# Javelin

the building process

**How to build a Javelin Skiff**

This is not your grandfather's plywood boat! The Javelin involves a high-tech type construction, called composite. The hull can be constructed with foam or plywood; these materials are used as a core sandwiched between two layers of fiberglass
with epoxy resin.
This type of construction is different than conventional boat building. But don't let this scare you. Many people have built the Javelin, and have never built a boat before. As long as you put enough determination and patience this will be rewarded with the final result, a high performance sailboat capable of speeds in excess of 20 knots.

Weight is one of the most important factors, impacting on the boat performance. The goal is to build a light boat but also strong, to be capable of withstand high stress forces.

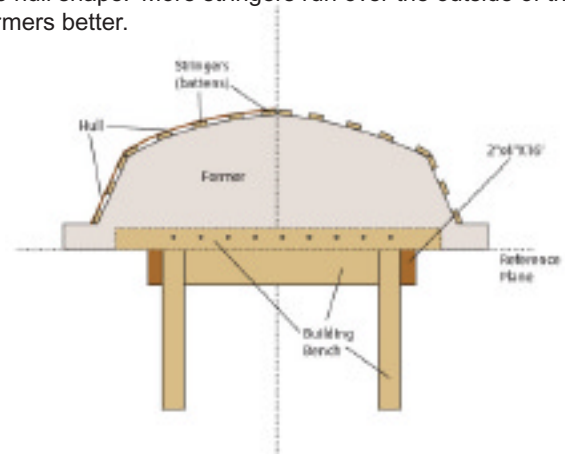
This article describes the construction process using plywood. It is important to select the best materials for this project to get the best results.

**Materials**

The plywood used is Okoume marine plywood, and it complies to BS 1088 standard. There is another grade of plywood below Marine bonded, which complies to BS6566. That sometimes is also used, but care is needed in selecting the best sheets due to voids between the plies.
The plywood thickness is 3mm with the exception of the false floor where it is recommended to use plywood at least 4mm thick, or if you prefer you may use 4mm through out. For this project you will need a total of eight (8) sheets of plywood.
The fiberglass used is 4oz S, and biaxial fiberglass tape 4" wide for the joints. A better material to use would be carbon fiber tape, which is much stronger that fiberglass.

**The Mold**

The Javelin hull is built around a male mold.
The first phase of the construction process is to build the mold. The mold is made with transversal formers erected on a building bench, accurately aligned, and braced to prevent movement.
The stringers, or battens, are attached to the formers creating the hull shape. More stringers run over the outside of the formers better.




The building bench is constructed with two 2"x4"x16' studs, plus some additional wood for the cross-members and legs. The bench has to be sturdy and leveled. The bench height is very important to provide the best working conditions.

The formers can be made of plywood at least ½" thick, or particle board at least 1" thick. The stringers can be 1/2" thick, and 15' long, cut from 2"x4" studs.
*Very important*
Before you transcribe the measurements into the formers, you have to take in consideration the thickness of the hull, plus the thickness of the stringers. For example, if you use 4mm plywood, plus 2mm for the thickness of the fiberglass, plus 126mm for the thickness of the stringers, you have to discount 132mm on both sides, and bottom of the former measurements.
Notching the formers to accommodate the stringers it's not a good option, because you won't be able to re-adjust the stringers once they are in place.
When transcribing the measurements to the formers, remember to add the height of the formers in relation to the reference plane.

**Always remember as a rule, measure twice cut once.**

After the formers have been traced, verify the measurements before cutting. Mark the formers F6 to F1/2, and mount them securely on the building bench. Make sure the forms are correctly placed according with the drawing. Then attach the stringers to the formers.
Cover the stringers with brown packaging plastic tape, to prevent the panels to be glued to the stringers, specially in the areas where the panels join each other.
After the mold is finished, verify the accuracy in your measurements, to assure that no mistakes were made. Remember the boat that you are building is as good as the mold you built.

**Attaching the panels to the mold.**

The second phase of the project is the construction of the hull shell. Place a sheet of plywood against the area, and mark the shape of the panel, leaving some excess to be trimmed after the panel is installed.
The hull is made of joint panels of plywood, since a single sheet is not long enough for the entire length of the hull. The panel joints are made after the panels are attached to the mold.

One process of attaching plywood panels to the mold is by drilling small holes, and using thin plastic coated electrical wire to tie the panels to the stringers, and in some locations you may have to use sheet-rock screws in order to bring the panel into the proper shape.
Start by attaching the side panels. Once the side panels are attached, trim them to the proper dimensions.

One of the most challenging parts of the project is the bow area. The bottom panels for the bow require that you leave quite a bit of extra margin for adjustment, due to the twist that the panels are subjected to in this area.
The plywood has to be forced into place in this area, and you may have to use "C" clamps, sheet-rock screws, to bring the plywood into the right shape. Bring the plywood slowly into shape, otherwise it will crack.2

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**A few words about epoxy resin.**

Use only epoxy, other types of resin are not strong enough and they don’t bond. Follow the manufacturer instructions to the letter.

Use dispensers (pumps) for the epoxy/hardener mixture to be correct. The mixing proportions should be held as accurately as possible. Otherwise it will not cure properly and it will never provide the proper strength.
If the epoxy and hardener stand for a long period of time (6 months or longer), stir or agitate each ingredient before use. Do not attempt to mix too much resin at a time. The best mixing containers are graduated and made of flexible polyethylene plastic. They are reusable, and the resin once cured will not stick to them. Make sure you stir the ingredients thoroughly, this is extremely important for the epoxy to cure properly.

Avoid working in high humidity whenever possible; drastic changes in humidity can affect bonding strength. Ideal working temperatures range between 70oF and 85oF. However some manufacturers make special hardeners for lower temperatures. Surfaces must be clean and dry. These are two main factors affecting the success of the bonding.

The picture below shows a great tool to apply epoxy resin in small surfaces, and hard to reach places. It can easily be done, by cutting a piece of a paint roller, and stapling it into a paint stick.


To apply epoxy resin to large surfaces a foam roller provides good results, then on the final coat use a large plastic spatula. To clean epoxy resin use acetone, or alcohol, or other epoxy-compatible water free solvents. Do not use other products that may contain contaminants, or leave oily residue

**The Joins**

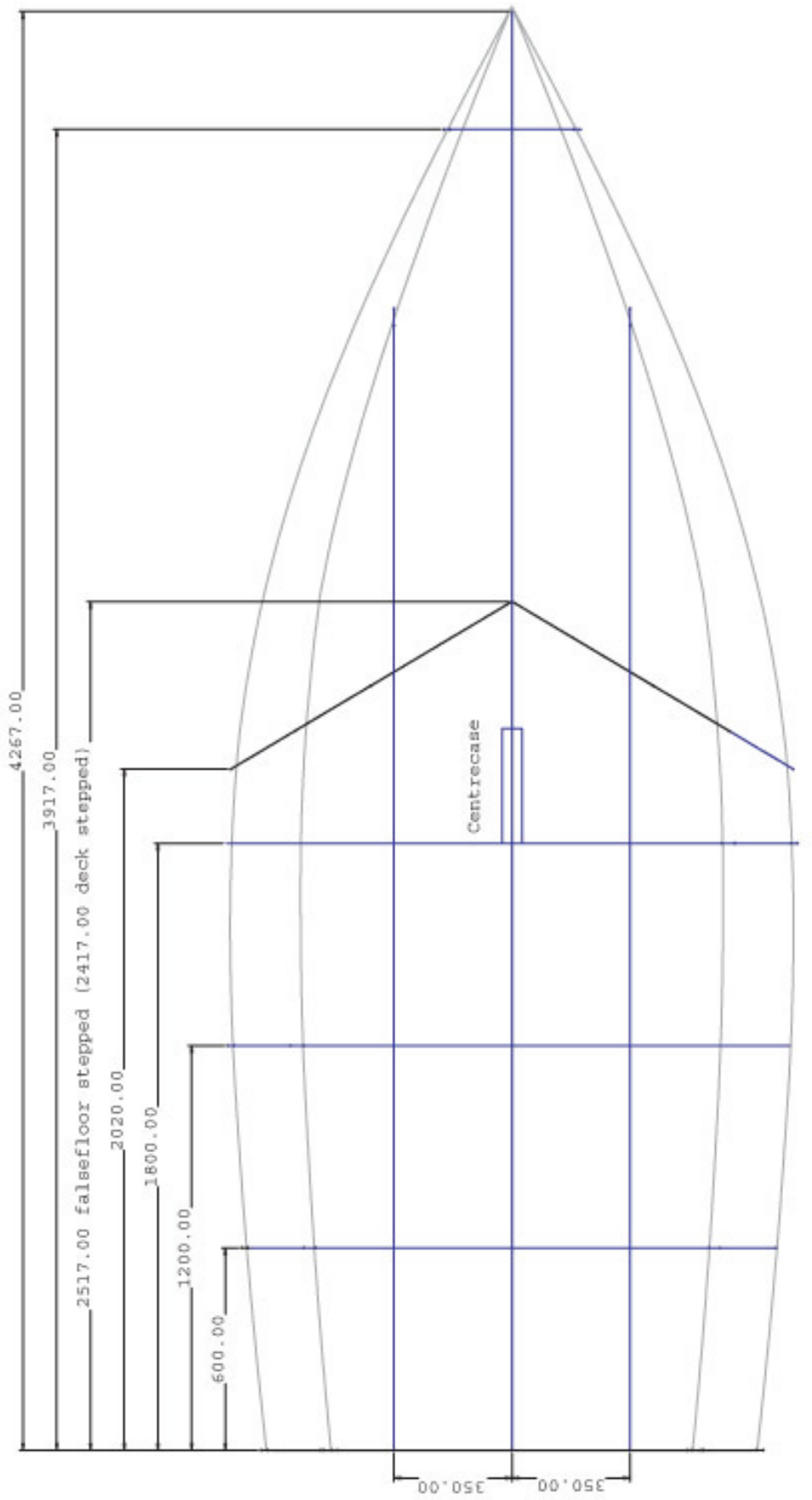
Once all the panels are attached to the mold, it’s time to make the joins. The joins require special attention to keep them to a minimum height, and at the same time they have to be strong. One misconception is to add more epoxy to make it stronger. This is far from the truth. By adding more epoxy, the weight increases and the joint becomes more susceptible to break. You should always remove the excess of epoxy.

On the joins one should use biaxial tape. The fibers run at 45 degrees of each layer, providing better strength. Carbon tape is a better choice, but its cost is much higher.
After applying the epoxy resin to the tape, you may cover it with kitchen wax paper to make the join smooth. Apply pressure using a flat surface object, to squeeze out the excess of resin. Leave the wax paper in place until the epoxy resin is cured.

After the resin is completely cured, remove any wax residue with acetone.
When you need to apply layer of fiberglass on top of another, sand the layer underneath to provide better adhesion.

Cut the fiberglass cloth of the size of each panel, over-lapping the joins slightly.

Use a foam roller to apply the epoxy. Wet the surface with epoxy, then lay down the cloth, and make sure that there are no air pockets.
Apply the epoxy resin in two coats, on the first coat the cloth threads are still visible after the resin is cured. Within a short time of the first coat being cured, apply the second coat. If you wait too long between coats you need to clean the entire surface with acetone, before applying the second coat.
In general, epoxy resin is not self-leveling, due to its viscosity, so don’t attempt to do this with a single coat of resin. This may cause an irregular surface with runs, and the use of excessive amounts of resin. At the end you will have a tremendous amount of work sanding it down.
The second coat is applied with a plastic spatula. This requires a bit of practice, but once you acquire the skill you’ll be able to spread the epoxy creating a smooth surface. Once again, don’t use more epoxy than what you have to.

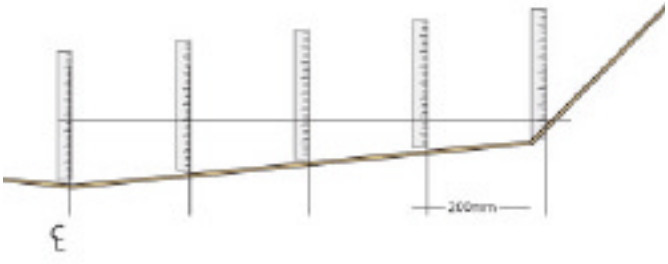

4267.00
3917.00
2517.00 falsefloor stepped (2417.00 deck stepped)
2020.00
1800.00
1200.00
600.00
Centrecase
350.00
350.00

Once the hull outer shell has been fiber-glassed, it's time to remove the hull from the mold. You may use the building bench with the formers removed, to place the hull up righted. Place two stringers across the hull, side to side, for the hull to keep the right shape.

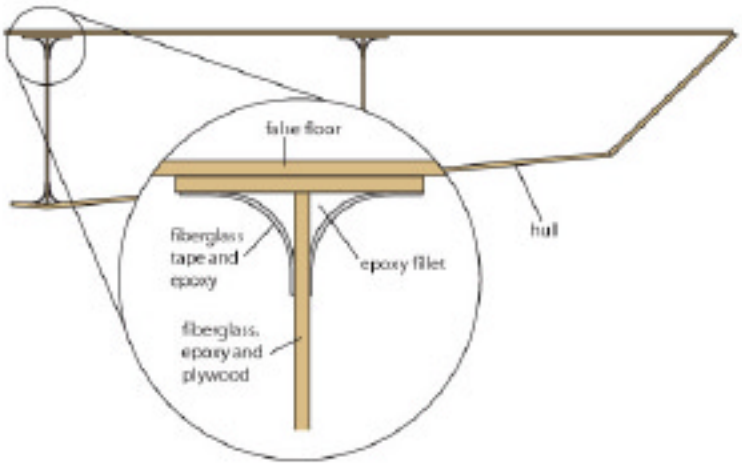
The next step is to make the inside joins, using the same process used for the outside. For the inside joins, carbon tape is the ideal material to be used for its strength. Remember to place fiberglass at the bow.
After the joins are done, fiberglass the inside of the hull.

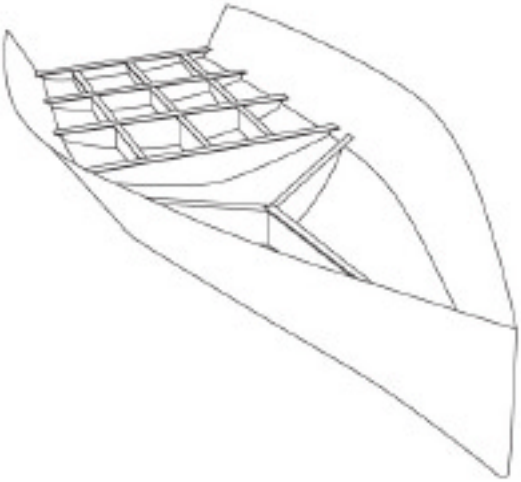
**The frames**

The frames provide not only support for the false floor, but structural strength to the boat.
Refer to the drawing on page 4 for the location of the frames. Note that the location different than the location of the formers. Mark each frame location on the inside of the hull, then place a string across and make several depth measurements, every 200mm, and note on a paper. Subtract 4mm from the depth, to compensate for the plywood strip to be placed on top. Then transfer the measurements to the plywood, and draw the line for the bottom of the frame, by connecting all the points with a flexible ruler or batten.

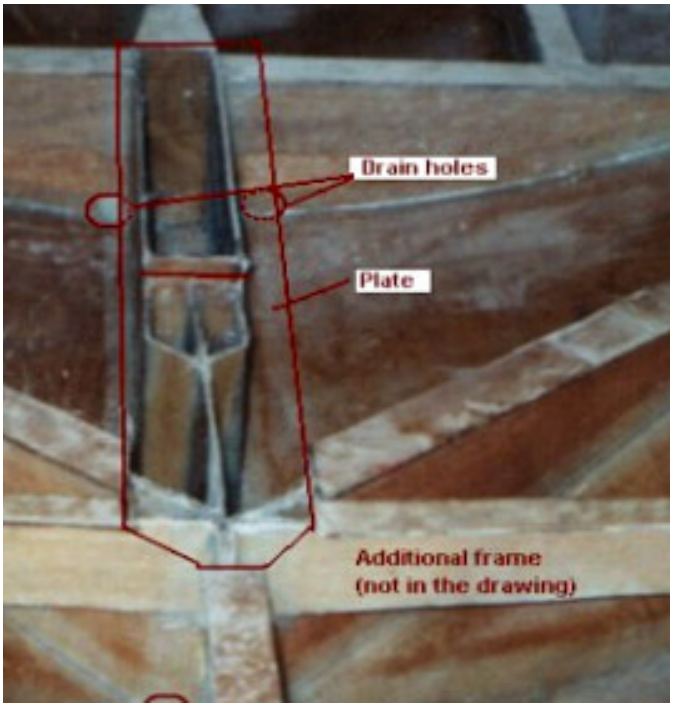


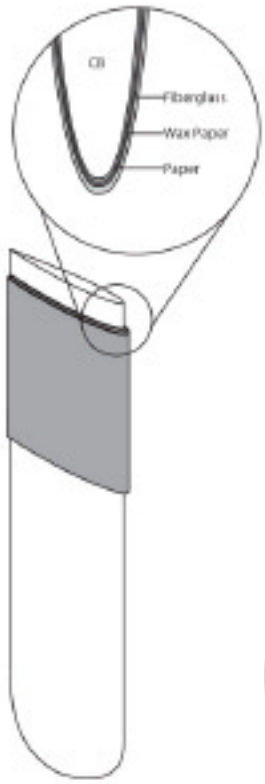

The frames are fiber-glassed on both sides, and are T-shape. A strip of plywood, one inch wide, is fiber-glassed on top of the frame, to allow the false floor to have enough surface to attach to the frames. It's easier if all the frames are fiber-glassed outside.
The stern frame should be doubled with two pieces of 4mm plywood. An additional block of hard-wood can be fiber-glassed on the inside to provide a place to attach the rudder hardware.

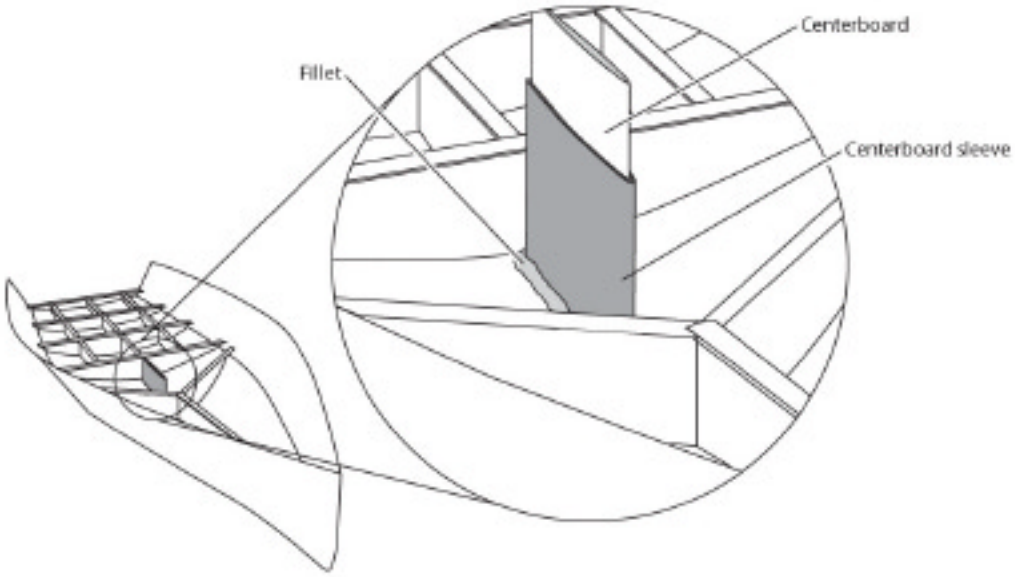


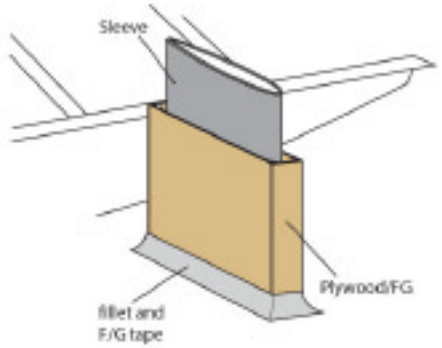



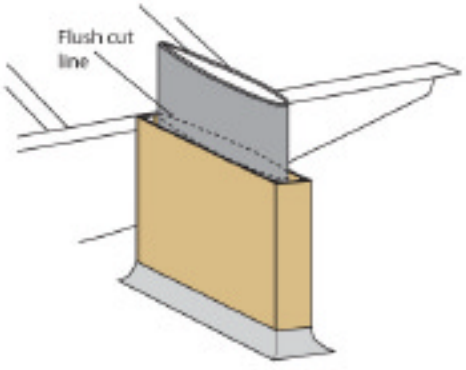
The picture below shows the area near the center board box.




Oil
Fiberglass
Wax Paper
Paper


Centerboard
Fillet
Centerboard sleeve


Sleeve
Plywood/FG
fillet and
F/G tape


Flush cut
line

**Pictures of the boat finished**