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Russia's shipbuilding industries are continuing their steady progress and expanding their international activities, while particular emphasis is being placed on ships to support booming domestic oil exports from fields in the Arctic, Far East, and Caspian areas. In a different sector, one of a number of interesting recent Russian designs is this refrigerated cargo ship from Zelenodolsk Design Bureau. More information can be found in our special Russia feature, which begins on page 25.

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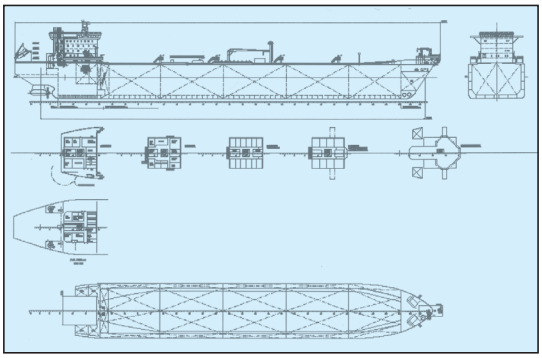
Oil, gas, and minerals spur Russia's marine industries

AFTER several years of low-key operations, Russian shipyards are emerging even further into the real world of commercial shipbuilding. We reported in September 2002 on that fascinating and diverse country's aspirations and achievements, and following a further June visit to the maritime and marine capital St Petersburg, we can report that things have certainly moved on, most notably in development of oil and gas reserves in three strategic regions - the Sakhalin fields in the Far East, the Arctic, and the Caspian Sea region.

In recent months, important orders have been placed at Admiralty Shipyards for a quartet of 70,000dwt ice-strengthened tankers to run a shuttle service from the Pechora field to a floating storage and offloading terminal (a former VLCC) at Murmansk. We discussed various proposals for such ships in our September 2002 special feature. Admiralty is well placed to build such tonnage - this yard has already built five 20,000dwt Arctic tankers for Lukoil, and recently completed a series of 47,000dwt designs (not ice-strengthened) for another domestic owner.

Unfortunately, full details of the new ships are not yet available since the designs is still being finalised, but it is believed that they will employ the Aker Finnyards/ABB double-acting concept (at the time of writing, this had not been confirmed). Elsewhere in this issue we also report on the new Finnish-built double-acting icebreaker/offshore



Positive hope for a prosperous Arctic future: preliminary general arrangement plans of the 70,000dwt tankers recently ordered at Admiralty Shipyards. This particular proposal was made by Aker Arctic Technology and employs that company's double-acting principle.

support ship *Fesco Sakhalin*. This large and novel vessel was ordered by the Far East Shipping Co, designed to support the Orlan gravity platform in the Sakhalin region.

The Caspian area is of special interest; because of its land-locked status and often shallow waters, ships to operate here have to be carefully dimensioned to pass through the inlet and exit waterways. However, there is much activity taking place, aided by newly emerging Russian republics, such as Kazakhstan, eager to take part in developments and to order their own tanker fleets.

A number of Russian shipyards, notably Krasnoye Sormovo and Volgograd (both situated on the country's enormous river systems, and both members of the enterprising MNP group) are already active here - best illustrated by the *President Heydar Aliyev*, lead example of a large new tanker design (13,470dwt), which was completed last year (*Significant Ships of 2004*).

Like many such ships, she is also designed to trade into the Black Sea and elsewhere. Meanwhile, one of a number of new names now promoting themselves to a wider world, the Zelenodolsk Design Bureau, is hoping to be involved in plans to build a series of 150m-long tankers able to reach ports such as Genoa, in Italy, and elsewhere with Caspian oil products and chemicals. One of the three sites of another MNP group member, Astrakhan Shipyard, ideally situated on the Volga river delta, on the northern coast of the Caspian, is particularly earmarked for upgrading and expansion to meet planned new ship orders. It certainly seems likely that this part of the world will be making a greater impact on the marine scene.

Most of these projects are largely for domestic owners (although international oil companies are taking part in the oil exploration) but it is to the international market that many might raise more questioning eyebrows. What prospects does the current scene have for Russian yards? A number of companies, such as the Vympel consultancy, are keen to point out their already successful cooperation with Scandinavian and other European companies in various projects, and their willingness to cooperate further. Indeed, many leading Russians believe that this is the only way to ensure effective design and shipbuilding for their country in this high-speed electronic age.

In 2002, we noted that several Russian managements would have agreed that their productivity needed to be improved, and indeed, the number of commercial ships actually on order today is still not huge compared with the facilities available or when compared with other leading nations (eg, Baltiysky Zavod is building two modest-size icebreakers and two ro-pax ferry hulls). In fairness, it must be pointed out that several yards are also involved in domestic and export warship programmes.

At the same time, big efforts have been and are being planned to upgrade facilities; for example, a new steelworking shop is in operation at Baltiysky Zavod, with a capability of processing 60,000tonnes annually. Alongside this, some naval architectural consultancies (Vympel and Zelenodolsk) now using the latest versions of Tribon integrated software. Up in the north, Sevmash (formerly a submarine builder) will employ its Foran package, plus new extensions, to assist with its very brave decision to build that most tricky and complex of ship types - large chemical tankers, for the major Norwegian operator Odfjell. Stainless-steel cargo-tank designs have been the downfall of other much more modest yards in western Europe in recent years.

One organisation that has been making interesting waves on both the international and domestic scene is the Russian Maritime Register of Shipping. This class society, with its fine 18th century headquarters on the banks of the river Neva, in St Petersburg, is currently involved in several cutting-edge projects, including the Rosmorport new-generation icebreakers for the Gulf of Finland (under construction at Baltiysky Zavod), the planned new 70,000dwt Arctic shuttle tankers at Admiralty Shipyards, and the prototype Arctic double-acting cargo ship on order at Aker Finnyards for Norilsk Nickel. Very recently, the society has also signed an important cooperation agreement with the Norwegian society Det Norske Veritas; this involves dual-class arrangements for ships operating in cold-climate conditions.

There are still obstacles for Russia's shipbuilding and associated industries to overcome, including inevitable hangovers from the Soviet era and the fearsome Far East competition. Notwithstanding this, at least one shipyard (Baltiysky) and the internationally known Krylov Institute are already considering plans to design and build LNG tankers (for Arctic exports from the huge gas reserves there) – an indication of the status to which the country is aspiring.

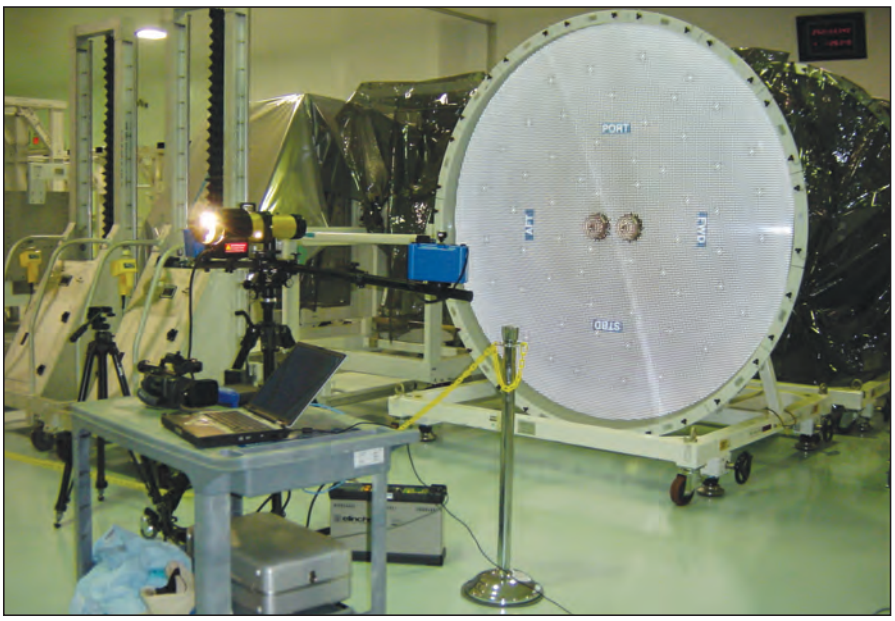
A special report on Russia's marine industries begins on page 25 of this issue.

New safe tanker design for Baltic and Black Sea shipping

STENA Bulk, creator of the innovative V-Max, C-Max, and P-Max tankers, is currently working on a new so-called B-Max design, in conjunction with the Russian owner Sovcomflot. This 229m vessel will have an extra wide beam of 66.50m, a deadweight of 195,000dwt-200,000dwt on a scantling of 15.40m for Baltic operations, or alternatively a deadweight of 240,000dwt-250,000dwt on an 18.00m scantling draught, for operation in the Black Sea. Like the earlier Max classes, this double-hull design will have twin-skeg redundant propulsion, high manoeuvrability, and will be constructed to ice class 1A (or higher).

The B-Max designed for the Black Sea should ensure 60% more cargo than a typical Suezmax-type tanker, and 120% more cargo than an Aframax tanker. In the Baltic Sea the design allows 67% more cargo than a Suezmax, and 82% more cargo than an Aframax. The ship will be able to discharge at the majority of Suezmax ports, and all VLCC ports.

Meanwhile, Brodosplit Shipyard, in Croatia, is set to deliver the prototype 54,000dwt P-Max tanker, *Stena Paris*, this year, with five more to follow up until 2008. More details can be found in our Croatia report, which will be published in September.



This interesting piece of equipment forms part of a new cutting-edge measuring system for shipbuilders and other involved in the fabrication of large structures. It is the satellite antenna used in the Inca3 photogrammetric camera and V-Stars software from Geodetic Systems Inc to form a third-generation package for capturing measurements under difficult conditions. More details can be found in our special feature on Shipbuilding Technology, which begins on page 8.

LNG SAFETY CENTRE ESTABLISHED - The US arm of DNV has set up a Waterway Suitability Assessment (WSA) centre of excellence in Houston, Texas. The intention of this unit is to assist owners and operators of LNG marine terminals in safety and security guidance. The centre will provide the marine LNG industry with a turnkey approach to the WSA submittal process. A number of new terminals are expected to be built in the USA.

In June this year, the US Coast Guard issued Navigation and Vessel Inspection Circular - Guidance on Assessing the Suitability of a Waterway for Marine Traffic (NVIC 05-05). Developed to meet the urgent needs for national safety and security guidance on assessing the suitability of waterways for LNG marine traffic, NVIC 05-05 requires an approved WSA for each marine shoreside LNG terminal prior to its construction.

NVIC 05-05 also requires each marine LNG terminal to analyse a multitude of elements from a LNG tanker's entrance into US territorial waters, through its transit to and from the marine terminal - including operations at the vessel/facility interface.

The new centre will guide owner and operator through the process while communicating with local, state, and federal stakeholders. From developing and submitting the letter of intent and preliminary WSA, to tendering a completed suitability assessment to the federal maritime security coordinator, DNV will ensure all WSA elements are thoroughly considered and addressed.

ABB TO INVEST MORE IN PODS - As part of expansion of its marine business, ABB has begun building new office and production facilities in Helsinki, Finland. All the company's electric propulsion business, including pods, will be concentrated in these new facilities, which are located in the Vuosaari port area. Current facilities are located in the Vuosaari shipyard area.

The new offices and production facilities will house 200 employees, and is expected to be complete in 2007. This development is expected to assist in increasing production capacity.

HVAC OPERATION PURCHASED - The Callenberg Group AB has signed an agreement with ABB Automation Technologies AB concerning the acquisition of ABB's Gothenburg-based marine ventilation operation. The agreement came into effect in June.

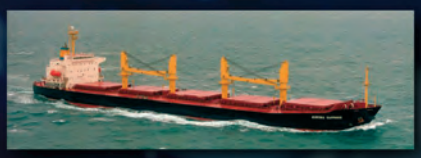
The Callenberg Group AB is wholly owned by the Swedish private equity company Segulah. The Swedish-based part of the Callenberg Group consists of the business units Callenberg Engineering, Andersson & Callenberg, and El-Marine. There are subsidiaries in Denmark, Norway, the USA, Singapore, and China.

The group manufactures electrical, automation, and HVAC systems for the offshore and marine industries. In conjunction with the acquisition, a new company, Callenberg Fläkt Marine AB, has been established as a wholly-owned subsidiary of the Callenberg Group.

COMMON RULE CONCLUSIONS - In June this year, chief executive officers of the members of IACS met in Paris to discuss the progress of IACS common rule developments for oil tankers and bulk carriers. The following was eventually agreed:

- the implementation date of common rules will take place for all members on April 1 2006
- adoption of the rules will be the property of each individual member of IACS
- certain harmonisation work has been specified and will be completed before adoption, and other work will be undertaken after adoption. Details of this work will be stated to the industry before adoption of both sets of rules
- cost arrangements are no longer an issue between IACS members.

US/CANADIAN CONSULTING LINK - Oceanic Consulting Corp, from Canada, and Chesapeake Marine Technology, based in the USA, have joined forces to provide testing and consulting services. This union will make it easier for USA-based customers to access a 199m and a 57.9m towing tank, located in St Johns, Newfoundland, as well as an offshore engineering basin, an 89.9m ice tank, a cavitation tunnel, a 21.9m flume tank, and a simulation centre. This suite of facilities is also supported by numerical simulation capacity.



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Conceiving next-generation ice-going ships at AARC

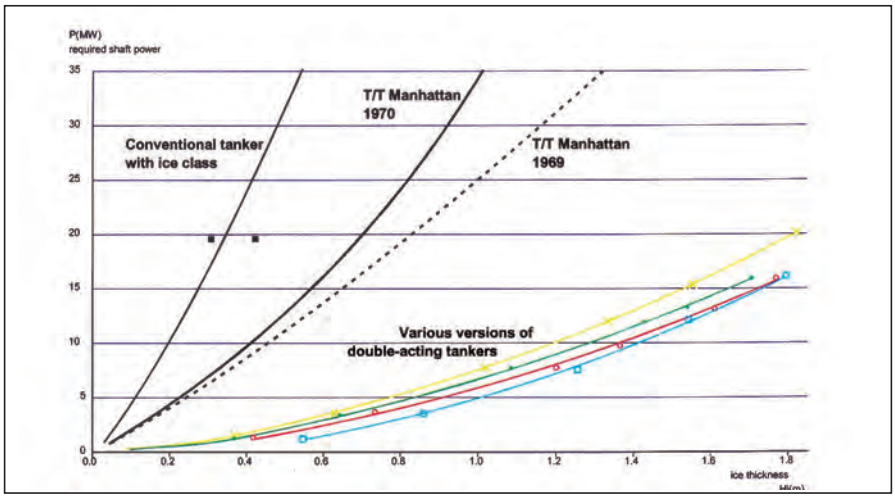
PIONEERING work in the field of ice navigation by Aker Arctic Technology (formerly known as Masa-Yards Arctic Research Centre - MARC) is storming ahead as worldwide excitement in natural resources hidden under Polar ice, both on- and offshore, intensifies. Some of this is the result of concerns over the limited volume of Russian oil that can be shipped through the Bosporus and out of the Baltic terminal of Primorsk; however, other interest is being shown once again in the Canadian Arctic.

Activities at AARC, as it is colloquially known, will further improved early next year when a brand-new headquarters at Vuosaari, outside Helsinki, with a new, wider model tank, comes into operation (*The Naval Architect* February 2005, page 28). Under new arrangements, the facility has also been separated from the Aker group's shipbuilding activities, so that it will be freer to offer its special services to yards and owners worldwide - if necessary, in association with its cooperation partners, Helsinki University of Technology, VTT Technical Research Centre, and the Krylov Shipbuilding Research Institute, at St Petersburg, Russia. It is perhaps a measure of interest in the Arctic today that several companies, above those already with shares in AARC, wanted to join (shareholders already include both ABB and Wärtsilä).

Over recent years, much work has been carried out for leading oil and shipping companies, also for the US Coast Guard, and a number of pivotal technologies have been conceived here - icebreakers with bow propellers, air-bubbling systems to reduce friction, stainless-steel icebelts, the double-acting icebreaking principle, and the oblique icebreaker hull.

AARC has built up a large database of some 300 model and full-scale ice tests, particularly regarding ice ridges (level ice is not generally so much a problem for ship design) and ice movement. One of the most exciting current projects involves the design of two 70,000dwt Arctic tankers to be built at Admiralty Shipyards in Russia (first reported in this journal in September 2002, page 31). AARC naval architects and engineers assisted with a proposed outline concept, and at the time of writing negotiations were under way for drawing up the whole design and class details.

Other AARC projects that are currently attracting great interest include ice-classed LNG carriers, FPSOs for areas such as the Sakhalin fields, research ships, and oil-spill recovery ships. The centre is additionally drawing up a series of standard designs, and it is hoped to have the first ready this year.



Interesting graphs from Aker Artic Technology showing ice performance of tankers in the 80,000dwt-100,000dwt class, operating in level ice at a continuous speed of 2knots. Those lines representing the much lower power needed for ships featuring the double-acting concept are particularly notable. *Manhattan* was a 100,000dwt tanker retrofitted in 1969 with a special bow for experimental voyages into the US/Canadian Arctic.

Modern materials and processes for shipbuilding

George Bruce analyses some of the newest progress on steel processing and assembly, and discusses a new grade of tanker steel from Japan.

The brand-new Inca3 camera developed for Geodetic Systems as part of its V-Stars photogrammetry measurement system. This is ideal for measuring large steel sections such as built in shipyards.

ALMOST all commercial ships are built of steel, and have been for many decades. Steels are well-understood, relatively easy to process, and inexpensive compared with alternatives. Aluminium may be used for smaller vessels where high speed (and therefore light weight is important), and has found some applications in superstructures. Fibre-reinforced composites are also used or smaller vessels. More exotic materials also find occasional, specialist applications. However, steel is considered the 'ideal' low cost structural material for most ships.

In order to obtain lightweight structures, novel material combinations have been developed, including a variety of sandwich panel structures. These include the innovative sandwich panel system (SPS) from Intelligent Engineering (*The Naval Architect* July/August 2004, page 9 and September 2004, page 124), principally designed for large-scale major components and for repair work, and Lascor panels, used in cruise ships. But for most commercial ships, steel remains the only real alternative.

Despite the long-term use of steel, it is not without problems as a ship structural material. Since the adoption of thermal processes, primarily cutting and welding, to achieve high productivity, distortion has been a major issue. The problems caused by distortion are often curable, but only at a cost in time and labour.

Distortion is generally accepted as having three components, these being:

- residual stresses from the steel mill production processes and possibly from transport, handling, and storage
- heat-induced distortion during shipyard operations, which are compounded by residual stresses
- failure to maintain the correct procedures in the shipyard, mainly controlling heat input through correct procedures and careful handling during preparation and assembly.

Thermal distortion particularly affects thinner steel plate, generally accepted as being less than 8mm, but the effects can also be serious for thicker material. In this case, distortion is much more difficult to correct. Management of the processes, especially where ships are produced in series and where the production process can be carefully designed and managed, is a partial solution. When used with carefully applied corrective action, good quality structures can be achieved. Nevertheless, there is a cost associated with creating accurate ship structures in steel.

Once the steel has been assembled into ship structures, and sometimes before the ship is complete, the problem of corrosion appears. Unless the steel is carefully protected throughout the production process and then through the life of the ship, corrosion is inevitable. Coating the steel is a solution where practicable, but various aspects of operations can damage the coating, and in some areas coating is not feasible.

Mechanical damage in cargo operations, aggressive cargoes, and environmental conditions, along with stress-induced cracking, all contribute to deterioration of the coatings and hence of the steel in the ship structure.

New developments in processes and materials

There have been some recent developments, both in steel materials and in the processes used in shipbuilding. These have the potential to manage some of the problems caused by corrosion and distortion. An important part of the overall process of creating the steel structures is the accurate measurement of parts and assemblies during production. This makes it easier either to correct thermally-induced distortion or to better manage the problem when it does occur. Some new processes offer potential for minimising distortion, by reducing the heat input to the steel.

Managing residual stresses

Bender Shipbuilding & Repair Co Inc, based in the USA, is routinely using (as do some other leading yards, such as Mitsui, in Japan) laser cutting as a process which does minimise heat input. This is specifically to deal with the problems of distortion in thermally-cut, thin steel plate. During its development of the use of lasers, Bender has identified problems with distortion due to residual stresses.

When steel plates cool after the manufacturing process at the steel mill, thermal stresses are retained as residual stress. This inherent stress causes the plate to move during the thermal (laser) cutting process, which misaligns the plate from the numerically controlled tool cut-path. Bender had been using external mechanical restraints and varying cut path sequences for controlling the movement of plates during the cutting operation; however, neither of these methods proved to be consistently successful.

Bender now claims to have improved control of thermal (laser) cutting operations for steel plates through correlation of known plate stresses and monitoring of plate movement to produce more accurately cut parts. Tool cut-paths are compensated, based on the correlation of plate stresses and plate movements to eliminate the need for micro-tabs on the material to be cut away.

Bender was innovative in developing a new process for controlling residual stress movement by placing micro-tabs - thin sections of uncut material that arrest movement, in discrete locations - along cut paths. The micro-tabs placement process has reduced monitored plate movements that occur during cutting operations. As a result, micro-tabs are also used to retain plate cut-outs through the panel line to the assembly stage. Residual stress maps in each plate can be determined using a laser interferometer (an advanced portable instrument that works on a proprietary technology).

An advanced process under development by Bender attempts to couple known thermal manufacturing parameters with measured residual stress characteristics in each plate and correlate them to monitored plate movements. This correlation during cutting will determine

the appropriate compensation for tool cut-paths. Further benefits will be evident through the correlation of coupled plate stress characteristics and compensated tool cut-paths for plate responses during thermal (laser) cutting. More accurate part dimensions will result from improved control of cutting operations.

Measuring structures

Accurate measurement of the steel at various stages of processing is critical to improvements in the final assemblies. Non-contact processes which do not interfere with production operations by introducing delays are essential.

Photogrammetry has been used for many years, but the advent of the digital camera has transformed the process. V-Stars, from Geodetic Systems Inc, is one example of the technology, suitable for large structures, such as ship sections, that can determine 3D coordinates (XYZ) from digital images. Typically, pictures are taken from two or more locations using a very precise digital camera such as GSI's new Inca3. The photographs are then automatically processed using the powerful V-Stars software to produce the 3D coordinates of the measured object. The 3D coordinates can be visualised and analysed using either V-STARS software or a third-party software.

The points to be measured can be either physically targeted (stick on targets, tooling targets) or projected dots (via the company's Pro-Spot projector) or probed (hand-held probes).

The process can be used in two different configurations:

- V-STARS/S or V-STARS/E, using a single camera
- V-STARS/M, using 2 or more cameras.

V-STARS claims to be the most accurate and the most capable 3D measurement system using digital photogrammetry. Accuracy to within 5mm with a single camera is stated to have been obtained. An important consideration is set-up time, and this is claimed to minimal. There is no warm-up time and fast data acquisition is guaranteed.

Digital photogrammetry is said to offer several advantages for accurate measurement in a shipyard environment. These include the ability to take pictures in unstable environments, which may, for example, be subject to vibration and temperature changes. There are also no size restrictions of the object to be measured.

The systems are suitable for repeat measurements or for periodic inspection. They are also very suitable where there are large numbers of points to be measured. The ability to measure thousands of points simultaneously, in a short time is said to be an important production consideration. The V-STARS systems are said to be both rugged and portable so they can easily be carried to a work environment.

Waterjet cutting benefits

The use of waterjetting for hull cleaning, and ultra-high pressure water for surface preparation of ships under repair is well-established. Another potential application of water is to use even higher pressure for material cutting.

Waterjet cutting is claimed to have many advantages over conventional cutting methods.

One of Sumitomo Metal Industries' new Smicore corrosion-resistant steel plates, specially developed for cargo spaces in tankers and first used in the 105,000dwt *Nan Fung* (published by permission of Lloyd's Register of Shipping).

These include the fact it is a cold-cutting process, and so there is no heat distortion, edge-hardening or heat-affected zones. This eliminates the distortion problems which have been mentioned earlier.

Water is a clean cutting process with no contamination, which might be found in thermal processes. There is no restriction on the hole sizes which can be made, allowing precision work. Although slower than many thermal processes, the elimination of thermal effects is claimed to make the use of waterjetting both fast and cost-effective in overall terms.

With only 2mm spacing between nested parts, there is excellent material utilisation. The cut width is only 1.2mm, which also contributes to the minimisation of material losses. Another result is that this is a very high accuracy process, which gives clear benefits during the later assembly of structures from the cut parts. The clean-cut edge which is obtained is also claimed to reduce or eliminate any secondary edge cleaning operations.

All the advantages of numerical cutting equipment are also found, in that there are no tooling costs (apart from programming), complex shapes can be cut and there is a single set-up. Speed of cutting varies with thickness. Control Waterjet Cutting, a specialist in this field, gave some examples. Aluminium of 10mm thickness is said to be cut at 500mm/min, whereas steel of the same thickness is cut at a rate of 150mm/min.

The process is stated to be capable of cutting a wide range of materials. Aluminium up to 250mm thick can be cut, and the maximum thickness in steel (which may be stainless steel, mild steel or tool steel) is up to 60mm. An advantage over some other processes is the ability to cut brass, copper, and many reflective materials, including those with special surface finishes and polishes. For some applications, specialist materials which can be cut include titanium, inconel, graphite, glass, laminates, foam, rubber and a wide range of plastics.

Control Waterjet Cutting claims to be one of the longest established subcontract waterjet cutting companies in the UK, serving a wide range of customers. This company has equipment which has the ability to cut plates up to 4m x 3m. The cutting machine is CNC-controlled and there is a 2tonne lifting capacity. Cutting on this scale indicates that the process has potential for shipyard applications, and the company says that it is currently cutting parts for a small vessel in aluminium.

Novel steel types

Turning to the corrosion issue, Sumitomo Metal Industries Ltd has developed a steel (reported in the June 2005 issue of Lloyd's Register's technical journal *Horizons*) which claims improved corrosion-resistance properties. This could both reduce the risk of cargo tank failure due to corrosion and reduce newbuilding costs for tankers.

The deckheads and bottom plating of cargo tanks do suffer from corrosion, so SMI has invested in research and development to find solutions. The outcome is several new steels for shipbuilding which could benefit both shipyards and owners.

According to Hideo Okuda, vice president of the Steel Sheet, Plate, Titanium & Structural Co at Sumitomo, the steel was developed to help reduce the life-cycle cost of oil tankers by eliminating the need to coat cargo tanks. Smicore is a thermo-mechanically controlled rolled steel with special alloy additions. It can be used without being coated and therefore offers savings over traditional steels that may require the high cost of a corrosion-resistant coating.

The steel was recently approved by Lloyd's Register for use in the No 2 and 3 cargo tanks of a 105,000dwt double-hull oil tanker *Nan Fung* built at Yokosuka by Sumitomo Heavy Industries Marine & Engineering. The vessel, which is being built to Lloyd's Register class, will be chartered to Sanko Steamship, of Japan, upon delivery in August this year.

As part of the approval process, Lloyd's Register reviewed SMI's research methodology to verify that the controlled laboratory conditions used in the research replicated those inside a laden cargo tank and from this, acknowledged that results produced the improvements claimed. Lloyd's Register also initiated a separate test programme for SMI to successfully show that welding had no effect on the corrosion results already seen. It was also confirmed that the mechanical properties and weldability of the new steel are suitable for standard ship construction techniques and designs.

'We intend to place the steel on a number of 'pilot' ships in the near future and will then begin to approach tanker owners and shipyards to encourage its adoption,' says Mr Okuda. Future development work from SMI also includes elucidating the mechanism by which the alloy additions improve the steel's ability to resist corrosion.

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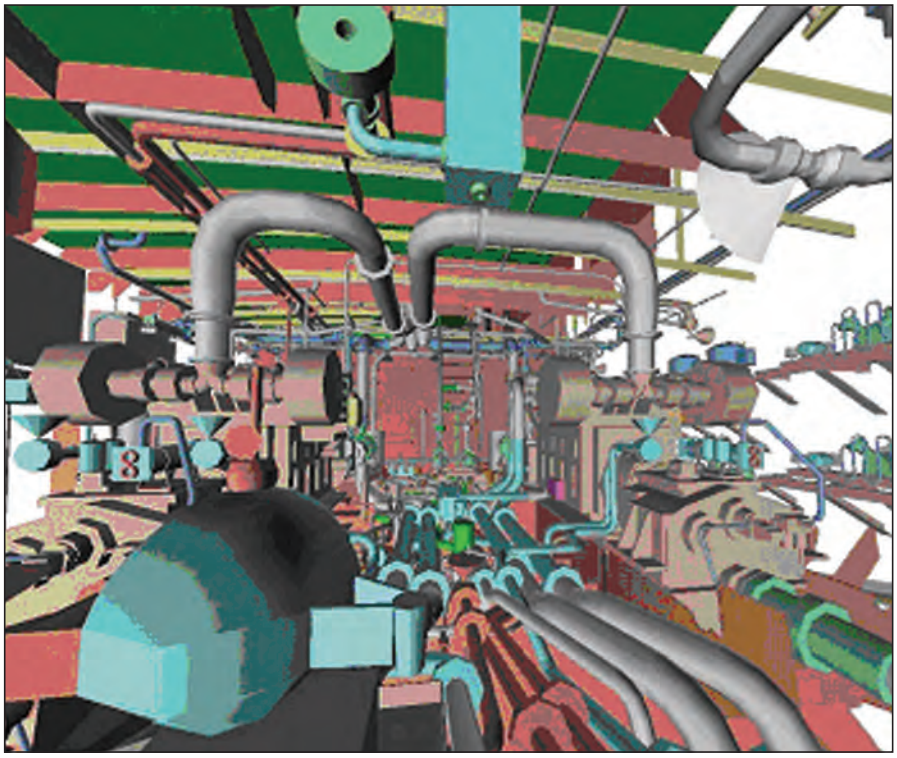
Improving shipyard efficiency with computer and IT application

The 4th International Conference on Computer and IT Applications in the Maritime Industries (COMPIT)* was held recently in Hamburg. COMPIT discusses advanced IT through-life support from initial design, production, and ship operation to IT support in emergencies. A total of 59 participants from 15 nations heard 50 papers on several themes. George Bruce attended the event for *The Naval Architect* and reports on some of the activities.



3D product data models form the base for simulations and virtual-reality applications in modern CAD software (from the SENER paper).

AN interesting aspect of COMPIT is the use of IT tools across different marine disciplines, one of these being simulation in shipyards and ports. Both port operation and ship production can be viewed as sets of discrete events to be optimised. In the past, common problem structures were not fully realised so port and ship production simulations developed in parallel. COMPIT brought specialists in both fields together for mutual benefit.

Simulation can be used for strategic planning (eg, to build or improve transport infrastructure) and for operational planning (to improve resource use). The leading German shipbuilder Flensburger Schiffbau-Gesellschaft (FSG) has been one pioneer in yard simulation using the commercial software eM-Plant. FSG continues to lead, as presented in the paper 'SAPP - simulation-aided production planning - at Flensburger' by Dirk Steinhauer. Others using eM-Plant for customers include Sofie Bernaert *et al* (TU Delft) who described in 'Simulation of production in a shipyard's machining centre', modelling a workshop in the Dutch shipyard IHC Beaver Dredgers, and Frederic Bair *et al*, of the University of Liège, in 'Modelling, simulation and optimisation of a shipbuilding workshop', discussing cooperation with Chantiers de l'Atlantique.

Intelligent operations-planning is a cost-effective way to increase port capacities, where decisions are often based on incomplete data from the port and shipowners. Martijn Schut, from the Free University of Amsterdam, discussed simulation to support planning in 'Distributed ship scheduling with partially known time windows'. Lawrence Henesey, of Blekinge Institute of Technology in Sweden, in his paper 'A multi-agent-based simulator for managing a container terminal', described agents (effectively numerous small expert systems) to support port planning in Europe and India.

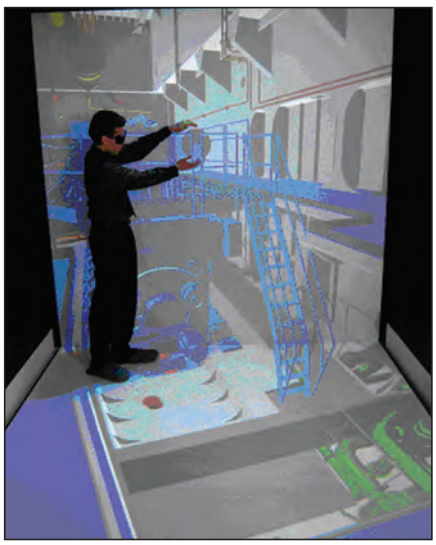
Naval architecture aspects

Information technology (IT) takes the ship from initial design to production, with decisions increasingly based on simulation rather than experience. Best practice intelligently blends experience with modern tools.

COMPIT included presentations of the latest developments in maritime software, with the challenge of supplying flexibility without increasing complexity for the user. Several developers see parametric design as a promising approach to solve this apparent contradiction. In parametric design, standard solutions are varied by controlling a few parameters, with flexibility through user-defined macros. Marcus Bole, from the UK company Graphics Research Corp, presented in 'Integrating parametric hull generation into early stage design', one such application for the initial design of ship hull shapes, combining parametric design with curve definition in IntelliHull software.

Switching design tools between initial and detailed design has required repeating previous design work to obtain data in the required format, and progress in supplier response was reported at COMPIT. Hans-Günther Mütze *et al* (from AVEVA) presented integration of basic and detail design within the Tribon suite in 'New developments in early design support', and Iñigo Gurrea and Carlos González (from the Spanish company Sener) presented similar developments within Foran in 'Trends in hull structure design - a practical approach: from initial to detailed design, tools for the design process'.

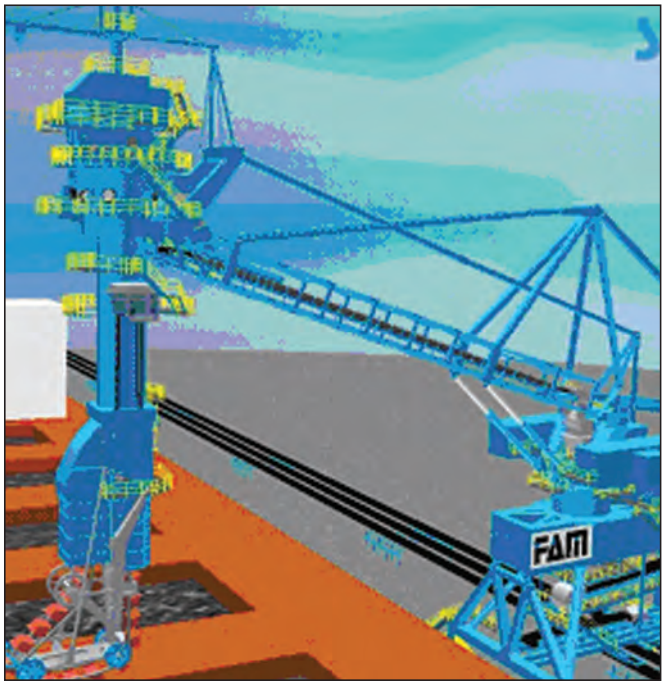
Universities and small enterprises showed interest in 'The potential of free software for ship design', by Bastiaan Veelo, who listed



Virtual reality allows shipbuilders and others to inspect a ship already in the design stage (from a paper presented by Technical University of Hamburg-Harburg).

* Pdf files of the papers from COMPIT can be downloaded from www.ssi.tu-harburg.de/compit/papers.html

The same software that helped in planning Hamburg's new container terminal, CTA, is used by many shipyards for production planning.



Virtual reality improves understanding of complex systems, such as cargo handling in port (IFF paper).

available (and sophisticated) free software, including CAD systems, CFD tools and mathematical software. The trend towards distributed web-based work was also included. Integration and interfaces were common themes in several papers. Leo C van Ruijven, of Croon TBI Techniek, presented an interesting holistic approach in 'A data-driven integrated knowledge framework for the total ship life cycle'. B Bongiorni *et al* described, in 'An integrated design environment for the navy using an agent model of marine design', the US Navy approach to integrated simulation-based ship design, supporting concurrent engineering with distributed partners and heterogeneous software via the internet.

Optimising ship design

Ship design optimisation is a constant theme, and both optimisation algorithms and the sophistication of such design models improve continually. Evolutionary algorithms, mimicking natural processes, are now the preferred option. They are robust, find the global optimum, and adapt easily to parallel computer architectures.

Genetic algorithms have been adopted by naval architects as almost a standard in some applications. Within the next decade they may well be out-performed by robust but more efficient swarm algorithms. These mimic strategies of swarming animals (fish or bees), as Antonio Pinto and Emilio Campana, from the Italian ship model basin INSEAN, showed in 'A multi-swarm algorithm for multi-objective ship design problems'.

Virtual reality allows shipbuilders and others to inspect a ship already in the design stage (from a paper presented by TUHH), and 3D product data models form the base for simulations and virtual-reality applications in modern CAD software (from the SENER paper).

Improving ship operation

Ship operation is increasingly IT-based, and Martha Grabowski (Le Moyne College, USA) gave a keynote lecture surveying 'Impacts of next-generation intelligent ship navigation'. The paper focussed on recent and future implementations on the St Lawrence Seaway.

Most maritime accidents are caused by human error, with information exchange a critical factor. Zbigniew Pietrzykowski *et al*, from of the Maritime University of Szczecin, described a proposal of a ship's cooperation and communication system, based on the Marine Information Meta Language (MIML). The prototype system automatically exchanges information between ships and shore-based traffic centres, especially on intended manoeuvres. Olle Blomberg *et al* pointed out pitfalls of current developments in 'AIS and the loss of public in-formation'. Automated information exchange can lead to loss of information and consequent wrong decisions.

Increased IT in ship operation also challenges classification societies, through increased complexity of software systems and the rapid development of new generations of products. Duncan Gould, from Lloyd's Register, presented an 'Overview of the assessment process for software within the marine sector'.

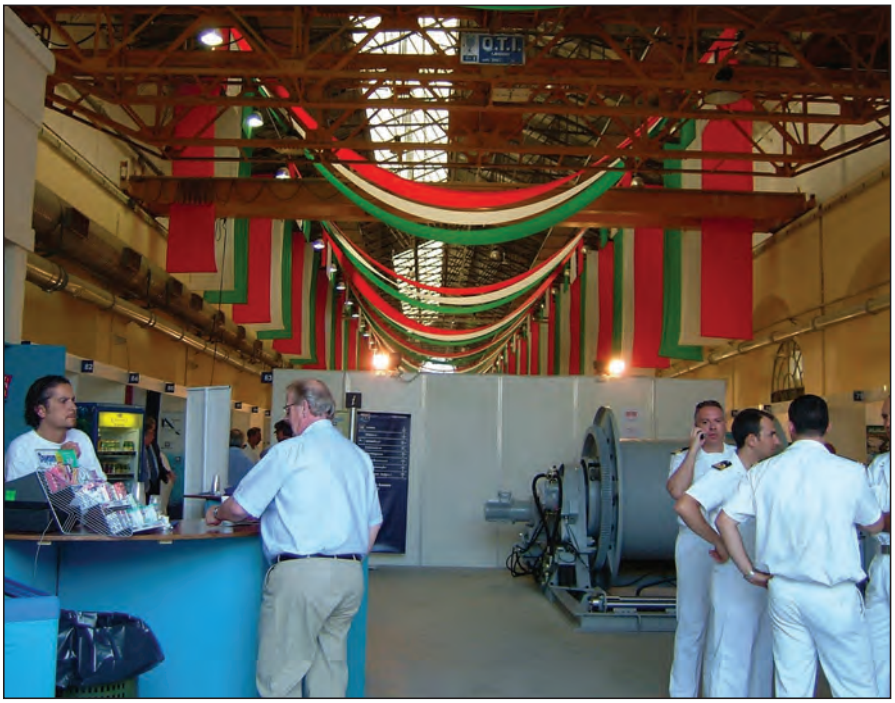
The 'life cycle' approach integrates ship design and operation. Ship operation uses design data and simulations for everyday operations and in emergencies. An example of commercial software to improve ship safety is Germanischer Lloyd's 'Decision support for container ship operation in heavy seas - shipboard routing assistance', presented by Helge Rathje and Christian Beiersdorf.

Local seaway data measured by onboard radar, with a database of seakeeping simulations for a ship, can identify critical combinations of speed and heading. The SRA system is installed on some large container ships with apparently ready acceptance by ship owners and crews. David Jaramillo and Henning Schier, again of Germanischer Lloyd, showed in 'XML-based data exchange for emergency response' how XML as standard language allows people to exchange data between ship and shore automatically to support advanced simulations in emergency response centres, saving time and reducing errors.

The next COMPIT conference will be held on May 8-11 2006 in Leiden, The Netherlands (www.3ME.TUDelft.nl/COMPIT06). Venues in Budapest (Hungary) and in Tuscany (Italy) are under discussion for 2007.

SMART international workshop, 2005

SMART 2005, held on June 23-24 in La Spezia Naval Arsenal, Italy, was the third in a series of bi-annual workshops of pre-arranged meetings between various enterprises in the shipbuilding and marine sector, on a 'business to business' (B2B) basis. It should be emphasised that SMART (Ship Manufacture Alliance Research and Technologies) is not a fair. Eric Tupper attended the event for *The Naval Architect*.



A general view of part of the SMART event held during June in La Spezia, Italy.

AMONGST the 200 mainly EU-based firms attending, Italy was well represented and, naturally, organisations from La Spezia had a strong presence. Manufacturers covered a broad spectrum of activities in support of shipbuilding and the small craft industry. Although many were modest companies, they had created a market for themselves often by specialising in a small range of products, or services, which they could provide efficiently at reasonable cost with a good record of reliability. For instance, **Gdansk Engineering Works** produces amongst other items, propeller nozzles in steel, including stainless steel, thruster tunnels, rudders, and offshore crane jibs. Large shipyards can produce these themselves but often find it more economic to buy in from a specialist provider.

Again, by specialising, firms have been able to develop new products, or new uses for older ones. One of the companies based in La Spezia, **Euroguarco SpA**, produces special, very light insulating material, Soliboard, in the form of board and pre-shaped wrappings which is in use in more than 15 navies and is being supplied to Fincantieri for the new Italian Navy's aircraft carrier *Conte di Cavour*. The company also produces a lead/mineral fibre acoustic insulation sheet, which is non-combustible and able to meet the latest requirements for yacht machinery spaces. Soliboard products insulate over the range -185°C to +300°C, and the foam retains its flexibility even at cryogenic temperatures. They are said to be durable and fire-resistant and to emit virtually no smoke or toxic fumes. Their density is 6.4kg/dm^3.

Meeting new regulatory requirements

With so many companies present, it is not possible to give other than a snapshot of the products presented and this report can only provide a flavour of what was on offer.

Some changes are brought about by the increasingly severe requirements products must meet, many such demands being aimed at protecting the environment. Thus **Victor Marine**, from the UK, has developed the Victor MiniSep VM series of oily water separators to comply with IMO MEPC 107(49), which replaces IMO MEPC 60(33). The separators handle heavy fuel, diesel and emulsified oils, and other solid contaminants. They are fully typed-approved by classification societies worldwide.

The new regulation applies to all vessels over 400dwt with keels laid after January 1 2005. The separators achieve efficiency of less than 1ppm, and they can handle emulsion spikes of above 20,000ppm. Flow capacity ranges from 0.5m^3/h to 4.3m^3/h. Low waste production leads to reduced discharge costs. Victor Marine has an agreement with **Korting Hannover AG** for marketing ejectors. Korting also produces incinerators and waste treatment plant, as did several other firms present. Perhaps seperators are not the most exciting of subjects, but one demanding exacting technology and good design capability to provide acceptable answers.

Safety issues

Safety is another important issue these days. Several of the firms present produce firefighting equipment and alarm systems. **Eusebi Impianti Srl** supplies automatic fire fighting systems all over the world including to Russia as well as to a number of navies. **Microdata Due** is also involved in this field, developing and implementing electronic systems to provide sensors and data acquisition stations for fire and bilge water detection. The company also provides remote control feeders for cathodic protection.

ZF Italia Srl provided information on its range of transmission systems and propellers, both FP and CP types, for a range of vessels from small pleasure craft to large commercial ships. Propellers range from 300mm to 3810mm diameter.

Bridging the gap between designer and shipyard

As one would expect, many firms were marketing computer-based systems. One, **Cincom Monaco SAM** was offering to bridge the gap between the CAD system and manufacture. This concept has been used in many engineering fields; it takes information from the CAD system and seeks suppliers to provide equipment with suitable interfaces, acceptable delivery dates, and at competitive prices. Such a facility is already built into the more advanced CAD/CAM systems such as Foran but in some cases there is advantage in using a system specifically addressing this need. It has been used by some large organisations but is expected to be increasingly useful to smaller companies.

By adopting a modular approach, it will be possible to personalise products to meet individual customer needs (eg, in the luxury yacht field). In May, Cincom announced the release of Socrates 7.0* which captures the knowledge an expert uses to make informed decisions. This is then presented in an easy-to-understand, graphical, way so that non-technical personnel can use it.

Another specialist in the CAD/CAM field is the Dutch company **Mastership**, which was offering to bridge the same gap. Its software translates a concept design into production information and is fully integrated with the latest Autocad versions. It comprises three generators - for shape, parts, and NC. The shape generator defines and connects multiple surfaces, making it suitable for ship hulls, while the parts generator creates all parts for a hull and superstructure including internal structure.

Parts information is then converted by the NC generator into production information, nesting parts and providing control of all types of cutting machine. A shipbuilder may have to adjust to suit that yard's specific production

The Royal Institution of Naval Architects

Marine Heavy Transport & Lift

20 - 21 September 2005, RINA HQ, London

Second Notice

The need to lift and transport increasingly large and heavy components has led to the design of several "Heavy Lift" ships. These components can be anything from dockside cranes and oil platforms to damaged vessels or anything too big to be carried on a conventional cargo ship. The carriage of such large items presents a variety of problems that must be overcome by the Naval Architect. Each type of item presents a different selection of problems and requires a different solution.

This conference will bring together naval architects, operators, warranty surveyors and design engineers to examine the various issues and design solutions. The Royal Institution of Naval Architects invites papers on all aspects of Heavy Transport and Lift. Suggested topics are:

- Float over and float off; offshore discharge
- Stationkeeping, ballast control and stability
- Weather Routing
- Redundant propulsion
- Design criteria for short trip scenarios
- Extreme Cribbing loads.
- Risk management

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equipment. Mastership, already strong in The Netherlands, has expanded into most European countries and is trying to achieve worldwide sales. To assist new customers, the first project can be carried out in a Mastership centre.

Employing artificial intelligence

Two interesting applications of artificial intelligence techniques were being promoted at La Spezia. One company, **Artificial Intelligence 2001 Srl**, is developing automatic navigation and data recording - ANDRU (automatic navigation and data recording universal) - from an earlier AI-based system used in mine-countermeasures vessels. Essentially, the technique notes the features of the seabed, the pattern of tides and currents (eg, the way they vary with time and geographical location) to provide a database with which a captain can interact to decide more accurately where his ship is and what action he should take.

Inputs are obtained from a number of sensors and weighted according to experience. In effect, the system gives the best estimate based on inputs which are giving slightly different answers, and which may be subject to interference of some sort. Another firm, **Navaltec Management Group BV**, using techniques developed by NASA, is applying artificial intelligence to CAD. Rather than apply detailed rules, the system responds to desired changes expressed in more general terms. It includes applications using CFD techniques. In effect, this brings the possibility to develop more innovative designs to meet a given requirement. It takes a design up to the point where class approval can be sought and the specification for the ship written. The system is aimed at more specialised types of design, such as research vessels, rather than cargo ships.

On the afternoon of the second day there was a series of presentations covering innovation in shipbuilding and yacht and boat building. This will be reported on separately.

Software aids structural integrity

A NEW software package, FlawCheck, is a comprehensive integrity assessment tool for metal structures from BMT Fleet Technology Ltd, based in Canada. This tool was developed to support the implementation of integrity assurance and maintenance programmes.

The FlawCheck tool uses industry-accepted analytic techniques to consider measured or estimated load effects (force, moment, stress or pressure), estimate fatigue initiation and growth of flaws, and determine fracture potential for stable cracks or those growing by fatigue. The software streamlines the assessment process, provides easily-interpreted intermediate and final results, and documents the analysis procedure. It includes versions in MS Windows (95, 98, NT4.0, 2000, XP) environments. New features in version 4 of the program include a leak-before-break criteria, and CSA Z662 Appendix K assessment.

The software's Load Characterisation module can be used to evaluate time history data to develop spectra of load cycles and capture mean and peak load effects. The spectra may be used to assess cyclic load induced crack growth. The module may also be used to evaluate the relative severity of random amplitude load time history records (for example, from different events or different structural locations) in terms of a Fatigue Spectrum Severity Index. The Severity Index represents the number of constant amplitude load cycles promoting an equivalent amount of fatigue damage as a user-defined spectra. This is a useful means of ranking load history severity.

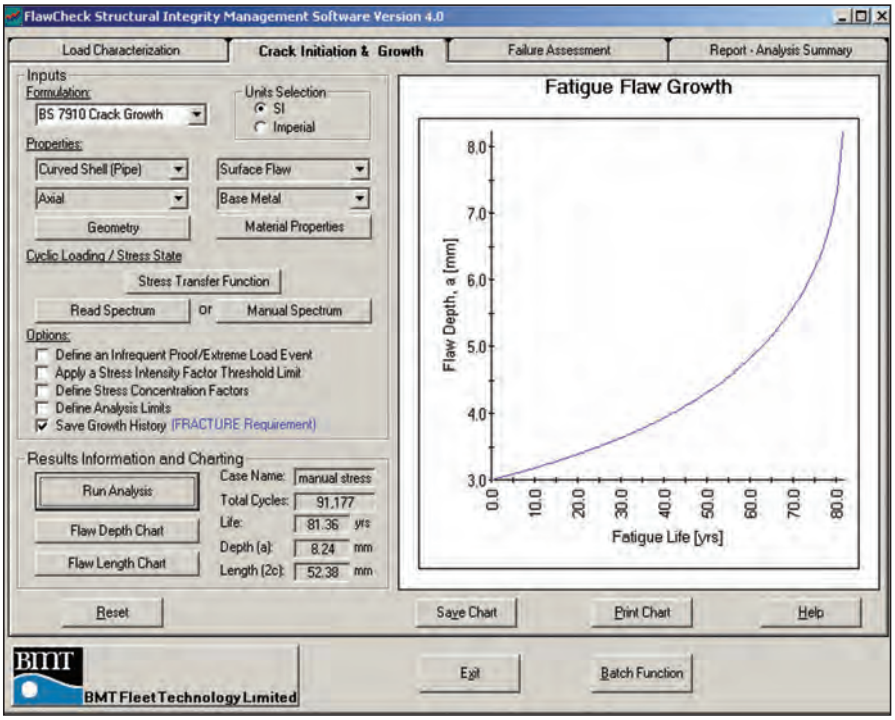
The Fatigue Analysis module includes linear elastic fracture mechanics procedures to evaluate the extension of surface, embedded, through thickness, and edge flaws in flat plate or curved shell sections. The crack growth calculations can incorporate a range of user-defined features. These include weld-toe stress concentration factor (SCF) estimation for propagating surface flaws and the inclusion of infrequent load events (for example, proof tests or one-in-10-year load events) not included in the cyclic load spectrum. The Fatigue Analysis module also incorporates procedures to undertake S-N based fatigue analysis incorporating Miner's summation and the ability to define virtually any S-N curve supplied by the user.

The fracture assessment incorporated into the Failure Assessment Module is based upon either the Failure Assessment Diagram (FAD) approach (considering fracture and plastic collapse for a variety of flaws and structural geometries) or the PRCI NG-18 surface flaw formulation for ductile line-pipe materials under internal pressure loading. Features of this module include the ability to assess the safety of a specific flaw; determine the time to fracture for fatigue crack propagation; and develop families of critical flaw geometries for a range of loading conditions.

The batching function allows the user to perform and document load characterisation, fatigue, and/or failure analyses for up to 200 scenarios with a single execution of the program. The reporting function creates a word processor ready document (*.rtf) containing analysis input data, results, charts, and title page information.

BMT Fleet Technology has recently completed projects using FlawCheck on a CNG/LNG storage containment system for damage-tolerance design for EnerSea Transport LLC, of Houston, Texas. FlawCheck was used to establish fabrication inspection limits defining flaws that would not grow by fatigue to a critical size and thus lead to structural integrity concerns through the service life of the vessel. The leak-before-break behaviour of hypothetical pressure containment vessel through wall cracks was investigated in support of damage mitigation reviews. Other applications include container ship fatigue crack growth analysis, and machinery failure investigations.

In addition, BMT has carried out extensive research into the effect of ballast water treatment systems on structural integrity, including de-oxygenation, chlorine, ozone, Peraclean, and SeaKleen.



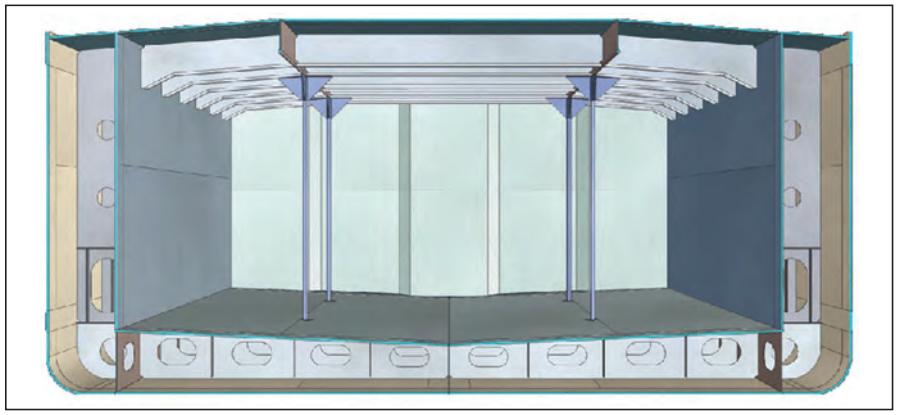
A screen display from the FlawCheck structural integrity management software.

Composite material chosen to construct Rhine inland tanker

UK-based Intelligent Engineering (IE) has received final approval from the river Rhine regulatory authorities for a new inland waterway chemical tanker design using its innovative SPS (sandwich plate system) technology. Working in cooperation with Germanischer Lloyd, chemical company (and IE partner) BASF, and Rhine shipowner and operator Jaegers, delivery of the first newbuilding (actually a new cargo mid-body joined to existing bow and stern sections) could be as soon as March 2006.

SPS is particularly suited for size-constrained inland waterway vessels. The composite material comprising two metal faceplates bonded by an elastomer core provides properties including in-built stiffness and resistance to impact, fire, fatigue, vibration, and explosion. Unlike conventional steel structures, SPS requires no secondary stiffeners, thus saving space and enabling the carriage of more cargo whilst also improving safety and reducing through-life operating and maintenance costs.

The need to upgrade the Rhine's fleet is driven in part by the imminent phase-out of single-hulled tankers and a requirement to raise the standards of vessels carrying hazardous cargoes on the busy waterway. SPS will provide a pioneering construction material for the double-hulled 110m-long Type-C chemical tanker, which will incorporate a hull, deck, and longitudinal bulkheads made from SPS to be spliced into the vessel's existing aft-end and bow sections.



Cross-section of a Type C chemical tanker fabricated using Intelligent Engineering's SPS composite technology.

The SPS section will not require stiffeners and will eliminate almost two-thirds of the usual weld requirement. Construction is said to be light, fast, simple, and safe and should require less protective coating. A 24-month series of tests to re-confirm the material's performance as compared with conventionally stiffened steel, carried out by Germanischer Lloyd and Technische Universität Hamburg-Harburg, is now more than half way through.

Germanischer Lloyd has been closely involved with the development of SPS over the last few years and has first-hand experience of SPS Overlay, which is also successfully used for large-scale structural strengthening, re-instatement, and repair projects (as detailed in our associate journal *Shiprepair and Conversion Technology*), in a project involving renewal of the inner bottom of a Rhine push-barge for owner Haniel. This class society has already approved the new chemical tanker design and will class the Jaegers vessel.

Another potential benefit offered by SPS is scope to use two different types of metal for the face plates. Stainless steel, for example, could be used on the aggressive chemical cargo tank side whilst conventional steel could be used over the ship's exterior, resulting in substantial materials cost savings.

Reliable welding of aluminium to steel

John G Banker, Dynamic Materials Corp, and Job Visser, from Merrem Materials, **discuss the problems for designers and shipbuilders in joining two dissimilar metals, and the technical solution to this difficulty.**

TODAY'S ship or offshore structure designer faces complex materials selection problems; he or she must simultaneously provide a sound structure, minimise topside weight, and protect against marine corrosion - all within a reasonable budget. Rarely does one single structural material adequately satisfy all of these requirements. The usual solution to this problem is to employ a variety of metals, each selected for appropriate properties for the specific component.

This creates a need for reliable structural joints between dissimilar metals. Most dissimilar metal combinations cannot be welded by traditional methods and are commonly joined mechanically by bolting or riveting. The combination of a crevice at the mechanical joint and galvanic potential differences between metals can result in accelerated corrosion in shipboard environments.

Aluminium and steel are commonly used in ship construction and present an excellent example of this problem. Aluminium offers light weight, good strength, marine corrosion resistance, and reasonable cost. It is often the metal of choice for superstructures, deckhouses, and upper deck structures. Steel has lower costs, a higher density, and a higher strength, making it the preferred choice for hulls and working decks. The interface between the aluminium and steel presents the classical example of a connection between non-weldable, galvanically dissimilar metals.

Dynamic Material Corp's (DMC) explosion-welded bi-metal transition joints provide a solution for shipyard fabrication of reliable aluminium-steel structures. The aluminium and steel components can then be welded to the respective surfaces of the transition joints in the shipyard using conventional fusion-welding processes. DMC's explosion-welded aluminium-steel transition joints have demonstrated good performance in shipboard environments for more than 35 years.

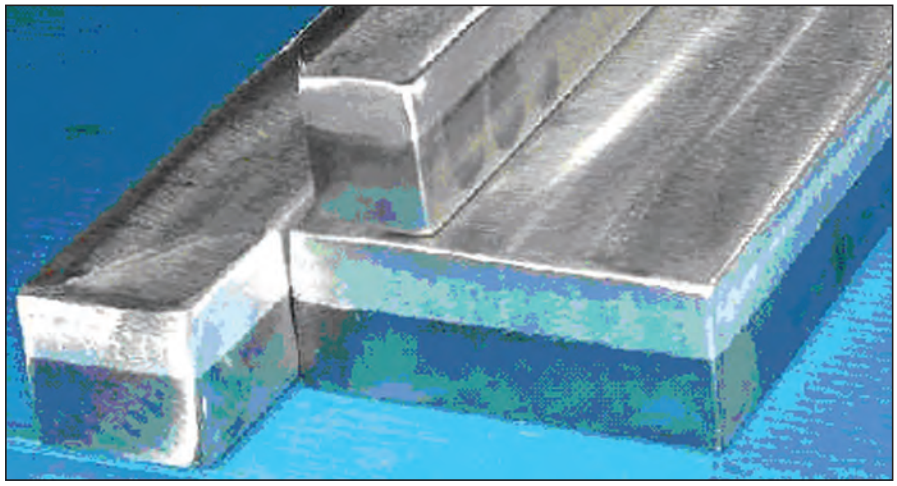


Fig 1. Typical aluminium-steel Triclad transition joint bars.

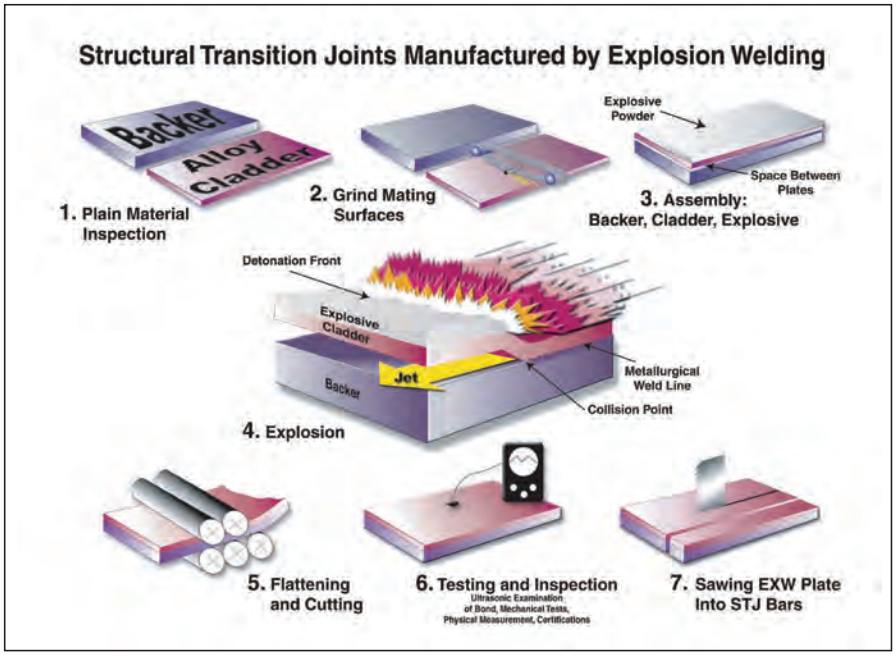


Fig 2. The manufacturing process for transition joint bars.

Solving the corrosion problem

The combination of a galvanically dissimilar 'couple', combined with a crevice, results in accelerated corrosion at bolted or riveted joints between aluminum and steel. The galvanic corrosion aspect can only be totally eliminated by complete electrical insulation of the metal components, a solution that is extremely difficult or impossible to achieve in most practical design situations. The bi-metallic transition joint eliminates the crevice. In the absence of the crevice, traditional corrosion control painting systems, combined with the self-passivating effect of corrosion products, provide reliable control of galvanic corrosion.

History of explosion-welded joints

In 1962, DuPont Detaclad patented the explosion-welding process (EXW) and in the subsequent years codified and mastered the robust industrial technology. In the latter 1960s, working with the US Navy, DuPont patented the Detacouple transition joint concept for making aluminium-steel welds in shipyard environments. During the development and qualification of the explosion-welding transition joints, DuPont and the US Navy conducted an extensive battery of tests. These included:

- multi-year corrosion testing in both the painted and unpainted conditions
- cyclic fatigue testing of superstructure panels
- laboratory fatigue testing exceeding 1,000,000 cycles
- shock testing and explosive bulge testing of welded assemblies
- traditional tensile, shear, and impact testing.

The product was determined to be suitable for use in naval ships and has been used on virtually all aluminium-steel US Navy ships built since 1970. During the subsequent 35 years it has gained acceptance as the solution for providing reliable, corrosion free aluminium-steel construction. Today, it is also used extensively on ferries, cruise ships, and offshore structure, as well as naval vessels.

During the same period, DuPont licensed the Detaclad technology to companies in Europe and Asia. Nobelclad in France and Nitro Metall, in Sweden, were two of the technology licensees. Nobelclad adopted the DuPont transition joint technology and distributed its Tri-clad shipbuilding transition joints worldwide. Today, the original DuPont Detaclad division and both

Nobelclad and Nitro Metall are divisions of DMC, the leading manufacturer of explosion-welded materials worldwide.

Detaclad technology

The Detaclad explosion cladding process uses the energy of an explosive detonation to create a metallurgical weld between metals (Ref 2). The process creates a high-strength, ductile, metallurgical weld over the entire surface. Although the explosion generates intense heat, there is insufficient time for the heat to conduct into the metals, thus no bulk heating or melting occurs. Consequently, reliable welds between highly dissimilar metals, such as aluminium-to-steel, can be achieved. Transition joints are typically produced from flat aluminum-steel clad plates by sawing or water jet cutting as shown in Fig 2.

A wavy bondzone is typical of explosion-welded products, produced in the highly reliable so-called 'sweet spot' of the explosion welding parameter range. DMC aluminium-steel transition joints today.

DMC manufactures a broad range of Detacouple products for bi-metal junctions in shipboard applications (Ref 3). Aluminium-steel transition joints are the workhorse of the DMC shipboard product line, and today, the company manufactures three 'standard' Detacouple products, including the original Triclad. All three products are produced using a three-layer explosion-weld system (Refs 4, 5):

- a top layer of aluminum alloy
- a bottom layer of steel or stainless steel
- an interlayer to enhance strength and ductility.

In addition to the three standard products, a considerable range of non-standard product thicknesses can be manufactured.

Specifications and properties

Detacouple products are manufactured for dual certification to a number of transition joint product specifications. These include Lloyd's Register and ABS specifications as well as DMC proprietary specifications. When needed, additional certification to US MIL-J-24445A can be provided. Factories are located in Sweden, France, and the USA.

These specifications all require a battery of mechanical tests to confirm reliable strength and toughness of the product. These include tensile testing of the product in the through-thickness dimension, as well as either a bond shear strength test or a side bend test. Testing is performed on specimens of the metal in the as-supplied condition and with a heat treatment of 15 minutes at 315ºC to simulate the effects of welding. Fig 3 presents typical properties of the DMC Detacouple products, and offers a comparison with other shipboard transition joints commonly available in the European marketplace.

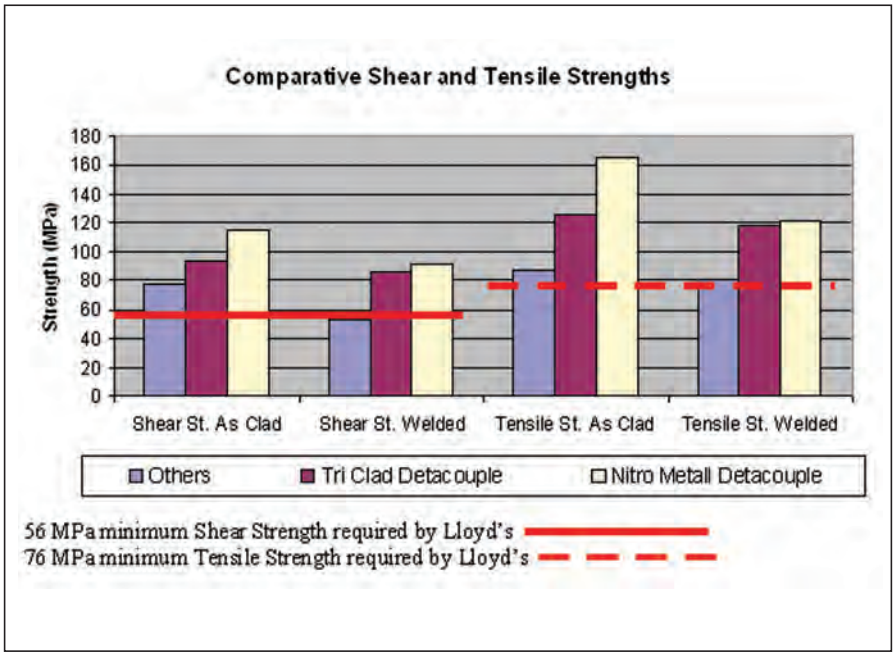


Fig 3. Strength data on typical aluminium-steel transition joint products.

	Triclad Detacouple	Nitro Metall Detacouple	Stainless steel Detacouple
Top layer	6.4mm alloy 5086	10mm alloy 5083	10mm alloy 3003
Interlayer	9.5mm unalloyed aluminum	3mm unalloyed aluminium	1.5mm titanium
Bottom layer	19 mm carbon steel	20 and 15mm carbon steel	20mm stainless steel

Table 1. Components of DMC transition joints.

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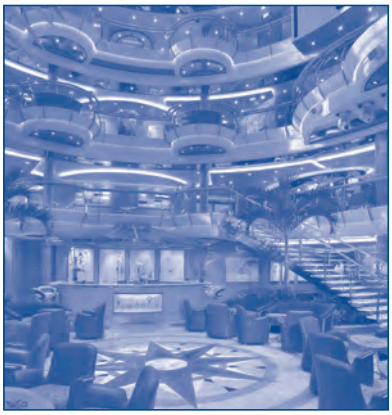

The modern yacht, motor cruiser, cruise ship or passenger ferry is the product of a dialogue between the engineer as the ship and systems designer who is primarily concerned with function and performance, and the marine designer who is concerned with both interior and exterior form and style. Such dialogue is essential if the inevitable conflicts between the technical and aesthetic aspects of design are to be avoided, and full advantage taken of advances in materials, computer modelling, construction techniques and equipment. For example, stronger materials and more advanced construction techniques mean that structural material can be reduced allowing greater freedom of design. Advanced computer modelling allows different layouts to be compared at a preliminary stage, thereby allowing novel concepts to be comprehensively tested. Such advances and other have given designers greater freedom and the ability to meet the increasingly demanding specifications of yacht and passenger ship owners.

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Inegrated control system for LNG carriers

Kongsberg Maritime has been awarded contracts to supply integrated control systems, consisting of automation, navigation, and custody transfer systems, for new three LNG carriers. The total value of the orders is approximately NKr55 million, and delivery is scheduled to take place from late 2005 to early 2007. The vessels will be built by Daewoo Shipbuilding & Marine Engineering, in South Korea.

Kongsberg Maritime has targeted the market for automation and steering systems for gas carriers since 2000. So far, it has supplied steering systems to a total of 59 LNG carriers, 28 of which are on order or under construction.

Contact: Pål Rønning, vice-president sales & marketing Asia, Kongsberg Maritime. Tel: (+47) 958 85 208.

Water-lubricated propeller shaft bearings for cruise ships

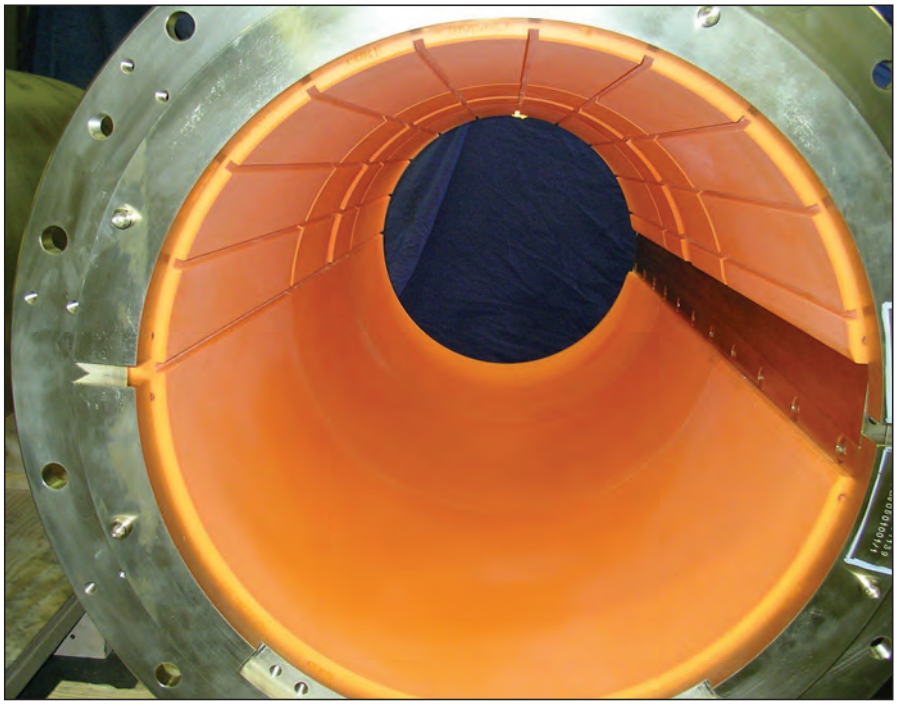
Princess Cruises has specified Thordon water-lubricated COMPAC propeller shaft bearing systems for two new Grand-class cruise ships currently being built at Fincantieri for 2007 and 2008 delivery. There is an option for a third bearing system for a follow-on ship.

Princess Cruises, part of Carnival Corp, currently has seven vessels fitted with water-lubricated COMPAC bearings after the first installation in 1998 on *Grand Princess*. Thordon Bearings is supplying its COMPAC single-key-design bearings for the 116,000gt twin-screw liner. The tapered single-key design allows bearings to be easily withdrawn from the bronze carrier, inspected, and re-installed with the shaft still in place.

The COMPAC elastomeric polymer alloy bearings for the 642mm diameter propeller shafts are designed to promote hydrodynamic operation at low shaft speeds and provide long wear life. A flow of seawater will be provided to the bearings for efficient cooling and lubrication in this pollution-free system. By completely eliminating oil from the sterntube and struts, the COMPAC system should ensure there is no risk of pollution or subsequent environmental violations.

Contact: Craig Carter, marketing manager, Thordon Bearings Inc, 3225 Mainway Drive, Burlington, Ontario L7M 1A6, Canada. Tel: +1 (905) 335 1440. Fax: +1 (905) 335-4033. E-mail: craigc@thomson-gordon.com www.thordonbearings.com

A COMPAC single-key bearing supplied to Fincantieri for Princess Cruises.



Low-pressure extinguishing systems specified for new ferries

Samsung has ordered SoftEx's low-pressure water-mist fire extinguishing system for three 34,000gt newbuildings (yard numbers' 1523, 1524, and 1574) for UK-based Norfolk Line. These ro-pax ferries also include delivery of ro-ro equipment from MacGregor. The first ferry is scheduled for handover this summer, to be followed at four-month intervals by the other two. The fire-extinguishing contract includes design, system approval, and key component delivery, whilst Samsung will undertake pipework and installation, with final support from a MacGregor commissioning engineer.

The MacGregor SoftEx water mist fire-extinguishing system is claimed to have a number of advantages over traditional installations. It operates at low pressure - around 4bar at the nozzle - so power requirements are low, between 22kW and 30kW. SoftEx is said to be easy to install, using thin-walled piping with fast-fit couplings, without the need for strengthening behind the nozzle, so it can be directly mounted to wall or ceiling panels.

The system's extinguishing technique is fully approved, and all components, including the centrifugal pumps, normal PN16 valves and piping, are chosen for simplicity, low weight, and proven reliability. In addition to use in accommodation/public areas, the system can also be installed in machinery spaces, galleys and pantries, provisions stores including alcohol stocks, and spaces with electrical equipment.

This year, the system has completed rigorous testing to gain approvals for application in complete enginerooms. Testing was successful, and final approval is expected soon. The concept uses around 80% less water than a traditional sprinkler system, achieved by adding a small amount of fire-extinguishing additive to the water, reducing water droplet size to a fine mist (100µm-600µm). This water mist cools gases very quickly, therefore limiting damage and reducing the spread of a fire.

SoftEx systems comply with Solas II-12, A.800, and IMO Circ 913 and are type-approved by the American Bureau of Shipping, Det Norske Veritas, Lloyd's Register, Germanischer Lloyd, Bureau Veritas, the Finnish Maritime Administration, the Swedish SNMA, MED, Russian Register, Registro Italiano Navale, and the Japanese Government.

Contact: MacGregor Group AB, PO Box 4114, SE-400 40 Gothenburg, Sweden. Tel: +46-31-85 09 00. Fax: +46-31-85 09 01.

Furniture contract secured with Odense Steel Shipyard

Norac, a Norwegian supplier of interior component to the shipbuilding industry, recently announced that it had reached agreement with Odense Steel Shipyard, in Denmark, to provide furniture solutions. The agreement requires Norac's Nordic Marine Furniture (NMF) business unit to manufacture and supply furniture for installation in eight newbuilding projects. The contract may also be extended to cover options on other vessels scheduled for construction though to 2010 but covers eight ships at present.

The agreement represents a significant breakthrough for NMF, which is a joint-venture with T&H Furnishings Industries, a Japanese-owned company with operations in the Philippines. Norac has had a long relationship with Odense, and has been supplying the yard with a broad range of interior systems - including wall units and acoustic ceiling tiles - and has provided manpower support for about 15 years.

Contact: Frank Robertsen, director of marketing, Norac. Tel: +47 37 05 92 50. Fax: + 47 37 05 92 51. E-mail: frank.robertsen@norac.no www.norac.no

Sliding door latches enhance security

A pair of new marine door latch solutions, which provide security without the need for custom doors and frames, have been launched by Southco Marine, of the UK. The two models, Star Slider and Star Talon, are extensions of the company's Mobella line of hardware, and are part of the 'One look-one lock' concept that enables marine designers to implement a single piece of equipment style

Star Talon is a door entry latch model that comes in a number of finishes and can be used in all areas of a vessel.

throughout a vessel. It also integrates a common key lock mechanism across multiple latch styles as a means of providing security with one key.

The new latches are said to provide firm operation and feature the Star-Lock key mechanism which includes a compact six-pin DIN lock plug, which fits in standard door frames. Both products have a modular key box and matchbox mechanisms. This ensures more variation in backset dimensions and door thicknesses than traditional sliding door locks, and means that different match boxes can be used with the same key box.

In addition, Star Talon and Star Slider can be specified with an optional top-stop intermediate latching feature to secure doors in virtually any open position. This helps to prevent accidental door movement, even in rough seas, and helps minimise opening a door when using air conditioning.

Star Slider is available in modular flush matchbox or protruding-hook match box form. Both can accommodate electric door-opening systems when using their hold-open feature. Star Slider has a one-piece pivot actuator handle with an integrated key box and a full-size styled handle grips on both sides of the door. Slider comes with a standard offset, stainless steel handle grip. Other grips can be specified from among 40 Mobella McCoy and Olivari swing door handles.

The Star Talon latch uses a streamlined flush-face design that can be used alone to provide a minimalist look, or can be combined with a high-seas handle to provide a more substantial grip for opening and closing the door. Star Talon latches are available in black anodised aluminium and chrome finishes for use indoors or outdoors.

Contact: Southco Marine, Midway House, Staverton Technology Park, Cheltenham, Gloucestershire GL51 6TQ, UK.
Tel: +44 1452 717454.
Fax: +44 1452 715490.
E-mail: luedwards@southco.com
www.southco.com

New standards for ships' furniture released

In a major push into the cruise ship market, Southampton-based Morgan Contract Furniture recently established a new marine quality furniture mark, believed to be the first of its type in the industry. The new standard will apply to all chairs, sofas, stools, tables, and custom-built furniture that is made by the company.

Morgan is a designer and manufacturer of high-quality, free-standing furniture and has been a well-known brand in the furniture industry for more than 50 years.

The company's current client list includes Fred Olsen, Cunard, Norwegian Cruise Line, P&O Cruises, and Princess Cruises. The most recent contract was for *Saga Ruby*, Saga Cruises' newly acquired vessel.

The key points of the new Marine Quality mark are that all wood is to be kiln dried and treated to be insect- and vermin-free; metal parts are to be non-rusting; foam, wood stains, and lacquers are to be fire resistant; commercially-toughened glass is to be used; and all materials are to meet or exceed applicable marine codes.

Contact: Morgan Contract Furniture, Clovelly Road, Southbourne, Emsworth, Hampshire PO10 SPQ, UK.
Tel: +44 1243 371111.
Fax: +44 1243 378 796.
www.morganfurniture.co.uk

BOOK REVIEW

Ship Design and Performance for Masters and Mates

By Dr C B Barrass, FRINA. Published by Elsevier Butterworth-Heinemann, Linacre House, Jordan Hill, Oxford OX2 8DP, UK. 252 pp. Softback. ISBN 0 7506 6000 7. Price: £19.99.

This new volume complements Dr Barrass' book *Ship Stability for Mates and Masters*, published in 1999, and his *Ship Stability Notes and Examples*, published in 2001. It is in two parts; the first deals with ship design and the second with ship performance, including trials and other checks to establish whether a vessel has met the owner's specification. The text includes many worked examples, and there are some 100 set examples with answers. This helps the reader to follow the author's arguments and aids understanding of the underlying principles.

The first part follows, in simple terms, the traditional preliminary design procedures. It deals with the basic ship concept and explains how first estimates of ship dimensions, group weights, capacities, and approximate hydrostatic particulars can be obtained. It goes on to consider the components of ship resistance, how ship speed may be defined, powering (including the Admiralty coefficient), and preliminary design of propellers and rudders.

The second part of the book is rather less orthodox in its coverage. It concentrates on modern merchant ships, including a chapter on 'ships of this millennium', listing the largest ships currently at sea, on order, or in the pipeline. Five chapters deal with ship trials, beginning with a typical diary of events followed more detailed descriptions of individual trials. As one would expect in a book by Dr Barrass, ship squat and the effects experienced by ships operating in restricted waters are covered in an expert way.

The second part of the book concludes by considering vibration and ways of improving ship performance in terms of handling and propulsion. These latter chapters introduce the reader to a number of devices he, or she, may meet in real life, providing some understanding of why they are used, how effective they are, and under what conditions. The photographs, diagrams, and graphs illustrating this part of the book should prove very useful to the reader.

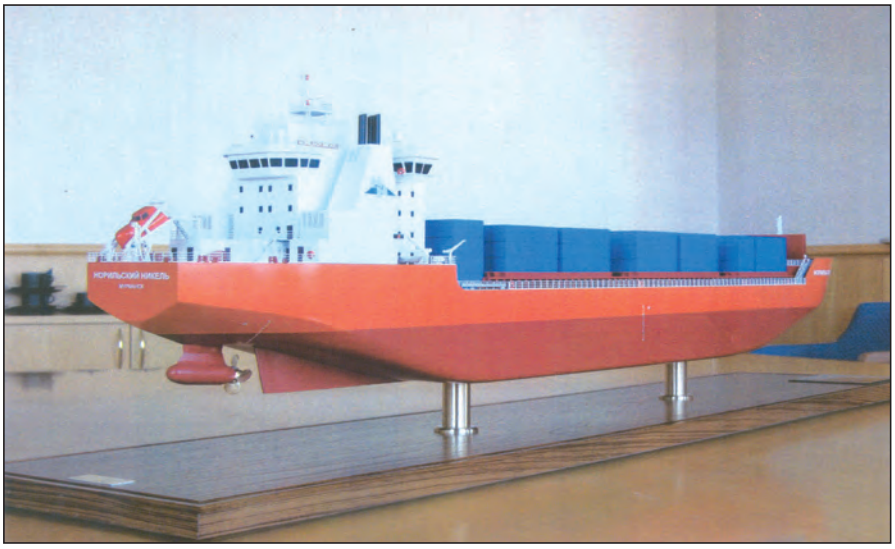
Another very useful feature of the book, for both experienced and inexperienced personnel, is the gathering together in an annex of useful design and performance formulae. For those who are undertaking examinations, the author includes some tips on how to improve their performance.

The author's stated purpose, in producing this book, is to assist those who are interested in, and need an introduction to, ship design and performance. In this, he has succeeded, and the book should prove useful to those for whom the more advanced treatises in naval architecture and marine engineering are not appropriate. It will provide these people with general background knowledge of design and ship performance, including features specifically intended to improve seagoing performance. It will also give seagoing personnel an understanding of how a ship can be expected to behave in certain conditions such as operations in restricted waters. The book should prove a useful addition to the range of maritime publications offered by Elsevier.

E C Tupper

Busy times ahead for the Russian Maritime Register

Orders for new ships to serve Russia's rapidly expanding oil, gas, and other mineral industries in three principal regions are spurring growth at the St Petersburg-based classification society.



A model of the new double-acting 14,500dwt Arctic cargo ship for Norilsk Nickel, designed to export unitised loads of nickel plate, also to carry inbound general cargo to Dudinka on the river Yenisey. The prototype is being constructed at Aker Finnyards' Helsinki site to Russian Maritime Register class, with ice strengthening to JIU7 level. If successful, a series could be built as replacements for the SA-15 class vessels.

PROMISING times lie ahead for the Russian Maritime Register of Shipping (RS) as development of that country's huge mineral resources gathers pace. During the last 10 years or so, as a result of economic difficulties following the break-up of the Soviet Union, Russian owners have displayed a low profile on the newbuilding market, and this has reflected on RS activities.

Today, the whole scene has altered radically, as *The Naval Architect* was able to confirm during a special recent interview at the society's magnificent 18th century headquarters in St Petersburg, and the Russian Maritime Register of Shipping is actively promoting its newest rules to leading shipbuilders and renewing its contacts with equipment manufacturers. Despite this international activity, and although class societies are, by shipping's nature, working around the world, most projects at present are centred at home on three particular economically strategic regions - the lengthy Arctic coast, the Caspian Sea, and the Sakhalin oil and gas fields in the Far East. Booming oil exports from Baltic terminals should also not be forgotten.

Construction work is about to begin at Aker Finnyards on a prototype special Arctic cargo ship for Norilsk Nickel (*The Naval Architect* February 2005, page 48). Two new-generation Baltic icebreakers are also on order to RS class at Baltiysky Zavod, St Petersburg. At the same time, RS has concluded an important dual-class agreement with Det Norske Veritas.

For the Russian Maritime Register of Shipping, the country's massive push into oil and gas projects will principally mean working on new generations of service craft, such as tugs and supply designs, firefighting vesssels, also accommodation and transport barges, but not forgetting important new series of tankers and special cargo ships, including restricted-dimension models specially designed to serve the Caspian Sea plus sea/river designs.

Today, many of the country's shipping companies prefer to operate their own vessels rather than charter in tonnage; Norilsk Nickel's new double-acting Arctic container carrier at Aker Finnyards and the 70,000dwt Arctic tankers recently ordered by Sevmorneftegaz at Admiralty Shipyards, are typical examples. Designs for the tankers were expected to be submitted for RS approval during July. The society does, of course, have a huge database of ice technology, particularly on propulsion and safety aspects and including details of ice-strengthened offshore platforms; it is interesting to note that recently the society's new-generation ice rules have been positively appraised by the Rolls-Royce group.

New icebreaker to aid Baltic oil exports

One of the particularly notable projects under way at present is the construction of two new Baltic icebreakers at Baltiysky Zavod for Rosmorport, the contract for which was reported in our September 2004 issue (page 6). Possible parameters for such a new Russian-built design (most earlier non-nuclear icebreakers had been built in Finland, using the expertise of the MARC - today AARC - ice basin in Helsinki) were discussed in our May 2004 edition, page 40.

The new design has been conceived in Russia by the Iceberg Central Design Bureau, with model tests carried out at the Krylov Institute to optimise the hull for manoeuvring and going astern, and to ensure that the icebreaking speed astern is not less than that when moving forward. Provision will be made for carrying a helicopter, together with a full outfit of firefighting equipment.

A 21MW diesel-electric power plant will be fitted (at the time of writing the manufacturer had not been decided), and the propellers will be of a Steerprop azimuth design from Finland. These will comprise two open built-up types with stainless steel blades and delivering what is believed to be one of the highest outputs ever from a mechanical azimuthing drive: 2 x 8MW. This plant should be capable of providing a continuous speed ahead or astern of 3knots in ice of 1m thickness. Classification standards will be: KM ⊛ JIJI6 ⍰ A1 II 1.

Revolutionary Arctic container ship

Norilsk is an example of a modern company that has opted to carry all future cargoes in its own ships. The company's highly interesting new design was described in *The Naval Architect* February 2005, page 48, and the most notable technical feature will be employment of the Aker Arctic/ABB double-acting principle. This will be only the third cargo-carrying vessel to employ this principle of moving astern when in heavy ice by turning the Azipod propulsion pod through 180deg and using the propeller to drill through and break up the ice. General characteristics will be similar to the earlier and successful Finnish-built SA-15-class vessels, built during the 1980s, which the new ships will replace. If the prototype is successful, this work will be continued at Aker Finnyards' Helsinki site. Although no reference is made in the specification to the Finnish/Swedish ice rules used as a standard by many Baltic and Arctic operators, the RS classification is to JIU7 level, which is equal to the Finnish/Swedish 1A Super class. This means that the hull will be strengthened to operate in level ice up to 1.5m thickness.

Dedicated Caspian Sea rail ferries

Due to sail on sea trials during July was the first of an interesting new quartet of ferries specially designed to RS class, to sail on a Caspian Sea shuttle route carrying crude oil in 55 standard rail tank wagons. No passengers will be carried. These 5000dwt/9000tonne displacement ships, being built at the Uljanik yard in Croatia, are carefully dimensioned (154.5m in length) to be able to pass through locks on the Russian inland waterway system so that they can reach the Caspian Sea.

It might seem unusual to transport crude oil in railway wagons, but the owner has judged this to be the most economic form of transport on a service where no pipelines exist. The service will run from the ports in Kazakhstan to Baku or Makhachkala.

New-generation Russian Arctic shuttle tankers

Back on the Arctic front, the Russian Maritime Register of Shipping is currently

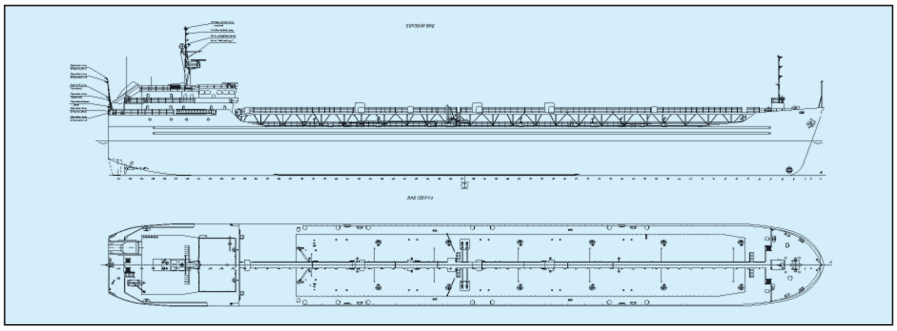
evaluating the proposed design of the four 70,000dwt Arctic tankers that are scheduled to be built at Admiralty Shipyards. These will operate a shuttle service from an ice-strengthened gravity platform at the Prirazlomnoye field on the Pechora Shelf to a floating storage depot (the former VLCC *Belokamenka*) moored at the relatively ice-free port of Murmansk; from here, oil will be transhipped to conventional tankers for export around the world.

More details of the new tankers are expected to become available shortly; however, as reported in a separate article in this issue, it is known that, like the Norilsk ship, they will probably be of the Finnish double-acting patent type and thus will be somewhat similar to the Japanese-built Neste pair *Tempera* and *Mastera* (*Significant Ships of 2003*). Model-testing was carried out at the Aker Arctic Research Centre (AARC) in Helsinki, and that organisation has recently also been negotiating to draw up the complete design.

Working with both tankers and fast ferries at Zelenodolsk

ZELENODOLSK Design Bureau has been involved in the shipbuilding field for more than 55 years, during which time around 800 vessels have been constructed for the Russian Navy, frontier troops, and commercial sector; more than 150 ships of these have been exported. The bureau has the capability to design ships with displacements up to 5000tonnes and lengths up to 150m.

Recently, taking into account the needs of the market, Zelenodolsk has also been involved in passenger craft, as well as new models of tanker and dry cargo ship. The bureau has also created the designs for a series of 4200tonne displacement refrigerated cargo ships, as well as the detail design of a brand-new 5000dwt-plus river/sea tanker.



Profile and deck plan of the new 5000dwt river/sea tanker developed by Zelenodolsk Design Bureau for Tatarstan.

The story of the involvement of Zelenodolsk Design Bureau in designing this latter tanker stretches back several years to when the Tatarstan government made the decision to build a bulk-oil tanker fleet for the Tatarstan Republic. The ships will be classed to Russian Maritime Register КМ ЛУ2 ⊛ ⚿ II A1 (Oil-Tanker) standards, with an endurance of 20 days and a range of 7500 km. This new series, developed with the assistance of model tests and work at an experimental station on the Volga river, will be presented during September at the Neva exhibition in St Petersburg. Zelenodolsk is further considering cooperation with Finnish companies for construction of both these tankers and other ships in the Caspian region, for both Tatarstan and Kazakhstan owners. Such cooperation would involve the bureau's newest computer technology.

Good prospects are also forecast for Zelenodolsk Design Bureau's high-speed passenger craft, such as large hydrofoils of *Sokol* type, pilot projects for skeg hovercraft, vessels using the new air-cavity technique, and high-speed trimaran ferries.

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For further information contact Capt Esmiley on 02380 329324 for Southampton and Capt Legget on 0151 931 6610 for Liverpool.

For an application form please visit our website www.mcga.gov.uk or contact Simon Boyd-Smith on 02380 329308, e-mail Simon_Boyd-Smith@mcga.gov.uk Please note that we do not accept CVs.

Closing date: 12 noon, 8th September. Interviews will be held 21st and 22nd September at MCA Southampton.

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JSC Vympel: active at home and proud of its international connections

THE Caspian Sea region, with its attractive deposits of oil and gas, has been one of the main areas on which the JSC Vympel Design Office, based in Nizhniy Novgorod, has been concentrating in recent years and months. In late June this year, the second in a series of nine single-screw Vympel-designed 12,000dwt tankers has been completed by the Vyborg Shipyard especially for Caspian operation (although they can also trade elsewhere). They are being built for two Kazakhstan owners, Kazmortransflot (three ships) and Mobilex (six ships). Negotiations are continuing for a further two tankers, which will probably be built at the Zelenodolsk yard.

At the same time, Vympel is proud of its international activities, and as reported in our September 2002 feature, the consultancy used its Tribon CAD/CAM software to supply working plans of superstructure sections to Aker Finnyards' Rauma complex for the ferry *SeaFrance Rodin* and the cruise-ferry *Romantika* for Tallink. Vympel also works in two Finnish joint ventures (in St Petersburg and Astrakhan) in association with the leading consultancy Deltamarin and another with a well-known company Pirauma. In addition, Vympel made the technical specification for an offshore supply/tug to be built for Vietnam at the Amur Shipyard, in the Russian Far East, as part of a Rolls-Royce group project for this vessel.

Another contract for an overseas owner, this time a German company, involves preparing the specification for an 18,500dwt chemical tanker, construction of which will probably start next year, again at the Amur yard. It is anticipated that this vessel could be the prototype for a series of IMO III designs with coated cargo tanks. A further overseas project (not yet fully confirmed) is expected to result in work on a new floating oil terminal, to be carried out in association with foreign designers of single-point moorings.

***Astana* is one of the first of a new series of 12,000dwt tankers for Caspian Sea operation, built by Vyborg Shipyard to a Vympel design. They can load both crude and residue fuel. All 12 cargo tanks are fitted with their own pump.**

An impression of the new 7825dwt universal dry cargo ships designed by Vympel for North Western Shipping.

TECHNICAL PARTICULARS NEW VYMPEL-DESIGNED CARGO SHIP

Length, oa	124.90m
Length, bp	118.90m
Breadth, moulded	17.40m
Depth	8.25m
Draught	6.00m
Deadweight	7825dwt
Gross	7250gt
Cargo hold capacity	10,740m³
Container capacity	457TEU
in hold (height to 2896 mm)	180TEU
on deck (height to 2896mm)	277TEU
Crew/berths	11/13
Speed	approx 13knots
Main engine	4000kW
Bow thruster	1x250kW
Classification	Russian Maritime Register of Shipping KM⊛ЛУ3 A1

Back on the domestic front, Vympel designers are working on a 30,000dwt oil storage barge, planned to be moored in the Caspian Sea, as well as on the design of a new 8000dwt tanker for a Russian owner, again to operate on the Caspian Sea. Vympel was also, of course, designer of the Valday-class river/sea cargo ships, built at Severnaya Verf (*The Naval Architect* September 2002, page 27), which heralded the first major order by a Russian owner (North Western Shipping) at a Russian yard since the break-up of the Soviet Union. A total of four ships were actually ordered (originally reported to be 10).

At the time of writing, these had been completed but later hulls have been slightly modified, with improved crew accommodation but identical deadweight. The first of these so-called Rusisch variants is understood to have been completed in 2003 at the Krasnoye Sormovo yard, which is building three in total. Further hulls will be assembled at the Zelenodolsk Shipyard in Tatarstan and at the Okskay Shipyard near Nizhny Novogorod. Sixteen such ships are now planned to be built in total.

At the same time, Vympel is drawing up a new project for North Western Shipping, to develop a future class of 7825dwt universal dry cargo vessels, the builder of which is expected to be decided soon. These will be sea-going ships.

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MNP - VIP on the Russian shipbuilding stage

SEGREGATED from the OMZ company in 2004, MNP - Onshore & Offshore Group (MNP Group) specialises in commercial and military shipbuilding. We reported on some of this company's activities both in September 2002 and in May 2004 (before its segregation from OMZ). Today, MNP Group is an active player - and is certainly likely to remain so in coming years as new Russian maritime ventures gather speed.

The Group has the ability to generate both strategic and engineering solutions, as well as undertaking procurement and managing its shipbuilding assets. In addition, it is able to attract investment capital to finance both shipbuilding and yard upgrading.

Several Group members leading in the medium-size vessels market (up to 15,000dwt) are strategically located on the Volga river - Krasnoye Sormovo Shipyard (Nizhniy Novgorod), Volgograd Shipyard (Volgograd), and Nizhegorodskiy Teplokhod (Bor) , as well as Almaz Shipbuilding Co in St Petersburg. Also today, Astrakhan III International Shipyard is growing in importance for MNP Group.

Up to now, Astrakhan III International Shipyard, on the Volga river delta has mainly concentrated on non-self-propelled vessels and hulls, but is today earmarked for expansion into other activities, in line with nearby Caspian Sea oil and gas exploration. The shipyard has capabilities to fabricate modules for offshore drilling platforms, construction barges, and other offshore structures. In addition, several hulls for river/sea tankers and container ships have been built here.

One interesting project is taking shape at the Astrakhan sites, where the III International Shipyard is assembling the lead example of new type of a tanker - the LMG34PT class. This 3400dwt class is designed for the carriage of both crude oil and oil products. These ships (two firm orders plus options) have 11 cargo tanks and can load oil and oil products in six grades. The hull, which is strengthened for lying aground, has a length of 79.90m, a breadth of 15m, a depth of 7.80m, and a maximum draught of 5.5m.

Under a new arrangement, the hulls of this LMG34PT class will be towed to Tallinn, in Estonia, for outfitting. This movement will avoid ice season limitations and help to optimise the MNP Group's shipbuilding programme. The first tanker of this series is scheduled to be delivered in January 2006, and the second one in June of the same year.

Krasnoye Sormovo Shipyard, one of the oldest Russian shipyards, is currently building the largest oil tankers yet planned for the Caspian Sea - 13,000dwt. These Project 19619 designs are built under a contract awarded by Azerbaijan State Caspian Shipping Co (CASPAR). The tanker was designed by MNP's in-house engineering centre, working in close cooperation with leading design firms. Two tankers were delivered in 2004 (one, *President Heydar Aliyev*, was presented in *Significant Ships of 2004*), and the third was launched in July; it is scheduled to be delivered this coming autumn. Two more tankers whose keels have recently been laid are planned to be delivered in 2006.

Seen here on the transverse berth at Krasnoye Sormovo Shipyard is one of MNP's Project 19619 tankers - the largest yet for the Caspian Sea. Two are already in operation with the Azerbaijan State Caspian Shipping Co.

An impression of the new 8000dwt tanker design to be built at MNP's Volgograd Shipyard. These vessels will feature a state-of-the art outfit, and Volgograd Shipyard is believed to be the first Russian yard to construct this type of tanker.

This is a twin-screw vessel with 12 cargo tanks and one slop tank, with double side-skins and a double bottom. Length is 149.9m, breadth 17.3m, and draught 6.99m. The tanker is capable of reaching at any port of the Caspian Sea.

New steelworking line for Krasnoye Sormovo

New investment is planned for Krasnoye Sormovo Shipyard, where a line for auto-assembly and auto-welding of sections has been ordered for installation. The contract with IMG Co was awarded at the beginning of 2005. Commissioning of the line will lead to a production output increase: two sections with dimensions up to 18m will be produced at one shift. Moreover, inauguration of the new automatic line will release 260 workers. When in full operation, this will considerably improve efficiency and boost steel throughput to 25,000tonnes annually.

Volgograd Shipyard is likewise improving its existing technologies as well as planning new ones. Meanwhile, work here is continuing on construction of the prototype 8000dwt-class crude/product tanker, which is scheduled for completion next February. This 10,000m^3 capacity design has 10 cargo tanks, each fitted with individual pumps and piping systems so that 10 grades can be loaded, and three slop tanks. Length is 110.50m, breadth is 17.00m, and draught is 7.60m. Construction is to Det Norske Veritas standards.

The MNP Group is keen to build long-term relationships with its clients, as well as with suppliers and service companies. Plans are already in hand to push into new areas, mainly centred on the Caspian Sea region.

One of the first blocks on the berth for the LMG34PT tankers of 3400dwt, which are currently being built by MNP's Astrakhan III International Shipyard for a Swedish owner. As part of a new policy, the hulls will be towed to a yard in Tallinn, Estonia, for outfitting.

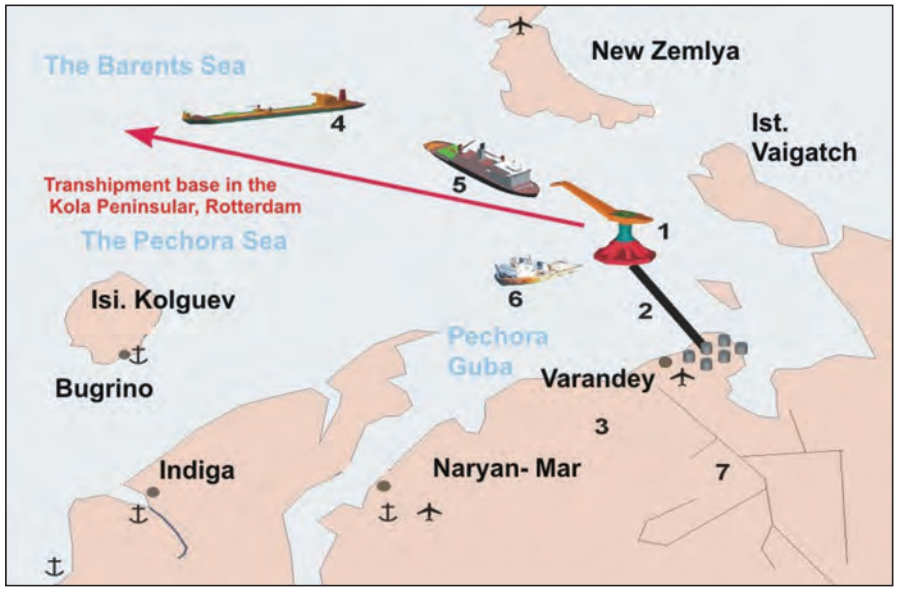
Arctic projects keep Krylov busy

AS reported in our 2002 Russian feature, the Krylov Shipbuilding Research Institute enjoys a worldwide reputation for its model testing and R&D activities, and also for ship design through the institute's associated consultancy Baltsudoprojekt. Projects are carried out not only for shipbuilding but also for the offshore sector, including on such topics as offloading systems and floating oil refineries - and particularly work that involves oil and gas exploration in the Russian Arctic, Far East, and Caspian regions. On the Arctic theme, in 2001, Krylov and Baltsudoprojekt worked together on the design of a new 65,000dwt icebreaking tanker. Later, the size was increased to 70,000dwt, and four ships have very recently been ordered at Admiralty Shipyards.

During the following years, in line with Russia's great interest in its vast natural gas projects in the Arctic, Krylov has been examining LNG ship designs and developing associated projects, also making experimental studies concerning possible carriers that might be employed in the Shtokman field and in other regions of Russia. The Institute has particularly been working with Moss Maritime, of Norway, and concentrating on twin-screw designs using the Moss spherical-tank cargo containment concept, as reported in *The Naval Architect* May 2005, page 3.

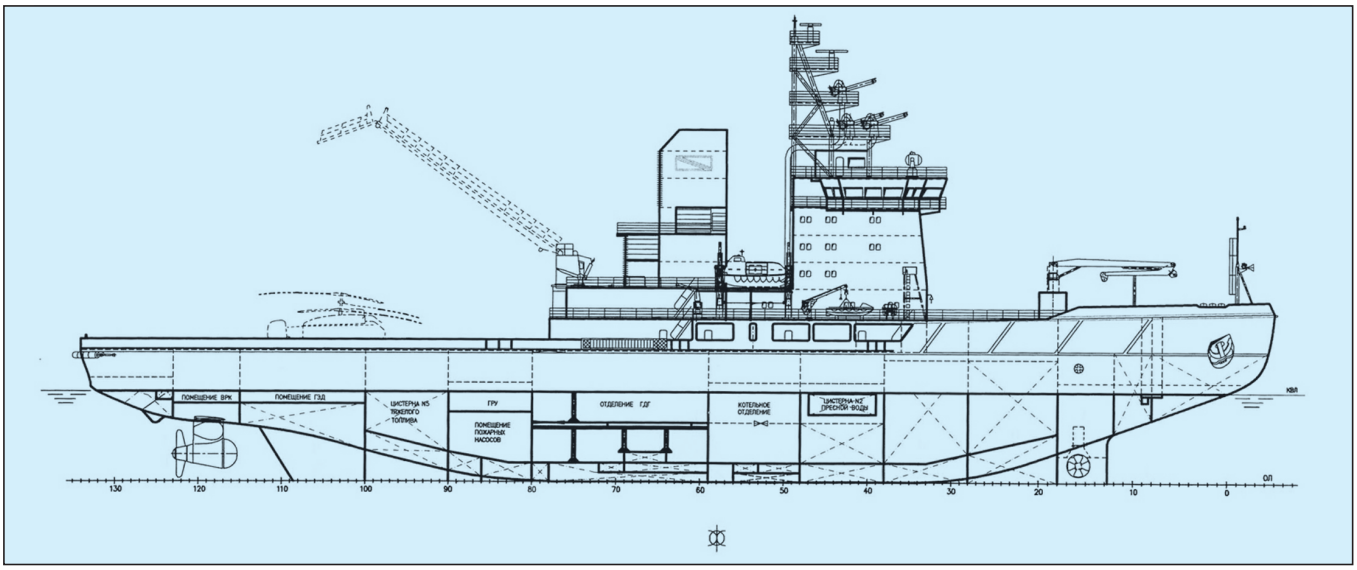
Moss believes that some important benefits can be obtained with twin propellers, even for standard-size LNG carriers of around 150,000m³. Studies into hull-line optimisation have been made and increases in efficiency in the order of 10% have been achieved. A modified design with an icebreaking hull has additionally been developed for the Kara Sea, while further work at Krylov has centred on FPSO hulls for LNG.

The Krylov Institute has also played a leading role in the development, model testing, and design of the new multipurpose Baltic/Gulf of Finland icebreakers. The first of these is now being constructed at Baltiysky Zavod, in St Petersburg, to Russian Maritime Register class. For shipment of oil extracted on the Arctic province of Timano-Pechora, and its onward transportation by sea for export, Krylov, together with KBR (Kellogg Brown Root) and PermNIPIneft have developed a project for an export terminal. The institute is also working on new concepts for other Arctic oil and gas field projects.



A map of the Timano-Pechorskaya region in the Arctic (Pechora field), showing the planned Varandey offshore loading terminal, from where oil will be taken by new 70,000dwt shuttle tankers to Murmansk, for onward export. The Krylov Institute has been involved in drawing up the overall concept, and designing both the terminal and possible tanker designs for this project.

An updated profile of the new Baltic icebreakers developed at the Krylov Institute and to be built at Baltiysky Zavod, showing the open azimuthing propellers to be supplied by Steerprop. A diesel-electric propulsion plant of approximately 21MW/22MW will enable 1.00m level first-year ice with a snow cover up to 20cm to be broken at 100% MCR, moving either ahead or astern.



New Baltic icebreakers under construction at Baltiysky Zavod

THE giant St Petersburg shipyard and machinery plant of Baltiysky Zavod is currently enjoying a relatively happy period. It has recently secured a contract for a second new-generation Baltic icebreaker for Rosmorport and is fabricating the hulls for two Stena ro-pax ferries under subcontract to the Fosen shipyard, in Norway.

Criteria for Russia's new Baltic and Arctic icebreaker programmes were discussed at length in our September 2002 issue (page 20) and particularly May 2004 (page 40), and although at one time it was thought that the contract might be awarded to nearby Severnaya Verf, the order for the first ship was eventually placed last year with Baltiysky (the Aker group's Rauma and Helsinki yards also tendered) at a cost estimated to be worth between US$80 million and US$100 million.

The pair have been designed to support Russia's booming oil export traffic from terminals such as Primorsk, and apart from icebreaking duties, each will be equipped with gear for firefighting, rescue, and oil spill recovery. The design does not feature the Finnish double-acting concept (as in the new Fesco icebreaker/support ship *Fesco Sakhalin*); however, the 114m-long hull has been carefully optimised by Central Design Bureau Baltsudoprojekt and its associate, the Krylov Shipbuilding Research Institute. The aim has been to reduce power consumption, through model tests, to ensure that the ship can travel astern into ice - up to 1m thick with a snow cover of up to 20cm - at a speed not less that than when moving ahead at approximately 3knots or 4knots.

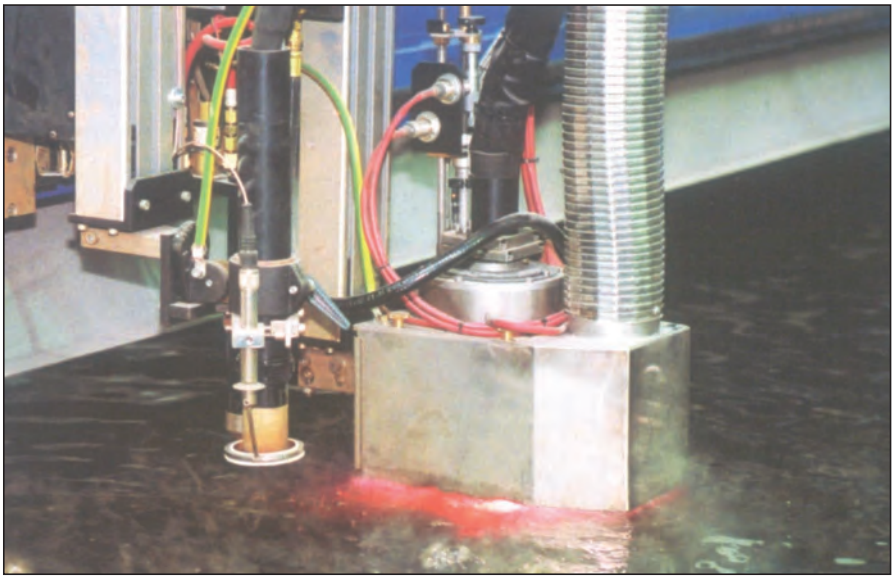
Of course, Baltiysky has considerable experience in icebreaker construction, although not for some years now. It is, however, still involved in the lengthy and intermittent outfitting process of another nuclear icebreaker *50 Let Pobedy* - that ship was at the outfitting quay during *The Naval Architect's* 2002 visit.

Steel cutting, using special strengthened grades, for the first of the new Baltic pair started in March this year, and the first blocks were laid on the berth in June, with launching (the name will be *Moscow*) planned for next May, followed by delivery in February 2007. A highly automated bridge will allow the new ships to be operated by a crew of only 20 or 25.

A special feature of the propulsion train is the specification of two SPO4.5ARC azimuthing thrusters from the Finnish company Steerprop for each icebreaker. These will have what is believed to be the largest ever output for mechanically driven designs - 8000kW each. Prior to this contract, the largest ones were those ducted units designed by Aquamaster for the Finnyards-built (1993) dual-role icebreaker/support ship *Fennica* and her sister (2 x 7500kW).

Each of the new 4.50m diameter units will have open built-up (and removable) stainless steel blades and will be driven in a Z-drive layout by electric motors. The power will be controlled by frequency converters, and steering will also be by electric motors. By installing the thrusters in a toe-out arrangement, the icebreakers will be able to clear a wide channel for tankers up to 50m breadth.

A further important contract for Baltiysky Zavod is that to fabricate the two ro-pax ferry hulls for Stena. These follow a smaller hull built in 2002 for the Portuguese yard ENVC, which was completed as the Madeira ferry *Lobo Marinho* (presented in *Significant Ships of 2003*). The Stena hulls are for a class known as the Seabridger type, and it is possible that they might also be outfitted in Russia. They are being assembled to Lloyd's Register class, and will be strengthened to Swedish/Finnish 1A ice

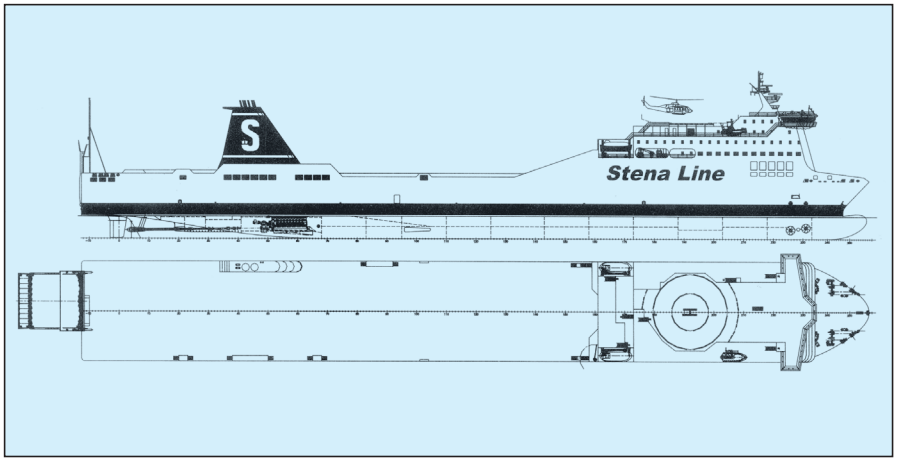


A plasma cutting machine at work in Baltiysky's brand-new steel cutting shop.

TECHNICAL PARTICULARS
BALTIC ICEBREAKERS

Length, oa	114.00m
Length, bp	97.20m
Breadth, oa	27.50m
Depth	12.40m
Draught, design	8.50m
Gross	9265gt
Diesel-electric power plant	2 x 6000kW 2 x 4500kW
Propellers	2 x 8MW
Speed, open water	16.00knots
Crew	20/25
Classification	Russian Maritime Register of Shipping KM⊛JIJI6⍰A1Π1

Profile and upper deck plan of the two Stena Seabridger-class ro-pax ferries, the hulls for which are being fabricated by Baltiysky Zavod under subcontract from Fosen Mek Verksted, in Norway.



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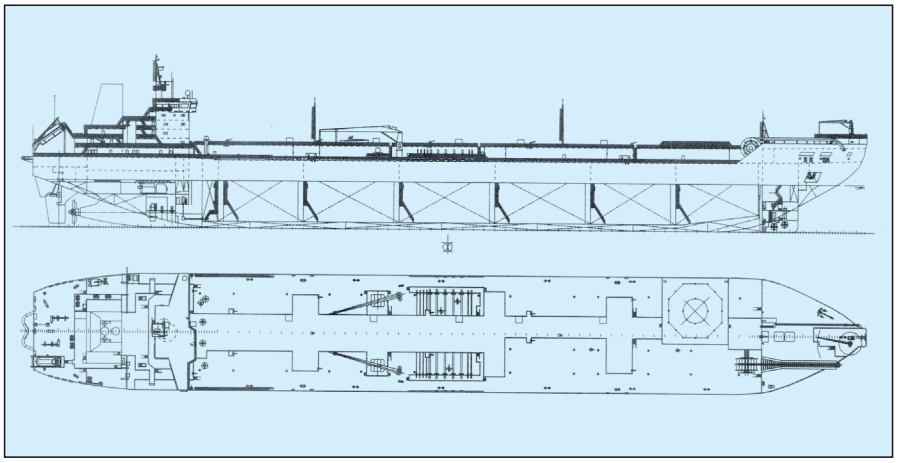
standards. Length overall is 212m, breadth is 26.70m, depth to the shelter deck is 15.50m, and the summer draught is 6.00m. Planned speed is approximately 23knots, and each ship will have 3100 lane metres of ro-ro capacity plus accommodation for 200 passengers in cabins.

Interest in Arctic tankers

In 2002, Baltiysky Zavod was promoting a new Arctic shuttle tanker of some 70,000dwt but that contract was eventually placed by Sevmorneftgaz with Admiralty Shipyards; however, it was possible that with the icebreaker orders and the Stena hulls, and any naval work, Baltiysky may not have been able to fit in four large tanker hulls.

Nevertheless, such a design still appears in the company's promotional material, and the latest version is of 73,400dwt with bow loading gear, a diesel-electric power plant, and twin four-bladed 6m diameter propellers driven by 13,000kW electric motors. Meanwhile, this yard is looking at other exciting possibilities, especially Arctic LNG carriers to export gas, although the company has not yet decided which containment type to select.



Although Baltiysky lost out to Admiralty Shipyards over the recent contract for new-generation Arctic shuttle tankers, the yard remains interested in such tonnage. Seen here is the newest 73,400dwt version of such tankers being offered, suitable for three cargo grades. It features twin FP propellers driven by electric motors, with primary power coming from six 5760kW diesel-alternators.

New steel cutting shop in operation

As we reported in 2002, Baltiysky has started a large investment programme, which initially concentrated on a brand-new steel cutting shop. This is now up and running, and includes a plate and profile transport system, shotblasting and primer line, profile cutting line, and plate cutting and welding machines. When fully operational very soon, potential annual steel throughput is expected to be in the order of 60,000tonnes (double today's 30,000tonnes).

Future plans are still in hand to build a new paint shop, to modernise the block assembly shop and to fit a sliding roof, to modernise the pipe shop, to install a new 900tonne gantry crane over Berth A, and to construct a two-bay covered berth served by 60tonne cranes and with supporting areas.

The yard would like to progress such investment as quickly as possible but finance remains a problem. As noted in our 2002 report, Baltiysky already operates an indoor horizontal construction hall for smaller types of ships up to 165m length. These are assembled on trolleys and transferred to a floating dock for launching.

This large shipyard is continuing to target the European export market for profitable and technical challenging contracts, and has achieved some success, having built several small chemical tankers for Germany, a bulk carrier for Greece, the ferry hull for Portugal, and now the two Stena hulls. Together with its large supporting propeller works and machine shops, Baltiysky remains ready and waiting.

Dual-class agreement for cold-climate shipping

THE Russian Maritime Register of Shipping (RS) and Det Norske Veritas (DNV) used the recent Nor-Shipping exhibition to sign an agreement for close cooperation within cold-climate shipping. This significant dual-class agreement, covering ships under Russian flag in Russian waters, will give the international and Russian shipping community access to further extensive cold-climate experience and should ensure compliance with Russian statutory requirements.

The new dual-class agreement - not to be confused with the common double-class arrangement for new ships - is thought to be more comprehensive than that which is the norm for such agreements between classification societies. Under the accord, the two societies have established one integrated common class service with shared work execution.

For ships operating under Russian flag in Russian waters, RS will perform all statutory work and all annual surveys on behalf of both societies, while jointly, DNV and RS will perform intermediate and renewal surveys. All surveys shall meet the requirements of both RS and DNV. Only nominated and specially trained surveyors shall perform work on dual-class vessels.

For newbuildings, a full range of DNV and RS class notations shall be available. Each society will take responsibility for a particular task - responsibility will not be shared, and the object is to provide the highest possible standards of work and to ensure first-class reliability. After discussion, one of the societies will be appointed as lead organisation for each newbuilding project. For ships in service, work will normally be carried out by which ever society happens to find the situation more convenient.

This fully integrated RS/DNV dual-class agreement, which took much time and effort to prepare, includes use of international and Russian safety and environmental standards, use of international design and quality standards, effective specification of fit-for-purpose ships, reduced in-operation off hire and delays, and compliance with recommendations from international financing and insurance.

Both societies believe this new service will be popular amongst operators of new tonnage that is under construction for oil and gas transport in cold Russian regions. Vessels are already being designed and ordered for operating in a number of mineral-rich areas, such as the Kara Sea (Arctic), and Sakhalin (Far East), as well as the Caspian Sea, where winter conditions can also be most severe. Level ice thicknesses in the Kara Sea can extend to 1.8m, while temperatures can drop to -35°C.

The first ship to which the new agreement will be applied will be a former VLCC, now re-named *Belokamenka*, which is being modified and moored at Murmansk to act as a floating transhipment terminal for oil delivered there by Russian shuttle tankers (such as the new 70,000dwt designs recently ordered from Admiralty Shipyards). From this point, tankers will load the oil for onward shipment.

MNP group

SHIPS FROM RUSSIA

tankers

offshore support vessels

dry cargo ships

Krasnoye Sormovo Shipyard
(Nizhny Novgorod)

•

Nizhegorodskiy Teplokhod
(Bor, Nizhny Novgorod region)

•

Volgograd Shipyard

•

Astrakhan III Int. Shipyard

•

Almaz Shipbuilding Company
(Saint-Petersburg)

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Commercial/naval mix for Severnaya

FOLLOWING the completion of its Chinese destroyer programme and the completion of four Valday-class cargo designs for North Western Shipping, St Petersburg-based Severnaya Verf (Northern Shipyard) is turning its attention to other types of vessel - the company believes it must continue with a mix of commercial and naval work in order to ensure a balanced workflow. It has recently launched the third of a series of corvettes for the Russian Navy and is tendering for more frigates, while at the same time beginning the construction of two offshore supply ship hulls to DNV class.

The latter are for the Norwegian operator Eidesvik's fleet replacement programme, and the design has been supplied by Vik-Sandvik, also from Norway. An option in the contract allows for any future hulls to be fully outfitted in Russia rather than towing the hulls to Norway for completion. The first hull should have been launched in July. Severnaya is additionally negotiating with a Danish owner for building and outfitting two icebreaking tugs for operation in the Sakhalin oil and gas fields.

Further negotiations are taking place with the Russian operator Sovcomflot over an order for dry cargo ships and bulk carriers of unspecified size. The operator is planning to ask a Chinese naval architectural consultancy to draw up the designs.

A destroyer built at Northern Shipyards ready for its launch.

Norwegian chemical tanker contract for Sevmash

ONE of the most remarkable commercial contracts to be won in recent times by Russian shipyards is that concluded by the Sevmash yard at Arkhangelsk with the leading Norwegian owner Odfjell. Historically, this builder specialised in submarines and, more recently, offshore projects, but is hardly known in the commercial marine market.

The new order calls for Sevmash to construct a series of eight 45,000dwt IMO II chemical/product tankers, plus four options. They will be built to a new design known as the KD-TCOP45000, developed by the Norwegian consultancy Kleven Design, a member of the Kleven Maritime group. Sevmash will use its Foran integrated design/production software (recently upgraded through more module licences from Sener) during the construction of these complex ships, which, it is believed, will include a mix of stainless steel and coated tanks.The first blocks will be laid during the coming autumn.

Guidance for single-hull-tanker phase-out

AS many readers will be aware, April 2005 was the date of the beginning of single-hull phase-out for certain ships, according to MARPOL guidelines. INTERTANKO, the International Association of Independent Tanker Owners, is aiming to assist owners and operators with this phase-out process, ensuring it is carried out as smoothly as possible.

The challenge to the tanker industry, according to INTERTANKO, and all those that make up the extended chain of responsibility, is to make the changes work in practice. To achieve this, the organisation believes, all the elements in the chain need to have total commitment to the process.

At a time when tanker tonne-mile performance is up by nearly half in the last 10-15 years, accidental oil pollution from tankers is down by around two thirds. Progress made by the tanker industry in advancing safety and environmental objectives needs to be consolidated, but this also needs drive to keep it moving forward.

Continuous improvement also needs to be sustainable so that everyday operations reflect commitments to society and to the environment. This improvement also needs to be sustained whatever the state of the market, and by the whole of the shipping industry; the public, according to INTERTANKO, still finds it hard to differentiate between tankers and other types of ship, and all are thought of as tankers if they cause pollution. This organisation, however, believes that the industry is gradually earning respect from those who realise improvements have been underway for a number of years.

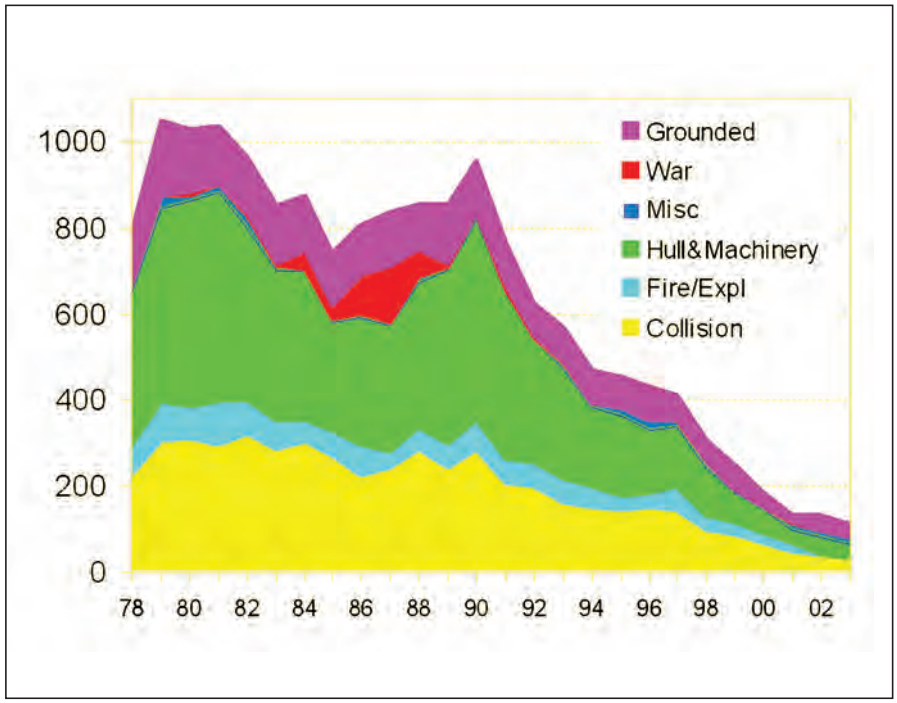
Phase-out is expected to actually have little market effect until closer to 2010, when the ban on single-hull tanker becomes absolute in the USA and Europe, and from when single-hull tankers can only trade internationally according to MARPOL regulations, ie, subject to trading life extensions granted by flag states, and subject to acceptance by port states of ships granted such extensions.

Confusion has arisen with the new regulations for a number of reasons. Firstly, there has been a lack of understanding of the complex regulations regarding phase-out and carriage of heavy-grade oils, which include the possibility of flag state and port state exemptions. In addition, there have been conversions from Category 1 to Category 2 vessels, which give up to three years extra trading. Finally, there has been inclusion of ships not subject to phase-out, such as combination carriers, or older chemical tankers that are obliged to leave only the mineral oil trade.

INTERTANKO statistics show that after deliveries of modern tankers and sales for recycling in 2001-2003, the average age of the tanker fleet has been reducing for some time, and the double-hull share has been over 50% since 2002. Partly because of the strong spot market and partly because of the reduction in older ships in 2002 and 2003, sales of tankers for decommissioning were 9 million deadweight in 2004, and are likely to be the same this year, which is roughly half the level seen in 2002 and 2003.

A regional effect on charterers' behaviour has already been noted since October 2003, when Europe unilaterally implemented an accelerated phase-out regime and ban on heavy oil in single hulls. This has already brought about a repositioning of tonnage.

During the first half of 2004 in the North Sea/north west Europe, 90% of trade by deadweight was in double-hull tankers, and another 8% in single hulls with double bottoms or sides, according to figures from Fearnleys. Oil exports from Russia are already mainly carried out by double-hull tankers.



As can be seen from this graph, tanker accidents have been in general decline for a number of years.

More growth for Germanischer Lloyd - and larger container ships to come

GERMAN class society Germanischer Lloyd continues along its path of growth and reports that in 2004 sales revenue increased by 22.70% to €268.5 million. The boom in global trade, especially linked to China, and consequent large shipyard order books resulted in 844 new ships being on the society's books at the end of 2004. Of this total, 469 hulls were, not surprisingly, container vessels, since this has always been a strong sector for GL. A further 148 were multipurpose ships. To cope with all the classification work that this high number involves, an extra 200 personnel are expected to join GL this year.

Speaking during May in London, executive board members Rainer Schöndube and Hermann J Klein say that they believe that demand for large post-Panamax container liners will continue - GL already has 11 new ships in the range 7100TEU to 7500TEU, plus 63 ships above 8000TEU. Technically, as most people know, much larger ships can easily be built but one of the limiting ship-related factors may be the number of tiers of boxes that can be loaded. At present, 10 tiers, equating a load of 356tonnes on the lowest container, is the limit. On deck, where 60% of a total cargo is often carried, the securing of ever-larger numbers presents new challenges for rough-sea navigation and speedy port turnrounds. It is essential to calculate carefully the dynamic loads on a stack of deck containers, and for large ships weather routing is becoming an increasingly important issue.

Rising fuel prices and increasing port expenses often tempt owners into larger ship sizes where more powerful but more emission-friendly engines make more commercial sense, says Germanischer Lloyd, and the society believes that liners capable of loading more than 12,000TEU will be built, but possibly not quite yet because of the fleet's youthful age. Already, the society has been asked to quote for classing a 15,000TEU giant. Certainly, increased length and breadth are likely to be features of larger vessels, coupled with draughts of up to 15m and plate thicknesses in certain parts of a hull of up to 86mm. This last-mentioned feature calls for special attention being paid to efficient welding. With yards trying to increase production speeds to shrink construction times, it is essential that quality control is given the highest priority.

Readers of our June issue may have noted that Nakashima's new factory in Japan for large propellers is planned to cast FP units of up to 12m diameter and 150tonnes weight; already ships are being built in Korea (such as the GL-classed *CMA CGM Hugo*, of 8200TEU) with propellers of 9.10m diameter. Greater sizes may be needed for next-generation container ships that might be powered by the 100MW low-speed engines being proposed by designers; however, cavitation may become a greater problem, and owners may well opt for two propellers of smaller diameter - more expensive but providing a degree of redundancy. At the same time, it is interesting to note that today most GL customers specify a 25-year lifespan for their new ships.

Oasis - state-of-the-art controls from JRCS

EXHIBITED at Nor-Shippping by the Japanese manufacturer JRCS Corp was an example of the company's newest technology - the Oasis console for integrated control and monitoring of propulsion machinery, electrical power, and cargo-handling equipment, principally on new-generation LNG carriers although the concept is eminently suitable for other value-added tonnage. Oasis is an acronym for 'operationally advanced super integrated system', and both software and hardware build on the considerable experience accumulated in this field by JRCS.

All operations are based on touch-screen motions, and either full-screen or segmented mimic or record displays can be selected, plus pop-up windows. Special attention has been focussed on memory alarm recording and recall, and Oasis is believed to be one of the most advanced suites in this field; it is expected to be especially attractive at maintenance and repair time. For the future, JRCS plans to develop a prediction module.

A special feature is the onboard training function that can be embedded. This module has been developed in association with the UK company MRPI Ship Analytics, which will match JRCS mimic displays, using the onboard training ideas discussed in the article in our special supplement *Design and Operation of Gas Carriers*, published in October 2004 (page 28). Oasis is expected to ready for the market very shortly.

A console display from the new JRCS Oasis control and monitoring system. Either full-screen or segment displays can be selected.

The Royal Institution of Naval Architects

Safety Regulations & Naval Class

23-24 November 2005, London

Second Notice

The first conference on Safety Regulations and Naval Class was held in 2002. This conference will follow on from that and draw on the experiences of the past few years.

Changes in national laws and public perceptions, developments in procurement and support, and recent accidents have increasingly led to Navies re-assessing their existing safety management policies. Foremost in supporting the navies in their re-assessments are the Classification Societies. Significant investment has been made by both Navies and Classification Societies in developing these new procedures and has resulted in a far better understanding of the Navies' requirements and the differences between naval requirements and the requirements of national merchant ship administrations. Since the last conference in 2002 warships have been built to comply with Naval Classification rules and kept in "Naval Class".

Influential speakers will be gathered from around the world to ensure the latest advances are available to the audience. Papers will be presented on the following topics:-

- **Safety Management Policy**: development of organisational safety management policies and their implementation.
- **Navies**: how recent changes in procurement and support policies, budgets and the public perception have altered the status quo. Implications of maintaining ships in Class
- **Classification Societies**: development of naval ship rules, regulations and procedures. Provision of independent on-site survey and product audit. Lessons learned from classing warships
- **Regulation**: development of strategic partnerships between Navies and Classification Societies, safety certification and safety cases, improvements in regulatory competence, dual use vessels, maintaining ships in class.
- **Defence Contractors**: reaction and lessons learnt in dealing with the new regulatory regimes and Classification Society requirements.

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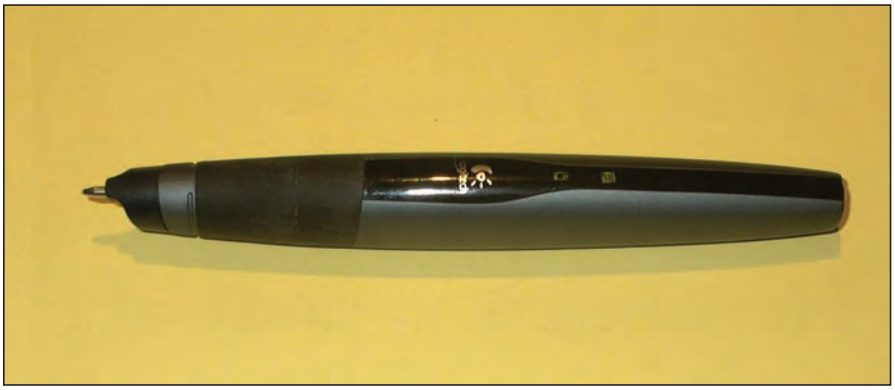
Novel technology to keep track of compliance and projects

A FASCINATING technique that won a prize in the 2005 Seatrade Awards competition could be of considerable assistance in aiding shipyards and owners to keep track of projects throughout their life. UK-based Datatrac Ltd employs data-capture technology to record information, using equipment which comes in two versions: Compliancetrac (using a pen to provide an electronic copy of a hand-written document or sketch) and Assetrac (to record data from electronic tags).

Compliancetrac was developed for users needing proof of compliance with regulatory bodies where, typically, the evidence is originated by marking a checklist. The record, which may be in the same form as currently used by a client, is an exact copy of what is written on a form, including any signatures. A digital pen, with a video camera under the nib, is used to capture the document as a JPG image file, which can be filed or transmitted elsewhere.

If required, Boolean progamming can be used to sort a series of check boxes and to analyse responses, which may be filed in a Datatrac management database. A third possible level of sophistication adds character recognition, which allows data to be exported into Excel spreadsheets.

Assetrac uses a hand-held reader in place of the pen, which reads information from tags.



This digital pen used in Datatrac's Compliancetrac system.

Each tag has a unique identification number. When the tag is touched by the reader head, a circuit is completed that enables the reader to record the number and any data on it. The time and date are recorded, and the operator is prompted to take any necessary action. An operator has to enter his own identification number at the start of work. Datatrac systems are already being used by several shipping companies, including the Royal Fleet Auxiliary, Stena Line, and Northern Marine Management.

Fesco Sakhalin: new double-acting icebreaker for Sakhalin operation

AN important new stage in the advance of the Finnish double-acting icebreaker concept has been reached with the handover by Aker Finnyards to the Far Eastern Shipping Co (FESCO) of the combined icebreaker/offshore supply/support ship *Fesco Sakhalin*. FESCO celebrates its 125th anniversary this year, and the new ship is also notable as being the first to be delivered to Russia by Aker Finnyards and its predecessors for 23 years.

This special vessel represents the first large example of an icebreaker built to the Kvaerner Masa/ABB double-acting principle (today the patent is held by Aker Arctic Technology Inc), in which a ship travels stern-first into heavy ice, using one or two ABB Azipod units (turned through 180deg) to drill into and break up ice. Thus, the bow can be more optimised for open-water operation.

Two smaller Caspian icebreaking supply ships, *Arcticborg* and *Antarcticborg*, were built in 1998 at Helsinki to the same principle, together with a River Danube icebreaker, *Röthelstein*. In addition, in 2002 a Norwegian coastguard patrol ship *Svalbard* was constructed by Aker Langsten, and a US Great Lakes icebreaker is due to be delivered by Marinette Marine later this year. In 2002 and 2003, the concept moved into commercial shipping when two Aframax Arctic tankers, *Tempera* and *Mastera*, were built - under licence utilising the same technology - by Sumitomo, in Japan, for Fortum Shipping (*Significant Ships of 2003*).

Considerable experience has thus been built up with this double-acting principle and in ice technology generally. Much recent work was pioneered by the Neste 16,000dwt Arctic tankers *Lunni* and *Uikku* (still performing successfully with their new owner Murmansk Shipping as *Indiga* and *Varzuga* respectively), which were retrofitted with Azipod propulsion during the mid-1990s. Crews on this pair first discovered that going astern into ice produced more efficient icebreaking.

The Aker Finnyards group has, of course, built large numbers of icebreakers - many for Russia - and including a trio of Finnish Baltic-class ships - from the Rauma yard. The latter were headed by *Fennica* (*The Naval Architect* February 1993, and *Significant Ships of 1993*), which are notable in the current context for being dual-role vessels. They were designed

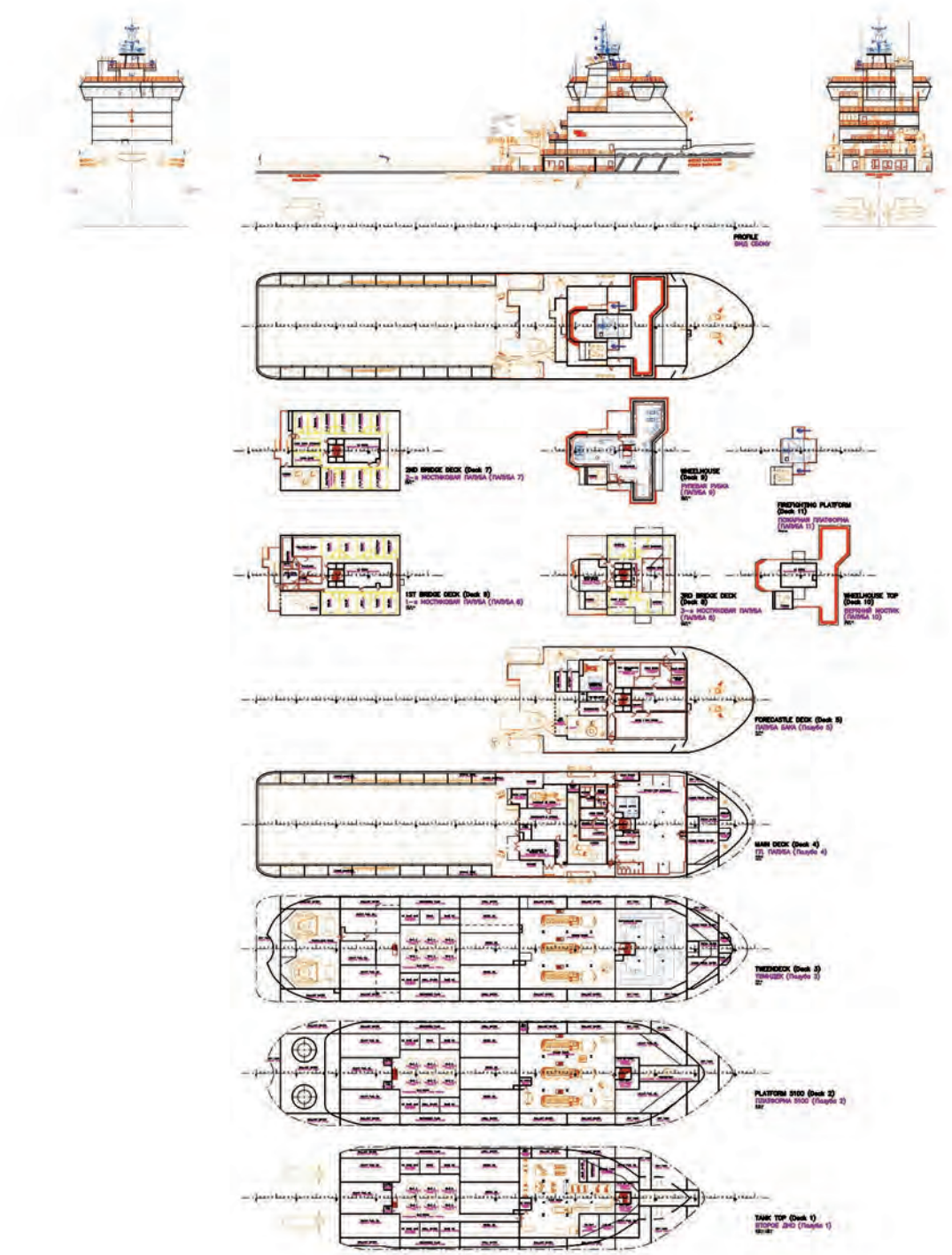
TECHNICAL PARTICULARS
FESCO SAKHALIN

Length, oa	99.90m
Length, bp	93.50m
Breadth, moulded	20.95m
Breadth, max	21.23m
Depth, moulded	11.00m
Draught, design/scantling	7.50m
Gross	6900gt
Deadweight	3950dwt
Crew	40
Rescue capacity	150
Main engines (diesel-electric)	3 x Wärtsilä 8L38B
Output	3 x 5800kW at 600rev/min
ABB Azipods	2 x 6500kW
Bow thrusters	2 x 1100kW
Flag (temporary)	Cyprus
Flag (permanent)	Russia
Classification	Det Norske Veritas +1A1 Supply Vessel, Icebreaker, Ice-10, DE-ICE, Standby Vessel, Fire Fighter I, NAUT-OC, DK(+), HL(2.0), DYNPOS-AUT, OILREC, SF, EO

***Fesco Sakhalin*, built by Aker Finnyards' covered Helsinki site, will employ the double-acting principle - going astern to break ice after turning her twin Azipods through 180deg - when operating in the difficult winter conditions of the Sakhalin fields in Russia's Far East.**

Seen here during outfitting in the covered building hall at Helsinki, *Fesco Sakhalin* displays her special stern and twin Azipods, each of 6500kW. Both hull and machinery have been strengthened to DNV Ice-10 standards.

General arrangement plans of the combined icebreaker and supply/support ship *Fesco Sakhalin*, built by Aker Finnyards' Helsinki site for the Far Eastern Shipping Co.



Apart from carrying out her critical icebreaking duties, *Fesco Sakhalin* will also supply bulk liquids, powders, and fuel to the Orlan platform. Six of these dry-bulk tanks, supplied by Rolls-Royce Marine, are fitted aft of the machinery space.

***Fesco Sakhalin* will also be able to deal with oil spills and is equipped with a full outfit of Lamor skimming and collecting equipment. Operations will be aided by this aluminium workboat which is lifted into the water by the Dreggen crane.**

for summer employment in the North Sea, rather than taking the traditional icebreaker lay-up.

At 99.90m overall length, *Fesco Sakhalin* is quite large for an offshore support ship but as noted, apart from carrying out these duties, she has an important - perhaps even more important - parallel role acting as an icebreaker. She has been assigned to support the ExxonMobil drilling and production platform Orlan, working in the Sakhalin-1 sector (Chaivo field) in the Russian Far East on a 10-year contract. Actual operator of the field is Exxon Neftegas.

Positioned in only 15m of water, this special gravity platform is subject, in winter, to huge build-ups of ice ridges and ice rubble against the base, which must be cleared regularly. Although designed for the Arctic, *Fesco Sakhalin* will sail to the Far East via the Suez Canal - a voyage along the Northern Sea Route is, in theory, possible during the months of July or August. FESCO has enjoyed a successful and transparent relationship with both ExxonMobil and Aker Finnyards during design and construction of the new ship.

Principal icebreaking capabilities come from a carefully honed aft hull form (developed in the AARC ice basin in Helsinki) in line with the double-acting principle and optimised for ice operations, and a pair of Azipod podded propulsion units, each with an output of 6500kW. The water flow along the hull when the pods are turned to their tractor pulling position means that ice friction is almost nil. *Fesco Sakhalin* should be able to deal with ridges up to 20m deep and will 4m of consolidation, also with level ice up to 1.5m thick - all in temperatures that can plummet to -40°C. To meet such difficult conditions, the hull and appropriate machinery are strengthened to the Ice-10 standards of Det Norske Veritas.

Primary power is generated in a diesel-electric plant comprising three Trieste-built Wärtsilä 8L38B medium-speed engines driving 6847kVA ABB alternators; there is an additional smaller 1080kW set for harbour and emergency use. The whole arrangement is monitored and controlled by CAE Valmarine equipment.

A large open-plan wheelhouse and control centre (there is also a modest engine office close to the diesel-alternator sets below) includes controls for a Kongsberg dynamic positioning centre; as well as controlling the two Azipods, this is linked to twin 1100kW Rolls-Royce tunnel bow thrusters. As with many vessels working in offshore oil and gas fields, there is a separate extensive control console at the aft end of the bridge and giving an excellent view over the large timber-sheathed working deck.

Speaking at *Fesco Sakhalin's* naming ceremony at the end of May, Mr Evgeniy Ambrosov, president and chief executive officer of the Far Eastern Shipping Co, presented a positive outlook for his company (which also runs container ships and bulk carriers) and hinted that a sister or near-sister to the new vessel could possibly be ordered in the future.

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Nupas-Cadmatic V5.0 is the ultimate 3D ship design software for ship designers and shipbuilders. Nupas-Cadmatic is a concurrent engineering software tool for ship hull-, machinery-, piping-, HVAC- and outfitting engineering. The open software is database-driven and utilizes advanced 3D modelling technology, providing the necessary information for accurate pre-outfitting and production.

With Nupas-Cadmatic you can successfully carry out the entire ship design project, right from the early start, up to the deck outfitting and final production phase. It improves engineering quality and shortens construction times.

The informative and easy-to-use 3D modeling capabilities can be used for the basic design, detailed engineering, and the production of workshop drawings and generation of ready-to-use production data for production machinery.

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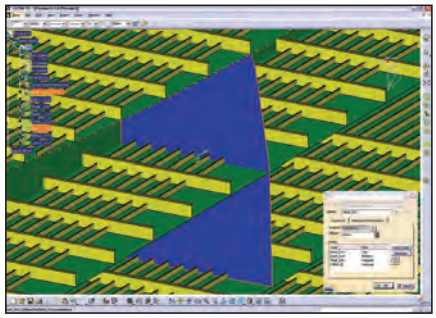
Focusing on design for production

IBM and its strategic partner Dassault Systèmes have again enhanced their interesting CATIA shipbuilding portfolio. Structure Functional Design and Ship Structure Detail Design modules now offer levels of design productivity and design re-use through rules-based knowledge tools. A totally new Structure Lofting offering provides process modelling, production simulation, and manufacturing documentation. With Version 5 Release 15 of IBM PLM Shipbuilding Solutions, shipbuilders can now design for production in a 'virtual shipyard' to a greater extent than ever before, claim the companies, enabling them to create a cost-effective ship design that can be built within the constraints of available resources. In this article, Maciek Jablkowski, Thibaud Colas, and Edward Popko discuss these new features.



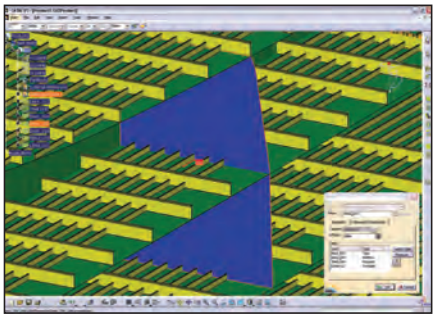
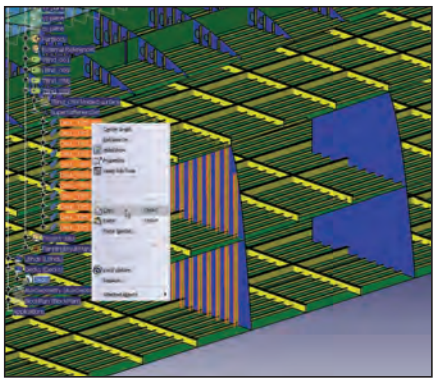


Fig 1. Example of built-in moulded convention rules at work. Customisable rule shows 'Fore' direction as compatible with a general rule for transversal bulkheads, while user overridden 'Aft' direction indicates the rule violation with red colour.



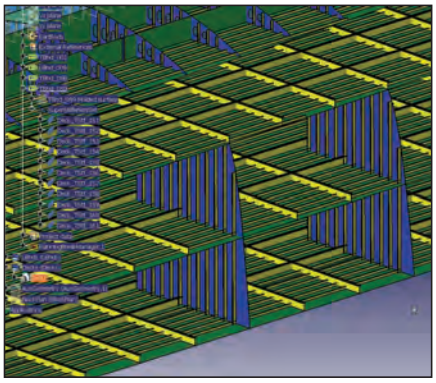


Fig 2. Examples of contextual copy/paste.

TRADITIONALLY, designers and production teams have used separate computer systems that do not share or extensively re-use data. This led to duplication of work, loss of data quality when data was translated system-to-system, unnecessary re-creation of production documents, and lack of optimisation where alternate build strategies could facilitate manufacturing.

Working with design and manufacturing teams at leading shipyards, IBM and Dassault Systèmes have focused on delivering a single system capable of integrating the work of designers and production planners. The goals were to automate as much of the detail work as possible and involve production planners early, when they can influence the build strategy and ensure that vital data is captured. An enhanced solution, available in the new CATIA PLM Shipbuilding Solutions, Version 5 Release 15, delivers:

- integration of design and manufacturing
- process-driven approach
- automated documents (sketches, lofting, BOMs, NC data extraction)
- construction simulation
- manufacturing design, work preparation and added manufacturing features.

Enhanced conceptual and functional design

The Structure Functional Design (SFD) workbench in CATIA V5 is dedicated to creating and modifying the basic ship structure. It includes features for all basic structural objects required for the preliminary and basic design stage, including plates, stiffeners, composite beams, openings, and material seams.

SFD achieves high levels of automation by applying knowledge-based design rules, as developed by a yard or required by classification societies, to drive and automate design work. Rules captured in the system use a shipyard's inherent knowledge of its craft to automate material specifications, conventions for aligning material around moulded surfaces and selection of structural connections between elements. All this adds up to high levels of automation, re-use, and standardisation.

Powerful copy/paste features allow users to copy an entire structural system, or any part of a system, and paste it into a new location. Throughout the operation, SFD maintains the topology, relationships and rules, taking into account the new boundary conditions and constraints of the new location. Considering the number of parts in structural layouts, this offers enormous productivity and quality benefits.

All connections between structural systems and their functional parts are stored as logical connections and are part of the product model. The connector defines what structural objects are connected (for example, a deck is bounded by the shell or a deck stiffener is attached to the deck plate). Through logical connectors, SFD can navigate every structural element by type or through an element's connection to another element in the structural system.

SFD logical connections offer users another benefit. Design intent can be captured because the logical connectors also facilitate automation of details like profile end-cuts, slots and collars. Parametric 'macros' exploit connectors to automate placement of standard re-usable structure components such as web frames, and bilge and docking brackets.

SFD provides a planning view of a ship's structure. The user can easily check the geometry of volumetric assemblies such as blocks and design units for manual editing or to automatically generate planning seams or detail design units.

After the seams are generated (but not necessarily modified), a set of reports can be generated, comparing the functional model to

the planning data. For example, weight and COG estimation can be performed at the block or design unit level. Similarly, material information or welding lengths can be reported.

Structure Functional Design highlights include:

- ability to capture full topology of the structural model (all connections and their characters)
- rapid modelling tools (extensive use of simple copy/paste)
- flexible modification possibilities
- early and accurate reports (such as materials and weights)
- design model integration with FEM packages
- ability to capture detailed design intent (seams and connection rules).

Detail Design

Release 15 of Ship Structure Detail Design (SDD) focuses on enhancing the creation and modification of detailed ship structures. Advances in PLM database infrastructure - namely the product-process-resource hub - maintain high performance and precision even given the extreme number of parts found in typical structural systems. SDD shares all data systems information with SFD and details all SFD elements such as plates, stiffeners, and composite beams. PPR integration links all SDD details with their SFD ancestors - a change to one automatically changes the other.

SDD converts the logical connections of SFD into physical joints (welds, bolt joints, and bi-metal joints). Those joints can be used to assign detailed weld information so that it is available for reports. A simple rule combining parts' categories with a welding table can be triggered to assign most weld information automatically. The user can exploit these features to standardise details or optimise features available on NC production machines.

Unlike traditional approaches to structural detail design, IBM PLM begins this phase with most of the needed parts, created automatically. This occurs during the process of automatically generating structural detail design models, which come out of the previous, functional design phase.

Designers and production engineers no longer focus on defining the structure scantling. Instead, they are free to focus on detailing the final structural piece parts, ensuring that they will fit together in the ship assembly process.

SDD offers detailing features such as structural penetrations (also known as slots), profile end-cuts, chamfers and brackets, as well as other small detailing features like water stops. If design rules have been attached to SFD connections, SDD parts can be made automatically. For example, profile end-cuts can be created, slots cut out and collars placed where required.

Structural Detail Design (SDD) highlights include:

- automatic generation of details parts from basic (functional) design
- ability to automate the generation of rule-driven structural details
- detailed solid representation of final structural model
- detailed reports (materials and weights).

New DPM structure lofting

A new DPM Structure Lofting (DST) module within DELMIA was specifically developed to bridge the design-production gap for ship structure. DST provides a toolset dedicated to creating all work preparation information required for ship structure fabrication and assembly.

A key feature of DST is its ability to model processes - the sequences, inter-dependencies, timing, and resource (equipment, space, man hours) required to meet a build strategy - rather than traditional assembly trees. The bridge between CATIA's structural design applications SFD and SDD, and DELMIA's production and simulation functions is managed by ENOVIA, IBM PLM's strategic product data management solution.

A typical workflow starts with the definition of a design unit, along with the activities and processes required to make it. Design units are broken down into manufacturing sub-assemblies - for example, units are made of deck and wall (or bulkhead) panels. They, too, have their own sub-assemblies and associated activities. Each of these interim steps, in making the unit, requires an interim product. Thus, a significant part of manufacturing planning is defining all these products, what is needed to make them and how they come together to make still larger assemblies - ending with the completed ship.

Production planners select which set of activities applies. Planners can review and manually modify each of the operations.

DPM - assembly simulation

DELMIA V5 DPM Assembly integrates completely with DST and provides process planning and verification solutions for assemblies. It offers manufacturing engineers and assembly process planners an end-to-end solution by incorporating a single, unified interface for pre-planning, detailed planning, process verification, and shop-floor instructions.

The assembly process and links to the product and resource data are stored in the PPR Hub - a shared database of product, process, and resource (PPR) information. The user populates a library of process 'best practices' to facilitate re-use, along with a catalogue of needed manufacturing resources. Then it is simply a matter of drag-and-drop to create the assembly process with the related resources.

This process library contains constraints, precedents, and actual performance data, based on previous experience. The process planner and manufacturing engineers can therefore begin their work before the product design is complete. They can develop the sequence of operations, re-using best practices whenever possible, and assign resources such as tooling, fixtures, and labour classes to each process step. Finally, they can determine throughput and estimate cost. As the product geometry becomes available, it is linked to each process step to validate the combination of product, process and resources in a 3D environment.

By using DELMIA process planning from the very beginning of the product realisation process - even before the product geometry is available, a process planner can have a significant impact on the product design in a concurrent engineering environment.

DPM Assembly introduces the concept of a hierarchical process model, which enables engineers to begin process planning at a high level and slowly populating the model with detailed activities and links, increasing the fidelity of the process model as the build strategy matures. Each product, activity or resource is linked to the data in the PPR Hub. As product engineers make changes to a design, those changes are automatically reflected in the process validation. Process engineers can also supply product engineers with necessary feedback regarding assembly feasibility.

continued

Fig 3. Connections stored for a bulkhead at the early functional design stage.

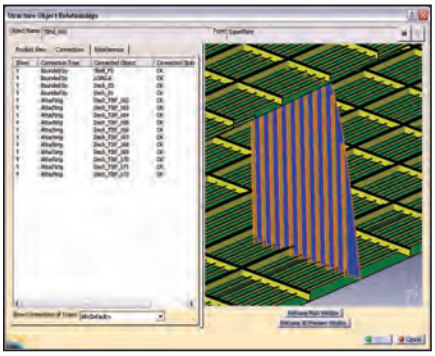


Fig 4. Structural Functional Design (SFD) workbench.

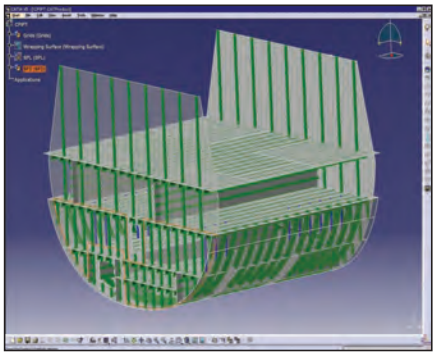
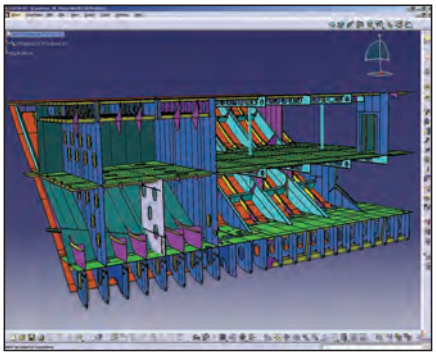


Fig 5. Shipbuilding Structure Detail Design (SDD) workbench.



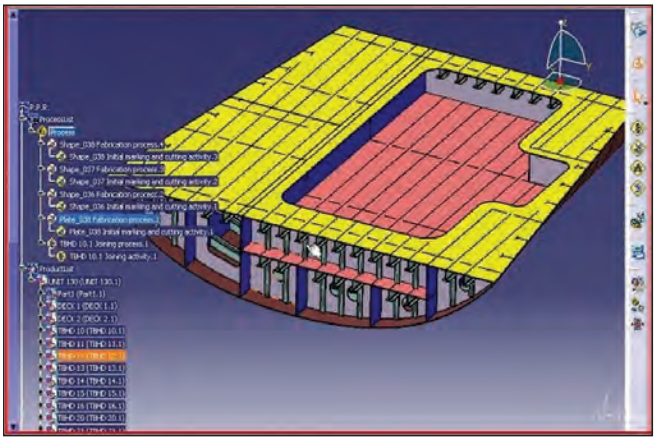


Fig 6. DPM Structure Lofting workbench.

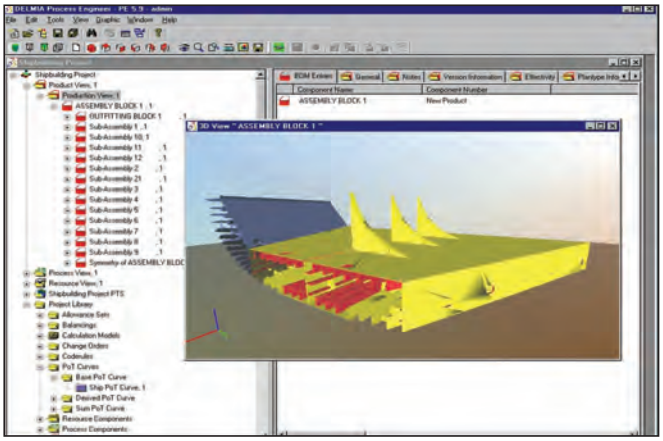


Fig 7. DPM Assembly workbench.

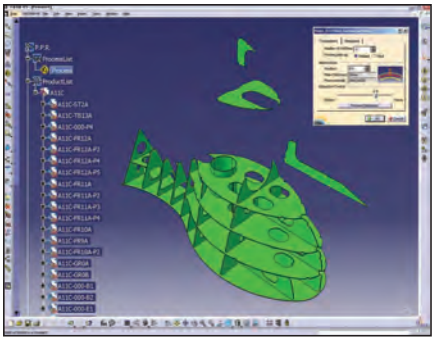


Fig 8. Another example of the DPM Structure Lofting workbench.

This module also enables users to quickly and easily generate assembly sequences and part motion through its intuitive interface. Users simply select the part and then begin scripting the desired assembly path.

DPM Assembly offers interference-checking capability that enables the user to specify acceptable part proximity. Part collisions and clearances are detected, displayed, and highlighted in real time. If parts collide, the system automatically generates an interference curve and sends relevant data to design.

Any collisions found can also be managed. Users can define and save lists that apply to their work (piping, structural, or machinery). This ensures that that the right groups are involved in resolving them. Dynamic interferences are also checked. Using dynamic cross-sectioning, a flat plane can be moved through 3D space, and an assembled part can be cut through to allow inspection of internal details. DPM Assembly automatically generates a swept volume to visualise clearances. This swept volume is created as a part, enabling it to be measured, exported to CAD and used in a collision clearance evaluation. This is particularly useful for reserving maintenance paths.

Simulation

Re-work and wasted material are areas where yards traditionally have lost time and money. Capital equipment under-utilisation and poor deployment of skilled labour are other sources of loss. Manufacturing simulation offers enormous potential for optimising all of these.

DPM Assembly utilises the PPR Hub and provides an analysis simulation component to DPM Structure Lofting, making it possible to simulate the entire construction sequence. These time-motion studies provide summary statistics on the resources (time, human, or equipment) required. Bottlenecks in the process are revealed. The amount of non-value-added expenditure is shown, such as temporary queuing of materials or interim assemblies. The same applications can also simulate strategies for accelerated processes by changing the capacity, equipment or deployment of skilled resources. The cost-benefit return for facilities/production cannot be overstated.

Manufacturing documents

Today, manufacturing output for structural fabrication mainly involves burning contours for parts (either drawings or NC code), as well as forming, bending, and assembly instructions for drawings, reports and work instructions. All this work is done automatically by DPM Structure Lofting. All required documentation is provided for pre-defined resources and processes. For example, a pin jig 'knows' that it requires a pin jig height report, which is generated automatically. The curved panel assembly process that is performed with this pin jig 'knows' that it requires a parts list and accuracy control data (such as a remarking report, known in the USA as a 'girth tape').

The moment that an association is made between a particular collection of parts (assembly) and the process used to produce the assembly, all required manufacturing output is known and can be extracted automatically. Obviously, all documents, drawings, reports may be customised to suit a specific shipyard's facilities layout and capital equipment arrangement.

Once a satisfactory workflow has been developed, DPM can extract manufacturing features from the model. These include joining, cutting, marking and forming, special section marking, extraction of plate parts, profile part extraction and documents. The most common documents needed include profile fabrication sketches, bent profile templates, plate fabrication sketches, plate forming templates and profile bending curve data for NC machines. Fig 8 shows an example of typical documents produced by DPM for Structures.

The features of DPM for Structures include:

- ability to bridge design to production using a single data model
- ability to capture production process
- full integration with design data
- use of PPR approach
- ability to model process rather than just an assembly tree
- shipbuilding manufacturing output generation
- data extraction for manufacturing such as NC or flat pattern
- simulation capabilities.

Conclusion

IBM's PLM Solutions have been upgraded to deliver new functional enhancements for structural steel work in shipbuilding. Structural Functional Design and Ship Structure Detail Design components in CATIA and DELMIA DPM Structure Lofting link design-to-production and deliver analysis and manufacturing documents. DPM Assembly allows simulation of assembly sequences to be optimised for a particular mix of capital equipment, facility layout and human resources. 'What-if?' scenarios allow engineers to determine the cost-benefit of changing production processes or enhancing the capacity of equipment, scheduling or human resources, as well as analysing build-around situations in response to real-world delays.

The benefits to yards of using IBM PLM Solutions with Structural Functional Design, Ship Structure Detail Design, DPM Structure Lofting and DPM Assembly include:

- integration of design and manufacturing
- shared product-process-resource (PPR) database for engineers and planners
- no re-entry of data between design and manufacturing
- the ability for manufacturing to always work with the current version of the model
- a process-driven approach subject to time/sequence optimisation
- automated extraction of documents
- full simulation of construction, which allows a shipyard to 'build' a ship many times in the virtual shipyard, ensuring a smooth process and build-it-right-first-time accuracy during the actual, physical build
- sub-detailing for manufacturing of assemblies to facilitate production.

New hull work module aids information flow

A HULL Work Preparation Manager module (Hull WPM) has been added to the Hull Viewer in Nupas-Cadmatic version 5.1. The purpose of Hull WPM is to streamline the information flow between planning, engineering, work preparation, and workshops. Hull WPM claims to speed up the process of work preparation significantly, and can thus shorten the throughput of the ships' several assembly stages.

The hull module provides a set of unique tools for automatic detection and assigning numbers to assemblies, panels, and parts. Parts such as profiles, brackets, and collar plates are automatically assigned to the correct panel. With this functionality, the complete work breakdown structure of a hull block can be fully determined automatically by the software. The depth of the work breakdown structure can be freely defined up to 16 levels.

Each individual part can, in addition, automatically receive a workshop 'process code' and 'job number', based on the part's properties and work process at hand, such as flanging, cutting, bending, or bevelling. These combined features enable the shipyard to flexibly generate the desired work breakdown structure automatically.

With this module, a user is able to control the complete work breakdown structure of a hull block easily and quickly. The Hull WPM module can be used directly in the 3D Hull Engineering module but is also available as a stand-alone version.

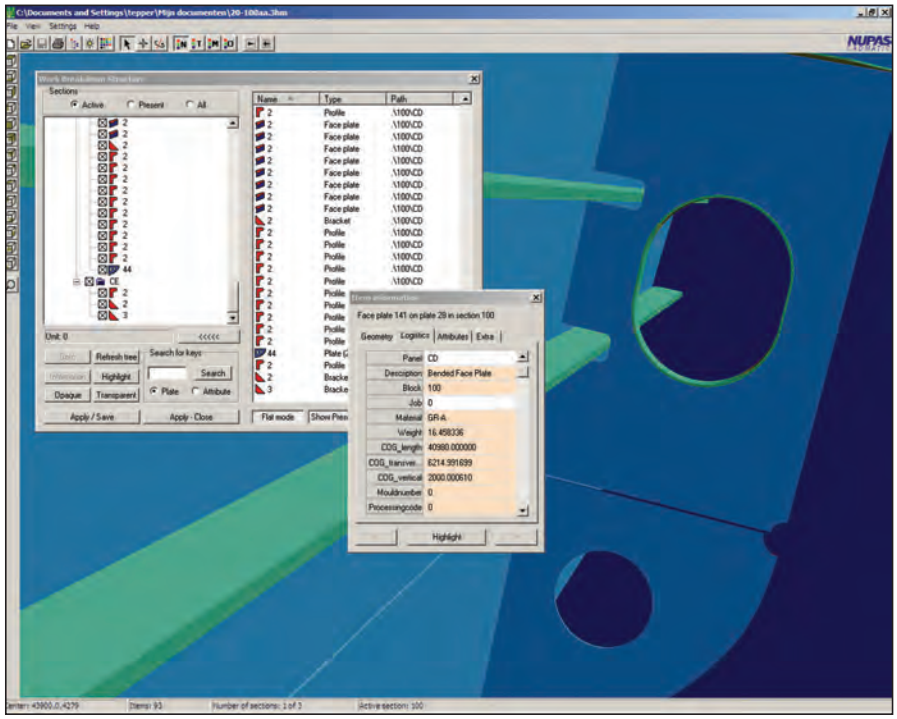
Hull WPM is claimed to be simple to use. Once a work breakdown structure has been generated by the software, a user can manipulate its structure by dragging and dropping items on the workstation screen, rename assemblies, panels and parts, and also create new ones. Hull WPM is operated like Windows Explorer. The work breakdown structure of the hull block is presented as a tree structure in the 3D Hull Viewer, showing both the 3D model and work breakdown structure in the same view.

Hull WPM is available both as integrated in the Hull Viewer or as a standalone module. The manipulation of the work breakdown structure with the integrated Hull Viewer is directly processed by the 3D Hull database.

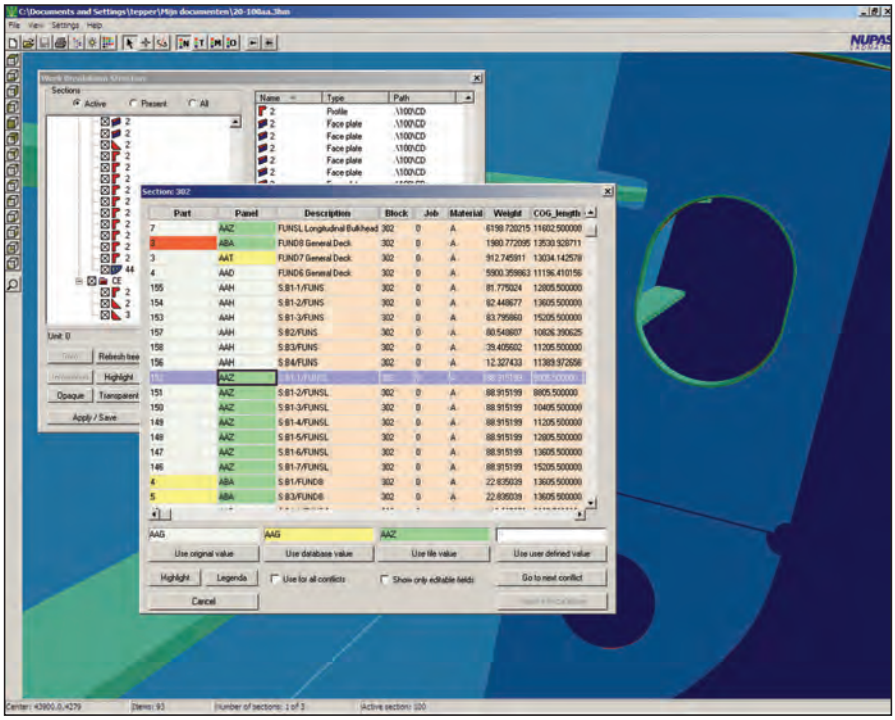
The standalone version of the Hull WPM has the advantage that it does not require a full Nupas-Cadmatic Hull licence. It is intended to be used between project partners, such as engineering offices and shipyards, or between the engineering and work preparation departments at a yard.

When used with the stand-alone Hull WPM module, the 3D Hull model and all logistic data are contained in one single compact file and can easily be synchronised with the 3D Hull database. During synchronisation the consistency with the 3D Hull database is checked and maintained.

A practical example of using Hull Work Preparation Manager is where the work preparation department determines the actual work breakdown structure based on the 3D Hull model. The modified logistical information in the 3D model is returned to the engineering office and merged into the hull database, after which the engineering office delivers the production information in the desired format to the workshops.



The work breakdown structure of a hull block.



Database consistency check with the 3D Hull database.

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Important updates to Foran

FOLLOWING its release of Foran Version 50R3.0 in December last year, Sener launched Version 60 at the end of June. There has been an ongoing beta installation, and this will be finalised in September. This new version of a well-established suite is heralded as the 'best shipbuilding CAD/CAM ever launched'. It comes after years of investment in a new Foran kernel, assimilation of the latest software techniques by the developers, and collaboration with the many users. It is this last feature that ensures the system addresses the real problems of the industry.

New tools are provided for defining internal hull structure using a single model for initial, basic and detail design, and re-using the same data throughout the process. This increases efficiency and, importantly, reduces the chances of transcription errors, and the time in each phase. The new system increases efficiency by using a specialised interface, with which it is possible to work simultaneously with several surfaces, define any structural element in 3D or 2D with the usual shipbuilding symbols represented.

Another feature is the use of advanced Oracle queries techniques that allow a designer to work on any kind of area, ranging from one piece, to a whole ship. The information produced on line interacts automatically with the other pieces of the project, even if they are not being worked on at that time. This increases productivity and avoids design errors, particularly between blocks or sub-assemblies, because there is only one source of information. The system also allows multiple access so that several designers can work in the same geographical area.

The new version includes important shipbuilding aid design techniques, such as the handling of crossing/non-crossing structural elements; intelligence in the notch and collars insertion depending upon whether the structure is watertight or not; and definitions of brackets, face bars, stiffeners, and corrugated plates. Additional features are provided for weight, centre of gravity, and painting area calculations.

Sener also claims that Version 60 provides the most innovative and fully integrated shipbuilding electrical CAD system. This is to help meet the demand for specialised types of ship with increasingly sophisticated onboard equipment and technologies. The benefits of the new version, resulting from the full integration achieved, include consistency with no redundant information or incompatibilities. Different activities can progress in parallel, so increasing productivity.

The system, supported by its 2D and 3D graphics, and working on the same relational database, provides an efficient connection between the electrical department and other disciplines in a yard design office. Besides the 2D and 3D environment, the application provides a report generator. Reports are generated directly from the database and cover items such as cable specifications, fitting rules, and equipment.

In the machinery and outfitting area of Version 60, pipe routing is empowered by its online pipe-bending control, ensuring that pipes defined during modelling will be capable of being produced in a bending machine. This version also includes advances in automatically generated information such as all outfitting components, piping and ducts insulation, piping, cable trays and auxiliary structure, and supports. For advanced users who wish to develop their own commands and functionalities, an easy access has been created to Model Definition and Exploitation tools through the Foran Development Environment embedded in the application.

There is a new module for damage probabilistic calculations, which has an efficient user interface and includes the latest class society rules. This module makes possible damage probabilistic calculations including data management, calculations, and classification rules that must be met. It includes the ship type (eg, cargo or passenger), the regulation to be met (such as SOLAS), initial and final calculations.

Subdivision can be based on already-defined compartments or defined online. At any time a new compartment can be introduced into the already calculated situation. For the initial phases of a project, in which only the hull form and main deck are defined, the sub-division will provide an initial compartmentation with decks and bulkheads to meet the SOLAS regulation. This can then be used to help define the final arrangement at a very early stage with the guarantee that the ship should meet regulations.

It is claimed that Foran is now better than ever for producing information on hull structures, providing an efficient way to generate, understand, check and control the production information. All outputs, such as plate development, panel jigs, and profile bending information, can be handled from any building strategy tree or directly from any selection of the 3D scene; all graphic outputs are completely integrated with the new Foran drawing formats; outputs are compatible with the suite's documentation system, and an interactive graphical 2D editor provides a preview of all graphical outputs.

In the plate development module, there are new options for bending plates; intelligent treatment for symmetrical plates; and a new cross-templates technique for large curvature plates. The information on each plate's own bending parameters is stored for ease of recalculation and modification.

Significant developments have been made in Panel Jigs or Panel Fabrication Berth. Powerful automatic fabrication plane definitions are used. Any subset of plates, on any Foran surface with the only condition of continuity, can be worked on, even when the subsets belong to different surfaces. The system will automatically calculate the outer contour of a panel composed by this group of plates. In Profiles Fabrication, more information is provided for reverse curvature when carried out in more than one segment and there is more information on drain holes and notches.

In April, SENER announced that the Russian Maritime Register of Shipping has issued an approval certificate for Foran naval architectural calculations including hydrostatics, cross-curves of stability, floodable lengths, damage stability, longitudinal strength, and freeboard. The approval covers monohulls and unconventional hulls (floating docks and multi-hulls). Also, earlier in the year Sener reported that the Bulgarian company Marine Design Ltd had become a Foran user and the company's representative in Bulgaria.

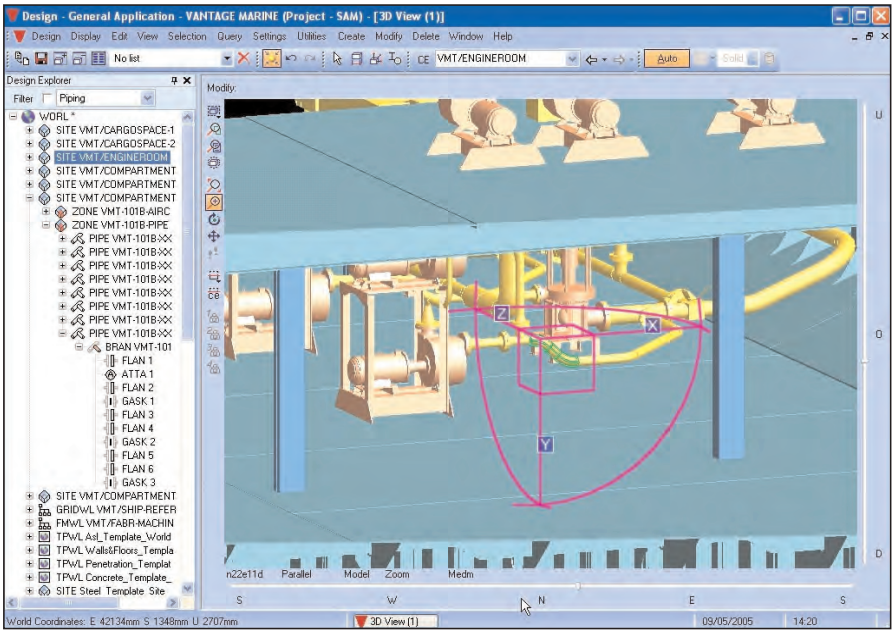
Company union results in comprehensive building solution

ONLY 14 months after the purchase of Tribon, AVEVA, the process, power, and marine solutions group, has released the first software that brings together its PDMS technology and Tribon. VANTAGE Marine 11.6 (coinciding with the 11.6 release of PDMS) is an advanced solution for shipbuilding and offshore design and production, bringing the two well-established systems together to offer design and production tools to the marine and offshore industries, as well as hull design and production solution with the outfitting functions of PDMS.

In the design phase, users can save calendar time, it is claimed, by working in parallel, both internally as well as externally, due to VANTAGE Marine's coordination capabilities. Man-hours can also be reduced through the efficient creation of production information and documents for manufacturing and assembly. In the production phase, material costs can be decreased and man-hours saved due to manufacturing information. This leads to better fitting of parts in the assembly process, less rework, and full utilisation of workshop machines.

Data from all structural and outfitting disciplines, required to define a complete design and its production information, are stored in one and the same ship model database. The close association between the hull and the outfitting data allows the hull structure and outfit designers to work in parallel, sharing the most up-to-date information during design development and producing integrated, clash-free final arrangements with all hull penetrations and supports defined.

The system has parametric modelling tools for each specific design discipline. These functions are also claimed to have best-in-class modification features, enabling design changes to be made efficiently. The design functions include specific production checks to ensure that the design fits the production process at a shipyard, ensuring the most cost-efficient production.



The close association between hull and outfitting data allows hull structure and outfitting designers to work in parallel, sharing the most up-to-date information during design development and producing well-integrated, clash-free final arrangements, with all hull penetrations and supports defined.

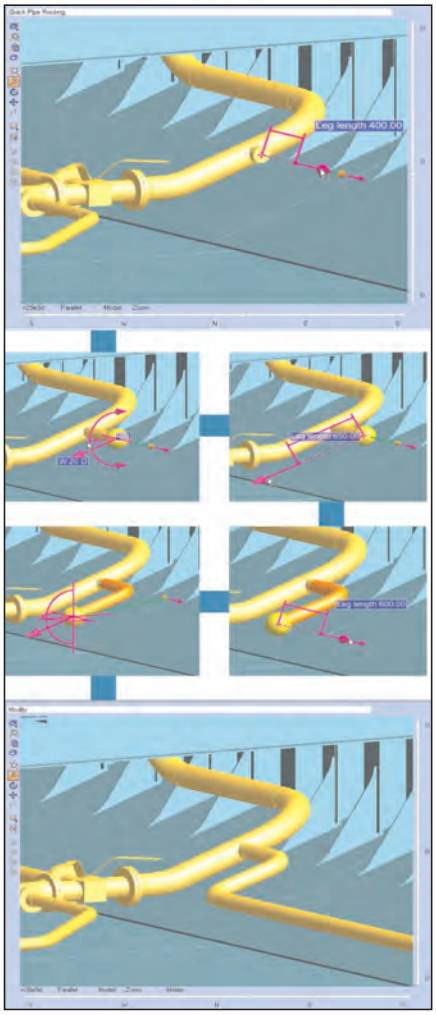
Defining parametric hull structures

A new concept for definition of parametric hull structures is also introduced in this new software. This is a development of the already existing reference surface objects (RSOs), to which information about plating and stiffening can now be added. This information is in the form of parameters that form a 'recipe' for how steel panels will be automatically generated from the RSOs.

The recipes can be created via the ordinary interactive user interface of the surface/compartment or basic design applications. In this way, a preliminary steel structure for a ship can be generated from parameter values in a matter of few hours and several different alternative design and dimensioning approaches can be analysed for steel weights, surface areas, and section modulus.

There are also a number of production benefits in the software. Minimisation of rework comes from close attention to accuracy at all stages of design and production, so that everything is done correctly the first time. Built into VANTAGE Marine 11.6 is knowledge of the shipbuilding process, including a high standard of automatically created production information for all parts. This information includes items such as allowance for shrinkage in manufacturing, so that all parts fit first time. Avoiding unnecessary rework saves time and money, and also eliminates internal conflicts.

VANTAGE Marine 11.6 has practical, common-sense features that should promote accuracy. Piece parts and their related production information are automatically created from the model, without the need for input by the designer. These piece parts are therefore consistent and include all necessary production features, such as marking lines and allowance for shrinkage and edge bevels, to ensure high-quality and accurate results in production.



Quick Pipe Routing enables users to graphically define the route of a pipe by employing the mouse pointer to specify changes in direction in absolute terms or relative model features. Bends are automatically inserted where a route changes direction.

All drawings, sketches, and reports are generated directly from the 3D Ship Model. Dimensions and intelligent annotations can be added, and are automatically updated when the model is changed. Drawings can be set up to highlight changes made since the last revision of the drawing was created.

Bending and flange rotation checks are carried out against the actual machines in a customer's pipeshop, and all pipe sketches contain full instructions for pipe spool manufacture, taking into account the capabilities of these production machines.

Product data is available to all parties involved so that users can 'pull' out the information they need, when they need it. All data relevant to parts manufacturing and assembly is contained in the model, and can be extracted in the format each individual user requires. Each production activity can have its own document, containing precisely the information needed to perform that particular activity. As production information is automatically created, engineers or workshop planners can prepare and print work instructions on a 'just-in-time' basis.

Users of this new software include Hyundai Heavy Industries, in Korea, which is implementing the system at the present time. This shipyard worked closely with AVEVA in evolving the programme and will be the first users. This contract with Hyundai, worth an estimated £6.5 million, is said to be AVEVA/Tribon's most significant deal ever.

An upgrade for version 11.6 is already being worked on, and version 12 is planned for release at the end of 2006. All users of 11.6 will automatically be upgraded to version 12 when it is available, if they pay for software maintenance.

Quick preliminary steel structures now offered

In other news, a package of enhancements for the Tribon M3 ship design and construction system has recently been released. Tribon M3, Service Pack 4 was available from the end of June and includes a number of new functions as well as enhancements that should further improve the usefulness of the Basic Design application of Tribon M3.

A new concept for definition of parametric hull structures is introduced in the new Service Pack. This is a development of the existing Reference Surface Objects (RSO), to which information about plating and stiffening can be added. This information is in the form of parameters that form a 'recipe' for how steel panels will be automatically generated from RSOs. Recipes can be created via the ordinary interactive user interface of the Surface/Compartment or Basic Design applications or in batch mode via csv-files (that is, Excel types). In this way, a preliminary steel structure for a ship can be generated from parameter values in a matter of few hours, and several different alternative design and dimensioning approaches can be analysed for steel weights, surface areas, and section modulus.

2D views in a drawing can now be converted into RSOs and thus oriented in 3D space. Elements of the drawing view can then be used as backdrop references for modelling of 3D steel structures, placing of equipment, and routing of pipes. In this way, a general arrangement drawing can be imported from any 2D-based drafting system, converted into a Tribon drawing view (using DXF), and then used as a backdrop for modelling.

Another addition in Service Pack 4 is the new XML-based export functions for 2D cross-sections of ship structures. A series of 2D sections can be requested from the 3D model and the system will create an XML file with all necessary data about the longitudinal members to satisfy rules check and strength calculation software packages from classification societies. Together with the previously released 3D-based export format, the new 2D cross-section-based features presents a full set of open export facilities for hull steel structures.

Service Pack 4 also presents a new way of creating so-called sliced views of a 3D model. This means that a section slice can be cut from several thousands of 3D model objects and subsequently presented in a drawing with interactive performance. A Tribon M3 drawing can contain a virtually unlimited number of graphical elements, and a view of, for example, a complete deck with all details can now be created in a very short time.

Five new languages supported

A major part of the new Tribon upgrade comes in response to business growth in the largest growth centres of the marine industry. Version 10 of Tribon.com now supports Chinese, English, Japanese, Korean, and Russian languages, enabling users of non-Latin character sets to select a preferred language for the user interface on the Tribon.com website.

The possibilities for communicating between shipyards and suppliers have been further enhanced by the introduction of a new Enquiry function. This allows users at the design and procurement departments within a shipyard to collaborate directly with suppliers in the creation of material enquiries.

Enquiries are based on standardised categories, providing individual templates for different kinds of shipbuilding products. When an enquiry draft has been completed, it can easily be sent to multiple suppliers via e-mail.

A shipyard is then informed of the supplier's acceptance or rejection of the enquiry, as well as the availability and technical suitability of their products. The shipyard can therefore easily evaluate the responses and make a selection of supplier. This integration within the supply chain is expected to radically reduce cost, time and error in the material procurement task.

Integrated workflow for Japanese shipyards

A NEW integrated workflow for Japanese customers who want to use EasyStruct for structural design and ShipConstructor for piping and penetrations has been announced by Albacore Research Ltd (ARL) and Universal Marine Systems (UMS). ShipConstructor, developed by ARL, is a well-established AutoCAD-based 3D product modelling system for the design and fabrication of ships and offshore structures. Users have the benefit of a single integrated solution for the engineering of shell plate, structure, piping, HVAC, and equipment.

EasyStruct, developed by UMS, is an AutoCAD-based 2D design and 3D structural modelling system widely used by shipbuilders and other industry manufacturers. EasyStruct users have long been in need of a way to augment their current structural design process with solution for piping and penetrations, and this new union has provided the solution.

Engineers can now convert structural design created within EasyStruct to a ShipConstructor 3D model. ShipConstructor is then used to place outfit items and run pipe through the EasyStruct structural model. Penetrations are then automatically created from the library of approved penetrations. Using a transfer mechanism, penetrations are easily transferred from ShipConstructor into the EasyStruct drawings. The database transfer mechanism even deals with changes to existing penetrations or deletions. This is said to result in significant time-savings and improved accuracy that facilitate early outfitting and generate the potential for automation.

Making this project a success required the close collaboration of the two companies. Developers at both organisations have been working together, not only to enable the transfer of data between applications, but to make the dataflow as simple and robust as possible. Over the past year, ARL has increasingly focused development efforts on the specific needs of the Japanese shipbuilding industry. A recently released update of ShipConstructor includes, among other features, a feature for easily creating accuracy control marks, a practice common in Japan for accurately aligning stiffeners on plates and aligning plates for welding.

The new ShipConstructor/EasyStruct integrated flow will be available to ShipConstructor and EasyStruct customers in forthcoming updates of ShipConstructor and EasyStruct.

Multihull design tools come of age

WITH the continuing increase in the number of multihull vessels that are being designed and built, it comes as no surprise that software developers are extending their CAD/CAE tools to better support the specific requirements of multihull designers. One such example is Formation Design Systems' Maxsurf suite of naval architecture software. Maxsurf is used by a wide range of designers and shipyards all over the world, with the largest user group being medium-sized shipyards such as Austal Ships, in Western Australia, or Damen Shipyards, Singapore, specialising in innovative, high-performance workboats and ferries.

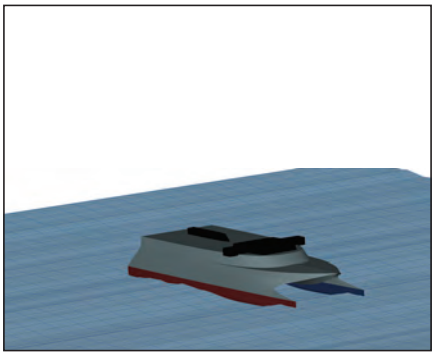
In the latest release of the Maxsurf suite, Formation Design has focused on providing additional tools that will enable users to quickly develop and optimised prototype multihulls. Whilst it has always been possible to design and analyse stability characteristics of multihulls in Maxsurf, it has been more difficult to analyse the resistance and seakeeping performance of such vessels. The capability to do this has been achieved by adding theoretical-based resistance and seakeeping analysis functions into the Maxsurf suite.

Formation's philosophy for analysis tools has been to provide software that is easy to use by naval architects who do not have specialist computational fluid dynamics (CFD) knowledge, yet is powerful and accurate enough to provide meaningful comparisons between design alternatives in the preliminary design stage; if the project warrants it, an analysis can be refined using more sophisticated tools as the design is developed.

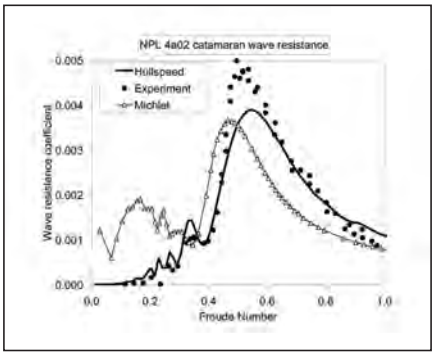
Michell's method employed for wave-resistance calculation

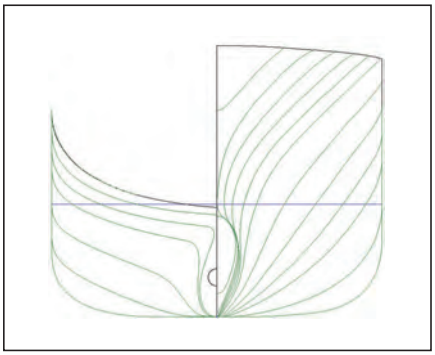
Hullspeed is the resistance prediction tool in the Maxsurf suite. It includes a comprehensive range of regression-based methods for a variety of monohull vessel types. In the latest version, a theoretical wave-resistance method has been added. The theory, which is based on Michell's method, is suitable for predicting the resistance of slender mono and multihull designs. Because

Seakeeper: real-time simulation of a catamaran vessel in a seaway.

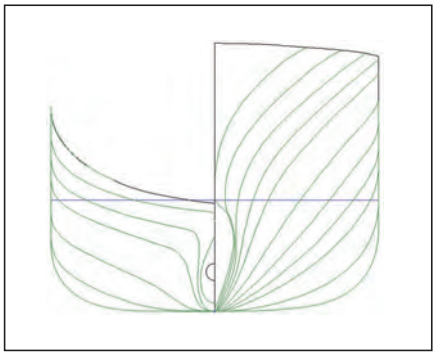


Hullspeed: a catamaran resistance curve computed and visualisation of the vessel-generated waves.

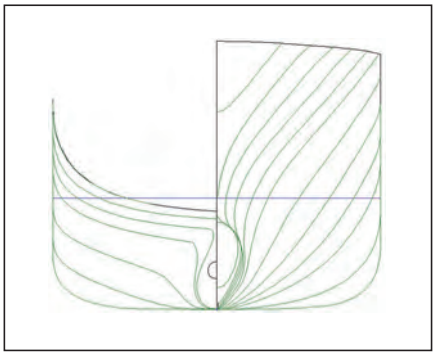




Parent Cb = 0.50, Cm = 0.93.



Cb = 0.55, Cm = 0.93.



0.55, Cm = 0.95. The parametric transformation dialogue in Maxsurf and systematic series generated from a single parent hull form.

the individual demi-hulls of catamarans (and other multihulls) are normally extremely slender, this method is ideally suited to resistance prediction. Using the same theory, Hullspeed is also able to predict the wave system generated by these vessels. This provides effective visualisation of results and helps explain the results of the analysis to clients in a format that is readily accessible to non-naval architects.

Michell's method is said to be ideally suited to initial design and prototyping due to its speed (vessel resistance for a complete range of speeds can be solved in a few seconds on a standard PC), robustness, and ease-of-use (requiring virtually no domain-specific knowledge on the part of the user). This means that a large number of candidate hull forms can be compared efficiently early in the design stage or during a tender. If funds and time permit, successful designs can then be analysed in greater detail either by using more sophisticated CFD analysis or by tank testing with physical models.

Seakeeper, the Maxsurf suite's seakeeping analysis package, provides users with the ability to perform seakeeping performance comparison at the initial design stage. Seakeeper uses a strip-theory method, based on the well-known work of Salvesen, Tuck, and Faltinsen. Although quite simple in many ways, this method has, over the years, been shown to provide remarkably good results for a wide range of hull forms. Again it is suitable for application to slender hulls and can provide useful predictions of heave and pitch motions for catamarans. Formation Design is actively working on providing improved capability for analysing catamarans and other multihulls.

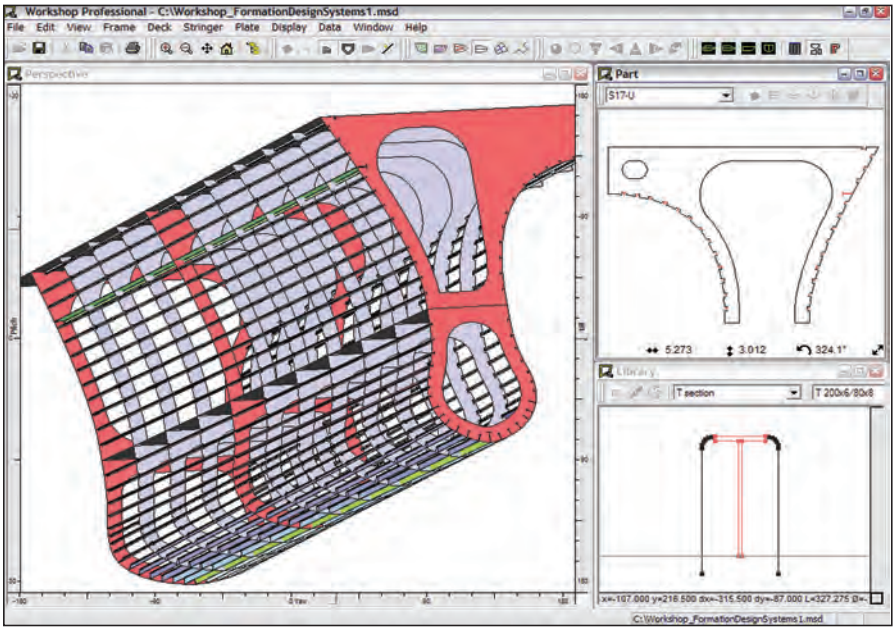
Assistance from Force Technology

Whilst the analysis methods described above are useful in initial design, or where the project does not warrant more expensive analysis of resistance and seakeeping performance, many design offices are making use of today's powerful computers and using sophisticated CFD packages. Hydrolink (the Maxsurf suite's data exchange program) is able to export to a growing number of these file formats. Currently file formats for both SHIPFLOW (calm-water resistance) and VERES (vessel motions) are supported. In the case of the SHIPFLOW interface, the development was done with the assistance of Force Technology, Denmark.

Force Technology is an experienced user of SHIPFLOW and was able to assist with the development of an easy-to-use interface for exporting Maxsurf designs. This facility enabled Force Technology to quickly generate SHIPFLOW models from Maxsurf designs assisting in the optimising of hull lines and in particular the flows around bulbous bows. The SHIPFLOW interface allows the user to define both hull- and lift-groups; the extents, surfaces, and number of sections can also be specified for each group, allowing complex Maxsurf designs to be exported for analysis.

The additional analysis tools and interfaces described above become even more powerful when coupled with the parametric transformation tool in Maxsurf. This enables rapid generation of a systematic series of hull forms from one parent hull. The systematic series can then be analysed in Hullspeed for resistance and in Seakeeper for seakeeping performance. The parametric design tool allows for complex manipulation of a parent design whilst still maintaining the fairness of the original. Not only can simple scalar transformations in displacement, length, beam and draught be achieved, but also more complex hull form manipulations such as distorting the hull to provide a desired sectional area, block or prismatic coefficient, or longitudinal centre of buoyancy.

Generation of structure in Workshop, showing structure of a typical catamaran with details of one frame.



Enhancements to Workshop module

Maxsurf's integrated design environment extends from initial concept design, through analysis, to parametric modelling of the primary ship structure. This link from design to production is being expanded with enhancements to Workshop - the structure definition program in the Maxsurf suite.

In Workshop, a parametric design philosophy is maintained, allowing concurrent design practices: the main structural elements can be defined while the hullform is still undergoing final refinement. Once the hull form is finalised, it is simply a matter of asking Workshop to recalculate the frames and other structural elements, taking into account the modified hull form. These elements are then exported for final structural detailing and design for production.

Formation Design Systems has teamed with industry partner Albacore Research to link to the latter's structural detailing program ShipConstructor. The Workshop/ShipConstructor link is now being used by a range of shipyards involved in construction of naval vessels, high-speed ferries, and tanker refits, amongst others. The link, which fully supports multihull vessels, helps improve communication between design and production teams by creating a unified 3D product model of the ship structure.

CAD system extended company-wide at MHI

JAPANESE shipyard Mitsubishi Heavy Industries Ltd (MHI) has taken NAPA, Napa Ltd's naval architectural software package, into corporate-wide use as the company's primary system for early ship design. NAPA will be deployed in Japan throughout all MHI shipyards, at the corporate headquarters in Tokyo, and at the MHI research institute. MHI is also allocating resources to the development of company-specific NAPA Manager applications, with the aim of enhancing the overall design system.

Initially, MHI put NAPA into use at the Nagasaki yard for its Princess cruise ship project in 2001; since then, the shipbuilder has gradually expanded the system's use to other ship types, and to other yards within the group. Features to be used throughout MHI include, among others, the NAPA Steel system for ship structural design at early stages, and a wide range of naval architectural subsystems.

MHI's decision to invest in in-house Manager application development follows a number of similar decisions made by some of the world's largest shipbuilders. NAPA Manager applications are said to have gained wide-ranging acceptance from the industry in a short period of time. The NAPA Manager offers tools for organising complex ship design processes into logical hierarchies. Tasks can be carried out by following organised work flows, making the design process straightforward and manageable.

Attractions of Contract Design and Stability Booklet Manager modules

Napa Ltd offers a selection of standard NAPA Manager applications, such as the NAPA Contract Design Manager and NAPA Stability Booklet Manager. Experienced users, however, can also develop and customise Manager applications to meet their own specific needs. Several Manager customisation projects have already been successfully completed by a number of NAPA users.

Contract Design Manager is intended for quick and easy creation of the 3D product model at an early design stage. The 3D model thus created serves as the primary source of design information at stages leading up to the contract. The application already covers the creation of the hull form, compartments, and the general arrangement, calculation of capacities, equipment numbers and freeboard, hydrostatics output, speed, and power prediction as well as loading and stability. In other words, the Contract Design Manager encompasses most of the disciplines required for making a contract-winning design.

Most significantly, the soon-to-be-released enhanced version of the Contract Design Manager introduces a feature for quick definition and editing of container arrangements. The defined container arrangement can be visualised in 3D, making it easy to check and view the arrangement. With the Manager, a container arrangement can, it is claimed, be made in a matter of hours. In addition, definition of master planes and of the tanker inner shell have been included in the new version.

It is said to be easy to make changes, adjustments, and updates to a design. Relevant detailed analyses can be performed and the feasibility of the design re-evaluated effortlessly, making the application ideal for the early design stages.

With the Stability Booklet Manager, a typical stability booklet containing some 250 pages can be compiled in approximately an hour, provided that a complete NAPA product model of the ship is available. Loading conditions must be defined prior to the compilation of the booklet, during which the loading condition calculations will be carried out. The traditional method of making stability booklets is claimed to pale in comparison to NAPA Stability Booklet Manager: putting together a stability booklet in the traditional way can easily take several working days.

Goal-based standards develop at IMO

BIMCO took an active role in the 80th session of the Maritime Safety Committee (MSC), held in London from May 11-20 this year. A number of issues relevant to BIMCO members were discussed, including goal-based standards and changes to SOLAS.

IMO secretary-general Efthimios Mitropoulos welcomed participants to the meeting, stressing his belief that standards and their effective implementation are vital to IMO's mission of promoting safe, secure, and environmentally sound shipping. This year's World Maritime Day theme, 'International Shipping - Carrier of World Trade', embraced this message as well. The widely held idea that shipping is a selfish industry with little interest in the environment is unfair, according to the secretary-general, who asked that those involved in the maritime sector continually strive to make ships safer and the environment cleaner.

In terms of harmonising IMO's goal-based standards with class society rules, Mr Mitropoulos reminded the committee that decisions on such basic principles as design life, fatigue evaluation, corrosion margins, and environmental load assessments are important to classification societies as well. The secretary-general further indicated his hope that the IMO and IACS approaches to standardisation remain complementary.

Goal-based ship construction standards

At its previous session, the MSC extensively debated the subject of goal-based construction standards, during which it reached a basic understanding on the meaning of the term 'goal-based standards' (GBS) and the use of the five-tier system. The committee had also established a working group to address the issues, which presented its findings at this meeting along with a text of the basic principles, Tier I goals, Tier II functional requirements, and its work plan.

Basic principles

Several delegations advocated a risk-based approach to the development of GBS, including structural reliability analyses, status assessments and introduction of a Tier 0 for top-level safety objectives. In contrast, other delegations maintained that a risk-based approach should not be pursued at this particular point in time, as the present methodology is based on practical experience with oil tankers and bulk carriers.

The general view of the committee was to continue with the development of GBS using the current, non-risk based methodology. While no one had opposed the utilisation of the risk-based approach, timing is of the essence. IMO goal-based standards are to be:

(1) broad, over-arching safety, environmental and/or security standards that ships must meet throughout their lifecycle
(2) the required level to be achieved through the requirements of class societies, administrations, and IMO
(3) clear, demonstrable, verifiable, long-standing, implementable, and achievable, irrespective of ship design and technology
(4) specific and not open to differing interpretations.

The working group had discussed the issue of GBS applicability. The goal-based standards for new ship construction are being developed for all types of new ships, and will therefore apply to all types of ships considered new as of the entry into force date. However, the working group indicated that these discussions are only preliminary.

Tier I - Goals

Current Tier I goals include the following concepts: ships are to be designed and constructed for a specified design life to be safe and environmentally friendly when properly operated and maintained in intact and specified damage conditions. In this regard, 'safe and environmentally friendly' means that the ship must have adequate strength, integrity and stability to minimise the risk of losing the ship and causing marine pollution. 'Environmentally friendly' requires the ship to be constructed of materials for environmentally acceptable dismantling and recycling. 'Safety' encompasses the ship's structure, which must be arranged to provide for safe access, escape, inspection and proper maintenance. 'Specified operating and environmental conditions' are defined by the operating area for the ship throughout its life and cover the conditions arising from cargo and ballast operations. 'Specified design life' is the nominal period that the ship is assumed to be in use and is used for selecting appropriate ship design parameters.

Tier II - Functional requirements

At this point, Tier II will only apply to tankers and bulk carriers, although an extension to all SOLAS ships may be considered at a later stage. The proposals concentrate on the issues of design life, environmental conditions, fatigue life, coating life, corrosion addition, structural strength, construction quality, maintenance and transparency. The inclusion of new requirements concerning operating conditions, information keeping, actual service life, and watertight and weathertight integrity was also suggested.

Delegations expressed their concern with the lack for a definition of 'functional requirement'. In addition, members felt that the functional requirements should be neither too detailed nor too prescriptive, and that they should apply to all types of new ships. Furthermore, they felt that finalising the functional requirements as soon as possible is imperative in view of the coming into effect of the IACS Common Structural Rules (CSR) in April 2006.

Design life

Much of the discussion of the design life functional requirement was devoted to whether a specific quantitative value should be included. The working group agreed that while it is appropriate to include a specific value for oil tankers and bulk carriers engaged in unrestricted navigation, it is not for others, such as those with restricted navigation. At this time, Tier II will only be applied to oil tankers and bulk carriers engaged in unrestricted navigation. The group agreed on 25 years as the appropriate design life for oil tankers and bulk carriers engaged in unrestricted navigation.

Environmental conditions

Working group discussions focused on whether environmental conditions need to be specified. The group agreed that, at this time, the North Atlantic should serve as the basis for appropriate environmental conditions.

Fatigue life

Due to the uncertainties in calculating fatigue life, some delegations argued that this timeframe needs to be longer than the design life. Other delegations noted that using the North Atlantic as the environmental basis provided a suitable safety margin since ships do not generally trade exclusively in the harsh conditions of the North Atlantic. The majority of the group agreed that the fatigue life need not be longer than the specified design life.

Structural strength

The issue of structural redundancy is a separate functional requirement, the text for which was agreed by the working group. Additional text addressing safety margins will also be included.

Corrosion protection

A number of delegations strongly felt that there are two separate functional requirements in terms of corrosion protection: corrosion addition and coating life. They maintained that the corrosion addition was needed in addition to other corrosion protection measures, such as coating or cathodic protection, as the corrosion addition, is an integral component of compliance with strength requirements. However, the majority of the group did not feel it was necessary to include corrosion additions in their considerations. In their view, the issue of corrosion protection should be addressed by one functional requirement, with separate sub-items for both corrosion addition and coating life.

Tier III - compliance verification

The Committee instructed the working group and the correspondence group to develop draft Tier III criteria for the verification of compliance with the functional requirements set out in Tier II.

Formal safety assessment

At this MSC session, a working group was established to consider the need for establishing a group of experts on formal safety assessment (FSA), as well as to consider such a group's membership, funding, independence and transparency. The working group was also established to consider documents aimed at improving the FSA Guidelines, and to consider the link between FSA and goal-based standards.

The fact that formal safety assessments have been used successfully in the past to assist the committee in its decision making and that it should continue to be used for making decisions

on future issues was of main concern during the debate. However, many of the problems faced in the past when considering formal safety assessments could have been avoided had there been a standing group of experts to review such assessments. In the light of this debate, the committee agreed that a group of experts on FSA should be established.

In order to enable the IMO to base its future decisions on a single, internationally recognised set of findings and recommendations, the committee agreed that the expert group should review FSA studies on specific subjects as directed by the committee and prepare relevant reports. To ensure that the leadership is properly supported, the committee agreed that those participating in the expert group should have risk assessment experience, a maritime background, and knowledge or training in the application of FSA Guidelines.

SOLAS issues

Changes and developments with regard to SOLAS were also prominent on the MSC agenda. Among the issues discussed were SOLAS Chapters II, V, XI, and XII.

SOLAS Chapter II-1

Amendments to Regulation 3-6 on Cargo Area Access will enter into force on January 1 2006, while regulation 3-7 on Maintenance of Construction Drawings will be applied as of January 1 2007, along with regulation 3-8 on Towing and Mooring Equipment. Furthermore, Regulation 24-1 on Water Level Detectors in single hold cargo ships will come into effect on January 1 2009.

The committee considered draft guidelines for damage control plans and information to the master, in compliance with new requirements that damage stability information should provide masters with a simple and easily understandable way of assessing a damaged ship. The document was referred to the Sub-Committee on Stability and Load Lines and on Fishing Vessel Safety for detailed consideration.

SOLAS Chapter V

Several delegations stated that the transmission of the wrong automatic identification system (AIS) signals from ships endangers navigation. The committee therefore considered whether the information provided by the AIS should be presented to the officer of the watch (OOW) to enable him to rectify any incorrect information.

SOLAS Chapter XI-1

Given the difficulties encountered during the testing phase of the mandatory IMO identification number scheme, the MSC had previously agreed to discuss the adoption of mandatory IMO unique company and registered owner identification numbers at this meeting. After reviewing the work of Lloyd's Register/Fairplay, as well as the reported need for a considerable amount of resources, the committee agreed that this amendment to SOLAS Chapter XI-1 will enter into force on January 1 2009.

SOLAS Chapter XII

In December 2004, the MSC adopted amendments to the SOLAS Convention, including a completely revised text for Chapter XII - additional safety measures for bulk carriers. An inter-sessional working group was established to prepare a unified interpretation of the revised regulations 6.5.1 and 6.5.3, recognising that protection of cargo hold structure can be achieved through structural design features.

In addition, BIMCO, along with several other industry organisations, requested that an MSC circular be developed by the Sub-Committee on Ship Design and Equipment to provide an authoritative interpretation on the new SOLAS regulation 6.5. BIMCO also submitted its comments on the interpretation of this new regulation. In terms of demonstrating compliance with the regulation, the committee agreed that these submissions, together with the work carried out by other entities, provided the necessary clarification. The committee also agreed that the restrictions put in place by SOLAS regulation XII/14 should be annotated in the ship's booklet but should not be mentioned in the BLU Code.

ISM Code

At its previous meeting, the MSC deferred the adoption of amendments to the ISM Code to this session. As no comments on the text of the proposed amendments to the ISM Code were submitted, the committee confirmed their contents. These amendments will therefore enter into force on January 1 2009.

An Independent Experts Group, in which BIMCO is an active participant, has been established by IMO to study the impact of the ISM Code. In order to further the work of this group, BIMCO has distributed more than 500 company questionnaires to selected owner members. In addition, the group has circulated questionnaires for administrations, shipboard personnel and shore-based personnel.

Passenger ship safety

The World Maritime University (WMU) submitted a proposal to the MSC to undertake a research project on passenger ship safety. This extensive project would cover a number of areas including state of the art, current research efforts and results on passenger ship safety, development of an online database of current research; and organisation of a passenger ship safety workshop. In addition, the project would identify gaps in knowledge and a long-term vision for this sector of the industry.

The initial phase is expected to last one year and will be undertaken at no cost to IMO. In this phase, the IMO will ask all member states to provide the WMU with information on similar research programs either recently completed or currently underway. The university will then contact the research teams to get further information on their efforts.

Circulars and manuals

The circular providing guidance on serious structural deficiencies in containers was approved by the committee, as were the manual for loading and unloading of solid bulk cargoes for terminal representatives, and a circular on shipboard towing and mooring equipment. In addition, the committee endorsed DSC 9's establishment of a correspondence group on the safe practice for cargo stowage and securing code. The correspondence group will review proposals for new annexes 14 and 15 to determine whether those proposals merit inclusion in either the Code of Safe Practice for Cargo Stowage and Securing (CSS Code) or in a circular.

The committee noted that a circular letter is being prepared on a user's manual describing the structure and capabilities of the Global Integrated Shipping Information System (GISIS), and that the GISIS modules on recognised organisations (ROs), on the condition assessment scheme (CAS), and on casualties are available on IMO's website. The GISIS makes electronic data exchange and reporting facilities available to users. On a related issue, the committee approved a draft MSC/MEPC circular on reports on marine casualties and incidents. The revised reporting format corresponds to entries in the GISIS module on casualties, the committee invited member states to keep the format and the related GISIS module under review.

A draft MSC/MEPC circular on recommended conditions for extending the period of validity of a certificate was also approved. The recommended conditions for extending the period of validity may also be included in the Revised Survey Guidelines under the Harmonised System of Survey and Certification (HSSC).

Other issues

IMO audit scheme

The Joint MSC/MEPC/TCC Working Group on the Voluntary IMO Member State Audit Scheme resulted in a draft Framework and Procedures for Member State Audit, together with an associated draft Assembly resolution. When considering this document, the committee agreed to the tables listing the obligations of states and instruments made mandatory under IMO Conventions, and approved the tables for incorporation in the final text of the draft Code. These tables will constitute the list of obligations against which states will be audited. The tables will be reviewed regularly.

Protective coatings

The development of performance standards for protective coatings for dedicated seawater ballast tanks and void spaces in double-hull bulk carriers is now well underway. The committee therefore considered whether these standards should be expanded to all ballast and void spaces on all types of ships. While some delegations suggested that an expansion of this magnitude had not been properly evaluated, others supported the recommendation, stating that void spaces should not be ignored. Based on this discussion, the committee agreed to the expansion of the scope of the standards for protective coatings. Appropriate amendments to SOLAS may also be developed.

This report is compiled in association with BIMCO (The Baltic and International Maritime Council).

Evolution of a high-efficiency propeller with new blade section

In this article, Dr Noriyuki Sasaki and Dr Graham Patience, from Stone Manganese Marine, introduce a newly developed high-efficiency propeller, designated the NBS (new blade section) model, which is said to reduce the optimum diameter without adversely affecting propulsion efficiency. More than 100 examples have already been successfully fitted.

THE marine propeller is the most commonly adopted propulsion system for existing ships. Its design methodology has been investigated for more than 50 years, based not only on model tests but also on theoretical approaches formulating wake-adapted propellers, eg, Morgan and van Manen [Refs 1, 2]. Based upon these principles, the optimum design of a propeller can be readily established utilising propeller charts, the most common of which are the Troost B, the Japanese MAU, and the SMM Meridian series.

It is now well understood that the most dominant parameter of marine propeller design is its diameter because, for a given propeller loading, the ideal efficiency is a function of the diameter. This explains why propeller charts concentrate upon the optimum propeller diameter. However, the optimum diameter varies not only with the working conditions of the propeller but is also dependent upon the profile shape of the blade section.

The NBS propeller has several advantages as summarised below:

- higher efficiency compared with conventional propellers
- superior cavitation performance
- smaller optimum diameter for the same propeller design conditions
- a more compact design for the propeller rudder aperture
- a lower ballast draught to satisfy propeller tip immersion
- improved trim condition for visibility
- a more compact design of propeller
- lower capital cost of propulsion system.

Theory and model tests

Efficiency

The NBS propeller is a modern sophisticated propeller with its primary objective being to minimise propeller efficiency losses in its operation. Fig 1 shows typical propeller losses for a tanker configuration as predicted by modern vortex theory. There are three main components which together make up the total efficiency loss:

1. Momentum loss is due to acceleration in flow by the propeller action and is fixed for a given propeller loading condition
2. Rotational loss derives from the flow swirl induced by propeller rotation, which is sometimes recovered by the adoption of systems such as contra-rotating propellers or other pre-swirl/post swirl devices

Fig 1. An NBS propeller installed on a pure car/truck carrier.

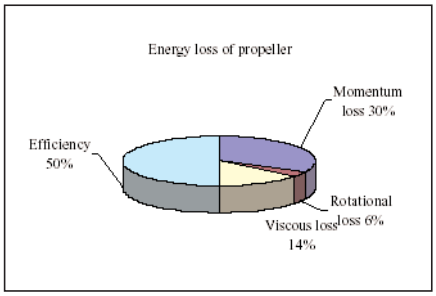


Fig 2. Efficiency losses of typical marine propellers.

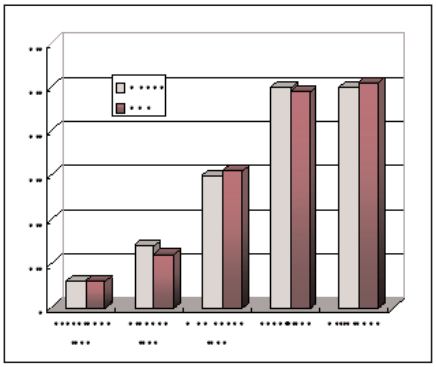


Fig 3. Efficiency-loss comparison of a conventional and NBS propeller.

3. Viscous loss depends upon the profile drag originating from the viscous drag of wing sections. This can be represented by the following equation:

$$\Delta D(x) = 0.5\, Cd(x).\ \rho V(x)2\ .\ \Delta S(x)$$

where

Cd(x) : section drag coefficient at radius x

ρ: density of water

V(x) : inflow velocity at radius x

ΔS : area of a blade strip at radius x

From Fig 2, propeller efficiency ηo can be represented by the following equation:

$$\eta o = 1 - \Delta\eta$$

where,

$$\Delta\eta = \Delta\eta\, om + \Delta\eta rot + \Delta\eta vis$$

From this it is clear that maximum efficiency can be obtained when Δη is minimised.

The viscous component is influenced by the profile shape and the magnitude of the propeller surface area. For the NBS propeller, the profile adopted is a modern development of a high-efficiency aerofoil - ie, having low drag properties - combined with superior cavitation properties that can be exploited to indirectly increase efficiency by the manipulation of the amount of surface area.

When conducting model experiments with scaled propellers, the predicted efficiency at full scale is a function of scale due to variation in the applicable Reynolds Number. In the case of the NBS propeller, using a profile significantly different from conventional profiles, it has been found that the model efficiency is similar to that obtained with a conventional propeller.

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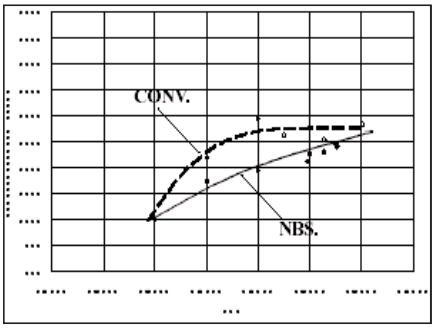


Fig 4. Reynolds effects on an NBS propeller.

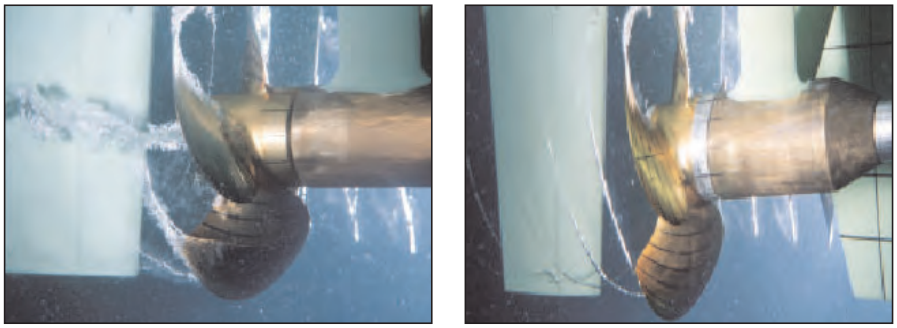


Fig 5. Cavitation observation at the National Maritime Research Institute of Japan, showing conventional (left) and NBS (right) propellers.

However, full-scale observations, as will be seen later, imply that the NBS propellers are superior to conventional propellers. This is attributed to a greater Reynolds number effect, which is demonstrated in Fig 4.

Cavitation and exciting forces

For a given diameter, the choice of surface area will have a significant influence upon the efficiency that can be achieved, and this is constrained by the requirement to achieve acceptable cavitation properties. One way to evaluate this is to employ a criterion expressed in terms of a maximum thrust density for the propeller.

The allowable thrust density is a function of propeller radius, because cavitation will occur when the minimum pressure coefficient, Cpmin, reaches at cavitation number σ: $Cpmin = -(Po - P8)/(1/2\ \sigma\ V_2) < \sigma$

This implies that the outer radii will have more difficult pressure conditions compared with the inner radii, and this is the reason why the blade tip will cavitate more readily as shown in Fig 5. This figure shows the cavitation behaviour of a conventional propeller designed for a high-speed car ferry, which was conducted by NMRI, Tokyo, as part of that organisation's ongoing research work. Included is the cavitation behaviour of the corresponding propeller utilising the NBS profiles [Ref 3].

The superior cavitation performance of the NBS profile is clearly demonstrated in Fig 5, and this advantage can be exploited to improve propeller efficiency by reducing the blade area when applying the NBS profile. When considering pressure fluctuations, the superior cavitation performance of the NBS profile will clearly assist in the reduction of propeller excitation forces. There is however an additional benefit in that the smaller diameter associated with the adoption of the NBS profile, which is discussed in the next section, will provide even lower excitation effects due to the greater distance of the propeller from the hull and its improved clearances.

Fig 6 shows model test results obtained from cavitation experiments conducted at HSVA, Hamburg, in the HYKAT facility, for the case of an Aframax tanker in which pressure fluctuations generated by the

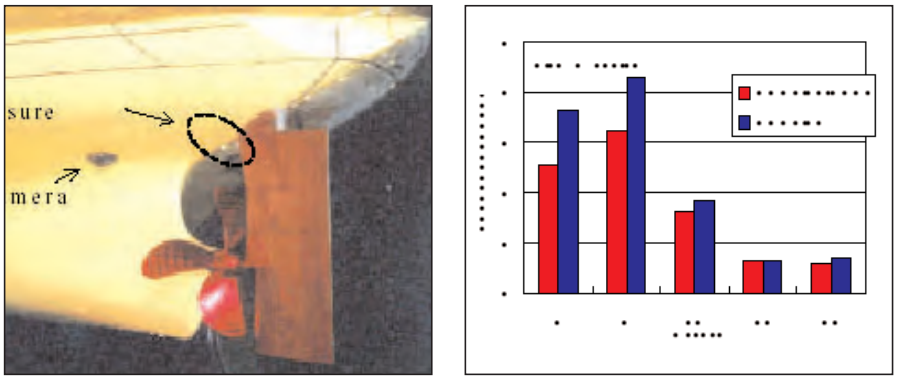


Fig 6. Pressure fluctuations of NBS and conventional propellers.

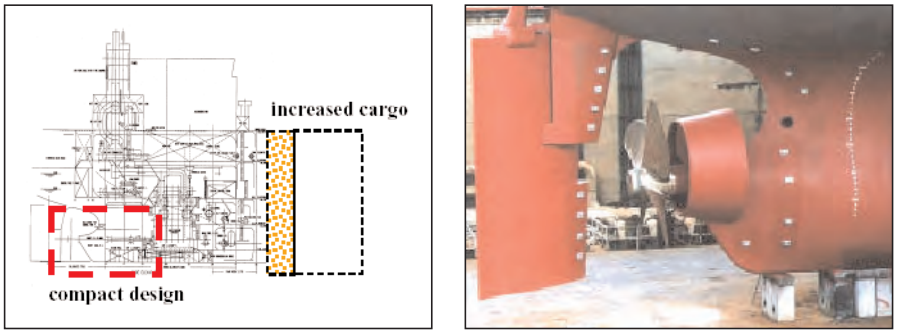
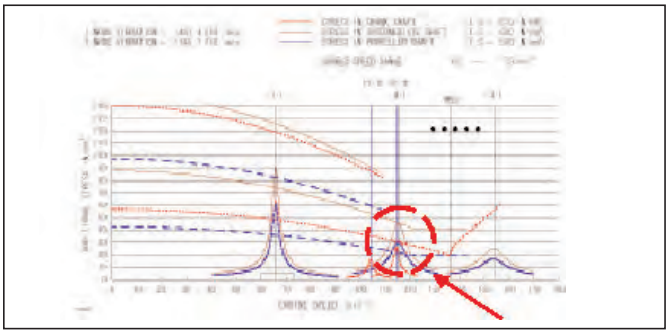


Fig 7. A profile plan and photograph of an Aframax tanker showing the compact stern arrangement possible with an NBS propeller.

	Case 1 Conventional	Case 2 NBS
Main engine	Makita-Mitsui-MAN B&W 7S42MC	
Power and engine speed	MCR 7175kW at 136rev/min NCR 6098kW at 128.8rev/min	
Design ship speed	15.00knots	
Propeller diameter	5.50m	5.15m
Boss diameter	1.55m	1.45m
Propeller weight	14.40tonnes	12.00tonnes
Propeller moment of inertia	23,020kg/m^2	16,230kg/m^2
Propeller shaft diameter	0.50m	0.46m
Interim shaft diameter	0.44m	0.40m
Turning wheel	maximum weight	maximum weight
Flywheel	heavy type	heavy type
Vibration damper	required	not needed

Table 1: Effect of NBS propeller on shaft alignment design



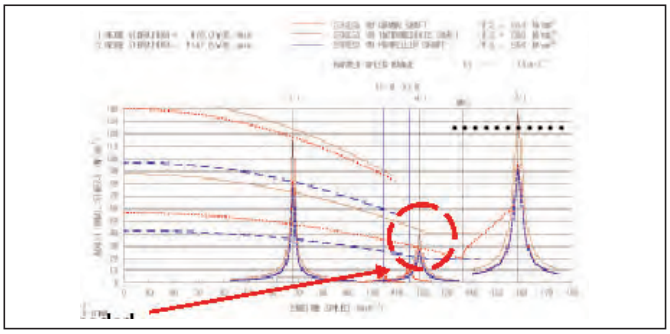
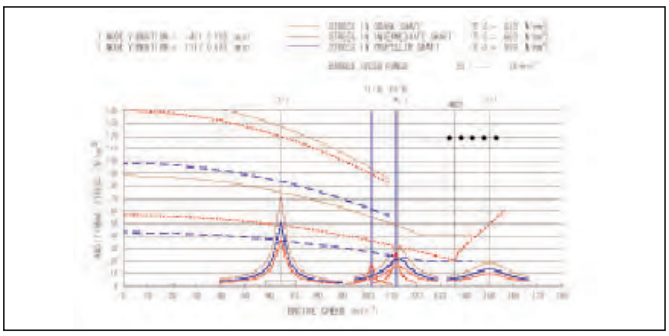


Fig 8. Additional stress due to torsional vibration (conventional) exceeded.



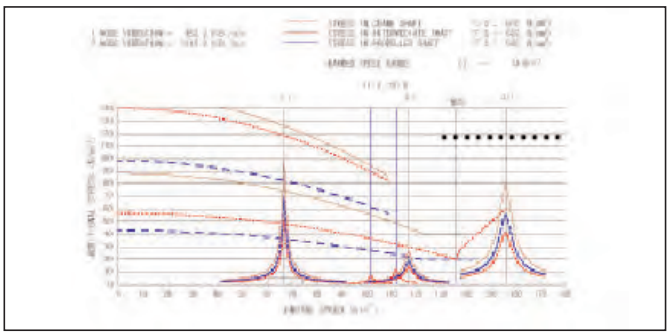


Fig 9. Additional stress due to torsional vibration (NBS).

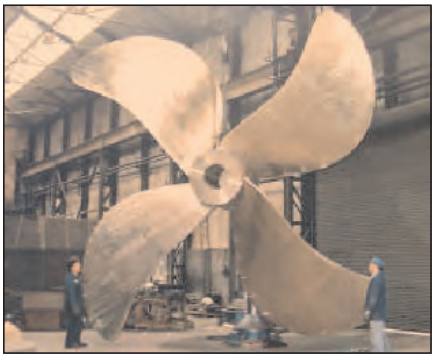


Fig 10. Propeller manufacturing at DMPP (Dalian Marine Propeller Plant).

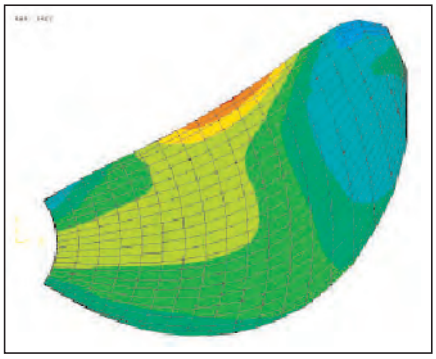


Fig 11. FEM calculation.

propeller were measured by pressure gauges flush-mounted in the stern. As shown in Fig 6, the NBS propeller reveals lower pressure fluctuations compared with a conventional propeller which has been installed on existing vessels.

Design impact

Cargo capacity

Because the envelope of existing main engine ratings - ie, the relationship between propeller rotational speed and engine output - has been primarily influenced by the design of conventional propellers, then, when applying the NBS design principles to these envelopes, the resulting optimum diameter of the NBS propeller is reduced - in comparison with the diameter of the corresponding conventional propeller - by between 5%-10%.

This reduction brings important advantages not only for ship operators but also for shipbuilders, because a reduction in the space and weight of the propulsion system, including propeller shafts, can be correspondingly achieved. Fig 7 shows an example of this application to a 105-type Aframax tanker. By introducing the NBS system, the engineroom length was shortened by two frames.

To illustrate the advantages achievable with the NBS propeller to obtain higher propeller efficiency with a more compact engine/shafting system, two propulsion systems are investigated, as shown in Table 1. Case 1 is a conventional engine-shafting system based on a conventional propeller and Case 2 is a system based on a NBS propeller.

Due to other design restrictions, these investigations do not include engine selection and other shafting arrangements, for example, the length of the engineroom. Therefore, this simulation was carried out by changing only the shaft diameter, the weight of the flywheel/turning-wheel, and by installing a torsional vibration damper instead of the turning wheel. As shown in Fig 8, the additional stresses on the propeller/crankshaft with the conventional propeller exceed classification requirements.

The conclusion of these particular investigations is that there is no way of satisfying the rule requirement other than by the use of a torsional vibration damper for the conventional propeller case. On the other hand, stresses with the NBS propeller satisfy the classification requirement without using a damper, as shown in Fig 9. From the economic viewpoint, therefore, an owner can save initial investment and maintenance costs of more than US$100,000 in this particular example by the adoption of the NBS propeller.

Manufacture

Production

An NBS propeller should not present any specific problems from the manufacturing point of view. Its particular characteristics are a smaller diameter, low blade area, and a proprietary profile shape in comparison with a conventional propeller, and these have little impact upon the manufacturing process. In fact, the smaller diameter of the NBS propeller will contribute to reducing manufacturing costs and facilitating production, as might generally be expected for smaller propellers.

In general the unit cost of propeller manufacture decreases with increasing size or mass, reflecting the benefits of scale, so the reduced mass of the NBS propeller will actually result in a relative increase in unit cost, in comparison with the corresponding conventional propeller.

However, the quantifiable saving in weight far exceeds the increase in unit cost so that its capital cost will be less than a conventional propeller designed to the same specification. Since the complexity inherent in its design does not translate into any complex shape, other than the need to ensure the profile shapes are achieved to the required accuracy, this feature

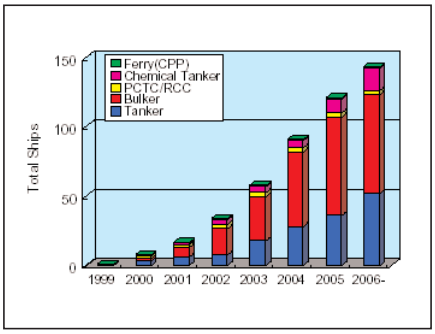


Fig 12. Deliveries and orders for NBS propellers.

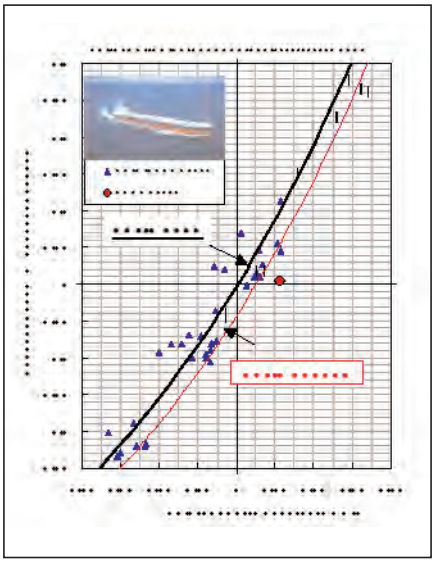


Fig 13. Comparison of sea trial results for a Panamax bulk carrier.

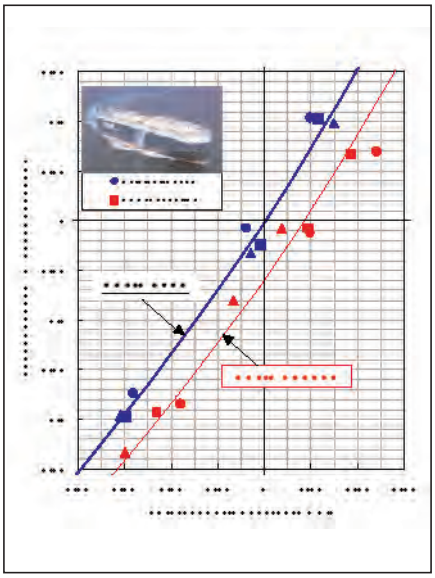


Fig 14. Comparison of sea trial results for a pure car/truck carrier.

of the NBS propeller represents an important factor to be exploited in its marketing and promotion.

This means that the end user - the owner - can confidently specify an NBS propeller for his new ship in the full knowledge that the higher efficiency and superior cavitation performance is achieved without additional cost and, in fact, may even be achievable at a saving in his capital expenditure.

Tolerances

A conventional propeller, as an industry standard, will be specified to ISO Class 1 definition. The NBS propeller requires no higher specification. Its superior performance is achieved on a like-for-like basis, as has already been demonstrated in the full-scale applications so far undertaken.

Strength

The strength requirements of an NBS propeller are no different than those of the conventional propeller it will replace. Its profile will, of course, have different properties which must be taken into account in the assessment of the propeller's strength and its resistance to failure. These are no more onerous than would be expected for the variation of profile shapes currently adopted amongst the available range of conventional profiles. Fig 11 shows an example of FEM calculation at initial design stage, which has been done as a standard work flow.

Full-scale data

During the last six years, more than 100 NBS propellers have been installed on a range of ship types. In addition, orders for 30 propellers are in hand. This is shown in Fig 12. As a result of this successful experience, commencing from 2002, the NBS propeller is now being applied as standard equipment for all new buildings within the shipyards operated by Stone Manganese Marine.

Sea trials

Propeller performance at full scale has been investigated for a range of ship types. The prototype vessel for which an NBS propeller was installed was an Aframax tanker in November 1999. Subsequently, all vessels of this series have been equipped with this propeller. The second example was a high-speed ferry, the NBS propeller being applied with the objective of achieving not only high propulsive efficiency but also low vibration and noise. NBS propellers have also been introduced to a series of Panamax bulk carriers and, finally, two PCTC vessels (pure car and truck carriers) were fitted with six-bladed units during the year 2000.

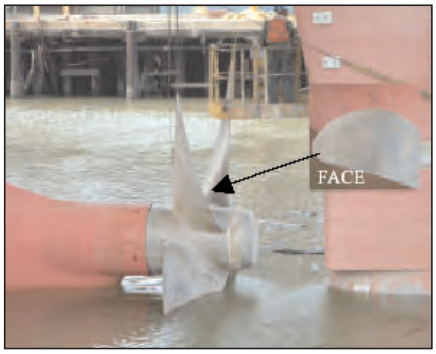


Fig 15. Propeller investigation five months after delivery.

Following the successful performance of NBS propellers fitted to these vessels, a decision was taken to install NBS propellers as standard equipment to all new vessels now built by Sumitomo.

Subsequently, during the last three years, the sister shipyards of Oshima and Sanoyas have adopted a similar policy. As an example of the NBS applications undertaken to date, Fig 13 and Fig 14 show the comparison of trial results and predictions. Fig 13 and Fig 14 show the comparison of sea trial results for the Panamax bulk carrier series and pure car carrier respectively where the improvement is clearly seen. Summarising these full-scale investigations we can conclude that the NBS propeller shows consistently better propulsive performance than conventional propellers.

Follow-up

Several of the examples given above were investigated after their delivery into service in order to evaluate the propeller performance, in particular regarding cavitation. These investigations confirmed satisfactory operation and furthermore confirmed the propellers to be free of cavitation erosion, as shown in Fig 15. No claims have ever been received for any of these vessels over the performance achieved.

Summary

A new high-efficiency propeller, designated the NBS (New Blade Section) propeller has been successfully developed. Owing to its special wing section, superior cavitation performance and smaller optimum diameter compared with a conventional propeller can be obtained without adversely affecting propulsive efficiency. These two favourable features bring many advantages as described. During the last six years, more than 100 NBS propellers have been installed on a range of ship types, and no claims from users or shipyards have so far been received.

References

[1] Morgan W B, *et al* 'A Propeller Design Method'. Trans. SNAME 1955.

[2] J D van Manen, Troost L, 'The design of Ship Screws of Optimum Diameter for an Unequal Velocity Fields' Trans. SNAME 1952.

[3] Ukon Y, *et al* 'Experimental Evaluation of Trans-Cavitating Propellers', *Journal of the Society of Naval Architects of Japan*, Vol.186 (1999).

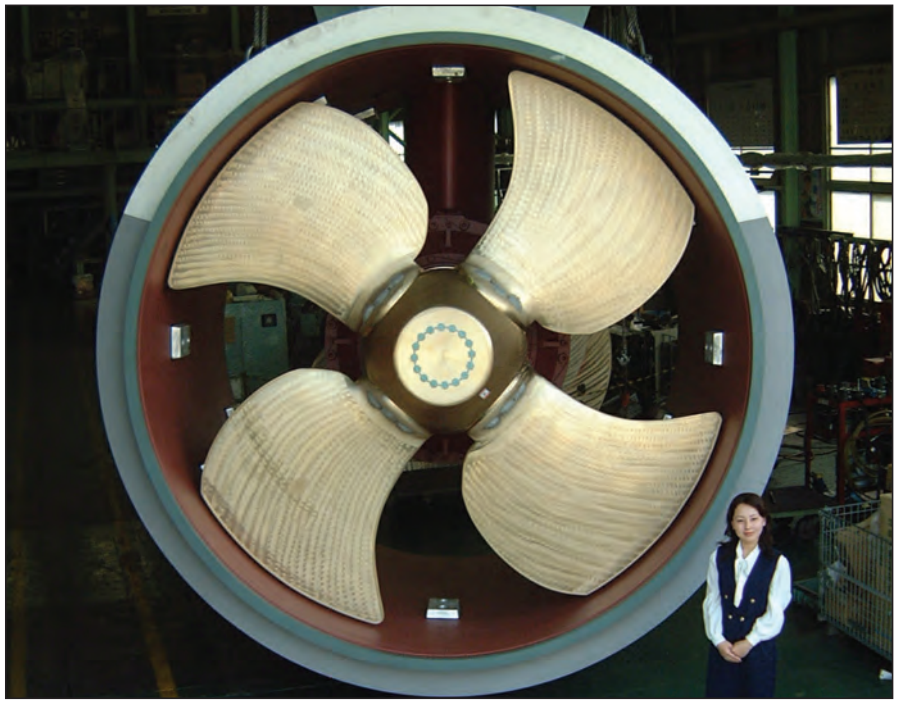
Innovative thrusters for different ship types

ONE of the largest tunnel-type thrusters ever built has recently been delivered by Nakashima Propeller Co, of Japan. This CP TCT-315 model has a propeller diameter of 3150mm and a nominal thrust of around 450kN at an input power of 3000kW. It has been installed on a 7500TEU container vessel ordered by Reederei Blue Star at IHI Marine United. This ship has an overall length of 319.9m and a width of 42.8m. This propeller series was first introduced in 2003, and more details can be seen in *The Naval Architect* July/August 2003, page 18.

There are 12 sizes in the TCT range, from TCT-105 up to TCT-315, with nominal thrust ranging from about 8.8kN up to approximately 450kN. New models in the range are more powerful but more compact.

These thrusters have forward skews, ensuring lower vibration and lower noise levels, while thrust has been improved by a larger margin through using optimised designs on blade section shape and skew. Increased bow turning moment has been made possible due to installation nearer to the stem - this is achieved by reduction of the unit's overall length - around 20% compared with that of the previous model.

The structure now has higher reliability, using the hub mechanism for the Model XL CP propeller as the main propulsion system. The units are now said to be easier to maintain and control, using the same control and lubricating oil.



Nakashima Propeller's TCT 315 thruster was installed on a 7500TEU container vessel built for Reederei Blue Star. It is believed to be one of the world's largest tunnel-type thrusters ever built.

This side thruster, the TCT 105, was specially designed for the Techno-Superliner project. The high-speed ferry is fitted with four 50kN units conceived to avoid loss of cushion air between the two hulls.

Special delivery for Techno-Superliner

Nakashima has also recently developed and delivered four 50kN side thrusters (Model TCT-105) for the part-air-cushioned Techno-Superliner *Super Liner Osagawara*, being built at the Tamano works of Mitsui Engineering & Shipbuilding Co (*The Naval Architect*, June 2005, page 52) for Ogasawara Kaiun Co.

This high-speed air-cushion/waterjet vessel is raised over the water surface, with the space between the double hulls provided with high-pressure air by lift fans. This necessitates air ventilation from the thruster tunnels (two in each hull) being prevented from escaping while the bow thrusters are not in action. To avoid this, the propeller's blade area ratio needed to be increased - although this will decrease thruster efficiency, due to a lack of camber in the blades.

Despite these difficult conditions, Nakashima has successfully developed a thruster with a five-bladed propeller, different to the usual four-bladed variety, which avoids air ventilation whilst maintaining efficiency. This thruster is thought to be the only type of it kind.

Each unit produces the same amount of thrust as a conventional thruster, but without deterioration. In addition, the thruster has been designed so that the amount of air ventilation, at the time of hydroplaning, is reduced as much as possible, with a clearance between each blade minimised to the maximum limit.

Super Liner Osagawara has been constructed in aluminium, as a weight-saving tactic, and this meant that the insulation for the hull and the thruster had to be taken into careful consideration. Nakashima's thruster, provided with suitable insulation, saw a weight reduction of around 40% compared with the company's standard thrusters, as aluminium was used to construct the unit where possible.

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PBCF model tests confirm fuel efficiency

THE PBCF (propeller boss cap fin) is a well-established device which can cut fuel consumption and exhaust gases by up to 5%, incurs no additional maintenance costs once installed, and is manufactured by Mitsui OSK Techno Trade, of Japan. We have discussed this propeller-enhancing device comprehensively on several occasions in *The Naval Architect*, most recently in July/August 2004, page 32, and in October 2003, page 33, and now, further evaluation of the PBCF's performance has taken place, through large-scale model tests this March.

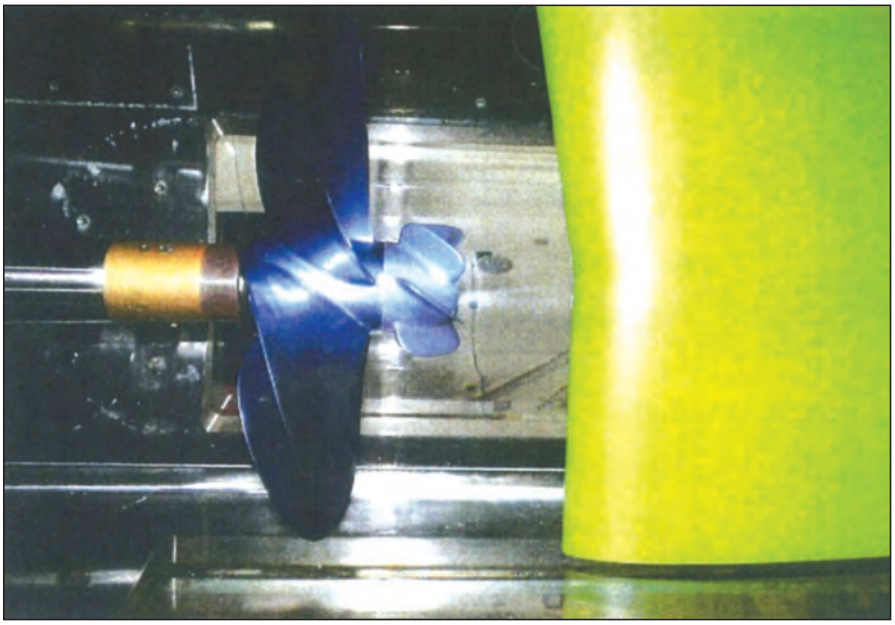
In order to investigate the two following problems, tests were carried out using six-bladed model propellers of 250mm and 400mm diameter. Problem one was that the PBCF has six fins on a six-bladed propeller, and has been designed by extrapolating design data from four- and/or five-bladed propellers. Only a limited amount of data has been collated in the past about the six-bladed variety. The second issue was the survey of the scale effect (Reynolds number effect) on the fuel saving between propellers with and without PBCFs.

Actual ship test data shows around 5% fuel saving, while the model test data usually shows 1%-2%. These differences have been considered from a scale effect, in other words, the difference in size between the actual and model propellers. Thus, detailed Reynolds number model tests have been carried out using a 400mm diameter propeller.

The model propeller has been designed and manufactured based on the propeller installed on a new container ship with 60,390kW machinery. So far, the PBCF has been installed in two of three sister ships, and these have already been constructed and tested. Trial test data showed around a 5% fuel saving on average.

Ordinary propeller open tests were also carried out in the 400m towing tank at the National Maritime Research Institute Japan on 250mm and 400mm diameter model propellers. These tests were also conducted for various Reynolds numbers to indicate the scale effect on the PBCF's economical performance.

The tested parameter range for the Reynolds numbers were between 0.6 x 106 and 2.2 x 106. The tested design parameters for the PBCF were angle and the distance of the fins corresponding to propeller end and axis. The following results were obtained:



A 400mm-diameter model propeller with a PBCF fitted, seen here in a large cavitation tank.

- PBCF design for the six-bladed propellers has been confirmed to be correct and the configuration of the PBCF will be properly provided by the standard method. The measured values during these tests for 250mm and 400mm diameter propellers have been stable and the scattering of these measured data has been relatively small.
- the differences for the propeller open performance and the economic effect from the Reynolds number change of 0.6 x 106 to 2.2 x 106 have been small, where Reynolds number is nDp^2/υ, n: number of revolution of propeller per second, Dp: propeller diameter, υ: kinetic viscosity coefficient.

Increase in new orders

In response to the increase in oil prices, raised environmental awareness, and the number of new ships, orders for the PBCF have increased. Many owners and operators in the Far East and Asia have recently begun using the PBCF on container ships, tankers, and bulk carriers. In addition, a number of shipping companies in Japan, beside MOL, the developer of the PBCF, have begun installing the unit on their vessels. Following instructions received from an owner, one shipyard replaced its own standard fuel-saving device design on 10 container ships with the PBCF. There is also increasing debate on installing the PBCF on LNG carriers. Recent orders for the unit include an additional eight 62,920kW container sister ships, of which two in the series have already been installed.

Determination of coefficient K for prediction of ship squat

Following on from the June 2004 and November 2004 articles on ship squat by Dr C B Barrass, FRINA, P J Helmore* proposes a regression equation for calculation of the coefficient *K* for prediction of the amount of squat.

IN the November 2004 issue of *The Naval Architect*, Bryan Barrass (Ref 1) presented a method for the prediction of ship squat when navigating in a rectangular channel or shallow water, and for the location of maximum squat. The amount of squat is given by:

$$\text{squat} = \frac{KC_B V^2}{100}$$

where

squat = loss of under-keel clearance (m)
C_B = block coefficient
V = ship speed (knots)
K = coefficient depending on (H/T) and (B/b)
H = water depth (m)
T = draught (m)
B = breadth of water (m)
b = beam (m)

The coefficient K was given by Barrass (Ref 1) in Fig 2, a 2D plot for H/T values between 1.1 and 1.3 and B/b values between 3 and about 8.5. For values of H/T below 1.1, the conditions are dangerous, and above 1.3, squat should not be a problem. For values of B/b below 3, the channel is very narrow, and above 8.5 the water is simply shallow (and wide). The plot is easy to read, and a simple calculation using the above equation gives the predicted amount of squat; very useful when required.

Regression analysis

The plot is at a small scale, and the most time-consuming part of the operation is in reading the value of K. The values of K appear to be continuous and well-behaved on the plot, and this author wondered if a surface could be fitted to the data so that the values of K could be determined from an equation. This would enable it to be programmed and, hence, the calculation to be performed more quickly in the design office.

Values of B/b were therefore lifted from the plot at five values of H/T for each value of the 11 values of K, a total of 55 data points. These data points were then run through a regression analysis using the mathematical package Matlab. A number of combinations of variables were tested, using polynomials of varying degrees. The best fit (with a correlation coefficient $R^2 = 0.997$) was obtained from the following equation, cubic in both H/T and B/b and without any cross products:

$$K = 5.0583915 - 0.2569568(H/T) - 1.0814519(B/b) - 0.4883445(H/T)^2 + 0.1306850(B/b)^2 + 0.1240496(H/T)^3 - 0.0057542(B/b)^3$$

Polynomials of lower and higher degrees, and inclusion of cross-products, did not improve the 'goodness of fit'.

Testing

The resulting equation was programmed, and then tested to see how well it would play back the original data. The maximum departure of K values given by this equation from the data lifted from the curves was $\pm$3.2%, some of which may well have been due to the accuracy with which data could be lifted from the small-scale plot. However, 67% of the calculated values showed differences of less than 1% from the lifted data.

However, the ultimate test of any such regression equation is how well it can reproduce results which were not in the original data set. With this in mind, the equation was programmed, and compared with Barrass' (Ref 1) published results, as shown in the accompanying table.

It is doubtful whether the K values could be read from the published small-scale plot to four-significant-figure accuracy as shown; three significant figures would be reasonable. However, all values of squat calculated from the K equation are within 0.01m of Barrass' values.

Barrass (Ref 2) also calculated the squat for *Queen Mary 2* for a given set of conditions, using a different approach and without using the K coefficient in his Worked Example 1. Applying the new equation to the same set of data gives H/T = 1.2, B/b = 6.098, from which K = 1.221 and squat = 1.00m, which is the same value as obtained by Barrass.

Conclusion

A regression analysis of data lifted from the plot of Barrass' (Ref 1) K values has yielded an equation for K in terms of H/T and B/b. The equation enables values of K to be determined quickly and easily without having to refer to the plot. Values generated by the equation give results for squat which are close to published values.

Worked example	H/T	B/b	Barrass graph K	Barrass graph squat (m)	Equation K	Equation squat (m)
1	1.25	3.55	1.752	0.36	1.767	0.37
2	1.10	5.60	1.374	0.24	1.382	0.24
3	1.15	7.25	1.120	0.45	1.142	0.46

Comparison of figures obtained by Dr C B Barrass with the new equation of P J Helmore.

References

1. Barrass, C B, 'Squat formula for ships in rivers', *The Naval Architect*, November 2004, page 24.
2. Barrass, C B, 'Ship squat and *Queen Mary 2*', *The Naval Architect*, June 2004, page 6.

* Philip J Helmore, MRINA, senior lecturer, naval architecture plan coordinator, director of undergraduate teaching, School of Mechanical & Manufacturing Engineering, The University of New South Wales, Sydney, Australia.

Optimistic period at Indian Register of Shipping

A FIRST-TIME exhibitor at Nor-Shipping was the Indian Register of Shipping, which hopes to become a full member of the International Association of Classification Societies (IACS) next year. The IRS has been most active recently and is perhaps most noted for its Ship_Mate software suite, launched two years ago (*The Naval Architect* July/August 2003, page 36); this is principally designed for onboard use and can be employed for strength and stability analysis, for hull condition monitoring, and for planned maintenance.

The society has also, as part on an extensive on-going R&D programme, developed software for direct strength analysis; this is expected to be used by IACS for the current joint tanker project.

IRS could be playing an increasingly prominent role on the international stage, following the current upswing in export orders at Indian shipyards in the wake of full berths in the Far East. Indian import regulations have been relaxed to aid shipbuilders in purchasing key European or Far Eastern equipment.

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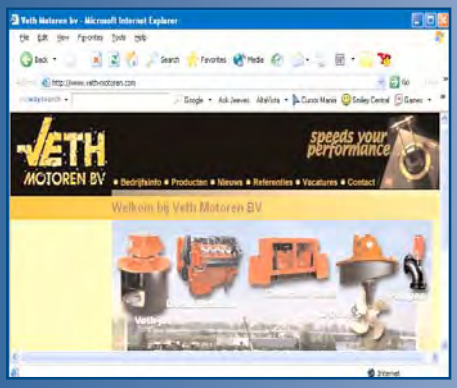

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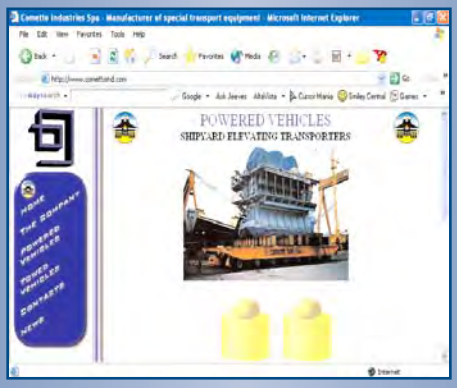

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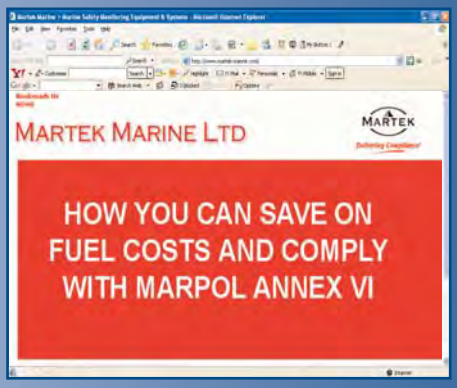

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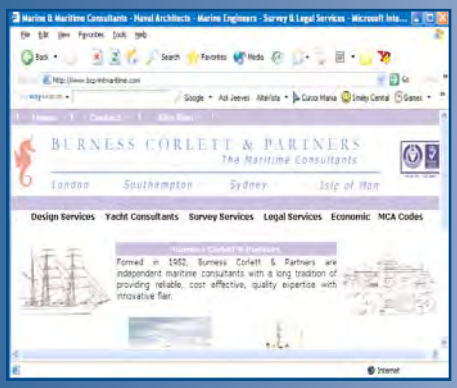

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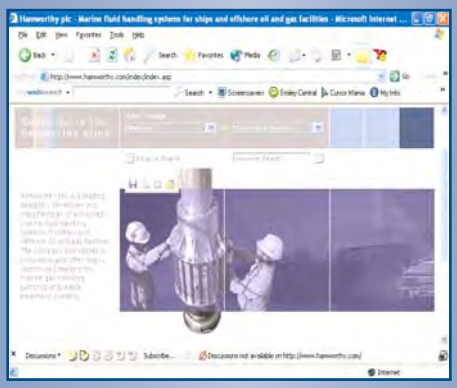

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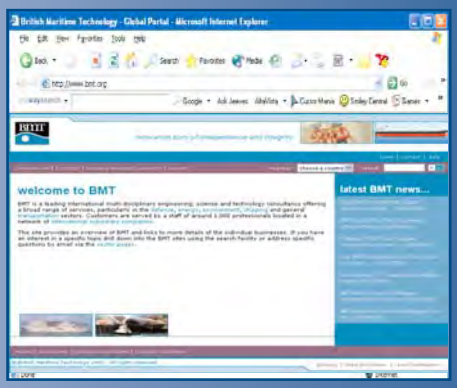

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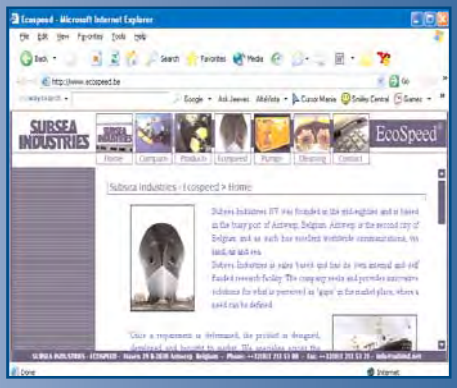

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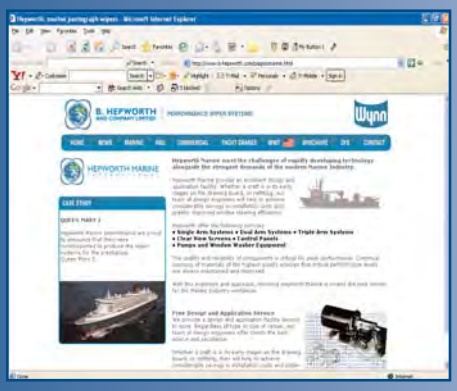

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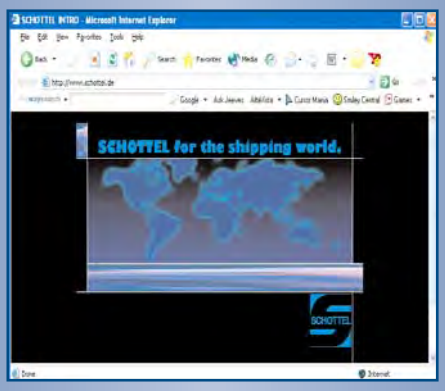

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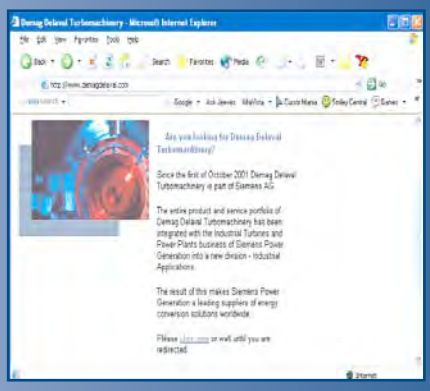

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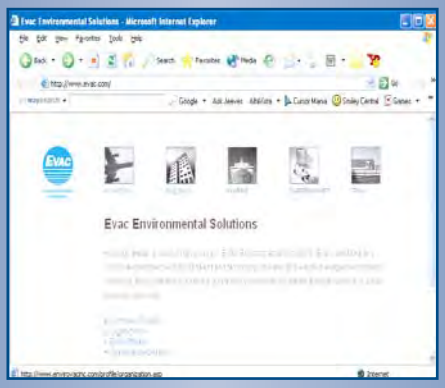

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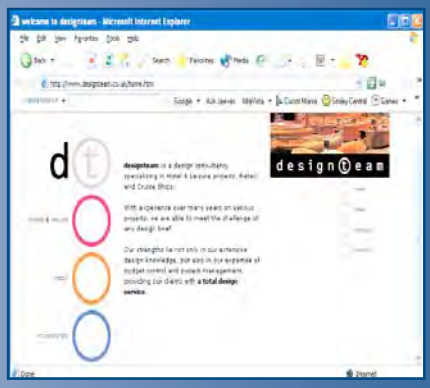

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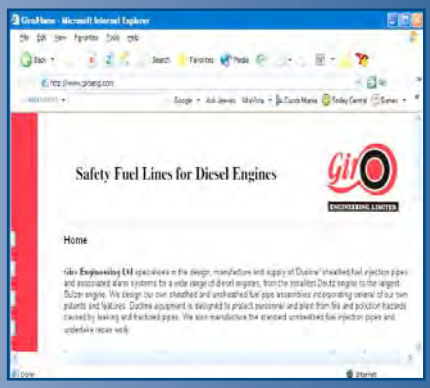

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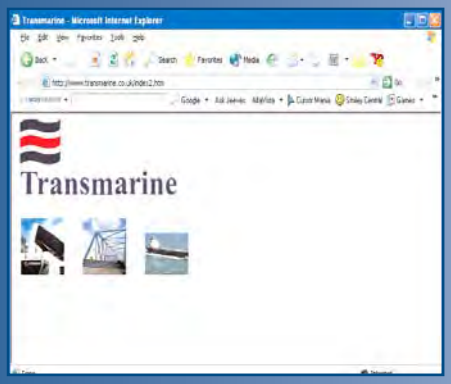

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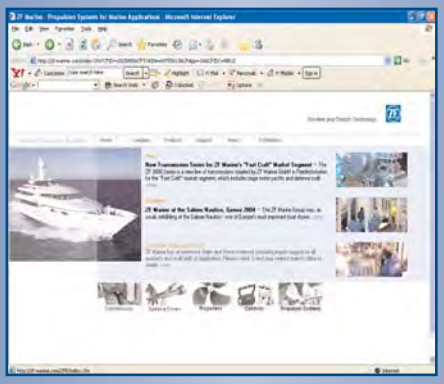

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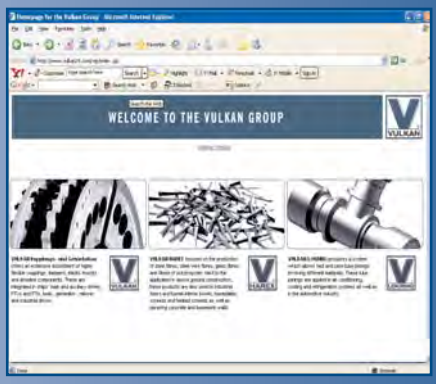

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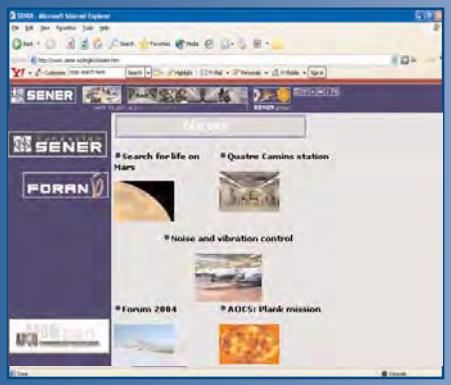

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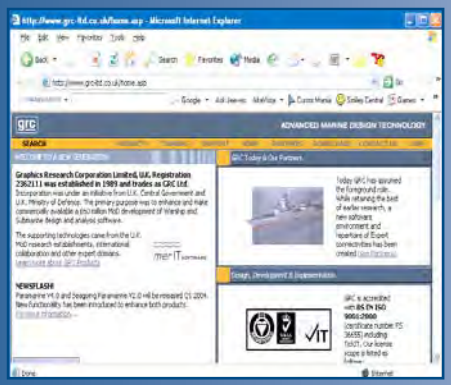

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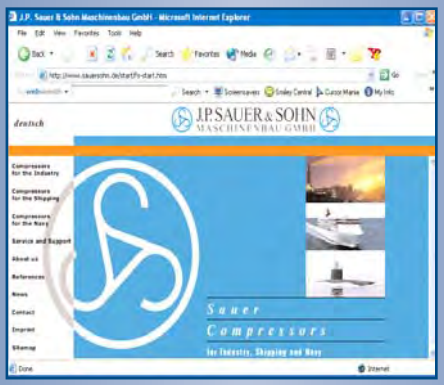

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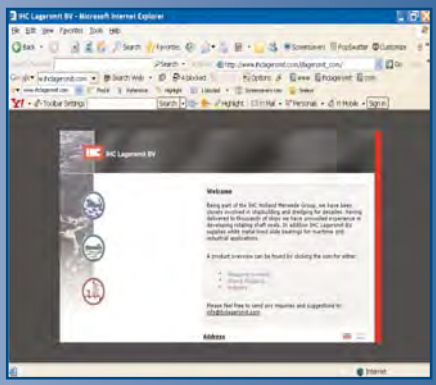

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November 7-9 2005: ShipRepair & Conversion 2005: Dubai, UAE. Contact: Lloyd's List Events, Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK. E-mail: maria.alm@informa.com www. shiprepairex. com

November 8-9, 2005: Launch And Recovery Of Manned And Unmanned Vehicles From Surface Platforms: Current And Future Trends, Maryland, USA. Contact: The American Society of Naval Engineers. www. navalengineers.org/events /launch/recovery/call4papers.pdf

November 22-23, 2005: The 20th Annual European Autumn Gas conference, London, UK. Contact: Judith Patten. Tel: +44 20 8241 1912. Fax: +44 20 8940 6211. E-mail: judithpatten@wwmail.co.uk www.theeagc.com

November 23-24, 2005: Safety Regulation and Naval Class 11, London, UK. Contact: Sophie Armitage, RINA, 10 Upper Belgrave Street, London, SW1X 8BQ. Tel: +44 20 7235 4622. Fax: +44 20 7259 5912. E-mail: sarmitage@rina.org.uk

January 23-24, 2006: Marine Environmental Engineering Technical Symposium - MEETS 2006, Virginia, USA. Contact: Morris Bateman, Co-Chair, Exhibits, The American Society of Naval Engineers. Tel: +1-815-639-8300. E-mail: Morris_Bateman @Evac.com www. navalengineers.org /Events/MEETS2006/

May 16-19, 2006: The International Marine Design Committee (IMDC 2006,) Michigan, USA. Contact: IMDC2006 Technical Committee. E-mail: IMDC2006TC@umich. edu

July 10-12, 2006: 3rd International ASRANet Colloquium, integrating structural analysis, risk, and reliability, Glasgow, UK. Contact: Professor P K Das, Department of Naval Architecture and Marine Engineering, Universities of Glasgow and Strathclyde, Henry Dyer Building, 100 Montrose Street, Glasgow G4 OLZ, UK. Tel: +44 141 548 3462. Fax: +44 141 522 2879. E-mail: p.k.das@na-me.ac.uk

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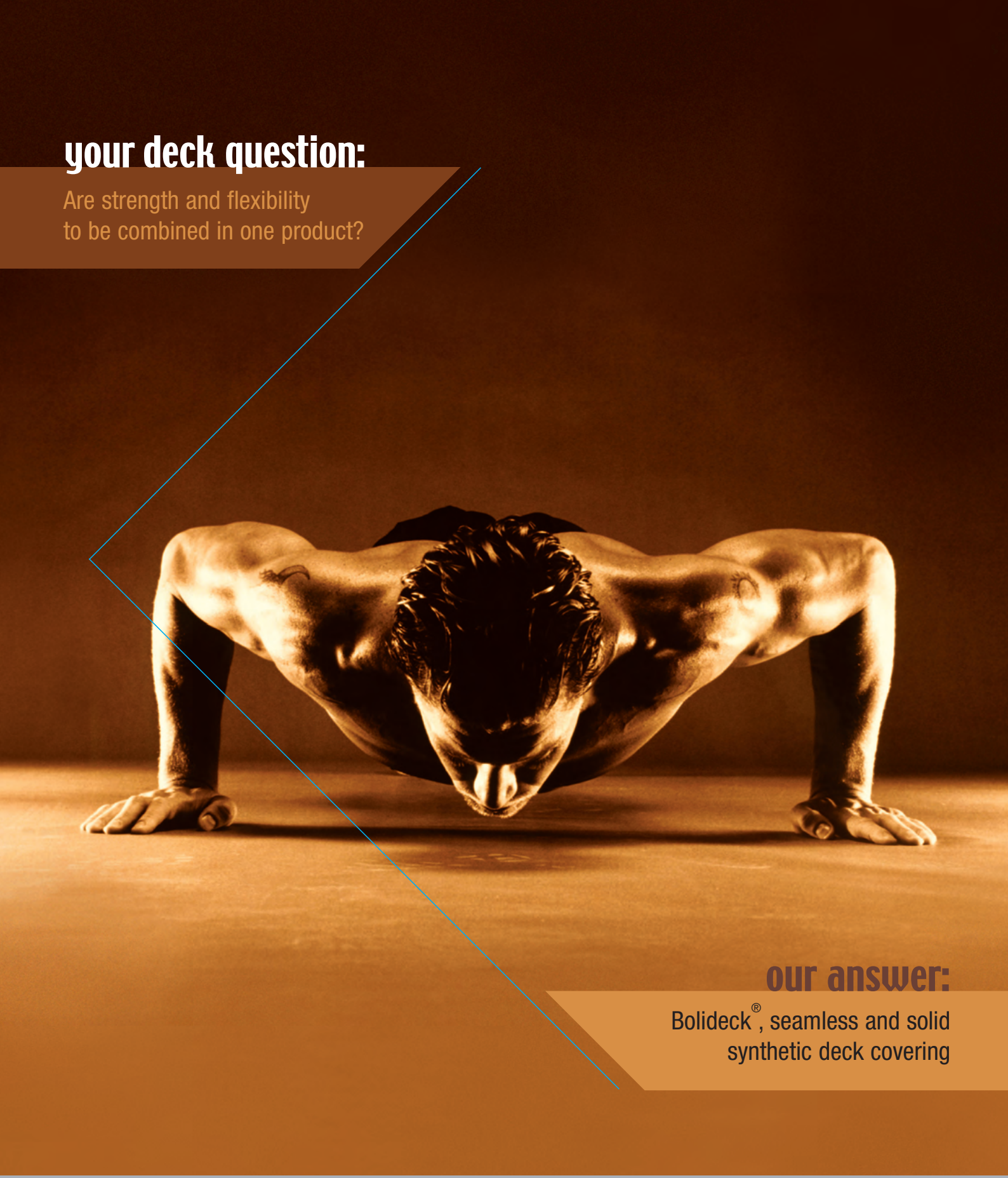

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