VERHEES DELTA

Aesthetically challenging? Perhaps, but, rest assured, Max Zuijdendorp's 1/6-scale take on the novel single-seater homebuilt will turn heads at the patch!

words » Max Zuijdendorp | photos » Max Zuijdendorp

Designed and built by Dutchman Bart Verhees, the full-size Verhees Delta is perhaps one of the more unusual homebuilds. According to Bart the aircraft has proven to be very successful and although he's been trying to get other homebuilders interested, no other 'Deltas have been started at time of writing. Construction of this single-seater is entirely from aluminium sheet, mostly with single curvatures. The aircraft features tandem-type landing gear consisting of a retractable nose wheel, a tail wheel in a streamlined pod and a small wheel at each wing tip.

When I wrote on the modelflying.co.uk forum a while ago about my intention to design and build a model of this aircraft, someone referred to it being aesthetically challenged and, of course, he was right! I had to fight to resist any beautification, especially the sharp corner on top of the fin/cockpit and although I stuck to the scale shape I have taken some liberties, particularly with the retractable nose wheel.

NEWBIE NO-GO

Please note that this is no beginner's model. A bit fiddly in places, construction requires a bit of insight and experience with balsa & ply and a dash of creativity. Some bodging (aka skillful assembly of prefabricated bits) will be required to get it right, especially around the cockpit, windshield, cowl and tail wheel fairing-cum-bottom cover. The latter is available as a vac-formed part, alternatively you can construct it from balsa but you'll be left to your own devices as only the outlines are given on the plan. The same goes for the cowl. The airfoil and wing anhedral also present some difficulty with regard to supporting it whilst under construction, in particular during the sheeting process. Provisions have been made in the form of tabs on the rib bottoms and on the rear spar, and the design of the tail wheel bracket, but care has to be taken to prevent warps.

CENTRE BUILD

Effectively there's no fuselage to build as a separate assembly. Construction starts with the central section, which holds the battery

and electronics and, of course, to which the motor is mounted.

The build kicks off by gluing parts B1 - B5 together as per the plan. Note that the drawing shows tabs & notches to facilitate construction and keep things square; features that are easy to add if producing the parts on a laser or CAD cutter, but a bit laborious if cutting them by hand. The good news here is that you can omit many of these tabs & notches provided you position the parts carefully and judiciously add reinforcement to some of the joints (the plan indicates where this can be applied).

There's no specific order in which the central section has to be assembled, but do think it through before reaching for the glue. My method has been to glue both parts B2 to the ribs R1. If using machine-cut parts the holes will be accurate enough to guide you, but if you've cut them by hand you may have to think of another way to align them.

The next step is to assemble the parts that will hold the retract unit (this assembly is slotted into the sides). The rest is a matter of preference; I slipped spar S2 into the slots of ribs R1, then fitted and glued the retract fixture and firewall B1 simultaneously, making sure everything was aligned and square. I then completed the central section with parts B3 - B5 followed by B6 - B8 that later hold the tailwheel and rudder/nose wheel steering servo.

WING

The wing is basically an egg crate construction - study the plan and the build will be pretty self-explanatory. Note that the tabs on the outer ends of spar S3 rest on the building board, as do the tabs on the underside of ribs R2 - R4. This should help to keep everything warp-free. Ribs R5 are best left off for now.

Glue the ply strips that enclose the tip wheel wire to A4, then glue R5 to A4 such that the ply strips are flush with the underside. Add the assembled parts to R4, aligning the rear of the rib with the rear spar tip and the front by supporting it on a scrap of 1.5 mm balsa sheet laid onto your building board. This is one of the fiddly bits

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I warned you about earlier, as is chamfering forward edges of the ribs and fitting the false leading edge.

Add R6, the hard balsa blocks that anchor the wing tip wheel axles, the balsa blocks around the elevon hinges and the wing is now ready for sheeting.

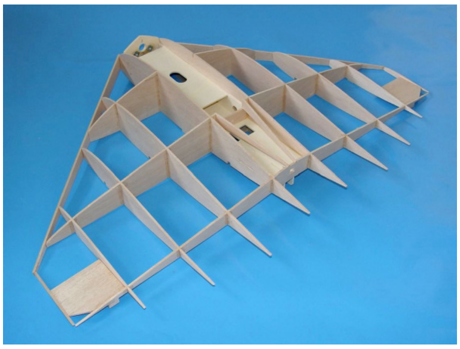
Prepare the sheeting by gluing together the sections as shown on the plan, noting the grain direction. When applying the sheeting to the ribs and spars, make sure the wing is well supported by the tabs on each rib and on the outer ends of the rear spar. The tail wheel bracket has also been designed to rest on the board but be careful, since variations in positioning B6 may result in the need to shim the bracket, or (worse) sand off the excess.

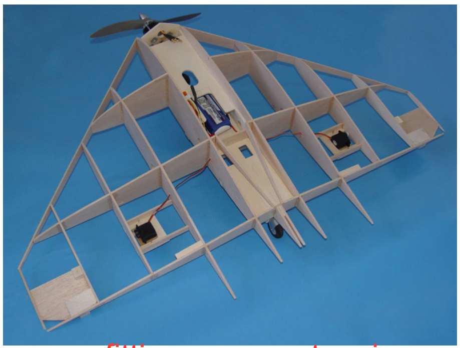
Remove the structure from the building board, turn it over, and sand off the support tabs from the ribs and spar. Run a pair of extension leads for the elevon servos from the servo bays up to the Rx bay, securing the lead ends in the servo bay such that you don't run the risk of sticking them to the sheeting but are able to access them after opening up the sheeting for the servo covers. You may want to insert the tip wheel wires at this point (see the Landing Gear narrative below). Once everything that goes inside is in place, you're ready to sheet the bottom of the wing. With this done, cut away the sheeting where the servo covers need to go, glue the servos to the covers and screw the latter in place. Remove the servo arms (or rotate them out of the way) for final finishing.

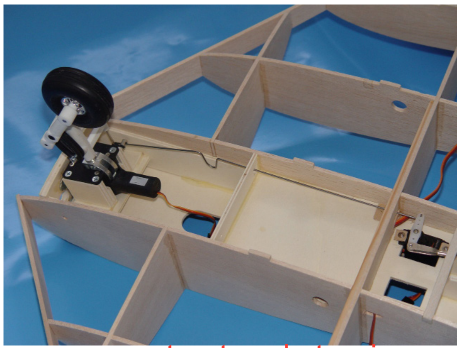
TAIL UP

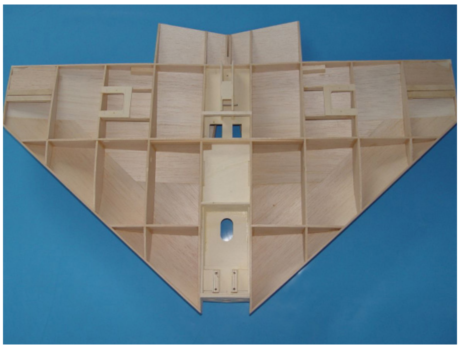
There's nothing special about the fin and rudder - simply follow the plan, noting that the grain of the sheeting is aligned with F4. Don't forget to install the cockpit catch before sheeting the second side. The (8mm sheet) rudder isn't essential, so if you wish you can fix it to the fin and omit the linkage.

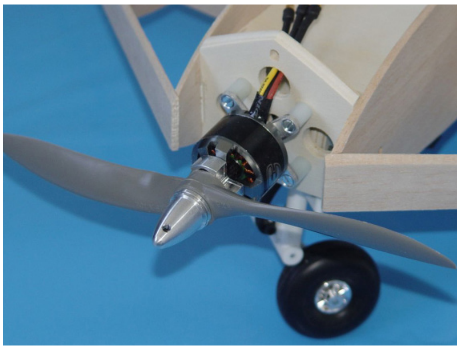
Cut away the wing sheeting between parts R6 and between ribs R1. Glue the fin to the wing, resting it on the cutouts in the spars and wedging it between parts R6. Note that the fin protrudes slightly ahead of S2 - this is an area where some bodging may be required; you have to ensure that the cockpit hatch fits between fin and firewall, so you may prefer to finish that first before permanently installing the fin assembly.

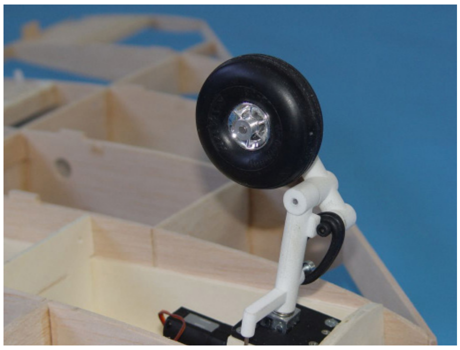

xxxxxx eggcrate construction…

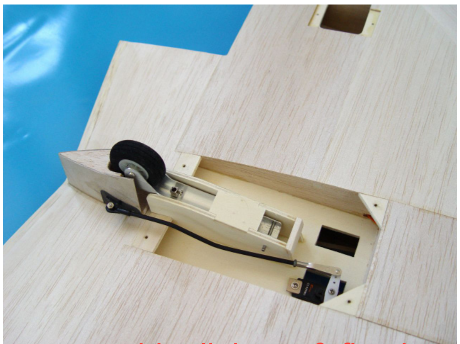

xxxxxx fitting servo extension leads

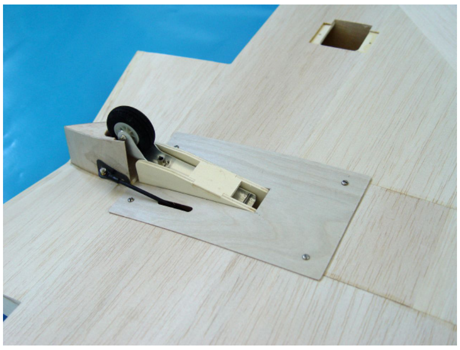

xxxxxx retract and steering linkage

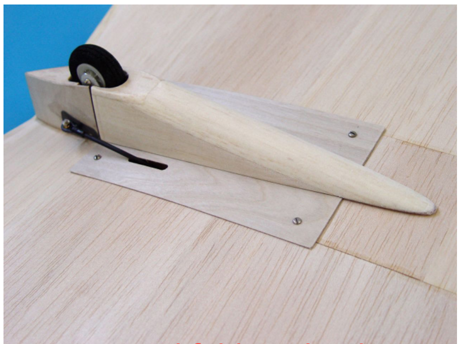

xxxxxx top sheeting installed


xxxxxx motor installation


xxxxxx nose wheel retract test


xxxxxx rudder linkage & fixed part of pod installed

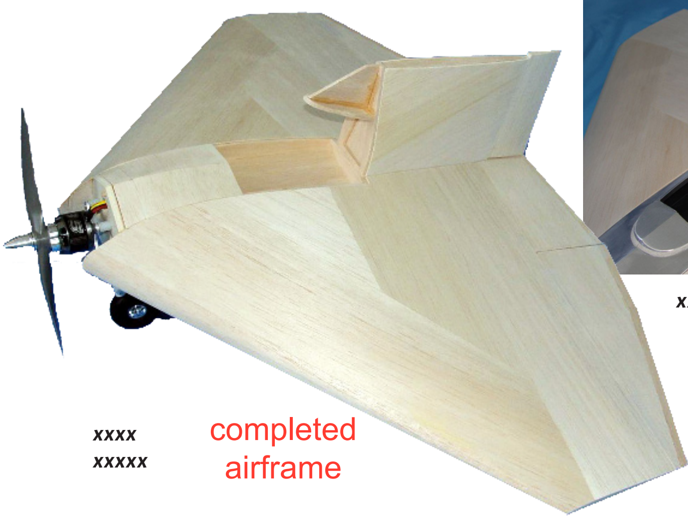

xxxxxx servo bay cover


xxxxxx pod fairing glued to cover

COCKPIT

Before you start building the cockpit and battery/equipment access hatch, a few thoughts on the subject. I originally planned to use a 3000mAh LiPo, laid flat over the retractable nose wheel housing, but even the thinnest I could find still left very little space for the cockpit hatch.

After checking the expected motor current, which came out at approx. 15A max (with a 9 x 6" prop), I decided that a 1500mAh pack would be sufficient. This was handy as I already had two of those available, but due to their size I couldn't get them far enough forward to get the model onto its C of G without having to add ballast in the motor bay. I decided to install the battery behind the nose wheel bay and add


xxxx xxxxx completed airframe


xxxx fin and cockpit fitting

xxxxxx Landing approach of the 'other' (fellow modeler Rob Bulk's) prototype

ballast, which is the way it's detailed on the plan. If you can acquire a sufficiently thin battery then you'll be able to locate it further forward, possibly with some adaptation of the hatch assembly. You may have to sacrifice some of the pilot and instrument panel accommodation though.

For the windshield, cut acetate sheet to shape using the template shown on the plan, then form and fit the 2mm sheet doubler that provides a gluing surface for the forward bottom edge of the windshield. Cut out the top sheeting of the hatch as shown; the sides of this cutout form the side edges of the windshield. I glued a narrow (4 - 5 mm wide) strip of 0.5mm ply to the inside edge of the sheeting and glued the windshield edge to that, but be warned that clamping it is a bit of a nightmare since the acetate sheet insists on bowing out. It may be better to carefully locate and glue a strip to the inside / bottom of the windshield first, then glue this to the edge of the hatch sheeting cutout.

0.3 mm thick

Lastly, the hatch requires some chamfering at the rear as detailed on the plan - you won't be able to rotate it upwards without doing this.

LANDING GEAR

Easy bits first. The wheels supporting the wing tips are simple affairs, made from a plywood disk with an O-ring stuck to the circumference. Bend a length of 1.5mm diameter piano wire to shape, then drill a matching hole in the right spot between the ply strips glued to A4, through the anchor block. Don't worry if you drill right through the top sheeting, you may need that hole to pry the wire out again if you're not happy with it.

The wheel is secured onto the piano wire with two short ends of snake control inner; the yellow, fluted Sullivan type is ideal for this, as it will push on with just the right amount of force. I opted to open up the wire slot by cutting away the sheeting and screwed on a little wire keeper to hold it down, recessing it into the sheeting. If you're not worried about the wire getting in the way a little, you can also install it prior to sheeting and stick a small strip of tape over the wire slot to prevent gluing the wire to the sheeting. The sheeting alone is enough to hold the wheel in place.

Shock absorption is provided to the tail wheel by adding an aluminium trailing arm and two sections of garden hose, all held in place with parts from two tie-wraps. You can simplify all this by shaping parts B7 as per the alternative presented on the plan, creating a fixed tail wheel fork. This will be fully adequate but for the worst tail-first landings.

As per the full-size, the nose wheel is retractable. I used a steerable nose wheel retract unit (#HK15090S from HobbyKing) that has a 4mm diameter steel pin protruding from an alloy trunnion. I designed my own nose wheel strut with a trailing arm holding the wheel, and used 2 x O-rings as damping elements for the suspension. I then had this design 3D printed by a specialist company in their 'strong, white plastic' material, similar to Nylon; the result is very robust indeed, as some of my landings have proved! If you wish to follow this route, my design is available for purchase online via Shapeways, www.shapeways.com. You'll also need some socket-head hex bolts, 2 x 19mm I/D O-rings, an axle, wheel, and a wheel retainer. The tiller arm is integral with the 3D printed strut, so take the original tiller arm off the HK unit, unscrew the slider rail, and screw it into the new unit. Make a control rod from 1.5mm piano wire and bend it into a U-shape to act as a servo saver (and help a little in tweaking 'rudder vs. nose wheel' alignment). The assembled retract unit secures with 4 x M3 bolts, through the captive nuts in RS1.

size 19 mm ID / 3.2 mm thick

SERVOS & BITS

I fitted the prototype with Corona CS929MG servos, but whatever your choice, do use

DATAFILE

Name:	Verhees Delta
Model type:	Scale delta
Designed by:	Max Zuijdendorp
Wingspan:	29.5" (750mm)
Fuselage length:	21.5" (545mm)
Wing area:	2.8 sq. ft / 0.26 sq. m
All-up weight:	2.2 lb (1.0 kg)
Wing loading:	12.6 oz / sq.ft. (3.85 kg / sq.m)
Powertrain used:	NTM 35-30, 1100 kV outrunner; Aerostar Composite 9 x 6" prop; 40A ESC; 20C 3S 1500mAh LiPo. 30A
Functions (servos):	Elevon (2); rudder/nose wheel (1); throttle (via ESC); nose wheel retract (integral unit)
Control deflections:	Elevator: +/- 9mm min, 15mmmax Aileron: +/- 9mm min, 15mm max Rudder: +/- 25mm Nose wheel: +/- 25-deg

SUPPLIER LIST

www.rbckits.com	Pre-cut parts, vac-formed cowl & tail wheel pod
www.shapeways.com	3D printed nose wheel strut, order ref. SRKNPC8GS (also available via RBC kits)

FULL SIZE STATS

First flight:	October 2004
Wingspan:	4.5m (14ft 9in)
Empty weight:	210kg (463lb)
Powerplant:	Subaru EA71 four cylinder, liquid-cooled, four-stroke automotive conversion, 37kW (50hp)
Maximum speed:	168mph
Cruise speed:	137mph
Stall speed:	53mph

metal-geared items. I used a single servo for both rudder and nose wheel steering, however there's enough room for separate servos if your Tx is capable of mixing the two channels to one control stick. It also makes final adjustment from the Tx a bit easier.

The streamlined pod for the tail wheel doubles as a cover for the rudder / nose wheel servo bay. Vac-formed versions of both this and the cowl are available as from RBC kits, www.rbckits.com.

The nose wheel bay has to largely remain open; a part cover is shown on the plan, and is screwed down together with the rear cover and cowl. Part B10 is fixed between ribs R1, flush with the balsa sheeting, and serves to screw down both covers where they meet. The plan also shows two triangular plywood scrap pieces in the rear bay to fix the tail wheel pod rear end.

MOTOR & ESC

The prototype is amply powered by a 380W 1100kV motor and 9 x 6" propeller, powered through a 25A ESC. A smaller motor would probably do but I wouldn't recommend it, since some weight is needed up front to get the C of G in the right place. The motor is fixed with M3 bolts, needing 15mm extension bushings (I used the space between these to install ballast).

30A

FLYING

Set the controls to the minimum throws indicated on the plan with either some expo' or dual rates on elevator to give more authority during landing. Keep the neutral position of the elevons flush with the fixed part of the wing.

Launching is strictly ROG – there's no proper way to hand launch this one. Being a delta with a tandem gear you can't 'lift the tail and rotate' as you would with a taildragger; just stay off the elevator stick and let it take off by itself. Ground steering is positive so there's no problem in keeping it straight, but beware of catching a wing tip right after take-off, which will make it swerve rather violently. Be gentle with aileron control until the 'Delta is properly airborne, whereupon you'll find it quite lively around the roll axis.

Landing isn't difficult – the model will glide in easily without power, but be sure to have enough elevator authority to reduce speed and avoid a bounce. A timely power burst may help here to quickly increase the angle of attack.

The Verhees Delta is unlikely to be the prettiest aircraft in your hangar but it certainly is different, and great fun to fly!