

# Representação geométrica da embarcação: Fundamentos da Engenharia Naval

**Prof. Dr. Gustavo R.S. Assi**

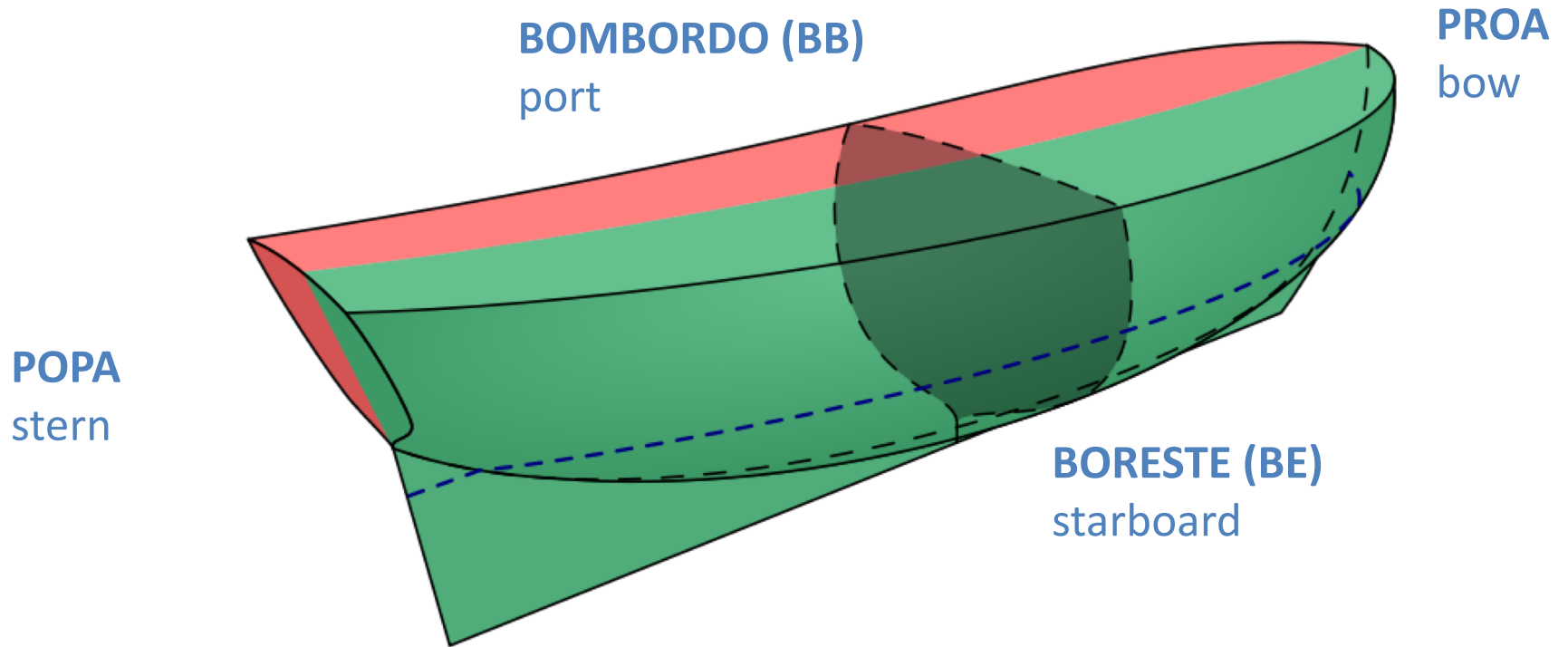
Departamento de Engenharia Naval e Oceânica  
Escola Politécnica da Universidade de São Paulo



**PNV3391 – Lab Naval 1**  
**2019**

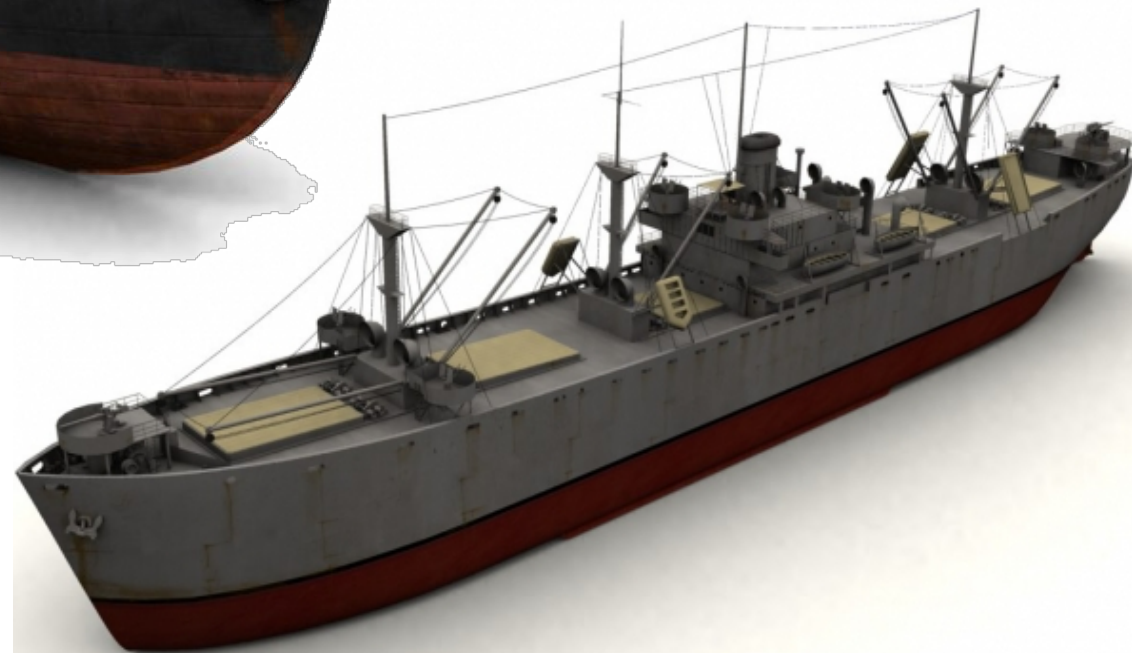


# Nomenclatura

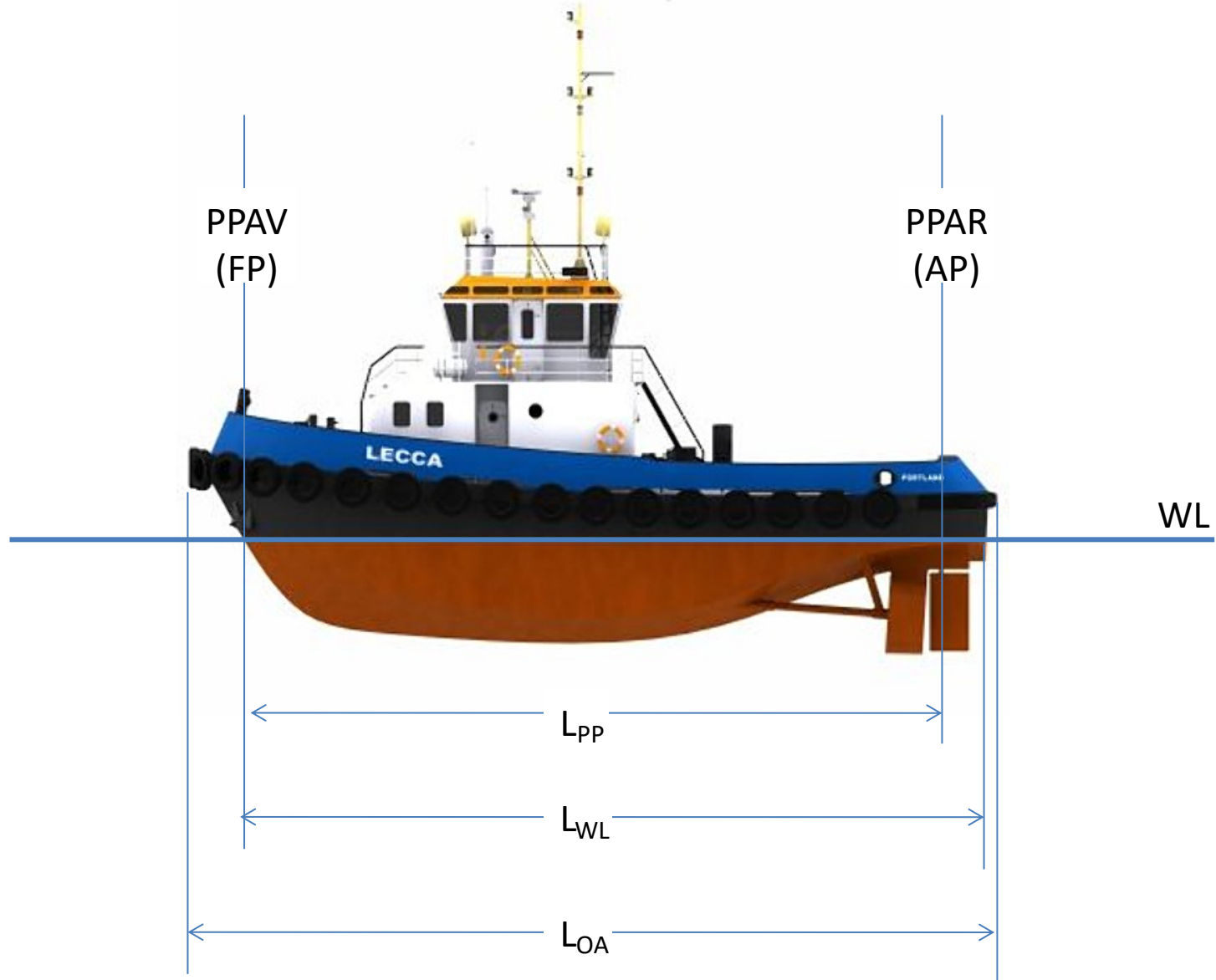


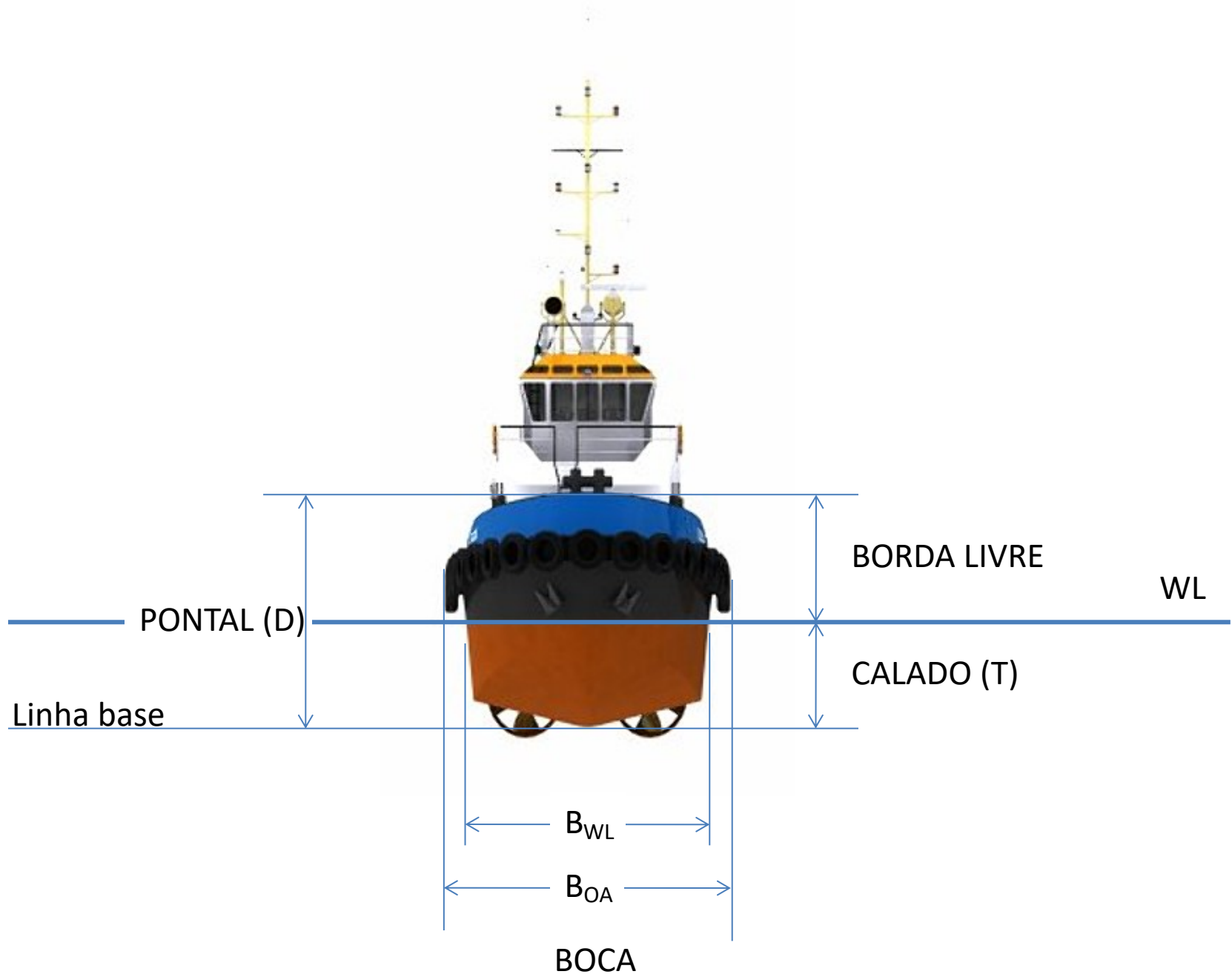
- Casco
- Superestrutura
- Convés
- Proa / Popa
- Meia-nau
- Bombordo / Boreste
- Barlavento / Sotavento

- Costado
- Obras vivas / obras mortas
- Borda
- Quilha
- Bojo
- Bolina
- Leme, Hélice
- Bulbo



# Dimensões





# Nomenclatura

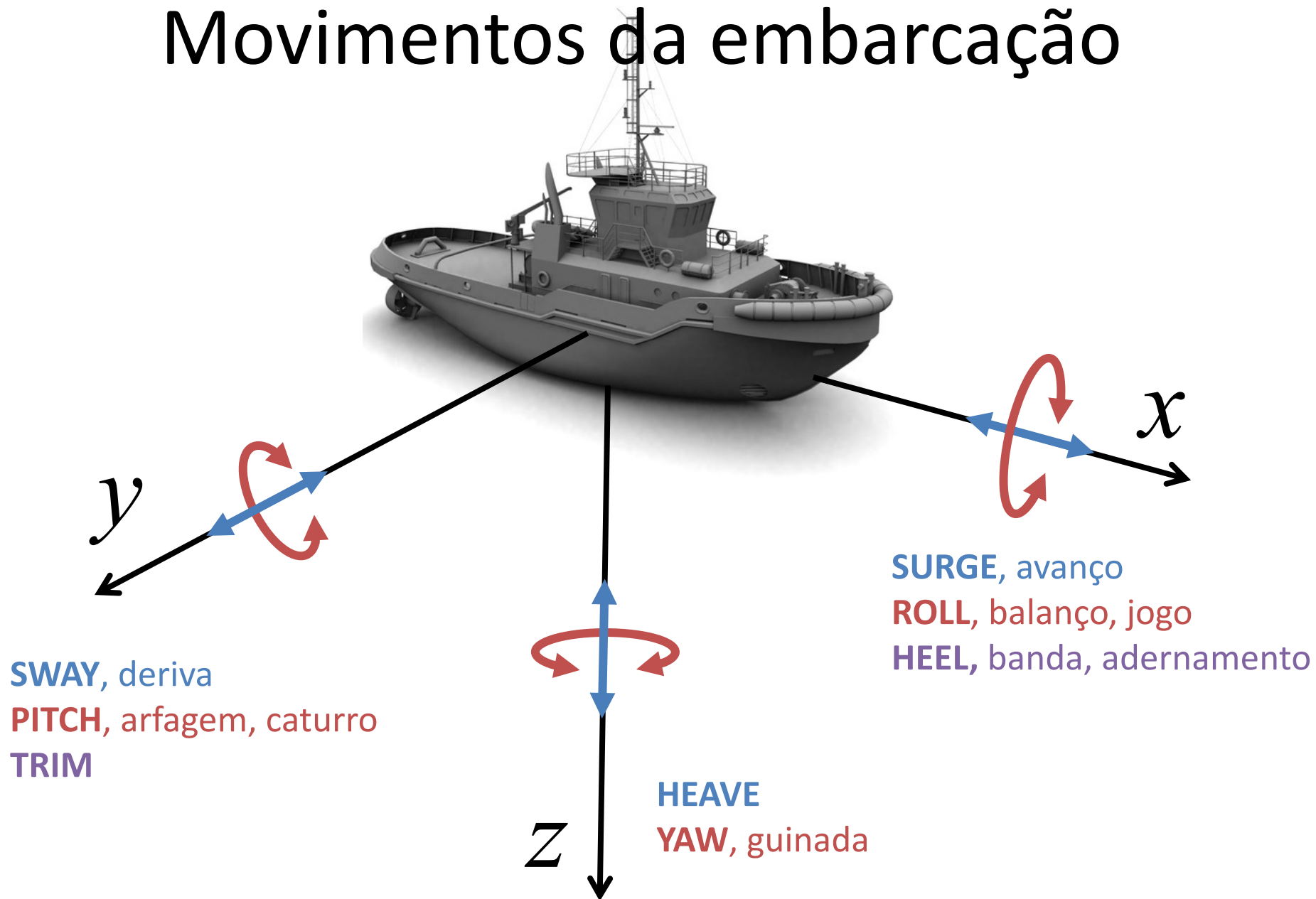
## Partes

- Casco [hull]
- Superestrutura
- Convés [deck]
- Proa [bow] / Popa [stern]
- Bombordo [port] / Boreste [starboard]
- Barlavento / Sotavento
- Meia-nau [midship]
- Costado
- Obras vivas / mortas
- Borda [board]
- Quilha [keel]
- Bolina [bilge keel]
- Leme [rudder]
- Hélice [propeller]
- Bulbo [bulbous bow]
- Bojo

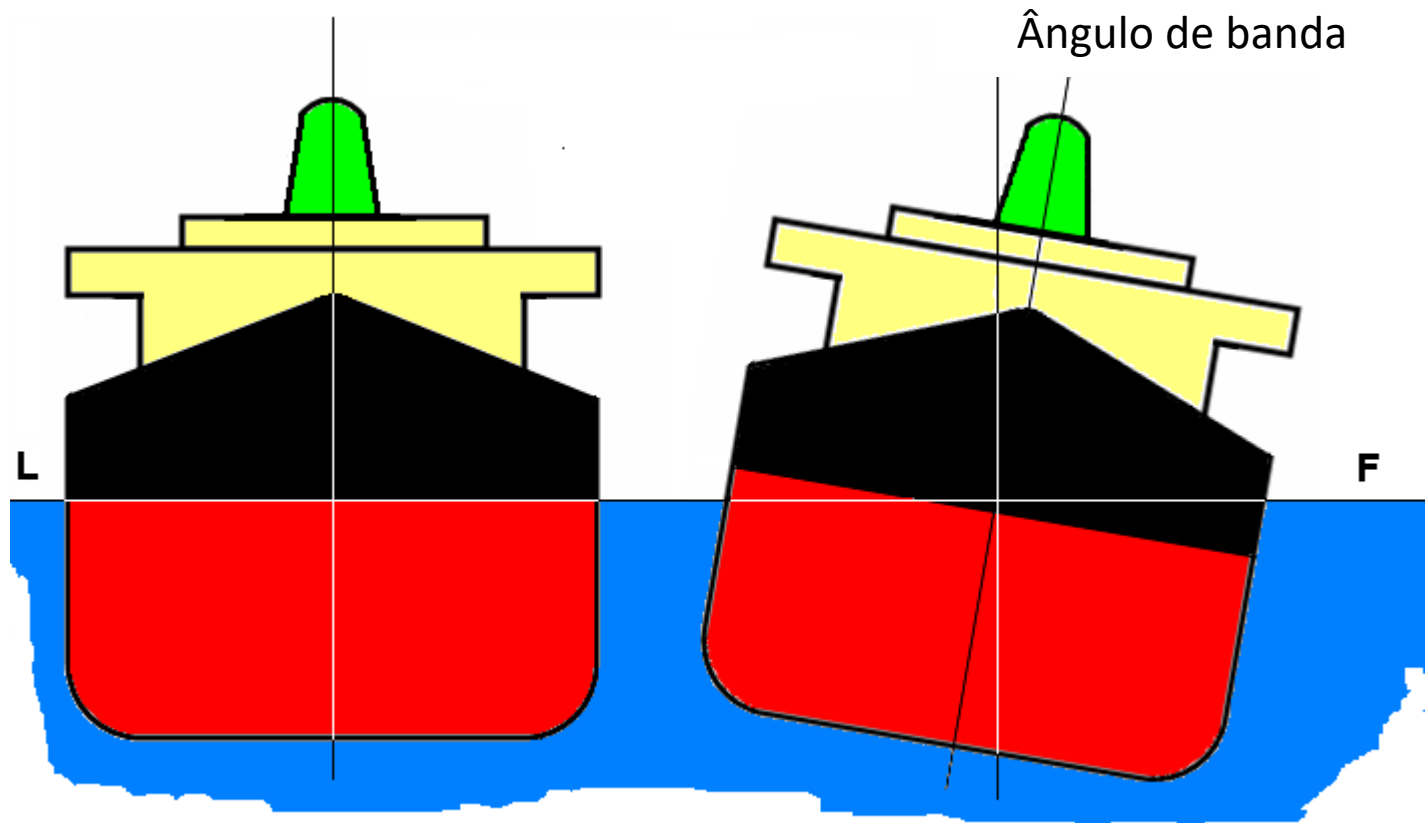
## Dimensões e referências

- Linha base (BL) [base line]
- Linha d'água (WL) [water line]
- Linha d'água de projeto (DWL) [design WL]
- Perpendiculares (PPAV, PPAR)
- Comprimentos (LPP, LOA, LWL)
- Boca (BOA, BWL) [beam]
- Calado (T) [draft/draught]
- Pontal (D) [depth]
- Borda livre [freeboard]
- Deslocamento (W,  $\Delta$ ) [displacement]
- Superfície molhada [wet surface]
- Plano diametral
- Plano de meia-nau

# Movimentos da embarcação

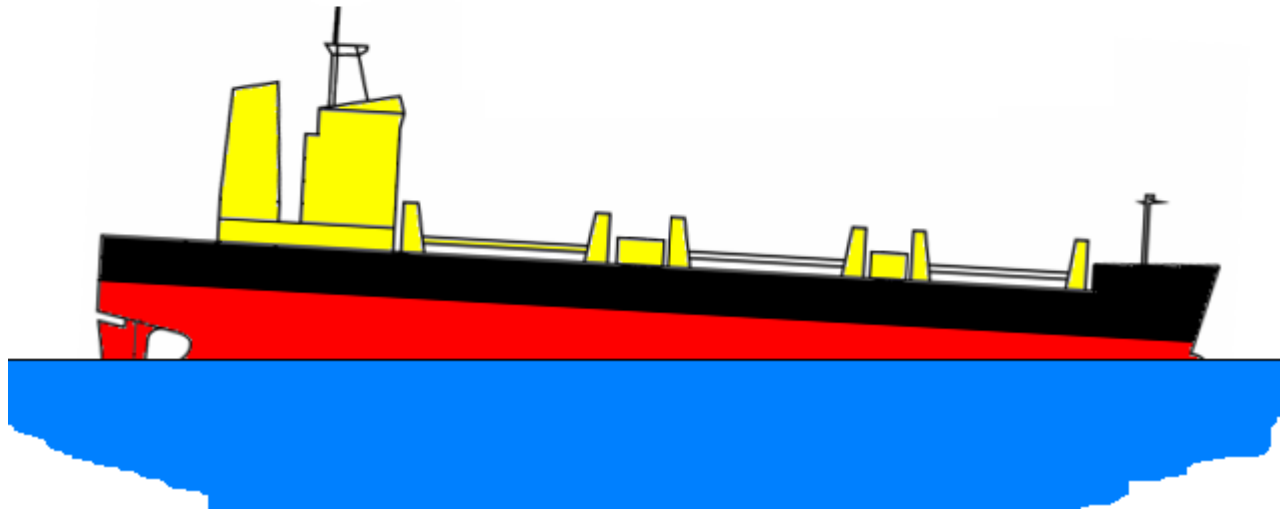
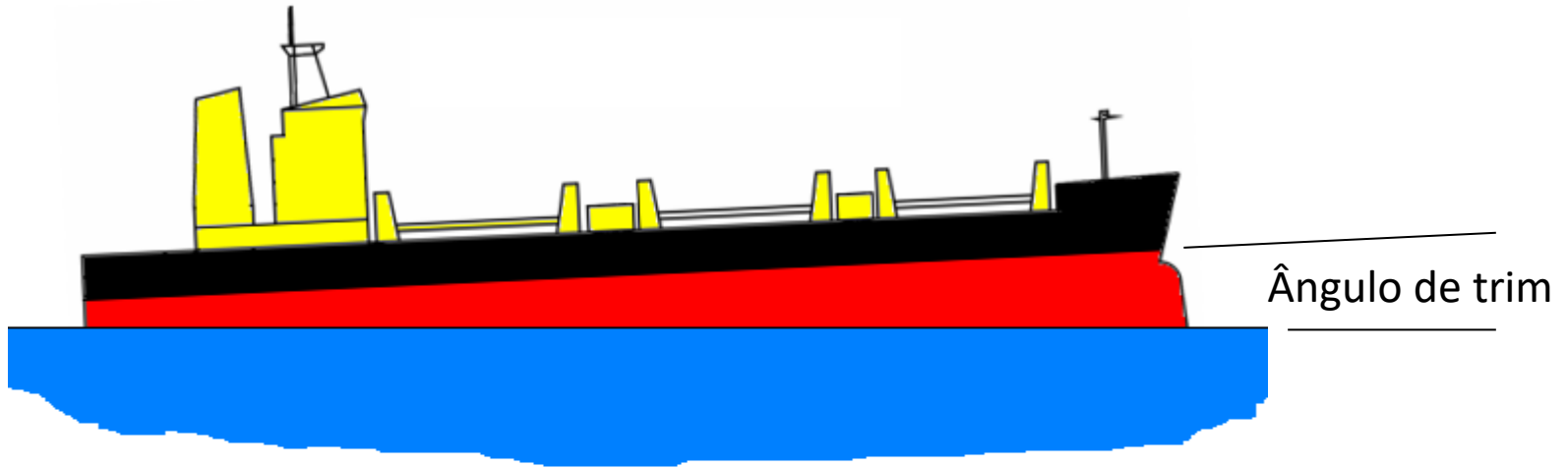


# Banda





# Trim





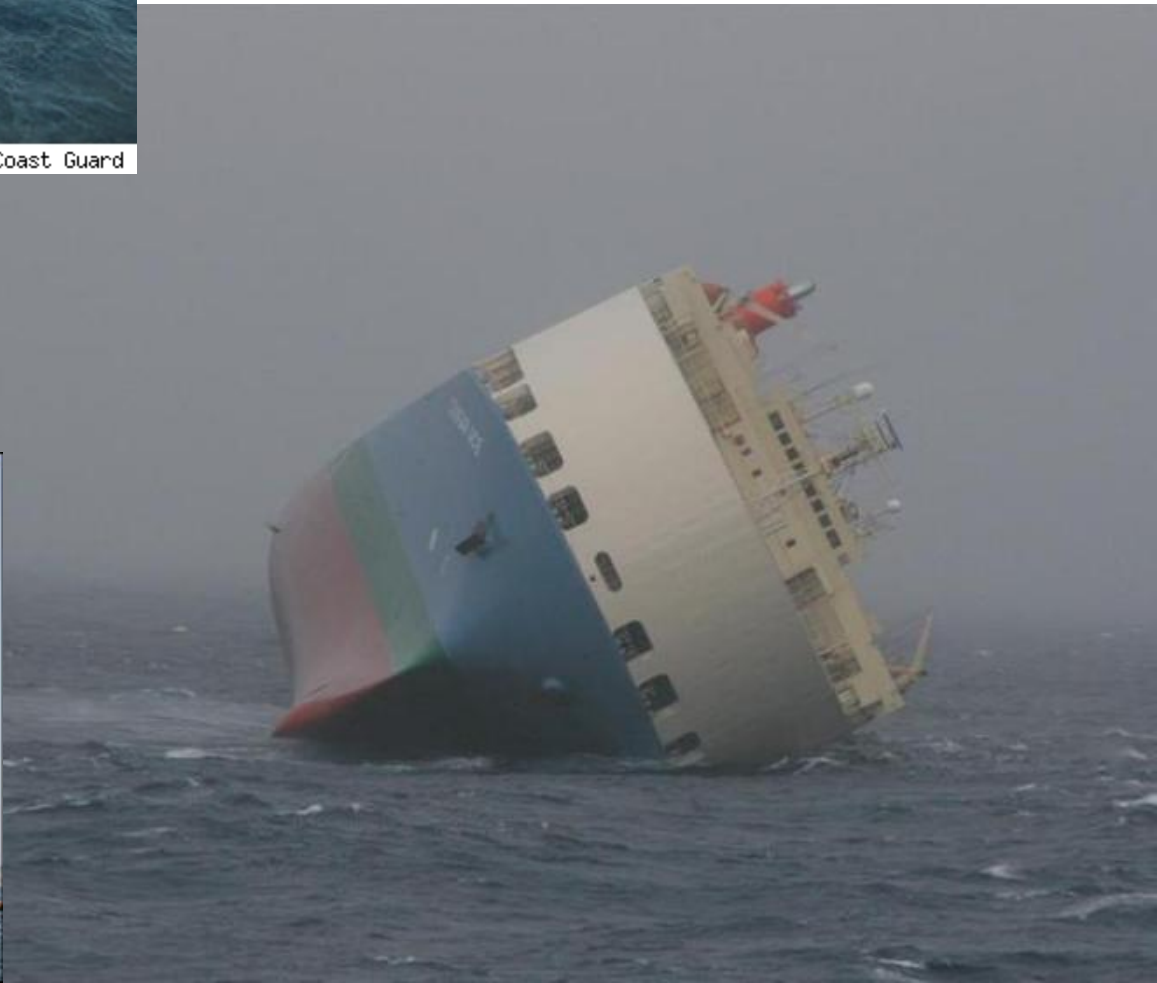


EXPLORER





Photo: United States Coast Guard









**ITAL FLORIDA  
TRIESTE**

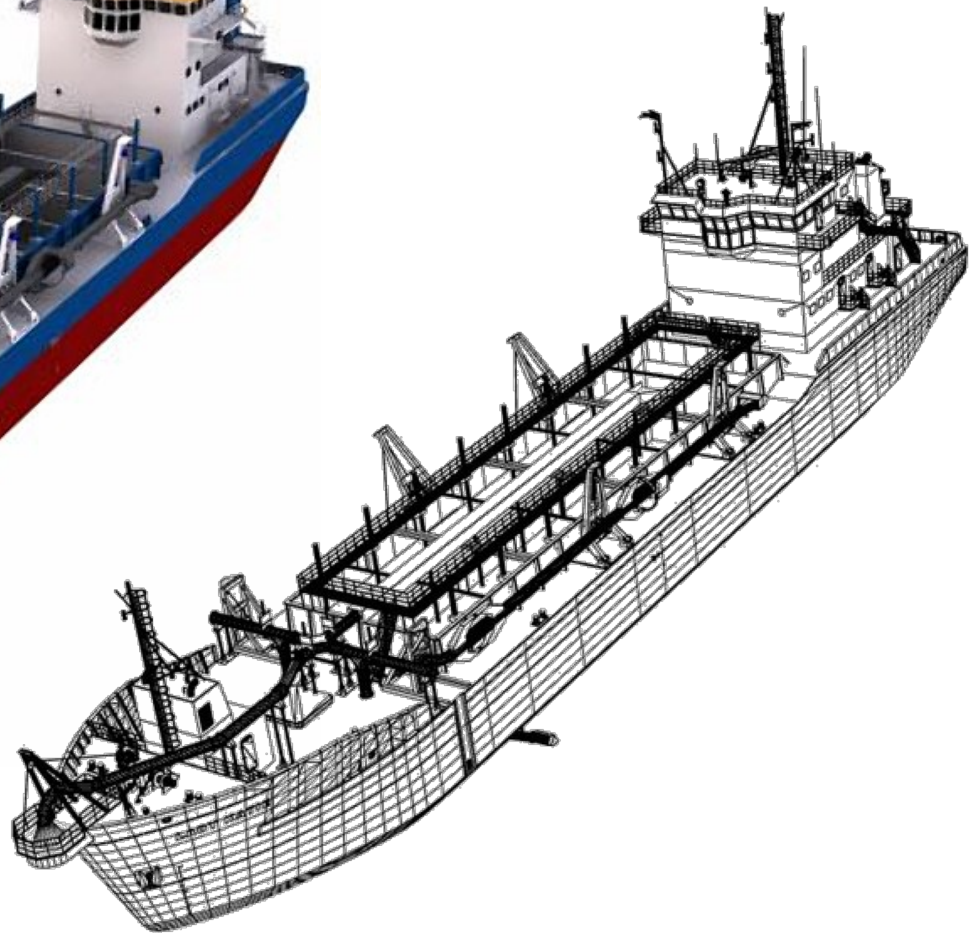
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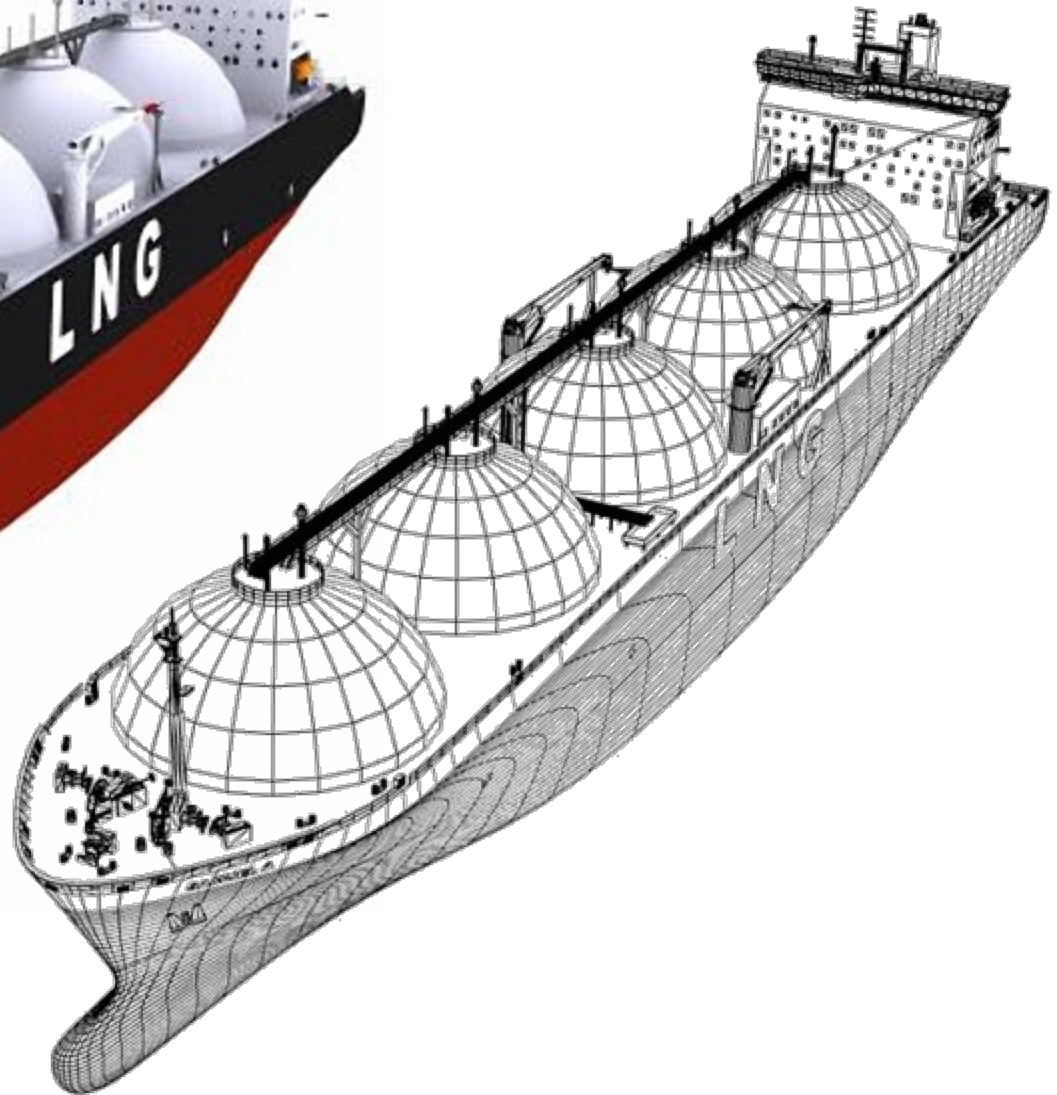
22.06.2007



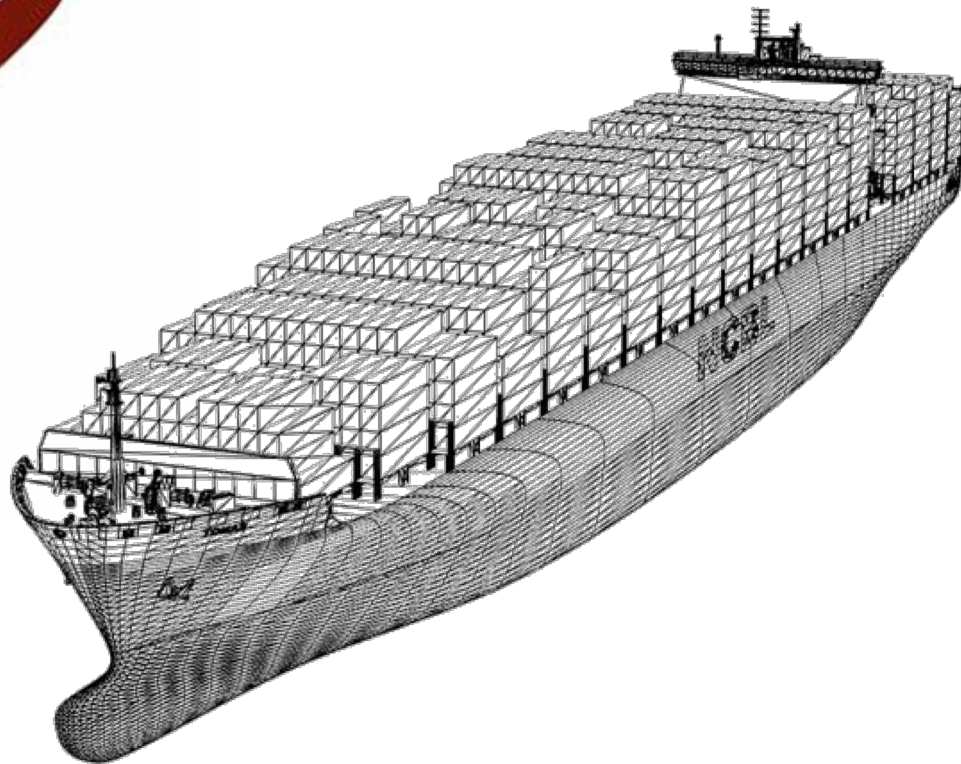
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## Exemplos de embarcações

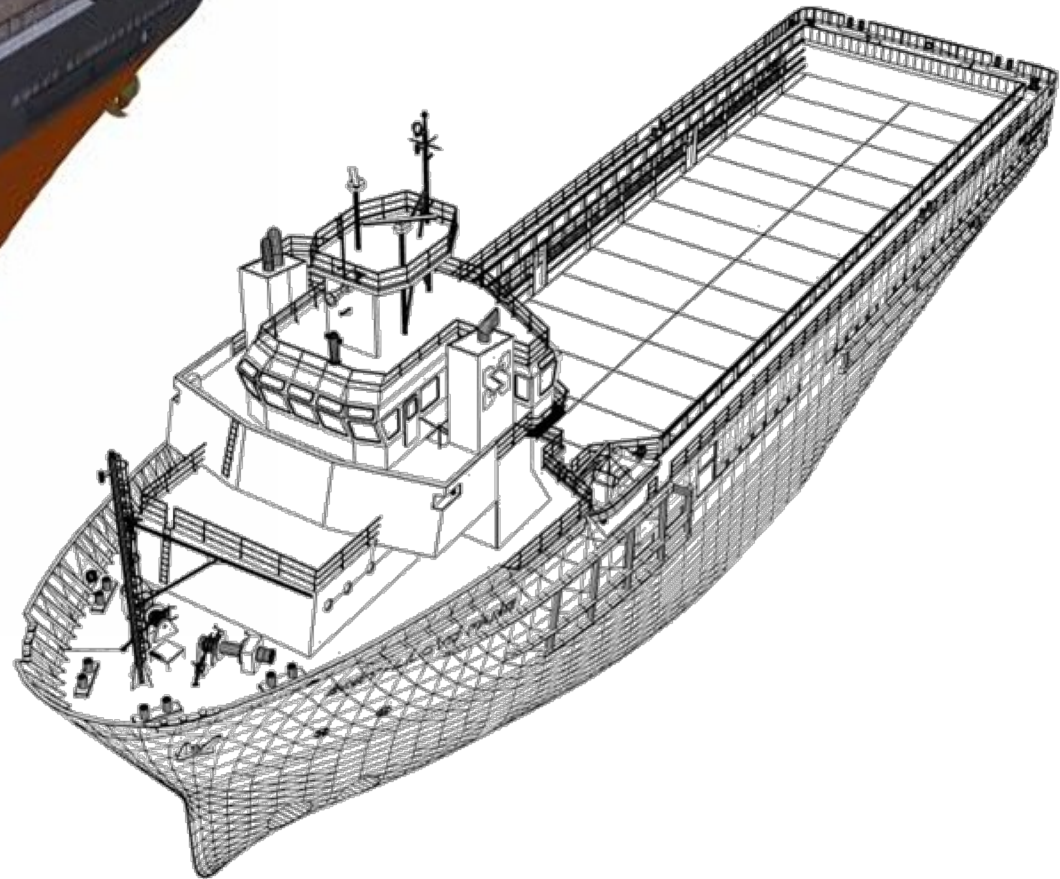


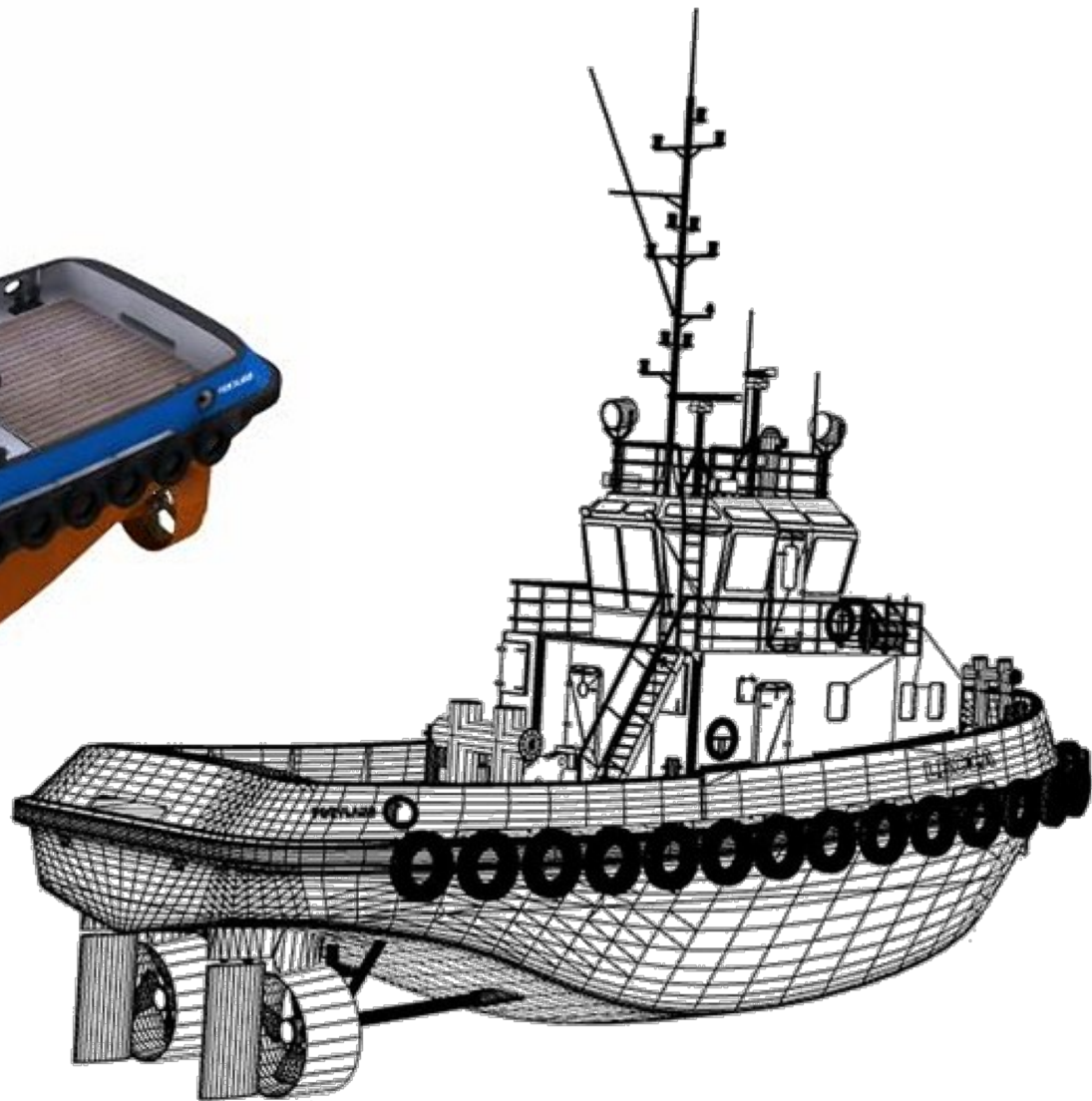






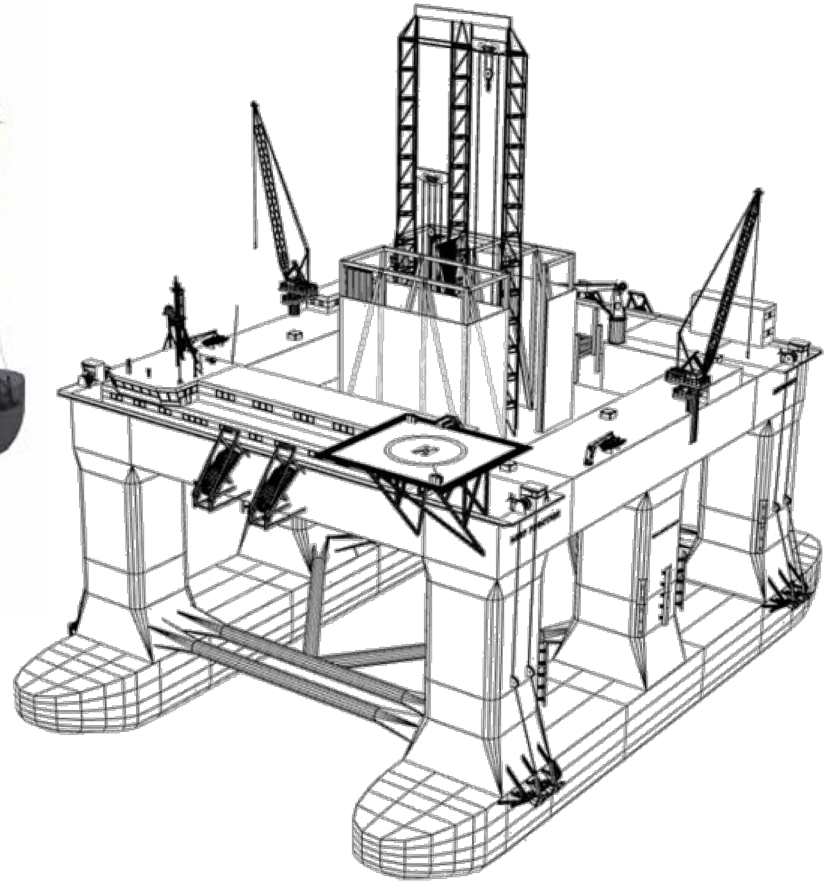




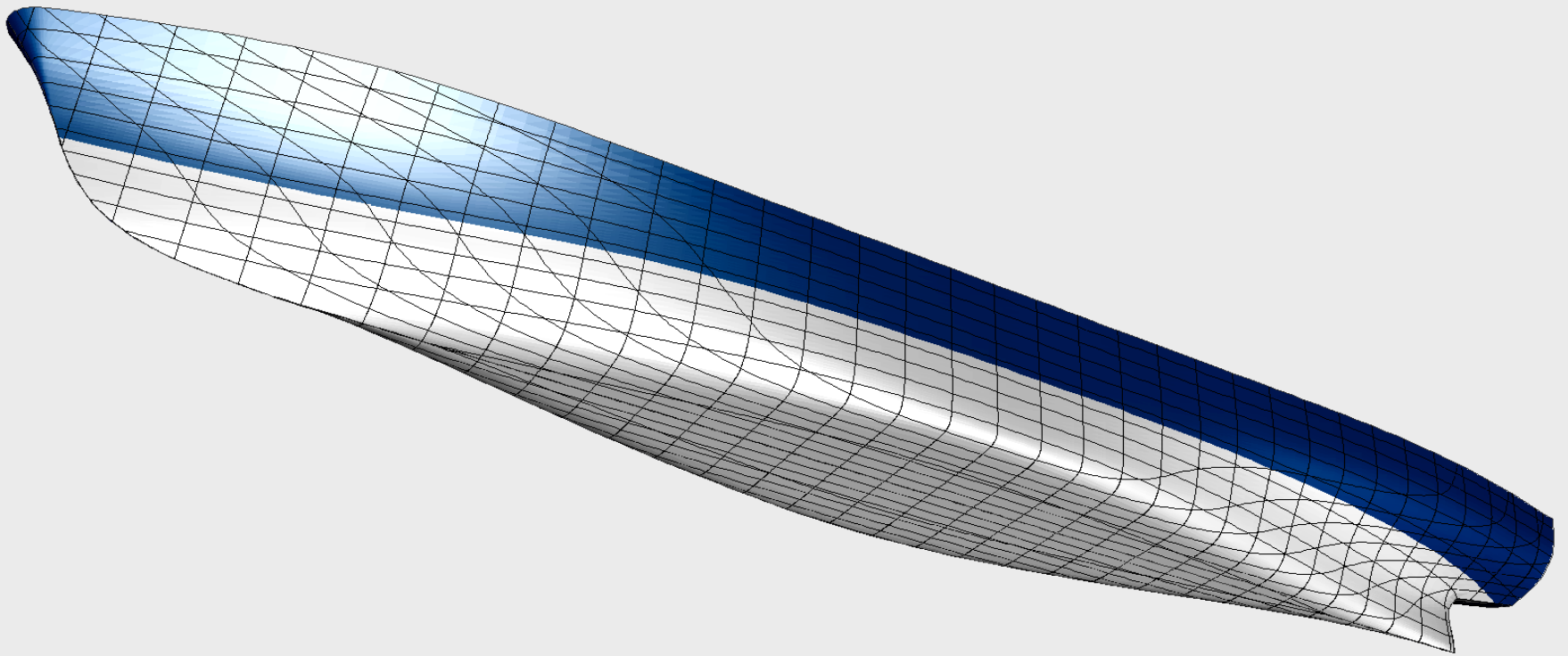




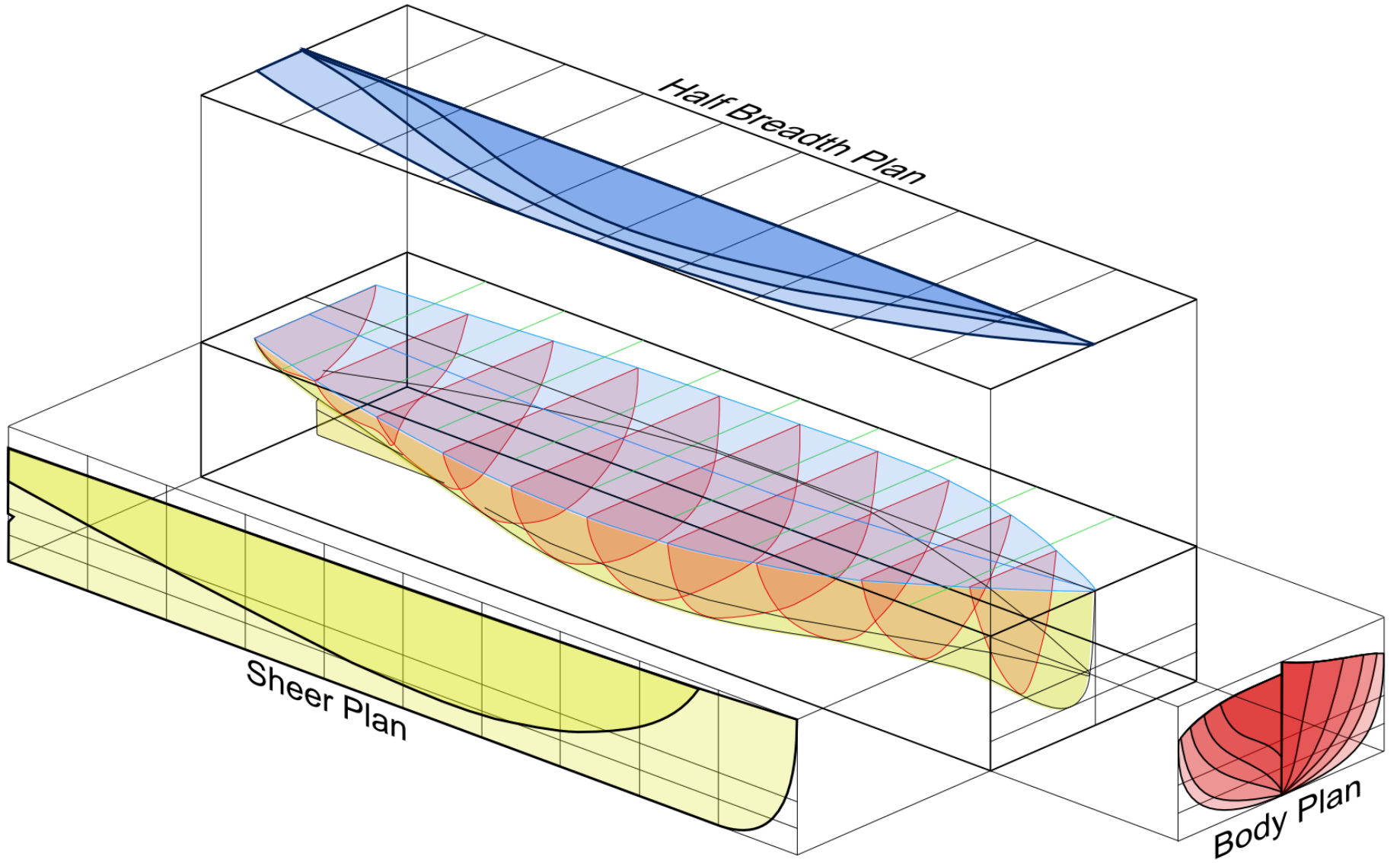




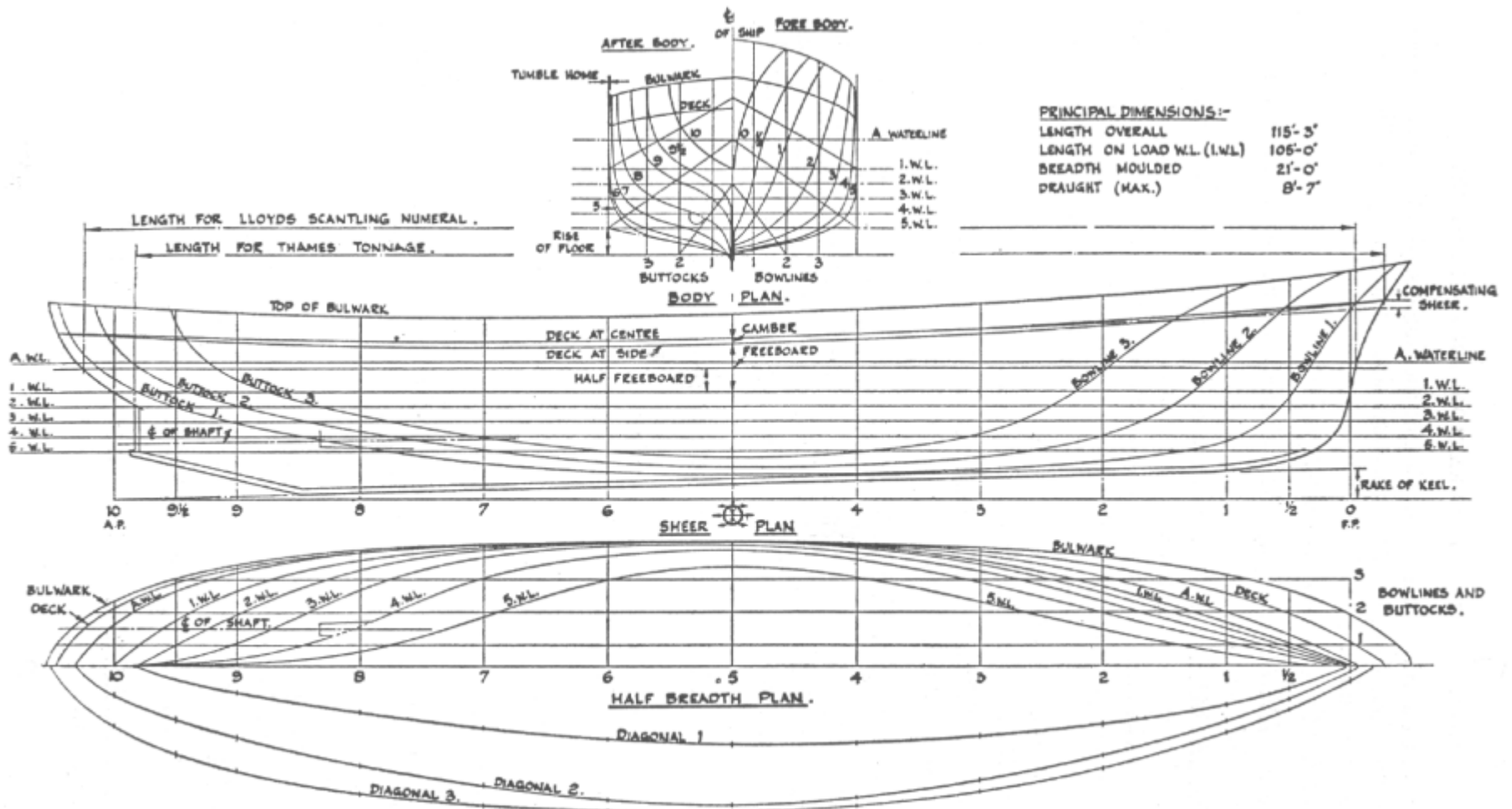




**REPRESENTAÇÃO DA GEOMETRIA DO CASCO**



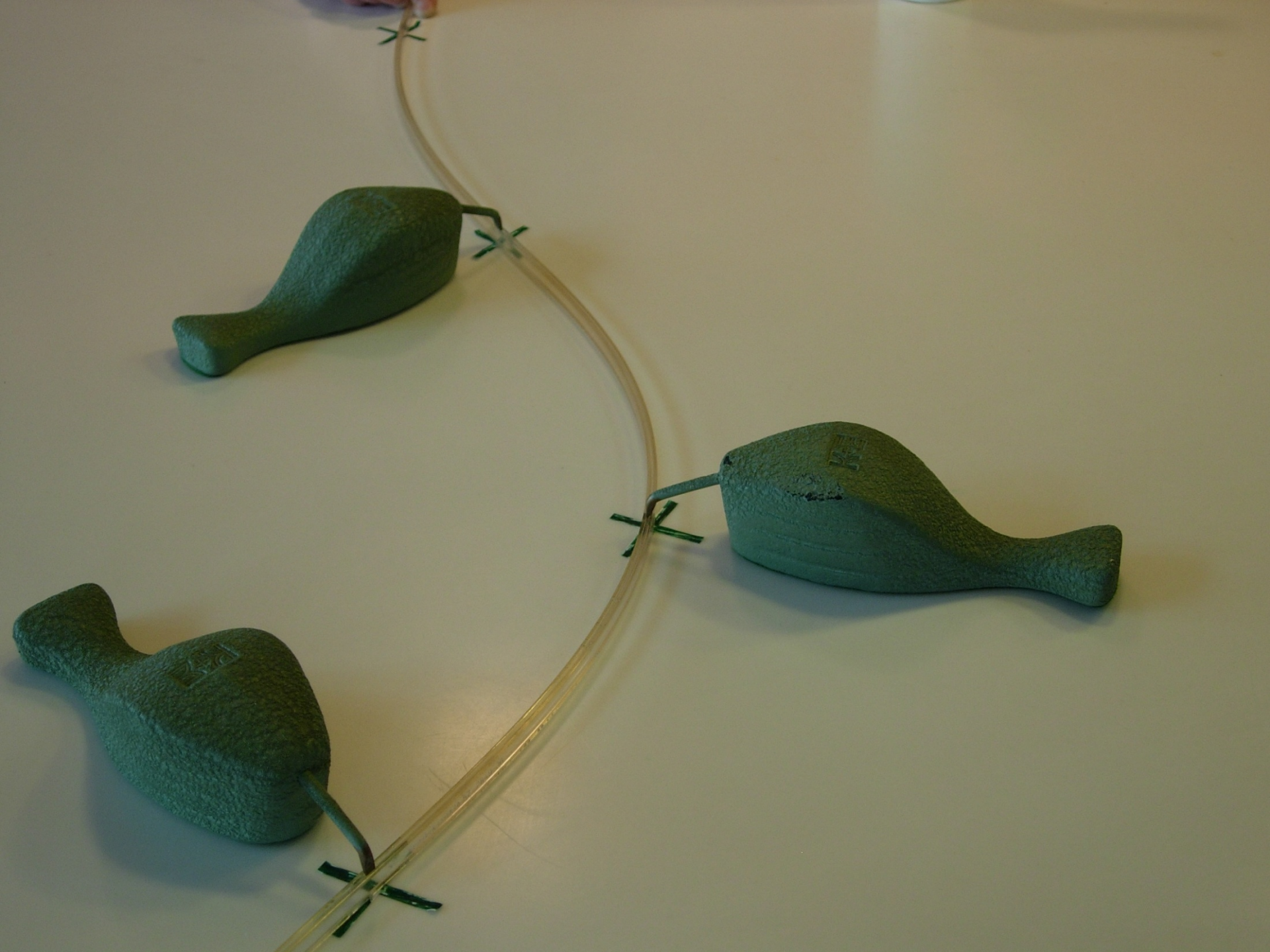
# Plano de linhas



PRINCIPAL DIMENSIONS:-

LENGTH OVERALL	115'-3"
LENGTH ON LOAD W.L. (LWL)	105'-0"
BREADTH MOULDED	21'-0"
DRAUGHT (MAX.)	8'-7"

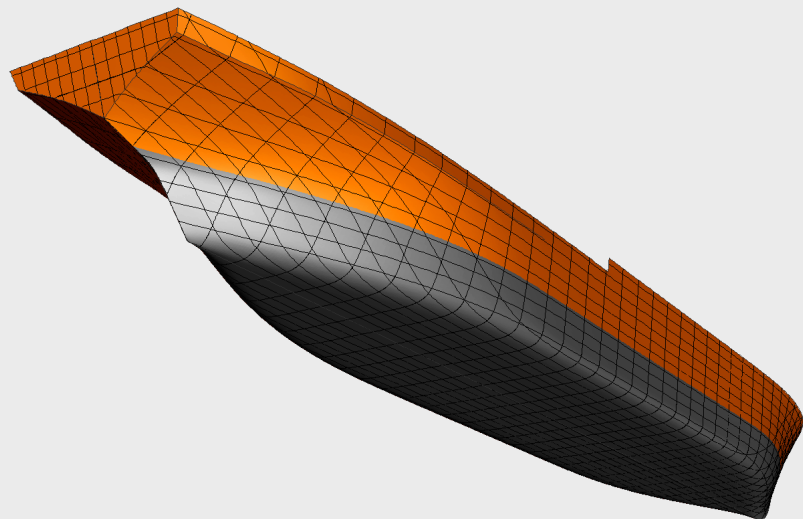
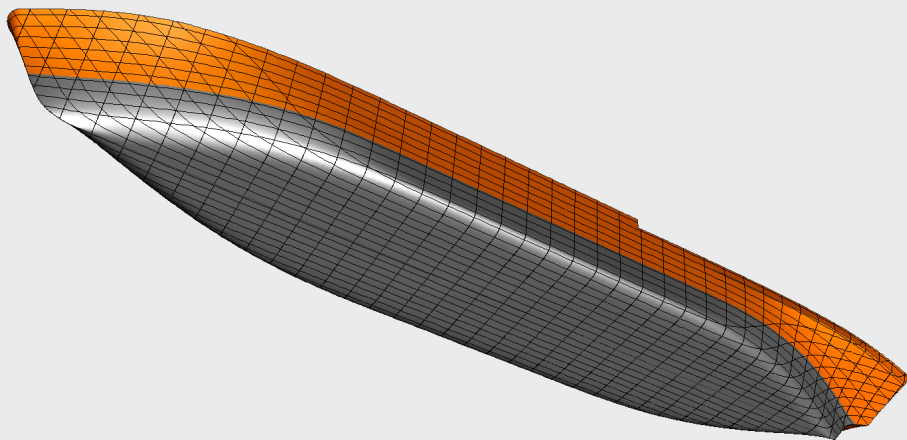
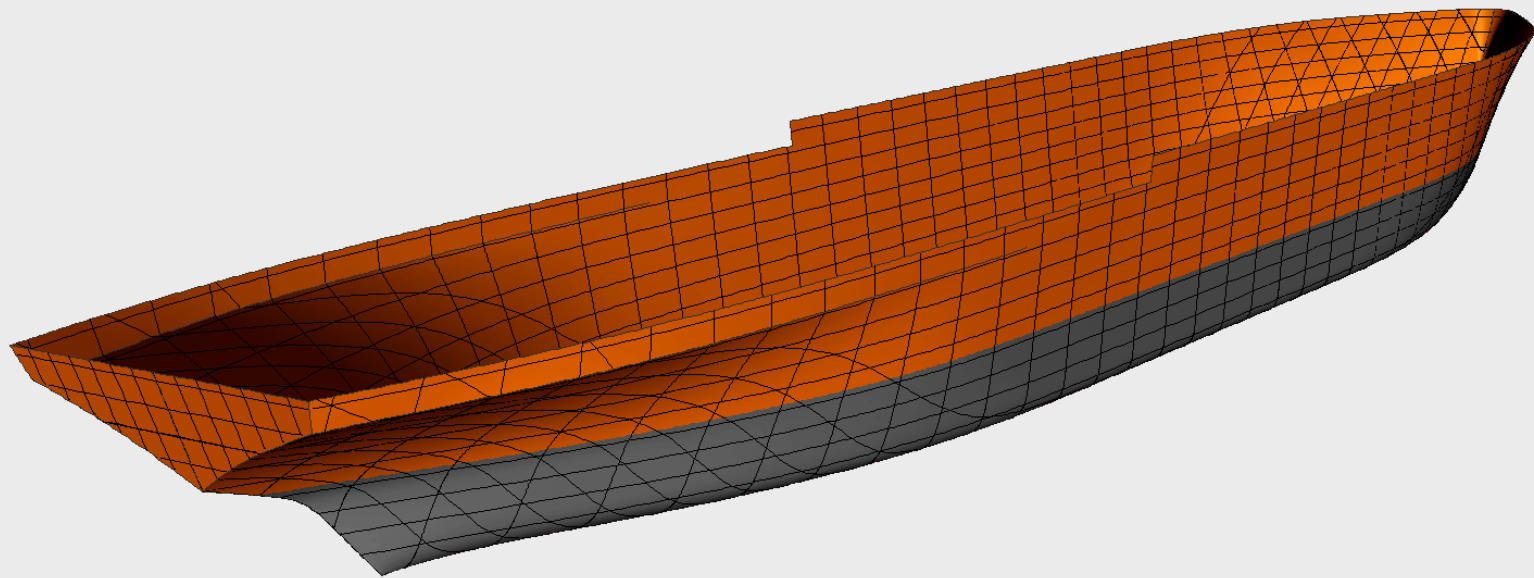
Fig. 1  
LINES PLAN OF A MOTOR YACHT.

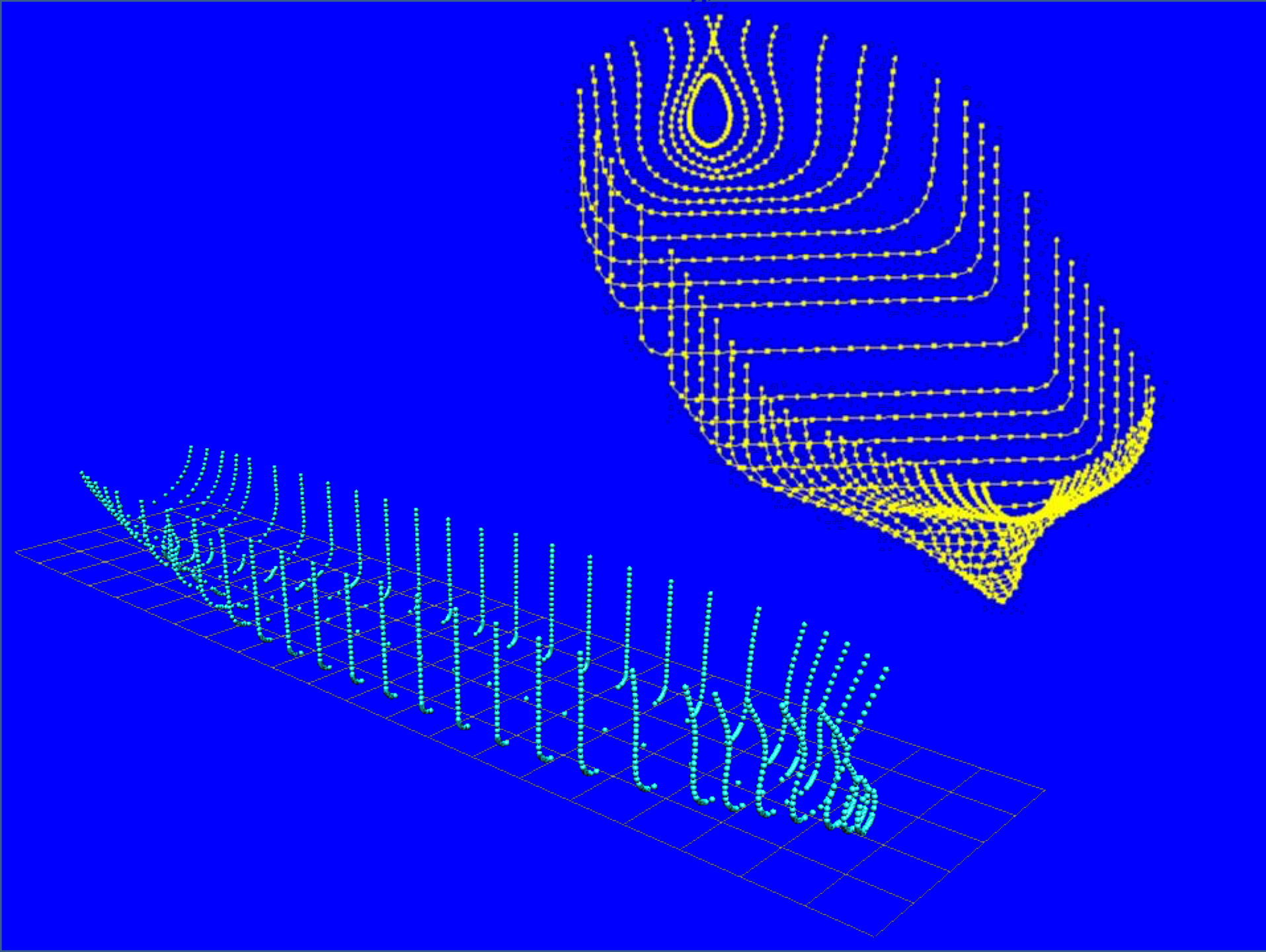












	0.000	2.000	4.000	6.000	8.000	10.000	12.000	14.000	16.000	18.000			
	133.185	4.215	4.213	3.916	2.240	-7.455	-7.780	-8.106	-8.431	-8.756			
-5.000	0.000	0.000	0.000	0.000	0.000	2.072	5.801	7.097	7.587	7.770	19.500	7.866	9.247
0.000	0.000	0.000	0.000	0.000	0.000	4.038	7.162	8.214	8.597	8.762	19.500	8.860	8.386
5.000	0.004	0.259	0.286	0.418	1.715	5.639	8.280	9.168	9.479	9.628	19.500	9.723	0.000
10.000	0.026	0.948	1.203	1.773	3.513	6.922	9.165	9.947	10.212	10.339	19.500	10.422	0.000
15.000	0.085	1.741	2.223	3.089	4.967	7.952	9.863	10.548	10.778	10.879	19.500	10.943	0.000
20.000	0.193	2.642	3.346	4.401	6.239	8.815	10.428	10.992	11.171	11.244	19.500	11.289	0.000
25.000	0.560	3.674	4.568	5.708	7.384	9.531	10.870	11.311	11.435	11.475	19.500	11.498	0.000
30.000	1.302	4.825	5.842	6.974	8.410	10.102	11.185	11.518	11.599	11.609	19.500	11.609	0.000
35.000	2.024	6.028	7.075	8.123	9.286	10.549	11.381	11.614	11.662	11.657	19.500	11.647	0.000
40.000	2.732	7.208	8.211	9.107	10.004	10.895	11.463	11.615	11.651	11.653	19.500	11.650	0.000
45.000	3.453	8.303	9.216	9.919	10.585	11.173	11.480	11.581	11.620	11.639	19.500	11.650	0.000
50.000	4.163	9.286	10.034	10.549	11.024	11.391	11.534	11.593	11.623	11.639	19.500	11.650	0.000
55.000	4.834	10.127	10.676	11.024	11.332	11.543	11.611	11.636	11.646	11.649	19.500	11.650	0.000
60.000	5.435	10.791	11.168	11.371	11.530	11.622	11.649	11.656	11.657	11.653	19.500	11.650	0.000
65.000	5.919	11.253	11.471	11.564	11.623	11.650	11.657	11.658	11.656	11.653	19.500	11.650	0.000
70.000	6.259	11.530	11.633	11.659	11.672	11.675	11.672	11.668	11.662	11.655	19.500	11.650	0.000
75.000	6.416	11.642	11.725	11.742	11.744	11.737	11.723	11.706	11.687	11.666	19.500	11.650	0.000
80.000	6.347	11.594	11.726	11.754	11.758	11.751	11.736	11.716	11.693	11.669	19.500	11.650	0.000
85.000	6.035	11.376	11.603	11.652	11.671	11.680	11.683	11.681	11.672	11.660	19.500	11.650	0.000
90.000	5.523	10.977	11.345	11.448	11.508	11.559	11.602	11.636	11.649	11.650	19.500	11.650	0.000
95.000	4.853	10.390	10.908	11.101	11.230	11.341	11.441	11.529	11.590	11.627	19.500	11.650	0.000
100.000	4.067	9.617	10.275	10.579	10.791	10.973	11.140	11.303	11.449	11.568	19.500	11.650	0.000
105.000	3.223	8.697	9.516	9.904	10.198	10.448	10.691	10.946	11.208	11.462	19.500	11.650	0.000
110.000	2.378	7.635	8.578	9.045	9.408	9.727	10.059	10.435	10.857	11.307	19.500	11.650	0.000
115.000	1.575	6.458	7.454	8.003	8.416	8.803	9.243	9.775	10.400	11.098	19.500	11.635	0.000
120.000	0.801	5.222	6.259	6.837	7.265	7.710	8.268	8.975	9.827	10.804	19.500	11.560	0.000
125.000	0.230	3.984	5.058	5.624	6.045	6.517	7.180	8.060	9.131	10.383	19.500	11.357	0.000
130.000	0.059	2.808	3.879	4.433	4.843	5.302	6.028	7.054	8.309	9.798	19.500	10.961	0.000
135.000	0.009	1.821	2.782	3.303	3.694	4.126	4.865	5.969	7.345	9.001	19.500	10.299	0.000
140.000	0.000	1.053	1.813	2.268	2.624	3.028	3.736	4.829	6.242	7.977	19.500	9.342	0.214
145.000	0.000	0.467	1.001	1.365	1.669	2.033	2.664	3.652	4.996	6.703	19.500	8.056	0.756
150.000	0.000	0.000	0.293	0.573	0.822	1.122	1.627	2.441	3.624	5.210	19.500	6.481	2.554
155.000	0.000	0.000	0.000	0.000	0.000	0.251	0.594	1.189	2.154	3.554	19.500	4.697	8.474
160.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.299	19.500	2.651	17.409
	137.150	148.932	151.944	153.572	154.752	155.758	156.719	157.756	158.987	160.442			

Cabeçalho

Altura das 10 linhas d'água

Distância do contorno da popa para cada WL

Altura do contorno na quilha

Tabela de cotas (meia-boca)

Distância das 34 balizas

Distância do contorno da proa para cada WL

Altura e meia-boca do convés



# Vista frontal

## Seções transversais: BALIZAS (stations)

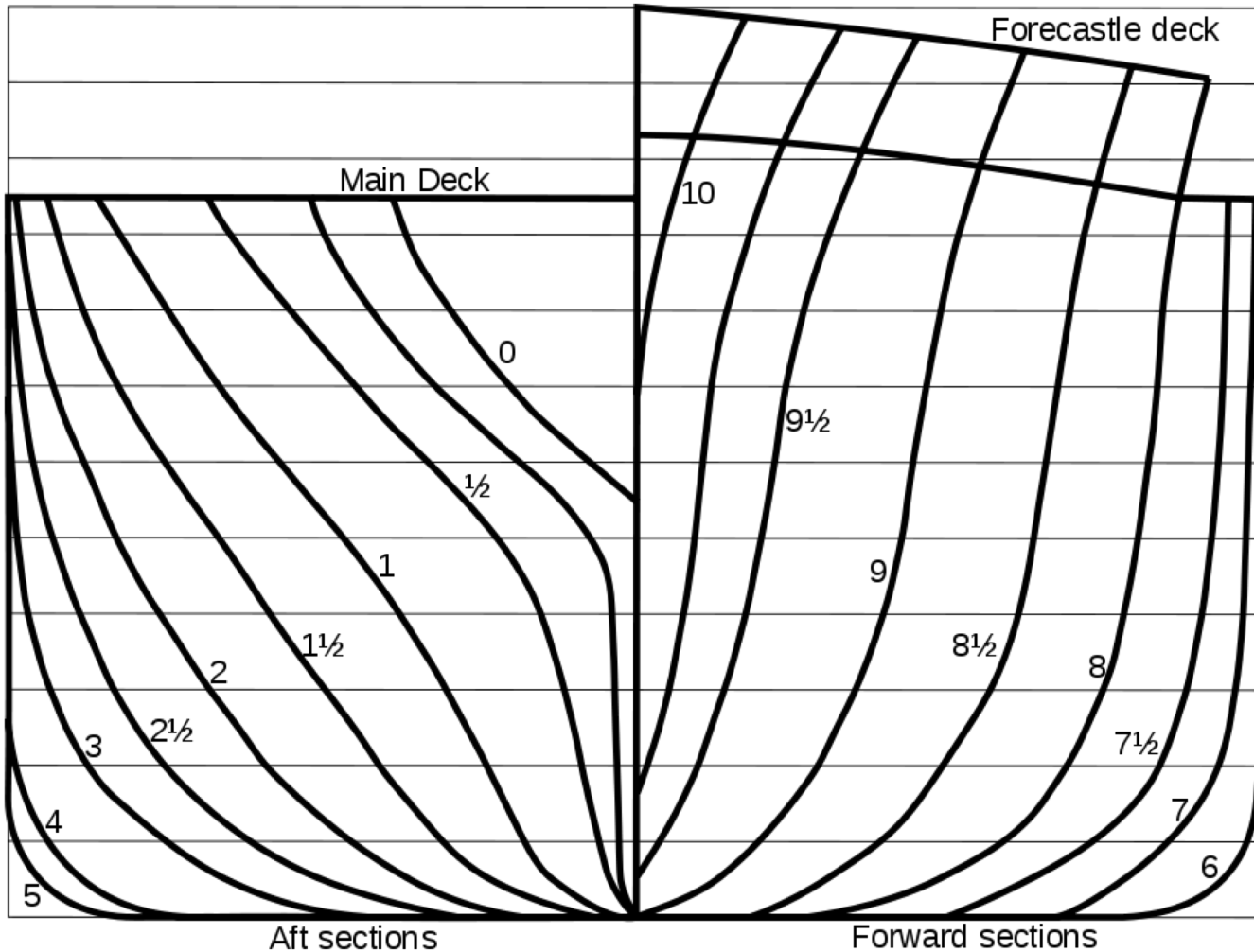
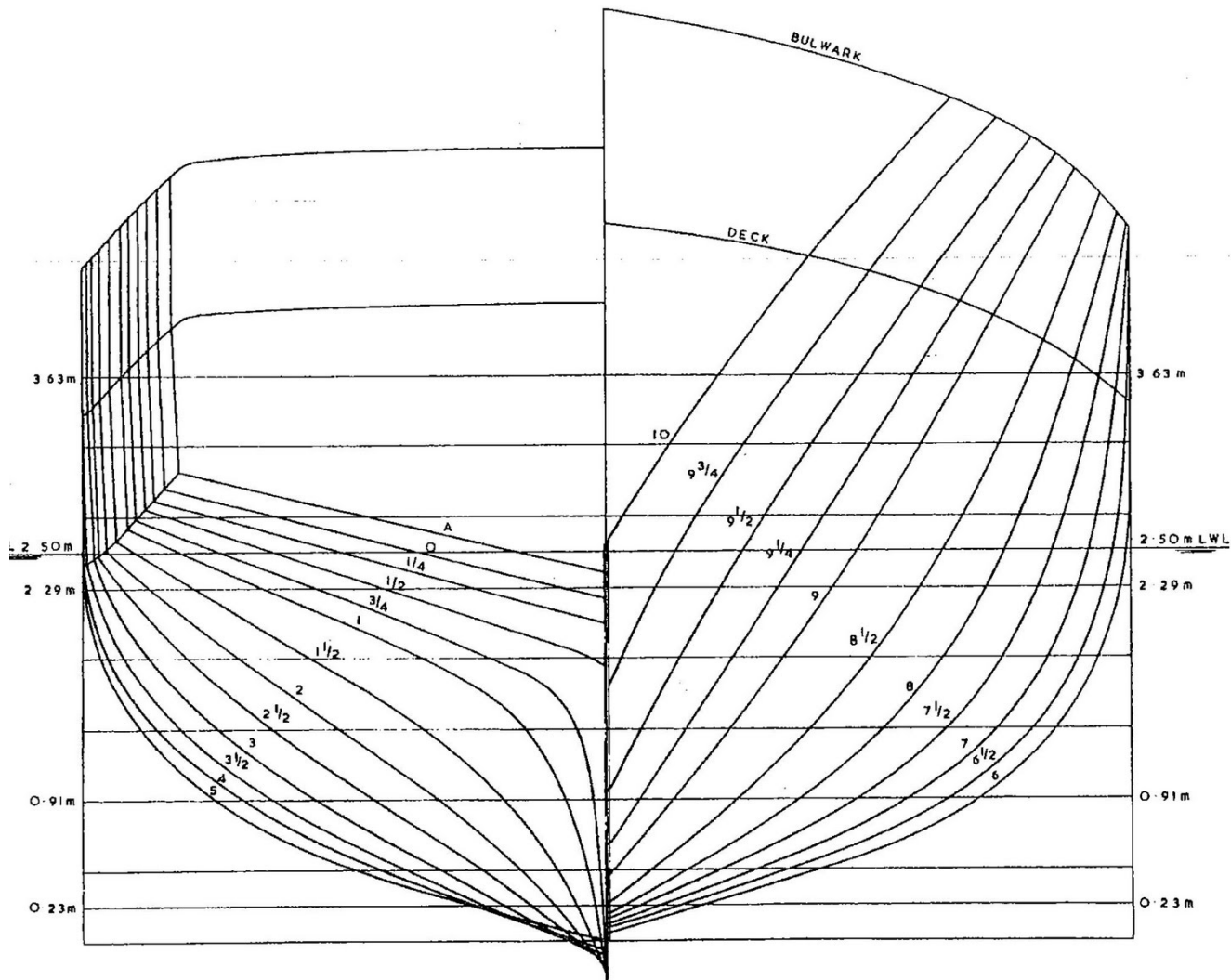
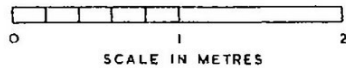


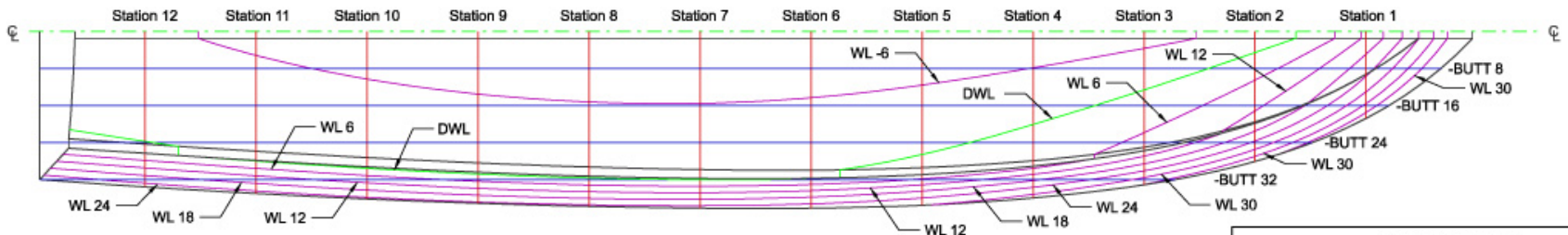
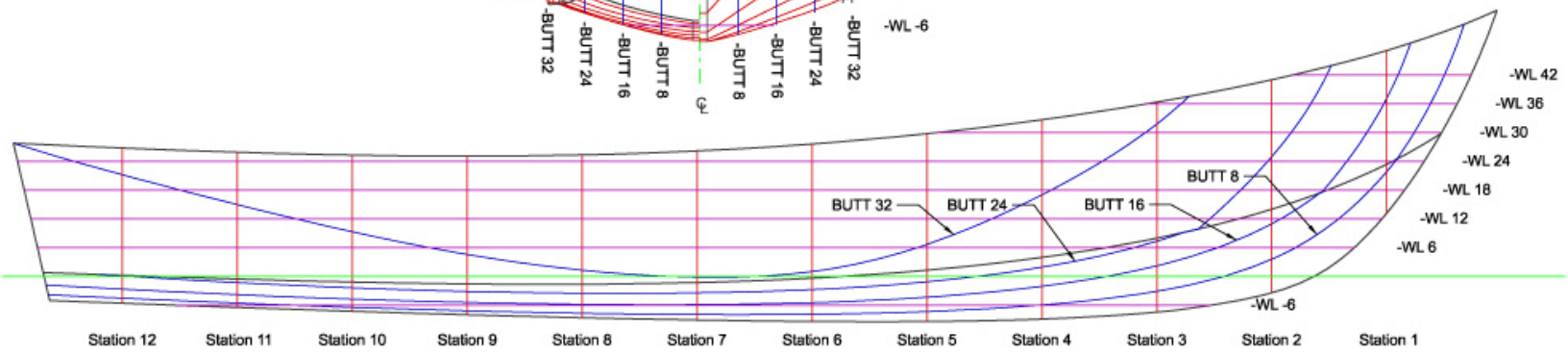
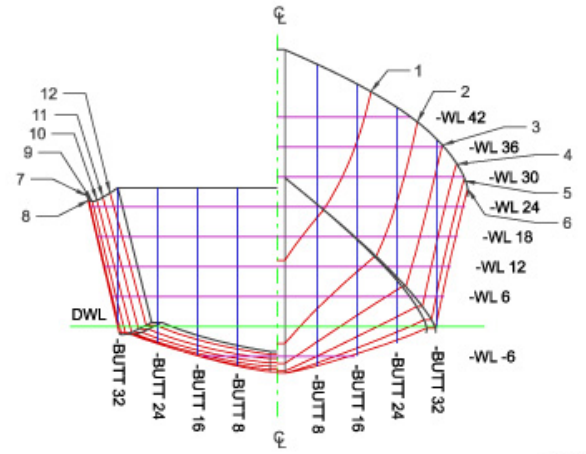
FIG. 3A BODY SECTIONS

(TRIDENT)



REVISIONS	BY	DATE

**Specifications**  
 Length Overall 25'- 9 3/4"  
 Length on DWL 22'- 0 3/4"  
 Beam (Max.) 6'- 4 1/2"  
 Draft 0'- 9 3/8"  
 Displacement 2,327 Lb.

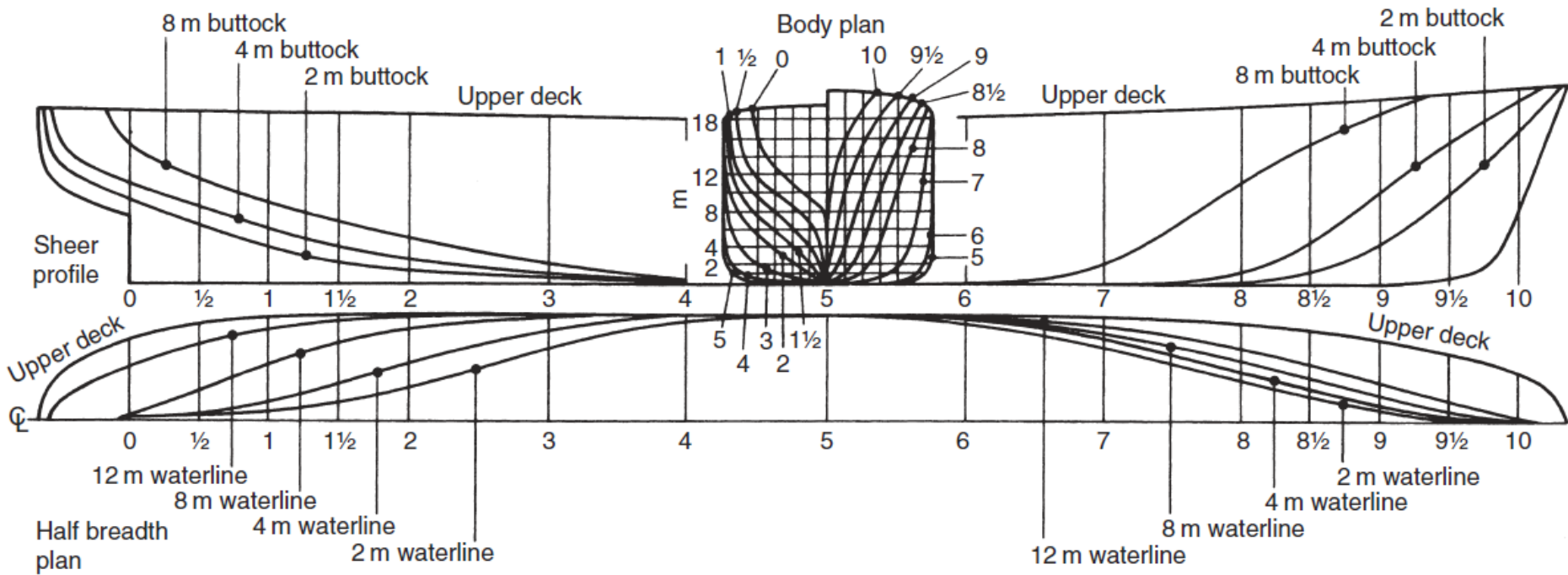


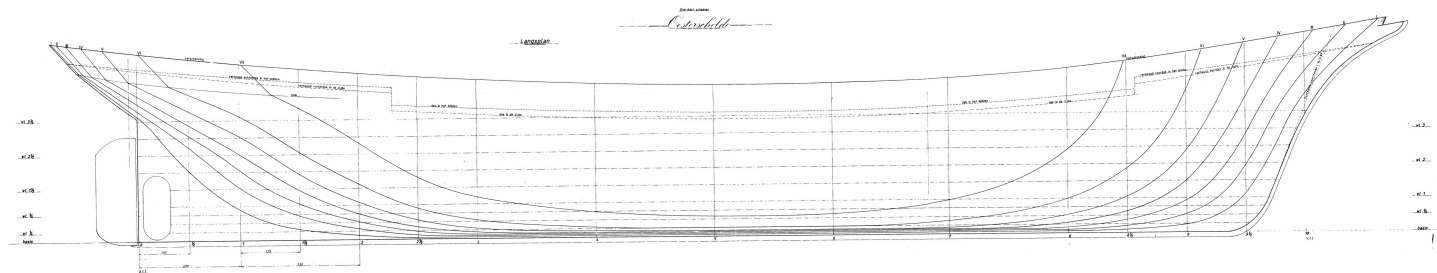
<b>Final Lines Plan</b>			
<b>26' Fishing Boat for Russell Boat Works</b>			
Oak Hill Marine Design, LLC			
PO Box 1266 Southwest Harbor, Maine 04679 (207) 244-9591			
SCALE	FILE NAME	Russell 26 Lines Plan.dgn	
1/2 in = 1 Ft			
DATE	DRAWN BY	DRAWING NO.	REV.
16 Jan 2004	S. Hudson	A0401-001	0

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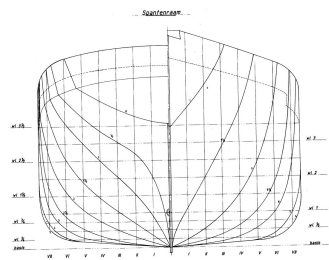


# Plano de linhas



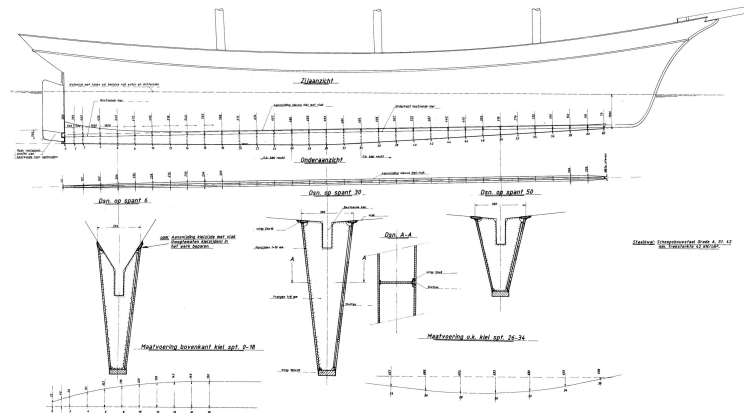


Het lijnenplan van de "Oosterschelde" met rechts de tekening van de in 1995 aangebouwde kiel.  
(Tekening: Olivier F. van Meer)



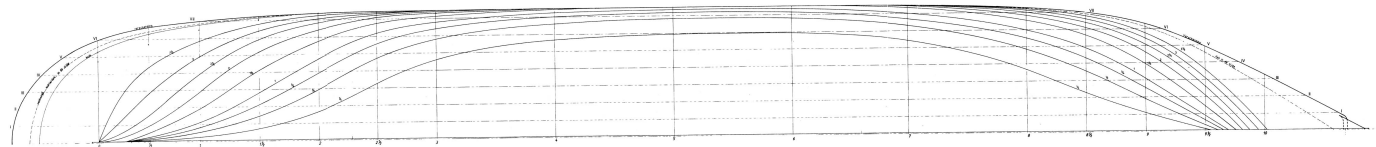
Luchtvaartafdeling van de Koninklijke Marine  
Bureau voor de Afdeling van de Marine

Maatschappij  
Lengte van de kiel: 145,0 m  
Breedte van de kiel: 22,0 m  
Diepte van de kiel: 10,0 m  
Gewicht van de kiel: 1000,0 t

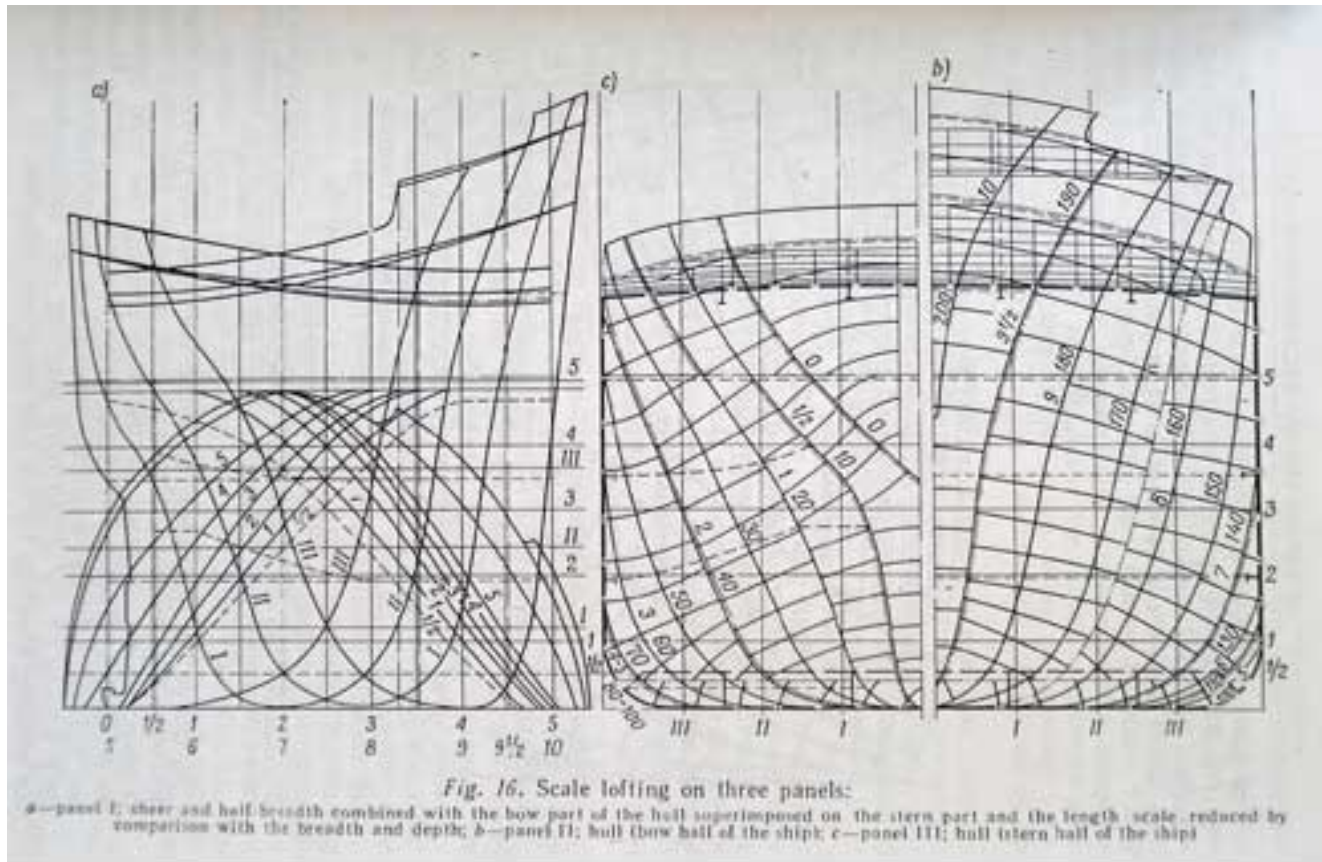


Bureau voor de Afdeling van de Marine  
Bureau voor de Afdeling van de Marine

Waterlijn



# Plano de linhas



Nas próximas duas semanas...

Caracterização  
geométrica do modelo

# Nas próximas duas semanas...

Caracterização  
geométrica do  
modelo

## **MAX Surf**

Instalado na sala de CAD (versão estudantil gratuita)

## **DELFTship Free**

[www.delftship.net](http://www.delftship.net)

## **Free!ship**

[sourceforge.net/projects/freeship/](http://sourceforge.net/projects/freeship/)

# Nas próximas duas semanas...

- Levantar tabela de cotas do casco
  - Como?
  - Descrever método utilizado (foto)
- Modelar casco em CAD
  - MAX Surf
    - Instalado na sala de CAD (versão estudantil gratuita)
  - DELFTship Free
    - [www.delftship.net](http://www.delftship.net)
  - Free!ship
    - [sourceforge.net/projects/freeship/](http://sourceforge.net/projects/freeship/)
  - Outro CAD...

Caracterização  
geométrica do  
modelo

# Nas próximas duas semanas...

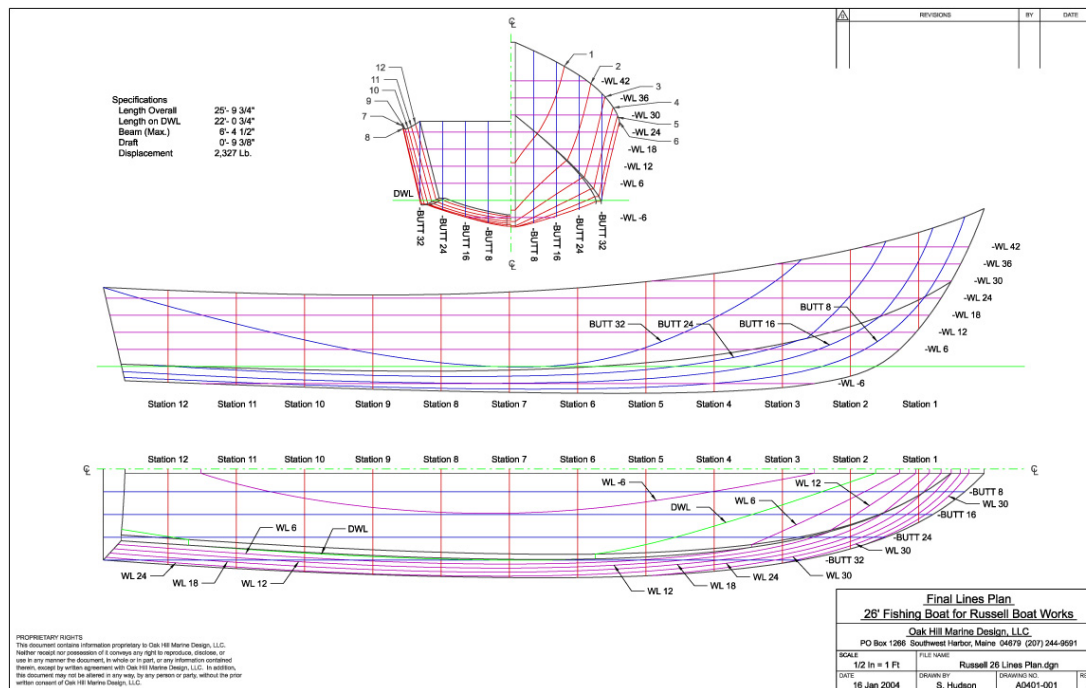
- Determinar propriedades do casco:
  - Linha base (BL) [base line]
  - Linha d'água (WL) [water line]
  - Linha d'água de projeto (DWL) [design WL]
  - Perpendiculares (PPAV, PPAR)
  - Comprimentos (LPP, LOA, LWL)
  - Boca (BOA, BWL) [beam]
  - Calado (T) [draft/draught]
  - Pontal (D) [depth]
  - Borda livre [freeboard]
  - Deslocamento (W,  $\Delta$ ) [displacement]
  - Superfície molhada [wet surface]

Caracterização  
geométrica do  
modelo

# Nas próximas duas semanas...

- Desenhar plano de linhas
  - Veja normas no PNA
    - Principles of Naval Architecture

Caracterização geométrica do modelo





# Divisão dos grupos

- 8 grupos
- Mesmo grupo para todas as atividades.