# 5. Finishing and launching the boats

University of Murcia

## Objective

At the end of this module, the student will be able to…

## Duration

20 hours

## Outcomes

1. Understand and manage the terms associated with the completion and launch of the vessel
2. Handle the following tools
3. Know the materials used
4. Perform basic repairs
5. Caulking
6. Complete the deck and all its elements
7. Profile parts
8. Prepare products for the waterproofing of wooden boats
9. Waterproof boat hulls
10. Install auxiliary elements
11. Sanding boat hulls
12. Launch boats.
13. Prime and paint boats.

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# Contents



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# 1. Finalising the hull

The construction of a ship in its final phase entails its preparation for its launching and the beginning of its useful life at sea. It is the moment in which the guarantee of watertightness of the hull must be delved into, as well as the steps prior to equipping it in terms of navigation. The methodology used in its construction, as well as the materials, are decisive at this point and the details must be correctly known in order to guarantee the correct subsequent maintenance of the ship's hull and systems by the crew. It will be the only viable way to keep the basic properties, such as watertightness, and prolong the operational life depending on the type and navigation areas that the boat is going to undergo.

The correct waterproofing of the hull and those elements of the upper works that require it (superstructures, gates, ventilation, etc.), will logically be the first point of this phase in the construction process. In our days and regardless of the construction methods used, we have multiple solutions that will guarantee the waterproofing process both by materials and by facilities in the process itself.

Beyond the fact of building a boat in wood or other materials, it must be understood that the process involves many specialists in different fields and materials. The use of wood, synthetic fibers, metals, electricity, plumbing, electronics, etc. must be coordinated. The compendium of all of them makes it necessary for the riverside carpenter to know how to fit the pieces and make them correspond. For example, it is necessary for a metal worker to advise and manufacture a specific piece that in turn must fit into a part of the hull or the ship that will make it interact with the rest of the infrastructure. A failure in the management of these processes can produce errors that ruin the safety or maintenance of the ship. In this regard, the effect of galvanic corrosion and physical-chemical processes between materials that can lead to material fatigue or leaks and similar problems is known by many.

Focused on the finishing processes and looking beyond any aesthetic finish, it is necessary to understand the effect on the hull of the use of nails of a specific material, with or without protection on wooden boards, depending on its origins and characteristics. Likewise, the patents and putties to be used and their results must be studied, the durability of the materials with respect to the area and use in which they are available, and an endless number of things that will make the difference between a good traditional shipbuilding professional , and a bad manager of this trade.

Returning to the completion of a boat, we will differentiate the aesthetic-functional finishes and trims from the process of waterproofing the hull and deck. The first would encompass both the aesthetics and the uprooting of the ship for its

commissioning and start of its operational life. The second seeks to guarantee the main characteristic to look for in a helmet along with buoyancy: impermeability.

Depending on the method and materials used in the construction, we must apply specific techniques for waterproofing. The process will also be conditioned by whether we use traditional, modern or combined techniques and materials. Except in specific experimental archeology projects, it would be inconvenient to rule out the use of more effective or useful contemporary materials in a process of these characteristics. For this reason, it must be carefully studied how to manage it before launching and during subsequent maintenance, with those responsible being correctly instructed in all possible techniques to be controlled.

It would be advisable for the crew to be aware of this, as they depend on it for daily care or emergency repairs that may occur throughout its operational life. The first step in terms of safety on board is the training of the crew, including those parts of maintenance that can prevent further damage or deterioration. An example could be the problem of a crew that is not capable of guaranteeing a hull repair that puts its tightness to the test because they are not capable of dealing with leaks or leaks generated by caulking failures.

Reducing waterways not only seeks to avoid, logically, the non-flooding of the ship. It is also about avoiding humidity in the environment, thus guaranteeing the extension of the useful life of the structural elements and components of the ship. For this reason, once the launch has taken place, the impermeability control must be maintained at the necessary levels for this to be an effective part of the maintenance process on board.

As we mentioned before, in the stage of completion of the ship, it will also be necessary to prepare the assembly of those elements that are going to be required in terms of safety on board or that may compromise it: fire-fighting elements, specific assemblies, additional watertightness guarantees, tanks and services, etc.

Most of the safety and rescue elements must be prepared in the post-launch stages and based on certain aspects to be determined (navigation areas, crew, ship characteristics...). However, most of this work must be foreseen a posteriori to facilitate the necessary assemblies. We would be referring to conduits, pipes and those spaces that are necessary by forecast to present on the ship for the aforementioned purposes. It will therefore be the job of the engineering team and constructors to foresee in the design and construction the disposition of equipment and elements in this regard, following what is established for this purpose by current regulations under the control and surveillance of the maritime authorities.

Likewise, anticipation in the installation of this type of system will save time and work in the development of the construction process, not being the first time that severe structural changes must be undertaken in order to provide what is necessary in terms of maritime safety. From the smallest boat to the largest vessel, these days, it is required to comply with these requirements in order to be approved for navigation and functions that it must present.

## 1.1. Caulking

Caulking is the hull waterproofing process consisting of filling joints and joints with those materials required for that purpose. Traditionally, and especially focusing on the construction of wooden boats, the caulking process was vital in the completion of a boat. Through the use of tow and other natural fibers soaked in pitch, the different gaps between the planks and joints of the hull were filled in order to subsequently putty and paint with the necessary patent.

Logically, steel constructions and modern fiber constructions save time and facilitate processes with almost de facto seals in the process itself. However, even in these cases it will be necessary to review those areas that require it or prepare them in order to guarantee that there are no leaks or leaks using welding or various solutions. For terminology purposes this would not be considered caulking, although the process has the same effect: to waterproof the hull. In the case of fiber boats, it is usual to focus on caulking on the deck or wooden superstructures arranged on the hull that require it. For these cases and in recent times, sealants and synthetic putties are used. It maintains the term at this point but moves away from the original procedure.

With all this, it must be understood that the caulking process is directly linked to wooden boats. It is a fundamental point in the construction process and must be carried out by a person who is knowledgeable about the procedures in this regard. For this, the necessary tools and materials must be used, without ruling out the most modern techniques and materials that can facilitate the work and provide greater guarantees in the sealing of the ship. In the next few lines we will talk about caulking in wooden ships, but it is necessary to emphasize that a riverside carpentry can take care of the maintenance or construction of boats made of metallic or synthetic materials. It is necessary to know how to work with them in order to find effective solutions.

In this process, the figure of the caulker becomes important, having to be treated as an independent person from the riverside carpenter, although closely linked and with an extensive tradition in the sector. The caulker will be the specialist in charge of the caulking process. Although he can and should be a shipwright at his base, he

specializes in the waterproofing process focusing on this task throughout the construction of the ship or boat. As traditional as this figure in riverside carpentry is the material representation of the process that he executes: tow and pitch.

The tow, along with other natual fibers[1], it was the main element to be used in caulking, being introduced in the joints and unions after being prepared by reaming, stretching and preparing the balls. The concept will refer to the preparation of filamentary braids, with a touch and visual similar to wool but composed of vegetable fiber or recycled from old textiles and ropes. The preparation of the same would begin with the weeding or separation of the fibers to prepare the braid to the desired thickness. Subsequently, they will be stretched by joining sections to prepare cords of variable length and with the necessary thickness, collecting them in balls of 1 or 2 tens of meters. It will be necessary to consider that said ball must maintain the guarantee of malleability of the tow braid, so it should not be pressed or tightened, keeping the tow "soft" and without many turns.[2]

Pitch or tar would traditionally be used as a dual-action substance together with the tow: it protects the fiber and the joints of the wood against the effects of constant humidity and facilitates waterproofing. To do this, the tow was tarred and, in certain parts and after the introduction of the tow courses, the joint above them could be sealed with pitch.

Nowadays it is common to see how certain synthetic materials have been supplied to the pitch, with a better result in the process. The minium[3] or the galipote[4], are predominant in caulking. With a more modern character and of synthetic origin, we will see certain polyurethane or epoxy putties and preparations that allow them to act as sealants on planks and decks. We will emphasize that in modern constructions of boats and fiber boats, waterproofing and even caulking of decks and areas built in wood are still necessary. In these latter cases, the traditional process is not followed and the process goes directly to filling and sealing with the putties and sealants mentioned above. This would be the case, for example, of teak decks arranged on yachts from small to large lengths or on ships that require or must waterproof some part of the dead or live work.

[1] Hemp fiber has proven throughout history to be the most suitable for preparing tow with which to caulk. Its durability and resistance to the maritime environment is hardly matched by other fibers (linen, cotton...).
[2] López Martínez, J., Moreno Sorli, F., Mejías Tavero, J. C. (2014). *Libreta de notas de un Carpintero de Ribera. Un Oficio y una vida en el Cabanyal*. Valencia: ADD Editorial, pp. 137-139.
[3] An iron-based paint or paste commonly used to paint metals for its protective characteristics. Given its pasty character and its properties, it has supplied pitch for decades in caulking.
[4] Oil-based preparations in which they are mixed with tars and oils, wood fibers and other elements to paste.

In addition to the materials to develop the caulking, the caulking will use a series of its own tools that are also characteristic. Part of the base of any carpentry: hammers and mallets, chisels, chisels and gouges, files and brushes, saws, etc. But if something characterizes the caulker it is the use of the mace together with the different irons. As *irons* we will know the different metallic tools that are used to open the joints, stuff the tow and attack it in the different rows until the end of the process. Some would be intended to open the joints, others to introduce the tow between boards and others to "attack" it or press it in the different courses.

Likewise, their shapes will vary to adapt to the part of the hull that the caulker must attend to, having curved and flat shapes to facilitate application. Thus we will find *irons to open* or *avian*, which will allow the planks to be opened. We will also identify *channel irons*, with one or several channels, designed to attack the different courses together with other *blades and irons* designed to introduce the tow in smaller areas or even extract it from the required joints. In order to be able to remove the previous joints or rows, for example in maintenance and new caulking, we will have irons and hooks to remove tow and clean the joints.

The correct maintenance of the tools corresponds to the caulker himself, depending on his care the delicate completion of his work.

## 1.2. Brief description of the process of caulking a hull

The waterproofing process of a wooden hull must be carried out with awareness of which part of it is going to be worked on. Following notes of different riverbank carpenters throughout the Iberan Peninsula[5] and focusing on the case of those of the Cabanyal,[6] in Valencia (Spain), The process in caulking the ship's lining will not be the same as that in belts, rails or covers. The number of rows of tow will depend on each part and the different types of wood, as well as their thickness, as well as the type of application that will be given.

Starting from the finish of the lining, the joints of the planks would be opened with chisels and irons to open, thereby enlarging the joints for the introduction of the tow. Understand that if it is not done and despite the wood appearing “together” at first glance, there is an open passage for the water between the boards. The introduction of the tow seeks to reduce or close this opening and facilitated the subsequent caulking and painting to guarantee correct impermeability. A couple of millimeters that at first glance may even seem non-existent supposes a waterway open to the interior.

[5] The different studies and compilations carried out in the Basque Country in the last decade are noteworthy and are reflected in the execution of projects for the recovery of the Ribera carpenter's trade in the region. https://www.gipuzkoa.eus/es/web/aintzinako-lanbideak/calafateado.
[6] *Ibidem*, pp. 137-159.

The type of wood was decisive in the process of opening the joints. A softwood may simply require the introduction of irons to open. However, in harder woods it would be necessary to prepare the boards beforehand, leaving previously carved channels to facilitate caulking. The thickness of the table is also decisive at this point. A lining board of 4 centimeters should not be treated the same as one of 7 or less, requiring the use of specific irons throughout the process.

Taking the above into account, we could summarize the process in the following phases:

1- It begins by enlarging the joints and preparing them until they have the desired dimensions to be able to introduce the different rows of tow. The millimeters of opening, as well as the shape of the opening, will depend on whether it is caulking between lining strakes, joints to structural parts such as the stem or stubs, whether they are belts or rails, or covers. For this point chisels and saws will be used if necessary.

2- With the opening or avian irons, it will be deepened as far as necessary, according to the sizes depending on the wood, area and diameter of the planks used.

3- It is opened up to the frame using the previous tools.

4- The required rows are introduced, starting with a long row and then the overlapping ones, which will be stuffed into the joint with the different channel irons as required.

5- Putty the joint and prepare for subsequent painting. If it is the living work, you should think about the application of patents. In the dead work, the paints and varnishes that protect the hull assembly from the elements must be taken care of.

## 1.3. Closing the hull and other miscellanea finishing

We can summarize the completion process in the following lines, emphasizing that once the hull is finished as a whole, it must be closed at the top with the deck and the inner linings. In the case of boats without a deck, it will be necessary to reinforce the structure on the inside with the installation of a plan on frames and interior linings if necessary. Logically and by construction, we will see in the construction of ships and boats that the closing with an upper deck and the preparation of the interiors in the accommodations and rooms that are required will thus be foreseen.

In the latter cases, an inner lining will be used that offers greater integrity to the hull, as well as being able to install the bulkheads, struts, beams and any other element that is necessary in the layout and internal functionalities of the ship. Although these internal linings should not require waterproofing for outdoor use, they must be

prepared and stored for humidity, being a second line of protection in the hull both at an integral level and for habitability.

The plans (floors) of the ships must be arranged with mobility, especially in those situations in which they must give access to the different bilges of the ship. It is important to understand that a bilge does not have to be dry or completely devoid of water. Its main function is to collect, due to its position in the lower part of the hull, any liquid that seeps into or emanates from it. Of course, we will always consider the lack of liquids in the bilges as ideal, and this will mean that the general tightness of the boat is functional. In any case, the access, review and control of the bilges will allow us to keep track of the accesses, leaks and waterways, as well as possible spills or losses of carbides or oils (for example in the engine rooms). For all this, in addition to the periodic review, electromechanical and manual bilge pumps will be installed, as well as other bilge elements will always be available in case they are needed.

Regarding the roofs, they will be installed on a series of structural elements called beams, which must have been calculated and prepared for the function they perform. Being a structural part and being treated as such in the construction process, the joints to the frames and all of these joints to the rest of the structure (lining, belts, rails, sleepers...) must be reviewed. The part we would care about the most is that they hold the hull latch at the top of the deck.

The roof will be arranged in different boards or boards that must be treated correctly and must be waterproofed to prevent water from entering the interior. For this, the caulking process described above, and the application of the relevant sealing techniques will be followed. Likewise, the planking will be treated as appropriate in the exterior roofs due to the duty to guarantee its resistance to the elements.

Completed and closed, the preparatory work will continue inside and outside, preparing for its launch. It will be time to start refining the parts that require it. For this, the parts that will be required will be sanded and prepared to paint. The use of primer and the correct execution of the application of paints and varnishes will not only allow a good visual finish of the boat but will also favour the effective protection of the hull and its parts against the weather.

Nowadays there are many paints, varnishes, patents and primers for naval use that give a full guarantee. However, the correct application will depend on the shipbuilder's training in this regard, as well as being aware of what is needed in each part. For example, the need for a good patent on the hull after caulking and puttying will give us effective protection against anything that attacks the boat from the water and can reduce the integrity of the lining and structure. The effective maintenance of

the hull in this sense, with periodic strandings where the hull is cleaned, sanded and painted, will also allow better performance of the boats in navigation.

Deadwork and structures must also be protected and built accordingly. Not only functionality will be sought, but also that they withstand the ravages of the sea, constant humidity, the sun and all the elements of the marine environment. A good base execution in the construction, as well as a constant and correct maintenance, will prolong the useful and operational life of any ship.

# 2. Launching

Launching is a process in which, as a general rule, the boat is not completely finished, producing its completion with the boat afloat in most cases. As was the case in the golden age of sailing, large ships were launched without rigging and were later placed using the rigging machine.

Currently, when launching a boat into the water, there are three types of systems: longitudinal, sideways and float launching.

## 2.1. Side launching

Launching with the system called "side or lateral launching" is the most modern of the three, in Spain it is not very common but on occasions it has been done. It is a technique that is used with the boat built in its entirety, moving the hull seated and secured on the launching bed, forming this set the slipway and imadas.

Until the moment of launching, the ship is secured with cables, braking systems that, together with the launch keys, prevent any movement of the ship that could cause a disaster.

At the time of launching, the boat is only supported on the skids, which slide with the boat sideways towards the water on the bed impregnated with grease for the best sliding of the skids, until the boat enters the water of side stand.

This system is basically used when there is no space for the boat to slide safely or due to the lack of depth necessary to enter from the stern, which is why it is normally carried out in lakes or rivers.

In Spain two very different dates are indicated, the first in the 18th century and the second in the 20th century. According to Díaz Lorenzo, in 1731 the ship Hércules was launched from the side in 1731 at the Carraca arsenal "the entire royal family officially visited it in 1731, when the ship Hércules was launched from the side, with 60 cannons" (2018, page 68). However, Villa Caro writes that in Spain this technique was used in the 20th century "In Spain, this method was used around the 1960s" (2020, p. 936) carried out by the Tomás Ruiz de Velasco shipyard.

**Image 1. Where the launching of a ship from the side is represented. On the right we can see the launch bed (La "BOTADURA": el nacimiento de un "BUQUE", 2020).**

## 2.2. Longitudinal launching

Of the systems used today, it is the oldest when it comes to large ships, since small ships do not require these systems to introduce them into the sea.

The nao factory has been carried out for many years on the same beach, looking for areas where the depth would allow the boat to be launched without running aground. Over time, the means in the manufacture of ships were improved, allowing the technique to be improved, although the ship's failure was very difficult to avoid, causing the keel to lose its straightness due to the failure.

The problem generated by carrying out the riding schools on the beach is the launching of the boat into the sea, since it had to be introduced into the sea at a sufficient distance so that the work area would not be flooded with the rising tide.
At the beginning of the 18th century, the launching of large ships was already highly evolved with a system that allowed the ship to be moved through the sand from the beach to the sea by mechanical means and sometimes with the help of draft animals.
In the first quarter of the 18th century, launching was done with the bow towards the sea, the stem being the first part of the ship to enter the waters.

**Image 2. Boat on the riding stables before preparing the base for the boat to the water of the boat (Navarro, 1995, Lámina 15).**

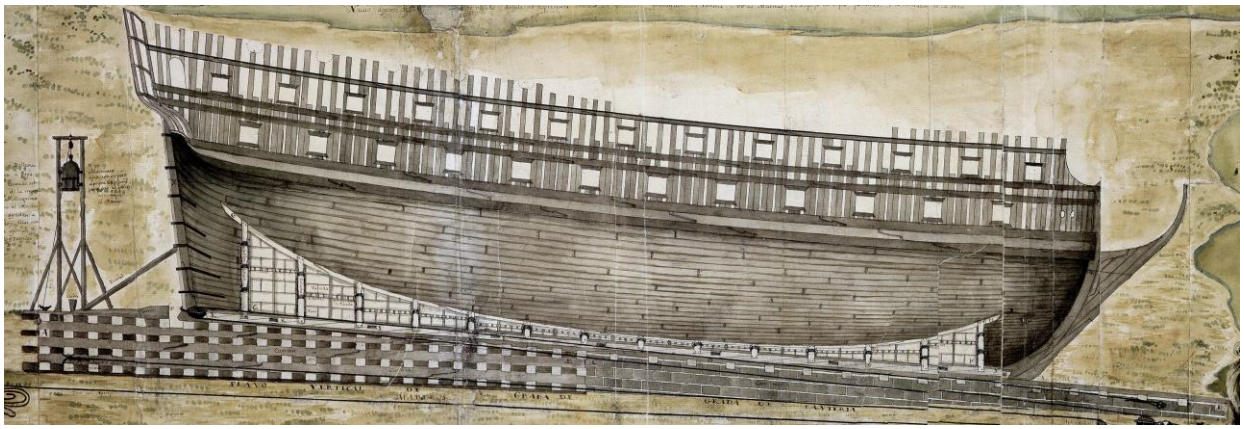

**Image 3. Warship from the first quarter of the 18th century prepared in slipway to be launched with the bow facing the sea (Navarro, 1995, Lámina 16)**

Before launching, the preliminary required a study of the land to verify that it can withstand the weight of the ship and the subsequent construction of the bed to launch the ship into the water and once selected, the riding arenas began to be placed.

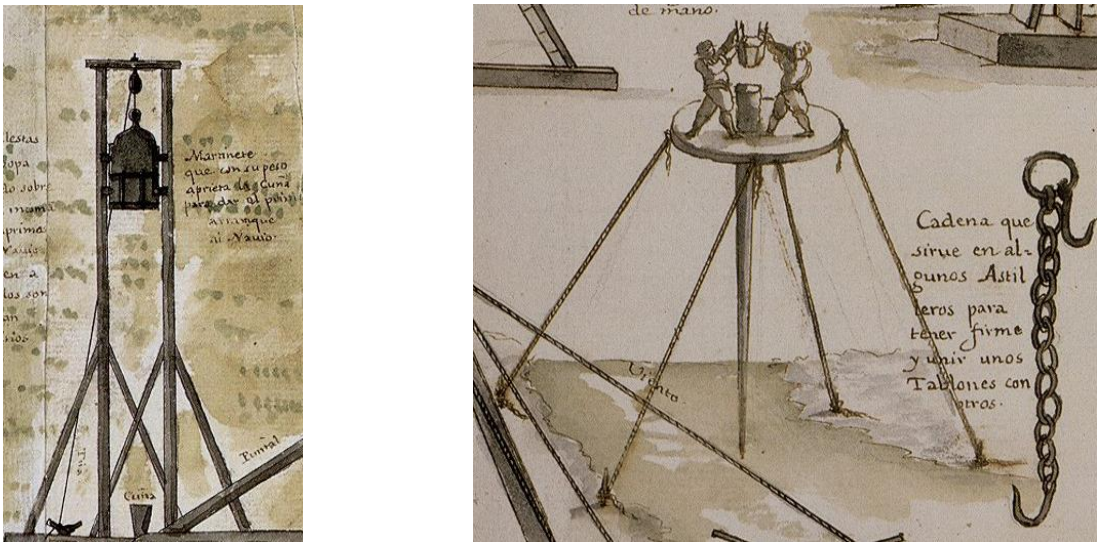


**Image 4. Images that represent the use of hammers for driving stakes. On the right with a manual use of the pile driver.**

At the time of carrying out the review of the land, its compaction was taken into account, carrying out for this verification through holes or driving stakes with a pile driver, thus verifying the reliability and compaction of the land.

The draft was studied in the place where the ship is to be launched, the inclination, checking with calculations the degrees of fall that the slipway must have with respect to the weight of the ship in order to extract data that allow them to know the strength and resistance of all the elements that participate in the action, such as rigging, levers, wedges and, not least, the personnel that have to carry out their work in the launching under the orders of the engineer.

When the terrain does not have the necessary characteristics, but there is no option to search for a new location, it was artificially consolidated. It is made with crossed logs that serve as a firm seat for the imadas to later secure them with bolts, placing the riding stables between log and log. If when giving the inclination the timbers that form the riding arenas are very high, a stand is made with timbers or stonework to be the base of the imadas or based, because this bed or based requires more width than the riding arenas.

To get a more graphic idea, let's imagine that the imadas are the train tracks with a certain length and width between them. Now they tell us that a ship has to go along this route, well, on the tracks we would place a kind of platform wagon, the eels being the wheels of the wagon that will go on the rails of the track and so that the boat does not fall off the wagon we will make a settlement where the bottom of the hull rests without gaps and well supported, being embraced with the structure up to plan height. In this way we can move the ship on the wagon without it falling.

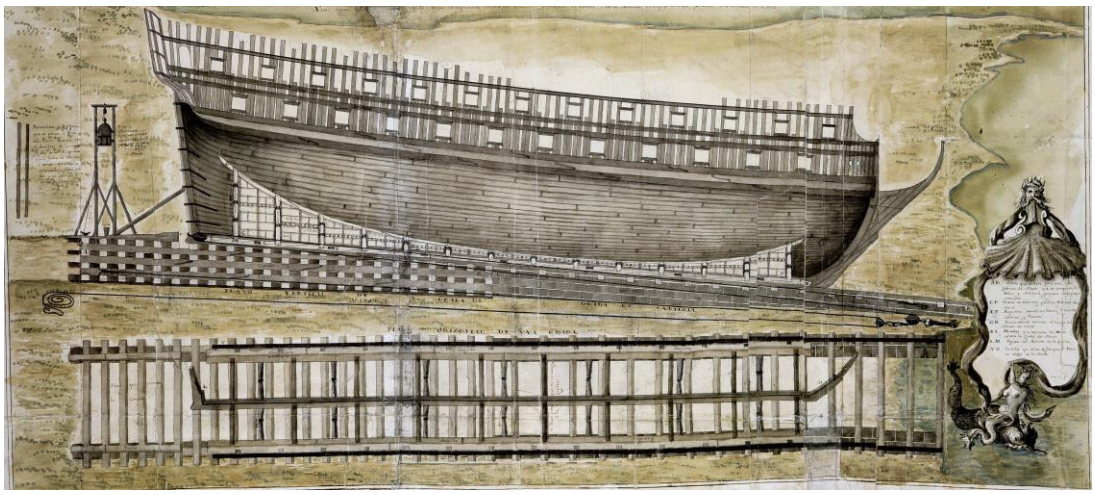

**Image 5. Representation of the one based on imadas, eels, columns, vessels and other elements for the boat overboard with the bow towards the sea, it could be alternated by launching it from the bow or stern into the sea, the latter being the one that required the most draft (Navarro, 1995, Lámina 16).**

Sometimes and depending on the country, if it is not possible to achieve a safe settlement due to the type of terrain, the base is carried out considering the weight of the unfinished ship, the ship is launched once it has been structurally finished up to the sleepers of the second battery and lined the hull up to the batyport of the main deck, that is, above the main girth. Without placing the setbacks that complete the upper deadwork, managing to reduce a fifth of the total weight of the boat but with the risk of breaking because the entire structure of the vessel is not well reinforced (O-Scanlan, 1847, pág. 189).

# 3. Description of the necessary elements for a boat to the water from a ship

To make it easier to understand the process of preparing and launching a ship in ancient times, we will describe the different elements that can intervene in the launching of the ship.

## 3.1. Picaderos

The picaderos are some pieces of wood that are placed at a certain distance along the keel of the boat, providing a straight base and with the inclination that is needed for the subsequent launching into the water.

Each riding school is made with thick and strong timbers placed one on top of the other and bolted at their heads in the form of a pyramid, its height will depend on its location in relation to the keel. Depending on whether the boat is launched with the stern or the stem into the sea, the lower riding school is closer to the water.

As a general rule, about 30 riding arenas were placed with a thickness of 16 inches (37.15 cm) with a clearance between one and the other of 4 (8.28 cm) feet (O-Scanlan, 1847, p. 190). Its width is approximately 1/6 part of the beam of the ship or frigate that you want to launch into the water and sometimes the base wood is lengthened to be able to base the imadas.

Between the keel and the riding ring some wedges are placed that will serve to rectify the seat of the keel and to release the keel from contact with the riding rings when launching, thus remaining free of any friction against the riding rings and being the hull already attached with the launch system.

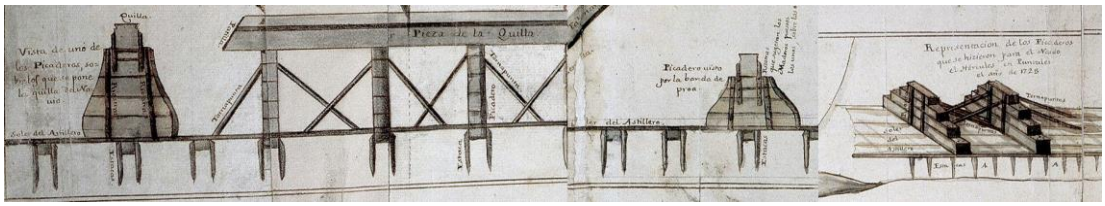

**Image 6. Representation of how the riding arenas are placed on a wooden base with struts for better settlement on the surface. In the image on the right we see the riding arenas used for the Hercules ship (Navarro, 1995, Lámina 8).**

## 3.2. Imadas

They are a series of thick and long logs that are placed parallel throughout the length of the ship on both sides to the water with a width of approximately a quarter of the ship's beam in slipway. These timbers establish the route of the hull in its descent towards the water, being the base where the eels will later slide to precipitate the ship towards the sea in a controlled way.

To give strength to the set of imadas, logs are crossed from one side to the other between the riding arenas, without the upper face of the imada reaching the same height as the riding arenas and taking into account that the eels will go on top.

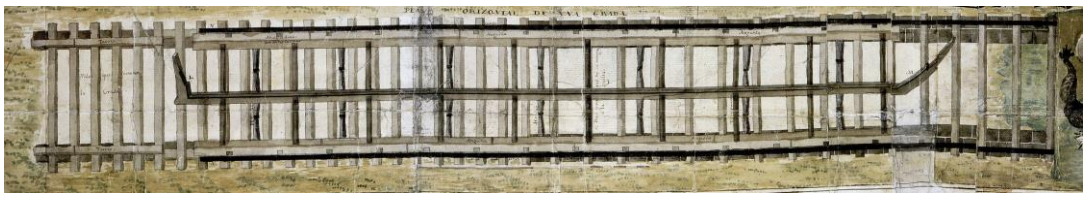

**Image 7. Representation of a boat based on the water of an 18th century vessel (Navarro, 1995, Lámina 16).**

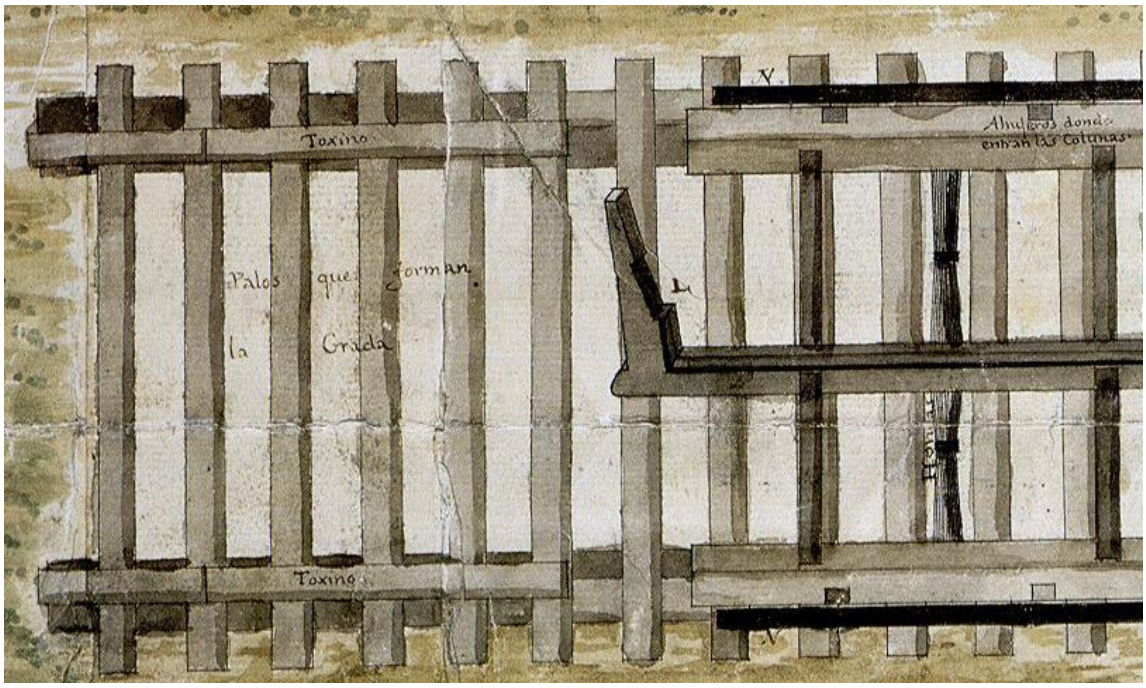


**Image 8. Representation of the imadas, above the eels. We can see the logs that cross under the imadas pass between the riding arenas to confirm the launching base. We also see in the upper and lower part the rope that is used so that the glass does not leave the stand. (Navarro, 1995, Lámina 16).**

## 3.3. Anguilas

They are the timbers armed with crossbars secured with bolts that act as the seat or base of the settlement of the hull, these rows of wood have a length similar to the length of the boat that is launched into the water.

The eels are placed on top of the imadas that, once the boat is fixed on the eels, will slide down the imadas like a train track to the water. To facilitate sliding, the imada is impregnated with fat or tallow.

When the structure of the eels and their reinforcement crossbars are assembled, what we call the base would be and manufactured.

In the eels, some quadrangular-shaped recesses are made at a certain distance that are used to fit the columns.

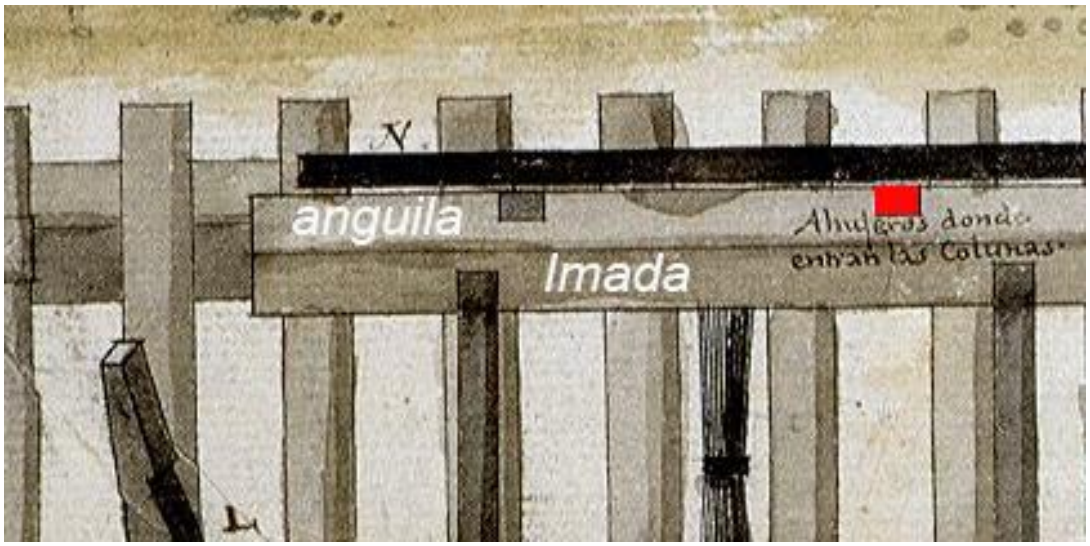


**Image 9. Representation of the eel that is seated on top of the imada and in red the grooves or gouges for the columns (Navarro, 1995, Lámina 16).**

## 3.4. Columns

They are wooden struts, one end is inserted into the grooves made in the eels and in a vertical position the upper end rests against the caco making this firm, remaining seated on the base and held vertically by the columns.

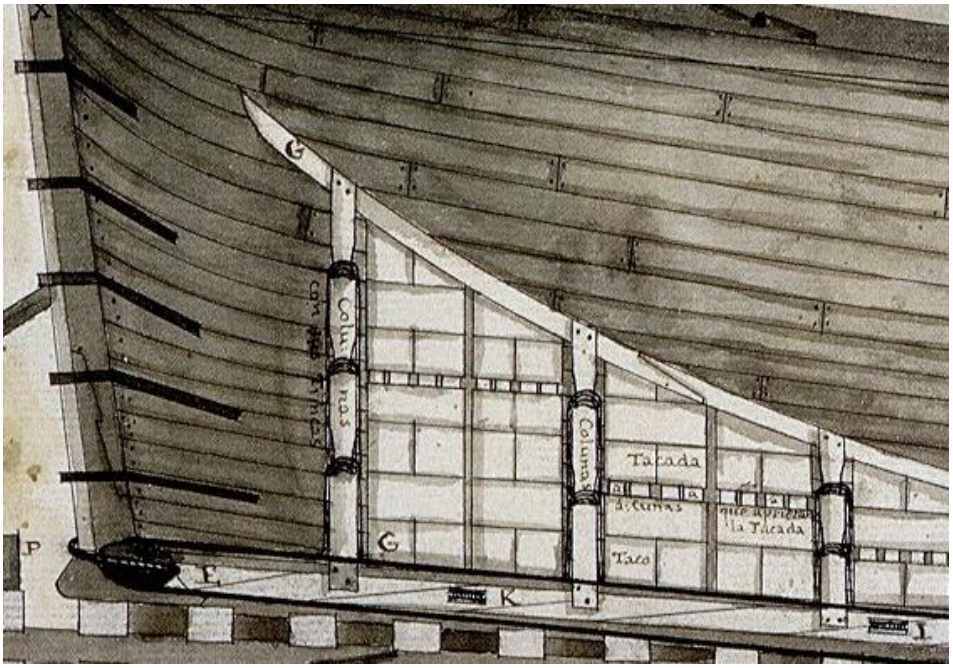


**Image 10. Representation of the columns fixed in the eels in its upper part and the wooden crossbar that with a curved shape runs through the shape of the hull approximately at the height of the bilge.**

As we can see in the previous image, the fixing and bolting of the columns in their lower part in the eels and the upper part against the crossbar that runs through the hull at the height of the bilge and the keel being seated on the base, a firm structure is achieved that hug the helmet To improve the consistency of this block, every two columns were joined with ropes that passed from one band to another.

Once the block was made and the hull well seated, the wedges were removed from the riding arenas to release the keel, losing contact with the riding arenas, from that moment on being held by the base.

In the meantime the ship was held back and allowed to fall by holding it back with flying winches to prevent the ship from falling sharply into the water. Sometimes, if there was a risk that the stern or rod would run aground, wooden barrels were attached to the end that went into the water first to help buoyancy when entering the water.

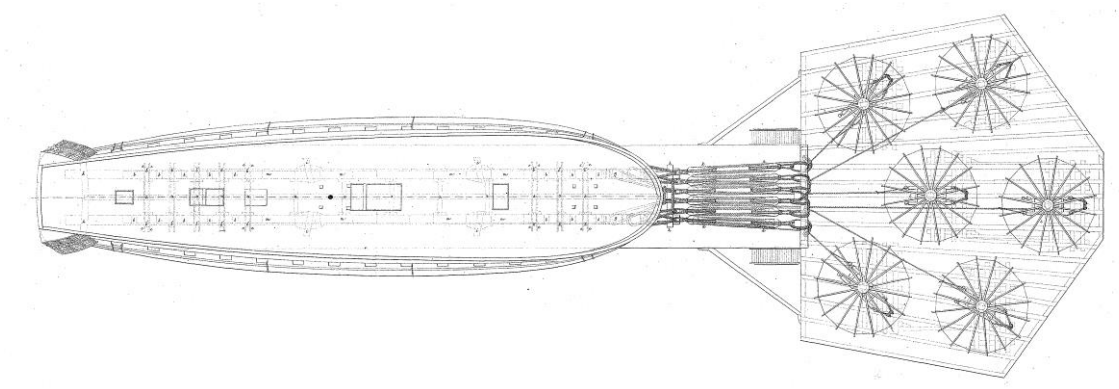

**Image 11. Representation of the slide based on the imadas and being held by the winches on the right. With this system the ship fell at the desired speed and under control** (Campaignac, 1840, Lámina 193).

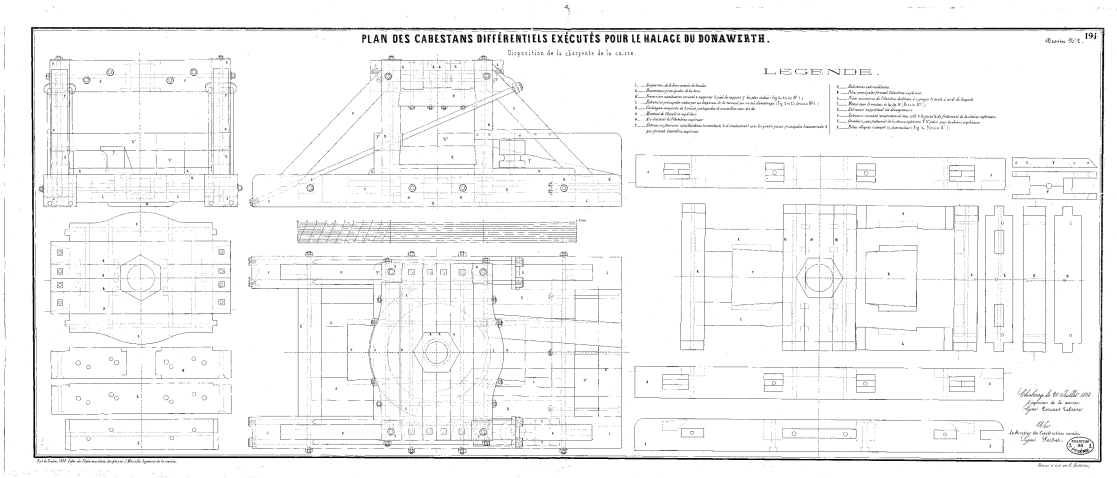


**Image 12. Plan of a capstan used for launching ships** (Campaignac, 1840, Lámina 191).

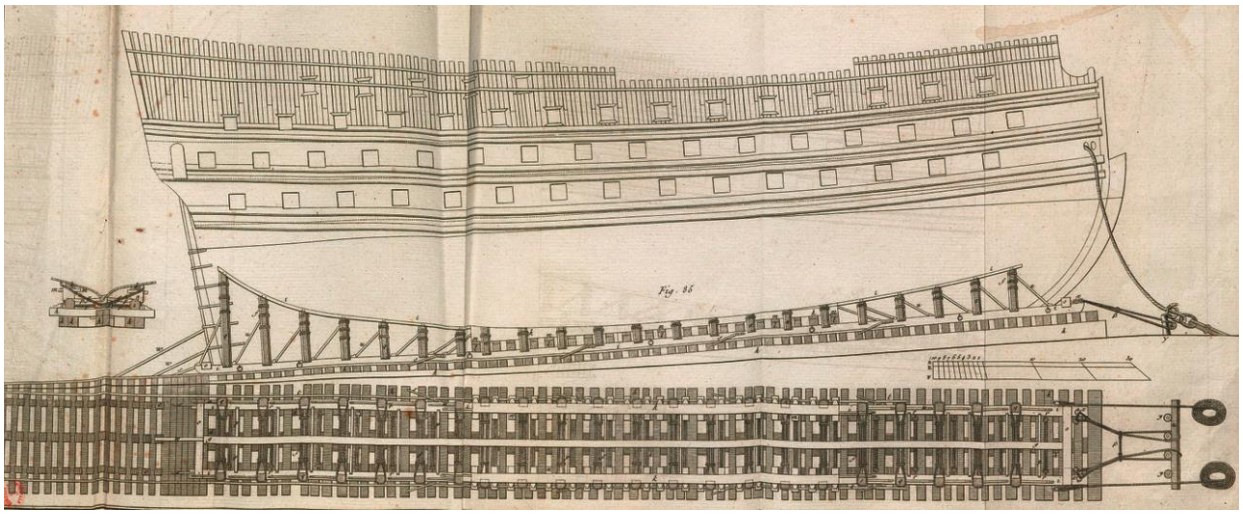

**Image 13. Ship in slipway ready to be launched into the water and already settled in the base. In the lower part details of the imadas, eels with the retained one to the right of the drawing** (Vial Du Clairbois, 787, Lámina 19).

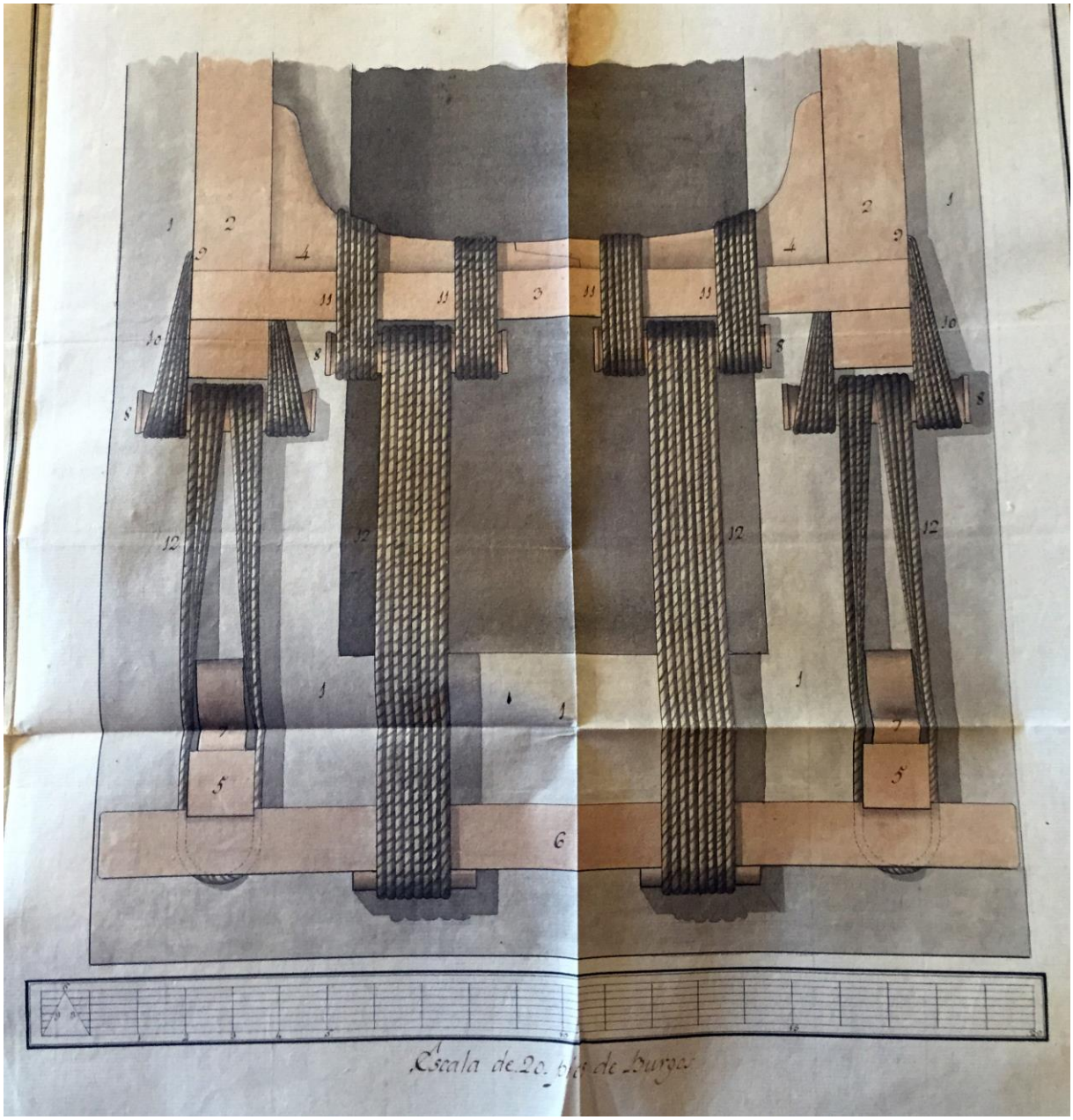


**Image 14. Representation of the retained and real lashings used in Mahón in the launching of the Dian frigatea. AGMAB. Leg. 3834 Arsenales y maderas, 1799.**

## 3.5. Description of the retained with which the Diana frigate was launched

In the following texts, a document is transcribed in which the use of real lashings is exposed in such a way that they can be used more times, saving time and money:[7]

*Plan and explanation of the method used in the royal shipyard of Mahón to launch the 34-cannon frigate Diana into the sea, by means of which the royal retaining lashings essential for the safety of this task are preserved to serve infinite times, which until now they have been rendered useless by chipping; In this way, it is possible to ensure the baro of the largest warships without any cost of rigging as manifested and that of the aforementioned frigate has been verified.*

*Numbers*

*1 Tier.*

*2 Eels from the based.*

*3 Naughty that joins other eels.*

*4 Curves for greater support of the eels with its crossbar.*

*5 bitts of the slipway.*

*6 Sleeper of other bitts.*

*7 Curves of other bollards.*

*8 four burels, each 15" in diameter, placed horizontally, two of them facing the ends of the eels, 50-10 21/2 inches distant from them (which is the thickness of the Guindaresa or 30 reales of retention) and the other two facing It crosses it from other eels at the same distance as the previous ones.*

*9 Groeras of the eels.*

*10 Two seams of excluded rope that by means of windlasses strongly joins the burels with the expressed eels passing through the crane was practiced at the end of them.*

*11 space other four hard seams of the same type of rope as the previous ones that strongly join the burels with the traverse and curve of the eels by means of windlasses as well.*

*12 four real retaining lashings that consist of 150 6" white guindaresa embers and in this way that strongly join all the burels with the bitts and their crossbar, so that the six seams are chopped by six individuals destined for this purpose are left by the bazada (sis) attached to their respective burels, leaving the four lashings not only unharmed, but also more suitable for successive tasks of this species due to the more tensed that remain and so that the zenos (sic) that forms the aforementioned Guindaresa, being circular arcs of 15" in diameter, do not cause any fading.*

*Note*

*the excluded ropes that are used for the aforementioned seams and are used entirely by cutting them, can be like this one, some column lashings already used in three or four varos of ships that, although drained and useless for their first object, are excellent and can have very useful applications, so that by taking from the draining warehouse by weight all the quantity that is needed from the referred vein and returning it to zero, as has been verified, the consumption of rigging in the referred task can be ensured more with greater number of burels and seams if deemed necessary.*

*Royal Shipyard of Mahón March 10, 1792*

*Onorato Bouyon*

7 AGMAB Leg. 3834 Arsenales y maderas 1799.

## 3.5. Images of a model in its base

The images that are reproduced are the model of a ship in slipway of the system implanted by Francisco Gautier in the 18th century. Naval Museum of Madrid — Inventory number: MNM-918Model of a ship with 74 guns on slipway. Gautier system, Saint Paul and Saint Peter type (c. 1770) François Gautier system plans

**Image 15. Longitudinal section of a 74-gun ship in grad and on the based. You can see all the elements that have been previously described, such as imadas, eels, props, etc.. Museo Naval de Madrid. Nº de inventario MNM 918.**

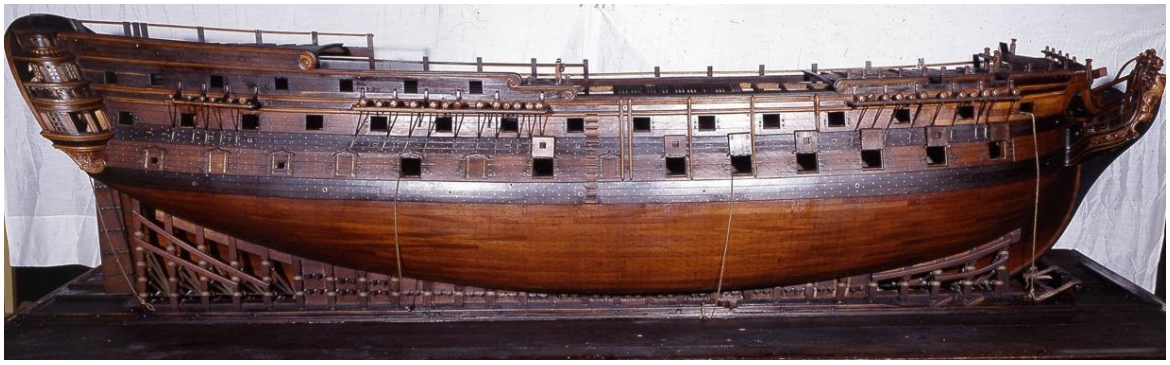

**Image 16. Starboard side of a 74-gun ship on the base with all its elements. Museo Naval de Madrid. Nº de inventario MNM 918.**

**Image 17. Detail of the stern of the 74-gun ship with its ropes that pass from side to side. Museo Naval de Madrid. Nº de inventario MNM 918.**

**Image 18. Detail of the bow with the retained to the right. Museo Naval de Madrid. Nº de inventario MNM 918.**

Co-funded by the
Erasmus+ Programme
of the European Union

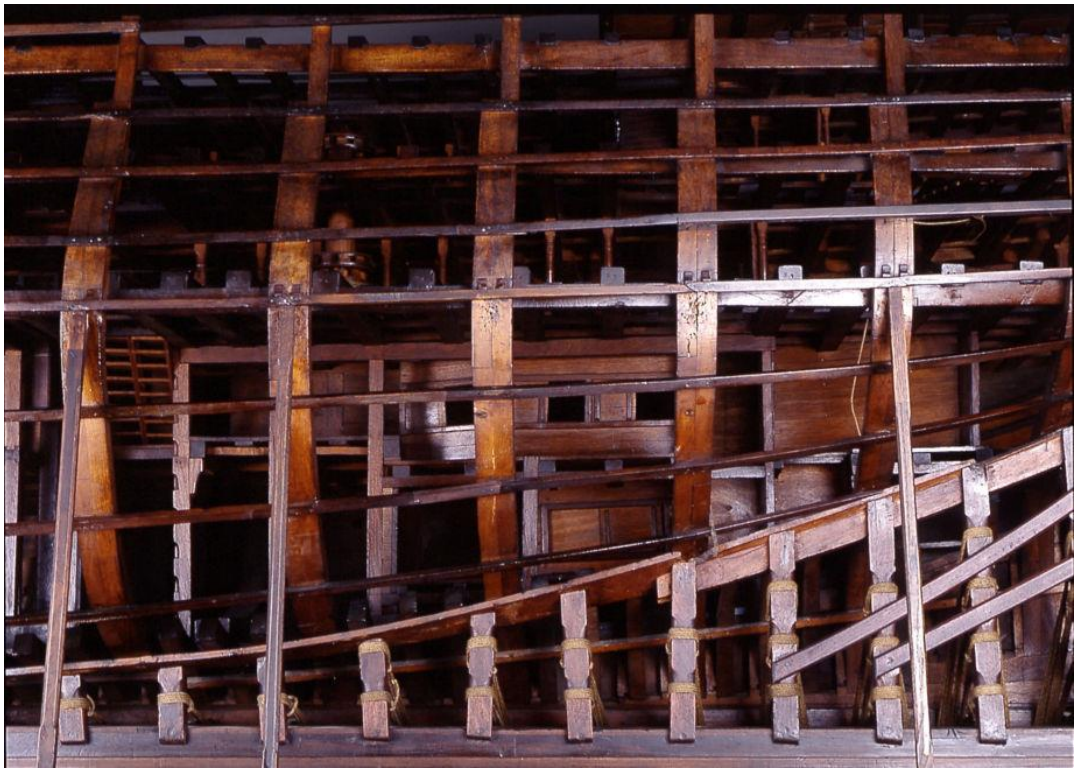

**Image 19. Details of the columns with their ropes that pass to the opposite band with the struts embedded in the eels. Museo Naval de Madrid. Nº de inventario MNM 918.**

**Image 20, Same details as in the previous image, but from the bow of the ship. Museo Naval de Madrid. Nº de inventario MNM 918.**

## 4. Float launchinhg: dry dock construction

This last system allows the realization of a ship in a dry space and once finished it is gradually flooded with sea water until it is afloat to later leave said space which is called dry dock. Making the ships in a dry dock allows the action of launching the ship to be easier, less expensive and safer, in addition to avoiding the breaking of the keel. Its construction is carried out as a general rule within a shipyard or port, its highest level being a little above sea level to facilitate the entry of water when desired and its extraction is carried out once the gates are closed by means of pumps. bilge until all the water is removed.

Before opening the gates, chocks adapted to the hull of the ship have to be placed as riding arenas, in ancient times they would be riding arenas like the ones we have seen in the stands.

The dock is then filled with the gates still closed by means of pumps until reaching sea level, at which point the gates are opened to allow the ship to enter.
As the water is being extracted, care must be taken to set the keel well in the rigs or chocks and prop up the boat on the sides until it is seated by its keel and without any list.

Dry docks are not only used to build ships, but also for repair or careening.
Description of a dry dock No. 2 of the Arsenal de la Carraca:[8]

*1. Stakes to strengthen the ground.*
*2. Dovetailed stakes (sic) to prevent seepage.*
*3. Augers placed on the heads of the stakes.*
*4. Cruise over the Barengas (sic) with what is formed the grid.*
*5. 3-inch (6.96 cm) high concrete that goes under the toilets.*
*6. Laying of baths stuffed their heads in the wall.*
*7. Bathrooms to form the sidewalk.*
*8. Block thousands to hold the heads of the baths against the walls.*
*9. Wooden swing that supports the doors.*
*10. Door with its axis and half cane at the top.*
*11. Bronze plate where the door roller rolls.*
*12. Channels to form boardwalk when it is offered to compose the doors.*
*13. Channels to support the door struts.*
*14. Aztecs with a bronze roller, to open and close the doors.*
*15. Water conduit, which comes from the third dam.*
*16. Conduit leading to the pump house.*
*17. Stairs for the dock service.*
*18. Ramps to raise and lower the wood.*
*19. Pavement decking.*

[8] Archivo General Militar de Madrid, Signatura: CA-35/18. Plano del 2 Dique del arsenal dela Carraca de Cádiz nombrado San Luis / Comdanda. de Yngs. de las Palmas.

*20. Sidewalk decking.*
*21. Boxes for props, on which the scaffolding of the dead work of the ships is formed, in their hulls.*
*22. Large masonry stone that is embedded in the bronze pieces on which the doors play.*
*23. Thickness of walls and disposition of their coatings.*
*24. Slabs on which the heads of all the baths rest.*

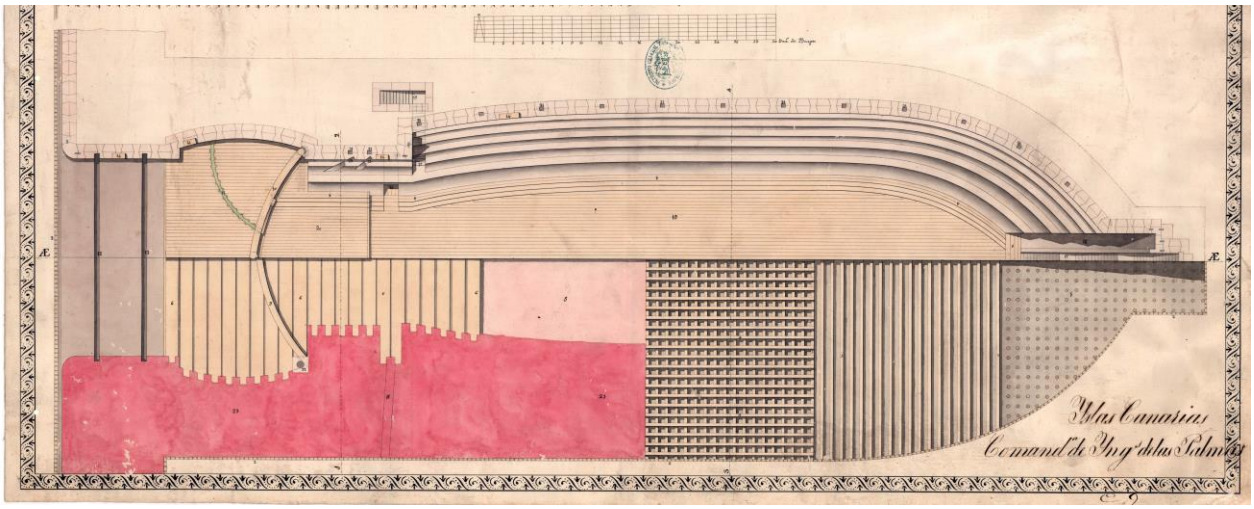

**Image 21. Plan of a dry dock with its gates on the left and access to the slipway on the right. AGMM. Signatura CA-35/18.**


**Image 22. Dry dock elevation plan. AGMM. Signatura CA-35/18.**

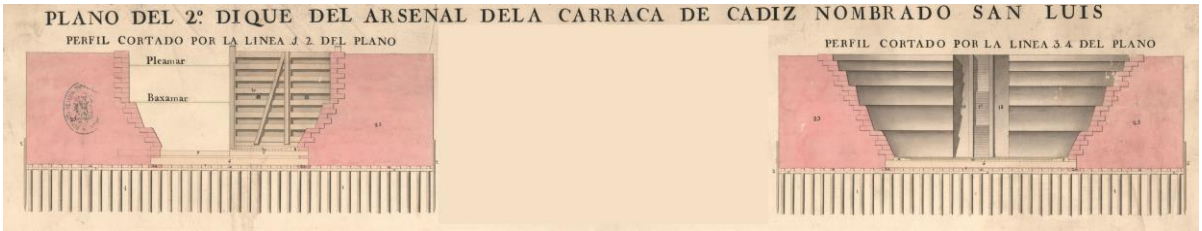


**Image 23. Plans of cuts by the line of the compound ones and access to the stands. AGMM. Signatura CA-35/18.**

# 5. Preparatives for sailing

After the launch of the ship, a final phase of completion would begin, which entails, among other things, the installation of systems, completion and preparation of interiors, rigging and preparing rigging if the ship were a sailboat, etc. If we break down this process by separating all the "aesthetic" part and what the specific preparation of habitability and useful spaces entails, we are left with a fundamental part: preparing the boat for navigation.

Said preparation refers almost exclusively to the installation of all those navigation and steering systems, emergency control on board and requirements that are demanded by the maritime authorities to enable the ship for its flagging and dispatch and, therefore, to obtain the legal patents that enable it to exercise navigation. Regarding this point, it will be necessary to think beyond the installation of technological aids to navigation, since every ship that currently navigates the world's seas must comply with a series of basic characteristics and elements on board aimed at preventing of accidents and pollution events associated with them.

A good part of these elements will be installed at the request of the navigation areas that will be required. The preparation of spaces and elements associated with these systems must be foreseen at the time of design and correspond to those requirements that emanate from current regulations on safety and safeguarding of human life at sea. Regardless of whether we are talking about navigable historical reproductions, newly built classic models or boats in wood or other materials built for specific commercial purposes, everything must pass through the filter of the administration. Any contemporary naval engineering team will be aware of this forecast, alerting and specifying in the designs what is required for the shipyards and shipyard carpenters to execute it.

The installation of these systems is the result of the different agreements and legislation that currently govern safety at sea and the fight against pollution. Regulated by the IMO, the International Maritime Organization (IMO-International Maritime Organization in English), reaches the maritime authorities of the different countries for its development and application. It should be noted that these approaches come as bases for general compliance, in the event that countries take liberties to increase the requirements in each matter for application in their civil and military navies. It is therefore possible that a ship with a Spanish flag has security requirements that differ in number or type from those of another nation, having the same basic ones in any case. Thus, it will be the pertinent maritime authority that will determine, throughout a construction and/or refurbishment or fine-tuning project of

a ship, what requirements it must meet for its legality and what tests a ship must undergo to guarantee with the certifications of relevant security.

The current legislation in this regard extends beyond the material. Crews must be trained and certified to operate any of these systems on board, as governed by the 1978 Manila Convention and its successive revisions. From this convention emanate a series of training requirements known in the maritime world as Standards of Training, Certification and Watchkeeping, and which regulate the pillars of operational knowledge of any degree, certification and recognition that allows anyone in the world to operate on board ships on a professional basis. Under this premise, a crew made up of members of different nationalities and origins is capable of knowing in an elementary way how to manage their work and emergencies on board, above any socio-cultural difference.

Another fundamental pillar at a normative level and decisive in the completion of any ship is the MARPOL agreement for the prevention of maritime pollution. This standard establishes what material and executive measures must be taken on board ships and in port facilities for the treatment of different fuels, waste and substances. Surveillance in compliance with this regulation is also an object of attention by the different maritime administrations, subjecting non-compliance to strong sanctions and denying patents and certificates to those ships that do not comply with what is required.

The authorities will account for compliance with the regulations through periodic inspections of the vessels. These will be subject to what the law establishes in this regard and will guarantee that the inspected vessel meets the requirements to issue or maintain the dispatch and navigation certificates for the area, dedication and type of navigation that is planned. To this end, the inspectors will verify that they comply with the installation on board of all the navigation and safety equipment established by the regulations, as well as the state of the ship and its systems. The condition of the crew and their adequacy and preparation for the exercise on the ships will also be the result of inspection. Any irregularity in these processes would cause the non-approval of the inspection and therefore the risk that a ship cannot go to sea.

It is also necessary to point out that the boats must have mandatory elements in terms of propulsion and, therefore, adapt the structure and spaces to it in the construction. Even when the construction of sail propulsion boats is considered, we must by regulation guarantee mechanical propulsion or submit the project to external aid for maneuvering or assistance. The latter will be the trend in the vast majority of current maritime spaces, by law. Therefore, the installation of motorizations and their systems, inboard or outboard, if the boat has the necessary length and function, must also stand out in the construction process and undergo the

necessary regulations and inspections. Despite this, we can find caveats in some countries regarding flagging or in some types of vessels that, due to length or function, do not require these elements (light sail, specific reproductions of certain ships and boats, experimental archaeology, etc.). Even so, the project must be submitted to consultation and inspection to establish what security elements it should equip.

For everything summarized so far, we will try to synthesize some of the most important points regarding the preparation of a newly built ship

## 5.1. Emergency and firefighting systems

Throughout these pages, the importance of anticipating the emergency control systems and subsystems on board was emphasized at the end of the construction process of any ship. Many vessels must have fixed fire-fighting elements or prevention of pollution and discharges into the sea. All this will be the result of study in the design processes by engineers and builders in application of the SOLAS agreements established for firefighting and prevention on board. In the same way, any modification or repair on ships and vessels already built must be preceded by a study or analysis regarding these needs.

Depending on the length and power of machines installed for on-board service, the installation of fixed or mobile means, or a combination of both, may be required. Likewise, the requirements for a vessel whose purpose is recreational use will not be the same as those of a vessel intended for fishing or professional services of any kind. Therefore, the purpose of the ship will already mark the compass of the construction and the adequacy of those elements that may be required in the installation of systems: tanks, pipes and channels, pumps and pressure equipment, etc. The forecast of these should be marked from the early stages of construction to determine the spaces where they will be stowed and installed.

In addition to any possible fixed installation, the preparation of the ship for the beginning of its operational life will require the incorporation of other portable or individual use elements. Following those guidelines that are mandated by the legislation, portable extinguishing elements of the type and size required by each area of the ship and in the amount indicated by length and functionality of the same must be distributed throughout the ship and as appropriate. It is therefore possible for a ship with a size X engine room to have, in addition to fixed extinguishing systems, portable fire extinguishers capable of attacking fires caused by fuels or oils, or that in their function do not disable vital electrical systems on the ship . The on-board kitchen, if any, may require fire blankets for suffocation or fire extinguishers suitable for fires characteristic of the area. Likewise, an electrical fire will require

another type of extinguishing agent. Water, foam, CO2, are some of the agents that will make up the extinguishing and firefighting systems on board any ship.

Stowage places will also be provided for individual fire-fighting equipment, such as fire-retardant suits, autonomous breathing systems or whatever is required for use on each ship.

As important as the installation of the extinguishing systems will be the placement and commissioning of detection and alarm systems. These must be coordinated with the audible and visual alarms necessary to be able to monitor possible emergency locations, especially when we are preparing boats and ships of certain lengths and displacements larger than usual. With this, it is possible to attack the first point in firefighting: prevention.

It should be noted that all media will be duly signposted following the IMO signage in this regard.

## 5.2. On board safety elements

Although a fire on board is one of the most serious situations, if not the most serious, that can occur and as such trigger other risk conditions, the ship must be prepared to deal with other possible scenarios: leaks and floods, abandonment of the ship, individual safety of the crew, etc.

One of the most important systems on board, historically, are those that configure the water control on board: the bilge system. Every ship collects in its bilges water from different leaks and routes. Without having to pose a danger to the integrity of the ship, it is a part to be controlled in ships of any constructive type. In accordance with this section, it will be specified which electromechanical and manual elements may be available for the pumping of liquids from the bilges, as well as the associated pipes.

Another highly relevant contingency is people falling into the water. For this, the appropriate means of recovery must be established that, together with the established protocols, allow a person to be saved from falling lost at sea. Lifebuoys, individual signaling elements and those elements that are considered useful will be distributed along the deck and areas susceptible to falling into the sea.

Of course the most critical moment in an emergency is the need to abandon ship. This point should be the last in any emergency plan, assuming that in the middle of the sea the ship is the safest element whatever the contingency while the buoyancy of the hull can be guaranteed. However, in the event that the abandonment of the

ship by the crew is decreed as an order, rescue elements and survival guarantees will have to be available until the pertinent rescue is carried out according to the protocols.

Life rafts, rescue boats, individual life jackets or personal immersion equipment are some of the instruments focused on providing a means of buoyancy and survival at sea. In the case of rafts or boats, their stowage must be prepared in the deck areas and in the number established by regulations in relation to the length, function of the boat and people on board. If we focus on rafts, stowage cradles of sufficient size should be prepared for the whole. These usually come prepared in the form of a drum or in a drawer, prepared for automatic or manual release in case of emergency, so the placement points must guarantee easy access to the water when it is required to be activated or if it should be activated automatically. The ship's rescue and auxiliary boats and vessels, if carried, must also present a stowage place that facilitates access to them to launch them into the sea and operate them without compromising work on deck.

Individual elements such as vests or survival suits must have a correct stowage point that facilitates their access in case of emergency. This could be taken into account when distributing these means or providing storage points in sollaos and cabins or in work areas.

These means, as occurs with fire-fighting means, will be duly indicated and marked following the guidelines indicated by the IMO.

## 5.3. Contamination prevention

Another fundamental point to deal with, both in construction and in the ship itself when it is launched, is preparation for compliance with anti-pollution parameters. Every ship, whatever its function, must comply with the standards set forth in the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). This set of regulations marks in six annexes differentiated by the type of polluting matter, how to act on board at a functional and material level. It is applicable to maritime-port elements, thus extending the need to prepare structures on land to receive polluting elements from ships or to also avoid spills and derivatives.

Ignoring the functional part of MARPOL as something in the hands of the "day to day" of the ship in its operation, the construction of a ship must prevent certain spaces oriented to the different standards. In this way, we could think about how the spaces destined for fuel, organic waste, garbage or, in the very end of the ship's construction, are going to be treated, how to avoid the use of substances that may pollute the marine environment in their application.

It will be scrupulously attended to that the installation of the fuel tanks and related services does not cause any loss or malfunction afterwards. Despite the existence of protocols, poor forecasting can lead to the dumping of carbides into the sea through losses to the bilge (which could later be drained together with what is considered "water"). It can also be of serious damage in the event of an accident that a failure in the arrangement or systematization of these elements can more easily lead to a spill into the sea.

The human nature of the crew on board will naturally generate waste in the form of dirty water (black or grey). Despite the fact that Annex IV of MARPOL establishes the guidelines in which this type of water is allowed to be discharged in certain areas of the sea, every ship must have a pipeline to specific tanks. These tanks must have sufficient capacity to retain this waste during navigation and, assuming that they are not sailing in areas of discharge into the sea, they can be unloaded at the ports of call during navigation. Similarly, special care must be taken both in the placement of tanks and systems and their subsequent maintenance.

To a lesser extent, the garbage generated by ships on a daily basis also complies with MARPOL in its annex V. Taking into account the function and navigation that a ship is going to develop, builders must provide spaces that allow the collection of those Waste that by its nature should not be or is acceptable to be thrown into the sea.

The crew, who must be trained and prepared in the fight against contamination as with other emergencies, must have as many material resources on board as required to avoid spills. It will be taken into account if additional bilge means are required with respect to polluting substances or to establish barriers on board. A watertight door, for example, can be just as useful in preventing a flood as a spill. Of course, and with a view to emptying the holding tanks or transferring fuel, pumping and pressure equipment must be prepared. The amount, type, number and whether or not it is necessary to equip it will depend at all times on the length and utility of the ships. It will not be necessary to prepare certain equipment in a boat built for pleasure as for a fishing boat, or for a tall ship of 24 or 30 meters in length than for a 7 meter sailboat.

Taking into account that the majority of boats that leave a riverside carpentry work in fishing, recreation, school or similar, we understand that they should not comply with the annexes and guidelines for the transport of goods. However, if any functionality is seen that requires establishing parameters in this regard, the ship under construction must be prepared and set up for it with respect to what is indicated in MARPOL and nuanced by the maritime authorities.

## 5.4. Government, propulsion, navigation systems and radiotelephony

As a final point to the preparation of any ship for its departure to the sea, we are going to mention some elements to prepare and that would influence the construction process in the final stages.

Each ship must adapt spaces of variable size and accessibility for propulsion and steering elements, as well as for all of its systems. The machines of a ship must have their own space, isolated and prepared, taking the necessary exhausts and ventilations with the same care as the rest of the surrounding installation (wiring, service tanks, pipes, bilges, etc.). In the same way, it will be done with the opening of registers in the boat that allow easy access to government elements (from the rudder blade to the wheel or tiller that governs it, passing through the entire assembly) or to navigation and control systems of the ship. ship in general. This must be taken into account in the finish, since in the event of a breakdown in any system, the crew must have immediate access. The interior or exterior finish must take into account these spaces, as well as those intended for the control of emergencies on board.

It could also be riverside carpentry work, preparing bridges and decks for the supports on which the ship's electronics and navigation systems will be managed. Thus, antennas for radios (VHF, MF/HF), radars (antennas and screens), GPS navigation systems and their reading screens, probes and as much equipment as may be required will be established and installed.

In the case of sailing boats, regardless of their size, the shore carpenter will have to know everything necessary about the manufacture, arrangement and assembly of the rigging, both mobile and fixed. Regardless of whether they are more classic or modern materials and forms, they will use everything within their reach to provide these elements to their constructions. The hull must be prepared for this by establishing seating points and reinforcements for masts, shrouds, stays and backstays, as well as for fittings and all associated hardware.

It is interesting to add to the training of future riverbank carpenters the application of construction techniques and preparation of rigging and ropes. In this way it will be possible to manage a comprehensive service in the construction of traditional boats, especially sailboats. All this must be done without neglecting modern materials and techniques, since the combination of traditional construction and contemporary techniques and materials can give great results and increase guarantees of maintenance, durability and safety.

# 6. Practicum

## 6.1. Practice 1

Make a section of a 1/10 scale hull that includes the basic structural elements (keel, frame, stringer, beam, linings and deck).

**General objectives.**

Establish mechanics and access to the handling of materials, tools and techniques for cutting, assembling and finishing a hull.

**Specific objectives**

Selection and cutting of wood according to its purpose.

Carved wood to create joining mechanisms.

Union of parts by preparing shapes and joints and using different materials and tools.

Practice lining a boat.

Create a base of liner and/or cover on which to practice caulking techniques.

**Material**

Wood.

Various tools (chisels, saws, files, sandpaper, squares, brushes, drills and augers, caulking irons, mallets and hammers, tow...).

**Timing**

2 weeks.

**Evaluation**

To evaluate on the following data:

1. Wood preparation and management.
2. Cuts, carvings and unions.
3. Practice and perfect techniques of cutting, brushing, carving and derivatives on wood.
4. Adjustment of work to established times.

## 6.2. Practice 2

Make a batch of wood joints on a 1/1 scale following different examples, guidelines and possibilities.

**General objectives.**

Establish mechanics and practice means of joining wood before the manufacture of structural assemblies of a ship (bindings, keels, stems, sternposts, stringers) and the union between them.

**Specific objectives**

Selection and cutting of wood according to its purpose.

Carved wood to create joining mechanisms.

Union of parts by preparing shapes and joints and using different materials and tools.

**Material**

Wood.

Various tools (chisels, saws, files, sandpaper, squares, brushes, drills and augers, caulking irons, mallets and hammers, tow...).

**Timing**

5-12 hours

**Evaluation**

To evaluate on the following data:

1. Wood preparation and management.
2. Cuts, carvings and unions.
3. Practice and perfect techniques of cutting, brushing, carving and derivatives on wood.
4. Adjustment of work to established times.

# Bibliography

Arce y Jurado, J. d., & Rodriguez Ayuso, M. (1878). *Lecciones elementales de agricultura.* Madrid: Imprenta y Estereotipia de Aribau y Cª.

Asesores técnicos: George P.B. Naish, A. V. (1982). *Enciclopedia ilustrada de la navegación a vela.* (L. Carbonell Relat, Trad.) Barcelona: Editorial Planeta, S. A.

*Atlas de poulierie.* (1855). Toulon.

Baistrocchi, A. (1952). *Arte naval* (4ª ed.). (J. Navarro Dagnino, Trad.) Barcelona: Gustavo Gili, S.A.

Bautista Costa, J. (1983). *Tratado de maniobra y tecnología naval.* Formentera: J.B. Costa, 1983.

Boudriot, J. (1987). *The seventy-Four gun ship* (2º ed., Vol. III). (D. H. Roberts, Trad.) Great Britain: Staple Printers Rochester Limited.

Campaignac, A. (1840). *Atlas du Génie maritime* (Vol. 1). Toulon: Lithographie du Génie maritime.

Canal Vega TV. (28 de marzo de 2011). *Museo del cáñamo de Callosa de Segura*. Obtenido de Yourube.com: https://www.youtube.com/watch?v=oJYTOQVCpiA

Company Ballesteros, G. (2020). El legado del cáñamo en callosa de segura (Alicante): clave en su industrialización y configuración de su territorio. ((. Universidad de Alicante, Ed.) *GeoGraphos , 11*, 1-25.

De Aranda y Antón, G. (1999). *La carpintería y la industria naval el el siglo XVIII. Cuadernos Monográficos del Instituto de Historia Naval* (Vol. Nº 33). Madrid: Instituto de Historia y Cultura Naval.

De Lucio, L., Solano, A., Rebaza, V., Alfaro, S., Tresierra, Á., & Campos, S. (2013). La pesca artesanal marina en la región la libertad, Perú. *Informe. Instituto del mar del Perú , Vol. 40* (Nº 1-2), 31-134.

Díaz Lorenzo, J. C. (2018). *La construcción naval en España en el siglo XX (1900-1975). Visicitudes y desafios tecnológicos. El caso de Compañia trasatlántica española.* (U. d. Coruña, Ed.) Coruña.

Fernández y Rodríguez, G. (1877). *Lecciones de Construcción Naval escritas para uso de los aspirantes a guardias marinas.* Madrid.

García de Paredes y Castro, J. (1925). *Estructura del Buque y Maniobra.* Barcelona: Tipografía Catalana.

Lever, D. (1842). *Arte de aparejar y maniobras de los buques.* (D. J. Palacios, Ed., & B. Villarino, Trad.) Madrid.

*Manuel de Reales Ordenes de Generalidad para el Gobierno de la Armada, que dá principio en el año 1824* (Vol. Tomo VI). (1832). Madrid.

Ministerio de Marina. (1849). *Estado General de la Armada.* Madrid.

Ministerio de Marina, comercio y gobernación de ultramar. (1846). *Estado General de la Armada .* Madrid.

Navarro, J. J. (1995). *Diccionario demostrativo con la configuración o anatomía de toda la arquitectura naval moderna. Álbum del Marqués de la Victoria (Facsimil).* Madrid: Lunwerg.

Orden, R. (1748). *Ordenanza, que su magestad, (dios le guarde) manda observar para la cria, conservacion, plantìos, y cortas de los montes.* Madrid.

O-Scanlan, T. (1847). *Cartilla práctica de construcción naval, dispuesta en forma de vocabulario* (Segunda ed.). Madrid: Imprenta Nacional.

O-Scanlan, T. (1831). *Diccionario marítimo español.* Madrid: Imprenta real.

Real Academia Española. (1978). *Boletin de la Real Academia Española* (Vol. 58). Madrid.

Ruiz García, V. (2018). Maderas de Cataluña para la Marina de la Ilustración. Fuentes para el estudio de los bosques catalanes y su relación con la construcción naval en el siglo XVIII. (U. d. Rioja, Ed.) *Brocar. Cuadernos de investigación histórica.* (Nº 42), 97-123.

Secretaría de Estado y del Despacho Universal de Marina. (1802). *Estado General de la Real Armada .* Madrid.

Sociedad Rural Argentina. (1871). *Anales de la sociedas rutal Argentina: revista pastoril y agrícola.* (Vol. 5). Buenos Aires.

steel, D. (1794). *The elements and practice of rigging, seamanship, and naval tactics* (Vol. I). London.

Vallarino, B. (1868). *Ancla de Leva. El arte de aparejar y maniobras de los buques* (Vol. 1). Cadíz: Imprenta y litografía de la revista médica.

Vento Tapia, A., Quispe Sosa, P., Morán Savatierra, V., Mendoza Humppire, F., & Jair de la Vega de la, R. Botadura por costado.

Vial Du Clairbois, H.-S. (787). *Traité élémentaire de la construction des vaisseaux, à l'usage des élèves de la marine.* Paris.

Vidaur, L. (1895). *Un curso de agricultura elemental.* Barcelona.

Villa Caro, R. (2020). Evolución de las botaduras en España a lo largo de la historia. (M. d. Española, Ed.) *Revista General de Marina , 278*, 933-950.

Villa Caro, R. (13 de marzo de 2020). *EXPONAV FUNDACIÓN*. Obtenido de EXPONAV: https://www.exponav.org/la-botadura-el-nacimiento-de-un-buque/

*Wikipedia*. (21 de julio de 2021). Obtenido de wikipedia.org: https://es.wikipedia.org/wiki/Pinus_sylvestris