e-maritime

MARCH 2019 SPECIALIZED VESSELS

DAMEN RSD TUG 2513
´Innovation´

Front Cover:

RSD Tug 2513 ´Innovation´

Photo Courtesy of Damen Shipyards Group

Back Cover:

The 1,800 ton floating sheerlegs 'Matador 3' with Allseas' multipurpose offshore construction vessel (OCV) 'Fortinade'

Photo Courtesy of Bonn & Mees Drijvende Bokken

International, interactive magazine about vessels, maritime equipment, ports and docks e-maritime.

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Dear Readers

This Issue of our magazine e-maritime is focused on tugs, sheerlegs, specialized vessels and equipment for maritime industry.

In our first article we present Damen Reversed Stern Drive Tug 2513 ´Innovation´. The article is accompanied with drawings and photo gallery.

Inma Gómez of Rúbrica Maritime wrote for us an article about Monolithic Construction of Quays on Piles. The company Rúbrica Bridges is a partner of our magazine e-mosty and we are happy to extend our scope of cooperation to our magazine e-maritime.

Next part of the magazine brings an Overview of some projects realized by floating sheerlegs ´Matador´, ´Matador 2´and ´Matador 3´ of Bonn & Mees in the years 2016 – 2019.

Last article of this issue was written by Hans Tompot and it is about Tugs and their Development Through Centuries.

I would very much like to thank all people and companies who have helped me prepare this issue, especially the companies Damen, KotugSmit Towage, Bonn & Mees Drijvende Bokken and Rúbrica.

We have established a separate LinkedIn page for the magazine and we kindly invite you to follow us. We will mostly share information on the content of the magazines, editorial plan, details of the projects and articles, and their photos. We may also promote some specific projects (conferences, books, charities etc.).

Next Issue will be released on 30 June and it will focus on Cargo Ships, Passenger Ships, Cruisers and other vessels for transportation. Our plan for November Issue is to focus on Construction in the Maritime Industry; Ports, Offshore (wind farms, oil platforms, pipe laying etc.); design, installation, construction, operation and maintenance. We also plan to include Heavy Lifting projects.

Let us congratulate to Hans van der Ster on his 20 years anniversary of publication of "Tugs, Towing & Offshore Newsletter". We wish you all the best in the future!

Magdaléna Sobotková

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e-maritime

The magazine **e-maritime is an international, interactive, peer-reviewed magazine about vessels, ports, docks and maritime equipment**.

It is published on www.e-maritime.cz **three times a year:** 30 March, 30 June and 30 November.

September Issue is shared with the magazine e-mosty ("e-bridges"): "Vessels and Equipment for Bridge Construction" which is published on 20 September on www.e-mosty.cz.

It can be read **free of charge** (open access) with possibility to subscribe.
The magazines stay **available on-line** on our website. It is also possible to download them as **pdf**.

The magazine brings **original articles about design, construction, operation and maintenance of vessels and maritime equipment, docks and ports from around the world**.

Its electronic form enables publishing of high-quality photos, videos, drawings, links etc.

We aim to include all important and technical information and show the grace and beauty of the vessels and structures as well.

www.e-maritime.cz

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e-mosty

The magazine e-mosty ("e-bridges") is an international, interactive, peer-reviewed magazine about bridges.
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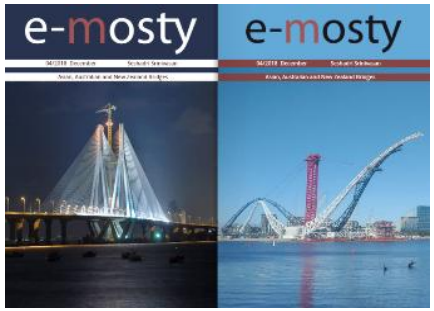
We are happy to provide media support for important bridge conferences, educational activities, charitable projects, books etc.

Our Editorial Board comprises bridge engineers and experts from the UK, US and Australia.

The readers are mainly bridge engineers, designers, constructors and managers of construction companies, university lecturers and students, or people who just love bridges.



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Thank you for showing me the vessels and shipyards, and for giving me inspiration for my work.

DAMEN REVERSED STERN DRIVE TUG 2513 ´INNOVATION´

Hans Tompot, Damen Shiprepair & Conversion

Viktoria Adzhygyrei, PR & Communications Coordinator, Damen Shipyards Group

Annet van Brussel, Communications & Public Relations Manager, KOTUGSMIT TOWAGE

Thank you for reviewing the article and for your time and cooperation.

Monolithic Construction Of Quays On Piles

Inma Gómez, Division Manager, Rúbrica Maritime

Pablo Urbea, CMO, Rúbrica Engineering

Floating Sheerlegs ´Matador´, ´Matador 2´ And ´Matador 3´

Martijn Otten, Manager Operations, Bonn & Mees Drijvende Bokken BV

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Tugs And Their Development Through Centuries

Hans Tompot, Damen Shiprepair & Conversion

Hans van der Ster, Towingline -*Thank you for reviewing the article and for your valuable comments.*

I would like to thank the following people and companies for providing permission to publish photos:

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Gerrit-Jan Fidder, Sales and Marketing Manager , ALP Maritime Services B.V.

Roger van der Kraan, Zeesleperlelbe

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Thank you very much for your constant support of both our magazines (e-mosty and e-maritime), for excellent cooperation and for your time.

Richard Cooke, Independent Consultant

Thank you for reviewing the articles, for your cooperation on both magazines, for your assistance and time.

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DAMEN REVERSED STERN DRIVE TUG 2513 ´INNOVATION´

Magdaléna Sobotková

Figure 1: RSD Tug 2513 in KotugSmit Colours
Photo Courtesy of Kotug Smit Towage

GENERAL INTRODUCTION

Damen Shipyards unveiled a new design of tug for harbour towage and ship manoeuvring in tight areas in the second quarter of 2018 when the tug 'Innovation' was put through trials.

It is Damen's first Reversed Stern Drive (RSD) tug.

The Damen RSD TUG 2513 is designed for assisting all types of vessels to work always bow first, see Figure 3.

The always bow first principle offers the flexibility for the vessel to operate optimally as both a bow and stern assisting tug.

The RSD tug is characterised by a compact, wide hull (1.90 : 1) with a high freeboard, resulting in a large dynamic stability and high bollard pull.

The new RSD concept, featuring the Damen patented twin fin, combines elements of the Damen Azimuth Stern Drive Tug (ASD) 2411 and the Damen Azimuth Tractor Drive Tug (ATD) 2412.

Damen Shipyards has worked on the development of this concept for more than four years, together with several knowledge institutes and tug owners.

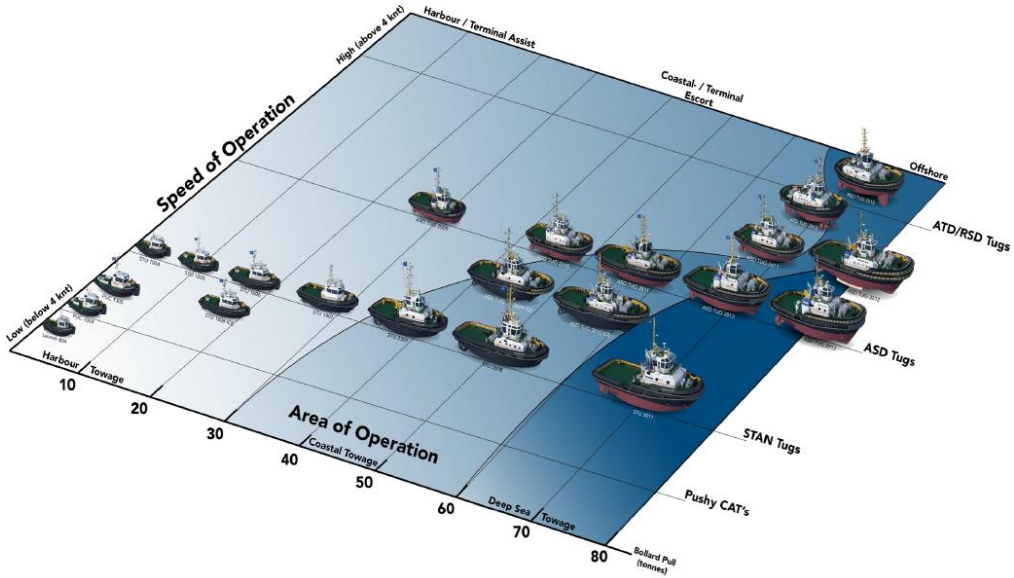

Figure 2: Area and Speed of Operation of tugs

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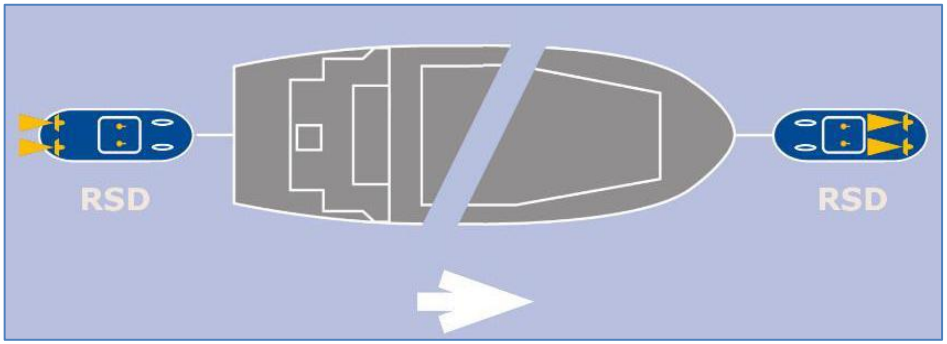


Figure 3: Assisting a vessel with bow first

The Reversed Stern Drive (RSD) Tug 2513 was developed with an emphasis on optimisation via computational fluid dynamics (CFD), concerning directionally stable sailing behaviour in both directions.

Validation tests were performed at the Maritime Research Institute Netherlands (MARIN), which provided input for both the development of this vessel and for the further progression of our Virtual Towing Tank programme.

TWIN FIN

The Twin Fin provides directional stability, combined with an increased freeboard and a pronounced bow at each end of the vessel to cope with the significant forces generated, see Figure 5.

The Twin Fin:

- Increases damping during sailing at steady course
- Increases turning moment

Figure 4: RSD Tug Model

- Generates high towing performance at low engine power, resulting in low overall fuel consumption and lower emissions
- Reduces interaction between thrusters and fins
- Gives the tug high manoeuvrability for ease of use especially in confined harbours

PRINCIPAL DIMENSIONS	
Length overall	*24.73 m*
Length b.p.p.	*23.95 m*
Breadth overall	*13.13 m*
Breadth mld.	*12.63 m*
Depth mld.	*4.60 m*
Draught aft	*5.50 m*
Displacement approx.	*525 tons*
Deadweight	*105 tons*
ENGINES	
Make:	*MTU*
Type	*2x 16V 4000 M63L*
Total output	*4,480 kW (6,072 BHP) at 1800 rpm*
PERFORMANCES	
Bollard pull	*ahead 75 tons / astern 70 tons*
Speed	*ahead 13 knots / astern 12.8 knots*
Rudder propellers make Rolls-Royce, type US 255,	*diameter 2700 mm*

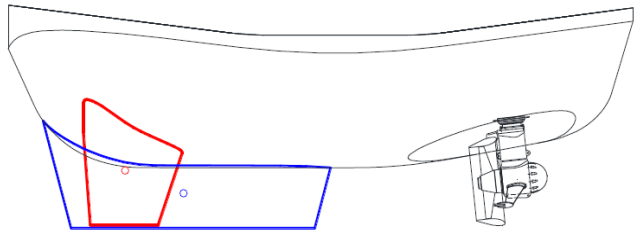


Figure 5: Comparison of twin fin (red) with single fin (blue) tug

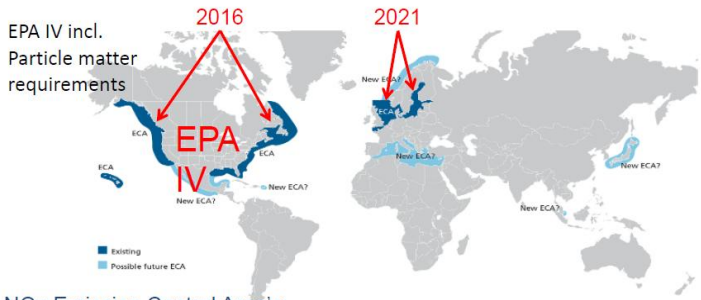
IMO TIER III AND EPA COMPLIANCE

IMO Tier III

The NO_x control requirements set by IMO (International Maritime Organization) to installed marine diesel engine of over 130 kW output power other than those used solely for emergency purposes irrespective of the tonnage of the ship onto which such engines are installed.

Different levels (Tiers) of control apply based on the ship construction date, a term defined in regulations 2.19 and hence 2.2, and within any particular Tier the actual limit value is determined from the engine's rated speed.

As of 1st January 2016, IMO TIER applies only to the specified ships while operating in Emission Control Areas (ECA), and as of 1 January 2021 operating in the Baltic Sea ECA or the North Sea ECA.



NOx Emission Control Area's:
North America (incl. Canada) and the United States Caribbean Sea
Baltic Sea and North Sea

Figure 6: A map showing application of ECA and IPA IV

EPA Compliance

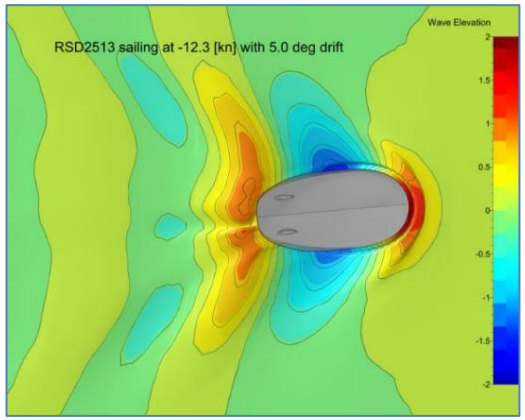
EPA (US Environmental Protection Agency) has adopted exhaust emission standards for marine diesel engines installed in a variety of marine vessels ranging in size and application from small recreational vessels to tugboats and large ocean-going vessels. These domestic emission standards apply for engines installed on US vessels.

Additional international requirements may apply for engines installed on US vessels that operate in foreign ports and waters and for foreign vessels.

A recently Damen developed modular selective catalyst reduction (SCR) system lowers the threshold for IMO Tier III compliance, which can be applied off the shelf at any stage of construction or as retrofit.

DECK

The deck is spacious working area with smooth surfaces with anti-slip paint coupled with a bulwark of 1.1mfor additional crew safety. It is set only with essential equipment for towing operations.



← Figure 7: Wave elevation at 12.3 knots

WINCHES

The 'Innovation' is fitted with a towing winch designed by Damen Winch Technology and built by Damen Marine Components.

The winch is driven by a variable speed, high torque hydraulic drive motor enabling to haul and veer the towing line at the highest speed possible for the force applied. The hydraulic system is powered by main engine driven pumps via a power-take off.

The towing winch of the 'Innovation' has a split drum, capable for a pull of 31-ton at 11 m/min. Maximum speed is 38 m/min at reduced pull.

The winch is designed for a brake load of maximum 175-tons.

Furthermore, the winch is fitted with an electrically driven windlass.

↗ Figure 8: The split drum towing winch

ENGINES and the ENGINE ROOM

The tug is equipped with two main engines of make MTU, type 16V 4000 M63L, that deliver 4,480 kW (6,072 BHP) at 1800 rpm and allow fast acceleration and de-acceleration.

Full control of the engine room is possible from the wheelhouse and main deck when the tug is carrying out an operation so that the crew can monitor the alarms, analyse any problem and take essential actions via the Alarm Monitor Control System. The wide hull allows for a particularly spacious engine room with easy access to the machinery and all equipment necessary for regular operations, like the main engines, thrusters and generator sets.

Electric power is generated by two Caterpillar type C4.4 TA diesel generator sets, each with an output of 65 kW / 81 kVA, 400/230 Volt 50 Hz.

The 'Innovation' is classed by Bureau Veritas and has the class notation:

I ✠ HULL ● MACH Tug Coastal Service AUT UMS COMF-NOISE 3, COMF-VIB 1

AUT-UMS = Unattended Machinery Space - remote control from Main deck / Wheelhouse

COMF-NOISE 3 = Noise levels according limited level according Rules

COMF-VIB 1 = Vibration levels according limited level according Rules

The RSD Tug 2513 features low levels of noise and vibration thanks to a flexibly mounted superstructure, engines and interior floors, 45 dB(A) silencers and double glazed windows with an argon filled gap acting as sound insulation.

Furthermore, the engine room is equipped with spaces for stores and spare parts as well as a workbench.

Piping is colour coded and flow directions are indicated. Handgrips and handrails are provided throughout for maximum safety.

The main and auxiliary engines are cooled by means of closed fresh cooling water systems. The systems are designed for 35 degrees Celsius seawater temperatures for diesel engines and AC systems.

A ballast water system is excluded by a smart tank layout in combination with a hull form capable of safe operation at all loading conditions.

Figure 9: One of the 2,240 kW MTU main engines

Figure 10: One of the 65 kW Caterpillar diesel generator sets

Figure 11: Auxiliary equipment in the engine room

Figure 12: The engine room is spacious with easy access for maintenance

WHEELHOUSE

The wheelhouse has a focus on ergonomics, comfort and control. Ventilation is separated from the superstructure, ensuring almost no noise and vibration, minimising the risk of complacency.

The vessel features electronic stability feedback technology. This assists in assessing the limits of the tug to ensure safe performance.

Integrated in the propulsion control, an integrated push-to-talk button connects to the VHF.

When desired, the winch can be controlled by foot pedals, facilitating all operations to be done from a single position.

The layout of the wheelhouse consoles is a result of in-depth research and development and feedback from tug operators.

The wheelhouse is provided with a Furuno radar, echo sounder, speed log, Navtex and AIS (automatic identification system) equipment.

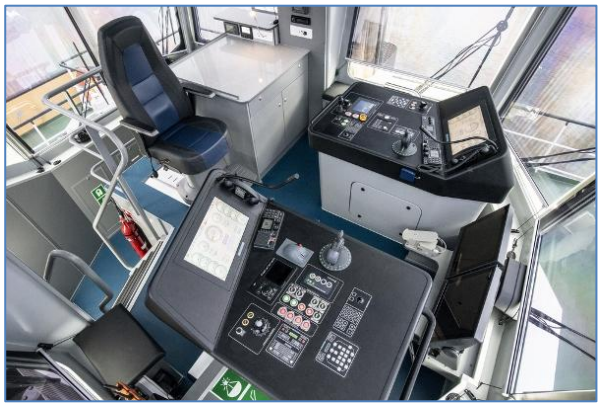
Simrad provided the autopilot and GPS. An emergency position-indicating radio beacon and a search and rescue transponder were delivered by Jotron.

'Innovation's communication is relatively unique for tugs as it has a 60-cm diameter VSAT terminal (Very Small Aperture Terminal) supplied by Intellian that operates over Inmarsat's Global Xpress network.

Other communication means are two Sailor 6222 VHF sets and hand-held VHF sets of Jotron.

The screens are clear, supporting the captain by showing only what he needs during operation, whilst allowing operators to select more detailed data when desired; including remote monitoring of fuel consumption patterns.

Remote monitoring can also shed light on equipment performance, to ensure the correct equipment is used for a given application.



SAFETY

Safe operation is ensured by predictable handling characteristics, excellent visibility from the wheelhouse in all directions, ensuring the operator of distraction-free control.

The 'Innovation' is one of the first Damen vessels to feature the new Damen Safety Glass – shatterproof safety glass developed with TÜV Rheinland, offering protection to the crew.

MAINTENANCE

The tug comprises modular systems and components. This approach reduces both spare parts and maintenance requirements to a minimum, guaranteeing fitness for purpose.

The connectivity of the tug enables to verify the status of the vessel(s) at any place and time and guarantees uptime on everything from the timely replacement of worn parts to full condition based maintenance.

Digital monitoring allows more precise scheduled maintenance planning, extending the periods between maintenance based on accurate monitoring of, for example, fuel and oil quality.

Similar practice has had much success in the automotive industry where such in-depth knowledge of components and parts wear has led to demonstrable cost savings and maximised uptime.

← Figures 13 and 14: Operator´s place in the wheelhouse

‘INNOVATION’ ON TOUR 2018

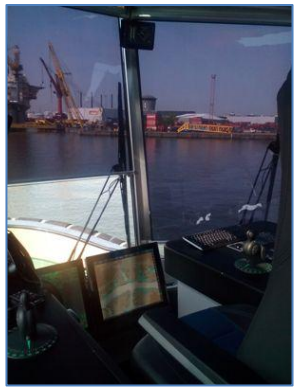
After delivery by Damen Shipyards Galati to Damen Marine Services in April 2018, the ‘Innovation’ made an introduction tour around Europe from the Adriatic to the Baltic Sea, stopping at nearly thirty ports to give customers from around the continent the opportunity to view and experience the vessel first-hand.

Among others, the RSD 2513 was introduced to ship-owners in Malta, Italy, France, Spain, Portugal, Gibraltar, Great Britain, Belgium, the Netherlands and Germany.

TOWING TESTS WITH SVITZER

The ’Innovation’ undertook a number of towing tests in Felixstowe in co-operation with Svitzer Europe, the Port of Felixstowe and pilots from Harwich Haven Authority.

The intention of the tests was to allow the ‘Innovation’ to undertake a number of tows, in various positions, in a controlled and safe manner, gradually building up until she took on a powered indirect on ultra large container vessel (ULCC) the ‘OOCL Hong Kong’. This 21,413 TEU container vessel with a length of 399.87m and a draught of 14.8m was departing from container terminal Trinity 9 during this operation.



← *Figure 15 (Left):*
The wheelhouse features good visibility in all directions

← *Figures 16 and 17 (Right):*
Windshields offer good protection against the sun

These tests took place over ten days between 28th July and 6th August 2018 and were successfully completed.

CONCLUSION

The tug ‘Innovation’ was one of the three vessels nominated for ‘Ship of the Year 2018’ by the Koninklijke Nederlandse Vereninging van Technici op Scheepvaartgebied (Royal Dutch Association of Technicians in Shipping).

The ‘Innovation’ is now based in the Port of Rotterdam, where Kotug Smit Towage operates her.

Another vessel of the same type is the tug ‘Bis Viridis’ (meaning ‘double green’ in Latin), which was delivered in June 2018.

This RSD tug 2513 made a promotion tour along European ports, visiting some of the important ports of the Baltic region and the port of Kaliningrad.

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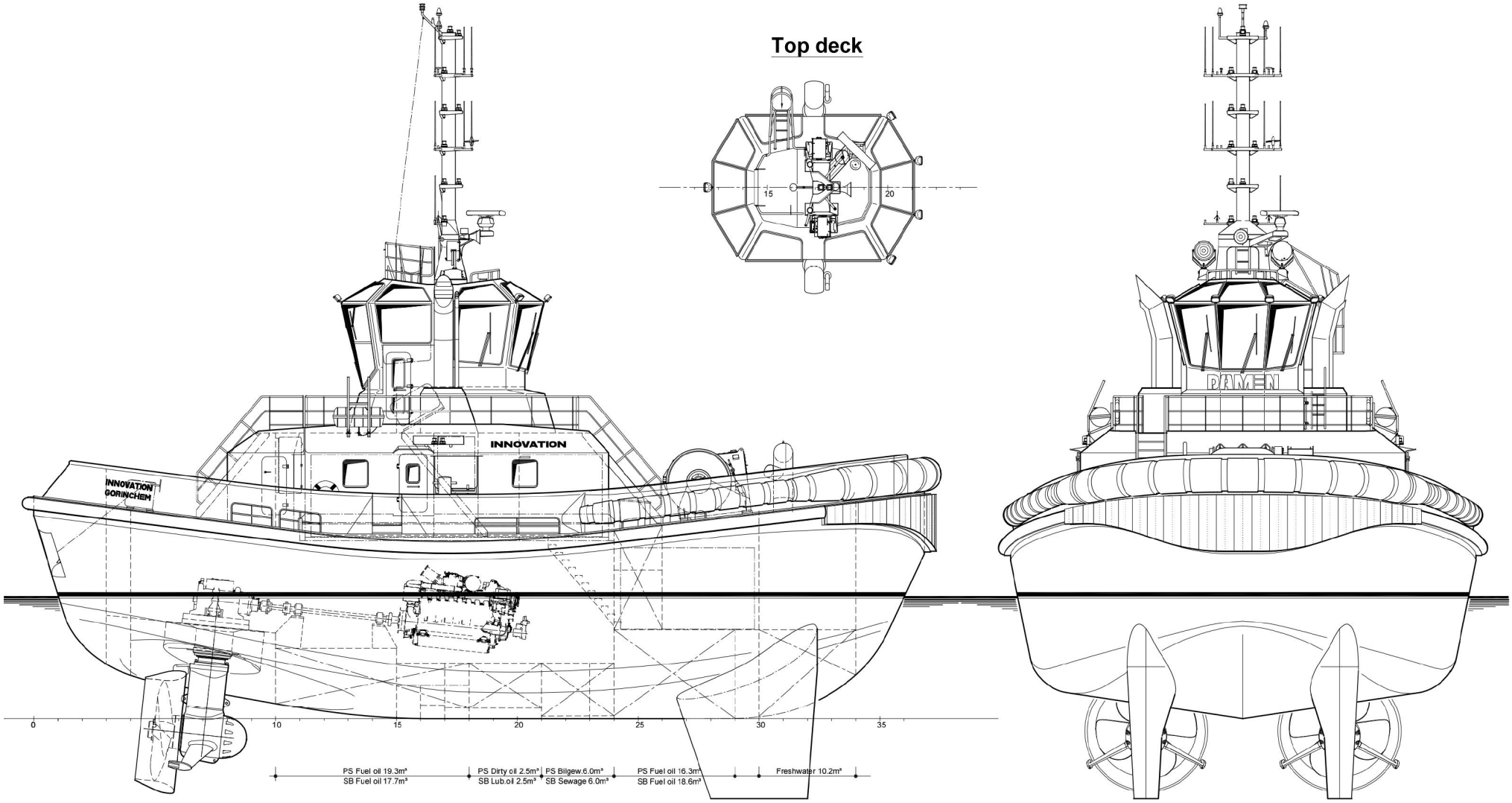
Top deck
INNOVATION
INNOVATION
GORINCHEM
DAMEN
0
10
15
20
25
30
35
PS Fuel oil 19.3m³
SB Fuel oil 17.7m³
PS Dirty oil 2.5m³
SB Lub.oil 2.5m³
PS Bilgew.6.0m³
SB Sewage 6.0m³
PS Fuel oil 16.3m³
SB Fuel oil 18.6m³
Freshwater 10.2m³

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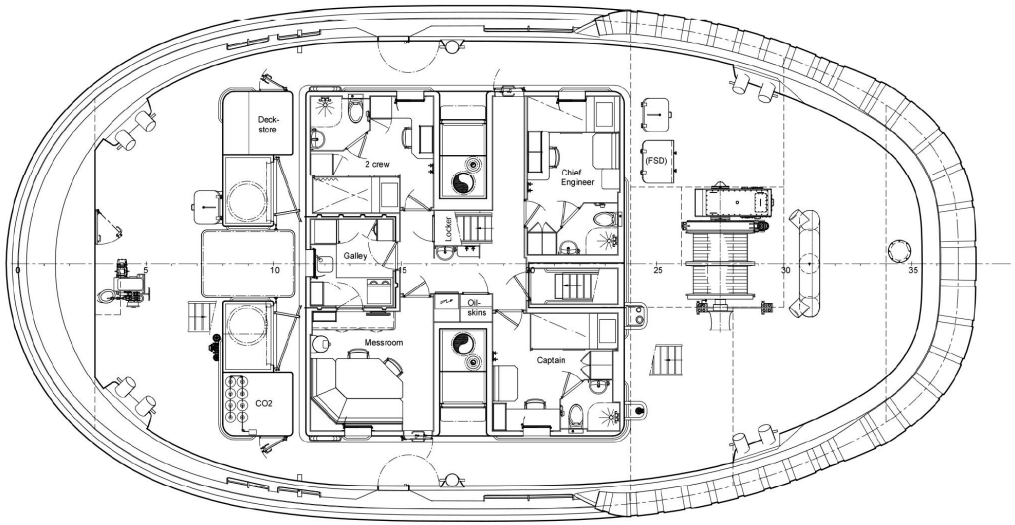
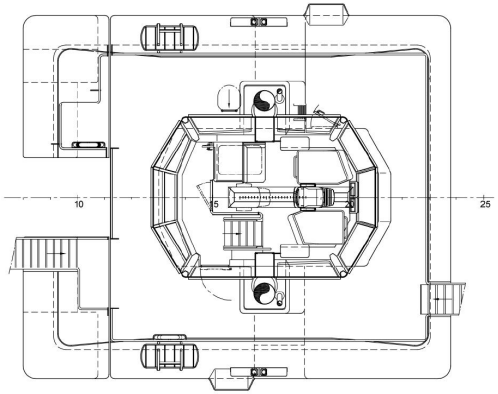
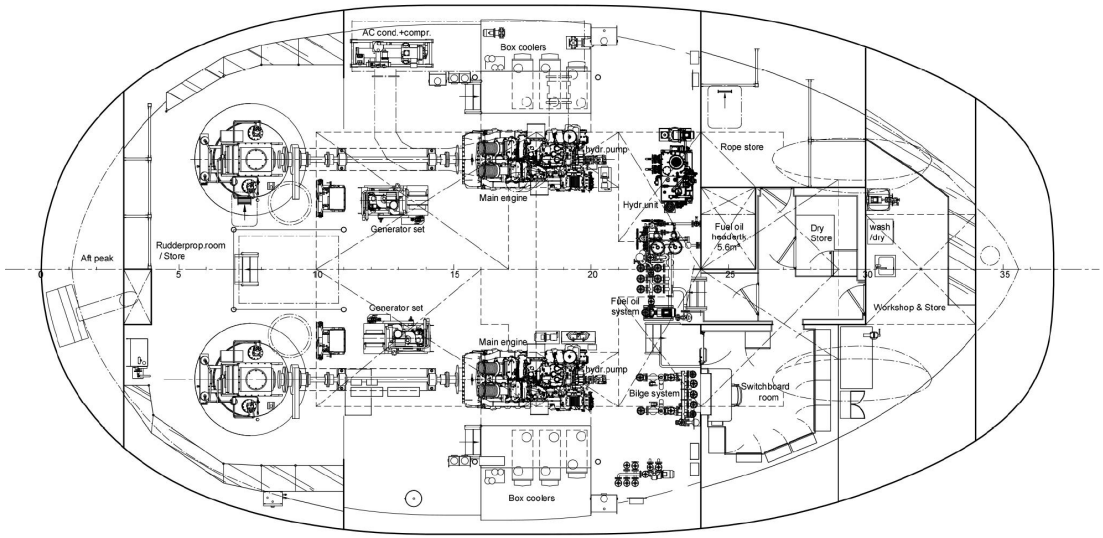
Main deck

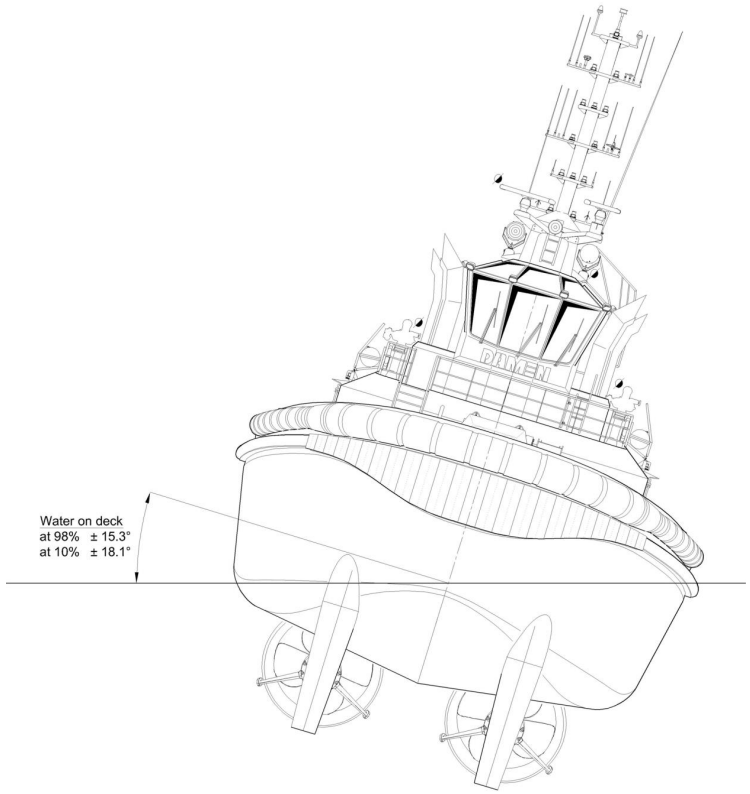


Bridge deck



Below Main deck





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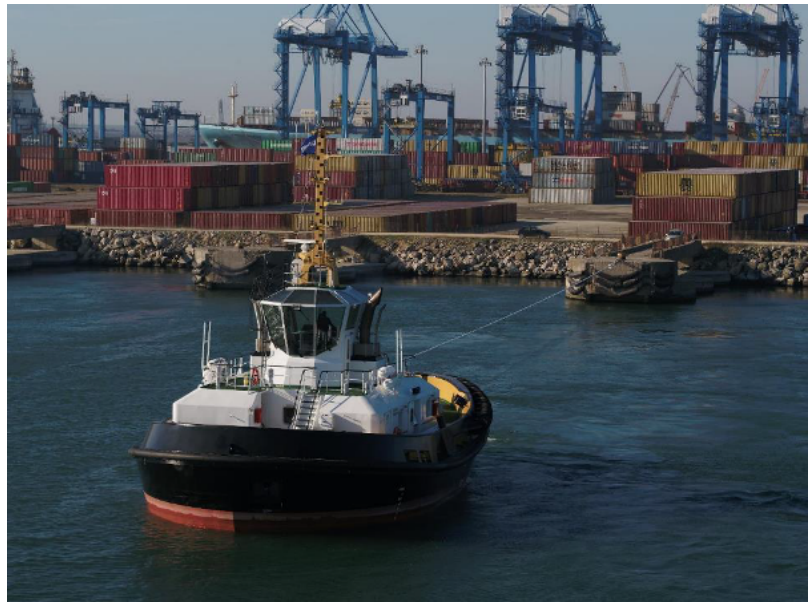
´BIS VIRIDIS´



Bollard Pull Test

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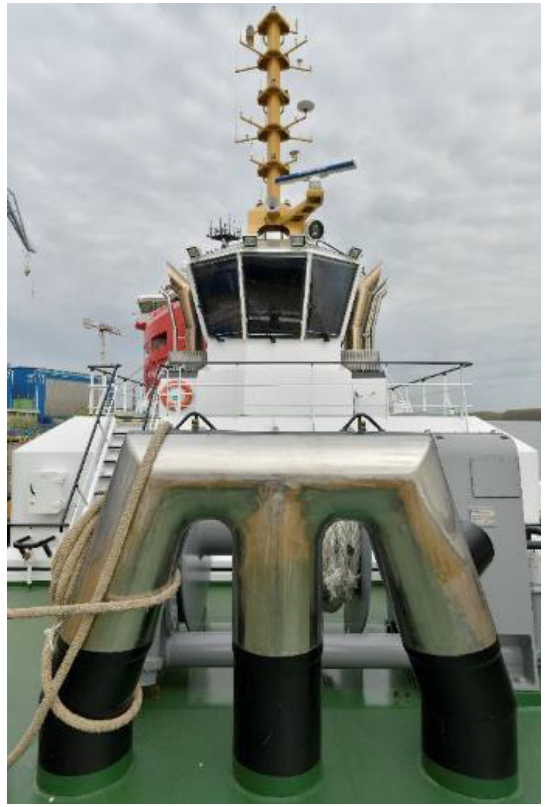

Drawings and Photos on pages 14 - 19
Courtesy of Damen Shipyards

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Photos Courtesy of KOTUGSMIT TOWAGE

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MONOLITHIC CONSTRUCTION OF QUAYS ON PILES

Inma Gómez, Division Manager, RUBRICA MARITIME (Rúbrica engineering)

INTRODUCTION: QUAYS ON PILES

A quay on piles is a structure formed by a platform supported by a series of piles that resist all exterior actions, horizontal and vertical, transmitting them to the ground of the foundation by shear, bending, compression and tension.

This type of pier is especially illustrated in the following cases:

- In areas where the foundation geology has low bearing capacity and/or is highly deformable.
- In seismic zones. Since a structure with less mass will have a better behavior in the face of earthquake situations.
- In areas where it is sought to eliminate the reflection of waves.
- In areas where a large depth is required. This solution allows achieving any required depth, having manufactured piles up to 100 m in length.

Until quite recently, the main emphasis for a piled quay was dependent on the construction method of the piles. Little information or study on the system of execution of the slab of the quay had been undertaken, since in general, the solution was always the same.

On the pile heads a reinforced concrete superstructure was installed using a framework of prefabricated beams, joints, prefabricated slabs and finally the main slab.

However, a few years ago, Rubrica presented a new construction system with which the entire slab of the quay is executed in just a single phase of concreting, thus eliminating a large amount of work and intermediate elements and achieving a structure with a considerably more efficient behavior.

Quays on piles have a high 'specific' surface (surface per unit volume) so their deterioration (cracking) is rapid if the design and materials are not adequate.

Hence the great importance of finding a technical solution that optimizes the behavior of the quay.

BACKGROUND: TRADITIONAL CONSTRUCTION METHOD

Following the traditional method, after the driving and preparation of the piles, the necessary phases for the completion of the slab of the pier were the following:

1. Execution of pile caps;
2. Placement of the slab beams supported on the pile caps;
3. Concreting the joints (steel reinforcement cages in pile head);
4. Placing of prefabricated slabs;
5. Concreting the main slab.

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Technical means and logistics

This construction method requires the need for a prefabricated area in which all the constituent elements of the quay will be built, a collection area for these elements and a transport fleet to move them from the manufacturing and storage area to the point of construction of the quay.

Once at the work site, it will be necessary to operate high capacity equipment with sufficient power to manipulate, hoist and position the elements, often of great size and weight, onto the piles.

This complexity of work operations is necessary throughout the entire construction period of the quay.

Construction and behavior of the dock

One of the main disadvantages of the quay executed with jointed prefabricated elements is that, in the long run, the performance of the structure will be worse than one executed in a monolithic way.

As it is built by interconnected independent elements, the chances of cracking will be much greater than in an integral structure.

And also the response to an earthquake situation will be much better if it is a single compact slab than if it is formed by numerous elements.

As for the construction system, the main drawbacks are the limitations of the geometry to be achieved and the difficulties presented when connecting the different elements.

The steel reinforcement cages in the head of piles usually constitute a work of highly congested steelwork bars.

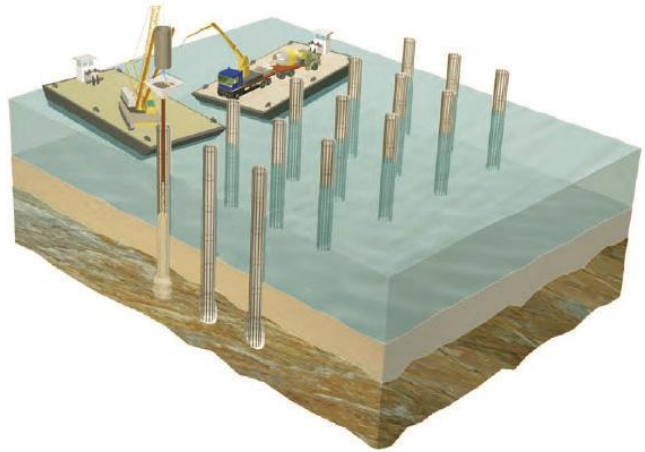
NOWADAYS: MONOLITHIC EXECUTION OF THE QUAY ON PILES

Technology advances by leaps and bounds and every day we push the limits of what is possible a little further.

Faced with this accelerated evolution, it is important to assume that some of the changes will also require major changes in mentality and misconceptions.

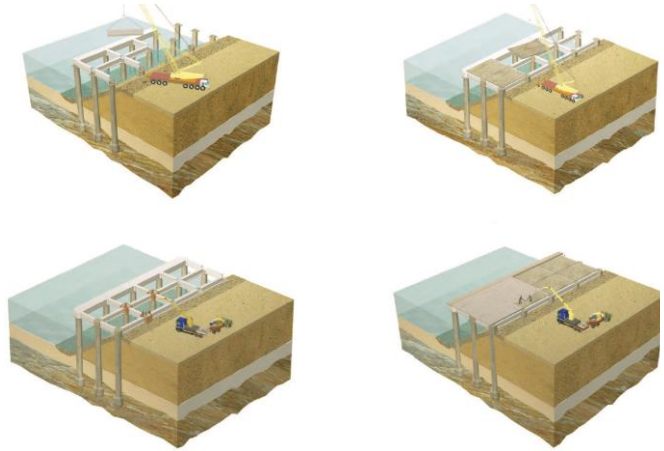
"Evolution is part of our essence, and together, researchers and society have to carry it out."

And it is in this eagerness to evolve where RUBRICA MARITIME appears with a new system that will simplify, and facilitate the construction of the quays on piles, passing from a prefabricated method to the construction of an "in-situ" dock.

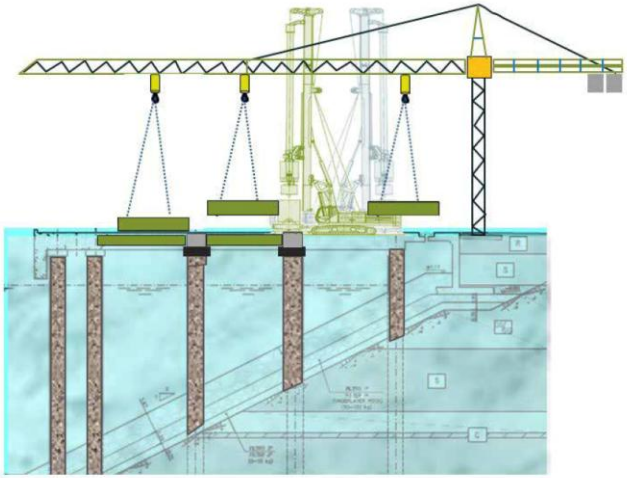


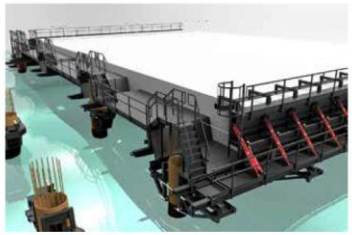
The essential concept of this new system is to achieve a bespoke horizontal surface with the geometry of the lower face of the slab, which will be fixed to the piles and will form the base on which to pour the concrete to configure the quay.

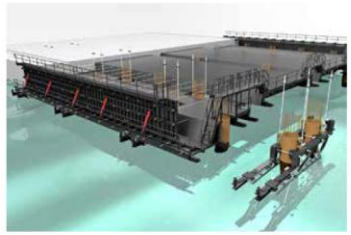
The exterior modules of the structure will have vertical closing panels with the necessary preparation so that, simultaneously with the execution of the slab, they will leave embedded the connections for the fenders, and form other elements such as stairs, cable pits, etc.

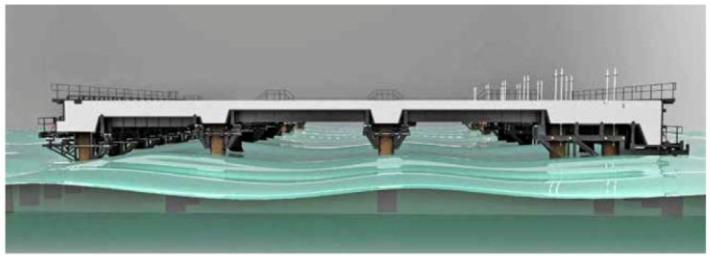


Figures 1 and 2: Renderings of construction process









Figures 3 and 4:

From the construction of docks with prefabricated elements (left) ....

... to the construction of the entire dock "in situ" and in a single phase of concreting (right)

Depending on the conditions and characteristics of the site, the solution will vary between a self-launching formwork system and a floating table system.

The determining factor for the choice of one or the other method will be the distance between the lower face of the slab and the water level.

Whenever this space is sufficient, for the construction of this type of quay, the optimal solution is through the use of a self-launching formwork system.

The self-launching structure is composed of a series of internal tables for the execution of the longitudinal zone between pile grid lines and two cantilever modules that, in addition to the bottom panel, will have the vertical panel to close the beam.

This vertical panel will have horizontal and plumb regulation to absorb possible misalignments of the piles.

The transverse gap between piles is covered with hinged panels fixed to one of the longitudinal tables. These are lifted and fixed to the adjacent table or module prior to concreting, and are lowered in order to move the table forward without clashing with the pile.

Both the tables and the cantilever modules rest on some supports fixed to the pile.

The advance of the structure is made by sliding the different tables and modules that make up the same on rollers placed in the supports. Each module moves independently, so that the total movement of the structure is achieved by independently moving each of the units that it comprises.

The system allows the execution of the entire section of the slab in a single concreting phase. But the formwork must allow the stripping of the structure after the concrete has cured, so the vertical face of the beams on the piles should be slightly tilted.

In cases when the self-launching formwork system cannot be used, the floating table system follows the same concept but with different elements. Instead of sliding forward on supports, they hang from these supports during the concreting process and at the moment of the advance they are dropped to the water below the slab to be dragged, by flotation, to the next concreting point.

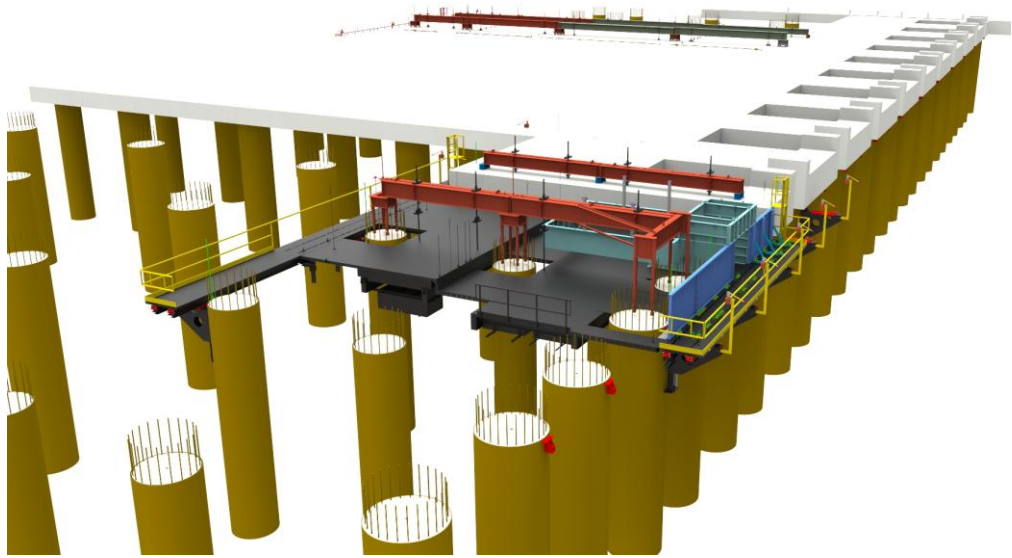


Figure 5: Render Syncrolift Barcelona

These new "in-situ" execution systems have important technical, economic, and safety advantages over the traditional prefabricated method.

In a quick comparative examination between both systems, many of these advantages will therefore clearly appear:

1. As the entire slab is built "in-situ" in a single concreting phase, the work process is simplified due to the reduction in the operational stages - there is no need for a prefabrication area to manufacture and store prefabricated elements, there is no need for a transport fleet to move them, there is no lifting of heavy loads.
2. While in the traditional method it is necessary the use of heavy machinery during the entire life cycle of the project, with the new system it will only be necessary in the initial assembly of the structure, requiring minimum means for subsequent handling and movement of the structure.
3. The system described also has important advantages with respect to safety, since the work operations are simplified, the elements involved are smaller, and the handling of loads at height is eliminated.

   All the equipment is at or below the slab, which eliminates the work with suspended loads and, consequently, the dangers that this implies.
4. As the whole section is carried out in a single phase, the rebar splices and construction joints are eliminated, especially in the pile heads, thus facilitating the placement of the reinforcement and at the same time, reducing the necessary amount of it.
5. Depending on the use for which the quay was intended, it sometimes occurs that the cantilever area required is very large and the robust geometry to achieve it with prefabricated elements is truly a challenge.

   To maintain stability of a large suspended weight, supported only by the beams on the pile heads and to carry out the concreting of the slab, was sometimes, one of the main construction challenges.

   The self-launching system, by building the entire slab structure as a single monolithic element, overcomes this issue, without major problems, even for complex and robust geometries in general and in the cantilever area in particular.
6. As already mentioned above, as it is a single and uniform section without construction joints, the behavior of the slab will be better both in terms of its durability and also in response to earthquake situations, for example.

ORIGIN OF THE IDEA

At the beginning of 2009, a good customer of RUBRICA offered the company a project for the future expansion of the container terminal in the port of Sines.

Reviewing the drawings and seeing the components of the work, one of the innovative minds of RUBRICA immediately realized a visual association between the construction elements of this project and those corresponding to the construction works of bridges, executed with self-supporting structures.

In a synthesized way, one type of work and the other consist of a series of piles on which a platform or slab lies. Therefore, if the self-supporting formwork worked in the construction of bridges, why would not it work for ports?

With this idea in mind, the technical office of RUBRICA began the process to adapt the construction method of these bridge decks to use it in port work.

Figure 6: Self-Launching Botafoc Port , Ibiza (Spain)

As the definition says:

"A falsework is a structure that has as a mission to support another structure temporarily, while it is being concreted and the section acquires the capacity to support its own weight, that is, while the concrete gets enough resistance, the prestressing is introduced, etc."

A self-launching falsework system also has the ability to move from one position to the next by its own means.

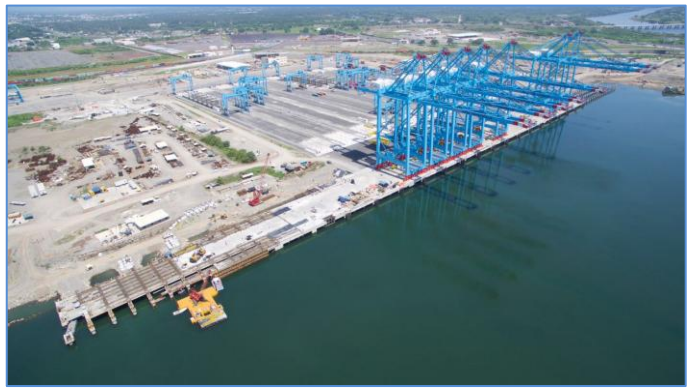
RUBRICA began to study the project in the port of Sines, and presented for the first time it as a solution for the execution of a quay on piles, using self-supporting and self-launching structure that would allow the execution of the entire platform "in situ". This operation will be carried out in a single phase, working with a supported structure, where the operators will work on a plain surface and without elements being suspended constantly over their heads.

Thanks to the confidence of the client and his commitment for innovative solutions, he accepted this ambitious proposal and instructed RUBRICA to go ahead with this new technical solution, finishing the project with a resounding success.

They were able to reduce the execution times of the work, the economic costs and also hazards to ensure the highest standard of safety.

The next project in which a client commissioned this new construction method, and also one of the most emblematic works of RUBRICA's portfolio, was the construction of the new Botafoc docks in the port of Ibiza.

The trust of the leaders of both construction companies allowed the successful introduction of the new system patented by RUBRICA of self-launching formwork for these two projects, which opened the opportunities for many other projects that have been carried out since then with this constructive system.



Figures 7 and 8: Self-launching Lázaro-Cárdenas Port (México)

FLOATING SHEERLEGS ´MATADOR´, ´MATADOR 2´ AND ´MATADOR 3´

Overview of some projects realized by floating sheerlegs (cranes) ´Matador´, ´Matador 2´and ´Matador 3´ of Bonn & Mees (The Netherlands) in the years 2016 - 2019.

All photos Courtesy of Bonn & Mees

400 ton SWL floating sheerlegs ‘Matador’ and ‘Matador 2’ en route with a lower part of a travelling crane, in tow of 1,724 BHP Bonn & Mees tug ‘Jan Leenheer’

Matador 3 seen at HSM Schiedam where she lifted the cable deck on top of the Borselle Beta Jacket together with a Mammoet crawler crane

March 2019

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The ‘Matador 3’ transported a 600 tons upper crane part from ADM Europoort to Franklin Offshore Europe at the Rotterdam Heijsehaven.

Here the Figee crane will be repaired and maintained by Cargo Tec.

The sheerleg with its load is here seen just passing the Maeslantkering, the Rotterdam storm surge barrier.

In February 2018, the ‘Matador 3’ installed two modules on board the 6407/10 Njord A Platform, which is under construction at the Norwegian offshore yard Kvaerner at Stord, Norway.

Joint operation of the sheerlegs ‘Matador’, ‘Matador 2’ and ‘Matador 3’ while unloading the 1,500 ton tons heavy crane house of the ‘Pioneering Spirit; from the Dutch flag heavy transport vessel ‘BigLift Barentsz’.

The crane house was fabricated at the Huisman construction plant at Zhangzhou, China and is part of a tub-mounted crane with a SWL of 5,000 metric tons.

The journey from China to Rotterdam was taken by way of the Northern Searoute, reducing the distance between China and Europe considerably compared to sailing round Asia and through the Suez Canal.

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‘Matador 3’ in operation in the Port of Ostend, Belgium while installing a steel structure on top of one of the two Gravity Based Foundations (GBFs) for the high voltage station of the Danish offshore wind farm Kriegers Flak.

The Belgian Jan de Nul Group and steel construction company Smulders joined forces to build the foundations.

Both GBFs where transported to the windfarm site on the semi-submersible barge ‘BOABARGE 37’ with dimensions 152 x 38 x 9.15m.

March 2019

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The old Botlek Bridge was transported to Janssen Recycling Group by ´Matador 3´

The floating sheerlegs ‘Matador’ and ‘Matador 2’ are involved in a launching operation of the hull of a luxury new-build yacht in The Netherlands.

Floating sheerleg ‘Matador 2’ while loading a luxury yacht on board of the 277m long container vessel ‘CMA CGM Chopin’. The width of the vessel is 40m and she can load maximum 5,782 TEU.

← In August 2016, the floating sheerleg 'Matador 3' was used for a large-scale renovation of the famous pier of the Dutch seaside resort of Scheveningen.

Hereby a 1,004-ton heavy steel construction was lifted off the pier to be demolished in Vlaardingen.

The construction was lifted on the pontoon ‘Stemat 65’ (50 x 14 x 3m) for transport to the Jansen Recycling Group.

March 2019

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All ‘Matador’ floating sheerlegs during an upending operation of a 600-ton jacket with dimensions 20 x 20 x 49m (L x W x H).

The jacket is part of the P11-E natural gas processing platform on the Dutch continental shelf.

The 500-ton topside and the jacket will be transported to their offshore location on board of the 9,000-ton deadweight deck cargo barge ‘CC Biscay’ (91.44 x 27.43 x 6.1m).

Sheerlegs ‘Matador’, ‘Matador 2’ and ‘Matador 3’ unloading the new-building deck cargo barge ‘SM 253’ with dimensions 76 x 24.50 x 5m, built in China by Jiangsu Huatai Shipbuilding Co., Ltd.

Floating sheerleg ‘Matador’ while loading dock doors on board of the seagoing ro-ro pontoon ‘6615’ with dimensions 66 x 15.50 x 4m, owned by Muller Zwaar Transport. The pontoon can carry loads up to 2,427 ton.

BACK COVER PHOTO:

In tandem with Allseas’ multipurpose offshore construction vessel (OCV) ‘Fortinade’, the 1,800 ton floating sheerleg ‘Matador 3’ installed the crane house of the 5,000 metric ton SWL Huisman offshore crane on board of the largest construction vessel in the world ‘Pioneering Spirit’ also owned by Allseas.

The ‘Fortinade’ is fitted with a 900-ton SWL offshore luffing jib crane. The ‘Pioneering Spirit’ measures: length over all including stinger 477m, breadth 124m and depth to main deck 30m.

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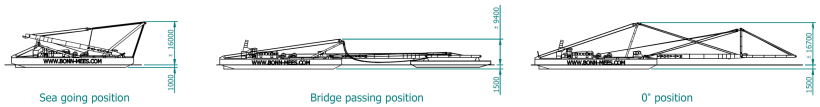
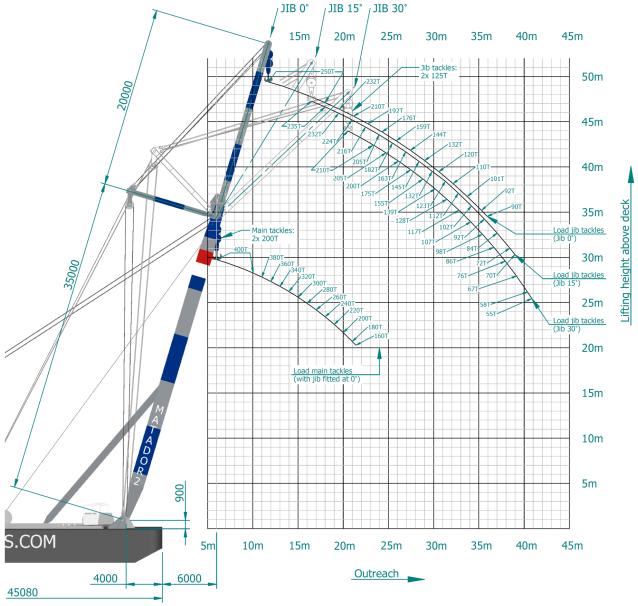


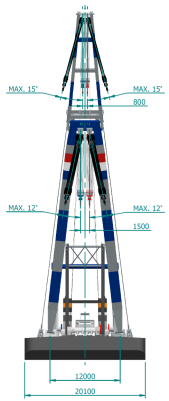
PRINCIPAL PARTICULARS:

LENGHT:	pontoon	45.08m
BREADTH:	mld.	20.10m
DEPTH:	mld.	3.60m
STERN THRUSTERS:		N/A
BOW THRUSTER:		N/A
ANCHOR WINCH:		3x 7.5 TON
ANCHOR/MOORING WINCH:		6x 7.5 TON
A-FRAME HOOK SIZE ACC. TO DIN 15402:		#100P
JIB HOOK SIZE ACC. TO DIN 15402:		#63P

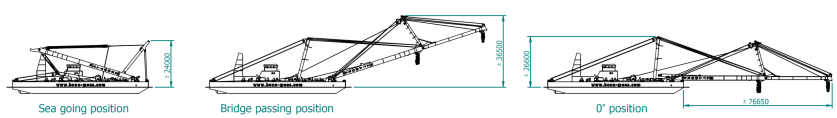
ALL LOADS IN METRIC TONS

MATADOR:		
CALL SIGN:		PJWJ
CLASSIFICATION:		BUREAU VERITTAS
YEAR OF COMPLETION:		1970
MATADOR 2:		
CALL SIGN:		PJWA
CLASSIFICATION:		BUREAU VERITTAS
YEAR OF COMPLETION:		1976





´Matador´and ´Matador 2´

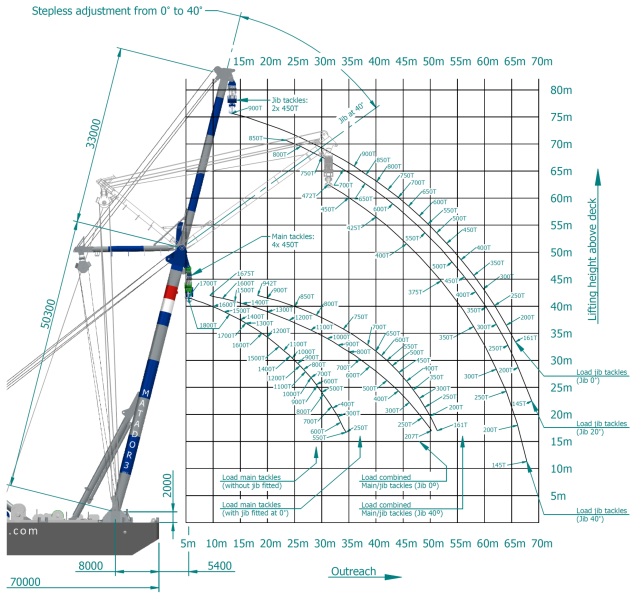


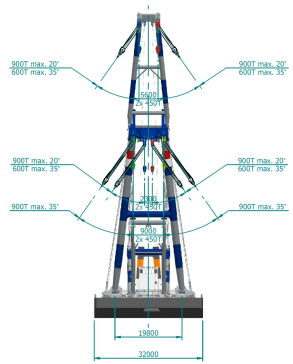
PRINCIPAL PARTICULARS:

LENGHT:	pontoon	70.00m
BREADTH:	mld.	32.00m
DEPTH:	mld.	6.00m
STERN THRUSTERS:		2x 400kW
BOW THRUSTER:		1x 800kW
ANCHOR WINCH:		1x 26 TON
ANCHOR/MOORING WINCH:		6x 30 TON
HOOK SIZE ACC. TO DIN 15402 (B):		#125V

ALL LOADS IN METRIC TONS

CALL SIGN:		PBHF
CLASSIFICATION:		BUREAU VERITTAS
YEAR OF COMPLETION:		2002





´Matador 3´

March 2019

TUGS AND THEIR DEVELOPMENT THROUGH CENTURIES

Hans Tompot, Naval Architect

INTRODUCTION

A tug is a ship that is designed to tow. For this purpose, the vessel has a large engine output in comparison to its length. In the steam era, the vessels were usually driven with paddles, nowadays with a propeller drive, optimized for bollard pull.

Tugs are available for different purposes:

- Ocean-going (salvage) tugs
- Coastal tugs
- Harbour tugs
- Inland tugs

DEVELOPMENT OF TUGS THROUGH THE CENTURIES

In the first decade of the 21st century, much has changed in the towage industry.

Today's tugs hardly seem technically anymore similar to the vessels that were built with the same purpose some around 1950 / 1960; the contrast with those built hundred years ago is even larger.

Steam harbour tugs from the past 50 years ago changed into motor tugs; resulting in another look.

The fine vessels still had funnels, the length of which was shortened because burning coal did not result anymore in fat clouds of soot.

´Nestor´providing assistance to general cargo vessel in IJmuiden Northern Lock
Source: Historical Postcard from ***Gebr. Spanjersberg, Rotterdam***

Even the motor sea tugs of the past still had beautiful funnels. It was secretly said for commercial reasons: 'The thicker the funnel, the stronger the tug'. That was not true, but the designers of that time considered it.

The steam tug 'Nestor' was built in 1919 as 'Hercules', owned by the N.V. Maatschappijtot Exploitatie van de Zeesleepboot 'Hercules' and chartered by Wijsmuller.

She sank in 1919 North West of the Northern Pier. Salvaged and after repairs renamed 'Nestor'. Engine output of 600 IHP.

March 2019

The short funnels later became smoke ducts, especially to improve the view 'backwards', while towing.

The number of crew members of the tugs has also changed considerably.

Steam and motor-tugs from the Fifties and Sixties sometimes had more than 20 men on board.

Nowadays the powerful tugs operate with half of this figure while the smaller tugs work with three of four men on board. That saves considerably on costs.

Manilla ropes disappeared. Nylon ropes and steel wires took their place. Later it even became polypropylene, which is lighter and stronger than nylon.

The 'towing bit', a construction on the aft deck on which the towing wire was fixed, disappeared and was replaced by electric or hydraulic driven winches on both the bow and aft deck. In the wheelhouse, steering is no longer with a large steering wheel but by means of joysticks or handles.

The Captain, Mate or helmsman is no longer dressed in a uniform controlling the steering wheel, but sits comfortably in casual clothing on a specially adapted seat, with the joysticks or handles in their vicinity.

The 4,500 IHP ocean-going tug 'Elbe' of L. Smit & Co's Internationale Sleepdienst, built in 1959.
Source: L. Smit & Co.

PROPULSION

The most import changes occurred in the propulsion systems.

In 1906, the Dutch tug 'Zwarte Zee' (II) fitted with a triple expansion steam engine of 1,500 HP was the strongest tug in the world.

The 'Elbe is still operational as museum tug and makes regularly trips by sea with guests.

Photo Courtesy of Zeesleperelbe

Over the years, the ships and objects to be towed became larger and the tugs had to become more powerful.

The switch to engine driven tugs was carefully made, resulting in a tremendous increase in the bollard pull of the tugs.

The first Dutch motor tug entered service in 1933; the famous tug 'Zwarte Zee' (III). Two Werkspoor diesel engines with a total output of 4,200 HP powered her.

With this output, the tug was the most powerful ocean-going tug in the world for decades.

The 'Zwarte Zee' was the flagship of L. Smit & Co's Internationale Sleepdienst of Rotterdam, which became later Smit Internationale.

Also their main competitor Bugsier Reederei- und Bergungs-Gesellschaft of Germany came with engine driven tugs on the market.

In November 1924 the 2,400 BHP double-screw tug 'Seefalke' entered service, followed in November 1939 by the 3,300 BHP tug 'Atlantic'.

See the development of tug's engine output in the fleet of L. Smit & Co's Internationale Sleepdienst:

1933 – 4,200 IHP – 'Zwarte Zee' (III) – single screw

1963 – 7,000 BHP / 9,000 IHP / 73-ton BP – 'Zwarte Zee' (IV) and 'Witte Zee' (1966) – single screw

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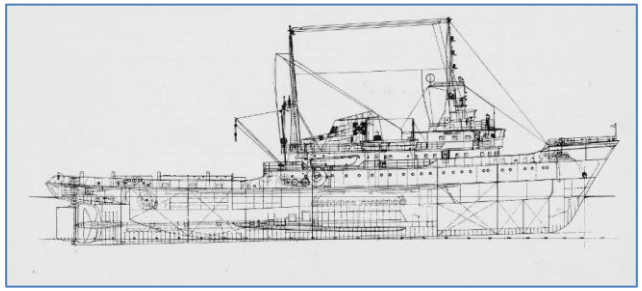
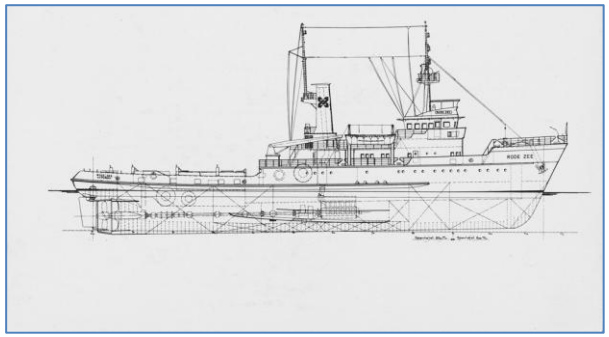


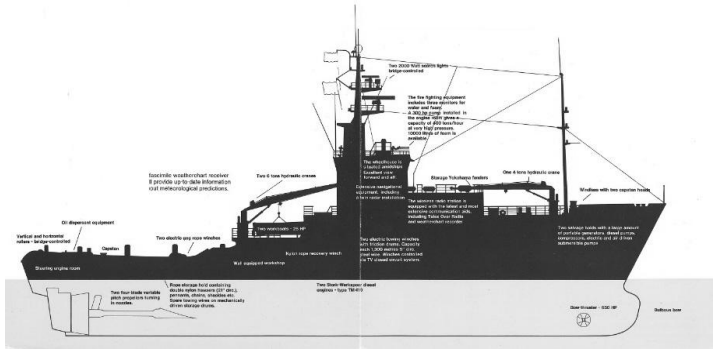
The 'Zwarte Zee' - world's most powerful tug in 1963
Source: Leaflet Smit Internationale

1968 – 7,200 BHP / 11,000 IHP / 100-ton BP - 'Rode Zee', 'Noordzee '(1970) and 'Poolzee' (1971) – double screw



Source: Leaflet Smit Internationale

1975 – 13,500 BHP / 22,000 IHP / 152-ton BP - 'Smit Rotterdam' and 'Smit London' (1975) – double screw



In 1975, the 'Smit Rotterdam' became the strongest tug of the world with 22,000 IHP / 13,500 BHP engine output.
Source: Leaflet Smit Internationale

In addition, the development of tug's engine output in the fleet of Bugsier Reederei- und Bergungs-Gesellschaft:

- 1950 – 2,680 BHP - 'Wotan' (III)
- 1959 – 5,000 BHP / 51-ton BP - 'Atlantic' (II)

1969 – 12,800 BHP / 17,500 IHP / 150-ton – 'Oceanic' (I) and 'Arctic' - double screw.

Bugsier Reederei- und Bergungs-Gesellschaft became in 1969 the proud owner of world's strongest tug with the delivery of the 'Oceanic'.

Not only in The Netherlands and in Germany, powerful tugs were built elsewhere through the years.

Other powerful tugs are:

- 1966 – 'Alice L. Moran' of 9,600 BHP / 90-ton, owned by Moran International Towing Corporation, USA
- 1974 - 'North Sea' of 8.000 BHP / 80-ton BP owned by Fukada Salvage K.K. Japan
- 1976 - 'Wolraad Woltemade' and 'John Ross', both of 19,200 BHP / 185-ton BP for South Africa
- 1977 – 'Abeille Normandie' and 'Abeille Provence', both of 8,400 BHP / 120-ton BP, owned by Les Abeilles Towage, France
- 1978 / '79 - 'Neptun Suecia' and 'Neptun Gothia, both of 12,800 BHP / 160-ton BP, owned by Neptun Transport & Marin Service A.B. of Sweden
- 1978 – 'Dahlia' of 12,000 BHP / 162-ton BP owned by Yushin Kogyo and The Tokyo Marine Services Ltd. of Japan
- 1979 - 'De Da' and 'De Yue', both of 20,800 BHP / 200-ton BP for People's Republic of China
- 1989 - 'Fotiy Krylov' and 'Nikolay Chiker', both of 24,480 BHP, owned by Russian Government

March 2019

Most of the harbour and coastal tugs of the past were driven by one propeller.

Around 1961, the shipping in Rotterdam Europoort was served by Voith-Schneider tugs of 1,250 HP (tugs 'Azie' and 'Europa') and 1,650 HP, all of the Nieuwe Rotterdam Sleepdienst (NRS).

At the end of the sixties, the NRS fleet was expanded with more powerful Voith-Schneider tugs up to 3,000 HP. Later tugs were developed with Z-peller drive, Azimuth thrusters and the so-called 'Rotor'-tugs, powered by three propellers.

In the 21st century, the first hybrid tug entered service and other forms of environmentally friendly propulsion are developed.

At the end of the 19th century, long-distance sea towages really started. In the beginning, mainly towages along the European coasts took place, sometimes up to North Russia and the Mediterranean.

In the first years of the 20th century, long-distance towages across all oceans began. During this period, they started towing various objects such as dredgers, barges and dry docks all over the world.

Everything was, of course, in relation to the size of the ships at the time. The ocean-going tugs became indispensable for the shipyards and dredging companies. They wanted to carry out projects all over the world.

The Dutch shipyards built dry-docks for foreign shipyards, which were then towed to the various locations. In 1896 the Smit tugs 'Oostzee' (750 IHP) and 'Oceaan' (1,200 IHP) performed a towage from Schiedam to St. Paul de Loanda (nowadays Luanda in Angola) with a 1,350-ton dry-dock.

Nowadays all oceans are navigated by these tugs and the floating objects are delivered to their destination.

The last steam tugs were gradually replaced by engine-driven and diesel-electric driven tugs with more power and range after World War II.

The scaling up of the tugs and with it the engine power also continued over the years as shown in the overviews above of Smit and Bugsier.

This development was a consequence of the increasingly heavier and more extensive objects to be towed, partly because of the rise of oil production at sea.

The appearance of the ocean-going tug also changed in the Sixties. Instead of the familiar funnel, the exhaust gas pipelines were integrated in two aft masts; these masts were connected by a transverse structure, on which the top aft mast was placed.

Bureau Wijsmuller from IJmuiden was the towage company that introduced this new form to its 'Province' - class.

From the bridge, the towed object could now be more easily watched through a better view to the stern.

This idea was such a success that all other towage companies followed the example in the designs of their newly built tugs.

The Chinese ocean going tug 'De Da' with an engine output of 20,800 BHP. Source: SmitWIjs Towage

WHEELHOUSE

In the Wheelhouse the traditional steering wheel disappeared; the automatic pilot ('autopilot') made its appearance.

On the autopilot the tug's course, which must be sailed, is entered and the device then holds this. Both the telegraph on the bridge and in the engine room disappeared. Manoeuvring was arranged from the bridge. The bollard pull meter was introduced. This meter can be used to determine which force will be present on the towing wire. The bollard pull of the tug can now be adapted to the weather conditions as the occasion arises.

The power changes that are entered from the bridge are now monitored in the engine room. After departure, after manoeuvring in the port, the engines are adjusted to sail / tow as economically as possible during the long voyage.

Also in the engine room, the manoeuvring stand for reversing the engines from 'full ahead' to 'full astern' and vice versa disappeared. This technical capability became superfluous because the tugs were equipped with the newly introduced controllable propellers.

This new technique meant that the engine no longer needed to be changed or the direction of rotation of the engine changed to allow the tug to move forward or backward at a certain speed.

The engines were set to a fixed speed by the use of the controllable propeller, and the blades of the propeller were adjusted when changes were made in speed or traction.

SALVAGE STATIONS

Until approximately the Seventies it was common practise that towage and salvage companies positioned one or more tugs on salvage stations – mostly during the Autumn and Winter period - to render assistance to shipping in case of a casualty (collision, engine breakdown, rudder lost, fire, running aground, etc.).

The salvage stations were at strategic places along shipping routes, for example Gibraltar, Malta, Ponta Delgada (Azores), Falmouth (South-England), Brest (France), Colombo (Sri Lanka), Djibouti, Cape Town (South Africa), and Port Said (Egypt).

However, the shipping became safer as a result of more reliable diesel engines and stricter international requirements regarding equipment and maintenance, resulting in less casualties at sea and a fewer number of salvage operations and assistance to shipping in general.

For private towage and salvage companies it was no longer profitable to keep a tug on a salvage station. These salvage tugs were less suitable for the 'normal' towage operations, especially since the transport of floating objects was gradually replaced by a new way of sea transport.

NEW WAY OF SEA TRANSPORT

This alteration within sea towage started around 1973, when the towage company International Transport Contractors (ITC) was founded. The ITC management, including two former Wijsmuller employees devised a revolutionary way of transporting equipment by sea.

Until that year, transport of a floating object was only by one or more tugs. At ITC, it was believed that many objects could be loaded on a pontoon, which would be towed to the desired location by a tug, where the cargo would be unloaded again. It was assumed that this method of transport was better and safer for the object and by the use of a pontoon, it would also be faster.

The method was tested in practice; expectations were fulfilled and more and more floating objects were transported in this way, including dredgers, jack-up rigs, etc.

Other towage companies responded to this successful initiative by also using pontoons.

Wijsmuller introduced in 1976 their propulsion-assisted semi-submersible pontoons, called 'Ocean Servant 1' and 'Ocean Servant 2' with great success.

The concept was further improved and in 1979 the first of four semi-submersible 'Super Servant' heavy lift vessels with their own propulsion entered service, and in 1983 followed by three larger vessels 'Mighty Servant 1, 2 and 3'.

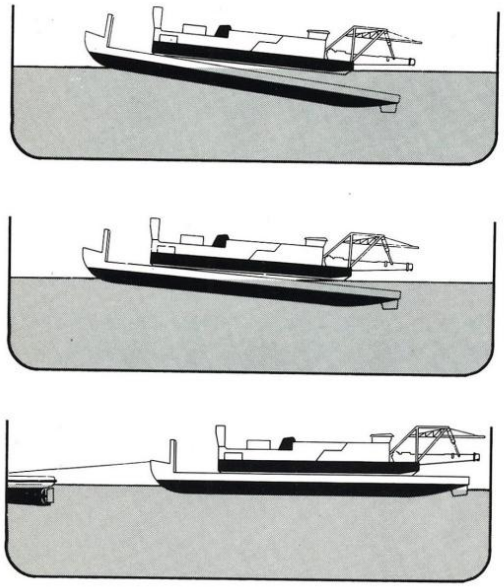
The heavy lift vessels were operated by Wijsmuller Zwaar Transport.

The German company Ulrich Harms G.m.b.H. & Co. was the first one to introduce the submersible barge with the 'Mulus' barges.

The success of this transport method led to other shipping companies also investing in semi-submersible heavy lift vessels, resulting in overcapacity in this market.

Danish company JL Heavyweight Transport (part of the J. Lauritzen Group) entered the market in 1982 with the 'Dan Mover' and 'Dan Lifter', almost identical to Wijsmuller's 'Super Servant' vessels.

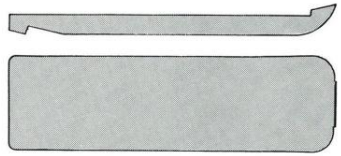
Between 1982 and 1984, Jan Erik Dyvi of Norway came with four 30,000-ton deadweight heavy lift vessels and also in 1982, the fleet of ITC was expanded with a self-propelled heavy load carrier, the 44,144-ton deadweight 'Sibig Venture'.



Main dimensions and capacities submersible barges

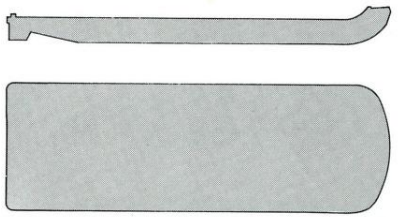
336-series

number	4
deadweight	11.339 tons
length x beam x draught	102.4 x 29.8 x 5 m
light draught	1 m
deck area	2,610 sq.m



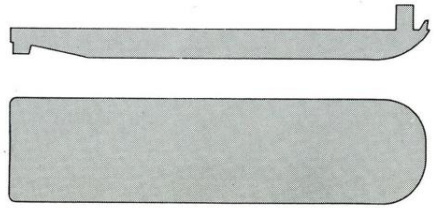
393-series

number	3
deadweight	19.600 tons
length x beam x draught	120 x 40 x 6 m
light draught	1.4 m
deck area	4,500 sq.m



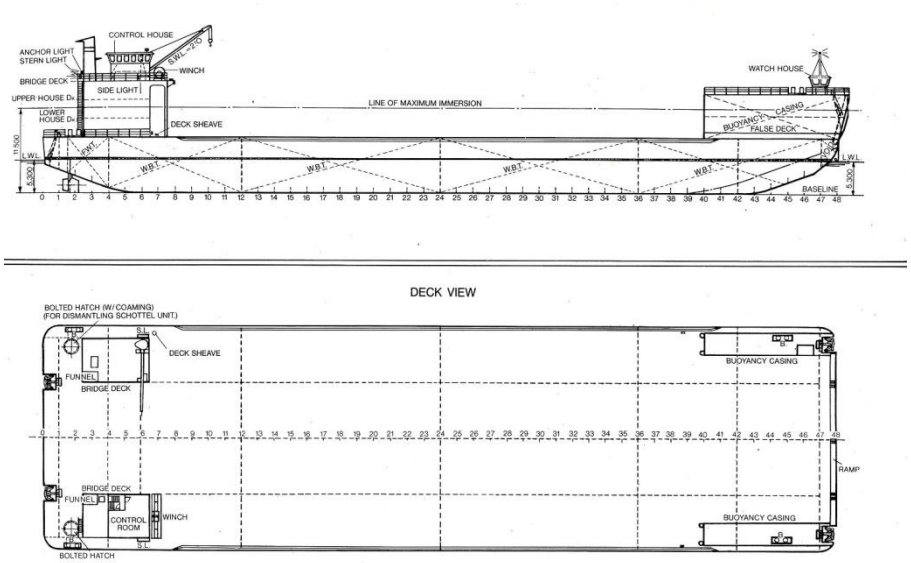
427-series

number	2
deadweight	21.500 tons
length x beam x draught	130 x 32 x 6.5 cm
light draught	1,4 m
deck area	3,820 sq.m

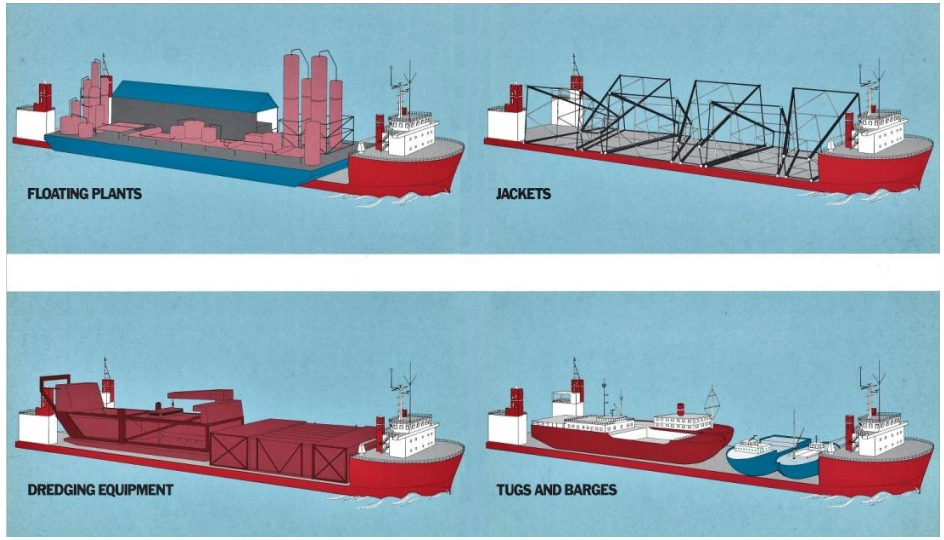


The towage company International Transport Contractors (ITC) introduced transports over sea with submersible barges. In contrast to the semi-submersible barges and vessels, these barges were not capable to submerge horizontally; during loading / unloading, the stern of the barge rests on the bottom of the port.

Source: Leaflet International Transport Contractors



Source:Leaflet Wijsmuller Transport



Some of the transport features of semi-submersible heavy lift vessels, as shown in a brochure of the Danish company JL Heavyweight Transport for projects with their vessels 'Dan Mover' and 'Dan Lifter', which were later integrated in the fleet of Wijsmuller Transport as 'Super servant 5' and 'Super Servant 6'

Source: Leaflet JL Heavyweight Transport

Ocean Servant 1' and 'Ocean Servant 2'

Length o.a.	109.00 m
Length b.p.p.	108.00 m
Breadth mld.	30.00 m
Depth mld.	7.50 m
Draft loaded	5.30 m
Draft submerged	12.00 m
Propulsion assistance	1,440 BHP

In 1977 / '78, Smit Internationale took delivery of three semi-submersible pontoons, the 24,000-ton deadweight 'Giant 2, 3 and 4'.

At the time, Smit saw no reason to invest in self-propelled pontoons like Wijsmuller did. In the opinion of Smit, unmanned towed barges were cheaper than a manned vessel with high crew costs.

Because of this overcapacity and the decline in the offshore industry, Wijsmuller ran into financial troubles; the company changed into the hands of Heerema and Van Ommeren.

The sea transports with pontoons and semi-submersible heavy transport vessels took away an important part of the traditional towing market and in fact, the decline of sea towage started with the upswing of sea transports by means of the self-propelled heavy transport vessels.

These ships could sail much faster than the tugs could tow and the transport method was also safer, resulting in lower transport insurance premiums.

Most towage companies had tugs in different power classes, each suitable for a specific part of the market. The smaller ones for dredging equipment and the like; the larger and more powerful tugs for towing, amongst others, drilling rigs.

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However, the development of the heavy transport ships did not last despite the overcapacity.

The transport of one or even more drilling platforms at the same time by such high-tech vessels expanded enormously. Although there was still plenty of other work left for the time being, the trend had been set and the towage companies started thinking about the reduction of their fleet of tugs.

TUG / SUPPLY VESSELS

In the meantime, supply vessels had entered the market, because the extraction of oil and gas from the North Sea seabed, which started in the 1960s, proved to be a profitable business.

In particular, Smit-Lloyd, a joint venture between L. Smit & Co's Internationale Sleepdienst and the Royal Rotterdamse Lloyd, was a pioneer in supplying drilling rigs.

Although the towing service was initially reluctant, the supply vessels were eventually also used as tugs for so-called rig moves: moving drilling rigs and other offshore equipment.

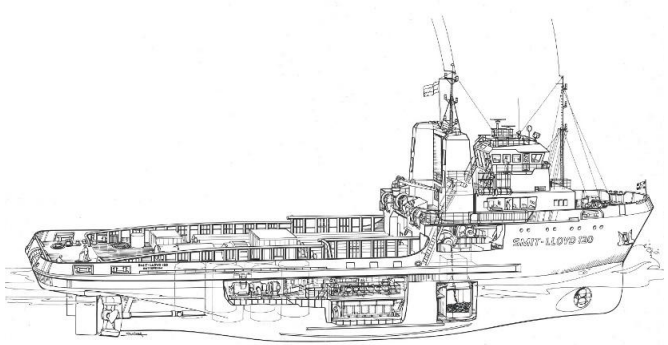
The first Smit-Lloyd supply vessels (A-Class) had engines fitted with 3,000 BHP (1965), the 100-Class with 4,000 BHP (1969), the 100S-Class with 7,200 BHP (1973) and the 120-Class with 9,200 BHP (1983).

Later Norwegian and Danish companies like Maersk Supply Service, Farstad Shipping and Solstad Offshore took over the leading position in the offshore market with vessels of more than 24,000 BHP, the so-called anchor handling tug supply vessel (AHTS).

From a technical point of view, a tremendous development had been achieved, because these vessels are suitable for:

- Handling and positioning of anchors (anchor handling)
- Manoeuvring close to drilling platforms
- Fighting fires in case of calamities on offshore installations (with a capacity of 7,200 m3/hour for vessels classed 'Fire-Fighter II' and 9,600 m3/hour for 'Fire Fighter III'
- Transferring of offshore workers and materials (cement, mud, barite, drilling water, fuel, potable water) to the rigs and platforms
- Towage of large offshore structures

Nowadays, there are special offshore construction vessels with a bollard pull of more than 400 tons.



The Smit-Lloyd 120-Class anchor handling tug supply vessels

Source: Smit-Lloyd leaflet

One of them is the Norwegian 'Far Samson' with a maximum continuous bollard pull of 423 tons, designed to provide comprehensive support for a multitude of offshore and deepwater tasks worldwide, including pipeline trenching, subsea construction, towing, ROV inspection and survey operations, pile driving, cable and flexible installation, supply service and pre-commissioning works.

The result of this development was that the old style tugs were used less and less for conventional towing work and became idler. Many of the older tugs with modest engine outputs were therefore sold for scrap or transferred to a foreign flag and subsidiaries in countries like Singapore, Greece, Panama, etc.

In these areas, the tugs could operate with local (cheaper) crews, making the vessels still profitable in many cases.

'Smit-Lloyd 121' with in tow the semi-submersible drilling rig 'Sedco 714'

Source: http://www.smit-lloyd.com/121

The large and powerful units remained in operation, but strong competition was not in the interest of the towage companies.

There was a need for a partnership. In 1991, Smit and Wijsmuller brought their most powerful tugs together; the rivals for more than 80 years were now united in one new towage company called SmitWijs Towage.

The fleet consists of the tugs 'Smit Singapore', 'Smit Rotterdam', 'Smit London', 'Smit New York', 'Typhoon', 'Tempest' and 'Waker' (ex 'Smit Houston') in charter of the Dutch Coastguard.

Later SmitWijs also co-operated in the Global Towing Alliance, including the powerful tugs 'De Da', 'De Yue', 'De Hong' and 'De Zhou' from China and 'Wolraad Woltemade' and 'John Ross' from South-Africa.

Between 2005 and 2007, the Dutch company Fairmount Marine introduced a new generation of five powerful tugs, suitable for long-distance towages, salvage operations, anchor handling, etc.

Each tug is powered by four Wärtsilä engines with a total output of 12,000 kW, suitable for 200-ton bollard pull.

Fairmount Marine also joined forces; together with the Singapore-based company Semco Salvage & Marine Pte. Ltd. they formed OneAllianz in September 2004. Their tugs were ranging between 150 and 205-ton bollard.

Dutch Emergency Towing Vessel 'Waker'
(8,500 BHP – 120 ton bollard pull

Source: Dutch Coastguard

The 13,800 BHP ocean-going tug 'SmitWijs Singapore'

Source: SmitWijs Towage

The anchor handling tug 'SmitWijs Tempest', operating in charter of offshore contractor McDermott

Source: SmitWijs Towage

Dutch tug 'London' of Svitzer Ocean Towage and Chinese tug 'De Da' of COESS towing together in the Indian Ocean

Source: Svitzer Ocean Towage

The partnerships had the desired effect; the prices in the towage market became more competitive.

In 2001, the Danish towage and salvage company Svitzer – part of the Maersk Group – took over Wijsmuller with the result that SvitzerWijsmuller became a 50% shareholder of SmitWijs.

In October 2006 Smit announced that it had the intention to sell its 50% interest in SmitWijs Towage to the other shareholder SvitzerWijsmuller.

The former Smit tugs became the property of Svitzer. In the meantime, all tugs of SmitWijs Towage / Global Towing Alliance have been scrapped except the 'De Hong' and 'De Zhou'.

'ALP Striker', the first of four 305-ton bollard pull DP II anchor handling salvage tugs of ALP Maritime Services.

Photo Courtesy of ALP Maritime Services

At this moment Boskalis, service provider in the field of dredging and maritime services, has a large fleet of self-propelled semi-submersible heavy cargo vessels, including the 117,000-ton deadweight 'BOKA Vanguard' (formerly 'Dockwise Vanguard').

Increasing competition is coming from the Chinese company COSCO Shipping Heavy Transport with seven vessels up to 98,000-ton deadweight.

Due to the major disappearance of the station salvage tugs, national authorities were forced to hire salvage tugs to protect their national coasts from driftkng ships or stranded ships, which could possibly cause oil spills.

For example, the UK Maritime & Coastguard Agency chartered four vessels of Klyne Tugs; 'Anglian Monarch' (11,400 BHP / 152 tons BP), 'Anglian Prince' (11,280 BHP / 172 tons BP), 'Anglian Princess' and 'Anglian Sovereign' (both 16,320 BHP / 180 tons BP).

For protection of the 3,120 km long French coasts, to prevent shipwrecks and assistance and salvage of vessels in distress, there are four Response, Assistance, and Salvage Tugs (RIAS); *the* 'Abeille Bourbon' and 'Abeille Liberté (both of 21,740 BHP / 209 tons BP) and the 'Abeille Languedoc' and 'Abeille Flandre' (both of 12,800 BHP / 156 tons BP*).*

The first Dutch Emergency Towing Vessel was the former Smit tug 'Smit Houston', called 'Waker' (translated 'Guardian').

Unfortunately, this Coastguard chartered tug became a total loss after an engine room fire in September 2009.

Nowadays the Multraship Towage and Salvage operated 'Guardian' of 10,876 BHP / 134 tons BP) is chartered by the Dutch Coastguard.

The ocean-going tug 'Oceanic' has served in Germany as Emergency Towing Vessel (ETV) until January 2011 when she was replaced by the purpose built ETV 'Nordic' (23,385 BHP / 210 tons BP).

← A new dimension to the towage market was created between 2016 and 2018 with four newly built DP II anchor handling salvage tugs of the Dutch towage company ALP Maritime Services. These tugs have a bollard pull of approx. 305 ton and are equipped with four MaK diesel engines with a total output of 24,472 BHP.

The company owns six anchor handling salvage tugs more, ranging in bollard from 192 to 298-ton bollard pull; all tugs were taken over from the German company Harms Offshore.

Photo Courtesy of ALP Maritime Services

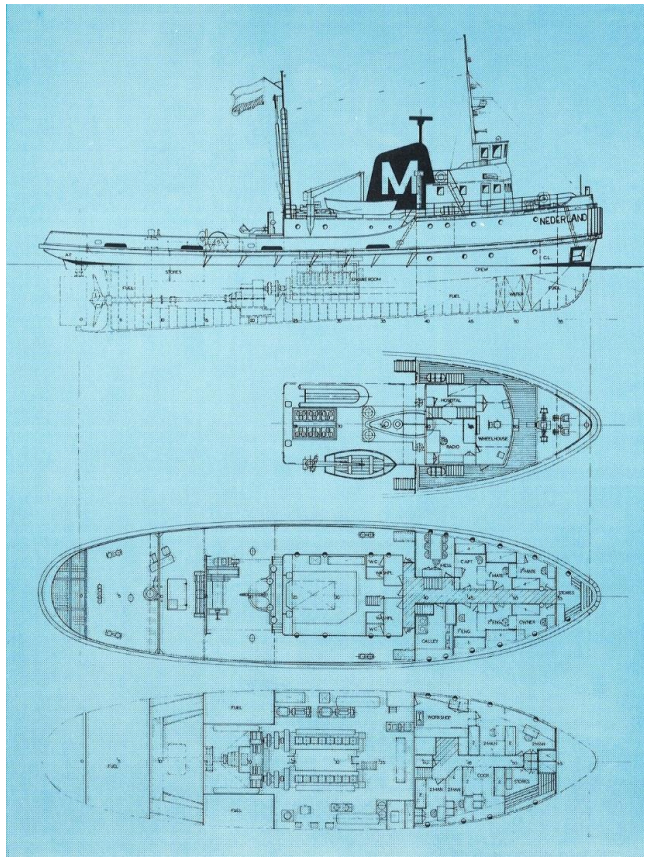
SHORT-SEA TOWAGES

Because the larger towage companies were more focused on the heavy towage transport, space was created for other towage companies to carry out operations which needed less power and bollard pull.

Formerly these towages were performed by tugs of around 1,200 to 1,500 HP and with a bollard pull of around 20-tons.

However, tugs of that size can hardly be found anymore for coastal towages. Nowadays newly built tugs with an engine output of 4,000 to 7,000 HP are now used for this purpose, like:

- The Damen ASD Tug 2810 'Waterstroom' and 'Waterstraat' (both 5,068 BHP / 60-ton BP) of Wagenborg Towage;
- The Robert Allen RAstar 3200.W tugs 'Brent' and 'Ginger' (both 7,200 BHP / 83-ton BP) of Iskes Towage and Salvage;
- The Damen Shoalbuster 3512 tugs 'Lingestrooom' and 'Noordstroom' (both 3,957 BHP / 55-ton BP) of Van Wijngaarden Marine Services;
- The Damen Stantug 3009 'MTS Vanquish' (5,072 BHP / 70-ton BP);
- The Damen Shoalbuster 3209 'MTS Vanguard' (3,548 BHP / 48-ton BP) of Marine & Towage Services (MTS).



A typical short sea tug from earlier days: the 20-ton bollard pull tug 'Nederland' of Willem Muller Zeesleepdienst

Source: Leaflet Willem Muller Zeesleepdienst

Other towage companies engaged in service to the oil and gas sector offshore and the offshore wind energy sector, rig moves and coastal and short sea towage operations:

- Bugsier-, Reederei- und Bergungs-Gesellschaft GmbH
- Fairplay Towage, incorporating Multraship Towage and Salvage
- Kotug International
- Unterweser Reederei GmbH, part of the Spanish Boluda Corporación Maritima
- Tug & Workboat company Herman Senior B.V.
- Muller Dordrecht

HARBOUR TOWAGE

Due to the upscaling of shipping, in dimensions, engine output as well as the arrival of all kinds of vessels for oil and gas extraction offshore, the requirements for the assisting harbour tugs rapidly increased in terms of power (bollard pull) and manoeuvrability.

In the Port of Rotterdam, tugs with an output of 600 HP were sufficient in the Sixties; in the last decade of the 20th Century, an output of 2,500 HP was required.

Nowadays, tugs with an engine output up to 7,370 BHP and 94-ton bollard pull are operational in Rotterdam Europoort and Rotterdam Maasvlakte.

This power and bollard pull would not be out-of-place in a seagoing tug. These tugs are classified as 'Escort Tug' and specially designed for assistance to the increasing number of LNG tankers.

Not only the engine power and the bollard pull of the tugs changed, but also the shape of the hull changed. In the Sixties and Seventies, the Length / Breadth ratio of the harbour tugs was about 3.4: 1. Nowadays this value is about 2.5: 1.

The higher bollard pull requires greater stability to prevent the tug from capsizing during a manoeuvre. The tug is therefore proportionately wider than a tug with the same length and less engine power.

In addition, the way of towing has been changed through the years. In the past, there was always towing from the aft deck.

Nowadays tugs have, in addition to a towing winch on the aft deck, also an equally strong towing winch on the fore deck. This makes manoeuvring easier, gives a better overview and more direct response.

The ship, that has to be moored at a quay, is then pushed to the quay by means of rubber fenders on the bow or stern of the tug.

The great manoeuvrability of these tugs makes it easier to handle them. The tugs can now turn around their axis. This is mainly due to the drive of the tug.

In the past, there was only one fixed pitch propeller, nowadays there are many drive options.

The 1,250 BHP Voith-Schneider tug 'Aziebank' – one of the first tugs of this type in The Netherlands

Through the years, other types of propulsion have also been developed. Beside Voith Schneider tugs up to 45-ton bollard pull, the following tug propulsion systems can be found in the Rotterdam area:

- Azimuth Stern Drive (up to 94-ton BP), like 'Smit Panther', 'Smit Tiger' and 'Smit Cheetah' (Damen ASD 3213)
- Reversed Stern Drive (up to 75-ton BP), like 'Innovation' (Damen RSD 2513)
- Z-peller (up to 70-ton BP) like 'Beagle' (Damen Azimuth Tractor Drive Tug 2412 Twin Fin)
- Fixed pitch Tractor Z-Peller (up to 45-ton BP) like 'Texelbank' and 'Thamesbank'

↗The Damen ASD Tug 3213 'Smit Cheetah' showing her manoeuvrability; one of the three 7,370 BHP / 94-ton bollard pull tugs in Rotterdam Europoort

Photo courtesy of Damen and made by Mr Huib Lievense

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← In December 1958, N.V. Reederij v/h Gebr. Goedkoop of Amsterdam took delivery of the first Voith-Schneider tug in The Netherlands. The 600 BHP tug 'Jan Goedkoop Jr.' was built by the Arnhemsche Scheepsbouw Maatschappij N.V. In 1961, the Nederlandsche Stoomsleepdienst v/h van Piet Smit Jr. had the tugs 'Europa' and 'Azië' built at the Scheepswerven v/h H.H. Bodewes,.

Both tugs were later part of the Nieuwe Rotterdamse Sleepdienst (NRS). This towing company had a large number of Voith-Schneider tugs built in the following years, which would dominate the Europoort tugs for a long time.

The Damen Reversed Stern Drive (RSD) Tug 2513 sailing in rough weather. She is powered with 4,480 kW, suitable for a bollard pull ahead of 75 tons and astern of 70 tonnes

Photo courtesy of Damen

The 'Texelbank' and the 'Thamesbank' are both French-built fixed pitch Tractor Z-Peller with an engine output of 3,256 BHP and a bollard pull of 45 tons

Photo © Hans Tompot

The 84-ton hybrid Rotortug Hybrid 'RT Adriaan' during her assistance to a container feeder

Photo © Hans Tompot

HYBRID DRIVE

In addition, hybrid drive versions of the Rotortug ('RT Adriaan' – 84 tons BP) and Azimuth Stern Drive tug ('Hampshire' and 'Experience' – both 60 tons BP) are introduced to reduce polluting emissions from the tug's engines. Hybrid drive is a combination of electric and conventional diesel propulsion.

Reducing polluting emissions from diesel engines will become more and more important. To achieve this goal, LNG fuelled tugboats have already been put into service in Norway.

In 2017, the company Østensjø Rederi took delivery of three Dual Fuel ASD Escort Tugs for operations at the Statoil's LNG production terminal at Melkøya, Hammerfest in northern Norway.

The 'Audax', 'Dux' and 'Pax' are each powered by two Wärtsilä main engines with a total output of 8,150 BHP, suitable for 107.5 tons bollard pull.

ADVANCES IN TECHNOLOGY IN THE SEA TOWAGE

Apart from changes to the tugs themselves, other adjustments have also been made to towage.

In the past, there were usually wireless operators on board of the tugs, especially if they had station service. Nowadays they are no longer needed. Their tasks have been taken over by modern communication technology, like mobile phones, the internet and satellite communications.

In the past, a tug's wireless operator could intercept messages from a vessel in distress while

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The 'Dux', one of the three 8,150 BHP Dual Fuel ASD Escort Tugs escort tugs of Østensjø Rederi for operations at Statoil's LNG production terminal. Bollard pull 107.5 ton

Photo Courtesy of Spanish Yard Astilleros Gondán S.A

communicating to the ship-owner and asking for assistance. In those days the wireless operator could then offer assistance to the vessel in distress without interference of the ship-owner.

SAFETY ON BOARD IS AN IMPORTANT TOPIC

The number of crewmembers on both ocean-going tugs and short-sea and harbour tugs has been substantial reduced. The admission requirements to sail on the ships in any function have been considerably tightened over the years. Nowadays diplomas and certificates for ship's crew members are necessary. The decrease in the number of crew members have been made possible due to the improved technology. This applies to both engine room and deck staff.

In the past, there were 32 crewmembers on board of an ocean-going tug, while that is now 14 or even less. Especially with techniques like satellite navigation, GPS and autopilot systems to hold the ship automatically on the desired course have greatly influenced the number of crew on board.

Due to the reduction of personnel, the tasks on board were also more divided, so that individual crew members must work in more disciplines. On smaller ships, the function of mate or engineer has almost ceased to exist; it has now more likely to be a multidisciplinary function.

Due to the high degree of reliability of the ship's engines and their operation directly from the bridge, extensive engine room utilization is no longer necessary.

Tugs sailing under a Dutch flag with a full Dutch crew are now no longer self-evident. More and more foreign seafarers are sailing on Dutch ships, but usually the officers are Dutch.

As mentioned earlier, also the techniques of towing have changed. The towing equipment has been adjusted over the years. In the early years, manila hawsers were used, later steel wires, which were thinner, stronger and easier to handle.

These towing wires could be stored on drums, so towing with the aid of a winch became possible. The towing bit, a steel construction on the aft deck, which was used to fasten the towing wire, became superfluous.

After some time, almost at the end of the Fifties, the nylon hawser replaced the manila hawser. The nylon hawser was lighter, more elastic and stronger. After the nylon stretcher, the material Supermix came, blend of continuous filament polyester and staple Polyolefin.

In recent years, a high modulus polyethylene SK62 or SK75 towing rope (Dyneema) was used for towing; Dyneema is lighter and stronger than the steel towing rope.

By using the bollard pull meter, which can be read on the bridge, it is possible to determine exactly how much towing force will be placed on the towing wire, so that breakage of the wire can be prevented by using too great a force.

Pusher tug 'Veerhaven III – Waterbuffel' - 5,550 BHP – built in 2012, operated by Thyssen Krupp Veerhaven of Brielle

Photo © Hans Tompot

German pusher tug 'Herkules XII'- 3,672 BHP – built in 1969 – operated by the Imperial Shipping Group of Duisburg Ruhrort

Photo © Hans Tompot

RHINE AND INLAND TOWAGE

The first tugs on the inland waterways in The Netherlands and Germany were mainly paddle wheel tugs. Paddle wheels on the sides of the tug were driven by a steam engine.

As early as around 1825, pioneers saw the great advantages of steam power and several shipping companies were set up to tow steam ships. In 1845, the first steel paddle wheel tug was built, named 'Ruhr' with an engine of 500 HP, which could tow four wooden barges, each with a capacity of 150-tons.

After the Mannheim Act, which guaranteed freedom of navigation on the Rhine, transport along the Rhine was given a good start.

In 1870, the first steam-powered propeller tugs were put into service, although on a modest scale.

After the World War I, the diesel engine developed more and especially the German shipping companies switched to engine-driven tugs with propeller propulsion. In 1929, the last paddle wheel tug with steam drive was built.

There has been only one paddle wheel tug on the Rhine with motor propulsion; she was converted from a steam paddle wheel tug.

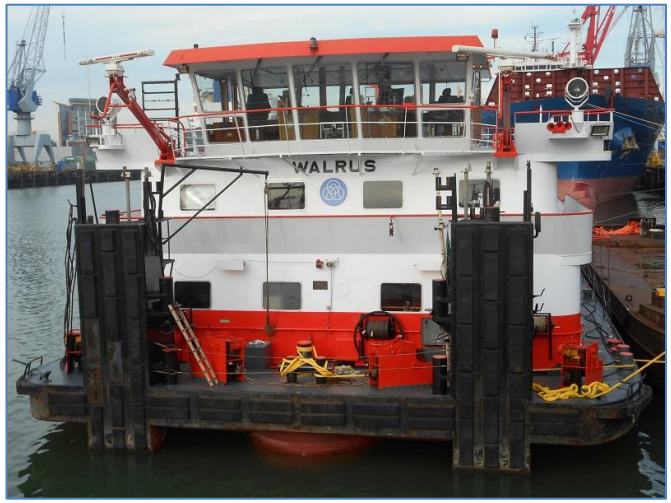
At the end of the Fifties, Rhine and inland shipping evaluated from towage to push-pull. The first pusher tugs entered service on the Rhine. Since the Seventies, the typical Rhine tugs disappeared.

One of the most modern and leading pusher shipping companies in the dry bulk sector is ThyssenKrupp Veerhaven, belonging to the ThyssenKrupp Concern.

This company is engaged in the transport of ore and coal between Rotterdam, Amsterdam and Antwerp with destination the steel mills of ThyssenKrupp Steel Europe in Duisburg, Germany.

Daily the company transports approx. 60,000 to 80,000 tons of ore and coals to Duisburg by means of 7 pusher tugs and approx. 100 push barges.

On an annual basis, this equals to approx. 25 million tons.



↗ Pusher tug 'Veerhaven VII - Walrus'

5,400 BHP – built in 1990

Photo © Hans Tompot

→ Pusher tug 'Veerhaven VIII - Nijlpaard'

5,550 BHP – built in 1997

Photo © Hans Tompot

March 2019

CONCLUSION

From steam tug to hybrid tug or LNG-fuelled tug, a development of tugs for one century.

From a tug with one fixed pitch propeller to a dynamic positioned tug with two controllable pitch propellers, two bow thrusters and two stern thrusters; from position determination with a sextant to an Electronic Chart Display Information System.

Just a number of facts that make it clear which technical developments the tug design has gone through - developments in the field of propulsion, diesel engines, automation, towing equipment, manoeuvrability, but also new requirements to serve other industries, such as the offshore industry.

The anchor handling tug/supply vessel was the result. In the meantime, this type of vessel has grown to a multi-purpose vessel with facilities like subsea crane, helideck, moonpool and ROV system.

In the future, the technology will continue to develop according to the needs of the industry.

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BUSINESS OPPORTUNITIES IN THE CZECH REPUBLIC

The Czech Republic ranks among countries with a strong economy and good potential. According to recent data, industrial production in the Czech Republic has increased by 5.7% year-on-year, and the value of new orders has increased by 6.6% year-on--year. The employment rate has increased by 2% and the unemployment rate is currently around 2.5%

The economic situation of the Czech Republic is very good and gives opportunity to invest in both state and public sectors. State-run organizations are creditworthy and cooperation with them is sought-after.

In the area of public investment, there has been an obvious and long-term effort to open up the market as much as possible and to allow participation of entities with a registered office or place of business outside the Czech Republic. The basis of this trend is given both at the level of the European Union and at the level of national legislation where it is stipulated mainly by Act No. 134/2016 Sb., on Public Procurement.

Due to the simplification of participation in the tender procedure (introduction of a uniform European Certificate, the contracting authority's obligation to accept documents issued under foreign law), there is no restriction on participation in tenders in the Czech Republic provided the participant fulfils the conditions of the tender. The market is open to companies from the whole world.

The participant shall be well acquainted with the legislation to be able to submit a perfect offer in compliance with any procedure given by the contracting authority – especially in the case of above-the-threshold public tenders which might be of interest due to their financial volume (supplies and services with an estimated value of more than 443,000 EUR or equivalent; construction works with an estimated value of more than 5.548,000 EUR or equivalent).
Due to the fact that the procedure in above-the--threshold public tenders is relatively rigid, and even the minor non-compliance with the conditions by the participant may lead to their disqualification, it is necessary to be familiar with this area or to contact a reliable partner.

To conclude, the Czech market offers many possibilities and is open to foreign investors. Czech legislation does not impose any significant restrictions on participation in public tenders, however, it is worthwhile to cooperate with a company which is familiar with the local market, legislation and local customs, and is able to find suitable opportunities.

In the case you are interested in the public tender market in the Czech Republic and intend to apply for public contracts, if you search for answers to your questions or for regular monitoring of relevant opportunities – our company KGS legal s.r.o. as a leading law firm with a focus on public procurement law is always at disposal for you.

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