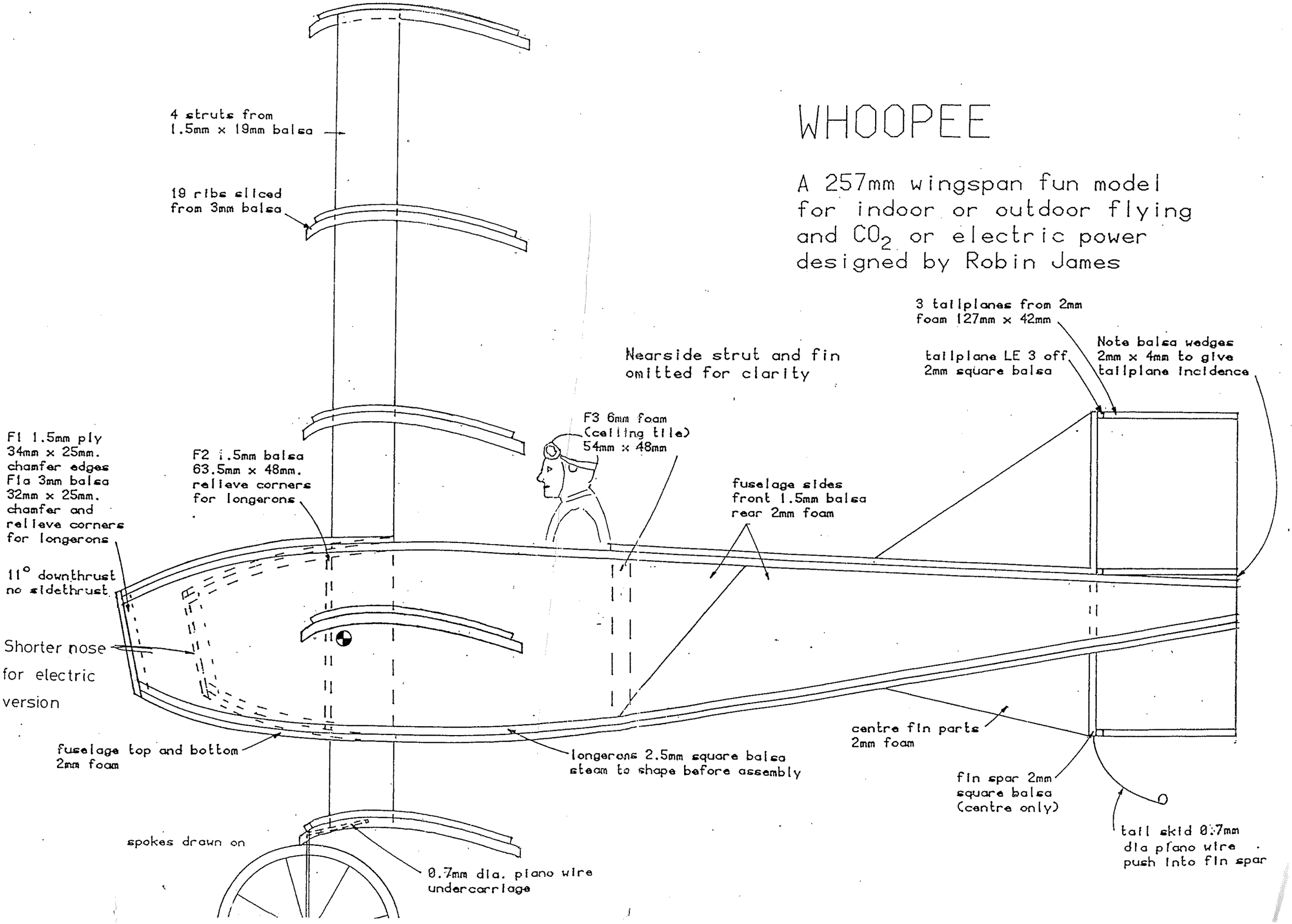
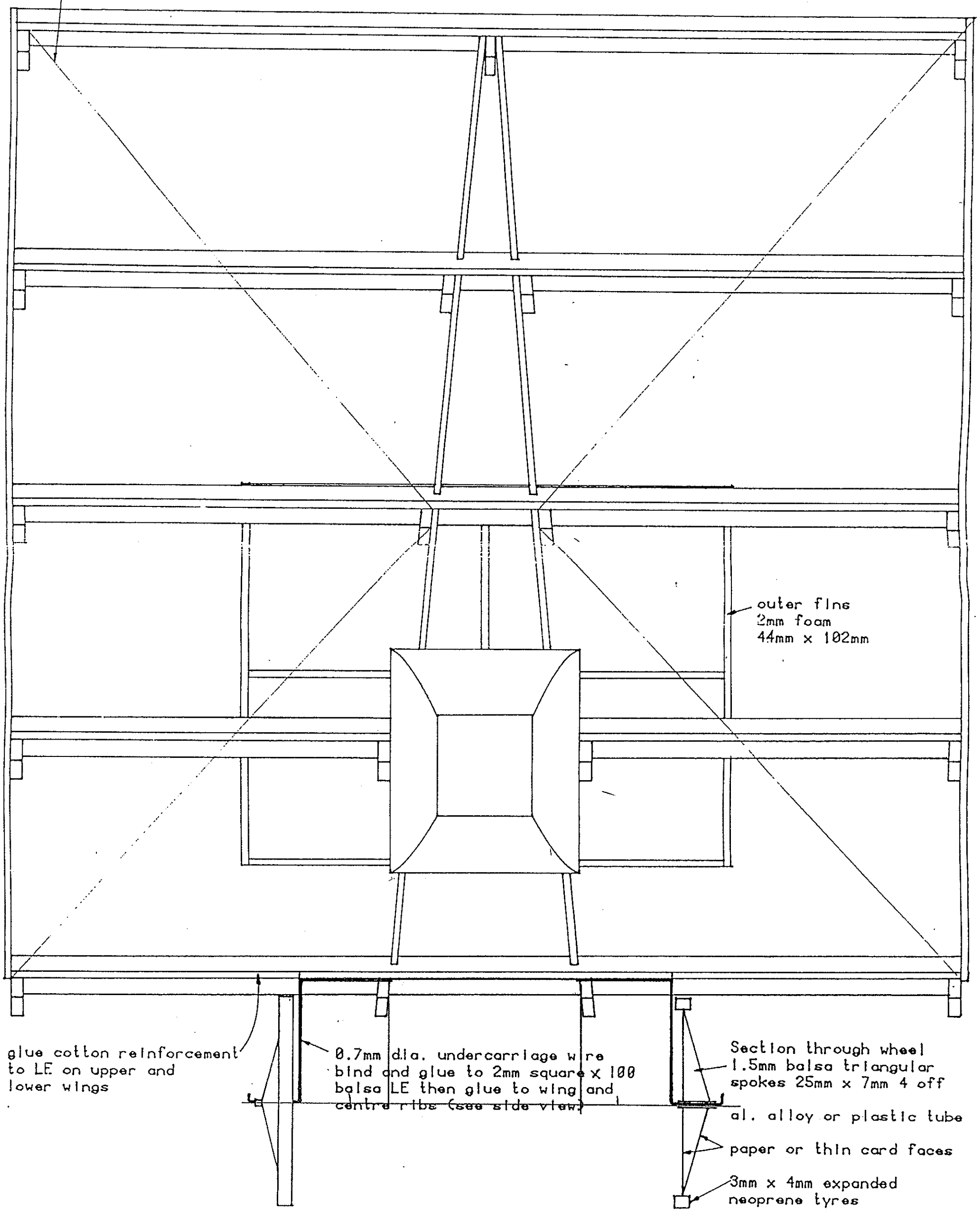
WHOOPEE

A 257mm wingspan fun model
for indoor or outdoor flying
and CO_2 or electric power
designed by Robin James



cut 5 wings from 2mm foam, 254mm x 64mm
note slots for centre struts:
top wing: no slot
second wing 13mm spacing
third wing 24mm spacing
bottom wing 46mm spacing

rigging wires from 'invisible' sewing thread
tie around ribs at leading edge
seal knots with glue



WHOOPPEE

Whoopee was designed as an indoor model to fly in a small hall. Many CO_2 models fly too fast for a small hall, so I needed plenty of wing area to give a low flying speed and a small wingspan to permit tight turns. A typical CO_2 powered indoor model weighs around 35 grams. Reducing the weight below 35 grams will give slower flying speeds but as the motor weighs 15 grams not much speed reduction can be obtained without resulting in a model which is too easily damaged. I decided therefore to build a compact model with more wing area, and to make it reasonably robust by not building it too light.

Question: how do you design a model with a very large wing area and a small wingspan? Answer: use plenty of wings! So Whoopee was born. It flies better than it looks as if it should! Why not build one? The good news is that there is no covering or finishing to be done!

At first sight it might seem as if this model has no lateral stability as there is no dihedral, but in fact the combination of side area and low centre of gravity give very adequate pendulum stability.

Choice of motors

This model has been flown with both electric and CO_2 power. The plan shows both versions- the electric version has a shorter nose to maintain the balance. As the Telco CO_2 motor weighs less than the Knight and Pridham electric motor it should technically be better for flying in a small hall. The weight is about 40 grams with CO_2 and 55 grams with electric. However in practice there does not seem to be much difference. The electric unit is more reliable, and both the power level and length of motor run can be set accurately and repeatably.

Materials

Much of this model is made of 2 mm polystyrene foam wall veneer. This is an excellent material for indoor models as it does not break on impact (unlike balsa), it is very light (being only half the weight of 0.8mm sheet balsa for the same area) and it is also very cheap! Also, it needs no sanding , covering or finishing. It is available from decorating shops (eg Fads): a roll of 30 feet costs a little over £1.

Adhesives

Balsa cement and cyanoacrylate (super glue) cannot be used as they dissolve the foam. Copydex can be used but has the disadvantage that eventually it falls apart, particularly when exposed to sunlight. White glue (PVA) is better, or, best of all, is so-called 'R/C modellers glue' which is available from Deluxe Materials. Both white glue and 'R/C modellers glue' are slow drying and require pins or thin strips of masking tape to hold the components in position while drying.

Assembly

Begin by cutting out the four struts and 19 ribs. Glue 5 ribs onto each outer strut over the plan, remembering to make one right hand and one left hand. While this is drying cut out the fuselage sides, longerons and formers, and 5 rectangles of foam for the wings. If you are using CO_2 power put in ventilation holes in F1 (below the engine) and F2 (behind the bottom of the tank). If you are using electric power cut out the hole in F1 for the motor using the template supplied, and cut a hole in F2 to clear the battery holder.

Steam the longerons to shape and cut out the slots for the centre

struts in wings 2, 3 and 5. These slots are 6 mm back from the leading edge, and the spacings are shown on the plan. Assemble the fuselage sides over the plan, remembering that the sides should be flush with the longerons on the outside. While these are drying cut out the components for the tail surfaces and glue the leading edges onto the tailplanes.

Cut out the components for the wheels and draw the spokes onto the flat discs. Assemble the wheels over a small hole drilled in the building board. "Uhu" in the yellow tube is the best glue I have found for this. Lay the flat disc over the hole in the building board and glue in the tube. The hole in the board allows the tube to protrude downwards by about 1.5mm. Next glue the balsa triangles in position. Lay the second disc (the one with the slit to allow it to be formed into a cone) in position and mark the positions of the spokes from the first disc. This disc can now be laid on a flat surface and the spokes drawn in. Apply glue to the spokes, hub and rim and then press the cone into position- start by putting one end onto a spoke then work round the rim and finally apply more glue and overlap the second end. When this has dried sufficiently lift it from the board and add the rim, from a stip of card or stout paper 4mm wide, and glue the tyre on, again using "Uhu".

Slide wings 2,3 and 5 onto the centre struts, approximately in position, then assemble these onto the outer struts and top wing, gluing the wings onto the outer ribs. You may find it helpful to pin two or three strips of wood across the outer struts to hold them in position during this operation. The inner ribs on these wings can now be glued in position onto the centre struts and wings. Use a rule laid along the leading and trailing edges to ensure that the wings are straight.

Assemble the rear fuselage, joining the sides at the rear and gluing F3 in position. Steam a curve into the fuselage sides at the front, being careful not to damage the foam. This makes the assembly of the fuselage onto the wing easier. Place former F2 over the plan and mark the positions of the centre wing struts. Glue F2 onto the centre struts. When these parts are dry the fuselage can be assembled onto the wing. Pull in the fuselage sides at the nose to hold F1 and F2 in position. Retain in position with small rubber bands. Note that F1b goes between the fuselage sides but F1a is wider, extending to the outside of the fuselage sides. Add the 2mm foam fuselage top and bottom. The fuselage top finishes at the tailplane leading edge.

Glue the two remaining wing ribs onto the fuselage sides, measuring with a ruler from the wings above and below to ensure alignment. The tail surfaces can now be added starting with the tailplane support wedges and the centre tailplane. Then build the centre fin. First cut holes in the fuselage top and bottom decks for the fin spar, and then add the four sections of 2mm foam that make up the centre fin. Lastly add the outer fins and top and bottom tailplanes. The remaining wing can now be trimmed to fit each side and glued in position.

The one piece undercarriage wire is bent to shape then bound (with cotton) and glued lightly to a piece of 2mm square hard balsa 100 mm long before being glued to the leading edge of the lower wing. The undercarriage wire runs along the inside edges of the centre ribs on the lower wing for a distance of 20mm or so, and is tacked in place with PVA. The wheels are retained by bending the end of the wire as shown on the plan.

Install the engine. I use tapped holes in the plywood former (strengthened with cyanoacrylate) rather than messing around with those fiddly little nuts which always get lost on the bench or worse still in the grass. Finally add the rigging wires from invisible sewing thread or very thin nylon line, and reinforce the leading edges of the upper and

lower wings by gluing a piece of cotton in place.

Finishing

This model requires no covering or finishing! When you have finished assembling it, it is ready to go! If you really want to add some colour I suggest a thin coat of Tamiya paint sprayed on. This paint is water based and so does not attack the foam. It gives a good colour even with a very thin coat and adds hardly any weight.

Flying

The centre of gravity should be about 8 to 10 mm behind the leading edge, it does not seem to be very critical. Whoopee should be trimmed to turn left, and can be made to turn very tightly, which means it can be flown in a very small hall. It does very nice take offs and landings.

CO_2 version With the CO_2 version, test glides are best done with the engine running very slowly. The model should descend and land gently on its wheels. Adjust the turn by bending the rudders, and cure a stall or dive by bending the elevators or adding weight to the nose or tail as appropriate. Gradually increase the power until the model starts to climb. Trim adjustments at high power are made by altering the thrustline, up or down or to the side as required. Any excessive bank can be controlled by bending in 'aileron' to the trailing edges of the wings. Flight duration is about 30 seconds on a liquid charge.

At very high power the torque causes the model to fly in a very tight circle at a very steep angle of bank, almost looping in the horizontal plane, and without climbing much. I have found that changing to a Knight and Pridham propeller cut down to 120 mm diameter results in a higher climb and a longer flight. This is because the torque is reduced: the engine produces the same power at higher RPM and lower torque. When cutting down propellers, remove the propeller from the model and mark each blade with a pair of compasses, inserting the point of the compasses in the centre hole. Cut each blade accurately with a pair of scissors. This way the propeller stays balanced.

Electric version With the electric version I elected to reduce the power by cutting down the propeller diameter. This gives very consistent results and gives a longer flight time. Initial trimming was done outdoors and I found that cutting down the propeller to 120 mm diameter gave an increased rate of climb, owing to the reduced torque already mentioned. I would recommend the use of a Knight and Pridham propeller cut down to 120 mm diameter for flying outdoors. The rate of climb is much too high for trimming indoors: I would suggest a propeller diameter of 110 mm for initial trimming indoors, with a very short motor run (10 seconds charge).

Make trimming adjustments to the model as described above. If the rate of climb is too high gradually cut down the propeller, cutting about 1.5 mm off each blade at each step. Increase the charge time when it is seen that the model will not climb too high. Under a ceiling of about 10 or 12 feet I ended up with a propeller diameter of 100 mm, which with a 50% charge (1 1/2 minutes) gave a flight time of 30 seconds, including a take off from the ground. Under a high ceiling, with a 110 mm diameter propeller and on a full charge the flight time was 60 seconds.

The slow flight and generous side area result in a model that has no vicious tendencies, and if upset it quickly returns to equilibrium: any oscillations are well damped.