THE eNEWSLETTER OF THE ROYAL INSTITUTION OF
NAVAL ARCHITECTS, U.A.E. BRANCH

December 2008


We wish all our readers Best Seasons Greetings
&
A Very Prosperous New Year

CHIEF EXECUTIVE'S COLUMN

The President's Address to the 2008 AGM is published in full in this issue of RINA Affairs. In his Address, the President spoke of the great professional honour which had been bestowed upon him by his election as the Institution's 29th President, which he was sure was shared by his 28 predecessors. He reported that in his first year as President, he had enjoyed the opportunity to meet with both members and non members, and in doing so, he had been impressed - albeit not surprised - by the standing which the Institution enjoys throughout the international maritime industry.

In looking back over the Institution's achievements during the last twelve months, the President recognised that such achievements are invariably the result of the efforts of many individuals, whether as members of Council, the Institution's standing committees, the Divisional Councils and Branch Committees, or as conference organisers and in many other ways. He acknowledged that without their efforts, the Institution would certainly not be the forward looking, highly respected international professional institution that it is today, with its modern outlook, responsive to the needs of its members and the profession.

The President reported that, as in previous years, the Institution's priorities had been to extend the internationalism of the Institution, continuing its emphasis on involving the younger members of the profession and on the strengthening of its links with industry. At the same time, he reported that the Institution had continued to promote and facilitate the exchange of information and discussion through its international publications, conferences and website.

The President also announced the results of the 2008 elections to Council, welcoming new members and thanking those who had completed their terms of office. The spread of nationalities represented on Council continues to reflect the internationalism of the Institution.

A particularly enjoyable feature of the AGM is the announcement of the Institution's medals and prizes for achievements in 2007. In addition to recognising papers of exceptional merit and of distinction published in the Institution's Transactions, it was also pleasing to acknowledge the achievements of the Institution's younger members with the Wakeham, Calder, W H C Nicholas, Ian Telfer, and Samuel Baxter Prizes awarded to the authors under the age of 30 of papers published in the Transactions. The David Goodrich Prize for the best paper at the 2007 Warships Conference, and the 2007 Small Craft Medal were also presented by the President. Full details of the prize and award winners are reported in this issue of RINA Affairs.

As in previous years, the 2008 Annual Dinner was well supported by the maritime industry, including a number of companies and organisations taking tables for the first time. As is traditional at the Annual Dinner, the winners of the 2007 RINA – Lloyd's Register Educational Trust Ship Safety Awards were announced. The winner in the industry category was Saipen, whilst the University of Belgrade were the winner in the academia category. The Institution is grateful to Lloyd's Register Educational Trust for their continuing sponsorship of this Award and to all those companies who supported the Annual Dinner.

I am sure members will join with me in congratulating all those whose achievements in 2007 have been recognised by the Institution's prizes and awards.

Chief Executive

After *Napoli*

The Marine Accident Investigation Board investigation into the case of *MSC Napoli*, concludes that the hull failure was by no means an isolated incident. But Class body DNV stresses the problem is not of an industry-wide scale.

During the morning of 18 January 2007, when on passage in the English Channel, the 4419TEU containership *MSC Napoli* (built in 1991 by Samsung Heavy Industries, to Bureau Veritas Class) encountered heavy seas, causing the ship to pitch heavily. The ship, which had been switched to Det Norske Veritas Class, was making a good speed of 11knots and the height of the waves was up to 9m. At about 1105, the vessel suffered a catastrophic failure of her hull in way of her engineroom. The master quickly assessed the seriousness of the situation and decided to abandon ship.

MSC Napoli was then taken under tow towards Portland, UK but, as the disabled vessel approached the English coast, it became evident there was a severe risk she might break up or sink, and she was beached in Branscombe Bay on 20 January 2007.

MSC Napoli, in distress, 18 January, 2007.

The subsequent Marine Accident Investigation Board inquiry concluded that a number of factors had contributed to the failure of the hull structure, including:

- The vessel's hull did not have sufficient buckling strength in way of the engineroom.
- The Classification rules applicable at the time of the vessel's construction did not require buckling strength calculations to be undertaken beyond the vessel's amidships area.
- There was no, or insufficient, safety margin between the hull's design loading and its ultimate strength.
- The load on the hull was likely to have been increased by whipping effect.
- The ship's speed was not reduced sufficiently in the heavy seas.

In view of the potential vulnerability of other containerships of a similar design, the MAIB asked Classification Societies to conduct urgent checks on the buckling strength of a number of ship designs.

DNV, in cooperation with Lloyd's Register, developed a two-stage methodology to identify containerships potentially vulnerable to localised buckling in severe conditions.

Each IACS member was asked to use the methodology (or similar) to screen its vessels, focusing on vessels of 2500TEU capacity and greater, with two or more cargo bays aft of their accommodation/engineroom.

The screening process involved over 1500 container ships: 12 vessels were identified as potentially having insufficient buckling strength in severe conditions and requiring remedial action; a further 10 vessels were identified as being borderline and require more detailed investigation; and the screening of eight containerships was still in progress.

The Classification Societies of the 12 containerships identified entered consultation with the vessels' owners, to determine permanent technical solutions.

Recommendations have been made to IACS members to increase the requirements for containership design, consolidate current research into whipping effect, and to initiate research into the development and use of technological aids for measuring hull stresses on containerships.

However, DNV placed a different emphasis on investigations, stressing that it did not believe that the accident's cause constituted a general problem for container shipping at large. Only minor structural modifications would have to be made to a 'very restricted' number of the existing containership fleet, the Class body said.

DNV concluded that the buckling strength in the forward part of the ship's engineroom was insufficient. Two ships under DNV class would have to be strengthened. 'This is a minor structural modification, which may be done afloat and only involves a small amount of steel,' said Olav Nortun, DNV Maritime's technical director. 'Alternatively, the still water bending moment may be reduced by modifying the loading conditions.'

DNV said that, in its assessment, the probability of an accident like that involving *MSC Napoli* recurring is very small. 'The damage statistics for containerships are very good,' said DNV. 'In addition, the investigation has shown that the strength of this particular ship was less than that of similar vessels.' *NA*

FEATURE 1 | **DESIGN**

DSME sharpens edge for 14,000TEU carrier

The Naval Architect asked Lee Yeon-Seung and Choi Young-Bok of DSME's Hydrodynamic R&D Team, and Stefan Harries of FRIENDSHIP SYSTEMS to highlight the hydrodynamic optimisation work done for a new 14,000TEU ultra large container carrier.

The tight coupling of Computer Aided Design (CAD) and Computational Fluid Dynamics (CFD) to bring simulation-driven design to the early stages of product development has been successfully utilised by South Korean shipyard Daewoo Shipbuilding and Marine Engineering Co for its latest giant container carrier.

Applying the CAD-CFD systems provided by German and Swedish software developers FRIENDSHIP SYSTEMS and FLOWTECH, respectively, DSME now runs hundreds of design simulations overnight and during the weekends to scan design space and identify all potential for further improvement.

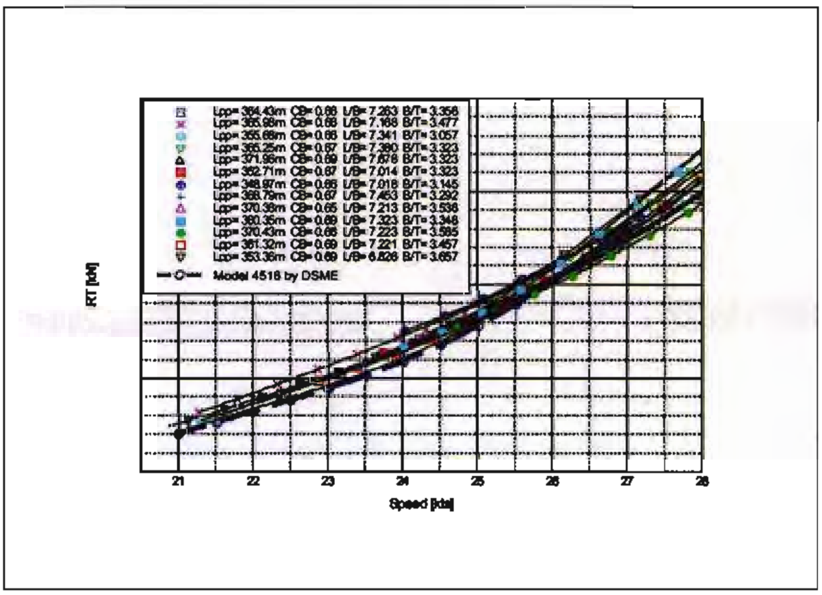
The anticipation of the Panama Canal's new capacity and the high cost of fuel have influenced the characteristics of container carriers during the last couple of years. In order to achieve optimal fuel economy, capacities have been increased while operating speeds have been reduced. This led to the rise of Ultra Large Container Carriers (ULCC) with capacities of more than 12,000TEU.

From a hydrodynamics point of view the hullforms associated with relatively slow ULCCs differ from those of the general Panamax ships. Typical Froude numbers of the ULCC built by DSME range from 0.2 to 0.22. To establish the best design concept for its new ULCC, a global study was carried out, combining state-of-the-art systems, best practice and the broad experience available at DSME in Seoul.

As a long-time user of the CFD system SHIPFLOW and one of the leading pioneers in coupling CAD and CFD on the basis of the FRIENDSHIP-Framework, DSME had all of the necessary ingredients at its fingertips:

- A reliable CFD system for design assessment
- A flexible parametric CAD approach for design variation
- A comfortable optimisation environment for systematic investigations

Comparison of designs on the basis of HSVA's database.



DSME's design approach

The design conditions for the new 14,000TEU carrier are as follows: LOA of almost 380m, LPP around 360m, breadth just below 52m, design draught of 14m and the guaranteed speed of 24knots (Fn approximately 0.207) at 90% MCR with 15% sea margin at a scantling draught of 15.5m.

DSME's approach in design and optimisation comprised several steps:

1. Select proven parent ships and scale to principal dimensions
2. Undertake CFD simulations for re-combinations of various forebodies and aftbodies
3. Choose most promising candidate (baseline) for systematic parameter variations
4. Conduct formal studies of a series of variants by means of CFD
5. Identify influences of individual parameters, eg change of volume distribution, parallel mid-body, and bulbous bow
6. Pick hullform and conduct model test campaign

In particular, two parent ships with high nose type bulbs provided a starting point, giving rise to four re-combinations (steps 1 and 2). The best compromise between hydrodynamic and operational performance, for instance with respect to container loading, was then selected (step 3) and subsequently varied by swinging the baseline's sections using the Generalised Lackenby approach as available in the FRIENDSHIP-Framework (steps 4 and 5).

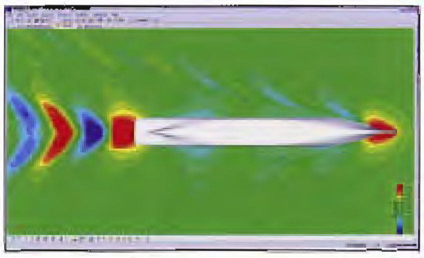
Key characteristics of the Generalised Lackenby approach are that the region of

Model test for new hull form (photo courtesy of HSVA).

influence on the hull shape can be selected flexibly and, furthermore, that the slopes of the shift functions can be defined freely at either ends. In this way variations may start well forward of the bossing and may end just aft of the forward perpendicular. With zero slopes at the beginning and at the end transitions become very smooth. An elaboration is given in *The Naval Architect's* September 2007 issue.

A series of variants was thus produced and numerically simulated for wave resistance by means of SHIPFLOW (steps 4 and 5). Variants displayed a modification of parallel length of mid-body from 5% to 15% LPP. The angles of change to the sectional area curve (SAC), as available with the Generalised Lackenby, were varied from minus 25° to 25° in steps of 5°.

By increasing the parallel mid-body reductions of the wave resistance coefficient could be detected of up to 8%. Further tangible improvements could be found by adjusting the volume distribution at the forward perpendicular. The hullform that was finally chosen for model tests (step 6) featured a straight type and rather steep SAC with sharp angles at entrance and run and a comparatively long parallel mid-body. The design waterline displayed a small entrance angle and a relatively pronounced shoulder between stations 12 and 16.



Baseline (upper half) vs. optimised hull (lower half) at design speed.

Selected results

In relationship to the baseline the final hull displayed less than 50% in wave resistance and, in addition, a favorable effect on the propulsion performance. The wave patterns seen in the numerical simulations and in the model tests, conducted at Hamburgische Schiffbau-Versuchsanstalt (HSVA), were found to be favourable and very stable, respectively.

A further comparison was undertaken with regard to the wide scope of ULCCs already tested at HSVA. Filtering HSVA's database for vessels from 300m to 365m in LPP, 42m to 52m in breadth, and block coefficient from 0.65 to 0.70, it could be seen that the new DSME 14,000TEU carrier performed excellently at the target speed of 24 knots.

DSME has decided to use advanced methods for simulation-driven design to surpass its already considerable design expertise. For the development of its new ULCC the SHIPFLOW FRIENDSHIP Design Package was utilised, consisting of the CAD-CFD integration platform FRIENDSHIP-Framework and the advanced CFD code SHIPFLOW. While the FRIENDSHIP-Framework allows for parametric variation and formal exploration of the design space, SHIPFLOW yields reliable flow analysis within short response times. Benefiting from this, DSME was able to study an extensive series of variants before selecting its favored hullform for model tests. The model tests proved the final design to be highly competitive. At target speed it did even better than all of those available for meaningful comparison.

Having started with two people that use the new techniques, DSME is quickly introducing additional sites in order to empower more members of its team. A clearer appreciation of the cause and effect of changes, a shorter development time, and a better product are the direct benefits, not only to DSME but also to the owner/operator and, ultimately, the environment. *NA*

New thinking on container losses

The commitment to analyse and assess rule-related technical aspects of safe container shipping has initiated new research and development at Germanischer Lloyd. Helge Rathje, GL head of department, analysis of hull Structures and damages, ship newbuilding division, provides this update.

The number of containers reported lost overboard during the recent years has been significant. Estimates varying between 2,000 and 10,000 boxes damaged and lost per year have been reported in the maritime press, and several insurance companies recently announced increases of up to 20% in their premiums. On top of these commercial concerns, the marine environment is at risk from lost containers carrying dangerous goods.

Although damage records reveal that smaller containerships suffer substantial losses and damages, post-Panamax ships are suspected to be even more vulnerable, because of immature technical standards that do not reflect the rapid growth of these ships and because of the associated lack of sufficient experience with these ships.

It is not only the designs of large new ships, carrying up to 14,000TEU, that are deemed partly responsible for certain container losses; it is also the presumed malfunctioning of so-called fully automatic locks (FALs), which are primarily used to stow vertically stacked containers on deck.

Consequently, the better understanding and enhancement of the safety of container transport at sea has become an imperative. The commitment to analyse and assess rule-related technical aspects of safe container shipping has initiated various R&D activities to resolve this matter at Germanischer Lloyd (GL).

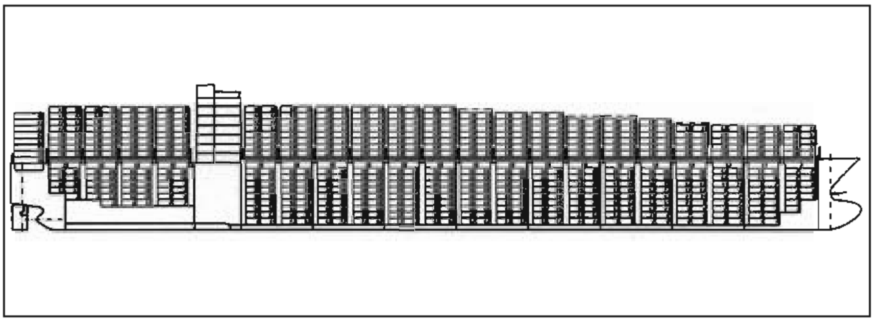


Figure 1: Sample extract from 'Container Stowage and Lashing Plan'.

The national joint project 'Seaborne Container Losses and Damages' forms the backbone of this research.

Stowage and lashing plan

Safe sea transport of containers stowed in holds and on weather ;decks requires containers and their lashing gear to be able to withstand extreme forces caused by gravity and dynamic accelerations and wind-induced pressure loads acting on the outer container stacks. As part of the 'Container Stowage and Lashing Plan', the 'Cargo Securing Manual' stipulates the allowable weights of the container stacks and properties of the lashing system used. The boundary the structural strength of the container itself specifies limits of allowable stack weights, and ship-specific spatially varying rule-based accelerations, as well as the lashing system used, also affect the allowable stack weight.

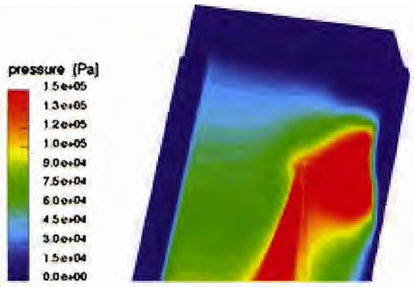


Figure 2: Screen shot of slamming pressure distribution on aft ship.

Furthermore, as almost all containers are designed and built according to the standards of the International Organization for Standardization (ISO), design accelerations are merely maintained and updated in the Classification rules. Therefore, the determination of accurate design

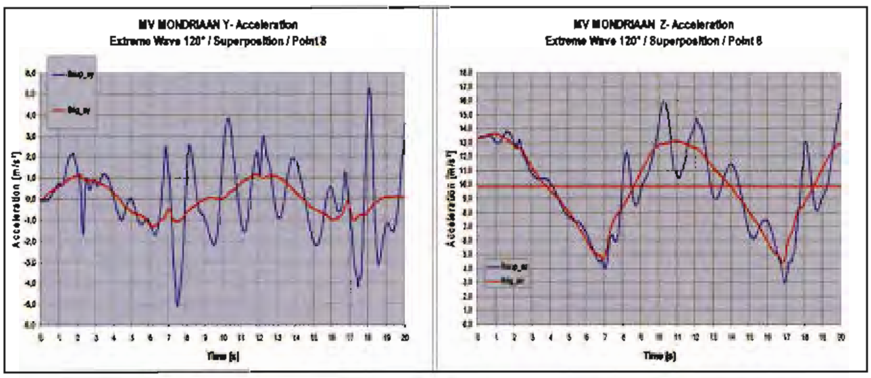


Figure 3: Lateral and vertical accelerations.

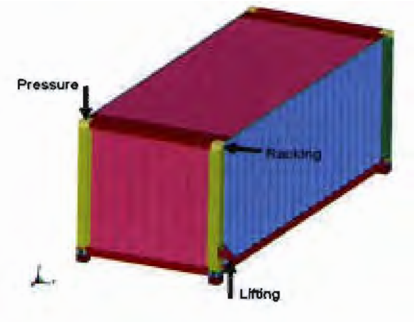


Figure 4: FE model of container with imposed forces.

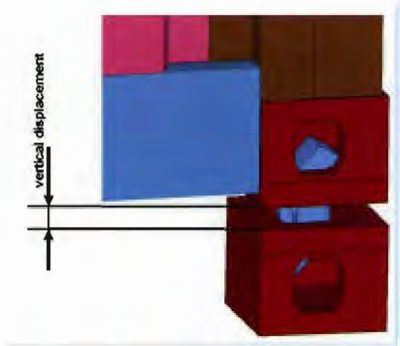


Figure 5: Vertical displacement of corner castings during FAL release.

Figure 6: Container test bed.

accelerations is of prime importance to ensure safe and reliable container loadings and adequate dimensioning of the lashing equipment.

The overall loading of lashing equipment results from container weight forces due to gravity acceleration, forces of inertia due to dynamic accelerations, and wind-induced pressure forces for outer container stacks that are exposed to squalls.

Dynamic accelerations depend on the following governing parameters:

- Ship's loading condition
- Ship's hull form
- Ship's speed
- Ship's route and associated wave climates
- Hull flexibility
- Lashing system (bridge type, lock type, container type, etc)

Thus, the development of respective rules needs to account for a complex network of contributing sources to yield design values. Traditionally, due to the limitations of computer capacity and lack of appropriate physical formulations and corresponding computer routines, sea-keeping computations to determine dynamic accelerations were conducted by treating the ship's hull as a rigid body.

In February 2006 the Hamburg based shipowner Blue Star informed GL that their 8400TEU liner *Mondriaan* lost over 100 containers within one week on its way to Hamburg and outbound in the Bay of Biscay. The need to find plausible explanations for these losses triggered the national joint project 'Seaborne Container Losses and Damages'. Partners of the still-running project are Blue Star, the Technical University of Hamburg-Harburg (TUHH) and GL. This investigation, focusing on the Bay of Biscay incident, pursues the following scope of work:

- Numerical computer simulation of the incident
- Laboratory tests with real 20foot containers and re-calculated loads imposed on the FALs
- Comparing computed results with experimental results
- Conducting an extensive full-scale measurement campaign on six Mondriaan class ships

While the full-scale measurement campaign was primarily set up to identify the magnitudes of the contributing sources of dynamic acceleration sources originating from rigid body ship motions, elastic hull vibrations, and especially the container stack movements, the laboratory tests served to validate the newly developed computational procedure that predicts the behaviour of locking components exposed to dynamic container loads.

Therefore, the first task was to determine so-called equivalent design waves (EDWs) based on the seaway information gathered from the German DWD Metocean Office. The seaway at the time of the losses in the Bay of Biscay was very rough – peak energy wave periods of about 12seconds and significant wave heights of 10m in stormy winds up to 11Beaufort. According to the wave scatter diagram given in the IACS Rec. 34, this particular seaway occurs for about 23 hours during 25 years exposure time in the North Atlantic Ocean. Together with precise information regarding the ship's course, speed and loading condition two EDWs with a slightly varied angle of encounter were found and the time of varying wave-induced pressure distributions on the ship's hull were computed applying GL's in-house developed CFD techniques.

The first EDW from 105° abeam (0° means following wave) induced a slamming impact in the aft ship, see Figure 2, whereas the second EDW from 120° entailed a heavy impact in the flared bow area. It should be emphasised that the high ship response was not caused by the parametric roll excitation.

In a second step the computed pressure distributions of the EDWs were imposed on the structural FE model of *Mondriaan* and the resulting lateral and vertical dynamic accelerations that include the contributions from the flexible hull vibrations were computed for a container on the highest tier in bay 74 aft of the deckhouse, the location where the containers were lost.

Figure 3 shows the time traces of the dynamic lateral and vertical rigid body accelerations (red curves) and the total accelerations that include the contributions from the flexible hull girder vibrations (blue curves). Obviously, a large part of the total lateral acceleration stems from the two-node lateral hull girder vibration.

These time traces served as input for the calculation of the lifting, pressure and racking forces acting on the FALs of a few investigated highly loaded containers in the stack. Here, the required mass information from the loading computer for bay 74 containers was utilised.

No	Name	Installation finished
1	Maersk SARNIA	October 09, 2006
2	Maersk SYDNEY	October 16, 2006
3	Maersk SEVILLE	October 30, 2006
4	Maersk SANTANA	November 07, 2006
5	Maersk SANA	November 21, 2006
6	Maersk SHEERNESS	November 25, 2006

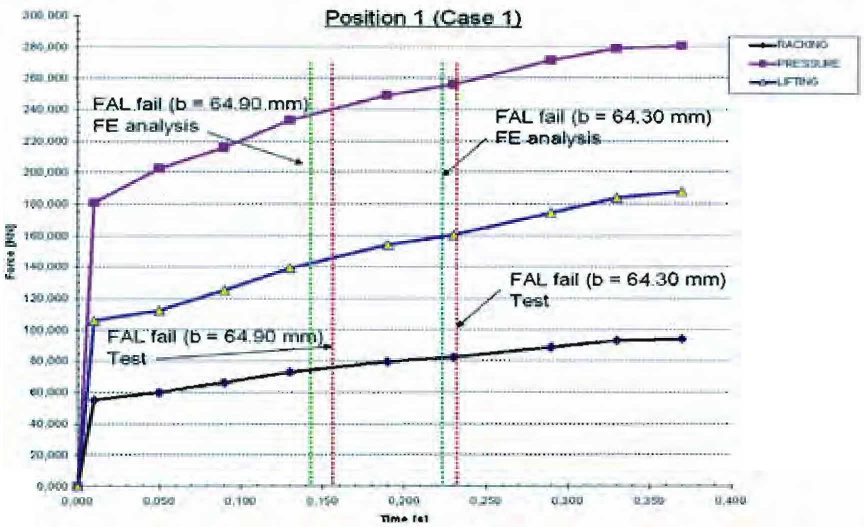


Figure 7: FAL test versus FE analysis.

Figure 8: Measurement container.

In the next step the forces were applied to the wall-side of an FE modelled 20foot container and the behaviour of the FE modeled FAL was computed, see Figures 4 and 5.

The same loading scenario was later imposed on a real 20foot container in a laboratory test (see Figure 6).

The comparison of the FAL behavior between the tests and calculations is plotted in Figure 7.

Figure 7 reveals that the results obtained with numerical FE analysis correlates well with the corresponding test results. The Figure further shows that widening the ISO hole of the corner casting by 0.6mm yields the expected reduced locking capacity (hole width 63.5mm + 1.5mm tolerance).

Concluding, both the numerical computations and the corresponding experiments showed that the release of the FALs during the storm in the Bay of Biscay was likely to happen. However, the prevailing seaway conditions when the containers were lost overboard were very harsh and ongoing investigations thus emphasise identifying design seaway conditions.

To investigate the dynamic behaviour of container stacks in the aft ship of the *Mondriaan* class vessels, an extensive measurement campaign was set up in autumn 2006 on the following six ships.

Besides a gyro to measure ship motions, 10 laterally and vertically oriented accelerometers and two strain gauges amidships were installed to record the dynamic behavior of the flexible hull girder. Trigger conditions to record interesting events were imposed to obtain simultaneous time traces of the sensors. On *Maersk Sydney* a measurement container has further been installed since February 2007 (see Figure 8).

The main purpose of installing the measurement container was to find out whether the behaviour of the container stack induces additional dynamic accelerations that could not be modelled numerically so far. Thus, the preferred position of this movable container is the uppermost tier in the aft ship bays. All six ships operated in the eastbound service and, unfortunately, no serious seaways leading to high ship responses have been encountered yet. Therefore, it was recently decided to dismantle the sensors on five ships and to continue the measurement campaign on *Maersk Sydney*, given that the ship is also equipped with the measurement container.

Outlook

The investigation of the container loss incident of *Modriaan*, in Bay of Biscay, was focused on the acceleration-induced loading of the FALs. The composition of the total vertical and lateral acceleration is technically complex to formulate. However, sound knowledge regarding the magnitudes of the individual contributions is necessary to check and update the corresponding expressions laid down in the rules.

Other non-technical safety relevant factors for container transport are, for instance,

- Structural integrity of container and corner castings
- Improper stacking of containers
- Deviations of container weights from weights in loading computer data
- Inside stowage of container
- Locking capacity of different lock types (FALs and semi-automatic twistlocks)

It is necessary to clarify the importance of these factors to assess the safe sea transport of containers, and emphasis will be put on efforts to quantify the contributions from these sources. *NA*

New ideas from Cosnav

Two new vessel types are emerging from the innovative Trieste-based designer. Both flow from the designer's close relationship with owner Naftotrade.

In order to consolidate its relationship with the Greek shipowner Naftotrade, Trieste-based designer Cosnav Engineering has developed a new 15,500dwt self unloading 'green' cement carrier.

The successful results obtained during the two years of service from two smaller sister vessels *Naftocement XI*, and *Naftocement XV*, which 'reached the top of the Australian market' due to their strict adherence to the environmental regulations, encouraged Cosnav Engineering to improve the security and the versatility of the new vessel.

The new construction provides six cargo holds, including a pneumatic discharging system with improved performance. The hydrodynamic design has also been optimised thanks to the tank tests done by the Model Basin of Vienna. The ship is now under construction at the Selah Makine ve Gemicilik Endustri Ticaret Shipyard in Tuzla under the supervision of classification society RINa.

Naftocement vessels 'reached the top of the Australian market'.

Cosnav Engineering said it was also designing a new project for a 25,000dwt bulk carrier Ice Class 1A on behalf of Naftotrade, whose intention is to build the new vessel in the new shipyard Therme of Samsun (Turkey).

In this project the company is exploiting its 30 years of experience in Ice Class building and investigating new ways to build an environmentally-friendly ship.

The hullform features a bulbous bow, above which is an efficient stem line. The design includes a forecastle with an incorporated bulwark for protection against the heavy seas.

At the aft end a high efficiency rudder, including an ice knife, is attached to the open-water stern frame and improves manoeuvrability and direction stability on the vessel.

The vessel is a geared bulk carrier with five wide hatch openings, all closed by end-folding pair covers of the end-stowing type, and hydraulically operated.

The vessel is divided into five cargo holds by double skin transversal bulkheads built on stools and the space between these is used for ballast or HFO tanks.

The double hull configuration, which is structure-free, in conjunction with the large holds, is said to guarantee easy discharge and cleaning.

The tank top is strengthened for heavy cargoes with a uniform load of 25tonnes/m^2 and the hatch covers for a load of 2.5tonnes/m^2. The strengthening of the vessel allows for alternated hold loading, therefore leaving holds 2 and 4 empty.

All the cargo holds can carry dangerous goods and are mechanically ventilated.

Ballast piping and valves are run in a duct in a duct keel, and the wing and double bottom tanks are separated to facilitate the sequential water ballast exchange.

The cargo is handled by four sets of hydraulically-operated level-luffing deck cranes of 30tonnes x 28m-outreach radius and mounted on a pedestal to stowage of deck cargoes.

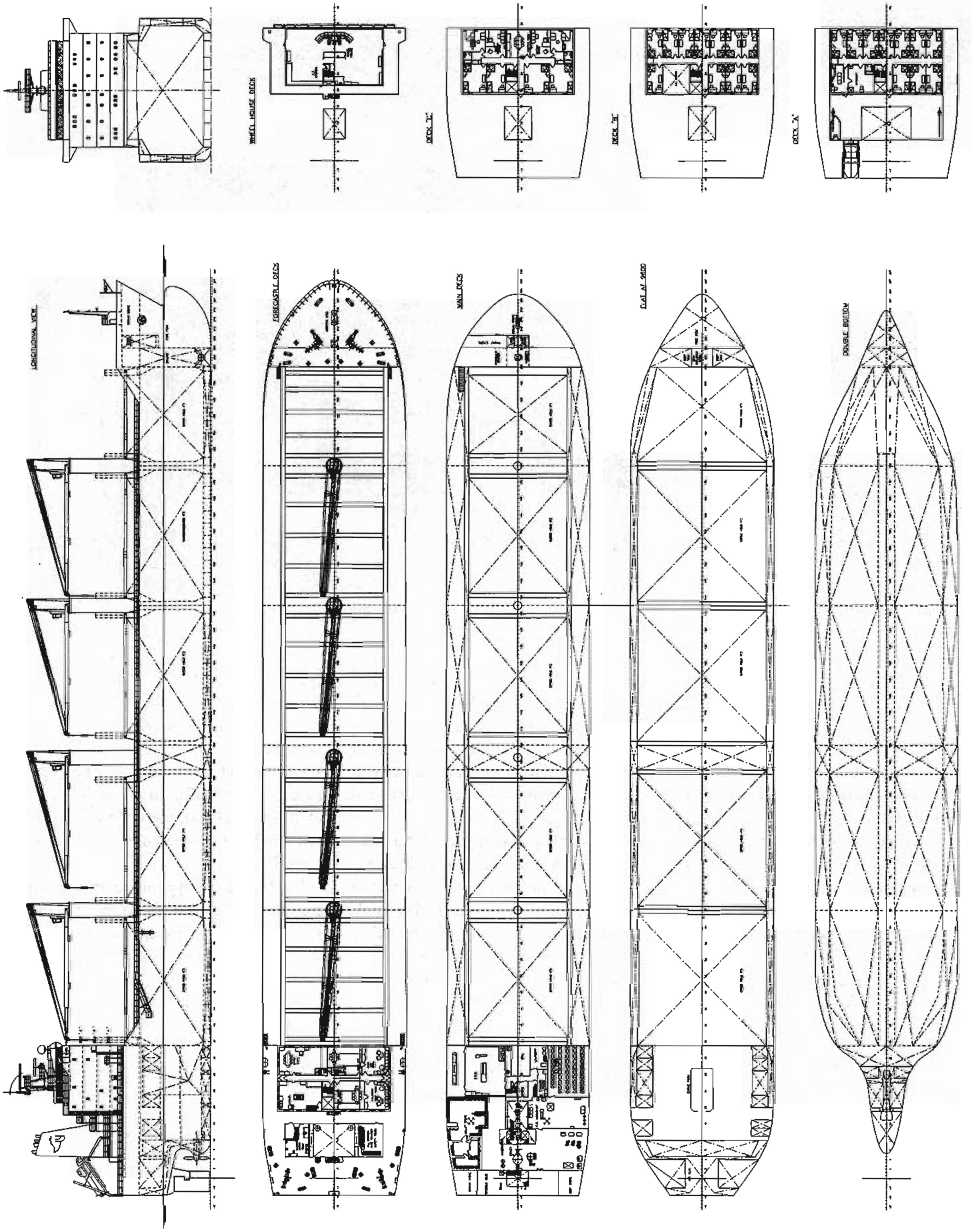
According to the requirements set out in the RINa classification, this project fully complies with all of the environmental regulations and will be classified as a 'Green Star 3 Design' vessel, which implies that all of the bunker tanks are protected from the sea. The high ballast tanks capacity avoids having to carry ballast in the holds and all of the installed machinery is arranged for low-sulphur fuel operation and is NOx compliant.

The two-stroke type main engine will create about 7400kW at 136rev/min and will provide a service speed of 14knots at 85% MCR using a 5900mm diameter propeller operating in an open water stern frame. The stern bulb is designed to optimise the propulsion efficiency.

The electrical requirements are served by three diesel alternators sets, each with an output of 680kW, while the boiler and economiser satisfy the steam requirements.

A remote automatic control system will serve the propulsion system with an integrated alarm and monitoring system, which includes power management and an integrated navigation system. NA

GA of the 25,000dwt bulk carrier Ice Class 1A, developed by Cosnav on behalf of Naftotrade.



New steel proves its point

Four 8100TEU capacity containerships turned out by Mitsubishi Heavy Industries already benefit from the new high tensile steel YP47 in their deck area that is making waves among builders of larger capacity ships.

As containership sizes have increased, steel thickness has also increased, and today's largest containerships of 10,000TEU capacity and above can feature decks where steel is as thick as 100mm. One consequence is that such plate is vulnerable to brittle fracture. It is for this reason that MHI and Nippon Steel began their investigation into using high tensile E Grade YP47 steel, a material featuring a higher bending moment than the conventional 40kgf/m^2 steel used in box ship building. With a bending moment 10% higher than conventional materials, YP47, offering 47kgf/m^2, is available in thicknesses of 65mm-70mm and its higher yield stress, beyond which permanent deformation occurs, improves safety.

As well as promising improved materials reliability, the thinner plate is easier to weld with, and the weight reduction accrued, by definition, enhances fuel efficiency. The safety of YP47 has been verified by ClassNK and, according to the Class Society, the material could be applied more widely in ship structures.

The 316m long, 8100TEU capacity *MOL Creation*, the first ship to benefit from YP47, has experienced no problems in service since its delivery last year.

According to a ClassNK source: 'Once YP47 has proved itself to be successful, Hyundai Heavy Industries is very interested in applying this steel for 10,000TEU capacity ships and above.' NA

ESSO test.

Typical brittle fracture propogated in thick base plate (ESSO test).

The first application of YP47 E Grade high tensile steel to an 8100TEU containership.