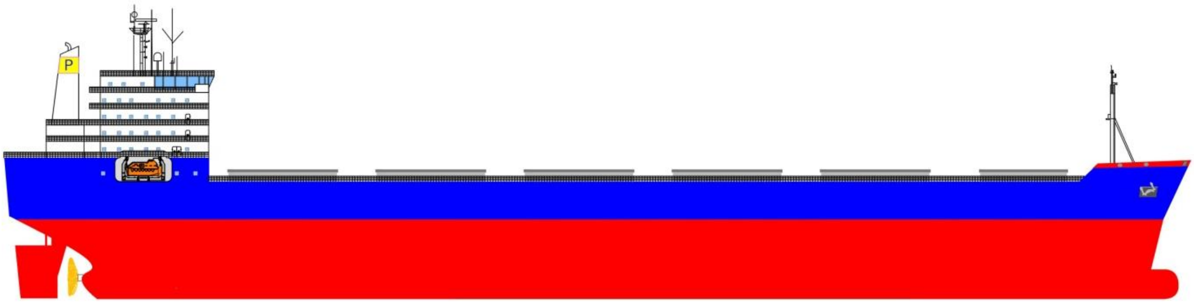
UNIVERSIDADE DA CORUÑA

BULK CARRIER TIPO PANAMAX DE 70.000 TPM



Caderno 1

ELECCIÓN DA CIFRA DE MÉRITO E DEFINICIÓN DE ALTERNATIVAS.

SELECCIÓN DA MÁIS FAVORABLE

AUTOR : **PEDRO OJEA GONZÁLEZ**

PROXECTO NÚMERO: **16-10P**

Escola Politécnica Superior
UNIVERSIDADE DA CORUÑA

DEPARTAMENTO DE ENXEÑERÍA NAVAL E OCEÁNICA

CURSO 2.015-2016

PROXECTO NÚMERO: 16 - 10 P

TIPO DE BUQUE : BULK CARRIER TIPO PANAMAX DE 70.000 TPM.

CLASIFICACIÓN , COTA Y REGLAMENTOS DE APLICACIÓN : ABS, SOLAS, MARPOL, REGLAMENTO PARA LA NAVEGACIÓN EN AGUAS DEL CANAL DE PANAMÁ, SUEZ.

CARACTERÍSTICAS DE LA CARGA: 70.000 TPM. GRAN, MINERAL, CARBÓN.

VELOCIDAD Y AUTONOMÍA: 14.5 NUDOS EN CONDICIÓNS DE SERVIZO. 85% MCR E 15% DE MARXE DE MAR. 11.000 MILLAS Á VELOCIDADE DE SERVIZO.

SISTEMAS Y EQUIPOS DE CARGA / DESCARGA : ESCOTILLAS DE ACCIONAMENTO HIDRÁULICO. SEN GRÚAS.

PROPULSIÓN : UN MOTOR DUAL FUEL (DIÉSEL/LNG) ACOPLADO A UNHA HÉLICE DE PASO FIXO.

TRIPULACIÓN Y PASAJE : 25 PERSOAS.

OTROS EQUIPOS E INSTALACIONES : OS HABITUAIS NESTE TIPO DE BUQUE.

ALUMNO: PEDRO OJEA GONZÁLEZ

Ferrol, 3 de Marzo de 2016

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1. Introdución.

Os bulk carriers ou cargueiros son un tipo de buque que se dedica ao transporte de cargas a granel, é dicir, carga non envasada. Este tipo de carga fai que se abaraten os custos do transporte debido a que non existen os custos de envasado e a carga e descarga pódese facer de maneira máis sistemática e polo tanto máis rápida. Este tipo de cargas son moi variables e chámanse xeralmente carga sólidas ou cargas secas. Algunhas das cargas son as seguintes:

- Carbón.
- Grans (millo, arroz, soia, trigo, etc.)
- Mineral de ferro
- Bauxita.
- Cemento.
- Químicos (fertilizantes, resinas, fibras sintéticas, gránulos plásticos, etc.)
- Comestibles secos (para animais ou humanos, azucre, manises, pallets de alfalfa, fariña, etc.)
- Produtos mineiros (arena, cobre, sal, grava, etc.)

A UNCTAD (United Nations Conference on Trade And Development) publicou unha táboa na que se compara a cantidade de Toneladas de Peso Morto (de aquí en adiante TPM) transportadas anualmente segundo o tipo de buque nos últimos 35 anos en todo o mundo. Desta táboa pódense extraer os seguintes gráficos:

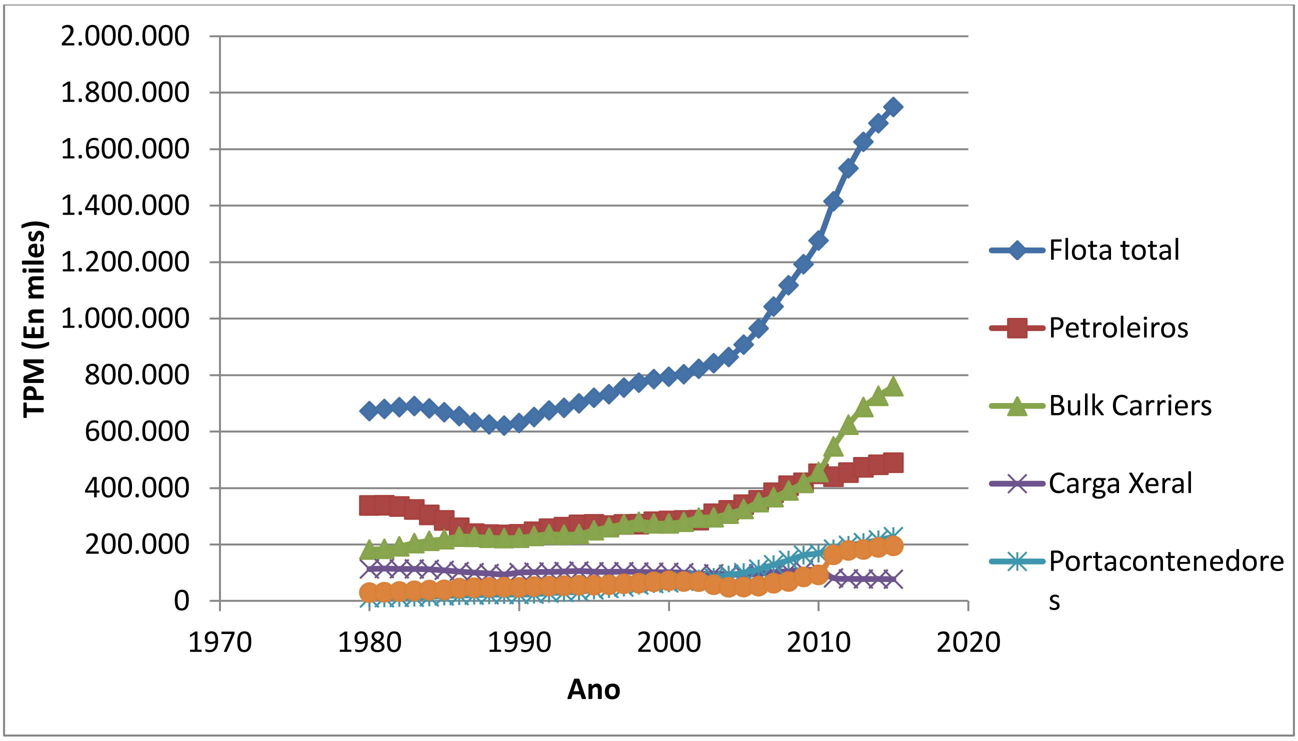


Figura 1. Gráfica de TPM anuais dos distintos

tipos de buques nos últimos 35 anos.

Vemos que na actualidade o tipo de buque que máis TPM transporta anualmente son os bulk carriers. Vémolo máis claro no seguinte gráfico de sectores.

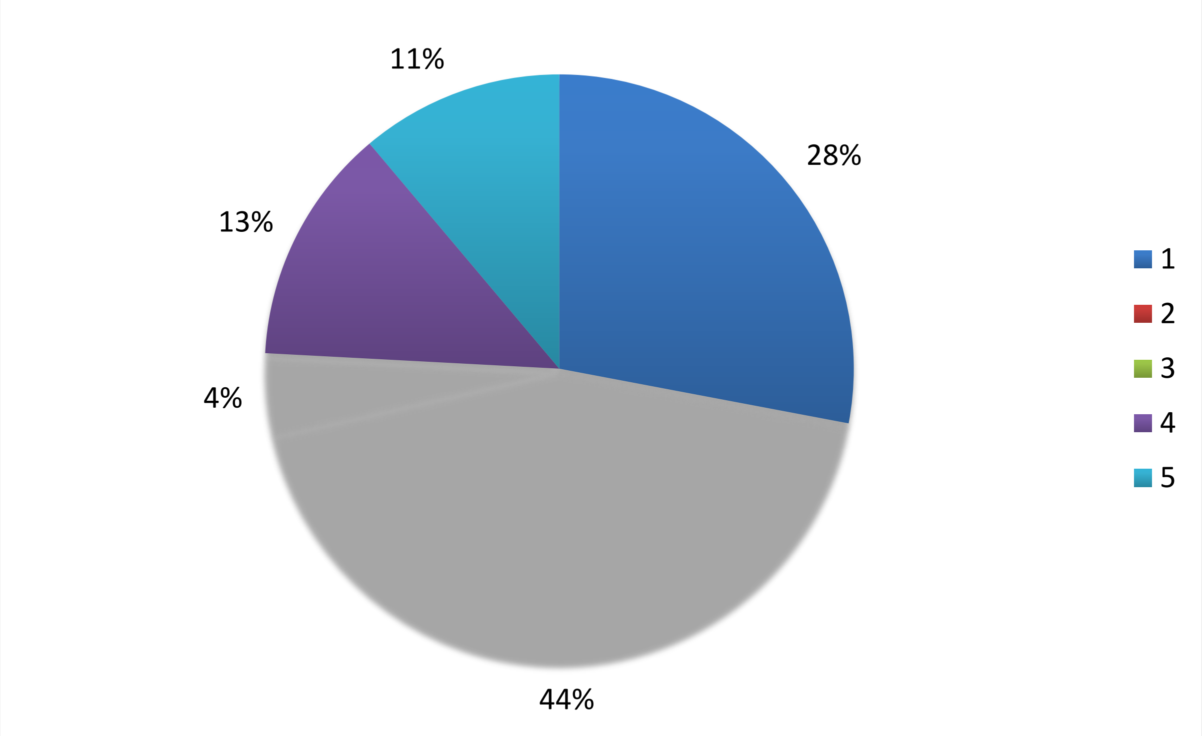


Figura 2. Gráfico do porcentaxe de TPM transportadas

por distintos tipos de buques en 2015.

Sendo:

1- Petroleiros.

2- Bulk Carriers.

3- Carga Xeral.

4- Portacontenedores.

5- Outros tipos de buques.

Entón, como vemos, os bulk carriers teñen unha enorme importancia no transporte mundial de mercadorías. Este é un do motivos polos que o estudo dun cargueiro se me fixo interesante.

Agora vexamos outro punto, neste caso presento uns datos da "Unidad de Estatísticas y Administración de Modelos" do Canal de Panamá. No primeiro gráfico preséntase unha comparativa dos diferentes tipos de cargas que se transportaron polo Canal durante os anos 2013, 2014 e 2015. (Anexo II)

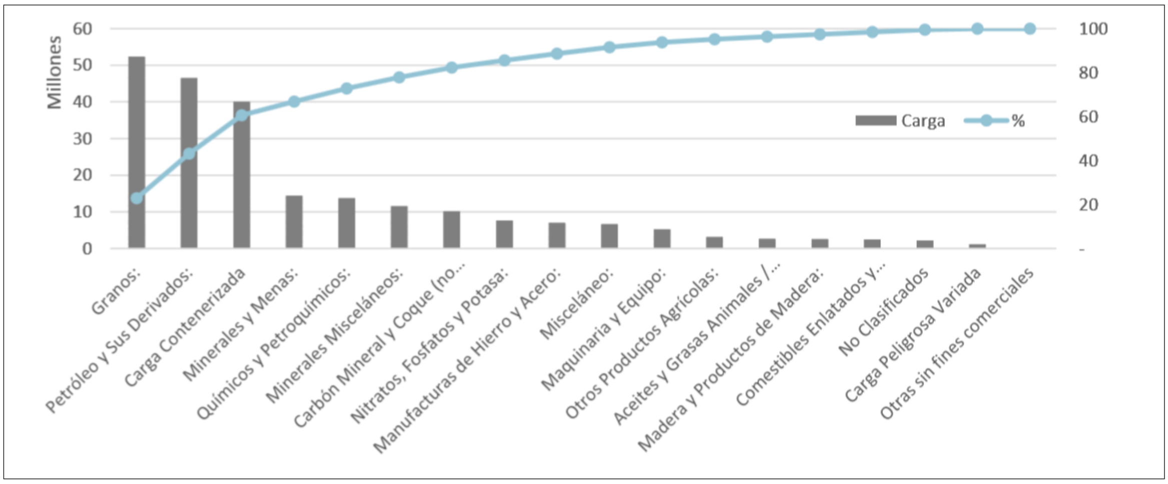


Figura 3. Mercadorías transportadas polo Canal de

Panamá nos anos 2013 a 2015.

Vemos de novo que tamén a través do Canal o transporte de grans, minerais, carbón, etc; produtos que se transportan nos bulk carriers, son os que máis toneladas se transportan. E isto lévanos ao seguinte gráfico. (Anexo III)

Figura 4. Tránsitos e peso de mercadoría transportada

no Canal de Panamá en 2014 e 2015.

Vemos que aínda que os portacontenedores teñen case o mesmo número de tránsito que os bulk carrier (neste caso "graneleros") en toneladas de mercadorías os bulk carrier supoñen case a metade de todas as mercadorías transportadas.

Visto isto non me parece estraño considerar o estudo dun buque que cumpra as características para poder circular polo Canal de Panamá, é dicir, un buque do tipo Panamax.

Este tipo de buque encontrase dentro dunha clasificación que, aínda que varía lixeiramente dependendo da fonte de información que busques, ten a seguinte estrutura:

- Mini-bulker: Transportan ata 10.000 TPM.
- Handysize: Transportan entre 10.000 e 39.999 TPM.
- Handymax/Supramax: Transportan entre 40.000 e 59.999 TPM.
- **Panamax**: Transportan entre 60.000 e 79.999 TPM. Teñen as dimensións máximas para poder pasar polo Canal de Panamá.
- Post-Panamax: Transportan entre 80.000 e 109.999 TPM.
- Capesize: Transportan entre 110.000 e 199.999 TPM.
- Very Large Ore Carriers (VLOC): Transportan máis de 200.000 TPM.

Tras esta introdución contextual, agora pasaremos a comezar co estudo do buque en cuestión. Neste primeiro caderno imos a calcular as dimensións principais do buque a partir dunha base de datos de buques de similares características, calcularemos os coeficientes de arquitectura naval e a Cifra de Mérito.

A partir dese momento pasaremos a comprobar e validar tecnicamente diferentes alternativas ata encontrar a máis favorable. Unha vez encontrada farase unha profunda validación da alternativa escollida.

Despois pasaremos a realizar os primeiros croquis tanto da sección transversal como da disposición xeral.

Por último, realizaremos as Especificacións preliminares do buque para este proxecto.

1.1. Características do buque proxecto.

Primeiramente, debido a que o buque debe poder pasar polo Canal de Panamá, este deberá cumprir as limitacións que a propia Autoridade do Canal impón no seu Regramento.

Nesta primeira descrición só nos centraremos nas limitacións dimensionais, sendo estas as enumeradas no Capítulo IV Sección segunda e que se mostran a continuación:

- Calado máximo: "Artículo 52. El calado máximo permitido para transitar es de 12.04 metros (39.5 pies) agua dulce tropical (ADT), con el Lago Gatún al nivel de 24.84 metros (81.5 pies) ó más. Esto permite un margen de seguridad de por lo menos 1.50 metros (5 pies) para la navegación sobre las áreas críticas del Canal y un margen de por lo menos 0.60 metros (2 pies) sobre el umbral de las esclusas."

- Manga máxima: "Artículo 55. La manga máxima aceptable de un buque mercante y de la unidad compuesta para el tránsito normal es de 32.3 metros (106 pies). "

- Eslora máxima: "Artículo 55. La eslora máxima de un buque mercante aceptable para el tránsito regular es de 289.6 metros (950 pies), incluyendo la proa de bulbo, con la excepción de los buques de pasajeros y de contenedores, que puede ser de hasta 294.3 metros (965 pies). Los buques que transiten por primera vez y que tengan una eslora mayor de 274.3 metros (900 pies), ya sean de nueva construcción o modificada, estarán sujetos a inspección y revisión y aprobación previa de los planos del buque. A los buques que no hayan recibido aprobación previa y/o no cumplan con los requerimientos del Canal, se les podrá negar el tránsito de acuerdo a lo señalado en el artículo 50 del anexo."

- Anchura máxima: "Ningún buque cuya anchura máxima sea mayor que su manga máxima podrá transitar sin la revisión y aprobación previa de los planos del buque. A los buques que sin aprobación previa o que no cumplan con los requerimientos del Canal, se les denegará el tránsito."

- Altura máxima: "La altura máxima permitida para cualquier buque que vaya a entrar al puerto de Balboa o que vaya a transitar es de 57.91 metros (190 pies) en cualquier estado de la marea, medida en la línea de flotación hasta el punto más alto de la estructura. Podrá permitirse una altura máxima de 62.48 metros (205 pies), sujeta a la aprobación de la Autoridad en cada caso individual, para pasar bajo el puente en Balboa a la hora de la marea baja (MLWS)."

- Protuberancias: " Cualquier cosa que se extienda más afuera del casco del buque se considerará como una protuberancia, y se aplicarán las normas y limitaciones respectivas."

Ademais de cumprir estas características o buque en proxecto será un buque de unha soa cuberta, con grandes escotillas que se accionarán hidraulicamente e que permitirán facilitar tanto a carga como a descarga.

Contará con unha cámara de máquinas en popa, nela instalarase un motor dual fuel que funcione tanto con combustible diésel como con Gas Natural Licuado (de aquí en adiante LNG). Nela levará tamén os diésel-alternadores así como as bombas para o funcionamento do sistema antincendios.

A propulsión estará a cargo dunha soa hélice de paso fixo acoplada ao motor a través dun eixo e dunha redutora.

Sobre a cámara de máquinas irá situada a superestrutura na que estarán os camarotes e instalacións para os tripulantes. Na cuberta máis alta situarase a ponte de mando.

O gardacalor irá separado da superestrutura tal e como se están deseñando os buques modernos deste tipo.

2. Base de datos de buques de referencia.

Para realizar a base de datos establecín uns criterios mínimos que debían cumprir os buques que nela aparecesen. Estes criterios principais serían:

- Entrega do buque posterior a 2005.
- TPM nun rango de 55.000 a 90.000.
- Manga inferior a 32.3 m.

Con estes criterios elaborei a miña lista de buques de referencia. As características aparecen anexadas ao final do documento como Anexo IV e foron tomadas da revista Significant Ships dos anos 2006 a 2014.

BUQUE	TPM	L(m)	Lpp(m)	B(m)	T(m)	D(m)	V(kn)	Ano
STX Arborella	57539	199,90	191,80	32,26	12,70	19,30	13,90	2012
Thalassini Axia	58608	196,00	189,00	32,26	13,00	18,60	14,60	2010
Libertas	75511	225,00	216,20	32,24	14,20	19,70	14,50	2007
Orange Trident	78932	225,00	219,00	32,24	14,35	19,90	14,50	2007
Giewont	79649	229,00	222,82	32,26	14,65	20,25	14,28	2010
Cash	81434	229,00	223,00	32,26	14,52	20,20	14,92	2013
Prime Rose	81595	229,00	223,00	32,26	14,50	20,20	15,06	2012
Leda C	81600	229,00	223,00	32,26	14,50	20,20	14,40	2011
Azur	82282	224,86	221,50	32,26	14,42	20,05	14,50	2007
Framura	89871	223,00	217,00	32,26	14,22	19,90	15,01	2014

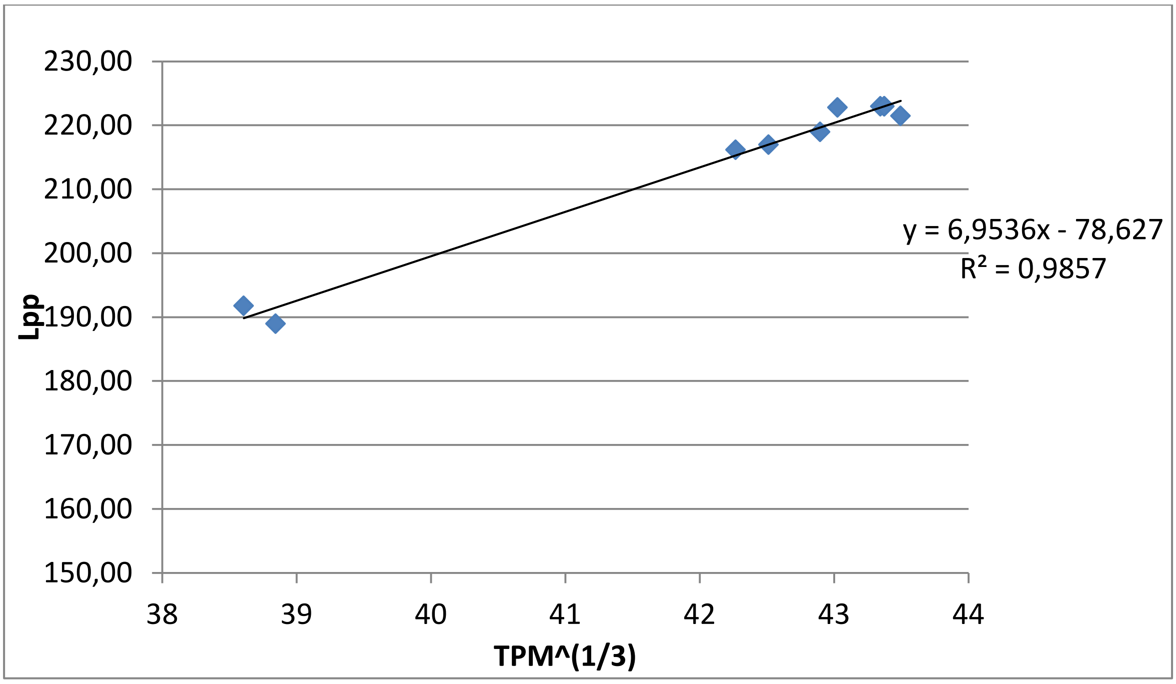
3. Dimensionamento básico.

A partir da base de datos anterior realizaremos un primeiro dimensionamento mediante rectas de regresión en función das TPM .

3.1. Dimensionamento por regresión.

3.1.1. Eslora entre perpendiculares.

A primeira lonxitude que analizaremos será a eslora. Neste caso realizamos un gráfico que enfronta a eslora entre perpendiculares e as TPM elevadas a un terzo.



Obtida a regresión, vemos que o coeficiente de determinación R^2 nos dá un valor bastante próximo a 1 polo que podemos establecer que realmente hai unha correlación entre as variables e polo tanto podemos usar a fórmula da recta de regresión para calcular cal será a eslora entre perpendiculares:

Lpp=6.9536x-78.627

Sendo "x" as TPM elevadas a 1/3.

Polo tanto quedaranos:

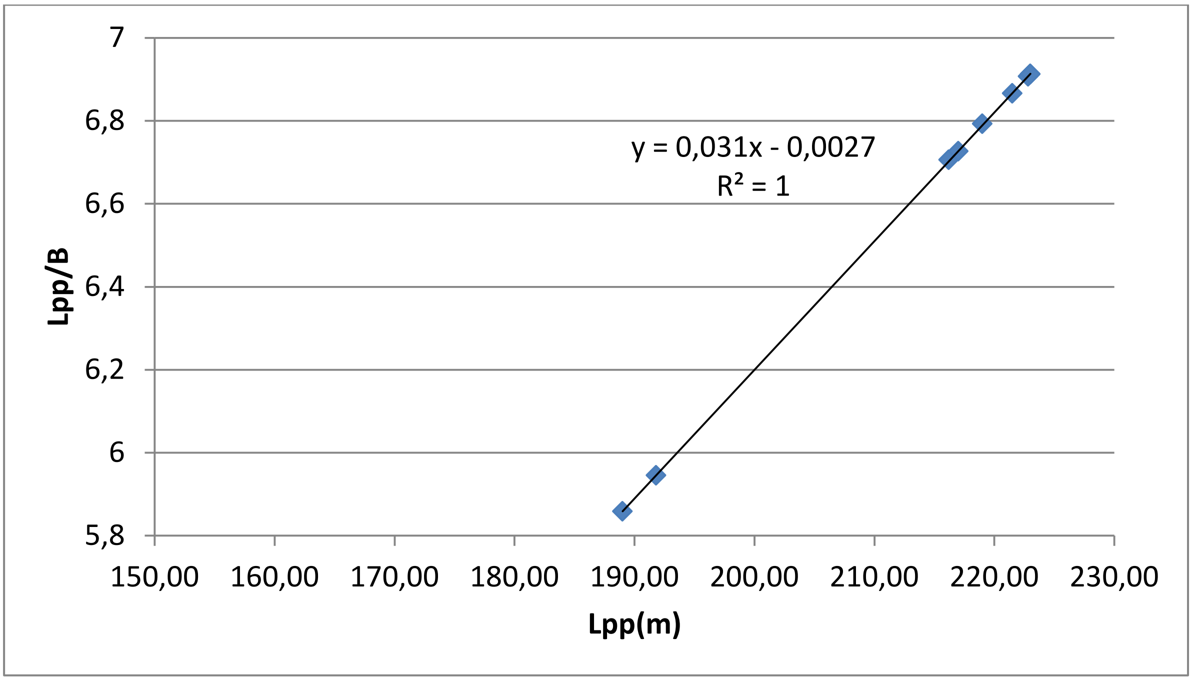
Lpp=6.9536*[70000^(1/3)]- 78.627=207.9507m

Aproximaremos esta eslora entre perpendiculares a unha soa cifra decimal quedando polo tanto:

Lpp=**208.0** m

3.1.2. Manga.

Calculada a eslora entre perpendiculares agora pasaremos a calcular a manga. Debido as restricións impostas polo Canal de Panamá o noso buque non poderá ter unha eslora maior de 32.30 m. A partir dos buques de referencia e mediante unha regresión veremos a relación entre a eslora e o coeficiente adimensional Lpp/B.



Vemos que o coeficiente de determinación R^2 é igual a 1 o que nos indica que hai unha correlación perfecta entre a eslora entre perpendiculares e a relación Lpp/B.

Para obter a manga do noso buque utilizaremos a fórmula da recta de regresión.

L/B=(0.031*Lpp)+0.0027

Polo tanto quedaranos,

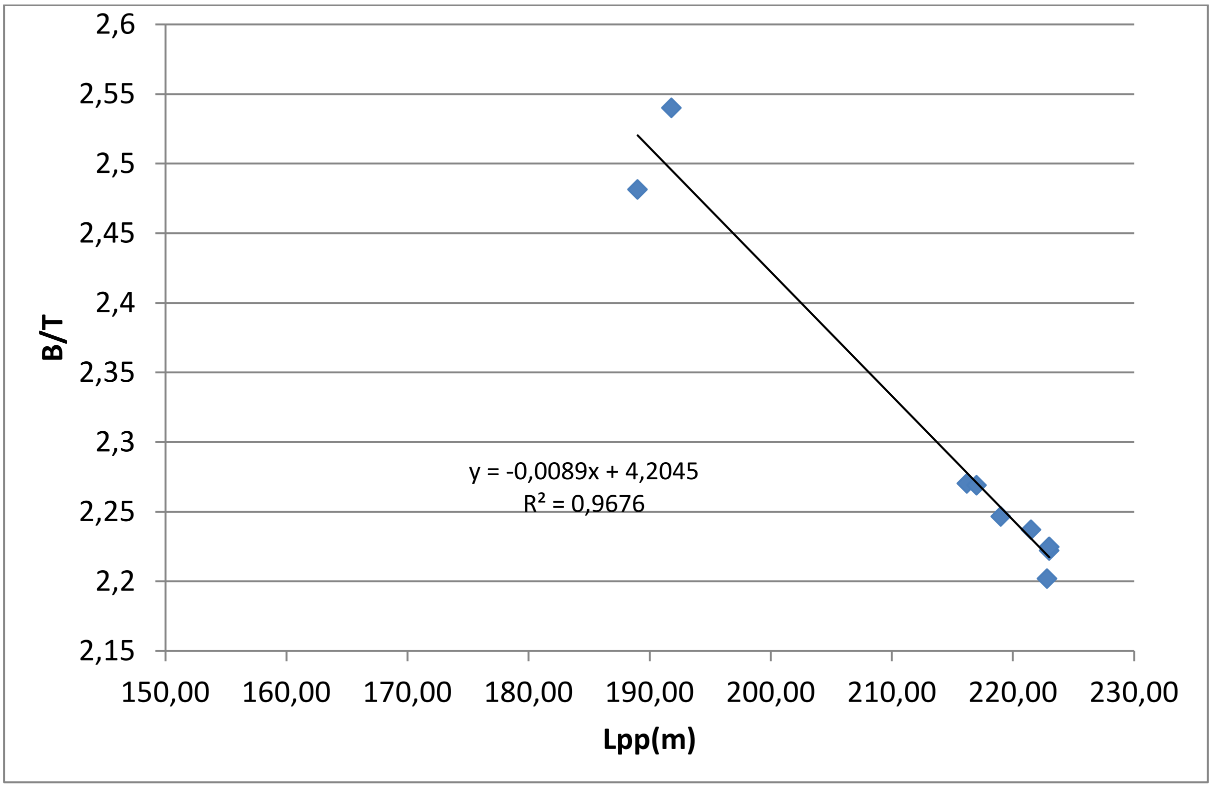
L/B=(0.031*208.0)+0.0027=6.45

Polo tanto, despexando a manga teremos:

B=Lpp/6.45=208.0/6.45=**32.24** m

3.1.3. Calado

Para calcular o calado deberemos, ao igual que nos casos anteriores valernos dunha relación adimensional, neste caso B/T, e confrontala coa eslora entre perpendiculares dos buques de referencia.



Vemos que o coeficiente de determinación R^2 é case 1 polo que a correlación entre os valores é case perfecta. Entón, da recta de regresión sacaremos o valor do calado da seguinte forma:

B/T=(-0.0089*Lpp)+4.2045

Polo tanto:

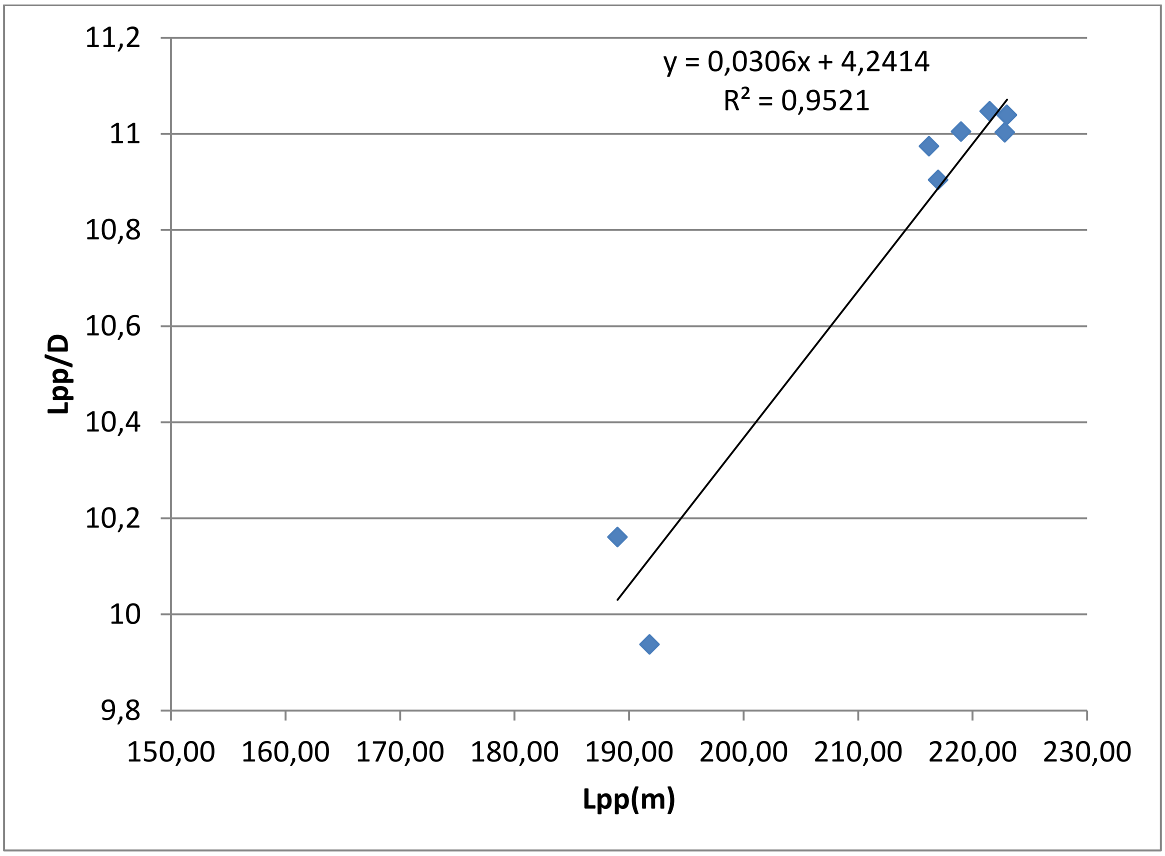
B/T=(-0.0089*208.0)+4.2025=2.3537

Finalmente,

T = B/(B/T)=32.24/2.3537=**13.70** m

3.1.4. Puntal.

Por último quédanos por calcular o puntal á cuberta principal, este farémolo de novo a partir dunha recta de regresión que obteremos a partir dunha gráfica na que enfrontaremos a relación Lpp fronte a Lpp/D.



Unha vez máis o coeficiente de determinación R^2 é un valor próximo a un o que nos demostra que a correlación é boa. Da función da recta de regresión sacaremos o valor do puntal a partir da Lpp do noso buque.

Lpp/D=0.0306*(Lpp)+4.2414

Entón:

D=208.0/(0.0306*208.0+4.2414)= **19.6** m

3.2. Dimensionamento mediante o método proposto no "*Elements of Ship Design*".

Neste artigo técnico utilízanse unha serie de relacións, que veremos a continuación, para facer unha estimación das dimensións principais do noso buque proxecto.

Inicialmente debemos definir o coeficiente de peso morto que será:

$$C_D = \frac{Peso\ morto}{Desprazamento}$$

No mesmo artigo dannos uns rangos de valores típicos para distintos tipos de buques sendo para bulk carriers de 0.78 a 0.84.

Para levar a cabo esta estimación daranse uns valores de referencia de eslora aproximada e a partir dela calcularemos as demais lonxitudes e calcularemos o desprazamento de cada unha das esloras propostas. Tras obter o desprazamento do noso buque da fórmula do coeficiente de peso morto, deberemos interpolar para sacar as dimensións correspondentes ao noso buque.

Visto isto, agora podemos enumerar as relacións:

- C_D = 0.78 a 0.84. Escollemos 0.80.
- B = L/9 + 6 m
- D = $\frac{B-3}{1.5}$ m
- T = 0.66D + 0.9 m
- $C_b = 1.00 - 0.17V/\sqrt{L}$
- $\Delta = L*B*T*C_b*1.025$

Para realizar os cálculos suporemos as seguintes esloras: 190, 195, 200, 205 e 210.

L	190	195	200	205	210
B	27,11	27,67	28,22	28,78	29,33
D	16,07	16,44	16,81	17,19	17,56
T	11,51	11,75	12,00	12,24	12,49
Cb	0,82	0,82	0,83	0,83	0,83
Δ	49898,94	53521,49	57314,86	61283,00	65429,90

Agora debemos calcular o desprazamento do noso buque mediante a fórmula do coeficiente de peso morto. polo tanto:

$$\Delta = \frac{Peso\ morto}{C_D} = \frac{70000}{0.80} = 87500$$

Vemos que na primeira aproximación que fixemos non supuxemos unha eslora o suficientemente grande como para alcanzar o peso morto necesario, agora probaremos con 4 esloras máis; 220,230, 235 e 240.

L	220	230	235	240
B	30,44	31,56	32,11	32,67
D	18,30	19,04	19,41	19,78
T	12,98	13,46	13,71	13,95
Cb	0,83	0,84	0,84	0,84
Δ	74275,83	83884,45	88984,71	94287,58

Agora si conseguimos chegar ao rango que nos interesaba e polo tanto agora será cando debamos interpolar entre as esloras 230 e 235 para obter as dimensións do noso buque.

L	233,54
B	31,95
D	19,30
T	13,64
Cb	0,84
Δ	87479,27

Tras interpolar vemos que as dimensións obtidas son as da táboa e vemos que agora o desprazamento é case o desprazamento que calculamos do noso buque. O erro entre un é outro é menor do 1% e polo tanto creo que estas son as dimensións finais que se obteñen do cálculo mediante o artigo técnico.

3.3. Dimensionamento mediante formulación.

Este dimensionamento farase a través de fórmulas obtidas do libro "*Proyecto de buques y artefactos*" .

Comezamos por calcular a Lpp. Esta calcularase pola fórmula de D. Anderson:

$L=19.10*(TPM)^{1/3}$ (pes)

$L=19.10*(70000)^{1/3}=787.16$ pes = 239.9 m

Volvemos utilizar outra fórmula de Anderson para calcular neste caso a manga.

B=0.1133L+13 (pes)

B=0.1133*787.16+13=102.19 pes=31.15 m

Segundo este libro a relación L/B para bulk carriers debería estar entre 6.00 e 7.40 mentres que no noso caso temos que L/B= 7.70.

Para o puntal utilizaremos a fórmula de Murray e Anderson:

D=0.08125L+2 (pes)

D=0.08125*787.16+2=65.96 pes= 20.1 m

De novo segundo este libro, a relación L/H debería estar ente 10.70 e 12.80 e neste caso o noso buque si cumpre xa que ten unha relación L/H de 11.94.

Por último para calcular o calado utilizamos a seguinte fórmula proposta como a máis exacta:

T=0.05077L+1.94 (m)

T=0.05077*239.9+1.94=14.12

3.4. Resumo e conclusións do dimensionamento básico.

Tras analizar tres métodos distintos para o dimensionamento estes son os resultados aos que chegamos.

	Lpp	B	D	T
Regresións	**208.0**	**32.24**	**19.6**	**13.7**
Artigo técnico	233,54	31.95	19.3	13.64
Formulación	239.9	31.15	20.1	14.12

Vemos que a principal diferenza entre os distintos métodos está na eslora entre perpendiculares mentres que nas outras tres dimensións as diferenzas son pequenas.

Á hora de escoller como válido un dos tres dimensionamentos vou ter en conta as dimensións do buque real de case as mesmas TPM que teño nos buques de referencia e polo tanto escollerei os resultados do primeiro método, o das regresións, como o correcto para continuar co proxecto.

4. Cálculo de coeficientes de arquitectura naval.

4.1. Coeficiente de bloque.

Nome	C_b
Thalassini Axia	0.8585
STX Arborella	0.8746
Libertas	0.8827
Giewont	0.8682
Cash	0.8851
Prime Rose	0.8851
Framura	0.8673

Segundo o libro "Elements of Ship Design"

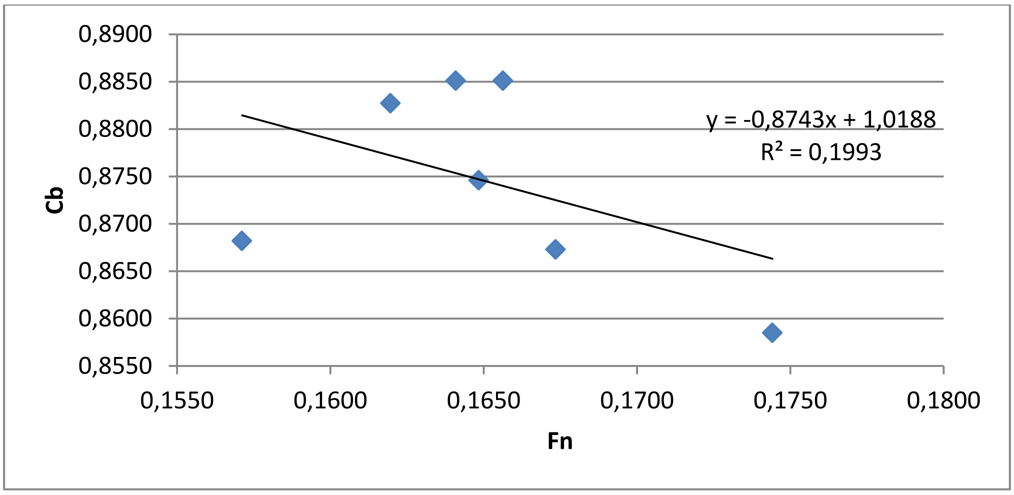
$$C_b = a - b * Fn$$

Sendo a e b valores que tomaremos da recta de regresión a partir dos buques de referencia e Fn o número de Froude para o noso buque en particular.

O número de Froude do noso buque será:

$$Fn = \frac{v}{\sqrt{g*Lpp}} = \frac{14.5*0.5144}{\sqrt{9.81*208.0}} = 0.1651$$

Na seguinte gráfica móstrase a relación entre o Fn e o coeficiente de bloque que demostra a teoría do libro mencionado anteriormente.



Polo tanto,

$$C_b = 1.0188 - 0.8743*0.1651 = 0.8744$$

Podemos calcular o coeficiente de bloque tamén por fórmulas como a de Katsoulis, Hollenbach, Munro-Smith, Alexander ou Schneekluth. Neste caso utilizaremos a de Katsoulis e a de Alexander.

A fórmula de Katsoulis é a seguinte:

$$C_b=K \times f \times L^a \times B^b \times T^c \times V^d$$

Sendo:

- K=0.8217
- a=0.42
- b=-0.3072
- c=0.1721
- d=-0.6135
- L= eslora entre perpendiculares (m)
- B= manga (m)
- T=calado (m)
- V=velocidade (nudos)
- f (para bulk carriers)=1.00

Polo tanto, para o noso buque, o coeficiente de bloque segundo a fórmula de Katsoulis será:

$$\mathbf{C_b}=0.8217x1.00x208.0^{0.42}x32.25^{-0.3072}x12.7^{0.1721}x14.5^{-0.6135}= \mathbf{0,8092}$$

Agora mediante a fórmula de Alexander:

$$C_b=K1-K2*Fn$$

Sendo:

- K1 (para buques de unha hélice)=1.08
- K2=1.68

Polo tanto quédanos que:

$$\mathbf{C_b}=1.08-1.68*0.1651=\mathbf{0.8026}$$

Para escoller o coeficiente de bloque final do noso buque fixarémonos nos coeficientes do buques da base de datos. Todos eles están por encima do 0.85 polo que imos a descartar os valores obtidos polo métodos de Katsoulis e de Alexander e utilizar o coeficiente obtido mediante as regresións.

Polo tanto:

$$\mathbf{C_b=0.8744}$$

4.2 Outros coeficientes.

Para calcular o coeficiente da sección mestra utilizaremos as fórmulas para buques de peso morto (bulk carriers principalmente) recomendadas polo libro *Proyecto de Buques y artefactos*.

O coeficiente da mestra calcúlase a partir da seguinte fórmula:

$$C_M=0.947+0.057*C_b$$

Polo tanto, para o noso buque quedará:

$$C_M=0.947+0.057*0.8744=0.9968$$

Agora calcularemos o coeficiente prismático tamén a partir das recomendación para bulk carriers do libro *Proyecto de buques y artefactos* que di que este coeficiente se calcula a partir da división do coeficiente de bloque entre o coeficiente da sección mestra, polo tanto:

$$C_P= C_b/ C_M=0.8772$$

Agora pasaremos a calcular o coeficiente de flotación tamén a partir das recomendacións para bulk carriers do xa mencionado libro. Para obter o valor do coeficiente faremos unha media das tres seguintes fórmulas:

$$C_F=0.619C_b+0.371$$

$$C_F=1.265C_b-0.146$$

$$C_F=1.167C_b-0.057$$

Polo tanto,

$$C_F=0.619*0.8744+0.371=0.9123$$

$$C_F=1.265*0.8744-0.146=0.9602$$

$$C_F=1.167*0.8744-0.057=0.9635$$

O valor final do coeficiente de flotación será, como xa diximos, a media dos tres valores:

$$\mathbf{C_F}=(0.9123+0.9602+0.9635)/3=\mathbf{0.9453}$$

4.3 Conclusións.

Por último imos a comprobar que o desprazamento que obtemos con estas dimensións e coeficientes é suficiente respecto ao que estimáramos de mediante a fórmula do coeficiente de desprazamento e que nos daba 87500 toneladas.

O desprazamento coas dimensións obtidas queda:

Δ=1.025*Lpp*B*T*C_b

Δ=1.025*208.0*32.24*13.7*0.8744=82340 toneladas

Como vemos quedámonos curtos polo que para poder acercarnos ao valor desexado deberemos aumentar unha ou varias das nosas dimensións principais. Tras analizar as distintas posibilidades a solución tomada será a seguinte:

- Aumentar 4 metros a eslora. Pasará de 208.0 a 212.0 metros.
- Aumentar en 0.5 metros o calado. Pasará de 13.7 a 14.2 metros.
- Aumentar o C_b de 0.8744 a 0.88.

Así, o desprazamento que nos queda será:

Δ=1.025*212.0*32.24*14.2*0.88=87544 toneladas

E polo tanto con esta modificación si cumpre o desprazamento estimado.

Finalmente as dimensións do buque serán:

Lpp	B	D	T	C_b
212.0	**32.24**	**19.6**	**14.2**	**0.88**

5. Elección da cifra de mérito.

5.1. Custos de construción.

Os custos de construción calcúlanse a partir da seguinte fórmula dada polo libro *Proyecto de buque y artefactos*.

CC=CMg+CEq+CMo+CVa

sendo:

- CC: Custo de construción.
- CMg: Custo dos materiais a granel.
- CEq: Custo dos equipos do buque.
- CMo: Custo da man de obra.
- CVa: Outros custos do estaleiro.

5.1.1. Cálculos dos custos dos materiais a granel.

Comezaremos por calcular os custos dos materiais a granel. Para iso utilizaremos a fórmula recomendada polo libro anteriormente mencionado que expoño a continuación:

CMg=ccs*cas*cem*ps*PS

Sendo:

- ccs: Coeficiente ponderado das chapas e perfís de distintas calidades de aceiro.
- cas: Coeficiente de aproveitamento do aceiro en relación co pedido de materiais (Peso bruto/peso neto)
- cem: Coeficiente de incremento por equipo metálico incluído na estrutura.
- ps: Prezo unitario do aceiro para referencia.
- PS: Peso dos aceiros do buque.

Os tres primeiros coeficientes varían dentro dos seguintes rangos:

1.05<ccs<1.10

1.08<cas<1.15

1.03<cem<1.10

Para este buque colleremos uns valores medios que serán os seguintes:

ccs=1.075

cas=1.115

cem=1.065

O seguinte parámetro a determinar é o prezo unitario do aceiro naval A comprado en China posto xa no almacén está por debaixo dos 700 €/t mentres que comprado en Europa está por debaixo dos 800€/t. Para este caso collerei un prezo de 750€/t

Por último quédanos determinar o peso dos aceiros do buque e para iso utilizaremos as fórmulas propostas no libro *Proyecto de buques y artefactos* capítulo 7 e unha vez achados os distintos valores decidiremos o valor final.

A primeira fórmula proposta é o que denomina "Método dos produtos":

$$PS=3.444*Z^{0.69}*L*M*N*P*Q$$

sendo:

- M=1.104-0.016*L/B
- N=0.530+0.040*L/H
- P=1.980-0.040*L/H
- Q=1.146-0.0163*L/H
- Z é o módulo resistente da caderna mestra, en m^3, e calculase mediante a seguinte fórmula:

  $$Z=F*L^2*B*(C_b+0.7)*10^{-6} \quad (m^3)$$

  sendo F para L<300 metros:
  - $F=12.32-1.0802((300-L)/100)^{3/2}$

Calculados os distintos valores o valor final do peso dos aceiros segundo este primeiro método é:

PS1=10018.00

A segunda fórmula proposta é a fórmula de Murray que é a seguinte:

$$PS2=32.76596*10^{-3}*L^{1.63}*(B+H+T/2)*(0.5*C_b+0.4) \quad (tons)$$

Calculado este valor obtemos que:

PS2=10047.08 toneladas

Para calcular o valor final do peso dos aceiros faremos a media entre os dous valores obtidos polo que o valor final será:

PS=10032.54 t

E finalmente podemos calcular o custo dos materiais a granel coa formula que previamente indicáramos e obteremos:

$$CMg=9.605\ M€$$

5.1.2. Cálculo do custo dos equipos do buque.

Para calcular o custo dos equipos do buque utilizaremos a fórmula proposta polo libro *Proyecto de buques y artefactos* que é a que sigue:

$$CEq+CMe=CEc+CEp+CHf+CEr$$

Sendo:

- CEq: Custo dos equipos.
- CMe: Custo da man de obra da montaxe dos equipos.
- CEc: Custo dos equipos de manipulación da carga, montaxe incluída.
- CEp: Custo dos equipos de propulsión, dos seus auxiliares e da súa montaxe.
- CHf: Custo da habilitación e fonda incluída a montaxe.
- CEr: Custo dos equipos restantes, incluída a súa montaxe.

E ademais:

$$CEp=cep*BP$$

$$300<cep<400\ €/kW$$

$$CHf= chf*nch*NT$$

$$0.90<nch<1.20$$

$$chf=32000/35000\ €/tripulante$$

$$CEr=cer*PEr=cpe*ps*PEr$$

$$1.25<ccs<1.35$$

sendo:

- cep: coeficiente de custo por unidade de potencia dos equipos de propulsión e dos seus auxiliares.
- BP: Potencia propulsora total.
- chf: Coeficiente de custo unitario da habilitación por tripulante.
- nch: Representa o coeficiente de nivel de calidade da habilitación.
- NT: Representa o número de tripulantes.

Custo dos equipos de manipulación da carga

Tal é como se reflexa nas RPA, este buque non leva grúas para a manipulación da carga polo que os custos de tales equipos neste caso son nulos. Se ben as escotillas das bodegas se poderían considerar un equipo de manipulación da carga nun sentido moi amplo do concepto, neste caso non as incluiremos neste apartado senón no de equipos restantes.

Custo dos equipos de propulsión, dos seus auxiliares e da súa montaxe

Para calculalos utilizaremos:

CEp=cep*BP

300<cep<400 €/kW

Como primeiro paso escolleremos un valor intermedio para o cep que será:

cep=360€/kW

A potencia calcularémola mediante a fórmula simplificada proposta no libro *Proyecto básico del buque mercante* denominada no mesmo como fórmula de D.G.M. Watson e que é:

$$BP=\frac{0.889*\Delta^{2/3}*(40-\frac{Lpp}{61}+400(K-1)^2-12CB)}{15000-1.81N\sqrt{Lpp}}V^3$$

sendo:

- K: constante da fórmula de Alexander
- CB=K-0.5V/$\sqrt{3.28Lpp}$
- V= Velocidade en nudos, en condicións de probas a plena carga
- BP: Potencia desarrollada polo motor propulsor directamente acoplado en HP
- N: R.P.M. do motor propulsor.

O propio libro di que esta formula foi deducida para cargueiros pero que tamén se pode utilizar en bulk carriers. Ademais dinos que proporciona a potencia necesario en condicións de probas a plena carga, con un grado de aproximación da orde do 10%.

Calculando todo isto obtemos:

BP=9662.9 kW

Polo tanto agora xa podemos calcular o custo dos equipos de propulsión que será:

CEp=360*9662.9=3.479 M€

Custo da habilitación e fonda incluída a súa montaxe

Para realizar estes cálculos utilizaremos as fórmulas e rangos que xa nos propón o propio libro anteriormente mencionado.

CHf= chf*nch*NT

$0.90 < nch < 1.20$

chf=32000/35000 €/tripulante

Para tomar os valores de chf e nch consideramos escoller os valores medios do rango, polo tanto:

nch=1.05

chf=33500 €/tripulante

Escollidos estes valores e sabendo que o número de tripulantes é 25 xa podemos obter os custos de habilitación e fonda:

CHf=1.05*33500*25=0.879 M€

Custo dos equipos restantes e da súa montaxe

Para realizar estes cálculos utilizaremos as fórmulas e rangos que xa nos propón o propio libro anteriormente mencionado:

CEr=cer*PEr=cpe*ps*PEr

$1.25 < cpe < 1.35$

Do coeficiente cpe (coeficiente de comparación do equipo restante) tomaremos como valor 1.32 e para o prezo unitario do aceiro volvemos a tomar 750€/t.

Para calcular o peso dos equipos restantes PEr utilizaremos a seguinte fórmula:

$PEr=0.045*Lpp^{1.3}*B^{0.8}*D^{0.3}$

Con todo os factores calculados podemos determinar o custo dos equipos restantes que será:

CEr=1.851 M€

Custo final dos equipos e da súa montaxe

Calculados todos os apartado xa os podemos sumar:

CEq+CMe=0+3.479+0.879+1.851=**6.209 M€**

5.1.3. Custo da man de obra.

O custo da man de obra calcularémolo mediante a fórmula proposta no libro *Proyecto de buque y artefactos* e que é a seguinte:

CMo=Cmm+CMe

sendo:

- CMo: custo da man de obra.
- Cmm: custo da man de obra da montaxe do material a granel.
- CMe: custo da man de obra da montaxe dos equipos e instalacións do buque. Este custo xa se tivo en conta no apartado anterior polo que neste caso non o teremos en conta e a fórmula final será:

CMo=Cmm

Para calcular os custos do Cmm debemos ter en conta que:

Cmm=chm*csh*PS

$20/30 < csh < 80/100$ horas/t

$21/25 < chm < 30/40$ €/t

Para estes dous coeficientes escolleremos valores dentro do rango dado tomando un valor da parte media baixa para o csh; csh=35 horas/t; e un valor da parte media alta para o chm; chm=30 €/t.

Finalmente, o custo de man de obra será:

CMo=10.534 M€

5.1.4. Outros custos do estaleiro.

Tamén chamados custos varios aplicados calcúlanse como unha porcentaxe do total do custo de construción:

CVa=cva*CC

o coeficiente cva, coeficiente dos custos varios do estaleiro referidos ao custo de construción do buque, varía entre 0.05 e 0.1. Neste caso escolleremos cva=0.065

Para calcular os custos de construción sen haber calculado os custos varios aplicados deberemos dividir a suma dos demais custos por 1-cva aumentando deste modo o porcentaxe exacto que lle corresponde aos devanditos custos.

$$CVa=0.065*\left(\frac{CMg+CEq+CMe+CMm}{1-0.065}\right)=1.832\ M€$$

5.1.5. Custo de construción total.

Para calculalo solo teremos que sumar todos os sumandos que fomos calculando apartado a apartado e así:

CC=CMg+CEq+CMo+CVa=9.605+6.209+10.534+1.832=**28.180 M€**

5.2. Custos de adquisición.

Unha vez máis utilizamos a fórmula que nos recomenda o libro *Proyectos de buques y artefactos* no seu capítulo 5.

CA=CC+BI-PB

sendo:

- CA: Custo de adquisición para o armador e prezo de venta do buque ao estaleiro.
- CC: Custo de construción.
- BI: Beneficio industrial.
- PB: Valor das primas á construción naval.

Para calcular este coeficientes dinos que:

BI=bi*CC

$0.05<bi<0.2$

PB=pb*IT

pb=0 ;xa que non hai axudas a día de hoxe.

sendo:

- bi: Beneficio industrial sobre o custo de construción.
- pb: Coeficiente das primas á construción naval referidas á inversión total.
- IT: Inversión total do armador.

O custo de construción xa o coñecemos do apartado anterior, para o coeficiente bi tomamos bi=0.12 e polo tanto xa podemos calcular o beneficio industrial:

BI=0.12*28.180=3.382 M€

Para calcular o valor das primas á construción naval necesitamos calcular a inversión total, polo que pasamos ao seguinte apartado e unha vez calculado poderemos acabar con este apartado.

Calculado o apartado seguinte obtivemos unha inversión total IT=35.463 M€ polo que xa podemos calcular o noso valor das primas á construción:

PB=pb*IT=0*35.463=0 M€

E polo tanto o custo de adquisición quedará en:

$$\mathbf{CA}=28.180+3.382-0=\mathbf{31.562\ M€}$$

5.3. Inversión total.

Para a inversión total utilizamos a seguinte fórmula:

$$IT=(1+bi)*CC/(1+pb-ga)$$

sendo:

- ga: Coeficiente dos gastos do armador referidos á inversión total.

E ademais:

$$0.15<ga<0.25$$

Tomaremos ga=0.20 e así xa podemos calcular a inversión total:

$$\mathbf{IT}=(1+0.12)*28.180/(1+0-0.2)=\mathbf{39.453\ M€}$$

5.4. Custos financeiros.

Para calcular estes custos imos seguir o que nos propón o libro *Proyecto básico del buque mercante* e dinos que a amortización técnica AT é cantidade destinada anualmente para construír un fondo que permita repoñer o buque ao cabo da súa vida útil e que se calcula da seguinte forma:

$$AT=(IT-VR)/vu$$

Sendo:

- AT: Amortización técnica
- IT: inversión total. IT=ITp+ITa
- ITp: Inversión total propia.
- ITa: Inversión total allea.
- VR: Valor residual do buque ou valor de desguace.
- vu: Vidal útil.

A vida útil suporémola de 25 anos e o valor residual proponnos o libro que sexa o 5% da inversión total.

Polo tanto quédanos:

$$AT=(39.453-0.05*39.453)/25=1.499\ M€$$

Dinos tamén que a inversión total é unha parte de inversión total propia ITp e outra de inversión allea ITa. Esta inversión allea ou préstamo hai que devolvelo nun prazo de "n" anos con un interés "a" e que neste caso escolleremos realizalo mediante o método de devolución anual constante Dai. Neste método o interés anual Rai é variable e tamén o é o servizo de préstamo Pai, e polo tanto para cada ano "i" temos que:

Pai=Dai+Rai=ITa/n + ITa*a*(n-i+1)/n

Tomaremos:

ITa=0.5*IT=0.5*35.463=19.726 M€

n=10

a=5.23. Tomado dos datos do Banco de España sobre os intereses aplicados polas entidades de crédito en decembro de 2015 para operacións a prazos superiores a cinco anos.

(http://www.bde.es/clientebanca/es/areas/Tipos_de_Interes/entidades/)

Polo tanto, unha vez calculado o Pai, os custos financeiros anuais quedarán como:

CFi=AT+Pai; durante os 10 anos do crédito.

CFi=AT; durante o resto dos anos de vida útil, é dicir 15.

5.5. Gastos de explotación anuais.

Seguimos utilizando o libro *Proyecto básico del buque mercante* que nos propón a seguinte fórmula:

GEi=Gti+Gci+Gpi+Gmi+Gsi+Gvi

sendo:

- GEi: Gastos de explotación dun ano.
- Gti: Gastos de tripulación.
- Gci: Gastos en consumos.
- Gpi: Gastos portuarios.
- Gmi: Gastos en mantemento e reparacións.

- Gsi: Custo do seguro.
- Gvi: Gastos varios anuais.

Calcularemos agora cada un dos sumandos comezando polos gastos de tripulación. Estes gastos calcúlanse en función do número de tripulantes NT e do custo anual por tripulante gti. O custo anual por tripulante suporémolo igual a 33500€ como xa collemos nun apartado anterior.

Polo tanto:

$$Gti=gti*NT=0.8375\ M€$$

Para calcular Gci deberemos estimar algúns parámetros xa que non sabemos inda cal será o motor do buque. Diremos que estimando un consumo medio de 180 g/Kwh e un prezo medio do gasóleo de 0.5 €/l podemos calcular o prezo por Kw anual.

$$gci=947.60\ €/kW\ ano$$

E polo tanto Gci será:

$$Gci=gci*BP=9.157\ M€/ano$$

O propio libro que estamos seguindo dinos que o resto dos sumandos son desprezables á hora de analizar calquera función de mérito polo que non imos tomalos en consideración.

Polo tanto:

$$GEi=Gti+Gci=9.944\ M€/ano$$

5.6. Custos de operación.

Finalmente podemos calcular xa os custos de operación que non son máis que a suma dos dous apartados anteriores.

$$CO=CFi+GEi$$

Anos	Dai	Rai	Pai	AT	CFi	GEi	CO
1	1,973	1,03168385	3,00431072	1,499	4,504	9,994	14,498
2	1,973	0,92851547	2,90114234	1,499	4,400	9,994	14,394
3	1,973	0,82534708	2,79797395	1,499	4,297	9,994	14,291
4	1,973	0,7221787	2,69480557	1,499	4,194	9,994	14,188
5	1,973	0,61901031	2,59163718	1,499	4,091	9,994	14,085
6	1,973	0,51584193	2,4884688	1,499	3,988	9,994	13,982
7	1,973	0,41267354	2,38530041	1,499	3,884	9,994	13,879
8	1,973	0,30950516	2,28213203	1,499	3,781	9,994	13,775
9	1,973	0,20633677	2,17896364	1,499	3,678	9,994	13,672
10	1,973	0,10316839	2,07579526	1,499	3,575	9,994	13,569
11	0	0	0	1,499	1,499	9,994	11,493
12	0	0	0	1,499	1,499	9,994	11,493
13	0	0	0	1,499	1,499	9,994	11,493
14	0	0	0	1,499	1,499	9,994	11,493
15	0	0	0	1,499	1,499	9,994	11,493
16	0	0	0	1,499	1,499	9,994	11,493
17	0	0	0	1,499	1,499	9,994	11,493
18	0	0	0	1,499	1,499	9,994	11,493
19	0	0	0	1,499	1,499	9,994	11,493
20	0	0	0	1,499	1,499	9,994	11,493
21	0	0	0	1,499	1,499	9,994	11,493
22	0	0	0	1,499	1,499	9,994	11,493
23	0	0	0	1,499	1,499	9,994	11,493
24	0	0	0	1,499	1,499	9,994	11,493
25	0	0	0	1,499	1,499	9,994	11,493

5.7. Criterio de mérito.

Considero que como criterio de mérito o que máis interesante pode ser é que o custo ciclo de vida do buque sexa o menor posible xa que deste modo estaremos intentando diminuír tantos os custos de construción e adquisición como os custos de explotación anuais.

Polo tanto, segundo o libro *Proyectos de buques y artefactos*, o custo de ciclo de vida mínimo ten como cifra de mérito:

CCV=IT+∑GEi=289.303 M€

6. Cálculo e análise da mellor alternativa.

Para calcular a mellor alternativa utilizaremos o complemento de Excel chamado solver. Este complemento permítenos minimizar unha determinado valor calculado a partir de outros. No noso caso tomaremos como valor a minimizar o custo do ciclo de vida e como parámetros tomaremos as dimensións principais do buque xunto co coeficiente de bloque. Como limitación poremos que o desprazamento non pode ser menor de 87500 toneladas tal e como calcularamos mediante o coeficiente de desprazamento.

Dado que esta alternativa debe cumprir co Convenio de Liñas de Carga do ano 1966 e coas súas últimas modificacións publicadas no BOE o 21/04/2006, calcularemos o francobordo e faremos que a resolución do programa teña en conta o cumprimento do francobordo mínimo.

Para calcular o francobordo mínimo utilizamos unha folla Excel facilitada na materia de Proxecto de buques.

Como necesitamos que o volume de carga sexa o suficiente imos incluír aquí tamén unha restrición sobre este apartado e para iso necesitamos calcular as densidades dos distintos tipos de cargas.

Do libro *El proyecto básico del buque mercante* obtemos os seguintes coeficientes de estiba:

Tipo de carga	**pc/lt**
Carbón	42-48
Gran	42-50
Mineral de ferro	12-15

Sabendo que:

- Os pes cúbicos pc equivalen a 0,0283168 m^3
- As toneladas longas lt equivalen a 1.01605 t
- Polo tanto pc/lt=0.02787 m^3/t

Polo tanto a partir da táboa anterior obtemos:

Tipo de carga	**m^3/t**	**t/m^3**	**t/m^3(para cálculos)**
Carbón	1.17-1.34	0.746-0.855	0.8
Gran	1.17-1.39	0.719-0.855	0.787
Mineral de ferro	0.33-0.42	2.38-3.03	2.705

Como vemos, o que máis nos limita é o gran polo que calcularemos que volume necesitamos para transportar as 70000 toneladas estipuladas.

$$VCAR=70000/0.787=88945.4\ m^3$$

Para calcular o volume de carga, o libro *El proyecto básico del buque mercante* danos unha fórmula para calculalo específica para bulk carriers.

$$VCAR=750+0.615*N$$

Sendo N o número cúbico N=Lpp*B*D

As dimensións principais vounas a facer variar entre o 90 e o 110% dos valores iniciais excepto a manga que deberá ser sempre menos 32.25 m.

Polo tanto, no programa solver introducimos os seguinte parámetros:

- $190.8 \text{ m} \leq Lpp \leq 233.2 \text{ m}$
- $B \leq 32.25 \text{ m}$
- $17.64 \leq D \leq 21.56$
- $12.68 \leq T \leq 15.62$
- $0.88 \leq C_b \leq 0.9$
- $\Delta \geq 87500$
- D - T ≥ Francobordo mínimo calculado.
- VCAR ≥ 89000

Unha vez escollidos os parámetros facemos que o programa nos calcule o novo custo do ciclo de vida e obtemos:

CCV=288.573 M€

Polo tanto, respecto a alternativa inicial temos un aforro de 0.730 M€.

Para obter este valor as novas dimensións son as seguintes:

DIMENSIÓNS PRINCIPAIS						
Lpp	206,38	m		TPM	70000	t
B	32,25	m		Δ	87500	t
D	21,56	m		V	14,5	nudos
T	14,58	m		NT	25	persoas
Cb	0,88			FB	6,98	

O francobordo mínimo calculado para este caso é 6.48 m.

Para comprobar que está é a mellor alternativa imos fixar algúns dos valores das dimensións principais e manter os outros variando tal e como dixen anteriormente. Así, obteremos unha serie de resultados que se mostran no Anexo V no que se pode ver que ou non cumpren algún dos requisitos, e polo tanto aparecen en vermello, ou que simplemente son opcións máis caras que a escollida como máis favorable.

Con este novo coeficiente de bloque e utilizando as fórmulas xa utilizadas no apartado 4 os coeficientes de arquitectura naval quedan da seguinte forma:

- C_M=0.9972
- C_P=0.8825
- C_F=0.9510

7. Validación técnica da solución máis favorable.

7.1. Estimación preliminar de pesos.

Para calcular unha estimación dos pesos debemos calcular o peso do aceiro, o peso da maquinaria e o peso da habilitación e equipo. O peso do aceiro xa o temos calculado na nosa folla de Excel para poder calcular o custo do ciclo de vida. Tomando o valor da mesma:

PS=9668.89 toneladas

Para calcular o peso da maquinaria imos seguir as recomendación do libro *Proyectos de buques y artefactos.* Nel dinos que este peso se dividirá en dous apartados, o peso do motor principal e o peso da instalación restante de maquinaria.

Comezamos por determinar o peso do motor principal, que se fará a partir dunha fórmula que recomenda o libro anteriormente mencionado no seu capítulo 9 para motores diésel aínda que este non sexa unicamente diésel.

$$M_{MP}=0.075*MCR + 300$$

$$M_{MP}=0.075*9678.6 + 300 = 1025.17 \text{ toneladas}$$

Para calcular o peso restante da instalación de maquinaria utilizaremos a fórmula que propón o libro que estamos seguindo no capítulo 7.

$$M_{MR}=120+32.29*10^{-3}*L*(B+0.8245*D+1.85T)$$

$$M_{MR}=120+32.29*10^{-3}*206.38(32.25+0.8245*21.56+1.85*14.58)$$

$$M_{MR}=633.06 \text{ toneladas}$$

Polo tanto o peso total da maquinaria será:

$$M_M= M_{MP}+ M_{MR}=1658.22 \text{ toneladas}$$

Por último quédanos calcular o peso da habilitación e equipo para o que de novo utilizaremos unha fórmula do libro que estamos seguindo neste apartado:

$$M_{H+E}=0.8*L^{0.797}*(B+0.8245D+1.85T)^{0.797}$$

$$M_{H+E}=0.8*206.38^{0.797}*(32.25+0.8245*21.56+1.85*14.58)^{0.797}$$

$$M_{H+E}=1783.87 \text{ toneladas}$$

Polo tanto, o peso total do buque será a suma dos tres valores anteriores multiplicados por un 5% de marxe:

M_{TOT}=0.05*(PS+ M_{MP}+ M_{MR})+(PS+ M_{MP}+ M_{MR})

M_{TOT}=0.05(9668.89+1658.22+1783.87)+ (9668.89+1658.22+1783.87)

M_{TOT}=13766.53 toneladas

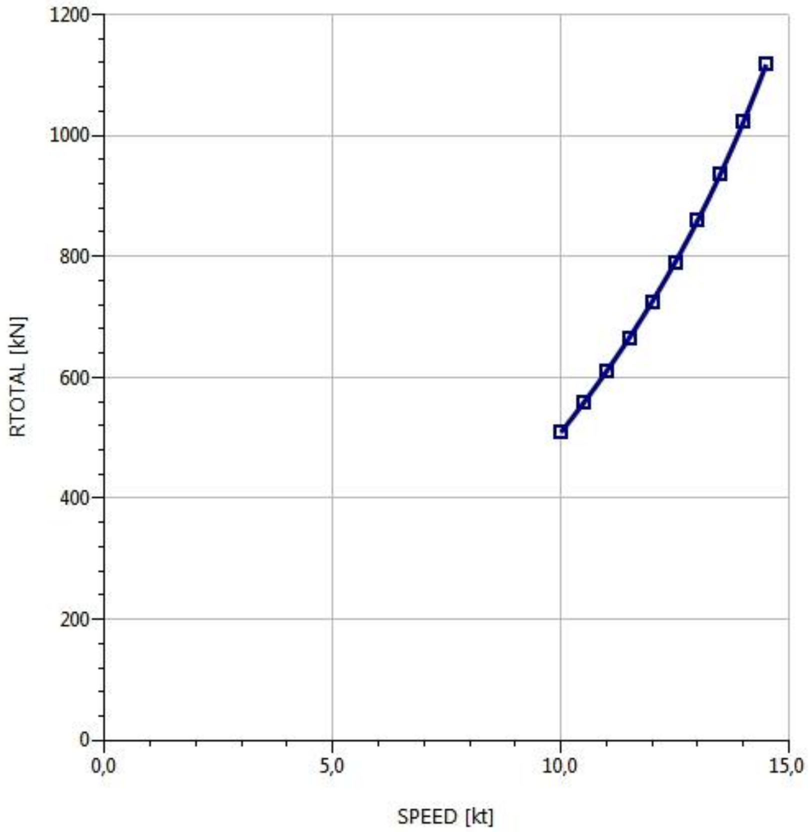
Agora para calcular o desprazamento só nos falta sumar as TPM.

Δ=70000+12849.72=**83766.53 toneladas**

Como vemos este desprazamento é inferior ao desprazamento que calcularamos co coeficiente de desprazamento así que de momento o noso buque está cumprindo.

7.2. Estimación da potencia propulsiva.

Para a estimación da potencia propulsiva utilizouse o programa NavCad cuxos resultados obtidos son os que se mostran a continuación:



Resistance

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Description
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Analysis parameters

Vessel drag	ITTC-78 (CT)	Added drag	
Technique:	[Calc] Prediction	Appendage:	[Calc] Percentage
Prediction:	Holtrop	Wind:	[Off]
Reference ship:		Seas:	[Off]
Model LWL:		Shallow/channel:	[Off]
Expansion:	Custom	Towed:	[Off]
Friction line:	ITTC-57	Margin:	[Calc] Hull drag only [15%]
Hull form factor:	[On] 1,179	**Water properties**	
Speed corr:	[Off]	Water type:	Salt
Spray drag corr:	[Off]	Density:	1026,00 kg/m3
Corr allowance:	0,000176	Viscosity:	1,18920e-6 m2/s
Roughness [mm]:	[On] 0,15		

Prediction method check [Holtrop]

Parameters	FN [design]	CP	LWL/BWL	BWL/T	Lambda
Value	0,16	0,85	6,63	2,21	1,03
Range	0,06··0,26	0,55··0,85	3,90··14,90	2,10··4,00	0,01··1,07

Prediction results

	SPEED COEFS		ITTC-78 COEFS						
SPEED [kt]	FN	FV	RN	CF	[CTLT/CF]	CR	dCF	CA	CT
10,00	0,112	0,248	9,25e8	0,001546	1,179	0,000741	0,000000	0,000176	0,002739
10,50	0,118	0,260	9,71e8	0,001536	1,179	0,000737	0,000000	0,000176	0,002725
11,00	0,124	0,272	1,02e9	0,001527	1,179	0,000737	0,000000	0,000176	0,002714
11,50	0,129	0,285	1,06e9	0,001519	1,179	0,000742	0,000000	0,000176	0,002709
12,00	0,135	0,297	1,11e9	0,001511	1,179	0,000753	0,000000	0,000176	0,002711
12,50	0,140	0,310	1,16e9	0,001503	1,179	0,000772	0,000000	0,000176	0,002720
13,00	0,146	0,322	1,20e9	0,001496	1,179	0,000798	0,000000	0,000176	0,002739
13,50	0,152	0,334	1,25e9	0,001489	1,179	0,000835	0,000000	0,000176	0,002767
14,00	0,157	0,347	1,29e9	0,001483	1,179	0,000883	0,000000	0,000176	0,002807
+ 14,50 +	0,163	0,359	1,34e9	0,001476	1,179	0,000944	0,000000	0,000176	0,002860

	RESISTANCE								
SPEED [kt]	RBARE [kN]	RAPP [kN]	RWIND [kN]	RSEAS [kN]	RCHAN [kN]	RTOWED [kN]	RMARGIN [kN]	RTOTAL [kN]	
10,00	424,20	21,21	0,00	0,00	0,00	63,63	63,63	509,04	
10,50	465,14	23,26	0,00	0,00	0,00	69,77	69,77	558,16	
11,00	508,54	25,43	0,00	0,00	0,00	76,28	76,28	610,24	
11,50	554,80	27,74	0,00	0,00	0,00	83,22	83,22	665,76	
12,00	604,45	30,22	0,00	0,00	0,00	90,67	90,67	725,34	
12,50	658,14	32,91	0,00	0,00	0,00	98,72	98,72	789,77	
13,00	716,65	35,83	0,00	0,00	0,00	107,50	107,50	859,98	
13,50	780,92	39,05	0,00	0,00	0,00	117,14	117,14	937,10	
14,00	852,02	42,60	0,00	0,00	0,00	127,80	127,80	1022,43	
+ 14,50 +	931,19	46,56	0,00	0,00	0,00	139,68	139,68	1117,43	

	EFFECTIVE POWER		OTHER		
SPEED [kt]	PEBARE [kW]	PETOTAL [kW]	CTLR	CTLT	RBARE/W
10,00	2182,3	2618,7	0,01060	0,03916	0,00049
10,50	2512,5	3015,0	0,01054	0,03895	0,00054
11,00	2877,7	3453,3	0,01054	0,03880	0,00059
11,50	3282,3	3938,7	0,01061	0,03873	0,00065
12,00	3731,5	4477,8	0,01077	0,03875	0,00070
12,50	4232,2	5078,6	0,01103	0,03889	0,00077
13,00	4792,8	5751,4	0,01141	0,03915	0,00084
13,50	5423,5	6508,2	0,01194	0,03956	0,00091
14,00	6136,5	7363,8	0,01263	0,04013	0,00099
+ 14,50 +	6946,1	8335,4	0,01349	0,04089	0,00109

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Hull data

General			Planing		
Configuration:		**Monohull**	*Proj chine length:*		***0,000 m***
Chine type:		**Round/multiple**	*Proj bottom area:*		***0,0 m2***
Length on WL:		**213,790 m**	*LCG fwd TR:*	*[XCG/LP 0,000]*	***0,000 m***
Max beam on WL:	[LWL/BWL 6,629]	**32,250 m**	*VCG below WL:*		***0,000 m***
Max molded draft:	[BWL/T 2,212]	**14,580 m**	*Aft station (fwd TR):*		***0,000 m***
Displacement:	[CB 0,848]	**87500,00 t**	*Deadrise:*		***0,00 deg***
Wetted surface:	[CS 2,671]	**11405,4 m2**	*Chine beam:*		***0,000 m***
ITTC-78 (CT)			*Chine ht below WL:*		***0,000 m***
LCB fwd TR:	[XCB/LWL 0,483]	**103,190 m**	*Fwd station (fwd TR):*		***0,000 m***
LCF fwd TR:	[XCF/LWL 0,483]	**103,190 m**	*Deadrise:*		***0,00 deg***
Max section area:	[CX 0,999]	**469,6 m2**	*Chine beam:*		***0,000 m***
Waterplane area:	[CWP 0,918]	**6326,1 m2**	*Chine ht below WL:*		***0,000 m***
Bulb section area:		**22,9 m2**	*Propulsor type:*		***Propeller***
Bulb ctr below WL:		**12,120 m**	*Max prop diameter:*		***8500,0 mm***
Bulb nose fwd TR:		**216,000 m**	*Shaft angle to WL:*		***0,00 deg***
Imm transom area:	[ATR/AX 0,026]	**12,1 m2**	*Position fwd TR:*		***0,000 m***
Transom beam WL:	[BTR/BWL 0,624]	**20,110 m**	*Position below WL:*		***0,000 m***
Transom immersion:	[TTR/T 0,000]	**0,000 m**	*Transom lift device:*		***Flap***
Half entrance angle:		**46,08 deg**	*Device count:*		***0***
Bow shape factor:	[AVG flow]	**0,0**	*Span:*		***0,000 m***
Stern shape factor:	[AVG flow]	**0,0**	*Chord length:*		***0,000 m***
			Deflection angle:		***0,00 deg***
			Tow point fwd TR:		***0,000 m***
			Tow point below WL:		***0,000 m***

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Appendage data

General		Skeg/Keel	
Definition:	**Percentage**	Count:	**0**
Percent of hull drag:	**5,00 %**	Type:	**Skeg**
Planing influence		Mean length:	**0,000 m**
LCE fwd TR:	**0,000 m**	Mean width:	**0,000 m**
VCE below WL:	**0,000 m**	Height aft:	**0,000 m**
Shafting		Height mid:	**0,000 m**
Count:	**1**	Height fwd:	**0,000 m**
Max prop diameter:	**8500,0 mm**	Projected area:	**0,0 m2**
Shaft angle to WL:	**0,00 deg**	Wetted surface:	**0,0 m2**
Exposed shaft length:	**0,000 m**	**Stabilizer**	
Shaft diameter:	**0,000 m**	Count:	**0**
Wetted surface:	**0,0 m2**	Root chord:	**0,000 m**
Strut bossing length:	**0,000 m**	Tip chord:	**0,000 m**
Bossing diameter:	**0,000 m**	Span:	**0,000 m**
Wetted surface:	**0,0 m2**	T/C ratio:	**0,000**
Hull bossing length:	**0,000 m**	LE sweep:	**0,00 deg**
Bossing diameter:	**0,000 m**	Wetted surface:	**0,0 m2**
Wetted surface:	**0,0 m2**	Projected area:	**0,0 m2**
Strut (per shaft line)		Dynamic multiplier:	**1,00**
Count:	**0**	**Bilge keel**	
Root chord:	**0,000 m**	Count:	**0**
Tip chord:	**0,000 mm**	Mean length:	**0,000 m**
Span:	**0,000 m**	Mean base width:	**0,000 m**
T/C ratio:	**0,000**	Mean projection:	**0,000 m**
Projected area:	**0,0 m2**	Wetted surface:	**0,0 m2**
Wetted surface:	**0,0 m2**	**Tunnel thruster**	
Exposed palm depth:	**0,000 m**	Count:	**0**
Exposed palm width:	**0,000 m**	Diameter:	**0,000 m**
Rudder		**Sonar dome**	
Count:	**0**	Count:	**0**
Rudder location:	**Behind propeller**	Wetted surface:	**0,0 m2**
Type:	**Balanced foil**	**Miscellaneous**	
Root chord:	**0,000 m**	Count:	**0**
Tip chord:	**0,000 m**	Drag area:	**0,0 m2**
Span:	**0,000 m**	Drag coef:	**0,00**
T/C ratio:	**0,000**		
LE sweep:	**0,00 deg**		
Projected area:	**0,0 m2**		
Wetted surface:	**0,0 m2**		

Environment data

Wind		Seas	
Wind speed:	**0,00 kt**	Significant wave ht:	**0,000 m**
Angle off bow:	**0,00 deg**	Modal wave period:	**0,0 sec**
Gradient correction:	**Off**	**Shallow/channel**	
Exposed hull		Water depth:	**0,000 m**
Transverse area:	**0,0 m2**	Type:	**Shallow water**
VCE above WL:	**0,000 m**	Channel width:	**0,000 m**
Profile area:	**0,0 m2**	Channel side slope:	**0,00 deg**
Superstructure		Hull girth:	**0,000 m**
Superstructure shape:	**Cargo ship**		
Transverse area:	**0,0 m2**		
VCE above WL:	**0,000 m**		
Profile area:	**0,0 m2**		

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Symbols and values

SPEED = Vessel speed
FN = Froude number [LWL]
FV = Froude number [VOL]

RN = Reynolds number [LWL]
CF = Frictional resistance coefficient
CV/CF = Viscous/frictional resistance coefficient ratio [dynamic form factor]
CR = Residuary resistance coefficient
dCF = Added frictional resistance coefficient for roughness
CA = Correlation allowance [dynamic]
CT = Total bare-hull resistance coefficient

RBARE = Bare-hull resistance
RAPP = Additional appendage resistance
RWIND = Additional wind resistance
RSEAS = Additional sea-state resistance
RCHAN = Additional shallow/channel resistance
RTOWED = Additional towed object resistance
RMARGIN = Resistance margin
RTOTAL = Total vessel resistance

PEBARE = Bare-hull effective power
PETOTAL = Total effective power

CTLR = Telfer residuary resistance coefficient
CTLT = Telfer total bare-hull resistance coefficient
RBARE/W = Bare-hull resistance to weight ratio

+ = Design speed indicator
* = Exceeds parameter limit

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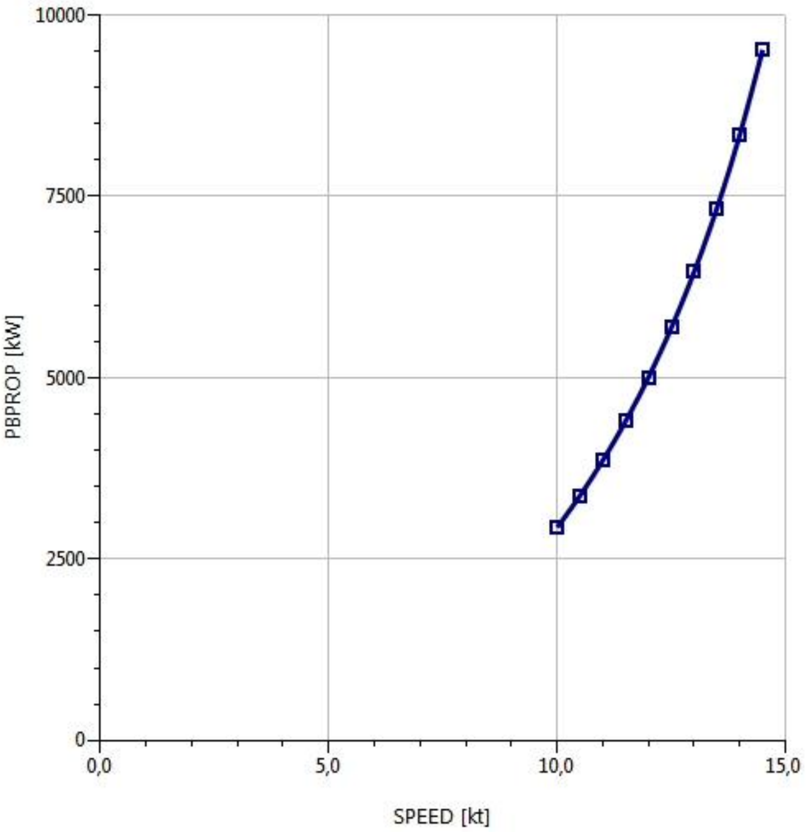

Propulsion

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Project ID
Description
File name **datos 1.hcnc**

Analysis parameters

Hull-propulsor interaction		System analysis	
Technique:	[Calc] Prediction	Cavitation criteria:	Keller eqn
Prediction:	Holtrop	Analysis type:	Free run
Reference ship:		CPP method:	
Max prop diam:	8500,0 mm	Engine RPM:	
Corrections		Mass multiplier:	
Viscous scale corr:	[Off]	RPM constraint:	
Rudder location:		Limit [RPM/s]:	
Friction line:		**Water properties**	
Hull form factor:		Water type:	Salt
Corr allowance:		Density:	1026,00 kg/m3
Roughness [mm]:		Viscosity:	1,18920e-6 m2/s
Ducted prop corr:	[Off]		
Tunnel stern corr:	[Off]		
Effective diam:			
Recess depth:			

Prediction method check [Holtrop]

Parameters	FN [design]	CP	LWL/BWL	BWL/T
Value	0,16	0,85	6,63	2,21
Range	0,06··0,80	0,55··0,85	3,90··14,90	2,10··4,00

Prediction results [System]

	HULL-PROPULSOR				ENGINE			
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]
10,00	2618,7	0,6768	0,1922	1,0271	71	2935,1	---	0,0
10,50	3015,0	0,6763	0,1922	1,0271	74	3373,8	---	0,0
11,00	3453,3	0,6758	0,1922	1,0271	78	3860,3	---	0,0
11,50	3938,7	0,6753	0,1922	1,0271	81	4401,6	---	0,0
12,00	4477,8	0,6749	0,1922	1,0271	85	5006,9	---	0,0
12,50	5078,6	0,6745	0,1922	1,0271	89	5687,8	---	0,0
13,00	5751,4	0,6741	0,1922	1,0271	92	6459,3	---	0,0
13,50	6508,2	0,6737	0,1922	1,0271	96	7339,6	---	0,0
14,00	7363,8	0,6733	0,1922	1,0271	101	8351,3	---	0,0
+ 14,50 +	8335,4	0,6730	0,1922	1,0271	105	9521,3	---	0,0

	POWER DELIVERY							
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP
10,00	43	644,18	393,28	2847,0	2935,1	2935,1	2935,1	---
10,50	45	706,57	431,37	3272,6	3373,8	3373,8	3373,8	---
11,00	48	772,69	471,74	3744,5	3860,3	3860,3	3860,3	---
11,50	50	843,14	514,75	4269,5	4401,6	4401,6	4401,6	---
12,00	52	918,67	560,87	4856,6	5006,9	5006,9	5006,9	---
12,50	54	1000,23	610,66	5517,2	5687,8	5687,8	5687,8	970,1
13,00	56	1088,98	664,84	6265,5	6459,3	6459,3	6459,3	888,4
13,50	59	1186,27	724,24	7119,4	7339,6	7339,6	7339,6	812,0
14,00	61	1293,70	789,83	8100,7	8351,3	8351,3	8351,3	740,0
+ 14,50 +	64	1413,02	862,67	9235,7	9521,3	9521,3	9521,3	672,3

	EFFICIENCY				THRUST	
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]
10,00	0,3584	1,0000	0,8922	0,70906	630,19	509,04
10,50	0,3595	1,0000	0,8937	0,70826	691,00	558,16
11,00	0,3604	1,0000	0,8946	0,70763	755,47	610,24
11,50	0,3610	1,0000	0,8948	0,70719	824,20	665,76
12,00	0,3613	1,0000	0,8943	0,707	897,96	725,34
12,50	0,3612	1,0000	0,8929	0,70708	977,72	789,77
13,00	0,3606	1,0000	0,8904	0,70748	1064,64	859,98
13,50	0,3595	1,0000	0,8867	0,70823	1160,11	937,10
14,00	0,3579	1,0000	0,8818	0,70936	1265,75	1022,43
+ 14,50 +	0,3557	1,0000	0,8754	0,71088	1383,34	1117,42

Propulsion

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Prediction results [Propulsor]

SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
	PROPULSOR COEFS								
10,00	0,2708	0,2255	0,02711	3,0748	1,3656	7,8298	21,273	3,82e7	
10,50	0,2717	0,2251	0,02708	3,0482	1,3494	7,7623	21,022	4,01e7	
11,00	0,2725	0,2248	0,02705	3,0274	1,3369	7,7093	20,826	4,19e7	
11,50	0,2730	0,2246	0,02703	3,0133	1,3283	7,6734	20,693	4,38e7	
12,00	0,2732	0,2245	0,02702	3,007	1,3245	7,6574	20,634	4,57e7	
12,50	0,2731	0,2246	0,02703	3,0098	1,3262	7,6643	20,66	4,77e7	
13,00	0,2727	0,2247	0,02704	3,0228	1,334	7,6975	20,782	4,98e7	
13,50	0,2718	0,2251	0,02708	3,0474	1,3489	7,7601	21,014	5,19e7	
14,00	0,2704	0,2256	0,02713	3,0849	1,3717	7,8555	21,369	5,41e7	
+ 14,50 +	0,2686	0,2263	0,02719	3,1364	1,4032	7,9868	21,86	5,65e7	

SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
	CAVITATION								
10,00	70,32	5,16	1,05	19,29	0,419	16,33	2,0	2,0	4570,5
10,50	63,58	4,69	0,96	20,22	0,440	17,91	2,0	2,0	4573,5
11,00	57,76	4,29	0,87	21,15	0,462	19,58	2,0	2,0	4575,9
11,50	52,69	3,93	0,80	22,10	0,486	21,36	2,0	2,0	4577,5
12,00	48,26	3,60	0,73	23,08	0,512	23,27	2,3	2,3	4578,3
12,50	44,37	3,31	0,67	24,08	0,539	25,34	2,6	2,6	4577,9
13,00	40,92	3,04	0,62	25,11	0,569	27,59	3,0	3,0	4576,4
13,50	37,86	2,80	0,57	26,20	0,602	30,07	3,5	3,5	4573,6
14,00	35,13	2,57	0,52	27,33	0,639	32,81	4,1	4,1	4569,4
+ 14,50 +	32,68	2,36	0,48	28,53	0,680	35,85	4,8	4,8	4563,6

Report ID20160509-1120 HydroComp NavCad 2014 14.02.0029.S1002.539

Propulsion

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HydroComp NavCad 2014

Project ID
Description
File name **datos 1.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**213,790 m**
Max beam on WL:	[LWL/BWL 6,629]	**32,250 m**
Max molded draft:	[BWL/T 2,212]	**14,580 m**
Displacement:	[CB 0,848]	**87500,00 t**
Wetted surface:	[CS 2,671]	**11405,4 m2**
ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,483]	**103,190 m**
LCF fwd TR:	[XCF/LWL 0,483]	**103,190 m**
Max section area:	[CX 0,999]	**469,6 m2**
Waterplane area:	[CWP 0,918]	**6326,1 m2**
Bulb section area:		**22,9 m2**
Bulb ctr below WL:		**12,120 m**
Bulb nose fwd TR:		**216,000 m**
Imm transom area:	[ATR/AX 0,026]	**12,1 m2**
Transom beam WL:	[BTR/BWL 0,624]	**20,110 m**
Transom immersion:	[TTR/T 0,000]	**0,000 m**
Half entrance angle:		**46,08 deg**
Bow shape factor:	[AVG flow]	**0,0**
Stern shape factor:	[AVG flow]	**0,0**

Planing		
Proj chine length:		***0,000 m***
Proj bottom area:		***0,0 m2***
LCG fwd TR:	*[XCG/LP 0,000]*	***0,000 m***
VCG below WL:		***0,000 m***
Aft station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Fwd station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Propulsor type:		***Propeller***
Max prop diameter:		***8500,0 mm***
Shaft angle to WL:		***0,00 deg***
Position fwd TR:		***0,000 m***
Position below WL:		***0,000 m***
Transom lift device:		***Flap***
Device count:		***0***
Span:		***0,000 m***
Chord length:		***0,000 m***
Deflection angle:		***0,00 deg***
Tow point fwd TR:		***0,000 m***
Tow point below WL:		***0,000 m***

Propulsor data

Propulsor			
Count:		**1**	
Propulsor type:		**Propeller series**	
Propeller type:		**FPP**	
Propeller series:		**B Series**	
Propeller sizing:		**By thrust**	
Reference prop:			
Blade count:		**4**	
Expanded area ratio:		**0,6799**	**[Size]**
Propeller diameter:		**8500,0 mm**	**[Size]**
Propeller mean pitch:	[P/D 0,7248]	**6161,1 mm**	**[Size]**
Hub immersion:		**11,1 mm**	
Engine/gear			
Engine data:			
Rated RPM:		**0 RPM**	
Rated power:		**0,0 kW**	
Gear efficiency:		**1,000**	
Load correction:		**Off**	
Gear ratio:		**1,638**	**[Size]**
Shaft efficiency:		**0,970**	

Propeller options	
Oblique angle corr:	**Off**
Shaft angle to WL:	**0,00 deg**
Added rise of run:	**0,00 deg**
Propeller cup:	**0,0 mm**
KTKQ corrections:	**Custom**
Scale correction:	**None**
KT multiplier:	**1,000**
KQ multiplier:	**1,000**
Blade T/C [0.7R]:	**0,00**
Roughness:	**0,00 mm**
Cav breakdown:	**Off**
Design condition	
Max prop diam:	**8500,0 mm**
Design speed:	**14,50 kt**
Reference power:	**0,0 kW**
Design point:	**0,000**
Reference RPM:	**100,0**
Design point:	**1,050**

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Propulsion

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Project ID
Description
File name **datos 1.hcnc**

Symbols and values

SPEED = Vessel speed

PETOTAL = Total vessel effective power
WFT = Taylor wake fraction coefficient
THD = Thrust deduction coefficient
EFFR = Relative-rotative efficiency

RPMENG = Engine RPM
PBPROP = Brake power per propulsor
FUEL = Fuel rate per engine
LOADENG = Percentage of engine max available power at given RPM

RPMPROP = Propulsor RPM
QPROP = Propulsor open water torque
QENG = Engine torque
PDPROP = Delivered power per propulsor
PSPROP = Shaft power per propulsor
PSTOTAL = Total vessel shaft power
PBTOTAL = Total vessel brake power
TRANSP = Transport factor

EFFO = Propulsor open-water efficiency
EFFG = Gear efficiency (load corrected)
EFFOA = Overall propulsion efficiency [=PETOTAL/PSTOTAL]
MERIT = Propulsor merit coefficient

THRPROP = Open-water thrust per propulsor
DELTHR = Total vessel delivered thrust

J = Propulsor advance coefficient
KT = Propulsor thrust coefficient [horizontal, if in oblique flow]
KQ = Propulsor torque coefficient
KTJ2 = Propulsor thrust loading ratio
KQJ3 = Propulsor torque loading ratio
CTH = Horizontal component of bare-hull resistance coefficient
CP = Propulsor thrust loading coefficient
RNPROP = Propeller Reynolds number at 0.7R

SIGMAV = Cavitation number of propeller by vessel speed
SIGMAN = Cavitation number of propeller by RPM
SIGMA07R = Cavitation number of blade section at 0.7R
TIPSPEED = Propeller circumferential tip speed
MINBAR = Minimum expanded blade area ratio recommended by selected cavitation criteria
PRESS = Average propeller loading pressure
CAVAVG = Average predicted back cavitation percentage
CAVMAX = Peak predicted back cavitation percentage [if in oblique flow]
PITCHFC = Minimum recommended pitch to avoid face cavitation

+ = Design speed indicator
* = Exceeds recommended parameter limit
! = Exceeds recommended cavitation criteria [warning]
!! = Substantially exceeds recommended cavitation criteria [critical]
!!! = Thrust breakdown is indicated [severe]
--- = Insignificant or not applicable

Report ID20160509-1120 HydroComp NavCad 2014 14.02.0029.S1002.539

Como podemos ver dos resultados, obtemos unha potencia propulsiva de 9521 kW.

7.3. Comprobación do peso morto

Para calcular o peso morto debemos calcular o peso que suman os seguintes apartados:

- Carga útil.
- Tripulación e pasaxe.
- Pertrechos.
- Consumos.

Carga útil

Como carga útil tomamos as 70000 toneladas que o buque debe poder transportar tal e como di a RPA.

P_{Cu}=70000 t

Tripulación e pasaxe

O número de tripulantes é de 25 como establece a RPA. Segundo as recomendación do libro *Proyectos de buques y artefactos* considéranse 125 kg por tripulante. Polo tanto:

P_{Tr}=25*125=3125 kg=3.125 toneladas

Pertrechos

Neste apartado tomaremos como peso dos pertrechos P_{Per}= 60 toneladas aínda que este valor sería un valor que debería darnos o armador.

Consumos

Neste apartado inclúense os seguintes conceptos:

- Combustible.
- Aceite.
- Auga doce, auga de alimentación e auga potable.
- Víveres.

Todos eles dependen da autonomía do buque. Esta ven definida na RPA e son 11000 millas.

Calculando que se recorran á velocidade de servizo a autonomía en horas será de:

Autonomía=11000 millas/14.5 nudos=758.62 horas=31.61 días

O motor deste buque utiliza tanto diésel como LNG polo tanto calcularemos as necesidades de cada un.

Para o caso en que utilizásemos o modo diésel unicamente teríamos un consumo medio de 180 g/kWh o que faría que necesitásemos:

$$P_{Di}=180*758.62*9521=1300.11 \text{ t}$$

Para o caso no que utilizásemos o modo gas o consumo de gas sería de 139.2 g/kWh e polo tanto necesitaríamos:

$$P_{gas}=139.2*758.62*9511=1005.42 \text{ t}$$

Para este mesmo modo de gas o consumo de diésel sería de 1.6 g/kWh e polo tanto estaría máis que cuberto coa cantidade de diésel que xa temos para o modo solo diésel.

Para o caso do aceite recoméndase que sexa sobre un 3-4% do peso total do combustible de propulsión. Tomaremos o 3.5% do peso do diésel en modo diésel.

$$P_{Oil}=0.035*P_{Di}=0.035*1300.11= 45.5 \text{ t}$$

Ademais vaise a dispoñer unha capacidade de tanques de auga potable de 200 litros por persoa e día, é dicir:

$$P_{AP}=200\text{l/pers. día}*25\text{persoas}*1\text{kg/l}*31.61 \text{ días}=158050\text{kg}=158.05 \text{ t}$$

Por último, o peso de víveres recomendado para buques mercantes é de 5 kg por persoa e día e polo tanto:

$$P_{Vi}=5*25*31.61= 3951.25 \text{ kg}=3.951 \text{ t}$$

Finalmente o peso total dos consumos será:

$$P_{Con}=P_{Di}+ P_{gas}+ P_{Oil}+ P_{AP}+ P_{Vi}$$

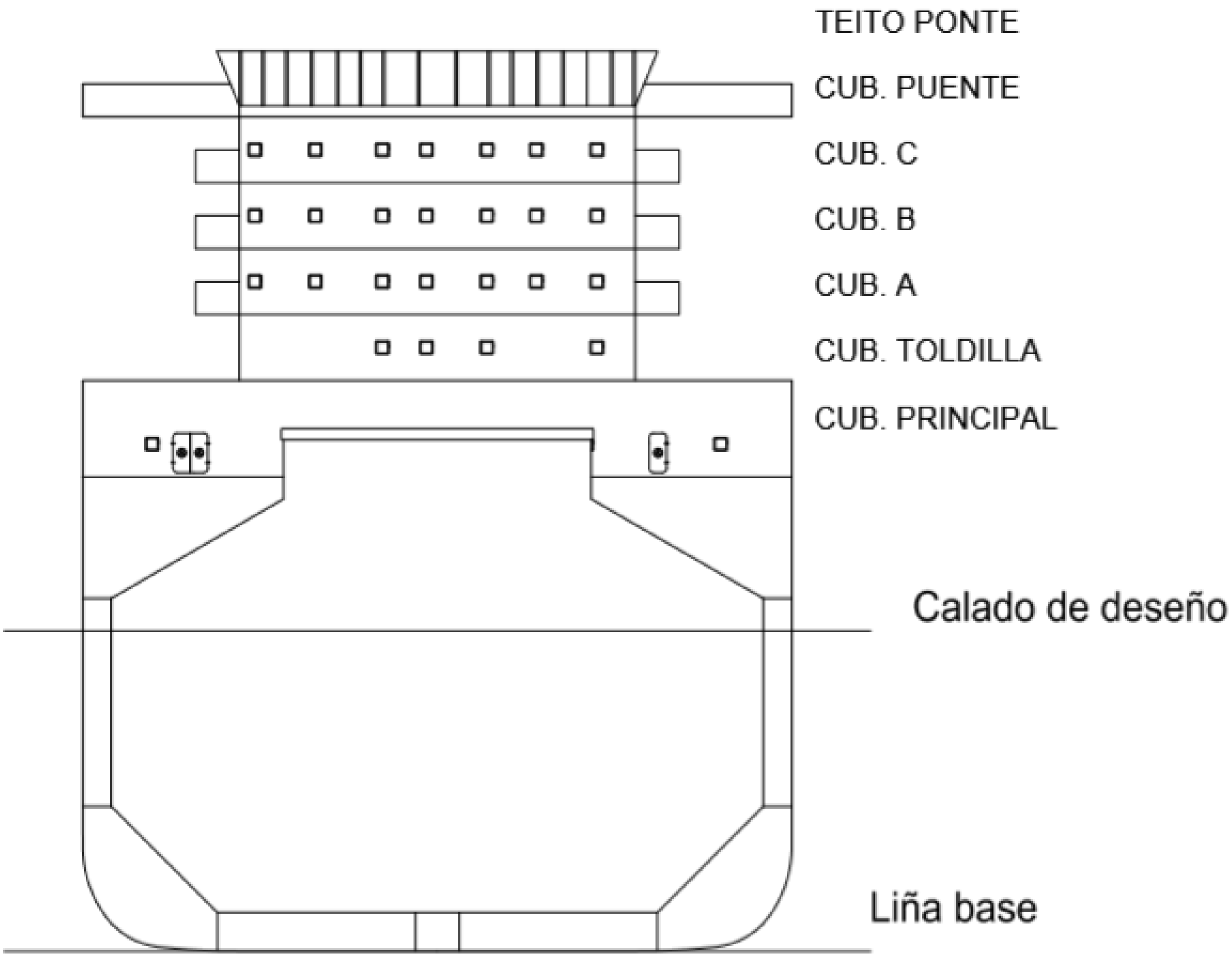
$$P_{Con}=2513.03 \text{ t}$$

Calculados os consumos podemos calcular xa o peso morto total que será:

$$P_{morto}= P_{Cu}+ P_{Tr}+ P_{Per}+ P_{Con}$$

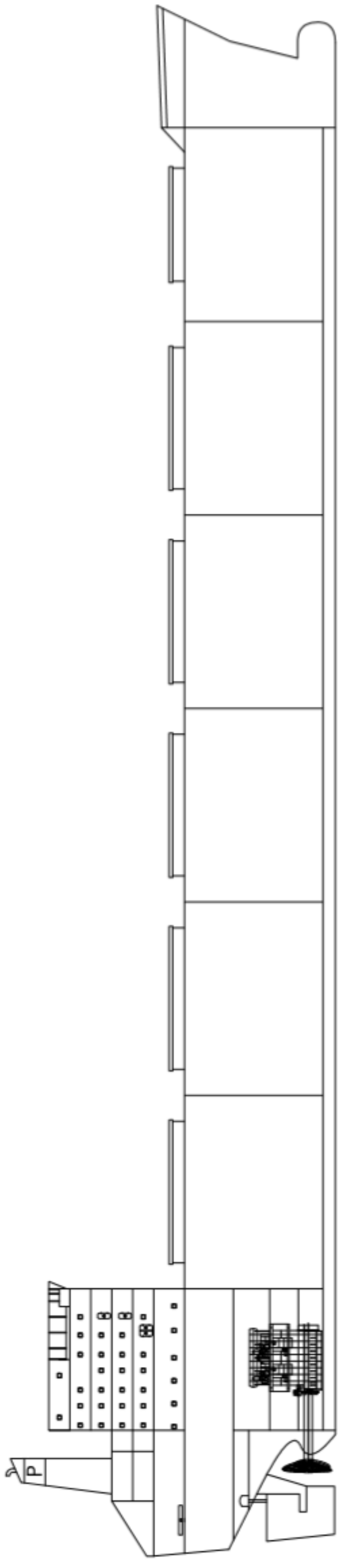
Peso morto=2576.15 t

8. Croquis preliminar.



Sección transversal.

Sección lonxitudinal.



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ANEXO I.

	1980	1981	1982	1983	1984	1985
Total fleet	672142,5	679704,8	686028,9	690093,1	681538,9	668140,1
Oil tankers	337895,6	338616,3	334237,8	323668,2	304466,3	284945,9
Bulk carriers	181880,3	184501,2	193217,2	204630,7	212915,2	218518,1
General cargo	112840,9	114832,9	113293,8	113269,1	111863	108308,4
Container ships	10290,11	11060,52	12108,26	12809,77	14088,79	17266,77
Other types of ships	29235,64	30693,84	33171,79	35715,38	38205,51	39101,01

	1986	1987	1988	1989	1990	1991
Total fleet	654327,4	632237,8	625045,8	620734,2	629976	651282
Oil tankers	258932,4	238144,5	234908,4	233608,5	235785	244818
Bulk carriers	227550,8	226967,4	223659,1	222432	223619	230028
General cargo	103921	100222	97110,25	93795,68	100457	102109
Container ships	18732,55	20180,65	21489,53	22295,22	22346	23611
Other types of ships	45190,68	46723,25	47878,48	48602,75	47770	50716

	1992	1993	1994	1995	1996	1997
Total fleet	674421,1	683639	699744,5	719216,2	731870,5	755297,9
Oil tankers	255657,2	261081,5	269289,3	270942,4	266708,2	270899,1
Bulk carriers	236143,1	234696,6	236843,3	250142,4	261168,6	271702,3
General cargo	102931,7	104193,3	106185,6	103502,8	103052,4	103556,1
Container ships	27251,89	29844,26	32045,91	38923,35	43805,67	48732,52
Other types of ships	52437,16	53823,32	55380,43	55705,12	57135,54	60407,95

	1998	1999	2000	2001	2002	2003
Total fleet	772801,2	785331,1	793770,8	802771,5	822011,4	841735
Oil tankers	271633,3	280276,9	283065,7	284864,3	286001,4	308683,1
Bulk carriers	280055,2	274689,6	274445,4	280323,4	294780	296140,2
General cargo	102563,3	101757,1	101519,6	99895,17	95693,19	96457,01
Container ships	56076,26	61154,93	63580,49	69124,02	77328,68	83281,35
Other types of ships	62473,23	67452,6	71159,62	68564,57	68208,18	57173,28

	2004	2005	2006	2007	2008	2009
Total fleet	863667,5	907474,3	965006,2	1042328	1117779	1192317
Oil tankers	320657,8	340748,4	356109,2	382975	407880,9	418266,4
Bulk carriers	308935,2	325665,8	349720,6	367542,5	391127	418356
General cargo	94330,98	91827,05	96391,92	100934,2	105491,7	108880,8
Container ships	91621,15	100226,4	112702,2	128321,5	144654,7	161919
Other types of ships	48122,28	49006,64	52248,6	62554,41	68624,31	84894,96

	2010	2011	2012	2013	2014	2015
Total fleet	1276137	1415110	1532114	1625750	1691628	1749222
Oil tankers	450052,7	439932	454348,7	472889,5	482017,4	489388,3
Bulk carriers	456623,2	547191,6	624021,9	686635	726318,7	760467,7
General cargo	108231,6	81159,28	78137,86	77589,26	77551,63	76730,76
Container ships	169157,5	183691,4	196821	206546,6	216344,8	227741,4
Other types of ships	92072,16	163135,5	178784,2	182090,1	189395,1	194893,4

ANEXO II.

Pricipales Mercaderías Transportadas a Través del Canal de Panamá
Años Fiscales 2013 a 2015
(Miles de Toneladas Largas[(1)])

Rumbo Sur – Atlántico a Pacífico 2013	2014	2015	MERCADERÍAS	Rumbo Norte – Pacífico a Atlántico 2015	2014	2013
29,209	**44,679**	**49,084**	**Granos:**	**2,939**	**3,943**	**3,666**
44	-	44	Cebada	24	45	77
7,137	13,164	11,765	Maíz	515	538	349
297	191	387	Arroz	372	529	342
3,619	8,426	13,835	Sorgo	446	712	304
13,888	18,964	19,432	Soya, frijol	41	52	156
2,429	1,529	1,067	Trigo	1,342	1,807	1,957
1,795	2,406	2,555	Otros y no clasificados	200	260	481
23,289	**21,885**	**18,418**	**Carga Contenerizada**	**21,594**	**24,952**	**27,122**
33,991	**32,230**	**36,772**	**Petróleo y Sus Derivados:**	**9,713**	**8,452**	**6,942**
1,973	2,372	2,959	Crudo	3,649	4,155	2,552
8,651	8,236	9,488	Diesel	273	334	207
5,858	6,293	9,139	Gasolina	1,409	1,109	1,307
341	351	286	Combustible de aviones de reacción	1,752	737	661
102	114	162	Querosén	619	342	172
1,505	2,213	4,074	Gas licuado	78	30	43
6,531	4,566	4,094	Coque de petróleo	851	811	1,146
4	-	1	Combustible residual	-	-	-
9,025	8,085	6,569	Otros y no clasificados	1,082	932	855
4,350	**3,702**	**2,001**	**Minerales y Menas:**	**12,313**	**11,353**	**9,910**
1,614	**1,884**	**1,261**	**Metales:**	**7,513**	**7,140**	**6,002**
488	646	381	Aluminio	5	7	46
13	7	-	Cobre	466	626	652
651	710	661	Hierro	6,842	6,387	4,652
-	-	-	Plomo	10	18	-
461	502	219	Chatarra	150	79	57
-	-	-	Estaño en hojas y metal	-	-	-
2	-	-	Zinc	14	24	589
-	20	-	Otros y no clasificados	25	-	5
2,736	**1,817**	**741**	**Menas:**	**4,801**	**4,213**	**3,908**
517	243	191	Alúmina/Bauxita	160	22	88
217	63	90	Cobre	2,160	1,945	2,116
1,758	1,258	105	Hierro	284	400	340
68	93	67	Plomo	283	214	209
-	-	29	Manganeso	145	128	168
151	55	40	Zinc	1,530	1,246	698
25	106	220	Otros y no clasificados	239	257	290
13,993	**11,671**	**7,499**	**Carbón Mineral y Coque (no incluye coque de petróleo):**	**2,526**	**2,618**	**2,250**
13,873	11,627	7,453	Carbón mineral	2,491	2,583	2,169
119	44	46	Coque	35	35	81
8,654	**8,393**	**8,608**	**Químicos y Petroquímicos:**	**5,117**	**4,101**	**4,015**
4,209	**4,504**	**5,316**	**Químicos:**	**2,533**	**2,178**	**2,324**
1,536	1,536	1,671	Compuestos de amoníaco	430	254	32
662	873	946	Soda cáustica	150	11	153
119	228	337	Metanol	54	158	198
-	-	-	Ácido Sulfúrico	-	-	-
1,893	1,866	2,361	Químicos misceláneos	1,899	1,755	1,940
4,445	**3,890**	**3,292**	**Petroquímicos:**	**2,584**	**1,923**	**1,692**
-	-	19	Benceno	1,252	903	687
-	-	-	Carbón hollín	-	-	11
62	11	8	Tolueno	71	54	80
421	441	457	Xileno	-	-	-
3,962	3,438	2,808	Petroquímicos misceláneos	1,261	966	914

Statistics and Models Administration Unit (MEEM) 1 TABLE NO. 7

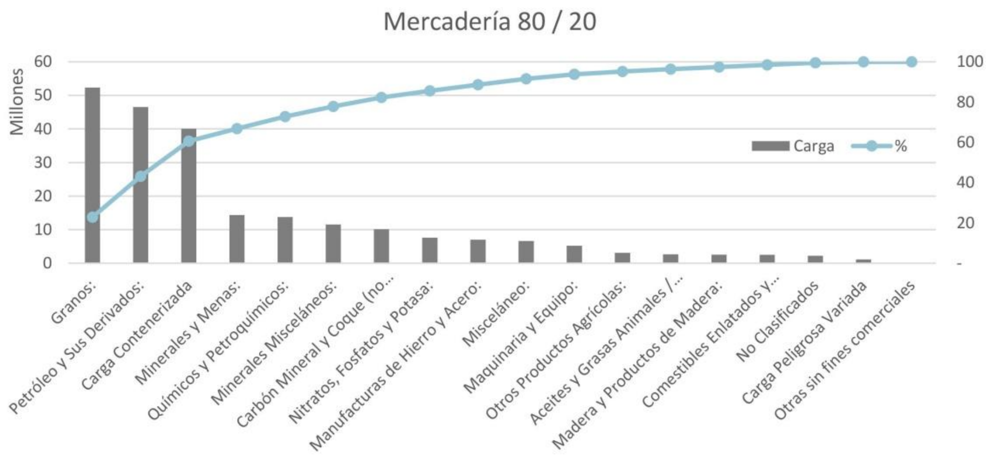
Pricipales Mercaderías Transportadas a Través del Canal de Panamá
Años Fiscales 2013 a 2015
(Miles de Toneladas Largas[1])

Rumbo Sur – Atlántico a Pacífico				Rumbo Norte – Pacífico a Atlántico		
2013	2014	2015	MERCADERÍAS	2015	2014	2013
167	**202**	**172**	**Minerales Misceláneos:**	**11,299**	**9,199**	**5,610**
-	-	2	Asbesto	-	-	-
-	-	-	Bórax	92	130	119
7	57	49	Sal	10,784	8,721	4,850
84	121	111	Soda y compuestos de sodio	153	89	144
76	24	10	Azufre	270	259	497
3,988	**4,116**	**3,958**	**Nitratos, Fosfatos y Potasa:**	**3,581**	**3,602**	**3,061**
6	-	-	Harina de pescado	8	-	-
-	-	-	Nitrato de soda	51	33	93
263	485	488	Fosfatos	1,060	975	513
16	4	12	Potasa	42	-	17
3,703	3,628	3,459	Fertilizantes misceláneos	2,419	2,594	2,437
2,846	**3,036**	**2,736**	**Misceláneo:**	**3,913**	**4,439**	**3,908**
1	7	-	Explosivos y municiones	1	-	-
-	-	-	Radiactivo	-	-	-
-	1	-	Carga militar U.S.	-	-	-
2	97	-	Ladrillos, tejas y losas	3	38	8
5	50	77	Cemento	335	559	433
266	283	215	Arcilla de alfarería y vajilla	-	-	-
643	119	46	Harina de trigo	57	108	-
-	-	5	Vidrio y artículos de vidrio	-	-	-
301	448	467	Comestibles misceláneos	198	289	278
-	-	-	Mármol y piedra	72	142	27
370	244	284	Papel y productos de papel	95	13	56
-	-	-	Porcelana, artículos de	27	8	20
56	-	1	Resina	79	73	-
19	29	17	Caucho manufacturado	12	19	7
-	-	-	Semilla (no incluye semilla oleaginosa)	38	-	35
295	333	255	Escoria y clinker	1,955	1,841	1,927
5	27	3	Textiles	-	3	-
3	5	-	Parafina	46	36	80
878	1,393	1,367	Carga Miscelánea	994	1,311	1,035
2,300	**1,685**	**539**	**Manufacturas de Hierro y Acero:**	**6,378**	**5,045**	**4,425**
11	47	8	Ángulos, formas y secciones de hierro y acero	20	21	15
30	12	20	Planchas, láminas y rollos	679	1,002	986
125	157	77	Tubería, cañería y acoplamientos de hierro y acero	550	382	421
401	338	116	Alambres, barras, vallas y varillas de hierro y acero	502	398	280
1,733	1,131	318	Otros y no clasificados	4,627	3,243	2,723
1,895	**1,898**	**1,800**	**Maquinaria y Equipo:**	**3,382**	**2,984**	**2,857**
5	**5**	**2**	Accesorios y partes para automóbiles y camiones	-	-	**3**
1,682	1,706	1,660	Autos y camiones	3,007	2,770	2,590
8	-	-	Maquinaria, implementos agrícolas	-	-	-
34	24	21	Maquinaria de construcción y equipos	49	22	47
49	28	32	Maquinaria eléctrica y aparatos	89	20	73
-	-	-	Motocicletas y bicicletas, partes	-	-	-
116	134	85	Otros y no clasificados	238	171	144
932	**1,380**	**935**	**Madera y Productos de Madera:**	**1,554**	**1,634**	**2,057**
-	-	-	Tablas	-	2	-
-	-	-	Madera terciada y hoja de madera	156	117	139
601	645	622	Pulpa de madera	413	920	1,059
331	736	313	Otros y no clasificados	985	595	859
436	**459**	**418**	**Aceites y Grasas Animales / Vegetales**	**2,216**	**2,414**	**2,626**
29	**39**	**20**	**Aceites y Grasas Animales**	**71**	**59**	**105**
3	11	-	Aceite de pescado	52	42	101

Statistics and Models Administration Unit (MEEM) 2 TABLE NO. 7

Pricipales Mercaderías Transportadas a Través del Canal de Panamá
Años Fiscales 2013 a 2015
(Miles de Toneladas Largas[1])

Rumbo Sur				Rumbo Norte		
Atlántico a Pacífico				Pacífico a Atlántico		
2013	2014	2015	MERCADERÍAS	2015	2014	2013
26	28	20	Sebo	19	17	4
407	**420**	**398**	**Aceites Vegetales y Molasas**	**2,145**	**2,355**	**2,521**
2	11	2	Melaza	821	622	607
-	-	2	Aceite de coco	207	260	302
34	45	68	Semilla oleaginosa	86	74	193
371	364	326	Otros y no clasificados	1,030	1,399	1,419
436	**513**	**992**	**Otros Productos Agrícolas:**	**2,102**	**2,063**	**1,304**
-	1	52	Frijoles comestibles	150	72	55
-	-	-	Guisantes secos	-	21	-
-	-	366	Pieles y cueros	15	-	-
436	511	573	Azucar	1,937	1,970	1,248
96	**58**	**145**	**Comestibles Enlatados y Refrigerados:**	**2,332**	**2,488**	**2,831**
-	**37**	**117**	**Comestibles enlatados:**	**18**	**26**	**37**
-	-	-	Pescado	18	26	37
-	30	105	Vegetales	-	-	-
-	7	13	Otros y no clasificados	-	-	-
96	**22**	**27**	**Comestibles refrigerados:**	**2,314**	**2,462**	**2,794**
45	9	-	Bananos/Guineos	1,731	1,847	1,971
27	7	27	Pescado	196	231	248
7	5	-	Frutas (no incluye bananos)	381	357	517
-	-	-	Carnes	-	-	-
17	-	-	Otros y no clasificados	5	27	57
1,502	**1,210**	**2,148**	**No Clasificados**	**799**	**91**	**153**
1,136	**765**	**1,035**	**Carga Peligrosa Variada**	**132**	**257**	**154**
129,220	**137,883**	**137,261**	**Total**	**91,888**	**89,635**	**82,889**

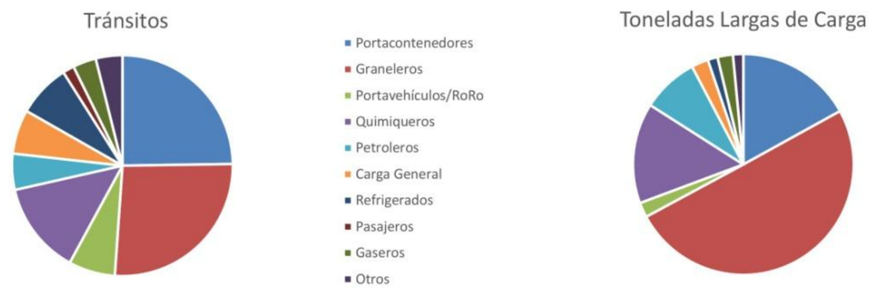


[1] Datos mostrados en miles están sujetos a diferencias de redondeo. Mercaderías con menos de 500 toneladas no aparecen en esta tabla.

ANEXO III.

Trafico de Naves a Través del Canal de Panamá por Segmento de Mercado[1]
Años Fiscales 2015 - 2014

Segmento de Mercado	Número de Tránsitos		Toneladas Netas CP/SUAB[2] (miles)		Toneladas Largas de Carga (miles)		Porcentaje de Incremento o Decremento		
	2015	2014	2015	2014	2015	2014	Tránsitos	CP/SUAB	Carga
Portacontenedores	3,067	2,891	115,105	111,025	38,895	45,639	6.1%	3.7%	(14.8%)
Graneleros	3,263	3,339	82,943	85,975	114,957	112,349	(2.3%)	(3.5%)	2.3%
Portavehículos/RoRo	844	815	48,207	45,836	4,979	4,604	3.6%	5.2%	8.2%
Quimiqueros	1,678	1,494	34,714	29,713	33,710	30,413	12.3%	16.8%	10.8%
Petroleros	655	585	18,336	15,650	18,991	17,518	12.0%	17.2%	8.4%
Carga General	803	883	9,042	9,492	5,663	6,915	(9.1%)	(4.7%)	(18.1%)
Refrigerados	963	999	8,988	9,308	3,319	3,230	(3.6%)	(3.4%)	2.8%
Pasajeros	208	218	8,374	9,107		-	(4.6%)	(8.0%)	0.0%
Gaseros	422	274	10,203	6,043	5,164	3,181	54.0%	68.8%	62.3%
Otros	483	458	4,136	3,733	3,465	3,670	5.5%	10.8%	(5.6%)
Total	**12,386**	**11,956**	**340,047**	**325,882**	**229,145**	**227,518**	**3.6%**	**4.3%**	**0.7%**



[1] Solo incluye naves de alto calado, aquellas que pagaron peajes mayores a las tarifas mínimas implementadas el 1 de junio de 1998.
[2] El sistema de arqueo del Canal de Panamá, conforme al Sistema Universal de Arqueo de Buques (CP/SUAB).
Esta cantidad también incluye las toneladas CP/SUAB de los buques portacontenedores y pasajeros.

Unidad de Estadísticas y Administración de Modelos (MEEM) 1 TABLA NO.10

ANEXO IV.

Thalassini Axia: Supramax bulk carrier from SPP Shipbuilding

Shipbuilder:	**SPP Shipbulding Co., Ltd**
Vessel's name:	***Thalassini Axia***
Hull No:	**H-1030**
Owner/operator:	**Enesel S.A**
Country:	**Greece**
Designer:	**Korea Maritime Consultants (KOMAC)**
Country:	**South Korea**
Model test establishment used:	**Maritime and Ocean Engineering Research Institute, KORDI (MOERI)**
Flag:	**Malta**
IMO number:	**9452490**
Total number of sister ships already completed (excluding ship presented):	**3**
Total number of sister ships still on order:	**0**

THALASSINI Axia is the first Supramax bulk carrier design in a series of four, to be constructed at SPP Sacheon Shipyard that has a deadweight of 58,608dwt that was delivered to its Greek owner Ensel S.A in March.

The vessel is an ocean going bulk carrier with a bulbous bow, a single cambered upper deck with forecastle, a transom stern, a single rudder, and a single screw propeller. The cargo area consists of five cargo holds having double bottom water ballast tanks with hopper and top side wing ballast tanks.

Thalassini Axia is 196m in length overall and a width of 32.26m with a depth of 18.60m. The 58,608dwt bulk carrier is the first of its type to be constructed at the shipyard. The vessel is powered by a MAN B&W Licensee 6S50MC-C produced by Doosan that has a power output of 7795kW giving the vessel a service speed of 15.15knots at 121.5 rev/min when running at 90% MCR power with a 15% sea margin.

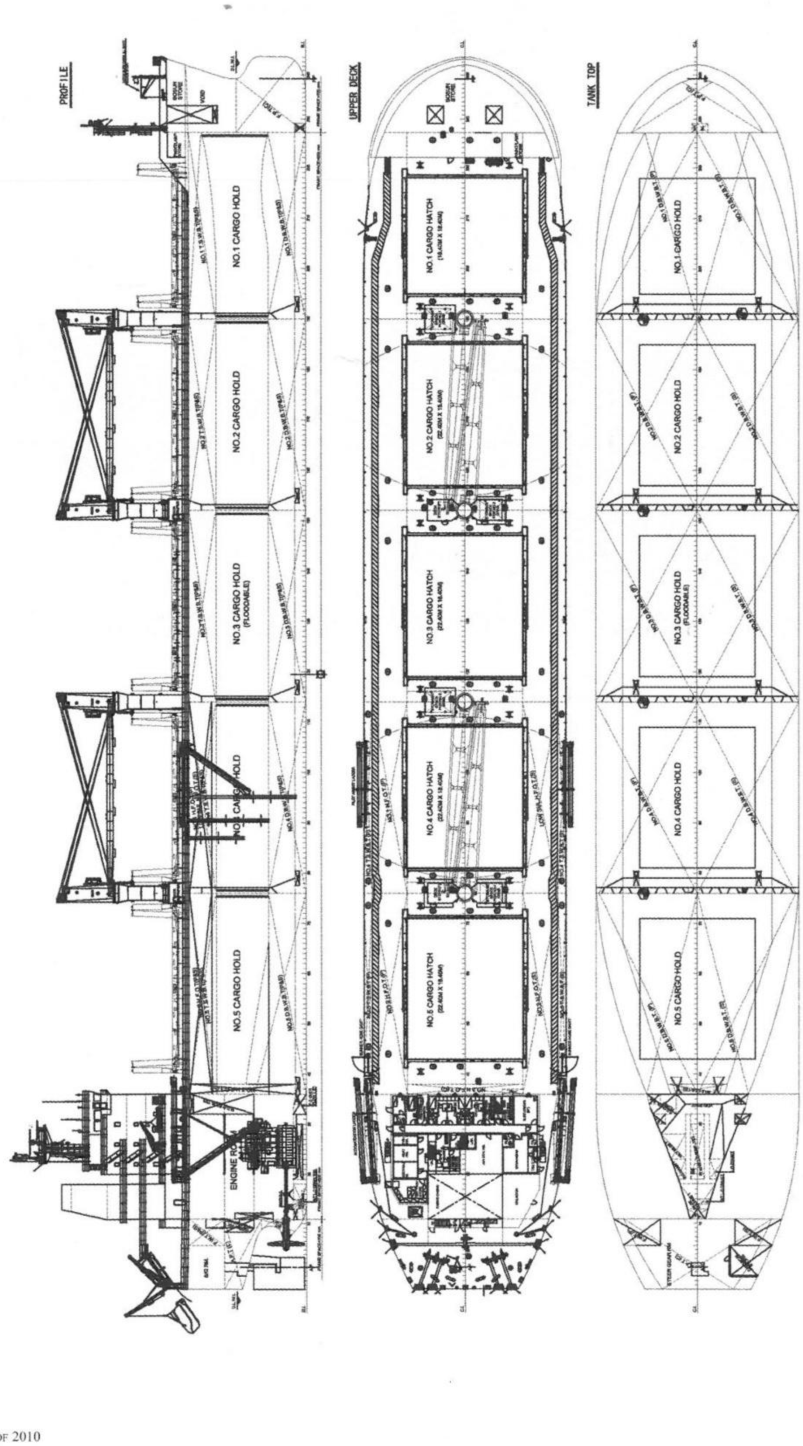
The heavy fuel oil tanks are arranged in two pairs with No.4 and 5 top side wing tanks that are protected by water ballast tanks and in a deep tank located between the engine room and No.5 hold. The vessel is primarily intended for coal, iron ore, grain, steel coil, and cement. Performance Standard for Protective Coating (PSPC), also applies to the vessel to protect water ballast tanks from corrosion. Deck machinery system have been arranged to safely come alongside a pier by mooring rope. Also, a control lever on the hydro motor for the winch can be remotely operated. The hold traffic is suitably designed for the vessel in compliance with guideline in AMSA Marine Orders Part 32.

TECHNICAL PARTICULARS

Length oa:	196.00m
Length bp:	189.00m
Breadth moulded:	32.26m
Depth moulded	
To main deck:	18.60m
Draught(mld.)	
Scantling:	13.00m
Design:	11.10m
Gross:	34,318gt
Displacement:	69,919.8tonnes (at Scantling)
Lightweight:	11,311tonnes
Deadweight	
Design:	47,493dwt
Scantling:	58,608dwt
Block co-efficient (please state relevant draught):	0.8585 (at Scantling)
Speed, service:	14.6 knots
Cargo capacity	
Bale:	70,733m³
Grain:	75,530m³
Liquid volume:	15,588m³
Bunkers	
Heavy oil:	2,198m³
Diesel oil:	145.8m³
Water ballast:	16,045m³
Classification society and notations:	ABS +A1, Bulk Carrier, BC-A[holds 2 and 4 may be empty], , +AMS, +ACCU, CSR, AB-CM, ESP, GRAB[20], TCM, UWILD, POT, CRC, CPS
Main engine	
Design:	MAN DIESEL
Model:	6S50MC-C (Mark8)
Manufacturer:	DOOSAN ENGINE
Number:	1
Type of fuel:	HFO with MDO for cold condition
Output of each engine:	9960Kw
Propeller(s)	
Material:	Ni-Al-Bronze (type4)
Designer/Manufacturer:	Silla Metal / Silla Metal
Number:	1
Fixed/Controllable pitch:	Fixed pitch
Diameter:	5.9m
Speed:	127rpm at mcr
Diesel-driven alternators	
Number:	3
Engine make/type:	Yanmar Diesel / 6N21L-UV
Type of fuel:	HFO with MDO for cold condition
Output/speed of each set:	660kW / 720rpm
Alternator make/type:	TAIYO / FE547B-10
Output/speed of each set:	600Kw / 720rpm
Boilers	
Number:	1
Type:	MC (composite type boiler)
Make: SPP Machine Tech Co.,LTD.	
Output, each boiler:	1200kg/h(fire side) / 1200kg/h(exh. Side) x 7kg/cm²
Cargo cranes/cargo gear	
Number:	4
Make:	MacGregor
Type:	Electro-hydraulic single jib
Performance:	SWL 36tonnes, working radius 26m
Other cranes	
Number:	1
Make:	SPP Machine Tech
Type:	Electric
Tasks:	Provision
Performance:	SWL 3tonnes, working radius 9m~3.1m
Mooring equipment	
Number:	6
Make:	Rolls-Royce
Type (electric/hydraulic/steam):	Electric-hydraulic
Special lifesaving equipment	
Number of each and capacity:	1 x 24P
Make:	Hyun-dai life boat
Type:	Free fall launching
vertical or sloping chutes:	Sloping chutes
Hatch covers	
Design:	MacGregor
Manufacturer:	Tanktech
Type (upper deck/other decks):	Floding type (upper deck)
Cargo tanks	
Number:	5
Ballast control system	
Make:	Scana Korea Hydraulic Ltd.
Type:	Horizontal panel
Complement	
Officers:	15
Crew:	9
Suez/Repair Crew:	6
Bridge control system	
Make:	Yokogawa Denshikiki Co., Ltd.
Type:	PT500A-J-N2
Fire detection system	
Make:	Consilium Marine AB
Type:	CS4000/3L
Fire extinguishing systems	
Cargo holds:	NK / High Pressure CO_2 Fire Extinguishing System & Smoke Detecting System
Engine room:	NK / High Pressure CO_2 Fire Extinguishing System & Smoke Detecting System
Radars	
Number:	2
Make:	Japan Radio Co., Ltd.
Models:	JMA-9132-SA/9122-9XA
Contract date:	29 May 2007
Launch/float-out date:	30 December 2009
Delivery date:	24 March 2010

106 SIGNIFICANT SHIPS OF 2010

THALASSINI AXIA



STX ARBORELLA: open-hatch bulker

Shipbuilder:	**STX Offshore & Shipbuilding Co., Ltd**
Vessel's name:	***STX Arborella***
Hull No:	**S1539**
Owner/operator:	**POS Maritime CA S.A/ STX PanOcean Co., Ltd**
Country:	**Korea**
Designer:	**STX Offshore & Shipbuilding Co., Ltd**
Country:	**Korea**
Model test establishment used:	**MOERI**
Flag:	**Marshall Islands**
IMO number:	**9613288**
Total number of sister ships completed (excluding ship presented):	**nil**
Total number of sister ships still on order:	**9**

STX Arborella is the first order for STX Offshore and Shipbuilding for an open-hatch type bulk carrier with a removable deck for open-hatch and hold to accommodate heavy-lift cargo in the holds, valued at 20 to 30% higher than other bulk carriers of a similar size. *STX Arborella* is the first in a series of 10 vessels for STX Pan Ocean.

STX Pan Ocean signed a contract for the specialised vessels with Fibria of Brazil in October 2010. Subsequently, in October 2011, it signed an additional transportation contract worth US$246 million.

The ship is the first of a total of 230 open hatch general cargo carriers ordered by STX Pan Ocean and will be deployed on the trade lanes between Brazil and the Americas, Europe and Asia, beginning in September 2012. *STX Arborella* will be on a 25-year long-term charter contract with Fibria to export wood pulp. The nine ships in the series are scheduled to be delivered in due order by 2014.

STX Arborella was optimally designed to suit the characteristics of wood pulp freight. This ship is expected to contribute to Fibria being able to maintain its competitiveness in its distribution costs, leading the market in the future and present an opportunity for STX Pan Ocean to strengthen its status as the leading maker of specialised shipping vessels in the world's wood pulp market.

Shipping companies from northern Europe have mainly operated the South American wood pulp transportation market. The order for the vessel and the 25-year charter sees the first Asian-based shipping firm to operate in the wood pulp market.

STX Arborella is 199.9m long, 32.26m wide and 19.3m high, can ship more than 55,000tonnes of wood pulp as the largest-scale ship of the Supramax-grade open hatch ship type. The vessel has eight cargo holds that have a double bottom with water ballast tanks and side ballast water tanks. The longitudinal passageway (P&S) is arranged at the port and starboard sides under the upper deck.

Another notable point about this series of vessels is that they will have dual classification with both DNV and the Korean Register (KRS) classifying the vessel. DNV will be the classification society for the first five Vessels (Hull No: S-1539/40/41/42/43), which will be classed to DNV +1A1 General Cargo Carrier, HC-A (Holds 2, 4, 6 & 8 may be empty Maximum Cargo Density 3.0t/m^3), BIS, COAT-PSPC(B), BWM-T, E0, TMON, NAUTICUS (Newbuilding), GRAB[20].

Whereas, the second five vessels will be dual classed by KRS. In this case, DNV shall be the main class and KRS shall be entitled as sub-class. In addition, if there is any discrepancy in the rules, following an inspection, between DNV and KRS, DNV shall have the overall say.

For the second five Vessels (Hull No: S-1544/45/46/47/48) will be classed to KRS, +KRS1-Cargo Ship General Dry Cargo HC (Hold No 2, 4, 6 and 8 may be empty with maximum cargo density 3.0t/m^3), GRAB[20], IWS, PSPC, ENV (IBWM, IAFS, IOPP, ISPP, IAPP), CHA, LI, +KRM1-UMA, STCM.

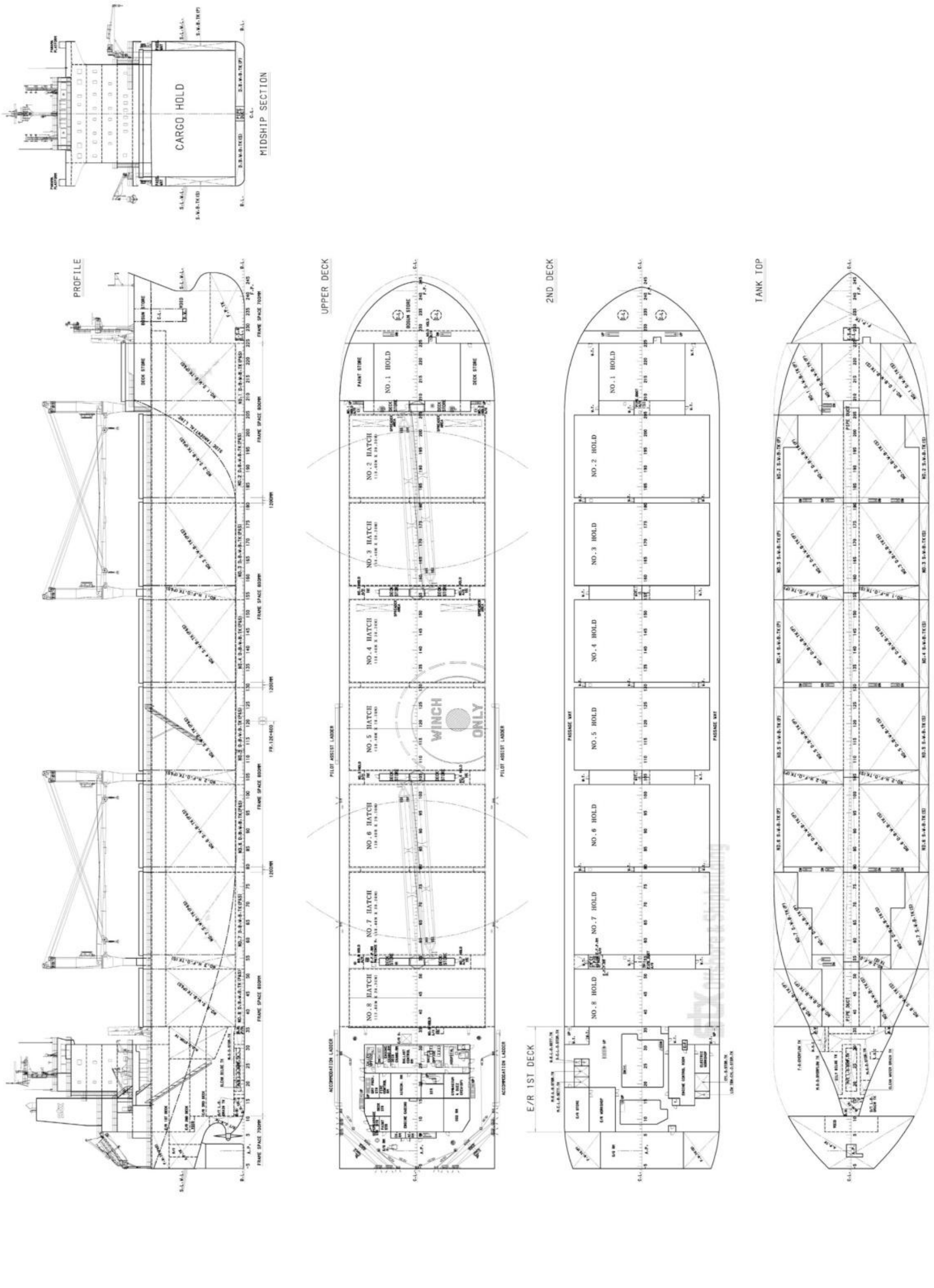
STX Arborella will transfer wood pulp cargoes for Votorantim Celulose e Papel (VCP) and Arazruz two of the largest wood pulp manufacturers in Brazil. Also, the vessel is able to transfer to other cargoes such as steel coil, grain, coal, sulphur.

TECHNICAL PARTICULARS

Length oa:	199.9m
Length bp:	191.8m
Breadth moulded:	32.26m
Depth moulded	
To main deck:	19.3m
To upper deck:	19.3m
To other decks:	16.4m
Width of double skin	
Side:	2.03m
Bottom:	1.9m
Draught	
Scantling:	12.7m
Design:	11.0m
Gross:	39,009gt
Displacement:	70,605tonnes
Lightweight:	13,065tonnes
Deadweight	
Design:	47,171dwt
Scantling:	57,539dwt
Block co-efficient:	0.8746
Speed, service:	13.9knots
Cargo capacity	
Grain:	68,539m^3
Bunkers	
Heavy oil:	3,149m^3
Diesel oil:	250.7m^3
Gas oil:	162.5m^3
Water ballast:	23,019m^3
Daily fuel consumption	
Main engine:	37.2tonnes/day
Auxiliaries:	449tonnes/day
Classification society and notations:	DNV, +1A1 General Cargo Carrier, HC-A (Holds 2, 4, 6 & 8 may be empty maximum cargo density 3.0tonnes/m^3), BIS, COAT-PSPC(B), BWM-T, E0, TMON, Naticus (newbuilding), GRAB[20]
Main engines	
Model:	MAN 6S50MC-C8.1
Manufacturer:	STX Heavy Industries
Number:	1
Type of fuel:	HFO
Output of each engine:	9,960kW x 127rpm
Propellers	
Material:	Ni-Al-Bronze
Designer/manufacturer:	STX/SILLA Metal
Fixed/controllable pitch:	Fixed
Diameter:	6m
Special adaptations:	PBCF
Diesel-driven alternators	
Number:	L23/30H-S-1539
Engine make/type:	STX engine/ 6L23/30H
Type of fuel:	HFO, MDO, MGO
Output/speed of each set:	960kW x 900rpm
Alternator make/type:	Hyundai/ HFC7 508-84K
Output/speed of each set:	910kW x 900rpm
Boilers	
Number:	MPS012011STV
Type:	Composite boiler
Make:	SeAH E&T Co., Ltd
Output, each boiler:	1,200kg/h (oil fired), 1,100kg/h (exhaust gas)
Cargo cranes	
Make:	MacGregor
Type:	Electro hydraulic
Other cranes	
Make:	Oriental
Type:	Electro hydraulic, single jib type
Tasks:	Provision and engine part handling
Performance:	SWL 2tonnes
Mooring equipment	
Number:	2 xWindlass, 4 x winches
Make:	Flutek-Kawasaki
Type:	Electro hydraulic
Special lifesaving equipment	
Number of each and capacity:	1 x 24 persons, 1 x 6 persons, 2 x 25 persons, 1 x 6 persons
Make:	Oriental/ Viking
Type:	Freefall, rescue boat, liferafts
Hatch covers	
Manufacturer:	MacGregor
Type:	Piggy bag type & folding
Cargo tanks	
Number:	8
Coated tanks make:	Jotun/ Jotacote Universal
Ballast control system	
Make:	Lyngso Marine
Type:	MOS2200
Water Ballast Treatment System	
Make:	Techcross electro chamber unit
Capacity:	2 x 1,000m^3/h
Complement	
Officers:	11
Crew:	13
Bridge control system	
Make:	Tokyo-Keiki
Type:	PR-6000
Fire detection system	
Make:	B-I Industrial Co., Ltd
Type:	BDS-4000
Fire extinguishing systems	
Cargo holds:	NK/ CO_2, seawater
Engine room:	NK/ CO_2, seawater
Cabins:	NK/ Portable fire extinguisher
Public spaces:	NK/ portable fire extinguisher
Radars	
Make:	SAM Electronics
Model:	NACOS Platinum
Waste disposal plant	
Incinerator:	Hyundai Machinery Co., Ltd/ MAXI NG100SL WS
Waste compactor:	SAMJOO/ BS520
Sewage plant:	Il-Seung/ ISS-25N
Contract date:	13 December 2010
Launch/float-out date:	6 December 2012
Delivery date:	9 November 2012

104 SIGNIFICANT SHIPS OF 2012

STX ARBORELLA



SIGNIFICANT SHIPS OF 2012 105

LIBERTAS: STX delivers Panamax bulker to Croatian owner

Shipbuilder: .... STX Shipbuilding Co Ltd (Jinhae yard), Korea
Vessel's name: .... *Libertas*
Hull number: S-1211
IMO number: 9321914
Owner/operator: .... Atlantska Plovidba dd, Croatia
Designer: .... STX Shipbuilding Co Ltd, Korea
Model test establishment used: .... Maritime & Ocean Engineering Research Institute (MOERI), Korea
Flag: .... Croatia
Total number of sister ships already completed: .... Nil
Total number of sister ships still on order: 1

STX Shipbuilding Co Ltd, and its now defunct predecessor company Daedong, has been in existence for a relatively short 45 years, yet it is already considered to rank as the fifth-largest shipbuilder in the world, with references covering virtually every aspect of large, merchant ship newbuilding. Currently, containerships carrying up to 13,100TEU, Aframax and Panamax tankers, VLCCs, car carriers, LPG/ethylene tankers, and most recently LNG carriers, all feature on the orderbooks. A recently discerned market for bulk carriers (partly in the light of China's continued appetite for raw materials) has, however, led the company to add designs for this class of vessel to its catalogue, with many of these new standards destined to be built by STX China, at a recently laid out 'greenfield' site at Dalian.

Libertas is the first of a pair of Panamax-size, gearless bulk carriers ordered by Atlantska Plovida, a company with a long history dating back to former Yugoslav days. The design features a double-skin hull subdivided into seven cargo holds by troughed, transverse bulkheads, built on stools. Side tanks incorporating top and bottom wing tanks, are joined with a centrally divided double bottom to provide four pairs of water ballast tanks and a pair of bilge-water handling tanks. Nos 1 and 2 DB tanks have port, starboard, and centre sections, with the latter designated as bunker spaces. The water ballast tanks are coated with Hempel grey-coloured, tar-free epoxy, with loading/discharge handled by two 2000m³/h pumps.

No structural obstacles are arranged within the cargo spaces, and the resulting plain surfaces are coated with modified epoxy. The holds are particularly suitable for bulk cargoes such as iron ore, coal, and grain, and are closed by side-rolling, chain driven covers, manufactured by Tsuji. The upper deck has a slight sheer forward and is arranged with a forecastle. At the aft end a deckhouse, separated from the engine casing and funnel, provides accommodation for a total complement of 24, of which 15 are officers. Six Suez/repair crew are also carried. Lifesaving equipment includes a 24 person freefall lifeboat, launched over the stern from a platform linked to the deckhouse.

The machinery installation is based upon a MAN B&W 7S50MC-C (Mk 7) main engine, manufactured by the builder's sister company STX Engine. This develops 11,060kW MCR at 127rev/min, and produces a service speed at 85% MCR of 14.50knots. The FP propeller has a diameter of 6200mm and operates in an open water sternframe. Electrical requirements are satisfied by three Hyundai alternators each driven by STX-MAN 6L23/30H 795kW/720rev/min diesel engines, and each producing 740kW. A KangRim composite boiler is installed and this can generate 1200kg of steam hourly.

TECHNICAL PARTICULARS

Length, oa 225.00m
Length, bp 216.20m
Breadth, moulded 32.24m
Depth, moulded 19.70m
Width of double skin
- side 1.40m
- bottom 1.80m

Draught
- design 12.20m
- scantling 14.20m

Gross 40 914gt
Displacement 87,370tonnes
Deadweight
- design 62,203dwt
- scantling 75,511dwt

Speed, service, 85% MCR 14.50knots
Cargo capacity, grain 84.326m³
Bunkers
- heavy oil 2013m³
- diesel 166m³

Water ballast 26.634m³
Fuel consumption, main engine only 38.10tonnes/day
Classification .... Bureau Veritas, I + Hull, + MACH, Bulk Carrier BC-A (Holds 2, 4, and 6 may be empty), ESP, Unrestricted Navigation, VeriSTAR-HULL, 20 years North Atlantic (descriptive note: Worldwide 25 Years), + AUT-UMS, WS, MONSHAFT
Percentage of high-tensile steel used in construction ... 60%
Main engine
- Design .... MAN B&W
- Model .... 7S50MC-C (Mk 7)
- Manufacturer .... STX Engine Co Ltd
- Number 1
- Type of fuel .... HFO
- Output 11,060kW/127rev/min

Propeller
- Material .... Nickel-aluminium-bronze
- Designer/manufacturer .... Sila Metal
- Number 1
- Pitch .... Fixed
- Diameter 6200mm
- Speed 127rev/min

Diesel driven alternators
- Number 3
- Engine make/type .... STX MAN 6L23/30H
- Type of fuel .... HFO/MDO
- Output/speed .... 3 x 795kW/720rev/min
- Alternator make .... Hyundai
- Output/speed .... 3 x 740kW/720rev/min

Boiler
- Number 1
- Type .... Composite
- Make .... KangRim
- Output 1200kg/h

Hatch covers
- Designer/manufacturer .... Tsuji Heavy Industries
- Type .... Side rolling, chain driven

Ballast control system
- Make .... Damcos
- Type .... Hydraulic actuator, mimic diagram

Complement
- Officers 15
- Crew 9
- Suez/repair crew 6

Bridge control system
- Make .... KTE
- Type .... Desk type
- One man operation .... No

Fire detection system
- Make .... Saracom
- Type .... Thorn T1016

Fire extinguishing systems
- Make .... NK

Radars
- Number 2
- Make .... JRC
- Models .... JMA 9932 SA/9922 9XA

Integrated bridge system .... No
Waste disposal plant
- Incinerator
  - Make .... Hyundai
  - Model .... MAXI 50SL 1
- Shredder/crusher
  - Make .... Lolpart
  - Model 520
- Sewage plant
  - Make .... DVZ
  - Model DVZ-SKA-30

Contract date .... 19 March 2004
Launch/float-out date .... 4 July 2007
Delivery date .... 20 August 2007

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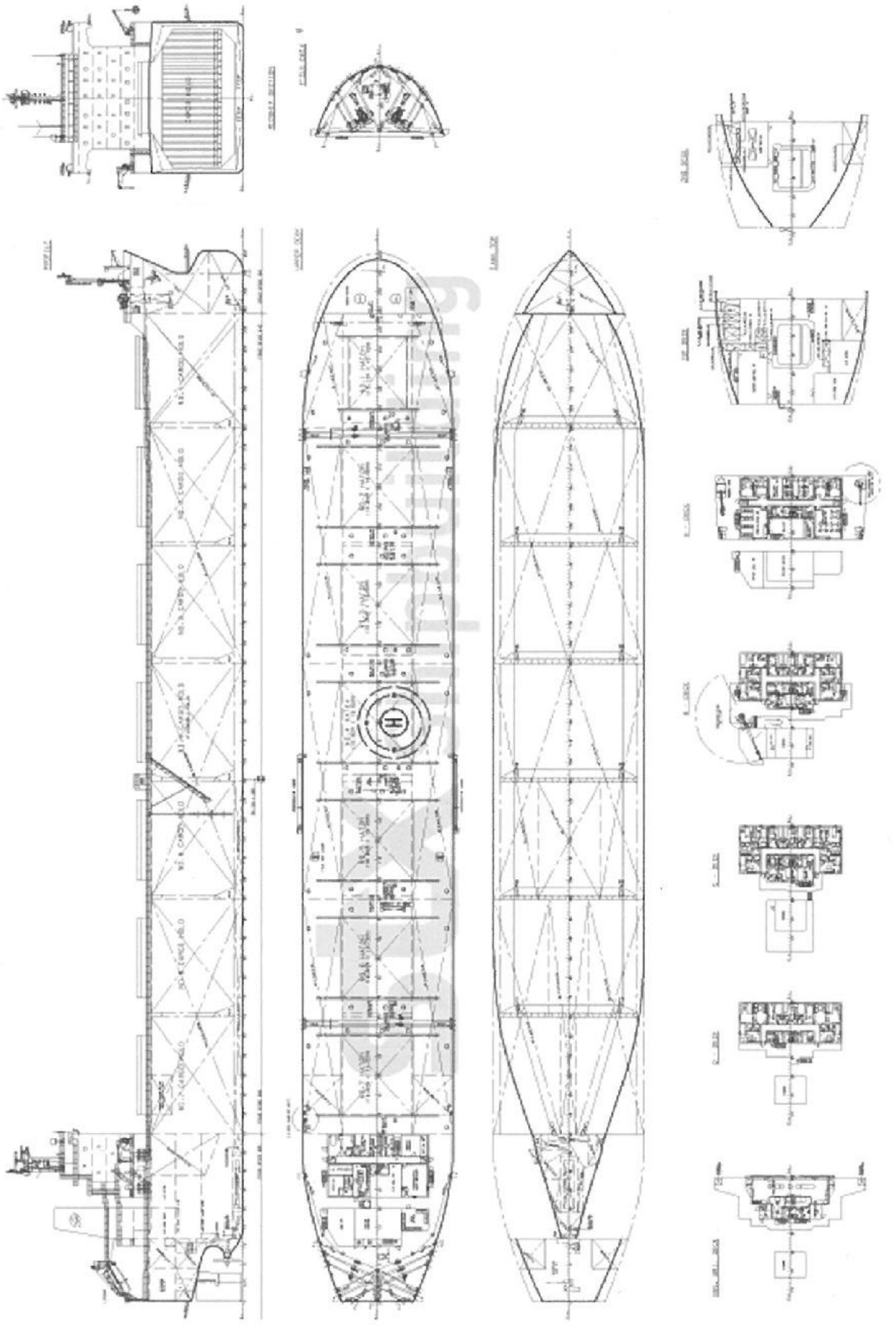
LIBERTAS



72 Significant Ships of 2007

ORANGE TRIDENT: Sanoyas super-Panamax bulker

Shipbuilder:	Sanoyas Hishino Meisho Corp, Japan
Vessel's name:	*Orange Trident*
Hull number:	1257
IMO number:	9341873
Owner/operator:	Victoria Steamship Inc, Panama/Naishin Senpaku KK, Japan
Designer:	Sanoyas Hishino Meisho Corp, Japan
Flag:	Panama
Total number of sister ships already completed:	1
Total number of sister ships still on order:	7

SANOYAS has a long and enviable reputation as a builder of efficient Handymax and Panamax bulk carriers, with close to 70 examples of its 70,000dwt and 75,000dwt bulkers delivered. However, with new IMCO and IACS rules and regulations coming on stream, and a more positive approach to environmental issues now apparent in this 21st century, the company felt the time was right to update its portfolio, and two replacements for those popular, earlier designs, are now available. Marketed as 'Eco-Ships', the new vessels are of 78,000dwt and 83,000dwt, respectively, with *Orange Trident* an example of the smaller variant.

Sanoyas has long held the view that there is still a place in the market for well constructed, single-skin bulk carriers, and these new designs follow that concept, with a variety of environmental measures added to the arrangement. These include moving the main fuel tanks to protected locations at the sides and front of the engineroom, providing dedicated tanks for grey-water retention, and allocating a saddle tank for collecting dirty, hold-cleaning, fresh water, with a hopper tank in the holds available for storage of that clean, hold-washing water. In addition, tin-free antifouling paints, light coloured ballast tank compositions, and R404A refrigerants are used, whilst to meet ISPS security requirements, special locks have been fitted to relevant access doors.

Orange Trident is gearless with a forecastle. The seven cargo holds (No 4 is also designated for water ballast) offer cleat openings equal to half the vessel's beam, and are fitted with MacGregor-Kayaba side-rolling covers. The tanktop is strengthened for heavy cargoes and grab discharge, and top and bottom wing tanks are incorporated into the structure with transverse bulkheads built on stools.

To avoid heat damage to cargo, the fuel tank layout at the fore end of the engineroom has been modified so that only a small compartment is heated under automatic control, rather than the complete space. Another innovation is the provision of separate tanks for oil and water bilge liquids, coupled with the inclusion of a larger capacity separator.

A de-rated Mitsui MAN B&W 7S50MC-C main engine is fitted. This produces 9561kW MCR at 110rev/min (8121kW/104.2rev/min CSR) for a service speed of 14.50knots, with the economies attributed to this installation claimed to be enhanced by the fitting of the shipbuilder's own Sanoyas Tandem Fin (STF) for which patents are pending.

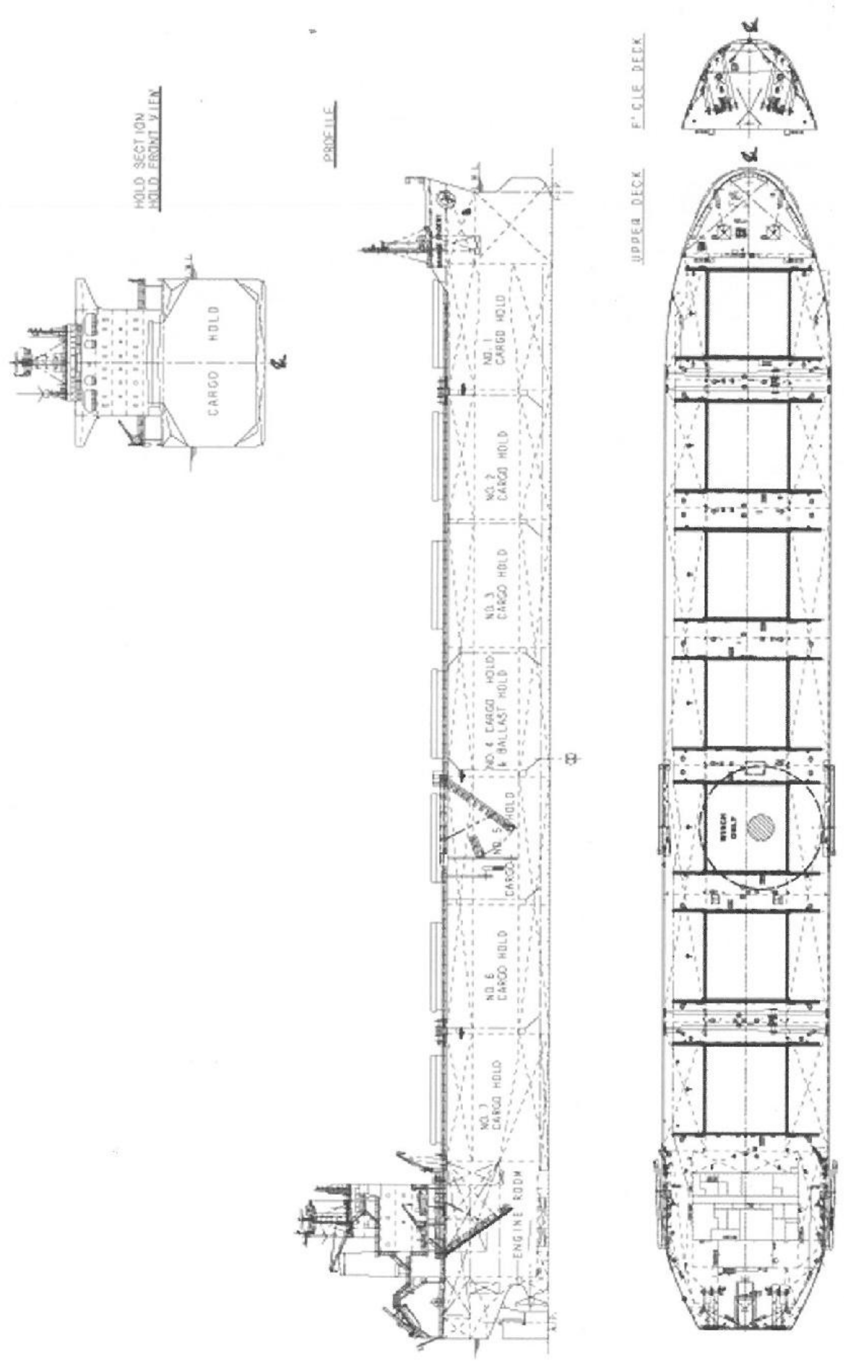
Comprised of a fin positioned at the aft end on each side of the hull, slightly angled and roughly in line with the propeller shaft, and another fin placed at a higher level, and wrapped around the hull forward of the propeller, the arrangement is understood to save around 4% on fuel, depending on the hull draught. Three 420kW diesel alternator sets are fitted, and steam is generated by an 800/600kg/h smoke tube boiler.

Accommodation is provided in a deckhouse right aft, for 10 officers and 15 crew in single berths, with vibration and noise levels reportedly very low. Lifesaving equipment includes a freefall lifeboat operating over the stern.

TECHNICAL PARTICULARS

Length, oa	225.00m
Length, bp	219.00m
Breadth, moulded	32.24m
Depth, moulded to main deck	19.90m
Draught	
design	12.20m
scantling	14.35m
Gross	14,662gt
Deadweight	
design	64,142dwt
scantling	78,932dwt
Speed, service, 85% MCR	14.50knots
Cargo capacity, grain	91,188m³
Bunkers	
heavy oil	2549m³
diesel oil	204m³
Water ballast	23,663m³
Fuel consumption	
main engine only	33.50tonnes/day
auxiliaries	1.50tonnes/day
Classification	Nippon Kaiji Kyokai (ClassNK) NS* (BC-A, BC XII, GRAB), (ESP), MNS* Strengthened for Heavy Loading where Hold Nos 2, 4, and 6 may be empty
Percentage of high tensile steel used in construction	80%
Main engine	
Design	MAN B&W
Model	7S50MC-C (de-rated)
Manufacturer	Mitsui Engineering & Shipbuilding
Number	1
Type of fuel	HFO
Output/speed	9561kW/110rev/min
Propeller	
Material	Nickel aluminium bronze
Designer/manufacturer	Nakashima Propeller Co Ltd
Number	1
Pitch	Fixed
Diameter	6200mm
Speed	110rev/min
Diesel-driven alternators	
Number	3
Engine make/type	Yanmar/6N18AL-HV
Type of fuel used	HFO
Output/speed	3 x 455kW/900rev/min
Alternator make/type	Nishishiba/NTAKL
Output/speed	3 x 420kW/900rev/min
Boilers	
Number	1
Type	Smoke tube
Make	Osaka Boiler Mfg
Output	800/600kg/h
Mooring equipment	
Number	10 drums
Make	Kawasaki Precision Machinery
Type	Hydraulic
Lifesaving equipment	
Type	1 x 25-person freefall lifeboat
Make	Shigi Shipbuilding
Hatch covers	
Design	MacGregor Kayaba
Type	Side rolling
Complement	
Officers	10
Crew	15
Stern appendages	Sanoyas Tandem Fin; High-lift rudder
Bridge control system	
Make	Mitsui Zosen Systems Research
One man operation	No
Fire detection system	Nohmi Bosai
Fire extinguishing systems	
Engineroom	Kashiwa
Type	High-expansion foam
Radars	
Number	2
Make	Japan Radio Co
Models	JMA 9932 SA; JMA 8922-6XA
Integrated bridge system	No
Incinerator	Sunflame
Sewage plant	Taiko Kikai Ind
Contract date	22 November 2004
Launch/float-out date	21 March 2007
Delivery date	8 June 2007

ORANGE TRIDENT



Significant Ships of 2007 89

GIEWONT: Kamsarmax bulker for Polsteam

Shipbuilder: **New Times Shipbuilding Co. Ltd**
Vessel's name: ***Giewont***
Hull No: **0108001**
Owner/operator: **Fiona One Shipping Ltd Bahamas/Polska Zegluga Morska P.P – Poland**
Designer: **SDARI Shanghai**
Country: **China**
Model test establishment used: **Shanghai Merchant Ship Design & Research Institute**
Flag: **Bahamas**
IMO number: **9452593**
Total number of sister ships already completed (excluding ship presented): **2**
Total number of sister ships still on order: **1**

AS part of its newbuilding investment plan that will see a total of 34 vessels delivered up to 2015 to Polsteam, which includes bulk carriers, handy-size and Panamax vessels.

Giewont is the first in the series of four Kamsarmax bulk carriers for Polish ship operator Polska Zegluga Morska P.P.(Polsteam) with a further two vessels delivered through 2011. The vessel was delivered from New Times Shipbuilding Co. Ltd in China to its owner in early 2010. *Giewont* is the largest bulk carrier currently on the Polish Register.

Giewont is 229m in length overall and has a width of 32.26m and a deadweight of 79.649dwt and has a cargo capacity of 97,885m^3.The vessel is powered by a Hyundai-MAN B&W 7S50MC-C7 with an output of 11.060kW giving the vessel a speed of 14.28knots at 85% MCR. *Giewont* also features one Bolin crane for operation at the Suez Canal and hatch covers that are designed by MacGregor.

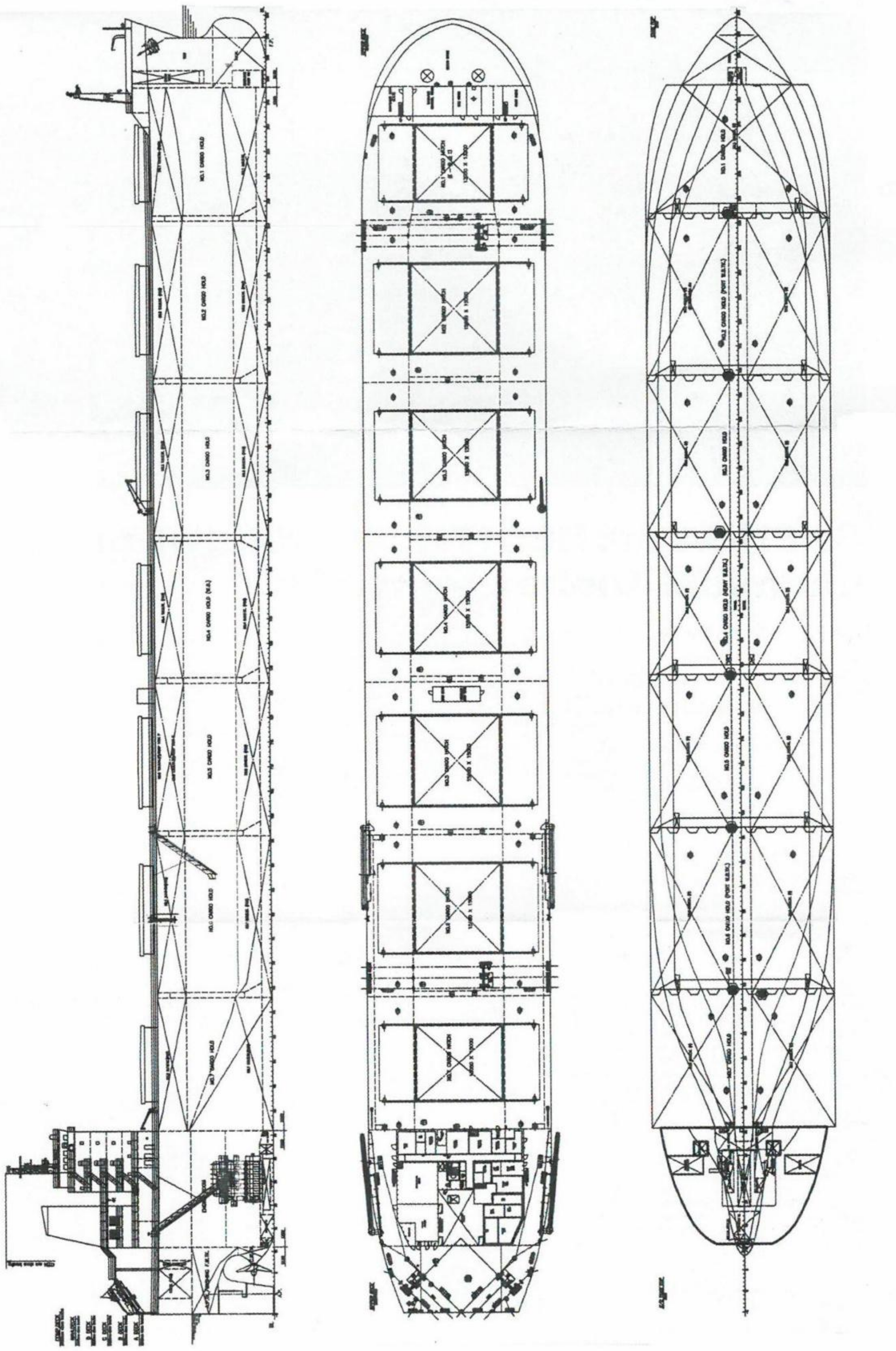
The vessel is classified by Lloyds Register with notations for + 100A1, BC-A, CSR, ESP, L1, IWS, BWMP(S), +LMC, UMS, SCM. Giewont has been certified to the latest ballast water management plan notation and also common structural rules (CSR).

TECHNICAL PARTICULARS

Length oa: 229.00m
Length bp: 222.82m
Breadth moulded: 32.26m
Depth moulded
To main deck: 20.25m
Draught
Scantling: 14.65m
Design: 12.50m
Gross: 43.506gt
Displacement: 93.377tonnes
Lightweight: 13.727tonnes
Deadweight
Design: 64.771dwt
Scantling: 79.649dwt
Block co-eeficient: 0.8682
Speed, service: 14.28knots
Cargo capacity
Grain: 97,885m^3
Bunkers
Heavy oil: 2954m^3
Diesel oil: 220m^3
Water ballast: 20,072m^3
33,833m^3 with No.4 cargo hold
Daily fuel consumption
Main engine only: 38,5tonnes/day
Auxiliaries: 2tonnes/day
Classifications society and notations: LR + 100A1, BC-A, CSR, ESP, L1, IWS, BWMP(S), +LMC, UMS, SCM
% high tensile steel used in construction: 55%
Main engine
Design: MAN Diesel A/S Denmark
Model: Hyundai-MAN B&W 7S50MC-C7
Manufacturer: Hyundai Heavy Indsutry Co
Number: 1
Type of fuel used: HFO
Output of each engine: 11.060kW
Propellers
Material: CU3
Designer/manufacturer: Wartsila CME Zhenjiang Propeller Co. Ltd
Number: 1
Fixed/controllable pitch: Fixed
Diameter: 6.2m
Diesel-driven alternators
Number: 3
Engine make/type: Wartsila Auxpac 645W4L20
Type of fuel: HFO
Output/speed of each set: 680kW/900rpm
Alternator make/type: Fenxi ECP34 – 2L/4
Output/speed of each set: 806kVA/900rpm
Boilers
Number: 1
Type: Mission tm OC
Make: Aalborg Industries
Output, each boiler: Steam Output – Oil Fired SFC 1600kg/h Exhaust SFC 1200kg/h
Other cranes
Number: 1
Make: Bolin
Type: 4tonnes x 5m
Tasks: Suez Canal
Mooring equipment
Number: 6
Make: Rolls-Royce
Type: Electric
Special lifesaving equipment
Number of each and capacity: 1 x 30 persons
Make: Jiaoyan Boat
Type: 7Y- FN – 6,80
Hatch covers
Design: MacGregor
Manufacturer: MacGregor
Type: Side-rolling
Ballast control system
Make: Damcos AS
Type: MTM System
Complement
Officers: 9
Crew: 12
Bridge control system
Make: Kongsberg Maritime AS
Type: AutoChief C20
Fire detection system
Make: Consilium Marine & Safety AB
Type: CS 4000
Fire extinguishing systems
Engine room: NK High pressure CO_2
Radars
Number: 2
Make: Furuno
Model: FAR 2827/ FAR 2937S
Waste disposal system
Incinerator: Teamtec OG 200CS
Sewage plant: Hamworthy ST3A
Contract date: 7 December 2006
Launch/ float-out date: 19 September 2009
Delivery date: 7 January 2010

44 SIGNIFICANT SHIPS OF 2010

GIEWONT



CASH: Kamsarmax from SPP

Shipbuilder: **SPP Shipbuilding Co., Ltd**
Vessel's name: ***Cash***
Hull No: **H1060**
Owner/operator: **Geden Line**
Country: **Turkey**
Designer: **SPP Shipbuilding Co., Ltd**
Country: **Korea**
Model test establishment used: **SSPA**
Flag: **Malta**
IMO number: **9628087**
Total number of sister ships already completed (excluding ship presented): **nil**
Total number of sister ships still on order: **3**

CASH is the latest Kamsarmax design from SPP shipbuilding that was delivered to its owner, Geden Line, in May. The 82,000dwt bulk carrier is the first in a series of three sister vessels ordered by Geden Line, *Cash* has been fully designed by SPP with the aim of designing an advanced Kamsarmax vessel.

The cargo holds have a capacity of 97,000m^3 with the water ballast tanks having a capacity of 23,000m^3. The cargo areas consist of seven cargo holds having double bottom water ballast tanks with hopper and top side wing ballast tanks. The heavy fuel oil tanks are arranged in the engine room and top side wing tanks. The No.4 hold can be used as water ballast tank during heavy sea conditions.

The vessel is powered by a Doosan manufactured 6S60MC-C(MK8.1) that has a power output of 10,450kW that gives the vessel a service speed of 14.92knots. The yard noted at the time that the vessel made a remarkable achievement for its speed performance of about 14.92knots at design draught and NCR with 15% of sea margin by the sea trial. With the capacity of 2,500m^3 for the fuel oil, the cruising range is about 20,000 nautical miles on the basis of speed of 14.5knots considering three reserve days.

The vessel has a bulbous bow, transom stern and a continuous deck with forecastle deck. The hatch covers that are manufactured by Tanktech are rack and pinion operated. A Six-tiered deckhouse that complies with the SOLAS visibility regulation provides accommodation for a complement of 24 persons excluding the Suez crew cabin.

TECHNICAL PARTICULARS

Length oa: 229.00m
Length bp: 223.00m
Breadth moulded: 32.26m
Depth moulded
- To main deck: 20.20m
- To upper deck: 20.20m

Width of double skin
- Side: 1.50m
- Bottom: 1.75m

Draught
- Scantling: 14.517m
- Design: 12.20m

Gross: 44,619gt
Displacement: 94,867tonnes
Lightweight: 13,432tonnes
Deadweight
- Design: 65,154.2dwt
- Scantling: 81,434.8dwt

Block co-efficient: 0.8699 (design)/ 0.8851 (scantling)
Speed, service: 14.92knots
Cargo capacity
- Bale: 92,534.8m^3
- Grain: 97,090.7m^3

Bunkers
- Heavy oil: 2,461m^3
- Diesel oil: 196.6m^3 + 240.5m^3 (MGO)

Water ballast: 22,603m^3
Daily fuel consumption
- Main engine only: 37.5tonnes/day
- Auxiliaries: 3.1tonnes/day

Classification society and notations:. DNV 1A1, Bulk Carrier, ESP ES(S), CSR, BC-A, Holds 2,4 and 6 may be empty, GRAB[20], BIS, TMON, BWM-E(f), E0, COAT-PSPC(B)
% high-tensile steel used in construction: 80%
Main engine
- Model: 6S60MC-C(MK8.1)
- Manufacturer: Doosan Engine
- Number: 1
- Type of fuel: HFO, MDO, MGO
- Output of each engine: 10,450kW x 96rpm

Propellers
- Material: Ni-Al-Bronze
- Designer/manufacturer: Hyundai Heavy Industries
- Number: 1
- Fixed/controllable pitch: Fixed
- Diameter: 7.1m
- Speed: 96rpm

Diesel-driven alternators
- Number: 3
- Engine make/type: Yanmar/ 6EY18ALW
- Type of fuel: HFO, MDO, MGO
- Output/speed of each set: 660kW x 900rpm
- Alternator make/type: Taiyo/Fe
- Output/speed of each set: 600kW x 900rpm

Boilers
- Number: 1
- Type: MC
- Make: SPP Machine Tech
- Output, each boiler: 1,300kg/h 1,200kg/h x 7kg/cm^2

Other cranes
- Number: 1
- Make: SPP Machine Tech
- Type: M/E overhead crane

Mooring equipment
- Number: 6
- Make: Flutek
- Type: Hydraulic

Special lifesaving equipment
- Number of each and capacity: 1 x 24 persons
- Make: Beihai
- Type: Freefall

Hatch covers
- Design: SMS
- Manufacturer: Tanktech
- Type: Rack & pinion side rolling

Ballast control system
- Make: Scana Korea Hydraulic
- Type: Piano type

Complement
- Crew: 13

Bridge control system
- Make: Samsung
- Type: Self-standing type

Fire detection system
- Make: Consilium
- Type: Addressable

Fire extinguishing systems
- Cargo holds: NK/ CO_2
- Engine room: NK/ CO_2

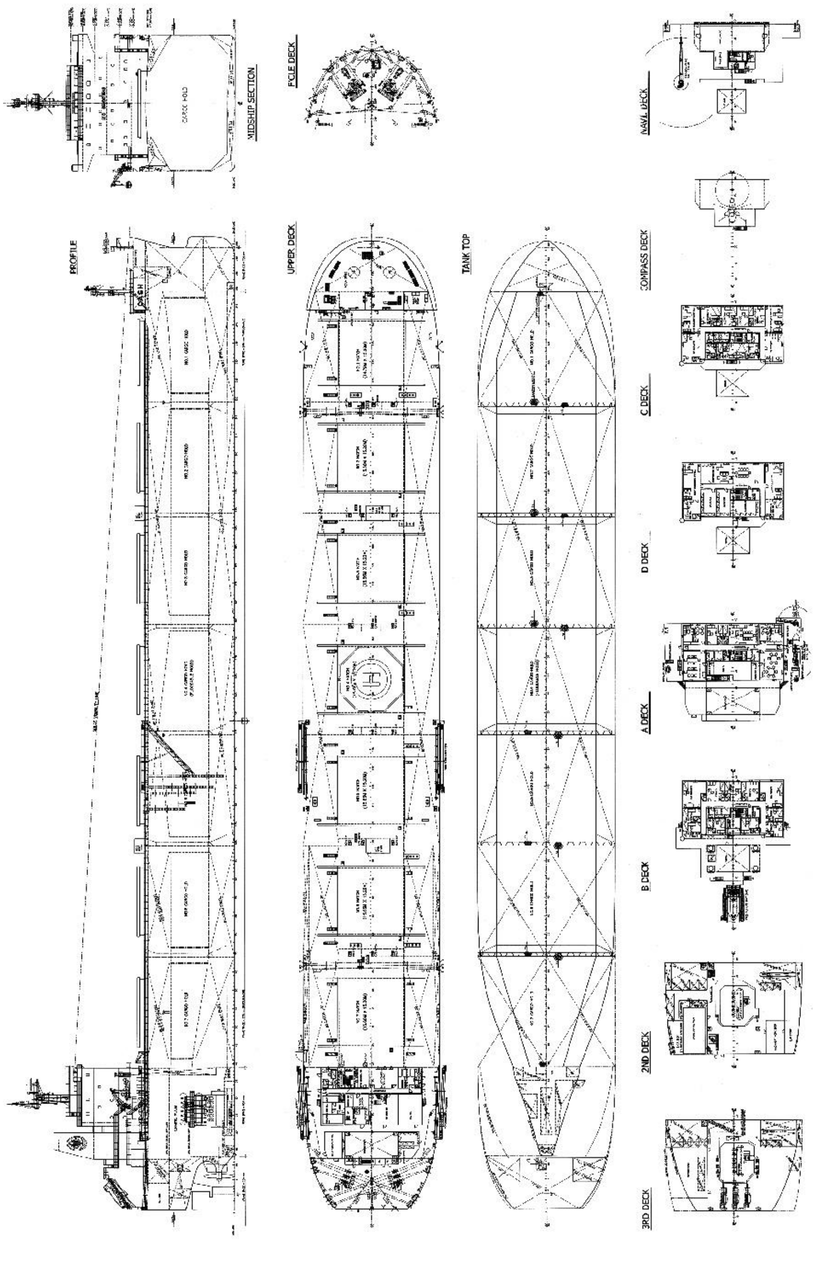
Radars
- Number: 2
- Make: Furuno
- Models: FAR-2827/ FAR-2837S

Waste disposal plant
- Incinerator: Hyundai-Atlas/ MAXI T50SL WS
- Waste shredder: Samjoo Eng/ BS515
- Sewage plant: Il Seung/ ISS-25N

Contract date: 24 August 2010
Launch/float-out date: 5 December 2012
Delivery date: 2 May 2013

30 SIGNIFICANT SHIPS OF 2013

CASH



SIGNIFICANT SHIPS OF 2013 31

PRIME ROSE: 82,000dwt bulk carrier

Shipbuilder: .... **SPP Shipbuilding Co., Ltd**
Vessel's name: .... ***Prime Rose***
Hull No: **S5093**
Owner/operator: .... **Active Shipping**
Country: .... **Turkey**
Designer: .... **SPP Shipbuilding Co., Ltd**
Country: .... **Korea**
Flag: .... **Marshall Islands**
IMO number: **9590747**
Total number of sister ships already completed (excluding ship presented): .... **nil**
Total number of sister ships still on order: **4**

PRIME Rose is the first in a series of four 82,000dwt bulk carriers that were ordered by Active Shipping, in 2010. The vessel was constructed at Korean-based SPP Shipbuilding Co., Ltd and delivered at the beginning of 2012 to its owner. The other four sister vessels of the series were delivered throughout 2012.

Prime Rose has been designed by SPP with the focus on efficiency for a modern Kamsarmax design. SPP Shipbuilding Co., Ltd has achieved this through hull form optimisation and the installation of energy saving devices.

The vessel is an ocean going Kamsarmax size bulk carrier with bulbous bow, transom stern and a continuous deck with forecastle. The cargo areas consist of seven cargo holds having double bottom water ballast tanks with hopper and top side wing ballast tanks. Heavy fuel oil tanks are arranged in engine room and top side wing tanks. The No.4 hold can be used as water ballast tank during heavy sea conditions. Also, holds 2, 4 and 6 can be used as water ballast tanks for air draft adjustment conditions at the special ports.

The six-tier deckhouse complies with the SOLAS visibility regulation and provides accommodation for a complement of 24 persons excluding the Suez crew cabin. The vessel is fitted with a MAN B&W Licensed 6S60MC-C8.2 with optimised rating of 10,770kW (SMCR) at 95rpm by de-rating by about 25% from the 14,280kW (NMCR) at 105rpm in order to reduce the fuel oil consumption. Also three sets of generators with each 650kW capacity are installed.

The capacity of the cargo holds and water ballast tanks is 97,000m^3 and 23,000m^3 respectively. With the capacity of 2,500m^3 for the fuel oil, the cruising range is about 24,000 nautical miles on the basis of speed of 14.5knots considering three reserve days.

The vessel is designed and constructed to be loaded not only Group A and B type of IMSBC code but also steel coils (15tonnes, 2tiers) and dangerous cargoes including sulphur.

The vessel has made a remarkable achievement for her speed performance of about 15.1knots at design draft and NCR with 15% of sea margin by the sea trial. This is due to the optimisation of the hull form by SPP, this performance of speed is said to reduce oil-consumption of DFOC, which is about 28.1tonnes/day at 14.4knots with design draft. Also, the installation of the Mewis Duct also adds to the reduction in fuel and can save up to a further 1.5tonnes/day.

TECHNICAL PARTICULARS

Length oa: 229.00m
Length bp: 223.00m
Breadth moulded: 32.26m
Depth moulded
- To main deck: 20.20m
- To upper deck: 20.20m

Width of double skin
- Bottom: 1.75m

Draught
- Scantling: 14.5m
- Design: 12.2m

Gross: 44,485gt
Displacement: 94,867tonnes
Lightweight: 13,282tonnes
Deadweight
- Design: 65,304dwt
- Scantling: 81,595dwt

Block co-efficient: 0.8851
Speed, service: 15.06knots
Cargo capacity
- Bale: .... 92,534m^3
- Grain: .... 97,090m^3

Bunkers
- Heavy oil: .... 2,517m^3
- Diesel oil: .... 154.7m^3

Water ballast: .... 22,612m^3
Daily fuel consumption
- Main engine only: 43.68tonnes/day
- Auxiliaries: 3.13tonnes/day

Classification society and notations: ....LR +100A1 Bulk Carrier, CSR, BC-A [Holds 2, 4 and 6 may be empty], GRAB[20], ESP, LI, *IWS, ShipRight (CM, ACS(B)), +LMC, UMS, SERS EP (B,I,R) with descriptive notes "ShipRight (SCM, BWMP(F)), P. Ht., Green passport"
Main engine
- Design: .... Hyundai-MAN B&W
- Model: 6S60MC-C8.1
- Manufacturer: .... Hyundai
- Number: 1
- Type of fuel: .... HFO
- Output of each engine: .... 10,770kW x 95rpm

Propellers
- Material: .... Ni-Al-Bronze
- Designer/manufacturer: .... Silla Metal
- Number: 1
- Fixed/controllable pitch: .... Fixed
- Diameter: 7.15m

Diesel-driven alternators
- Number: 3
- Engine make/type: .... Yanmar 6N21L-SW
- Type of fuel: .... HFO
- Output/speed of each set: .... 745kW x 720rpm
- Alternator make/type: .... Nishishiba 3GT4167
- Output/speed of each set: .... 680kW x 720rpm

Boilers
- Number: 2
- Type: MC-RMS7-ZMD
- Make: .... SPP Machine Tech
- Output, each boiler: ....1,500/1,200kg/h x 7kg/cm$_2$

Provision cranes
- Number: 1
- Make: .... SPP Machine Tech
- Type: .... Electric motor driven
- Tasks: ....Provisions, engine room spare parts handling
- Performance: .... SWL 4tonnes x 10m

Mooring equipment
- Number: 6
- Make: .... Flutek-Kawasaki
- Type: .... Electric-hydraulic

Special lifesaving equipment
- Number or each and capacity: .... 1 x 24persons
- Make: .... Norsafe
- Type: .... Totally enclosed free-fall type

Hatch covers
- Design: .... MacGregor
- Manufacturer: .... MacGregor
- Type: .... Side rolling type

Complement
- Officers: 13
- Crew: 14

Stern appendages/special rudders: .... Mewis Duct
Fire detection system
- Make: .... Consilium
- Type: .... Salwico Cargo

Fire extinguishing systems
- Engine room: .... Tank Tech/X-mist

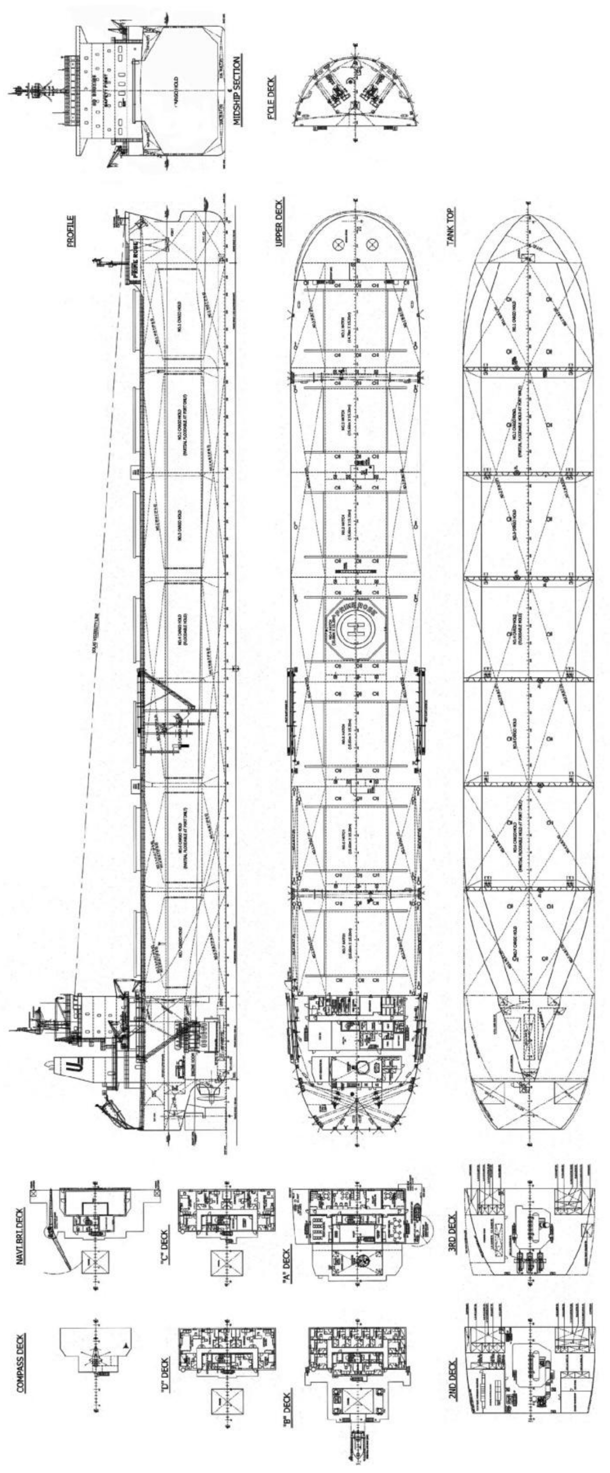
Radars
- Number: 2
- Make: .... Furuno
- Model: FAR-2837S, FAR-2827

Waste disposal plant
- Incinerator: .... Hyundai-Atlas/ MAXI NG100SL WS
- Sewage plant: .... Il Seung/ ISS-25N

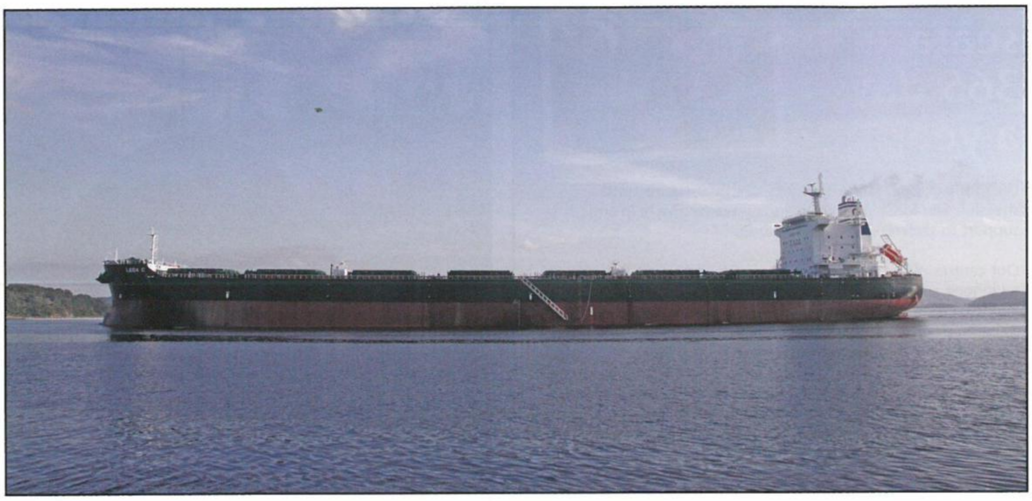
Contract date: .... 23 march 2010
Launch/float-out date: .... 19 November 2011
Delivery date: .... 20 February 2012

86   Significant Ships of 2012

PRIME ROSE



SIGNIFICANT SHIPS OF 2012 87



LEDA C: Kamsarmax bulk carrier

Shipbuilder:	**SPP Shipbuilding Co., Ltd**
Vessel's name:	***Leda C***
Hull No:	**H-1056**
Owner/operator:	**Target Marine S.A**
Country:	**Greece**
Designer:	**SPP Shipbuilding Co., Ltd**
Country:	**Korea**
Flag:	**Marshall Islands**
IMO number:	**9583768**
Total number of sister ships already completed (excluding ship presented):	**nil**
Total number of sister ships still on order:	**1**

Leda C is the first in a series of two 82,000dwt bulk carriers built by SPP Shipyard. The vessel was constructed for Greek operator Target Marine by SPP Shipbuilding Co., Ltd and was delivered to the owner in October. The second vessel of this series, *Athanasia C* is scheduled to be delivered in February 2012.

Target Marine placed its orders for the Kamsarmax vessels in 2010 to further keep up to date with modern technological advances and to grow the fleet further. In 2010 Target Marine also entered the large crude carrier market with an order for four Suezmax tankers.

Leda C is an ocean going, single screw diesel engine, direct driven, bulk carrier with bulbous bow, transom stern and a continuous deck with a forecastle deck. The cargo areas consist of seven cargo holds having double bottom water ballast tanks with hopper and top side wing ballast tanks. Heavy fuel oil tanks have been arranged in the engine room and top side wing tanks.

The No.4 hold can be used as a water ballast tank during heavy sea conditions. Also, holds No.2 and 6 together with No.4 can be used as water ballast tanks for air draft adjustment conditions at the special ports. A six-tiered deckhouse that complies with SOLAS visibility regulation provides accommodation for a complement of 24 persons excluding the Suez crew cabin.

Leda C was constructed to be loaded not only for Group A and B type cargoes of the International Maritime Solid Bulk Cargoes (IMSBC) Code, but is also capable of carrying heavy cargoes when hold No. 2, 4 and 6 may be empty, as well as 15tonne hot coils in two tiers. The capacity of cargo holds and water ballast tanks are 97,000m^3 and 23,000m^3 respectively. With the capacity of 2500m^3 for the fuel oil, the cruising range is about 24,500 nautical miles on the basis of speed of 14.4knots considering three reserve days.

The vessel is fitted with a MAN B&W Licensed 6S60MC-C8.2 with an optimised rating of 10,170kW(SMCR) at 93.0rpm by de-rating of about 30% from the 14,280kW(NMCR) at 105.0rpm in order to reduce the fuel oil consumption. Also three generators each with 650kW capacity have been installed.

The vessel has a speed performance of about 14.9knots at design draft and NCR with 15% of sea margin at sea trial. This is due to the optimisation of hull form by SPP's own studies, which has improved performance of speed and reduced oil-consumption of DFOC by about 33.7tonnes/day at 14.4knots which has given the vessel a competitive edge among similar size vessels of its type.

Leda C has also been issued with an EEDI (Energy efficiency design index) certificate with the Lloyd's Register classification verification. A certificate was also issued for a helicopter landing system on the No.4 hatch cover to comply with AMSA requirements. Also, the vessel has the notations of ✠100A1 Bulk Carrier, ESP, CSR, BC-A {Holds 2,4 & 6 may be empty}, GRAB[25}, LI, IWS, ShipRight(CM, ACS(B)) ✠LMC, UMS, with descriptive note ShipRight(BWMP)(F), Pt, Ht.

TECHNICAL PARTICULARS

Length oa:	229.00m
Length bp:	223.00m
Breadth moulded:	32.26m
Depth moulded	
To upper deck:	20.20m
Draught	
Scantling:	12.20m
Design:	14.50m
Deadweight	
Design:	65,400dwt
Scantling:	81,600dwt
Speed, service:	14.4knots @ 90% MCR with 15% sea margin
Cargo capacity	
Liquid volume:	97,078m^3
Bunkers	
Heavy oil:	2517m^3
Diesel oil:	221.2m^3
Water ballast:	22,612m^3
Classification society and notations:	✠100A1 Bulk Carrier, ESP, CSR, BC-A {Holds 2,4 & 6 may be empty}, GRAB[25], LI, IWS, ShipRight(CM, ACS(B) ✠LMC, UMS, with descriptive note ShipRight(BWMP)(F), Pt, Ht.
Main engines	
Design:	MAN Diesel
Model:	6S60MC-C8
Manufacturer:	STX Heavy Industries Co., Ltd
Number:	1
Type of fuel:	HFO
Output of each engine:	10,170kW x 93rpm
Propeller	
Material:	Ni-Al-Bronze
Designer/manufacturer:	Sil La Metal/ Si La Metal
Number:	1
Fixed/Controllable pitch:	Fixed
Diameter:	7.15m
Speed:	93rpm
Diesel-driven alternators	
Number:	3
Engine make/type:	STX engine/5L23/30H
Type of fuel:	HFO
Output/speed of each set:	650kW x 720rpm
Alternator make/type:	HHI/HFCS 502-10P
Output/speed of each set:	750KvA x 720rpm
Boilers	
Number:	1
Type:	MC904P15
Make:	Kangrim Heavy Industries
Output, each boiler:	1500/1200kg/h x 7kg/cm^2
Other cranes	
Number:	1
Make:	SPP Machine Tech
Type:	Electric
Tasks:	Provisions
Performance:	SWL 4tonnes, working radius 10m-3m
Mooring equipment	
Number:	6
Make:	Oriental
Type:	Hydraulic
Special life saving equipment	
Number of each and capacity:	1 x 30 persons
Make:	beihai
Type:	Freefall life boat
Hatch covers	
Design:	Cargotec
Manufacturer:	Cargotec
Type:	Side rolling rack & pinion type
Cargo tanks	
Number:	7
Product range:	Bulk carrier
Ballast control system	
Make:	Scana Korea
Type:	Hydraulic double acting actuators, a piano type ballast control console
Complement	
Officers:	15 persons
Crew:	9 persons
Stern appendages/special rudders:	Semi-spade rudder
Bridge control system	
Make:	Hyomyung
Type:	Self standing type
Fire detection system	
Make:	Consilium
Type:	Salwico Cargo
Fire extinguishing systems	
Cargo holds:	NK/ Fixed CO_2
Engine room:	NK/ Fixed CO_2
Radars	
Number:	2
Make:	Japan radio Co., Ltd
Model:	JMA-9132-SA/9122-9XA
Waste disposal plant	
Sewage plant:	IL Seung ISS-35N
Contract date:	March 2010
Launch/float-out date:	July 2011
Delivery date:	October 2011

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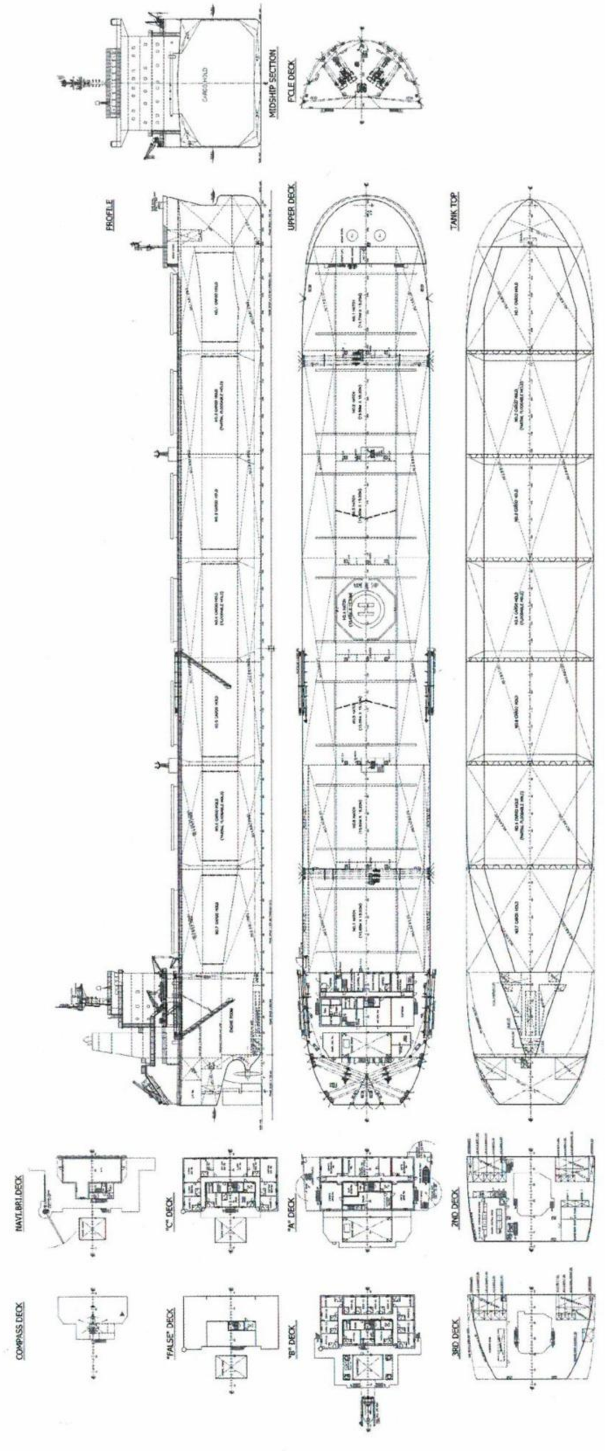

SIGNIFICANT SHIPS OF 2011

AZUR: maximum deadweight 'Japanamax' bulker from Oshima

Shipbuilder: ...... **Oshima Shipbuilding Co Ltd, Japan**
Vessel's name: ...... ***Azur***
Hull number: **1044**
IMO number: **9314648**
Owner/operator: **Azur Shipping Corp, Marshall Islands/Transocean Maritime Agencies SAM, Monaco**
Designer: ...... **Oshima Shipbuilding Co Ltd, Japan**
Flag: ...... **Marshall Islands**
Total number of sister ships already completed: ...... -
Total number of sister ships still on order: ...... -

ALTHOUGH current shipping industry opinion seems to be that double-hull bulk carriers should be the future norm, there are builders (and, of course, owners) who consider that there is still a place in the market for well built, and well maintained, single-hull designs of this ship type. Oshima Shipbuilding, whose shipyard is located near Nagasaki on the Japanese island of Kyushu, is one such company, and *Azur* (whose delivery last year occurred just too late to allow its inclusion in *Significant Ships of 2007*) is a product of this philosophy. Nevertheless, it should not be forgotten that Oshima was also, in the early 1990s, a pioneer of several own-design bulk carriers built with double skins, such as the Handysize *Top Sugar*, presented in 1998, and the so-called Chu-Panamax type, *Top leader*, of 1999.

Azur demonstrates a new design, based on Oshima's regular 77,000dwt Panamax type, but omitting the obligatory bulbous bow, in favour of the builder's Seaworthy Bow. This features an almost straight stem and a fuller forebody, which, by also eliminating top and bottom wing tanks in Nos 1 and 7 holds, has resulted in an increased grain cargo capacity.

The new bow form has extended the length between perpendiculars by some 2m whilst retaining a Panama Canal maximum overall dimension of 225m. Since this is also the overall length limitation at most major Japanese grain terminals, a new descriptive term 'Japanamax', has been coined for what is now marketed as an 82K (maximum) deadweight bulker.

Technically, the new hull form is said to have increased propulsive performance, reducing required power by around 5% compared with the builder's earlier design. Other performance enhancing features included in this new series are a Schilling design high-lift rudder operated by a rotary vane steering gear, which improves manoeuvrability and course keeping, and the installation of a set of 'Flipper Fins', a simple structure attached to the hull.

Azur is configured as a single deck vessel with seven holds, closed by Tsuji side-rolling covers. As noted above, top and bottom wing tanks are fitted in all holds except numbers 1 and 7, and these are arranged to carry water ballast, the bottom wings being joined to centrally divided double bottom tanks. No 4 hold serves as a floodable hold and, along with Nos 2 and 6 compartments, may be left empty when loaded.

The main engine is of MAN B&W 5S60MC-C design, manufactured by Kawasaki Heavy Industries. This develops 10,959kW MCR at 102rev/min, and 8767kW at 94.7rev/min (80% full power). At this rating a directly coupled fixed pitch propeller gives a service speed of 14.50knots. Electrical power is drawn from three Daihatsu/Nishishiba 400kW diesel alternator sets, and a vertical composite boiler satisfies steam requirements.

TECHNICAL PARTICULARS

Length, oa	224.06m
Length, bp	221.50m
Breadth, moulded	32.26m
Depth, moulded, to main deck	20.05m
Draught	
design	12.20m
scantling	14.42m
Gross	42,712gt
Deadweight	
design	66,976dwt
scantling	82,282dwt
Speed, service, 80% MCR	14.50knots
Cargo capacity	
bale	94,473m³
grain	96,041m³
Bunkers	
heavy oil	2054m³
diesel oil	254m³
Water ballast (including floodable hold)	38,553m³
Fuel consumption, main engine only	35.90tonnes/day
Classification	Nippon Kaiji Kyokai (ClassNK), NS* (Bulk Carrier, Strengthened for Heavy Cargoes, Nos 2, 4 and 6 may be empty), (ESP), MNS*, PSCM
Main engine	
Design	MAN B&W
Model	5S60MC-C
Manufacturer	Kawasaki Heavy Industries
Number	1
Type of fuel used	HFO
Output, MCR	10,959kW/102rev/min
Propeller	
Material	Nickel-aluminium-bronze
Designer/manufacturer	Nakashima Propeller Co Ltd
Number	1
Pitch	Fixed
Diameter	6100mm
Speed (at service power)	94.7rev/min
Diesel-driven alternators	
Number	3
Engine make/type	Daihatsu/5DK-20
Type of fuel used	HFO
Output/speed	3 x 441kW/720rev/min
Alternator make	Nishishiba Electrical
Output/speed	3 x 400kW/720rev/min
Boiler	
Number/type	1 x vertical composite
Make	Aalborg Industries KK
Output	
oil fired	1000kg/h
exhaust gas heating	700kg/h
Lifeboats	
Type	2 x 25person, totally enclosed
Manufacturer	Shigi Shipping Co Ltd
Hatch covers	
Design/manufacturer	Tsuji Heavy Industries Co Ltd
Type	Side rolling
Ballast control system	
Make	Nakakita Seisakusho
Type	Electric touch display
Complement	
Officers	10
Crew	13
Special rudder	Oshima-Schilling high-lift type
Fire detection system	
Make	Nohmi Bosai
Type	Ionic, thermal flame
Fire extinguishing system	
Cargo holds/engineroom	
Make	Air Water Safety Services
Radars	
Number	2
Make	Japan Radio Co Ltd
Models	JMA-9922-9XA; JMA-9932-SA
Waste disposal plant	
Incinerator	
Make/model	Sunflame/OSV-600SAI
Sewage plant	
Make/model	Taiko Kikai Industries/SBI-40
Contract date	24 November 2003
Launch/float-out date	3 October 2007
Delivery date	12 November 2007

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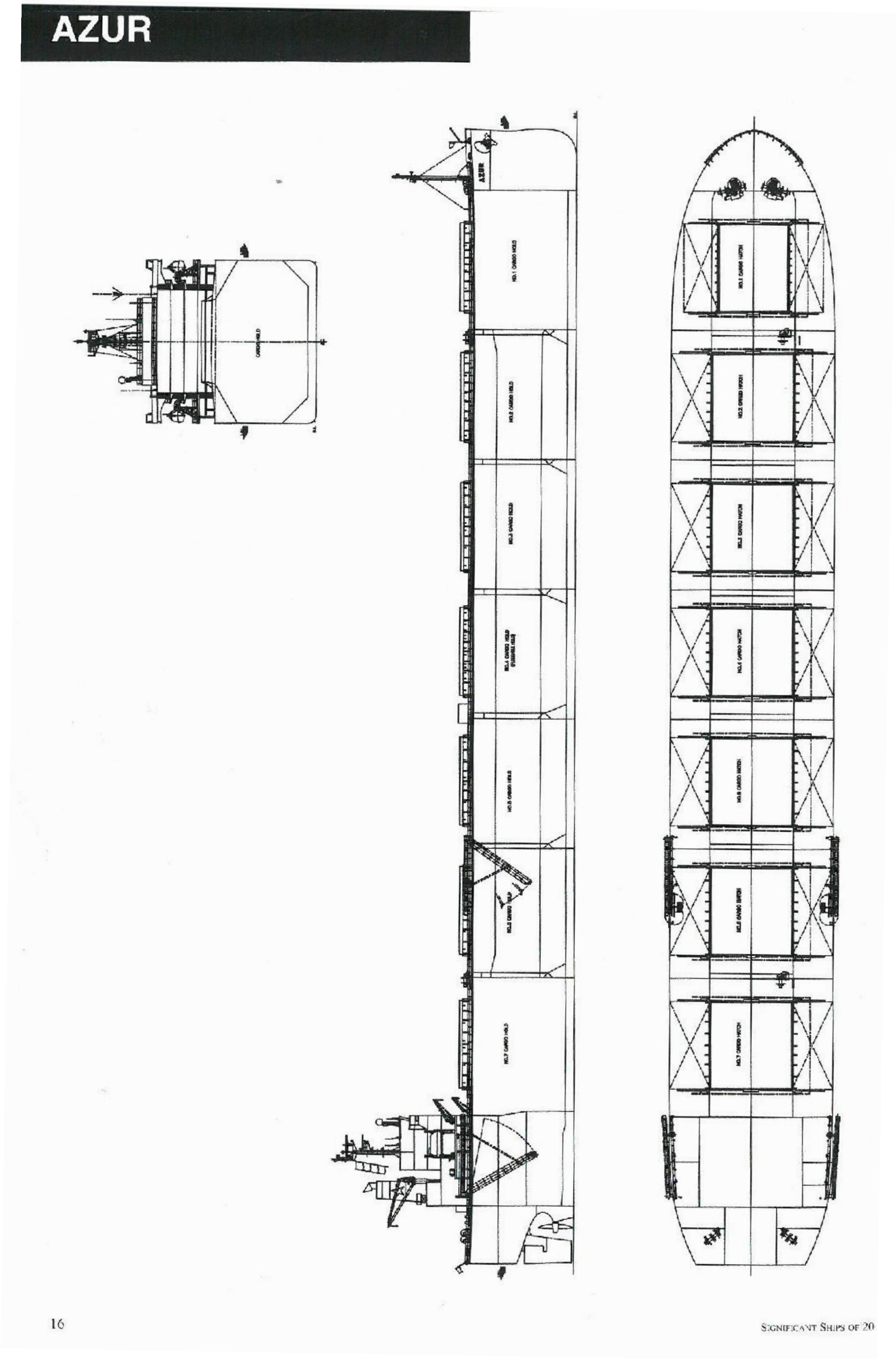
AZUR
16
SIGNIFICANT SHIPS OF 20

FRAMURA: Optimised bulk carrier from SPP

Shipbuilder: **SPP Shipbuilding**
Vessels name: *Framura*
Hull No: **H1068**
Owner/operator: **Premuda**
Country: **Italy**
Designer: **SPP Shipbuilding**
Country: **Korea**
Flag: **Cayman Island**
IMO number: **9691395**
Total number of sister ships already completed (excluding ship presented): **1**
Total number of sister ships still on order: **nil**

FRAMURA is the first in a series of two latest Kamsarmax designs, which were both delivered from SPP Shipbuilding, Korea for Italian owner Premuda to meet with modern environmental demands.

Framura's most notable point is its speed performance of about 15knots at design draught and NCR with 15% of sea margin by sea trial. SPP Shipbuilding has noted that to be able to achieve this speed with reduced fuel consumption, optimisation of the hull form has been carried out, which has reduced fuel consumption to about 38.1tonnes/day. The vessel is fitted with an MAN B&W licensed 5S60ME-C8.2 with optimised rating of 10,220kW (MCR) at 94rpm, along with three sets of generators with a power output of 660kW.

The vessel has a bulbous bow, transom stern and a continuous deck with forecastle. The cargo areas consist of seven cargo holds with double bottom water ballast tanks, with hopper and top side wing ballast tanks. Heavy fuel oil tanks are arranged in the engine room and topside wing tanks. SOLAS visibility regulations mean that there is a six-tier deckhouse for the complement of 24 crew, excluding the Suez crew cabin.

Framura has a cargo capacity of 91,800m^3 and 22,300m^3 in its cargo holds and ballast tanks, respectively. With the capacity of 2,300m^3 for the fuel oil, the cruising range is about 19,800 nautical miles on the basis of a speed of 15.01knots considering three reserve days. The vessel is designed and constructed to be loaded not only for Group A and B type of IMSBC code, but also dangerous cargoes including sulphur.

TECHNICAL PARTICULARS

Length oa: 223.00m
Length bp: 217.00m
Breadth moulded: 32.26m
Depth moulded
- To main deck: 19.90m
- To upper deck: 19.90m

Width of double skin
- Side: 1.5m
- Bottom: 1.75m

Draught
- Scantling: 14.217m
- Design: 12.20m

Gross: 42,495gt
Displacement: 89,871tonnes
Lightweight: 13,038tonnes
Deadweight
- Design: 63,087dwt
- Scantling: 76,832dwt

Block co-efficient: 0.8673 (Design)
Speed, service: 15.01knots
Cargo capacity
- Bale: 89,824m^3
- Grain: 91,839.7m^3

Bunkers
- Heavy oil: 2,347.8m^3
- Diesel oil: 333.4m^3

Water ballast: 22,305m^3
Daily fuel consumption
- Main engine only: 37.04tonnes/day
- Auxiliaries: 3.07tonnes/day

Classification society and notations: RINa C+, Bulk Carrier ESP CSR, BC-A Nonhomoload [holds 2, 4 and 6 may be empty], +STAR-HULL-NB, In WaterSurvey, Grab (20), MON-SHAFT, +AUT-UMS, BWE-F, COAT, WBT
% high-tensile steel used in construction: 80%
Main engine
- Model: 5S60ME-C (MK8.2)
- Manufacturer: Hyundai Heavy Industries
- Number: 1
- Type of fuel: HFO, MDO, MGO
- Output of each engine: 10,220kW x 94rpm

Propeller
- Material: Ni-Al-Bronze
- Designer/manufacturer: SPP Shipbuilding/ Silla Metal
- Number: 1
- Fixed/controllable pitch: Fixed
- Diameter: 7.15m
- Speed: 94rpm

Diesel-driven alternators
- Number: 3
- Engine make/type: Yanmar/6EY18ALW
- Type of fuel: HFO, MDO, MGO
- Output/speed of each set: 660kW x 900rpm
- Alternator make/type: Taiyo/FE
- Output/speed of each set: 600kW x 900rpm

Boilers
- Number: 1
- Type: MC
- Make: SPP Shipbuilding (Haman factory)
- Output, each boiler: 1,300/1,200kg/h x 7kg/CM^2

Other cranes
- Number: 1
- Make: SPP Machine Tech
- Type: Electric
- Tasks: Provisions crane
- Performance: 4tonnes

Mooring equipment
- Number: 6
- Make: Flutek
- Type: Hydraulic

Special lifesaving equipment
- Number of each and capacity: 24 persons
- Make: Beihai
- Type: Freefall

Hatch covers
- Design: SMS
- Manufacturer: SME
- Type: Hydraulic (Rack & pinion side rolling)

Ballast control system
- Make: KSB Seil
- Type: Hydraulic type

Complement
- Officers: 9
- Crew: 15

Bridge control system
- Make: Hyomyung Eng
- Type: Self-standing type

Fire detection system
- Make: Consilium
- Type: Addressable type

Fire extinguishing systems
- Cargo holds: NK/ fixed CO_2 fire extinguishing system
- Engine: NK/ fixed CO_2 fire extinguishing system

Radars
- Number: 2
- Make: JRC
- Model: JMA-9132-SA/ JMA-9122-9XA

Waste disposal plant
- Incinerator: Hyundai-Atlas/ Maxi T50 SL WS
- Sewage plant: Jowa/ STP2010series

Contract date: January 2011
Launch/float-out date: September 2013
Delivery date: January 2014

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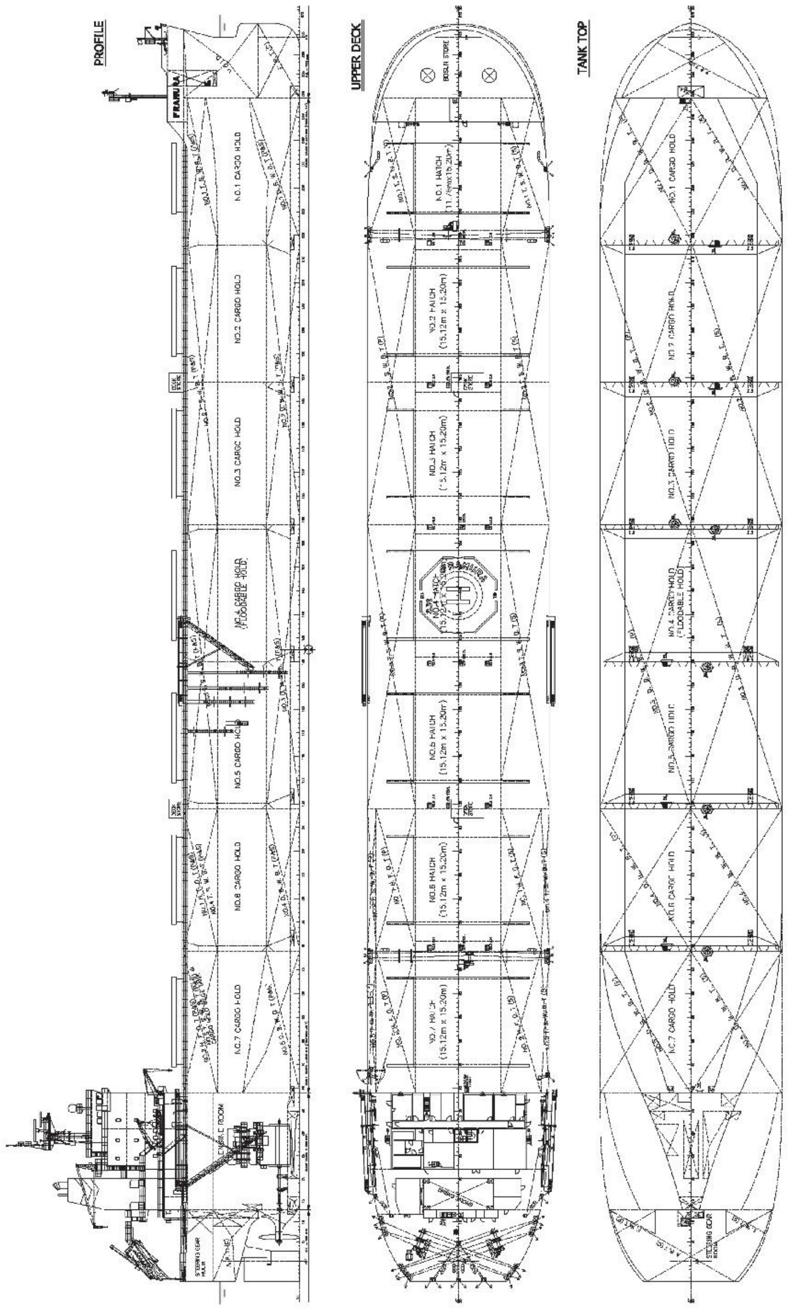
FRAMURA



SIGNIFICANT SHIPS OF 2014 51

ANEXO V.

Para Lpp=195						
DIMENSIÓNS PRINCIPAIS						
Lpp	195,00	m		TPM	70000	t
B	32,25	m		Δ	86719	t
D	21,56	m		V	14,5	nudos
T	14,95	m		NT	25	persoas
Cb	0,90			FB	6,61	m

Custo do ciclo de vida		
IT	35,267	M€
∑GEi	249,767	M€
CCV	285,034	M€
FB mínimo	6,60	m
N	135585,45	
VCAR	84135,0518	

Para Lpp=200						
DIMENSIÓNS PRINCIPAIS						
Lpp	200,00	m		TPM	70000	t
B	32,25	m		Δ	88942	t
D	21,56	m		V	14,5	nudos
T	14,95	m		NT	25	persoas
Cb	0,90			FB	6,61	m

Custo do ciclo de vida		
IT	36,826	M€
∑GEi	253,252	M€
CCV	290,078	M€
FB mínimo	6,623	m
N	139062	
VCAR	86273,13	

Para Lpp=205						
DIMENSIÓNS PRINCIPAIS						
Lpp	205,00	m		TPM	70000	t
B	32,25	m		Δ	87500	t
D	21,56	m		V	14,5	nudos
T	14,35	m		NT	25	persoas
Cb	0,90			FB	7,21	m
Custo do ciclo de vida						
IT	38,203	M€				
∑GEi	250,332	M€				
CCV	288,534	M€				
FB mínimo	6,652	m				
N	142538,55					
VCAR	88411,2083					

Para Lpp=210						
DIMENSIÓNS PRINCIPAIS						
Lpp	210,00	m		TPM	70000	t
B	31,69	m		Δ	87500	t
D	21,56	m		V	14,5	nudos
T	14,58	m		NT	25	persoas
Cb	0,88			FB	6,98	m
Custo do ciclo de vida						
IT	39,082	M€				
∑GEi	249,933	M€				
CCV	289,014	M€				
FB mínimo	6,63	m				
N	143495,935					
VCAR	89000					

Para B=30						
DIMENSIÓNS PRINCIPAIS						
Lpp	221,86	m		TPM	70000	t
B	30,00	m		Δ	87500	t
D	21,56	m		V	14,5	nudos
T	14,58	m		NT	25	persoas
Cb	0,88			FB	6,98	m
Custo do ciclo de vida						
IT	41,491	M€				
∑GEi	248,997	M€				
CCV	290,489	M€				
FB mínimo	6,682	m				
N	143495,935					
VCAR	89000					

Para B=31						
DIMENSIÓNS PRINCIPAIS						
Lpp	214,70	m		TPM	70000	t
B	31,00	m		Δ	87500	t
D	21,56	m		V	14,5	nudos
T	14,58	m		NT	25	persoas
Cb	0,88			FB	6,98	m
Custo do ciclo de vida						
IT	38,676	M€				
∑GEi	250,093	M€				
CCV	288,769	M€				
FB mínimo	6,619	m				
N	143495,935					
VCAR	89000					

Para T=12						
DIMENSIÓNS PRINCIPAIS						
Lpp	233,20	m		TPM	70000	t
B	32,25	m		Δ	83254	t
D	19,0801302	m		V	14,5	nudos
T	12,00	m		NT	25	persoas
Cb	0,90			FB	7,08	m

Custo do ciclo de vida		
IT	45,911	M€
∑GEi	240,703	M€
CCV	286,614	M€
FB mínimo	6,16	m
N	143495,935	
VCAR	89000	

Para T=13						
DIMENSIÓNS PRINCIPAIS						
Lpp	233,07	m		TPM	70000	t
B	31,30	m		Δ	87500	t
D	19,6671429	m		V	14,5	nudos
T	13,00	m		NT	25	persoas
Cb	0,90			FB	6,67	m

Custo do ciclo de vida		
IT	45,609	M€
∑GEi	248,123	M€
CCV	293,731	M€
FB mínimo	6,307	m
N	143495,935	
VCAR	89000	

Para T=14						
DIMENSIÓNS PRINCIPAIS						
Lpp	232,86	m		TPM	70000	t
B	29,74	m		Δ	87500	t
D	20,7213711	m		V	14,5	nudos
T	14,00	m		NT	25	persoas
Cb	0,88			FB	6,72	m

Custo do ciclo de vida		
IT	44,380	M€
∑GEi	248,139	M€
CCV	292,519	M€
FB mínimo	6,514	m

N	143495,935
VCAR	89000

Para T=15						
DIMENSIÓNS PRINCIPAIS						
Lpp	206,38	m		TPM	70000	t
B	32,25	m		Δ	90051	t
D	21,56	m		V	14,5	nudos
T	15,00	m		NT	25	persoas
Cb	0,88			FB	6,56	m

Custo do ciclo de vida		
IT	38,504	M€
∑GEi	254,657	M€
CCV	293,161	M€
FB mínimo	6,611	m

N	143495,935
VCAR	89000

Para Cb=0,89						
DIMENSIÓNS PRINCIPAIS						
Lpp	206,38	m		TPM	70000	t
B	32,25	m		Δ	87500	t
D	21,56	m		V	14,5	nudos
T	14,41	m		NT	25	persoas
Cb	0,89			FB	7,15	m
Custo do ciclo de vida						
IT	38,481	M€				
∑GEi	250,222	M€				
CCV	288,703	M€				
FB mínimo	6,636	m				
N	143495,935					
VCAR	89000					

Para Cb=0,90						
DIMENSIÓNS PRINCIPAIS						
Lpp	206,38	m		TPM	70000	t
B	32,25	m		Δ	87500	t
D	21,56	m		V	14,5	nudos
T	14,25	m		NT	25	persoas
Cb	0,90			FB	7,31	m
Custo do ciclo de vida						
IT	38,612	M€				
∑GEi	250,222	M€				
CCV	288,833	M€				
FB mínimo	6,661	m				
N	143495,935					
VCAR	89000					