UNIVERSIDADE DA CORUÑA

BUQUE PORTACONTENEDORES POST-PANAMAX 9000 TEU'S

CUADERNO 6. Predicción de potencia y diseño de propulsores y timones.

PROYECTO NÚMERO: 15-13

Nadia Conde Alonso

Escola Politécnica Superior

UNIVERSIDADE DA CORUÑA

DEPARTAMENTO DE INGENIERÍA NAVAL Y OCEÁNICA

ANTEPROYECTO Y PROYECTO FIN DE CARRERA

CURSO 2015-2016

PROYECTO NÚMERO 15-13

TIPO DE BUQUE: Buque Portacontenedores Post-panamax.

CLASIFICACIÓN, COTA Y REGLAMENTOS DE APLICACIÓN: Lloyd's Register. Marpol. Solas.

CARACTERÍSTICAS DE LA CARGA: 9000 TEUS.

VELOCIDAD Y AUTONOMÍA: Velocidad máxima de 25,5 nudos, al 85% de MCR y 10% de margen de mar.

SISTEMAS Y EQUIPOS DE CARGA / DESCARGA: Sin grúas.

PROPULSIÓN: Motor acoplado a la línea de ejes.

TRIPULACIÓN Y PASAJE: 15 camarotes oficiales, 13 camarotes tripulación.

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

Ferrol, Septiembre de 2015

ALUMNO: Dª Nadia Conde Alonso

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1. INTRODUCCIÓN

El objetivo de esta entrega es la estimación de la potencia propulsora del buque y el cálculo del propulsor, analizando varias alternativas para la obtención del resultado óptimo. Además se realizarán los cálculos de dimensiones de timón así como su posición en el codaste.

A continuación se muestran las dimensiones obtenidas y utilizadas en los cuadernos anteriores:

TEU'S TOTALES	9000 TEU'S
TEU'S BODEGA	4256 TEU'S
TEU'S CUBIERTA	4744 TEU'S
ESLORA TOT *(LOA)*	333,37 m.
ESLORA PERPENDICULARES *(LPP)*	318,4 m.
MANGA *(B)*	44,23 m.
PUNTAL *(D)*	26,41 m.
CALADO *(T)*	14,73 m.
DESPLAZAMIENTO *(Δ)*	144.194 ton.
VELOCIDAD *(V)*	25,5 kn.

N FROUD	0,235
COEF BLOQUE	0,67
COEF MAESTRA	0,99
COEF PRISM	0,68

2. PREDICCIÓN DE POTENCIA

Para la realización de la estimación de la potencia propulsora del buque se utilizará el programa informático *NavCad*. Se calculará primero la resistencia al avance del buque y a partir de ahí la potencia propulsora necesaria.

Para la realización de ambas será necesario introducir en *NavCad* los datos que se muestran en el siguiente apartado.

2.1. DATOS NECESARIOS

En las diferentes pestañas del programa será necesario introducir los siguientes datos:

- CASCO, hull data:

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**325,000 m**
Max beam on WL:	[LWL/BWL 7,348]	**44,230 m**
Max molded draft:	[BWL/T 3,003]	**14,730 m**
Displacement:	[CB 0,664]	**144194,00 t**
Wetted surface:	[CWS 6,889]	**18622,6 m2**
ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,463]	**150,430 m**
LCF fwd TR:	[XCF/LWL 0,423]	**137,600 m**
Max section area:	[CX 0,993]	**647,0 m2**
Waterplane area:	[CWP 0,819]	**11768,9 m2**
Bulb section area:		**50,2 m2**
Bulb ctr below WL:		**6,640 m**
Bulb nose fwd TR:		**333,000 m**
Transom area:	[ATR/AX 0,607]	**393,0 m2**
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**
Transom immersion:	[TTR/T 0,000]	**0,000 m**
Half entrance angle:		**18,00 deg**
Bow shape factor:	[WL flow]	**1,0**
Stern shape factor:	[WL flow]	**1,0**

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***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Deadrise:		***0,00 deg***
Fwd station (fwd TR):		***0,000 m***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Deadrise:		***0,00 deg***
Propulsor type:		***Propeller***
Propeller diameter		***9700,0 mm***
Shaft angle to WL:		***0,00 deg***
Position fwd TR:		***0,000 m***
Position below WL:		***0,000 m***

Report ID20160523-1633 HydroComp NavCad 2012 12.02.0019.S1002.539

Tanto los valores de las dimensiones principales del buque a la flotación como las áreas han sido obtenidas a partir de las hidrostáticas del buque al calado de diseño, 14,73 m.

Displacement	144194 t
Volume (displaced)	140677,28 m^3
Draft Amidships	14,73 m
Immersed depth	14,73 m
WL Length	325,285 m
Beam max extents on WL	44,23 m
Wetted Area	18622,63 m^2
Max sect. area	647,07 m^2
Waterpl. Area	11768,86 m^2
Prismatic coeff. (Cp)	0,68
Block coeff. (Cb)	0,67
Max Sect. area coeff. (Cm)	0,99
Waterpl. area coeff. (Cwp)	0,83
LCB length	150,43 from zero pt. (+ve fwd)
LCF length	137,60 from zero pt. (+ve fwd)
LCB %	47,25 from zero pt. (+ve fwd)
LCF %	43,22 from zero pt. (+ve fwd)
KB	7,97 m
KG fluid	0 m
BMt	11,69 m
BML	543,07 m
GMt corrected	19,66 m
GML	551,04 m
KMt	19,66 m
KML	551,04 m
Immersion (TPc)	120,63 tonne/cm
MTc	2495,49 tonne.m
RM at 1deg = GMt.Disp.sin(1)	49487,27 tonne.m
Length:Beam ratio	7,18
Beam:Draft ratio	3,01
Length:Vol^0.333 ratio	6,12
Precision	Medium 66 stations

En el caso del bulbo y del espejo:

- Área del bulbo, 50,2 m^2. Esta área ha sido obtenida a partir de la curva de áreas seccionales del buque.
- Altura, 6,64 m obtenida del Cuaderno 3, y protuberancia del bulbo desde el espejo de popa, 333 m a partir del plano de formas.
- Área del espejo, 393 m^2. Obtenida a partir del plano de formas.

El semi-ángulo de entrada del casco en proa, 18^0, se ha obtenido del plano de formas del buque.

Los factores de proa y popa son 1 debido a las formas en "U" del buque.

- APÉNDICES, appendage data.

Appendage data

General	
Definition:	Component
Percent of hull drag:	0,00 %
Planing influence	
LCE fwd TR:	0,000 m
VCE below WL:	0,000 m
Shafting	
Count:	1
Max prop diameter:	9700,0 mm
Shaft angle to WL:	0,00 deg
Exposed shaft length:	0,000 m
Shaft diameter:	0,000 m
Wetted surface:	0,0 m2
Strut bossing length:	0,000 m
Bossing diameter:	0,000 m
Wetted surface:	0,0 m2
Hull bossing length:	0,000 m
Bossing diameter:	0,000 m
Wetted surface:	0,0 m2
Strut (per shaft line)	
Count:	0
Root chord:	0,000 m
Tip chord:	0,000 mm
Span:	0,000 m
T/C ratio:	0,000
Projected area:	0,0 m2
Wetted surface:	0,0 m2
Exposed palm depth:	0,000 m
Exposed palm width:	0,000 m
Rudder	
Count:	1
Rudder location:	Behind propeller
Type:	Balanced foil
Root chord:	6,410 m
Tip chord:	5,290 m
Span:	11,070 m
T/C ratio:	0,150
LE sweep:	0,00 deg
Projected area:	58,0 m2
Wetted surface:	63,1 m2

Skeg/Keel	
Count:	0
Type:	Skeg
Mean length:	0,000 m
Mean width:	0,000 m
Height aft:	0,000 m
Height mid:	0,000 m
Height fwd:	0,000 m
Projected area:	0,0 m2
Wetted surface:	0,0 m2
Stabilizer	
Count:	0
Root chord:	0,000 m
Tip chord:	0,000 m
Span:	0,000 m
T/C ratio:	0,000
LE sweep:	0,00 deg
Wetted surface:	0,0 m2
Projected area:	0,0 m2
Dynamic multiplier:	1,00
Bilge keel	
Count:	0
Mean length:	0,000 m
Mean base width:	0,000 m
Mean projection:	0,000 m
Wetted surface:	0,0 m2
Tunnel thruster	
Count:	0
Diameter:	0,000 m
Sonar dome	
Count:	0
Wetted surface:	0,0 m2
Miscellaneous	
Count:	0
Drag area:	0,0 m2
Drag coef:	0,00

En el apartado del timón, rudder, situado a popa de la hélice, introduciremos las dimensiones de este calculadas, más adelante, en el apartado 4.

- Altura de la pala, 11,07 m.
- Longitud inferior, 6,41 m.
- Longitud superior, 5,29 m.

- ENTORNO, environment data.

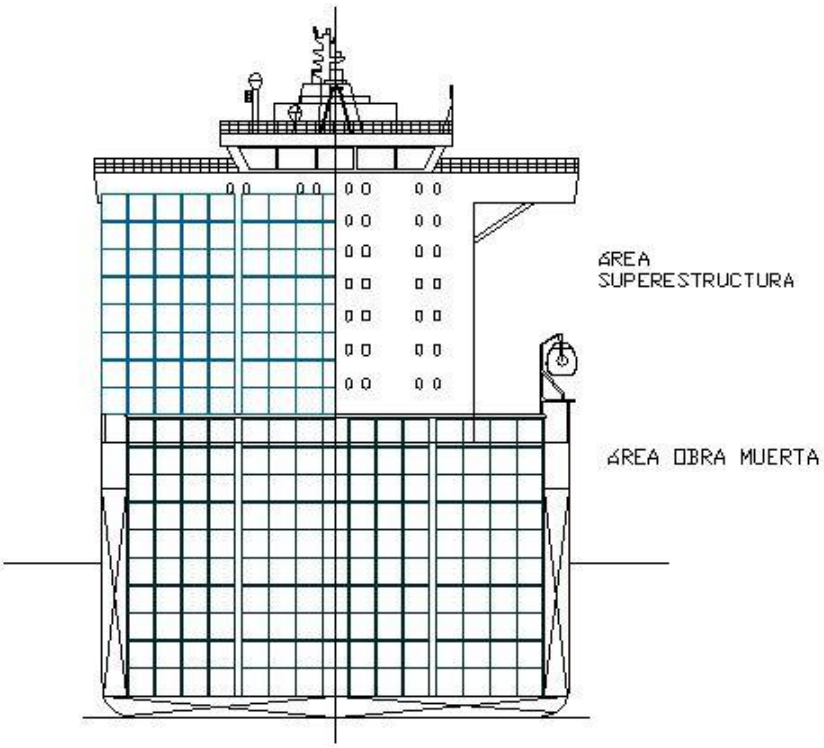
Environment data

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:	612,8 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:	Container ship		
Transverse area:	838,3 m2		
VCE above WL:	0,000 m		
Profile area:	0,0 m2		

En esta pestaña se introducirá el área transversal de la obra muerta del buque así como el área transversal de la superestructura, indicando que nuestro buque es un portacontenedores.

- Área transversal de la obra muerta, 612,8 m^2.
- Área transversal de la superestructura, 838,3 m^2.

Se muestra a continuación un croquis de ambas áreas.



- MARGEN, margin. Se introduce un margen del 10% dado en las RPA y se define como "Hull drag only".

2.2. CÁLCULO DE LA RESISTENCIA

Una vez introducidos los datos anteriores se procede al cálculo de la resistencia del buque en el modo *Resistance* del programa.

Se realizará el cálculo para 10 velocidades distintas, de un nudo en un nudo hasta llegar a la velocidad de diseño, 25,5 kn, y pasando medio nudo de esta.

SPEED [kt]
19,00
20,00
21,00
22,00
23,00
24,00
24,50
25,00
+ 25,50 +
26,00

Para el cálculo de la resistencia se utilizará el Método Andersen ya que para este tipo de buque resulta el más acertado:

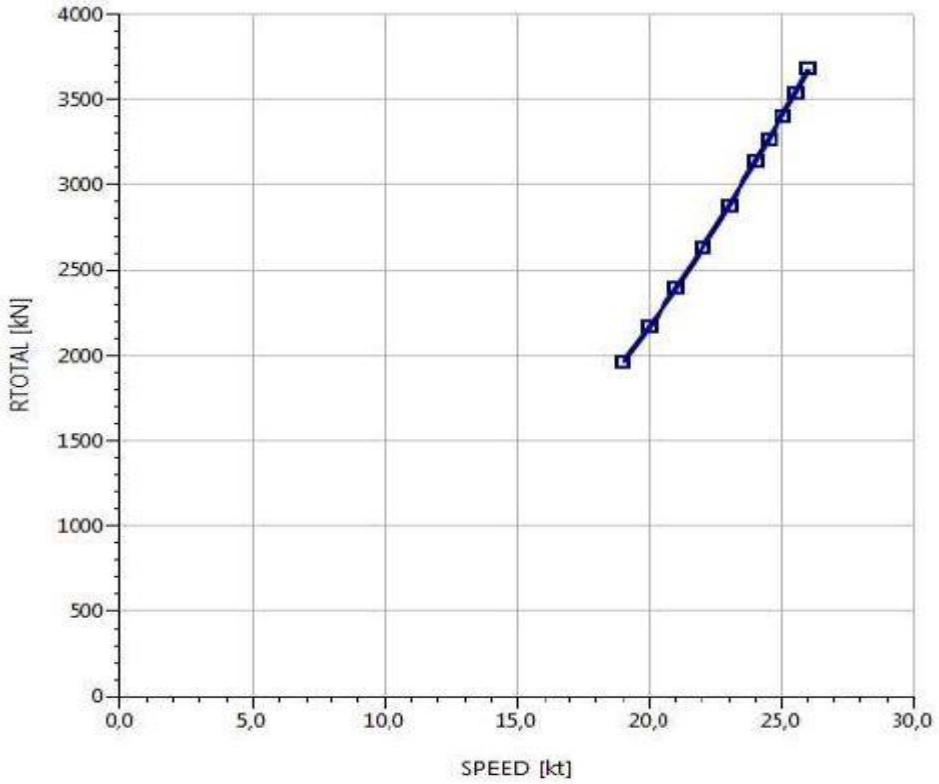
Analysis parameters

Vessel drag	ITTC-78 (CT)	**Added drag**	
Technique:	[Calc] Prediction	Appendage:	[Calc] Holtrop (Component)
Prediction:	Andersen	Wind:	[Calc] Taylor
Reference ship:		Seas:	[Off]
Model LWL:		Shallow/channel:	[Off]
Expansion:	Standard	Towed:	[Off]
Friction line:	ITTC-57	Margin:	[Calc] Hull drag only [10%]
Hull form factor:	[On] 1,195	**Water properties**	
Speed corr:	[Off]	Water type:	Salt
Spray drag corr:	[Off]	Density:	1026,00 kg/m3
Corr allowance:	ITTC-78 (v2008)	Viscosity:	1,18920e-6 m2/s
Roughness [mm]:	[On] 0,15		

Tras el cálculo se obtiene para 25,5 kn, una resistencia al avance de **3.539 kN.**

Esta será la resistencia que nuestro propulsor tendrá que vencer para hacer avanzar al buque en una dirección con esta velocidad.

A continuación podemos ver una gráfica en que se ven enfrentados los valores de resistencia y velocidad. Se trata de una gráfica exponencial, a medida que aumenta la velocidad lo hace con mayor medida la resistencia:



Se mostrarán en el Anexo I los resultados completos del análisis de la resistencia.

2.3. CÁLCULO DE LA POTENCIA

Una vez obtenida la resistencia se calculará la potencia del buque utilizando el modo *Propulsion* del programa.

Además de los datos ya introducidos en el cálculo de la resistencia se utilizará una pestaña más para este cálculo en la que se introducirán los datos de la propulsión del buque.

- PROPULSOR, propulsor data.

En esta pestaña se introducen el diámetro de la hélice, obtenido en el Cuaderno 3, y la altura del eje desde la línea base obtenida del plano de la disposición general del buque.

Para una primera aproximación de la potencia, se hará el estudio con una hélice de cuatro palas a 102 revoluciones. Para ello debemos seleccionar la función de *propeller sizing* y elegir la opción "By thrust" es decir, que la potencia requerida es proporcional a la resistencia al avance del buque o empuje obtenido en el apartado anterior.

Propulsor data

Propulsor				Propeller options	
Count:		1		Oblique angle corr:	Off
Propulsor type:		Propeller series		Shaft angle to WL:	0,00 deg
Propeller type:		FPP		Added rise of run:	0,00 deg
Propeller series:		B Series		Propeller cup:	0,0 mm
Propeller sizing:		By thrust		KTKQ corrections:	Custom
Reference prop:				Scale correction:	None
Blade count:		4		KT multiplier:	1,000
Expanded area ratio:		0,8267	[Size]	KQ multiplier:	1,000
Propeller diameter:		9700,0 mm	[Keep]	Blade T/C [0.7R]:	0,00
Propeller mean pitch:	[P/D 0,7281]	7063,0 mm	[Size]	Roughness:	0,00 mm
Hub immersion:		6000,0 mm		Cav breakdown:	Off

En los datos de la hélice, se dejará que el propio programa calcule sus parámetros principales.

Para el cálculo de la potencia se utilizará también el Método Andersen y las mismas velocidades que en el cálculo de la resistencia:

Analysis parameters

Hull-propulsor interaction		System analysis	
Technique:	Prediction	Cavitation criteria:	Keller eqn
Prediction:	[Calc] Andersen	Analysis type:	Free run
Reference ship:		CPP method:	
Max prop diam:	9700,0 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:			

Una vez calculado, obtenemos para esta primera estimación una potencia de 56.704 kW.

El motor propulsor del buque proyecto deberá funcionar al 85% de su régimen. Su potencia mínima requerida será la siguiente:

$$\boldsymbol{Potencia\ mínima\ requerida} = \frac{56.704\ kW}{0{,}85} = \mathbf{66.711\ kW}$$

A continuación como ya se conoce la potencia demandada por el buque, se busca en catálogos de casas fabricantes de motores un modelo que sea capaz de proporcionar la potencia requerida.

La casa elegida es Wärtsilä y a continuación se presentan los 4 posibles modelos:

MAIN DATA RT-flex96C AND RTA96C

Cylinder bore	960 mm
Piston stroke	2500 mm
Speed	92 - 102 rpm
Mean effective pressure at R1	18.6 bar
Piston speed	8.5 m/s
Fuel specification: Fuel oil	730 cSt/50°C 7200 sR1/100°F ISO 8217, category ISO-F-RMK 55

RATED POWER: PROPULSION ENGINES

Cyl.	Output in kW/bhp at							
	102 rpm				92 rpm			
	R1		R2		R3		R4	
	kW	bhp	kW	bhp	kW	bhp	kW	bhp
6	34 320	46 680	24 000	32 640	30 960	42 120	24 000	32 640
7	40 040	54 460	28 000	38 080	36 120	49 140	28 000	38 080
8	45 760	62 240	32 000	43 520	41 280	56 160	32 000	43 520
9	51 480	70 020	36 000	48 960	46 440	63 180	36 000	48 960
10	57 200	77 800	40 000	54 400	51 600	70 200	40 000	54 400
11	62 920	85 580	44 000	59 840	56 760	77 220	44 000	59 840
12	68 640	93 360	48 000	65 280	61 920	84 240	48 000	65 280
13	74 360	101 140	52 000	70 720	67 080	91 260	52 000	70 720
14	80 080	108 920	56 000	76 160	72 240	98 280	56 000	76 160

Basándonos en la similitud con otros buques de mismas características se establece un motor Wärtsilä RT-flex96 con 12 cilindros. Es un motor de 2 tiempos de gran tamaño que a 102 revoluciones por minuto nos ofrece una potencia de 68.640 kW/93.360 hp.

La potencia otorgada es ligeramente superior a la requerida lo cual no es negativo porque nos ofrece un margen de error en la predicción de la potencia.

Se mostrarán en el Anexo II los resultados completos del análisis de la potencia.

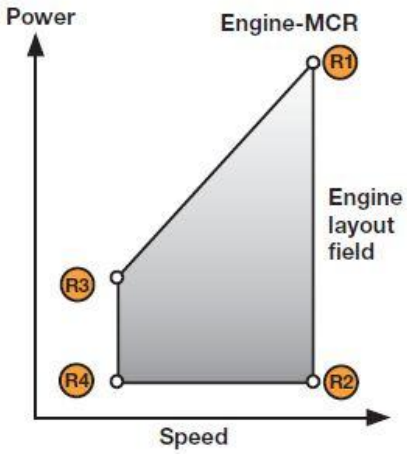
3. CÁLCULO DEL PROPULSOR Y ANÁLISIS ALTERNATIVAS

Por último se realizará el cálculo del propulsor más eficiente. Para esto se variará el número de palas de la hélice en 4, 5 y 6 buscando la mejor eficiencia de la misma.

En este caso como el análisis será mediante la potencia, "by power".

Se ha tenido que definir el motor anterior dentro de software, introduciendo la potencia calculada anteriormente y la relación entre la potencia y las RPM del motor seleccionado.

Esta relación entre la potencia y las RPM se muestra en el Anexo IV.



Con esto obtenemos:

NÚMERO DE PALAS	EFICIENCIA	POTENCIA	POTENCIA, 85% RÉGIMEN
4	**0,747**	**56.704 kW**	**66.711 kW**
5	0,739	57.290 kW	67.400 kW
6	0,715	59.191 kW	69.636 kW

La hélice escogida será la de 4 palas, ya que ofrece una eficiencia mayor que las otras dos.

Aunque en nuestro caso con los datos del buque proyecto se obtiene una mejor eficiencia con una hélice de 4 palas, fijándonos en los buques de la base de datos se comprueba que el número de palas es mayor debido a que el diámetro del propulsor es mucho menor que el calculado en nuestro caso.

Realizando los mismos cálculos pero con un diámetro de 8,9 m. del buque base se obtiene que la eficiencia es superior con una hélice de 5 palas como sería lo habitual en estos buques:

NÚMERO DE PALAS	EFICIENCIA	POTENCIA	POTENCIA, 85% RÉGIMEN
4	0,751	56.439 kW	66.399 kW
5	**0,766**	**55.305 kW**	**65.064 kW**
6	0,764	55.439 kW	65.222 kW

Se presentan como Anexo III los resultados del análisis por potencia para propulsores de 4, 5 y 6 palas, Anexo IV los resultados para el análisis con un diámetro menor y Anexo V las características técnicas del motor utilizado.

3.1. CLARAS DEL CODASTE

Las claras del codaste están definidas por las Sociedades de Clasificación y que hemos calculado en el Cuaderno 3 mediante dos formulaciones distintas y haciendo una media.

En este apartado se realizará el cálculo de las claras definitivas utilizando el número de palas más favorable obtenido en el apartado anterior y la formulación especificada por el Lloyd's Register, *Pt 3, Ch 6, 7.6 Propeller hull clearances.*

Se escogerá la siguiente formulación para un propulsor de 4 palas, ya que dependiendo del número de palas sus coeficientes variarán:

- *Clara a*: $\mathrm{a} = 1 \times \mathrm{K} \times \mathrm{D_P}$

siendo,

$$K = \left(0{,}1 + \frac{L_{PP}}{3050}\right) \times \left(\frac{2{,}56 \times C_B \times BHP}{L_{PP}} + 0{,}3\right)$$

$$K = \left(0{,}1 + \frac{318{,}4}{3050}\right) \times \left(\frac{2{,}56 \times 0{,}67 \times 93360}{318{,}4} + 0{,}3\right) = 103$$

$$a = 1 \times K \times D_P = 1\ m$$

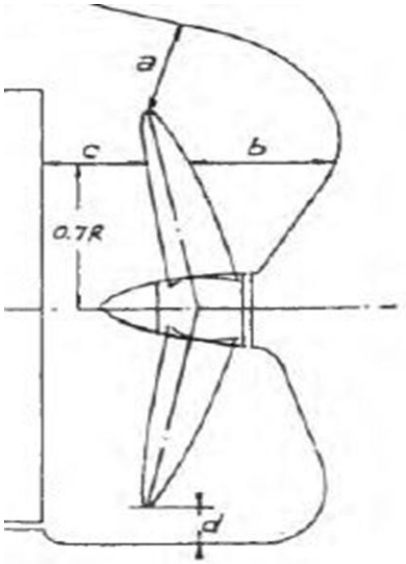
$$a_{min} = 0{,}10 \times D_P = 0{,}97\ m$$

- *Clara b:* $b = 1{,}5 \times K \times D_P = 1{,}5\ m$

$$b_{min} = 0{,}15 \times D_P = 1{,}45\ m$$

- *Clara c:* $c = 0{,}12 \times D_P = 0{,}12 \times 9{,}7 = 1{,}17\ m$

- *Clara d:* $d = 0{,}03 \times D_P = 0{,}03 \times 9{,}7 = 0{,}29\ m$



Sobre el plano pueden medirse las siguientes claras que cumplen con las mínimas exigidas por el reglamento:

- *Clara a:* $\boldsymbol{a = 1{,}12\ m}$
- *Clara b:* $\boldsymbol{b = 1{,}68\ m}$
- *Clara c:* $\boldsymbol{c = 1{,}53 m}$
- *Clara b:* $\boldsymbol{d = 0{,}29\ m}$

Se adjuntará un plano en el Anexo VII del conjunto de la hélice, codaste y timón.

4. CÁLCULO DEL TIMÓN

Para la obtención de las dimensiones del timón se utilizarán las fórmulas extraídas del Reglamento Lloyd's Register of Shipping, *Pt 3, Ch 13, 2 Rudders*.

Se realizará el cálculo de la fuerza lateral del timón a partir de la siguiente fórmula:

$$P_L = 132 c_1 c_2 c_3 C_{TH} A_R V^2$$

donde:

- c_1, es un factor que depende de la relación de aspecto λ del área del timón.

$$c_1 = \frac{\lambda + 2}{3} = \frac{2+2}{3} = 1{,}33$$

- c_2, coeficiente del perfil del timón, que será para el tipo NACA-00, 1,1 para avance y 0,8 para ciar.

- $c_3 = 1$, coeficiente que depende del montaje de timones convencionales.

- $C_{TH} = 1$

- $V = 25{,}5\ kn$, velocidad máxima. En el caso de ciar $V = 0{,}5V = 12{,}75\ kn$.

- $\lambda = {h_R}^2/A_T$, pero no se tomará mayor que 2.

$$\lambda = \frac{{h_R}^2}{A_T} = \frac{11{,}07^2}{58} = 2{,}11 > 2 \rightarrow \lambda = 2$$

- h_R, altura de la pala del timón.

- A_R, área de la pala del timón

- A_T, suma del área de la pala del timón más el área a proa de la mecha.

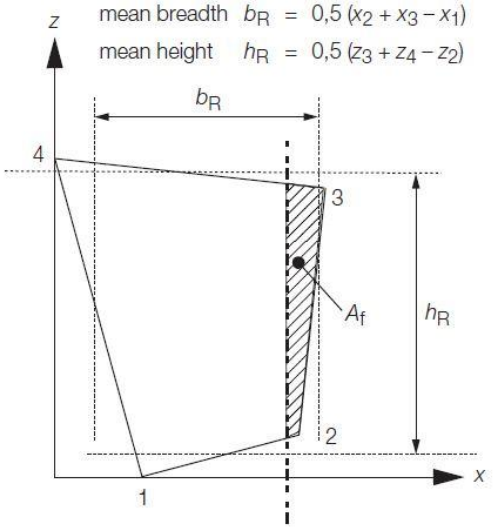


Figure 13.2.2 Rudder co-ordinate system

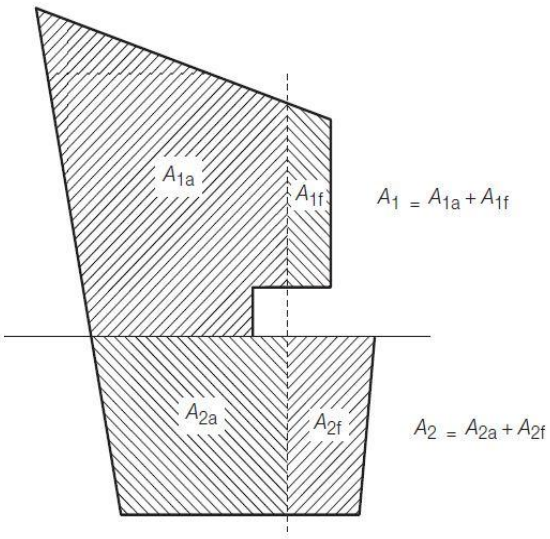


Figure 13.2.3 Rudder areas

Se muestra a continuación una tabla con los resultados del cálculo de las dimensiones y áreas del timón que utilizaremos para obtener la fuerza.

	A1a				**A2a**		**A1f**		**A2f**	
	A11a		**A12a**							
	x, m	**z, m**	**x, m**	**z, m**	**x, m**	**z, m**	**x, m**	**x, m**	**x, m**	**z, m**
1	0	0	0	0	0	0	0	0	0	0
2	4,79	0	4,29	0	4,79	0	0,5	0	0,5	0
3	4,79	3,32	4,29	0,66	4,79	7,09	0,5	3,32	0,5	7,09
4	0	3,2	0	0,66	0	7,09	0	3,32	0	7,09
TOTAL	**16,37 m2**		**2,83 m2**		**33,96 m2**		**1,66 m2**		**3,54 m2**	

	DIMENSIONES	
	bR	**hR**
	x, m	**z, m**
1	0	0
2	6,41	0
3	5,29	11,07
4	0	11,07
TOTAL	**5,85 m**	**11,07 m**

AT			
AR		**Af**	
A1a	A2a	A1f	A2f
19,2 m2	33,96 m2	1,66 m2	3,54 m2
52,8 m2		**5,2 m2**	
58 m2			

Los resultados obtenidos para la fuerza lateral en la pala del timón serán dependiendo del caso a estudiar:

	AHEAD	ASTERN
FUERZA P_L, kN	**6.178 kN**	**1.123 kN**

Para el cálculo del par se obtendrá a partir de la siguiente expresión:

$$M_T = M_1 + M_2$$

donde:

- $M_1 = P_{L1} x_{P1}$
- $M_2 = P_{L2} x_{P2}$
- $P_{L1} = \left(\frac{A_1}{A_R}\right) \times P_L$

- $P_{L2} = (A_2/A_R) \times P_L$
- $x_{P1} = b_{R1}(\alpha - k_1)$
- $x_{P2} = b_{R2}(\alpha - k_2)$
- $A_1 = A_{1a} + A_{1f} = 19{,}2 + 1{,}66 = 20{,}86\ m^2$
- $A_2 = A_{2a} + A_{2f} = 33{,}96 + 3{,}54 = 37{,}5\ m^2$
- $b_{R1} = 5{,}29\ m$, ancho del área parcial A_1.
- $b_{R2} = 6{,}41\ m$, ancho del área parcial A_2.
- α, será 0,25 para avante y 0,55 para ciar.
- $k_1 = \frac{A_{1f}}{A_1} = \frac{1{,}66}{20{,}86} = 0{,}079$
- $k_2 = A_{2f}/A_2 = 3{,}54/37{,}5 = 0{,}094$

	Ahead	Astern
α	0,25	0,55
x_{P1}, m	0,904	2,49
x_{P2}, m	0,99	2,92
P_L, N	6.178.225	112.332
P_{L1}, N	2.440.867	44.380
P_{L2}, N	4.387.944	79.781
M_1, Nm	2.206.544	110.506
M_2, Nm	4.344.065	232.961

Los resultados obtenidos para el par del timón serán dependiendo del caso a estudiar:

	AHEAD	ASTERN
PAR M_T, kN	**6.551 kN**	**343 kN**

Además para el caso de avante, M_T no se debe tomar menor de:

$$\boldsymbol{M_{Tmin}} = 0{,}1P_L \times \frac{A_1 b_{R1} + A_2 b_{R2}}{A_R} = 4.103.890\ Nm = \boldsymbol{4.104\ kN}$$

Se adjunta un plano del timón en el Anexo VI junto con un plano de la situación propulsor, codaste y timón en el Anexo VII.

ANEXO I: RESULTADOS ANÁLISIS RESISTENCIA

Resistance

4 sep 2016 10:22

HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

Analysis parameters

Vessel drag		**ITTC-78 (CT)**
Technique:	**[Calc]**	**Prediction**
Prediction:		**Andersen**
Reference ship:		
Model LWL:		
Expansion:		**Standard**
Friction line:		**ITTC-57**
Hull form factor:	**[On]**	**1,195**
Speed corr:	**[Off]**	
Spray drag corr:	**[Off]**	
Corr allowance:		**ITTC-78 (v2008)**
Roughness [mm]:	**[On]**	**0,15**

Added drag		
Appendage:	**[Calc]**	**Holtrop (Component)**
Wind:	**[Calc]**	**Taylor**
Seas:	**[Off]**	
Shallow/channel:	**[Off]**	
Towed:	**[Off]**	
Margin:	**[Calc]**	**Hull drag only [10%]**
Water properties		
Water type:		**Salt**
Density:		**1026,00 kg/m3**
Viscosity:		**1,18920e-6 m2/s**

Prediction method check [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,23**	**6,25**	**0,66**	**7,35**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results

	SPEED COEFS		ITTC-78 COEFS						
SPEED [kt]	FN	FV	RN	CF	[CTLT/CF]	CR	dCF	CA	CT
19,00	**0,173**	**0,433**	**2,67e9**	**0,001360**	**1,195**	**0,000079**	**0,000000**	**0,000172**	**0,001876**
20,00	**0,182**	**0,456**	**2,81e9**	**0,001352**	**1,195**	**0,000097**	**0,000000**	**0,000164**	**0,001876**
21,00	**0,191**	**0,478**	**2,95e9**	**0,001344**	**1,195**	**0,000116**	**0,000000**	**0,000156**	**0,001878**
22,00	**0,200**	**0,501**	**3,09e9**	**0,001337**	**1,195**	**0,000135**	**0,000000**	**0,000149**	**0,001881**
23,00	**0,210**	**0,524**	**3,23e9**	**0,001330**	**1,195**	**0,000153**	**0,000000**	**0,000142**	**0,001884**
24,00	**0,219**	**0,547**	**3,37e9**	**0,001323**	**1,195**	**0,000169**	**0,000000**	**0,000135**	**0,001886**
24,50	**0,223**	**0,558**	**3,44e9**	**0,001320**	**1,195**	**0,000176**	**0,000000**	**0,000131**	**0,001885**
25,00	**0,228**	**0,570**	**3,51e9**	**0,001317**	**1,195**	**0,000182**	**0,000000**	**0,000128**	**0,001884**
+ 25,50 +	**0,232**	**0,581**	**3,59e9**	**0,001314**	**1,195**	**0,000187**	**0,000000**	**0,000125**	**0,001883**
26,00	**0,237**	**0,592**	**3,66e9**	**0,001311**	**1,195**	**0,000195**	**0,000000**	**0,000122**	**0,001883**

	RESISTANCE								
SPEED [kt]	RBARE [kN]	RAPP [kN]	RWIND [kN]	RSEAS [kN]	RCHAN [kN]	RTOWED [kN]	RMARGIN [kN]	RTOTAL [kN]	
19,00	**1712,20**	**11,04**	**63,77**	**0,00**	**0,00**	**171,22**	**171,22**	**1958,23**	
20,00	**1897,59**	**12,14**	**70,66**	**0,00**	**0,00**	**189,76**	**189,76**	**2170,15**	
21,00	**2094,24**	**13,28**	**77,90**	**0,00**	**0,00**	**209,42**	**209,42**	**2394,85**	
22,00	**2302,08**	**14,47**	**85,50**	**0,00**	**0,00**	**230,21**	**230,21**	**2632,26**	
23,00	**2520,12**	**15,71**	**93,45**	**0,00**	**0,00**	**252,01**	**252,01**	**2881,29**	
24,00	**2745,91**	**16,99**	**101,75**	**0,00**	**0,00**	**274,59**	**274,59**	**3139,24**	
24,50	**2860,76**	**17,65**	**106,03**	**0,00**	**0,00**	**286,08**	**286,08**	**3270,51**	
25,00	**2976,88**	**18,32**	**110,41**	**0,00**	**0,00**	**297,69**	**297,69**	**3403,29**	
+ 25,50 +	**3095,35**	**19,00**	**114,87**	**0,00**	**0,00**	**309,54**	**309,54**	**3538,75**	
26,00	**3218,82**	**19,69**	**119,41**	**0,00**	**0,00**	**321,88**	**321,88**	**3679,81**	

	EFFECTIVE POWER		OTHER			
SPEED [kt]	PEBARE [kW]	PETOTAL [kW]	CTLR	CTLT	RBARE/W	
19,00	**16735,8**	**19140,6**	**0,00170**	**0,04039**	**0,00121**	
20,00	**19524,1**	**22328,4**	**0,00209**	**0,04040**	**0,00134**	
21,00	**22624,8**	**25872,4**	**0,00250**	**0,04044**	**0,00148**	
22,00	**26054,5**	**29791,4**	**0,00291**	**0,04051**	**0,00163**	
23,00	**29818,7**	**34092,1**	**0,00330**	**0,04057**	**0,00178**	
24,00	**33902,8**	**38759,2**	**0,00365**	**0,04060**	**0,00194**	
24,50	**36056,7**	**41221,2**	**0,00379**	**0,04059**	**0,00202**	
25,00	**38286,0**	**43770,1**	**0,00391**	**0,04056**	**0,00211**	
+ 25,50 +	**40605,8**	**46422,5**	**0,00404**	**0,04054**	**0,00219**	
26,00	**43053,6**	**49219,5**	**0,00419**	**0,04055**	**0,00228**	

Resistance

4 sep 2016 10:22

HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**325,000 m**
Max beam on WL:	[LWL/BWL 7,348]	**44,230 m**
Max molded draft:	[BWL/T 3,003]	**14,730 m**
Displacement:	[CB 0,664]	**144194,00 t**
Wetted surface:	[CS 2,755]	**18622,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,463]	**150,430 m**
LCF fwd TR:	[XCF/LWL 0,423]	**137,600 m**
Max section area:	[CX 0,993]	**647,0 m2**
Waterplane area:	[CWP 0,819]	**11768,9 m2**
Bulb section area:		**50,2 m2**
Bulb ctr below WL:		**6,640 m**
Bulb nose fwd TR:		**333,000 m**
Imm transom area:	[ATR/AX 0,607]	**393,0 m2**
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**
Transom immersion:	[TTR/T 0,000]	**0,000 m**
Half entrance angle:		**18,00 deg**
Bow shape factor:	[WL flow]	**1,0**
Stern shape factor:	[WL flow]	**1,0**

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:		***0,0 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***

Resistance

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**
Description
File name **FINALSI.hcnc**

Appendage data

General		Skeg/Keel	
Definition:	**Component**	Count:	**0**
Percent of hull drag:	**0,00 %**	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:	**0,0 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:	**1**	Count:	**0**
Rudder location:	**Behind propeller**	Wetted surface:	**0,0 m2**
Type:	**Balanced foil**	**Miscellaneous**	
Root chord:	**6,410 m**	Count:	**0**
Tip chord:	**5,290 m**	Drag area:	**0,0 m2**
Span:	**11,070 m**	Drag coef:	**0,00**
T/C ratio:	**0,150**		
LE sweep:	**0,00 deg**		
Projected area:	**58,0 m2**		
Wetted surface:	**63,1 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:	**612,8 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:	**Container ship**		
Transverse area:	**838,3 m2**		
VCE above WL:	**0,000 m**		
Profile area:	**0,0 m2**		

Resistance

4 sep 2016 10:22

HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

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

ANEXO II: RESULTADOS ANÁLISIS POTENCIA

Propulsion

4 sep 2016 11:25

HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

Analysis parameters

Hull-propulsor interaction		**System analysis**	
Technique:	**[Calc] Prediction**	Cavitation criteria:	**Keller eqn**
Prediction:	**Andersen**	Analysis type:	**Free run**
Reference ship:		CPP method:	
Max prop diam:	**9700,0 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 [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,23**	**6,25**	**0,66**	**7,35**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE			
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]
19,00	**17467,0**	**0,3743**	**0,1442**	**1,0200**	**78**	**23369,7**	**---**	**0,0**
20,00	**20376,0**	**0,3743**	**0,1442**	**1,0200**	**82**	**27262,4**	**---**	**0,0**
21,00	**23609,9**	**0,3743**	**0,1442**	**1,0200**	**86**	**31593,5**	**---**	**0,0**
22,00	**27185,9**	**0,3743**	**0,1442**	**1,0200**	**91**	**36386,6**	**---**	**0,0**
23,00	**31110,2**	**0,3743**	**0,1442**	**1,0200**	**95**	**41648,3**	**---**	**0,0**
24,00	**35368,9**	**0,3743**	**0,1442**	**1,0200**	**99**	**47353,8**	**---**	**0,0**
24,50	**37615,5**	**0,3743**	**0,1442**	**1,0200**	**101**	**50359,6**	**---**	**0,0**
25,00	**39941,5**	**0,3743**	**0,1442**	**1,0200**	**103**	**53468,9**	**---**	**0,0**
+ 25,50 +	**42361,9**	**0,3743**	**0,1442**	**1,0200**	**105**	**56704,1**	**---**	**0,0**
26,00	**44914,1**	**0,3743**	**0,1442**	**1,0200**	**107**	**60122,7**	**---**	**0,0**

	POWER DELIVERY							
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP
19,00	**78**	**2823,13**	**2823,13**	**22668,6**	**23369,7**	**23369,7**	**23369,7**	**591,4**
20,00	**82**	**3128,57**	**3128,57**	**26444,6**	**27262,4**	**27262,4**	**27262,4**	**533,7**
21,00	**86**	**3452,05**	**3452,05**	**30645,7**	**31593,5**	**31593,5**	**31593,5**	**483,5**
22,00	**91**	**3793,52**	**3793,52**	**35295,0**	**36386,6**	**36386,6**	**36386,6**	**439,8**
23,00	**95**	**4151,60**	**4151,60**	**40398,8**	**41648,3**	**41648,3**	**41648,3**	**401,7**
24,00	**99**	**4522,89**	**4522,89**	**45933,2**	**47353,8**	**47353,8**	**47353,8**	**368,7**
24,50	**101**	**4712,17**	**4712,17**	**48848,8**	**50359,6**	**50359,6**	**50359,6**	**353,9**
25,00	**103**	**4903,87**	**4903,87**	**51864,8**	**53468,9**	**53468,9**	**53468,9**	**340,1**
+ 25,50 +	**105**	**5099,42**	**5099,42**	**55003,0**	**56704,1**	**56704,1**	**56704,1**	**327,1**
26,00	**107**	**5302,51**	**5302,51**	**58319,0**	**60122,7**	**60122,7**	**60122,7**	**314,6**

	EFFICIENCY				THRUST	
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]
19,00	**0,5523**	**1,0000**	**0,7474**	**0,47397**	**2088,23**	**1787,01**
20,00	**0,5523**	**1,0000**	**0,7474**	**0,474**	**2314,21**	**1980,39**
21,00	**0,5522**	**1,0000**	**0,7473**	**0,47415**	**2553,80**	**2185,42**
22,00	**0,5521**	**1,0000**	**0,7471**	**0,4744**	**2806,94**	**2402,05**
23,00	**0,5520**	**1,0000**	**0,7470**	**0,47465**	**3072,47**	**2629,28**
24,00	**0,5519**	**1,0000**	**0,7469**	**0,47475**	**3347,52**	**2864,65**
24,50	**0,5519**	**1,0000**	**0,7469**	**0,47471**	**3487,50**	**2984,43**
25,00	**0,5520**	**1,0000**	**0,7470**	**0,47461**	**3629,08**	**3105,60**
+ 25,50 +	**0,5520**	**1,0000**	**0,7471**	**0,47451**	**3773,53**	**3229,20**
26,00	**0,5520**	**1,0000**	**0,7470**	**0,47455**	**3923,94**	**3357,92**

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
19,00	**0,4837**	**0,1353**	**0,01886**	**0,57841**	**0,16668**	**1,4729**	**2,6145**	**1,11e8**	
20,00	**0,4836**	**0,1353**	**0,01886**	**0,5785**	**0,16671**	**1,4731**	**2,615**	**1,17e8**	
21,00	**0,4835**	**0,1354**	**0,01886**	**0,57904**	**0,16689**	**1,4745**	**2,6178**	**1,22e8**	
22,00	**0,4833**	**0,1355**	**0,01887**	**0,5799**	**0,16717**	**1,4767**	**2,6223**	**1,28e8**	
23,00	**0,4831**	**0,1356**	**0,01888**	**0,58076**	**0,16745**	**1,4789**	**2,6267**	**1,34e8**	
24,00	**0,4830**	**0,1356**	**0,01889**	**0,58112**	**0,16757**	**1,4798**	**2,6286**	**1,40e8**	
24,50	**0,4831**	**0,1356**	**0,01888**	**0,58096**	**0,16752**	**1,4794**	**2,6278**	**1,43e8**	
25,00	**0,4832**	**0,1355**	**0,01888**	**0,5806**	**0,1674**	**1,4785**	**2,6259**	**1,46e8**	
+ 25,50 +	**0,4832**	**0,1355**	**0,01888**	**0,58027**	**0,16729**	**1,4776**	**2,6242**	**1,49e8**	
26,00	**0,4832**	**0,1355**	**0,01888**	**0,58041**	**0,16734**	**1,478**	**2,6249**	**1,52e8**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
19,00	**8,34**	**1,95**	**0,38**	**39,72**	**0,547**	**34,18**	**2,0**	**2,0**	**6034,5**
20,00	**7,53**	**1,76**	**0,35**	**41,82**	**0,584**	**37,88**	**2,0**	**2,0**	**6034,5**
21,00	**6,83**	**1,60**	**0,31**	**43,92**	**0,624**	**41,81**	**2,0**	**2,0**	**6033,9**
22,00	**6,22**	**1,45**	**0,29**	**46,03**	**0,666**	**45,95**	**2,0**	**2,0**	**6033,1**
23,00	**5,69**	**1,33**	**0,26**	**48,14**	**0,710**	**50,30**	**2,1**	**2,1**	**6032,3**
24,00	**5,23**	**1,22**	**0,24**	**50,24**	**0,756**	**54,80**	**2,6**	**2,6**	**6031,9**
24,50	**5,02**	**1,17**	**0,23**	**51,28**	**0,779**	**57,09**	**2,9**	**2,9**	**6032,1**
25,00	**4,82**	**1,12**	**0,22**	**52,32**	**0,803**	**59,41**	**3,2**	**3,2**	**6032,4**
+ 25,50 +	**4,63**	**1,08**	**0,21**	**53,36 !**	**0,827**	**61,77**	**3,6**	**3,6**	**6032,7**
26,00	**4,45**	**1,04**	**0,21**	**54,41 !**	**0,852**	**64,23**	**4,1**	**4,1**	**6032,6**

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

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:		**325,000 m**		*LCG fwd TR:*	*[XCG/LP 0,000]*	***0,000 m***
Max beam on WL:	[LWL/BWL 7,348]	**44,230 m**		*VCG below WL:*		***0,000 m***
Max molded draft:	[BWL/T 3,003]	**14,730 m**		*Aft station (fwd TR):*		***0,000 m***
Displacement:	[CB 0,664]	**144194,00 t**		*Deadrise:*		***0,00 deg***
Wetted surface:	[CS 2,755]	**18622,6 m2**		*Chine beam:*		***0,000 m***
ITTC-78 (CT)				*Chine ht below WL:*		***0,000 m***
LCB fwd TR:	[XCB/LWL 0,463]	**150,430 m**		*Fwd station (fwd TR):*		***0,000 m***
LCF fwd TR:	[XCF/LWL 0,423]	**137,600 m**		*Deadrise:*		***0,00 deg***
Max section area:	[CX 0,993]	**647,0 m2**		*Chine beam:*		***0,000 m***
Waterplane area:	[CWP 0,819]	**11768,9 m2**		*Chine ht below WL:*		***0,000 m***
Bulb section area:		**50,2 m2**		*Propulsor type:*		***Propeller***
Bulb ctr below WL:		**6,640 m**		*Max prop diameter:*		***9700,0 mm***
Bulb nose fwd TR:		**333,000 m**		*Shaft angle to WL:*		***0,00 deg***
Imm transom area:	[ATR/AX 0,607]	**393,0 m2**		*Position fwd TR:*		***0,000 m***
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**		*Position below WL:*		***0,000 m***
Transom immersion:	[TTR/T 0,000]	**0,000 m**		*Transom lift device:*		***Flap***
Half entrance angle:		**18,00 deg**		*Device count:*		***0***
Bow shape factor:	[WL flow]	**1,0**		*Span:*		***0,000 m***
Stern shape factor:	[WL flow]	**1,0**		*Chord length:*		***0,000 m***
				Deflection angle:		***0,00 deg***
				Tow point fwd TR:		***0,000 m***
				Tow point below WL:		***0,000 m***

Propulsor data

Propulsor				Propeller options	
Count:		**1**		Oblique angle corr:	**Off**
Propulsor type:		**Propeller series**		Shaft angle to WL:	**0,00 deg**
Propeller type:		**FPP**		Added rise of run:	**0,00 deg**
Propeller series:		**B Series**		Propeller cup:	**0,0 mm**
Propeller sizing:		**By thrust**		KTKQ corrections:	**Custom**
Reference prop:				Scale correction:	**None**
Blade count:		**4**		KT multiplier:	**1,000**
Expanded area ratio:		**0,8267**	**[Size]**	KQ multiplier:	**1,000**
Propeller diameter:		**9700,0 mm**	**[Keep]**	Blade T/C [0.7R]:	**0,00**
Propeller mean pitch:	[P/D 0,7281]	**7063,0 mm**	**[Size]**	Roughness:	**0,00 mm**
Hub immersion:		**6000,0 mm**		Cav breakdown:	**Off**
Engine/gear				**Design condition**	
Engine data:				Max prop diam:	**9700,0 mm**
Rated RPM:		**0 RPM**		Design speed:	**25,50 kt**
Rated power:		**0,0 kW**		Reference power:	**0,0 kW**
Gear efficiency:		**1,000**		Design point:	**0,000**
Load correction:		**Off**		Reference RPM:	**102,0**
Gear ratio:		**1,000**	**[Keep]**	Design point:	**1,030**
Shaft efficiency:		**0,970**			

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.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

ANEXO III: RESULTADOS ANÁLISIS DEL PROPULSOR

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

Analysis parameters

Hull-propulsor interaction		**System analysis**	
Technique:	**[Calc] Prediction**	Cavitation criteria:	**Keller eqn**
Prediction:	**Andersen**	Analysis type:	**Free run**
Reference ship:		CPP method:	
Max prop diam:	**9700,0 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 [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,23**	**6,25**	**0,66**	**7,35**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE			
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]
19,00	**17467,0**	**0,3743**	**0,1442**	**1,0200**	**78**	**23369,7**	**---**	**41,2**
20,00	**20376,0**	**0,3743**	**0,1442**	**1,0200**	**82**	**27262,4**	**---**	**48,1**
21,00	**23609,9**	**0,3743**	**0,1442**	**1,0200**	**86**	**31593,4**	**---**	**55,7**
22,00	**27185,9**	**0,3743**	**0,1442**	**1,0200**	**91**	**36386,6**	**---**	**64,2**
23,00	**31110,2**	**0,3743**	**0,1442**	**1,0200**	**95**	**41648,3**	**---**	**73,4**
24,00	**35368,9**	**0,3743**	**0,1442**	**1,0200**	**99**	**47353,8**	**---**	**83,5**
24,50	**37615,5**	**0,3743**	**0,1442**	**1,0200**	**101**	**50359,6**	**---**	**88,8**
25,00	**39941,5**	**0,3743**	**0,1442**	**1,0200**	**103**	**53468,8**	**---**	**94,3**
+ 25,50 +	**42361,9**	**0,3743**	**0,1442**	**1,0200**	**105**	**56704,1**	**---**	**100,0**
26,00	**44914,1**	**0,3743**	**0,1442**	**1,0200**	**107**	**60122,7**	**---**	**106,0**

	POWER DELIVERY							
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP
19,00	**78**	**2823,12**	**2823,12**	**22668,6**	**23369,7**	**23369,7**	**23369,7**	**591,4**
20,00	**82**	**3128,56**	**3128,56**	**26444,6**	**27262,4**	**27262,4**	**27262,4**	**533,7**
21,00	**86**	**3452,05**	**3452,05**	**30645,6**	**31593,4**	**31593,4**	**31593,4**	**483,5**
22,00	**91**	**3793,51**	**3793,51**	**35295,0**	**36386,6**	**36386,6**	**36386,6**	**439,8**
23,00	**95**	**4151,59**	**4151,59**	**40398,8**	**41648,3**	**41648,3**	**41648,3**	**401,7**
24,00	**99**	**4522,88**	**4522,88**	**45933,2**	**47353,8**	**47353,8**	**47353,8**	**368,7**
24,50	**101**	**4712,17**	**4712,17**	**48848,8**	**50359,6**	**50359,6**	**50359,6**	**353,9**
25,00	**103**	**4903,86**	**4903,86**	**51864,8**	**53468,8**	**53468,8**	**53468,8**	**340,1**
+ 25,50 +	**105**	**5099,41**	**5099,41**	**55003,0**	**56704,1**	**56704,1**	**56704,1**	**327,1**
26,00	**107**	**5302,50**	**5302,50**	**58319,0**	**60122,7**	**60122,7**	**60122,7**	**314,6**

	EFFICIENCY				THRUST	
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]
19,00	**0,5523**	**1,0000**	**0,7474**	**0,47397**	**2088,23**	**1787,01**
20,00	**0,5523**	**1,0000**	**0,7474**	**0,474**	**2314,21**	**1980,39**
21,00	**0,5522**	**1,0000**	**0,7473**	**0,47415**	**2553,80**	**2185,42**
22,00	**0,5521**	**1,0000**	**0,7471**	**0,4744**	**2806,94**	**2402,05**
23,00	**0,5520**	**1,0000**	**0,7470**	**0,47465**	**3072,47**	**2629,28**
24,00	**0,5519**	**1,0000**	**0,7469**	**0,47475**	**3347,52**	**2864,65**
24,50	**0,5519**	**1,0000**	**0,7469**	**0,47471**	**3487,50**	**2984,43**
25,00	**0,5520**	**1,0000**	**0,7470**	**0,47461**	**3629,08**	**3105,60**
+ 25,50 +	**0,5520**	**1,0000**	**0,7471**	**0,47451**	**3773,53**	**3229,20**
26,00	**0,5520**	**1,0000**	**0,7470**	**0,47455**	**3923,94**	**3357,92**

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
19,00	**0,4837**	**0,1353**	**0,01886**	**0,57841**	**0,16668**	**1,4729**	**2,6145**	**1,11e8**	
20,00	**0,4836**	**0,1353**	**0,01886**	**0,5785**	**0,16671**	**1,4731**	**2,615**	**1,17e8**	
21,00	**0,4835**	**0,1354**	**0,01886**	**0,57904**	**0,16689**	**1,4745**	**2,6178**	**1,22e8**	
22,00	**0,4833**	**0,1355**	**0,01887**	**0,5799**	**0,16717**	**1,4767**	**2,6223**	**1,28e8**	
23,00	**0,4831**	**0,1356**	**0,01888**	**0,58076**	**0,16745**	**1,4789**	**2,6267**	**1,34e8**	
24,00	**0,4830**	**0,1356**	**0,01889**	**0,58112**	**0,16757**	**1,4798**	**2,6286**	**1,40e8**	
24,50	**0,4831**	**0,1356**	**0,01888**	**0,58096**	**0,16752**	**1,4794**	**2,6278**	**1,43e8**	
25,00	**0,4832**	**0,1355**	**0,01888**	**0,5806**	**0,1674**	**1,4785**	**2,6259**	**1,46e8**	
+ 25,50 +	**0,4832**	**0,1355**	**0,01888**	**0,58027**	**0,16729**	**1,4776**	**2,6242**	**1,49e8**	
26,00	**0,4832**	**0,1355**	**0,01888**	**0,58041**	**0,16734**	**1,478**	**2,6249**	**1,52e8**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
19,00	**8,34**	**1,95**	**0,38**	**39,72**	**0,547**	**34,18**	**2,0**	**2,0**	**6034,5**
20,00	**7,53**	**1,76**	**0,35**	**41,82**	**0,584**	**37,88**	**2,0**	**2,0**	**6034,4**
21,00	**6,83**	**1,60**	**0,31**	**43,92**	**0,624**	**41,81**	**2,0**	**2,0**	**6033,9**
22,00	**6,22**	**1,45**	**0,29**	**46,03**	**0,666**	**45,95**	**2,0**	**2,0**	**6033,1**
23,00	**5,69**	**1,33**	**0,26**	**48,14**	**0,710**	**50,30**	**2,1**	**2,1**	**6032,3**
24,00	**5,23**	**1,22**	**0,24**	**50,24**	**0,756**	**54,80**	**2,6**	**2,6**	**6031,9**
24,50	**5,02**	**1,17**	**0,23**	**51,28**	**0,779**	**57,09**	**2,9**	**2,9**	**6032,1**
25,00	**4,82**	**1,12**	**0,22**	**52,32**	**0,803**	**59,41**	**3,2**	**3,2**	**6032,4**
+ 25,50 +	**4,63**	**1,08**	**0,21**	**53,36 !**	**0,827**	**61,77**	**3,6**	**3,6**	**6032,7**
26,00	**4,45**	**1,04**	**0,21**	**54,41 !**	**0,852**	**64,23**	**4,1**	**4,1**	**6032,6**

Propulsion

4 sep 2016 11:28

HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

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:		**325,000 m**		*LCG fwd TR:*	*[XCG/LP 0,000]*	***0,000 m***
Max beam on WL:	[LWL/BWL 7,348]	**44,230 m**		*VCG below WL:*		***0,000 m***
Max molded draft:	[BWL/T 3,003]	**14,730 m**		*Aft station (fwd TR):*		***0,000 m***
Displacement:	[CB 0,664]	**144194,00 t**		*Deadrise:*		***0,00 deg***
Wetted surface:	[CS 2,755]	**18622,6 m2**		*Chine beam:*		***0,000 m***
ITTC-78 (CT)				*Chine ht below WL:*		***0,000 m***
LCB fwd TR:	[XCB/LWL 0,463]	**150,430 m**		*Fwd station (fwd TR):*		***0,000 m***
LCF fwd TR:	[XCF/LWL 0,423]	**137,600 m**		*Deadrise:*		***0,00 deg***
Max section area:	[CX 0,993]	**647,0 m2**		*Chine beam:*		***0,000 m***
Waterplane area:	[CWP 0,819]	**11768,9 m2**		*Chine ht below WL:*		***0,000 m***
Bulb section area:		**50,2 m2**		*Propulsor type:*		***Propeller***
Bulb ctr below WL:		**6,640 m**		*Max prop diameter:*		***9700,0 mm***
Bulb nose fwd TR:		**333,000 m**		*Shaft angle to WL:*		***0,00 deg***
Imm transom area:	[ATR/AX 0,607]	**393,0 m2**		*Position fwd TR:*		***0,000 m***
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**		*Position below WL:*		***0,000 m***
Transom immersion:	[TTR/T 0,000]	**0,000 m**		*Transom lift device:*		***Flap***
Half entrance angle:		**18,00 deg**		*Device count:*		***0***
Bow shape factor:	[WL flow]	**1,0**		*Span:*		***0,000 m***
Stern shape factor:	[WL flow]	**1,0**		*Chord length:*		***0,000 m***
				Deflection angle:		***0,00 deg***
				Tow point fwd TR:		***0,000 m***
				Tow point below WL:		***0,000 m***

Propulsor data

Propulsor				Propeller options	
Count:		**1**		Oblique angle corr:	**Off**
Propulsor type:		**Propeller series**		Shaft angle to WL:	**0,00 deg**
Propeller type:		**FPP**		Added rise of run:	**0,00 deg**
Propeller series:		**B Series**		Propeller cup:	**0,0 mm**
Propeller sizing:		**By power**		KTKQ corrections:	**Custom**
Reference prop:				Scale correction:	**None**
Blade count:		**4**		KT multiplier:	**1,000**
Expanded area ratio:		**0,8267**	**[Size]**	KQ multiplier:	**1,000**
Propeller diameter:		**9700,0 mm**	**[Keep]**	Blade T/C [0.7R]:	**0,00**
Propeller mean pitch:	[P/D 0,7281]	**7062,9 mm**	**[Size]**	Roughness:	**0,00 mm**
Hub immersion:		**6000,0 mm**		Cav breakdown:	**Off**
Engine/gear				**Design condition**	
Engine data:		**Untitled Engine Obje...**		Max prop diam:	**9700,0 mm**
Rated RPM:		**102 RPM**		Design speed:	**25,50 kt**
Rated power:		**56704,0 kW**		Reference power:	**56704,0 kW**
Gear efficiency:		**1,000**		Design point:	**1,000**
Load correction:		**Off**		Reference RPM:	**102,0**
Gear ratio:		**1,000**	**[Keep]**	Design point:	**1,030**
Shaft efficiency:		**0,970**			

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.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

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

Analysis parameters

Hull-propulsor interaction		**System analysis**	
Technique:	**[Calc] Prediction**	Cavitation criteria:	**Keller eqn**
Prediction:	**Andersen**	Analysis type:	**Free run**
Reference ship:		CPP method:	
Max prop diam:	**9700,0 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 [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,23**	**6,25**	**0,66**	**7,35**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE			
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]
19,00	**17467,0**	**0,3743**	**0,1442**	**1,0200**	**78**	**23613,0**	**---**	**41,6**
20,00	**20376,0**	**0,3743**	**0,1442**	**1,0200**	**83**	**27546,1**	**---**	**48,6**
21,00	**23609,9**	**0,3743**	**0,1442**	**1,0200**	**87**	**31921,5**	**---**	**56,3**
22,00	**27185,9**	**0,3743**	**0,1442**	**1,0200**	**91**	**36763,1**	**---**	**64,8**
23,00	**31110,2**	**0,3743**	**0,1442**	**1,0200**	**95**	**42077,5**	**---**	**74,2**
24,00	**35368,9**	**0,3743**	**0,1442**	**1,0200**	**99**	**47841,2**	**---**	**84,4**
24,50	**37615,5**	**0,3743**	**0,1442**	**1,0200**	**101**	**50878,4**	**---**	**89,7**
25,00	**39941,5**	**0,3743**	**0,1442**	**1,0200**	**103**	**54020,4**	**---**	**95,3**
+ 25,50 +	**42361,9**	**0,3743**	**0,1442**	**1,0200**	**105**	**57289,8**	**---**	**101,0**
26,00	**44914,1**	**0,3743**	**0,1442**	**1,0200**	**107**	**60743,3**	**---**	**107,1**

	POWER DELIVERY							
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP
19,00	**78**	**2845,42**	**2845,42**	**22904,6**	**23613,0**	**23613,0**	**23613,0**	**585,3**
20,00	**83**	**3153,26**	**3153,26**	**26719,7**	**27546,1**	**27546,1**	**27546,1**	**528,2**
21,00	**87**	**3479,24**	**3479,24**	**30963,9**	**31921,5**	**31921,5**	**31921,5**	**478,6**
22,00	**91**	**3823,28**	**3823,28**	**35660,2**	**36763,1**	**36763,1**	**36763,1**	**435,3**
23,00	**95**	**4184,04**	**4184,04**	**40815,2**	**42077,5**	**42077,5**	**42077,5**	**397,6**
24,00	**99**	**4558,18**	**4558,18**	**46406,0**	**47841,2**	**47841,2**	**47841,2**	**364,9**
24,50	**101**	**4748,97**	**4748,97**	**49352,0**	**50878,4**	**50878,4**	**50878,4**	**350,3**
25,00	**103**	**4942,22**	**4942,22**	**52399,8**	**54020,4**	**54020,4**	**54020,4**	**336,7**
+ 25,50 +	**105**	**5139,36**	**5139,36**	**55571,2**	**57289,8**	**57289,8**	**57289,8**	**323,8**
26,00	**107**	**5344,02**	**5344,02**	**58921,0**	**60743,3**	**60743,3**	**60743,3**	**311,4**

	EFFICIENCY				THRUST	
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]
19,00	**0,5466**	**1,0000**	**0,7397**	**0,46909**	**2088,23**	**1787,01**
20,00	**0,5466**	**1,0000**	**0,7397**	**0,46912**	**2314,21**	**1980,39**
21,00	**0,5465**	**1,0000**	**0,7396**	**0,46928**	**2553,80**	**2185,42**
22,00	**0,5464**	**1,0000**	**0,7395**	**0,46954**	**2806,94**	**2402,04**
23,00	**0,5463**	**1,0000**	**0,7394**	**0,46981**	**3072,47**	**2629,27**
24,00	**0,5463**	**1,0000**	**0,7393**	**0,46992**	**3347,52**	**2864,65**
24,50	**0,5463**	**1,0000**	**0,7393**	**0,46987**	**3487,50**	**2984,44**
25,00	**0,5464**	**1,0000**	**0,7394**	**0,46976**	**3629,09**	**3105,60**
+ 25,50 +	**0,5464**	**1,0000**	**0,7394**	**0,46966**	**3773,53**	**3229,20**
26,00	**0,5464**	**1,0000**	**0,7394**	**0,4697**	**3923,94**	**3357,92**

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
19,00	**0,4825**	**0,1346**	**0,01891**	**0,57841**	**0,16841**	**1,4729**	**2,6417**	**9,62e7**	
20,00	**0,4824**	**0,1346**	**0,01891**	**0,5785**	**0,16844**	**1,4731**	**2,6422**	**1,01e8**	
21,00	**0,4823**	**0,1347**	**0,01892**	**0,57904**	**0,16862**	**1,4745**	**2,645**	**1,06e8**	
22,00	**0,4821**	**0,1348**	**0,01893**	**0,5799**	**0,1689**	**1,4767**	**2,6494**	**1,11e8**	
23,00	**0,4819**	**0,1349**	**0,01894**	**0,58076**	**0,16918**	**1,4789**	**2,6538**	**1,17e8**	
24,00	**0,4818**	**0,1349**	**0,01894**	**0,58112**	**0,1693**	**1,4798**	**2,6556**	**1,22e8**	
24,50	**0,4819**	**0,1349**	**0,01894**	**0,58096**	**0,16925**	**1,4794**	**2,6548**	**1,24e8**	
25,00	**0,4820**	**0,1349**	**0,01893**	**0,5806**	**0,16913**	**1,4785**	**2,653**	**1,27e8**	
+ 25,50 +	**0,4820**	**0,1348**	**0,01893**	**0,58027**	**0,16902**	**1,4776**	**2,6513**	**1,29e8**	
26,00	**0,4820**	**0,1348**	**0,01893**	**0,58041**	**0,16907**	**1,478**	**2,652**	**1,32e8**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
19,00	**8,34**	**1,94**	**0,38**	**39,82**	**0,588**	**31,56**	**2,0**	**2,0**	**6019,5**
20,00	**7,53**	**1,75**	**0,35**	**41,92**	**0,630**	**34,97**	**2,0**	**2,0**	**6019,5**
21,00	**6,83**	**1,59**	**0,31**	**44,03**	**0,675**	**38,59**	**2,0**	**2,0**	**6019,0**
22,00	**6,22**	**1,45**	**0,29**	**46,14 !**	**0,722**	**42,42**	**2,0**	**2,0**	**6018,2**
23,00	**5,69**	**1,32**	**0,26**	**48,26 !**	**0,771**	**46,43**	**2,0**	**2,0**	**6017,4**
24,00	**5,23**	**1,21**	**0,24**	**50,36 !!**	**0,823**	**50,59**	**2,0**	**2,0**	**6017,1**
24,50	**5,02**	**1,16**	**0,23**	**51,41 !!**	**0,849**	**52,71**	**2,2**	**2,2**	**6017,2**
25,00	**4,82**	**1,12**	**0,22**	**52,45 !!**	**0,875**	**54,85**	**2,5**	**2,5**	**6017,5**
+ 25,50 +	**4,63**	**1,08**	**0,21**	**53,49 !!**	**0,902**	**57,03**	**2,7**	**2,7**	**6017,8**
26,00	**4,45**	**1,03**	**0,20**	**54,54 !!**	**0,930**	**59,30**	**3,1**	**3,1**	**6017,7**

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

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:		**325,000 m**		*LCG fwd TR:*	*[XCG/LP 0,000]*	***0,000 m***
Max beam on WL:	[LWL/BWL 7,348]	**44,230 m**		*VCG below WL:*		***0,000 m***
Max molded draft:	[BWL/T 3,003]	**14,730 m**		*Aft station (fwd TR):*		***0,000 m***
Displacement:	[CB 0,664]	**144194,00 t**		*Deadrise:*		***0,00 deg***
Wetted surface:	[CS 2,755]	**18622,6 m2**		*Chine beam:*		***0,000 m***
ITTC-78 (CT)				*Chine ht below WL:*		***0,000 m***
LCB fwd TR:	[XCB/LWL 0,463]	**150,430 m**		*Fwd station (fwd TR):*		***0,000 m***
LCF fwd TR:	[XCF/LWL 0,423]	**137,600 m**		*Deadrise:*		***0,00 deg***
Max section area:	[CX 0,993]	**647,0 m2**		*Chine beam:*		***0,000 m***
Waterplane area:	[CWP 0,819]	**11768,9 m2**		*Chine ht below WL:*		***0,000 m***
Bulb section area:		**50,2 m2**		*Propulsor type:*		***Propeller***
Bulb ctr below WL:		**6,640 m**		*Max prop diameter:*		***9700,0 mm***
Bulb nose fwd TR:		**333,000 m**		*Shaft angle to WL:*		***0,00 deg***
Imm transom area:	[ATR/AX 0,607]	**393,0 m2**		*Position fwd TR:*		***0,000 m***
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**		*Position below WL:*		***0,000 m***
Transom immersion:	[TTR/T 0,000]	**0,000 m**		*Transom lift device:*		***Flap***
Half entrance angle:		**18,00 deg**		*Device count:*		***0***
Bow shape factor:	[WL flow]	**1,0**		*Span:*		***0,000 m***
Stern shape factor:	[WL flow]	**1,0**		*Chord length:*		***0,000 m***
				Deflection angle:		***0,00 deg***
				Tow point fwd TR:		***0,000 m***
				Tow point below WL:		***0,000 m***

Propulsor data

Propulsor				Propeller options	
Count:		**1**		Oblique angle corr:	**Off**
Propulsor type:		**Propeller series**		Shaft angle to WL:	**0,00 deg**
Propeller type:		**FPP**		Added rise of run:	**0,00 deg**
Propeller series:		**B Series**		Propeller cup:	**0,0 mm**
Propeller sizing:		**By power**		KTKQ corrections:	**Custom**
Reference prop:				Scale correction:	**None**
Blade count:		**5**		KT multiplier:	**1,000**
Expanded area ratio:		**0,8954**	**[Size]**	KQ multiplier:	**1,000**
Propeller diameter:		**9700,0 mm**	**[Keep]**	Blade T/C [0.7R]:	**0,00**
Propeller mean pitch:	[P/D 0,7125]	**6911,5 mm**	**[Size]**	Roughness:	**0,00 mm**
Hub immersion:		**6000,0 mm**		Cav breakdown:	**Off**
Engine/gear				**Design condition**	
Engine data:		**Untitled Engine Obje...**		Max prop diam:	**9700,0 mm**
Rated RPM:		**102 RPM**		Design speed:	**25,50 kt**
Rated power:		**56704,0 kW**		Reference power:	**56704,0 kW**
Gear efficiency:		**1,000**		Design point:	**1,000**
Load correction:		**Off**		Reference RPM:	**102,0**
Gear ratio:		**1,000**	**[Keep]**	Design point:	**1,030**
Shaft efficiency:		**0,970**			

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.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

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

Analysis parameters

Hull-propulsor interaction		**System analysis**	
Technique:	**[Calc] Prediction**	Cavitation criteria:	**Keller eqn**
Prediction:	**Andersen**	Analysis type:	**Free run**
Reference ship:		CPP method:	
Max prop diam:	**9700,0 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 [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,23**	**6,25**	**0,66**	**7,35**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE			
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]
19,00	**17467,0**	**0,3743**	**0,1442**	**1,0200**	**79**	**24398,9**	**---**	**43,0**
20,00	**20376,0**	**0,3743**	**0,1442**	**1,0200**	**83**	**28462,8**	**---**	**50,2**
21,00	**23609,9**	**0,3743**	**0,1442**	**1,0200**	**87**	**32983,1**	**---**	**58,2**
22,00	**27185,9**	**0,3743**	**0,1442**	**1,0200**	**92**	**37983,8**	**---**	**67,0**
23,00	**31110,2**	**0,3743**	**0,1442**	**1,0200**	**96**	**43472,7**	**---**	**76,7**
24,00	**35368,9**	**0,3743**	**0,1442**	**1,0200**	**100**	**49426,6**	**---**	**87,2**
24,50	**37615,5**	**0,3743**	**0,1442**	**1,0200**	**102**	**52564,9**	**---**	**92,7**
25,00	**39941,5**	**0,3743**	**0,1442**	**1,0200**	**104**	**55812,2**	**---**	**98,4**
+ 25,50 +	**42361,9**	**0,3743**	**0,1442**	**1,0200**	**106**	**59191,1**	**---**	**104,4**
26,00	**44914,1**	**0,3743**	**0,1442**	**1,0200**	**108**	**62758,6**	**---**	**110,7**

	POWER DELIVERY							
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP
19,00	**79**	**2916,92**	**2916,92**	**23667,0**	**24398,9**	**24398,9**	**24398,9**	**566,5**
20,00	**83**	**3232,49**	**3232,49**	**27608,9**	**28462,8**	**28462,8**	**28462,8**	**511,2**
21,00	**87**	**3566,59**	**3566,59**	**31993,6**	**32983,1**	**32983,1**	**32983,1**	**463,2**
22,00	**92**	**3919,11**	**3919,11**	**36844,3**	**37983,8**	**37983,8**	**37983,8**	**421,3**
23,00	**96**	**4288,75**	**4288,75**	**42168,5**	**43472,7**	**43472,7**	**43472,7**	**384,9**
24,00	**100**	**4672,18**	**4672,18**	**47943,8**	**49426,6**	**49426,6**	**49426,6**	**353,2**
24,50	**102**	**4867,78**	**4867,78**	**50988,0**	**52564,9**	**52564,9**	**52564,9**	**339,1**
25,00	**104**	**5065,95**	**5065,95**	**54137,9**	**55812,2**	**55812,2**	**55812,2**	**325,8**
+ 25,50 +	**106**	**5268,10**	**5268,10**	**57415,4**	**59191,1**	**59191,1**	**59191,1**	**313,4**
26,00	**108**	**5477,84**	**5477,84**	**60875,9**	**62758,6**	**62758,6**	**62758,6**	**301,4**

	EFFICIENCY				THRUST	
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]
19,00	**0,5290**	**1,0000**	**0,7159**	**0,45398**	**2088,22**	**1787,00**
20,00	**0,5290**	**1,0000**	**0,7159**	**0,45401**	**2314,20**	**1980,39**
21,00	**0,5290**	**1,0000**	**0,7158**	**0,45418**	**2553,81**	**2185,43**
22,00	**0,5289**	**1,0000**	**0,7157**	**0,45445**	**2806,94**	**2402,05**
23,00	**0,5288**	**1,0000**	**0,7156**	**0,45473**	**3072,47**	**2629,27**
24,00	**0,5288**	**1,0000**	**0,7156**	**0,45484**	**3347,52**	**2864,65**
24,50	**0,5288**	**1,0000**	**0,7156**	**0,45479**	**3487,50**	**2984,44**
25,00	**0,5288**	**1,0000**	**0,7156**	**0,45468**	**3629,10**	**3105,61**
+ 25,50 +	**0,5289**	**1,0000**	**0,7157**	**0,45457**	**3773,53**	**3229,21**
26,00	**0,5288**	**1,0000**	**0,7157**	**0,45462**	**3923,94**	**3357,92**

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
19,00	**0,4786**	**0,1325**	**0,01908**	**0,57841**	**0,17402**	**1,4729**	**2,7297**	**8,54e7**	
20,00	**0,4786**	**0,1325**	**0,01908**	**0,5785**	**0,17405**	**1,4731**	**2,7302**	**8,99e7**	
21,00	**0,4785**	**0,1326**	**0,01909**	**0,57904**	**0,17423**	**1,4745**	**2,733**	**9,44e7**	
22,00	**0,4783**	**0,1327**	**0,01910**	**0,5799**	**0,17451**	**1,4767**	**2,7374**	**9,90e7**	
23,00	**0,4781**	**0,1328**	**0,01911**	**0,58076**	**0,17479**	**1,4789**	**2,7418**	**1,04e8**	
24,00	**0,4781**	**0,1328**	**0,01911**	**0,58112**	**0,17491**	**1,4798**	**2,7436**	**1,08e8**	
24,50	**0,4781**	**0,1328**	**0,01911**	**0,58096**	**0,17486**	**1,4794**	**2,7428**	**1,10e8**	
25,00	**0,4782**	**0,1328**	**0,01910**	**0,58061**	**0,17474**	**1,4785**	**2,741**	**1,13e8**	
+ 25,50 +	**0,4782**	**0,1327**	**0,01910**	**0,58027**	**0,17463**	**1,4776**	**2,7393**	**1,15e8**	
26,00	**0,4782**	**0,1327**	**0,01910**	**0,58041**	**0,17468**	**1,478**	**2,74**	**1,17e8**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
19,00	**8,34**	**1,91**	**0,38**	**40,14**	**0,630**	**29,84**	**2,0**	**2,0**	**5972,0**
20,00	**7,53**	**1,72**	**0,34**	**42,25**	**0,677**	**33,07**	**2,0**	**2,0**	**5972,0**
21,00	**6,83**	**1,56**	**0,31**	**44,38**	**0,726**	**36,49**	**2,0**	**2,0**	**5971,5**
22,00	**6,22**	**1,42**	**0,28**	**46,51 !**	**0,778**	**40,11**	**2,0**	**2,0**	**5970,8**
23,00	**5,69**	**1,30**	**0,26**	**48,64 !**	**0,833**	**43,91**	**2,0**	**2,0**	**5970,0**
24,00	**5,23**	**1,19**	**0,24**	**50,76 !!**	**0,889**	**47,84**	**2,0**	**2,0**	**5969,7**
24,50	**5,02**	**1,15**	**0,23**	**51,82 !!**	**0,918**	**49,84**	**2,0**	**2,0**	**5969,9**
25,00	**4,82**	**1,10**	**0,22**	**52,87 !!**	**0,947**	**51,86**	**2,0**	**2,0**	**5970,2**
+ 25,50 +	**4,63**	**1,06**	**0,21**	**53,92 !!**	**0,977**	**53,92**	**2,3**	**2,3**	**5970,4**
26,00	**4,45**	**1,02**	**0,20**	**54,98 !!**	**1,008**	**56,07**	**2,5**	**2,5**	**5970,3**

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.hcnc**

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:		**325,000 m**		*LCG fwd TR:*	*[XCG/LP 0,000]*	***0,000 m***
Max beam on WL:	[LWL/BWL 7,348]	**44,230 m**		*VCG below WL:*		***0,000 m***
Max molded draft:	[BWL/T 3,003]	**14,730 m**		*Aft station (fwd TR):*		***0,000 m***
Displacement:	[CB 0,664]	**144194,00 t**		*Deadrise:*		***0,00 deg***
Wetted surface:	[CS 2,755]	**18622,6 m2**		*Chine beam:*		***0,000 m***
ITTC-78 (CT)				*Chine ht below WL:*		***0,000 m***
LCB fwd TR:	[XCB/LWL 0,463]	**150,430 m**		*Fwd station (fwd TR):*		***0,000 m***
LCF fwd TR:	[XCF/LWL 0,423]	**137,600 m**		*Deadrise:*		***0,00 deg***
Max section area:	[CX 0,993]	**647,0 m2**		*Chine beam:*		***0,000 m***
Waterplane area:	[CWP 0,819]	**11768,9 m2**		*Chine ht below WL:*		***0,000 m***
Bulb section area:		**50,2 m2**		*Propulsor type:*		***Propeller***
Bulb ctr below WL:		**6,640 m**		*Max prop diameter:*		***9700,0 mm***
Bulb nose fwd TR:		**333,000 m**		*Shaft angle to WL:*		***0,00 deg***
Imm transom area:	[ATR/AX 0,607]	**393,0 m2**		*Position fwd TR:*		***0,000 m***
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**		*Position below WL:*		***0,000 m***
Transom immersion:	[TTR/T 0,000]	**0,000 m**		*Transom lift device:*		***Flap***
Half entrance angle:		**18,00 deg**		*Device count:*		***0***
Bow shape factor:	[WL flow]	**1,0**		*Span:*		***0,000 m***
Stern shape factor:	[WL flow]	**1,0**		*Chord length:*		***0,000 m***
				Deflection angle:		***0,00 deg***
				Tow point fwd TR:		***0,000 m***
				Tow point below WL:		***0,000 m***

Propulsor data

Propulsor				Propeller options	
Count:		**1**		Oblique angle corr:	**Off**
Propulsor type:		**Propeller series**		Shaft angle to WL:	**0,00 deg**
Propeller type:		**FPP**		Added rise of run:	**0,00 deg**
Propeller series:		**B Series**		Propeller cup:	**0,0 mm**
Propeller sizing:		**By power**		KTKQ corrections:	**Custom**
Reference prop:				Scale correction:	**None**
Blade count:		**6**		KT multiplier:	**1,000**
Expanded area ratio:		**0,9470**	**[Size]**	KQ multiplier:	**1,000**
Propeller diameter:		**9700,0 mm**	**[Keep]**	Blade T/C [0.7R]:	**0,00**
Propeller mean pitch:	[P/D 0,6962]	**6753,2 mm**	**[Size]**	Roughness:	**0,00 mm**
Hub immersion:		**6000,0 mm**		Cav breakdown:	**Off**
Engine/gear				**Design condition**	
Engine data:		**Untitled Engine Obje...**		Max prop diam:	**9700,0 mm**
Rated RPM:		**102 RPM**		Design speed:	**25,50 kt**
Rated power:		**56704,0 kW**		Reference power:	**56704,0 kW**
Gear efficiency:		**1,000**		Design point:	**1,000**
Load correction:		**Off**		Reference RPM:	**102,0**
Gear ratio:		**1,000**	**[Keep]**	Design point:	**1,030**
Shaft efficiency:		**0,970**			

Propulsion

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Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI.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

ANEXO IV: ANÁLISIS DEL PROPULSOR CON UN MENOR DIÁMETRO

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI,8900mm.hcnc**

Analysis parameters

Hull-propulsor interaction			**System analysis**		
Technique:	**[Calc]**	**Prediction**	Cavitation criteria:		**Keller eqn**
Prediction:		**Andersen**	Analysis type:		**Free run**
Reference ship:			CPP method:		
Max prop diam:		**8900,0 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 [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,23**	**6,25**	**0,66**	**7,35**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE			
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]
19,00	**17467,0**	**0,3947**	**0,1394**	**1,0200**	**74**	**23255,0**	**---**	**33,9**
20,00	**20376,0**	**0,3947**	**0,1394**	**1,0200**	**78**	**27128,9**	**---**	**39,5**
21,00	**23609,9**	**0,3947**	**0,1394**	**1,0200**	**82**	**31441,1**	**---**	**45,8**
22,00	**27185,9**	**0,3947**	**0,1394**	**1,0200**	**86**	**36214,7**	**---**	**52,8**
23,00	**31110,2**	**0,3947**	**0,1394**	**1,0200**	**90**	**41455,4**	**---**	**60,4**
24,00	**35368,9**	**0,3947**	**0,1394**	**1,0200**	**94**	**47136,6**	**---**	**68,7**
24,50	**37615,5**	**0,3947**	**0,1394**	**1,0200**	**96**	**50127,9**	**---**	**73,0**
25,00	**39941,5**	**0,3947**	**0,1394**	**1,0200**	**98**	**53220,7**	**---**	**77,5**
+ 25,50 +	**42361,9**	**0,3947**	**0,1394**	**1,0200**	**100**	**56438,7**	**---**	**82,2**
26,00	**44914,1**	**0,3947**	**0,1394**	**1,0200**	**102**	**59842,1**	**---**	**87,2**

	POWER DELIVERY							
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP
19,00	**74**	**2950,57**	**2950,57**	**22557,4**	**23255,0**	**23255,0**	**23255,0**	**594,4**
20,00	**78**	**3269,82**	**3269,82**	**26315,1**	**27128,9**	**27128,9**	**27128,9**	**536,3**
21,00	**82**	**3608,08**	**3608,08**	**30497,9**	**31441,1**	**31441,1**	**31441,1**	**485,9**
22,00	**86**	**3965,23**	**3965,23**	**35128,2**	**36214,7**	**36214,7**	**36214,7**	**441,9**
23,00	**90**	**4339,77**	**4339,77**	**40211,8**	**41455,4**	**41455,4**	**41455,4**	**403,6**
24,00	**94**	**4728,02**	**4728,02**	**45722,5**	**47136,6**	**47136,6**	**47136,6**	**370,4**
24,50	**96**	**4925,85**	**4925,85**	**48624,1**	**50127,9**	**50127,9**	**50127,9**	**355,5**
25,00	**98**	**5126,11**	**5126,11**	**51624,1**	**53220,7**	**53220,7**	**53220,7**	**341,7**
+ 25,50 +	**100**	**5330,39**	**5330,39**	**54745,5**	**56438,7**	**56438,7**	**56438,7**	**328,7**
26,00	**102**	**5542,73**	**5542,73**	**58046,9**	**59842,1**	**59842,1**	**59842,1**	**316,1**

	EFFICIENCY				THRUST	
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]
19,00	**0,5340**	**1,0000**	**0,7511**	**0,51478**	**2076,56**	**1787,00**
20,00	**0,5340**	**1,0000**	**0,7511**	**0,5148**	**2301,28**	**1980,38**
21,00	**0,5339**	**1,0000**	**0,7509**	**0,51494**	**2539,55**	**2185,42**
22,00	**0,5337**	**1,0000**	**0,7507**	**0,51516**	**2791,27**	**2402,05**
23,00	**0,5335**	**1,0000**	**0,7504**	**0,51537**	**3055,31**	**2629,27**
24,00	**0,5335**	**1,0000**	**0,7503**	**0,51546**	**3328,83**	**2864,64**
24,50	**0,5335**	**1,0000**	**0,7504**	**0,51542**	**3468,03**	**2984,44**
25,00	**0,5336**	**1,0000**	**0,7505**	**0,51533**	**3608,83**	**3105,61**
+ 25,50 +	**0,5336**	**1,0000**	**0,7506**	**0,51525**	**3752,46**	**3229,21**
26,00	**0,5336**	**1,0000**	**0,7505**	**0,51529**	**3902,03**	**3357,92**

Propulsion

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Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI,8900mm.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
19,00	**0,5357**	**0,2094**	**0,03344**	**0,72984**	**0,21752**	**1,8585**	**3,4121**	**1,13e8**	
20,00	**0,5356**	**0,2094**	**0,03344**	**0,72996**	**0,21756**	**1,8588**	**3,4127**	**1,19e8**	
21,00	**0,5355**	**0,2095**	**0,03345**	**0,73065**	**0,21781**	**1,8606**	**3,4167**	**1,25e8**	
22,00	**0,5353**	**0,2096**	**0,03346**	**0,73172**	**0,2182**	**1,8633**	**3,4228**	**1,31e8**	
23,00	**0,5350**	**0,2098**	**0,03348**	**0,73281**	**0,21859**	**1,8661**	**3,4289**	**1,37e8**	
24,00	**0,5349**	**0,2098**	**0,03348**	**0,73326**	**0,21876**	**1,8672**	**3,4315**	**1,43e8**	
24,50	**0,5350**	**0,2098**	**0,03348**	**0,73306**	**0,21869**	**1,8667**	**3,4304**	**1,46e8**	
25,00	**0,5351**	**0,2097**	**0,03347**	**0,73262**	**0,21853**	**1,8656**	**3,4278**	**1,49e8**	
+ 25,50 +	**0,5352**	**0,2097**	**0,03347**	**0,73219**	**0,21837**	**1,8645**	**3,4254**	**1,52e8**	
26,00	**0,5351**	**0,2097**	**0,03347**	**0,73238**	**0,21844**	**1,865**	**3,4265**	**1,55e8**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
19,00	**8,91**	**2,56**	**0,50**	**34,70**	**0,610**	**31,79**	**2,0**	**2,0**	**6414,0**
20,00	**8,04**	**2,31**	**0,45**	**36,53**	**0,654**	**35,23**	**2,0**	**2,0**	**6413,9**
21,00	**7,29**	**2,09**	**0,41**	**38,37**	**0,701**	**38,88**	**2,0**	**2,0**	**6413,3**
22,00	**6,64**	**1,90**	**0,37**	**40,21**	**0,751**	**42,73**	**2,0**	**2,0**	**6412,4**
23,00	**6,08**	**1,74**	**0,34**	**42,06**	**0,803**	**46,77**	**2,4**	**2,4**	**6411,5**
24,00	**5,58**	**1,60**	**0,31**	**43,89**	**0,857**	**50,96**	**2,9**	**2,9**	**6411,1**
24,50	**5,36**	**1,53**	**0,30**	**44,81**	**0,884**	**53,09**	**3,1**	**3,1**	**6411,3**
25,00	**5,15**	**1,47**	**0,29**	**45,71**	**0,912**	**55,25**	**3,5**	**3,5**	**6411,7**
+ 25,50 +	**4,95**	**1,42**	**0,28**	**46,62**	**0,940**	**57,45**	**3,8**	**3,8**	**6412,0**
26,00	**4,76**	**1,36**	**0,27**	**47,54**	**0,970**	**59,74**	**4,2**	**4,2**	**6411,9**

Propulsion

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Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI,8900mm.hcnc**

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:		**325,000 m**		*LCG fwd TR:*	*[XCG/LP 0,000]*	***0,000 m***
Max beam on WL:	[LWL/BWL 7,348]	**44,230 m**		*VCG below WL:*		***0,000 m***
Max molded draft:	[BWL/T 3,003]	**14,730 m**		*Aft station (fwd TR):*		***0,000 m***
Displacement:	[CB 0,664]	**144194,00 t**		*Deadrise:*		***0,00 deg***
Wetted surface:	[CS 2,755]	**18622,6 m2**		*Chine beam:*		***0,000 m***
ITTC-78 (CT)				*Chine ht below WL:*		***0,000 m***
LCB fwd TR:	[XCB/LWL 0,463]	**150,430 m**		*Fwd station (fwd TR):*		***0,000 m***
LCF fwd TR:	[XCF/LWL 0,423]	**137,600 m**		*Deadrise:*		***0,00 deg***
Max section area:	[CX 0,993]	**647,0 m2**		*Chine beam:*		***0,000 m***
Waterplane area:	[CWP 0,819]	**11768,9 m2**		*Chine ht below WL:*		***0,000 m***
Bulb section area:		**50,2 m2**		*Propulsor type:*		***Propeller***
Bulb ctr below WL:		**6,640 m**		*Max prop diameter:*		***8900,0 mm***
Bulb nose fwd TR:		**333,000 m**		*Shaft angle to WL:*		***0,00 deg***
Imm transom area:	[ATR/AX 0,607]	**393,0 m2**		*Position fwd TR:*		***0,000 m***
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**		*Position below WL:*		***0,000 m***
Transom immersion:	[TTR/T 0,000]	**0,000 m**		*Transom lift device:*		***Flap***
Half entrance angle:		**18,00 deg**		*Device count:*		***0***
Bow shape factor:	[WL flow]	**1,0**		*Span:*		***0,000 m***
Stern shape factor:	[WL flow]	**1,0**		*Chord length:*		***0,000 m***
				Deflection angle:		***0,00 deg***
				Tow point fwd TR:		***0,000 m***
				Tow point below WL:		***0,000 m***

Propulsor data

Propulsor				Propeller options	
Count:		**1**		Oblique angle corr:	**Off**
Propulsor type:		**Propeller series**		Shaft angle to WL:	**0,00 deg**
Propeller type:		**FPP**		Added rise of run:	**0,00 deg**
Propeller series:		**B Series**		Propeller cup:	**0,0 mm**
Propeller sizing:		**By power**		KTKQ corrections:	**Custom**
Reference prop:				Scale correction:	**None**
Blade count:		**4**		KT multiplier:	**1,000**
Expanded area ratio:		**1,0500**	**[Size]**	KQ multiplier:	**1,000**
Propeller diameter:		**8900,0 mm**	**[Keep]**	Blade T/C [0.7R]:	**0,00**
Propeller mean pitch:	[P/D 0,9153]	**8146,3 mm**	**[Size]**	Roughness:	**0,00 mm**
Hub immersion:		**6000,0 mm**		Cav breakdown:	**On**
Engine/gear				**Design condition**	
Engine data:		**Untitled Engine Obje...**		Max prop diam:	**8900,0 mm**
Rated RPM:		**102 RPM**		Design speed:	**25,50 kt**
Rated power:		**68640,0 kW**		Reference power:	**68640,0 kW**
Gear efficiency:		**1,000**		Design point:	**1,000**
Load correction:		**Off**		Reference RPM:	**102,0**
Gear ratio:		**1,000**	**[Keep]**	Design point:	**1,030**
Shaft efficiency:		**0,970**			

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Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI,8900mm.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

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Description

File name **FINALSI,8900mm.hcnc**

Analysis parameters

Hull-propulsor interaction		
Technique:	[Calc]	**Prediction**
Prediction:		**Andersen**
Reference ship:		
Max prop diam:		**8900,0 mm**
Corrections		
Viscous scale corr:	**[Off]**	
Rudder location:		
Friction line:		
Hull form factor:		
Corr allowance:		
Roughness [mm]:		
Ducted prop corr:	**[Off]**	
Tunnel stern corr:	**[Off]**	
Effective diam:		
Recess depth:		

System analysis	
Cavitation criteria:	**Keller eqn**
Analysis type:	**Free run**
CPP method:	
Engine RPM:	
Mass multiplier:	
RPM constraint:	
Limit [RPM/s]:	
Water properties	
Water type:	**Salt**
Density:	**1026,00 kg/m3**
Viscosity:	**1,18920e-6 m2/s**

Prediction method check [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,23**	**6,25**	**0,66**	**7,35**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE			
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]
19,00	**17467,0**	**0,3947**	**0,1394**	**1,0200**	**74**	**22788,1**	**---**	**33,2**
20,00	**20376,0**	**0,3947**	**0,1394**	**1,0200**	**78**	**26584,1**	**---**	**38,7**
21,00	**23609,9**	**0,3947**	**0,1394**	**1,0200**	**82**	**30809,6**	**---**	**44,9**
22,00	**27185,9**	**0,3947**	**0,1394**	**1,0200**	**86**	**35487,5**	**---**	**51,7**
23,00	**31110,2**	**0,3947**	**0,1394**	**1,0200**	**90**	**40622,9**	**---**	**59,2**
24,00	**35368,9**	**0,3947**	**0,1394**	**1,0200**	**94**	**46190,0**	**---**	**67,3**
24,50	**37615,5**	**0,3947**	**0,1394**	**1,0200**	**96**	**49121,1**	**---**	**71,6**
25,00	**39941,5**	**0,3947**	**0,1394**	**1,0200**	**98**	**52151,8**	**---**	**76,0**
+ 25,50 +	**42361,9**	**0,3947**	**0,1394**	**1,0200**	**99**	**55305,3**	**---**	**80,6**
26,00	**44914,1**	**0,3947**	**0,1394**	**1,0200**	**101**	**58640,4**	**---**	**85,4**

	POWER DELIVERY							
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP
19,00	**74**	**2907,44**	**2907,44**	**22104,4**	**22788,1**	**22788,1**	**22788,1**	**606,5**
20,00	**78**	**3222,02**	**3222,02**	**25786,6**	**26584,1**	**26584,1**	**26584,1**	**547,3**
21,00	**82**	**3555,33**	**3555,33**	**29885,4**	**30809,6**	**30809,6**	**30809,6**	**495,8**
22,00	**86**	**3907,25**	**3907,25**	**34422,8**	**35487,5**	**35487,5**	**35487,5**	**451,0**
23,00	**90**	**4276,29**	**4276,29**	**39404,2**	**40622,9**	**40622,9**	**40622,9**	**411,9**
24,00	**94**	**4658,85**	**4658,85**	**44804,3**	**46190,0**	**46190,0**	**46190,0**	**378,0**
24,50	**96**	**4853,79**	**4853,79**	**47647,5**	**49121,1**	**49121,1**	**49121,1**	**362,8**
25,00	**98**	**5051,12**	**5051,12**	**50587,3**	**52151,8**	**52151,8**	**52151,8**	**348,7**
+ 25,50 +	**99**	**5252,43**	**5252,43**	**53646,1**	**55305,3**	**55305,3**	**55305,3**	**335,4**
26,00	**101**	**5461,66**	**5461,66**	**56881,2**	**58640,4**	**58640,4**	**58640,4**	**322,5**

	EFFICIENCY				THRUST	
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]
19,00	**0,5450**	**1,0000**	**0,7665**	**0,52533**	**2076,57**	**1787,00**
20,00	**0,5449**	**1,0000**	**0,7665**	**0,52535**	**2301,28**	**1980,38**
21,00	**0,5448**	**1,0000**	**0,7663**	**0,52549**	**2539,55**	**2185,42**
22,00	**0,5447**	**1,0000**	**0,7661**	**0,52571**	**2791,28**	**2402,05**
23,00	**0,5445**	**1,0000**	**0,7658**	**0,52593**	**3055,31**	**2629,27**
24,00	**0,5444**	**1,0000**	**0,7657**	**0,52603**	**3328,83**	**2864,64**
24,50	**0,5444**	**1,0000**	**0,7658**	**0,52599**	**3468,03**	**2984,43**
25,00	**0,5445**	**1,0000**	**0,7659**	**0,5259**	**3608,83**	**3105,60**
+ 25,50 +	**0,5446**	**1,0000**	**0,7660**	**0,52581**	**3752,47**	**3229,21**
26,00	**0,5445**	**1,0000**	**0,7659**	**0,52585**	**3902,03**	**3357,92**

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Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
19,00	**0,5387**	**0,2118**	**0,03331**	**0,72984**	**0,21315**	**1,8585**	**3,3436**	**9,01e7**	
20,00	**0,5386**	**0,2118**	**0,03332**	**0,72996**	**0,21319**	**1,8588**	**3,3442**	**9,49e7**	
21,00	**0,5385**	**0,2119**	**0,03333**	**0,73065**	**0,21344**	**1,8606**	**3,348**	**9,96e7**	
22,00	**0,5382**	**0,2120**	**0,03334**	**0,73173**	**0,21382**	**1,8633**	**3,354**	**1,04e8**	
23,00	**0,5380**	**0,2121**	**0,03336**	**0,73281**	**0,2142**	**1,8661**	**3,3601**	**1,09e8**	
24,00	**0,5379**	**0,2122**	**0,03336**	**0,73326**	**0,21437**	**1,8672**	**3,3626**	**1,14e8**	
24,50	**0,5379**	**0,2121**	**0,03336**	**0,73306**	**0,21429**	**1,8667**	**3,3615**	**1,16e8**	
25,00	**0,5380**	**0,2121**	**0,03335**	**0,73262**	**0,21414**	**1,8656**	**3,359**	**1,19e8**	
+ 25,50 +	**0,5381**	**0,2120**	**0,03335**	**0,7322**	**0,21399**	**1,8645**	**3,3567**	**1,21e8**	
26,00	**0,5381**	**0,2121**	**0,03335**	**0,73238**	**0,21405**	**1,865**	**3,3577**	**1,23e8**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
19,00	**8,91**	**2,58**	**0,50**	**34,51**	**0,659**	**31,79**	**2,0**	**2,0**	**6449,8**
20,00	**8,04**	**2,33**	**0,46**	**36,33**	**0,708**	**35,23**	**2,0**	**2,0**	**6449,7**
21,00	**7,29**	**2,11**	**0,41**	**38,15**	**0,761**	**38,88**	**2,0**	**2,0**	**6449,1**
22,00	**6,64**	**1,92**	**0,38**	**39,99**	**0,817**	**42,73**	**2,0**	**2,0**	**6448,1**
23,00	**6,08**	**1,76**	**0,34**	**41,82**	**0,875**	**46,77**	**2,3**	**2,3**	**6447,2**
24,00	**5,58**	**1,62**	**0,32**	**43,65**	**0,935**	**50,96**	**2,7**	**2,7**	**6446,8**
24,50	**5,36**	**1,55**	**0,30**	**44,56**	**0,966**	**53,09**	**3,0**	**3,0**	**6447,0**
25,00	**5,15**	**1,49**	**0,29**	**45,46**	**0,997**	**55,25**	**3,3**	**3,3**	**6447,4**
+ 25,50 +	**4,95**	**1,43**	**0,28**	**46,36 !**	**1,029**	**57,45**	**3,6**	**3,6**	**6447,7**
26,00	**4,76**	**1,38**	**0,27**	**47,27 !**	**1,062**	**59,74**	**4,0**	**4,0**	**6447,6**

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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:		**325,000 m**		*LCG fwd TR:*	*[XCG/LP 0,000]*	***0,000 m***
Max beam on WL:	[LWL/BWL 7,348]	**44,230 m**		*VCG below WL:*		***0,000 m***
Max molded draft:	[BWL/T 3,003]	**14,730 m**		*Aft station (fwd TR):*		***0,000 m***
Displacement:	[CB 0,664]	**144194,00 t**		*Deadrise:*		***0,00 deg***
Wetted surface:	[CS 2,755]	**18622,6 m2**		*Chine beam:*		***0,000 m***
ITTC-78 (CT)				*Chine ht below WL:*		***0,000 m***
LCB fwd TR:	[XCB/LWL 0,463]	**150,430 m**		*Fwd station (fwd TR):*		***0,000 m***
LCF fwd TR:	[XCF/LWL 0,423]	**137,600 m**		*Deadrise:*		***0,00 deg***
Max section area:	[CX 0,993]	**647,0 m2**		*Chine beam:*		***0,000 m***
Waterplane area:	[CWP 0,819]	**11768,9 m2**		*Chine ht below WL:*		***0,000 m***
Bulb section area:		**50,2 m2**		*Propulsor type:*		***Propeller***
Bulb ctr below WL:		**6,640 m**		*Max prop diameter:*		***8900,0 mm***
Bulb nose fwd TR:		**333,000 m**		*Shaft angle to WL:*		***0,00 deg***
Imm transom area:	[ATR/AX 0,607]	**393,0 m2**		*Position fwd TR:*		***0,000 m***
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**		*Position below WL:*		***0,000 m***
Transom immersion:	[TTR/T 0,000]	**0,000 m**		*Transom lift device:*		***Flap***
Half entrance angle:		**18,00 deg**		*Device count:*		***0***
Bow shape factor:	[WL flow]	**1,0**		*Span:*		***0,000 m***
Stern shape factor:	[WL flow]	**1,0**		*Chord length:*		***0,000 m***
				Deflection angle:		***0,00 deg***
				Tow point fwd TR:		***0,000 m***
				Tow point below WL:		***0,000 m***

Propulsor data

Propulsor				Propeller options	
Count:		**1**		Oblique angle corr:	**Off**
Propulsor type:		**Propeller series**		Shaft angle to WL:	**0,00 deg**
Propeller type:		**FPP**		Added rise of run:	**0,00 deg**
Propeller series:		**B Series**		Propeller cup:	**0,0 mm**
Propeller sizing:		**By power**		KTKQ corrections:	**Custom**
Reference prop:				Scale correction:	**None**
Blade count:		**5**		KT multiplier:	**1,000**
Expanded area ratio:		**1,0500**	**[Size]**	KQ multiplier:	**1,000**
Propeller diameter:		**8900,0 mm**	**[Keep]**	Blade T/C [0.7R]:	**0,00**
Propeller mean pitch:	[P/D 0,9014]	**8022,8 mm**	**[Size]**	Roughness:	**0,00 mm**
Hub immersion:		**6000,0 mm**		Cav breakdown:	**On**
Engine/gear				**Design condition**	
Engine data:		**Untitled Engine Obje...**		Max prop diam:	**8900,0 mm**
Rated RPM:		**102 RPM**		Design speed:	**25,50 kt**
Rated power:		**68640,0 kW**		Reference power:	**68640,0 kW**
Gear efficiency:		**1,000**		Design point:	**1,000**
Load correction:		**Off**		Reference RPM:	**102,0**
Gear ratio:		**1,000**	**[Keep]**	Design point:	**1,030**
Shaft efficiency:		**0,970**			

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PSPROP =	Shaft power per propulsor
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PBTOTAL =	Total vessel brake power
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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
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+ =	Design speed indicator
* =	Exceeds recommended parameter limit
! =	Exceeds recommended cavitation criteria [warning]
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Description

File name **FINALSI,8900mm.hcnc**

Analysis parameters

Hull-propulsor interaction			**System analysis**		
Technique:	**[Calc]**	**Prediction**	Cavitation criteria:		**Keller eqn**
Prediction:		**Andersen**	Analysis type:		**Free run**
Reference ship:			CPP method:		
Max prop diam:		**8900,0 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 [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,23**	**6,25**	**0,66**	**7,35**
Range	**0,05··0,33**	**4,00··6,00**	**0,55··0,85**	**5,00··8,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE			
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBPROP [kW]	FUEL [L/h]	LOADENG [%]
19,00	**17467,0**	**0,3947**	**0,1394**	**1,0200**	**74**	**22844,2**	**---**	**33,3**
20,00	**20376,0**	**0,3947**	**0,1394**	**1,0200**	**78**	**26649,5**	**---**	**38,8**
21,00	**23609,9**	**0,3947**	**0,1394**	**1,0200**	**82**	**30885,0**	**---**	**45,0**
22,00	**27185,9**	**0,3947**	**0,1394**	**1,0200**	**86**	**35573,7**	**---**	**51,8**
23,00	**31110,2**	**0,3947**	**0,1394**	**1,0200**	**90**	**40720,8**	**---**	**59,3**
24,00	**35368,9**	**0,3947**	**0,1394**	**1,0200**	**94**	**46300,8**	**---**	**67,5**
24,50	**37615,5**	**0,3947**	**0,1394**	**1,0200**	**96**	**49239,2**	**---**	**71,7**
25,00	**39941,5**	**0,3947**	**0,1394**	**1,0200**	**98**	**52277,6**	**---**	**76,2**
+ 25,50 +	**42361,9**	**0,3947**	**0,1394**	**1,0200**	**99**	**55439,1**	**---**	**80,8**
26,00	**44914,1**	**0,3947**	**0,1394**	**1,0200**	**101**	**58782,2**	**---**	**85,6**

	POWER DELIVERY							
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP
19,00	**74**	**2914,12**	**2914,12**	**22158,9**	**22844,2**	**22844,2**	**22844,2**	**605,0**
20,00	**78**	**3229,41**	**3229,41**	**25850,1**	**26649,5**	**26649,5**	**26649,5**	**545,9**
21,00	**82**	**3563,44**	**3563,44**	**29958,5**	**30885,0**	**30885,0**	**30885,0**	**494,6**
22,00	**86**	**3916,09**	**3916,09**	**34506,4**	**35573,7**	**35573,7**	**35573,7**	**449,9**
23,00	**90**	**4285,89**	**4285,89**	**39499,2**	**40720,8**	**40720,8**	**40720,8**	**410,9**
24,00	**94**	**4669,28**	**4669,28**	**44911,8**	**46300,8**	**46300,8**	**46300,8**	**377,1**
24,50	**96**	**4864,66**	**4864,66**	**47762,0**	**49239,2**	**49239,2**	**49239,2**	**362,0**
25,00	**98**	**5062,48**	**5062,48**	**50709,3**	**52277,6**	**52277,6**	**52277,6**	**347,9**
+ 25,50 +	**99**	**5264,28**	**5264,28**	**53775,9**	**55439,1**	**55439,1**	**55439,1**	**334,6**
26,00	**101**	**5473,97**	**5473,97**	**57018,7**	**58782,2**	**58782,2**	**58782,2**	**321,8**

	EFFICIENCY				THRUST	
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]
19,00	**0,5436**	**1,0000**	**0,7646**	**0,52404**	**2076,57**	**1787,01**
20,00	**0,5436**	**1,0000**	**0,7646**	**0,52406**	**2301,28**	**1980,38**
21,00	**0,5435**	**1,0000**	**0,7644**	**0,52421**	**2539,54**	**2185,42**
22,00	**0,5433**	**1,0000**	**0,7642**	**0,52444**	**2791,28**	**2402,05**
23,00	**0,5432**	**1,0000**	**0,7640**	**0,52467**	**3055,32**	**2629,27**
24,00	**0,5431**	**1,0000**	**0,7639**	**0,52477**	**3328,82**	**2864,64**
24,50	**0,5431**	**1,0000**	**0,7639**	**0,52473**	**3468,03**	**2984,43**
25,00	**0,5432**	**1,0000**	**0,7640**	**0,52463**	**3608,83**	**3105,60**
+ 25,50 +	**0,5433**	**1,0000**	**0,7641**	**0,52454**	**3752,47**	**3229,21**
26,00	**0,5432**	**1,0000**	**0,7641**	**0,52458**	**3902,04**	**3357,93**

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI,8900mm.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
19,00	**0,5386**	**0,2117**	**0,03338**	**0,72984**	**0,21368**	**1,8585**	**3,3518**	**7,51e7**	
20,00	**0,5385**	**0,2117**	**0,03338**	**0,72996**	**0,21372**	**1,8588**	**3,3524**	**7,91e7**	
21,00	**0,5384**	**0,2118**	**0,03339**	**0,73065**	**0,21396**	**1,8606**	**3,3562**	**8,31e7**	
22,00	**0,5382**	**0,2119**	**0,03341**	**0,73173**	**0,21434**	**1,8633**	**3,3622**	**8,70e7**	
23,00	**0,5379**	**0,2120**	**0,03342**	**0,73281**	**0,21472**	**1,8661**	**3,3682**	**9,10e7**	
24,00	**0,5378**	**0,2121**	**0,03343**	**0,73326**	**0,21488**	**1,8672**	**3,3707**	**9,50e7**	
24,50	**0,5379**	**0,2121**	**0,03342**	**0,73306**	**0,21481**	**1,8667**	**3,3696**	**9,70e7**	
25,00	**0,5380**	**0,2120**	**0,03342**	**0,73262**	**0,21465**	**1,8656**	**3,3671**	**9,89e7**	
+ 25,50 +	**0,5380**	**0,2120**	**0,03341**	**0,7322**	**0,2145**	**1,8645**	**3,3648**	**1,01e8**	
26,00	**0,5380**	**0,2120**	**0,03341**	**0,73238**	**0,21457**	**1,865**	**3,3658**	**1,03e8**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
19,00	**8,91**	**2,58**	**0,50**	**34,51**	**0,708**	**31,79**	**2,0**	**2,0**	**6448,7**
20,00	**8,04**	**2,33**	**0,45**	**36,33**	**0,763**	**35,23**	**2,0**	**2,0**	**6448,6**
21,00	**7,29**	**2,11**	**0,41**	**38,16**	**0,821**	**38,88**	**2,0**	**2,0**	**6448,0**
22,00	**6,64**	**1,92**	**0,38**	**40,00**	**0,883**	**42,73**	**2,0**	**2,0**	**6447,1**
23,00	**6,08**	**1,76**	**0,34**	**41,83**	**0,947**	**46,77**	**2,2**	**2,2**	**6446,2**
24,00	**5,58**	**1,61**	**0,32**	**43,66**	**1,014**	**50,96**	**2,6**	**2,6**	**6445,8**
24,50	**5,36**	**1,55**	**0,30**	**44,56**	**1,048**	**53,09**	**2,8**	**2,8**	**6445,9**
25,00	**5,15**	**1,49**	**0,29**	**45,47**	**1,083**	**55,25**	**3,1**	**3,1**	**6446,3**
+ 25,50 +	**4,95**	**1,43**	**0,28**	**46,37 !**	**1,118**	**57,45**	**3,4**	**3,4**	**6446,7**
26,00	**4,76**	**1,38**	**0,27**	**47,28 !**	**1,154**	**59,74**	**3,8**	**3,8**	**6446,5**

Propulsion

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HydroComp NavCad 2014

Project ID **PORTACONTENEDORES 9000**

Description

File name **FINALSI,8900mm.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**325,000 m**
Max beam on WL:	[LWL/BWL 7,348]	**44,230 m**
Max molded draft:	[BWL/T 3,003]	**14,730 m**
Displacement:	[CB 0,664]	**144194,00 t**
Wetted surface:	[CS 2,755]	**18622,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,463]	**150,430 m**
LCF fwd TR:	[XCF/LWL 0,423]	**137,600 m**
Max section area:	[CX 0,993]	**647,0 m2**
Waterplane area:	[CWP 0,819]	**11768,9 m2**
Bulb section area:		**50,2 m2**
Bulb ctr below WL:		**6,640 m**
Bulb nose fwd TR:		**333,000 m**
Imm transom area:	[ATR/AX 0,607]	**393,0 m2**
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**
Transom immersion:	[TTR/T 0,000]	**0,000 m**
Half entrance angle:		**18,00 deg**
Bow shape factor:	[WL flow]	**1,0**
Stern shape factor:	[WL flow]	**1,0**

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:		***8900,0 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 power**	
Reference prop:			
Blade count:		**6**	
Expanded area ratio:		**1,0500**	**[Size]**
Propeller diameter:		**8900,0 mm**	**[Keep]**
Propeller mean pitch:	[P/D 0,8833]	**7861,1 mm**	**[Size]**
Hub immersion:		**6000,0 mm**	

Engine/gear			
Engine data:		**Untitled Engine Obje...**	
Rated RPM:		**102 RPM**	
Rated power:		**68640,0 kW**	
Gear efficiency:		**1,000**	
Load correction:		**Off**	
Gear ratio:		**1,000**	**[Keep]**
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:	**On**

Design condition	
Max prop diam:	**8900,0 mm**
Design speed:	**25,50 kt**
Reference power:	**68640,0 kW**
Design point:	**1,000**
Reference RPM:	**102,0**
Design point:	**1,030**

Propulsion

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Project ID **PORTACONTENEDORES 9000**
Description
File name **FINALSI,8900mm.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

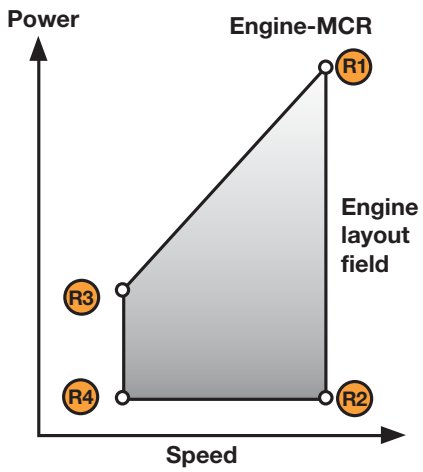
ANEXO V: CARACTERÍSTICAS MOTOR PRINCIPAL

MAIN TECHNICAL DATA

DEFINITIONS:

- Dimensions and weights: All dimensions are in millimetres and are not binding. The engine weight is net in metric tonnes (t), without oil and water, and is not binding.
- R1, R2, R3, R4 = power/speed ratings at the four corners of the engine layout field (see diagram).
- R1 = engine Maximum Continuous Rating (MCR).
- Contract-MCR (CMCR) = selected rating point for particular installation. Any CMCR point can be selected within the engine layout field.
- BSFC = brake specific fuel consumptions (BSFC). All figures are quoted for fuel of lower calorific value 42.7 MJ/kg, and for ISO standard reference conditions (ISO 15550 and 3046). The BSFC figures are given with a tolerance of +5%.
- Wärtsilä RT-flex96C engines have a lower part-load fuel consumption than the corresponding Wärtsilä RTA96C engines.
- The values of power in kilowatts and fuel consumption in g/kWh are the standard figures, and discrepancies occur between these and the corresponding brake horsepower (bhp) values owing to the rounding of numbers. For definitive values, please contact Wärtsilä local offices.
- ISO standard reference conditions

  Total barometric pressure at R1 ..... 1.0 bar
  Suction air temperature ..... 25 °C
  Relative humidity 30%
  Scavenge air cooling water temperature:
  - with sea water ..... 25 °C
  - with fresh water ..... 29 °C



WÄRTSILÄ **RT-flex**

WÄRTSILÄ **RTA**

MAIN DATA RT-flex96C AND RTA96C

Cylinder bore	960 mm
Piston stroke	2500 mm
Speed	92 - 102 rpm
Mean effective pressure at R1	18.6 bar
Piston speed	8.5 m/s
Fuel specification:	
Fuel oil	730 cSt/50°C 7200 sR1/100°F ISO 8217, category ISO-F-RMK 55

RATED POWER: PROPULSION ENGINES

Cyl.	Output in kW/bhp at							
	102 rpm				92 rpm			
	R1		R2		R3		R4	
	kW	bhp	kW	bhp	kW	bhp	kW	bhp
6	34 320	46 680	24 000	32 640	30 960	42 120	24 000	32 640
7	40 040	54 460	28 000	38 080	36 120	49 140	28 000	38 080
8	45 760	62 240	32 000	43 520	41 280	56 160	32 000	43 520
9	51 480	70 020	36 000	48 960	46 440	63 180	36 000	48 960
10	57 200	77 800	40 000	54 400	51 600	70 200	40 000	54 400
11	62 920	85 580	44 000	59 840	56 760	77 220	44 000	59 840
12	68 640	93 360	48 000	65 280	61 920	84 240	48 000	65 280
13	74 360	101 140	52 000	70 720	67 080	91 260	52 000	70 720
14	80 080	108 920	56 000	76 160	72 240	98 280	56 000	76 160

BRAKE SPECIFIC FUEL CONSUMPTION (BSFC)

	g/kWh	g/bhph	g/kWh	g/bhph	g/kWh	g/bhph	g/kWh	g/bhph
Load 100%	171	126	163	120	171	126	164	121
BMEP, bar	18.6		13.0		18.6		14.4	

PRINCIPAL ENGINE DIMENSIONS (MM) AND WEIGHTS (TONNES)

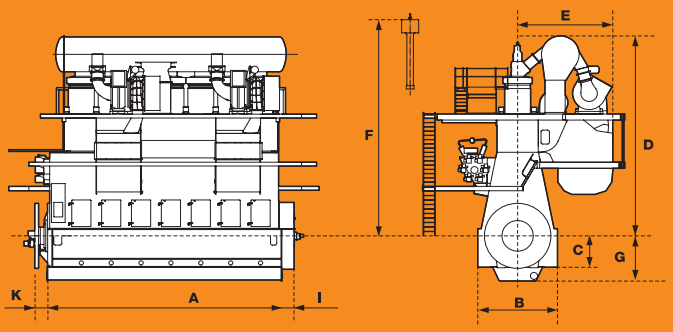
Cyl.	A	B	C	D	E	F*	G	I	K	Weight
6	11 564	4 480	1 800	10 925	5 232	12 950	2 594	723	676	1 160
7	13 244	4 480	1 800	10 925	5 232	12 950	2 594	723	676	1 290
8	15 834	4 480	1 800	10 925	5 232	12 950	2 594	723	676	1 470
9	17 514	4 480	1 800	10 925	5 232	12 950	2 594	723	676	1 620
10	19 194	4 480	1 800	10 925	5 232	12 950	2 594	723	676	1 760
11	20 874	4 480	1 800	10 925	5 232	12 950	2 594	723	676	1 910
12	22 554	4 480	1 800	10 925	5 232	12 950	2 594	723	676	2 050
13	24 234	4 480	1 800	10 925	5 232	12 950	2 594	723	676	2 160
14	25 914	4 480	1 800	10 925	5 232	12 950	2 594	723	676	2 300

* Standard piston dismantling height, can be reduced with tilted piston withdrawal.

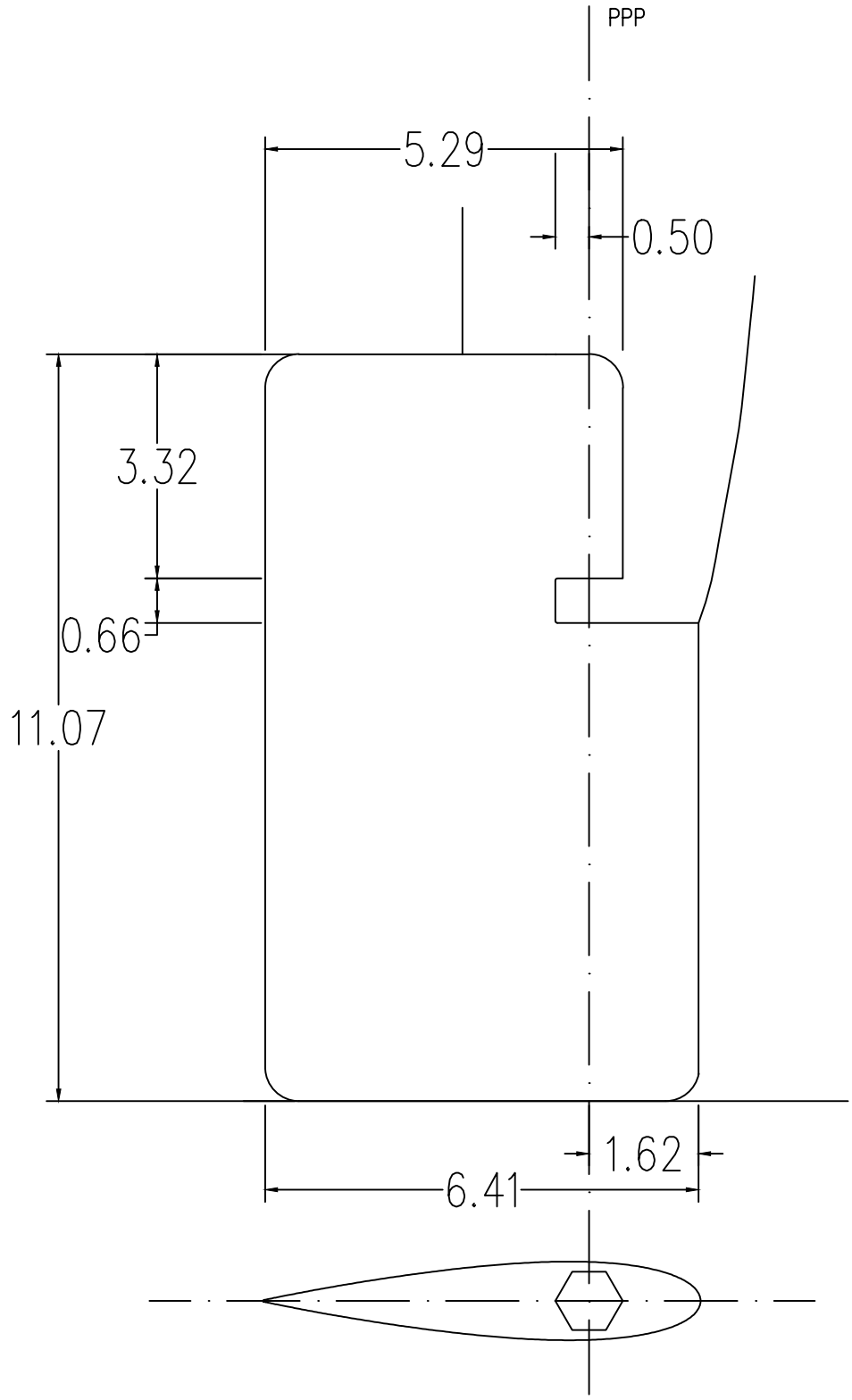
13- and 14-cylinder engines are only available in RT-flex versions, and not RTA versions.

All the above data apply to both RTA96C and RT-flex96C versions. However, there may be differences in weights for the RT-flex96C.

Wärtsilä RT-flex engines are also available with part-load optimisation for lower fuel consumptions.



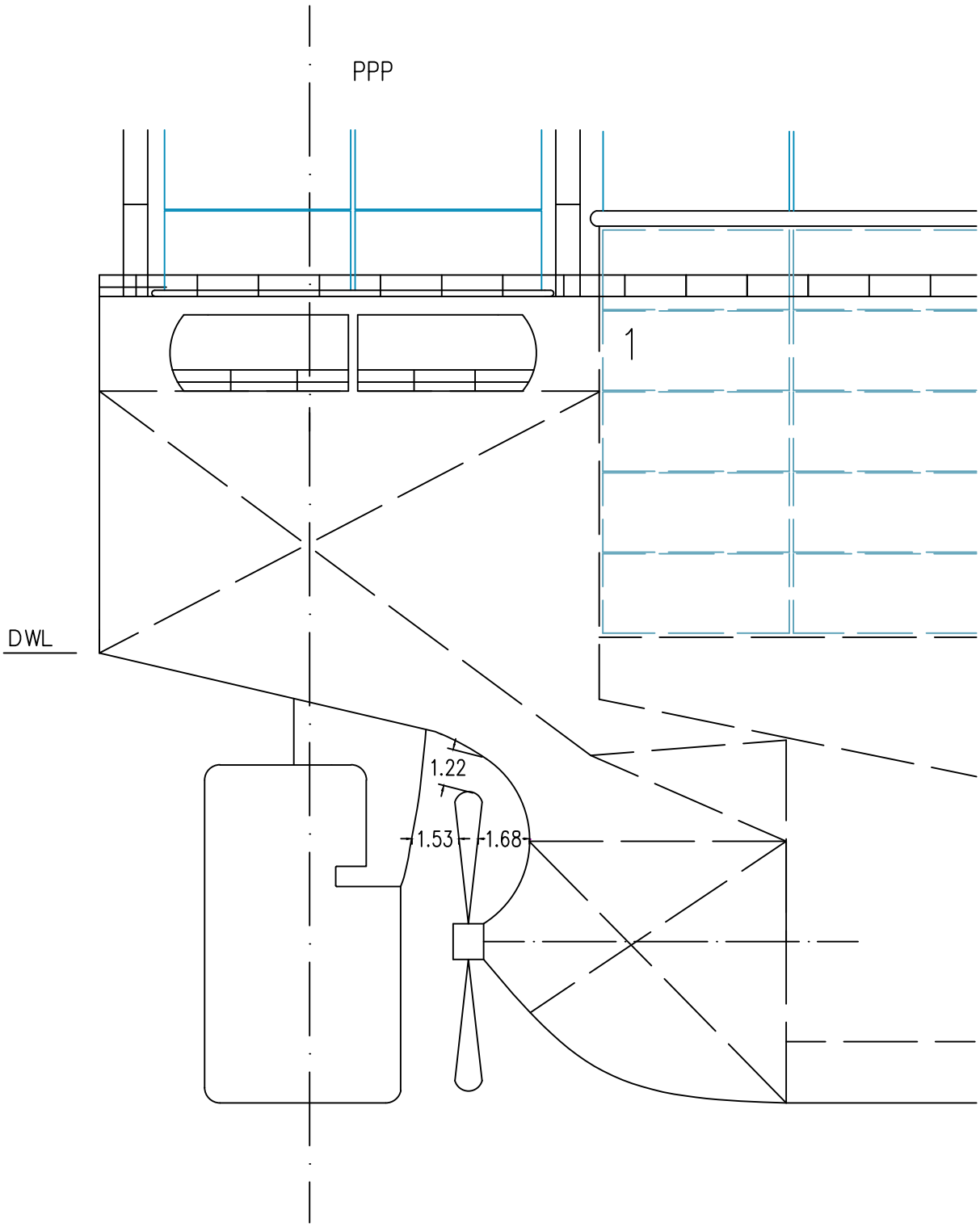
ANEXO VI: TIMÓN



Estado	Fecha	Nombre	Firmas	Proyecto:	A4
Dibujado	29/07/16	Nadia Conde		Portacontenedores 9000 TEU's	
Comprobado					

Escala:	Num proyecto: 15 – 13	Escuela Politécnica Superior de Ferrol	
1:100	Alumna: Nadia Conde Alonso		
	Título: TIMÓN	Num plano: 12 Rev:	Hoja: 1/1
	Sustituido por:	Sustituye a:	

ANEXO VII: SITUACIÓN PROPULSOR, CODASTE Y TIMÓN



Estado	Fecha	Nombre	Firmas	Proyecto:	
Dibujado	29/07/16	Nadia Conde		Portacontenedores 9000 TEU's	A4
Comprobado					

Escala: 1:200	Num proyecto: 15 – 13 Alumna: Nadia Conde Alonso	Escuela Politécnica Superior de Ferrol
	Título: PROPULSOR, TIMÓN, CODASTE	Num plano: 13 Rev: Hoja: 1/1
	Sustituido por:	Sustituye a: