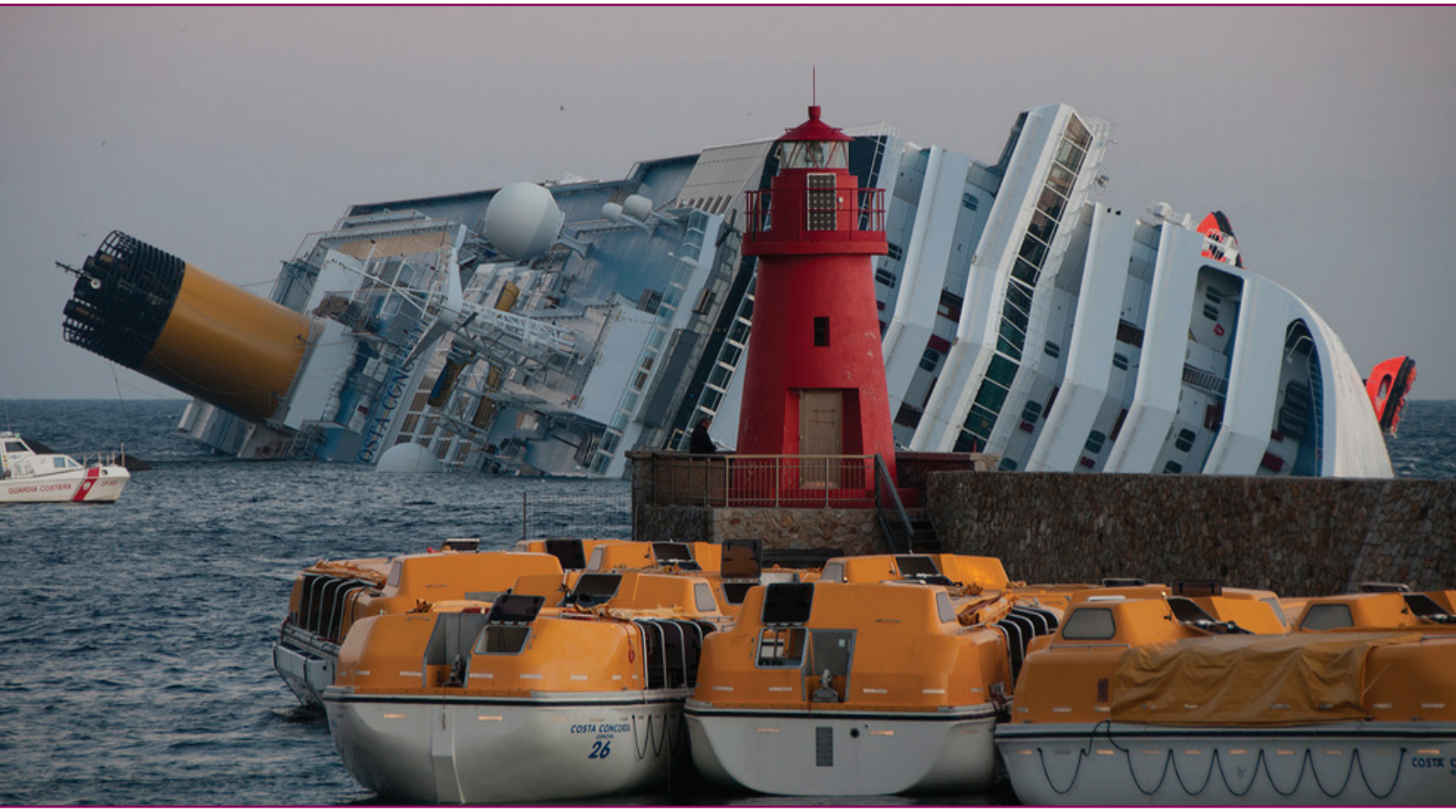
International Conference

THE DAMAGED SHIP II

The Royal Institution of Naval Architects



Conference Programme

The 2nd International Conference on Damaged Ships

WEDNESDAY 30th & THURSDAY 31st JANUARY 2013
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Abstracts

SMALL PATROL BOATS: DESIGN FOR SELF RIGHTING
A Nazarov, Albatross Marine Design, Thailand
Self-righting concept is widely applied on patrol and rescue boats enabling safe operation in severe conditions; this feature if often specified as 'a must' by operators for such designs. The questions that often stay unanswered are probable conditions of capsize and cost of self-righting solutions.
Present paper examines self-righting phenomena from point of view of practicing designer. Self-righting and flooding process is studied for intact and damaged craft conditions, with affect of flooding rates for superstructures and inflatable volumes. Accelerations during capsize and their impact on crew/personnel, design loads on structures of self-righting craft are studied. Equipment and system design are touched upon. Results of scale model testing on surf are presented showing capsize conditions and measured capsize parameters.
Recommendations are provided for self-righting measures, sample design briefs are presented for different types of self-righting craft.

THE DAMAGED SHIP – NOTIONS AND TRUTHS
D Vassalos, University of Strathclyde, Scotland, UK
Damage stability is not any longer limited to considering the properties of the residual GZ curve or damage freeboard alone. For passenger ships, in particular, damage stability limitations constitute 90% of the risk to life, a fact that simply needs careful attention. The truth is now visible and measurable. A painstaking evolutionary development on ship stability is giving way to unprecedented scientific and technological developments that raised understanding on the subject as well as capability to address even the most demanding societal expectations on human life safety and do so cost-effectively. This enhanced capability brought with it knowledge on the level of safety ships are being designed to and on the way ship operation impacts on this. In this regard, tolerability and safety standards find themselves wanting every time there is an accident, with serious questions being raised on the damage survivability of ships, a reminder that damage stability is very much the "Achilles heel" of passenger ship safety. Moreover, still "hidden" in the rules book is the chasm in safety levels between existing ships and newbuildings, making continuous monitoring of safety onboard, hence preparedness and emergency response services, even more imperative.
As a result, notions about damage ship stability and safety are also giving way to some important truths: ships are vulnerable platforms, a fact that is further exacerbated by traditional operational practices. This realisation necessitates raising awareness to stimulate and nurture a maritime industry safety culture, striving to raise and uphold high safety standards in ship design and operation through a regime that aims for and supports continuous safety improvement.
The author, having played a protagonist role in every major contemporary rule development on damage stability and having been involved at the core in implementing these developments to the design of modern safety-critical ships, will demonstrate the aforementioned notions and truths as well as the implications of contemporary developments on the design and operation of passenger ships with suitable examples from existing ships and newbuildings.

THE DEVELOPMENT AND IMPACT OF CURRENT AND POSSIBLE FUTURE NATIONAL AND INTERNATIONAL DAMAGE STABILITY REGULATIONS.
K W Hutchinson, Marine and Technology Division - Integrated Technology, UK
A L Scott, Maritime and Coastguard Agency, UK
Building on papers presented by the authors at the previous 'Damaged Ship 2011' (also see The Naval Architect April 2011) and 'Design and Operation of Tankers 2011' conferences, this paper will consider and critically discuss the recent and potential future development of national, regional and international damage stability regulations etc. in light of recent incidents and events. The impact of such legislation etc. will be considered with respect to the work of designers, regulators and educators. The paper will also consider the availability of suitable analytical techniques for safe ship design, development and operation, hence investigating how such regulations and techniques can be utilised in the development of compliant and near-optimal design solutions with respect to safety / survivability and other performance criteria. The survivability performance of a damaged ship will be discussed from a range of perspectives such as flooding, stability, strength, seakeeping, evacuation etc. The paper will look at the development of various regulations over the years and will
attempt to highlight and discuss potential future developments. Recent and impending developments will be specifically addressed with respect to previous and existing regulations and also potential future developments. The concepts and principals adopted in new regulations will be discussed with respect to their impact on the development of designs, their suitability for applicability to certain specific ship types and experience in their application and impact on design development and ship operation. Hence, the question as to how these new design and operational regulations, some potentially conflicting and diverse in nature, can be applied as a coherent whole for practical application within the design process will be addressed. As part of this, current issues surrounding regulations will be discussed along with a critique of recent research and the needs of the shipping industry. The impact of these will be investigated considering the practicing ship designer, regulators assessing and ensuring the inherent and operational safety of new designs and major conversions and also those involved in the education of naval architects and seafarers

ONBOARD STABILITY COMPUTERS AND DECISION SUPPORT SYSTEMS - REGULATION ON DAMAGE STABILITY
J Gullaksen, JG Consultant Engineers, UK
The IMO will introduce a mandatory requirement for either onboard stability computers or shore-based support to ensure that certain systems on passenger ships of 120 m length or more, or having 3 or more main vertical fire zones, remain operable after a fire or flooding. These guidelines are the "Guidelines on operational information for Masters of passenger ships for safe return to port by own power or under tow" MSC.1/Circ.1400.
Thus, builders, designers, owners and managers will need to remember that provision of a computer able to carry out damage stability calculations for any damage scenario will be required. Further, Flag Administrations and Recognized Organizations will need to ensure that the necessary stability information is available onboard the affected ships.
The goal of an onboard stability computer, used as a survivability assessment system, is to provide useful recommendation to ship operator so as to ensure the safety of life and ship. Decision support system infers calculated results from the damage stability and structural safety. The system shall provide proper methods based on inferred results, and give timely and appropriate instructions such as necessary ballasting plan considering stability and structural safety.
The purpose of this paper is to investigate information requirements to be provided as guidelines for minimum information to ensure the safety of life and ship, including details of input loading conditions, and output to be provided as guidance and within the tolerances specified in the Guidelines for the approval of stability instruments (MSC.1/Circ.1229). The aim is to take into account known loading and flooded condition of the ship and any measures that may be proposed to improve or affect the survivability of the ship.

THE NEWEST DAMAGE STABILITY CRITERIA
R Perez, Universidad Politécnica de Madrid, Spain
After damage is sustained ships stability is a critical aspect of modern naval design. Nowadays, in actual ocean navigation as in the shipyards technical offices, ship stability tests with different loading conditions and Seakeeping, both in intact condition as in damage condition, are computer simulated. These tests using the ship design as input are able to quickly simulate real conditions and outcomes. Even in the comparative analysis for different models' behaviour, these tests are often used as necessary complements to the utilization of actual physical models. In this technical paper direct applications of the most important stability criteria for different vessels (military as non-military) are introduced. It is also described a method to determine the criteria that best fit the vessel typology enabling the identification of the most restrictive ship stability criteria in case of damage for that vessel type. There are explained examples of criteria applications from the philosophy of these criteria of ship stability to how they are applied. In addition it is tried to expose a method with which it is possible to choose the criterion that better adapts to the methodology of the ship. Another point of interest of the paper is the comparison between civilian and military ships, never normally compared due to the great historical divergences among them.

DAMAGE STABILITY OF RO-RO PASSENGER SHIPS: INVESTIGATIONS ABOUT THE "WATER ON DECK"ISSUES WITHIN SAFETY RULES
M Nattero, F Ghigliazza Studio di Ingegneria Navale - M. Nattero Genoa
P Gualeni, University of Genoa, Italia
Ro-Ro passenger ships engaged in regular international voyages, to or from Europe member states, have to fulfil the directive 2003/25/EC, which requires the compliance with SOLAS 90, Regulation II-1/B/8 paragraph 2.3 to 2.3.4, with the defined amount of water on deck (this criterion is also known as "Stockholm Agreement" requirement). At the same time, after a long period of review and development at IMO, the probabilistic SOLAS 2009 is at present the new regulation for the damage stability assessment of a ship. The point is that SOLAS 2009 doesn't take into account the effect of water on deck. Therefore a further improvement in SOLAS2009, involving the water on deck issue is in the Agenda of IMO SLF Committee and several Administrations and research groups have carried out calculations and analysis in order properly face the issue. The question is still open. In this paper, some damage stability investigations for real ship within the probabilistic approach are carried out in order to observe the influence on results of the inclining moment due to the presence of water on the garage deck; the water amount and the application modality are identified within the paradigm of the Stockholm agreement requirements but then they are properly "translated" into the probabilistic approach.
This lesson should be a contribute to the common knowledge on the matter A further insight into the problem is gained performing parametric calculations for different Ro-Ro ship sizes, addressing specifically the influence of ship size with special attention to the different residual freeboard values.

Abstracts

ASSESSMENT OF THE RESIDUAL HULL GIRDER ULTIMATE STRENGTH OF A DAMAGED VESSEL SUBJECTED TO VERTICAL AND HORIZONTAL BENDING MOMENTS

E VanDerHorn, M Lee, G Wang, ABS, USA

Current methodology for the rapid evaluation of the residual hull girder ultimate strength (HGUS) of damaged vessels primarily relies on proven analysis techniques from existing design guidelines, such as the IACS Common Structural Rules (CSR). As these guidelines were developed for symmetrical intact vessels, their application in calculating the residual HGUS must be re-evaluated to identify where improvements can be made to provide a more accurate analysis of the damaged condition. This paper compares the current CSR methodology against an improved HGUS analysis procedure which considers damage-induced geometric asymmetry subjected to combined vertical and horizontal bending moments. Using a simplified method based on the incremental-iterative procedure, two convergence criteria are used to determine the rotation and translation of the neutral axis due to asymmetries in the geometry and loading. A case study of two incident responses is presented to demonstrate the effect of combined bending moments on the residual HGUS of asymmetrically damaged vessels..

APPLICATION OF AN IMMERSED BOUNDARY METHOD TO SIMULATING FLOW AROUND MARINE VESSELS FOR FLOW-INDUCED STABILITY ANALYSIS

K Yang, Inha University, Korea

Flow-induced stability analysis on marine vessels including damaged ships is quite challenging because simulation of flow around them is very difficult due to the complexity of vessel shape and the presence of the free surface. The conventional approach using body-fitted or unstructured grids demands much time in dynamic grid generation, and yields slow convergence of solution. Since a flow-induced stability analysis must be based on accurate simulation results, a more efficient way of simulating flow around marine vessels, without sacrificing accuracy, is desirable. We propose application of an immersed boundary method to simulating vessel flow. An immersed boundary method facilitates implementation of a complicated vessel shape on a Cartesian grid system. The 2nd-order accuracy of our simulation is maintained with the aid of an adaptive mesh refinement (AMR) technique. A volume-of-fluid (VOF) method and an LES modeling are also incorporated to resolve the motion of the free surface and the turbulent eddies, respectively. In this presentation, we will demonstrate the effectiveness of the immersed boundary method we adopted, by presenting the simulation results of the flow around a floating ship of complex geometry in the presence of tidal waves.

DIRECT BREP SOLID INTEGRATION: A STEP TOWARDS VIRTUAL SHIP'S 'HIGH RESOLUTION' STABILITY

M Pommelet, Sistre, Greece

As long as ship's master model was a traditional lines drawing, the hydrostatic and stability calculations were based on 2D lines integration. The initial hydrostatic solvers have then simply transcribed this manual process by digitizing the physical lines drawing, allowing to speed-up the calculations and to process more and more complex ship models.
But finally, following to computer's growing power and affordability, the traditional lines drawings have been gradually replaced by 3D surface models, so that most of today's hulls are now designed and faired as 3D surface models (we announced this trend in our 1984 RINA paper: "Three-Dimensional Representation of Ship Geometry").
Although the common sense shows that compartments and tanks are solids by nature, this deep mutation of the hull design process hasn't yet brought many changes in the field of hydrostatic and stability calculations, which still remains most often a line process, in which the surface->lines conversion introduces significant time, interactivity and accuracy wastes. The goal of this paper is therefore to discuss the benefits of this new approach as well as its computational cost, thanks to our experience in developing MAAT Hydro, our new BREP Solid based hydrostatic solver.

GLOBAL STRENGTH ASSESSMENT OF DAMAGED STEEL SHIPS DURING EMERGENCY RESPONSE

J M Underwood, A J Sobey, J I IR Blake, R. A Shenoi
University of Southampton, UK

During a damage incident where the vessel remains afloat and in need of assistance, assessment of the residual strength of the hull structure is critical in attempts to prevent loss of life and the vessel; to avoid potential environmental disaster and ensure the most economic recovery mechanism for the vessel.
This paper proposes and demonstrates the application of a novel method to assess the residual strength of a damaged vessel. This approach allows greater definition of the damage event than is currently available to emergency response services, whilst operating within the timescales for crew safety. The method draws on the strengths of finite element analysis to assess the damaged strength of large generic ship type structures, storing this data within a response surface. The ultimate collapse strength of the damaged ship can then be rapidly assessed by implementing the procedure of progressive collapse analysis through the response surface. This allows the effects of the damage event on the larger structural arrangement to be assessed, accounting for both interframe and overall collapse modes that may develop in the structure across multiple frame bays. The paper outlines the method, the results of this method in comparison to current best practice and provides guidance for the behaviour of damaged steel structures.

RESIDUAL CAPABILITIY OF DAMAGED COMPOSITE SHIP STRUCTURE

J Davies, University of Southampton, UK

Composites are used in the marine industry due to the ability to tailor their properties to specific designs as well as favourable strength to weight ratio, corrosion resistance and low thermal expansion. Conversely low stiffness properties require top-hat stiffened shell laminates in primary structures for the marine industry including deck, hull and super-structures. Catastrophic failure is often avoided in damage events occurring in composite marine structures but can lead to cracks, delaminations and debonds. The effect of such in-service damage on the residual capability of the vessel must be fully understood in order to develop both efficient designs and deal with post damage events. It is imperative that once damage has occurred that it can be rapidly assessed and precautions taken to ensure safety of the crew and vessel, but this must be done cost efficiently. To reduce expensive maintenance costs it is imperative to know if damage must be fixed immediately, in the near future or that if it poses no current threat. Literature shows that the effect of delaminations and de-bonds have been investigated in laminated panels but most research is focused on open section stiffeners simulating only single stiffened configurations. There is currently limited published knowledge on the response of damaged top-hat stiffened panels. This paper presents an analysis investigating the effect of damage parameters on the residual capability of multi-stiffened top-hat marine structures. Non-linear finite element models accurately assess the crack propagation, progressive damage and ultimate collapse of the structure and provide guidance for post-damage maintenance.

CONTAINER SHIP WRECK REMOVAL

W Leschaeve, London Offshore Consultants Ltd., UK

In recent years container ship wreck removals have presented a huge challenge for salvors. The author will review recent high profile container ship wreck removals and give an insight into the particular issues container ships present, focusing on structural integrity, removal of containerised cargo and associated stability issues.
Removal of containerised cargo in remote locations with limited resources complicates dealing with grounded container ships, especially where the ship is listed and has suffered structural damage. The first operation in these projects is often to stabilise the wreck in order to deal with the cargo more efficiently. With new container ships being ever larger these issues will be exacerbated in the future.
Subsequent to removal of the wreck, the work of the naval architect continues. The number of parties involved in container ship litigation is proportional to the number of containers onboard. Settling such cases may take years of effort involving teams of lawyers and technical experts addressing causation and liability. The paper will outline examples of the work entailed.

RESIDUAL STRENGTH ASSESSMENT OF AN ALUMINIUM PATROL BOAT

T Magoga, S Aksu
Defence Science and Technology Organisation, Australia.

Marine-grade aluminium alloys are being increasingly used as the hull material of naval vessels, particularly in the case of high speed patrol vessels for which the requirement for reduced structural weight is critical. The demand for operation of naval vessels in harsh seaway environments, and the risk of collision, grounding and combat damage, has led to increased interest in the application of limit-state analysis procedures to evaluate the residual strength of the hull-girder.
The Defence Science and Technology Organisation, Australia, is undertaking a range of research programs in the area of structural integrity of naval vessels, including improved techniques and tools for the assessment of reduction in ultimate strength of welded aluminium ship structures due to various damage scenarios.
This paper investigates the effects of damage severity and location on the residual strength of a generic aluminium hull structure with scantlings typical of a patrol vessel. The state-of-the-art rapid assessment procedure ISFEM (Intelligent Supersize Finite Element Method) is used for the investigation. Damage scenarios defined in Det Norske Veritas (DNV) High Speed Light Craft (HSLC) rules and Lloyd's Register Rules and Regulations for the Classification of Naval Ships are considered.

International Conference

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