Storm Petrel

The Storm Petrel has a span of 54ins and has been specially designed for the novice R/C pilot.

Presenting Ted Davison's lightweight trainer for .20 size motors

IN the late autumn of 1988, 1 found myself at a loose end with little or nothing to do. I had exhausted the supply of small running repairs to my modest collection of model aircraft. If memory serves me correctly the weather was foul – much too bad for flying after much deliberation, I turned to the back issues of RCM&E for inspiration.

Initially, I looked for an engrossing winter project; something to absorb my concentration on those dark stormy evenings when there is little to watch on television. About this time my daughter was becoming interested in aeroplanes. She was approaching the tender age of three but had an intellect far advance of her years. I mention this not simply out of parental pride, but she made an ideal subject on which to test a theory. So often, when describing the flyability of a given aircraft, have I heard the expression 'so easy a child could fly it' that I wondered whether this could be so.

An aeroplane of this type may not look complicated outwardly, but having laid the ground rules for the model it is surprising how difficult a project it eventually became. It is true there were more taxing projects I could have chosen but there is something to be said for returning to one's grass roots. It enables the modeller to evaluate personal experience and gives perspective to an individual's accomplishments.

Inspiration

Inspiration duly came from the pages of my magazines. I saw features in other models that I liked which were thrown into the 'melting pot' with ideas of my own. The outcome was the Storm Petrel – a dainty, intrinsically stable, three channel trainer with commendable good looks. The name Storm Petrel, as ornithologists will know, is taken from a sea bird of that name. This creature is so flightly and agile that it appears to possess the ability to walk on water. It glides effortlessly on a breeze and is a joy to watch. The model lives up to this part of its name.

Let us ponder for a moment the word 'trainer'. A trainer is widely regarded as a suitable first model; one that flies in a stable fashion. A trainer should have the capacity to fly slowly thus giving ample thinking-time, and a trainer should have no idiosyncrasies that are likely to give the pilot a heart attack. All too often I see newcomers to aeromodelling arrive at our local flying site with aircraft that are not really suitable for training purposes. Even some so-called trainers give cause for few raised eyebrows.

The Storm Petrel is designed specifically for those who have never flown a radio-controlled model before. I do not make the claim that the Storm Petrel is the 'definitive' trainer but she is streets ahead of many kit-built aircraft, especially some almost-ready-to-fly (ARTF) types. This is substantiated not least by virtue of the fact that she is much lighter than most. In David Boddington's own words, 'weight is the enemy of aircraft', and this a fundamental principle.

I am not in the habit of making unjustified claims for my aircraft but as a tool for building confidence, she is positively brilliant. With more than a modicum of success, the newcomer is likely to stay with model aircraft. This benefits us all.

Fuselage construction

I have always held the opinion that the world of radio controlled model aircraft should not be the preserve of the rich. I am dismayed when I look through the pages of advertisements at the price of radio equipment, engines and ancillary components. I often wonder how an old aged pensioner, schoolboy, or (another category long overlooked) the disabled can ever hope to afford to make an entry into this hobby. I can do little amend the situation with regard to engines or radio equipment, but what I can do is enable those mentioned above and others less fortunate than myself to build an aircraft a little at a time when they can afford to so. This is the significant advantage plans have over kits.

An old, but reliable, OS Max 20 was used in the prototype. Larger engines are not necessary due to lightweight construction.

Before the building work commences, it is a good idea to buy a quality building board. Experience has taught me how important this vital piece of equipment is. My board is an off-cut taken from a kitchen worktop and measures 36in x 24in approximately. The board is overlaid with cork sheet. Most DIY stores sell such pieces at very reasonable prices.

As the designer of the Storm Petrel, I had to be mindful of the fact that the potential builder may not have sufficient experience to construct an elaborate airframe. Simplicity is the keyword here but not at the expense of strength.

Get it right

Getting the strength equation right took a bit of working out. The tendency these days is to use plenty of plywood in aircraft kits. Whilst adding strength, there is a substantial weight penalty. More weight means more airspeed is needed to make the model fly which in turn means they hit the ground harder.

Fuselage construction is not difficult. For the fuselage sides, choose two sheets of 1/8in medium balsa with similar grain. The fuselage depth is greater than four inches (the width of the off-the-shelf balsa sheet) so we need to buttjoin a strip, one inch wide, in the area of the wing seat. Cut two sides as per the plan.

Cut F1 (the engine bulkhead) and F2 from 3/16in plywood and make F3 from 1/8in medium balsa. We need to make a hole in F2 of sufficient size to allow a nicad plug to pass through. To do this, drill two holes as shown on the plane then remove the unwanted plywood in between to give an elongated slot.

Glue the wing seat doublers in place followed by the 1/4in triangle section strips that run form the bottom of F3 forwards to the engine bulkhead. Be sure to make two opposite, rather than two identical sides.

Take the right hand fuselage side (as viewed from the top, looking forward) and epoxy formers F2 and F3 in their respective positions. Ensure both are at right angles. When cured, epoxy the left hand fuselage side in a similar way. Cyano the 1/4in triangle section balsa top and bottom rearwards of F3. We now have the beginnings of a fuselage.

The engine bulkhead on the prototype was a little awkward to fit. F1 is narrower than F2 which meant that the fuselage sides had to be lightly scored at F2. 1 then made sure both sides tapered in towards the front by the same amount before epoxy was applied. When I was certain everything was square and true, I worked a smear of PVA glue into the score line to stiffen the fuselage up again.

The next stage was to strengthen the bulkhead and tankbay. I glued a strip of hardwood across the rear of the bulkhead with epoxy. Two pieces of 1/4in triangle section were epoxied vertically, followed by two pieces of 3/8in x 1/8in balsa doublers running from F1 to F2 in line with the tankhatch. In years gone by, undercarriages were bound and glued to an internal former deep within the fuselage. I myself have used this method but have never been totally happy doing so. If the undercarriage became bent or broken, it was nigh impossible to repair. My preferred method is to retain the undercarriage wire using saddles bolted to a plywood floorplate using captive nuts on the inside. This 1/8in ply plate is the next item to fit, again using epoxy. Place a piece of 1/4in x 1/4in strip across the tank hatch bearers at the point shown on the plan. The hatch itself is simply a piece of 1/8 balsa sheet cut to size. Without carrying out any further work on the tank bay at this stage, give the whole bay area a good thorough coat of fuelproofer and leave to dry. It will be seen that the tank bay is almost completely isolated from the radio compartment. So often have I witnessed fuel from a leaking tank or fuel line permeate items of radio equipment causing damage that I thought it prudent to include this feature in the interest of safety.

We need to drill the engine bulkhead to accept a commercially made engine mount. To do this, one must firstly find and mark the vertical centre line. Refer to the plan, find the thrustline and mark the bulkhead accordingly, Place the mount in the appropriate place on the bulkhead and make the centre of each bolt hole. Drill these to the required size. An advantage with this method is replaceability. It is far easier to replace in the event of damage.

F4 is made from a piece of 1/8in balsa sheet fixed cross-grain to the rear

of the fuselage. The ends need to be pulled in this operation (making sure the fuselage is symmetrical and not shaped like a banana). Cut the tailplane form 1/4in medium balsa and cyano in place. On the original Storm Petrel I used two 1/8in balsa sheets laminated together as an experiment, but I would not recommend it; for they tended to warp. Ordinary sheet can warp too so if the builder wishes, he may include pieces of 1/4in sheet let-in cross grain. Be careful not build the tail too heavy or the centre of gravity may be difficult to get right. Cover the fuselage bottom with 1/8in sheet laid cross-grain.

The fin is cut from 1/4in sheet also. The main body is epoxied to the tailplane and floor within the fuselage making sure it is vertical at 90 degrees. Make a right angle bend and a 45 degree bend in line in the 14 gauge tailwheel wire. Make a small hole in the tailplane at the base of the fin trailing edge and pass the wire through before bending to fit the tailwheel. Fit the 1/6in medium balsa top sheeting cross-grain with cyano but where it meets the main body of the fin, run a generous fillet of PVA along the join. Shape and cyano the smaller pieces of the to the top sheeting as per the plan. This 'spine' gives the fuselage still more strength.

Employing the tail-dragger configuration dispenses with the extra weight of a large nose-wheel. The tailwheel is steerable and locates into a pre-drilled hole in the rudder. Most of the hard shocks borne by the tailwheel on take-off and landing are absorbed by the tailplane and not by the rudder hinges as on so many aircraft. To give extra strength to the tailplane at the point where the tailwire exits the fuselage, a small 1/32in ply plate, an inch square, may glued before covering. The tailwire itself is relatively long giving it an amount of 'springing' making for even more shock absorbance and giving food ground clearance. It is nice to have a steerable tailwheel but be very careful when taxi-ing and please, do not taxi to or from the pits – this is a very dangerous practise.

The rudder and elevator are cut from 1/4in medium balsa to the pattern shown on the plan. I have used Mylar hinges which are simple to install and prove robust in service. The rudder is thicker in planform at the top than at the bottom. The top is well away from turbulence created by the wing and is therefore arguably more efficient. Returning to the front end of the fuselage, we next epoxy some scrap pieces of hardwood onto the bulkhead leaving a margin of 1/8in around the edges. This leaves space for the cowl when fitted. Fuelproof the outside of the bulkhead and pass the four engine mounting bolts through from the inside. At this point, I fit rubber 'O' rings over the threaded portion of the bolts before guiding the mount into place and securing with Nylon nuts. This helps to reduce noise resonance being transmitted to the wing where it is amplified, much like a drum. Remember to drill holes in the bulkhead for the fuel lines.

The cowl, like everything else, is easy to construct. When fitted, it looks pan of the aircraft yet still gives good cooling. When removed, (without the need to remove the propeller or silencer) it provides excellent access to the engine bolts, throttle linkage and fuel lines. Simply make two sides and a bottom, then glue them together. The sides should obviously follow the line of the fuselage and the bottom size can be worked out from this. The original cowl took me less than ten minutes to build.

The Storm Petrel is powered by a trusty old OS Max 20 fitted with a 9 x 4 Master propeller. When using 'Five per cent' fuel, she peaks and runs very well despite her age. She is not an overpowerful engine so do not be tempted to give her loads of side-thrust. Down-thrust is built into the aircraft and should be sufficient.

The undercarriage is made from 8 gauge piano wire bent to the pattern shown on the plan. It gives a favourable propeller clearance and is largely responsible for the dainty, almost 'daddy-longlegs' appearance- an altogether enhancing.characteristic. The 2in wheels are retained by wheel collets which are far easier to fit and remove than soldered washers, or washers fitted with epoxy. In fairness, a spot of Loctite inside the collet does no go amiss.

With engine mount in place, the builder is given a good idea where the throttle wire is going to run. I prefer a snake or the wire-in-plastic-tube linkage on such a short run but I leave that decision to the individual. The outer tube can be fitted after drilling the engine bulkhead and F2. Penultimately, the cabin front can be fitted together with the 3/16in wing band dowels. The dowels must be allowed to protrude by 3/4in. They can be sanded to a radius and given a dab of fuelproofer after covering. Finally, the fuselage should be sanded smooth with 400 grit sandpaper.

Wings next

The wings are remarkably light in weight but lose none of their resilience despite this. They employ the ubiquitous Clark Y section which is quite adequate for the Storm Petrel's needs. In fact, the wing configuration is possibly the most widely used design there is.

The wings are held in place with elastic bands as a precautionary measure. No matter how undesirable it may be, we must be prepared to crash our first model. Wingbands allow the wing to 'give' should the aircraft be landed wing-tip first. This lessens the risk of serious damage but can detract from the model's overall appearance. I once tried to encourage a band manufacturer to produce wingbands in various colours to match those of the heat-shrink films and fabrics, to no avail. Perhaps this article may spur someone into action if the rewards are found to be high enough.

Each wing is built flat on the building board directly over the plan. It is wise to afford the plan a little protection form modern fast-penetrating glues such as cyano acrylate. Clingfilm is possibly the best.

Begin the assembly cutting out the ribs, but remember that with the depth of the dihedral brace, the central ribs are effectively halved. Cut out the dihedral brace to the pattern shown on the plan. Be sure to use good quality ply as sold by most model shops and do not be tempted to use coarse grain exterior grade ply.

Lay the two bottom 1/4 x 1/4 hard balsa mainspars onto the plan and cyano the ribs onto the spars at the prescribed places, starting at the tip. For the time being, work only as far as the last complete rib outboard of the dihedral brace. The port wing is a mirror image of the starboard wing so a start can be made on this too. Next, cyano the top mainspars into position.

Assuming a classic taildragger pose; the design incorporates good ground clearance to minimise prop strikes.

Mark the centre line of the dihedral brace. This line runs directly between the two 'V' shapes. Place the brace against the top and bottom mainspar and mark where the dihedral brace centre line passes. Do this with both wing halves and cut the mainspars accordingly. Epoxy the brace in place, then fit the centre 'halved' ribs with cyano.

The bottom 1/16in sheeting is now glued in place. Be careful at every stage to ensure that the structure is free from warps. At this juncture, I generally run a bead of PVA glue around all joints for added strength and leave it overnight to dry. Fit the top 1/16in sheeting the next day followed by the vertical grain 1/16in balsa sheet webbing, the top and bottom rib capping strips and the 1/8in tip ribs. Lastly, epoxy the 1/16in ply pates on top of the upper centre sheeting at the points shown on the plan. When covered, these plates distribute the loads

imposed by the wing retaining bands.

As a footnote, I would like to mention a theory concerning wing tips and the propensity of a given wing to tip stalling. A wing generates lift by creating a high pressure area below the wing and a low pressure area above it. The differential between the two increases and decreases with airspeed. High pressure air is constantly trying to creep around the tip and destroy the partial vacuum. When, through lack of airspeed, equilibrium is restored, the wingtip no longer produces lift and drops - this is called tipstalling. An over simplification I know, but sufficient for our needs.

The Storm Petrel is quite light and therefore needs only a small amount of lift to become and remain airborne. This factor can be improved funher by incorporating a device in the wingtip to physically bar high pressure air from the upper surface.

On the Storm Petrel's mainplane, I have angled the tip ribs outwards at the top so giving an obtuse angle below. Air flows around the bottom of the rib easily and relatively quickly. However, with an acute angle at the top, the slightly faster air finds it harder to 'double-back' and destroy the lift. Anyway, that is the theory. I angled my tips outwards because they look better and I am sticking to it!

Finishing

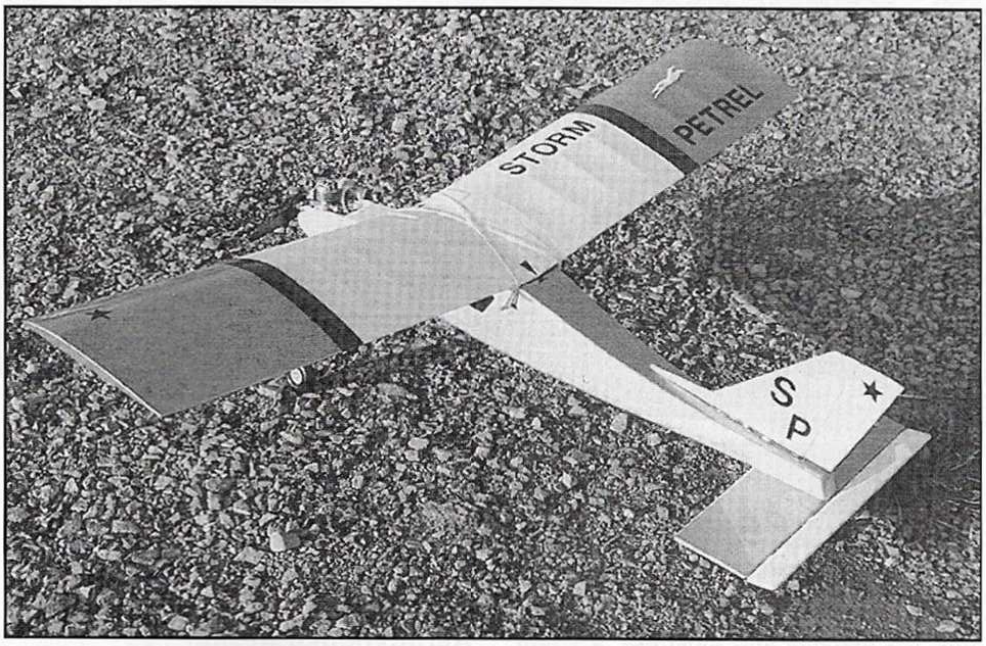
The aircraft is film covered throughout. The colour scheme I chose for the prototype may look impressive but it is not to be recommended. The yellow is not too bad but the red is very difficult to see against a grey sky.

Retrospectively it would have been much better to use the yellow outboard at the wingtips.

The motifs on the fuselage sides and wings were drawn freehand on card and cut out. Then, using the card as a template, the outline was drawn, then cut from because.

To be pedantic, the deeply forked tail shown on the bird motif is representative of Leaches Petrel rather than a Storm Petrel but I seek to reassure the reader that the overall appearance and flight performance is not likely to be troubled by this minor detail. Be sure though to include that tiny piece of self adhesive plastic for the eye. Without it the motif looks incomplete. It is desirable that all the edges of the chosen trim are sealed with a drop of fuelproofer to prevent fuel ingress and ultimately lifting. Be sure to fit small pieces of triangular plastic in the centre of the wing at the leading and trailing edges. These should be fitted so as to correspond with similar marks on the fuselage with the wing centrally placed.

When testing the centre of gravity, move the servos or engine forwards or backwards rather than be tempted to add lead weights. Try and keep her as light as possible.



Large area tailplane surfaces give good control response. Note the banded-on wing.

Flying

The Storm Petrel has been thoroughly flight tested and has proven to be a real gem. A number of people have flown the aircraft ranging from fully qualified instructors at one end of the spectrum, to my young daughter at the other. All have found the Storm Petrel easy to fly and, to use a word in common contemporary parlance, she is 'forgiving'.

Laura, my little girl, loves giving the stick full down then full up. She has not quite learned to use the throttle correctly but when she makes a mess of a loop, she knows the best policy is to let go of the sticks and let the Storm Petrel son herself out. She inevitably does given adequate height.

Generally, she flies so slowly when throttled back that one could almost reach out and catch her in mid-flight, although I am certain none of the RCM&E readership would be silly enough to try! My daughter's Storm Petrel flies straight and level in perfect calm with just three notches of throttle. There are one or two things to look out for during each flight. The first, and potentially the most dangerous point, is complacency. I once flew her straight into a leafless tree through waning concentration, so simple is she to control. The only damage was a slightly dislodged elevator – her good looks belying her rugged construction. Dainty she may be but fragile she most certainly is not.

I must say in all fairness, there are things she will not do. She will loop easily and stall turn with little trouble but inverted flight, outside loops and rolls are difficult. In her defence, she is not designed for such manoeuvres. Landing and taking off cross-wind is also not to be recommended. With all that dihedral, she can be blown about, especially at low airspeeds. It is far better to land and take-off directly into wind.

A gentle breeze is beneficial to the Storm Petrel. She has a shorter take-off run and is thus less prone to displacement due to unseen divots and small pot-holes in the landing strip. The landing approach is unusually long due to the aircraft's light wing loading - she seems to take ages to come down. Gentle is the operative word.

With the Editor's permission I would like to mention two young lads, Jonathan Phillips and Richard Davis. They both belong to the Burbage Model Aircraft Club of which I too am a member. It is truthful and accurate to say the Storm Petrel has had a profound effect on the 'learning curve' of Jonathan and Richard who have since progressed into the world of aerobatics.

With every aircraft I have ever owned. I religiously check the duration of the engine, Flat out from start to stop with a given tank capacity. The tank I have used in the Storm Petrel is a 4oz SLEC tank which nestles into the tankbay just right alongside an in-line nicad. From this size I get thirteen minutes flying time.

There still seems to be an inordinate number of fliers prepared to make unnecessary 'dead-stick' landings due to running out of fuel. Landings of this nature are fine provided the landing strip is clear but I have witnesses countless close shaves – too many.

I prefer to time my flights using a digital timer that incorporates an audible alarm so I do not have to take my eyes off the plane. I fly the Storm Petrel for ten minutes, at which point the alarm sounds and I begin to make my landing approach. If something untoward happens, I know I have a reserve of fuel in case I need to go round again.

Conclusion

As stated earlier, the primary reason for designing, building flying the Storm Petrel was for my daughter to learn to fly. To pass on the fruits of my labours to the public via the RCM&E for others to find enjoyment is a bonus.

I can state without fear of contradiction that the Storm Petrel is so easy to fly, a child could do it. I only wish I had a plane like it when I learned to fly. The little plane has drawn admiration from numerous modellers, some even asking where they can buy one from – and endorsement if ever one were needed.

If you are setting out for the time into the hobby and want a pleasant aircraft to fly rather than a hot rod, give the Storm Petrel a try – she will not let you down.