The Royal Institution of Naval Architects

SURV 9 - Surveillance, Search and Rescue Craft

International Conference

SURV 9 - Surveillance, Search and Rescue Craft

18th April 2018,

RINA HQ, London, UK

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9:00h - 9:30h **Coffee and Registration.**

9:30h - 10:00h **Structural analysis of composite search and rescue vessel under the new BS EN ISO 12215-5**
Jean-Baptiste R.G. Souppez, Southampton Solent University, UK

Among the new implementations to the new BS EN ISO 12215 features a workboat annex. This will allow commercial vessels, such as search and rescue crafts, to be designed under the new regulations. Moreover, to account for the increasing design and operating speeds since the previous BS EN ISO 12215-5 published in 2008, the scope has been extended beyond speeds of 50 knots, while also accounting for higher accelerations.
The technical background and practical applications of the regulation will be presented, highlighting the increased factors of safety adopted by the working group 18 to ensure reliability. This will be the very first presentation of the new regulation to industry, ahead of the publication currently scheduled in 2019.

10:00h - 10:30h **Design Verification Framework for Search & Rescue Craft**
H J Phillips, M Pitman, M Boulton, Royal National Lifeboat Institution, UK
Hans van der Molen, Koninklijke Nederlandse Redding Maatschappig, Netherlands
Klaus Stromenger, K&S Maritiem Technisch Bureau, Netherlands

Due to the specific requirements and challenges associated with search and rescue craft, it can be difficult to complete designs of such craft in accordance with most codes of practice, regulations and classification society rules. Whilst these are used as industry best practice and guidelines there is a need to take a more risk based approach to verify the design and through life operation of search and rescue craft forming part of the safety case.
Consequently and following consultation, a project between the Royal National Lifeboat Institution (RNLI) and Koninklijke Nederlandse Redding Maatschappij (KNRM) was set up in 2014 and included staff members from both organisations. The team has delivered a process that can be followed to provide assurance and design verification of lifeboats. Based on the Failure Modes, Effects, Criticality and Assessment (FMECA) approach, a framework has been created that can be used as part of the initial design process. This can then be audited internally or by a third party e.g. another Lifeboat Rescue Organisation (for example, members of the International Maritime Rescue Federation (IMRF)) or Statutory Authority. Once completed, the in-built reporting tool allows the user to visually identify the systems presenting the highest risks, capture the required mitigating actions and state whether these have been completed or not. This initial basis must then be maintained and kept current throughout the operational life of the craft for example as experience of the craft is gained or when modifications are applied.

10:30h - 11:00h **Noise, Vibration, and Repeated Shock Exposure on High Speed Craft: Measurement, Mitigation, Preventative Design.**
Phill Moxley, Thomas Coe, Frazer-Nash Consultancy, UK

Surveillance and search and rescue craft need to operate in a “maximum effort” capacity, transiting to incidents quickly to ensure maximum impact. This presents operational challenges, including injurious noise and vibration exposure. Understanding and mitigating noise and vibration requires three key activities: measurement, mitigation, preventative design.
This paper discusses challenges around these areas using a whole system approach. Exposure to non-propagating wind noise is a high risk to crews on high speed craft. The use of a head and torso simulator (HATS) is effective in measuring noise, establishing conditions which produce non-propagating wind noise at significant levels, and assessing performance of communications and hearing protection.
This data highlights problems relating to speed, and helps generate engineering control actions, as well as organisational and PPE solutions, which are cheaper and easier to implement. It also facilitates rapid solution iteration, enabling users to test PPE or communications solutions in situ.
Shock and vibration measurement on high speed craft has enabled practical issues to be overcome, and severe vibration exposure and events which may cause severe injury to be identified, and then mitigate them through technology or organisational change. For noise and vibration, it is essential to consider control at source, especially for new platforms where designs can be easily influenced. Hydrodynamic modelling enables quantification of the impact of hull features on vertical vibration, and consequently select hull forms to minimise vibration exposure while balancing other requirements. Similarly, noise and airflow modelling allows for the design of wind noise mitigation strategies during design.

11:00h - 11:30h **Coffee**

11:30h - 12:00h **Full-Scale Seakeeping Trials of an All-Weather Lifeboat**
F Prini, S Benson, R W Birmingham and R S Dow, Marine Offshore and Subsea Technology Group, School of Engineering, Newcastle University, UK
L J Ferguson, P J Sheppard and H J Phillips, Royal National Lifeboat Institution, UK
M C Johnson, J Mediavilla Varas† and S Hirdaris, Lloyd’s Register, UK*
(†work initiated whilst at Lloyd’s Register. Now at Materials Innovation Institute, NL)
*(*work initiated whilst at Lloyd’s Register. Now Visiting Research Scholar at Maritime Technology Group, Department of Mechanical Engineering, Aalto University, FI)*

The Severn Class of the Royal National Lifeboat Institution (RNLI) has recently undergone extensive sea trials as part of collaborative research with Newcastle University and Lloyd’s Register. The paper presents the first findings from an analysis of the data collected.
The scope of the trials was to investigate the seakeeping behaviour of the craft in real operational conditions. For this purpose, a Severn lifeboat was fitted with accelerometers, a rate gyro and a number of strain gauges to measure hull girder loads and local loads due to hydrodynamic, slamming and green water pressure. The tests took place in the Centre North Sea offshore at Tynemouth (UK). A range of speeds and headings were tested in seas with a significant wave height from 0.3 to 4.6 metres. In addition to visual observations, a measure of the sea state during the trials was obtained from wave buoys. Time-domain and spectral analyses were applied to the data collected. The Response Amplitude Operators (RAOs) of motions and vertical bending moment were compared against numerical predictions.
The sea trials form part of a major plan that combines numerical methods and experiments to investigate the sea loads sustained by the structure during operation in waves. The sea trials contribute to validating the wave loads predicted numerically and allow to account for slamming-induced load effects. The structural response of the Severn to a combination of hydrostatic, wave and slamming-induced loads is then calculated through finite element analysis.

12:00h - 12:30h **Rescue boats on catamaran platform: case studies**
Albert Nazarov, Albatross Marine Design, Thailand

Catamaran platform provides certain benefits for some rescue tasks, but unfortunately is not widely applied for such applications. Number of rescue catamarans with paramedical, dive support and firefighting capabilities have been developed by Albatross Marine Design team during recent years. Based on such experience, the paper presents catamaran design specifics related to general dimensions, architecture, performance and structural design of these craft. Parametric approach to dimensioning a typical high-speed catamaran craft with payload, performance and seakeeping restrictions is proposed. Perspective areas of catamaran applications are discussed; new concepts and their potential applications are features.

12:30h - 13:00h **Numerical Investigation of Double Continuous Welding and Alternatives in Bottom Shell Plates of Aluminium High-Speed, Mono-hull Craft.**
Vimal Kumar, Lloyd's Register, Singapore

Generally, most of the classification societies recommends Double Continuous Welding (DC) in bottom shell plates of Aluminium High-Speed Craft, and has always been a major point of discussion in the industry. It’s mainly due to space constraints, distortion, complex welding sequence and enhanced heat affected zone. In this study; numerical strength investigation of three welding methods (DC, CI and SI) used in bottom shell plate of high-speed mono-hull aluminium craft is carried out. Applied load is mainly bottom impact pressure, which exceeds combined loads of hydrostatic and hydrodynamic force, and mainly dependent on vertical acceleration; are estimated based on the LR SSC Rules and validated with the commercial hydrodynamic tool Ansys AQWA 17.2. Load considered is primarily bottom impact pressure and in-plane compressive loads due to global bending of the craft is considered insignificant and ignored. Structures including the weld metals are modelled as 3-D solid geometry. Stresses in gross structures including weld-metals and weld-metals exclusively are estimated with the help of Ansys Mechanical 17.2. Further, simplified fatigue approach is used to estimate fatigue damage life of the craft in different weld configurations. Study concludes for this case, where predominant loads are bottom impact pressure, stress variation in different weld configuration is minimal. It also finds that, based on appropriate S-N Curves for different welding configuration, fatigue life of structures with intermittent welding is significantly lower than that of expected design life with DC Welding configuration. However, crack initiation and fatigue failure is expected to occur not necessarily in weld metals but structures as well and with minimal changes; design life can be improved.

13:00h - 14:00h **Lunch**

14:00h - 14:30h **A Modular Search and Surveillance SES Platform to Support Port and Harbour Security in the Future Megacities of 2050**
Sean McCartan, EBDIG-IRC, Coventry University, UK
J Hill, Trident Marine, UK
T H Espeland ESNA AS, Norway
Trevor Dobbins, STResearch, UK

By 2050 urbanisation will be the most consequential event in the history of mankind, with the rise of numerous megacities primarily located in coastal areas. The plans for any security or disaster operation in a megacity involves a full spectrum of capabilities, spanning both government/military and civil roles in the face of natural or adversarial threats. The security resources of a megacity may also be called upon in more non-security/defence missions to protect or sustain life, such as SAR. This paper discusses the maritime capability required to support the search and surveillance operations within and around the megacity. The overall capability is delivered by an integration of manned, unmanned and autonomous systems, including the use of swarm technology. Specific domain capabilities include: littoral and harbour areas; riverine and canal operations; underwater operations; urban airspace, with tethered and untethered C4ISTAR sensors; road, cross-country and tunnels. The maritime system proposed in this paper consists of a fleet of modular platform vessels, based on a 25m SES (Surface Effect Ship), operating within a common command infrastructure. Where a range of platforms are deployed from the vessels depending on the situation requirements. The recognised stake-holder informed Marine Design approach is applied to the platform system and sub-systems development, which also draws on the results of horizon scanning activities to identify the technological and cultural developments that are anticipated. These include AI and machine learning, and how they will operate alongside the humans to maintain the security and health of the population.

14:30h - 15:00h **The Application of Unmanned Marine Vehicles to Maritime Search and Rescue**
J Dalziel, R. Pelot, Dalhousie University, Canada

The technology supporting Unmanned Vehicles, land, sea and air is rapidly improving. These vehicles are becoming more affordable, and much more capable. Unmanned vehicles, land and air, are making inroads into Search and Rescue (SAR) response. Unmanned Marine Vehicles (UMVs) are already under evaluation for military applications, such as mine hunting and disposal, and surveillance.
UMVs will likely also play a significant role in Maritime SAR response. Their role could encompass a range of duties: providing SAR resources in locations where these would otherwise not be available; working with air dropped personnel and resources; a place of temporary refuge; first response in a Man Overboard Situation; assisting local first responders (fire services, police) in rescue and recovery operations, and so on. In addition, a UMV could be launched in conditions where it might not be deemed safe to launch a manned rescue boat, and proceed into conditions (such as surf zones) which may be dangerous for a manned boat.
This paper initially looks into the question: 'Do Unmanned Marine Vehicles have a potential role in Maritime Search and Rescue?', and if so, 'What roles might they best fulfill?'. It will look at SAR resource needs; at Unmanned (and Autonomous) technologies, their advantages and disadvantages, operational and technical hurdles and solutions. One or more scenarios will be outlined; including the unmanned marine vehicles and their control technologies, and clarify how these fit into an integrated SAR response system.

15:00h - 15:30h **A large Unmanned Vessel Concept for Remote & Autonomous Surveillance, Search and Rescue Operations**
Harry Turner, Edward Wright, Rolls Royce, UK

This paper presents an unmanned vessel concept, optimised for naval operations, and capable of carrying out surveillance, search and rescue as well as intelligence gathering and scientific exploration. The rapid progress of remote and autonomous vessel technology in the commercial sector serves as the catalyst to this concept – with point-to-point ferries currently operating to varying degrees of autonomy, and technology roadmaps indicating that unmanned ocean going vessels could be a reality by 2035.
The introduction of increasing levels of autonomy in the naval market provides opportunities for operational advantage over traditional manned vessels. Such an example is in the flexible replacement of crew required spaces such as manned bridges and living quarters, which can then provide space for additional fuel capacity to permit an increased range without compromising on vessel size, or additional payload capacity for use in multi-mission operations. Maritime agencies are expected to benefit from the removal of crew on certain ship types, enabling smarter, safer and more efficient operations, as well as enabling increased levels of persistence and environmental operability. For example, such a vessel could operate autonomously in remote areas and/or in harsh weather conditions and use UAVs to cover large areas under the limited time constraints of surveillance or rescue missions before acting as the first responder and, if necessary, enlisting the help of a standby manned asset, which are fewer in number. This paper will also explore the opportunities and challenges associated with the specification and design of highly autonomous propulsion systems.

15:30h - 16:00h **Coffee**

16:00h - 16:30h **Marine Propulsion Shafting Configurations**
Mohamed Zeid, Caterpillar Propulsion, Sweden

The marine propulsion drive train function is mainly to transfer the torque from Prime mover (Power source) to Power absorber (Propeller). The most important information to know at the beginning is the configuration of the power supplied to the system as well as location and type of propeller to be able to configure the shafting system in between. Considering the hull design itself from vessel to vessel also the vessel operating routes are different, this will influence the propulsion shafting configuration as well. The marine propulsion shafting configuration shall be well optimized in respect of suitable layout, minimum essential dimensions for components and possibility of installation. The paper is a conceptual paper where illustrating the most common shafting configurations for marine propulsion systems in three phases. The first phase “Layout” where considering different power and propulsion configurations for different vessels. The second phase “Dimensioning” where considering the main principles of different dimensions and sizes of the components for the same layout. The third phase “Installation” where studying the configuration from installation point of view where basically how to make it possible and easy to install in practical.

16:30h - 17:00h **Understanding engine power characteristics and their effects on vessel performance and engine reliability in low hour, high load, RNLI SAR lifeboat applications**
Spencer Johns, Royal National Lifeboat Institution, UK

RNLI lifeboat designers have long been stuck selecting a high-performance pleasure rated engine for maximum power to weight ratio, whilst trying to achieve continuous duty rating reliability.
Not understanding, how an engine achieves its rated power, power tolerances and effects of adjustments to performance parameters, can have significant implications for both boat performance and engine reliability, ultimately leading to catastrophic engine failure. Conversely boat modifications can have similar consequences for engine performance. This becomes more pertinent where long fleet build periods allow more opportunity for change to occur.
With an introduction into how marine high-speed diesel engines are typically derived from on-highway applications before being converted for marine use, this will highlight how RNLI use doesn’t fit typical engine rating profiles with low hours but high load factors, specific requirements such as capsize capability along with the typical 5-year engine design life and continuous engine development.
Discussed with reference to specific example cases, will be details such as engine power and torque curves and how small changes to these and components such as propellers can have a big impact, along with methods and approaches to try and control these changes. Lessons learnt and solutions developed to achieve the required performance and reliability through modifications and engine selection will also be covered.
A key theme drawn on throughout will be the design fundamental of ‘Communication’, lack of which can often be the root cause of the issues highlighted.
Concluding with the knock-on effects of resolving engine performance through re-powering and the potential to operate closer to the structural limit of the vessel.

17:00h - **General Discussion**

International Conference

SURV 9
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