The 'ART' of Tug Design

ROBERT G. ALLAN P.ENG.

Although it is a company with more than a century of corporate history, when Kotug introduced the 'Rotor Tug' concept they were really put onto centre stage in the world towage industry. The RotorTug is the patented concept of Ton Kooren, now the retired chairman of the organization, and it was introduced to the industry at the International Tug & Salvage Conference in 2000. The patent for the idea covers the use of three omni-directional drive units of any type in a tug, in any triangular configuration. Essentially a Rotor Tug is a true 'Tractor Tug' with 2 Z-drives forward rather than Voith propellers, and with the addition of a third drive unit aft (see Fig 1). Conceived and initially used for working in the confined ports of Western Europe, especially in restricted canals and lock systems, a primary advantage of the triple drive concept is that it can work very effectively in the sideways direction where space for conventional tug operations is constrained. This can involve simply pushing athwartships with the tug, beam on to the ship's side, but the real merits are in the operating configuration dubbed 'rotoring' in which the tug works at the ends of the ship and effectively within the beam limits of the ship. In the rotoring attitude shown in Figure 2, it can readily be seen that the wash of the tug does not impact on the ship at all and therefore is far more efficient at controlling the ship.

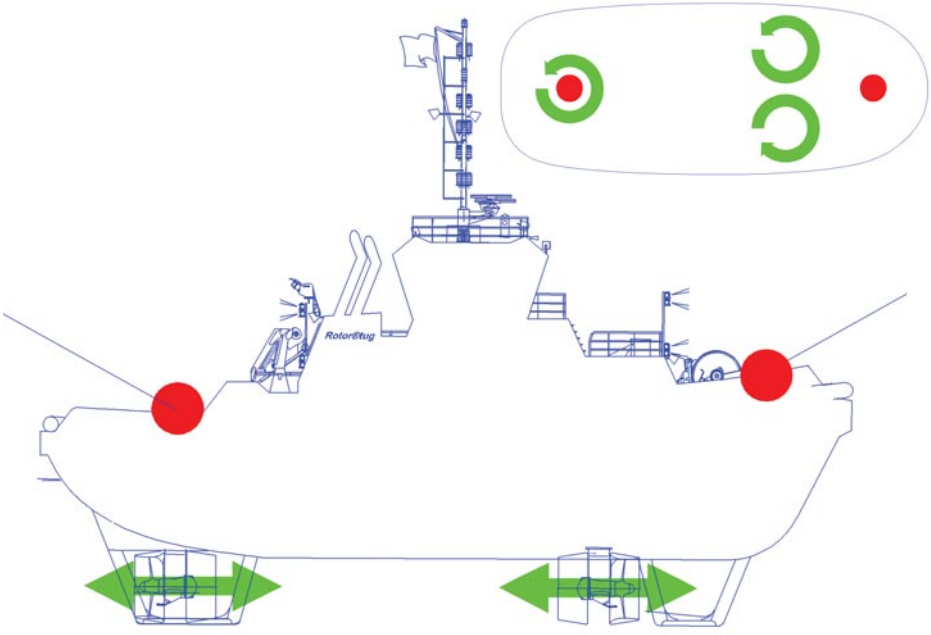

Fig 1: Typical Rotor Tug Configuration

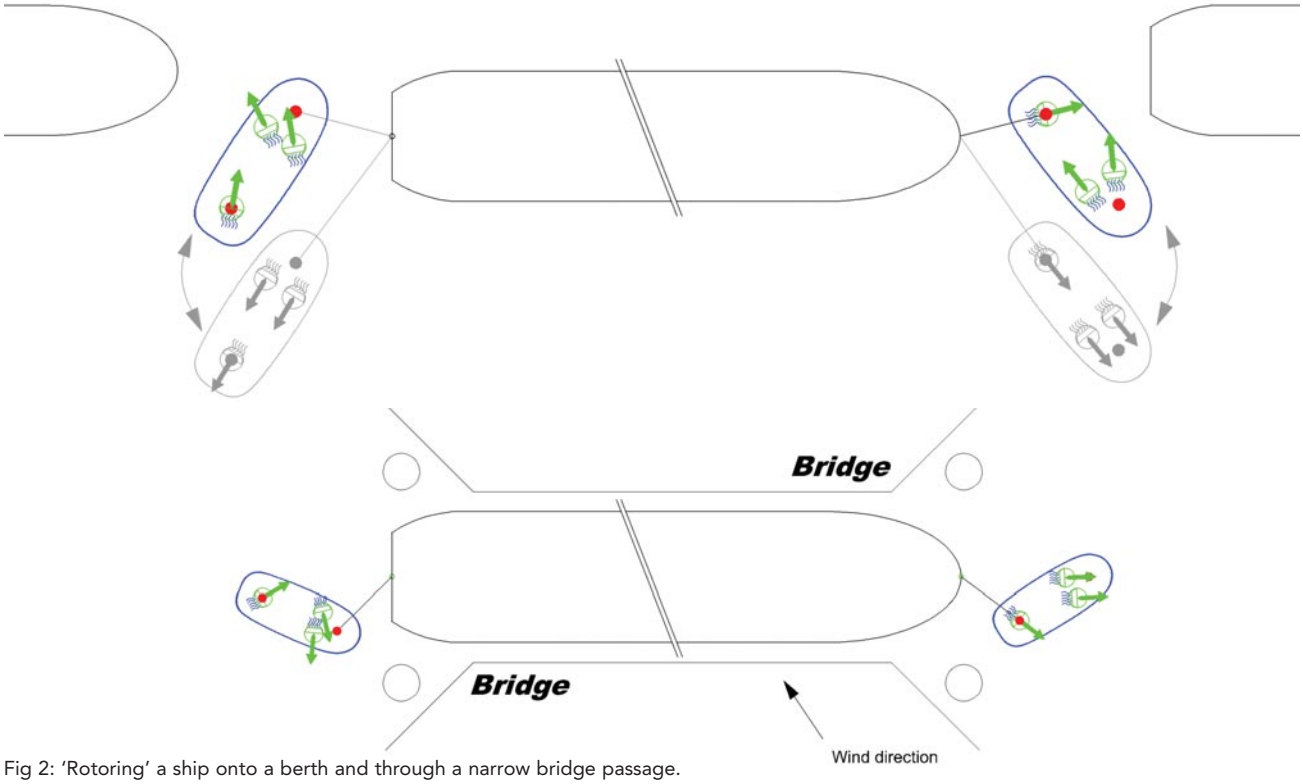

Fig 2: 'Rotoring' a ship onto a berth and through a narrow bridge passage.

Fig 3: ART 100-37 Class escort Rotor tug

After working together on several major design projects, Robert Allan Ltd and KST BV, (now Rotortug BV, as opposed to the 'Kotug' towing business) concluded an agreement in 2012 which made Robert Allan Ltd the exclusive designer of all Rotor Tugs worldwide. This enables the company to offer any of the major tug propulsion configurations currently in use to all its clients. In addition it brings to the Rotor Tug portfolio the expertise which Robert Allan Ltd has gained designing hundreds of major high-performance VSP and Z-drive escort and harbour/terminal tugs. In particular the blending of the *RAstar* style hull form with the triple drive Rotor Tug shows great promise in exciting new escort and terminal tug concepts. This combination has been branded as the Advanced Rotor Tug (ART) and has been applied to a family of new designs now emerging on the world tug stage under this recent cooperative/licensing agreement.

The first tug using the *ART* designation was a concept developed in 2005, prior to the design agreement. The objective was a large and capable escort/terminal tug for major ports anticipating handling the new generation of ultra-large container ships. The *ART 100-37* (Figure 3; 100 tonnes BP / 37 metres loa) was extensively model-tested and its superior escort performance surprised all involved in the design and testing.

The next major design project was for a series of 85 tonne BP, 35 metre tugs *(ART 85-35)* to escort large bulk carriers through a long, narrow channel at the iron ore port of Port Hedland in Western Australia. That design was also extensively model-tested to verify that the demanding operational performance requirements could be met. As part of the process the relative merits of Rotor Tugs with two drives forward (tractor style) and with two drives aft (ASD style) were examined extensively. The results were most interesting and indicated that there was a place for both types, depending on the application, but ultimately the tractor style was selected for this particular project.

With the signing of the exclusive design agreement with Robert Allan Ltd, work began in earnest on several new Rotor Tug concepts. The major changes initiated related to refining the hull form, particularly incorporating the shapes used in RAL's high performance *AVT* series of VSP and *RAstar* series of ASD escort tugs into the Rotor Tug family of designs. The original Rotor Tugs were based on the hull shape of the Faust Tractor Tugs built in the US Gulf (probably in the early '90s) and ultimately purchased by Kotug for service in European ports. These were very simple but quite effective single chine shapes. The unique sponsoned hull shapes developed by Robert Allan Ltd have been proven through extensive model and full-scale testing to provide much enhanced stability, seakeeping, and escort performance far superior to any standard 'wall-sided' alternative. On-going research is still being conducted however concerning the optimum hull form for the Rotor Tug, particularly examining the relative merits of single vs. double chine forms.

An interesting aside to the Rotor Rug story was the adoption in 2005 by Foss Maritime of the triple drive system, where they added a Z-drive aft to their older VSP tugs in order to boost power and performance. This 'Tractor-Plus' configuration, covered by the Rotor Tug patent, has proven very effective in enhancing the capability and thus extending the life of older lower-powered tugs. To date Foss has reconfigured three of their tugs in this fashion.

In March 2013 orders were placed for the first four of the new *ART 80-32* Rotor Tug design, the first project completed under the exclusive agreement. Damen Shipyards Group of the Netherlands are constructing two 'hybrid' versions and Cheoy Lee Shipyards of Hong Kong are building two with 'all-diesel' propulsion systems, all equipped to a Fi-Fi 1 standard.

The *ART 80-32* class has a propulsion system delivering 3 x 1765 kW, achieving a bollard pull of 80 tonnes. The *ART 80-32* 'hybrid' version will be equipped with the Aspin Kemp & Associates' (AKA) XeroPoint Hybrid Propulsion System, nicely rounding out the Canadian input to this unique new design. The AKA power management system integrates electrical and mechanical energy to provide optimal operational modes, resulting in significant environmental and economic savings. Other designs currently under development include the *ART 70-30* and *ART 60-28* nicely rounding out the portfolio offer-

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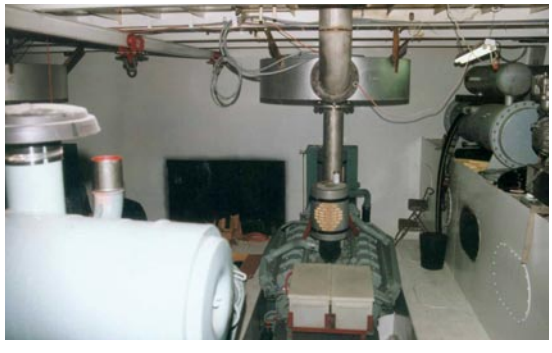

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Figure 4: ART 80-32 Class Escort Rotor Tug

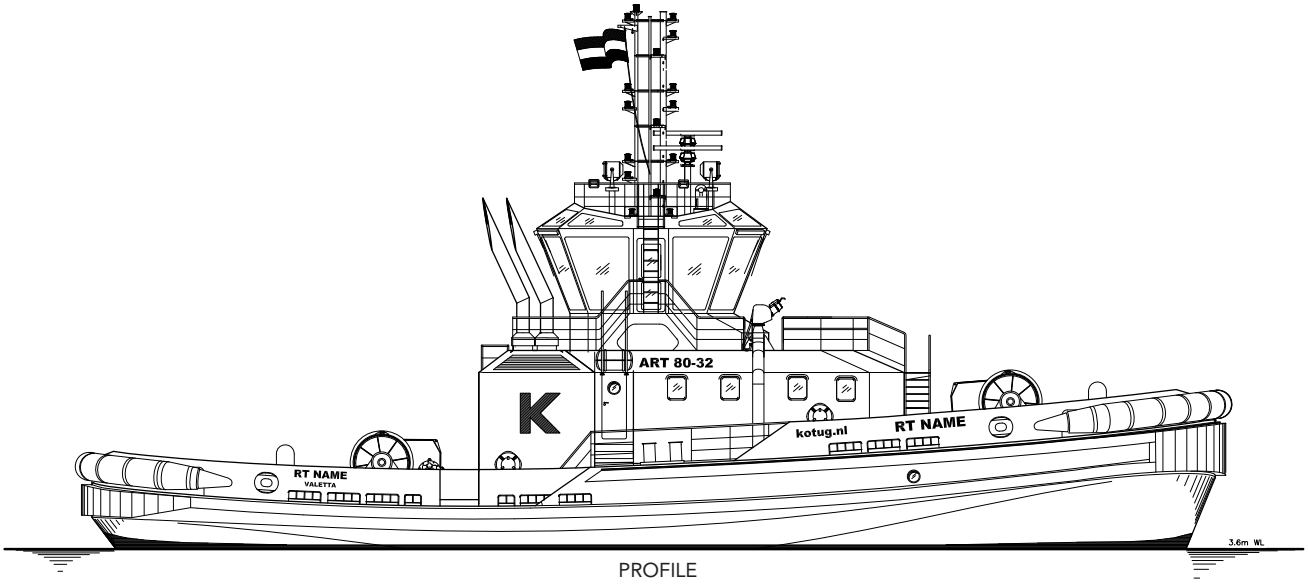
ings in terms of size and power. The particulars of all three of these designs are as shown in the table below. The General Arrangement for the *ART 80-32* is shown in Figure 5.

Current *ART* Series Tugs

	units	*ART 60-28*	*ART 70-30*	*ART 80-32*	*ART 85-35*
Length OA	*metres*	28.00	30.00	31.95	34.95
Beam	*metres*	12.40	12.60	12.60	14.50
Depth	*metres*	4.80	4.80	4.82	5.40
Load Draft	*metres*	5.90	6.18	6.30	6.87
GT (app.)		430	460	491	650
BP ahead	*Tonnes*	60	70	80	85
BP astern	*Tonnes*	60	70	80	85
Speed (min)	*knots*	12.0	12.5	13.0	14

While these are being developed as essentially standard design options, work is also being done on custom designs to meet the requirements of very specific projects, which include several major offshore and escort towing projects with very large and powerful options — tugs in the 40-50 metre size range and with up to 125 tonnes BP.

The potential use of the *ART* class of tugs as tanker escort tugs deserves special mention. The model testing and analysis done to date on the 37-metre and 35-metre designs indicates that the escort performance capability of a Rotor Tug is definitely superior to that typically associated with the current standard of VSP or ASD escort tugs. This could have significant



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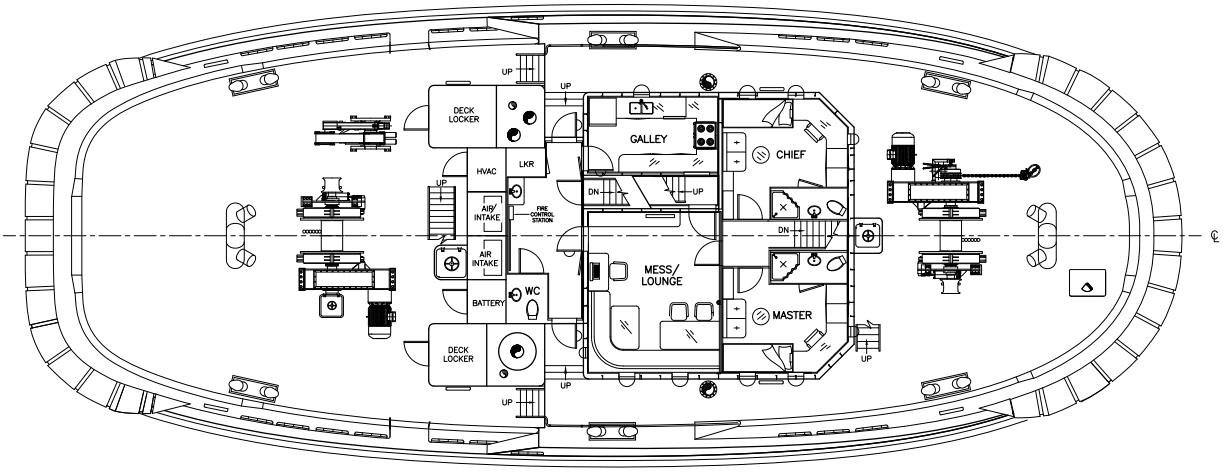


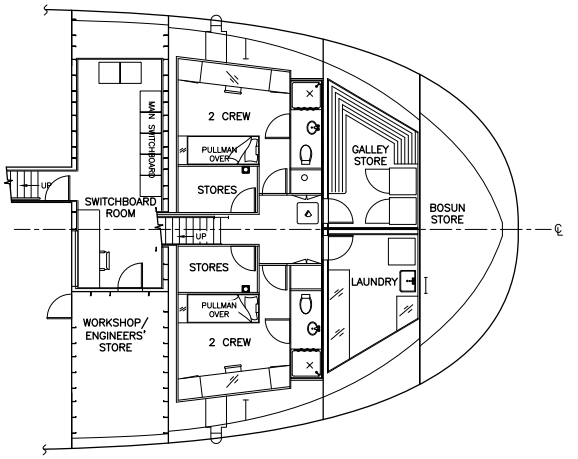
MAIN DECK

import for coastal BC if and when the various energy transportation projects currently under consideration move forward with plans for active spill prevention through advanced tanker escort tugs and escort towing operations. The use of such high-performance escort tugs provides the all-important 'prevention' part of the equation which no amount of spill response capability can hope to accomplish.

Robert Allan Ltd are also just commencing the very 'fun' design of a unique 15 metre Training Advanced Rotor Tug *(a TART??)* which will be outfitted to a high standard to also serve as a corporate demonstration/hospitality vessel for Kotug at their waterfront offices in Rotterdam.

In summary the *ART* series of Rotor Tugs are an exciting new development in the ever-changing face of progressive tug design worldwide. While no specific type of tug is ever the panacea for tug operations everywhere, these new *ART* class tugs will certainly raise some eyebrows when their performance and capabilities are compared to more conventional tug designs. ◀

Robert G. Allan P.Eng. is the Executive Chairman of Robert Allan Ltd.



LOWER ACCOMODATIONS

Fig 5: ART 80-32 GA (212-035)