Building your first hull.

You've built your first model boat from a kit, and now you're ready to scratch-build a scale model. You may find what you need as a ready-made hull. Alternatively you may decide for reasons of cost or simply for the satisfaction of doing so, to make it yourself. Where to begin?

There are a number of ways you can construct a hull. The purpose of this article is to describe the 'rib and plank' method as it's one of the most common among modellers. What will be described is not the only method of building a hull. At the end we'll mention some other methods.

This article will describe how you go about building a hull that reproduces the shape and look of a full size vessel. The hull will be hollow so that it can contain the power and controls to make a sailing model. Building the hull will include fitting the deck, but not the superstructure.

Plans needed.

The first thing you need is a plan, and specifically a "Lines Plan". If you buy a copy of the shipbuilder's plans then you will probably get the lines plan as a separate drawing sheet. If you obtain a plan that has been prepared specially for making a model, the information you need will probably be a part of the whole plan.

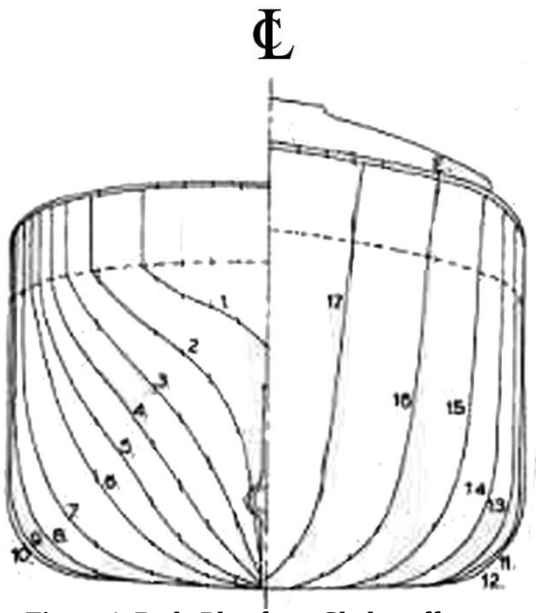

Figure 1. Body Plan for a Clyde puffer.

The first part you need is the Body Plan. To illustrate the method we're going to use the plans for a Clyde Puffer. This is a free modeller's plan available from www.freeshipplans.com. The method will be the same if you obtain copies of the original shipbuilder's plan for your vessel.

The body plan for the hull of the Clyde puffer is shown in Figure 1. On this one diagram is shown the complete shape of the hull. The vertical line down the middle represents the bow-to-stern centreline of the hull. The shape of the hull from midships to the bow is shown on the right side of this diagram, and the shape from midships to the stern is shown on the left side. (You can tell the left is the stern because it has a hole for the propeller shaft.) This is actually sufficient to make a complete hull.

To understand what the body plan shows, imagine you have the finished hull. Then at different locations along the length you slice it into sections. Figure 2 shows such a section for a ship's hull.

Now take the section of Figure 2 and cut it in half on the centreline, turn the open end towards you, and trace the outer edge of the face. You will get an outline as in Figure 3. This process is repeated for all the sections you cut; they are numbered from stern to bow and then all drawn onto one diagram with a common centreline, as shown in Figure 1.

So building your model reverses this process. You make ribs to the same shape as the numbered outlines and assemble them. Once that

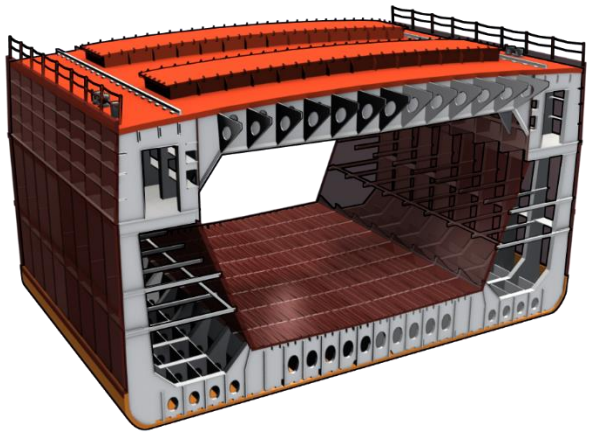

Figure 2. Section through a ship's hull.

Figure 4. The ribs assembled for Ernie's model *Egremont.*

is done you form a hull by glueing planks on the outside.

The second part of the Lines Plan you need is the "Sheer Plan". This is a side view of the hull and the important information for us on this plan is the location of each of the ribs we will make. If you are working from a modeller's plan, the Sheer Plan is probably incorporated into a profile view of the vessel. The profile view and Sheer Plan for the Clyde puffer is shown later in Figure 14.

There is a plethora of excellent information on the internet about how to plank a hull, where you can learn all about 'stealers' and 'spiling'. Almost all of it refers to old-time sailing ships, where all of the finished planking is visible. They provide a good introduction to the topic, but this article is about merchant ships which will have the planking covered in fibreglass and paint, and not be visible.

It is not necessary on such models to continue the planking right up to the bow or to the stern. It is easier to use either solid blocks or layers in these areas and shape them as necessary. The blocks can be any suitable material, such as wood, or pink or blue foam insulation.

When shaping these blocks we need an external template for the shape, instead of an internal template for a rib.

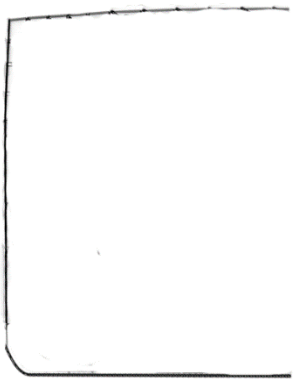

Figure 3. Half of a Body plan for a hull section.

Deciding how the deck will fit.

The third piece of plan information you need is the deck plan. For the Clyde puffer this is simply a drawing of the deck viewed from above. For a shipbuilder's plan you will get the same information from a General Arrangement drawing showing the deck.

Neither of these sources will tell you how the deck and the hull fit together. There are two choices: the deck fits on top of the hull planking, or it fits inside the hull planking. If you fit the deck inside the planking, the deck forms a guide between ribs that you trim the top plank to. It's the modeller's choice about which way to do it.

Your choice will be influenced by how you make the bulwarks, which is discussed later.

Stacking the ribs.

Figure 4 shows the ribs that Ernie assembled for his model of the ferry *Egremont.* This shows you how the assembled ribs will look. There are 4 things in particular to note from this picture.

1. The ribs are set on a plank or board. This is a vital piece for the hull building process, and needs to be strong and flat.
2. The ribs are arranged with the bottom of the hull at the top. (This is called "keel up" - the keel is a longitudinal structure running along the bottom of the hull on the centreline.) The advantage in building the hull upside down is that the whole of the hull (except the deck) can be built in this position.
3. Most of the ribs have holes in the middle. This provides a reasonably clear space to fit

the internal parts; the motors, radio, servos, etc.

4. Not all the ribs are the same height. This occurs near the bow and the stern where often the hull is not as deep.

Making the ribs and templates.

To make the ribs we first need to create templates of the right shape. This involves the following steps.

1. Because the ribs have to be the full width of the hull we need to make a full-width template, and then cut a rib out of wood to that shape.

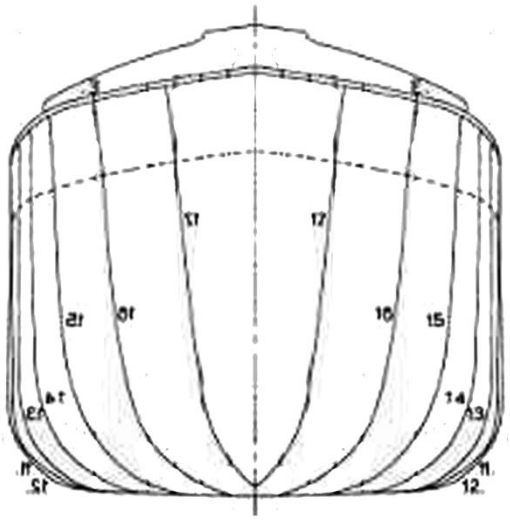

Figure 5. Full-width template of the bow portion.

2. One way to do this is to take a scan of the body plan, and digitally separate the bow and stern sides. Flip a copy of what's left so that you make a mirror image, which you combine with the original to make the full-width template, as shown in Figure 5 for the bow portion of the plan. Suitable software is Photoshop Elements, or OpenOffice Draw (which is free).
   For those without a computer, the alternative method is to print out a copy of the original body plan, fold it in half down the centreline, cut out the pattern of the template, and then unfold it.

3. All of the ribs will need to be positioned on the building board so that their hull shapes are at the correct height relative to one another. We make sure that this happens by drawing a horizontal baseline at a fixed distance from the hull bottom. See figure 6. This is where we will cut the edge of the template, where the rib will rest on the building board. There is no hard-and-fast rule about where to position this baseline, but 3 inches above the deck line is reasonable.

4. On figures 1 and 5, the position of the deck edge is shown by the dotted line that runs across from side to side. This shows where the deck meets the hull side at each rib.

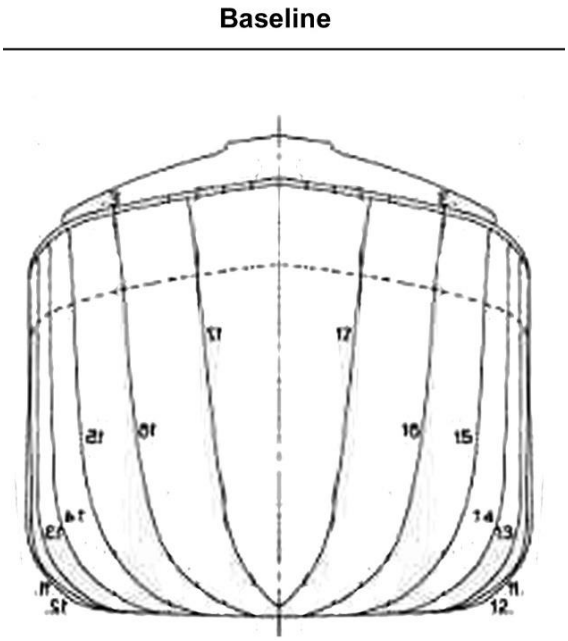

Figure 6. Bow templates with baseline.

5. At this point, let's focus our attention on just one rib, say number 16, by erasing all the rest. This is shown in Figure 7. The position of the deck is shown by the "Deck line", a horizontal line drawn through the intersection of rib 16 with the dotted deck-edge line.
   Ensure that you draw the hull centreline all the way to the baseline. You will use this to position the ribs so that they all line up correctly.
   The outline of the finished hull body at rib 16 is shown in green in Figure 7.

6. It is at this time that you need to know the materials you will use to make the deck and the hull sides. The outline of the rib shown in Figure 7 must be lowered at the deck line by the thickness of material to be used for the deck. The outline must be reduced on the rest of the

edges by the thickness of the planking. These new lines should be drawn inside the hull and deck lines, as shown by the red lines in Figure 8.

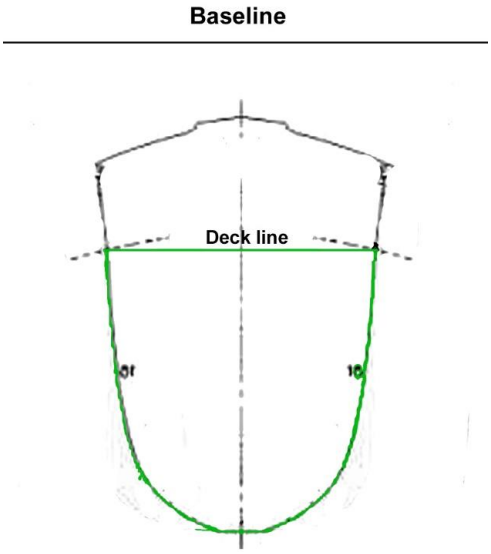

Figure 7. The basic outline of rib 16 from the Body Plan.

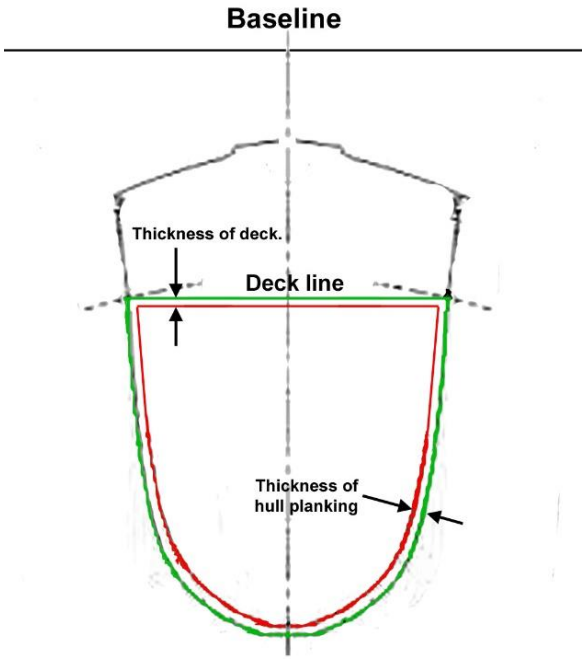

Figure 8. The rib outline modified for deck and planking thickness. The outer line is the original outline from the Body Plan; the inner line shows the shape required inside the hull.

7. The outline that we need to work with is thus shown in Figure 9.

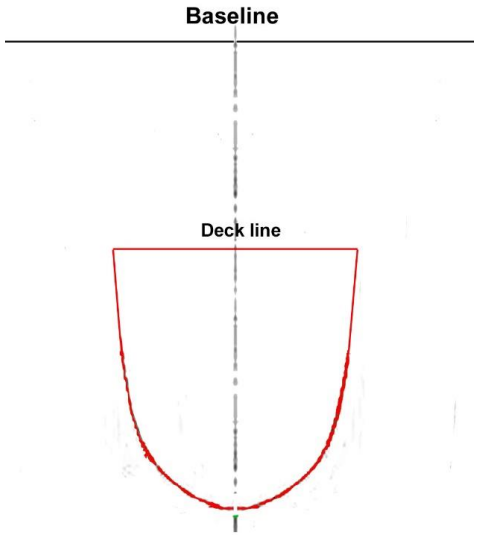

Figure 9. The internal outline of the hull at rib 16.

8. Rib 16 may be one of the ribs that should have a cutout in the middle. Some modellers like to have one or two ribs which do not have a cutout and, in effect, act as watertight bulkheads in case water gets into the hull. Let's assume that rib 16 is to have a cutout. There is no fixed rule about what size it should be, but ½" (15mm) is reasonable for the rib width which remains. At the same time a notch should be marked at the bottom for the keel.

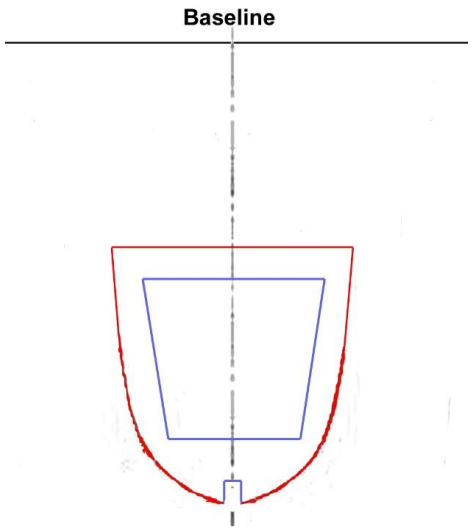

Figure 10. Rib 16 showing in blue the internal cutout and the notch for the keel.

9. If the rib is in a part of the hull where we want access to the internals, we will eventually need to remove the top piece. For example, if the rib is under the superstructure, or in way of a hatch, these areas can be used for internal access. In the Clyde puffer, rib 16 is not under the hatch or superstructure. (Another part of the plan - which is not shown here - indicates that the hatch opening extends only to rib 13.) For present purposes we will assume that we will want access at rib 16.

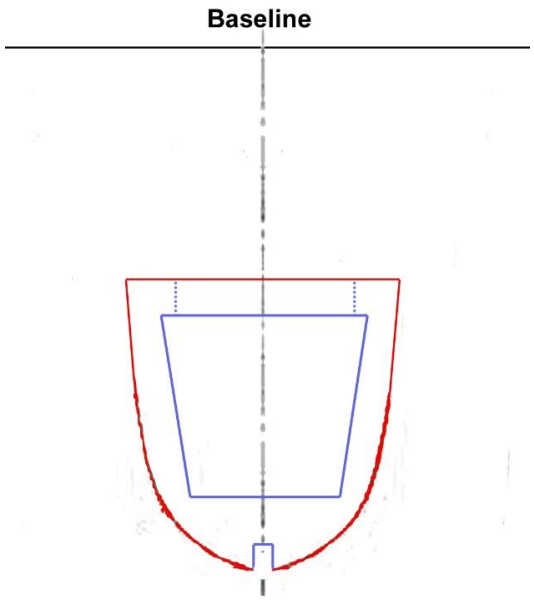

Figure 11. Cutting lines added to top part of rib.

Mark 2 lines (shown dotted in Figure 11) where the top part of the rib will be cut out. (If there was a hatch or superstructure at this rib we would want these dotted lines to line up with the edge.)

10. The last step in preparing this template for rib 16 is to extend the template to the baseline, so that we can position the rib at the correct height. The simplest way to do this is to extend the cutting lines we added in step 9. The final outline is shown in Figure 12, with the cutting outline shown in red.

After the hull has been planked, it can be turned right side up and a saw used to cut through the top cross-piece and so remove the extension that was necessary to position the rib on the building board.

To attach the rib to the building board you want to screw it down and have the screws accessible outside the edge of the hull. Glue wooden strips across the baseline edge of the rib as shown in Figures 19 – 21.

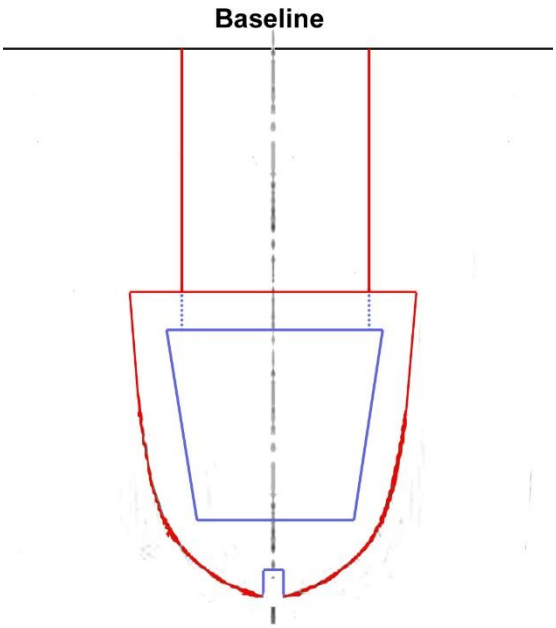

Figure 12. Finished outline of rib 16 template – as prepared for internal hull access - with vertical cuts to remove extension.

11. Let's go back to Step 9 and discuss how we should make the rib template when we don't want access to the internals at the position of

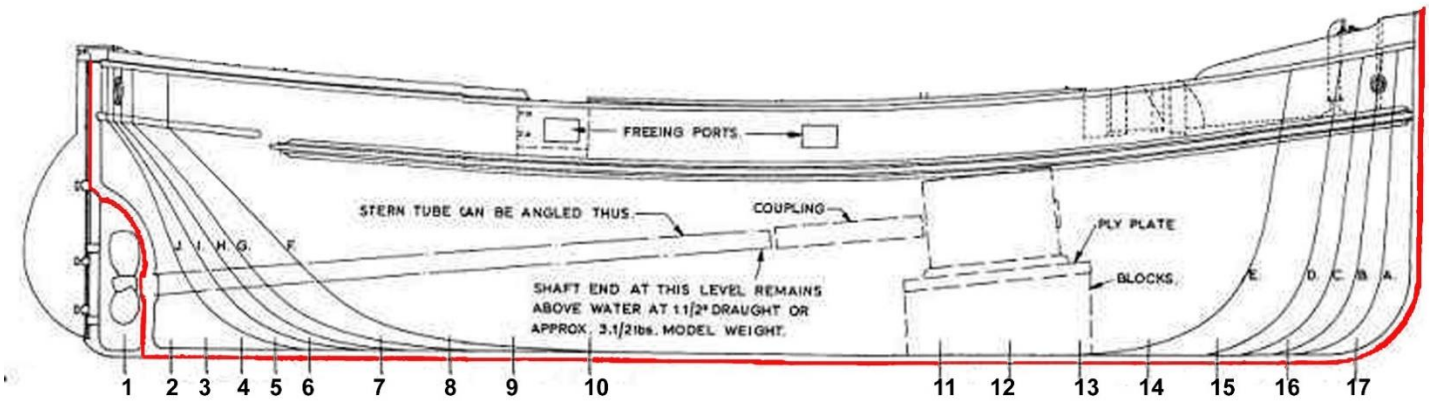

Figure 14. Side view of the Clyde puffer hull.

rib 16, or we don't want a cutout. We go back to the outline as we had it in Figure 10, and add the extension that we applied in Figure 12. We have to separate the extension with a horizontal cut.

A suggested way of doing this is to drill two holes a short way in, say ½", from the edge of the extension at deck level, and then make a cut between them, as shown in Figure 13. Ease of cutting off the extension is the reason for doing this. The cut between the holes can be done on a scroll saw, but the outside cuts must be done with a handsaw. Only two short cuts are needed to remove the extension.

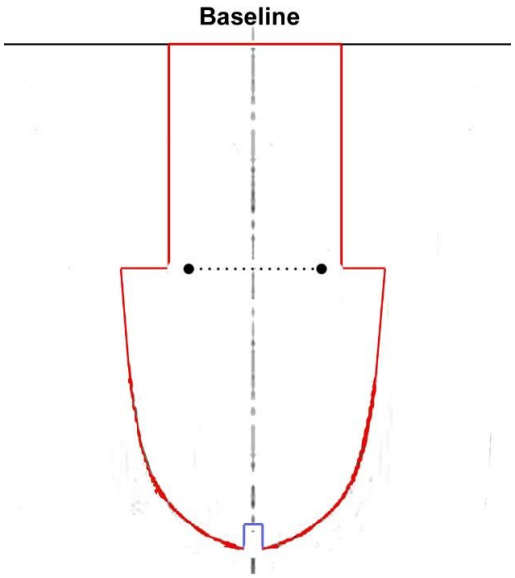

Figure 13. Making a horizontal cut to remove the extension.

This is also a way of removing the extension if you **do** make a cutout in the middle of the rib.

12. Steps 1 to 10 or 11 are repeated for the remaining ribs.

13. After the rib templates have been prepared they are transferred to the material that will be used for the ribs. The templates can be printed on paper which is then glued to the material, or the outlines can be transferred by some other means. The ribs are then cut to shape.

14. After the ribs are prepared they have to be mounted on a building board. The distance between each rib is found by referring to the side view on the lines plan or the profile. The side view of the Clyde puffer hull is shown in Figure 14. Along the bottom, this shows the location of each rib along the length of the hull. A line should be marked down the centre of the building board, and each rib centreline aligned with it. The ribs should be secured to the building board so that they do not move while the planks are glued.

15. If this is your first hull, it is probably a good idea to glue copies of the templates to cardboard (cereal boxes are good for this), cut them to shape, and then locate them on the building board. This will give you a clear idea of the shape and help you to decide where to end the planking near the ends and change to solid, shaped blocks.

16. The position and size of opening for the anchors should be considered when deciding where to use solid blocks at the bow. The hawse pipe (which the anchor chain runs through between deck and hull side) is near the bow. You can decide whether you want to have the pipe fully represented by a through hole, or just a recess at each end. Some vessels, especially tugs, have a recess that the anchor fits into when housed. This would have to be cut out and modelled after planking the hull.

17. Templates for checking the shape of the end blocks need to be external – you cut out the portion inside the line. If you took account of the planking thickness as described in Step 5, you can use the outline directly from the Body Plan. You can make a one-half external template and use it for both sides, as shown in Figure 15 for section 17.

18. The edges of the ribs near the bow and the stern should be sanded to an angle so that the planks contact the full width of the rib. This can be checked just by placing a plank in position across the ribs.

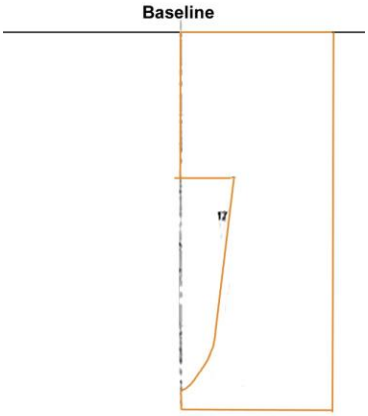

Figure 15. Outline of an external template.

19. The final step prior to planking is to fit the keel. The outer edge of the keel follows the outline of the hull shown in red in the side view of Figure 14. Its depth is a matter of personal choice, but obviously has to match the depth of the notch cut into the ribs. The keel can be made in one piece, or several pieces glued together. If made from several pieces the joints should have overlaps to give it strength.

Some variations.

I. If you are not concerned about building the model exactly to scale you can omit step 6. Doing so will make the hull a little deeper and wider than scale size. If your plan shows the outline for cutting the deck piece, you will have to make it wider to compensate for the width of the planking. The same applies for the external templates for bow and stern described in step 16. You need to add the thickness of the planking on the outside of the line, and then cut internally to this new line.

II. Instead of the vertical cuts illustrated in step 10 and Figure 12, you can make the cutout larger so that the cuts to remove the extension are horizontal, as shown in Figure 16. It's a matter of personal preference.

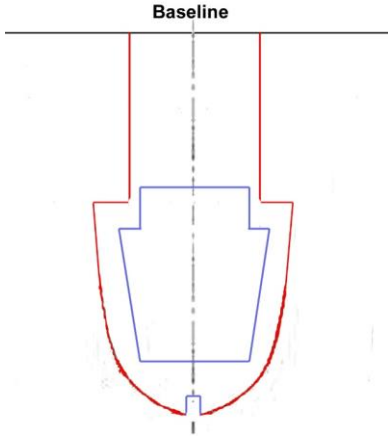

Figure 16. Alternative extension cutoff arrangement.

Hull types.

The information provided so far has illustrated a particular type of hull, the "round bilge hull". The bilge is the area where the side of the hull meets the bottom, and this location is 'radiused' or rounded. An alternative is what's known as a 'hard chine" hull, where there is a sharp corner between the side and the bottom.

Figure 17. A section through a hard chine hull.

Figure 18. Roy's *Wahine* hull during planking. On this hull, blue foam insulation was used along the top edge of the hull, and planking started from there.

Figure 17 shows a section through a shallow vee fast boat, which has a hard chine hull. The angle between the side and the bottom is the chine line. In some examples you may see the chine line referred to as a 'knuckle'.

Hull types do not always fall neatly into one of the two categories. Figure 19 shows the body plan for a cruiser which has a round bilge form on the forward part, and hard chine on the after part.

Planking the hull.

Before you begin planking, you must decide what material you are going to use. Balsa is light, easy to cut into strips, but not very strong. Plywood, basswood, cedar etc. are stronger, but not so easy to cut into strips. It's a good practice for all materials to be fibreglassed after planking for strength and water-tightness when the hull is complete, and even a balsa hull is quite strong when this is done.

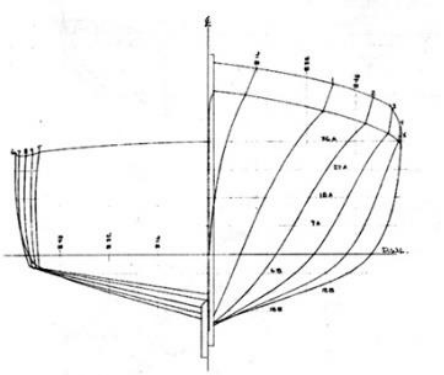

Figure 19. A section through a hull of mixed type.

Another decision is required on the width of planks to be used. Where the hull changes shape rapidly, narrow planks are better than wide ones. Planks do not have to be the same width all over the hull; the width can be varied to suit.

There is lots of information on the internet about planking, mostly directed to the construction of wooden warships. Two useful sites are: Knight Dreamers website and Ship Model Society of New Jersey website.

Some key points can be highlighted.

Calculate how many planks you will need by first measuring the length of the outside edge of the ribs – lay a piece of string on the rib and measure it. Repeat this action for each of the ribs. You will see that, at bow and stern, the rib length is shorter. This will give you an idea of how the planks must be trimmed to fit as you add each one. Decide how many planks you will fit. You will need 4 planks ¼" wide for each inch, etc. As you fit each plank, lay it on the ribs next to its predecessor, and hold it in place with pins or tape. Mark where it overlaps, and then trim the plank to fit.

If you are planking a hull that has a chine line, you probably want to lay the first planks along the chine line, one above the line and one below. From that line work up and down towards the deck and the keel. The next location to consider for planking is the topmost plank. Most ships and models have some sheer, which means that the deck rises up near the bow and the stern.

Figure 20. Garth's hull for the *Edwin M Cotter*. Planking started first at the deck but is now being done at the keel.

Figure 21. Radley's (Steve M's dad) trawler hull after shaping of the bow and stern, removal of some of the rib extensions, and with Bondo applied. Ready for painting.

The topmost plank needs to follow this line.

It is important to alternate between each side of the hull when attaching the planks. This helps to prevent twist or distortion.

Where there is a lot of twist or curvature in a plank it is a good idea to soften it before glueing. There are a number of ways of bending the planks to make them easier to fit. These include soaking the planks in Windex, or a similar cleaner containing ammonia, steaming, or using a plank bending tool.

If the planks to be used are not long enough to run from one end of the hull to the other, it will be necessary to butt two planks end-to-end to form one strip. It is recommended that you stagger these butt joints, otherwise the joint line will become a weakness in the hull. You may wish to make the ribs at this join from thicker material so that there is adequate surface for the two planks to adhere to. Or you can make two ribs of the same shape glued together.

Figures 19 and 20 show two hulls partway through planking. Figure 19 is planked with ¼" wide strips of 1/16" thick balsa attached with CA glue. Note that the two ribs either side of amidships are double thickness where the butt joints are placed. Figure 20 is planked with ¼" wide cedar strips ⅛" thick attached with Gorilla wood glue. Once the hull has been planked, the bow and stern can be shaped to match.

The external surface will be uneven in places and need smoothing and filling. Where small amounts of filler are needed, Bondo Glazing and Spot Putty works well, and there are also equivalents made by the model suppliers such as Tamiya. For larger amounts, either Bondo Autobody Filler or Minwax High Performance Wood Filler are good for the planked areas. Both of the latter are two-part pastes that require mixing. The wood filler is a little softer than the autobody filler. For the areas where the foam insulation is used, Polyfilla is good as it is softer again than the above-mentioned fillers. Most modellers apply fibreglass cloth on the inside and/or outside, and secure it with epoxy or polyester.

Sheets for flat areas.

As already mentioned, many model hulls have areas where a flat sheet can be used instead of planks. This occurs most often on a ship's bottom and sides in the midships area. If you look back at Figure 1 you will see that ribs 8, 9 and 10 merge together at the bottom and the side. This means that the hull is flat where the lines merge. A straight line forming a part of the outline of a rib means that the hull is flat in that area.

Also on Figure 1 you can see that a lot of the ribs in the forward part of the hull have straight portions, from rib 11 all the way to rib 17. On the after part of the hull there is not so much. From ribs 1 to 6 the only straight portions are above the deck edge line.

Because the sides of ribs 15, 16 and 17 are sloping, a flat sheet extending over these ribs will have a twist in it. A template must be

made to check the size of the sheet that will fit.

So if there is a large area of the hull that is flat, you can consider using flat sheets instead of planks. You will probably need to use planks near the bow and stern, and so you should consider thicker (or double) ribs where the planks butt up to the sheets.

Above the deck line.

Every commercial vessel will have either railings or bulwarks around the edge of the deck, so that passengers and crew don't fall over the edge. Railings always consist of horizontal bars supported by vertical bars called stanchions. Bulwarks are solid steel continuations of the hull above deck level. On some vessels they extend maybe to knee height, on others up to chest height. Your plan should indicate their height. The bulwarks always have supports welded to the deck, and these supports may be made from plate, angle iron or pipe, or a combination.

Figure 22. Bulwark supports on a real tug, made from pipe and plate.

If your model has bulwarks, and you also intend to include the bulwark supports on your model, then you need to plan how you will represent them. You have 2 main choices for bulwarks:

1. Use a wide plank for the topmost plank, so that it extends to the top of the bulwark.
2. Use another material, typically styrene, to make the bulwarks after the hull planking has been completed.

The final step in the hull planking process is to remove the extensions from most of the ribs. Two or three can be left in place to support the hull while it is filled, sanded and fibreglassed.

If you are fitting the deck as one piece, you have to remove the rib extensions to get the deck on. However, you will need some means of supporting the hull upside down so that you can paint it, after you've fitted the deck. A pair of T-shaped supports should be made and screwed to suitable ribs, after fitting the deck. If the ribs have a cutout, you should leave the horizontal strip in place until after painting so that you can attach these T supports.

The deck can be wood or styrene. If you are using styrene, it is recommended that you glue a sheet of plywood on top of the ribs, and then firmly glue the styrene to the plywood. Styrene expands more than wood, especially out in the sun on the pond, and if the styrene is not firmly glued down it is likely to buckle.

If you are using styrene for the bulwarks, it is best is to fasten the styrene deck very securely in place on the wood hull, and then start adding all the additional styrene parts you wish, on top of the deck. Wooden blocks can be taped to the deck to help support the bulwark as the glue is setting up. You can also use a bit of strip styrene glued to the side of the bulwark, flush with the bottom surface of the bulwark, to increase the gluing surface of the bulwark.

Providing for Anchors.

There are 3 ways that anchors are housed.

1. On the deck. A derrick is used to lift and lower the anchor. This method requires no more work on the hull.
2. Against the hull. This requires a hole be made in the side of the hull, and a tube (known as the hawse-pipe) run from it to the deck. When the anchor is hauled up, the anchor shank sits in the hawse-pipe, and the anchor flukes sit flat against the hull, but outside it.
3. In a recess. Similar to 2 above, but with a part of the hull wall sloped inwards so that the anchor, when housed, does not protrude. This is common in tugs, for example, which often contact the hull of other ships.

The location of the anchor is shown on a side view of the hull. Because of the shape of the hull near the bow, you cannot copy dimensions read from the plan directly onto the hull.

4. We'll describe the method for an anchor recess. A side view of the hull will show the recess as a kind of distorted rectangle. What we need to do is locate the four corners on the hull, and then draw straight lines between them. Ideally this can be done while the hull is still attached to the building board, but it's not necessary.
5. The hull should be upside down on a flat, level surface so that it's also level. Measure the height from the flat surface to the bottom of the hull, call this dimension 'H'. For example purposes, let's say it's 6 inches. From the side view plan, measure the distance from the bottom of the hull to one corner of the recess; call this dimension 'X'. Let's say it's 3.5 inches. Subtract X from H; in our example 2.5 inches. Mark a line on the hull at this distance up from the flat surface. Repeat this procedure for each corner of the recess.
6. Now stand the hull up on the floor (or a bench), so that it's vertical. (It's easier to do this if the hull is still mounted on the building board.) Measure the height from the bow to the floor (or bench). On the plan, measure the distance from the bow to one corner of the recess. Add these two dimensions together and mark a horizontal line on the hull at this distance from the floor. Draw the line where it intersects the line you marked when the hull was horizontal. The intersection of these two lines is one corner of the anchor recess. Repeat this for the remaining three corners. Draw the lines to connect the corners and then cut out the rectangle.
7. If there is no recess, you treat the centre of the hawse hole as if it were a single corner.
8.

Other methods of hull-building.

There are a few different ways of building a hull.

1. Horizontal "Bread and butter". This method involves cutting planks to the outline of the hull and then glueing them one on top of another, as you would build a sandwich. This requires a different plan, a "Half-breadth" plan which shows horizontal slices through the hull, called "waterlines". The planks can be hollowed out before or after glueing together. The outer surface has to be shaped and sanded to obtain the correct external shape.
2. Vertical "Bread and butter". This is a very similar method except that the planks are arranged vertically. This uses "buttock lines" to define the shape of the planks. Buttock lines are shown on the Sheer Plan. The lines marked A to J on Figure 14 are examples of buttock lines.
3. Plank base. Think of turning the building board into an integral part of the hull, slotting the top of it and fitting the ribs into the slots. This is the plank base method of construction.
4. Solid. This means starting from a block of wood the overall size of the hull, and then shaping it internally and externally to match the plan.
5. Foam core. These methods use building foam insulation, usually pink or blue in colour. Not while polystyrene foam.
   a. Rib and foam. This method uses insulation pieces between the ribs instead of planks. They are made oversize and then shaped to fit, using the ribs as guides to shaping the foam.
   b. Any of methods 1 to 3 above can be built using slabs of insulation instead of wood.

   After shaping, the hull is fibreglassed externally. After fibreglassing, the foam can be left in place or removed, by physically cutting it out or by dissolving it with acetone.

Supplementary information obtained from www.greatlakesgraphics.net , [www.cruisersforum.com.](http://www.cruisersforum.com)