RINA

The Royal Institution of Naval Architects

International Conference

THE DAMAGED SHIP

26 - 27 JANUARY 2011

RINA HQ, LONDON, UK

day 1

09.00 - 09.30 **Coffee and Registration.**

09.00 - 09.35 **The Damaged Ship - The Steepest Learning Curve Yet**
D. Vassalos and A. Jasionowski, University of Strathclyde
L. Guarin, Safety at Sea Ltd

The authors, having played a protagonist role in every major contemporary rule development in damage stability and having been involved at the core in implementing these developments to the design of modern safety-critical ships, will make use of their collective knowledge and experience to provide a complete account of the "The Damaged Ship Learning Curve" and demonstrate the implications of contemporary developments on the design and operation of modern ships with a complete design implementation example.

09.35 - 10.10 **A Practical Guide to Damage Stability Assessment - Regulation on Damage Stability**
J. Gullaksen, JG Consultant Engineers

Damage stability calculations are required in order to assess the attitude and stability of the ship after flooding. The SOLAS, MARPOL, IGC & IBC regulations require that all operational loading conditions meet the damage stability requirements. This paper is intended to serve as a practical guide to the use of these regulations when designing vessels based on these regulations, respectively when preparing the required documentation and calculations.

10.10 - 10.45 **Consideration of Damage to Ships from Conceptual Design to Operation: The Impact of Recent and Potential Future Regulations Regarding Application, Impact and Education**
K. W. Hutchinson, Babcock International Group
A. L. Scott, MCA
M. Woodward, P. N. H. Wright and J. Downes, Newcastle University

This paper will consider the recent and potential future developments of damage stability regulations and damage scenarios with respect to safe vessel design, development and operation and hence investigating how such regulations and techniques can be utilised in developing compliant and optimal design solutions. Arguments regarding the application of such regulations and techniques will be presented based on the view points of designers, regulators and educators hence presenting a three pronged view of issues and challenges facing the industry.

10.45 - 11.15 **Coffee**

11.15 - 11.50 **A Comparison in Approach between Emergency Responce Services and Salvors to a Damaged Ship**
H. van Rooij, Salvage and Marine Consultants

The paper will identify and challenge the differences between a professional salvage approach by professional salvors and the approach taken by the so-called Emergency Response Services (ERS). Salvage in general is more than calculating stability, strength, remaining buoyancy etc. Salvage Companies consist of experienced personnel able to work in environments with often a much higher risk level, able to improvise and out of the box thinking and the ability to execute on-site assessments/calculations. ERS services could be an added value to the salvage industry, because of their excess to in-depth knowledge of particular ships design and design criteria.

11.50 - 12.25 **The Damaged Ship?**
V. Martin, R. Gregory and J. Poulson, Noble Denton

This paper will present a brief background of the technical and operational aspects of marine casualties, whilst expanding on the roles and responsibilities of the different stakeholders. With the support of case studies the paper will illustrate several types of marine insurance claims and loosely relate to the cost arising. This will help create an understanding of how the damaged ship affects the various interests in different ways. This paper will provide considerations for emergency preparedness providing particular focus to the management of liabilities associated with marine casualties.

12.25 - 13.00 **Damaged Stability? What Went Wrong?**
S. Pollard, London Offshore Consultants

Consultants supporting owners, their P&I clubs and/or their salvors are frequently required to assess damaged or lost ship casualty scenarios based on minimal evidence and minimal ship data. Was the ship damaged or were there other forces at work? Based on some typical case studies, the paper will look at casualty causation and identify some techniques available to analyse what may have gone wrong in the ship's operation and whether, in the case concerned, there ever was a damaged ship.

13.00 - 14.00 **Lunch**

14.00 - 14.35 **The Flooding of a Warship Immediately Following Damage**
G. J. Macfarlane, M. R. Renilson, Australian Maritime College
T. Turner, Cooperative Research Navies group (CRN)

When a ship suffers sudden damage below the waterline, water will flood into the internal compartments that have become open to the sea, causing it to take on an angle of heel and trim. This may exceed the steady state value, and even result in capsizing or sinking during the transient stage immediately following the damage. Therefore, in order to understand the dynamics of a ship immediately following damage it is necessary to be able to predict the way in which the water flows into the internal compartments.

14.35 - 15.10 **Estimation of Orifice Flow Rates for Flooding of Damaged Ships**
C.D. Wood, A. J. Sobey, D. A. Hudson and M Tan, University of Southampton
P. James, Lloyd's Register

This paper concentrates on the accurate modelling of compartment flooding rates following the occurrence of damage. Typical state of the art flooding models use Torricelli's formula to calculate flooding rates using a constant coefficient of discharge (Cd). Based on Bernoulli's theorem, turbulence and viscosity effects are included using a Cd independent of damage size or shape. Initial studies indicate that this assumption over-simplifies the problem to an extent where the calculated flooding rates are in error.

15.10 - 15.40 **Coffee**

15.40 - 16.15 **Dealing with the Hinged Ship, A Review of the Analytical and Practical Issues Based upon the MT Elli**
K. Ellam, Swire Salvage
R. Tagg, Herbert Software Solutions
C. Moore, Herbert Engineering

In August 2009, south of Suez, the MT Elli broke her back in calm water while being ballasted in preparation for dry-docking. The hull girder hinged near amidships and the overall hull deformation, about 22m, was sufficient for the bottom of the hull to clear the water. This paper outlines some of the analytical issues in salvaging such a hinged ship including; modeling the geometry, estimating the moment distribution and how it got there, problems with predicting hinge behavior, estimating residual strength.

16.15 - 16.50 **The Rapid Reliability and Risk Assessment of a Damaged Ship Structure**
M. Shahid, Binary Systems and Engineering

Presently used computer aided structural analysis tools such as Finite Element Analysis and related technologies are neither developed for Emergency Response Services nor suitable for such application needing quick assessment of structural strength. A computer aided structural analysis tool based on artificial neural network and structural response parameters can provide rapid strength assessment and shall be of immense help for Emergency Response Services to make reliability and risk assessment of residual structural strength and to formulate informed and reliable emergency response actions. This paper aims to presents such techniques for reliability and risk assessment of damaged ship structures.

16.50 - 17.25 **Progressive Structural Failure and Residual Strength of Damaged Ships**
S. Kwon, D. Vassalos and G. Mermiris, University of Strathclyde

To date, research on damage stability and structural failure has been carried out independently by assuming that the damage extent is fixed and the damaged ship is in a structurally stable condition. However, the initial structural damage can propagate during the evolution of flooding. These complex situations may result in excessive flooding and ultimately hull girder collapse before the damaged ship founders or capsizes. In this research, a first-principles methodology is pursued to simulate progressive structural failure

17.25 - 17.30 **General Discussion**

17.30 - **Drinks Reception**

day 2

09.00 - 09.30 Coffee and Registration.

09.00 - 09.35 Global Wave Loads on Damaged Ship Structures: An Experimental Procedure and Some Preliminary Results
D. Fone, T. Smith, J. Borg and K. Drake, University College London

When a ship is involved in a damage event, a rapid evaluation of residual structural integrity is required in order to provide quantifications that can aid the decision making process for emergency response. It is suggested that the effect on global structural loads caused by any flooding of ship compartments should be incorporated into a structural analysis when determining residual structural integrity. Results from the experiments will be used to validate tools being developed at University College London and The University of Southampton.

09.35 - 10.10 Simulations of Motions of a Damaged Ship
A. C. Gaillard and G. X. Wu, University College London
X. B. Chen, Bureau Veritas

Most simulation for ship motions in waves is based on an intact ship, or there is only fluid loading external to the ship. Research has been done for a ship with a liquid tank, such as an LNG. However, there is no direct link between the external and the internal flow, and their mutual interactions are through the motion of the ship. The present work is to consider the motion of a damaged ship. The external and internal flows are directly connected. This will have direct effect on both the external and internal loading.

10.10 - 10.45 Selecting the Safest Option after Damage - A Tool for Decision Support
A. Martin, QinetiQ Ship Structures Team

When a ship suffers a collision or grounding that results in significant structural damage, the owner must rapidly decide whether the vessel is structurally sound enough to continue, whether to wait for assistance, or to plot courses to suitable ports for repair. This was the situation faced by the UK MoD in July 2002 when HMS Nottingham struck a rock off the coast of Lord Howe Island. This accident spurred research into a tool able to inform the decision making process, under a programme known as DALAS. This paper will describe the background to, and development of the DALAS tool, together with examples of its use to select the safest option after a ship has suffered structural damage.

10.45 - 11.15 Coffee

11.15 - 11.50 The Structural and Stability Assessment and Subsequent Recovery of a Damaged Lifeboat
A. Harman, N. Chaplin, H. Phillips and S. Austen, RNLI

Whilst on operational service at night in rough seas, a Severn Class lifeboat grounded in shallow water off a remote island, instigating a salvage operation. The original design requirements for this class of lifeboat and the construction methods used are described in conjunction with the sequence of events that took place from the point at which the vessel grounded. This includes the theoretical and practical stability and structural analyses that were carried out to establish the residual integrity of the lifeboat. The paper also details the evaluations of a variety of salvage options in terms of damaged stability and structural integrity that were investigated.

11.50 - 12.25 Use of Damage Ship Assessment Software for Emergency Response Support
S. Chudziak, QinetiQ

This paper discusses the use of computerised tools during an emergency response situation from both the view point of the crew and onshore technical support team. It takes into account aspects of the incident response chain in case of damage to a Royal Navy ship. Onboard loading software is now widely used onboard Royal Navy ships to assist the crew in assessing the damaged stability as well as the residual structural strength. These computerised tools can also assess different proposed recovery plans and thus help the crew to take an informed course of action.

12.25 - 13.00 A G.A. Based Decision Support Tool for Stability and Structural Viability Under Damage
Paulo Manuel Marques da Silva Triunfante Martins, Portugese Navy

As far as stability is concerned, stability calculators are available that allow for the ship's master to simulate any load condition and ensure that stability criteria are fulfilled. On the other hand, whatever stability or structural criteria are applied, it is impossible to foresee every possible damaged situation at every load condition. Therefore, this paper proposes a decision support tool to help the masters' decision after damage and to monitor the ship stability during operation.

13.00 - 14.00 Lunch

14.00 - 14.35 Refloating and Strength Assessment of Grounded Ships
P. Mangriotis, London Offshore Consultants

The refloating operation should avoid worsening the casualty situation. Calculation of the global longitudinal strength and the likely local loads together with an assessment of the residual structural capacity is required at each stage. The techniques and typical assumptions involved will be outlined and the refloating techniques employed by salvors in recent operations described. Finally, mention will be made of retrospective investigations into the risks involved during salvage in order to apportion salvage awards. Such investigations are made without the same time pressures and afford an opportunity for more detailed and accurate analysis.

14.35 - 15.10 Damage Decision Books for use by Masters on Vessels with no Computer Based Loading System
M. Simpson, Hart, Fenton & Co.

When a vessel is damaged, quick decisions by the master are critical to the successful outcome of an incident. Statutory damage stability books do not cover every damage scenario possible. Additional information in the form of damage decision books, covering all survivable damage scenarios, to enable the master to make an informed decision on the most appropriate course of action, are very useful. These books should be easy to use as it is hoped that they will not be used often.

15.10 - 15.40 Coffee

15.40 - 16.15 Expanding the Scope of Rapid Response Damage Assessment to Address Ultimate Strength - A Classification Society Perspective
G. Wang, ABS

This paper will highlight these major enhancements of the ABS RRDA program, and describe the current development and application of the advanced software tools that can be quickly applied to support timely engineering analysis and informed decisions in the immediate aftermath of an incident.

16.15 - 16.50 MoD Salvage Response to HMS ENDURANCE in the Magellan Strait in December 2008
J. Ward, M. Watts and D. Price, MoD

In December 2008, the Royal Navy's Ice Patrol Ship, HMS ENDURANCE, suffered a major flood in the Engine Room, resulting in the ship losing power and drifting in marginal weather conditions in the Magellan Strait. This paper describes the Salvage and Marine Operations Team response to the incident, including mobilisation of the deployed salvage team, activities in theatre to stabilise the vessel and recover the Engine Room, and details of the technical liaison with responding operating and design authorities in the UK.

16.50 - 17.25 Tollerable Safety of Damaged Naval Ships
S. Marshall, Sea Systems Group, MoD

One of the key elements of naval doctrine is the ability to absorb substantial damage before becoming non-operational. In terms of damage stability this has traditionally been delivered for naval ships through the application of damage extents relating to hostile threats. It has generally been assumed that this also provides adequate survivability against mercantile accidents such as collision & grounding. Military damage stability standards can be tailored by navies to reflect the ship role and survivability requirements, thus defining the ship "capability". This is illustrated by warships having a high degree of survivability and naval auxiliaries being closer to mercantile standards. It is however, becoming more common for navies to adopt minimum safety levels that are as least as effective as merchant ships. Whilst naval ships are exempt from IMO conventions, compliance may compromise their war-fighting capability and may not adequately protect the asset from minor damage.

17.25 - 17.30 General Discussion

International Conference

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