About the free plans:

T³ is a new designer who mainly focuses on high efficiency designs in wood and composites, in power, sail and human power. T³ is offering this plan to the public for promotional purposes, for a limited time. The catch is anyone who downloads and builds the boat, agrees to send pictures and some feedback on the build to T³. These images will eventually be collated on a webpage showcasing this design. The feedback is also valued to be able to create plans that are as easy to use as possible. The pictures and feedback can be sent to his email, which is on all the design sheets.

Naturally, T³ is also available for custom design work at tttangvald@gmail.com.
3.6 M utility pram

Design No. 7081
Date 07/08/13
Sheet number 1
Sheet description Lines Plan

Notes:
- Loa 3589 mM
- Beam 1203 mM

Shown in design condition one rower

Scale 1 : 20
Units mM

Design by T3
Email tttangvald@gmail.com
### 3.6 M utility pram

Mass moments of inertia not calculated

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Design No. 7081
Design Name 3.6 M utility pram
Date 07/08/13
Sheet number 2
Sheet description general construction views

No scale on perspective view
Scale 1:20
Units mM

Notes: Plan and profile views are semi transparent to facilitate seeing all the parts. Measurements for rowlocks and thwarts.
The quarter knees are the ones indicated by the arrow with "fr'rd"
The thwart knees are indicated by the arrow with "up"

Where dimensions are omitted look for that piece's twin
All cuts are with the saw set at 90 degrees unless specified otherwise
All bevels are deductive EXCEPT for the bow transom bevels which are additive!

Outline of two 1219.2 x 2438.4 mM (4' x 8') plywood sheets

Landing area for joining pieces

This edge must be dead straight when the two panels are pressed firmly against one another

The quarter knees are the ones indicated by the arrow with "fr'rd"
The thwart knees are indicated by the arrow with "up"

Where dimensions are omitted look for that piece's twin
All cuts are with the saw set at 90 degrees unless specified otherwise
All bevels are deductive EXCEPT for the bow transom bevels which are additive!
Keel cut out of 18 mM stock or planed down to 18 mM. If keel is thicker, correction must be applied to half moulds. Refer to construction manual.
Measurements are for the face making contact. Moulds are not beveled.
Thus moulds 1 & 2 are ahead of the face plane, and mould 3 is behind.
In this way thickness and bevel of mould does not affect hull geometry.
### Materials list

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The Boat
I designed this 3.6 metre (12') long utilitarian dinghy to be handy with from between 1 and four people on board, although it can carry five or even more people, depending on their individual weights. The main design priorities were to be reasonably light so as to be beach draggable by one man, liftable by two, sturdy enough to withstand a bit of rough treatment, as well as the inevitable beach goer who likes to sit on upturned dinghies. Also it very much had to be quick and easy to build, with a minimum of materials and complex cuts and time & labour consuming jigs. All this whilst retaining good design characteristics balancing the need for stability and ease of rowing.

I purposefully did not try to optimize it too much for any one design trait, maintaining a more “Jack of all trades” design concept. This fits well with the purpose of a general purpose utilitarian dinghy. Although it rows quite well, certainly far better than the vast majority of dinghies seen in ports, it is not a performance rowboat as it had to have enough stability to be usable by anyone. * Furthermore, the idea that a small outboard motor may be used was incorporated into the requirements of the final shape. Although it could plane given a big enough motor, the shape is not meant for this at all, since the correct type of shape for decent planing is completely unsuitable for rowing, and the principal intent is for this boat to be rowed and rowed well. Therefore, if being used with an engine, any more than a few horsepower is wasted power, weight, expense and hassle. A 1.5 hp will work fine, certainly never more than 3.5 hp.

*
mast partners & step and some lateral resistance, such as a daggerboard, leeboard(s) or making the keel 25 to 35 cm deeper, as well as some kind of rudder.
Feel free to contact me for recommendations on this kind of conversion or a suitable sail plan. This construction guide I have written with considerable detail with the novice builder in mind. More experienced builders may find it a bit long winded therefore, but I think this is preferable to leaving the first time builders guessing.

Although there are boats that are simpler to build, these usually make certain concessions in terms of design in order to facilitate construction as much as possible. This boat makes no concessions in hull form apart from the fact of the necessity of hard chines so it can be made out of plywood, yet is still straightforward to build. Anyone with reasonable woodworking aptitude; a familiarity with the operation of tools, measuring techniques and dealing with wood should not have any problems putting this boat together. No matter your skill level it is highly recommended you read this entire booklet before starting any of the work.

You should count on approximately 100 hours of work to complete this build. The final hour count will be highly dependant on the level of finishing. Typically for a good finish anywhere from one quarter to one third of the total hours go into finishing. That means a lot of sanding. The very next thing you should do after going through this booklet is print out the BOM and go to the suppliers of all the materials and write down the prices. This will enable you to find the best prices for everything as well as add up the total material cost of the boat before committing.

Some details

This design is a bit unusual in that it has been designed to be built right side up and without full moulds. This saves on wasted material and allows the thwarts to be installed, setting the final hull shape, before detaching the boat from the construction jig. More experienced builders may want to adapt the construction process to their own preference. To these I say go ahead, and I would like to hear how the build went using a different method. But don't complain to me if it does not turn out well.

In theory since the skin panels are pre cut to the exact final shape, and this determines the shape of the boat in all but two degrees of freedom, the boat could actually be built without any sort of jig, setting the two final degrees of freedom by checking that the bottom of the keel is perfectly straight in the xz plane when the thwarts are installed (should be automatic since the thwarts dimensions and installation positions are also predetermined) and the twist by the corner knees. However I do not recommend attempting this, as the complications that could ensue could easily dwarf any labour saved by skipping on the setting up of the building jig, as well as resulting in a sub standard boat.

Another simplification that has been applied is the elimination of all non essential bevels. Out of the the main construction panels, only the bow transom needs to be bevelled. All the other main cuts are done with the saw straight up and down. (90 degrees) There are other bevels to cut in the smaller pieces, but for all but the chine logs and hog, these are at a constant angle and the angle is given for each piece.
Preparations;
Workspace;
A flat working space at least 3 M x 4.5 M (10' by 16') as an absolute minimum preferably more, although only a section 1.3 M x 3.6 M (4' by 12') of this need be flat and level. A wooden floor is practical since it allows for easily screwing the moulds down firmly in place and is easy to draw on.

In my case I had the unusual good situation to have a perfectly flat and even floor to build on. This was because I had gone to great effort when I built our house to ensure that this was so.

But, in general, a wooden floor, no matter how perfectly flat it may seem, must be checked with great thoroughness to see how flat and level it really is. Normally it will be close enough for some correcting shims to be able to correct the unevenness.

A common place to build a dinghy like this is in the garage. Be aware that it is pretty much guaranteed that the cement garage floor, even if it appears to be perfectly flat and level, will not be sufficiently so for the purpose of using it as a reference plane to build a boat on. If it is quite close shims can be used to correct at critical points.

Otherwise you will have to build a strongback. The purpose of the strongback is to provide a perfectly rigid and planar virtual surface on which to build and to use as the reference plane for the boat.

Note that it is not in fact required to build on a level surface. You could in principle set up the jig at any angle, even flat on a wall, provided it is rigid and planar. However, it is certainly an advantage to be able to use a bubble level, particularly in the direction perpendicular to the centreline. For this reason; if you can't get a work base that is level in both directions then at least set up so that the work is perfectly level across the boat, preferably with the bow uphill.

If you will be building over the dirt then the strongback must be a self contained rigid unit, so a bit more elaborate than if you can use take advantage of the rigidity of the workfloor to hold the individual parts of the jig in position.

The material for the jig can usually be scrounged from building sites' scrap pile. This saves on expenses for something that will have no further use after the boat is built, apart from firewood.

A roof for shelter from the elements of some kind is pretty much a must. Wet wood cannot be glued. If wet it must be dried and and murphy's law (axiom 2) states that as soon as it is dry it will start raining again. So not having a roof is a great way of making a boat building project stretch into eternity, an all too common feature of amateur construction, so be sure to avoid this easily avoidable pitfall.

Tools;
Required;
Circular saw
Electric planer and/or handplane (jackplane)
Mini angle grinder + plastic backing plate for sandpaper discs
Drill(s)
Drill bit set and one 18 mM (¾") wood bit or auger
C clamps
At least one framers clamp with an aperture of at least one meter (3 feet)
Jigsaw
Set square
Level
Measuring tape with millimetres
Bevel gauge
Chalk line and chalk
Hand saw
Chisels
Hammer
Screwdrivers
Ballpoint pen
Scissors
Spatula
Squeegees
Nice to have;
Table saw
Thicknesser
Router + ¼ round bits
Rasps
Materials list;
Two------------sheets of 9 millimetre marine ply
One------------sheet of 6 millimetre marine ply
One------------1” x 8” x 12’ (18 x 203 x 3654 mM) clear planed pine or hardwood.
One------------1” x 8” x 10’ (18 x 203 x 3045 mM) clear planed pine.
Seven---------1” x 2” x 12’ (18 x 36 x 3654 mM) clear planed pine.
Quarter round stainless steel rubbing strip (optional)
Seven metres of 10 or 12 mM three strand nylon rope.
Oarlocks and oarlock sockets.
100 25 mM small screws
20 45 mM long screws
Epoxy glue approximately two liters
Cabosil/Microballons approximately two liters
Measuring and dispensing equipment
Vinegar four liters
Lacquer thinner four liters
Sticky tape
Plastic bags
Grinding discs
Sandpaper wet or dry 10 x 100 and 10 x 220 grit
Paint
Thinner
Paintbrushes
Jars for paintbrushes
Mixing pots for paint and glue

**Notes on the tools**

The circular saw is not in fact, required as the whole boat could very well be all hand-sawn, but given that most everyone has some kind of access to electricity and given the tremendous saving of time, as well as the convenience of being able to set a given bevel angle that is accurate and constant, I put it as a 'required' tool. If you do not have one, think about investing in one as they are not usually very expensive, and represent great value considering the amount of labour they save. Otherwise, they are common enough that there should not be great difficulty in borrowing one.

The correct saw blade is important when cutting plywood, as if the teeth are too big, they will lift up the top veneer end grains in a very ugly way, which then has to be filled, sanded and repaired on the boat afterwards. A blunt blade will also do this, even if the teeth are not so big.

Given that you will be cutting a reasonable amount of plywood and it is very important that the cuts be done neatly and accurately, don't hesitate to buy yourself a brand new blade for the project. 60 teeth is small enough for perfect cuts in plywood, but will still let you rip boards, just a bit slower than if using a ripping blade.

I would not put as much importance on the electric planer as on the circular saw. That is not because the electric planer is not extremely useful at saving effort but because in this particular project there is not that much planing to do.

For the screws it is a tremendous time saver to have several drills, so each drill can be set up with a different size drill bit or with the screwdriver tip. This avoids having to swap bits multiple times for each screw.

In general, one has to drill three different size holes for each screw; the thinnest bit, whose size corresponds to the diameter of the screw inside the thread. This hole goes down to the depth at which the tip of the screw will end up. The next size of bit corresponds to the outside diameter of the screw and goes right the way through the first layer of wood. The final bit is the same diameter as the head of the screw and is just deep enough so the head is countersunk enough to not be a nuisance when sanding and painting the boat. There exist special countersink bits just for this, but I don't think their relatively high cost is justified here when an ordinary large metal drill bit gets the job done just fine. Often one can do the countersink by just holding a big sharp bit in one's hand and twisting it back and forth. Nevertheless, in soft woods one can quite often get away with fewer drilling steps. Sometimes the thinnest deepest hole can be foregone and the screw will drill its own hole. Be mindful though especially when near the end of a piece of wood that this can lead to cracking the piece. Also, the screw can countersink itself with judicious use of the final tightening. The hole that is least likely to be optional, and the least recommended to omit is the medium size hole through the first layer of wood.

Using a drill for driving saves a huge amount of time too, but here it is important to use a variable speed drill, or too many screws will get their heads stripped, or worse,
break. If none of the available drills are variable speed, they can still be used to drive screws, but only partway, the screw being driven the last bit by hand.

Be sure to tape plastic around the handle and body of the drills, leaving holes where the blower fan holes are, or it will overheat. This is so that you don't get the tool all begrimed in a mixture of hardened epoxy and workshop dirt. At least do it on any tools you may have borrowed.

Metal bits are the standard for having a set of, from 1 mM to 10 or 12 mM, as they will bore any of the boat materials. There should be several duplicates of all the smaller bits as these are the ones most frequently broken. Spare bits need be stored in a jar full of oil, as their high carbon steel rusts very quickly, and even a slightly rusty bit is very much degraded in terms of cutting ability. They can of course be sharpened and restored, but it is a tedious chore that is best avoided if possible.

For the larger sizes, spade bits for boring only wood are the thing as they cost just a fraction of the same size metal bit, and there is usually no need to drill large holes into metal.

Clamps you can never have too many of. For this project an absolute minimum of three C clamps should be at hand. More is better.

The framer's clamp or two of them is for pulling the two halves of the bottom together while twisting them up. If you do not have any, the following solution will save you the expense of a tool that you may no longer ever need after building this boat; get yourself two or three trucker's mechanical cinches. A lot of people carry some light duty ones around in the trunk of their car to strap things securely onto the roof of the car. Passing the webbing under the boat and around so the ratchet lever is on top, more or less over the centreline will get the job done tolerably. A hole or slot in the strongback will have to be made, however to allow the strap to pass. Care will have to be taken too, to not soil the straps with epoxy.

The level should be a meter long. If it is a short one, tape it solidly to the middle of a one or one and a half meter piece of straight rectangular metal piping or similar. Verify that the edges of this extender are in fact perfectly straight. Regularly check the accuracy of the level. This is done by finding something that apparently measures perfectly level and then rotating the level exactly 180 degrees around the vertical axis and checking to see if that exact same 'level' still measures as level. If there is any discrepancy at all, the level needs to be calibrated. If the level has been lengthened as suggested, it is easy to adjust fine shims at one end or the other of the level until it passes the test.

If several measuring tapes are to be used, extend them all to the length of the shortest one and carefully compare their measurements. Even one tenth of a per cent difference will add up to several millimetres error over the length of the boat. Quite enough to cause some serious headaches further along the building process.

Also do not trust the hook at the end of the tape. Measure from the ten cM mark (say) and add this (10 cM) to the required measure. Then measure in the normal way and see if the measure is exactly the same. The slots in the hook can get worn over time.

If the hook is not a right angles (from having been stepped on for example) then there will be an error which varies depending on the depth to which the hook is placed on the wood.

The spatula is for applying the thickened epoxy glue (also known as glop) so should be narrow, no wider than 5 cM and springy with an easy to clean finish.
The squeegees are for applying filler over the hull for a superior finish and to seal and protect the plywood. Thus they should be of non stick flexible plastic and as wide as possible, say 15 or even 25 cm.

Notes on the materials

Marine plywood is a wonderful boatbuilding material; has great mechanical properties, dimensionally stable, and allows boats to be constructed much faster than when using straight lumber. It is also very durable provided a bit of care is provided.

I have seen boats made with external grade plywood last for decades too, and at a considerable price reduction, but it all comes down to how the plywood was glued up at the factory. To be safe I would only use exterior plywood if I had seen it had passed the test of time on another existing boat, and then made sure that I bought the exact same plywood.

Normally if the ply has survived several years in regular immersion without delaminating it will stay together indefinitely. In any case, external plywood normally has a finish that is far inferior to marine plywood.

Some people check the reliability of the plywood bond by boiling a small piece of it several hours in a pressure cooker. This test is somewhat flawed, but normally any plywood that can survive three or four hours in a pressure cooker will not delaminate ever.

It has become extremely common to see plywood boats that are fiberglassed, either on just the outside, or on both sides. Despite this being the most commonly seen method of building I avoid, apart from in certain specific applications, this construction method for a number of reasons.

Fiberglass and epoxy is materially more expensive strength for strength than plywood. The time required to add a layer of fiberglass is also considerable.

The extra strength provided is very slight compared to the extra weight. If the layer is only on the outside, the implosion pressure stiffness is barely altered as is the implosion pressure breaking point. For explosion direction forces it will be significantly improved but considering the weight increase, the same result would have been achieved by increasing the wood thickness a certain amount, with less total weight increase, and this has almost no effect on build time.

If the layer is on both sides, then you get a significant increase in the both the stiffness and strength in both the inward and the outward directions. However, just increasing the panel thickness the correct amount would achieve the same for about the same weight increase but without the significant increase in material and labour cost of the fiberglass.

Really the only situation where fiberglass sheathing on a plywood boat of this size and construction type is justified is where the boat is intended to take a lot of abuse. This is because fiberglass is much harder than wood, so resists abrasion and dinging much better.

In this case, the intent of the boat is to be rugged and practical, but on the assumption that a certain level of care will be taken to avoid dinging it, smashing into things, excessive amounts of careless dragging on the beach, etc, so the fiberglass is not needed.

When selecting the plywood always look through the pile and reject any sheet with damage or a surface flaw. It is very common for the first sheet on the top of the pile to have been damaged, so look at the sheets a couple down from the top.

Never let the workers at the lumberyard choose the lumber for you. Insist on looking through the pile and only getting the best pieces. There can be no knots or at least no major knots. The pieces must not be damaged nor warped.

It is a sad fact that there is no place left on earth that does not suffer from the
effect of over harvesting of wood. Therefore the quality of lumber worldwide has been in steady decline for centuries and finding good wood is always becoming more and more difficult as well as more and more expensive.

So do the planet a big favour and plant a few trees to make up for the wood consumed in the dinghy. Seriously.

On the wide pieces try to find the pieces that have the growth rings going as perpendicular to the main surfaces as possible. This is called quarter sawn and makes the wood far less prone to warping and cupping. Unfortunately, only a small percentage of lumber ends up quarter sawn and is instead slab sawn in bulk, which is more economical for the sawmills. Also avoid major amounts of sapwood and large knots. Heartwood is not important.

For the keel you can if you prefer, get a piece of hardwood instead of pine. It costs more but is stronger and will take more wear and tear.

Also optional but a definite plus is a quarter round metal protective strip running the full length of the underside of the keel. If care is taken to always maintain the boat upright when dragging up a beach, so the actual hull is not touching the grit, the only thing taking the abrasive wear will be this metal strip, tremendously prolonging the life of the boat. If you decide this strip is too expensive you could compromise and just put one meter of strip starting at the aft end of the keel. This will still take most of the wear if one lifts the bow slightly whenever dragging the boat.

**Tolerances and dimensions**

The above picture should be what all your cuts look like.

Note the cut is right to the marked line.

As an ordinary circular saw blade removes exactly 3 mM of material always check which is the offcut side of the marked line. This is the side of the line that the blade is going to be on.

In the above image you see that the plywood closest to the viewer from the line is the part to be used, the plywood on the other side of the line is the excess.

It is a good habit to identify the offcut side with a few cross-hatched lines, so confusion is avoided, especially if two people are working.
Strive to work at half mM tolerance. Anything more than one mM tolerance in your work is getting sloppy.

Keep in mind that precision in the beginning will ensure everything falling into place later on. As work progresses one can relax one's tolerances a bit, but at the beginning, precise work is central to ensuring the boat comes together smoothly.

Also, the angles shown on the blueprints are the bevel angle, ie; 90 degrees means no bevel. Therefore if your circular saw marks 0 when the blade is at right angles you will have to convert the angle to the correct reading on your tool. Otherwise, if your saw marks 90 when the blade is set for no bevel, you can just use the angles as is.

So for the case of saws that read 0 for no bevel - here is an example; if the plan specifies a 55 degree bevel you would set the saw at 35 degrees because 90 – 55 = 35.

**Notes on working with epoxy**

Epoxy has become the absolute standard for wood composite construction. Its material properties are specially formulated to mimic those of wood and thus minimize stress strain discontinuities across bond surfaces.

A pair of well bonded wood surfaces using epoxy will generally fail somewhere in the wood not across the glue interface. This is because the epoxy bond strength is higher than the strength of the lignin binding the cellulose of the wood together.

Additionally, epoxy has tremendous gap filling properties and contrary to older generation wood adhesives (now all made obsolete by epoxy) can bond well even poorly fitted joints.

A particularity of epoxy is that the two parts must be mixed together in exactly the correct proportions. The label should specify the correct ratio and whether it is by weight or by volume. The yellow part is always less dense than the white part.

It is technically incorrect to refer to these as resin and hardener. Putting either more or less than the correct amount of “hardener” will not make it set faster or slower. In either case it will make it fail to reach the designed material properties. If you deviate from the correct proportions it means that the excess molecules of that part will never find their mate or mates and be just hanging around in liquid form within the epoxy matrix, lowering the overall quality of the set plastic.

Instead there exist different formulations that are designed to set at certain rates. For this boat you will want to get the kind that is slow, especially if working in a hot place. This gives more working time to get everything set up right.

Epoxy of the kind that interests us is a thermosetting, exothermic polymeric plastic derived from coal tar, although it is possible to derive it from a variety of different plant matter. The molecules of either isolated part remain as a fluid, but when mixed together they are strongly attracted to each other and lock together as a solid. In so doing they create heat (exothermic) and this heat -atomic motion- helps their mobility in finding corresponding pairing molecules (thermosetting). This is a positive feedback loop, only moderated by shedding the heat off to the cooler surroundings. Small amounts of mix will thus reach an equilibrium temperature differential above that of its immediate surroundings. However, a large enough amount concentrated in a pot will reach an equilibrium temperature so high that it will spontaneously burn, ruining the batch and potentially causing fires and/or injury. Large amounts must therefore always be quickly transferred into shallow, preferably metallic, trays where the heat can be easily dissipated.
through the large surface area relative to the mass.

Exciting stuff this chemistry!

It's actually more complex than that but you don't need to know any more than this to start working with it.

Measuring out batches can be done many different ways; counting spoonfuls, cups with pre-established marks on them, oversize syringes, scales and a print out of different corresponding weights, measuring the depths with a dedicated little ruler in a cylindrical pot, store bought epoxy dispensing pumps.. Whichever method you use be sure it is accurate, reliable and relatively quick.

Be meticulous about avoiding cross contamination; never swap the lids to the two pots – you will never be able to open them again! Never put anything with even a small amount of part A into the pot with part B, or vice versa. This will damage the product. Therefore have two separate spoons or syringes etc one for each part and clearly marked as such.

If you use the measuring cup to also mix the batch in, always float the yellow part on top of the white part; since they have quite different densities they will not mix until physically stirred. This gives you a second visual check that the ratio looks correct and a bit of time before actually mixing to do anything else you may have forgotten to prepare.

Always mix thoroughly to be quite sure there are no unmixed pockets in the batch. Remember every molecule of part A needs to react with every molecule of part B, so really mix it up. If you can see any unevenness in the colour it needs to be mixed more.

There exist a tremendous variety of additives that can be used to modify the final properties and working characteristics of epoxy. Mainly fillers are used to increase the viscosity of the mix so that it does not run out of a joint before setting. The bigger the gaps , the higher the viscosity needs to be in order to assure this does not happen. A joint with voids will be markedly weakened and may be invalid.

Certain companies would like to have you think you should buy all their different additive powders, each specialized for a certain application. Practically though, in most situations two powders are enough; one high density and one low density.

High density is used for thickening when the joint is a high stress joint (small bonding surface compared to load). High density thickened epoxy does not increase in bulk, so retains a maximum of glue per volume of mix. It is difficult to sand.

Low density fillers are used for low stress bonds and for fairing and filling. It bulks up the mix significantly, reducing weight as the filler has a very low density as well as cost as the filler is much cheaper than epoxy. It also creates a softer, easy to sand final result.

Mixing the two fillers in determined proportions can provide the appropriate glue characteristics for almost any given application.

At the other extreme you can also thin epoxy with specially formulated epoxy thinner, for enhanced penetration and wetting of the substrate although this is not usually necessary. Lacquer thinner will also thin out epoxy (cheaper) as well as clean the brushes.

For cleaning hands and tools after a glue session get a gallon of cheap vinegar at the 'buy in bulk and save' store. Provided it is not already setting this is a non toxic and very cheap way of cleaning up. Always clean the spatula after use to save the effort and inevitable tool wear of chipping or grinding off hardened epoxy. A damaged edge on the spreading tool is highly annoying as it creates ridges on the glop.

You may want to get plastic film gloves to avoid getting epoxy on your skin. Although there are certainly worse products out there, epoxy is toxic, particularly the
yellow part. Many people eventually develop a sensitivity to it after years of handling and working with it. The worst aspect of epoxy are the BPA additives, although it is possible to obtain 'food grade' (meaning suitable for water tank construction not for literally eating!) epoxy without BPA. There should not be problems provided you follow certain guidelines.

Neat and tidy; Have a work plan. Know beforehand what you will be doing and what you will need to get it done. Keep the shop mess to tolerable proportions. Have a dedicated space just for preparing epoxy mixes, where food, drink and any other consumables never go. Keep rags, thinners and all the epoxy kit there so you don't lose them and can clean up promptly. Always be sure the pots are tamped shut and at no risk of falling over nor of getting accidentally kicked. When adding in thickening powders be sure to be out of any drafts as these extremely light powders will get blown all over the place with the slightest breeze. Do not breathe in these thickening agents. A dust mask is a wise precaution, as enough of this in the lungs can cause silicosis of the lungs. Having warned about drafts keep in mind that you still do need good aeration to keep any fumes from building up in the work shop.

When grinding epoxy, be sure to always wear a respirator or at least a dust mask.

Fillets are curved extra thick applications of glop in the corners between glued components, that increase glue area. The way to apply them is to cut out a special throw away 'spatula' from a piece of stiff cardboard, with the intended radius.

For applying pure epoxy get a bunch of narrow cheap throw away brushes. Just because they are throw away does not mean they get used only once though! Get deep narrow jars, so you can let the brush soak in lacquer thinner to not harden and get re-used up to a dozen times before it is too far gone to be of use.

Get an old coat hanger or a piece of ductile wire to make a paintbrush hanger. Start by straightening the wire out. Make a circular loop in it just small enough to pass through the mouth of the jar. Bend this loop so it is at right angles to the rest of the wire. From the loop, at a distance about the same as the length of the brushes bend the wire at 90 degrees. Clip the wire about three cm away from this last bend. The idea is that the loop sits in the bottom of the jar, as a stand for the rest of the wire which then goes on to support the brush by its handle hole.

Arrange so that when the paintbrush is hung on the holder, the tips of the bristles are 10 to 15 mm above the bottom of the jar. This keeps the bristles from getting all bent out of shape and keeps the brush out of the sediment that builds up at the bottom.

Put lacquer thinner in the jar just up to the level of the metal band on the brush. Periodically decant this lacquer thinner into another jar and throw out the gunk at the bottom. This lacquer thinner can then get used to give the brush a preliminary rinse, getting rid of the bulk of the epoxy. It this way you get the most out of the thinner, which is not cheap.

Be sure to always keep the lids on the jars tight to keep the thinner from evaporating away. On the jar with brush, wrap it up tight with a plastic bag and a rubber band.
Foundation step; Making the building jig

In this section I will explain how to build the jig or strongback in three different ways.

It is up to you to choose which is most appropriate for the kind of floor you will be building on. A tip for choosing between method 1 and 2 is to get a wide board with one perfectly straight edge and put it on edge at various angles across the floor where the boat will take shape. If the gap is between straight edge and floor is nowhere more than about one cm, corrective shims can be used with method 1. Otherwise use method 2. Method 3 is if the floor is overtly irregular.

Whichever system you use, the first step is to cut out the keel. Mark and draw the outline of the keel on the board destined for this purpose as per the measurements on design sheet 5. Drill the hole for the painter. Saw the curve of the top edge of the keel. Leave the front of the keel uncut. This can be cut off later, leaving this excess on gives a place to drive a screw through the keel and into the floor or strongback so the keel cannot slip around.

Method 1;

Cut out the six half moulds to the dimensions given on design sheet 6, without any bevels.

Draw two perfectly straight and parallel lines on the floor, the width of the keel apart, indicating where the keel goes. Mark also where the aft end of the keel goes.
In the case that the keel is thicker (wider) than the designed 18 mMM the correct amount must be removed from the inner end of each mould. It is not recommended to use wood less than 18 mMM thick to make the keel.

Set the half moulds on the floor sandwiching the keel at the correct distances (check design sheet 6) being sure that they are all quite square to the keel and at 90 degrees to the bottom edge of the keel. Mould pairs 1 and 2 go in front of the measuring plane, mould pair 3 goes behind.

Check that the outer top corners of each mould pair are at the same height. Use the level for this and check at the same time that the distance from the top of the keel to the top of the moulds is indeed as specified on design sheet 6.

If it is not, cut out a number of thin shims and thin wedges from scrap lumber to correct the height of everything until all measures correctly and is level. Then screw the moulds down to the floor or glue them in place with a blob of glop near each end. If there are any shims put the glue there so nothing can move. Avoid glueing the keel to the floor or the moulds. The keel gets just one screw forward so it can't move fore and aft. The moulds keep it in place side to side. If the keel is not aligned with the guidelines all the way along, correct it by nailing a little block of wood along one side or other of the keel, in order to force it into place.

Method 2;

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Keel not yet in place

This is much the same as the first except that now we will put the keel on top of a strongback. The strongback is any piece of stiff lumber at least as long as the keel. The length can built up out of several shorter pieces by butting the pieces together and nailing.
more wood on either side solidly. It can be as rough as you like, only one face matters; the upper face upon which the keel sits. This face if not already perfect needs to be cleaned up, inspected for any foreign objects that could damage the plane, and planed till it is ruler straight.

On this face you mark the two parallel lines as before as well as the line across indicating the aft corner of the keel.

Note the height of the strongback at the position of where each mould pair will go. This is how much needs to be added on to the vertical mould measurements shown on design sheet 6. Notches as appropriate need to be cut away on each mould to accommodate the strongback. Don't worry about a good fit between the moulds and the strongback; what matters is that the moulds press against the keel itself, keeping the keel aligned with the two lines.

Align the keel to its marks, screw the keel to the strongback at the front and position everything perfectly as in system one and screw or glue each piece to the floor.

Method 3;
This is for if the ground is too uneven or actual soil. It is the way to make the jig have autonomy from the ground, although it is still prudent to attach it to stakes in the ground or otherwise keep it from shifting and potentially twisting.

How it looks with the keel in place

Proceed the same as in method 2 but using five extra pieces of rough, but rigid
lumber to put the mould and strongback on as per above illustration. Nail everything together with cheap nails.

**Step One; Measuring, Marking, cutting out and assembly of all Panels**

Plywood panels do not come necessarily perfectly square, so check the corners with the large set square and by taking diagonals. Choose the best corner to use as the origin when marking the panel ordinates and decide which side is the better side. Arrange so that if there is a better side, the better side faces the outside of the boat. If no corner is perfectly square, measure diagonals and mark a new end that is indeed square. Use the plane to shave off to the line you marked.

For the 9 mM panels, the panels are pressed against one another making quite sure they cannot shift accidentally before finishing the measuring and marking process and that the edge used for measuring off is indeed ruler straight.

Mark a tick line with the pen every 300 mM from the origin on both edges of the plywood panel. Connect the corresponding marks with the chalk line.

Mark off the ordinates along each line. It is most helpful to have a helper for this read out the numbers and move the end of the tape along. This easy task saves a lot of time and makes mistakes less likely.

The marks must be made neatly parallel and at right angles to the side of the plywood sheet, never as an 'X'.

Check that all is properly marked and draw the straight lines with a straight edge. Use the best piece of narrow stock to draw the curves joining up all the other marks. Lightly drive nails on one side or the other as required to force the batten to follow the marks exactly. Don't worry about these little holes in the plywood, they will get filled up with epoxy later.
If the batten does not want to follow the marks or the marks do not appear to be fair, check the measurements. All these curves are by design smooth gentle curves without harsh kinks or sudden changes in curvature.

Once all the lines are marked, annotate the pieces and edges as necessary to identify the correct orientation, side that faces out, and any bevels that need be cut.

When cutting at 90 degrees always verify that it really is so with the set square against the saw base plate and the saw disc. Check this before plugging in. Check also that the bevel angle screw is firmly tightened so that vibrations cannot make it loosen, allowing the bevel setting of the saw to vary as the cut is being made.

Remember that the **bow transom bevels are additive**, all other bevels are subtractive.

Once all the pieces have been carefully cut out, check that they are indeed accurately sawn. If not use the plane with a fine setting to shave down to the marked lines. The keel line is the most critical; even a small deviation here will radically alter the shape of the hull.

Place the panels that make up the bottom and the sides on a flat section of floor. Where the glue joins will be glued protect the floor by taping plastic sheeting. This also ensures that the panels do not get accidentally bonded to the floor.

Check that every piece is oriented correctly, including the joining pieces. Draw marks so that the joining pieces can be lined up correctly. Check that the edges make fair curves when the various pieces are joined up as they will remain.
Mix up a batch of epoxy and paint pure epoxy on all bonding surfaces. Do not neglect the end grain faces of the actual panels. Now with the remainder of the epoxy, mix in enough filler (half and half light/dense) to get a ketchup like consistency. Spread this out with the spatula, dividing it among the bond surfaces, including the ends of the panels that will come together. Press the joins together with heavy items. Check that the pieces do not move around or creep. The epoxy creates a highly lubricated interface at first so this is quite a problem. Coming back a few hours later to see that the pieces have crept out of alignment due to, for example, an imperceptible slope of the floor and has now set up rock hard is discouraging to say the least! Use temporary tacks, nails, small screws or whatever it takes to ensure nothing can move around. Keep pets and children away from the work area too!

Heavy pails of paint as clamping weights
A small amount of epoxy should squeeze out all the way around the join; this indicates a good bond, free of voids. Clean up this excess now with the spatula and save yourself the effort of
unnecessary grinding later.

Step Two; Keel, Bottom and Keelson.
You should now have the keel held in position by the half moulds and the keel aligned on its marks as per the foundation step.
You will notice that the moulds are slightly proud of the keel. This is correct and is because the panels are not bevelled. The bottom panels contact the keel on their edge close to the centreline of the keel. A straightedge on the top of any half mould should touch the keel at this contact line.
Get one of the battens and draw a centreline running down the full length. This will be the keelson or hog. Mark off the bevels and plane till the angles vary correctly along the length.
Draw a line one centimetre away from the edge of the keel line on both bottom panels on their outside face. This is to give a visual check that the bottom panels are indeed correctly centred on the keel.
Put the panels into position on the keel. Weigh them down so they start to conform to their correct final bend and twist. At the back where the curvature is less the panels should already be in their correct position, touching each other on the centreline of the keel, in contact with the keel. Check that the upper back edges at the centreline is aligned directly above the aftmost top edge of the keel. Notice that due to the angles, the panels will protrude beyond the end of the keel about 1.5 mM at the bottom when the top edge is actually in line with the aft end of the keel.
Drive in two small screws near the stern, staggered slightly, through the bottom panels and into the keel.

Now working forward finish bending the panels into place. Near the bow quite some force will be required. Weights can be used to help coerce the panels into the correct place. The two sides of the bottom must touch each other the whole way along their length, must rest on the keel on their whole length and be in full contact with each half mould. Once they are like this and are symmetrically aligned on the keel (check those lines you drew on the underside of the bottom), screw the panels onto the moulds with two long screws into each half mould.
Check that the keelson is bevelled correctly by springing it into place. Remember that the keelson stops 9 mM short at the back end and 11 mM short of the front edge to give space for the transoms. Mark a line either side of the keelson checking that it is indeed well centered. Mark where the keelson must start at the aft end 9 mM forward of the aft edge of the bottom.

Once it fits right, weight it down into place and, starting aft, drill straight down through the bottom and into the keel. It is important not to miss the keel, which is why so much care went into lining everything up so well with all the marks. Screw it in place successively with the long screws right the way through into the keel. Put in a screw every 30 cM about, except forward of the painter hole where two screws are recommended. Be sure not to screw through the painter hole and that the frontmost screw is not so far forward that it will have to be sawn when the front of the keel is trimmed to its final shape later.

Now that this dry run is done, take it all apart just leaving the keel and moulds in place, and prepare enough glue to bond the bottom onto the keel. The glue must be applied generously since the panels are not bevelled, so there is all that gap to fill. Wet the bond area first in the usual manner then heap on a big bead of thickened (high density) epoxy.
Heap on at least this much epoxy on the top of the keel

Without delay get the bottom panels back into place, starting at the stern as before and putting screws in all the holes previously made, thus guaranteeing that the panels assume the correct position as previously determined. Check that all is correct on the underside while scraping off excess glue.

Mix more epoxy as needed to bond the keelson into place. Starting at the back, screw it in place with the long screws in the premade holes.

Glue in the usual manner; wetting bonding surfaces then applying a bead of thickened high density glop to the underside of the transom.

Glue the transom into place, checking that it is perfectly aligned with the after edges of the bottom all the way along. Prop it so it can’t fall over. Place blocks under the bottom panels if needed to lift up the bottom panels so they are at the same angle as the bottom of the transom. You want to be sure there are no gaps between the transom and the bottom and that the transom is flush with the back edges of the bottom panels along the whole width of the boat.

Clean up the excess epoxy.

Go around and scrape away all excess glue, then create a nice fillet on either side of the keelson. Be careful to not knock over the transom!
Choose two battens to make the chine logs. If you have a tablesaw run them through at the angle indicated in design sheet 7. Otherwise use the circular saw steady as you can. Then with the plane continue the bevelling process so that it varies smoothly along the length, and measures correctly at the control points. As you can see on design sheet 7, the control points are at, one meter, and at two meters back from the bow end. You will notice the angle barely changes until that last meter at the bow. If you are a couple degrees off, don't worry too much as you can still knock it back a bit (or fill with epoxy when the sides go on) after it is glued in place.

getting the bevel angle to change along the length with the plane

68 degree bevel all the way down
Clamp the chine logs into place. Mark the angles at the front that the bow transom will make and carefully cut the front few cm's off creating both bevels at once, such that the log will stop neatly against the bow transom when the bow transom is in place. This is a deceptively difficult cut to make, but if you don't get it right the first time there is enough excess at the stern to let you make a new cut a couple of cm's back, shifting the whole log forward this amount. You can transfer these angles to the other chine log and cut that one at once now that you see the correct angles.

Chamfer off a face one cm wide between the top and the inner faces of the log.
Mark at the back the point at which the log must end and trim with the handsaw.

Pre-drill and put in the screws making sure the chine log is exactly aligned with the edge of the bottom all the way along. Do not try and save time by doing this while glueing at the same time. It will almost certainly end up taking more time in the end, apart from guaranteeing a mess.

Glue the chine log into place. If you are building on the floor or low, you will have to screw temporarily from the top with long screws. In this case, these screws will be removed later and permanent screws put in from the bottom, so make sure these screws now have their heads free of glue, or they will be difficult to extract. See in the next picture how the outside lower edge of the chine logs lines up with the upper outside edge of the bottom.

Aft end
Step Four; Sides and Bow Transom.

Check that the bow transom fits perfectly pressing up against the ends of both chine logs and the keelson with the front face aligning exactly with the front top edge of the bottom panels. Correct if necessary; gaps can be filled with epoxy when the bow transom is installed, excess wood must be trimmed back now with the grinder and a sharp chisel.

Set this transom aside.

Do a dry run with both sides of the boat putting in enough screws to fix the sides in their correct position with the lower inner edge of the side coinciding exactly with the upper outer edge of the bottom, and the aft edge flush with the aft side of the transom. One screw should go through the side and into the transom to secure their correct relationship. Work from the aft end propping the other end up temporarily and adjusting it up and down so the bottom of the side comes onto the chine log correctly.

Remove the sides and glue. If you are working alone you will have to start in the middle to hold the side at its point of balance and find the correct screw hole made earlier. Aim to end up with a screw every about 30 cm. Make sure they are slightly countersunk so as to not cause trouble later when finishing the hull.

Clean up excess glue and create a small fillet above the chine log.

Now you can go straight onto the bow transom. Whilst holding it so it is perfectly aligned all the way around with the sides and bottoms, get at least one screw through the side and into the bow transom up high. Notice that the aft top edge of the transom is higher than the inner top side edges. This is because it is not yet bevelled. You will bevel this edge later with the plane. The front top edge of the transom should however be aligned with the front top inner corner of the sides.

Clean up thoroughly around the transom to not have problems fitting in the corner pieces that go all around the edge of (both) transoms, solidly bonding the transoms to the rest of the hull.

Step Five; Final details.

You can, once the sides and bow are cured, install the rubbing strips or you can install the thwarts first.

I will describe the gunwales first.

Take two battens and router them on the two outboard edges each with a quarter round 12 or 18 mm radius router bit. These are so simple a dry run should not be necessary. Glue them onto the sides so that their upper edge lines up with the sheerline. Start at the bow with a clamp, and go down the side getting it into place with the rest of the clamps. Then go back again and put in small screws every 30 cm or so from the inside. Get one done, remove the clamps and repeat on the other side for the other one.

Be sure to clean up all excess epoxy. You can take advantage of this excess epoxy to get the upper edge of the side panels coated in epoxy which will seal and protect the plywood sides.

When the glue is hard, carefully saw off the excess rubbing strip sticking out from the ends of the boat.
That's it for the big work; all the rest is now the fiddly bits, which take time, but are essential to make the boat strong and functional.

Cut out the thwarts as per the design sheet 8 out of the remaining wide plank, respecting the bevel angles. Mark a line at right angles across the plank defining the center of the thwart and use this as a base for your measurements. If your stock is not 188 mM wide and you would rather not change it to 188 mM then you must transfer the measurements as if it was 188 otherwise the ends will be at the wrong angle.

For example, if the plank is 196 mM wide, mark a line 4 mM away from each edge and put the sheet measurements along these lines which are 188 mM apart.

Mark on the undersides of the thwarts a line about eight or ten cM away from the ends. Write in pencil «do not pass with router!». Route the bottom edges with a 12 mM radius quarter round router bit up to these lines. Do not router all the way to the ends of the thwart!

Turn the thwarts right side up and change to a 6 mM radius quarter round router bit and router the top edges, this time going all the way to the ends. The top round makes the seats comfortable. The bottom round is cosmetic making the seats appear thinner and more delicate than they really are. If you don't have a router use the plane and sandpaper on a wooden block for the top edges. Use the plane on the bottom edge holding it a shallow angle. The illusion does not work if this chamfer is so steep that you can see the underside of this face.

Measure the distances from the aft face of the transom to the centres of each thwart by placing a straight stick across the boat. Measure on both sides so the stick is straight across the boat. Mark these points on the hull.

Leaving the stick in place, measure from the bottom of the stick the indicated distance (refer to design sheet 2) straight down to the side of the boat where the top of the thwart needs to go and put a horizontal mark there. This marks the height of the top surface of the thwart.

Cut out all six risers. They are all the same, apart from the two for the bow thwart which need a 6 mM jog cut out to fit over the joining piece in the side panel. The front thwart too will need a 6 mM jog taken out. Put this thwart in its correct longitudinal position and mark where the jog has to start and cut it out with the circular saw with the same bevel setting used to cut the ends of the thwarts in the first place. Finish the last bit with the handsaw. Check that it does indeed drop into place now.

Check that the thwarts all fit correctly in place. It may be that some will push the sides of the boat out or they may be a small gap which means the sides of the boat need to be pulled slightly together at that point. Use some rope around the hull or the framer's clamp for this. It should not be more than about 5 mM though.

Look over the boat with the thwarts temporarily in their correct positions (fore and aft, up and down, and at the correct angle; they must be horizontal when the boat is floating) The sides of the boat should be symmetrical and have no bumps or hollows; just a nice flowing curve from end to end. If you cut out all the panels precisely and aligned everything correctly this is what should happen.

Trace the undersides of each thwart marking where they start and end. Remove the thwarts and install all the risers according to these lines with the same amount of riser extending in front of the thwart as behind. Glue them in place as usual with two small screws each. Clean up.
Cut out the seat supports. Glue the thwarts in their correct positions with two screws at each end going down into the riser. This must be strong because the seats may be used to lift the boat by. Glue in place the seat supports with one clamp each. No screws are needed here, but check that they do not start leaning over as the glue sets. Be meticulous with cleaning and filleting the epoxy, here is a hard to sand place.

Glue in place the four thwart knees. These get one screw each from the outside through the sides of the boat, just under the rubbing strip. Make a batch of glop with about 2/3 light density 1/3 high density filler and create a big fillet around each knee where the glue joins are.

Cut out the little battens that join the quarter knees to the hull. Glue each knee in place flush with the top edges of side and top edge of transoms with two screws each side down into the supporting batten, and each batten with two screws into the hull.

These quarter knees are the usual handhold whenever moving the boat around out of the water so they must be strong. Large fillets can used as well. However you finish the glue join be sure to be thorough because sanding in these corners is extremely awkward. You want to make sure that you really only have to do a little light sanding here, just thorough enough for the paint to stick.

Now sit in both rowing positions and find where your feet naturally rest. Place a light mark there for each foot at the right position and angle for you. Measure these marks both sides and take the average measurements and now mark in bold the definitive foot rest positions so they are symmetrical about the centreline. Glue in place the four foot rests one pair for each rowing position. Go through the offcuts and find pieces that look like they will be comfortable to push against. Cut them to around 15 or 18 cm long. A piece of tape is enough to hold them in place while the glue sets. It is a nice touch to add in more foot rests for anyone else who might row this boat and who has longer or shorter legs. If you do not know their leg measurements just add in the other foot rests parallel to the first eight or ten cm away, just far enough that no matter which one you use the next one does not dig into the ankles.

Now that the knees are all in place you can unscrew and free the boat from its jig.

But there are still a couple more carpentry tasks;
The corner pieces that go around each transom.
Cut out these eight pieces. The angles are given in design sheet 7. You will have to measure and mark the end cuts and bevels. I do not include this because it will depend on the final dimensioning of the wood used for the chine logs and keelson. It is not strictly necessary to put screws in these pieces although it won’t hurt having them for greater join security. You can often use a prop and wedge or a weight to keep each piece in place while the glue sets. Remember that the wet epoxy makes the pieces very slippy and that what seems to work dry may creep or slip once the glue is on.

Remove the temporary screws in the chine logs.
Turn the boat over and put in a screw every 30 cm about through the bottom and into the chine log. Be sure to aim right. Keep checking after each screw to make sure it is not coming through on the inside. If one does, just take it out and move it along a few cm. Use the mistake as a hint on which way to correct so it does not happen again.

Cut off the front end of the keel following the mark you already made with a handsaw.

Go around the boat with the planer on a very fine setting and the abrasive disc grinder, knocking back all the unfinished bevels on the top of the bow transom, the aft ends of the bottom and a slight amount on the aft ends of the sides as well as the front edges of both bottom and sides so they are flush with the bow transom. You will also want to check the chine all around and plane anything that protrudes beyond the prolongation of its neighbouring panel. Be careful not to damage the planer on any screws!

Now cut out a female filleter from cardboard and fill the gap along each chine with glop. This seals up the endgrain of the plywood and finishes the chine off. While at it fill in all the screwheads and any blemishes you may find. Once this has hardened go back with the grinder and a fine disc and some 100 grit sandpaper on a sanding block and round it off evenly to a radius of about 5 mm. If you did a good job filleting the glue to start with, just a quick once over with the sanding block will suffice.
Step Six: Finishing.

What level of finishing you decide on is up to you, it can go from a light sanding and a couple coats of enamel, all the way up to full epoxy sealing followed by urethane primer, topcoat and clear-coat all extensively sanded with ever finer grades of sandpaper, applied by spray and finally buffed with wax. If you go with the latter option you can be sure that people will notice your new boat! They may have to put on their sunglasses too whenever you approach.

Since there are too many options to fully describe in detail I will instead give some general recommendations and guidelines for a successful finish.

It is important to keep in mind that the main function of finishing is not to prettify but to protect the boat, extending the lifespan of the boat. The greater the effort gone to in finishing the more years the boat will last - up to a point.

No matter the level of finishing, count on having to repaint the boat once a year if the boat sees everyday use. This is part of the regular maintenance schedule of any boat.

In the tropics, avoid any dark colour as they will get very hot in the sun and not do the structure of the boat any good. Epoxy degrades at high enough temperatures too.
Furthermore the boat may even get so hot that bare or bikinied bottoms may not want to sit in it which may not be the intended outcome!

It is a good idea to start by painting the whole boat inside and out with a thinned coat of epoxy followed by a regular coat of epoxy. This provides superb waterproofing and an excellent base for the next layers of coating. However, if using modern urethane or two part epoxy paint, the paint itself is a very good sealant so pre-sealing in epoxy is not necessary. Rather it is just extra protection.

For the ultimate finish I would paint in thinned epoxy and then follow that with a meticulously applied thin layer of low density glop applied with a wide squeegee over the whole boat. Then this is all sanded back with wet and dry sandpaper so the surface becomes utterly smooth and all traces of wood grain are gone.

Even if you are not aiming for this level of perfection, a bare minimum is to go around the boat applying glop light to each screw head and any other surface blemish so the surface is smooth and even. Try and apply as evenly as possible to save yourself as much subsequent smoothing with the sandpaper and sanding block. Also be sure to grind back any screw points that may have poked through anywhere. Be aware that grinding metal, even stainless steel, will create a fine spray of metal particles which will eventually corrode and create havoc with your paint, so be diligent about removing all traces before painting.

Crucial for any paint job is preparation and sanding. All surfaces to be painted must be thoroughly sanded and then all dust removed with a clean rag and some thinner. In between coats everything must be sanded again to provide good grip for the next coat.

Some exceptions to this is when using two part paints which will dry no matter how thick the layer one can keep adding layers without stopping. As soon as the first layer is hard enough to not get dragged around by the brush the next coat can go on. There is a window of time that can be used in other words to save on a sanding operation.

With enamels (oil based paint) also there is this window, starting about two hours after application, depending on the actual paint and the conditions. You know it's ready the moment it is “tack free”. However, since enamels do depend on drying processes, you can only apply two consecutive coats in this manner or the first coat will never fully dry.

Another key to a quality paint job is many thin layers of paint. Don't pay any attention to paint labels saying 'do not dilute'. I find that in almost every case the paint goes on far better after thinning. In the case of enamels 5% mineral spirits is usually about right, but try a little at a time (in a separate pot) and see where the sweet spot is where the flow of the paint is just right.

For urethane paints in the tropics the dilution ratio is about 100%. No that's not a typo. It's got to be the consistency of water, otherwise you'll get horrible brush marks. The brush must be a high quality brush or that expensive paint will have been completely wasted. The hardener must be slow if painting by brush, especially in a hot climate, or else you don't physically have the time to keep up with the wet edge. Even doing all that, one has to work extremely fast in narrow bands so the wet edge does not start dragging and a bottle of thinner be kept close by to keep on topping up the ratio in the paint pot. These thinners evaporate very quickly. Xylene is the thinner for urethane, but you can get away with lacquer thinner if you want to cut costs, and are willing to sacrifice a little of the final result's shine. But as mentioned before, you can just keep on applying coats until the job is done in one fell swoop.

It is always a good idea, particularly with the high end paints to do a test bit, even on an offcut of the boat to see that there won't be any bad surprises. And by bad surprises I mean potentially having a disaster which requires sanding the whole boat down
and starting over which is a frustrating and thankless task best avoided at any cost.

Another thing is do not waste your money on fancy “marine” paint. There is no difference between urethanes worth paying double for. Get your urethane at the auto body shop, get a middle of the road price brand or even a generic brand and you'll end up with a top notch finish for half the price of that 'marine' stuff provided you do your prep well.

One liter of car urethane and a camel hair brush resting on a paint pot.

First coat of urethane goes onto the primer.

It's worth also looking into some of the epoxy paints. These are two part, hard as nails and have excellent build. There is even a two part epoxy paint which dilutes with water which I highly recommend.

Once done painting you can finally install the metal band on the underside of the keel if you have it.

Oars and Oarlocks;

Oarlocks are meant to go 25 cm behind the rear edge of the thwart, but since the stock you use for this may be a slightly different width I specify the distance from the centres of the thwarts. Refer to design sheet 2. If your arms are unusually long or short this may be altered slightly, but generally this measurement is correct and will be good for anyone, including children.

When buying the oarlocks do not buy the closed loop kind which should be internationally banned. Get the classic open style where you can ship an oar in an instant, with a smartly executed movement, leaving the oarlock in place ready for the oar to be rapidly deployed again. The closed kind will not allow this, instead sliding down the oar all the way to the blade in the water and must be retrieved usually requiring both hands and put back in its socket.

Also check while still in the store if you can, that both oarlocks can in fact be easily inserted into any of the oarlock sockets. Some of these made in china parts are so sloppily machined that they won't fit together properly and bind or even not enter all the way!

Only get bronze or stainless steel oarlocks and sockets. Be sure the oarlocks have a small hole at the bottom end of the pin. This is to tie a short piece of strong line or
sinkhole chain through, the other end being tied to any object that is skinny enough to pass through the oarlock socket, but that will not let the oarlock from actually getting lost if for whatever reason it should get knocked overboard. When taken in, the oarlocks will hang from this small chain inside the boat, ready at hand to be re-inserted into position quickly. When leaving the boat in questionable areas be sure to remove the oarlocks and take them with you!

If you are on a tight budget you may consider fashioning rigid wooden oarlocks as in the example in the photos, out of hardwood, but they are more awkward to use.

The height of the thwarts is important too. It is upsetting to see how many dinghies have thwarts that are far too high; this makes the boat less stable, exposes more of the body to windage and forces a terrible rowing posture. Provided you installed the thwarts as specified you should find that the rowing position feels natural on either of the two seats, and you can pull well.

Rowing is an art and sport as well as a practical science and there is much to it. It is well worth the time to read up on some of the finer points of rowing.

This free book Rowing and Sculling available on the internet and can be downloaded and will give you an idea as to the magnitude of the subject, for while anyone can learn to generally row about in a dinghy in a short time, the perfectioning of the technique is something that can be developed continually during one's lifetime.

The oars **must** be 2.4 M (8') long. If the oars are not this length you will not be rowing correctly or efficiently.

The oars that are likely offered at the chandlers are certain to be of the glorified butter paddle variety. This can be improved by judiciously planing away all the excess wood down at the blade end as well as tapering the shaft away from the oarlock. It should require very little effort in order to raise the blades out of the water when you are rowing.

The length however must be 2.4 M and if this is not available you will have to lengthen the loom to the correct length. The ones in the photo have been lengthened and balanced.

Alternatively you can contact me and order plans for well balanced built up Norwegian style oars exactly matched to this boat. 

([http://archive.org/details/rowingandsculli00woodgoog](http://archive.org/details/rowingandsculli00woodgoog) in case the above link does not work)
Readers who do a want a classy performance rowing boat may want to have a look at my designs # 6024

and # 6103

Contact T³ at ; tttangvald@yahoo.com