SECTION 1– INTRODUCTION

1.1 Terminology

1.1.1 We shall use boatbuilding terminology throughout as the words usually have precise meanings.

1.1.2 Most of the names of the structural items are fairly clear from the drawings themselves. Rather than give a long list of terms, the names of the various structural elements will be introduced as they occur naturally during the build of the boat.

1.1.3 One name that often causes confusion however is “floor”. In boatbuilding terms a floor is a transverse structural member that lays across the centreline structure and helps to link the centreline structure to the hull skin and other parts of the transverse structures. The “floor” that you walk on in a boat is known as the “sole”.

1.2 Principals of structure

1.2.1 The hull, deck and superstructure skins are supported by a sub-structure consisting of longitudinal and transverse elements. In this way individual panel areas of skin are kept reasonably small and regularly supported.

1.2.2 The transverse structures are the frames, floors and bulkheads (and the transom - which is both a transverse and part of the hull skin).

1.2.3 The major longitudinal structures in the hull consist of the backbone, shelf chine pieces and stringers. Furniture elements, centrecase structure etc. also provide longitudinal structure

1.2.4 The deck and superstructure longitudinals are the carlings, king plank, mast runner together with the hatch and coachroof runners. The pattern of longitudinals and transverses is not quite so regular in the deck and superstructure as it is in the hull, because it is more dependent on the internal layout of the boat.

1.3 The Drawings

1.3.1 The drawings and information to build the boat are divided into groups as follows:

001 Proposal drawings
002 Build instructions & specification
003 Longitudinal structures
004 Transverse structures
005 Keel, centrecase & ballast
006 Engine installation
007 Tanks
008 Steering
009 Sundry structures
010 Interior furniture
011 Spars & rig
012 Deck gear and equipment

1.3.2 All dimensions on the drawings, specifications and instructions will be millimetres unless otherwise noted.

1.3.3 The plans are almost always drawn to scale and the scales used are noted on them. However, paper is notorious for stretching, shrinking and generally going out of shape; also printers do not necessarily print entirely true to size. By all means scale off the drawings to get a general idea of size, to check on something that seems to be wrong etc. But all the dimensions that you require to build the boat

should be written on the drawings. If a measurement seems to be missing please let us know and we will supply it.

SECTION 2 – THE "LINES"

2.1 What are they?

2.1.1 The boat is designed on a computer and resides in the computer as a set of data representing 3-dimensional surfaces. However, to build the boat, we have to start with some 2-dimensional shapes and build these up into the 3-dimensional object that is the boat as a whole. The 2-dimensional shapes that we look at for this purpose are known collectively as the "lines".

2.1.2 When boats were designed manually, the design itself was built up from drawing and measuring the 2-dimensional shapes - so the 3-dimensional design was also derived from the lines. Although this is no longer the case, we still tend to draw out from the computer-generated 3-dimensional surfaces the same 2-dimensional views as were previously used to design the boat.

2.1.3 A major difference however is that manually drawn lines were drawn at a reduced scale (so they could fit on a piece of paper) and they needed to be drawn out full size so that they could be checked for accuracy and "fairness". This process is known as "laying off" or "lofting". Computer generated surfaces are inherently fair and entirely accurate dimensions of them can be obtained directly from the computer - so lofting is no longer required.

2.1.4 Another major difference is that, with manually drawn lines, the designer only knew the shape of the hull on the lines. With computer generated surfaces we know the shape of the hull everywhere (or at least almost everywhere - software still has a few bind spots!). This means that we have the facility to extract the accurate position of almost any point on the surface of the hull. It is this facility that allows us to provide accurate dimensions, bevels etc. of the majority of the elements of the boat.

2.2 Datum points

2.2.1 We have to set datum points (or perhaps more accurately datum lines) from which other points on the boat can be measured. The datum points that we are using on this boat are as follows:

2.2.2 The Datum Waterline (dwl). This is a horizontal line drawn at the approximate flotation position of the boat. It should not be confused with the Load Waterline (LWL) which is the calculated flotation line under specified load conditions (perhaps two-thirds loaded).

2.2.3 The Zero Point. This is the intersection of the stem face with the dwl.

2.2.4 The Centreline. This is the fore-&-aft centreline of the boat.

2.3 Point measurements

2.3.1 Position. This is measured forward and aft of the Zero Point. Positions aft of the Zero Point are negative. So Position -400 is a point 400mm aft of the Zero Point.

2.3.2 Offset. This is measured out from the centreline. So a point at Offset 870 is 870mm out from the centreline. If necessary

an offset is designated port or starboard. Port is the left-hand side of the boat when you are facing forward; starboard is the right hand side when you are facing forward. Don't confuse "offset" with "width" - width has its usual meaning, while offset is a distance measured out from the centreline. Thus for example, the backbone of the boat is 300mm wide, but has an offset of 150mm.

2.3.3 Height. This is measured above or below the dwl. Heights below the dwl are negative. So Height -50 is a point 50mm below the dwl.

2.3.5 Thus any point in the boat can be identified by three co-ordinates - Position, Offset and Height. These co-ordinates are often brought together in tabular form - somewhat confusingly known as a "Table of Offsets". There is a Tables of Offsets for all the frames - and as the build progresses, on other drawings as well.

2.3.6 Now we will just identify the various lines we use to find the shape of the boat.

2.4 Sections

2.4.1 A section is a vertical athwartships (across the boat) slice through the boat (like a slice of bread off a loaf).

2.4.2 Sections are designated "s" followed by their position. Thus s -400 is a section through the boat 400mm aft of the Zero Point.

2.4.3 Athwartships elements like frames and bulkheads are drawn using sections.

2.5 Waterlines

2.5.1 A waterline is a horizontal fore-&-aft slice through the boat.

2.5.2 Waterlines are designated "wl" followed by their height. Thus wl -150 is a waterline 150mm below the dwl; wl 600 is a waterline 600mm above the dwl.

2.5.3 Waterlines are used to obtain the shapes of horizontal elements of the boat - soles, bunk tops, furniture unit tops etc.

2.6 Buttocks

2.6.1 A buttock is a vertical fore-&-aft slice through the boat.

2.6.2 Buttocks are designated "b" followed by their offset. Thus b 200 is a buttock 200mm out from the centreline.

2.6.3 Buttocks are used to obtain the shape of any fore-&-aft partition, items like bunk fronts, furniture unit fronts, bottom edges of engine beds etc.

2.7 Diagonals

2.7.1 Diagonals are fore-&-aft slices through the boat taken at an angle (i.e. neither horizontal nor vertical - but some angle in between).

2.7.2 Diagonals are designated "d" followed by the height on the centreline of their start point and the angle (usually downwards) that they make to the centreline. Thus d 100 45° is a diagonal that starts on the centreline, 100mm above the dwl and is at an angle of 45° with the centreline.

2.7.3 Diagonals are not often used directly to obtain shapes of items but the offsets on diagonals are often used to help delineate the

shapes of other items, particularly sections, where they cross the hull skin more nearly at right angles than either a waterline or a buttock (thus making measuring more accurate).

2.7.4 An offset on a diagonal is measured down the line of the diagonal from the centreline. We use two diagonals on this boat. Mostly you won't need to use them except as a check if something doesn't work out fair.

2.8 Body Plan & Grid

2.8.1 The body plan shows the outlines of the sections, with the waterlines, buttocks and diagonals drawn as a grid over them.

2.8.2 If you refer to drawing 012/002/10 you will see a body plan (although only a single section is shown) and a basic grid consisting of waterlines, buttocks and diagonals.

2.8.3 This grid is used to obtain the shape of the frame components and to check the frames for shape and accuracy once they are made and assembled.

SECTION 3 – PREPARATION & GENERAL REMARKS.

3.1 Basics

3.1.1 The boat is constructed using WEST™ system epoxies.

3.1.2 The boat is built upside down. The frames, floors, bulkheads and transom are made first - on the plans, frames, bulkheads and structural floors are all called "frames" for ease of reference. These are set up on a jig.

3.1.3 The stem and backbone is laminated up in situ on the frames and transom, and beveled off to the correct angles to receive the hull skin. The chine piece is similarly laminated up on the frames and transom and beveled off. The shelf, upper & lower stringers are then bent around the frames, and secured to the stem and transom

3.1.4 The skin of 12mm ply is then fitted.

3.1.5 The boat is turned over and the remainder of the superstructure, together with the structural furniture, centrecase etc., is fitted.

3.1.6 The vessel can then proceed to completion, paintwork etc.

3.1.7 WEST™ is to be used as set out in the WEST™ system manual "The Gougeon Brothers on Boat Construction". A WEST™ fact Sheet is also included with the Instructions.

3.2 Setting out the grid

3.2.1 The basic grid as shown on drawing 012/002/10 needs to be drawn out on a flat, level surface. We will call this the “setting-out floor”.

3.2.2 The best type of surface is a board floor - chipboard (particle board) or plywood is ideal. This should be thick enough to take small nails to bend battens around and to screw blocks to. 20mm material is about the right thickness. The floor should be emulsion painted white, so that pencil or ball-point lines show up clearly. It is important that it is rigid and flat - and preferably level. Make the floor big enough for the largest frame, with some to spare. (2 sheets 1220 x 2440 should suffice).

3.2.3 You will need a metre folding rule, a 5 metre steel tape, some 20mm wire nails, a couple of battens (say 2000mm long x 10mm x 15mm - good clean pine with no knots, planed up straight and square) and if possible a few weights (10kg or more). You will also need a straight edge (about 2500mm long x 145mm x 20mm, planed) and a large square. This can be made from part of a sheet of 12mm (or thinner) ply - see ¶3.2.4 on how to construct a right angle using a 3:4;5 triangle. Examples are also given on the grid drawing.

3.2.4 Draw the grid out on the setting out floor. Use an 'H' pencil or fine ball-point pen. Start with the centreline and then draw the dwl truly at right angles to it. Boatbuilders usually use a 3:4:5 triangle to check for square (90°). So, to check the dwl/centreline for square measure a multiple of 3 (say 4 x 3 = 1200mm) along the dwl from the point of its intersection with the centreline and mark this on the dwl. Now measure the same multiple of 4 (in this case 4 x 4 = 1600mm) up the centreline from the point of its intersection with the dwl and mark this off on the centreline. Now join the two points and measure this length (the hypotenuse of the triangle). It should measure the same multiple of 5 (in this case 4 x 5 = 2000mm) exactly. Remember to draw the dwl with reference to the setting-out floor so that there is height above it for the superstructure.

3.2.5 Now draw the waterlines above and below the dwl and parallel to it - these are at heights of 100 through 800 and -100 through -300

3.2.6 Now draw the buttock lines each side of the centreline and parallel to it. These are at offsets of 250mm, 500 and 750.

3.2.7 Draw the two diagonals, one starting from +250 and angling down at 60º. The other starting at 000 and angling down at 45º.

3.2.7 Label up the grid clearly (as it is on drawing 012/002/10). Double check everything because on the accuracy of your grid depends the accuracy of your boat.

3.2.9 This is the basic grid and part or all of it is used to mark out and make every frame. Other waterlines, buttocks and diagonals may be used temporarily for other components and these will need to be marked on the grid as we go along.

3.3 Sided & moulded dimensions

3.3.1 You will sometimes see the terms "sided" and "moulded" on the drawings.

3.3.2 Sided is the width of a component measured from side to side. On a transverse like a beam this will be the fore-&-aft width; on a longitudinal like a shelf or carling, this will be the athwartships width.

3.3.3 Moulded is depth of a component measured from face to face. On the majority of components on your boat this will be the top to bottom depth. With frames, the moulded depth is the depth from inside to outside.

3.3.4 The sizes of components are usually given sided first followed by moulded.

3.4 Bevels

3.4.1 If boats were shaped like shoe boxes then life would be very simple. Unfortunately, they are boat shaped, which usually means they are pointed at one end and curved in various ways. Thus the structural components

have to be shaped to match the various curves and shapes.

3.4.2 A component such as frame is shaped to suit the cross section of the boat at its position in the boat. This cross sectional shape is shown on the frame drawings. However, the edges of the frame will also often need beveling (planing off at an angle) to suit the fore-&-aft shape of the hull at the frame position. The fore-&-aft shape is is in fact usually curved but because the frame is relatively thin, the shape to be applied fore-&-aft to the edges can be expressed as a simple bevel.

3.4.3 The curves of the hull, deck and superstructure are not constant, nor are they necessarily all getting bigger or smaller at the same point. This will mean the you may get a twisted bevel on the edges of the frames or that the bevel on the hull for example may be opposite to that for the deck. At some point, most of the curves in the boat change direction - because the stern is smaller than the largest section. Again this does not happen at one position in the boat, but different parts of the boat and different curves change direction at different positions.

3.4.4 This may all sound rather a nightmare, but in fact it works out very simply. All the information you need for a particular frame is contained in the Table of Offsets for that frame. By looking at the Table of Offsets you can compare the dimensions of the frame on the aft face of the ply with those for the fwd face. You mark out and make the frame to the larger dimension and find the edge bevel to be planed off by subtracting the smaller dimension from the larger.

3.5 Accuracy

3.5.1 Normally the smallest unit of measurement we shall use is the millimetre. Occasionally you will see half-millimetres marked on a drawing but this is usually when something is in the centre of a component of odd millimetres in size (two measurements of 12.5mm on a 25mm piece of timber for example).

3.5.2 Measure to the exact number of millimetres given - 327mm is not “near enough 325mm” for example; and try to make components accurate to within 1mm.

3.5.3 It is especially important that the frames (and transom) are accurately made and beveled, and, when the time comes, set up accurately on the building jig. If you get these right, then the rest of the structure will flow easily and accurately, and so will the furniture fit properly.

3.5.4 WEST is a wonderful material for boatbuilding and it can have remarkable gap filling properties. However, try to make a good fit of things as this is usually very much easier and more satisfactory that a bad fit made good by a bed of WEST. When things fit nicely, then they can be fastened, cramped etc. while the WEST cures, so much more easily and they are much more likely to stay in place without distortion etc. By all means use WEST to gap fill if a mistake is made or in cases where it is not possible sensibly to get a good fit, or of course where structures are designed to be put together on a bed of WEST - but try not to rely on it to replace careful workmanship.

3.6 Chine hull

3.6.1 As this is a chine hull, there are two

sections of the hull:

The topsides section from the sheer to the chine point.

The bottom section from the chine point to the hull centreline.

3.6.2 Each section of the hull is very slightly curved but the chine point is a sharp transition.

SECTION 4 – FRAME 0.

4.1 Marking out the frame

4.1.1 The frame is 12mm ply. The fwd face is at Position +220.

4.1.2 If you look at the Table of Offsets you will see that there is a set of dimensions (Position, Offset, Height) given for the aft face of the frame at Position+208 and the fwd face of the frame at Position +220.

4.1.3 Look at the Table of Offsets and compare the dimensions of the aft face with those of the fwd face. On the hull, generally the aft face dimensions are larger, except for the height of the sheer which is greater on the fwd face. On the foredeck, the heights are either the same or greater on the fwd face.

4.1.4 First we shall mark the frame outline on the setting-out floor, using the larger dimensions in the Table of Offsets.

4.1.5 Mark in the aft face sheer point by measuring 263 (Offset at Position +208) out from the centreline and 945 (Height at Position +208) up from the dwl.

4.1.6 On wl 800 mark out 218 from the centreline. On wl 700 mark out 186; on wl 600 mark out 154; on wl 500 mark out 121 and so on until you get to the chine at Height 219 and Offset 26

4.1.7 Then on wl 200 mark 15. On the centreline mark a Height of 172.

4.1.8 Mark out the topsides section. Drive a small nail in at each of the points from sheer to chine and bend a batten around the outside of the nails and secure it with weights, or nails driven on the outside of the batten opposite those on the inside (do not nail through the batten) - The batten should lay nice and fair just touching all the nails. If it can't seem to lay fair, then check that you have measured correctly and that you have put the right measurements on the right lines. If you haven't made an error and the batten still won't lay fair, then contact support. The various dimensions are computer generated, but are actually transferred to the frame drawing by typing them in, so there is the possibility of error there.

4.1.9 Once you are satisfied that the batten is laying fair, then draw round on the inside of it to mark the outline of the topsides section section of the frame.

4.1.10 Repeat the process for the bottom section (very short on this frame - just a straight line). Though in fact for this frame we don't need to do this because the bottom section is entirely cut off for the stem lamination.

4.1.11 Repeat the process on the other side of the boat so that the whole hull outline is marked on the setting-out floor.

4.1.12 Now mark out the deck. Here we

measure heights up from the dwl on some extra buttock lines (and the centreline, which is effectively a buttock at offset zero). We are using the fwd face measurements. Draw in buttock lines 100 and 200. Measure up 969 on the centreline, 965 on b 100 and 955 on b200. Mark the sheer at height 946, offset 257. Repeat these measurements on the other side of the boat.

4.1.13 Drive a nail in all the heights, including the sheer points and join these up with a batten as you did for the hull and mark the line on to the setting-out floor right across the deck. Don't mark out only half of a deck or roof camber as this will tend to give you an unfair spot on the centreline - mark right across from one side to the other. At the sheer, extend the line of the deck and the hull so they meet.

4.1.14 The bottom of the frame is going to be cut off to take the stem laminations. The height of this on the aft face is shown on the frame drawing as 340 above the DWL and 358 on the fwd face. Mark across at 340.

4.1.15 We don't need to mark out the internal frame lines on the floor.

4.2 Making the frame

4.2.1 Now you have to transfer the outside line of the frame to the plywood itself. We shall keep the face veneer grain in the ply vertical. The common way transfer the outline is to make up a rectangular lattice framework - like a gate. This can be made from softwood strips about 40mm x 10mm placed about 100mm apart. The overall size should be about 1800mm x 1200mm and it should have some bracing bits to keep it rigid. The actual dimensions are not vital at all.

4.2.2 This is also emulsioned white. It is then laid over the outline of the frame and the line of the outside of the frame can be marked on to the gate. Also mark the DWL, the centreline and any other datum lines that you wish to transfer from the floor to the plywood frame itself.

4.2.3 Lay the gate on the plywood and transfer the appropriate marks on to the plywood. Join the marks together - using a batten as before. We only need to mark down to the 340 line, where the frame sits on top of the stem lamination. Apart from the hull outline marks, make any other marks VERY lightly as they will be really difficult to clean off the ply if you are going for a clear finish - and even a nuisance if you are going for a pigmented finish.

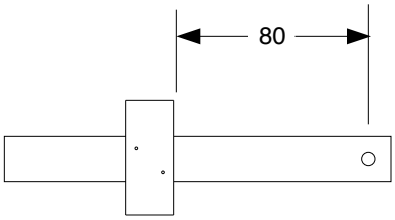
4.2.4 Cut the ply out to the marked lines. Use a good solid jig saw with a sharp blade intended for plywood of this thickness and the blade nice and square to the base. Be sure to just keep the lines visible. When the plywood is cut out, the various sections (where there is more than a single piece) can be laid back on the floor for joining up and checking that the outline of the plywood is correct. In this case you only have a single piece of ply.

4.2.5 Clean up the edges so that the frame ply matches its outline on the floor nicely. While the frame is laid on the floor matching its outline, measure and mark the centre of the upper stringer which is 580 above the dwl on the aft face and 582 on the fwd face.

4.2.6 Now we need to mark and cut the inside line of the frame, to give the central aperture. The inner edges of the frame are

basically 80mm parallel to the outer edges on the larger face - the aft face in this instance (we are not worried about the minor height difference at the sheer).

4.2.7 Make a little marking gauge out of a pieces of timber, say 30mm wide, with a hole at one end to be a tight fit for a pencil. Then screw a second piece of timber (say about 60mm long) across it at right angles, so that the inner edge of the second piece is accurately 80mm from the centre of the pencil hole – as shown below. Leave enough length to move the cross bar to give a 100 parallel mark as this is used in many of the later frames.



4.2.8 Run the gauge along the outer edge of the frame to make a parallel 80mm line for the inner edges. The bottom of the aperture finishes 545 above the dwl – mark this in. The top finishes level across at 885 above the dwl. Cut a piece of stiff card or similar to 140mm diameter (you might find a tea-plate or similar to do the job). Enter this into the inner corners until the circumference just touches the 80mm inner lines, and draw in the corner radius. Do the same at the bottom. Cut out the aperture, using a good sharp jig saw blade.

4.3 Beveling the edges

4.3.1 On the hull sections we will be beveling off the fwd face of the ply. We get the bevels by subtracting the smaller dimension from the larger. Thus at wl 800 the bevel is an offset bevel (that is measured along the wateline) of 218 - 211 = 7. So on the fwd face of the ply at wl 800, measure 7mm in from the edge along the line of the waterline (i.e. horizontally -- not at right angles to the line of the hull). The other bevels are as follows:

At wl 700 it is 186 - 179 = 7.
At wl 600 it is 154 - 147 = 7.
At wl 500 it is 121 - 115 = 6.
At wl 400 it is 88- 82 = 6
At wl 300 it is 54 - 48 =6.

4.3.2 We can use the bevel at 300 to give us the bevel at 340, the bottom of the frame.

4.3.3 Join the lines up with a batten and draw in the fwd face outline on the ply.

4.3.4 Repeat the process on the other side. Mark the bevel on the frame bottom (21mm as shown on the frame drawing)

4.3.5 Now plane and spokeshave the edges of the frame so that they match the bevels. Try not to take any material off the existing larger face. To help prevent this, run a pencil line around the edge of the frame about 2mm away from the larger face. As you are cleaning the edge off, make sure this line remains visible until the last few strokes of the plane or spokeshave.

4.4 Cutting the notches

4.4.1 The stem lamination sits on the frame bottom and we have already cut and beveled this.

4.4.2 Mark out the notches each side for the upper stringer. These are 15 x 40. So the notch will be 15 deep, beveled to match the bevel on the frame edge. measure in and mark a line 15 parallel to the hull, on each face of the

frame. We have already marked the centre heights on both faces, so now we simply need to mark a line square to the hull 20mm above and below these on each face of the frame. Cut the notch out carefully. You can set your jig saw blade to an angle for the hull cut and another angle for the top and bottom cuts (you need to mark these out on a piece of scrap and set a bevel gauge, so as to be able to set the saw blade/base). Or you can cut the smaller lines and bevel back – in this case you would cut the aft face line on the hull line and the top line, and the bottom line on the fwd face. It is easy to make a mistake with notches, so just take the time to sort it out in your mind before starting in with the saw!

4.4.3 Mark and cut the notches each side for the shelf. The shelf is 20 x 80. The hull/deck angle here is less than 90º, so the highest point of the shelf is on the outside. So you can measure parallel 20 in from the hull. And measure 80 down from the sheer. The bottom of the shelf is square, so square in off the hull at the bottom point. Do this on both faces of the frame. Then cut the notch, being aware of the bevels as described for the stringer notch. The hull line cut have hull offset bevel and the bottom cut will have sheer height bevel.

4.4.4 Similarly cut the notch for the king plank. This is 15 deep on the centreline and 60 wide. There is no bottom bevel because the foredeck has no centreline bevel. The bottom is horizontal across.

4.4.5 It is probably best to cut the limbers after the stem is laminated up but before planking the hull skin.

4.4.6 Just a reminder, when marking out notches etc. Don't make you lines too heavy – in fact keep them as light as possible, especially if you are going for a clear finish.

4.5 Finishing the frame

4.5.1 Sand the frame up smooth and clean off all the pencil lines

4.5.2 Run a trimmer around the inside corners of the frame using a 3mm radius rounding off cutter with a bearing guide. Sand smooth.

4.5.3 WEST the frame so that all parts have had two coats - but the outer edges or any edge to which future components will be bonded, just one coat. Sand the frame again smooth and matt finish.

4.5.4 Lay the frame back on the setting-out floor so that it matches its outline and transfer the centreline and dwl back on to the frame (marked lightly in pencil; you can stick a piece of masking tape top and bottom and pencil on this if preferred).

4.5.5 Label the frame, label the aft face and store the frame until required. Store the frame carefully flat so that it does not become twisted.

4.5.7 We have discussed the making and finishing of this frame in detail; from now on we shall discuss principally matters peculiar to each frame, rather than repeating the same detail frame by frame.

SECTION 5 – FRAME 1

5.1 Making & finishing the frame.

5.1.1 The frame is similar to Frame 0. Its fwd face is at Position -280 and its aft face at

Position -292. It is made from a single sheet of 12mm ply, face veneer grain vertical.

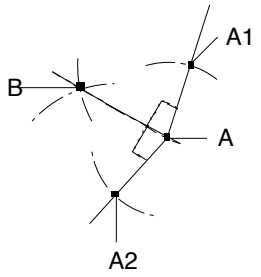
5.1.2 Mark out the frame, much as you did for Frame 0. The bottom section will have a little shape now. Mark the frame on the setting-out floor down to the centreline, even though the bottom will be cut off. Mark the hull on the aft face dimensions and the deck on the fwd face dimensions. The frame has a height dimension on b 250. Bevels on buttocks are measure vertically along the buttock. The frame also has diagonal offsets, but there is no set these out - they are there just for checking purposes if something is amiss. If you do use them, bevels on diagonals are measured along the line of the diagonal.

5.1.3 After the frame is cut out and cleaned up to match its outline on the floor, mark the bevels as described for Frame 0. The bevel for the bottom edge is given on the frame drawing. For the chine point, it is easier to mark the actual height and offset on the fwd face, rather than derive bevels.

5.1.4 Once the frame is beveled, mark out and cut the aperture as shown on the drawing.

5..1.5 The shelf, upper stringer and king plank notches are marked, cut and beveled as described for Frame 0.

5.1.6 On this frame we have a chine notch. The chine is 30 x 80 (before it is beveled off to suit the hull shape). We need to mark a line bisecting the topside/bottom angle. The little drawing below sets this out. Set a compass and with the chine point (A) as centre describe an arc on to the topside and bottom line (A1 and A2). Using A1 and A2 as centres describe arcs (or the same radius as each other) to cross at B. Join A to B. This is the centreline of the chine, projected inwards. Mark out the top and bottom of the chine notch, 40 parallel from line AB. measure 30 along line AB for the depth of the chine notch and set the base of the notch out square to AB. Do this on both the aft and fwd faces, to give the notch bevels. Cut the notch taking care of the bevels, much as described for the stringer notch.



5.1.7 Sand the frame up smooth and clean off all the pencil lines

5.1.8 Run a trimmer around the inside corners of the frame aperture using a 3mm radius rounding off cutter with a bearing guide. Sand smooth.

5.1.9 WEST the frame so that all parts have had two coats - but the outer edges or any edge to which future components will be bonded, just one coat. Sand the frame again smooth and matt finish.

5.1.10 Lay the frame back on the setting-out floor so that it matches its outline and transfer the centreline and dwl back on to the frame (marked lightly in pencil; you can stick a piece of masking tape top and bottom and pencil on this if preferred).

5.1.11 Label the frame, label the aft face and store the frame until required. Store the frame carefully flat so that it does not become twisted.

5.1.12 As with Frame 0, we haven't cut the limbers at this stage. In fact this bulkhead could be retained as a watertight bulkhead, provided that the area forward of it was leveled off nicely with WEST/microballons and a separate bilge pump installed.

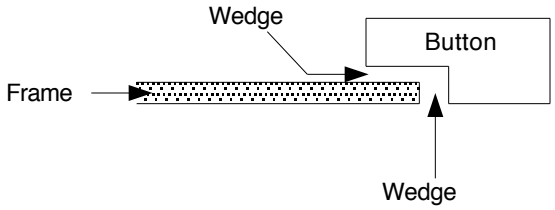
SECTION 6 – FRAME 2

6.1 Making & finishing the frame.

6.1.1 The frame is 12mm ply and is in two sections butt jointed together as shown on the drawing. The fwd face of the frame is at Position -780, the aft face at Position -792. The drawing indicates a butt strap on the fwd face in way of the join. An alternative is to rout a groove (say 4 x 12) in each joining edge and bond in a 20 x 4mm ply tongue. Another option is to use a biscuit jointer and biscuits if you have one of these useful little machines.

6.1.2 Mark out the frame as usual. Transfer the outlines to the ply. Cut out the ply sections. The bottom of the frame is cut off at 209 below the DWL to take the backbone.

6.1.3 It is easy to join the two sections together on the setting out floor. Lay the frame sections on the floor aft face down. Put shiny brown parcel tape on the floor in way of the join (which will be on the stbd side at the moment). Arrange some cleats or turn buttons to hold the frame components tightly together. Prepare the butt strap and pre-drill it for 3/4" x 8 g countersunk screws. Cut the countersinks just flush with the surface of the butt strap. Just prick the screw holes through into the frame itself. Now release the frame, wet out the join well, then apply the WEST/fibre bond. Set the frame on the floor and push the two parts tightly together with the cleats or turn buttons and wedges as shown below. Now WEST bond and screw the butt strap on. Clean off all excess WEST. When the WEST has cured, the complete frame can be lifted off the floor. Use a similar system for a tongue or biscuit joints.



6.1.4 Bevel the frame edges as previously described. The bevel on the bottom will be the same as the centreline bevel (281 - 279 = 2) so the bottom bevel will be 2 off the fwd face (i.e. 207 below the DWL).

6.1.5 Mark out the two apertures in the frame. Offsets for the top curve of the upper aperture are given on the frame drawing. You can modify the marking gauge shown earlier to make a 100mm parallel mark as this is used in a lot of the frames from now on. These apertures are to suit the interior furniture design that goes with the plans. If you are building a different interior, you may need to change these. Apertures should leave at least 100mm of material from inside of frame to the hull. If you are making changes and are unsure about anything please contact support@whisstock.com .

6.1.6 The edges of the apertures are fitted with a trim later on when the interior is fitted out so they don't need rounding off.

6.1.7 Cut the notches for the shelf, upper and lower stringers, and the chines. The shelf ,

chine and upper stringer notches have bevel as previously described. The lower stringer notch will have bevel on its inner face to match the hull bevel. It will also have 2mm of bevel from face to face - 2mm on the top edge and 2mm off the bottom edge on the fwd face. Do not cut the notches for the main carlings; there aren't notches for the coachroof carlings as they butt on to the aft face of this frame. The limber can be cut in this frame.

6.1.8 Sand the frame up smooth. Sand out all pencil marks. WEST the frame so that all parts have had two coats - but the outer edges or any edge to which future components will be bonded, just one coat. WEST the edges of the limber hole very thoroughly, at least three coats. Sand the frame again smooth and matt finish.

6.1.9 Lay the frame back on the setting-out floor so that it matches its outline and transfer the centreline and dwl back on to the frame (marked lightly in pencil; you can stick a piece of masking tape top and bottom and pencil on this if preferred).

6.1.10 Label the frame, label the aft face and store the frame until required. Store the frame carefully flat so that it does not become twisted.

SECTION 7 – FRAME 3

7.1 Making & finishing the frame.

7.1.1 This frame is 12mm ply and is in three sections – two hull/deck sections with a join on the centreline and a coachroof section. The forward face of the frame is at Position -1280 and the aft face at Position -1292.

7.1.2 Mark the frame out on the setting-out floor as usual. Transfer the hull/deck section marks for one side of the vessel to the ply and mark out as usual. Leave the deck section a little long for fitting to the coachroof section . Cut the hull/deck outer edge. Lay the ply on the setting-out floor and check that it matches its outline. Clean up the edge as necessary. Cut the bottom off at 285 below the DWL as shown on the drawing.

7.1.3 Mark the inside edge of the hull/deck section 100mm parallel in from the outside edge. Mark the inside bottom at 200 below the DWL as shown on the drawing. Using a 200mm disc of ply or stiff card, mark in the 100 radius corners. Don't mark the 50mm radius on the inside edge deck/coachroof join yet.

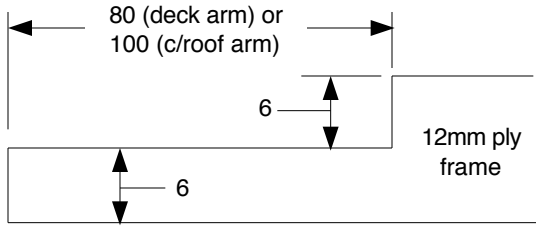
7.1.4 Cut the inside edge and clean up. Use this section to mark out the other side. Cut this out, check against the setting-out floor and clean up the edges as necessary.

7.1.5 Mark and cut the coachroof section out in a similar way, but in one piece. You can make it in two pieces with a join on the centreline if you wish to – this should be a tongue or biscuit join as discussed earlier; a butt strap would look ugly. Leave the coachroof side 'arms' a little long for fitting to the hull sections. Note that the coachroof section inside edge is 80mm in parallel to the outside edge.

7.1.6 Make the centreline join if there is one, clean off any excess WEST, allow the WEST to cure and clean up the joint. Check the coachroof section on its outline on the setting-out floor, clean up the edges as necessary.

7.1.7 Now lay all three sections on the setting out floor and make any adjustments necessary so that the whole frame matches its outline on the setting-out floor. Mark the line of the deck sections on the coachroof section and vice-versa.

7.1.8 The drawing shows the coachroof sections joined to the hull/deck sections with a half joint - that is cutting a 6mm thickness off the join inner faces of each section as shown below.



7.1.9 When brought together the frame at the joint should be 12mm thick and the sections match their outline on the setting-out floor.

7.1.10 An alternative to a half-join is a biscuit join. For this it is probably best to mitre the two sections as this will produce the neatest result. A mitre with a tongue would also be satisfactory.

7.1.11 The butt join at the bottom centreline can be a simple butt with a butt strap as shown on the drawing, a biscuit join or a butt join with a tongue.

7.1.12 Once all the joints are prepared, tape over the joint areas on the setting out floor. Screw buttons to the floor in positions to tighten the joint together. Make sure that you have plenty of shallow wedges. You may also want to screw some cleats to the floor to locate the components in their correct place. If you are fitting a butt strap to the bottom join, you will need to lay the frame on the floor aft face down. Have a dry run (no WEST) just to be sure everything is OK. Wet out the joints thoroughly with WEST and then bond together with WEST/fibres, wedging the components together and flat down on the floor so the whole frame matches its outline. Clean off excess WEST. Allow to cure well.

7.1.13 Once the WEST has cured, lift the frame gently off the floor and lay aside flat for a couple of days for the WEST to reach full strength.

7.1.14 Clean the frame up. Radius off the inside corner where the coachroof section joins the deck. Mark and cut the bevels. Mark and cut the notches for the shelf, coachroof carlings, upper and lower stringers, and the chines, generally as previously described. The lower stringer has the same 2mm bevel as for Frame 2. The bevel on the bottom of the frame is the same as the hull centreline (1mm off the fwd face). If you have a butt strap over the centre join, then this will need beveling too – another 1mm.

7.1.15 The notch for the coachroof carlings is marked out in a similar way to that for the shelf, except that the coaming/roof angle is greater than 90º, so we need to mark a 20mm in parallel line first and extend this up to the roof edge. Then measure down 40mm from the intersection of the line with the roof edge and square off the line back to the coaming edge. The carling notch will carry the coaming and roof bevels.

7.1.16 Do not cut the main carling notches. The R20 limber can be cut.

7.1.17 Now clean up the frame and sand smooth. Run a trimmer around the inside edges with a 3mm radius cutter. Sand smooth. WEST the frame so that all parts have had two coats - but the outer edges or any edge to which future components will be bonded, just one coat. WEST the edges of the limber hole very thoroughly, at least three coats. Sand the frame again smooth and matt finish.

7.1.18 Lay the frame back on the setting-out floor so that it matches its outline and transfer the centreline and dwl back on to the frame (marked lightly in pencil; you can stick a piece of masking tape on and pencil on this if preferred).

7.1.19 Label the frame, label the aft face and store the frame until required. Store the frame carefully flat so that it does not become twisted.

SECTION 8 – FRAME 4

8.1 Making & finishing the frame.

8.1.1 This frame is the mast frame. It is basically 12mm ply bulkhead, with a door aperture. There is a substantial beam formed from two layers of 12mm ply, on both faces of the ply frame itself. At the bottom there is a similar floor stiffener, again formed from two layers of 12mm ply on each face of the 12mm ply bulkhead. 25 x 80 mast posts, on both faces of the bulkhead, run from beam to floor.

8.1.2 The 12mm ply bulkhead can be made from two sections, joining on the centreline.

8.1.3 Mark the frame on the floor in the usual way – aft face for the hull; fwd face for the deck and coachroof (though there is no discernible bevel on the coachroof). Transfer the frame outlines to the ply in the usual way and cut the two sections out. The joins are the beam and floor stiffeners so a simple butt is sufficient – with a short length of butt strap on the fwd lower section above the floor (or you can tongue or biscuit joint this).

8.1.4 Assemble the sections on the setting-out floor and check that they match their outline on the floor. Adjust and clean up the edges as necessary. Cut the door aperture and clean up the edges.

8.1.5 Now get out the ply for the floor and beam stiffeners. You will need four pieces of 12mm ply for each, making 24mm per side, top and bottom.

8.1.6 The top shape of the beam pieces is the same as the coachroof top edge. There is in fact 1mm of bevel from the very aft face to the very fwd face, so you could make the aft pair a smidgen larger (0.5mm at most) and the fwd pair 0.5mm smaller.

8.1.7 The bottom pair will have a little more more bevel. b 250 has 1mm of height bevel over the 12mm ply thickness, so it will have 2mm of bevel over the 24mm thickness of the beam stiffener, giving a total of 5mm over the whole 60mm combined thickness (stiffeners and bulkhead). The bottom, sitting on the hog has 4mm of bevel over the whole 60mm total thickness. So on the hull edges of the stiffeners make the first aft layer 1mm larger and the second 1mm larger again; Make the first fwd layer 1mm smaller and the second 1mm smaller again. On the bottom edge, do pretty much the same - but using a scant mm, rather than a full mm.

8.1.9 On the setting-out floor, screw 20mm

high cleats to the floor at 1150 above the dwl and 200 below the dwl (the inside faces of the beam and floor.

8.1.10 Lay the fwd two beam sections and fwd two floor sections on the floor, accurately on the centreline. The first of floor pieces should be 2mm shy of the frame outline. The first of the beam pieces should be just marginally shy of the frame outline. Fit some cleats to the floor to hold them securely in place. Drill from the top layer for 3/4" x 8g countersunk screws. Remove the beam and floor sections and tape the cleats so that WEST won't stick to them. Now the two layers of each can be screwed and bonded together on the floor. The screws can be left in after the WEST has cured, or removed.

8.1.11 Get the material out for the four post sections, cut accurately to length. Remove the cleats on the inside edges of the beam and floor sections and reposition them to locate the inside edges of the mast posts. Fit additional cleats to locate the outside edges of the mast posts. Tape over the cleats as usual. Tape the floor in way of the join of the posts to the floor and beam. Now drop the mast posts into place and check for fit. Once they fit accurately, wet out the end grain thoroughly and bond in place to the beam and floor. Allow the WEST to cure.

8.1.12 Lay the two ply sections on the mast post, beam and floor assembly. Adjust so that it matches its outline on the setting out floor. Screw some 35mm cleats to the setting-out floor around the perimeter to keep it in place.

8.1.13 Once you are satisfied with the fit, drill off for 1" x 8g countersunk screws at about 150mm centres generally, to fix the ply to the posts, floor and beam. Wet out the ply joining edges, then screw fix and WEST bond the ply to the posts, floor and beam sections. Clean off excess WEST.

8.1.14 Once the WEST has cured, just ease the frame off the setting-out floor to make sure it is not stuck there in some way.

8.1.15 The inner layers of the mast posts, beam and floor sections can now be bonded on to the ply bulkhead, remembering that the bottom edge is growing 1mm and the top edge is flush. Screw and bond these in place.

8.1.16 The outer floor section can then be screwed and bonded in place - the bottom edge is growing another mm.

8.1.17 The outer mast post and beam sections can either be screwed and bonded in place, counterboring the screw holes for dowels (use a stanley "screwsink" or similar), or you can remove the frame from the setting-out floor at this stage and cramp them in place. Clean up excess WEST. Dowel over the screw heads, if used.

8.1.18 Clean up the whole frame. Cut the bevels as usual. Mark, cut and bevel the notches (not the main carling notches) as usual. The lower stringer notch has 1mm of bevel top and bottom. The notch for the mast runner is similar to that for the king plank in previous frames, 25 deep on the centreline and 200 wide, level across on the bottom. The bottom will have the same bevel as the coachroof top – just 1mm aft to fwd. Radius the edges of the ply in the door aperture.

8.1.19 Sand everything smooth. WEST the frame so that all parts have had two coats - but the outer edges or any edge to which future components will be bonded, just one coat.

WEST the edges of the limber hole very thoroughly, at least three coats. Sand the frame again smooth and matt finish.

8.1.20 Lay the frame back on the setting-out floor so that it matches its outline and transfer the centreline and dwl back on to the frame (marked lightly in pencil; you can stick a piece of masking tape on and pencil on this if preferred).

8.1.21 Label the frame, label the aft face and store the frame until required. Store the frame carefully flat so that it does not become twisted.

SECTION 9 – FRAME 5

9.1 Making & finishing the frame.

9.1.1 This frame is 12mm ply, with the fwd face at Position -1780 and aft face at Position -1792.

9.1.2 The construction, assembly and finishing of the frame is very similar to Frame 3, so make the frame in the usual way, bevel, cut the notches and bevel these. Do not make the main carling notch. The lower stringer notch has 1mm of bevel top and bottom.

9.1.3 Radius the inner frame edges, except the bottom at -200, where the sole will sit, and the upstand at offset 310 and the top at Height -10, where the bunk/galley fronts and tops will sit. Sand and WEST coat the frame as usual. Label and store flat.

SECTION 10 – FRAME 6

10.1 Making & finishing the frame.

10.1.1 Frame 6 is 12mm ply and is really a floor rather than a complete frame. The fwd face is at Position -2280 and the aft face is at Position -2292. The Table of Offsets gives a full set of dimensions for this frame, but only the lower hull ones are needed.

10.1.2 Set out and make the frame in the usual way. The face veneer grain can be vertical or horizontal.

10.1.3 There is a notch for the hog on this frame, rather than the frame simply sitting on top of the hog. The notch is 300 wide. There is no bevel (because there is no bevel on the hull centreline).

10.1.4 The notch for the lower stringer has no top or bottom bevel, though it still has hull bevel on its inner face. There is only a part notch for the chine, which is otherwise as usual.

10.1.5 There is no need to radius the inner edges of this frame as the sole and bunk/galley components sit on them. The small section between the sole and the bunks could be radius trimmed however.

10.1.6 The centrecase butts on to the aft face of this frame.

10.1.7 We will cut limbers once the hog is laminated up in place and before planking the hull.

10.1.8 Sand and WEST coat the frame as usual. Label and store flat.

SECTION 11 – FRAME 7

11.1 Making & finishing the frame.

11.1.1 This frame is 12mm ply with its fwd face at Position -2780 and its aft face at Position -2792. We are getting to the middle of the boat now so the bevels are changing, so check out the Table of offsets carefully.

11.1.2 Otherwise set out and make this frame as usual. The coachroof section on the port side can be half jointed, butted and tongued or butted and biscuit jointed. The stbd side can be half jointed as shown, or mitred and then tongued or biscuit jointed.

11.1.3 This frame is split at the bottom for the centrecase. The outside dimension of the case is 74mm. Allow a bit more for the split because the case sides will be WESTed – so say a 76mm gap.

11.1.4 Once the frame is made and the sections joined up, screw a temporary strap across the bottom to stabilize the frame in way of the centrecase gap.

11.1.5 Bevel the frame edges, mark and cut the notches. There is no top or bottom bevel on the stringer notches. Make the hog notch as you did for the previous frame - the bevel on the base of this will be the same as the centreline bevel. Do not cut the main carling notches or limbers at this stage.

11.1.6 Radius the frame inner edges, except the bottom where the sole sits and the stbd side bunk upstand and top. The interior design uses Trim B on the edges of the port bulkhead (see galley unit furniture drawing), but it not entirely clear where the trim finishes – it is probably best to run it up the Offset 690 edge, split it where the radius emerges and run the trim side up to under the coachroof. So none of that bulkhead edge needs radius trimming either.

11.1.7 Remove the temporary strap in way of the centrecase, sand the frame smooth and WEST two coats minimum, except the bonding edges, which just have one coat. Sand smooth and matt. Screw the temporary strap back in place. remember to WEST fill the screw holes later on when the strap is removed. Label the frame and store flat.

SECTION 12 – FRAME 8

12.1 Making & finishing the frame.

12.1.1 This is a 12mm frame with the fwd face at Position -3280 and the aft face at Position -3292.

12.1.2 Like Frame 6, it is a floor frame, not a complete frame. It can be made just as Frame 6, with the centrecase slot fitted with a temporary strap as for Frame 7. There is no bevel on the top and bottom of the stringer notch.

SECTION 13 – FRAME 9

13.1 Making & finishing the frame.

13.1.1 This is a 12mm frame with the fwd face at Position -3780 and the aft face at Position -3792. It forms the aft cabin bulkhead and companionway.

13.1.2 The frame is in two sections with a butt join on the centreline. In way of the centrecase, which finishes on the fwd face of the frame, the butt strap is incorporated into the centrecase structure (as the centrecase

post). Above the centrecase, the butt strap is on the fwd face and will butt up under the companionway bottom trim. You need to take a look at these drawings to get this correct. If you use a tongued joint or a biscuit joint, these factors won't trouble you.

13.1.3 Set out and make the frame as usual. Bevel the edges and cut all the notches. The main carlings and coachroof carlings do not pass through the bulkhead – they finish on the fwd face. There is no top or bottom bevel on the stringer notches.

13.1.4 The engine beds sit very close to the hog and the small gap between the hog and the beds will be best filled with WEST/microballons. Therefore we shall need a single limber on the centreline on to of the hog, which can be cut now, and a limber each side outboard of the engine beds. You need to be sure what engine you are installing and the exact dimensions and locations of the beds before cutting these.

13.1.5 Trim radius the aperture edges, except the bottom of the bunk apertures, and the companionway opening. Sand the frame, WEST as usual, label and store flat.

SECTION 14 – FRAME 10

14.1 Making & finishing the frame.

14.1.1 This is a 12mm ply frame. Its fwd face is at Position -4280; the aft face is at Position -4292.

14.1.2 We are in the cockpit now. For more economical use of material, you can make this frame with the face veneer grain running horizontally if wished.

14.1.3 Get the frame out as usual, bevel the edges and cut the notches. Do not cut the notches for the cockpit carlings yet. There is no top or bottom bevel on the stringer notches.

14.1.4 The engine beds are close to the hog on this frame just like they are on Frame 9 – so cut the centreline limber on top of the hog, but not the limbers outboard of the beds.

14.1.5 Trim radius the aperture edges around the hull and under the bridgedeck in way of the quarterberths, but leave the other edges square (cockpit sides, cockpit sole, berth tops etc.) Sand the frame, WEST as usual, label and store flat.

SECTION 15 – FRAME 11

15.1 Making & finishing the frame.

15.1.1 This is a 12mm frame with the fwd face at Position -4780 and the aft face at Position -4792.

15.1.2 Like Frame 12, it is a floor frame, not a complete frame. There is no bevel on the top and bottom edges of the stringer notch.

15.1.3 Finish the frame as usual. Radius the frame edges on the angled section up the hull. The horizontal section doesn't need to be radiused off. Cut the limbers later.

15.1.4 Sand the frame, WEST as usual, label and store flat.

SECTION 16 – FRAME 12

16.1 Making & finishing the frame.

16.1.1 This is a 12mm frame with the fwd face at Position -5280 and the aft face at Position -5292.

16.1.2 For more economical use of material, you can make this frame with the face veneer grain running horizontally if wished.

16.1.3 Get the frame out as usual and cut and bevel the notches. There is a 1mm bevel off the fwd edge of the upper stringer notch top and bottom edges. There is no bevel on the top and bottom edges of the lower stringer notches.

16.1.4 There are no limbers in this frame if the lazarette is to be kept watertight from the rest of the vessel.

16.1.5 Finish the frame as usual. No radius edges on this frame. Sand the frame, WEST as usual, label and store flat

END.