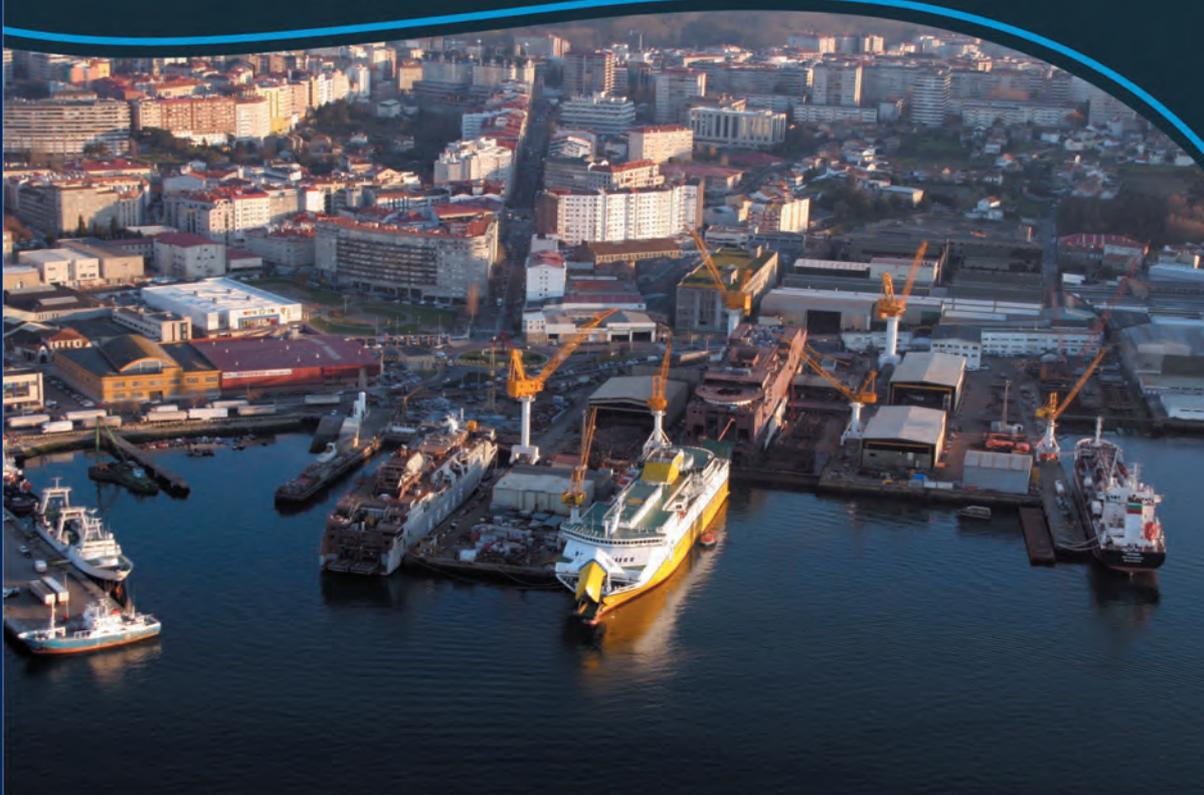


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Gdynia Shipyard has continued its successful refinement of hulls with the completion of the first examples of a new series of feeder car/truck carriers for Ray Shipping. The smooth wake seen here is the result of an elongated ducktail transom with a fin above the rudder blade, and the rudder itself includes a Costa bulb and so-called scissor plates. A special article on *Thames Highway* begins on page 6.

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Superyachts: an attractive niche sector

SCANTILY-clad girls reclining on teak-planked forecastles is the popular image of the luxury motor yacht. Yet behind the scenes a huge amount of technical work is needed to ensure that such girls can grace those polished decks in a refined manner - especially today, with an abundance of technical and operational regulation, also safety considerations, that require compliance. Luxury yachts, both sail and mechanically-powered, have been around for many years; however, in 2006 there will be a minor boom in the design and construction of such delights, perhaps as a result of much 'new money' being available worldwide for disposal.

Many projects are often surrounded in secrecy, being ordered by wealthy people not always willing to reveal their identities or the hedonistic internal content of their new status symbols. Today, a significant number are additionally - and most importantly today for this journal - growing in size up to 100m lengths and even beyond.

Not only that, they are beginning to feature the most advanced technology available to the naval architect,

professional project director working inside a formal project management system. Several other speakers at this conference will also address aspects of the superyacht sector.

A new yacht boom has also called for new rules, and class societies have already risen to the challenge. We reported last year on new rules launched by Registro Italiano Navale for charter yachts above 24m long but carrying less than 12 passengers. These cover class and survey, hull, materials, welding, and other aspects; a voluntary anti-pollution notation for yachts, Green Star, follows that for cruise liners. New rules from French society Bureau Veritas also address superyachts of all kinds ranging up to 100m length and cover structural strength, propulsion, piping, electrical and automation systems, and fire safety.

A pertinent consideration at the present time for such expensive craft - and their possibly also expensive complement - is security, with designers taking special care to ensure that no handholds are available on hulls. How does the bathing party take to the water? A dedicated tender dock, which can be closed off completely, is inbuilt. Of course, traditional naval architect features of stability and fire protection will still need to remain at the top of the list.

A radical hull feature that might one day soon make its first appearance in the superyacht sector is the ram bow - last seen in early 20th century dreadnought battleships. Free-spirit naval architects such as Laurent Giles believe that the commercial market is not quite ready for such an advance, although the first ship to feature Ulstein's near-ram X-bow, an anchor-handling/tug/supply ship, is already under construction.

In McFarlane Ship Design's portfolio, conventional merchant-ship bulbous bows make an appearance, as explained in our September 2005 edition (page 8), for the Force 1 Project. It is explained that this feature serves several purposes, including shifting the centre of buoyancy forward, reducing pitching in short waves (as in the Mediterranean), and allowing the collision bulkhead to be placed further forward.

While many designers are ploughing a traditional propulsion furrow, using high-speed diesel engines driving twin propellers through reduction gearboxes, bolder ones are proposing a diesel-electric plant and azimuthing pods - ABB's Compact Azipods, for example, and competing designs would fit perfectly in these smaller-size ships. Others still are proposing to use sails, with auxiliary diesel propulsion in association with fully-feathering propellers (Rolls-Royce Kamewa) for use when the sails are set, as on the 87m long three-masted superyacht *Maltese Falcon*. This vessel is under construction in Turkey.

Meanwhile, several large shipbuilders, perhaps more well-known to readers of this journal for other marine skills, have already, or are beginning to, stake a claim in this niche. These include the large and internationally renowned Italian builder of cruise liners and ferries, Fincantieri, which has teamed up with Benetti to develop its skills. It would appear that this interesting sector has many promising prospects lying ahead. 

Modern free-spirit thinking in superyacht design is alive and well. This glass-encased lift, which acts as a crow's nest and viewing point for amateur astronomers, is a feature of a new 70m-long superyacht (Project Prospect) being planned by Laurent Giles Naval Architects for Fincantieri Yachting.



such as gas turbines and electrical pods, as part of their grandiose and often graceful creations, where imagination can be allowed to take some wings. The superyacht sector is additionally starting to attract many leading mainstream equipment manufacturers in several countries; they see such vessels as a useful high-value niche market.

At the same time, Barry Gilmour, from UK consultancy Burness Corlett-Three Quays, will argue in a paper to be presented later this month at La Spezia to The Royal Institution of Naval Architects' International Symposium on Marine Design*, that there is a clear parallel need for designers and others to keep their feet firmly on the ground. This especially means, for a superyacht construction project, the appointment of a

* International Symposium on Marine Design, to be held at La Spezia, Italy on April 12-13, 2006, in conjunction with the University of Genoa, Coventry University, and Massey University.

New proposal for European fast freight by trimaran

A NEW milestone in the struggle to shift European freight off the roads and onto the sea could be reached soon, with the announcement of a plan by a French company, named **BGV International**, to market a large stabilised monohull ro-ro ferry to carry cargo from France to Norway (Boulogne to Drammen), with other routes planned to serve Santander and Sheerness. An operator named as **NorFerries** is reported to be involved. BGV is a French acronym for *bateau de grande vitesse*, ie, a fast ferry.

BGV has created passenger and military versions of its trimaran but the wave-piercing cargo format proposed for this new service is expected to sail at 35knots fully loaded and to be able to operate in all weathers. Such a speed is claimed to be competitive with a door-to-door road service. Hull lengths proposed are believed to up to 230m.

The port of Boulogne is especially interested in this new project since it could give a much-needed boost to its ferry fortunes. Today, only one operator, SpeedFerries, sails there, from Dover, using a fast catamaran passenger/vehicle ferry.

GOOD TIMES FOR ROLLS-ROYCE - The year 2005 was a good one for the Rolls-Royce group, with a rise in sales to £1097 million, and profit boosted to £89 million from a 2004 figure of £67 million. Such figures do, of course, partly reflect the current healthy state of commercial shipbuilding and high oil prices - the order book for designs and equipment was up 23%, reported president of the marine division Saul Lanyado. During the year, an order was secured for the 500th UT offshore supply/support series.

Rolls-Royce continues to be a strong player in the naval field with its gas turbines - the MT30 aero-derivative model is currently undergoing trials as part of the US Navy's DD(X) destroyer demonstration programme, and orders are anticipated for Lockheed Martin's littoral combat ship (LCS). The only disappointment in the gas turbine field has been a failure so far to gain a foothold in the cruise liner field - or perhaps more importantly, in the new generation of LNG carriers powered by alternatives to the traditional steam turbine. This is partly because operators want to retain as much cargo gas as possible to sell in the present fuel climate, and the high price of fuel generally.

Today, the merchant ship equipment headquarters is in China, where a new factory was inaugurated at Shanghai last year, to complement an existing one in Korea. New technology recently launched has included a rim-drive tunnel thruster and an integrated propeller, twisted rudder, and rudder bulb, while the mechanical Azipull Z-drive continues to advance into ever-larger merchant ships. The first marine LNG-fuelled Bergen K-G4 engines - built in a factory that has seen a positive turnaround in its fortunes (partly with the help of



An impression of the new cruise liner ordered by MSC Cruises from Alstom Marine (Chantiers de l'Atlantique). She will be similar to the earlier *MSC Musica* and *MSC Orchestra* in being a Panamax design with 1275 cabins.

some engines developed in associated with Hyundai) - are anticipated to enter service this year with Fjord 1's new double-ended ferries. Dr Lanyado hopes to increase the R&D budget generally from 2% to 4%.

EXTRA NEW SHIP FOR MSC - French shipbuilder Alstom Marine is to build yet another new Panamax liner for MSC Cruises. This will be smaller than the two giants ordered earlier this year, being in the same class as *MSC Musica* and *MSC Orchestra*, and thus having 1275 cabins. Delivery is planned for 2008, and the contract includes an option for a second vessel.

EVERGREEN URGES 'GREEN' POLICIES - The vice-chairman of the giant Taiwan-based Evergreen group, Mr Chang Kuo-Cheng, speaking in Los Angeles at the annual Transpacific Maritime Conference, urged the international transportation industry to develop new ways to protect the environment. Some of the features he recommended are: double-skin hulls, transverse fuel tanks, high-capacity oily-water separators, low-NOx engines able to switch to low-sulphur fuel, and cold-ironing (shutdown of auxiliary engines in port). Mr Chang's own company already has a high profile in this matter, as witnessed by the design of the new *Hatsu Shine* series (S-class) of container liners (presented in *The Naval Architect* January 2006, page 7), where all these features are included.

BOW EQUIPMENT FOR ARCTIC TANKERS - The three 70,000dwt Arctic shuttle tankers ordered by Russian owner Sovcomflot from Samsung in Korea and discussed in our February 2006 issue (page 36) are to be fitted with a new type of bow loading system needed for offshore loading, designed by Aker Kvaerner Pusnes. Similar equipment was delivered last year to Hyundai Heavy Industries for five ExxonMobil shuttle tankers to work in the Sakhalin field.

With this new arrangement, the 508mm hose connection point is located well within the deck area, compared with the traditional external

position protruding from the bow. A dedicated mooring system will be included in the Sovcomflot package.

US OFFICE FOR FASTSTREAM - The Southampton-based niche recruitment bureau Faststream has opened an office in the USA. One of the company's special sectors is shipping, marine, and offshore, and the new Fort Lauderdale (Miami) office aims to continue to offer a similar service, focussing on marine and shipping positions. For a number of years, Faststream has already been recruiting on behalf of US companies.

SECOND LARGE LNG SHIP FOR BLUESKY - The Asia-based LNG owner Bluesky has ordered a second large LNG carrier from DSME (Daewoo) in Korea, where the company's first ship is nearing completion. The latter is one of the few ice-classed and fully winterised ships of this type to be contracted.

The second ship will be much larger than the first, at 166,000m³, but will also feature the GTT NO96 membrane containment system. Bluesky says that it will continue to work with DSME to create further LNG carriers to enhance its so-called 'taxi concept' strategy, whereby, instead of being tied to anyone operator or producer, the company will work 'across the board' to offer the most cost-effective shipping services to a wide range of clients.

ICEPRONAV ASSISTANCE TO ALSTOM - Assistance with the design of Alstom Marine's newest mega cruise liners for MSC (*The Naval Architect* February 2006, page 57) is to be provided by the active Romanian consultancy Icepronav, which will create a major portion of the ship's hull basic and detail design. The consultancy's Tribon M3 software will be employed. Icepronav has worked with Alstom previously, on MSC's smaller *MSC Musica*. Another recent contract has been to provide the detailed design of the forward hull and the hatch covers of the Arctic special container ship *Norilskiy Nickel*, about to be delivered by Aker Finnyards (see our February issue, page 20). 

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Thames Highway: a high-specification shortsea vehicle carrier

This representative of a new advanced class of four 2137-car-capacity ro-ro vessels for the Ray Shipping group builds on earlier and larger designs from Stocznia Gdynia. Ice-class strengthening to 1A standards allows trading into the Baltic Sea and to Russia.

AN image of modern car/truck carriers conjures up visions of 6000-unit capacity giants today sailing on deepsea routes around the world; even a few 8000-car units are now on order. Yet, running in parallel to these is a less publicised but equally important trade using smaller ships travelling on shortsea routes.

A leading name in the ownership of deepsea ships is the well-established Israeli group Ray Shipping (based on the Isle of Man), which has mainly ordered its vessels in Poland at Stocznia Gdynia. Last year, this enterprising company launched itself into the shortsea sector when it took delivery of the first of a new quartet of advanced-design vessels principally planned for the European shortsea trades.

Most significantly, they are both larger and faster than ships of competitors. At the same time, they are flexible enough, having bunker capacity for 13,000nm, to sail to areas such as the Far East or Caribbean if necessary; indeed, it seems quite likely that the third in the series will sail on a deepsea route.

These are expensive, high-specification ships created by Gdynia's own design team to offer a quality service, using the shipyard's accumulated experience from constructing larger vessels such as the 6000-car *Crystal Ray*, featured in *Significant Ships of 2000*, also from its first car/truck carrier completed as long ago



Elbe Highway, first ship in the series, viewed from astern and revealing a very good wake pattern - the result of a refined hull form with an extended ducktail transom and a centreline fin above the rudder blade.



The TTS 70tonne-capacity quarter ramp on *Thames Highway* is seen here being deployed at Sheerness to offload cars. Beyond is the second stern ramp, with the control station for both alongside.

TECHNICAL PARTICULARS THAMES HIGHWAY

Length, oa.....	148.00m
Length, bp.....	134.00m
Breadth, moulded.....	25.00m
Depth, to main deck.....	11.80m
Draught, design.....	7.20m
Draught, scantling.....	7.90m
Gross.....	23,500gt
Deadweight, design draught.....	5800dwt
Deadweight, scantling draught.....	7800dwt
Car capacity.....	2137 RT43-size cars
Main engine.....	Cegielski-MAN B&W 7S46MC-C
Output.....	9170kW at 129rev/min
Speed, service, design draught, 90% MCR, 15% sea margin.....	19.00knots
Complement.....	11 officers + 12 crew
Classification.....	Det Norske Veritas +1A1 Car Carrier, MCDK, ICE-1A, EO, NAUT-OC, TMON, CLEAN

as 1982 for Leif Hoegh. Many extra features have been built in at the start to save expense later.

Ray normally charters its new ships to leading operators such as EUCOR, NYK, and Kawasaki Kisen Kaisha, and it is for the latter's newly established European distribution operation - KESS, or K-Line European Sea Highway Services GmbH - that the new series has been built. These new 2000-car ships, while part of the Ray Shipping fleet, are actually owned by individual companies, eg, Thames Maritime for *Thames Highway*, while all technical management is in the hands of Jahre Wallem, based in Norway, using Polish

crews. From a recent inspection by *The Naval Architect of Thames Highway* (second in the series) at the UK car-importing port of Sheerness, it was apparent that the whole operation, from the owner downwards, is very efficiently and professionally run. The lead ship, *Elbe Highway*, was presented in *Significant Ships of 2005*, and the following vessels will be named *Danube Highway* and *Seine Highway*. The owner has options for further units of the series.

As a typical example of the KESS operation, *Thames Highway* is sailing on a regular two-week round trip that takes in Zeebrugge, Bremerhaven, Cuxhaven, Malmö, Södertälje,



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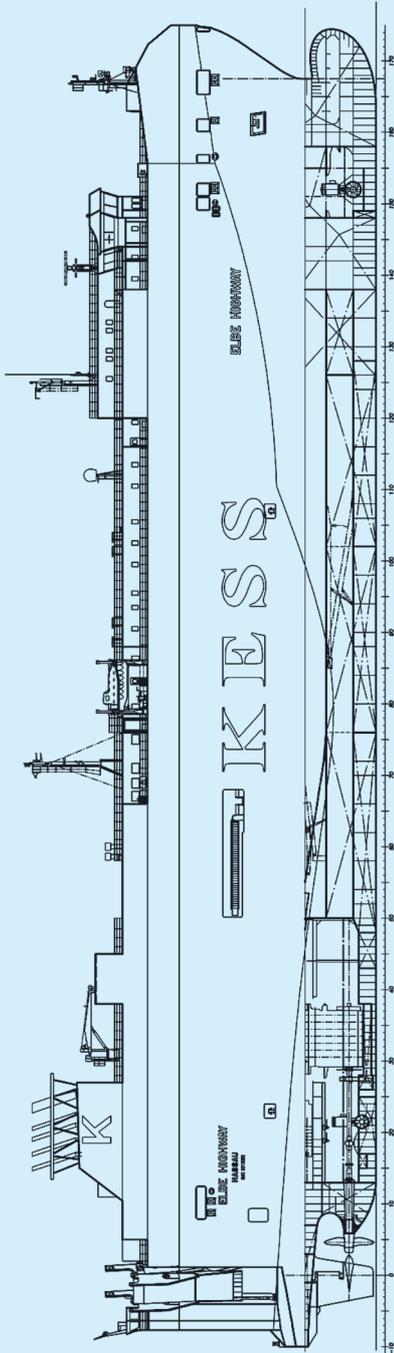
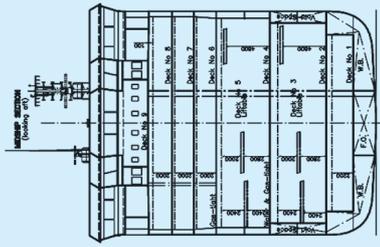
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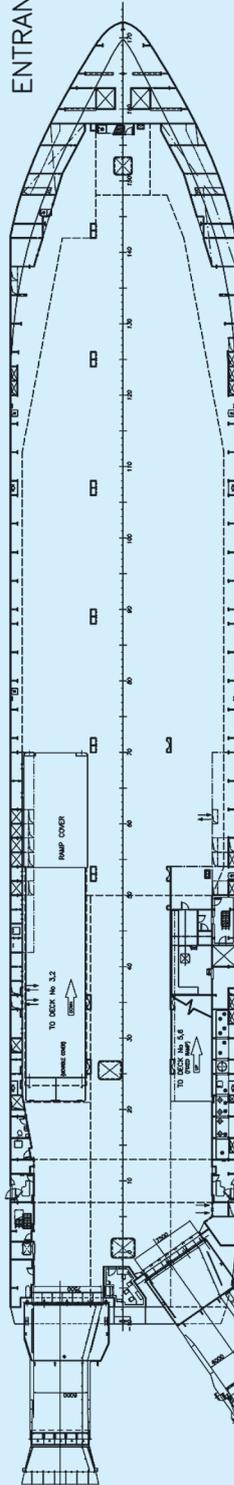
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General arrangement plans of the 2137-car capacity vehicle carrier *Elbe Highway* and her sisters, built by Gdynia Shipyard for the Ray Shipping group.

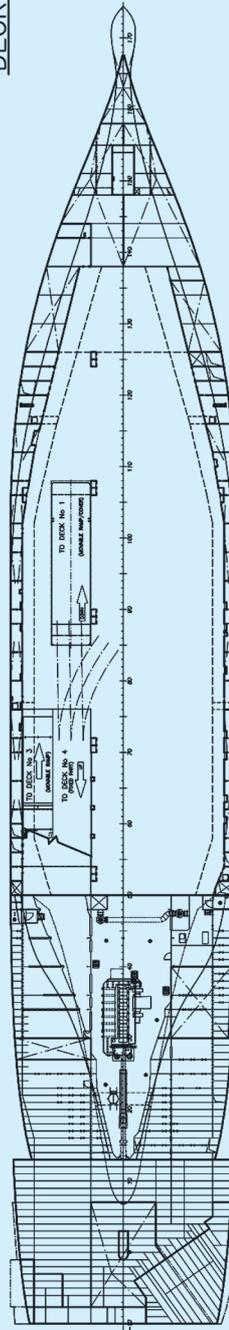


DECK No. 4

ENTRANCE DECK



DECK No. 02



Hanko, Hamina, St Petersburg, Gdynia, and Sheerness. The ship is acting as a full service in its own right as well as a feeder service to deepsea ships. Gdynia is included to load Polish-built Opel cars, while the St Petersburg call (believed to be a first for dedicated car carriers), which often includes secondhand cargoes, is expected to benefit from the opening soon of a Toyota manufacturing plant in Russia. To ensure efficient working in the Baltic region, strengthening to meet Det Norske Veritas 1A class is included.

Gdynia refinements again included

As with many ships from Gdynia, the hull of *Thames Highway* and her sisters has been carefully refined, using experience from previous designs, to match her owner's specific requirements. Extensive model testing was carried out at the CTO basin in Gdansk, including running radio-controlled models on Lake Wdzydze (*The Naval Architect* July/August 1998, page 47).

As we noted in September 2004, Gdynia refinements have already been successful in achieving, for the yard's car carriers, improved seakeeping, better course stability, decreased air resistance, and sustained sea speed. On the new series, to ensure minimum water resistance, the duck-tail transom has again been elongated and a centreline fin above the rudder blade extended (it was not possible to introduce twin fins, as first introduced on the 5000-unit ship *Global Leader* and built by Gdynia in 2003, because the draught is too shallow to make use of this benefit).

The rudder also features a Costa bulb and so-called scissor plates to limit cavitation and to improve rudder efficiency, while to minimise air resistance, the shipyard has again designed an aerodynamic form to the bow (similar to that used on larger Ray ships built at Gdynia). A spoiler is also fitted to the top of the wheelhouse, and all fan houses are enclosed in blocks, rather than being distributed along the upper deck. All external and antifouling paints were supplied by International Paint, while Jotun provided internal coatings.

In unsolicited confirmation of all this, Ray Shipping told *The Naval Architect* that it was impressed both by Gdynia's cutting-edge design work as well as by the quality of its construction. The captain also reports no significant speed losses at the result of bad weather.

Optimum ro-ro vehicle handling

Like all similar vessels, the focus is on efficient vehicle handling, the centrepieces being two large 70tonne-capacity stern ramps - one at the stern for use at ro-ro berths (at Zeebrugge, Malmö, and St Petersburg) and the other a starboard quarter design for a wide range of conventional quay heights - and a series of internal fixed and movable decks. All decks have clear heights of more than 2m, while the two levels for larger vehicles and other rolling cargo, deck Nos 2 and 4 (which might, in the future, also load forest products), have a height of 4.80m and are strengthened for loads of 2tonnes/m².

The whole movable access package was designed by TTS Ships' Equipment to suit a full



A cascade ramp arrangement is employed inside the ship for speedy vehicle handling. All ramps are coated with Bimagrip composition in place of conventional metal chevrons.



The new ships carry two of these Taavura deck lifters, specially designed for Ray Shipping. Sets of four large yellow circles painted on the deck ensure the lifters are positioned correctly when hoisting or lowering panels. Each ship also carries a forklift truck and a deck sweeper.

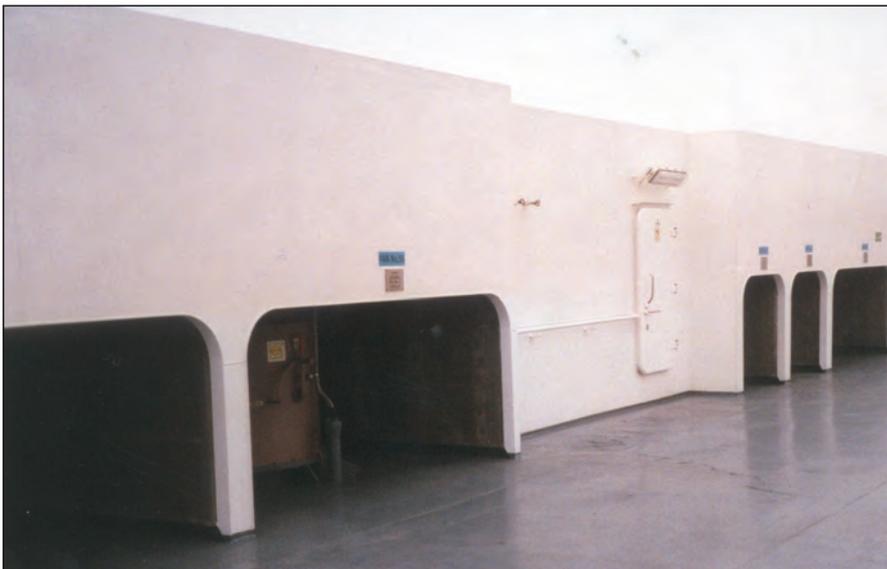
load of 2137 cars of the RT43 Japanese industry standard size on a total deck area of 17,400m². The stowage and driving system was designed by Gdynia, to meet both owner's and charterer's requirements.

Both stern ramps and the internal ones are coated with a special composition, Bimagrip, made by the UK company Bimark. This is claimed to give superior wheel grip compared with the conventional metal chevrons and has been used on all Gdynia car carriers in recent years.

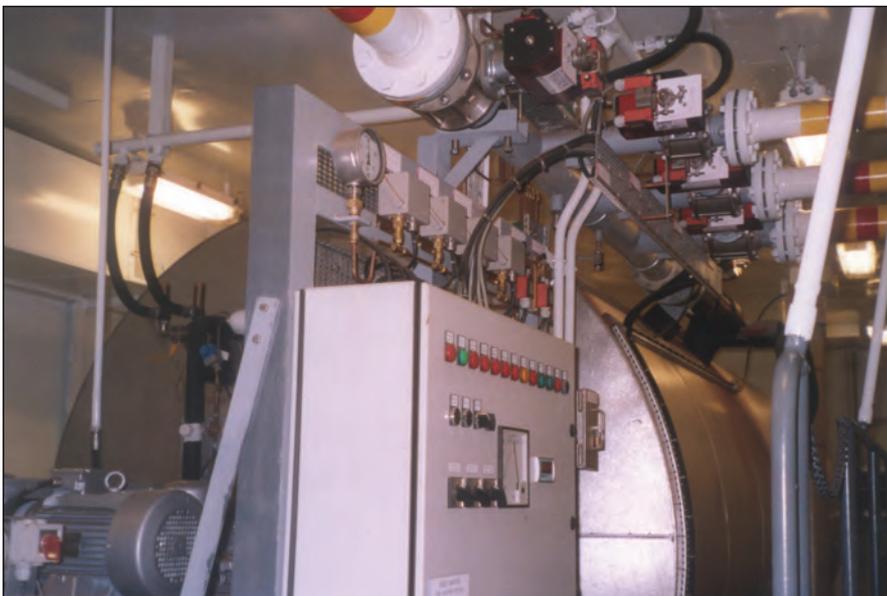
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The two hoistable decks (Nos 3 and 5) allow lorries and other high cargoes to be carried on deck Nos 2 and 4. The sections can be fixed in one of three positions, 2.40m, 2.80m, and 4.80m above the deck. The yellow support is the lowest.





Supply and exhaust fans, manufactured by the Polish company Alwo, are arranged in enclosed banks both for improved air flow and for reduction of noise transmitted to the accommodation.



Fire detection is provided by Consilium equipment, with actual firefighting for the vehicle decks and machinery spaces carried out by a Semco Maritime low-pressure CO₂ arrangement; the gas is stored in this single tank. Local firefighting in the engineroom and galley is by a Semco water-mist system.



A Gdynia-designed cascade system of internal ramps for fast cargo operation is fitted on all eight decks, two of which, No 3 and No 5, are hoistable. An economical method of raising and lowering the latter is employed, using two special diesel-powered lifters built by the Israeli company Taavura and designed specially for Ray. These sail with the ship, as do a Toyota forklift truck (for general assistance) and a Hako sweeper - employed at the end of every discharge operation to clean the decks for the next cargo.

An outfit of supply and exhaust fans - manufactured by Alwo, of Poland, and enclosed together in blocks for improved air flow and less noise - enables the air in the vehicle decks to be changed at a rate of 20 times hourly during cargo handling and 10 times hourly at sea. Fire protection is supplied by a Semco Maritime low-pressure CO₂ system using a bulk tank placed in the aft superstructure. Such an arrangement is often specified where large areas have to be protected; the system is divided into three gas-tight zones for the vehicle decks, plus an extra one for the engineroom. The latter space also has the now-mandatory local water-mist system, this being of Semco delivery; a separate Semco system covers the galley.

Close to the Semco plant is an impressive array of different-colour bins for separating and recycling waste material. Non-recyclable material is burnt in a nearby incinerator supplied by TeamTec, of Norway. These are essential features for a shortsea ship, to ensure compliance with MARPOL Annex VI. All the new ships will also carry a DNV CLEAN notation, as part of Ray's philosophy to be as eco-friendly as possible.

Straightforward machinery spaces

A neat, uncomplicated machinery space, planned along the same lines as Ray's deepsea vessels, is centred on a Cegielski-built MAN B&W seven-cylinder S46MC-C two-stroke engine, rated at 9170kW at 129rev/min. This drives a FP nickel-aluminium-alloy propeller of 5840mm diameter, cast by Alstom Power Elblag, to give a cruising speed of 19.00knots - exceeding the original contract speed by 0.2knots.

Electrical power is generated by three MAN B&W Holeby 7L23/30 engines driving 1325kVA alternators from Dozamel; one set is normally sufficient when the ship is at sea. Steam and hot water are supplied by two boilers: a 1500kg/h oil-fired unit and a 1000kg/h exhaust-gas economiser; both have been supplied by the Korean manufacturer KangRim.

The whole plant is masterminded by an integrated alarm, monitoring and control system from the Israeli specialist Totem-Plus, which has now fitted systems to many Gdynia-built ships. This system also extends to ballast water and heel control.

Comprehensive manoeuvring outfit

A comprehensive manoeuvring outfit comprises both ABB bow and stern tunnel CP thrusters - 1000kW at the bow and 660kW at the stern. These operate in conjunction with a rudder which has an extended turning angle of 65deg, for use

As an example of the high specification and attention to detail, this covered walkway protects people walking from the lift to the accommodation.

when at speeds below 6 knots. Despite this impressive equipment, tugs are sometimes still needed for safety in exceptionally strong winds (because of the high ship sides), and in St Petersburg, tugs are needed to clear ice away from the berth. All the anchor and mooring winches have been supplied by the Polish specialist, Towimor.

A fully enclosed bridge includes a comprehensive array of equipment, including closed-circuit TV surveillance of important areas throughout the vessel. This is seen as particularly important to ensure a high quality service and protection against unauthorised access.

A high standard of accommodation on one level is included for the 23-man crew, with 15 single and five twin-berth cabins, all with private shower and toilet units. All cabins have been made-up individually, but using prefabricated wet units, and a gym also doubles as a computer training room. Wide stairways without any sharp banister edges are fitted, and coloured door frames help to identify each section of the accommodation. To complement the K-Line charter, decorations include a large number of specially purchased Japanese prints and wall hangings.



Special efforts have been made to remove sharp edges throughout the ship, as this curved staircase banister shows.

Bright future for car carriers

The Ray group already owns 25 ships, excluding the new shortsea series featured here, and expects to take delivery of a total of eight new vessels during 2006. The forthcoming years are expected to see a substantial number of both large and feeder-size new ships. Ray sees a 'brilliant future' for car carriers, notwithstanding current concerns over exhaust emissions and global warming, and suggests that further shortsea ships (between eight and 12) could be ordered, since distribution by sea is considerably more economic than road or rail. These could be even larger than the current quartet. Several projects are also in hand for new deep sea ships.



All principal machinery, also the ballast and anti-heel system, is masterminded by a Totem-Plus system, whose display screen with mouse is seen here on the bridge. Duplicate screens are provided in the engine control room for redundancy. Totem-Plus also supplied the ship's VDR equipment.

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DESSO: a ferry designed for survival onboard

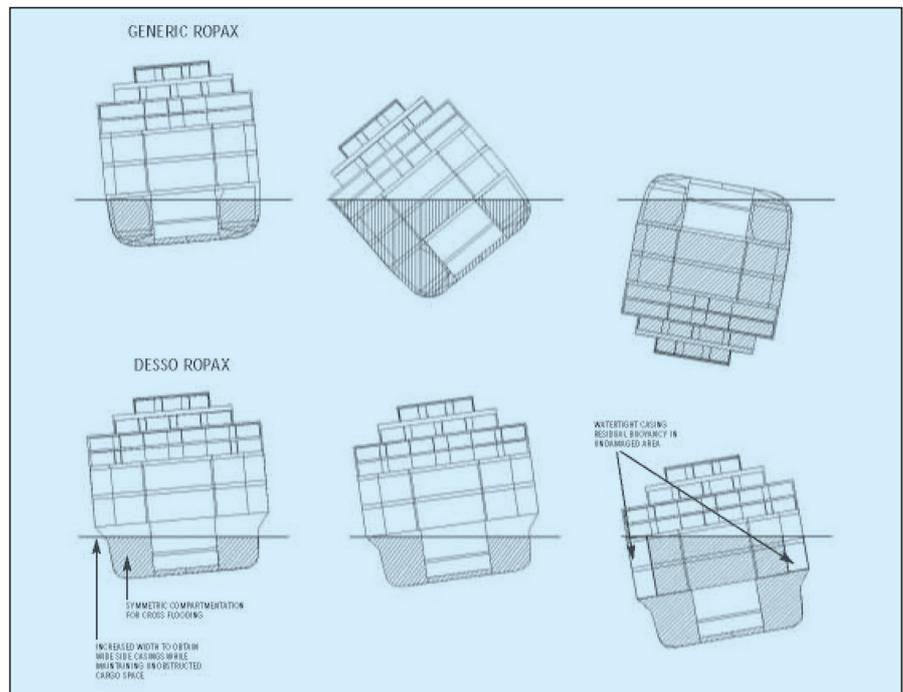
Over the last few decades, roll-on/roll-off passenger ferries have been involved in some serious accidents, some of which have resulted in many casualties. Although ferries built today are considered to be much safer, a modern ship could still capsize if involved in a severe accident such as a high-speed collision. Abandoning ship for any reason, whether it is as the result of collision damage or fire, is always a risky operation; therefore, the new Swedish government-funded DESSO project aims to create a concept ship where it is safe to remain on board in cases of emergency.

THE DESSO project resulted in the design of a concept ship, the DESSO ro-pax ferry, that will stay upright and afloat for 24 hours, even after sustaining severe damage. It also has what is claimed to be better than state-of-the-art current fire safety measures. This means that in the event of a serious accident, passengers can stay onboard such a ship while a safe means of rescue is arranged. The main objectives of the project were:

- to create a template for the conceptual design of a roll-on/roll-off passenger ship that demonstrates the possibilities of 'the ship serving as its own lifeboat'
- to increase significantly the current understanding of a ship's capacity to remain upright and afloat after suffering structural damage, fire, or terrorist attacks
- to establish a Swedish/European network of companies, research institutes, and interested parties within the public sector
- to study passenger and crew survival, both regarding moving large numbers of passengers onboard and accommodating passengers for extended periods in an emergency situation.

The research partners in DESSO were SSPA Sweden AB (project management), Chalmers University of Technology, SP Swedish National Testing & Research Institute (Fire Technology), Globtech Marine AB, and Kockum Sonics AB. Collaborating partners were Stena, Silja Line, Lloyd's Register, and The Swedish Club. The main subcontractors were NAOS, MarDeQ, and Kattegatt Design. DESSO was funded primarily by VINNOVA, the Swedish Governmental Agency for Innovation Systems. Significant funding also came from the Swedish Maritime Administration, the Swedish Mercantile Marine Foundation, as well as from collaborating partners.

An important finding of the safety assessment portion of the DESSO project was that a well-organised safety management system and a highly skilled crew is probably the most cost-effective way to avoid or limit the severity of ship accidents. Some important features developed for the DESSO ro-pax concept ship are as follows:



The DESSO concept ferry is claimed to be superior in safety to standard ferries of this type since it should not capsize or sink.

- wide side casings to keep the hull upright and afloat if severe structural damage occurs
- selection of interior materials that minimise the growth and spread of fire
- specification of systems to ensure rapid and effective fire detection and suppression
- onboard decision support system.

Upright and afloat concept

The goal of the DESSO project was to design a ferry that is superior in safety compared with current state-of-the-art ships. This means that the ship will survive damage significantly more severe than that specified by current regulations governing ferry design. Survival means that the ship will neither capsize nor sink, ie, it will stay upright and afloat. Furthermore, the DESSO ship has a spatial layout that ensures redundancy of the propulsion, electric power supply, and auxiliary systems.

The ability to stay upright is of paramount importance if the ship is to function as 'its own lifeboat'. To make the ship behave in this way, it is crucial that water entering the hull fills it as symmetrically as possible so that excessive heel is avoided. This means that the ship layout must be such that to the largest possible extent starboard and port side compartments are connected.

For the ship to stay afloat, there must be enough spare buoyancy above the waterline to compensate for compartments that are flooded during an accident. The spare buoyancy in the

DESSO ro-pax ferry is provided by enclosed watertight side casings that are maintained up to the first accommodation deck.

The ship width was increased to provide wider side casings while still maintaining an unobstructed cargo area. Most of the width increase is above the waterline - this means that the ship's intact stability and hydrodynamic properties are substantially maintained.

Redundancy concept

Redundancy of systems for electric power and for manoeuvrability was considered to be of high importance for the DESSO ship. This will facilitate 'safety by action' during incidents such as flooding of compartments or fire, or if the ship must be abandoned.

Maintaining manoeuvrability means that it may be possible to lessen the impact of waves, to avoid grounding during incidents that occur close to shore, to avoid collision if in proximity to other ships, and to reach sheltered waters.

For the DESSO design, propulsive redundancy shall also remain after incurring damage that extends along three adjacent compartments or after a penetration that extends along the double bottom over 65% of the ship's length. To achieve this, the engines have been arranged in separate compartments where the aft engine rooms are also separated transversely. This is an exception to the aforementioned principle of cross-flooding arrangements.

continued



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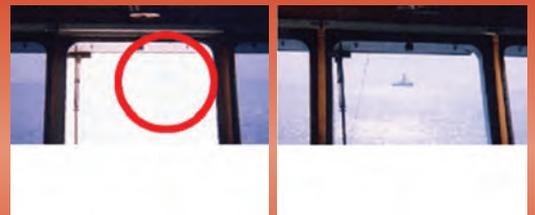
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with active fire-resistant smoke and fire barriers (traditionally known as fire curtains). These fire barriers are shut upon completion of loading and opened during loading and unloading of the deck. Furthermore, fire resistance between the individual ro-ro cargo decks and the division between the upper ro-ro deck and the accommodation spaces above this deck was improved.

In addition, it is possible to remotely close the aft door and the internal hoistable ramps in case of fire. The reason for the measures described above is to limit the availability of air to a fire and thereby reduce its size. The active fire protection systems, ie, the fixed fire detection and fire suppression systems, were again enhanced through improvements to design, performance, reliability and redundancy.

Decision support system

A special DESSO decision support system will be continuously active and if water enters the vessel it will automatically calculate the vessel's stability and predict its future motions and state. Intact and damage stability will be calculated directly. Cargo shifting will also be included in the calculation. The vessel's entire geometric shape is entered into the system. This system provides:

- early warnings of water ingress, cargo shifting, smoke, and fire
- prediction of floating, capsizing, or sinking conditions
- estimated time to reach these final states

- advice on ship handling (manoeuvring, water pumping, fire fighting)
- advice on evacuation, if necessary.

The system will be connected to onboard video camera and fire alarm systems, and provides data to the shipping office and rescue centres. The system has a simulation mode for hands-on training to practice handling critical situations.

Prediction by modelling and measurement

Prediction of the ship's present and future motions and state is based on an advanced mathematical model and measurements of the following:

- fluid levels in tanks and void spaces obtained from sensors or video image processing
- cargo shifting obtained from video image processing
- wind speed and direction
- wave height and direction (indirect computation from the ship motions)
- ship's course and speed
- meteorological wind and wave prognoses.

Loading program

A software loading program will perform a position check of the cargo, and provide information on ballast volumes and flow, as well as any water entering the hull. This system compiles all the data available, performs a calculation and then gives advice to

the officers about possible courses of action. Benefits of the loading program include the following: image processing from cameras to track cargo on deck, automatic crosschecking of load condition, and damage simulation for training.

Operations

If flooding occurs during a voyage, the real-time system emits an alarm. The crew on the bridge is also given an early indication of possible cargo movements and their effects on the vessel. Video cameras monitor doors, corridors, and the cargo on decks. Image processing software automatically recognises abnormal situations, such as cargo shifting, fire, smoke, water on deck, and passengers/crew in prohibited areas. The system has four main functions:

- automatically calculating stability if water enters the vessel or if the cargo shifts
- monitoring of cargo and ballast via tank measurements and acceleration/lashing calculation
- constant monitoring of stability, and providing information and advice to officers
- automatically transmitting a ship's condition in real-time to appropriate land-based organisations in the event of damage. These organisations can thus provide practical support in an emergency situation.

Time will always be a determining factor for the success of an evacuation. Onboard the DESSO ferry, passengers and crew might face a

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24-hour wait. To be able to keep them as comfortable as possible during this time, the accommodation has been divided into three zones - yellow, orange, and red alert areas. This will enable a sequential evacuation of the accommodation based on the seriousness of the situation:

- yellow alert - as long as the crew estimates the situation to be safe, passengers will be allowed to stay in all areas
- orange alert - a change of the situation to a more serious state will cause the alert level to be raised to orange. Passengers will have to be awakened and moved from cabins and family rooms, but will be allowed on the leisure and evacuation decks. The cabin decks will be searched by crew members and then closed
- red alert - an even more serious development of the situation will trigger an evacuation and closing of the leisure decks. When all passengers are gathered on the evacuation deck, an evacuation will be initiated.

Sequential evacuation of the accommodation areas will provide the time necessary to inhibit crowding and to prepare passengers. If crowding is prevented, most factors which risk triggering violent behaviour within the group are eliminated. The additional time will also give passengers the opportunity to group with family and friends, dress properly, receive information, and mentally prepare themselves to evacuate the ship.

Information is another important factor. The provision of sufficient information will help keep passengers calm and will lessen worries. The crew must at all times be updated on the most recent developments. The continuous display of information on screens or via loudspeaker is also an important tool to make sure that each passenger can obtain information on the situation whenever required.

These new demands that are required of the safety organisation will call for further training and education of crew members. More crew members, in positions other than the traditional, will require medical training as well as training in handling crowds. New functions are also added; the responsibility of providing crew members and passengers with continuous information must be delegated to separate positions in the safety organisation.

To facilitate the task of emergency evacuation for both passengers and crew, some improvements to the design of evacuation routes and technical support systems are suggested. The aim of these is to prevent problems that can occur during time-limited evacuation. These problems can include:

- breakdown of the safety organisation due to heavy workload and stress caused by an accident
- escape route identification difficulties caused by complex interiors and confusing signage

- difficulties with radio communication within the safety organisation
- difficulties searching cabins and public spaces
- public address system malfunctions and sound quality issues.

Evacuation in smoke

The suggested improvements to facilitate evacuation include installation of an interactive information system that supports passenger education and preparation for an effective evacuation. It can also support passengers by providing information during an accident and be a complement to other sources of safety information, such as information broadcast over the PA system.

Improvements to signing and emergency lighting will take into account human factor aspects and evacuation strategies in smoke. The use of directional sound as a complement or alternative to low location lighting, and provision of emergency escape breathing devices (EEBDs) are other proposals.

In addition, it has been suggested that a digital mobile communication system covering all communication needs, both internal and external on a normal daily basis, as well as safety-related and emergency communication, should be installed. Furthermore, a system should be set up for passenger surveillance using RFID (radio frequency identification); this can facilitate search tasks and give management the ability to identify bottlenecks and uneven passenger distribution during evacuation.

Looking for fresh ideas

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Côte d'Albâtre: a new cross-Channel contender

A BRAND-NEW delivery from the Spanish shipbuilder Hijos de J Barreras, at Vigo, is the 600-passenger ro-pax ferry *Côte d'Albâtre*, first of two ships ordered by Transmanche Ferries, a company backed by the French local government authority of Seine Maritime, in Normandy, to promote the medium-distance service (four-hour voyage) across the English Channel between Dieppe and Newhaven, for both trade and tourism. Up to now, secondhand ships have been plying this route, which has seen its fair share of ups and downs.

The new twins are based on the same hull as used by Barreras for its recent pair delivered to the Spanish Armas group, *Volcan de Tamasite* (presented in *Significant Ships of 2004*) and her virtual-sister *Volcan de Timanfaya*. The prime difference on the Transmanche ships is the inclusion of a bow door, and thus a different internal ramp arrangement to suit. Two fixed



The 600-passenger *Côte d'Albâtre* is the first of two new ro-pax ferries completed by the Spanish yard Barreras for Transmanche Ferries. She will sail on the cross-Channel route between Dieppe and Newhaven.

decks (Nos 3 and 4) are provided for ro-ro cargo; on No 4 level, space is available on a short section of platforms at the forward end for extra cars.

All doors and ramps were supplied by MacGregor and consist of twin stern combined doors/ramps each of 16.00m x 7.00m and designed for handling two vehicles of 16m length and 54tonnes weight. Internally, two fixed ramps lead from the stern to the upper ro-ro deck, where the hoistable car platforms with their associated ramps are positioned. A further two ramps are positioned forward of amidships on deck No 3 for use by lorries entering through the bow door and visor.

Public rooms, the design of which was created by the Spanish consultant Oliver Design, are positioned on deck Nos 6 and 7, with a total of 50 cabins, all with private toilet and shower facilities, at the forward end of the lower level. These comprise 48 cabins with four berths, one suite for two passengers, one cabin outfitted for two disabled passengers, and an owner's cabin. On the deck above is accommodation for a crew comprising captain, chief engineer, six other officers, and 44 crew members (including four twin-berth rooms).

Passenger access from the stern is by way of a portside moving staircase, which takes them to the reception area on deck No 6. Two passenger lifts by Enor are also fitted, one aft serving deck Nos 3 and 8 and another forward serving deck Nos 3 and 7. On deck No 6 is a passenger

cafeteria and a two-level lounge/bar, a galley, also a video games room and a nursery. On deck No 7 are located the officers' lounge and crew mess, and aft of this are a further lounge, a bar, and snack bar, also an à la carte restaurant. All key areas of the ferry - 22 in all - are covered by an Interbon closed-circuit TV surveillance system, while passenger comfort should be ensured by a pair of Rolls-Royce folding fin stabilisers.

Lifesaving equipment comprises four Viking marine escape systems (two each side of the hull); these are supported by two lifeboats, a man-overboard boat, and a rescue craft. All this latter equipment came from the German company Ernst Hatecke.

Firefighting is provided by a Semco CO₂ system covering the machinery spaces (plus a Heien-Larsen local system) also the galley, with sprinklers fitted in the ro-ro spaces and accommodation.

Propulsion power is supplied by twin Wärtsilä medium-speed diesel engines, each developing 9450kW at 600rev/min. These drive a pair of 4200mm diameter CP propellers from Rolls-Royce turning at 176rev/min, with transmission through a pair of Reintjes gearboxes each fitted with a power take-off shaft for driving a 1875kVA Leroy Somer alternator. Further electrical supplies come from three Wärtsilä/Leroy Somer 1124kVA diesel-alternators. Rolls-Royce also supplied a pair of electrically-driven tunnel bow thrusters, each of 1300kW. ⚓

TECHNICAL PARTICULARS CÔTE D'ALBÂTRE

Length, oa.....	142.45m
Length, bp.....	125.00m
Breadth, moulded.....	24.20m
Depth, to main deck.....	8.35m
Draught, design.....	5.70m
Draught, scantling.....	6.00m
Deadweight, design draught.....	2900dwt
Heavy fuel.....	660m ³
Diesel oil.....	80m ³
Lubricating oil.....	38m ³
Fresh water.....	104m ³
Ballast water.....	1550m ³
Passengers.....	600
Crew.....	44 (approx)
Trailers.....	62 or 51 + 124 cars
Main engines.....	2 x Wärtsilä
Output.....	2 x 9450kW at 600rev/min
Speed, service.....	22.00knots
Classification.....	Bureau Veritas
	1 +Hull, +Mach, Ro-Ro
	Passenger Ship,
	Unrestricted Navigation,
	AUT-UMS, ALP, SDS,
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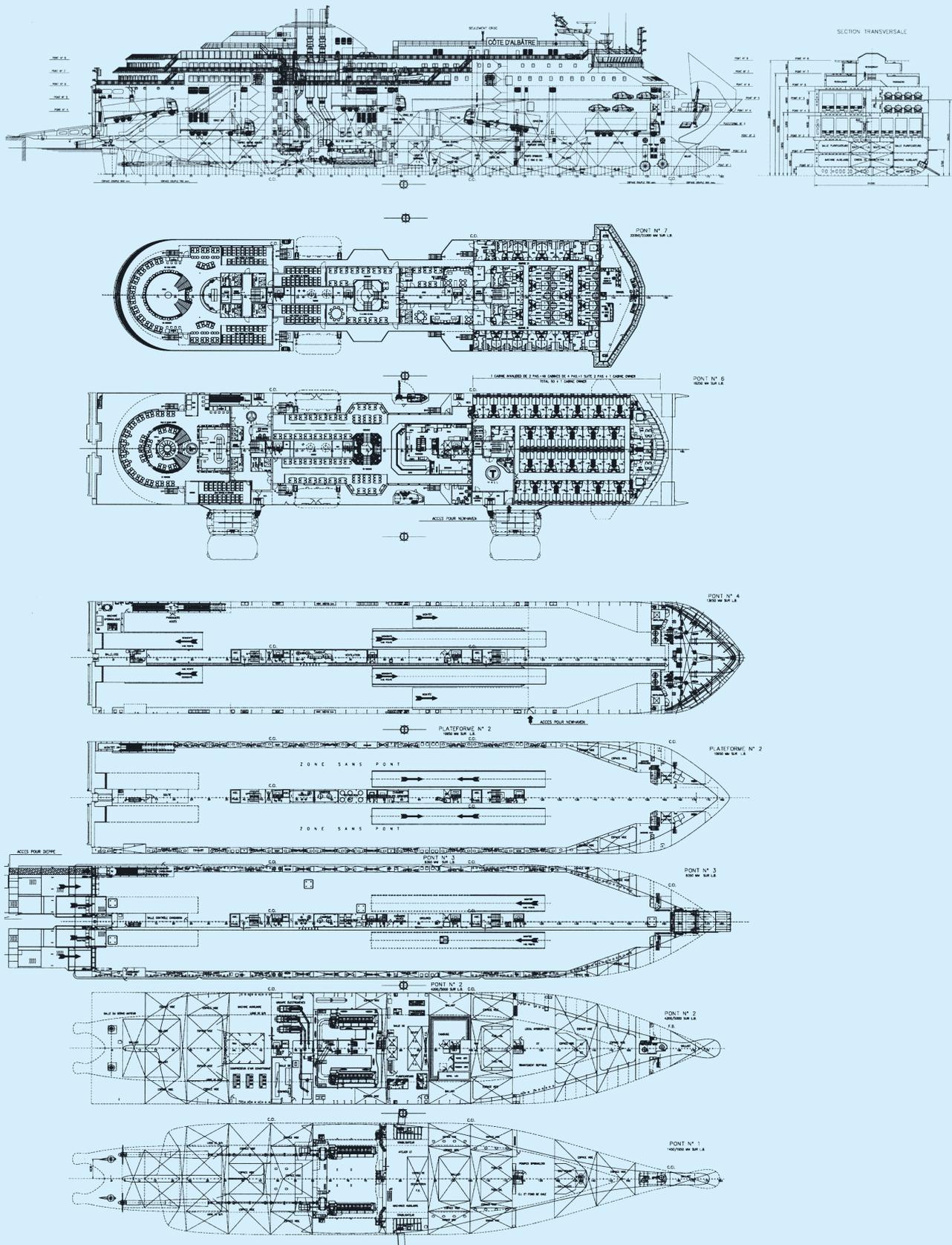
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General arrangement plans of the 2900dwt ro-pax ferry *Côte d'Albâtre*, built by Hijos de J Barreras, at Vigo, for the French operator Transmanche Ferries.





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Follow-up car-carrier order in Japan for TTS

GOTHENBURG-based cargo access specialist TTS Ships Equipment has secured yet another significant order for two pure car and truck carriers building in Japan. The order comes from Wilh Wilhelmsen, which has two 6400-unit ships contracted at the Nagasaki shipyard of Mitsubishi Heavy Industries.

The ships will be sisters of six state-of-the-art vessels already ordered at Nagasaki, of which three have been delivered. They are claimed as being particularly efficient with regards to cargo capacity, cargo handling, and fuel consumption. Delivery of the two new ships will take place in October and December 2008.

Cargo access equipment comprises a large stern quarter ramp, side ramp, and internal ramps and covers, including the necessary hydraulic and electric systems. The wire-operated quarter ramp will give access to No 5 deck; it is of a combined ramp and watertight door design, having a length of approximately 38.00m and a breadth (at the narrowest part) of 7.00m. The ramp is designed to take a total load of a heavy Samson-type wagon with a payload of 170tonnes and an axle load of 60.00tonnes/four wheels.

The wire-operated side ramp comprises one section and one flap, and gives access to Nos 5

and 6 decks (No 6 deck in three positions). It has a total length of 25.00m and a driveway width of 6.50m. The maximum load is a vehicle of totally 35tonnes with an axle load of 20tonnes/four wheels.

Internal ramps comprise a total of 10 movable units. These will give access throughout each ship's 12 car decks. No 5 and 7 decks are watertight, and No 10 deck is gastight. Lifiable ramps are in position on Nos 2, 4, 6, and 8 decks. All the necessary hydraulic and electric control and monitoring systems are also part of the package. ⚓

Joint industry project to investigate lashing loads

OWNERS, suppliers, authorities, and researchers are to cooperate in a two-year project, whose goal is to improve cargo lashing safety on ro-ro ships, container vessels, and heavy-lift ships. This joint industry project, known as Lashing@Sea, is an initiative by the Dutch research institute MARIN.

Recently reported container losses and stack collapses indicate a lack of understanding in the loading and response of present-day lashing equipment, believes MARIN. It is clear that this jeopardises the safety of people, navigation, and the environment. In other sectors, such as ro-ro ferries and heavy-lift transport, 'over-lashing' of cargo, based on conservative regulations, leads to excessive costs and time in ports. Weather-dependent lashing and level playing fields are being urged, with the additional aim of improving the economy of these trades.

The Lashing@Sea project will investigate the mechanisms of lashing loads and identify the key parameters. After a review of current practice and documented incidents, a monitoring campaign will be conducted on deep-sea container vessels. For this purpose, a dedicated container will be equipped with sensors to measure loads, motions and vibrations. Vertical and torsional hull deformations will be monitored since these responses contribute to

lashing loads. In addition, detailed wave information will be collected. This monitoring campaign will run for one year and will also involve a shortsea container carrier, a ro-ro vessel, and a heavy-lift ship.

Lashing@Sea is being conducted with the participation of eight ship owners, three lashing suppliers, three class societies, and the Dutch Department of Transport. P&I clubs have also been invited to join the consortium. ⚓



Seen here prior to final drydocking is the new icebreaking bulk carrier *Umiak I*, which was discussed in our bulk carriers feature last month. This most interesting 31,500dwt vessel was constructed in Japan at Universal Shipbuilding's Maizuru yard for the Canadian operator Fednav. Her heavily cutaway bow - she is classed to Det Norske Veritas standards - can be clearly seen. *Umiak I*'s main propulsion engine is a Hitachi-MAN B&W 7S70ME-C model, chosen by Fednav for a number of factors, with an ability to operate over the full range of difficult service requirements, including 36% MCR in open water, and able to provide the high torque required to maintain engine speed while ice is being forced through the CP propeller and its duct.

The relevant DNV ice notations are ICE-15 and DAT (-30°C), which refer - in the first case - to a vessel which may sail in an icy waters but is not intended for ramming (POLAR or ICEBREAKER notations cover ramming, either accidental or repeated); the number 15 refers to nominal ice thickness (1.5m). DAT (-30°C) refers to the design ambient temperature (ie, -30°C), which determines the steel grades used in the hull and machinery construction. ⚓



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New seating ranges from Australia

AUSTRALIAN company Transport Seating Technology recently introduced the Evolution, Breeze, and Deliver ranges of seats for marine use. In this company's experience, shipbuilders want a versatile and light seating system that is easily installed, while operators look at the aesthetics and the price of seating, before any of the features or specifications. Transport Seating Technology's range aims to cater to both parties, and where possible the company can adapt any product to meet special needs.

Evolution has a dry weight of 7.75kg/passenger (in a four-passenger configuration with two legs), what is claimed to be a unique no-weld aluminium frame, and it features ergonomically-designed injected moulded foam for comfort. This design is available in fixed or reclining models.

Weighing 5.75kg/passenger, the Breeze range features a built-in lumbar support by using a new suspension mesh-fabric, also a new urethane top with a safety grab handle. Even though these seats are manufactured for an outdoor environment, they can also be adapted for interior use by attaching padded fabric covers.

The Deliver seat can be fitted to all marine vessels and is made from UV-treated polypropylene with optional padded cushions and an inbuilt lumbar support. All of the company's marine seats now have adjustable legs for easy installation.

The 27m wavepiercing catamaran *Evolution*, built by Aluminium Boats, Australia, and designed by Stuart Friezer Marine for Haba Dive to use on the Great Barrier Reef, was installed with 63 Evolution seats in the main saloon. The seats were arranged at a pitch of 1750mm around 13 tables with a catering area forward. Although the catamaran is designed for dive excursions, the configuration of the two passenger saloons is similar to that of a ferry. At present, Transport Seating Technology is manufacturing Evolution seats for three ferries commissioned by Brisbane Ship Constructions Pty Ltd.

Transport Seating Technology believes that the main factors affecting the design and specification of seating systems for ferries today are an ability to be flexible in the



Deliver, made from UV-treated polypropylene, can be fitted to all classes of vessel.

Pictured are Evolution seats, which have a no-weld aluminium frame, and are available in fixed or reclining models.



The Breeze range of seats features a built-in lumbar support and can be installed inside or outside.



positioning of the legs on any configuration, and designing a seat that absorb the energy

produced by wave impact, rather than merely cushioning that impact.

Substantial worldwide orders for lifts

NEW orders for shipboard lifts in France, Germany, Finland, and the USA have recently been secured by Kone. Alstom Marine (Chantiers de l'Atlantique), in France, has awarded the company two orders to supply a total of 58 lifts for the two giant 3887-passenger cruise liners (*The Naval Architect* February 2006, page 57), hull numbers A-33 and B-33, to be built for Italian shipowner Mediterranean Shipping Co. These orders are turnkey projects comprising engineering, equipment supply, and installation.

In Germany, Kone has signed a repeat order with Meyer Werft, for the turnkey supply of 24 lifts for the fourth ship (NB-670) in a series of cruise liners building for Norwegian Cruise Lines. Kone was earlier awarded the contracts for the previous three ships in the same series.

Aker Finnyards has also placed an order with Kone for all five lifts for one of the newest passenger/car ferries to be built for Tallink, the Estonian owner, for operation on the Baltic Sea. Kone is also the supplier to all other ships recently built for Tallink.

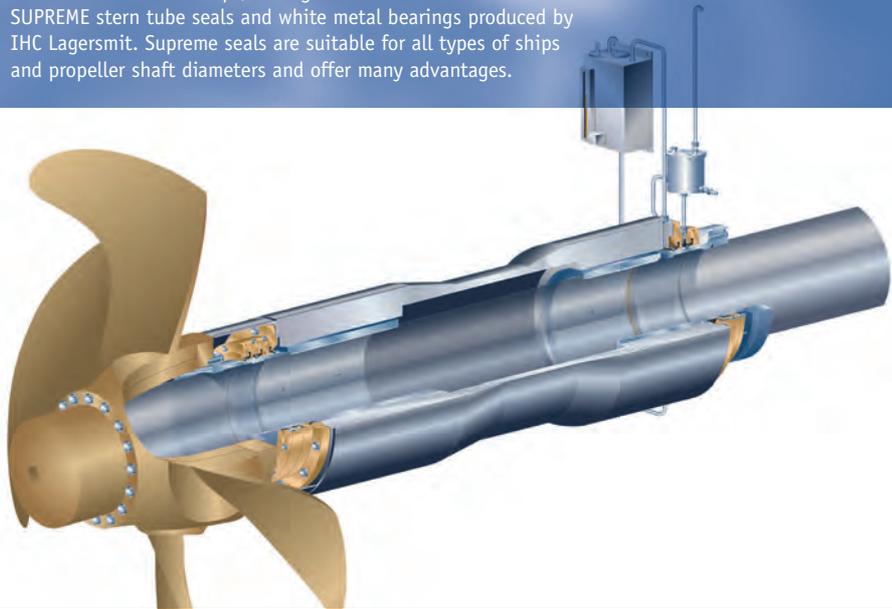
Other contracts include special lifts for Austal USA, which will be installed on two new ferries for use in Hawaii. These low-speed and lightweight units are manufactured at Kone's factory in Motala, Sweden.

Finally, Crystal Cruises, the USA-based operator, has awarded Kone a contract for the modernisation of all lifts onboard the 1990-built cruise ship *Crystal Harmony*. The project will be carried out while the ship is in service in the Pacific.

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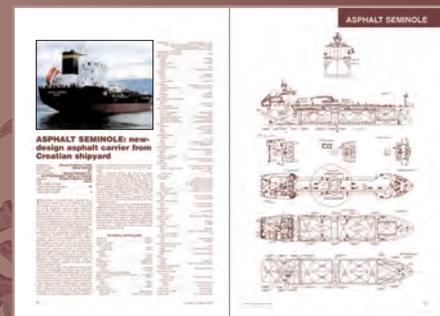
The Royal Institution of Naval Architects has published the sixteenth edition of its annual *Significant Ships* series. Produced in our usual technically-orientated style, *Significant Ships of 2005* presents approximately 50 of the most innovative and important commercial designs delivered during the year by shipyards worldwide. Emphasis has been placed on newbuildings over 100m in length, although some significant smaller cargo ships, fast ferries and offshore vessels have been considered, including a cross-section of ship types, with each vessel being either representative of its type or singularly significant. Each ship presentation comprises of a concise technical description, extensive tabular principal particulars including major equipment suppliers, detailed general arrangement plans and a colour ship photograph.

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Traditional and modern luxury aboard *Queen Victoria*

THE interiors of the new *Queen Victoria*, currently being built by Fincantieri and which is scheduled to enter service in December 2007, will, according to Cunard, have a modern twist on a traditional theme, and will feature some interior innovations. These will include what is claimed to be the first private viewing boxes at sea, in the Royal Court Theatre; the first floating museum, housing Cunard artefacts and memorabilia; also the first two-storey, 'spiral staircase' library at sea, holding around 6000 books. Another impressive feature will be a grand, colonial-style conservatory, complete with central fountain, greenery, and a retractable glass roof, that opens to the sky.

Rooms on this 90,000gt liner, the second largest in the owner's fleet, will be endowed with wood panelling, mosaics, chandeliers, and marble. The ship will also feature Cunard's

Grills accommodation and dining concept, further enhanced on *Queen Victoria* with deck terraces and an al fresco dining option.

The introduction of this ship is also noteworthy as it will mark the first time that

three Cunard Queens (*Queen Victoria* joins *Queen Mary 2* and *QE2*) have been in service together in the company's 167-year history. *Queen Victoria* should depart on her maiden voyage on Tuesday 11 December 2007. ⚓



Two of the grand interiors that will be seen on Cunard's latest liner *Queen Victoria*, when she is completed by Fincantieri at the end of 2007.

Furniture chosen for Japanese re-design

THE London-based interior consultancy SMC Design has specified Morgan Furniture's Chevy chairs, sofas, and tables as part of a re-branding and repositioning of Crystal Cruises' *Crystal Harmony*. This liner will be altered to the NYK brand, under the new name of *Asuka II*; the 48,621gt vessel was built by Mitsubishi Heavy Industries and entered service in 1990.

The layout and design of the public rooms on *Asuka II* have been carefully re-planned to provide a uniquely Japanese cruise experience, in which culture, hospitality, and service are extremely important. The vessel now has space for around 720 passengers, less than as originally built, when she could accommodate 960 guests.

Morgan furniture will be used in the Lido café, a number of conference rooms, the arts centre, a new sushi restaurant named Umihiko, and the bridge lounge. Other new rooms on the ship include a Mah Jong room, a grand spa, and a Tatami room, which will be used for traditional Japanese activities such as tea and flower ceremonies. The new ship design has been tailored for the over-50s market. ⚓



Examples of the claims that Morgan Furniture is supplying for the re-branding of *Crystal Harmony* and her change of name to *Asuka II*.



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By Joe Stiglich

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- Incidents/accidents

The Course Leader, Joe Stiglich, is a retired Naval Officer, qualified NAVSEA Docking Officer and holds a Masters Degree from MIT in Naval Architecture and Marine Engineering. He has been responsible for over 250 safe docking and undocking operations. He currently runs a series of conference and training courses for personnel involved in all phase of the drydocking industry and acts as a consultant for ship repair companies.

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Trim optimisation for reduction of bunker costs

DURING recent years, bunker prices have steadily increased. For this reason, many owners are facing increased operating costs of their fleet, which could be reduced by loading their ships to optimum trim. Recently, Force Technology has been involved in several studies where the focus has been to optimise the performance of ships en route, especially where, as for many ships, bunker costs form a high proportion of voyage and operational costs.

Since fuel consumption is almost equivalent to the resistance and propulsive power of a ship, owners should try to focus on optimum performance of their vessels. In the accompanying table the annual savings of just 1% reduction of propulsive power is calculated for three typical ship types. It is seen that for all three types, the savings are considerable.

Many owners think of hull resistance and propulsive power as a parameter determined only by deadweight and ship speed. In many cases this is not true; for many vessels, resistance may also depend on the trim of the hull. This means that for a given mean draught or deadweight, the resistance may vary with the given trim. Thus, an owner may optimise his bunker costs simply by sailing at 'optimum' trim.

This is especially true for container ships also ro-ro and ro-pax ferries. For these vessels, the wave-making resistance is significant, in which case the performance of the bulbous bow is important.

The bulbous bow of a ship is normally planned for a design draught, and for this draught the bulbous bow works very well by reducing the wave-making resistance. However, for other loading conditions, the bulbous bow may have less or even negative effect. In such cases it may be beneficial to trim the hull to have a better performance of the bulbous bow. As an example, the accompanying figure shows the effect of trim for a 170m ro-ro vessel. From the diagram, it can be clearly seen that the hull should trim slightly by the bow for optimum performance.

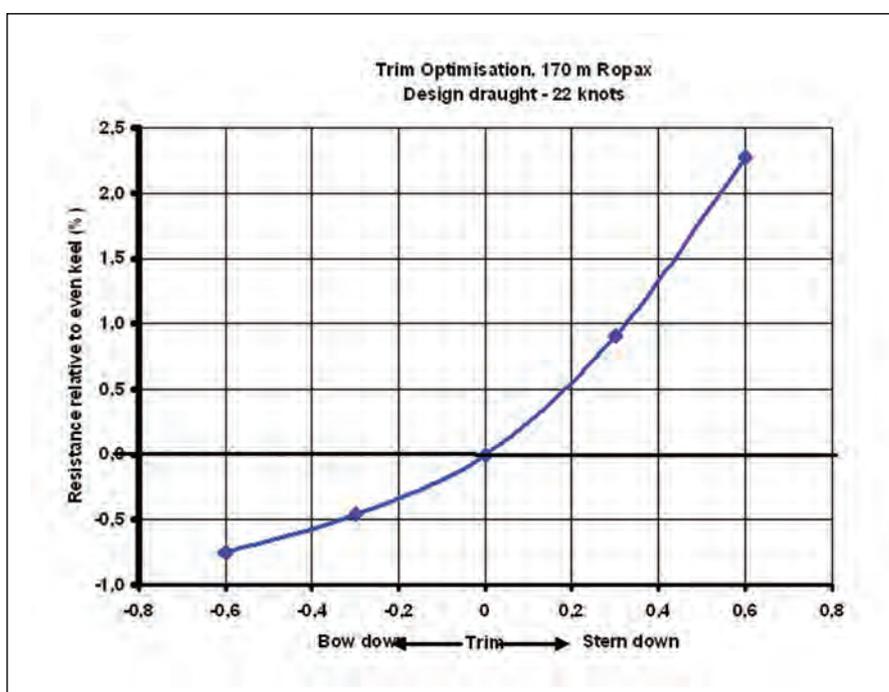
In order to have the correct decision for optimum trim, Force Technology offers to provide ships with a 'trim optimisation diagram'. This trim diagram can be posted on the bridge in order to provide the master with sufficient information as to whether to load or ballast the ship to optimum trim at any time during the operation. The trim diagram is either based on model tests or CFD calculations, or a combination. Studies have also recently been carried out on several tankers and even here potential savings have been found.

Onboard system

The trim estimation diagram is, in a software version, part of the on-board software tool SeaTrend, which will include trim optimisation, hull fouling evaluation, propeller fouling evaluation, and other features - all tools to help an operator to evaluate the performance of the ship and fleet. This software tool will be able to

	130m Ro-ro	170m Ro-pax	4000 TEU
Service speed (knots)	20	28	24
Installed power (MW)	12	40	44
Daily operation (h/day)	16	12	24
SFOC (g/kWh)	185	185	160
Daily fuel consumption (tonne/day)	36	89	169
Days of operation (days)	300	300	300
Bunker price (US\$/tonne)	320	320	300
Bunker costs (US\$/year)	3.5 million	8.5 million	15.2 million
Savings (US\$/year)	35,000	85,000	152,000

Table 1. Potential savings for three ship types from reducing propulsion power by 1%.



A graph showing the beneficial effect of trim on a 170m long ro-ro ship.

provide on-line preview of performance and generate management reports, enabling an entire fleet performance to be evaluated.

SeaTrend will be the third software tool in the onboard series from Force Technology, which also includes SeaSense (onboard decision

support designed to assist the crew in evaluation of performance in bad weather in order to minimise damage to ship and cargo), and the new SeaPlanner (route planning tool developed together with the Danish Meteorological Institute). 

Vortex generators: a simple method of reducing propeller-induced vibration

A SIMPLE add-on feature has been the solution to problematic vibration on a 45,800dwt medium-range product tanker, *Torm Mary*, operated by the Danish owner D/S Torm. A diagnosis of the vibration by the Danish specialist in noise and vibration, Ødegaard & Danneskiold-Samsøe (ØDS), followed the classical procedure. First, a comprehensive measurement campaign was performed on-site during a voyage. The purpose of this investigation was to discover the magnitude of vibration levels and possibly also to identify whether those vibration levels were caused by a specific source, by a resonance condition, or by something else.

It proved up be easy to identify the most important contribution to the existing vibration level. The vibration amplitude originated from vibration at single frequencies corresponding to higher harmonics of the blade passing frequency of the propeller. The pattern was most pronounced in ballast conditions, but was also present when the tanker was loaded.

The conclusion was therefore obvious: excitation originated from the propeller and resonance did - in general - not occur. Consequently, the diagnosis and the cure became clear. There was an unstable distribution of the wake flow, causing an uneven distribution of the water flow into the propeller. The cure was therefore installation of vortex generators.

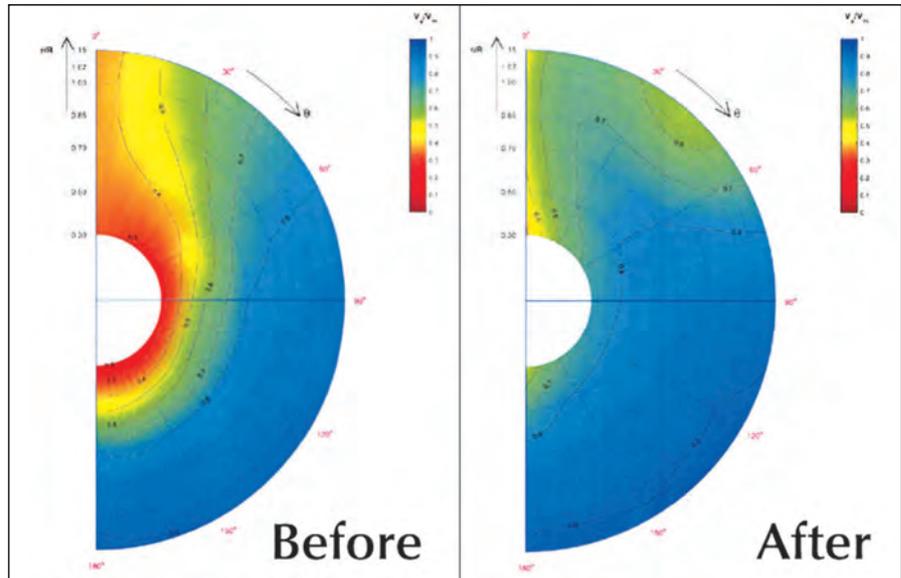
Use of these generators as a measure to reduce vibration has been developed over the years by ØDS and has been recommended in several previous projects, all of which were successful. A vortex generator changes the direction of the water inflow to the propeller. In the actual case of *Torm Mary*, there was a lack of water inflow to the upper part of the propeller area. This lack of water caused annoying vibrations in ballast conditions.

Design and result

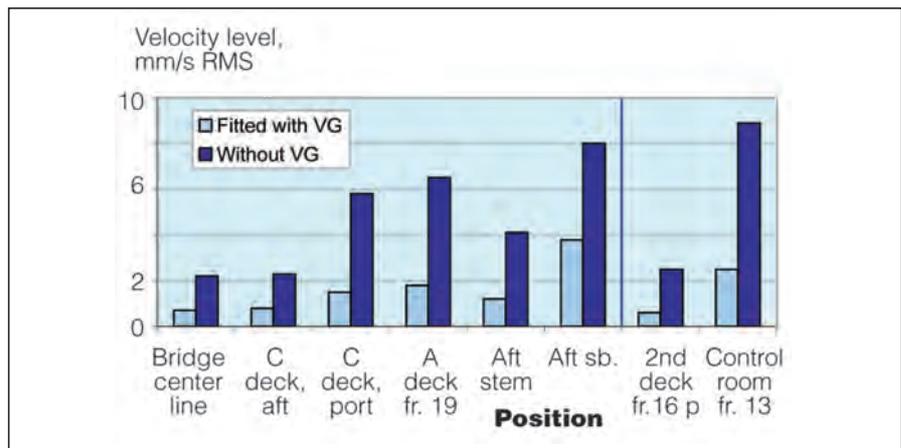
Force Technology (the former Danish Maritime Institute), at Lyngby, has wind tunnel facilities where it is possible - prior to on-site installation - to simulate the result of vortex generators. These generators have the geometry of a triangle, are made as scale models, and are tested in the wind tunnel on a scale model of the hull. Flow along the hull is identified as streamlines generated by means of paint on the surface of the model.

Scale models of vortex generators were tested, and the optimum geometry of each generator and its position on the hull were identified. Subsequently, full-scale versions were installed on *Torm Mary* - one each on the

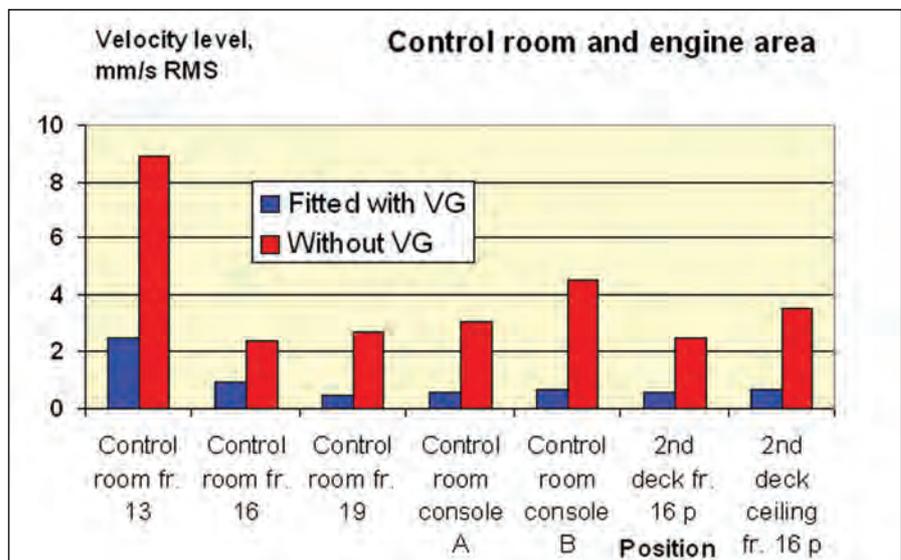
Details of velocities recorded in the engine control room of *Torm Mary*, before and after fitting the vortex generators.



Axial wake distributions calculated by Force Technology before and after mounting the vortex generators (one on each side of the hull) of the 45,800dwt medium-range product tanker *Torm Mary*.

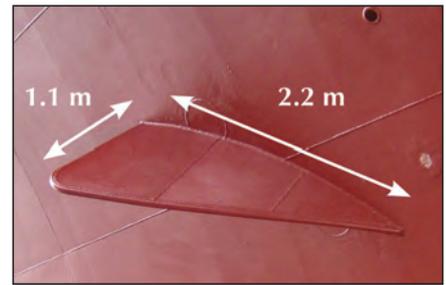


Velocity levels measured under ballast conditions before and after mounting the vortex generators on *Torm Mary*. Columns 1-6 record levels in the deckhouse and upper deck area, and columns 7-8 show levels in the control room and engine area.





The port-side vortex generator on *Torm Mary*, viewed from forward.



One of the actual vortex generators mounted on *Torm Mary*, showing the dimensions. The propeller is to the left.

port and starboard sides. After mounting the generators, water was more equally led to the propeller, ie, the wake peaks were reduced.

The improved wake reduced hull excitation forces, and a significantly better vibration

comfort level was obtained. Additionally, it proved possible to increase engine revolutions by a few percent while fuel consumption decreased by a few percent. A significant increase in the lifetime of machinery is also

anticipated. After the successful result on this ship, Torm decided to vortex generators on five other ships in the fleet. ⚓

This article is based on the article 'Vortex generator can be a simple measure to reduce vibration originating from the propeller', in the No 8 - Winter 2006 edition of *News*, published by Ødegaard & Danneskiold-Samsøe.

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CO₂: a beneficial firefighting medium on car/truck carriers

SEMCO Maritime's department in Copenhagen is continuing recent years' success in delivering large-scale CO₂ low-pressure firefighting systems to the booming car/truck carrier (PCC/PCTC) market worldwide. Production has now increased to more than 25 plants annually, and the present order book extends well into 2009. According to reliable sources in the shipbuilding industry, up to 150 older car carriers have to be replaced with new tonnage within the next few years, thus a bright future is forecast.

Due to the advent of steadily more electronically sophisticated cars, Semco reports a dramatic increase in self-ignited car fires during voyages from factories to importers around the world. With a CO₂ system distributed in various fire zones, a fire in a car can quickly be extinguished, leaving no or only minor damage to the very nearest vehicles. The CO₂ should not harm other cars - in a large fire zone.

Tests with, for example, high-expansion foam, are said to show large-scale damage to many other cars in the fire zone, which has to be followed by a tremendous cleaning-up job since high-expansion foam will penetrate all openings around car engines and wheels. Furthermore, aggressive foam liquids could be harmful to car paint, for example.

Other alternatives using watermist systems have so far been considered unrealistic since most systems have nozzle spacings of 4m-5m. This spacing calls for a huge volume of nozzles and distribution piping.

Semco Maritime is capable of building single-tank systems up to 55,000kg and double-tank systems up to approximately 80,000kg - a capacity which is able to cover by far the largest ocean-going car/truck carriers.

Opting for watermist in the engineroom

Just 10 years ago, it was not common to use watermist for firefighting in machinery spaces - only pioneers had the courage to install water-based system in Class A rooms. Semco Maritime, one of the first in the market with such a concept, installed the first equipment on a new ship in 1995, although some systems had been installed on existing vessels even earlier. Today, owners are no longer worried about possible water damage, and documentation has proven that high-pressure watermist causes no damage in the engineroom, which would probably be the case with low-pressure and sprinkler systems.

Since 2002, watermist has become a natural part of ships' firefighting system for local protection, in accordance with IMO MSC 913 regulation. By having watermist onboard,

owners have become aware of the advantages of such a system, and now demand is claimed to be rising.

The reason for this is that a water-based system can be activated very quickly, and extinguishes equally rapidly, even with open doors. The water cools the interior so re-ignition is avoided. Thus, both fire and water damage is reduced dramatically, and a vessel can be back in service much faster than with a traditional system.

Ferries were the first to adapt the technique, but now supply and offshore vessels, as well as inspection and navy vessels have all started using water mist as standard. For chemical tankers, rising demand is also being experienced, which is expected to grow rapidly in the future. Revised rules from June 2005 have increased possibilities for the system. At the same time, the safety level has been increased due to special demands concerning the use of additives.

Semco should have no problems in meeting these demands, because all its high-pressure systems are based on pure water which gives a clean, harmless, and environment-friendly extinguishing medium. Watermist still has restrictions regarding the size of engineroom which can be covered, so this is a challenge of the future. Meanwhile, the company continues to develop new refinements in order to meet market demands. 

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First air-cavity ship to be ordered soon?

Amongst a number of interesting projects on which work is being carried out at the Knud E Hansen A/S consultancy is a 10,000dwt cargo ship, which could possibly be the first to feature the revolutionary air-cavity concept.

LEADING Danish consultancy Knud E Hansen A/S, which has been through a lean period recently, is today back on course after reporting satisfactory financial results for 2005. The company's team of naval architects and marine engineers are currently very busy on several projects, one of the most interesting being a 10,000dwt multipurpose cargo ship, with icebreaking features, for an undisclosed owner.

It is possible that this ship might be a demonstration platform for the radical air-cavity hull form, which was illustrated in our April 2005 edition, page 16. This concept is being examined by Knud E Hansen A/S as subcontractor for DK Group and the model test facilities of Force Technology.

At the present time, this technology is not optimised for a cargo ship of this size (larger vessels are generally being considered), but several hulls have been tested and a large database set up. Installation of such a concept, which claims lower hydrodynamic efficiency and fuel savings, on a hull could be 'very close'. Although the construction costs of a ship fitted with this system could be in the order of 0.1%-0.3% extra, the investment could be recovered in only one or two years. The accompanying schematic diagram explains some of the benefits.

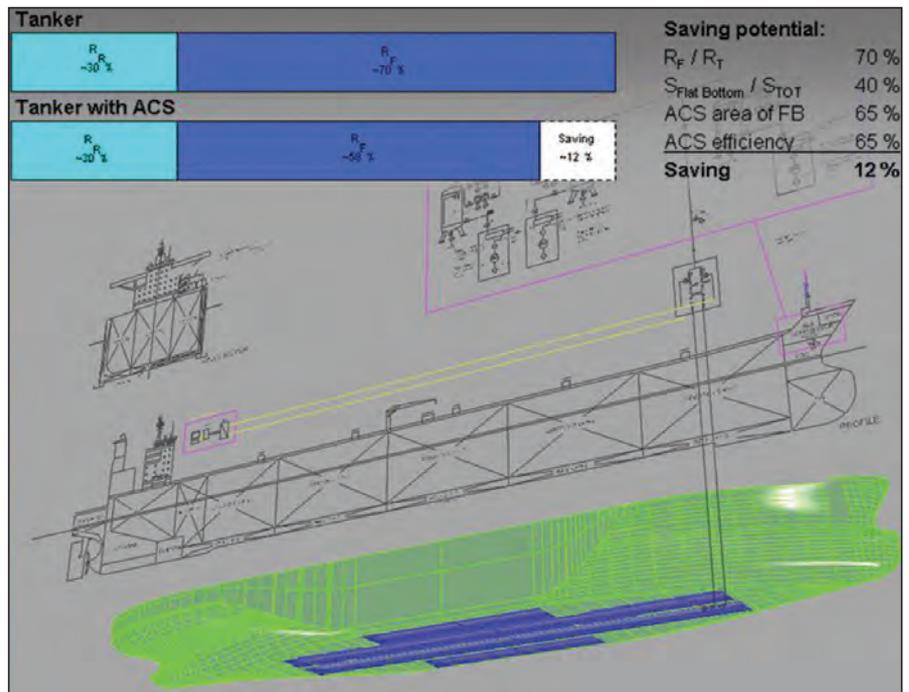
In another project, naval architects at Knud E Hansen A/S are upgrading a design from the former Ringkøbing Shipyard (now closed) for a 100m long container ship, which is expected to be ordered by a Danish owner at a shipyard in Vietnam - if a building slot can be obtained. The full basic design is being prepared, and particular attention is being paid to stability, to meet the newest regulations, since the hull will only have one hold.

A further contract on which work is being carried out, in association with the Singaporean/Italian owner Ultrapolis, is the design of a new 100m superyacht. Knud E Hansen A/S will be involved up to class approval stage.

Expected to go out to tender soon is the proposal for the construction of a new fisheries inspection ship for the Danish government. Here, Knud E Hansen A/S has prepared the complete basic design.

A large project, which has involved many naval architects and engineers, is the planned conversion of the Stena ro-pax ferry *Stena Britannica*, built in 2002 by Hyundai Heavy Industries, in Korea, (presented in *Significant Ships of 2002*) and operating on the Harwich-to-Hook of Holland service. This 43,500gt ferry was based on the smaller Seapacer class

An impression of the 100m-long superyacht to be built for Singaporean/Italian owner Ultrapolis. Knud E Hansen A/S has carried out all design work up to classification approval.



A schematic diagram of the highly interesting air-cavity-ship (ACS) concept, which is being developed by Knud E Hansen and the DK Group. For slower ships, such as tankers and bulk carriers, power savings of between 10% and 15% are anticipated, while for container vessels, the potential saving is between 5% and 10%.

(originally ordered by Stena from the former IZAR Puerto Real yard in Spain, but acquired by Finnlines while under construction).

Another interesting project for the consultancy is the design of two small 60.40m-long shuttle ferries for the Elsinore-to-Helsingborg route across the Øresund. They will not have any ro-ro capacity and will carry passengers only - a total of 386 - at a maximum speed of 14.00knots. They will have steel hulls, with aluminium superstructures and will feature a diesel-electric power plant: three 569kW gensets supplying power to two 600kW Schottel STP500 thrusters.

General layout was conceived by Petter Yran and Björn Storbraaten but the design and layout was further developed and refined by Knud E Hansen A/S, which also made the engineering and classification drawings, and carried out the stability calculations. Copenhagen-based Steen Friis Design is refining the interiors in cooperation with the owner, Sundbusserne A/S. The two ferries are under construction at the Remontowa yard in Poland, for delivery early next year.

Finally, Knud E Hansen A/S is working as subcontractor to Swedish air conditioning specialist Callenberg Fläkt Marine to coordinate air conditioning stations and trunks for the heating and airconditioning (HVAC) system for



During autumn 2004, Knud E Hansen A/S was contracted by Clipper Group, of Denmark, to develop a ro-ro concept for that company's Seatruck operation on the Irish Sea. With an overall length of 142m, the vessels were specifically designed and optimised to suit the infrastructure in the ports of Heysham and Warrenpoint. Subsequently, Knud E Hansen A/S has been responsible for the basic design of the ferries on behalf of the Spanish shipbuilder, Astilleros de Huelva, where the first vessel is now well into the construction phase. This substantial package has included, among other things, structural class drawings, probabilistic damage stability calculations and analysis, also lifesaving and evacuation plans. More details appear in *The Naval Architect* April 2005, page 13.

the two new Aida cruise liners ordered from Meyer Werft, in Germany. Additional studies to improve HVAC systems generally are being carried out in association with Aarhus Shipyard in Jutland, and Hansen expects to continue cooperation with this company in the future. ☺



Eliminating vibration problems at source

THE shrinking or removal of vibration problems created by marine diesel propulsion engines and propellers is one of the specialities of Danish company Gertsen & Olufsen, which designs, manufactures, and installs electrically-driven moment compensators. Such equipment is able to reduce or even eliminate guide force moments, unbalanced moments, also axial thrust- and hull-beam vibrations by creating an opposing sinusoidal varying force and phase-angle that simply outbalances the vibration source.

A typical package consists of three components:

- synchronising unit, which measures and controls frequency, phase-angle, and position of the actual compensator, based on measured engine speed
- encoder unit, which detects main engine speed (3000 pulses/revolution) and the top dead centre of No 1 cylinder
- compensator, which ensures correct synchronisation with the main engine by means of small mass-moments of flyweights and high torque of a servomotor.

External unbalanced moments

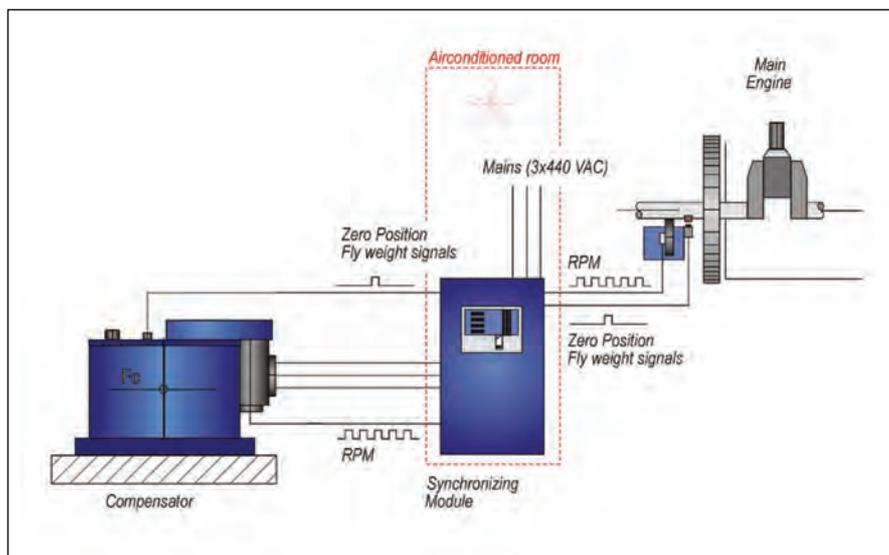
External unbalances are normally caused by inertia of the rotating unbalanced engine mass, with the most common external unbalanced moment being the second order one acting in the vertical direction only and with a frequency corresponding to two cycles/revolution. This problem is most commonly found on four- to six-cylinder engines, and in most cases these can be fitted with an inbuilt mechanical second-order moment damper. By locating a ship's zero hull node, the second order reaction forces causing hull vibration can be enhanced.

As an alternative to built-on flyweights, Gertsen & Olufsen can offer a solution where the outbalancing source (ie, the compensator) can be placed in the steering gear space. The advantage of a longer lever arm between engine and compensator is utilised, and consequently a much smaller unit could be used. Furthermore, the unit is electrically driven and independent from mechanical connections to the main engine.

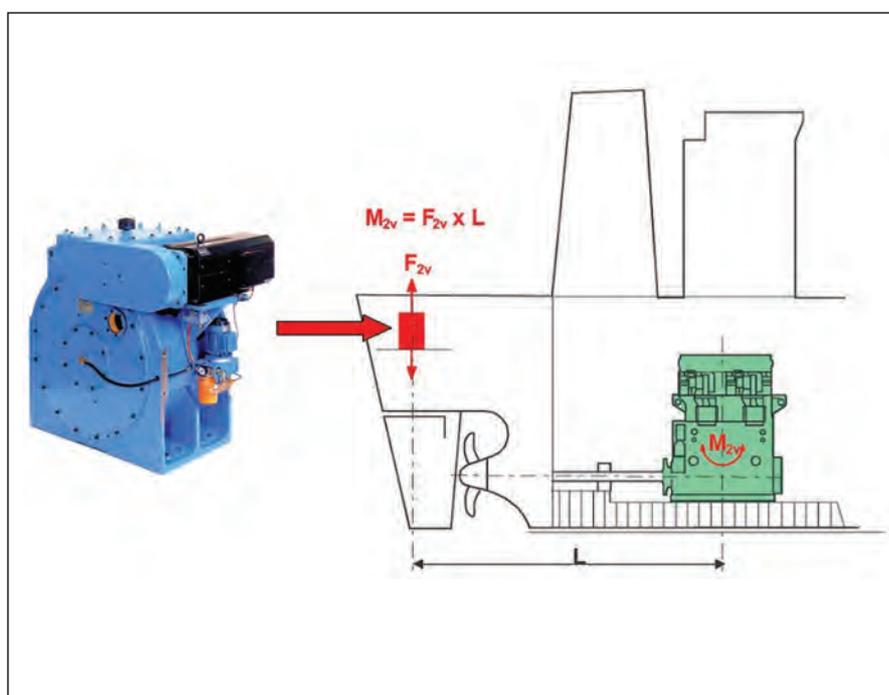
On tankers, for example, the natural hull frequency can change dramatically when the ship is either fully loaded or in ballast. In one condition, the engine could create a resonance, and in the other there could be no resonance at all. By using an independent and electrically driven unit, it is possible to operate the unit only when needed.

Guide force moments

Transverse reaction forces that occur when engine crossheads are acting on an engine's upper structure (converting linear movements to rotating ones causes such guide-force moments) mean that these moments are exciting engine vibrations and moving an engine in a transverse direction. Conventional solutions such as hydraulic top-stays or hull



Overview of a typical Gertsen & Olufsen vibration-eliminating arrangement using electrically driven moment compensators.



An alternative to placing a compensator on the engine itself is to place it in the steering gear room. This is most suitable for relieving external unbalanced moments, particularly of the second-order type; these are most frequently found on four-to-six cylinder engines.

reinforcement will have limited impact on this type of moment, says Gertsen & Olufsen, since they tend to either transfer vibration to other parts of the ship or change the natural hull frequency. Slow-speed engines with four, five, six, or seven cylinders normally produce a guide-force H moment, which can be identified as a transverse rocking moment of the engine top.

To solve such difficulties, the company can fit a compensator directly on the engine so that no moment is spread to other components. The advantage of a lever arm between the compensator and an engine's 'rocking point'

(height H) is harnessed, and consequently a relatively small imbalance is required to outbalance the source. In most cases, removal of top bracings and dampers is recommended.

Confirmatory tests were made on a MAN B&W 5S80MC slow-speed engine installed in a 135,000dwt tanker. A C-40H compensator was fitted on the gallery brackets of the engine outside No 5 cylinder, and measurements show that vibration was reduced from 62mm/sec to less than 3mm/sec in the resonance area.

An alternative solution to remove guide-force moments is to fit two compensators. A test was carried out in Korea at the HSD (now Doosan)

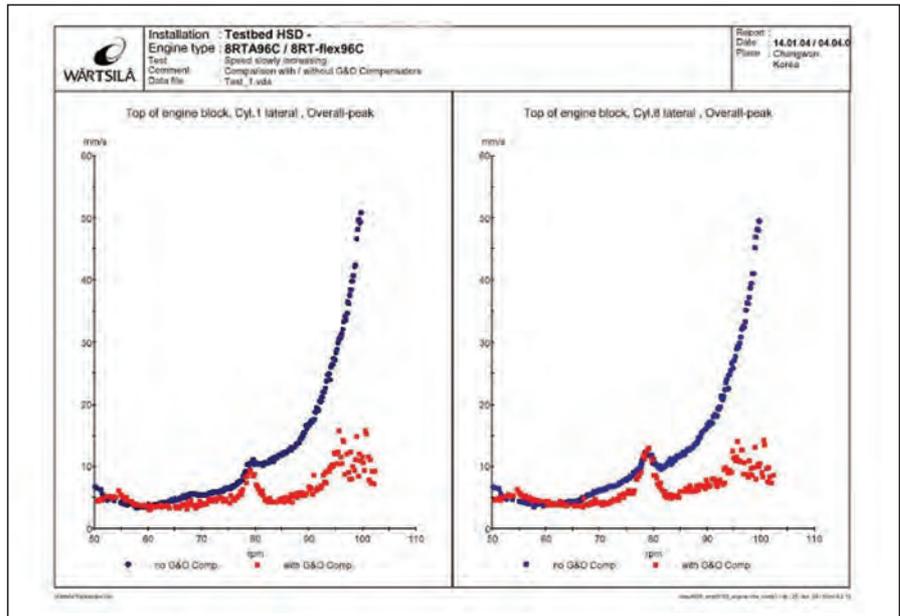
factory on a Sulzer 8RT-flex96C engine, where two C-40H compensators were installed on the gallery brackets outside No 1 and No 8 cylinders. Measurements showed that vibrations were reduced from 52mm/sec to less than 10mm/sec in the resonance area. Additional reductions could be expected once the engine is installed in the ship and specific fine tuning made.

Dealing with hull beam and propeller vibration

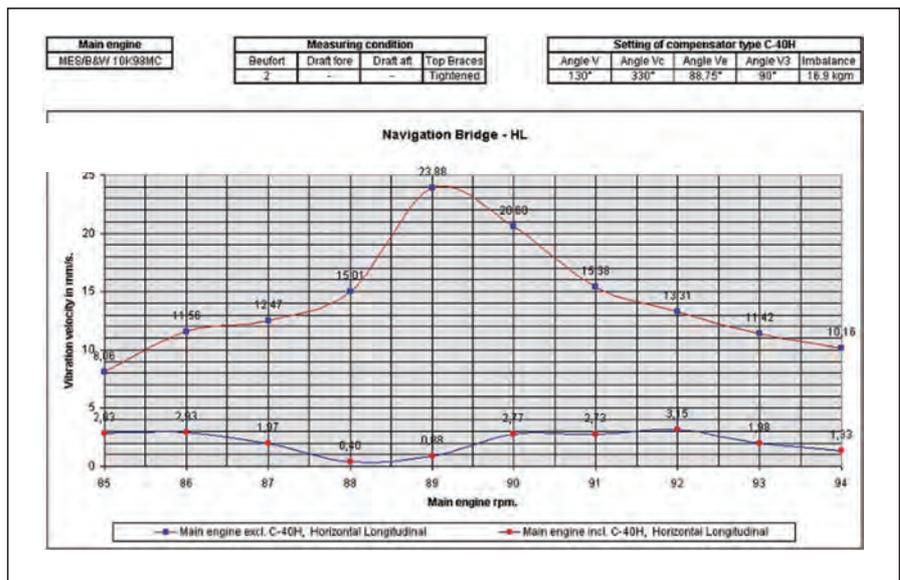
In cases where it is not possible to outbalance the source of a vibration, the second-best choice is to outbalance the symptom/local vibration where it occurs. The advantage of a lever arm between the inducing source and the compensator is utilised, and consequently a relatively small imbalance is required to outbalance the local vibration. Hull-beam vibrations are dealt with by placing a horizontal compensator at a reinforced area of the hull and creating a corresponding counterforce. Propeller-induced vibrations can either be treated as hull-beam vibrations or, in some cases, it is possible to place a vertical compensator above the propeller and thereby outbalance the source.

Such a solution is confirmed by tests made on a MAN B&W 10K98MC-C main engine on a 6000TEU container liner. A C-20H compensator was installed in a small provision room on one of the upper decks. Measurements made on the bridge revealed that vibrations were reduced from 24mm/sec to less than 1mm/sec in the resonance area.

A graph showing measurements made on a 6000TEU container liner fitted with a MAN B&W 10K98MC-C slow-speed engine and showing the reductions measured on the bridge following the installation of a Gertsen & Olufsen C-20H compensator in a small store room on an upper deck.



Graphs showing the results of workshop tests in Korea on a Wärtsilä-Sulzer 8RT-flex96C engine fitted with two Gertsen & Olufsen C-40H compensators installed on the gallery brackets outside Nos 1 and 8 cylinders to remove guide force moments. Vibrations in the resonance area were reduced from 52mm/sec to less than 10mm/sec.



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Danish Marine Group active in the international market

THE Danish Marine Group represents leading companies in Denmark of all sizes, ranging from naval architects, consultancies, equipment and enginemakers, also spare parts and services suppliers, to pipe and fitting specialists, cargo handling equipment makers, and electrical installers. Today, the Danish Marine Group, which was set up more than 30 years ago, is said to be larger and stronger than ever.

With some 120 companies in its portfolio, the group is a strong and very active player worldwide. The group's members cooperate with large maritime classification societies and are generally both creative and quality-conscious.

The Danish Marine Group runs a programme of joint activities and international campaigns including workshops, seminars, meetings, and participations in exhibitions with national pavilions. It is a forum in which member companies can exchange know-how and create formal and informal networks. Additionally, it provides an important platform on which Danish exporters and foreign buyers can meet.

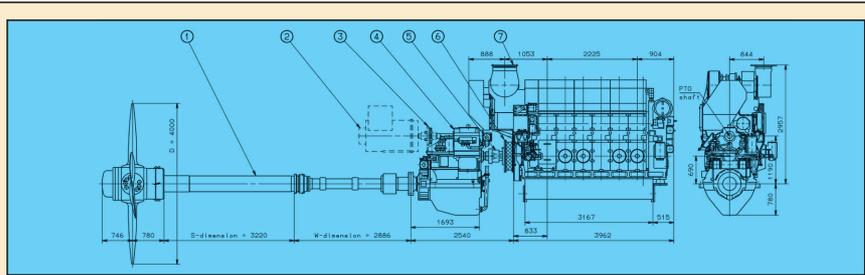
China: an important market

The Danish Marine Group began its export activities in China as early as 1981, and this country is now one of the industry's most important markets. Due to very positive results

at previous Marintec China exhibitions, the Danish Marine Group once again participated in the December 2005 Marintec exhibition in Shanghai, and more than 40 companies took part. Other activities have included trips to Denmark for representatives from Chinese shipyards as well as visits to Chinese shipyards for Danish members. In November 2005, the Danish Marine Group hosted a successful visit in Denmark for a group of representatives from CSSC, the China State Shipbuilding Corp.

More than 20 Danish companies from the Danish Marine Group participated at Vietship 2006, in Hanoi (February 21-24). As a part of the programme, a seminar was organised in cooperation with the Vietnamese shipbuilding industry (VINASHIN). This seminar also served as special Danish-Vietnamese kick-off to the exhibition.

The next joint activity of Danish Marine Group will be Sea Japan 2006 in Tokyo where 17 companies are participating.



An installation drawing for the propulsion package being supplied by MAN B&W Alpha for the series of 3300m³ LPG/ethylene tankers being built by the Madenci Shipyard in Turkey for Italian owner G&H Shipping. These interesting ships were featured in our March issue, page 41. The engine (7) is a 6L27/38-VO model developing 2040kW at 800rev/min, operating on heavy fuel. Between the engine and the Alpha 60VO28EV reduction gearbox (4) is a Vulkan Rato-S GO31W-2301 flexible coupling (6) and a Renk HAW-140 tooth coupling (5). A take-off shaft with flexible coupling (3) is arranged for driving a 650kW Leroy Somer alternator (2), and the CP propeller (1) is a VBS980 model. An Alphasonic 2000 propulsion management system is included in the package.

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Laurent Giles project for Neorion Holdings

IN the world of superyacht and so-called gigayachts, secrecy and client confidentiality is of supreme importance. So rarely is there an opportunity to publish any information on these often immensely lavish and extravagant jewels.

Having recently completed its responsibilities as consultant for the DML-built 77m-long Project Lana diesel-electric vessel (on sea trials during March), Laurent Giles Naval Architects is currently working on four projects in the 100m-plus size range and has, with permission of its client Neorion Holdings, released some brief preliminary details and renderings of the design of a six-deck 'citadel' which, although 122m long, is not by any means the largest of the quartet.

Not long ago the designer's task was really very simple: to create the most eye-catching, innovative, and wonderful opus, providing his client with a vehicle on from which he can enjoy wonderful experiences. Today, there are additional far-reaching and challenging considerations of passenger safety, security, and operational limitations, all of which - if not properly addressed at the outset of a project - could certainly lead to an otherwise avoidable compromise of exceptional proportions.

The Neorion profile is stylish, futuristic and minimalist. Gone are the grand stairways leading from the aft deck to bathing platform. All water access will now be from a beach club or central tender dock, both of which can be closed off and secured. Freeboards are high but cleverly disguised by the organic hull styling features which provide little or no footholds.

Design for Fincantieri includes glass lift

Throughout the spring and summer of 2005 a project that is claimed to be quite unique in superyacht world was taking shape. Subsequently, this proposal - with an external appearance reminiscent of a naval vessel - was launched at the Monaco Yacht Show by Laurent Giles as Project Prospect; this has been created for Fincantieri Yachting (more details of this Italian builder's plans appear elsewhere in this feature).

This 70m-long design includes a lengthy waterline and a conventional forward raked stem. The great potential within a long waterline and full flared hull forward has provided increased interior accommodation volume and comfort for both owner and guests. Throughout the design process, the team of designers has paid very strict



An impression of the 122m-long superyacht being designed by Laurent Giles for Neorion.

attention to the comfort and privacy of guests, and to service routes. Crew access and areas are unobtrusive and self-contained.

In the long gestation period of any such project, the exterior and interior layouts are subject to continued development and refinement. Laurent Giles' standard practice at commencement of any new design is to undertake a thorough preliminary technical study. Initially, a study of similar-size yachts is followed by a preliminary review of naval architecture; weights; also power and stability issues.

Three basic options were considered for the stem: conventional forward raked bow; vertical bow; and after raked, or ram, bow. It was

generally agreed that the market, and the client, was not yet ready to accept the radical ram bow evocative of dreadnought battleships; however, this is being pursued on another design.

Hull work progresses in parallel to the interior space planning as a continuing design spiral, and it is at this time that a commitment is made to the hull lines and superstructure lines, with in-house naval architects using CAD design tools.

In this design, storage spaces are centrally located below the crew areas and replenishment routes are direct. Now, almost commonplace on large yachts, is the inside tender garage, which leaves the open deck areas clear for passenger use. This is a practical use of accommodation

Seen here is an impression of a smaller Laurent Giles design, 70m long, for Fincantieri's portfolio.



TECHNICAL PARTICULARS NEORION SUPERYACHT

Length, oa.....	121.71m
Breadth.....	18.00m
Draught.....	5.50m
Speed, cruising.....	18.00knots
Speed, maximum.....	22.00knots
Range at cruising speed.....	7800nm
Main engines.....	6 x 2500kW
Main propulsion.....	2 x azimuthing pod drives

spaces aft of machinery rooms. It also allow for comfortable embarkation to waterborne shoreside transportation.

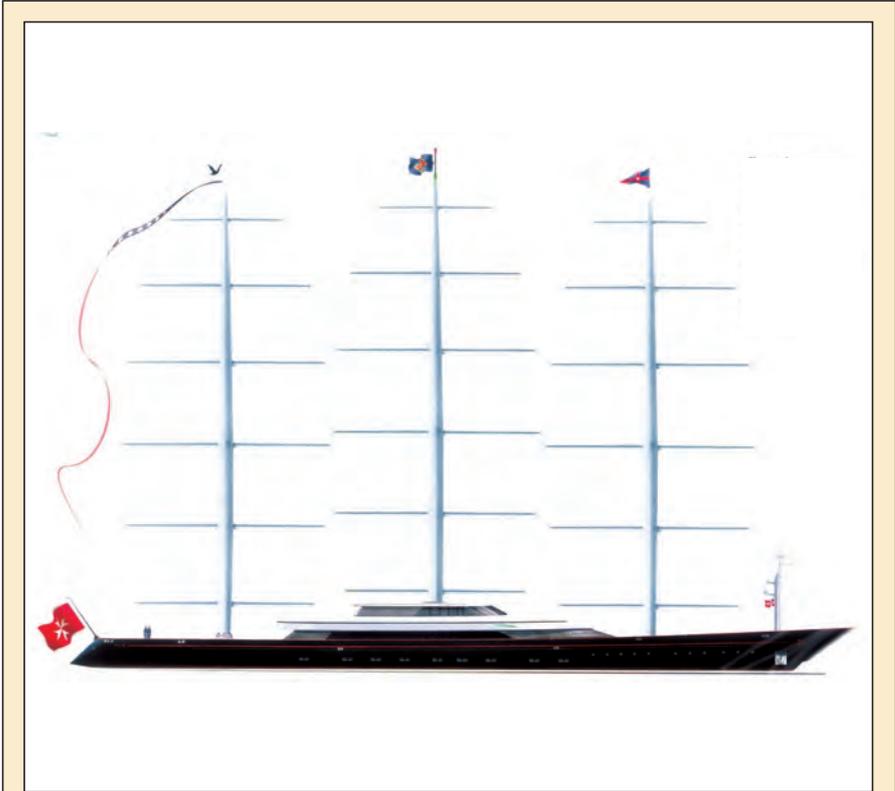
There has been much debate as to the best location for an owner's apartment. Designers of larger yachts devote most or all of a whole deck length. More recently, there has been a fashion to place these rooms forward on the main deck, which within full beam superstructures provide an immense amount of volume and flexibility of layouts.

In Project Prospect, the aft two thirds of the bridge deck in the forward superstructure are devoted to the owner. Each of the two VIP cabins has private terraces and together they have a combined internal floor area of over 100m². As guest cabins, they offer dual-aspect views.

Project Prospect is so named because the vessel has a unique open observation deck which can be reached via a glass lift that rises on the forward face of the main mast and links the bridge and observation decks. This is also a light-free environment ideal for studying the sky at night.

This glass lift, on the crow's nest level, reaches a height of 21m. On the bridge deck, the lift station is attached to and separated from the round spa pool by a glass wall, an effect which, when descending, gives the impression that the lift is about to plunge beneath the water surface.

One special feature of the pool area is the change from inside to outside location facilitated by rotating the full-height clear partitions. This is a system that has been used successfully for dining areas, but as yet never, Laurent Giles believes, on a spa pool.



An impression of a graceful new 87m-long combined sail and diesel-powered yacht currently under construction in Turkey for Perini Navi, and to be named *Maltese Falcon*. When the sails are set on the three square-rigged masts, the two Rolls-Royce Kamewa 50XF5/4D-B/F CP propellers can be fully feathered. Illustration courtesy of Rolls-Royce.

New-concept megayacht design unveiled by Fincantieri

AT the end of 2004, Italian shipbuilder Fincantieri announced its entrance into the megayacht business and a strategic alliance with fellow Italian company Benetti. Since then, the two companies have effectively worked together, starting joint research, development, and training programmes, defining standards and processes, selecting the key strategic suppliers, actively operating on the market, and developing new concepts designs which can be tailored to the specific needs of an owner.

During February, Fincantieri chose the Miami International Boat Show to unveil a new concept design: project Morpheus, by Tim Heywood, an acclaimed designer of large yachts. The 115m-long Morpheus is intended to be a timeless contemporary classic vessel.

All Fincantieri new projects are based on a common set of features, among them, a claimed unique and elegant character of the external design; interiors providing a luxurious décor with a high level of comfort and brightness as well as being developed with a view to logistical efficiency and functionality; a high level of technical content; design solutions targeted to ensure attractive delivery dates; and an overall high product quality. Fincantieri projects should benefit



This artist's impression is of the new 115m-long Morpheus megayacht concept design, conceived jointly by Fincantieri and Benetti.

from Benetti's vast expertise in yachting and Fincantieri's well-established technical capability, engineering, and long-term building expertise.

Fincantieri has already displayed other concept designs at the Monaco Yacht Show 2005, including the 102m project Marco Polo, by Camillo Costantini, which is claimed as an unprecedented off-the-shelf design combining retro and modern styling with a strong Italian character.

These new design developments are a long-term strategy for Fincantieri, and further new design concepts may follow at the next important 'rendez-vous' of the megayacht industry.

Fincantieri's corporate head office is in Trieste, where the company has one of its two design centres; the other is in Genoa. Production is carried out at eight shipyards for vessels of all types, which report to three main areas: the Cruise and Merchant Ship Division, including the Shiprepairs & Conversions Business Unit; the Naval Vessel Division, including the Marine Systems Business Unit; and the Mega-Yacht Division. Fincantieri also controls CETENA - the Italian Ship Research Centre, at Genoa, which works in R&D in the field of shipbuilding and propulsion.

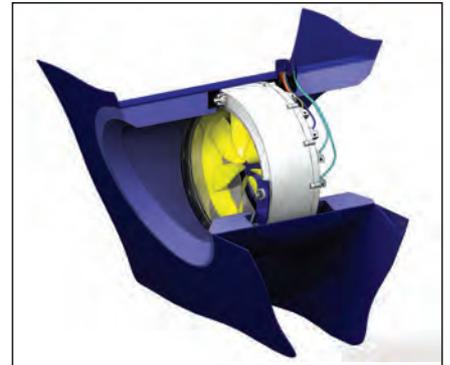
Innovative thruster design aims at significant noise reduction

MEASUREMENTS on a prototype of the new EPS silent thruster developed by Van der Velden Marine Systems, which uses rim technology as opposed to a conventional drive, indicate that expectations are fulfilled. One of the main purposes of the new tunnel thruster developed by the Dutch manufacturer was to obtain low noise levels when compared with conventional products. Measurements were verified by the Danish noise consultancy Ødegaard & Danneskiold-Samsøe during a preliminary prototype test at MARIN, in Wageningen.

The EPS thruster has a significantly different design compared with conventional thrusters. The drive of the new unit consists of a permanent magnet electric ring motor, where the stator is the outer ring and the rotor is an inner ring with the propeller blades attached to it. This eliminates the need for the vertical shaft, gearing, and hub, which connect the electric motor and the



Van der Velden Marine Systems' EPS thruster mounted in a mock-up installation at MARIN, in The Netherlands, for noise tests, which were verified by the Danish noise consultancy Ødegaard & Danneskiold-Samsøe.



An impression of the new EPS thruster developed by Van der Velden Marine Systems. No tip clearance is necessary at the tunnel wall. (Illustration by courtesy of Van der Velden Marine Systems.)



propeller blades as in a conventional thruster. The vertical shaft has an adverse effect on noise level, since it generates a turbulent inflow to the propeller, causing increased noise cavitation.

Another important noise-reducing feature - compared with the conventional design - is elimination of the clearance between the propeller blades and the tunnel wall. With the new thrusters, the tip-vortex is avoided and cavitation minimised.

Noise test

The magnitude of noise level generated by the EPS thruster was evaluated by determination of the underwater noise source strength. The thruster was mounted in a mock-up, and operated with the thrust in the longitudinal direction of the tank.

Ødegaard & Danneskiold-Samsøe used hydrophones mounted in an array in the tank for measuring the noise signal. The actual sound propagation properties of the tank were

A cutaway view of the EPS thruster. As can be seen, no external requirements, apart from power, are necessary. (Illustration by courtesy of Van der Velden Marine Systems.)

determined before mounting of the mock-up by use of a calibrated sound source mounted in the same position as the thruster. This source was a detonator of the same type as occasionally applied in harbour tests of ship natural frequencies.

How much quieter?

At the present time, it is difficult to say how much quieter a production EPS thruster will be. A magnitude of 5dB-10dB was obtained by comparing the measured level with the predicted level of a conventional thruster. But in order to be able to make the final comparison, the mounting method also has to be included.

The EPS was rigidly mounted via load cells to the mock-up during the MARIN tests. The elastic mounting planned for installations in real ships is expected to further reduce the level of noise transmitted to the ship structure. Further measurements on a real installation, which is currently on order, will verify the effect. 

This article is based on the article 'Innovative thruster design aims at significant noise reduction', published in the No 8 - Winter 2006 edition of *News*, published by Ødegaard & Danneskiold-Samsøe.

FACT, NOT FICTION

THE NAVAL ARCHITECT



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IF YOUR **NEXT** ADVERTISING SCHEDULE INCLUDES TITLES
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Selecting a suitable hull definition package

IN this introductory article, the focus is on hull modelling software, though most packages offer additional capabilities such as hydrostatics and resistance analysis. Obviously, these other features are very important, but it is beyond the scope of this article to investigate them in any great detail. It should be noted that only software running under Microsoft Windows has been examined, since this is the platform that the majority of ship designers are currently using.

Background to hull modelling software

Computers require a mathematical representation of the vessel being created. There are many ways in which this may be done. One of the most common is by representing the vessel's envelope by a number of 3D surfaces. An alternative method is to use 3D curves to create a mesh which defines the envelope. Using this mathematical representation, modern computers are able to perform sophisticated analysis of characteristics such as fairness, plate expansions, mass, centre of gravity, hydrostatics, stability, resistance, and seakeeping performance. With the correct tools, a designer is able to investigate a wider range of design alternatives in greater detail.

The vast majority of these programs use NURB (non-uniform rational B-spline) surfaces to represent a vessel. Some, notably MultiSurf, support a wider range of surface types in an attempt to overcome some of the limitations imposed by using only NURB surfaces. Other programs have functions to calculate NURB surfaces for the user, which fulfil certain requirements, for example, developable surfaces between two edges, lofting a surface through master curves, and filleting and joining surfaces.

Because the NURB surfaces representation is so universal, it is worth giving a reminder of some of their properties; if a NURB surface modeller is being used, then this background information is almost essential to understanding how to achieve desired characteristics in your hullforms. A NURB surface can be thought of as a rectangular patch of rubber that can be stretched by pulling an array of control points; one or two edges may be collapsed to reduce the patch to a triangle or line.

These topological restrictions are typically overcome by allowing the hull model to be made up of a number of NURB surfaces, which may be connected along common edges or trimmed where they intersect one another. NURB surfaces may also be made to have hard points or creases, which run part or the whole length of the surface; this can be useful for defining chine lines and knuckles in hulls.

* Patrick Couser, MEng, PhD, CEng, MRINA. Before becoming an independent consulting naval architect in 2004, Patrick worked for Formation Design Systems, BMT Seatech, and several universities, using and developing a wide range of design and analysis software. Amongst other projects he still continues to be involved in the development of Formation Designs Systems' Maxsurf suite.

In a unique series of articles specially compiled by consultant Patrick Couser*, a selection of hull modelling software currently available will be reviewed. As an introduction, the author provides some suggestions for technical features that prospective purchasers should seek when selecting this type of software package for their design office or shipyard.

Today, a very wide range is available, and naval architects will find it well worth spending some time examining demonstration versions, user documentation, and sample files to obtain a feel for particular programs prior to a purchase. It is emphasised that in these articles, only hull modelling software has been included, and that such software is primarily suited to medium-sized and small companies, or for individuals. Only a selection of products is being reviewed, and the first reviews will appear in May.

Creases may be made by adjusting a surface's knot vector or by compacting adjacent control points to the same point in space. Knot-vector adjustment will affect the surface along its entire length, though suitable positioning of neighbouring control points can be used to make a chine that fades out. Compacting control points is ideal for this type of feature. Not all modellers support the use of compacted control points, so it may be necessary to check compatibility. Alternatively, two surfaces may be joined to form a chine, and again suitable placement of neighbouring control points can be used to make the chine fade.

Regarding the manipulation of NURB surfaces, there are essentially two schools of thought. The first focuses on direct manipulation of the control point mesh that defines the NURB surface (for example FastShip, Maxsurf, and Naval Designer). A variation of this method uses a small number of points on the surface itself and calculates the required movements of the NURB control points automatically (for example, ProSurf). This is practical if the surface has a relatively small number of control points but is impractical and very difficult to fair if the surface has many control points closely clustered together.

The second method hides the control points from the user and uses other methods for defining the shape. These might include definitions of master curves and automatic generation of surfaces between these curves (for example, SeaSolutions). Some systems implement both of these; for instance, AutoShip, Rhino, and MultiSurf will allow a user to generate surfaces from master curves but also allow direct manipulation of the surface's control points.

NURB surfaces have the useful property that they are always at least as smooth as the control point net defining them. For a linear surface, the surface will follow the control point net exactly, for higher-order surfaces the surface will be smoother than the control point net, with the smoothness increasing as the order of the surface is increased. This means that if a user defines a regular and smooth control point net, then the surface defined by the net will be even smoother.

However, if the surface has a large number of control points (and especially if the order of the surface is relatively low) then it becomes much harder to maintain a smooth net and hence fair surface. Under these conditions, semi-automated faring tools are required, which can be used to smooth patches of the surface.

If a system based on NURB surfaces is being employed, then the better the understanding of their capabilities the better use will be able to be made of them in vessel designs. For a more detailed discussion, there are many texts (and web sites available). The *NURBS Book*, Piegl and Tiller, 2nd Edition. Springer 1997, ISBN 3-540-61545-8, is a useful start.

This article can only be a starting point. Each user's needs will be unique so the software will have to be evaluated carefully. Here are a few points to consider when doing this.

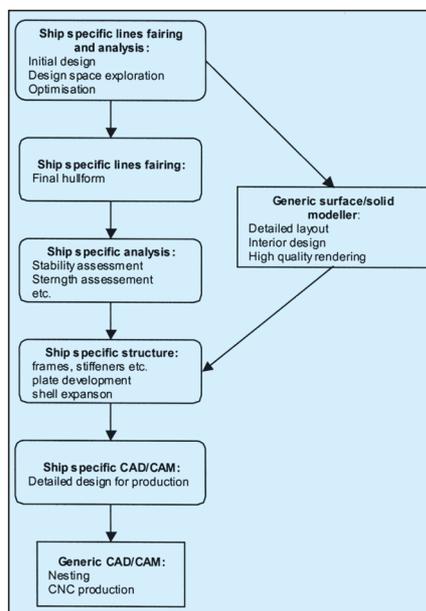
Value time

First of all, it is recommended not to simply choose the cheapest product. Time is a most valuable asset so choosing a system which will increase productivity and save time may cost less in the long term.

Try the software

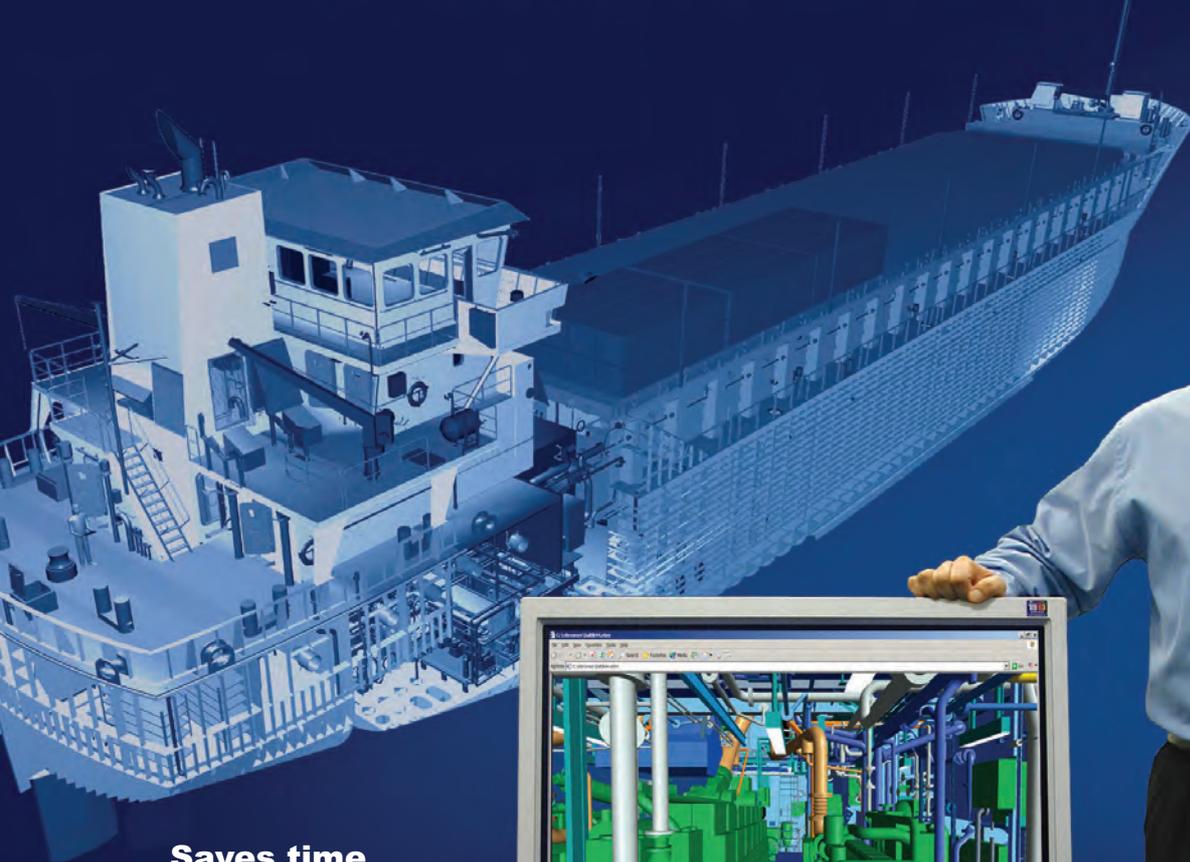
It is all too easy to try and compare software by looking at a list of features, but the author would recommend trying as much of the software as possible. It is only in this way that a true feel for the program's capabilities can be secured. Most

Progress chart for selection of the most appropriate CAD package.



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companies have demonstration versions which are either time-limited, or have limited or no save and print capability. However, these demo versions will at least give a chance to try the software first-hand.

Manuals should also be provided and this is also a good place to assess the quality of the product: well-written and thought-out manuals can be indicative of well-written and thought-out software - the converse is also true! First impressions can be important - is there an immediate feel of being at home with the software? Do the expected functions and controls fall at the fingertips?

A user should be able to load a sample model, navigate through the various views, and perform some basic manipulations on the model. A well-designed user interface should not take long to become familiar. However, sophisticated, powerful software with many features (not just a word processor) is being discussed here, so give it time and work through the examples and tutorials, especially with some of the more complex functionality.

Samples, tutorials, training, user support

What is offered and what costs extra? A demo version should come with a wide variety of samples which show the software's features and give useful examples of how to model specific hull features. Ideally, there should also be a number of tutorials, working through examples and helping the user to familiarise him or herself with the software. Sometimes these may be in the manuals themselves so at least have a quick look through the documentation.

This will also give a feel for the functionality that is available in the software. Is there any more advanced training material available or can training be provided? What level of user support is available? Also ask a few questions and see if a useful response is received in a timely manner. Are there any other resources - sometimes there is an online users' forum?

User interface

Like it or not, Microsoft has been and will be setting the standards for PC-based applications. Everyone who uses a PC with a Microsoft operating system will use some Microsoft applications such as Word, Excel, Outlook, and Internet Explorer. For CAD users, the de-facto standard is set by AutoCAD. Now these may not have the best user interfaces, but everyone is familiar with them, so software which deviates from these norms must provide a significantly better user interface for it to be accepted.

When a new piece of software is being examined, if the user interface, or at least parts of it, are familiar, then a user will instantly feel more at ease and more confident in exploring the software. Similarly, with an infrequently used piece of software, if the general layout is similar to the software used daily, re-familiarisation will be that much quicker.

Hull modelling is conceptually a relatively simple task; it is the execution of the interface that differentiates good software from poor software. Any interface can be learned, but learning will be quicker and the program easier to come back to if it follows good user interface design principles and standards. The user interface should follow these principles:

Intuitive: new users should be able to pick up the program and go

Feedback: should provide instant feedback. Computers are fast: instantaneous graphical and numerical feedback for all but the most complex tasks - dynamic updating of the hull surface/fairing lines; position of cursor; tool tips and menu item explanation

Standard menus

File: loading/saving, export, and printing

Edit: general editing, such as copy and paste

View: how the data is displayed on the screen

Application-specific menus: range of menus specific to the application, for model definition and other purposes

Window: window arrangement and selection

Help: access to online help, manuals, tutorials and program information

Context menus: invoked by a right click on a certain object, these menus provide a short list of relevant commands. Most modern software now has this feature

Context-sensitive help: help which automatically relates to the command being used

Interactive drawings: selection and manipulation of objects on screen

Customisation: tool bars, default mouse button behaviour, macros and scripting with Visual Basic for Applications (VBA)

Efficiency: Minimise number of mouse clicks and keystrokes required to achieve a certain task

Multiple user-interface methods: Provide interface to commands via keyboard and menu items. New users will tend to follow menu items; however, experienced users will be more efficient using a combination of keyboard and mouse

Make best use of mouse buttons: Left, right, wheel, wheel click

Consistent: Should 'feel' like other commonly used software (even if it is not perfect) such as Word, Excel, or AutoCAD).

Furthermore, the conceptual model of the program should be simple and easily understood: how data is stored and how the user interacts with it.

First models

Do not try to fit a NURB surface model to a 2D lines plan as a first project - it is almost certain to fail! This is especially true for newcomers to 3D and NURB surface modelling. This is a difficult problem and requires a reasonable knowledge of the limitations of NURB surfaces and how best to set-up the surface topology to model a vessel.

Instead, try a really simple round-bilge form that can be modelled with a single surface - like a round-bilge yacht hull with a transom stern. Once the basic hullform is formed, decks, keels, and rudders can be added and surface trimming investigated. As a second project, try a chine power-boat, here bonding surfaces or controlling the surface knot vector can be investigated to produce chines and features in the surface. Do not

worry about the dimensions of the hull early on. Once the desired shape is achieved, this can easily be re-scaled to the desired length, breadth, and draught.

It is probably inevitable that at some point NURB surfaces will need to be fitted to offset data. It is beyond the scope of this article to go into the details of how to do this; suffice it to say that it is not an easy problem to solve, especially if the user wants to end up with a fair parent hullform for subsequent modification. A very good article which covers this subject in some detail has been written by Bruce Hays, of FastShip which can be found at www.proteuseengineering.com/files/surfacefitting.pdf

Data exchange

Any user will have to export data from his/her system and import it into another, whether it is for high quality rendering or because a customer or shipyard uses a different system. Virtually all modellers use a NURB surface representation, so it makes sense to choose a system that can export NURB surfaces in IGES format.

A surface-mesh representation is much less useful since it is only at one resolution and may not be compatible with all other systems. For the export of lines-plans and other drawings, this can be done with polylines in DXF format, though this still has the problem that it is only at one resolution. However, this drawback is less restrictive for simple lines compared with a surface model.

If you are changing systems, can you transfer designs backwards and forwards between these two? It may not be possible to save or export from some demo versions so ask the vendor to do some sample exports so that the user can verify that they can be read.

If the modeller is part of an integrated suite of software, then there is a greater chance of seamless data exchange between the different programs in the suite. The better integrated systems will allow concurrent engineering so that additional vessel information (eg, layout of main structural components) can be commenced before the final fairing is completed. Modifications to the vessel can then be taken into account simply by recalculating the necessary components, but without the need to redefine them.

Reliability

A computer crashing and subsequent loss of data can be very annoying. However, operating system and software reliability has improved significantly since the days of Microsoft Windows 95. Having said that, it is still very good practice to save a design regularly - every two minutes, or before attempting a command from which it may be necessary to roll back. Some of the software tested did crash, and this is an indication that the vendor's quality assurance is perhaps not always as good as it could be.

Licensing

An important consideration, especially when purchasing software for a design office with a number of people in the team, is the method used to license the software. In many cases, a network licence can be purchased and this allows one or more licences to be shared over a network. However in some cases, a stand-alone licence

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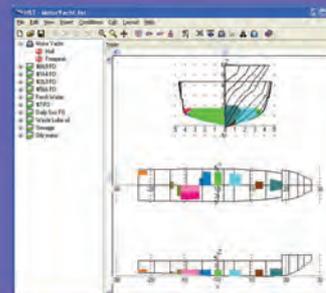
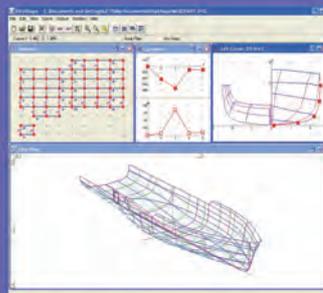
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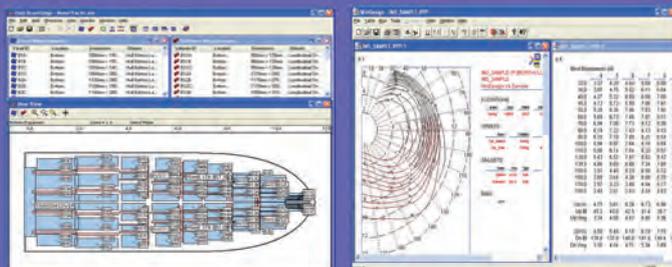


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may be preferable as this allows use of the software when a network connection is not available. The vendor should be able to provide a system to suit specific requirements.

Useful hull-modelling software features

Below is a list of commands that are useful for ship design (depending on the type of vessel) but that are also, in many cases, quite specific to software developed for ship design. Although some may seem trivial, they have been found to be great time-savers:

- numerical display of cursor position, and tools for taking measurements off the design
- group numerical editing of control points, for example, selecting all control points that define a deck and specify their vertical value without changing their offsets or longitudinal position
- align to vector and align to plane (with constraint). The ability to align control points along a vector is essential to smoothly connecting surfaces and for making a smooth transition from keel to stem in the forward part of a ship. Align to plane is very useful for making the deck edge a planar curve, which is better aesthetically. Being able to apply constraints in a particular direction is also very handy. For instance: aligning stem control points to make a straight stem line, a designer may wish to constrain their vertical position so that the height of chines is not altered; or constrain their longitudinal position so that the vessel length is unchanged
- step through control point row and columns sequentially. Although modelling in 3D, it is often easier to manipulate hull sections in a body plan view. To do this efficiently, it is useful to be able to hide all control point columns except the one that is being worked on. In the same way, when working in plan view, especially if there is a bulbous bow, it is convenient to be able to work on a single control point row at a time. It is very useful to have a tool which allows all control points except those of interest to be quickly masked out
- tabulated values of control point locations that may be copied to and from a spreadsheet. This provides a very useful method for manipulating surfaces in a mathematical manner. It can also be useful for ensuring symmetry for all, or a particular part, of a catamaran demihull
- multiple surfaces and efficient ways of managing surfaces. Initial designs are becoming more and more detailed. To make a clean design, several surfaces are often needed, sometimes tens or perhaps hundreds of them depending on the level of detail. Although there are tricks for making quite complex shapes from single surfaces by compacting control points or manipulating the surface's knot vectors, these can become unwieldy. Once multiple surfaces are obtained, an efficient method of managing them is needed - hiding their control points so that the surface shape cannot be edited, and changing surface visibility. This is typically done by placing the surfaces on different layers or, perhaps more often, grouping surfaces in a logical manner in a tree
- automatic slope - C1 (and possibly curvature - C2) continuity between surface edges
- trimming and bonding surfaces to surface curves. These are two quite different, but equally useful features. Trimming allows discrete surfaces

that need to be faired independently to be connected, for instance, a rudder or stabiliser fin entering a hull, or a moon-pool through a vessel; in these cases the surfaces are quite independent of each other. Bonding to surface curves allows surfaces to be connected in a manner that also allows fairing of one surface to affect the other. This is useful where there are surfaces which blend into one another, such as a sonar dome or perhaps a skeg keel or thruster pod

- fairing tools. One of the main aims of the naval architect is to produce a fair vessel. 3D false-colour rendering of curvature is useful, but of more use is the ability to plot curvature porcupines along surface curves, sections, waterlines and buttocks; these allow a designer to see exactly where inflections appear in the curves. A foreshortening tool, which compresses the display in the longitudinal axis with respect to the transverse and vertical axes, is also very useful, especially for long, slender hull-forms
- tools for fitting surface edges and surfaces to spatial data. It is a very common requirement to model an existing vessel with a NURB surface model. Fitting surfaces to spatial 3D data is perhaps the hardest aspect of NURB modelling. Any tools which can assist in this process will be valued
- display of a background image. If no access to a digitiser is available, being able to display a scanned lines-plan in the background can allow a user to fit surfaces and/or digitise spatial data. Ideally, the software should be able to scale and position the drawing as required
- developable surface tools, ruling lines, and automatic generation of developable surfaces. These tools assist with the definition of developable surfaces. Some programs have the ability to automatically generate developable surfaces between two suitable edge curves (there is not always a smooth developable surface between two arbitrary curves). Others calculate ruling lines between the edge curves; the ruling lines are then used as the basis for generating a developable NURB surface. It is extremely helpful if the ruling lines update automatically with changes in the two curves as this enables the designer to adjust the edge curves so that a suitable developable surface exists (generally speaking, none of the ruling lines can cross within the edge curves)
- Visual basic for application (VBA) automation (or COM) allows design software to be programmed with the VBA scripting language, giving access to the software from spreadsheets, optimisers and other tools.

Ship-specific or generic CAD package?

The answer is probably both, depending on the level of detail required in the design. Listed below are some of the advantages of each.

Ship-specific package

Optimised for ship design: knowing that software is going to be used for ship design enables developers to focus on features that are useful for ship design. This (generally) results in a less cluttered interface, eg, exploiting the fact that most surfaces will be symmetrical about the centreline plane to avoid unnecessary duplication

Developed by or with the input of naval architects: if all the user feedback is from

naval architects, then there is a better chance that the tools required by naval architects will be found in the software.

Useful tools that require ship knowledge: some manipulations require this: parametric transformation of hull to specified displacement, form coefficients, and other aspects.

Integrated naval architecture analysis: hydrostatics, resistance, seakeeping analysis, part development. This is essential for being able to perform a full design cycle. If a team is doing the design, it is often more useful if the analysis software is independent of the design software but working from the same design data. This enables concurrent design and analysis with different team members checking stability compliance, resistance, and seakeeping analysis, and planning primary hull structure, then feeding this information back into the next design cycle.

Customer support by people who know ships: when difficulties arise, users are more likely to be speaking to people who know the subject.

Generic package

More features: due to a wider customer base requiring a wider range of tools, there will generally be more features

Generic CAD features: the software will probably have more general CAD features such as annotations and dimensioning, not typically found in ship-specific software

Cheaper software: because the vendor can sell the same software to a much wider user-group, the software should generally be cheaper than the ship-specific software which has a much smaller user-group.

Better quality rendering, virtual reality: more and more emphasis is being placed on high-quality visualisation. Not only does this provide valuable marketing material but these tools can be very useful for ensuring that a customer is going to be happy with the product when it is built. Generic CAD packages will tend to have greater capabilities than the ship-specific software, either through built-in functions or third party plug-ins. These can offer features such as ray-traced renderings with texture mapped surfaces and realistic lighting and backgrounds for a photo-realistic impression of the finished product; and virtual reality fly-through, which can assist in picking up potential construction or operational problems due to the design and layout of structure and machinery.

The ideal is probably a combination of several software products (depending on which parts of the vessel design/build/analysis process one is involved with).

Further reading

www.pilot3d.com/NurbSecrets.htm - an interesting article on the implications of modelling hulls with NURB surfaces.
www.boatdesign.net - includes an interesting software review forum and popularity polls. 

The first reviews of individual software will appear in the May 2006 edition of *The Naval Architect*. Companies not already contacted are invited to submit details of their hull definition packages for consideration, together with a demonstration disc for analysis.

Handling of hull surfaces enhanced through software merge

AVEVA'S Vantage Marine suite, now in version 11.6, combines Tribon's well-established hull design and production solution with the outfitting functions of PDMS. Version 11.6, with its major new features, is actually a merger of the Tribon M3 Hull module and PDMS for outfitting; PDMS is an established outfitting design product from Aveva that has been used in over 80% of all new offshore projects, platforms, and FPSOs since 1995. The Tribon shipbuilding system (today, Tribon Solutions is part of the Aveva group) was developed from two starting points: the need to control plate-cutting machines, also the requirement to calculate intact and damage stability for several load cases using digital computers.

These two requirements both demanded a digital representation of a ship's hull surface, and the techniques for defining and manipulating surfaces has always been one of the cornerstones of the system. Vantage Marine covers the whole hull design process from initial concept studies to final block assembly. The hull surface plays an important role all the time, but three distinct milestones can be identified:

- definition of a preliminary surface for initial capacity, stability, and hydrodynamics assessment
- refinement of the initial surface to basic design quality, ie, to a level of accuracy sufficient for classification purposes and for a first high-quality estimate of steel weights, steel surface areas, and other factors
- final fairing of the surface for production quality and final calculation of stability.

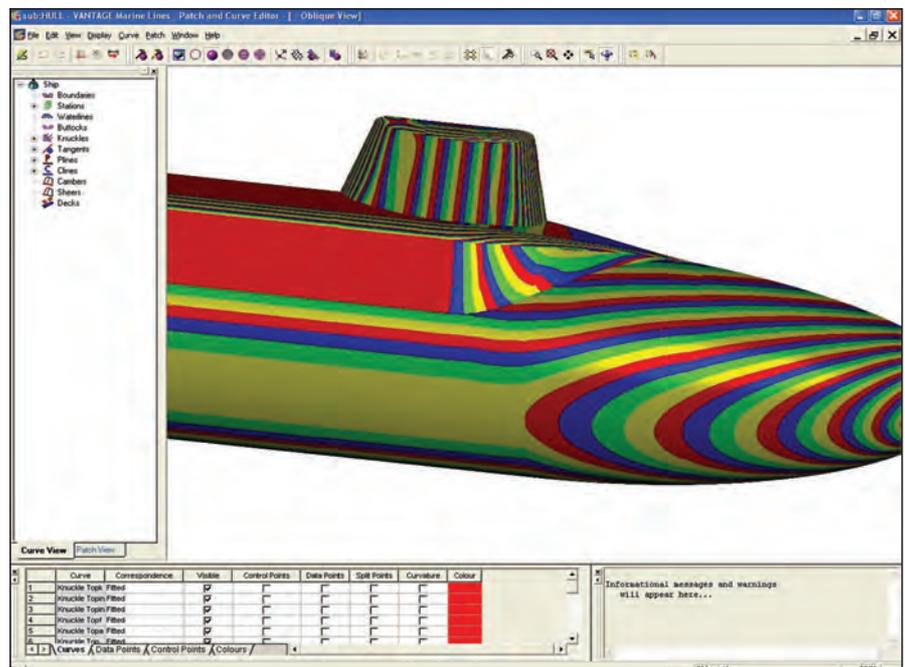
Those three versions of the surface are all handled by the same tools in Vantage Marine. This means that there are no discrete transfers from one version to the subsequent one; instead, they can overlap and be used in a mixed mode.

The structural modelling tools are generative, which makes it possible to regenerate automatically the steel structure when a new version of the hull surface becomes available. In this way, a complete hull surface and structural steel definition process in Vantage Marine is fully integrated, offering freedom for the user to shape work processes the preferred way.

Initial design module - features

Lines - This is a hull fairing tool based on traditional methods that can be used to create virtually any form of marine vehicle including multi-hulls, chined, and asymmetrical hulls. The hull form is initially represented as a loosely connected mesh of curves that is used to create a network of 3D surface patches.

Features include: interactive point and curve editing; traditional 2D or advanced 3D fairing; automatic curve fairing and data reduction; special handling of waterline ending and frame feet; sectional area curve distortions and scaling; deck creation; lines plans and loftbooks; semi-



A screen shot from Vantage Marine's hull-handling software. In its newest version, 11.6, this package is a union of Tribon M3 Hull and PDMS for outfitting.

automatic surface generation; and downstream transfer of hull surface to other Vantage Marine modules.

Surface - This module is principally used to define a product model of the outer surfaces of a main hull and its appendages. At its core is a 3D solid modelling kernel (ACIS) that can be used to create many additional features for ships and other structures. Main features include:

- primitives - plane, block, pyramid, cylinder, cone, sphere, toroids
- curved surfaces - swept, extruded, rotated, formed surfaces, three or four-boundary interpolated patches, tube
- curve primitives - polylines, splines, lines, arc, ellipse, NACA sections
- operations - subtract, unite, solid intersection, intersect, imprint, join, blend, scale, move, rotate, align, reflect, copy, concatenate, control point editing
- 2D operations - join, trim, cross, offset, fillet
- visualisation - principal curvature, curvature tufts, Gaussian, Isophotes, transparency, lights
- lines plans and loftbooks.

Compartment - This facilitates the quick definition of transverse bulkheads, longitudinal bulkheads, decks, compartments, and superstructure. This shares the same framework as the surface module. Features include:

- creation of transverse and longitudinal bulkheads, decks and compartments
- non-planar bulkhead/deck options including cranked, corrugated, upper and lower stools

- calculation of mass properties - volume, surface area, LCG, TCG, VCG
- primitives - plane, block, pyramid, cylinder, cone, sphere, toroids
- operations - subtract, unite, solid intersection, intersect, imprint, join, scale, move, rotate, align, reflect, and copy
- downstream data transfer of the hull surface and internal structures to other Vantage Marine modules.

Calc - This is a toolkit of naval architectural hull form-related calculations including the assessment of: cross-curves; deadweight scale; floodable length determination; grain stability and damage control evaluation; hydrostatic characteristics; inclining experiment; intact and damaged (deterministic/probabilistic) stability assessment; launching; lightweight and loading conditions; longitudinal strength; sectional area curves; tank calibration; tonnage measurement; and freeboard.

Hydro - This gives prediction of the hydrodynamic performance of vessels and includes:

- powering - propeller optimisation; resistance calculations; ship powering characteristics; and resistance ratio
- seakeeping - sectional hydrodynamic coefficients; regular wave responses (RAOs); added resistance due to waves and dynamic loads; short-term, irregular vessel responses (RMSs); and long-term seakeeping performance predictions
- manoeuvring - crash stop calculation; zig zag manoeuvre; turning manoeuvre; and reverse spiral calculation.

Fundamentals of advanced hydrodynamic design

Tightly integrating geometric modelling and flow simulation offer new opportunities in hydrodynamic design. In this article, Stefan Harries, managing director of Friendship Systems, gives an overview of methods, processes, and potentials of studying extensive sets of design variants by combining parametric modelling and state-of-the-art CFD analysis through formal optimisation. Examples are presented from recent consultancy projects.

MANY naval architects frequently face the challenge of having to either reduce energy consumption for an agreed design speed or increase attainable speed with the power available. The most favourable design solution is a subtle change that neither requires substantial additional investment nor entails any operational complications. As the hull governs the hydrodynamic quality and, hence, the success of the entire system, it is a crucial task to identify the optimal ship hull form within the specific constraints. Besides, the highest potential for energy saving and emission reduction will likely result from optimised hull shapes, for instance, Henningsen (2000).

Careful design teams draw on the experience of naval architects which have been involved in many projects. Naturally, they also want to advocate their individual solutions to distinguish themselves from competitors. However, even good designs can always be improved by a few percent, which is particularly important if power delivered should be reduced to allow for an engine of smaller size or if a fraction of a knot is still needed to reach the contract speed. Moreover, lowering fuel consumption in an environment of rising fuel prices and worsening ecological impact is attractive to operators, owners, and shipyards alike.

Table 1 gives potential savings for representative container carriers and illustrates what to expect from a typical hull form optimisation. Assuming constant speed, a first estimate for the present worth of future savings was determined on the basis of 2% inflation and a linear forecast of fuel price which was hypothesised to double from \$225/tonne in early 2005 to \$550/tonne in 2015.

Assuming that the engine configuration and available power are already fixed, a hull form improvement may also be used to increase speed. For today's container carriers at design condition, power delivered approximately scales with speed to V^3 or $V^{4.5}$ (Fig 1). Therefore, a 1% increase of speed can be expected if power requirements are reduced by approximately 4%. This would then lead to three days a year of extra time at sea (along with the power-speed relationships from the two simple models, Fig 1 presents the data of a recent example ship which was model-tested, supporting the validity of the above approximation).

This article is intended to show how ship hull forms can actually be improved even beyond common practice. The keys to success are to model and analyse extensive sets of design

Container carrier	TEU	1600	3400	4100
Power (CSR)	kW	11,500	26,000	37,000
Time at sea	days/year	220	250	250
	h/year	5280	6000	6000
Fuel consumption	kg/kWh	0.166	0.166	0.166
Assumed improvement	%	4.0	4.0	4.0
Utilisation of improvement	%	70	75	80
Fuel savings	Tonnes/year	282	777	1179
Fuel price (March 2006)	US\$/tonne	300	300	300
Annual savings per vessel	US\$/year	84,668	233,064	353,779
	€/year	70,557	194,220	294,816
Estimated savings over first 10 years	US\$	1,039,718	2,862,013	4,344,389
	€	866,432	2,385,011	3,620,324

Table 1: Savings for container carriers by means of hull form optimisation.

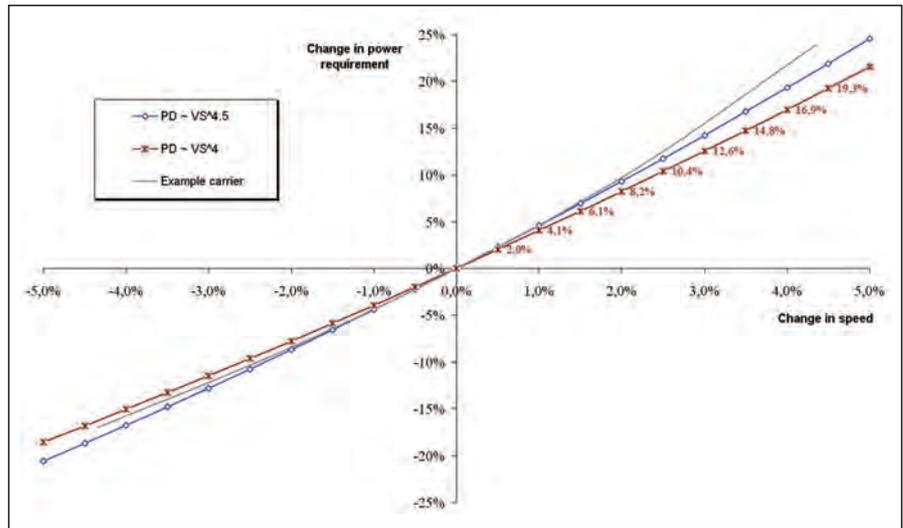


Fig 1. Change in power requirement with change in speed at design condition.

variants by combining advanced modelling techniques - so-called parametric design principles - with numerical flow simulations and to execute systematic studies by employing formal optimisation strategies. Concepts, methods, and examples will be presented with the aim to encourage regular application.

Geometric modelling

First-principle methods such as computational fluid dynamics (CFD) are proven to assist the naval architect in modelling, analysing, and assessing prospective design solutions. Nevertheless, restrictions in time and budget mean that often only a few alternatives are investigated. In ship hull design, this is because establishing the geometry is a time-consuming task if based on conventional methods of geometric modelling as still prevalent. Since some 70%-80% of the costs associated with a new project relate to decisions made in the first weeks, a major advantage is gained when investigating many hundreds or even thousands of hull variants at an early stage.

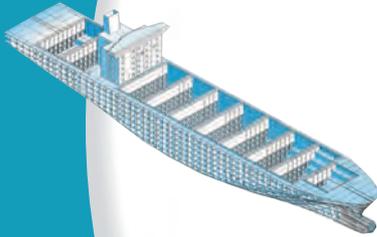
While conventional methods of CAD usually are very flexible they, unfortunately, lack effectiveness when generating, and efficiency when changing, geometry. Advanced geometric modelling is therefore considered mandatory if high-quality variants need to be generated without the delay and costs associated with interactive CAD work. An excellent technique of advanced geometric modelling is parametric design, which adopts a high-level and solution-oriented definition.

So as to introduce the idea of parametric modelling, let us consider a simple cuboid. A cuboid is completely defined by its eight corner points in Cartesian space. Conventionally, the three components of each corner point would be specified individually, resulting in a total of 24 real numbers. Each component would be accessible and, thus, any change to the shape could be realized.

While this is very flexible, any arbitrary variation would lead to unintended loss of the cuboid's fundamental nature, ie, to feature plane faces that are either parallel or rectangular to each

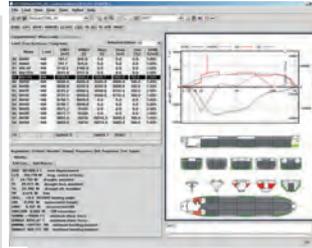
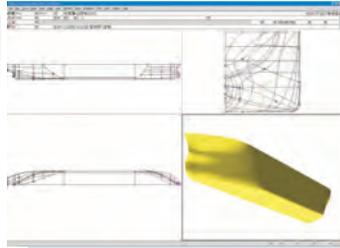
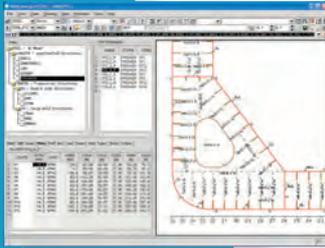


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Applications should arrive before 15 April 2006.

other. The burden and labour of keeping the shape within the specific confines thus remains with the designer. This would not be the case if a parametric model was applied.

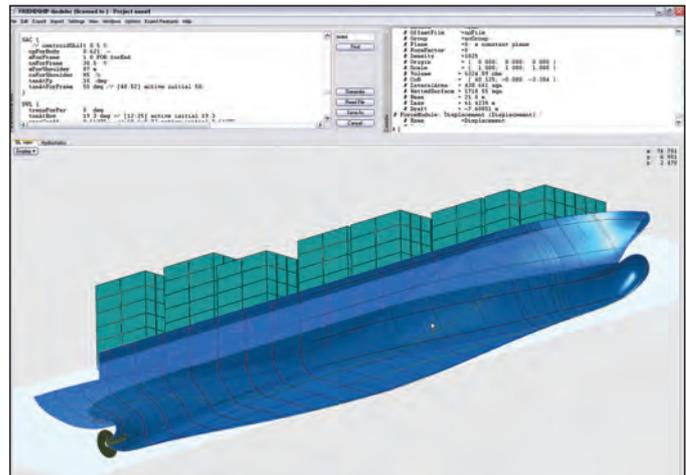
The cuboid is fully determined by just three parameters, namely length, beam, and height. The entire geometry is set as soon as values have been assigned to all parameters. Each parameter can be changed independently and still all variants belong to the same family (of cuboids). As a consequence, a gain in efficiency is achieved.

Based on this simple example, we can now state what we mean by parameters and parametric modelling. Parameters are the descriptors which define a product in a context-dependent and solution-oriented manner. Parametric modelling establishes a meta-model in which concepts, rules, hierarchies, dependencies, and functionality are present.

Naturally, the parametric design of an entire ship hull form is substantially more complex but it follows the same concept, Harries (1998) and Harries *et al* (2004). Fig 2 shows a container carrier as modelled with the Friendship-Modeler, which is a modular CAD environment developed for the parametric modelling of functional surfaces.

Friendship-Modeler is available for both Windows and Linux and offers a collection of standard modules for different hull types. It also allows the inclusion of tailor-made modules for special fields of application. Fig 3 depicts a sailing yacht with appendages, as generated with Friendship-Modeler on the basis of special modules for the bare hull, fins (keel and rudder), and the keel bulb with winglets. In order to provide top efficiency, context-specific models are developed for various ship types, see Dudson *et al* (2005) for a pentamaran, Abt *et al* (2004) for a double-ended ferry, and Heimann *et al* (2003) for a ro-ro ferry.

Fig 2. Parametrically generated container carrier.



Parameter sets for complex shapes such as ship hull forms may comprise some 50 entities. Changes to the geometry can be established by changing one or several parameters at a time. While a few parameters are clearly compulsory, such as length, breadth, and draught, most parameters are optional.

Typical parameters are, for instance, the prismatic coefficient of the forebody, the entrance angle of the design waterline, and the length of the bulbous bow. Fig 4 illustrates changes when modifying one single parameter, here the displacement volume of the forebody while maintaining the aftbody.

Let us consider the hull in the middle of Fig 4 as the starting point. A slight decrease in volume leads to the more slender variant in the upper picture of Fig 4, while an increase yields the fuller forebody depicted in the lower picture. Accomplishing these modifications is a matter of

just a few CPU seconds and can be done either interactively or in a batch mode, the latter being a requirement for automated execution.

Formal optimisation

Advanced geometric modelling, as discussed above, constitutes one of the two prerequisites for any comprehensive design study. The other prerequisite is the availability of simulation techniques which capture the (flow) phenomena of interest with sufficient accuracy yet reasonable computing time. Manually driven design work rarely manages to cover more than a handful of alternatives while an automated investigation may comprise many hundreds of variants. This naturally boosts the likelihood of finding a significant improvement.

The strategies of formal optimisation support a design team in identifying the best solution from the set of feasible solutions. Feasible solutions, as opposed to infeasible ones, satisfy all constraints that have been formulated for a specific problem. Constraints are bounds, limits, restrictions, and other factors, to be observed. The different solutions are ranked with regard to one (or several) objectives.

The freedom to change and vary is expressed by free variables, which are the entities within the control of the design team. Usually, quite a few free variables are considered, spanning a multidimensional search space. The different optimisation strategies are concerned with spreading and marching through this search space to discover maxima or minima, Birk and Harries (2003). Naturally, everybody hopes to come across all or most optima but this is usually beyond the resources of commercial projects. It must be pointed out, however, that by looking at just three or four alternatives the chances to obtain an excellent solution are much smaller.

The hydrodynamic optimisation of a ship hull form represents a multi-stage, iterative process in which the expertise of the owner, naval architect, and consultant in terms of economics, operation, geometric modelling, hydrodynamics, optimisation, and information technology (IT) are brought together. Based on the specifications

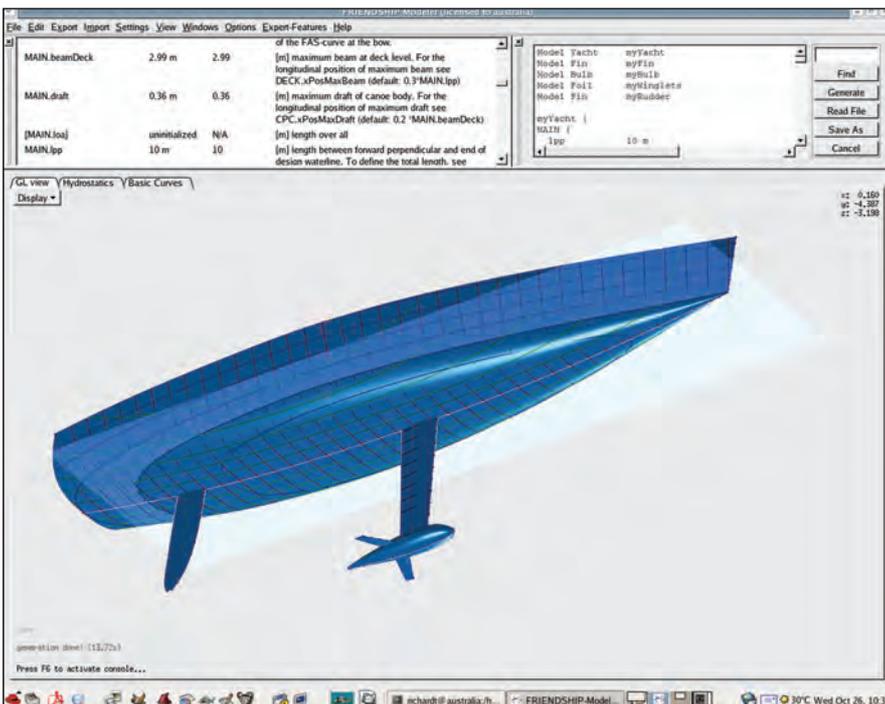


Fig 3. A parametrically generated yacht.

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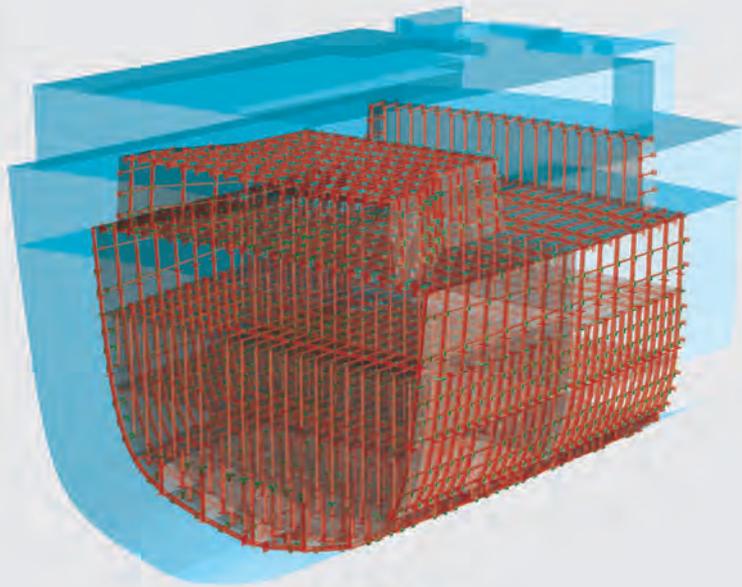
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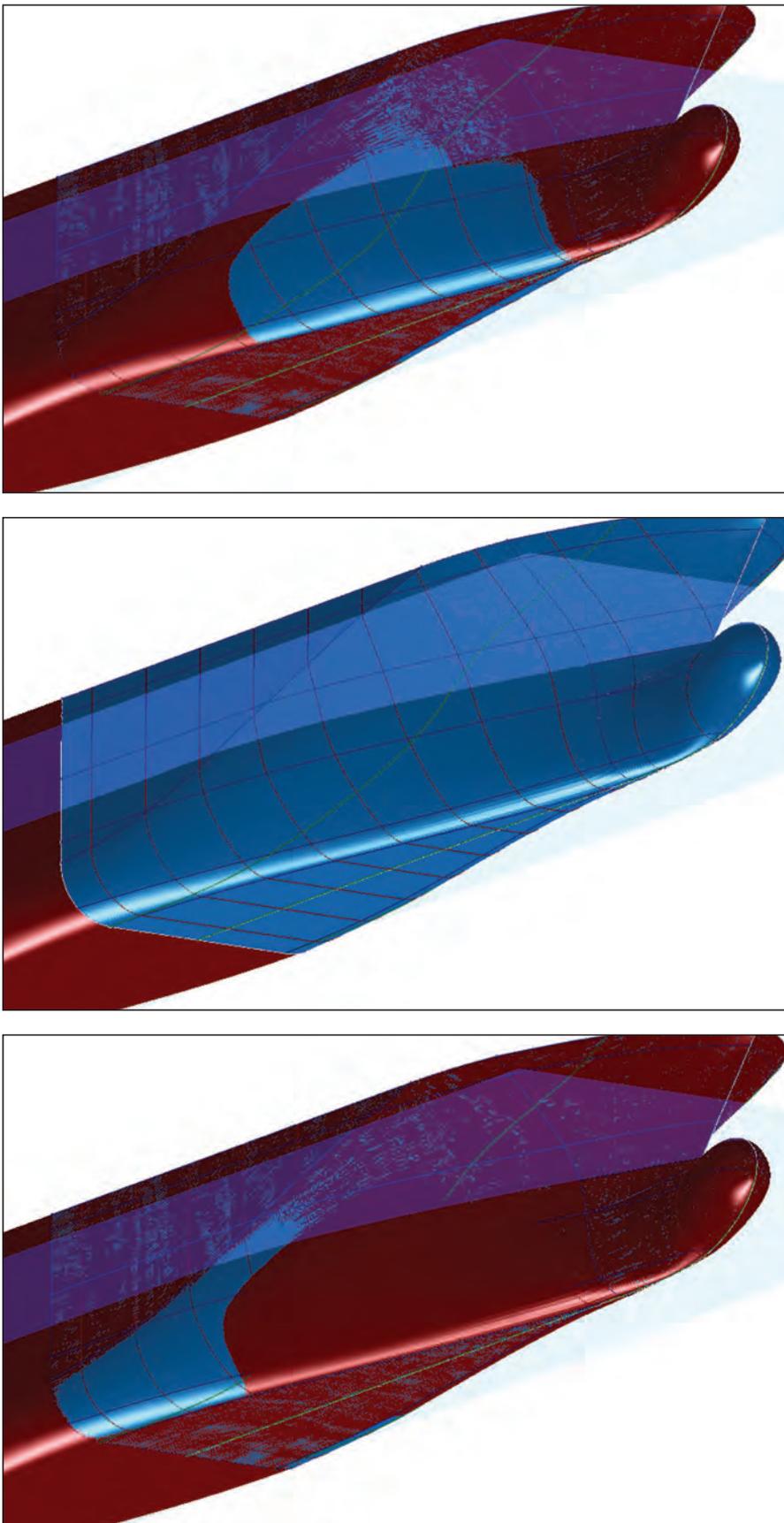


Fig 4. Parametric variations of the forebody of a container carrier as realised with the Friendship-Modeler.

and requirements stated by the owner and the design team, the objectives, constraints and free variables are compiled and a detailed first analysis of the ship is undertaken (pre-processing

phase). Frequently, this includes the parametric redesign of a parent hull form and a careful flow analysis with the CFD code of choice. If experimental data is available from a preceding

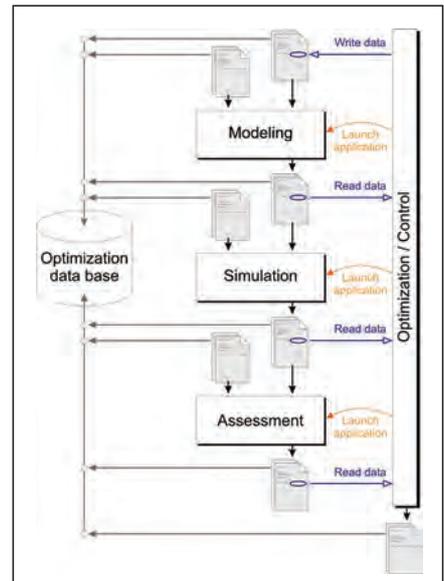


Fig 5. Process of automated optimisation.

project, the validity of the simulation tool is checked and a trade-off between computational accuracy and processing speed is established.

Subsequently, the optimisation itself is set up and the design space is explored (optimisation phase). Based on intermediate results, the investigation is refined, which regularly involves input from all parties. Repeating the exploration phase a few times creates the repository for detailed assessments which lead to a conscious and rational decision for one or several promising candidates. These are then exploited, ie, they are further fine-tuned to produce even better results.

At the end of the exploitation phase, a set of optimal designs is available, from which the best compromise can be selected. At the end, the optimum design is studied in further detail (post-processing phase) which implies that additional CFD simulations are performed and, as it is prudent and recommended, that model tests are undertaken.

This optimisation process has been developed by Friendship Systems for its consultancy work. An IT illustration is given in Fig 5. One should note the uninterrupted sequence of geometric modelling as realised with Friendship-Modeler, hydrodynamic simulation as undertaken with a state-of-the-art CFD tool, and detailed performance assessment to better rank design variants.

The automated execution of all tools is controlled by means of an optimisation environment. Here Friendship-Modeler is put to use which offers various techniques of formal optimisation such as design-of-experiments (DoE) as well as deterministic and stochastic search strategies. The optimisation strategies manipulate the values of the free variables which

are, of course, selected parameters of advanced geometric modelling. Friendship-Modeler controls the process by creating input files, launching computations, retrieving data from output files and managing the data base.

Selected examples

On the basis of the above fundamentals, two hydrodynamic design examples will be discussed which stem from recent consultancy work. The first example is taken from the design effort for a 3400TEU Panamax container ship while the second one is drawn from the hydrodynamic optimisation of a 1600TEU feeder design. Further examples with regard to other hull types are given in the references.

The state-of-the-art CFD tool Shipflow, Larsson (1997), was used for the flow simulations. The non-linear free surface was determined with the potential flow module from which the wave resistance components were derived via spectral-wave-cut analysis (using Friendship-Waves) and pressure integration. The viscous resistance components were estimated according to the recommendations of the ITTC with form factors determined from Holtrop (1984).

In the first design example, a very comprehensive investigation was requested, in the course of which more than 2000 hull variants were assessed. Constraints were imposed from the shipyard's side on initial stability at two different loading conditions, on displacement volume, and on the associated performance of two sister ships (a shortened and an elongated alternative).

In the exploration phase, 19 form parameters were selected as free variables and some 1000 hull variants were studied. Subsequently, several exploitation runs were performed which produced again around 1000 hull variants. From

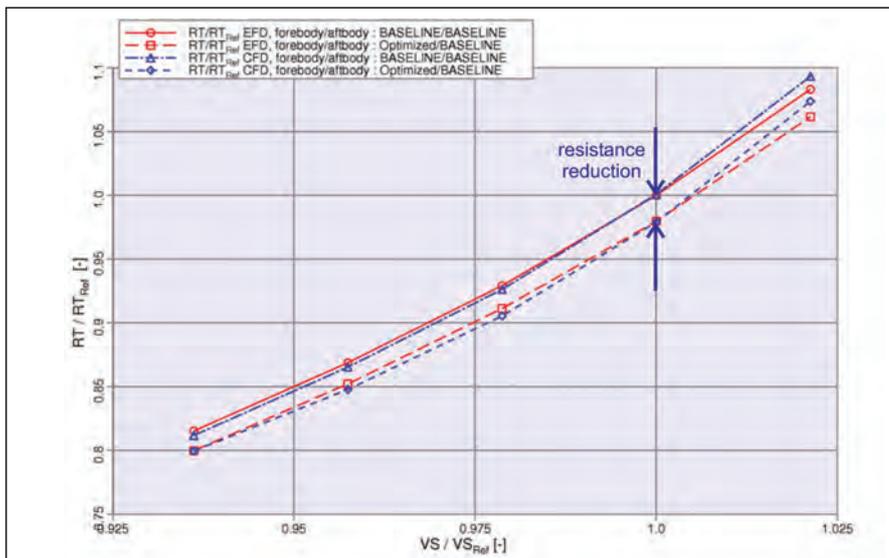


Fig 6. Comparison of total resistance for the initial and the optimised hull.

the optimisation data base, a final hull form was selected which best compromised superior performance with moderate lines.

The optimised hull featured a reduction of wave pattern resistance by 7%, resulting in an improvement of 2% with regard to total resistance. Interestingly, the displacement increased by approximately 1%, which constituted a very welcome side effect and highlights that an innovative solution may be found by leaving the well-known path.

The initial hull form had already been pre-optimised by means of traditional methods, including thorough tank testing in a major

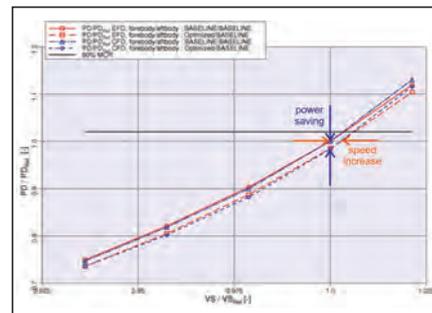


Fig 7. Comparison of delivered power for the initial and the optimised hull.

European basin. Following optimisations, the proposed new hull form was tested, too. This then allowed a careful examination of the optimisation results. Fig 6 depicts the non-dimensional resistance curves, the normalisation being done for all data with the measured resistance of the initial hull at reference speed. The resistance reduction of 2% can be readily seen.

Furthermore and importantly, Fig 6 serves to validate the numerical flow simulation. It should be noted that one needs to be aware that there were small deviations between CFD and experimental data at the reference point, but that a single empirical adjustment was made to match numerical and experimental results, and that this slight correction was then utilised throughout the remaining analysis.

The curves show excellent agreement between CFD and experiments for both the initial and the optimised hull. Moreover, the CFD prognosis for the reduction in resistance (luckily) turned out to be very accurate. Fig 7 illustrates the effects on power versus speed. The benefit gained from optimisation is evident.

The second design example stems from a different question. The shipyard wanted to study

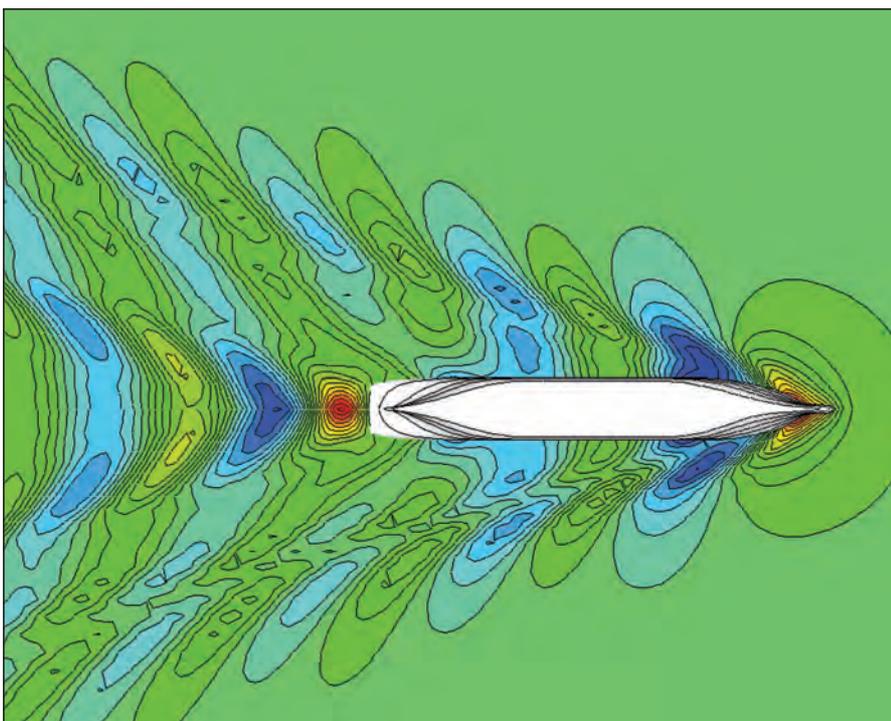


Fig 8. Comparison of waves generated by the initial (top) and the hull form from design-of-experiments - DoE (bottom).

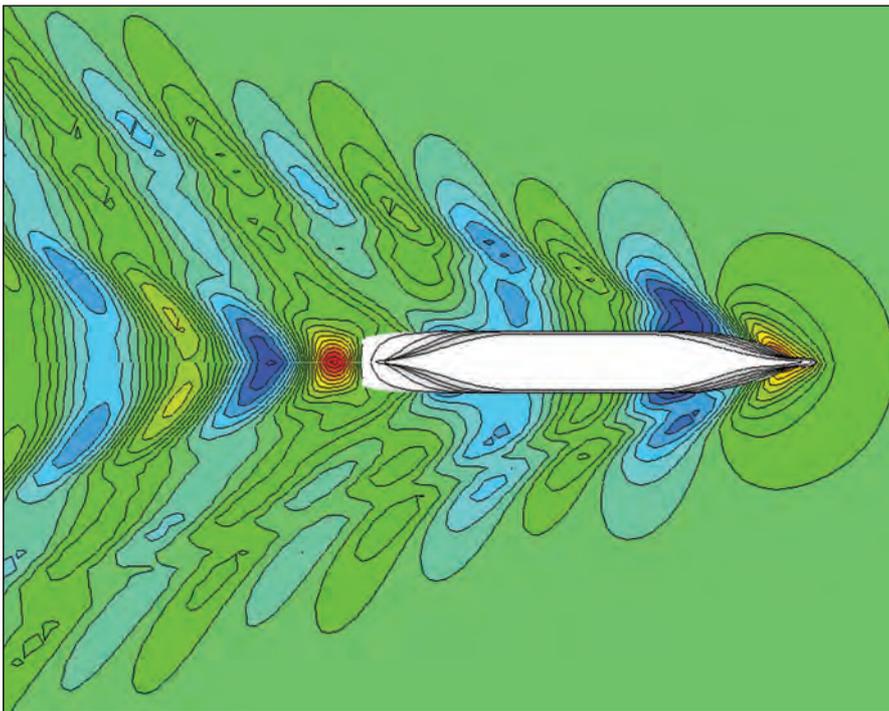


Fig 9. Comparison of waves generated by the initial (top) and the final hull form (bottom).

a possible boost of design speed for its successful series of current feeder ships by combining a modification of the forebody with installing an engine of the same make but with one extra cylinder and 20% more power. Constraints were given on initial stability at two draughts, on displacement which was not allowed to fall more than 100tonnes, and on the extremes of the bulb.

Figs 8 and 9 depict the waves generated by the initial hull form in comparison with the favoured variant from the DoE and the final hull form, respectively. The optimisations were undertaken at the desired new ship speed. While the DoE already furnished a 3% decrease of total resistance, the final hull form featured an improvement of 6% over the initial hull. The latter corresponds to a 22% reduction of wave pattern resistance.

The effects on the wave patterns by modifying the hull form can be nicely seen in both Figs 8 and 9. Since the entire aftbody was left

unchanged, adverse effects on either the viscous resistance components or the propulsive efficiency ought to be minor. When combining the resistance decrement with installing a more powerful engine, it appears realistic that the ship's speed can be raised up to 5%.

Conclusion

In this article, the fundamentals of advanced hydrodynamic design have been presented. Examples have been given to illustrate what can be achieved in commercial projects. Combining advanced geometric modelling and numerical flow simulation by means of formal optimisation enables design teams to compute large and consistent sets of variants in time spans compatible with the overall design process.

Concerted variations in ship hull forms improve even good designs which lead to lower fuel consumption or higher design speed

and, consequently, considerable economic benefit. This allows the decision-makers to gain a much clearer picture, leading to higher quality, stronger robustness and lower risk. Shipowners, naval architects, and consultants should incorporate the proposed techniques for their joint success. 

Acknowledgement

The author would like to thank H Hinrichsen, from Nordseewerke GmbH, ThyssenKrupp Marine Systems, and H Poggendorf, from Peene-Werft GmbH, Hegemann-Gruppe, for consenting to the publication of data from recent projects in which Friendship Systems provided design consultancy.

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Extended use of Autoship in UAE

THE UAE-based marine engineering company, Navispec Marine Services, of Dubai, has recently chosen Autoship Systems' Autohydro Pro for its hydrostatics and stability engineering, for one of its main clients, Hellenic Shipping. Autohydro 6.2 offers features requested from the worldwide Autohydro user group, which is now over 800 members strong.

Autohydro, part of the Autoship suite, includes a GUI (graphical user interface) that allows a new

user an intuitive work environment. The software is backed up with a service that includes on-going software updates and customer support that responds in 24 hours to the UAE.

Autoship has also recently supplied its software to Bharati Shipyards, of Mumbai, India. The shipyard is now using Autoship for hull design, Autopower for resistance and power prediction, and Autohydro for

hydrostatics and stability. Bharati Shipyards has indicated that this purchase is a first step, and that in the near future it will consider acquiring Autoship's CAM programs.

This new installation is part of a growing installed base of Autoship System users in India that now includes: Tebma Shipyards, Chowgule Shipbuilding, Marine Consultants Inc, Turbo & Larsen, Aries Institute of Marine Technology, and others. 

New modules added in updated version

THREE new modules have been added by Proteus Engineering to its hydrostatics, stability, and sections plug-in, RhinoMarine. The modules in version 3.5 include hull design and fairing, performance analysis, and model management. RhinoMarine is a complete 3D CAD/CAM program for the marine designer and builder; by adding the RhinoMarine plug-in, marine-specific functionality is integrated into the system.

This new release brings more of the design process into the Rhino environment by adding new features such as hull design wizards, dynamic section updating, new editing tools, weight and cost tracking, and drag prediction for planing hulls.

The hydrostatic, stability, and sections module uses a proven hydrostatics engine for accuracy. This is claimed to be able to analyse 'anything that floats' including monohulls, multihulls, and submarines. Righting-arm calculations can be made for a range of heel angles, allowing free trim and heave inputs. The module can also analyse one or more conditions, by specifying waterplane heights; displacement and centre of buoyancy can then be computed. Alternatively, displacement/CG can be entered, and the flotation plane calculated.

Critical aspects, such as downflooding points and vent positions, can be tracked as the model heels and trims, while the module promises easily visualisation of the flotation condition, by transforming the model to the flotation plane, or inserting a flat surface to represent the flotation plane.

Dynamic automated control of the forefoot assures curvature continuity, and traditional three-view lines plans can be created with a single click. Constraint planes are said to make it easy to move control points in any view, and there is easy set-up of viewports and the coordinate system to accommodate profile, plan, and body-plan views.

RhinoMarine's performance analysis module is based on a modified Savitsky method for planing hulls and is claimed to be able to compute easily complete intact hydrostatics and stability within Rhino, and display the results in Excel or in a web browser. This module uses the HydroComp

drag prediction library, and basic hydrostatic data can be entered or taken from RhinoMarine calculations.

Performance analysis can be used for the speed range, supplying trim, drag, power, 'porpoising' stability, effective planing beam, and effective deadrise. The software will also validate a condition against acceptable ranges for the prediction method. User-specified inputs for overall propulsive coefficient and design margin allow conversion from drag to required horsepower to be executed, and a drag-reduction analysis helps users improve an overall design. Data can also be exported to SwiftCraft.

A further module is Model Management; this can keep a Rhino model organised and easier to manage, as it tracks the weight and cost of a design. This module can also organise a model in a hierarchical drag-and-drop tree, using RhinoMarine Explorer. It names objects in the models and sets properties on groups of objects. This is said to make it easy to isolate that part of a worked-on model.

Finally, weight and cost properties can be set on objects in the model, as well as a specific value or a 'density' (such as weight/metre or cost/square metre). A weight can be used as input to the RhinoMarine hydrostatics and stability calculation, and results can be exported to Excel spreadsheets. ⚓

Increased use in China for Tribon

A CONTRACT has been awarded to Aveva, the supplier of IT solutions, by Dalian New Shipbuilding Heavy Industry. This shipyard has extended its application of the company's marine solutions for both its shipbuilding and offshore businesses. With this extension, the shipyard believes it will be able to extend its building capability by shortening delivery time.

Aveva also recently signed a contract to provide its design and production solutions to New Century Shipbuilding (NCS), China. ⚓

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Performance standard for ballast tank coatings

ESTABLISHMENT of a performance standard for ballast tank coatings was among the important issues discussed at the recent 49th session of IMO's Sub-Committee on Ship Design and Equipment (DE 49), held on February 20-24 2006, in London. Other associated matters included amendments to guidelines on the enhanced programme of inspections during surveys of oil tankers and bulk carriers (ESP Guidelines) concerning the introduction of survey requirements for double-hull oil tankers. These particular rules are expected to enter into force on January 1, 2007.

The revised SOLAS Chapter XII (Additional Safety Measures for Bulk Carriers), which is due to enter into force on July 1, 2006, refers to performance standards for protective coatings to be adopted by IMO. In this connection, the MSC had agreed that the performance standards, when finalised, should be made mandatory by modifying the relevant SOLAS regulations.

After an intensive debate at the 2005 DE meeting (DE 48), it was agreed that the coating performance standards should apply to all ballast and void spaces on all types of ships; that the target coating life should be 15 years; that the concept of a Coating Technical File could be supported, and that verification and inspection issues, also requirements for steel primers should be further considered. DE 48 subsequently established a correspondence group to further develop the draft performance standards for protective coatings.

BIMCO was a member of this correspondence group, where it quickly became apparent that there were conflicting views on numerous issues. It was consequently agreed to establish a working group during this DE meeting to complete, at the session, the draft standards.

The working group was then established, with BIMCO participation. As expected, differences in views - those of traditional shipbuilding countries versus owners' representatives (NGOs such as BIMCO) and some flag states - were very apparent, and although there was a general understanding that the group should reach agreement, a few decisions had to be left for decision by MSC.

Out of the key issues, BIMCO would like to draw attention to the following:

- the coating type shall be epoxy-based or other systems with performance according to specified test procedures. A multi-coat system with each coat of contrasting colour is recommended. The top coat shall be of a light colour in order to facilitate in-service inspection
- application of the performance standard to combined tanks. For combined tanks, the standard would be recommended, not mandatory, but this matter should be further considered in more detail once the performance standards for coatings for dedicated seawater ballast tanks have been finalised
- discussions took place as to whether the coating technical file (CTF) should only be prepared at the new-ship construction stage

or whether it should also record relevant activities for maintenance and re-coating. It was eventually agreed that maintenance should be included in the CTF, in cases where significant repair and re-coating have taken place. The CTF shall be kept onboard and maintained throughout the life of the ship. Any reference to maintenance or repair during the operational life of the ship, unless explicitly stated otherwise, should be taken to refer only to that of mechanically introduced damage and not deterioration by gradual processes

- it was not possible to reach agreement on to what extent the standard shall consider maintenance, and consequently, two possible wordings will be suggested:
 1. Maintenance is to include inspection of the coating, and repair of mechanically caused damage or that caused by circumstances outside the operating environment for which the coating was designed and specified. This should not include re-coating of non mechanically-induced damage in the intended operating environment.
 2. Maintenance is cleaning and inspection of the coating and repairing if required.

Verification: type approval and inspection

The group had an extensive discussion on verification and inspection issues (to prove that the performance standards have been followed). Basically, the issue is which entity should have the responsibility for implementing and ensuring compliance with the performance standard. Eventually it was agreed that the following procedures should be used:

- results from pre-qualification tests of the coating system shall be documented, and a statement of compliance or type-approval certificate shall be issued if found satisfactory by a third party, independent of the coating manufacturer
- inspectors shall inspect surface preparation and coating application during the coating
- emphasis shall be placed on initiation of each stage of surface preparation and coatings application since improper work is extremely difficult to correct later in the coating progress
- representative structural members shall be non-destructively examined for coating thickness. The inspector shall verify that appropriate collective measures have been carried out
- results from inspection shall be recorded by the inspector and shall be included in the CTF
- 'qualified coating inspectors' shall be certified to NACE Level II, FROSIO level Red or equivalent.

Test procedures for alternative and equivalent coating systems

It was considered whether the test procedure should be included in the draft performance

standard or whether it should be developed separately at a later stage. Having agreed that the test procedure should be included in the performance standard, it was decided that it should apply only to alternative systems.

Scope of application of the performance standard

Having considered the scope of application of the performance standard for protective coatings, it was agreed that the standard should be applied to all dedicated seawater ballast tanks constructed of steel on all new ships of 500gt and over, and double-side-skin spaces of new bulk carriers of 150m length and upwards.

Technical issues

The group considered various options of dry film thickness. However, it was not possible to reach any agreement and two options were consequently brought forward for MSC to decide. The two options are: nominal dry film thickness (NDFT) 335 together with 90/10 rule and NDFT 300, also together with 90/10 rule. (The 90/10 rule means that 90% of all thickness measurements shall be greater than or equal to NDFT, and none of the remaining 10% shall be below 0.9 x NDFT.) Maximum total dry film thickness shall be according to manufacturers' detailed specifications. Type of gauge and calibration shall be in accordance with the standard: SSPC-PA2.

Regarding job specification, the group agreed to two stripe and two spray coats, and also agreed that the second stripe coat by way of welded seams only could reduce the scope depending on DFT.

Regarding pre-washing, the group, recognising that it is sufficient if limits of contaminating substances are stated, agreed to delete the requirements for pre-washing.

The group also considered the soluble salt limit and agreed to a figure of 50mg/m² of sodium chloride (equal to 30mg/m² of sodium chloride). However, some delegations preferred to express the limit in terms of total soluble salts and preferred a level of 70mg/m².

The steel surface should be prepared by removing sharp edges so that the coating selected can achieve an even distribution at the required NDFT and have an adequate adhesion. The edges are to be treated to a rounded radius of minimum 2mm or subjected to three-pass grinding, or at least an equivalent process before painting.

The surfaces shall be treated to SA2½ on damaged shop primer and welds; for shop primer which has not been proved compatible, SA2, removing at least 70%. However, if the complete coating system comprising epoxy-based coating and compatible shop primer has passed a pre-qualification certified test procedure, then the intact shop primer may be retained. The retained shop primer shall be cleaned by sweep blasting, water washing, or equivalent method.

With regard to surface treatment after erection, the group agreed to the following requirement: Butts and small damages up to 3% of total area

of the tank, St3 or for butts SA2½ where practicable. In cases where more than 3% of total area of the tank, then SA2½.

Draft standard to be submitted to MSC

Following the above considerations, the sub-committee agreed to the draft performance standard for submission to MSC 81 (10-19 May 2006) for consideration and approval. It was agreed that the above-mentioned standard should not apply to void spaces and a correspondence group was consequential established with the following terms of reference:

- identify and define those void spaces to which the performance standard of protective coatings should apply, considering as a priority tankers and bulk carriers
- identify and define those void spaces to which a different standard could apply and to develop a draft standard for such spaces for tankers and bulk carriers
- identify and define those void spaces to which a different standard could apply for other types of ship
- submit a report to DE 50.

Mandatory emergency towing systems

On a different matter, members of DE 49 discussed mandatory emergency towing systems in ships other than tankers of not less than 20,000dwt. The sub-committee agreed in principle to the possible application of the proposed draft SOLAS amendments and, in view of the decision made earlier, to apply the proposed amendments to cargo ships above 500gt and all passenger ships.

The sub-committee noted possible difficulties regarding application to existing ships, in particular, that certain information may not always be available, eg, capacity of bollards. However, the sub-committee agreed that the proposed draft SOLAS amendments should apply to existing ships, and that the above-mentioned difficulties could be taken into account when developing the guidelines for procedures.

Bearing in mind that one date of coming into force for all ships, both new and existing, could lead to a bottleneck in developing the required procedures, the sub-committee agreed to split the date of entry into force into two phases: one date for new ships, existing cargo ships of not less than 20,000dwt, and existing passenger ships; and another date for existing cargo ships of less than 20,000dwt two years later.

Noting that SOLAS Regulation II-1/3-4 requires emergency towing arrangements on tankers of not less than 20,000dwt, the sub-committee discussed the application of emergency towing procedures to such tankers as well. Noting further that the existing SOLAS requirements, as well as the guidelines on emergency towing arrangements for tankers, do not explicitly contain requirements for procedures, but on the other hand most of those ships are provided with respective procedures anyway, the sub-committee agreed to apply the new procedures also to tankers of not less than 20,000dwt.

The sub-committee noted the comments made during previous meetings and in the correspondence group, and discussed the exemption of ships fitted with redundant

propulsion systems. Some delegations were of the opinion that having redundant propulsion would significantly reduce the likelihood of a ship facing such emergency situations and consequently, this additional investment in the ship's safety should be encouraged by exemptions, while other delegations felt that emergency towing procedures would also be beneficial for ships having redundant propulsion.

However, after further discussion, the sub-committee agreed not to provide for the exemption of ships having redundant propulsion systems. In the case of offshore supply vessels, for example, it was mentioned that in particular, such ships could be used for towing, and subsequently it could be of additional value to reflect this different view in their on board procedures.

Regarding the question as to whether to limit the procedures to towing over the bow only or not, the sub-committee was of the opinion that there would be no benefit in such a limitation, in particular as the additional burden to extend the considerations for establishment of emergency towing procedures to towing over the stern would be minor. Subsequently, no such limitation to one end of a ship was included in the draft SOLAS amendments.

The sub-committee agreed to recommend an extension of the target completion date for the item to 2007 in order to complete the work at the next session.

Crew access inspections

DE 48 (2005) had discussed the development of amendments to SOLAS to require inspections of the means of crew access to, and egress from, the ship, such as gangways and accommodation ladders, as part of the survey of a ship's equipment. DE 48 agreed that this was not mainly a design and specification issue, but very much related to maintenance and that a number of national and international standards, including an ISO standard, addressing the matter already existed.

It was also agreed that pilot ladders should be considered under this item. DE 48 had subsequently invited concrete proposals on inspection and survey requirements for accommodation and pilot ladders to this session.

Having recognised that development of the requirements would take some time, the sub-committee agreed to prepare a draft MSC Circular for approval by MSC 81, drawing attention to the need for adequate maintenance and inspection of accommodation and pilot ladders, pending finalisation of the aforementioned requirements.

Gas-fuelled ships

DE 48 had agreed that mandatory regulations for gas-fuelled ships should be developed and should not only cover natural gas but also other potential gas fuels such as hydrogen and propane. Following discussion, DE 48 had agreed to consider the draft provisions for gas-fuelled ships further at this session.

Having recognised that gas as fuel was becoming increasingly more interesting as an alternative to conventional fuels since it produces low emissions, such as SO_x, NO_x, and other particulate matter, it had been agreed that IMO should take an active role in the development of draft provisions for gas-fuelled ships, given the environmental benefits of gas.

The sub-committee considered various documents, reporting on the outcome of BLG 9 and FP 50 on the matter and a submission containing comments on provisions for gas-fuelled ships, in particular drawing attention to the need to ensure that the safety level of the arrangements on gas-fuelled ships is equal to that of ships using oil as fuel, advocating the establishing of a goal-based system approach and recommending that experience gained by the offshore industry in the operation of gas-fuelled installations should be utilised.

Following a brief discussion, the sub-committee agreed to invite BLG 10 to take into account the above comments and be invited to submit comments and proposals on the development of provisions for gas-fuelled ships to DE 50.

SOLAS regulations for single- to double-hull tanker conversions

The sub-committee considered the applicability of SOLAS Regulation II-1/3-6 in the case of single-hull tankers converting to double-hull tankers. It was noted that a document referring to the implementation of MARPOL Annex I, Regulations 13G and 13H envisaged a potential increase in single-hull tankers converting to double-hull tankers. Considering that there is a need to determine the applicability of SOLAS regulation II-1/3-6 (Access to and within spaces in, and forward of, the cargo area of oil tankers and bulk carriers) to such a conversion, the document suggested that the regulation should not be applied retroactively in cases of ships modified to comply with MARPOL regulations Annex I, 13G and 13H.

Following consideration, the sub-committee agreed that:

- SOLAS regulation II-1/3-6 should not apply to tankers converting from single hull to double-hull
- if, in the course of conversion, substantial new structures are added, these new structures should comply with the regulation
- in the case of an existing tanker being converting to a FPSO/FSU, the regulation would likewise not apply.

Consequently, the sub-committee agreed to include the following text in the draft MSC circular:

'Regulation II-1/3-6 is applicable to new, purpose-built, FPSOs or FSOs if they are subject to the scope of the ESP Guidelines (Resolution A 744(18), as amended). Considering that the principles of the technical provisions for means of access for inspections (resolution MSC 158(78)) recognise that permanent means of access should be considered and provided for at the design stage so that, to the maximum extent possible, they can be made an integral part of the designed structural arrangement. Regulation II-1/3-6 is not considered applicable to an FPSO/FSU that is converted from an existing tanker.'

Next meeting

The next DE Sub-Committee meeting is scheduled to take place from March 5-9, 2007. 

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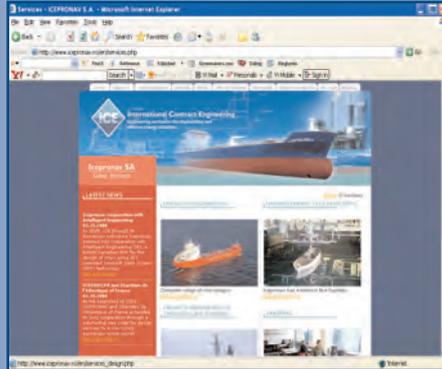
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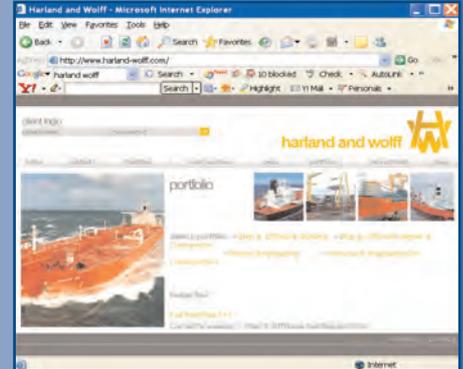
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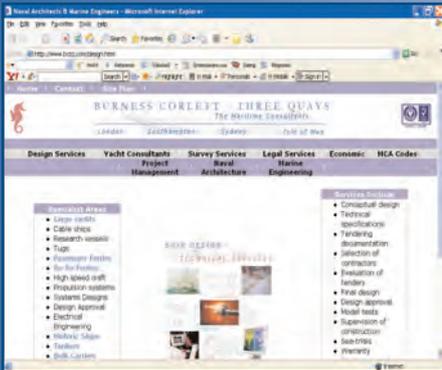
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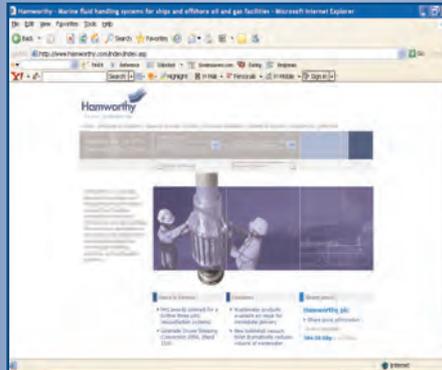
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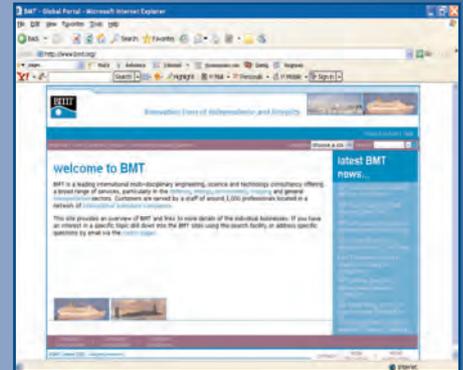
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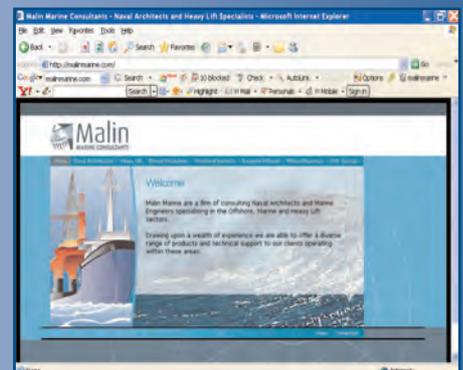
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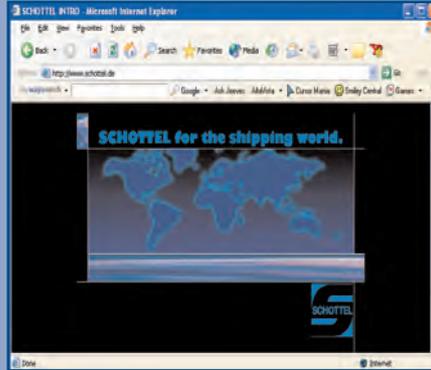
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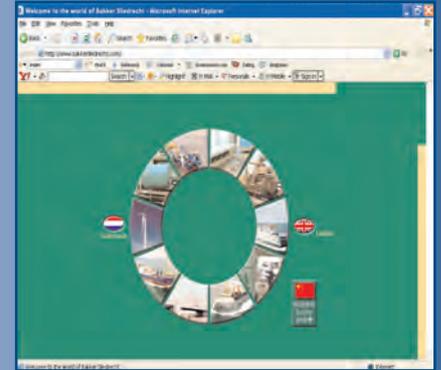
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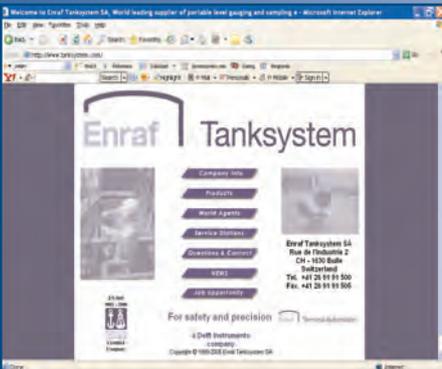
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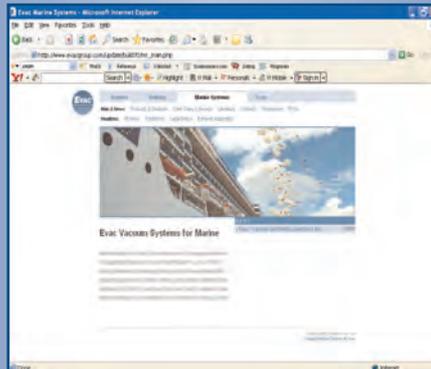
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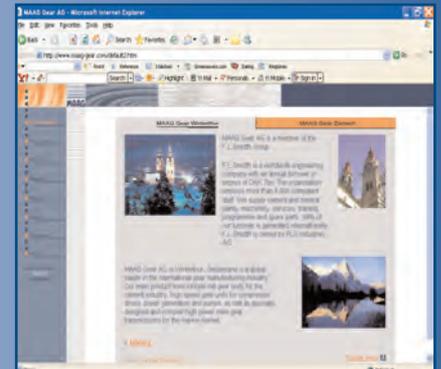
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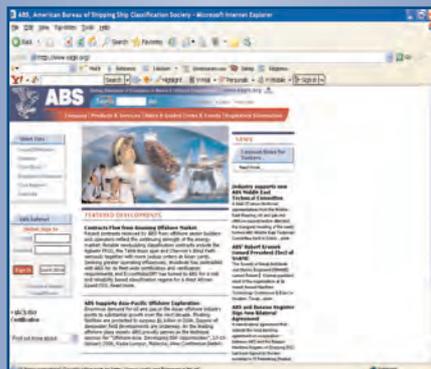
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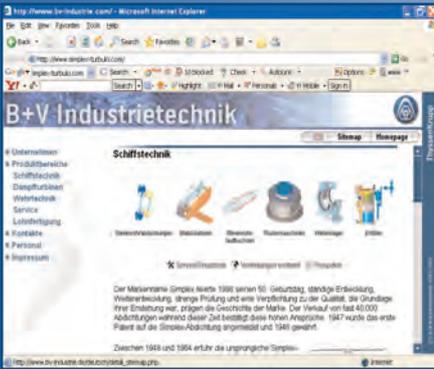
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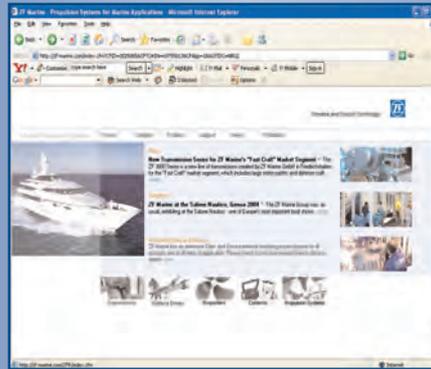
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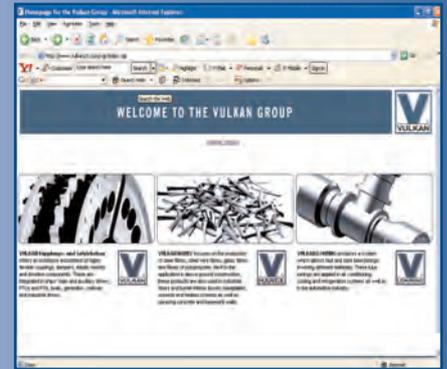
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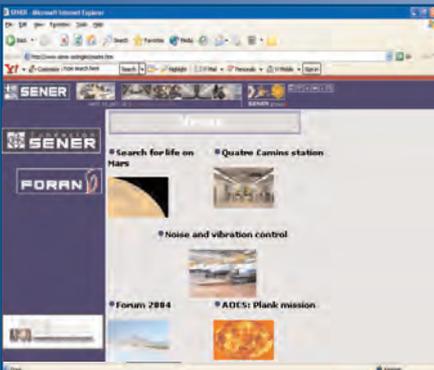
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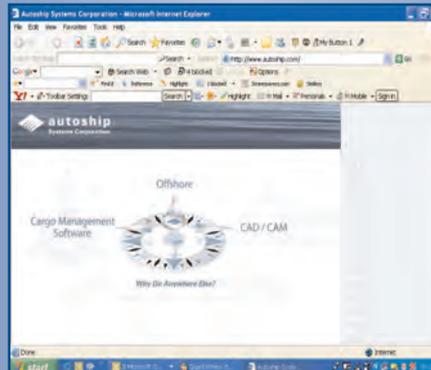
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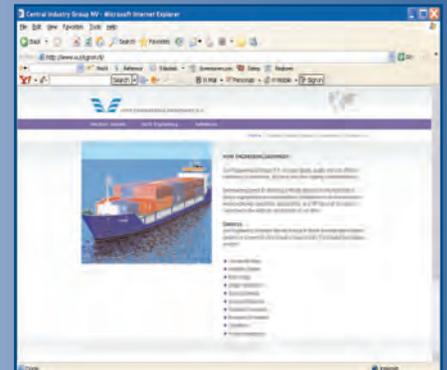
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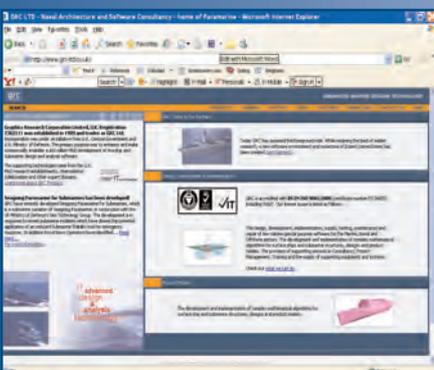
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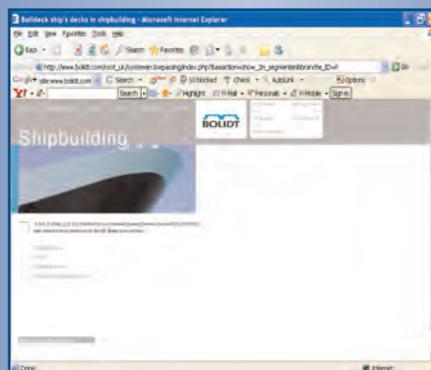
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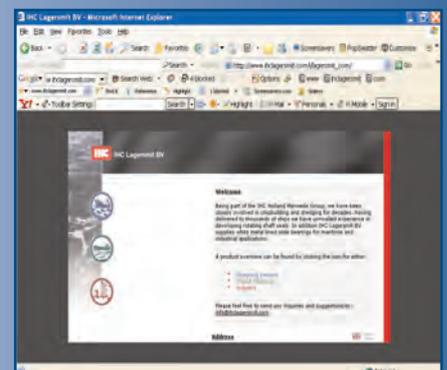
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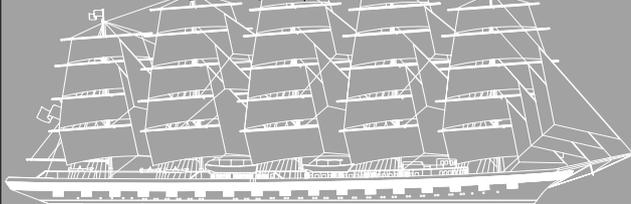
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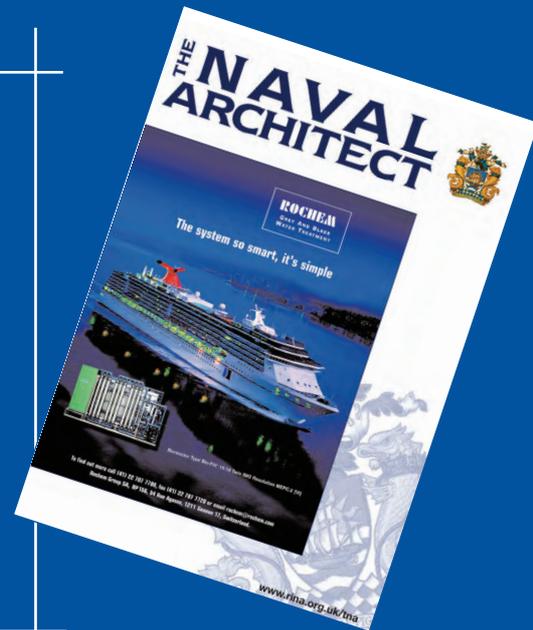
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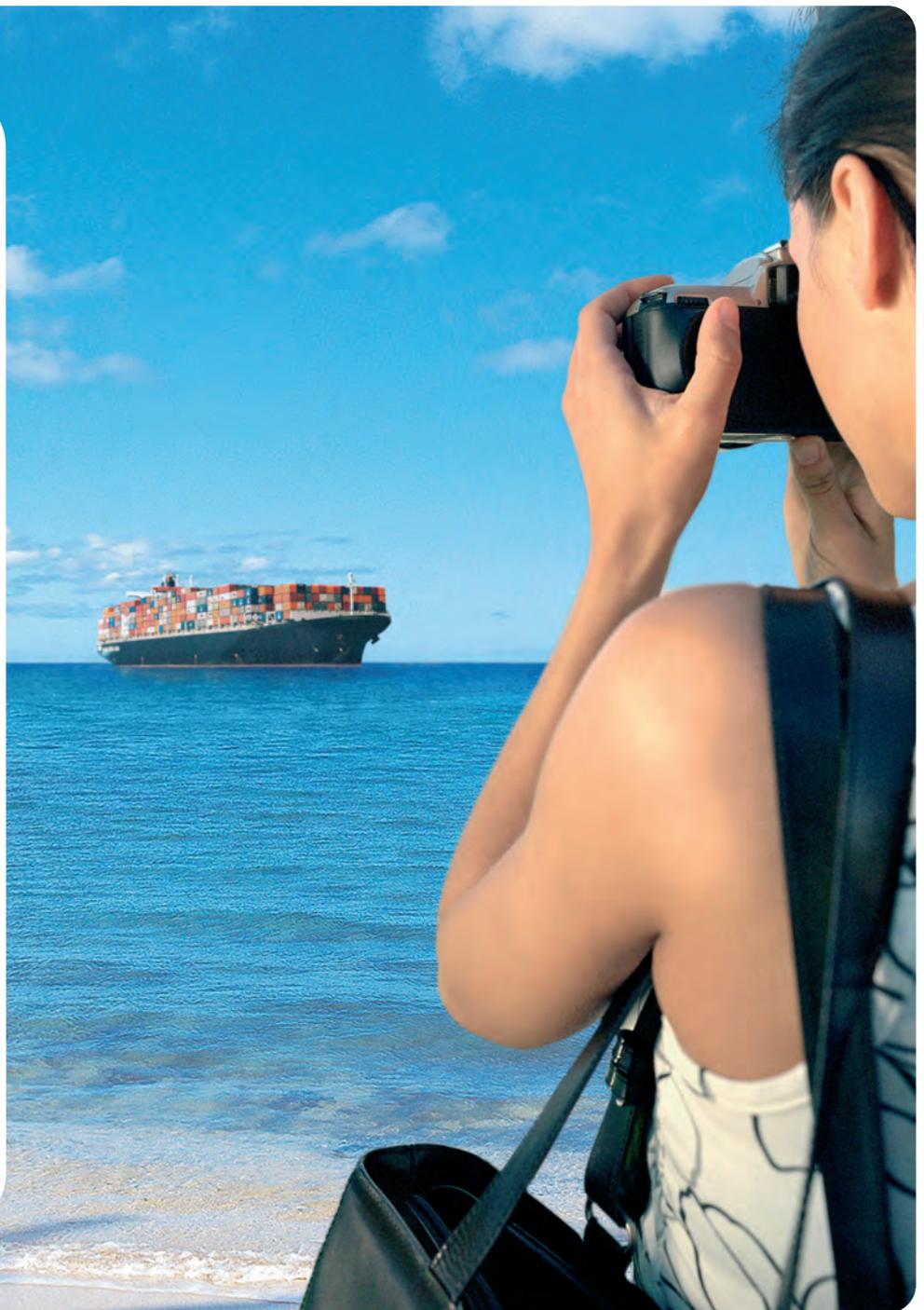
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