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THE NAVAL ARCHITECT



New ro-ro ship for the paper trades: an artist's impression of *Iberian Express*, one of two 9500dwt forest products carriers order from J J Sietas by Finnish operator Godby Shipping. Apart from three large cargo decks, the design features an emphasis on environment-friendly credentials, also ice strengthening to GL E4 class and fin stabilisers. More details appear as part of our report on the recent RoRo 2006 conference, which begins on page 6.

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 DR. ZABI BAZARI – Lloyd's Register
 JAMES BENNETT – Austal
 ALAN BLUNDEN – Fast Ferry International
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Towards more effective tankcleaning

TANK cleaning is a subject that may possibly pass by many naval architects, but in reality, perhaps they should pay more attention to this important operation, since good tank structural design and superior ship equipment can play a key role in completing this task satisfactorily. Cleaning out cargo tanks is an essential but time-consuming chore for chemical and product tanker operators - failure to remove the last residues of a previous cargo can be the basis for rejection of suitability to load the next one.

Tank cleaning is also labour-intensive work, which includes the deployment of portable machines, and is not always helped - naval architects please note - by poor structural arrangements, insufficient hot water availability, few and/or low-capacity fixed cleaning units, and too many so-called shadow areas, where a cleaning jet cannot reach effectively. As if these are not enough, additional contamination problems can be caused by deteriorating coatings in cargo piping.

These points were made clear by representatives of the Swedish manufacturer Alfa Laval (whose portfolio includes the Gunclean and Toftejorg tankcleaning

Where no industry-standard rules exist, nearly everything can apparently be omitted from diagrams. The tanks of chemical and product tankers, for example, can be calculated as smooth and square, even though they are often corrugated, either vertically or horizontally. Ideally, naval architects should be aware that corrugations should have angles greater than 45deg, otherwise there are definite possibilities of cargo sticking and shadows appearing. More shadows are likely where corrugations are vertical.

To complicate matters, there are no fixed definitions of a tankcleaning machine's performance. Although effective jet length is defined in Det Norske Veritas and Class NK tank cleaning notations, these apply only to crude oil washing machines.

Even jet angle is not controlled by any other guidelines; it is possible, claims Alfa Laval, that shadows can be calculated using a zero-degree 'hit' angle, which means in practice that a jet has neither impact nor cleaning power. This company believes that a minimum liquid pressure of 700mm WG should always be available.

Such problems can now hopefully be overcome however by use of Alfa Laval's new G-Pass software. This creates a 3D representation of a tank and its internal obstructions, including obstructions that are often disregarded, and by using class society guidelines for jet length and hit angle, G-Pass can generate diagrams that optimise real-life performance. Additional assistance can be provided by specification of Alfa Laval's new Gunclean Toftejorg i65S machine (details will appear in the next issue).

Use of this software can be further enhanced by employing the higher standards today specified by Det Norske Veritas's voluntary Effective Tank Cleaning (ETC) notation, in use for products and chemical tankers for more than 10 years. This now requires better surface coverage and the use of machines with DNV-certified performance; the new specifications can be especially helpful for operators wishing to change from black to white products.

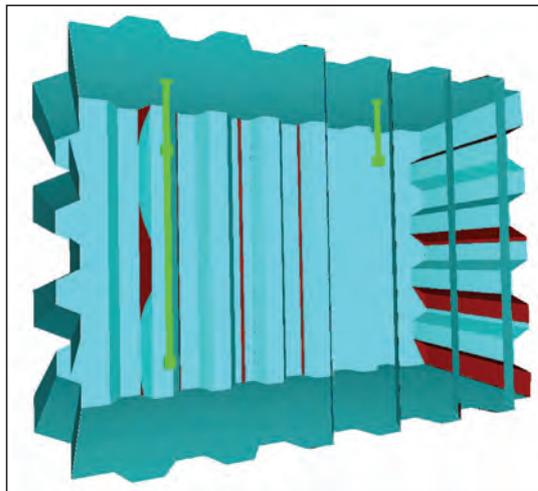
The basic ETC specification generally calls for no internal structures, and for surfaces to be stainless steel or coated, with piping and heating coils also to be of stainless steel or an equivalent material. Individual cargo pumps should be fitted, with their suction wells placed to ensure optimum drainage. In addition, hot-water boilers and/or heat exchangers must be able to supply fluid at 85°C minimum temperature, with capacity suited for washing at least the largest cargo tank.

Today, revisions to the ETC notation call for permanently installed washing machines to give a minimum coverage of 96%, based on a DNV certified jet length (calculated using the TA Program 785.70) at normal operating pressure and a minimum 10deg jet hit angle. Shadows caused by pump stacks are to be included in the shadow area. Portable washing units with access openings must be available to ensure complete washing of shadow areas to be undertaken.

At the present time, some 90 ships, the great majority in the 5000dwt-60,000dwt range, feature the ETC notation, and a further 80 tankers are on order. Although most are product or chemical tankers, a few are carrying oil only.

Hopefully, airing of these problems and proposed solutions will be a timely reminder to naval architects to inject new thinking when planning future breeds of product and chemical tankers. Ⓢ

Cargo tank shadows: a special problem for operators of product and chemical tankers. Superior overall system design, including corrugations with angles greater than 45degrees, sufficient boiler and heat exchanger capacity, effective tankcleaning equipment, and use of Alfa Laval's G-Pass software, can all help to ensure more efficient cleaning. Compliance with a Det Norske Veritas ETC notation, with its new revisions, would be a useful bonus.



businesses) and from Norwegian class society Det Norske Veritas at a recent press meeting in London. Although many tankcleaning solutions are prepared with the help of shadow diagrams, these are not always as detailed as they might appear, believes Alfa Laval. Weaknesses in existing regulations mean that system designers can disregard important obstructions or otherwise misrepresent tankcleaning performance.

Current IMO rules, which date back to the 1970s, only apply to crude oil tankers and can allow certain obstructions to be disregarded; however, MARPOL Annex II will, from early 2007, require new pre-wash and stripping performance for chemical tankers. According to Alfa Laval, customers should always specify a thorough assessment of tank shadows, taking into account the actual features of a tank's construction.

Specialised vegetable oil tanker for 2007 delivery

SHIPYARD K Damen, at Hardinxveld-Giessendam, The Netherlands, has signed a contract with the Dutch company **Koole Tanktransport**, at Zaandam, for the delivery of a chemical tanker. The vessel is especially intended for transport of vegetable oil and will have a length of 108.00m, a breadth of 13.50m, and a moulded draught of 4.60m, and will be constructed entirely at the shipyard in Hardinxveld-Giessendam. The vessel will be built as yard number 784, and delivery is scheduled for the end of 2007.

For carrying vegetable oils, the tanker will be installed with seven cylindrical stainless steel tanks with a total capacity of 4050m³. The sea-going vessel will be built according to the rules and regulations of Bureau Veritas and will be sailing under The Netherlands flag. A propulsion installation centred on a Wärtsilä 9L20 engine will have an output of 1800kW at 1000rev/min and this will drive a Lips/Wärtsilä CP propeller.

NEW FERRY TO REPLACE OLD SHIP IN FLEET

- In keeping with its commitment to accelerate the replacement of its older vessels, BC Ferries has signed a Can\$45.5 million contract with Vancouver Shipyards, a Washington Marine Group company, to build a new 125-car intermediate size ferry. Construction on this 100m vessel will begin later this year, and the ship is expected to enter service by the summer of 2008. Over the next five years, BC Ferries will add eight new vessels at a cost of Can\$1 billion.

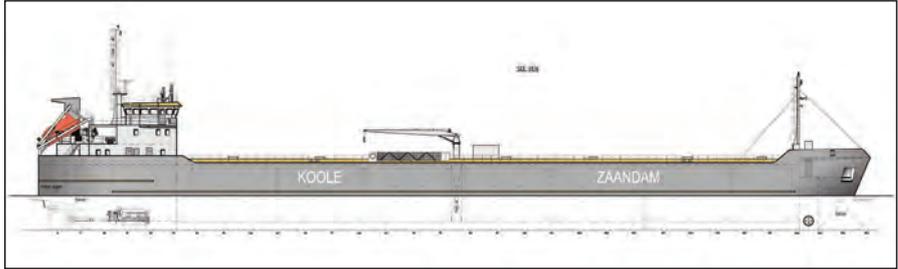
The new ship will allow for the retirement of the 46-year old *Queen of Tsawwassen*, and will sail initially on the Earls Cove-Saltery Bay route on the Sunshine Coast. Design features will include a lounge, a snack bar, and a state-of-the-art lifesaving system.

A process for selecting the successful builder was started last year with 14 shipyards invited to participate in the prequalification process, as a result of which, two Canadian shipyards and one other yard were short-listed. In September 2005, BC Ferries signed a formal letter of intent with the Washington Marine Group.

The 3500gt ferry will have a breadth of 27m, and a capacity for 125 vehicles, and 600 passengers. It will be able to reach a service speed of 14.5knots and will be installed with four right-angle drive propulsion systems.

The new vessel is one part of BC Ferries' commitment to keep pace with the needs and expectations of its customers, and under the fixed-price contract, the shipyard will be responsible for both detail design and construction, as well as guaranteeing performance related to speed, carrying capacity, manoeuvrability, fuel consumption, and delivery.

NEW TESTING LAB OPENS - The examination of metallic materials and failure analysis for ship operating systems, as well as for civil engineering, plant technology, and machinery will now also be offered in Hamburg by GLP, the testing laboratory of Germanischer



A profile view of the new vegetable-oil tanker building at K Damen, Hardinxveld-Giessendam. The vessel will meet new IMO rules for these special cargoes.



An impression of the new BC Ferries' intermediate-size ferry to be built by Vancouver Shipyards, showing the quadruple right-angle-drive propulsion units.

Lloyd. To complement branches in Mülheim, Herne, and Stuttgart, the operating area of materials testing and failure analysis is being expanded into the north German region. The spectrum of routine materials testing will include destructive and non-destructive tests, metallography, corrosion examinations, chemical analyses, as well as investigations employing light-optical and scanning electron microscopy. In the failure analysis of components, the laboratory's offering is directed at the steel trade, materials manufacturers, engineering firms, suppliers of marine technology, and steel construction companies.

CONTINUED CONCERN OVER CARGO-SHIP SAFETY

- In 2004, The Royal Institution of Naval Architects (RINA) presented IMO with research that proved that 20% of the world merchant fleet is made up of general cargo ships, yet experienced 40% losses, and 40% of fatalities. This amounts to the loss of 90 ships annually, and the death of 170 seamen. This risk of death to individuals is higher than on any other type of vessel, and the total death is approximately equal to that from oil tankers, bulk carriers, and ro-ro vessels combined.

The Maritime Safety Committee concluded that more investigation into the above statistics was needed. It then invited governments to make a joint submission with RINA for the inclusion of a new work item. No action has so far been taken by any member government.

RINA has now written to the secretary-general of IMO expressing its frustration and concern that no action has yet been taken over the

compelling data to improve the situation. RINA urges IMO to provide strong leadership in this matter by initiation of a study to identify the most effective ways to improve general cargo ship safety.

CHEMICAL TANKER EXPERTISE ACQUIRED

- Aker Yards has now entered the chemical tanker market with the purchase of Kleven Florø and Kleven Design, both located in Florø, Norway. These important purchases, along with a union with the Damen Shipyard group in the Ukraine, will add to Aker Yards' merchant vessel business area with a range of specialised chemical tankers to its portfolio. ☺

PEOPLE

MARTINUS BRANDAL, former executive vice president of Aker ASA, has assumed the role of president and chief executive officer of Aker Kvaerner, succeeding **Inge K Hansen**.

ADMIRAL ROBERT E KRAHEK, president and chief operating officer of the American Bureau of Shipping, will retire on December 31 2006.

CHRISTOPHER J WIERNICKI, currently president and chief operating officer of ABS Europe, has been selected to replace Mr Krahek, from January 1 2007. ☺

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Philosophy behind BC Ferries' new Super-C double-ended designs

David Tinsley distils some of the key features of the ship design papers presented at the recent RoRo 2006 conference, held on May 16-18, 2006 in Ghent, Belgium, and organised by Lloyd's List Events. He begins with the highly interesting BC Ferries Super-C class project, currently under way in Germany at Flensburger Schiffbau.

CANADIAN operator BC Ferries has implemented a major fleet revitalisation strategy, based on both new construction and mid-life upgrades of existing vessels, intended to raise efficiency, capacity, and service levels (also see News, this issue). Three large double-enders ordered from Flensburger Schiffbau-Gesellschaft (FSG) form the leading edge of a build programme which envisages the introduction of 22 new vessels by 2020.

The trio of Super C-class vessels entrusted to the Flensburg yard reflects a highly circumspect and pragmatic approach to design and engineering issues, founded on clear operational, commercial, and technical objectives. In particular, the adoption of a double-ended configuration, and the nomination of diesel-electric powering and propulsion based on a constant-speed, power station-type plant of 16MW total output, were the outcome of a thorough investigation into service requirements and assessment of system options.

Each of the new ferries will be laid out for 1650 passengers and 370 vehicles, and the first vessel is expected to arrive in British Columbia by December 2007, with the second and third ships following in March and June 2008, respectively. The deal is a coup for the export-orientated German shipbuilder, which has emerged as one of the world's most prolific and creative yards in the ro-ro sector. The new Super-C generation is intended to replace smaller-capacity tonnage on routes linking the Vancouver region with the southernmost end of Vancouver Island. With further planned investments, it is anticipated that the proportion of double-enders in the BC Ferries' fleet will grow from the current 50% to 75% by 2021.

C-class series used as reference point

The reference vessel type for the Super-C project was the C-class double-ender, five examples of which were commissioned into British Columbia duties between 1976 and 1981. In a paper* prepared for RoRo 2006 by BC Ferries' Bruce Paterson and FSG's Dr Gerhard Holbach, the C-class ships were described as 'extremely cost-effective vessels',

* Diesel-electric propulsion concept for BC Ferries' new double-ended ferries', by Bruce Paterson of BC Ferries and Dr Gerhard Holbach, of Flensburger Schiffbau-Gesellschaft.



An image of the Super-C ferries under construction at Flensburger Schiffbau.

offering a capacity for 362 cars and 1465 passengers on a gross tonnage of just over 6500gt, and 21knots on 9MW of power.

A double-ended configuration reduces in-dock manoeuvring, achieving significant savings in relation to the 90-minute transits provided by the ships. The propulsion system in the current *Queen of Coquitlam* C-class series features one CP propeller at each end and two main engines with a common gearbox, enabling power sharing so as to drive one propeller in transit mode, and two propellers in docking mode. Each of the screws is feathered when forward to the direction of travel during transit.

The 16,000kW diesel-electric power and propulsion plant chosen for each of the new Super-C vessels will be based on four diesel prime movers, two constant-speed propulsion motors, and twin CP propellers. These arrangements were selected after considering a range of options which included podded electric drives, also variable-speed propulsion motors and FP propellers.

One of the Super-C series has been earmarked for the crossing between Tsawwassen and Victoria (Swartz Bay), while

the two other newcomers are to be allocated to the route connecting Horseshoe Bay with Nanaimo, currently maintained by C-class vessels. The acquisition process for the Super-C project applied a design-build philosophy, in which the bid specification was developed by a BC Ferries working group, made up of representatives from the deck, engineering, technical, catering and retail departments, and which comprised a statement of operational requirements (SOR), a high-level technical statement of requirements (TSOR), supporting documentation, and a makers' list.

Gulf of Georgia design criteria

ABS was selected by BC Ferries to provide classification services and to participate in the design process, employing 'Gulf of Georgia' design criteria. The multi-phase selection process encompassed prequalification requests to 11 shipyards, whereby five qualified bids were reviewed, and three yards were shortlisted. The negotiation phase resulted in FSG landing the contract.

At each stage, the specification was refined. Criteria for shipyard selection included the design and construction plan, recent experience

of building large ferries, references from yard customers, delivery schedule, price and payment terms, financial stability, and the ability to provide financial guarantees.

As explained by Mr Paterson and Dr Holbach, interoperability was a key programme objective, along with the fundamental need for safe and reliable transportation. Design and performance parameters were accordingly determined by the requirement to meet schedules and efficiency criteria relating to a number of routes, and to ensure terminal compatibility on those various services. Use of 'fit for purpose', proven technology and systems that would be supportable within British Columbia's marine industry was a fundamental aim, as was the requisite level of flexibility for a 40-year design life.

Customer expectations as to comfort as well as capacity were a core consideration in the technical project. The engineering concept is based not only on factors of through-life efficiency, service reliability, and safety, but also on setting a new benchmark in the minimisation of propulsion noise and vibration. These features should benefit the complement of 1650 passengers and 35 crew, ultimately influencing the market's perceptions of this owner and the company's service quality.

Given the commitment to a double-ended design, propulsion issues and objectives addressed in the Super-C project included reduced shaftline lengths and minimised dependence on clutches and complex gearing, with companion high expectations as to reliability. Redundancy in terms of machinery spaces was a precondition, as was an improved growth margin relative to the C-class as regards power, along with a high level of passenger comfort allied to specific ABS notational standards.

The latest technology is being brought to bear on fuel efficiency, performance, and power management system capabilities. At

the same time, the design had to ensure limited impact on terminal infrastructure and incorporate restrictions on beam and draught.

Analysis of wind, wave and current conditions on the various routes, hydrodynamic model tests of various double-ended concepts, and propulsion system trade-off studies were undertaken. Results were synthesised to develop the contracted propulsion configuration.

Pod propulsion considered

Hydrodynamic model evaluations entailed the development of a baseline set for assessment of shipyard design offers, exploration of new propulsion concepts, including cost-benefit studies into the use of podded systems in a double-ender, investigation of bow and stern power sharing issues, appendage drag issues, including propeller feathering and parasitic drag of rudders, and calibration of wake wash.

Pods were found to offer an incremental improvement, but this was deemed insufficient to offset the baseline shafted configuration on a 90mile route. The ability to feather the bow propeller corresponded to a power saving of around 15%, while the parasitic drag induced by a high-lift rudder in the bow position was significant, equating to a 10%-14% penalty over the 'bare hull'.

As a result of all this, it was concluded that conventional shafted propulsion would be most cost-effective. This was based on route profile and vessel size; at the same time, high-lift rudders were favoured for operational reasons.

Three propulsion-plant possibilities studied

Three propulsion-plant options were considered, based on a shafted configuration. A diesel-electric power station concept, comprising four or more prime movers, variable-speed motors, and FP propellers was

one proposal. Another was a diesel-electric hybrid arrangement, with one or more prime mover at each end and a motor or alternator acting on each shaft, plus CP propeller, with a separate generation system for ship's services. The third possibility was a geared diesel layout, using one or more father-and-son prime mover sets, with a CP propeller at each end, plus shaft generator and standby genset for shipboard services.

Little difference in first cost or life-cycle costs was found between the various options. The power station concept was seen to pose the least technical risk for a large, double-ended ferry, while offering operational merits in terms of system configuration and in-service maintenance potential.

These various ideas were synthesised into a constant-speed power-station concept, based on four prime movers, delivering power to both propulsion and ship services buses, two constant-speed propulsion motors, and two feathering, CP propellers. Savings were achieved on the power station diesel-electric proposal, known as model A, by incorporating bow propeller feathering and by eliminating cyclo-converters and frequency control.

The four main gensets will be driven by engines of German origin, in the shape of MaK 8M32C medium-speed models. Contractual service speed is 21knots, at 85% maximum continuous rating. It is anticipated that each vessel will be able to maintain a cruising speed of 18knots with just two gensets running, such is the flexibility and power margin encapsulated in the installation.

The Super-Cs will be named *Coastal Renaissance*, *Coastal Inspiration*, and *Coastal Celebration*. An advisory board comprised of BC Ferries' employees and local newspaper reporters chose the names after reviewing 7602 entries submitted in a contest that ran from October 2005 to January 2006. ☺

Ro-ro ship design safety

In a presentation* to RoRo 2006 aimed at revitalising discussion and promoting dedicated research into the concept of an intrinsically safe passenger ship, TNO's Alex Vredeveltdt highlighted alternative methods aimed at improving survivability.

REDUCING the vulnerability of ships with respect to damage stability is usually accomplished by reducing the height of the centre of gravity, increasing the width of the hull, or providing additional subdivision bulkheads. However, these design options either reduce a ship's earning capacity or increase building costs, according to Mr Vredeveltdt. He pointed to two other options, namely the use of solid buoyancy to improve damage stability characteristics, and the adoption of 'crashworthy' side structures.

Although solid buoyancy is often difficult to accommodate, Mr Vredeveltdt contended that void spaces, which many ro-pax vessels have below the vehicle deck, could easily be filled with foam blocks of low-density material. He referred to a case where solid buoyancy had already been used to reduce the permeability of the void below a vehicle deck. 'Model tests showed that, because of this design measure, the ship could comply with SOLAS 90 and Stockholm Agreement requirements for which the vessel was not designed'.

Studies have indicated that reducing the permeability down to 20% increases the survival boundary well beyond the mandatory threshold of a 4m significant wave height. Solid buoyancy proves very effective in this respect, and can also provide some protection of the lower hold in a collision situation. Fire tests showed that no major danger exists, because the buoyant material is stowed in a closed, airtight compartment.

Crashworthiness (although not new - the concept was applied to the collision protection of the reactors of nuclear-powered cargo ships in past decades) is an option that is attracting more interest among ship designers. Recently, a guideline relating to hazardous cargo movement on inland waterways was adopted by the Central Commission for Navigation on the Rhine. This allows the use of cargo tanks with capacities exceeding the regulatory maximum, when sufficient protection is provided against penetration. 'The guideline is based on the concept of equivalent safety. It uses the definition of risk as a multiplication of probability times effect', explained Alex Vredeveltdt.

As a result of an EU-funded research project known as Crashcoaster, a method is now available, for use in the ship design stage, to calculate the effect of the crashworthiness of a side structure on the probability of survival with respect to damage stability. ☺

*'Concepts for passenger survival', by Alex W Vredeveltdt, TNO, The Netherlands.

New Finnish ro-ro paper carriers

Family-owned ro-ro specialist Godby Shipping, domiciled on the Åland Islands at Mariehamn, is fostering an important new stage in its development through investment in a pair of versatile ro-ro carriers for the Finnish forest-products trade. The new ships will be delivered in the second half of 2007.

ORDERED from prolific German shipbuilder J Sietas through Godby's associated companies Trailer-Link and Minicarriers, these 9500dwt new designs have been optimised for sto-ro working and transportation of paper and paper products, in accordance with long-term charter obligations to Finnish producer UPM-Kymmene.

As explained by Godby's managing director, Dan Mikkola, in a presentation* to the RoRo 2006 gathering, particular attention has been paid to ensuring high environmental credentials along with flexibility in working and transporting handling-sensitive cargoes. In addition to unit cost efficiency in handling and shipping, the design of shortsea ro-ro ships keyed to industrial traffic is strongly influenced by producers' and importers' competitive requirement for cargo delivery on time and in pristine condition.

* 'A new generation of ro-ro vessels to serve Nordic paper exports', by Dan Mikkola, managing director, Godby Shipping.

Moreover, environmental factors are increasingly coming into play in transport logistics. This is particularly so in the Nordic region, and Godby's new breed demonstrates a circumspect design approach to this situation.

Scheduled to be phased in during the second half of 2007, the new vessels will be suited to all kinds of forest products. While the cargo decks' smooth steel surfaces and a double-skin construction reflect the particular needs of sto-ro paper cargo, the ships will also be conducive to cassettes, trailers, and containers.

The three-deck design's intake corresponds to 1900lane metres of ro-ro cargo, or 161 x 12.5m cassettes, while flexibility is further expressed in the scope for triple-stacked containers amounting to 420TEU or 210FEU on the weather deck. Boxed cargo can be accommodated in 20ft, 30ft, 40ft, 45ft and pallet-wide (2.5m) units. Examples of possible cargo make-up cited by Godby include 3200tonnes of paper in the lower hold plus 5500tonnes of paper on the main deck, or a mixed freight of 2300tonnes of paper in the lower hold, 3200tonnes of paper on the main deck, and 2700tonnes of containerised cargo (around 192 units at 14tonne payload).

As with Godby's previous generation of ro-ro cargo vessels, all loading and unloading will be effected over a stern ramp at the main deck threshold, with fixed ramps to both the lower hold and weather deck, thus facilitating simultaneous freight handling at all three levels.

Mr Mikkola underscored the environmental attributes of the design, including provision in a Wärtsilä twin-engine propulsion plant to cut emissions of oxides of nitrogen (NOx) to 50% below current IMO requirements, along with a dual heavy-fuel system, and the protected location of all fuel tanks within the double hull. Furthermore, the sterntube will incorporate a spare seal, and the bilge water separator installation has been engineered to give less than 5ppm discharge, while each ship will be built to meet Germanischer Lloyd's Environmental Passport notation.

The Finnish owner was among the first to endorse Wärtsilä's recently developed 46F medium-speed diesel engine. Two such engines, in six-cylinder configuration, have been nominated for each ship, to give a total output of 15,000kW and ensure the requisite, comparatively high speed of 20knots.

Preparation for Wetpac H system

Common-rail technology embodied in the 46F offers a high degree of operational flexibility, translating into efficiency and emission-curbing benefits; in addition, environmental attributes of the installation are further enhanced by its preparation for the Wetpac H system. The principle of Wetpac H is to introduce pressurised water into the combustion process so as to reduce NOx formation. 

2006 RINA LLOYDS REGISTER SHIP SAFETY AWARDS

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Entries close 1st January 2007

The RINA - Lloyds Register Ship Safety Awards

recognise recent innovations or developments which have led to an improvement of safety at sea, or which have the potential to do so.

Entries may be submitted directly by individuals or teams from universities and industry from any country, and may cover design, construction, research, equipment or operations. Entries are judged on originality, quality of design, feasibility of production and contribution to ship safety.

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There are separate categories for universities and industry. An Award of £1500 is made in each of the categories and will be presented at the 2007 RINA Annual Dinner.

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Norwegian LNG-fuelled ferries ready soon

LNG-fuelled main engines made their debut in 2000 in the 94.8m double-ended ferry *Glutra*, run by MRF, a subsidiary of Norwegian transport group Fjord 1. The adoption of gas-electric propulsion in Fjord 1's new programme of five, large double-enders signals a major commitment by Norway to a national fuel resource as well as to indigenous engine technology, promising important environmental as well as economic benefits.

THIS important new series of five ships, designed by the LMG Marin consultancy, is to be employed on two of the longest and busiest fjord crossings connecting the west Norwegian coastal highway system. Construction has been assigned to Aker Yards, the group which also built the seminal *Glutra*. At 129.5m length, but with two different capacities, the nascent series of ferries is significantly larger than the earlier vessel, which is reported to have proved to have been an operational success.

Outlining this bold scheme in a paper* to the RoRo 2006 conference, Fjord 1's executive vice president Hallgeir Kleppe said that diminished environmental impact had been one of the primary objectives of the project, along with reduced travel time and increased capacity, also safe and efficient transportation of passengers and vehicles.

The stipulation of gas engines has been inspired by government, concerned over the considerable proportional contribution of shipping activities to Norwegian air pollution. Gas fuelling has fundamental merits in terms of emissions performance.

The Oslo administration is also keen to maximise the use by transport as well as by industry of nationally-developed LNG resources. Investments in the gas supply infrastructure are now making bunkering on gaseous fuel a practical proposition to local vessels, coastwise traders and offshore support vessels. Ferry connections can be a tool to build up an infrastructure for LNG', observed Mr Kleppe.

Three of the double-enders will offer a transit speed of 21knots, for deployment on the Halhjem/Sandvikvaag service in Hordaland, and two will be of 17knots, for use on the Arsvaagen/Mortavika link in Rogaland, under the operating aegis of More og Romsdal Fylkesbaatar (MRF). Fjord 1 has been awarded licences for both ferry routes, which lie on the E39 main road between Bergen and Stavanger. Deliveries are scheduled over the period between August and December 2006, with a view to full service start-up under a 10-year contract from January 1 2007.

All five ferries will carry a mix of vehicles within a 212-car equivalent limit, and up to 590 passengers, but will be powered for different speeds. Three of the vessels will have two vehicle decks, and hence a larger capacity.



An impression of the new double-ended ferries for Fjord 1 (the lower-capacity version with one ro-ro deck is seen here), which will be powered by Bergen gas engines fuelled by LNG.



One of the KVGS-12G4 spark-ignited gas-fuelled engines being built by Rolls-Royce Bergen for Fjord 1's new LNG-powered double-ended ferries (two sets on each vessel) is seen here with its alternator outside the Bergen factory. The three faster ships will also be installed with two 16-cylinder models.

Those three double-enders to be assigned to the Halhjem/Sandvikvaag connection will have a total power of 12,370kW, supplied by two Bergen KVGS-16G4 spark-ignited engines, each of 3535kW, and two KVGS-12G4 prime movers of 2650kW apiece, to give a service speed of 21knots. Since only 17knots is required for the Arsvaagen/Mortavika run, the two smaller ferries have been specified with just two of the 12-cylinder G4 engines, for an overall power of 5300kW.

Relative to comparable diesel power, Mr Kleppe said that this new breed of ferries would achieve a 90% cut in NO_x, a 25% reduction in carbon dioxide (CO₂) emissions, and the virtual elimination of particulate, matter as well as oxides of sulphur (SO_x). LNG has a higher calorific value (52MJ/g) compared to diesel fuel (42.7MJ/g), although its lower density requires a larger storage volume for a given quantity of energy than diesel oil.

A key advantage of the pure gas engine in the context of marine propulsion is that it lends itself both to direct mechanical coupling to propellers or thrusters, and to electric production in gas-electric drive applications.

Schottel is supplying its proprietary Combi Drive and Twin Propeller systems to the series. Each of the three 21knot newbuilds in the programme will be equipped with four 2750kW Combi Drive SCD 2020 units in twin-propeller configuration, while the pair of 17knot ferries will each be fitted with four STP 1515 installations of 1600kW apiece.

In contrast to pod drives, whereby the electric motor is located within the underwater nacelle, the motor in the Combi Drive is integrated vertically into the support tube of the Schottel Rudderpropeller. The STP 1515 Twin Propeller units ordered for the 17knot double-enders will also be gas-electric-driven, although by a separate, horizontal electric motor via a cardan shaft. ⚓

*LNG-powered double-ended ferries operated by Fjord 1', by Hallgeir Kleppe, executive vice president, Fjord 1.

Issues affecting marine coatings

In the context of our June 2006 special feature - Paints for New-generation Ships, and the present climate of increased costs of fuel, those factors, which give serious cause for concern to the shipping industry, are the overall performance of a vessel and the cost of maintenance; in particular, fouling prevention and fuel consumption. UK coatings consultancy Safinah comments on some of the pressing issues raised in that feature.

IT comes as no surprise, therefore, to see three items in this feature on antifouling developments, all of which address these issues of concern. In addition, it can be noted that the featured coatings contain no biocides, in keeping with continuing environmental awareness.

The first of these new products, from Jotun, presents that company's launch into the foul-release coating (FRC) antifouling market with SeaLion, the second updates Hempel's FRC Nexus, whilst the third, from Subsea Industries, re-introduces Ecospeed as an innovative alternative to the growing 'hard coatings' FRC silicone sector of antifouling as a tough, smooth composite coating with non-stick properties.

Jotun has joined the biocide-free FRC club with SeaLion, for which at least 60 months fouling protection is claimed, not only for hulls and rudders, but also propellers - a significant period of time. Jotun claims fuel savings of 1.5% for a container vessel over a two-drydocking, 10-year period - equivalent to that of its 'high quality TBT-free antifouling.'

It is also said that improved SeaLion paint properties can bestow a relative cost benefit by reduced paint volume consumption, due to very low dry spray on application when compared with up to typically 40% loss on application for other silicone FRC products. As good house-keeping to prevent dry spray contamination onto other surfaces by silicones is an important consideration with FRC applications, this property could give additional tangible benefits.

Hempel's biocide-free FRC, Nexus, aimed at high-activity, high-speed vessels has now achieved the milestone of a 50-application track-record, and the company claims fuel savings of the order 2%-4% from actual results. Significantly, Nexus's mechanical coating strength is equated to that of normal antifouling systems, and thus no more susceptible to mechanical damages.

It is interesting to note that after decades of SPC antifouling supremacy, the opposing concepts of polishing and non-polishing antifouling are both said to yield equivalent savings in these cases.

Although resilience of silicone FRC is perceived as a product weakness on certain types of vessels, this is an issue that does not trouble the coating approach taken by Subsea Industries. Subsea Industries' Ecospeed claims

fouling control as only one of its properties. As a tough, glass-flake composite coating with ice-resistant properties, Ecospeed is specified for abrasion-resistant and anti-corrosion protection of hulls and rudders, as well as propellers.

Moreover, Subsea Industries' literature quotes reduced fuel consumption arising from the smooth surface profile of Ecospeed, achieved by 'conditioning' it, after cure and re-floating the vessel, to a roughness figure of 'less than 20microns', and a self-cleaning property said to prevent settlement at speed over an extended, but undefined, period of time. Should settlement occur, however, it is further said that Ecospeed's smoothness can be restored at any time by in-water cleaning.

Further antifouling advances forecast

Jotun's, Hempel's, and Subsea Industries' products indicate that innovation is still very much alive in the antifouling arena. And they are not alone. Although not discussed in the June feature, Nippon Paint Marine Coatings has been promoting Ecolosilk, as its entry into the FRC antifouling market. With the pressure of fuel costs and environmental consideration continuing on operators, further developments in antifouling technology can be anticipated.

Already the preponderant use of copper compounds as principal biocide following the banning of TBT under the operation of the IMO Antifouling System Convention has raised concerns about copper leaching into the maritime environment for biocidal antifouling. This in turn has led to the formulation of products using heavy-metal-free biocide packages to mitigate this effect.

Such packages also have the added benefit of compatibility with aluminium-hulled vessels, and the potential to produce bright antifouling colours. Additionally, the impact of huge price rises in paint raw materials - in particular metal prices such as copper, with their direct impact on antifouling - will only intensify the search for, and the introduction of, alternative antifouling products.

With regard to foul-release coatings that are restricted at present to types of vessels that rely on high speed and activity for self-cleaning, new developments can be expected to increase the potential market for FRC by lowering the speed at which self-cleaning occurs. Biocide-free and biocide-containing antifouling are set to challenge each other for market dominance in years to come. However, that is not to say that FRC products are necessarily entirely free from environmental scrutiny, with the issue of potential exudation of silicone fluids from the FRC coating in service now being of concern to authorities.

Greater interest in performance-monitoring software

In addition to the attention being paid to antifouling coatings, and their impact on fuel consumption, owners are showing greater interest in vessel speed and performance monitoring software. New entrants to meet

this demand offer services to owners, managers and operators, to aid decision-making to improve hull performance.

Many initiatives are underway regarding issues, such as operation and management of ships' cargo and water ballast tanks, also harmful aquatic organisms in ballast water - indeed MetaFil's OceanSaver ballast water treatment technology was winner of the prestigious 2006 Seatrade Award in the Protection of the Marine & Atmospheric Environment category. Revisions to IMO's Annex II of Marpol 73/78 now mean that many cargoes previously carried on product tankers will now have to be transported on chemical tankers.

Implications of these revisions will result in a number of high-volume cargoes, eg, all vegetable oils, will need to be carried on Type II or Type III (under an exemption) ships, bringing a substantial volume of cargo into the chemical trade. These industry changes have a consequence for tank linings and their performance and will continue to be of concern to owners.

Problems of water ballast tanks

Water ballast tanks are complex spaces to prepare, coat and inspect, and it has been a matter of great concern that cracking of ballast-tank coating schemes and consequential corrosion, has been a problem for the industry. In response, Hempel's Hempadur Fibre 4760 is targeted at overcoming this problem of cracks by incorporating synthetic mineral fibres in its composition to improve tensile strength and elongation.

Improved crack-resistant coatings offer benefits, particularly where inspection and maintenance is difficult due to access restrictions. In addition to this principal role as ballast tank coating, Hempadur Fibre 4760, is certified by DNV to B1 standard and pre-qualified for NORSOK, and by its versatility can act to control inventory as a universal primer throughout new construction painting.

Meanwhile, Advanced Polymer Coatings' MarineLine-based protective tank lining system is promoted for cargo tanks; it is compatible with an extensive range of chemicals and meets all IMO Annex II specifications, emphasising the acid-carrying capability.

By way of examples, a series of five new vessels constructed for KS Shipping are referenced for the MarineLine system, not only for their chemical transport capabilities, but also for their mechanical barrier properties, the latter being provided as a consequence of MarineLine having glassfibre-reinforced matting incorporated into its composition. The vessels are certified to operate year-round in the Baltic Sea, holding ice class IA certification, in addition to being IMO II-approved chemical tankers. Such a lining scheme offering both chemical and mechanical protection may well be of interest to other chemical tanker operators. 



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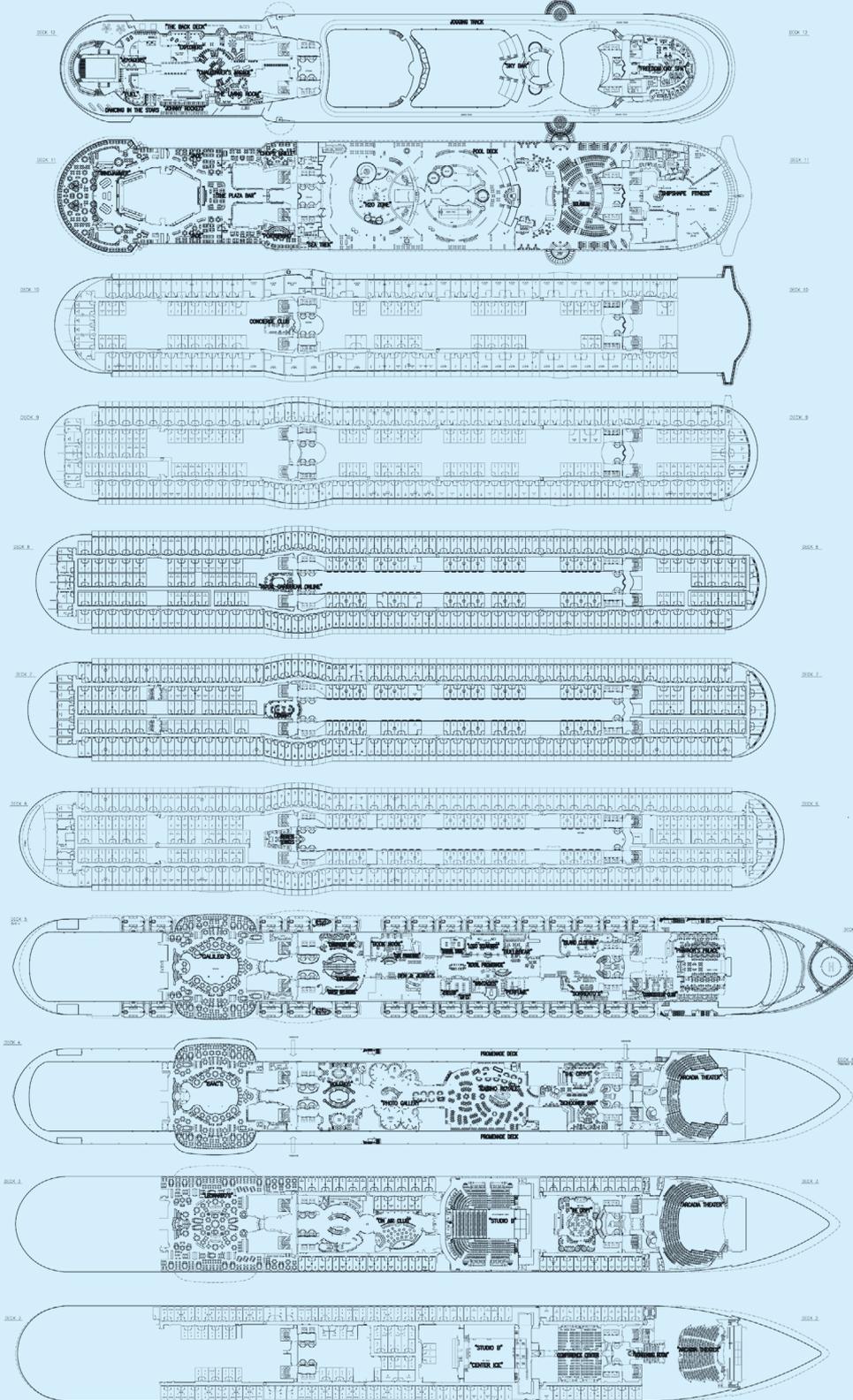
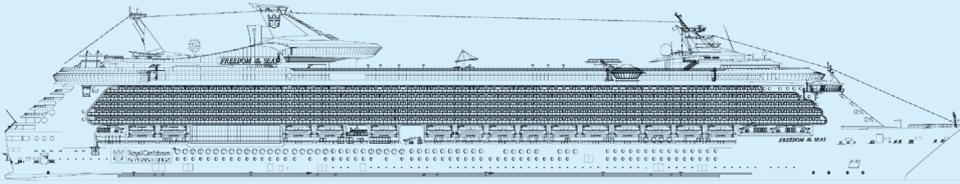
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General arrangement plans of the new 154,000gt Royal Caribbean cruise liner *Freedom of the Seas*, built by Aker Yards (Turku).



of around 22knots for the previous series. The maximum speed is some 22knots; however, the diesel-electric machinery is the same; six Wärtsilä 12V46C main engines, placed in two redundant engine rooms, each developing 12,600kW at 514rev/min, to bring the total output to 75,600kW. These were the last engines of this type completed at the now closed Turku factory. The ship's fuel tank capacity is approximately 3000tonnes. An approximate average daily consumption at service speed is 100tonnes.

The main engines are each coupled to an ABB 17,600kVA (12.3MV) 3-phase generator producing electricity at 11,000V/60Hz. Total propulsion requirement is 42MW, distributed over three ABB 14MW Azipod units - the one at the centreline is not capable of azimuthing. Once again, a huge bow thruster plant has been specified: four Rolls-Royce tunnel units with ABB electric motors and an increased power over Voyager ships of 3.4MW each - up from 3MW on the previous vessels (and three 3200kW units on *Queen Mary 2*).

The six main generators supply electricity to the 11kV main switchboard with 43 UniGear panels with associated protection units, internal arc sensors, and monitoring systems. ABB also supplied the six 13,200kVA propulsion transformers and three doubled frequency converters, one for each double-wound propulsion motor, with a one-pole high-speed breaker between cycloconverter and motor.

In total, there are 19 engine room and ship supply transformers and low-voltage distribution systems. These include the 440V main switchboard, emergency switchboard, shore connection switchboard, motor control centres and propulsion auxiliary boards, with altogether 186 cubicles.

Aalborg Industries has supplied the two oil-fired steam boilers onboard, of type Unex CHB-15000, each with a capacity of 15,000kg/h steam, also the six Unex G-572 exhaust-gas boilers/economisers, each with a steam capacity of 4900kg/h.

Alfa Laval has delivered the separators for the fuel and lubricating oil, also two desalination tube-type DTU 900tonne/24h fresh-water generators. In addition, Alfa Laval's new PureVent system is installed for cleaning of crankcase gases from the diesel engines. Traditionally, crankcase gases have been released into the atmosphere or have been cleaned with filters, which generates waste. PureVent, which has been developed by Alfa Laval and tested by Wärtsilä, represents a radical new approach to crankcase gas cleaning in high-capacity situations.

Developed specifically for marine and power plant applications, and launched last year, PureVent uses centrifugal force to remove oil mist, soot and unburned fuel from crankcase gas, and thus does not generate any waste. The system has a claimed 98% efficiency, and collected oil is drained into a tank from where it can be recirculated or burnt in the incinerator. *Freedom of the Seas* is one of the first vessels installed with this system.



The primary power plant is similar to that on the Voyager series: six 12,600kW Wärtsilä 12V46C main engines driving ABB 17,600kVA alternators.

Hamworthy has supplied the 111 centrifugal engine room pumps for *Freedom of the Seas*. Most pumps are of the new C2G type, developed over the past few years. Standard components are used where possible, to reduce costs and to minimise spare parts inventories. For example, only five sizes of seal bearing assembly and eight sizes of pump couplings are used throughout the C2G range of pumps. The capacity range is from 30m³/h to 2200m³/h. The largest pumps have a capacity of 1566m³/h with a head of 33m.

The ship's CAE Damatic automation system is supplied by **CAE Valmarine**, today part of L-3 Communications MAPPS Inc. This includes the complete machinery automation arrangement as well as automation and monitoring for heating, ventilation, and air conditioning. CAE Damatic automation enables full control of all shipboard machinery and equipment by a single crewman. This equipment is claimed to be highly reliable and is built to guarantee uninterrupted operations, with back-up in the event of system failure.

Autronica Fire and Security AS has provided the network-distributed addressable interactive fire alarm and detection system for *Freedom of the Seas*. In the system, called AutoSafe, information is routed to panels on a network. Information indicating which unit has given an alarm is directed where it is needed. AutoSafe also has a built-in automatic testing function.

PureVent separators, a new development by Alfa Laval in cooperation with Wärtsilä, are used to separate crankcase gases from the diesel engines and to avoid possibilities of crankcase explosions.



A triple Azipod plant (3 x 14MW) has again been chosen. The central pushing unit is fixed and the other two pulling models are azimuthing.



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DNV congratulates Royal Caribbean with *Freedom of the Seas*.

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The AutoMaster 5000 centralised graphic system indicates and controls the fire detection system, the fire-suppression systems onboard, such as sprinkler, carbon dioxide and foam systems, fire doors, low-location lighting, the CCTV system, and supplies all vital data to the ship's voyage data recorder. The equipment normally has two control and monitoring panels on the fire control station on the cruise ships' bridge.

On *Freedom of the Seas*, there is also an AutoMaster panel in the machinery control room. This gathers the relevant information in an emergency and is used also for regular maintenance purposes. It presents the information in a logical way using maps, icons and texts, giving control of fire-safety systems.

On the new liner, there are some 6000 sensors, and some 200 flow switches for the grouped sprinkler system. This controls and monitors all the more than 1200 fire doors onboard (all hinged fire doors were delivered by **Saajos** and watertight sliding doors by **Tebul**).

There are eight fire detection panels onboard, one in each fire zone. In addition, there are some 200 separate low-location light systems (delivered by **YIT Shipins**), and a huge number of 340 CCTV cameras. In case of a fire alarm, the CCTV surveillance camera in the area is automatically switched on, in the alarm area. **Bryant Security Corporation DBA** supplied the control video monitoring systems.

The liner's decision support system, required by SOLAS, is integrated with the AutoMaster 5000. This equipment is intended to provide support in case of an emergency. All information on fire sensors, alarms, and actions is automatically sent to the voyage data recorder. In addition, the system stores the information history for one year, for maintenance and other back-up purposes. Autronica is currently working on a project where the same information which is displayed onboard is also transmitted to an owner's onshore emergency control station.



Passenger comfort on the new liner should be ensured by a pair of these S800-type Simplex-Compact fin stabilisers, delivered to the yard by B + V Industrietechnik. Each has a surface area of 18m².



On *Freedom of the Seas*, there are two of these Autronica AutoMaster 5000 control and monitoring panels at the bridge fire control station, plus one panel in the machinery control room. Most of the ship's safety systems are centralised on these.

Comprehensive bridge layout

An integrated navigation and communication package was supplied by the **Sperry Marine** business unit of Northrop Grumman Corp.

This includes the complete suite of bridge electronics for the ship, which meets or exceeds international regulatory requirements. The integrated bridge system is based on the new-generation Sperry Marine Vision FTTM architecture, with large, high-resolution flat-screen displays, convenient console layouts, ergonomic controls, and new operating software.

The bridge layout is arranged with all consoles and displays in a U-shaped configuration for easy control from trackball devices built into the armrests of the two watch officers' chairs. All critical components are duplicated, providing total redundancy and continuous safe operation. Bridge systems include multiple navigation radars, adaptive self-tuning autopilot, a fibre-optic gyro heading reference system, Doppler speed logs, and electronic chart display and information system running on Sperry Marine's proprietary voyage management

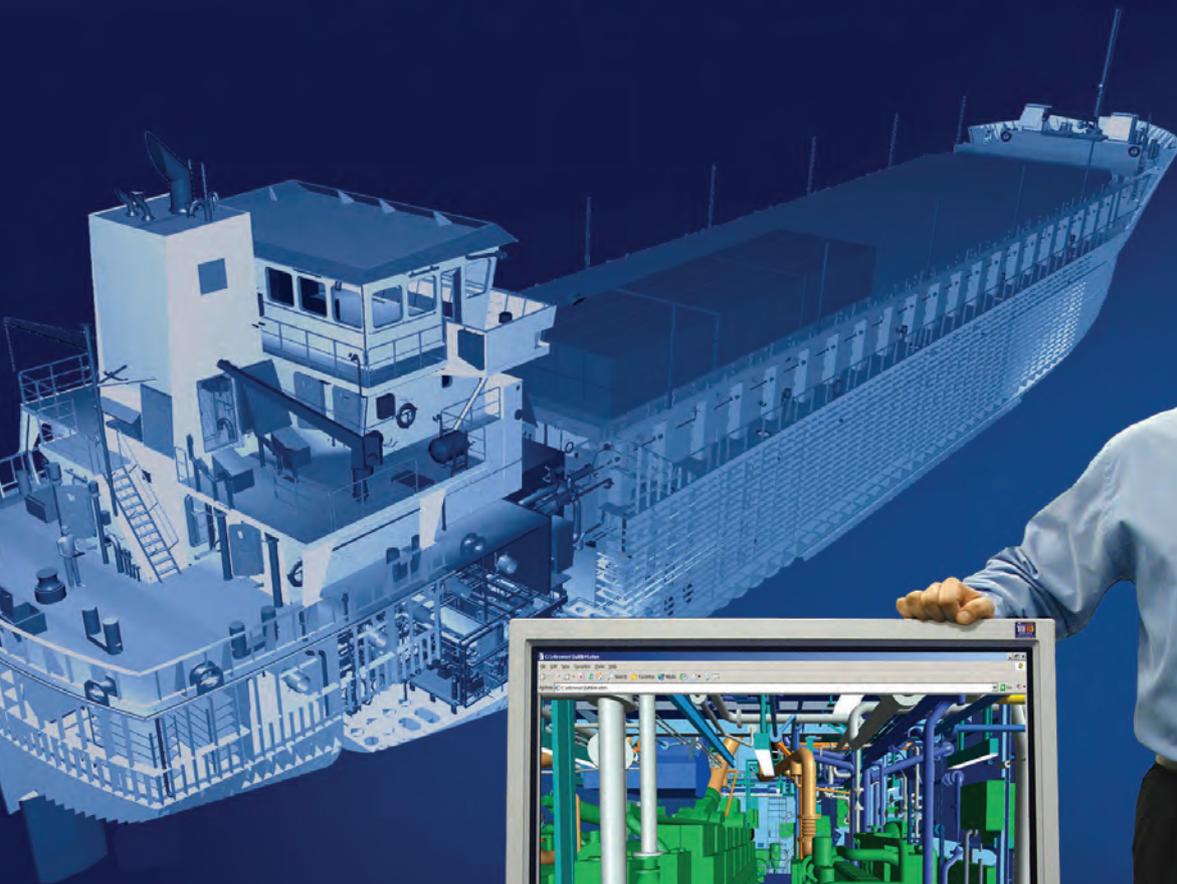
The large bridge-front console is in a U-shape, and trackballs in the watch officers' chair armrests are used for control.





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A very large air conditioning plant by Koja is installed on the new liner. Total compressor capacity is 21,200kW.

system software, as well as a full array of communication equipment meeting international requirements.

On both sides of the bridge are consoles used when docking the vessel, incorporating the Azipod and thruster controls, a radar, and a multifunctional screen. On *Freedom of the Seas* there is an additional steering wheel placed midships towards the front on the bridge.

A high-pressure water-mist fire extinguishing system onboard, as well as a local fire extinguishing system in the machinery spaces, with some 400 water mist spray heads, was supplied by **Marioff**, whereas **Unitor** provided a total-flooding CO₂ system as the main protection for engine room spaces. As an enhanced safety measure, a Unitor low-expansion foam system is fitted for the bilge areas beneath the floor plates.

Large air conditioning plant

Koja supplied the massive air conditioning system for the accommodation, public rooms, and service areas onboard. The system is designed for 'worldwide operation', guaranteeing a constant room temperature of 22°C in summer and 23°C in winter. In all, there are in 29 fan rooms for the 101 airconditioning and ventilation plants, and a total air volume of approximately 1,890,000m³/h (supply) and 1,840,000m³/h (exhaust) is handled. The installed

airconditioning compressor capacity is 21,200kW compared with 17,644kW on the Voyager-class ships, which had 92 AC ventilation plants in 26 fan rooms and handled about 1,690,000m³/h (supply) and 1,580,000m³/h (exhaust).

Public rooms are served by central air handling units, capable of keeping the temperature at a constant level. In the theatre, a chair ventilation system is used to ensure draughtless and efficient ventilation. Cabins have Koja's CFAC fan-coil system for individual temperature control. Koja delivered fan-coil units for all passenger and crew cabins as well as a cabin's condition monitoring system for the passenger cabins.

This allows monitoring of each cabin's indoor condition and its history from the purser's office or from the control room - a useful benefit in cases of passenger complaint. The cabin actual temperature, set-point temperature, and balcony door position are monitored using the liner's CAE Valmarine central information system.

Today, **Kone Marine** today handles the marine lift business formerly held, in a cooperation agreement, by MacGregor. The Voyager-series cruise ships were each fitted with 26 lift packages. For *Freedom of the Seas*, a total of 28 elevators were delivered. These include 14 MiniSpace-type passenger units with a capacity of 1800kg or 24 persons, six of which are of the glazed scenic type. Service lifts include twelve 1000kg or 13-person MiniSpace-type units and two eight person/1000kg MonoSpace types which dispense with the need for a machinery room. Deliveries also included two 300kg galley lifts and a wheelchair unit.

Swedish cargo access manufacturer **TTS Ships Equipment** supplied a package for *Freedom of the Seas*. This includes the external side shell doors for passengers and crew embarkation, all doors for loading of luggage, provisions, bunkers and spares, and also doors and platforms for mooring. In addition, internal hatch covers and lifts were provided for vertical distribution of luggage, provisions, and spares. The total weight of the TTS deliveries, which included design and

complete turnkey installation, is some 140tonnes and includes some 50 components in total with their necessary hydraulic systems.

Lifesaving outfit

As for the Voyager-class vessels, lifeboats and davits were supplied by **Umoe Schat-Harding**. These include 30 partially enclosed lifeboats each for 150 persons, with pivot gravity davits, two fast rescue boats with pivot davits, and 10 low-type liferaft davits. The contract also included installation and testing identical to that of the previous Voyager-class series.

A total of 82 davit-launched liferafts, each with a capacity for 35 persons, was supplied by **Viking Life-Saving Equipment**; these are placed on decks 6 and 7. An interesting addition supplied by the Danish company was three 12-person davit-launched training liferafts.

A major task for the crew will be to arrange for the tendering ashore of the more than 4000 passengers. In those ports-of-call where tendering is necessary, a fifth boat, supplied from ashore, has been added.

Fire wall for internal promenade

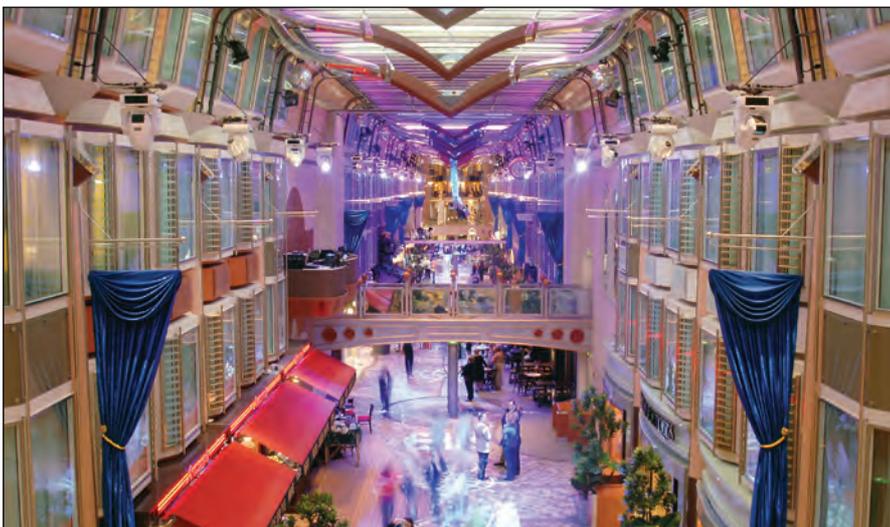
On this new Freedom-class as well as on the earlier Voyager-class vessels, all public rooms and some cabins are designed around the central four-deck-high horizontal promenade, a technical masterpiece, which until then had not been seen on cruise ships before. The idea was originally created for two Silja Line ferries, the first of which, *Silja Serenade*, was built in 1990 by the same yard. On *Freedom of the Seas*, the length of the *Royal Promenade*, on deck 5, has been increased by some 20m to 160m.

On the earlier vessels, the promenade area extended over three fire zones. On *Freedom of the Seas*, a third fire-wall arrangement has been added for the four fire zones of the promenade area. Normally, these are kept folded into the side bulkheads of the promenade, and cannot be recognised by the passengers. On decks 6, 7 and 8, altogether 171 cabins face towards the promenade, an addition of 33 from the previous ships.

The additional 780m² deck area has been used for extra passenger amenities. These include the *Clean Shave* barber's shop for men, and a book shop and café, the *Book Nook*, in addition to a number of shops and bars. The increased size has also allowed for a new Italian restaurant in the area, *Sorrento's*. As on the previous vessels, there is a secondary lounge forward of the promenade, named *Pharaoh's Palace*.

On deck 4 is the ship's huge *Casino Royale*, the *Schooner Bar*, an enlarged disco and,

continued on page 24



Freedom of the Seas continues the revolutionary feature first employed in 1990 on the ferry *Silja Serenade*, of an internal promenade. The length is 160m.



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The magnificent main dining room is spread over three decks named *Leonardo's*, *Isaac's*, and *Galileo's*.

forward, the uppermost level of the art-deco

style *Arcadia Theatre* seating 1356. On this deck is also the main entrance onboard, into a lobby bar area.

Comprehensive dining facilities

As in the Voyager-class series, the main dining room is arranged over three separate decks and is named *Leonardo's*, on deck 3, *Isaac's* on deck 4 and *Galileo's*, on deck 5, next to three adjacent galleys aft on same decks. Compared with the Voyager-class, the restaurant side bulkheads are rounded and stretched out somewhat, becoming wider than on the previous vessels, in order to facilitate the added passenger capacity. Together, there are seats for some 2100 people, compared to 1900 on the Voyager-class ships.

There are additional dining areas, such as the *Chops Grille* and *Portofino*, on deck 11, both somewhat enlarged and separated from the buffet area. On deck 11 aft is the *Windjammer* buffet, which has been widened by some 250m². Additional dining possibilities are offered by the *Jade* restaurant, on each side of the vessel forward of the *Windjammer*, *Johnny Rocket's* hamburger-type restaurant, next to the children's area on deck 12, and the new Italian restaurant, *Sorrento's*, on the promenade.

The *Studio B* ice skating rink, on deck 3, seats about 918 persons. Next to *Studio B* is a new *On-Air Club* lounge for karaoke and other performances. This is a new facility, fitted with a private recording studio adjacent to the ship's broadcasting room.

Advanced information system

The information system onboard is very advanced. The ship has its own TV and radio programme production, which allows passengers to follow, for example, the ice skating shows, from their cabins, if they prefer. Broadcasts are created especially for guests' portable radios by Mariner's own station RCTV production team.

Freedom of the Seas has her own skating rink, *Studio B*. For non-ice events, the rink can be covered with insulated panels.



Consultants for design tasks

Elomatic Marine Engineering has worked with the design of *Freedom of the Seas* since 2003. Principal work included participation in basic design for hull, machinery, HVAC, deck outfitting, and electrical power. The engineering company also carried out the steel modelling using the Napa Steel program. Detailed design was also completed for the hull, technical machinery spaces, and switchboards.

Interior design work by Elomatic included the *Island Grill* and *Photo Gallery*, *Studio B*, *On-Air Lounge* and staircases, as well as passenger cabins. Another task was to check that the interior standard was up to that of the reference ship.

The owner commissioned **Deltamarin** to study the duck-tail interceptor configuration. This was done together with alliance partner Safety at Sea, from Glasgow, using Reynolds-averaged Navier-Stokes (RANS) simulations. Combined with other hydrodynamic improvements, the new ducktail design, which will be fully utilised with interceptor plates, as from the second sister to *Freedom of the Seas*, should result in improved propulsion efficiency and fuel economy.

An estimate by the yard is a gain of about 0.5knots. For the yard, Deltamarin carried out hull, HVAC, and interior detail design for specified areas and for turnkey contractors' piping and HVAC detail design for the main theatre, secondary lounge, and aft main staircase.

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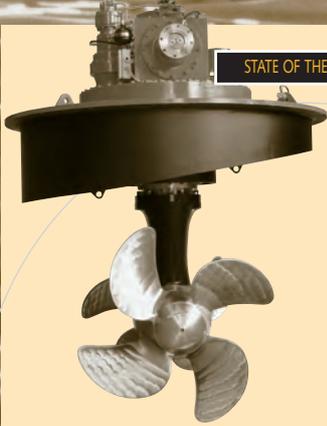
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The ship has flat-panel television panels throughout, also in the cabins, to provide convenient viewing of information, events, and entertainment. Wireless connectivity is available throughout the ship for surfing the internet and using regular mobile phones, making *Freedom of the Seas* one of the most digital cruise vessels existing. As on the previous vessels, there is a cinema and a large four-room conference area on deck 2.

Spacious cabins and balconies

The majority of the ship's cabins/suites are on decks 6 to 10. Finnish manufacturer **Piikkiö Works** has delivered all the prefabricated passenger and crew cabins onboard - 2565 in total. Differing from other recent deliveries, Piikkiö Works did not do the installation work; instead, this was carried out by turnkey companies including **Orsap**, **Europlan**, and **Shippax**.

Piikkiö Work's deliveries also included the 22 B-suites, each with a size of some 36m². In total, there are 24 cabin categories on *Freedom of the Seas*, with some 11 cabin sizes ranging up from the smallest 14.4m² inside cabins to the 113m² Presidential Suite facing aft - the biggest ever on a RCCL ship - which accommodates up to 14 persons, and has four bedrooms and bathrooms. Its 75m² outdoor area has a whirlpool and a wet bar. There are also 16 family cabins for five or six persons.

Of the 1817 passenger rooms onboard, 842 have private balconies and 172 have a promenade view. All the ship's balconies have been extended out from the side shell by 600mm, making them 2.3m wide, which adds notably to the available outdoor space. **Lautex** supplied most of the ceiling panels onboard, including panels for public areas, cabins, cabin corridors, and crew areas. **SBA Interior** and **Aluwood** supplied the wall panels.

New fun on sun deck

On deck 11 is the *Pool Deck* and on deck 12, aft, is the *Adventure Ocean* with large facilities for children and teenagers. In all, there is some 530tonnes of pool water on this high level, which is believed to be another record on a ship. A new feature on *Freedom of the Seas* is that all pools and jacuzzis have fresh water instead of seawater, as is the case on the previous vessels. This sets added requirements on fresh water production and purification but gives additional comfort for passengers.

The sun deck area features three massive pool areas. New concepts include an interactive water park, whirlpools, and a dedicated sports pool. The extra hull length has also allowed for bigger pool areas, and new attractions, such as the *H2O Zone* water park area behind the main pool area, with spraying water and a current pool, for children. The main pool area has synchronised fountains, lighting and music, at night time, when it becomes an open-air nightclub with dance floor.

On decks 12-13 aft is a 10m x 12.2m *FlowRider* surfable wave pool, supplied by **Wave Loch Inc**, using two 60kW water



Lautex supplied most of the ceiling panels. Seen here is that of the *Portofino* restaurant.



A new attraction for children is the *H2O Zone* water park behind the main pool, with spraying water, and current pool.

pumps to create the artificial wave. The 13m high rock climbing wall, built behind the funnel structure, is larger on this ship, made possible by the extra space on the sun deck. Above the Pool Deck, in front of the funnel on deck level 14, is another Royal Caribbean trademark, the *Viking Crown Lounge*.

The spa area, *Freedom Day Spa*, as well as the fitness centre, *Shipshape Fitness*, on decks 11-12, has a new design with new options. The fitness centre has been enlarged,

compared with the Voyager-class vessels, by some 270m². In the *Solarium* pool area, on deck 11, on each side is a cantilevered 20-person ocean-view jacuzzi extending almost 9m over the ship's side. The fitness centre spa area now also has a real boxing ring, intended primarily for training purposes.

Advanced waste treatment systems

Scanship Environmental AS has delivered the new ship's total waste treatment package,



A huge fresh-water generator plant is installed onboard. It was supplied by Alfa Laval and can supply a daily total of 1.8 million litres.



A comprehensive waste treatment plant, part of which is seen here, was supplied by the Norwegian specialist, Scanship Engineering.



Loipart's turnkey deliveries included also the three main galleys, with equipment also from Seaking.

with the main systems placed on deck 1. Dry burnable and non-burnable unsorted rubbish is collected from the hotel section, crew areas, pantries, bars, and provision areas by trolleys and transported to a main rubbish room, and sorted into burnable waste, glass, tin cans for recycling, aluminium cans for recycling, cardboard and paper for recycling, and plastic for compacting and landing onshore.

Sorted burnable garbage is fed to the heavy-duty dry waste shredders in order to minimise the volume and to homogenise the burning value, and shredded waste is collected in a dry garbage silo. The incinerator feeding takes place automatically. The SES1600 1600kW newly-designed marine incinerator is fully automated and is be remotely controlled, with incineration taking place in two phases.

Should the heat generated by the burning

waste be insufficient in either zone to maintain effective combustion, an oil burner is switched on automatically as soon as the temperature falls below a predetermined level. The incinerator has an automatic continuous residual ash removal system, and the whole arrangement enables the incinerator plant to be in operation 24 hours a day, without interruptions.

De-watered food waste is fed out from a de-watered food waste tank by a pump and into the incinerator. The incinerator is also able to burn sludge oil.

Glass crushers are located in the main galleys with collecting boxes. A heavy-duty glass crusher is placed in the waste room for discharge into bags/boxes, while a SE-30-type densifier is supplied for packing aluminium tin cans for transportation ashore. There is also a waste compactor and a shredder for general use.

A food waste system for handling all food waste generated onboard is based on vacuum transport technology. It is completely automatic and features entirely closed units with stainless steel piping leading to a main collecting tank, via a shredder. There are 19 feeding stations and one bone crusher. From the waste collecting tank, food waste is pumped to a dewatering unit, after which it is dried and incinerated. These units are integrated into one control system. More details of Scanship waste treatment technology appear in *The Naval Architect* February 2006, page 50.

Scanship has also supplied the ship's water purification plant, which handles all grey and black water. The overall design features a combination of mechanical, biological and physical process treatment. It includes a buffer tank, pre-filtration unit, bioreactors, flotation units, polishing units, and ultra-violet sterilisers.

Separated sludge is subsequently dried and incinerated with other combustible waste. The Scanship system is approved for continuous discharge. It has automatic remote control that uses the ship Ethernet and a server for monitoring from ashore so that Scanship and the owner's technical office can, if needed, assist with the operations from land.

Evac delivered the vacuum toilet system. The delivery included five 25m³ vacuum collecting units and one 10m² unit, together with 2784 Evac 900 wall-type silent vacuum toilets as well as an automation control system for black and grey water.

Galley and provision store rooms were supplied by **Loipart** together with modular pantries and ice stations as a complete turnkey package. Units include the three main galleys on decks 3, 4 and 5, totalling some 2000m², the 500m² *Windjammer* galley on deck 11, and the officers' and staff cafeteria and dayroom including some equipment deliveries totalling 500m² on deck 5.

All these were delivered as partial modules. The pantries and ice stations (altogether twenty 15m²-20m² areas) were delivered as complete or partial turnkey packages. In addition, Loipart delivered the dry stores and cold rooms, totalling some 1800m², as part of the turnkey arrangement. **Seaking** delivered, for these areas, all equipment for the main galleys, pantries, and ice stations, also the stainless steel equipment for the officers' and crew cafeteria and dayroom.

Waagner-Biro Stage Systems supplied, and installed, all of the stage machinery for the main theatre and *Studio B*, including the computer control system which has seen service around the world. According to the company, theatre installations on land are a challenge; on a ship, the additional fact of constant motion has to be taken into account.

For example, all lamp battens had to be installed vertically to prevent them from swaying with the movement of the ship. Hull movements also have to be taken into account when designing the stage facilities including stage cars, orchestra stage, and under-stage machinery. Normally two shows are arranged every night in the main theatre. A total of 47 drives, most of which are fully automatic and processor-supported, ensure that systems work smoothly.

All scenic processes are precisely reproduced to the millimetre and second as pre-programmed sequences; they are

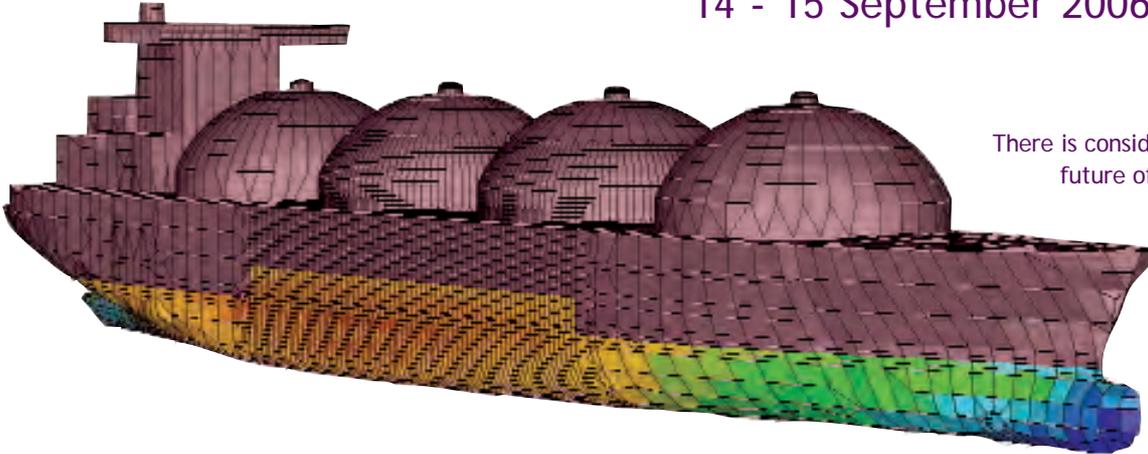
TURNKEY SUPPLIERS

Hermann's Project	
Design Oy.....	night club and Children's World
Tino Sana Srl.....	restaurant
Merima Oy.....	main theatre and secondary lounge
Kaefer Eristystekniikka Oy.....	spa and solarium
Euoplan Engineering Oy..	airconditioning rooms and cabin areas
Jukova Oy.....	cabin balconies
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Shippax Ltd.....	cabin areas
Lindal Private Finland Oy.....	main staircase 166 and conference area
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Tejara Oy.....	engine funnel
Finn-Brass Oy.....	rails
Pilkington Automotive Finland Oy....	glass walls and windscreens
S.A.Svendsen Oy....	Viking Crown lounge
Omni-Sica Oy.....	deck coverings

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Second Notice

There is considerable optimism about the future of the natural gas market. A significant growth in the number of gas carrying vessels is expected, resulting from both an increase in demand and the current programme of scrapping older vessels.



While some companies are looking at the possible economies of scale of larger vessels (in the range of 175,000- 250,000 cu.m.) others are looking to develop options for developing small vessels to exploit shortsea and coastal trades in natural gas.

New alternatives to LNG including compressed/pressurised natural gas (CNG/PNG), where the gas is stored under pressure at ambient or semi-refrigeration temperatures, are also being developed. There is also a growing interest in floating production, storage and offloading systems for offshore oil & gas developments and re-gasification tankers and plants designed to avoid the need to construct huge land-based processing and distribution centres. Technical Papers will cover the following topics:



- Design of larger capacity vessels
- Design of Shortsea & Coastal Vessels
- Greater flexibility in design to cater for spot market trading
- Floating plants/vessels
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Oy Lautex Ab.....	ceiling panels
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Corus Aluminium Walzprodukte GmbH.....	aluminium plates
TTS Ships Equipment AB.....	shell doors and lifting platforms
Saajos Oy.....	hinged fire doors
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Alfa Laval.....	separators, fresh water generators, PureVent system
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Piikkiö Works.....	prefabricated cabins
Kone Marine.....	lifts
Evac Oy.....	vacuum toilet systems
Koja Oy.....	airconditioning units and system
York Marine AB.....	cooling systems
Marioff Corp Oy Hi-Fog.....	sprinkler system
Teknoware Oy.....	low-location lighting system
Loipart Oy.....	galley areas and pantries + turnkey
Seaking Trading AG.....	catering equipment
Oy Vestek Ab.....	laundry equipment
Mitel Networks Ltd.....	automatic telephone and DECT system
Oy HedTec Ab Hedengren.....	light fittings

initiated fully automatically, and the complete system is maintained by radio. In the event that maintenance needs to be carried out at sea, a satellite link will enable Waagner-Biro specialists to examine the heart of the control system and carry out any necessary software adjustments. *Studio B*, which has the so far largest ice arena on a ship, arranges daily spectacular ice shows similar to 'Holiday on Ice'. For other types of show, the ice surface can be completely covered by insulated panels stowed beneath the spectator stands. **Teledimensions International** delivered the show systems onboard.

Major turnkey construction task

Aker Yards in Turku employs altogether 2000 people. An additional 2500 people from outside companies are physically working at the yard as turnkey and subsuppliers. In addition, there are an increasing number of companies, some 600 in all, and people working outside the yard's gates, including engineering companies actively involved with designing vessels.

For some years now, Aker Yards has applied a new 'assembly yard' strategy, giving freedom regarding employment and pricing. Outsourcing inevitably leads to the fact that an increasing amount of know-how is transferred to and is created by these outside companies, as will many new ideas and inventions in coming years, although this process can partly be slowed by co-operation agreements.

Two sisters to *Freedom of the Seas* are on the orderbook of Aker Yards Turku. Newbuilding 1353, *Liberty of the Seas*, will be delivered in spring 2007, and newbuilding 1354, apparently ending this series of ships, in spring 2008. After that, in 2009, follows the first spectacular Genesis-class vessel, of 220,000gt, recently ordered by Royal Caribbean Cruises. According to the Cruise Lines International Association, 10.1 million North Americans will take a cruise this year, which is almost double the number five years ago. Even more passengers are needed to fill the cruise ships currently on order until autumn 2009, having a total capacity of more than 80,000 double-occupancy lower berths. 



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Price recalculations for Sigma paints

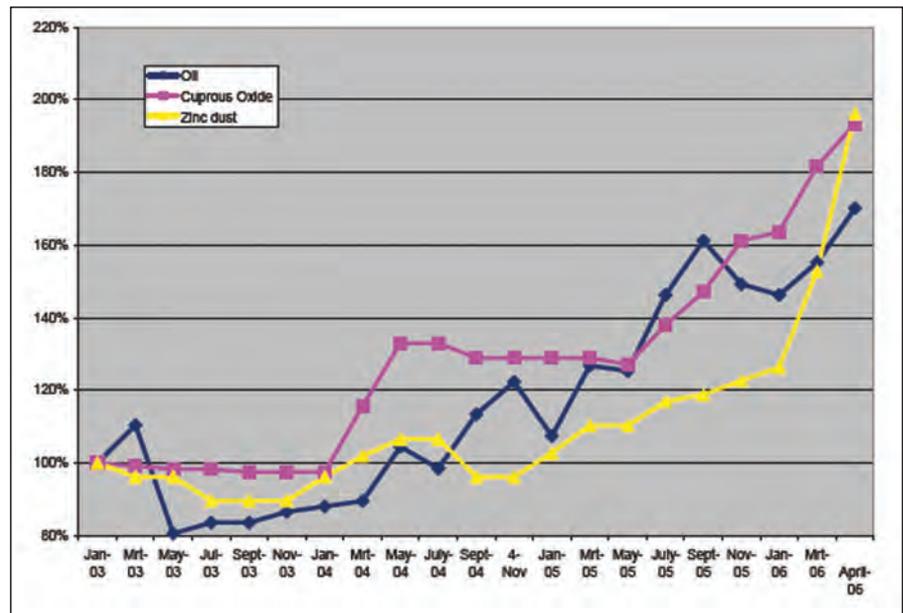
FOLLOWING the news reported in our June edition, that further price increases would be forthcoming from International Paint, another leading producer, SigmaKalon Marine & Protective Coatings, has likewise announced a new price structure. This again follows 'dramatic developments in raw materials markets', with incessantly rising costs for key marine paint components such as copper, zinc, and crude oil. At the same time, steel demand from Asian industries means that prices for paint cans have also increased significantly over the last two years.

Cost for derivatives such as epoxies, solvents, and alkyds - further basics for marine coatings - are suffering from supply constraints for crude oil in Iraq, Nigeria, and the Gulf of Mexico, and prices are expected to remain high, believes Sigma.

Over the past 12 months, prices in the copper trades have increased dramatically. This base material - vital to conventional antifouling - rose from US\$2.25/lb last February to US\$3.75/lb in the first week of May, and is

currently double that of the same time last year. However, owners could, of course, opt for biocide-free foul-release alternatives, such as Sigmaglidle, which remain unaffected by copper prices.

Zinc, a key component to any anti-corrosive coating, also rose from US\$1.00/lb in February 2006 to nearly US\$1.70/lb at the start of May. The accompanying graph illustrates some of these dramatic price hikes.



A graph compiled by SigmaKalon and illustrating the dramatic rises since January 2004 in the price of base marine paint components: oil, cuprous oxide, and zinc powder.

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MANAGING RISK

Reduced emissions and embracing green passports

NORWEGIAN classification society Det Norske Veritas Many has noted that ship owners can reduce their fuel cost by 10%. Emissions to air can then be reduced correspondingly and the ship owner's bottom line will be improved - both achieved by a systematic focus on fuel efficiency. Through studies, testing and a systematic approach, DNV and Norwegian shipowner Stolt-Nielsen have initiated these results.

For example, a 10% reduction in NOx emission of one single VLCC will reduce the ship's NOx emissions by 400tonnes a year - the same amount as that emitted by 10,000 cars. Approximately two-thirds of the world's cargo is transported by ship. In the years to come, stricter environmental regulations will affect the shipping industry. Last month, new Baltic Sea regulations restricted the amount of sulphur in fuel to a maximum of 1.5%.

The same regime will be introduced for other seas, and a new revision of MARPOL is expected to come in 2007. More is expected to follow. These regulations will increase the shipping industry's focus on reducing emissions. A ship owner's motivation may be strengthened by the fact that such moves can also reduce fuel costs.

By establishing a fuel energy management strategy that includes all the elements - from how to run the vessel, its bunkering plan, the efficient speed, the route chosen and a structured approach to all fuel-saving elements - many ship owners can reduce their total fuel cost. By coordinating its efforts throughout the organisation, Stolt-Nielsen has found that it can reduce fleet costs by the equivalent of the price of one new vessel every fifth or sixth year.

Utilising Green Passports

Green Passports and inventories, which document all the hazardous materials onboard a ship, are in the process of becoming established concepts in the maritime industry. Several shipowners, such as Stena and Concordia Maritime, are now choosing to be at the forefront of future requirements. Their intention is to achieve safe operation and take the ship recycling perspective seriously, regarding both newbuildings and ships in operation.

The International Maritime Organisation (IMO) is expected to introduce a mandatory

regime relating to inventories, or lists of potentially hazardous materials onboard, for all ships in the future. Such an inventory forms part of a Green Passport. Prior to being delivered to a recycling facility, an inventory of the stores and operationally generated waste and cargo residues is also to be added.

An inventory study starts off by obtaining all the available documentation, following which a survey is carried out. Samples are taken and analysed in accredited laboratories. Based on these, a statement of compliance - a Green Passport - is issued describing what is found onboard.

Concordia Maritime recently took delivery of *Stena Primorsk*, the third P-MAX tanker built by the Brodosplit shipyard, in Croatia. All the P-MAX tankers built have a statement of compliance - a Green Passport - issued by DNV. With such certificates, which are voluntary, Concordia Maritime is acting proactively to comply with future mandatory regulations and ship recycling recommendations. Concordia Maritime states that the passports are a result of close cooperation with the yard and DNV. Ⓡ

LETTER TO THE EDITOR

NURBS and hull modelling software

Sir - I encourage the commencement of a series of articles on hull definition software packages, in the April issue of *The Naval Architect*. However, I must admit that I disagree with a core assumption in the article on page 42, which is that the NURBS surface method is the most appropriate one for the hull modelling task. Although in the article a couple of restrictions are mentioned, in my opinion this list is not complete, see, for example, the discussions in [Ref 1] and [Ref 2].

Furthermore, it is questionable whether the proposed remedies will suffice; although the article mentions that 'these topological restrictions are typically overcome by allowing the hull model to be made up of a number of NURBS surfaces...', this view is not generally shared, and practice many situations can occur where also a configuration of multiple NURBS surfaces cannot do the job properly.

That is not only our experience, sooner or later it has also been encountered by most of our clients. Considering the solution of collapsing edges to introduce triangular parts, this can only be expected to work at the boundaries of patches; I do not think that a layout as, for example, sketched in the accompanying Fig 1, can be mapped with one single NURBS surface, even one with collapsed edges.

I sincerely hope that besides user-interface issues, these fundamental aspects will also be addressed in the series of articles.

References

1. Koelman, H J (2001), 'Properties, resemblances and differences between CAD programs for hull form design', *The Naval Architect*, January 2002, pp.42-45.
2. Koelman, H J (2003) 'Application of the H-rep ship hull modelling concept'. *Ship Technology Research*, vol. 50 No. 4, pp. 172-181, October.

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Patrick Couser, author of this series of articles, responds

The intent of the introductory article was to provide some guidelines for selection and objective comparison of hull design software. Since the majority of such software uses NURB surfaces to model the ship envelope, some background to this type of surface and some of their limitations were noted.

The article was not advocating the use of NURB surfaces or suggesting that this is the only, or indeed best way, to model a vessel, but was merely pointing out that it is a very (probably the most) common method in use today, and that this is an important consideration for compatibility.

With specific regard to the sentence in question, 'These topological restrictions are

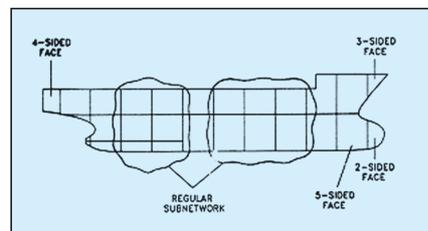


Fig 1. Typical irregular network of curves.

typically overcome by allowing the hull model to be made up of a number of NURB surfaces...', the topological restrictions in question are those mentioned in the preceding paragraph, ie, that NURB surfaces are topologically rectangular but can be made into triangles, lines, or points by making the length of one or more edges zero. It is acknowledged that there are other methods, which can be used to represent a ship's hull, including the hybrid-representation used in Fairlines, subdivision surfaces, and others. It is up to the user to try the different software and find what he feels most comfortable using. Ⓡ

Modular and standard: enticing goals not always achieved

Modularisation to help achieve standardisation and thus lower costs has been a theme of leading shipyards for at least two decades. Volker Bertram, Department of Mechanical Engineering, Stellenbosch University, South Africa, and Jan-Jaap Nieuwenhuis, TU Delft/Schelde Naval Shipbuilding, The Netherlands, re-examine some of the major attempts to achieve significant results, in both naval and merchant yards. They conclude that despite the many attractions of such concepts, plans often fail due to a fragmented suppliers' market and weak negotiating positions of the customers.

IN today's internationally competitive shipbuilding market, success is often based on offering both keen prices and competitive delivery dates. Over the last three decades, there has been a continuous pressure to improve shipbuilding performance, to reduce build times, and to reduce costs. Modularisation and standardisation are widely seen as key techniques in this respect. The general approach is tried and proven in assorted industries such as aerospace, automotive, and domestic appliances.

Modules can be built and tested in parallel at providers' premises. This shortens the overall construction time and reduces the risk for integration of various systems, thus leading to overall cost savings for the whole ship. However, modularisation comes at price: it usually means higher initial design effort, reduced design freedom (possibly retarding technological progress), more weight, and increased space requirement.

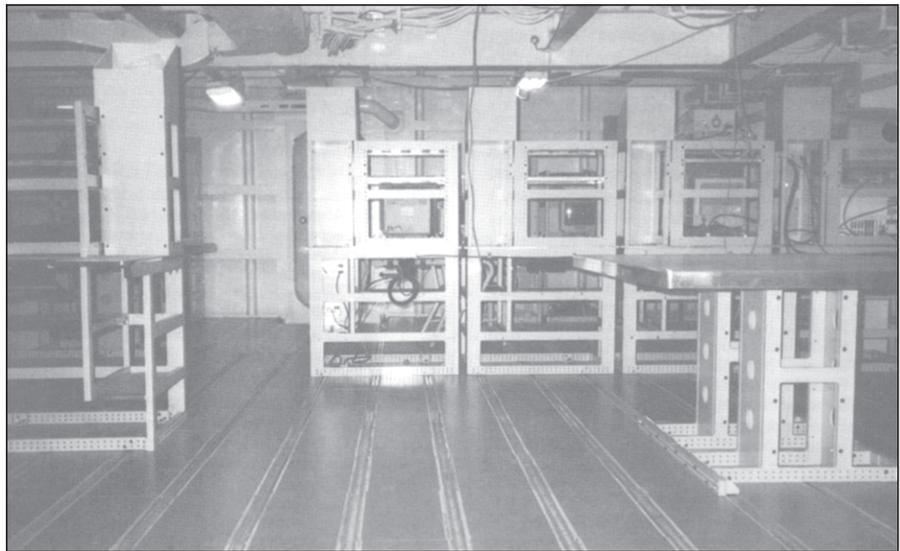
Modularity and standardisation at unit level are commonly practised at world-class shipyards, eg, with modular cabins. *Ichinose* (1978) describes very early implementation of standard components and modules at the Japanese shipyard IHI. Continued efforts at IHI have resulted in numerous related patents. *Boudreaux et al* (1986) present modular concepts at Avondale Shipyards in the USA, which followed from cooperation with IHI.

Paetow (1997) describes efforts of the German shipyard HDW within the framework of the Euroyards consortium. Since only two main suppliers shared the market for slow two-stroke diesel propulsion engines, joint discussions between suppliers, shipyards, and class resulted in harmonisation of the interface engine-foundation. A similar harmonisation for four-stroke engines was deemed impossible due to the multitude of potential suppliers. Modules for cooling water and separator stations are mentioned as standards for HDW.

Case studies

Navy applications

A general trend towards fewer warships having to fulfil a greater variety of mission in their lifetime motivates modular ship design and



Shipboard modular-arrangement reconfiguration technology (SMART) at work: this uses a railtrack system that enables equipment to be bolted to the deck, bulkhead, or overhead.

operation. Thus, naval procurement programmes around the globe take advantage of the modular design and operation philosophy.

US naval projects

In 1967, the J J Henry Co investigated the feasibility and advantages of modular construction of deckhouses for MARAD, *Spero et al* (1971), but apparently the concepts were never put to practice. In 1992, the US Naval Sea Systems Command (NAVSEA) began an initiative titled 'Affordability Through Commonality' (ATC), *Bosworth and Hough* (1993), *Hane et al* (1995), and *Cecere et al* (1995). The object was to develop the necessary strategies, standards, designs, specifications, and procedures for cost reduction through equipment modularisation, equipment standardisation, and process simplification.

The ATC program primarily focused on HM&E (hull, mechanical and electrical) modularity. Modules consisting of standard components are assembled and interconnected in a workshop, possibly even outside the shipyard. Ideally, a module must be applicable across several ship types and across the fleet to increase equipment standardisation.

Standardisation proved to be increasingly difficult, moving from unit modules to system and zone modules. Tested in practice were: standard fire pump units, reverse-osmosis desalination units, and modular crew sanitary spaces. *Christensen and Koenig* (1995) analysed how shifting to standard outfit package units would affect production of the LPD-17 amphibious dock ship.

The shipboard modular arrangement reconfiguration technology (SMART), *Alexander and Olmstead* (1997), is a methodology for installing equipment in shipboard spaces to provide flexibility and cost efficiency. The heart of this technology is a track

rail system, similar to that used by the aircraft industry, which enables equipment to be bolted to the deck, bulkheads, or overhead. The SMART system includes a foundation track system, modular connected power and lighting, and modular work-stations.

In the early 1990s, the US Navy and Electric Boat (the shipbuilding division of General Dynamics) started developing a new-generation attack submarine (NSSN), *Carey* (1997). The NSSN needed to be much more affordable than previous Seawolf-class submarines, but also the design and manufacturing process had to be sufficiently flexible in order to adapt to mission requirements that could not be fully anticipated at the time the construction began. Therefore, the Navy and Electric Boat focused on integrated product teams, concurrent engineering, and modular design and construction concepts. The design philosophy stressed a three-fold modularity: in construction, in technology, and in operation.

Schelde's SIGMA plans

In the SIGMA (ship integrated geometrical modularity approach) philosophy of Schelde Naval Shipbuilding, in The Netherlands, a set of geometrical parameters are defined which are applied throughout the entire product family, thus providing a repetition of identical units, both in the dimensioning of ship spaces as well as in the layout of systems, *Post* (2003). Furthermore, the hull form itself is 'modular'. With a few fore and aft 'ships', all hulls within the product family range can be created.

This approach has been applied at Schelde Naval Shipbuilding to a range of offshore patrol vessels (OPVs). Schelde's Enforcer family (landing platform docks, multi-role vessels) employs the modular design concept, offering pre-designed customised options for dock, garage, flight deck and hangar area,

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accommodation, and propulsion systems. The basis design consists of five modules, with distinctly grouped functions, such as a hangar module, which facilitates the hangar and all helicopter support functions. These modules can be used across the entire range of Enforcers. Differences in length are created by inserting parallel mid-body sections.

Success of the MEKO concept

The Blohm & Voss MEKO naval design is probably the best-known example of modularity in shipbuilding, *Jacobi* (2003). In the patented MEKO concept, all components needed to run a specific system are accommodated in a single module, and modules are connected to the power supply, HVAC, and the data network via standard interfaces. MEKO mainly focuses on so-called SEWACO systems (sensor, weapons, and communications). More than 50 MEKO frigates and corvettes had been built by 2003.

Platform concepts from Germany

The Modular Platform Concept (MOPCO) of the German shipyard Abeking & Rasmussen (A&R) is based on experience since the 1980s when a replacement programme of German mine-counter/measure vessels started, *Jacobi* (2003). This concept is based on strict modularisation of all systems and equipments which are integrated in an improved design of the common platform. There are standard interface connections for the various mission containers and equipment such as winches and cranes.

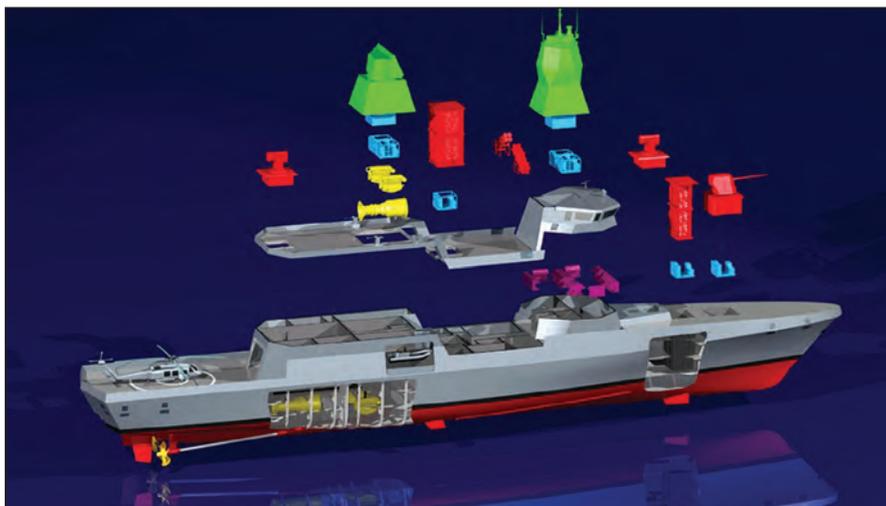
Within the framework of preliminary studies for the MJ2000 (*Minenjagd 2000* = mine hunting 2000) concept of the German Navy, a consortium involving Abeking & Rasmussen and Lürssen Werft developed a SWATH platform which supports shock-elastically supported modules. The complete superstructure with accommodation and bridge is one module. Another module was developed for launching/retrieving drones.

While the MJ2000 proposal failed to attract funding, Abeking & Rasmussen continued to develop the modular SWATH concept under the registered name SWATH@A&R. The platform contains only the absolutely necessary equipment, eg, manoeuvring devices, electrically driven propulsion, also fuel and ballast tanks.

The platform is structurally self-supporting and carries modules which do not contribute to global strength and are in themselves structurally self-supporting. Bridge and engine room are added as base modules located up-front. The central module hosts the operational central and accommodation units, galley, and further equipment for the operation such as electric transformers. The aft module may be exchanged for individual missions, containing weapons, launching-retrieval systems for AUVs or boats.

Danish successful with the Stanflex 300

The Danish Standard Flex 300 (Stanflex 300), also known as the Flyvefisken class, is a multi-role vessel based on a standard hull with containerised systems and equipment, which allows the vessel to change role quickly for surveillance, surface combat, anti-submarine warfare, countermeasures/mine hunting, or pollution control tasks, *Rodholm* (1990),



The Blohm + Voss Meko frigate project is one of the best-known examples of modular shipbuilding. At least 50 ships have been completed to this concept.

Hornhaver (1995), and *Jacobi* (2003). This fibre-reinforced plastic vessel was designed by the Danish Navy and Navalteam Denmark (a project group of Danyard and the Nordic defence industry). Between 1987 and 1996 a total of 14 of these vessels were built by Danyard A/S (now closed). The principles of the Stanflex 300 concept were adapted for three (much larger) fishery protection/offshore patrol vessels of the Thetis class, also for the flexible support ships of the Absalon class.

Merchant ship applications

M1000 accommodation system

During the 1960s, driven by a demand to replace Liberty ships built during the Second World War, Blohm & Voss developed a 'design for production' ship named Pioneer, *Gallin* (1977). Many other yards world-wide also created so-called Liberty Replacements; the Blohm & Voss ship, however, introduced a series of novelties, including a prefabricated accommodation system, the M1000. This consisted of a steel framework for cabin structures, in standard parts, in metre measurements, and equipped with standard metric furniture. Well thought-out connection details and fireproof panels ensured quick assembly. While the Pioneer concept as such flopped, the M1000 accommodation system, taken separately, proved to be a success and was used in many other ships.

Thyssen concentrates on the engine room

After projects to reduce costs in steel construction, Thyssen Nordseewerke (TNSW) concentrated on the engine room, *Sell* (1996), *Baade et al* (1998). The machinery spaces, accounting for 40% of production hours and ship costs, offered considerable potential for cost savings. This consideration led to the introduction of standardisation and modularisation in engine room design.

In 1991 this yard started building a series of 1500TEU container ships, in which piping and pump groups were replaced by completely assembled and pre-outfitted functional modules (low-temperature cooling water module; high-

temperature water module; sea-water cooling module; separator module; lubricating and fuel oil module; and starting air and control air module).

After the first series of container ships, the module series was extended with some additional units. In total, 13 container ships were built between 1991 and 1996 with this (patented) modular engine room. TNSW also patented a concept of modular supports for engine rooms, which consists of vertical supporting columns in the hull supporting one of more horizontal rectangular deck elements.

Modular deckhouses from Rostock

In 1998, a consortium of shipbuilding suppliers in Rostock, Germany, started with the prototype of a modular deckhouse, *Höpfner* (1997). This consisted of five modules: accommodation cells, floors, bridge, funnel, and appendages. Decks consisted of mass-produced laser-welded sandwich panels.

Engine room modules at NASSCO

During the contract design phase of the Strategic Sealift New Construction Programme engine room at National Steel and Shipbuilding Co (NASSCO), in San Diego, the yard's management recognised that procurement would be technically challenging and highly competitive, *Jaquith et al* (1996). To reduce the construction time required for designing and building such a complex engine room, and due to facility and crane lifting constraints, a modular approach was taken instead of the conventional block outfit approach. This resulted in a two-layer engine room, with 10 lower layer modules and three upper layer modules. Each module contains one or more completely outfitted and tested systems. During the design of the modules, extra attention was paid to improve the piping and cabling architecture.

According to NASSCO, the project proved to be successful, although some refinements are being considered for future programmes. NASSCO continued work on modular and



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standard outfit of (US Navy) ships. A pilot implementation project focused on production processes associated with the machinery unit PU-707, *Altic et al* (2003). The outfitting unit consists of a foundation made-up of angles, beams, and deck plates that support distributive systems, tanks, and equipment for the starting, control, and ship service air systems, lube oil transfer system, stern tube lip tank and electrical group control center, load centres, and display panel.

The unit was re-engineered for modular outfit, using a family of interim products, optimised for repeated assembly. During the course of this project, it became obvious that a clear definition of an interim product hierarchy was needed to reach agreement as to the defining criteria for each of the levels of the product hierarchy. The creation of a series of previously established products or a product family album, which could be built with established production processes, would make the preproduction evolution much quicker and cost-effective.

Project 21

The NSRP/ASE Project 21 was initiated to improve ship design at US shipyards and to assist them in achieving commercial competitiveness, *Tomassoni et al* (2003). The aim is to develop a template-based design process, utilising standard ranges of parametric interim products (\approx modules). The project focuses rather on generation of product data templates. More than 200 such templates will be developed in the project.



A Thyssen Nordseewerke machinery module seen during transit in the yard. This German shipbuilder has successfully employed engine room modules during container-ship construction.

Ulstein's modular strategy

In late 2002, the Ulstein A101 design (offshore supply vessel) was launched; this employed the Ulstein Modular Design Strategy. This is based on standardised components employed in different combinations to preserve flexibility in design while reducing cost.

Futura Carrier prototype

The Futura Carrier system is a German modular concept proposed for inland waterways cargo

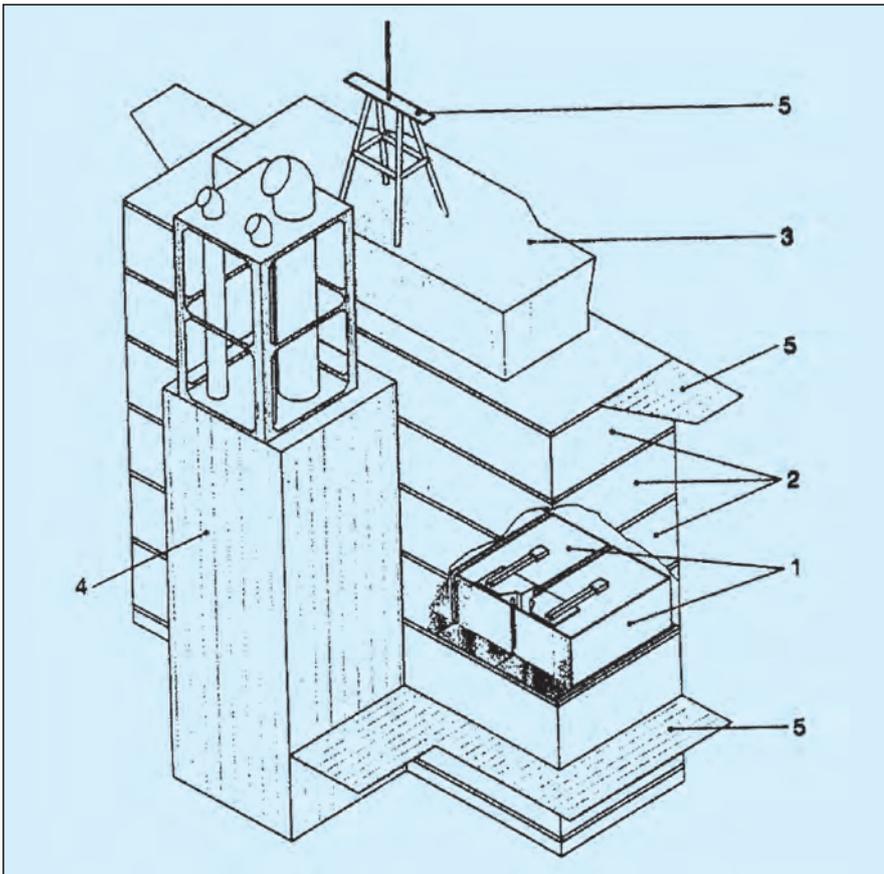
ships, *Mühlhausen* (2004), NN (2005a,b) and *The Naval Architect* September 2005, page 56.

This vessel is equipped with four propulsion units, two astern and two forward. Aft and forward propulsion modules can be combined with standard accommodation units and cargo modules (tanker, container, general cargo). A prototype of this ship was built in 2005 by the German shipyard ConMar, but recent reports indicate that this yard was in financial difficulties and the prototype will be completed elsewhere.

Bulgarian modular series

In 1989, the shipbuilding department of the Varna Higher Institute of Machine & Electrical Engineering developed a series of modular transport ships (bulk carriers, product tankers, multi-purpose vessels), *Parashkevov et al* (1989). The bulk carrier range is based on the assumption that the ship's width is kept constant. Together with the selection of the topology of the main transverse section and the frame space on the one hand, and the special approach of the development of the hull lines on the other hand, high levels of ship form and structure unification were allowed along the range.

For all bulk carriers in the investigated range, the required section modules can be achieved by only changing the plate thickness and the transverse stiffeners, without changing the rest of the construction. The high level of unification between the different vessels allows for easy group and in-series production of module parts, units, sections, and blocks. To further utilise the possibilities of unification, the series is designed such that the arrangement and the equipment of all deck structures is the same for all ships.



In recent years, a consortium of shipbuilding suppliers in Rostock, Germany, has developed a modular deckhouse, consisting of five units employing mass-produced laser-welded sandwich panels. The five units are: accommodation cells (1), floors (2), bridge (3), funnel (4), and appendages (5).

Studies in India

In India, The Indian Institute of Technology, in Kharagpur, patented a family of modular ship hull forms, combining a choice of one aft body, two fore bodies, and six mid-bodies to generate a total of 12 hull forms, *Misra et al* (2002), *Sha et al* (2004). No information is yet available on this interesting system's implementation in industry.

French catamarans

As yet another example, the French shipyard, Iris Catamarans, has developed a modular fast catamaran ferry family, *N N* (1994). The concept consists of closed modules for the passenger space (one or two decks), a control module which groups all functions of propulsion, steering, safety and transmission together, and the two side hulls, which are connected by three strong girders. The side hulls contain engines, auxiliary engines, waterjets, and electric systems.

Conclusion

Despite potential disadvantages, modularisation is increasingly used by successful shipyards and navies. This indicates potential for further progress in modular design and operation; however, fragmentation of suppliers' market for many equipment and outfit items, together with the weak position of customers, prevents further rapid progress in this respect.

Acknowledgement

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References

Alexander, R K; Olmstead (1997), 'Meeting the 21st century with smart mission flexibility', *Naval Engineers Journal*, 109/3, pp.341-348.
 Altic, B E; Burns, R M; Fontaine, B J; Scott, I; Silveria, J L; Softley, J (2003), 'Implementation of an improved outfit process model', *Journal of Ship Production* 19/1, pp.1-7
 Baade, R; Klinge, F; Lynaugh, K; Woronkovicz, F; Seidler, K M (1998), 'Modular outfitting', *Journal of Ship Production* 14/3, pp.170-179

Bosworth, M; Hough, J (1993), 'Improvements in ship affordability', *Transactions, SNAME* 101, pp.705-721
 Boudreaux, C P; Lewis, W W; Smith, E E (1986), 'The application of shipyards modular construction techniques to other industrial projects', *Energy Processes* 6/3, pp.141-148
 Carey, M (1997), 'Modularity times three', *Sea Power*, April, pp.81-84
 Cecere, M L; Abbott, J; Bosworth, M L; Valsi, T J (1995), 'Commonality-based naval ship design', production and support', *Journal of Ship Production* 11/1, pp.1-14
 Christensen, W L; Koenig, (1995), 'Standard outfit package units in the LPD-17 ship design: a production impact study', *SNAME Ship Production Symposium*, Seattle, pp.9.1-9.11
 Gallin, C (1977), 'Inventiveness in ship design', *Transactions, North East Coast Institution of Engineers and Shipbuilders* Vol. 94/1, 1977, pp.17-32
 Hane, T H; Gauthier, E A; Lang, S W; Valsi, T J (1995), 'Modularity in H&M Systems', *Naval Engineers Journal* 107/3, pp.149-166
 Höpfner, R (1997), 'Entwurf eines modularen Deckhauses und Konzeption für seine Fertigung', *Jahrbuch Schiffbautechnische Gesellschaft* 91, Springer, pp.88-89
 Hornhaver, H (1995), 'Standard Flex – distributed architecture combat system' *Naval Engineers Journal* 107/3, pp.41-48
 Ichinose, Y (1978), 'Improving shipyard production with standard components and modules', *SNAME STAR Symposium*, New London, pp.10.1-10.11
 Jacobi, F (2003), 'Modular ship design', *Naval Forces* 1/2003, pp.36-44
 Jaquith, P E; Burns, R; Dunbarr, S; Nelson, H; Silveria, J; Thompson, T (1996), 'Modular engineroom design and construction for the strategic sealift ships', *Journal of Ship Production* 12/4, pp.230-243
 Jaquith, P E; Burns, R M; Duneclift, L A; Gaskari, M; Green, T; Silveria, J L; Walsh, A (1998), 'A parametric approach to machinery utilization in shipbuilding', *Journal of Ship Production* 14/1, pp.59-84
 Misra, S C; Sha, O P; Gokarn, R P (2002), 'Modularised ship designs for competitive construction in India', *Trans. SNAME* 110, pp.279-299

Mühlhausen, A (2004), 'Effiziente Binnenschiffe durch Baukastenprinzip', *Schiff + Hafen*, July, pp.27-30
 N N (1994), 'Iris catamarans unveils a novel design', *Fast Ferry International* 33/10, pp.27-29
 N N (2000), 'SWATH Technologie für kompakte Marineschiffe' *Hansa* 142/2, pp.29-34
 N N (2005a), 'Forward-looking freighter has future in shallow water', *The Naval Architect*, September, pp.56-63.
 N N (2005b), 'Das flussangepasste Binnenschiff', *Hansa* 142/11, pp.32-36.
 PAETOW, K.-H. (1996), *Standardisierung - ein Weg zur Kostenreduzierung (Standardisation - A chance for cost reduction)*, Jahrbuch Schiffbautechnische Gesellschaft 90, Springer, pp.391-399
 Parashkevov, G; Draganchev (no initial ?); Trendafilov, C (1989), 'A methodological approach and effectiveness of design, building operation and reproduction of module bulk carriers', 4th International Symposium, Practical Design of Ships and Mobile Units, Varna, pp.83.1-83.6.
 Post, R (2003), 'Affordability and flexibility in naval patrol vessel design', *Naval Forces* 24/2, pp.130-131.
 Rodholm, I B (1990), 'Standard Flex 300 – An innovation in warship construction', *Warship '90 – International Symposium, Future for Surface Warships*, London, RINA.
 Scott, R (2004), 'Denmark's new standard ships offer greater flex', *Janes' Navy International*, July/August, pp.12-18.
 Sell, G (1996), 'Modularisierter Maschinenraum (modularised engineroom)', *Jahrbuch Schiffbautechnische Gesellschaft* 90, Springer, pp.401-405
 Sha, O P; Misra, S C; Gokarn, R P (2004), 'Ship hull form design – a modular approach', 9th Symposium, Practical Design of Ships and Other Floating Structures (PRADS), Lübeck-Travemünde.
 Spero, J R; Hicks, W F; Greene, D L (1971), 'A philosophy of naval ship design and construction', *Naval Engineers Journal*, October, pp.45-52.
 Tomassoni, C; Huynh, T; Schiller, T (2003), 'Production-based design methodology for shipboard machinery spaces', *Journal of Ship Production*, 19/1, pp.53-63.

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New welding-wire feeders from ESAB

Two lightweight, portable, and intelligent welding-wire feeders, the Origo YardFeed 200 and Aristo YardFeed 2000, have been launched by ESAB. Both are especially designed for use under shipyard conditions.

THE development of ESAB's newest wire feeders resulted from a survey of shipbuilding applications and requirements carried out in cooperation with shipyards across Europe. One conclusion was that the ESAB range was lacking a portable wire feed unit accommodating 5kg wire spools, not only for ship and offshore yards but also for any production site handling large objects, indoors or outdoors.

In this respect, shipyards have very demanding conditions. Much of the work is done outdoors, all year around, and under all kinds of weather conditions. Welders often have to work in uncomfortable positions, often deep inside ship structures, reached via ladders and manholes as small as 400mm, at distances up to 50m from the power source.

A key requirement from the survey was therefore to have a lightweight feeder to reduce the weight to be carried by welders. The combination of feeders with 5kg spools, a trend in most European countries, offered the best answer to this requirement. Additional demands included small dimensions, a sturdy construction, and easy operation of all important parameters at the wire feeder itself.

In the process of developing and testing the new yard feeders, ESAB received support and input from various shipyards, as well as from the company's own sales engineers. One of the yards, Ferus Smit, at Westerbroek, in The Netherlands, was also involved in testing the prototypes, and gave valuable recommendations that resulted in the eventual design. The Origo YardFeed 200 and Aristo YardFeed 2000 were launched in December 2005 and have been well received by welders.

Two versions - analogue and digital

The Origo YardFeed 200 is the analogue version for communication with step- and thyristor-controlled power sources. This feeder is provided with a so-called M13Y-panel (MMC-man machine communication) with the following functions: wire feed speed, voltage setting, 2/4 stroke, inching, and gas purge at the front panel. Adjustable burn-back timer and manual valve for gas flow are inside the cabinet.

The Aristo YardFeed 2000 is designed for communication with CAN-based power sources. It has ESAB's MA6 panel, the main difference with the M13Y panel being the availability of



One of a number of small manholes with diameters as small as 400mm, in a new ship at Ferus Smit, in The Netherlands. Welders had to crawl through such spaces with their equipment.

(synergic) pulse functions, pre-programmed synergic lines, and the possibility of storing settings in 10 memory positions.

Both feeders have the same robust, high-quality housing made from high-strength steel, treated with a powder coating. Powder coating is relatively hard and tough, abrasion- and corrosion-resistant. Each feeder is equipped with a protective frame, made of steel tubes to protect controls and connectors during transport and operation.

The door for changing spools has its hinge on top and should be easy to open and close. The well-balanced, integrated handle bar makes the unit easy to carry, with or without spools, while a sledge underneath facilitates sliding over a work floor. The control panel has an optional protective shield to protect the control panel from, for instance, spatter and grinding sparks.

Both feeders are equipped with heavy-duty Amphenol connectors meeting MIL standard, ensuring good contact after many times connecting and disconnecting the sockets. Both types of feeders are available for air-cooled or water-cooled torches. When using the water-cooled variant, the feeder is equipped with ESAB's LogicPump ELP-system, an automatic switch to ensure safe working and prevent overheating of the torch. Welding cables are lightweight with a reduced diameter, and only quick-connectors are used for fast installation. A safety chain between the wire feeder and the cables prevents these connectors from becoming tensioned by the cable weight.

The ESAB True Arc Voltage system installed in both feeders should guarantee welding with the selected arc voltage, independent of cables or torch length. The feeders meet the IP 23 safety standard.

The Origo YardFeed 200 is developed for MIG/MAG welding in both short arc and spray arc. The Aristo YardFeed 2000 has the additionally possibility of (synergic) pulse welding and an outlet for the MMA process. Both feeders are suited to weld mild steel, stainless steel, and aluminium, with solid or cored wires with wire diameters up to 1.4mm, to meet the increasing use of larger diameter cored wires in shipbuilding.

The electronically controlled four-wheel feeder mechanism, with 30mm diameter wheels, ensures stable feeding under all conditions. A 'long-life' inlet nozzle is used for nearly maintenance-free feeding performance. Since, for productivity reasons, cored wires are used for almost 50% of all weld metal deposited in today's ship and offshore yards, the feeders have excellent characteristics for rutile, basic, and metal-cored wires used in mixed gas or CO₂.

Heating element

A useful option is a built-in heating element, enabling sensitive consumables to be heated during standstill hours, to prevent moisture absorption. This is very useful, for instance, when welding aluminium or duplex materials. A switch in front of the panel activates the heating. Another option is to have a gas flow regulator built-in inside the wire feeder, where it is well protected from dust.

Yard experiences

Feeder prototypes were tested at various European yards, from where positive feedback was reported. At Ferus Smit Shipyard, welders tested a number of feeders under almost any production condition - downhand, vertical up and horizontal-vertical - including the functionality in

This article, by John van den Broek, global shipbuilding manager, ESAB Group BV, The Netherlands, and Anders Allansson, project manager, ESAB Welding Equipment AB, Laxå, Sweden, first appeared in Issue 3, 2006 of *Svetsaren*, the journal of ESAB.

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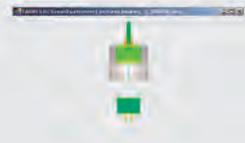
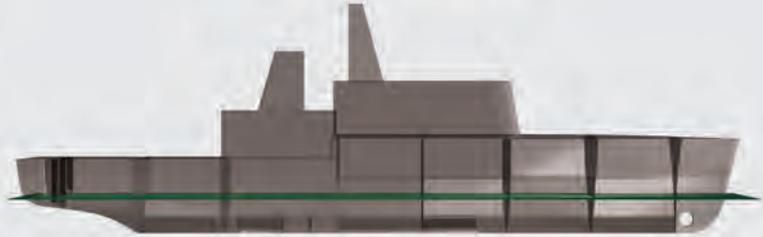
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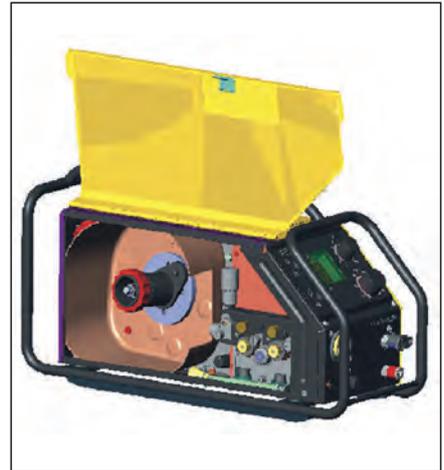
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An Origo Yardfeed 200 in use at the Ferus Smit yard in The Netherlands.



A 3D-CAD image of one of the new ESAB welding-wire feeders, showing the top-hinged opening.

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pre-assembly and double bottoms. Results were frequently reported by Ferus Smit welding engineer Herbert Winkelmann through ESAB sales engineer, Sjabbe Datema.

The welders, used to working for many years with yard feeders, appreciated the design and functionality. In particular, the small dimensions of the new units proved practical in the construction of a new ship design where some manholes were as small as 400mm diameter. These good experiences made Ferus Smit decide to buy a number of Origo YardFeed 200 feeders, which are now in daily use.

At Ferus Smit, the feeders are used almost exclusively in combination with OK Tubrod 14.12 all-position metal-cored wires (1.2mm diameter), allowing all work to be done with the same consumable. These wires have a good reputation for downhand work on primed and non-primed plate, as well as for vertical downwelding of small fillet welds with secure penetration. In addition, these are believed to be the only wire allowing vertical-up welding in the semi-spray arc mode at settings of around 180A in 80% Ar/20% CO₂ shielding gas. Improved overall productivity and availability on 5kg Eco basket spools were the key issues for the yard's decision in favour of this consumable.

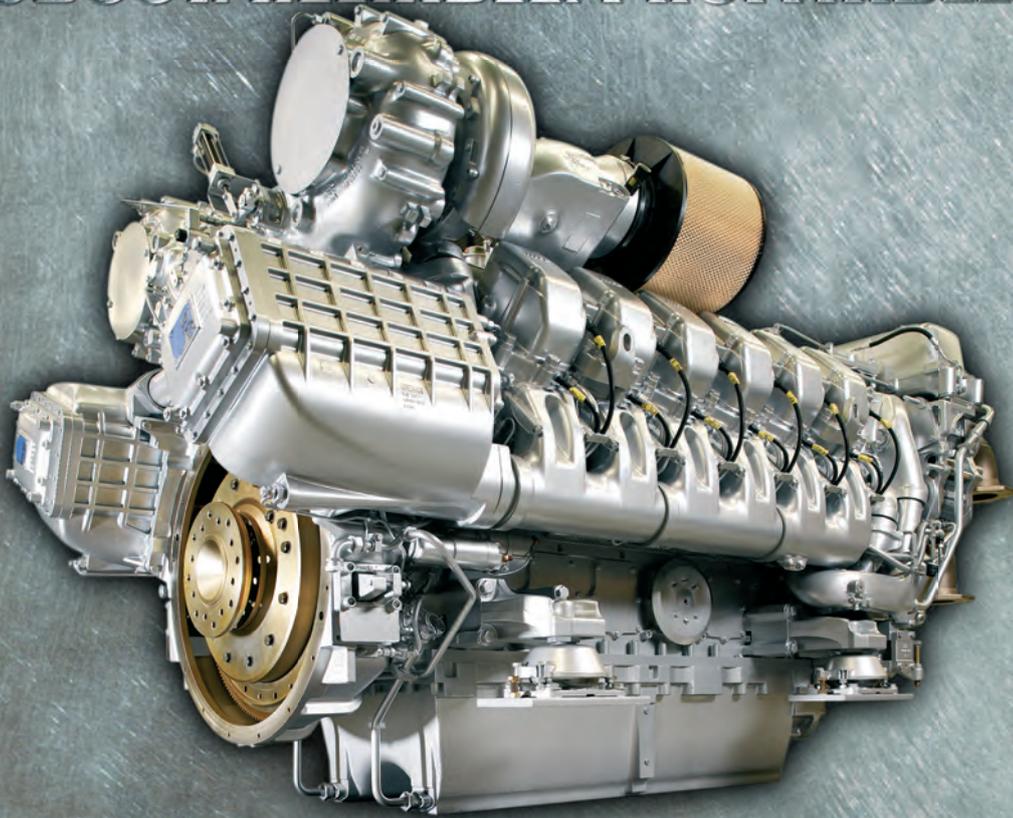
The overall result from the cooperation with a number of yards is, ESAB believes, a well-designed product for arduous yard conditions, allowing the company to make a complete and comprehensive MIG/MAG offer to its customers.

Acknowledgement.

ESAB would like to thank Ferus Smit Yards' welding engineer, Herbert Winkelmann, for his good support and close co-operation in testing prototypes of the new yard feeders. 

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Hull aperture blanks: useful for both shipbuilders and repairers

NEUTRALLY buoyant aperture blanks - useful items mainly for shiprepairers but also shipbuilders as part of a new vessel's outfit - were first developed by UMC International in the early 1980s and were approved by Lloyd's Register. Later, ABS approved the calculations separately for blanks supplied to a specific ship; however since that date that class society has accepted the blanks as suitable in a similar way to LR.

In 1998 UMC was asked to submit to more rigid quality checks since ABS thought the historical data needed re-validating. Thus, the manufacturing facility and production methods were fully audited and three sets of calculations sent to ABS for approval. These were for a typical large, medium, and small blank, on the understanding that type approval would be given for the design and manufacturing of blanks in a similar way to the LR approval. This did not happen and therefore UMC has a type approval certificate relating to three specific sizes of blanks. Again, the understanding is that provided the company retains the same design method, and that all blanks will be suitable for the purpose intended.

Bureau Veritas approved the calculations for one specific job and has since assumed the same stance as LR. Det Norske Veritas has issued final inspection certificates for many years on the basis of the LR approval.

In 1997 UMC was required to submit a full set of design calculations to DNV for a set of blanks being supplied to an offshore project. The society was not happy with the allowable shear stress figures submitted for the marine ply being used; therefore testing was carried out, the results submitted, and DNV approved the blanks.

UMC has since had another set of calculations fully approved by DNV, again for the offshore industry, however on other occasions since full design approval for blanks for commercial ships have been given and a final certificate issued without the need for full calculation approval. Today, other societies such as ClassNK, GL, and RINA accept these blanks as suitable on the basis of the LR approval.

Recent press reports have confirmed that some owners are seeking to reduce the number of drydockings required throughout a ship's life cycle. Some are aiming for seven and a half years in the water whilst others are aiming for a more ambitious 10 years. UMC is used to this strategy since many navies are adopting this plan, and the company has been working together with related design departments to ensure that they realise their objectives at design and planned maintenance stages. The use of UMC hull aperture blanks has particularly been taken up by the UK Royal Navy where specific maintenance requirements have dictated a blanking system is required.

The blanks are normally attached to an aperture grid using two T-bolts as standard. Very small blanks would only use a single T-bolt. Around 10 years ago, some shipyards insisted on four T-bolts for each blank, but this may have been to



A standard UMC neutrally-buoyant hull aperture blank for sea chests.



An example of the new Magnaseal.

make them easier to trial-fit in drydock. Because the blanks are near neutral buoyancy there is very little load on the bolt fixings, they are merely there to prevent the blank floating away. Two T-bolts are easier for a diver to align and fit through a grid than four, therefore two is now standard UMC practice.

The wing nuts on the T-bolts are standard small wing nuts to prevent a diver putting excess load

on the grid. They are not meant to compress the gasket against the hull, merely to hold it against the hull. Opening a valve or separating a pipe joint releases seawater pressure, inside the sea chest, then the external seawater pressure compresses the gasket to form a seal.

Discharge blanks are normally held in place using a single hook bolt anchored to an expanding jack. The jack is placed across the

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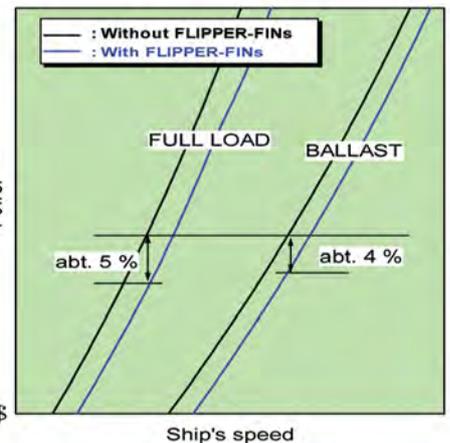
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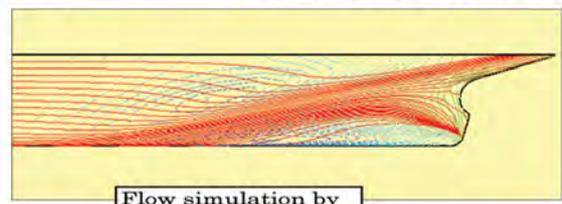


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internal diameter of the pipe and tightened to grip the wall of the pipe. Since no load is placed on the jack by over-tightening the hook bolt, there is no chance of the jack slipping or pulling out. Where sea chests are fitted with perforated plates, an option exists to cut slots where required for T-bolts or introduce other forms of special fixing which lock into the holes in the plate.

All blanks are all designed such that they are supported by the hull shell and do not rest on the grid. As span increases, the laminate structure of the blank increases; however the extra weight of the aluminium skins is balanced by an increased thickness of plywood core to maintain near neutral buoyancy of the blank.

Blanks are normally limited to a maximum size of 6m x 2m, which is the standard aluminium plate size; however given plenty of lead time, UMC can obtain plates specially rolled for blanks 2.4m wide. Allowing 100mm overlap on the opening, the opening dimensions must be 200mm shorter than the blank in both directions.

The plywood core is solid, not honeycomb. The plywood sheets and aluminium plates are bonded as flat panels in a veneer press. All laminates are through-bolted, primarily to take inter-laminar shear stresses but also to attach the shaped distance piece, which conforms to hull curvature. The edges of the blanks are sealed with two coats of epoxy resin, then over-painted with black paint for cosmetic purposes.

Today, UMC is supplying thousands of these blanks, mostly to new ships. Since the company's customer base is predominantly aligned to this sector, a manufacturing facility was opened last year in Pusan, Korea. One yard in that country has now specified UMC blanks for all 50 of its 2800TEU container ships delivered to date.

In addition, both standard and bespoke blanks are being made for offshore platforms, such as FPSO units. Some of these blanks have to be designed, fabricated, and delivered so that they can be fitted by a remote-operated vehicle. Exterior drain valves are sometimes fitted, which can be operated by ROV manipulator arms.

The current increase in demand for LNG carriers has also contributed heavily to both development and supply of UMC blanks. The large seawater intakes on such vessels, and particularly the large discharge apertures without



A large blank being constructed for an overboard discharge aperture (condenser outlet) of an LNG carrier.

grids, have presented UMC with a challenge. Large box blanks have been delivered to fit over large-bore overboard pipes. These blanks have had to be of box section to enable them to fit over deflector lips fitted to some of the apertures.

Magnaseal for small-bore discharge overboards

During 2005, UMC developed a standard-size unit for small-bore discharge overboard pipes. The new unit, christened and patented Magnaseal, is now in full production and being delivered as part of current orders. This design will blank off all apertures below 110mm

diameter. Its standard 'one-size-fits-all' status reduces the amount of plugs required onboard and reduces the total cost of the blanks package for each vessel.

The increasing FPSO presence worldwide has established another obvious demanding customer base and candidate for hull aperture blanks. With platforms being on station for 25 years, without docking, a set of blanks onboard ensures that the right tool is in place for the eventuality that a sea valve system has to be externally inspected. Off-hire time for such a simple task is not an option and considered unnecessary with such an easy and cost-effective solution. 

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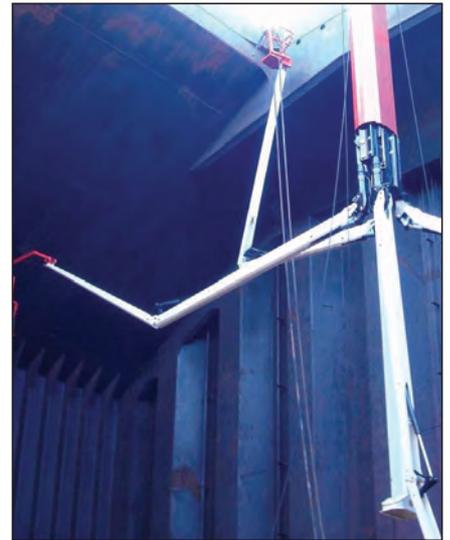
Suspended platform system for efficient hold/tank work

A MOST interesting new piece of shipyard equipment is the internal tank platform concept from the Austrian company Palfinger HTC Systems (HTC Systems GmbH). Although aimed primarily at shiprepair yards, the ITP 4 equipment could also prove of valuable assistance to shipbuilders wishing to inspect, paint, or clean holds or tanks without the need to erect complex scaffolding or to lift in cherrypickers.

The HTC system, which was created in 2004 as the result of suggestions from shipyards, is designed to avoid the difficulties of setting-up, dismantling, and cleaning scaffolding, and should make for superior working conditions. It consists of a central vertical column, suspended from a crane, from which four independent platforms radiate.

One of the prime requirements was that the complete arrangement should be able to fold into the smallest possible dimensions - for lowering through access hatches. After much effort, the HTC team succeeded in restricting the dimensions to 1250mm by 725mm, and sets were sent to yards for testing. In particular, Lisnave, in Portugal, used the equipment for high-pressure washing and grit blasting, while Lloyd Werft, in Germany, used the sets for ultra-high-pressure washing and painting. These field tests proved that the ITP4 withstood all the reaction forces and that the equipment was easy to handle.

A HTC ITP-4 system, with four independent platforms, deployed in a bulk carrier hold. The column is suspended from a dock crane.



Total weight of one set with four arms is 8200kg, and the outreach of each arm is 15m. HTC claims that set-up and dismantling time totals 10hours, compared with 50hours for a set of scaffolding. At the same time, only three men are required, compared with 30hours for a

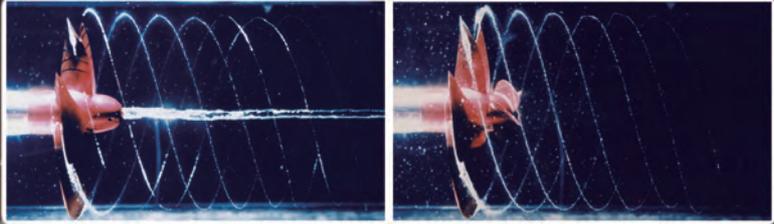
scaffolding project. The overall time to wash, grit-blast, dispose of grit, and apply two paint coats, plus set-up and dismantling, in a tank with an overall size of 2610m², is claimed to be only 58.6hours, compared with 113hours when scaffolding is used. Ⓜ

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Arctic projects dominate work of RS

DEVELOPMENT of promising oil, gas, and condensate fields on the Arctic shelf is one of the main tasks of the Russian Federation. However, these ventures cannot be solved without a modern fleet of ice-going vessels designed to transport oil, gas, and other mineral resources, to service platforms and terminals.

The Russian Maritime Register of Shipping (RS) has been a traditional leader in this field, due to the society's extensive operational experience, accumulated over nearly 100 years. In 1999, RS developed and implemented a new set of rules for the classification of ice-going vessels and icebreakers. This was based on the analysis of records of long-term Arctic operations.

For the first time in global practice, RS classification now covers numerical data on the ice situation, operation modes, and permissible navigation speeds, which enable the development of scientifically substantiated requirements for the strength of hull structures, propulsion plant components, and required power - all determining factors in ensuring safety under the prevailing difficult conditions.

The new classification stipulates nine categories for ice-going commercial vessels (J1Y1-J1Y9) and four categories for icebreakers (J1I16-J1I19). These new classification and hull strength requirements should ensure safe ship operation under any ice conditions to be encountered in the Arctic.

Alongside these rules, RS has developed new requirements for the hull structures of ice-going vessels, including large hulls for severe conditions. These are based on a number of quite new concepts. Using the probabilistic methods of FSA, procedures have been developed to ensure an equal failure rate for ice-strengthened areas, which makes it possible to efficiently distribute the material and reduce the specific amount of steel while preserving the necessary strength margins.

The ability of an Arctic ship to move in ice is one of the main factors in determining the economic efficiency and safety of any ship operation. RS has prepared a draft of new requirements for the power of ice-going vessels, based on records of Arctic ship operation on the Northern Sea Route. This should enable a correct power assignment to be calculated for large tankers and gas carriers, including those of the new double-acting type (DAT). New decisions will have to be made on the choice of propeller: FP type, CP type, azimuthing thruster, or the addition of a bow propeller (the last-mentioned is sometime used in icebreakers).

Arrival of *Norilskiy Nickel*

A new era in Arctic ship design has dawned with the entry into service of *Norilskiy Nickel*, the first general cargo/container vessel of the double-acting type, to be built to RS class (*The Naval Architect* February 2006, page 20). She leads a pioneering project for year-round operations in the Russian Arctic, although some experience has also been gained from the



Norilskiy Nickel, the prototype for a new class of Arctic container/cargo ships, is seen here earlier this year in double-acting mode during ice tests.



Norilskiy Nickel amongst the ice hummocks of the Kara Sea.

pair of double-acting Aframax tankers *Mastera* and *Futura* operated by Fortum (Neste) and built in Japan by Sumitomo to Lloyd's Register class.

Offshore experience

RS has additionally gained extensive experience of classification and technical supervision for the design, construction, and

operation of offshore oil and gas production facilities of various types, including minimising risk.

At present, the society is engaged in a number of projects associated with the development of various offshore shelves. Among the most noteworthy are: an ice-resistant fixed platform for the Prirazlomnoye offshore oil field in the Barents Sea, an ice-

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Upon the order of Hyundai Heavy Industries Co. Ltd, South Korea, we are manufacturing two stainless steel adjustable pitch bolted propellers

tem CAD/CAM/CAE "Unigraphics" the specialists of Propeller Production on the basis of hydrodynamic design can develop the detailed drawings of propellers upon individual request with the drawings approval by main Classification Societies. Our enterprise has close relations with "Krylov" Shipbuilding Research Institute in St.-Petersburg, which acts as hydrodynamic researcher.

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Cruise liner of «Fantasy» type with propellers from «ZVEZDOCHKA».

(diameter 8,1 meters, weight about 50 tons) for oil tankers. These propellers are planned to be delivered to Hyundai Heavy Industries shipyard in end of 2006 and in the beginning of 2007.

The ship propellers were produced under supervision of Lloyd's Register of Shipping, Det Norske Veritas, American bureau of Shipping, Germanischer Lloyd, RINA, Russian Maritime Register of Shipping. Our quality management system has certified by DNV certified organization according to ISO 9001:2000 since 2001. Our workshop is equipped with universal lathes, milling, turning and drilling machines and special milling machines with computer numerical control.

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resistant fixed platform for the Korchagin field in the North Caspian Sea, and the Varandey ice-resistant tanker loading unit in the Arctic Timano-Pechorskaya region. The latter will be located 22km off the coast where the water depth exceeds 17m, to enable operation of ice-classed tankers of 40,000dwt to 70,000dwt. A mooring and loading installation capable of revolving through 360deg is to be fitted on the upper hull, with a cargo arm to ensure single-point mooring, delivery of a hose to a tanker's manifold, and loading of oil.

Accent on safety

RS is making extensive efforts in parallel to its commitment to ensuring high standards of maritime safety, security, and marine environment protection. In particular, strict

requirements are being imposed on those personnel involved in the process of classification and statutory surveys.

The society has been undertaking, together with a number of Russian research institutions, a complex series of research projects aimed at quantifying the influence of the human element upon maritime safety and in developing techniques to upgrade the safety management systems of shipping companies.

The results of this research were submitted for consideration by the 53rd session of IMO's Marine Environment Protection Committee. IMO supported the RS work and recognised it as one of the most promising issues in those activities connected with the human element study. RS will continue this research with a view to achieving the target of accident rate reduction.

Since 1998, the international seminars 'Substandard Shipping - Solution through Partnership' have become a traditional forum for discussing the most vital issues of maritime safety by members of the world maritime community. In 2005, those problems connected with the negative impact of man's activities upon the marine environment were discussed at the eighth seminar.

At a forthcoming meeting, speakers will present both a thorough analysis of the ISM Code implementation experience, together with an evaluation of this instrument efficiency and its influence upon maritime safety enhancement and marine environment protection. The subject of this ninth seminar (October 5-6, 2006) will be the ISM Code: Lessons and the Future. ☺

Transporting gas by Russian CNG ships: becoming a closer reality

OFFSHORE deposits of natural gas hold up to 50% of the explored world reserves. While deposits in traditional extraction areas are becoming exhausted, the demand for energy in the main import markets is growing; therefore, compressed natural gas (CNG) sea transport technology attracts increasing interest, reports the Russian company Intari, since it enables cost-effective commercialisation of offshore deposits, particularly at smaller fields and relatively short distances to market.

The main advantage of CNG technology (as reported previously in *The Naval Architect*) is the possibility of loading the special vessels with gas directly from a deposit and discharging it directly to a utility grid (Fig 1).

As has been extensively estimated by international experts, when the natural gas delivery rate is 0.5 billion m³ to 4.0 billion m³ annually, on sea routes of 250 to 2500 nautical miles, CNG vessels will be 1.5-2.0 times cheaper when compared with LNG carriers. This new technology will utilise already existing and widely used solutions, such as deepwater development of deposits (up to depth of 1000m) and loading/unloading of vessels at submerged offshore terminals.

In reality, the CNG carriers themselves are the only innovation. Lately, a number of reliable technologies for storage and transportation of natural gas under high pressure have been perfected, and so now creating CNG vessels does not seem technically insuperable. A number of companies in Norway, the USA, and Canada are actively involved in this process.

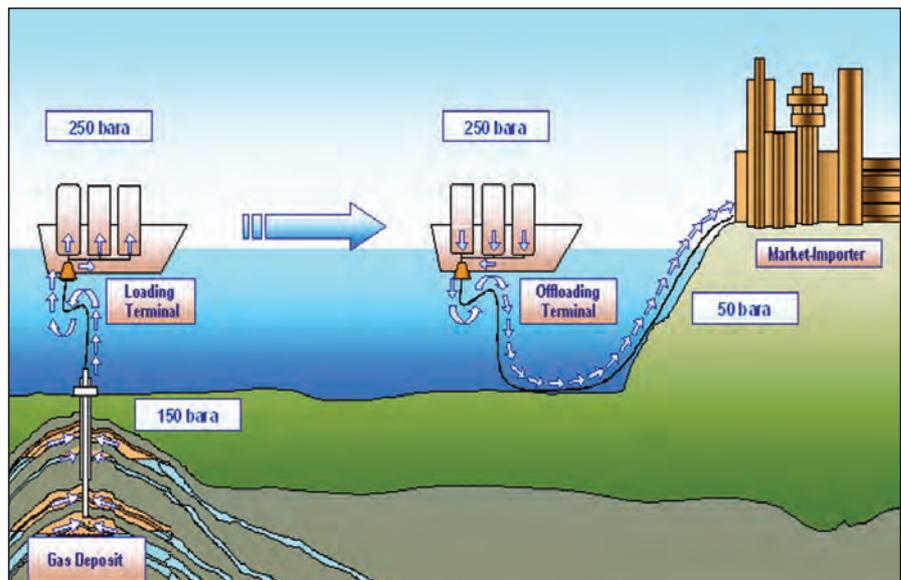


Fig 1. A typical CNG train for commercialisation of an offshore natural gas deposit.

Fig 2. Arctic version of a proposed CNG carrier from Intari.

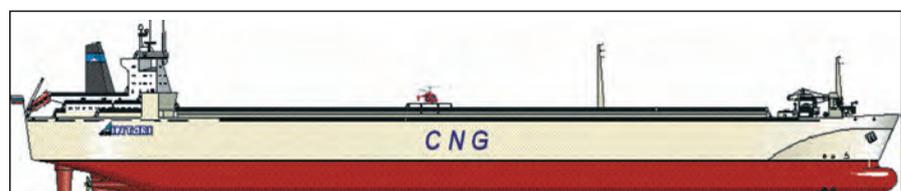
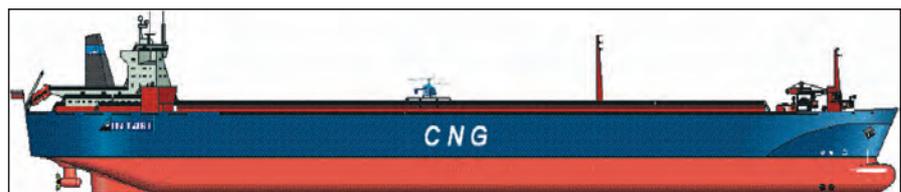


Fig 3. Tropical/temperate version of a proposed CNG carrier from Intari.

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Length of gas cylinders.....	24.00m
Number of cylinders.....	2200
Cargo volume.....	12 million m ³
Propulsion power plant.....	26,000bhp (19,110kW)
Speed.....	18.00knots

As estimated by their designers, CNG vessels will look much like modern LNG vessels: their length will be between 280m and 320m, with breadths from 55m to 60m, draughts from 13.5m to 14.5m, and capacities varying from 3 million m³ to 33 million m³ of natural gas on each voyage. The first CNG vessels could commence transportation of natural gas in various regions worldwide in 2010-2011.

According to Intari's analysis, Russia possesses enough R&D and production capabilities for creating the key element of the new technology: competitive CNG vessels, with a cargo capacity of up to 12

million m³ (Figs 2 and 3).

Such vessels up to 12 million m³ could be constructed in St Petersburg by Baltic Shipyards, while smaller versions could be built by Admiralty Shipyards or Severnaya Verf, alternatively in Severodvinsk by Sevmashpredpriyatie. Designing and construction of the first CNG vessels, believes Intari, could be completed in five-to-six years. An important factor is that construction costs in Russia are estimated at one and a half times less than in foreign yards.

Thus, real preconditions exist for the arrival in the near future of pioneering Russian CNG vessels, perhaps with a name of a Russian shipping company (possibly named Gas Line). This means that Gas Line Shipping Co, for example, will be able to commence regular voyages with its first two CNG carriers simultaneously with foreign CNG carrier operators.

Due to low cost of transportation by CNG carriers constructed in Russia, the company would have wide opportunities in gas transportation pricing, and operation of the first two CNG vessels could provide Gas Line with high, stable profits and financial security. With stable and high world natural gas prices, the internal rate of return (IRR) is expected to be more than 25%-30%.

Upon Gas Line business expanding and CNG vessel fleet replenishment, IRR could even reach 30%-35%. Discounted payback period (from keel-laying of the first CNG

carriers) will be between seven and eight years. Should adverse conditions prevail and natural gas world prices drop to those of 2002-2003 (approximately US\$125/1000m³-US\$130/1000m³), IRR will still be expected to remain higher than 10%.

Further, development of the company will be determined by a successful marketing policy that can provide advance filling of transportation contracts and by the CNG vessel fleet grow rate.

Orientation on acquisition of cheaper Russian-built CNG vessels is expected to provide the company with additional pricing abilities. Using a 'foreign companies' price minus 10%' policy, Gas Line might be able to increase profits by 45%-60%. However, the company may gain its maximum profit by entering the market not only as a transporter, but also as a natural gas dealer. Thus it will be able to coordinate transport prices with market natural gas and raw gas prices, and to respond flexibly to business environment changes.

In the anticipated situation of stable high world gas prices, the transport component in the price chain (taking into account export fees and a 10% discount for Gas Line clients) could amount to more than US\$100/1000m³. Besides economic advantages, a CNG-based business should be highly flexible: should a natural gas deposit exhaust or should market situation become unfavorable, a CNG vessel can be repositioned in other deposits and markets. 

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Solving problems of propeller model scaling

Tomi Veikonheimo, chief engineer, hydrodynamics, at ABB Oy, the Finnish manufacturer of the Azipod propulsor, discusses problems that can sometimes arise from the different scaling techniques employed at various model basins.

ABB performs continuous model scale testing at all major European model test facilities carrying out commercial and R&D work, where each basin has a different scaling method for pod-housing drag and unit open-water performance. For cooperation partners such as owners, shipyards, and consultants, these can sometimes result in very confusing issues, and the company is concerned that this may influence negatively the reliability of the Azipod concept.

This also means constant extra careful consideration of the scaling method and final power prediction for a vessel. ABB has experienced difficult situations in some projects due to these scaling problems during the model testing phase. Sometimes, unexpected results lead to poor performance predictions that could result in production problems, creating additional costs that cannot be predicted.

One real example of this issue is presented in Fig 1. This shows the model-scale efficiency of an Azipod unit in full-scale prediction using the scaling method of one test facility and full-scale prediction using the scaling technique of another basin. In this particular case, the design point is indicated as the vertical line in the figure. As can be seen, the difference between the full-scale predictions of unit efficiency is significant, leading to a difference of 6.4% at the propeller design point. The model basins used in this example are both well known and widely accepted as being reliable.

When considering the differences, it is important to remember that the model scale values used in this comparison are the same for both full-scale predictions, so the only difference is in the scaling method. The question remains, what are the differences between model basins if testing method - measurement - differences are considered?

Guaranteed performance values are verified by model tests, because this is the only way to

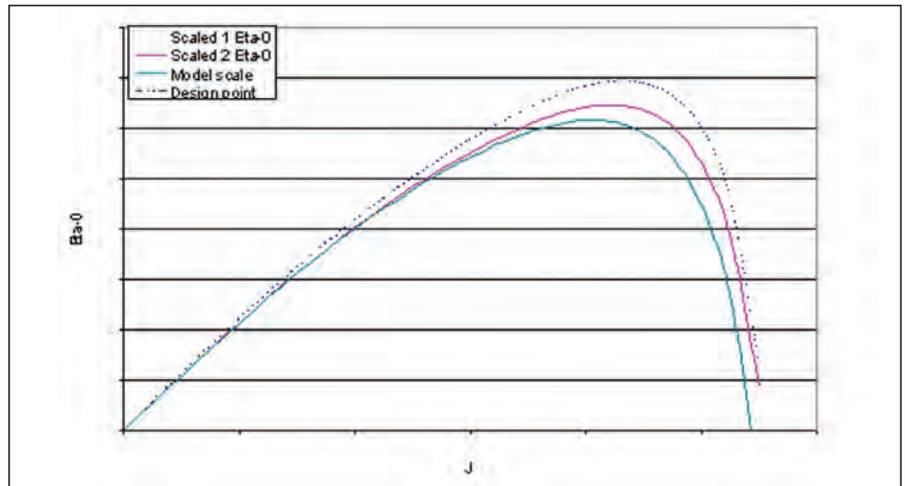


Fig 1. A comparison of scaling methods from two different model basins but with the same model-scale values.

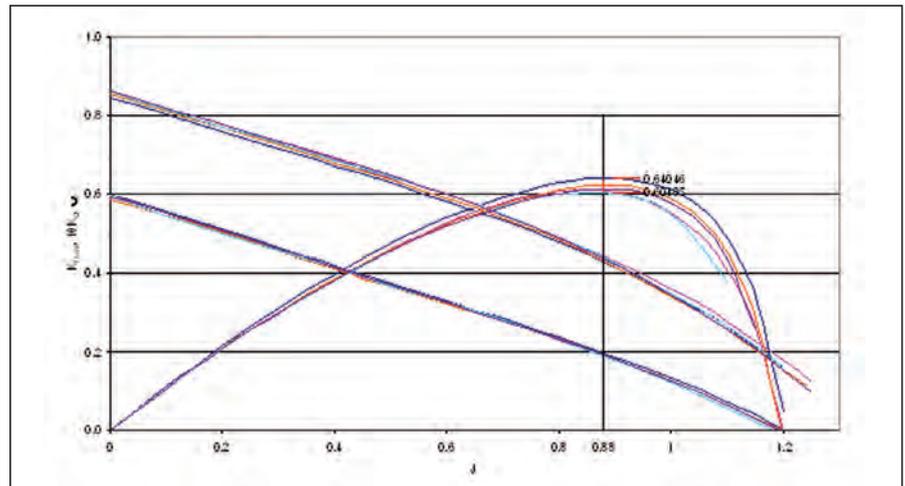


Fig 2. Unit open-water test: measured (model scale) unit thrust (Kt/unit) and propeller torque (10Kq) without any corrections.

separate the performance of a pod unit from the performance of the vessel. Since ABB is a sub-supplier of a shipyard, the company rarely has

the possibility of influencing a test facility's selection and rarely has any contractual connections to these facilities. It is therefore felt

Fig 3. Unit open-water test: unit thrust (Kt/unit) and propeller torque (10Kq) corrected to full scale.

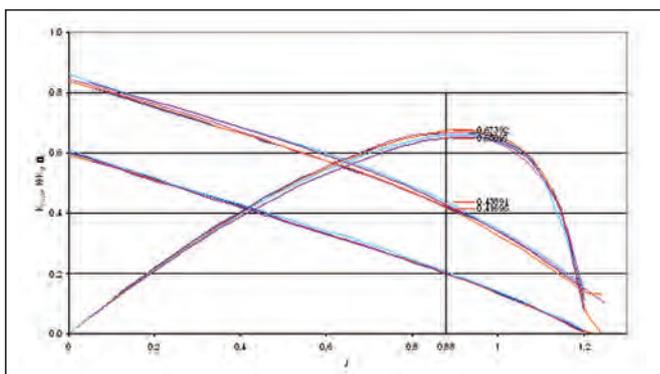
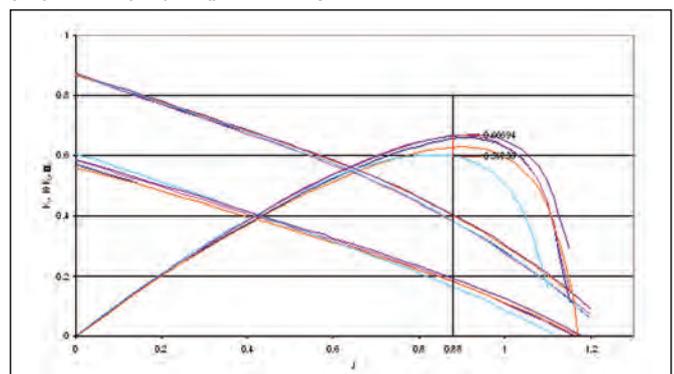


Fig 4. Propeller open-water test: measured (model scale) thrust (Kt) and propeller torque (10Kq) without any corrections.





Figs 5, 6, 7, 8, and 9. Illustrations of all the tested pod models.

that any chance of modifying methods at model basins is limited.

For these reasons, ABB decided to test one type of Azipod unit in several basins in Europe, in order to benchmark the current status of measurement and analysis methods. When model basins were approached, they were all very cooperative and had positive attitudes towards this project. In addition, the ITTC (International Towing Tank Committee) pod committee was made aware of this test campaign.

Objectives of benchmarking tests

The aim of this campaign was to gather information from open-water tests in five model basins and to compare those results to design values. The acceptable level of results scattering in all tests was to be within $\pm 2\%$. One propeller design and one Azipod design were tested in all the selected basins, using a propeller with and without a pod unit and analysed at both model and full-scale. The five basins were: HSVA (Germany), VTT (Finland), MARIN (The Netherlands), SSPA (Sweden), and Marintek (Norway).

Another purpose of this project was to increase the accuracy of performance predictions, depending on the basins involved (propeller thrust and efficiency) and to reduce risks (cost

from extra tests or penalties) when performance is guaranteed to ABB's customers.

The selected model propeller was circulated for tests in all basins, but the model Azipod unit had to be manufactured in each basin because of the different measuring equipment. However, the geometry of the model Azipod unit was the same in all tests and the test scope was identical in all basins.

The test program included open-water tests for the propeller alone and with Azipod unit. The basins had freedom to analyse and correct the measured model scale results according to their own best methods and knowledge. This means that each basin had a different method of scaling the pod drag from model to full scale.

Propeller and pod unit

The selected propeller model for the tests was a modern skewed design suitable for cruise liners; the pod unit was also designed for cruise liners and is of the pulling open-water type. This combination of propeller and pod unit has already been delivered to one cruise liner propelled by ABB Azipods.

Results

Test setup

As can be seen from the illustrations, the testing setup for the pod unit was not identical but very

close to each other in all basins. Differences could be found in propeller revolutions and in use of turbulence stripping on the pod unit.

The open-water test setup for the propeller alone (see illustrations) showed some fundamental differences between basins. The location of the transition area from hub and open-water device was not the same and also the location of the gap between the non-rotating and rotating part varies considerably between basins. It was seen in the results that devices that had the gap and cone transition area very close to each other had larger differences in the results.

Unit measured values

When results of model (measured) values are compared at design J (advance coefficient), a difference of 5.9% in efficiency could be seen. Most of this difference is due to variation of torque coefficient, which has much larger scatter than thrust coefficient (Fig 2). The reason for this may be accuracies in measurement where the torque signal is transferred via slip rings to the data acquisition system. Thrust of the unit is almost constant within basins.

The full-scale predictions, which include all scale effects for propeller and pod drag, give better estimation (Fig 3) of efficiency between model basins. All the basins are within 3.5%, which is better when compared with model-scale measured values. However, the scatter in torque coefficient still is large, at around 5.3%.

Propeller alone

In Fig 4, the results of measured results of the propeller alone are shown. Here, the results vary much more, and it is to be especially noted that both thrust and torque variation is large. In the pod unit tests, only variation of torque was large when thrust measurement was more constant. These results (Fig 4) appear to indicate that the effect of the test set-up is dominant. If the basins test with an identical propeller dynamometer setup, the results should be much better.

This test is very important for a propeller designer, because with propeller-alone data he can more accurately match the results to his own predicted values. If the results variation is this large, it is difficult to validate a design. Figs 5, 6, 7, 8 and 9 show the pod models which were tested.

Conclusions

As a result of this interesting project, ABB's main conclusions were:

- unit open-water test result measurement variation was beyond the target of $\pm 2\%$. The target was fulfilled after all corrections were included. This means that all basins have their own correction method 'calibrated' with some full-scale feedback
- the unit open-water tests show a large variation in torque coefficient. It is unclear what the main reason is for this but one possibility is delicate measurement via slip rings
- surprisingly, the open-water test for the propeller alone showed the greatest differences, although this should be one of the very standard tests. The main cause of scattering in these results is assumed to be

- the shape of the propeller hub in an open water device
- the ITTC pod committee and each basin received all the results anonymously for their own knowledge
- from this benchmarking project, ABB learned that there is still work to be done when accuracy level of results within +/-2 is reached, no matter which facility is selected for verification tests
- it is desirable that model basins work together within the ITTC towards more harmonised methods to scale podded propulsion performance to full scale. For example, a propeller open-water device for a pod propeller alone should not be difficult to standardise. For a pod unit test procedure and especially the analysis method, the harmonisation process will be more difficult and complicated. 

Azipull propulsion well-suited to product tankers

A SERIES of four combined product/chemical tankers, of which *Bro Deliverer* is the first, are set to be propelled, manoeuvred, and moored using Rolls-Royce equipment. These D-class Broström vessels (*The Naval Architect*, January 2006, page 16), which were ordered from the Jinling Shipyard, in China, are designed to meet the present and future requirements of the oil and chemical industry, both in terms of the volumes and types of cargo to be carried, and in providing safe, low environmental impact, and economical transport. The lead ship is now believed to be complete.

Since these ships will often be manoeuvring in port, operating in shipping lanes with heavy traffic, and need to meet future regulations and expectations, a high level of manoeuvrability and propulsion redundancy has been specified by the owner, Swedish-based oil and chemical logistic company Broström.

Rolls-Royce will supply each Skipskonsulent-designed vessel with two Azipull mechanically-driven thrusters rated at 2380kW each for main propulsion. The AZP120 units with pulling propellers are the first Azipull thrusters to go into service on tankers. They provide both propulsion and steering, and are supplemented by a TT1850 tunnel bow thruster of 1000kW. Loaded service speed is approximately 13knots.

By using two azimuth thrusters for propulsion, each with its own medium-

speed main engine, independent steering, and separate fuel systems for each engine, a high level of propulsion redundancy has been achieved. In addition, *Bro Deliverer* is the first vessel to be classified with a new environmental notation from Det Norske Veritas, entitled 'Clean'.

Broström's D-class tankers have a deadweight of 14,500dwt on a draught of 8m, an overall length of 146.8m, a beam of 22m, and have 14 tanks with a capacity of 18,556m³ when 98% full.

In addition to the propulsion equipment, Rolls-Royce is supplying deck machinery for all these tankers. Each has a total of eight winches; two of which are combined anchoring and mooring winches, with a 10tonne line pull and a cable lifter for 58mm chain. The others are pure mooring winches. All units have direct drive using low-pressure hydraulic motors.

Azipull thrusters were first applied to a series of 22knot double-ended ferries. A totally different market segment then opened up with the installation of Azipull units in an offshore supply vessel. Since then, a large number of offshore vessels have been ordered with Azipull thrusters, and now the product tanker is utilising the advantages of this design. As well as *Bro Deliverer* and sisters, a Bergen Tankers product tanker built to a Rolls-Royce design, equipped with two AZP100 units, is currently on sea trials in Turkey. 

The new D-Class tanker *Bro Deliverer* and three sisters will be equipped with two 2380kW Rolls-Royce Azipull thrusters for main propulsion.





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Kamewa Ulstein tunnel thrusters upgraded

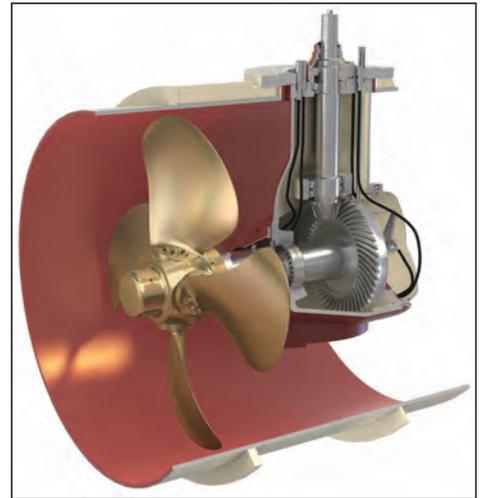
THE range of Kamewa Ulstein tunnel thrusters has been upgraded to meet the needs of offshore vessels operating in dynamic positioning (DP) mode for long periods, under tough operating conditions. As well as applying to new units, the upgrades can also be made to thrusters in service when they require scheduled overhaul work.

Upgrades cover a number of areas, and include the general application of features that were in the past only found on thrusters that had been tailor-made for customers with unusually tough operating requirements. Other changes represent progress in design techniques and materials technology. For example, the hydrodynamic form of the Kamewa Ulstein tunnel thruster has been improved to give a smoother flow of water through the tunnel, while the propeller blades feature an optimised profile designed to achieve greater efficiency and lower noise levels.

Tunnel thrusters in DP vessels may run several thousand hours a year with variable speeds and/or small and frequent changes in blade pitch. To improve the time between overhauls under these conditions, the blade bearing-wear resistance and sealing of the thrusters has been upgraded, while their shaft sealing has also been improved. In addition,

the hydraulic pitch control system has been simplified - the system used is now based on the new version of Helicon X, which is itself based on the Rolls-Royce common control platform - to facilitate installation and interfacing.

At the same time as it is upgrading the thrusters, Kamewa Ulstein is adopting a modular production system for the manufacture of its tunnel thruster range. This is intended to simplify the spares situation for owners, while yards will be able to utilise a product that fits better with modular shipbuilding systems.



Kamewa Ulstein tunnel thrusters have been upgraded for improved operation in offshore vessels running for long periods in DP mode.

CAV2006 takes place in September

THE sixth international conference on propeller cavitation, CAV2006, is to be held in Wageningen, The Netherlands, at the internationally known MARIN (Maritime Research Institute Netherlands) model basin, from September 11-15, 2006. The aim of this conference is to provide a platform in which state-of-the-art knowledge of control of cavitation and its effects, are presented and discussed. Physical insights, numerical modelling, and applications in propellers, pumps, and turbines will be amongst the major topics.

The time available for presentations and discussions has now been extended to five days, and so far more than 150 papers have been submitted. More than 100 of these will be orally presented, whilst the others will be in a poster presentation format. More information can be found at www.cav2006.com

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Need for speed poses propulsion challenges for large vessels

While propulsion of 12,500TEU ships by twin screws can provide greater speeds, achieving a service speed of 25knots using a single propeller is now possible*.

PROPULSION has long been a determining factor in gauging the maximum size for container ships. Of prime concern is whether 12,500TEU ultra-large container ships (ULCS) can provide a cost-effective means of transporting containers, after speed restrictions, as a result of propulsion challenges, have been taken into account.

Anticipating the trend towards even larger container ships, Lloyd's Register commenced a ULCS study in 1999 in association with Ocean Shipping Consultants. This concluded that limitations at container terminals would dictate the size of ship that could be built, that size being 12,500TEU.

Building on that initial study and subsequent ones, LR has examined the propulsion aspects of a 12,500TEU container ship, defined using 9ft 6in high-cube containers, with a nominal operating draught of 13.5m and a sea margin of 15%. Based on a slow-speed, direct-drive diesel engine as the prime mover for the propulsion system, a propeller with a diameter of 9.70m was designed. The study used a six-blade propeller, principally to control the effect of cavitation, made of nickel-aluminium-bronze.

With the propeller installed in the hull aperture and located such that firstly, there was sufficient clearance between the propeller and rudder to permit the propeller to be removed without disturbing the rudder and, secondly, a clearance of 150mm between the blade tips and the ship's base line; the propeller-hull clearance was 0.27D.

The predicted suction-side blade-sheet cavitation extents are shown in Fig 2 for a ship speed of 25knots at the operating draught of 13.5m. For this conceptual study, the propulsion system comprised the elements shown in Table 1.

A range of commercially available engines was considered, embracing cylinder diameters from 960mm through to 1080mm. Variations in cylinder number, with attendant changes in brake mean effective cylinder pressure, and firing order had a minimal influence on the overall system characteristics.

A lateral vibration analysis showed that the propeller-span mode gave the largest response and although lateral vibration natural frequencies occur within the $\pm 20\%$ MCR speed range, LR considered it unlikely that these critical speeds will cause problems in a detailed design. Given that the propeller will be a keyless type and will have a shaft taper that can be fitted in such a way that design contact stresses can be achieved, calculations showed that a 12,500TEU

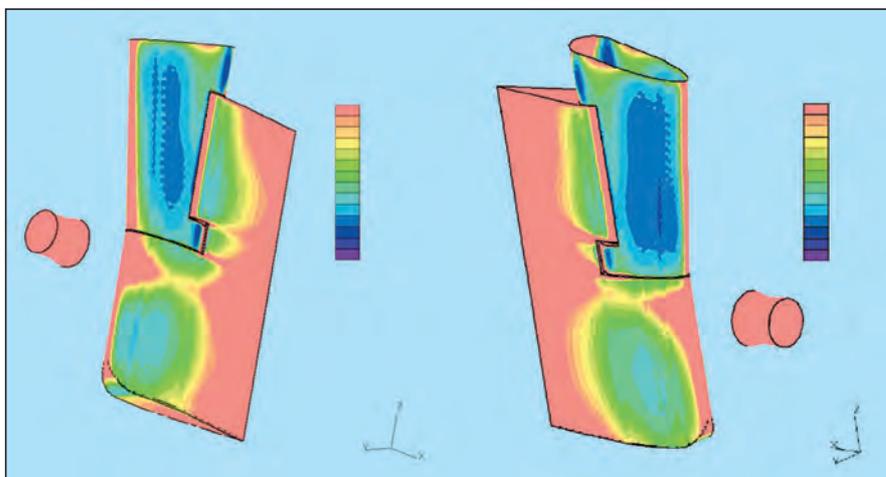
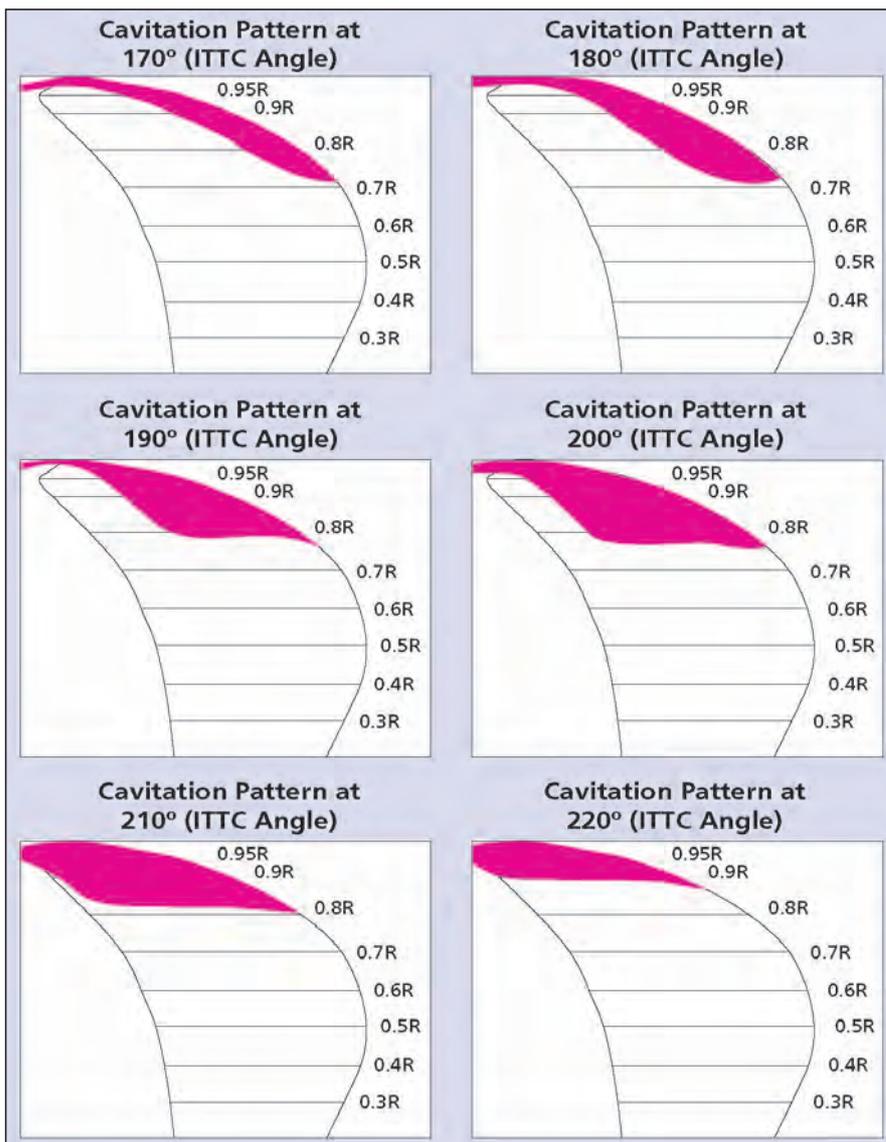


Fig 1. Local cavitation numbers over the surface of a semi-balanced large container ship rudder at zero degrees helm.

Fig 2. Predicted suction-side cavitation extends from 170deg to 220deg.



* This article is extracted from the June 2006 edition of *Container Ship Focus* and is published with permission of Lloyd's Register.

Shaft speed at MCR rating.....	94rev/min	102rev/min
Rule tailshaft diameter.....	1042mm	1018mm
Rule intermediate shaft diameter.....	853mm	834mm
Shaft length to engine flange.....	70m	70m
Tailshaft length.....	15.5m	15.5m
Intermediate shaft 1 length.....	13.7m	13.7m
Intermediate shaft 2 length.....	12.8m	12.8m
Intermediate shaft 3 length.....	14.0m	14.0m
Intermediate shaft 4 length.....	14.0m	14.0m

Table 1. Shafting system principal dimensions.

the ship speed beyond 26knots towards 27knots, the largest diesel engine would need to be augmented by an electric shaft motor of around 4MW, and propeller cavitation problems would be considerable. Indeed, LR found that for higher speeds a twin-screw design would probably need to be employed.

The society also found that existing technology and capabilities in machinery can provide the desired propulsion system, but rudder design needs to be undertaken with care if poor results are to be avoided. The class society recommends performing extensive model testing at the largest scale possible, over the normal autopilot range of angles as well as being supplemented by computational fluid dynamics studies.

ship will need a propeller with a dry weight of 128tonnes.

It is worth noting that when considering the propulsion of large container ships, the propeller and rudder must be examined together, since the eventual propulsion system will have a significant influence on the performance of the rudder. Thus, care should be employed when designing rudders for such large ships.

When high power and speed are called for, careful attention to rudder design is essential so that cavitation erosion problems can be avoided. Because the rudder operates in a combination of the helicoidal flow field produced by the propeller and the ship's layer boundary, the incident flow to the rudder has a strong rotational component. Also, the rudder tends to distort the flow field, so that the slipstream generated by the propeller often expands up the leading edge of the rudder.

While the presence of cavitation does not necessarily result in erosion, it is true that many rudders fitted to large container liners suffer from erosion. Attempts have been made to reduce the corrosive effects of cavitation by fitting stainless steel or stellite armour to the rudder and horn. However, in LR's experience, these attempts have only been partially successful and have required continuous maintenance. There is evidence that other materials might be able to withstand a cavitation attack in more mild cases of erosion.

Fig 1 shows the local cavitation number over the surface of a large container ship rudder for a range of rudder angles that would normally be associated with an autopilot range of movement. The results shown derive from a Reynolds-Averaged Navier-Stokes CFD study in which the propeller inflow was modelled for the continuous service rating. These results demonstrate the small but extremely important changes in local cavitation and the consequences for erosion, underlining the importance of studying the range of likely autopilot angles at the rudder design stage.

Conclusions

This LR study concluded that it is possible to use a single-screw concept and currently available slow-speed diesel engines to propel a 12,500TEU container ship at 25knots with a 15% sea margin. However, single-screw propulsion needs a minimum of six blades, moderate skew, and a judicious use of rake. Employing a seven-bladed propeller could reduce hull surface pressure generation by around 3% over the six-bladed option, but few have been manufactured for merchant ship use and none of the size contemplated for a ship of 12,500TEU.

The maximum ship speed that can be accommodated by a single slow-speed diesel engine operating at its continuous service rating is around 26.7knots at 13.5m draught. But to extend

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Propulsion packages and future trends

In a new paper presented recently to licensees, Jens Ring Nielsen, manager, propulsion R&D, at MAN B&W Alpha, offers some candid advice for owners considering a package propulsion plant and particularly urges them to pay more attention to their propeller specification. The addition of one or two special features can also help owners extract the maximum benefit from their plant.

THE design and engineering of propulsion packages in the lower power range has been a long tradition with MAN B&W Alpha, mainly in the four-stroke sector but also with two-stroke machinery. Today, this trend is being continued into higher powers, and as always, propeller/hull interaction and cavitation prevention are important themes, while dramatic rises in fuel costs call for close attention to be paid to general efficiency.

A propulsion package involves a single-source supplier - useful in today's marine environment where workforces are lean and much engineering is farmed out to consultants, but such a concept also puts more responsibility onto the supplier, particularly regarding torsional vibration and flanged connections.

Most clearly, the concept of system integration is demonstrated by optimisation of the propeller and its interaction with the hull. Not only is it important to strive for a high efficiency but also to ensure that the comfort onboard a vessel is not hampered by excessive vibrations originating from cavitation.

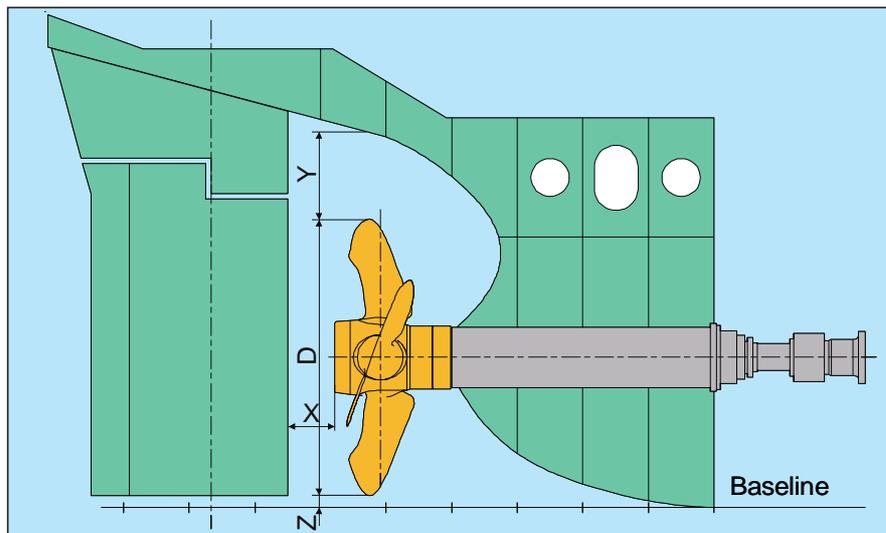
The two requirements are, in many cases, in conflict with each other, and close cooperation between the naval architect and propeller hydrodynamist is thus of vital importance. Other items that have to be addressed are:

- aft ship hull lines should be designed with due attention to producing an even inflow to the propeller
- adequate clearance should be present between the propeller and hull at all pitch settings to ensure that propeller-generated noise and vibration are kept at a minimum
- rudder must be positioned relative to the propeller to prevent cavitation erosion on the rudder surfaces
- on twin-screw vessels, shaft struts must be aligned in order to prevent flow disturbance into the propeller plane, and the location of shaft bearings must be optimised to ensure an even load distribution and to prevent lateral shaft vibration (whirling).

All these items must be addressed at an early phase in the project - and in many cases before an order for the propulsion system is even placed. To handle all queries, a strong and competent project organisation is thus of utmost importance.

Optimisation

Rising fuel prices have signified the importance of having low fuel oil consumption, and in the years ahead, the focus will be on different techniques to perhaps shrink it even further.



To achieve the highest possible propulsion efficiency, the diameter of a propeller should be as large as possible while still considering carefully hull clearance.

Already, much attention is paid to a main engine's specific fuel oil consumption (SFOC), and practically all engines sold today are backed-up by a guarantee in this respect. Much to some people's surprise, the efficiency of a propeller is not treated in the same fashion, even though the difference in fuel consumption for two propulsion solutions can be much larger than that between two competing engine types.

The most important parameter determining propeller efficiency is the diameter. To achieve the highest possible efficiency, a propeller's diameter should be chosen so as to be as large as the hull can accommodate while still paying due attention to the hull clearance. Furthermore, the propeller tip should not protrude out of the water when the ship is sailing at its ballast draught, to limit the load on the blades.

The high efficiency of a large propeller can only be realised if the revolutions are chosen accordingly. A relation exists between the power, diameter, and revolutions that must be adhered to in order to reach an optimum. For some reason, this simple message is not fully recognised, and in many cases high efficiency is traded off for a lower initial cost solution on the expense of a vessel's operating cost.

Cavitation

As most naval architects are aware, cavitation plays an important role in designing propellers since it can lead to unacceptable vibration. The propeller is one of the main sources with regard to noise and vibrations and, as a consequence, cavitation aspects must be considered carefully during the design phase. Cavitation will be present on most propellers of today's merchant vessels, especially when operating at maximum power. Cavitation is associated with generation of air bubbles caused by a decrease in the local pressure below the prevailing saturation pressure.

Even though the mechanism behind cavitation is not yet fully understood, it is not the creation of the bubbles themselves that causes concern but the collapse of the same. In addition to the unwanted excitation of vibrations, cavitation can lead to erosion if the bubbles impinge and collapse on surfaces. In particular, propeller blades, rudders, and shaft brackets on high-speed vessels are susceptible to erosion that can develop to a serious level over a short period.

A particular problem associated with cavitation today is increasing powers on the propeller and the more full body hulls (high block coefficients) often created, which unfortunately results in a more uneven inflow to the propeller. These facts make it almost impossible to design a propeller for a modern commercial vessel without cavitation being present, unless a pronounced drop in efficiency is accepted. The optimum propeller design is thus the one in which these two conflicting requirements are balanced.

Future trends

The MAN B&W CP propeller has been on the market for more than a century now. It has been through numerous development steps - much like the diesel engine - to refine its design and improve its efficiency, cost, and production effectiveness. The efficiency of a propeller has reached a plateau where new revolutionary inventions, which can raise efficiency dramatically beyond the present level, are difficult to imagine. However, concluding that further improvements in efficiency will not occur could not be more wrong.

A number of efficiency-improving measures which have successfully been applied in connection with the MAN B&W CP propeller illustrates the potential that is readily at hand.

Today, efforts taken to improve efficiency are more directed towards enhancing propulsion

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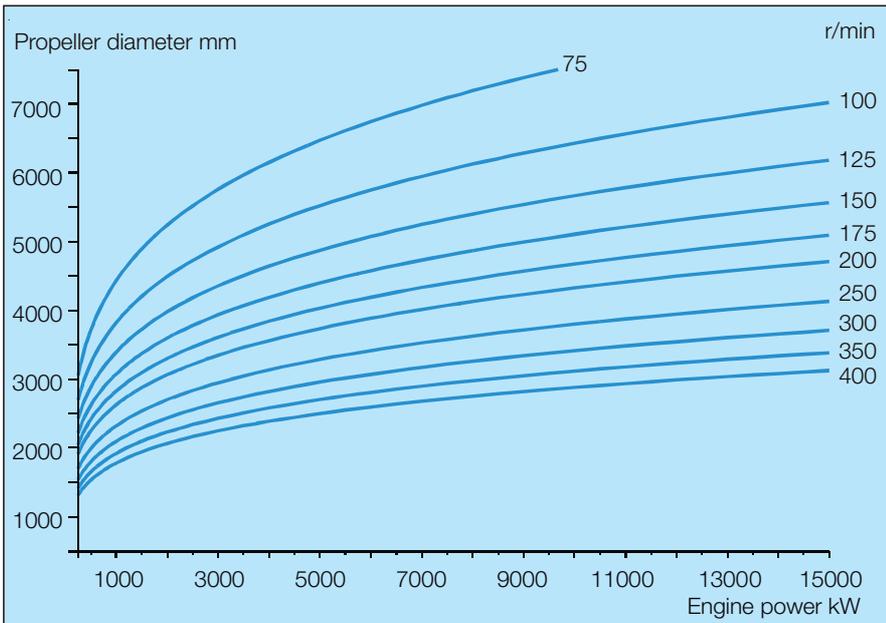
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Good efficiency can also be secured by carefully choosing propeller speed - a relationship exists between power, diameter, and revolutions that must be adhered to, in order to reach an optimum. This message is often passed over.

efficiency as a whole rather than the propeller in particular. Instead of focusing on the optimisation of individual elements, the design philosophy is now to optimise them together.

One example that reflects this new approach is the Costa bulb, which, if correctly designed, can improve efficiency by up to 2%-3%. The Costa bulb has been known for many years and has been applied in several projects with mixed results.

A series of model test undertaken by MAN B&W was carried out to find the potential of this efficiency-improving device. These showed that the Costa bulb alone would not bring a measurable efficiency increase unless both propeller and bulb were adapted to each other.

An optional version of the MAN B&W CP propeller hub with a special conical extension was developed for this type of application. In particular, the shape and the distance between the two are important, as well as the hydrodynamic design of the propeller blades, which should yield a load distribution that reflects the presence of the bulb. The Costa bulb is an attractive solution as the expense of modifying the propeller hub and the inclusion of the bulb on the rudder is limited, thus leading to a short pay-back time.

Kappel tipped propeller

Another attractive solution is the Kappel tipped propeller, which is characterised by a special shape of the blade in its tip region. This concept was first explored by the aviation industry and is now universally applied on many commercial aircraft - seen as winglets at the ends of each wing. The inventor, Mr Jens Kappel, from Denmark, pursued the idea and developed, together with the Technical University of Denmark, the necessary theory for marine propellers. Through model testing and later full-

scale measurements, an efficiency improvement of 3%-5% - or even more in some cases - has been obtained.

In 2003, MAN B&W concluded a cooperation agreement with Kappel Marine Consult to apply the theory and design for CP propellers (FP versions are handled by Stone Manganese Marine). Since then, two projects have materialised, and one was subjected to model testing that showed an impressive improvement of 7.5% compared with the stock propeller used during the initial testing.

As with the Costa bulb, the Kappel tipped propeller is an attractive solution from a cost point of view. The additional cost of designing the blades with a curved tip is limited and should be recovered within a short period of time.

Conclusion

The future will, believes MAN B&W Alpha, show an increasing market for integrated complete propulsion systems, whether using two or four-stroke engines. The need for system integration and an overall optimisation of the ship, including the propulsion system, will call for new cooperation involving consultants, yards, and propulsion suppliers if the full potential for efficiency improvement is to be exploited.

Low fuel oil consumption is not only a matter of SFOC but that propeller and hull are optimised in conjunction with each other if the most efficient and competitive vessel is sought. Apart from being efficient, a vessel must also possess other qualities such as a high comfort level with minimum vibration and noise in order not to impair the comfort and working conditions for the crew - not to mention passengers onboard cruise liners and ferries. The struggle for higher efficiency and fuel-optimised solutions continues, with the highest potential, believes this company, being overall optimisation of a vessel as a whole.

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New Japanese factory for construction of very large propellers

A NEW factory located at Harbor Island, Tamashima, in Okayama Prefecture, Japan, has now been opened by Nakashima Propeller (*The Naval Architect*, June 2005, page 45). Situated in a corner of the Mizushima port - which has been recently been developed into a domestic and international port and trading centre - construction of the new Tamashima works has enabled the Nakashima Propeller Co to ship its propellers directly to shipyards around the world.

The new facility was specially built to enable Nakashima to meet industry demand for larger types of propeller, and to expand the manufacturing capacity of its existing factories. These factors will shorten delivery time by utilising Mizushima port's sea routes and modern equipment.

With a site area of 57,739m² and a building area of 12,643m², the new factory has been designed to reduce lead time by establishing an efficient flow system. The production process flow is arranged logically so parts go from the foundry to the machining shop then on to the finishing shop. Simplification of this process flow minimises lost time during production.

The facility has also been designed as environment-friendly. Power sources include electricity and liquefied natural gas (LNG), and isolated finishing booths with acoustic panelling and air conditioning have been installed. In addition, there is a dust collection system in the grinding section. It is possible to recycle all materials, and casting sand is washed, dried, and re-used. Metal swarf from the manufacturing processes is also collected for recycling.

The Tamashima works will be particularly notable for its ability to cast and machine



This electric furnace is amongst a range of advanced equipment at the new Nakashima Propeller factory at Tamashima.

large-sized propellers from 6m to 12m in diameter and ranging in weight from 15tonnes to a huge 150tonnes - much larger than most other propeller foundries. It is expected to fabricate around 350 propellers annually, a production capacity one and a half times as great as that of the factory at Nakashima's

head office in Okayama. The new works' machine tools include a cutting-edge CNC blade-milling machine which can cut a propeller's complicated 3D helicoidal surface extremely accurately to the design data; it has a machining capacity of up to 12m in diameter, and 150tonnes. 

New research advances use of CLT propeller

SINCE 1997 Sistemar has carried out a series of R&D projects on CLT propellers together with Navantia (formerly known as IZAR) and CEHIPAR (El Pardo model basin), as discussed in our CLT supplement, July/August 2005. The results of this research have now been announced.

A number of new procedures have been established, including one to extrapolate at full scale the results of model tests carried out with CLT propellers, and one to define the parameters of the cavitation tests for highly loaded blades, which is also valid for CLT designs. Validation of both these measures was gained through the installation of full-scale CLT blades on Trasmediterranea's ferry *Fortuny*.

As a result of the R&D projects CEHIPAR is now in position to carry out model tests with CLT propellers and can achieve the same accuracy in the results as with conventional propellers.

The Spanish Navy has been informed by Navantia, CEHIPAR, and Sistemar of the progress and results of these R&D projects. As a consequence, the Navy has formally decided to install CLT blades on a fleet replenishment vessel - the BAC project - which is being built at Navantia's Puerto Real yard. The possibility of this contract was forecast in our 2005 supplement.

The 162m length bp vessel will be installed with Sistemar-designed CLT blades, and model tests have been carried out on the cavitation inception by CEHIPAR. The replenishment ship has an MCR engine output of 21,780kW, and the propeller is five-bladed with a diameter of 5.7m. Maximum ship speed is to be 22.5knots.

The propeller blades are being manufactured by Casuso Propellers and will be installed on a CP system supplied by Rolls-Royce. Close cooperation between Rolls-Royce and Sistemar

has taken place in order to ensure correct performance of the CP system with CLT blades.

The Spanish Navy has also agreed with Navantia to build a series of 12 patrol boats named BAM (*buque de acción marítima*), each with an 83m length bp and with 9000kW of power on two shaft lines. These vessels will also be fitted with CLT blades of 3.4m diameter.

In addition to the Spanish Navy, Navantia, CEHIPAR, and Sistemar will all be participating in more R&D projects along with a number of other companies and institutions. A complete series of experiments both using model tests and full-scale investigations, including the measurement of radiated noise, will be carried out within the framework of the project. It is hoped that these investigations will have a positive contribution in the application of the CLT concept for military vessels. 

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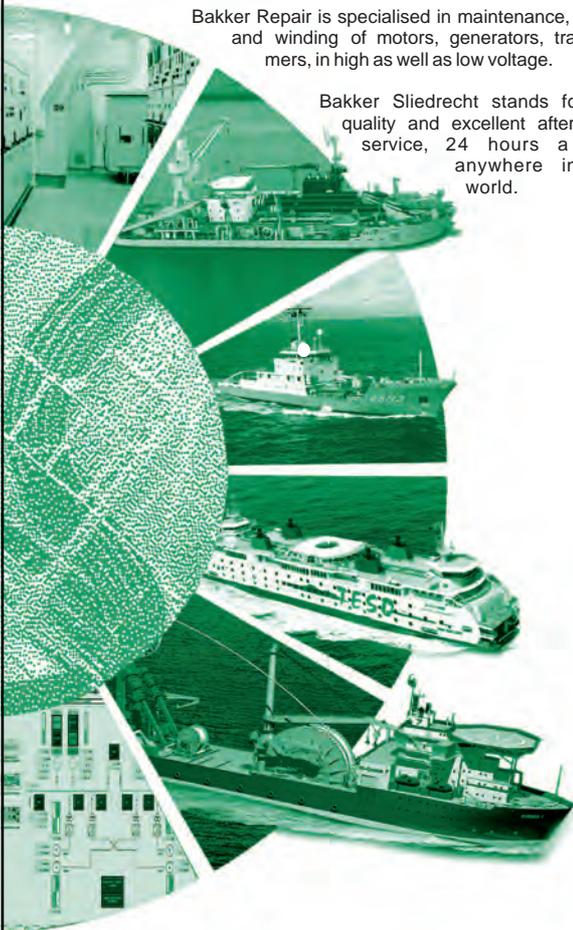
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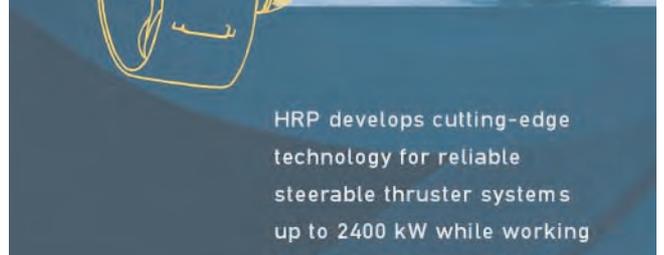
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Open-source and 'shareware' software development models for marine use

Free or 'shareware' software often has the stigma of being non-professional, but with the advent of the internet as a distribution and online collaboration tool, much free yet semi-professional software being developed is available for anyone to download and use. In this article, Ing Martijn van Engeland and John A MacSween, from Henry Abram Ltd, review a selection being developed for marine applications.

WITH the development and increasing popularity of Linux, an open-source operating system, there is a growing interest in open-source software. This is not merely a matter of finance, although buying new software and paying the required annual maintenance fees places many commercial packages out of the reach of hobbyists and small-scale design houses. Projects developed under an open-source or shareware licence system offer many common advantages.

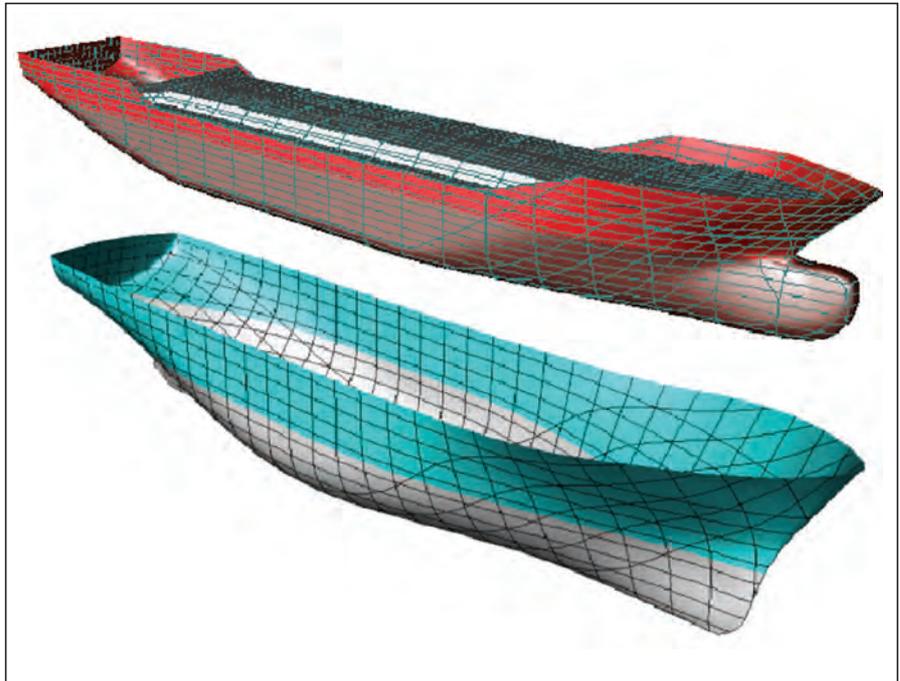
Generally, these projects are developed by people with a specific knowledge and interest in the field applicable to their software. This motivation, coupled with the fact that the software is easily and freely accessible to any who wish to try it, uninhibited, is most useful. Developers of free or shareware software are often in possession of a huge user-base, many of whom are willing to participate with great enthusiasm in these projects.

Particularly so in the case of open-source software, where users have complete access to the source code of a program and can contribute by becoming a co-developer, fixing 'bugs' and adding features they, and others, wish to see in the software, with the results of their labour adding to the freely available code base. This can drastically speed up development of a project.

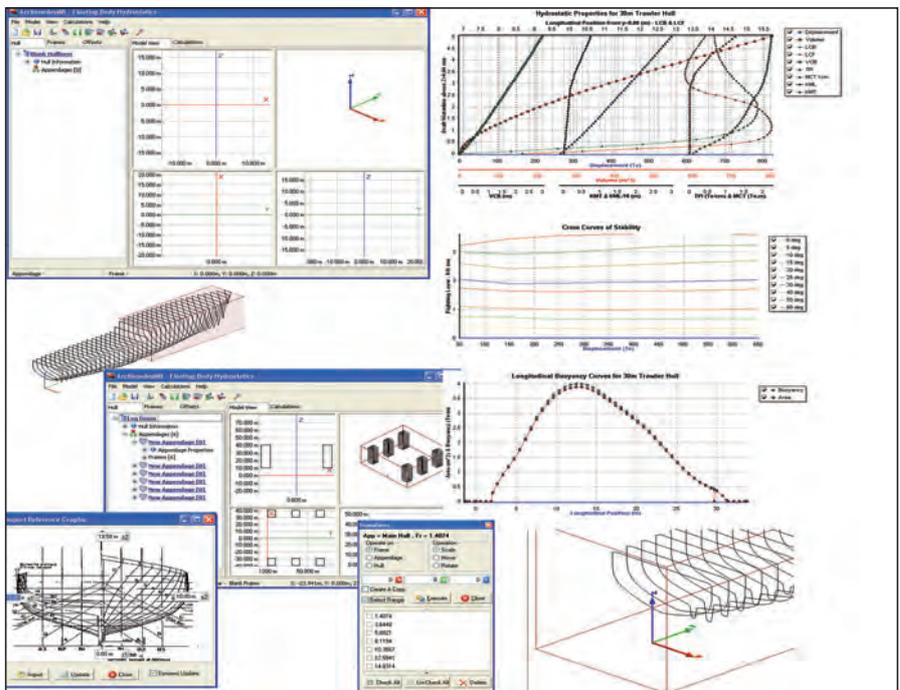
Equally important are community contributions in the form of software testing, validation, writing of tutorials and manuals, and translating the software into different languages. This high interactivity between developers and users is a trademark of this type of collaborative development environment. As these projects grow more popular, more people are willing to participate, lending the process greater, self-sustaining momentum. Three examples of free yet professional-use marine software will be dealt with in this article, namely Free!SHIP (also discussed in this issue as part of our review series), ArchimedesMB, and Michlet.

Free!SHIP

Free!ship is a relatively new project which was started little over a year ago. The program was developed to offer an alternative to existing hull form modellers which are mostly based on surface modelling with NURB surfaces. As well as being absolutely free, it is also distributed under the GPL open-source licence.



This asphalt carrier has been designed using Free!SHIP.



A screenshot of ArchimedesMB software details.

Open-source programs do not only offer the opportunity to inspect or modify the original source code but the development is also mainly controlled by its users rather than a software company. The program runs on all modern Windows platforms but also under WINE on Linux.

Also available, true to the open-source spirit, is an online database of FREE!ship designs, currently consisting of more than 135 downloadable files. This combination of factors has proven to be very successful. At the time of writing the program has been downloaded 58,443 times.

The technique used to model the surface representing a ship differs from other hull form-definition programs in the type of mathematical surface that is being used. The FREE!ship modelling kernel uses the technique known as 'subdivision surfaces' rather than BSpline or NURB surfaces.

Using subdivision surfaces, it is possible to model even the most complex shapes with only one surface, otherwise multiple spline surfaces would be needed, with all associated problems such as maintaining fairness over surface boundaries. Other key properties include the fact that fewer points are generally needed to model a shape, greater freedom in adding knuckle lines is possible, and the option to include holes in the 3D surface.

A few of the program's growing number of features include: hydrostatic and cross-curve calculations based on surface panels rather than ordinates; Lackenby hull form transformation to desired displacement and/or LCB; visualisation of flowlines along the hull; curvature display of curves and surfaces; default formatted lines plan; and IGES export.

Using FREE!ship, the Italian naval architectural and marine engineering firm Cosnav Engineering SRL designed the asphalt carrier *P288*, and Astilleros y Maestranzas de la Armada (ASMAR), of Chile, has used the software to recreate the lines of an old existing fishing trawler which was converted to a fish discharge pontoon. With the model completed, hydrostatic calculations were performed for submission to the maritime authorities and validation purposes.

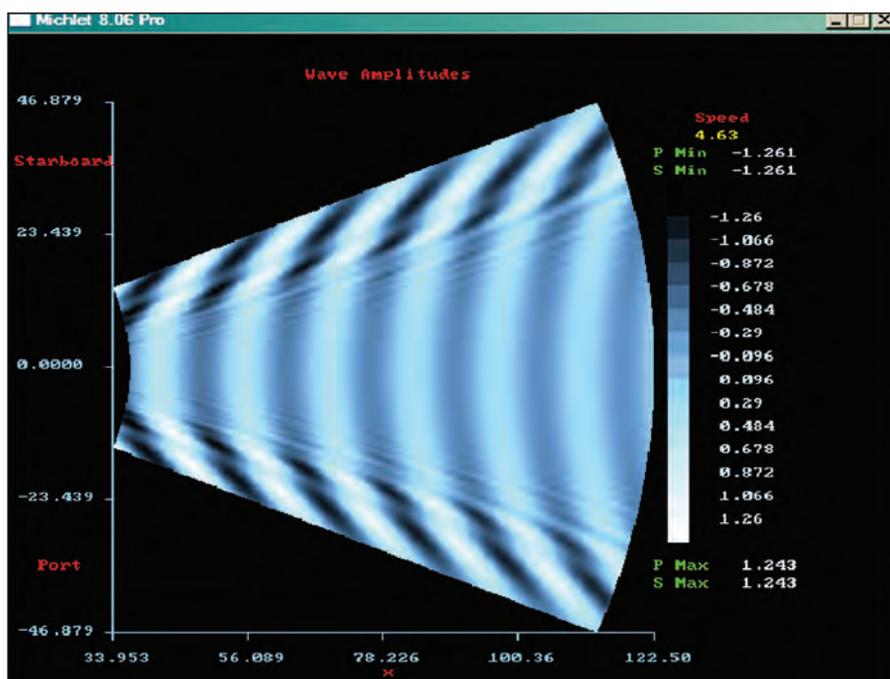
ArchimedesMB

ArchimedesMB is a software package that is free for personal use and which can build and manipulate complex models of floating bodies and report their key hydrostatic properties. The program is built around a flexible core that is continually being improved and offers great potential for future additions to the existing feature set. These include reporting for any angle of trim and heel, intuitive and accurate point and click entering of section data, scanning of existing lines plans, and a growing number of supported files for import/export.

The package has been written to provide all home users, students, and professionals access to hydrostatics of complex models in a clear and user-friendly manner. It is released under the shareware banner as 'trust-ware', in that the full, unlimited package is available for anyone to download and use, with the proviso that any commercial users register their package for a nominal fee to support future development.

At present, the program supports generation of all standard hydrostatics particulars as well as KN curves for any angle of heel. Much time has been spent optimising the calculation engine. A video on the website shows five complete hull models loaded in as a series of appendages totalling 50,000 offsets, and the full hydrostatics are generated almost instantly. It is currently employed by a wide range of users from hobbyists and students to professional design houses and shipyards.

ArchimedesMB already has a proven track record in commercial projects for generation of hydrostatics for submission to class for



This Michlet screenshot displays the result of the wave elevation calculations for a yacht.

approval. For example, SHM Marine International Inc, of Canada, has been using Archimedes in a number of recent projects, including a production pleasure boat, a shrimp trawler, for the lengthening of a fishing boat in Mexico, and a number of naval projects. Indian shipyard Mech Marine Engineers has been using Archimedes for over a year, and recent projects include the design of a high-speed crew boat and a 750dwt bunker barge. Both projects used ArchimedesMB for hydrostatics and stability booklet for class approval.

Presently under development for the next release of ArchimedesMB is full stability assessment through all angles of heel and trim followed by the addition of GZ curves. The engine at the core of Archimedes has been written from scratch in c++, employing object-orientated techniques which allow future features such ballast tanks and damage stability to be easily added to the code base.

Archimedes' website has been recently upgraded to a system which allows users to post comments and feedback on any of the content in the site, along with forums allowing discussions on the future course of development of the software.

Michlet

Michlet is a computer workbench that can be used for investigations into some aspects of ship hydrodynamics, and it is free for all users. It calculates the viscous and wave resistance and far-field wave elevations of both monohulls and multihulls. In addition, users can also calculate the interaction of up to five hulls simultaneously.

The program runs under Windows on most modern PCs. Examples bundled with the program include kayaks, rowing shells,

catamarans, proas, SWATH types, trimarans, submarines, and destroyers. Michlet also has an optimisation module called Godzilla which uses artificial life algorithms to search for hulls of minimum resistance, or for hulls with other specific characteristics. This aspect can be particularly interesting in the preliminary design stage. The program can also be used for inverse ship problems, such as predicting the ship responsible for making a user-defined wave pattern.

Michlet is based on Michell's thin-ship theory, which is best suited for relatively slender hulls with a large length-over-beam ratio. The thin-ship theory is conceptually similar to the slender-body theory, however there are some important differences. Some elements in the Michell theory, such as exponential decay with depth, for example, are absent in the slender-body theory.

Michlet also uses an advanced transom stern model to include transom effects, and it implements an eddy kinematic viscosity model in wave pattern calculations. Skin friction is calculated according to ITTC 1957 or Grigson's algorithm. Water depth effects are also taken into account. The program comes with a constantly updated spreadsheet of comparisons with tank test results.

FREE!ship can be used to quickly generate the input files needed for Michlet, while in return the offsets files generated by the Godzilla optimisation routine and even the wave elevations can be imported in FREE!ship.

Current users include the US Navy, several large shipyards such as Bath Iron Works, also many multihull and small boat builders. A special version is available for rowing applications that takes into account the motion of rowers in the shell. 

Selecting an optimum hull definition package

Following on from his articles in our April and May editions, Patrick Couser continues his reviews of various software suites that include a hull-definition module.

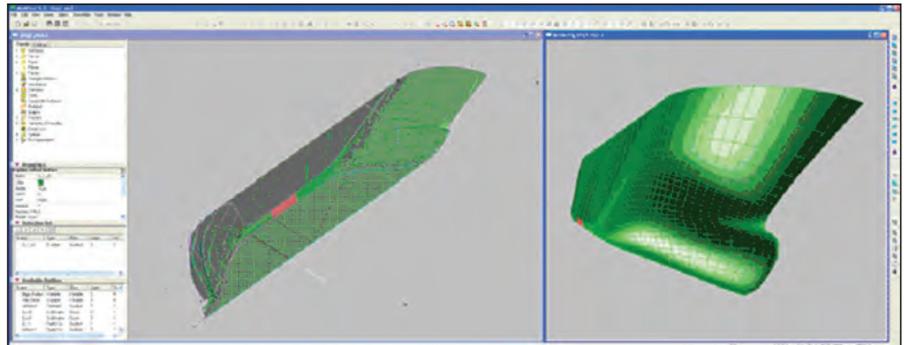
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MULTISURF is primarily a surface modeller, though the surfaces are generally defined from curves which are in turn defined from points. MultiSurf entities are relational; that is, entities depend on one another in a parent/child relationship. A wide range of types of point, curve, and surface may be used, each having unique properties. Making the best use of the available entities is critical to effective use of the software; and as with any system (but perhaps more so in MultiSurf), it is extremely useful to have a clear picture of how the model is going to be put together and the various relationships that need to be built into the model.

The relational aspect can be very powerful: by using 'beads' (which are points constrained to stay on their parent curve) as the control points for a second curve tangent (and, if desired, curvature) continuity between the two curves is easily achieved. These beads automatically adjust as the first curve is modified, thus ensuring the desired degree of continuity between the two curves at all times.

MultiSurf 6 has a thoroughly revised user interface and some extra tools (such as being able to insert a spline directly, bypassing the need to define the points first), which make it significantly easier to use than previous versions. Surfaces may be trimmed and joined along edges and also along 'snakes', which are parametric curves defined in a surface.



MultiSurf version 6.0.

Developable surfaces may be defined between two curves, and the surface updates dynamically as the curves are adjusted.

Fairing tools are not very comprehensive. Curvature plots are limited to a single surface at a time and porcupines can only be displayed on a single curve at a time. It is not possible to display porcupines on 'contour' entities; instead, a user needs to create intersection snakes between a specified plane and selected surfaces - though using the relational geometry, it is possible to set this up in such a manner that the section, with porcupines, can be dragged longitudinally through the model (or vertically, or transversely). The display cannot be foreshortened.

An important issue with MultiSurf is that of exporting geometry in IGES/NURB surface format. This is because many surfaces in MultiSurf cannot be represented exactly as NURBS; in these cases the NURBS in the IGES export are only approximations. Problems with the export of ruled and developable surfaces for some sample designs were apparent.

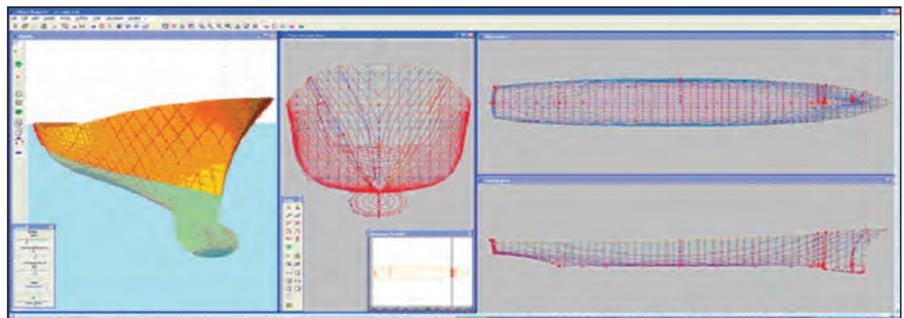
A question that should be asked is: Is this level of relational geometry really necessary? Many of the other systems have relationships where it is required to have a certain job done without the overhead: connections between surface edges, embedded contours in surfaces, automatically updating surface/surface intersections, and control over the relationship between groups of surface control points. However, the relational geometry is useful for surfaces lofted through master curves, because the surfaces can be faired by manipulating the master curves without having to manually re-loft each time.

MultiSurf involves a steep learning curve but in the right hands could be a powerful modeller, though not necessarily the most efficient, especially for inexperienced users. The manual is comprehensive but users should remember to also look through the tutorial manual for step-by-step instructions. MultiSurf supports scripting using VBA macros within the program and is also accessible from Excel etc using COM. There were no reliability issues with MultiSurf, and technical support was good. ☺

Naval Designer: Verre-Mer

www.navaldesigner.com
 verremer@navaldesigner.com
 Verre-Mer, 2 rue Bellan, 78490 Méré,
 France. Tel: +33 6 87 28 20 10.

THIS modeller, developed in France, is available in both French and English language. The English-language version was tested in this review, and the translation from the



Naval Designer version 1.1.0.2.

original French is adequate. Documentation is adequate, but not exceptional (some knowledge of French would be useful).

It is a NURB surface modeller which can handle multiple surfaces but not trimming of surfaces (the Pro version allows a maximum of 200 surfaces). Surfaces are manipulated by moving their control points directly. NURB curves are not fully supported, since surfaces with non-uniform knot vectors are not correctly displayed. However, this is not a problem unless users want to import an IGES file that contains such surfaces.

This software also seemed to have a problem in reading IGES files with surfaces with very many control points columns or rows (several hundred). Again, this is not really a significant limitation for designs done in the Naval Designer system, but does impact on compatibility.

Although the features are limited, they are well implemented. A range of well-designed icons covers most of the commonly used commands in a single toolbar as well as a floating toolbar which offers most of the other commands. The rendered view contains its own toolbar for setting the rendering properties. None of the toolbars are customisable.

Due to its clean layout, and relatively few commands, it is extremely easy to pick up. Hydrostatic and stability calculations are provided.

The only guide to surface fairness is a Gaussian curvature plot, which is rather limiting. Surfaces may be developed out. The calculation assumes that the surface is developable and this can be checked by a Gaussian curvature plot in the rendered view. However, there are no guides to help produce a developable surface, such as ruling lines.

Good use is made of floating toolbars and windows, though it is a shame that these cannot be docked. Especially useful is the tool for selecting a single control point column or control point row for display. This is useful when defining the section shapes in the body plan view and defining bulbous bows in the plan view.

A rather interesting tool is the one which defines the symmetry axis for each surface. This can be offset and also canted, meaning that symmetrical objects offset from the centreline plane can still be modelled by a reflected surface. This is useful when the reflection plane is canted and/or the object is not necessarily reflected about the centreline - for example: a canting keel and a symmetrical outer hull of a trimaran that has a non-vertical reflection plane.

There were no reliability issues with Naval Designer during the review. Technical support is good. 

ProSurf: New Wave Systems Inc

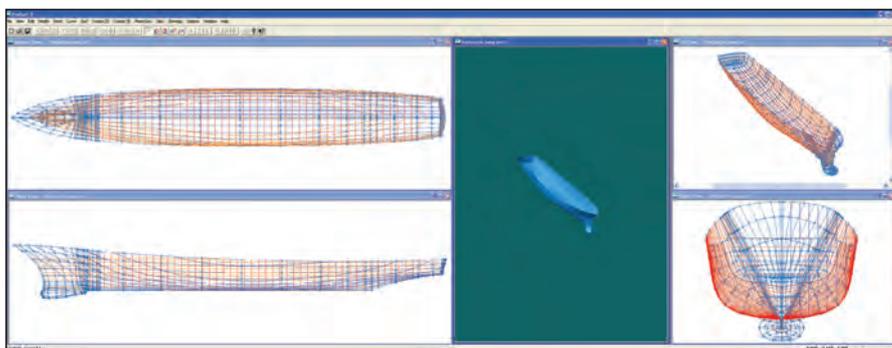
www.newavesys.com
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PROSURF has been developed and refined since the mid-1980s. The main components for modelling the vessel are NURB curves and surfaces. It is different from many other NURB modellers in that it allows users to edit the curves and surfaces by manipulation of point on the curves and surfaces, rather than being forced to use the NURB control points (this feature is also available in Rhino, but only on curves). Within the program, all surfaces and curves are cubic (or lower order, if there are insufficient control points), though they may be rational; surfaces from an IGES file with non-uniform knot vectors and different orders are correctly displayed.

ProSurf is feature-rich but the user interface is a little cumbersome, requiring many mouse clicks, especially regarding interaction with the views, eg, no middle-click pan or scroll-wheel zoom, which is fairly standard these days. Manipulation of the view in 3D is particularly poor, requiring clicks on toolbar buttons to rotate the model. The toolbar is non-customisable and only offers a small selection of the available commands. Thus the program is essentially menu-driven which can be quite slow.

Some useful fairing tools include 'move percent' which moves the control point by a certain percentage of the distance moved by the mouse, allowing fine control over the control points, but without having to zoom in too far - thus enabling the effect on the whole model to be seen. The 'Ooch' command (used to nudge the control points by small increments) could be better implemented by using the cursor keys. The only problem is that it is not possible to drag more than one control point at a time.

Surfaces can be created directly and then manipulated by their control points, alternatively they may be generated by extruding, sweeping or lofting curves. Surfaces may be trimmed, but the surface/surface trimming procedure is rather involved, and



ProSurf version 3.222.

trimming does not update dynamically. Curves may be embedded into a surface and these too may be used for trimming.

Developable surface support is reasonable; there are basically two options. Firstly, define edge curves with the aid of dynamic ruling lines drawn between them. Then a developable surface may be fitted to the edges. However, this resultant surface is often hard to modify manually since it can have many control points. The final control points defining the edge lines should also be adjusted to ensure that the final ruling lines coincide with the lines joining the ends of the edge curves.

The alternative is to define a surface with no intermediate control points. Each patch (defined by adjacent control point pairs in each edge) can then be made developable. Unfortunately, it is not possible to display ruling lines when using this method and this makes it harder to define a suitable starting

surface with appropriate edge curves. Both developable and compound curvature surfaces may be expanded.

Basic fairing tools are provided: static curvature plot on the surface and dynamic curvature porcupines. The porcupines can only be drawn on the control point rows and columns and not on sections, waterlines, or buttocks.

A foreshortened display may be generated by adjusting the corrections factors for the monitor. Upright hydrostatic calculations as well as resistance prediction using a number of standard regression methods are available.

The online help is essentially a reference rather than providing many examples or tutorials. The software did not crash, but when opening a new design with one of the existing windows maximised, the display went 'crazy', flicking between several views. Random clicking on menu items brought it back to normal! 

SeaSolution: Sea Tech Ltd

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Russia.

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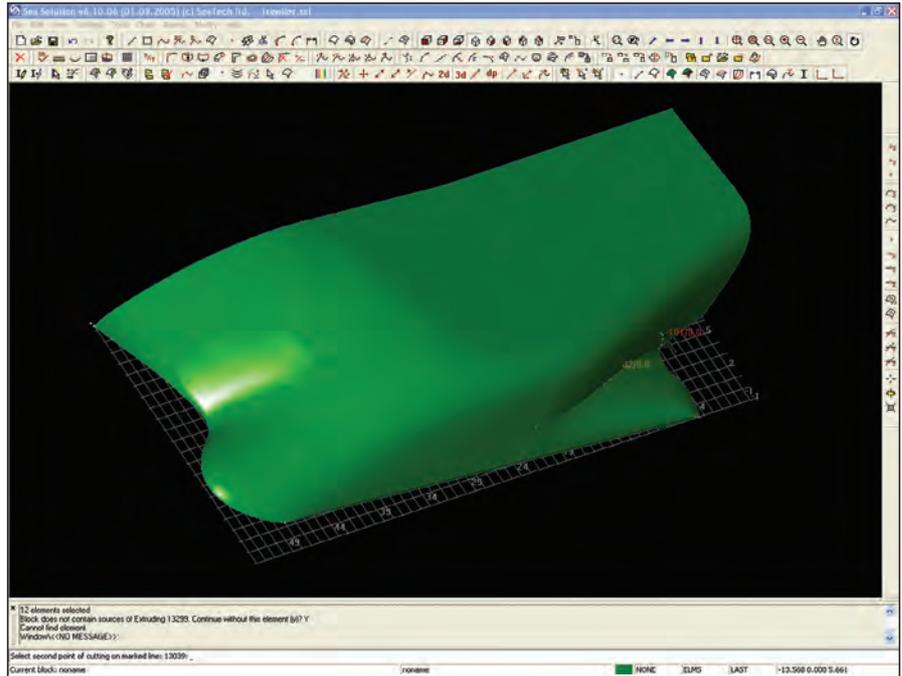
SEASOLUTION is essentially a cubic B-spline surface modeller. It also supports cubic B-spline curves and these may be used as 'drivers' to define the surfaces. In some ways, this is similar to the relational geometry used in MultiSurf but limited to only one type of surface.

The relationships between the curves and the surfaces generated from them are maintained so that the surface is adjusted if any changes are made to its 'driver' curves. 'Driver' functions which may be used to generate surfaces include: extruding a cross-section along a curve; rotation of a curve about an axis; and offsetting a surface. In addition, there are tools for filleting; extruding a pipe along a curve; and extruding a stiffener profile along a curve.

The use of 'drivers' ensures that relationships between the objects are maintained so that they automatically update when the driver object are changed. The relationship (eg, pipe diameter, fillet properties, and offset properties) can also be updated at any time. SeaSolution has a number of other tools: It is also possible to generate plates and shell expansions, also compute hydrostatics.

The user interface looks well presented at first, but there are some odd quirks. For example, the shortcut for the undo command is not Ctrl Z; there is no recently used file list; and on launching the application, the Open dialogue is automatically displayed. Also, the English translations are sometimes somewhat cryptic. A minor irritation is that the model is clipped to the grid. So if a design is being created free-hand, it is a good idea to set the grid to be quite large.

Some fairing tools exist, such as dynamically updating curvature porcupines on surface contours. These porcupines are drawn proportional to radius of curvature (rather than inversely proportional, which takes getting used to and makes it harder to determine when a line is



SeaSolution version 6.10.06.

straight). Similar to ProSurf, there is also a scaled drag command where control points are moved only a proportion of the distance moved by the mouse. The view may be foreshortened by a user-specified ratio.

It is possible to show areas where the Gaussian curvature changes sign, but these are slightly more difficult to interpret than the more usual false-colour shading methods. An interesting feature is the ability to plot contours through the inflection points of sections, waterlines or buttocks, assisting in achieving a smooth transition of inflection points. As with Maxsurf, a patch of control points on a surface may be automatically smoothed. SeaSolution only supports cubic B-spline surfaces so there are likely to be compatibility issues when importing models from other systems.

The software and documentation have been adequately translated into English from the original Russian. The manual is purely a reference guide for each of the commands. However an 'introduction' document is available on request and this provides a bit more background information into the concepts of the program; without this, the program is a little impenetrable. A number of sample designs, including some quite complex models, are available from the website (or upon request), as are several instructional videos which are extremely useful for getting started with the software.

Software reliability was below average, with the software crashing on a number of occasions. However, when Sea Tech was informed of these problems, they were promptly resolved. ☹

Rhino: Robert McNeel & Associates

In the UK, Rhino is available
from Simply Rhino:

www.simplyrhino.co.uk

paul@simplyrhino.co.uk

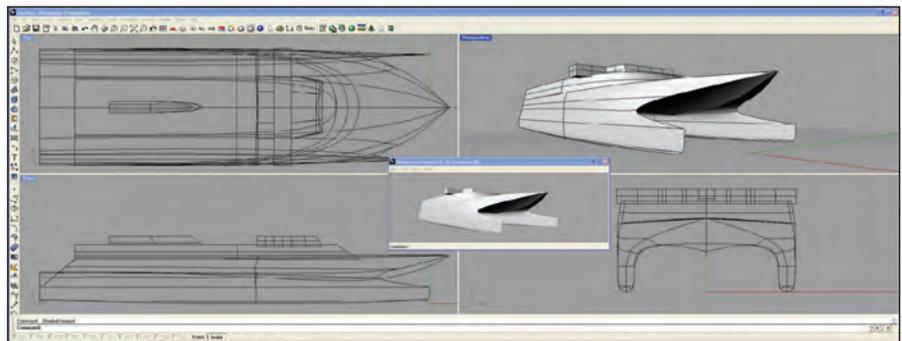
16 Essex Road, London E4 6DG, UK.

Tel: +44 845 601 5970.

Rhino Marine plugin for Rhino:

www.rhinomarine3d.com

RHINO 3D is a generic NURB curve and surface modelling package; solids may be made from closed surfaces. It also has some support for polygon meshes. It is extremely flexible and there are many third-party plug-ins providing hydrostatic analysis and other naval architecture requirements, ray-traced rendering, animation, and a multitude of other features.



Rhino version 3.0 SR4; RhinoMarine 3.4.

In most instances, the Rhino user interface is well thought-out and very customisable, with

some handy short-cuts and clever use of context menus. Users who are familiar with

Autocad will immediately feel at home with Rhino. Most commands may be accessed in three ways: menu item, toolbar button, and command line, or by a combination of all three. This means that users employ the same command for moving an object dynamically, by dragging it, or numerically, by typing in the required values at the command line. There are some minor irritations, such as the fact that the current construction plane is not ticked in the menu.

Whilst Rhino provides an extremely comprehensive set of tools for generating and manipulating curves and surfaces, its generality means that it is not optimised for ship hull modelling. Some of the other programs reviewed here certainly provide specific hull modelling tools which are more easily accessed. It is also lacking in ship-specific fairing tools: for instance, it is only possible to plot curvature porcupines along surface iso-parametric contours and not along sections, waterlines, or buttock curves as is possible in most ship-specific modelling programs; nor is there a foreshortened display option.

Having said that, Rhino is the only program tested to offer environment mapping and zebra-shading render options. Zebra mapping, in particular, can be useful in assessing surface slope and curvature continuity (see accompanying article). The 'loft' command, which can be used to fit a surface through a set

of section- and profile-like curves, offers some interesting possibilities for generating ship hulls. However, the resulting surfaces are normally too complex for manual fairing, requiring that the original curves be both fair in themselves and also represent a fair surface longitudinally. It is this second constraint, which is particularly difficult for some hullforms and requires a certain amount of trial and error (the lofted surface does not update automatically as the master curves are edited).

Rhino has many tools for creating surfaces from curves, such as extrude or revolve, and also supports a facility to loft a developable surface between two edge curves. However, this function has limited utility because it is not possible to display ruling lines to help define suitable edge curves in the first place - thus it may only be possible to generate a surface over a part of the edge curves; and the surfaces that are generated often have too many control points for manual adjustment.

Surfaces may be trimmed by intersecting with other surfaces or by embedding curves into the surface. Trimming is straightforward: select cutting objects, then click in the region that is required to be trimmed away. However, trimming is not dynamic so if the cutting object is moved, a user will have to re-trim. Also, the embedded trimming intersection is a parametric curve which may change shape if the trimmed surface is modified.

Adding to its flexibility, Rhino supports a VBA scripting language, so that users can write scripts to perform special tasks. These scripts may access other software that has a COM interface, such as Microsoft Word and Excel; however, Rhino does not have its own COM interface so Rhino cannot be accessed from an Excel or Word macro.

Initially, Rhino can be a little overwhelming, but if users work through the tutorials (in the Help menu) they will soon start to get a feel for the program. The standard of the documentation is above average, with good online help and tutorials in the trial version. Purchasers will receive a bound user guide that complements the more reference style of the online help and additional tutorials covering more advanced features.

Whilst Rhino can be used to design and fair a ship hull, this is probably not its strongest feature; where it really comes into its own is in adding detailed, general 3D geometry to a design. It is well worth considering as a complementary, downstream modelling tool to a ship-specific hull modelling and fairing package. However, the functions added with the Rhino Marine plug-in, provide considerable improvement to Rhino's ship design capability.

Generally Rhino was reasonably stable but the program crashed on one occasion and stopped responding on another, although this was with a model imported from a different system. ☹

FREE!ship

www.freeship.org
info@freeship.org

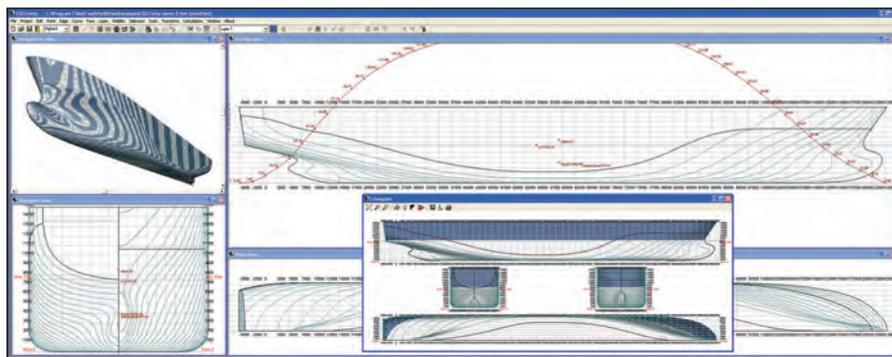
FREE!ship is unique amongst the software reviewed in this series of articles in several ways: it is free and open-source (see also our article on shareware elsewhere in this feature), it uses subdivision-surfaces to represent the vessel envelope, and it runs under Microsoft Windows and certain versions of Linux. The fact that it is open-source means that any one so inclined can download the source code to examine (or even modify). The project may be found on SourceForge:

<http://sourceforge.net/projects/freeship>.

The subdivision surface scheme used in FREE!ship is based on that developed by Scott Schaefer and Joe Warren: On C^2 Triangle/Quad subdivision,

<http://www.cs.rice.edu/~sschaefer/research/triquad.pdf>. This scheme uses a hybrid quadrilateral/triangle control polygon giving C^2 continuity. The scheme is an approximating scheme, meaning that like NURB surfaces, the control point polygon lies off the actual surface. Although technically feasible with subdivision surfaces, FREE!ship does not make use of control point weights, hence the exact representation of conics is not possible. However, this feature is on the wish list!

By default, FREE!ship has four viewports, namely: bodyplan, plan, profile, and perspective, but users may add as many as required; this can be useful for zooming in on a particular part of the hull or displaying Gaussian



A screenshot of FREE!ship version 2.6.

and Zebra renderings concurrently. FREE!ship has a reasonably intuitive user interface and it does not take long to be able to modify parent designs and start to create simple models.

However, it is not quite as refined as that of some of the commercial software available, for example there is no multiple point drag; multiple point numerical edit is non-intuitive and fiddly; and there is no orthogonally-constrained point drag. A non-customisable toolbar containing the most frequently used commands is provided and a number of useful viewing/display functions are accessible from a right-click context menu.

Some users may not like the automatic zooming and centring as the model is rotated in the perspective view. The lack of a progress bar and a Cancel/Escape feature during

computationally-intensive tasks, such as plate development and IGES export (of complex models), can be irritating, as it can appear that the program has crashed.

As with Rhino, one of the most useful fairing tools is the zebra-mapped rendering (see accompanying story for further details of zebra mapping). It is also possible to display a false colour rendering of Gaussian curvature and developability (areas where the Gaussian curvature is zero). Curvature porcupines can be displayed on sections, buttocks, waterlines and diagonals, and on user-defined 'control curves' (similar to NURB surface parametric curves). Other than the false colour rendering of surface developability, there are no other tools to assist naval architects with the design of developable surfaces. ☹

Although the surface may contain holes and points may be inserted where surfaces intersect, there is no support for dynamic surface trimming. Where the subdivision surfaces method stands out is in its ability to blend different surfaces together, especially where the surface requires more than four edges. Thus it is relatively easy to blend a sonar dome, bulbous bow or stern bulb into the main hull (whilst maintaining C^2 continuity), but it is more difficult to penetrate and trim a bow thruster tunnel or fin stabiliser through the hull and once done the intersection cannot be easily moved.

A wide range of import and export formats are supported, including some useful tools for generating hulls from section contours or chines. FREE!ship supports full export to NURB surfaces via the IGES format, thus compatibility with other CAD/CAM systems should not be an issue. This implies that the model could in fact have been modelled with a standard NURB modeller, which is indeed the

case. However maintaining C^2 continuity across the NURB patch boundaries would be much more difficult to achieve manually; it may be easier for a human to generate the model using subdivision surfaces in FREE!ship and let the computer do the translation to NURBS. In practice the occasional hole was found in the exported IGES surfaces. Also there is no equivalent import of IGES surfaces, so this is a one-way translation.

FREE!ship also includes a number of add-ons:

- linesplan export with profile, plan and bodyplan views arranged and scaled onto one drawing
- non-linear transformation of hull using Lackenby-type approach to achieve desired LCB and other parameters
- dynamically-updating hydrostatic centres and sectional area curve
- upright hydrostatics and cross-curves of stability report

- resistance prediction for yachts (Delft) and canoes and kayaks (Kaper)
- unfolding of developable surfaces into flat panels
- simple flow lines based on surface geometry.

FREE!ship has a reasonably comprehensive user manual and there are many resources available online including a wide range of hull forms and a users' forum. FREE!ship has also been translated into a range of languages including English, Dutch, German, French, Castellano, and Suomi. There were no reliability issues during the review of FREE!ship for this article (problems can be reported and viewed in the on-line forum). Technical support was excellent. FREE!ship is just another example of free open-source software that is as good as, if not better than, commercial software and would make a useful addition to the naval architect's software toolbox. 

Background to subdivision surfaces

Patrick Couser comments on three aspects of hull definition, starting with subdivision surfaces.

BECAUSE subdivision surfaces are somewhat different to NURB surfaces and relatively new, it is worth reviewing some of their properties and looking at differences between subdivision and NURB surfaces.

Although subdivision as a basic geometric modelling method was first proposed in 1978, it is only since the mid-1990s that it has received greater attention in the CAD community. A ground-breaking application of subdivision surfaces was made by Pixar in 1997 called Geri's Game, a four-minute CGI (computer-generated imagery) film.

The fundamental concept behind subdivision surfaces is that of refinement. An initial, arbitrary polygonal mesh can be repeatedly refined, generating a sequence of successively smoother meshes. Taken to its limit, this refinement yields the smooth subdivision surface; in practice the refinement is terminated once a suitable accuracy has been achieved.

Property	NURB surface	Subdivision Surface
Control polygon	Requires regular, rectangular m-by-n control point mesh.	Arbitrary, irregular control point mesh.
Topology	Rectangular.	Arbitrary (n-sided) including holes.
Continuity	Any level of continuity (given sufficient control points).	Up to C^2 (curvature continuity) in most cases – depends on algorithm used.
Local detail	Control vertices must be inserted so as to maintain a regular rectangular m-by-n mesh. Thus inserting detail may corrupt other parts of the surface.	Ability to insert control vertices arbitrarily as required to define local details.
Surface discontinuities	Must follow a control point row or column.	May follow any edge between two adjacent control points, eg, possible to create closed crease-line in a single surface.

There are several popular subdivision schemes and hence the same initial polygon will define different surfaces depending on the scheme used. The representation of the hull envelope using

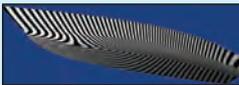
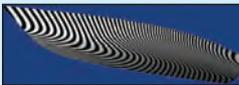
subdivision surfaces differs from the more common NURB surface method. It is interesting to compare the properties of subdivision and NURB surfaces, as shown in the accompanying table. 

Zebra-stripe surface analysis

ZEBRA-STRIPE renderings are useful for examining surface smoothness and degree of continuity, particularly where surfaces join. Zebra mapping enhances what designers use to judge the fairness of a 3D surface with the eye, that is, they look at the reflection contours and check if these look smooth.

The stripes of the zebra mapping provide the same functionality, and each band represents a range of light reflection intensity values, and the stripe edges correspond to reflection contours. 

Examples of zebra stripes.

C^0 Surface continuity (no holes)	Surfaces touch meet but stripes are discontinuous. C^0 continuity defines a chine or knuckle.	
C^1 Tangent/slope continuity	Stripes continuous but not smooth. C^1 continuity is found between a circular arc bilge and flat of side/flat of bottom.	
C^2 Curvature continuity	Stripes join smoothly. C^2 continuity is generally considered fair for most ship applications.	
C^3 'Rate of curvature' continuity	Smoother stripes. This level of smoothness is not possible with most subdivision surface schemes; NURB surfaces can have C^3 , and greater, continuity.	

Surface trimming and blending

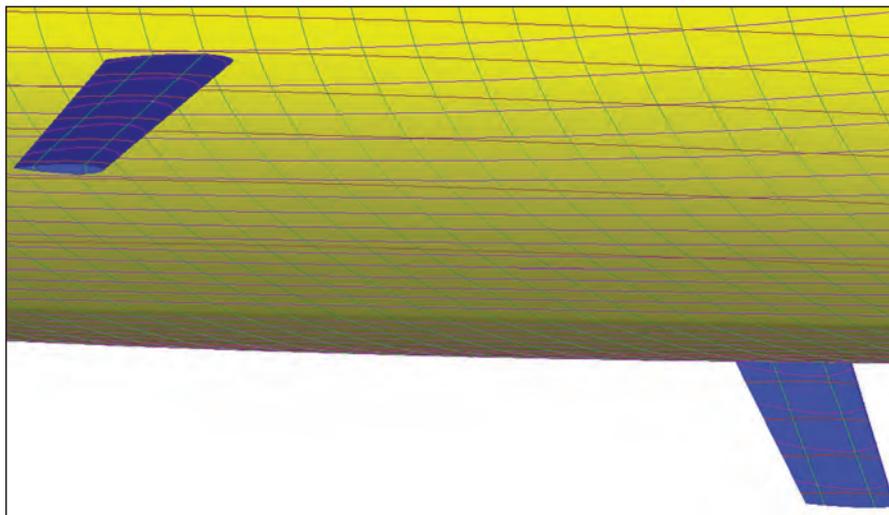
THERE are two distinct ways of joining surfaces, and the appropriate method depends on the desired end result. One of these is by trimming. This is where a surface is split into regions by trimming curve(s). Selected regions of the surface are then removed from the model. When the trimming curves are defined by the intersection lines of two (or more) surfaces, and the appropriate regions removed from the model, this effectively joins the surfaces at the common intersection lines.

Trimming is particularly useful where two distinct surfaces intersect and where it is desirable to be able to fair the surfaces independently (ideally the intersection line and hence the surface trimming will update dynamically as the surfaces are faired). An example of trimming is where a bow thruster tunnel or fin intersects the hull surface.

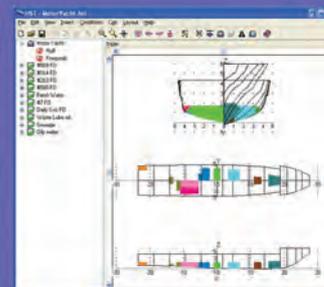
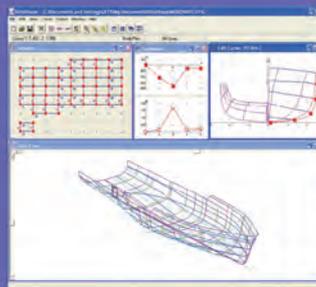
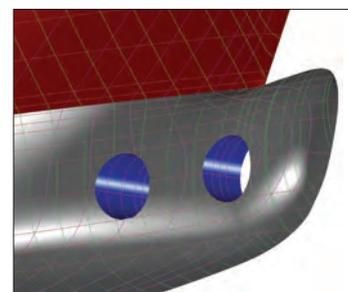
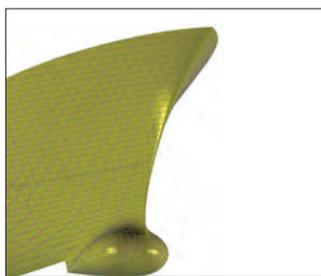
Blending is used where it is desirable to have a smooth join between two surfaces and where there is some interaction between the surfaces during fairing. For example, blending can be used for the junction between a sonar dome and main hull.

Right. Surface blending used to model a sonar dome.

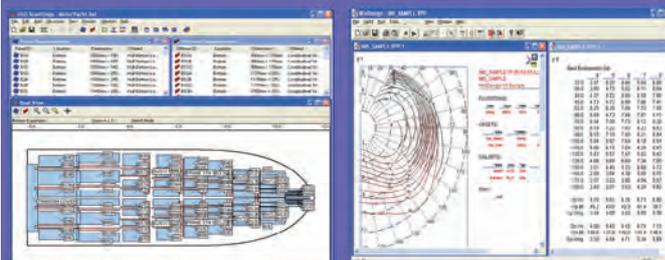
Far right. Surface trimming used to model bow thruster tunnels.



Above. Surface trimming used to model fin stabilisers.



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Major upgrade for hull design software

VANCOUVER-BASED Autoship Systems Corp has released Autoship 9.0, the newest version of its ship hull design and surface modelling program. New design tools include feature patches, edge mate, project integration and export, and a number of other additions.

Feature patches is a system for introducing local shape control on a surface without dealing with unwanted control points. The feature patch blends at its edges to the shape of the parent surface. When the parent surface shape is changed, the patch moves with the change, retaining its own shape.

Edge mate allows all or part of the edge of one surface to be matched exactly to all or part of another surface's edge. The user can choose positional, tangent or curvature continuity from one surface to the other.

Surfaces which incorporate feature patches and/or edge mate are fully integrated into the Autoship project through project integration and export. The surfaces are contoured, intersected, trimmed, meshed and rendered - just like any other Autoship surface. Plus, the surfaces export exactly via IGES, making transfer of designs from Autoship to other programs simple and accurate. Autoship 9 incorporates other advances including:

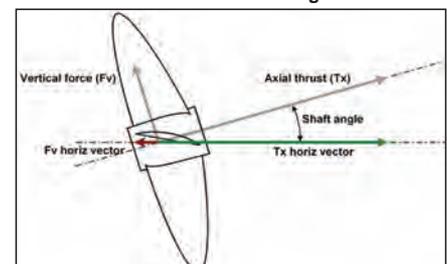
- a revised navigator for organising and accessing model components
- edit planes allow a designer to set up a list of rotated views in the 3D viewer and then edit in that view and have the vertices constrained to move only in the plane of that view
- alternate main screen layouts
- surfaces can be coloured, making it easy to pick out one surface in a complex design
- translucency in rendering
- single-button operation to create station contours from baseline data
- increased use of context menus to speed access to operations
- walk-through in rendering
- improved IGES export and import.

New additions for prediction software

A SOFTWARE tool for the prediction and analysis of vessel speed and power performance, NavCad, also provides for the selection of suitable propulsion system components such as engines, gears, and propellers. NavCad has a significant number of new features under development for 2006, especially for propeller performance and sizing. Additions made this year include:

- cavitation analysis - a new proprietary prediction method for propellers in the ranscavitating mode
- effect of shaft angle - high shaft angle can greatly affect a propeller's thrust and torque. Unexpected overload and peak cavitation surprises can be avoided with a new 'inclined flow' algorithm
- propeller sizing - a designer often needs to find the best propeller for a vessel's top speed. A new iterative technique has been developed to automatically match the propeller sizing design speed to the attainable top speed
- measures of propulsion merit - a designer always compares a design to industry standard measures of merit. New propulsion criteria are being added, including 'transport efficiency'.

The shaft angle effect can affect thrust and torque. This can be avoided with a new algorithm.



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Foran users meeting 2006

More than 90 delegates attended Sener's Forum 2006 - fourth in the series of biennial meetings - which was held from May 31-June 2 in Santiago de Compostela, Spain. This year marks the 50th birthday for Sener, a family-owned company, which deals with a wide range of engineering disciplines but is most noted in the marine field for its Foran integrated CAD/CAM suite. The company employs 1500 engineers worldwide but Foran itself started as an in-house tool. The newest version, V60r1.0, was reviewed in *The Naval Architect* January 2006, page 32. Eric Tupper attended the event and reports on some of the highlights.

THE first presentation was on INNOVAMAR (a group of domestic companies and the Spanish government) and the R&D policy for Spain's shipbuilding industry. INNOVAMAR's aim is to create a 'Spanish Maritime Platform' to improve competitiveness by promoting levels of technology, encouraging research, development, and innovation, and making use of synergies between subsections and activities.

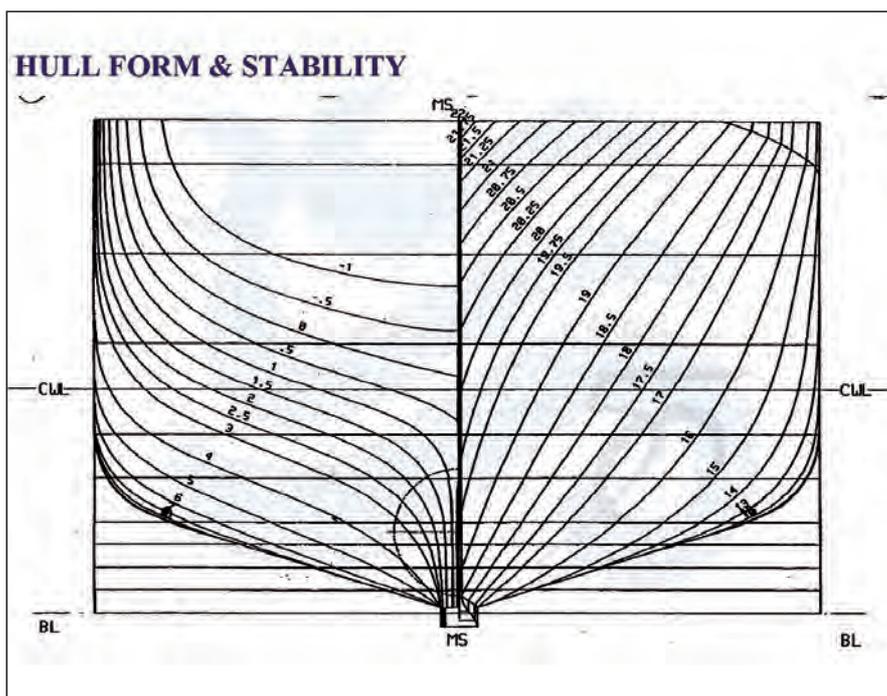
INNOVAMAR was likened to a 'technological lighthouse', highlighting needs and opportunities and then promoting projects. This helps the maritime sector towards integration with the European maritime network, MARTEC. It provides an evaluation and monitoring service, also fiscal certification, to enable the industry to take advantage of substantial tax incentives. Tax-deductible cost percentages can be as high as 50% to 70%.

The Spanish platform collaborates with the European Waterborne platform, and the Green Paper on the future of EU maritime policies sets out the need for a strong European maritime community. It encourages the creation of national clusters to advance the competitiveness of sectors by sharing knowledge, research, and innovation. At present, there are nine national clusters, including the UK. Spain is currently only an observer but a Spanish cluster is being created, financed equally from the private and public sectors.

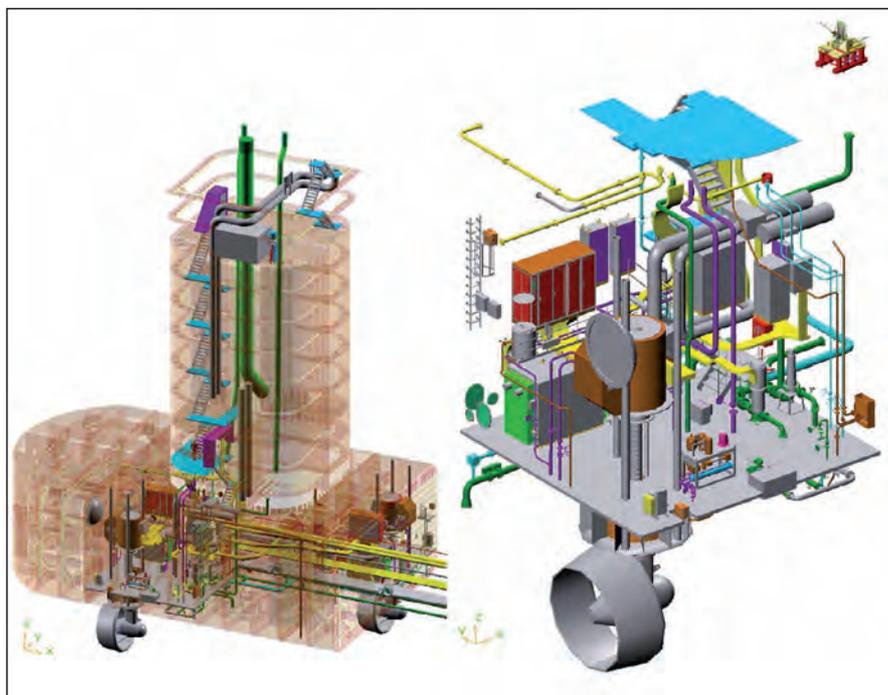
Managing ship spaces

The next speaker, from the new Spanish shipbuilder and repairer Navantia (formed following the collapse of IZAR to handle mainly warship construction and repair, plus some merchant work), described a 'Ship Spaces Management Tool'. This began in-house, for early design work, and then was developed under the InterSHIP Project (a consortium of seven European builders), in which there are three technical suppliers, including Sener and Strathclyde University.

The objectives of InterSHIP are to increase competitiveness of Europe's cruise and ferry yards, to develop better products considering the total life of complex ships, and to reduce costs and time-to-market of innovative solutions.



Positive stability for sail training ships, ideally up to 70degrees, calls for careful hull design, as does avoidance of downflooding through hatches. Sener has been involved in several successful projects and is currently tendering for two more.



Foran was used by Brevik Engineering to develop the new Aker H6-e semisubmersible drilling platform for Arctic operations. Much complicated and detailed work is needed for this type of vessel.

The aim is to provide an advanced interactive 3D graphical system with automatic and manual initial subdivision, a design meeting the requirements of classification societies, IMO plus other organisations, and with good import/export capabilities. At present, the basics, with automatic and manual subdivision,

are at the prototype stage, while the introduction of rules and regulations is being investigated.

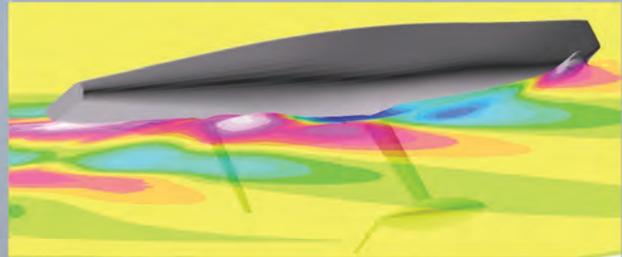
Aircraft carriers and submarines

A speaker for the Aircraft Carrier Alliance presented the design of the new carrier for the



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Attention Naval Architects

GHS version 9.5 introduces a choice of color and enhanced black-and-white reports along with many other enhancements including more support for offshore and salvage work.

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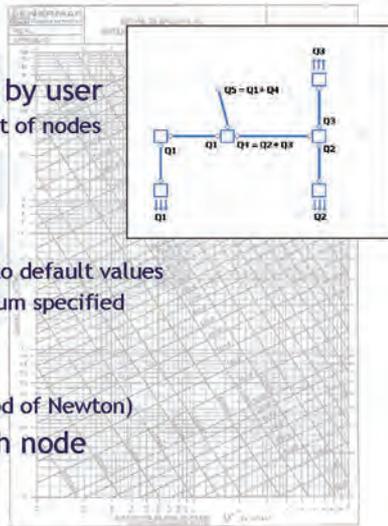
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CALCULATIONS (I)

- Flow on terminal nodes provided by user
 - Automatic calculation of flow in the rest of nodes
- Straight duct dimensioning
 - Fixed dimensions upon user decision
- Calculation criteria
 - Pressure loss per length and according to default values
 - Circulating speed not exceeding maximum specified
- Calculation procedure
 - Equation of Darcy
 - Equation of Colebrook (solved by method of Newton)
- Equivalent friction losses for each node



Design of HVAC ducting calls for careful evaluation of pressure drops, together with duct dimensions and balancing. The new Foran V60r2.0, available next April, will make this difficult task simpler.

British Royal Navy. At 65,000 tonnes deep displacement, this ship will be a major challenge to build. It is currently at the first-design phase (following on from concept design). Systems design and production are to follow.

Another military-application paper, which could also be of interest to commercial ship designers, discussed the initial and basic design of a submarine for the Brazilian navy. The Brazilian Navy Ship Design Office (CPN) is using Foran as its electronic design tool. This project was started using Version 40, which required some impromptu adaptations. For instance, at that time the module DECKB could only manage hull forms below main deck level, so the main deck was assumed to be at the top of the pressure hull.

When Version 50 was launched, the main deck could be defined internally to the closed hull, as an internal hull surface, using FSURF. Foran has been good for modelling submarine hull forms but has presented a few limitations in performing some naval architecture calculations, due to the need to calculate displacement in flooding sections outside the pressure hull. With very streamlined hull forms, it was necessary to make some adjustment to let FHULL process them. The lack of decks and bulkheads in the casing and sail made defining positions of pipes and fittings more difficult.

Foran is however good for modelling the electric propulsion and accommodation sections, but including the crew members themselves would assist in calculations for trim and weight control. In summary, it was felt that each new version of Foran has brought significant improvements, making it suitable for warship design including submarines.

Arctic drilling platforms

Another Foran application that necessitated some adaptation is the Aker H6-e semi submersible drilling platform. This is intended for deepwater operation (3000m) and harsh

environments (35m wave height). It is designed to operate in the Arctic with everything on deck covered and escape routes electrically heated.

Two platforms of this type, with operating displacement of 64500 tonnes, are to be delivered in 2008 with options on two more; Foran has been used for structure and outfitting. To enable the Foran modules to be used, a 'dummy' reference bulkhead was introduced through the centre of the rig. Defining the interface between the columns and topsides presented some interesting problems since pipes, ducts, cabletrays, elevators, and stairs were all involved.

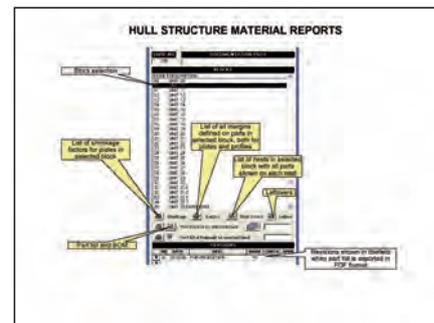
Brevik Engineering (a member of the Aker group) started work on the H6-e using V50r3.0 (2005) then converted to V60r1.0. The consultancy found the new FDESIGN module much better than DRAW but not as easy to use. A spokesman said the company had received good support from Sener when problems arose in implementing Foran. Dubai Dry Docks, the yard responsible for pontoon and column fabrication, uses ShipConstructor as its main 3D tool but purchased Foran for the H6-e project.

Access and change control

A Sener engineer gave the next presentation on access and change control in Foran. It is essential to control who has access to, and who can change, information in any database. This becomes even more important as more subcontractors become involved, with a need to work on selected areas of a design.

The speaker likened the system being developed to a boundary with a door. To one side of the door is a brick wall and to the other side a wire fence. Some users are allowed through the door and can change the design database. Some can look through the fence and see what is being done. Others, behind the wall, can see nothing.

The status of the user will depend upon the application. The situation also changes with time.



Managing material reports is an essential part of any shipbuilding project. Rolls-Royce Marine's detail engineering company, Navis Consult, in Croatia, reported on its own special system for extracting Foran details for reports. The objective is better quality and materials control.

As the design matures, more areas will become frozen, with ability to change requiring very high authority. Areas to be controlled are represented as units. A unit is defined by a discipline (a Foran field of work such as cable routing) and an activation level (such as zone and system, or routing area).

Sail training ships

Sener next reported on its involvement since the late 1960s with sail training ships. Besides training personnel, such vessels act as ambassadors to their country, drawing favourable attention wherever they go. Using Foran, Sener designed four well-known types which were built by Astilleros y Talleres Celaya, and in 2000 the consultancy created *Sea Cloud II*, a sail cruising ship of 102m length overall. Currently, the consultancy is bidding for two more ships.

Russian experience

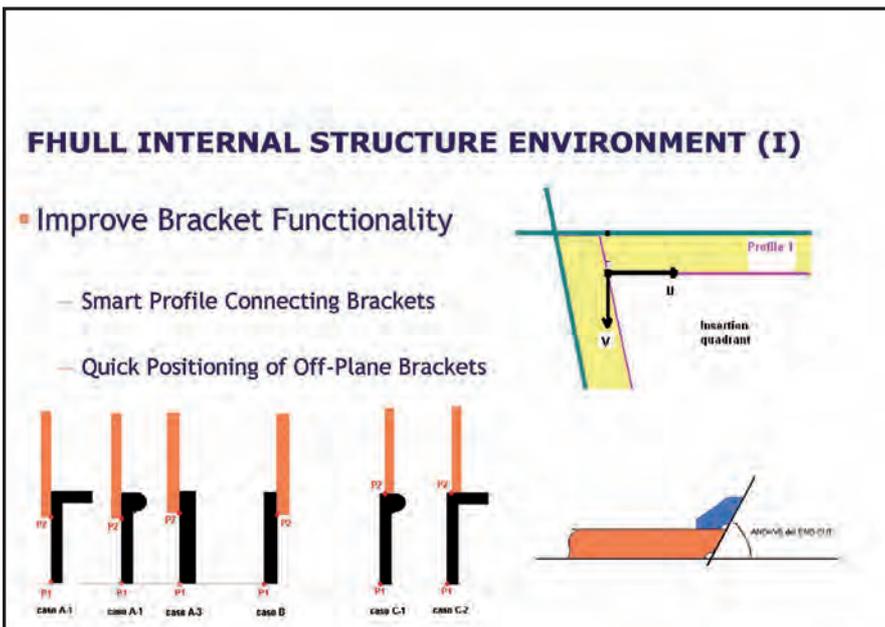
The next speaker, from the Russian Severomoye Project Design Bureau (SPDB), in St Petersburg, discussed the bureau's experience in using Foran for ship design. A package was first implemented in 1998, and from that time it has been the common CAD/CAM tool for all design activities, being used for destroyers, frigates and missile cruisers also, in recent years, for merchant ships such as container ships, tankers, and reefers.

Clearly, SPDB has been pleased with Foran as a tool and currently has 40 workstations and over 100 licences for various modules. Most of the work has been with V50 but conversion to V60 took place recently.

HVAC and electrical work

Next, a Sener engineer described the new HVAC Diagrams and Calculations tools. The design of HVAC systems requires evaluation of fresh-air needs and the correct balancing of ducts. Relative to fluid piping systems, this balancing is very sensitive to routing and duct form. Foran has been able to handle 3D ducts for a long time but in recent years has been enhanced in all routing aspects as well as in the generation of production and assembly information.

continued



Future versions of Foran will include several useful new tools. Amongst work currently being perfected by Sener for its FHull module is improved bracket connections (illustrated here), and stiffener crossing points.

Sener is now tackling the definition of HVAC diagrams (to become available with V60r1.1) and the calculation of pressure drops, to balance systems and dimension ducts automatically. HVAC calculations and the creation of 3D models from the HVAC diagrams will be available with V60r2.0.

Another Sener presentation dealt with integrated ship electrical design. This involves a number of basic functions, such as main power and lighting, switchboards and wiring diagrams, backed up by detail design features such as connection charts, cable tray details, and other items. Definition involves many documents showing aspects of each of the many processes used by design, production and procurement teams.

Product life management

A Navantia speaker dealt with the interfacing of Foran with Windchill, a Navantia product life management (PLM) system. This was found not to be difficult and it took only four months to achieve. The PLM system facilitates control of documents generated with Foran information - such as storage, revision, and distribution. Accessing CAD information requires specific technical skills but accessing published CAD parts in Windchill is much easier for non-trained users.

Extracting details for material reports

Navis Consult, Rolls-Royce Marine's associated detail-engineering consultancy in Rijeka, Croatia, presented an interesting report into its own-developed tools for extracting information from Foran for material reports. Implementation started in 2001 with Foran V40, and capacity has gradually increased, with most detail engineering work being carried out with Foran (the company has 75 licences). With V60, the company expects efficient drawing extraction,

global modelling and re-use of data, with a collaborative engineering solution. Quality control will be of the 3D model rather than individual output documents. All parts are always checked, and the overall objective is improved quality and materials control.

Bureau Veritas described its ship hull monitoring in-service 3D system, being evolved under the European Union-sponsored condition assessment system (CAS) and presented in our associate journal *Shiprepair and Conversion Technology* 2nd Quarter 2006, page 3. Sener is a partner in this project as a shipyard software vendor. CAS requires a simplified model of the ship within which to identify structure and equipment, and to record the history of thickness and other condition measurements. This model can be provided by Foran or another shipyard 3D model.

StoGda, a design and engineering consultancy associated with Stocznia Gdansk, from Poland, reported on its experience in Foran new-user training. The shipyard found that separate modules should be dealt with separately; printed material is very helpful; students should try using program commands on their computers (one console for each pair of students recommended); and students should start using their knowledge within a few days rather than weeks.

Future goals

The final formal presentation was one on a future strategy for Foran. The current situation is that V60r1.0 was released in August 2005 and has been installed by around 30 customers. It is planned to release V60r1.1 in October 2006, and V60r2.0 in April 2007.

The future goal is to continuously evolve Foran as a CAD/CAM reference system in shipbuilding. Sener is making a large investment in development and to respond to

Foran licence for Imabari

A PERMANENT licence agreement to use the Foran CAD/CAM software suite has been signed by Sener, from Spain, and the Japanese company Imabari Shipbuilding. This agreement marks the continuation of a pilot project started last year when, following training in Madrid, teams at Imabari's Marugame headquarters began work on modelling the engineroom for a new VLCC, which will be constructed at the group's 'greenfield' Saijo yard. The pilot project ended with the generation of drawings and other production-related details. In the months ahead, Foran will be gradually and progressively implemented at all group yards.

The very active medium-sized Imabari group has three main sites: Marugame, Imabari City, and Saijo, while associated companies include Koyo Dockyard, Imai Shipbuilding, Iwagi Zosen, Nishi Shipbuilding, Shimanami Shipyard, Shin Kasado Dockyard, Shin Yamamoto Shipbuilding, and Toyo Works Ocean Yacht.

new market challenges. In response to feedback from Forum 2004, effort is being put into initial and basic design tools, compliance with user requirements, reduction in design hours, reductions in cost, and in delivery times.

Overall, this conference was characterised by the variety of applications - commercial and military - with hull shapes as diverse as submarines, sail training ships, and offshore platforms. This shows the flexibility of Foran as a tool for designers and shipyards. Naturally, some of these applications required adaptations, particularly as those reported had, of course, been using earlier versions of the suite. For instance, a dummy bulkhead was assumed to exist on the middle-line plane of the platform, between the vertical members; while, the 'main deck' was sited at the top of the pressure hull for the submarine.

The latest version of the software should eliminate the need for some of these special devices. This illustrates how Sener is evolving the system in response to feedback. Users spoke well of the support given by Sener in installing and using the systems, and a complete set of tutorials is planned for the next version.

Clearly, Sener takes note of feedback to try to improve systems in line with customer needs. The company is therefore to be congratulated on a versatile package suitable for both large companies and smaller users.

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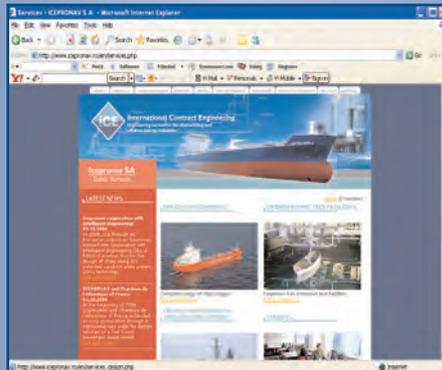
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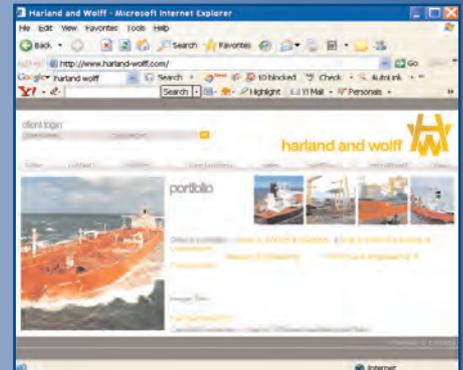
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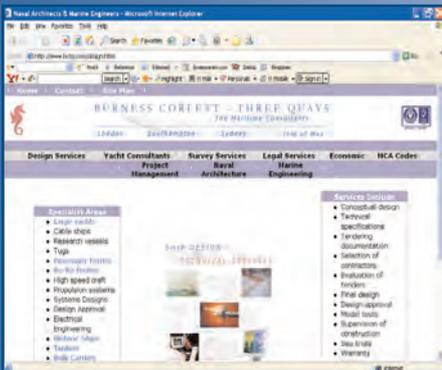
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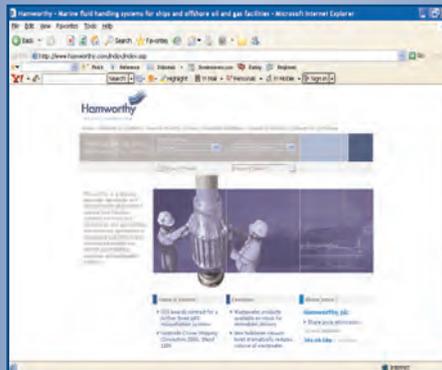
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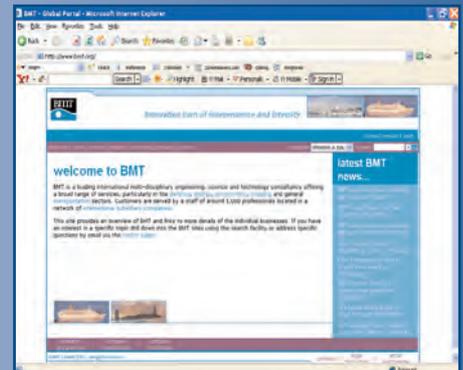
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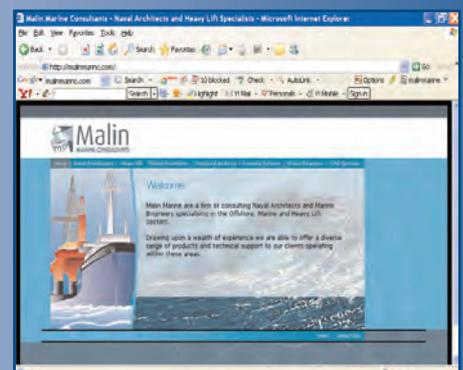
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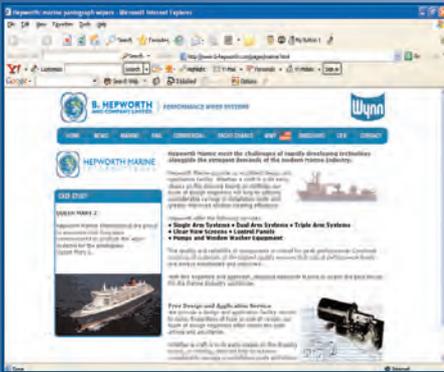
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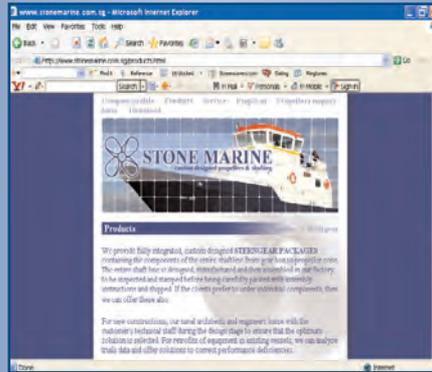
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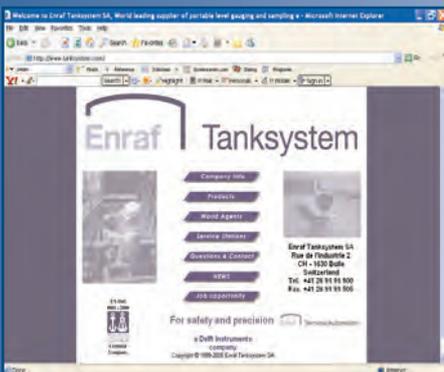
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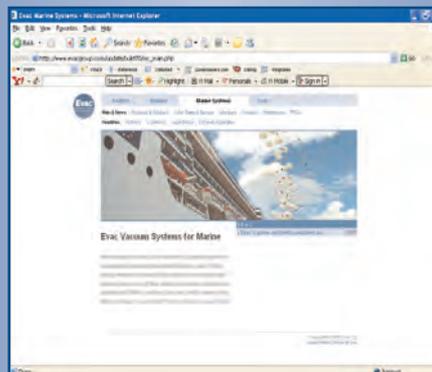
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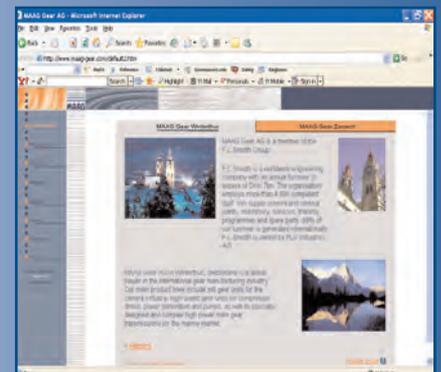
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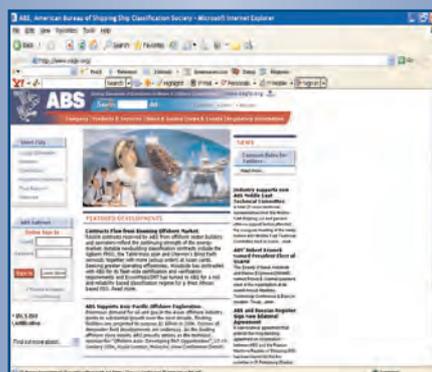
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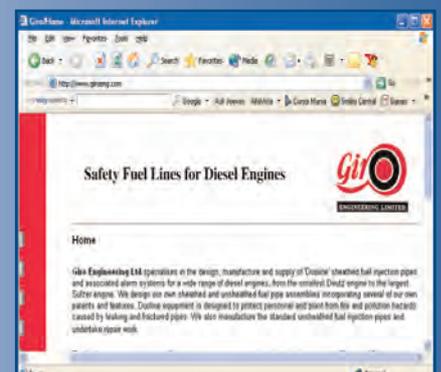
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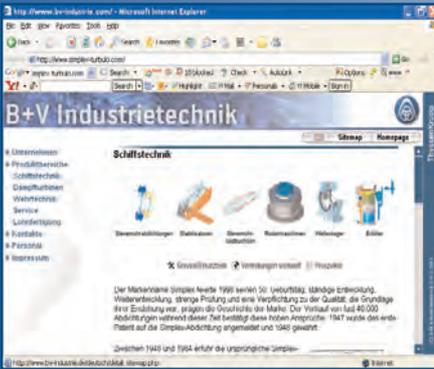
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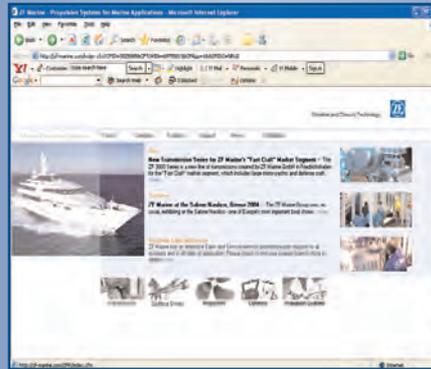
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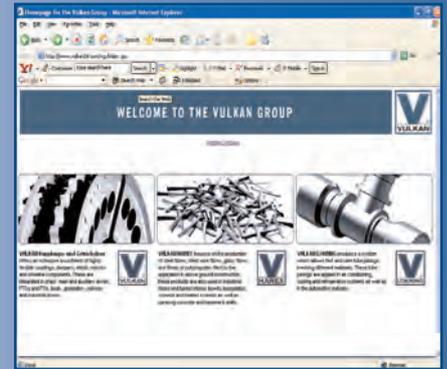
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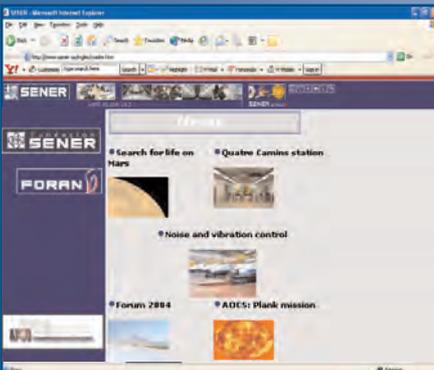
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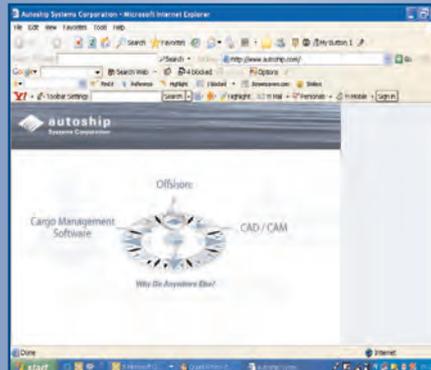
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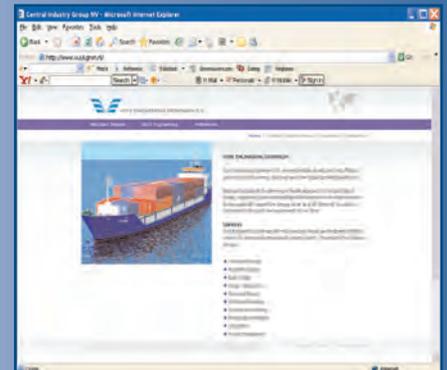
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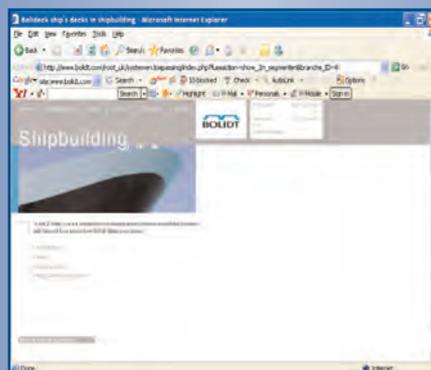
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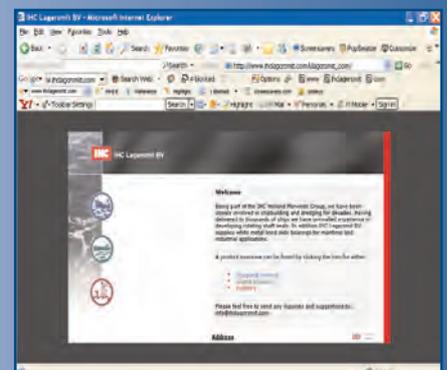
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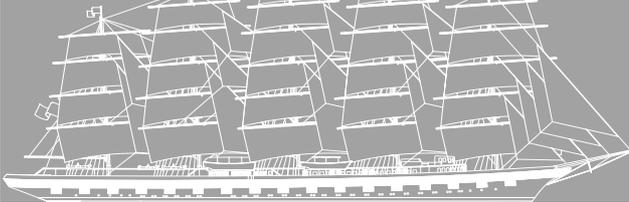


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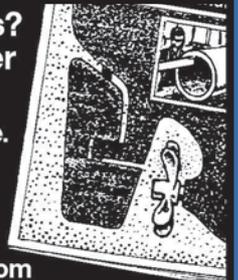
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Giro Engineering Ltd	44	H14	TTS Marine	40	H36
Graphics Research Corp	39	H15	Unifrax Ltd	IFC	H37
Greenpeace International	79	-	Veth Motoren BV	25	H38
HRP Thruster Systems	63	H16	Voith Hydro	59	H39
IMSA	74	H17	Vuyk Engineering	29	H40
Interferry 2006	2	H18	Wolfson Unit	71	H41
Jaure SA	55	H19	Wartsila Finland Oy	13	H42
Koja Marine Oy	25	H20	Zvezdochka Plant	47	H43
Kinon Aachen GmbH	22/23	H21			
Lloyd's Register	OBC	H22			
MARIN	78	-			



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for Defence, Security and Safety

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Monday 4 September - Wednesday 6 September 2006

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