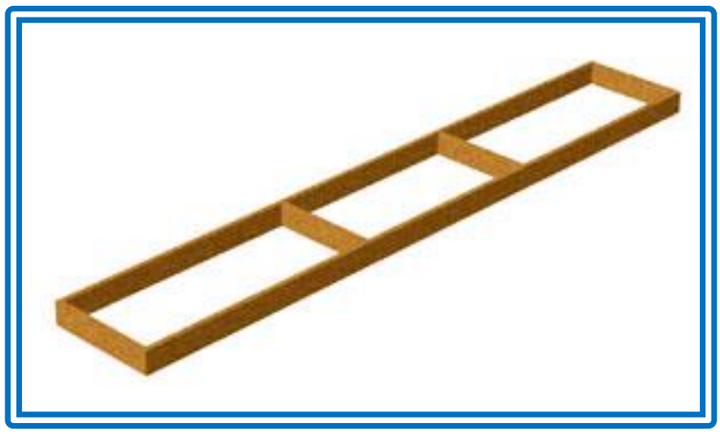
SELF ALIGNING JIG SYSTEM

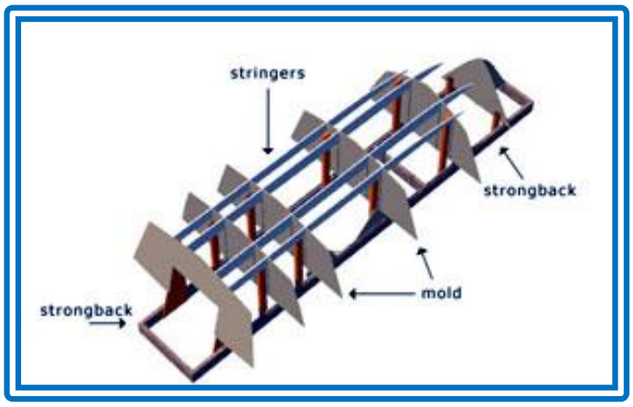
INTRODUCTION

Building a boat hull upside down on a jig is the traditional method described in all books about wooden boat building, in particular, Steward's "Boat Building Manual". Stitch and Glue or composite boats can also be built on a jig, but the requirements and setup method are different from wooden boat building and it is important to understand those differences before starting. In a wooden boat, the jig defines the shape of the boat: molds and their spacing must be exactly lofted and positioned very accurately. Also, the size of the planks or outside panels is never shown on the plans or calculated. In our method, it is the planking, the outside panels, that define the shape of the boat, not the molds or the jig. The jig is an accessory, not the main component. It exists only to facilitate the building. The molds and their spacing do not define the shape of the boat. All our boats can be built without a jig and that is the way most of our small boats are built. That simple method is sometimes called the Sharpie method. For larger boats, we use a jig because the handling of large and flimsy plywood panels would make the assembly difficult. In some cases, mostly for sailboats, we prefer a female jig: see pictures of our basket mold method at our web site. Some power boat builders use a variation of the basket mold, for example the Tolman Skiffs or in the boatbuilding industry, the flat panel method. We prefer a male jig for planing power boats. It is easier to produce a good hull with no rocker or hook on that type of jig. On a male jig, the builder will completely fiberglass the outside of the hull before working on the interior. The hull will be straight and stiff with strakes applied, before turning it over. To build a fast power boat without a jig or in a basket mold can result in a warped bottom that porpoises. To correct that bottom problem is very difficult and always requires the hull to be turned upside down. We prefer to start upside down, make certain that we have a perfect running bottom, and then finish the boat. The remarks above do not apply to displacement hulls like sailboats or trawler type boats. Back to our jig. Our jig does not need to be built as accurately as a wooden boat jig. Neither is it important for the jig to be perfectly level. Our frames and stringers are part of the jig and since they are assembled with notches, like a puzzle, it is impossible to go wrong. Misalignment mistakes will be corrected automatically. There is no need for centerline strings, plumb lines, or laser alignment holes.

Let's start with two strong longitudinal beams. We will call them **strongbacks**. They should be as long as the boat and of an appropriate size: 2x8's (50 x 200 mm) will always do the job. The distance between the strongbacks should be approximately equal to the beam at the chine, see the plans for details. The exact distance does not matter if the jig is square. Check that the strongbacks are level and secured in place. Scribe a line across the 2 beams close to one end and name it "*Origin*". You will measure mold locations from there. Install cross pieces at locations where they will not interfere with the molds. You should have something like the picture.



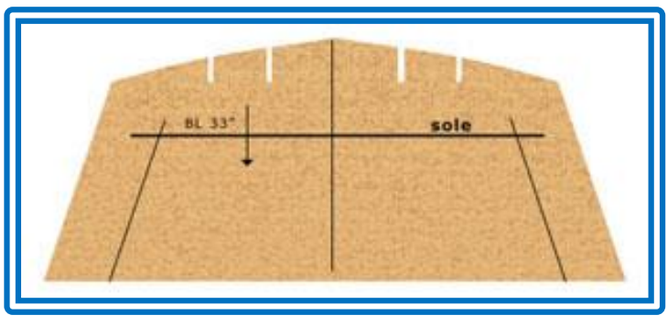
SELF ALIGNING JIG SYSTEM



In almost all our plans, we use the frames as molds. There is no reason to waste good plywood on throwaway molds. Let's use the frames, bulkheads and stringers in our mold. The same part can have different names at different stages of the building process, see the picture for an explanation of those terms: molds, frames and bulkheads refer to the same part in some cases. In our building method, we build the boat around the internal structure of stringers, bulkheads and frames. We use the bulkheads and frames as molds. Later, with their insides cut to size, they become a bulkhead if solid across, or a frame if only the perimeter is used.

First Mold:

Cut a first frame to the dimensions given on the plans, with the notches for the stringers but do not cut the inside. Mark important lines like floor level and the baseline if it is not outside of the limits of that first frame. More about that baseline later. If you don't know how to cut that first frame, see our tutorial about cutting one frame, it is easy.

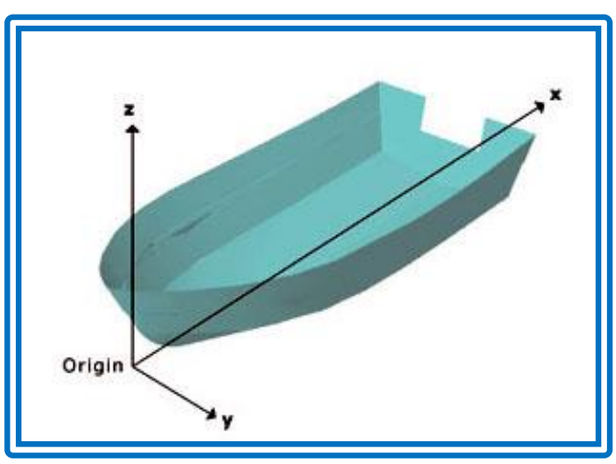


First Stringer:

Next, cut one stringer with the notches. See "Notches for Stringers and Frames". In many cases, our stringers are made of two layers of plywood epoxy glued together. The joints are staggered, see the plans. In some rare cases, the height of the two layers is different. They make a "step" that will conform to the shape of the hull. In most cases this is not needed. The stringer dimensions are on the plans. Cut the notches in that first stringer. Now, try to assemble the frame and the first stringer. Push the stringer in the notch of the frame. It should slide in easily, with approximately 1/8" (3 mm) play. On the plans, we give the exact dimensions of the notches and we account for the thickness of the saw blade to provide that 1/8" gap. If your assembly is too tight, enlarge the notches until there is a 1/8" (3 mm) total gap. We mean 1/8 total, 1/16 (1 mm+) each side, not more. The purpose of this test is to check assembly before cutting all the other notches. Disassemble the two parts.

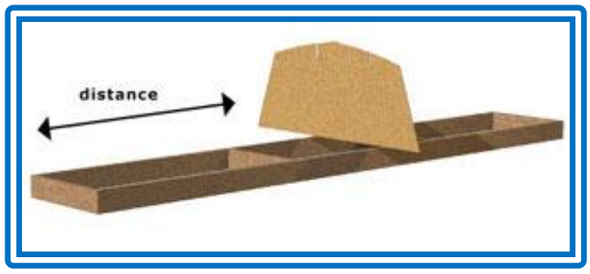
The Origin:

We measure everything, on the boat and on the plans, from a point named Origin. That point is always on the centerline of the boat. It is usually at the cutwater. The cutwater is where the bow intersects the waterline. In some rare cases, the origin is at upper tip of the bow or somewhere else: check your plans, we show it. We measure lengthwise along the X axis: that means the length of the boat is measured on the X axis. We measure the width (or breadths or beam) along the Y axis and the height of the boat or boat parts along the Z axis, up and down. Those heights are measured from a baseline and this implies that the Origin is on the baseline. In many cases, you can decide that the baseline will be at the level of the top of the strongbacks. It makes measuring easy but feel free to raise the imaginary baseline a few feet above the strongbacks. A higher baseline will allow you to climb under the hull during construction and is easier on your back: ergonomically recommended. In other words: in most cases, we show the baseline at the top of the strongbacks. But if you want the whole jig to be one foot higher, add one foot to each height dimension. Or subtract one foot or add two feet etc. That is called coordinates translation, big word but very easy to do.

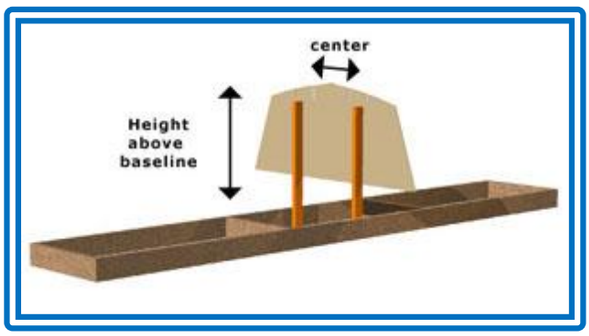


SELF ALIGNING JIG SYSTEM

Construction:



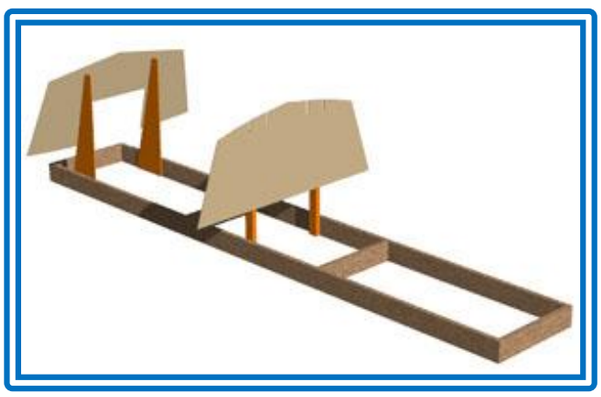
Take the first mold (frame) and install it on the jig in the correct location. Proceed one step at a time. First, locate the distance at which that mold is from the origin. Let's locate that first frame on our strong backs. We will position it longitudinally first, lengthwise, along the X axis. See your plans and decide where the origin will be on the strongbacks. You can use one end of the strongbacks or scribe a line a few inches away from one end. Now, look at the plans and see how far that mold is located from the origin lengthwise. Measure that distance on each of the strong backs and scribe a line. I hope that you saw on the plans that we measure from a specific mold face, forward or stern side. Align that face with the line, not the other one. Center the mold on the strongbacks. All that is needed to find the final position of that first mold is the height.



The height is the distance above the baseline. On some molds, you will be able to scribe the baseline on the plywood but very often it will be further below. No problem: we did scribe the deck level (or cockpit sole) and can measure from there. See the plans, that dimension is shown. You will probably need some "legs" to raise the mold high enough. Clamp a 2x4 (50 x 100 mm) on the strongback on the alignment mark. Mark the height to which you are going to refer on those 2x4's. For example, if you are going to align on the cockpit sole level marked on the mold, scribe that line on the 2x4. You know how high it is above the baseline from the plans.Now, take your mold and raise it on the upright 2x4's to the proper level, center it and clamp to the uprights. You can use temporary screws instead of clamps but clamps are much easier for later adjustments. The method we describe is easy to understand but to lift and position that mold is not very practical. A better method consists of fastening the uprights to the mold while it is still flat on the floor. You know the spacing of the strongbacks, better, if your mold rests on the strongbacks you have it automatically. Fasten the uprights parallel to each other. Height is not important as long as they don't stick out through the hull or below the floor: use common sense. Once fastened to the mold, measure the distance to the baseline on the upright, scribe it and set up that way.

To install the other molds and stringers, we recommend the following sequence: **One mold in the middle first, then transom, then stringers, then fit all other molds in between.** It is easier to keep the aft part of the bottom straight that way.

Transom installation:

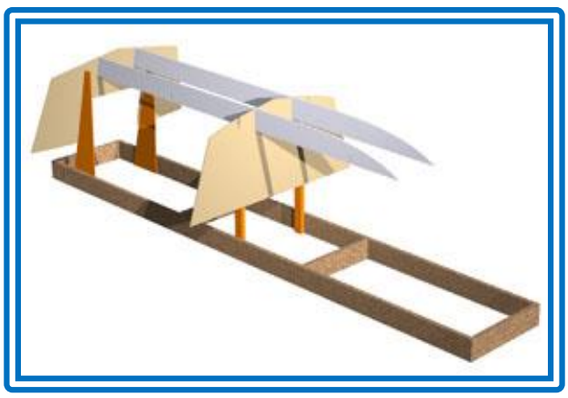


Before installation on the jig, we should frame the transom, cut the outboard well, and install the outboard clamping board if applicable. Build your transom as shown on the plans, flat on the floor. On the jig, the transom is installed at an angle. The plans show that angle and also show a triangular brace that automatically produces that angle. Cut the triangular brace and install it on the jig. The distance from the origin and the height are on the plans, same as for the molds.

SELF ALIGNING JIG SYSTEM

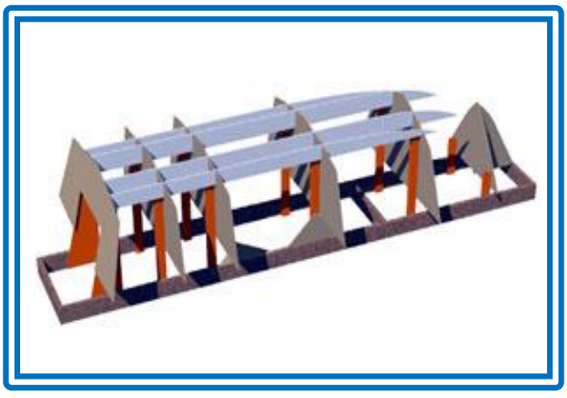
Stringers and Molds:

Next, we will install the stringers between the transom and the mold. With the stringers and molds locked together, the alignment is guaranteed:



Install inside stringers first. In some cases, the stringers fit in notches in the transom framing. If not use temporary cleats. Outside stringers are fitted next. Check diagonals as shown: the distances must be within 1/8" (3 mm).:

Add molds starting from the transom. They should fit in the stringer's notches. Some optional molds and bracing can be added at this time



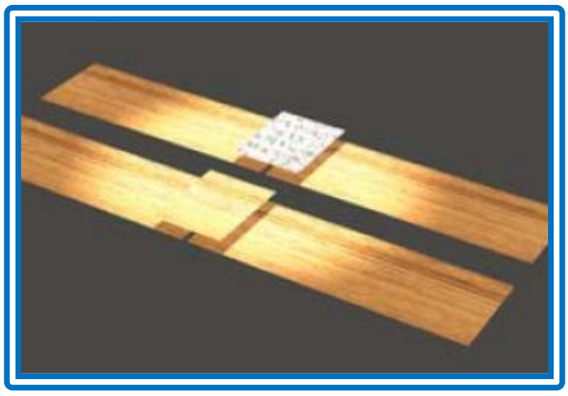
The bow mold is optional. The bow shape is created automatically by the planking, but a bow mold will help to bend and secure the panels. Braces are generally not required since all parts are locked in place, but they will not hurt: we show one vertical, one horizontal, use none or as many as you want.

Planking:

Before planking the hull, we must make certain that the planing area (bottom of the boat, rear part) will be straight, without hook or rocker. Since the stringers are straight aft of the middle of the boat, there should not be any problem. If the notches are loose, you may have to wedge the stringers at the proper level.

Planking is the easy part. The bottom panels are cut from the dimensions given on the plans, no lofting, no patterns required. Install on the jig, stitch loosely at the keel. Don't try to get the exact bow shape at this point.

SELF ALIGNING JIG SYSTEM



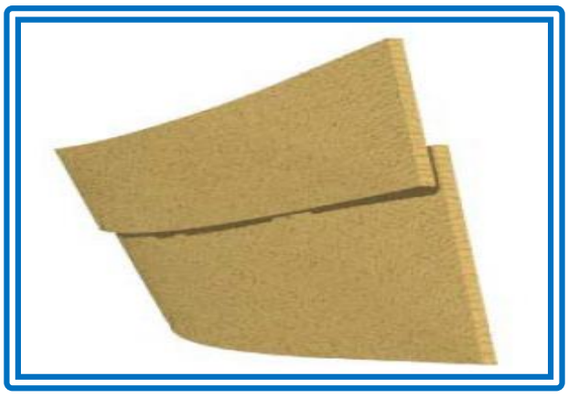
Once the jig is ready, cut the panels for the sides and bottom. The dimensions on our expanded panel drawings are very accurate so there is no need to use a safety margin. We suggest starting planking with the bottom panels. Cut the panels and use fiberglass splices to join the pieces of plywood. The plans or building notes specify the type of glass to use. The picture shows a butt block at the bottom and a fiberglass splice at the top. Note: No butt blocks needed if puzzle joints are used.

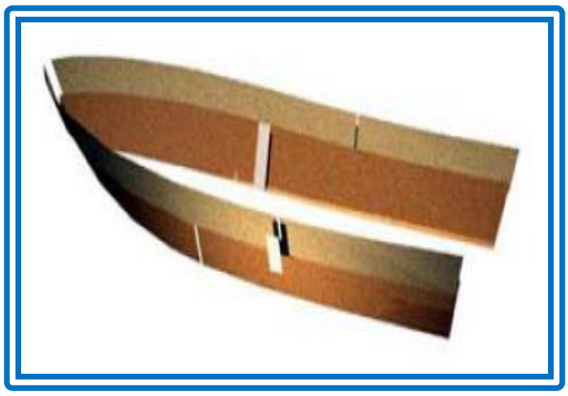
Install the bottom panels on the jig. Make sure to keep the stitches loose, you will tighten them later. The side panels are next. Proceed the same as the bottom panels: cut, splice, and install.

When installing the side panels, beware of longitudinal alignment. If the side panels seem not to fit, slide them back and forth. A small movement will bring everything into alignment. As is typical with our method, allow the panels to float, meaning that we try to attain fairness first. Use as little fasteners as possible and do not pull the panels against the frames unless absolutely necessary.

Overlapping Topsides:

Some of our boats have their topsides in one piece, others use two overlapping panels. This has several advantages: it creates an extra longitudinal stiffener, the smaller panels are easier to handle, and in some cases, it allows for a more economical nesting of the plywood. The small ridge between the panels, called a style line, visually breaks that large surface in two. It is not only more pleasant to the eye but hides small fairness problems. It also acts as a small spray rail.





To make long panels, splice the plywood parts together with one layer of the same biaxial fiberglass used for the hull on one face side only. On the lower panel, the splice is inside and on the upper panel the splice is outside. We must avoid the extra thickness where the panels overlap. A second layer will be applied to the other side of the splice after assembly. Without this precaution, the extra thickness of the fiberglass between panels would interfere. Large panels are delicate to handle when spliced with only one layer of tape. Some builders use a temporary butt block or add a layer on the other side except where the panels will join. To add the second side panel, adjust it dry first and mark the overlap area with a pencil. Remove the upper panel, generously coat the contact area with an epoxy slurry, and reassemble.