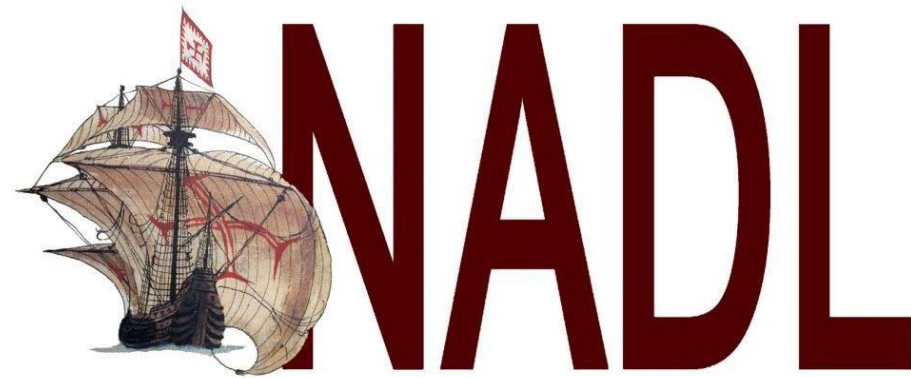


Treatises and Technical Texts of Shipbuilding



13.01 Antonio de Gaztañeta e Iturribalzaga

Jesús Alberto Aldana Mendoza

Last edited: Dec. 2020

José Antonio de Gaztañeta e Iturribalzaga



Born in Motrico (Guipúzcoa Province) Spain in 1656, he is one of the most influential sailors, soldiers and naval engineers in Iberian shipbuilding.

In the final decades of the 17th century, he dedicated himself to learning the arts to build interoceanic vessels in different shipyards during his travels around the world.

Thus, in the early years of the 18th century, he wrote the first official treaties for the construction of the ships for the Spanish Navy.



(Museo Marítimo Vasco, 2020)



(Cátedra de Historia y Patrimonio Naval, 2016)

This is one of the first most complete and elaborate manuscripts about shipbuilding, together with the work done by Antonio Garrote in 1691 “Fábrica de Bajeles”.

Even though both texts were not considered "official" by the Spanish Crown, they turned out to be fundamental antecedents in the architectural conception of a ship and its subsequent construction.

Arte de Fabricar Reales (1688)

In this document various parts of the construction process of several Spanish galleons in which Gaztañeta assisted in their construction are exposed.

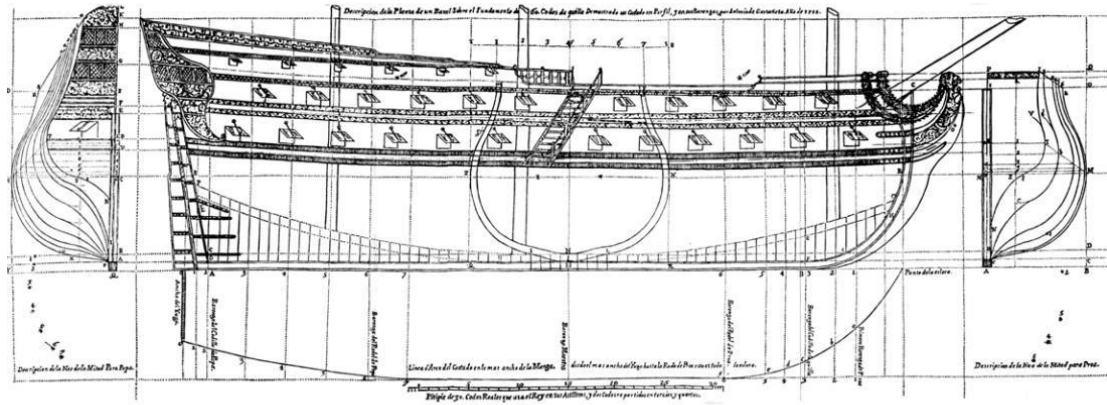
However, in his role as an apprentice, this is a manuscript of notes on Gaztañeta's experience during his stay at the shipyard.

Surely for the drafting and implementation of the future ordinances or treaties of Gaztañeta of the 18th century, this text was a foundation of the basic principles for the construction of Spanish ships.

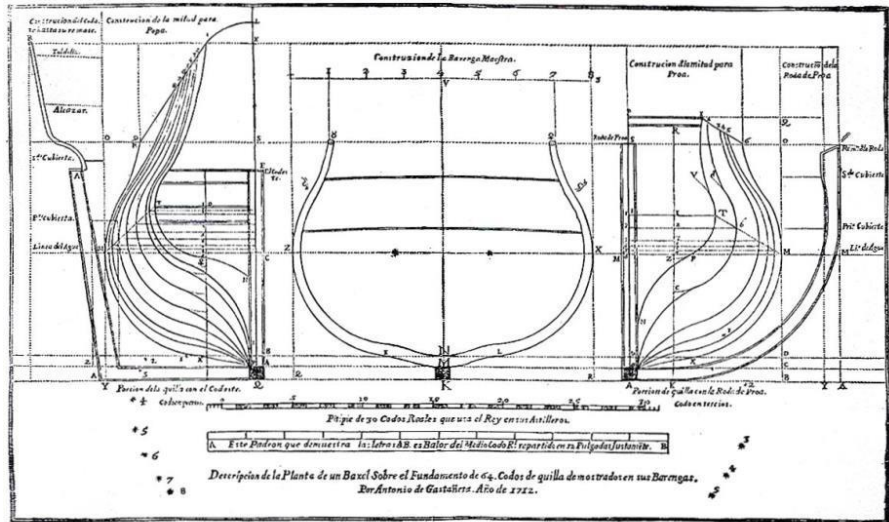


(Cátedra de Historia y Patrimonio Naval, 2016)

Proporciones de las medidas arregladas a la construcción de un bajele de guerra de sesenta codos de quilla (1712)



AGI MP Ingenios, 17



AGI MP Ingenios, 16

(Hormaechea et al., 2018)

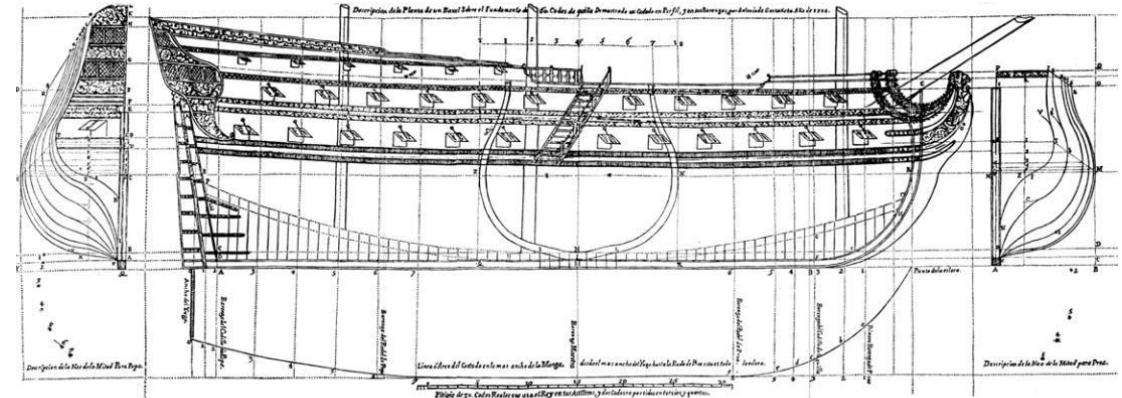
Gaztañeta wrote this document after the War of the Spanish Succession (1701-1713), with the signing of the Utrecht Peace Treaty and with the officially established “Real Armada Española.” It is the first official Spanish shipbuilding treatise since the ordinances of 1666 and 1679.

Finally, a standardization for the manufacture of boats is established, which must be carried out in all the European and American shipyards.

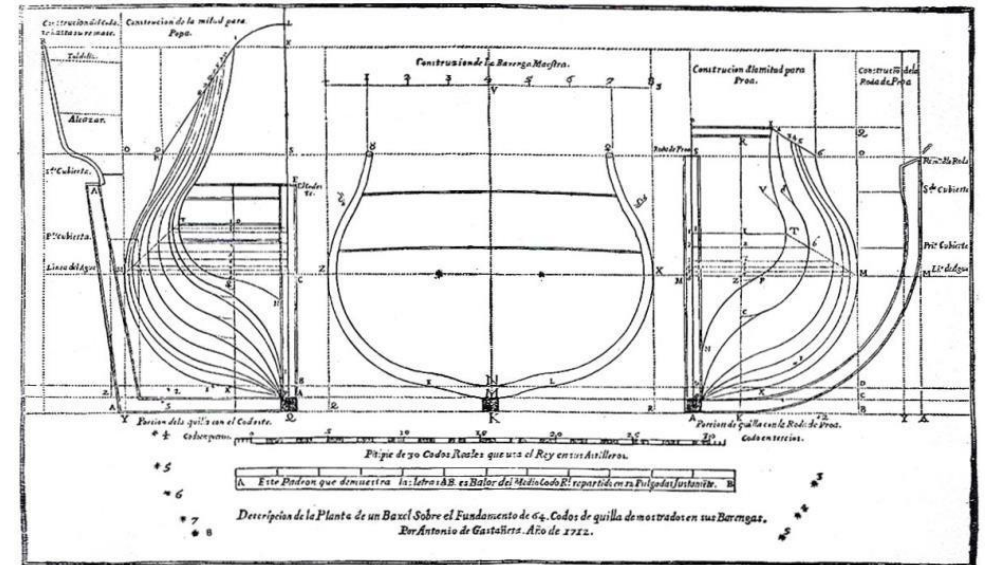
Proporciones de las medidas arregladas a la construcción de un bajel de guerra de sesenta codos de quilla (1712)



“Proposiciones de las medidas arregladas a la construcción de un Bagel de Guerra de sesenta codos de quilla, limpias de codillo a codillo, esto se entiende en plano, y línea recta, contándose desde el ángulo que forma el codaste de la popa en la quilla de la parte interior, y alefriz de la tabla, hasta el punto que empieza a formar arco la roda de proa, o branque, y sobre este fundamento, y principio se irán declarando las demás dimensiones” (Gaztañeta, 1712).



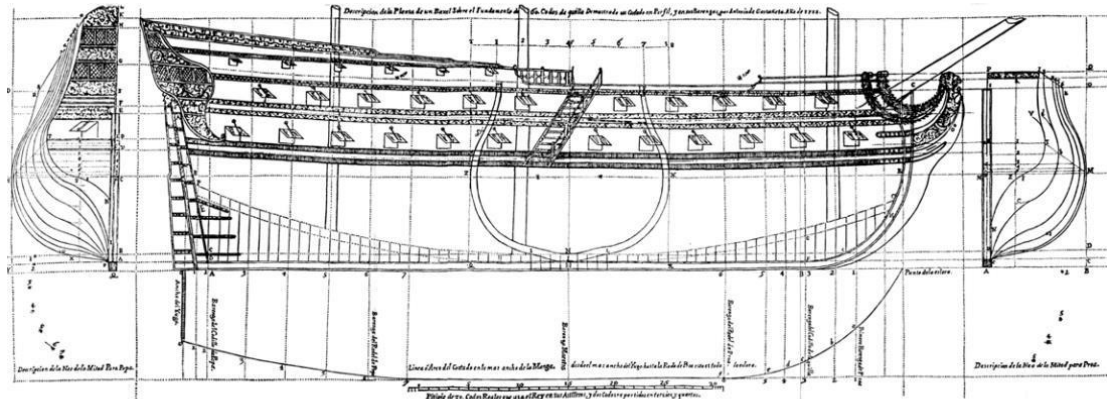
AGI MP Ingenios, 17



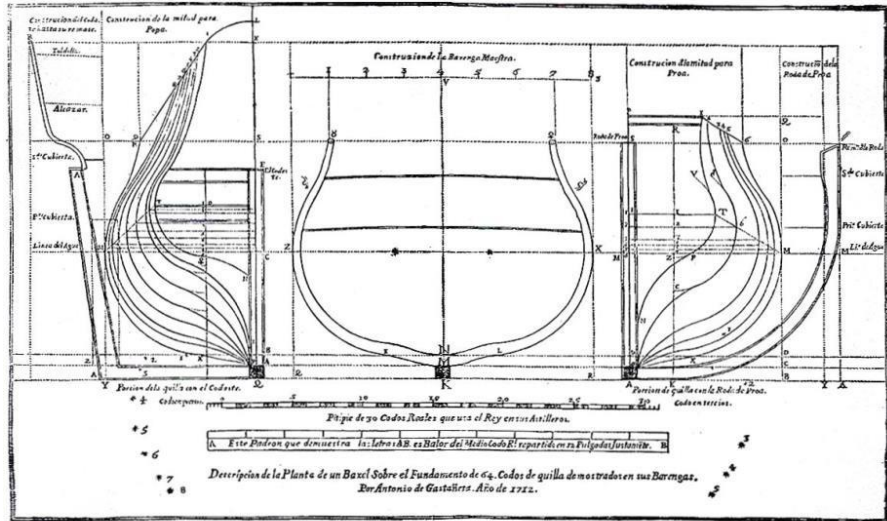
AGI MP Ingenios, 16

(Hormaechea et al., 2018)

Proporciones de las medidas arregladas a la construcción de un bajeel de guerra de sesenta codos de quilla (1712)



AGI MP Ingenios, 17



AGI MP Ingenios, 16

(Hormaechea et al., 2018)

The information presented by the document is divided into the following sections:

- "Declaration of the most notable parts and their amounts"
- "Explanation of the plant lines"
- "Declaration of the floor timber"
- "Explanation of the construction of the half of the nao from the middle to the stern"
- "The explanation of the construction of the half of the nao from the middle to the bow"
- "The description of the 'bajeel' over sixty-four keel cubits"
- "Ratio of the artillery to be counted by each of the ten vessels from these factories, and calibers to be"

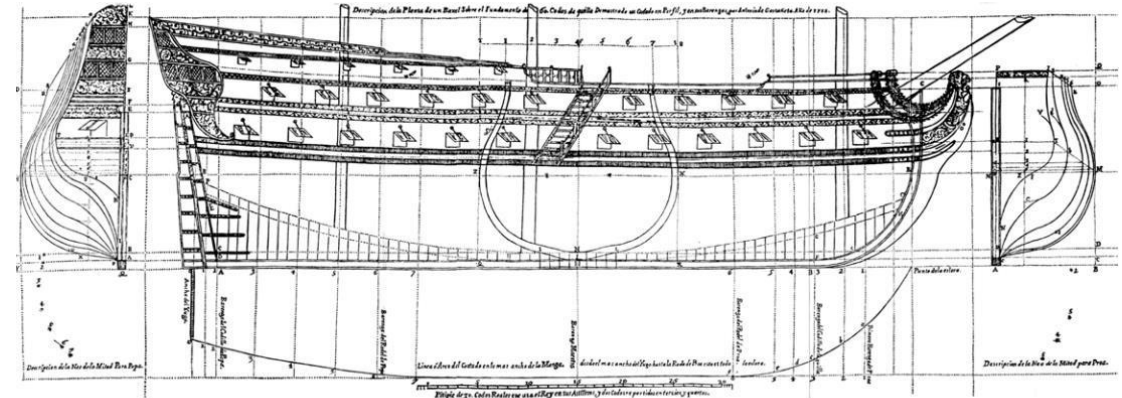
Proporciones de las medidas arregladas a la construcción de un bajel de guerra de sesenta codos de quilla (1712)



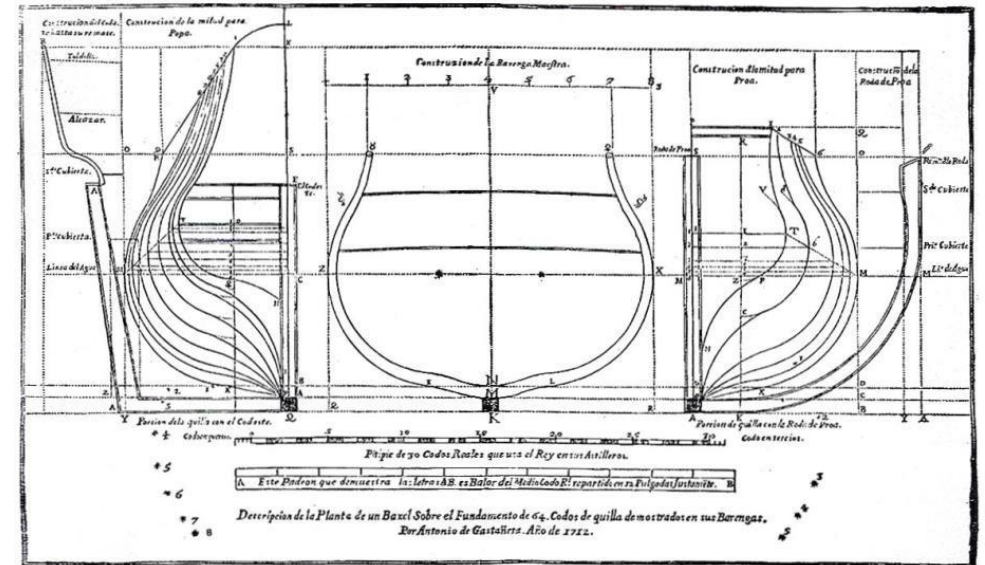
The importance of the “master frame” is highlighted as an element from which the construction of the hull of the boat starts, subject to the assembly of the keel.

It is a construction system that produces large, resistant and robust boats with good maneuverability.

About this construction typology, which is part of the "Traditional Spanish System", several aspects can be highlighted depending on the main measurements of the ship and its structural elements.



AGI MP Ingenios, 17



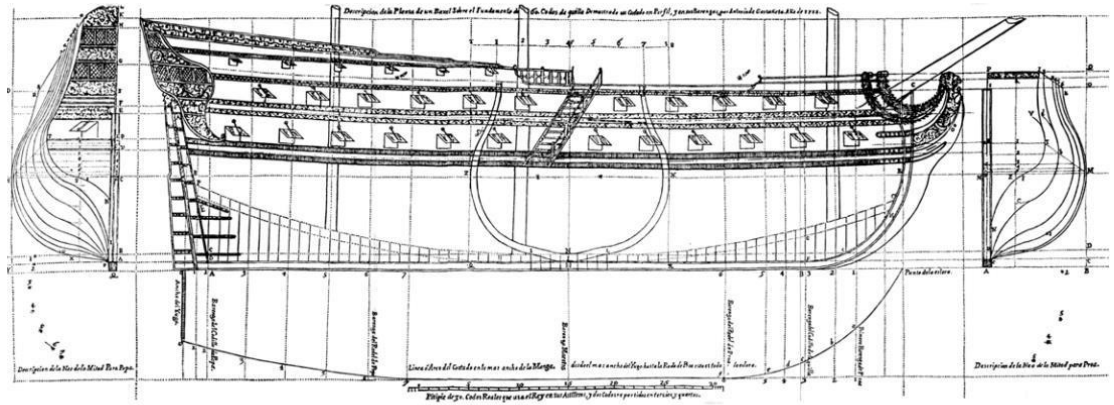
AGI MP Ingenios, 16

(Hormaechea et al., 2018)

Proporciones de las medidas arregladas a la construcción de un baje de guerra de sesenta codos de quilla (1712)

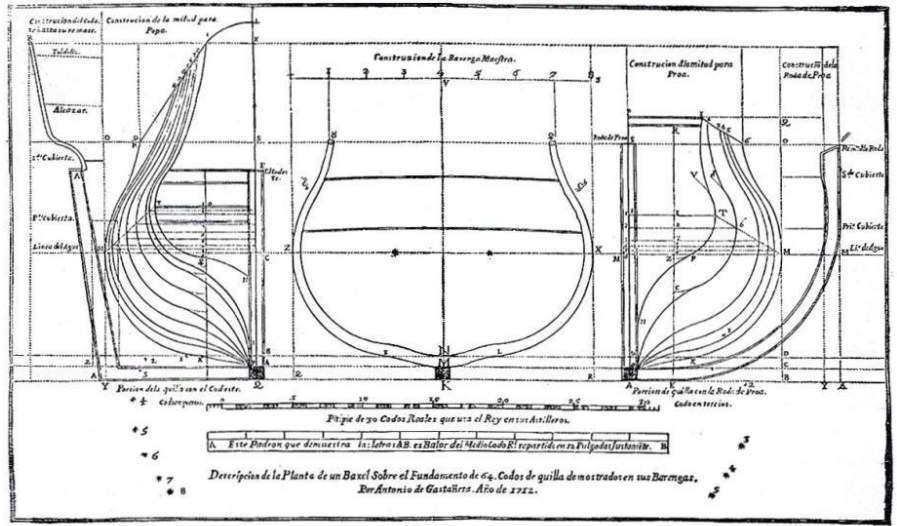


Main and more general measurements that the document details for a ship with 60 guns (in "real cubits" – "codos reales" of the time and its conversion into current meters according to Castro et al. (2014), where a real cubit is equal to 0.57468 meters)



AGI MP Ingenios, 17

- 72 length cubits (41 meters approx.)
- 60 keel cubits (34.2 meters approx.)
- 20 sleeve cubits (11.4 meters approx.)



AGI MP Ingenios, 16
(Hormaechea et al., 2018)

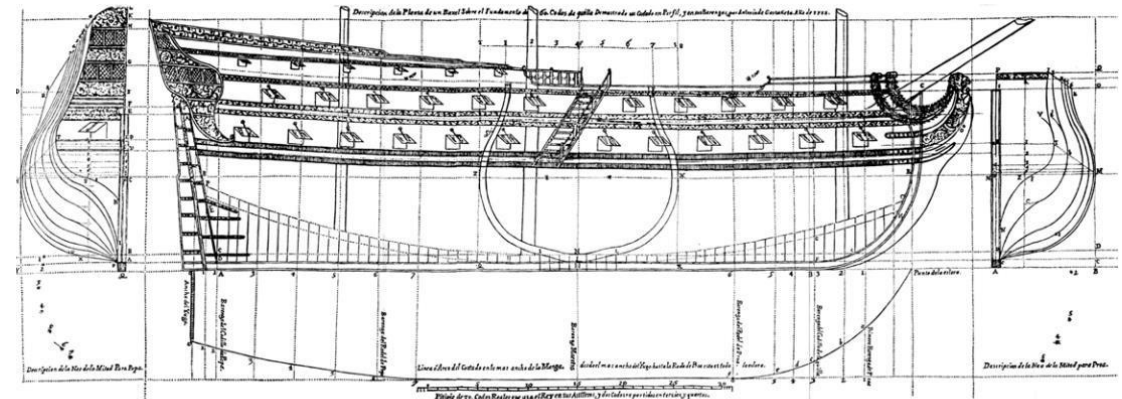
- 8 strut cubits (4.6 meters approx.)
- 7 cubits for each tailframe (first floors timbers) of bow and stern (4 meters approx.)
- 15 cubits the perpendicular height of the stem (8.5 meters approx.)
- 15 cubits the perpendicular height of the sternpost (7.4 meters approx.)

Proporciones de las medidas arregladas a la construcción de un baxel de guerra de sesenta codos de quilla (1712)

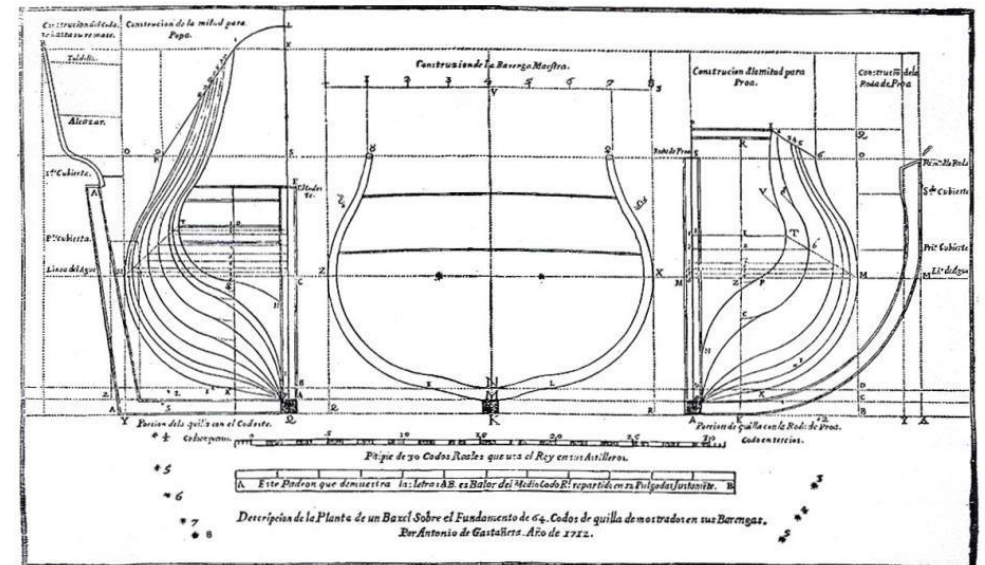


Some extra notes on this treatise:

- It is stated that an “inch” is 1/24 of a cubit.
- No particular attention is paid to the keelson.
- It can be understood that the size of the sleeve is the same of the master frame, since no special mention is made of the measures of this element (although to form it there is the section of "Declaration of the floor timber").
- The warship that is detailed with 60/64 keel cubits carries 60 guns distributed in two batteries and the “alcázar”.



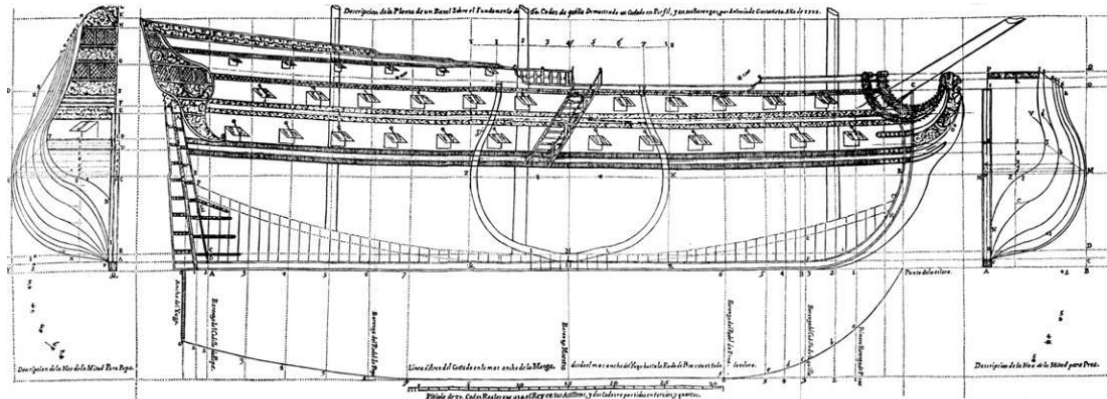
AGI MP Ingenios, 17



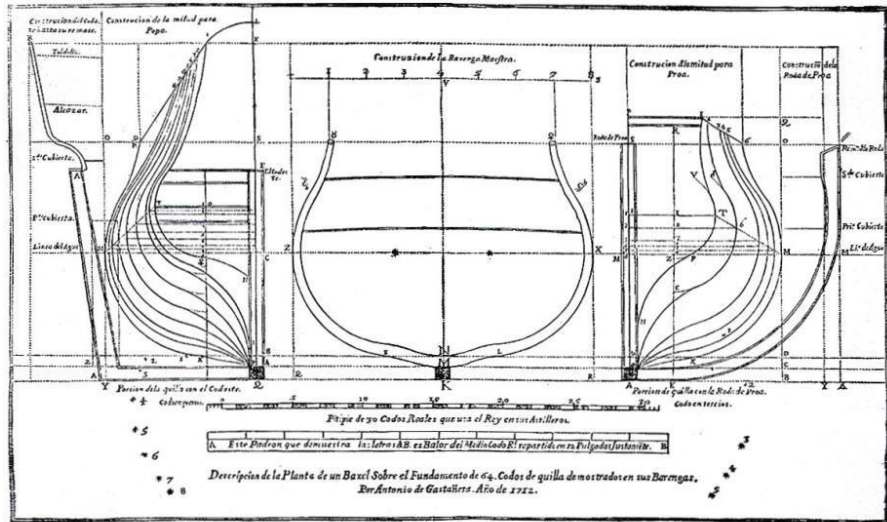
AGI MP Ingenios, 16

(Hormaechea et al., 2018)

Proporciones de las medidas arregladas a la construcción de un bajel de guerra de sesenta codos de quilla (1712)



AGI MP Ingenios, 17



AGI MP Ingenios, 16

(Hormaechea et al., 2018)

- Special emphasis is placed on the artillery ports and the measurements between them in each of the batteries: 13 ports in the first, 12 in the second, and 5 or 6 ports in the “alcázar”.

- In the first battery there are 26 18-pound guns, in the second 24 12-pound guns and 10 6 or 8-pound guns on the “alcázar”.

- The tonnage of this type of vessels ranges between 800 and 960 tons.

- In the text it is recommended not to exceed the number of guns specified for this type of ship.

- The plans attached to the end of the document are explained in various sections of the document

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)

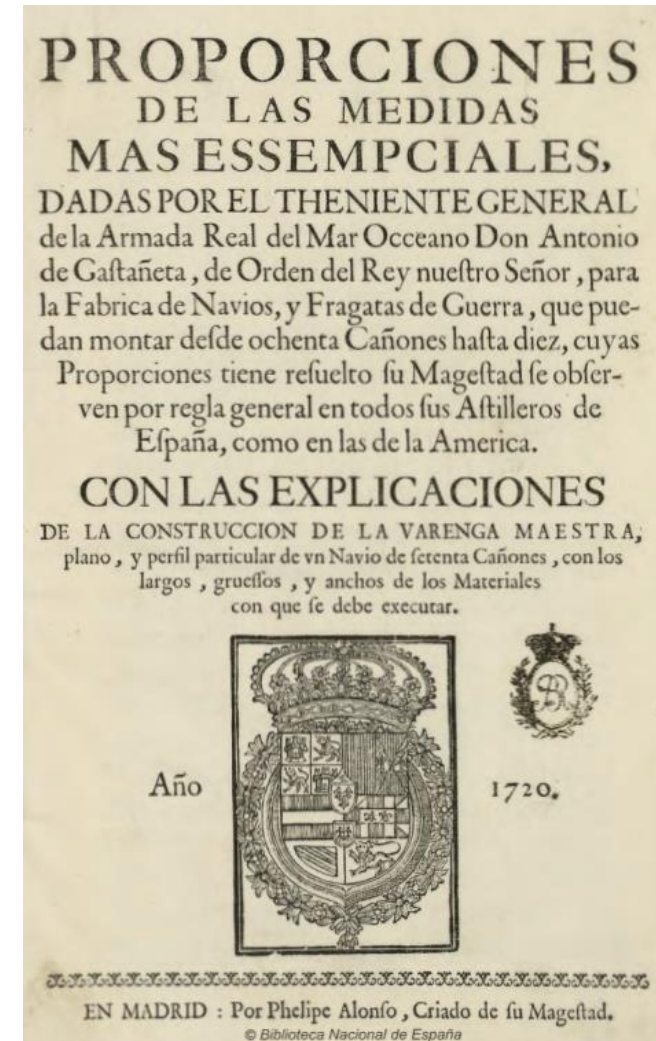


This document is written when Spanish shipbuilding is booming, thanks to the efforts of Gaztañeta and the exponential growth of vessels of the “Real Armada Española.”

It can be called as one of the most important and complete treatises written in the constructive history of Spain.

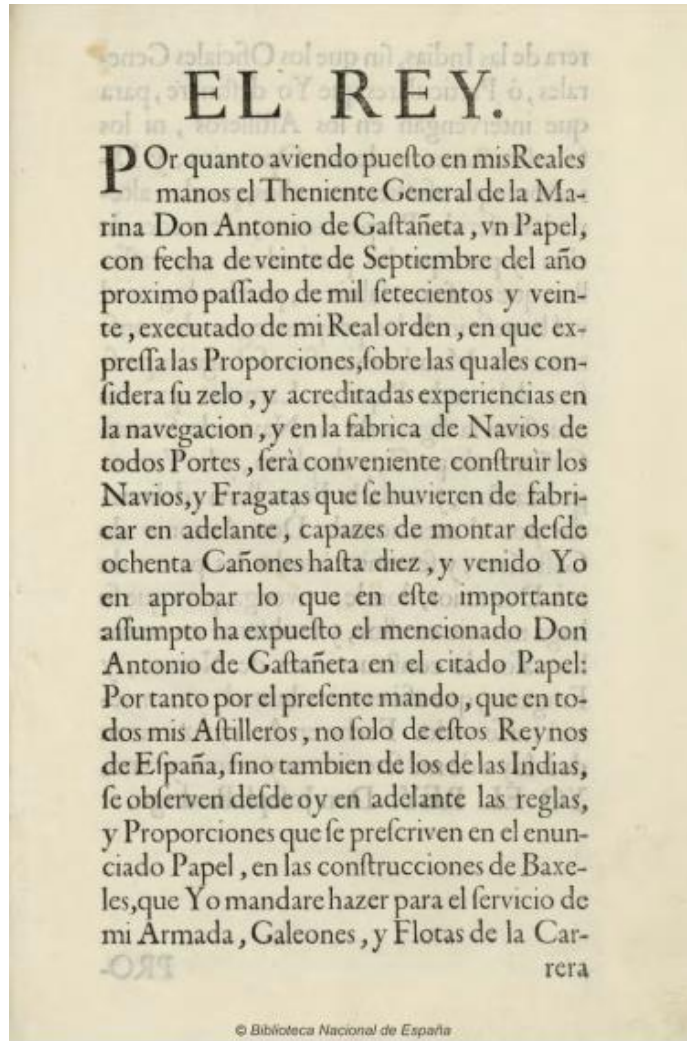
It consolidates the "Traditional Spanish System" in the international scope, although the important French influences in this construction typology are well known.

Detailed information is presented on the main measurements (although not so much about the construction process) of different warships (frigates and ships of the line) that carry from 10 to 80 guns.



(Biblioteca Nacional de España, 2019)

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



(Biblioteca Nacional de España, 2019)

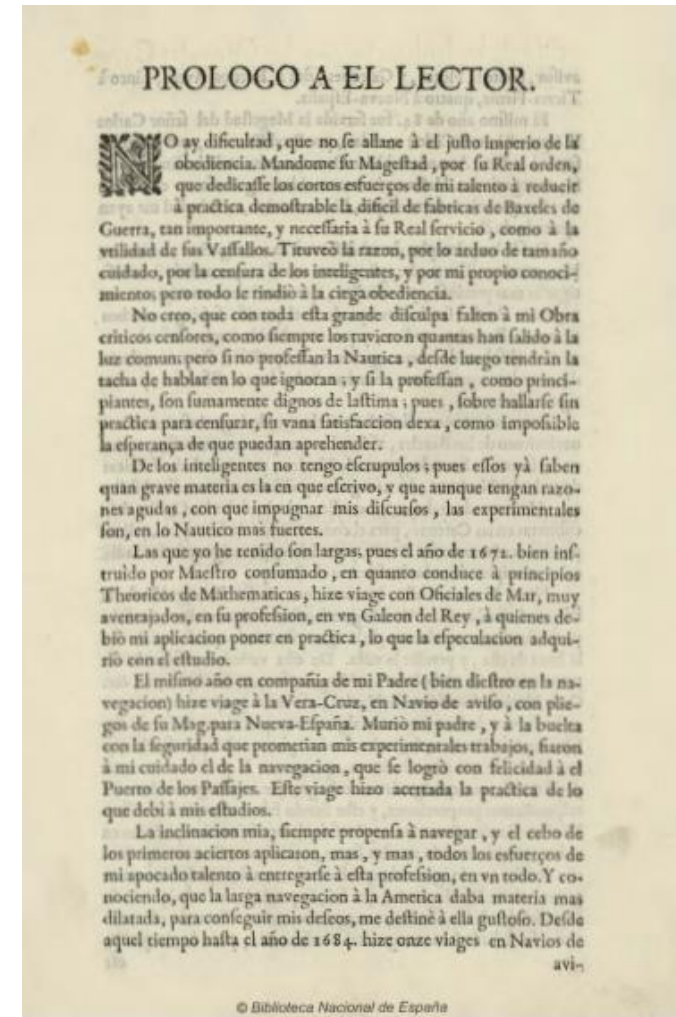
“Proporciones de las medidas mas essemprciales, dadas por el theniente General de la Armada Real del Mar Occeano Don Antonio de Gastañeta, de Orden del Rey nuestro Señor, para la Fabrica de Navios, y fragatas de Guerra, que puedan montar desde ochenta Cañones hasta diez, cuyas proporciones tiene resuelto su Magestad se observen regla general en todos sus Astilleros de España, como en las de la America. Con las explicaciones de la construcción de la varenga maestra, plano, y perfil particular de un Navio de setenta Cañones, con los largo, gruessos, y anchos de los Materiales con los que se debe executar” (Gaztañeta, 1720).

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



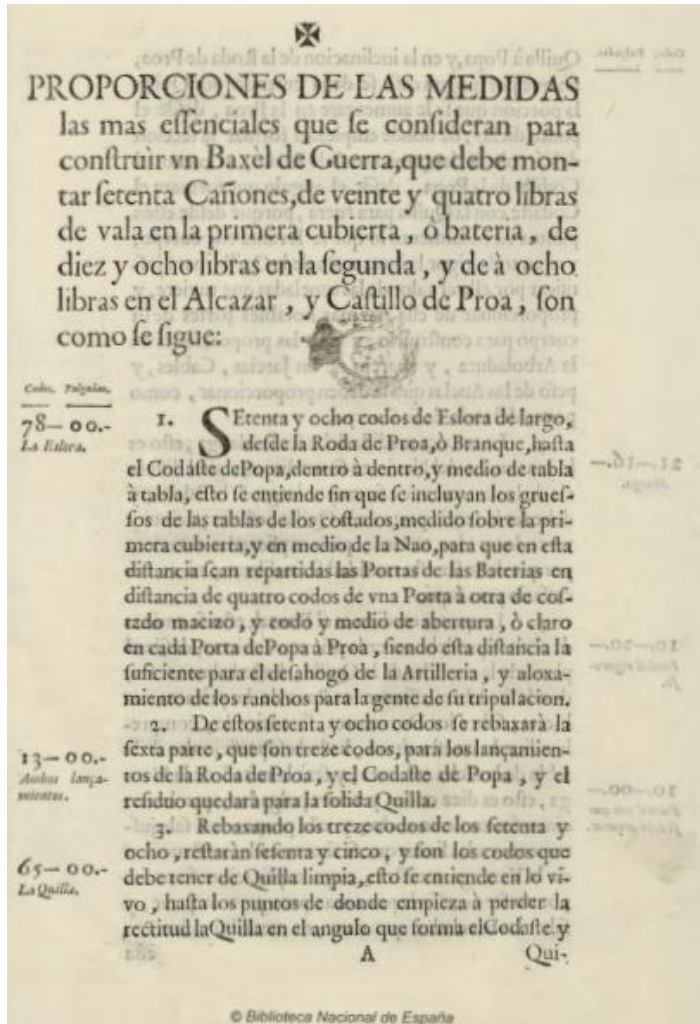
The document presents its contents in different sections:

- "Dedication to the King"
- "Prologue to the reader"
- Proportions of each of the measures of the ships of the line carrying 50, 60, 70 (greater emphasis on this one in the second part of the document) and 80 guns, and 10, 20, 30 and 40 gun frigates.
- "Explanation of the master frame, and the construction of it, and that of the flat stern with all its parts, and the practice that must be observed in all"
- "Explanations of the plan to build a vessel capable of carrying seventy guns"
- "Explanation of the plan of a war vessel with seventy guns"
- "Explanation of the length, thickness, and width of the materials that a vessel of seventy guns must carry"



(Biblioteca Nacional de España, 2019)

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



(Biblioteca Nacional de España, 2019)

Measurements and more general data that are presented of a ship of the line with 70 guns:

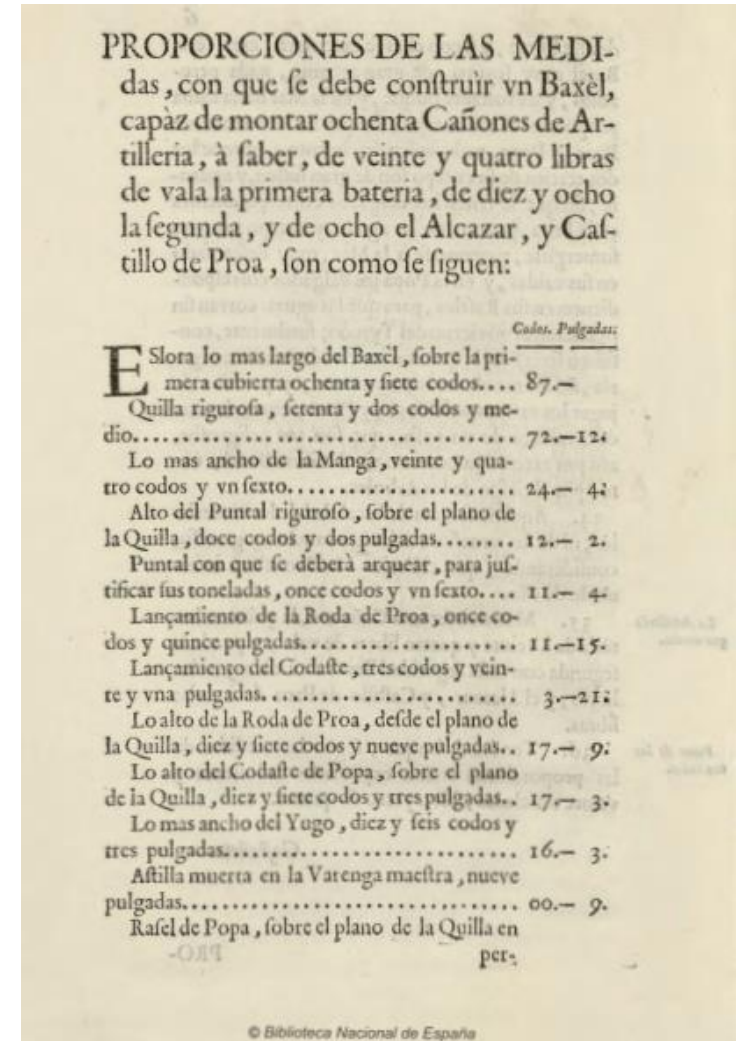
- 78 length cubits (44.4 meters approx.)
- 65 keel cubits (37 meters approx.)
- 21 sleeve cubits (12 meters approx.)
- 10 strut cubits (5.7 meters approx.)
- 22 cubits for the tailframe of bow and 21 cubits for the tailframe of stern (12 meters approx. each one)
- 15 cubits the perpendicular height of the stem (8.5 meters approx.)
- 15 cubits the perpendicular height of the sternpost (8.5 meters approx.)
- Armed with 70 guns divided in 26 24-pound in the upper deck, 28 18-pound in the lower deck, and 16 8-pound in the "alcázar"
- Its tonnage was 1095 tons

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



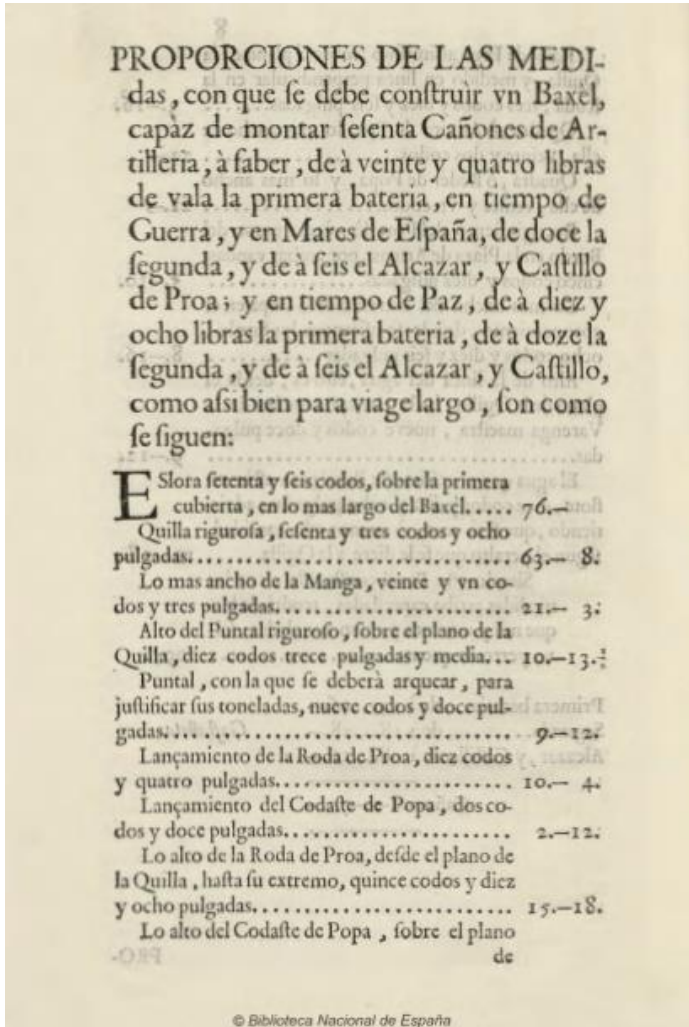
Measurements and more general data that are presented of a ship of the line with 80 guns:

- 87 length cubits (49.5 meters approx.)
- 72 keel cubits (41 meters approx.)
- 24 sleeve cubits (13.6 meters approx.)
- 12 strut cubits (6.8 meters approx.)
- 24 cubits for the tailframe of bow and 23 cubits for the tailframe of stern (13.5 meters approx. each one)
- 17 cubits the perpendicular height of the stem (9.7 meters approx.)
- 17 cubits the perpendicular height of the sternpost (9.7 meters approx.)
- Armed with 80 guns divided in 30 24-pound in the upper deck, 30 18-pound in the lower deck, and 20 8-pound in the "alcázar"
- Its tonnage was 1534 tons



(Biblioteca Nacional de España, 2019)

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



(Biblioteca Nacional de España, 2019)

Measurements and more general data that are presented of a ship of the line with 60 guns:

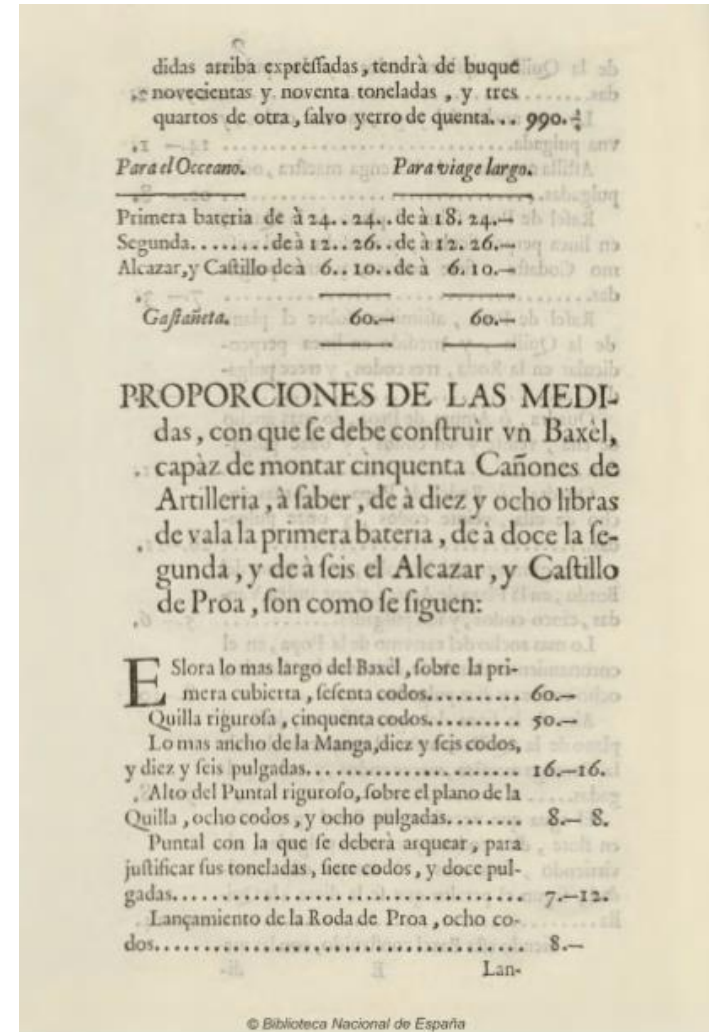
- 76 length cubits (43.3 meters approx.)
- 63 keel cubits (36 meters approx.)
- 21 sleeve cubits (12 meters approx.)
- 10 strut cubits (5.7 meters approx.)
- 21 cubits for the tailframe of bow and 20 cubits for the tailframe of stern (11.5 meters approx. each one)
- 15 cubits the perpendicular height of the stem (8.5 meters approx.)
- 15 cubits the perpendicular height of the sternpost (8.5 meters approx.)
- Armed with 60 guns divided in 24 24-pound in the upper deck, 26 12-pound in the lower deck, and 10 6-pound in the "alcázar"
- Its tonnage was 990 tons

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



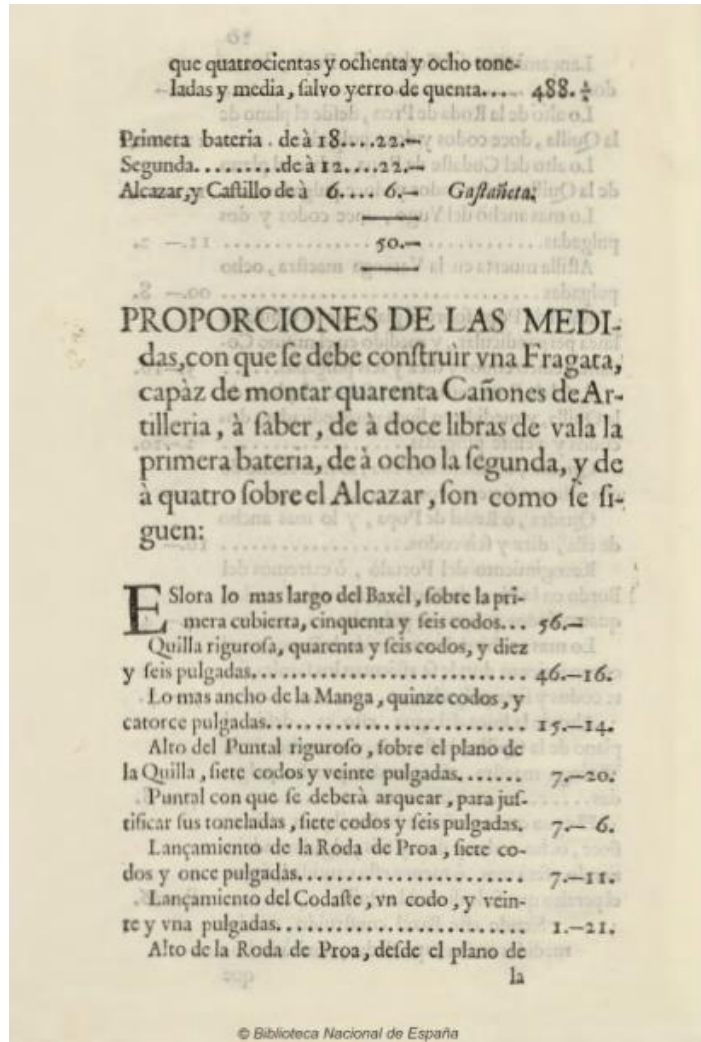
Measurements and more general data that are presented of a ship of the line with 50 guns:

- 60 length cubits (34.2 meters approx.)
- 50 keel cubits (28.5 meters approx.)
- 16 sleeve cubits (9.2 meters approx.)
- 8 strut cubits (4.6 meters approx.)
- 17 cubits for the tailframe of bow and 16 cubits for the tailframe of stern (9.2 meters approx. each one)
- 12 cubits the perpendicular height of the stem (6.8 meters approx.)
- 13 cubits the perpendicular height of the sternpost (7.4 meters approx.)
- Armed with 50 guns divided in 22 18-pound in the upper deck, 22 12-pound in the lower deck, and 6 6-pound in the "alcázar"
- Its tonnage was 488 tons



(Biblioteca Nacional de España, 2019)

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



(Biblioteca Nacional de España, 2019)

Measurements and more general data that are presented of a frigate with 40 guns:

- 56 length cubits (31.9 meters approx.)
- 46 keel cubits (26.2 meters approx.)
- 15 sleeve cubits (8.5 meters approx.)
- 7 strut cubits (4 meters approx.)
- 15 cubits for the tailframe of bow and 14 cubits for the tailframe of stern (8 meters approx. each one)
- 11 cubits the perpendicular height of the stem (6.2 meters approx.)
- 12 cubits the perpendicular height of the sternpost (6.8 meters approx.)
- Armed with 40 guns divided in 18 12-pound in the upper deck, 18 8-pound in the lower deck, and 4 4-pound in the "alcázar"
- Its tonnage was 410 tons

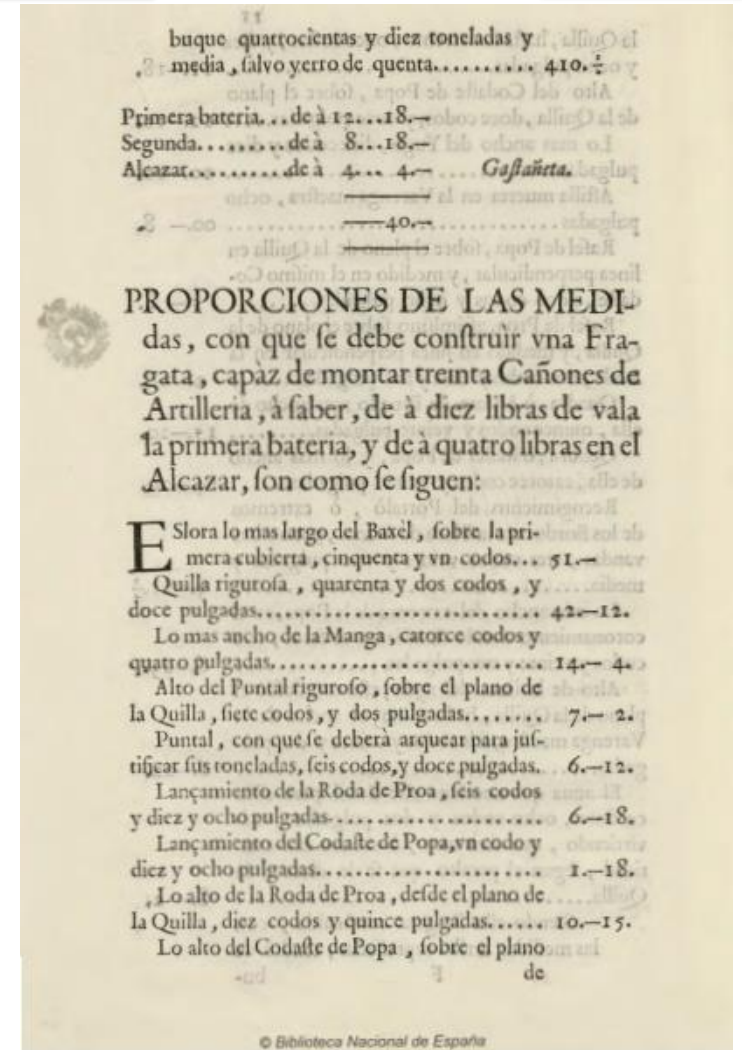
Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



Measurements and more general data that are presented of a frigate with

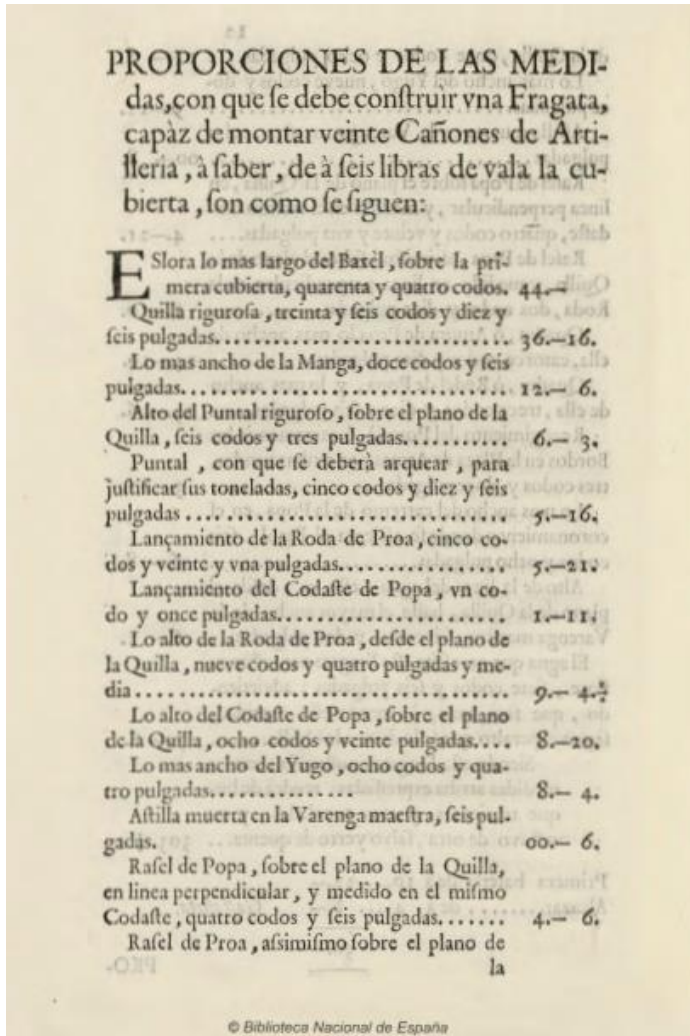
30 guns:

- 51 length cubits (29 meters approx.)
- 42 keel cubits (24 meters approx.)
- 14 sleeve cubits (8 meters approx.)
- 7 strut cubits (4 meters approx.)
- 14 cubits for the tailframe of bow and 13 cubits for the tailframe of stern (7.4 meters approx. each one)
- 10 cubits the perpendicular height of the stem (5.7 meters approx.)
- 11 cubits the perpendicular height of the sternpost (6.2 meters approx.)
- Armed with 30 guns divided in 22 10-pound in the upper deck, and 8 4-pound in the "alcázar"
- Its tonnage was 303 tons



(Biblioteca Nacional de España, 2019)

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



(Biblioteca Nacional de España, 2019)

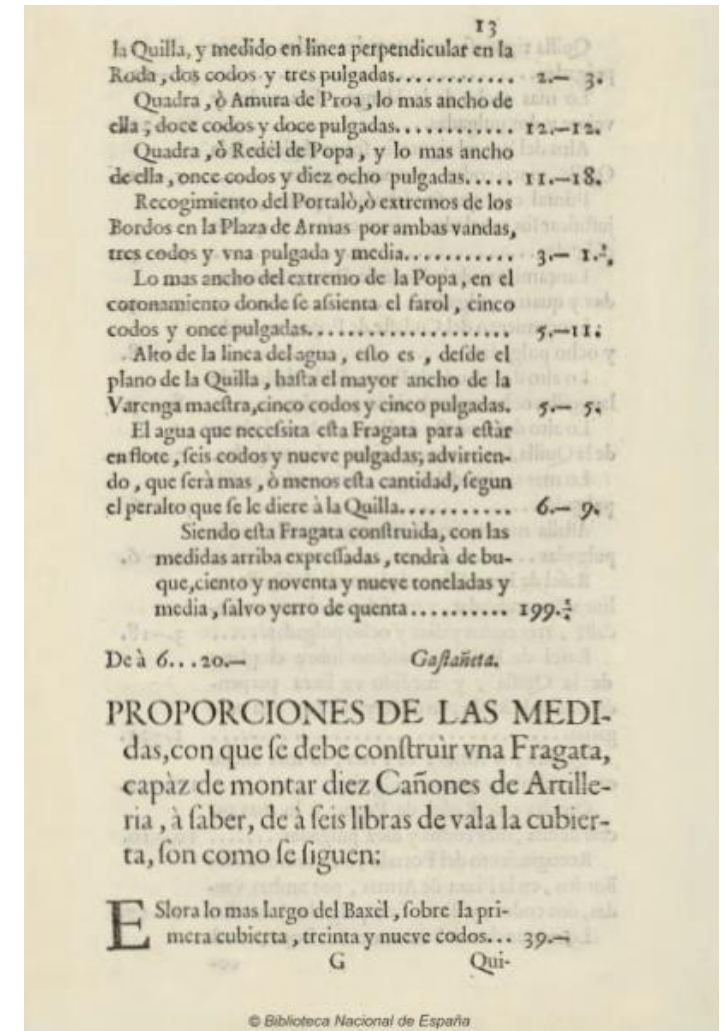
- Measurements and more general data that are presented of a frigate with 20 guns:
- 44 length cubits (25 meters approx.)
 - 36 keel cubits (20.5 meters approx.)
 - 12 sleeve cubits (6.8 meters approx.)
 - 6 strut cubits (3.4 meters approx.)
 - 12 cubits for the tailframe of bow and 11 cubits for the tailframe of stern (6.3 meters approx. each one)
 - 9 cubits the perpendicular height of the stem (5.1 meters approx.)
 - 8 cubits the perpendicular height of the sternpost (4.5 meters approx.)
 - Armed with 20 6-pound guns
 - Its tonnage was 199 tons

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



Measurements and more general data that are presented of a frigate with 10 guns:

- 39 length cubits (22.2 meters approx.)
- 32 keel cubits (18.2 meters approx.)
- 10 sleeve cubits (5.7 meters approx.)
- 5 strut cubits (2.8 meters approx.)
- 11 cubits for the tailframe of bow and 10 cubits for the tailframe of stern (6 meters approx. each one)
- 8 cubits the perpendicular height of the stem (4.5 meters approx.)
- 7 cubits the perpendicular height of the sternpost (4 meters approx.)
- Armed with 10 6-pound guns
- Its tonnage was 144 tons



(Biblioteca Nacional de España, 2019)

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



Some additional notes on this document:

- As in the treatise of 1712, no data regarding the keelson is presented .
- A large amount of information on the 70-gun ship is exposed and these data are useful as an approximate model for the construction of the other vessels, both carrying fewer or more guns.
- Regarding the master frame, only its height is detailed in inches ("dead splinter"- "astilla muerta"-) for each of the ships presented.
- Information on the "water line" is detailed, which is the measure of the ship's upper work, something rare to date.
- Gaztañeta himself points out that in this treaty it is not necessary to deal with very specific details of naval construction, since these aspects must be well known by the master builder of each shipyard.

✱

TABLA DE LAS PROPORCIONES LAS MAS PRECISAS, Y ESSENCIALES QUE SE DEBEN observar en la construccion de los Baxeles, siendo el mayor de ochenta Cañones con dos cubiertas, Alcazar, y Casti- llo, hasta el menor de diez Cañones, que puede servir para Fragata ligera, es, como se van declarando en las columnas de la Tabla figuiente, donde en sus cabezas van declarados los nombres propios que se observan en los Astilleros, assi bien en cada columna se explican los codos, y pulgadas, à saber: El codo con C. y las pulgadas con P. para que se entiendan los numeros; y en la vltima columna se señalan las toneladas que puede tener cada vno, como se han con- struidas con las proporciones, y medidas exprefiadas.

Numero de Cañones	La muel de la Estera		La largo de la Quilla		Anchura de la Manga		Alto del Puntal en el centro de la Roda de Proa		La muel de la Roda de Proa		La ancho del Codo de la Proa		La ancho del Codo de la Popa		La ancho del Codo de la Popa		La ancho del Codo de la Popa		La ancho del Codo de la Popa		La ancho del Codo de la Popa		La ancho del Codo de la Popa		La ancho del Codo de la Popa				
	C.	P.	C.	P.	C.	P.	C.	P.	C.	P.	C.	P.	C.	P.	C.	P.	C.	P.	C.	P.	C.	P.	C.	P.	C.	P.			
80	87-00	71-12	24-0	11-2	11-0	11-0	3-21	17-0	17-0	16-0	0-0	8-0	4-0	24-10	32-11	6-2	10-18	10-12	11-18	11-18	11-18	11-18	11-18	11-18	11-18	11-18	11-18	11-18	1134
70	78-00	63-00	21-15	10-20	10-0	10-20	2-14	15-22	15-12	14-11	0-8	7-8	3-16	22-00	21-00	5-10	8-16	9-12	10-18	10-18	10-18	10-18	10-18	10-18	10-18	10-18	10-18	1091	
60	76-00	61-0	21-0	10-12	9-12	10-0	2-12	15-18	15-2	14-0	0-8	7-0	3-12	21-11	20-11	5-6	8-10	9-8	10-14	10-14	10-14	10-14	10-14	10-14	10-14	10-14	10-14	990	
50	60-00	50-00	16-16	8-8	7-12	8-0	2-0	12-12	12-12	11-0	0-8	5-16	2-10	17-00	16-00	4-4	7-8	7-8	8-16	8-16	8-16	8-16	8-16	8-16	8-16	8-16	488		
40	56-00	46-16	15-14	7-10	7-6	7-11	1-12	11-18	12-12	10-10	0-8	5-8	2-16	15-20	14-20	2-17	6-23	6-22	8-2	8-2	8-2	8-2	8-2	8-2	8-2	8-2	410		
30	51-00	42-12	14-0	7-0	6-12	6-18	1-18	10-15	11-8	9-12	0-8	4-21	2-10	14-10	12-16	3-12	6-8	6-2	7-6	7-6	7-6	7-6	7-6	7-6	7-6	381			
20	44-00	36-16	12-6	6-3	5-16	5-3	1-12	8-4	8-10	8-0	0-8	4-6	2-0	12-12	11-18	3-2	5-11	5-6	6-9	6-9	6-9	6-9	6-9	6-9	6-9	360			
10	32-00	22-12	10-32	5-11	5-0	4-8	1-0	8-0	8-0	7-12	7-0	0-6	3-18	1-12	12-0	2-17	4-10	4-10	5-10	5-10	5-10	5-10	5-10	5-10	5-10	244			

En esta Tabla se dan las proporciones de las medidas, segun el codo Real de su Magestad, que tiene mandado se observen en sus Astilleros de las Fabricas, como assi bien en los Reales de los Carneros de las Armadas del Océano, Galeones, y flotas de las Indias, y para todo lo que su Magestad huviere de recibir, y entregar de su Real orden, siendo el codo del valor de dos tercias de la vara de Castilla, medida de Avila, y vna de las treinta y dos partes de los dos tercios mas, añadido à los exprefiados dos tercios, que componen el codo Real de su Magestad, llamado así comunmente, y este codo se divide en veinte y quatro partes, que son llamadas pulgadas, con el qual estan arregladas estas medidas de las claſes de Baxeles, desde los ochenta Cañones, hasta diez de la Tabla precedente; y si se quisiere construir otros de mayor, ó menor porte de sus intermedios, guardando las proporciones correspondientes, se observará en toda la regla, como en los exprefiados arriba.

Gaztañeta.

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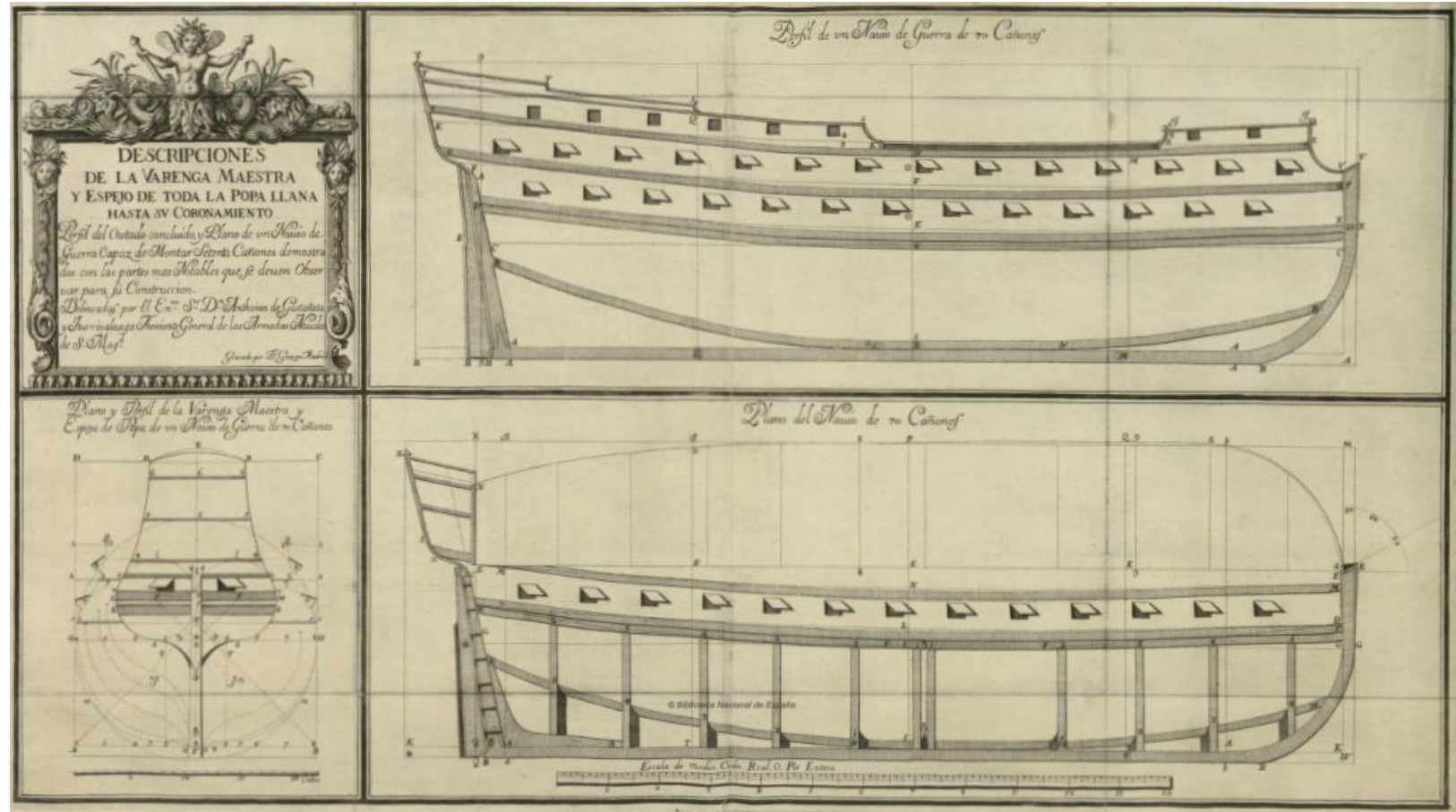
(Biblioteca Nacional de España, 2019)

Proporciones de las medidas más esenciales para la fábrica de navíos y fragatas (1720)



“Tres cosas te pido, lector amigo, por ti mismo. Una es, que si no tienes perfecta comprensión de la náutica, no censure lo que no entiendes.

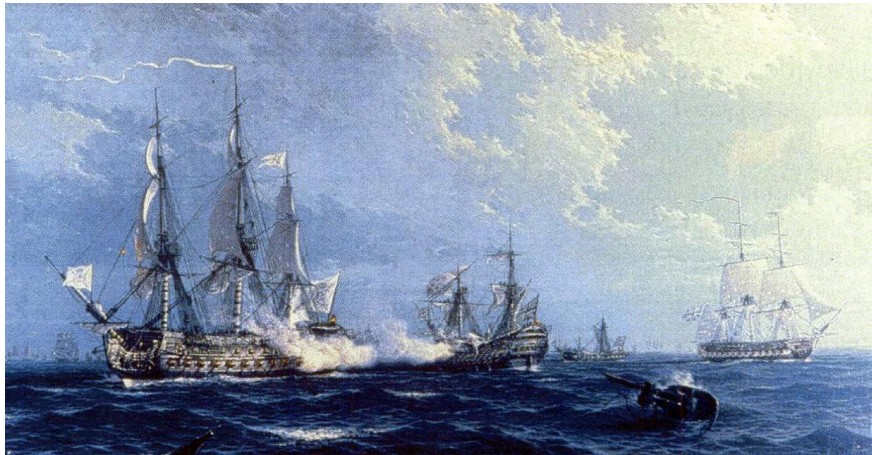
Otra, que si la posees, y dificultas, me hagas honra de suspender la censura, hasta la experiencia. Otra, que no te detengas en buscar flores en mi estilo; porque jamás tuve cuidado de ellas, ni la sincera verdad las necesita”
(Gaztañeta, 1720).



(Biblioteca Nacional de España, 2019)



(Todoavante, 2020)



(Todoababor, 2020)

Despite Gaztañeta's death in 1728, his treatises were implemented for more than 20 years, until the incursion of the Marqués de la Ensenada and Jorge Juan around 1750.

However, during the 1730s the shipbuilding was inspected by two French builders: Ciprián Autrán and Pedro Boyer.

Both maintained the construction process of Gaztañeta, although it is known that they included certain modifications in the design of the ships and corrected some failures of the system.

Pedro Boyer y Ciprián Autrán

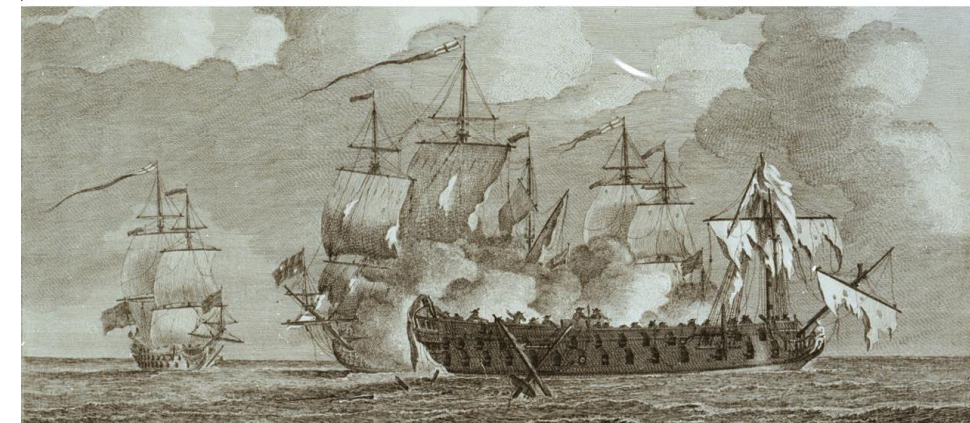
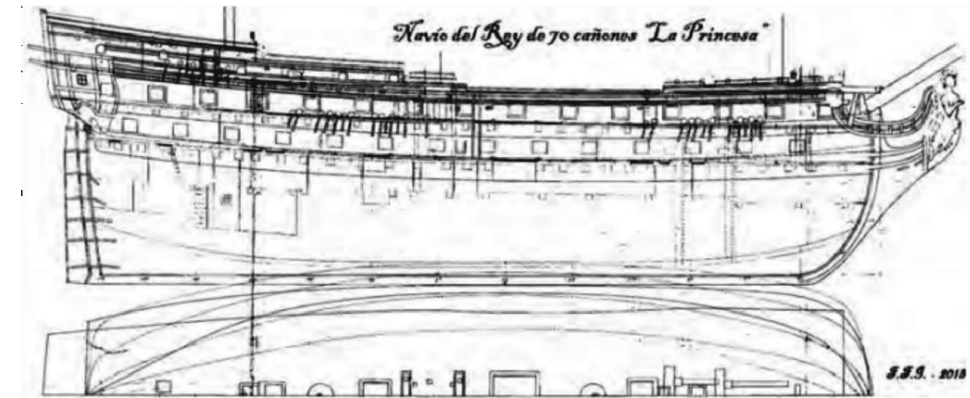


With the arrival of both, the naval construction system began to be called “a la Moda Francesa”, which the 70-gun ship *Princesa* (1730) was built.

Boyer in 1720 wrote “Medidas principales para un bajel de 74 cañones y lo que necesita para su perfecta construcción”

Autrán, for his part, writes “Métodos, reglas y proporciones para la construcción de bajeles y memoria puntual de las maderas y tablones necesarios para un navío de 70 cañones” around 1744.

However, none of these texts have been found.



(Arre Caballo, 2020)

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