple of pieces of small diameter heat shrink tubing. Secure with thin CA. The elevator horn should then be on the bottom of the stab and simply slip over the 90 degree bend in the wire. Once mounted the stab horn will trap the pushrod against the boom and prevent it from disengaging.

Wing [\[top\]](#)

The airfoil section I used is Mark Drela's AG04 thinned to 6% and de-cambered to 1.6%. This launches very well and floats surprisingly well as long as you keep the weight down (my model weighs in at 270g (9.5oz). If you want a 'floatier' model at the expense of a little launch height then the standard AG04 works very well - this airfoil will also tolerate a slightly higher weight better than the thinned/decambered version.



A completed pair of wing panels (118 gm, or 4.2 oz for the pair)



Here is a view of the wing root with cutouts.



And here is the final product of all that work, mounted on the fuselage.

Cores are cut from blue foam - mine were done on a CNC foam cutter care of James Pengally (he cuts cores on a commercial basis - if you are interested in a set you might try contacting James at [foamworks "at" xtra.co.nz](mailto:foamworks@xtra.co.nz)). Preparation is pretty simple, just clean off the surface hair, sand a nice curve into the tip LE, and glue them together. I also like to insert balsa blocks (around 25mm x 12mm (1" x 0.5")) into the root where the hold down bolts will pass through.

Skin layup is detailed in the diagram. Essentially it's a single layer of 35g (1oz) kevlar over the entire wing, with reinforcing patches of the same kevlar at root and tip. Spar caps are cut from 100g (3oz) uni-directional carbon. One little trick I use is to insert carbon 'weblots' under the spar caps. These are really simple to do and greatly increase the buckling resistance of the spar caps. Start by laying up some uni-carbon onto some glass or similar hard surface. Anything from 100-200g (3-6oz) will do, just try to keep the fibres as straight as possible. Once cured lightly sand both surfaces then slice into 3mm (1/8") wide strips - if you've used the stitched type uni-carbon it should split nicely between the tows. Now simply make a knife slit in the core at the correct position and press the carbon strip into it so it's flush with the core. No need to glue as epoxy will get

in under vacuum when you bag the skins.

I use 0.014" mylar for the bagging and cut it about 3mm (1/8") short of the LE. Leave them oversize at the TE so you've got a full-span straight edge along which to hinge the mylars together with tape. Makes it much easier to handle this way. I mark the positions of the various reinforcing patches on the back side of the mylars with felt pen, which makes it really easy to line them up when bagging. Wax then paint the mylars if desired.

You really don't want to be trimming or sanding into the kevlar once the wing is bagged, so it's important to cut the wing skins and patches to the exact size, especially at the LE where the kevlar should stop about 3mm (1/8") or so inside the mylar. The TE is not so critical as this can be trimmed later with a sharp knife. The light weight kevlar is a very open weave and will pull out of shape easily, which makes it pretty difficult to cut the exact skin shapes as required. To get around this, cut panel templates out of non-stick baking paper, lightly spray them with 3M77 adhesive, then apply to the kevlar and cut around. Make sure you've got them the right way around as you'll be applying the panels to the mylars before removing the paper templates, and it's much easier to get the paper off the top of the kevlar than out from under it :-)

By the way, if you have problems cutting the kevlar cleanly try some Mundial Serasharp scissors - should be available from a good sewing or craft store. These cut kevlar like paper straight out of the box - no grinding of the blades required.

Before laying up the wings, cut a 25mm (1") wide strip of 60g (1.7oz) kevlar on a 45 degree bias. Lightly spray with 3M77 adhesive and carefully wrap around the LE of the cores. With a little coaxing it should even wrap around the tip curve in one piece (if you don't cut it on the bias it'll be too stiff for this).

Once everything is prepared, the first step is to wet out the strip of kevlar on the core LE. I also like to thoroughly wet out the carbon spar caps separately on some newspaper so I can be sure there's no dry spots. Once wet out transfer the carbon to some clean newspaper and blot off the excess resin. I use the uni-web style carbon which stays together nicely through this process. The stiched stuff may end up fraying and be better wet out in place on the mylars.

Now pour a little resin on the mylars and spread out with a foam roller. Place the main kevlar skins in position (kevlar down, paper up) and gently press or roll into the resin. Carefully separate the paper from the kevlar at a corner and peel off the paper. If you didn't use non-stick baking or wax paper you'll probably have a real mess here... Use the roller to completely wet out the kevlar skin, being careful not to lift it away from the mylars at the edges. Then add the spar caps and doublers and ensure everything is wet out but there's no pools of excess resin anywhere. When satisfied align the core on the bottom mylar and fold over the top one. Place the sandwich into the vacuum bag and double check the alignment - the mylars should stop just back from the LE of the core. Place the entire bag and sandwich between the core outers and weight down on a flat surface to ensure a true wing. Pull the vacuum and let cure, preferably in a hot box or warm environment.

Straight out of the bag my wings weigh just under 60g (2.1oz) each.

Once out of the bag, the TE can be simply trimmed with a sharp knife. The LE will require more work however. The quick and dirty approach is to simply sand off the ridges caused by the mylars and then apply tape to the LE to cover any voids or areas where you've hit the kevlar. The better approach is to make up a stiff, light micro-balloon/resin mixture (lots of microballoons in little resin) and apply to the LE, taking extreme care not to get any behind the ridge created by the mylars - you must go back to this ridge, but not behind it. Once it's cured, carefully wet-sand 99% of the filler off using a hard-backed sanding block (I use 180 grit wet-and-dry paper glued to an aluminium T-section). Work slowly and try not to sand into the kevlar. With a bit of care you can remove the ridge and blend the LE into the rest of the wing without touching the wing surface with the sander. Any areas where you do hit the kevlar can be treated with foam-friendly thin CA, then lightly wet-sanded with fine paper. Sounds tedious but in fact took me a total of 2 hours to sand both LE's, and the result is well worth it.

The flaperons are skin-hinged using the top surface. Simply cut out a 4-5mm (3/16") strip of the lower skin along the hinge line and remove the foam (a small-bladed screwdriver is quite handy for picking the foam out of the channel). To gap seal, tape the flaperons back out of the way and apply some thin hinge tape to the bottom surface of the wing half overlapping the hinge gap. Brush talcum powder onto the exposed sticky part of the tape and trim to the desired width. Flaperon horns are from 1mm (1/32") ply glued into slots cut into the surfaces. The servos are mounted in front of the spar caps within the reinforced area at the wing root. The servos I used (9g (0.3oz) GWS Naros) were slightly proud of the wing surface, but given the size of the flaperons and the high launch speeds I wouldn't want to go to smaller servos.



Servo installation - they barely fit! The 9g GWS Naro servos are slightly proud of the 6% section. All tape provides a rock-solid servo installation compared to standard tape.



A close-up of the aileron horn and linkage.

Before joining the wing panels make sure you've bored holes for the servo wiring... then sand the roots to mate nicely at the specified dihedral angle and glue with epoxy. Trim off any excess glue, lightly sand the joint area and wrap with a 25mm (1") strip of 60g (1.7oz) kevlar. Once the wing bolt holes (3mm (1/8") steel front bolt, 3mm nylon rear bolt) are located and drilled glue a small washer of 1mm (1/32") ply in place to prevent the main bolt from crushing the wing.

For the throwing peg I used a section of streamlined aluminium tubing about 6x12mm (1/4" x 1/2"), although 6mm (1/4") carbon tube would also do. The peg is installed about 25mm (1") in from the tip and at the rear edge of the carbon spar caps. 0.4mm (1/64") ply doublers are glued top and bottom of the wing to spread the load - I think this works much better than kevlar or carbon cloth reinforcing as I've seen these crush under the side-loads from the peg.



The throwing peg A real close-up view of the peg!

Revision History

July 9, 2001 (jaf)
- all new!