ICSOT INDIA 2011:
Technological Innovations in Shipbuilding
8 – 9 December 2011, Kharagpur, India

The second International Conference in Ship & Offshore Technology - India, will have Technological Innovations in Shipbuilding as its theme and will bring together members of the international maritime industry and academia to discuss the newest trends in ship design and construction process which will provide the improvements in productivity and cost competitiveness necessary to respond to the demand for lower cost of ownership. The papers to be presented in the conference include:

"Hull Integration and Reliability Studies of Topside Modules on Ship Shaped Offshore Floating Structures."

Kumar D. Roy University Marine International - Singapore, Dr A.K. Dev and Dr S.Aksu, Newcastle University Marine International-Singapore

The paper is aimed to study the main technical parameters related to hull integration of topside modules and to formulate a mathematical framework for reliability study for a typical connection. This study is carried out on available industry guidelines, technical notes as well as actual projects for identification of technical nature and importance of the keyword parameters. The study begins with investigation of governing technical parameters for heavy lifting followed by installation phase and hull integration covering necessary structural modifications on deck for the stated purpose. Major areas of this study are interrelation of weight control, heavy lifting and rigging consideration, local FEM analysis of lifting points and members, installation tolerance and design of fine guides along with operational considerations.

"Side Launching of Catamarans in Restricted Space"

Hardika Dayalani, Corporated Shipyard Pvt. Ltd, India

Space constraints force small time shipbuilders to take some unsavoury decisions. These constraints, along with lack of high end infrastructure, challenge the naval architect to take risky and unconventional decisions. At our yard, we were building a 50 passenger catamaran. As space along the riverfront was limited, we built the vessel alongside a ditch of length 35m and width 20m. For launching the vessel, we chose to close the ditch with an earthen dam, and side launch the catamaran. The feasibility of such a proposition was questionable, but we did sound mathematical analysis to support our decision. The most important challenge was to limit the travel and ensure that the vessel does not hit the other side of the ditch. The following paper elucidates the preparations and measures that went into the enterprise.

"Techniques to Improve the Interface between Design & Production in Shipbuilding"

Joshin John, Dr. Sushil Kumar. Indian Institute of Management Lucknow, India
Toby Thomas, University of Strathclyde & Glasgow, UK
Bhagyaraj C. Wilson, Larsen & Toubro Limited, Chennai, India

Significant changes in the shipbuilding industry led shipyards to constantly innovate in order to deliver quality vessels faster & cheaper and yet remain competitive. However, the data passed on from the design office to the production department through 2D drawings, often fails to capture the big picture leading to information loss - ultimately leading to rework, cost overruns and delivery delays. This paper discusses of some techniques such as: Providing 3D environment to production personnel; Concurrent Engineering; Incorporation of design clearance inspection by design personnel to minimize errors right at the onset; Direct channel of communication using tablet device between design & production teams; Proper integration of databases of design office, production department, subcontractors and vendors of various disciplines; Online document transfer scheduler and storage system connecting Design Office, Production Department, Class, Owner, Vendors etc. to enable time-based trigger of deliverables by concerned party.

"Technological Innovations & Best Practices in Shipbuilding: Competitively Positioning Indian Shipyards in the Global Context"

Vijaya Dixit, Joshin John, Dr. Rajiv K. Srivastava, Indian Institute of Management, Lucknow, India

Over recent years, productivity and market share comparison of Indian and foreign yards have been done by many authors. But the scope was restricted to productivity figures and broad strategic level factors. In this work, we dig deeper into the operational aspects by visiting and observing the shop floor operational practices and principles followed at leading shipyards in India and East Asia. This paper identifies the technological innovations and best practices followed across these shipyards in various aspects including design, product mix, modular construction, planning & scheduling, supply chain management etc. The paper concludes with suggestions to competitively position Indian Shipbuilding industry in the global context.

"Knowledge Management In Submarine And Ship Building"

Naveen Badrinarayan, Indian Navy, India

India is poised to transit from a buyer's Navy to a Builder's navy. Ship building and submarine construction projects are lined up in the next decades. Every organisation is facing the daunting problem of losing their skilled manpower due to competition, retirement, and other reasons. As submarine design and construction, is a niche and complex activity, the problem is more emphasised. Therefore, a prudent step would be to harness technology to ensure that a system of capturing and brokering knowledge is institutionalised across various organisations related to design and construction. This would ensure a system of continuous learning and archival system that ensures continuity in the system and a better quality end product. The paper discusses various applications of the Knowledge Management Systems for project management, training etc.

"Design and Concurrent Manufacturing using Digital Solutions in Shipbuilding Industry"

Bharath Krishnan, Mohit Ekbote, Marine Design Centre, India

The conventional ship building approach followed in India severely delays the commissioning and delivery of the ship. Construction of scaled or prototype physical models is cumbersome, expensive, exhaustive and inadequate to simulate essential complicated details. Design and detailing carried out using 3D mockup and virtual reality simulations in iterative process, will enhance productivity by reducing time required to manage the continual changes in the build sequence, availability of material while the construction is in full swing. Entire production planning and assembly sequence can be captured in virtual environment incorporating yard's existing infrastructure capabilities. This paper explores the use of Digital Solutions which can be employed in the Ship Building Industry for the Design, Execution and the Intermediate domains.

"Measuring Effectiveness Of Technology Employed In Shipbuilding Industry Using Data Envelopment Analysis (Dea) Technique"

S Navaneetha Krishnan, Submarine Overseeing Team, MDL, Indian Navy, India

Introduction of advanced technology helps in improving the infrastructure of a shipyard, which accelerate the rate at which a ship is manufactured. However, "high technology infrastructure" increases the overhead cost for a shipyard as well as reduces the "labour" cost required to manufacture a ship. Therefore, to keep the overall cost of the ship low, an optimum combination of "high technology infrastructure" and "labour" is to be used. To identify this optimum combination of labour and infrastructure, this paper proposes to use a mathematical technique known as Data Envelopment Analysis (DEA). DEA technique will be used to calculate the "relative technical efficiency" of several shipbuilding projects, which will establish the optimum combination of labour and infrastructure.

"A component-based software framework for the information management of PLM for shipbuilding industries"

, Bo Kim and Tae-wan Kim, Seoul National University, Republic of Korea, M. Sharma, Indian Institute of Technology Guwahati R.Sharma, Indian Institute of Technology Madras, India

In this paper, we present a component-based software framework that can facilitate the development of the information management of PLM for shipbuilding industries. This software framework is based upon 'structured data' and 'open source code', and it can accommodate the management of lifecycle information at all stages, especially data that occur in design task distribution, production task distribution, usage, maintenance and end-of-life stages, and use them to provide logical bases of information and knowledge.

“Parametric Approach For Design And Analysis Of Planing Craft”

Albert Nazarov, Managing Director, ‘Albatross Marine Design Co., Ltd, Thailand

Parametric approach is presented for planing powerboats covering special, pleasure and small commercial craft with hull length below 30m. Disused is combined analysis of hull dimensions and volumes, weight estimates, performance and range predictions, seakeeping check. Dimensions of hull are defined form requirements of usable areas and essential volumes. Equations are proposed for components and weight groups based on available statistics. Approaches for preliminary estimate of powering, range and fuel efficiency are provided. Samples of application of method are presented for analysis of different craft.

“Study on Resistance Parameters of Coastal Research Vessel for Different Hull Forms.”

M Premchand , SMDR (Indian Maritime University),India

This thesis signifies the importance of catamaran hull form benefits as a research vessel and the reasons for selecting this hull form. Study is also done on the spacing between the two hulls with symmetrical demihull and asymmetrical demihull. Resistance, working deck space, operating cost options are the primary factors in determining catamaran hull form as the most efficient out of the comparison between monohull and catamaran. This thesis signifies the effect of bulbous bow in reducing the resistance components and increasing the volume of displacement for a given set of constraints.

“Modern Tools for Efficient Hydrodynamic Design of Ships”

L Broberg, FLOWTECH International AB, Sweden

Recent developments on CFD and CAD integration have opened new possibilities to improve the efficiency and quality of the hydrodynamic design process. Specialized software for ship hydrodynamics can automatically configure the simulations, create grids and create reports based on the draft and speed conditions. This significantly reduces the turn-around time and the requirements of the user skills and benefits organizations with varying resources and levels of application complexity. This is illustrated in the paper by three examples based on SHIPFLOW.

“Effects of Wide-Gap Welding of Block Joints on the Fatigue and Fracture Behaviour”

Wolfgang Fricke, Hamburg University of Technology, Germany

Fabrication of block joints without margins in shipbuilding can lead to relatively large gaps which have to be filled by string-beads during welding. Questions were raised regarding the quality and the strength of the welded joints in view of occurring constraint conditions. Therefore, experimental and numerical investigations were performed with butt joints of 15 mm thick shipbuilding steel plates. The results were affected by residual stresses and angular misalignment. The reasons were further evaluated by numerical simulation of both welding techniques. The results confirm the angular misalignments observed and revealed high welding-induced residual stresses in the root layer welded with the string-bead technique contributing to the low fatigue strength. Finally, an outlook is given on current investigations of a block joint where welding-induced residual stresses are computed and assessed considering stress re-distribution due to service loads.

“The Effect of Welding Sequences and Welding Tacks on Residual Stress in Stiffened panel Fabrication”

Pankaj Biswas, Rajesh Ranjan3, Indian Institute of Technology, Guwahati, Sujoy Tikader Haldia Institute of Technology, & N. R. Mandal, IIT Kharagpur, India

In the present work a numerical elasto-plastic thermomechanical model was developed for predicting the effect of welding sequences and welding tacks on residual stresses on large stiffened panels. It was observed that with proper sequencing of welding and choosing an adequate tacking scheme resulted in substantial decrease in residual distortion and stresses. The results obtained showed a good agreement with available published results. The results are encouraging, however for further strengthening and validating the computational methodology, suitable laboratory experiments are to be carried out.

“Iterative Laser Forming Of Steel Plates For Generation Of Compound Curved Surfaces Used In Shipbuilding”

Asit Kumar Dalai, IIT Kharagpur, India

A considerable amount of work has been carried out on 2-D laser forming of thin sheet metal, however, the mechanisms of 3-D laser forming is still not very well established. Further work is necessary to advance the process for realistic forming applications as required in shipbuilding industry.The work presented in this paper uses an iterative approach to control the 3-D laser forming of 2mm Mild Steel sheet into a doubly curved surface. The results obtained demonstrate the potential of the iterative laser forming process for shipbuilding in terms of automated manufacture of curved panels as per the desired hull shape.

“Sandwich Plate System (SPS) in Shipbuilding Applications”

Stephano Y. Heo, ManSoo Kim Daewoo Shipbuilding & Marine Engineering, Martin A. Brooking Intelligent Engineering, Andreas Chung, SPS Marine Technologies, Korea

Sandwich Plate System (SPS) is a lightweight and simplified alternative to conventional stiffened steel. This paper describes the development of applications using SPS for new shipbuilding. The example applications introduced in the paper represent significant advantages to a wide range of applications on ship structures. Based on comprehensive engineering and in-service experience, this paper recommends SPS for new shipbuilding with benefits such as reduced maintenance costs, improved fatigue resistance, excellent vibration and acoustic performance, built-in fire protection and improved impact resistance

“Zone wise Full-kit Approach on Ship Outfitting”

Shelton Ponnayya J H1, DK Phule, Marine Design Centre, India

System oriented outfitting has been the conventional approach in most Indian shipbuilding industries which has not been very efficient in terms of productivity. This paper describes a much improved approach to the use of the enclosed volume. It highlights the options in the use of space and the reduction in construction costs that can result from using zone outfitting methods in shipbuilding instead of conventional system-oriented methods. In zone outfitting method the available volume is divided into separate work packages which can be executed with certain degree of independence. Digital mock up of the whole boat is carried out. This kind of approach is well suited for complex projects with huge space constraints and where modular approach is required. This practice leads to better utilization of resources, reduction in lead time and rework.

“Forced Vibration Analysis of Laminated Composite Stiffened Plates Using Higher-Order Shear Deformation Theory”

A. Bhara Applied Mechanics Department, MNNIT, S. K. Satsangi IIT, Kharagpur and S. K. Bhattacharyya Central Building Research Institute (CSIR-CBRI), India

Laminated composite plate / panel structures are used in multitude of applications in ship / marine and other industries. To achieve enhanced strength, such structures are often appended with ribs / stiffeners. The most general kind of mechanical loading, such structures are subjected to, is that of forced vibration. A number of studies on forced vibration analyses of such stiffened laminated structures are presented in literature, using classical bending or first-order shear deformation theories (FSDT). However, analyses using higher-order shear deformation theories (HSDT) in such cases are scanty. Hence, the present work is aimed at studying the effect of using higher-order theories on prediction of forced vibration response of such laminated stiffened plate structures.

“Investigation of Practical methods for introducing uniformity in the wake field for existing vessels”

B.Agarwa, D.Poojari, O. P. Sha, Dep. of Ocean Engineering & Naval Architecture, IIT Kharagpur, India

An existing twin screw hopper suction dredger of 112 metres length is not able meet the design speed requirements of 11 knots by about 5 knots. The vessel also experiences very high propeller induced vibrations in the engine room. The presence of very high curvatures in the stern region of this vessel is the cause of highly uneven flow to the propeller, with the inner radii of the propeller having regions of very high wake.The paper deals with experimental and CFD studies done on the existing vessel for fitting guide fins on either side of the propeller and getting their correct location and orientation so that an improved flow to the propeller is achieved.

"Application of Response surface method for the Strength and Reliability of stiffened cylinders in offshore marine structures"

Pretheesh Paul C., Subin K.K., P.K. Das, NA-ME Department, University of Strathclyde, UK

Stiffened cylinders are one of the major structural components used in offshore marine structures. Structural reliability is an essential criterion for structural integrity. As the complexity of the model increases and in the absence of such a proved analytical structural performance model, FE analysis is the immediate option for reliability based designs. In this paper, a reliability analysis is carried out for stiffened cylinders used in offshore marine structures based on Response surface method and FE analysis. The FE analysis is used for the strength assessment of the structure and Response surface method is used to approximate the limit state function and subsequently the reliability index of the structure.

"Design and development of an integrated CAD+CFD model for simulation based ship hydrodynamic optimization problems"

A. K. P. B. Patel and R. Sharma, Department of Ocean Engineering, IIT Madras, Chennai, India

Simulation based ship hydrodynamic (SBSH) optimization combines conventional areas of resistance and propulsion, sea-keeping, maneuvering, and computer aided design (CAD) + computational fluid dynamics (CFD), and offers a remarkable possibility of the implementation of an integrated design process from conception to design to production. Additionally, the environmental effects too can be incorporated and that can allow design and development of new and novel ships to meet the challenges of the 21st century. In the present paper the fundamental constitutive elements of a SBSH environment are presented and analyzed.

"Hydrodynamic performance enhancement using stern wedges, stern flaps and interceptors for ships"

J Shiju, Naval Science and Technological Laboratory, India

Computational efforts are not completely able to elucidate the performance of wedges, flaps and interceptors fitted to ship hulls, so hydrodynamic model test are the most reliable option. Experimental studies were carried out in High Speed Towing Tank at NSTL, India on a variety of hull models. Model tests were performed to study the effects of such devices and their combinations on hydrodynamic performance. The present paper brings forward some interesting facts as how the performance of such devices varies with hull form and among their respective combinations. This work culminates in a qualitative approach to select an optimum configuration of such devices for any given hull form, also looking into its cost effectiveness.

"Longitudinal Ultimate Strength Assessment of a Bulk Carrier under Random Corrosion"

S Vhanmane, Indian Register of Shipping, India

Ship structures operate in a very complex environment and they are subjected to strength degradation due to corrosion. In the past, different linear and non-linear corrosion wastage models have been developed. For a power law type non-linear model of corrosion growth, there are three governing parameters: (i) random corrosion rate, (ii) random corrosion initiation time or coating life and (iii) exponent. The present study aims to study the effect of these parameters on the statistical parameters and probability density function of longitudinal ultimate strength of a bulk carrier hull girder.

"Regulation for Probabilistic Damage Stability – Current Status and Future Possibility"

A.R.Kar, Indian Register of Shipping, India

In the context of existing and future rules and standard regimes, attempts will be made in this paper to provide an over-view of what actually has been achieved through the new harmonized damage stability rules in SOLAS 2009 and its further prospects. The paper will address issues such as- Impact on the Design approach, Critical Elements, Inherent Safety Level and Transition from Probabilistic to Risk Based framework with reference to SOLAS 2009 Probabilistic Damage Stability Regulation.

“Study Of Alternate Engine Propulsion Systems To Reduce Co2 Emissions From Coastal Ships”

V.Srinivas and Mr. U.S.Ramesh, IMU, India

LNG is emerging as a strong alternative to the petroleum fuels that are presently being used in the shipping industry This paper focuses on using LNG as fuel for the propulsion system on coastal ships and looks into the designing of a 120m long ship’s engine room lay out to accommodate propulsion systems with combination of fuels like LNG, HFO, DO in various combinations including corresponding fuel storage arrangements. The cost benefit analysis is carried out for the additional expenditure incurred in way of the additional/alternate equipment and the benefits due to complying with IMO’s Tier II and III requirements, reduced carbon foot print, reduced maintenance costs, increase in the thermal efficiency of the engine, etc

“Ship maneuvering - A review of past and present developments”

Anil Kumar Dash, Vishwanath Nagarajan, IIT Kharagpur, India

In this paper a review of progress of research in the field of ship manoeuvring has been carried out. The present ship manoeuvring mathematical model contains second order differential equation with surge, sway and yaw components with non-linear and cross-coupled terms. The developments in the determination of different components of the mathematical model for ship manoeuvring, theoretical and semi-empirical methods for calculation of hydrodynamic forces, procedures of different experimental techniques to find the manoeuvring characteristics of ship, etc are reviewed. Some of the results on hull, propeller and rudder interactions of previous researchers are presented here.