UNIVERSIDADE DA CORUÑA

Escola Politécnica Superior

Traballo Fin de Grao
CURSO 2021/2022

Remolcador Acimutal de Puerto

Grao en Enxeñaría Naval e Oceánica

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DATA 1/12/21

UNIVERSIDADE DA CORUÑA

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CUADERNO 1

Grao en Enxeñaría Naval e Oceánica

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UNIVERSIDADE DA CORUÑA

GRADO EN INGENIERÍA NAVAL Y OCEÁNICA
TRABAJO FIN DE GRADO

CURSO 2021-2022

PROYECTO NÚMERO GENO-2020-04

TIPO DE BUQUE: Remolcador Acimutal de puerto - 50 TPF

CLASIFICACIÓN, COTA Y REGLAMENTOS DE APLICACIÓN: Bureau Veritas, SOLAS, MARPOL.

CARACTERÍSTICAS DE LA CARGA: Bollard Pull 50 toneladas.

VELOCIDAD Y AUTONOMÍA: Velocidad en servicio 12 nudos, 500 millas de autonomía. Propulsión DUAL.

SISTEMAS Y EQUIPOS DE CARGA / DESCARGA: Las propias del tipo de buque.

PROPULSIÓN: Propulsión azimutal Motores Dual Fuel.

TRIPULACIÓN Y PASAJE: 6 de tripulación.

OTROS EQUIPOS E INSTALACIONES: Maquinilla de remolque en proa.

Ferrol, 27 noviembre 2021

ALUMNO/A: **Dª MARIA VICTORIA BOADO ANTÓN**

ÍNDICE

1 INTRODUCCIÓN

En este primer capítulo de tratará de hacer el dimensionamiento preliminar de un Remolcador Acimutal de puerto.

El remolcador tendrá 50 t de tracción a un punto fijo y alrededor de 25 metros de eslora. La velocidad de servicio será de 12 nudos. La propulsión será de tipo azimutal, con motores Dual Fuel. Tendrá maquinilla de remolque en proa y propulsión en popa.

Este remolcador llevará a 6 tripulantes.

Para el dimensionamiento se partirá de una base de datos con buques de características similares a este. Se harán relaciones lineales entre las dimensiones principales de los buques de la base de datos para conseguir las del buque proyecto.

2 BASE DE DATOS

Para la base de datos hay 16 buques con características similares al remolcador en el que se va a centrar este proyecto.

Por un lado, los nombres, clasificación y referencia de cada uno:

	año	clasificación	Referencia	TIPO DE PROPULSIÓN
CAP DE FER	2018	Bureau Veritas	Significant Ships	ASD
FREGATE	2018	Bureau Veritas	Significant Ships	ASD
MED XXIV	2018	RINA	Significant Ships	ASD
NOORDZEE	2016	Lloyd´s Register	Significant Ships	ASD
PACIFIC TITAN	2017	Lloyd´s Register	Significant Ships	ASD
TELSTAR	2016	Bureau Veritas	Significant Ships	ASD
TAI PARI	2015	Lloyd´s Register	Significant Ships	ASD
EDDY1	2014	Bureau Veritas	Significant Ships	ASD
VALLIANT	2010	ABS, A1…	Significant Ships	ASD
OCEAN PIONEER	2011	Lloyd´s Register	Significant Ships	ASD
ST ELMO	2011	RINa C	Significant Ships	ASD
JIN GANG LUN 26	2013	CCS	Significant Ships	ASD
ZEYCAN Y	2013	ABS, A1…	Significant Ships	ASD
RT EMOTION	2015	Lloyd´s Register	Significant Ships	ASD
YENIÇAY 1	2015	ABS, A1…	Significant Ships	ASD
IBAIZABAL QUINCE	2019	Bureau Veritas	Ibaizabal	ASD

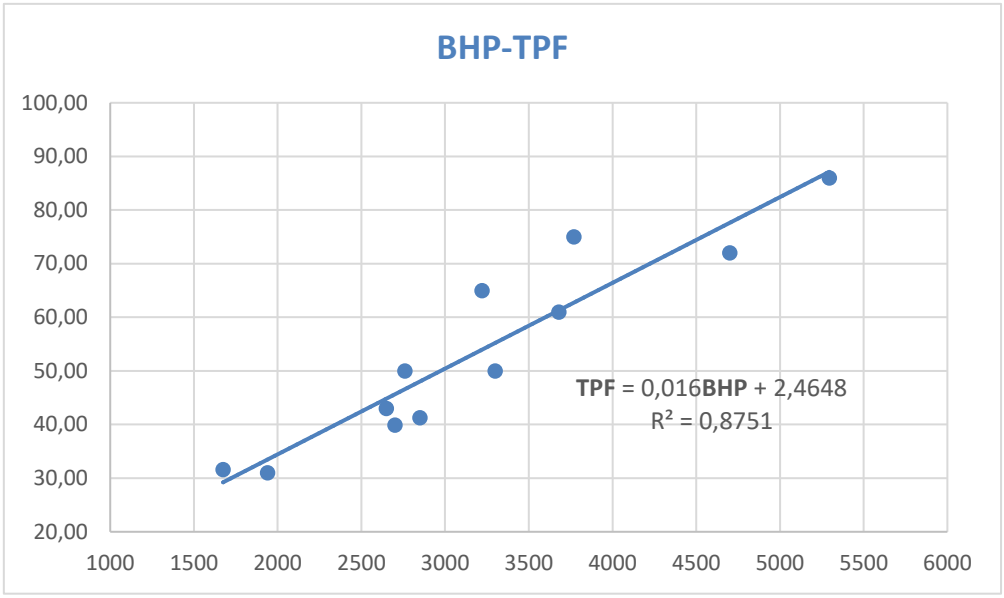
Por otro lado, un resumen de las características principales:

	TPF(t)	Δ(t)	Lpp (m)	Lt (m)	B (m)	D (m)	Td (m)	v(nudos)	P(KW)
CAP DE FER	43,00	592	25,65	26,00	10,00	5,35	3,85	12,50	2650
FREGATE	41,30	577	25,65	29,20	12,50	5,50	5,10	12,20	2850
MED XXIV	50,00			23,00	10,90	4,40	3,15	12,00	2760
NOORDZEE	61,00	590		28,67	10,43	4,60	5,05	13,20	3680
PACIFIC TITAN	31,60	365		25,80	9,10	3,60	2,65	12,70	1674
TELSTAR	75,00	529	23,57	25,45	11,40	7,01	5,65	8,20	3770
TAI PARI	72,00	517		24,40	11,25	4,20	5,34	13,00	4700
EDDY1	65,00	500	28,95	30,30	12,40	6,65	4,75	13,40	3220
VALLIANT	39,90	527	25,17	27,42	11,65	5,00	4,88	12,00	2700
OCEAN PIONEER		885		32,00	12,40	5,40	4,88	13,00	3678
ST ELMO		905		30,25	11,75	5,28	5,85	13,00	4200
JIN GANG LUN 26		1059	29,43	35,00	12,40	5,40	4,20	13,00	4780
ZEYCAN Y		500	23,45	24,40	11,25	4,38	5,20	12,00	3530
RT EMOTION	86,00	598		31,95	12,60	4,82	6,25	13,10	5295
YENIÇAY 1	31,00	256	17,40	18,70	9,20	3,50	3,70	12,00	1940
IBAIZABAL QUINCE	50,00		23,40	29,00	12,00	4,80	3,80	12,00	3300

3 DIMENSIONAMIENTO PRELIMINAR

3.1 Estimación de la eslora

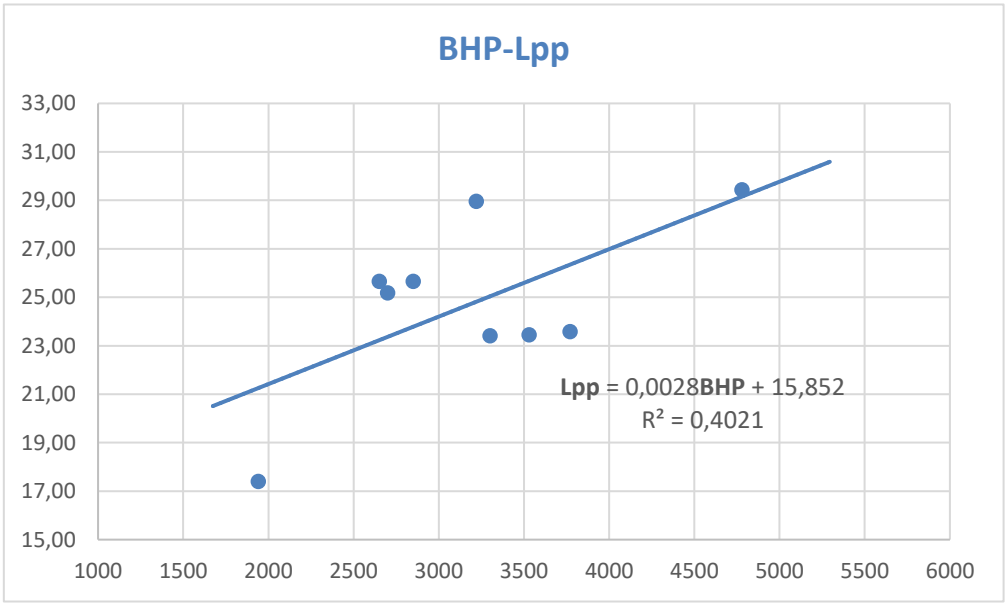
Para la estimación de la eslora, se establece la relación entre la potencia y la tracción a un punto fijo, obteniendo la ecuación de la gráfica y de ahí sacando el valor de BHP del remolcador a dimensionar.



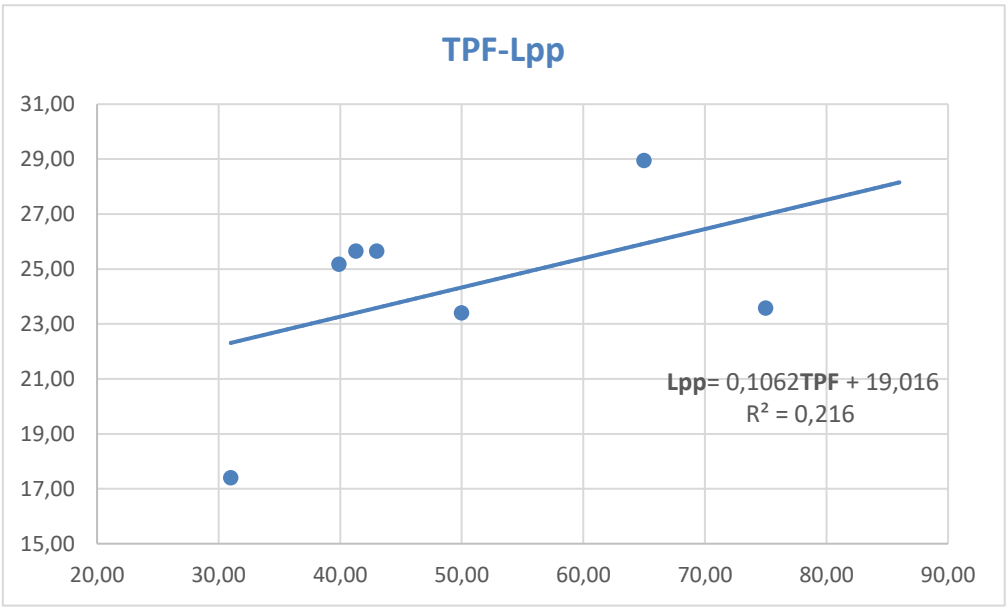
Despejando BHP queda:

BHP= 2970,95 KW

Ahora se relaciona la potencia con la eslora entre perpendiculares de cada buque de la base de datos. Con la ecuación de la recta y el valor de BHP calculado en el paso anterior, se obtiene la eslora entre perpendiculares.



Ahora, el TPF con las esloras entre perpendiculares y, siguiendo el mismo método, se vuelve a calcular la eslora que corresponde.

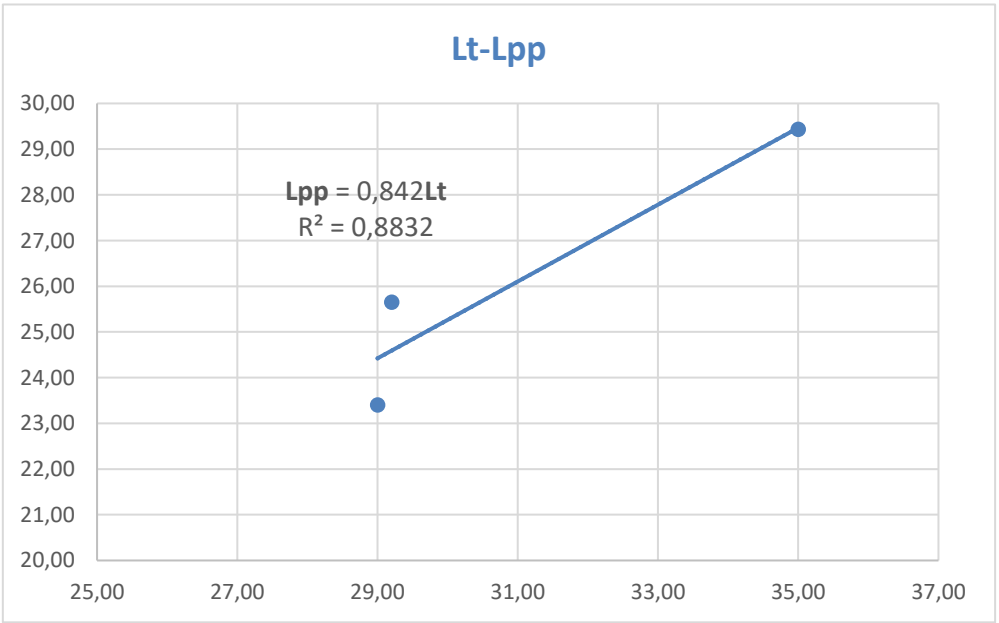


Este último dato se va a descartar, ya que la R^2 es muy pequeña (menor de 0.4). El resultado más fiable será:

Lpp= 24.17 m

Ahora, enfrentando Lt y Lpp, se despeja la eslora total.

Quedaría:



Lt= 28,71 m

3.2 Estimación de la manga

Igual que con la eslora, se enfrenta Lpp/B con Lpp, se saca la ecuación de la recta y se obtiene B, la manga del remolcador.

	Lpp (m)	B (m)	Lpp/B
CAP DE FER	25,65	10,00	2,57
FREGATE	25,65	12,50	2,05
MED XXIV		10,90	
NOORDZEE		10,43	
PACIFIC TITAN		9,10	
TELSTAR	23,57	11,40	2,07
TAI PARI		11,25	
EDDY1	28,95	12,40	2,33
VALLIANT	25,17	11,65	2,16
OCEAN PIONEER		12,40	
ST ELMO		11,75	
JIN GANG LUN 26	29,43	12,40	2,37
ZEYCAN Y	23,45	11,25	2,08
RT EMOTION		12,60	
YENIÇAY 1	17,40	9,20	1,89
IBAIZABAL QUINCE	23,40	12,00	1,95

B= 11,31 m

3.3 Estimación del puntal

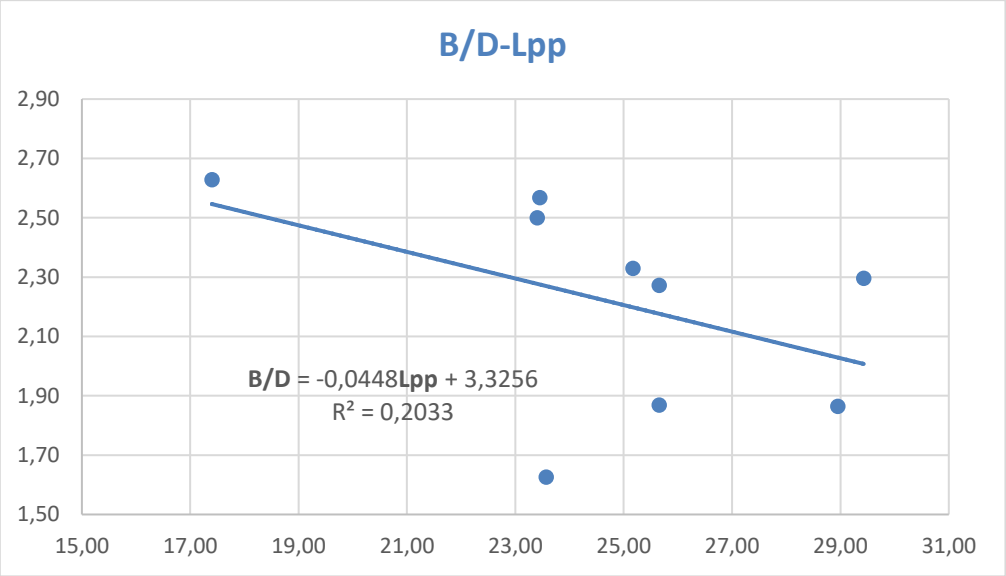
Para el puntal, se enfrentan Lpp/D con Lpp y B/D con Lpp.

	Lpp (m)	D (m)	Lpp/D	B (m)	B/D
CAP DE FER	25,65	5,35	4,79	10,00	1,87
FREGATE	25,65	5,50	4,66	12,50	2,27
MED XXIV		4,40		10,90	2,48
NOORDZEE		4,60		10,43	2,27
PACIFIC TITAN		3,60		9,10	2,53
TELSTAR	23,57	7,01	3,36	11,40	1,63
TAI PARI		4,20		11,25	2,68
EDDY1	28,95	6,65	4,35	12,40	1,86
VALLIANT	25,17	5,00	5,03	11,65	2,33
OCEAN PIONEER		5,40		12,40	2,30
ST ELMO		5,28		11,75	2,23
JIN GANG LUN 26	29,43	5,40	5,45	12,40	2,30
ZEYCAN Y	23,45	4,38	5,35	11,25	2,57
RT EMOTION		4,82		12,60	2,61
YENIÇAY 1	17,40	3,50	4,97	9,20	2,63
IBAIZABAL QUINCE	23,40	4,80	4,88	12,00	2,50

Con esta fórmula el puntal sería:

D= 5,08 m

Se descarta por tener un valor de R^2 demasiado bajo.



Con esta regresión el puntal será:

D= 5,04 m

Este es el valor final.

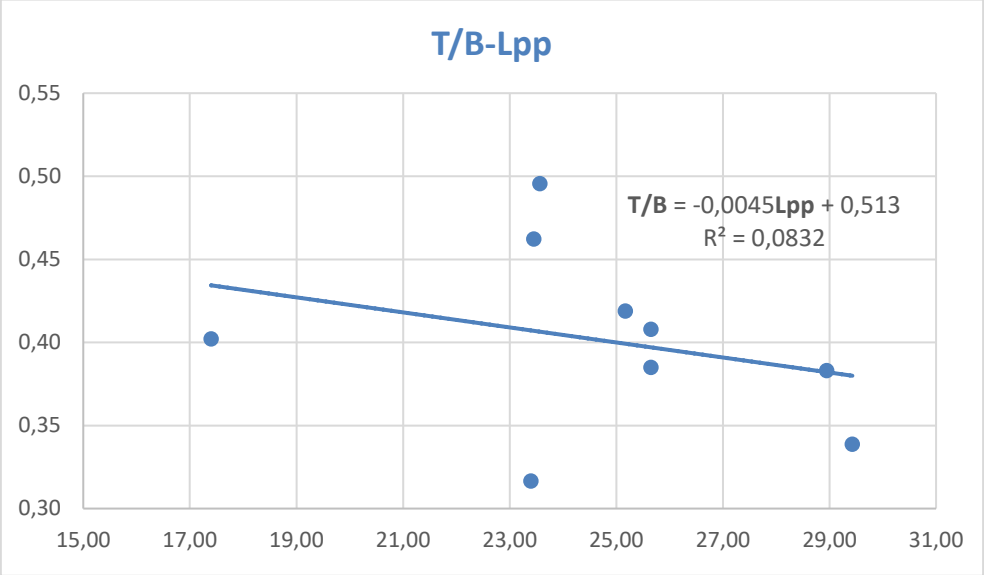
3.4 Estimación del calado

En este caso se comparan tanto T/D con Lpp, como T/B con Lpp. Se sacan dos valores de T.

	Lpp (m)	D (m)	B (m)	Td (m)	T/D	T/B
CAP DE FER	25,65	5,35	10,00	3,85	0,72	0,39
FREGATE	25,65	5,50	12,50	5,10	0,93	0,41
MED XXIV		4,40	10,90	3,15	0,72	0,29
NOORDZEE		4,60	10,43	5,05	1,10	0,48
PACIFIC TITAN		3,60	9,10	2,65	0,74	0,29
TELSTAR	23,57	7,01	11,40	5,65	0,81	0,50
TAI PARI		4,20	11,25	5,34	1,27	0,47
EDDY1	28,95	6,65	12,40	4,75	0,71	0,38
VALLIANT	25,17	5,00	11,65	4,88	0,98	0,42
OCEAN PIONEER		5,40	12,40	4,88	0,90	0,39
ST ELMO		5,28	11,75	5,85	1,11	0,50
JIN GANG LUN 26	29,43	5,40	12,40	4,20	0,78	0,34
ZEYCAN Y	23,45	4,38	11,25	5,20	1,19	0,46
RT EMOTION		4,82	12,60	6,25	1,30	0,50
YENIÇAY 1	17,40	3,50	9,20	3,70	1,06	0,40
IBAIZABAL QUINCE	23,40	4,80	12,00	3,80	0,79	0,32

Este valor es el definitivo:

T= 4,54 m



Este valor se descarta por tener un valor de R^2 demasiado bajo:

T= 4,57 m

3.5 Estimación del coeficiente de bloque

El coeficiente de bloque se calcula a partir de la siguiente fórmula, de **"EL PROYECTO BÁSICO DEL BUQUE MERCANTE":**

Cb= 1,20-0,5*V/Lpp^0,5

Cb= 0,57

3.6 Estimación del coeficiente de la maestra

Igual que el coeficiente de bloque, el de la maestra se calcula a partir de la siguiente tabla, también sacada del libro **"EL PROYECTO BÁSICO DEL BUQUE MERCANTE":**

Interpolando con Cb=0,57:

TABLA 2.11.4.

COEFICIENTE DE LA MAESTRA, CM

CB	CM
0,450	0,805
0,500	0,845
0,550	0,870
0,600	0,895

Cm=0,88

3.7 Estimación del coeficiente prismático

Se calcula a partir de la relación:

Cp=Cb/Cm

Cp= 0,65

3.8 Estimación del desplazamiento:

Δ= cb*ρ*Lpp*B*T

∆= 733,22 t

3.9 Resumen de resultados:

T (m)	4,57
Lpp (m)	24,17
Lt (m)	26,48
BHP (KW)	2970,95
TPF (tons)	50,00
B (m)	11,31
D (m)	5,04
Cb	0,57
Δ (tons)	733,22
Cm	0,88
Cp	0,65

4 RELACIÓN POTENCIA (KW)/TPF (T)

Según la tabla, del libro **"EL PROYECTO BÁSICO DEL BUQUE MERCANTE"**, la relación potencia/TPF:

K= 59,41

Por lo tanto, el buque proyecto tendría dos hélices con tobera, azimutal.

TABLA 2.11.1.

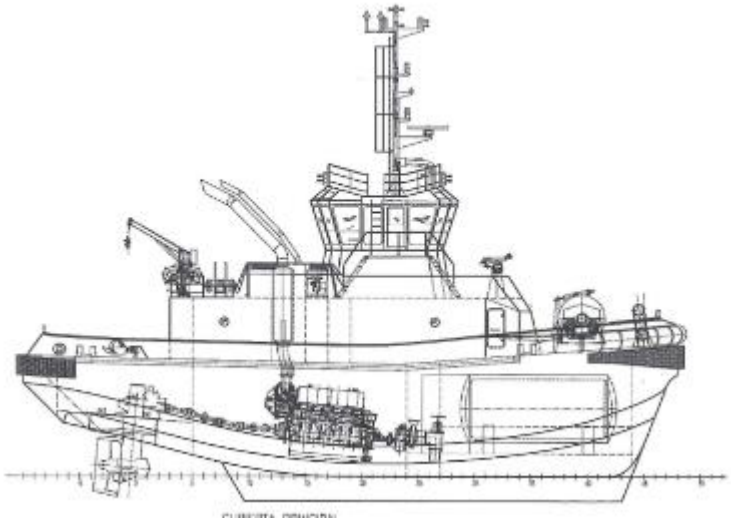
K1, RELACIÓN POTENCIA (kW) / TPF (t)

Una hélice sin tobera	65-70
Dos hélices sin tobera	63-68
Una hélice con timón-tobera (Kort)	60-65
Dos hélices con timón-tobera (Kort)	55-60
Dos hélices con tobera, azimutal (*)	55-60
Dos hélices cicloidales azimutales (**)	63-68

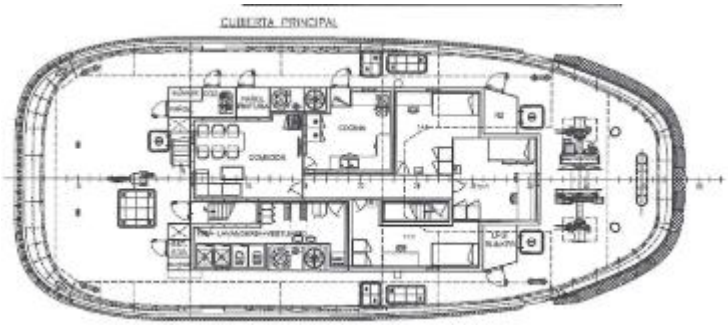
5 DISPOSICIÓN GENERAL

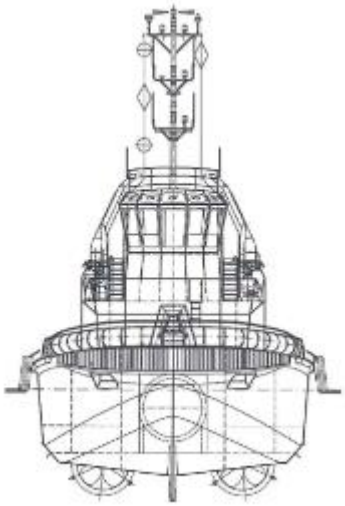
El IBAIZABAL QUINCE sería el buque base.

Perfil:



Cubierta principal:





6 CÁLCULO DE LA CIFRA DE MÉRITO

Después de las regresiones, con los datos finales ya obtenidos, se pasa a calcular la cifra de mérito. Se usará como esta, el coste mínimo de construcción del buque proyecto.
Para realizar las iteraciones, se escogen una serie de alternativas. Estas alternativas se escogen del libro **"SELECCIÓN DE CONFIGURACIÓN: DIMENSIONES COEFICIENTES".** Con estas, se varía la eslora, el desplazamiento, la manga y los coeficientes de bloque, maestra y prismático.

ALTERNATIVAS
0,90
0,93
0,95
0,98
1,00
1,03
1,05

Por otro lado, para que el numero cúbico del buque sea siempre el mismo, el puntal sigue la fórmula:

D= L0*B0*D0/L*B

Así mismo, el calado será:

T= ∆/ (1.025*L*B*Cb)

Con todas las variaciones dimensionales, se pasa a calcular el coste aproximado de cada alternativa en base a su peso, siguiendo los libros del **"CÁLCULO DEL DESPLAZAMIENTO"** y **"CRITERIOS DE EVALUACIÓN TÉCNICA Y ECONÓMICA DEL PROYECTO DE UN BUQUE"** para las fórmulas de coste y pesos (CC, PS, PER, PQ).
Por un lado, PS sería:

$$PS = \left(\frac{Lpp}{10}\right)^{1,37} x \left(\frac{BxD}{100}\right)^{0,74495} x(0{,}054244 - 0{,}0116919xCb)$$

PER. El peso de los equipos restantes:

$$PER = 0{,}045xLpp^{1,3}xB^{0,8}xD^{0,3}$$

Por último, PQ, el peso de la maquinaria:

$$PQ = POTENCIAxKQ$$

Donde:

- KQ=0,0035

- POTENCIA= 2970,95 Kw

	Potencia Kw	Peso t/Kw	R.P.M.
Motores lentos	2,000-5,000 5,00-10,000 10,000-70,000	0.015-0.022 0.022-0.029 0.029-0.039	250-175 175-100 100-80
Motores velocidad media	600-17,000	0.009-0.018	900-400
Motores alta velocidad		0.003-0.004	
Turbinas		0.001	

El siguiente paso es realizar los cálculos que nos permitan estimar los Costes de Construcción (CC) del buque y elegir aquellas alternativas en las cuales es menor. El coste será:

$$CC = CMg + CEq + CMo + CVa$$

Donde:

- CMg es el costo de los materiales a granel (el del acero).
- CEq es el coste de los equipos (coste de la maquinaria y de los equipos restantes) CMo es el coste de la mano de obra.
- CVa incluye los costes extras del astillero.

La fórmula desarrollada:

$$CC = (ccs * cas * cem * ps + chm * csh) * PS + CEc + cep * BP + chf * nch * NT + ccs * ps + cva * CC)$$

Donde:

- **ccs** el coeficiente ponderado de las chapas y perfiles de distintas calidades de acero €1.25<ccs<1.35, se toma un valor medio de 1,30.
- **cas** el coeficiente de aprovechamiento del acero 1,08<cas<1,15, cogiendo un valor intermedio cas= 1,12.
- **cem** el coeficiente de incremento por equipo metálico 1,03<cem<1,10., será= 1,08.
- **chm** el coste horario medio del astillero 21/25<chm<30/40, se coge un valor intermedio de 30 €/h.
- **csh** coeficiente de horas por unidad de peso 20/30<csh<80/100, por lo que csh=65€/tn.
- **CEc** el coste de los equipos de manipulación de carga.
- **cep** el coeficiente de coste por unidad de potencia de los equipos de propulsión y sus auxiliares 300<cep<400€/Kw por lo que cep= 350€/Kw.
- **BP** la potencia estimada.
- **chf** el coeficiente de coste unitario por habilitación de tripulante.
- **nch** coeficiente de nivel de calidad de la habilitación.

- **NT** la tripulación.
- **cva** el coeficiente de los costes varios del astillero 0,05<cva<0,10, por lo que cva=0,08.

Así los coeficientes quedarían:

coeficientes	
ccs	1,30
cas	1,12
cem	1,08
chm	30,00
csh	65,00
cep	350,00
cva	0,08
ps	450,00

Los costes asociados a la tripulación y habilitación no se calculan dado que en todas las alternativas se tiene el mismo número de tripulantes a bordo y tampoco los equipos de manipulación de carga debido a que en este buque no tienen mucha importancia.

Con los pesos ya calculados quedaría:

$$dCPS = ks * dPS$$

$$dCPQ = km * dPot\ d$$

$$CPER = ker * dPE$$

Donde:

- $ks = ccs * cas * cem * ps + chm * csh = 802{,}616\ (€/\text{tn})$
- $km = ce = 350\ (€/\text{tn})$
- ker = cer = ccs * ps = 585 (€/Kw)

$$dCoste = (dCPS + dCPM + dCPER) * 1.08$$

Con todo, salen una serie de posibilidades. Con cada una de ellas, se compara la diferencia de coste con el buque proyecto inicial.

Además, las posibilidades que se salgan de estos rangos se irán descartando:

- 3,36<**L/D**<5,45
- 1,63<**B/D**<2,68
- 1,30<**T/D**<0,71

Estos rangos corresponden a los valores máximos y mínimos de la base de datos inicial.

Ahora, ordenando de menor a mayor según la diferencia de coste de cada alternativa con el buque proyecto inicial, se obtienen las alternativas posibles (dentro de rango) y más baratas. El buque escogido es la alternativa 193 de las 343 que hay en total. Es una alternativa que sale 1130,48 € más barata que la inicial y además las dimensiones se adecuan a las del buque base.

Lpp(m)	B(m)	D(m)	T(m)	Cb	Cm	Cp	Desplazamiento (t)	LBD (m3)
23,57	11,87	4,92	4,57	0,56	0,86	0,64	731,91	1377,56

7 ESTIMACIÓN DE PESOS

7.1 Peso en rosca

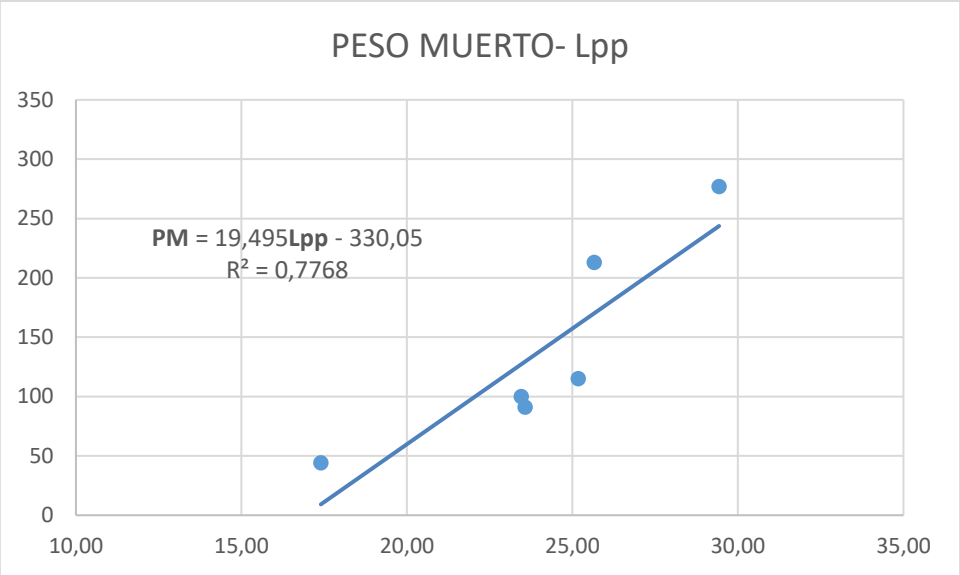
El peso en rosca se calcula a partir de la fórmula:

PR = PS + PER + PQ = 104,81 + 31,98 + 237,78

PR= 374,57 t

7.2 Peso muerto

Para el peso muerto hacemos la regresión de la recta PESO MUERTO/Lpp.



PM= 19,45***Lpp**-330,05

PM= 140,05 t

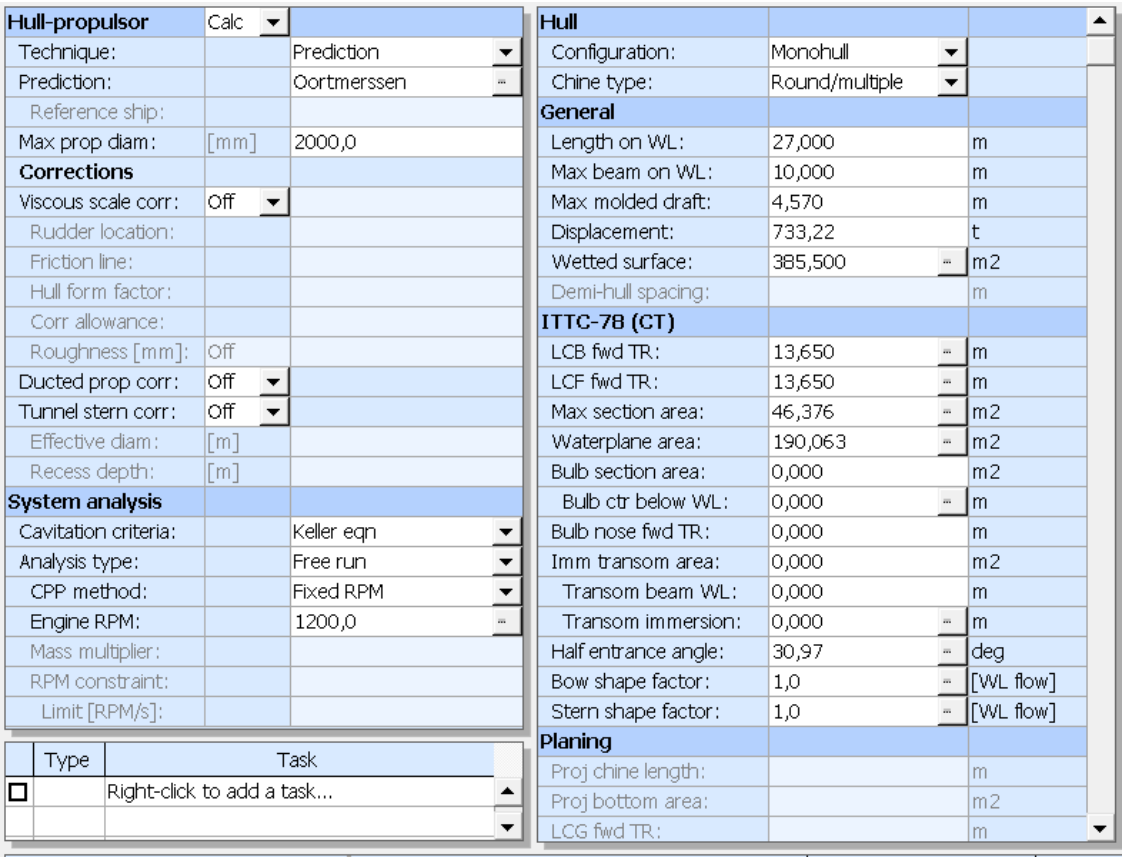
7.3 Desplazamiento

El desplazamiento será la suma del peso en rosca y el peso muerto:

Δ= PR + PM = 514,62 t

8 CÁLCULO DE LA POTENCIA EN LA NAVEGACIÓN

Para calcular la potencia que debe transmitir el eje de la hélice, se utilizará la aplicación "Navcad".



Hull-propulsor	Calc	
Technique:		Prediction
Prediction:		Oortmerssen
Reference ship:		
Max prop diam:	[mm]	2000,0
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]:		

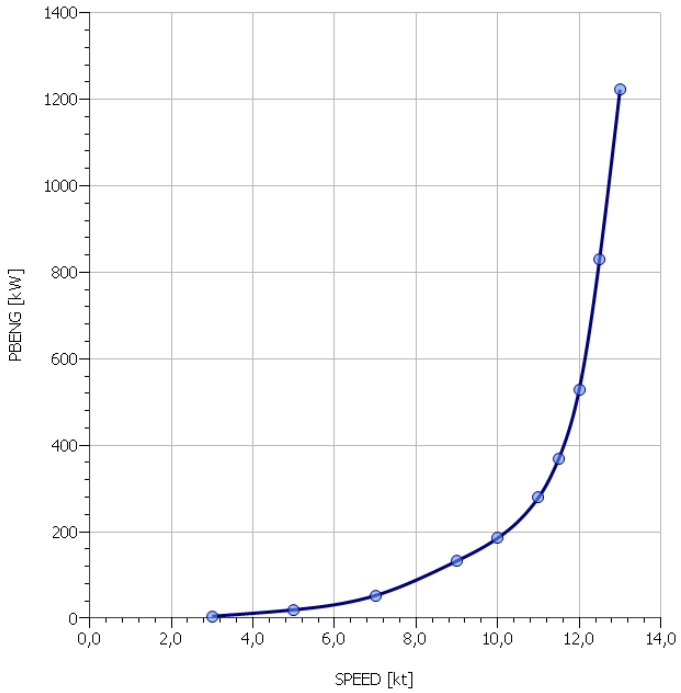
Type	Task
	Right-click to add a task...

Hull		
Configuration:	Monohull	
Chine type:	Round/multiple	
General		
Length on WL:	27,000	m
Max beam on WL:	10,000	m
Max molded draft:	4,570	m
Displacement:	733,22	t
Wetted surface:	385,500	m2
Demi-hull spacing:		m
ITTC-78 (CT)		
LCB fwd TR:	13,650	m
LCF fwd TR:	13,650	m
Max section area:	46,376	m2
Waterplane area:	190,063	m2
Bulb section area:	0,000	m2
Bulb ctr below WL:	0,000	m
Bulb nose fwd TR:	0,000	m
Imm transom area:	0,000	m2
Transom beam WL:	0,000	m
Transom immersion:	0,000	m
Half entrance angle:	30,97	deg
Bow shape factor:	1,0	[WL flow]
Stern shape factor:	1,0	[WL flow]
Planing		
Proj chine length:		m
Proj bottom area:		m2
LCG fwd TR:		m

Se introducen las dimensiones del buque y sus coeficientes en la parte de propulsión. Se seleccionan los métodos más apropiados para un remolcador de puerto en la fase de cálculo. Con todo, se introduce también el número de hélices que va a llevar el buque. En este caso 2.

La aplicación devuelve:

- La gráfica de resistencia al PBENG-SPEED queda:



- Finalmente, la potencia efectiva (a 12 nudos):

SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP	CPPITCH [mm]
3,00	89	0,51	0,11	4,2	4,3	8,6	8,9	---	900,2
5,00	145	1,34	0,30	18,2	18,7	37,5	38,6	478,5	900,2
7,00	201	2,56	0,57	49,1	50,7	101,3	104,4	247,9	900,2
9,00	267	4,78	1,06	124,5	128,3	256,6	264,6	125,8	902,7
10,00	267	6,60	1,47	174,1	179,5	358,9	370,0	100,0	1096,3
11,00	267	9,80	2,18	262,2	270,3	540,7	557,4	73,0	1336,6
11,50	267	12,89	2,86	347,4	358,1	716,2	738,4	57,6	1510,6
+ 12,00 +	267	18,30	4,07	497,2	512,6	1025,1	1056,8	42,0	1757,1
12,50	267	28,54	6,34	781,5	805,7	1611,3	1661,2	27,8	2130,4
13,00	267	41,66	9,26	1150,3	1185,9	2371,8	2445,2	19,7	2572,9

La potencia que realmente se necesita para operar en un remolcador es la calculada por regresiones, que tiene un valor de 2970,95 Kw.

Por otro lado, está la potencia necesaria para que el buque proyecto pueda navegar, ósea, la que transmiten las hélices. Esta será de 1025,1 Kw (para ambas hélices).

9 CÁLCULO DE FRANCOBORDO

Para el cálculo del francobordo se utiliza el convenio sobre líneas de carga de 1966. Se irán calculando las reglas aplicables del convenio para conseguir el valor final del calado de verano.

9.1 Regla 27

Según el convenio, los buques se pueden dividir en dos tipos:

- Buques de tipo “A”: Un buque de tipo “A” es aquél proyectado para transportar solamente cargas líquidas a granel, y en el cual los tanques de carga tienen sólo pequeñas aberturas de acceso cerradas por tapas de acero u otro material equivalente, estancas y dotadas de frisas. Estos buques necesariamente tendrán las siguientes características propias:
  - Una gran integridad de la cubierta expuesta
  - Gran seguridad contra la inundación, por la pequeña permeabilidad de los espacios llenos de carga y por el grado de compartimentación utilizando habitualmente.
  - Para buques de tipo “A” de eslora superior a 150m en un casco y 225 m en otro, el buque debe cumplir unas condiciones mínimas frente a la inundación.
- Buque de tipo “B”: Son del tipo “B” todos aquellos buques que no cumplan con las condiciones indicadas para los buques de tipo “A”.

Por lo tanto, se identifica al buque proyecto de tipo “B”.

9.2 Regla 28

Siguiendo la regla 28 del convenio, se escoge un francobordo tabular especifico según la eslora y el tipo de buque. La eslora de francobordo coincidirá con la eslora de la flotación para el calado de diseño. Interpolando:

Table	
L	*freeboard*
27	225
28	233

L	*freeboard*
27,2	227

9.3 Regla 29

La regla 29 afecta a todos los buques con una eslora comprendida entre 24 m y 100 m que, además, tengan superestructuras cerradas hasta un 35 % de la eslora.

La corrección se aplica:

$$7{,}5\ x\ (100 - L)\ x\ \left(0{,}35 - \frac{E}{L}\right)$$

Siendo:

- E= 0
- Corrección= 192

9.4 Regla 30

Esta regla se aplica cuando el coeficiente de bloque es superior a 0,68. El buque base tiene un coeficiente de bloque de 0,57. Esta regla no se aplica.

9.5 Regla 31

La regla 31 afecta los buques que, tengan un D>(L/15). Por cumplir esta condición, hay que aplicar este aumento del francobordo. Siendo esta:

- (D-(L/15)) *R
- R=L/0,48

Corrección= 178

9.6 Regla 32

Esta regla afecta a los buques que tengan un puntal real mayor o menor que D. El puntal real coincide con D. No aplica.

9.7 Regla 33

La altura normal de la superestructura dependerá de la Eslora. Para este caso:

Raised quarterdeck (saltillo)	***All Other superestructures***
0,9	1,8

9.8 Regla 34/35

El forro lateral de la estructura del buque está separado del costado una distancia de más del 4% de la manga, por lo que es un tronco y no una superestructura.

9.9 Regla 36

La longitud del tronco no se considera eficaz, ya que es menor de 0,6L.

Trunk	*Lenght (S)*	*Sup. br. (b)*	*Ship br. (Bs)*	*Height*
Centre	16,478	8,135	11,870	2,503

9.10 Regla 37

Esta regla no aplica, dado que la longitud del tronco no cumple las condiciones.

9.11 Regla 38

En cuanto al arrufo, se aplica la curva de arrufo normal:

Standard Sheer Profile					
Station	*Ordinate*	*Factor*	*Product*		
After perpendicular	478	1	478		
1/6 L from A.P.	212	3	636		
1/3 L from A.P.	54	3	162		
Amidships	0	1	0	After Sheer	1276
Amidships	0	1	0		
1/3 L from A.P.	107	3	321		
1/6 L from A.P.	425	3	1275		
Forward perpendicular	956	1	956	Forward Sheer	2552

Ahora la curva de arrufo del buque:

Sheer Profile							
Station	*Ordinate*	*Sum for Le=L*	*Total*	*Factor*	*Product*		
After perpendicular	417,1681416	0	417	1	417		
1/6 L from A.P.	208,5840708	0	209	3	627		
1/3 L from A.P.	208,5840708	0	209	3	627		
Amidships	0	0	0	1	0	After Sheer	1671
Amidships	0	0	0	1	0		
1/3 L from F.P.	417,168142	0	417	3	1251		
1/6 L from F.P.	667,469027	0	667	3	2001		
Forward perpendicular	1251,50442	0	1252	1	1252	Forward Sheer	4504

La curva real es diferente a la normal:

$$Factor = 0{,}75 - \frac{s}{2L}$$

Donde:

- S= 0 (Longitud total de superestructuras cerradas).
- Factor= 0,75

La corrección por exceso de arrufo no aplica en este caso ya que no hay superestructuras y no hay defecto de arrufo.

- Corrección= 0

9.12 Regla 39

La altura de proa se define como distancia vertical, en la perpendicular de proa, entre la flotación correspondiente al francobordo de verano asignado y al asiento de proyecto, y el canto alto, en el costado, de la cubierta expuesta.

Según esto:

- Altura de proa= 1370 mm

  En este caso, la altura es mayor que el francobordo para agua salada (597 mmm), por lo que hay que aplicar una corrección de:

- Corrección = Altura de proa – FB agua salada= 773 mm

Por otro lado, esta altura de proa, al estar tomada por arrufo, se debe extender por un 15% de la eslora como mínimo desde la perpendicular de proa.

La altura de proa se extiende por un 15% de la eslora. Por lo que cumple esta regla.

9.13 Regla 40

Por último, los resultados finales serán:

Minimun Summer Freeboard	*1370*	*mm*
Maximun Summer Draught	*3570*	*mm*

Summer Freeboard	***1370***	***mm***
Summer Draught	***3570***	***mm***
Tropical Freeboard	***1296***	***mm***
Winter Freeboard	***1445***	***mm***
Winter N. Atlantic Freeboard	***1495***	***mm***
Fresh Water	***1365***	***mm***

El calado máximo será de 3.57 m. El calado de diseño del buque es de 3,57 (desde la línea base), por lo que es correcto.

ANEXOS

Lpp(m)	B(m)	D(m)	T(m)	Cb	Cm	Cp	Δ (t)	LBD (m3)	Fn	PS (t)	PER (t)	pot	PQ	DCOSTE
24,17	11,31	5,04	4,57	0,57	0,88	0,65	733,22	1377,56	0,40	104,81	31,98	2970,95	10,40	
21,75	10,18	6,22	6,19	0,51	0,79	0,59	723,24	1377,56	0,42	99,51	27,31	2970,95	10,40	-8929,74
21,75	10,18	6,22	6,02	0,53	0,82	0,60	722,90	1377,56	0,42	99,16	27,31	2970,95	10,40	-9085,06
21,75	10,18	6,22	5,86	0,54	0,84	0,62	722,55	1377,56	0,42	98,82	27,31	2970,95	10,40	-9240,37
21,75	10,18	6,22	5,71	0,56	0,86	0,64	722,21	1377,56	0,42	98,47	27,31	2970,95	10,40	-9395,68
21,75	10,18	6,22	5,56	0,57	0,88	0,65	721,86	1377,56	0,42	98,13	27,31	2970,95	10,40	-9550,99
21,75	10,18	6,22	5,42	0,59	0,91	0,67	721,52	1377,56	0,42	97,78	27,31	2970,95	10,40	-9706,30
21,75	10,18	6,22	5,29	0,60	0,92	0,68	721,17	1377,56	0,42	97,44	27,31	2970,95	10,40	-9861,61
21,75	10,46	6,06	6,03	0,51	0,79	0,59	723,62	1377,56	0,42	99,51	27,68	2970,95	10,40	-8402,44
21,75	10,46	6,06	5,86	0,53	0,82	0,60	723,28	1377,56	0,42	99,16	27,68	2970,95	10,40	-8557,75
21,75	10,46	6,06	5,70	0,54	0,84	0,62	722,93	1377,56	0,42	98,82	27,68	2970,95	10,40	-8713,06
21,75	10,46	6,06	5,55	0,56	0,86	0,64	722,59	1377,56	0,42	98,47	27,68	2970,95	10,40	-8868,38
21,75	10,46	6,06	5,41	0,57	0,88	0,65	722,24	1377,56	0,42	98,13	27,68	2970,95	10,40	-9023,69
21,75	10,46	6,06	5,28	0,59	0,91	0,67	721,90	1377,56	0,42	97,78	27,68	2970,95	10,40	-9179,00
21,75	10,46	6,06	5,15	0,60	0,92	0,68	721,55	1377,56	0,42	97,44	27,68	2970,95	10,40	-9334,31
21,75	10,74	5,90	5,87	0,51	0,79	0,59	723,99	1377,56	0,42	99,51	28,05	2970,95	10,40	-7882,22
21,75	10,74	5,90	5,71	0,53	0,82	0,60	723,65	1377,56	0,42	99,16	28,05	2970,95	10,40	-8037,53
21,75	10,74	5,90	5,56	0,54	0,84	0,62	723,30	1377,56	0,42	98,82	28,05	2970,95	10,40	-8192,84
21,75	10,74	5,90	5,41	0,56	0,86	0,64	722,96	1377,56	0,42	98,47	28,05	2970,95	10,40	-8348,15
21,75	10,74	5,90	5,27	0,57	0,88	0,65	722,61	1377,56	0,42	98,13	28,05	2970,95	10,40	-8503,46
21,75	10,74	5,90	5,14	0,59	0,91	0,67	722,27	1377,56	0,42	97,78	28,05	2970,95	10,40	-8658,78
21,75	10,74	5,90	5,02	0,60	0,92	0,68	721,92	1377,56	0,42	97,44	28,05	2970,95	10,40	-8814,09
21,75	11,02	5,74	5,72	0,51	0,79	0,59	724,36	1377,56	0,42	99,51	28,42	2970,95	10,40	-7368,79
21,75	11,02	5,74	5,57	0,53	0,82	0,60	724,01	1377,56	0,42	99,16	28,42	2970,95	10,40	-7524,11
21,75	11,02	5,74	5,42	0,54	0,84	0,62	723,67	1377,56	0,42	98,82	28,42	2970,95	10,40	-7679,42
21,75	11,02	5,74	5,27	0,56	0,86	0,64	723,32	1377,56	0,42	98,47	28,42	2970,95	10,40	-7834,73
21,75	11,02	5,74	5,14	0,57	0,88	0,65	722,98	1377,56	0,42	98,13	28,42	2970,95	10,40	-7990,04

21,75	11,02	5,74	5,01	0,59	0,91	0,67	722,63	1377,56	0,42	97,78	28,42	2970,95	10,40	-8145,35
21,75	11,02	5,74	4,89	0,60	0,92	0,68	722,29	1377,56	0,42	97,44	28,42	2970,95	10,40	-8300,67
21,75	11,31	5,60	5,58	0,51	0,79	0,59	724,72	1377,56	0,42	99,51	28,78	2970,95	10,40	-6861,91
21,75	11,31	5,60	5,43	0,53	0,82	0,60	724,38	1377,56	0,42	99,16	28,78	2970,95	10,40	-7017,23
21,75	11,31	5,60	5,28	0,54	0,84	0,62	724,03	1377,56	0,42	98,82	28,78	2970,95	10,40	-7172,54
21,75	11,31	5,60	5,15	0,56	0,86	0,64	723,69	1377,56	0,42	98,47	28,78	2970,95	10,40	-7327,85
21,75	11,31	5,60	5,01	0,57	0,88	0,65	723,34	1377,56	0,42	98,13	28,78	2970,95	10,40	-7483,16
21,75	11,31	5,60	4,89	0,59	0,91	0,67	723,00	1377,56	0,42	97,78	28,78	2970,95	10,40	-7638,47
21,75	11,31	5,60	4,77	0,60	0,92	0,68	722,65	1377,56	0,42	97,44	28,78	2970,95	10,40	-7793,78
21,75	11,59	5,46	5,45	0,51	0,79	0,59	725,08	1377,56	0,42	99,51	29,14	2970,95	10,40	-6361,33
21,75	11,59	5,46	5,30	0,53	0,82	0,60	724,73	1377,56	0,42	99,16	29,14	2970,95	10,40	-6516,64
21,75	11,59	5,46	5,16	0,54	0,84	0,62	724,39	1377,56	0,42	98,82	29,14	2970,95	10,40	-6671,95
21,75	11,59	5,46	5,02	0,56	0,86	0,64	724,04	1377,56	0,42	98,47	29,14	2970,95	10,40	-6827,27
21,75	11,59	5,46	4,89	0,57	0,88	0,65	723,70	1377,56	0,42	98,13	29,14	2970,95	10,40	-6982,58
21,75	11,59	5,46	4,77	0,59	0,91	0,67	723,35	1377,56	0,42	97,78	29,14	2970,95	10,40	-7137,89
21,75	11,59	5,46	4,66	0,60	0,92	0,68	723,01	1377,56	0,42	97,44	29,14	2970,95	10,40	-7293,20
21,75	11,87	5,33	5,32	0,51	0,79	0,59	725,43	1377,56	0,42	99,51	29,49	2970,95	10,40	-5866,81
21,75	11,87	5,33	5,18	0,53	0,82	0,60	725,09	1377,56	0,42	99,16	29,49	2970,95	10,40	-6022,13
21,75	11,87	5,33	5,04	0,54	0,84	0,62	724,74	1377,56	0,42	98,82	29,49	2970,95	10,40	-6177,44
21,75	11,87	5,33	4,91	0,56	0,86	0,64	724,40	1377,56	0,42	98,47	29,49	2970,95	10,40	-6332,75
21,75	11,87	5,33	4,78	0,57	0,88	0,65	724,05	1377,56	0,42	98,13	29,49	2970,95	10,40	-6488,06
21,75	11,87	5,33	4,66	0,59	0,91	0,67	723,71	1377,56	0,42	97,78	29,49	2970,95	10,40	-6643,37
21,75	11,87	5,33	4,55	0,60	0,92	0,68	723,36	1377,56	0,42	97,44	29,49	2970,95	10,40	-6798,69
22,36	10,18	6,06	6,04	0,51	0,79	0,59	725,72	1377,56	0,42	101,23	28,06	2970,95	10,40	-7094,40
22,36	10,18	6,06	5,88	0,53	0,82	0,60	725,37	1377,56	0,42	100,88	28,06	2970,95	10,40	-7252,39
22,36	10,18	6,06	5,72	0,54	0,84	0,62	725,02	1377,56	0,42	100,52	28,06	2970,95	10,40	-7410,39
22,36	10,18	6,06	5,57	0,56	0,86	0,64	724,67	1377,56	0,42	100,17	28,06	2970,95	10,40	-7568,38
22,36	10,18	6,06	5,43	0,57	0,88	0,65	724,32	1377,56	0,42	99,82	28,06	2970,95	10,40	-7726,38
22,36	10,18	6,06	5,29	0,59	0,91	0,67	723,97	1377,56	0,42	99,47	28,06	2970,95	10,40	-7884,37

22,36	10,18	6,06	5,16	0,60	0,92	0,68	723,62	1377,56	0,42	99,12	28,06	2970,95	10,40	-8042,37
22,36	10,46	5,89	5,88	0,51	0,79	0,59	726,11	1377,56	0,42	101,23	28,45	2970,95	10,40	-6552,45
22,36	10,46	5,89	5,72	0,53	0,82	0,60	725,76	1377,56	0,42	100,88	28,45	2970,95	10,40	-6710,44
22,36	10,46	5,89	5,57	0,54	0,84	0,62	725,41	1377,56	0,42	100,52	28,45	2970,95	10,40	-6868,44
22,36	10,46	5,89	5,42	0,56	0,86	0,64	725,06	1377,56	0,42	100,17	28,45	2970,95	10,40	-7026,43
22,36	10,46	5,89	5,28	0,57	0,88	0,65	724,70	1377,56	0,42	99,82	28,45	2970,95	10,40	-7184,43
22,36	10,46	5,89	5,15	0,59	0,91	0,67	724,35	1377,56	0,42	99,47	28,45	2970,95	10,40	-7342,42
22,36	10,46	5,89	5,03	0,60	0,92	0,68	724,00	1377,56	0,42	99,12	28,45	2970,95	10,40	-7500,42
22,36	10,74	5,74	5,73	0,51	0,79	0,59	726,49	1377,56	0,42	101,23	28,83	2970,95	10,40	-6017,77
22,36	10,74	5,74	5,57	0,53	0,82	0,60	726,14	1377,56	0,42	100,88	28,83	2970,95	10,40	-6175,77
22,36	10,74	5,74	5,42	0,54	0,84	0,62	725,79	1377,56	0,42	100,52	28,83	2970,95	10,40	-6333,76
22,36	10,74	5,74	5,28	0,56	0,86	0,64	725,44	1377,56	0,42	100,17	28,83	2970,95	10,40	-6491,76
22,36	10,74	5,74	5,15	0,57	0,88	0,65	725,09	1377,56	0,42	99,82	28,83	2970,95	10,40	-6649,75
22,36	10,74	5,74	5,02	0,59	0,91	0,67	724,74	1377,56	0,42	99,47	28,83	2970,95	10,40	-6807,75
22,36	10,74	5,74	4,90	0,60	0,92	0,68	724,38	1377,56	0,42	99,12	28,83	2970,95	10,40	-6965,74
22,36	11,02	5,59	5,59	0,51	0,79	0,59	726,87	1377,56	0,42	101,23	29,21	2970,95	10,40	-5490,09
22,36	11,02	5,59	5,43	0,53	0,82	0,60	726,52	1377,56	0,42	100,88	29,21	2970,95	10,40	-5648,08
22,36	11,02	5,59	5,29	0,54	0,84	0,62	726,17	1377,56	0,42	100,52	29,21	2970,95	10,40	-5806,08
22,36	11,02	5,59	5,15	0,56	0,86	0,64	725,81	1377,56	0,42	100,17	29,21	2970,95	10,40	-5964,07
22,36	11,02	5,59	5,02	0,57	0,88	0,65	725,46	1377,56	0,42	99,82	29,21	2970,95	10,40	-6122,07
22,36	11,02	5,59	4,89	0,59	0,91	0,67	725,11	1377,56	0,42	99,47	29,21	2970,95	10,40	-6280,06
22,36	11,02	5,59	4,78	0,60	0,92	0,68	724,76	1377,56	0,42	99,12	29,21	2970,95	10,40	-6438,06
22,36	11,31	5,45	5,45	0,51	0,79	0,59	727,24	1377,56	0,42	101,23	29,58	2970,95	10,40	-4969,13
22,36	11,31	5,45	5,30	0,53	0,82	0,60	726,89	1377,56	0,42	100,88	29,58	2970,95	10,40	-5127,12
22,36	11,31	5,45	5,16	0,54	0,84	0,62	726,54	1377,56	0,42	100,52	29,58	2970,95	10,40	-5285,12
22,36	11,31	5,45	5,02	0,56	0,86	0,64	726,19	1377,56	0,42	100,17	29,58	2970,95	10,40	-5443,11
22,36	11,31	5,45	4,90	0,57	0,88	0,65	725,84	1377,56	0,42	99,82	29,58	2970,95	10,40	-5601,11
22,36	11,31	5,45	4,77	0,59	0,91	0,67	725,48	1377,56	0,42	99,47	29,58	2970,95	10,40	-5759,10
22,36	11,31	5,45	4,66	0,60	0,92	0,68	725,13	1377,56	0,42	99,12	29,58	2970,95	10,40	-5917,10

22,36	11,59	5,32	5,32	0,51	0,79	0,59	727,61	1377,56	0,42	101,23	29,95	2970,95	10,40	-4454,64
22,36	11,59	5,32	5,17	0,53	0,82	0,60	727,26	1377,56	0,42	100,88	29,95	2970,95	10,40	-4612,63
22,36	11,59	5,32	5,04	0,54	0,84	0,62	726,91	1377,56	0,42	100,52	29,95	2970,95	10,40	-4770,63
22,36	11,59	5,32	4,90	0,56	0,86	0,64	726,55	1377,56	0,42	100,17	29,95	2970,95	10,40	-4928,62
22,36	11,59	5,32	4,78	0,57	0,88	0,65	726,20	1377,56	0,42	99,82	29,95	2970,95	10,40	-5086,62
22,36	11,59	5,32	4,66	0,59	0,91	0,67	725,85	1377,56	0,42	99,47	29,95	2970,95	10,40	-5244,61
22,36	11,59	5,32	4,55	0,60	0,92	0,68	725,50	1377,56	0,42	99,12	29,95	2970,95	10,40	-5402,61
22,36	11,87	5,19	5,20	0,51	0,79	0,59	727,97	1377,56	0,42	101,23	30,31	2970,95	10,40	-3946,39
22,36	11,87	5,19	5,05	0,53	0,82	0,60	727,62	1377,56	0,42	100,88	30,31	2970,95	10,40	-4104,38
22,36	11,87	5,19	4,92	0,54	0,84	0,62	727,27	1377,56	0,42	100,52	30,31	2970,95	10,40	-4262,38
22,36	11,87	5,19	4,79	0,56	0,86	0,64	726,92	1377,56	0,42	100,17	30,31	2970,95	10,40	-4420,37
22,36	11,87	5,19	4,67	0,57	0,88	0,65	726,57	1377,56	0,42	99,82	30,31	2970,95	10,40	-4578,37
22,36	11,87	5,19	4,55	0,59	0,91	0,67	726,21	1377,56	0,42	99,47	30,31	2970,95	10,40	-4736,36
22,36	11,87	5,19	4,44	0,60	0,92	0,68	725,86	1377,56	0,42	99,12	30,31	2970,95	10,40	-4894,35
22,96	10,18	5,90	5,90	0,51	0,79	0,59	728,18	1377,56	0,41	102,93	28,82	2970,95	10,40	-5266,85
22,96	10,18	5,90	5,74	0,53	0,82	0,60	727,82	1377,56	0,41	102,57	28,82	2970,95	10,40	-5427,50
22,96	10,18	5,90	5,59	0,54	0,84	0,62	727,47	1377,56	0,41	102,21	28,82	2970,95	10,40	-5588,15
22,96	10,18	5,90	5,44	0,56	0,86	0,64	727,11	1377,56	0,41	101,86	28,82	2970,95	10,40	-5748,80
22,96	10,18	5,90	5,30	0,57	0,88	0,65	726,75	1377,56	0,41	101,50	28,82	2970,95	10,40	-5909,45
22,96	10,18	5,90	5,17	0,59	0,91	0,67	726,40	1377,56	0,41	101,14	28,82	2970,95	10,40	-6070,10
22,96	10,18	5,90	5,05	0,60	0,92	0,68	726,04	1377,56	0,41	100,79	28,82	2970,95	10,40	-6230,75
22,96	10,46	5,74	5,75	0,51	0,79	0,59	728,58	1377,56	0,41	102,93	29,22	2970,95	10,40	-4710,25
22,96	10,46	5,74	5,59	0,53	0,82	0,60	728,22	1377,56	0,41	102,57	29,22	2970,95	10,40	-4870,90
22,96	10,46	5,74	5,44	0,54	0,84	0,62	727,87	1377,56	0,41	102,21	29,22	2970,95	10,40	-5031,55
22,96	10,46	5,74	5,30	0,56	0,86	0,64	727,51	1377,56	0,41	101,86	29,22	2970,95	10,40	-5192,21
22,96	10,46	5,74	5,16	0,57	0,88	0,65	727,15	1377,56	0,41	101,50	29,22	2970,95	10,40	-5352,86
22,96	10,46	5,74	5,03	0,59	0,91	0,67	726,79	1377,56	0,41	101,14	29,22	2970,95	10,40	-5513,51
22,96	10,46	5,74	4,91	0,60	0,92	0,68	726,44	1377,56	0,41	100,79	29,22	2970,95	10,40	-5674,16
22,96	10,74	5,59	5,60	0,51	0,79	0,59	728,97	1377,56	0,41	102,93	29,61	2970,95	10,40	-4161,13

22,96	10,74	5,59	5,45	0,53	0,82	0,60	728,61	1377,56	0,41	102,57	29,61	2970,95	10,40	-4321,78
22,96	10,74	5,59	5,30	0,54	0,84	0,62	728,26	1377,56	0,41	102,21	29,61	2970,95	10,40	-4482,43
22,96	10,74	5,59	5,16	0,56	0,86	0,64	727,90	1377,56	0,41	101,86	29,61	2970,95	10,40	-4643,08
22,96	10,74	5,59	5,03	0,57	0,88	0,65	727,54	1377,56	0,41	101,50	29,61	2970,95	10,40	-4803,73
22,96	10,74	5,59	4,90	0,59	0,91	0,67	727,19	1377,56	0,41	101,14	29,61	2970,95	10,40	-4964,38
22,96	10,74	5,59	4,79	0,60	0,92	0,68	726,83	1377,56	0,41	100,79	29,61	2970,95	10,40	-5125,03
22,96	11,02	5,44	5,46	0,51	0,79	0,59	729,36	1377,56	0,41	102,93	30,00	2970,95	10,40	-3619,18
22,96	11,02	5,44	5,31	0,53	0,82	0,60	729,00	1377,56	0,41	102,57	30,00	2970,95	10,40	-3779,83
22,96	11,02	5,44	5,17	0,54	0,84	0,62	728,64	1377,56	0,41	102,21	30,00	2970,95	10,40	-3940,48
22,96	11,02	5,44	5,03	0,56	0,86	0,64	728,29	1377,56	0,41	101,86	30,00	2970,95	10,40	-4101,13
22,96	11,02	5,44	4,90	0,57	0,88	0,65	727,93	1377,56	0,41	101,50	30,00	2970,95	10,40	-4261,78
22,96	11,02	5,44	4,78	0,59	0,91	0,67	727,57	1377,56	0,41	101,14	30,00	2970,95	10,40	-4422,43
22,96	11,02	5,44	4,67	0,60	0,92	0,68	727,22	1377,56	0,41	100,79	30,00	2970,95	10,40	-4583,09
22,96	11,31	5,31	5,33	0,51	0,79	0,59	729,74	1377,56	0,41	102,93	30,38	2970,95	10,40	-3084,14
22,96	11,31	5,31	5,18	0,53	0,82	0,60	729,38	1377,56	0,41	102,57	30,38	2970,95	10,40	-3244,79
22,96	11,31	5,31	5,04	0,54	0,84	0,62	729,03	1377,56	0,41	102,21	30,38	2970,95	10,40	-3405,44
22,96	11,31	5,31	4,91	0,56	0,86	0,64	728,67	1377,56	0,41	101,86	30,38	2970,95	10,40	-3566,09
22,96	11,31	5,31	4,78	0,57	0,88	0,65	728,31	1377,56	0,41	101,50	30,38	2970,95	10,40	-3726,74
22,96	11,31	5,31	4,66	0,59	0,91	0,67	727,96	1377,56	0,41	101,14	30,38	2970,95	10,40	-3887,39
22,96	11,31	5,31	4,55	0,60	0,92	0,68	727,60	1377,56	0,41	100,79	30,38	2970,95	10,40	-4048,04
22,96	11,59	5,18	5,20	0,51	0,79	0,59	730,12	1377,56	0,41	102,93	30,76	2970,95	10,40	-2555,75
22,96	11,59	5,18	5,05	0,53	0,82	0,60	729,76	1377,56	0,41	102,57	30,76	2970,95	10,40	-2716,40
22,96	11,59	5,18	4,92	0,54	0,84	0,62	729,40	1377,56	0,41	102,21	30,76	2970,95	10,40	-2877,05
22,96	11,59	5,18	4,79	0,56	0,86	0,64	729,05	1377,56	0,41	101,86	30,76	2970,95	10,40	-3037,70
22,96	11,59	5,18	4,67	0,57	0,88	0,65	728,69	1377,56	0,41	101,50	30,76	2970,95	10,40	-3198,35
22,96	11,59	5,18	4,55	0,59	0,91	0,67	728,33	1377,56	0,41	101,14	30,76	2970,95	10,40	-3359,00
22,96	11,59	5,18	4,44	0,60	0,92	0,68	727,98	1377,56	0,41	100,79	30,76	2970,95	10,40	-3519,65
22,96	11,87	5,05	5,08	0,51	0,79	0,59	730,49	1377,56	0,41	102,93	31,13	2970,95	10,40	-2033,76
22,96	11,87	5,05	4,94	0,53	0,82	0,60	730,13	1377,56	0,41	102,57	31,13	2970,95	10,40	-2194,41

22,96	11,87	5,05	4,80	0,54	0,84	0,62	729,78	1377,56	0,41	102,21	31,13	2970,95	10,40	-2355,06
22,96	11,87	5,05	4,68	0,56	0,86	0,64	729,42	1377,56	0,41	101,86	31,13	2970,95	10,40	-2515,71
22,96	11,87	5,05	4,56	0,57	0,88	0,65	729,06	1377,56	0,41	101,50	31,13	2970,95	10,40	-2676,36
22,96	11,87	5,05	4,45	0,59	0,91	0,67	728,71	1377,56	0,41	101,14	31,13	2970,95	10,40	-2837,01
22,96	11,87	5,05	4,34	0,60	0,92	0,68	728,35	1377,56	0,41	100,79	31,13	2970,95	10,40	-2997,66
23,57	10,18	5,74	5,77	0,51	0,79	0,59	730,63	1377,56	0,41	104,61	29,58	2970,95	10,40	-3446,82
23,57	10,18	5,74	5,61	0,53	0,82	0,60	730,26	1377,56	0,41	104,25	29,58	2970,95	10,40	-3610,10
23,57	10,18	5,74	5,46	0,54	0,84	0,62	729,90	1377,56	0,41	103,89	29,58	2970,95	10,40	-3773,38
23,57	10,18	5,74	5,32	0,56	0,86	0,64	729,54	1377,56	0,41	103,52	29,58	2970,95	10,40	-3936,66
23,57	10,18	5,74	5,18	0,57	0,88	0,65	729,17	1377,56	0,41	103,16	29,58	2970,95	10,40	-4099,94
23,57	10,18	5,74	5,06	0,59	0,91	0,67	728,81	1377,56	0,41	102,80	29,58	2970,95	10,40	-4263,22
23,57	10,18	5,74	4,93	0,60	0,92	0,68	728,45	1377,56	0,41	102,44	29,58	2970,95	10,40	-4426,50
23,57	10,46	5,59	5,62	0,51	0,79	0,59	731,03	1377,56	0,41	104,61	29,99	2970,95	10,40	-2875,58
23,57	10,46	5,59	5,46	0,53	0,82	0,60	730,67	1377,56	0,41	104,25	29,99	2970,95	10,40	-3038,86
23,57	10,46	5,59	5,32	0,54	0,84	0,62	730,31	1377,56	0,41	103,89	29,99	2970,95	10,40	-3202,14
23,57	10,46	5,59	5,18	0,56	0,86	0,64	729,94	1377,56	0,41	103,52	29,99	2970,95	10,40	-3365,42
23,57	10,46	5,59	5,05	0,57	0,88	0,65	729,58	1377,56	0,41	103,16	29,99	2970,95	10,40	-3528,70
23,57	10,46	5,59	4,92	0,59	0,91	0,67	729,22	1377,56	0,41	102,80	29,99	2970,95	10,40	-3691,98
23,57	10,46	5,59	4,80	0,60	0,92	0,68	728,86	1377,56	0,41	102,44	29,99	2970,95	10,40	-3855,26
23,57	10,74	5,44	5,47	0,51	0,79	0,59	731,44	1377,56	0,41	104,61	30,39	2970,95	10,40	-2312,00
23,57	10,74	5,44	5,32	0,53	0,82	0,60	731,07	1377,56	0,41	104,25	30,39	2970,95	10,40	-2475,28
23,57	10,74	5,44	5,18	0,54	0,84	0,62	730,71	1377,56	0,41	103,89	30,39	2970,95	10,40	-2638,56
23,57	10,74	5,44	5,05	0,56	0,86	0,64	730,35	1377,56	0,41	103,52	30,39	2970,95	10,40	-2801,84
23,57	10,74	5,44	4,92	0,57	0,88	0,65	729,98	1377,56	0,41	103,16	30,39	2970,95	10,40	-2965,12
23,57	10,74	5,44	4,79	0,59	0,91	0,67	729,62	1377,56	0,41	102,80	30,39	2970,95	10,40	-3128,40
23,57	10,74	5,44	4,68	0,60	0,92	0,68	729,26	1377,56	0,41	102,44	30,39	2970,95	10,40	-3291,68
23,57	11,02	5,30	5,34	0,51	0,79	0,59	731,83	1377,56	0,41	104,61	30,79	2970,95	10,40	-1755,80
23,57	11,02	5,30	5,19	0,53	0,82	0,60	731,47	1377,56	0,41	104,25	30,79	2970,95	10,40	-1919,08
23,57	11,02	5,30	5,05	0,54	0,84	0,62	731,11	1377,56	0,41	103,89	30,79	2970,95	10,40	-2082,36

23,57	11,02	5,30	4,92	0,56	0,86	0,64	730,74	1377,56	0,41	103,52	30,79	2970,95	10,40	-2245,64
23,57	11,02	5,30	4,79	0,57	0,88	0,65	730,38	1377,56	0,41	103,16	30,79	2970,95	10,40	-2408,92
23,57	11,02	5,30	4,67	0,59	0,91	0,67	730,02	1377,56	0,41	102,80	30,79	2970,95	10,40	-2572,20
23,57	11,02	5,30	4,56	0,60	0,92	0,68	729,66	1377,56	0,41	102,44	30,79	2970,95	10,40	-2735,48
23,57	11,31	5,17	5,21	0,51	0,79	0,59	732,23	1377,56	0,41	104,61	31,18	2970,95	10,40	-1206,67
23,57	11,31	5,17	5,06	0,53	0,82	0,60	731,86	1377,56	0,41	104,25	31,18	2970,95	10,40	-1369,95
23,57	11,31	5,17	4,93	0,54	0,84	0,62	731,50	1377,56	0,41	103,89	31,18	2970,95	10,40	-1533,23
23,57	11,31	5,17	4,80	0,56	0,86	0,64	731,14	1377,56	0,41	103,52	31,18	2970,95	10,40	-1696,51
23,57	11,31	5,17	4,68	0,57	0,88	0,65	730,77	1377,56	0,41	103,16	31,18	2970,95	10,40	-1859,79
23,57	11,31	5,17	4,56	0,59	0,91	0,67	730,41	1377,56	0,41	102,80	31,18	2970,95	10,40	-2023,07
23,57	11,31	5,17	4,45	0,60	0,92	0,68	730,05	1377,56	0,41	102,44	31,18	2970,95	10,40	-2186,35
23,57	11,59	5,04	5,08	0,51	0,79	0,59	732,61	1377,56	0,41	104,61	31,57	2970,95	10,40	-664,38
23,57	11,59	5,04	4,94	0,53	0,82	0,60	732,25	1377,56	0,41	104,25	31,57	2970,95	10,40	-827,66
23,57	11,59	5,04	4,81	0,54	0,84	0,62	731,89	1377,56	0,41	103,89	31,57	2970,95	10,40	-990,94
23,57	11,59	5,04	4,68	0,56	0,86	0,64	731,52	1377,56	0,41	103,52	31,57	2970,95	10,40	-1154,22
23,57	11,59	5,04	4,56	0,57	0,88	0,65	731,16	1377,56	0,41	103,16	31,57	2970,95	10,40	-1317,50
23,57	11,59	5,04	4,45	0,59	0,91	0,67	730,80	1377,56	0,41	102,80	31,57	2970,95	10,40	-1480,78
23,57	11,59	5,04	4,34	0,60	0,92	0,68	730,44	1377,56	0,41	102,44	31,57	2970,95	10,40	-1644,06
23,57	11,87	4,92	4,96	0,51	0,79	0,59	733,00	1377,56	0,41	104,61	31,95	2970,95	10,40	-128,65
23,57	11,87	4,92	4,83	0,53	0,82	0,60	732,63	1377,56	0,41	104,25	31,95	2970,95	10,40	-291,93
23,57	11,87	4,92	4,70	0,54	0,84	0,62	732,27	1377,56	0,41	103,89	31,95	2970,95	10,40	-455,21
23,57	11,87	4,92	4,57	0,56	0,86	0,64	731,91	1377,56	0,41	103,52	31,95	2970,95	10,40	-618,49

CAP DE FER: Multipurpose tug designed for optimal manoeuvrability in harsh conditions

Builder	**Cantiere Navale Vittoria**
Designer	**Mes Engineering**
Vessel's name	***Cap de Fer***
Owner/operator	**Enterprise portuaire de Skikda**
Country	**Algeria**
Flag	**Algeria**
Total number of sister ships already completed	**0**
Total number of sister ships still on order	**0**
Contract date	**December 2016**
Delivery date	**March 2018**

Vittoria Shipyard's pledge to diversify further into tug production resulted in the March 2018 delivery of *Cap de Fer*, an ASD tug completed for Algeria's Skikda Port Authority, situated in the country's north-west, close to the border with Tunisia. The Italian boatbuilder managed to fend off rival tenders from 14 international boatyards to scoop this contract, as part of chairman Luigi Duò's ambitions to add tugs to its roster of offerings, which has traditionally more typically included patrol and SAR craft, plus small tankers and fishing boats.

The Bureau Veritas-classed vessel can displace 500tonnes, fully laden, and accommodate up to seven crew members. Two medium-speed diesel engines, supplied by Anglo Belgian Corporation (ABC), grant the vessel a top speed of 12.5knots and a bollard pull (bp) of 42tonnes - reportedly well above the initial request of the Skikda Port Authority, which initially specified a bp of 30tonnes.

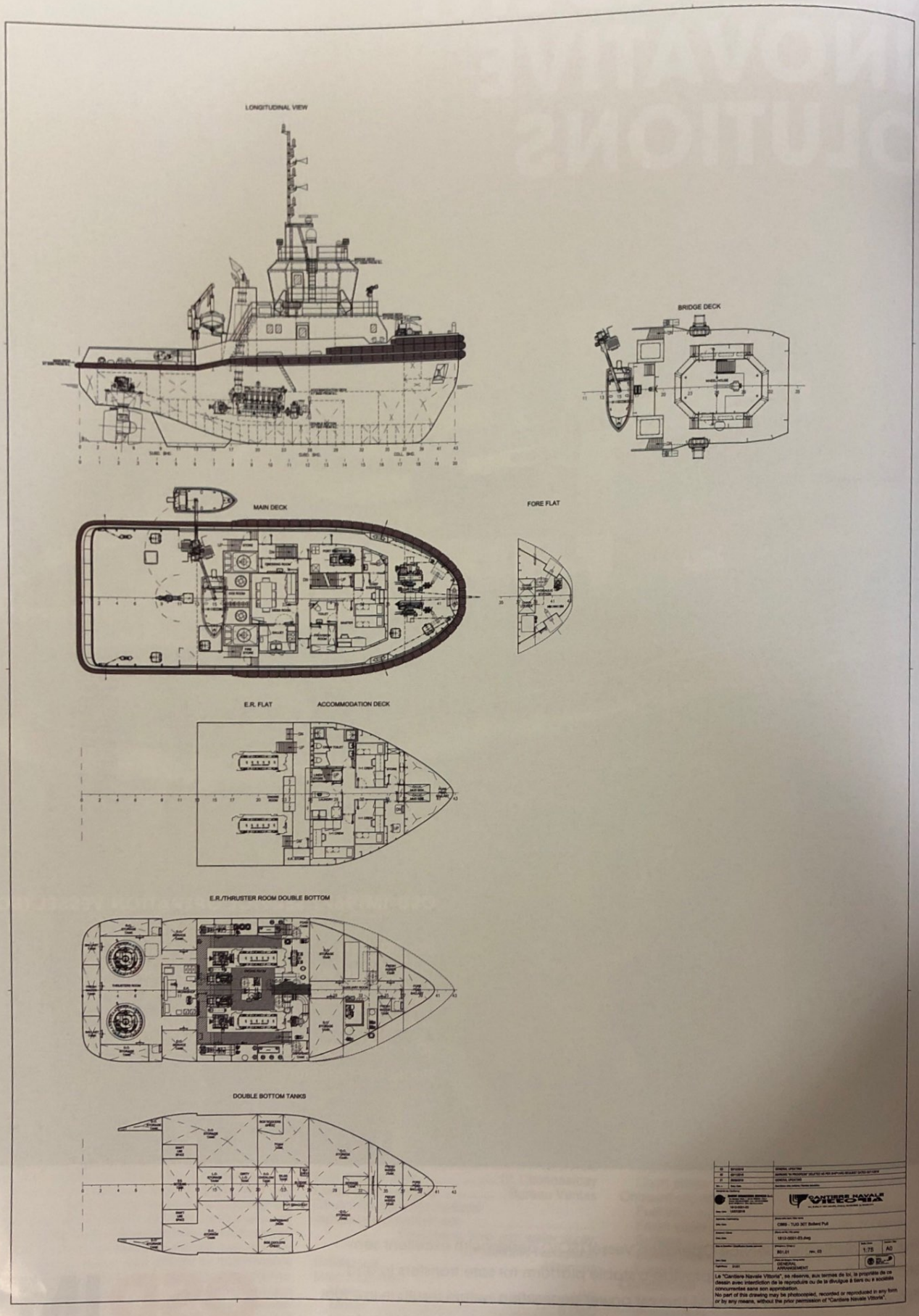
Cap de Fer's scope of roles includes: port and coastal towing services; assistance and emergency response operations in extreme conditions; and conducting push-pull operations. As such, special focus was put on maximising the tug's power/performance ratio and ability to comfortably manoeuvre in harsh sea and weather conditions. Visibility was also deemed a top priority, as was a robust structure to shield crew from collision-related bumps and shocks. The fitting and arrangement of onboard equipment was also planned to enable easy and safe access to those components most likely to require maintenance and repair work. Designed and built for challenging workloads, and with a fuel capacity of nearly 162tonnes, *Cap de Fer* can count on 12 days of autonomy between required port calls.

Meanwhile, her firefighting system, supplied by Jason Engineering, features an engine-powered pump feeding a pair of water- and foam-equipped monitors, each rated 600,000litres per hour. As a demonstrator of its ability to successfully diversify into relatively new vessel types, *Cap de Fer* certainly represents a high point for Vittoria. And, with a second ASD tug, designed to dismantle nuclear submarines, launched in September 2018 and due for handover to the Russian Government in 2019, it's clear that the yard's interest in these hardy vessel types is far from being a one-off fling.

TECHNICAL PARTICULARS

Length, oa	26m
Length, bp	25.65m
Breadth, moulded	10m
Depth, moulded	5.35m
Gross tonnage	340tonnes
Displacement	592tonnes
Design, draught	3.85m
Design, deadweight	213tonnes
Lightweight	334tonnes
Deck space	52m^2
Deck capacity	3tonnes/m^2
Max speed	12.5knots
Fuel consumption	12.13tonnes/day
Classification society	Bureau Veritas
Other important international regulations complied with	Firefighting Ship with water spray; Unrestricted Navigation
Bollard pull	43tonnes
Main engine(s)	
Make	ABC
Model	6 DZC
Number	2
Output of each engine	1,325kW
Propeller(s)	
Material	Bronze
Manufacturer	Schottel
Number	2
Fixed/controllable pitch	Fixed
Diameter	1.9m
Open or nozzled	Nozzled
Generators	
Number	3
Make/type	Deutz BF4M1013MC
Output/speed of each set	91kWe
Deck machinery	
Hook	
Model	DCX
Manufacturer	Mampaey
Number	1
Capacities/ SWL	100tonnes
Winch(es)	
Model	ATWH 1250/300/AW19U2
Manufacturer	Rolls-Royce
Number	1
Capacities	30tonnes@14 m/min 6tonnes@45m/min
Other deck equipment	Rescue boat with davit Palfinger RSQ450
Bridge electronics	
Radar(s)	Furuno FAR-2117
Autopilot	Simrad AP70
GMDSS	Furuno VHFV100
Other communication systems	Navtex
GPS	Furuno GP170
Gyro	GC80
Chart plotter	MaxSea
Onboard capacities	
Fuel oil	161,810litres
Fresh water	32,700litres
Sullage	2,740litres
Ballast water	40,020litres
Lube oil	6,340litres
Complement	
Crew	7
Passengers	0
Number of cabins	5

CAP DE FER



FREGATE: Unique harbour tug incorporating innovative dredging system

Builder	**Damen Shipyards**
Designer	**Damen Shipyards**
Vessel's name	***Fregate***
Owner/operator	**Dutch Dredging De Boer / Iskes Towage & Salvage**
Country	**French Guiana**
Flag	**France**
Total number of sister ships already completed	**0**
Total number of sister ships still on order	**0**
Contract date	**December 2016**
Delivery date	**May 2018**

The Reverse Stern Drive (RSD) WID Tug 2915 Hybrid *Fregate* is a unique harbour tug, designed to provide a single vessel that is a fully functional tug with 42.5tonnes of bollard pull, fitted with a water injection dredging (WID) system that enables it to maintain the depths of the harbours of Cayenne and Kourou in French Guiana.

The reason for the unusual design arose from the specific requirements of the contracting port authority GPM-Guyane, which manages both ports. The authority recognised that specialist tugs and dredgers could not be kept fully occupied at its locations, and so, in its 2016 renewal tender, it specified that designs be submitted that combined both attributes in two separate vessels – one of which would become the RSD WID Tug 2915 Hybrid.

To achieve this, Dutch Dredging, which had been working with GPM-Guyane for 15 years, teamed up with tug expert Iskes Towage & Salvage to form De Boer Remorquage SARL. The design process has been very much a joint effort: for instance, Dutch Dredging contributed its knowledge of the unique technique of water and air injection dredging that it has built up over 20 years, plus its experience of more than 15 years of operating in the specific conditions of French Guiana. Iskes Towage & Salvage, meanwhile, provided valuable input for the towage element of the design and build process.

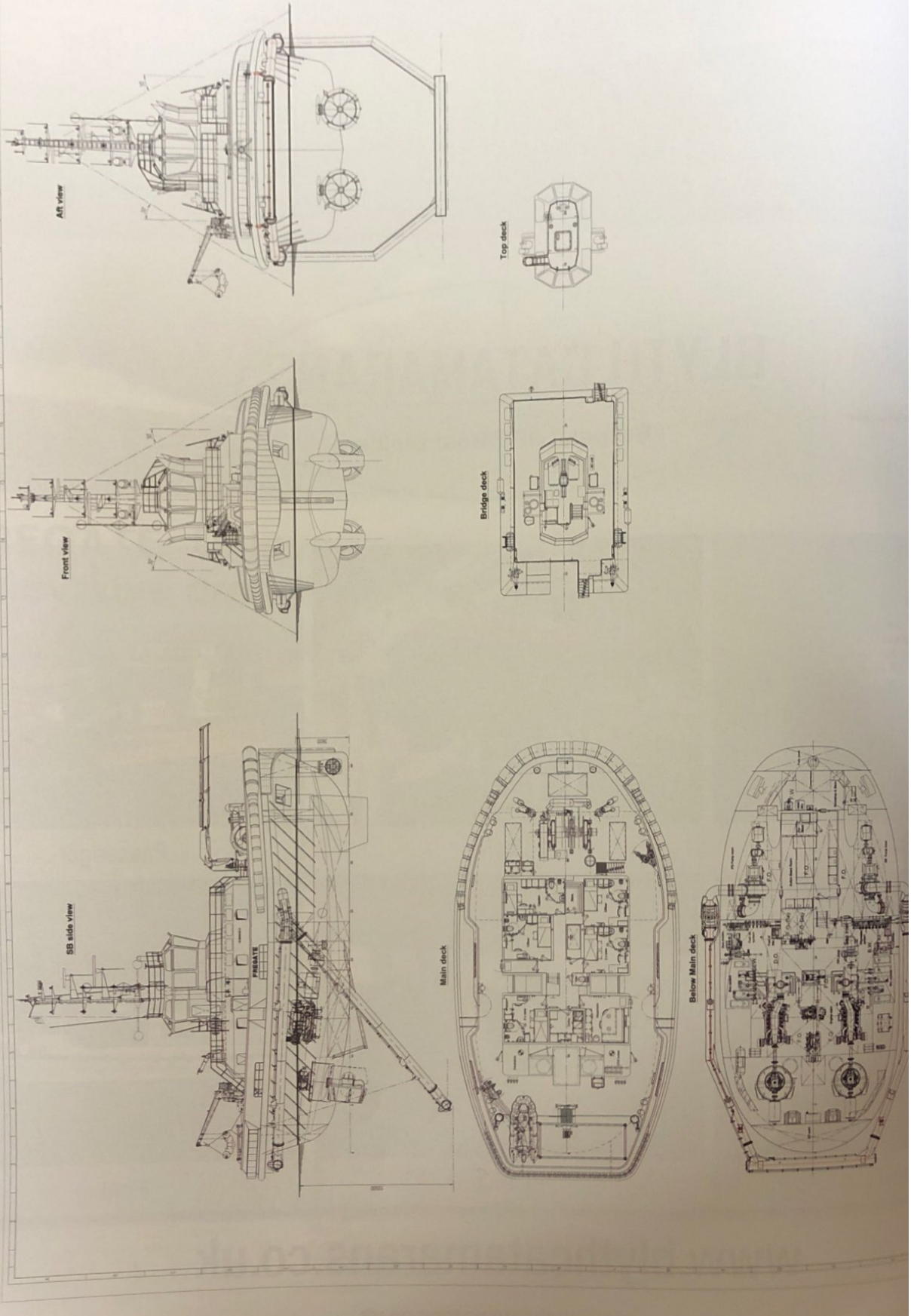
GPM-Guyane contributed to the development of the designs via its consultants, Hydro GC and Earthcase. They checked and approved the designs, and helped optimise the dredging/towing balance so as to achieve an equilibrium within the given specifications. As well as assisting vessels as they enter and leave port, the RSD WID Tug 2915 Hybrid is equipped for other roles including firefighting (FiFi1) and equipment transportation.

WID – or, to give it its full name, air and water injection dredging (AIRSET) – is a relatively new dredging technique that is particularly suited to smaller, tidal harbours. It works by 'fluidising' the sediment layer using waterjets and injecting air to bring the sediments to the surface where the air can escape and the sediment can flow horizontally out of the harbour or channel using natural processes and forces. This removes the need for the physical extraction and transportation of the sediment, thereby reducing disruption to port traffic.

TECHNICAL PARTICULARS

Length, oa	29.2m
Length, bp	25.65m
Breadth, moulded	12.5m
Depth, moulded	5.5m
Gross tonnage	434tonnes
Displacement	577tonnes
Design, draught	5.10m
Max speed	12.2knots
Classification society	Bureau Veritas
Notations	BV I ✠ HULL. MACH Tug Unrestricted Navigation AUT UMS FIFI 1 IWS Green Passport
Bollard pull	41.3tonnes
Main engine(s)	
Make	Caterpillar
Model	Type 3512 C
Number	2
Output of each engine	1,425kW
Gearbox(es)	Incorporated in thruster
Propeller(s)	
Manufacturer	Veth VZ 1250 VHD
Number	2
Fixed/controllable pitch	Fixed
Diameter	2,100mm
Open or nozzled	Nozzled
Alternators	
Number	2
Make	Caterpillar C7.1 & C4.4
Output/speed of each set	188kVA & 107kVA@1,500 rpm
Bow thruster(s)	
Make	Veth VT 240
Number	1
Output of each	200kW
Deck machinery	
Crane(s)	
Manufacturer	HS Marine AK30 HE 2
Number	1
Capacities/SWL	2tonnes@9.2m
Winch(es)	
Manufacturer	THR Marine
Number	1
Capacities	44tonnes@8m/min / 14tonnes@24m/min
Holding force	150tonnes
Other deck machinery/equipment	WID Pumps 2 × 5,200m³/HR@2bar; Air compressor 1,490m³/HR@7.5bar; FiFi 1 System 2,650m³/HR; Hybrid 2 × 400kW e-motors
Bridge electronics	
Radar(s)	Furuno FAR-2117 / RHRS-2014
Autopilot	Simrad AP-70
GMDSS	Sailor RT 6222 / 6310 / 6110
GPS	Furuno GP - 170
Gyro	Anschütz Compact 22
Chart plotter	Furuno FMD 3100
Onboard capacities	
Fuel oil	118,000litres
Fresh water	40,000litres
Complement	
Crew	7
Number of cabins	5

FREGATE



MED XXIV: First of six firefighting tugs for Turkey

Builder	**Med Marine (Eregli Shipyard)**
Designer	**Robert Allan Ltd.**
Vessel's name	***Med XXIV***
Owner/operator	**Med Marine Pilotage & Towage**
Country	**Turkey**
Flag	**Turkey**
Total number of sister ships already completed	**5**
Total number of sister ships still on order	**0**
Contract date	**Not specified**
Delivery date	**June 2018**

Med XXIV was the first unit to be delivered in a six-vessel series, designed by Robert Allan Limited (RAL) exclusively for Med Marine and designated RAmparts 2300-MM tugboats. These ASD-type vessels are designed for harbour and terminal operations, as well as coastal towing.

For each unit, a pair of Caterpillar 3512C diesel engines delivers a total output of 2 × 1,380 bkW at 1,600 rpm with a free sailing speed of 12knots and bollard pull of 50tonnes. Two Caterpillar C4.4 gensets provide 86kWe of electrical power apiece for vessel services, including the deck machinery.

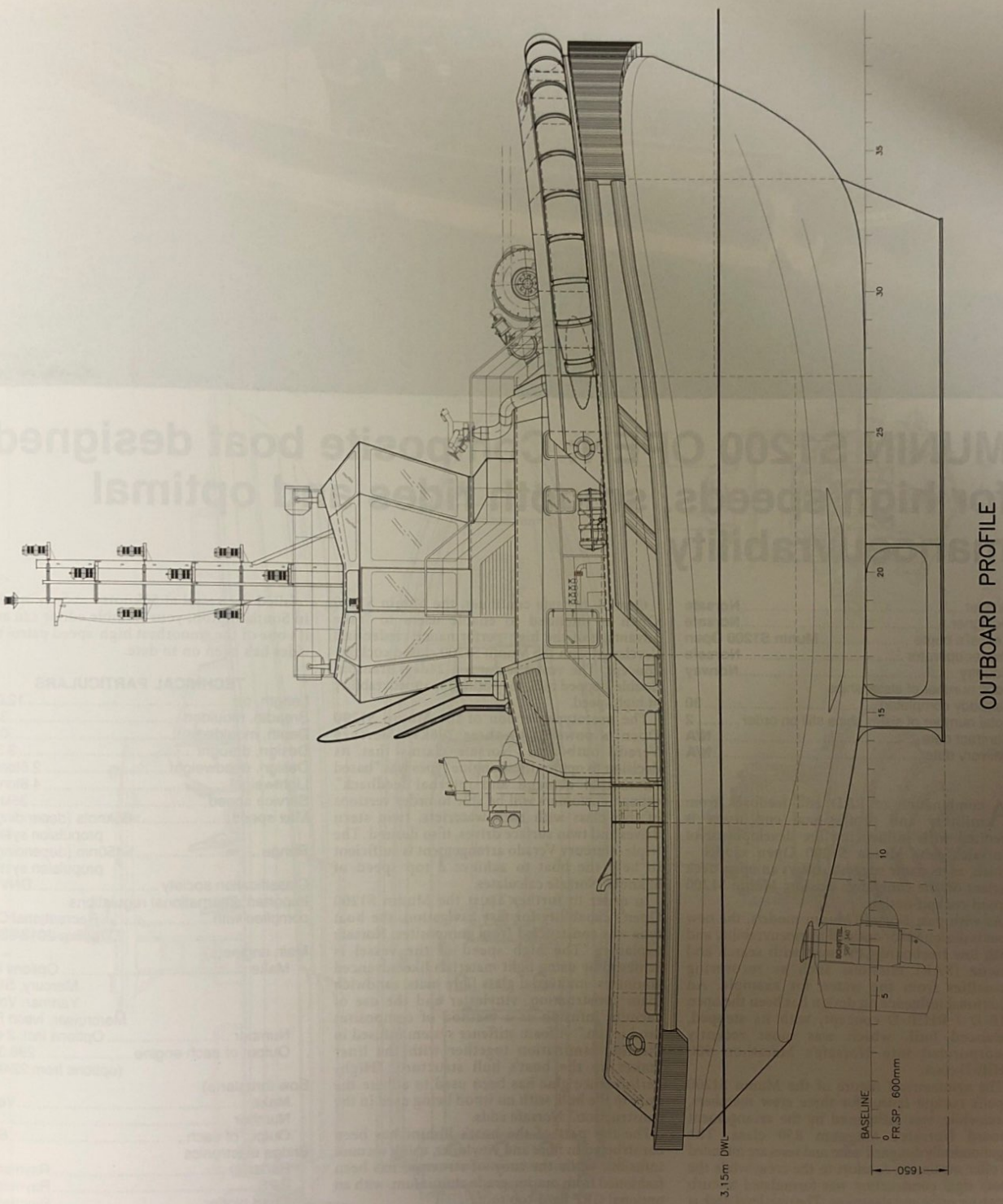
Each vessel drives two Schottel SRP340 azimuthing thrusters with fixed-pitch propellers of 2,100mm diameter. The diesel-driven fire-fighting (FiFi) pump for the tug's FiFi E system is mounted on one of the main engines and can deliver 1,400m³ per hour to two electrically controlled monitors.

The RAmparts 2300-MM tugs are compliant with the Maritime Labour Convention (MLC) with high-quality and high-comfort accommodation, including a captain's cabin, an officer cabin and two double crew cabins.

Optional items of equipment for this series include: an electric frequency-controlled aft towing winch; a Toimil T-10500M deck crane, rated 1tonne at 8m; two main fire pumps with a total capacity of 2,800m³ per hour and two FFS foam/water monitors; HVAC hot and cold climate packages; and a hydraulic rescue boat crane, with an SWL of 12kN.

TECHNICAL PARTICULARS

Length, oa	23m
Breadth, moulded	10.9m
Depth, moulded	4.4m
Gross tonnage	289tonnes
Design, draught	3.15m
Service speed	12knots
Classification society	RINA
Notations	C ✠ HULL ✠ MACH ✠ AUT-UMS, Firefighting Ship E with Water Spray, Unrestricted Navigation, Greenstar 3, MLC Design
Bollard pull	50tonnes (approx.)
Main engine(s)	
Make	Caterpillar
Model	3512C
Number	2
Output of each engine	2 × 1,380bkW@ 1,600rpm
Propeller(s)	
Manufacturer	Schottel
Model	SRP 340
Number	2
Diameter	2,100mm
Special adaptations	ASD
Deck machinery	
Winch(es)	
Fore towing winch	
Manufacturer	SEC Ten Horn
Type	Electric frequency controlled towing winch
Capacities	300 kN
Other deck machinery/equipment	
Anchors & chain	1 × 240kg (high holding power). short link chain, 19mm Gr 2
Rescue boat	Brig 420 CM foldable boat
Anchor capstan	One piece SEC Ten Horn electric anchor capstan(s), to suit a 20.5mm stud link chain with quality U2
Capstan	One piece SEC Ten Horn electric capstan(s), 50 kN
Towing hook	Data DTH 70-130P (quick release, disc type towing hook)
Fenders	Rubber, cylinder, W and D type fendering around the hull
Life raft	2 × on top deck, 10 persons
Bridge electronics	
Radar(s)	JMA-5212-6BB
Autopilot	NT921MKII
GPS	JLR-7500
Inmarsat SSAS	JRC JUE 87
Speed log	JLN-205 MK2
AIS CLASS A	JHS 183
AIS CLASS B	iMarine3.5
Navtex	NCR 3333
Compass	Reflecta 1 - 1200MM
Onboard capacities	
Fuel oil	62,000litres
Fresh water	11,400litres
Sewage	10,300litres
Ballast water	21,800litres
Foam	3,200litres
Oily water	3,200litres
Lube oil	1,800litres
Complement	
Number of cabins	4
Other significant or special items of equipment	
Generator set	2 × C4.4 86ekW, 1,500rpm, 50hz;
Fresh water system	Electrical hydrophore and sewage pump;
Ventilation	Mechanical ventilation exhaust - 2 × 100 m³/h, 1 × 470 m³/h centrifugal direct driven fan; Mechanical ventilation supply - 2 × SALOR HUA-S 630-10-2 (reversible, 2-speed).
External firefighting	Jason - 1 × main fire pump: driven through clutched flexible coupling on front of one main engine, Total capacity: 1,400m³/hour, 2 × Monitors: FFS foam/water monitors, Remote operated, electric controls



NOORDZEE: Hybrid tug for the Royal Netherlands Navy

Builder	**Damen Shipyards Group**
Designer	**Damen Shipyards Group**
Vessel's name	***Noordzee***
Owner/operator	**Royal Netherlands Navy**
Country	**Netherlands**
Flag	**Netherlands**
Total number of sister ships already completed	**2**
Total number of sister ships still on order	**0**
Contract date	**2014**
Delivery date	**February 2016**

Upon delivery to the Royal Netherlands Navy (RNLN) last year, *Noordzee* represented the first in a series of three of Damen's ASD Tug 2810 Hybrid models, selected for performance as well as environmental sustainability. The two follow-up sister vessels – namely *Waddenzee* and *Zuiderzee* – were delivered in Q1 and Q2 2016 respectively.

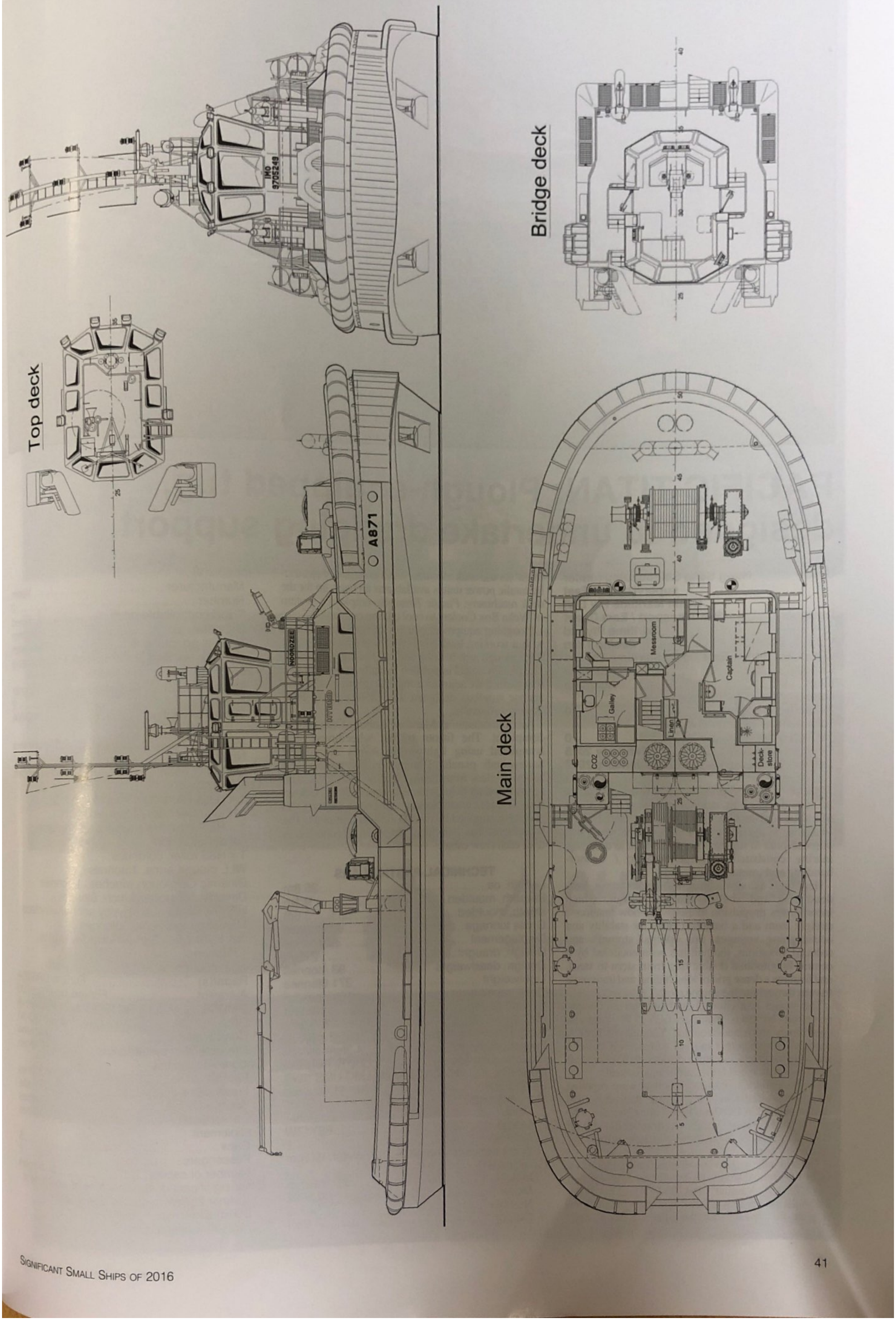
The RNLN was reportedly looking for a standard tug that was very environmentally friendly, albeit also being powerful enough to undertake heavy operations. The ASD Tug 2810 Hybrid utilises two rudder propeller units for optimum manoeuvrability and is able to sail on full electric power, via a set of batteries, or in diesel mode, care of her two MTU main engines.

When full pull is required, both MTU engines are deployed, granting the tug a top bollard pull (bp) of 60tonnes – a considerable increase on the 22tonnes bp-rated, Linge-class RNLN tugs which this trio has replaced. When sailing under diesel power, meanwhile, the vessels within the Damen ASD Tug 2810 Hybrid class are able to store any electrical energy that is not immediately being used in its battery pack. As such, this energy can be used for onboard hotel applications / operating systems, or saved for use when the tug switches to electric sailing mode.

Post-delivery, Damen Shipyards is also responsible for the maintenance of these three vessels – a task that has previously been handled by the RNLN in-house – thus reflecting growing expectations for after-sales customer support as a key part of the overall newbuild contract.

TECHNICAL PARTICULARS

Length, oa	28.67m
Breadth, oa	10.43m
Depth	4.6m
Gross tonnage	<300tonnes
Displacement	590tonnes
Draught	5.05m (aft)
Max speed	13.2knots (main engines) 8.7knots (generator) 4.8knots (batteries – 1hr max)
Classification society	Lloyd's Register
Notations	✠100A1 Tug [✠] LMC UMS ECO IWS
Bollard pull	61tonnes (ahead) 56.5tonnes (astern)
Main engine(s) (DIESEL)	
Make	MTU
Model	16V4000M63R
Number	2
Output of each engine	3,680bkW@1,600rpm
Main engine(s) (ELECTRIC)	
Make	ABB
Model	M3LP450
Number	2
Output of engines	460bkW@900rpm (free sailing) 100bkW@500rpm (standby)
Propeller(s)	
Material	NiAlBr
Manufacturer	Rolls-Royce
Number	2
Diameter	2,400mm
Open or nozzled	Nozzled
Deck machinery	
	1 x Heila HLM 10-2S crane and winch, 100kg@8.4m
	1 x capstan, 5tonnes@15m/min
	1 x towing hook aft, 650kN/65tonnes SWL
Bridge electronics	
Radar(s)	Furuno FAR-2117
Autopilot	Simrad AP-70
ECDIS	2 x Furuno FMD 3200 BB
DGPS	Furuno GP-170-D
Gyro	Anschütz Standard 22 Compact
Compass	Magnetic Kotter
Other communications systems	2 x Sailor 6222 VHF radio telephones 2 x Jotron TRON TR-20 VHF handheld 4 x Motorola DP-4401 ATEX handheld
AIS	Saab R5 Supreme
Onboard capacities	
Fuel oil	72,300litres
Fresh water	16,500litres
Foam	8,100litres
Lube oil	6,800litres
Sewage	8,800litres
Ballast water	5,600litres
Complement	
	Accommodation for 5+1 persons


Top deck
Bridge deck
Main deck
IMO 9705249
A871
NOORDZEE
Messroom
Captain
Galley
Linen
CO2
Deck-store

PACIFIC TITAN: Plough-equipped tug, designed to undertake dredging support

Builder	**Hung Seng Shipbuilding (under supervision of East Coast Maritime Pty Ltd)**
Designer	**Sea Transport / East Coast Maritime Pty Ltd**
Vessel's name	***Pacific Titan***
Owner/operator	**East Coast Maritime Pty Ltd**
Country	**Australia**
Flag	**Australia**
Total number of sister ships already completed	**0**
Total number of sister ships still on order	**0**
Contract date	**February 2015**
Delivery date	**January 2017**

Pacific Titan comprises a shallow-draught utility tug, designed in tandem by owner East Coast Maritime and architect Sea Transport, and built at Malaysia's Hung Seng Shipbuilding. The vessel was purpose-built to support operations such as dredging, marine construction, barge-handling / anchor-handling and towage.

Her hull is a double-chine, high-displacement, low-dead rise and shallow-draught design, which incorporates propulsion tunnels. The bow features a straight stem and a balanced entry for stability and ocean-going voyages. For optimal strength and reduced vibrations, the hull has been encircled by a central longitudinal double ring from stern to stern, and features a dense grid of longitudinal and transverse frames throughout the engine room.

The vessel is a conventional twin-screw design, powered by two Yanmar 6EY17W engines. Gearboxes are island-mounted Yanmar YXH500L models with an output ratio of 4.96:1. The vessel's main engine shafts, rudder stocks and stern roller shaft have been fabricated from 2205 stainless steel.

Nickel-aluminium-bronze propellers were supplied by Veem Australia and are a 4-blade skewed Kaplan design, housed in 1,880mm Rice Thrust Nozzles. The vessel is equipped with a hydraulically driven Nakashima TFN-100S bow thruster, supplying 2tonnes of thrust.

The hydraulic system was designed and supplied by HES Winches Australia. Hydraulic power is supplied by a 257kW Yanmar 6HA2M-WHT. The diesel hydraulic power unit is fitted with two pumps: one running the bow thruster, the other running a 'ring-main' for the deck machinery. An emergency electric-hydraulic power unit is available as an back-up for the deck machinery. *Pacific Titan* also employs a system of Weka Box Coolers to cool all five engines.

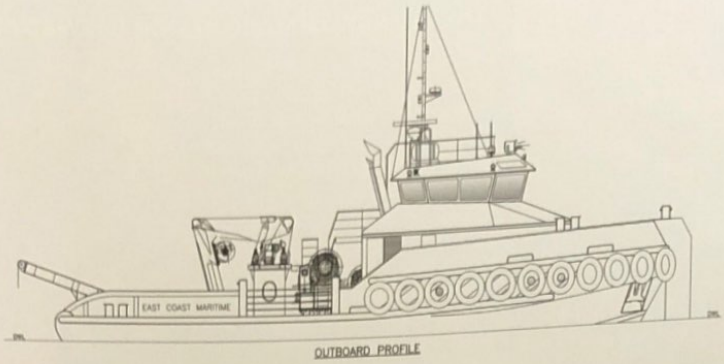
Ploughing equipment consists of twin plough arms with a working load limit (WLL) of 15tonnes each. Each plough arm is fitted with a Dinamic Oil winch. The plough is held in position laterally using twin side stays, which are adjusted using the custom quad-gypsy anchor windlass designed and fabricated by HES Winches Australia.

Accommodation is Maritime Labour Convention-compliant. The fit-out of the wheelhouse was completed using lightweight Ayres aluminium honeycomb panels, Dampa ceiling panels and adhesive glass from Sealed Marine Windows. The forward and aft helm stations feature custom cockpit-style dash panels and Norsap helm chairs. Heating and cooling is supplied by twin Daikin air-con units. The wheelhouse has individual temperature controls, as does each crew cabin.

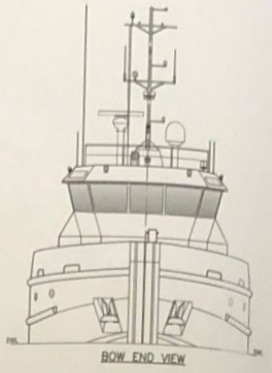
TECHNICAL PARTICULARS

Length, oa	25.8m
Breadth, moulded	9.1m
Depth, moulded	3.6m
Gross tonnage	212tonnes
Displacement	365tonnes
Design, draught	2.65m
Design, deadweight	93.4tonnes
Lightweight	271.6tonnes
Deck capacity	10tonnes/m²
Service speed	11knots
Max speed	12.7knots
Range (nautical miles)	5,650
Fuel consumption	4.3tonnes/day
Classification society	Lloyd's Register
Notations	✠100A1 Tug [✠] LMC UMS *IWS
Bollard pull	31.6tonnes
Main engine(s)	
Make	Yanmar
Model	6EY17W
Number	2
Output of each engine	837kW@1,450rpm
Gearbox(es)	
Make	Yanmar
Model	YXL500L
Number	2
Output	4.96:1
Propeller(s)	
Manufacturer	Veem
Number	2
Fixed/controllable pitch	Fixed
Diameter	1,880mm
Special adaptations	Skewplan
Open or nozzled	Rice Thrust Nozzle
Alternator(s)	
Make	Yanmar
Number	2
Output of each set	60kVA
Bow thruster(s)	
Make	Nakashima
Number	1
Output of each	132kW@634rpm
Deck machinery	
	1 x Heila telescopic knuckle boom, 18tonnes@7.5m / 8tonnes@14m
	1 x HES Australia double drum reverse waterfall winch
	1 x HSS roller, 65tonnes
	WLL plough arms, 15tonnes
	Dinamic Oil plough winches, 10tonnes
	Dinamic Oil tugger winch, 8tonnes
	HES Australia quad-gypsy anchor windlass
	Mampaey tow hook, 30tonnes
	WK-Hydraulics 3-In-A-Row towing pins, 35tonnes
Bridge electronics	
Radar(s)	Furuno DRS25A
Autopilot	Furuno NavPilot 700
GMDSS	Furuno RC1800T w/2x Felcom18
GPS	Furuno SC-30
Chart plotter	Maxsea
Fire detection system	Firepro
Onboard capacities	
Fuel oil	107,000litres
Fresh water	25,000litres
Sullage	7,500litres
Ballast water	3,000litres
Complement	
Crew	5
Passengers	7
Number of cabins	5 (single)
Other significant or special items of equipment	
	Yanmar 257kW hydraulic power unit
	550x550mm moon pool
	High-lift fishtail rudders

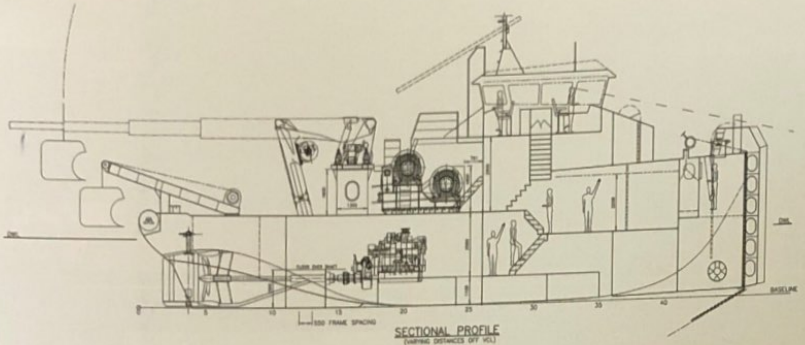
PACIFIC TITAN



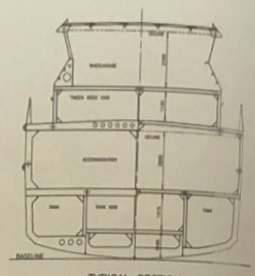
OUTBOARD PROFILE



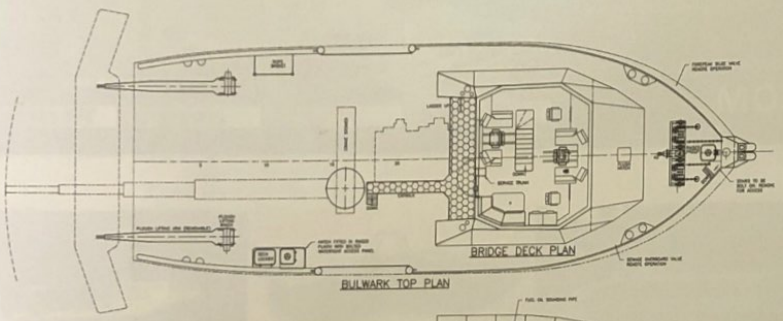
BOW END VIEW



SECTIONAL PROFILE

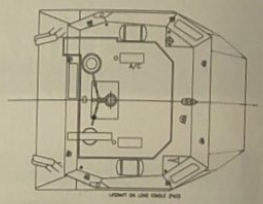


TYPICAL SECTION

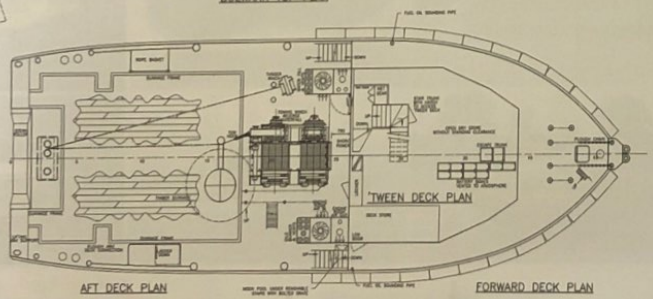


BRIDGE DECK PLAN

BULWARK TOP PLAN



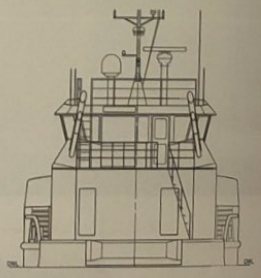
WHEELHOUSE ROOF DECK



'TWEEN DECK PLAN

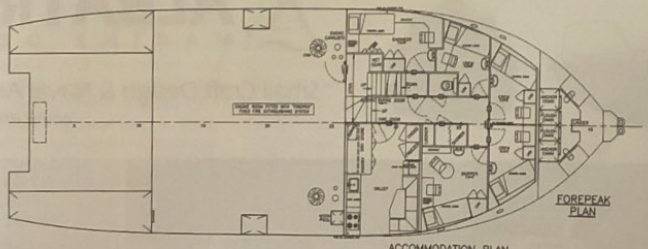
AFT DECK PLAN

FORWARD DECK PLAN



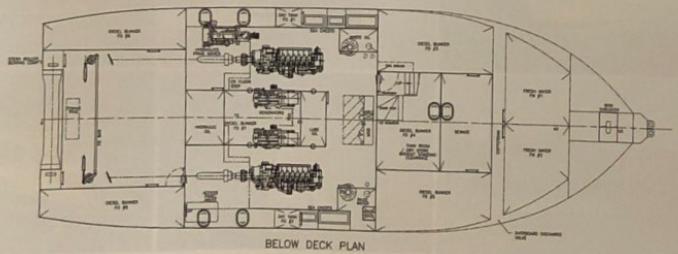
STERN END VIEW

DECK EQUIPMENT NOT SHOWN



FOREPEAK PLAN

ACCOMMODATION PLAN



BELOW DECK PLAN

TELSTAR: EDDY Tug concept vessel matches clean electric power with high manoeuvrability

Builder	**Holland Shipyards**
Designer	**Eddy Tug**
Vessel's name	***Telstar***
Owner/operator	**Iskes Towage and Salvage**
Country	**Netherlands**
Flag	**Netherlands**
Total number of sister ships already completed	**0**
Total number of sister ships still on order	**0**
Contract date	**November 2015**
Delivery date	**October 2016**

Slightly more compact than her predecessor *Eddy 1* (see *Significant Small Ships of 2014*, pages 26 and 27), the compact, 25m *Telstar*, which was delivered in October 2016, is a further refined version of the hybrid-driven 'Efficient, Dynamic, Double-Ended' tug (EDDY Tug) concept, which aligns azimuthing thrusters, one under the prow and one under the stern, to realise a vessel capable of high-precision manoeuvring and the ability to exert full thrust in any direction.

As with *Eddy 1*, *Telstar* was built at Holland Shipyards to the specs of the EDDY 24-75 design. The vessel was delivered to Iskes Towage & Salvage in the Port of IJmuiden – an ideal location to test the tug's manoeuvrability. The design also allows for towing pins to be fitted on the aft bulwark, to assist with control when encountering narrow lock and bridge passages. Stability is an important consideration given that lock transits are a key part of the Iskes harbour towage business.

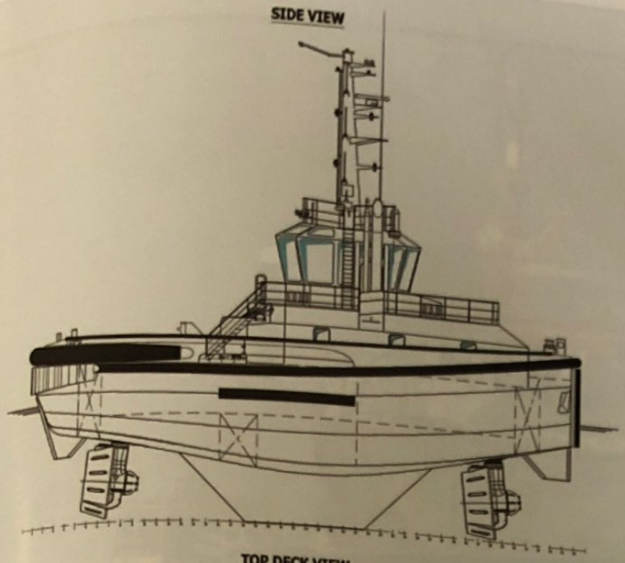
Telstar is powered by two Mitsubishi main engines and two permanent magnet electric motors. The vessel also features the Veth Hybrid Drive (VHD) system manufactured by Veth Propulsion, which supplied the vessel's Z-drive VZ1800 VHD thrusters, Scania Dl16 gensets and a Sisu harbour set.

The tug's hybrid arrangement incorporates diesel-direct and diesel-electric inputs to the thrusters. The electric motors, rated 600kW each, are powered by the two 640kW Scania gensets. A transit speed of 8knots can be attained using one generator, and 10knots on two. The bollard pull of 75tonnes in diesel-direct mode is measured at 30tonnes in 'e-mode'. Operating in 'e-mode' could help to slash fuel costs and emissions by 50%, depending on the port of operations, whilst also reducing main diesel engine running hours, lowering maintenance costs. When more power is required in e-mode (for push-pull and active assist operations, for example) the operator can add the power of the diesel-direct input for extra kick.

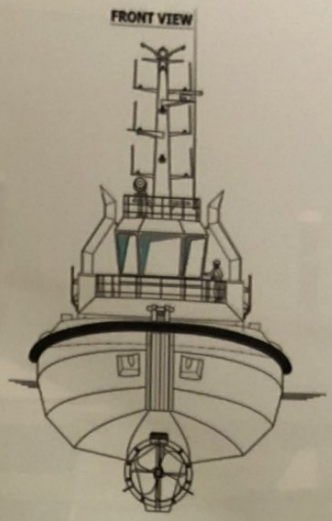
TECHNICAL PARTICULARS

Length, oa	25.45m
Length, bp	23.57m
Breadth, moulded	11.4m
Depth, moulded	7.01m
Gross tonnage	303tonnes
Displacement	529tonnes
Design, draught	5.65m
Design, deadweight	91tonnes
Lightweight	438tonnes
Service speed	8.2knots (on 640kW electric motor)
Max speed	13.5knots
Range (nautical miles)	4,700
Classification society	Bureau Veritas
Notations	I TUG, _HULL. MACH, AUT-UMS
Bollard pull	76.4tonnes
Main engine(s)	
Make	Mitsubishi
Model	S16R2
Number	2
Output of each engine	1,450kW@1,350rpm
Propeller(s)	
Manufacturer	Veth Propulsion
Type	Veth VZ-1800
Number	2
Diameter	2,600mm
Speed	1,540rpm (input speed)
Special adaptations	Diesel and e-motor in-line
Open or nozzled	Nozzled
Deck machinery	
	1 x Ridderinkhof double drum, rope diameter 88mm, rope storage 2 x 170m, 149kW, 30tonnes pull on first layer@15m/min
	1 x MKB Machinefabriek angled towing pin system, 75tonnes SWL
	2 x Holland Shipyards towing bits, 75tonnes SWL
	1 x capstan, 50kN with speed approx. 10m/min
Bridge electronics	
Radar(s)	Furuno FAR2117
Autopilot	Pilotstar D
GMDSS	VHF – 1 / 2 Sailor-6222
AIS	Furuno FA-150
GPS	Furuno GP-170
Magnetic compass	Cassens & Plath, Reflecta 1 Fiberline
GPs compass	Furuno SC-50
Chart plotter	Transas, Tsunamis Navigator
Onboard capacities	
Fuel oil	80,000litres
Fresh water	16,000litres
Sullage	11,000litres
Bilge water	3,500litres
Sludge	4,000litres
Dirty oil	4,000litres
Complement	
Crew	5
Passengers	0
Number of cabins	4

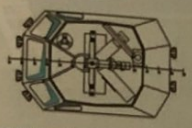
SIDE VIEW



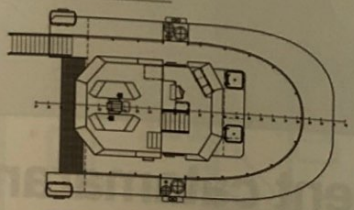
FRONT VIEW



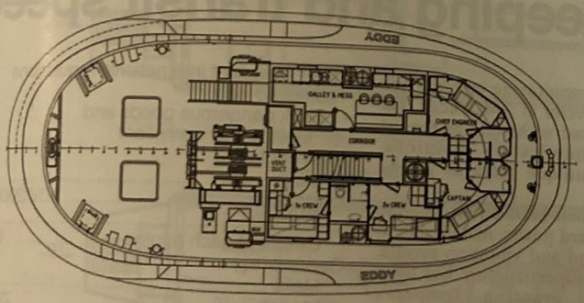
TOP DECK VIEW



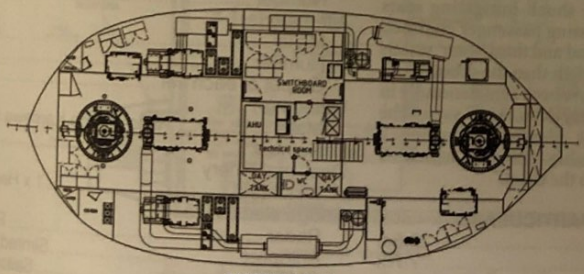
BRIDGE DECK VIEW



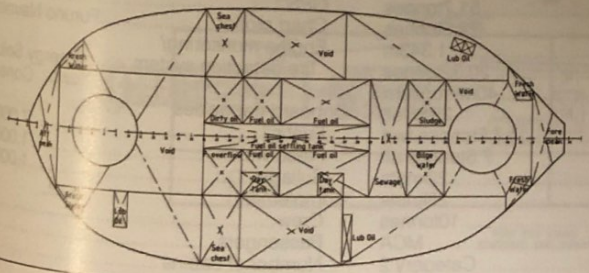
MAIN DECK VIEW

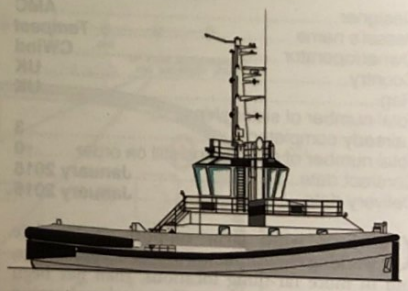


ENGINE ROOM VIEW



TANKTOP VIEW





TAI PARI: First of two customised China-built tugs, complete with optimised Z-drive units

Builder	**Hin Lee (Zhuhai) Shipyard Co, Ltd (Cheoy Lee)**
Designer	**Robert Allan Ltd**
Vessel's name	***Tai Pari***
Owner/operator	**The Port of Tauranga Limited**
Country	**New Zealand**
Flag	**New Zealand**
Total number of sister ships already completed	**1**
Total number of sister ships still on order	**0**
Contract date	**December 2013**
Delivery date	**June 2015**

As part of its fleet renovation programme, the Port of Tauranga Limited, New Zealand, took delivery of a pair of tug newbuilds, constructed in China to a customised version of Robert Allan Ltd's (RAL's) RAmparts 2400W class design. *Tai Pari* was delivered in June 2015 (her sole sister, *Tai Timu*, followed hot on her heels later on in the month), with design input based on the Port of Tauranga's operational specifications. The contract was certainly a significant one for Cheoy Lee, being its first RAL-designed construction project to date.

The now familiar RAmparts hull design incorporates an enhanced dead rise for superior seakeeping, as well as RAL's conically shaped double chine stern for effective control and vessel stability at high speed. The Port additionally requested a vessel type that would be capable of towing, albeit with a high side stepping speed. As a result, RAL conducted a detailed CFD study to determine the optimal skeg geometry to yield the desired effects. Tests were conducted, utilising modelled Z-drive thrusters and rotating propellers. Another challenge was to restrict the hull length, so that it would fall under the 24m rule length for load line and tonnage conventions.

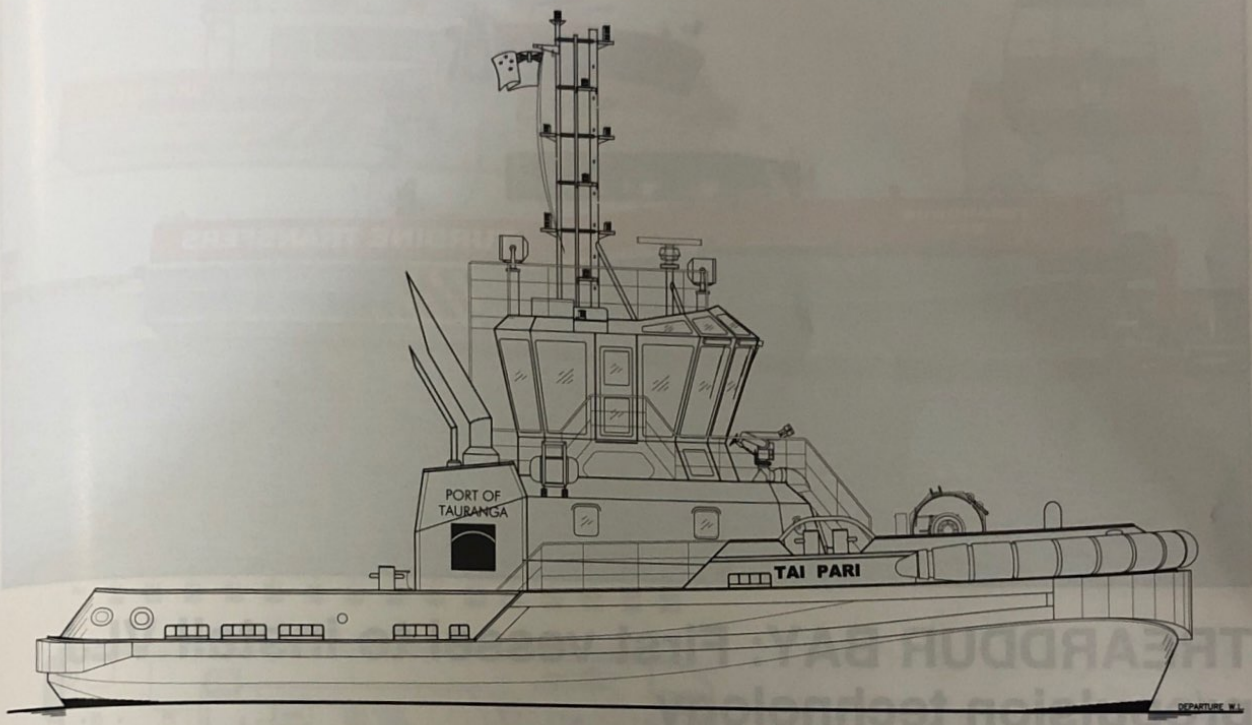
With environmental protection in mind, *Tai Pari*'s main Caterpillar 3516C engines, each rated 2,350kW at 1,800rpm, are 'C' rated, compliant with IMO Tier II guidelines. *Tai Pari* has also been fitted with firefighting equipment, including a single centrifugal pump, which is fed by the port main engine, and a forward-mounted monitor, the latter featuring a dispersal capacity of 1,200m³ per hour.

Tai Pari and *Tai Timu* can each accommodate up to six members of crew. Each tug's forward lower deck houses a pair of two-man crew rooms, complete with laundry and washroom facilities; meanwhile, the master and chief engineer enjoy their own individual cabins on the main deck.

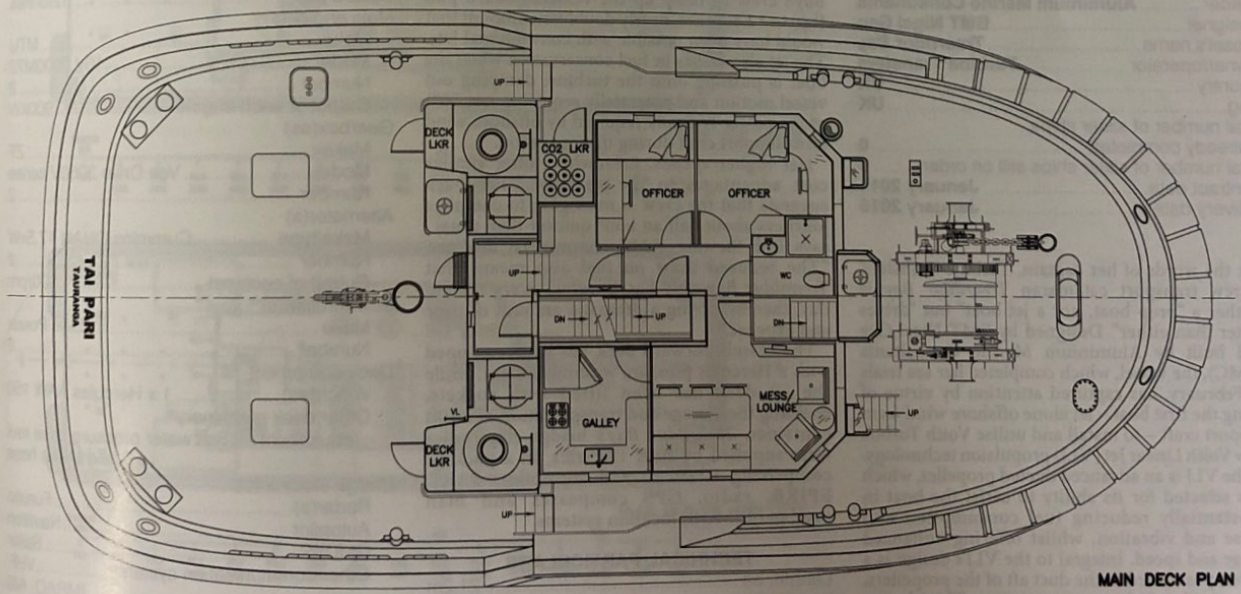
TECHNICAL PARTICULARS

Length, oa	24.4m
Breadth, moulded	11.25m
Depth, moulded	4.2m
Gross tonnage	310.4tonnes
Displacement	517tonnes
Design, draught	5.34m
Design, deadweight	105tonnes
Lightweight	412tonnes
Service speed	10knots (25% MCR)/ 12knots (50% MCR)
Max speed	13knots
Bollard pull	72tonnes
Range (nautical miles)	2,040 (at 10knots)
Daily fuel consumption	7.5tonnes
Classification society	Lloyd's Register
Notations	✠100A1 Tug, *IWS, ✠LMC. UMC for restricted service
Main engine(s)	
Make	Caterpillar
Model	3516C HD
Number	2
Output of each engine	2,350kW @ 1,800 rpm
Z-drive(s):	
Make	Rolls-Royce
Model	US 255 FP
Number	2
Output	240rpm
Material	NiAlBr
Fixed/controllable pitch	Fixed
Diameter	2,600mm
Special adaptions	TK (high performance) nozzle
Open or nozzled	Nozzled
Alternator(s)	
Make	Caterpillar C6.6
Number	2
Output of each set	125kWe @ 1,500rpm
Deck machinery	
	1 x MacGregor winch, 175tonnes brake capacity
	1 x MacGregor capstan, 5tonnes@0-15m/min
	1 x Mampaey tow hook, 100tonnes SWL
Bridge electronics	
GMDSS	Furuno A3
AIS	Garmin AIS 300
Chart plotter	Garmin
Engine monitoring/ fire detection system	Wilhelmsen
Onboard capacities	
Fuel oil	76.8m³
Fresh water	10.1m³
Grey water	2.8m³
Black water	2.8m³
Ballast water	45.8m³
Complement	
Crew	6
Passengers	0
Number of cabins	4

TAI PARI



OUTBOARD PROFILE



MAIN DECK PLAN

EDDY1: Hybrid tug setting new bar for fuel efficiency and energy optimisation

Builder	**Holland Shipyards**
Designer	**Eddy Tug**
Vessel's name	***Eddy1***
Owner / operator	**URAG**
Country	**Germany**
Flag	**Dutch**
Total number of sister ships already completed	**0**
Total number of sister ships still on order	**0**
Contract date	**October 2013**
Delivery date	**June 2014**

Officially launched in June 2014, *Eddy1* represents the debutante in the new Efficient, Double-ended and DYnamic (EDDY) 30-65 class, developed by architects Baldo Dielen and Walter van Gruijthuijsen, and realised by Dutch builder Holland Shipyards.

The vessel has been specifically designed to limit fuel consumption and enhance manoeuvrability when conducting operations. As a step towards achieving this goal, *Eddy1*'s hull has been designed in a manner unusual for tugs; ripping up the old diktat that tugs should match a bulky fore to a shallow aft, *Eddy1*'s layout instead opts to position most of its volume amidships. The freeboard has been raised for optimised seaworthiness, both at the fore and aft of the vessel. Also, the keel has been designed to be deeper than is typical for a tug of this size, to simplify the docking process and to enhance escort performance.

The tug has been fitted with a propulsive set-up comprising two Mitsubishi main engines, each delivering 1,610kW, and a pair of Schottel SRP3000 PTI hybrid azimuthing thrusters, generating a combined 1,950kW. The vessel features two separate engine rooms, which have been designed for ease of access during maintenance routines. Each engine room also features a Scania DI 16 generator, rated 568kWe.

The balanced equipment layout, combined with the simple but efficient hull shape, has a dramatic impact on fuel consumption. During her first months of operation, it soon became apparent that *Eddy1* required less than half the fuel of those conventional tugs of similar power which perform the same operations.

The towing point is located on the foredeck, in between a forward and an aft thruster, both positioned on the centreline. This not only highly simplifies and improves manoeuvring but ensures that high line-pulls can be maintained over a broad speed range and oblique angles of over 90degs.

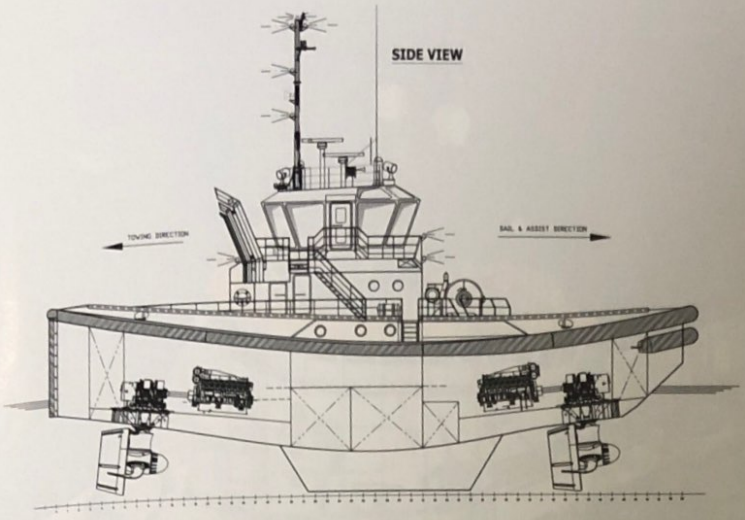
The shape of the hull helps to provide additional lift and line pull when the vessel is towed at an angle, thereby reducing the amount of energy, and subsequent fuel burn, required from the thrusters. According to Holland Shipyards, the line can be moved around a span of 270degs without making contact with the tug's superstructure.

Kraaijeveld has provided *Eddy1*'s SafeWinch unit, a double-drum with a holding capacity of 175tonnes. Onboard tank capacity enables the tug to store more than 100m³ of fuel and 36m³ of fresh water, which grants *Eddy1* a range of 30 days at a continuous cruising speed of 9knots. Protection is provided by a double 800mm cylinder fender at the bow and a 500mm cylinder fender all around the vessel.

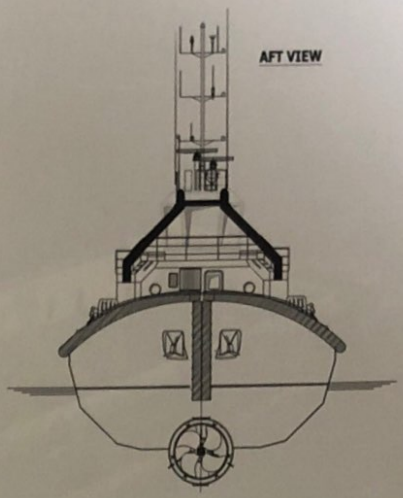
TECHNICAL PARTICULARS

Length, oa	30.3m
Length, bp	28.95m
Breadth, moulded	12.4m
Depth, moulded	6.65m
Gross tonnage	399tonnes
Displacement	500tonnes
Design, draught	4.75m
Service speed	9knots @ 450kW, diesel-electric 11.2knots @ 2 x450kW, diesel-electric
Max speed	13.4knots
Range (nautical miles)	10,000
Daily fuel consumption (tonnes/day)	2.7m³ @ 9knots/5.4m³ @ 11knots/1.5m³ average ops
Classification society	Bureau Veritas
Notations	✠HULL MACH ESCORT TUG AUT-UMS Unrestricted Navigation
Other important international regulations complied with	MLC 2006
Bollard pull	65tonnes
Main engine(s)	
Make	Mitsubishi
Model	S16 R
Number	2
Output of each	1,610kW@1,800rpm
Thrusters	
Make	Schottel
Model	SRP 3000 PTI
Number	2
Propeller(s)	
Material	CuNiAl
Manufacturer	Schottel
Number	2
Fixed / controllable pitch	Fixed
Diameter	2,400mm
Max speed	300rpm
Open or nozzled	Nozzled
Alternators/gensets	
Make	Scania / Stamford
Number	2
Output of each set	568kWe
Deck machinery	
Winch	Kraaijeveld SafeWinch
Number	1
Capacity	30tonnes @ 15m/min
Bridge electronics	
Radar(s)	2 x JRC JMA-5312-6, with ARPA
Autopilot	Alphatron Alpha-Seapilot-MFC
GMDSS	2 x Sailor SP-3510
Other communications systems	2 x JRC JUE-87 (Inmarsat C)
GPS	1 x JRC JLR-7500
Gyro	1 x JRC JLR-21 (GPS compass)
Chart plotter	Alphatron / Transas Alphachart-T dual ECDIS system
Engine monitoring / fire detection system	Holland Ship Electric
Onboard capacities	108m³
Fuel oil	36m³
Fresh water	2 x 3.6m³
Sullage	
Complement	7
Crew	0
Passengers	5
Number of cabins	

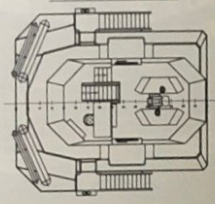
SIDE VIEW



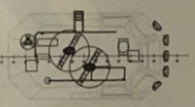
AFT VIEW



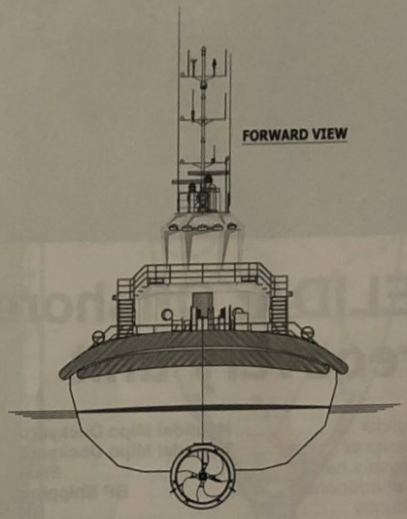
BRIDGE DECK VIEW



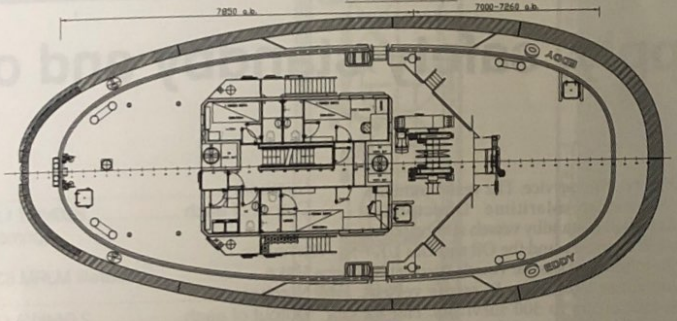
TOP DECK VIEW



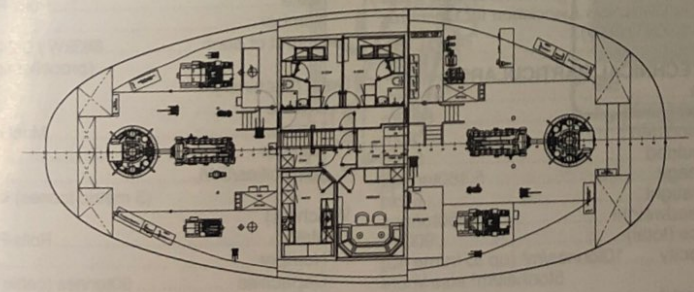
FORWARD VIEW



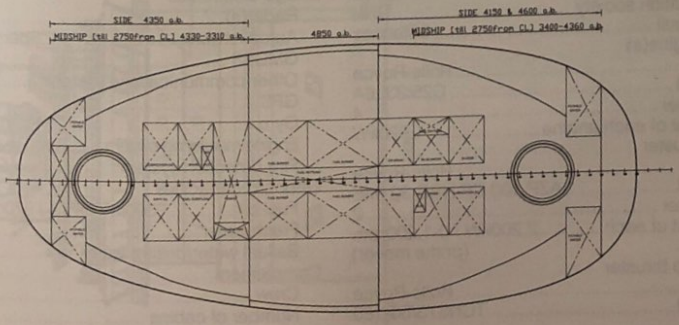
MAIN DECK VIEW



ACCOMMODATION/ENGINE ROOMS VIEW



TANKTOP VIEW



VALIANT: US Navy tug built to Z-Tech 4500 class

Builder's name	**J.M. Martinac Shipbuilding Corporation**
Designer	**Robert Allan Ltd**
Vessel's name	***YT-802 Valiant***
Owner/operator	**US Navy/ Bremerton Pilots**
Country	**USA**
Flag	**USA**
Total number of sister ships already completed	**3**
Total number of sister ships still on order	**1**
Contract date	**2007**
Delivery date	**December 2009**

Valiant was the first in a series of Z-Tech 4500 tugs delivered to the US Navy by J.M Martinac, a subcontractor to California-based Pacific Tugboat Services. Tailor-made to suit specific US Navy requirements, the Z-Tech 4500 specifications build on the industry-accepted Z-Tech 6000 hull form, which was originally developed by designer Robert Allan for tugs operating in the Port of Singapore.

Alongside her already-delivered sisterships, *Reliant* and *Defiant*, *Valiant* is deployed in the US Navy's Naval Region Northwest zone. Each of the Z-Tech 4500 class tugs features a length of 27.42m, moulded breadth of 11.65m, moulded depth of 5m and a maximum load draught of 4.88m.

Her propulsion equipment consists of a pair of CAT 3512 main engines, each of which is rated 1350kW at 1600rpm. Each drives a Schottel Model SRP 1012 steering / propulsion Z-Drive unit, with 2100mm diameter fixed pitch propellers. In total, *Valiant's* propulsion set-up amounts to total bollard pull rates of 42tonnes ahead and 45tonnes astern. Her free-running speed is recorded at 12.4knots.

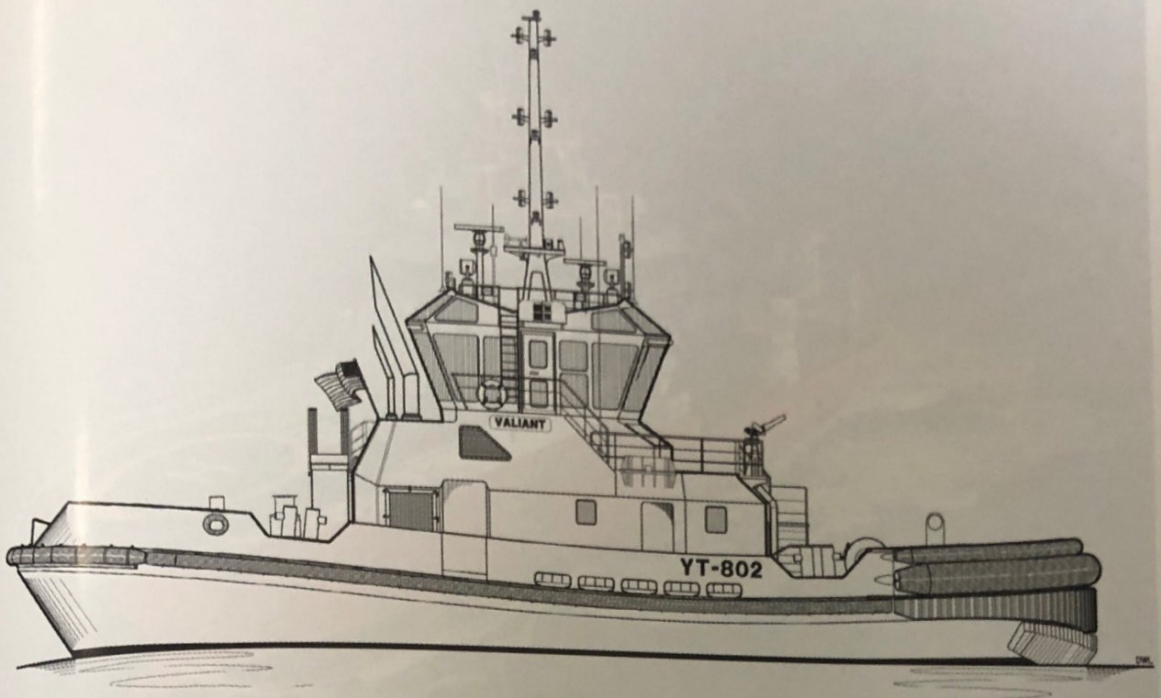
Valiant's electrical power derives from a pair of R.A Mitchell Co. diesel gen-sets with a John Deere 6068SFM75 prime mover. Each of these is rated 130kWe at 1800rpm. Her deck machinery includes a ship-handling hawser winch forward and a JonRie Series 210 Assist winch, which is fitted with 180m of 175mm line. The latter has a brake capacity of 136tonnes and a line pull/speed rating of 9tonnes at 53m/min.

The onboard firefighting system, meanwhile, is a PTO hooked up to the starboard engine, and engages a Stang fire pump. This arrangement removes the requirement for excess onboard piping. The Stang monitor is capable of delivering 2000gpm at 150psi.

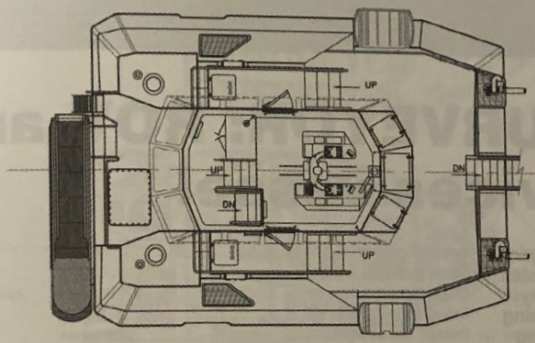
To ensure noise reduction for the crew is kept to a maximum, the accommodation deckhouse is separated from the machinery spaces. The tugs are also fitted with Shibata non-marking grey extruded rubber, above and below the waterline, so as to not leave abrasive marks against the hulls of naval surface ships and submarines with which they come into contact.

TECHNICAL PARTICULARS

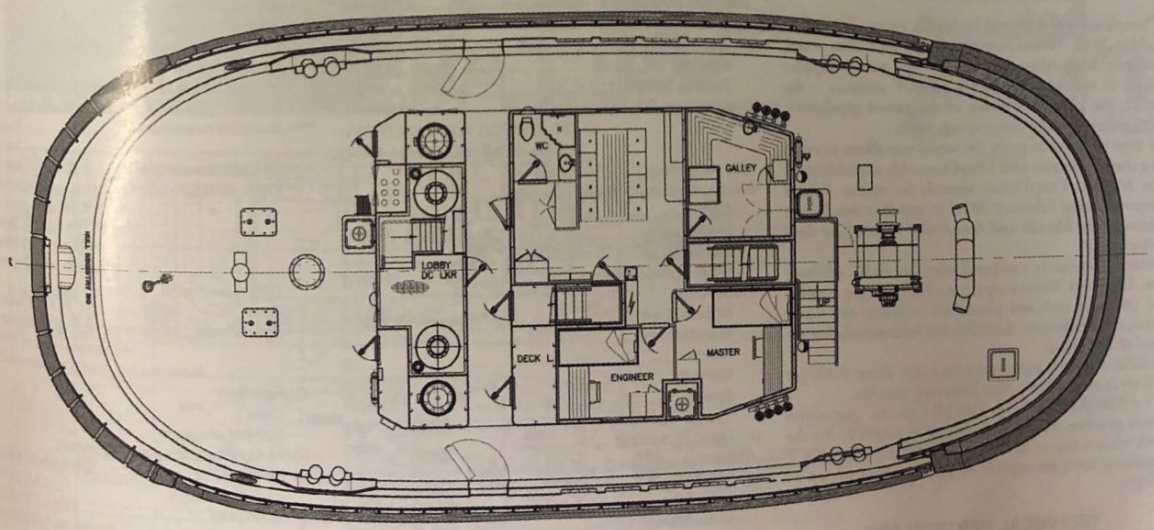
Length, oa	27.42m
Length, bp	25.17m
Breadth moulded	11.65m
Depth, moulded	5.00m
Gross tonnage	342gt
Displacement	527tonnes
Design, draught	4.88m
Design, deadweight	115tonnes
Lightweight	412 tonnes
Speed, service	12.0knots
Maximum speed	12.3knots
Classification society and notations	ABS ✠A1, E, Towing Vessel, Unrestricted Navigational Service, ✠AMS
Bollard Pull:	39.9tonnes
Crew:	6
Main engine(s)	
Make	Caterpillar
Model	3512C HD, A-Rated
Number	2
Output of each engine	1350kW @ 1600rpm
Gearbox(es) (Slipping Clutch)	
Make	Twin Disc
Model	MCD 3000-5 HD
Number	1
Output speed	Varies
Use:	controls starboard propeller speed during fire fighting operations
Azimuthing Thrusters	
Propeller Material	GS-CuAl10Fe5Ni5-C
Manufacturer Schottel	SRP 1012
Number	2
Fixed/Controllable pitch:	Fixed pitch
Propeller Diameter	2100mm
Speed	12knots
Special adaptations:	Azimuthing Thrusters
Open or nozzled	Nozzled
Alternators	
Number	two
Make/type	R.A. Mitchell Co. Inc
Output/speed of each set	130kWe at 60 Hz
Deck machinery	
Bow Winch	Jon Rie InterTech LLC Series 210 Assist Winch Line Pull = 9.07tonnes Brake = 136.08tonnes
Complement	
Crew	4 normal, maximum to 6
Number of cabins	4
Other significant or special items of equipment	2000 gpm at 150 psi Fire pump driven off the front PTO of the stbd main engine Telescoping brow (Gangway), which allows personnel to board a submarine when tug along side. Underwater fendering and guards to allow ship handling of submarines



PROFILE



WHEELHOUSE



MAIN DECK

OCEAN PIONEER: First of two steel sister ships for flexible fire-fighting and tug services

Builder	**Cheoy Lee Shipyards**
Designer	**Robert Allan Ltd**
Vessel's name	***Ocean Pioneer***
Owner/operator	**Ocean Sparkle Ltd**
Country	**India**
Flag	**Funafuti**
Total number of sister ships already completed	**1**
Total number of sister ships still on order	**0**
Contract date	**August 2009**
Delivery date	**May 2011**

Canadian marine designer Robert Allan and Chinese shipbuilder Cheoy Lee Shipyards have enjoyed a long-standing collaborative relationship since the pair teamed up in 2004, to deliver the first Z-Tech class tug, *Indee*, to BHP Billiton Iron Ore, and the former group estimates that Cheoy Lee has produced approximately 50 of its tug designs in the seven years since, with approximately 10 of these including the designer's RAmparts 2800 and 3000 series.

Fittingly, then, the summer of 2011 saw Cheoy Lee deliver two 32m by 12.4m sister tugs, built to Robert Allan's new RAmparts 3200-CL class specifications, the duo comprising *Ocean Pioneer* and *Ocean Perfect*. Both vessels were successfully delivered to Ocean Sparkle in India, providing a change from Cheoy Lee's constant Z-Tech 6500 tug output on behalf of the Panama Canal Authority, and are reported to be currently operating in Colombo, Sri Lanka.

Both *Ocean Pioneer* and her sister are constructed from steel and feature twin air start Caterpillar 3516B diesel engines, each of which is capable of generating 1839kW. These engines drive a pair of azimuthing Schottel SRP1215FP fixed-pitch rudder propellers, resulting in a maximum speed of 13knots, a bollard pull of 62tonnes and enhanced manoeuvrability options.

Electrical power is supplied courtesy of two 3-phase 112kW Perkins generators, while a 40kW unit is utilised for harbour service.

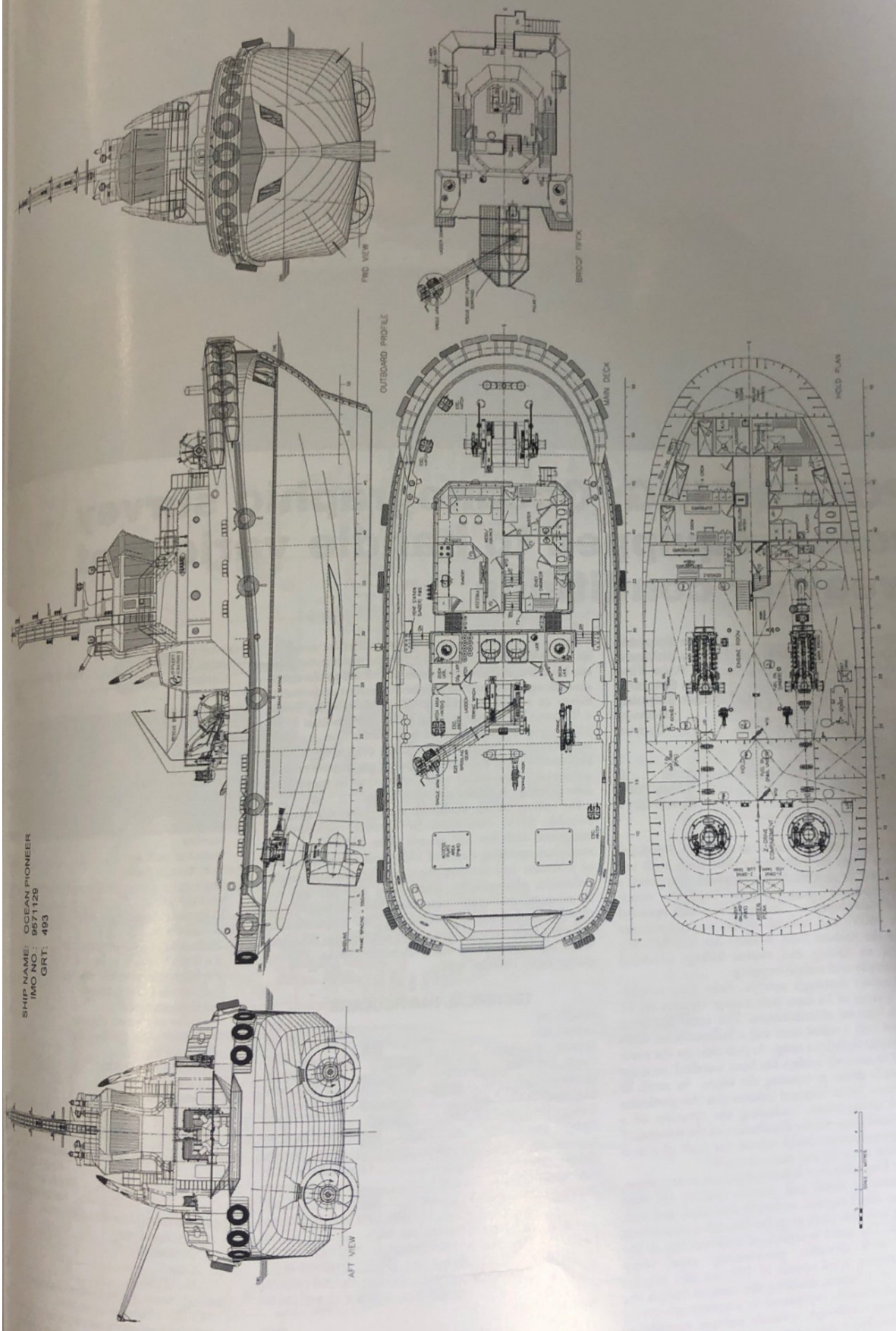
The vessel is well equipped to undertake the responsibilities expected of her, with deck equipment including items such as a single-drum towing winch / windlass, supplied by MacGregor, positioned at her bow. A MacGregor single-drum winch, cruciform towing bitt and a Mampaey towing hook with remote release are present on her aft, as is a fixed-arm davit, enabling *Ocean Pioneer*'s crew to launch a Safety of Life at Sea (SOLAS)-approved, six-person capacity inflatable rescue boat in the event of an emergency.

Fire-fighting capability has gradually become a mainstay feature of Robert Allan's internationally delivered tugs, and *Ocean Pioneer* is no exception. One main engine provides the power for a Fire Fighting Systems (FFS) supplied fire pump, which is rated at 2740m^3 per hour. This pump, in turn, feeds two FFS-supplied fire monitors, each rated at 1200m^3 per hour. This configuration has granted *Ocean Pioneer* and her sister Fi-Fi 1 class notation, and has granted Ocean Sparkle a higher degree of confidence when facing the possibility of tackling onboard blazes in her area of deployment.

TECHNICAL PARTICULARS

Length, oa	32m
Breadth, moulded	12.4m
Depth, moulded	5.4m
Gross tonnage	493tonnes
Displacement	885tonnes
Design, draught	4.88m
Design, deadweight	290tonnes
Lightweight	595tonnes
Max speed	13knots
Fuel capacity	235m^3
Classification society and notations	Lloyd's Register, ✠100A1, Tug, Fi-Fi 1 with Water Spray, *IWS, ✠LMC, UMS
Main engine(s)	
Make	Caterpillar
Model	3516B
Number	2
Output of each engine	1839kW
Propeller(s)	
Manufacturer	Schottel SRP1215FP rudder propellers
Number	2
Fixed / Controllable pitch	Fixed
Diameter	2400mm
Open or nozzled	Nozzled
Generators	
Make/type	Perkins, diesel
Number	3
Output of each set	2 x 112kW, 1 x 40kW
Deck machinery	
	MacGregor single-drum towing winch/windlass at bow
	MacGregor single-drum winch on aft deck
	Cruciform towing bitt
	Mampaey towing hook with remote release
	Fixed-arm davit for launching six-man rescue boat
Bridge electronics	
Radar(s)	JRC JMA-5212-4HS
Autopilot	Anschütz NP60
GMDSS	Furuno Felcom-15 / Furuno FS-1570 c/w DSC
Other communications systems	2 x Furuno 8800S c/w DSC, 3 x Sailor SP-3540
GPS	Furuno GP-32
Gyro	Koden KGC-1
Other	Furuno FA-150 AIS
	Furuno NX-700B Navtex
	Furuno FE-700 echo sounder
	Furuno DS-80 doppler log
Engine monitoring/fire detection system	Thorn T1008
Complement	
Crew	12
No. of cabins	5

OCEAN PIONEER



ST ELMO: Wide-beamed escort tug for Malta, with fire-fighting capabilities

Builder	**Astilleros Zamakona**
Designer	**Robert Allan Ltd**
Vessel's name	***St Elmo***
Owner / operator	**Rimorchiatrori Riuniti**
Country	**Italy**
Flag	**Malta**
Total number of sister ships already completed	**0**
Total number of sister ships still on order	**0**
Delivery date	**October 2011**

Delivered to Italian tug operator Rimorchiatrori Riuniti in October 2011, the Robert Allan-designed RAmparts 3000W tug *St Elmo* is currently being put through her paces within and around Malta's territorial waters, deployed on behalf of the operator's Tug Malta subsidiary. As befits her name, the 30.25m-long vessel, whose order constituted a welcome ray through the recession-laden clouds for Spanish shipbuilder Astilleros Zamakona's Pasaia yard, was blessed by Archbishop Paul Cremona of Malta upon her christening – though the vessel has clearly been designed and assembled to get by on more than the power of prayer alone.

St Elmo's RAmparts 3000W design features a notably wider beam than typical members of the standard RAmparts 3000 family, and this enhancement enables her to take full advantage of a pleasingly large working deck for a tug of this length. In total, the deck area can accommodate up to six 2.4x2.4m containers.

Modern tugs are consistently rocketing in terms of strength, and *St Elmo* is no exception. Her propulsive arrangement of two Caterpillar 3516B engines, rated at 2100kW at 1600rpm apiece, and each driving a Rolls-Royce US 255P30 fixed-pitch Z-drive through twin-disc marine control drives, has granted the vessel a mean ahead bollard pull (bp) capacity of 75tonnes and a mean astern bp of 71tonnes, while her free-running speed has been logged at 13knots. Onboard electrical power is provided by two Caterpillar C6.6 diesel generating sets, each rated 125eKW at 1500rpm, in addition to a harbour genset, supplied by Deutz, which generates 78eKW at 1500rpm.

With this power at her disposal, the tug incorporates a hydraulically driven, double-drum, render-recover escort winch, manufactured by Ibercisa and situated on her foredeck. The winch set-up is bolstered by the addition of an adjustable constant tensioning system, which enables *St Elmo*'s crew to monitor loads from the wheelhouse. The tug's aft deck is equipped with a 100tonne safe working load (SWL) gob eye, a 4tonne vertical capstan, a 75tonne SWL remote quick-release tow hook and a 25tonnes-per-metre knuckle boom crane.

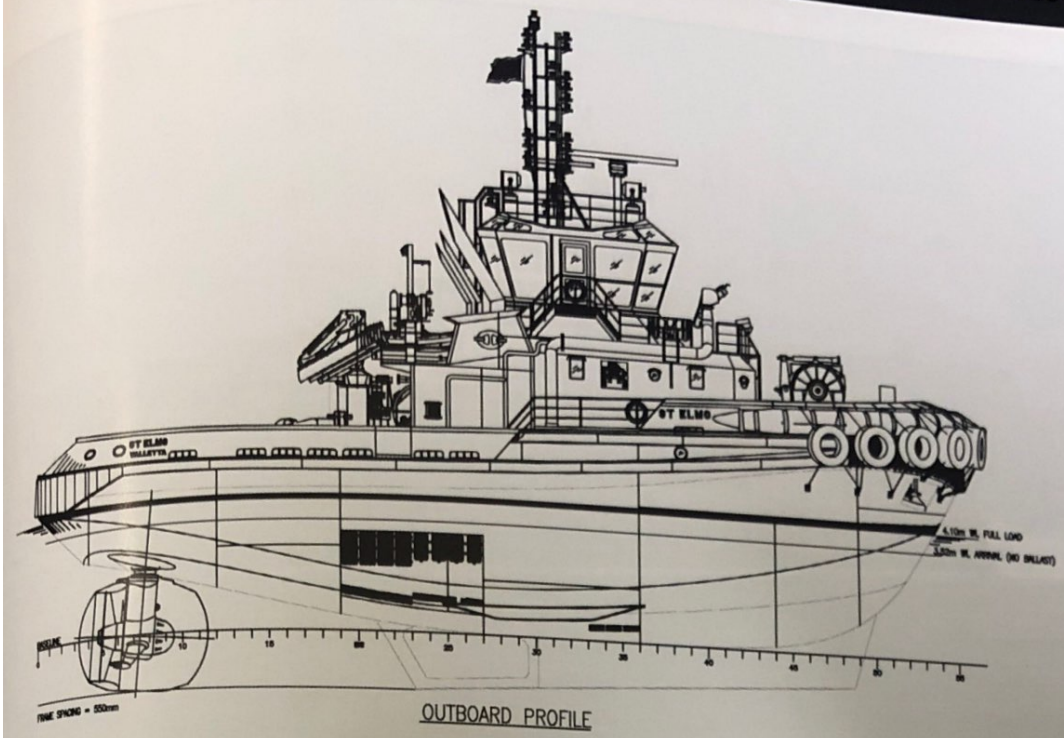
When it comes to fire-fighting capacity, *St Elmo* is no slouch: her Fi-Fi 1 – compliant system comprises a pair of main engine-driven centrifugal pumps, manufactured by long-term Robert Allan favourite Fire Fighting Systems. Each pump has a capacity of 1358m^3 per hour, and both monitors are capable of delivering 1200m^3 per hour of water, with one of these units able to deliver 300m^3 per hour of foam. Additional life-saving equipment includes a 4m rigid inflatable boat (RIB), fitted with an outboard motor rated at 18.4kW and a Safety Of Life at Sea (SOLAS)-compliant launch davit, should the crew need to respond to an emergency.

For crew comfort, Robert Allan specified resilient mounting of the vessel's main engines, and the use of visco-elastic floating floor systems throughout *St Elmo*'s interior, in order to severely curb noise and vibrations. The vessel can accommodate a maximum of 10 persons in total, and the wheelhouse has been ergonomically designed to ensure an increased scope of visibility for crew. The mess area, galley, WC and two officer cabins are situated on the main deck, while the lower accommodation deck hosts two crew cabins, a WC and shower, and a stores room.

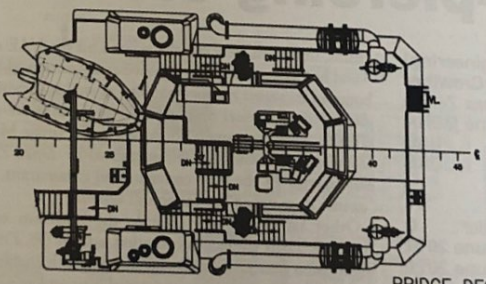
TECHNICAL PARTICULARS

Length, oa	30.25m
Breadth, moulded	11.75m
Depth, moulded	5.28m
Gross tonnage	458tonnes
Displacement	905tonnes
Design, draught	5.85m
Lightweight	649tonnes
Speed, service	13knots
Classification society and notations	RINa C✠Hull, ✠Mach, Escort Tug, Fire-Fighting Ship 1, Unrestricted Navigation, ✠Aut-Ums, ✠Aut-Port
Main engine(s)	
Make	Caterpillar
Model	3516B
Number	2
Output of each engine	2100kW@1600rpm
Propeller(s)	
Manufacturer	Rolls-Royce
Model	Aquamaster
Number	2
Fixed/controllable pitch	Fixed, Azimuth
Open or nozzled	Nozzled
Alternators	
Number	2 auxiliary / 1 emergency genset
Make / type	2 x Caterpillar CAT C6.6 + 1 x CAT
Output/speed of each set	2 x 125kWe@1500rpm + 1 x 78kWe@1500rpm
Deck machinery	
	1 x aft towing winch, 175tonnes
	1 x combined windlass and anchor winch, 150tonnes
	1 x storage drum wire 56mm/1m
	1 x tow hook
	1 x deck crane, 2.1tonnes @ 12m
	1 x capstan
Bridge electronics	
Radar(s)	Furuno FAR-2117, FAR-2137
Autopilot	Navitron NT-888G
GMDSS	A3, Inmarsat Sailor P5000, TT3000
Other communications systems	Nautical package
Gyro	Furuno
Chart plotter	Furuno
Complement	
Crew	10
No. of cabins	4
Other significant or special items of equipment	
	Foam tank
	2 Fi-Fi pumps (2 x 1358m^3/hour)

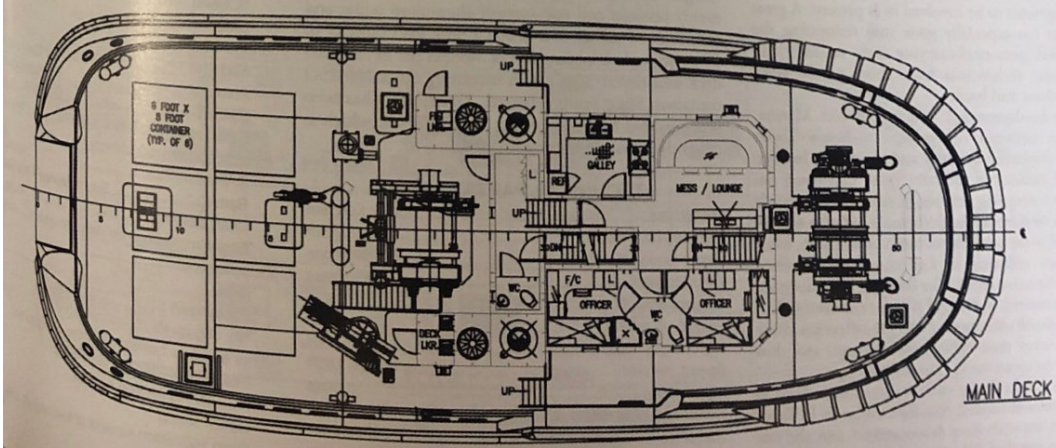
ST ELMO



OUTBOARD PROFILE



BRIDGE DECK



MAIN DECK

JIN GANG LUN 26: Customised ASD tug, to meet Chinese port requirements

Builder	Shanghai Harbour Fuxing Shipping Service Company
Designer	Robert Allan Limited
Vessel's name	*Jin Gang Lun 26*
Owner /operator	Tianjin Port
Country	China
Flag	Chinese
Total number of sister ships already completed	0
Total number of sister ships still on order	1
Contract date	April 2012
Delivery date	November 2013

As an extension of the designer's previous 32m loa tug models, Robert Allan Ltd's new series of the RAmparts 3500 class ASD tug design has been realised in the form of *Jin Gang Lun 26*, an expanded creation measuring 35m x 12.4m and featuring tailor-made hull, wheelhouse and accommodation layout considerations to suit the particular operational requirements of ports in China.

Classed according to Chinese Classification Society (CCS) requirements, *Jin Gang Lun 26*'s hull is bolstered by heavy-duty fendering; 700mm x 350mm cylindrical fendering protects the bow at the main deck level, while 600mm x 400mm M block fenders have been positioned between the main deck and the knuckle. Two steel half-pipe fenders, with elements of 400mm x 400mm rubber 'D' fenders, provide protection at the main and forecastle sheer deck lines, providing a section of 'outset' fenders to act as a lifting point for the tug when it is pulled alongside an attended ship. A 500mm x 250mm cylindrical fender is used at the stern, and, additionally, heavy duty tyres are provided all around the tug.

For ship-handling service in LNG terminals, *Jin Gang Lun 26* is fitted with a safety system which features gas detection alarms in the wheelhouse, sensors around the deckhouse and explosion-proof motors for the air intake fans situated on the main deck and in the deckhouse. The wheelhouse has been designed for all-round visibility, with a U-shaped control station providing maximum visibility to both fore and aft deck working areas.

The tug has been outfitted with full accommodation for a crew of up to 14 persons. The master's cabin is situated on the main deck, alongside a spacious mess / conference room, while the chief engineer's quarters, and three additional four-man cabins, are located on the lower accommodation deck.

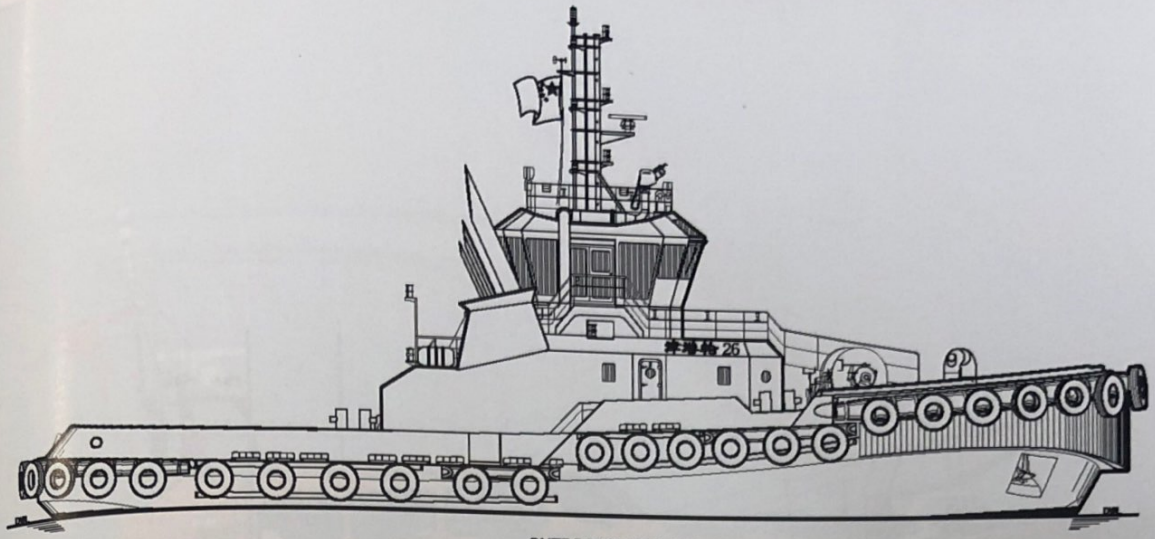
Onboard tanks have been designed to accommodate 171m³ of fuel oil, 30m³ of fresh water and 20m³ of foam. Robert Allan explains that the tug was designed and built to CCS Ice Class B and FiFi 1 specifications, though the vessel is not formally classed to these notations. In order to combat fire, two pumps, supplied by Norway's Fire Fighting Systems (FFS), are driven by the tug's main engine and feed a pair of FFS 1200 and 300LB firefighting monitors.

At time of going to press, a sister RAmparts 3500 model, bound for Tianjin Port, was also nearing completion.

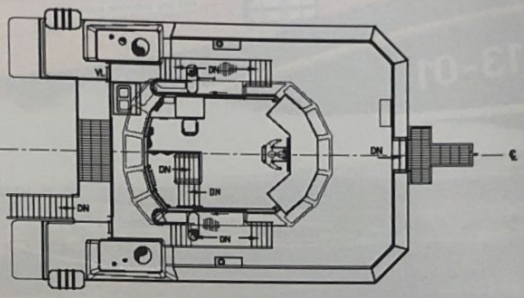
TECHNICAL PARTICULARS

Length, oa	35m
Length, bp	29.43m
Breadth, moulded	12.4m
Depth, moulded	5.4m
Gross tonnage	583tonnes
Displacement	1,059tonnes
Design, draught	4.2m
Design, deadweight	277tonnes
Lightweight	782tonnes
Service speed	13knots @ 85% MCR
Max speed	14.3knots
Range (nautical miles)	1,800
Daily fuel consumption (tonnes/day)	4.5tonnes
Classification society and notations	CCS, Tug, Coastal Service
Other important international regulations complied with	International Loadline regulations
Main engine(s)	
Make	Daihatsu
Model	8DKM-28eF
Number	2
Output of each engine	2,390kW @ 750rpm
Propeller(s)	
Material	NiAlBr
Manufacturer	Kawasaki
Number	2
Fixed/controllable pitch	Controllable
Diameter	2,800mm
Special adaptations	Built-in, hydraulic-type clutch
Open or nozzled	Nozzled
Generators	
Make	Cummins 6CT8.3-GM115
Number	3
Output of each set	1,500rpm
Deck machinery	2 x Manabe Zoki Co. WL TO-28-5-1HD-2CD-2WE hawser winches, 120tonnes brake capacity each 1 x Mampaey MXX.125 tow hook, 93.5tonnes SWL
Bridge electronics	
Radar(s)	COSCO Telecommunication & Navigation Co, FR8062
GMDSS	COSCO Telecommunication & Navigation Co, FS-1570, FM-8800S, Fax-408
GPS	COSCO Telecommunication & Navigation Co, GP-150
Gyro	COSCO Telecommunication & Navigation Co, CPL165+CF-3
Chart plotter	COSCO Telecommunication & Navigation Co
Complement	14
Crew	9
Passengers	5
Number of cabins	

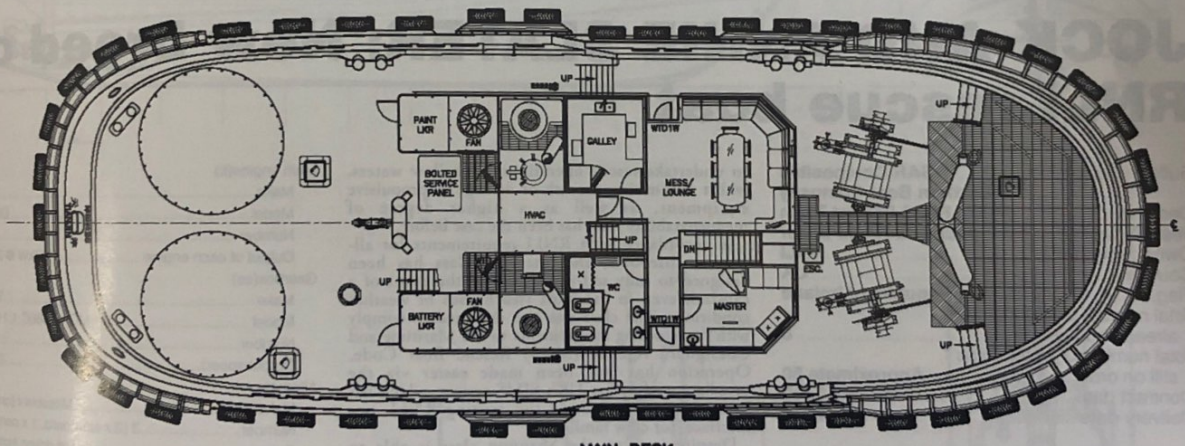
JIN GANG LUN 26



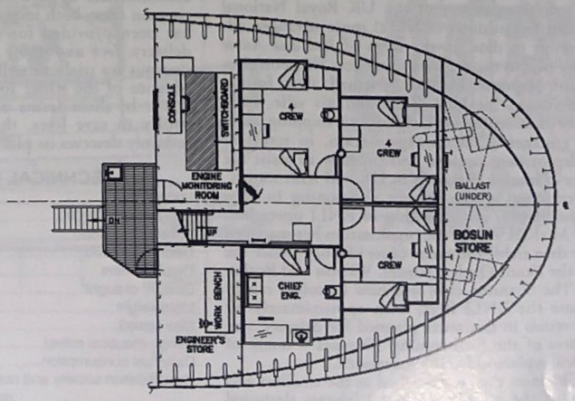
OUTBOARD PROFILE



BRIDGE DECK



MAIN DECK



LOWER ACCOMMODATION DECK

ZEYCAN Y: Debut tug in new RAmparts 2400SX series

Builder	**Sanmar**
Designer	**Robert Allan Limited**
Vessel's name	***Zeycan Y***
Owner/operator	**Gemport**
Country	**Turkey**
Flag	**Turkey**
Total number of sister ships already completed	**1**
Total number of sister ships still on order	**TBC (ongoing series)**
Delivery date	**July 2013**

Designed specifically for Turkish shipbuilder Sanmar, and representing the yard's 100th tug delivery, Robert Allan Limited's (RAL's) first RAmparts 2400SX series vessel, *Zeycan Y* (formerly *Boğaçay I*), was delivered to Turkish owner Gemport in mid-Summer 2013, followed by a sister vessel, *Boğaçay II*, which joined Sanmar's fleet in September last year. Sanmar has dubbed the RAmparts 2400SX class the Boğaçay class (literally translating as 'bull steam'), and is marketing the vessels as part of its new breed of tug solutions.

The RAmparts 2400SX class builds on RAL's previous RAmparts 2500W tug concept, with the hull remaining essentially the same as its predecessor, having been designed with good dead rise for improved thruster performance, modest side flare, a half-raised forecastle deck for good sea-keeping and RAL's trademark conically shaped double chine stern, to ensure that the tug can run astern at high speeds whilst retaining good stability and control.

The remainder of the RAmparts 2400SX tug has been customised to suit Sanmar's unique requirements for flexibility when it comes to available options and production efficiency. Sanmar raised a number of specifications for the RAL design team; one being the ability to install three different Z-drive sizes, in order to achieve 50tonne, 60tonne and 70tonne bollard pull (bp) versions of the tug, whilst maintaining the same shaft line and same diameter drive well. Additionally, Sanmar wanted the capability to fit both Caterpillar-manufactured CAT 3512C and 3516C engines on the same engine bed, to accommodate the differing power levels required to attain the aforementioned variations in bp. Other considerations requested by Sanmar included: the ability to fit a double drum winch, a split drum winch or a single drum winch on the same deck foundation; an option for firefighting systems capable of meeting FiFi 1 class notation, whether fitted with CP thrusters or half-driven by an independent auxiliary engine; an optional aft winch; and an the ability to fit both a single aperture staple and a double aperture staple on the same seating, to suit the three winch options.

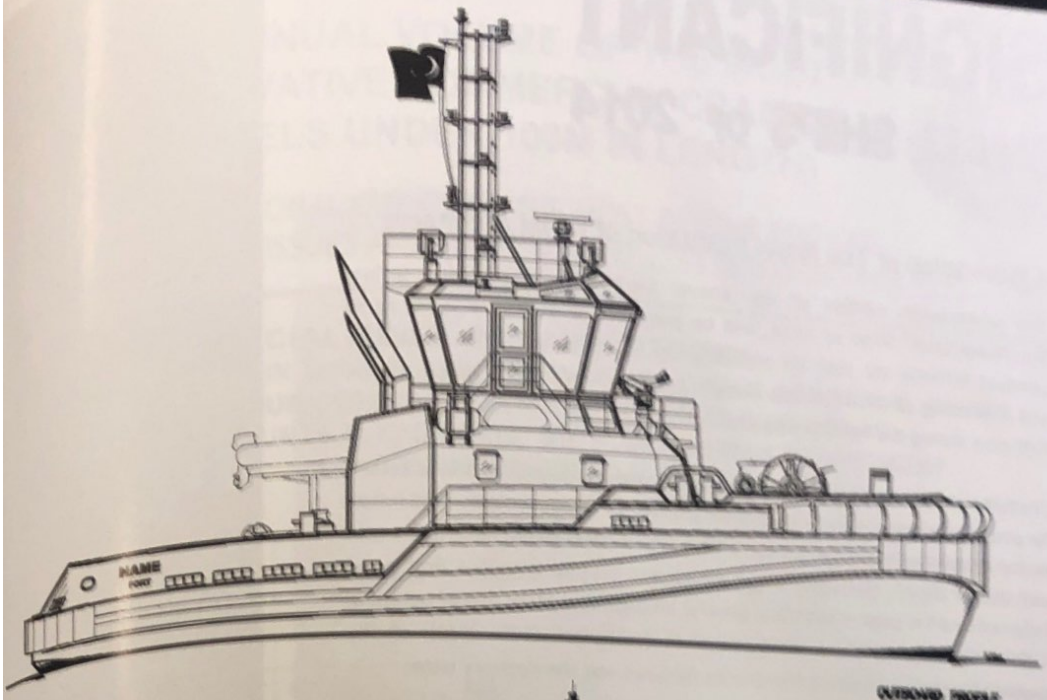
For the first two vessels in this class, Sanmar selected a FiFi pumpset half-driven off the front of the port main engine, and delivering 1,200m³/hr seawater to one 1,200m³/hr water/foam remotely operated monitor.

Tank capacities at 98% include: 87.3m³ for fuel oil; 10.6m³ for potable water; 41.8m³ for water ballast; 1.6m³ for oily water; and 3m³ for sewage. *Zeycan Y* has been outfitted to accommodate six members of crew, with two double-berth cabins situated on the lower deck, and two officer cabins on the main deck. Ship-handling fenders at the bow comprise an upper row of 800mm-diameter cylindrical fenders and a lower course of W-fenders.

In sea trials, *Zeycan Y* and *Boğaçay II* have achieved a bp of 60tonnes ahead, matched with a free running speed of 12knots. Plans are now underway to tinker with the RAmparts 2400SX design to ensure a bp of 75tonnes on future models.

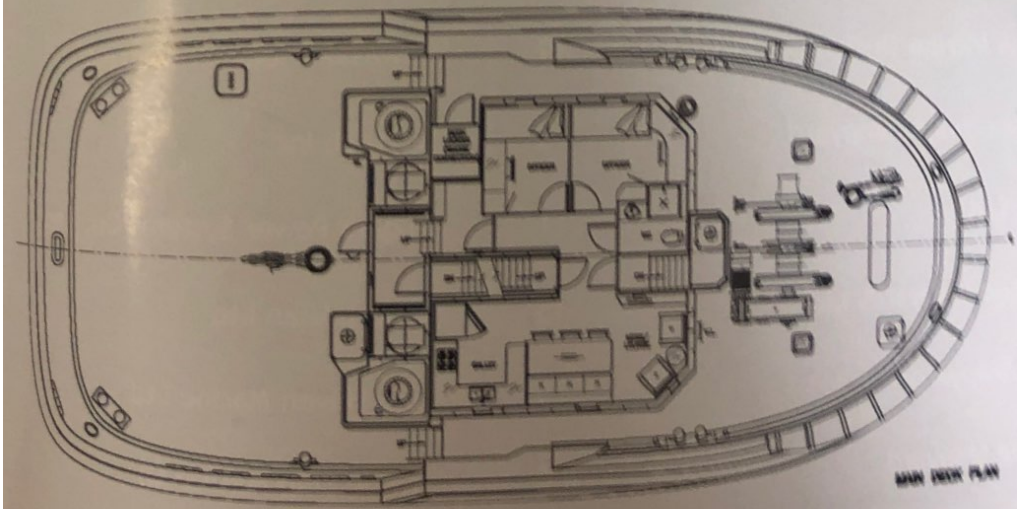
TECHNICAL PARTICULARS

Length, oa	24.4m
Length, bp	23.45m
Breadth, moulded	11.25m
Depth, moulded	4.38m
Displacement	500tonnes
Design, draught	5.2m
Design, deadweight	100tonnes
Lightweight	400tonnes
Max speed	12knots
Classification society and notations	ABS ✠A1 TUG, ✠AMS
Main engine(s)	
Make	CAT
Model	3512
Number	2
Output of each	1,765kW @ 1,800rpm
Propeller(s)	
Manufacturer	Rolls-Royce
Make	US 205
Fixed/controllable pitch	Fixed
Diameter	2,400mm
Open or nozzled	Nozzled
Alternators	
Make	CAT C 4.4
Number	2
Output of each set	86kWe @ 1,500rpm
Deck machinery	
	1 x DMT Type TW-E 250KN electric double drum hawser winch, 250kN pull at 0-9m/min, low speed / 80kN at 0-28m/min, high speed
	1 x Data Hidrolik tow hook
	1 x Data Hidrolik aft capstan
Complement	
Crew	6
Number of cabins	4



OUTBOARD PROFILE

BOW VIEW



MAIN DECK PLAN

RT EMOTION: First hybrid tug to operate within German waters

Builder	**Damen Shipyards Hardinxveld**
Designer	**Robert Allan Ltd**
Vessel's name	***RT Emotion***
Owner/operator	**Elisabeth Ltd/ KOTUG**
Country	**Malta**
Flag	**Malta**
Total number of sister ships already completed	**1**
Total number of sister ships still on order	**0**
Contract date	**March 2013**
Delivery date	**June 2015**

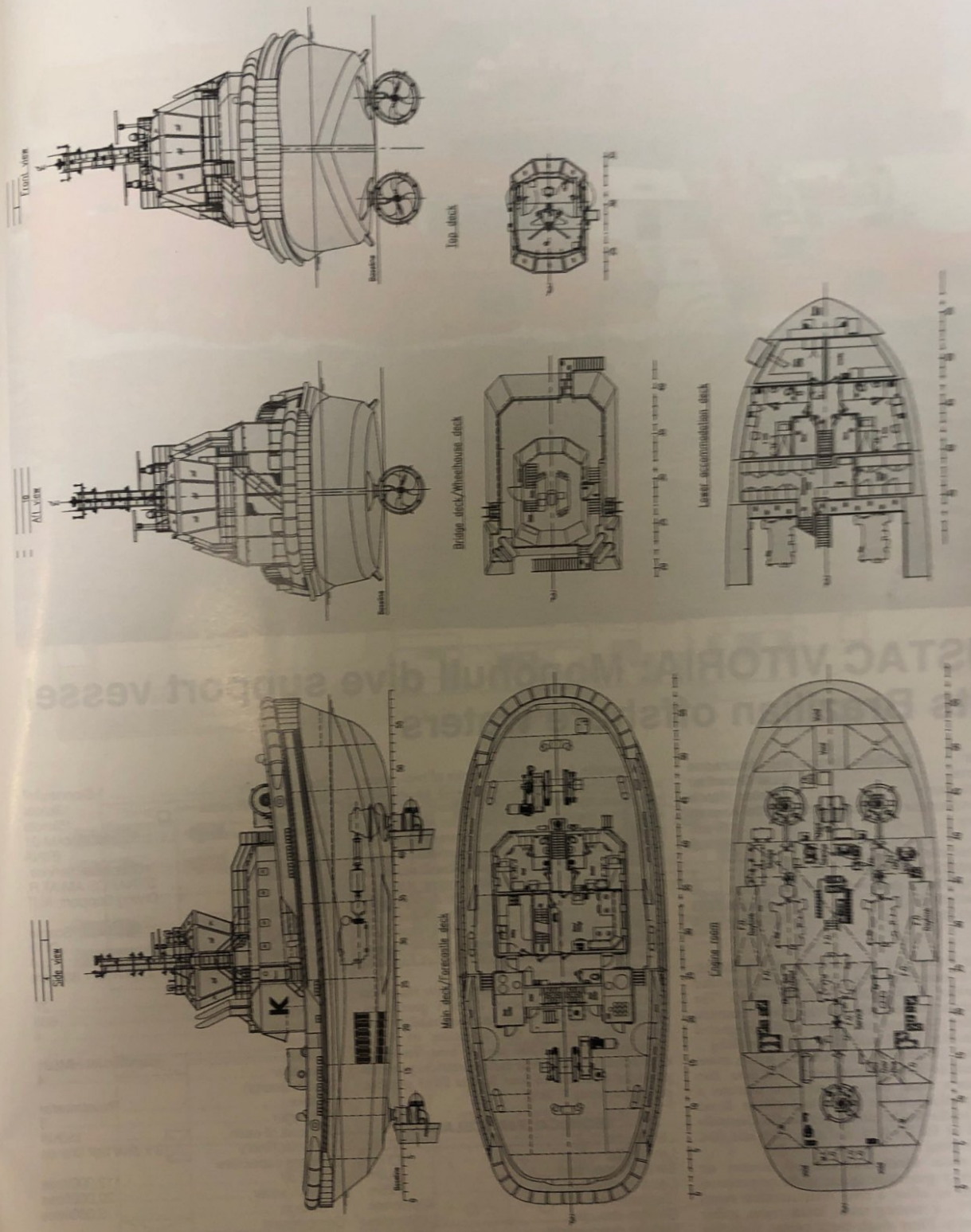
June 2015 saw the handover of the 32m *RT Emotion*, the next-generation ART80-32 Rotortug built by Damen and designed by an alliance of Rotortug B.V, in the Netherlands, and Canada-based naval architect Robert Allan Ltd. *RT Emotion* has subsequently been hailed as the first hybrid tug to operate within German waters.

The key drive behind this class has been to blend environmentally clean, hybrid technology with high performance and significant pulling power. Dubbed the 'E-KOTUG' series, the designer and builder claim 50% less harmful emissions, notable noise reduction, cleaner combustion and substantial maintenance savings thanks to the vessel's improved fuel economy. The tug's XeroPoint hybrid propulsion system oversees three electric motors and the Corvus-supplied battery pack.

The ART80-32's optimised hull shape enables ahead and astern speeds of more than 13knots and, in terms of bollard pull, the tug can achieve 84tonnes over the stern and 82tonnes over the bow. Similarly, versatility and flexibility were key considerations; as KOTUG puts it, the "ability to respond very quickly to changes in manoeuvring requirements" was of prime importance when developing the tug as a "highly responsive" addition to its fleet.

TECHNICAL PARTICULARS

Length, oa	31.95m
Breadth, moulded	12.6m
Depth, moulded	4.82m
Gross tonnage	498tonnes
Displacement	598tonnes
Design, draught	6.25m
Max speed	13.1knots
Bollard pull	86tonnes (ahead) 82.1tonnes (astern)
Classification society	Lloyd's Register
Notations	✠100A1 TUG, [✠] LMC, UMS, IWS
Main engine(s)	
Make	Caterpillar
Model	3512C TA/HD+
Number	3
Output of each engine	1,765kW
Hybrid system	Aspin Kemp Associates / Xeropoint
Electric motor	Teco Westinghouse
Output of electric motor	500kW
Batteries	Corvus Energy, Corvus Lithium Polymer
Slipping / disengagement clutch	
Make	Twin Disc
Model	MCD 3000-3 LD
Number	3
Output	1,800rpm max
Rudder propeller(s)	
Material	GS-CuA110Fe5Ni5-C
Manufacturer	Schottel
Type	SRP-3000
Number	3
Fixed or controllable pitch	Fixed
Diameter	2,300mm
Speed	266rpm
Open or nozzled	Nozzled
Alternators	
Make	CAT C9 / CAT C18
Number	2
Output of each set	250kVA, 50 Hz (C9) 575kVA, 50 Hz (C18)
Deck machinery	2 x DMT winches, fwd and aft 30tonnes@0-15m/min 10tonnes @0-45m/mi 225tonnes holding force 250m wire capacity 70mm diameter 1 x HHP AC-14 anchor, 360kg 165m / 22mm studlink chain
Bridge electronics	
Radar(s)	2 x JRC, JMA 5312-6 / JMA 610-7
Autopilot	Alphatron Alphaseapilot MFC
GMDSS	Thrane 6310 Mini-C LRIT
GPS	Alphatron
Chart plotter	Alpha T ECDISchart
Engine monitoring / fire detection system	Böning
Onboard capacities	
Fuel oil	204.6m³
Fresh water	33m³
Sullage/sewage	8.8m³
Lube oil, engines	2.4m³
Lube oil, thrusters	2.4m³
Hydraulic oil	3.1m³
Used oil	5.4m³
Sludge	4.6m³
Complement	
Crew	3
Passengers	0
Number of cabins	4 (2 single, 2 double)



YENIÇAY 1: 'Big sister' to RAL's previous RAscal 1500 class makes her debut

Builder	**Sanmar Shipyard**
Designer	**Robert Allan Ltd.**
Vessel's name	***Yeniçay 1***
Owner/operator	**Sanmar**
Country	**Turkey**
Flag	**Turkey**
Total number of sister ships already completed	**1**
Total number of sister ships still on order	**2**
Contract date	**Unspecified**
Delivery date	**January 2015**

Robert Allan Ltd (RAL) continued its long-standing relationship with Turkey's Sanmar Shipyard in 2015, one of the notable deliveries being the first of RAL's new RAscal 1800 class of azimuth stern drive (ASD) tug.

Incorporated directly into Sanmar's fleet, *Yeniçay 1* and the RAscal 1800 series builds on RAL's previous RAscal 1500 class, and has been described as the 'big sister' to that particular breed of twin Z-drive tug. Whereas the RAscal 1500 measured some 14.9m x 8.3m – as featured on the vessel *Brage*, which Sanmar delivered to Norwegian owner Bukser og Berging in 2014 – the RAscal 1800 features an extended length of 18.7m loa and 9.2m, with a corresponding increase in vessel depth.

Yeniçay 1's propulsive set-up comprises: two Caterpillar C32 diesels, each rated 970kW at 1,800rpm; a pair of Veth VZ-900 fixed pitch Z-drive units; and five-bladed, nozzled, 1,700mm-diameter propellers. This set-up grants the tug a bollard pull of 31tonnes and a free running speed of 12knots. Designed for a four-man crew, *Yeniçay 1* features two below-deck double cabins, a galley, a mess and toilet/shower facilities. By incorporating resiliently mounted engines, visco-elastic floor technology and composite shafting into her design, onboard noise levels have been restricted to 63dbA in the wheelhouse and 60dbA in the galley area and cabins.

The vessel's primary tasks include ship-assist work, line-handling, inland coastal towing and general harbour duties. Additionally, she has also been equipped for firefighting operations. In addition to her spacious fuel and water tanks, the tug can store up to 1,618litres of foam, and the vessel has been fitted with a fi-fi pump, courtesy of Fire Fighting Systems (FFS), with a capacity of 600m³ per hour.

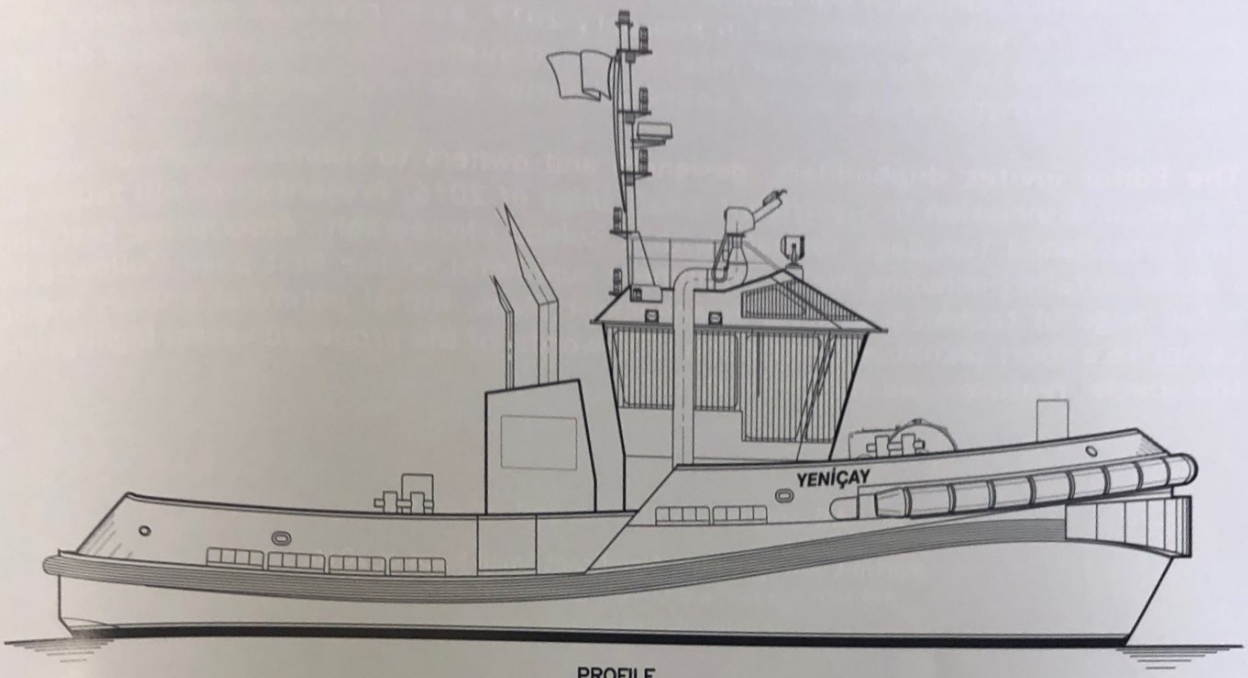
The bow and stern are equipped with stainless steel fairleads, to accommodate a towline during her ship-assist operations, and the bow also features a DMT TW ship assist hawser winch, which is rated 0-30m/minute at 3tonnes. The hawser drum contains 100m worth of 40mm nylon rope, arranged in four layers, with a brake capacity of 75tonnes. RAL explains: "The hawser winch forward is used for normal ship-handling arrangements but the towline can also be passed aft through a tunnel beneath the wheelhouse, and then through a towing portal on the aft deck, for aft towing operations." A 30tonne SWL towing hook is positioned aft, for ship-handling tows.

Bigger may be yet to come; Sanmar is reportedly working on a 'super-powered' version of the RAscal 1800, which would replace the 1800's C32 engines with Caterpillar 3512 units, which would boost the bollard pull to 40tonnes.

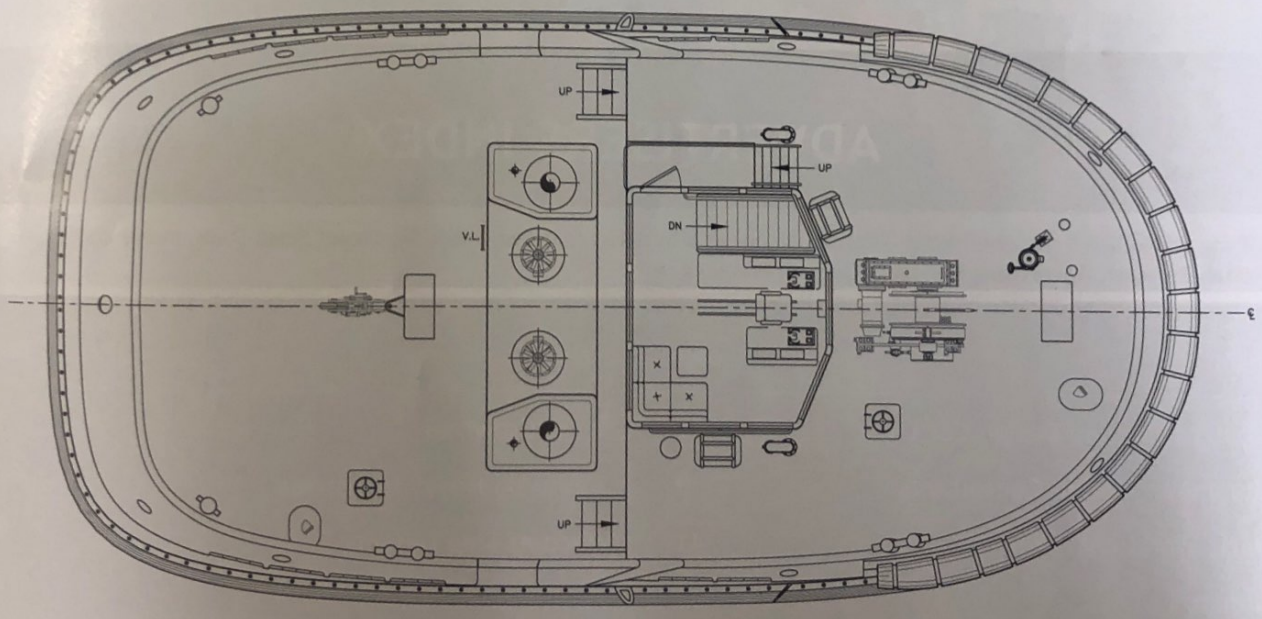
TECHNICAL PARTICULARS

Length, oa	18.7m
Length, bp	17.4m
Breadth, moulded	9.2m
Depth, moulded	3.5m
Gross tonnage	146tonnes
Displacement	256tonnes
Design, draught	3.7m
Design, deadweight	44tonnes
Lightweight	212tonnes
Service speed	12knots
Max speed	12knots
Range (nautical miles)	800
Daily fuel consumption	9.7tonnes
Classification society	ABS
Notations	✠A1, Towing Vessel, ✠AMS, UWILD, BP(30)
Bollard pull	31tonnes
Main engine(s)	
Make	Caterpillar
Model	C32
Number	2
Output of each engine	970kW
Propeller(s)	
Material	NiAlBr
Manufacturer	Veth
Number	2
Fixed/controllable pitch	Fixed
Diameter	1,700mm
Speed	352rpm
Open or nozzled	Nozzled
Alternator(s)	
Make	Caterpillar C4.4
Number	2
Output of each set	86kWe
Deck machinery	
1 x DTM TW-E winch, 100kN	
1 x DTH towing hook, 30tonnes	
Onboard capacities	
Fuel oil	33,500litres
Fresh water	5,700litres
Ballast water	10,200litres
Complement	
Crew	4
Passengers	0
Number of cabins	2

YENIÇAY 1



PROFILE



DECK PLAN

MURUETA

ASTILLEROS - SHIPYARDS

REMOLCADOR PROPULSADO A GAS

IBAIZABAL QUINCE

MURUETA
ASTILLEROS - SHIPYARDS

NB321 - *IBAIZABAL QUINCE* - *REMOLCADOR*

CARACTERISTICAS PRINCIPALES

Eslora total	28,00 m
Eslora entre perpendiculares	23,40 m
Manga	12,00 m
Puntal	4,80 m
Calado medio	3,80 m
Velocidad	11 kn
Tripulación	6
GT	395 GT

EQUIPO AUXILIAR Y DE TRACCION

Tiro por popa	57 Ton
Tiro por proa	55 Ton
Maquinilla de proa	1x
Gancho de popa	1x
Sistema contra incendios	FIFI1
1x Grúa de servicio-*Fassi F80AFM22-*	1 Ton @ 7,25 m

PROPULSION Y AUXILIARES

Motor principal- *Wärtsila 9L20DF-*	2x 1.665 Kw @1200 rpm
Propulsor Azimutal - *RRM US 205 P20 CP-*	2x 1.665 kW
Grupo principal– *ARDORA 634 DSBG*	2x 130 kW
Grupo puerto– AGCO SISU POWER	1x 90 kW
Tanque de LNG - *Wartsila*	1x 25 m3

CLASIFICACION

BV- Class; I, ✠HULL, ✠MACH, HARDBOUR TUG, DUAL FUEL COASTAL AREA, Temporary Unrestricted Navigation, ✠AUT-UMS, Fire-fighing ship 1 ,Water spray.

ARMADOR

- IBAIZABAL, Compañía de remolcadores

COMPAÑIA DE REMOLCADORES
IBAIZABAL

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