THE IRIS DINGHY

DESIGNED BY CATALIN POGACI

THE STORY

AND THE

BUILDING MANUAL


Iris

The muse of this project is the Shrike kayak, designed and popularized by Nick and Christopher Crowhurst from CNC Kayaks. Despite the fact Iris is not a kayak, her creator hopes she will equal the Shrike in popularity amongst the amateur boat builders one day. Therefore, spread the news, enjoy the build, enjoy the boat and keep the tradition going.

MEETING IRIS

THE STORY BEHIND

Many years ago I built my first stich and glue kayak, the Shrike. I accidentally stumbled upon the design when googling for a free project to suit my needs. I already had experience building skin on frame boats, but knew nothing about stitch and glue ones. Nick and Christopher's website, structured around the Shrike and more recently around the Vember, provided the needed know-how in a way which made perfect sense even for a total beginner in epoxy works. They provided the building templates as a .pdf document, the AutoCAD files, the building manual and the online support in such an altruistic way (not to mention free of charge), that I instantly fell in love with the entire project and the whole thing got embedded deep into my heart. I promised myself on the spot, to give something back to the world, in a manner similar to theirs.

The time passed, I built more boats, I became better at it and I finished an entire self-imposed apprenticeship in boat building. Then, Ira came one day, a skin on frame sailing dinghy, created to carry 3 or even 4 people under sail, the natural result of an expanding family with whom I wanted to share my love for the water.

But alas, despite being a very dear boat to me, literally a part of my soul, she came out a bit heavy and a tad premature. My first son was baptized in her, shown the strings of rowing and sailing; he bravely witnessed the mean old carp hitting the gunwale when jumping out of the water (while his mother and a friend of hers were shouting their lungs out in horror, for the great entertainment of the onshore anglers), but she was built for a crew: a

crew needed to sail her, a crew needed to put her on the roof rack, a crew needed to move her from one place to another, a crew had to carry her to the water. One of my crew members was one and a half years old. The other was pregnant.

After a season of breaking my back and destroying the car with 50 kilos of single handed wood and nylon, I decided something needs to be done. So along came Iris.

Iris is one of the few boats I created and built according to some measurements (the rest of them being simply eyed in shape and size). She was born during the winter, coming out of a free boat design software; two of them in fact: Hulls and Freeship.

She was created around a different set of needs and I used the experience earned with Ira and the boats before her. The wish list defining her was not able to be fulfilled by none of the stitch and glue designs out there. Despite being by the hundreds, maybe by the thousands, some as old as the world (in tradition at least) I fancied none enough to build. Found them either too small, too heavy, too complex, too ugly, too beautiful, not

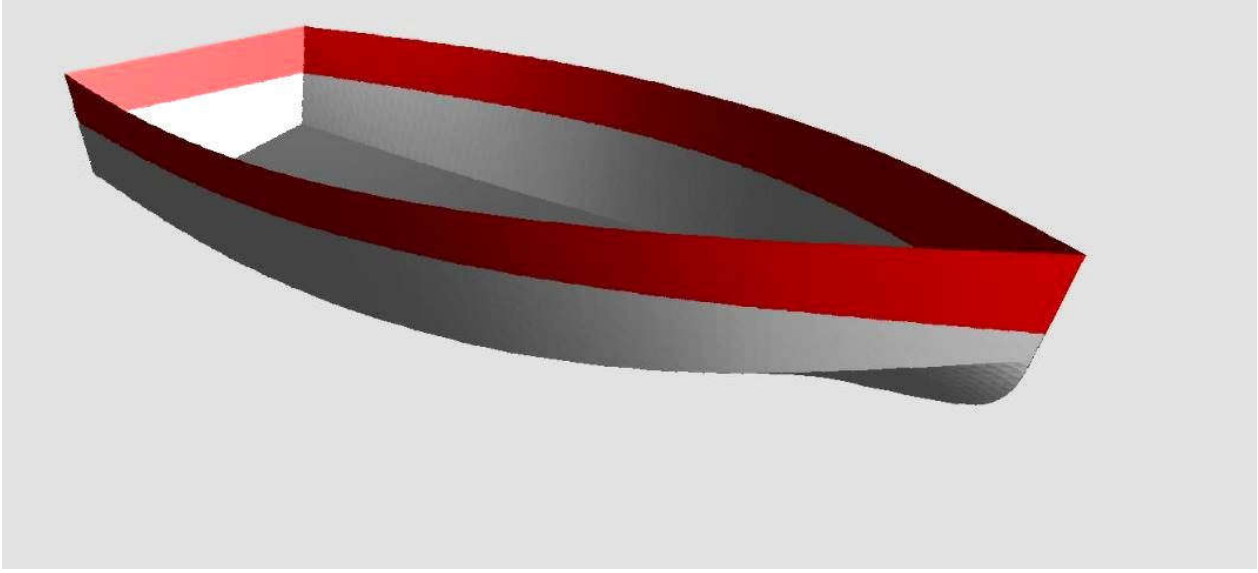
matching the car's roof rack, not matching the storage space, not and not and not with a capital N.

I needed a dinghy light enough to be carried on a shoulder by a single person, capable to carry 3 to 4 people when rowed and an adult and a child when sailed. She had to be stitch and glue built, to have simple and beautiful lines, similar to a Greenland qajaq, to be able to plain at speed and to be built out of ordinary materials, accessible to everyone.

She had to be daddy's boat, nimble under sail but well balanced, fast, but not a racer, to be spacious, but for daddy's 60kilos frame, beamy, but narrow enough to fit an ordinary roof rack without any extensions.

She had to fly a classical sail on a classical rig, as daddy doesn't really like bermudans, but he's in love with luggers, gaffs and crab claw sails (even square ones are not despised).

Daddy had a few attempts and eventually settled upon a design which got the name of Iris, in line with the "I" names established a long time ago in the family.



Daddy did what he does best in general when it comes to boat building: studying, imagining, thinking, picturing the water flowing around the hull, hearing the wind in the sail and feeling the tension in the mainsheet. Daddy watched countless boats sliding through the water.

Iris was born. First as a small model emerging from failed or discarded variants, then she grew inside a cold unfinished house, surprising

an owner who never imagined such a project will take place in his house (unfinished as it was).

The time had come to know her better and decide if she fits your needs. If she does, you can build her as she is. If not, you can try and modify her lines as such as to create your own Iris and tell us about her, as this is the point of the whole writing: to give a boat to the world the same way the Shrike was given some time ago. If you like reading, you may have already noticed I did my best to join two passions together here: writing stories and building boats. If throwing a bit of dreaming in the quest, who knows, maybe Iris will form a class of her own one day.

THE PURPOSE

Iris is designed to carry one adult and one child under sail and 3 to 4 lightly built adults when rowing. Her frame is wrapped around lightly built constitutions in fact, as ancient kayaking knowledge was used to dimension her (why creating a bulky boat with a lot of space needing a lot of materials when we're small and can fit in a smaller boat with room to spare even). She superficially resembles the Argie 10 and the Walker Bay 10, but there is no connection between the projects. Iris was made to be Daddy's boat and to teach sailing to the kids: a nicer looking Optimist or a Mirror on steroids.

She can be built from cheap materials more or less by anyone.

The boat is easy to row empty or fully loaded, stable enough to stand up in it and due to the closed spaces of the frame she is virtually unsinkable (but this doesn't mean it is comfortable to have her full of water).

She sails nicely under a balanced lug sail, but precautions need to be taken in a stronger wind, as the sail is cut to respond well in very light air (about this we'll talk later).

She can be used as a tender for bigger yachts, but only on sheltered waters.

DIMENSIONS

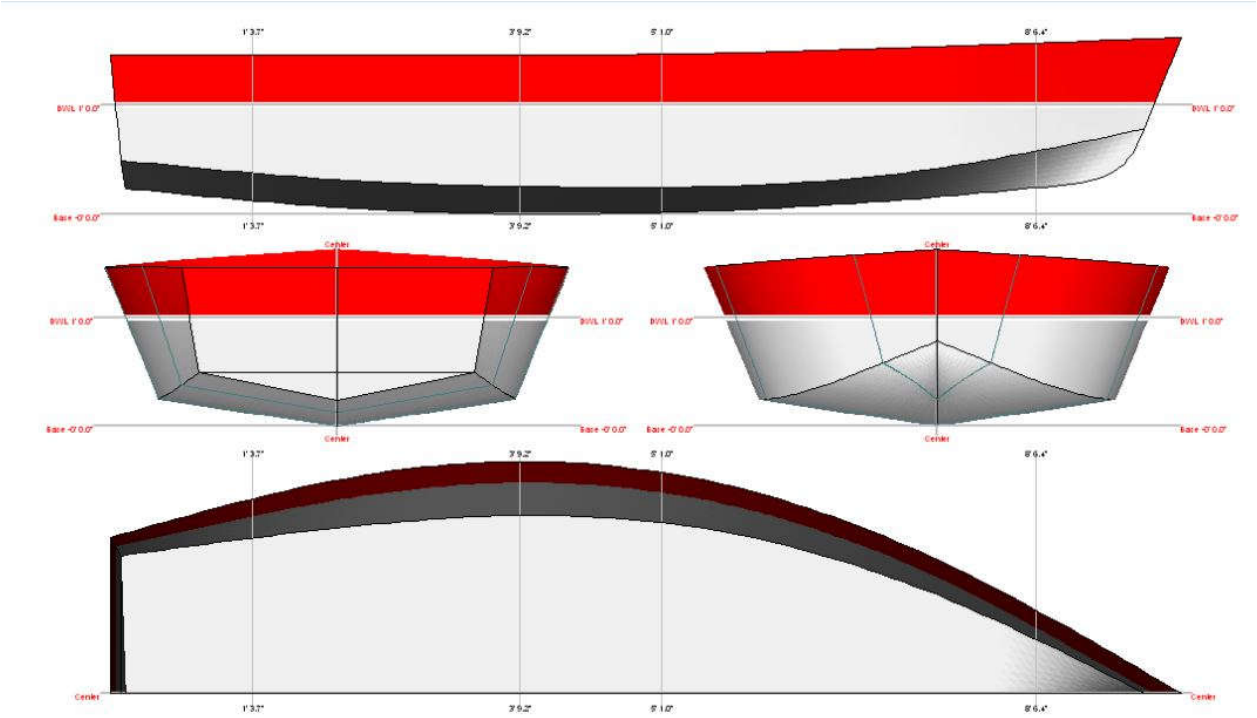
Length: 3m;

Beam (max width): 1.2m (fits on top of almost any car);

Depth to sheer (the distance from the top of the gunwale to the keel): 40cm at the transom and 45cm at the stem

Number of bulkheads: 4

Weight without the rigging: 30kg (subject to the materials used it can be more, it can be less)



CAPACITY

3 to 4 people when rowed, max 200kgs total load.

1 adult and one child under sail, or two children/teenagers. She can take also 2 small sized adults (we sailed her even with 3 adults).

RIGGING

Iris is rigged as a catboat and as said before she carries a balanced lug sail.

Mast height: 3m

Sail area: 5 square meters

INTRODUCTION TO THE BUILDING METHOD

THE PLYWOOD EXPLAINED

Plywood is a composite building material made from thin layers of wood which are glued and pressed together. It has been around for centuries, but came in use on a large scale at the beginning of the 20th. The ply layers, also known as sheets or veneer, are shaved of a log rotated on a lathe in a fashion similar to sharpening a pencil. The sheets are then rotated with their grain up to 90 degrees to one another and glued together.

Plywood is very strong by comparison to a single layer piece of wood of similar thickness due to the different orientation of the grain and the glue holding the veneer sheets together. Its properties make it ideal for many applications, from households to ship and aircraft building. In fact many producers create their plywood according to the purpose it will be used for, altering the grain orientation, number of plies, the wood it is cut from and the glue used to keep the sheets together. Subject to all this, it can come out as a strong or not so strong material, flexible or rigid, for exterior use or interior, for wet or dry use (aka in humid environments or not) and what interest us the most, for boats building.

The boat industry has been using plywood for quite a while, but it became better known amongst the amateur builders somewhere in the 60s, when it was used for the first time to create hulls in an origami fashion. Due to its strength and light weight, plywood became the ideal material to build simple, light boats by thousands of home builders. Countless angular or rounded shapes can be easily cut out of a plywood panel.

Talking about panels, they generally come in standard sizes. In Europe, they are sold at 1200x2400mm, or half of that at 600x1200mm. Some are even dimensionally specialized, taking the shape of an A4 or A3 sheet of paper. There are some other dimensions too, like the 1500x1500mm panels.

In the US, they mainly come as 4x8s or 2x4s, meaning the panels are 4x8ft or 2x4ft, roughly the same dimensions as their metric brothers mentioned above. They can start at 2 to 3mm in thickness and go all the way to even 100. The most common thickness of the panels ranges between 4 to 20mm though.

The plywood panels follow other standards too. They are related to the quality of the veneer, the quality of the glue and the wood itself. They are marked with the letters of the alphabet or the standardization codes of a country or a region (for example A, A/B, EN 314, etc). When it comes to the letters, the closer they are to the beginning of the alphabet, the better the ply (and more expensive).

The marine builders are relying on a magical standard, invented by the Brits and called BS1088. As such, a ply panel produced according to this standard is made of rot proof tropical wood, each veneer sheet is almost perfect and the glue holding them together is water proof. Basically the ply can be kept in the water for a long time, without decomposing. The wood essences used to make it are of a harder and harder to find kind, such as the Okoume or the Meranti (due to the merciless destruction of the tropical forests). However, the standard has its drawbacks, as there are virtually

only 2 colors available and the ones who like to varnish the wood instead of painting will be quite disappointed. But let us despair. The BS1088 is used mostly for serious projects and expensive boats, meant to spend most of their life in the water. For a cheap, small one, such as a dinghy, canoe or qajaq, which will hang around mostly on dry land, almost any ply will work. Most of my prototypes (Iris included) were built from reclaimed ply, found in the rubbish.

As long as it is properly and correctly laminated, the non-marine grade ply will serve its purpose well. And speaking of laminating, let us see what it is all about in the next subchapter.

THE EPOXY RESIN EXPLAINED

The epoxy resin is one of the wonder materials of the modern world. It is liquid plastic, when not cured and solid plastic when cured. Just like this.

Despite saying it is a wonder material of the modern world, it was discovered almost 100 years ago. It started to be used on a large scale starting with the 50s and today it has so many applications that it would be useless to mention them all: paints, glues, lamination systems, floors, electronics, medicine, art, just to name a few.

Epoxy is a petroleum industry byproduct of sorts and in order to keep it short and avoid a lengthy chemistry explanation, I can say it mainly comes as a two parts goo (having more or less the same density and weight as the honey), which transforms into solid plastic once the parts are mixed and the resulting brew cured. One of the parts is the resin itself. The other one is the hardener. This doesn't mean every epoxy component on the market is good for boat building. As said before, epoxy has many applications and we definitely cannot use epoxy destined for floor covers in boat building.

The raw materials for the resin are produced on a large scale by only a few manufacturers around the world, but the industry doesn't stop here. There are others involved, called blenders or formulators. In fact they are the gross of the epoxy business. They transform the raw epoxy materials into specialized resins, destined to match the application they are destined for. Our application is boat building therefore we need an epoxy system optimized for lamination. Epoxy in itself is brittle after curing and needs to be strengthen by means of an inside structure in order to form a very solid sandwich. Our sandwich core is the plywood and the glass fiber (we'll talk about it below).

We are going to use our resin to laminate the plywood in order to encapsulate it inside a water proof cocoon and strengthen the boat frame. We are going to use it also to create glue, filler and fillets. We are going to talk about what kind of epoxy we'll use in the bill of materials. For now, let us read a bit about the fiberglass.


RESIN
HARDENER

THE GLASS FIBER EXPLAINED

As the name says, these are very fine fibers of glass, technologically obtained through various processes (sometimes they also occur naturally). The fibers are then woven into meshes, fabrics or other products used in a variety of roles. What interests us the most are the ones used as a reinforcement agent for polymer products, like the one mentioned above.

Glass fiber, also known as fiberglass, forms a durable composite with such polymers, composites known as glass reinforced plastic, or GRP. As we

already know, an agent such as the epoxy is quite brittle when used alone. If we add the glass fibers into the composition its durability and strength will increase considerably, as the fibers will evenly distribute the loads across the fabric. As such, we can dress in fiberglass certain surfaces of a boat in order to strengthen them and consolidate certain joints. The obtained composite will also provide added protection against abrasion and water ingress.

GRP is the bread and butter of major yacht builders, many aircraft manufacturers, automotive industries, construction industries, interior designers, sport products manufacturers and many others. For us, obtaining the GRP will provide the opportunity to learn new working skills and properly reinforce and water proof Iris.

Fiberglass comes in many forms. Mainly, it comes woven into fabrics, as glass wool or it comes as chopped strand mat (CSM). We are mostly interested in the fabrics as this is what we are going to use.

The fabrics are divided into a few categories, according to the density and fiber diameter. The thicker the fabric, the more durable, but also less flexible and more epoxy thirsty. More epoxy means more weight. What we need is a compromise and when talking about the needed materials, we'll discuss about the ideal glass fabrics. Till then, let us see how we can combine the three main elements described so far into a boat.

THE STITCH AND GLUE CONCEPT EXPLAINED

This is a method of assembling simple boats (and more) out of plywood panels by stitching them together with wire, or zip ties and using epoxy to reinforce and water proof the seams. The stitching is then removed (like after surgery), but it can also stay in place. The whole craft can then be encapsulated in epoxy and fiberglass for added durability and waterproofness (but not always). This arguable is the easiest method to build a boat. It is so simple, that it basically eliminates the need of ribs, or frames (although some are still needed in critical points) and is achievable with only a few basic tools. The method is accessible to anyone capable of fielding basic eye-hand coordination and is able to work with tools. It is part of the syllabus of many vocational schools and is also part of many other hobbies apart from boat building.

The concept can give birth to boats of exceptional beauty when the advantages of the wood's grain and color are employed. It works up to a certain dimension of the boat, after which a frame will be needed.

The method has its disadvantages too. For example it is quite difficult to obtain pure round shapes due to the difficulty of bending the plywood past certain angles. As such, the method resembles a bigger origami, but made of ply instead of paper.

It was invented as we know it in the 60s, but some scholars claim the concept to be much older, as proven by the so called *sewn boats*, which are as old as the human civilization. No matter the history, it combines the above described concepts into a boat. All we have to do is to conceive it as an

angular 3D model of sorts, break it down to its primary elements, transpose them on plywood panels, then stitch and epoxy everything together as a full sized boat.

The 3D modeling and subsequent decomposition was already done by me. All you have to do now is to print the resulting templates, glue them on ply sheets, cut the shapes out and glue them together as an Iris clone. Before doing so, we need to talk a bit more, as there are a few more things to do.

THE SHOP, THE TOOLS AND BUILDING TIME

If you read by chance my “Qajaq Book” you may already know some of the basic prerequisites needed. Being too lazy to write everything from scratch, I’ll just import and adapt the corresponding sub-chapters in here.

SETTING THE SHOP UP

Given the simplicity of the build you don’t need to own a specialized shop; on the contrary. In fact, it doesn’t matter where you decide to build your boat as long as you follow the below basic and common sense rules:

- *To have sufficient space* to accommodate the boat, the tools and all the materials; it would be annoying and frustrating to realize later you have no space for the boat or you have no space to work around it. It would be good to have also everything around you as it may become tiring to carry stuff from one place to another;
- *To have easy access* and a method to remove the boat from your shop. In other words be careful not to have to demolish a wall in order to extract the boat from the shop. Take your time to measure the space properly;
- *To have decent lighting*. You have no idea how frustrating it is not to see what you are doing. It can be natural or artificial light, it doesn’t matter as long as it does the job;
- *To be able to make some noise* without disturbing anyone (family included). Normally the noise level is well under the decibels number of an apartment being refurbished;

- *To have a power source*: a well-placed plug, a power cord extension, anything which can power an electrical tool;
- *To be dry*. Dry can mean also outside if it is not raining.

The remaining conditions are according to how cushy you want to feel and your imagination. Ideally would be to also have the place heated but it is not mandatory. You can work under the clear blue sky and take a break when the sky is no longer blue and it is raining. You can improvise a small shelter out of a tarp. You can work only during the warm season if your shop is not heated. As long as you follow the above rules you can work in your own backyard, storage room, barn, apartment, dedicated workshop (if you have one) or even on a public space around your neighborhood, as long as you don't break any rules and there are no objections (you may even make new friends).

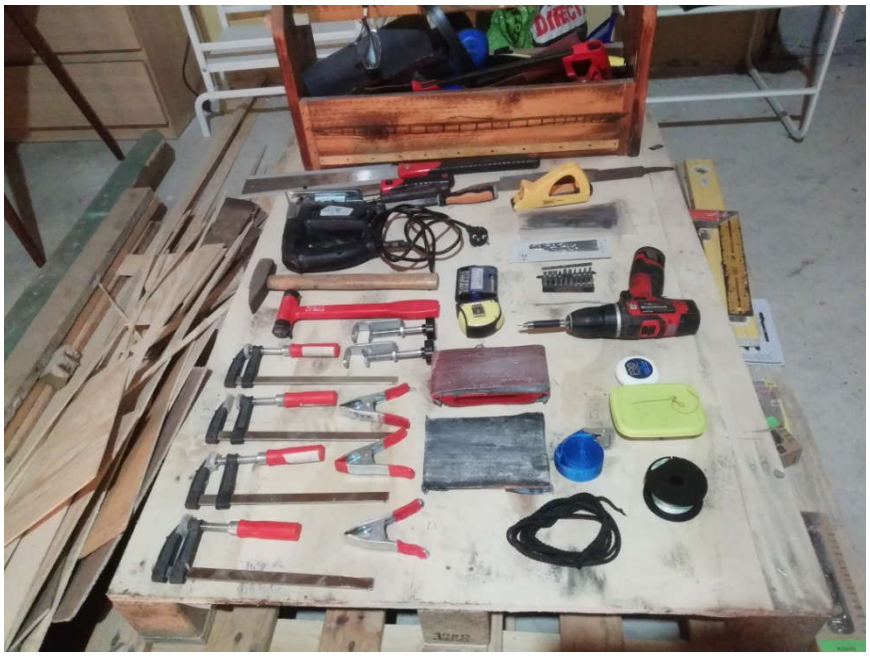
It would be good to have a printing shop around, in order to have your templates printed, but it not mandatory as today almost everything can be done online.

NEEDED TOOLS

You'll need the following:

- Measure tape;
- A universal wood saw; a medium sized one should be enough. It doesn't really matter the type as long as it cuts well (my favorite is a Japanese style one purchased from *Lidl* many years ago);
- A rubber or wooden hammer. Why a wooden one? Because it leaves no hitting marks on the wood. It is as stealthy as an Agatha Christie villain;
- A hand or battery powered driller, which can also be used as a screwdriver;
- Various drill bits for wood;
- A cross slot hand screw driver or the matching bit for the driller;
- A rasp;
- A round sectioned file for wood;
- 80 and 120 grit sandpaper;
- A piece of wood to dress it with the sandpaper for a better grip. You can easily use a piece cut from a plank;

- A knife, a box opener, any other sharp instrument which cuts well;
- Well sharpened scissors;
- A box of 2.5x3mm of chipboard screws or a box of nails roughly the same size which will be used for temporary joints instead of clamps, which are more expensive. Screws are the ideal ones as they are easy to remove;
- Three bags of nylon zippers (cable ties) at least 20cm long, also for temporary joints;
- All kind of clamps; the more the better. Would be nice to have a whole variation of them;
- Nylon straps (like the ones used to secure objects on the car with or without a ratchet);
- A jigsaw with various blades;
- A power cord extension;
- A few cheap plastic cups and jars to mix your epoxy in. Try to find graded ones in order to properly mix the epoxy components;
- A few big syringes (veterinarian ones) for the same purpose;
- Some old rags to clean your hands;
- Some old clothes you can work in, as most probably you'll discard them full of epoxy stains after the boat is complete;
- Many cheap medium sized brushes;
- Many rollers for painting.



NEEDED TIME

Taking into account a relaxed way of working, specific to a hobby builder you can expect the following:

- If you are a total beginner expect to have it done in a minimum of *one month* if you dedicate time every day. You will need it to find the space and prepare your workshop, gather materials, tools and a lot of *think*ing. At the start, things are going to move slower and maybe a bit frustrating, but later on, after finishing your "warmup" you'll do better. If you have very little time available and a relaxed style of working, let us say the project will extend for the whole winter. Anyway, the water is cold during this period.
- If you already are a hobby builder, familiar with wood working and already have the tools and a shop, you'll spend most of the time studying the build and not learning how to work. Without rushing you'll need *2 or 3 weeks* to finalize the project;
- If you are a dedicated boat builder having loads of experience with wooden boats, you should finish in a week or so;
- Do not forget the wife factor here; it may add considerable time.

THE BILL OF MATERIALS

(AND ASOCIATED COSTS)

MATERIALS FOR THE HULL

You need the following in order to build the hull:

- 1x 10 to 20mm thick, 600x1200mm panel of plywood or OSB. You'll need it to produce the outer molds (templates) of the boat. You can build without them, but you risk having a distorted hull. I used the outer templates and didn't feel sorry about doing so. If available you can use scrap ply from a different project. If big enough pieces are not available, you can glue smaller ones together. Expect to pay around 30E for a 10x600x1200mm piece or double for a 20mm thick one. I would not recommend using thinner panels for the outer mold as they are flimsy and distort easily;
- 3x 4x1200x2400mm (or 4x1250x2500) panels of A or B quality ply. It can be marine grade (but this one became very expensive), for the exterior or for the interior. Buy the soft wood one in order to save weight. If you plan for a bigger payload, maybe the bottom panels should be hard wood, 6mm thick. Expect to pay between 25 to 35E per piece; marine grade ply is around 60E per panel. If you are not very good at nesting (the process of fitting the paper templates on the ply sheets) consider having 4 panels instead of 3;
- 1x 6x1200x2400mm (or 6x1250x2500) for the interior bulkheads and the thwarts;
- 2x 30x50mmx3000mm pieces of soft wood timber for the gunwales. You can add an extra one to compensate for breakage. They cost around 10E per piece. If available, you can use 4x 25x25x3000 pieces, but I

rarely found them in the DYI stores. If you own a serious table saw you can rip them off a bigger plank;
- 2x25x25x3000mm sticks for the thwarts frames; 7E apiece;
- 1x30x200x1000mm soft wood plank to step the mast in. If you plan to build Iris only for rowing, you can ignore the plank;
- 2x 50x100mm stainless steel straight brackets for the oar locks. They cost a few Euro each;
- 1x 25x100mm stainless steel straight bracket for the ruder post. It costs a few Euros. If your Iris will have no sail, you don't need this;
- 4x 2x5mm round omega brackets for the ruder post, also stainless steel. They should under 1 Euro each. Once more, if you plan no sailing, you don't need them;
- 7 linear meters of 200g/m of fiberglass. This costs around 3E/meter. If you want your hull heavier and more solid, you can go for a thicker fabric which will cost around double;
- 7 to 10kgs of uncolored laminating epoxy (subject to how solid you want to make the boat). You'll need it to laminate the ply and to make glue and filler. Depending on the brand, you can expect to pay anywhere between 130 to 200E for the whole batch. Subject to where you are located, you can find 5M, Letoxit, C&C, West, etc. Select a slow curing product, as it will give you time to work with it without wasting any (the curing time is set by the hardener in most cases, so you can choose a slow acting one). You will also be able to prepare larger quantities, without the fear of having the resin hardening. Make sure you choose the resin according to the purpose. All the shops will clearly explain what their resin can be used for. Look for laminating systems dedicated to boats, cars, airplanes or general lamination. Do not use the systems dedicated to flooring or painting!!!
- Around 5 to 6 liters of paint or varnish, or both. It is up to you to devise the paint scheme of your boat. I cannot give any prices here due to the huge variation. Any exterior paint or varnish will work as long as it can catch on the epoxy. In general the paints dedicated for metallic surfaces work well;
- Two rolls of Gorilla tape to protect the bottom of the boat. They cost around 10E each;
- A few cyanoacrylate (aka Superglue) tubes of glue. They cost around 1 to 2 E each;
- 2kgs of fine flour. It costs 1E;
- A few meters of polyethylene line to tether the boat with. It costs a few Euros.

MATERIALS FOR THE OARS

You need the following pieces:

- 2x 30x30x2000mm pieces of timber to make the oar looms; They cost around 5E each;
- 1x 15x20x1000mm plank to cut the blades from; another 5E or so;
- 2x stainless steel omega brackets with a large enough opening of the omega to accommodate the loom of the oars. These will be your oar locks. If you are picky you can order them from a specialized shop. Expect to pay 15E for both;
- A few 6mm thick bolts or screws to make the oarlock pins from. They cost a few cents.

MATERIALS FOR THE RIGGING

If you wish to use Iris as a sailing dinghy you'll need the following:

- A 50x50x3000mm stick for the mast. That would be 7 to 10E;
- A 20x30x3000mm stick for the boom. Another 5 or 7 Euro please;
- A 20x20x3000mm stick for the yard. You can use also something thicker. It costs also 5 to 7E per piece;
- You need fabric for the sail. I used 170g/m Dacron for the prototype. It costs around 20E/m and you need roughly 10 linear meters. If you are on a shoestring budget, you can use a 20E tarp. They work like a charm and usually have grommets already installed;
- Count on around 50m of polyethylene or nylon line for the halyard, mainsheet and other connections. Subjects to its thickness, it can cost anywhere from 30 to 50E;
- You need an array of small blocks and carabiners. I used simple galvanized ones 5 cm in diameter. Given the simplicity of the rig

they can be replaced by carabiners. Expect to pay around 1 to 2 E for a piece;
- You need 3 loophead screws, with the loop large enough to allow the line to pass and the thread around 5cm long. They cost 1 to 2 E apiece;
- You need one or two simple quick release shackles, but not mandatory. The cost also 1 to 2 Euros.

MATERIALS FOR THE DOLLY

The dolly is the small cart like thing you'll carry your boat on. I highly recommend building one, if you don't have a proper launch spot and need to travel some distance from the car to the water. Iris can be built as a light craft, but even so, it may be very uncomfortable to carry her to the water due to her size. The dolly will facilitate this trip a lot. You will also be able to store your equipment in the boat and carry everything to the water on wheels. My dolly is very simple to build and can be easily made from leftovers or scrap wood. You'll need the following (subject to improvisation):

- 2x 400mm in diameter barrow wheels. Ideally would be to buy the inflatable ones in order to act like shock absorbers. One costs around 20E;
- 1x 20x10000mm threaded bar for the axle. This costs 10E;
- 1x 30x50x3000mm stick or several pieces of it, as you'll cut it. The dimensions may vary according to what you can source out, but make sure the wood is strong enough to withstand around 50kgs of boat with some marge. On mine I can easily carry the boat and my wife on my dolly. I will assume you'll find this for free, so I will not count it;
- You need a few 20mm nuts and washers, to secure the wheels with. They cost a few cents each;
- I made some simple spacers by wrapping Gorilla tape on the axel. As such, the wheels will not get the nuts loose, or get stuck in them. Works like a charm.

You have to add the plotting costs for the templates. That's 50 to 80E.

Let us see the total. Mind the fact I used approximate prices, as I cannot tell the exact ones in every shop. You may end up cheaper or more expensive, take a 10% marge. You can expect to spend around 6K for a rowing Iris and around 8K for a sailing one. Due to the Corona pandemic, many prices skyrocketed, it is true, but a factory made dinghy costs thousands (not to mention is almost double in weight). You can deduct some of the expenses if you are good at sourcing scrap wood. I built mine using reclaimed ply and scrap pieces of wood. It may not look very fancy, but she certainly does the job. My expenses were mostly the epoxy the fiberglass and the Dacron for the sail.

BUILDING IRIS

This is the chapter where we learn how to put Iris together. It is not a difficult project, even for a total beginner, but there are a few things which require improvisation and others in need of improvement. This manual will continuously be updated according to the feedback received from the builders. Therefore don’t be shy. Share your experience with us (as a community) and the book will be re-edited.

Just as a recap, the general lines of building Iris are the following:

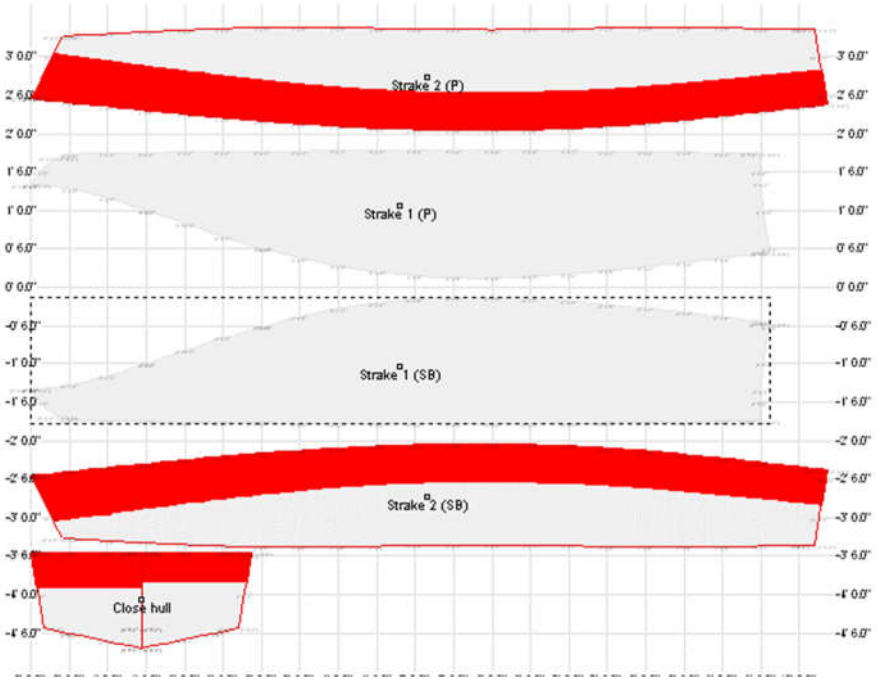
- Print the templates;
- Glue the templates on the ply panels in order to cut them out;
- Put the panels together;
- Laminate everything;
- Paint the boat.

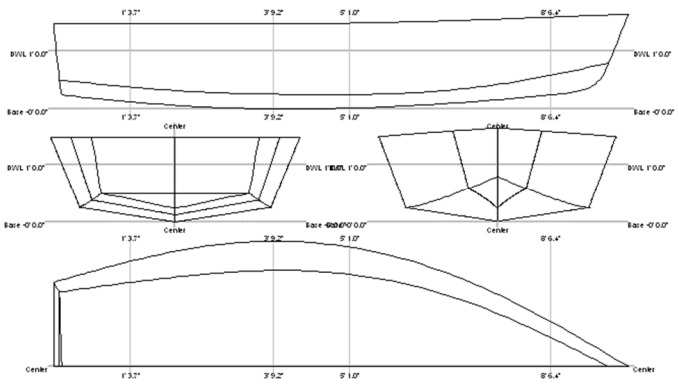
It is like building a model but on a 1:1 scale. The reality is a bit more complex than this. Let’s get into it and see how it goes.

PRINTING THE TEMPLATES

This is the easy part of the project as you don't have much to do. You have to source out a good plotting center, send them the .pdf documents containing the templates and ask them to print them out for you. There will be 3 rolls of paper coming out. One contains the bottom panel, one contains the side panel and the third one contains the bulkheads and the transom. The files are optimized for the average plotter paper size. If you are good at nesting, you can re-arrange the panels on the paper rolls and save some space and money. Maybe you can squeeze everything on two prints instead of three.

Another way of putting Iris on plywood panels is to calculate the full scale templates by measuring on a smaller scale. This involves printing the templates on normal printing paper (like A4 or A3) measure them and scale them up directly on the ply sheets. However, I do not recommend this method. There will be errors, you have no determined offsets and you'll obtain an inexact and possibly twisted hull.





NESTING

No matter how much we would try, it is quite obvious we cannot glue 3m long paper templates on 2.5m long pieces of plywood. The only solution is to extend the length of the ply panels as such as it will match the length of the paper templates. We do not need to glue them one next to another entirely, as we are not going to use their entire width. The average width of a template panel is 50cm for the bottom and 40cm for the sides. Therefore, as part of the nesting process, we can divide with a pencil a panel of plywood in 60cm wide strips (you should get 2 of those) and one into 50cm wide strips (you will also get 2 of them and a 10 or 15cm wide extra strip).

You are missing 50cm to reach the full desired length. You can sacrifice the first 50cm of the third plywood panel to mark them in 60cm long strips in order to complete the ones marked on the first panel. You have around 200cm left. Sacrifice another 50 to mark the 50cm wide strips. You will have around 150cm left from the third panel, enough to make the bulkheads and the thwarts.

The disadvantage of this variant is you'll have the joints between the panels quite visible on the inside of the hull as there will be nothing to cover it (unless you decide to extend the front waterproof compartment towards the stern or use scarf joints). Another disadvantage is it will be more difficult to join the panels into a harmoniously curved bow. Being close to the bow, the joint between the panels will somehow prevent this by

altering the natural elasticity of the plywood and you'll have to work more in order to obtain the proper line. Most probably you'll end up filling and sanding quite a lot, even if you decide to scarf the panels.

The only advantage of this method is its simplicity and the plywood economy.

The second method involves making the joints invisible by masking them inside the central waterproof compartment. Being almost at the middle of the boat, this position has its advantages:

- It can mask the joint between the bottom panels as well as the joint between the side panels at the same time;
- The joints will not affect the bending radius of the panels close to the bow.

Its disadvantage is the complexity of the nesting operation and the use of 4 plywood sheets instead of 3. The plywood panels have to be cut in a way that their joint fits between the two bulkheads of the central thwart.

Take a measure tape and see where the joint lands. Refer the distance to the transom. Split the first plywood panel in two 60cm wide strips to a length defined by your measurement. This length should be around 150cm.The remaining 1m piece should be left as it is.

Proceed in a similar way with the second plywood panel, but mark the 50cm wide strips.

Mark another two 60cm wide strips on the third panel, without touching the remaining length.

Mark another two 50cm wide strips on the fourth panel, without touching the remaining length.

Do not mark for splitting the whole sheet, as we'll need the remaining pieces as long and as wide as possible in order to make the bulkheads and the thwarts.

My nesting methods may not be the best ones but I couldn't figure any others. If you can do it better, feel free to put your mind at work.

For now, just mark the panels that need to be cut and continue reading below.

WORKING WITH EPOXY

The time has come to know a bit more about the epoxy resin, as we will soon start working with it. Cutting plywood sheets is easy enough. Working with epoxy can be a challenge for the ones who didn't do it before.

At this stage of the build, I can assume you already have most of the needed materials, including the epoxy. Most probably you are looking at two nicely labeled cans, one being the resin, the other being the hardener. Out of those two, you will first create glue, which you'll use to put the ply panels together in order to obtain the long pieces. By doing so, you'll also acquire a bit of experience with the epoxy. Later on, by using exactly the same method, you'll create more glue, filler and you will laminate the boat.

This subchapter will describe the method of working with the resin only. There is no need to start preparing it, as gluing panels is not the first operation of the build. I only want to express the theoretical basis, as it will be used later.

Therefore, let us take a look at how the content of the jars will get transformed into resin, glue and filler. I will start with the first, as it is the easiest.

Making the resin is a simple process. First of all, dress up for work, as for sure you'll spill some of the stuff on you.

Then, make sure the temperature and humidity conditions are right. Luckily you can work with epoxy in a vast array of conditions. As long as you are not far below 15C, or far above 30C and the humidity is between 50 to 80% you should be fine. If not, your brew may not cure or mix properly and later on problems will appear (blushing, bubbles, blisters and delamination). See the labels on the cans, or check the links at the end of the manual in order to get more knowledge.

Mix the two components, closely following the ratios inscribed on the cans. Prepare two separate recipients in which you can precisely measure the quantity of resin and hardener. Pour the resin and the hardener separately into its dedicated recipient. You can measure by volume or by weight, therefore you can use graded recipients (like the ones for cooking), syringes or a scale. Once you attained the desired quantities, mix the liquids into another plastic recipient. They are sold in the same shops you got the resin from, but if you are good at garbage gathering you can improvise them for free out of plastic bottles, casseroles, plastic jerry cans and so on. If you choose to improvise, make a small test by pouring a very small quantity of liquid first, as not all plastics go well with epoxy (especially with the hardener). You may have a surprise, when you'll powerlessly watch how your pot melts into fumes. Normally, plastic bottles should have no problem with the resin.

Mix the brew with a stick or a special tool mounted on a hand-held driller. I prefer the stick, as it is easier, it doesn't splash and it is disposable. You will soon notice how thick the resin is as you'll obtain a blueish or colorless honey like substance. That is your resin. You can use a brush to apply it, a roller, or you can pour it slowly on any surface and spread it with a piece of plastic, like a credit card (but don't use the good one). There are tricks to obtain a mirror like surface. Read about them or check some videos.

Make sure you mix enough for the job you intend to do. Mixing too much of it is counterproductive, as you'll throw your money away. Mixing too little will be a nuisance, as you'll run out of resin at critical moments. Unfortunately, this is a trial-and-error affair, but after a while you'll know exactly how much you'll need. As a hint, it is better to prepare less, than to prepare too much and throw it away under the form of shapeless blocks.

Making the glue is equally simple. Repeat the above process, but take into account the fact that the glue will require less resin, as it will be thicker. What you have to do is to add flour to the pot and slowly mix it in.

Instead of flour you can use dedicated silica, but flour is friendlier with the wood and the resulting color will closely match the color of the ply sheets. Add it to the epoxy one spoon after another, mixing continuously until obtaining some sort of a peanut butter. That will be your glue.

Making the filler will follow the exact steps as above, but you'll add a bit more flour to make the mixture even thicker. Do not exaggerate as you'll spoil everything. Do not oversaturate the resin with flour. The peanut butter comparison is not exaggerated, as that is the consistency you are aiming to obtain.

Thickening the epoxy with flour will be a fluid process. Sometimes you need it thinner, sometimes thicker, it depends. You will learn this process on the go.

After finishing, all you have to do is to wait for it to cure. In general, this will take around 24h. If the temperature is low, it may take even longer.

The epoxy is not applied in a single layer. When laminating something you'll need several layers in order to obtain the proper protection against the water. The first layer will invariably be sucked almost entirely into the wood. Applying the next ones requires a bit of knowledge as there are two ways of doing it. Epoxy resin is a curious substance. It bonds well with itself when still wet, but it will not adhere when being completely cured. Therefore, in order to apply several layers of epoxy you can either apply the first, then wait a while to give it time to settle, but not enough to allow it to cure completely. Just wait until it becomes sticky and you can apply the second layer. Repeat the procedure for the remaining coats.

In order to have a proper protection against the water, you'll need at least 4 coats of epoxy on your ply sheets.

If you have time and a lot of sandpaper you can wait until the first coat is completely cured. Before applying the second, you'll have to sand the first with a 200-grit piece. The bondage between the layers will no longer be

chemical, but mechanical. If the surface is left smooth, the next coat will not bond and will delaminate later.

After the last coat is applied, you can indeed wait for it to completely cure.

Well, this is what you more or less have to know. The rest can be picked up on the Internet. The subchapter was quite large, but the remaining ones will be shorter. When working with the resin during the next stages, I will only mention the process needed and not how to be done.

CUTTING THE MARKED PLYWOOD STRIPS AND BUTT BLOCK JOINING THEM

This operation is the first step of the origami. Prepare your jigsaw and an appropriate blade for the ply. Do not use a thick blade, as it will transform the ply into splinters and you'll have to sand a lot after.

Create a jig of sorts to have your ply sheets on, instead of lying on the floor. Use a few chairs and an aluminum ladder, or use a long table. Make sure the ply panel stays firm on it and don't vibrate, as it will break the blade of the jigsaw. Make sure the power cord of the machine is not in your way. Wear eyes and hands protection!

Start cutting the panels according to your nesting pattern. Remember, this operation is about cutting the plywood into more manageable strips which are going to be glued together, and not about cutting the template panels for the boat. The paper templates are going to be glued onto the ply panels you'll cut during this current operation. It is not a good idea to cut the templates in shorter pieces, in order to match the shorter ply dimensions and glue them together later, as they will not line up properly.

Continue with the jigsaw until all pieces are cut. It would be a good idea to have them marked and paired, so you will not have problems matching them. Once finished, you need to cut a few more strips for the butt joints.

Butt block joining is the technique of joining two pieces of wood by using a third piece to hold them together. In our case, we have to put the

ply panels head to head and glue a third piece over the joint. The width of the third piece should be at least 16times x the thickness of the plywood. You should obtain a width of at least 6cm. My Iris has 7cm wide joints. The length of the blocks needs to match the width of the ply panels.

After cutting everything out, group the pieces together (in order not to mix them) and prepare the epoxy glue as described in the precedent sub-chapter. Start gluing everything together. Use bricks, heavy objects or clamps to keep the joints together. Another alternative is to use small

chipboard screws to hold them tight, but this will leave holes in the ply, as you cannot leave the screws there (or maybe you can for some nice effects, I didn’t think much about it). The holes can be filled with thickened epoxy later.

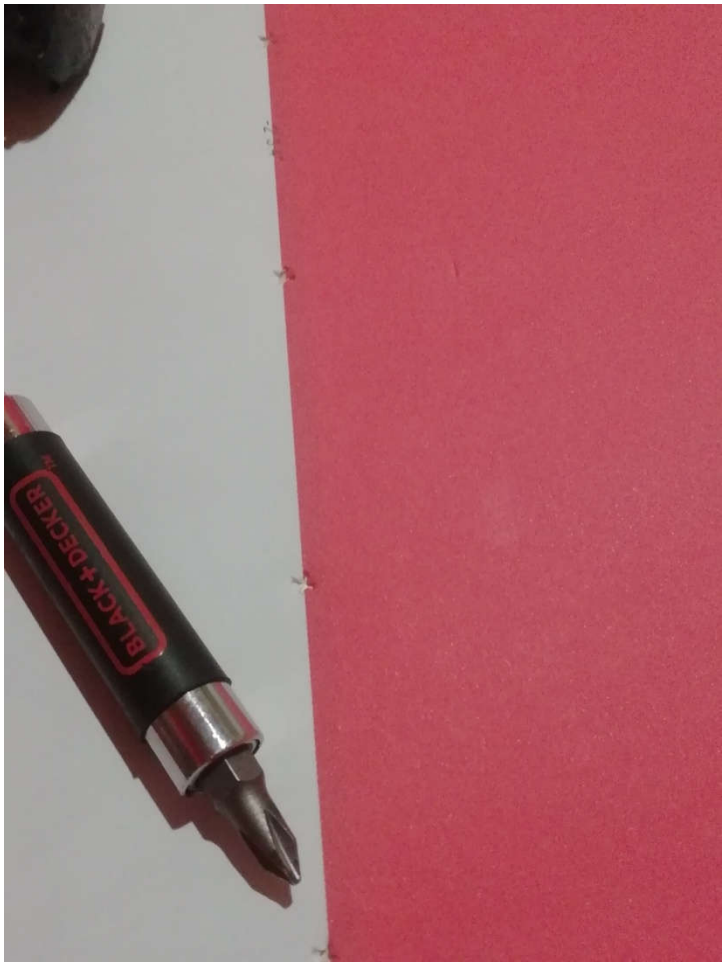
Use a flat surface to lay your panels on during the curing process. Put plastic foils under, as there may be some epoxy coming out, like the mustard out of a burger. If your floor is wood, you’ll have the panels glued to it.

Wait for the resin to cure. During this time you can cut out the bulkheads and the outer molds.

CUTTING OUT THE BOAT COMPONENTS (TEMPLATE PANELS)

Once the joints are nicely cured, you can overlay the paper templates on top and cut the boat parts out. You can either glue the paper to the ply, or you can use a small screwdriver to punch small holes in the ply, while following the lines of the template.

Make the holes 3cm apart so you can easily unite them with a pencil and render the shape of the template on the ply sheet. Like that you will be able to use your paper templates again and again if you plan to be a serial boat killer, sorry builder.



Once you projected the paper templates on the ply sheets, cut them out the same way you did when cutting the strips out. You should end up with all the major components of Iris scattered on the floor.

Pay particular attention when cutting the bottom panels out if you want to make Iris a sailor. You have to cut an extra notch in each panel, situated between the bulkheads. Through that notch will pass the central board. Subject to how thick you want your central board, you can make a combined width of the notches of 3 to 4cm (1.5 to 2cm on each panel).

Pay particular attention when cutting the bulkheads out. The inside ones will obviously be the boat’s bulkheads. The outside ones (the edges / frame) will be parts of your external temporary mold. And speaking of…let us see below.

THE OUTER MOLDS AND THE WORK BENCH

The outer molds are not exactly what they sound like. Don’t image they are some sort of shells in which you will cast metal or plastic. The outer molds are basically the edges of the bulkheads, transformed into outer jigs. The jigs will hold the panels in place helping to shape the hull. Without them and relaying solely on the internal bulkheads, there is the risk your hull will not line up properly. I never tried building Iris without the external molds and I cannot tell for sure. Maybe it works, maybe it doesn’t. If you want to try it, you can try it at your own risk.

After cutting out the bulkheads, you should have their shapes imprinted into the ply panels. Try to preserve those shapes as precise as possible, as you can use them as templates to draw on the thick piece of ply you’ll cut the real ones from. If it is not possible, just use the bulkheads as templates.

Cut your molds out of the thick sheet of ply as advised before. If using the same ply you cut the bulkheads from, it may distort as it is not strong enough to take the elasticity of the hull.

When cutting the external molds, you need to take into account the fact you’ll need to have them perfectly lined up.

As such, make sure the bottom side is equally wide for all of them. If not one may sit higher or lower than the other. The outer sides of the molds are not so important. Leave them thick/wide enough to be strong.

You need to glue a piece of timber at the base of the molds otherwise you cannot fix them on your bench. I used scrap wood to do so and screwed them onto the bench.

The bench can be made of one or two side by side planks. You can also use a thick piece of ply. The bench will have two roles: to support your boat at a convenient height for working and to line up the outer molds. I made mine from two planks which I positioned on top of some pallets stacked together. You can replace the pallets with a table, a real work bench, chairs, or a pair of sawhorses.

Positioning the molds on the planks is quite straight forward. Just measure the distance between the respective bulkheads on the templates (including also the transom) and mark the spots on your workbench (or planks). Draw a transversal axis at each point. Draw then a longitudinal axis to cross the transversal markings. Position each mold at the intersection between the longitudinal and transversal axis with its V exactly on the crossing. Make sure you position the molds in good order (1,2,3,4,5), in a way they match their respective place on the bench. Beware that the transom is also considered a bulkhead and has also an outer mold.

Double check the distances and the line-up then screw the molds in place.

!! Do not use the sticks you glued at the base of the molds as reference points, but the plywood molds themselves.

STITCHING THE HULL TOGETHER

Once you have the molds properly secured on the workbench, you can start thinking about placing the rest of the panels on and creating the boat. This may be a bit of a gift unwrapping experience, as you'll see your Iris clone for the first time.

Before doing this, you'll need to do a couple of things first:

- Decide what kind of stitching you want to use;
- Drill the needed holes in the ply for the stitching.

The stitching can be the traditional copper wire, a soft thin wire in general, given the fact copper price is quite high today, or cable ties. The cable ties are by far my favorite as they can be nicely tightened. Working with them has a slight disadvantage but: they need bigger holes than the wire. The holes need to be filled up with thickened epoxy later, after removing the cable ties, as otherwise they will allow the water to pass. Another disadvantage of the loop ties is they are nylon. Nylon will not bond with epoxy and sometimes you have to fight hard to extract them from the

hull. If left behind the epoxy will crack around them and allow the water to sip in.

No matter what you decided to use, drill the holes on the edges of the panels first. Make sure you drill on the right edges, the ones which will be in contact and not some random ones. Place the panels side by side, see where they will get glued together and mark the holes every 5cm or so. Do not go too deep towards the interior of the panels. Keep them at 1cm, maximum 1.5cm from the edges.

Drill also the holes for the bulkheads, the transom and the holes to secure the panels to the external molds.

After having them in place you can start inserting the cable ties for the bottom panels. Do not tighten them yet. Just insert them into the holes

and place the bottom panels onto the workbench. You can tighten them now. If inserting them after placing the panels on the bench, it will be more difficult to access them, as you may have to work under the boat.

The zip ties for the side panels can be added after having the panels on the bench, as there is more space for them.

Place all the external panels on the bench, arrange them properly and tighten them gently between each other and to the external molds. Make sure they are all aligned. Do not tighten them firmly yet. Wait to place the bulkheads too.

ADDING THE BULKHEADS

When having everything tethered on the bench, you can add the internal bulkheads and the transom. *Mind the fact you have to shave off around 10cm from the top edge of all the bulkheads*, apart from the transom. As such, the thwarts will fall under the gunwales and not at the same level with them. If you are a short person you can shave even more.

Cable tie them in place and tighten them slightly.

Start tightening the bonds slowly. Adjust the ply panels as such as to have as little space as possible between them, as you'll use less epoxy later in order to fill up the gaps.

Step back from time to time and inspect the entire layout of the hull. Intervene where and if it is the case. Complete tightening all the ties and admire your work. Iris took shape.

ADDING THE GUNWALES

To be honest I didn’t decide yet if this is the next logical step or not. Installing the gunwales at this point will stabilize or destabilize the whole hull, as they are stronger than the ply and will have a tendency to pull on the molds and the entire hull trying to de-tension like a bow. On the other hand, adding them after filleting all the joints with epoxy may be problematic, as the hull will be quite rigid by then. I added mine before filleting and had no problems. You can take your own decision and see how it goes.

Iris’s gunwales have also the role of the sheer clamps. They will fixate the hull and enable you to add the oarlocks, the rudder (if needed) and to create solid tethering points. They will also allow you to hike out and sit on them when sailing.

The gunwales can be made out of 2x 30x50x3000mmm sticks ripped in two, in order to obtain 4x 25x25x3000 ones. If you find them already cut at 25x25x3000, buy 5 of them. Use soft wood.

You may wonder why you need 4 of them when you can use only 2. Yes, it is true, but take into account the fact a 25x25mm stick can be bent much easier than a 30x50mm one. The hull is round and the gunwales will follow its contour. Even the thinner sticks will be relatively difficult to bend around it. This is why it is better to work with thinner ones. You’ll attach one of them on the outside and one on the inside of the hull. Taken together, you’ll obtain the full initial width of both plus the width of the ply between them.

In order to attach them to the hull you’ll need a whole batch of clamps, or a box of ply screws. You’ll also need to make kerfs at the critical bending points.

Kerfs are small striations made into the wood in order to help it bend without cracking.

Use a handsaw to make them 5mm apart and for at least 30cm of the bending area. Saw roughly half way through the wood's thickness. *Bend the stick towards the kerf and not the opposite way!*

Use the same handsaw to adjust the gunwales' tips at the bow, where they should meet.

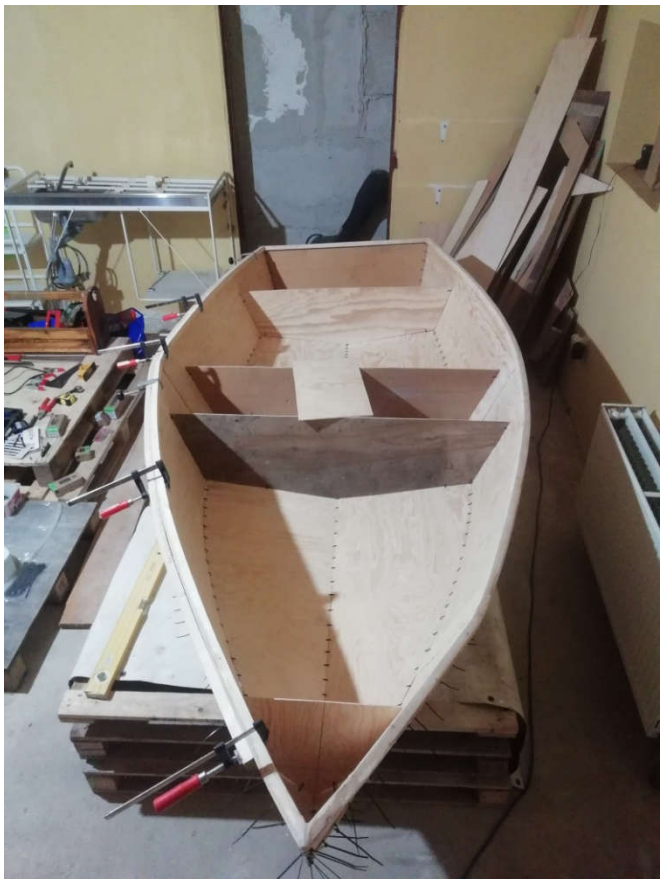
As you can see there was some preparation before adding them. If all is done, you can prepare a jar of epoxy glue. Spread it on the inside of the gunwales, one at a time, and add them to the hull. Secure them in place with the clamps or the screws.

I do not believe you'll be able to mount all 4 of them at the same time. I added the external ones first, waited for the resin to cure, then added the inside ones.

After having the gunwales tightened with the clamps *remove the epoxy surplus with a wide stick as it will come out from under the joints*. If not, you'll have a hard time sanding it down.

After the epoxy started to set, remove the screws one by one (if you used any). I do not recommend using screws to hold things in place, but if your budget is really small, they are a better solution than the clamps, as they are very cheap.

Take one final look at the hull and make sure everything is fine. The next steps will glue everything in place and erase any possibility to correct something if needed.



GLUING AND FILLETING THE JOINTS

At this stage of the build it is pretty obvious your boat will not remain fastened only in the cable ties. The stitching was done and the gluing part is next. Stitch and glue, right?

As a starter you need to employ the cyanoacrylate glue to temporarily stick all the panels together. Apply generous drops every 2 cm or so. There is no need to create a continuous line of glue. Work with caution. When used in quantity, the Superglue emanates nasty fumes. Make sure not to skip any of the joints.

After finishing, allow the glue to set properly, as some bigger drops may take some time to harden, despite the 60’ advertised on the tube.

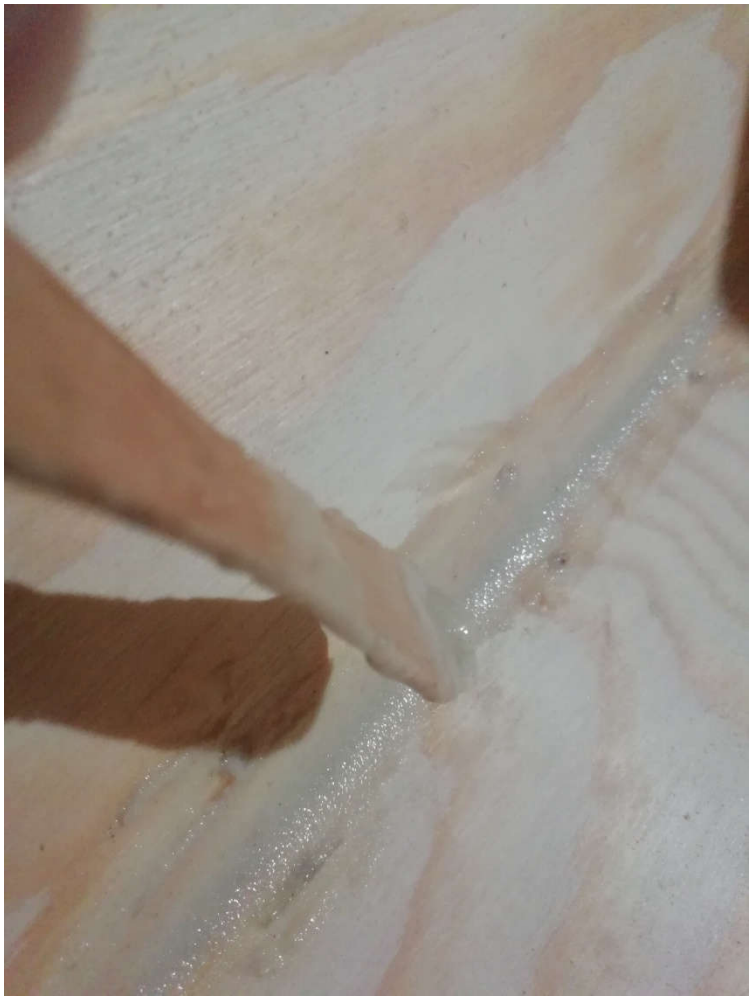
There may be areas where the ply panels are forced together by the zip ties. The glue will not hold them tight if the ties are removed. The gaps will simply crack open. In such a situation, keep one or two cable ties in place until the incoming epoxy operation will be fully cured. Remove the ties after. You may have to use plyers to pull on them, but mind the fact nylon will not bond with epoxy.

If the gaps are too big, apply duct tape on the outside of the hull. Use plastic tape (even Gorilla would work) and not cheap paper masking tape. The tape will have the role of a temporary barrier and will prevent the epoxy filler to pour through the gaps.

Remove all the cable ties except for the strictly needed ones. Your boat should be held together only by the glue.

Prepare a generous batch of thickened epoxy and a few 2 or 3 cm wide sticks. Ice cream sticks or tongue depressors are the best.

You are to fillet with thickened epoxy all the joints of the boat. It should be easy enough if you have experience with spreading the butter on the bread. Fill up generously all the joints and cracks, then remove the surplus and fair everything. Your fillets should look like nice ribbons spread across the boat.



Pay special attention to the places requiring more filler, like the large gaps. Make sure they are properly filled.

Do not epoxy the inside of the water tight compartments yet! This will be done later.

TAPEING THE JOINTS

This is an optional step. It involves re-enforcing the joints with fiberglass tape 5cm wide. The tape can be purchased at this exact dimension (it comes in rolls) or it can be cut out of a larger piece. I didn’t tape Iris’ joints because I fiberglassed the entire bottom and took care to pull the edges of the mesh above the joints. Voila, we shot two rabbits with one bullet! However, if you want to have extra strength, you can always tape the joints first, then fiberglass the bottom. If you want to save a lot of weight, you can leave the bottom of the boat clean, but mind its strength. I do not recommend the method, unless you will use thicker ply panels.

You can add the fiber glass tapes by the usual two methods:

A) You wait a bit after filleting and apply the tape after the fillets become sticky, but not completely cured. If applied to early, your tape may destroy the beautiful shape of your freshly laid fillets;
B) You wait until the fillets are properly cured, then you sand them and apply the tape.

Applying the tape is done as follows. Please remember the method, as you will use the same one, when fiberglassing the hull.

- Prepare enough clean resin for the job;
- Soak the surface you want to apply the glass to in resin; Mind the fact several layers may be required if the wood needs to be saturated, otherwise the glass will not bond properly and will delaminate in time;
- Apply the tapes / fiberglass mesh;
- Slowly stretch them with a wet brush (wet meaning soaked in resin not water);
- Baptize them in epoxy properly after having them in place;
- Later on, after the epoxy started to cure a bit, use a piece of plastic, or the metal part of a roller to remove the air bubbles from the epoxy. Draw your roller or the plastic piece one or two times across the wet surface.

If you are OK without the tapes, you’ll fiberglass (on both sides) the hull later.

MAKING THE THWARTS (FOR THE ROWBOAT)

This step is a bit tricky, especially for a beginner, as it involves some measuring and precise cutting. The thwarts of the boat are the little benches you and your passengers will sit on. They are an integral part of the water tight compartments, or the water tight compartments are an integral part of the thwarts, depends how you look at the problem. One of them is formed by the first bulkhead and the bow of the boat (as we cannot talk about a real stem). The second is formed by the central bulkheads. The third one is formed by the last bulkhead and the transom.

What you have to do is to cover the openings with another piece of ply. But there is always a "but". Made of ply as they are, they are not strong enough to withstand the weight of a person, even when laminated. They will crumple like a shoebox. Therefore, there is something else to be done, before closing the lid, and that is *an internal frame*.

I used 25x25mm pieces for it, ripped out of some scrap wood I had in the yard. You can do the same, or use the timbers I mentioned in a previous chapter. All these sticks will have to be skillfully lined up against the edges of the boxes, re-enforced with vertical beams and closed with horizontal beams on which the seats will be glued.

The bad part of the story is that I cannot give you any specific dimensions for the sticks. You have to measure the dimensions of the bulkheads and cut the sticks accordingly. I do not remember the distance between the vertical or the horizontal beams either. Just count how many of them are in the pictures and distribute them equally.

If you are a heavy person, or plan to place heavy loads on the thwarts, you may consider using thicker sticks. The 25x25ers can successfully withstand a load of around 100kg per thwart.

Placing the sticks of the upper edges needs to be done carefully. Leave around 6mm from the edge to spare in order to have a harmonious joint between the horizontal lids and the vertical panels. If you will put them right under the edges, you will have to use a lot of thickened epoxy to seal the remaining gaps.

Glue all the sticks with thickened epoxy. I used small screws placed on the other side of the walls to hold them tightly in place. I left the screws in there and obtained a nice effect.

After having your frame ready and glued in place, *epoxy in clear resin the entire interior of the boxes*. Once having the lids on top, you will no longer be able to epoxy the inside.

If you are planning to use the interior also as a storage compartment, you can plan the internal frame in a way to leave spaces where you can screw hatches. Make the holes for the hatches before laminating the interior and before closing the lids. It will be blind work to retrofit them later.

I used no frame for the bow box. The panels are small enough to take some weight, not to mention there will also be the mast step there, also taking some of the load.

After finishing the frame *and laminating the interior*, you can close the boxes if having no further plans with them.

Laminate the inside of the upper lids first. Apply a few coats on epoxy on them.

I used small screws to keep the upper panels glued in place and a lot of thickened epoxy to seal all the gaps. Try to spread it evenly in order to have as little sanding as possible later on. Sanding thickened epoxy is hard work.

THE CENTRAL BOARD SLOT

There are a few differences when making the thwarts for the sailing Iris, the central thwart more exactly. The central box will also host the central board and it is required to have a slit through it. This in turn, requires a more elaborate structure in order to waterproof the central box.

Basically you need to split the box in three watertight compartments. For such a deed, you need to cut two extra bulkheads, to seal the central gap, generated by the notches in the bottom panels. *The panels need to be epoxied properly on the side facing the gap,* then glued in place. The frame needs to be adapted for the newly created compartments.

It would be pointless to say, the slit needs to remain open on top.

Make sure you seal all the joints properly. If you plan for no hatches, you'll have no possibility to remove the water if it will sip somehow in.

The pictures above are for this variant of the boat, as I never built a rowing Iris.

FAIRING/SANDING THE HULL

After finishing putting all the major parts together, take a break and look at Iris. You can remove her from the outer molds, as she will not alter her shape any longer.

Take a good look at her lines, edges and the all the places where you used thickened epoxy as a glue or as a filler. Most probably there is some sanding to be done.

Take a look also at the outside of the hull, not only at the interior.

Grab several sheets of sandpaper, spread them on a block of wood or a dedicated holder and start sanding down the rough surfaces. Use a respirator.

Start with the 80grit and finish with a 200.

Happy dusting!

ADDING THE OARLOCK FITTINGS

If everything is already cured solid, you may risk taking a sit on the central box, facing the transom. You need to determine where exactly the oarlocks will be positioned. You may employ the help of two broomsticks for this feat. Position them on the gunwales one at the starboard and the other across the street, pretending they are oars. See how and at what distance they would best fit your physique (depending on how tall you are and how long your hands are). Mark the spots, in a symmetrical way. Drill one 8mm hole *through the outside gunwale*, where your marks are.

Glue a hard wood block of the same thickness as the outer gunwale and around 10cm long under each hole. Wait for the glue to cure then extend the

hole through the wooden block (it needs to penetrate it entirely). Make sure you go straight with the driller.

When the holes are ready, screw and glue a straight stainless-steel brace to the wooden block.

This should be it. If you have different plans with your oars and respective oarlocks, you can consider drilling a wider hole or using a different method.

Later on, after the whole boat will be dressed in epoxy, another straight brace will have to come on top of the holes in order to protect against rubbing.

ADDING TETHERING POINTS

These are destined to be the anchor points for the roof rack of your car, as otherwise the hull is quite smooth. I drilled simple 8mm wide holes into the inner gunwales. There are two of them on each side of the boat.

Measure your roof rack and see where the bars meet the gunwales. Drill the holes in that area. You can pass a rope or a nylon strap through each hole and tether the boat to the roof rack with it.

For long trips and motorways, I also pass one strap through the central board slot and tie it to the longitudinal bars of the car.

ADDING THE MAST STEP

This is an optional “step”. If your boat is not a sailor don’t mind it. Mind the fact but, a sailor can be a rowboat but not the other way around. The mast stepping method below can be greatly improved or altered. It is good to fit a simple mast, made out of a 50x50x3000mm piece of soft wood.

The structure supporting the mast is a bit tricky to build. You need two 2cm thick planks. If you can find something thicker it is fine. They are going to be placed next to the front box of the boat (as an extension of sorts), without any space between the box and the planks. One plank will be placed on top, exactly where the upper edge of the front box ends. The other plank will be placed at the bottom of the hull as deep as it can go. The edges of the planks will have to match the shape of the hull. You can temporarily place them on top of the gunwales and mark the shape of their edges with a pencil. The bottom one will be a trial-and-error affair.

Make a perfectly 5x5cm square hole in the geometrical center of the top plank. The mast will pass through it. Fix it temporarily with screws to the hull in the position it will stay. Proceed to do the same with the bottom plank. Mark their positions on the hull.

Ideally would be to already have the timber for the mast. If not, it will be difficult to determine its exact position, as you need to make a mortise in the bottom plank. A mortise is a notch scooped into the wood, like a small swimming pool. This mortise will host the bottom of your mast, the step. In order to correctly make the mortise on the bottom plank you need to have your mast timber positioned through the upper hole and see where exactly its step will be when the mast is vertical. Ask a friend to hold it and use an angle measuring tool to determine its verticality. When perfectly vertical, crayon around the base of the mast the mortise shape on the lower plank.

Remove the mast and the planks then make the mortise with a chisel (you can youtube on how to do it). Go around 1, 1.5cm deep, depending on how thick is your plank. The hole cut into the top plank and the mortise on the bottom will hold your mast in place (step it in place).

Once the planks are properly prepared, you can epoxy them into their places. Prepare the epoxy glue, place them in, then secure them with screws on the outside of the hull. Trim the surplus epoxy away and you’re done.

FIBERGLASSING THE HULL

This is a messy operation as it involves a lot of epoxy. It is also pretty long as you cannot epoxy the entire hull in one go. You need to work one side at a time.

You can start with the interior or the exterior, however you please. I build my Irisis starting with the inside. I fiberglassed only the floor panels in order to save weight. As mentioned before, the mesh covers also the joints. However you choose, you have to prepare the fiberglass mesh first.

Inside the boat you will use two pieces, as you don't need to fiberglass the central box. For the outside, a one-piece mesh is enough.

Make sure there is no sanding or fairing needed at this point. If there is, finish that first.

Once you have the glass prepared, brew the epoxy and start spreading it on the surfaces you'll apply the glass to. Make sure you apply it generously in at least 2 coats. Spread the mesh nicely and straighten it with an epoxy-soaked brush. Apply the resin until the mesh becomes transparent and shiny. Allow some curing time between each coating then apply the next, as previously described.

Mind the fact the resin will have a tendency to gather on the bottom of the boat. Spread it evenly with a brush, until it is too solid to flow. Do not turn the boat upside down, as small epoxy icicles will form in the middle of the boat.

Apply epoxy also on the sides, the gunwales, the boxes, inside the tethering holes and inside the holes destined for the oarlocks.

If applied correctly, the interior of the boat should look like a mirror.

Allow the resin to perfectly cure, turn Iris on the other side and start working again. The process is similar. Prepare the mesh, soak the surface, apply the mesh, saturate in epoxy and wait for it to cure.

PAINTING / VARNISHING

At this stage of the build, most major operations are complete. However, you cannot leave the boat as it is. The epoxy resin covering the boat needs protection again the UV light. Like any other plastic, epoxy is affected by it in a bad way.

You can use any exterior paint or varnish (providing UV protection), but the ones for metal or the PU varnishes are to be preferred. The way you want to paint your boat is entirely up to you. I used some cheap white exterior paint and varnished with PU over.

You have to sand the epoxy surfaces before painting or varnishing over. The paint will not bond well with shiny epoxy. No matter how painful it is to sand a nice, shinning looking boat, it is a must, if you don’t want your paint or varnish to peel off later. Use 200 grit sandpaper either by hand or with an orbiter. I sanded by hand, as I like Zen exercises.

Apply several coats of paint or varnish on all surfaces. Use a brush or a roller.

PROTECTING THE HULL

Your boat will inevitable get scratched, especially on the bottom. To prevent damage to the edges, which are the most exposed, it is recommended to protect them against abrasion.

I used Gorilla tape. It is thick, tough and has a hell of a glue. I applied two layers of it on the edges and the keel. If it gets damaged, it is easy to replace.

THE OARS

After finishing the hull of the boat, you can simply run to the store and buy a pair of plastic oars. They are light, strong and will do the job. However, they would be no match for a wooden boat. Building a pair of wooden oars is not difficult. I usually build mine (along with other side jobs) during the epoxy curing time, when I cannot do something else anyway.

There are countless ways of building oars. There are countless ways of making the oarlocks too. There is also a great amount of info out there about how to do it but what it is described below is the method I usually use. It is simple and uses easy to find materials.

You need two 30x30x2000mm sticks to transform them into shafts. You need two 15x20x1000mm boards to transform into blades.

You will need a long straight table to line the pieces on. If you have no such table, you can do it on the floor as long as it is straight.

Measure the dimensions and cut the needed pieces first. My oars are 2m long each. The blades are 65cm long and 12cm wide. The shaft is 162cm long (including the joint between the shaft and the blade).

Put all the pieces head-to-head on your straight surface, in order to draw the paddle's shape. Measure the blades' length and leave the shaft slightly longer, in order to accommodate the joints. You'll need to cut at the tip of the shaft a joining notch similar to a barbeque fork in shape. Cut it with your handsaw. If your blades are 1cm thick, your notch will be 1cm wide. The end of the notch can be drilled until the sawed piece will fall off. Level the rest with the rasp.

Do a similar notch into the blade, as such as it will match the cut in the loom. It has to be perfectly centered otherwise the blade will not align with the loom. Gently join the shaft of the paddle with the blade and check the line-up. It may not work as easy as you think. The notches may be cut too small, and in need of some rasping. The joint needs to allow very

little play between the parts, so, mind your rasping! Do not force the parts together either, as you'll crack the wood.

If all of the planets are properly aligned, you can seal the joints in thickened epoxy. Once having the pieces together, remove the surplus resin with a stick, as usual.

Leave the whole thing to harden for a minimum of 24h, making sure it is properly aligned.

When cured, you can continue your work. Nicely trim the blades and the loom by means of rasp and sandpaper. Varnish or paint the oars according to your own taste.

I used a simple "Omega" shaped brace and a 8mm screw in the middle of it to make the oarlocks.


Iris

THE RIGGING AND THE SAILPLAN

Iris is a simple boat and her rigging is the same. I am not going to enter into deep details on regards of sails and rigging as this will monopolize the entire manual. I am going to describe below only the way Iris flies her sail and how this can be achieved. If you know what you're doing, or if you are an old salty hand, feel free to design or adapt any kind of rigging you wish.

The configuration employs a lug sail due to several advantages: it uses a short un-stayed mast; it is a low aspect ratio sail which produces little heeling; it is a simple.

The author of the “Sail maker’s apprentice”, Mr. Emiliano Marino would be very unhappy about the way I build the sail. However, let us not forget, Iris was thought for fun sailing on a pond and not for a transatlantic regatta. I may have equally used a tarp or a piece of nylon foil to make the sail from.

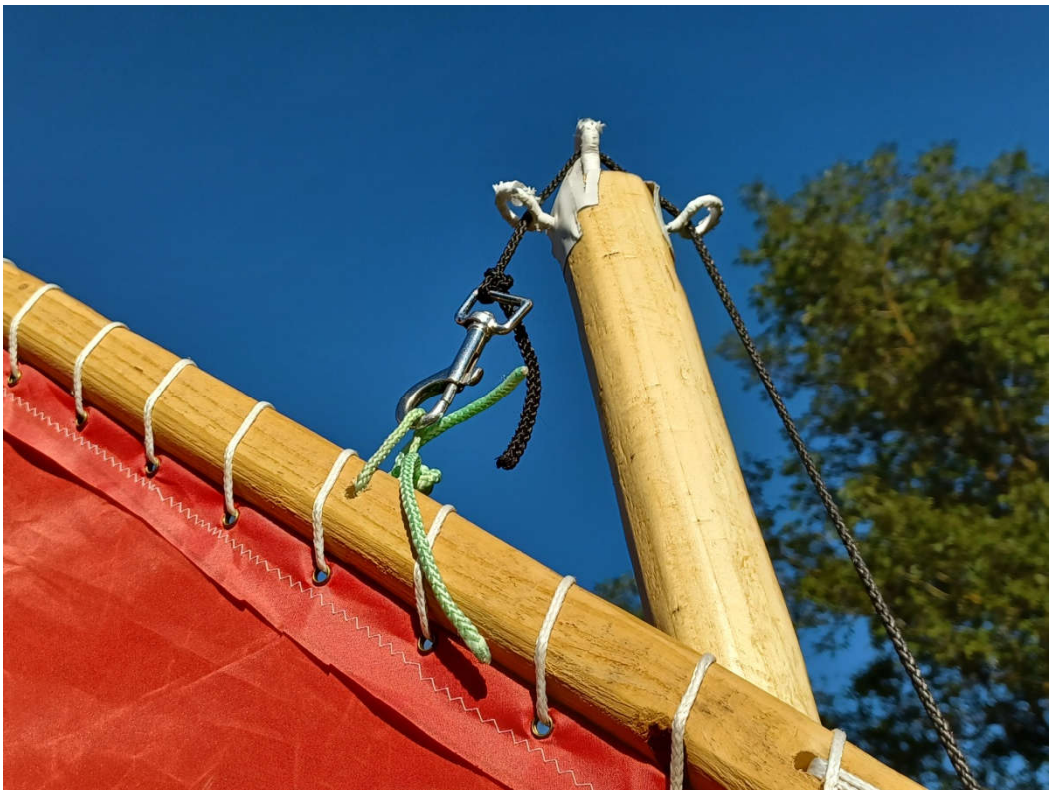
THE MAST

The mast is the 50x50x3000mm stick. It will not stay as it is, as it needs some processing. Therefore, step it into place, by planting it in its hole, all the way down. Mark with a pencil on the mast the area where it intersects the upper thwart. The entire mast above that line needs to be rounded. Grab the rasp and round the edges of the stick until achieving a round section. There will be the sail’s yard going up and down the mast, and this cannot be done on a square surface.

Place three loop headed screws with the loop 2.5cm in diameter as follows:

- One exactly on top of the mast;
- One on one side of the top at a 45degrees angle;
- The other on the opposite top side, at a similar angle;

The loops will be used for the halyard when hoisting and lowering the sail.



Screw and glue 2 horizontal pieces of wood at the base of the mast. They need to be 10cm long and 12mm thick with a round section. They will be used as cleats for the halyard and the downhaul line. The sticks should be placed at 25 and 30cm from the foot of the mast. *The sticks should be placed on the same side as one of the loop headed screws*, towards the stern of the boat (after choosing which will be the front side and which will be the back side of the mast).

Drill 2x 6mm hole next to each other, 48cm above the foot of the mast. They will accommodate the line tethering the boom to the mast.

Sandpaper the whole thing into a smooth surface. Varnish, oil or paint it. You can use Danish, linseed or tung oil.

THE SAIL

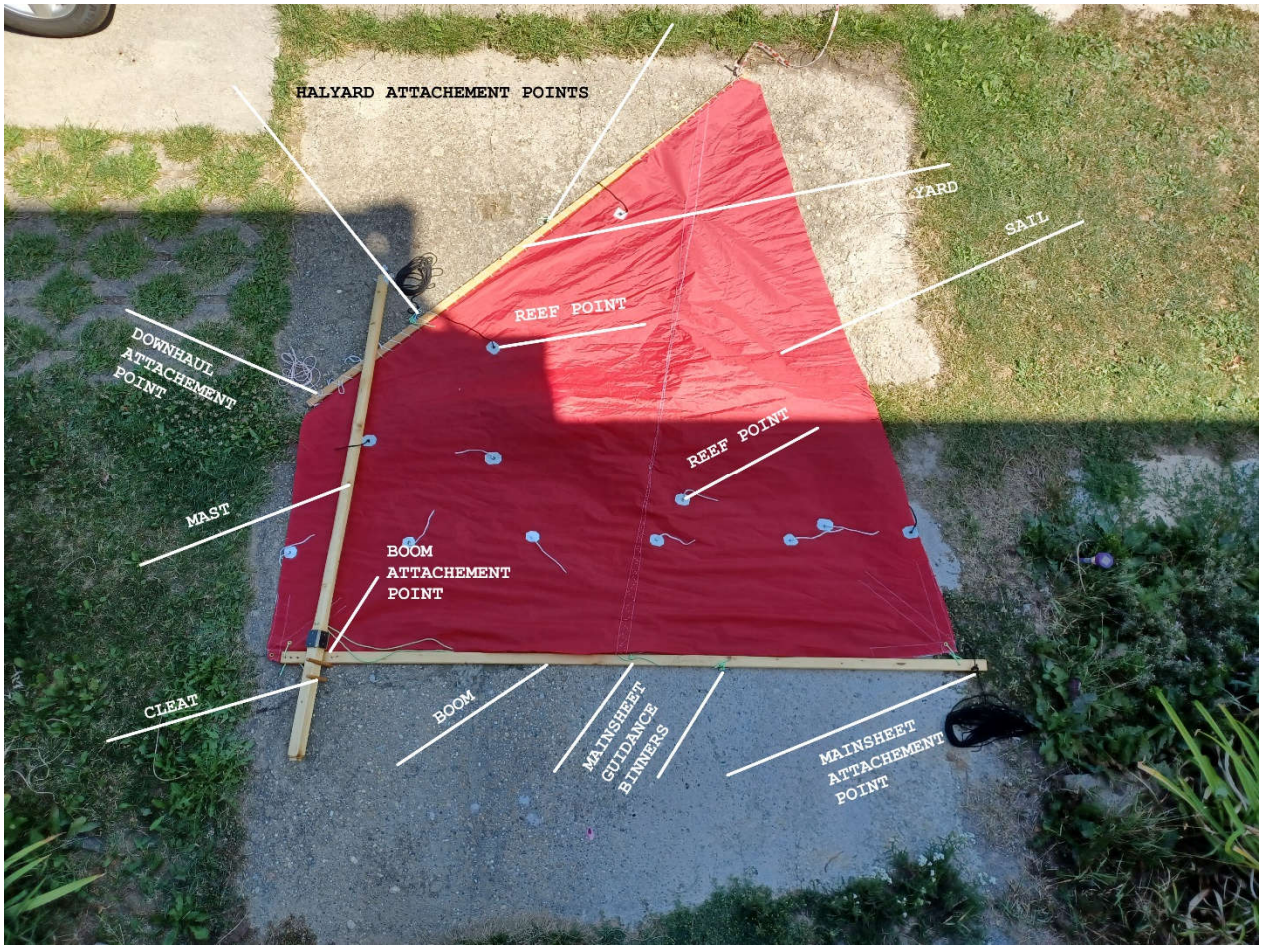
The sail will be a bit more difficult to build as there is a lot of sewing to be done. If you do not want to waste a lot of time, a stitching machine should be used.

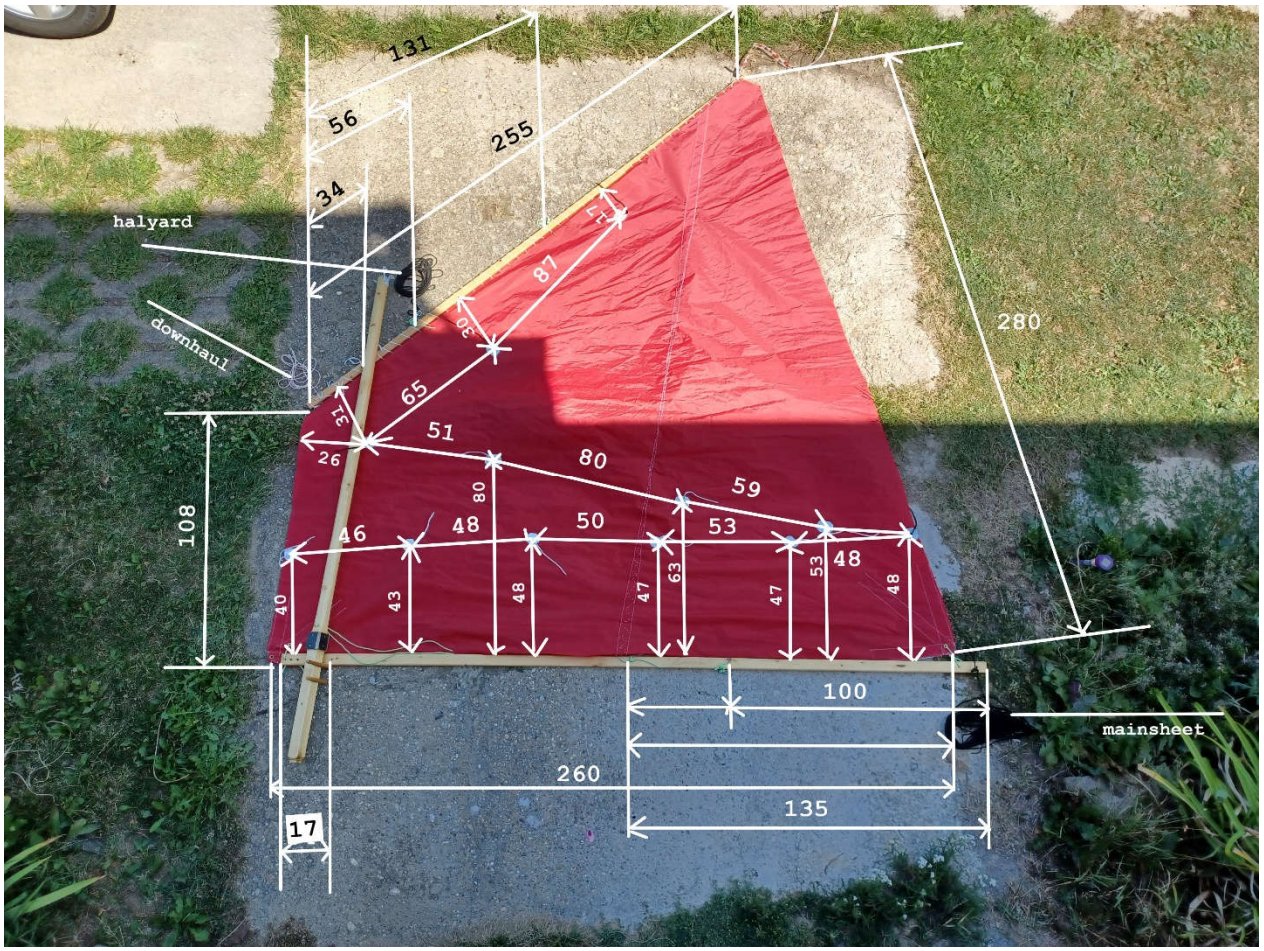
The sail is made from 170g/m Dacron material which I have purchased here:

https://www.extremtextil.de/dacron-gewebtes-polyester-segeltuch-170-mt-170g-qm-2-wahl.html

I bought 10m of it, as it is relatively narrow and you need to stitch two pieces together.

The sail is shaped and dimensioned as in the below pictures.

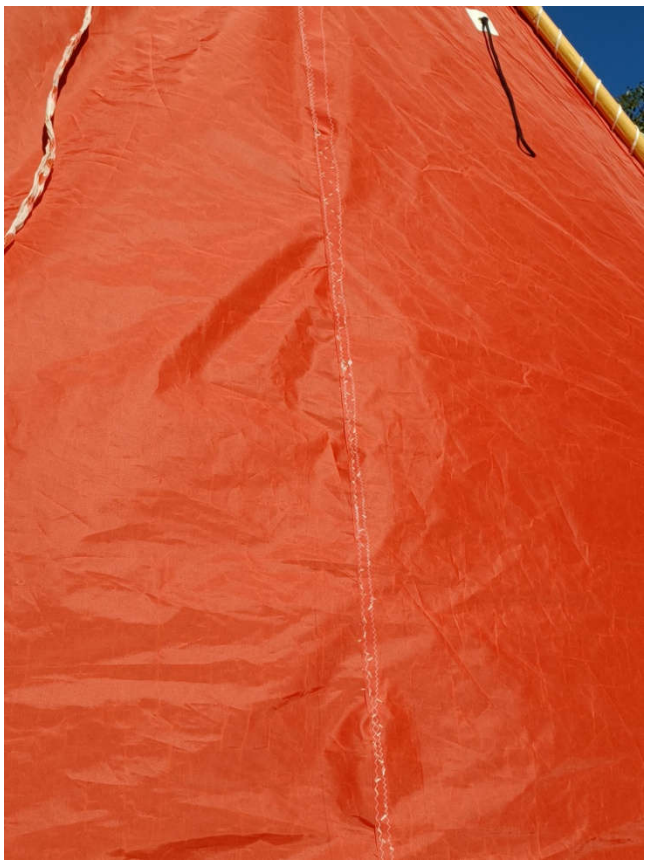




All the values are in centimeters.

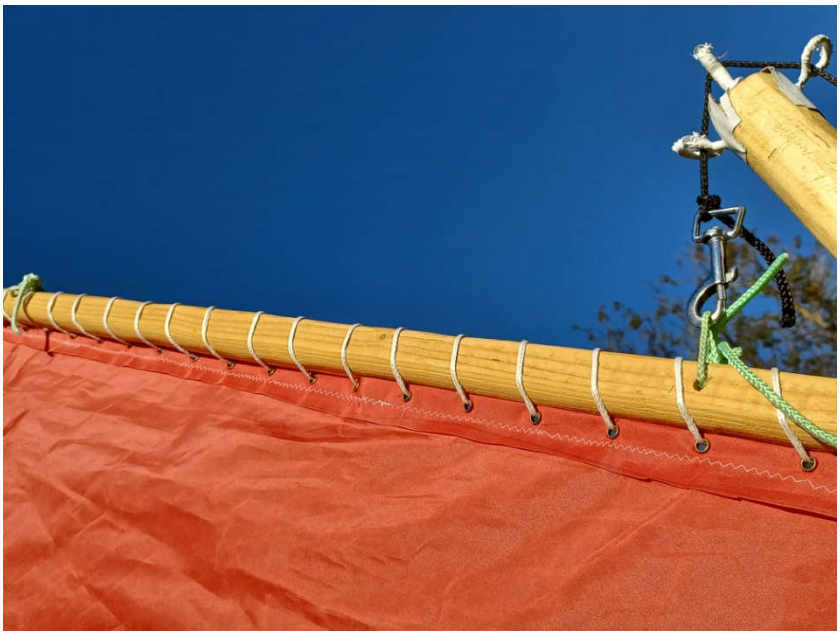
Its components are explained below:

- The stitching line between the Dacron panels: 03 cm overlap with the middle stitch in a zig-zag pattern flanked by 2 linear patterns. Since we are not very good at stitching, we did a sloppy job.



- The re-enforcing tape: it is meshed duct tape, glued and stitched on the corners. The tapes are 30 cm long;

- The grommets – the top grommets holding the yard are 5mm in diameter; the clew and the tack are 15mm in diameter; the grommets used for the reefing points are 15mm in diameter; the yard is lashed as seen below:



- The line lashing the sail to the yard is 4mm dynema;
- The top grommets are placed at 3.5cm from each other;
- The boom is a 20x50mm rounded stick;
- The yard is a 20x30mm rounded stick;

- Use a few evenly distributed small carabiners or pulleys along the boom to pass the mainsheet through;

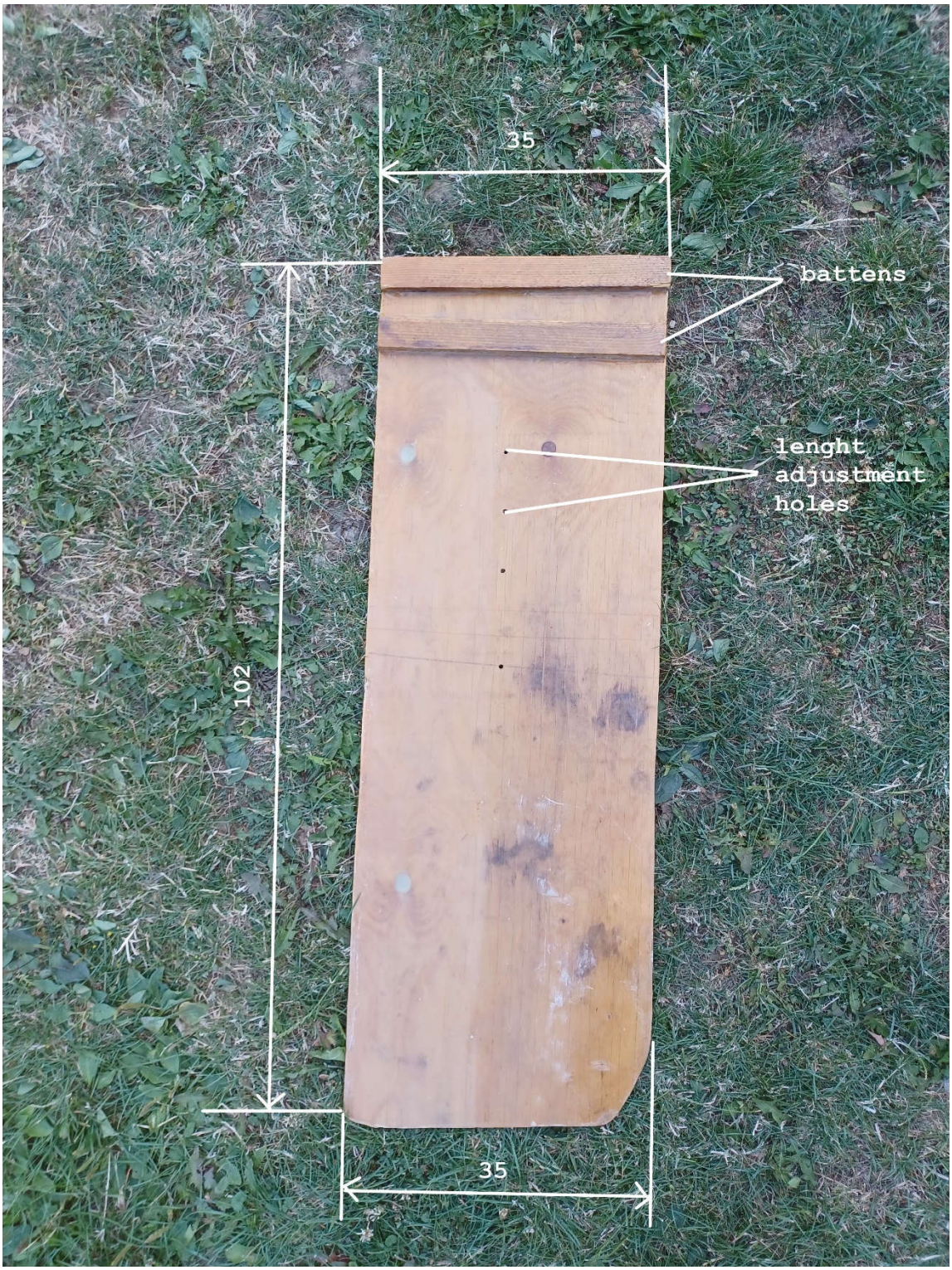
The main sheet can be connected as in the below image:

I assume it is easy enough to put all these things together with the help of the provided images. Varnish and oil the boom and the yard as well.

THE CENTRAL BOARD

It is made from a 10mm thick piece of ply. You can make out of whatever ply pieces you have left, or if you want to make it more solid, you can buy a hard wood sheet.

The central board needs to be *102cm long and 35cm wide*. Check the width of the central thwart, to make sure the board will fit. You can glue two pieces of wood at its end, to create a handle and you can also drill a few holes to be used as limiters when using the board in intermediate positions.



All measures are in cm.

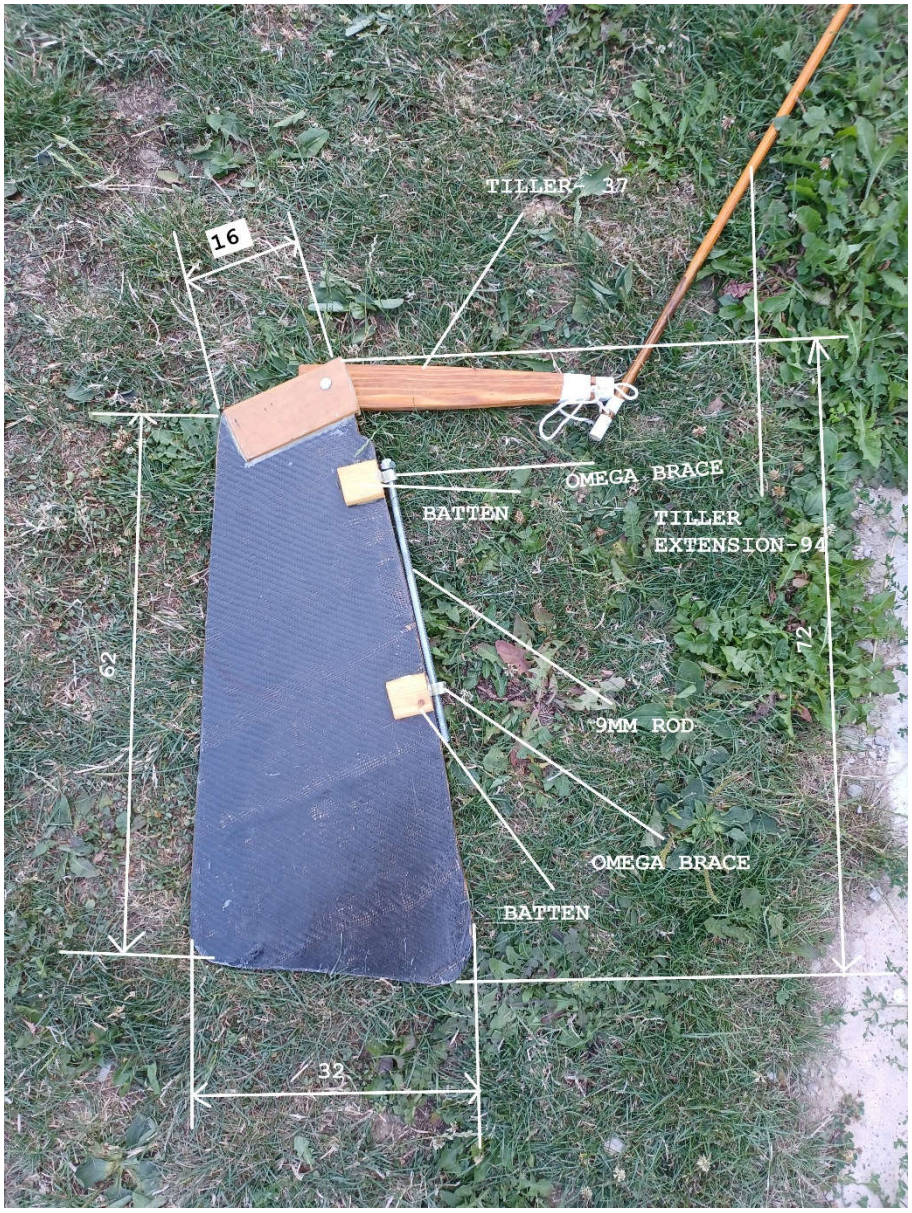
Cut it out with the jigsaw then laminate it in fiberglass or carbon fiber on both sides. Follow the same procedure as with the hull of the boat.

Make sure you leave no epoxy icicles on any of the sides, as the board will not pass through the slot in the thwart. There is no need to laminate the upper part, where the handle is.

After finishing with the epoxy work, trim and fair it nicely, then paint or varnish it.

THE RUDDER AND THE TILLER

The rudder is a tad more complex to build as it also needs to accommodate the hinges and the tiller. It should also be built out of laminated 10mm ply and here are its dimensions:



All dimensions are in cm.

The lamination process is similar to the one used for the central board. For mine, I used some carbon fiber leftovers instead of glass.

The hinge is basically composed of a 9mm threaded rod and 2 small omega braces. The braces are screwed and glued to 4 small wooden pieces which accommodate the screws. All this is secured to the rudder plate with epoxy glue.

The omega braces need to have their correspondents on the outside of the transom. Screw and glue them to the transom in a way that will not change the rudder's position or overlap them. Remove the threaded rod, position the rudder then insert the rod again through all the omega braces. This is how the rudder will work.

The rudder plate can be made from two articulated pieces, allowing it to swing upwards in shallow water, or when hitting something. I retrofitted this system to one of the boats, but in here there is the basic one described.

The tiller comes into a notch made into the upper batten. I used a normal 5mm screw, a washer and a nut to screw it in there. As such it can swing up and down as needed. The tiller is made from a 2.5x3x50cm plank. I rounded the edges and sharpened one of the ends a bit.

The tiller's extension is a 15mm thick wooden rod. I drilled one hole into one of its ends and another into the tiller's. I tethered loosely the two pieces with dynema rope and a quick release knot, instead of using a

complex joint. The rudder feels a bit flimsy and loose, but you'll get used to the sensation. This method has the advantage of simplicity.

At the end, paint or varnish the whole assembly as you please.

THE DOLLY

The dolly is a useful accessory if you need to carry the boat on the ground for longer distances. As such you can have all your stuff stored inside the hull and use the boat as an elegant barrow wheel.

There are countless methods to build such a dolly. The internet is full of know-how. You can build out of PVC pipes, aluminum, iron pipes and wood. I made mine from wood as I had a lot of it around. I used a simple structural solution, which enables the dolly to be easily dismantled and folded (in order to fit in a trunk) or inside the boat.

You need the following:

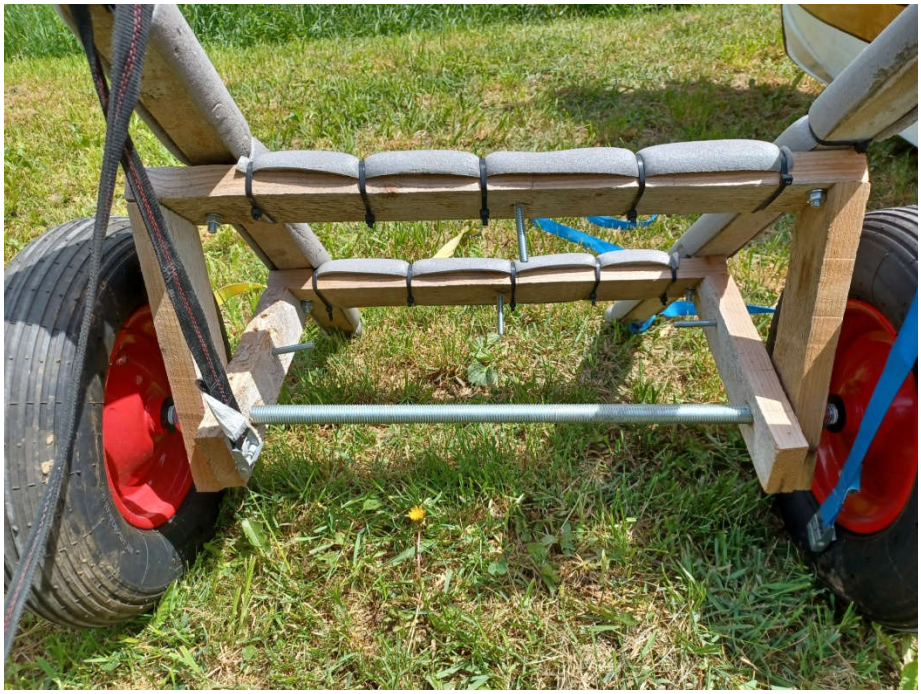
- A 2.5x10x200cm plank;
- 2x 40cm in diameter inflatable barrow wheels;
- 1x 20x1000mm threaded rod;
- 2x 20mm in diameter nuts, having the same thread as the rod;
- Wood screws;
- 8mm screws and nuts, normal thread;
- Some insulation for pipes;
- A few cable ties;
- Gorilla or some other solid tape.

The wood plank needs to be cut to the following dimensions and pieces:

All dimensions are in cm.


30


MAX 2.0 BAR
40
NOT FOR HIGHWAY USE
(400X100)



You need to drill two 20mm holes into the vertical elements in order to install the threaded axel. Screw with wood screws or angled braces the transversal elements on top of the vertical ones. Screw the longitudinal ones with normal screws and washers on top of the transversal ones. Use normal screws, as you'll need to remove them when folding the dolly.

Dress the frame with insulation foam to prevent the boat's bottom being scratched. Use the cable ties to fixate the foam to the frame.

Install the wheels to the axels and use the nuts to keep them in place. You can use the tape to create simple spacers, so the nuts will not be screwed tight or loosened by the rotation of the wheels.

Paint the whole thing and your dolly is done.

If you are picky you can add some accessories to it, such as a long tow bar, which will enable you to pull the boat on the bar, instead of holding the bow, or small retractable jacks, to have the dolly resting at a shallow angle. I tried them both, and removed them later as I like simplicity. The jacks were also a concern on rough terrain.

Secure the dolly under the boat with nylon straps passing through the tethering holes in the gunwales, otherwise the hull will slip and slide on top of it.

Arrange the boat on the dolly in a balanced way. The weight perceived at the bow should be equal to the one perceived at the stern of the boat.

Extra resources:

Links for working with epoxy:

https://www.youtube.com/watch?v=EAa6gLYvgqE

Other books I wrote

“THE QAJAQ BOOK. Conceiving and building a skin on frame qajaq” - A technical book about building SOF kayaks

“TALES OF THREE BOATS” – an adventure series mainly written for children and teenagers as part of the indoctrination process for boat building.

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