UNIVERSIDADE DA CORUÑA

Escola Politécnica Superior

Trabajo Fin de Grado/Máster
CURSO 2017/2018

PETROLERO SUEZMAX 148.000 TPM

Grado en Ingeniería Naval y Oceánica

ALUMNA/O: Pablo Martínez Martínez

TUTORAS/ES: Vicente Díaz Casás

FECHA: 3 / SEPTEIMBRE / 2018

El buque proyecto es un buque para transporte de petróleo crudo y derivados como la nafta por ejemplo. Este buque petrolero pertenece a la clase SUEZMAX, lo que significa que sus dimensiones están ajustadas al máximo a las de Canal de Suez.

La carga y descarga se realiza mediantes bombas de pozo profundo, lo que significa que no posee una cámara de bombas sino que cada tanque dispone de su propia bomba. En esta zona de carga posee un sistema de lucha contra incendios por espuma.

O buque proxecto é un buque para transporte de petróleo crudo e derivados como a nafta por exemplo. O buque petroleiro pertence á clase SUEZMAX, o cal siginifica que as súas dimensións están axustadas ó máximo as do Canle de Suez.

A carga e descarga realízase mediante bombas de pozo profundo, o que significa que non posee una cámara de bombas senón que cada tanque dispón da súa propia bomba. Nesta zona de carga o buque posee un sistema de loita contra incendios por espuma.

The Project ship is for transport of oil-crude and naftas. This oil-crude tanker belongs to the class of SUEZMAX, which means that dimensions are ajusted for the Suez Canal to the maximun.

The cargo system are formed by deep well pumps and that means that thhis vessel haven`t got a chamber of pumps In cargo area it has a fire protection system by foam.

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TRABAJO FIN DE GRADO

CURSO 2017/2018

PETROLERO SUEZMAX 148.000 TPM

Grado en Ingeniería Naval y Oceánica

CUADERNO 1

ELECCIÓN DE LA CIFRA DE MÉRITO Y DEFINICIÓN DE ALTERNATIVAS. SELECCIÓN DE LA MÁS FAVORABLE.

ESCOLA POLITÉCNICA SUPERIOR

UNIVERSIDADE DA CORUÑA

GRADO EN INGENIERÍA NAVAL Y OCEÁNICA

TRABAJO FIN DE GRADO

CURSO 2.016-2017

PROYECTO NÚMERO 17-12

TIPO DE BUQUE: Petrolero Suezmax 148000 TPM

CLASIFICACIÓN, COTA Y REGLAMENTOS DE APLICACIÓN: DNV, MARPOL, SOLAS, CONVENIO DE LINEAS DE CARGA TIER 3

CARACTERÍSTICAS DE LA CARGA: 148000 TPM. Transporte de petróleo CRUDOS Y DERIVADOS.

VELOCIDAD Y AUTONOMÍA: 15,8 nudos con 85%MCR+ 15% margen de mar

SISTEMAS Y EQUIPOS DE CARGA / DESCARGA: Bombas de carga y descarga en los tanques de carga. Calefacción en tanques de carga.

PROPULSIÓN: Motor diésel directamente acoplado.

TRIPULACIÓN Y PASAJE: 30 personas

OTROS EQUIPOS E INSTALACIONES: Los habituales en este tipo de buques.

Ferrol, 10 Setiembre 2016

ALUMNO/A: **Dª PABLO MARTÍNEZ MARTÍNEZ**

Fernando Junco Ocampo

Contenido

1 PRESENTACIÓN

El buque a proyectar en este trabajo es un buque de carga para el transporte de petróleo y derivados, cuya característica principal es que está preparado para transitar el Canal de Suez.

En el presente cuaderno se realizarán los cálculos del dimensionamiento, para el cual existen diversos procedimientos:

- Métodos Estadísticos: se parte de la información de una base de datos de barcos similares al barco objeto de diseño y se busca encajar las dimensiones con menor error posible gracias al volumen de datos tratados.
- Fundamentarse en uno o varios buques base de los que se disponga una amplia y fiable información.
- Método Experimental: existen diversos tipos, como puede ser el uso de series sistemáticas de formas.

En mi caso, se elige el método estadístico para obtener el dimensionamiento de nuestro buque.

2 BASE DE DATOS:

Una vez se conocen las características y los requisitos previstos de actividad del buque a proyectar (RPA), se confecciona una base de datos con buques de características similares al mismo.

Para la realización de la base de datos, se realiza una recopilación de datos de diversas fuentes “Significant Ships” y “Register of Shipping” sobre diversos buques petroleros tipo Suez Max, con una capacidad de peso muerto entre 130.000 y 170.000 TPM.

Esta base de datos permitirá conocer de forma aproximada las dimensiones del buque a proyectar en base a un análisis de regresión lineal de parámetros de los buques de referencia.

A continuación, se muestra la base de datos obtenida:

Lpp (m)	B (m)	D (m)	Td (m)	Ts (m)	Vs (knots)	Δ (t)	Cb	TPM(dwt)	Capacidad de carga (m3)
265	43,2	23,8	16	16,725	14			141720	163578
	44,4	24,1		15,6	14,5			145242	
	48							149997	
267	49	23,6	16,2	17,2	15,13			153680	167885
267	49	23,6	16,2	17,2	14,62			154101	164540
264	48	23,1	16	17,15	14,8	183400		155700	167500
267	49	23,3	16,2	17,2	15,97	181682	0,786	157849	175066
264	48	23,1	16	17,5	15,7			158000	170000
364	48	23,1	16	17,5	15,8	183839	0,8235	158007	173826
264	48	23,3	16	17	14,58	182914		159031	175742
264	50	23,1	16	17	15,3			163759	182025
270	50	23	15	16,5	15,5	188140	0,813	162390	183600

De esta tabla se obtienen las siguientes relaciones:

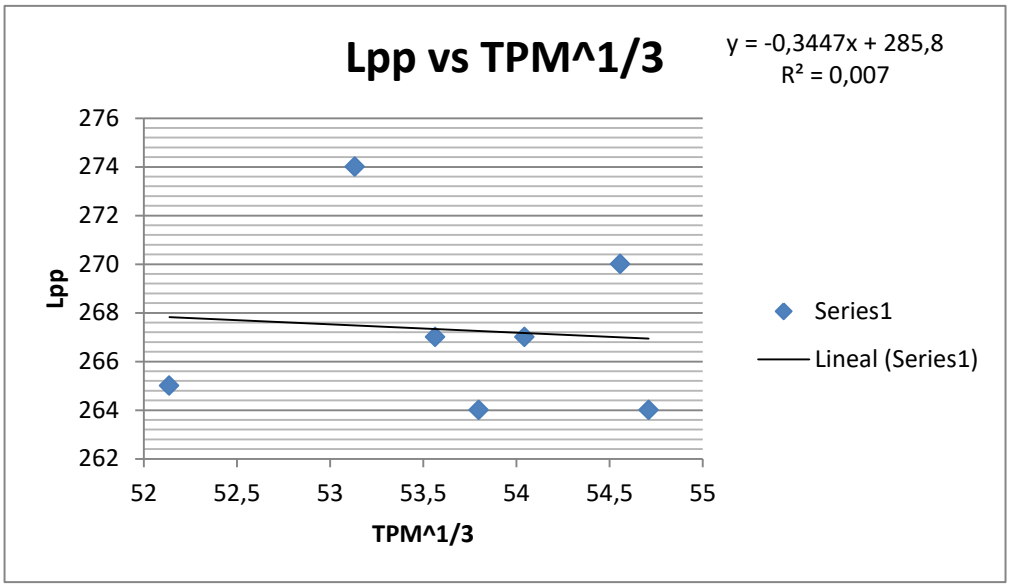
Lpp/B	B/Lt	B/T	Lpp/Ts	T/D	B/D	Lpp/D
6,13	0,16	2,58	15,84	0,70	1,82	11,13
5,71	0,18	3,04	17,34	0,65	1,98	11,32
5,45	0,17	2,85	15,52	0,73	2,08	11,31
5,50	0,17	2,80	15,39	0,74	2,08	11,43
5,45	0,18	2,85	15,52	0,74	2,10	11,46
5,28	0,18	2,94	15,53	0,74	2,16	11,43
5,40	0,18	3,03	16,36	0,72	2,17	11,74
6,06	0,17	2,95	15,70	0,75	2,10	11,74
6,06	**0,17**	**2,66**	**16,09**	**0,71**	**1,90**	**11,50**

3 CÁLCULO DE LAS DIMENSIONES PRINCIPALES

Los cálculos de las dimensiones principales del buque proyecto se obtiene mediante regresiones lineales, como se muestra a continuación.

3.1 Estimación de la Eslora entre Perpendiculares (Lpp):

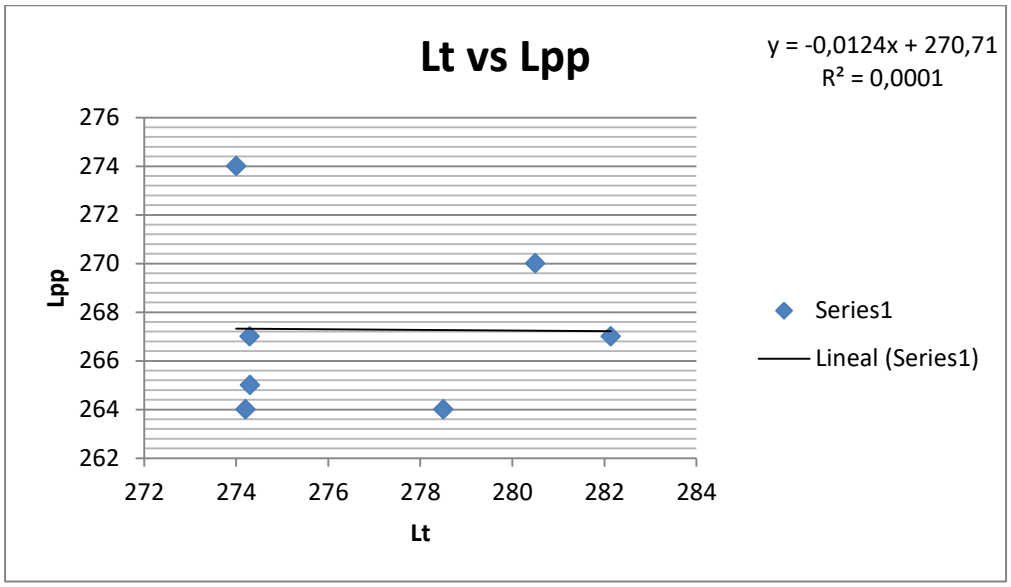
En el gráfico se muestra como calculo la Lpp en función de mis TPM$^{1/3}$ (=52,89), que es un dato de partida.



$$Lpp1 = -10.3447 * 52{,}89 + 285.8;$$

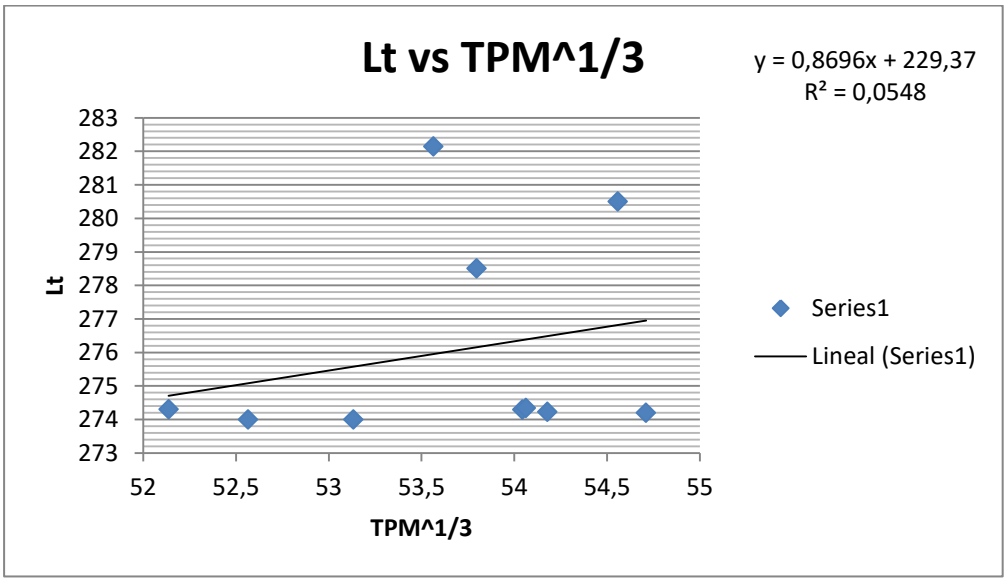
Lpp1 = 261,3 m

Sustituyendo la Lt (Lt calculada en el siguiente gráfico) en el siguiente gráfico obtengo Lpp2:



$$Lpp2 = -0{,}0124 * 276{,}4 + 270.71; Lpp2 = 267\ m$$

En el siguiente gráfico lo mismo que en el primero pero utilizando la Eslora total:



$$Lt = 0{,}8696 * 52{,}89 + 229{,}37;$$

$$\boldsymbol{Lt = 275{,}3\ m}$$

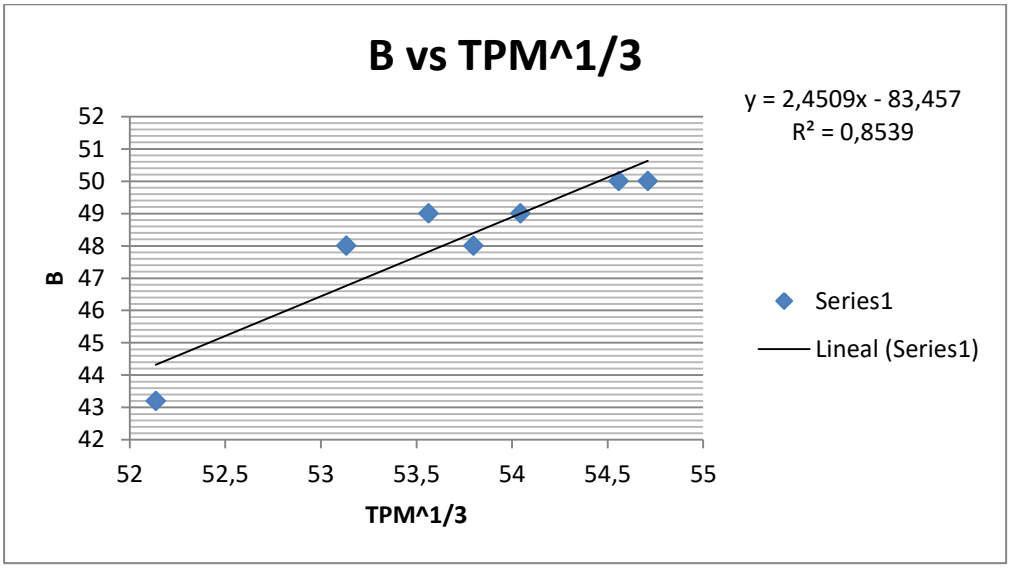
Haciendo la media entre las dos Lpp obtengo mi Eslora preliminar:

$$Lpp = \frac{Lpp1 + Lpp2}{2} = \frac{261{,}3 + 267}{2};$$

$$\boldsymbol{Lpp = 264{,}15\ m}$$

3.2 Estimación de la Manga (B):

- Calculo la B en función de $TPM^{1/3}$ (=54,06):



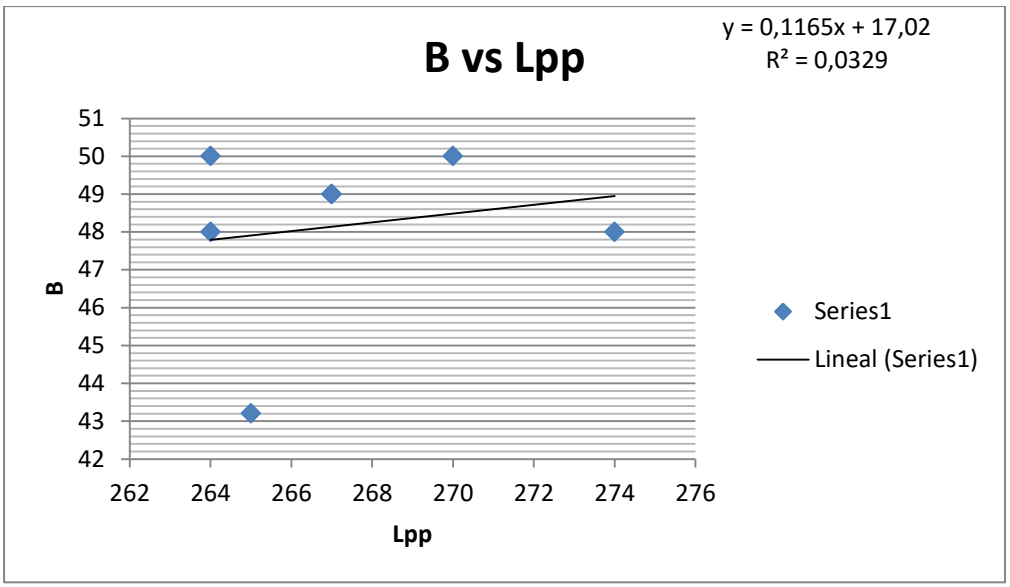
Estimación aproximada de la manga:

$$B = 2{,}4509 * 52{,}89 - 83{,}457;$$

$$\boldsymbol{B = 46{,}2\ m}$$

*Esta B es orientativa

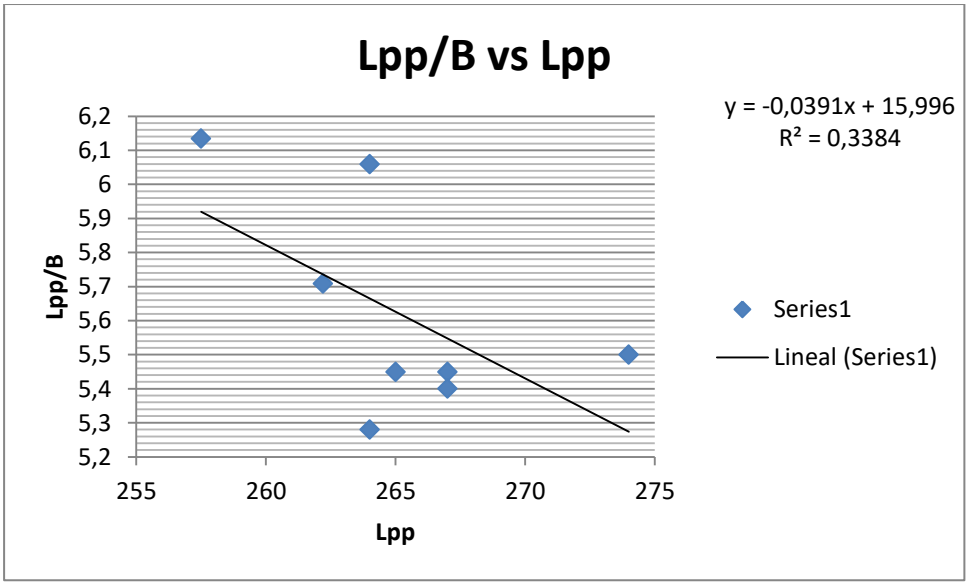
- Representando la B frente a la Lpp:



$$B2 = 0.1165 * Lpp + 17.02; B2 = 0.1165 * 264{,}15 + 17.02;$$

$$\boldsymbol{B2 = 48\ m}$$

- A continuación represento la relación $\frac{Lpp}{B}$ frente a la Lpp:



Sustituyendo la Lpp=264,15 en la ecuación:

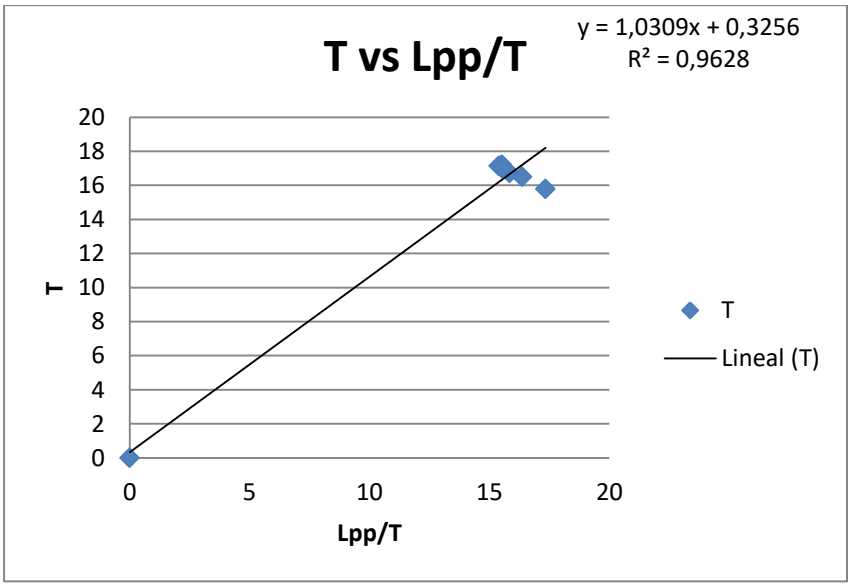
$$B3 = -0.0391 * \frac{Lpp}{B3} + 15.996 = 48{,}2\ m$$

- Finalmente, la Manga de mi buque será:

$$B = \frac{B2 + B3}{2} = \frac{48 + 48{,}2}{2}; \quad \boldsymbol{B = 48{,}1\ m}$$

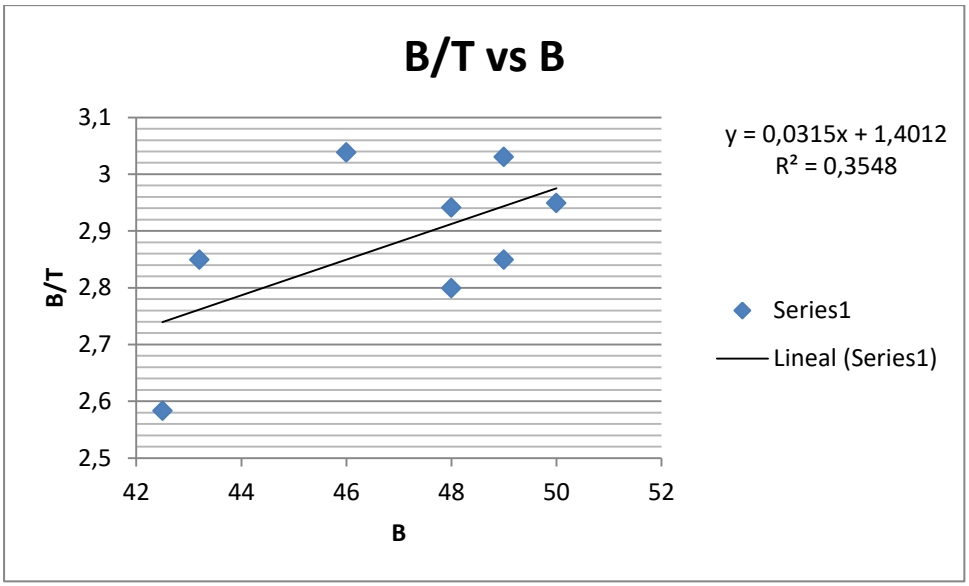
3.3 Estimación del Calado (T):

- Representando T frente a relación $\frac{Lpp}{T}$:



$$T1 = 1{,}0309 * \frac{Lpp}{T1} + 0.3256 = 16.9\ m$$

- En el siguiente gráfico represento la relación $\frac{B}{T}$ frente a la B:



$$T2 = 0{,}0315 * \frac{B}{T2} + 1{,}4012 = 16{,}5\, m$$

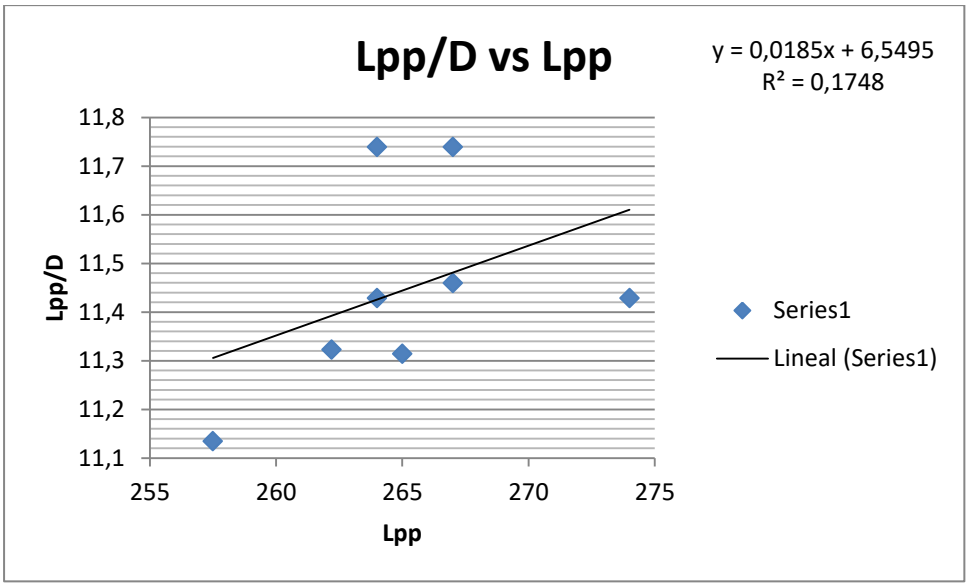
El Calado T del buque proyecto es:

$$T = \frac{T1 + T2}{2} = \frac{16.9 + 16.5}{2};$$

$$\boldsymbol{T = 16{,}7\, m}$$

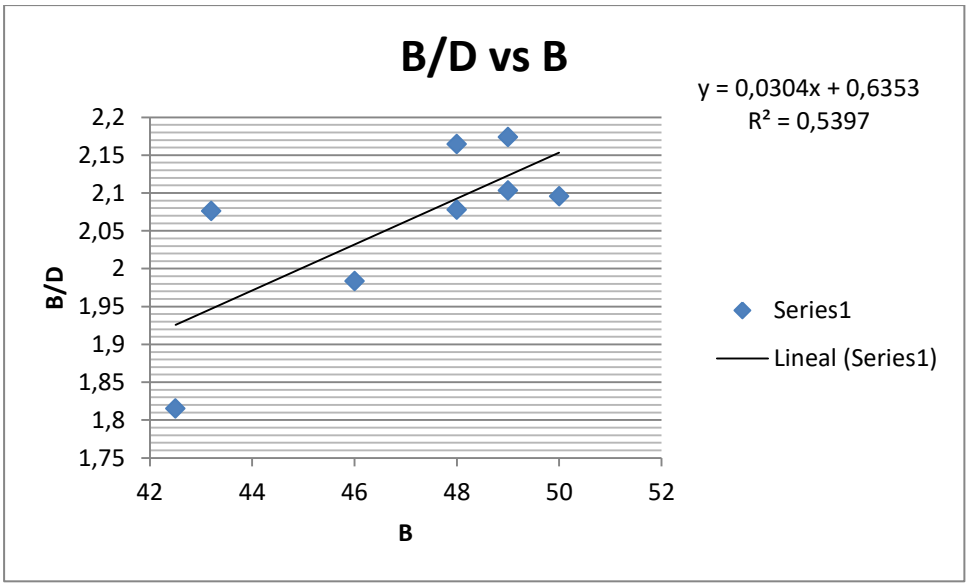
3.4 Estimación del Puntal (D):

- Representando la relación $\frac{Lpp}{D}$ frente a la Lpp:



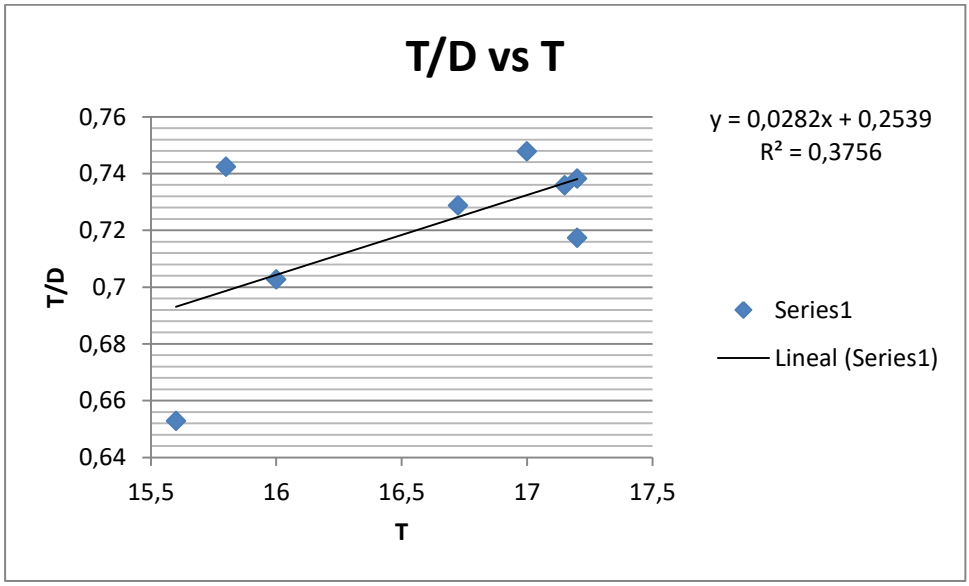
$$D1 = 0{,}0185 * \frac{Lpp}{D1} + 6{,}5495 = 23{,}3\ m$$

- En la siguiente gráfica represento $\frac{B}{D}$ frente a la B:



$$D2 = 0{,}0304 * \frac{B}{D2} + 0{,}6353 = 22{,}9\ m$$

- En la siguiente gráfica muestro T/D frente al T:



$$D3 = 0{,}0282 * \frac{T}{D3} + 0.2539 = 23.0 \text{ m}$$

- El Puntal (D) de mi buque será:

$$D = \frac{D1 + D2 + D3}{3} = \frac{23{,}3 + 22{,}9 + 23{,}0}{3}; \quad \boldsymbol{D = 23{,}1\ m}$$

3.5 RESULTADOS OBTENIDOS:

Lpp	264,15 m
B	48,1 m
T	16,7 m
D	23,1 m

4 SELECCIÓN DE ALTERNATIVAS

En este apartado se trata de buscar el buque cuya construcción sea más viable económicamente, entre las diferentes alternativas generadas a partir de una serie de parámetros.

Se estudian una serie de alternativas para conocer cuáles son las dimensiones en función de la cifra de mérito que en este caso es el coste de construcción (CC).

El proceso a seguir consiste en calcular una serie de alternativas de las dimensiones preliminares mediante variación sistemática de sus parámetros fundamentales, como son las dimensiones principales y los coeficientes. A cada una de estas alternativas se le calculara el coste de construcción y se elegirá aquella que cumpliendo todos los requisitos técnicos presente el menor coste de construcción.

- **Alternativa inicial:**

- Lpp= 264,15 m
- B=48,1 m
- D=23,1 m
- T=16.7 m

- Fn (Número de Froude) = $\frac{v\left(\frac{m}{s}\right)}{\sqrt{g*Lpp}} = \frac{15{,}8*0.5144}{\sqrt{9{,}81*264{,}15}}$ = 0,159

- Cb = 0,7+$\frac{1}{8}$ *(ATAN((23-100*Fn)/4)) = 0,832

  Aplicando esta fórmula a mi buque base (Eagle San Antonio) el Cb es 0,831 por lo tanto es correcto.

- Cm= 1,006-0.0056*$Cb^{-3,56}$ = 0,995

- Cp = $\frac{Cb}{Cm}$ = 0,836

- ∆ (Desplazamiento) = 1,025*Lpp*B*T*Cb = 183219,6 t

- PS (Peso de aceros del buque) = 0,094*Lpp^{1,5} * B* D^{0,333} = 30316

- Para el cálculo de la potencia relaciono mi buque base (Eagle San Antonio) con lo que va a ser mi buque nuevo:

  Primero calculo el Cr standard de mi buque base:

  $$C_{R,\text{Standard}} = c_{11} + c_{12}F_n + c_{13}F_n^2 + C_B \cdot (c_{21} + c_{22}F_n + c_{23}F_n^2) + C_B^2 \cdot (c_{31} + c_{32}F_n + c_{33}F_n^2)$$

  , y lo sustituyo en la siguiente ecuación:

  $$C_R = C_{R,\text{Standard}} \cdot (T/B)^{a1} \cdot (B/L)^{a2} \cdot (L_{os}/L_{wl})^{a3} \cdot (L_{wl}/L)^{a4}$$

  Resultando un coeficiente 'a'=1,121 y una potencia de:

  Bkw = 17400 kw

- BHP = Bkw/0,735 = 23673

- PQ (Peso de la maquinaria) = Bkw*(895-0.0025*Bkw)/10000 = 1482

- PEr = 0,0458*L^{0,333} * B^{0,333} * D^{0,333} = 16,5

- CMg (coeficiente de coste de material a granel) = 1,08*PS = 60800,6

- Ceq (costo de los equipos del buque) = Cec+CHf+CEr = 865773,2

  - CHf (coste habilitación y fonda)=chf*nch*NT=34500*1.05*30= 1086750

    - Chf (coeficiente de coste unitario de la habilitación por tripulante) = 34500 € / tripulante.
    - nch (coef de nivel de calidad de la habilitación) = 1,05
    - NT (número de tripulantes) = 30 tripulantes

  - CEr (coste equipo restante) = cer*PEr=1,27*600*(0,03*L^{1,3} * B^{0,8} * D^{0,3}) = 1858172,6

    - cer = ccs*ps = 1,27*600
    - ps (precio unitario del acero) = 600€

- CMo (coste de mano de obra) = Cmm+CMe = 43957685

    - Cmm (costo mano de obra montaje material a granel) = csh*chm*PS = 50*29*56297 =
      - csh (coef. De horas por unidad de peso)= 50 horas/tonelada

- chm (costo horario medio del astillero) = 29 €/hora

- Cva=cva*CC= 4269861
    - cva (costes varios del astillero) = 0,08
- CC (coste de construcción) = CMq+Ceq+Cmo= 53373259 €

- **Alternativas válidas**

Límites de los buques alternativa:

De todas las opciones posibles, se considerarán aquellas que cumplan los siguientes criterios de L, B,T, D sacados de la base de datos de cada buque:

	MÍN	MÁX
L/B (m)	**5,3**	**6,1**
B/D (m)	**1,8**	**2,2**
B/T (m)	**2,6**	**3,03**
L/D (m)	**11,1**	**11,7**

Debido a que el buque pasa por el ***Canal de Suez***, son necesarias un par de restricciones más:

➔ La **B máxima** será de **49** m
➔ El **T máximo** será de **18,9** m

A continuación, de las 3091 alternativas calculadas represento las que son válidas en cuanto a las relaciones $\frac{Lpp}{B}, \frac{B}{D}, \frac{B}{T}, \frac{Lpp}{D}$ y las limitaciones del Canal de Suez B=49 m y T=18,9 m:

L	B	D	T	CB	CM	CP	FN	PS	PQ	PER	BKW	CC
261,5	48,3	23,5	17,4	0,899	0,997	0,998	0,2	29703,4	1879,1	15,9	22396,8	54296678,36
264,5	48,3	23,5	17,4	0,899	0,997	0,998	0,2	30216,0	1845,6	15,9	21968,9	54909393,08
267,5	48,3	23,5	17,1	0,888	0,997	0,998	0,2	30731,5	1793,7	16,0	21310,1	55441024,21
267,5	48,3	23,9	17,1	0,888	0,997	0,998	0,2	31017,0	1793,7	16,1	21310,1	55865635,71
267,5	47,3	23,5	17,4	0,888	0,997	0,998	0,2	30095,8	1738,6	15,8	20612,7	54229432,44
267,5	47,3	23,9	17,4	0,888	0,997	0,998	0,2	30375,4	1738,6	15,9	20612,7	54645303,47
267,5	48,3	23,5	17,4	0,888	0,997	0,998	0,2	30731,5	1813,2	16,0	21556,9	55532362,21
267,5	48,3	23,9	17,4	0,888	0,997	0,998	0,2	31017,0	1813,2	16,1	21556,9	55956973,71
267,5	46,3	23,9	17,7	0,888	0,997	0,998	0,2	29733,8	1683,3	15,7	19915,2	53424805,9
267,5	47,3	23,9	17,7	0,888	0,997	0,998	0,2	30375,4	1757,2	15,9	20847,4	54732139,39
267,5	48,3	23,9	17,7	0,889	0,997	0,998	0,2	31017,0	1832,5	16,1	21802,4	56047783,84
267,5	48,3	23,5	17,1	0,889	0,997	0,998	0,2	30731,5	1793,7	16,0	21310,1	55441024,21
267,5	48,3	23,9	17,1	0,889	0,998	0,998	0,2	31017,0	1793,7	16,1	21310,1	55865635,71
267,5	47,3	23,5	17,4	0,889	0,998	0,998	0,2	30095,8	1738,6	15,8	20612,7	54229432,44
267,5	47,3	23,9	17,4	0,889	0,998	0,998	0,2	30375,4	1738,6	15,9	20612,7	54645303,47
267,5	48,3	23,5	17,4	0,888	0,998	0,998	0,2	30731,5	1813,2	16,0	21556,9	55532362,21
267,5	48,3	23,9	17,4	0,888	0,998	0,998	0,2	31017,0	1813,2	16,1	21556,9	55956973,71
267,5	46,3	23,9	17,7	0,888	0,998	0,998	0,2	29733,8	1683,3	15,7	19915,2	53424805,9
267,5	47,3	23,9	17,7	0,888	0,998	0,998	0,2	30375,4	1757,2	15,9	20847,4	54732139,39
267,5	48,3	23,9	17,7	0,888	0,998	0,998	0,2	31017,0	1832,5	16,1	21802,4	56047783,84
270,5	48,3	23,5	16,8	0,899	0,998	0,998	0,2	31250,0	1743,5	16,0	20674,2	55985427,19
270,5	48,3	23,9	16,8	0,899	0,998	0,998	0,2	31540,2	1743,5	16,2	20674,2	56417178,12
270,5	47,3	23,5	17,1	0,899	0,998	0,998	0,2	30603,5	1690,1	15,8	20001,7	54767035,17
270,5	47,3	23,9	17,1	0,899	0,998	0,998	0,2	30887,8	1690,1	16,0	20001,7	55189898,57
270,5	48,3	23,5	17,1	0,899	0,998	0,998	0,2	31250,0	1762,8	16,0	20918,0	56075617,48
270,5	48,3	23,9	17,1	0,899	0,998	0,998	0,2	31540,2	1762,8	16,2	20918,0	56507368,42
270,5	47,3	23,5	17,4	0,895	0,998	0,998	0,2	30603,5	1708,5	15,8	20233,4	54852771,4
270,5	47,3	23,9	17,4	0,895	0,998	0,998	0,2	30887,8	1708,5	16,0	20233,4	55275634,8
270,5	48,3	23,5	17,4	0,897	0,998	0,998	0,2	31250,0	1781,9	16,0	21160,3	56165277,47
270,5	48,3	23,9	17,4	0,897	0,998	0,998	0,2	31540,2	1781,9	16,2	21160,3	56597028,4
270,5	46,3	23,9	17,7	0,897	0,998	0,998	0,2	30235,4	1654,1	15,8	19548,8	54043734,21
270,5	47,3	23,9	17,7	0,899	0,998	0,998	0,2	30887,8	1726,8	16,0	20463,8	55360875,65
270,5	48,3	23,9	17,7	0,899	0,998	0,998	0,2	31540,2	1800,9	16,2	21401,2	56686170,26
273,5	48,3	23,5	16,8	0,899	0,998	0,998	0,2	31771,3	1713,9	16,1	20300,9	56631239,68
273,5	48,3	23,9	16,8	0,899	0,998	0,998	0,2	32066,4	1713,9	16,2	20300,9	57070169,4
273,5	47,3	23,5	17,1	0,899	0,998	0,998	0,2	31114,1	1661,4	15,9	19640,5	55401250,21
273,5	47,3	23,9	17,1	0,899	0,998	0,998	0,2	31403,1	1661,4	16,1	19640,5	55831144,53
273,5	48,3	23,5	17,1	0,899	0,998	0,998	0,2	31771,3	1732,9	16,1	20540,2	56719803,86
273,5	48,3	23,9	17,1	0,899	0,998	0,998	0,2	32066,4	1732,9	16,2	20540,2	57158733,59
273,5	46,3	23,5	17,4	0,899	0,998	0,998	0,2	30456,9	1608,6	15,7	18979,7	54170944,79
273,5	46,3	23,9	17,4	0,899	0,998	0,998	0,2	30739,7	1608,6	15,9	18979,7	54591802,95
273,5	47,3	23,5	17,4	0,889	0,998	0,998	0,2	31114,1	1679,5	15,9	19868,1	55485440,86

273,5	47,3	23,9	17,4	0,889	0,998	0,998	0,2	31403,1	1679,5	16,1	19868,1	55915335,18
273,5	48,3	23,5	17,4	0,889	0,998	0,998	0,2	31771,3	1751,7	16,1	20778,2	56807847,34
273,5	48,3	23,9	17,4	0,889	0,998	0,998	0,2	32066,4	1751,7	16,2	20778,2	57246777,07
273,5	45,3	23,9	17,7	0,889	0,998	0,998	0,2	30076,4	1555,7	15,7	18319,3	53352468,95
273,5	46,3	23,9	17,7	0,889	0,998	0,998	0,2	30739,7	1625,9	15,9	19195,8	54671768,13
273,5	47,3	23,9	17,7	0,889	0,998	0,998	0,2	31403,1	1697,5	16,1	20094,3	55999039,42
273,5	48,3	23,9	17,7	0,889	0,998	0,998	0,2	32066,4	1770,4	16,2	21014,8	57334311,81
273,5	48,3	23,5	16,8	0,889	0,998	0,998	0,2	31771,3	1713,9	16,1	20300,9	56631239,68
273,5	48,3	23,9	16,8	0,889	0,998	0,998	0,2	32066,4	1713,9	16,2	20300,9	57070169,4
273,5	47,3	23,5	17,1	0,889	0,998	0,998	0,2	31114,1	1661,4	15,9	19640,5	55401250,21
273,5	47,3	23,9	17,1	0,889	0,998	0,998	0,2	31403,1	1661,4	16,1	19640,5	55831144,53
273,5	48,3	23,5	17,1	0,889	0,998	0,998	0,2	31771,3	1732,9	16,1	20540,2	56719803,86
273,5	48,3	23,9	17,1	0,889	0,998	0,998	0,2	32066,4	1732,9	16,2	20540,2	57158733,59
273,5	46,3	23,5	17,4	0,889	0,998	0,998	0,2	30456,9	1608,6	15,7	18979,7	54170944,79
273,5	46,3	23,9	17,4	0,889	0,998	0,998	0,2	30739,7	1608,6	15,9	18979,7	54591802,95
273,5	47,3	23,5	17,4	0,889	0,998	0,998	0,2	31114,1	1679,5	15,9	19868,1	55485440,86
273,5	47,3	23,9	17,4	0,889	0,998	0,998	0,2	31403,1	1679,5	16,1	19868,1	55915335,18
273,5	48,3	23,5	17,4	0,889	0,998	0,998	0,2	31771,3	1751,7	16,1	20778,2	56807847,34
273,5	48,3	23,9	17,4	0,889	0,998	0,998	0,2	32066,4	1751,7	16,2	20778,2	57246777,07
273,5	45,3	23,9	17,7	0,889	0,998	0,998	0,2	30076,4	1555,7	15,7	18319,3	53352468,95
273,5	46,3	23,9	17,7	0,887	0,998	0,998	0,2	30739,7	1625,9	15,9	19195,8	54671768,13
273,5	47,3	23,9	17,7	0,887	0,998	0,998	0,2	31403,1	1697,5	16,1	20094,3	55999039,42
273,5	48,3	23,9	17,7	0,887	0,998	0,998	0,2	32066,4	1770,4	16,2	21014,8	57334311,81
276,5	48,3	23,9	16,5	0,888	0,998	0,998	0,2	32595,4	1666,5	16,3	19704,5	57644940,21
276,5	47,3	23,9	16,8	0,888	0,998	0,998	0,2	31921,2	1615,7	16,1	19067,6	56398248,81
276,5	48,3	23,9	16,8	0,888	0,998	0,998	0,2	32595,4	1685,3	16,3	19941,1	57732460,95
276,5	46,3	23,9	17,1	0,888	0,998	0,998	0,2	31246,9	1564,6	15,9	18429,9	55151094,17
276,5	47,3	23,9	17,1	0,888	0,998	0,998	0,2	31921,2	1633,6	16,1	19292,5	56481438,93
276,5	48,3	23,9	17,1	0,888	0,998	0,998	0,2	32595,4	1704,0	16,3	20176,2	57819457,99
276,5	46,3	23,9	17,4	0,888	0,998	0,998	0,2	31246,9	1581,7	15,9	18643,4	55230101,15
276,5	47,3	23,9	17,4	0,888	0,998	0,998	0,2	31921,2	1651,5	16,1	19516,0	56564140,04
276,5	48,3	23,9	17,4	0,888	0,998	0,998	0,2	32595,4	1722,5	16,3	20409,9	57905943,59
276,5	45,3	23,9	17,7	0,888	0,998	0,998	0,2	30572,7	1529,6	15,7	17994,7	53978766,02
276,5	46,3	23,9	17,7	0,889	0,998	0,998	0,2	31246,9	1598,7	15,9	18855,7	55308651,77
276,5	47,3	23,9	17,7	0,889	0,998	0,998	0,2	31921,2	1669,2	16,1	19738,2	56646363,4
276,5	48,3	23,9	17,7	0,889	0,998	0,998	0,2	32595,4	1741,0	16,3	20642,3	57991929,5
279,5	48,3	23,9	16,2	0,889	0,998	0,998	0,2	33127,3	1620,5	16,4	19127,9	58231268,21
279,5	48,3	23,9	16,5	0,889	0,998	0,998	0,2	33127,3	1639,2	16,4	19361,7	58317796,01
279,5	47,3	23,9	16,8	0,889	0,998	0,998	0,2	32442,1	1589,1	16,2	18735,9	57058788,28
279,5	48,3	23,9	16,8	0,889	0,998	0,998	0,2	33127,3	1657,7	16,4	19594,2	58403796,7
279,5	46,3	23,9	17,1	0,889	0,998	0,998	0,2	31756,8	1538,8	16,0	18109,3	55799320,72
279,5	47,3	23,9	17,1	0,889	0,998	0,998	0,2	32442,1	1606,8	16,2	18956,9	57140533,78
279,5	48,3	23,9	17,1	0,889	0,998	0,998	0,2	33127,3	1676,1	16,4	19825,2	58489282,84
279,5	46,3	23,9	17,4	0,889	0,998	0,998	0,2	31756,8	1555,7	16,0	18319,1	55876955,94
279,5	47,3	23,9	17,4	0,899	0,998	0,998	0,2	32442,1	1624,4	16,2	19176,5	57221798,82

279,5	48,3	23,9	17,4	0,899	0,998	0,998	0,2	33127,3	1694,4	16,4	20054,9	58574266,47
279,5	46,3	23,9	17,7	0,899	0,998	0,998	0,2	31756,8	1572,4	16,0	18527,7	55954142,76
279,5	47,3	23,9	17,7	0,899	0,998	0,998	0,2	32442,1	1641,8	16,2	19394,9	57302594,43
279,5	48,3	23,9	17,7	0,899	0,998	0,998	0,2	33127,3	1712,5	16,4	20283,2	58658759,12

De todas estas alternativas válidas me quedo con la que tiene menor coste de construcción (CC):

L	B	D	T	CB	FN	PS	PQ	PER	BKW	CC
273,5	45,3	24	17,7	0,889	0,157	30076,4	1555,7	15,7	18319	53352468,95

5 COEFICIENTES

5.1 COEFICIENTE DE BLOQUE

Este parámetro es fundamental para representar las formas del buque, tiene una incidencia muy grande sobre la resistencia a la marcha y sobre la capacidad de carga, y en menor medida, sobre la estabilidad.

Para calcularlo:

$$Cb = 0{,}7 + 1{,}8 * \left(tan^{-1} \left(\frac{23 - 100 * Fn}{4} \right) \right) = 0{,}889$$

5.2 COEFICIENTE DE LA MAESTRA

Tiene una repercusión directa sobre la extensión de la zona curva del casco en el pantoque.

Se puede calcular:

$$Cm = 1{,}006 - 0{,}0056 * Cb^{-3{,}56} = 0{,}998$$

5.3 COEFICIENTE PRISMÁTICO

El coeficiente prismático se calcula por la relación del coeficiente de bloque con el coeficiente de la sección media:

$$\mathrm{CP} = \frac{Cb}{Cm} = 0{,}998$$

6 ESTIMACIÓN DE LA POTENCIA PROPULSORA

Relacionando las fórmulas siguientes entre mi buque base (Eagle San Antonio) y mi buque nuevo:

$$C_{R,\text{Standard}} = c_{11} + c_{12}F_n + c_{13}F_n^2 + C_B \cdot (c_{21} + c_{22}F_n + c_{23}F_n^2) + C_B^2 \cdot (c_{31} + c_{32}F_n + c_{33}F_n^2)$$

$$C_R = C_{R,\text{Standard}} \cdot (T/B)^{a1} \cdot (B/L)^{a2} \cdot (L_{os}/L_{wl})^{a3} \cdot (L_{wl}/L)^{a4}$$

y mediante la siguiente fórmula:

$$Bkw = a * (V^3 * \left(B * \frac{T}{10}\right) * (Cr + Cfpp) = 18319 \text{ Kw}$$

La potencia de mi buque nuevo anteriormente calculada es:
Bkw = 17400 kw

Debido a que estamos en una fase preliminar, el resto de datos necesarios se estiman mediante el programa NAVCAD.

Se ha elegido el método “Holtrop”, ya que no tiene valores fuera de los límites, y es uno de los métodos más utilizados para esta tipo de buques.

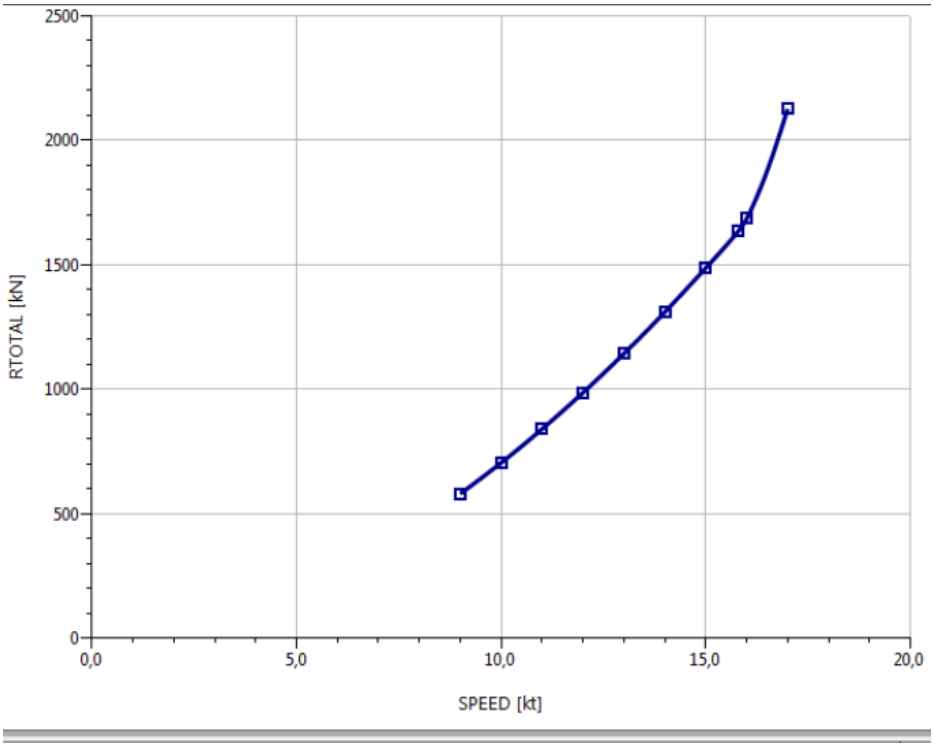
- <u>Resistencia total y potencia efectiva</u>

Para la resistencia :

Vessel drag	Calc	ITTC-78 (CT)
Technique:		Prediction
Prediction:		Holtrop
Reference ship:		
Model LWL:	[m]	
Viscous		
Expansion:		Standard
Friction line:		ITTC-57
Hull form factor:	On	1,522
Speed corr:	Off	
Spray drag corr:	Off	
Corr allowance:		ITTC-78 (v2008)
Roughness [mm]:	On	0,15
Catamaran		
Interference:	Off	
Added drag		
Appendage:	Calc	Percentage
Wind:	Off	
Seas:	Off	
Shallow/channel:	Off	
Towed:	Off	
Margin:	Calc	Hull + added drag [10...

Type	Task
	Right-click to add a task...

Hull		
Configuration:	Monohull	
Chine type:	Round/multiple	
General		
Length on WL:	275,000	m
Max beam on WL:	45,300	m
Max molded draft:	17,700	m
Displacement:	185392,00	t
Wetted surface:	15898,0	m2
Demi-hull spacing:		m
ITTC-78 (CT)		
LCB fwd TR:	137,500	m
LCF fwd TR:	137,500	m
Max section area:	801,0	m2
Waterplane area:	11738,2	m2
Bulb section area:	0,0	m2
Bulb ctr below WL:	0,000	m
Bulb nose fwd TR:	0,000	m
Imm transom area:	0,0	m2
Transom beam WL:	0,000	m
Transom immersion:	0,000	m
Half entrance angle:	61,09	deg
Bow shape factor:	1,0	[WL flow]
Stern shape factor:	1,0	[WL flow]
Planing		
Proj chine length:		m
Proj bottom area:		m2
LCG fwd TR:		m
VCG below WL:		m
Aft station (fwd TR):		m
Deadrise:		deg



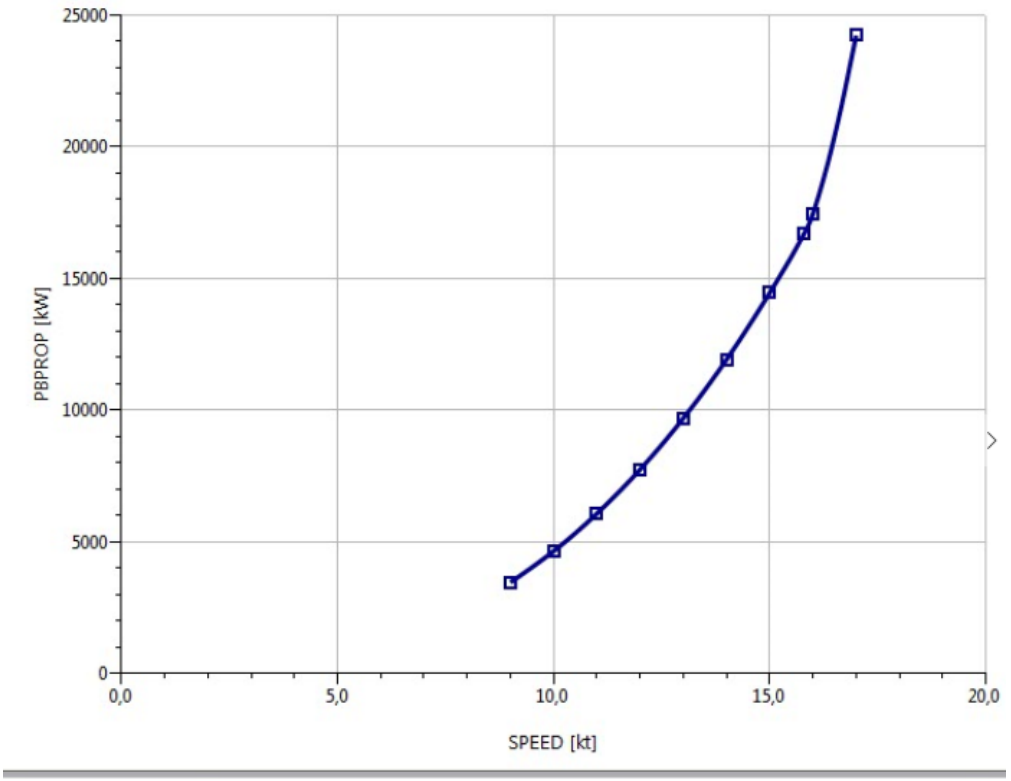
Para una velocidad de 15,8 kn se obtiene una Resistencia al avance de 1637 Kn

En cuanto a la potencia:

Hull-propulsor	Calc	
Technique:		Prediction
Prediction:		Holtrop
Reference ship:		
Max prop diam:	[mm]	10000,0
Corrections		
Viscous scale corr:	On	Custom
Rudder location:		Behind propeller
Friction line:		ITTC-57
Hull form factor:		1,522
Corr allowance:		0,000115
Roughness [mm]:	On	0,15
Ducted prop corr:	Off	
Tunnel stern corr:	Off	
Effective diam:	[m]	
Recess depth:	[m]	
System analysis		
Cavitation criteria:		Keller eqn
Analysis type:		Free run
CPP method:		Fixed RPM
Engine RPM:		
Mass multiplier:		
RPM constraint:		
Limit [RPM/s]:		

Type	Task
	Right-click to add a task...

Hull		
Configuration:	Monohull	
Chine type:	Round/multiple	
General		
Length on WL:	275,000	m
Max beam on WL:	45,300	m
Max molded draft:	17,700	m
Displacement:	185392,00	t
Wetted surface:	15898,0	m2
Demi-hull spacing:		m
ITTC-78 (CT)		
LCB fwd TR:	137,500	m
LCF fwd TR:	137,500	m
Max section area:	801,0	m2
Waterplane area:	11738,2	m2
Bulb section area:	0,0	m2
Bulb ctr below WL:	0,000	m
Bulb nose fwd TR:	0,000	m
Imm transom area:	0,0	m2
Transom beam WL:	0,000	m
Transom immersion:	0,000	m
Half entrance angle:	61,09	deg
Bow shape factor:	1,0	[WL flow]
Stern shape factor:	1,0	[WL flow]
Planing		
Proj chine length:		m
Proj bottom area:		m2
LCG fwd TR:		m
VCG below WL:		m
Aft station (fwd TR):		m
Deadrise:		deg



Se obtiene que a una velocidad de 15,8 Kn es necesaria una Potencia efectiva de 16718 KW

Una vez conozco tanto la resistencia al avance como la potencia efectiva, dimensiono en NavCAD en “Mode Propulsion” marcando en Propeller sizing la opción “by trust”.

Metiendo en este caso para la hélice 5 palas, ya que es con el que obtengo mejor rendimiento, así como la altura desde la línea de base hasta el eje de la hélice.

Por último marcando la opción “Size” para que el programa dimensione los datos que nos faltan

Hull-propulsor	Calc	
Technique:		Prediction
Prediction:		Holtrop
Reference ship:		
Max prop diam:	[mm]	8300,0
Corrections		
Viscous scale corr:	On	Custom
Rudder location:		Behind propeller
Friction line:		ITTC-57
Hull form factor:		1,522
Corr allowance:		0,000115
Roughness [mm]:	On	0,15
Ducted prop corr:	Off	
Tunnel stern corr:	Off	
Effective diam:	[m]	
Recess depth:	[m]	
System analysis		
Cavitation criteria:		Keller eqn
Analysis type:		Free run
CPP method:		Fixed RPM
Engine RPM:		
Mass multiplier:		
RPM constraint:		
Limit [RPM/s]:		

Type	Task
	Right-click to add a task...

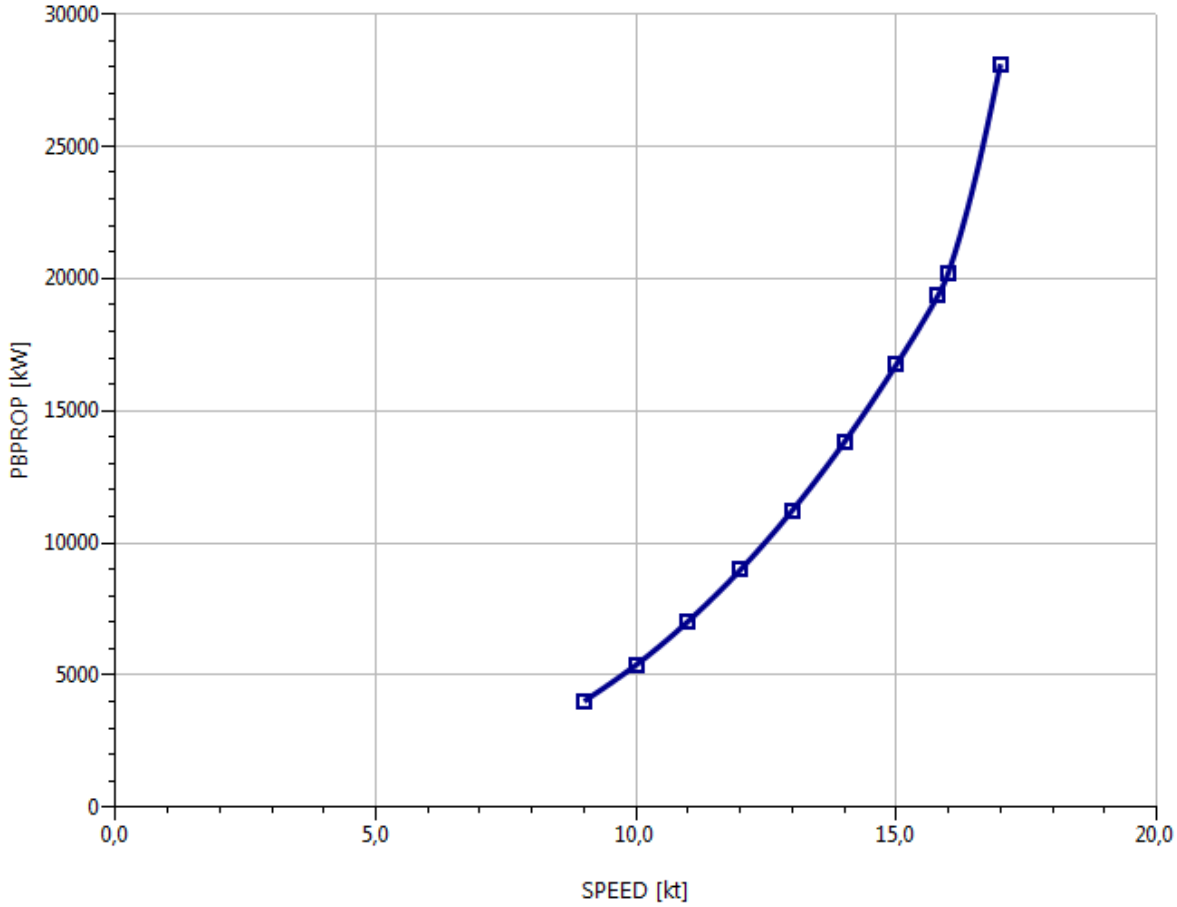
Propulsor		
Count:	1	
Propulsor type:	Propeller series	
Propeller type:	FPP	
Propeller series:	B Series	
Propeller sizing:	By power	
Reference prop:		
Blade count:	5	
Expanded area ratio:	0,5445	
Propeller diameter:	8300,0	mm
Propeller mean pitch:	5289,5	mm
Hub immersion:	7800,0	mm
Engine/gear		
Engine data:	None defined	
Rated RPM:		RPM
Rated power:		kW
Gear efficiency:	0,970	
Load correction:	Off	
Gear ratio:	1,000	
Shaft efficiency:	0,980	
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

Propeller sizing

To size			
Gear ratio:	Keep	1,00	
Expanded area ratio:	Size	**0,544**	
Propeller diameter:	Size	**8300,0**	mm
Propeller mean pitch:	Size	**5289,5**	mm
Design condition			
Design speed:		15,80	kt
Reference power:		14480,0	kW
Design point:		1,000	
Reference RPM:		82,8	
Design point:		1,030	
Max prop diam:		8300,0	mm
Review			
Tip speed:		0,00	m/s

Size | Save report | OK | Cancel | Help

A continuación se muestra la gráfica resultante potencia de freno (BHP)-VELOCIDAD



Los resultados obtenidos son los siguientes:

Velocidad (Knots)	R total (KN)	EHP (KW)	BHP (KW)
15,8	1637	15718	18356,7

Los BHP que nos proporciona el programa están calculados con el margen de mar del 15%, mientras que no se incluye el régimen de servicio al 85% y puesto que no disponemos de alternador de cola, la potencia del motor se calcula de la siguiente forma:

Velocidad (Knots)	RPM	BHP (KW)
15,8	85	19200

7 ESTIMACIÓN DEL PESO EN ROSCA

Se puede calcular el peso en rosca mediante la estructura de acero ,el equipo y habilitación y maquinaria.

- $WR = 0{,}0595 * L^{1{,}65} * B^{0{,}875} + 0{,}349 * BHP^{0{,}893} + 25{,}07 * PM^{0{,}381} = 22919{,}11$

7.1 Peso de la estructura

Relacionando mis datos obtenidos en la alternativa final con los datos de un proyecto buque semejante al mío (Nº 14-103) cuyos datos son:

Lpp (m)	B (m)	D (m)	T (m)	Δ (t)	Cb	Cm	Cp	Fn	V (kn)	PR (t)	TPM (t)
264	47	23,5	16,5	177816	0,847	0,997	0,85	0,152	15	26745	150000

Aplicando los siguientes métodos obtengo el peso de la estructura (W):

- Método de nº cúbico:

$$\frac{W1}{W2} = (\frac{L1}{L2})^3 \; ; W2 = 24517\ t$$

- Método por correcciones dimensionales:

$$dW_L = 0{,}85 * dL * \frac{W}{L} = 0{,}85 * 9{,}65 + \frac{22012{,}3}{263.85} = 684{,}3\ t$$

$$dW_B = 0{,}85 * (-1{,}27) * \frac{22012{,}3}{263{,}85} = -90{,}06\ t$$

$$dW_D = 0{,}85 * 0{,}64 * \frac{22012{,}3}{263{,}85} = 43{,}38\ t$$

$$W = Wi + (684{,}3 - 90{,}06 + 43{,}38) = 22289{,}546\ t$$

- Corrección por escantillones:

$$corrección\ L = \frac{1}{3} * dW_L = 228{,}1\ t$$

$$corrección\ B = \frac{1}{4} * dW_B = -22{,}515\ t$$

$$corrección\ D = \frac{1}{2} * dW_D = 22{,}69\ t$$

$$W = Wi + (228{,}1 - 22{,}515 + 22{,}69) = 22240{,}575\ t$$

→ Haciendo la media de los resultados obtenidos obtengo el peso final:

W= 22924 t

7.2 Peso de equipo y habilitación

$$W_{oa} = Ke * Lpp * B = \mathbf{2664{,}31}\ \boldsymbol{t}$$

- $\mathrm{Ke} = 0{,}36 - 0{,}53\mathrm{x}10^{-3} * Lpp = 0{,}215.$

7.3 Peso maquinaria propulsora y auxiliar:

- Peso motor: (ESTIMADO)

$$W_{ME} = 5 + 4 * \left(\frac{Mco}{N}\right)^{0{,}925} = 692\ t$$

- Peso del resto de maquinaria:

$$Wrp = Km * Mco^{0{,}7} = 681{,}2\ t$$

- Peso de otros elementos en cámara de máquinas:

$$Wqr = 0{,}03 * V_{MQ} = 308\ t$$

$$V_{MQ} = L_{CM} * B * D * \left(\frac{3{,}217 * L_{cm}}{Lpp - 0{,}0655}\right) = 10266\ m^3$$

$$L_{CM} = 0{,}28 * Lpp^{0{,}67} + 0{,}48 * Mco^{0{,}35}) = 28{,}33\ m$$

- Peso línea del eje:

$$Wae = 1 * L_{eje} * (5 + 0{,}0164 * Lpp) = 123\ t$$

$$L_{eje} = L_{pique\ pp} + 2 = 12{,}94\ m$$

$$L_{pique\ pp} = 0{,}04 * Lpp = 10{,}94\ m$$

→ Peso maquinaria propulsora y auxiliar:

$$Wq = Wme + Wrp + Wqr + Wqe = 692 + 681{,}2 + 308 + 123 = \mathbf{1804{,}2\ t}$$

PESO EN ROSCA	
Estructura	22924 t
Maquinaria	1804,2 t
Equipo y habilitación	2264,31 t
PESO ROSCA	**27392,14 t**

8 ESTIMACIÓN DEL PESO MUERTO

El peso muerto del petrolero a proyectar comprende: tripulación, víveres, pertrechos, combustible, aceites, agua dulce y carga.

- Peso combustible:

$$P_{hfo} = \frac{Autonomía}{Vs} * BHP * C_{hfo} x 10^{-6} = 3805\ t$$

  - Autonomía= 16000 millas
  - Vs=15,8 kn
  - BHP=22773 kw
  - C_{hfo}=165 g/Kw*h

$$Combust\ motores\ aux = BHP * (190 * 48 horas * 10^{-6}) = 208\ \ t$$

- Aceite:

$$P = 2 * P_{hfo} = 228{,}3\ \ t$$

  - Phfo=3% de 3805 t

- Agua dulce:

135 litros por persona y día → 30 personas

$$P = 135 * \frac{Autonomia}{Vs * 30} * 30 x 10^{-3} = 137\ \ t$$

- Víveres:

5 kg para cada persona por día

$$P = 5 * Ntrip * Autonomia = 6300\ t$$

- Autonomía= $\frac{16000\ millas}{15{,}8\ Kn} = \frac{1012{,}65}{24h} = 42\ días$

- Tripulación :

125 kg/tripulación

$$P = \frac{125 * 30}{1000} = 4\ \ t$$

- Pertrechos:

100 t

- Carga útil:

0,86g/ml

148000 TPM

$$Carga\ útil = TPM - (Ptrip + Pviv + Pcomb + Paceite + Pag.dulce + Ppertr$$
$$= \mathbf{137425{,}7\ \ t}$$

Δ = PR + PM = 175392 t

9 ESTIMACIÓN DEL FRANCOBORDO

Utilizando el Convenio de Lineas de Carga obtengo las siguientes correcciones.

- FRANCOBORDO TABULAR:

Mi buque a proyectar está clasificado en buque Tipo A y con la eslora al 96% (273 m) mi FB tabular es de 3143 mm

- Corrección por Cb (R-30)

Si el Cb es superior a 0,68 lo cual es mi caso se aplicará siguiente corrección:

$$\frac{Cb + 0{,}68}{1{,}36} = \mathbf{1{,}1537}$$

Corrección = 1,1537*FB TABULAR = 484 mm

- Corrección por Puntal (R-31)

D excede L/15 con lo que se aplicará:

$$\left(D - \frac{L}{15}\right) * R = \mathbf{1420\ mm}$$

  - R=250

- Corrección por superestructuras: (Regla-37)

Según la tabla 37.1:

E	%
0,1	7
0,1536	***10,8***
0,2	14

Para L > 122 m → 1070mm

Corrección = **116 mm**

- Arrufo (R-38)

	Ordinate	*Factor*	*Product*		
Ppp	2529	1	2529		
1/6 L	1123	3	3369		
1/3 L	283	3	849		
Centro buque	0	1	0	TOTAL PP	6747
Centro buque	0	1	0		
1/3 L	567	3	1701		
1/6 L	2246	3	6738		
Ppr	5058	1	5058	TOTAL PR	13497

	Real	**Normal**	**Diferencia**	**s**
Castillo	2800	2300	500	8
Toldilla	2800	2300	500	0

Corrección por arrfuro → **849 mm**

- Altura mínima de PROA:

$$F_b=(6075(L/100)-1875(L/100)^2+200(L/100)^3)x(2.08+0.609C_b-1,603C_{wf}-0,0129(L/d_1))$$

Alt. Minima**= 6151 mm**

Tabla resumen con las correcciones calculadas:

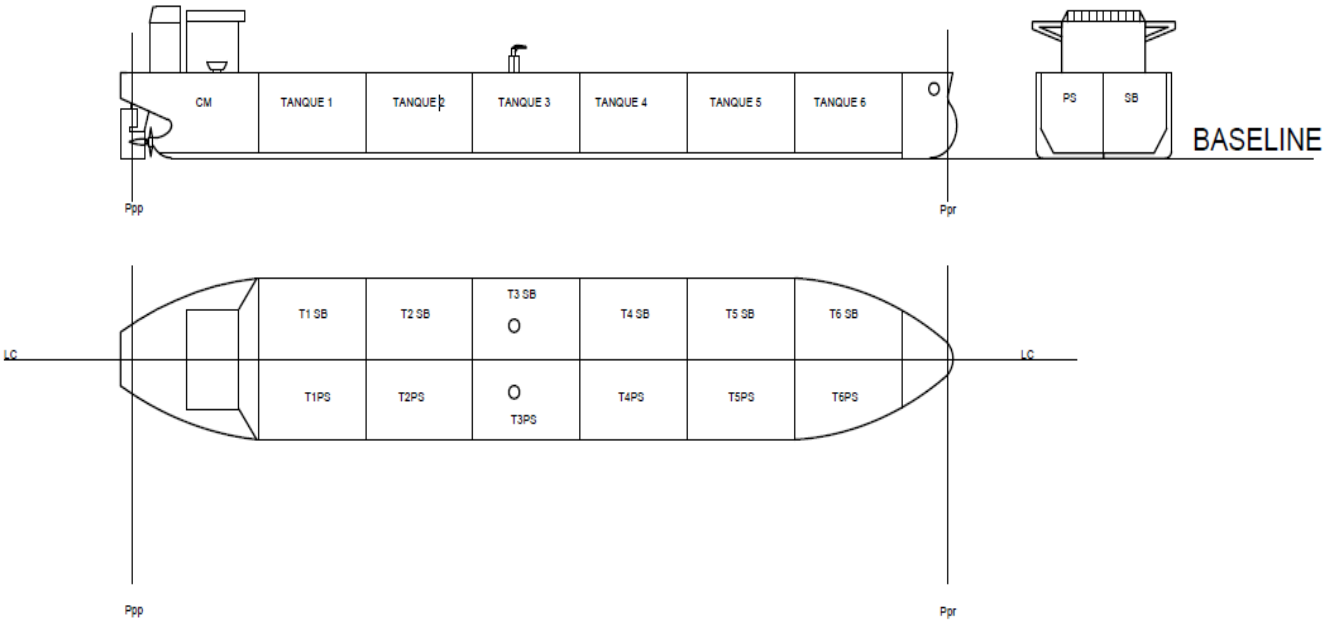
R-28	3146	mm
R-29		mm
R-30	484	mm
R-31	1420	mm
R-32.1		mm
R-37	-116	mm
R-38	849	mm
Sum	**5783**	**mm**

FRANCOBORDO = 6151 mm

FRANCOBORDO MIN DE VERANO = 6151 mm

CALADO DE VERANO= D*100-6151 = 17759 mm

10 CROQUIS


CM
TANQUE 1
TANQUE 2
TANQUE 3
TANQUE 4
TANQUE 5
TANQUE 6
PS
SB
BASELINE
Ppp
Ppr
T1 SB
T2 SB
T3 SB
T4 SB
T5 SB
T6 SB
LC
T1PS
T2PS
T3PS
T4PS
T5PS
T6PS
LC
Ppp
Ppr

➔ KNOCK ALLAN (Internet)

GENERAL INFORMATION:

Name: Knock Allan IMO No: 8904460
Ex: Built: 1/1991
Type: Suezmax tanker
SubType: Crude Flag: Liberia
DWT: 145,242 Draft: 15.60 Builder: Harland & Wolff
GT: 78,710 LOA: 274.00 Owner: Olsen & Co.
Beam: 44.40 Speed/Cons: 14.50/-
Class: LR Depth: 24.10 Engine Type: Burmeister & Wain

OWNER & FLAG HISTORY:

KNOCK ALLAN 12-05-2000 LRF
Flag Date of record Source
Singapore 18-04-2005 LRF
Liberia 12-05-2000 LRF
Registered owner Date of record Source
KNOCK ALLAN PTE LTD since 02-08-2007 LRF
ALLAN PTE LTD 18-04-2005 LRF
ALLAN SHIPPING 08-11-1993 LRF
Ship manager Date of record Source
FRED OLSEN MARINE SERVICES AS 02-08-2007 LRF
V. SHIPS NORWAY 16-05-2005 LRF
V SHIPS ASIA 18-04-2005 LRF
V. SHIPS NORWAY 24-04-2001 LRF
OLSEN FRED MARINE SERVICES 25-04-2000 LRF
OLSEN F. 01-01-1992 LRF

➔ BRASIL VOYAGUER (Significant Ships 2013)

BRASIL VOYAGER: Shuttle tanker for Brazil operation

Shipbuilder: ..... **Samsung Heavy Industries**
Vessel's name: ..... ***Brasil Voyager***
Hull No: **2033**
Owner/operator: ..**Chevron Shipping Company**
Country: ..... **Bahamas**
Designer: ..... **Samsung Heavy Industries**
Country: ..... **Korea**
Model test establishment: ..... **Samsung Ship Model Basin**
Flag: ..... **Bahamas**
IMO number: **9637777**
Total number of sister ships already completed (excluding ship presented): ..... **nil**
Total number of sister ships still on order: ..... **nil**

DUE to the development of Brazilian oil fields, a rise in vessels built to handle the geographic location of the fields was initiated in 2013. US-based Chevron placed its order for a one-off vessel, *Brasil Voyager,* that was delivered in May to operate in the Papa Terra field in Brazil. The vessel has been optimised to meet the requirements of working in Brazilian waters and also has a large cargo capacity. *Brasil Voyager* transports high viscosity oil from the fields in offshore Brazil to Bahamas oil refinery company (BORCO).

In order for the vessel to carry out operations in the location *Brasil Voyager*, has been specially designed with a finer hull shape and is equipped with dynamic positioning (DP2) technology. To create the finer hull form Samsung has used its Green Future hull design.

For the dynamic positioning at operation field, the vessel is equipped with one retractable type azimuth thruster and two tunnel thrusters in the forward and one retractable type azimuth thruster and one tunnel thruster in the aft. Also a full spade with flap high lift rudder, which has been developed by Becker marine systems, is applied together with a controllable pitch propeller. In order to increase the propulsion efficiency Saver-Fin technology has been applied.

Brasil Voyager is powered by a MAN Diesel & Turbo 6S70ME-C8.2 manufactured by Doosan that has a power output of 16,900kW and gives the vessel a service speed of 15.13knots at 90% MCR with a 15% sea margin.

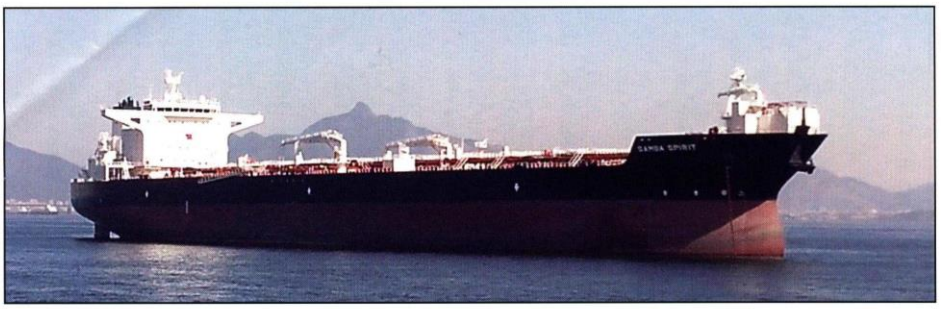
To enhance the loading and unloading of the vessel, Samsung has fitted it with a bow loading (BLS) system which has been designed for mooring the vessel to an offshore or crude loading terminal. Also the control system for cargo operations in the cargo control room is available in the wheelhouse via ICMS system. To further meet with the latest environmental regulations a Samsung Purimar ballast water treatment system with electrolysis (indirect) with a capacity of 5,500m^3/h has been fitted.

TECHNICAL PARTICULARS

Length oa: 282.14m
Length bp: 267.00m
Breadth moulded: 49.00m
Depth moulded
To main deck: 23.60m
Width of double skin
Side: 2.45m
Bottom: 2.55m
Draught
Scantling: 17.20m
Design: 16.20m
Gross: 83,942gt
Deadweight
Design: 141,470dwt
Scantling: 153,680dwt
Speed, service: 15.13knots
Cargo capacity
Liquid volume: ..... 167,885m^3
Bunkers
Heavy oil: ..... 3,215m^3
Diesel oil: ..... 555m^3
Water ballast: ..... 51,200m^3
Daily fuel consumption
Main engine only: 62tonnes/day
Classification society and notations: ..... ABS +A1,Ⓔ, Oil Carrier, CSR, AB-CM, SH-DLA, SFA(25), RES, PMA+, CPS, ✠ AMS, ✠ ACCU, NIBS, CRC, ESP, VEC-L, CPP, TCM, UWILD(no seachest blanking device), PORT, POT, ENVIRO, GP, BLU, SEC, MLC-ACCOM, RW, BWE, DPS-2, ✠ APS

Main engine
Design: ..... MAN Diesel & Turbo
Model: 6S70ME-C8.2
Manufacturer: ..... Doosan Engine
Number: 1
Type of fuel: ..... HFO, MDO
Output of each engine: ..... 16,900kW x 86.6rpm
Propeller
Material: ..... Ni-Al-Bronze
Designer/manufacturer: ..... Kawasaki Heavy Industries
Number: 1
Fixed/controllable pitch: ..... Controllable
Diameter: 8.3m
Speed: 86.6rpm
Boilers
Number: 2
Type: ..... Vertical, water drum
Make: ..... Alfa Laval Aalborg
Output, each boiler: ..... 35tonnes/h x 1.6MPa
Cargo cranes/cargo gear
Number: 2
Make: ..... Oriental
Type: ..... Electro-hydraulic luffing jib
Performance: 15tonnes
Other cranes
Number: ..... 2 + 1
Make: ..... Oriental
Type: ..... Electro Hydraulic luffing jib
Tasks: ..... Provision handling, BLS service
Performance: ..... 5tonnes + 5tonnes
Mooring equipment
Number: ..... 2 x Windlass
6 x Mooring winch
Make: ..... Rolls-Royce
Type: ..... Electro-hydraulic
Special lifesaving equipment
Number of each and capacity: ..... 1 x 42 persons
Make: ..... Hatecke
Type: ..... Freefall totally enclosed
Cargo tanks
Number: ..... 12 + 2
Cargo pumps
Number: 3
Type: ..... Vertical, single stage, centrifugal
Make: ..... Hyundai
Material: ..... Stainless steel for impeller shaft
Capacity: ..... 3,500m^3/h x 150m at S.G 1.025
Cargo control system
Make: ..... AMRI-Seil
Type: ..... Valve remote control
Water ballast treatment system
Make: ..... Samsung Purimar
Capacity: ..... 5,500m^3/h
Complement
Crew: 15
Bow thruster
Make: ..... Rolls-Royce
Number: ..... 2 x Tunnel
1 x Azimuth
Output: 3,300kW, 3,000kW
Stern thruster
Make: ..... Rolls-Royce
Number: ..... 1 x Tunnel
1 x Azimuth
Output: 1,600kW, 3,000kW
Bridge control system
Make: ..... Nabtesco
One-man operation: ..... Yes
Fire detection system
Make: ..... Consilium
Type: ..... Addressable type
Fire extinguishing systems
Engine room: ..... Wilhelmsen/ High expansion foam
Cabins & public spaces: ..... Samsung/ Seawater and portable fire extinguisher
Radars
Number: 2
Make: ..... Sperry Marine
Integrated bridge system
Make: ..... Sperry Marine
Model: ..... VisionMaster FT ECDIS
Contract date: ..... 9 June 2011
Launch/float-out date: ..... 29 Dec 2012
Delivery date: ..... 28 May 2013

➔ SAMBA SPIRIT (Significant Ships 2013)



SAMBA SPIRIT: Modern shuttle tanker for Teekay

Shipbuilder: ..... **Samsung Heavy Industries**
Vessel's name: ..... ***Samba Spirit***
Hull No: **2037**
Owner/operator: ..... **Teekay Shipping**
Country: ..... **Norway**
Designer: ..... **Samsung Heavy Industries**
Country: ..... **Korea**
Model test establishment used: ..... **Samsung Ship Model Basin (SSMB)**
Flag: ..... **Bahamas**
IMO number: **9637686**
Total number of sister ships already completed (excluding ship presented): **2**
Total number of sister ships still on order: **4**

THE latest shuttle tanker, *Samba Spirit*, delivered as the first out of four units specially designed for Brazilian waters, is equipped with DP2 technology. The vessel will be chartered by BG Group for operation at the Lula field (formerly Tupi field) in the Santos Basin. *Samba Spirit* was delivered by Samsung Heavy Industries (SHI) in May.

In order to increase the propulsion efficiency SAVER-FIN technology has been applied to the vessel, along with the yard's latest Green Future hull form to reduce resistance. For the dynamic positioning in the field of operation the vessel is equipped with two retractable type azimuth thrusters and one tunnel thruster in the forward and one retractable azimuth thruster and one tunnel thruster in the aft. Also a fish tail type high lift rudder, which has been developed by Samsung, has been applied together with a controllable pitch propeller.

It is believed *Samba Spirit* is the most advanced shuttle tanker ever built based on the new technology; a Knutsen volatile organic compound (KVOC) system is provided as a means of reduction for volatile organic compounds during loading and laden voyage. The KVOC system was designed by Knutsen OAS Shipping and approved by the class society.

The compact volatile organic compound (CVOC) system has also been fitted for the recovery of VOC during loaded voyages. A mix of VOC and inert gas is ejected from the main inert gas line and into the crude oil by circulating an oil stream through the swirl absorber located in the pump room. Furthermore, efficiency in the vessel's operational performance has been improved by increasing the cargo tank pressure compared with a conventional system.

The bow loading system (BLS) is designed for mooring the vessel to an offshore loading terminal and also for crude oil loading from a terminal where there is the possibility to discharge through the BLS as per Petrobras' requirement for use in Brazilian waters. Also the control system for cargo operations in the cargo control room is available in the wheelhouse via the integrated monitoring control system (ICMS).

For the power supply, four sets of main diesel generators have been installed along with one emergency generator. The high and low voltage switchboards are divided into four sections to separate the power feeding from the main generator and the switchboard, this configuration gives better flexibility during operation and minimises the loss of availability even in a worst single failure case scenario.

The ballast water treatment system with electrolysis (indirect), is a Samsung Purimar with a capacity of 5,500m^3/h has been installed to meet with the ballast water convention.

TECHNICAL PARTICULARS

Length oa: 282.14m
Length bp: 267.00m
Breadth: 49.00m
Depth moulded
To main deck: 23.60m
Width of double skin
Side: 2.45m
Bottom: 2.55m
Draught
Scantling: 17.20m
Design: 16.20m
Gross: 83,882gt
Deadweight
Design: 142,190dwt
Scantling: 154,101dwt
Speed, service: 14.62knots
Cargo capacity
Liquid volume: ..... 164,540m^3
Bunkers
Heavy oil: ..... 3,135m^3
Diesel oil: ..... 545m^3
Water ballast: ..... 51,205m^3
Daily fuel consumption
Main engine only: 51.2tonnes/day
Classification society and notations: ..... ABS +A1, (E), Oil Carrier, CSR, AB-CM, DPS-2, SH, SHCM, SH-DLA, SFA(25), HIMP, RES, PMA, CPS, IGS-Ballast, +AMS, +ACCU, +APS, NIBS, ESP, VEC-L, TCM, R1 (single shaft), UWILD, POT, ENVIRO, GP, BLU, BWE, Statement of compliance for DNV's F-AMC (excluding requirement B.201)
Main engine
Design: ..... MAN Diesel & Turbo
Model: 6S70ME-C8.2
Manufacturer: ..... Doosan Engine
Number: 1
Type of fuel: ..... HFO, MDO
Output of each engine: ..... 14,270kW x 81.8rpm
Propeller
Material: ..... Ni-Al-Bronze
Designer/manufacturer: ..... Kawasaki Heavy Industries
Number: 1
Fixed/controllable pitch: ..... Controllable
Diameter: 8.3m
Speed: 81.8rpm
Boilers
Number: 2
Type: ..... Vertical, water drum
Make: ..... Alfa Laval Aalborg
Output, each boiler: ..... 30tonnes/h x 16kg/cm^2
Cargo cranes/cargo gear
Number: 2
Make: ..... DMC
Type: ..... Electro-hydraulic luffing jib
Performance: 15tonnes
Other cranes
Number: ..... 2+1
Make: ..... DMC
Type: ..... Electro-hydraulic luffing jib
Tasks: ..... Provisions handling & BLS service
Performance: 2tonnes, 3.4tonnes, 5tonnes
Mooring equipment
Number: ..... 2 x Windlass
8 x Mooring winch
Make: ..... Flutek Kawasaki
Type: ..... Electro-hydraulic driven
Special lifesaving equipment
Number of each and capacity: ..... 1 x 40 persons
Make: ..... Norsafe
Type: ..... Freefall totally enclosed
Cargo tanks
Number: ..... 12 + 1
Cargo pumps
Number: 3
Type: ..... Vertical, single stage, centrifugal
Make: ..... Shinko
Material: ..... Stainless steel for impeller shaft
Capacity: ..... 3,800m^3/h x 135 at SG 1.025
Cargo control system
Make: ..... Samsung - AMRI SEIL
Type: ..... Valve remote control system
Water ballast treatment system
Make: ..... Samsung Purimar
Capacity: ..... 5,500m^3/h
Complement
Crew: 15
Bow thruster
Make: ..... Brunvoll
Number: ..... 1 x Tunnel
2 x Azimuth
Output: 2,200kW
Stern thruster
Make: ..... Brunvoll
Number: ..... 1 x Tunnel
2 x Azimuth
Output: 2,200kW
Bridge control system
Make: ..... Yokogawa
One-man operation: ..... Yes
Fire detection system
Make: ..... Consilium
Type: ..... Addressable type
Fire extinguishing systems
Engine room: ..... Wilhelmsen/ high expansion foam
Cabins/public spaces: ..... Samsung/ Sea water fire and portable fire extinguishers
Radars
Number: 2
Make: ..... Samsung
Integrated bridge system
Make: ..... Samsung
Model: ..... SSAS-Pro
Contract date: ..... 21 June 2011
Launch/float-out date: ..... 24 December 2012
Delivery date: ..... 10 May 2013

→RIO 2016

RIO 2016: EEDI compliant shuttle tanker

Shipbuilder: **Sungdong Shipbuilding & Marine Engineering Co., Ltd**
Vessel's name: ***RIO 2016***
Hull No: **S7001**
Owner/operator: **Tsakos Energy Navigation Ltd./ Petrobras**
Country: **Greece/ Brazil**
Designer: **Sungdong Shipbuilding & Marine Engineering Co., Ltd**
Country: **Korea**
Model test establishment used: **KIOST, Korea**
Flag: **Greece, Pireaus**
IMO number: **9623867**
Total number of sister ships already completed (excluding ship presented): **2**
Total number of sister ships still on order: **nil**

RIO 2016 is the first vessel in a series of two shuttle tankers designed by Sungdong Shipbuilding & Marine Engineering for Tsakos Energy Navigation Ltd that are compliant with the energy efficiency design index (EEDI) regulation. The vessel was delivered at the beginning of the year with its sister vessel *Brasil 2014* being delivered shortly afterwards in April.

RIO 2016 was chartered early to Petroleo Brasileiro SA with the Failure Mode Effect Analysis (FMEA) test and DP (dynamic positioning) tests carried out during the field trials in the Brazilian water basin, which showed satisfactory results and recorded an excellent grade. The company noted that this is the first type of this vessel to sail under the Greek flag.

The vessel has been designed as IMO dynamic positioning (DP) Class 2 shuttle tanker having one slow speed diesel engine, one controllable pitch propeller, two bow and one stern tunnel thruster, one bow and one stern retractable azimuth thruster and a bow loading system suitable for tandem loading operations in the Brazilian Waters-Campos Basin. It also features a flush deck with forecastle deck for arrangement of bow loading system and a full spade rudder with a flap system has been installed for better positioning and manoeuvring.

The vessel has six pairs of cargo oil tanks, two slop tanks, fore and aft peak tanks, segregated water ballast tanks, fuel oil tanks and fresh water tanks. Cargo tanks are divided by plane type transverse and longitudinal bulkhead. Engine room and living quarters, including an enclosed type navigation bridge, are located aft.

The cargo pumping system allows a maximum unloading rate of 12,000m^3/hr with three cargo oil pumps. The maximum cargo loading rate is 17,000m^3/hr through the midship cargo manifold. Alternatively, a cargo loading rate of 9,000m^3/h can be achieved through the bow loading station, based on the flow velocity of about 6m/s.

The main engine, a MAN 6S70ME-C8.2, is IMO Tier II compliant and has been de-rated to 15,200kW of MCR at 82rpm for better fuel economy and flexible operations at part load. The speed of the vessel at a draught of 16m is 14.8knots at 90% MCR (13,680kW) with a 15% sea margin. The EEDI is in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI resolution MEPC.214 (63) is satisfied up to phase 1. The vessel is equipped with Bow/Stern tunnel thruster having a power of 2,200kW and azimuth thruster having a power of 2,500kW with a single-speed motor for using dynamic positioning and auxiliary propulsion.

The vessel has been built under the survey of DNV and designed in accordance with IACS Common Structural Rules (CSR). The vessel fully meets the latest environmental guidelines such as an inventory of hazardous of materials used in its construction, OPP-F, CLEAN notation, performance standard for protective coatings (PSPC) rules and EU Directive 2005/33/EC.

TECHNICAL PARTICULARS

Length oa: 278.50m
Length bp: 264.00m
Breadth moulded: 48.00m
Depth moulded
- Main deck: 23.10m
- Upper deck: 23.10m

Width of double skin
- Side: 2.50m
- Bottom: 2.80m

Draught
- Scantling: 17.15m
- Design: 16.00m

Gross: 83,087gt
Displacement: 183,400tonnes
Deadweight
- Design: 142,100dwt
- Scantling: 155,700dwt

Speed, service: 14.8knots
Cargo capacity
- Liquid volume: 167,500m^3

Bunkers
- Heavy oil: 3,600m^3
- Diesel oil: 500m^3

Water ballast: 52,600m^3
Daily fuel consumption
- Main engine: 53.4tonnes/day

Classification society and notations: DNV
% high-tensile steel used in construction: 35%
Main engine
- Design: MAN B&W
- Model: 6S70ME-C8.2
- Manufacturer: Hyundai Heavy Industries
- Number: 1
- Type of fuel: HFO, MDO
- Output of each engine: 15,200kW x 82kW

Propellers
- Material: Ni-Al-Bronze
- Designer/manufacturer: Berg
- Number: 1
- Fixed/controllable pitch: Controllable
- Diameter: 8.3m
- Speed: 82rpm

Diesel-driven alternators
- Number: 4
- Engine make/type: Hyundai Heavy Industries/ 7H32/40 9H32/40
- Type of fuel: MDO
- Output/speed of each set: 3,500kW 720rpm 4,500kW x 720rpm
- Alternator make/type: HSJ7 805-10P HSJ7 913-10P
- Output/speed of each set: 3,300kW x 720rpm 4,300kW x 720rpm

Boilers
- Number: 2
- Type: Mission OI
- Make: Alfa Laval – Aalborg
- Output, each boiler: 27,000kg/h

Cargo cranes/cargo gear
- Number: 2
- Make: Oriental
- Type: Electro-hydraulic, cylinder luffing

Mooring equipment
- Number: 6
- Make: Aker Pusnes
- Type: Electro-hydraulic

Cargo tanks
- Number: 12 + 2 slop tanks
- Grades of cargo carried: Crude oil having a flash point below 60°C
- Product range: Crude oil
- Coated tanks make and type of coating: Epoxy

Cargo pumps
- Number: 3
- Type: 2 x steam turbine driven 1 x electric motor driven
- Make: Shinko
- Capacity: 4,000m^3/h x 135mTH

Cargo control system
- Make: SAAB
- Type: GL-300

Ballast control system
- Make: Hanla Ins
- Type: AP-PAN31E

Complement
- Crew: 12

Bow thruster
- Make: Brunvoll
- Number: 3
- Output: 2 x 2,200kW, 2,500kW

Stern thruster
- Make: Brunvoll
- Number: 2
- Output: 2 x 2,200kW, 2,500kW

Bridge control system
- Make: Hyundai Heavy Industries
- Type: T-shape
- One-man operation: Yes

Fire detection system
- Make: Hanla-IMS
- Type: Fixed gas sampling system

Fire extinguishing systems
- Cargo holds: NK/ Deck foam system
- Engine room: NK/ High expansion foam

Radars
- Number: 2
- Make: Kongsberg
- Model: 65612A, 65608

Integrated bridge system
- Make: Kongsberg
- Model: K-Bridge

Waste disposal plant
- Incinerator: Hyundai Marine Machinery/ MAXI NG150SL WS
- Sewage plant: Jonghap machinery/ BIO Aerob-18N

Contract date: March 2011
Launch/float-out date: November 2012
Delivery date: March 2013

➔ EAGLE SAN ANTONIO (Significant Ships 2012)

EAGLE SAN ANTONIO: eco-designed Suezmax from Samsung

Shipbuilder: ..... **Samsung Heavy Industries Co., Ltd**
Vessel's name: ..... ***Eagle San Antonio***
Hull No: **HN1962**
Owner/operator: ..... **AET/ AET Shipmanagement Pte Limited**
Country: ..... **Singapore**
Designer: ..... **Samsung Heavy Industries Co., Ltd**
Country: ..... **Korea**
Model test establishment used: ..... **Samsung Ship Model Basin**
Flag: ..... **Singapore**
IMO number: **9594822**
Total number of sister ships already completed (excluding ship presented): **3**
Total number of sister ships still on order: **4**

RECOGNISING the ever increasing demand for more fuel efficient and environmentally friendly vessels, tanker owner/operator, AET, took delivery of the first of its four "eco-design" Suezmax tankers in April last year. Constructed at Samsung Heavy Industries, Korea the remaining three sister ships were delivered during the course of 2012 and are the first Suezmax vessels to be owned by the company.

AET stated that it made a significant investment in these new "eco-design" vessels to maximise fuel efficiency and to minimise harmful emissions. Innovations include hull form optimisation and de-rating of the main engine power for low load optimisation. The application of energy saving devices such as saver fins, a star propeller and rudder bulb have also been fitted.

In addition, the vessel has obtained Lloyd's Register's "Environmental Protection" notation and a Letter of Compliance for a Green Passport. The Energy Efficiency Design Index (EEDI) attained by the vessel has been verified by Lloyd's Register and exceeds IMO's requirements. As a result, the vessel has also qualified for the "Green Ship Programme" under Maritime Singapore's Green Initiative.

Going forward, AET insists that a feature of its fleet renewal programme is that all new vessels joining the fleet will be significantly more fuel-efficient than those they replace. Other recent innovations include the introduction of two newbuild DP shuttle tankers, two newly converted specialist marine capture vessels, a fleet of the world's first purpose built lightering support vessels and four newbuild VLCCs to replace older tonnage in 2013.

TECHNICAL PARTICULARS

Length oa: 274.29m
Length bp: 267.0m
Breath moulded: 49.0m
Depth moulded
- To main deck: 23.3m
- To upper deck: 23.3m

Width of double skin
- Side: 2.45m
- Bottom: 2.55m

Draught
- Scantling: 17.2m
- Design: 16.2m

Gross: 80,783gt
Displacement: 181,682tonnes
Lightweight: 23,832tonnes
Deadweight
- Design: 145,946dwt
- Scantling: 157,849dwt

Block co-efficient: 0.7860
Speed, service: 15.97knots
Cargo capacity
- Liquid volume: ..... 175,066m^3

Bunkers
- Heavy oil: ..... 3,578m^3
- Diesel oil: ..... 437.8m^3

Water ballast: ..... 50,943m^3
Daily fuel consumption
- Main engine only: 60tonnes/day

Classification society and notations: ..... Lloyds Register 100A1, Double Hull Oil Tanker, CSR, ESP, ShipRight (ACS (B), CM), LI, LMC, UMS, ShipRight SCM, IWS (no searching blanking device), EP

Main engines
- Design: ..... MAN Diesel & Turbo
- Model: 6S70MC-C8.1
- Manufacturer: ..... Doosan Engine-MAN Diesel & Turbo Licensee
- Type of fuel: ..... HFO, MDO
- Output of each engine: ..... 16,400kW x 82.8rpm

Propellers
- Material: ..... Ni-Al-Bronze
- Designer/manufacturer: ..... MMG
- Fixed/controllable pitch: ..... Fixed
- Diameter: 8.45m
- Speed: 82.2rpm

Diesel-driven alternators
- Engine make/type: ..... STX Engine-MAN Diesel & Turbo Licensee/ 6L23/30H
- Type of fuel: ..... HFO, MDO
- Output/speed of each set: ..... 960kW x 900rpm
- Alternator make/type: HHI/HFC7 508-84K
- Output/speed of each set: ..... 900kW x 900rpm

Boilers
- Number: ..... 2 x auxiliary boiler 1 x composite boiler
- Type: ..... Mission OL3500, Mission OC2000/1600
- Make: ..... Aalborg
- Output, each boiler: ..... 3.5tonnes/h x 1.6MPa, 2tonnes/h x 0.6MPa for oil fired side, 1.6tonnes/h x 0.6MPa for exhaust side

Cargo cranes/cargo gear
- Make: ..... DMC
- Type: ..... Electric-hydraulic
- Performance: ..... 15tonnes x 17m

Other cranes
- Make: ..... DMC
- Type: ..... Electric-hydraulic
- Tasks: ..... Provisions, machinery equipment handling
- Performance: ..... 6.3tonnes x 14.5m, 2tonnes x 14.5m

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

Special lifesaving equipment
- Number of each and capacity: ..... 2 x 32 persons
- Make: ..... Hyundai Lifeboat
- Type: ..... Totally enclosed

Cargo tanks
- Number: 14
- Grades of cargo carried: ..... Crude oil having a flash point below 60°C
- Product range: ..... Crude oil

Coated tanks: ..... Epoxy anti-corrosive paint (Deckhead and 1.7m below x 1 + 200 micron. Bottom and 0.5m above x 2 = 250 micron)

Stainless steel: ..... Piping: Hydraulic line for valve control shall be of stainless steel

Cargo pumps
- Type: ..... Vertical, single stage, centrifugal
- Make: ..... shinko
- Stainless steel: ..... Stainless steel is installed for the impeller shaft
- Capacity: ..... 3,500m^3/h x 135m at S.G 1.025

Cargo control system
- Make: ..... Samsung – Amri Seil
- Type: ..... Valve remote control system

Ballast control system
- Make: ..... Samsung – Amri Seil
- Type: ..... Valve remote control system

Complement
- Officers: 19
- Crew: 13

Stern appendages/special rudders: ..... Rudder bulb

Bridge control system
- Make: ..... Tokyo Keiki
- Type: ..... Auto Pilot with adaptive function
- One-man operation: ..... Yes

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

Fire extinguishing systems
- Engine room: ..... Kashiwa/ High expansion foam system
- Cabins/public spaces: ..... Seawater

Radars
- Make: ..... SHI-JRC
- Models: JMA-9132-SA, JMA-9122-6XA

Integrated bridge system
- Make: ..... SHI-JRC
- Model: JAN-901-B

Waste disposal plant
- Incinerator: ..... Hyundai-Atlas/ Maxi T150SL

Contract date: ..... 25 June 2010
Launch/ float-out date: ..... 29 February 2012
Delivery date: ..... 26 April 2012

➔ SPYROS K (Significant Ships 2011)

SPYROS K: Suezmax tanker for Tsakos Energy Navigation Ltd

Shipbuilder: **Sungdong Shipbuilding & Marine Engineering Co., Ltd**
Vessel's name: ***Spyros K***
Hull No: **S2034**
Owner/operator: **Tsakos Energy Navigation Limited**
Country: **Greece**
Designer: **Sungdong Shipbuilding & Marine Engineering Co., Ltd**
Country: **Korea**
Model test establishment used: **MOERI, Korea**
Flag: **Liberia**
IMO number: **9565948**
Total number of sister ships already completed (excluding ship presented): **1**
Total number of sister ships still on order: **nil**

Spyros K is the first in a series of two crude oil tankers for Tsakso Energy Navigation that will both be on an 11 year time charter as part of the company's Suezmax newbuild programme. *Spyros K* was delivered from Sungdong shipyard in May, with its sister ship, *Dimitris P*, delivered later in 2011.

Spyros K has a higher performance efficiency than other vessels in the same class because of the advanced CFD, Shipflow and fluent technology for reduction of resistance and optimisation of the propeller, which has been applied to the design. In this process, particular attention has been paid to the reduction of wave making resistance and optimisation of the pressure distribution, velocity field and streamline pattern over the hull.

The vessel has six pairs of cargo oil tanks, two slop tanks, fore and aft peak tanks, segregated water ballast tanks, fuel oil tanks and fresh water tanks. Cargo tanks are divided by plane type transverse and longitudinal bulkheads. Cargo handling is performed by three cargo oil pumps of 4000m³/h, driven by stream turbine. The water ballast is handled by two ballast pumps, driven by a steam turbine and electric motor.

The 158,000dwt vessel meets with the Quebec terminal requirement, and is equipped with additional double drum mooring winch/chock/roller at forward of accommodation and silencer provision for engine room ventilation fan and pump room fan. Also the air draft of the vessel is 50.45m from base line to top of radar mast to pass Port Arthur, Martin Luther King Bridge.

Spyros K was constructed under the survey of ABS and designed in accordance with the IACS common structural rules (CSR). The vessel features a double side skin and has a flush deck, bulbous bow, transom stern, open water type stern frame, semi-balanced rudder and single propeller driven by a slow speed diesel engine. The vessel can navigate at a speed of 15.7knots at the design draft with well optimised hull form and propeller design.

Spyros K meets with the latest environmental guidelines such as fuel oil protection, green passport for ship's recycling, performance standard for protective coatings (PSPC), IMO Tier II NOx requirement, M.G.O. tank for European Ports and the ABS ES notation.

TECHNICAL PARTICULARS

Length oa: 274.2m
Length bp: 264m
Breadth moulded: 48m
Depth moulded
To main deck: 23.1m
To upper deck: 23.1m
Width of double skin
Side: 2.5m
Bottom: 2.8m
Draught
Scantling: 17.15m
Design: 16m
Gross: 81,000tonnes
Deadweight
Design: 145,000dwt
Scanting: 158,000dwt
Speed, service: 15.7knots @ 90% mCR with 15% sea margin

Cargo capacity
Liquid volume: 170,000m³
Bunkers
Heavy oil: 4500m³
Diesel oil: 200m³
Water ballast: 54,000m³
Daily fuel consumption
Main engine only: 69.3tonnes/day
Classification society and notations: ABS A1(E), Oil Carrier, ESP, CRS, AB-CM, CPS, UWILD, +AMS, +ACCU, TCM, COW, VEC-L, BWE, ENVIRO, HM2+R, CRC, RW, PMA, GP
% high tensile steel used in construction: abt. 40%
Main engine
Design: 2-stroke, direct revidible, crosshead
Model: 6S70MC-C7 Tier II
Manufacturer: Hyundai-MAN B&W
Number: 1
Type of fuel: HFO, MDO or MGO
Output of each engine: 18,660kW x 91rpm
Propeller
Material: Ni-Al-Bronze
Designer/manufacturer: HHI
Number: 1
Fixed/controllable pitch: Fixed
Diameter: 8.2m
Speed: 91rpm
Diesel-driven alternators
Number: 3
Engine make/type: HHI/ Himsen 6H21/32
Type of fuel: HFO, MDO or MGO
Output/speed of each set: 1050kW/ 720rpm
Alternator make/type: HHI-EES/ HFC7-564-14E
Output/speed of each set: 987kW/ 720rpm
Boilers
Number: 2 x Aux. boilers 1 x comp. boiler
Type: oil fired, vertical, water tube & forced draft
Make: Aalborg
Output, each boiler:
Aux boiler: 37,200kg/h
Comp. boiler: 1500kg/h oil fired 1200kg/h exh. Gas

Cargo cranes/ cargo gear
Number: 2
Make: Oriental
Type: Electro hydraulic, cylinder luffing jib rest
Performance: 15tonnes/ 17.4m outreach
Other cranes
Number: 2
Make: Oriental
Type: Electro hydraulic, cylinder luffing jib rest
Tasks: Provisions
Performance: 6.3tonnes/ 4m outreach, 2tonnes/ 4m outreach
Mooring equipment
Number: 9
Make: Rolls-Royce
Type: Hydraulic/ high pressure
Special lifesaving equipment
Number of each and capacity: 2 x 29 persons
Make: Hyundai lifeboats Co., Ltd
Type: Totally enclosed lifeboat
Cargo tanks
Number: 6
Grades of cargo carried: Crude oil
Coated tanks, make and type: Nippon/Epoxy
Cargo pumps
Number: 3
Type: Centrifugal steam turbine
Make: Shinko pump Japan
Stainless steel: Impeller shaft
Capacity: 4000m³/h x 135mTH
Cargo control system
Make: ACE valve Korea
Type: Console & VDU
Ballast control system
Make: ACE valve Korea
Type: Console & VDU
Complement
Officers: 11
Crew: 18
Bridge control system
Make: Nabtesco
Type: M-80000III
Fire detection system
Make: Autronica Dire and Secrueity
Type: Autoprime
Fire extinguishing systems
Cargo holds: NK/ Deck foam
Engine room: NK/ CO_2 Seaplus/ Low pressure system
Public spaces: Samjoo
Radars
Number: 2
Make: JRC
Models: JMA-9132-SA/ 9122-9XA
Waste disposal plant
Incinerator: Teamtec GS500CS
Waste compactor: Samjoo/ TT 160
Sewage plant: Jonghap/ JMC-18N073
Contract date: 14 July 2009
Launch/float-out date: 1 February 2011/ 11 Februaury 2011
Delivery date: 12 May 2011

➔ MIKELA P (Significant Ships 2009)

MIKELA P: Suezmax crude oil tanker from Hyundai Samho

Shipbuilder: ..... **Hyundai Samho Heavy Industries Co., Ltd**
Vessel's name: ..... ***Mikela P***
Hull No: **S401**
Owner/Operator: ..... **Daniel Marine Corp**
Country: ..... **Greece**
Designer: ..... **Hyundai Samho Heavy Industries Co., Ltd**
Country: ..... **Korea**
Model test establishment used: ..... **Hyundai Maritime Research Institute**
Flag: ..... **Liberia**
IMO number: **9440382**
Total number of sister ships already completed (excluding ship presented): **3**
Total number of sister ships still on order: **1**

Mikela P is the fourth in a series of five Suezmax vessels constructed by Hyundai Samho, Korea, for Daniel Marine Corporation, Greece.

Mikela P is a single decked tanker constructed with a double skin which combines side and bottom tanks to form six pairs of water ballast tanks surrounding a cargo space. The cargo space is also divided into six pairs of tanks which are used for the carriage of crude oil and dirty products. The underdeck area, including two metres down from the deck, the bottoms of the tanks and the two slop tanks in full are painted with International Paint's epoxy coatings. Cargo handling is by means of three Hyundai Heavy Industries (HHI) vertical, centrifugal pumps, each rated at 4000m^3/hour which are installed in a pump room forward of the machinery space. The lower part of the pump room is equipped with a void space to ensure compliance with MARPOL Reg.22. In addition to the regulatory requirements a gas detection system and high level alarm were installed.

The shafting system is optimised by omitting a forward stern tube bush. The arrangement adopted results in a more flexible shafting system which assists on keeping loads at a low level considering the various operating conditions likely to be encountered. Three diesel generators are installed, each producing 860kW of electrical power.

Accommodation for a total crew of 30 is provided in a deck house above engine room, separated from the engine/funnel casing to reduce possible noise and vibration problems.

TECHNICAL PARTICULARS

Length oa: 274.34m
Length bp: 264.00m
Breadth moulded: ..... 48.00 m
Depth moulded to main deck: 23.10m
Width of double skin:
side: 2.5m
bottom: 2.8m
Draught:
scantling: 17.15m
design: 16.00m
Gross: 81,347gt
Displacement: 183,839tonnes
Lightweight: 25,832tonnes
Deadweight:
Design : 144,452dwt
Scantling: 158,007dwt
Block co-efficient: ..... 0.8235 at scantling draft
Speed, service: ..... 15.8knots with 15% sea margin
Cargo capacity:
Liquid volume: ..... 173,826m^3
Bunkers:
Heavy oil: ..... 4061m^3
Diesel oil: ..... 233m^3
Water ballast: ..... 54,292m^3
Daily fuel consumption:
Main engine only: ..... 67.3tonnes/day (MDO at normal seagoing condition)
Auxiliaries: ..... 3.8tonnes/day (MDO at normal seagoing condition)
Classification society and notations: ..... Lloyd's Register +100A1, Double Hull Oil Tanker, CSR, ESP, ShipRight(CM), LI, *IWS, SPM, +LMC, IGS, UMS With the descriptive note COW(LR), ShipRight(SCM), GREEN PASSPORT, ETA
% high-tensile steel used in construction: ..... 33.5 %
Main engine:
Design/Manufacturer: ..... HHI-EMD
Number & model: ..... 1 x 6S70MC-C7
Type of fuel: ..... HFO or MDO
Output: ..... 18,660kW x 91rev/min
Propeller:
Material : ..... Ni.Al.Bronze
Designer/Manufacturer : ..... HHI
Fixed/Controllable pitch: ..... 1 x Fixed
Diameter: 8200mm
Speed: 91rev/min
Special adaptations: ..... TMON
Diesel-driven alternators:
Number: 3
Engine make/type: ... HHI-EMD/HiMSEN 4 stroke engine
Type of fuel: ..... HFO or MDO
Output/speed of each set: ..... 920kW @ 720rpm
Alternator make/type: ..... HHI/water cooled
Output/speed of each set: ..... 860kW @ 720rpm
Boilers:
Number & make: ..... 2 x Aalborg
Type: ..... Cylindrical type
Output, each boiler: ..... 35tonnes/h x 16/6 K
Cargo cranes:
Make: ..... 2 x Oriental Precision & Engineering Co., Ltd.
Type: ..... Electric-hydraulic
Performance: ..... SWL 15tonnes
Other cranes
Make: ..... 2 x Oriental Precision & Engineering Co., Ltd.
Type: ..... Electric-hydraulic
Performance: ..... 6.3tonnes SWL (Port), 2tonnes SWL (Stbd)
Mooring equipment:
Number & make: ..... 8 x Pusnes
Type: ..... Hydraulic
Cargo tanks:
Number: ..... 14 (including slop tanks p&s)
Grades of cargo carried: ..... Crude oi
Cargo pumps:
Number & Make: ..... 3 x HH
Type: ..... Centrifuga
Capacity (each): ..... 4000m^3/h
Cargo & ballast control system:
Make: ..... Nakakit
Type: ..... Conventional mimic board type
Complement:
Officers: 1
Crew: 1
Bridge control system:
Make: ..... HHI-EE
Type: ..... Self standing type (Piano type
Fire detection system
Make & type: ..... Consilium - CS400
Fire extinguishing systems
Cargo holds: ..... Sea-Plus deck foa
Engine room: ..... Tanktech / Local water mist typ
Radars:
Number: ..... S-band/X-Band, each one se
Make: ..... JR
Models: JMA-9132-SA/JMA-9122-6X
Integrated bridge system:
Make & model: ..... JRC - JAN-901
Waste disposal plant:
Incinerator: ..... TeamTec GS500C
Sewage plant: ..... Ilseung ISS-3
Contract date: ..... 26 March 200
Delivery date: ..... 6 November 200

➔ STENA SUPREME (Significant Ships 2012)

STENA SUPREME: eco tanker from Samsung

Shipbuilder: **Samsung Heavy Industries Co., Ltd**
Vessel's name: ***Stena Supreme***
Hull No: **HN1925**
Owner/operator: **Stena Bulk**
Country: **Sweden**
Designer: **Samsung Heavy Industries Co., Ltd**
Country: **Korea**
Model test establishment used: **Samsung Ship Model basin**
Flag: **Bermuda**
IMO number: **9585895**
Total number of sister ships already completed (excluding ship presented): **4**
Total number of sister ships still on order: **7**

STENA Supreme is the latest in eco-friendly Suezmax vessels constructed at Samsung, Korea for Stena. *Stena Supreme* is the first vessel out of the seven tankers that Stena Bulk has ordered from Samsung and it was delivered in June 2012.

The vessels have been designed by Stena's own design department in accordance with the most advanced technology available today. The result is a dramatically improved energy efficiency, which is expected to reduce fuel consumption by up to 15% compared with most conventionally designed Suezmax tankers currently in operation.

Stena has said that it has been reviewing the market for Suezmax tankers for the last couple of years to be able to expand its fleet. In this time Stena has been developing the designs of its future fleet to be able to meet upcoming requirements in shipping. Nearly US$7 million extra per vessel has been invested in state-of-the-art technology in order ensure the highest environmental class for the vessels.

The order of *Stena Superior* and *Stena Supreme* is part of Stena Bulk's strategic investment in its own high-class tonnage for the Stena Sonangol Suezmax Pool, together with the state-owned Angolan oil company Sonangol.

The 158,700dwt vessels will be the largest tankers in Stena Bulk's fleet. An option for two optional sister vessels, was also made at the start of the contract.

In addition Stena has already placed significant and major orders with Samsung Shipyard, including four drillships of the so called Stena DrillMAX design and two super ferries, in addition to the new Suezmax tankers.

TECHNICAL PARTICULARS

Length oa: 274.23m
Length bp: 264.0m
Breadth moulded: 48.0m
Depth moulded
To main deck: 23.3m
To upper deck: 23.3m
Width of double skin
Side: 2.45m
Bottom: 2.55m
Draught
Scantling: 17.0m
Design: 16.0m
Gross: 81,187gt
Displacement: 182,914tonnes
Lightweight: 23,883tonnes
Deadweight
Design: 147, 090dwt
Scantling: 159,031dwt
Block co-efficient: 0.8267
Speed, service: 14.58knots
Cargo capacity
Liquid volume: 175,742m^3
Bunkers
Heavy oil: 3,532m^3
Diesel oil: 608.2m^3
Water ballast: 52,032m^3
Daily fuel consumption
Main engine only: 49tonnes/day
Classification society and notations: BV I, +Hull, +MACH, Oil Tanker, ESP, CSR, Unrestricted Navigation, +AUT-UMS, +VeriSTAR-HULL, MON SHAFT, In Water Survey, VCS, _AUT-PORT, SYS-NEQ-1, Cleanship(C), ALP
Main engine
Design: MAN Diesel & Turbo
Model: 6S70ME-C
Manufacturer: Doosan Engine (MAN Licensee)
Type of fuel: 15,720kW x 81.4rpm
Propeller
Material: Ni-Al-Bronze
Designer/manufacturer: SHI/HHI
Fixed/controllable pitch: Fixed
Diameter: 8.4m
Diesel-driven alternators
Engine make/type: Yanmar/6N21AL-GV
Type of fuel: HFO, MDO
Output/speed of each set: 950kW x 900rpm
Alternator make/type: Hyundai/ HFC7 508-84K
Output/speed of each set: 1,187.5kVA
Boilers
Type: Mission OL 30000
Make: Aalborg
Output, each boiler: 30tonnes/h x 16kg/cm$_2$
Cargo cranes/cargo gear
Make: DMC
Type: ... Electric-hydraulic, self-contained type, single jib
Tasks: Provisions and machinery part handling
Performance: 2tonnes/6.3tonnes
Mooring equipment
Make: Flutek Kawasaki
Type: Electro-hydraulic driven
Special lifesaving equipment
Number of each and capacity: 1 x 32 persons
Make: Fassmer
Type: Freefall
Cargo tanks
Number: 12 + 2 slop tanks
Grades of cargo carried: Grade B
Product range: Crude oil (S.G 0.85)
Cargo pumps
Type: .. Vertical, single stage, centrifugal, double suction
Make: Hyundai Heavy industries Co., Ltd
Stainless steel: Impeller shaft
Capacity: 3,800m^3/h x 135m at S.G 1.025
Cargo control system
Make: Samsung
Ballast control system
Make: Samsung
Bridge control system
Make: Nabtesco
Type: M-800 III
One-man operation: Yes
Fire detection system
Make: Consilium
Type: Addressable type
Fire extinguishing systems
Engine room: Wilhelmsen/ High expansion foam & seawater
Cabins/ public spaces: Seawater & portable fire extinguishers
Radars
Make: Furuno
Model: FAR-2827, FAR-2837S
Integrated bridge system
Make: Furuno
Type: FEA-2807
Waste disposal plant
Incinerator: Hyundai-Atlas/ MAXI T150SL WS
Sewage plant: Il Seung/ ISS-35N
Contract date: 19 March 2010
Launch/float-out date: 19 May 2012
Delivery date: 30 June 2012

➔ MELTEMI (Significant Ships 2006)

MELTEMI: Hyundai Samho's ice-class Suezmax tanker

Shipbuilder: ...Hyundai Samho Heavy Industries Co Ltd, Korea
Vessel's name: ...*Meltemi*
Hull number: ...S248
IMO number: ...9298741
Owner/operator: ...Marmaras Navigation Ltd, Greece
Designer: ...Hyundai Samho Heavy Industries Co Ltd, Korea
Model test establishment used: ...Hyundai Maritime Research Institute (HMRI), Korea
Flag: ...Greece
Total number of sister ships already completed: ...Nil
Total number of sister ships still on order: ...2

Illustration shows sister ship *Sounion*.

MARMARAS is another operator who, at a late stage, has taken the decision to modify a newbuilding tanker contract in order to apply Ice Class 1A strengthening requirements to the design, in anticipation of an increase in future North Atlantic/Baltic/Russian oil trading. Three vessels, including *Meltemi*, are affected by the change, the only outward manifestation of which is, perhaps, the fitting of an ice knife to the open-water sternframe, but which, of course, involves many more modifications.

The double-skin hull has a centrally-divided double bottom tank joined with the side spaces to form combined water ballast tanks, and surrounding a cargo space divided by a centreline and transverse bulkheads into six pairs of tanks. Two slop tanks are arranged at the aft end of the cargo space and a discharge rate of 8400m³/h is achieved using three Shinko 4000m³/h steam turbine-driven pumps, arranged to handle three grades of oil simultaneously through a two-valve segregation system. Loading rate is 10,200m³/h. All cargo tanks are fitted with radar-type level gauges, and remotely operated fixed warning devices monitor hydrocarbon gas levels in tanks, pumproom and ballast spaces.

The hull form features a bulbous bow, above which an attractive stem line is achieved. The design does not include a forecastle; however, some protection against heavy seas is afforded by incorporating a straight-line sheer and bulwark into the main hull forward of the cargo space in lieu. At the aft end a semi-spade rudder is attached to the open-water stern frame and, as noted, an ice knife is incorporated.

Around 45% of the structural steel weight is higher-tensile material, and pre-construction included a finite-element analysis for different loading conditions as recommended by the class, and in accordance with the requirements of Lloyd's Register ShipRight (SDA, FDA and CM) systems. A vortex generator has been fitted, together with local reinforcement of the hull, deckhouse and casing, in order to reduce vibration.

The machinery installation is centred upon a MAN B&W 6S70MC-C main engine developing 18,660kW at 91rev/min. The propeller is an FP type which drives the ship at 15.30knots when running at 90% MCR with a 15% sea margin. Electrical requirements are served by three diesel-alternator sets each with an output of 915kW, whilst two boilers and an economiser satisfy steam requirements. An integrated navigation system supports various bridge operations including route planning and manoeuvring for collision avoidance and grounding.

TECHNICAL PARTICULARS

Length, oa ...274.20m
Length, bp ...264.00m
Breadth, moulded ...50.00m
Depth, moulded ...23.10m
Width of double skin
  side ...2.50m
  bottom ...3.00m
Draught
  design ...16.00m
  scantling ...17.00m
Deadweight
  design ...151,506dwt
  scantling ...163,759dwt
Speed, service, 90% MCR, 15% sea margin ...15.30 knots
Cargo capacity ...182,025m³
Bunkers
  heavy oil ...4,514m³
  diesel oil ...177m³
Water ballast ...57,304m³
Fuel consumption
  main engine only ...130.20 tonnes/day
Classification ...Lloyd's Register of Shipping, + 100A1, Double Hull Oil tanker, ESP, *IWS, L1, NAV 1, Ice Class 1A, FS, ShipRight (SDA, FDA, CM) with descriptive notes pt HT, ShipRight (PCWBT), COW (LR), ETA, SCM, BWMP (S, F, S+F), EP, SERS, +LMC, UMS, IGS

Main engine
  Design ...MAN B&W
  Model ...6S70MC-C
  Manufacturer ...Hyundai Heavy Industries
  Number ...1
  Type of fuel ...HFO
  Output ...18,660kW/91rev/min
Propeller
  Material ...Nickel-aluminium-bronze
  Designer/manufacturer ...Hyundai Heavy Industries
  Number ...1
  Pitch ...Fixed
  Diameter ...8200mm
  Speed ...91rev/min
Diesel-driven alternators
  Number ...3
  Engine make ...Hyundai Heavy Industries
  Type of fuel ...MDO
  Output/speed ...3 x 915kW/720rev/min
  Alternator make/type ...Hyundai Heavy Industries
  Output/speed ...3 x 860kW/720rev/min
Boilers
  Number ...2 plus economiser
  Make ...KangRim
Mooring equipment
  Number ...2 x windlass; 6 x mooring winch
  Make ...Pusnes
  Type ...Electric-hydraulic
Cargo tanks
  Number ...12 plus 2 x slops
  Product range ...Crude oil
Cargo pumps
  Number ...3
  Make ...Shinko
  Type ...KV450-4 steam turbine
  Capacity ...3 x 4000m³/h
Complement
  Officers ...12
  Crew ...16
  Suez/repair crew ...6
Bridge control system
  Make ...Hyundai Heavy Industries
Contract date ...16 July 2003
Launch/float-out date ...9 December 2005
Delivery date ...13 February 2006

➔ ETON (Significant Ships 2006)

ETON: Russian Suezmax tanker from DSME

Shipbuilder: .....Daewoo Shipbilding & Marine Engineering Co Ltd (DSME), Korea
Vessel's name: .....*Eton*
Hull number: 5272
IMO number: 9311610
Owner/operator: .....Sovcomflot Akp, Russia
Designer: .....DSME, Korea
Model test establishments used: .....SSPA, Sweden/HSVA, Germany
Flag: .....Liberia
Total number of sister ships already completed: .....Nil
Total number of sister ships still on order: 3

ETON is the first vessel in a series of four, Suezmax-sized, crude oil tankers building for a Russian-based owner. The design incorporates the requirements of a Norske Veritas 'ICE-1A' notation, thus joining an expanding list of tankers - some included in this 2006 review, which are prepared for the anticipated expansion of the Russian oil trades.

Within a double-skin hull, the vessel has six pairs of cargo tanks and two slop tanks, formed by a centreline and several transverse bulkheads. The structure is designed for a fatigue life of 40 years, with particular consideration given to the end-connections of longitudinal stiffeners in cargo areas to transverse webs and bulkheads, in accordance with DNV Nauticus (Newbuilding) requirements.

The single upper deck is without a forecastle, and the hull features a raked stem above a bulbous bow forward, and a transom with open-water stern frame incorporating an ice knife, a semi-balanced rudder and a CP propeller, at the stern. Side and bottom tanks within the double-hull space are given over to water ballast.

Eton's construction has been based on an ambient air temperature of -30°C for hull structure and equipment, with special attention given to working in ice with regard to heating for hydraulic equipment, and the use of electrical equipment on deck instead of air motors. Of note is the fact that the hull form was tested for open-sea performance at the SSPA tank in Sweden, with separate tests carried out in Hamburg to ascertain performance in ice.

Three vertical, centrifugal, Shinko steam turbine pumps, each having a duty of 3700m³/h, are installed. Operating independently, with separate suction and discharge lines in tanks and on deck, these are capable of handling three grades of oil simultaneously. Cargo and ballast systems are controlled from a conventional central console in the cargo control room.

The propulsion system selected for this new series of tanker is centred on a MAN B&W 7S70ME-C, electronically controlled main engine, supplied by the Doosan Engine Co. This develops 21,770kW at 91rev/min, and at 78% MCR derives a service speed of 15.50knots from the CP propeller. Operation of the main engine is monitored by means of a CoCos-EDS computer-controlled surveillance system. Electrical requirements are satisfied from three STX-MAN/Hyundai 980kW diesel-alternator sets, and two 40,000kg/h oil-fired boilers are installed. Manoeuvring is assisted by a 1500kW bow thruster.

TECHNICAL PARTICULARS

Length, oa 280.50m
Length, bp 270.00m
Breadth, moulded 50.00m
Depth, moulded 23.00m
Width of double skin
  side 2.50m
  bottom 2.55m
Draught
  design 15.00m
  scantling 16.50m
Gross 87,146gt
Displacement 188,140tonnes
Lightweight 25,750tonnes
Deadweight
  design 143,400dwt
  scantling 162,390dwt
Block coefficient, design draught 0.813
Speed, service, 78% MCR 15.50knots
Cargo capacity 183,600m³
Bunkers
  heavy oil 4380m³
  diesel oil 290m³
Water ballast 57,300m³
Segregated ballast 100%
Fuel consumption, main engine 66.4tonnes/day
Classification .....Det Norske Veritas, +1A1, Tanker for Oil, ESP, E0, NAUTICUS (Newbuilding), DAT (-30), ICE-1A, VCS-2, SPM, TMON
Percentage of high-tensile steel used in construction 53%
Main engine
  Design .....MAN B&W
  Model 7S70ME-C
  Manufacturer .....Doosan Engine Co
  Number 1
  Type of fuel .....HFO
  Output/speed 21,770kW/91rev/min
Propeller
  Material .....Stainless steel
  Designer/manufacturer .....DSME/Wärtsilä
  Number 1
  Pitch .....Controllable
  Diameter 8600mm
  Speed 91rev/min
Diesel-driven alternators
  Number 3
  Engine make/type .....STX-MAN 7L23/30
  Type of fuel .....HFO
  Output/speed .....3 x 1120kW/900rev/min
  Alternator make/type .....Hyundai
  Output/speed .....3 x 980kW/720rev/min
Exhaust-gas economiser
  Manufacturer .....KangRim
  Type .....Forced circulation
  Output 2000kg/h
Boilers
  Number 2
  Type .....Vertical oil-fired
  Make .....Aalborg
  Output .....2 x 40,000kg/h
Cargo tanks
  Number .....12 plus 2 slop
  Grades of cargo 3
  Product range .....Crude oil
  Tank coating .....Tar-free epoxy
Cargo pumps
  Number 3
  Type .....Steam turbine, vertical centrifugal
  Make .....Shinko
  Capacity .....3 x 3700m³/h
Cargo/ballast control systems
  Make .....Damcos
  Type .....Electro-hydraulic
Complement
  Officers 16
  Crew 18
  Spare 2
  Suez/repair crew 6
Bow thruster
  Make .....KTE
  Number 1
  Output 1500kW
Bridge control system
  Make .....Yokogawa Denshikiki Co Ltd
  One man operation .....No
Fire detection system
  Make .....Consilium
  Type .....Addressable
Fire extinguishing systems
  Cargo deck .....High-expansion foam
  Make .....NK
Radars
  Number 3
  Make .....Japan Radio Co Ltd
  Models JMA-9933-SA/JMA-9923-7XA
Integrated bridge system .....No
Incinerator
  Make .....Teamtec
  Model KEI-99SDA
Sewage plant
  Make .....Evac
  Model .....SRP 40C
Contract date .....17 December 2003
Launch/float-out date .....February 2006
Delivery date .....April 2006