

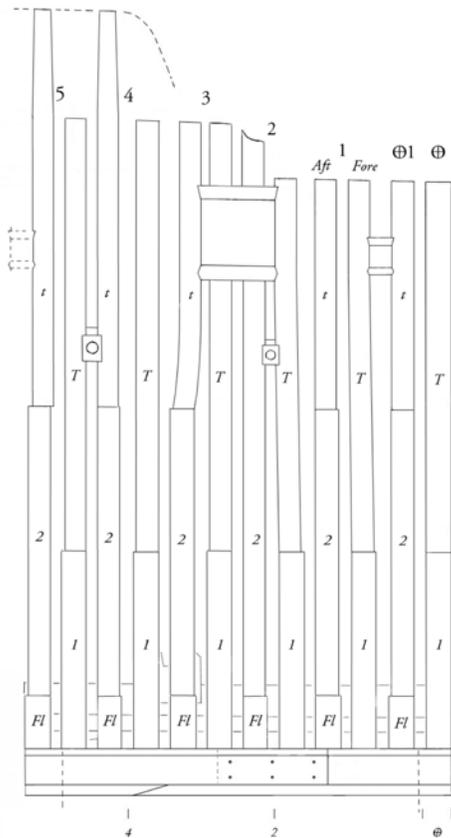
# H.M. Sloop *Echo* cross-section instruction manual – Part 1

## Introduction

Six ships of the *Echo* class were built at various private yards around the British coast for the Royal Navy. *Echo* of 1781 is an interesting subject for a number of reasons. One of these is evident in the cross-section that you will build. It has the typical mid-sectional shape of a French, not British, ship. The angular bilge and extreme tumblehome are characteristic of French design. French ships, although often not as well built or manned as British ships, were definitely speedier. The British capitalized on this fact by taking the lines off French captures and applying the hull forms to new ships themselves. This was the case with the *Echo* and other ships of her class.

## Getting started on the cross-section

You will have a wood selection from The HobbyMill as part of your workshop package in order to construct the backbone of your model. The first pieces to consider are the keel, false keel and rising wood. This section, from aft forward, begins at frame 5 aft and ends at the ‘dead flat’.



As you can see from the reduced illustration of the *disposition of frame*, there are some interesting features to your project. First of all, you will be constructing 'real' framing. In other words, each frame you make will be an exact model of the actual ship's frame, not a stylized version of this. While the gun and sweep ports are self-evident, the two circles with squares require explanation. These do not appear on the original draught, but are the reconstructed positions of the scuppers. The larger one of the two is the drain scupper for the chain pumps. Several of the toptimbers, marked 'T' and 't', are either *shifted* or *cast*. These terms will be clarified as we go along.

## The false keel

5" x 12" (the contract specifies 11½") in dimension, this is the lowest part of the keel. In the plan you will see an angle joint called a Harris cut joint. The sections are joined this way so that if the bottom of the ship snags the sea bed or rock, the false keel pieces can come away progressively without knocking off the piece aft of it. You may choose to omit this joint if you wish. Between the false keel and keel tarred flannel was laced as a seal. This may be indicated by thin black paper or colored glue, of you wish.

## The keel

This is 12" (contract 11½") wide by 14" high. There is a vertical scarph joint, 3' 4" long as shown on the plan, secured by six through bolts. The real joint was sloped, but you can use a square tongue for each half of the joint. The inside of the joint will, of course, be invisible. Paper or colored glue on the seen seams of the joint may be used. The bolts, 7/8" in diameter may be of blackened brass or copper, or of blackened wood. The parallel lines on the drawing show the extent of the rabbet for the bottom planking. The upper row of bolts must be drilled below this line!

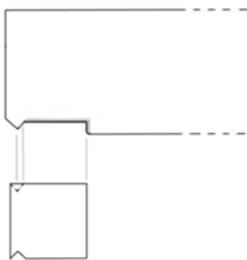
## The keel rabbet

There are two ways of cutting in the rabbet for the keel along the side at its upper edge. The first is with a well-sharpened and honed V-gouge. Don't make the mistake of using a miniature tool. It is, in fact, easier to use a larger tool for better control. If you want to see this technique demonstrated first, don't glue the rising wood to the keel before you come to the workshop.

Carefully mark out the lower edge of the rabbet (3" below the upper edges) on the sides of your keel. Make sure that your pencil lead is really sharp and that the line is as thin as you can make it. Here, as in other places, accuracy of mark-out really counts!

Make sure that the keel is firmly secured, either in the vise or clamped on the workbench. You need both hands free to control the gouge. Make a *very* light cut along the center of what will be the rabbet. Just score the wood; don't dig in! If the gouge 'wanders' a little, it is not a problem. Succeeding cuts will correct this. Place the tool at the beginning of the cut you have just made and make a slightly deeper cut. 'Lean' the tool slightly as you go, to correct any wandering from a straight line. It should take four or more passes to reach the depth and width of the rabbet.

The second method of cutting in the rabbet uses a specially formed scraping tool made from a scrap piece of hacksaw blade. Temper – that is, soften – the metal by heating it to a bright cherry-red and allowing it to air-cool. File off the teeth. This should be easy to do if you have tempered the piece properly. If the file skids on the metal, re-temper it. File the blade



to the shape shown here. Soften the edges of the contour tool where indicated by the gray shading. If you do not do this, you will score or nick the edges of your keel. Secure the keel in a vise or on the workbench. It is now easy to draw your scraper along the wood, gradually cutting in the rabbet to depth.

### The rising wood

This is 15" wide and varies in height along the ship. In the section you are building it is 7" high. (this description has been slightly simplified). It is centered over the keel. As this joint is on the inside of the ship, tarred flannel was not used here.

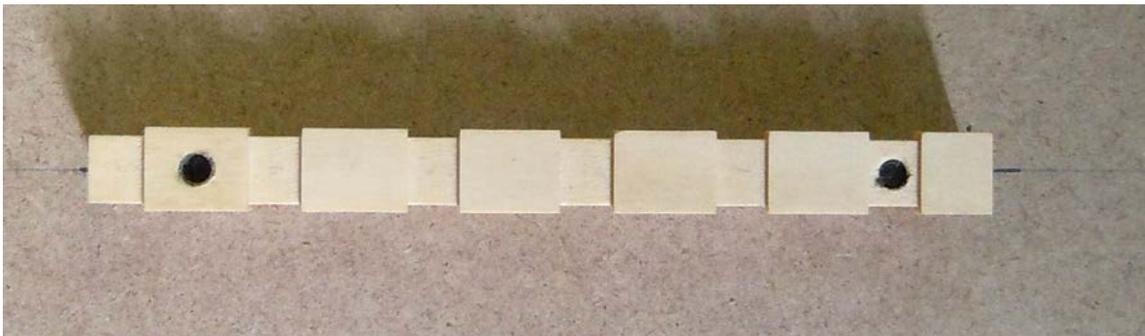
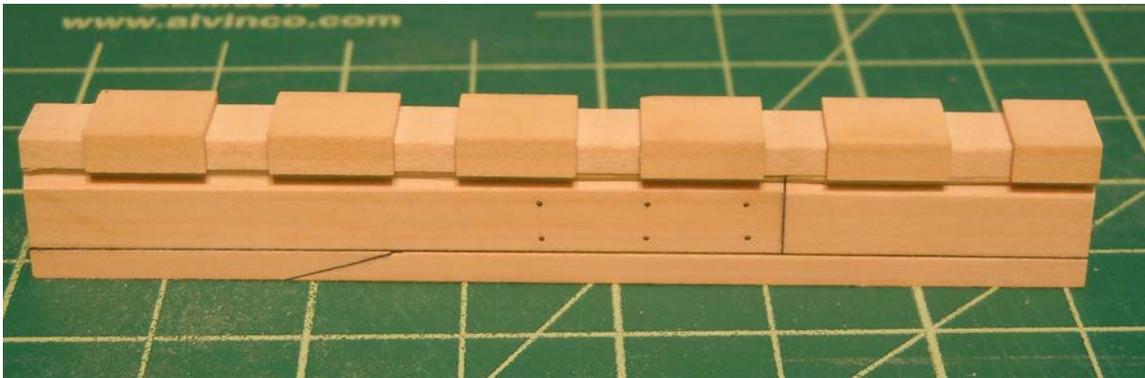
If you wish a *fully* authentic build; a number of *scores* (shallow grooves or rebates) will need to be cut into the rising wood. The pattern for these is available for download on our site [www.admiraltymodels.com](http://www.admiraltymodels.com) This detail is completely optional; it will be invisible when the framing has been completed.

## Preparing to bolt the model to the building board

Note the two vertical dashed lines on the plan through the backbone assembly, one near each end. These are the suggested positions for bolts. Carefully mark them on the centerline of the rising wood and center-punch these accurately. You will drill these holes at the workshop. This completes your homework before you come to your first session. *Further instructions will be provided at the workshop.*

**Please be sure to get your assembly completed to the point above before arriving.**

Our schedule during the workshop is tight and you will miss the benefit of attending if you are not up to speed upon arrival. If any of the above runs you into difficulty, e-mail us and we will do our best to get you back on track so that you are 'good to go' at the first session. We cannot be responsible for your progress otherwise. Thank you!



## H.M. Sloop *Echo* cross-section instruction manual – Part 2

### Introduction and Important Stuff

Now that you've completed the keel, false keel and rising wood assembly you are ready to begin the process of framing. Frames are built up of several components, namely *floors*, *futtocks* and *toptimbers*. In the real ship these were cut from *compass timber*: naturally curved wood. This is not practical for a scale model unless at a very large scale, so we will be cutting the various parts from straight-grained wood.

Note that the various component parts of the frame are of different thicknesses. Make sure you mark the thickness of each stock piece clearly and that you mark out the floor or futtock on the correct stock! I mark things out as scale inches (e.g. 9") rather than as a full-sized fraction (3/16"). It's much easier to think about dimensions on a model this way.

In general, as you move up the side of the ship, the *moulded thickness* of each part becomes less, as well as tapering upward – the *sided dimension*. (Think of the moulding way as the piece viewed from its curved face and the siding way as the thickness of the piece.)

### Marking out

There are several ways to mark out the component pieces of a frame. One way is to make a number of printed copies of the frame pattern, cut them out and glue the pieces to your stock. Rubber cement works well for this method. The only thing to check is that the printout is to the correct size. Measure the x and y scales provided on the print out to ensure that it is the right size!

Another method is to use graphite paper. Here, you only need one copy of the frame pattern. Graphite paper is a sophisticated form of carbon transfer paper, but without the mess or wax. Place the graphite paper, darker side down, on the stock and tape the pattern in position over it. Trace the shape down using a sharp hard pencil point. This brings me to my next point:

## Marking, a digression

The point you use to mark miniature pieces out accurately is critical. A regular pencil is useless, as the line it makes is far too wide, introducing considerable error before you even begin cutting. Particularly for a framed model, accuracy is essential. I recommend a clutch pencil, otherwise called a mechanical lead-holder. This takes leads that are 2mm in diameter. Various grades of lead are available. I find the 4H grade a suitable hardness of our purposes. You will need a mechanical lead sharpener as well. This will give you a really sharp point to the lead. Sharpen frequently! Lead holders and sharpeners are found in art supply stores such as Michael's. 4H leads are harder to source nowadays but may be sourced from eBay.

As a test, I took a regular HB wooden pencil and a 4H mechanical one and drew a few lines. I then measured their thickness. The HB averaged out at a scale 1" and the 4H at 1/4" thick. Had you used an HB pencil, the cumulative error across a single futtock piece could be as much as  $\pm 2$ "! At the sheer line this could make a 5" moulded thickness anywhere between 3" and 7". Obviously, then, this is not a trivial issue. So, keep that 4H point sharp.

## Marking out, continued

You can either mark out a number of pieces for several frames before cutting them out or just one at a time. I prefer to mark all the pieces for one frame at a time, then cut them out. Make sure that you identify each piece to prevent any confusion. Many pieces look almost identical, but they are not! Some modelmakers like to sandwich two layers of stock together to cut left and right side pieces at the same time. While this may be economical of time, if one makes a cutting error, twice as much wood is scrap. However, this is up to you. If cutting two pieces at once, rubber cement is my preferred adhesive for this purpose.

## Cutting tips and hints

Using a scroll-saw takes a little practice, but once you are comfortable with the machine you should be able to cut along a line with confidence. There are several set-up points to consider if you've not used a scroll-saw before.

First, consider the blade. It is a mistake to use too fine a blade for cutting out frame components. A narrow blade can wander off the line more easily and, if you are less than careful, may snap. Use a blade that is of a size where at least two to three teeth are in the thickness of the stock at any moment. Make sure that the blade is properly tensioned. A fairly high-pitched 'ping' should sound if you gently pluck the blade. (Touch the edge without teeth!) Too low a tension, and the blade will wander off the cutting line.

Next, light. Make sure that you have good illumination on the cutting line and blade. It is important to see which side of the line the blade is cutting. Hopefully the saw is fitted with a small blower to clear sawdust away from the line of cut. Adjust the nozzle to do this. If the saw has no blower, then you will need to supply the air current yourself by blowing gently. Do not hyperventilate!



Lastly, your viewpoint is important. I find it much easier to see the cut and its progress by using a low viewpoint in line with the blade, rather than by looking down on the saw table.

Now, a few words about cutting technique. Do not start the machine with the blade in the wood. Make sure that it is running smoothly before presenting the stock to the blade. Feed the stock slowly and do not force the cut. The blade will break! Take it easy. Keep your left hand (assuming that you are right-handed) on the stock near the blade and control the cut by feeding and turning the piece with your right hand. If you haven't used a scroll-saw before, make some practice cuts on scrap before attempting to shape actual pieces.

There is a fine line – word-play unintended! – between cutting too far from the line and too close to it. By cutting out with too much extra material on the pieces you will lose some accuracy of construction and have a lot of work fairing up. By cutting exactly to the line, any slight inaccuracy in assembly will result in spots that will not fair out smoothly. So the question is, what is a happy medium? My own preference is to cut about a saw blade's thickness outside the line. This is about 1/64" in full size terms. However, you may wish to leave a slightly greater margin of safety.

## Assembling your first frame, the dead flat

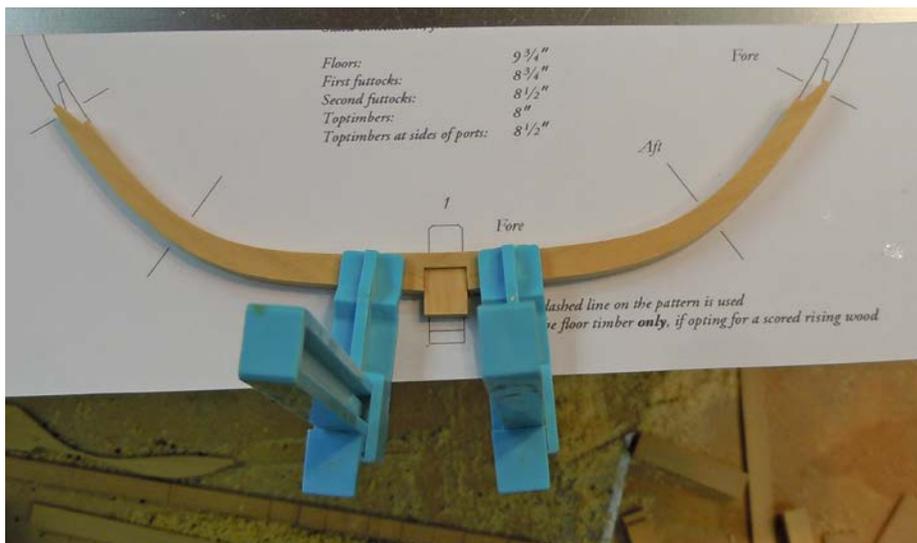
Let us assume that you have cut out two first futtock pieces and two long toptimbers as shown on the dead flat frame pattern. These are joined across the rising wood by a *cross-chock* of the same thickness as the first futtocks. The first task is to refine the joint surfaces of the first futtocks next to the cross-chock. This is easiest to accomplish using a sharp chisel. Make sure that you use a hard cutting surface on which to place the futtock and that your chisel is well-honed and held vertically. Cut exactly to the mark-out lines.

The cross-chock may now be marked and cut from a piece of scrap stock of the same thickness as the futtocks. Carefully trim and fit the first side of the joint to the first futtock. Glue up the pieces on a flat surface. Place this subassembly in position over a copy of the framing pattern. Now fit the other first futtock to the cross-chock. The chances are that the futtock will angle in or out from its position on the pattern. If the upper end angles out, you will need to shave the surface of the scarph nearest its shoulder to bring it in. Conversely, if the futtock leans inward, the corrective cut to make is to shave the end nearer the lip. Once

you are happy with the relative positions of the pieces, trim the lip until the joint is tight. Glue up over the pattern on your flat surface. Be aware that any deviation from the pattern will be magnified the further up the frame you go. Accuracy here is your insurance!

Follow the same procedure to fit the chocks between first futtocks and toptimbers. As the toptimber's sided dimension is narrower than the futtock, use scrap the thickness of the first futtock (8<sup>3</sup>/<sub>4</sub>"") to make the chocks. Again, adjust the scarp surfaces of the toptimbers until they cover the pattern below exactly. Glue the remaining elements of your first frame together. There should be a small step in thickness on the upper side of the frame.

If you wish, you can drill treenail joints the for



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additional security. The treenails, ideally 19 thousandths of an inch in diameter, are placed in a

diagonal pattern, two on each side of the joint line. At the junction of the first futtocks and toptimbers, there is a  $\frac{3}{4}$ " change in thickness. Pare down the chock from the joint line to match this step. You are now ready to raise the frame on the keel assembly.



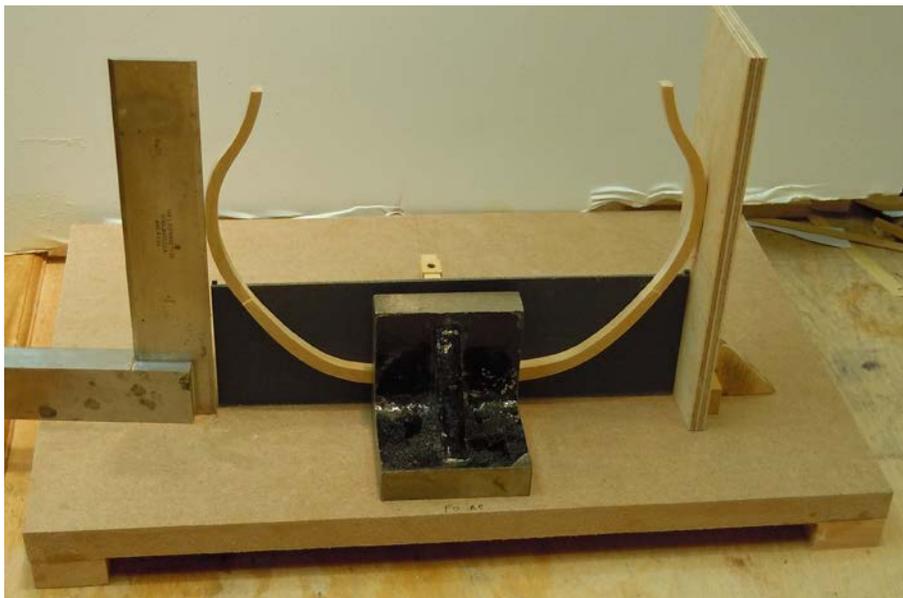
## Raising a frame

To do this successfully, there are several conditions to be met. First, the frame must be in the correct position on the keel and rising wood assembly. This means that the slot or score for the frame must be deep enough for the edge of the frame to coincide with the upper edge of the rabbet. (Allow for the fullness you left in cutting the frame.) The cutting mark still left on the futtock or floor is your guide here. If the frame sits too deep, a shim of paper or card should be used to correct this defect. If too high, gently deepen the score in the frame. A second method is to mark the height of breadth on the frame and see if it matches the measurement from the base of the false keel to this line on your sheer draught.

The second condition is that the frame be at right angles to the keel, unless it is a cant frame. The third is that the frame be vertical. The fourth is that the frame sits centrally; in other words, does not lean to port or starboard. This is where your framing square, made from the pattern supplied, will assist. Provided that the square sits on the keel/rising wood without play, the frame will be at right angles and vertical when placed against it.

In order to meet the last condition, this can be achieved in several ways. The first thing is to provide a strip of card or wood, and glue it across the frame near its top on the stepped side. Mark the centerline on this cross-spall or brace. Now mark the width of the rising wood off on either side of the centerline. You can use a set-square placed against the side of the rising wood to adjust the frame until vertical as seen from fore or aft. In the shipyard this process was called *horning in*.

Before you glue the frame in permanently, make sure that the correct side of the frame is facing forward! Many frames are not identical on both faces. Check the disposition of frame drawing. For the dead flat, the *aft* face is the plane (flat) one. If you put a frame in the wrong way around, it will throw all your subsequent work on ports and sweep ports off. When you are certain that you have it correctly oriented, glue and peg the frame in position. Congratulations: you have now raised your first frame!



## Frame dead flat 1

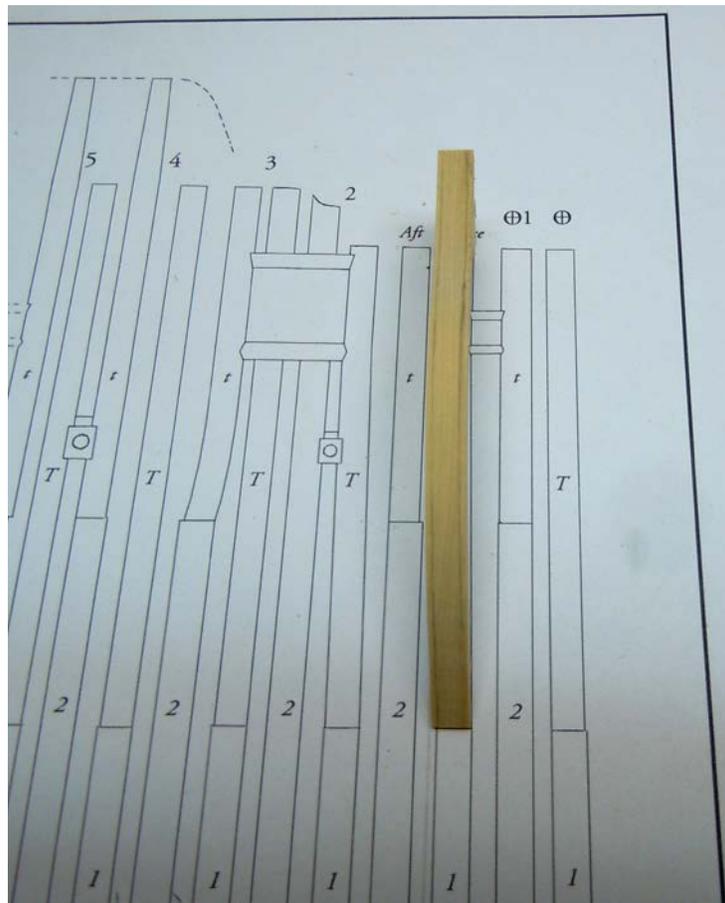
This frame consists of a floor, two second futtocks and two short toptimbers. You will deal with this frame in the same way as before, noting the sided thickness of the various components. One important difference is whether you are working with a scored rising wood or not. Those of you with a plain rising wood will cut the score in the floor to the *solid* line, those with a scored rising wood will use the *dashed* line to cut to. This applies to all the frames.

When raising this frame, note that the flat side of the frame faces *forward*.

## Special case toptimbers

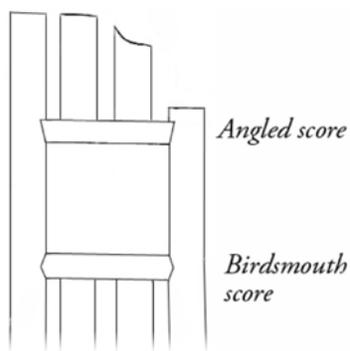
These are 1 fore, 2 fore, 3 aft and 5 aft. If you study the framing plan, you will see that these are not simple vertical continuations of the frame as seen from the side. The first three have bends in them (*cast*), and 5 aft is displaced forward by 1½" (*shifted*). Take 5 aft first. After gluing the floor and second futtocks together, you will need to shim them up by 1½" on the pattern before attaching the toptimbers. Note that the chock for the second futtock/toptimber joint will need to be 9½" thick (8" + 1½").

The three cast toptimbers are more interesting. 1 fore can simply be angled slightly while assembling so that aft upper end is 1½" aft of the first futtocks. Use shims while doing this assembly. 3 aft is quite curved, while 2 fore is more subtle in shape. Cut these toptimber pieces from stock 12" thick. They can then be shaped as shown. Don't forget that you need left and right hand pairs of each – don't make two toptimbers identical! Shim them up as appropriate when assembling.



## Cutting scores for port and sweep port sills

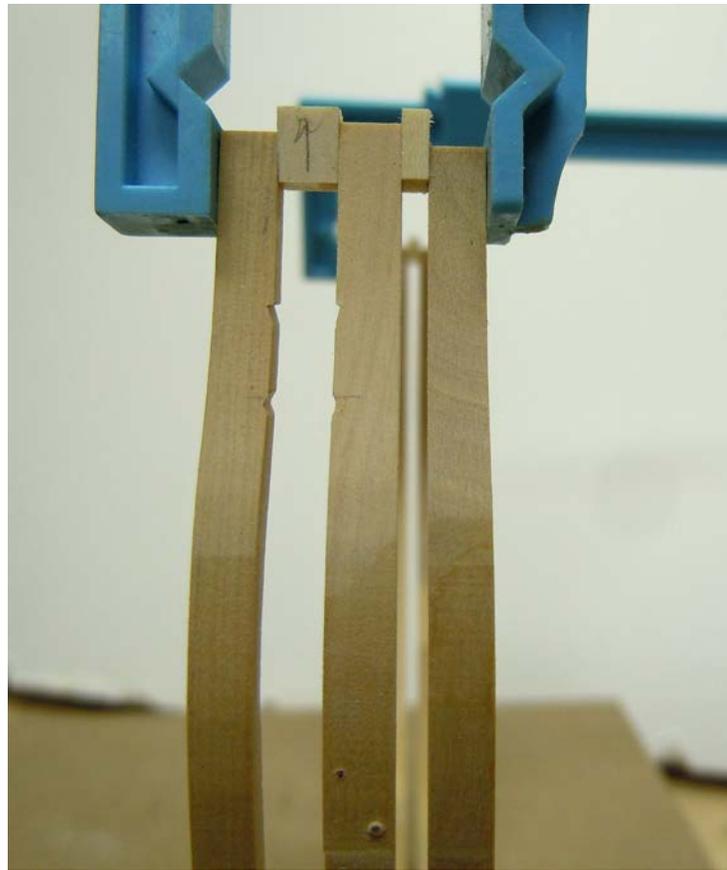
There are also two scores to be cut for the sweep port on the *aft* side (see the disposition of frame drawing). It is important that the scores are at the correct height and truly horizontal. Note that there are two different kinds of scores; the angled score used for upper sills and the birdsmouth score for the lower ones. There are two methods for doing this. The first method is to cut in the scores *before* you raise the frame. This is the method I use, but you need to be extremely accurate at all stages for this to work! Here is how I do it:



Using a tick strip, measure the height of the sills from the disposition of frame. Take as a base line the top of the rising wood, noting whether or not it is the scored level or not. Transfer these measurements to the frame pattern and draw horizontal lines across the drawing. Noting which side of the frame the scores are cut into (this is important!), lay the frame over the pattern and transfer the marks to the

side of the frame. You can now cut the scores in with a sharp chisel. Raise the frame as previously described, being particularly fussy about the first condition. Read the first paragraph of the previous section again.

The second method involves cutting the scores *after* the frames are raised and stabilized – see the next section. The heights of the scores are measured up from the building board and marked on the outer faces of the frames. Because of the tumblehome of the sides, you will need to slip the marking out strip between the frames to do this. Once marked out, the scores are cut using Swiss files. The advantage of this method is that it eliminates the need for extreme accuracy in raising the frames. However, the disadvantages are the limited space in which to use the file and the difficulty of keeping the score absolutely horizontal.



You will need to cut down the toptimbers 2 aft and 3 fore for the gun port (*see illustration on previous page*). Make your cut a little high so that you can file or sand the upper surfaces flat

with the sill. Keep the offcut pieces (identify which is which!) to add back above the upper sill later on.

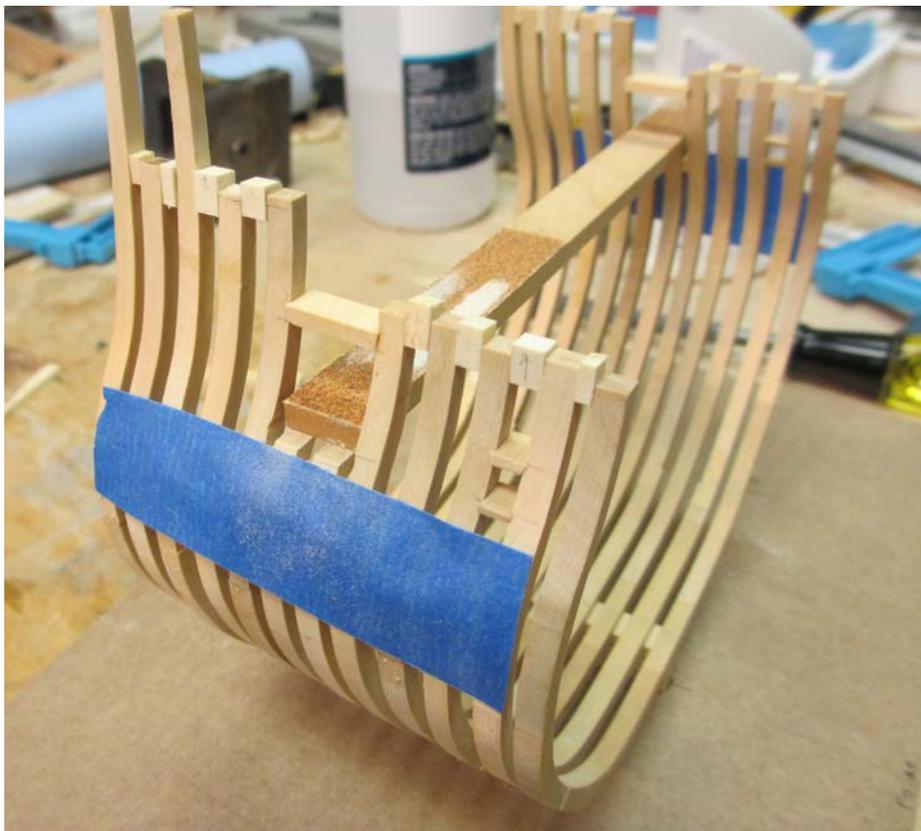
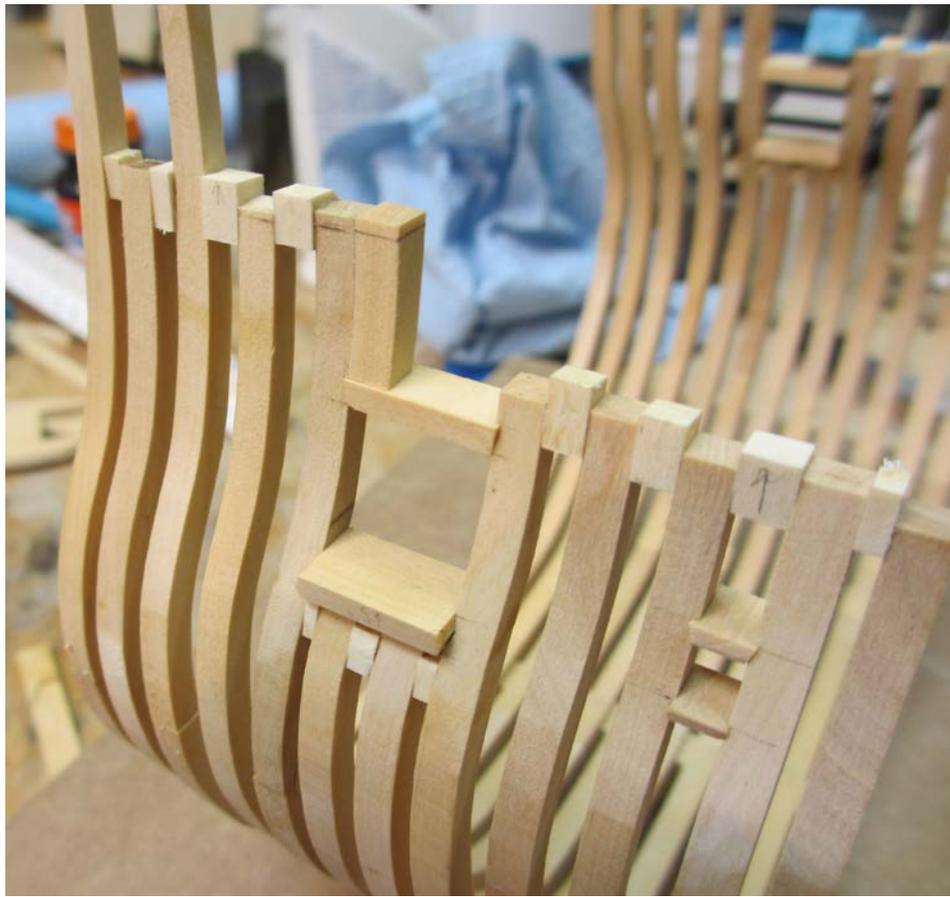
## Finishing the framing

Once you have worked through building and raising all the frames on your model, they need to be stabilized in order to fair them to a smooth finish and to add the port sills. The lower parts of the frames are solidly fixed to the keel, but the upper ends are unstable. You will need to cut and glue temporary spacers between upper ends of the toptimbers to firm things up. Make sure you don't push the frames out of line by forcing a spacer that is too wide between the toptimbers!

There are two scupper support pieces to be cut and inserted into the framing (see the disposition of frame.) As the scupper itself is made of soft lead pipe, these pieces are necessary. The regular scupper is located between frames 2 fore and 2 aft. The pumpdale scupper sits between 4 aft and 5 fore. Note that the pieces, which are square in section and bored through, are angled out and down through the framing to provide good drainage. To mark out and cut in these blocks, use the same technique as for the port sills.

There is one more task to do before fairing up. This is to make and fit the port and sweep port sills. Use stock that is the correct thickness for each, but much wider than the finished sill. It is exacting work to cut the ends to both exactly match the scores in the frames and the correct length, so that the frames are not pushed out of line. Add and stabilize the pieces of toptimber above the port.

You are now finally ready to fair up. Use sanding sticks for the job. I attach sandpaper to wood blocks using rubber cement. For the inside surfaces, use convex shaped sanding blocks. Start with 80- or 100-grit paper and work down to 320-grit. As the cross-section is close to the dead flat, it should not be much work to achieve a clean, smooth finish to your framing if you have been particular in raising your frames.





Rev. 27.6.12