X-RES

X-res

R.E.S. Modell

Wingspan: 1999 mm
Length: 1220 mm
Profile: AG-Profile modified
Wing Area: 38.0 dm2
Flying weight: from 430 g
Wing loading: from about 11.3 g / dm2
Controls: rudder, elevator, spoiler
Dihedral: 12.0 °
CG: about 73 - 76mm

X-RES

The X-RES is a R(udder) E(levator) S(poiler) - high-performance model in predominantly wood construction with 2m wingspan.

We have optimized the Allegro by Mark Drela using our ideas. It retained good flying characteristics with practical wood construction.

The following points were emphasized in the design:
• Min sink
• Good high starting heights
• Easy handling, especially circling in thermals
• Consistent braking and steering effectiveness during landing.

The modified Mark Drela airfoil was optimized specifically for rib construction.
The airfoils, coupled with the aspect ratio of 11.6 and almost elliptical lift distribution, makes an excellent soarer.
I have designed a model that allows long flight times, with the ability to scan a large area for thermals. At the same time the X-RES, is a model which the less experienced pilots can learn quickly.
I wish a lot of joy with the model

Alois Janowetz

2. Building Instructions
General construction
We tried to keep the structure of the aircraft as easy as possible, without compromising on the performance.
However, it is very important to proceed with the necessary care to build a straight and high-performance model.

Some modular sheets are for sheeting. Please
cut carefully here so there it is sufficient material for everything.
Separate out the CNC milled parts only when required.

The inner corners radius on parts where the mill stops, have to be reworked individually.

Bonds, unless otherwise described, thin Superglue, CA, should be used.

Epoxy 5 minute for fuselage / Wing screw connection joiner, Aluminum tube CFRP link at the Wing.

It is explicitly stated in these instructions, if epoxy or glue should be used.

If you are faced with unsolvable problems, you can reach me by email.

Additional Resources / Tools

To build the following tools are required:

- Xacto knife
- Aluminum ruler
- Set Square
- Small handsaw
- Sanding blocks (80, 120, 180)
- Swiss Files
- Pins
- needle-nose pliers
- Cannula for superglue 0.9 mm are available from the pharmacy
- Superglue CA
- 5 – Minute epoxy
- White glue
- Flat Building board
- Sealing iron i.e Monocote Iron

What else is needed?

- Servos e.g. 2 x Dymond D60 1.6 to 2 kg and 2 x 0.5 kg D45 8mm
- Battery: four cells NmH AAA 800mAh
- Receiver: 4 channel as small as possible and reliable
- Covering film: about 2.5 m Oralight.

2.2 Fuselage construction

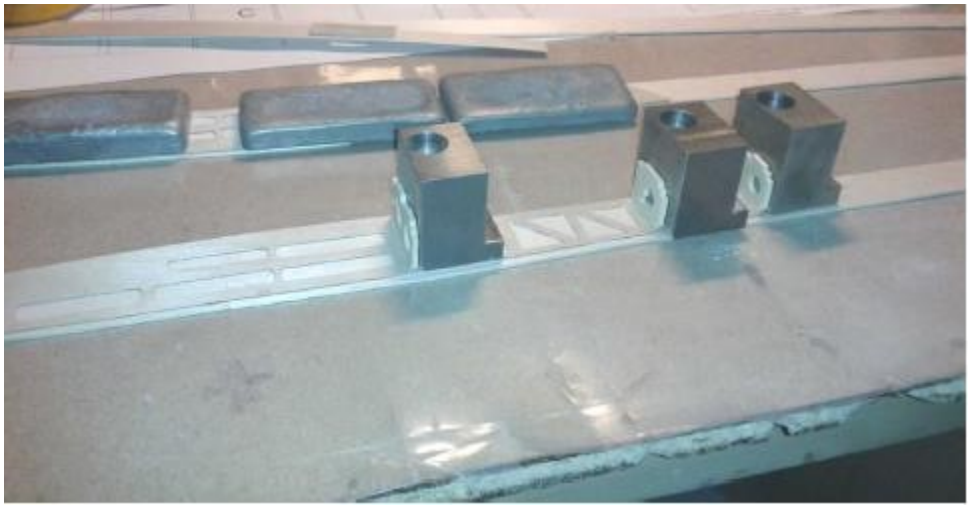
2.2.1 Material for the fuselage

1. 3 mm plywood bulkheads for fuselage
1. 0.8 mm plywood reinforcements for sides and bottom of fuselage
1. 2 mm balsa fuselage, bottom and sides
1. 2 mm balsa side and bottom + small parts for the hatch cover
2. Bowden tubes (pushrod tubes)
1. 0.6 mm steel wire pushrod rudder
1. 0.8 mm steel wire pushrod elevator
1. 10 mm balsa fuselage nose pieces
1. 4 mm plywood surface mounting
2. 5 mm plywood adjustable tow hook

2.2.2 Fuselage Construction

First, the CNC milled parts are separated and the webs that hold the parts are trimmed and sanded flush. Glue the two piece balsa sides of the fuselage and bottom together.
Now the 0.8 mm thick plywood reinforcements are glued to the 2mm balsa sides and bottom using white glue. The top edges of the balsa and ply reinforcement are flush at the front of the fuse. The fuselage bulkheads are used to align the reinforcing - not glued at this step.

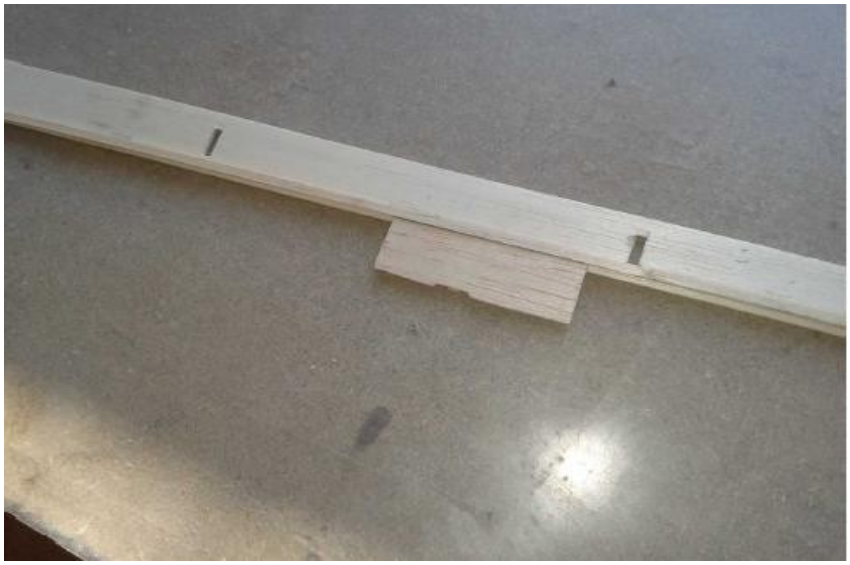
NOTE:
Make a left and right fuselage side!



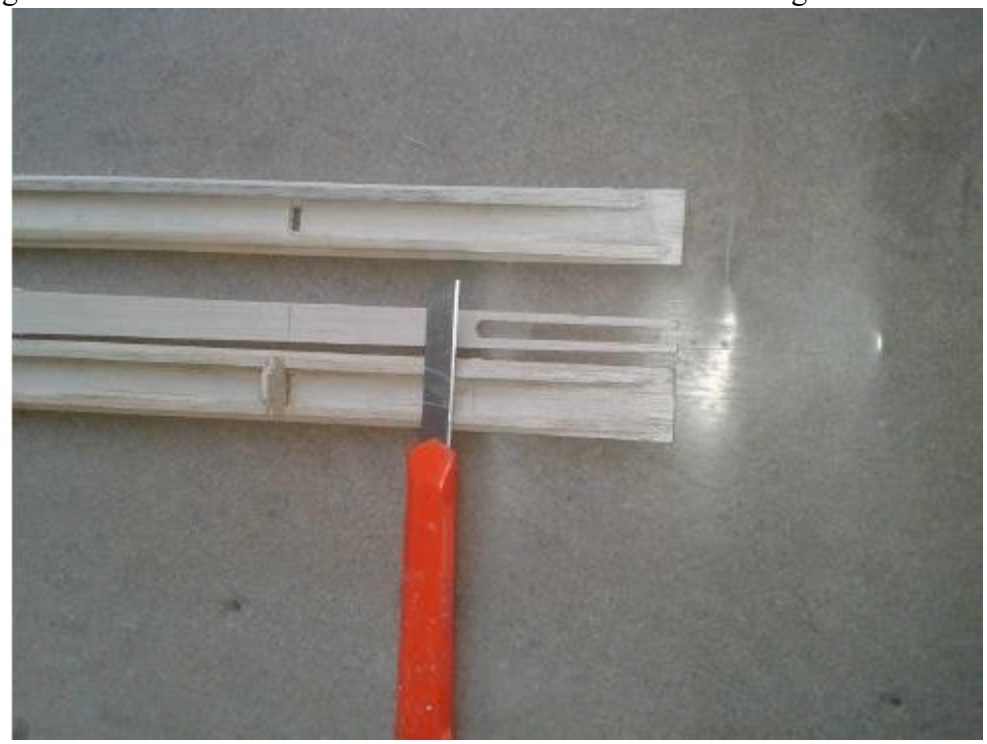
Glue the fuse bulkheads with superglue. Make sure that these are perpendicular to the fuse sides.
Now two 4x4mm balsa longerons are glued in place on each fuselage side. Up to the wing saddle (bulkhead 5) on top and to the nose on the bottom.
The two long bottom pieces must be scarfed together.
On forward fuselage, the lower piece is flush with the bottom of the 0.8 mm plywood reinforcement. From the end of the plywood reinforcement, both the top and bottom 4x4 pieces are 2mm in from the top and bottom edges of the sides. The top and bottom sheeting fits inside in this space later.

Assembled bulkheads and 4x4mm balsa longerons.

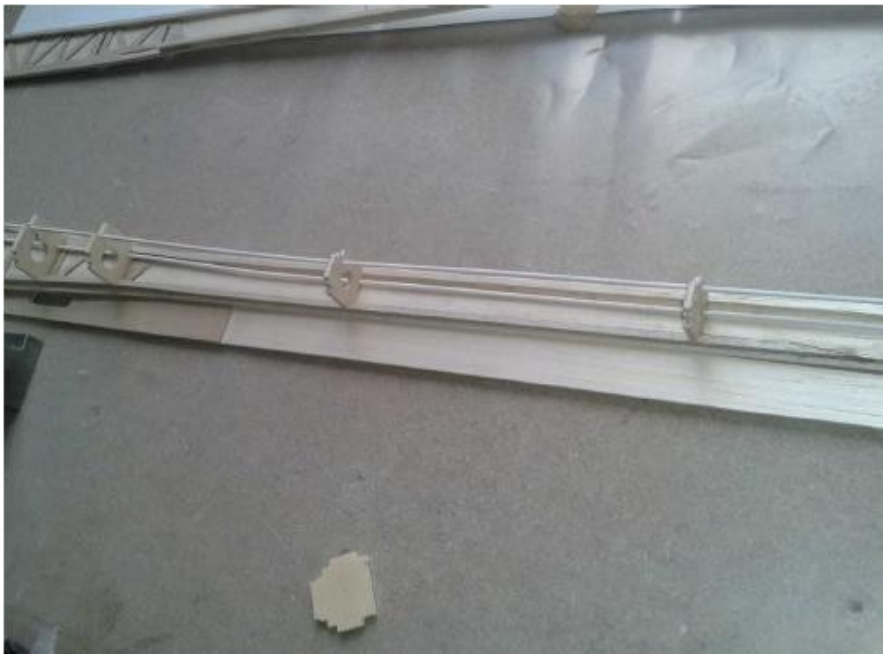
Use a spacer with 2 mm offset to locate the longerons.



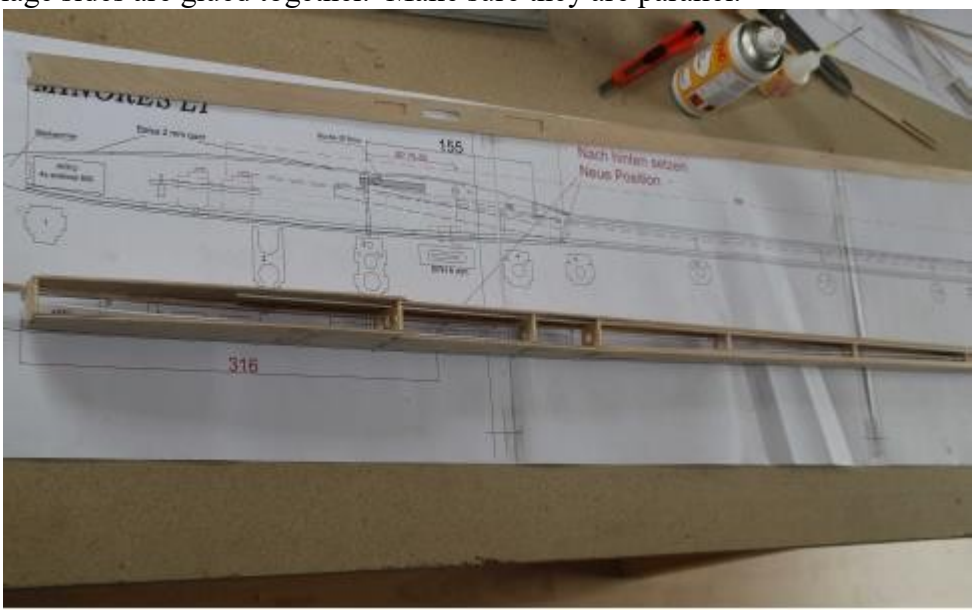
Taper the longerons at the rudder cutout so the back end of the fuse can be glued to the rudder.



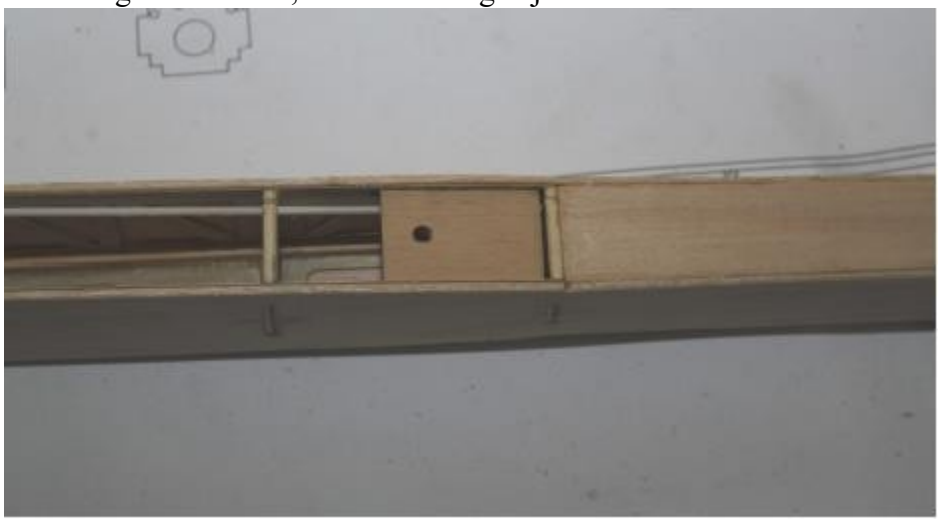
Now the pushrod housings are sanded with rough sandpaper and run through the bulkheads, but not glued.



Next, the fuselage sides are glued together. Make sure they are parallel.



Before the frame is bonded at the end of the plywood reinforcement, insert the wing retainer.
Insert the 4 mm sheet of plywood with the 5 mm threaded hole toward the front of the fuselage.
Do not glue yet. That is glued later on, when the wing adjustment is made with the locking pin



Now the pushrod housings can be glued to the fuse bulkheads.
Ensure the housings are as straight as possible. It is recommended that the steel pushrods be inserted to help straighten them. A slot still has to be cut into the side wall for the rudder pushrod housing.

Now the fuselage top is glued. The elevator pushrod goes through the elongated hole in the fuse top.

Fuselage top with pushrod housing shown.

Glued fuselage bottom.

Finally, the adjustable tow hook and the balsa nose are glued with white glue.
To accommodate trim weight, the nose can be slightly hollowed.

Wing retention system

(I built the wing first because of this step). If the wing locating dowel is not installed, drill a 5mm (0.196 diameter or # 9 drill) hole in the leading edge and install the locating dowel at the center of the wing.
Insert the wing into the fuse saddle, thread the nylon wing retention bolt into the plywood retainer plate, and put the 3mm plywood wing locating piece on the dowel and in the fuse. Measure the wingtip to back edge of fuselage and make sure the distance from each wingtip to the fuse end is the same. Make adjustments to the hole in the plywood piece if necessary.

When wing is lined up, glue the ply wing locating piece in the fuselage. Remove the wing and reinforce glue the wing retaining piece in the fuselage.

The wing retaining piece in the fuselage.

Fuselage Sanding

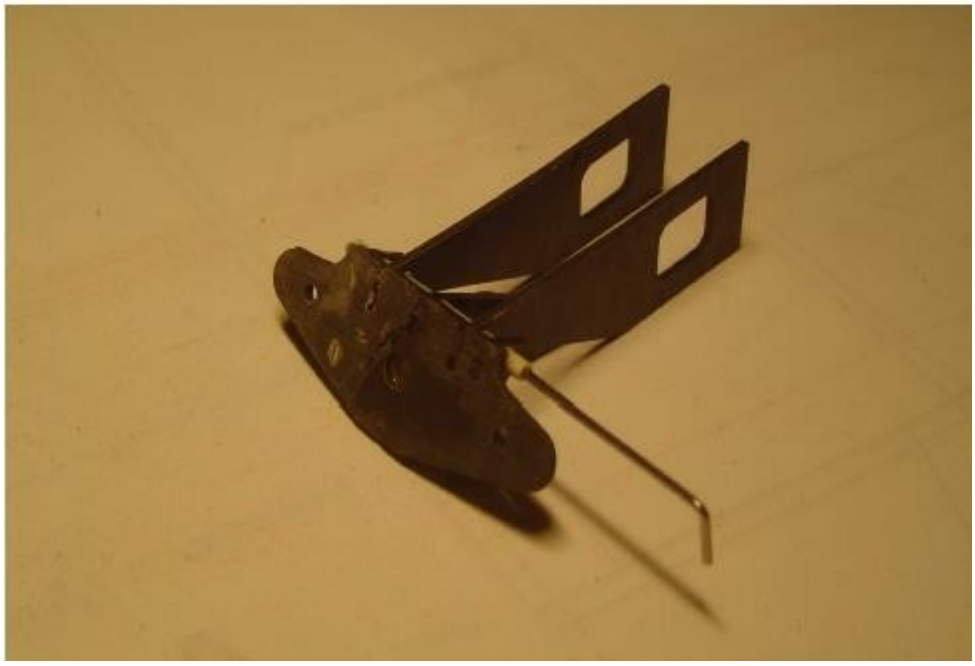
The fuselage edges can be slightly rounded. The nose is first sanded to match the fuselage walls and rounded thereafter. To the rear, the balsa of the sides can be sanded down. Sand the rear end of the fuselage to match rudder thickness.

Elevator Installation

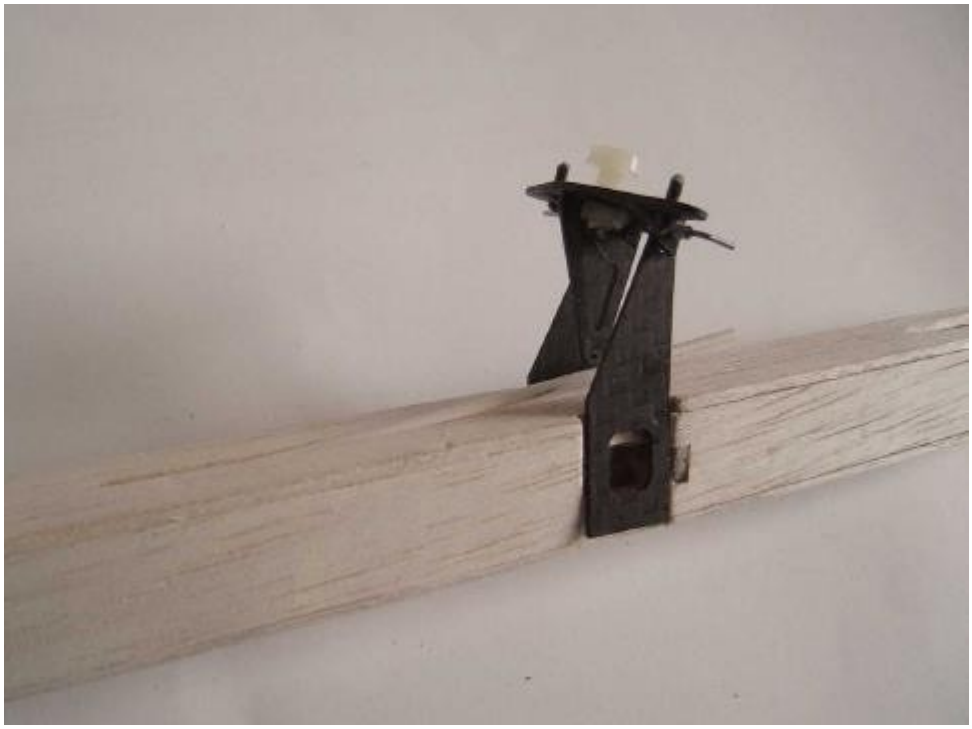
Install on the fuselage only after the wing center section is fitted to the fuselage.

The Elevator Pivot Assembly

First glue the two guide parts for the straight tube onto the elevator plate with superglue.
Then sand the nylon nut on all sides to roughen the surfaces. Apply a small amount of Vaseline to nut and bolt threads so glue will not stick to them. Thread the bolt into the nut, through the horizontal elevator plate.
Glue the control horn part onto the elevator plate and bolt using epoxy glue.
Sand the tube and insert through the holes, glue with epoxy.
Insert the 2 mm CF round pegs into the 2 mm holes in the elevator plate and glue with epoxy about 4mm extending from the top side.



The elevator pivot is located in front of the last bulkhead. Notch the fuse sides for the elevator mounting side plates. Install the horizontal elevator plate onto the side plates using a piece of wire.



Glue the elevator mounting plates to the fuse sides, making sure the horizontal elevator plate is parallel and level with the wing. Cut the pushrod housing to length.

2.4 Construction Stage - Wing

The material for the sheeting of the wing should be cut in each phase of construction.
Some small pieces, however, are not shown here. Therefore, do not throw away the cut off pieces.

2.4.2 Building Phase – Center Wing Section

2.4.2.1 Material Center Wing

1 sheet 5 mm Balsa root ribs A-1
1 sheet 1.5mm plywood A-reinforcing ribs A-2
1 sheet 3 mm plywood ribs and ribs for the wing joints
1 sheet 2.5mm balsa ribs
1 sheet 3.0mm balsa leading edge sanding templates
2 sheets 1.5mm balsa planking inside wing
1 sheet 2 mm balsa trailing edge inner wing
1 sheet 3mm balsa for spoilers
1 strip 3x3 mm balsa auxiliary web airbrakes
1 strip 4x10 mm balsa leading edge
2 6x2 mm spruce spar caps for center wing
2 carbon fiber rods 6 mm Ø, wing joiners
2 ALU tubes 58x7 mm joiner tubes
1 angle template 5 ° (plywood) alignment of the ribs A-9, B-1 for dihedral

2.4.2.2 Construction of the Center Wing

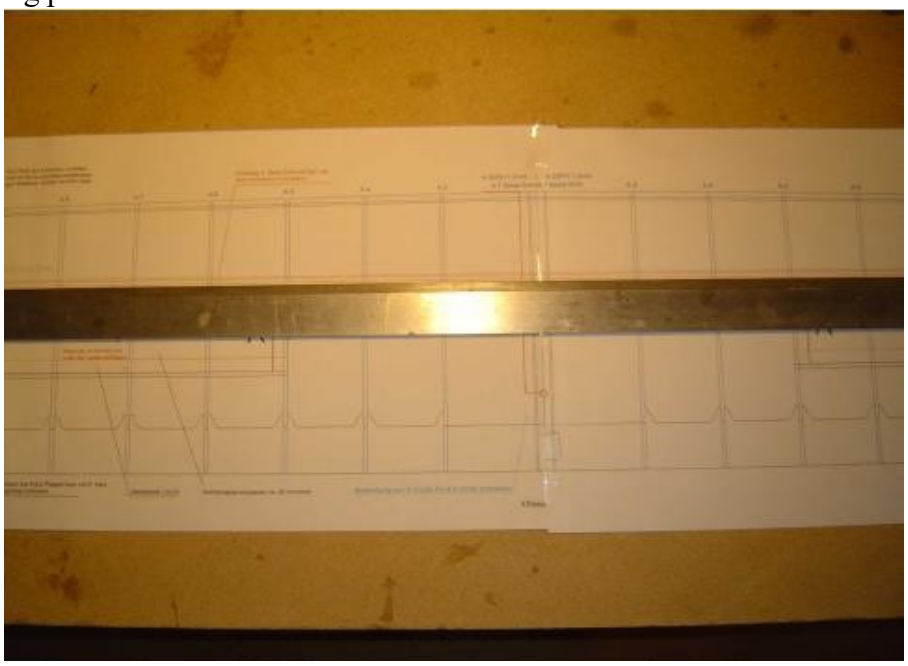
The printed plan must be glued together from the individual pages.
Tape he plans together using the alignment marks on each page.
Use a long ruler to check alignment of plans. Spar lines should be straight. See below.

First the 6x2 mm spruce spars are cut to length, slightly oversized.

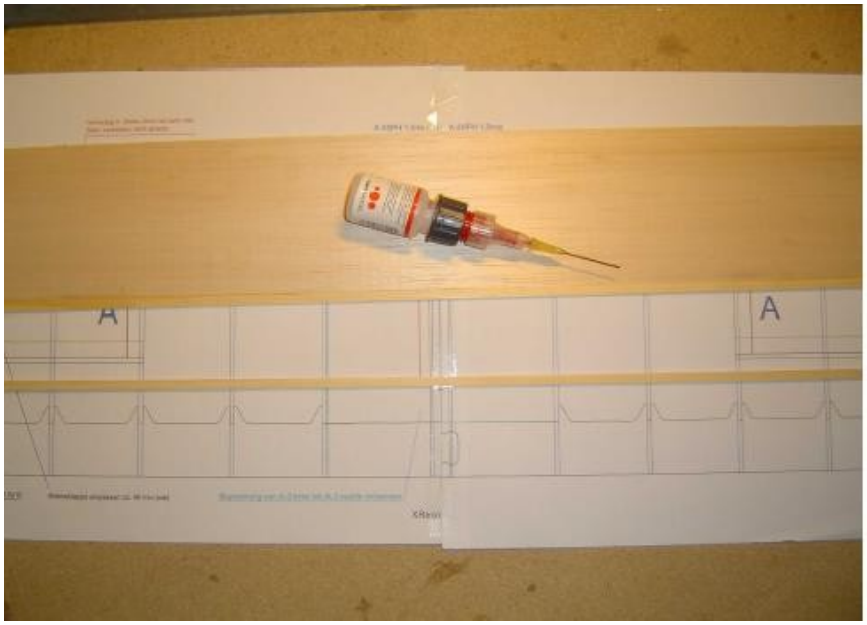
Now a 1.5mm balsa sheet (bottom sheeting) is glued to the edge of the spruce spar.

Care must be taken to ensure that the parts are accurately aligned. The balsa can now be cut off at the front, but it should extend about 5 mm in front of the ribs.
The balsa that is cut off should be saved for possible use in the future.

Aligning the wing plan.



Cutting and gluing the 6x2 spar to the bottom sheeting.

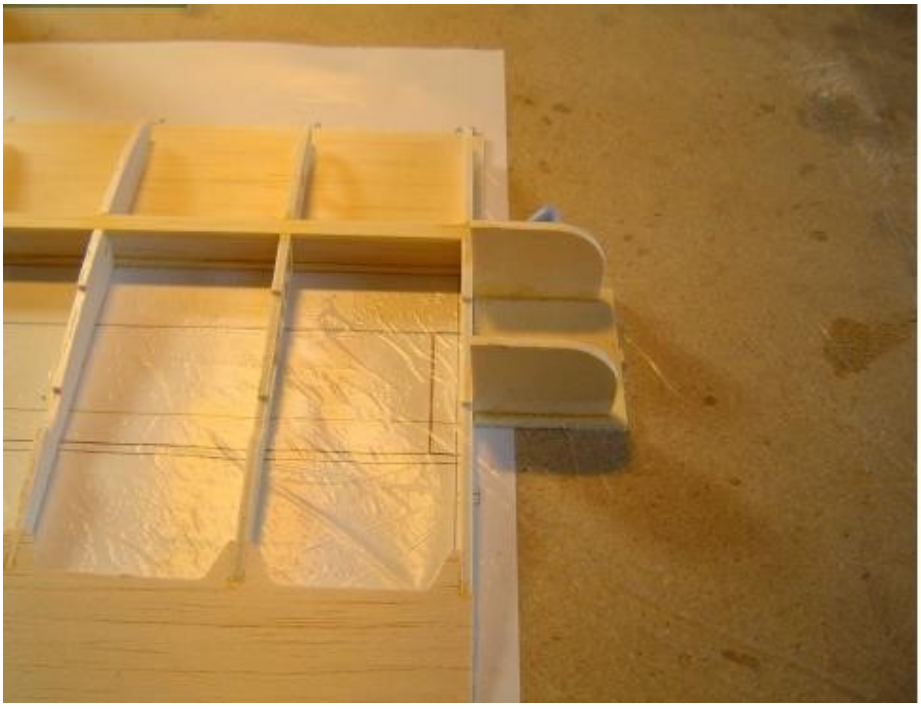


The ribs are cut and sanded to fit on the spruce spar. The 3mm balsa spar webbing is also prepared. The two ribs adjacent to the root rib have a section for the webs.
The outer ribs A8 and A9 are made of 3mm plywood.
An important criterion for distinguishing the ribs: All ribs of the inner wing are shorter as you move to the wingtip.

The two root ribs A1 from 5 mm Balsa and 1.5 mm plywood ribs A2 should be glued to each other. Use epoxy. Glue in the 1.5mm plywood reinforcement at the wing mounting bolt position.

Place ribs on the plan and glue to spar. Do not glue ribs to bottom sheeting yet. Ribs A9 are glued at a 5 degree angle, using the 5 deg jig. See below. Make sure ribs are perpendicular to the spar. Use plenty of glue around the spar and spar webs.

Aligning end rib A9 with 5 ° angle jig.

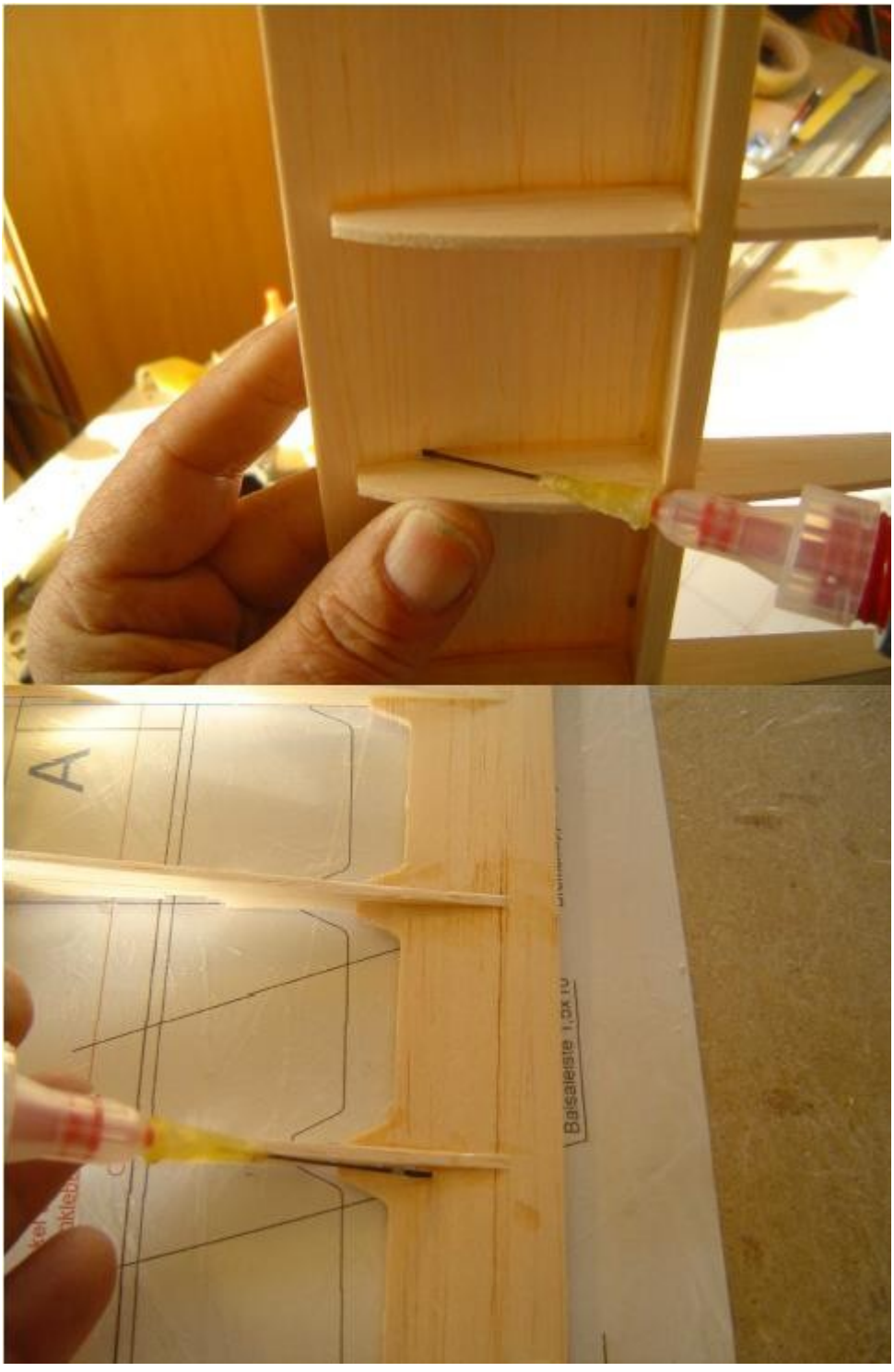


Roughen and thoroughly clean aluminum wing joiner tubes. Slide aluminum tube into ribs A-9 and A-8. Align at 90° to end rib. Gap between tube and spar webbing should be filled in with scrap 1.5mm plywood. Coat ply filler, Al tube, and spar webs with epoxy and assemble. Picture shows top spar in place, but do this step before top spar is glued in so the ply filler can be inserted.

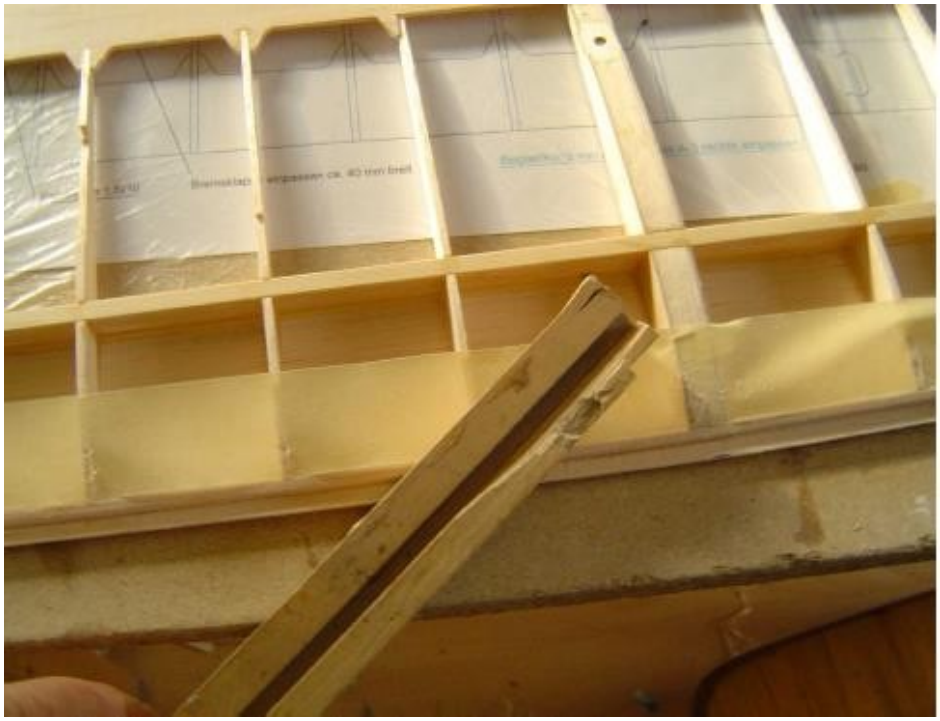
Glue in the top spar using plenty of glue. Carefully remove assembly from building board and turn over. Fit and glue on the trailing edge balsa, flush with the top of the ribs, gluing from the bottom side.

The wing can be turned right side up and the trailing edge can be sanded to a taper on the top side, starting from about 12 mm from the edge, so it is about 1mm thick at the trailing edge. Masking tape can be used to protect the area that is not sanded.

Thereafter, the middle part can be taken from the Plan and the bottom sheeting can be fully glued to the ribs.

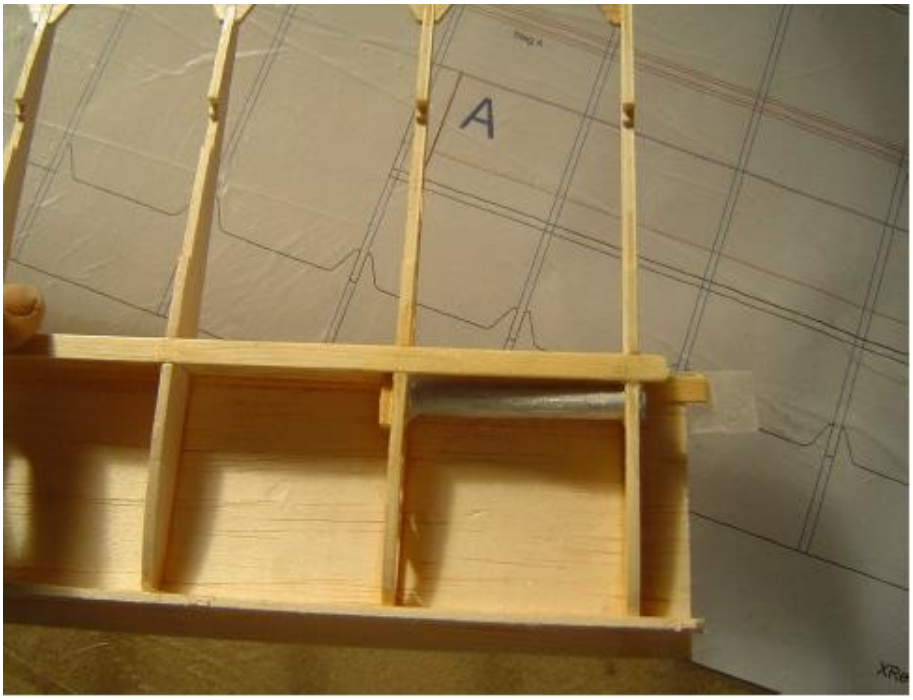


Now a strip of 2 mm balsa is cut from scrap balsa sheet and glued to the front of the ribs. Take a long sanding block to make the front edge straight.



After drying, cover the ribs to protect them and sand the 2mm strip to shape for sheeting.

Mid span wing with spruce spar and glued AL wing joiner tubes. Plug end of tube with wood.

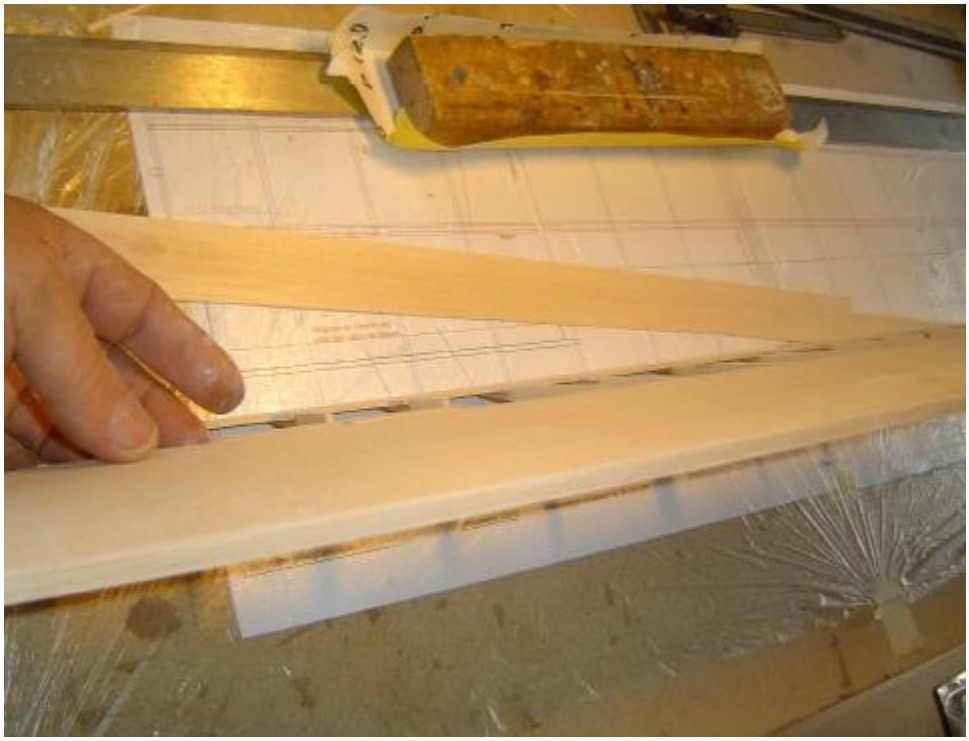


Now the upper sheeting can be glued to the ribs.

Then turn around and glue the ribs from behind to spar.

Now, through the gap between the strip on the nose and the upper sheeting, glue the upper sheeting to the ribs. Here it is advisable to use thin needles and take advantage of the fluidity of the superglue. Sheeting through the gap from the front are glued to the ribs.

The nose can now be sanded flat from the beginning to the 2 mm strip and a 4x10mm balsa strip leading edge is glued on. Now the middle 1.5mm sheeting is glued on. Sand the leading edge to shape using the ply jigs to get the correct shape. Each jig has the corresponding rib location on it.

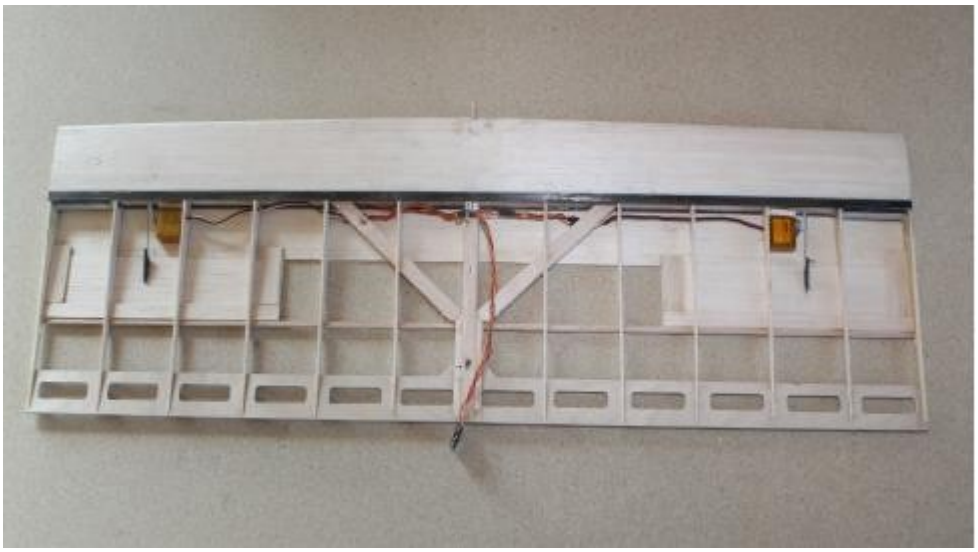


2.4.7 Fitting and Actuation of the Spoiler

Now the spoilers can be installed. Frame around the edges per the plan, with 3mm scrap, 3x3mm strip, and the 1.5x10 strip from scrap.
The spoilers are from the included 3mm balsa. Cut and fit into the recess and sand from the top side for a flush fit. Leave 0.5mm gap all around the spoiler. As shown in the drawing, a magnet is located at the middle of the spoiler. Insert the spoiler in the Center Wing and at the appropriate place, glue the magnets under the 1.5 mm balsa strip. Observe the polarity. The spoiler servo is glued behind the spar web. The servo horn is glued to the flap.

The pictures below are from a different plane.

The control wire should be bent toward the door only, so that the flap can be actuated, it can then be installed. On the servo make a Z-bend.



2.4.4 Construction Section Mid Span Wing

2.4.4.1 Material Mid Span Wing

1 sheet 3 mm balsa ribs
1 sheet 2.5mm balsa ribs
1 sheet 1.5mm balsa planking center wing
2 sheets 2mm Balsa trailing edge
1 strip 4 x10 mm balsa leading edge
2 strips 4 x 2 mm spruce spar caps outer wing
2 ALU pipe 58x7 mm guide the joiner
1 angle template 5 ° (plywood) alignment of the ribs A-9, B-1 for dihedral
1 angle template 6 ° (plywood) alignment of the ribs to the outer wing B-8, C-1 for dihedral

2.4.4.2 Construction of the Mid Span Wing

The construction of the mid span is similar to those of the outer wing and center wing. The lower spar is flush with the bottom planking.
Now remove the ribs from the CNC milled sheet, sand for assembly and sort for size. There are six balsa mid span wing 2.5mm ribs and two 3mm plywood ribs.
The position of the ribs can be easily determined on the basis of their length and the plan.
Position the spar webbing and ribs over the bottom spar and planking. Glue with CA glue.
Important: Place both outer ribs with the correct angle template.

Fit the aluminum wing joiner tubes and check alignment for each mid span wing to the center wing. The exact angle is not critical, they just need to be the same for each side. When adjusted, glue in place with epoxy. Shim the gap between the tube and the spar webs with scrap ply.
Fit and glue the upper spar cap, align shear webs and spar caps. Remove
from the building board and glue the trailing edge from the bottom. Glue the
bottom sheeting to the ribs forward of the spar.
Cut scrap 2mm balsa for the false leading edge and glue, then sand to the rib's shape.
Fit and glue upper sheeting 1.5mm balsa, just like in the inner wings, using thin CA glue.
Sand the front edge of the sheeting flat and glue on 4x10mm balsa leading edge.
Sand the leading edge to shape using the ply profile templates.

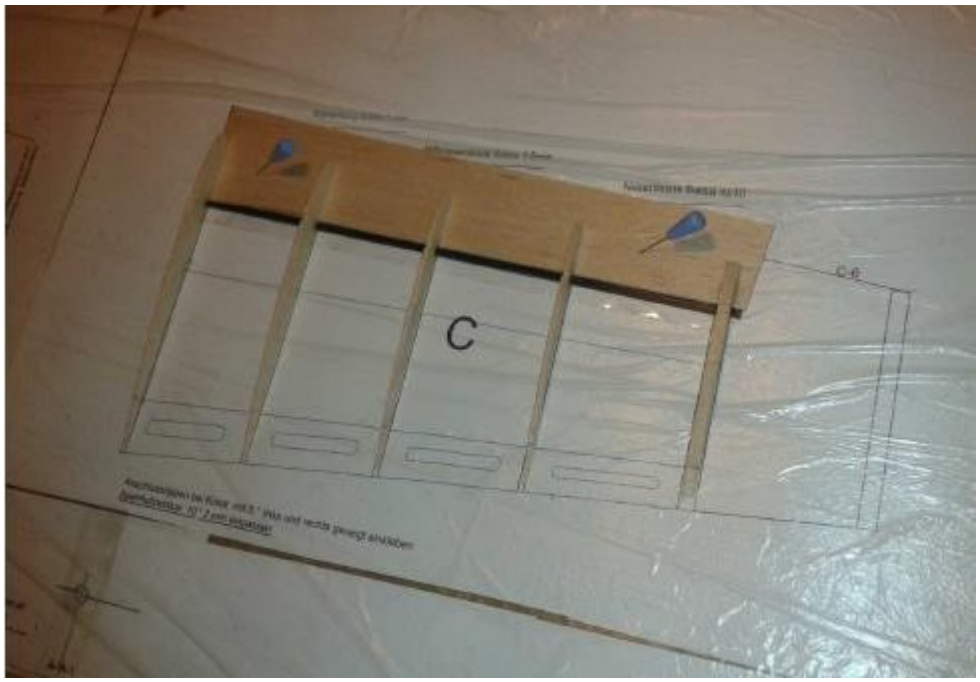
2.4.3 Wing Tip Construction

2.4.3.1 Material for outer Wing Tip

1 sheet 3 mm balsa ribs
1 sheet 2.5mm balsa ribs
1 sheet 1 mm balsa sheeting outer wing
1 sheet 1.5mm balsa trailing edge for wing
1 strip 4x10 mm balsa leading edge for wing
2 strips 4x2 mm spruce spar caps wing tip
1 angle template 6° (plywood) for alignment of the ribs (dihedral)

2.4.3.2 Construction of the Wing Tip

Construction of the wing tips is the same as the other wing parts.
Glue the bottom spruce spar to the trailing edge of the bottom sheeting. Bottom sheeting extends out past the wingtip. These photos are not from the X-RES and differ in details.



Fit the spar shear webs and ribs. Angle rib C1 for dihedral using the 6 degree ply template. Washout 3-4 mm can be built into the wing tip, or it can be done with the covering later. Glue ribs, spar webs and bottom spar together. There are no shear webs between the first two sets of ribs. A plywood angle part is put in here later.
Remove from building board and glue on trailing edge from the bottom side.
Glue on the top spar.
Glue the ribs in front of the spar to the bottom sheeting. Glue the wingtip on the outer rib and bottom sheeting. The wingtip is on the 4mm balsa sheet.

Make a false leading edge from 2mm scrap balsa. Shape top edge for upper sheeting. Cut top sheeting so it will extend over the wing tip. Glue on upper sheeting.

Sand front edge of outer wing flat and glue on 4x10 mm leading edge.
Sand leading edge to shape using the plywood templates. They are marked with the rib locations they correspond to.

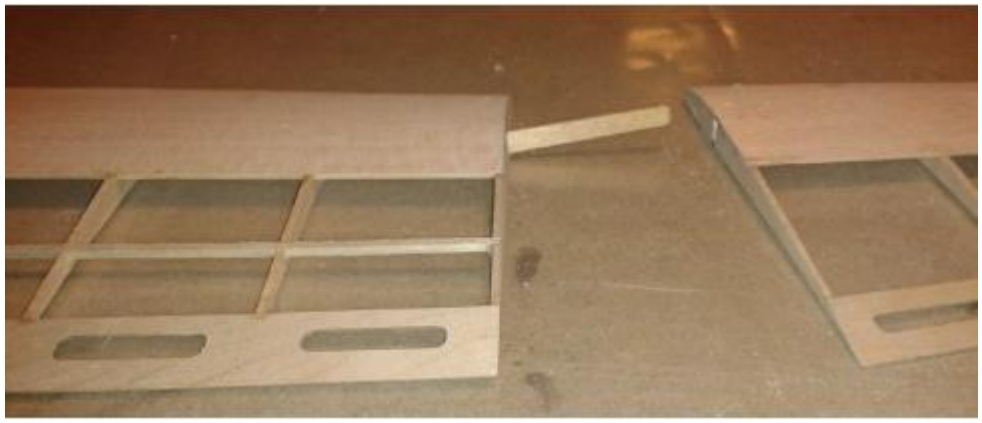
Wing tips

Sand the wingtip to shape following the rib shape of the outermost rib. Round the tip to shape per plans. Exact wingspan can be altered by changing the wingtips.
A 2 meter span conforms to competition rules.

2.4.6.1 Bonding Mid Span and Wing Tips

Cut a vertical slot between the upper and lower spars in the end of the mid span and wing tips. Test fit the plywood dihedral braces into the ends of the wings. Sand the plywood dihedral so the outer wingtip is 4.8 mm (check this dim.) high, and is the same for both sides of the wing. The narrower end of the dihedral brace fits into the outer wing.

Glue the mid span and wing tips together with epoxy. Glue the plywood dihedral brace between the spars using plenty of epoxy thickened with micro balloons. The dihedral brace should rest on the lower spar. Make sure the two parts align properly with no height differences.



Joining Mid Span and Center wing

Sand the joint between the center wing and the mid span wing so there is a good fit between them. Glue in the CF anti rotation pegs.

2.5 Tail

2.5.1 Tail material

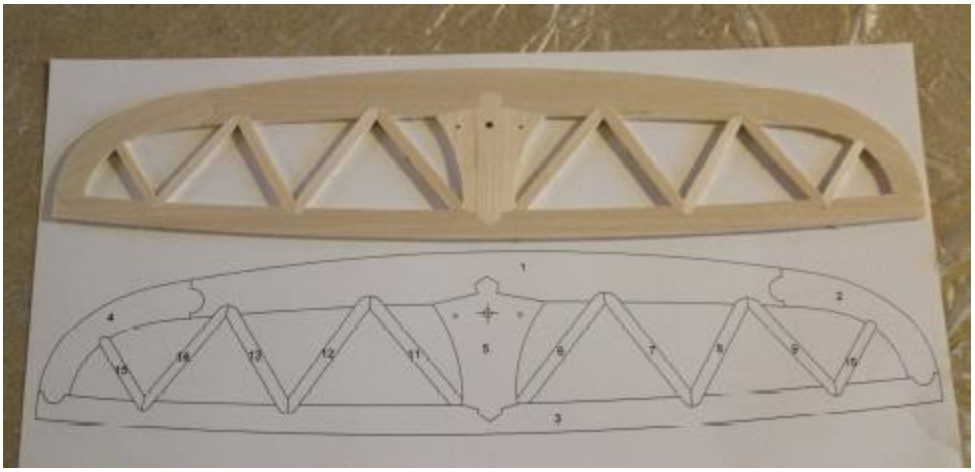
1 sheet 4 mm balsa tail parts

2.5.2 Tail Assembly

The tail can be assembled using the blueprint plan.

Rudder Construction

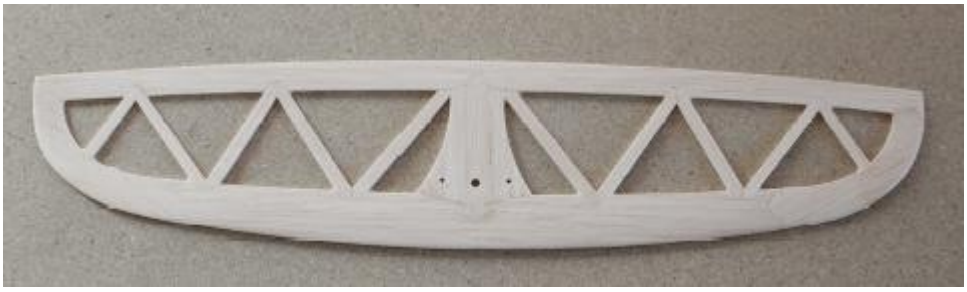
Elevator Construction



Sanding of the tail

Sand the tail surface according to the plan detail.
Sand the control surface part of the rudder down to approx 1.2mm at the trailing edge. Sand the leading edge down to 3mm.
On the leading edge of the rudder and trailing edge of the vertical stabilizer sand the edges round, making both sides symmetrical.

The elevator is sanded to the same airfoil shape as the rudder.
The 4mm (5/32 drill) hole should be countersunk so that a M4 countersunk screw does not protrude. Reinforce with hole superglue.



Covering

Now the plane can be covered. This is not described completely here, however, some tips: Temperature of the iron should only activate the adhesive 130-150 degrees C. Tack covering to undersides first, then the topside. Overlap top covering onto bottom covering. Increase iron temperature to shrink covering. The spoilers are covered separately, then attached with hinge tape.

Mounting and Actuation of the tail

Installation of the Vertical tail

Use hinge tape to fix the rudder to the vertical stabilizer. Now glue the vertical stabilizer into the slot in the fuselage. Remove covering so there is a wood to wood contact between the fuse and stabilizer. Line up the solid wood strut on the rudder with the pushrod tube. The rudder hinge line should be 90° to the top of the fuselage and to the wings. Installation of the wing in the fuselage will aid in lining it up.

Actuation of the Rudder

Glue the rudder horn into the rudder. Bend the spring steel rudder wire (0.6mm) about 1cm long 90° angle and slide it into the pushrod tube. Put the bent end into the rudder control horn. Later, glue a short piece of pushrod tube on the end to secure the pushrod in the horn.

Mounting Tail Plane

Cut the M4 screw to length so that it can be screwed onto the elevator pivot. Sand the 2 mm CF rods and glue into the holes provided from below, so that they project approx 1.5mm below.

Articulation Tail Plane and Fin

Bend a Z in the 1 mm spring steel wire with a pair of pliers. The hinge pin from take the shuttle. Insert the Z into the horn and introduce the wire into the pushrod tube. Insert the hinge pin and secure with a small drop of superglue outside.

Internals Fuselage

In the fuselage, glue the radio board. When a ballast tube needs to be installed, be careful that no parts of the servo leads prevent the loading and unloading of the ballast tube. The included board fits quite well for most 9mm servos as Dymond D60 or Graupner DES427. If wider servos are installed they should be slightly diagonally rotated.
The connection of the pushrod tubes to the servo is performed by a short length of 0.8mm spring steel wire in which a one-sided Z is bent up to mount it to the servo arm.
This piece of spring steel wire is secured with a small wheel collar.

Adjustments

Now the X-RES should be ready for the first flight.

CG for the first flight 73 mm behind the leading edge, can later be adjusted backwards 2-4mm
Rudder: As much as possible, but symmetrical.
Elevator: adjust to +/- 30 degrees
compensation for flap: +2 mm.
Zero position Elevator: From the front aiming across the face. Horizontal stab should now be seen a little from below.

First Flight

The first flight is best flown in a meadow. After a couple of throws you should find a good flight attitude and CG position.
The CG can be finely adjusted with lead shot in the nose.

Mounting Tow Hook

The adjustable tow hook can then be set approximately 1 mm in front of the center of gravity.

More settings

Now the plane can be launched for the first time with the hi-start. The X-RES is now ready to fly.
One determines the exact best CG with the flare out.
First, at low speeds. Later after 10 m launching at a 45° angle. In this maneuver the pilot can easily change the trajectory upward.
Set the height adjustment for airbrakes at a higher altitude.

Ballast Camber

Anyone who wants to use the X-RES for pure leisure fly does not need ballast chamber.
but in competition it is quite reasonable, that the model weight be adapted to the weather conditions.
For ballast a 10mm diameter material is used. The best here are brass rods or tubes poured with lead into copper tubes. The length of the ballast should be about 20 mm.
In order not to always have to fly with full ballast, spacers are made of balsa remnants as needed. be Ballast must be symmetrical to CG. The individual spacers pieces should all be the same length and ranged from 4 cm. This tube is closed safely back and forth with the locking mechanism provided.
The ballast tube is used, so that the CG of the ballast pieces later sits exactly as achieved during the flight center of gravity.

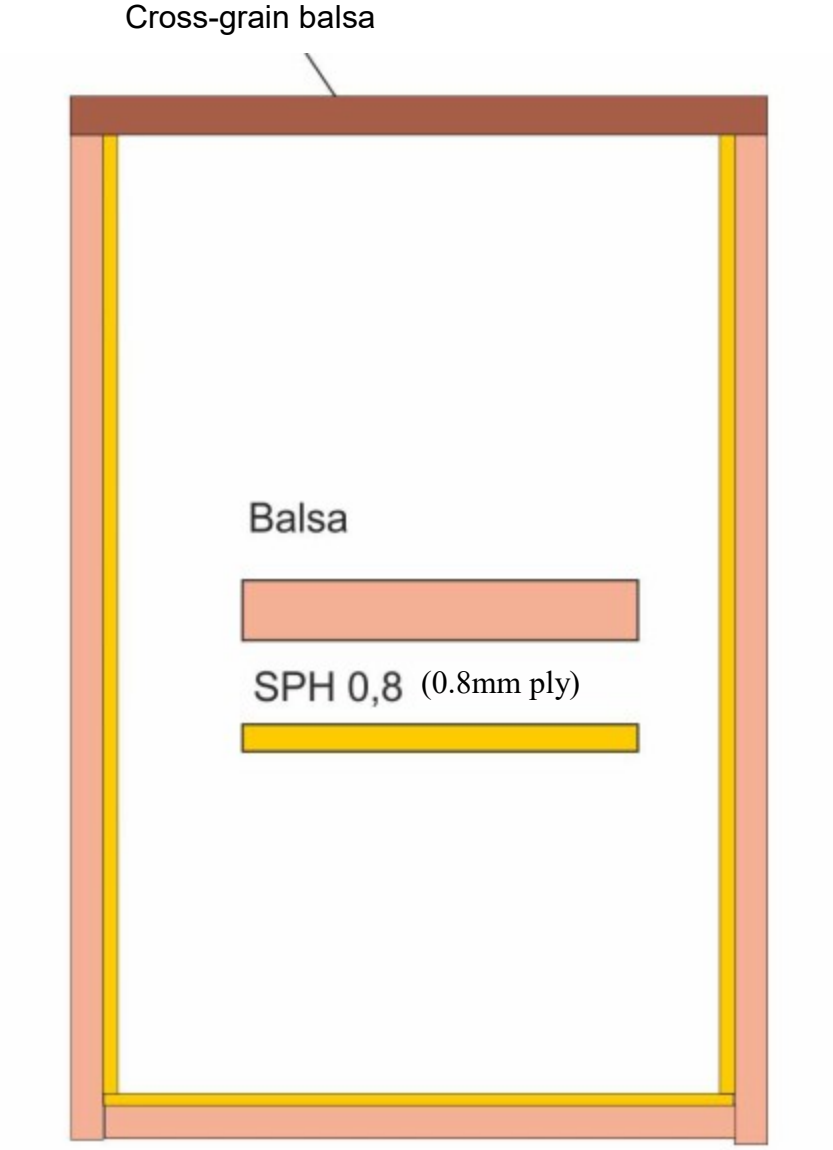
Your X-RES is flying right away - we promise!

You can adjust the CG, and the rudder and elevator deflections to suit yourself.

Set on high for spoiler at your own discretion.
Adjust the tow hook about 1 mm in front of the center of gravity, then the glider rises perfectly on the hi-start and you do not need, or only minimally need to get height.
I wish you much joy in flying, thermalling and successful participation in RES competitions!
Let Your X-RES always be insight!

All the best and have fun!
Alois

Forward fuselage cross-section



X-RES