UNIVERSIDADE DA CORUÑA

Escola Politécnica Superior

TRABAJO FIN DE GRADO

CURSO 2017/18

Buque PSV. Buque de suministro a plataformas de 5000 TPM

Grado en Ingeniería Naval Oceánica

CUADERNO 6

Predicción de potencia y selección de la planta propulsora

Sandra Allegue García

PROYECTO 18-02

Escola Politécnica Superior

UNIVERSIDADE DA CORUÑA

GRADO EN INGENIERÍA NAVAL Y OCEÁNICA
PROYECTO DE BUQUES Y ARTEFACTOS MARINOS 1

CURSO 2.017-2018

PROYECTO NÚMERO 18-02

TIPO DE BUQUE: Buque PSV (Platform Vessel Supply). Buque de suministro a plataformas.

CLASIFICACIÓN, COTA Y REGLAMENTOS DE APLICACIÓN: DNV GL, SOLAS, MARPOL.

CARACTERÍSTICAS DE LA CARGA: Carga líquida y seca a granel para suministro a plataformas, 5000 TPM.

VELOCIDAD Y AUTONOMÍA: 13 nudos en condiciones de servicio al 85% de MCR y 15% de margen de mar. 6000 millas a la velocidad de servicio

SISTEMAS Y EQUIPOS DE CARGA / DESCARGA: Bombas para la carga y descarga de la carga líquida. Dos grúas.

PROPULSIÓN: Propulsión diésel-eléctrica. LNG para estancias en puerto

TRIPULACIÓN Y PASAJE: 35 personas.

OTROS EQUIPOS E INSTALACIONES: Sistema de posicionamiento dinámico con redundancia DP 3. FIFI

Ferrol, 2 Noviembre 2017

ALUMNO/A: **Dª Sandra Allegue García**

ÍNDICE

1 INTRODUCCIÓN

En este Cuaderno se dimensionará la planta propulsora para que el buque alcance una velocidad de 13 nudos al 85% de régimen de servicio.

Todos los cálculos se efectuarán mediante el software NavCad, se comprobarán estos resultados con los obtenidos en el Cuaderno 2, efectuando un cambio en el propulsor de ser necesario.

Además, se calculará el timón que debería llevar el buque, no siendo necesario este cálculo debido a que las hélices son Azipull y no necesitan timón.

Las dimensiones principales del buque proyecto son:

Lpp = 78,58 m
Loa = 85,78 m
B = 19,13 m
T = 6,58 m
D = 8,26 m
BHP = 1985 kW
Δ = 7.742 t
Fn = 0,241
Cb = 0,764
Cm = 0,989
Cp = 0,772
Cf = 0,850
Acubierta = 0,7·Lpp·0,9·B = 947 m^2

2 CÁLCULO DE LA RESISTENCIA AL AVANCE

Primero, se hará el cálculo de la resistencia al avance en el programa NavCad.

Para ello, se usarán los datos de las tablas hidrostáticas, obtenidas mediante el programa Maxsurf para el calado de diseño del buque proyecto (6,58 m):

Displacement t	7711
Heel deg	0,0
Draft at FP m	6,580
Draft at AP m	6,580
Draft at LCF m	6,580
Trim (+ve by stern) m	0,000
WL Length m	86,386
Beam max extents on WL m	19,130
Wetted Area m^2	2314,578
Waterpl. Area m^2	1377,291
Prismatic coeff. (Cp)	0,772
Block coeff. (Cb)	0,756
Max Sect. area coeff. (Cm)	0,985
Waterpl. area coeff. (Cwp)	0,916
LCB from zero pt. (+ve fwd) m	36,697
LCF from zero pt. (+ve fwd) m	32,797
KB m	3,591
KG m	6,578
BMt m	4,965
BML m	85,753
GMt m	1,978
GML m	82,765
KMt m	8,556
KML m	89,343
Immersion (TPc) tonne/cm	14,117
MTc tonne.m	81,215
RM at 1deg = GMt.Disp.sin (1) tonne.m	266,184
Max deck inclination deg	0,0000
Trim angle (+ve by stern) deg	0,0000

A continuación, con estos valores, se irá al programa NavCad, en la pestaña 'Condition' y 'Hull':

Project		
Project ID:		
Description:		
Summary		
Scope:	Undefined	
Configuration:	Monohull	
Chine type:	Round/multiple	
Length on WL:	86,386	m
Displacement:	7711,00	t
Propulsor type:	Propeller	
Count:	2	
Water properties		
Water type:	Salt	
Density:	1026,00	kg/m3
Viscosity:	1,18920e-6	m2/s
Speeds		
Speed [01]	7,00	kt
Speed [02]	8,00	kt
Speed [03]	9,00	kt
Speed [04]	10,00	kt
Speed [05]	11,00	kt
Speed [06]	12,00	kt
Speed [07]	13,00	kt
Speed [08]	14,00	kt
Speed [09]	15,00	kt
Speed [10]		kt
Design condition		
Design speed:	13,00	kt

Hull		
Configuration:	Monohull	
Chine type:	Round/multiple	
General		
Length on WL:	86,386	m
Max beam on WL:	19,130	m
Max molded draft:	6,580	m
Displacement:	7711,00	t
Wetted surface:	2314,6	m2
Demi-hull spacing:		m
ITTC-78 (CT)		
LCB fwd TR:	40,647	m
LCF fwd TR:	36,747	m
Max section area:	124,0	m2
Waterplane area:	1377,3	m2
Bulb section area:	13,7	m2
Bulb ctr below WL:	3,000	m
Bulb nose fwd TR:	87,310	m
Imm transom area:	30,0	m2
Transom beam WL:	19,130	m
Transom immersion:	16,000	m
Half entrance angle:	37,00	deg
Bow shape factor:	1,0	[WL flow]
Stern shape factor:	1,0	[WL flow]

En la pestaña 'Appendages', en el apartado 'Shafting' solamente se añadirá el número de propulsores y el diámetro máximo de ellos ya que al tener Azipull no habrá eje expuesto:

Appendage		
Definition:	Component	
Percent of hull drag:		%
Planing influence		
LCE fwd TR:	0,000	m
VCE below WL:	0,000	m
Shafting		
Count:	2	
Max prop diameter:	2500,0	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

Se completará también el apartado 'Skeg/Keel' con los datos del Skeg que posee el buque proyecto:

Skeg/Keel		
Count:	1	
Type:	Skeg	
Mean length:	21,000	m
Mean width:	2,200	m
Height aft:	4,580	m
Height mid:	1,350	m
Height fwd:	0,000	m
Root chord:		m
Tip chord:		m
Span:		m
T/C ratio:		
LE sweep:		deg
Keel bulb length:		m
Keel bulb diameter:		m
Skeg projected area:	34,9	m2
Skeg wetted surface:	116,0	m2

Y por último en esta pestaña se rellenará el apartado 'Tunnel Thruster' con el número y el diámetro de estos:

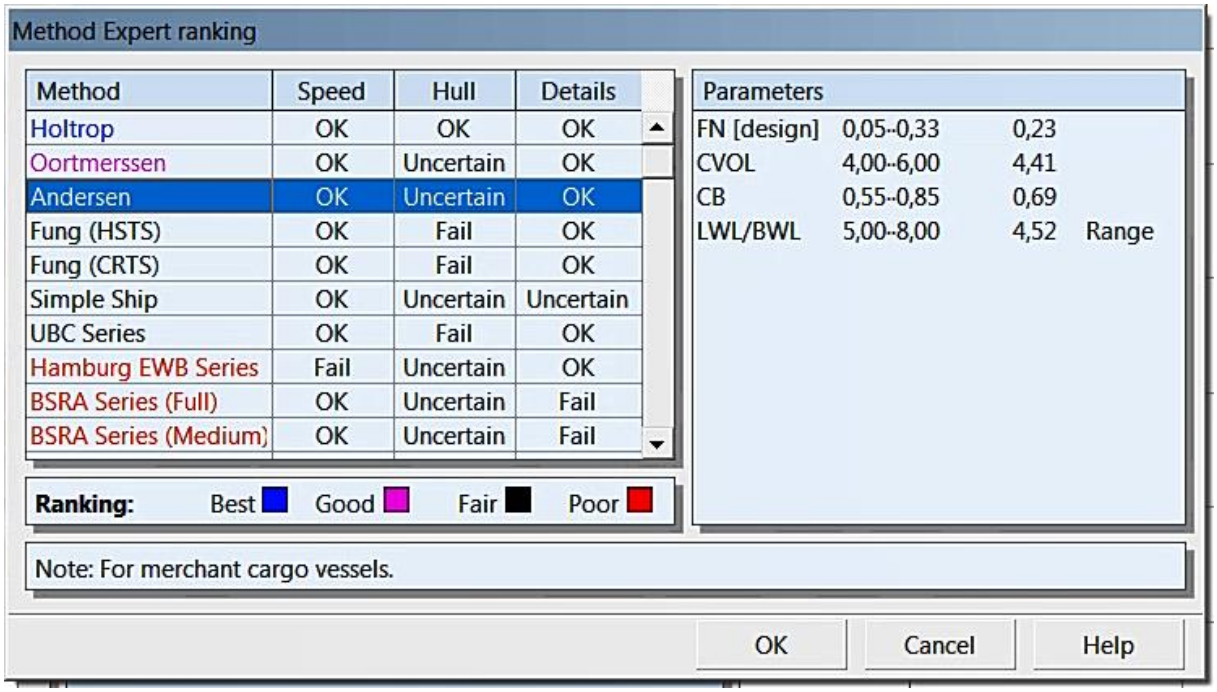
Tunnel thruster		
Count:	2	
Diameter:	1,850	m

En la pestaña 'Margin' se pondrá un margen del 15%:

Margin		
Design margin:	15	%
Basis:	Hull + added dr...	

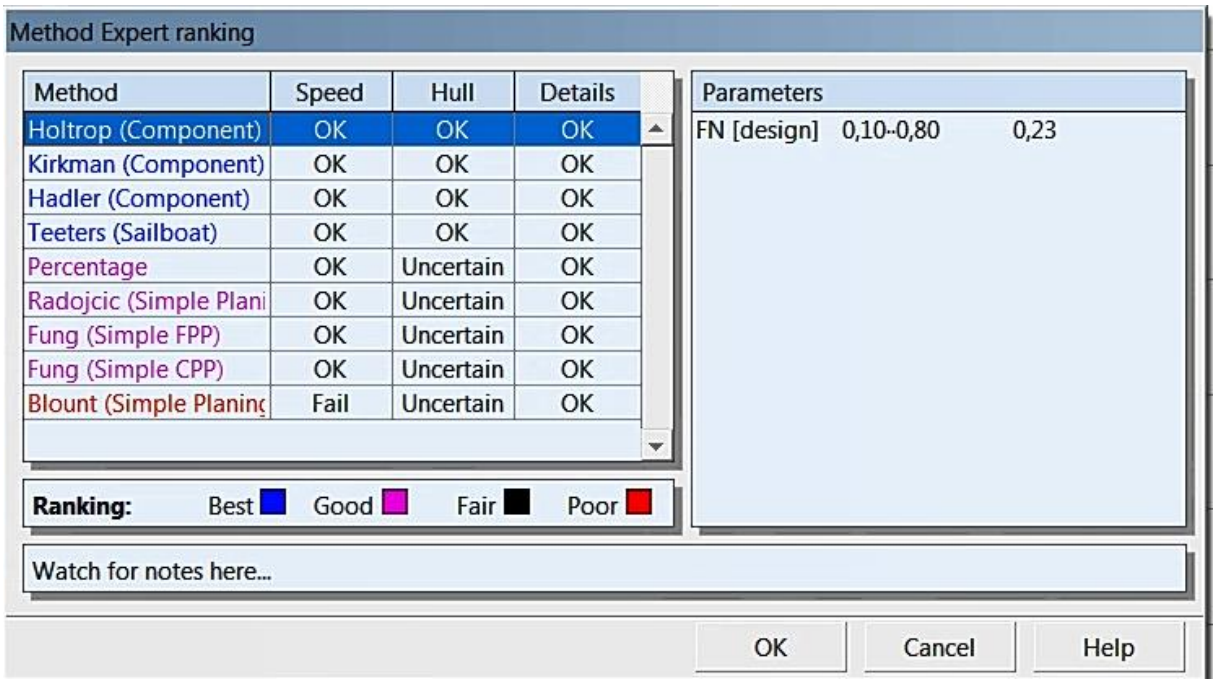
Para el cálculo de la resistencia se ha optado por el método De predicción Andersen en lugar del Holtrop:

Vessel drag	Calc	ITTC-78 (CT)
Technique:		Prediction
Prediction:		Andersen
Reference ship:		
Model LWL:	[m]	
Viscous		
Expansion:		Custom
Friction line:		ITTC-57
Hull form factor:	On	1,345
Speed corr:	Off	
Spray drag corr:	Off	
Corr allowance:		0,000366
Roughness [mm]:	Off	
Catamaran		
Interference:	Off	
Added drag		
Appendage:	Calc	Holtrop (Compone...
Wind:	Off	
Seas:	Off	
Shallow/channel:	Off	
Towed:	Off	
Margin:	Calc	Hull + added drag [15...

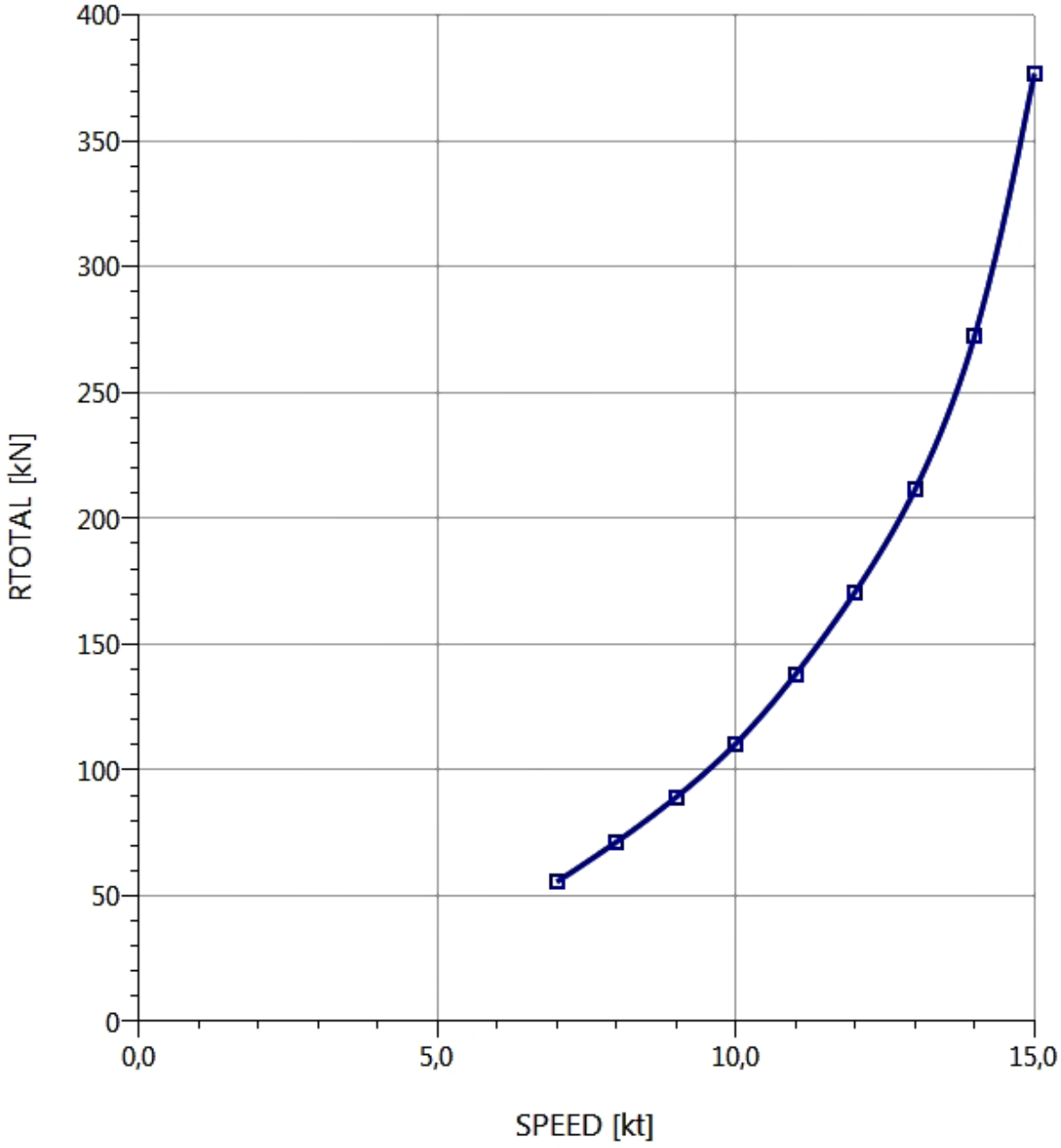


Se decide optar por este método, aunque haya un valor que no entra dentro del rango ya que está pensado para buques pequeños. Además, haciendo el estudio mediante el método Holtrop, los resultados no son coherentes ya que da una potencia muy superior a la que este tipo de buques lleva y en comparación a otros buques de referencia.

En el apartado 'Added Drag' se ha seleccionado el método Holtrop (Component) debido a que es de los que mejor se adaptan al cálculo



Los resultados de resistencia par el buque proyecto, a 13 nudos, se muestran a continuación:



$$\boldsymbol{R_T = 211,36\ kN}$$

Los informes completos de resistencia se pueden encontrar como Anexo 1.

3 DEFINICIÓN DEL PROPULSOR 'BY THRUST'

Para el cálculo del propulsor se definirá el mismo añadiendo los valores del diámetro máximo

Primero se hará un primer cálculo utilizando el método de cálculo 'By thrust' para hallar la potencia que ha de tener el motor propulsor. Para ello, introducimos todos los datos conocidos de nuestro propulsor:

Count:	2	
Propulsor type:	Propeller series	
Propeller type:	CPP	
Propeller series:	B Series	
Propeller sizing:	By thrust	
Reference prop:		
Blade count:	4	
Expanded area ratio:	0,4532	
Propeller diameter:	2500,0	mm
Propeller mean pitch:	2172,6	mm
Hub immersion:	3500,0	mm
Engine/gear		
Engine data:	None defined	
Rated RPM:		RPM
Rated power:		kW
Gear efficiency:	0,970	
Load correction:	Off	
Gear ratio:	6,498	
Shaft efficiency:	0,980	
Propeller options		
Oblique angle corr:	Off	
Shaft angle to WL:	0,00	deg
Added rise of run:	0,00	deg
Propeller cup:	0,0	mm
KTKQ corrections:	Custom	
Scale correction:	None	
KT multiplier:	1,000	
KQ multiplier:	1,000	
Blade T/C [0.7R]:	0,00	
Roughness:	0,00	mm
Cav breakdown:	On	
Nozzle L/D:	0,50	

Como ocurre con resistencia se usará el método de predicción Andersen debido a lo explicado anteriormente:

Hull-propulsor	Calc	
Technique:		Prediction
Prediction:		Andersen
Reference ship:		
Max prop diam:	[mm]	2500,0
Corrections		
Viscous scale corr:	Off	
Rudder location:		
Friction line:		
Hull form factor:		
Corr allowance:		
Roughness [mm]:	Off	
Ducted prop corr:	Off	
Tunnel stern corr:	Off	
Effective diam:	[m]	
Recess depth:	[m]	
System analysis		
Cavitation criteria:		Keller eqn
Analysis type:		Free run
CPP method:		Fixed RPM
Engine RPM:		1200,0
Mass multiplier:		
RPM constraint:		
Limit [RPM/s]:		

Method Expert ranking

Method	Speed	Hull	Details
Holtrop	OK	OK	OK
Andersen	OK	Uncertain	OK
Simple Towboat	OK	Uncertain	OK
Oortmerssen	OK	OK	Uncertain
Simple Ship	OK	Uncertain	Uncertain
Series 60	OK	Uncertain	Uncertain
SSPA Cargo Series	OK	Uncertain	Uncertain
Blount/Fox	Fail	OK	OK
Simple Sailboat	OK	Fail	Uncertain
Simple Planing	Fail	Uncertain	Uncertain

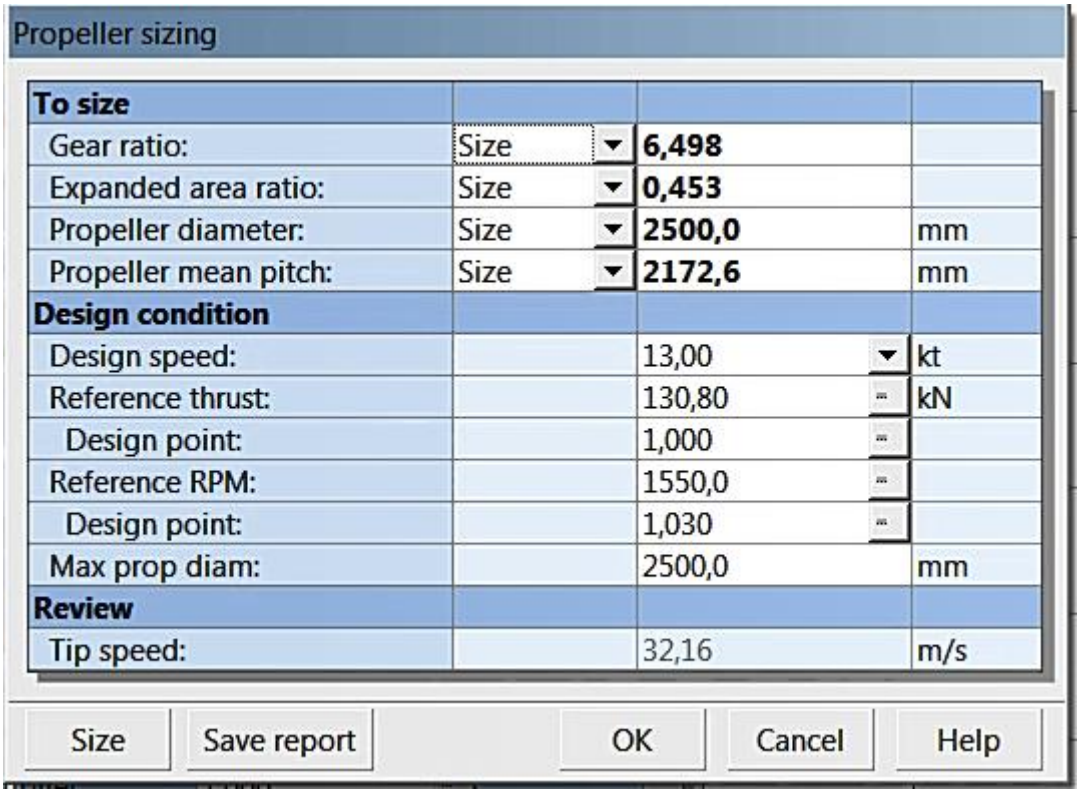
Parameters			
FN [design]	0,05-0,33	0,23	
CVOL	4,00-6,00	4,41	
CB	0,55-0,85	0,69	
LWL/BWL	5,00-8,00	4,52	Range

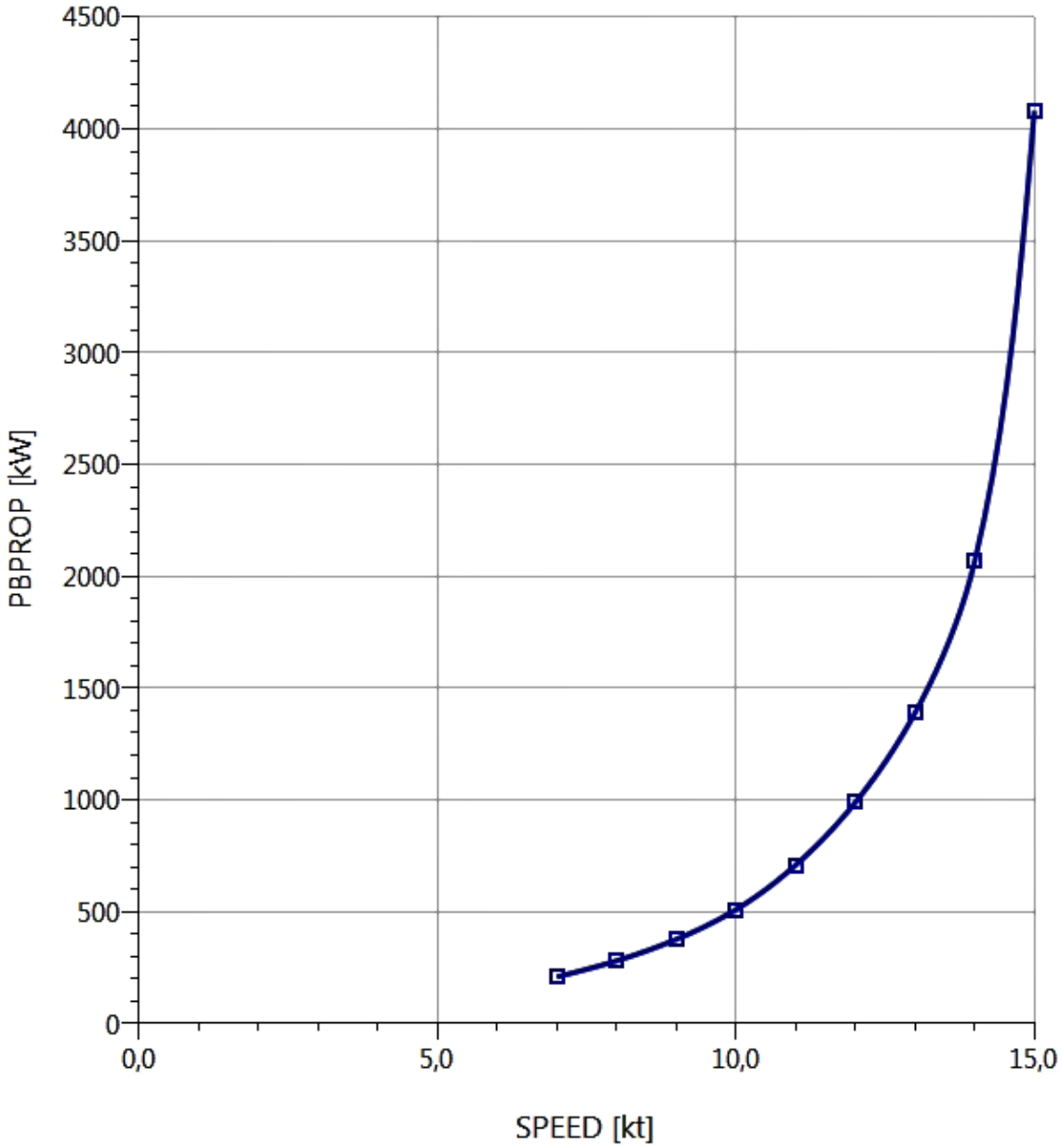
Ranking: Best Good Fair Poor

Note: For merchant cargo vessels.

OK Cancel Help

Con estos datos se obtienen los siguientes resultados:





$$\boldsymbol{PB_{PROP} = 1388,7\ kW}$$

Añadiendo a este resultado el régimen del motor:

$$Potencia\ propulsor = \frac{1388,7}{0,85} \cong 1650\ kW$$

Mediante el catálogo de Rolls Royce se seleccionan los motores se seleccionan los propulsores Azipull AZP 100 de las siguientes características:

$$\boldsymbol{Potencia = 1650\ kW}$$

$$\boldsymbol{Diámetro = 2500\ mm}$$

$$\boldsymbol{Revoluciones = 970\ rpm}$$

Se pueden encontrar los informes correspondientes al cálculo del propulsor como Anexo 2 y el catálogo del propulsor escogido como Anexo 3.

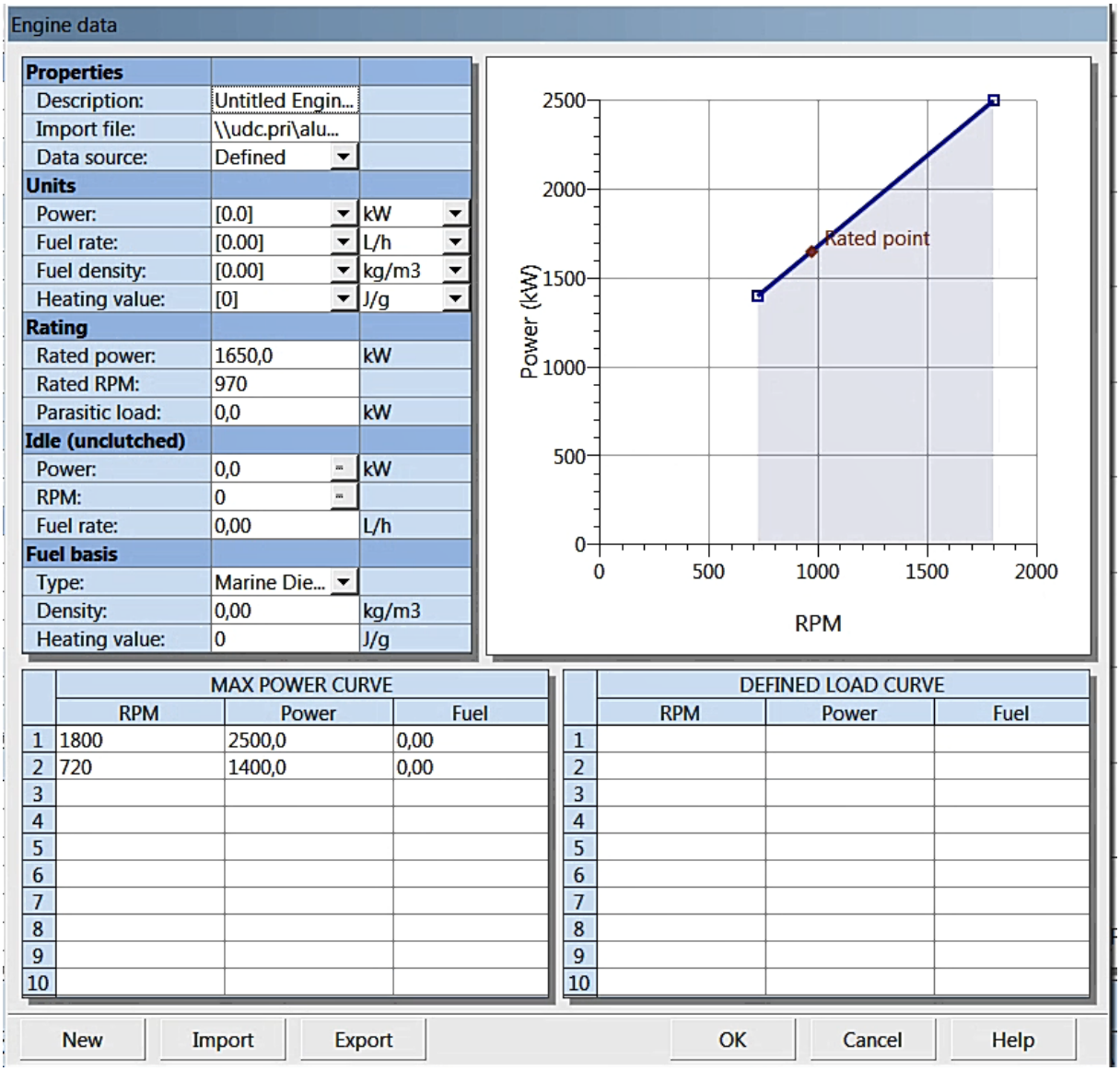
4 CÁLCULO DEL PROPULSOR 'BY POWER'

A partir de los datos calculados se comprobará, mediante el método 'By Power' la eficiencia del propulsor con 4, 5 y 6 palas para escoger la mejor opción.

Cambiando las revoluciones del propulsor por las obtenidas en el cálculo. EL método de predicción volverá a ser Andersen:

Hull-propulsor	Calc	
Technique:		Prediction
Prediction:		Andersen
Reference ship:		
Max prop diam:	[mm]	2500,0
Corrections		
Viscous scale corr:	Off	
Rudder location:		
Friction line:		
Hull form factor:		
Corr allowance:		
Roughness [mm]:	Off	
Ducted prop corr:	Off	
Tunnel stern corr:	Off	
Effective diam:	[m]	
Recess depth:	[m]	
System analysis		
Cavitation criteria:		Keller eqn
Analysis type:		Free run
CPP method:		Fixed RPM
Engine RPM:		970
Mass multiplier:		
RPM constraint:		
Limit [RPM/s]:		

Para este cálculo se añadirá la curva de funcionamiento del propulsor:

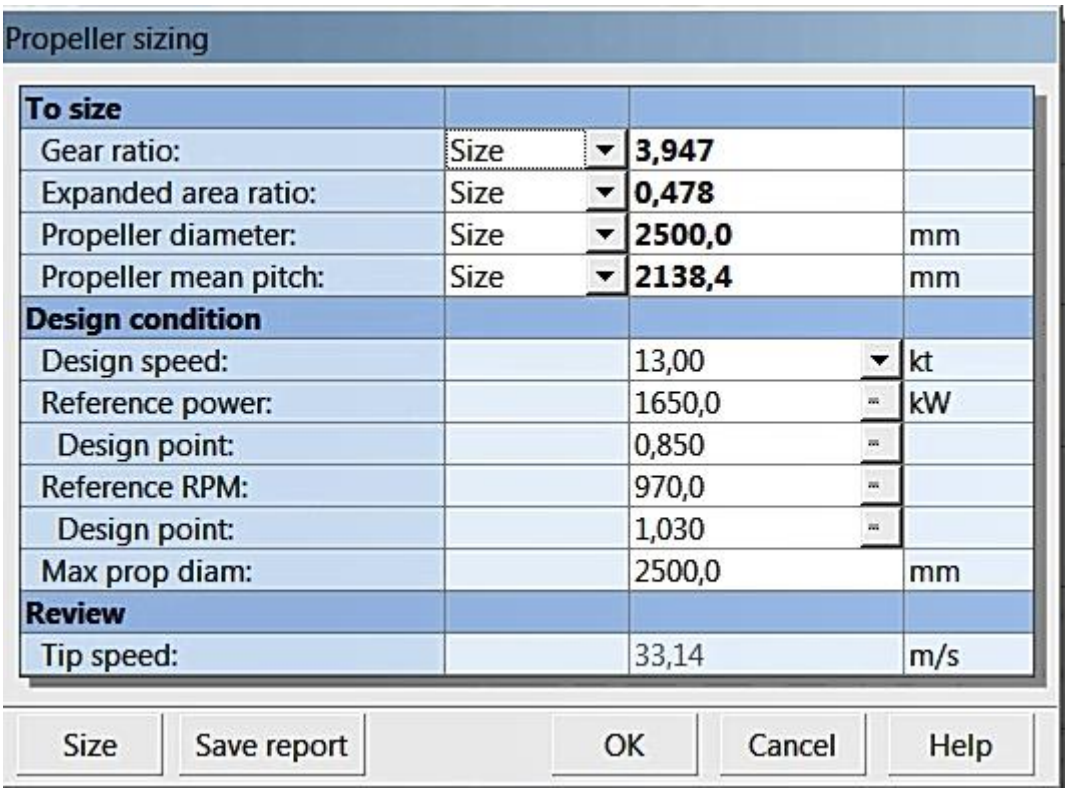


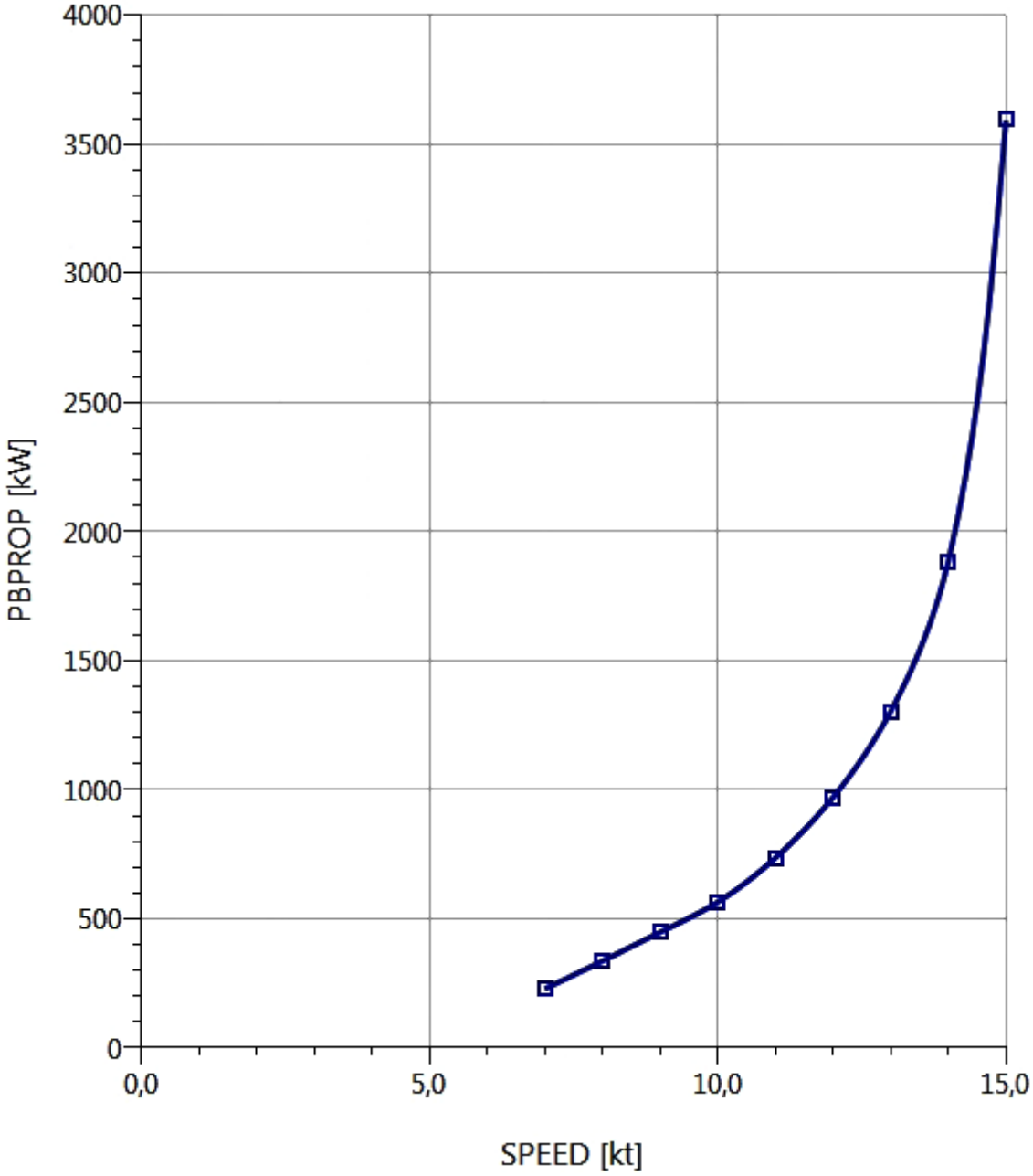
Ahora se procederá a analizar que sucede cuando se varía el número de palas.

4.1 4 PALAS

Se han añadido los datos necesarios en la pestaña de 'Design condition' y el programa ha calculado los parámetros principales de la hélice restantes

Se obtiene:





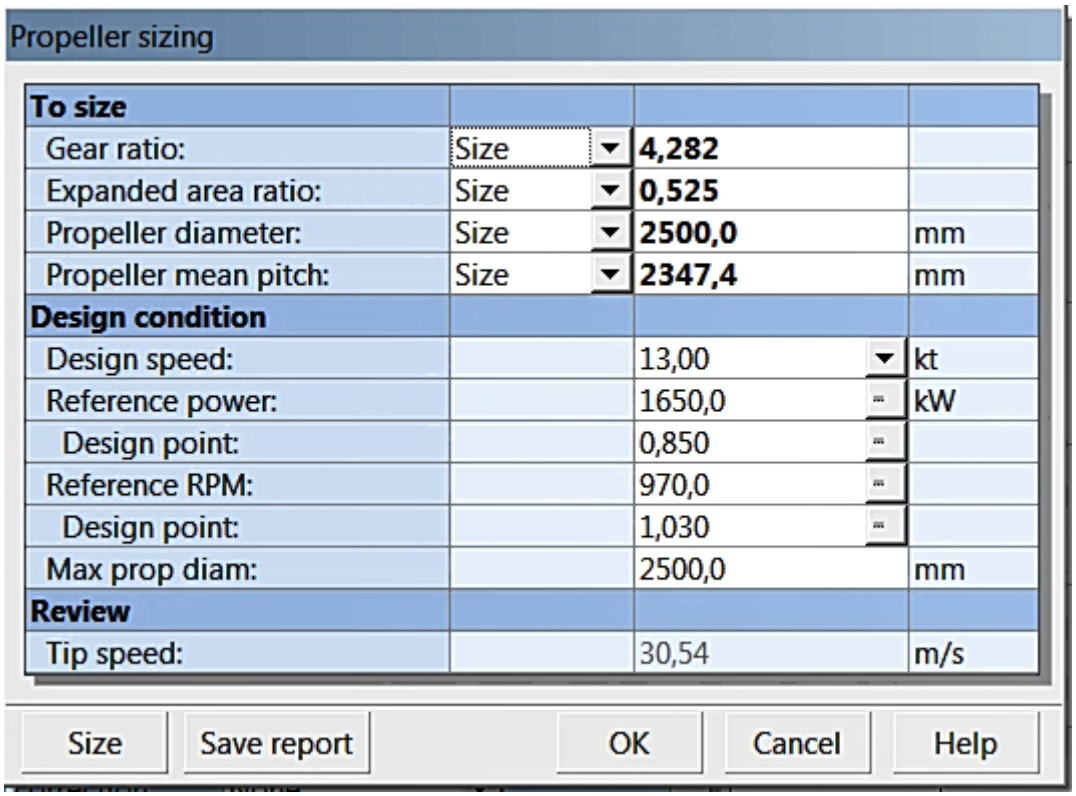
$EFFO = 0{,}5734$

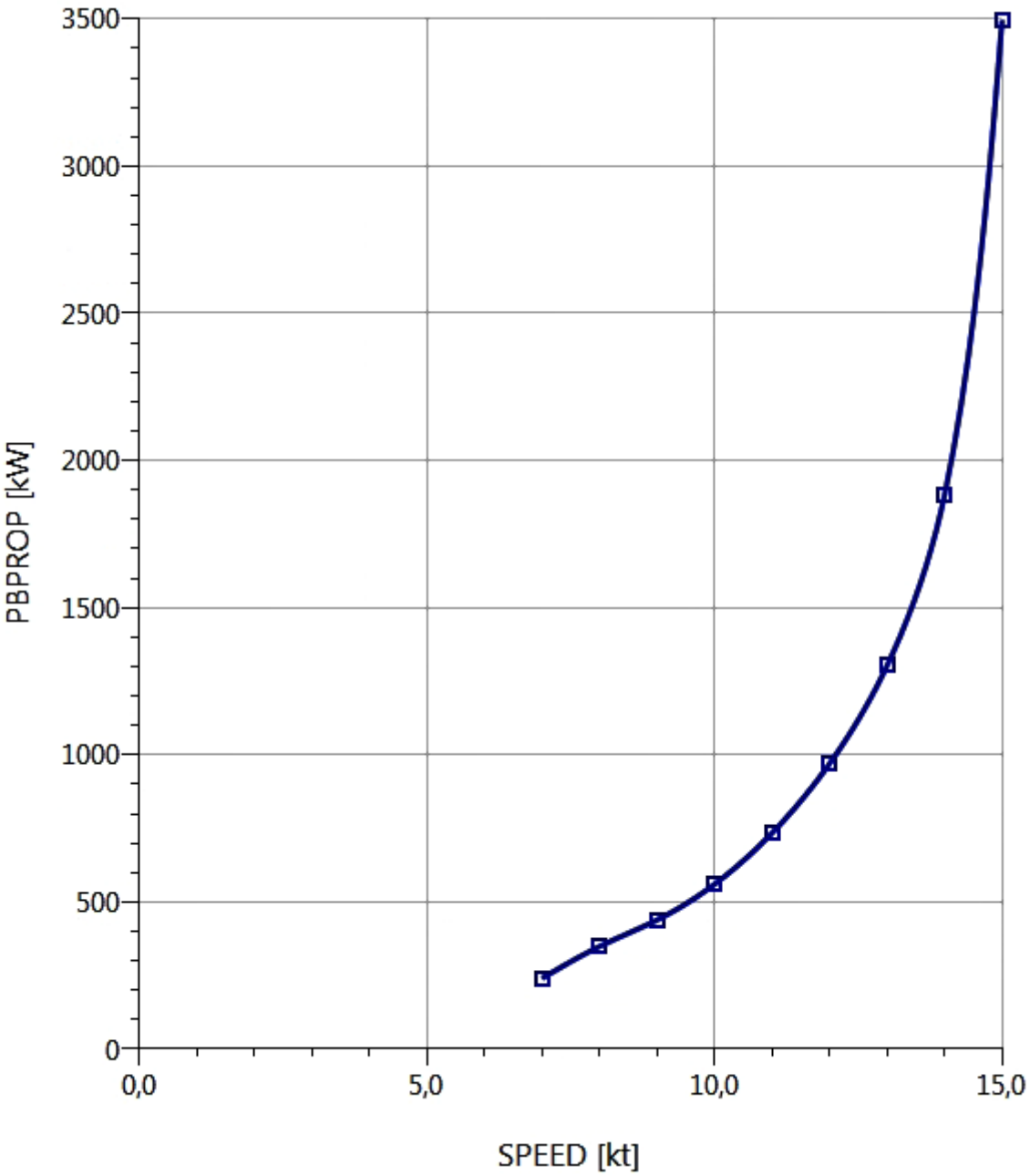
Se pueden encontrar los informes completos en el Anexo 4.

4.2 5 PALAS

Se han añadido los datos necesarios en la pestaña de 'Design condition' y el programa ha calculado los parámetros principales de la hélice restantes:

Se obtiene:





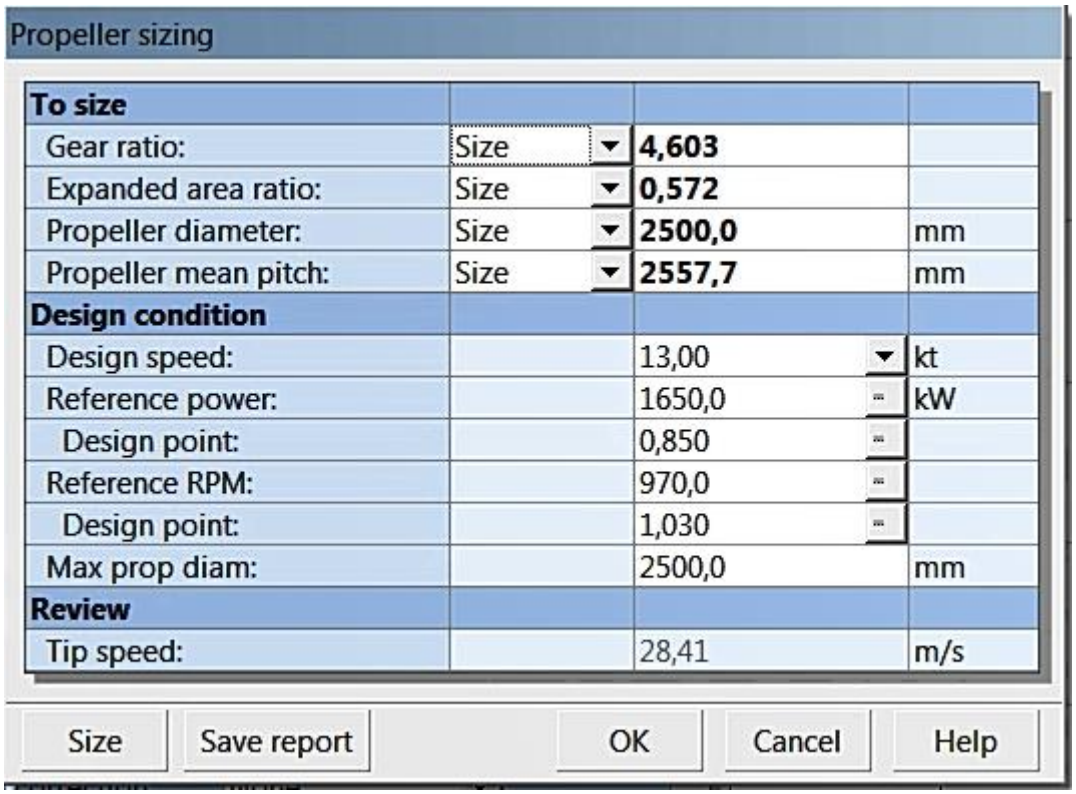
$EFFO = 0{,}5738$

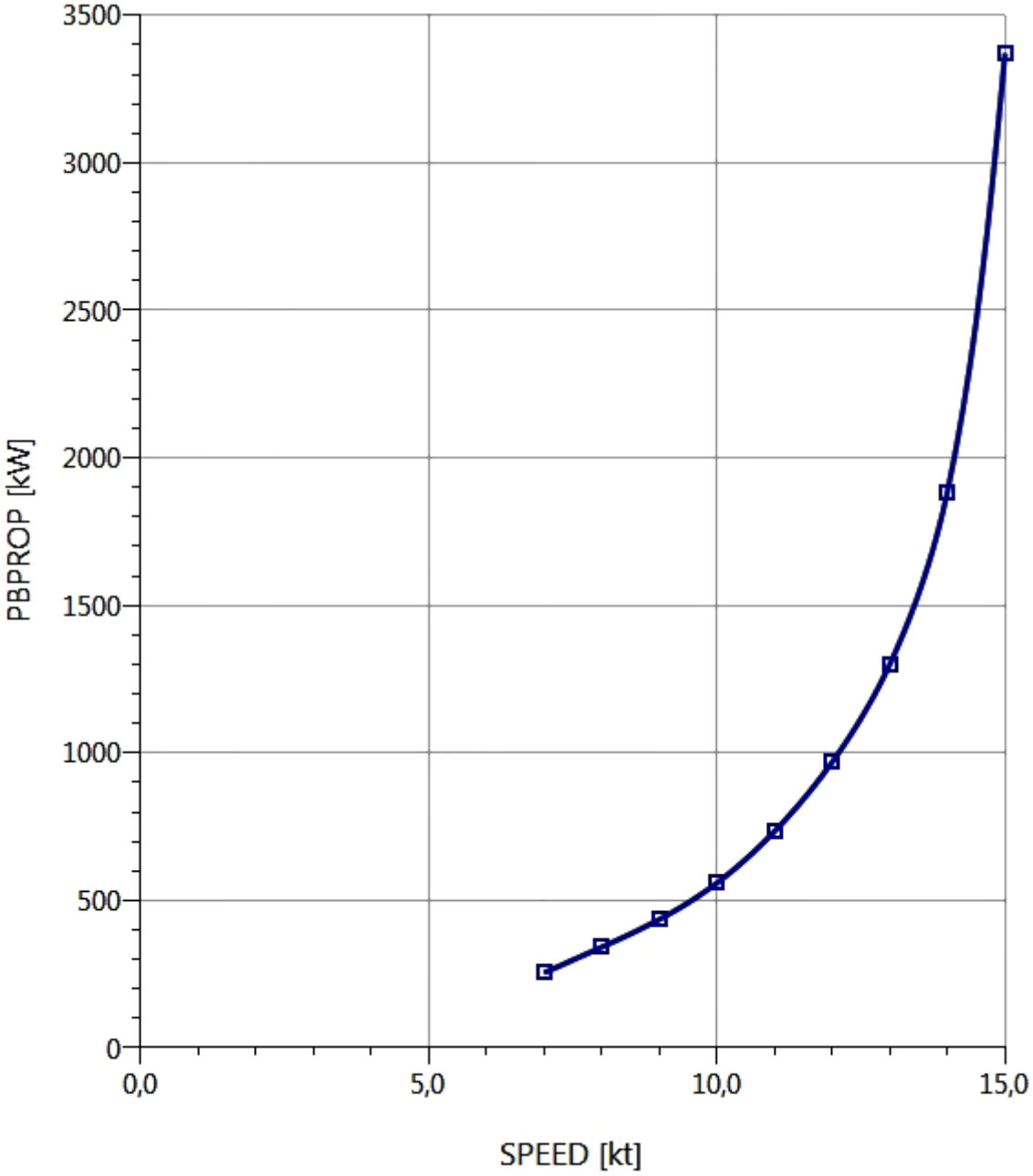
Se pueden encontrar los informes completos en el Anexo 5.

4.3 6 PALAS

Se han añadido los datos necesarios en la pestaña de 'Design condition' y el programa ha calculado los parámetros principales de la hélice restantes

Se obtiene:





$$EFFO = 0{,}5751$$

Se pueden encontrar los informes completos en el Anexo 6.

Se observa en todos los casos que las eficiencias son muy parecidas, empiezan a variar a partir del tercer decimal. Por lo tanto, debido a que no existe una mejora significativa se decide que el propulsor será de 4 palas, ya que el aumento en coste de elegir un propulsor con más palas no se ve suficientemente respaldado por los resultados.

Por último, se realiza la comprobación de la carga a la que va a trabajar el motor propulsor:

$$Carga = \frac{1303{,}7}{1650} \cdot 100 \longrightarrow \boldsymbol{Carga = 80}\ \%$$

Habiendo todavía un margen del 5% para cumplir con el valor indicado en la RPA del proyecto.

ANEXO 1: RESISTENCIA

Resistance

17 jul 2018 01:29
HydroComp NavCad 2014

Project ID
Description
File name **cuaderno 6.hcnc**

Analysis parameters

Vessel drag		**Added drag**	
Technique:	**[Calc] Prediction**	Appendage:	**[Calc] Holtrop (Component)**
Prediction:	**Andersen**	Wind:	**[Off]**
Reference ship:		Seas:	**[Off]**
Model LWL:		Shallow/channel:	**[Off]**
Expansion:	**Custom**	Towed:	**[Off]**
Friction line:	**ITTC-57**	Margin:	**[Calc] Hull + added drag [15%]**
Hull form factor:	**[On] 1,345**	**Water properties**	
Speed corr:	**[Off]**	Water type:	**Salt**
Spray drag corr:	**[Off]**	Density:	**1026,00 kg/m3**
Corr allowance:	**0,000366**	Viscosity:	**1,18920e-6 m2/s**
Roughness [mm]:	**[Off]**		

Prediction method check [Andersen]

Parameters	FN [design]	CVOL	CB	LWL/BWL
Value	**0,23**	**4,41**	**0,69**	**4,52***
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
7,00	**0,124**	**0,260**	**2,62e8**	**0,001821**	**1,345**	**0,000001**	**0,000000**	**0,000366**	**0,002816**
8,00	**0,141**	**0,297**	**2,99e8**	**0,001789**	**1,345**	**0,000001**	**0,000000**	**0,000366**	**0,002773**
9,00	**0,159**	**0,334**	**3,36e8**	**0,001761**	**1,345**	**0,000001**	**0,000000**	**0,000366**	**0,002735**
10,00	**0,177**	**0,371**	**3,74e8**	**0,001736**	**1,345**	**0,000046**	**0,000000**	**0,000366**	**0,002747**
11,00	**0,194**	**0,408**	**4,11e8**	**0,001715**	**1,345**	**0,000176**	**0,000000**	**0,000366**	**0,002848**
12,00	**0,212**	**0,445**	**4,48e8**	**0,001695**	**1,345**	**0,000330**	**0,000000**	**0,000366**	**0,002976**
+ 13,00 +	**0,230**	**0,483**	**4,86e8**	**0,001678**	**1,345**	**0,000534**	**0,000000**	**0,000366**	**0,003156**
14,00	**0,247**	**0,520**	**5,23e8**	**0,001661**	**1,345**	**0,000941**	**0,000000**	**0,000366**	**0,003542**
15,00	**0,265**	**0,557**	**5,61e8**	**0,001647**	**1,345**	**0,001752**	**0,000000**	**0,000366**	**0,004333**

	RESISTANCE								
SPEED [kt]	RBARE [kN]	RAPP [kN]	RWIND [kN]	RSEAS [kN]	RCHAN [kN]	RTOWED [kN]	RMARGIN [kN]	RTOTAL [kN]	
7,00	**43,36**	**4,89**	**0,00**	**0,00**	**0,00**	**7,24**	**7,24**	**55,49**	
8,00	**55,76**	**6,33**	**0,00**	**0,00**	**0,00**	**9,31**	**9,31**	**71,40**	
9,00	**69,62**	**7,94**	**0,00**	**0,00**	**0,00**	**11,63**	**11,63**	**89,20**	
10,00	**86,34**	**9,74**	**0,00**	**0,00**	**0,00**	**14,41**	**14,41**	**110,49**	
11,00	**108,30**	**11,71**	**0,00**	**0,00**	**0,00**	**18,00**	**18,00**	**138,02**	
12,00	**134,67**	**13,86**	**0,00**	**0,00**	**0,00**	**22,28**	**22,28**	**170,81**	
+ 13,00 +	**167,60**	**16,19**	**0,00**	**0,00**	**0,00**	**27,57**	**27,57**	**211,36**	
14,00	**218,17**	**18,69**	**0,00**	**0,00**	**0,00**	**35,53**	**35,53**	**272,39**	
15,00	**306,39**	**21,36**	**0,00**	**0,00**	**0,00**	**49,16**	**49,16**	**376,91**	

	EFFECTIVE POWER		OTHER			
SPEED [kt]	PEBARE [kW]	PETOTAL [kW]	CTLR	CTLT	RBARE/W	
7,00	**156,2**	**199,8**	**0,00001**	**0,03746**	**0,00057**	
8,00	**229,5**	**293,9**	**0,00001**	**0,03688**	**0,00074**	
9,00	**322,3**	**413,0**	**0,00001**	**0,03638**	**0,00092**	
10,00	**444,2**	**568,4**	**0,00062**	**0,03655**	**0,00114**	
11,00	**612,9**	**781,0**	**0,00234**	**0,03789**	**0,00143**	
12,00	**831,3**	**1054,5**	**0,00439**	**0,03959**	**0,00178**	
+ 13,00 +	**1120,9**	**1413,5**	**0,00710**	**0,04198**	**0,00222**	
14,00	**1571,3**	**1961,8**	**0,01252**	**0,04712**	**0,00289**	
15,00	**2364,3**	**2908,5**	**0,02331**	**0,05764**	**0,00405**	

Resistance

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HydroComp NavCad 2014

Project ID

Description

File name **cuaderno 6.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**86,386 m**
Max beam on WL:	[LWL/BWL 4,516]	**19,130 m**
Max molded draft:	[BWL/T 2,907]	**6,580 m**
Displacement:	[CB 0,691]	**7711,00 t**
Wetted surface:	[CS 2,873]	**2314,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,471]	**40,647 m**
LCF fwd TR:	[XCF/LWL 0,425]	**36,747 m**
Max section area:	[CX 0,985]	**124,0 m2**
Waterplane area:	[CWP 0,833]	**1377,3 m2**
Bulb section area:		**13,7 m2**
Bulb ctr below WL:		**3,000 m**
Bulb nose fwd TR:		**87,310 m**
Imm transom area:	[ATR/AX 0,242]	**30,0 m2**
Transom beam WL:	[BTR/BWL 1,000]	**19,130 m**
Transom immersion:	[TTR/T 2,432]	**16,000 m**
Half entrance angle:		**37,00 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:		**2500,0 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
Description
File name **cuaderno 6.hcnc**

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:	**2**
Max prop diameter:	**2500,0 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:	**0**
Rudder location:	**Behind propeller**
Type:	**Balanced foil**
Root chord:	**0,000 m**
Tip chord:	**0,000 m**
Span:	**0,000 m**
T/C ratio:	**0,000**
LE sweep:	**0,00 deg**
Projected area:	**0,0 m2**
Wetted surface:	**0,0 m2**

Skeg/Keel	
Count:	**1**
Type:	**Skeg**
Mean length:	**21,000 m**
Mean width:	**2,200 m**
Height aft:	**4,580 m**
Height mid:	**1,350 m**
Height fwd:	**0,000 m**
Projected area:	**34,9 m2**
Wetted surface:	**116,0 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:	**2**
Diameter:	**1,850 m**
Sonar dome	
Count:	**0**
Wetted surface:	**0,0 m2**
Miscellaneous	
Count:	**0**
Drag area:	**0,0 m2**
Drag coef:	**0,00**

Environment data

Wind	
Wind speed:	**0,00 kt**
Angle off bow:	**0,00 deg**
Gradient correction:	**Off**
Exposed hull	
Transverse area:	**0,0 m2**
VCE above WL:	**0,000 m**
Profile area:	**0,0 m2**
Superstructure	
Superstructure shape:	**Cargo ship**
Transverse area:	**0,0 m2**
VCE above WL:	**0,000 m**
Profile area:	**0,0 m2**

Seas	
Significant wave ht:	**0,000 m**
Modal wave period:	**0,0 sec**
Shallow/channel	
Water depth:	**0,000 m**
Type:	**Shallow water**
Channel width:	**0,000 m**
Channel side slope:	**0,00 deg**
Hull girth:	**0,000 m**

Resistance

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HydroComp NavCad 2014

Project ID

Description

File name **cuaderno 6.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

Resistance

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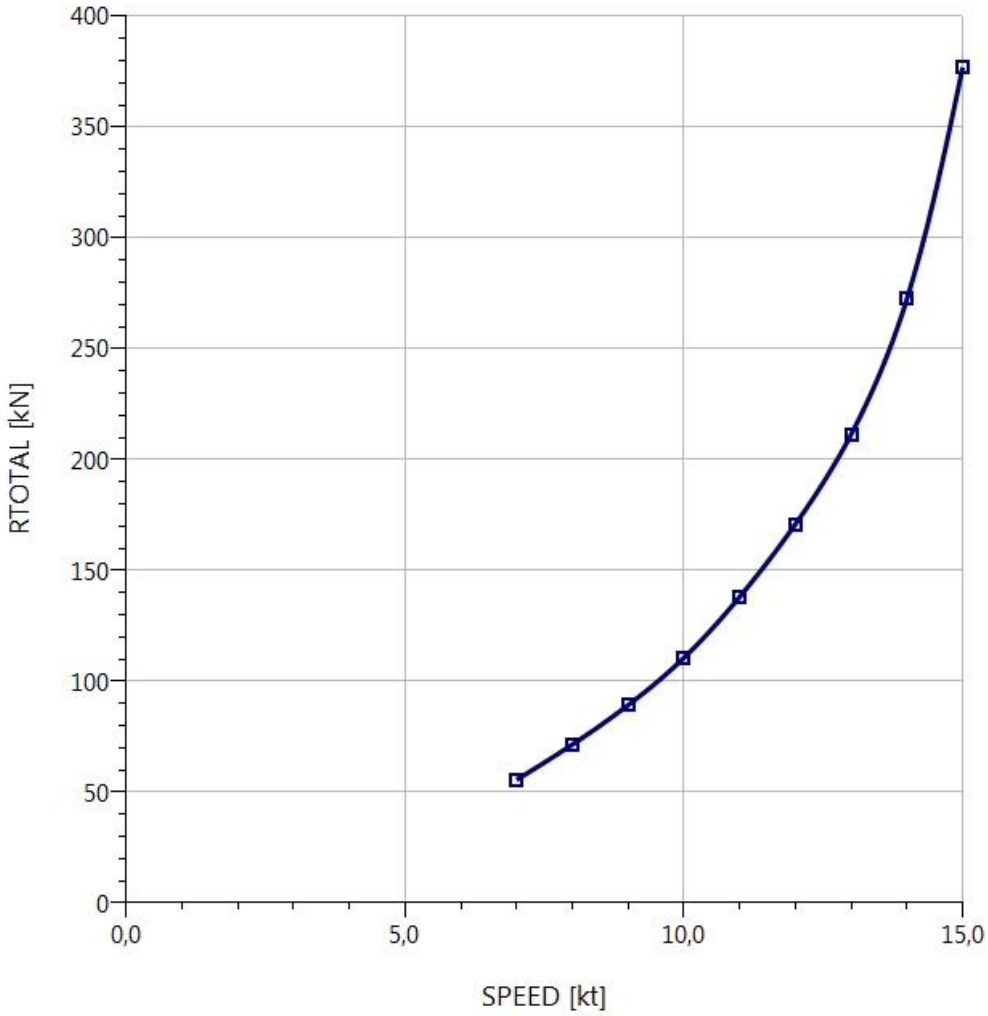
HydroComp NavCad 2014

Project ID
Description
File name **cuaderno 6.hcnc**

Analysis parameters

Vessel drag		Added drag	
Technique:	[Calc] Prediction	Appendage:	[Calc] Holtrop (Component)
Prediction:	Andersen	Wind:	[Off]
Reference ship:		Seas:	[Off]
Model LWL:		Shallow/channel:	[Off]
Expansion:	Custom	Towed:	[Off]
Friction line:	ITTC-57	Margin:	[Calc] Hull + added drag [15%]
Hull form factor:	[On] 1,345	**Water properties**	
Speed corr:	[Off]	Water type:	Salt
Spray drag corr:	[Off]	Density:	1026,00 kg/m3
Corr allowance:	0,000366	Viscosity:	1,18920e-6 m2/s
Roughness [mm]:	[Off]		

Predicted resistance



ANEXO 2: REPORTES ‘BY THRUST’

Propulsion

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HydroComp NavCad 2014

Project ID
Description
File name **cuaderno 6.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:	**Fixed RPM**
Max prop diam:	**2500,0 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**	**4,41**	**0,69**	**4,52***
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 [%]	
7,00	**199,8**	**0,1998**	**0,1921**	**0,9850**	**1200**	**208,9**	**---**	**0,0**	
8,00	**293,9**	**0,1998**	**0,1921**	**0,9850**	**1200**	**281,2**	**---**	**0,0**	
9,00	**413,0**	**0,1998**	**0,1921**	**0,9850**	**1200**	**377,0**	**---**	**0,0**	
10,00	**568,4**	**0,1998**	**0,1921**	**0,9850**	**1200**	**509,8**	**---**	**0,0**	
11,00	**781,0**	**0,1998**	**0,1921**	**0,9850**	**1200**	**708,4**	**---**	**0,0**	
12,00	**1054,5**	**0,1998**	**0,1921**	**0,9850**	**1200**	**988,6**	**---**	**0,0**	
+ 13,00 +	**1413,5**	**0,1998**	**0,1921**	**0,9850**	**1200**	**1388,7**	**---**	**0,0**	
14,00	**1961,8**	**0,1998**	**0,1921**	**0,9850**	**1279**	**2065,3**	**---**	**0,0**	
15,00	**2908,5**	**0,1998**	**0,1921**	**0,9850**	**1629**	**4081,2**	**---**	**0,0**	

	POWER DELIVERY								
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP	CPPITCH [mm]
7,00	**185**	**10,12**	**1,56**	**198,6**	**202,7**	**405,3**	**417,9**	**651,7**	**1278,6**
8,00	**185**	**13,62**	**2,10**	**267,3**	**272,8**	**545,6**	**562,4**	**553,3**	**1538,4**
9,00	**185**	**18,25**	**2,81**	**358,3**	**365,7**	**731,3**	**753,9**	**464,4**	**1812,6**
10,00	**185**	**24,68**	**3,80**	**484,6**	**494,5**	**989,0**	**1019,6**	**381,5**	**2118,8**
11,00	**185**	**34,30**	**5,28**	**673,4**	**687,2**	**1374,4**	**1416,9**	**302,0**	**2487,5**
12,00	**185**	**47,87**	**7,37**	**939,8**	**959,0**	**1918,0**	**1977,3**	**236,1**	**2921,5**
+ 13,00 +	**185**	**67,23**	**10,35**	**1320,1**	**1347,0**	**2694,0**	**2777,3**	**182,1**	**3463,9**
14,00	**197**	**93,81**	**14,44**	**1963,3**	**2003,3**	**4006,6**	**4130,6**	**131,9**	**3849,8**
15,00	**251**	**145,56**	**22,40**	**3879,6**	**3958,8**	**7917,5**	**8162,4**	**71,5**	**3849,8**

	EFFICIENCY				THRUST		
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]	
7,00	**0,5057**	**0,9700**	**0,4929**	**0,45828**	**34,34**	**55,48**	
8,00	**0,5526**	**0,9700**	**0,5386**	**0,49703**	**44,19**	**71,40**	
9,00	**0,5794**	**0,9700**	**0,5647**	**0,51773**	**55,20**	**89,20**	
10,00	**0,5897**	**0,9700**	**0,5747**	**0,5278**	**68,38**	**110,49**	
11,00	**0,5830**	**0,9700**	**0,5682**	**0,53021**	**85,41**	**138,01**	
12,00	**0,5641**	**0,9700**	**0,5498**	**0,52314**	**105,71**	**170,81**	
+ 13,00 +	**0,5383**	**0,9700**	**0,5247**	**0,51266**	**130,80**	**211,36**	
14,00	**0,5024**	**0,9700**	**0,4896**	**0,5043**	**168,57**	**272,39**	
15,00	**0,3769**	**0,9700**	**0,3674**	**0,4154**	**233,25**	**376,91**	

Propulsion

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HydroComp NavCad 2014

Project ID

Description

File name **cuaderno 6.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
7,00	**0,3745**	**0,0904**	**0,01066**	**0,64488**	**0,20294**	**1,6422**	**3,2965**	**9,44e6**	
8,00	**0,4280**	**0,1164**	**0,01434**	**0,63536**	**0,18299**	**1,6179**	**2,9724**	**9,48e6**	
9,00	**0,4815**	**0,1454**	**0,01923**	**0,62714**	**0,17227**	**1,597**	**2,7983**	**9,52e6**	
10,00	**0,5350**	**0,1801**	**0,02600**	**0,62926**	**0,16984**	**1,6024**	**2,7589**	**9,56e6**	
11,00	**0,5885**	**0,2250**	**0,03614**	**0,64957**	**0,17732**	**1,6541**	**2,8804**	**9,61e6**	
12,00	**0,6420**	**0,2784**	**0,05043**	**0,67554**	**0,19061**	**1,7202**	**3,0961**	**9,67e6**	
+ 13,00 +	**0,6955**	**0,3445**	**0,07083**	**0,71226**	**0,21058**	**1,8138**	**3,4205**	**9,72e6**	
14,00	**0,7027**	**0,3908**	**0,08700**	**0,79147**	**0,25075**	**2,0155**	**4,0731**	**1,04e7**	
15,00	**0,5911**	**0,3334**	**0,08321**	**0,95403**	**0,40286**	**2,4294**	**6,544**	**1,31e7**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
7,00	**31,66**	**4,44**	**0,89**	**24,17**	**0,177**	**15,44**	**2,0**	**2,0**	**1229,0**
8,00	**24,24**	**4,44**	**0,88**	**24,17**	**0,203**	**19,86**	**2,0**	**2,0**	**1400,6**
9,00	**19,15**	**4,44**	**0,88**	**24,17**	**0,232**	**24,82**	**2,0**	**2,0**	**1571,7**
10,00	**15,51**	**4,44**	**0,87**	**24,17**	**0,267**	**30,74**	**2,8**	**2,8**	**1747,5**
11,00	**12,82**	**4,44**	**0,86**	**24,17**	**0,314**	**38,40**	**6,1**	**6,1**	**1934,0**
12,00	**10,77**	**4,44**	**0,85**	**24,17**	**0,371**	**47,52**	**12,5**	**12,5**	**2126,0**
+ 13,00 +	**9,18**	**4,44**	**0,83**	**24,17**	**0,442**	**58,80 !!**	**24,7 !!**	**24,7**	**2327,6**
14,00	**7,91**	**3,91**	**0,73**	**25,77**	**0,553**	**75,78 !!**	**45,0 !!**	**45,0**	**2403,6**
15,00	**6,89**	**2,41**	**0,46**	**32,82**	**0,753**	**104,86 !!**	**100,0 !!**	**100,0**	**2107,2**

Propulsion

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Project ID
Description
File name **cuaderno 6.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**86,386 m**
Max beam on WL:	[LWL/BWL 4,516]	**19,130 m**
Max molded draft:	[BWL/T 2,907]	**6,580 m**
Displacement:	[CB 0,691]	**7711,00 t**
Wetted surface:	[CS 2,873]	**2314,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,471]	**40,647 m**
LCF fwd TR:	[XCF/LWL 0,425]	**36,747 m**
Max section area:	[CX 0,985]	**124,0 m2**
Waterplane area:	[CWP 0,833]	**1377,3 m2**
Bulb section area:		**13,7 m2**
Bulb ctr below WL:		**3,000 m**
Bulb nose fwd TR:		**87,310 m**
Imm transom area:	[ATR/AX 0,242]	**30,0 m2**
Transom beam WL:	[BTR/BWL 1,000]	**19,130 m**
Transom immersion:	[TTR/T 2,432]	**16,000 m**
Half entrance angle:		**37,00 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:		**2500,0 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:		**2**	
Propulsor type:		**Propeller series**	
Propeller type:		**CPP**	
Propeller series:		**B Series**	
Propeller sizing:		**By thrust**	
Reference prop:			
Blade count:		**4**	
Expanded area ratio:		**0,4532**	**[Size]**
Propeller diameter:		**2500,0 mm**	**[Size]**
Propeller mean pitch:	[P/D 0,8691]	**2172,6 mm**	**[Size]**
Hub immersion:		**3500,0 mm**	

Engine/gear		
Engine data:		**Untitled Engine Obje...**
Rated RPM:		**0 RPM**
Rated power:		**0,0 kW**
Gear efficiency:		**0,970**
Load correction:		**Off**
Gear ratio:		**6,498** **[Size]**
Shaft efficiency:		**0,980**

Propeller options	
Oblique angle corr:	**Off**
Shaft angle to WL:	**0,00 deg**
Added rise of run:	**0,00 deg**
Propeller cup:	**0,0 mm**
KTKQ corrections:	**Custom**
Scale correction:	**None**
KT multiplier:	**1,000**
KQ multiplier:	**1,000**
Blade T/C [0.7R]:	**0,00**
Roughness:	**0,00 mm**
Cav breakdown:	**On**

Design condition	
Max prop diam:	**2500,0 mm**
Design speed:	**13,00 kt**
Reference power:	**2250,0 kW**
Design point:	**0,850**
Reference RPM:	**1550,0**
Design point:	**1,030**

Propulsion

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HydroComp NavCad 2014

Project ID

Description

File name **cuaderno 6.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

17 jul 2018 01:32

HydroComp NavCad 2014

Project ID

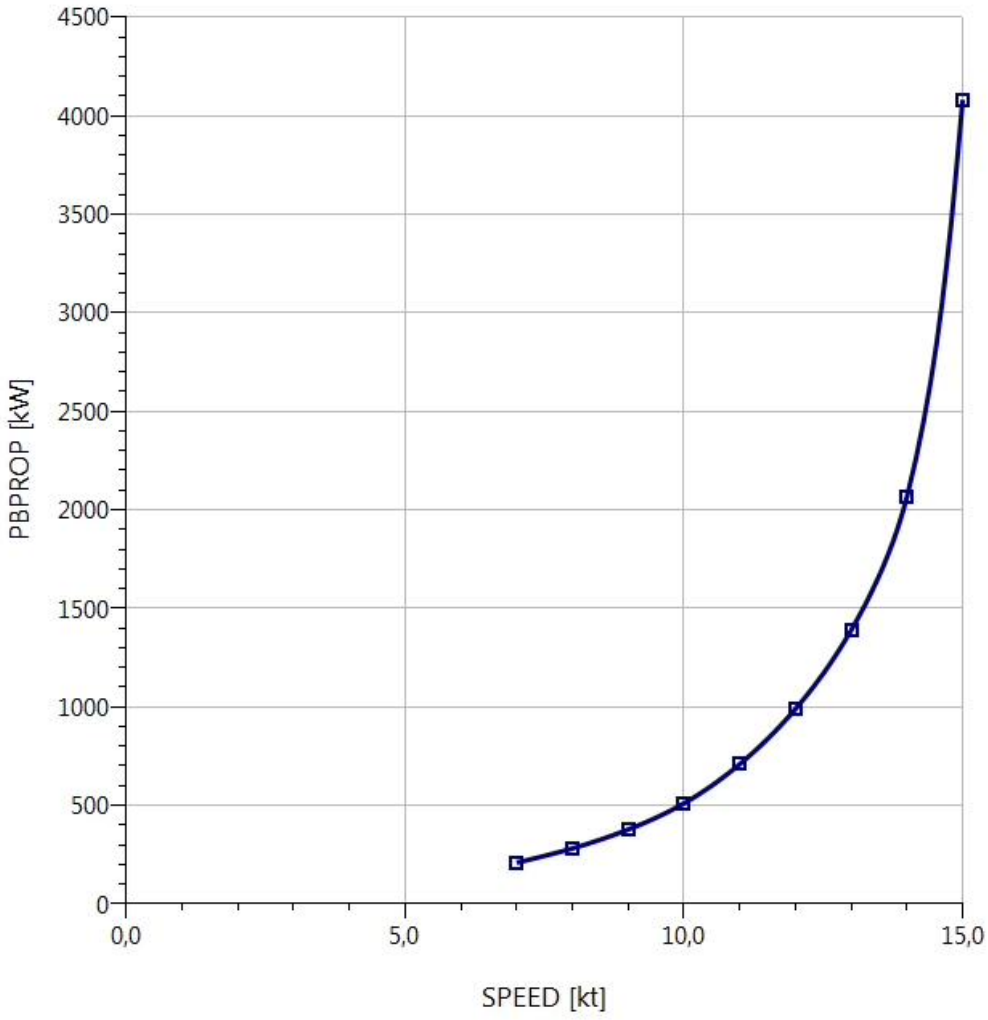
Description

File name **cuaderno 6.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:	**Fixed RPM**
Max prop diam:	**2500,0 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:			

Predicted propulsion



ANEXO 3: CATÁLOGO DEL PROPULSOR

Azipull thrusters

The Rolls-Royce Azipull is a low drag, high efficiency pulling thruster that provides both steering and propulsion. It combines the advantage of the pulling propeller with the flexibility of using almost any type of drive to suit specific vessel requirements. Azipull thrusters are designed for continuous service speeds up to 24 knots, while maintaining excellent manoeuvrability. They offer high hydrodynamic and fuel efficiency with low noise and vibration levels. A substantial rudder area delivers excellent course stability. Azipull units also allow the aft end of the hull to be optimised for minimum resistance and simplified construction.

Model variations

- All Azipull units are available with CP or FP propellers and can be delivered with remote control systems.
- The AZP 085 and 100 can also be available with FF propeller

Technical data

Thruster type	Power MCR (kW)	Input speed (rpm)	Dry wt (t)	Prop. Dia (mm)
AZP 085	900 - 1600	1200 - 2000	13	1900 - 2300
AZP 100	1400 - 2500	720 - 1800	31	2300 - 2800
AZP 120	1800 - 3500	720 - 1200	45	2800 - 3300
AZP 150	3000 - 5000	600 - 1000	85	3300 - 4200

All data subject to change without prior notice

ANEXO 4: REPORTES ‘BY POWER’ 4 PALAS

Propulsion

17 jul 2018 05:22
HydroComp NavCad 2014

Project ID
Description
File name **cuaderno 6.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:	**Fixed RPM**
Max prop diam:	**2500,0 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**	**4,41**	**0,69**	**4,52***
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 [%]	
7,00	**199,8**	**0,1998**	**0,1921**	**0,9850**	**800**	**229,1**	**---**	**13,9**	
8,00	**293,9**	**0,1998**	**0,1921**	**0,9850**	**911**	**336,6**	**---**	**20,4**	
9,00	**413,0**	**0,1998**	**0,1921**	**0,9850**	**970**	**448,0**	**---**	**27,2**	
10,00	**568,4**	**0,1998**	**0,1921**	**0,9850**	**970**	**565,0**	**---**	**34,2**	
11,00	**781,0**	**0,1998**	**0,1921**	**0,9850**	**970**	**736,2**	**---**	**44,6**	
12,00	**1054,5**	**0,1998**	**0,1921**	**0,9850**	**970**	**970,6**	**---**	**58,8**	
+ 13,00 +	**1413,5**	**0,1998**	**0,1921**	**0,9850**	**970**	**1303,7**	**---**	**79,0**	
14,00	**1961,8**	**0,1998**	**0,1921**	**0,9850**	**970**	**1884,1**	**---**	**114,2**	
15,00	**2908,5**	**0,1998**	**0,1921**	**0,9850**	**970**	**3594,8**	**---**	**217,9**	

	POWER DELIVERY								
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP	CPPITCH [mm]
7,00	**203**	**10,10**	**2,56**	**217,7**	**222,2**	**444,4**	**458,1**	**594,4**	**1125,1**
8,00	**231**	**13,04**	**3,30**	**320,0**	**326,5**	**653,0**	**673,2**	**462,3**	**1125,2**
9,00	**246**	**16,30**	**4,13**	**425,9**	**434,6**	**869,2**	**896,1**	**390,7**	**1210,3**
10,00	**246**	**20,56**	**5,21**	**537,1**	**548,1**	**1096,2**	**1130,1**	**344,2**	**1406,7**
11,00	**246**	**26,78**	**6,79**	**699,8**	**714,1**	**1428,1**	**1472,3**	**290,6**	**1631,7**
12,00	**246**	**35,31**	**8,95**	**922,6**	**941,4**	**1882,9**	**1941,1**	**240,5**	**1881,5**
+ 13,00 +	**246**	**47,43**	**12,02**	**1239,3**	**1264,6**	**2529,1**	**2607,3**	**194,0**	**2171,3**
14,00	**246**	**68,55**	**17,37**	**1791,0**	**1827,6**	**3655,2**	**3768,2**	**144,5**	**2573,3**
15,00	**246**	**130,78**	**33,14**	**3417,2**	**3487,0**	**6974,0**	**7189,6**	**81,2**	**3561,9**

	EFFICIENCY				THRUST		
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]	
7,00	**0,4613**	**0,9700**	**0,4496**	**0,41802**	**34,34**	**55,48**	
8,00	**0,4617**	**0,9700**	**0,4500**	**0,41524**	**44,18**	**71,40**	
9,00	**0,4875**	**0,9700**	**0,4751**	**0,4356**	**55,20**	**89,20**	
10,00	**0,5320**	**0,9700**	**0,5185**	**0,47616**	**68,37**	**110,48**	
11,00	**0,5611**	**0,9700**	**0,5469**	**0,51026**	**85,41**	**138,01**	
12,00	**0,5746**	**0,9700**	**0,5600**	**0,53288**	**105,71**	**170,81**	
+ 13,00 +	**0,5734**	**0,9700**	**0,5589**	**0,54608**	**130,80**	**211,36**	
14,00	**0,5507**	**0,9700**	**0,5367**	**0,55279**	**168,57**	**272,39**	
15,00	**0,4279**	**0,9700**	**0,4171**	**0,47159**	**233,25**	**376,91**	

Propulsion

17 jul 2018 05:22
HydroComp NavCad 2014

Project ID
Description
File name **cuaderno 6.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
7,00	**0,3411**	**0,0750**	**0,00883**	**0,64487**	**0,22248**	**1,6421**	**3,6138**	**1,09e7**	
8,00	**0,3425**	**0,0745**	**0,00880**	**0,63535**	**0,21902**	**1,6179**	**3,5578**	**1,24e7**	
9,00	**0,3618**	**0,0821**	**0,00970**	**0,62714**	**0,20475**	**1,597**	**3,3259**	**1,32e7**	
10,00	**0,4020**	**0,1017**	**0,01223**	**0,62922**	**0,18825**	**1,6023**	**3,0578**	**1,33e7**	
11,00	**0,4422**	**0,1270**	**0,01593**	**0,64958**	**0,18426**	**1,6541**	**2,9931**	**1,33e7**	
12,00	**0,4824**	**0,1572**	**0,02101**	**0,67554**	**0,18712**	**1,7203**	**3,0395**	**1,34e7**	
+ 13,00 +	**0,5226**	**0,1945**	**0,02821**	**0,71226**	**0,19769**	**1,8138**	**3,2112**	**1,34e7**	
14,00	**0,5628**	**0,2507**	**0,04078**	**0,79147**	**0,22875**	**2,0155**	**3,7158**	**1,35e7**	
15,00	**0,6030**	**0,3468**	**0,07779**	**0,95403**	**0,35485**	**2,4294**	**5,7641**	**1,35e7**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
7,00	**31,66**	**3,68**	**0,74**	**26,54**	**0,179**	**14,64**	**2,0**	**2,0**	**1119,5**
8,00	**24,24**	**2,84**	**0,57**	**30,21**	**0,208**	**18,84**	**2,0**	**2,0**	**1120,8**
9,00	**19,15**	**2,51**	**0,50**	**32,17**	**0,240**	**23,53**	**2,0**	**2,0**	**1181,0**
10,00	**15,51**	**2,51**	**0,50**	**32,17**	**0,276**	**29,15**	**2,0**	**2,0**	**1313,1**
11,00	**12,82**	**2,51**	**0,50**	**32,17**	**0,324**	**36,41**	**2,0**	**2,0**	**1453,3**
12,00	**10,77**	**2,51**	**0,49**	**32,17**	**0,381**	**45,07**	**3,9**	**3,9**	**1597,5**
+ 13,00 +	**9,18**	**2,51**	**0,49**	**32,17**	**0,453**	**55,77 !!**	**7,9**	**7,9**	**1749,0**
14,00	**7,91**	**2,51**	**0,49**	**32,17**	**0,563**	**71,87 !!**	**17,5**	**17,5**	**1925,1**
15,00	**6,89**	**2,51**	**0,48**	**32,17**	**0,752**	**99,45 !!**	**65,0 !!**	**65,0**	**2149,4**

Propulsion

17 jul 2018 05:22
HydroComp NavCad 2014

Project ID
Description
File name **cuaderno 6.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**86,386 m**
Max beam on WL:	[LWL/BWL 4,516]	**19,130 m**
Max molded draft:	[BWL/T 2,907]	**6,580 m**
Displacement:	[CB 0,691]	**7711,00 t**
Wetted surface:	[CS 2,873]	**2314,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,471]	**40,647 m**
LCF fwd TR:	[XCF/LWL 0,425]	**36,747 m**
Max section area:	[CX 0,985]	**124,0 m2**
Waterplane area:	[CWP 0,833]	**1377,3 m2**
Bulb section area:		**13,7 m2**
Bulb ctr below WL:		**3,000 m**
Bulb nose fwd TR:		**87,310 m**
Imm transom area:	[ATR/AX 0,242]	**30,0 m2**
Transom beam WL:	[BTR/BWL 1,000]	**19,130 m**
Transom immersion:	[TTR/T 2,432]	**16,000 m**
Half entrance angle:		**37,00 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:		**2500,0 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:		**2**	
Propulsor type:		**Propeller series**	
Propeller type:		**CPP**	
Propeller series:		**B Series**	
Propeller sizing:		**By power**	
Reference prop:			
Blade count:		**4**	
Expanded area ratio:		**0,4778**	**[Size]**
Propeller diameter:		**2500,0 mm**	**[Size]**
Propeller mean pitch:	[P/D 0,8554]	**2138,4 mm**	**[Size]**
Hub immersion:		**3500,0 mm**	

Engine/gear			
Engine data:		**Untitled Engine Obje...**	
Rated RPM:		**970 RPM**	
Rated power:		**1650,0 kW**	
Gear efficiency:		**0,970**	
Load correction:		**Off**	
Gear ratio:		**3,947**	**[Size]**
Shaft efficiency:		**0,980**	

Propeller options	
Oblique angle corr:	**Off**
Shaft angle to WL:	**0,00 deg**
Added rise of run:	**0,00 deg**
Propeller cup:	**0,0 mm**
KTKQ corrections:	**Custom**
Scale correction:	**None**
KT multiplier:	**1,000**
KQ multiplier:	**1,000**
Blade T/C [0.7R]:	**0,00**
Roughness:	**0,00 mm**
Cav breakdown:	**On**

Design condition	
Max prop diam:	**2500,0 mm**
Design speed:	**13,00 kt**
Reference power:	**1650,0 kW**
Design point:	**0,850**
Reference RPM:	**970,0**
Design point:	**1,030**

Propulsion

17 jul 2018 05:22
HydroComp NavCad 2014

Project ID
Description
File name **cuaderno 6.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

17 jul 2018 05:23

HydroComp NavCad 2014

Project ID

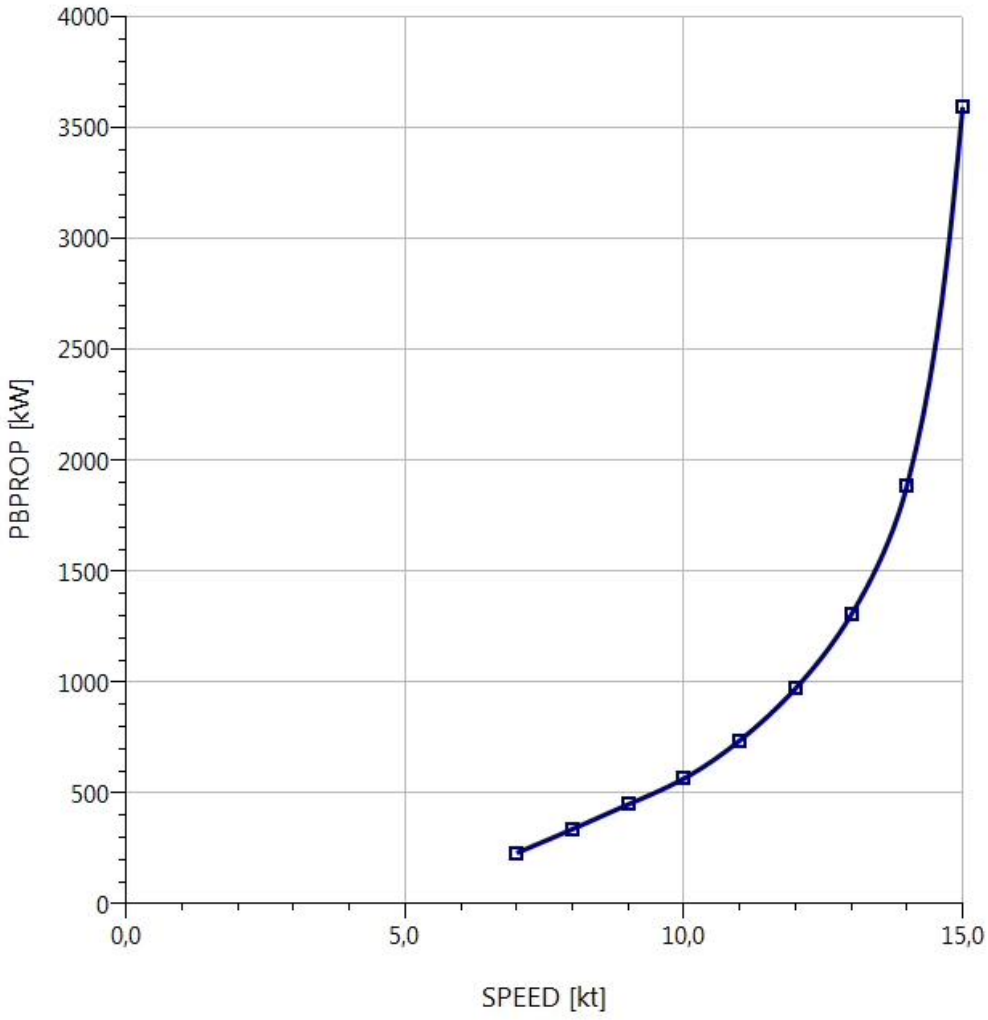
Description

File name **cuaderno 6.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:	**Fixed RPM**
Max prop diam:	**2500,0 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:			

Predicted propulsion



ANEXO 5: REPORTES ‘BY POWER’ 5 PALAS

Propulsion

17 jul 2018 05:23
HydroComp NavCad 2014

Project ID
Description
File name **cuaderno 6.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:	**Fixed RPM**
Max prop diam:	**2500,0 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**	**4,41**	**0,69**	**4,52***
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 [%]	
7,00	**199,8**	**0,1998**	**0,1921**	**0,9850**	**862**	**240,3**	**---**	**14,6**	
8,00	**293,9**	**0,1998**	**0,1921**	**0,9850**	**970**	**348,8**	**---**	**21,1**	
9,00	**413,0**	**0,1998**	**0,1921**	**0,9850**	**970**	**438,7**	**---**	**26,6**	
10,00	**568,4**	**0,1998**	**0,1921**	**0,9850**	**970**	**560,1**	**---**	**33,9**	
11,00	**781,0**	**0,1998**	**0,1921**	**0,9850**	**970**	**734,2**	**---**	**44,5**	
12,00	**1054,5**	**0,1998**	**0,1921**	**0,9850**	**970**	**970,0**	**---**	**58,8**	
+ 13,00 +	**1413,5**	**0,1998**	**0,1921**	**0,9850**	**970**	**1302,8**	**---**	**79,0**	
14,00	**1961,8**	**0,1998**	**0,1921**	**0,9850**	**970**	**1882,5**	**---**	**114,1**	
15,00	**2908,5**	**0,1998**	**0,1921**	**0,9850**	**970**	**3496,4**	**---**	**211,9**	

	POWER DELIVERY								
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP	CPPITCH [mm]
7,00	**201**	**10,68**	**2,49**	**228,4**	**233,1**	**466,2**	**480,6**	**566,6**	**1125,2**
8,00	**227**	**13,77**	**3,22**	**331,6**	**338,4**	**676,7**	**697,6**	**446,1**	**1143,3**
9,00	**227**	**17,32**	**4,04**	**417,1**	**425,6**	**851,2**	**877,5**	**399,0**	**1339,5**
10,00	**227**	**22,11**	**5,16**	**532,4**	**543,3**	**1086,5**	**1120,1**	**347,3**	**1551,6**
11,00	**227**	**28,98**	**6,77**	**697,9**	**712,2**	**1424,3**	**1468,4**	**291,4**	**1795,0**
12,00	**227**	**38,29**	**8,94**	**922,0**	**940,9**	**1881,7**	**1939,9**	**240,6**	**2066,3**
+ 13,00 +	**227**	**51,43**	**12,01**	**1238,4**	**1263,7**	**2527,4**	**2605,5**	**194,1**	**2382,6**
14,00	**227**	**74,31**	**17,35**	**1789,5**	**1826,0**	**3652,0**	**3765,0**	**144,7**	**2826,8**
15,00	**227**	**137,95**	**32,21**	**3323,6**	**3391,5**	**6783,0**	**6992,7**	**83,4**	**3849,9**

	EFFICIENCY				THRUST		
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]	
7,00	**0,4397**	**0,9700**	**0,4286**	**0,39847**	**34,34**	**55,49**	
8,00	**0,4455**	**0,9700**	**0,4342**	**0,40072**	**44,19**	**71,40**	
9,00	**0,4978**	**0,9700**	**0,4852**	**0,44481**	**55,20**	**89,19**	
10,00	**0,5367**	**0,9700**	**0,5231**	**0,48042**	**68,37**	**110,49**	
11,00	**0,5626**	**0,9700**	**0,5483**	**0,51162**	**85,41**	**138,01**	
12,00	**0,5749**	**0,9700**	**0,5604**	**0,53321**	**105,71**	**170,81**	
+ 13,00 +	**0,5738**	**0,9700**	**0,5593**	**0,54645**	**130,80**	**211,36**	
14,00	**0,5511**	**0,9700**	**0,5372**	**0,55325**	**168,56**	**272,38**	
15,00	**0,4399**	**0,9700**	**0,4288**	**0,48488**	**233,25**	**376,91**	

Propulsion

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Project ID

Description

File name **cuaderno 6.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
7,00	**0,3436**	**0,0762**	**0,00947**	**0,64493**	**0,23342**	**1,6423**	**3,7916**	**9,51e6**	
8,00	**0,3489**	**0,0774**	**0,00964**	**0,63537**	**0,22698**	**1,618**	**3,6869**	**1,07e7**	
9,00	**0,3926**	**0,0966**	**0,01213**	**0,62713**	**0,20051**	**1,597**	**3,257**	**1,07e7**	
10,00	**0,4362**	**0,1197**	**0,01548**	**0,62923**	**0,18658**	**1,6023**	**3,0308**	**1,08e7**	
11,00	**0,4798**	**0,1495**	**0,02030**	**0,64957**	**0,18377**	**1,6541**	**2,985**	**1,08e7**	
12,00	**0,5234**	**0,1851**	**0,02681**	**0,67554**	**0,187**	**1,7203**	**3,0376**	**1,09e7**	
+ 13,00 +	**0,5670**	**0,2290**	**0,03601**	**0,71226**	**0,19755**	**1,8138**	**3,209**	**1,09e7**	
14,00	**0,6106**	**0,2951**	**0,05204**	**0,79145**	**0,22855**	**2,0154**	**3,7126**	**1,09e7**	
15,00	**0,6539**	**0,4080**	**0,09651**	**0,95403**	**0,34513**	**2,4294**	**5,6062**	**1,10e7**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
7,00	**31,66**	**3,74**	**0,75**	**26,34**	**0,191**	**13,33**	**2,0**	**2,0**	**1127,8**
8,00	**24,24**	**2,95**	**0,60**	**29,65**	**0,224**	**17,16**	**2,0**	**2,0**	**1141,9**
9,00	**19,15**	**2,95**	**0,59**	**29,65**	**0,257**	**21,43**	**2,0**	**2,0**	**1281,4**
10,00	**15,51**	**2,95**	**0,59**	**29,65**	**0,298**	**26,55**	**2,0**	**2,0**	**1424,7**
11,00	**12,82**	**2,95**	**0,58**	**29,65**	**0,352**	**33,17**	**2,0**	**2,0**	**1576,8**
12,00	**10,77**	**2,95**	**0,58**	**29,65**	**0,416**	**41,05**	**3,7**	**3,7**	**1733,3**
+ 13,00 +	**9,18**	**2,95**	**0,57**	**29,65**	**0,497**	**50,79 !**	**7,6**	**7,6**	**1897,7**
14,00	**7,91**	**2,95**	**0,57**	**29,65**	**0,619**	**65,46 !!**	**17,1**	**17,1**	**2088,8**
15,00	**6,89**	**2,95**	**0,56**	**29,66**	**0,831**	**90,58 !!**	**58,8 !!**	**58,8**	**2331,1**

Propulsion

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Project ID
Description
File name **cuaderno 6.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**86,386 m**
Max beam on WL:	[LWL/BWL 4,516]	**19,130 m**
Max molded draft:	[BWL/T 2,907]	**6,580 m**
Displacement:	[CB 0,691]	**7711,00 t**
Wetted surface:	[CS 2,873]	**2314,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,471]	**40,647 m**
LCF fwd TR:	[XCF/LWL 0,425]	**36,747 m**
Max section area:	[CX 0,985]	**124,0 m2**
Waterplane area:	[CWP 0,833]	**1377,3 m2**
Bulb section area:		**13,7 m2**
Bulb ctr below WL:		**3,000 m**
Bulb nose fwd TR:		**87,310 m**
Imm transom area:	[ATR/AX 0,242]	**30,0 m2**
Transom beam WL:	[BTR/BWL 1,000]	**19,130 m**
Transom immersion:	[TTR/T 2,432]	**16,000 m**
Half entrance angle:		**37,00 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:		**2500,0 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:		**2**	
Propulsor type:		**Propeller series**	
Propeller type:		**CPP**	
Propeller series:		**B Series**	
Propeller sizing:		**By power**	
Reference prop:			
Blade count:		**5**	
Expanded area ratio:		**0,5246**	**[Size]**
Propeller diameter:		**2500,0 mm**	**[Size]**
Propeller mean pitch:	[P/D 0,9389]	**2347,4 mm**	**[Size]**
Hub immersion:		**3500,0 mm**	

Engine/gear			
Engine data:		**Untitled Engine Obje...**	
Rated RPM:		**970 RPM**	
Rated power:		**1650,0 kW**	
Gear efficiency:		**0,970**	
Load correction:		**Off**	
Gear ratio:		**4,282**	**[Size]**
Shaft efficiency:		**0,980**	

Propeller options	
Oblique angle corr:	**Off**
Shaft angle to WL:	**0,00 deg**
Added rise of run:	**0,00 deg**
Propeller cup:	**0,0 mm**
KTKQ corrections:	**Custom**
Scale correction:	**None**
KT multiplier:	**1,000**
KQ multiplier:	**1,000**
Blade T/C [0.7R]:	**0,00**
Roughness:	**0,00 mm**
Cav breakdown:	**On**

Design condition	
Max prop diam:	**2500,0 mm**
Design speed:	**13,00 kt**
Reference power:	**1650,0 kW**
Design point:	**0,850**
Reference RPM:	**970,0**
Design point:	**1,030**

Propulsion

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File name **cuaderno 6.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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Project ID

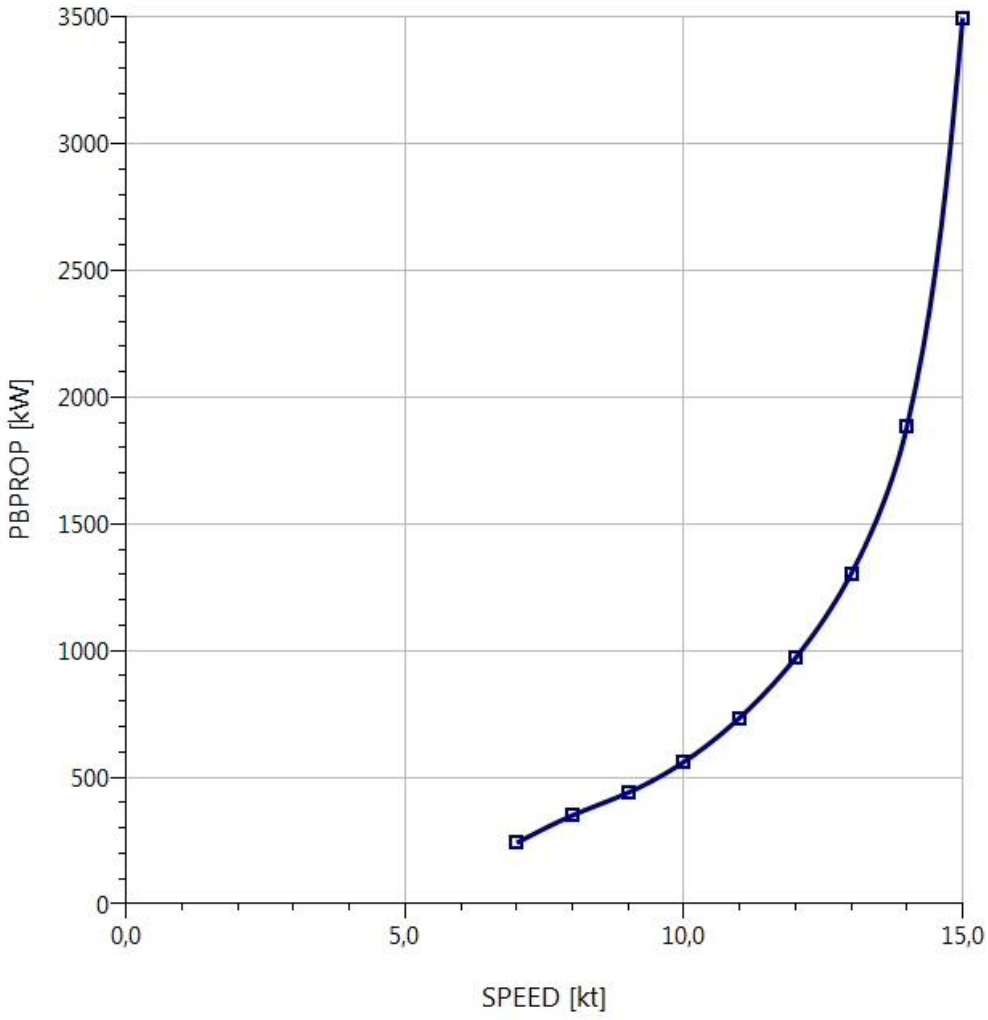
Description

File name **cuaderno 6.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:	**Fixed RPM**
Max prop diam:	**2500,0 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:			

Predicted propulsion



ANEXO 6: REPORTES ‘BY POWER’ 6 PALAS

Propulsion

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Project ID
Description
File name **cuaderno 6.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:	**Fixed RPM**
Max prop diam:	**2500,0 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**	**4,41**	**0,69**	**4,52***
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 [%]	
7,00	**199,8**	**0,1998**	**0,1921**	**0,9850**	**929**	**254,5**	**---**	**15,4**	
8,00	**293,9**	**0,1998**	**0,1921**	**0,9850**	**970**	**341,5**	**---**	**20,7**	
9,00	**413,0**	**0,1998**	**0,1921**	**0,9850**	**970**	**435,2**	**---**	**26,4**	
10,00	**568,4**	**0,1998**	**0,1921**	**0,9850**	**970**	**559,0**	**---**	**33,9**	
11,00	**781,0**	**0,1998**	**0,1921**	**0,9850**	**970**	**733,9**	**---**	**44,5**	
12,00	**1054,5**	**0,1998**	**0,1921**	**0,9850**	**970**	**968,8**	**---**	**58,7**	
+ 13,00 +	**1413,5**	**0,1998**	**0,1921**	**0,9850**	**970**	**1300,0**	**---**	**78,8**	
14,00	**1961,8**	**0,1998**	**0,1921**	**0,9850**	**970**	**1885,0**	**---**	**114,2**	
15,00	**2908,5**	**0,1998**	**0,1921**	**0,9850**	**1006**	**3371,9**	**---**	**204,4**	

	POWER DELIVERY								
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP	CPPITCH [mm]
7,00	**202**	**11,27**	**2,45**	**241,9**	**246,9**	**493,7**	**509,0**	**535,0**	**1125,1**
8,00	**211**	**14,49**	**3,15**	**324,7**	**331,3**	**662,6**	**683,0**	**455,6**	**1264,9**
9,00	**211**	**18,47**	**4,01**	**413,7**	**422,2**	**844,4**	**870,5**	**402,2**	**1474,4**
10,00	**211**	**23,71**	**5,15**	**531,3**	**542,2**	**1084,4**	**1117,9**	**348,0**	**1701,0**
11,00	**211**	**31,14**	**6,77**	**697,7**	**711,9**	**1423,8**	**1467,9**	**291,5**	**1961,4**
12,00	**211**	**41,10**	**8,93**	**920,9**	**939,7**	**1879,5**	**1937,6**	**240,9**	**2252,4**
+ 13,00 +	**211**	**55,15**	**11,98**	**1235,8**	**1261,0**	**2522,0**	**2600,0**	**194,5**	**2593,8**
14,00	**211**	**79,97**	**17,38**	**1791,9**	**1828,4**	**3656,9**	**3770,0**	**144,5**	**3081,4**
15,00	**219**	**137,90**	**29,96**	**3205,3**	**3270,8**	**6541,5**	**6743,8**	**86,5**	**3849,9**

	EFFICIENCY				THRUST		
SPEED [kt]	EFFO	EFFG	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]	
7,00	**0,4153**	**0,9700**	**0,4047**	**0,37631**	**34,34**	**55,49**	
8,00	**0,4550**	**0,9700**	**0,4435**	**0,40924**	**44,18**	**71,40**	
9,00	**0,5018**	**0,9700**	**0,4891**	**0,44841**	**55,20**	**89,20**	
10,00	**0,5378**	**0,9700**	**0,5242**	**0,48138**	**68,38**	**110,49**	
11,00	**0,5628**	**0,9700**	**0,5485**	**0,51182**	**85,41**	**138,02**	
12,00	**0,5756**	**0,9700**	**0,5610**	**0,53384**	**105,71**	**170,81**	
+ 13,00 +	**0,5751**	**0,9700**	**0,5605**	**0,54762**	**130,80**	**211,36**	
14,00	**0,5504**	**0,9700**	**0,5365**	**0,55253**	**168,57**	**272,39**	
15,00	**0,4562**	**0,9700**	**0,4446**	**0,50278**	**233,25**	**376,92**	

Propulsion

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HydroComp NavCad 2014

Project ID
Description
File name **cuaderno 6.hcnc**

Prediction results [Propulsor]

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KTJ2	KQJ3	CTH	CP	RNPROP	
7,00	**0,3425**	**0,0757**	**0,00993**	**0,64495**	**0,24718**	**1,6423**	**4,0151**	**8,67e6**	
8,00	**0,3750**	**0,0894**	**0,01172**	**0,63533**	**0,22223**	**1,6179**	**3,6098**	**9,07e6**	
9,00	**0,4219**	**0,1116**	**0,01494**	**0,62713**	**0,1989**	**1,597**	**3,2309**	**9,10e6**	
10,00	**0,4688**	**0,1383**	**0,01918**	**0,62925**	**0,18622**	**1,6024**	**3,0249**	**9,13e6**	
11,00	**0,5157**	**0,1727**	**0,02519**	**0,6496**	**0,18371**	**1,6542**	**2,9841**	**9,17e6**	
12,00	**0,5625**	**0,2138**	**0,03325**	**0,67554**	**0,18678**	**1,7203**	**3,034**	**9,21e6**	
+ 13,00 +	**0,6094**	**0,2645**	**0,04462**	**0,71226**	**0,19713**	**1,8138**	**3,2021**	**9,25e6**	
14,00	**0,6563**	**0,3409**	**0,06469**	**0,79147**	**0,22886**	**2,0155**	**3,7175**	**9,30e6**	
15,00	**0,6778**	**0,4383**	**0,10364**	**0,95404**	**0,33285**	**2,4294**	**5,4067**	**9,67e6**	

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
7,00	**31,66**	**3,71**	**0,75**	**26,43**	**0,203**	**12,23**	**2,0**	**2,0**	**1124,0**
8,00	**24,24**	**3,41**	**0,68**	**27,59**	**0,238**	**15,73**	**2,0**	**2,0**	**1227,3**
9,00	**19,15**	**3,41**	**0,68**	**27,59**	**0,275**	**19,65**	**2,0**	**2,0**	**1377,3**
10,00	**15,51**	**3,41**	**0,67**	**27,59**	**0,320**	**24,35**	**2,0**	**2,0**	**1531,3**
11,00	**12,82**	**3,41**	**0,67**	**27,59**	**0,380**	**30,41**	**2,0**	**2,0**	**1694,7**
12,00	**10,77**	**3,41**	**0,66**	**27,59**	**0,451**	**37,64**	**3,6**	**3,6**	**1862,9**
+ 13,00 +	**9,18**	**3,41**	**0,65**	**27,59**	**0,540**	**46,57**	**7,5**	**7,5**	**2039,6**
14,00	**7,91**	**3,41**	**0,65**	**27,59**	**0,676**	**60,02 !!**	**16,9**	**16,9**	**2245,0**
15,00	**6,89**	**3,17**	**0,60**	**28,62**	**0,913**	**83,06 !!**	**46,8 !!**	**46,8**	**2416,2**

Propulsion

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Project ID
Description
File name **cuaderno 6.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**86,386 m**
Max beam on WL:	[LWL/BWL 4,516]	**19,130 m**
Max molded draft:	[BWL/T 2,907]	**6,580 m**
Displacement:	[CB 0,691]	**7711,00 t**
Wetted surface:	[CS 2,873]	**2314,6 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,471]	**40,647 m**
LCF fwd TR:	[XCF/LWL 0,425]	**36,747 m**
Max section area:	[CX 0,985]	**124,0 m2**
Waterplane area:	[CWP 0,833]	**1377,3 m2**
Bulb section area:		**13,7 m2**
Bulb ctr below WL:		**3,000 m**
Bulb nose fwd TR:		**87,310 m**
Imm transom area:	[ATR/AX 0,242]	**30,0 m2**
Transom beam WL:	[BTR/BWL 1,000]	**19,130 m**
Transom immersion:	[TTR/T 2,432]	**16,000 m**
Half entrance angle:		**37,00 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:		**2500,0 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:		**2**	
Propulsor type:		**Propeller series**	
Propeller type:		**CPP**	
Propeller series:		**B Series**	
Propeller sizing:		**By power**	
Reference prop:			
Blade count:		**6**	
Expanded area ratio:		**0,5721**	**[Size]**
Propeller diameter:		**2500,0 mm**	**[Size]**
Propeller mean pitch:	[P/D 1,0231]	**2557,7 mm**	**[Size]**
Hub immersion:		**3500,0 mm**	

Engine/gear			
Engine data:		**Untitled Engine Obje...**	
Rated RPM:		**970 RPM**	
Rated power:		**1650,0 kW**	
Gear efficiency:		**0,970**	
Load correction:		**Off**	
Gear ratio:		**4,603**	**[Size]**
Shaft efficiency:		**0,980**	

Propeller options	
Oblique angle corr:	**Off**
Shaft angle to WL:	**0,00 deg**
Added rise of run:	**0,00 deg**
Propeller cup:	**0,0 mm**
KTKQ corrections:	**Custom**
Scale correction:	**None**
KT multiplier:	**1,000**
KQ multiplier:	**1,000**
Blade T/C [0.7R]:	**0,00**
Roughness:	**0,00 mm**
Cav breakdown:	**On**

Design condition	
Max prop diam:	**2500,0 mm**
Design speed:	**13,00 kt**
Reference power:	**1650,0 kW**
Design point:	**0,850**
Reference RPM:	**970,0**
Design point:	**1,030**

Propulsion

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Project ID
Description
File name **cuaderno 6.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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Description

File name **cuaderno 6.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:	**Fixed RPM**
Max prop diam:	**2500,0 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:			

Predicted propulsion