

Experiencias de intervención e investigación: buenas prácticas, alianzas y amenazas II

Especialización en Patrimonio Cultural Sumergido
Cohorte 2021

Universidad
Externado
de Colombia

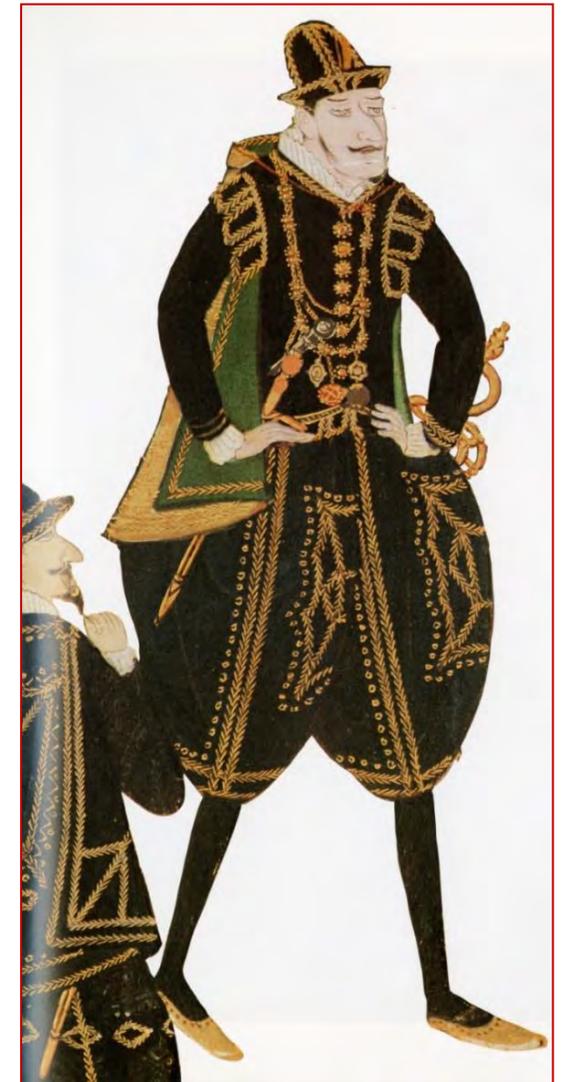
Filipe Castro
Bogotá, April 2021

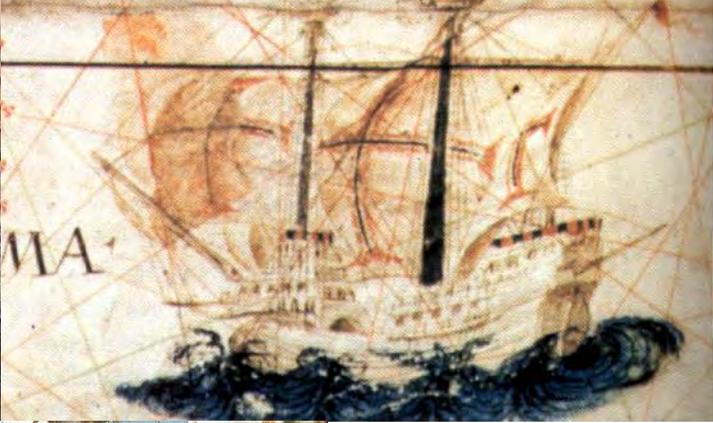


O projecto

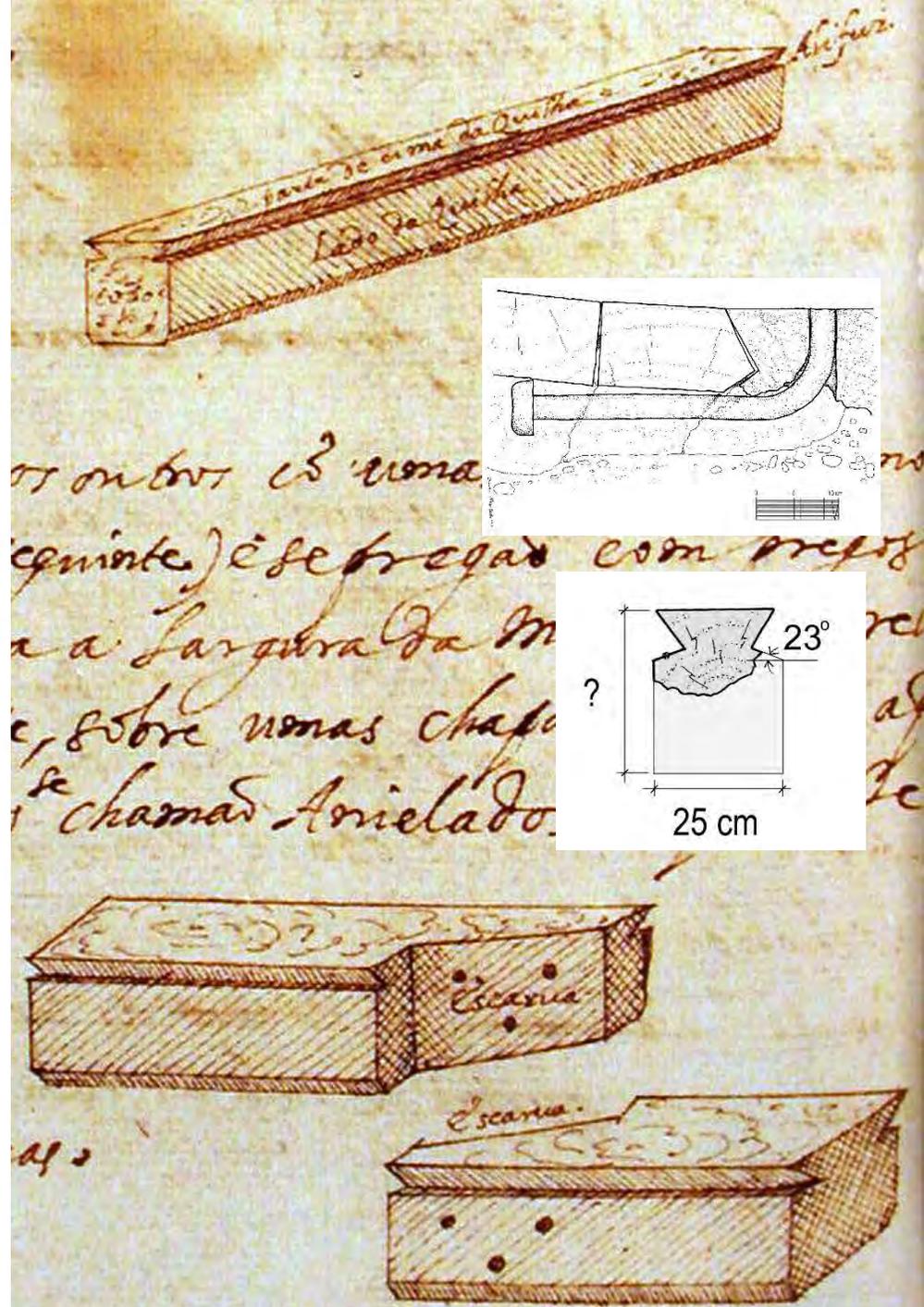
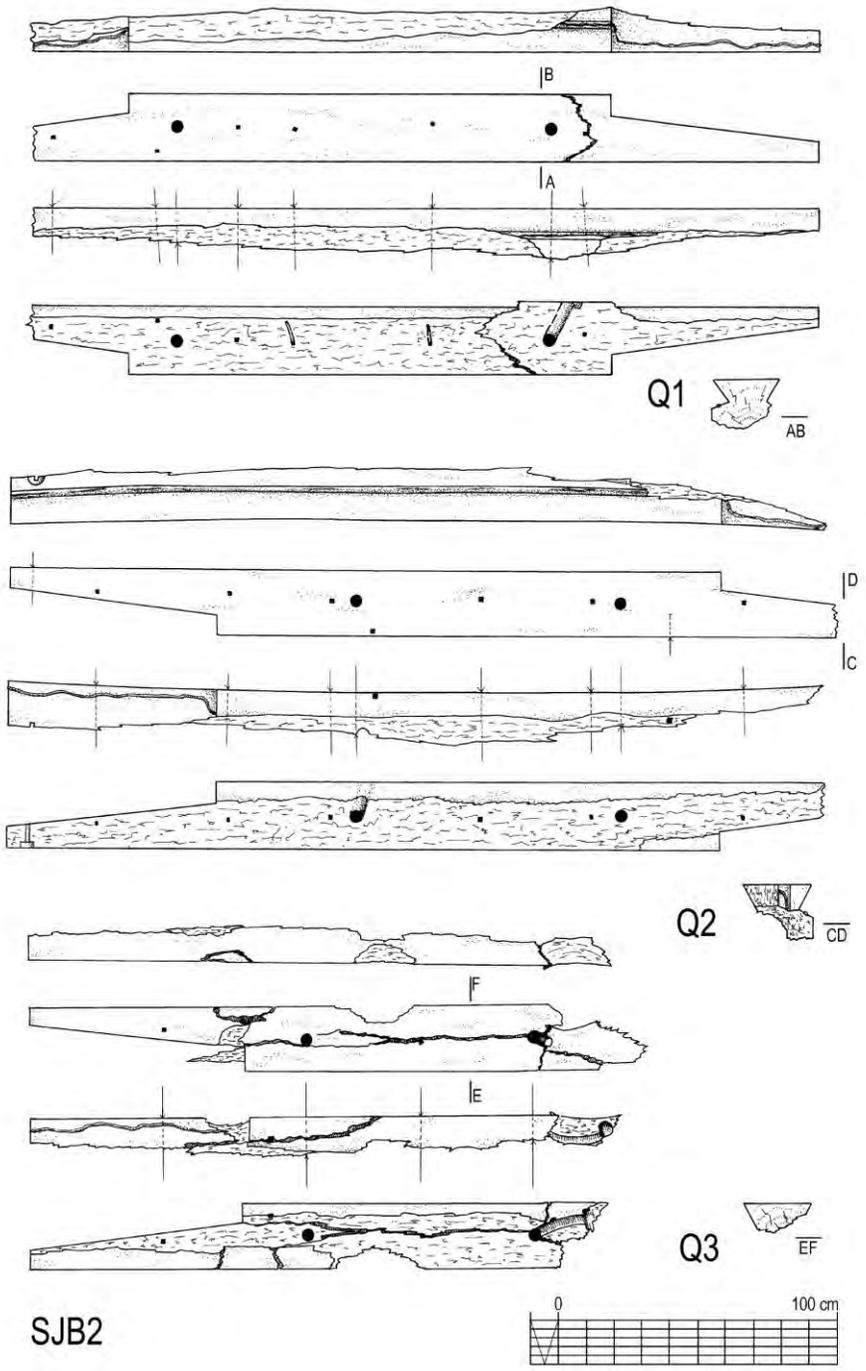


Reconstrução de uma nau da Índia



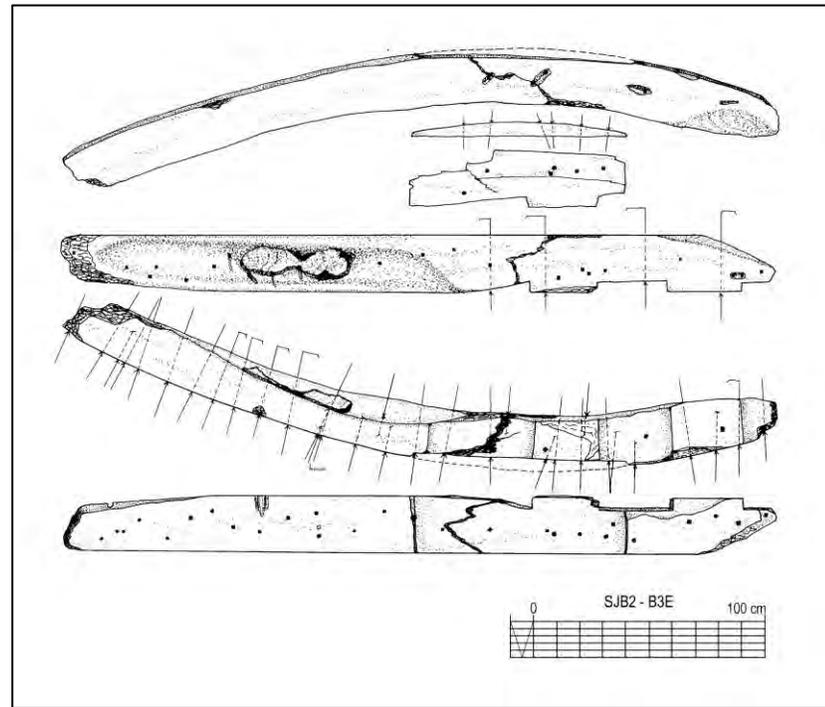
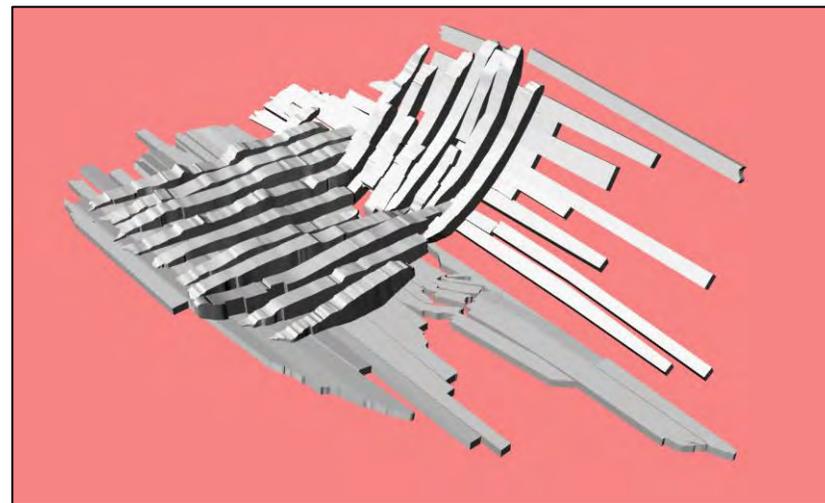
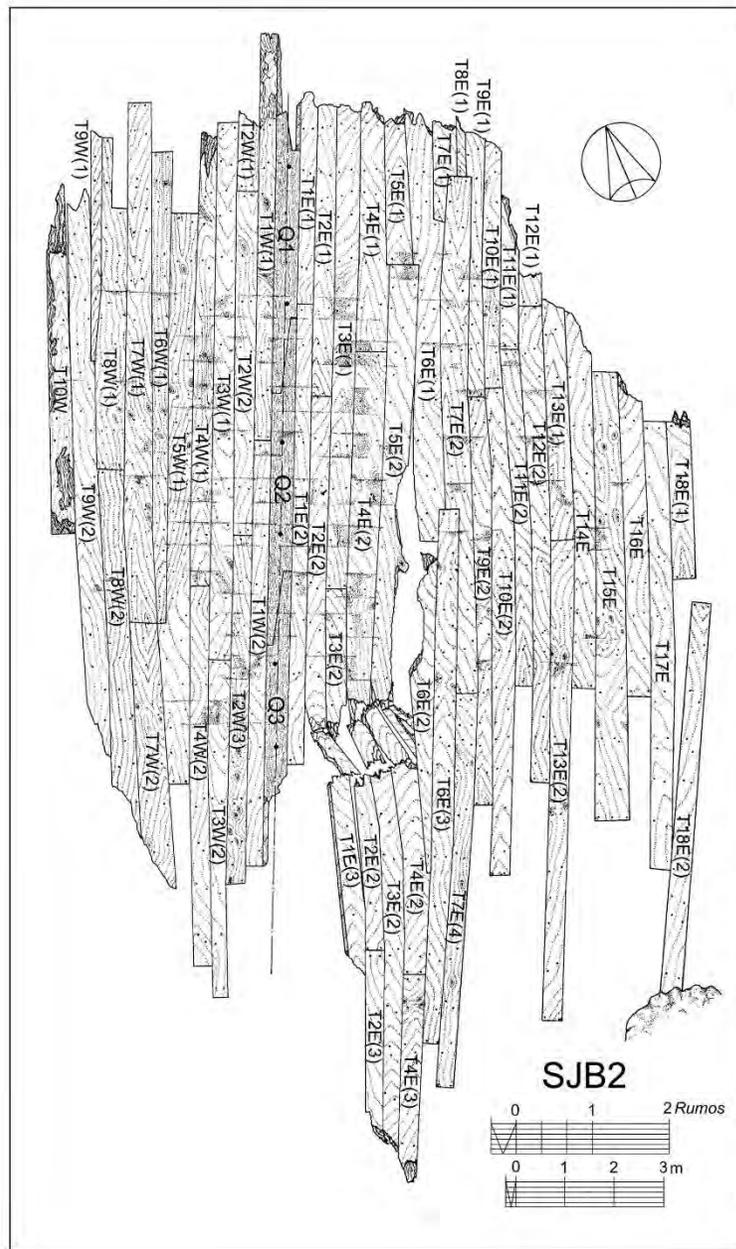
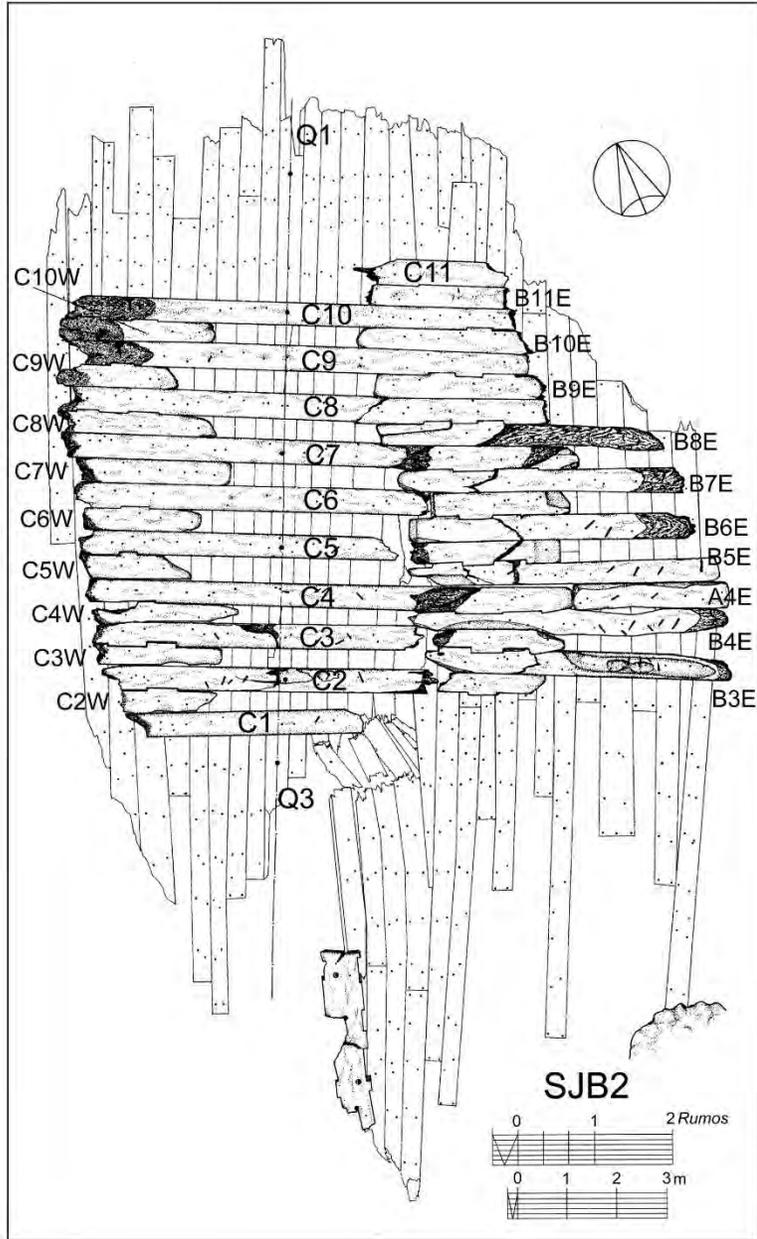


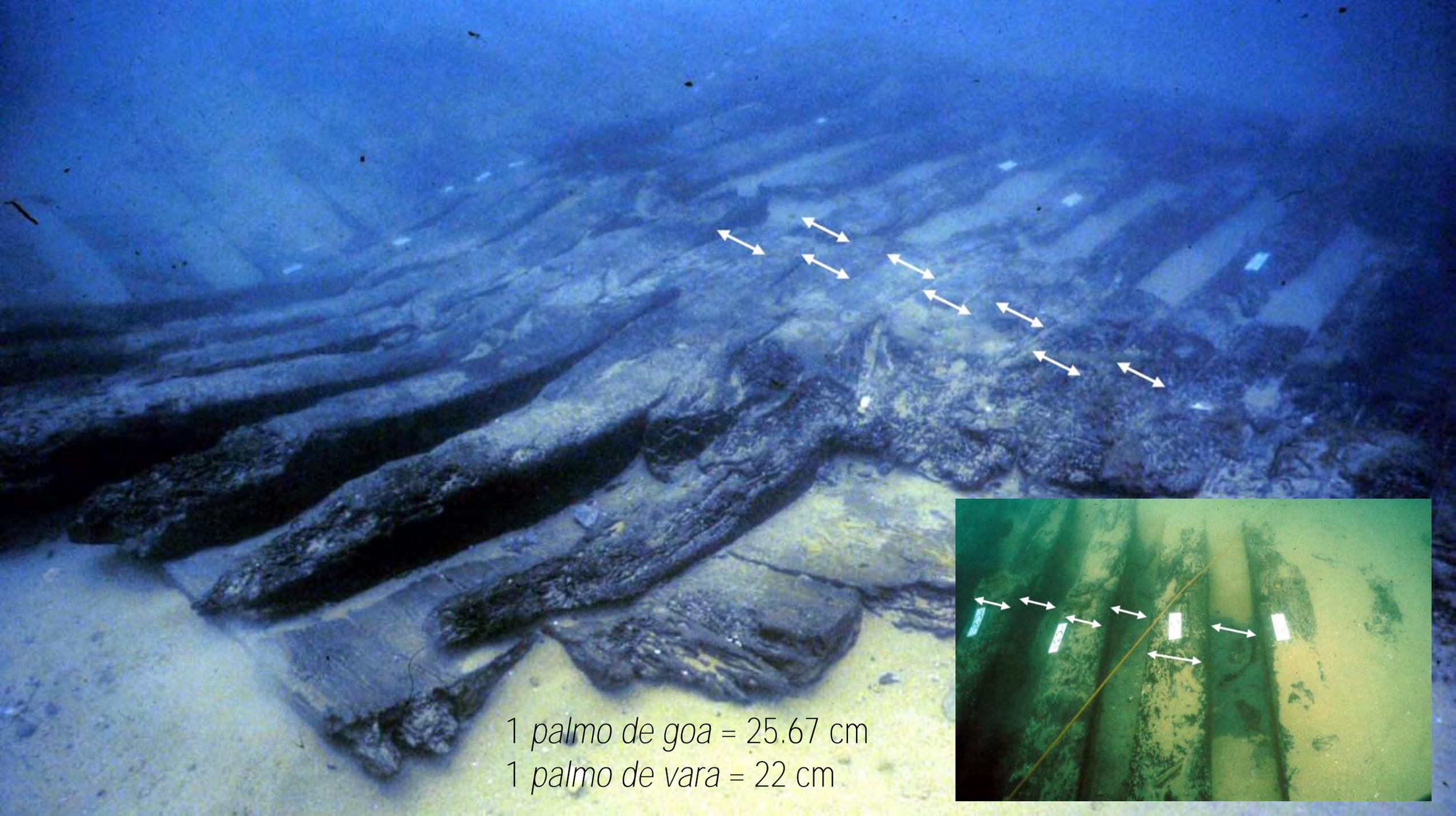




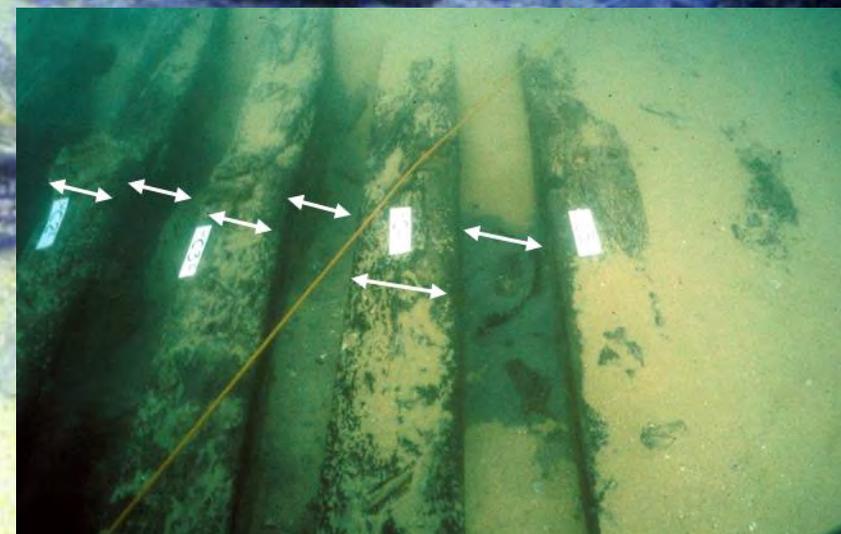
Timber remains were recorded (next page).
First impressions:

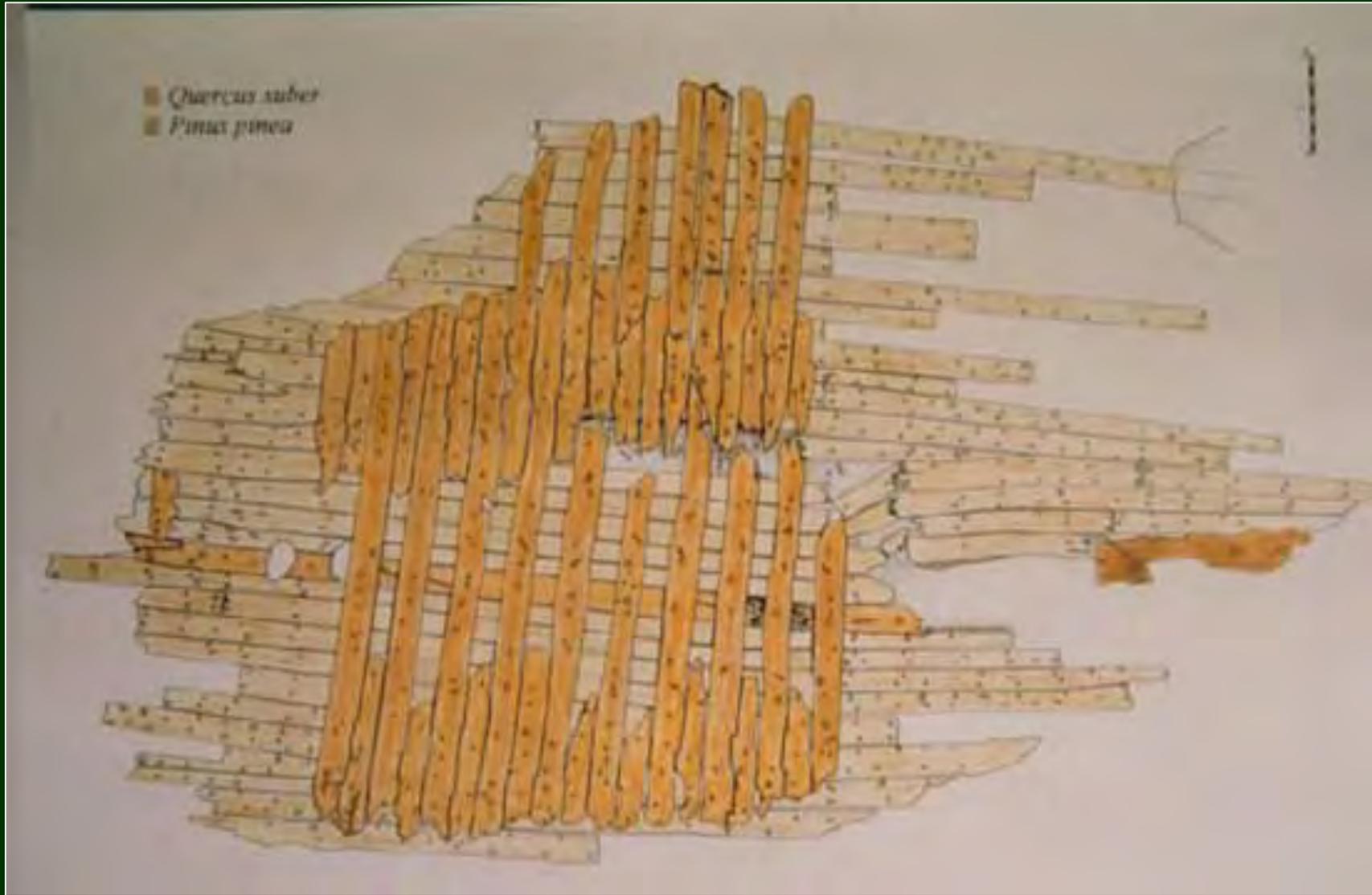
1. Timbers had construction marks;
2. Construction features known from treatises;
3. Units;
4. Timber species;
5. Caulking.



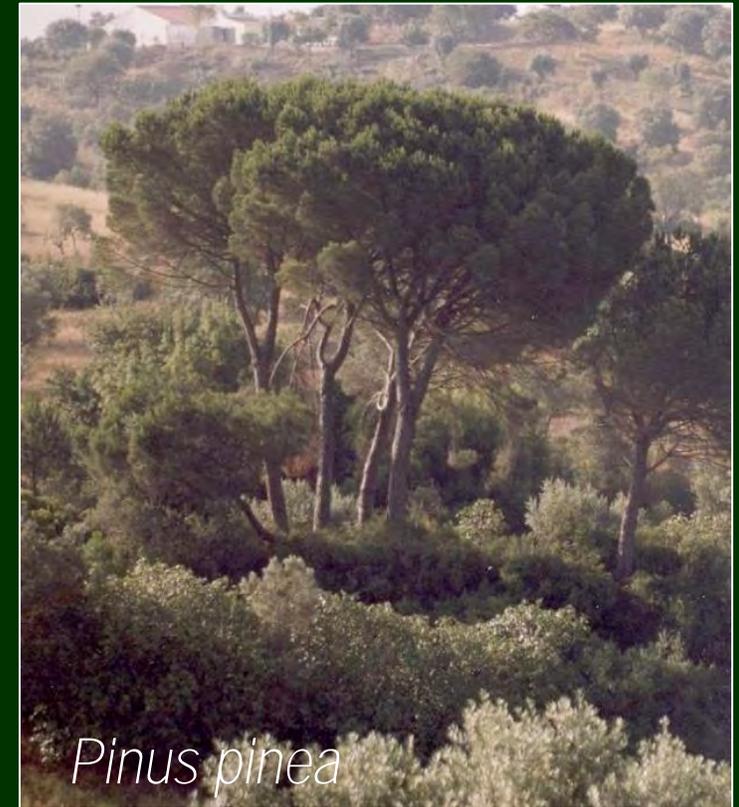


1 *palmo de goa* = 25.67 cm
1 *palmo de vara* = 22 cm





Keel, frames & apron: Cork Oak
Hull planking: Stone Pine



Pinus pinea



Quercus suber

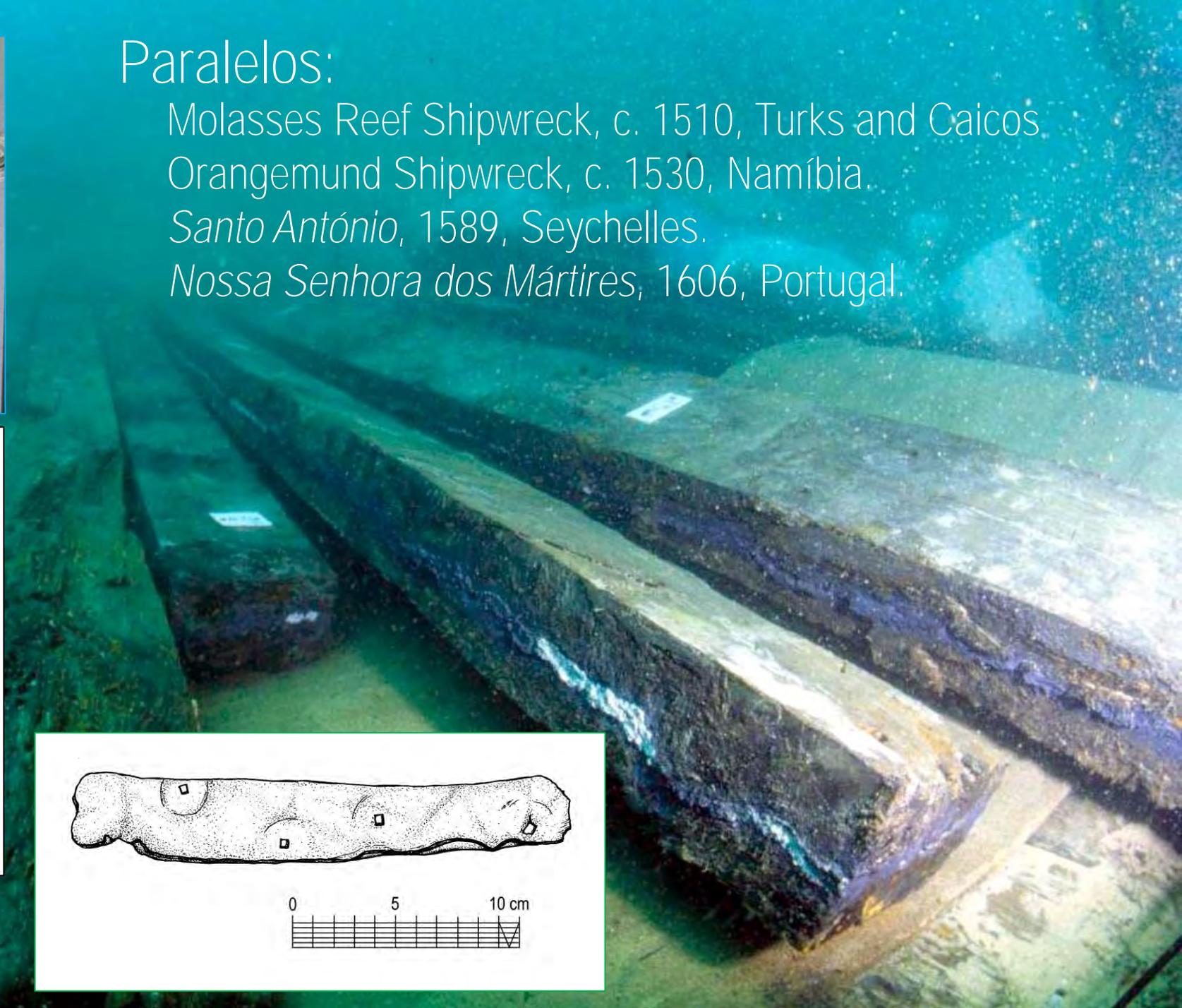
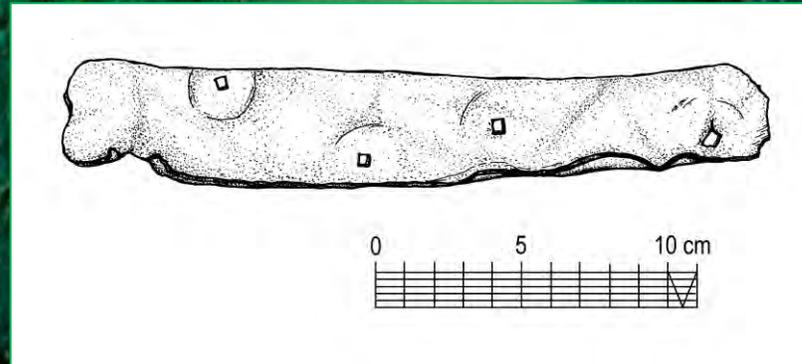
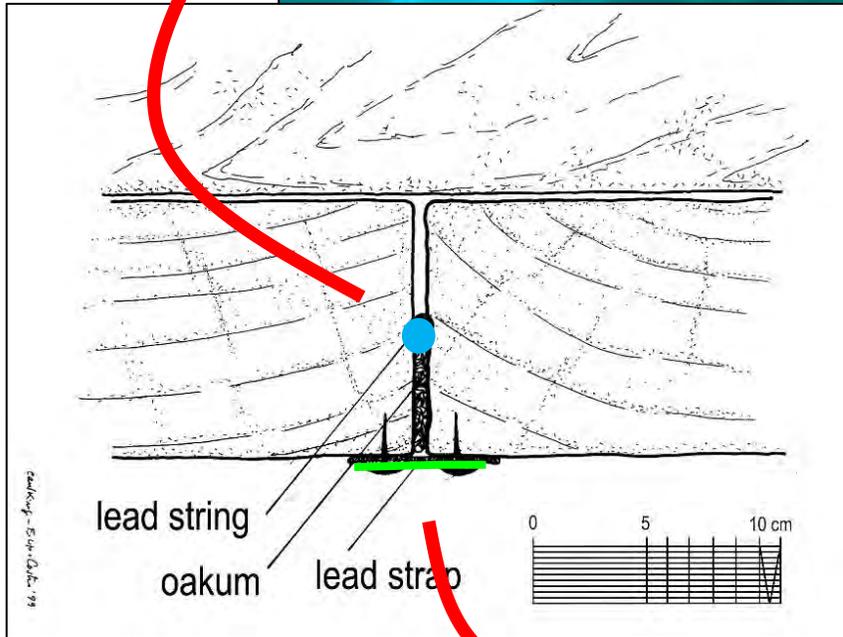
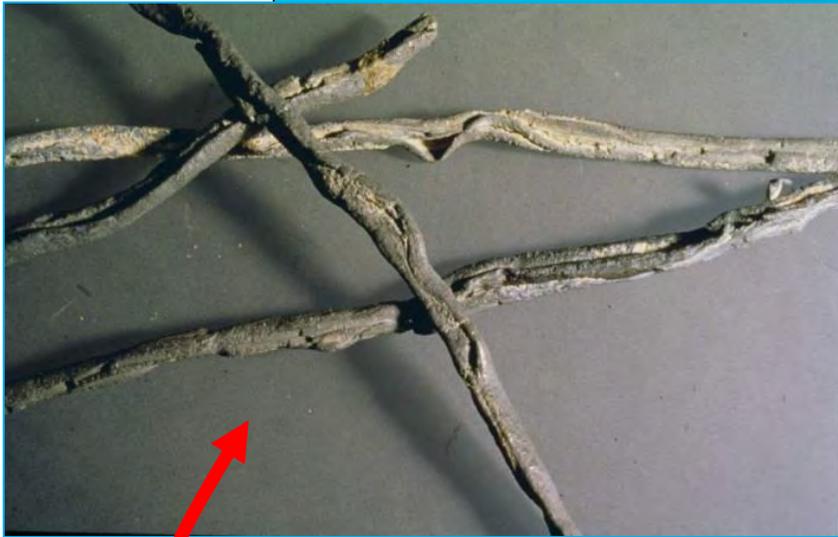
Paralelos:

Molasses Reef Shipwreck, c. 1510, Turks and Caicos

Orangemund Shipwreck, c. 1530, Namíbia.

Santo António, 1589, Seychelles.

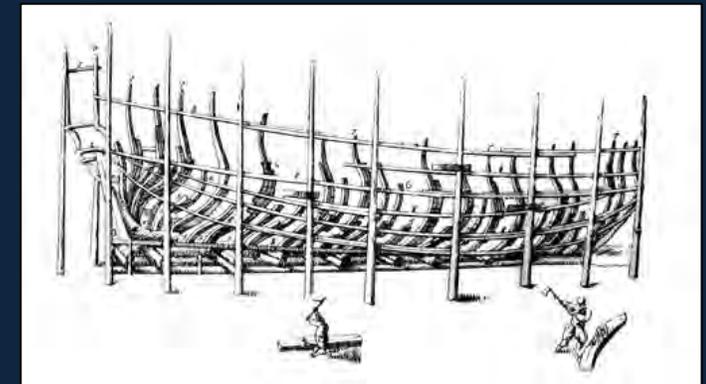
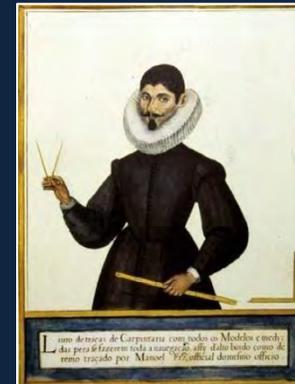
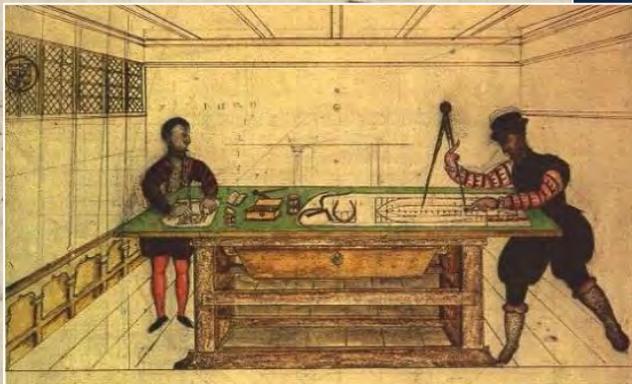
Nossa Senhora dos Mártires, 1606, Portugal.





Século XVI:

- Aparecem tratados;
- O estatuto social dos carpinteiros navais melhora com o tamanho e a complexidade dos navios.





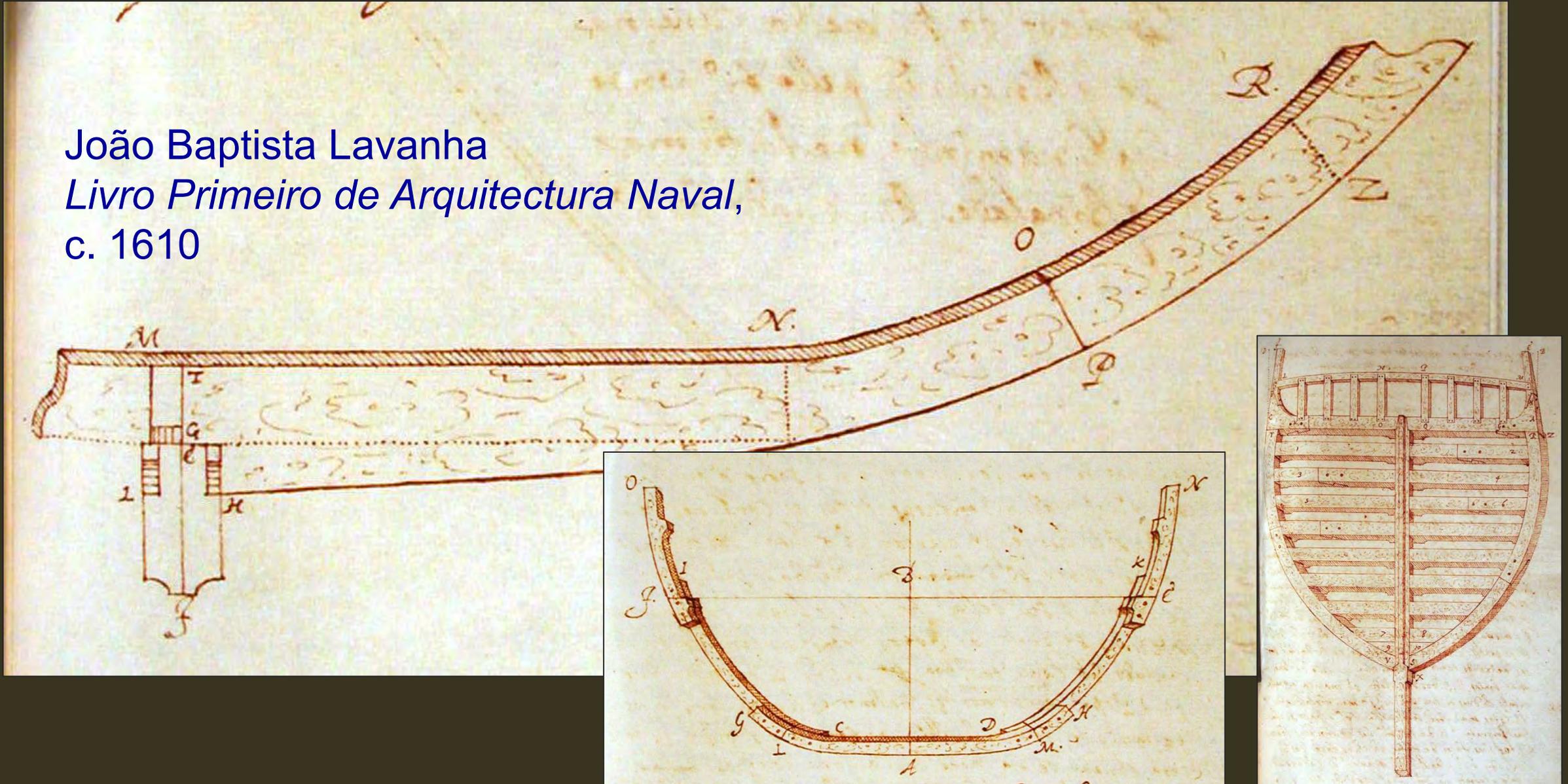
Manoel Fernandez
*Livro de Traças de
Carpintaria*, 1616

Alguns tratados são bonitos...



Outros são detalhados...

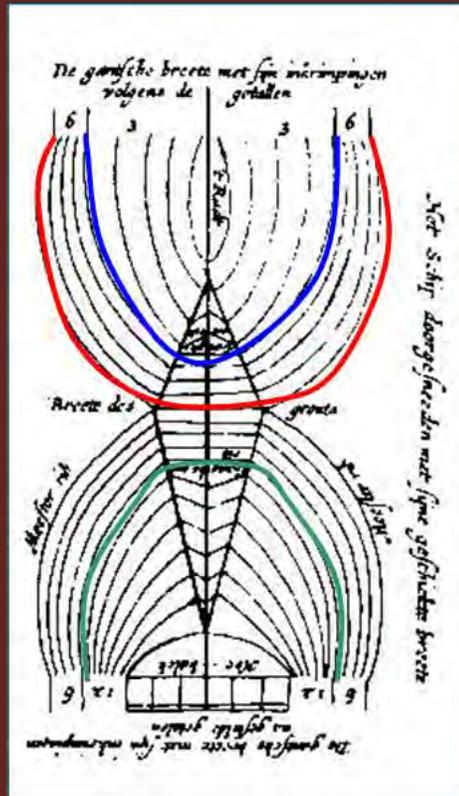
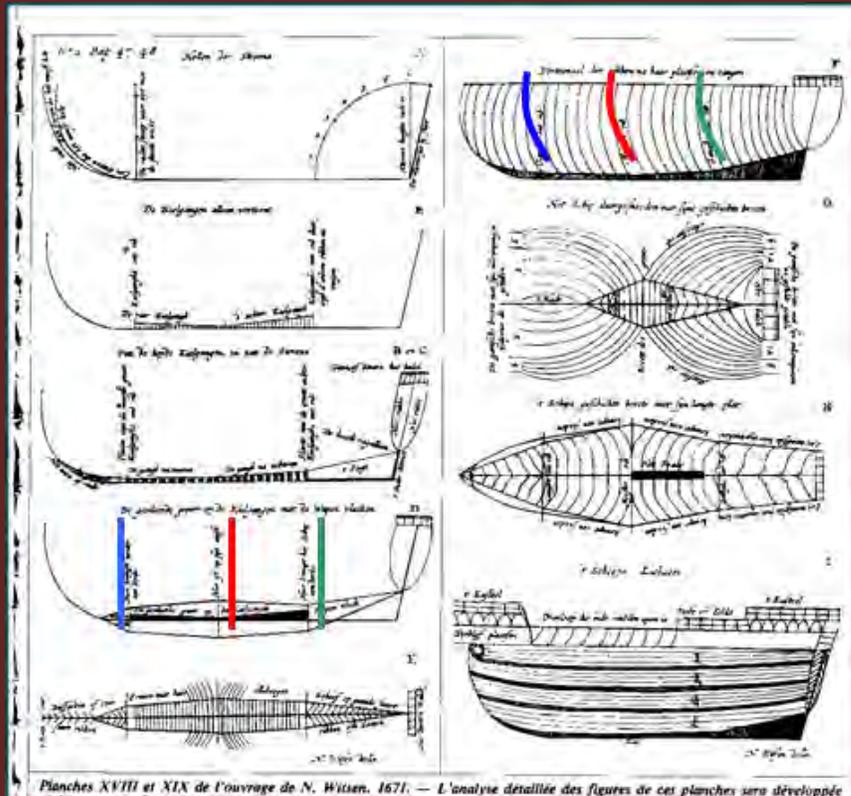
João Baptista Lavanha
Livro Primeiro de Architectura Naval,
c. 1610



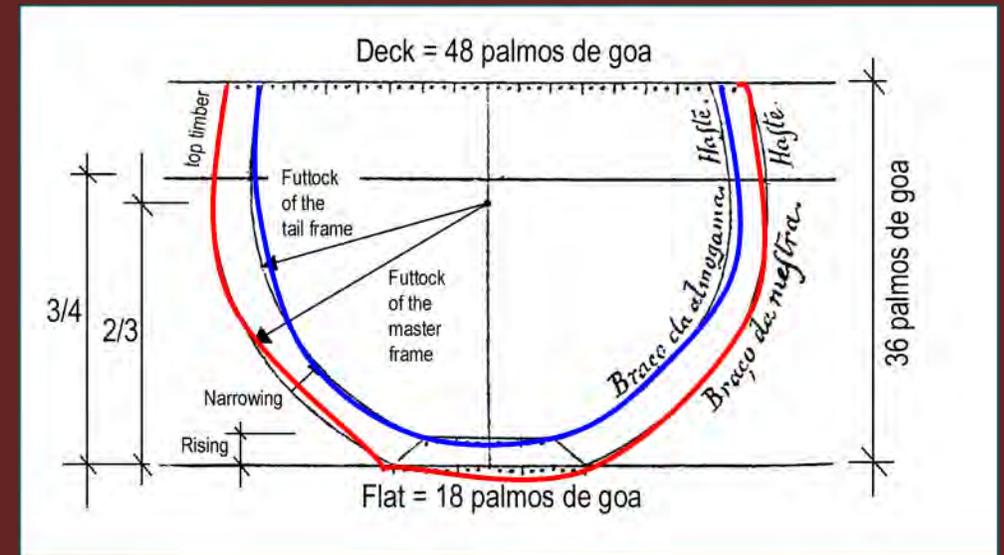
Fernando Oliveira's *Ars Nautica*, c.1570

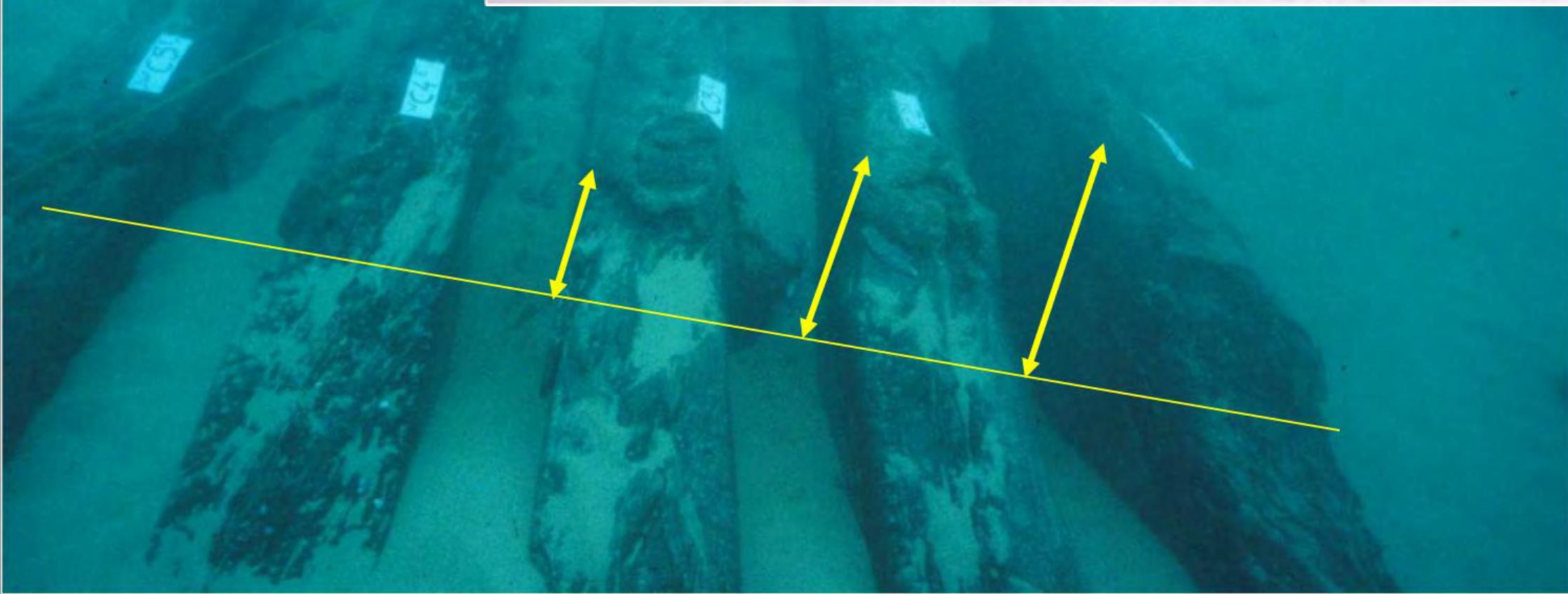
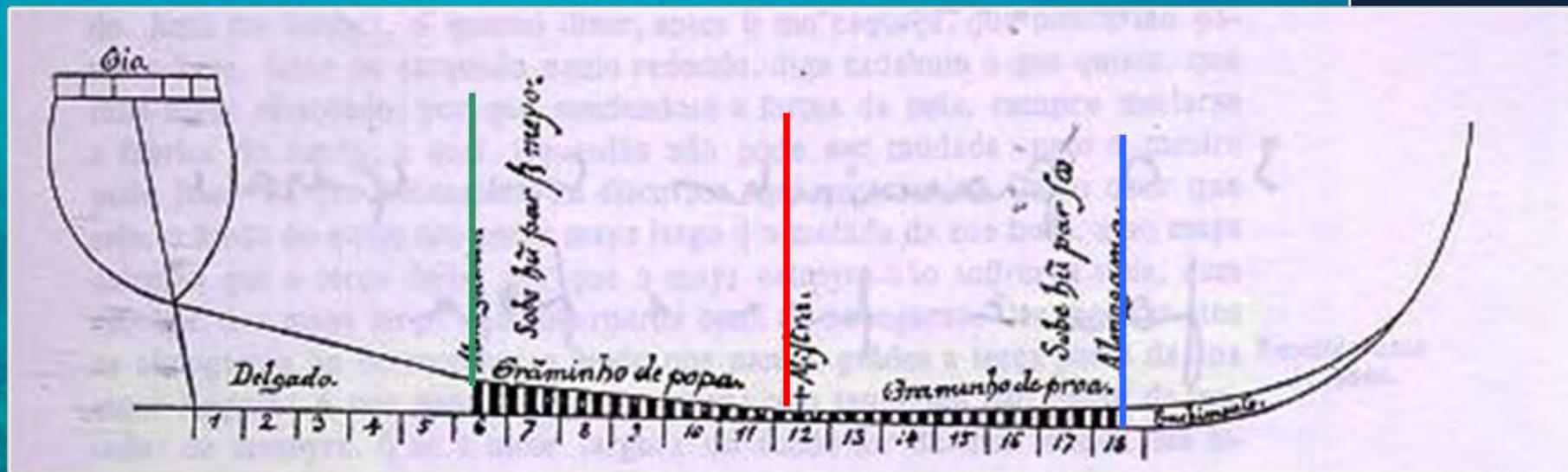
&

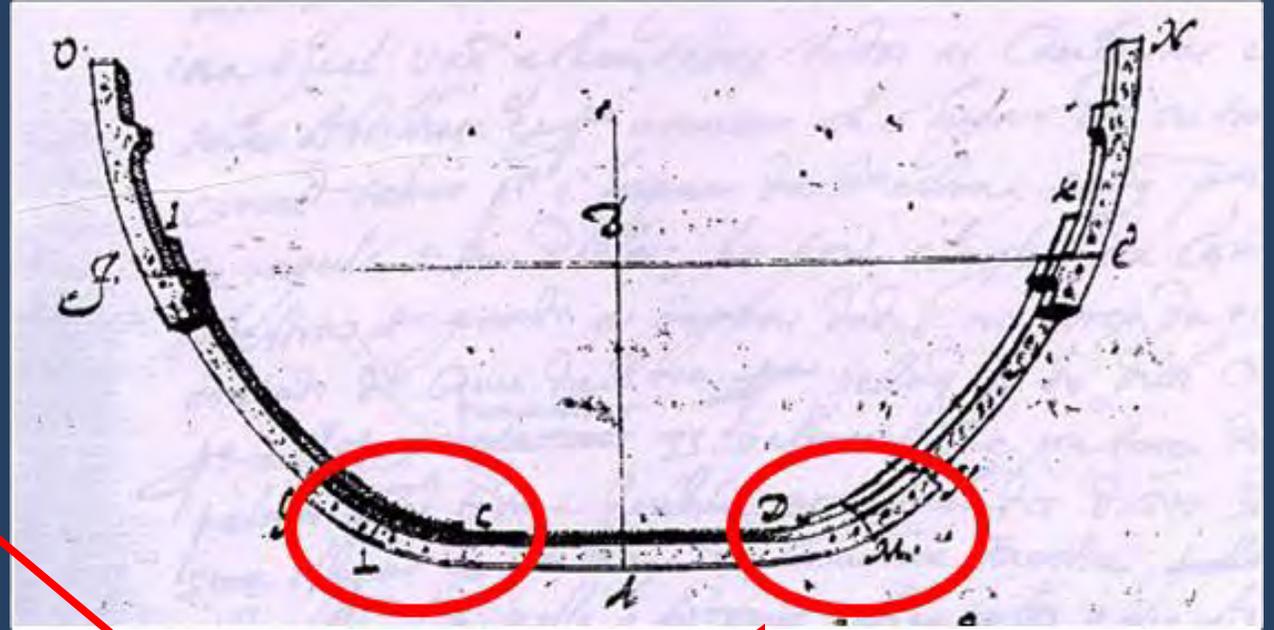
Liuro da Fábrica das Naus, c.1580



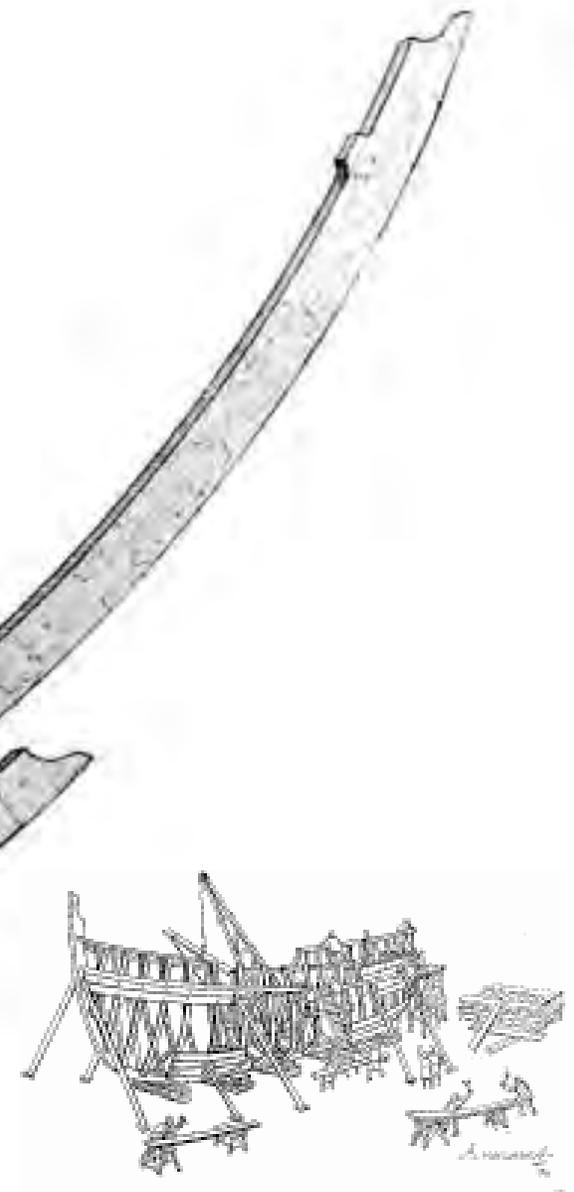
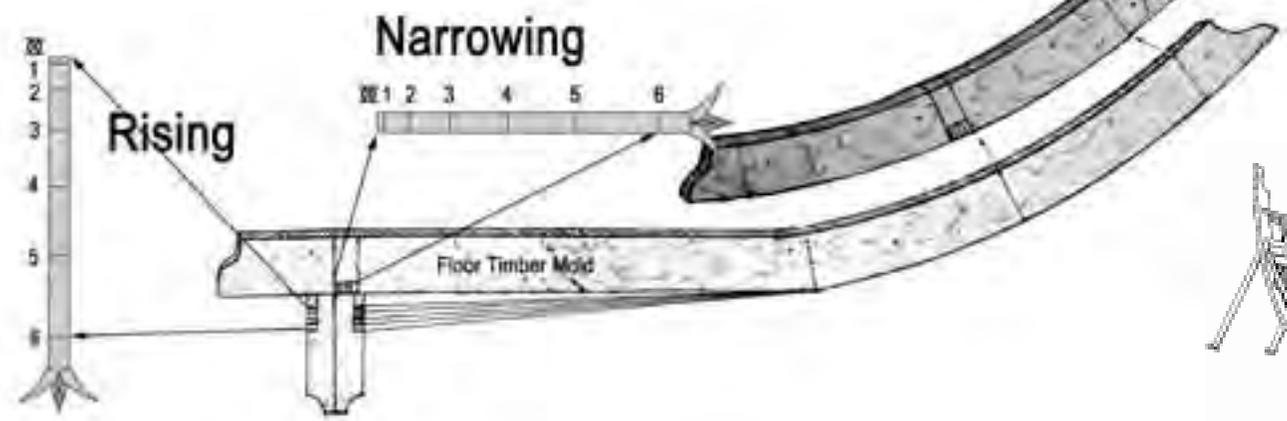
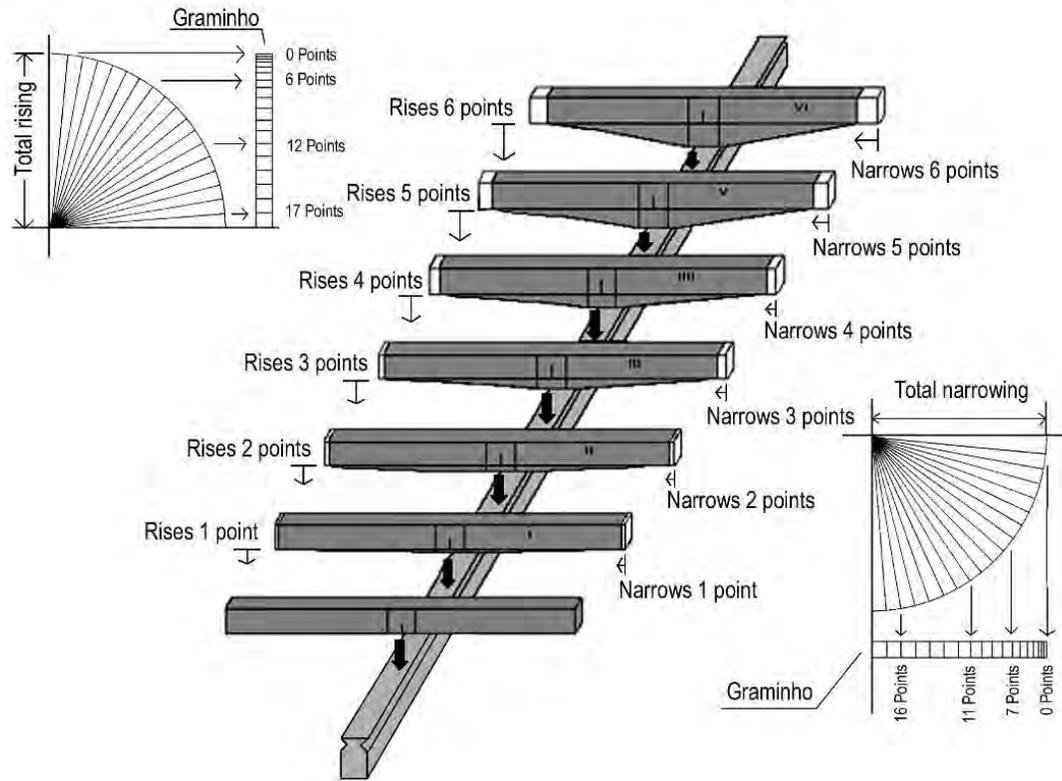
Outros são técnicos...

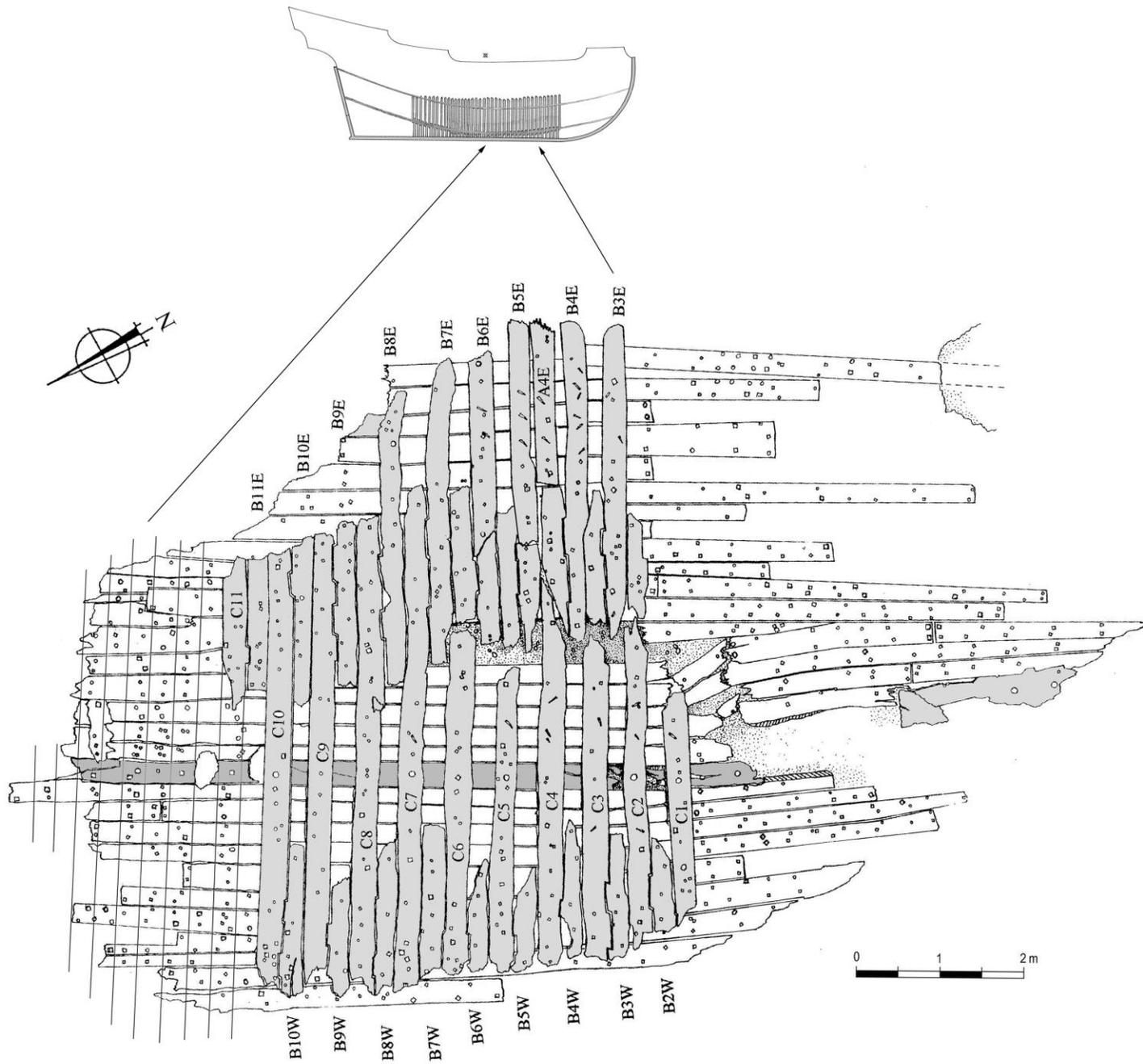






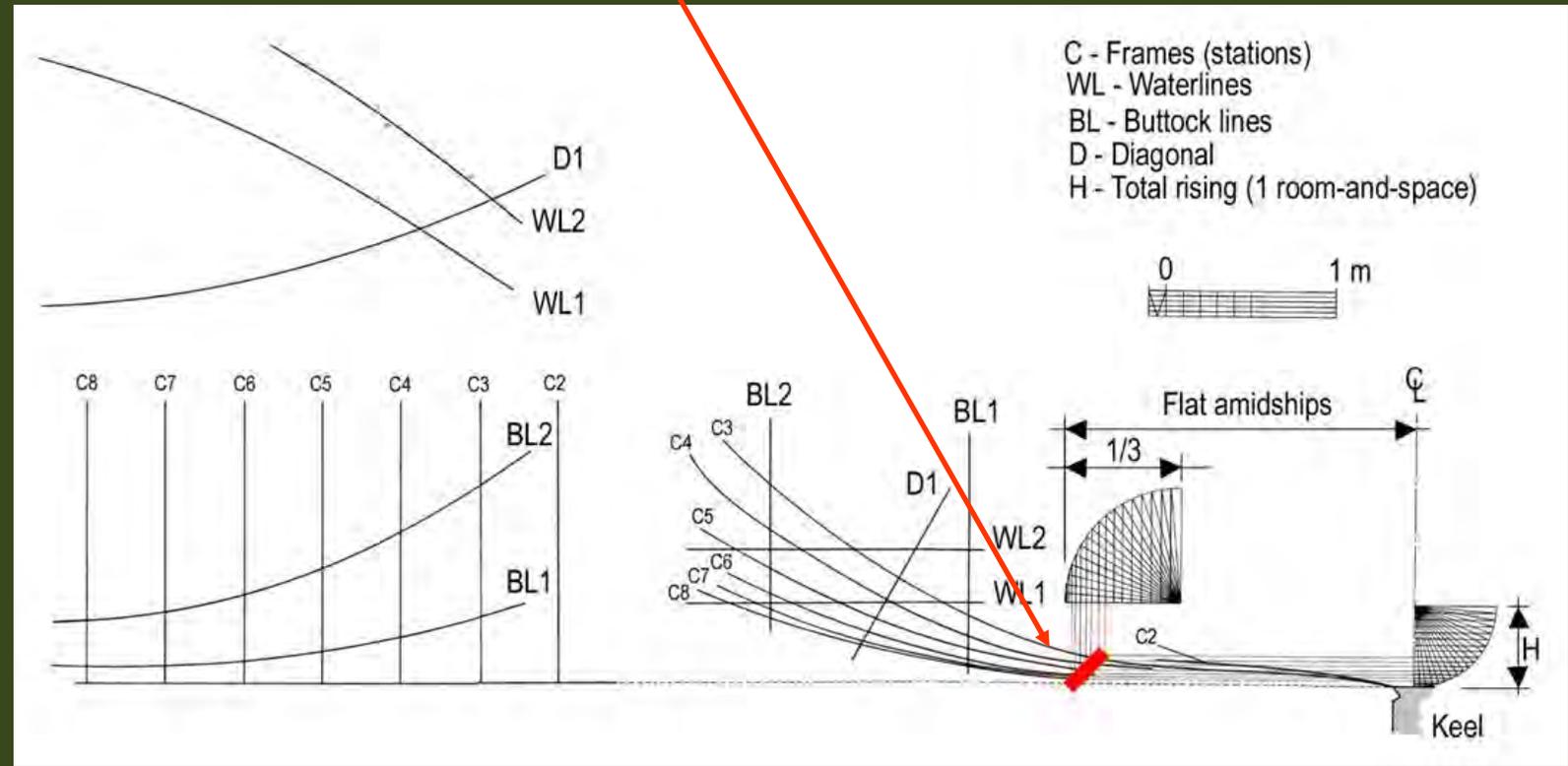
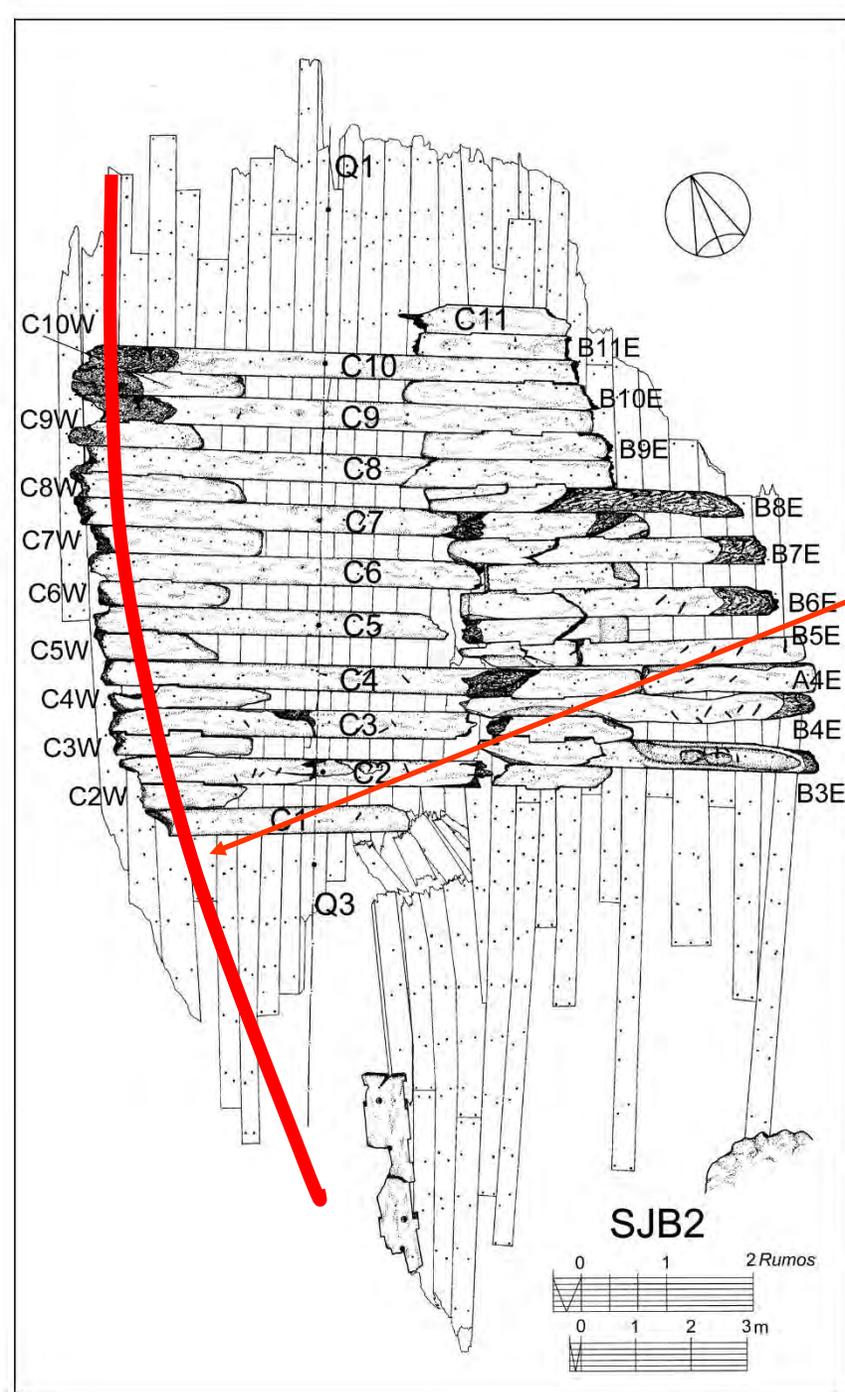
Côvados.



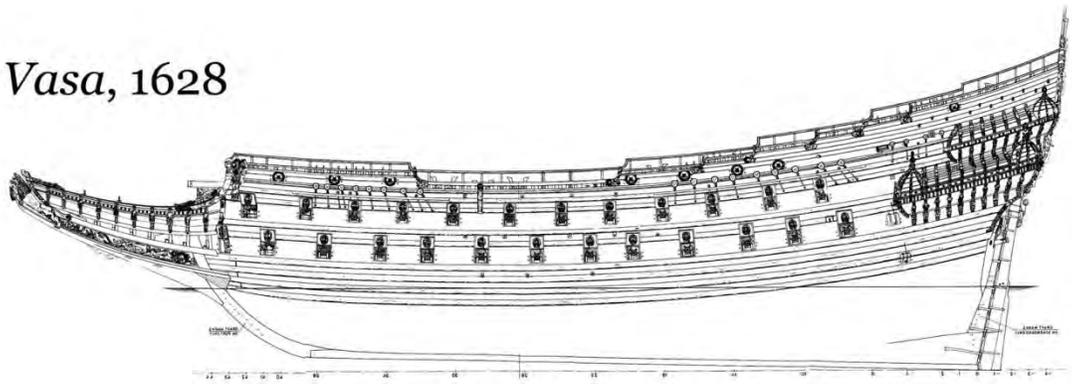


After all measurements were done it was clear that we had the central portion of the ship's forward bottom.

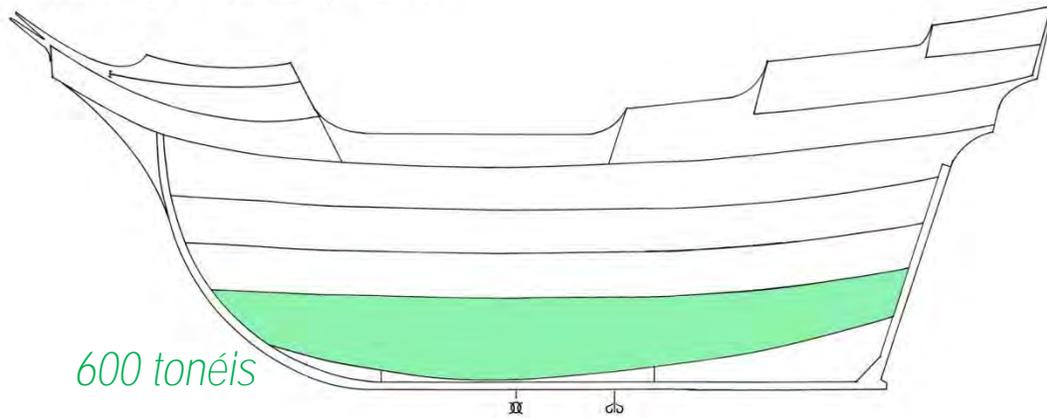
Curva do levantamento e recolhimento dos côvados.



Vasa, 1628

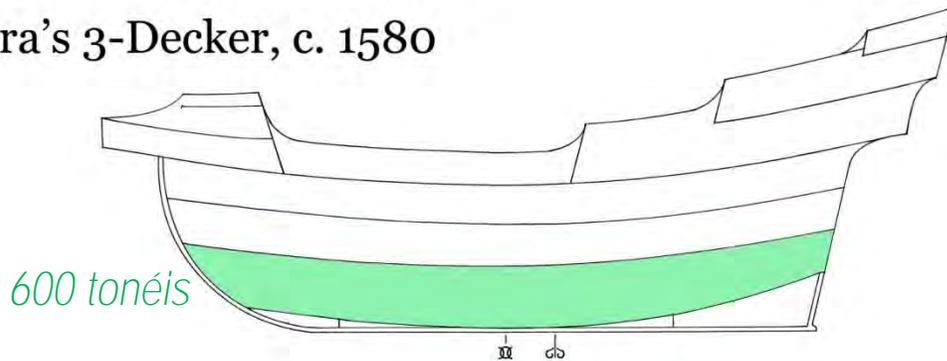


Fernandez' 4-Decker, 1616



600 tonéis

Oliveira's 3-Decker, c. 1580

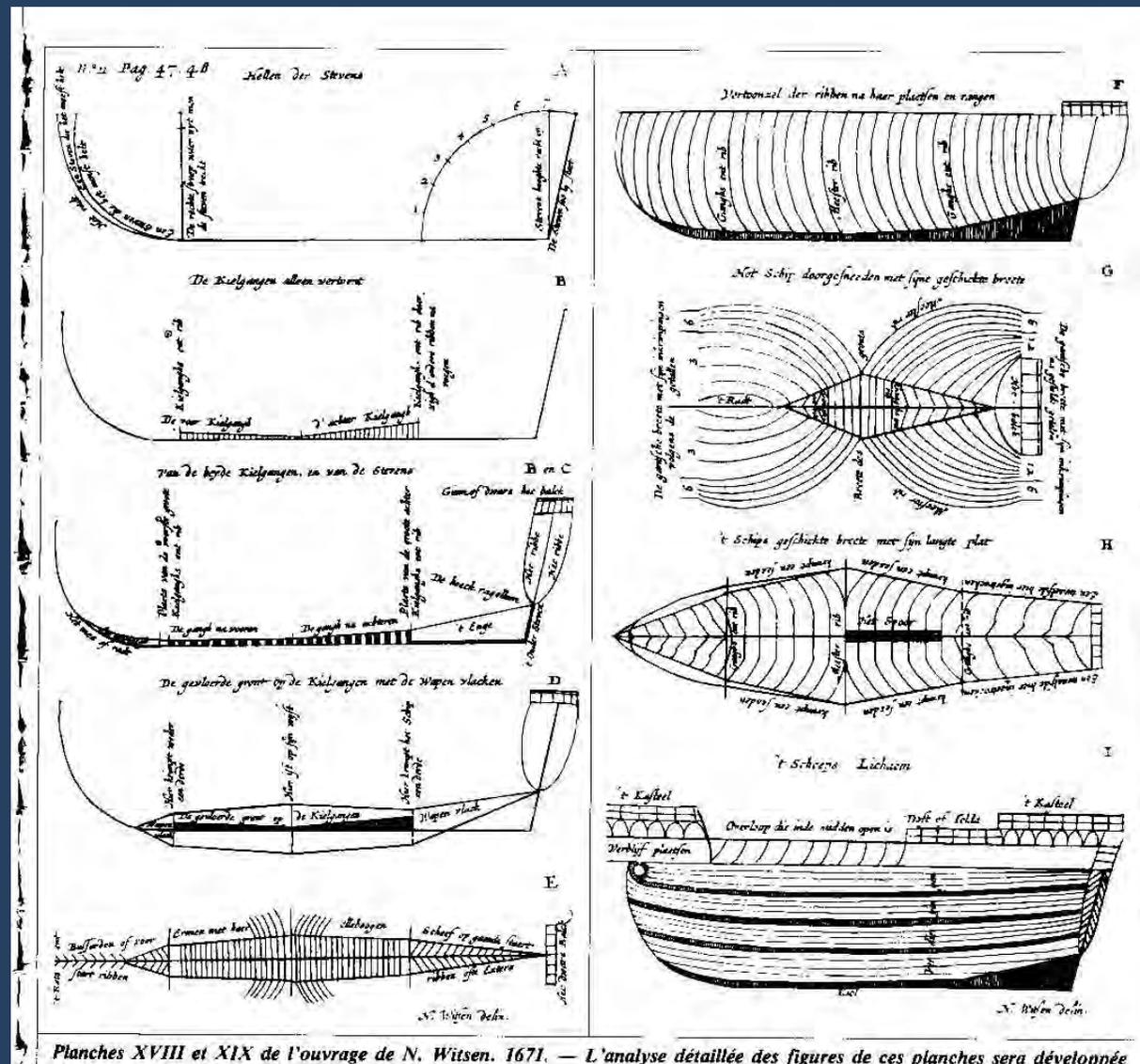


600 tonéis

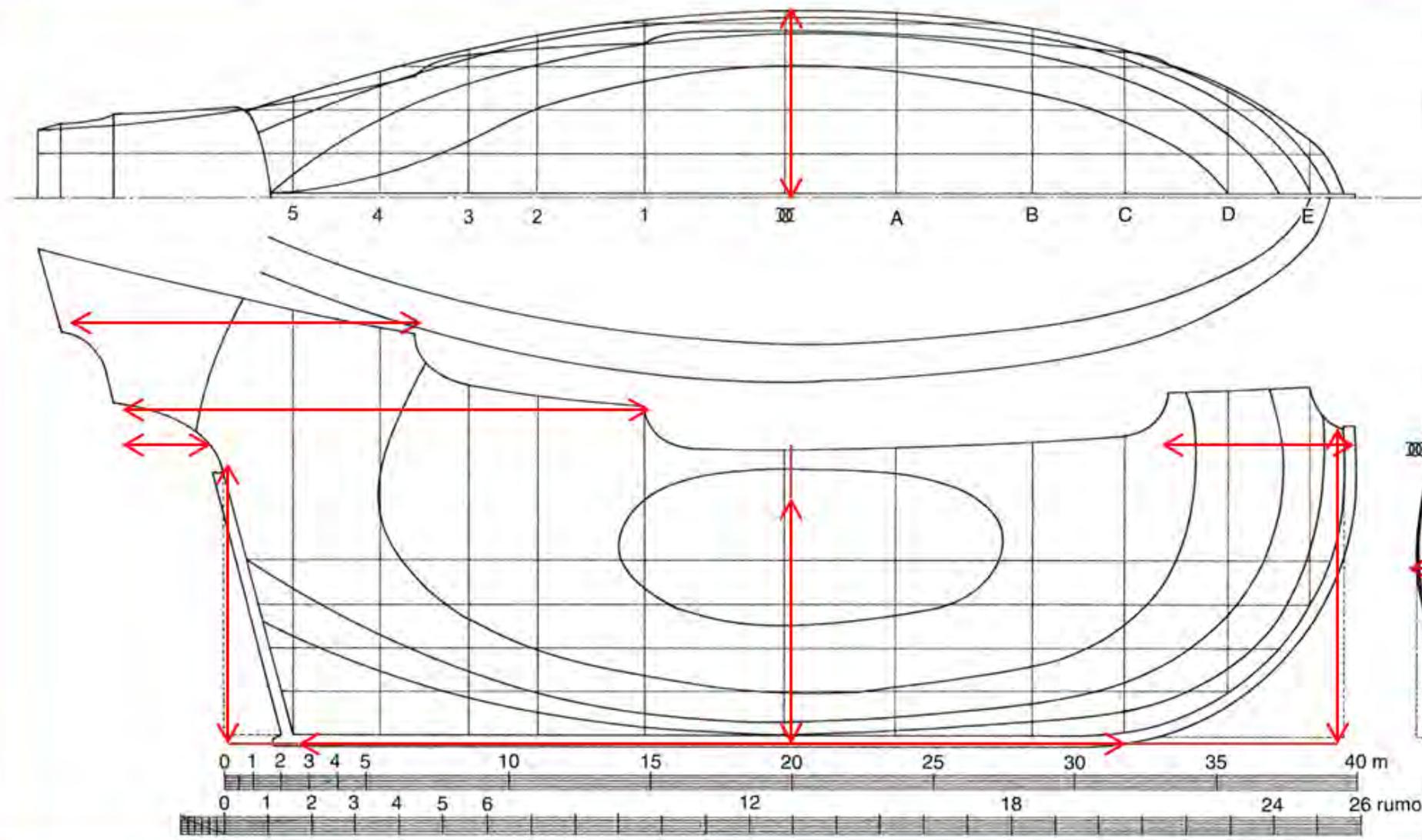
A tonelagem dos navios portugueses deste período era calculada a partir das medidas do porão e é difícil reconstruir o tamanho real da nau *N.S. dos Mártires* a partir de um pequeno fragmento do fundo.

A receita de Fernando Oliveira

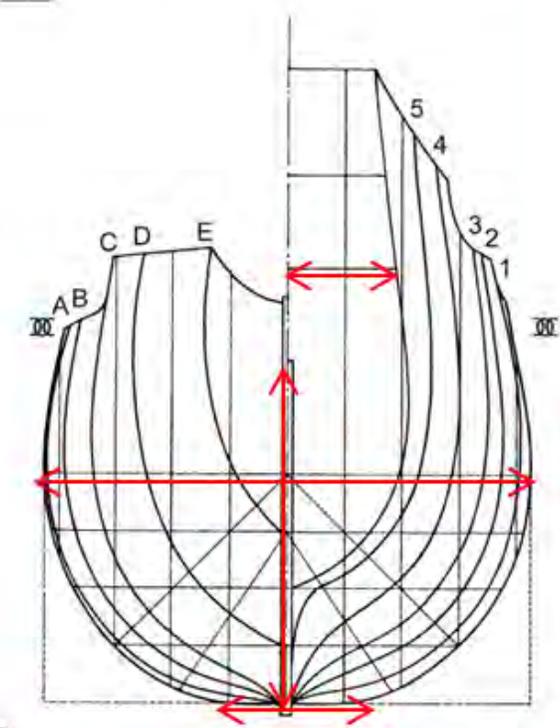
Basic measures for the construction of Oliveira's India nau		
Element	Rule of Proportion	Value (m)
A. Keel	18 <i>rumos</i> for 600 <i>tonéis</i>	27.72
B. Spring of the stem post	1/3 of A	9.24
C. Height of the stem post	1/3 of A	9.24
D. Rake of the stern post	1/4 of A/3	2.31
E. Height of the transom	1/3 of A	9.24
F. Maximum breath	1/3 to 1/2 of A	12.32
G. Flat amidships	1/3 to 1/2 of D	4.1
H. Room and space	1 <i>palmos de goa</i> + 1 <i>palmos de</i>	0.48
I. Rising of the bottom	Forward: H; Aft: 1.5 H	0.48/0.72
J. Narrowing of the bottom	1/6 of G	0.68
K. Height of the fashion pieces	Start at 1/3 of E	3.08
L. Breath of the transom	1/2 of F	6.16
M. Maximum breath on main deck	F - (» 1+1 <i>palmos de goa</i>)	11.81
N. Depth of the hold	14 <i>palmos de goa</i>	3.59
O. Depth of the second deck	9 <i>palmos de goa</i>	2.31
P. Depth of the gun deck	9 <i>palmos de goa</i>	2.31
Q. Length of the quarter deck	1/2 of length of deck (D+A+B)	20.46
R. Height of the quarter deck	8 <i>palmos de goa</i>	2.05
S. Length of the poop deck	1/2 of Q	13.86
T. Height of the poop deck	7 <i>palmos de goa</i>	1.8
U. Length of the forecastle	1/2 of M	5.9
W. Height of the forecastle	1/3 of M	3.94
V. Height of bulwarks on the deck	1 <i>rumo</i>	1.54
X. Height of bulwarks on the	3 <i>palmos de goa</i>	0.77
Y. Length overall	A+B+D	39.27



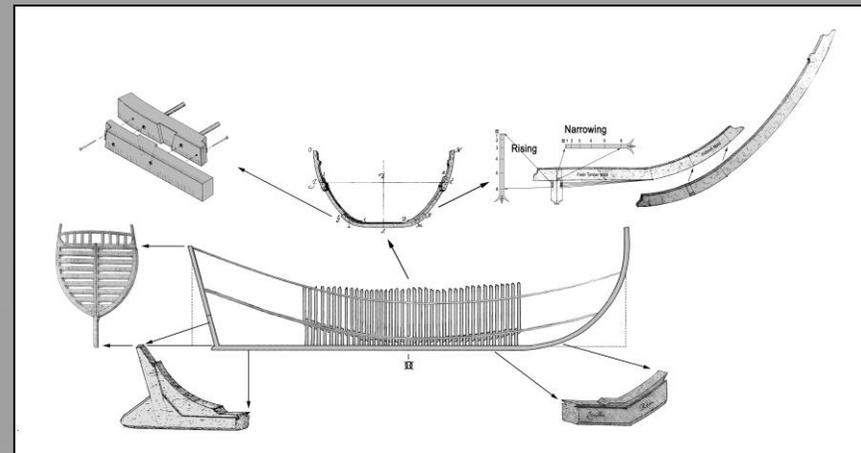
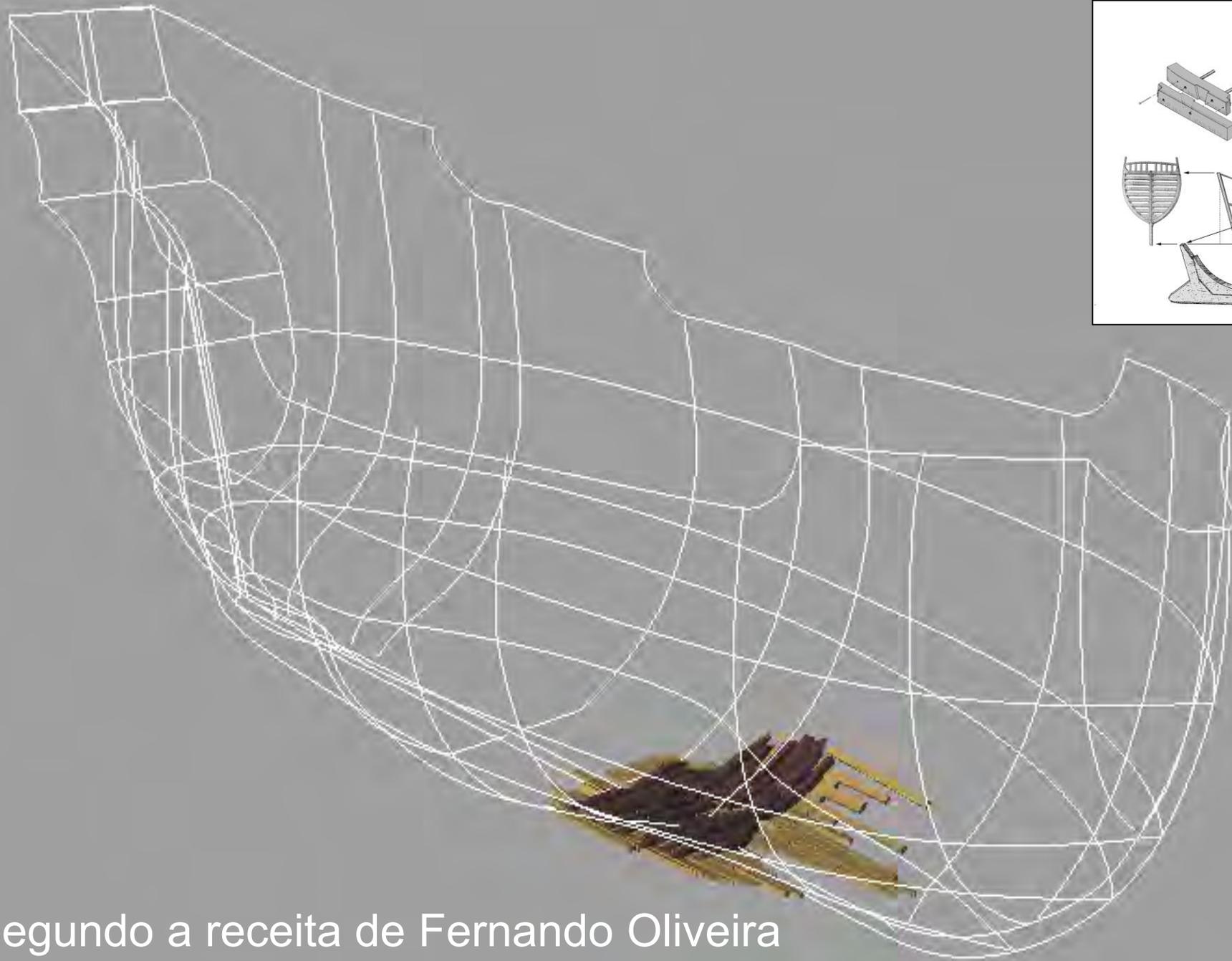
Planches XVIII et XIX de l'ouvrage de N. Witsen. 1671. — L'analyse détaillée des figures de ces planches sera développée



Pepper Wreck
 Nossa Senhora dos Mártires
 1606



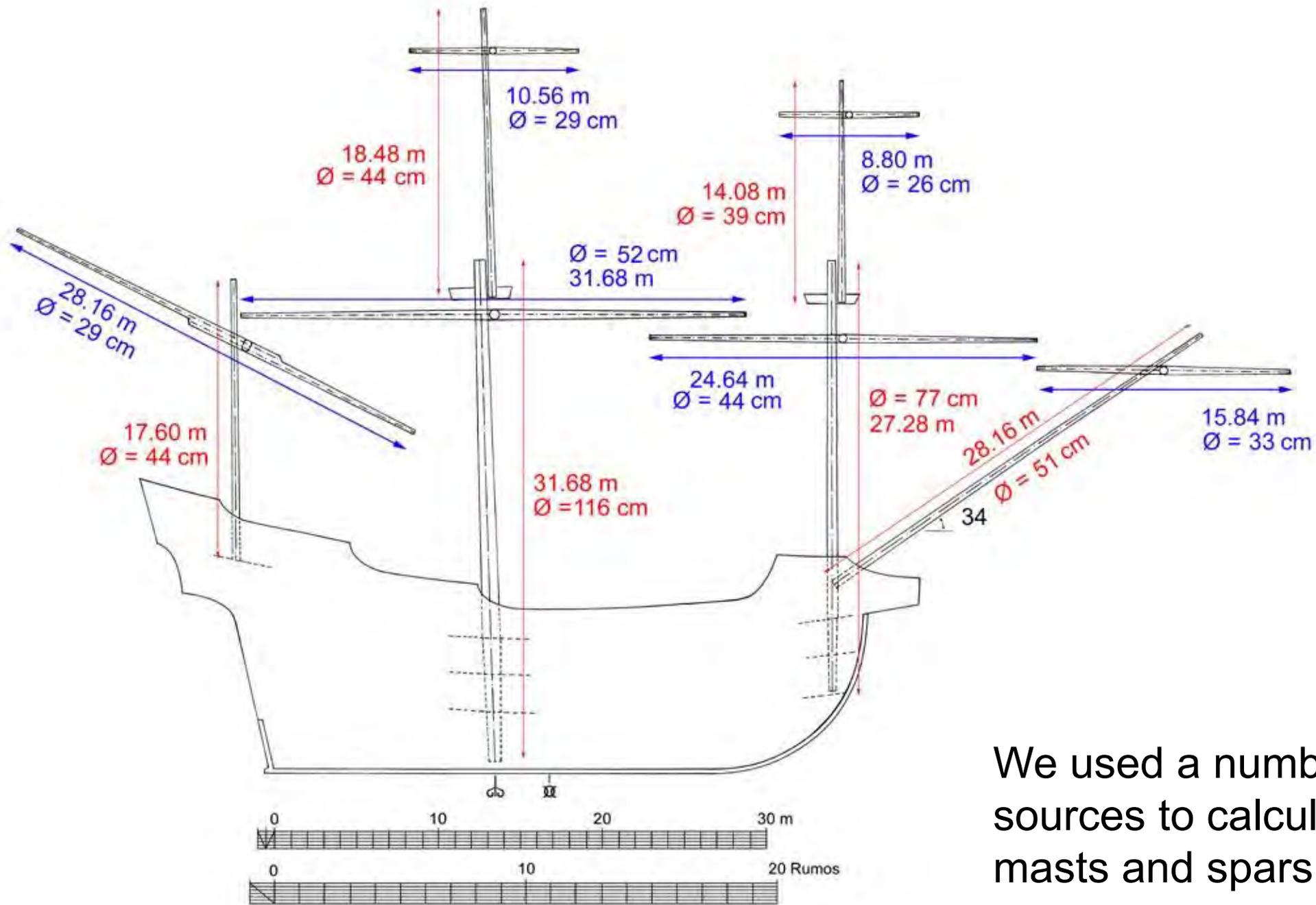
Obtivemos um deslocamento de cerca de 1,100 toneladas para uma linha de água a tocar a cinta mais baixa a meia nau.



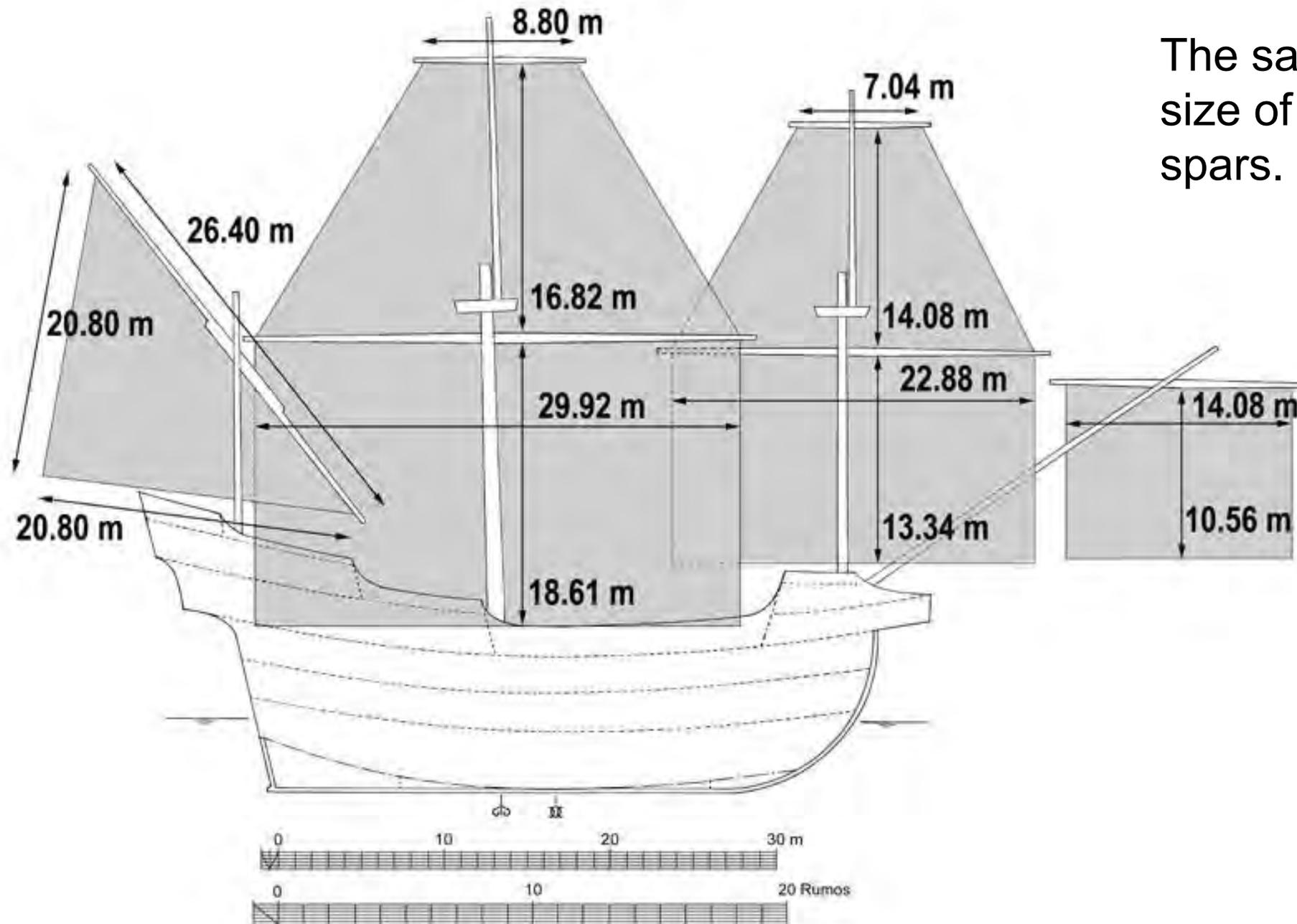
Segundo a receita de Fernando Oliveira

Aparelho



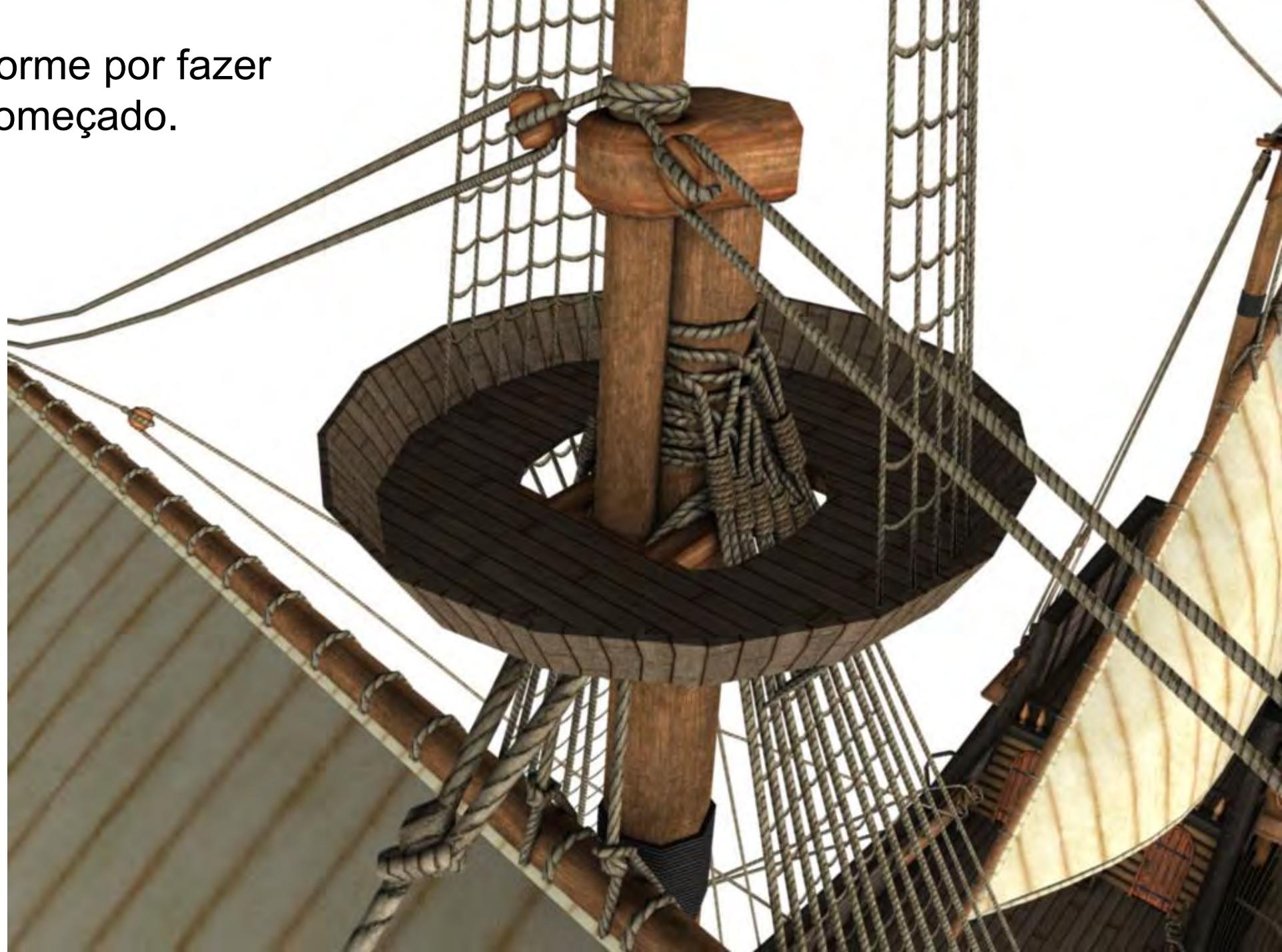


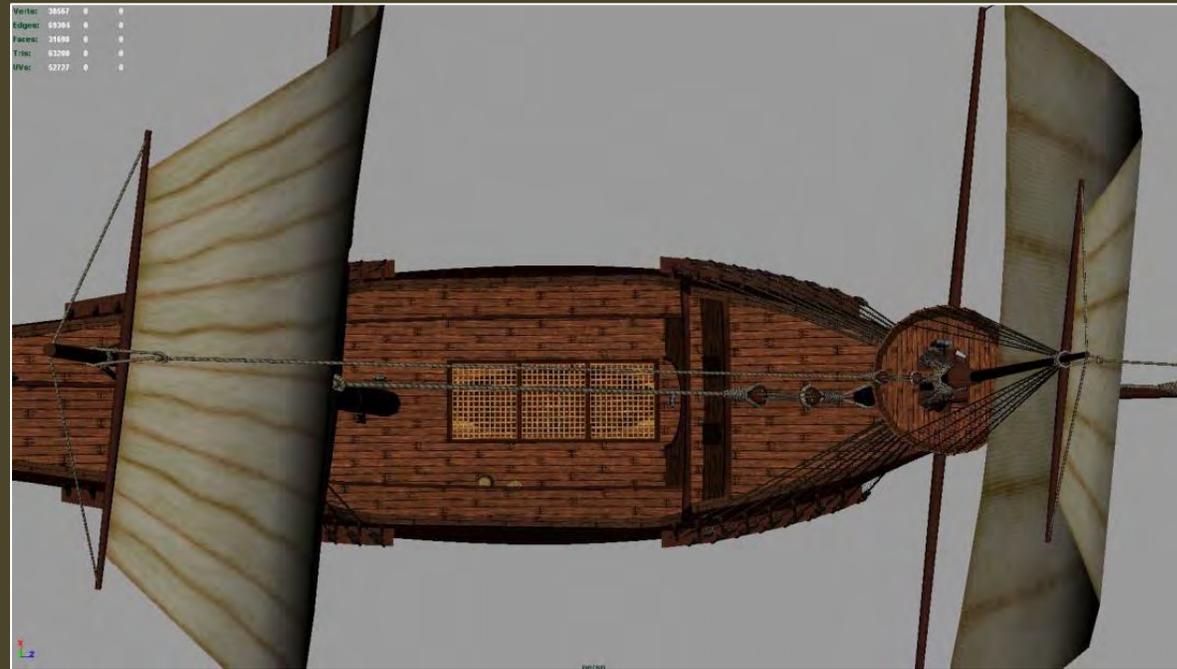
We used a number of different sources to calculate the sizes of masts and spars.



The sails resulted from the size of the masts and spars.

Há um trabalho enorme por fazer que está apenas começado.



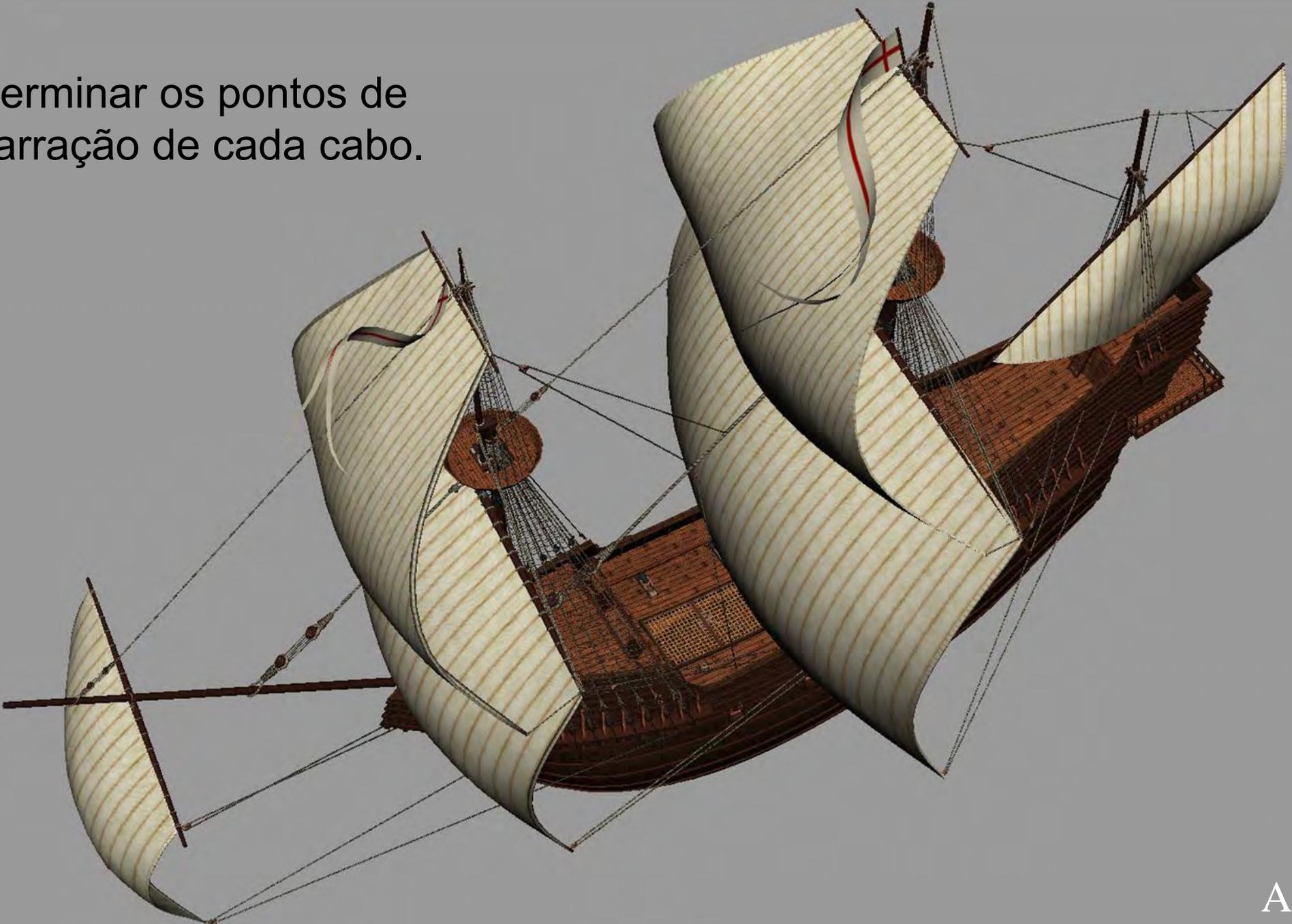


Inventariar
o poliame e
os cabos,
fixos e de
laborar.



Audrey Wells

Determinar os pontos de amarração de cada cabo.



Audrey Wells

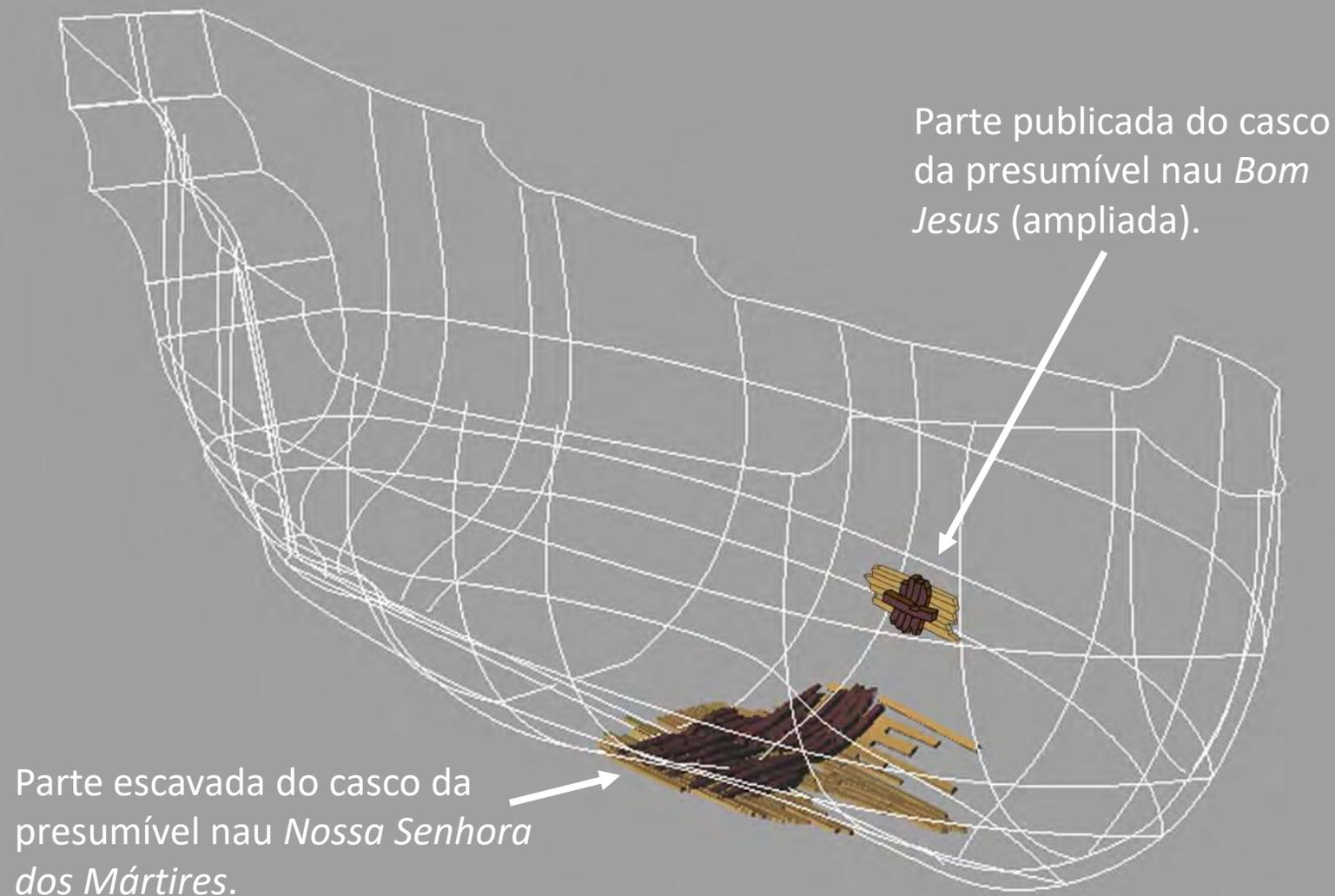


persp1

Estrutura



Os únicos dois navios da Carreira da Índia até agora parcialmente escavados por arqueólogos são os presumíveis *Bom Jesus* (1533), e *Nossa Senhora dos Mártires* (1606).

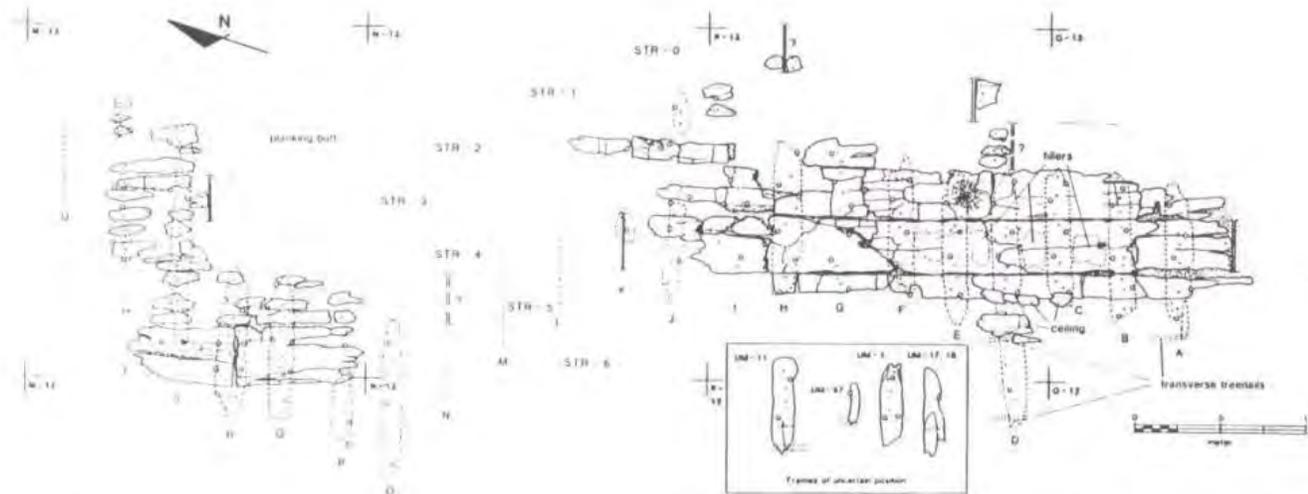




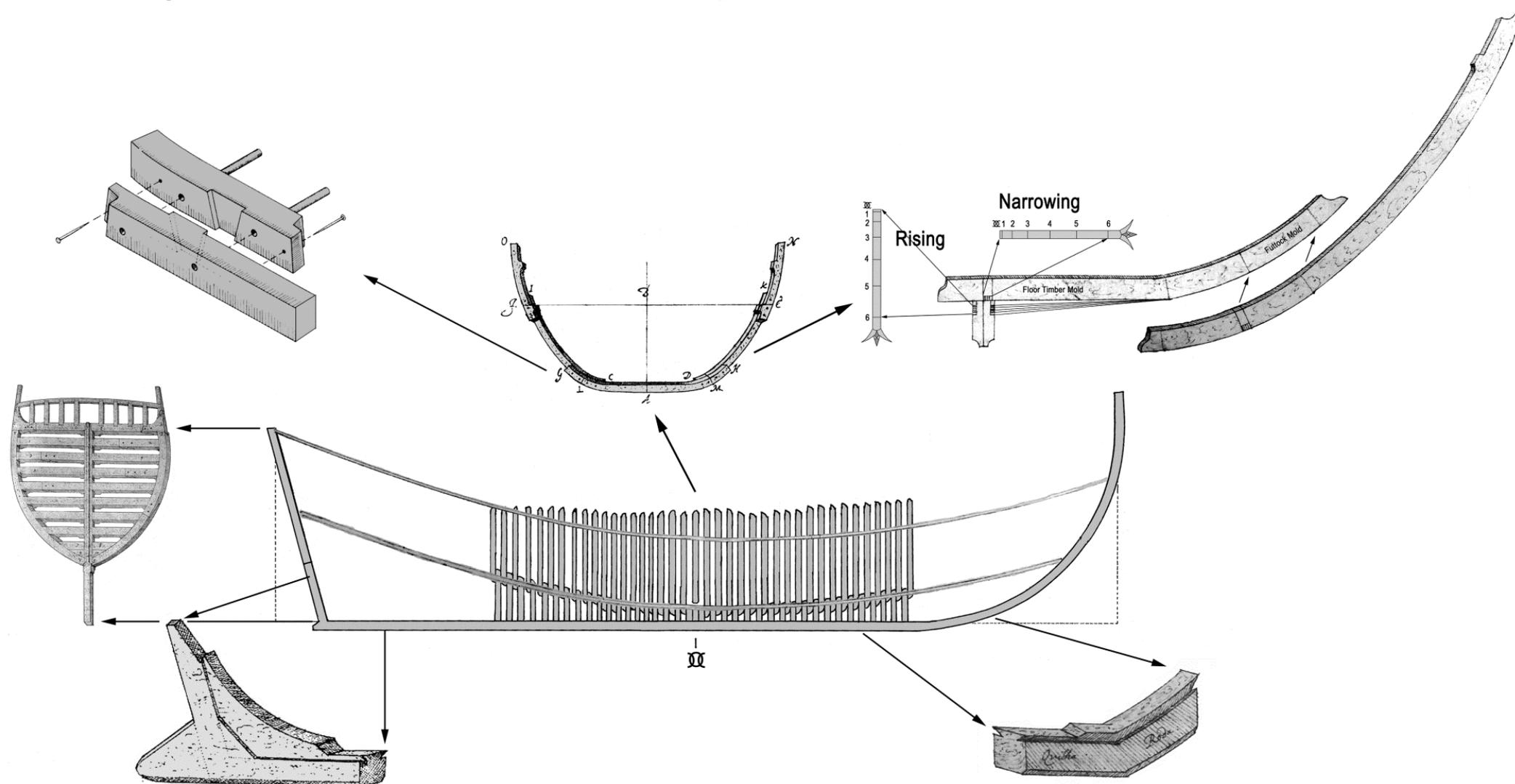
Restos de um navio, português, possivelmente a nau *Bom Jesus* (1533), encontrado na exploração de diamantes da NamDeb, Namíbia.



Há um terceiro navio, encontrado em Molasses Reef, nas Ilhas Turks and Caicos, datado do início do séc. XVI, que é quase de certeza português, mas que foi destruído (e dinamitado) por caçadores de tesouros.



Algumas soluções estruturais aparecem consistentemente em navios ibéricos e foram adoptadas na nossa reconstrução.



Ao longo dos anos fomos acumulando dados sobre a estrutura de navios de madeira na Europa que nos permitem avançar soluções plausíveis nas nossas reconstruções.

Shipwreck Name	Date E	Date L	Dating Method	Nationality	Route	Country	Site	Local	Depth	Type	Construction	Cargo	Survival	Obs	Dig Dates
Akko Tower	1799	location, construction	unknown	Roman		Israel	Akko harbor		4.0	unknown		none	fair		1975, 198
Alexandria A	70	unknown	construction	Roman		Egypt	Alex. Harbor			cargo		unknown	unknown		1999
Almere Wijk 13	1427	xxxx		Dutch		Netherlands	Zuyderzee		0	cargo	Atlantic	xx	good		1986
Angel	1596				Padilla Fleet	Spain		Finisterre		urca				Never Found.	
Angel de Jacumbelum	1596				Padilla Fleet	Spain		Finisterre		urca				Never Found.	
Angel Gabriel	1596				Padilla Fleet	Spain		Finisterre		urca				Never found.	
Angra B	1550	construction		Unknown		Portugal	Azores - Terceira	Angra Bay	5	unknown	Iberian	unknown	sparse		1996
Angra C	1600	construction		Dutch		Portugal	Azores - Terceira	Angra Bay	7	cargo	Dutch	unknown	fair		1997-98
Angra D	1600	artifacts				Portugal	Azores - Terceira	Angra Bay	7	cargo	Iberian	unknown	good	35 x 9	1997-98
Antikythera	-79	pottery, amphoras		Rhodian		Greece	Mediterranean		57	cargo		xxx	sparse		1900
Anunciada	1596					Spain		Finisterre		nao				Never found.	
Arade 1	1580	C14		Portuguese		Portugal	Arade River Mouth		3-4	cargo	Iberian	unknown	good		2001-06
Athlit Ram	-190	ram symbols		Cypriote		Israel	Mediterranean		3	warship		none	sparse		1980
Aveiro A	1475	Pottery, c.14		Portuguese	Short Sea	Portugal	Ria de Aveiro		0	cargo	Iberian	pottery, fruits	good		1993-98
Aveiro B	1550	artifacts		Portuguese		Portugal	Aveiro	Gran Caravela	2	cargo	Iberian	pottery	unknown		1993
B&W1	1584	dendrochronology		Dutch		Denmark	Christianshav	Burmeister & Wain		cargo	Dutch				
B&W2	1606	dendrochronology		Danish	Danish Indiaman	Denmark	Christianshav	Burmeister & Wain		cargo	Dutch				
B&W3	1607	dendrochronology		Danish		Denmark	Christianshav	Burmeister & Wain		cargo					
B&W4	1587	dendrochronology		Danish		Denmark	Christianshav	Burmeister & Wain		cargo					
B&W5	1625	dendrochronology		Danish		Denmark	Christianshav	Burmeister & Wain		cargo	Dutch				
B&W6	1689	laying next to B&W2		Danish		Denmark	Christianshav	Burmeister & Wain		cargo					
B&W7	1590	dendrochronology		Danish		Denmark	Christianshav	Burmeister & Wain		cargo					
B&W8	1738	dendrochronology		Danish		Denmark	Christianshav	Burmeister & Wain		boat					
Bahia Mujeres	1530	pottery		Spanish	Carrera de Indias	Mexico	Isla Mujeres	Yucatan	3		Iberian		unknown		1983
Baleal 1	1580	artifacts		Portuguese		Portugal	Baleal		4	cargo	Iberian		sparse		1992
Barland's Farm	295	xxx		Celtic		S. W. Wales	terrestrial		0	boat		xxx	good		1993
Basque Galleon 1	1550	construction		Spanish		Canada	Red Bay				Iberian		unknown		
Basque Galleon 2	1550	construction		Spanish		Canada	Red Bay				Iberian		unknown		
Basque Galleon 3	1550	construction		Spanish		Canada	Red Bay				Iberian		unknown		
Batavia	1629			Dutch		Australia							unknown		
Belitung	826	xxxx		Arab or Indian		Indonesia	Indonesia		17	cargo		xxx	fair		1998-99
Betsy	1782	location		British		Virginia	York River		coff.	collier		none	good		1983-88
Blackfriars 1	150	xxx		Celtic		London	Thames shore		0	cargo		ragstone	sparse		1963
Bon Porte	-535	amphoras		Etruscan		S. France	St. Tropez		51	cargo		amphoras	sparse		1976-78
Boscawen	1759	location, construction		British		Lake Champlain	shore		2.4	warship		none	fair		1984-85
Bozolla	1467			Italian		Spain		Galicia						Never found.	
Bremen Cog	1380	xxx		Hanseatic		Germany	Weser River		6	cargo	German	none	complete		1962-65
Brown's Bay	1815	construction, c14		British		Ontario			2	gunboat		none	good		1966-67
Brown's Ferry	1740	artifacts		Col. American		S. Carolina	Black River		7	cargo		bricks	good		1976
Bursledon	1418	location		English		S. England	R. Humble		1	warship	English	none	good		1859-1949
Caesarea	46	location		Roman		Israel	C. harbor		3.5	cargo	Roman M&T	none	good		1983-88
Cais do Sodre	1500	C14		Portuguese		Portugal	Subway excavator	Lisbon	6.5		Iberian		good		1995
Calvi 1	1580	artifacts				France	Calvi	Corsica	8	unknown	Mediterranean	unknown	good		1979
Cape Gelidonya	-1200	artifacts		Syrian		S. Turkey	Mediterranean		27	cargo		xxxxx	fragments		1960
Capitana de Ivela	1596	artifacts		Spanish	Padilla Fleet	Spain	Unknown. Cabo C	Finisterre		galleon	Iberian	unknown	sparse		
Capitana de Sana	1543			French		Spain	Ria de Muros	Galicia						Never found.	
Cattewater	1525	xxx		English		S. England	River Plym		3-4	cargo	English	xxx	fair		1776-78
Cayo Nuevo	1552	artillery		Spanish	Carrera de Indias	Mexico	Sonda de Campeç	Cayo Nuevo			Iberian				1979
Charon	1781	construction		British		Virginia	York River		4	warship		none	sparse		1980
Cheops	-2650	pyramid contents		Egypt		Egypt	tomb		0	funerary		none	complete		1954-57
Clydesdale Plantation	1800	location, construction		USA		Georgia	Savannah River		0	cargo		none	fair		1992
Contarina 1	1300	xxx		Venetian		N. Italy	terrestrial		0	cargo	Mediterranean		good		1898
Cornwallis Cave	1780	location		unknown		Virginia	York River		3.4	cargo		none	sparse		1976
Corpo Santo	1400	C14		Portuguese		Portugal	Subway excavator	Lisbon	4		Iberian		sparse		1996

Da mesma forma, para o aparelho temos uma base de dados da iconografia mais realista.

Iconography : Database (Access 2007 - 2010) - Microsoft Access

File Home Create External Data Database Tools

View Paste Copy Format Painter Filter Ascending Descending Selection Advanced Refresh All Delete Find Find Text Formatting

All Tables Intro

Intro : Table Intro

ID	Century	Date	Title
	16	1509	Livro das Fortalezas

Support: Parchment Work Title: Livro das Fortalezas Work - Folio or Page: 5

Work - Specific Details: Mértola Author: Duarte d'Armas Country of Origin: Portugal Country of Ob Represented: Portugal

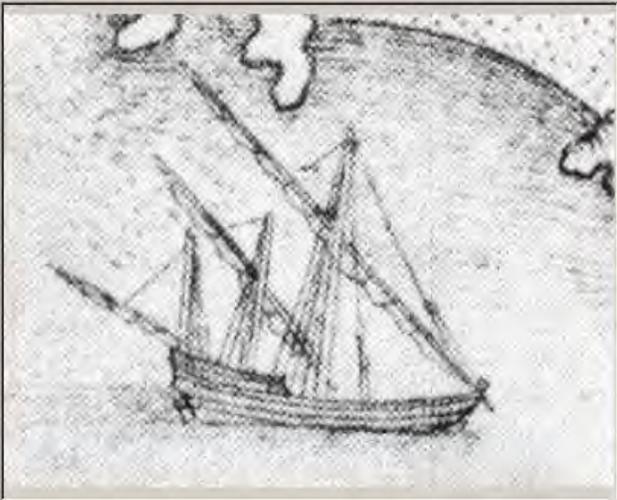
Ship Type: Type 13 - c Decks: 1 Transom

Tolda Alcáçova Capitéu
 Guarita Sobregarita

Stem Post: Roun Masts: 3
Stempost: Straik

At Anchor
Sailing Rowed
Maneuvering

Comments: Type 13 - Three-masted lateener (caravela?). At anchor. Sails furled.



Masts
 Bowsprit Topmast Fore Topmast Main Topmast Mizzen Topmast Bonaventure Topmast
 Foremast Mainmast Mizzenmast Bonaventure Outtrigger

Yards
 Fore Topg. Yard Main Topg. Yard
 B. Topsail Yard Fore Topsail Yard Main Tops. Y. Mizzen Tops. Y. Bonaventure Topsail Yard
 Sprit Yard Foreyard Mainyard Mizzen Yard Bonaventure Yard

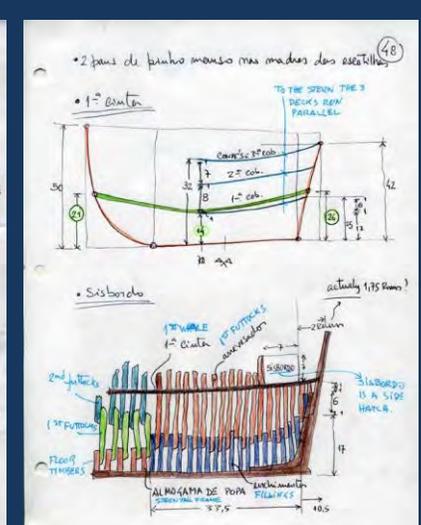
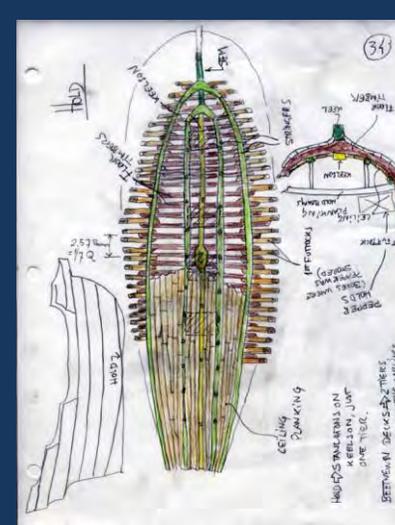
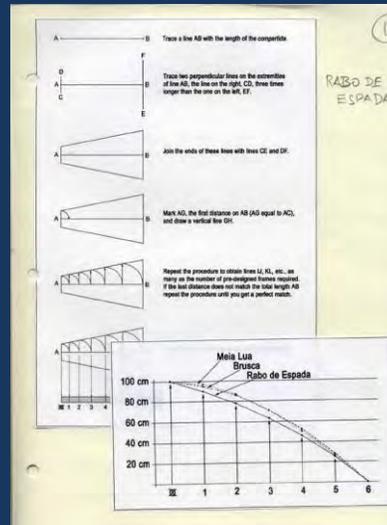
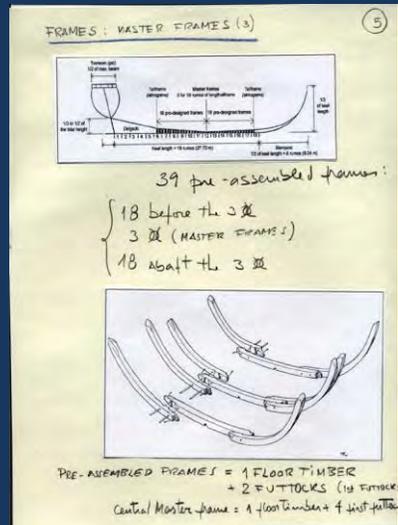
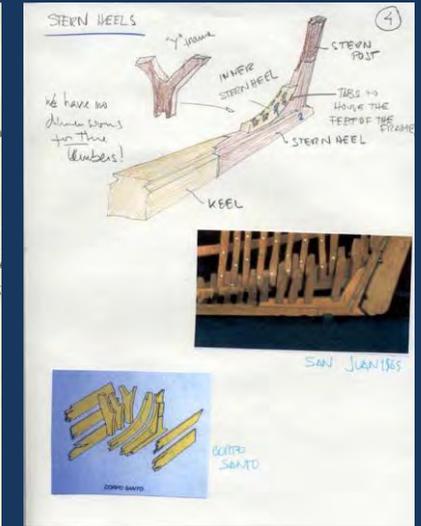
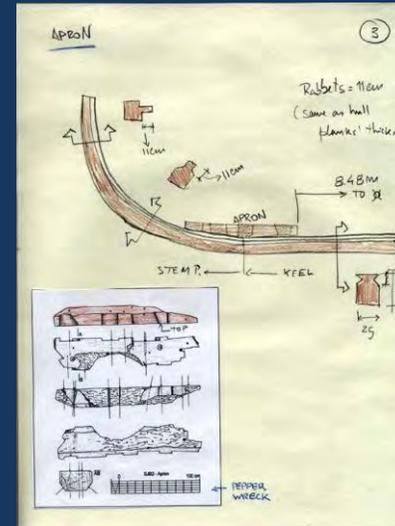
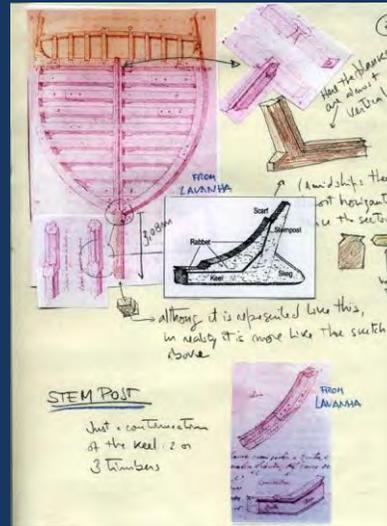
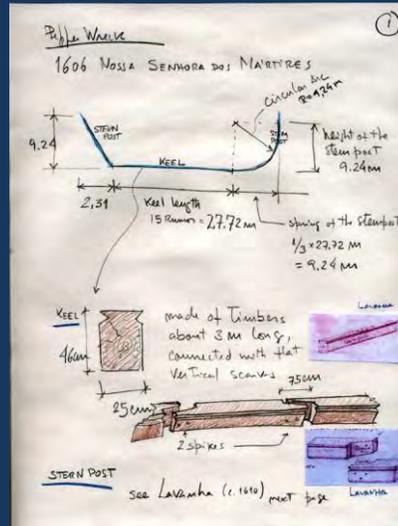
Sails
 Fore Topg. Sail Main Topgallant Sail
 Sprit Topsail Fore Topsail Main Topsail Mizzen Topsail Bonaventure
 Spritsail Foresail Mainsail Mizzensail Bonaventure Sail

Record: 1 of 1138 No Filter Search

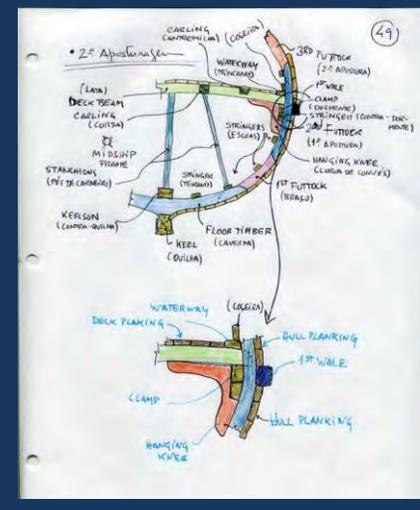
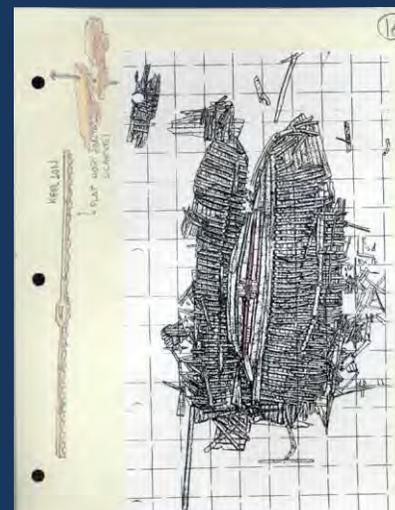
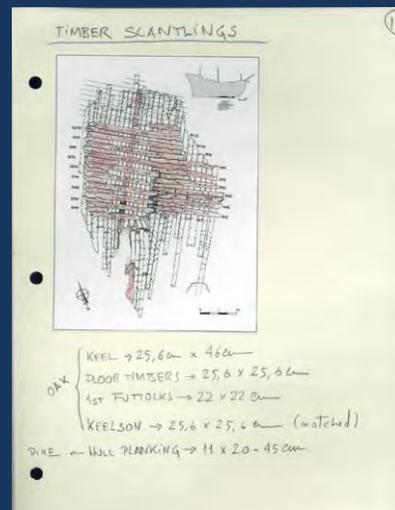
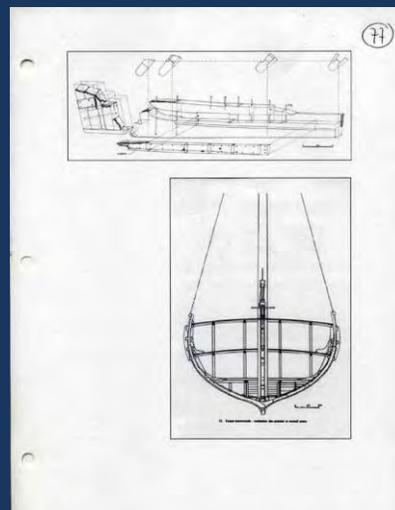
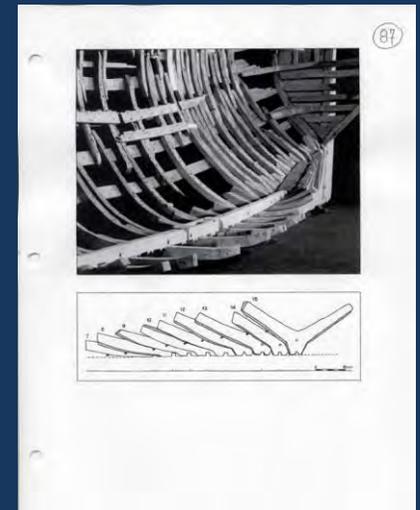
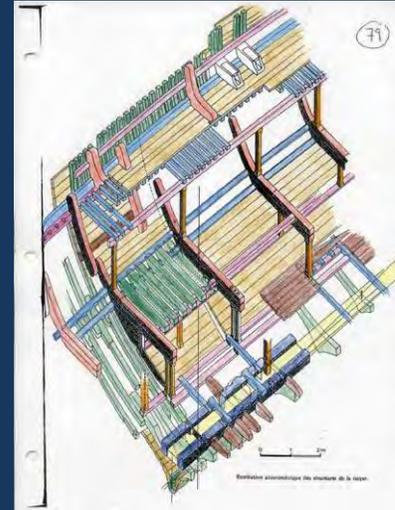
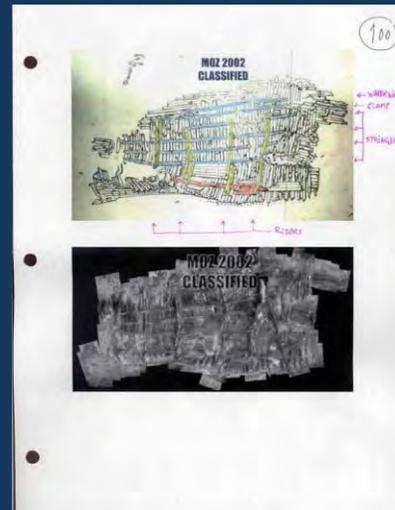
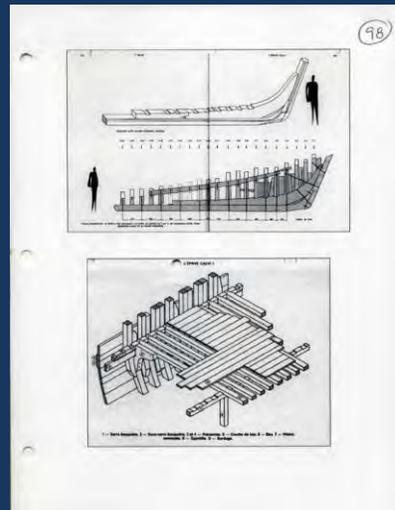
Form View Num Lock

Estrutura

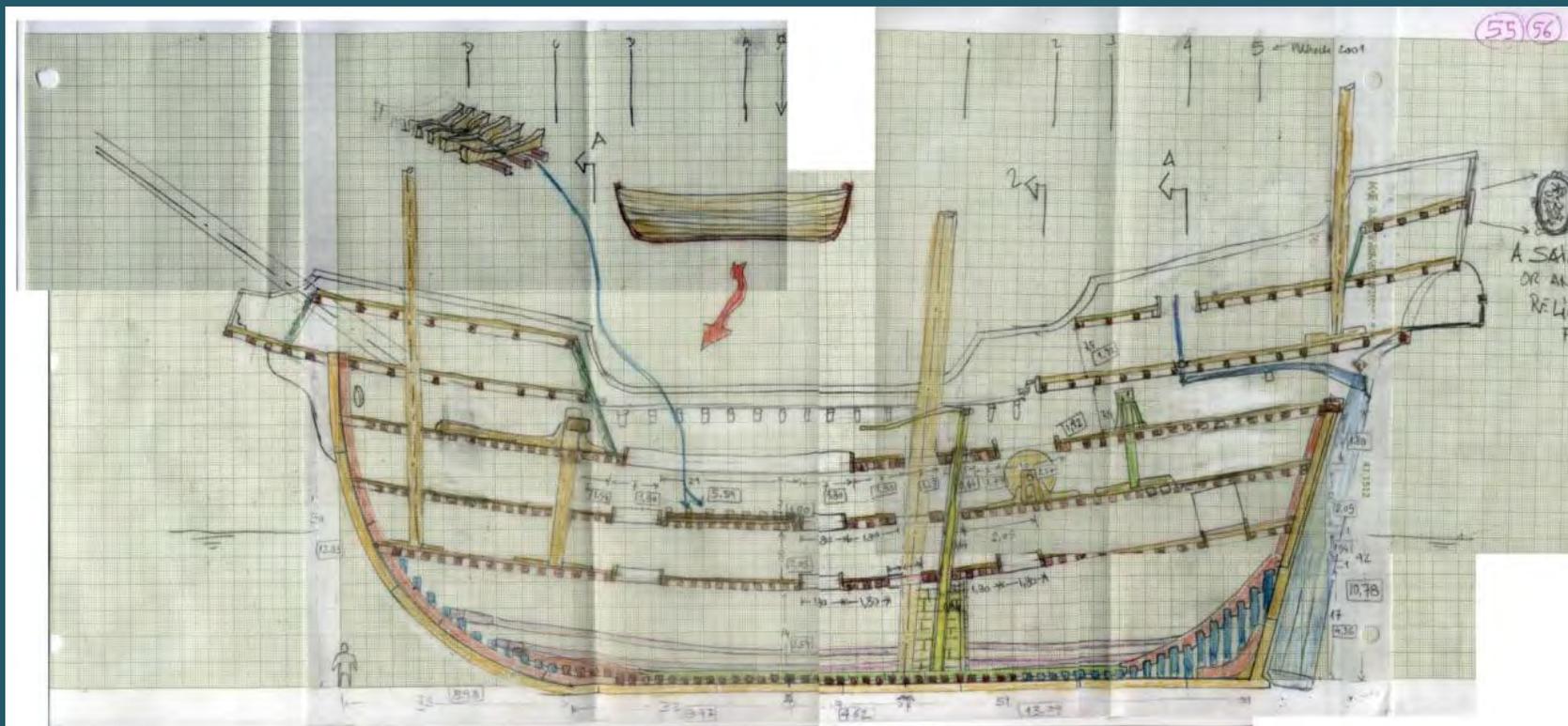
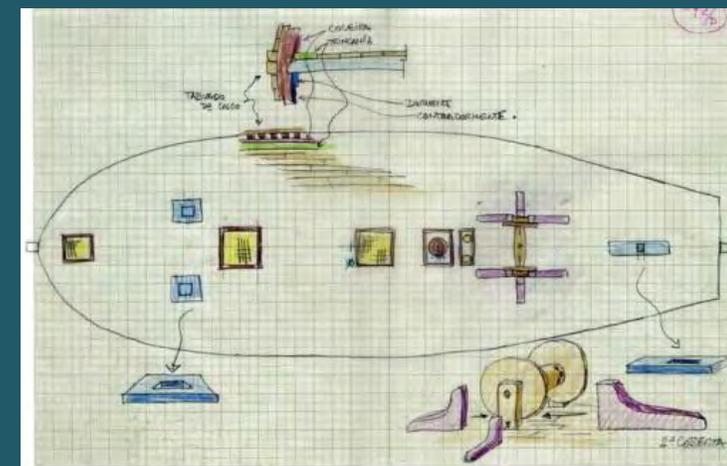
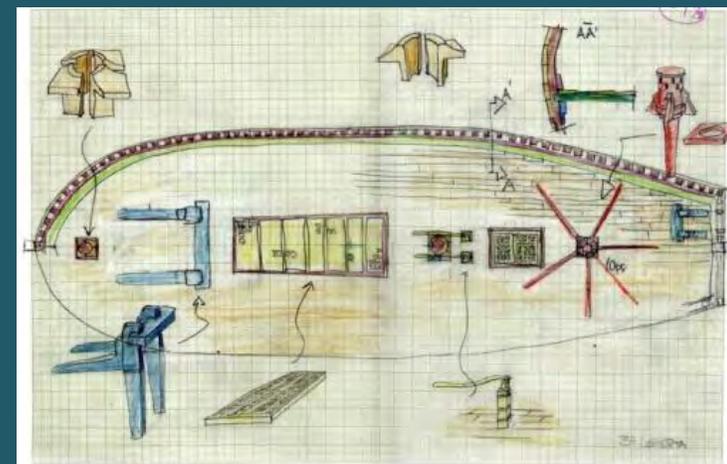
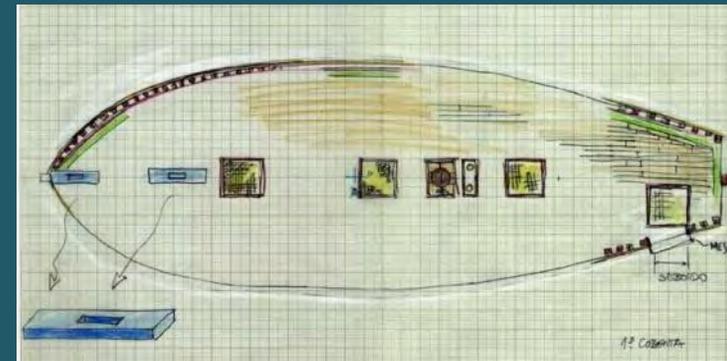
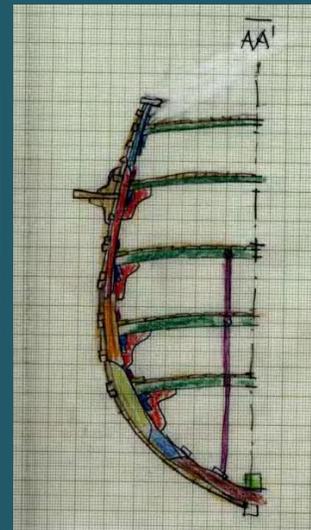
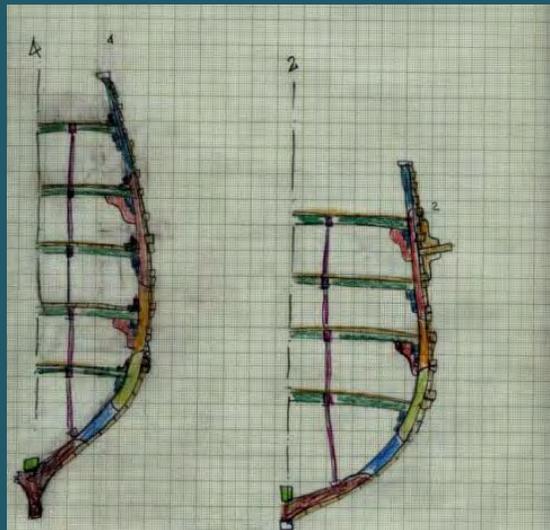
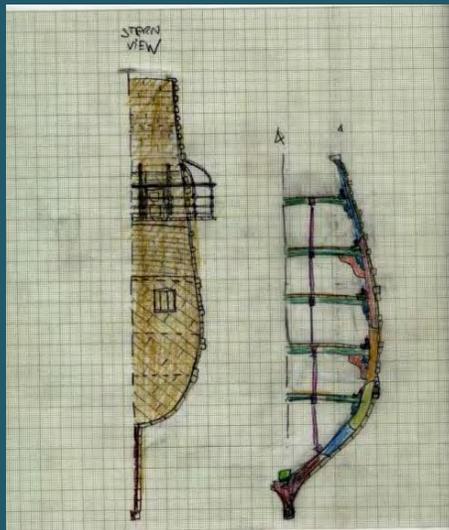
Exemplos contemporâneos publicados e informação extraída de documentos:



Navios mediterrânicos e ibéricos

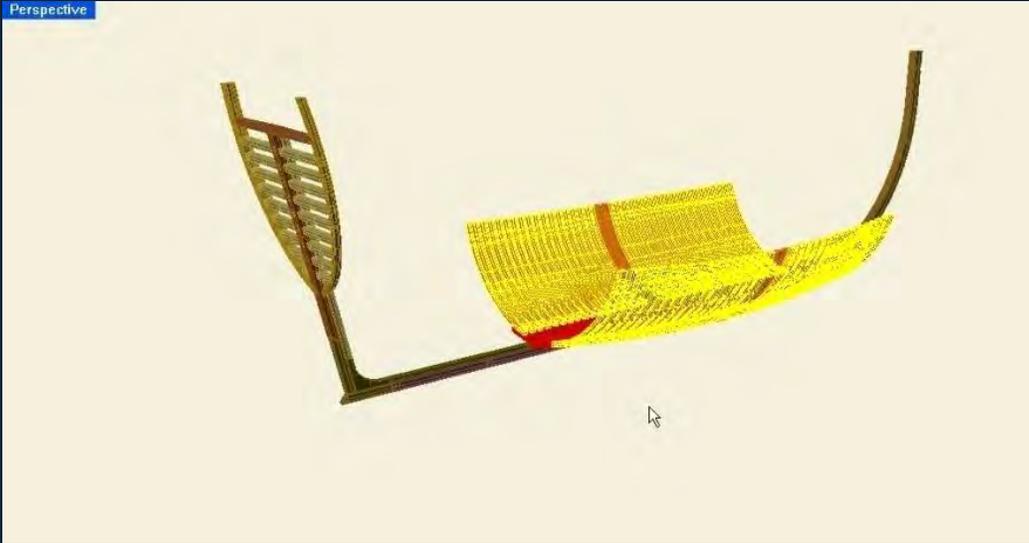
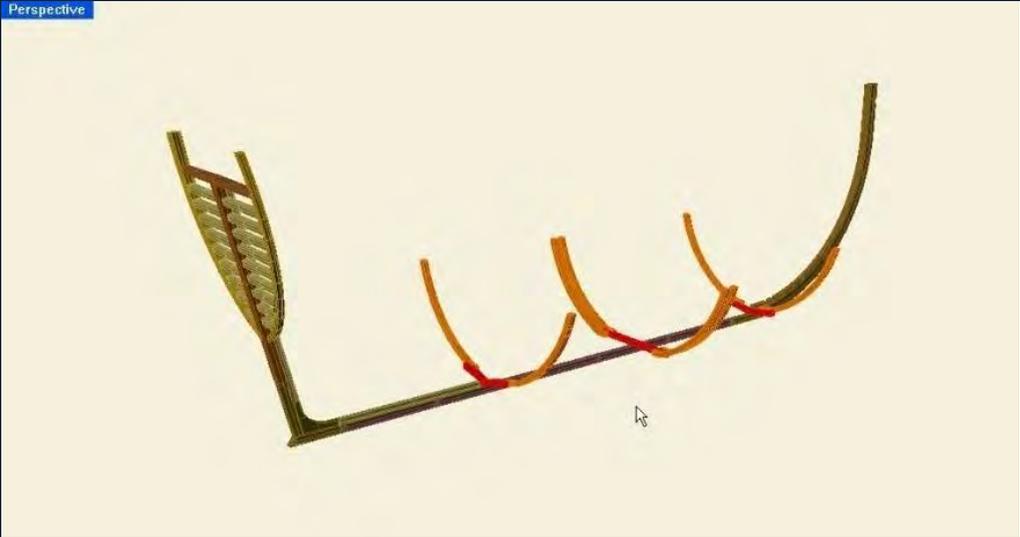
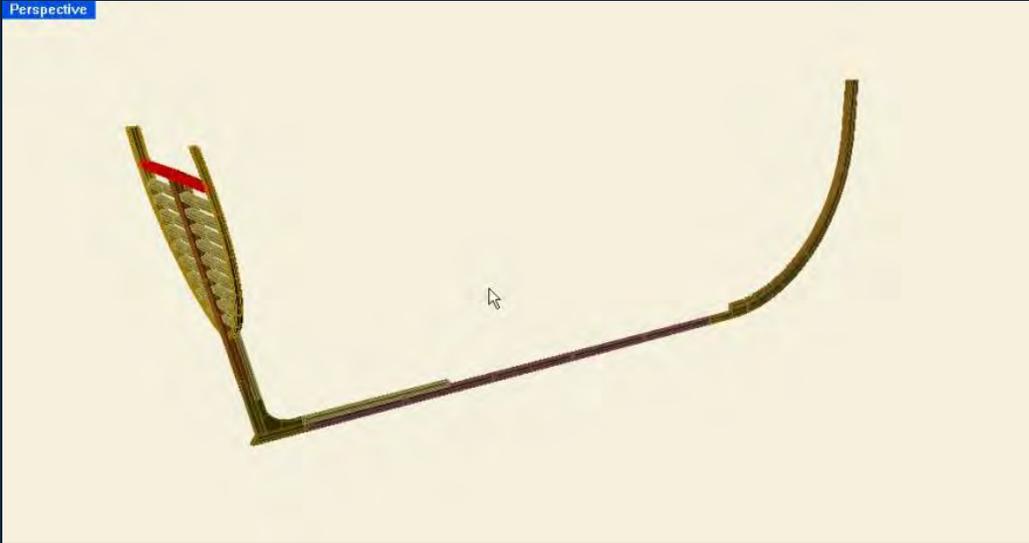
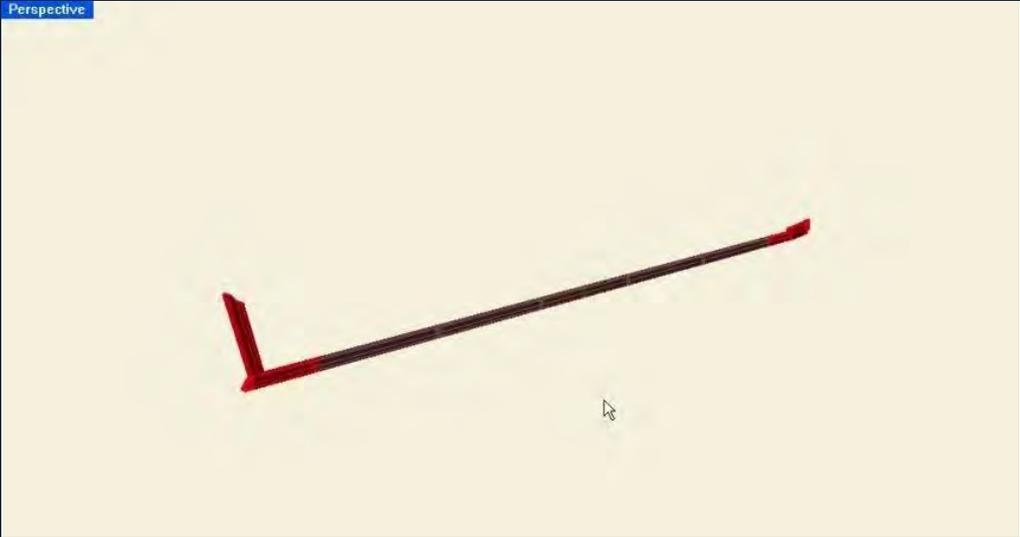


Nau do Livro náutico



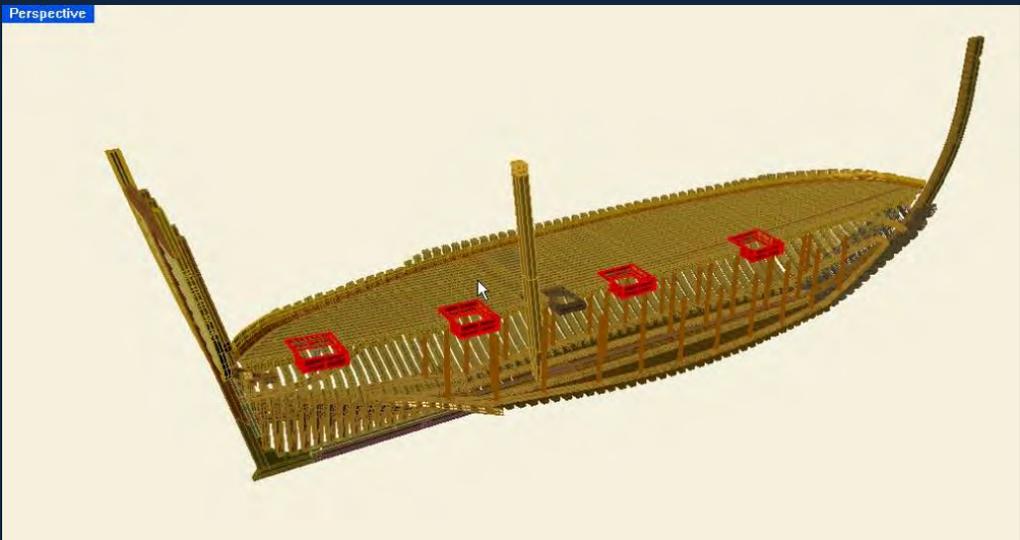
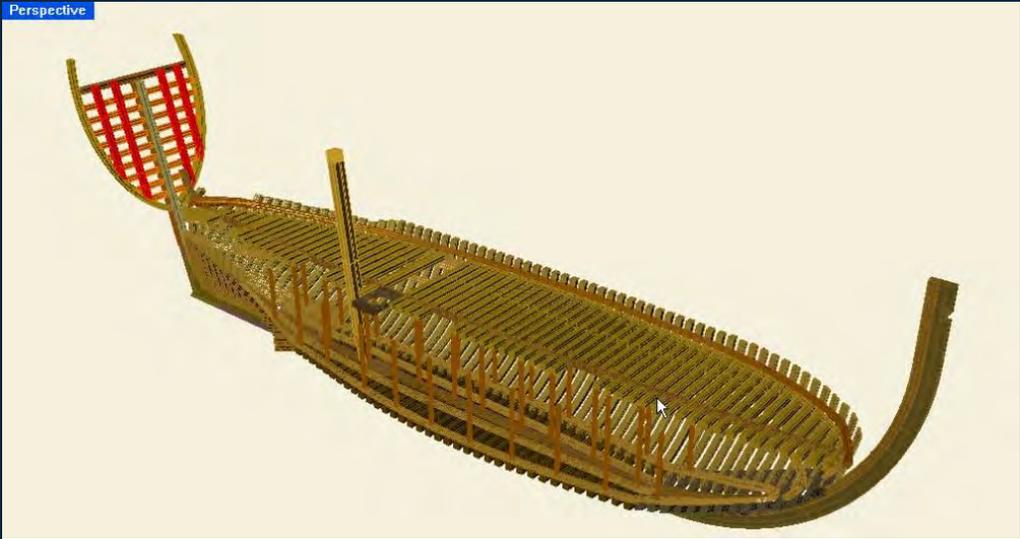
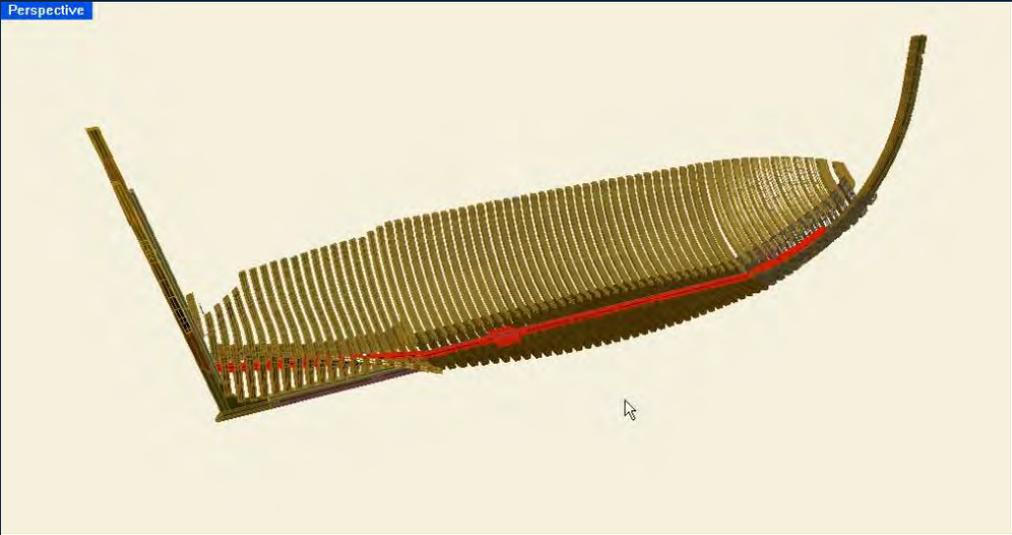
Estrutura

Alex Hazlett



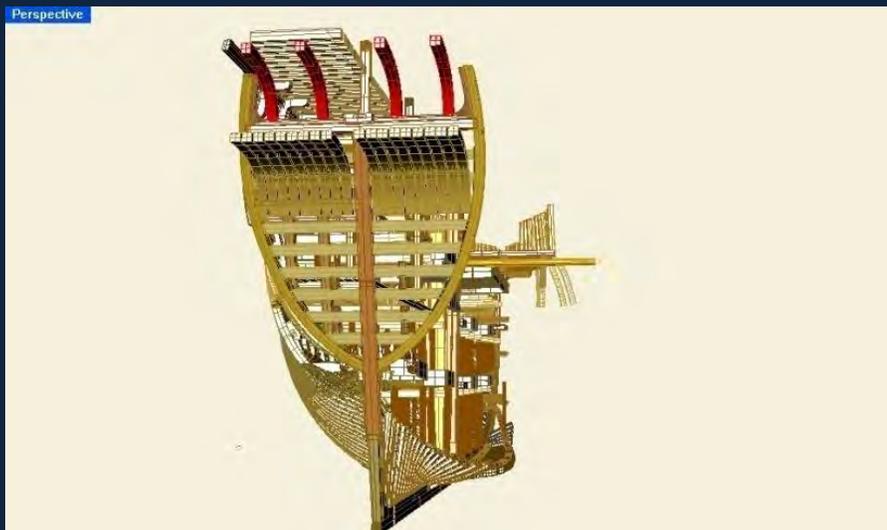
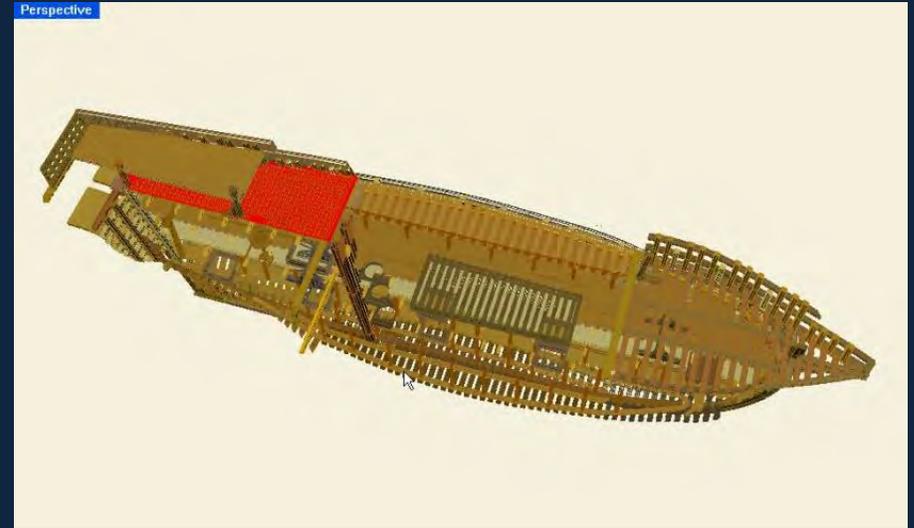
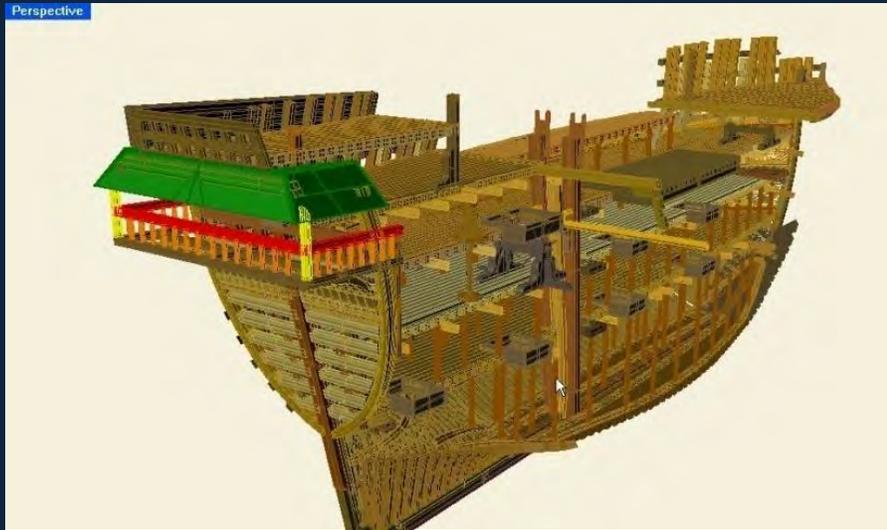
Estrutura

Alex Hazlett



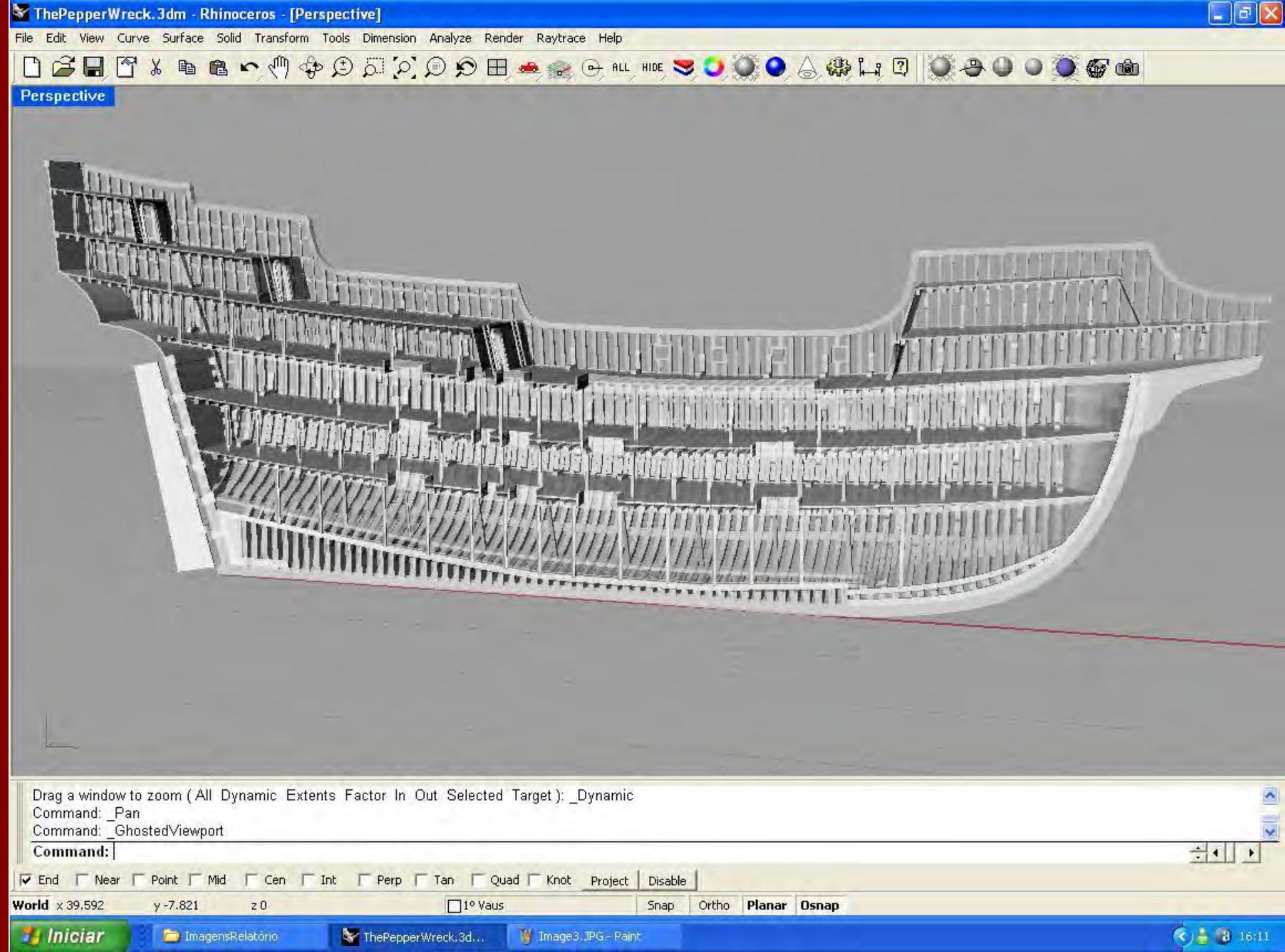
Estrutura

Alex Hazlett



Estrutura

Tomás Vacas

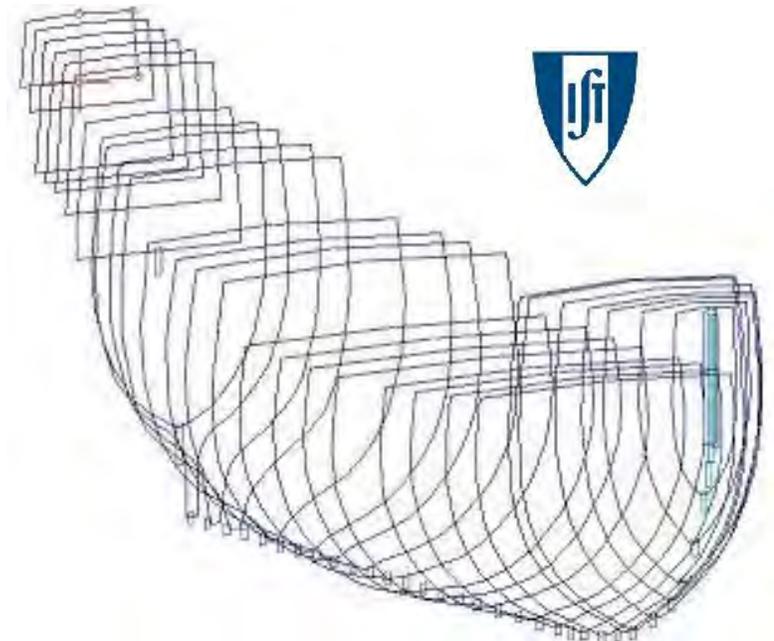
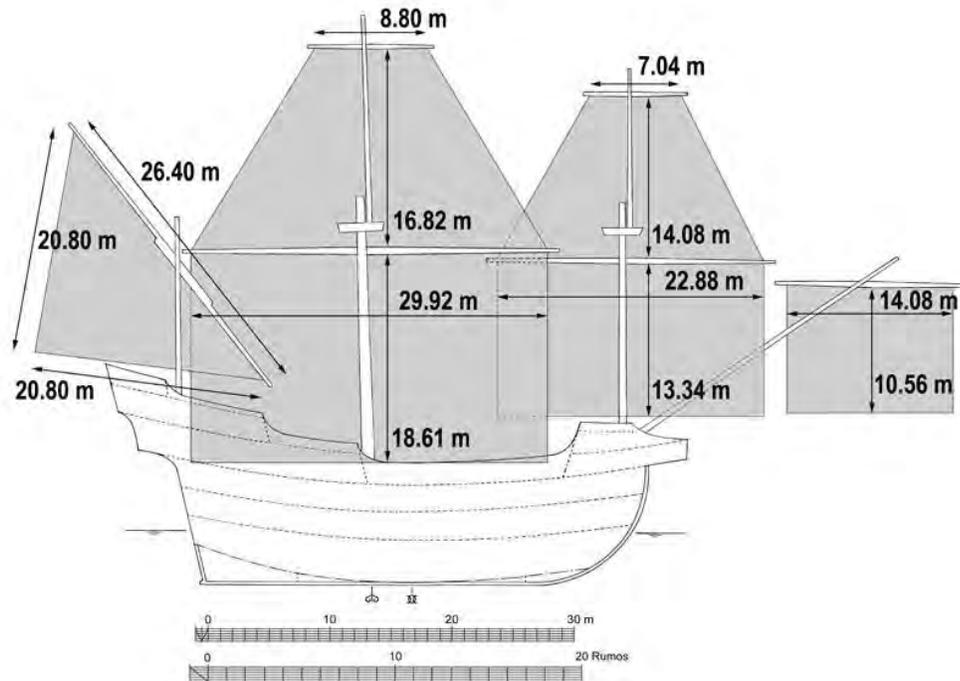
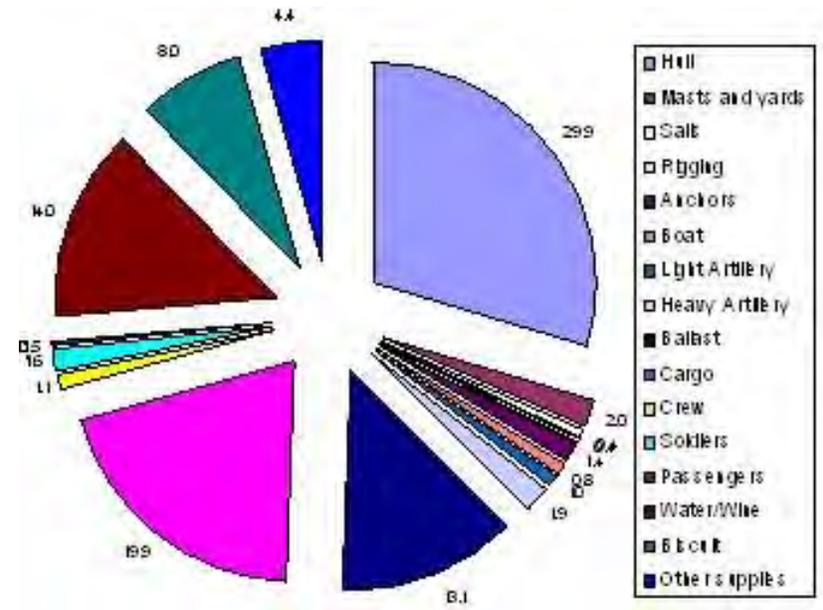
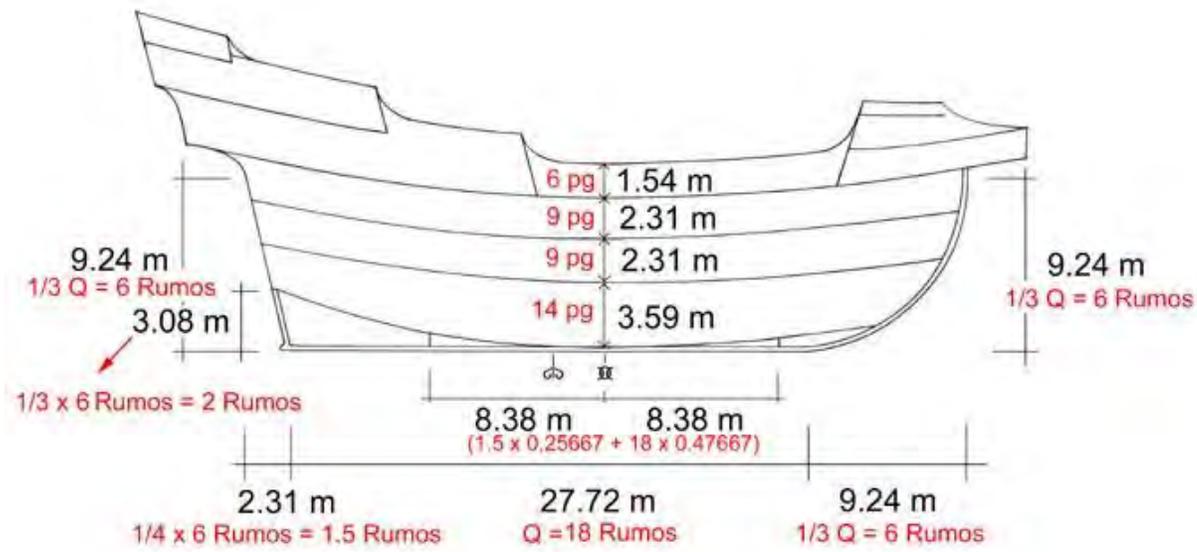


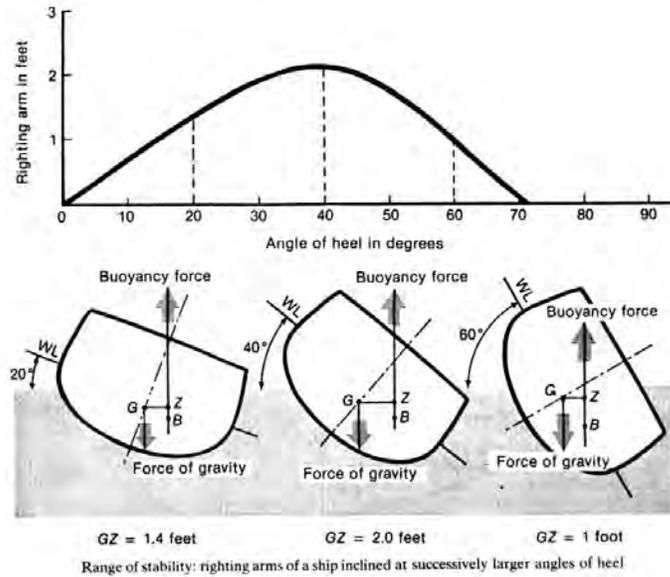
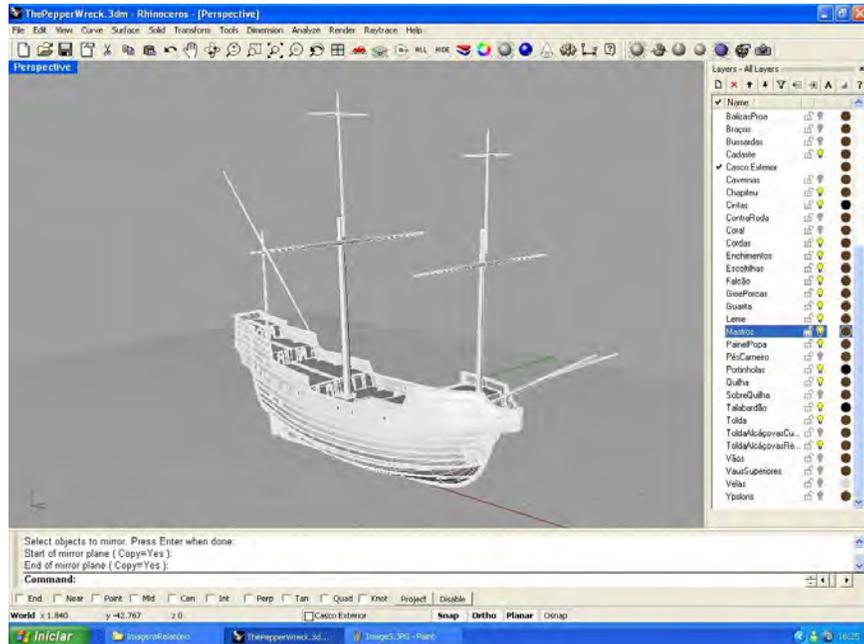
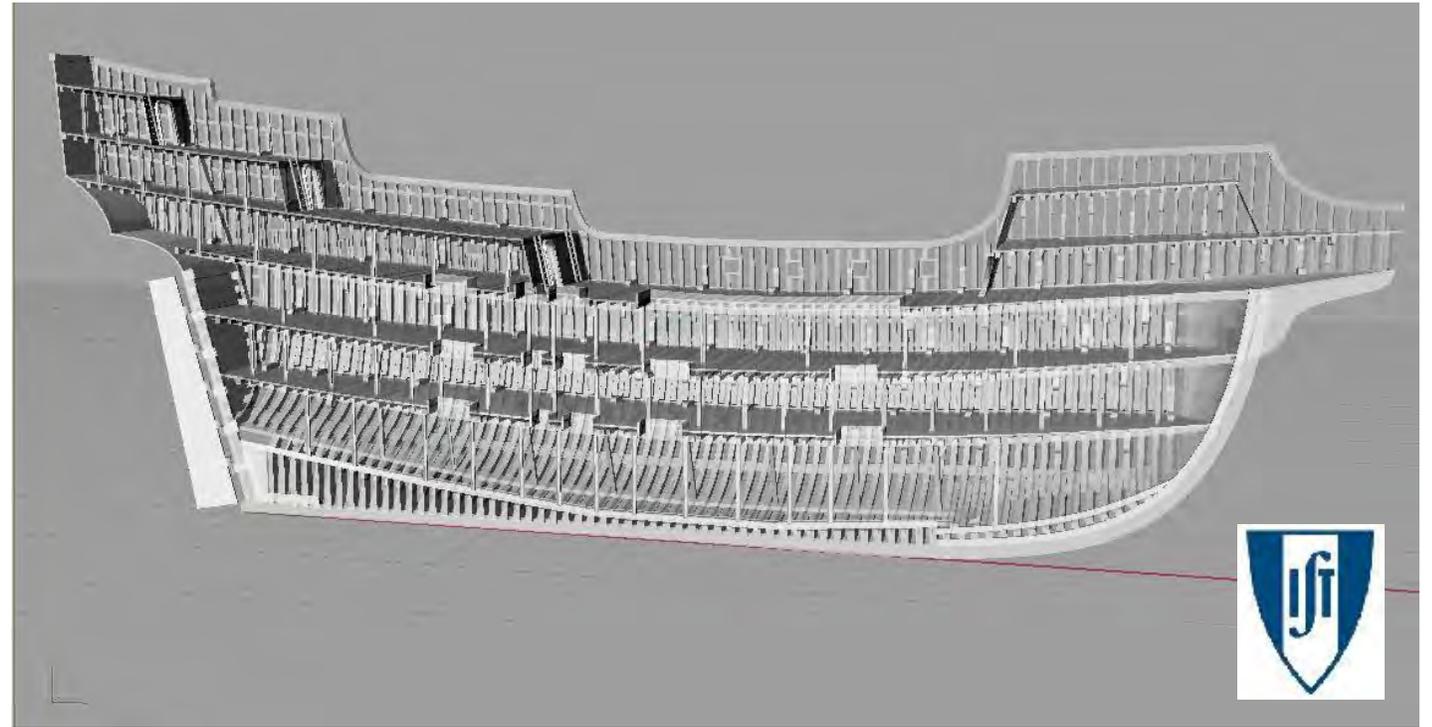
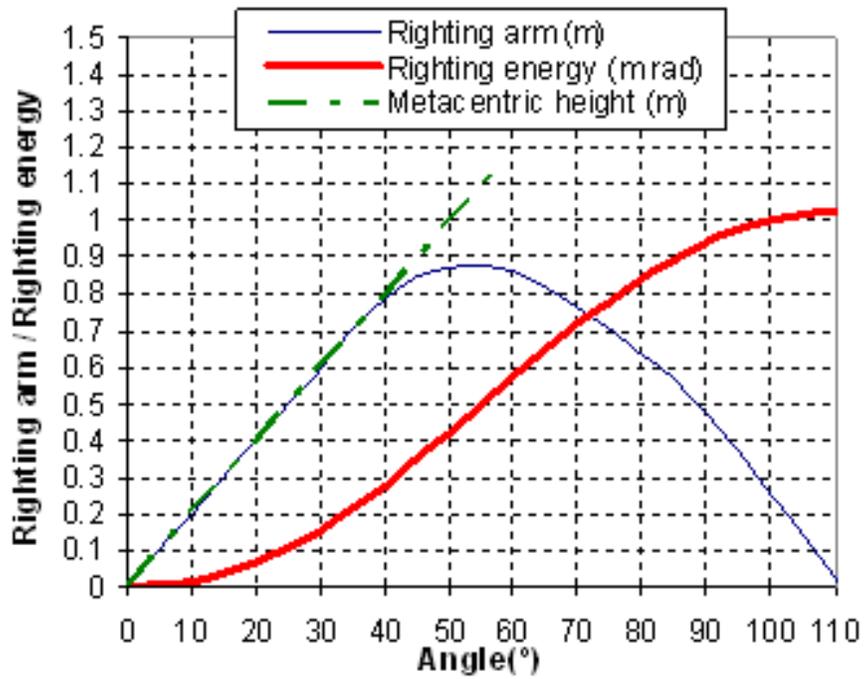
Estabilidade

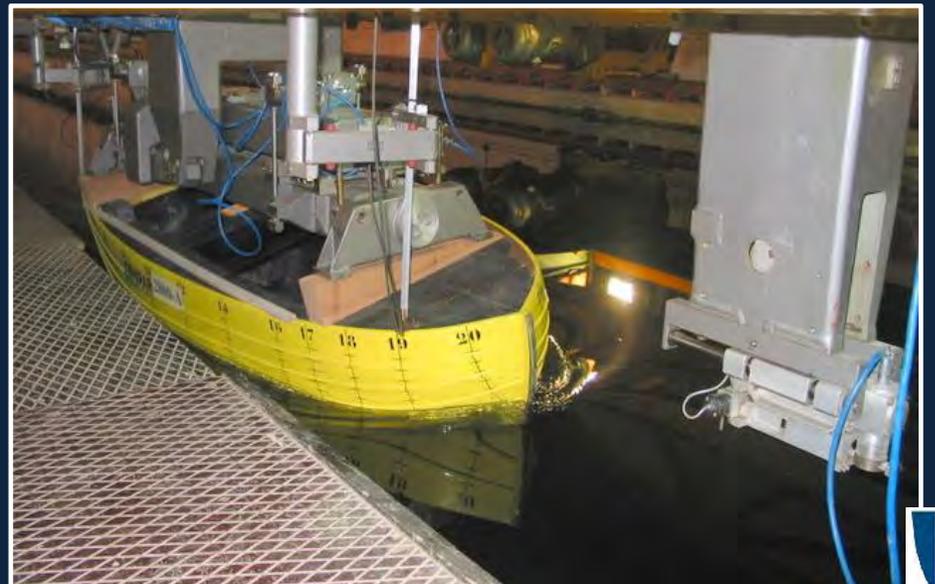
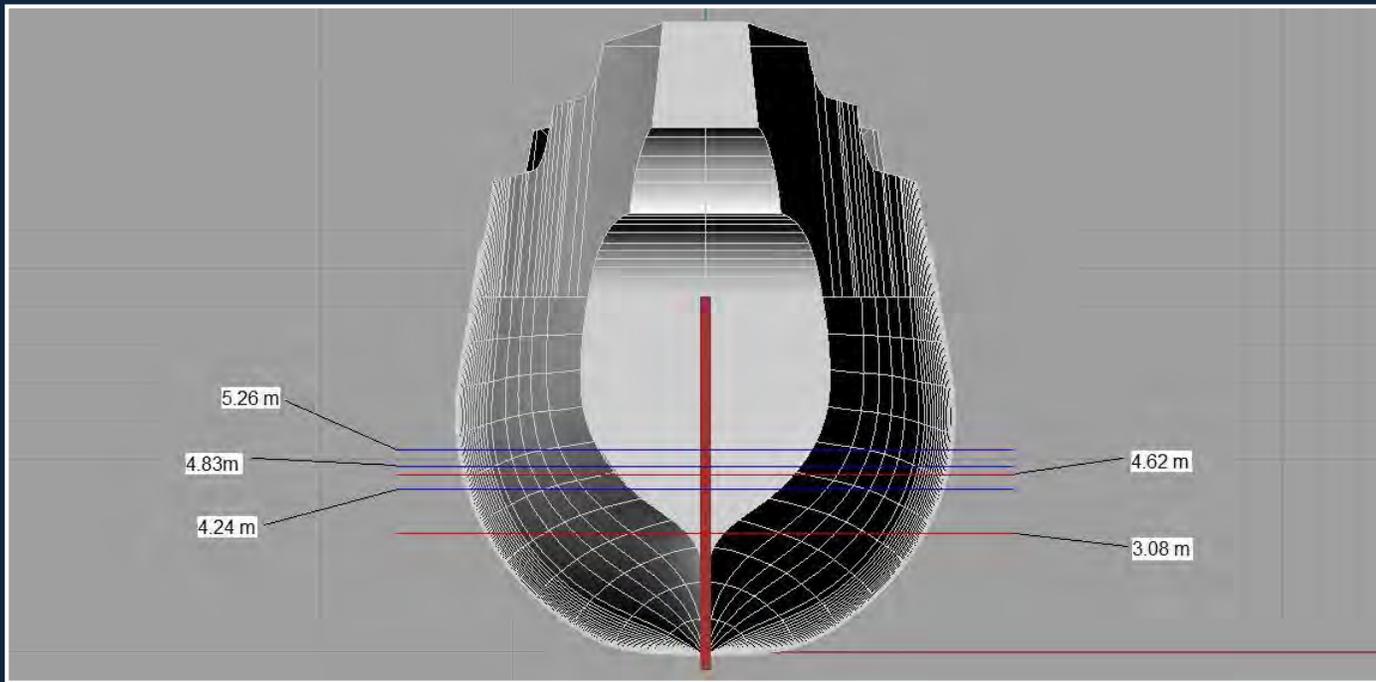


Condições diferentes à partida, no meio da viagem (roaring forties) e à chegada.





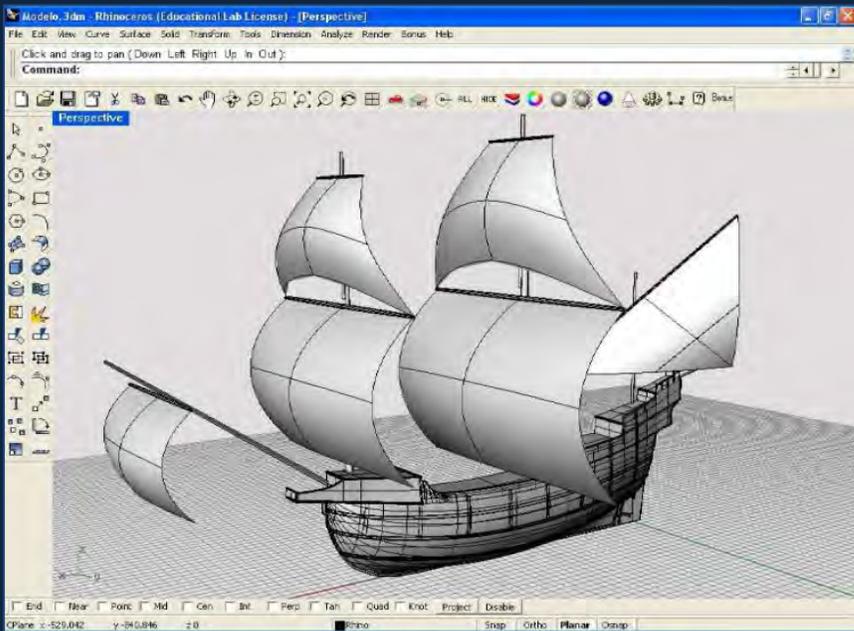






Desempenho





Distribuição de pressões - Vento pela alheta

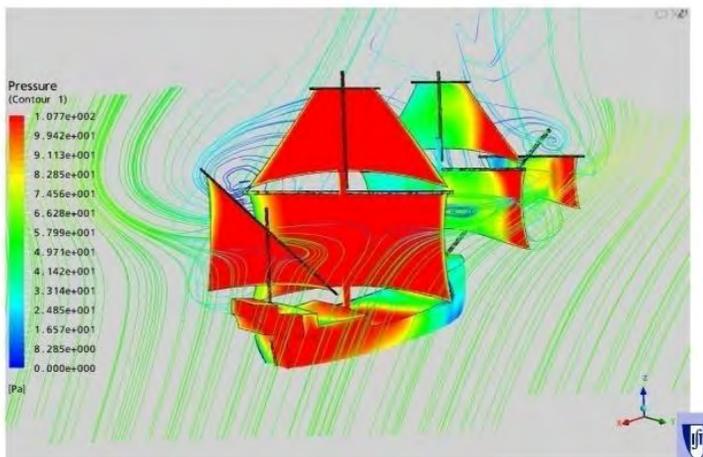


Performance under sail

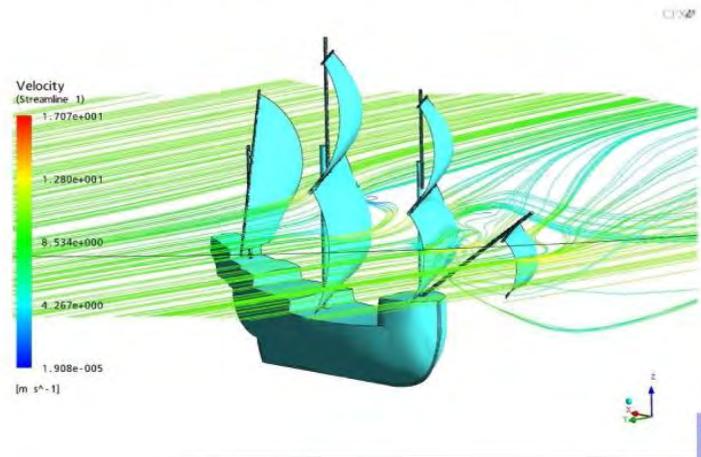
Nuno Fonseca

IST - SAEN

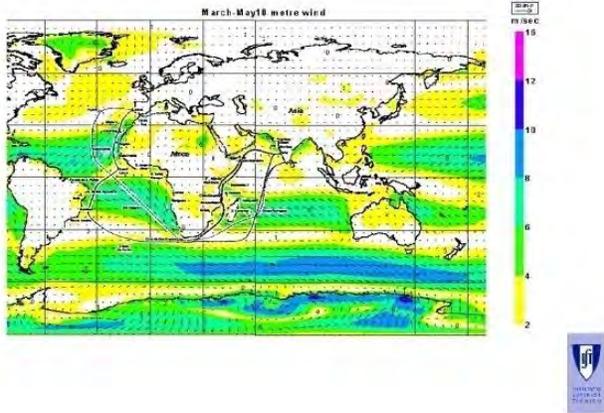
Distribuição de pressões - Vento pela alheta



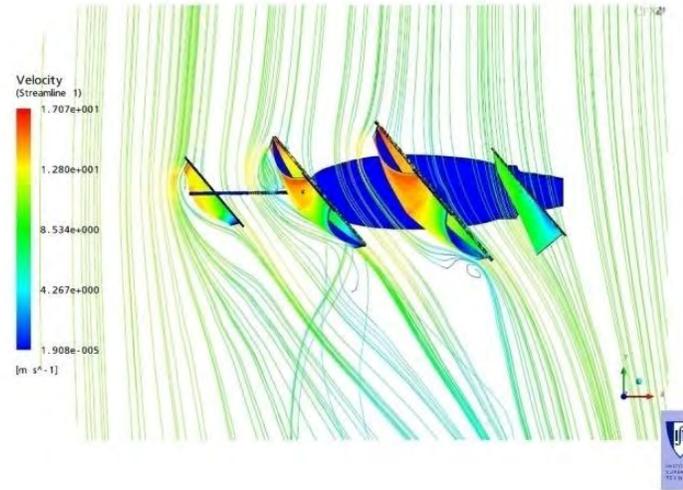
Linhas de corrente do escoamento - Vento de través



Partida de Lisboa em Março
Travessia do Atlântico preferencialmente durante Primavera



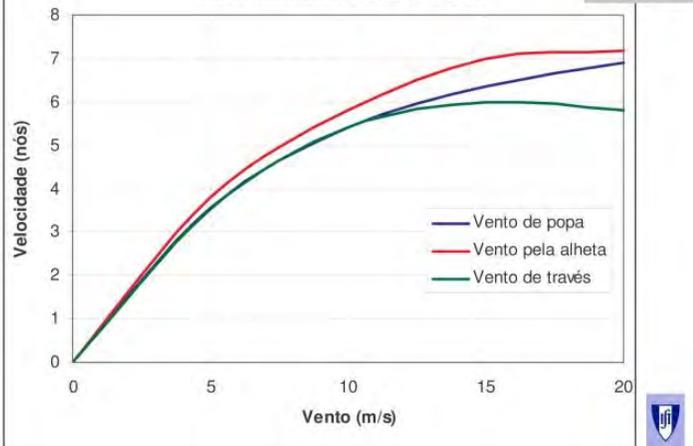
Linhas de corrente do escoamento - Vento de través



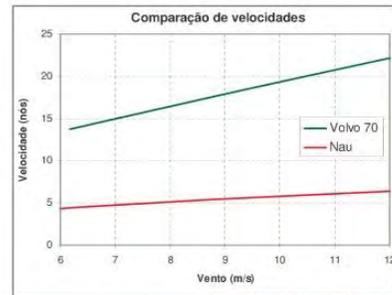
Performance under sail

Nuno Fonseca
IST, SAEN

Velocidades da Nau da Índia



Comparação de velocidades

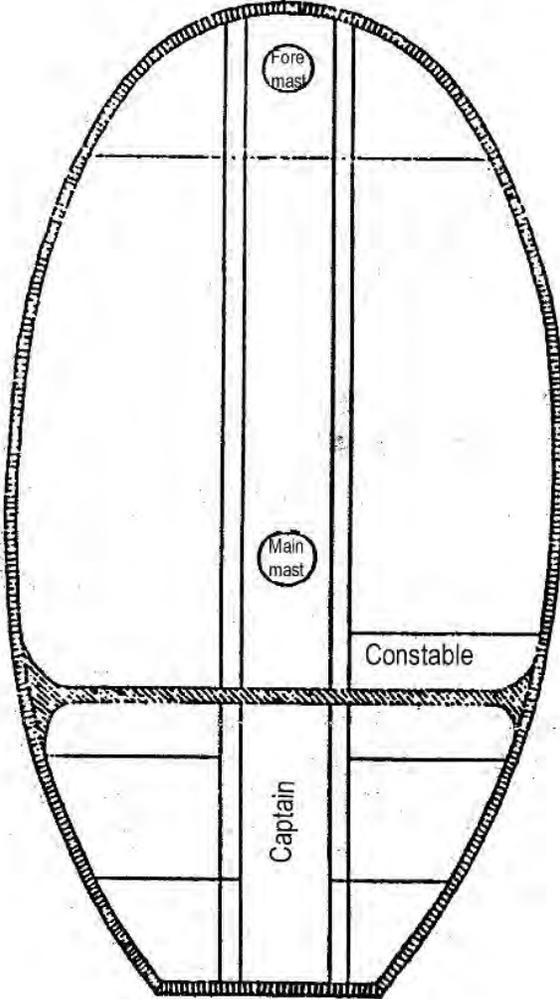


Divisão do espaço interior

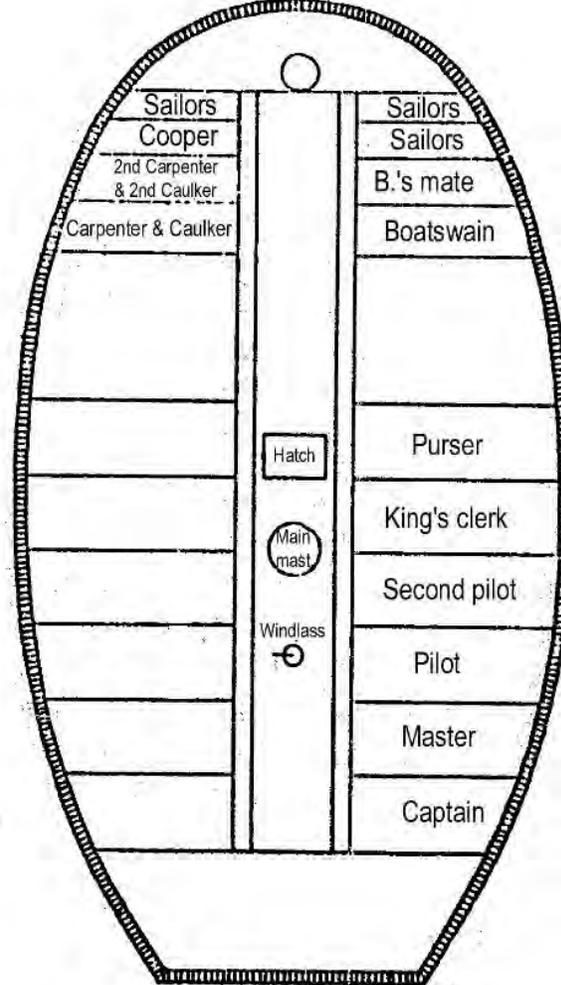


Luiz de Figueiredo Falcão

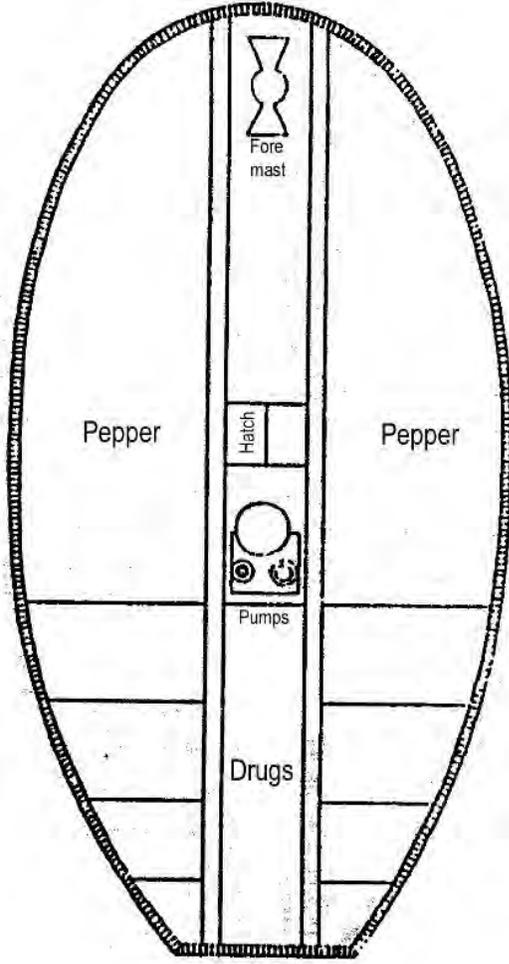
O Livro de Toda a Fazenda, 1607



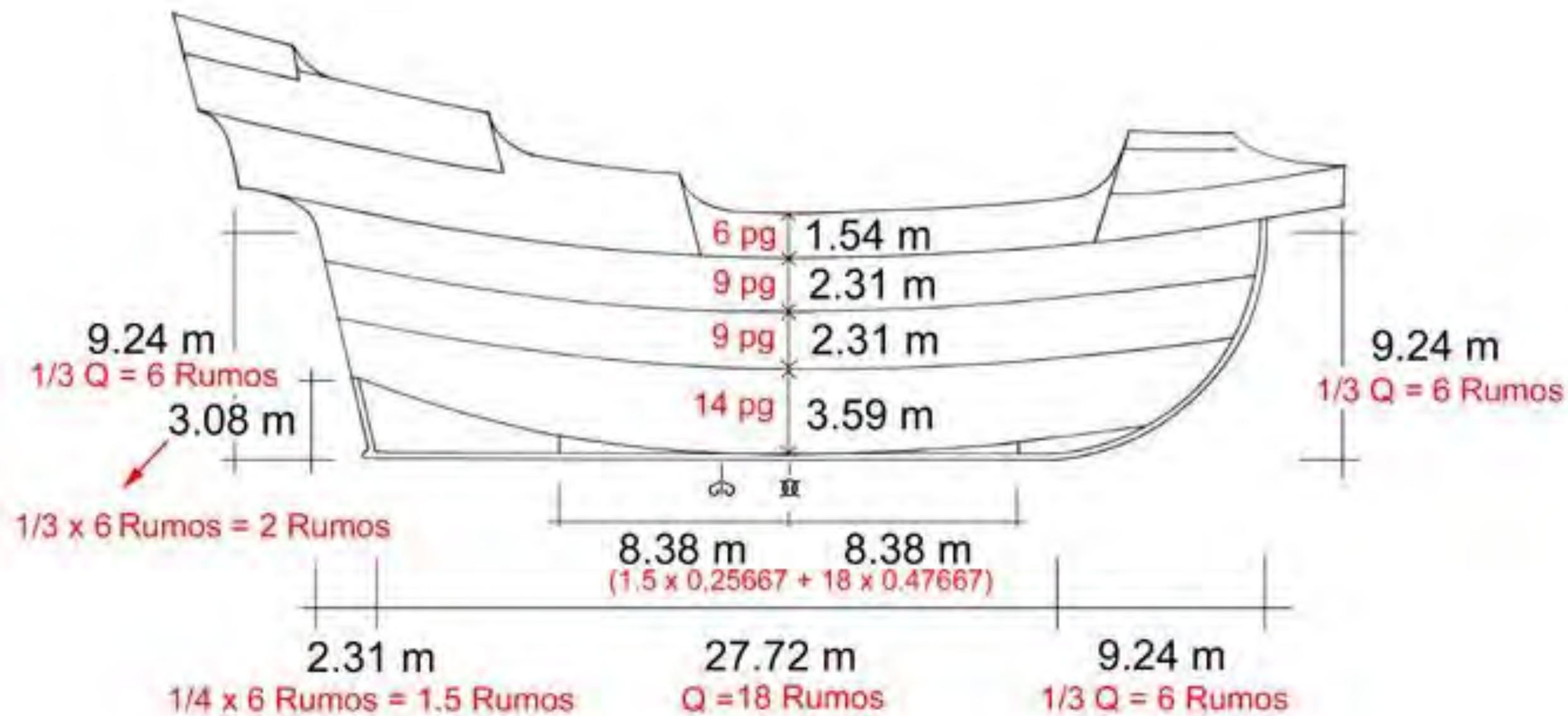
Main deck



Second deck



Hold



97865 0 0
48886 0 0
96203 0 0
81549 0 0

Audrey Wells:



Na torna-viagem, c. 450 pessoas: 150 marinheiros, 50 soldados, 40 passageiros, 200 escravos, 10 clérigos...

Carga





As naus eram carregadas com muito cuidado e segundo regras estritas. A logística das viagens requeria gente competente e experiente na preparação e aprovisionamento dos navios.

Sobressalentes, ferramentas e utilidades

Contentores

Mobília

Ferramentas

Sobressalentes

Madeira

Lenha

...



Carga e arrumos

Estivadores

Supervisão e responsabilidades

Durabilidade das especiarias, drogas e comidas

Estratégias de conservação

Carga

Especiarias

Drogas

Panos

Jóias e artigos preciosos

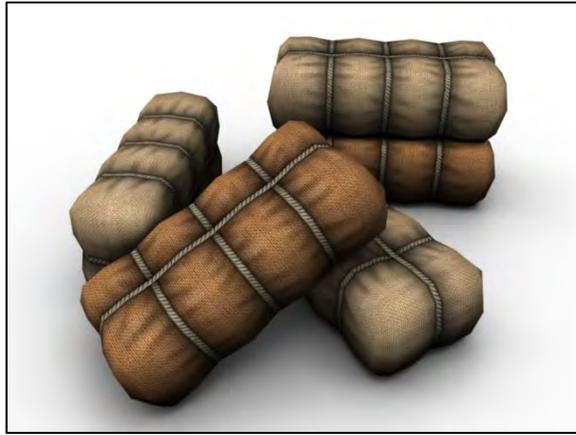
Mobílias

Cerâmicas e porcelanas

Animais

...





A determinação do mobiliário e do tamanho, composição e arrumo da carga basearam-se largamente no trabalho do Cte. Bruno Neves.

verts: 113911 0 0
Edges: 324363 0 0
Faces: 152367 0 0
Tris: 304122 0 0
UVs: 275999 0 0

Audrey Wells:



Azeite

Grão

Lentilhas

Feijão...

Agua

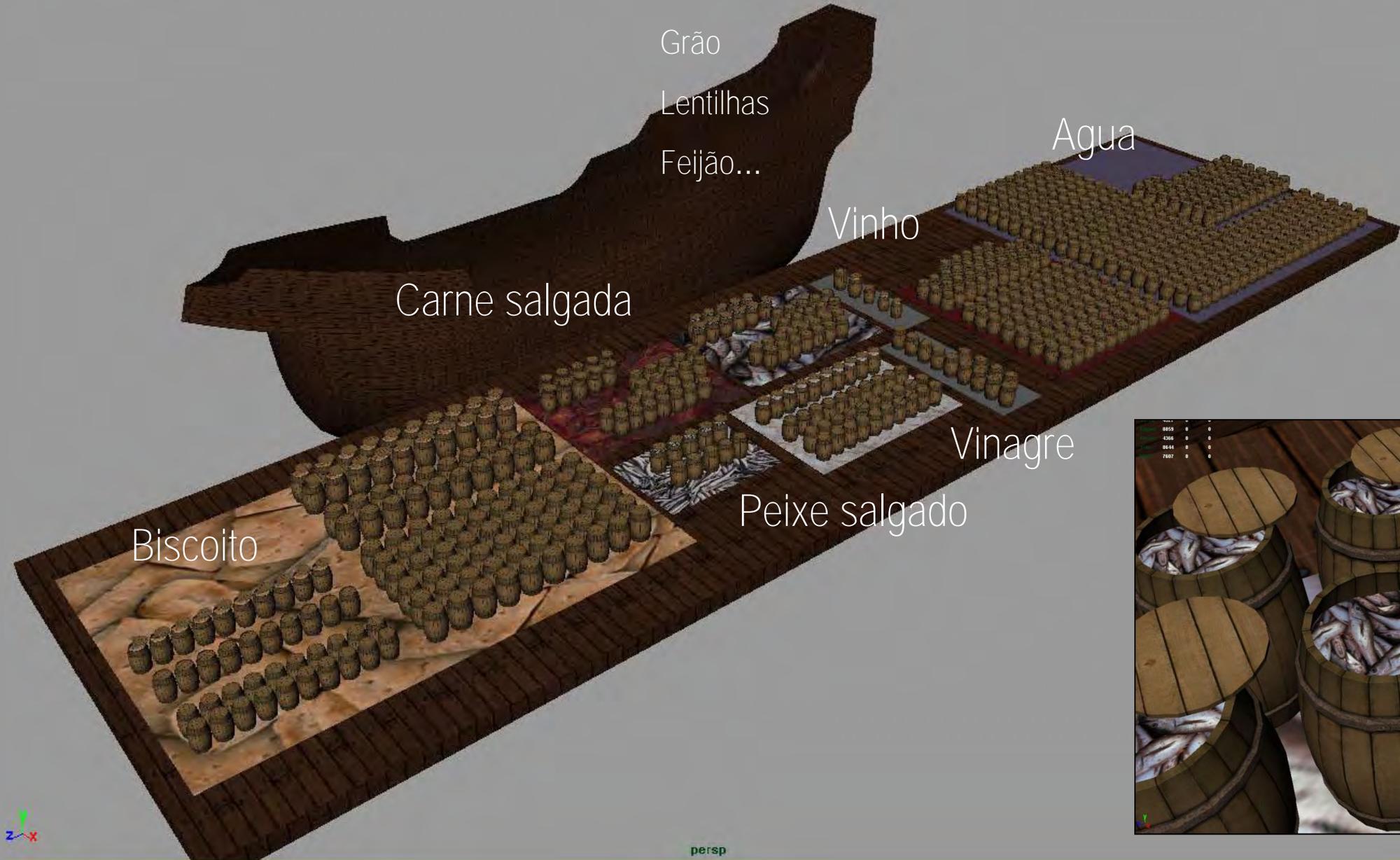
Vinho

Carne salgada

Vinagre

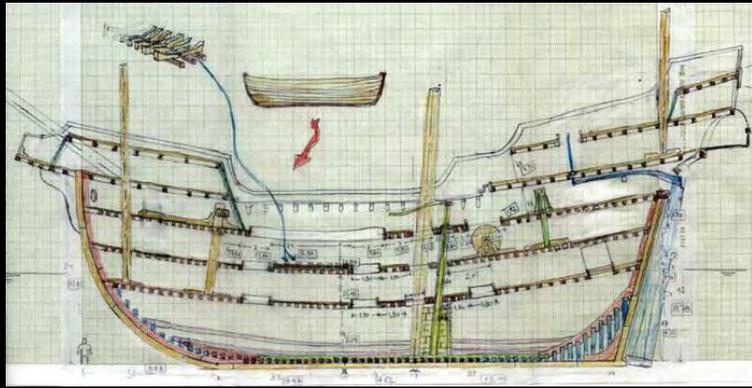
Peixe salgado

Biscoito

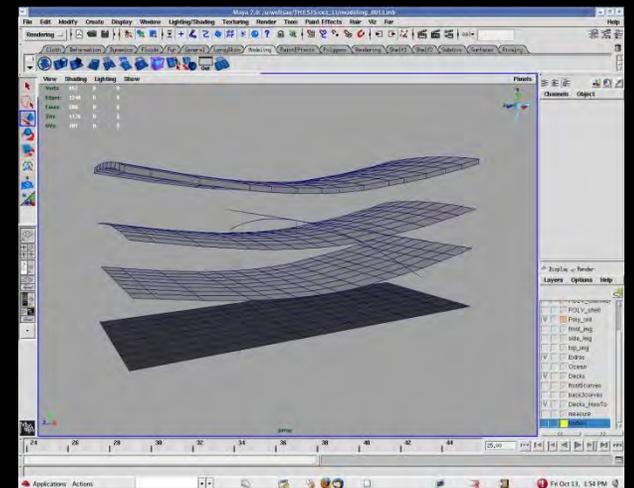
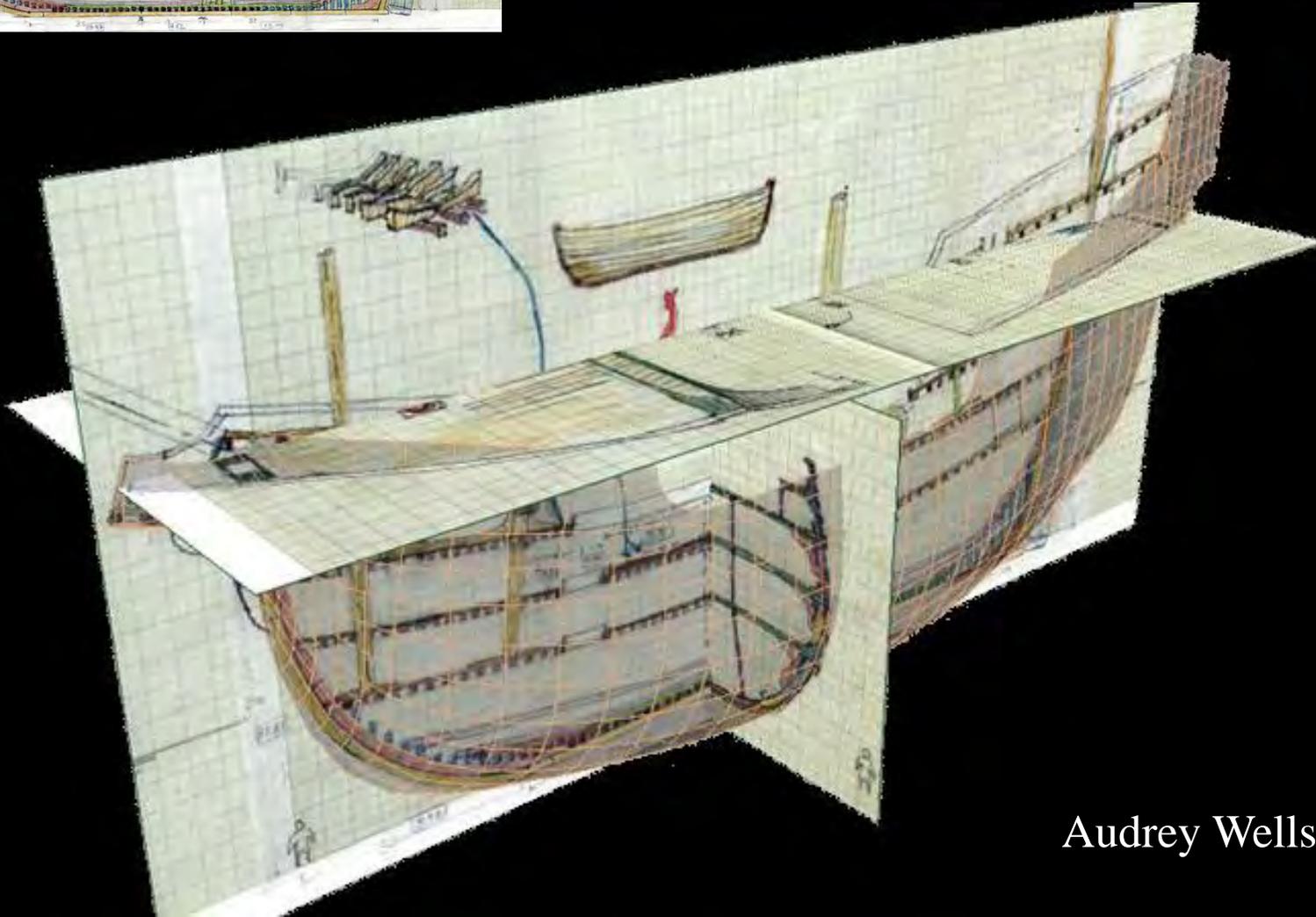
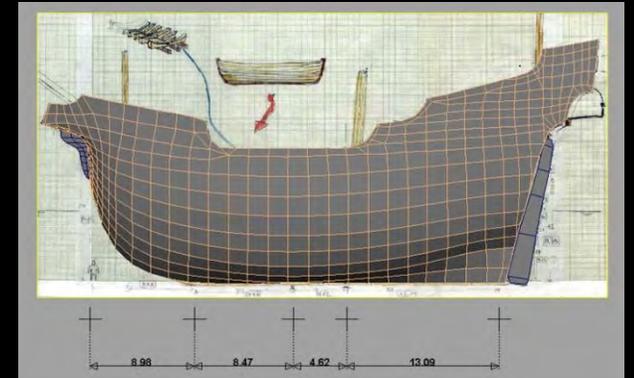
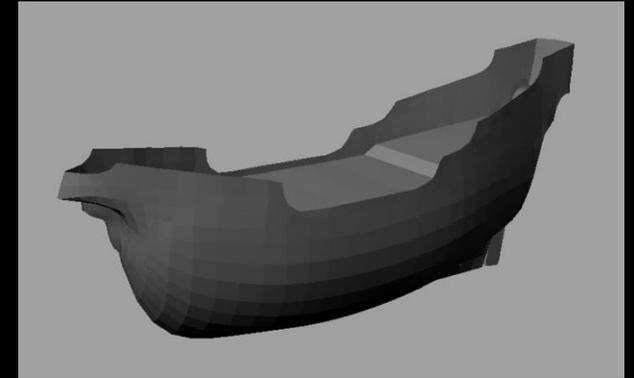


persp

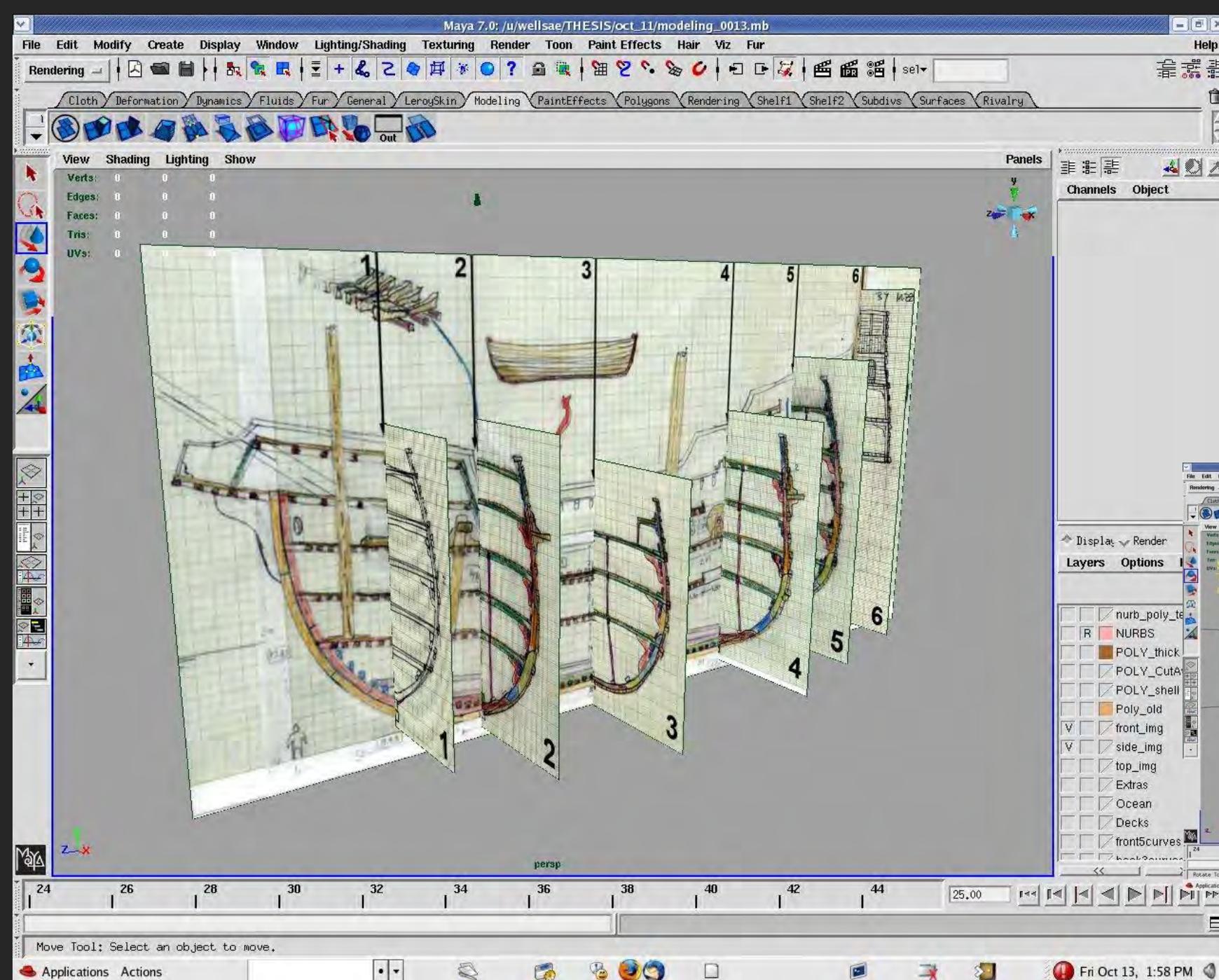




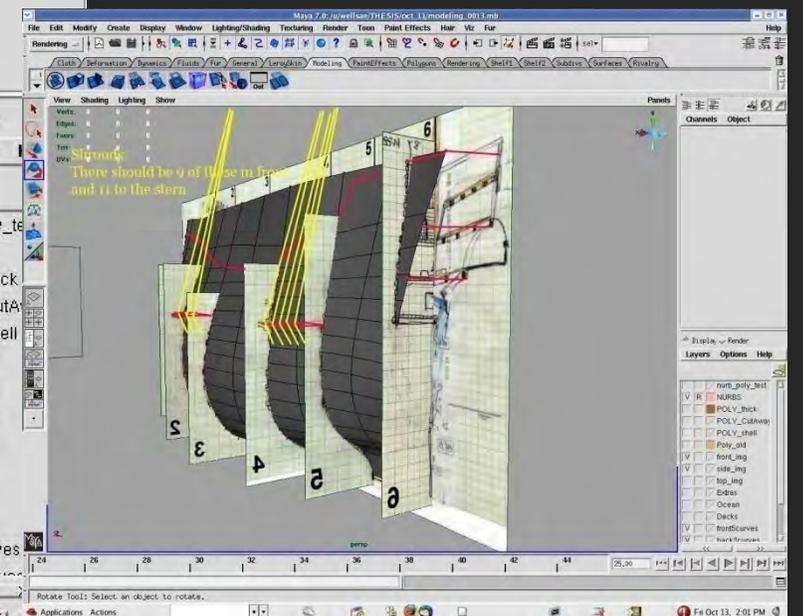
Volumes



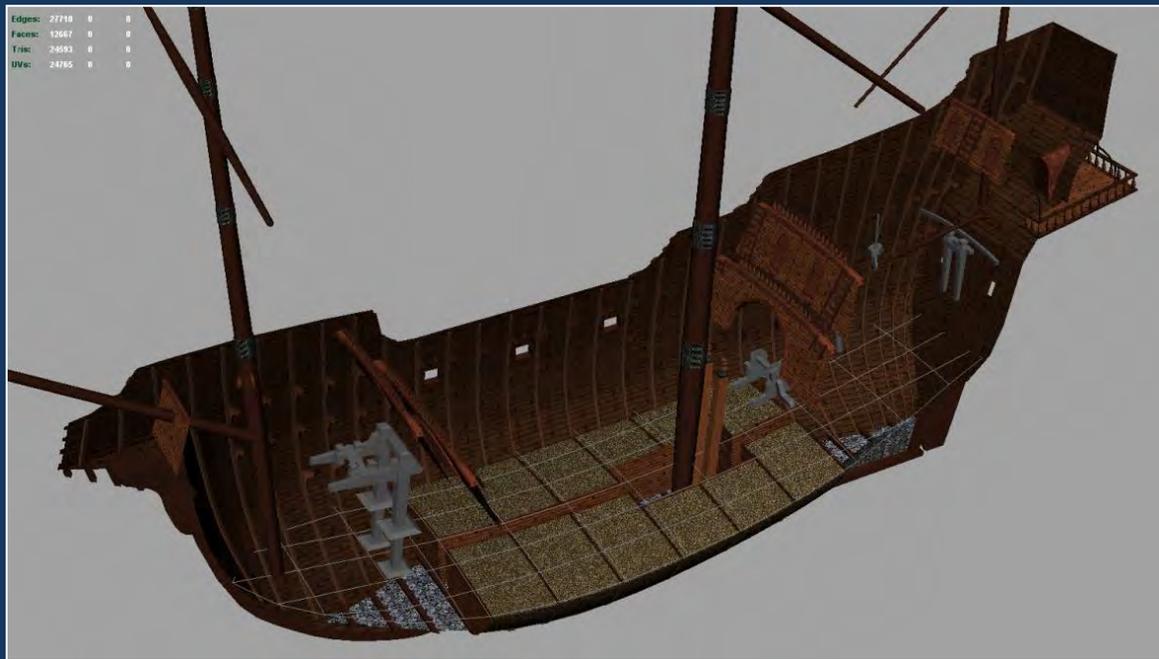
Audrey Wells



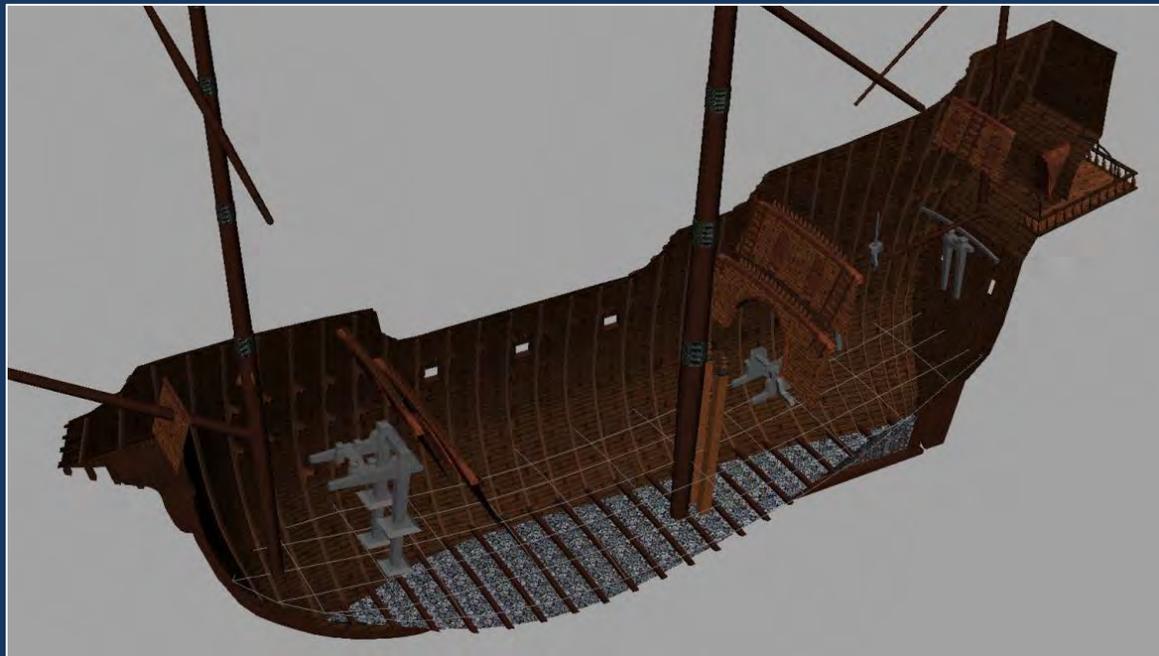
O tratamento tridimensional dos desenhos facilitou o trabalho.



Audrey Wells

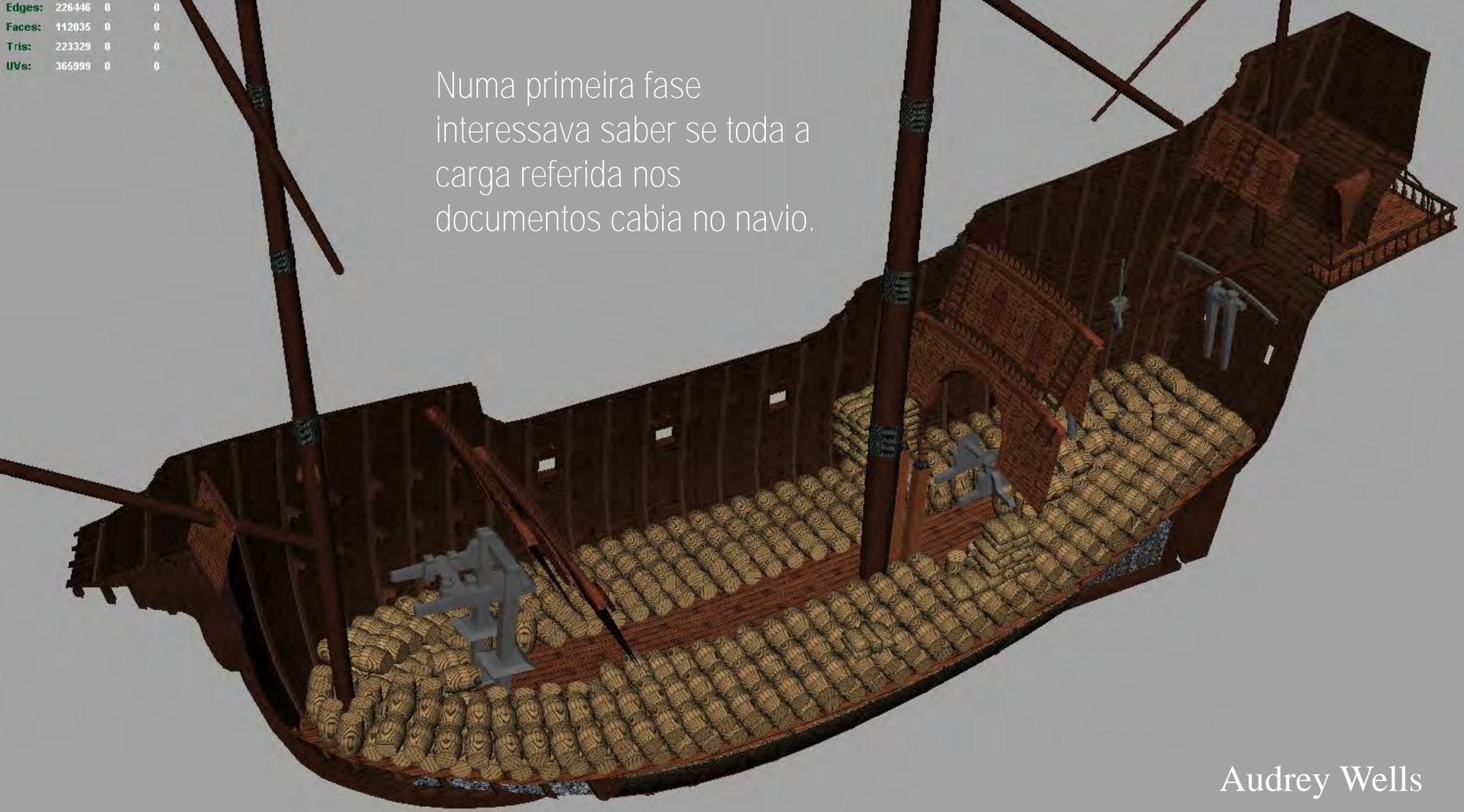


O processo de interpretação de documentos foi facilitado pela utilização de software tridimensional, que permitiu implementar um processo iterativo e rever cada solução à luz da anterior a cada incremento de informação encontrado.



Edges: 226446 0 0
Faces: 112035 0 0
Tris: 223329 0 0
UVs: 365999 0 0

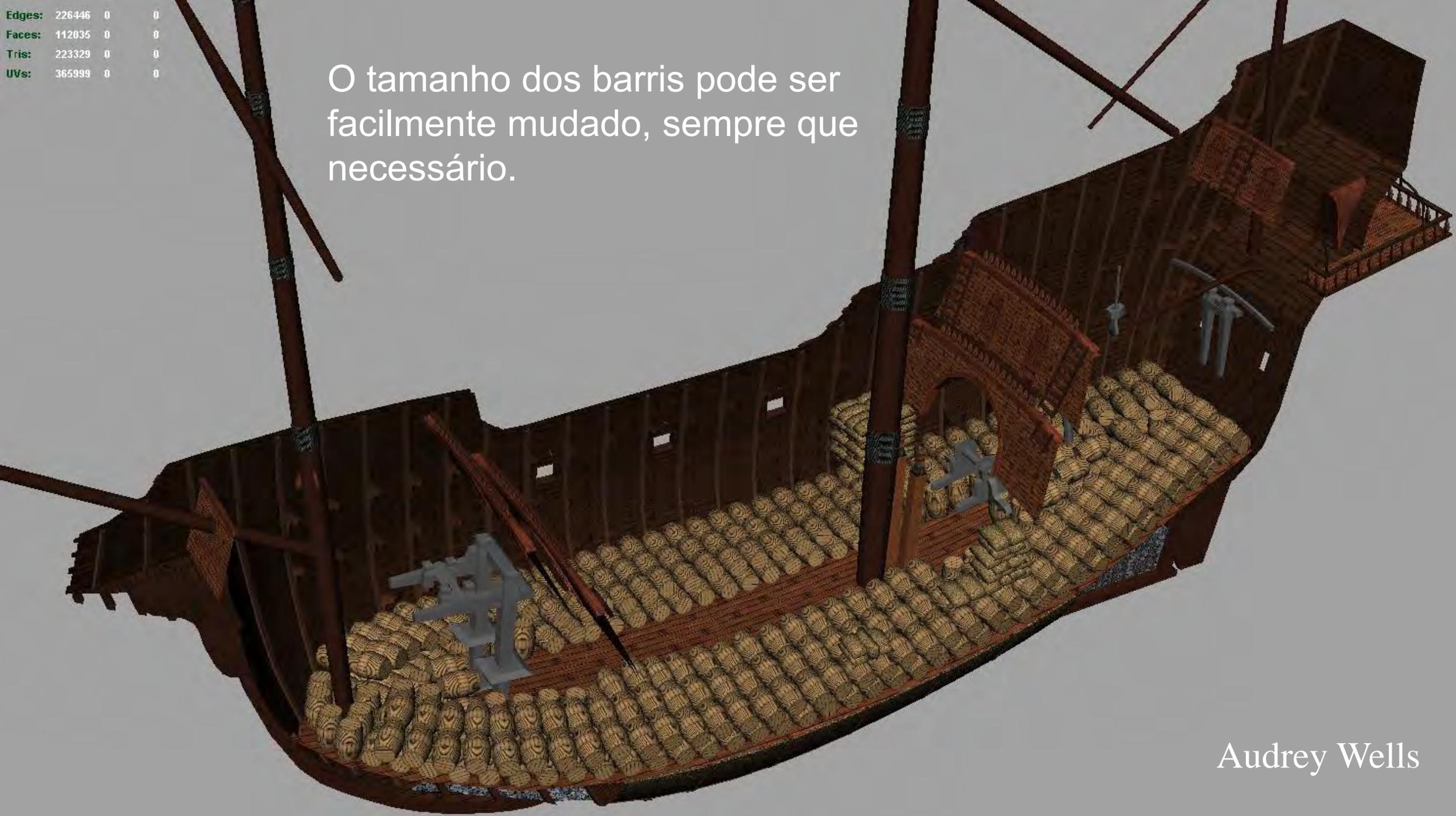
Numa primeira fase
interessava saber se toda a
carga referida nos
documentos cabia no navio.



Audrey Wells

Edges: 226446 0 0
Faces: 112035 0 0
Tris: 223329 0 0
UVs: 365999 0 0

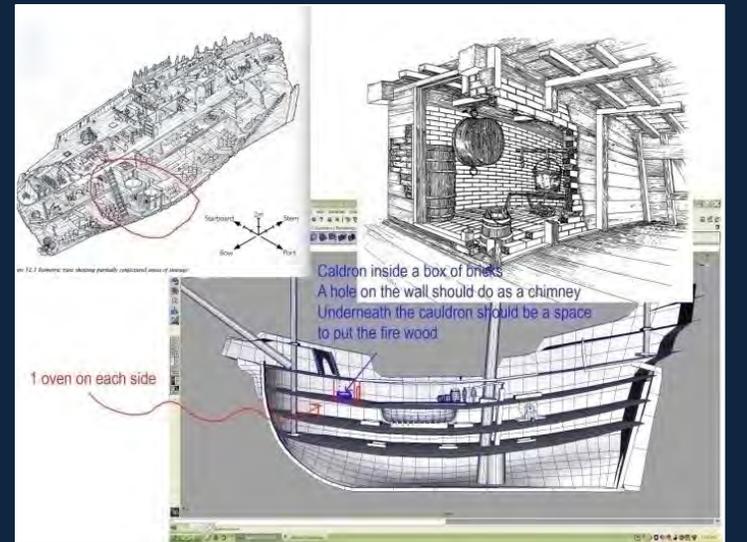
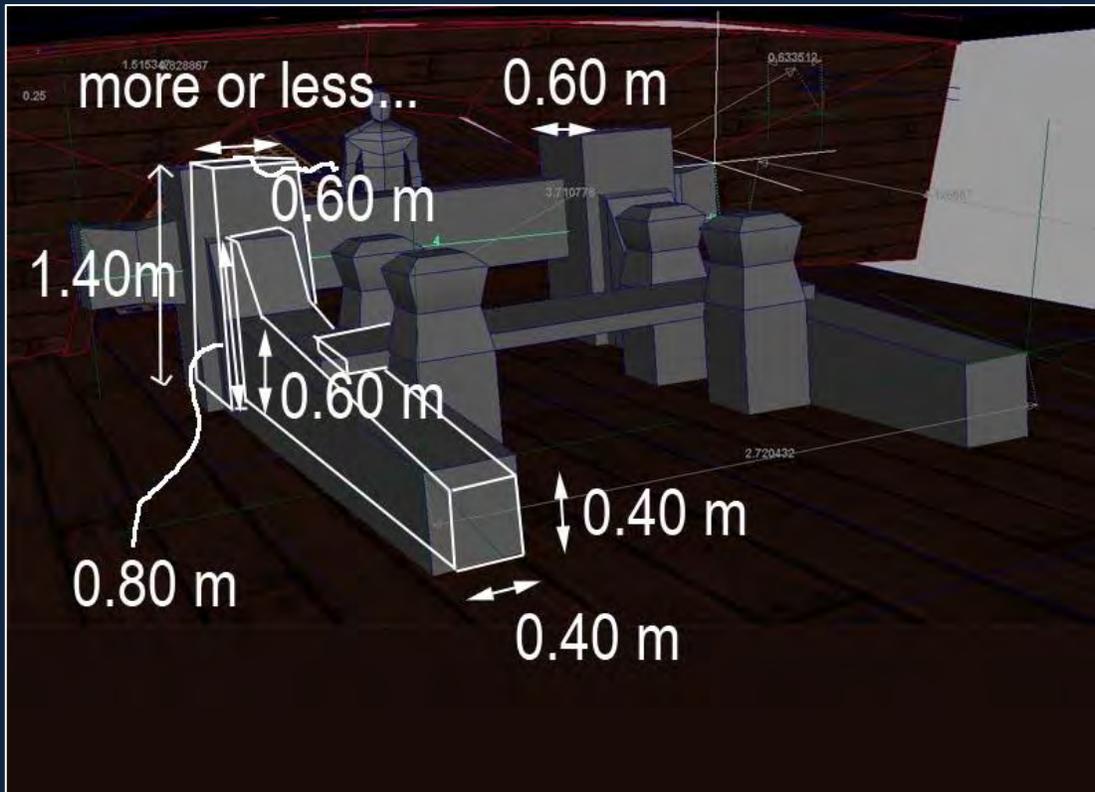
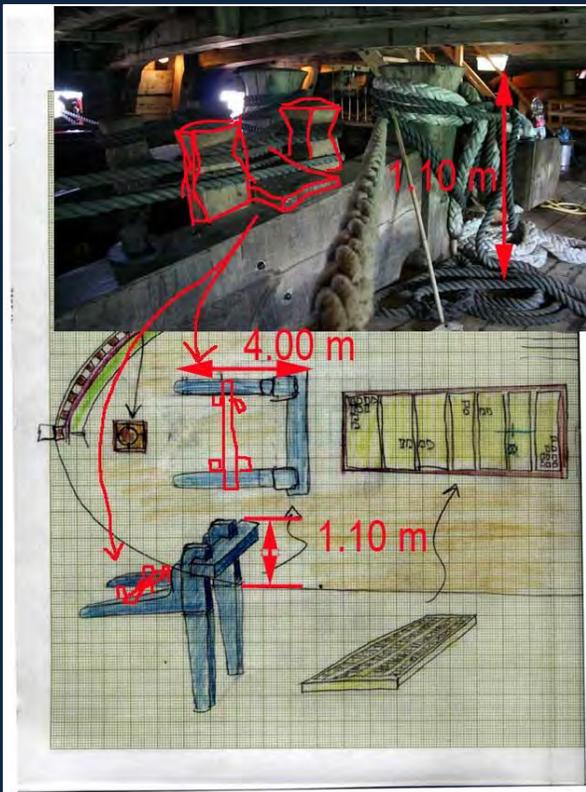
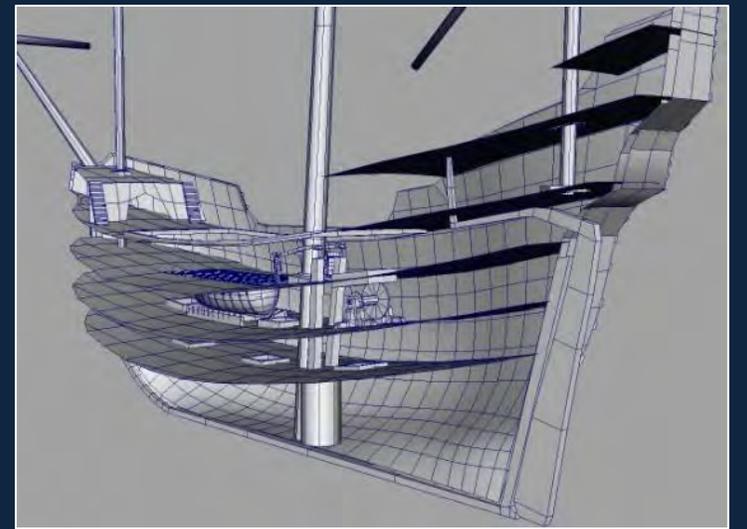
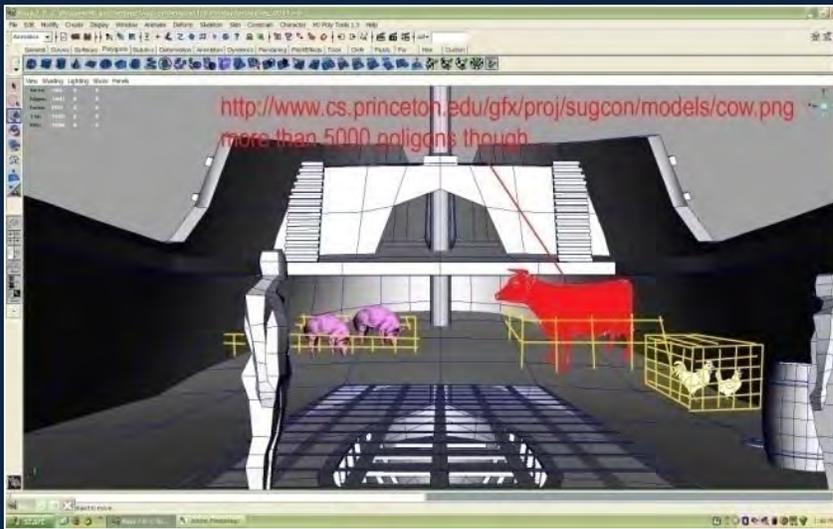
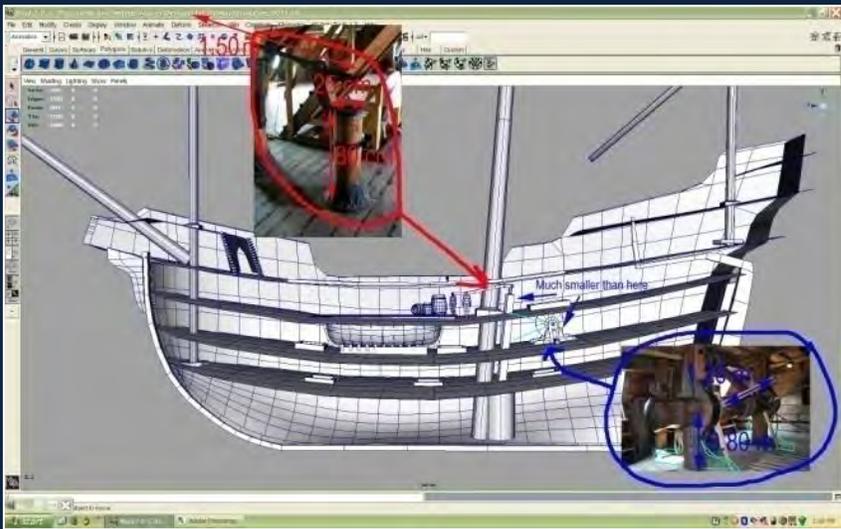
O tamanho dos barris pode ser facilmente mudado, sempre que necessário.



Audrey Wells

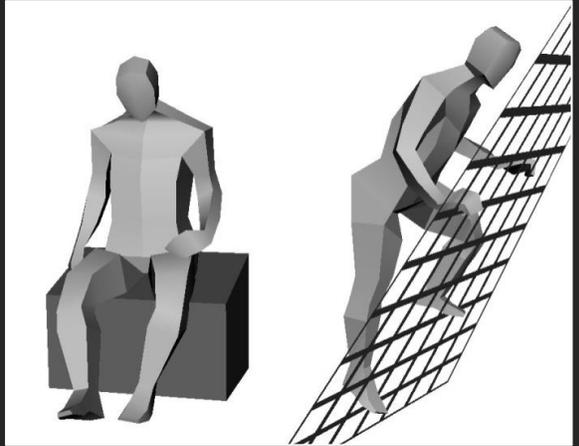
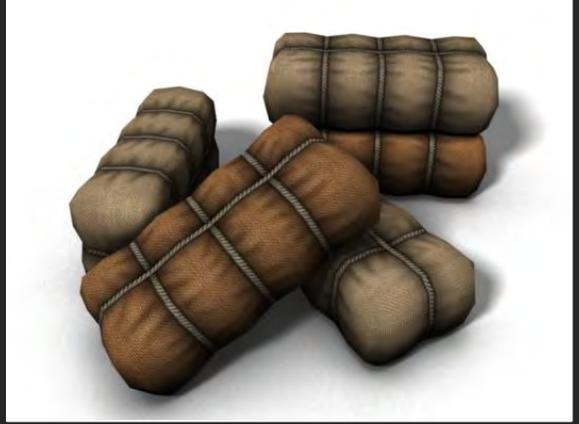
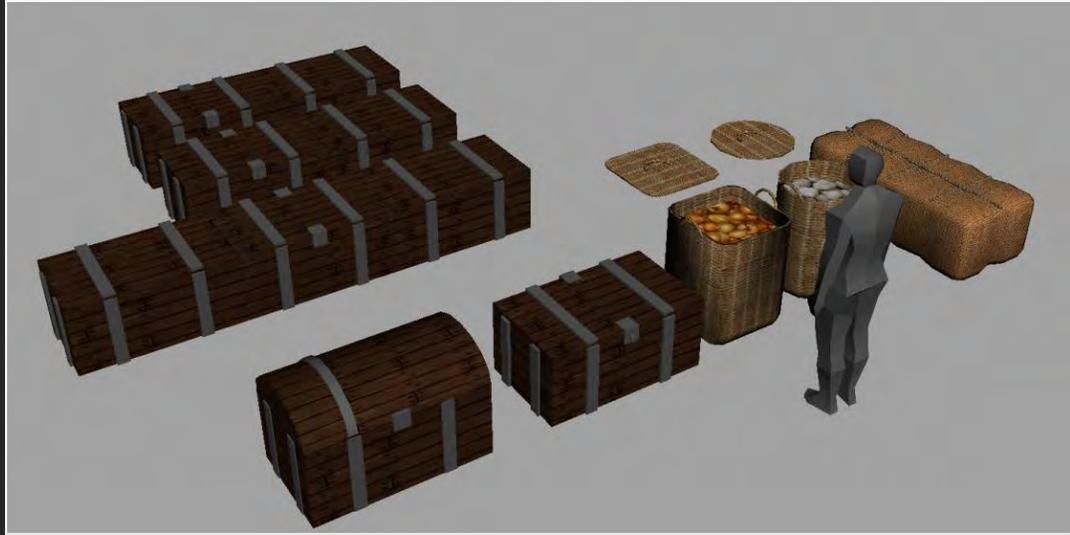
A plausibilidade de cada incremento na reconstrução era avaliada no contexto da viagem.



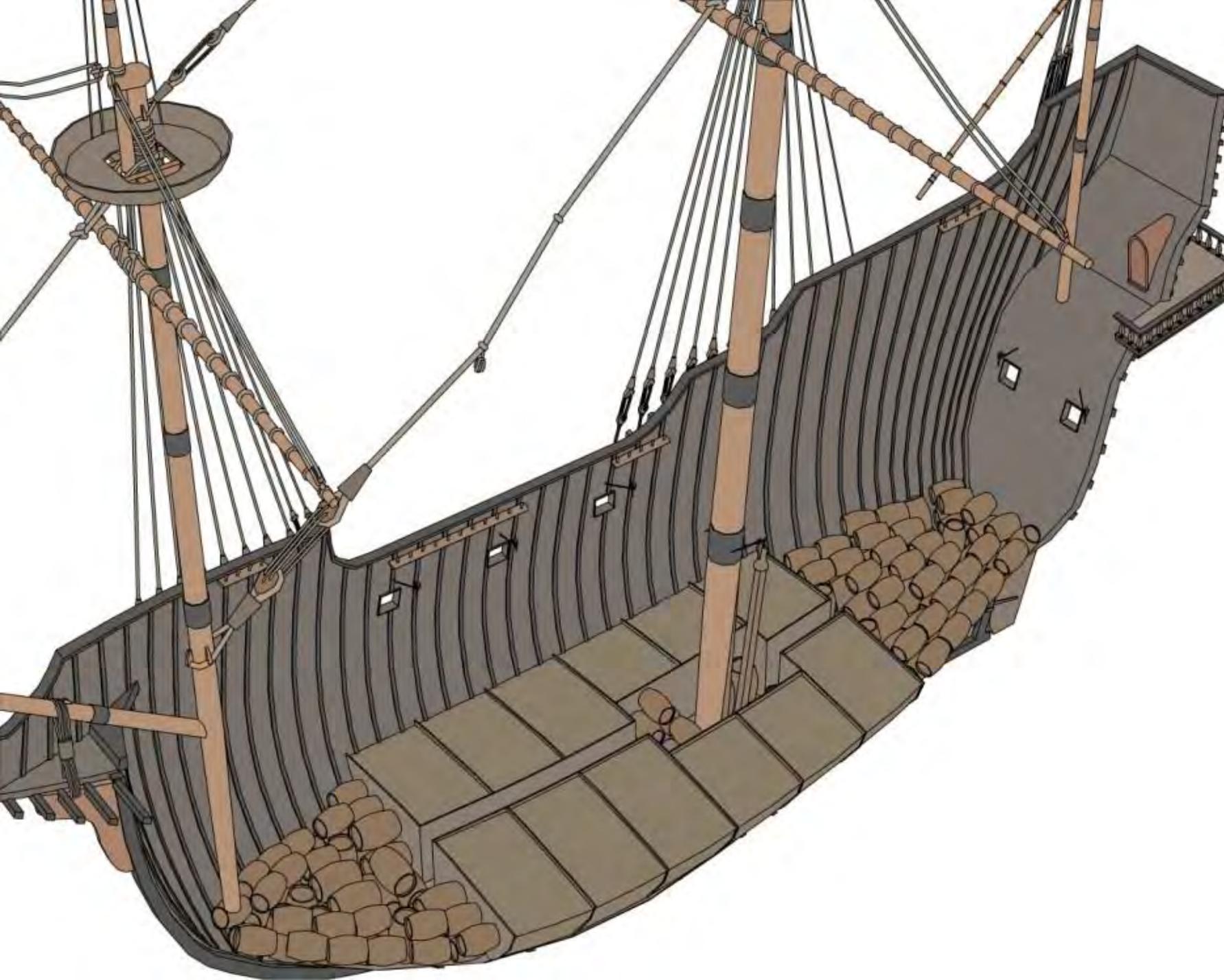




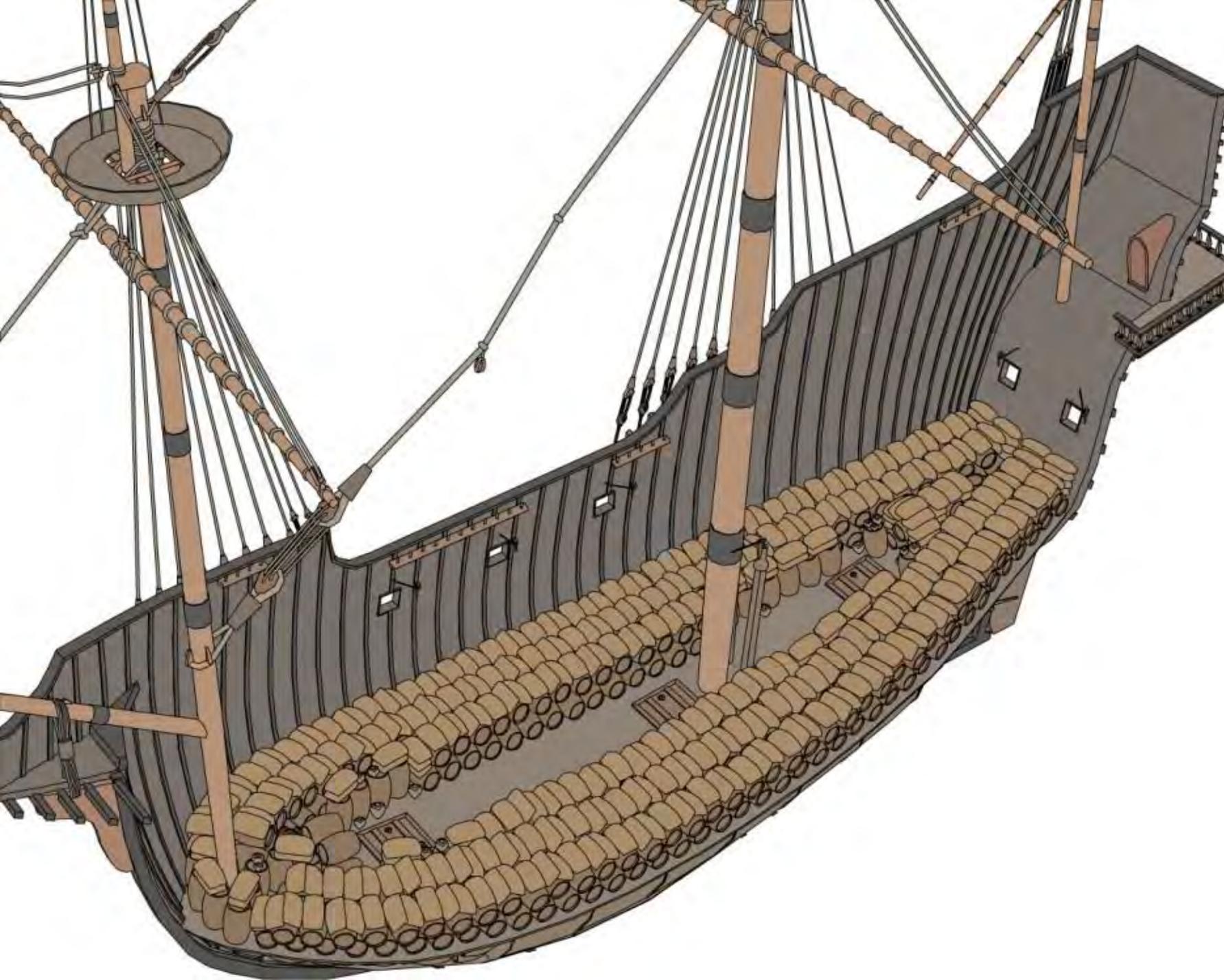
Luca Cambiaso (1527-1585)



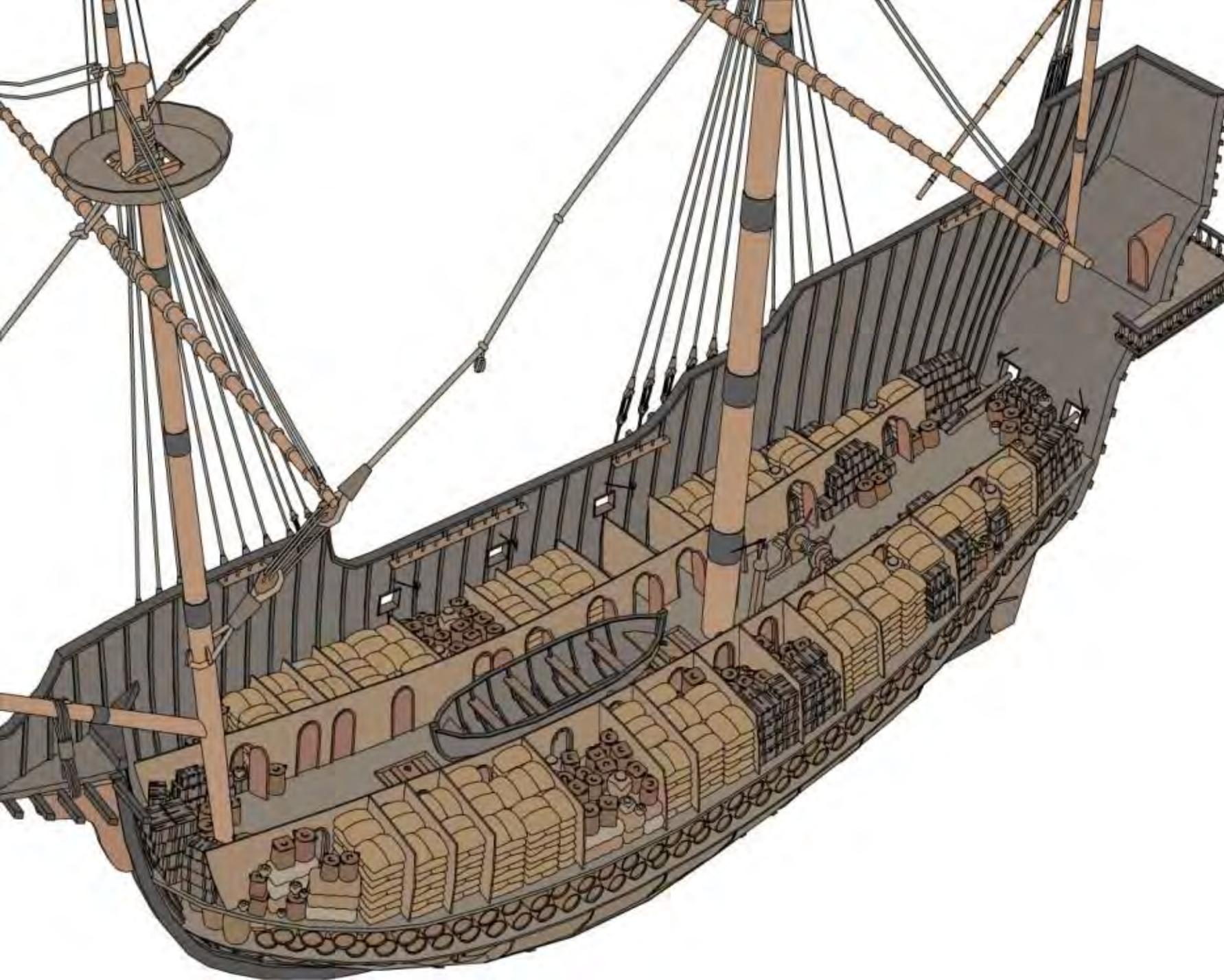
Audrey Wells



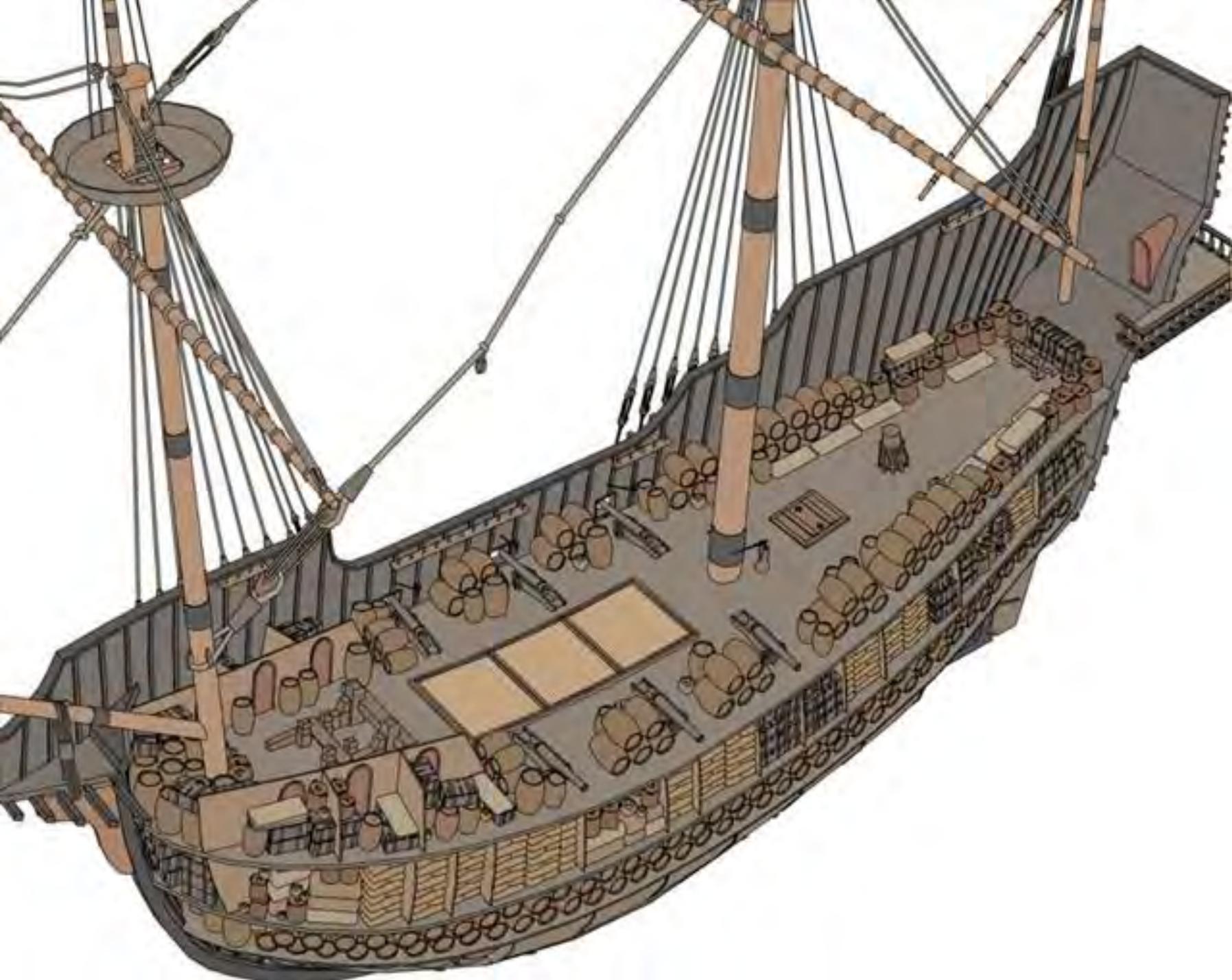
Audrey Wells



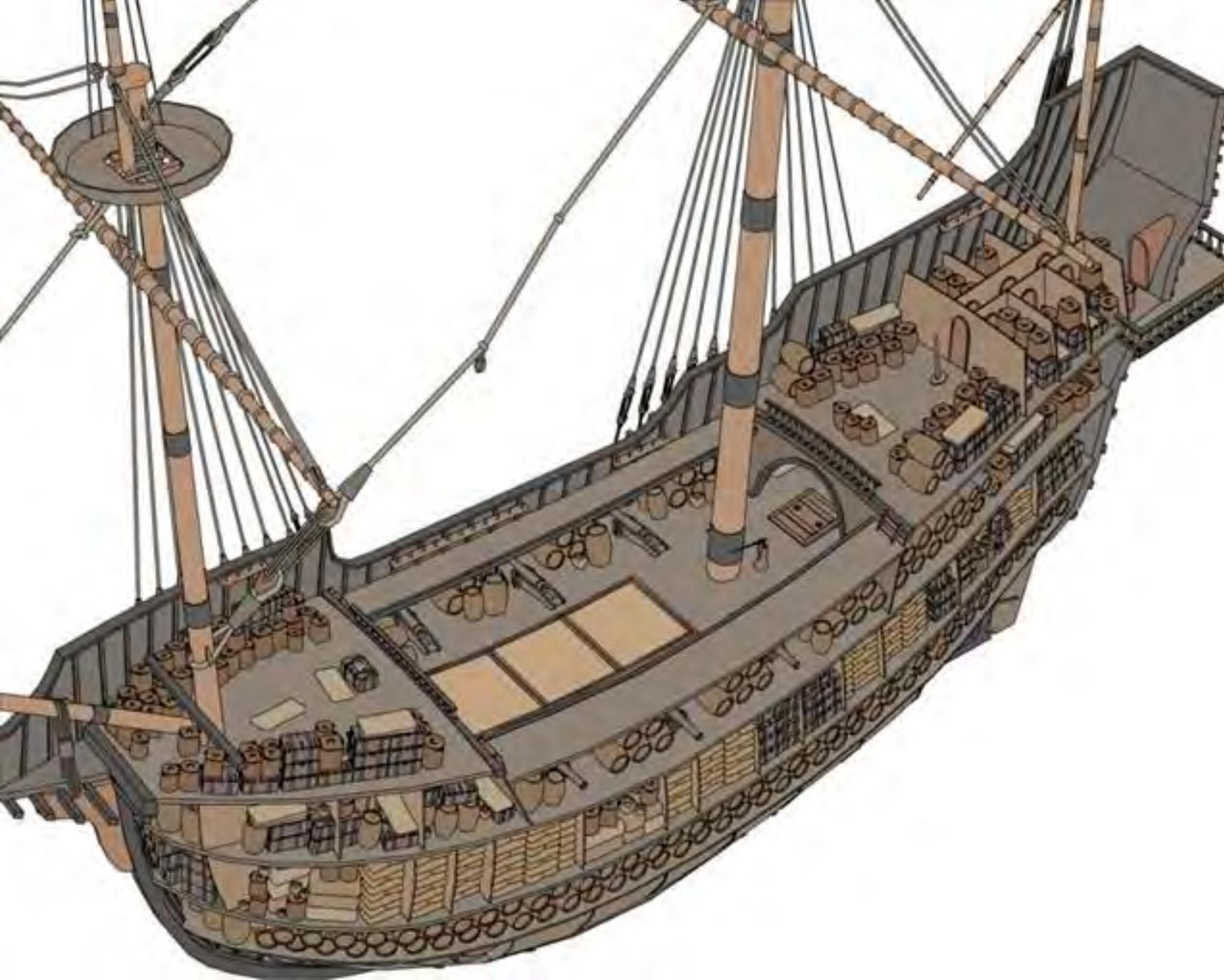
Audrey Wells



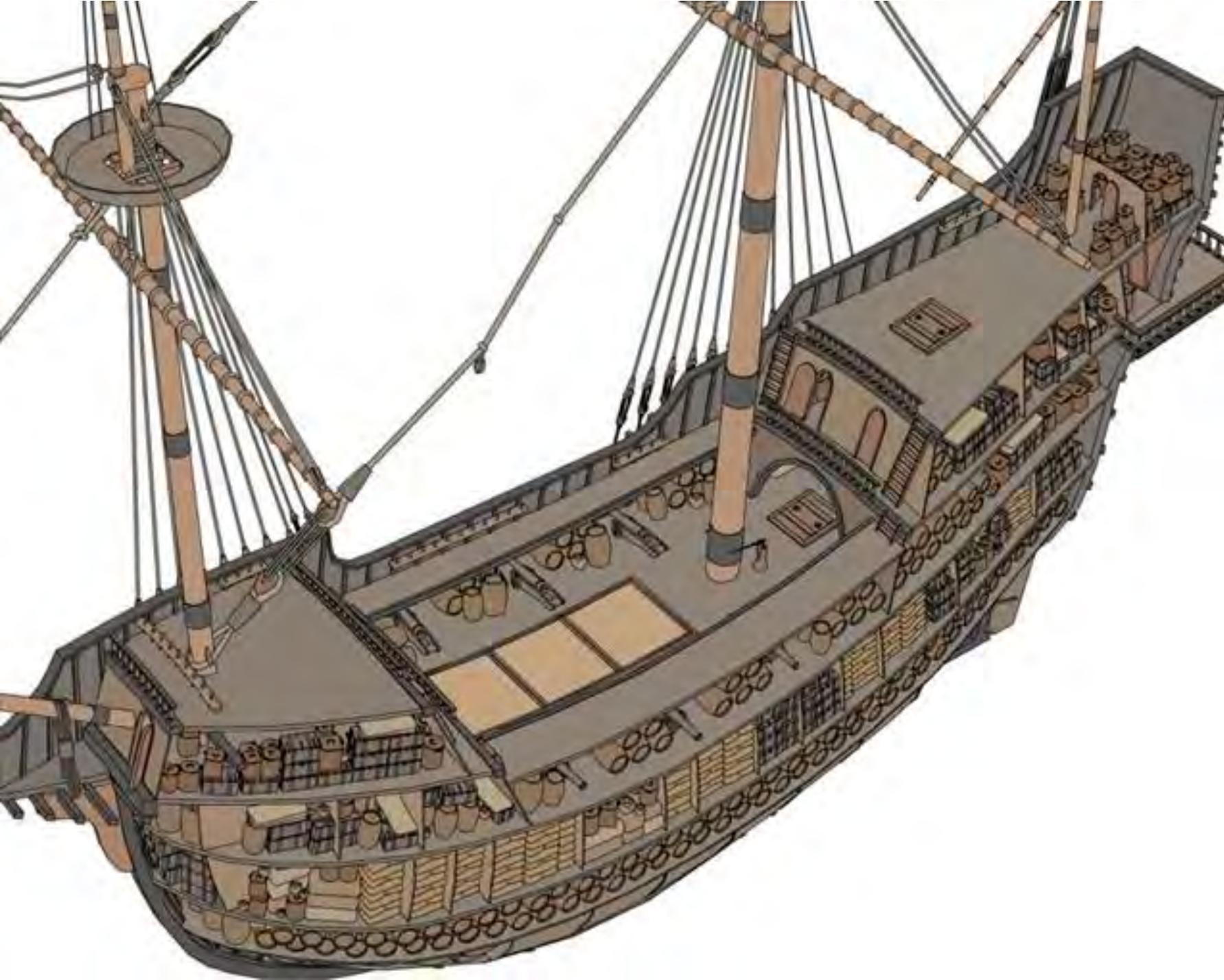
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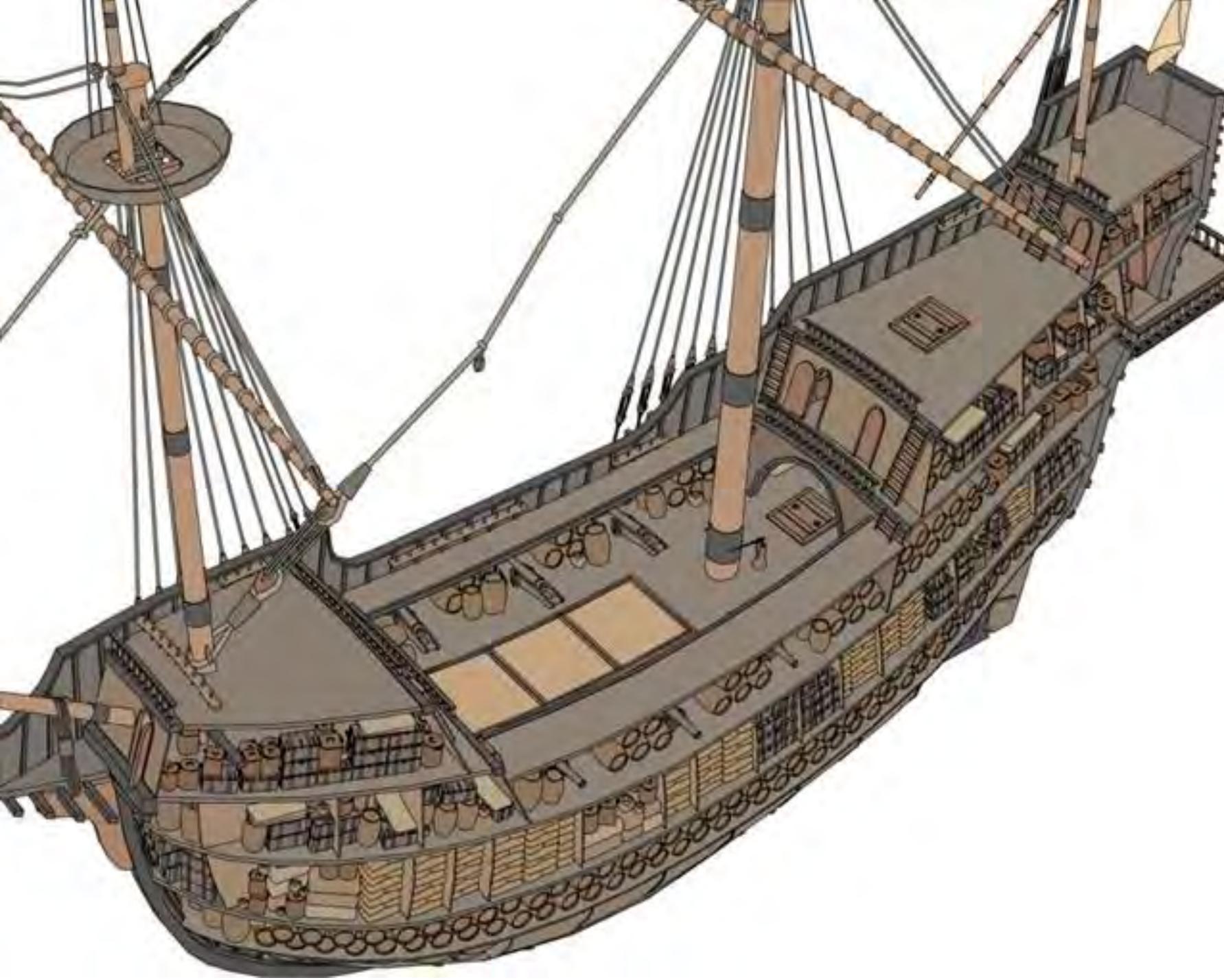
Audrey Wells



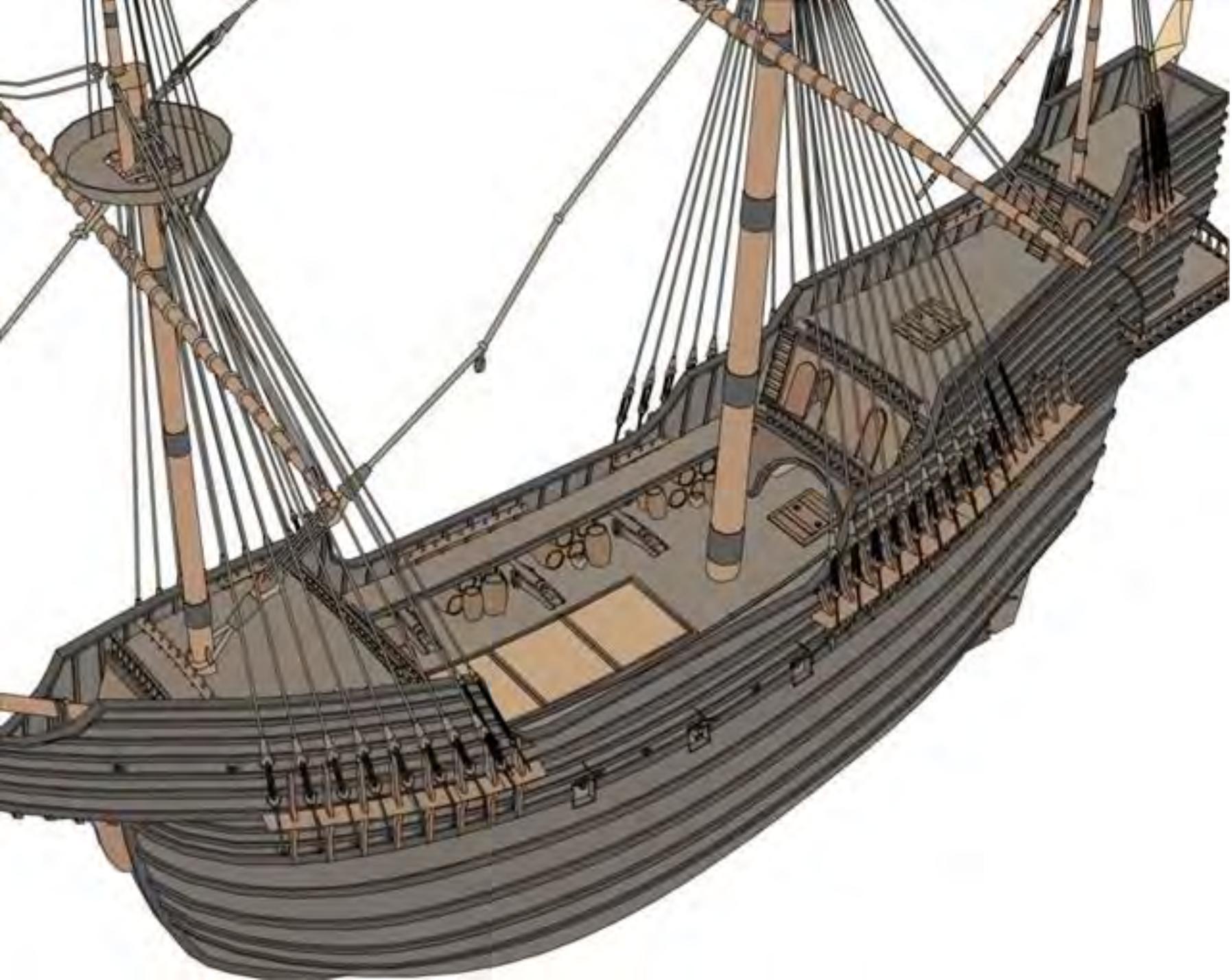
Audrey Wells



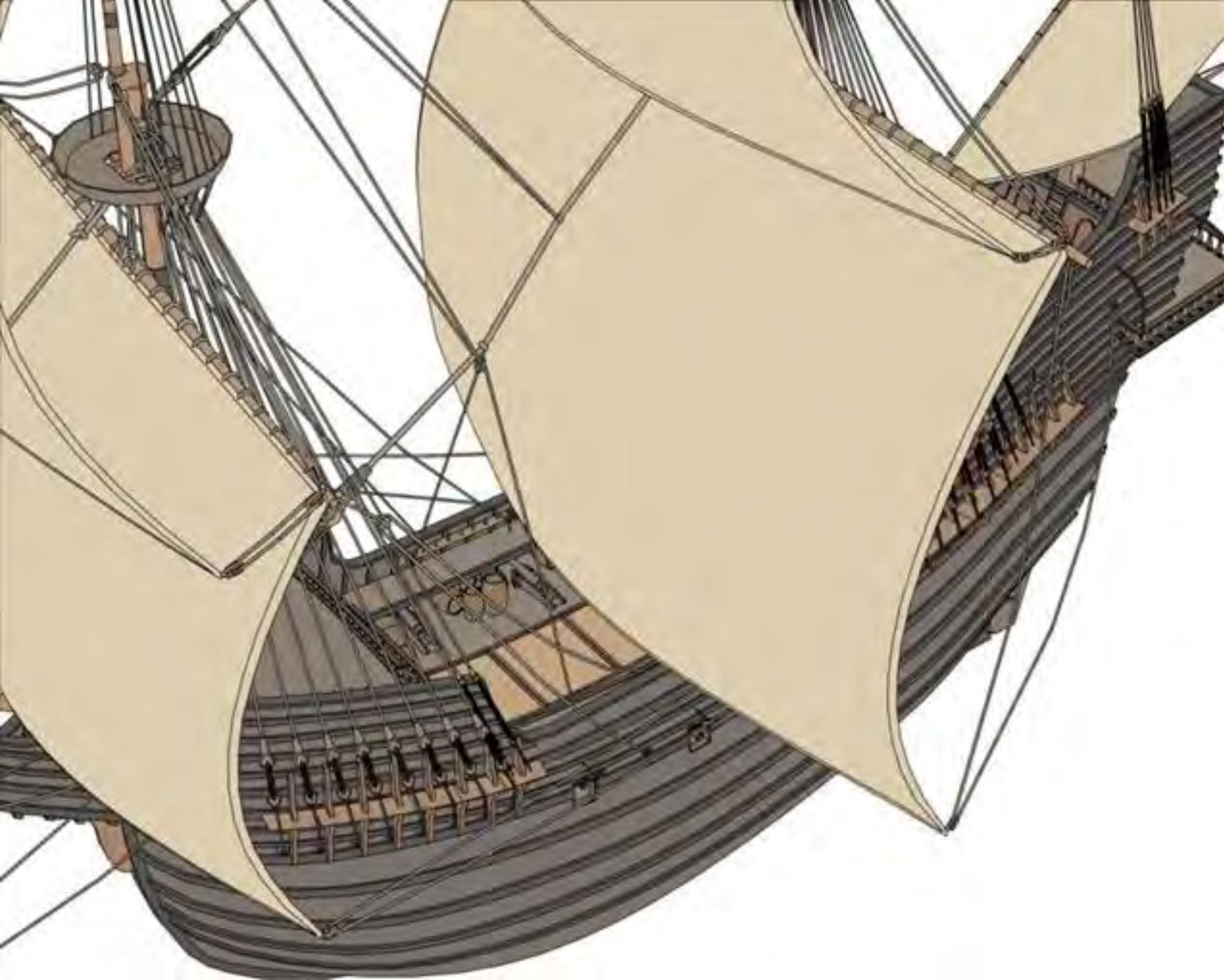
Audrey Wells



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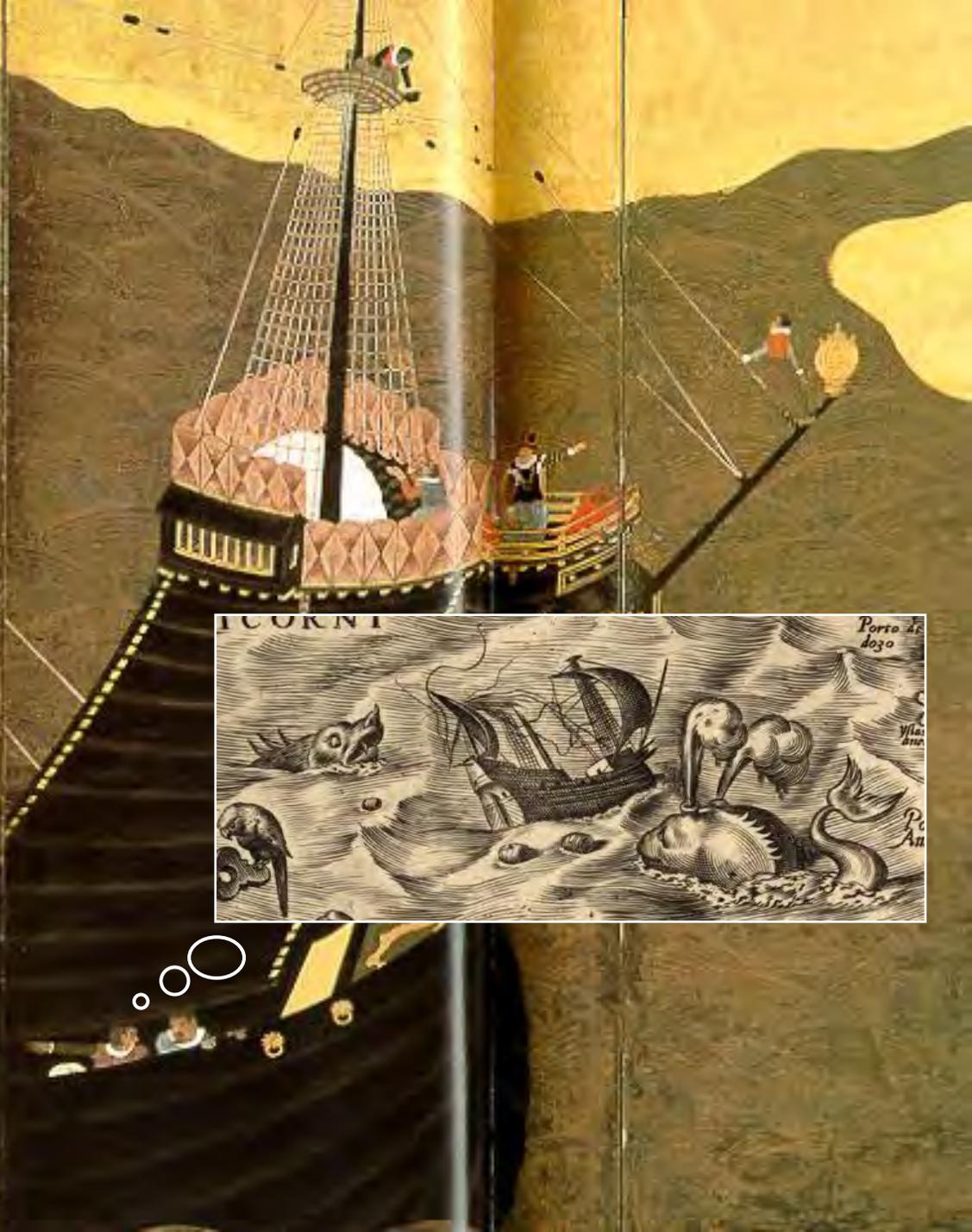


Audrey Wells

Vida a bordo









Thank You!

Mendrik J.