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Wind tunnel testing still forms an important part of the design process for many ship types. Seen here is a model of the new Cunard flagship *Queen Mary 2* being analysed for smoke dispersion at Force Technology, Lyngby, in Denmark. A special feature on Denmark's Marine Industries begins on page 28.

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Still an exciting future for ro-ro ships

READERS of last month's edition of *The Naval Architect*, who took the trouble to examine the lengthy text in the double-page advertisement placed by the Salut Federal State Unitary Enterprise would have been amazed to discover the ambitious dreams of at least one Russian design bureau. In this particular case, the plan involves building a fleet of eight or 10 ro-ro rail freight 'ferries' to sail at 35knots between Iran, India, and South East Asia.

The basic idea - one which has always been and still is at the heart of all ro-ro operations - is that transhipment delays are avoided. In Salut's proposal, rail wagons could be loaded at Russian factories with export cargoes, hauled by locomotive to Astrakhan on the northern coast of the Caspian Sea, taken by ferry to the Iranian side, shunted back on to the rails and hauled southwards to an Iranian sea port for the onward open-sea voyage.

Salut envisages what must be a very large ship, with space for 300 rail wagons. By comparison, the last major purpose-built railway freight ferries, the Railship trio (*Railship I*, *II*, and *III*) built between 1975 and 1990 for the long-haul route between Hanko in Finland and Travemünde in Germany, only carried 60 x 20m long wagons. Equally impressive is the power plant proposed: four Salut gas turbines totalling 220MW output and driving four propellers in a mechanical layout.

Clearly, such an expansive vision would require an enormous amount of planning. More likely to see the light of day within a shorter timescale - indeed possibly this year

One shape of things to come: an image of the Nigel Gee/IZAR pentamaran ferry, seen here in a freight ro-ro version. A prototype could well be ordered soon, for a ship to run between Italy and Spain.

- is the long-gestating plans of Mr Nigel Gee and his Southampton-based team to realise the construction of a pentamaran fast ferry - a slender high-tensile-steel monohull with two pairs of slightly submerged lateral sponsons. The design of this has been discussed on several occasions in this journal, most recently September 2003, page 14. Continuing European proposals to shift freight off congested motorways has been the principal catalyst for the lead project, which is expected to involve a new service between Italy and Spain across the Mediterranean.

The thrust behind this is a belief that Europe's road freight volume is expected to grow by an enormous 50% by 2010; already some motorway systems, such as the London orbital M25 motorway and the links around Rotterdam in The Netherlands, are at bursting point. A partly EU-funded project code-name INTERMODESHIP, in which 18 companies from nine countries are involved, is hoping to present some solutions, although apparently some people believe that long-term subsidies will be needed to sustain such new links.

High-speed ferries, as proposed by Nigel Gee, are anticipated to act as one pressure-relief valve - a sort of marine motorway. The ship that seems likely to result will be capable of carrying around 150 x 30tonne trailers at 31knots on a 15 hour voyage (Mr Gee reckons that haulage operators will expect a service speed of at least 30knots to make the shift to sea worthwhile). The subject of coastal so-called sea highways is to be a major theme at this year's RoRo 2004 conference to be held at the end of May in Gothenburg.

To satisfy generally conservative shipowners and to limit fuel costs, Nigel Gee's ferry will be powered by heavy-fuel-burning medium-speed diesel engines. The specification of heavy fuel would, it is claimed, save around 40% on fuel costs, as opposed to high-speed diesel machinery running on diesel oil. Construction would be undertaken by the Spanish shipbuilding group IZAR, with whom Nigel Gee has an exclusive European licence agreement. A ro-pax variant is also proposed with a higher speed of 40knots.

Whether other owners would prefer a more traditional monohull full-displacement design but still capable of around 30knots in service could form the subject of an interesting debate; examples are already in service, such as Minoan Lines' *Knossos Palace* class, whose service speed is 29.50knots but which comfortably achieved 31knots on trials. The Finnish ENVIROPAX proposal reported in our February issue expects to travel at 28knots, and a new full-displacement challenge between Spain and Italy is already up and running: the 27knot *Eurostar Roma* is today sailing between Civitavecchia (Rome's port) and Barcelona, as part of Grimaldi Ferries' strategy to aid the European Commission's sea highway scheme. Notwithstanding all this, Nigel Gee claims that conventional hulls are not economic above 27knots.

On a different philosophical plane is the newest Japanese Techno Superliner, under construction at Mitsui's Tamano yard. This aluminium-hull/semi air-cushion catamaran will travel at a maximum speed of 39knots over a 1000km route with 350 cars or equivalent, plus 725 passengers. Principal propulsion power will come from a pair of General Electric gas turbines, with four diesel-driven fans providing lift.

Despite a very tight ferry newbuilding market in Europe today - a situation that may have been a contributory factor in the terminal decline of Van der Giessen-de Noord, it is good to record that enterprising owners are pressing ahead with interesting projects.

Planned for completion at the end of this year is possibly the largest-ever cruise-ferry, the 74,600gt *Color Fantasy*, for the Olso-Kiel route, which is building at Kvaerner Masa-Yards, while a brand-new order is that of Norfolkline for two 34,500gt ro-pax ferries placed at Samsung in Korea. Samsung will no doubt be very pleased since it is now building up a respectable business in ferries - a long-held ambition.

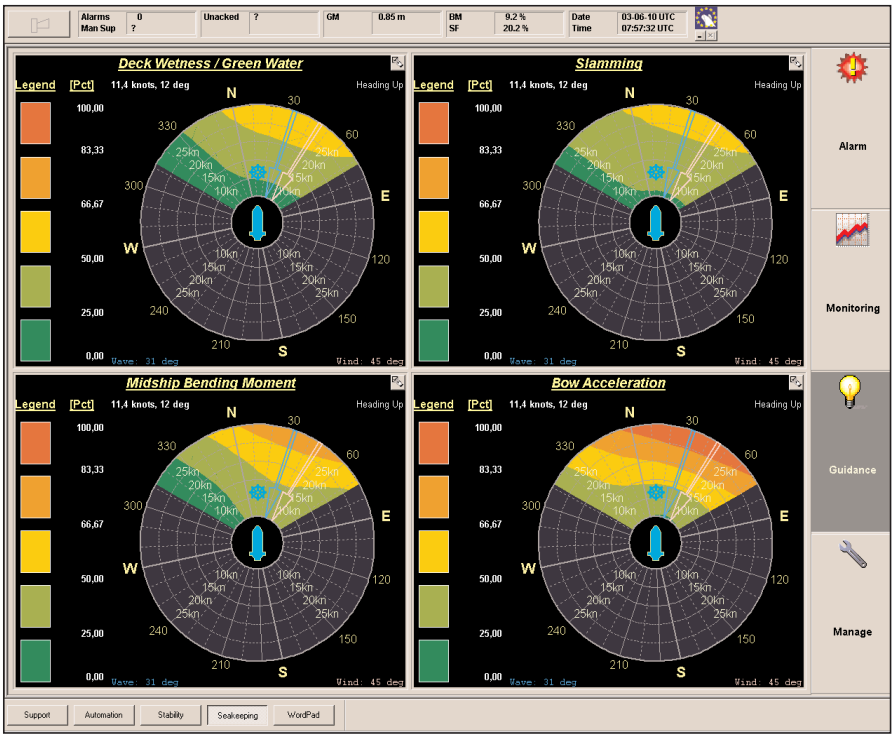
Despite the arrival of tunnels and bridges across key longstanding train ferry routes (such as the English Channel, Great Belt, and Øresund), it is heartening to note that train ferries are not dead. In possible conjunction with the futuristic proposal at the head of this column, a new generation of replacement train ferries is being built at the Uljanik Shipyard in Pula, Croatia, for the Caspian Sea; these are especially aimed at transporting oil and gas tank wagons - a wise move in view of the energy resources of the that region. In China, the new rail service linking the mainland with Hainan island is now in operation (*Yue Hai Tie 1 Hao*, presented in *Significant Ships of 2003*), and a second, longer, train route across the Bohai Strait in the north east of the country is still being planned. Given China's buoyant economy at present, we would not be surprised if this project became a reality very soon.

A special report on ro-ro ferry technology appears in this issue.

Joint action over container-ship stevedore safety

THE UK Maritime & Coastguard Agency (MCA) and the UK Health and Safety Executive (HSE) have taken joint action to highlight safety concerns on container ships following a recent joint inspection on a new ship on her maiden voyage to a UK east coast port.

These two organisations, with their counterparts in Germany, demanded that the operator improve access for lashing containers on deck, after it was found that stevedores were required to balance on a narrow ledge to fit lashings on outside tiers. Since then, the operator has restricted loading in these areas and is acting responsibly to tackle the issues on this ship, and address similar problems on other vessels, currently under construction. A special article on page 6 of this issue outlines the safety problems facing stevedores on container ships.



Bridge display for a new software safety tool developed in Denmark by Force Technology (previously the Danish Maritime Institute). SeaSense aims to alert crews to potential problems by monitoring wave conditions, structural loading, and seakeeping performance. Trials have already been carried out on a Danish Navy vessel and a second system is soon to be installed on an A P Möller container ship. More details appear in our special Denmark feature, which begins on page 28.

V.SHIPS CONTRACT FOR ICE-CLASS TANKERS - Primorsk Shipping Corp (PRISCO), of Nakhodka, Russia, has recently awarded V.Ships a contract for full technical management of three new 105,000dwt ice-class shuttle tankers. These ships will be on long-term charter to the Sakhalin-1 Consortium for operations in Phase 1 of the Sakhalin-1 project, operated by Exxon Neftegas Ltd, as subsidiary of ExxonMobil.

Following a call for tenders from Exxon Neftegas in November 2002 for a series of five ships, V.Ships Consulting was hired by PRISCO to assist in its bid to build these Aframax tankers. Work included the development of vessel specifications and help in reviewing shipyard offers.

In April 2003 PRISCO was confirmed as winner of three of the five new charters, with Sovcomflot having won the other two. Subsequently, V.Ships Consulting has aided both owners with negotiations at Hyundai Heavy Industries, and in monitoring ice model test trials at HSVA, in Hamburg. All five ice-optimised vessels are scheduled to be operational by 2006.

DNV ESTABLISHES GERMAN COMMITTEE - Det Norske Veritas recently held the first meeting of its new German committee at its head office in Høvik. This group consists of 18 leading representatives from the German shipping industry who can enforce their interests with the aid of DNV, and want particularly to influence international committees such as IMO, IACS, and EU organisations.

The committee has also been set up to share information and exchange views on market policy and class-related issues. Founder members have been appointed for three years, and Nikolaus Schües, of Reederei F Laeisz, is acting as chairman. Other members include representatives from Bernhard Schulte, Blohm & Voss, Peter Döhle, Flensburger Schiffbau, Meyer Werft, and Aker MTW, to name but a few.

***DIAMOND PRINCESS* CHRISTENED** - At the end of February, a christening ceremony was held for the Mitsubishi Heavy Industries-built 116,000gt *Diamond Princess*, at its Nagasaki shipyard and machinery works. Mitsubishi was originally commissioned to build two cruise ships for Princess Cruises, and construction began with *Diamond Princess*, followed by *Sapphire Princess*. However, after a major fire at the yard in October 2002, the delivery of the first liner was re-scheduled, so the second ship will be delivered first.

LARGEST-EVER CONTAINER SHIPS? - Samsung Heavy Industries is believed to be re-negotiating an order from Seaspan Container Lines Ltd, of Canada, to increase the size for eight container carriers from 9600TEU to 10,500TEU including an option for four more, worth for a total of US$690 million. If this project proceeds, the ships would be the largest in the world.

Seaspan ordered five 8100TEU containers from Samsung in December 2002, which were the largest ever at that time. There were a total of 79 orders for container ships larger than 8000TEU globally in 2003, and Samsung took approximately 30% of the market, with 23 of these orders.

Some analysts forecast global container freight to increase at a rate of 10% annually until 2010 and expect 10,000TEU container ships to dominate the market in the near future. As such, Samsung is focusing its efforts in positioning itself in that segment of the industry. At the same time, backed by its accumulated technology, Samsung will, it is believed, begin development of 12,000TEU liners.

EXTENSION TO VIETNAM SHIP ORDER - As reported in last month's issue, page 38, the Graig Group has ordered 15 Diamond 53 bulkers in Vietnam. Following on from this, the Group is developing a full range of modern-design bulk carriers at Vietnam Shipbuilding Industry Corporation (Vinashin) yards, that can be built in series. Sizes will range from Handysize up to Capesize.

PEOPLE

ABS has named TODD GROVE as president of the Americas Division. This role will be effective from May 1. Robert Kramek, who he replaces, will become president and chief operating officer at the same time.

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MANAGING RISK DNV

Improving container ship design for safer stevedore and crew operation

Supported by port employers and trade unions, three UK organisations, the Health & Safety Executive, the Maritime & Coastguard Agency, and the port industry's representative body, Port Skills & Safety Ltd, are working together to try to minimise risks to those who have to work on container ships at terminals. One important part of this is to raise awareness amongst those who design new vessels and who make modifications to existing ones.

In most cases, narrow ledges are unnecessary, since modifications in the form of extension plates to hatch covers of gratings not only ensure a better working surface but also improve lashing expediency.

INJURY accidents onboard ships are the largest single component of accidents to stevedores within UK container ports. The most common cause is the lack of suitable and safe access to lashing work-stations on individual vessels, resulting in unorthodox and unsafe work practices. This often involves tasks on unprotected platforms with a potential fall over the gunwale or into the well deck. Musculo-skeletal disorders can also occur when stevedores have to lift and manipulate heavy lashing bars, often in awkward positions. This is not just a question of safety - shipowners who have taken remedial action to address these issues have reported quicker turnround times, which have resulted in increased profits.

What can be done?

The key to this issue is to design out all slip, trip, and fall hazards prior to building or converting a vessel. The following examples demonstrate what has been found to work.

Many container vessels in operation are converted bulk or general cargo carriers, and these tend to offer the worst situations for access. Invariably, the design for container stowage concentrates on the maximum number of containers achievable, with little thought to how stevedores, or crew, will access these areas. On existing vessels and converted bulk carriers, much can also be done to improve lashing access and turnround time efficiency by simply providing good access platforms.

Hatch covers and coamings

Container lashing is often performed by standing on the exposed edges of hatch covers, or on a step formed by the coaming. Where three-high lashing is required, it is necessary to stand back from the container stack to locate the head of the lashing bar in the corner castings. These bars are often 5m long and weigh up to 21kg.

In most cases, narrow ledges are unnecessary, as modifications in the form of extension plates to hatch covers or gratings not only ensure an improved working surface, but also improve lashing expediency. Lashing platforms can be constructed to fill in the void spaces between hatches and other structures. In some cases, these gratings can be hinged to form secure storage space for gear during the voyage.

Extensions welded to hatch covers to provide better working conditions.

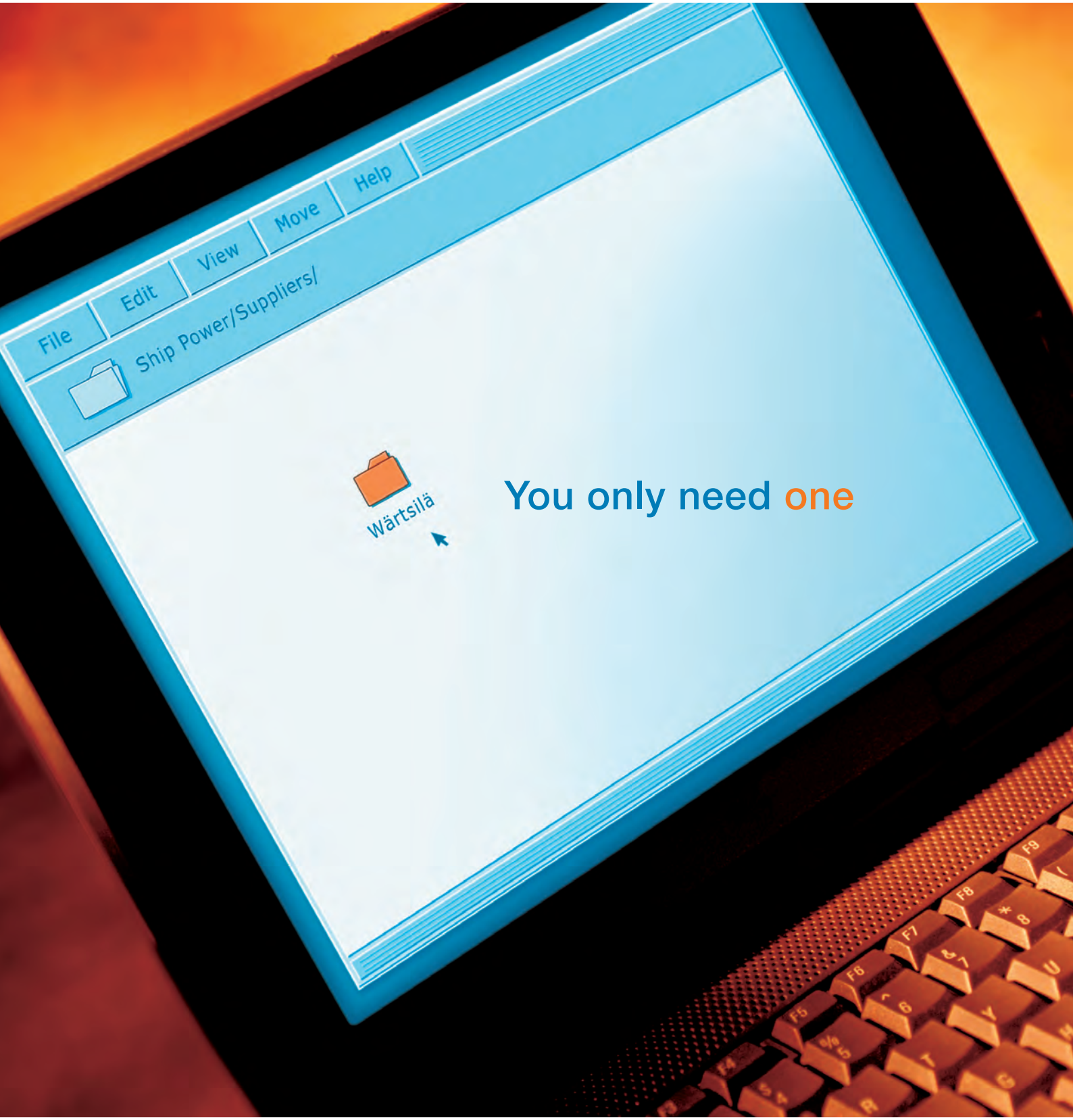
Outboard lashing stanchions

Containers stowed over weather-deck walkways are commonly secured by deck fittings and lashings attached to the top of a steel post structure, often an extension of the bulwark or gunwale. However, in most cases this post only performs that function with little consideration as to how workers will access it. On large container vessels, a fall from this post has the potential to be fatal - either falling onto the deck or over the side onto the quay.

Musculo-skeletal disorders (MSD)

MSDs are the most common cause of occupational ill health in the UK, currently affecting about 1.2 million people, costing society around £10 billion, and losing an estimated 9.9 million working days a year. Inspectors from the Health & Safety Executive have become increasingly concerned with the number of accidents at UK container terminals during the lashing and unlashing of 8ft 6in and 9ft 6in containers using different length lashing bars.

There are multiple risk factors involved in this manual activity. The most significant risk of injury occurs when stevedores lift the three-high bar (21kg) above shoulder height, with extended arms away from the body, whilst manipulating the hook into the lock. This places a lot of strain on the lumbar spine in particular, but due to the postures adopted, other parts of the upper body may be affected. This aspect of the job currently requires



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Before: No consideration has been given here to access. If a vessel securing plan dictates three-high lashing, it is not safe to work from this position.

After: The same vessel after modifications. Safer access is now provided, enabling better lashing efficiency and improved turnround times in port.

Before: A stevedore standing on the gunwale/rail to lash containers.

After: The construction of a lashing platform and access ladder, to allow safe access. This particular platform is collapsible to allow the removal of hatch covers.

Lashing bars can be up to 5m long and weigh 21kg. Significant risk of injury occurs when lifting these above shoulder height.

stevedores to be physically strong, of a certain height, and to have full range of movement of their trunk, neck upper, and lower limbs.

Perhaps this short article has given naval architects some food for thought. Maybe next-generation ships will reveal some more novel solutions to this difficult and often unsung problem. ⚓

Further information on this subject can be found in the publications section of the Safer Ports Initiative website www.saferports.org.uk. This includes a paper, 'Container ship design considerations for stevedore safety', presented at The Royal Institution of Naval Architects' conference Design and Operation of Container Ships, held in London on April 23-24 2003, also guidance on vessel design considerations for stevedore safety. Information on musculo-skeletal disorders can be found on the HSE website: www.hse.gov.uk

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Luxury features for Brittany Ferries' newest ro-ro delivery

MEYER Werft has recently completed its first ferry for nearly 10 years. The new and very fast 41,000gt *Pont-Aven* was handed-over to French owner Brittany Ferries at the end of February, three days before the date agreed in the contract. Brittany Ferries' last delivery was *Mont St Michel* (*Significant Ships of 2002*), built by Van der Giessen-de Noord to a completely different design.

Pont-Aven claims to be able to cross to Spain in just 18hours, virtually half that of any other direct ferry service from the UK to Spain, and achieved at a speed in excess of 27knots. In the summer, *Pont-Aven* will provide a daily service between France and England, and between England and Spain (Plymouth to Santander route). The rest of the time she will operate between France, England, and Ireland. Initially, the ship will enter service on the Plymouth to Roscoff route, giving an improved journey time of just four-and-three-quarter hours.

In addition to a refined hull form for the very fast speed, this new ferry offers comprehensive passengers amenities, such as a swimming pool and fitness centre, as well as the more normal shopping mall, restaurants, and bars, all featuring many glass facades. With a length of 184.30m and a breadth of 30.90m, *Pont-Aven* features 650 passenger cabins to accommodate up to 2600 people. A total ro-ro track length of 3500m also allows 650 cars and 20 trucks to be carried onboard.

Smooth sailing in rough weather should be assisted by the specification of a pair of B+V Industrietechnik's newest type of Simplex-Compact fin stabiliser: a model which features streamlined fin tips - so-called anti-vortex tip fairings - which reduce cavitation and therefore drag. This optimisation is designed to improve lift, which counteracts hull rolling, by between 10% and 25%, depending on the version employed. One of *Pont-Aven's* fin stabilisers was also notable as being the 500th unit built by this German company.

***Pont-Aven*, a 41,000gt ro-ro ferry recently delivered to Brittany Ferries by Meyer Werft, will sail between France and England, and England and Spain at speeds in excess of 27knots.**

TECHNICAL PARTICULARS
PONT-AVEN

Length, oa	184.30m
Length, bp	170.80m
Breadth, moulded	30.90m
Draught (at max load)	6.80m
Gross	41,700gt
Number of decks	11
Passenger capacity (max)	2600
Crew	183
number of passenger cabins	652
outside cabins (including suites)	210
inside cabins	442
Ro-ro lane metres	3500m
Number of cars	650
Number of trucks	20
Main engines	4 x MaK 12VM43
Output	4 x 10,800kW
Speed	more than 27.00knots
Classification	Bureau Veritas

Propulsion and manoeuvring

For optimum manoeuvrability, *Pont-Aven* has been equipped with two high-output bow thrusters and one stern thruster, as well as the more or less standard twin CP propellers with spade rudders. The latter have a surface of 18.5m² each, and are operated through rotary-vane steering gears. Both bow and stern thrusters have CP propellers and each has an output of 2000kW.

The ship is propelled by a four-engine arrangement with reduction gearboxes and twin shaftlines. The output of the flexibly mounted engines (each a MaK four-stroke 12VM43 model of this designer's recently launched vee-form type) is 4 x 10,800kW (14,700bhp) at 500rev/min, operating on heavy fuel. Through the reduction gears (two Flender twin-input/single-out models of 21,600kW propulsion output), each train drives a Wärtsilä CP propeller with a diameter of 5200mm, as well as a shaft generator (4500kW).

Further electrical power is provided by three diesel-generator sets (driven by MaK 8M25 engines) each with an output of 2400kW at 750rev/min. These are also flexibly mounted and have again been designed to operate on heavy fuel. In addition, one emergency generator driven by a Caterpillar engine of 600kW at 1500/min has been installed. Heat for ship's services is provided by two oil-fired boilers (steam production 5tonnes/h each at

***Pont-Aven* has capacity for 650 cars and 20 trucks on a main drive-through deck fitted with hoistable platforms and a lower hold (seen here) accessed by two ramps.**

Pictured here is a Commodore cabin. There are 18 of these luxury cabins onboard and each features a private balcony, wall panels, and veneered furniture. Passengers also have exclusive access to the Commodore lounge.

7bar) and four waste-heat boilers (steam production 1.5tonnes/h each at 7bar). The oil-fired boilers have been designed to operate on heavy fuel, while the waste-heat boilers utilise exhaust gases from the main engines.

Ro-ro equipment

Pont-Aven features two fixed vehicle decks (main deck and lower garage), with hoistable platforms on the main deck. The platforms are divided into six sections on each side of the ship, whose fore and aft lengths serve as access ramps and can therefore be lowered hydraulically. When not in use, the individual platforms can be hydraulically raised and locked in their stowed position under the deckhead. With only trucks onboard, the main deck can accommodate 72 trucks of 16.5m length each, and the lower garage will take another 16. With only cars onboard, the main hold, including the total hoistable decks, will take 624 cars and the lower hold will take 79 cars. Both car decks offer additional parking area for a total of 142 motorbikes.

Vehicles reach the lower garage from the main deck at both fore and aft ends over 40m long and 3.60m wide fixed ramps. These can be closed watertight by means of hydraulically operated covers. *Pont-Aven* features both bow and stern ro-ro access, and both ramps are opened and closed hydraulically and serve as watertight doors at the same time.

A one-piece door/ramp is fitted at the stern, with a three-part folding ramp at the bow (stowing at the collision bulkhead). The two forward parts of the closed bow ramp are stowed and locked below deck. The bow is also equipped with a hydraulically operated butterfly-type visor. To avoid any possible damage, the bow ramp can be lowered only with the visor completely open, and the bow visor can be closed only when the bow ramp is completely locked.

Automation

A Siemens automation system consists of several workstations and monitoring stations, and includes redundant main process stations communicating in a circular fashion. All decentralised input and output stations and several independent systems, such as the propulsion plant, auxiliary diesel engines, air conditioning cooling plant, steam boiler system, fresh water generator, and integrated bridge equipment, are connected to the independent main process stations through a field bus system using fibre-optic technology, which is also partially redundant.

This system covers the following main features:

- general automatic alarm and control of plants and systems
- process visualisation
- emergency shutdown features
- temperature control of systems
- control of all important consumers including standby valves
- control of remote-controlled valves
- measuring of tank contents and draught
- complete airconditioning plant control.

Water supply and treatment

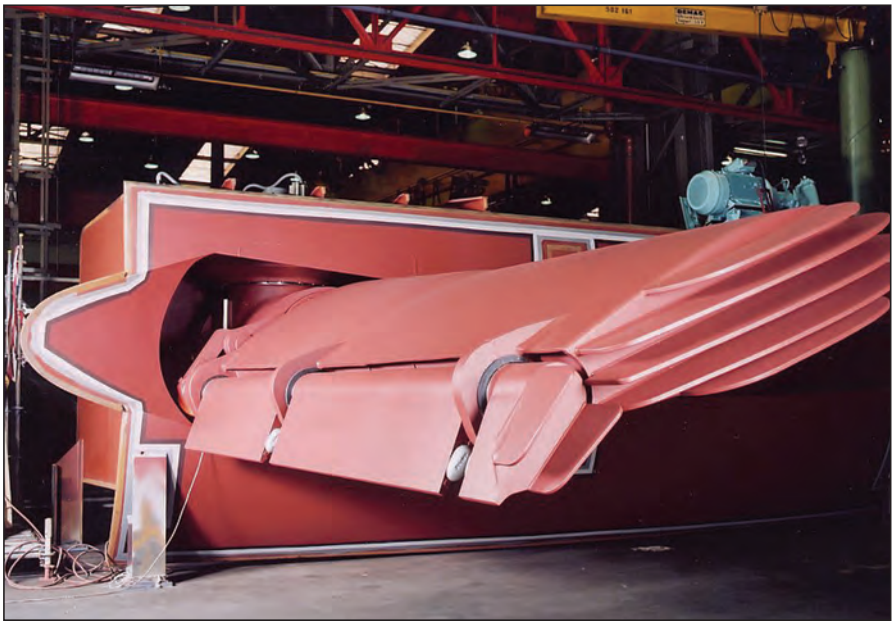
Up to 300m³ of potable water can be produced aboard *Pont-Aven* every day. This is generated from sea water through two vacuum evaporators heated by exhaust gas in the main engine cooling water circulation system. Water produced onboard will first be passed through a mineralisation and disinfecting device before reaching the potable water tank.

All sewage water is collected through vacuum piping from Evac toilets in two vacuum systems and will then be treated in a biologically operated plant. In addition, black water may be temporarily stored in special tanks, allowing later discharge ashore.

Air conditioning system

This ferry is fitted with an air conditioning system, guaranteeing, for its operating area, a year-round constant room temperature of 23°C. More than 120 airconditioning and ventilation plants are arranged in nine fan rooms and

The pool area, located on deck 9, features a retractable glass roof.



Pont-Aven **is one of the first ships to feature B+V Industrietechnik's new type of fin stabiliser. This has anti-vortex tip fairings at the outer end which can improve lift (to counteract rolling) by up to 25%.**

handle a total air volume of approximately 1,164,000m³/h. Public areas are served by central air-handling units, keeping the temperature at a constant level even under changing outside conditions and changing passenger frequency. All passenger cabins are equipped with individual temperature control, and all necessary automatic control and regulation functions of the plant are controlled by the Siemens automation system.

Public spaces

Pont-Aven features a total of 652 passenger cabins, with 210 outside rooms including 16 De Luxe and 18 Commodore-class suites, as well as two separate Owner suites. Commodore suites are characterised by private balconies, veneered furniture, and wall panels. Nine outside cabins are also available for passengers with disabilities, which are easily accessible on deck 6. All cabins feature individual temperature control air conditioning and all, apart from standard cabins, have a flat-screen TV and comfortable seating. The luxurious Commodore cabins feature wide patio doors that offer panoramic views and lead directly onto private balconies.

The atrium-style main hall (stretching from decks 5-9) represents the centre of the ferry. Two glass lifts offer a sky view, and a large glass facade on the starboard side offers a view of the ocean. The area next to the main hall was specifically designed for relaxation purposes. Inspired by the view of the ocean or the displays in the showcases, passengers can enjoy shopping on the arcade deck. Nearby there are also two cinemas, seating a total of 90 passengers.

A self-service restaurant, called Espace, includes a coffee area as well as a large buffet section, and a piano bar on deck 7 is comfortably furnished with a bar counter and live music at the piano. This area seats around 80 passengers. The main restaurant, also located on deck 7, is claimed to be one of the most beautiful rooms onboard. It features large panoramic windows which offer views of the ocean, an open grill station, and a cosy patio.

The so-called entertainment area, on deck 8 - connected via a large staircase from the mezzanine area on deck 9 - includes stages and dancing floors, as well as a bar. In addition to this, adjacent to the bar is a casino. Deck 8 also houses the main shopping region. This large shopping mall includes the special feature of a wine cellar. The entrance to the shopping mall can be reached by an arcade.

The Commodore Lounge on deck 8 is an exclusive room limited to passengers booking suites only. From this area, guests can enjoy an open view to the ship's stern as well as access to two side patio areas. Facilities on deck 9 include a swimming pool with a retractable glass roof, and a bar, with access to the sun deck. Nearby there is also a room of 47 reclining seats for passengers without a cabin.

All accommodation areas, as well as deep-fat fryers in the galley, and galley exhaust ducting, are covered by a Marioff Hi-Fog water-mist firefighting system. In addition, the machinery spaces are fitted with a total flooding and local-application system of the same type. The system fitted in the accommodation areas is of the manufacturer's Hi-Fog 2000 type, which is said to offering a saving of 20% in the number of sprinkler heads.

AGV ro-ro cargo-handling trials imminent

RESULTS coming from the first year of the EC-funded project INTEGRATION (a partnership of 24 companies from 13 European countries) have been presented in Rotterdam and Valencia by Carlo Camisetti, project coordinator and manager of the Italian research organisation CETENA. The first achievements of this new investigation, whose forerunner was the long-gestating IPSI project, are: new AGV (automated guided vehicle) devices to automate loading and unloading of ro-ro ships and terminals up to a 500TEU/h capacity, also new ro-ro ship designs specifically for AGVs.

The potentially high handling capacity can address one of the main bottlenecks to the development of the European Commission's 'sea highway' concept - loading and unloading times, and waiting time at the berth. Sea highways are planned to shift freight off congested motorways (see our article in this feature).

By forming a train up to 10 AGVs, it should possible to handle simultaneously up to 20 x 40ft containers or 40 x 20ft containers, whose weight can reach a total of 900tonnes. The AGV is a 'smart' device, capable of operating both in the terminal area and onboard ships, lifting containers or swap bodies and dropping them in the required position. The loading/unloading operation is achieved using cassettes, which are already in operation with some companies, such as Cobelfret.

A full set of new ro-ro and ro-pax vessels has been designed by Fincantieri, IZAR, and CETENA to satisfy a wide range of speeds (10knots-55knots) and cargo capacities between 80TEU and 1300TEU. They have been designed to berth at all possible terminal types, from the smallest and most modestly equipped ones to the largest and fully automated, in order to address current and potential requirements of short-sea shipping and intermodal transport.

One example of the above proposals is a large ro-ro ship, carrying 1500TEU at a speed of 20knots, designed to compete with traditional feeder container ships. A loading/discharge cycle for this vessel - in a fully AGV-automated terminal equipped with an external fixed ramp - has been evaluated as approximately six hours, enabling a single terminal to host up to four ships every 24 hours. It has been estimated that in such a situation, it might be possible to replace 25 traditional container feeder ships with 14 ro-ro vessels. Two AGV prototypes built by TTS and Danaher Motion are almost ready, and imminent trials are expected to take place in Gothenburg, Genoa, and Gioia Tauro.

Even if a fully automated ro-ro terminal is the solution which allows the greatest cargo flows, semi-automated systems based on some manual cargo handling, still using cassettes, can also be competitive where the terminal is equipped with a fixed ramp to allow simultaneous working of two decks.

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MacGREGOR

Three fast ro-pax ferries ordered in Italy by Finnlines

THE leading Finnish operator Finnlines has booked an order for three 42,000gt ro-pax ferries, claimed as one of the largest of their type, at Fincantieri in Italy - a somewhat surprising choice given the difficult state of the Finnish shipbuilding industry; however, Finnlines' last new tonnage, the *Finnmaster*-class freight ro-ro ships, were constructed at the Jinling Shipyard, in China (*Finnmaster*, *The Naval Architect* February 2000, page 32), while a pair of ro-pax ships were purchased on the stocks in Spain from Stena (*Finnclipper*, *Significant Ships of 1999*). Each new ferry, to be deployed on the long Helsinki-to-Travemünde service, is worth €100 million, and an option exists for two further sisters. It is possible that one ship will be built at Ancona and two at Castellammare di Stabia (Naples), but a final decision on the yards has not yet been taken.

An impression of the new 42,000gt ro-pax ferries ordered by Finnlines from the Italian Fincantieri group. They will have a very fast service speed of 25.00knots.

A very large ro-ro capacity - 4200lane metres for 300 trucks - and cargo capacity - 9300dwt - will be a special feature of the new designs, which were created by Fincantieri's merchant ship business unit, and space will be provided for 500 passengers, mostly in 225 deluxe cabins - a relatively large number for this class of vessel. Each hull will have a length overall of 216.00m, a breadth of 30.50m, a depth to upper deck of 16.00m, and a draught of 7.00m.

Propulsion power will be provided by a quartet of Wärtsilä 9L46D medium-speed engines, each developing 12,000kW, for a very fast service speed of 25knots. Delivery of the first ferry will be at the end of 2005, and the third in mid-2006.

'Sea highways' open new era in ro-ro shipping?

A PRIME theme at the forthcoming Ro-Ro 2004 conference, to be held (with an associated exhibition) from May 25-27 at the Svenska Mässan, Gothenburg, Sweden, is to be so-called sea highways - short-sea ro-ro services along a continuous coastline, running in competition with road haulage. This comes at a time when pressure is being exerted from various quarters - particularly in Europe but also in the USA and Japan - for industry to transfer freight from land to sea. Sea highways are seen as providing new markets at a time when traditional ro-ro business is under equal pressure from competition ranging from lift-on/lift-off (lo-lo) container ships to budget airlines.

Many people are, however, questioning the economics of such a transfer when compared with road transport operations; the latter are considered fast, flexible, and cheap, and in the UK at least, are supported by a powerful lobby. Apparently, some sectors of the industry believe that long-term subsidies will be needed if such ro-ro ferries are to attract large volumes of freight off the roads.

In the USA, the Transport Equity Act has been introduced to try and introduce short-sea shipping as an alternative to both road and rail. Mr Robert Kunkel, from the US company, Apex Marine Ship Management Co, believes that new ro-ro ship designs must be introduced to aid movement of 53ft domestic trailers and ISO containers on chassis; he will present his ideas on the second day of the conference.

Notwithstanding this possibly pessimistic scenario, organisations such as Nigel Gee & Associates and the Spanish shipbuilding group IZAR, as discussed in a separate article in this feature, are pressing firmly ahead with new designs of very fast freight ferries aimed specifically at such routes (in Europe). Another service, already in operation, that could be considered as a pioneer of short-sea 'highwaying' is that run by Cobelfret Ferries with its trio of freight ferries led by *Spaarneborg* (*Significant Ships of 1999*). These ships, sailing between Gothenburg and Zeebrugge, are principally designed to load forest products for Stora Enso using specially designed covered cassettes.

35knots by rail ferry to South-East Asia?

AN amazing plan is on the drawing board in Russia to build a fleet of very fast ro-ro ferries to carry rail wagons from the home country to India and Indo-China (Vietnam and neighbouring nations). The philosophy is based on a premise that no cargo transhipment will be needed; wagons will leave the factory or terminal and be taken on the railway to Astrakhan at the northern end of the Caspian Sea. Here, they will be shunted onboard a ferry which will take them to Iran, where they will be shunted on to tracks again and taken to a south-coast port in that country. When they reach there, wagons will be loaded onto a huge rail ferry capable of accommodating 300 units; this ship will have a massive power plant of 220MW with four screw propellers and will be capable of speeds of 35knots.

On the back of designs for generating land-based power, the Moscow-based Salut Federal State Unitary Enterprise is proposing to build a quartet of 55MW gas turbines to drive the propellers of this monster ship via mechanical transmissions. The large volume of exhaust gas would be passed through economisers to supply steam to turbines; it appears that some of this could be used to boost the gas turbine compressor, some used to cool the turbo-compressor, and part injected into the combustion chamber. A special 6MW reversing turbine would be fitted to two of the turbines so that the ship can go astern and manoeuvre satisfactorily.

Railway ferries are still popular in Russia. A new replacement fleet of ferries for the Caspian Sea is currently under construction at the Uljanik Shipyard in Croatia (*The Naval Architect* September 2002), and the Severnoye Design Bureau has been planning some large new rail/road vehicle designs for 30 wagons or 40 lorries. For many years, a rail ferry service has operated in the Russian Far East to the island of Sakhalin - a route that might assume new importance with the growing export of offshore oil and gas from that area.

Tor Magnolia: leading an innovative new series for DFDS Tor Line

Bold investment in a new series of trailer ships ranking as the largest and among the fastest in the North Sea market will result in a hoisting of capacity by nearly 40% on both Gothenburg/Immingham and Esbjerg/Immingham services maintained by DFDS Tor Line. David Tinsley reports on the innovative new class built by Flensburger Schiffbau-Gesellshaft.

The 10,407dwt *Tor Magnolia* heads a new class of six innovative freight ro-ro designs from Flensburger Schiffbau-Gesellschaft for DFDS Tor Line. The design builds on an earlier successful series for the Turkish operator UND and for AWSR Shipping.

A SUCCESSION of renewed and newly-won long-term contracts covering unitised cargo shipments between Sweden and the UK is testament to the strengthened competitiveness of DFDS as an industrial shipper as well as a carrier of general commercial freight. It is also an endorsement of the Danish group's vigorous ro-ro fleet modernisation strategy.

The new breed, led by *Tor Magnolia*, marries proven technology in an innovative manner, also best practice and refined features, with an advance in unit scale, to meet key operating goals relating to efficiency, productivity, and scheduling dependability. The tough short-sea trading environment in which DFDS conducts its business gives added import to factors of year-round ship, equipment, and service performance and reliability.

DFDS Tor Line's AngloBridge operation linking Gothenburg with the south Humberside port of Immingham has been the initial beneficiary of this construction programme, receiving *Tor Magnolia* in October 2003, followed in January this year by *Tor Petunia*. Third-of-class *Tor Primula* is expected be phased in at the beginning of May. The fourth and fifth newbuildings in the series from Flensburger Schiffbau-Gesellschaft are due for handover in August 2004 and January 2005, for deployment on the Esbjerg/Immingham route, marketed as the BritanniaBridge service.

Besides the scale economy implicit in her 3830lane-metre capacity, *Tor Magnolia's* design reflects the owner's quest for improved unit cost performance through the nomination of a single, two-stroke engine for propulsion - an unusual choice for a short-sea ro-ro vessel. Special features of the aft hull form and rudder design attest to optimisation of the design's hydrodynamic properties, and underscore the Flensburg yard's policy of maintaining a high level of in-house R&D to enhance the value of its products to clients. Model testing was carried out at the HSVA tank in Hamburg.

Each of the *Tor Magnolia* quintet embodies 37% more lane-metre capacity for just a marginal increase in length and breadth relative to the company's preceding generation of all-freight carrier, the *Tor Selandia* type (*Significant Ships of 1998*). That 2800lane-metre, Fincantieri-built trio had been commissioned into the AngloBridge run in 1999 and 2000, as DFDS Tor Line's first newbuildings for more than two decades. The latest series also provides for year-round scheduling at a service speed of 22.5knots, at least half a knot faster than the *Tor Selandia* class.

Refining a successful base design

The design employed for this new series draws on thinking applied by the German yard to smaller but highly successful twin-engined ro-ro ships built for Turkish ro-ro specialist UND and for AWSR Shipping, the latter in its capacity as contractor to the UK Ministry of Defence (*UND Akdeniz*, *Significant Ships of 2000*, and *Hurst Point*, *Significant Ships of 2002*). Tailoring to the precise operating needs of DFDS for the latest series is reflected in finer underwater lines and in a four-deck configuration as well as in adoption of the single-screw, low-speed diesel direct drive. Flensburger's interesting work in this sector was discussed in *The Naval Architect* September 2002, page 80.

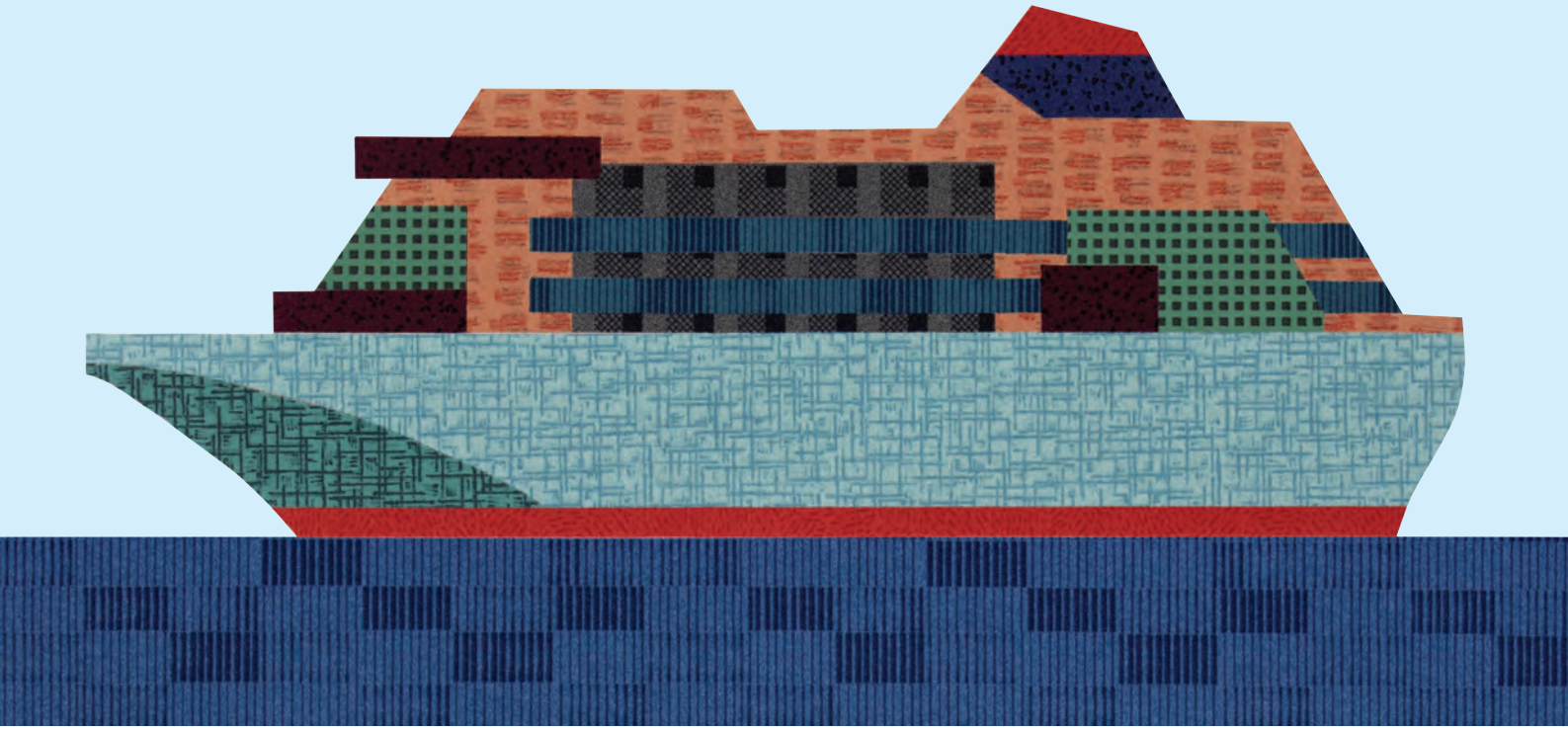
The fact that the major advance in payload has been achieved within a maximum length of 199.80m, only 2.3m in excess of that of *Tor Selandia*, and on a beam of 26.5m, little more than 0.5m greater than the earlier ships, is a measure of the design optimisation achieved within dimensional parameters set by DFDS Tor Line. The breadth specified is the absolute maximum for working through the lock to Immingham Dock from the tidal river Humber. However, a new agreement signed by DFDS in February with Associated British Ports will ultimately see all five *Tor Magnolia* sisters handled at new riverside berths. The main dimensions of the new class are also pertinent to the trade from both Sweden and the UK to Ghent, which entails passage through the lock system at the Western Scheldt end of the Terneuzen Canal.

The weatherdeck and upper trailer deck offer a free height of 4.7m, the tanktop gives a 5.2m headroom, while the main deck has a free height of 6.8m in its after part, and 6.2m forward of the engine casing. In addition, and making good use of the flared bow, the forward area of the main deck is equipped with two levels of hoistable car

TECHNICAL PARTICULARS
TOR MAGNOLIA

Length, oa	199.80m
Length, bp	190.29m
Breadth, moulded	26.50m
Depth, to main deck	9.40m
Depth, to weatherdeck	22.70m
Draught, design	6.95m
Corresponding deadweight	8780dwt
Draught, scantling	7.35m
Corresponding deadweight	10,407dwt
Gross	approx 32,289gt
Cargo capacity	256 x 14m trailers
Linear freight capacity	3831 lane-metres
Car capacity (on hoistable decks)	300
Main engine	MAN B&W 9L60MC-C
Output(MCR)	20,070kW at 123rev/min
Service speed	22.50knots
Class	Lloyd's Register+100A1, Roll-on/Roll-off Cargo Ship, IWS, NAV1, IBS,Ice class 1D, LMC, UMS

Floorcovering designed for the sea



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It's little wonder that Flotex Marine is specified by MSC Cruises, Grimaldi Luxury Ferries, Caledonian McBrayne Ferries, Sally Line, P&O Cruises, Stena Line and Stavanger Ferries & Catamarans.

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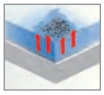
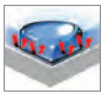


The smooth, straight fibres release dirt easily when cleaned – unlike conventional carpets



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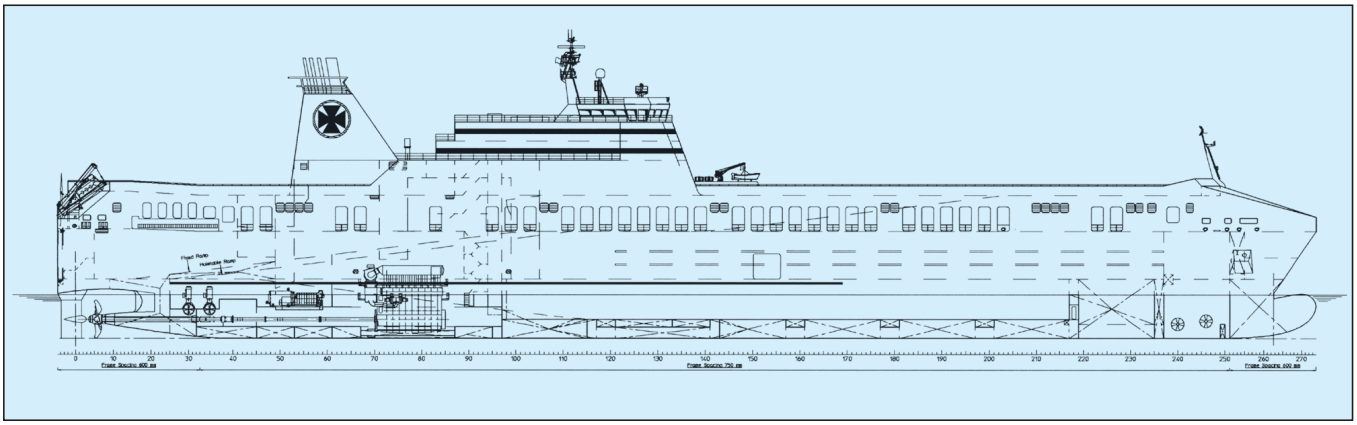


Profile of the new single-screw ro-ro freight ferry *Tor Magnolia* and her four sisters, being built by Flensburger Schiffbau for DFDS Tor Line.

decks, providing parking for more than 300 trade cars. The design has a double skin above main deck level, and side ballast tanks below.

Although trailers, such as the well-known MAFI type, remain the most important type of unit transported, the high headroom on the main deck offers versatility to meet the needs of traffic such as roll-trailer-borne double-stacked, high-cube 45ft containers. Notwithstanding the higher freight intake compared with the *Tor Selandia* class, the new generation from Flensburg offers full turnrounds within a comparable timeframe.

For speedy loading and discharge within existing schedules, distinct ramps are provided for vehicle transfers from the main deck to the two upper levels, namely the upper trailer deck and weatherdeck. Besides a fixed internal ramp between main and upper trailer decks, the two levels are also connected by a hoistable ramp, located on the port side aft. A fixed ramp serves movements between the main garage deck and lower hold.

Cargo access is by way of the stern across an 18.1m-wide x 14m-long axial ramp at main-deck level, supplemented by 4.3m x 4m hinged side doors forward, both port and starboard. The aftermost end of the upper trailer deck has been laid out to allow the possibility of an 8m wide shore linkspan being landed. Ramps, doors and hoistable decks have all been designed and supplied by MacGregor.

Cost benefits from single-screw propulsion

DFDS is no stranger to single-engined, single-screw ro-ros, and is also familiar with two-stroke plant in trailer ships, having acquired a number of vessels with low-speed, direct drives over the years. However, *Tor Magnolia* signifies the first-ever selection of two-stroke plant in ro-ro vessels ordered to its own account, and the arrangements represent an unusual choice in a European shortsea ro-ro context.

Each has an L60MC-C diesel from the MAN B&W stable, supplied in the new nine-cylinder format, and producing 20,070kW at 123rev/min. This drives a 6.1m-diameter, Kamewa Ulstein CP propeller for a service speed of 22.5knots when operating at 90% MCR with a sea margin of 15%.

By opting for a single, low-speed prime mover, the operator aims to realise significant unit cost benefits and reduced environmental impact, as well as anticipating high reliability and availability factors. The Danish group reckons that the single-engine arrangement offers a saving of around 15% in fuel consumption relative to the powering alternatives for the given vessel size and speed, translating into considerable economic benefits over a year. The chosen machinery also promises good part-load performance, plus benefits in terms of comparative installation and maintenance costs.

Asymmetric rudder and Costa bulb

The single skeg in the aft body reduces wave patterns and stimulates improved water flow to the propeller. So as to accommodate the largest possible propeller diameter, the hull form has been shaped into a soft tunnel beneath the transom. These ships are also the first to be fitted with a new Flensburger-designed single-piece rudder whose leading edge is twisted so as to gain maximum benefit from the rotational energy of the water behind the propeller.

This asymmetric-section rudder also incorporates a Costa bulb and can be turned through 45deg port and starboard by means of a KGW ram-type steering gear. Excellent manoeuvrability should be possible with twin Rolls-Royce Ulstein 1500kW tunnel thrusters at the bow and two 900kW units from the same company at the stern.

The DFDS fleet modernisation project has also provided MAN B&W with its opening contract for the L21/31 engine, the innovative medium-speed design initially slanted at the shipboard genset market. The 5600kW auxiliary power package for each vessel will consist of four 8L21/31-based gensets, individually rated at 1400kW, and supplied by MAN B&W's Holeby division in Denmark. Each of the heavy fuel oil-burning auxiliaries is equipped with a Munter SCR (selective catalytic reduction) converter.

English Channel ro-ro ships ordered in Korea

TWO new English Channel ro-ro vessels for Dutch company Norfolkline - a subsidiary of A P Möller, Denmark - have been ordered at Samsung Heavy Industries. These 34,500gt passenger/vehicle ferries will be used to serve the operator's route between Dover, England, and the French port of Dunkerque. Each ship is designed to carry 780 passengers, 70 crew, 200 cars, and up to 120 freight vehicles. They will be delivered from the shipyard's Koje facility in July and November 2005. The ferries will feature a package of MacGregor ro-ro equipment as well as galleys, bars, fast food outlets, pantries, and provisions stores.

The delivery of ro-ro equipment for these ferries will be MacGregor's first complete-system package of this type in Korea, which the company will complete in January next year. Ship/shore ro-ro efficiency for the Norfolkline service is being further enhanced by a reconditioned and modified MacGregor two-tier linkspan at Dunkerque.

The ro-ro package for the new ships includes:

- stern door
- bulwark visor
- forward door
- inner bow doors
- bow door mechanism
- two internal doors
- tilting ramp
- electrical and hydraulic equipment.

MacGregor's passenger ship division's contract includes the design and supply of 690m² of catering areas and equipment, 14 cold and dry stores covering an area of 160m², and over 600 pieces of equipment and shelving for various areas. The order also includes supervision and technical assistance at the beginning of installation.

The new pair will join Norfolkline's three 22,150gt ships in its Dover-Dunkerque fleet: the Spanish-built ro-pax *Dawn Merchant* (built 1998), and sisters *Northern Merchant* and *Midnight Merchant* (both completed in 2000). This 23.30knot trio was originally ordered by and entered service with Cenargo, prior to that company's difficulties; all were constructed at the Sevilla yard of Astilleros Españoles (today IZAR).

Contracts near for Nigel Gee pentamaran ferries?

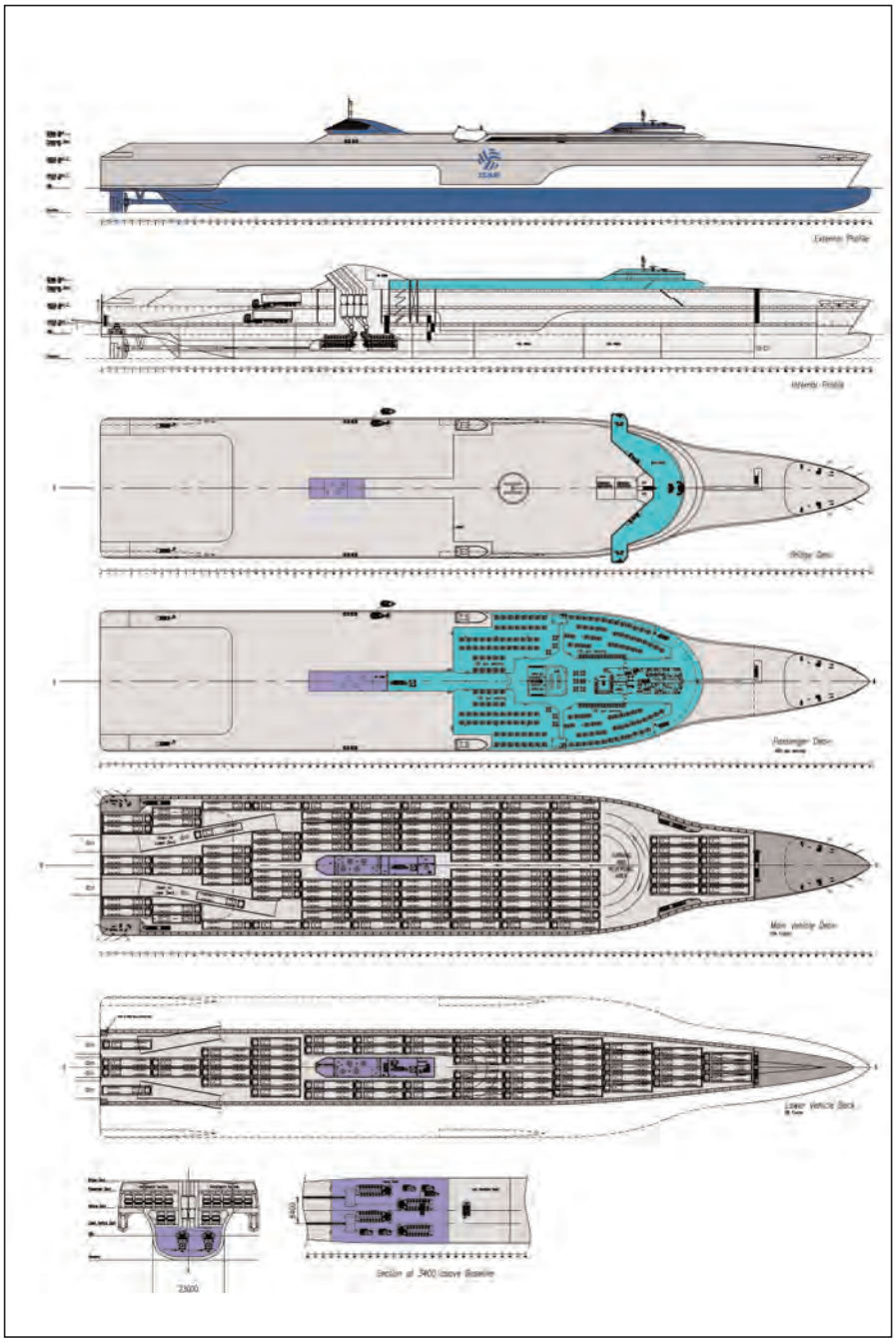
FOLLOWING several years of extensive design and model testing work, it really does appear that at long last Nigel Gee & Associates' proposals for European fast freight and ro-pax ferries could perhaps result in a firm contract. As reported in our September 2002 edition, an exclusive European construction licence has been signed with the Spanish state shipbuilding group IZAR for the UK company's slender stabilised monohull using patented pentamaran technology.

Speaking at the recent British Maritime Technology annual press meeting, Mr Nigel Gee (today, his company is a member of the BMT Group) spoke of the huge problems facing the European road network, with road freight expected to grow by 50% by 2010 and some systems, such as the London orbital M25 motorway, already almost at saturation point. Although unlikely to overtake land transport, water-based transport could form a highly useful complement - a sort of marine motorway. Already today in Japan (another nation with heavily congested roads), one in four freight journeys of more than 1000km length are transferred to ships.

Nigel Gee is primarily proposing a steel-hulled slender stabilised monohull (a pentamaran with two stabilising arms on each side) for between 150 and 200 trailers. To keep fuel costs at a tolerable level, this design would be powered by heavy-fuel-burning medium-speed diesel engines - these would burn 40% less fuel than an equivalent ship with high-speed engines running on marine diesel oil. Siemens gas scrubbing technology should ensure that such ships meet European emission regulations.

'Detailed negotiations' are claimed to be under way with an unspecified owner and on an unspecified route but understood to be between Spain and Italy. The proposed ferry could load 150 x 30tonne lorries and travel at 31knots on the 15hour voyage.

Activity on the ro-pax front is also centred on a pentamaran hull built of high-tensile steel. Originally, aluminium had been proposed but owners preferred to stick with a relatively traditional construction and again based on medium-speed diesel engines (rather than alternatives such as gas turbines). Here, Nigel Gee is proposing a 40knot design capable of carrying 200 trucks or trucks and cars, and 1000 passengers. Advanced negotiations are also believed to be under way for one of these, too.



General arrangement plans for a 247m long pentamaran ro-ro freight ferry proposed by Nigel Gee & Associates as a solution to motorway congestion. A ship similar to this could possibly be ordered quite soon from IZAR for a route between Italy and Spain, carrying around 150 lorries at 31knots.

FastShip alternative challenge

At the same time, a challenge for the FastShip Transatlantic plans is also being mounted by from the Nigel Gee/IZAR stable, where the pentamaran hull concept is being proposed to load containers in a conventional lift-on/lift-off format. Although not quite as speedy as the four days hoped for by FastShip, this pentamaran could cross the Atlantic in seven days, compared with three-to-four weeks for a normal cargo ship at present. With an 8000tonne payload, 1000TEU boxes with lighter cargoes could travel at speeds up to 40knots in seastate 6. Although the costs would be two-and-a-half times those of a conventional ship, they would be one-quarter of those of airfreight, and the transit time would be only one-third.

The pentamaran hull has design approval from Det Norske Veritas, and finite-element analyses have been made of the structure. A model hull has been tested in significant wave heights up to 15m (4m heights would be the equivalent of sea state 6). Waterjets from Rolls-Royce Kamewa or Wärtsilä Propulsion will almost certainly be used on all models travelling at very high speeds above 35knots, although for lower speeds propellers are perfectly satisfactory, as the general arrangement plan above shows.

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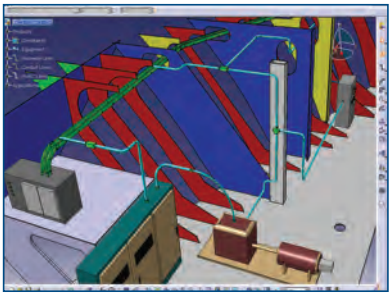

Organised by The Royal Institution of Naval Architects (RINA) and The Institute of Marine Engineering, Science and Technology (IMarEST) on behalf of the Confederation of European Maritime Technology Societies (CEMT) Supported by the EU, ESCA and CESA

Over the past 30 years, the European shipbuilding, and repair conversion industry has seen substantial rationalisations, mergers and consolidation. While there has been a reduction in market share, the industry has enjoyed relatively greater success in the high added value specialist vessel, shiprepair and the marine equipment sector.

Against a background of increasing shipbuilding capacity in China and South Korea continuing arguments on shipbuilding subsidies, how can the European maritime manufacturing sector maintain and increase its market share? Through the "LeaderSHIP 2015" initiative, the European shipbuilding and shiprepair industry has defined a long term strategy to develop appropriate policies to strengthen the competitiveness and ensure sustainable growth of the industry. This strategy envisages a knowledge-based industry for both product and production process, concentrating on more complex vessels. Research, Design and Innovation (RDI) is a key factor in this strategy.

In order for the European shipbuilding, repair and conversion industry to maintain and improve its competitiveness, it is essential that it develops and employs the latest technologies in design, engineering and production. The E*uropean Shipbuilding, Repair and Conversion - The Future* conference will provide an opportunity to examine the future needs for RDI, and to present current work in that and related sectors.

Papers are therefore invited on the following areas:
•Future demand for new construction, repair and conversation•Research and innovation within the industry•Design support technology•Development of new and improved products•Manufacture and assembly technology•Improving the production process•Supply chain logistics•Financial and legislative framework•Education and training

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Trends in ship sizes - will hulls always grow larger?

An assessment of reasons for the rise, and occasional fall, in ship sizes during the last 50 years, plus possible extrapolation for the future, are offered by Ian Buxton, FRINA, from the University of Newcastle, School of Marine Science & Technology.

EVER since iron was used in hulls and steam was the primary mode of propulsion, ships have been getting bigger. While there are technical limits to the size of wooden sailing ships, there are virtually no limits to steel hulls with mechanical propulsion. There are two factors which drive ship size upwards:

- *enabling technology* - the ability to design, build and operate bigger ships.
- *economic demand* - if the shipping market is expanding, this demand can be met by more ships or larger ships, or by a combination.

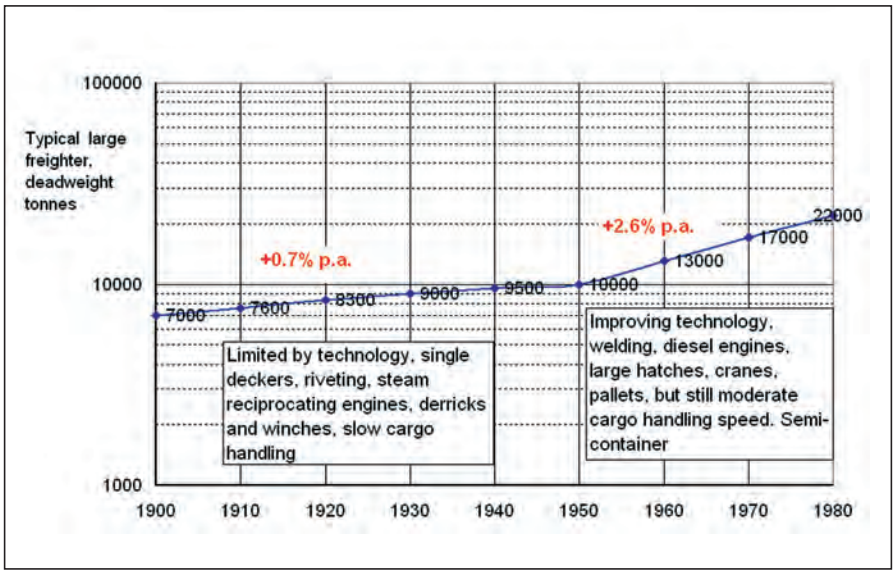


Fig 1. Dry cargo multi-deck ship deadweight trend.

Ships generally benefit from economies of scale, that is, doubling the size of ship does not double construction, fuel, or manning costs. Thus if we can fill a bigger ship, cost/tonne carried at sea will fall. Nevertheless, there may be diseconomies of scale in port. Longer cargo handling time or high port construction costs may actually increase costs/tonne. When adding sea costs to port costs, there may be a minimum cost at a size smaller than the physical maximum.

It is possible to examine trends in ship size over long periods of time to see if the empirical evidence points to any general conclusions. Ships for carrying coal or grain have been used for centuries, but useful conclusions can be drawn by looking just at 20th century trends. Fig 1 shows the trend of typical large dry cargo ship size from 1900. These are not necessarily the absolute largest ships of the day, but the most popular size of the larger ships.

Such freighters were multipurpose, capable of carrying both bulk cargoes and general cargo, but in 'break-bulk' form. Their non-unitised cargo could lead to such ships spending 50% of their time in port. Tweendecks were needed for 'shelf space', while the technology did not lend itself to single deckers much over 10,000dwt. A log-linear scale shows a constant annual percentage growth rate as a straight line, less than 1% annually from 1900 to 1950. Improved technology from 1950, including welding, led to slightly higher yearly growth of 2%-3%, although relatively few such vessels are built today.

Specialisation: the solution to slow cargo handling

The solution to the problem of slow cargo handling was specialisation, so that the single-deck bulk carrier evolved rapidly from the 1950s, while the introduction of the ISO container in the 1960s allowed much larger ships to be built for general cargo, without incurring excessive time (or cost) in port.

Fig 2 shows the rapid increase in size of bulkers in the 1960s, doubling in seven years, or 11% annually. This was partly due to expansion of trade, especially in the steel industry with its need for iron ore and coking coal, partly due to taking over cargoes such as grain from tween-deckers. Once that substitution was complete, and with the recession brought on by the quadrupling of oil prices following the 1973 Arab Israeli war, bulker size growth dropped back to around 2% annually, where doubling takes 40 years. Although a handful of ships have been built above 250,000dwt (sometimes combination carriers), the most popular large bulker is the Capesize, now around 170,000dwt-180,000dwt. While bulk carrier design has

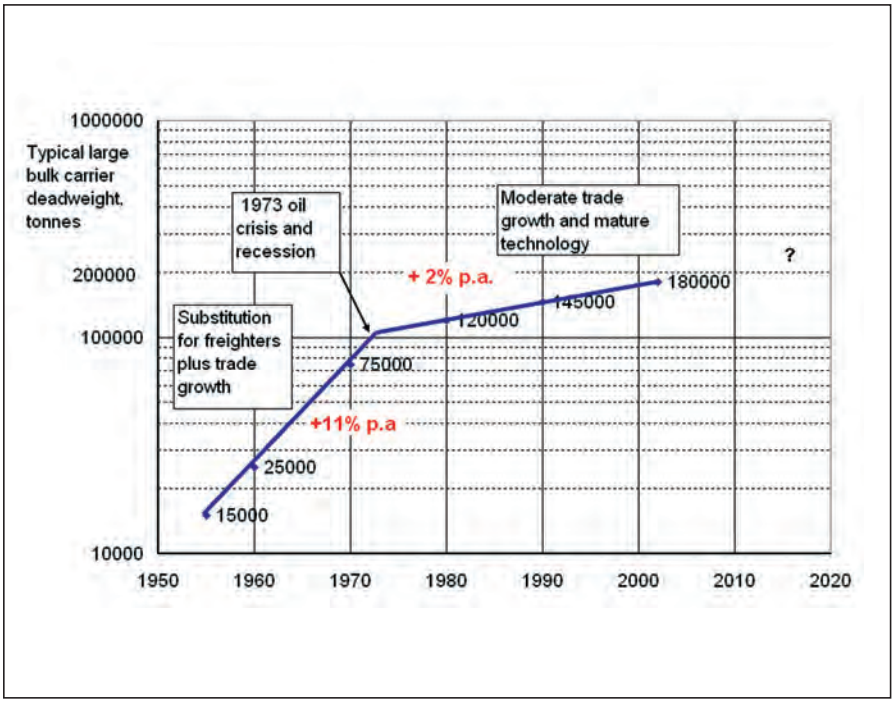
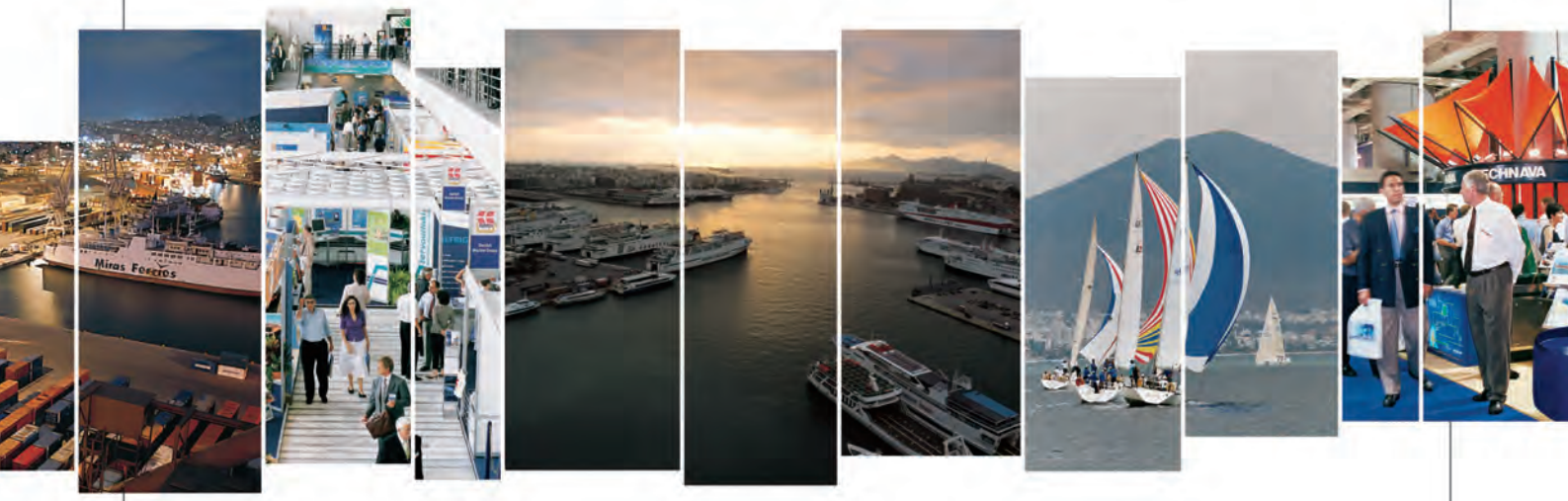


Fig 2. Bulk carrier deadweight trend.



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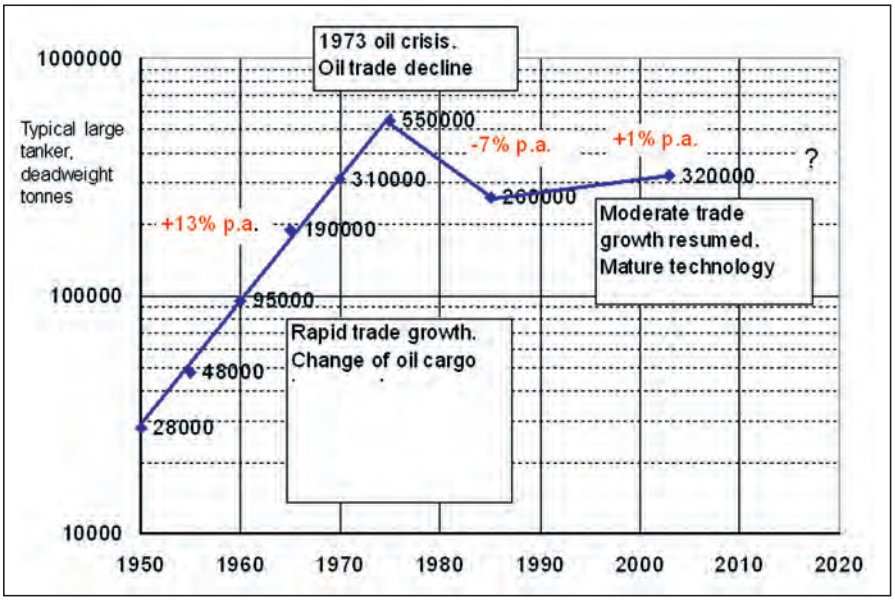

Fig 3. Tanker deadweight trend.

improved in detail, the basic technology has remained unchanged for 30 years, ie, has become mature.

Rise and fall of tanker sizes

Tankers showed the fastest rate of growth in the 1950s and 1960s of any ship type in history, increasing in size 20-fold in 25 years, or 13% annually, as Fig 3 shows. With surging energy demand in the post-Second World War era, oil taking over from coal as the primary fuel, refineries being sited in consuming areas (rather than the previous producing areas), and the rise of enabling technology (including computer-aided design), tankers (a few) of more than 500,000dwt were built. But from 1975 and with the then surplus of tankers, few refineries wanted parcels of 500,000tonnes, few ports could handle ships drawing 25m, and the ships proved inflexible.

Coupled with the decline of the role of oil majors, those few tankers ordered in the 1980s were much smaller, at around 260,000dwt, or the now popular 'million barrel' Suezmaxes of around 130,000dwt-150,000dwt, the largest then capable of transiting an enlarged Suez Canal. Since then, there has been only a very slight growth in tanker size of around 1% annually to today's 320,000tonner.

What future for container-ship size?

There has been much discussion in recent years on the future size of container ships. They started off larger than conventional dry cargo ships at around 20,000dwt or just over 1000TEU. Rapid growth ensued since containerisation offered lower costs and faster transit times door to door; the concept quickly displaced multi-deck vessels on main routes, contributing to a 9% annual growth rate. Once that substitution on the principal routes had taken place, the growth rate dropped back to an annual 5%, where it has remained for 30 years, but even that doubles in size every 14 years, as shown in Fig 4.

The 'constraint' of Panamax dimensions was soon breached for ships whose route was unlikely to involve a transit of the Canal, such as on the primary North America to Far East Transpacific route. No insuperable technical limits on hull or machinery were encountered while, with competition, ports geared up to handle ever bigger - and wider - container ships.

The worldwide economy continued to expand from the mid-1980s, with trade in manufactured goods, increasingly produced in East Asia, expanding faster than trade in raw materials. The growth of the hub-feeder concept on primary routes such as Rotterdam-Singapore allowed mainline ships to become larger yet still offer frequent services, with calls to secondary ports now made by transhipping to smaller feeder container ships, rather than direct calls.

But while large ships offer potential economies of scale, their operation can be negated by factors such as accumulation of ever larger parcel sizes and longer port times (in the absence of a breakthrough in cargo handling), which might be called systemic constraints, as opposed to technical constraints. There comes a point at which the advantages of larger size no longer outweigh the disadvantages.

What conclusions can be drawn?

So, can we draw any conclusions from these size growth trends? Table 1 shows 10 possible causative factors, which have been assigned to the historical growth rate of the four ship types at different periods. A pattern does emerge: rapid annual growth of 10% or so requires a new payload system, which can add substitution of the obsolescent ship type to the underlying trade growth rate, eg, tankers and bulkers pre-1973.

Low or negative growth occurs when technical limits are approached, coupled with a mature technology, plus external factors such as depths of channels. Prolonged decline in a trade, associated with inflexibility, forces ship sizes down, as with tankers post-1973 - no 500,000dwt tankers have been ordered since the 1970s.

So a view on future size trends depends on one's view of the causative factors. For example, it might be assumed that tankers are a mature technology and face only moderate trade growth, in which case history suggests an annual growth rate of 1%-2%, say around 400,000dwt by 2020. For bulkers, it might be assumed they face more technical limits with regard to hull structure and cargo operations, say 0.5%-1% annually, or around 210,000dwt by 2020.

For container ships, the debate continues. Design studies have been done for ships up to

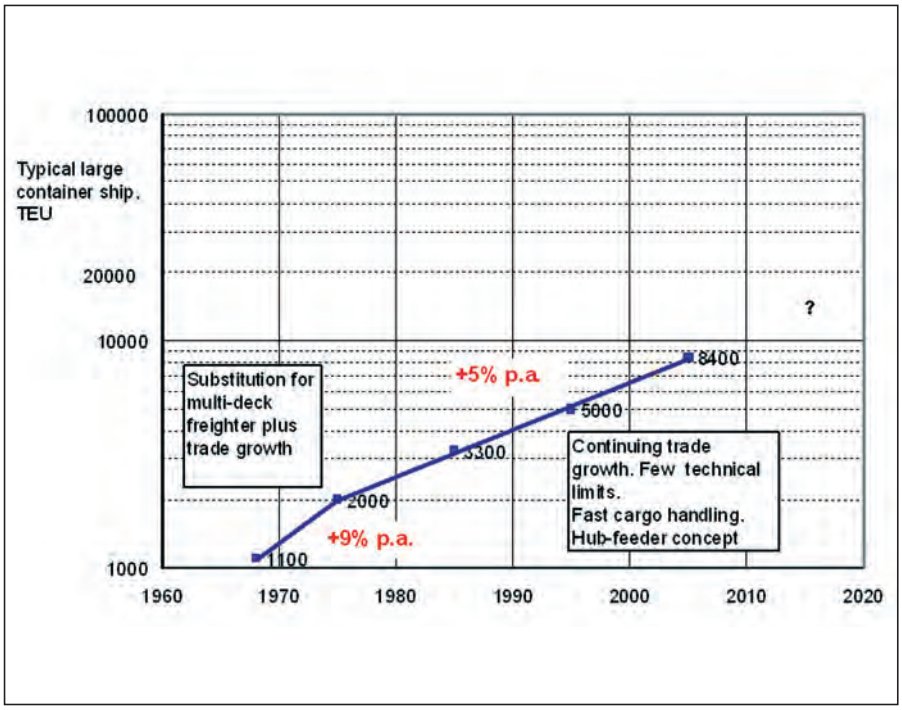

Fig 4. Container ship TEU trend.

	Tankers pre-1973	Bulk carriers pre-1973	Container ships pre-1975	Container ships post-1975	Dry cargo ships post-1950	Bulk carriers post-1973	Tankers post-1985	Dry cargo ships pre-1950	Tankers 1973-85
New payload or cargo handling system	x	x	x						
Substitution for older type		x	x						
Large trade growth	x	x							
Improving technology	x			x	x				
Hub + feeder concept				x					
Moderate trade growth			x	x	x	x	x	x	
Mature technology						x	x	x	x
Ship technical limits approached								x	
External limits approached									x
Prolonged trade decline									x
Annual % size increase	+13	+11	+9	+5	+2.6	+2	+1	+0.7	-7

Table 1. Ten possible causative factors affecting ship size since the 1950s.

20,000TEU - double the size of the largest on order today. A pessimistic view might suggest that the technology is mature, and that there are increasingly severe technical constraints from such things as container stack heights, crane spreader travel, and handling thousands of containers across a berth around 400m long, with few more economies of scale to be achieved. If so, this would point to near zero growth, say only about 10,000TEU by 2020.

An optimistic view would assume continuing rapid trade growth, new technology such as advanced handling systems at special berths, and even more concentration on mainline routes with most ports served by feeder designs. If so, this would point to more than 5% annual growth, or around 20,000TEU designs by 2020.

Make your own assessment - but remember we are discussing not the absolute largest ship, but the typical large ship - recall the technical success but economic failure of the Brunel's giant *Great Eastern*!

LETTER TO THE EDITOR

Bulk carrier design - a shipping industry dilemma

Sir - The question of the double-skin bulk carrier has become another divisive issue which confronts the international shipping community today. The reason for the debate stems from the appalling losses in seafarers' lives during the past decades, starting with the disappearance, with all onboard, of the three-year-old *Bolivar Maru* in January 1969, in the north-western Pacific. This was a 54,700dwt design, built, manned and operated by a reputable company, and flying the flag of a nation with a long maritime tradition.

Since then, dozens more bulk carriers have been lost, including *Derbyshire*, lost on September 9-10 1980, also in the north-western Pacific, again with all onboard. This was a four-year-old double-hull bulk carrier (actually an OBO type - Ed), designed, built manned and operated by a reputable company, also sailing under the flag of a nation with a long maritime tradition. Her loss was analysed and assessed by Lord Donaldson's committee in 1995, and Mr Justice Colman's findings concluded there was neither corrosion nor substandard maintenance of the hull structure that caused the ship to sink.

The bulk carrier sector of the shipping industry is now faced with the question of whether to adopt the double-side-skin configuration, about which a great deal of discussion has taken place internationally.

I would like to suggest the following for consideration by those parties involved in the debate.

Double sides in a bulk carrier should not be mandated. Such an arrangement will create more problems than it will solve, no matter how prudent the owner. Single-hull bulk carriers of the traditional configuration should only be constructed using mild steel forward of the machinery space. Higher-tensile steels may be allowed in way of the machinery space and for the superstructures.

Use only bulb plate profiles for the transverse framing and longitudinal stiffening throughout the cargo hold spaces, and the fore part of the hull. This type of stiffening will facilitate cargo hold cleaning and is easy to maintain.

Reduce cargo hold length. This will increase hull structure rigidity and torsional strength. Revise the single-hull design, based upon the assessment/analysis of Lord Donaldson's committee findings of the loss of *Derbyshire*, including cargo hatch coamings and covers, bow flare and bow reserve buoyancy, as well as main deck fittings, mentioned in the investigation conducted by Professor Douglas Faulkner of Glasgow University.

Classification survey work, when carried out by professional class society surveyors, will go a long way to eliminating substandard maintenance of the hull structure. Owners preferring double-side hull configuration should have that option.

It is, by no means, proven that a double-sides bulk carrier is necessarily safer (viz *Derbyshire*), while well-built single-hull bulk carriers are easier to monitor/maintain.

It should also be noted, during IMO's 20th Assembly Session in November 1997 in London, which met concurrently with the SOLAS Bulk Carrier Conference, it was found that the interpretation of the definition of 'bulk carriers', as given in Chapter IX of SOLAS 1994, required clarification. Perhaps this could be done during the forthcoming meeting at IMO in May this year.

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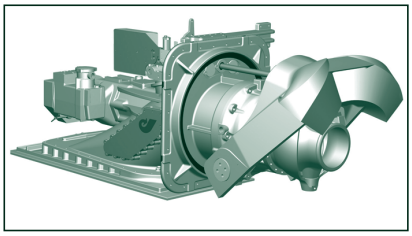

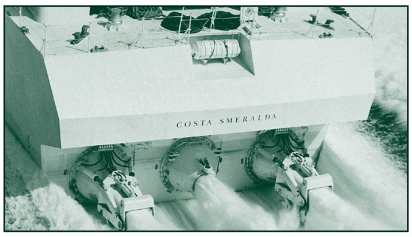

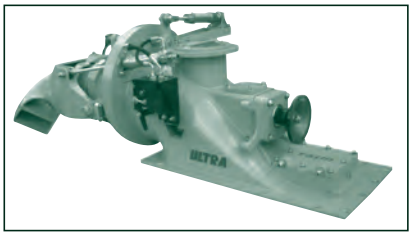

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This international conference continues the very successful series of RINA events looking at developments in waterjet propulsion.

Waterjets are now accepted as a proven technology, particularly for high speed craft and they are increasing their penetration into the small craft, leisure, workboat and military markets. Continuing developments now include very large units of 20-30MW capacity and the use of waterjets for high speed boost propulsion.

As the technology matures, designers need better tools to help predict the performance and efficiency of these systems across a wide range of operating conditions. Computational fluid dynamics is an increasingly powerful tool which has become almost universal, but traditional model testing and trials measurements are still required to confirm critical results.

Designers and manufactures also continue to seek to optimise the strength and weight of the various mechanical components and to improve reliability, reduce installation time and maintenance.

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Mayflower Resolution ready for service

LAST month, the pioneering wind-turbine installation ship designed in Denmark, which was briefly discussed in our April 2003 edition, started work at the North Hoyle wind farm four-to-five miles off the coast of north Wales with her owner, Mayflower Energy Ltd. *Mayflower Resolution* was built in China by the Shanhaiguan Shipyard (a yard that until recently was more well-known for its repair work) and arrived safely in the UK in mid-February having left China in December last year.

All basic design work, including general arrangement plans, hull lines, stability and weight calculations, engineroom layout, system and structural drawings, plus strength calculations, was made by the leading Danish consultancy Knud E Hansen, based in Copenhagen. The Gothenburg-based company Semcon Analys (today Knud E Hansen is a member of the Semcon group) conducted all finite-element analyses, plus fatigue calculations for the two crane pedestals. Model tests were carried by the Danish Maritime Institute, today known as Force Technology, and yard supervision was carried out by Graig Shipping, a UK owner that has accumulated much experience of building ships in China.

Mayflower Resolution **seen during jacking trials. The three Rolls-Royce Ulstein bow thrusters can be seen, and just showing at the stern are the four azimuthing ducted units.**

Governments in many industrialised countries are trying hard to generate around 10% of their energy from renewable resources by the year 2010, and the concept of offshore wind farms is one area which is being exploited. Some farms have already been erected but more are under construction, such as that off the Welsh coast, or are being planned.

Offshore farms are especially attractive - despite opposition from some groups, including ornithologists - because of the more reliable and higher wind velocities. It is also becoming more difficult to find suitable land-based sites, although several are already in operation, notably in Denmark and south-west England.

A typical 2MW offshore turbine has a nacelle (gear housing) approximately 70m above the water surface, and individual blades are around 40m long, so their installation is a complex problem, calling for special ships and equipment. Nevertheless, much larger turbines are being tested, and outputs of 5MW are anticipated; however, their nacelle heights will rise to 90m or 100m, with blade lengths of 55m or 60m.

Apart from *Mayflower Resolution*, it is understood that a few other special ships are already in operation but they are only able to operate in shallow and protected waters. The new vessel is completely self-supporting and is capable of operating in a much wider weather window and in water depths ranging from 3m to 35m depth. Space is available on a cargo deck for up to 10 complete 2MW turbines, ready for assembly. The planned installation rate is one turbine each day under North Sea conditions.

Mayflower Resolution is basically a carefully designed 130m long and 38m wide self-elevating and self-propelled barge, equipped with three bow tunnel thrusters and four 1500kW fully azimuthing stern ducted thrusters - all supplied by Rolls-Royce Ulstein. Primary power for these and for ship's services comes from four main 2280kVA Stamford gensets driven by Mitsubishi diesel engines, and two 325kVA auxiliary sets.

All thrusters are linked to a state-of-the-art dynamic positioning system from Kongsberg Simrad. This holds the hull on location while the jacking system, designed by IHC Gusto Engineering, raises it and all equipment and cargo on six legs to an operational position of 5m-10m above the water surface. Six were chosen after experiments in the model stage with various numbers including five and eight. Each leg is designed for a 3500tonne holding capacity.

Once out of the water, the barge provides a safe and stable working platform for the ship's 300tonne Kenz main crane and a 50tonne auxiliary unit from the same manufacturer. *Mayflower Resolution* is built to the standards of Det Norske Veritas +1A1, Self-Elevating Unit, EO, DYNPOS-AUT, Crane. More information on classification aspects of the novel design will appear in next month's issue.

Troubleshooting of noise and vibration problems

Ulrik Møller Rasmussen, marine department manager, and Ulrik Danneskiold-Samsøe, sales manager, Ødegaard & Danneskiold-Samsøe A/S, discuss some of the secrets of successful solutions, including a good toolbox and a pool of experience.

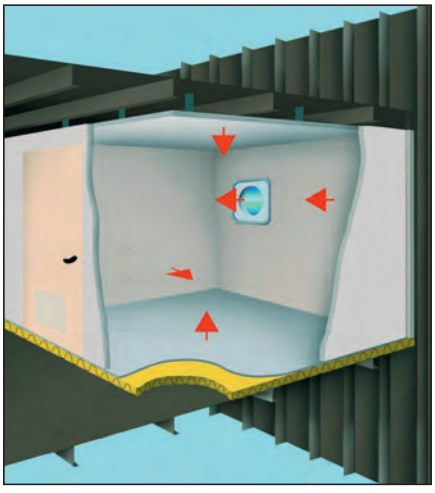
SUCCESSFUL preventive measures for noise and vibration problems are always the cheapest and most attractive solution. This is one of the main reasons why the largest number of Ødegaard & Danneskiold-Samsøe's (ØDS) projects lies within engineering design.

However, some clients also have existing vessels or other large structures where operating conditions have changed and therefore may necessitate a further reduction of the noise or vibration level, or both. These operating conditions may imply more severe legislation, increased rotating speed, a greater number of passenger complaints, additional requirements of higher performance, or non-compliance with a newbuilding contract. Because of this need, ØDS is continuously performing troubleshooting projects. To do this, the company has developed a marine-specific equipment toolbox, a pool of experienced engineers, and - in some situations - an independent position.

Equipment toolbox

A broad and portable equipment toolbox is necessary to carry out troubleshooting projects. ØDS has a large inventory of commercially available measuring instruments; however, commercial measurement equipment is not enough. ØDS's own in-house developed equipment fills a void, which cannot be met by purchased equipment. An example is the Omega system, and another example is our large excitation hammer, which is used for investigation of natural frequencies and modes of local structures.

Troubleshooting of a noise problem often includes a diagnosis of the amount of noise radiated into a cabin from the floor, bulkheads, and ceiling.



Omega system: quick availability of measurement results

The new Omega system (discussed in more detail in *The Naval Architect* March 2003, page 40) comprises advanced DAT (digital audio tape) equipment for maximum storage capacity and reliable, high-precision recording. Furthermore, it consists of a PC-based signal processing system that carries out real-time FFT (fast Fourier transform) analysis of recorded signals. The results of a real-time analysis can be monitored on the screen while the actual recording takes place. Immediately after completion of the recording, measurement engineers can display various diagnostic diagrams and curves, using purpose-developed software. Assessment of the technical problems can proceed instantly on this basis.

A typical 'total instrumentation' of a container ship can be seen in the accompanying diagram. Simultaneous recording of propeller pressure pulses, lateral shaft vibration, shaft torsion vibration and torque, axial shaft vibration, and structural vibration can be performed in 3D. This kind of set-up provides very comprehensive data, but for special applications even further data pick-up can be relevant. Examples of such additional data, which also can be simultaneously accomplished, are propeller pitch angle, and load and pressure data.

A major advantage when using Omega is that measurement engineers can work in a very flexible manner: users undertake some measurement series, review the results immediately after completion of the recordings, and then decide on the next measurement series. This kind of step-by-step approach is invaluable when investigating complicated hull resonance problems.

The Omega system has been developed during a two-year period. It has been in use for complicated measurement assignments on advanced container ships, and its reliability has generally been proven to be excellent. It is the intention of ØDS that the use of Omega be extended to a wide range of applications.

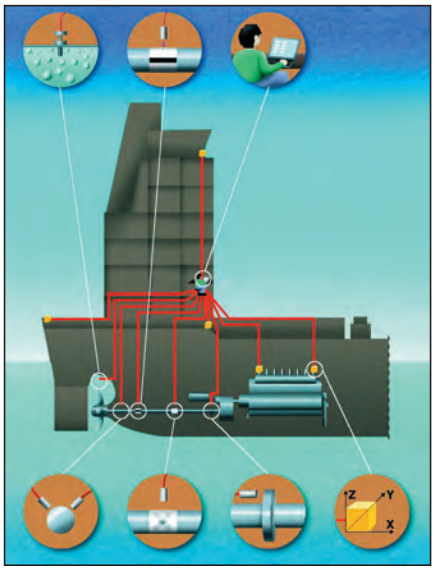
Pool of experienced engineers

Nearly all ØDS' troubleshooting specialists hold a MSc or an equivalent degree in naval architecture, structural mechanics, and noise and vibration control engineering. Besides this basic educational background, the specialists have several years of experience working with marine noise and vibration control engineering before they become responsible for troubleshooting projects. As a consequence, ØDS has a well qualified pool of experienced engineers.

Independent third party

A troubleshooting project often concerns investigation of non-compliance with contractual requirements. The result of such an investigation can have serious economic consequences for either the buyer or the seller. Since both buyer and seller often have long-term business relationships, both parties are interested in avoiding unnecessary conflicts and instead achieve a fair solution. In this situation, the introduction of a qualified neutral third-party specialist is often a solution, which can satisfy both parties. ØDS is able to act as a true third-party independent specialist company since it is privately owned, and can offer consulting assistance independent of yards, owners, component suppliers, and classification societies.

Engineers from ØDS using a 40kg excitation hammer for analysis of the natural frequencies and mode shapes of local structures in a deckhouse.



The new Omega system provides simultaneous recording and analysis of all relevant vibration parameters.

New life-saving products from Danish company

FOR more than 40 years, Viking Life-Saving Equipment's primary concern has been the safety of life at sea, and a series of new orders, new products and service expansion demonstrate its commitment to this field. The company has launched a 'fingertip facility' that enables customers to order the full range of life saving equipment from Viking via its on-line 'Safetyshop'.

The company has also introduced a new generation of body armour with an integrated lifejacket. This new product has been specially developed for waterborne operations, as protection offered by standard body armour materials can decrease by as much as 50% when exposed to humidity or in direct contact with water, which could result in a fatal lack of protection.

Viking offers standard or custom-made soft body armour lifejackets according to customer specifications. Additionally, ceramic or polyethylene hard armour plates can be inserted in special pockets to offer protection against rifle and armour-piercing bullets. Extra neck, shoulder and crutch protection is also available.

Viking's new Evacuation Minichute is seen here on the Spanish ferry *Volcan de Tindaya*.

Another recent development is a SOLAS-approved solid-type thermal protective lifejacket, which has been principally designed for vessels operating in cold water areas. The easy-to-wear lifejacket provides buoyancy of 150Newtons and thermal protection that decreases the risk of hypothermia if the wearer is subjected to cold water. The full range of inflatable SOLAS lifejackets provides buoyancy of 150Newtons to 275Newtons.

Viking's latest chute system, the Evacuation Minichute - designed for small passenger vessels - has recently passed its sea trial test, monitored by DNV, who subsequently issued the EC Wheelmark. The basic Evacuation Minichute unit comprises a chute and a 101-person liferaft, and is suitable for either short or long voyages. Capacity is evacuation of 354 passengers in 30 minutes. Evacuation height can range from 5m to 20m.

Korean joint venture for LR Industri

THE Danish specialist company which has successfully pioneered the technique of pre-insulated piping for various liquids and gases (including LNG), LR Industri, has, together with its parent, Løgstør Rør, made a joint venture agreement in Korea with Finetec; the latter is experienced in both LNG and LPG, and conventional, pipe insulation. A new company, Finetec-Løgstør, equally owned by both partners, has been set up and is planning a new permanent factory. A pipe insulation factory has also been set up in China.

Meanwhile, LR Industri's first set of equipment on an LNG tanker, a ship for A P Möller, was expected to have gone to sea at the end of March. Work on a second ship, for British Gas, is well under way at the same yard, Samsung. Some illustrations of the pre-insulated pipes being used for LNG cargo, steam, condensate, heavy fuel, and glycol on these tankers appeared in our April 2003 edition, page 35.

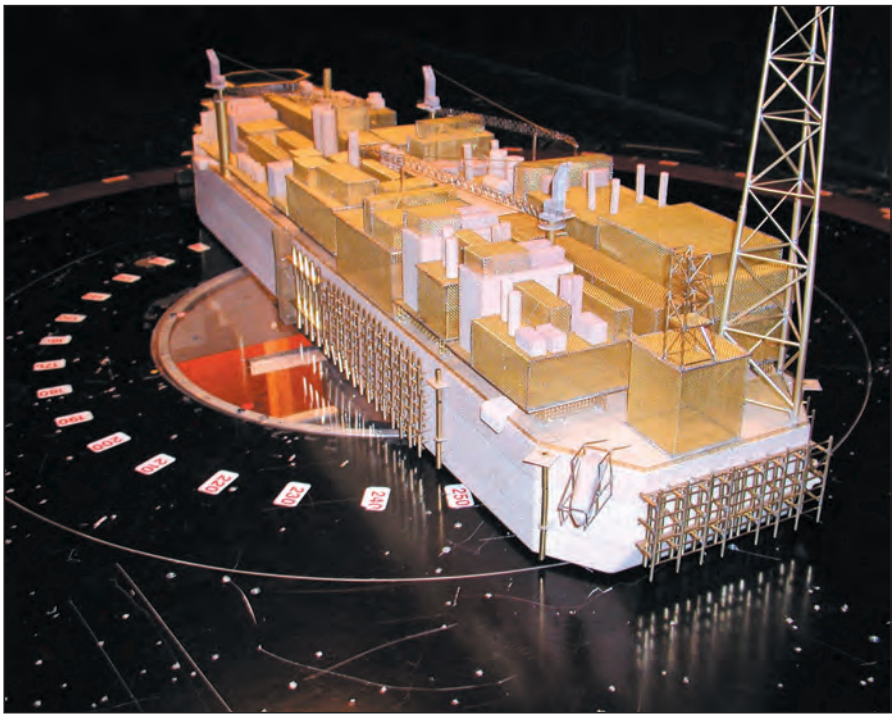
Low-speed manoeuvring project at Force Technology for offshore tankers

AMONGST many exciting projects during the past year at Force Technology (the new name for the Danish Maritime Institute), was a research commission in the ship and offshore department on low-speed manoeuvring of large tankers. This involved cooperating with the Brazilian state oil company Petrobras and COPPE/UFRJ, the new-built offshore basin in Rio de Janeiro. The aim of the study is to validate and improve the state-of-the art simulation models of a tanker sailing at low speed or moored to a single point (SPM), while exposed to current, wind and waves, which is typically the case for a shuttle tanker approaching a buoy or during off-loading operations.

Traditionally, the main effort in manoeuvring research has been concentrated on ships sailing at full speed and with drift angles up to around 30deg-40deg, as relevant for the standard manoeuvres demanded by IMO. However, the nature of this Brazilian study required that the tests should include low speeds and drift/heading angles covering the whole sweep from 0deg-180deg.

The classical captive PMM (planar motion mechanism) approach provides manoeuvring derivatives that are used in a mathematical model. To validate this classical approach, special tests were required, where the model was pulled at different connection points both directly (bifurcation tests) and via a rigid bar (hawser). In principle, if the numerical model is pulled in the same manner, the results should be identical, thus providing excellent validation data for the mathematical model.

Talks are currently focusing on the next steps of the investigation. Possible work ahead includes simulations and free sailing model tests.



A model of a large FPSO being examined in the wind tunnel at Force Technology. Numerous designs, both modified tankers and newly-built hulls, have been analysed for wind and current load measurements, smoke-dispersion, and helicopter operations.

SeaSense - part of the safety philosophy

The goal of Force Technology's SeaSense is to increase operational safety at sea by developing a system which constantly monitors wave conditions, structural loading, and seakeeping performance of a vessel. This system should improve a crew's ability to survey the actual structural loading of the hull and at the same time provide decision support on how to reduce environmental loads by, for example, suggesting speed and/or heading changes.

The project has focused on developing innovative sensors for relative wave motions, green water on deck, and structural loading of the hull girder. These sensor signals have been combined with information from traditional sensors on-board, and all information is fused together in one mathematical model capable of estimating the actual wave spectrum. A SeaSense system makes it easy for a crew to operate a vessel within predefined structural and seakeeping criteria.

The SeaSense system will alert the crew in case of critical values and/or critical trends, propose alternative speed and heading combinations, and predict the consequences on seakeeping performance. A pilot plant has been tested on a Danish Navy vessel for eight months and will be installed on an A P Møller container ship during the current year.

SeaSense is a project partly financed by the Danish Ministry of Science, Technology & Innovation, and the partners are The Danish Naval Material Command, A P Møller/Mærsk, Lyngsø Marine, Danish Technical University – Department of Mechanical Engineering, and Force Technology.

Wind-tunnel assignments

In the aerodynamic department, numerous wind-tunnel assignments have been carried out with FPSOs, both rebuilt VLCCs and new vessels eg, for FMC SOFEC and the following projects: Bijupira-Saleema, in Brazil, Su Tu Den, in Vietnam, and Kizomba B, off Angola. Some years ago, the test programme mainly covered measurements of wind and current loads but today a more extended test programme is often performed. Such an extended test programme can be subdivided into:

- wind and current load measurements
- smoke-dispersion studies
- helicopter-operation investigation.

Smoke-dispersion studies focus on evaluation of smoke dispersal from a funnel and to optimise the performance to avoid smoke contamination on open-deck areas and near fresh-air intakes. Such studies are performed with smoke visualisation techniques and tracer-gas concentration measurements. A typical recent project was work on Cunard's new flagship *Queen Mary 2*.

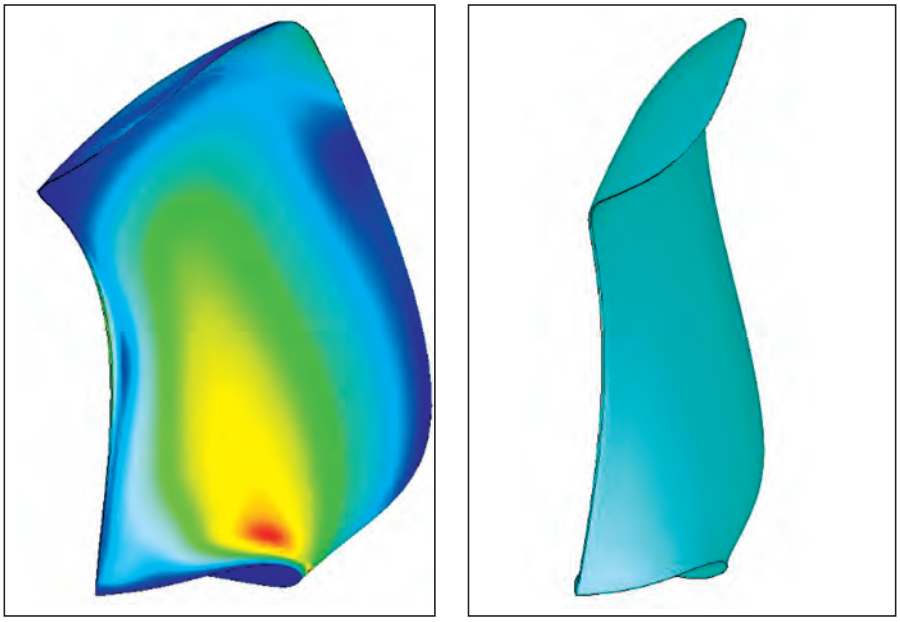
A helicopter-operation investigation usually covers an airflow study, where the suitability of helicopter operation is evaluated by means of helium-bubble flow-visualisation techniques and measurement of local velocities and turbulence intensity in the helicopter operation area by means of hot-wire anemometry.

Since helicopter operations are restricted by the potential temperature rise above ambient in the vicinity of the helideck, it is obviously necessary to measure the influence from eg, turbo-generators, which often have relatively high exhaust temperatures. The tests are conducted by means of tracer-gas where the relative concentration measured is converted into a temperature rise above ambient. With this information in hand, it is possible to relocate either the helideck or the turbo-generators to obtain less restrictions on helicopter operations if necessary.

Kappel propellers for Scandlines ferry upgrade

FOLLOWING the agreement signed at the end of last year between MAN B&W Alpha and J J Kappel (*The Naval Architect* January 2004, page 29), Alpha has secured its first orders for the Kappel tipped propeller. Over a period of two months during contractual and upgrading work at Blohm & Voss in Hamburg, the 16,000gt Scandlines ferry *Kronprins Frederik* will be retrofitted with two Kappel CP propellers. Her sister, *Prins Joachim*, to be upgraded at the same yard, will be retrofitted with new conventional propellers so that a performance comparison can be established between the two. Both ships, built in 1980 and 1981 by Nakskov Shipyard (now closed), formerly operated with Danish State Railways on the Great Belt service.

Scandlines has an option to order a further eight Kappel spare blades for a future retrofit on *Prins Joachim*. Both ferries' original tailshafts, sterntubes, bearings, and intermediate shaftlines will be retained; however, propeller diameters are to be increased from the original 4.3m to 4.5m to absorb 11,000kW on each train for a maximum ship speed of approximately 21knots on the Gedser to Rostock route.



A finite-element calculation and strength analysis by MAN B&W Alpha for the Kappel propeller (left), and a blade profile (right). The design is said to present new challenges with regard to strength analysis.

Both propellers will be strengthened to Lloyd's Register's Ice class 1C, and an important aspect will be design parameters to achieve high efficiency, reduction in pressure pulses, low noise, and high standards of manoeuvrability - all in addition to efficiencies calculated for the Kappel blade profiles (between 3% and 5% extra, alternatively a similar fuel reduction). MAN B&W's Alphatronic 2000 PCS system will manage propulsion control for the propellers, which will each be driven by three medium-speed B&W engines.

Fail-to-safe concepts in autopilot design

For more than three decades, Mr J C Nortoft Thomsen, MScEE, president of EMRI A/S, has been involved with the design of autopilots and steering control systems. Today's and tomorrow's standards require that systems are designed with due respect to handling of failures. FMEA (failure mode effect and analysis) must be performed at the factory and often also after installation of equipment onboard. Modern autopilots are used in several modes: heading control, radius control, and track control. The autopilot is now a communication tool using the signals from several sensors. The importance of safe error handling has therefore become mandatory. This article details an analysis of error types and failure sources primarily related to autopilot and hand steering of ships.

ARRANGED in a logical order of appearance, seen from the design point of view, failure sources may be listed as follows:

1. errors and over-simplifications in international standards
2. design errors
3. installation failures
4. failures due to the environment. Statistical failure mechanisms
5. human errors in the use of the equipment
6. wear and outdating.

In the following, each of the above sources will be illustrated by examples, and methods or principles to avoid failures will be discussed.

Errors and over-simplifications in international standards

Rules and standards from IMO, ISO, IEC and classification societies represent 'the law' and as such are to be respected. They are meant to increase design quality and thereby also safety at sea. High standards and required approvals prevent the sale of equipment, unscrupulously designed with low price as the only goal.

It is, for instance, illegal to sell autopilots, which are not type-approved. The EU MED Wheel Mark requirement governs this for European shipowners and equipment designers.

Any new autopilot must undergo and pass an extensive set of tests before it can be accepted by the authorities and thereby installed on a ship. IEC 60945 and ISO 11674 are two of the standards which autopilots must meet.

ISO 11674 includes ship motion simulation testing of autopilots using a mathematical model of ships' steering. Unfortunately ISO 11674's model (Laplace transform of a first order, linear Nomoto model) includes errors and is over-simplified.

No ships can behave like this mathematical model. Probably the worst simplification is the assumption in ISO 11674's ship model that a ship's rate of turn is strictly proportional to the applied rudder angle. This is a violation of all practical knowledge and scientific results.

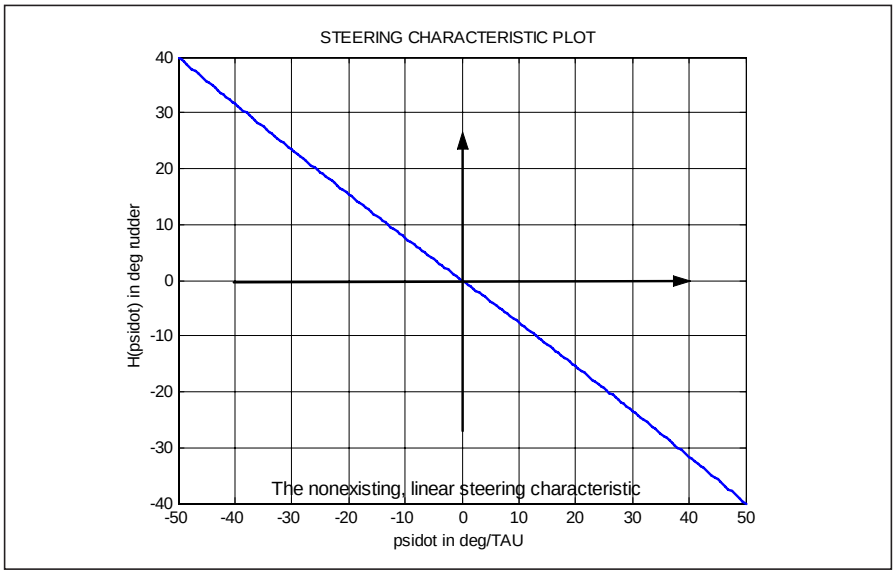


Fig 1. Steering characteristics: the non-existing linear steering example.

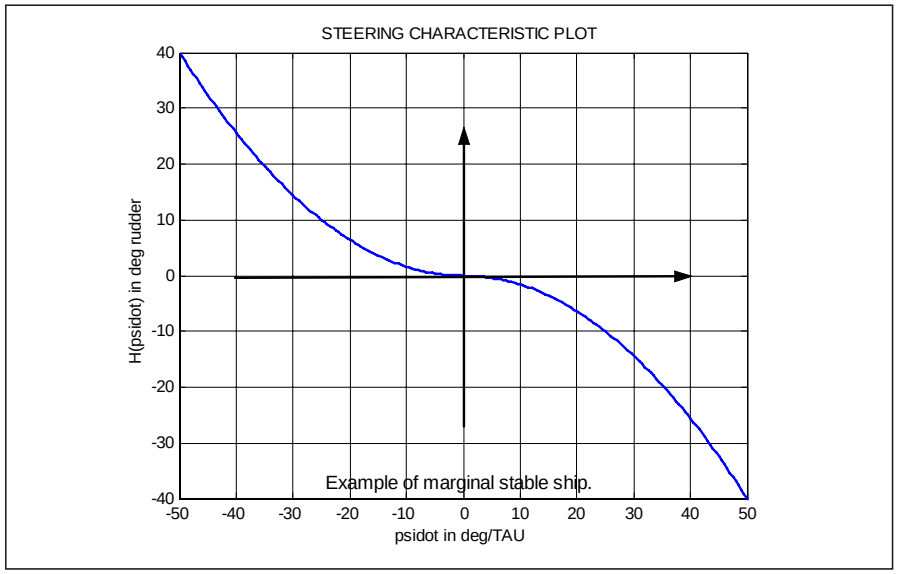


Fig 2. Steering characteristics: the marginally stable ship.

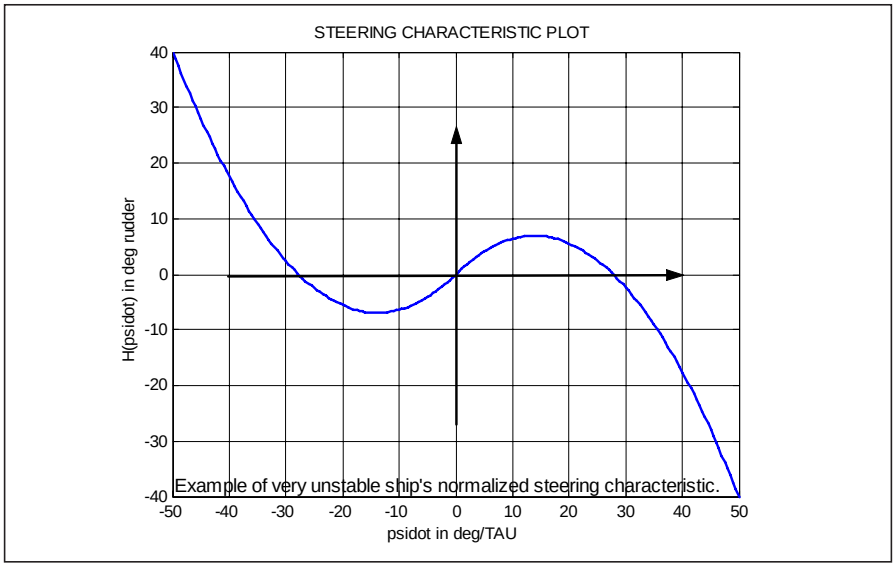


Fig 3. Steering characteristics: example of a very unstable ship's normalised steering.

Dieudonné (1953) and Mogens Bech (1966) described and explained ships' steering characteristics and proposed methods for full-scale testing.

It should be crystal clear to any autopilot standard writer as well as to any autopilot designer that the dynamic forcing function in ships' steering is not the rudder angle (δ) itself, but the difference between the rudder angle and the hull-determined feedback during turning, representing the steering characteristic of the ship:

δ-H(r) , where r = dψ/dt is the rate of turn, ψ being the ship's heading and H(r) is the reverse spiral test curve, the steering characteristic of the ship (See Figs 1, 2 and 3).

It is obvious that the ISO 11674 committee did not have an easy job: ships are known to behave very differently and the size spectrum is very large.

ISO 11674 is meant to be a performance standard for marine autopilots. It is not. It has become a performance standard for devices able to master a first-order linear Nomoto equation (ie, when the obvious errors in the stated equations have been corrected).

The conclusion is that real-time ship motions cannot be solved by Laplace transform techniques. Non-linear differential equations must be used.

IEC 62065, Performance Standards for Track Control Systems, is not much better on the same issue. A lot of effort is given over to ship model specification. The prescribed yaw model is still a first-order, linear equation. We are not even allowed to use a more realistic ship model. The small 'or better' phrase is missing.

Fail-to-safe and track control

The fail-to-safe concept is, in short, explained as: in case of equipment malfunction the steering system must be designed so that the error does not worsen the situation by the introduction of uncontrolled rudder movements (which typically have been hard-over movements).

In Det Norske Veritas's Worthing, failures while in heading or track control shall be dealt with as: *The most probable failures are to result in the least critical of any possible new conditions, that is fail-to-safe.* Everybody can agree to that. Unfortunately DNV continues with a guidance note, stating that if the ship, in the moment of a failing autopilot, was in radius or rate-of-turn control, then the equipment must put the rudder to a position derived from the full-scale spiral test.

This may be wise if the ship has a stable or a marginally stable steering characteristic. It is definitely not wise if the ship has an unstable steering characteristic, in which case the ship will soon turn fast, and it can even be to the opposite, unwanted direction, if the guidance of the standard is followed.

There is no solution to the problem of unstable ships fitted with only one autopilot, so neutral rudder (close to amidships) could very well be a better choice, because the forcing function is smallest at this point, and inertia will then continue the manoeuvre long enough to allow the officer on watch to change mode to hand steering and thereby continue the manoeuvre with manual control (assuming the officer is warned by an early alarm on the failure.)

A far better solution with unstable ships would be to require such vessels to be fitted with two independent autopilots, so that a failure in the active device could initiate an automatic, bumpless change-over to the backup-device.

To conclude, the autopilot performance standards have been published and submitted as 'the law' with a lot more attention given to a cost issue than to a safety issue.

The additional costs of a backup heading controller and to a backup follow-up servo are fractions of what other new rules have involved. Just think of the costs to VDR and AIS!

Design errors

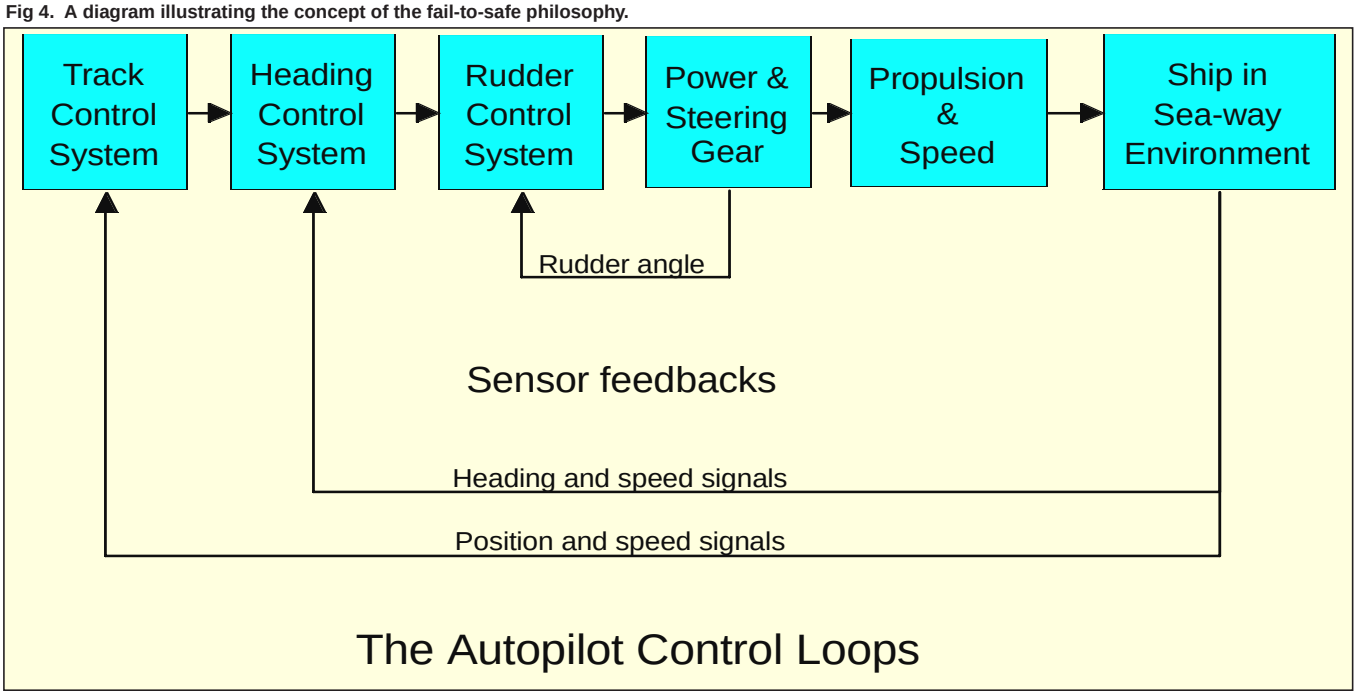
Errors in international standards will eventually give reason to design errors - simply because approval according to those standards is a non-negotiable parameter in design, which forces makers to develop equipment that can be approved. Such equipment is not necessarily able to perform optimally in use.

The author considers 'market forces' that ultimately lead to design of the cheapest possible equipment as a risk factor. As an example, all steering system makers know the 'single failure concept': no single failure in a steering system must be able to leave the ship without steering. To conclude, all steering control systems should be designed as two independent systems. In case of failure in one system, an alarm should be given and the officer on watch should immediately be able to start an undamaged system and stop the failing one (or even better, an automatic failure control system should go into action and perform the change-over in the shortest possible time).

However, double systems also means double price. Here again, a flaw in international standards opens up opportunities for bad design. It is legal only to duplicate the cheap contact type of backup-steering and use one single follow-up steering channel, able to drive both steering pump solenoids or torque motors (backup-steering = NFU = non-follow-up).

In case of failure in the (single) feedback unit or in the follow-up servo amplifier, a ship technically speaking, does not lose 'steering', only helm wheel steering and autopilot steering. This means that the ship is back to an emergency situation for the rest of the voyage, or at least until the failure is found and repaired.

Fig 4. A diagram illustrating the concept of the fail-to-safe philosophy.



The Royal Institution of Naval Architects

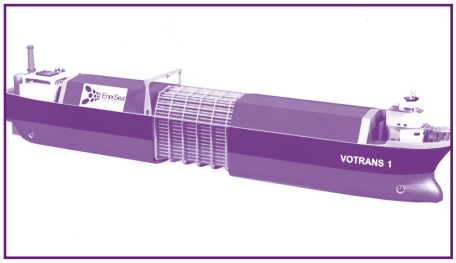
DESIGN & OPERATION OF GAS CARRIERS

22 - 23 September 2004, London, UK

Second Notice

There is currently considerable optimism about the future growth of the natural gas market and while not all the proposed LNG schemes may materialise, many still expect a significant increase in the number of vessels in the world LNG fleet. Recently, there has been both an increase in orders and an increased programme of scrapping of older vessels. The market is also moving away from the traditional long term 20-year time charter and greater use is being made of spot market vessel charters.

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



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

Steam turbines have traditionally been the preferred power plant for LNG carriers; however, other options such as medium speed diesel electric or slow-speed diesel engines, with reliquefaction plants to reclaim boil-off gas, are being developed.

RINA invites papers on all aspects of the design and operation of gas carriers, including the following topics:

- Design of larger capacity vessels
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Except for ships approved under the US Coast Guard (USCG), there is no international requirement to the installation of doubled follow-up steering channels. Why? Except for ships approved under the USCG, there is no international requirement to the installation of steering failure alarms. Why?

Many owners do not specify systems in detail, they rely upon international standards. Market forces ensure that those shipowners do not get too much… To conclude, design errors happen and international standards governing design of ships' steering control systems are not yet failsafe.

Installation failures

Autopilot and steering systems are essential systems, but they are not sacred. They are installed under the same time pressure as unimportant equipment. Maybe they are tested better under harbour acceptance tests, but also those tests take place under time pressure - and so do sea trials approval tests. How often is time set aside to testing of the steering control and autopilot systems in a sea trials programme?

No matter how, installation failures happen. 'Weak spots' are special dangers, which also could be called construction failures. Examples are feedback units and rudder servo units, which can be of a robust design, able to pass IEC 60945 and thereby able to survive the expected climate onboard. But what about other items in the steering loop, such as mechanical feedback links, motor starters, and other power supplies?

They may be constructed by the use of approved material, but they are in assembled form not subject to any environmental testing, and most of them would certainly never survive a vibration test. Still the uninterrupted function of those items is exactly as important for steering safety as is function of the other items in the loop. Maybe the only proof in the above statement is that some of the environmental tests are overkill? Because, after all, most of those (un-testable) items survive at sea.

Statistical failure mechanisms

The normal failure in a system happens without warning. The failure can be a broken wire, a failing electronic component, an over-voltage causing burns, a weak component subject to severe vibrations, unexpected wear, a burnt solenoid, or a hydraulic component blocked by dirt. Either the rudder freezes or it moves uncontrolled. Both failure modes are critical, but generally uncontrolled moving rudders present the most dangerous errors because the unexpected heading deviation will occur a very short time after the instant of failure.

There will always be two alternative ways to recover from a failure:

- the officer of the watch intervenes after being alerted by an alarm
- the steering system is fitted with an automatic failure control device that performs a restoring act.

In both cases, the ideal recovering act is the same: the failing system is stopped and the other supposed functioning system is started. This, of course, assumes that the ship is fitted with two (symmetric) steering system half parts. If not, then the result will be an emergency state with enlarged risk to consequential damages.

Furthermore, successful recovery by officer intervention assumes that he knows exactly what to do, which again requires a relevant alarm given as early as possible as well as it requires adequate training of officers. Unfortunately, the 'normal failure' often happens without an instant alarm given (the first alarm is typically an 'off heading' alarm from the autopilot).

Unfortunately the 'normal officer of the watch' is seldom sufficiently trained in how to restore the system.

Fail to safe

The philosophy behind the fail-to-safe concept is:

- it is possible to have an early detection and alarm of many failures
- many failures can be handled by automatic control so that the damage they involve can be limited by an automatic change of system mode. Fig 4 illustrates the concept.

Below are some of the examples that system designers meet:

- if more than one sensor is installed, then an automatic changeover to a working sensor should be performed in case a failure occurs to the pre-selected one
- in case of failure to the track controller, the ship should continue in heading control 'steady as she goes' on linear tracks and 'continue the turn with present radius' on curved tracks.
- in case of failure to the heading controller, the ship should continue under rudder angle control (non-follow-up mode). 'Amidships' followed by 'helmsman to the wheel' is probably better than the above mentioned automatic change over to non-follow-up mode. Non-follow-up lacks feedback and will be associated with drift. But 'freeze the rudder' is prescribed, and so be it. The officer-of-the-watch can, of course, change to follow-up hand steering at any time but it would have been far better to require the change over to a backup heading controller, able to continue the manoeuvre under automatic control.
- in case of failure to the rudder controller (the follow-up servo loop), then an automatic change over to non-follow-up mode is prescribed. The intention is to freeze the rudder, which definitely is far better than having it travelling towards hard over.

There are several problems associated with the automatic selection of non-follow-up mode:

1. it cannot prevent a 'hanging' valve from bringing the rudder to hard over
2. generally, it cannot fix any problems downwards toward the hydraulic power unit
3. non-follow-up mode is not a drift-free mode. Hydraulic leakage is always present and worse the older the steering gear is. Hydraulic leakage becomes proportional to the square of ship's speed due to the hydrodynamic forces acting upon the rudder/steering propeller. (Here, it is assumed that hydraulic leakage is proportional to hydraulic pressure)
4. fail-to-non-follow-up mode is a temporary solution to be followed by immediate officer-of-the-watch action
5. the implementation of a fail-to-non-follow up mode will, of course, increase the theoretic probability of errors by the simple fact that it adds complexity to the system at a high level of control priority
6. finally, a failure in the error detector itself will lead to an impossible situation on ships, where only one follow-up steering channel and two non-follow-up channels are installed. The consequence is emergency steering during the rest of the voyage.

To conclude, fail-to-non-follow-up mode is a part-solution, in some cases certainly better than doing nothing. But it seems to the author that it could be worth considering the fail-to-non-follow-up action, completed with an auto-start of the standby system half part.

Human errors

Reports indicate that worldwide there is at least one steering incident each week. Many of them are caused by operator failures. Some of them could have been avoided by due intervention by the officer of the watch. It is obvious that better training and better bridge procedures could improve the situation, but it should never be forgotten that things look simpler when analysed from behind your desk than they appear at sea, when the alarm goes off, or when the induced roll movement from an unexpected, large rudder angle is felt. Poor, missing, or misplaced instruction books or signs also belong to this category.

In a 'fail-to-safe' context, it is important to realize that no fail-situation is safe unless the officer-of-the-watch is trained in rapid recovery from it.

Wear and outdated equipment

There is nothing new to wear. Proper maintenance of steering gear has always been required. There may not necessarily exist a working system which can be failed safely into, unless the steering control system is properly maintained and regularly tested.

In years to come, outdated equipment will become a more and more serious problem, basically because the rapid development in the electronic sector now outdates this kind of equipment long before mechanical machinery. Spare parts simply become unavailable.

Shipowners are generally reluctant to upgrade steering control systems. 'Unavailability' of spare parts due to outdated electronic components might change this attitude.

Problem example

Fig 5 shows a block diagram of a duplicated rudder control system upgraded with a fail-to-non-follow-up subsystem. In each rudder servo unit, a micro-computer is fitted. In and out circuits monitor the following:

- follow-up rudder order is compared with actual rudder angle from an independent transmitter. Action (alarm and change to non-follow-up mode) is realised if the difference is larger than an acceptance limit and if this difference is not reduced by the servo-action
- two feedback sensors allow a comparison. Action is taken in case of unacceptable difference between the servo feedback device and the monitor device (broken wire or short-circuit is detected)
- the rudder order is monitored for legal range. Action is taken if an illegal order is sensed
- finally, the system alarms for unacceptable drift in non-follow-up mode as well as movement against the bridge order in non-follow-up mode
- further, the microcomputer can output an NMEA string on an RS485-line with data for a VDR-system or an independent performance monitor
- it should be noted that the system has not yet been delivered with a link to the motor starters for automatic failure control, but the option exists.

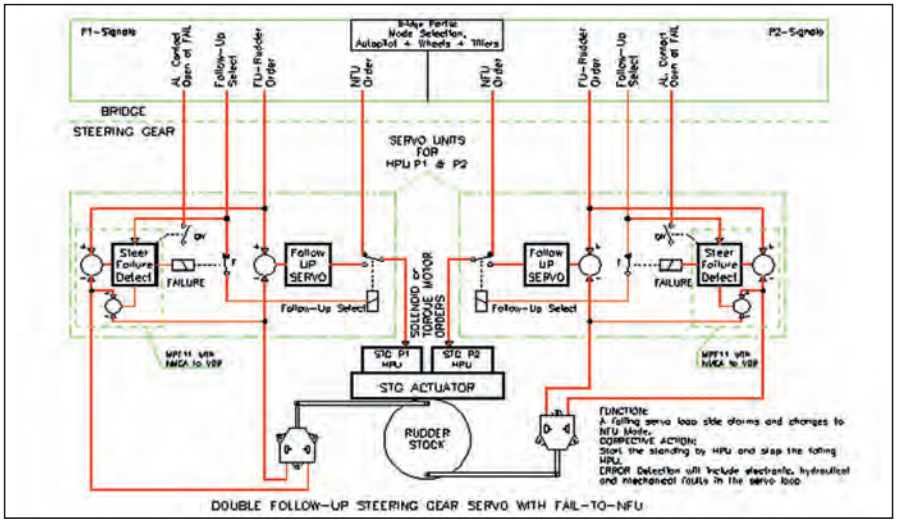


Fig 5. Block diagram of a duplicated rudder control system upgraded with a fail-to-non-follow-up subsystem.

Conclusions

International standards with ship-movement models should be upgraded to include a realistic, non-linear second-order steering equation, or should as a minimum not prevent its use.

International standards should be upgraded so that:

- a steering failure alarm becomes mandatory
- all rudders and steering propellers are fitted with double control systems (both follow-up and non-follow-up control must be duplicated)
- automatic failure control would be mandatory
- a backup heading controller becomes mandatory in ships fitted with a track control system
- training in the handling of steering systems should be made mandatory and steering drills including pre-sailing checks should be recorded as part of the ship's quality records.

Closing the design gap with Tribon M3

FURTHER advance towards its goal of providing a seamless package of software modules for shipbuilding - particularly to help close gaps at the early end of the basic design process - has been made by the Swedish specialist Tribon Solutions with the introduction of the M3 version of its respected Tribon suite. This follows the earlier M1 and M2 modules, all aimed at shrinking time and costs. Among the first yards to sign up to M3 are Daewoo, in Korea, and Damen Shipyards' Romanian yard in Galatz.

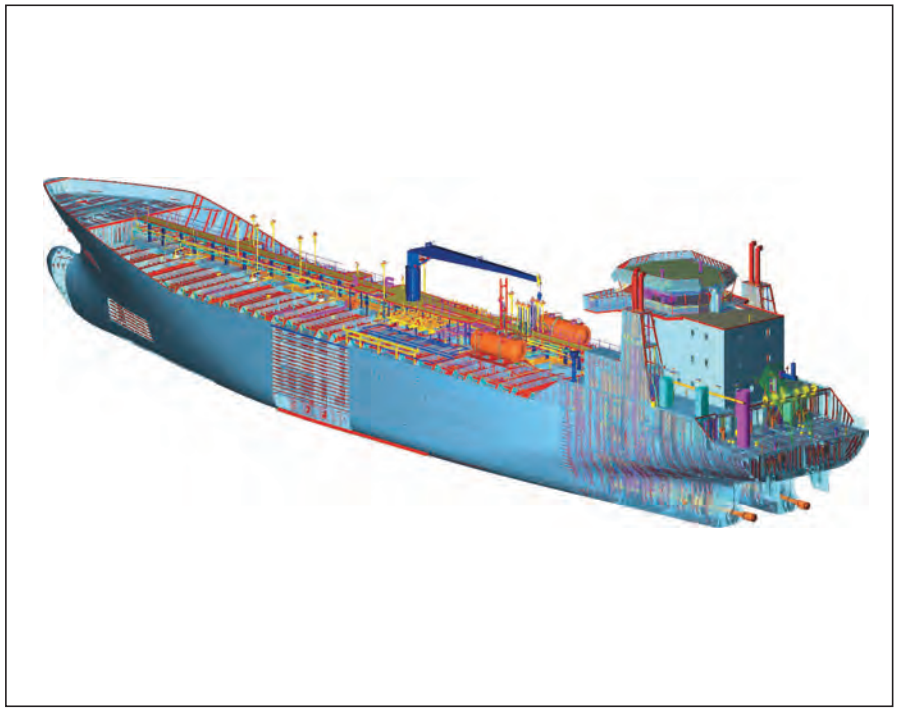
One of the principal M3 features is Equipment Selection, which should help ship designers - by providing a link to the Tribon.com database of suppliers which today lists 210,000 products - spend much less time on searching for components. However, other new tools include Project Copy for re-use of design data, System Performance for faster working, and two modules for managing large assemblies in the contract design phase: Advanced Rendering (for defining textures, highlights, shadows, and backgrounds in a ship model for the creation of photo-realistic images), and Continuous Flooding Simulation. An extra feature for the existing hull application is been especially added to deal with the handling of complex shell plates in submarine construction.

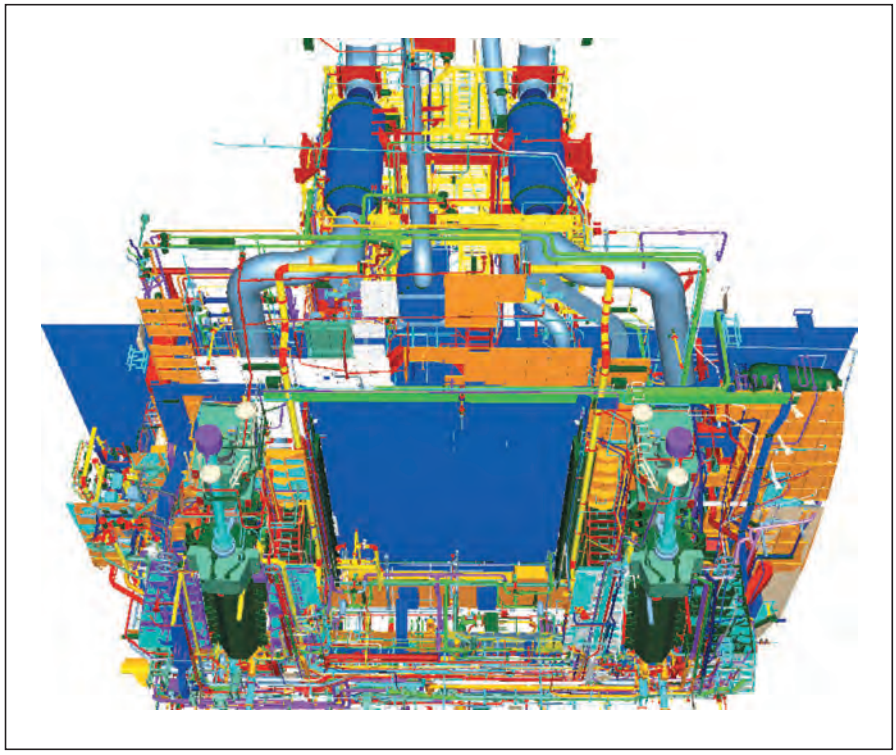
Today, tight budgeting continues to be a pressing concern for many yards in a highly competitive marketplace. For example, in Japan, leading yards are understood to be refining their already advanced structural-steel design processes through additional automation, using digital models which include budgetary and material information. Not only do such systems help to produce lower costs, they also enable critical savings in calendar time, which in turn allows earlier delivery-date quotations.

During the early stages of a shipbuilding project, many decisions have to be taken over equipment selection, a sometimes convoluted process which involves designers, owners, and suppliers. By using the Tribon.com module (Equipment Selection) in M3, naval architects can easily evaluate information which, when a choice has been made from the various alternatives presented, can be integrated directly into a design, thus achieving considerable savings in search time.

A further interesting feature of M3 is a selection of new tools for copying complete or parts of existing ship models into a new model, to become a Tribon Project Copy. The availability of this simpler version makes it possible to copy and/or re-use existing design data efficiently in shorter times; this ability is said to be especially useful for communication between various subcontractors when different companies are involved in parts of a new ship, alternatively, to avoid starting from scratch on nearly identical ship projects. Project Copy also allows controlled communication of design data between shipyards, and design and engineering subcontractors.

Finally, those naval architects involved in ferry designs will be especially interested in the Continuous Flooding simulation ability in M3. This has been developed to meet the changing IMO regulations that today allow flooding analysis of individual new ro-ro ships to be carried out using numerical simulation, rather than by the previous prescriptive method. Although ferries are a prime candidate for this module, Continuous Flooding can be applied to any ship type.





Two examples of images generated by the new M3 version of Tribon. The ship in question is the new 8150dwt twin-screw SCOT tanker built by the Galatz yard of Damen Shipyards to a Lindenau design. Information on this interesting series can be found in the presentation of *Wappen von Hamburg* in *Significant Ships of 2003*.

SafeHull Express: a important joint venture from Napa and ABS

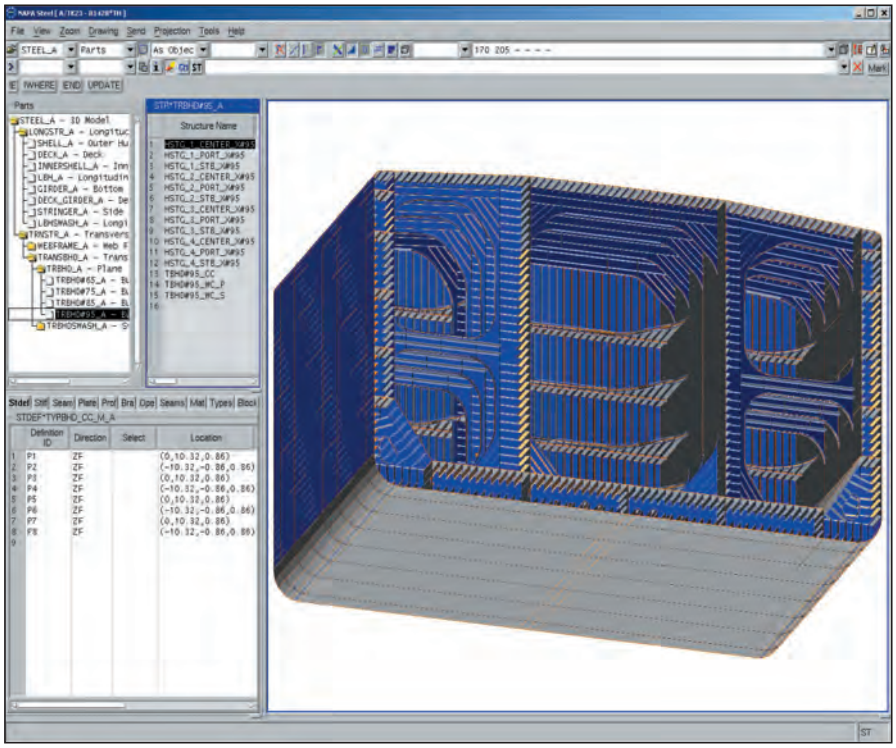
ONGOING collaboration between Napa Ltd, the software specialist from Finland, and the American Bureau of Shipping (ABS) has culminated in the recent release of a new version of SafeHull, called SafeHull Express. This software is used for the design and assessment of ship structures in accordance with ABS rules. The newly launched, and future, versions of SafeHull Express are based on Napa technology and functions, refined through cooperation between Napa Ltd and ABS Americas.

This joining of forces has resulted in the integration of a complete initial strength assessment system into the shipyard production process; it is claimed to be the first time that such integration has been achieved. The fundamental benefit of integration is that a single 3D ship model can be used consistently in various system environments, which should make the design-to-production process one continuous flow. The same 3D model can be utilised throughout the initial and structural design stage, and the production process. Exchange of data between Napa Steel, ABS rules, and finite-element-method (FEM) analysis, combining the basic design needs into one package, is said to speed up the design process considerably.

3D ship models created in SafeHull Express can be directly used in the Napa system for further refinements. These models contain information that can be used for rule calculation and finite-element analysis; the model is fully compatible with the Napa Steel and Napa compartments used for other design disciplines at shipyards.

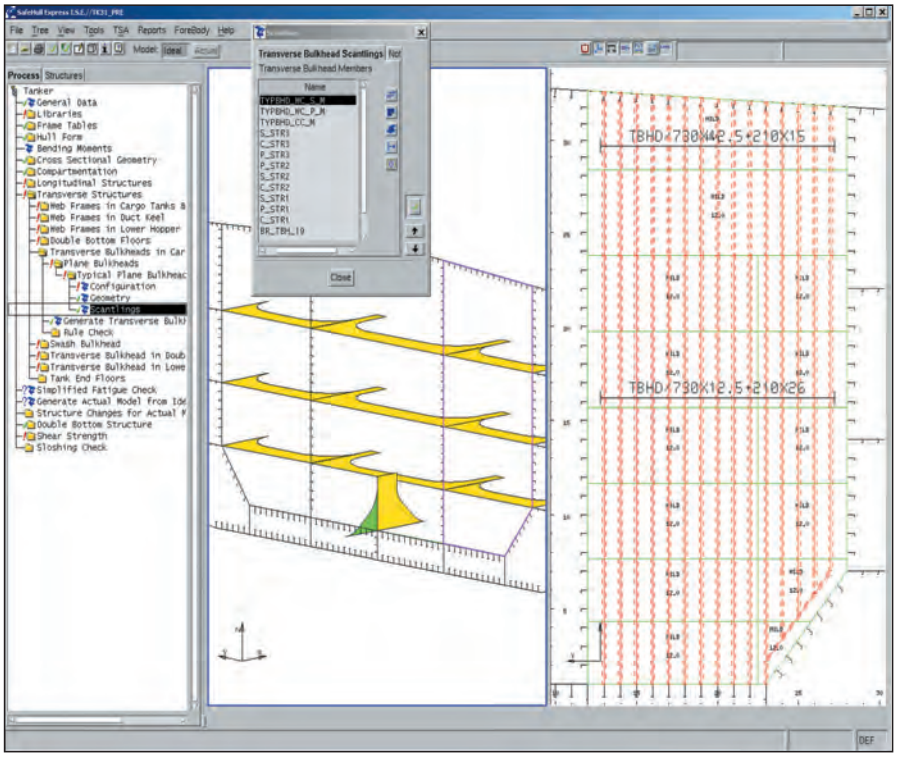
SafeHull Express provides easy-to-use templates for defining the geometry and scantlings of the main hull structures. The graphical user interface of SafeHull Express, such as templates and the main window, has been created by using Napa's built-in tools and functions. Utilisation of Napa features in the development of SafeHull Express was facilitated by means of the Napa application programming interface (API), which gives external programs direct access to the Napa database and functions on the software level. A very important part of SafeHull Express is the workflow control, which is based on Napa Manager. The topological functions of Napa play a central role in idealising the actual structure into a simplified model suitable for finite-element analysis.

Together, Napa and SafeHull Express provide a user-friendly software environment for designing ship structures, and verification with the ABS rules can be performed efficiently as part of the ship design process. SafeHull Express brings the benefits of 3D to the earliest stages of the design cycle, thereby helping to speed up the design process. Building a 3D structural model of the hull in the early design stage can also provide more accurate estimates of material and construction costs, thus helping shipyards to prepare bidding contracts more cost-effectively.



The end result of a SafeHull Express-Napa 3D structural model, as illustrated in the Napa Steel system.

The SafeHull Express main window created with Napa graphic-user-interface tools.



Improved communication between shipyards and suppliers

THE possibilities for communicating between shipyards and suppliers have been further enhanced by the addition of a new set of functions, as Tribon.com has been upgraded with release 8.0. This incorporates a global database of shipbuilding components and equipment. Shipbuilders can access, download and integrate accurate product information directly into their design, and shipyard users can now easily contact the supplier regarding a particular product, requesting a confirmation of the validity of the data at the time when a download takes place.

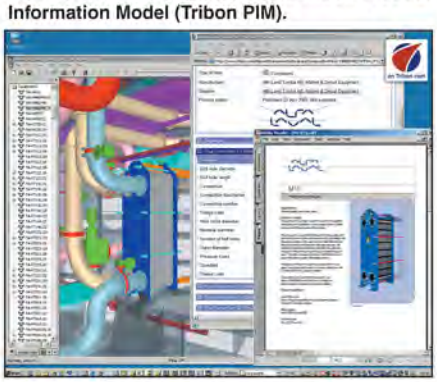
When a shipyard user is missing a supplier on Tribon.com, this can easily be reported and the supplier will be contacted by Tribon Solutions. Finally, when a shipyard user finds product information missing on Tribon.com, new functions are available so that a user can request suppliers to upload and publish additional product information in the global database.

Simplified searching for products

Among other general improvements there is now a spelling correction suggestion function connected to the free text search. As an example, if a user will type BOLIER, the system will detect the misspelling and give a suggestion to search for BOILER instead. Only relevant words that exist in the Global Database will be ranked and suggested.

Ship designers have now access to more than 221,000 products from suppliers world wide via Tribon.com. The designers can take the design information, pictures, technical specifications, certificates and 3D models of each product and integrate it in their design in a quick and easy way. As the 3D model consists of all necessary data for the connection of, for example cables, pipes and wires, designers can save a lot of time and effort.

The screen shot shows a plate heat exchanger from Alfa Laval Tumba AB. A full set of information including a 3D model with technical attributes has been downloaded from Tribon.com and integrated into a Tribon Product Information Model (Tribon PIM).



CATIA V5-based SAMCEF Gateway launched

SAMTECH, a leading European company that develops integrated computer-aided engineering (CAE) solutions, recently announced the launch of SAMCEF Gateway, which offers to SAMCEF users numerous facilities for modelling, linear and non-linear analysis, and post-processing from CATIA V5 design software, which is used by some major shipyards.

Gateway allows users to export SAMCEF data either from a CATIA V5 analysis document or from SAMTECH transparent extended analysis products (TEA Mecano and TEA Thermal) based on CATIA V5. It gives a basic access to linear static, modal, non-linear structures, and stationary thermal analyses of SAMCEF. SAMCEF Gateway also allows users to import SAMCEF results for post-processing in CATIA V5.

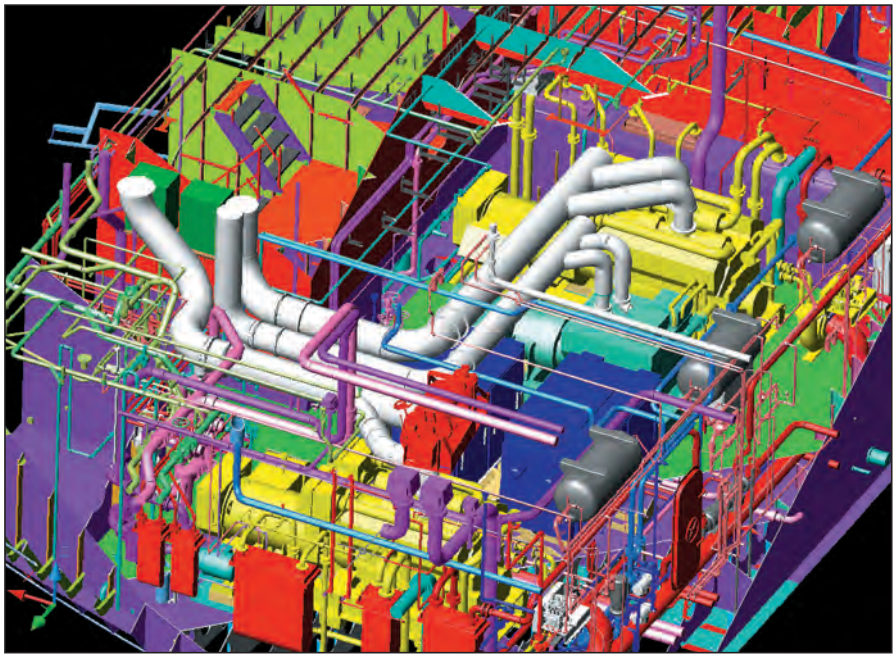
Using this software, CATIA V5 users are said to be able to quickly produce linear, non-linear, mechanical, and thermal models by adding specific features to an existing model built within its environment. Gateway speeds up design work due to the use of a single user interface for geometry definition, analysis data definition, meshing, translation into SAMCEF files, and post-processing.

ShipConstructor becomes US standard software

AT the end of last year, Albacore Research Ltd (ARL) announced that its ShipConstructor software had been named design software of choice under the US Second-Tier Shipyard Design Enhancement Program, which was recently granted funding under the National Shipbuilding Research Programme (NSRP) Advanced Shipbuilding Enterprise initiative. The NSRP Advanced Shipbuilding Enterprise is a collaborative project aimed at boosting productivity among US first- and second-tier shipbuilding and repair yards.

Recent project awards included US$1.25 million for the development of standard shared CAD software for commonality of designs of critical components such as HVAC and piping systems, and creation of common parts catalogues. NSRP project funding will provide, through an intensive six-month development programme, for ARL to upgrade, modify, and enhance selected portions of the ShipConstructor software package to fully meet the design requirements of the US second-tier shipyard industry.

Bender Shipbuilding & Repair Co selected ShipConstructor for this program, based on its core functionality as an affordable 3D product modelling software, which can integrate with AutoCAD, generally considered to be the international CAD software standard. This project represents the largest single collaborative effort by the US shipbuilding industry to standardise the use of a common design package through active participation in the development of software specifications to meet the needs of both the first- and second-tier yards.



A typical 3D screen display from Albacore's ShipConstructor suite, showing the engineroom of a platform supply vessel from Bender Shipbuilding & Repair Co.

The second-tier shipyard design improvement program, headed by Bender, includes seven shipyards and four naval architectural firms, representing the centre of second-tier shipbuilding and ship design in the USA. It complements a similar program also underway on behalf of the nation's first-tier shipbuilders. ARL believes this initiative will enable smaller shipyards, which often are faced with short-lead-time one-off design situations and a high level of reliance on design subcontractors for overflow work, to become world-class competitors through the use of an affordable AutoCAD-compatible standard design package.

BOOK REVIEW

Rebuilding the Royal Navy

By David K Brown & George Moore. Published by Chatham Publishing, London, UK. 208 pages. 289mm x 245mm. Hardback. 250 photographs and line drawings. ISBN: 1 86176 222 4. £35.00.

This book covers warship design for the UK Royal Navy since 1945. In some ways, as David Brown says in the foreword, it is a sequel to his four books dealing with British warship design from 1800 to 1945. It differs in that:

- it incorporates much research and analysis by George Moore for the first two decades of the period, where official records are available
- David Brown was involved actively in design and research for much of this period. Thus he can write with the authority of an insider - although not necessarily an unbiased one
- others associated with the designs are still living and have contributed their memories to the story, some quite illuminating.

The story is a fascinating one because of the changing political background against which the Navy's mission was set, the tremendous advances in weapons and sensors, and big changes in design and research methods made possible by the computer. A valuable feature of the book is the information given on the large number of designs which were considered but came to nothing. The effort devoted to these was not wasted as they contributed in various ways to those designs which did come into being.

The book will be of personal interest to many members of The Royal Institution of Naval Architects because they were themselves involved in one or more of the projects covered - either in Government or in industry. For others, it will bring home how much warship designs are dependent upon Government policies and the state of the economy.

Many are the compromises that have to be made between what is desirable and what is possible - financially, technically, or because of industrial capacity. Generally, those ships which did join the Royal Navy in the period discussed were very successful, although some suffered from the fact that the reasons for which they were wanted originally disappeared soon after they came into service.

The book is very well illustrated with photographs and line drawings. Copious references are given to official and other records used by the authors. The vast area covered means that many designs can only be touched upon in outline. Where possible, the reader is directed to other books or papers for more detail. Many of these papers were produced and discussed within the RINA, which can be proud of its contribution to the development of the Royal Navy in this period.

In reading the book, one must conclude that those involved during this period did a good job often under difficult conditions, and that the British were, and still are, willing and able to innovate. To quote just three examples, there was the angled flight deck for aircraft carriers, the use of glass-reinforced plastics (GRP) for mine countermeasures vessels, and development of the trimaran. The book provides a fascinating read.

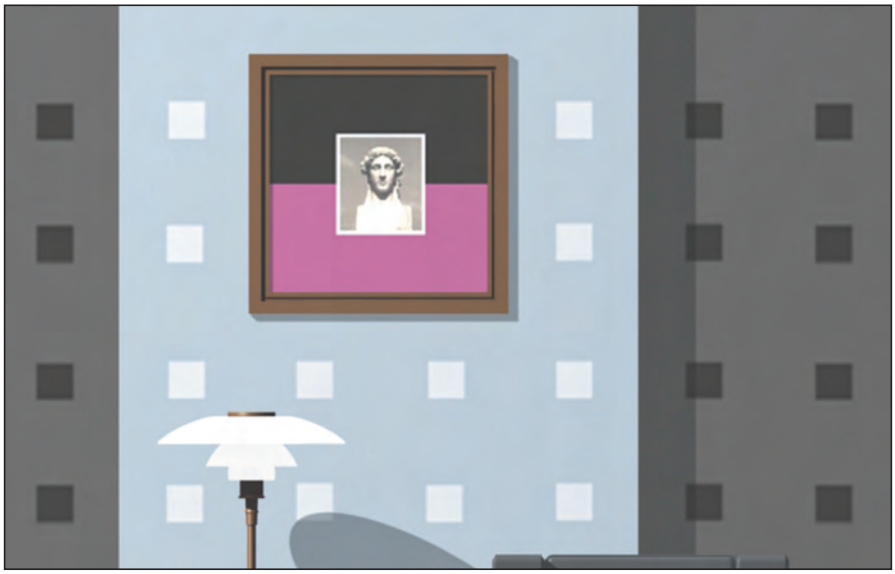
E C Tupper

Re-launch for Inexa panels with promotion of non-PVC finishes

A NEW era is opening in the history of the Danish-based interior company Inexa Panel, which will in future be known simply as Inexa; however, it will trade as TNF Interiors by Inexa. TNF Interiors was the original name of the steel sandwich-panel manufacturer prior to its acquisition by Inexa in 1993; TNF is an acronym for the 'thermal', 'noise', and 'fire-resistance' qualities of its product, which today is used not only in walls, but also floors, ceilings, wet units, and doors.

For 30 years, TNF panels for cabin, alleyway, and public room use have been well-known to ship designers, leading cruise liner owners, and shipyards - often in the cruise liner and ferry sectors, but also for merchant ships, where the panels are suitable for both bridges and enginerooms. Today, the company is emphasising the qualities of its 'green' TNF Magic silicon-polyester finish, which is a non-PVC type and claimed as free of halogens, cyanides and dioxins. PVC, the company claims, is highly dangerous, emitting smoke and sometimes fatal gases during fires, and it has called for this material to be banned. It is no longer used in corridors for this reason; however, the company will continue to supply PVC film coating where customers demand it. Nevertheless, Inexa is currently making an attractive offer to PVC customers, inviting them to switch to TNF Magic at no extra cost.

TNF Magic was first launched in plain colours in 1990 but today Inexa is also promoting two new decorated ranges - the Classic and Designer collections; the former has been specially created to give both owners and designers a greater choice - something which Inexa claims has not been offered by the industry in the past. On the other hand, the Designer range is planned as exclusive patterns; each is created by a leading designer for specific projects and will not be offered elsewhere.

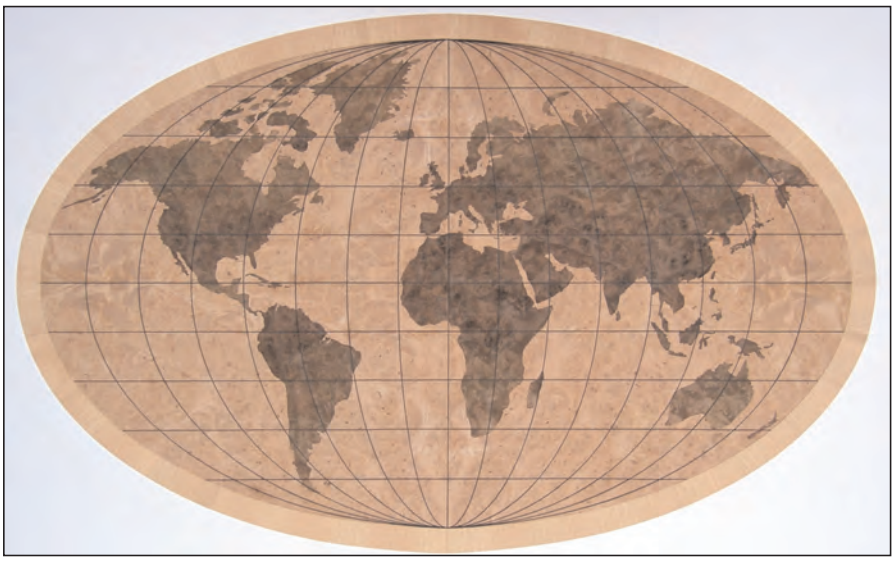


An example of a TNF Magic silicon-polyester finish from the Inexa Designer collection, aimed at exclusive projects. The pattern will not be available to anyone else.

TNF Magic is claimed to offer weight reductions up to 20tonnes for a typical cruise liner, and an important feature is the material's ability to be easily repaired. Short production runs are no problem, and the product is claimed to be competitively priced. Construction of the panels is two steel sheets with a mineral-wool core suitable for a minimum B15 fire rating, approved by all major classification societies. The product has been satisfactorily tested both by the Danish Fire Institute and by the UK Fire Research Centre at Warrington.

Although Inexa will continue to supply PVC films for those customers who require it, current 'green' philosophies abroad in the industry may mean the days of this type of film are numbered. Already, the leading Danish owner AP Möller has specified halogen-free panels for all future projects.

Utilising lasers and CAD technology, the Welsh company Anita Marquetry can supply highly creative decorative designs for inserting into floors, tables, and walls on cruise liners, superyachts, and similar vessels. These can be cut into veneers, shells, metals, and modern materials such as Corian. Where a client is unable to supply drawings or plans, Anita Marquetry's team can advise and help to develop a design by drawing on its comprehensive reference and design libraries. The company claims a unique ability in combining hand-crafted knife cutting with its three lasers and a CNC routing/milling machine at its 4500m² workshop. Principal marine customers are designers working on superyacht projects. This map of the world is created in mainly in burr walnut and burr maple, plus some other woods.



German panel system on *Pont-Aven*

CF-SYSTEMS GmbH, part of the Kaefer Group - was set up in Bremen, Germany, in 2001 for the production of the seamless and lightweight Lolamat panel system. This design has been developed to meet the demands made on interior finishing in ship accommodation areas and has been successfully applied in cruise ships, river cruise ships, high-speed craft, and yachts all over Europe. The fields of application range from cabins, wet cells, corridors, and public spaces to machinery rooms.

CF-Systems was awarded the contract for the production and delivery of approximately 2000m² of Lolamat panels by Binder, of Austria, for installation on new Brittany Ferries ship *Pont-Aven*. The contract comprised seamless walls for the Commodore and DeLuxe cabins - by using Lolamat, weight is said to be have been reduced by 40%, compared with conventional wall systems. In addition, modular prefabricated wall elements with finished surfaces were supplied, such as PVC foils for the Commodore corridors and latex colour coating for the locker and linen rooms.

New lightweight glass structures for ship interiors

DURING the last 10 years, the Finnish company Pocadel Oy, which manufactures fire-rated glass panels and doors for ship interiors, has delivered B-0 and B-15 glass panels and doors for public spaces in nearly 100 cruise and passenger ships. The company is now extending its product range with a new A-60 glass design.

The A-60 glass frame is designed for walls and doors, and is made from aluminium, in which the glass itself is a fire-resistant safety type. The frame material allows many finishing possibilities; it can be painted, anodised, chrome-plated, and gilded, for example.

These products are prefabricated and are claimed to be easy to install. The maximum sizes of A-60 constructions are: glazed panels of 1050mm x 2210mm, hinged door - single 1058mm x 2100mm, and hinged door - double 2000mm x 2150mm. All Pocadel fire-rated glass structures have passed strict fire-resistance tests according to IMO Resolution A754(18) and have been certified by Bureau Veritas (MED certificates).

Pocadel has already fitted type A-60 walls and doors to *Costa Mediterranea* and *Carnival Miracle*, which were delivered from Kvaerner Masa-Yards' Helsinki Shipyard in spring 2003 and February this year.

One of Pocadel's new A-60 glazed wall structures on *Carnival Miracle*, showing a promenade and staircase area. This 85,900gt ship has just been delivered by Kvaerner Masa-Yards' Helsinki yard; she is the sixth vessel in the Spirit series.

Cooperation agreement for integrated bridge system development

The electro/electric systems division of Hyundai Heavy Industries Co Ltd has recently chosen Transas as a cooperation partner for the joint development of a new Hyundai-Transas intelligent bridge system (HTIBS). According to this agreement, the new advanced HTIBS for the commercial marine market will incorporate hardware and software elements from both manufacturers.

Included in this system will be Hyundai's advanced control and integration system (ACONIS), intelligent voyage data recorder (HiVDR), and intelligent conning system (HiConning); and from Transas, a powerful new-generation navigation and information system (Navi-Sailor 3000 ECDIS-I) and digital radar system (Navi-Radar 3000-I) with advanced chart and AIS functionality.

This collaboration should ensure the development of technically advanced and fully customised solutions. Other anticipated benefits from the cooperation venture include enhanced system functionality, any language support, service support including software and system upgrades, technical support, and professional operator training programmes for navigating personnel.

Transas, Russia.
Tel: +7 (812) 325 31 31.
Fax: +7 (812) 325 31 32.
E-mail: em@transas.com www.transas.com

New range of wind-speed and direction sensors

Lilley & Gillie, the River Tyne-based manufacturer of navigational instruments and nautical equipment, has launched a complete new range of robust Walker wind-speed and direction sensors to suit different applications. Since the acquisition of Walker Marine in 2002, the combined company has actively been developing advanced navigational instruments and nautical equipment to augment its range. This new series of sensors is the first Walker product to be completely re-engineered since the take-over.

This range is suitable for most ship types, from high-speed craft to large cargo vessels, and fishing vessels. The sensors have been developed using state-of-the-art technology. This equipment uses solid-state principles for wind speed and direction, and since there are no calibration requirements, it allows simpler installation of multi-indicator systems. In addition, all processing will be carried out within each unit of the wind-speed and direction sensors.

As standard, the housing of each sensor unit is made of anodised aluminium, which provides a hard scratch-resistant, corrosion-proof surface, ideal for extreme operating conditions. The vane and cup units have a non-contact sensing operation with less moving parts, giving less friction, better reliability, and longer life.

The P292 wind-speed and direction sensor is ultrasonic - it has no moving parts, and has a low start speed (0.09knots, 0.01m/sec). The P296 is a combined wind-speed and direction sensor, it is lightweight and compact and said to be ideal for small high-speed craft. P297 and P298 are lightweight and have a mounting bracket of stainless steel.

P299 is a heavy-duty model suitable for top-of-the-range commercial vessels; it has larger cups for lower start-up speed, and has accuracy to within 0.5knots. P300 is a wind-direction sensor, it is also heavy duty and for commercial vessels, and has accuracy of less than +/- 1deg. All these new sensors will replace older models, and each unit will operate with all current Walker displays, either analogue or digital.

John Lilley & Gillie Ltd, Clive Street, North Shields, Tyne & Wear NE29 6LF, UK.
Tel: +44 191 257 2217.
Fax: +44 191 257 1521.
E-mail: sales@lilleyandgillie.co.uk

New range of adhesives for bonding

A new line of surface-activated methacrylate adhesives, designed to increase customer bonding options, has been introduced by Huntsman Advanced Materials. These adhesives allow fast cure and durable joining of metals, thermoplastics, and composites.

Known as Agomet methacrylates, eight adhesives and four hardeners are part of the new Araldite structural adhesives range. These products can bond substrates via surface pre-activation or by bead-on-bead application. Surface pre-activation allows users to apply hardener/lacquer to a substrate up to 30 days before the adhesive is added to a bond assembly. These adhesives can also be hand-mixed or can be dispensed by meter-mix machines.

Agomet methacrylates are suitable for bonding large and small areas, with work lives ranging from one to 20 minutes. Handling time varies from two to 35 minutes, and these adhesives have gap-filling properties from 0.4mm to 5mm depending on the application method used. Cured Agomet methacrylates are claimed to exhibit lap shear strengths as high as 35N/mm^2.

The new series includes: F300 - a three-minute handling time, fast-curing material of medium viscosity for 'no-mix' and meter/mix application; F305 - a fast-curing adhesive comparable to F300 but with low viscosity, ideally suited to rapid production line bonding, eg, for assembly of ferrite cores; and F307 - a high-viscosity (305Pas), gap-filling, low-shrinkage adhesive, which offers a three- to four-minute work life and a short handling time.

Huntsman Advanced Materials, Duxford, Cambridge CB2 4QA, UK.
E-mail: john_mchugh@huntsman.com
www.araldite.com

Merger ensures national network of spraying and finishing equipment

A new surface coatings company has been created with the acquisition of Bollom Finishing Equipment by Hi-Tec Spray Ltd. This union ensures that Hi-Tec Spray, it is claimed, is the only UK spraying and finishing solutions company with a national network of depots.

Customers include Fairline, Sunseeker, and A&P Falmouth, and Hi-Tec Spray also acts as a distributor for manufacturers of spraying, finishing, and pumping equipment, including Graco, Wagner, ITW deVilbiss, ITW Binks, Kremlin, Sames, Itawa, and Sagola. In addition, there is a 3M and applied chemicals/Gramos distributorship, plus a comprehensive choice of shotblasting materials.

Hi-Tec Spray Ltd, Heronden Road, Parkwood Industrial Estate, Maidstone, Kent ME15 9YR, UK. Tel: +44 1622 663444.
Fax: +44 1622 663555.
www.hitecspray.co.uk

Walker Marine's new range of wind-speed and direction sensors includes these masthead sensors.

'Largest-ever' thrusters from Kawasaki

The arrival of container liners of more than 8000TEU has prompted Kawasaki to develop what are claimed to be the world's largest transverse thrusters, models KT-300 and KT-355. So far the company has received an order for 14 of the KT-300B3 type thruster from a Korean shipyard. This order is believed to include thrusters for Seaspan's 8000TEU container ships at Samsung.

Kawasaki Heavy Industries, World Trade Centre Building, 4-1 Hamamatsu-cho, 2-chome, Minato-ku, Tokyo 105-6116, Japan.
Tel: +81 3 3435 2374.
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The Royal Institution of Naval Architects

HIGH SPEED CRAFT: TECHNOLOGY & OPERATION

17 - 18 November 2004, RINA Headquarters, London, UK

Call for Papers & First Notice

Prospects within the high speed craft sector are once again beginning to improve. Craft are being designed and built for an ever wider range of roles and more demanding applications. The industry is seeking to extend the economic operating envelope of these craft, reducing downtime, increasing reliability and safety.

The conference will consider a wide range of vessel types including small high speed craft, military vessels, passenger ferries, freight carriers, etc. Continuing the Institution's successful series of conferences on high speed craft, this two day event will give the industry the opportunity to debate these problems and look at possible solutions.

Technical papers are invited on the following areas:

Design & Build:
Including Monohulls, Multihulls, Special Craft such as ACV, SES, SWATH or Hydrofoils, Materials and Design & Manufacturing Processes.

Research & Development:
Including Model Testing, Hydrodynamics and Structural Response.

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Including Wash Implications, Machinery, Regulations and Economic Factors.

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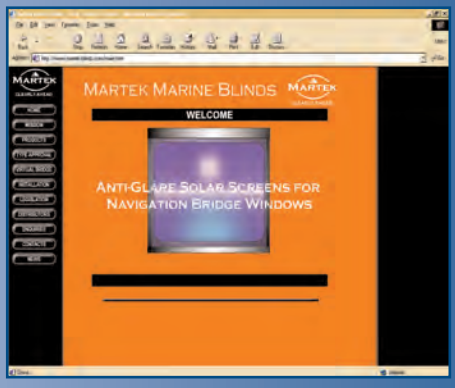

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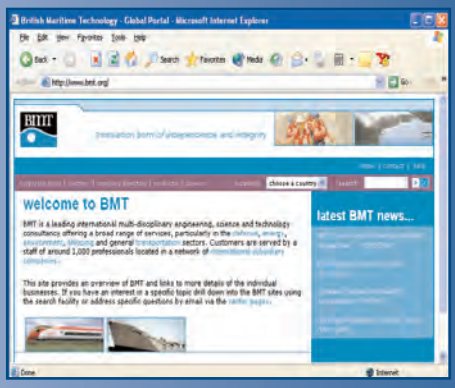

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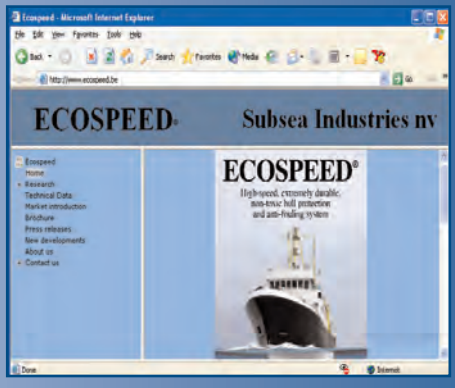

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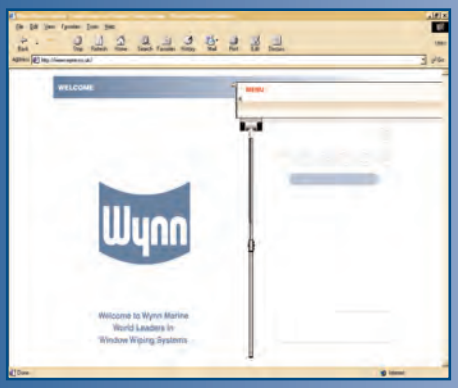

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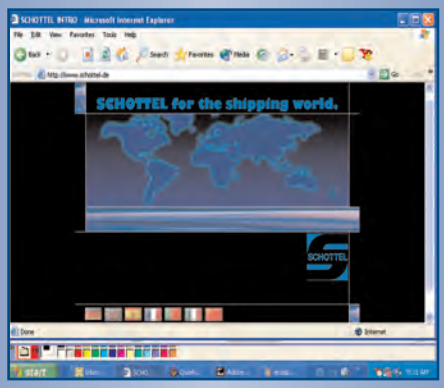

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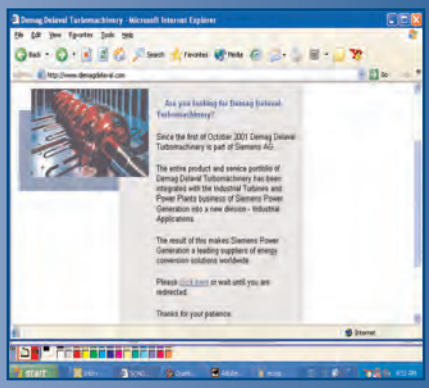

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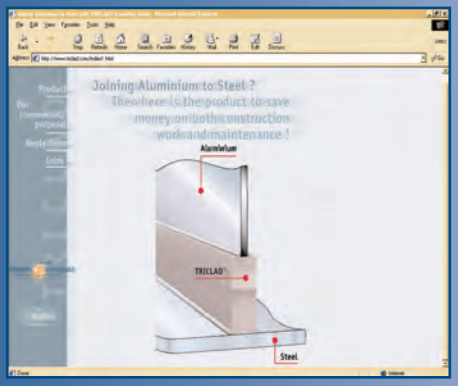

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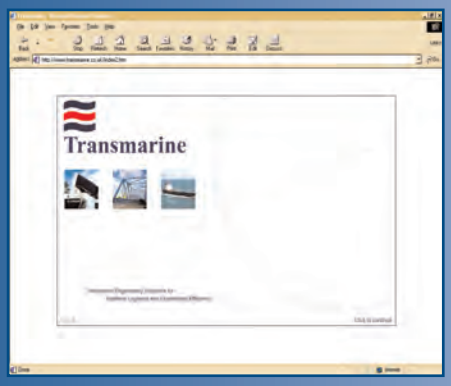

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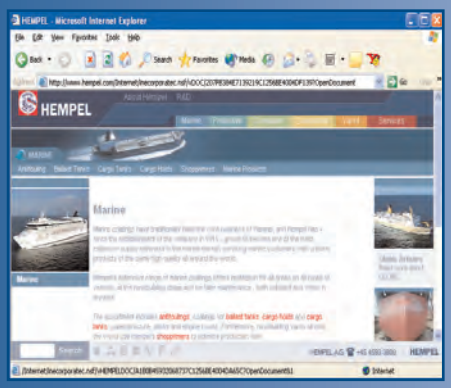

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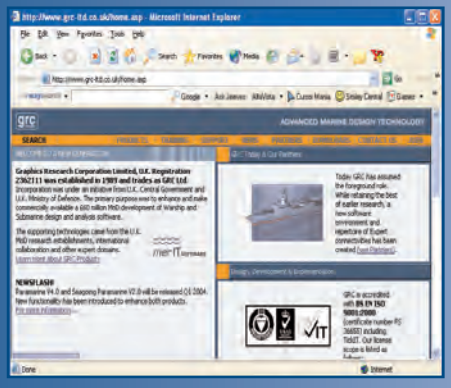

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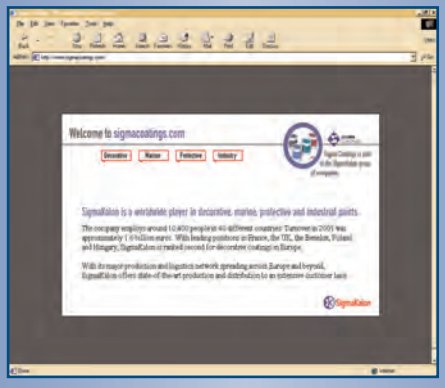

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