First to fourth day

Connect plank segments and prepare for assembly
Prepare moulds for installation

Steps:

- Unpack the kit and check for completeness
- Glue plank segments of the plank 1 together, prepare for assembly
- Glue plank segments 2, 3 and 4 together, prepare for assembly
- Scarf inwale battens, glue to plank 4
- Strengthen, shape and drill skeg
- Prepare moulds for installation

Tools and Materials:

- Long ruler or straight batten
- Knife
- Household cord
- Weights about 10 kg, (for weighting things down)
- Ruler and pen
- Mitre saw
- Stapler or hammer and small tacking nails
- Epoxy, scales, mixing cup, spatula, brush, glass fabrics
- Clamps, possibly a grey drain pipe, approximately 40 mm in diameter
- Hand plane
- File and / or sanding block with sandpaper (about P80)
- Drill with 2 mm / 4 mm / 6 mm drill bit

In these first days, do take care with the many small steps. These will be laid-back, relaxed days. When gluing the planks do take your time to fit and align the plank segments accurately. Usually I glue two planks in the morning, two more in the evening together - with glass weave strips on the inside, all without scarfing! In the meantime, I splice battens together, and prepare the construction moulds for installation.

Kit Contents List

The kit includes a bill of materials and clear drawings, which show how the individual parts are connected to each other, so you are ready to control all parts of the kit. Check if everything is there and properly labelled. Do not throw the packing away. The board packing can be used to collect epoxy drips under your boat, the thick plastic clear film is one of the most important tools for epoxy boat building. Read the whole chapter of instructions thoroughly, imagine the individual steps figuratively. Lay out tools and materials in front of you, to get started.

Materials to Purchase

From the hardware store buy about a ***5 roof battens*** (the cheap ones are about 19 mm x 28 mm and about 240 cm long, but it won't hurt if they are thicker. It would only be more expensive.) I peer with the eye along the long edges and look for the straightest; leave the lengths with large knots aside. As a ruler and wood mounting these slats are just right - and cheap.

One flat spline. I'm looking for the thinnest (about 5 x 9 mm) 240 cm long batten that I can find at the hardware store. With the eye I peer over the entire length to see whether the length is really straight.

8 smooth-planed, knotless battens from the hardware store, ***9 x 18 mm, each 240 cm long.*** The battens should be ***made of spruce or fir;*** pine is less suitable due to the higher weight. The 8 battens are sufficient for the whole build. If the hardware store has not so many in stock, 5 pieces would suffice for the first days.

Weight fetishists can order these battens made of ***Western Red Cedar*** instead. The weight savings potential is about 300 g.

For attaching the battens onto the hull planks you need at least 10 clamps and about 20 spring clamps. Alternative: slit **2 meters long grey plastic drainpipe with 40 mm outer diameter** lengthwise and cut into finger-length pieces. These pieces are makeshift claps for frugal people (or: poor man's clamps).

Next, ***20-30 meters of industrial weight clear plastic film*** (semi-transparent polythene film, which is used in the building industry a lot. It is smooth, just like your plastic wrap, but much thicker. It can

be bought in rolls of 1 or 1,50 m width) are on the shopping list. The 150 µm (0.15 mm) thick foil is best. You can also use 60 µm (0.06 mm) thick film. If the hardware store does not stock it, the builders' trade counter sells it cheaply by the meter from the roll.

This semi-transparent polyethylene film does not bond to epoxy. That is why it is used in bonding as a separation layer. You can remove the film after curing and have a nice, very smooth surface -. all without sanding! This saves a lot of work.

One can well use the film as a base –a table or the floor below will stay clean.

A roll of wire, about 1 – 1.3 mm. You find it easiest and cheapest in agricultural co – operative shops.

In addition, you still need some ***cheap brushes.*** I think the flat, about 2.5 cm wide brush works best for epoxy coating.

As long as the epoxy is not hard, you can wash the brush in a small jam jar with ***brush cleaner.*** Immediately afterwards I knead some undiluted dish washing liquid in, rinse the residue with clear water and allow the brush to air dry.

Some ***wooden spatula*** *are* a good choice for mixing of epoxy. In addition, you will need ***a box of disposable latex or nitrile gloves*** when working with epoxy. They come in different sizes. Nitrile gloves seem to be resistant for epoxy, it is unclear (according to the internet) whether powder-free latex gloves are.

A roll of ***transparent packing tape*** works as well as construction foil: epoxy will not stick to it. It is used to mask off splices or parts when gluing.

A role inexpensive narrow ***painter's tape.*** It does not stick so well, and epoxy adheres to it. Therefore, the painter's tape must always be removed before the epoxy is cured.

Preparing Planks

The plank segments are delivered ready cut into their final shape. Because the planks of the boat are longer than a sheet of plywood, they must be glued together from 2 or 3 segments. The splice is reinforced on the inside with fibreglass weave.

Lay out all the plank segments on the floor. The planks sections are delivered in pairs of two, always with the **hull outside** face turned to the outside. This face is generally the nicer side.

The plank 1, which constitutes the bottom of the boat is best painted later. A boat sooner or later gets scratched on the bottom, and these scratches can be repaired with some putty and paint much easier than with clear varnish. Therefore the lowest plank is ideal for practising - small errors will be hidden invisibly under the paint.

The planks 2 to 4 and the deck can be varnished to give the wooden boat class and style.

If the upper planks are varnished, it looks good when the grain of the plank segments match at the joints when they are positioned together. In this case, there is nothing stopping you from replacing individual right and left segments and from turning them upside down.

If it is clear which plank segments belong together, bind the segments together for each plank with household cord. It would be disastrous if we were to stick the wrong plank segments together.

Aligning the Planks

The alignment of the planks before bonding is a very important step. Imbalanced glued together planks will give an awry, crooked or distorted boat that makes no fun on the water.

When gluing the plank segments, accuracy is critical. It is important to adhere the plank seams in the correct curvature. Planks with too much curvature will result in a boat that looks like a banana. This boat would not hold a steady course. Conversely, too little curved planks would give a boat that would not be

nimble and would have a strong tendency to keep straight on.

To connect the planks segments we will take our time.

To measure the curvature of the planks exactly, adjust them along a straight line. In my boat building shed I have a long table with two straight table edge and a straight centre line available. I have used these straight edges as a straight line. But it is just as well with a ***string straight line using*** a taut cord, which is held at both ends by a weight at the bottom. Use petrol cans, or water containers, crates, a large pot filled with water, lead or iron scrap as weights – anything you might find in your household and which is currently in the budget.

The kit documentation shows the exact dimensions for the distance from this line to each splice in *Figure 1*. These measurements are used to align the plank segments before gluing. If the measured distances are correct, the plank will have exactly the right curvature.

Cutting the Glass Weave Strips

The plank segments are bonded together on the inside with glass strips.

The entire length of the supplied glass cloth will be used for the outer sheathing - but from 155 cm width only 120 cm are needed.

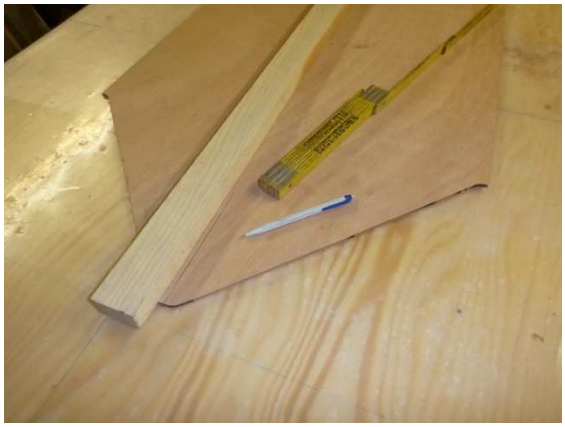
Cut one or two about **8 cm** wide strips from the **long side** of the supplied glass fabric. I use a knife, a scrap batten (or wood) underneath and a roofing batten as ruler. Then, also cut about 25 cm wide plastic film strips for an underlying base layer.

Preparing Keel Plank

The plank 1 is the keel plank. It consists of 3 parts. The rear part of the plank 1 needs an 11 cm long and 4 mm wide slot for the skeg.

Draw a centre line on the inside of the rear plank segment. Draw two lines to the right and to the left of the centre line, so that there is approximately 4 mm spacing between the lines. You can use a straight batten for that.

Draw in the pointed tail part of the keel plank segment a score of 4 mm in width and 11 cm in length and saw it with a hand saw. You can detach the sawn piece at the base with a small pointed screwdriver.



Now adjust the centreline of the rear plank segment on the string line, ***with the inside facing upwards. The inside is always the glueing side!*** Align the two front plank segments also along the string line. The measured distances of the tip points (of the plank segments) to the line must match the specification – given in *Figure 1* of the kit documentation. Weight the tips down to prevent them from slipping.

In the picture I have aligned the tips to the centre line of a long table and fastened them with small tacks. Yes, the two front plank segments overlap slightly at the centre line – that's right!

Check and Prepare Splice

The joints of the planks should fit together exactly. Sometimes just a few strokes with a file are needed. I file very little wood off right there, where the planks abut each other - until both parts lie everywhere close to each other and entire seam is uniformly narrow. Sure, you should fix the planks temporarily in the correct curvature, or the connection will go awry.

Then, prepare the plank segments for bonding: If the work surface is uneven, put a plate of scrap wood under the splice. One can then tack the plank segments down, to prevent slipping:

Plastic film is placed under the splice so that the plank will not stick to the surface.

The plank segments are placed tightly together, the distances from the centreline checked once more. Then the plank segments are ***weighted down so*** that they ***cannot slip.***

Working with Epoxy

Modern stitch-and-glue- boat building would not be possible without epoxy. This modern gap filling glue can be also used as a filler, a coating and for waterproof sheathing. However, epoxy is not without risks: in some cases, contact allergies are known. Epoxy fumes can cause respiratory problems. Well, there are risks for virtually all modern adhesives. For the safe handling of epoxy there are a few simple rules:

The most important information on handling epoxy stand in the safety data sheet of the manufacturer!

Process liquid epoxy always with ***disposable gloves.***

Often it is recommended to wear a mask in enclosed spaces in the processing of working with epoxy, this filters out solvent vapours. The epoxy I used does not smell of solvents, so I do not wear a mask.

When liquid epoxy gets on your skin, wipe it off. One should not allow to dry epoxy on the skin.

When liquid epoxy gets into the eyes, it must be thoroughly rinsed. This is unpleasant and unnecessary. This is why there are ***goggles.***

Liquid epoxy can be removed from tools, work pieces and from the skin fine with ***vinegar*** and a clean rag - it's cheap, and the vinegar is better tolerated by the skin as organic solvents.

Semi-hardened mixed epoxy is allergenic, more than completely hardened epoxy. One should therefore only ***grind epoxy*** when it is ***fully cured.*** Large lots I sand outdoors. If this is not possible, I prefer a ***dust mask*** with tight closing rubber ring.

Epoxy has a pot life, during which it is has to be processed. Therefore you work to the clock.

During curing, epoxy generates heat. Larger amounts of epoxy can ***overheat*** and then begin to smoke. The fumes are not healthy: I therefore remove such overheating epoxy immediately outside. I touch the hot discard box with an old rag, so I do not burn myself.

Use containers when mixing epoxy which keep the depth of mixed epoxy shallow, never narrow and tall so there is depth to the epoxy. Depth makes the epoxy overheat much more quickly. When mixing a larger quantity for coating or wetting out the hull, you would use a wide shallow tray to keep temperatures down.

I work clean, organize myself and prepare the work before mixing of epoxy and always put a plastic ***construction film*** under my work.

After work, I remove my working clothes and I put myself into the ***shower*** to wash off the dust.

I change my ***work clothes*** at least weekly and wash them at 60° C.

Last: Use enough epoxy for a perfect bond - but no more. To remove excess epoxy on the boat does not help, it only makes the boat heavier.

Glue Plank 1 together

The rear portion of the plank is somewhat thicker than the two front parts. Therefore, reduce the thickness of the rear part on the inside with some sandpaper to provide a smooth transition.

Now the plank segments in the joints are moistened with epoxy.

In the picture I did use painter's tape on the splices. Clear packing tape would have been better, because epoxy will not stick to packing tape.

It is important to soak all splices first with epoxy, and then wait until the epoxy is just beginning to thicken This can, depending on the ambient temperature and the hardener type used, take a few minutes to an hour. During this time, the epoxy has the opportunity to soak into the wood. If you don't do this, the wood will suck the epoxy out of the splice. There would be no epoxy remaining between the parts, and the bond would not hold.

This approach has proved successful ***for all bonding with epoxy.***

Only when the epoxy begins to thicken in the cup, you apply a little epoxy again evenly on the joint surface and submit a strip of glass cloth.

Again, wait a minute! During this time the epoxy soaks into a glass tissue and makes it appear transparent.

In the picture above this text two sections are visible where the glass fabric remained white. Here, apply a small additional amount of epoxy with the brush until the areas are transparent. In the picture below this text, all places are saturated with epoxy.

Put a strip of clear plastic film on top and wipe with your fingers the air bubbles between the film and glass fabric out to the side. A final check: Is the glass splice

completely transparent and all the air bubbles out? Are the distances between splice and the measuring string still right? Are the plank segments sufficiently weighted and cannot move?

Place a waste timber over the splice and weigh it with a weight of about 10 pounds. A bucket or canister with water works well.

Here I have the planks glued on a long table. The waste timber was slightly tightened with clamps so that it lies flat on the plank.

Epoxy glue is space-filling. If you bond epoxy with clamps, one can ***only tighten them slightly.*** The clamps should only press the glass fabric to the wood. If they would be tightened more, then one would force the epoxy out of the joint, no more epoxy would remain between the parts, and the connection would not be strong.

After curing, the film is stripped off.

The splice should look like this on the inside. The parts are joined together without gaps. The bond is smooth, with no air bubbles or white areas.

Glueing errors:

In principle, the plank segments are to be bonded so well that they do not fly apart when assembled in the hull. The strength of the hull is created later - during lamination of glass fabric. Therefore, small adhesive error are not bad at all. The worst thing that could happen is the fracture of a seam during wiring ... and you could easily glue this seam once more.

Here, not enough epoxy has been applied. Also, I have not completely pushed the air bubbles under the glass fabric to the side. So, some white spots are visible. The bond is generally sufficient. But the white spots will be noticed later when the boat interior is sheathed with fibreglass cloth and epoxy. So I'm going to sand out the white areas vigorously just prior to coating - but not until then! At the moment, I still need the entire load capacity of the seam.

Here, the surface of the parts were not all matching and smooth across the surfaces before gluing. So, a step has formed on the outside of the planks. Because it is the bottom plank, one can plane the protruding segment smooth later and use some filler for the rest.

When a bond has gone terribly wrong, undo the splice with the heat gun. Gradually, the epoxy will get viscous again for a short moment. Pull off the glass fabric with a pair of pliers and the seam will open. Then sand and re-glue.

This bond looks clean and smooth on the outside. Some epoxy has seeped through the gap and has sealed it completely. Well done!

The excess hardened glass tissue is removed with a knife, plane and coarse sandpaper.

Note: The wood at the edge must not be ground off. With the eye and the flat spline you can aim for over the edge and discover minor irregularities immediately. Work your way carefully up to the ideal line of the plank edge, look carefully, take your time, and ensure the bonded area is not narrower than the plank!

The smooth splices will not bond to epoxy, paint and varnish. Therefore, all epoxy coated parts must be sanded invariably with coarse sandpaper (60 or 80 grade).

One exception: During the hardening process, when the epoxy is still curing, a further layer of epoxy can be filled or painted directly onto it – it will bond because the not quite cured epoxy reacts chemically with the newly applied epoxy.

On the inside, the splice is sanded with coarse sandpaper, so that it will bond to the inner coating later. Only sand until that the shine is gone.

Please do not grind away the glass cloth, otherwise the connection may separate during assembly - and then you would have to glue the plank once again When I use the random orbit sander, I am very careful to take it away after a few strokes and watch the sanded part again and again, With a sandpaper on a block, it takes a little longer, but it is safer.

You should sand plank 1 quite carefully, because the front part is made from somewhat thinner plywood than the rear part. The fabric on the small edge must not be sanded away!

Planks 2 - 4 sticking together

The remaining planks are glued together in the same manner. All distances of the seams to the string line are indicated on *Figure 1* in the kit documentation. These measurements need to be followed strictly.

There is a right and left side of the planks 2 to 4 – as ***image and mirror image.***

It is important that the planks are glued together on both sides exactly the same, so that the boat is straight and will go straight forwards on the water.

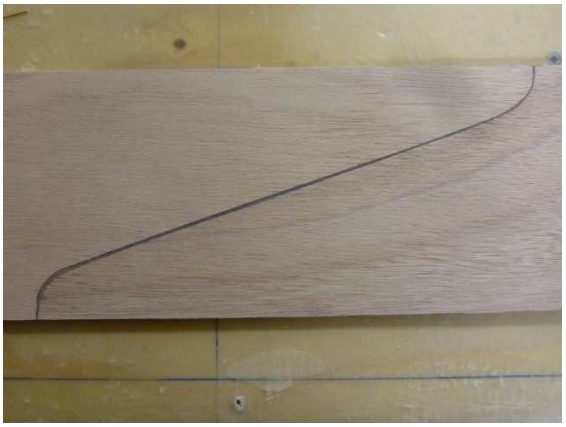
Therefore, the second side is glued directly on the first side - in this way the curvature of the two planks is exactly the

same. When gluing the second side **the outer sides of the planks lie against each other and in between a layer of film.**

On the outside face I sand the splice of plank 1 slightly.

If they will be varnished later, I sand the splices the plank No 2 - 4 on the outside slightly deeper until all the epoxy is carefully removed. Epoxy residues on the outside of these planks would later cause slight colour differences in the coating.

Caution The plywood veneer is only 1 mm thick! If you sand too deep the inner layer will be visible – that will not look nice on the outside of the clear wood finish. I use 120 grain and sand by hand, with a hard sanding block.



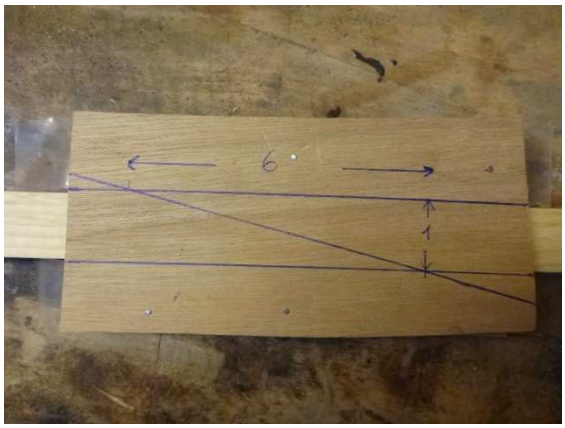
This seam is sanded clean on the outside and it is uniformly wide - really beautiful.

Jointing and Scarfing Battens

For the side stringers a total of 5 battens are needed, each 9 x 18 mm. Two and a half each of them must be scarfed.

Jointing the battens before scarfing is very easy with a saw guide. To build that you will need 2 pieces of 9 x 18 mm batten, about 15 cm long. They are each cut of half a bar. In addition take two offcuts from 4 mm plywood, about three times as wide as the battens:

I nail these parts together so that a batten will run smoothly and without play through the gap in the middle. I nail some film in between the battens and the plywood - which gives a tad more distance, so the batten in the middle will run easier.



A scarf joint with epoxy is at least six times as long as wide. Clean, mark, insert, fix the batten in the gap and just saw along the line till the bottom wooden plate. Finished!

Before the gluing together, it is important to impregnate the wood with epoxy first.

When the epoxy just begins to thicken, mix it with a little glueing powder. The thickened epoxy should just flow:

The splice is thinly coated with thickened epoxy. To prevent the glueing surfaces from sliding on one another, they will get staples on both sides. I staple them through some film, so that I can pull out the staples easily later...

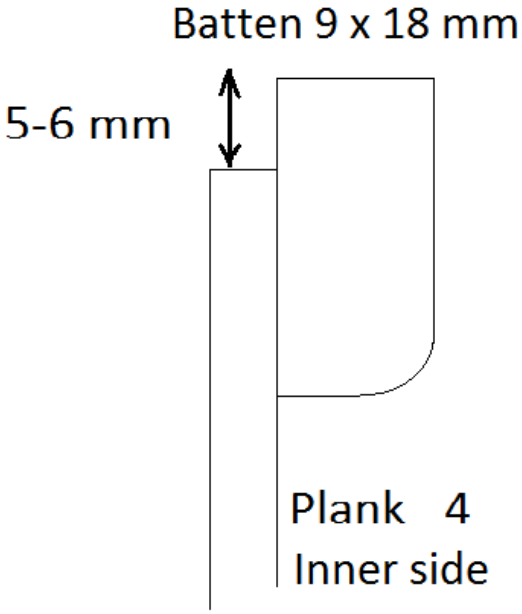
... and I will hold the splice together with a clamp or spring clamp.

After drying the glue joints are sanded clean.

One of the four edges shall be rounded generously with a plane and sanding paper.

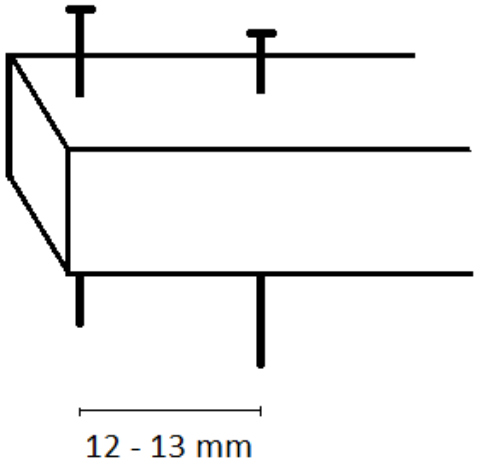
Glue Stringers on Plank 4

The two long scarfed inwhale stringers are glued like **mirror images** with epoxy on the **inner sides** of the two sheer planks No. 4. The inwhale is the **concave, inwardly curved** side. Namely, glue the stringers in such a way that the stringers protrude about 5-6 mm beyond the shear plank edge. The rounded edge should be the inner lower one:



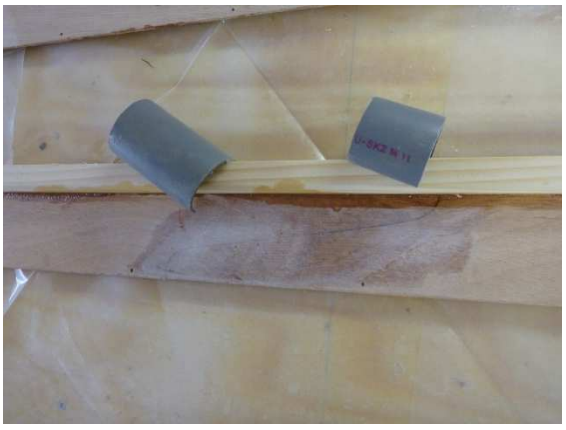
Just like scarfing, the glueing surfaces of the stringers are first moistened with epoxy. Just when the epoxy starts to thicken slightly, the stringer is coated with a little thickened epoxy

A fast way to mark the 12-13 mm depth line on the planks: use an offcut of a batten with two nails spaced 12 to 13 mm from each other to draw along the plank at right angle. The front nail marks a groove, the rear serves as a stop.



It is important to use about five clamps per stringer. They prevent slipping of the wet batten on the plank. In between, you can use spring clamps.

What to do if you do not have enough clamps and spring clamps? Additional spring clamps can be made out of a grey plastic drain pipe with 40 mm diameter from the hardware store. Just saw off pieces of a few centimetres in length and slot them lengthwise.



Remove epoxy oozing out of the joint before it hardens.

Glue Skeg Doublings

The aft end of the skeg later forms the stern. It will be strengthened with doublers on both sides. Between skeg and each of the doublers **a glass weave strip** must **be glued in.**
First of all doublers are impregnated with epoxy on both sides.

When the epoxy just begins to thicken, the glass weave strips are laid on the wood and some epoxy is brushed on them until they are transparent. These two could still use some epoxy:

The laminates are then aligned with the skeg and secured against slipping with two spring clamps ...

... or more simply fixed with staples.

After drying, the front of the skeg is roughly cleaned with the rasp. The back is tapered on both sides with a planer and a rasp to create a good bonding surface for the planks: The depth is that both tapered faces will meet exactly at the centreline, where a ridge will form. Tapering should start about 20 mm away from that edge, so a total angle of about 35° is achieved. An angle which is too small would not hurt,

because thickened epoxy will fill it. A too wide angle would also not matter much. It is very easy to correct that angle with a rasp during assembly.

Strengthen Skeg with Fibreglass Cord

If the boat touches on sand, pebbles or stones, it will mostly land on the skeg. And on the canoe trolley, it is also the skeg, that is often abraded on the tarmac. Therefore, the skeg edge is reinforced with glass fibre cord.
Cut a length of about 90 cm off the cord. A tape at the cutting edge prevents fraying. The remaining 60 cm are used later at the bow.
At first, you tack a strip of construction film on one side over the entire length of the skeg:

Then turn the skeg and apply epoxy resin onto the whole lower edge up to the skeg doublings:

Wait until the epoxy just starts to thicken. The slightly longer than necessary glass cord is dipped in epoxy so that it is soaked. I have added some graphite powder to the epoxy – this will give an extremely hard and slippery surface. Apply glass cord ...

... now fold over and staple the construction film down.

In the fore and aft bend, the film is stapled like a fan:

The picture shows that the glass cord at the rear end must go just around the curve up to the skeg doublers, not all the way up.

After curing, remove the foil and sand the sides smooth.

Drill skeg

The stern part of the skeg gets two holes for the rudder hinges.

The top hole is 1 cm away from the top edge. The bottom hole is 9 cm from the top edge. Both holes are drilled parallel to the lower long skeg edge.

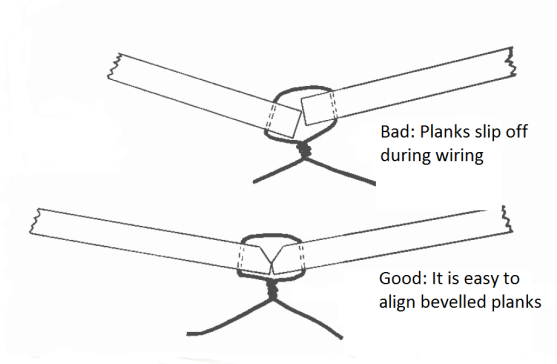
If you notch the outer edge, the drill enters more easily.

Drilling 4 mm holes through the skeg is really easy, because the drill is guided by the glass weave between the skeg faces. Anyway, ensure it does not overheat - then the epoxy would go soft. To prevent this from happening use a slower rotational speed and push somewhat stronger. Both of that will keep drill and hole cold.

Thereafter, the holes are re-drilled to 6 mm.

Bevel Insides of Planks

After gluing, all the planks are bevelled where they are bonded to other planks: along the ***long i*nner sides and at the leading side.** As a result, they nestle together well if they are stitched together later with wire.



The chamfering with a few strokes by hand planing and finishing with some coarse sandpaper (60 grit or 80) is quickly done.

Drill Holes

Next, the **planks** are **1 and 3** are prepared for wire stitching. Drill small 2 mm holes spaced 15 cm, about 5-6 mm from the edge of the plank. Do not forget the holes on the front part of the plank 1 along the centreline. **The planks 2 and 4 are drilled later during assembly!**

With a jig from an offcut drilling is much faster:

Clamp the right and left planks and drill them together -this saves time.

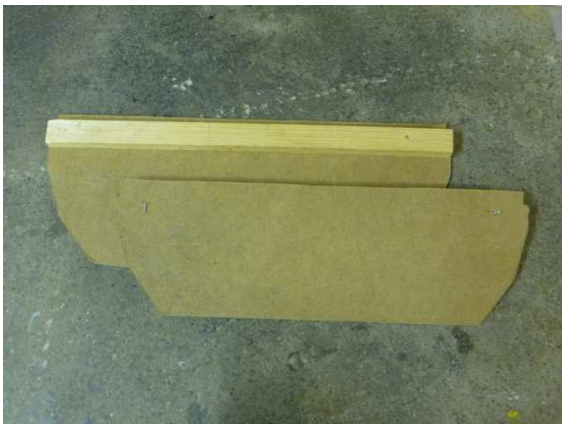
Drill the small holes with a sharp drill, high speed and low pressure, put underneath some waste timber. This will ensure that the holes will not fray.

Preparing Plank 1 for Assembly

At the plank 1, 2 mm holes are drilled right and left of the two lines near the centre line, as long as the skeg on the plank exterior extends forwards. The holes have a distance of 15 cm.

Construction Moulds, Prepare for Installation

The 5 moulds, **A to E,** made of particle board, give the boat stability during assembly. You need reinforcements at the notches.



Cut roof battens to correspondingly long pieces. To temporarily connect the wooden battens lengths to the moulds, drill two 2 mm holes close where the batten ends. Pull wires through and twist them together.

If the roof batten exactly is flush to mould C, then the boat is about 77 cm in width. It is possible to build the boat somewhat wider or narrower. If the boat shall be wider, let the batten protrude 2 cm beyond right and left of frame C:

If you want a narrower boat, then the moulds B, C and D have to be cut slightly narrower at the contact surfaces to the plank 2, 3 and 4.

The wider boat has a little more lift at the top of the coaming, therefore a little more resistance against capsize. For the smaller boat you can use a somewhat shorter paddle.