JIMMY

BUILDING INSTRUCTIONS

Build the JIMMY, a radio controlled model aeroplane especially designed for the first time builder or flyer.

The JIMMY is a model plane which is easy to be built by a first time builder, and can be flown by a novice pilot. The design is based on a number of pre-cut parts in balsa wood or poplar plywood.

To build the plane, you will need some tools and glue. Here is a summary:

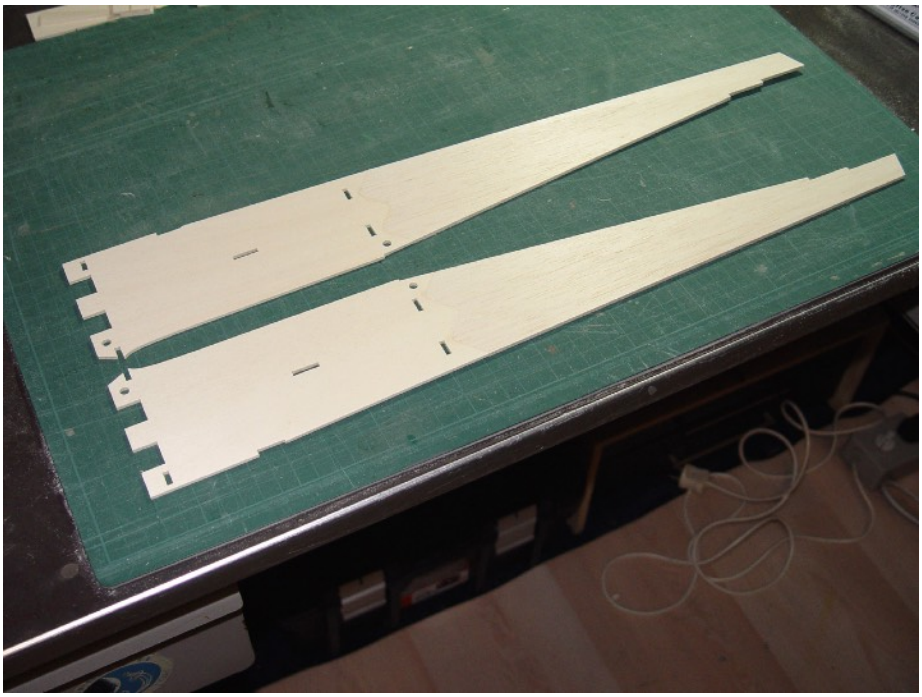
1. A sharp hobby knife, such as a small sized, break-off blades type.
2. A sanding block, a wooden block with a piece of sanding paper stuck to it with double sided sticky tape. Use grit size 150. Make a second block with 100 or 120 grit to trim the edges of the plywood parts. This will wear it off a bit faster, so you can keep the 150 grit block fresh for the balsa parts.
3. Dressmaker's pins to keep the parts in place during drying of the glue. Use only glass headed pins, the ones with plastic heads tend to lose their head when a bit of force is applied, ending up with an unpleasant hole in your finger. Special modelling pins are also available. To assemble plywood parts it is best to use short pin board pins, which have a stout grip.
4. Clothespins/pegs for the same purpose. You can use ordinary clothespins, but they tend to leave traces on the soft balsa. Purpose made little clamps are better, look at the pictures to get the idea.
5. Glue. PVA glue is the most suitable, since it will give you some time to adjust the parts to their proper position, and surplus glue can easily be removed with a piece of wood, or just use your fingers. PVA glue will clean off the skin without problems before it sets.
6. Building board, MDF, minimum thickness 12 mm when you can support it on a flat surface, but thicker when standing on its own. Make sure it is flat and not warped.

The parts will be supplied while still fixed in the balsa or ply sheet material from which they are cut, and your first task is to release them by cutting the bridges with a sharp knife. Sand off the remainder carefully, beware of changing the shape of the part by too much sanding.

Dry-fit each part before applying glue to ensure a proper fit, and adjust where necessary.

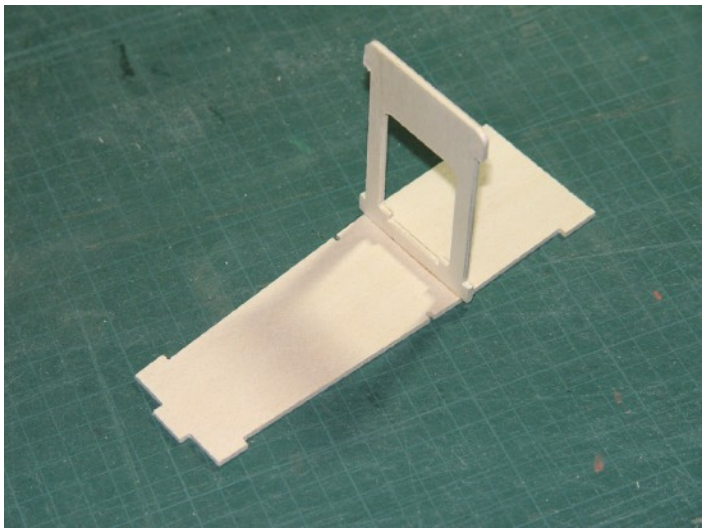
Please note: In the following instructions right hand and left hand are referred to as seen in the flying direction, i.e. looking from the rear to the front.

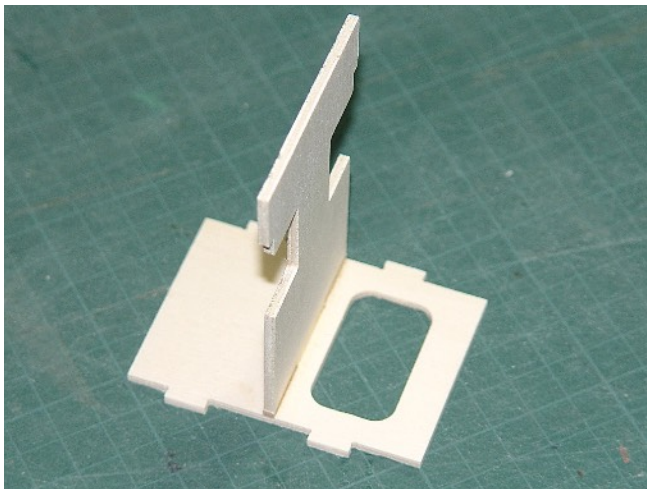
Start with building the fuselage. Pick the side panels up and lay them on a plastic sheet to prevent them from sticking to your work surface. Glue the balsa side panels to the ply parts using the zigzags to align them. Check the picture below for their orientation.



Lay down the bottom panel. Note that the front is not square, but at an angle to the right. This will offset the propellor thrust direction to the right, which is necessary to compensate for the air flow twist caused by the anti-clockwise rotation (as seen from the front) of the propellor. So check that the right hand edge of the bottom panel is shorter than the left hand edge.

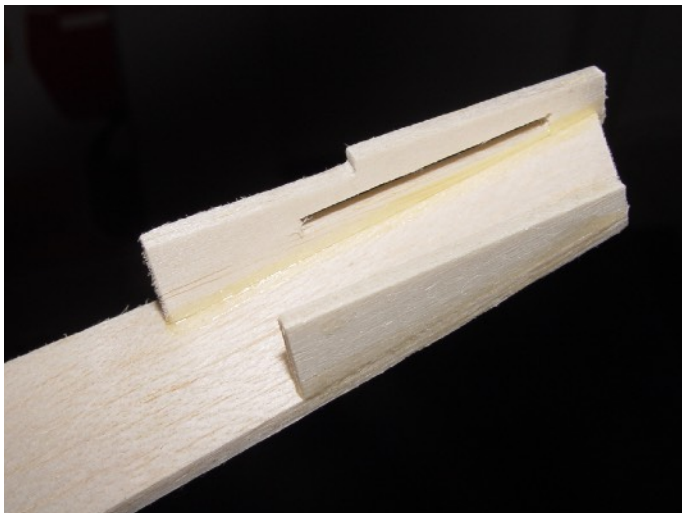
Glue the main former to the bottom panel, make sure it sits square to the bottom.



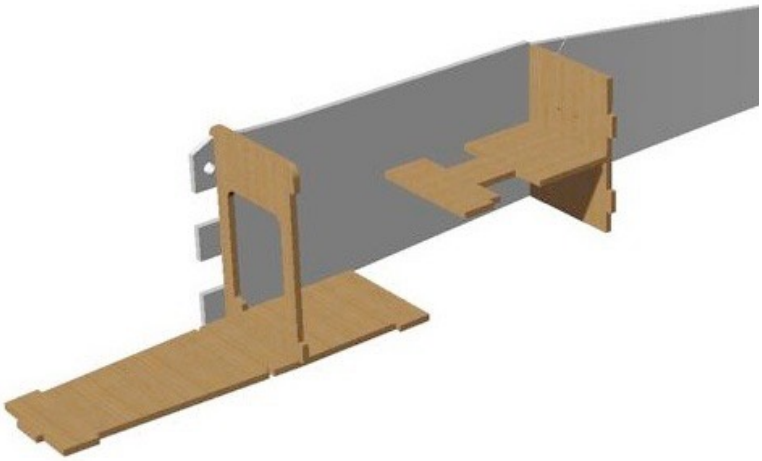


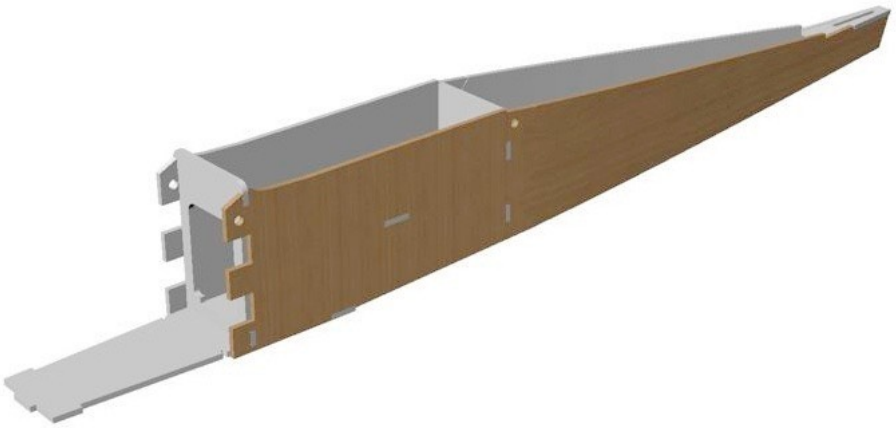
Glue the servo mounting plate to the rear former, check the squareness again (the rear former differs slightly from the picture).

The stabiliser support (balsa) and tail skid support (ply) parts are glued to the right hand side panel.



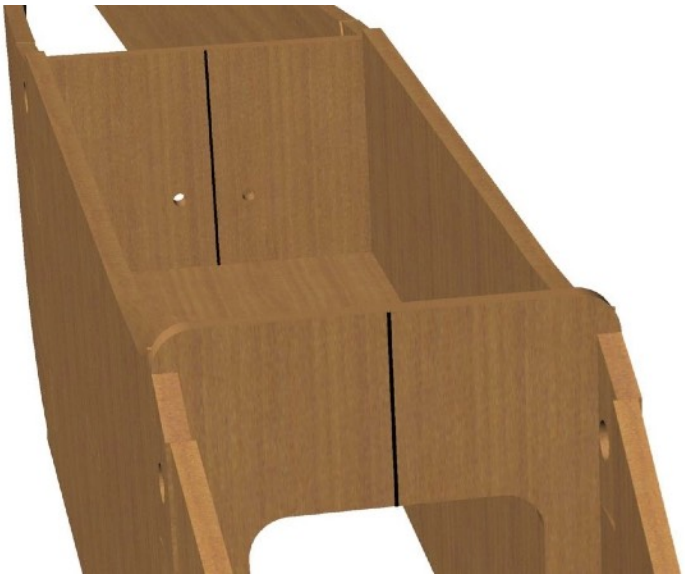
Glue the assemblies as prepared in the previous steps to the right hand side panel. Before the glue sets, glue the left hand side panel in place, and ballast the complete assembly with a weight of your choice. The bottom picture shows the tail end glued together, don't do this as yet, as this will be explained in detail in the next steps!





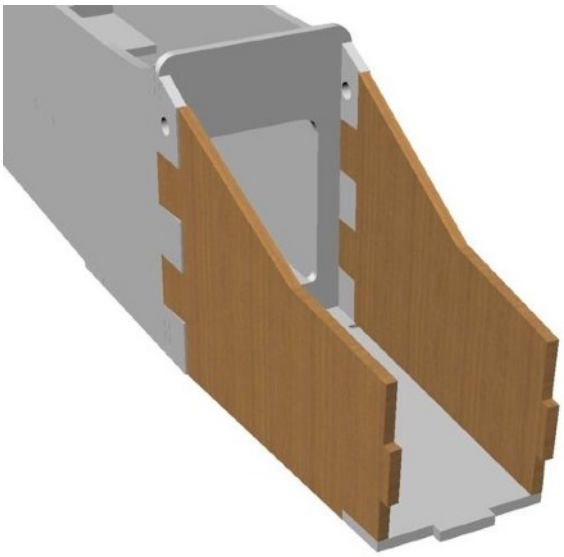
An old iron as shown in this picture of another model under construction is perfect.

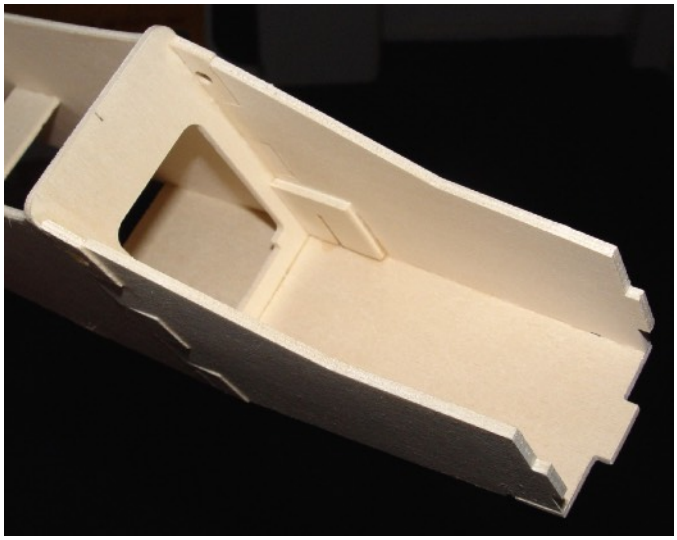
Mark the center of the two formers with a vertical pencil line, and……



line them up by sighting the two pencil lines and glue the side panels together ensuring their symmetry by aligning the stabiliser support slot with those lines:

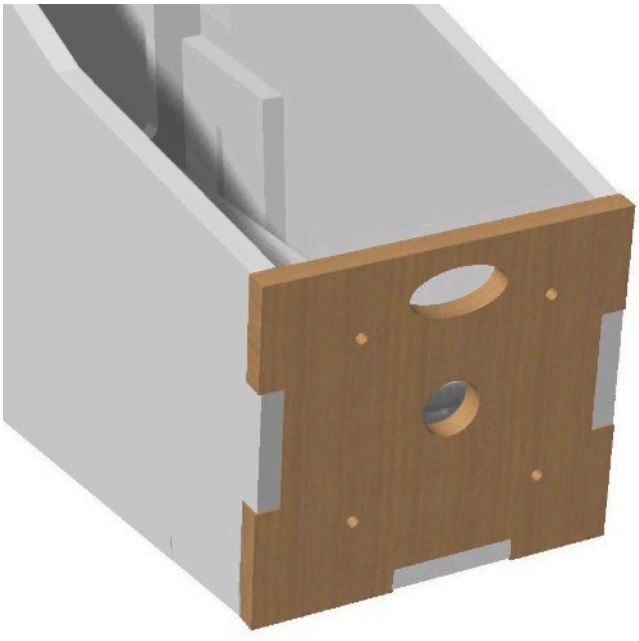
Complete the nose. The side panels first, the shortest one on the right. Apply glue to the teeth and on the side of the bottom panel. Slide the teeth into those on the fuselage sides and swing the sides inwards to close the joint with the bottom panel. Clamping may be a bit difficult, so use pins or tape to fix the joints.



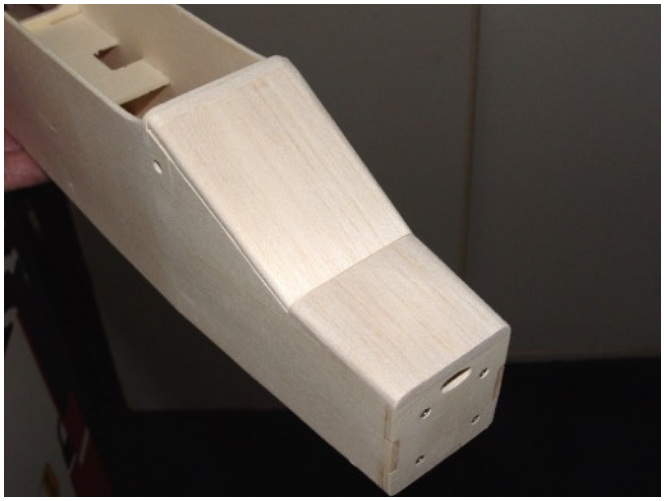


Use the mounting cross included with your motor to establish the correct position of the self tapping mounting screws. Center the cross over the hole in the middle of the firewall, mark the mounting holes and pre-drill the holes with an appropriate size drill. Screw the cross in place temporarily, do not over tighten the screws. Unscrew it again. When available, harden the screw holes with thin cyano glue, alternatively glue some scrap plywood pieces on the back side to provide more ”flesh” for the screw thread. Dry-fit the firewall. Slightly bevel the recessed surfaces of the side and bottom panels to provide a nice fit of the gluing surfaces, but do not overdo it to avoid altering the side and down thrust angles of the motor/propellor. Glue the firewall in position.

Glue the captive parts for the landing gear leg ends to the sides. Orient the parts such that the slot corresponds with the opening in the bottom panel. Clamping will be a bit difficult, fix the parts with pins or sand a bit of balsa scrap to size and push it between the parts. Keep the slot and the bottom opening free from glue, any excess should be removed with a matchstick or similar to enable sliding in the L/G legs from below.

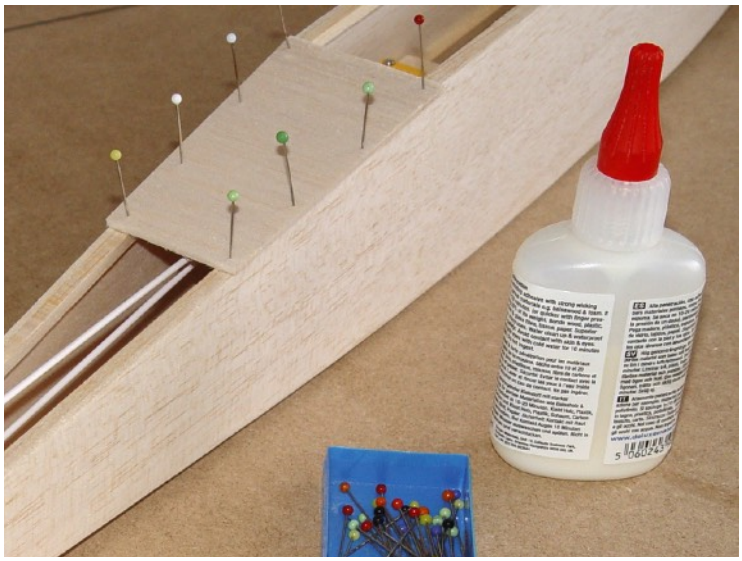


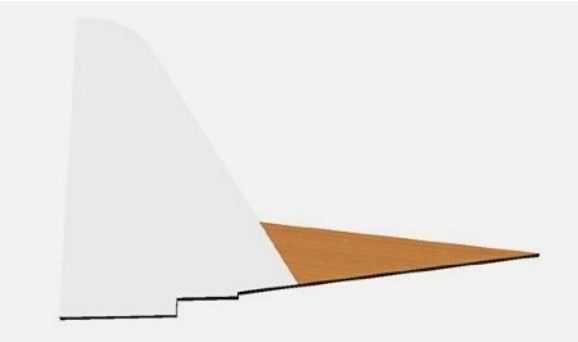
Glue the front part of the nose top in place, and sand it to shape after the glue has set. Sand the rear part to size but do not glue it to the fuselage. This part serves as battery and motor controller access hatch, and should be kept removable.



Dry-fit the control cable support in the rear end of the fuselage. Slide the outer control cables through the holes in the rear former and the rear support. The rear end of the cables should just protrude from the fuselage, the elevator cable through the opening at the rear of the fuselage, and the rudder cable through the top, accounting for the 1.5 mm top planking of the fuselage still to be fitted. The front end should protrude some 10-15 mm through the holes in the rear former. Check the drawing for the exact routing of the cables, and glue everything in place. It is important to run the rudder cable in such a way that the steel inner cable only needs a minimum of bending on its way to the rudder control horn.

Glue the top and bottom planking of the fuselage, with the grain direction across. Fix with dress pins. Start at the front with a slightly oversized piece, and continue to the rear by holding the balsa sheet against the previous piece, mark the size with a pencil, cut slightly oversized again, and glue in place. Maintain 2-3 mm oversize, and sand flush with the fuselage sides later.





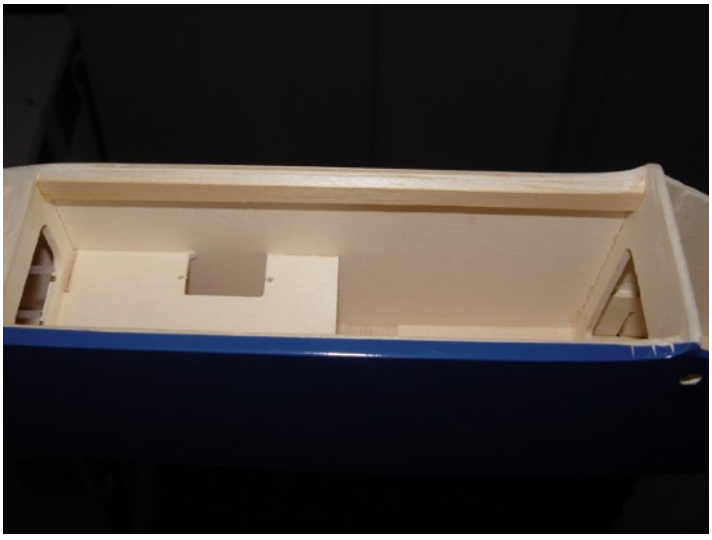
Prepare the 3 mm balsa tail surfaces, but wait with glueing those to the fuselage until after the iron-on covering has been applied. Glue the two pieces of the tail fin together, sand smooth and round the front and top edges. The rear edge shall remain squared since this is where the rudder hinges.

Sand the stabiliser smooth and round all edges except the rear edge, the elevator hinges here.
Bevel the front edges of the rudder and elevator parts at an angle of approx 40 degrees to allow deflection to either side (no picture, see drawing).

Glue two 50x8x2 mm pine pieces to the fuselage bottom, on either side of the removable landing gear. To adjust their position, temporarily slide the L/G legs into their mounting holes with the wires against each other, apply glue to the pine parts, position them close to the L/G wires and slide these against the wires while the glue is still wet. Remove the legs carefully without moving the pine parts and remove any excess glue.

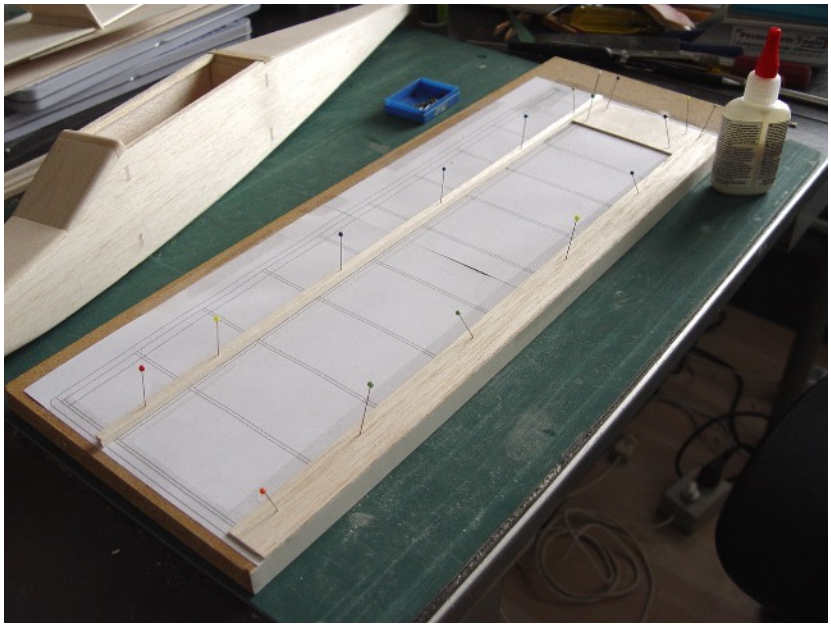
Glue the 3 mm ply tail skid directly to its ply support after making a slot in the balsa planking that covers it (no picture, see drawing).

Finally, add a strip 3 mm balsa to the inside of the fuselage sides at the wing rest, and bevel these to the dihedral angle of the wing to give it a larger supporting surface. This does not add any strength or rigidity, but it avoids indenting the wing bottom surface.

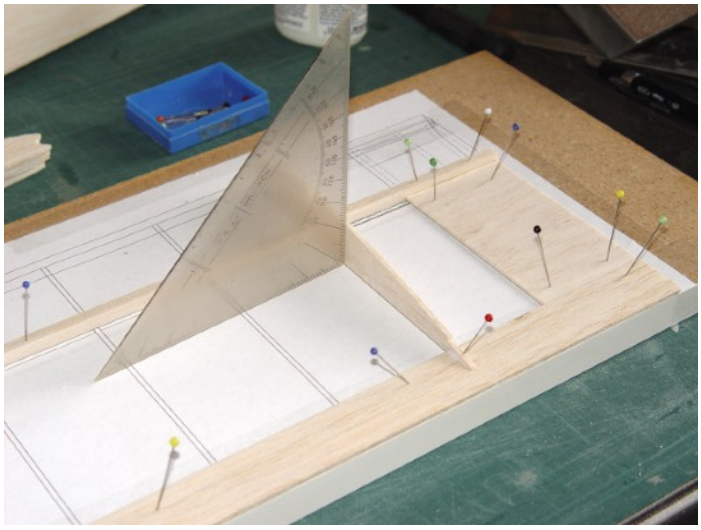


Wing

The wing will be built on top of the drawing, so start by getting a building board made out of a piece of mdf or chipboard of sufficient size for one half wing. Stick the drawing to the building board with tape, and cover the drawing with transparent plastic sheet to prevent glueing the parts to the drawing. As an alternative, you can cover the drawing with tape where parts will be glued together and touch the drawing, i.e. all ribs to the lower spar and to the trailing edge. The leading edge will stay clear of the drawing, so no need to protect the drawing there.

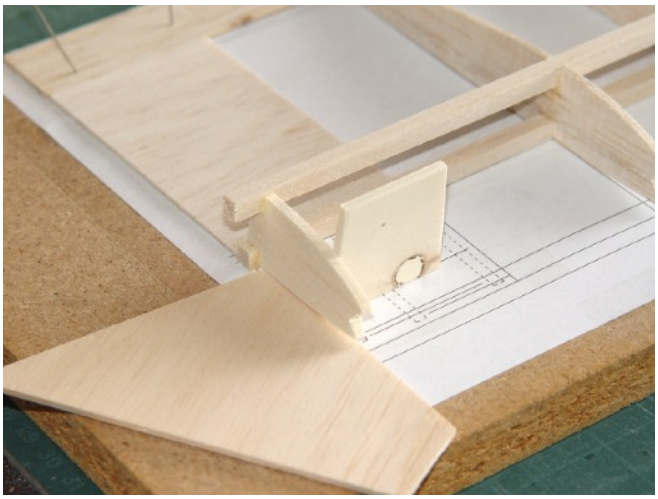


Fix the 6x6 mm lower spar to the building board with pins. Accurately cut a piece of 1.5 mm balsa to size for the planking of the root part and glue it to the lower spar. Fix this planking to the building board with pins. The trailing edge consists of a lower and an upper part made from 1.5 mm balsa sheet. Cut the lower part to size, and glue it to the rear edge of the planking and fix the rest of it with pins. Ensure that the lower trailing edge sits flat on the drawing board and exactly matches the spanwise lines on the drawing (a little oversize on the ends is ok).



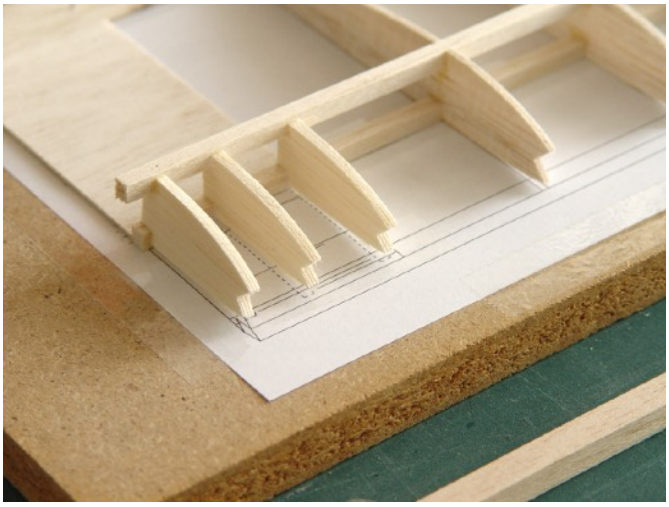
Glue the 9 outer ribs (2 mm balsa) to the lower spar and the trailing edge in the positions indicated on the drawing. Ensure that the ribs stand square to the building board and that the bottom edge of each rib rests on it.

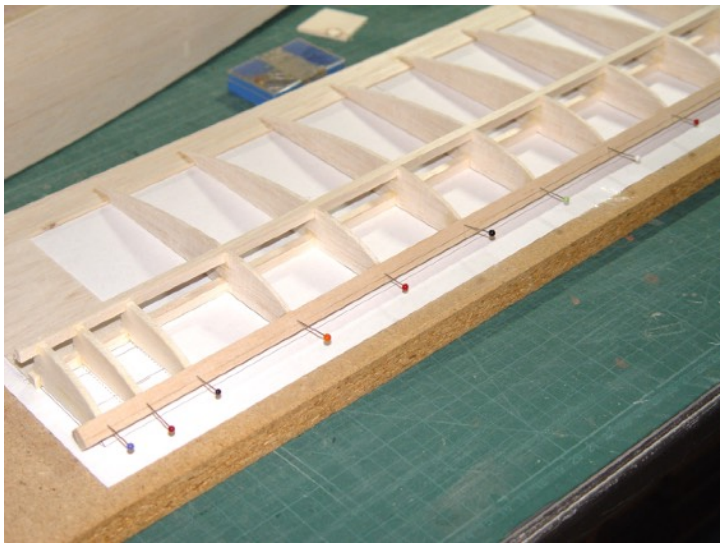
Check the fit of the upper spar in the ribs. The fit should be tight, but not overly so. Adjust the cut-outs in the ribs where necessary. Glue the upper spar in position.



Now for a slightly tricky bit: the root ribs are in two parts each, a front and a rear part. They are glued in a sequence combined with the wing dihedral brace: front parts first, then the brace, and lastly the rear part. An extra complication is that the first root rib has to be angled so that it matches its counterpart on the other wing half. Start with the front part of rib #1. Glue it at the required angle using the 3 mm ply template provided, checking alignment with the drawing by looking from above. Slip a piece of 1.5 mm scrap balsa underneath to allow for the planking thickness. Check the front cut-out alignment by sighting and comparing it with the other ribs, or hold the leading edge against it. Told you it was tricky…

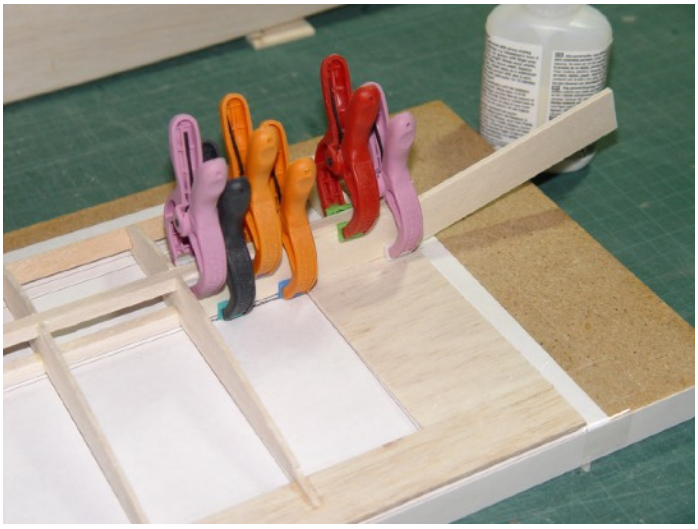
Glue the two other root rib front parts in place, square and upright. Test the front cut-out alignment.

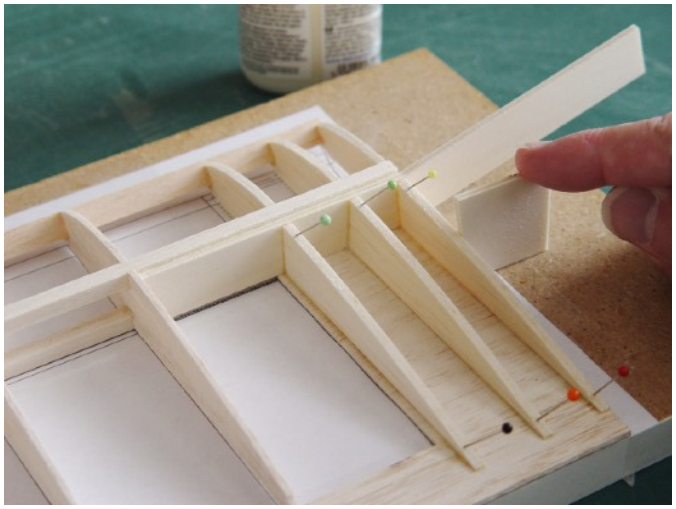




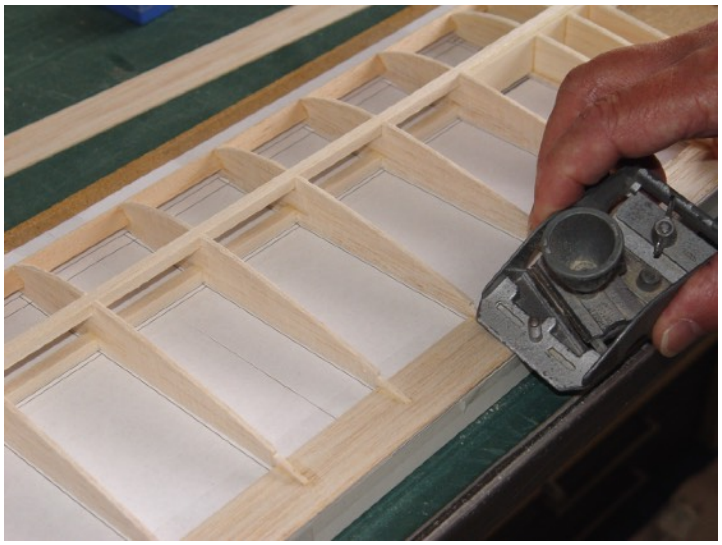
Glue the 8x8 mm leading edge in the cut-outs of the ribs, and temporarily fix it with pins as shown in the picture.

Glue the ply dihedral brace to the rear of the spars and to the bottom planking. The dihedral brace dictates the way the two wing halves fit together, so ensure that the underside is parallel to the building board. The kink in the brace should exactly match the position of the slanted front rib part. If necessary, sand a little off the end of the brace to achieve this. Be sure to clamp the brace to the spars until the glue has set.

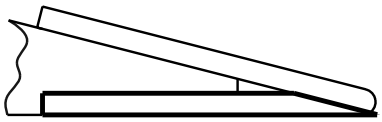


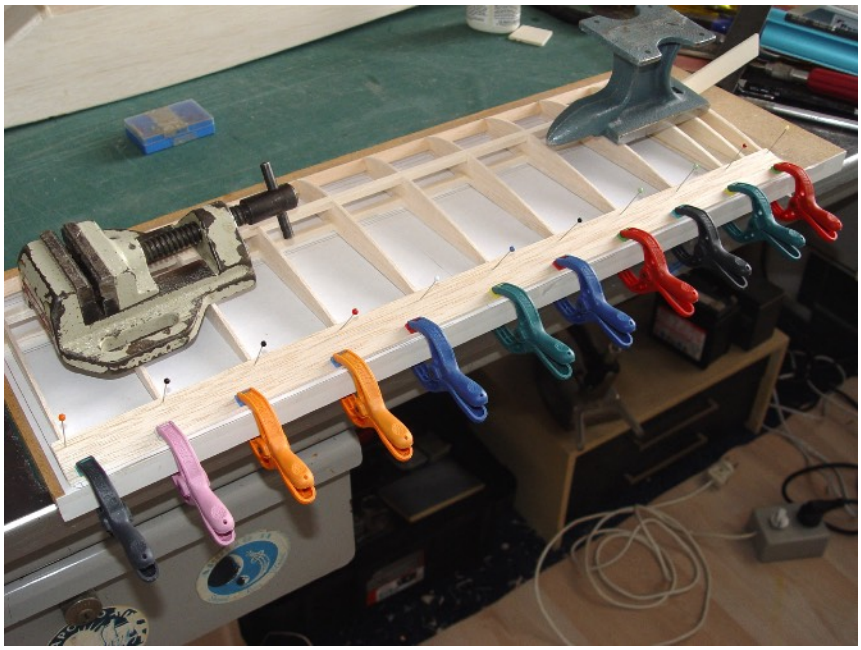


Glue the rear parts of the 3 mm balsa root ribs onto the bottom planking and against the dihedral brace. The first rib is again angled at the same angle as the front part (check with the template), and at right angles to the spars.

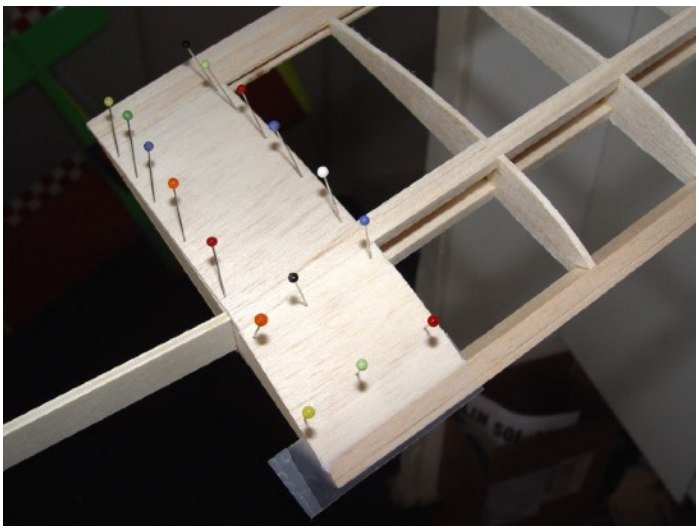


Use a plane to shave the bottom trailing edge to an angle, such that the top trailing edge fits flat in the rib cut-outs and on the bottom trailing edge. Ensure the top butts against the front of the cut-outs. Glue the top in place and use pins and clamps to keep it in place while the glue sets:



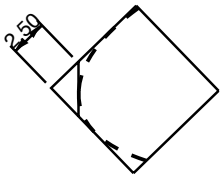


Cut and sand the last 2 planking sections to size, and glue/pin in place. Sand the excess planking and spars off, flush with the slanted first rib. The other wing half should fit against this.

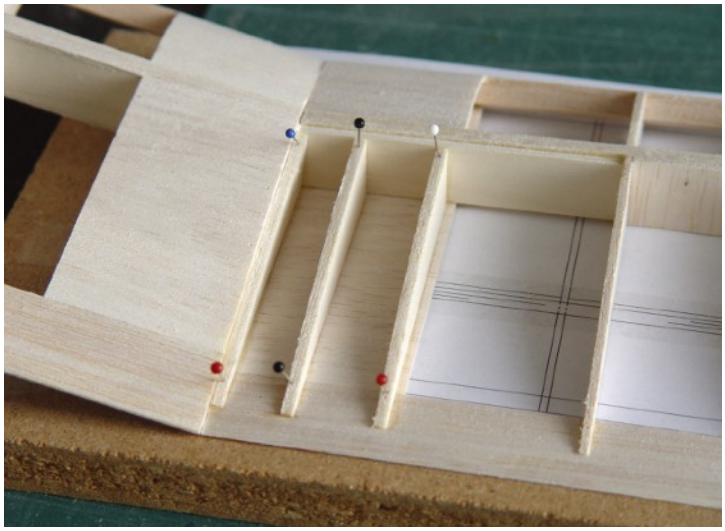


Cut the 1.5 mm balsa webbing pieces to size. These are the rectangular pieces which are glued between the ribs to the rear of the spars, **with the grain vertical!**

Shape the leading edge to the correct cross section. The easiest way is to mark the balsa strip with two pencil lines 2.5 mm offset from the front edge, and start shaving it vertically up to these lines. After that shave and sand to its final shape:



Sand the spars, leading and trailing edges flush with the outer rib. Glue the 5 mm balsa end ribs on and sand the edges to match the last rib. Round off the outer edges.



The second half wing is constructed the same way as the first, except that the dihedral brace, the rear part of the root ribs, the top planking, and the top trailing edge are all left to be completed until after the two halves are glued together.
Support the completed half wing at the tip with a 120 mm high stack of books, blocks, etc., and rest the root on the building board. Offer up the second half, and fettle the joint until you have an exact fit. Glue the two halves together. Be sure to clamp the dihedral brace to the spars until the glue has set.

Glue the rear root rib parts in place. Glue the top trailing edge and the 1.5 mm top planking in place.

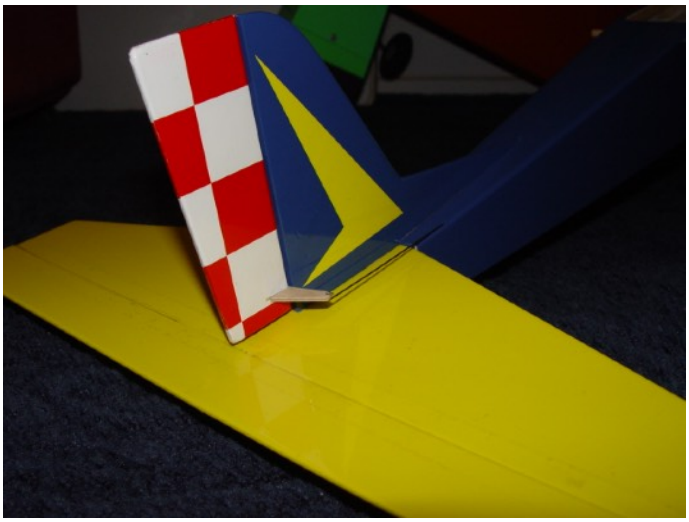
To avoid any damage caused by the rubber bands that hold the wing down it is best to add two rounded pine strips at the trailing edge of the wing. Try the wing to fuselage fit first, and adjust the position of the pine strips such that they are just in front of the rear former of the fuselage, as the V-form of the wing makes it sink slightly into the fuselage aperture.

Finishing

Wing and fuselage are now ready to get their final finish. Sand everything smooth, and round the corners of the fuselage. Do not overdo it, avoid reducing the glue areas too much. The simplest way to finish all surfaces and open structures is to use iron-on covering film. It is important to apply the covering at a low temperature setting of your iron to reduce initial shrinking, and only when everything is attached properly raise the temperature to tighten the covering and remove any wrinkles. This is especially important with open structures, i.e. the wing, which should be covered at low setting on top and bottom first, and only then raise the setting to tighten it evenly. Be careful not to introduce warping of the wing, but when you do you can iron those out by ”counter-warping” the wing by weighting one half down on the board and carefully rotate the other tip by hand, reheat the covering and let it cool before you release it.
It will be difficult to describe the details of iron-on covering in a few words, best is to let an experienced modeller show you how it’s done, or refer to the instructions of the iron-on film supplier, e.g. Solarfilm, Oracover and others.

As mentioned before, the tail surfaces are best covered before final assembly. Leave the area to be glued to the fuselage free from covering.
Mark the position of the rudder horns, cut a slot and glue the horns to the control surfaces. Check the drawing for the exact positioning of the horns.

Attach the elevator to the stabiliser with sticky tape. Stick the tape to the top of the stabiliser, leaving one half past the edge to stick to the elevator. To ensure a minimum hinge gap and a maximum deflection angle, hold the elevator in a downward attitude against the rear edge of the stabiliser and push down the tape onto the elevator.
Attach the rudder in the same way, pay attention to the bevel on the front edge of the rudder.



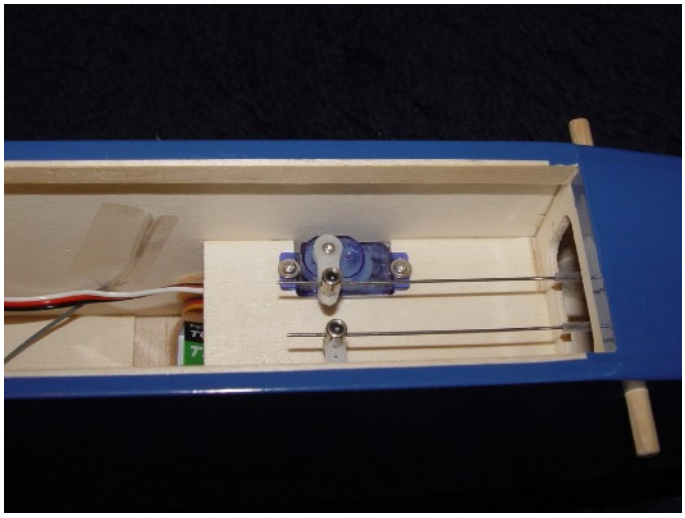
Propulsion and controls

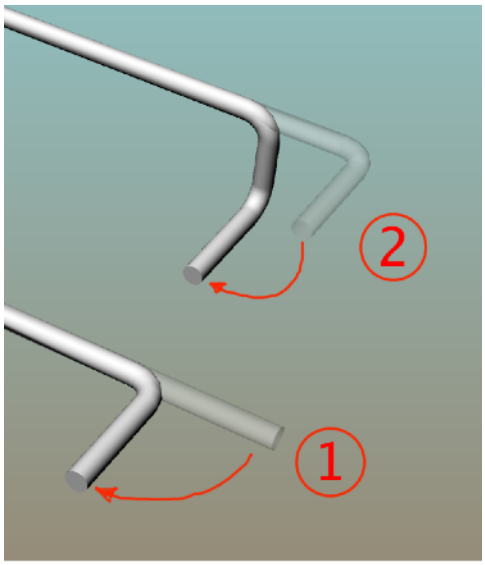
Propellor, r.p.m. and battery voltage can be applied in different combinations to achieve appropriate propulsion. The following combination works well on the prototype:

Battery: 3s lipo type, 1000mAh, which stands for 3 cells in series (= nominal voltage 11.1V) with a capacity of 1000 milliAmpere/hour
Motor: outrunner 100W type, 1100KV (1100KV = 1100 r.p.m. per Volt)
Propellor: 7 x 4 (= 7 inch diameter, 4 inch pitch)

What remains is to choose a motor controller a.k.a. ESC (= Electronic Speed Controller). Although current draw of the combination as described above will be around 10A maximum, it makes sense to choose an ESC suitable for a maximum continuous current of 20-25A. A BEC (= Battery Elimination Circuit) supplies power to the receiver and servos) is integral with most ESCs, if not it will have to be added separately.

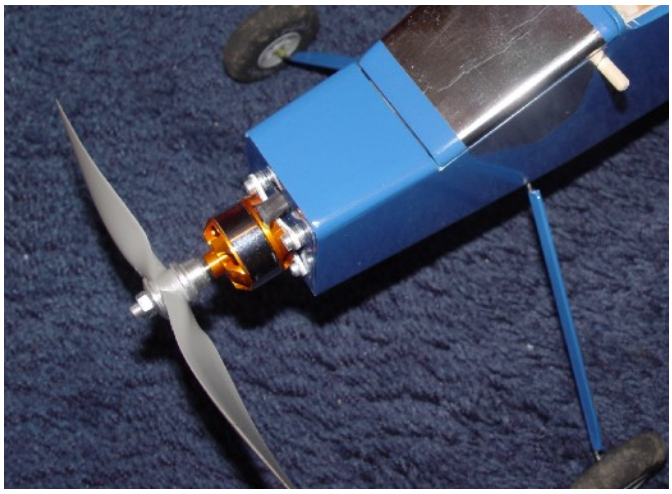
The rudder and elevator pushrods are connected to the servo arms with cylindrical connectors into which the pushrod is clamped with a setscrew. Drill the hole in the arm which is approx. 10 mm from the servo center to the correct diameter (usually 1 or 2 mm) to receive the connector, which should be free to rotate with a minimum of play. Mount the connectors on the arms and mount the servos in the dedicated openings.

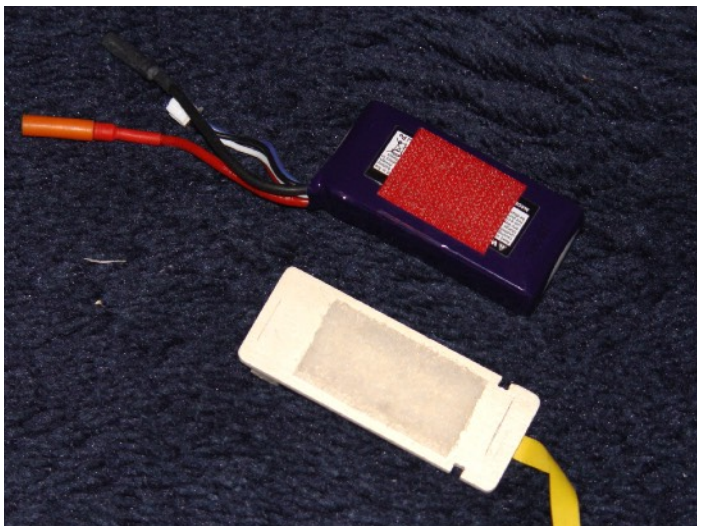




Cut the two pushrods from a length of 0.8 mm dia. pianowire. Bend the ends in two steps as shown in the picture, leaving approx. 2 mm straight where it rotates in the control horn. Slide the pushrods into the control cables in the fuselage from behind, pass them through the servo connectors and twist the bent end into the hole of the control horn, see the pictures on the previous page.
Make sure the servo is in its neutral position with the arm at 90 degrees, and fasten the setscrews of the connectors

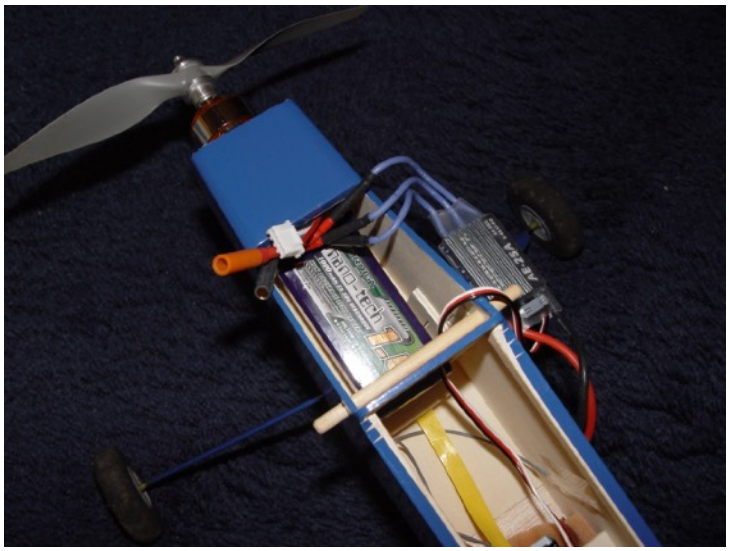
Solder 2 mm dia. gold connectors to the motor and ESC, and insulate with heat-shrink tubing. Push the motor wires through the opening in the firewall and connect them to the ESC. Mount the motor (without propellor!) to the firewall with two screws, temporarily connect the battery and check that the motor runs counter-clockwise. If not, take the motor off again, pull the connectors clear, swap two of them and push them in again. Mount the motor permanently with all screws. Do not mount the propellor as yet, see the ”Control Adjustments” chapter.

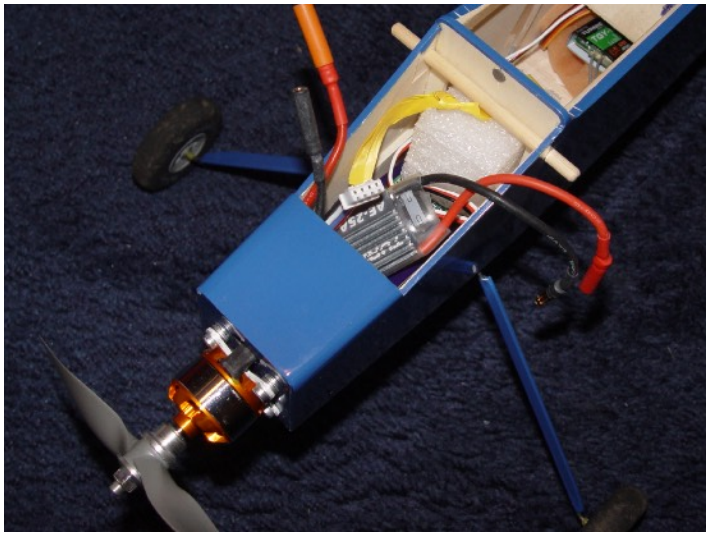




Use velcro to mount the battery onto the battery carrier plate. This will allow to mount the battery in various positions to adjust the balancing point (a.k.a. the Center of Gravity or CG) of the plane.

The battery carrier plate remains removable to simplify removing the battery for charging, but the notches in both sides lock into the bottom of the opening in the main former to keep it in place. The battery has to be immobilised further with a piece of foam of sufficient stiffness stuffed into the opening of the main former.





The ESC remains loosely pushed in place above the battery and under the nose top cover. It will have to be pulled back partly to allow the battery to be removed for charging. Space is limited, but it should be just enough to close the hatch.
Connect the servos and the ESC to the receiver, find a place for it and immobilise it with a piece of foam, and route and fix the antenna(e) as per the manufacturers instructions.

Final assembly

Open the holes for the wing holders in the fuselage by cutting the covering away with a sharp hobby knife, and insert the 4 mm dia. beech dowels. These will hold the elastic bands that in turn will hold the wing in place.
If you have not already done so (see page 8), bend the landing gear legs from 2 mm pianowire, and slide these into the holes in the fuselage. Fix the gear with the two ply straps screwed down into the pine strips alongside the gear. Mount the wheels and fix them with a wheel collar on both sides, clamped onto the wire. Alternatively, small, tight fitting sections of control cable can be used, the outer ones glued on with a dab of superglue.
The battery hatch has to be opened for each charge so add the 1.2 mm ply lip to the forward edge in such a way that it slides under the permanent nose cover, see the drawing. The hatch can be held in place with an extra small rubber band attached to the wing dowels.
This finalises the build of the JIMMY, but before you can go flying something else needs to be done, namely adjusting the……..

Center of Gravity or Balance Point

For the stability of flight it is important the the plane is balanced properly. The balance point shall be at the position as indicated on the drawing, which can be adjusted by sliding the battery backward and forward. Temporarily mount the propellor and -adapter, insert the battery upside down so the velcro does not ”bite”, balance the assembled plane on your fingertips by resting the wing on them, slightly forward of the wing spars, close to the fuselage. When the battery is at the correct position, the plane’s bottom will hang in a horizontal attitude. Turn the battery over and fix it in this exact position. Further adjustments can be made after flight testing by an experienced model pilot, or following instructions to be found on the internet (search for ”CG dive testing”). Remove the propellor.

Control Adjustments

Charge your battery. **Be aware that Lithium Polymer (Lipo) type batteries need a dedicated type of charger, set to the correct charging current and voltage depending on the cell count and capacity. Check the manufacturers instructions, ignoring these instructions may have serious consequences!**
Do not mount the propellor as yet. Loosen the set screws on the pushrod connectors. Switch on your transmitter. Connect the battery to the ESC. The built-in BEC will supply power to the receiver and the servos. Bind your receiver to the transmitter per the manufacturers instructions of your RC set. Check that the servo arms are in their neutral position, i.e. at right angles to the pushrods. If this is not the case, adjust the electronic trims of your transmitter (a.k.a. ”Sub Trims”). For large adjustments, you will have to remove the arm by undoing the mounting screw and reposition it on the splines of the servo drive end. Manually position the control surfaces until they are inline with the fin/ stabiliser surfaces and fasten the set screws in the pushrod connectors.
Check the ESC instructions how to adjust your ESC to the throttle settings of your transmitter. Finally, mount the propellor on the motor shaft with an appropriate adaptor.

Materials to be purchased separately:

Transmitter and receiver, 3 channels minimum
Motor 100W 1100KV with mounting cross
ESC 20-25A
Battery 1000mAh, 20C or higher discharge current
Propellor 7”x4”
Propellor/motor adapter
Electrical connectors motor/ESC (3x pair) 2mm dia.
Electrical connectors ESC/battery (2x pair, depending on battery standard)
Servos (2x) 5g
Pushrod connectors (2x)
Wheels light/foam type (2x) 40-50mm
Iron-on film 2m x 60cm
Rubber bands (4x + spares)
Velcro 100mm