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Maritime Institute of Finland

VTT

TEKNILLINEN KORKEAKOULU
TEKNISKA HÖGSKOLAN
HELSINKI UNIVERSITY OF TECHNOLOGY

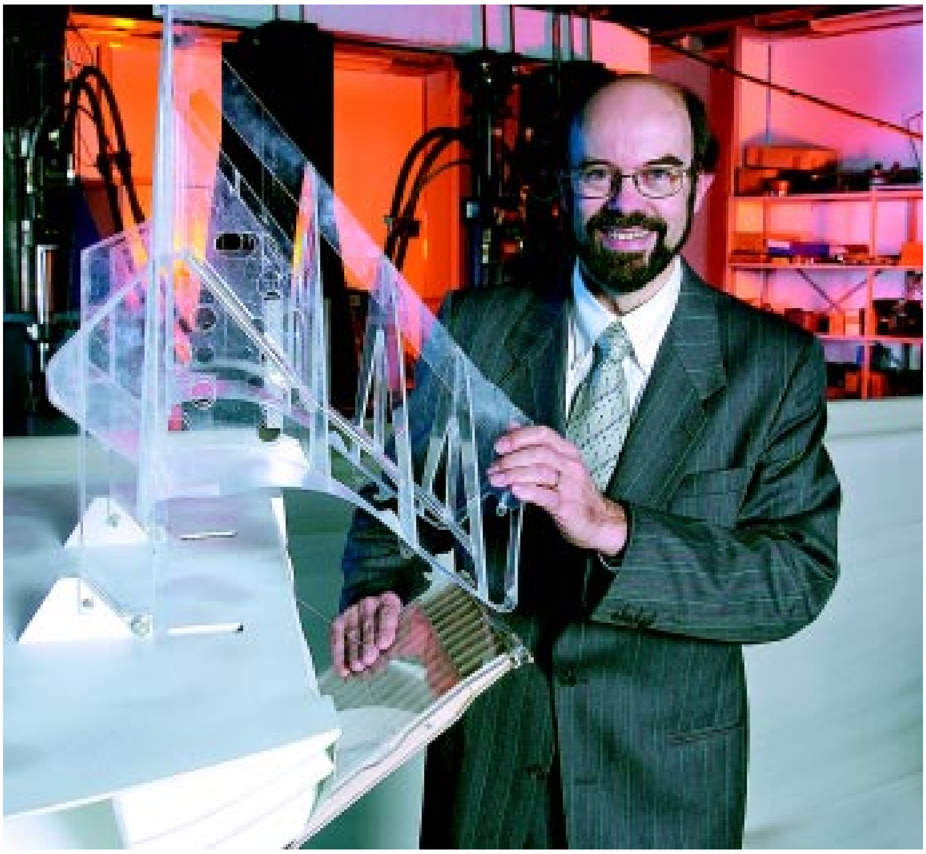
MARITIME INSTITUTE OF FINLAND 10 YEARS IN 2001, FUTURE CHALLENGES

Harri Soininen, Research Manager
VTT Manufacturing Technology

The Maritime Institute of Finland was founded in 1991. The background of the Institute was the restructuring of the Finnish shipyards at the end of the 80's and the beginning of the 90's. It was considered that those within the national maritime research field had to strengthen their co-operation in order to enable continuous service and quality in the future environment of changed industrial structure. A committee under the auspices of the Ministry of Trade and Industry considered various options and came up with the solution of the Institute model. The Institute was founded as a joint venture between the Ship Laboratory of the Helsinki University of Technology (HUT) and the Ship Laboratory of the Technical Research Centre of Finland (VTT), today known as Maritime and Mechanical Engineering of VTT Manufacturing Technology.

The aim of the Institute is to co-ordinate and strengthen research efforts in the fields of ship and ocean technology. The Institute produces customer-oriented impartial research and expert services for the international market. The services are based on deep knowledge and oriented towards design, operations and R&D. Both publicly funded and commissioned research is covered.

The Institute combines the scientific activities of a university and the applied research of a research center. The research projects and programs are developed and performed in areas that are considered essential for the maritime industry of Finland, which results in close co-operation between the parties concerned. The Institute is governed by a board consisting of three members from both organizations. The activities are supervised by an advisory committee consisting of members drawn from the related industry and government bodies. A strategy plan and a plan of action are discussed yearly in the advisory committee. The Institute jointly governs the major research facilities, the open water towing tank and the combined maneuvering, seakeeping and ice tank.



A jubilee seminar was arranged on March 28th to celebrate this 10th anniversary, although this was not the only reason to arrange the seminar. In this year, it is also the 60th anniversary of the first professorship of Naval Architecture at the Helsinki University of Technology. It is the 30th anniversary of the completion of the model basin building in Otaniemi and the 25th anniversary of the founding of the Ship Laboratory of VTT. The seminar turned out to be very successful. A description of the atmosphere in the seminar and references for the papers given can be found elsewhere in this number of Maritime News.

In the seminar, the industry showed its full support for both organizations behind the Institute, HUT and VTT. It is evident that the concept of industry is more complicated now than it was during the founding of the Institute. Networking and outsourcing are the trends of today. Companies concentrate on their core business. This means that shipyards do not have such a dominating role in shipbuilding industry as they used to have. Suppliers, equipment manufacturers, design companies, etc. have a growing role in today's networked environment, which was reflected in the participant structure of the seminar. This also means that the research environment has changed, which is especially true for applied, commissioned research. The pace of business is accelerating. The needs of clients are changing rapidly. Accordingly, the Institute is closely following the needs of its clients in order to better serve them. Last year, VTT Maritime and Mechanical Engineering made a major effort in renewing its strategy, emphasizing the ability to serve its customers well. The final goal is a partnership role with key customers. The organizational structure was also changed: the research area is now organized according to customer application groups. Some strategic research themes were identified. Special development teams were established to take care of these themes since the mission is to perform science-based applied research, not to act as an engineering company among other engineering companies. The traditional competence area has been performance predictions. Based on interviews with customers, today's services are also specifically oriented at safety, environment and reliability problems.

RESEARCH DIVERS ASSIST WITH RIDGE MEASUREMENTS

Mikko Lensu and Jukka Tuhkuri
HUT Ship Laboratory

During the last week of March, the pilots of Marjaniemi Pilot Station could follow from their eagle's nest how their quiet ice panorama was invaded by odd troops. Tents were erected behind pressure ridges and pulverized ice glistened in the sun as trenches were cut with oversized chain saws. An arabesque net of snow scooter tracks was created between a number of outposts by crazy drivers in bright overalls. A group of divers, ready in black drysuits and with their yellow air tanks lying on the snow, waited to enter the zero degree water through a hole fringed by chunks cut from the 70 cm thick ice.

In all probability, the pilots only quickly commented, "here they are again", in other words, the ice researchers. From a pilot's viewpoint, the icescape may appear monotonous, but the people on the ice found it full of intriguing complexity. Finnish ice researchers consider the Bay of Bothnia as their big ice tank and nowhere else it is so conveniently accessible as at Marjaniemi, the westernmost point of Hailuoto island. The research station of Oulu University, occupying the renovated timber houses of the old pilot station, provides food and lodging. Thus, field campaigns can be conveniently arranged without excessive logistics. It has been a custom in the Ship Laboratory of the Helsinki University of Technology to arrange a one-week field trip to Hailuoto at the end of March when the maximum extent and thickness of ice cover are attained and the weather is not usually too harsh.

This year, however, the field campaign involved a much larger group than usual. It was realized in co-operation with the adult education center Innofocus, which arranges courses for research divers. The courses teach not only basic diving skills in different underwater environments but also measurement, sampling and documentation techniques. The 12 participants in the course, led by two experienced research divers, had already dived below level ice and now it was the time for an advanced phase, diving below ice ridges. Thus, the need to get experience from underwater measurement techniques happily met the ice researchers' interests. Ridges and ridged ice fields may look complicated from above, but from below, they are, using the usual ratio, nine times more interesting and more apt to reveal their secrets. Some short dives among ridges have been done before, but during the week, it was possible to use a large group of divers for several days to study one ridge. Thus, it was possible to obtain quantitative measurements and not just collect the usual video recordings. In addition to the Ship Laboratory, the diver group also helped scientists from the University of Oulu, Helsinki University, and the Arctic Center at Rovaniemi in their work.

The interests of the Ship Laboratory were in the structure of the ridges. As suits the educational tenet of the campaign, the Ship Laboratory group included students who got experience on ice field research techniques. These got at times quite physical, beginning with the cutting of four 2x2 meter openings for the divers by the target ridge and removing the ice. Measurement sections were drawn over the ridge and marked underwater by plumb lines. As our group attacked the sections from above water, the divers, working in pairs, determined the keel profile using their depth gauges. Two corridors were cut through the ridge sail to reveal the block arrangement. After this came the main effort, the sectioning of the consolidated layer of the ridge keel. This procedure, only done before by the Ship Laboratory group, was started by cutting two 50 m long parallel slots 30 cm apart across the ridge and through the corridor, using a sledge-mounted chain saw with a 120 cm blade. The ice between the slots was then cut into 50 cm wide pieces that were lifted from the trench and arranged on the ice so that the consolidated layer cross-section with its block structure became visible. The arrangement of the blocks gives information about the formation process of the ridge. The new results confirmed the findings from previous fieldwork and the results of ridge formation tests made in the HUT ice tank. It appears that the ridging ice sheets are not constantly breaking into blocks during ridge formation, but that the process involves rafting of the parent ice into a multiple-layered horizontal structure in the upper part of the keel. Thus, the strength of the upper keel may be much larger than expected from a random block arrangement.

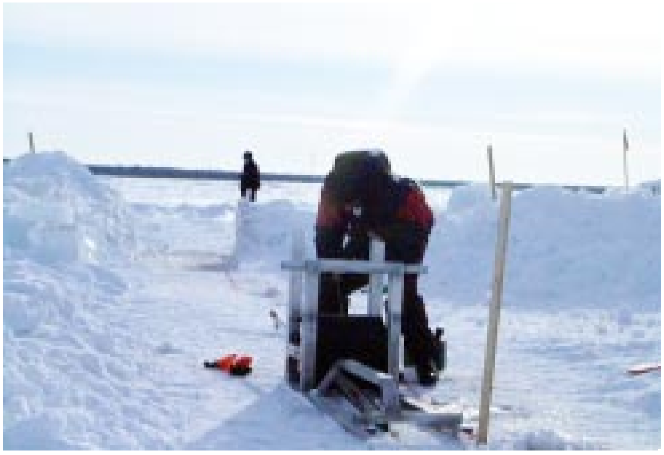


Figure 1. Cutting through the consolidated layer with a 120 cm chain saw.

Figure 2. The consolidated layer cross-section is being built on the ice. Behind, the divers get ready.

CORROSION TESTING FOR STEEL SANDWICH PANELS

Pentti Kujala
HUT Ship Laboratory

All-steel sandwich panels are up to 50% lighter than conventional steel-stiffened platings. The sandwich panel typically consists of a core with thin cover sheets that can be built using different types of profiles; using, for instance, corrugated plates, hat profiles or tubes. Thus, one crucial design and maintenance topic for these structures is corrosion behaviour as the thin plates have small corrosion margins. This problem has been studied by HUT Ship Laboratory as part of a project (Application of coated and stainless steel on sandwich panels) funded by TEKES. The corrosion tests were conducted in the Sheet Metal Development Centre in Hämeenlinna. The test results were analysed in close co-operation with experts from Rautaruukki and Outokumpu Polarit (Sopanen et al., 2000).

The materials used for the steel sandwich panels were produced by Rautaruukki and Outokumpu Polarit in Finland. The core structures were corrugated cores produced by Rannila Steel and laser-welded by LaserPlus. The materials studied include uncoated, zinc-coated and painted specimens. A summary of the materials and surface treatments used is presented in the following tables:

Table 1.Uncoated specimens.

Specimen	Thickness [mm]	Material
FORM 300 CO	0.80	Rautaruukki RACOLD 240 HSF steel, covered with protective oil.
COR-TEN AO	1.0	Rautaruukki RACOLD COR-TEN A^R steel, covered with protective oil.
POLARIT 725	0.75	Outokumpu stainless steel POLARIT 725
POLARIT 757	0.75	Outokumpu stainless steel POLARIT 757
Closed structure FORM 300 HERM	0.80	Rautaruukki RACOLD 240 HSF steel, covered with protective oil.
Composite inside FORM 300 CO	0.80	Rautaruukki RACOLD 240 HSF steel, covered with protective oil. Filled by polyurethane composite.

Table 2. Zinc-coated specimens.

Specimen	Thickness [mm]	Material
RAGAL 250S+ 140MBC	0.70	Rautaruukki hot zinced steel RAGAL 250 S. Zinc content 140 g/m^2 (~10µm)
RAGAL 550 S+Z275MCC	0.55	Rautaruukki hot zinced steel RAGAL 550 S. Zinc content 275 g/m^2 (~20 µm)
Cast zinced	0.80	Rautaruukki RAGOLD 240 HSF steel. Specimen cast zinced. Thickness of zinc cover about 70 µm.

Table 3. Painted specimens.

Specimen	Thickness [mm]	Material
FORM 300 CO, stove enamelled	0.80	Rautaruukki RACOLD 240 HSF steel. Stove enamelled, thickness of the paint cover about 125 µm.
COR-TEN AO, stove enamelled	1.0	Rautaruukki RACOLD COR-TEN A^R steel. Stove enamelled, thickness of the paint cover about 140 µm.
RAGAL 250S+Z140MBC, stove enamelled	0.70	Rautaruukki zinc-coated steel RAGAL 250 S. Zinc weight 140 g/m^2 (cover thickness~10µm). Stove enamelled, thickness of the paint cover about 140 µm.
RAGAL 550S+Z275MCC, Stove enamelled	0.55	Rautaruukki zinc-coated steel RAGAL 550 S. Zinc weight 250 g/m^2 (cover thickness~20µm), stove enamelled, thickness of the paint cover about 130 µm.
Closed structure FORM 300 HERM, surface painted	0.80	Rautaruukki RACOLD 240 HSF steel, surface painted by the Teknos "K27" treatment. Thickness of the paint cover about 240 µm.
Composite inside the panel FORM 300 CO, surface painted	0.80	Rautaruukki RACOLD 240 HSF steel. Polyurethane inside the panel, surface painted by the Teknos "K27" treatment. The thickness of the paint cover about 240 µm.
FORM 300 CO, Ship wet space paint	0.80	Rautaruukki RACOLD 240 HSFsteel. Painted by typical paint used in ship wet spaces (1 x Penguard HB/Primer NM + 1 x Jotamastic 87 paint). The thickness of the paint cover about 260 µm.
FORM 300 CO, Ship dry space paint	0.80	Rautaruukki RACOLD 240 HSFsteel. Painted by typical paint used in ship dry spaces (1x Akvanor 81 primer). The thickness of the paint cover about 60 µm.
RAGAL 250S+Z140MBC, Ship wet space paint	0.70	Rautaruukki zinc-coated steel RAGAL 250 S. Zinc amount 140 g/m^2. Painted by typical paint used in ship wet spaces (1 x Penguard HB/Primer NM + 1 x Jotamastic 87 paint). The thickness of the paint cover about 260 µm.
RAGAL 250S+140ZMBC, Ship dry space paint	0.70	Rautaruukki zinc-coated steel RAGAL 250 S. Zinc amount 140 g/m^2. Painted by typical paint used in ship dry spaces (1x Akvanor 81 primer). The thickness of the paint cover about 60 µm.
RAGAL 550S+Z275MCC Ship wet space paint	0.55	Rautaruukki zinc-coated steel RAGAL 550 S. Zinc amount 275 g/m^2. Painted by typical paint used in ship wet spaces (1 x Penguard HB/Primer NM + 1 x Jotamastic 87 paint). The thickness of the paint cover about 260 µm.

TEST ARRANGEMENTS

Two types of tests were conducted for the specimens: 1) continuous salt spray tests (ASTM B117) and 2) modified salt spray tests (modified SFS 3707 standard). The tests were conducted using the corrosion test box shown in Fig. 1.

The size of the specimens was 60mm*300 mm. In the continuous salt spray tests, the specimens were sprayed with 5 % sodium chloride (NaCl) liquid at 35°C. The total test time was 500 hours.

In the modified salt spray tests, the following cycles were used for the salt spray:

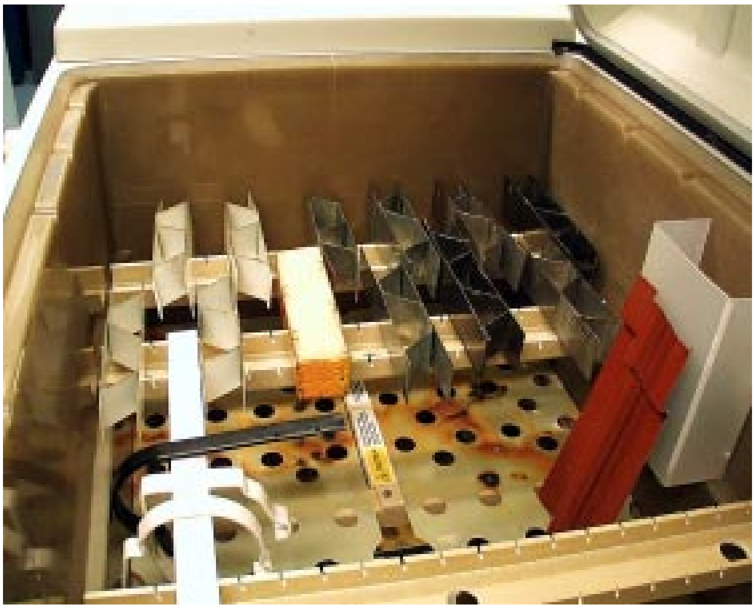


Fig. 1. Cyclic corrosion test box Q-Fog, model CCT and the test specimens inside the box.

Fig. 2. An example of an uncoated specimen after corrosion testing.

Cycle	Time	Temperature	Liquid
Spraying	5 min	+35°C	5 % NaCl
No spray	55 min	+35°C	

The total time for testing was 500 hours.

SUMMARY OF THE TEST RESULTS

The test specimens were evaluated by visual examination. The amount of corrosion on the surfaces, welds and cut edges was separately studied. In addition, the specimens were broken after the test to see the corrosion inside the panel and especially the corrosion between the core and cover plates (crevice corrosion).

The pure uncoated steel corroded very fast with clear red-coloured corrosions on the surface after 24 hours of testing (Fig. 2). All the painted specimens survived the corrosion tests well (Fig. 3), in particular, the stove enamelled specimens. The pure zinc-coated panels corroded very fast with white-coloured corrosion appearing on the surfaces. The red-coloured corrosion was first seen on the welds, except for the cast-zinced specimen, as it was zinc-coated after being welded. Due to corrosion, the zinc-coated surface was broken about 7-13 days after starting the tests. The specimens with zinc and a paint coat survived the corrosion tests well even though crevice corrosion can be critical, especially when the paint layer is thin.

Fig. 3. An example of the specimen, after the corrosion tests, painted with typical paint used in ship wet spaces.

The panels made from stainless steel also survived the corrosive environment well. The welds can, however, be critical for stainless steel specimens if the welds are not treated after being welded. The stainless steel specimen showed no visual crevice corrosion between the core and cover plates (Fig. 4), even though this is the most critical area for corrosion on the sandwich panels. For painted specimens, crevice corrosion could be prevented if the paint coat thickness is thick enough, as was the case with the typical paints used in ship dry and wet spaces.

In addition, the closed structures and the structures that had composite inside survived the corrosion tests fairly well, even though some corrosion effects could be seen inside these panels near the edges (Fig. 5).

REFERENCES

Sopanen, A, Talonen, J. and Kujala, P., 2000. Corrosion tests for steel sandwich panels. Helsinki University of Technology, Ship Laboratory. Research report M-252. Espoo. 43 p. (In Finnish).

Fig. 4. An example of the specimen with stainless steel showing no visual corrosion even in the surface between cover and core plate (crevice corrosion).

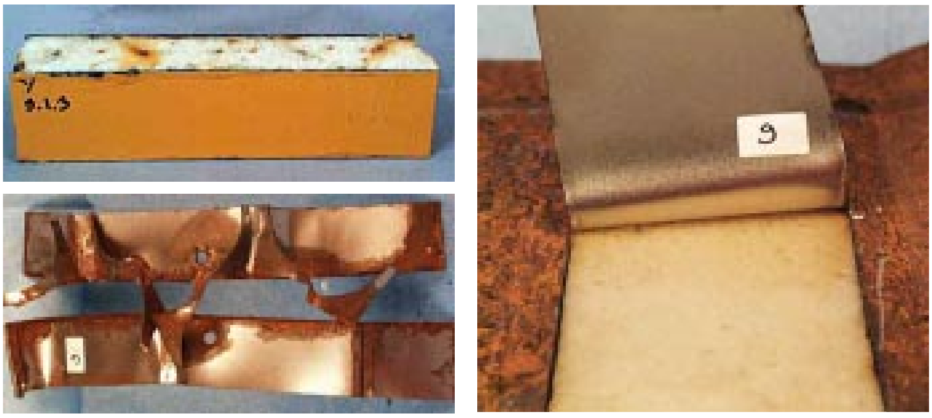


Fig. 5. The effect of PU foam on corrosion behaviour. The PU foam prevented corrosion except in the area near the specimen's edges.

SIMULATION OF SHIP MANOEUVRING IN WAVES

Jerzy Matusiak
HUT Ship Laboratory

Linear models of ship dynamics in waves are well established. In most cases they result in a sufficiently accurate prediction of loads and ship motions. Perhaps the biggest benefit of using the linear models is that the prediction of exceeding a certain level of load or response can be easily derived.

The biggest shortcoming of the linearity assumption is that it precludes prediction of certain classes of ship responses. The linear models can not predict the loss of ship stability in waves, parametric roll resonance and asymmetry of sagging and hogging.

The recently developed method[1] of evaluating non-linear ship motions in waves tackles these problems. The method does not make a distinction between seakeeping and maneouvring. In the method, the restoring forces and the Froude-Krylov part of the wave forces are represented by the fully non-linear model while radiation and diffraction forces are regarded to be sufficiently well represented by the linear approximation. Ship dynamic behavior is represented by rigid body dynamics having six degrees of freedom. There are no restrictions set on the motion's magnitude.

The special feature of the developed method is a two-stage evaluation of the non-linear responses. At the first stage a linear approximation is obtained using linear strip theory. At the second stage a perturbed, non-linear part of the response is solved in the time domain using a three-dimensional panel representation of ship hull. As a result, the total response of the ship in terms of three displacements in the inertial co-ordinate system fixed with Earth and Euler angles is obtained. The effects of added long wave resistance, propulsor action and rudder forces are included in the method.

The result of containership roll motion in long crested regular waves and travelled path during the turning circle manouvre is shown in Figure 1. An unsymmetry of the turning circle due to the 2nd order wave forces is clearly seen in the simulated result. High amplitude roll motion develops in the quartering and following waves. Low frequency roll motion with large amplitudes is also visible in Figure 2, where the results of simulated angular motions of the same ship operating in the quartering seas are presented.

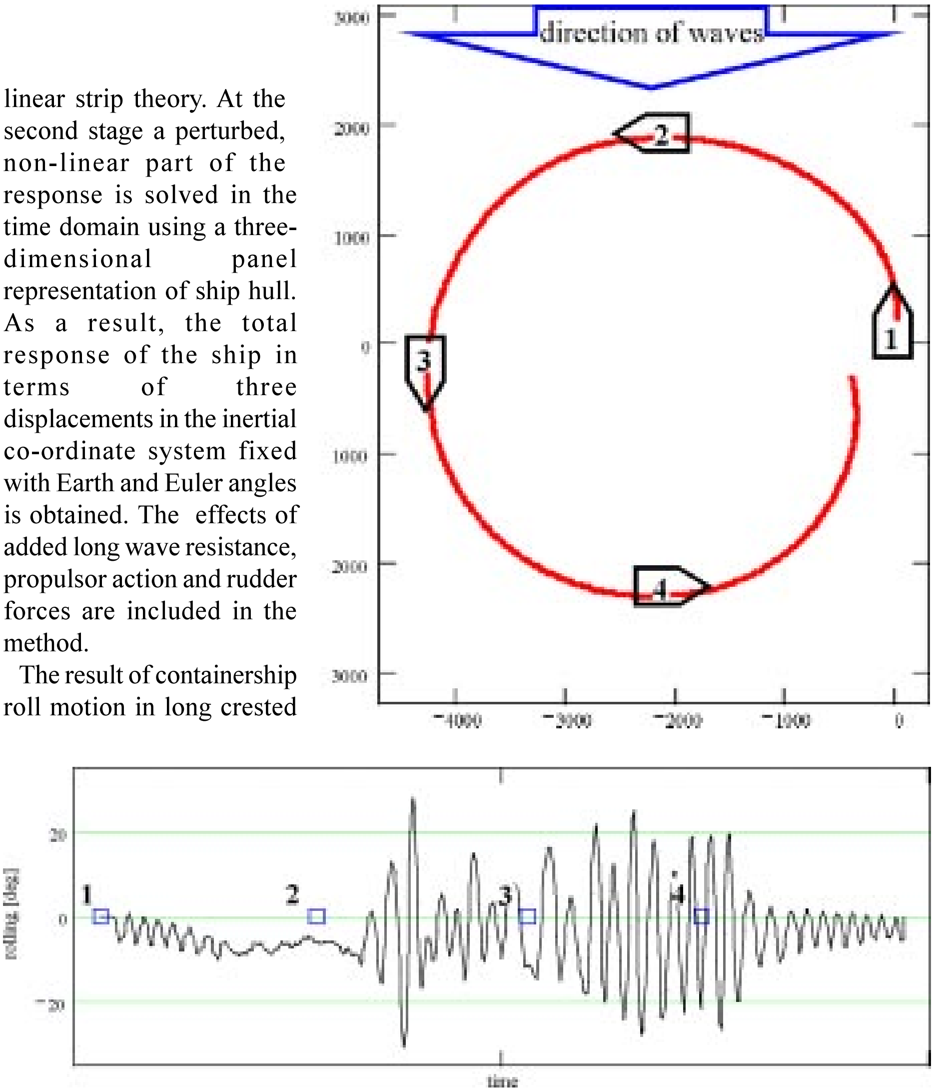


Figure 1. Ship roll motion in long crested regular during the turning circle manouvre. Ship length is L_{pp}=150 m. Regular wave of a length l=225 m and amplitude 2 m. Ship's metacentric height is GM_0= 0.15 m.

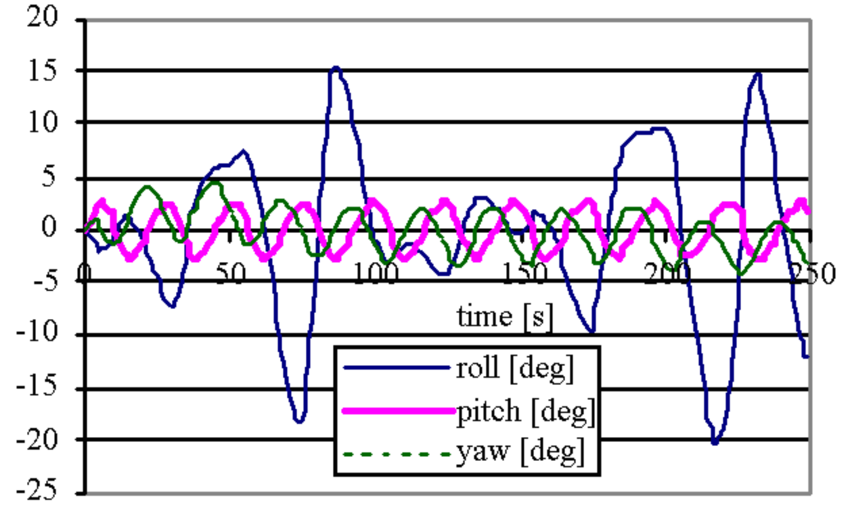


Figure 2. Simulated angular motions of containership. Fn=0.3, Heading m=30^0. Regular wave of a length l=1.5 L_{pp} and amplitude a_w= 3[m].

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[1] Matusiak, J. Two-Stage Approach to Determination of Non-Linear Motions of Ship in Waves, 4th Osaka Collouqium on Seakeeping Performance of Ships, 17-21 October 2000, Osaka, Japan.

VISUALISATION OF SIMULATIONS OF SHIP MOTIONS IN WAVES - ANIMATIONS & REAL-TIME

Pertti Broas
VTT Manufacturing Technology

In ship dynamics research, ship motions are visualised to illustrate numerical calculations of motions, particularly in critical situations. Ship handling simulator visual systems also need to visualise ship motions in waves. Modern full-mission simulators provide a realistic visual scenario that can replicate movements of both one's own ship and nearby target ships in six degrees of freedom (6DOF). In addition, new PC-based partial task simulators may have visual systems capable of visualising 6DOF motions.

Further needs for motion visualisation are created by virtual reality simulations, e.g. when simulating the actions of crew or equipment on board. Simulation Based Design (SBD) and Virtual Prototyping (VP) benefit from these kinds of simulations by using a virtual prototype in a virtual environment, where on-board operations can be tested and evaluated at an early design phase.

VTT has been developing its modular ship handling simulator system for several years. A virtual reality-based (VR) visual system programmed in C++ presented new opportunities to develop more features for the ship simulation model in the networked PC environment. This led to a project where real-time 6DOF simulation and visualisation has been developed.

At the same time, HUT Ship Laboratory has been researching new methods of calculating 6DOF ship motions (cf. J. Matusiak's article in this magazine). This work also needed suitable visualisation tools to illustrate ship movements. The calculations are used to study large amplitude motions in waves that may lead to a ship capsizing. VTT is coordinating a national VR project for ship design where, together with HUT, visualisation and new calculation methods are developed.

Visualisations are coded in C++ using WorldToolKit ™ virtual reality library in MS Visual Studio. The calculation method writes the ship's position and orientation in time domain to a database file. This file is then read by the visualisation software, which sets the geometric model in the right position. The wave model is created in the visualisation application by using the same wave parameters as in the calculation. The waves are then synchronised with the ship motion using the rational wave height at midships. Because the visualisation is built upon the manoeuvring simulator visualisation software, all visual effects and functions are available; for example, the viewpoint can be freely moved or it can be locked to the ship.

The visualisation for the six degrees of freedom manoeuvring model of PC-based ship simulator basically uses the same software, although the application is connected to a simulator running on another PC.

The manoeuvring simulator for 6DOF simulation in regular and irregular waves is based on the normal 3DOF model to which roll, pitch and heave motion equations have been added. Wave extracting forces are calculated in time domain using non-linear 2-D strip-theory and non-linear effects in restoring and Froude-Krylov forces, the diffraction forces are linear. Damping and added mass coefficients are calculated beforehand for specific frequencies.

This application can be used in research on broaching, slamming and sudden loss of stability, although some enhancements are necessary for it to be satisfactory for training use. The simulation is quite close to real-time behaviour, but the interval is too long for visualisation and a suitable dead reckoning method is needed.

Fig. 2. Visualisation in 6DOF manoeuvring simulator, the waves (without textures) are seen as parallel stripes. The viewpoint is here locked to "bird's eye view".

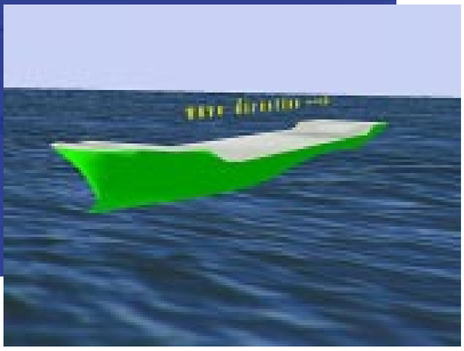

Fig. 1a. Visualisation of calculated ship motions in waves. Headwind (waves from bow), wave direction is shown using 3-D text object above the ship.

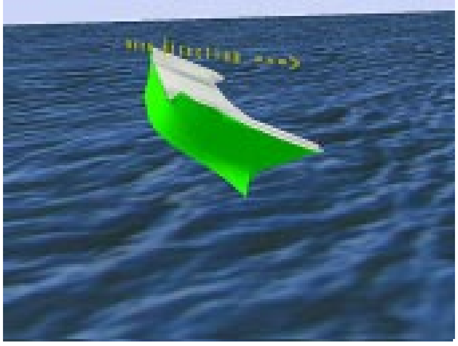

Fig. 1b. Visualisation of calculated ship motions in waves. Oblique stern waves, maximum roll angle. Wave direction is shown using 3-D text object above the ship.

ON-BOARD TREATMENT OF BALLAST WATER

Jorma Rytkönen
VTT Manufacturing Technology

There is a growing concern about the damage to aquatic ecosystems caused by the immigration of non-indigenous species. It is estimated that more than 10,000 million tons of ballast water is annually transported by shipping activities, and ballast water has been recognized as a major vector for the transplant of aquatic species across bio-geographical boundaries.

A new research project to develop on-board facilities for the ballast water treatment has been launched by the European Union. The main options for on-board facilities will be tested in laboratory scale followed by the full-scale testing in real environmental conditions. VTT's role in this three-year long EU-scale work is to test certain treatment options and to take care of Baltic Sea development together with the Åbo Akademi. This article is a brief introduction to the subject.

The high number of species carried in ballast water is an additional indicator for the need for ballast water management. Several studies have showed that more than 50 000 zooplankton specimens may be found in one m^3 of ballast water. A single ship may carry anywhere from tens of thousands to millions of organisms.

This large amount of non-indigenous species creates a potential risk for the environment. Mussels, polyps and other bivalves may block the water in-take systems of factories and power plants. The European zebra mussel (*Dreissena polymorpha*), for example, was transferred to the Great Lakes in North America via ballast water. The remedial measures to prevent the blockage of pipelines and other submerged installations has incurred costs in the over on billions USD a year.

The American comb jelly (*Mnemiopsis leidyi*), which was introduced to the Black Sea via ballast water, has had a devastating effect on the local anchovy fishery because it eats the food supply of the anchovy. Likewise, many UK oyster fisheries have been adversely affected by competition from the slipper limpet and predation by the oyster drill, both introduced from the US. There are also a lot of examples of alien seaweeds spreading via ballast and replacing native seagrasses thus limiting the habitats for larval fish and invertebrates.

One of the most obvious reasons for the "immigration development" of these organisms is increased maritime activity and modern ships. Indeed, during the last 30 - 40 years, the amount of these organisms has been increased dramatically (Fig. 2).

Due to the fact that ships are faster and bigger than before, the following facts increase the risk of invasion by unwanted organisms:

- the organisms will not die during the short voyage,
- larger ships equal a larger amount of ballast water,
- ship's calls have been increased a lot,
- new terminals and ports - new risk for pristine areas,
- new commercial routes and political changes since the world war II ,
- water quality improvements in ports.

There are currently three recognized types of ballast water exchange methods - the empty-refilling option, flow through and dilution method. Regardless of the method used, ballast water exchange is not likely to be 100% effective. It is difficult to achieve a total exchange of all the ballast water in a tank, and in addition, some organisms may cling to the sides or hide in the bottom sediment thus avoiding being flushed out. Despite these limitations, ballast water exchange is considered a sufficient measure if the process can be practiced effectively. The exchange of the ballast, however, cannot be done in situations such as bad weather conditions, where there is a risk to the ship's stability and structural strength. It has also been pointed out that existing ships are not designed for ballast water exchange.

The ballast water exchange is also costly for ship operators. Depending on the type of ship and ballast capacity, one ballast-deballast may cost anywhere from a few thousand to tens of thousands of US dollars. The new on-board treatment facilities under development are not cheap

Figure 1. The development of an on-board ballast water treatment facility for a tanker is a challenging task due to the large amount of ballast water.

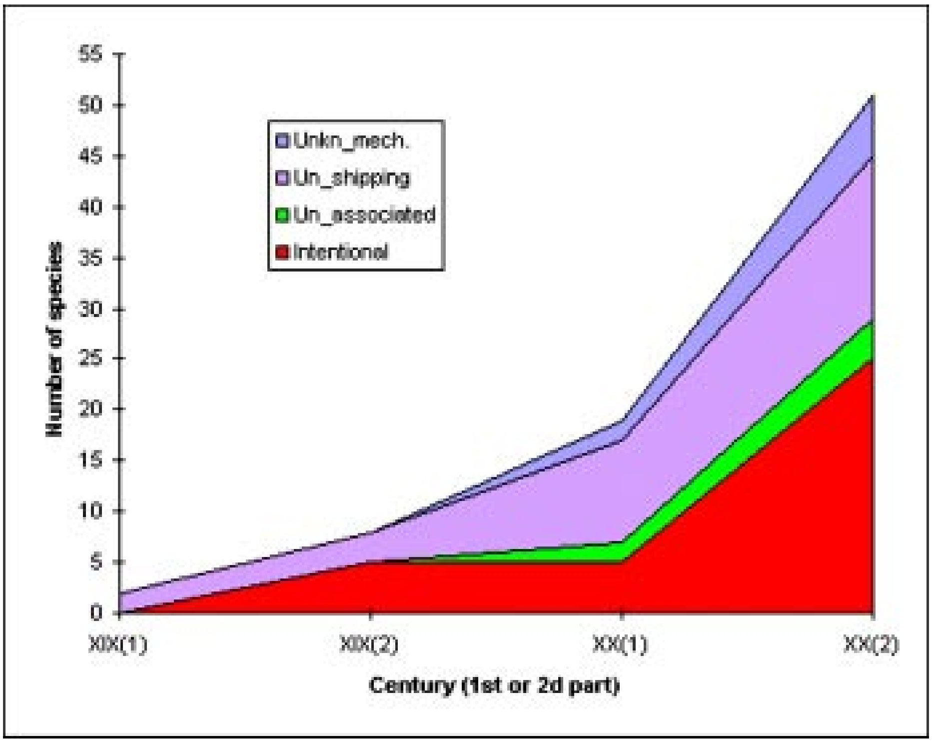

Figure 2. The non-indigenous species introduced to the Baltic. Unkn_mech = unknown distribution; Un.shipping = via shipping; Un.associated = spread accidentally with planted fish or oysters; Intentional = planted on purpose (Leppäkoski & Olenin, 2000. Non-native species and rates of spread: lessons from the brackish Baltic Sea. Biological Invasions 2:151-163).

Figure 3. Sampling is an important tool to monitor changes in the environment.

either: a system for 200 t/h costs approximately 120 000 - 140 000 US dollars, a tanker version ten times more.

Due to the aforementioned reasons, the R&D work to minimize the impact of unwanted organisms has been intense worldwide. The leading countries have been Australia, New Zealand, USA and Canada, where also the acts to prevent the problems caused by exchange of ballast water in side territorial waters have been reduced or totally denied (Australia).

The International Maritime Organisation (IMO) has, since the Rio de Janeiro Convention in 1992, started strengthening the development of on-board ballast water treatment technology. The current tools are recommendation, for example, the IMO resolution A.868(20), and the development of international legislative actions in the IMO's Marine Environmental Protection Committee (MEPS). In addition, IMO has, together with the UN's UNDP, started a demonstrative pilot project in six locations of the world in 2000.

Safety concerns and the high cost make ship operators reluctant to adopt ballast water exchange as the standard system, and there is considerable interest in alternative treatments. Alternatives to ballast water exchange should not only favor operation of the ship, but also be effective in removing non-indigenous species as well as be environmentally friendly.

Figure 4. These mussels came from America to Europa first time probably by Vikings. To the Black Sea, however, they immigrated by the maritime traffic in 1960's.

10TH ANNIVERSARY MEETING WAS HELD 28.03.2001

A total of 624 naval architects have obtained their master's degree at the Helsinki University of Technology by the end of 2000. A reunion was scheduled in Otaniemi for these naval architects when six decades had elapsed since the first naval architecture professor, **Dr. Jaakko Rahola**, took the chair in 1941. This reunion also links other significant events: three decades since the completion of the Ship Technology building, 25 years since the founding of the VTT Ship Laboratory and 10 years since the Finnish Maritime Institute was organized.

Jaakko Rahola created an international reputation with his research on ship stability during the 1930's. His criteria for stability are universally applied. During fifteen years, he raised and inspired the naval architect generation whose first challenge was the major responsibility of the war replenishment ship production from 1947 to 1953. Rahola also possessed great administrative skills, which were utilized when he became HUT headmaster in 1955 and the under-secretary of Ministry for Commerce and Industry in 1965. Rahola died in 1973.

This meeting was not, however, organized to commemorate the past. Active members of the Finnish shipping and shipbuilding organizations were also invited to the seminar where the connection between research and competitive maritime industry was the key issue.

In his opening presentation, **Martin Saarikangas** described the growth of Finnish shipyards over the years. After the peace treatment in 1944, Finland was obliged to deliver a wide assortment of advanced ships to Soviet Union as war replenishment. This forced the rather modest shipyards to rapidly expand their design and production capacity. The receiving Soviet organizations were extremely strict in the items of ship performance, quality and delivery dates.

Saarikangas pointed out that, after having completed this heavy burden, the Finnish shipbuilding industry gradually grew to be universally competitive. Contracts were signed with Western owners. Numerous examples can be given on prototype ships whose size, performance and design excelled in comparison with concurrent standards. Since labor costs were higher and subsidies missing or lower than in other shipbuilding nations, innovations and increased productivity were needed for compensation.

Jouni Arjava, engineer-in-chief of the Finnish Coast Guard (retired) described the early years of university education. The number of master level naval architect graduates grew to the present level already in the 1960's. Doctoral thesis production has grown at a slower pace. Here, the major discipline has been ice research. Since the 1980's, basic scientific research has also been systematically executed in other fields to strengthen the applied research and development in industry.

Pekka Lopmeri, Captain (Navy Eng.), Finnish Navy, demonstrated the complex requirements of modern naval vessels. Among the recent trends, he mentioned the increase of ship design speed and the requirement of a low signature level. Higher speeds pinpoint weight reduction. Replacing steel with non-ferrous metals and composite structures requires a new approach in corrosion, fatigue, fire resistance and manufacturing. Naval ship structures are given operational lifetime predictions similar to those in aircraft.

Pekka Lopmeri, Captain (Navy Eng.), Finnish Navy H.Q.

Jukka Laiterä, Managing director, Deltamarin Ltd.

Christian Landtman, former president of Wärtsilä Shipbuilding group.

Low signature levels in acoustic, vibration, thermal and magnetic excitation is a specific feature in naval ship development. Combining these requirements with increased ship speed sets new challenges for the research and development.

The managing director of Deltamarin Ltd, **Jukka Laiterä,** presented the new role of consultant offices. The leading offices have moved a long way from shipyard supportive drafting bureaus and frequently hold a central position in large new building projects. The increased rate of outsourcing and the number of involved parties have promoted this change. Consultants are often hired by the owner at an early state in the new building project. Many of the tasks begin with the search for adequate conceptual designs.

Both Pekka Lopmeri and Jukka Laiterä emphasized the benefits of product model where the entire ship is defined in 3D CAD format. All parties involved may have access to this constantly updated database. Design phase outsourcing would not even be possible without such models, which include essentially related information that is utilized for such things as material handling or advanced simulation processes. As the models are large, the demands on computer capacity are high. In fact, information technology is incorporated in shipbuilding much more than generally acknowledged.

In the afternoon, the seminar was continued by greetings from the top management of HUT and VTT. The creation of the Finnish Maritime Institute was recalled. In 1990, drastic changes in shipyards were jeopardizing the future of R&D in Finland. Members of industrial administration are renowned for their actions, which secured the continuation.

Petri Varsta, who was professor at the time, and research manager **Harri Soininen** explained the strategy and mission of both organizations, HUT and VTT Ship laboratories. The concluding presentation by professor **Kaj Riska** described the *alumni* project. Senior graduates are invited to renew their contacts with their *alma mater*. A regular dialogue would both foster university teaching and encourage individual students.

The seminar finished off with an exhibition and vivid discussion over refreshments. Due to constant research and professional cooperation, the Finnish shipping circles have a family atmosphere.

The evening culminated with a festive dinner, a reunion of naval architect graduates from seven decades. The dinner speech was given by **Christian Landtman**, president of Wärtsilä Shipbuilding Group (1970-1984). He commemorated the pioneering years of the 1940's and 1950's. He expressed his satisfaction with this type of event being organized for the first time, which was also the opinion of everyone present. He also gave, in his personal manner, advice to the present shipyard management. These detailed instructions garnered loud applause and promoted lively discussion.

Prof. Pentti Häkkinen
HUT Ship Laboratory

Jouni Arjava, chief Naval Architect (retired), Finnish Coast Guard.

Martin Saarikangas, former CEO, Kvaerner Masa-Yards Ltd.

RECENT PUBLICATIONS

LABORATORY REPORTS

Holopainen, T. et al. Mekatronisten järjestelmien mallinnus ja simulointi tuotekehityksen ja kunnonvalvonnan tarpeisiin (in Finnish). Loppuraportti MASI-hankkeesta. Tutkimusselostus BVAL 35-011096. VTT Valmistustekniikka, Espoo. 45 p.

Kajaste-Rudnitski, J. & Kujala, P. Analysis of a grounding event of a ship with sandwich bottom structure. HUT Ship Laboratory. Report M-259. Espoo 2001.

Klinge, P.Osakappaleen dynaamisten ominaisuuksien tiivistäminen (in Finnish). VTT Valmistustekniikka, Technical Report BVAL : 35-001015, Espoo. 24 p.

Klinge, Paul; Hynninen, Antti. Material model for stator a packet. 2000, TEKES SMART/MASI techology program. Espoo, VTT Manufactruring Technology, 2000. 5 p. BVAL; 35-001082.

Lax, R. Karille ajavan aluksen liiketilan simulointi (in Finnish). HUT Ship Laboratory. Report M-260. 129 p + app. Espoo, 2001.

Leiviskä, T., Kennedy, R., Tuhkuri, J., Herrington, P., Aspelund, A., Riska, K. Model tests on resistance in ice-free ice channels. Report M-255 of the Hut Ship Laboratory, Otaniemi: 2000. 27 p.

Mikkola, T. Implementation of an implicit scheme into a free surface rans solver in order to improve the convergence. Report M-257 of the HUT Ship Laboratory, Otaniemi. 80 p.

Riipi, T. & Rytkönen, J. Merenpohjan liettymisen vähentäminen ruoppaus- ja läjitystoiminnassa, ja silakan kutualueiden saneerauksen mahdollisuudet Turun Airistolla (in Finnish). Tutkimusselostus BVAL 34-011094. VTT Valmistustekniikka, Espoo, 2001. 63 p.

Rytkönen, J., Laasonen, J. Nyman, T. & Rekonen, T. Possibilities for all-year navigation in Saimaa Canal and in the planned Kymijoki and Mäntyharju Canals. VTT Manufacturing Technology. Research Report BVAL-34-001005. Espoo, 22.05.2000. 24 p + 4 app.

Rytkönen, J. Suomenlahden meriliikenne ja satamatoiminta nyt ja tulevaisuudessa (in Finnish). Espoo, VTT Valmistustekniikka, 2000. 92 p. + app. 14 p. BVAL; 400.

Rytkönen, J., Sassi, J. & Koskivaara, R. Laivojen aiheuttama aalto- ja virtaushäiriö rannassa. Aalto- ja virtausmittaukset Airistolla 02.-05.05.2000 (in Finnish). Tutkimusselostus BVAL 34-001016. VTT Valmistustekniikka, Espoo, 2001. 40 p. + app 51 p.

Schweighofer, J. Computations of two-dimensional transom waves using inviscid and viscous free-surface boundary conditions. HUT Ship Laboratory. Report M-258. Espoo, 2001.

CONFERENCE PAPERS

Bäckström, M. & Marquis, G. Evaluation of interaction equations for multiaxial loaded welded structures. 6th International Conference on Biaxial/Multiaxial Fatigue and Fracture. Lisboa, PT, 25 - 28 June 2001. ESIS - European Structural Integrity Society. Lisboa (2001), 8 p.

Holopainen, T. (ed.). Modelling and simulation of multitechnological machine systems. VTT Symposium : 209, Espoo, 30.11.2000. 175 p. ISBN 951-38-5712-3; 951-38-5713-1.

Kajaste-Rudnitski, J. & Kujala, P. Ultimate local Strength analysis of steel sandwich panels filled with composite. Sandwich Construction 5, Sept. 5-5, Zürich. Zürich 2000, EHTS, Swiss Federal Institute if Technology, pp. 469-481, Vol. II.

Lehtonen, M. (ed.). Virtual prototyping - VTT Research Programme 1998-2000. VTT Manufacturing Technology, Espoo. 81 p. VTT Symposium : 210. ISBN 951-38-5710-7; 951-38-5711-5.

Marquis, G. & Murakami, Y. Scatter in the fatigue limit of nodular iron. Materials Science for the 21st Century - JSMS 50th Anniversary Conference. Osaka, JP, 21 - 26 May 2001 (2001), 5 p.

Marquis, G. & Karjalainen-Roikonen, P. Long-life multiaxial fatique of SG cast iron. 6th International Conference on Biaxial/Multiaxial Fatigue and Fracture. Lisboa, PT, 25 - 29 June 2001. European Structural Integrity Society - ESIS. Lisboa (2001), 8 p.

Mikkola, T. et al. Offshore HVL sea-transport safety by direct strength and Fatigue assessment. 20th International Conference on Offshore Mechanics and Arctic Engineering. OMAE 2001. Safety and Reliability Symposium. Rio de Janeiro, RJ Brazil, 3 - 8 June 2001.

Rytkönen, J. Veneiden talvisäilytys vedessä (in Finnish). Helsingin venemessut / venesatamaseminaari. Helsinki, 14.2.2001. Venesatamaryhmä / Suomen veneilyliitto. Helsinki (2001), 6 p.

Rytkönen, J., Liikenneruuhka Suomenlahdella. Seminaari Itämeren öljyonnettomuuden riskeistä ja Suomen roolista riskien vähentäjänä. WWF, Sas Royal Radisson Hotel, 24.04.2001.

Tuhkuri, J. Failure of the edge of an ice sheet against a vertical structure. The 15th International Ice Symposium, IAHR ’00, Gdansk, Poland, 28.8. - 1.9.2000. Gdansk 2000, Institute of Hydroengineering, Polish Akademy of Sciences, Gdansk, Poland, p. 173-179.

Vilpas, M., Kujala, P., Salminen, A., Alenius, M & Kyröläinen, A. Development of Laser Welded Stainless Steel Sandwich Panels for Lightweight Vehicles - Design Manufacturing and Properties.
ICALEO-2000, Detroit, MI, October 1st - 5th, 2000. P. C156-165.

OTHER PUBLICATIONS

Airila, M.et al. Smart machines and systems. Recent advances in mechatronics in Finland. Helsinki University of Technology, Department of Mechanical Engineering, Machine Design, Espoo. 458 s.
Helsinki University of Technology Publications in Machine Design : 1/2001. ISBN 951-22-5312-7.

Holm, G. Tehokkaat rakenteet monimateriaalitekniikalla (in Finnish). Finnboat News. (2000) 3.P. 12.

Holm, G. Huvivenedirektiivin päästölisäys - vihdoinkin jäsenmaiden käsittelyyn (in Finnish). Finnboat News. (2000) 4. P. 12.

Matusiak, J. Laivateorian perusteet - Potkuri. In: Räisänen, P., Laivatekniikka, Modernin laivanrakennuksen käsikirja. (toinen korjattu painos). Jyväskylä 2000, Turun ammattikoulu, s.
8.1-8.21.

Rytkönen, J. & Happonen, K. Wind limits definitions. Cruise liner Voyager of the Seas in Caribbean ports and approaching fairways. Navigator Yearbook 2001, Maritime Finland (2001), P. 44 - 45

Rytkönen, J. Mereen joutuneen öljypäästön torjunnasta talvella (in Finnish). Tekniikka ja kunta,vol. 25 (2001) No: 2, p. 74 - 76.

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