WOODEN SHIPBUILDING TECHNIQUES AT VILA DO CONDE'S SHIPYARDS

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INTRODUCTION

This presentation was conceived based on project elements and the traditional techniques used in the mould loft, for the last wooden vessel built in Portugal for inshore fishing, at the Samuel e Filhos Lda. Shipyard in Azurara, Vila do Conde.

Identification of the ship
Name: Novo Rosa Clara
Construction started: April 2005, ended: July 2007
Length: 18m; Beam: 5.2m; Moulded depth: 2.25m

1. THE LAST KEEPERS OF KNOWLEDGE

While it is uncertain when exactly the oldest shipbuilders began using designs with the intent of both planning the construction of ships and record information and techniques for future generations, it is generally agreed that it must have emerged during the first millennium of the Current Era, motivated by the development of new techniques pertaining to construction.

The oldest elements represented in drawings, dating from sometime between the turn of the sixteenth century and the dawn of the seventeenth century, allow us to ascertain the type of architecture and methods employed in the construction of the ships in the aforementioned period.

The contents of Fernando de Oliveira's (*Ars nautica*, 1570, and *Livro da Fabrica das naos*, 1580), João Baptista de Lavanha's (*Livro Primeiro da Arquitetura Naval, circa* 1600) and Manuel Fernandes' (*Livro de Traças de Carpintaria*, 1616) opuses not only demonstrate how advanced shipbuilding was at the time but also evidence that, at its core, the aforementioned craft did not undergo any major changes during these last 400 years.

João Baptista de Lavanha greatly emphasises the role of the naval architect within the shipyard, the extensive knowledge required, the study and planning that preceded the construction processes, from the design to the resources to be employed, the cost of the endeavour, the choosing of the woods to be used, the shapes (moulds)… The chronicler asserted that the success of all the work hinged on this knowledge.

Naval architecture and all the construction process appear as well consolidated fields in the sixteenth century and kept evolving in many ways up until the present day. However, some practices remained unchanged over the centuries. One example is the use of the *graminho* technique for the creation of the moulds (a process of moulding for the narrowing and the rising of the frames), that has seen little to no evolution since the seventeenth century.

This technique is still used nowadays, especially in smallerscale shipyards, where empirical knowledge plays a significant role in the shipbuilding process.

On the other hand, regarding larger-scale shipyards, where teams of artisans of various crafts work together in the construction of large vessels, we can see the use of more complex techniques. On these spaces, the shipbuilding process is preceded by a large number of studies, execution of designs, models and moulds. All is meticulously planned through designs and calculations beforehand; these plans are brought to the mould loft and only then is the execution of moulds done. Hence, the role of the naval architect is one of pivotal importance in the whole shipbuilding process.

The mould loft is yet another decisive element, since it is the cornerstone of all the shipyard. From this room and the moulds that come out from there depends its success. When the whole-moulding is well executed, all the framework turns out perfect. All the parts fit flawlessly, thereby reducing production time by a large amount.

Since this technique was a true trade secret, and also due to its complexity, only a few individuals were privy to it. Fernando de Oliveira, in 1580, mentioned the matter in the following manner: «[…] In which part the masters of this work are granted free reign to demonstrate their skills: & and, if they are indeed able artisans, their work shall demonstrate it. This is what they hide, & keep for themselves, & are in this so stingy, so much so that they do not want to teach their craft even to their own children»[1]. This was one of the best-kept secrets by the master builders in the sixteenth century and, without a doubt, one of the reasons behind the Portuguese Crown's dominion over the seas.

[1] OLIVEIRA, 1995: 105.

Since the Late Middle Ages up until the current day, Vila do Conde has always distinguished itself as one of the centres of wooden shipbuilding; its shipyards were always a cut above the rest. The refined construction technique of its carpenters and the knowledge in lofting methods of its masters and designers contributed to unique constructive processes. Vila do Conde's shipbuilders were the only craftsmen in the world to master the technique of designing the moulding of all the framework in only one mould.

Even after 10 years since the construction of the last wooden boat, this secret is still well kept in Vila do Conde.

Next, we will show the process of the mould lofting, wood shaping, counter-drawing (*contralinhar* — drawing the other side of the wooden part) and the frame futtocks connection of said boat. We will discuss the remaining construction process, which is the allocation of frames, keel, stem, sternposts, stern panel, and all that remains to conclude the building of the vessel in a future paper.

2. THE MOULD LOFT

2.1. Designs to Use

The complete project of a wooden vessel for inshore fishing is itself the embodiment of the large empirical and scientific knowledge, accumulated and passed on within its shipyard. Its «architect» is a profoundly knowledgeable expert in all the stages that make up this complex process.

The geometrical plane and the cut-to-length design are, among others, elements used in the construction of this kind of ship.

The geometrical plane of the hull planking exterior (Fig. 3.1) has as objectives the ascertaining the volumetry of the ship, make the graphics of straight or titled careens, calculate the careen and gravity centres, among other calculations. This design will later be passed on to the mould loft.

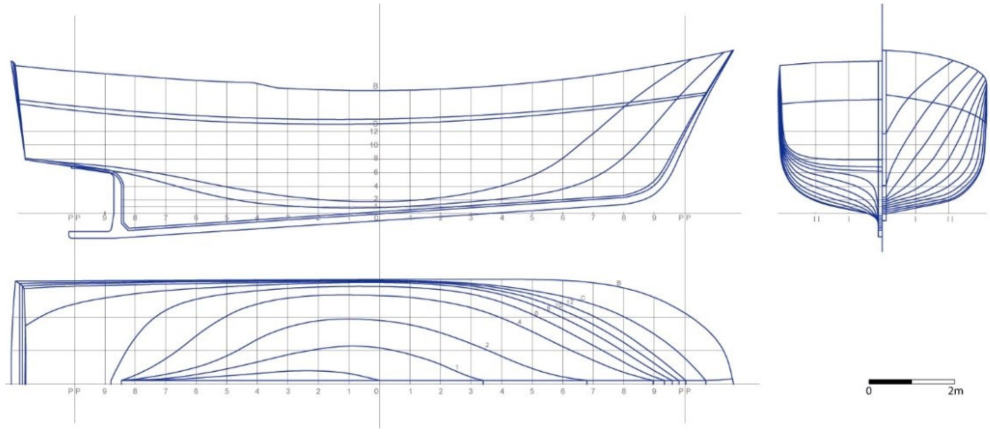

Fig. 3.1. Geometrical plane of the hull planking exterior
Source: António Carmo

The cut-to-length design, scale of 1/25 (Fig. 3.2), defines the structure and architecture of the vessel. This is also essential to obtain structural informations of the hull.

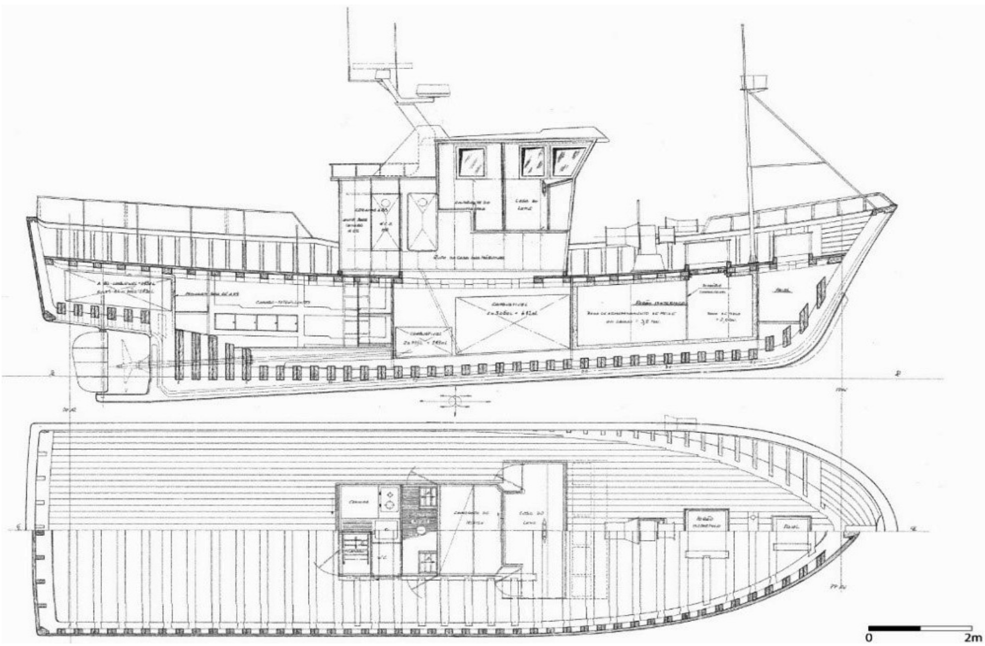

Fig. 3.2. Cut-to-length design
Source: António Carmo

2.2. Designing the Full-Scale Geometrical Plane on the Mould Loft's Floor

The whole lofting process will be developed based on the design of the hull planking exterior's geometrical plane (Fig. 3.1). This will have to be drawn — the drawing being a life-size replica —, to then be used to ascertain, with the help of a scale, all the required dimensions. On the wooden-coated floor are drawn longitudinal, horizontal and transversal planes.

Using carpenter's pencil, wooden sticks, set squares and a chalk line tool, splines (long and thin wooden sticks, suited for drawing curves), the entirety of the geometrical plane is designed, starting with the straight lines:

- water lines (from 0 to 12);
- perpendicular lines of the bow, the stern and in the middle;
- geometrical plane frames, dividing the design into 20 tranversal sections (from 1 to 9 for the bow and from 1 to 9 for the stern);
- longitudinal lines, named *linhas do alto* I and II.

Next, all curved lines are drawn. Splines are used for this purpose. These must be larger and thicker for lines with less curvature, and narrower and thinner for more accentuated curves. All splines must have one end narrower than the other, the narrower side being the one used to draw the more curved section. After the designing process is complete, the intersections between the three planes are verified, and, if necessary, they are corrected.

2.3. Procedure of passing from the hull planking exterior's geometrical plane to the framework

This procedure is required to obtain the geometrical plane in the framework (construction frames' lines). We can see on Fig. 3.3, highlighted in blue, the transversal sections of the geometrical plane of the hull planking's exterior, and in red the same transversal sections (frame's geometrical plane), now inside the hull planking, in other words, in the framework.

This method consists of drawing lines that run parallel to these sections, reducing the hull planking's thickness. This process can also be done with the help of «balance lines» (we will discuss the nature and function of these «balance lines» further on). However, this procedure, albeit more rigorous, is also more complex.

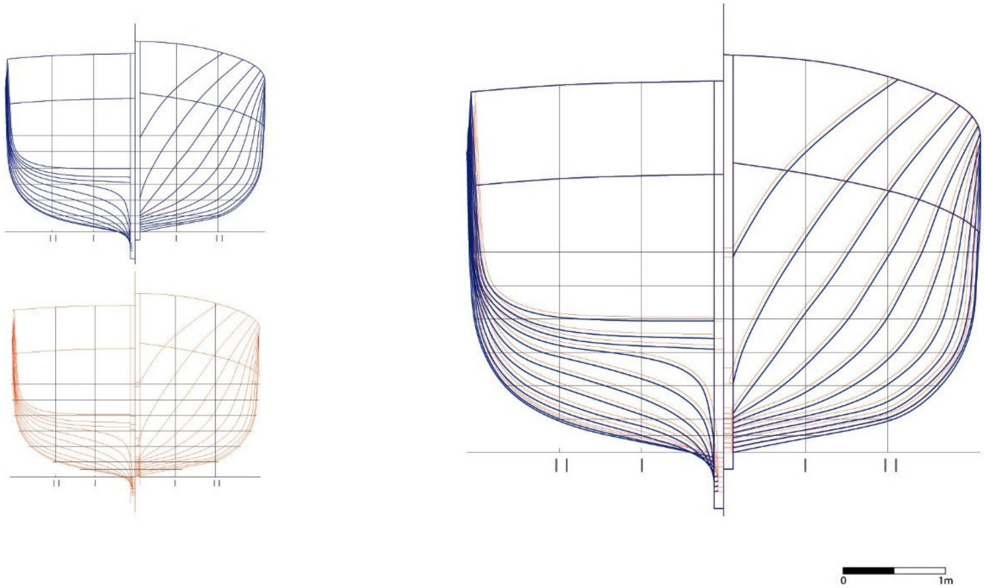

Fig. 3.3. Passing from the geometrical plane of the hull planking's exterior to the framework
Source: António Carmo

2.4. Division and Marking on the 40 Construction Frames (Frame Lines)

With the geometrical plane's frames drawn in the framework, we will now turn to the process of transposing the half-beams to the horizontal plane, the drawing of water lines, numbered from 1 to 12, C and B (Fig. 3.4), now in the framework.

Next, we divide and mark the 40 construction frames (Fig. 3.4, red lines from 01 to 40 on the longitudinal, horizontal and transversal planes).

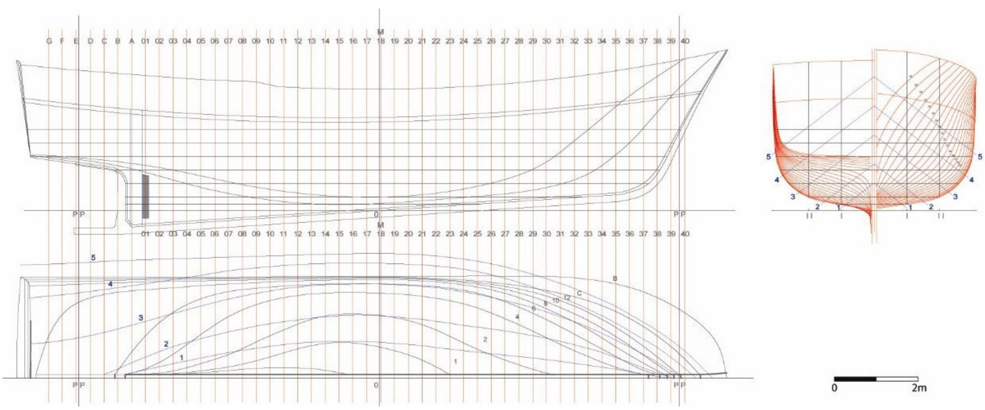

Fig. 3.4. Division and marking of the 40 frame lines
Source: António Carmo

The first frame line to be marked is number 01 (red 01 line on the longitudinal plane), which is leaning on the internal sternpost. In this regard, we firstly mark the sternpost in the design positions, in this case 0.32m, and the internal sternpost, 0.30m (highlighted in blue in Fig. 3.4), from the keel to the deck line. In the same figure we depict frame 01, in its «full» position.

As the frames are doubled, we mark it leaning to the internal sternpost forwards, the size of half of the frame, in this case 0.085m. This line defines exactly the centre lines of frame 01. Based on the markings of frame 01, all others are marked, up until the 40th one, along the longitudinal and horizontal design, maintaining an equal distance between them, which we call *gálimo*, and which is, in this case, 0.30m. In the same figure 3.4, on the right side, highlighted in red, all frame lines are drawn, in the transversal sections' plane.

2.5. The Process of Obtaining the Plane of the Frames' Transversal Sections

Using a wooden stick, we place it on the frame's lines in the horizontal plane and we mark all the intersection points in each water line and from frame line to frame line (Fig. 3.5, lefthand side). Next, all those points are transposed to the transversal sections' plane, and, by joining them with the help of a spline, we get the shape of the frames' lines (Fig. 3.5, righthand side).

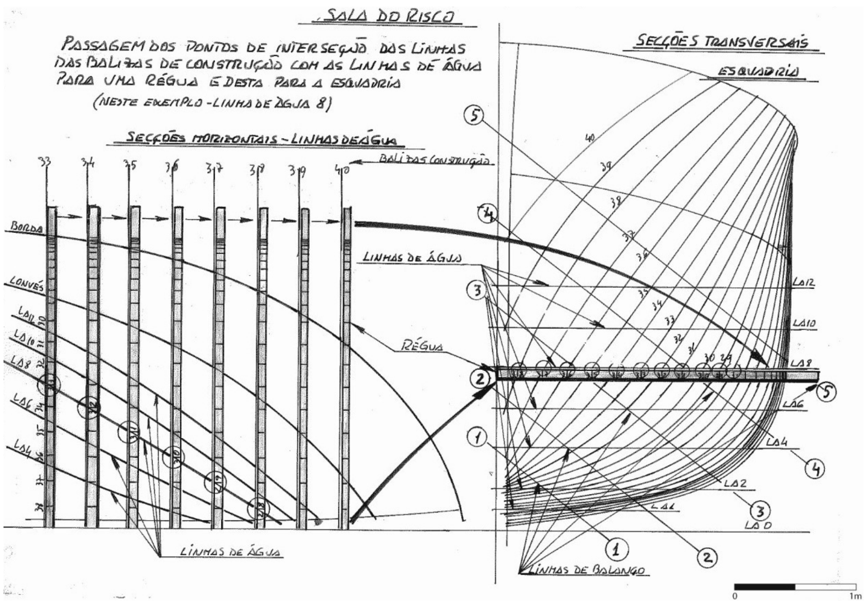

Fig. 3.5. The process of obtaining the plane of transversal sections
Source: António Carmo

2.6. Horizontal Projection of Balance Lines

In Fig. 3.4, righthand side, we can also see, drawn on the transversal sections' plane and over the frame lines, some tilted planes, highlighted in blue, named «balance lines», numbered 1 to 5, and which are transposed to the horizontal plane, as is shown on the process of Fig. 3.6.

The position and slope of the balance lines are determined by the designer in charge of the mould loft. These lines define the places where the connection of the frame parts is made. The distance between these lines is defined according to the size of the timber that is part of the frame.

As seen in Fig. 3.6, righthand side, we place a wooden stick over the balance line (in this case, line 3), marking all the intersection points between the stick and the frame lines on the stick.

Next, on the horizontal plane, Fig. 3.6, on the lefthand side and over the lines of each frame, we mark, using the stick, all points that will define the curves of the balance lines. These lines will be drawn on the horizontal plane to get the slope angles of the narrowing of the frames. This procedure is applied to all balance lines, deck line and border line.

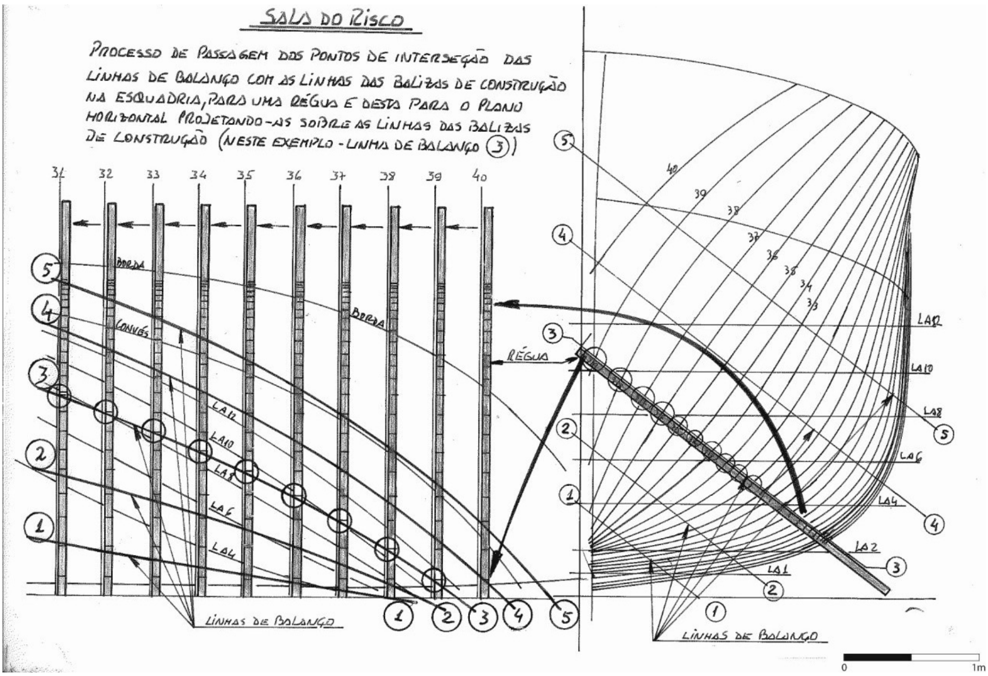

Fig. 3.6. Horizontal projection of balance lines
Source: António Carmo

2.7. The Slope Angles' Wooden Board

On this wooden board, we keep recorded the angles between the frame line with the tangent to the balance line curve at the intersection point with the frame line. We also record the width lines of all the connection parts.

In Fig. 3.7, lefthand side, we can see how, with the help of a sliding T bevel, the angles at the balance lines and all frame lines are measured. Then, these are transposed to the wooden board (Fig. 3.7, righthand side).

On the slope angles' wooden board, on one side, we mark all seven sets of the bow's slope angles (balance lines 1 to 5, deck line and border line). On the other side of the board, we mark the stern's slope angles.

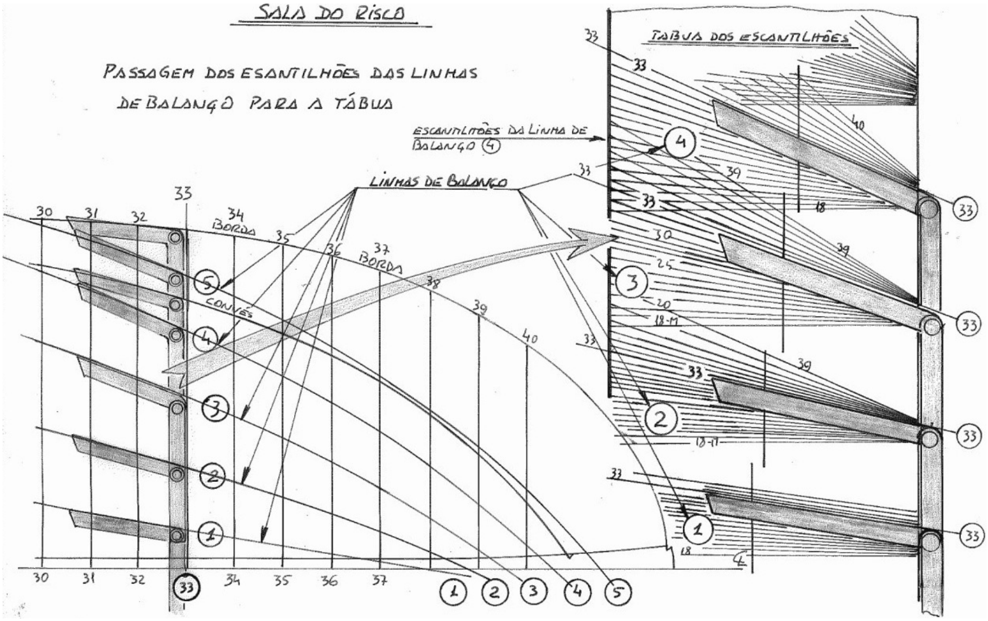

Fig. 3.7. Transferring from the balance lines slope angles to the slope angles' wooden board, between the 30th and the 40th frames
Source: António Carmo

2.8. Process to Determine the Transversal Width of the Connection Parts

This process is divided in two steps that complement each other:

1st — After all frame lines are drawn on the plane of the frames' transversal sections, we place a spline over the master frame's line, in this case number 18, depicting the same curvature. We transpose to the spline all intersection points of the master frame's line with the CL line (center line), with the balance lines (1, 2, 3, 4, 5), with the deck line and with the border line — Fig. 3.8.

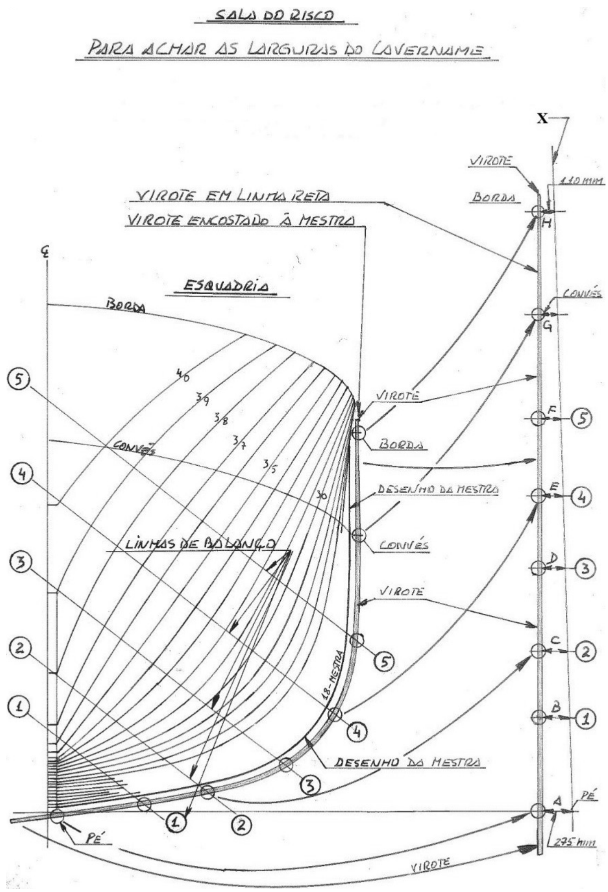

Fig. 3.8. Width extraction to the spline (1st step) Source: António Carmo

2nd — The spline is put on the floor in a straight line (Fig. 3.9). At the *pé do virote* point (spline's foot point — the intersection point between the CL line with the master), we mark in a straight line the width of the frame's foot, stipulated on the project — in this case 275mm. Then, on the other side of the spline — that is, the intersection point between the master with the border line — we mark, equally in a straight line, the width of the top futtock on the border — which, in this case, is 110mm. We draw a straight line between these two points (foot and border). From the remaining points marked on the spline (balance lines 1, 2, 3, 4, 5, deck and border), to the line, we get the B, C, D, E, F, G and H distance values. Those distance values are marked on the wooden board by line segments, parallel to the right side of the board, over the set of corresponding balance lines (Fig. 3.9, righthand side).

The width of the frames we will shape is obtained with the compass at the angles board, over the angle line of the frame we are shaping, with the same angle value, at the corresponding balance line, opening the compass' legs from the board's border until the line segment marked over the angles. Fig 3.9, righthand side, a process we shall delve into further on.

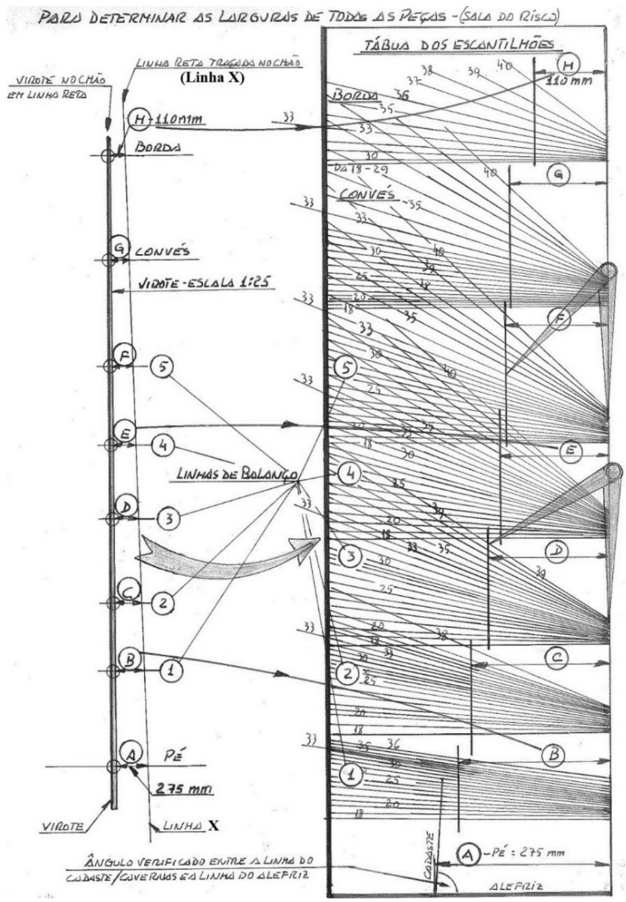

Fig. 3.9. Transposing the widths from the spline to the wooden board (2nd step)
Source: António Carmo

2.9. Execution of the Moulds for Wood Shaping

These are executed in pine wood sticks, with about 8mm thick and 80mm wide. The mould is constructed over the plan of the frames' transversal sections, being composed of three parts, divided by balance lines 2 and 4.

We transpose from the plane of the frames' transversal sections to the mould all the necessary marks to wood shape all frames. In figure 3.10 we can see the set of the bow's frame lines (righthand side) and the stern's frame lines, on the other side of the mould (lefthand side).

It should be noted that the size and quantity of moulds to be used and the position and quantity of the balance lines vary, according to the size of the vessel. This is determined at the mould loft.

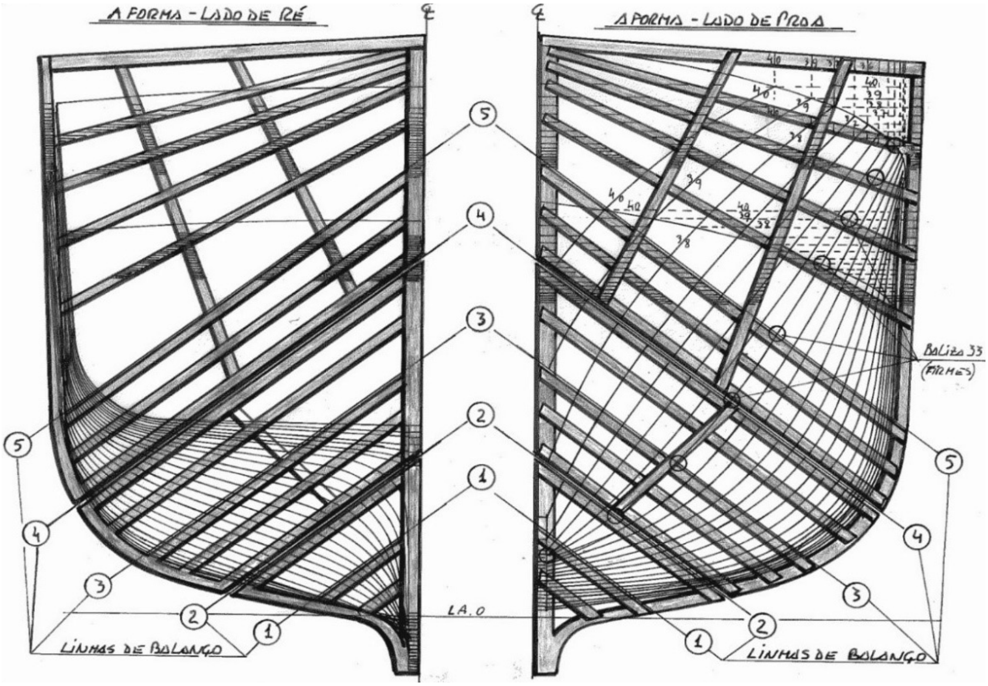

Fig. 3.10. Moulds for wood shaping the frames
Source: António Carmo

The mould is divided in three parts, Fig. 3.11 The bottom one, next to the keel, we call *bico* (lit. «beak»), the middle one, we call *chata* (lit. «flat»), and the top one, we call *grande* (lit. «big»).

The one named *bico* shapes the piece of the connection parts named floor timber (even numbers side), going from one side to the other, between both balance lines 2.

The one named *chata* shapes the piece of the connection parts named second (even numbers side), from balance line 2 to balance line 4.

The one named *grande* shapes the piece of the connection parts named fourth (even numbers side), from balance line 4 to the deck line.

By connecting the *bico* and *chata* parts, we shape the piece of the connection parts named first (odd numbers side), from the centre line (centre of the *bico*, that is) and balance line 3, at the *chata* mould.

By connecting the *chata* and the *grande* parts, we shape the piece of the connecting parts named third (odd numbers side), from balance line 3 at the *chata* mould to balance line 5, at the *grande* mould.

Finally, we shape only with the *grande* mould, the piece of the connection parts named fifth (odd numbers side), from balance line 5 to the border line.

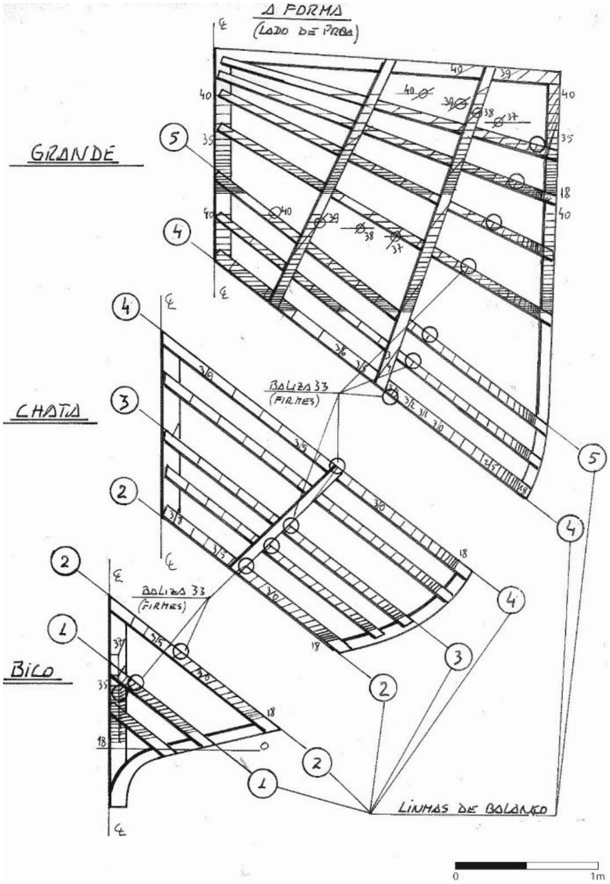

Fig. 3.11. Moulds for wood shaping the frames, apart
Source: António Carmo

3. PROCESS OF SHAPING THE FRAMES

3.1. How to Form a Frame — (Even Pieces and Odd Pieces)

In the previous sections we demonstrated the processes that take place within the mould loft, as well as how to get and make the framework moulds and the slope angles' wooden board. We wil now see how we design the frames using the models — a process called wood shaping.

As we previously said, the frames are doubled, having half of the connection parts for the bow and the other half for the stern. All these parts fit by counterlocking (tops of the connections of the bow's and stern's parts, mismatched and alternated). The position of these tops, where divisions are made, at the same lines where the mould's division was made, are coincidental and determined by the balance lines. We only have a single line available for each frame, called frame line, and it is this line that we use as basis for all the wood shaping process.

Wood shaping consists in drawing that line and 5 more directly on the wood, which in turn enables us to ascertain its real volumetry.

These are the initial steps of all the process. Keep in mind that none of the 6 lines in a parabolic arch that constitute a frame, and that we need to draw on the wood, are equal, making this a highly complex process.

In Fig. 3.12, which details the design of frame 33 in perspective, we can see the frame line (centre line through the external side of the frame), that splits the bow and stern parts, being virtually intersected by the balance lines, intersections which are marked with small circles (numbered 1 to 5) over the frame line. We can also see how the stern's parts are positioned, in this case called evens, and the bow ones, called odds (which we will talk about in the next chapter), as well as the way we determine the joining of the connection parts by the balance lines.

In Fig. 3.13, which pertains to the design of the transversal plane of the same frame, we can see on the left the central face and the splitting of even parts being intersected by balance lines 1 to 5. On the righthand side, we see the longitudinal design of the frame over the keel with the even parts and odd parts joined by the central face.

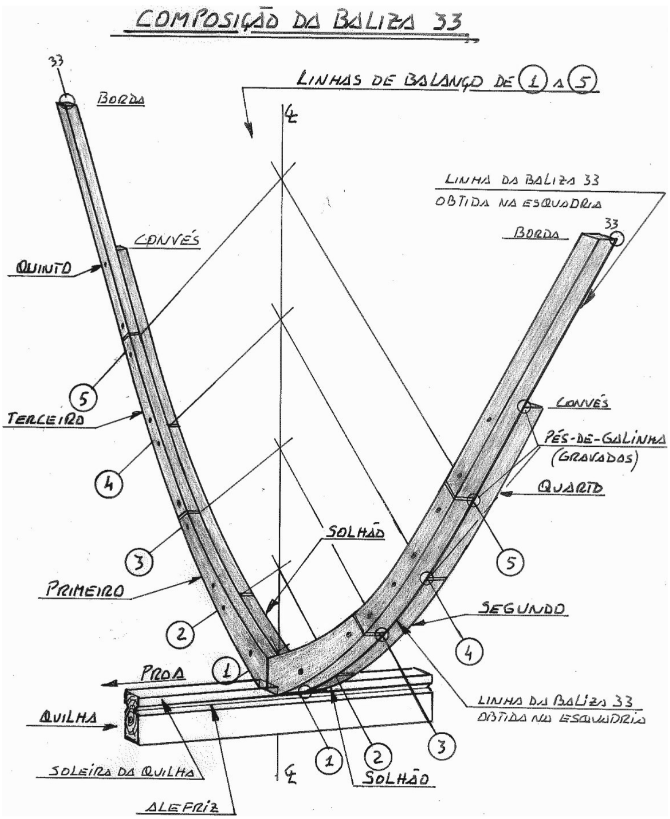

Fig. 3.12. Design of frame 33 in perspective
Source: António Carmo

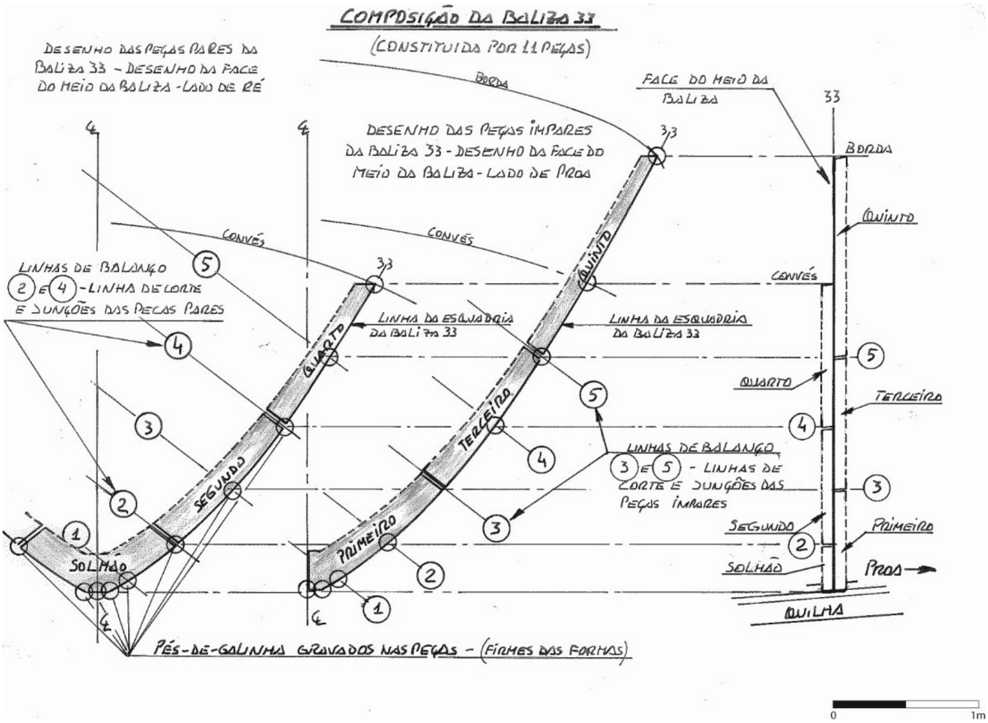

Fig. 3.13. Section in the middle of the frame, dividing the odd and even parts
Source: António Carmo

3.2. Rule of Inversion of Wood Shaping, Slope Angles Inversion and Inversion of the Position Between the Even and Odd Parts, From the Master Frame to the Bow and From the Master Frame to the Stern

The shaping of the frames' connection parts constitutes one of the most complex techniques of all wood shipbuilding. There are a few rules that guide the craftsmen and enable their work to proceed smoothly. Hence, there are rules that define different procedures when shaping the connection parts of the frames from the master to the bow and from the master to the stern. As we have mentioned previously, all frames are doubled, comprising sets of connection parts to the bow and sets of connection parts to the stern. So, it is stipulated that the parts to the set of the frame's connection parts that are facing the middle of the boat are named «even parts», while those that are facing the edges of bow and stern are referred to as «odd parts».

As we can see in Fig. 3.14, in the master frame we reverse the way of shaping.

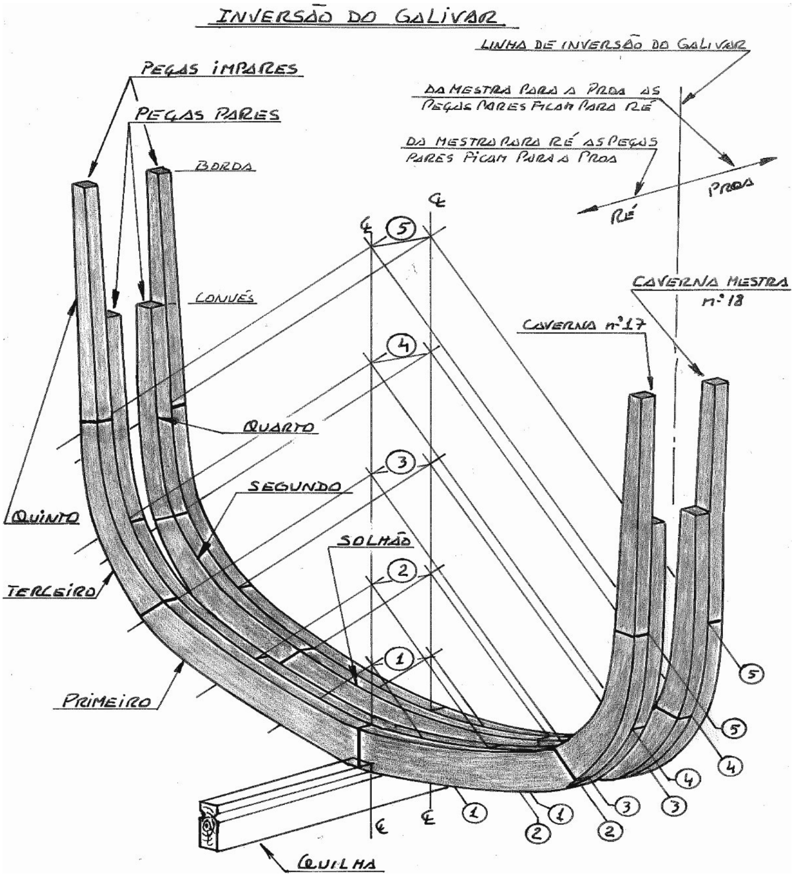

Fig. 3.14. Reversing the position of the even parts with the odd parts in the master frame
Source: António Carmo

As the layout of the hull is wider in the middle and becomes progressively narrower toward the edges, as we wood shape from the frame's middle line (frame line) to the bow and stern and as we always have the even parts facing the middle of the vessel, it's stipulated that to shape even parts, we always use slope angles called *cheios* (lit. «full» — obtuse angles), over 90 degrees. This has to do with the fact that the slope angle that starts from the frame line, of the even parts, faces the stern in the bow's frames, and faces the bow in the stern's frames. Instead, on the odd parts that remain on the opposite side of the even ones, facing the edges, the slope angle starting from the frame line faces the bow at the bow's frames, and faces the stern at the stern's frames, always less than 90 degrees, what we call *sulinhados* (acute angles). This gave rise to a saying, one which is useful to avoid mistakes during the aforementioned process: «the evens are to be used for the obtuse and the odds are always to be used for the acute» (see Fig. 3.15).

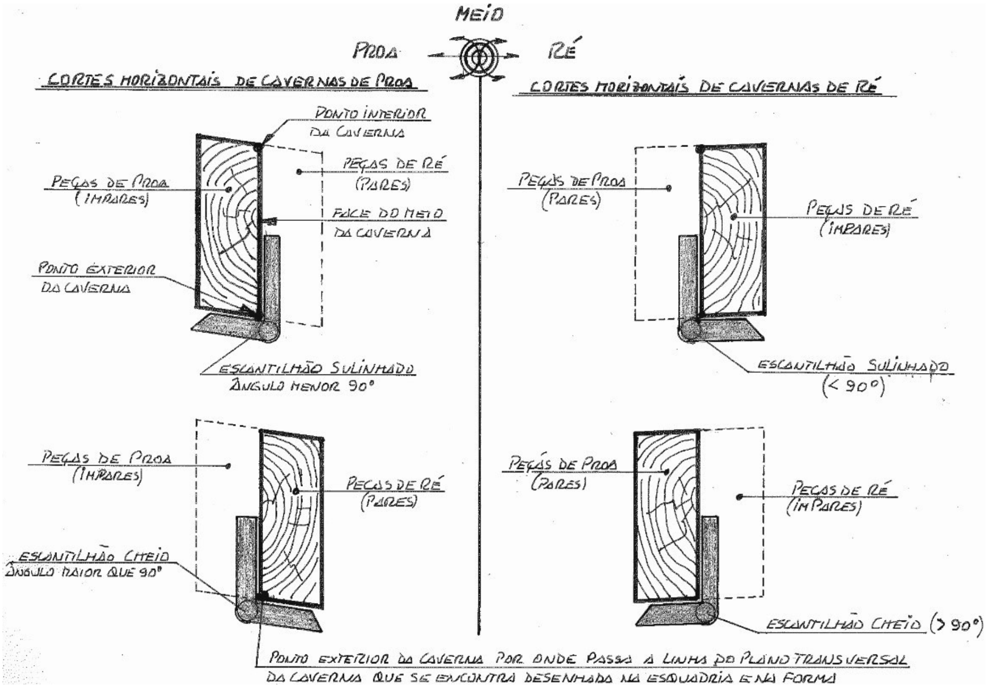

Fig. 3.15. Obtuse slope angles and acute slope angles
Source: António Carmo

3.3. Demonstrating the Wood Shaping of Frame 33

We will now present the process of wood shaping of only one frame, in this case 33, as the process is the same for all other frames, albeit with a different design.

3.3.1. Wood Shaping the Floor Timber of Frame 33

Using the appropriate moulds, we start shaping the floor timber. As we have seen, the floor timber is the only part of the frame that goes through the centre line, serving as a structural connection for both sides.

The first step is to draw in the wood the bow's face of the floor timber, which is also the frame's middle face. As the *bico* only had the design of one side, the other side will be «mirror copied». To mirror to the other side, it's common to have another *bico* that was «mirror drawn» in the mould loft. Both *bicos* are put against each other over the centre line and according to the balance lines, obtaining the total size of the floor timber. Both *bicos* are put on the wooden board, checking if its size is enough, always leaving some room, to the other side, as the part widens to the stern's side. Balance lines 1 and 2 are transferred from the mould to the wooden board and the *chicken feet* (or markings) that are relevant from the exterior line of the floor timber (intersection between frame 33's line with balance lines, centre line and keel width lines, marked on the several marking woods of the mould. Fig. 3.16, lefthand side). Intersecting the points and lines marked on the wooden board, with the aid of a spline, we draw the line facing the floor timber's exterior, facing the bottom of the hull.

We will now draw the line that defines the upper outline of the floor timber, facing the hull's interior. For that, we use the data we have on the slope angles' wooden board. As we see in Fig. 3.16, right side, the slope angles' wooden board shows the widths of the floor timber in balance lines 1 and 2. Using the compass, we take these measurements, which we name B' and C', and transpose them to floor timber wooden board (Fig. 3.16).

Hence, we attain the design of all the bow's face of the frame 33's floor timber (frame's middle face). We now need to draw the other face of the floor timber, its stern face (also frame's stern face).

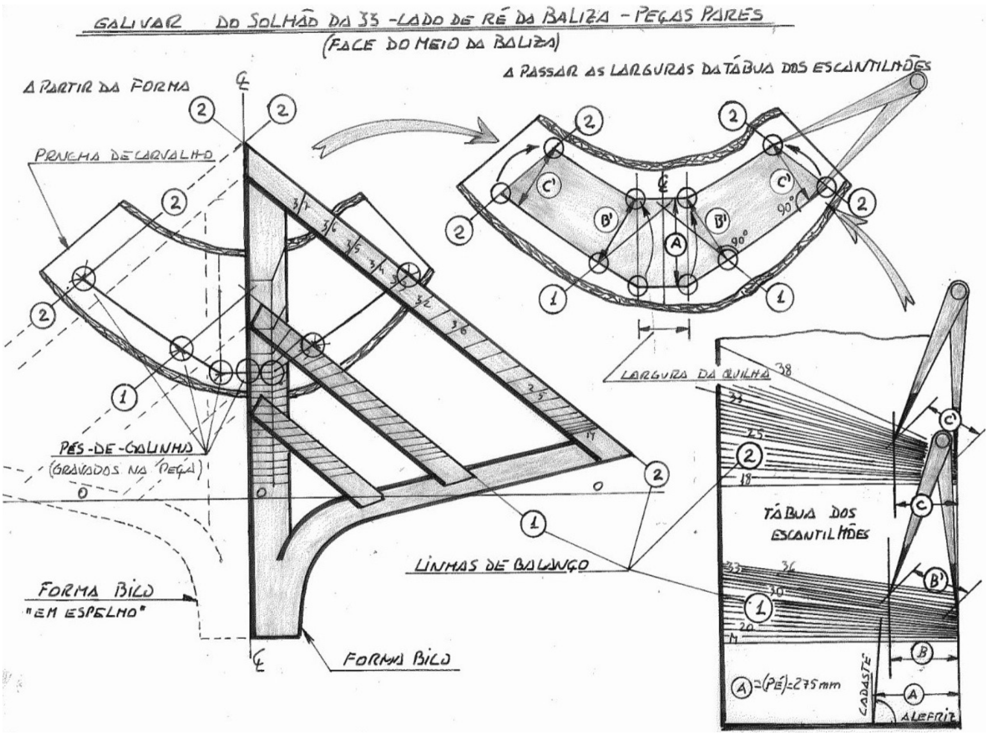

Fig. 3.16. Wood shaping the floor timber of frame 33
Source: António Carmo

3.3.2. *Counterdrawing* the floor timber of frame 33

As the frame 33 is positioned by bow of the master's frame, its floor timber is facing the stern, we will next have to design its stern's face. To the process of drawing the other side of the frame, we call *counterdrawing* (in Portuguese *contralinhar*).

We transfer the keel lines, the middle line and the balance lines from one face of the floor timber to the other, a process made with the help of a U-shaped handcrafted tool we call a *counterdrawing* grid, whose legs enter, with a bit of slackness, in both sides of the part, which allows us to make the concordance of the lines from one side to the other (Fig. 3.17).

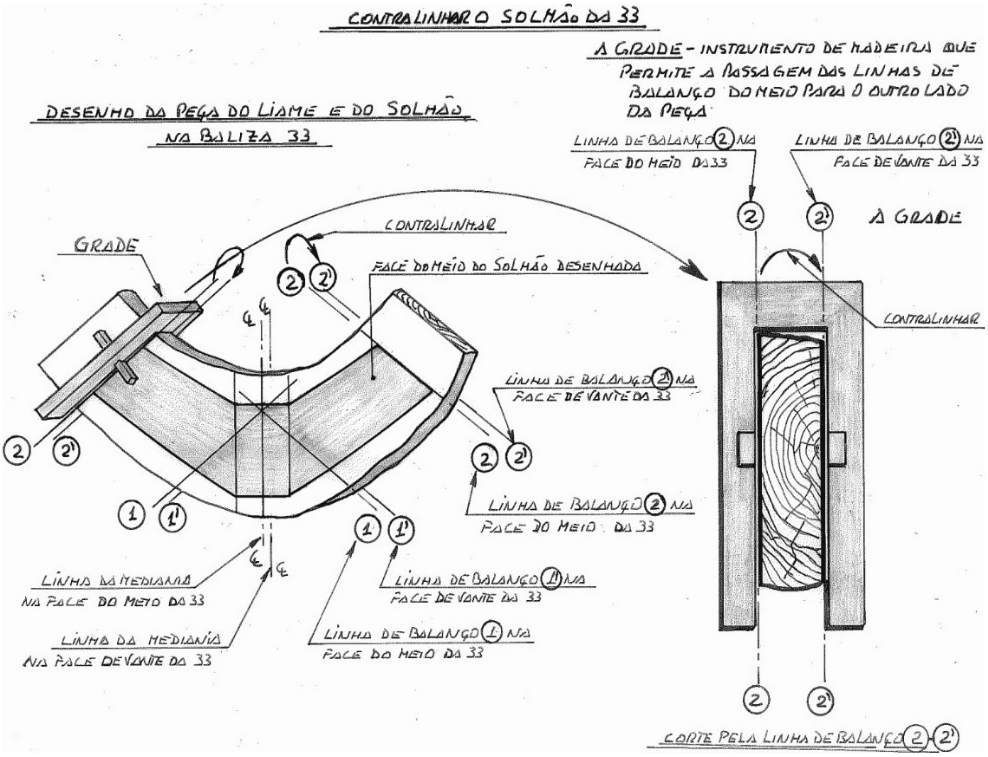

Fig. 3.17. *Counterdrawing* — Image of the *counterdrawing* grid
Source: António Carmo

Starting from the face drawn on the floor timber (bow's face), we will draw the other face, the stern's face of the floor timber (Fig. 3.18). With the sliding T bevel, at the slope angles' wooden board, we «take the angles» of frame 33 over balance lines 1, 2 and foot, bringing the bevel with those angles to the floor timber's board we want to *counterdraw*. We put the handle of the bevel over the corresponding balance line, turning the other side to the side of the face that is to be drawn. The interior part of the bevel's mobile stick is leaned against the wood that is in excess. With the bevel and the compass, we first transfer the intersection points between the frame line and the balance lines to the other side, points of the external outline, as shown in figure 3.18. Next, we measure, with the compass over the balance lines, the width on the line of the floor timber's bow side, transferring it over to the side of the stern. This way, we get the outline of the floor timber's stern face. The board will finally be cut around in the bandsaw, following the lines and slopes designed, making the floor timber set for completion.

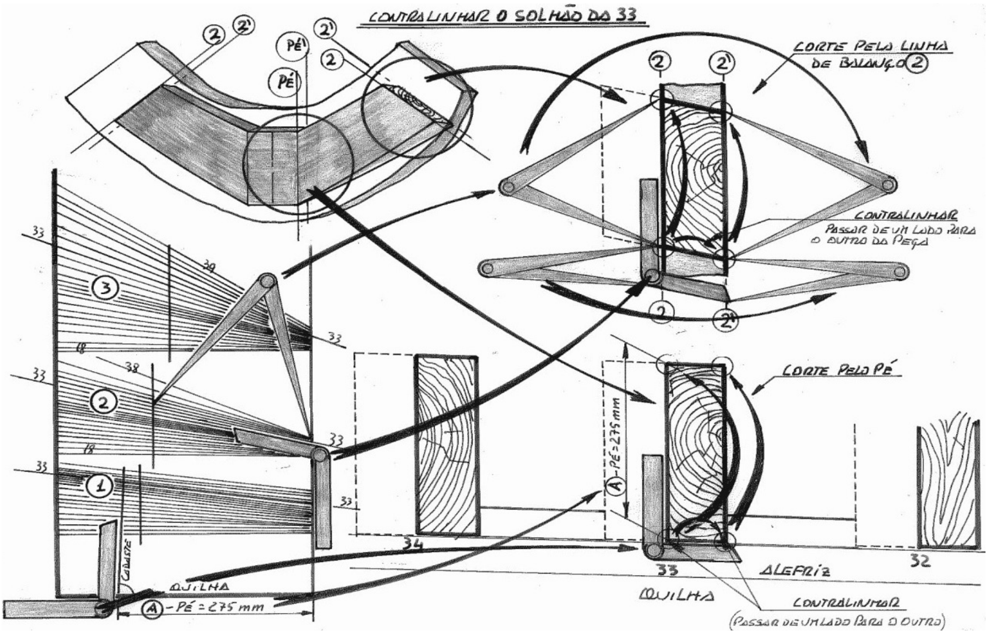

Fig. 3.18. *Counterdrawing* the floor timber of frame 33
Source: António Carmo

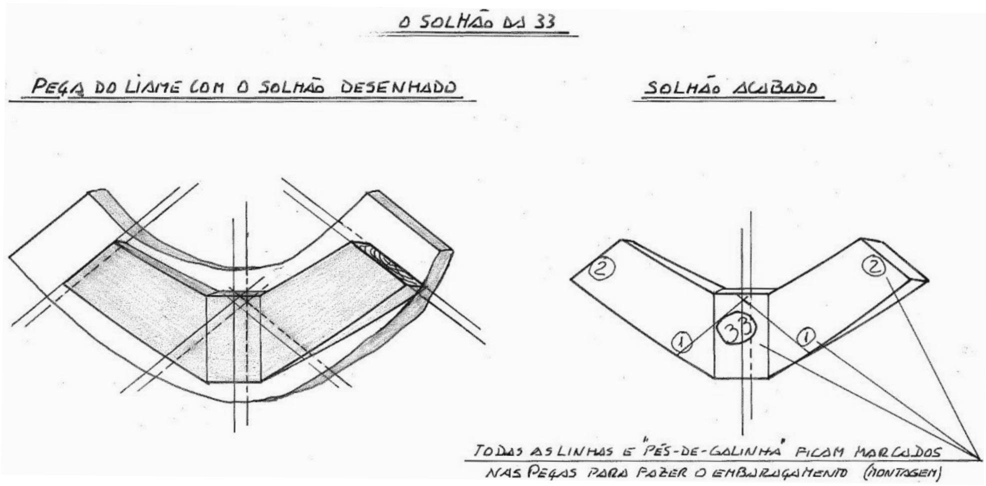

Fig. 3.19. The completed floor timber
Source: António Carmo

3.3.3. Wood Shaping and *Counterdrawing* the Remaining Even Parts of Frame 33

The sequence of the following images (Figs. 3.20, 3.21, 3.22, 3.23 and 3.24) show how to wood shape and *counterdraw* the remaining even parts, which form frame 33 (the second and the fourth). As the process is the same as used for the floor timber, we only illustrate it through images.

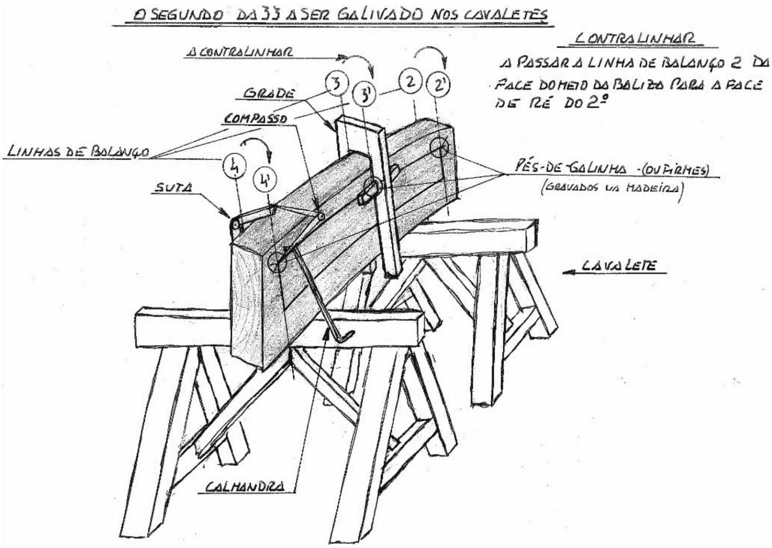

Fig. 3.20. Wood shaping the second of frame 33 at the easels
Source: António Carmo

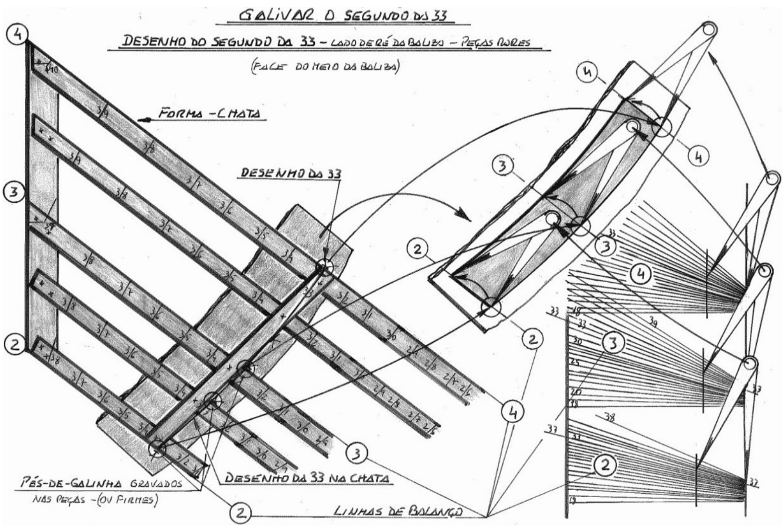

Fig. 3.21. Wood shaping the second of frame 33
Source: António Carmo

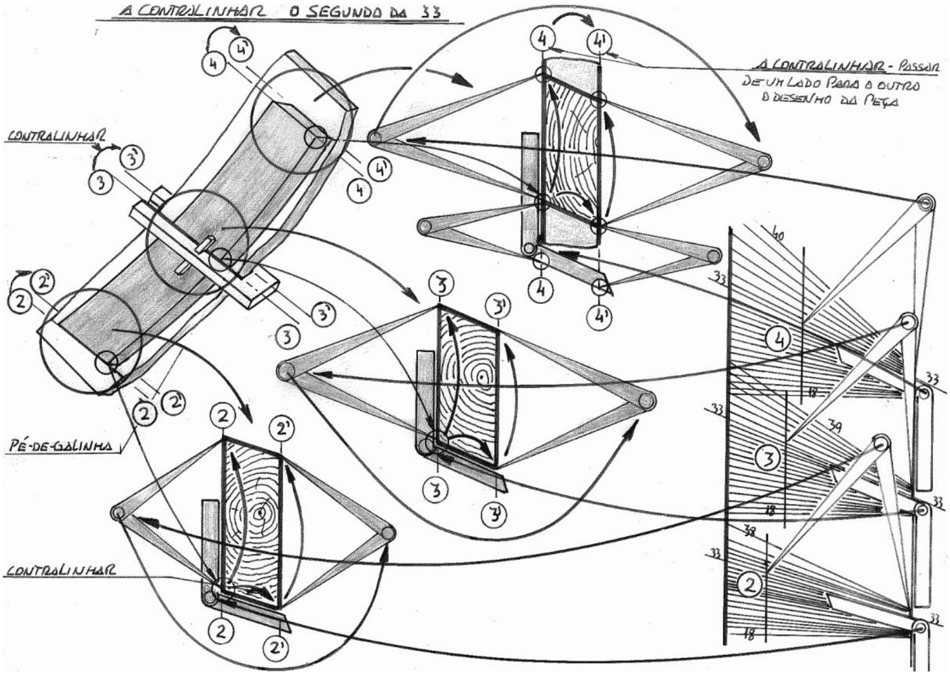

Fig. 3.22. *Counterdrawing* the second of frame 33
Source: António Carmo

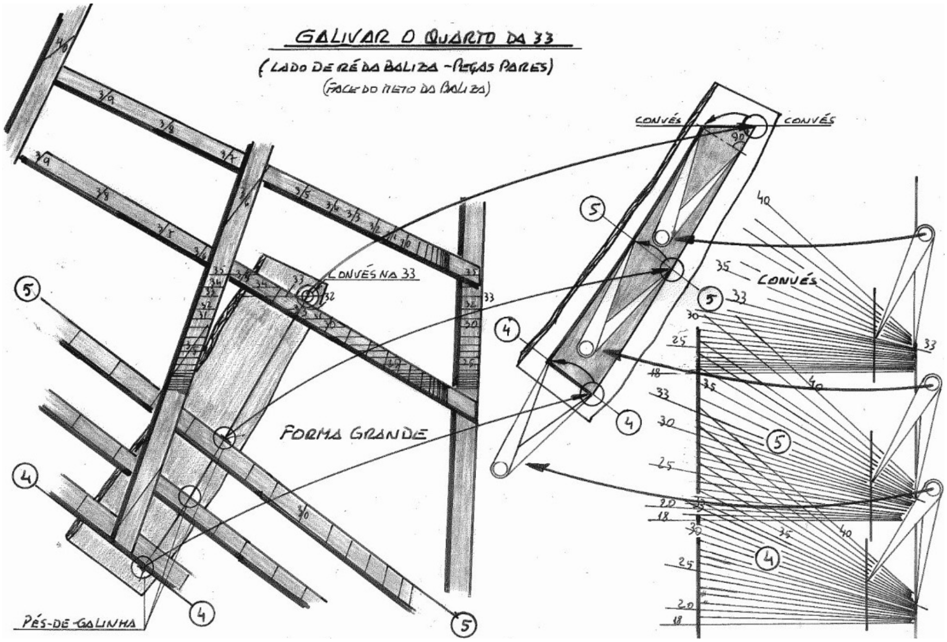

Fig. 3.23. Wood shaping the fourth of frame 33
Source: António Carmo

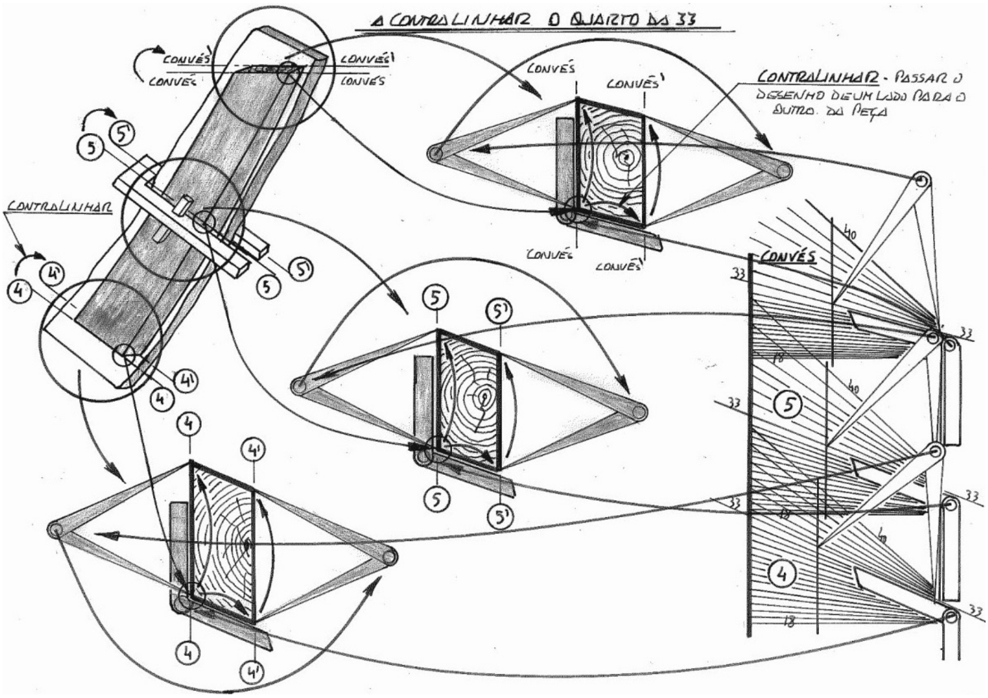

Fig 3.24. *Counterdrawing* the fourth of frame 33
Source: António Carmo

3.3.4. Wood Shaping and *Counterdrawing* the Odd Parts of Frame 33

For the odd parts (bow parts), in this case of frame 33, we use:

- For the first one, the *bico* mould and the *chata* mould — in between the centre line and balance line 3;
- For the third part, the *chata* mould and the *grande* mould, in between balance line 3 and balance line 5;
- For the fifth one, we only use the *grande* mould, in between balance line 5 and the border line (Fig. 3.25).

3.3.5. «Marrying» the Connection Parts

As the boat is symmetrical, we only wood shape the connection parts of one of the sides, using the completed part for mirror copying, a process known as «marrying» (from the Portuguese term, *casar*) and that consists in putting down the completed part on the wooden board used for drawing, serving as a mould. In order to avoid mistakes we wood shape the bow frames of the portboard side (in this case of frame 18 — master), until frame 40, and then we «marry» it to the starboard side. We shape the stern's frames from the starboard, from frame 17 until the panel and then we marry it to the portboard side.

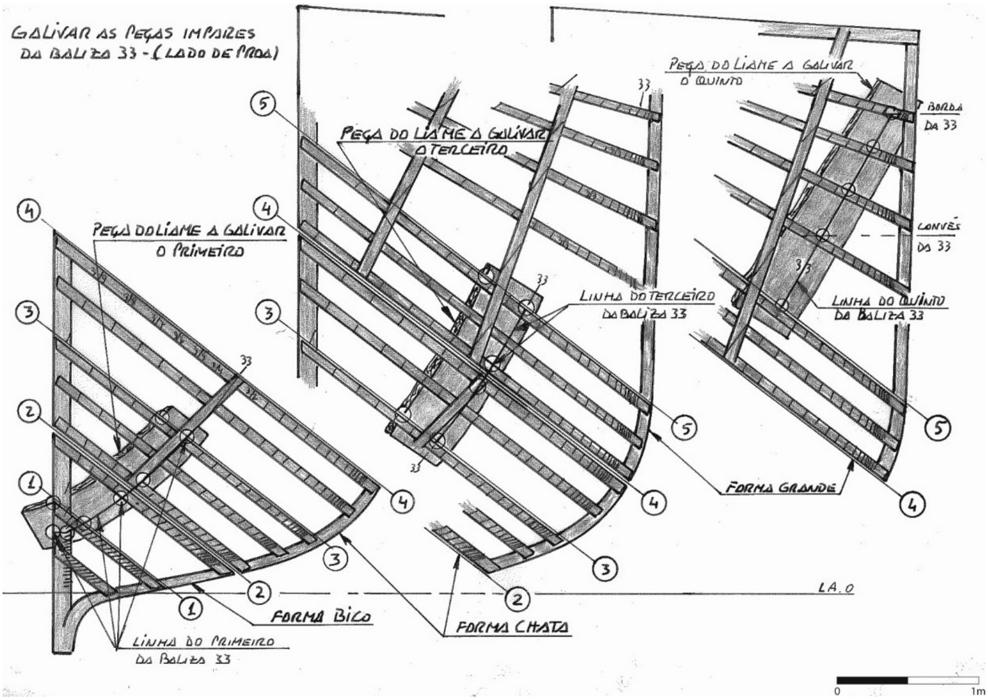

Fig. 3.25. Wood shaping the odd parts (the first, the third, and the fifth)
Source: António Carmo

4. THE FRAME FUTTOCKS CONNECTION

The *embaraçamento* (connecting the connection parts) is the assembly of the connecting parts that were previously shaped.

4.1. The Markings Needed for the Connection

We mark in all shaped parts, all the *chicken feet* (markings carved on the wood pieces, with the balance lines' positions), as well as the frame number, the part number, which also enables us to ascertain whether a given part is even or odd, and the side to which it belongs, so we can easily identify it during the assembly process (*embaraçamento*).

4.2. *Undercutting* the Connecting Parts

In the middle faces of the frame's parts, which are leaned against each other, a small concavity is carved with the help of a plane (tool), in the middle and along all the extension of the parts, what we call *undercut* (*socavar* in Portuguese), so that when all the connection screws are screwed, the union will be perfect.

4.3. The Screws for the Connection Parts

In this case, these are 12mm screws, in zinc-plated iron achieved by the old method of dipping in a hot boiler. The heads of the aforementioned screws are hexagon-shaped and their edges are screwed by female threads, using rings.

CONCLUSION

The work presented here illustrates the technique of designing, the mould loft, the making of the moulds, the wood shaping, *counterdrawing* and frame futtocks connection, only relating to the starting stage of the entirety of the complex process of shipbuilding, using the unique techniques of Vila do Conde's naval carpentry masters. Well supported by the vast amount of knowledge amassed throughout the ages, the technique shown in the present paper is unique, as there are no known records of any other shipyard in the world using this process. As there are type of recordings of it, as it is only passed on by members only to other members of this shipyard, usually from fathers to sons, it is preserved only in the memory of very few craftsmen. The work expounded on here intends to be an effective support effort of traditional techniques of wooden shipbuilding, and we hope it contributes to the preservation of a knowledge that is far too valuable for both our maritime culture and to this industry's future in Vila do Conde and in Portugal.

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