
STAB&S 2021

1st International Conference
on the Stability and Safety of Ships and Ocean Vehicles

7-11 June 2021, Glasgow, Scotland, UK



STAB&S 2021

Conference Programme

Organisation



UNIVERSITY of STRATHCLYDE
**MARITIME SAFETY
RESEARCH CENTRE**

Sponsors



Preface

The First International Conference on the Stability and Safety of Ships and Ocean Vehicles will take place online from 7 to 11 June 2021. It is the successor of two successful series of conferences: the International Conferences on the Stability of Ships and Ocean Vehicles (STAB) and the International Maritime Conferences on Design for Safety (DfS). STAB&S 2021 is organised by the Maritime Safety Research Centre, Department of Naval Architecture, Ocean, and Marine Engineering, University of Strathclyde, Glasgow, Scotland.

History

In 1975, Professor Chengi Kuo organised in Glasgow the first International Conference on the Stability of Ships and Ocean Vehicles that has become the flagship conference in this field. In 1994/95 Professor Sevastianov organised stability workshops in Kaliningrad by invitation, which led to the first International Stability Workshop organised by Professor Vassalos in Glasgow in 1995. The following year has seen the introduction of the first “Design for Safety” Conference, again in Glasgow. With a combined history of some 70 years, a joint Conference was organised in Japan in 2018 bringing these two Conferences together and laying the foundation for a wider-audience Conference in the marine sector that addresses stability and safety together.

The subject of stability has been a keen focus, catalysing a process of discovery and achievement at the highest of levels, serving in the process the marine industry and laying the foundations for the wider implications afforded to maritime safety. Indeed, ship safety permeates all physical and temporal boundaries, embracing and nurturing socio-technical influences to affect and define the life cycle of ships and marine assets in the most profound way. As such, the subject of ship safety is one of the fastest changing topics, absorbing all forms of knowledge in the strife to respond to unrelenting societal pressure for higher safety standards and do so cost-effectively.

Topics

Considering our previous history, Glasgow has been selected once again to lay the foundation for widening the historical stability focus to embrace other key contributors to maritime safety without derailing the traditional first-principles approach and scientific rigour that characterises our core

(stability) group. In the first instance, the target is to focus on established disciplines and groups in maritime safety to ensure maximum immediate benefit and hence encouragement for broader participation and co-operation by Industry, Government and Academia. These include:

- Intact & Damage Stability
- Fire Safety
- Evacuation
- Operational Safety
- Human Factors
- Cyber-physical Systems & Autonomous Vessels
- Structural Reliability and Crashworthiness
- Design for Safety, Risk-Based Design, Life-cycle Risk Management
- Ship Salvage and Emergency Response
- Innovative Safety Concepts, Theories and Methodologies

Opening Address

Emphasis will be not only on widening the focus but also on identifying common threads to foster wider integration, hence maximise impact. This, in turn, nurtures better understanding of the need and capability for stability/safety enhancement in the maritime sector and facilitates and supports the regulation-making process at IMO. Who better to state emphatically this than the Secretary General of the IMO Mr Kitack Lim who will open the Conference, sending a clear message the world over of the need for vigilance and continuous development when **safety of life at sea** is the focus.

At a glance

The STAB&S 2021 conference programme includes:

- 12 keynote speeches
- 14 technical sessions and 5 workshops
- 109 technical papers
- 5 workshop papers and 8 presentations

The full programme is outlined in the following pages, with all times shown in UTC+1 (British Summer Time).

Day 1 – Monday, 7th June 2021

Opening & Keynotes

Opening of the Conference & Welcome Speeches

Chair: Prof Dracos Vassalos,
University of Strathclyde
d.vassalos@strath.ac.uk

Time (UTC+1)	
11:00	Welcoming of delegates Prof Feargal Brennan, Head of Naval Architecture, Ocean & Marine Engineering Department, <i>University of Strathclyde</i>
11:15	Opening of the conference & Welcome address Prof Atilla Incecik, Dean of Engineering, <i>University of Strathclyde</i>
11:30	Opening keynote Mr Kitack Lim, IMO Secretary General, <i>IMO</i>
11:45	Welcome addresses Prof Kostas Spyrou, Chair of the International Standing Committee, <i>National Technical University of Athens</i> Prof Dracos Vassalos, Chair of the Conference, <i>University of Strathclyde</i>

Keynote Presentations

Chair: Prof Osman Turan,
University of Strathclyde
o.turan@strath.ac.uk

12:00	Keynote 1 "Closing the safety gap in the era of transformation" Dr Pierre Sames, <i>DNV</i>
12:15	Keynote 2 "Stability of perfect solids" Prof Kostas Spyrou, <i>National Technical University of Athens</i>
12:30	Keynote 3 "The impact of intact and damage stability regulations on cruise ship design" Prof Henning Luhmann, <i>Meyerwerft</i>
12:45	Discussion & Break Prof Osman Turan, <i>University of Strathclyde</i>
13:00	End of Plenary Sessions

Session 1

Intact Stability

Chair: Prof Naoya Umeda,
Osaka University
umeda@naoe.eng.osaka-u.ac.jp

Fire Safety

Chair: Alessandro Maccari,
RINA
alessandro.maccari@rina.org

Innovation in Ship Design

Chair: Prof Evangelos Boulougouris,
University of Strathclyde
evangelos.boulougouris@strath.ac.uk

Time (UTC+1)			
13:00	<p>“An approach for the implementation of operational limitations in the level 1 vulnerability criterion for the dead ship condition” Gabriele Bulian et al., <i>University of Trieste</i></p>	<p>“An analysis of the parameters affecting the propagation of fire on the vehicle deck of a ro/ro passenger ship” Nikos Themelis et al., <i>National Technical University of Athens</i></p>	<p>“Innovation in ship design” Stuart Ballantyne, <i>Sea Transport Solutions Ltd.</i></p>
13:15	<p>“Parametric roll excited by low wave heights: a new method to predict critical sea states” Olger Koop et al., <i>Aktis Hydraulics</i></p>	<p>“A probabilistic method for assessing holistic fire safety of a cruise ship” Iiro Tapani Vanne, <i>Aalto University</i></p>	<p>“Holistic optimisation in ship design” Apostolos Papanikolaou, <i>National Technical University of Athens</i></p>
13:30	<p>“Probabilistic estimation of large heel due to broaching associated with surf-riding for a ship in short-created irregular waves and its experimental validation” Kazuma Matsubara et al., <i>Osaka University</i></p>	<p>“Fire prevention and mitigation measures onboard large passenger ships” Alexandros Komianos et al., <i>University of Strathclyde</i></p>	<p>“Ship Design Innovation - Lessons Learnt” Markku Kanerva, <i>Mare Consulting Oy</i></p>
13:45	<p>Discussion & Break Prof Naoya Umeda, <i>Osaka University</i></p>	<p>Discussion & Break Alessandro Maccari, <i>RINA</i></p>	<p>Discussion & Break Prof Evangelos Boulougouris, <i>University of Strathclyde</i></p>
14:00	End of Session 1		

Session 2

Intact Stability

Chair: Prof Kostas Spyrou,
National Technical University of Athens
spyrou@deslab.ntua.gr

Human Factors

Chair: Dr Rafet Emek Kurt,
University of Strathclyde
rafet.kurt@strath.ac.uk

Time (UTC+1)		
14:00	<p>"Course stability assessment of a ship on surf-riding conditions using the computed hydrodynamic derivatives by CFD" Chengqian Ma et al., <i>Shanghai Jiao Tong University</i></p>	<p>"An analysis of accidents in inland navigation in context of autonomous shipping" Igor Bačkalov et al., <i>University of Belgrade</i></p>
14:15	<p>"Overview and applications about operational measures in the framework of second-generation intact stability criteria" Nicola Petacco et al., <i>University of Genoa</i></p>	<p>"Analysis of reporting systems in safety critical domains to develop the SHIELD HF taxonomy." Luca Save et al., <i>Deep Blue srl</i></p>
14:30	<p>"New aspects of stochastic evaluation of random roll motion of ships" Atsuo Maki et al., <i>Osaka University</i></p>	<p>"Enhancing a shipping company's safety through utilization of safety KPIs" Saleh Ghonaim et al., <i>King Abdulaziz University</i></p>
14:45	<p>Discussion & Break Prof Kostas Spyrou, <i>National Technical University of Athens</i></p>	<p>Discussion & Break Dr Rafet Emek Kurt, <i>University of Strathclyde</i></p>
15:00	End of Session 2	

Workshop 1

Intact Stability

Chair: Prof Naoya Umeda,

Osaka University

umeda@naoe.eng.osaka-u.ac.jp

Time (UTC+1)	
15:00	"The experimental and numerical study of the ship parametric rolling at irregular wave groups" Shan Ma et al., <i>Harbin Engineering University</i>
15:10	"Towards a better accuracy in the draught survey" Francois Grinnaert et al., <i>Ecole Nationale Supérieure Maritime</i>
15:20	"An iterative method to estimate damping coefficients from roll decay time series" Vivien Kristopher Luthy et al., <i>CMA CGM</i>
15:30	Discussion & Break Prof Naoya Umeda, <i>Osaka University</i>
15:40	-
16:00	End of Day 1

Day 2 – Tuesday, 8th June 2021

Keynotes

Keynote Presentations

Chair: Prof Gerasimos Theotokatos,
University of Strathclyde

gerasimos.theotokatos@strath.ac.uk

Time (UTC+1)	
11:00	Keynote 4 "Computational modelling techniques for the structural crashworthiness analysis in extreme conditions and accidents: recent advances and challenges" Prof Jeom Kee Paik, <i>Pusan National university</i>
11:15	Keynote 5 "Towards a more general and flexible ship damage stability assessment framework" Prof Gabriele Bulian, <i>University of Trieste</i>
11:30	Keynote 6 "Maritime accident investigations and role of EMSA" Enrico Gironella, <i>EMSA</i>
11:45	Discussion & Break Prof Gerasimos Theotokatos, <i>University of Strathclyde</i>
12:00	End of Plenary Session

Session 3

Intact Stability

Chair: Prof Luis Perez Rojas,
Universidad Politécnica de Madrid
luis.perezrojas@upm.es

Structural Integrity & Crashworthiness

Chair: Prof Spyros Hirdaris,
Aalto University
spyros.hirdaris@aalto.fi

Operational Safety

Chair: Dr Jan de Kat,
ABS
jdekat@eagle.org

Time (UTC+1)			
12:00	<p>“Numerical Investigation on the Effect of bilge keels in ship roll damping” Ioannis Taro Spyrou et al., <i>National Technical University of Athens</i></p>	<p>“The influence of collisions-based crashworthiness on passenger ship damage stability analysis” Fabien Conti et al., <i>BV Marine & Offshore</i></p>	<p>“Establishing uncertainty analysis procedures for inaccuracies in operational ship stability” Hossein Enshaei, <i>University of Tasmania</i></p>
12:15	<p>“Study on a new stability failure model in stern quartering waves” Jiang Lu et al., <i>China Ship Scientific Research Centre</i></p>	<p>“Accidental limit state based safety assessment of LNG-fuelled containerships in collisions” Su Kyeong Kim et al., <i>Pusan National University</i></p>	<p>“Potential risks affecting navigation safety in narrow waterways: Çanakkale and Istanbul straits case study” Ahmet Lutfi Tunçel et al., <i>Istanbul Technical University</i></p>
12:30	<p>“Limits of applicability of linear seakeeping within the framework of multifidelity modeling” Timothy Smith, <i>Naval Surface Warfare Center</i></p>	<p>“A comparison of crashworthiness methods for the assessment of ship damage extents” Hervé Le Sourne et al., <i>ICAM, Institut Catholique d'Arts et Métiers</i></p>	<p>“Experimental and theoretical determination of natural roll periods of ships in deep and shallow water” Larissa Jannsen et al., <i>Hamburg University of Technology</i></p>
12:45	<p>Discussion Prof Luis Perez Rojas, <i>Universidad Politécnica de Madrid</i></p>	<p>Discussion Prof Spyros Hirdaris, <i>Aalto University</i></p>	<p>Discussion Dr Jan de Kat, <i>ABS</i></p>
13:00	End of Session 3		

Session 4

Intact Stability

Chair: Prof Marcos Míguez González,
Universidade da Coruña
marcos.miguez@udc.es

Damage Stability

Chair: Prof Dimitris Konovessis,
Singapore Institute of Technology
dimitrios.konovessis@singaporetech.edu.sg

Design for Safety, Risk-based Design & Lifecycle Risk Management

Chair: Dr Pierre Sames,
DNV
pierre.sames@dnvgl.com

Time (UTC+1)			
13:00	<p>“An alternative vulnerability criteria: An example presentation format for pure loss of stability” William Peters et al., <i>Office of Design and Engineering Standards</i></p>	<p>“Benchmark study on simulation of flooding progression” Pekka Ruponen et al, <i>NAPA</i></p>	<p>“Development of collision and grounding accident database for large passenger ships” Mujeeb Ahmed Mughadar Palliparambil et al., <i>University of Strathclyde</i></p>
13:15	<p>“Influence of deck submergence events on extreme properties of wave-induced VBM” Dr Vadim Belenky et al., <i>David Taylor Model Basin</i></p>	<p>“Damage stability of passenger ships: Smart methods to identify critical scenarios” Francesco Mauro et al., <i>University of Strathclyde</i></p>	<p>“An online risk assessment tool to improve the standards of ship recycling operations” Siti Fariya et al., <i>University of Strathclyde</i></p>
13:30	<p>“Bifurcations in roll responses of uncoupled parametric roll equation and its estimation by an averaging method” Masahiro Sakai et al., <i>Osaka University</i></p>	<p>“Evolutionary developments of ship stability and safety measurement” Dracos Vassalos et al., <i>University of Strathclyde</i></p>	<p>“A rational approach to life-cycle stability management for passenger ships” Dracos Vassalos et al., <i>University of Strathclyde</i></p>
13:45	<p>Discussion & Break Prof Marcos Míguez González, <i>Universidade da Coruña</i></p>	<p>Discussion & Break Prof Dimitris Konovessis, <i>Singapore Institute of Technology</i></p>	<p>Discussion & Break Dr Pierre Sames, <i>DNV</i></p>
14:00	End of Session 4		

Session 5

Intact Stability
Chair: Prof Gabriele Bulian,
University of Trieste
gbulian@units.it

Innovative Safety Concepts, Theories, and Methodologies
Chair: Dr Vadim Belenki,
CIV USN NSWC
vadim.belenky@navy.mil

Cyber Physical Systems & Autonomous vessels
Chair: Ørnulf Jan Rødseth,
SINTEF Ocean
OrnulfJan.Rodseth@sintef.no

Time (UTC+1)			
14:00	"Natural roll period of river-sea ships" Stefan Rudaković et al., <i>University of Belgrade</i>	"A maritime collective view on safety management" Chengi Kuo et al., <i>University of Strathclyde</i>	"Evolution of the maritime autonomous surface ships: An administrative perspective" Mikko Valtteri Laine et al., <i>Finnish Transport and Communications Agency</i>
14:15	"Excessive acceleration criterion applied to an Indonesian ro-ro ferry" Daeng Paroka et al., <i>Hasanuddin University</i>	"The concept of a maritime risk management process" Thomas Finne, <i>Novia UAS</i>	"Feasibility study on the use of evolution strategy: CMA-ES for ship automatic docking problem" Dimas M. Rachman et al., <i>Osaka University</i>
14:30	"Investigation into false negative cases for low freeboard ships in vulnerability criteria of dead ship stability" Satoko Munakata et al., <i>Osaka University</i>	"Predicting extreme loads and the processes for predicting them efficiently and with confidence" Arthur M. Reed, <i>David Taylor Model Basin</i>	"Robotics and autonomous systems for in-service inspection of ships" Alessandro Grasso et al., <i>RINA</i>
14:45	Discussion & Break Prof Gabriele Bulian, <i>University of Trieste</i>	Discussion & Break Dr Vadim Belenki, <i>CIV USN NSWC</i>	Discussion & Break Ørnulf Jan Rødseth, <i>SINTEF Ocean</i>
15:00	End of Session 5		

Workshop 2

ShipFC Project

Chair: Dr Nicky Trivyza,
University of Strathclyde
nikoletta.trivyza@strath.ac.uk

Time (UTC+1)	
15:00	Welcome Tore Boge, Project Coordinator for the ShipFC Project
15:10	ShipFC Prof Evangelos Boulougouris, <i>University of Strathclyde</i> Tjalve Magnusson Svendsen, <i>Prototech</i>
15:20	Flagships-project Alexandre Bellot, Project Coordinator Low Carbon Shipping, <i>LMG Marin</i>
15:30	Hydro – the world’s first hydrogen ferry Ivan Østvik, Project Manager, <i>Norled</i>
15:40	Discussion & Break Dr Nicky Trivyza, <i>University of Strathclyde</i>
16:00	End of Day 2

Day 3 – Wednesday, 9th June 2021

Keynotes

Keynote Presentations

Chair: Prof Evangelos Boulougouris,
University of Strathclyde

evangelos.boulougouris@strath.ac.uk

Time (UTC+1)	
11:00	Keynote 7 "Cruise Ship Design for Operational Safety" Prof Tor Svensen, <i>RCL</i>
11:15	Keynote 8 "Overview of legislation on evacuation, search and rescue for large passenger ships" Mr Fernando Pou Feliu, <i>EMSA</i>
11:30	Keynote 9 "Operational safety of containerships" Dr Jan de Kat, <i>ABS</i>
11:45	Discussion & Break Prof Evangelos Boulougouris, <i>University of Strathclyde</i>
12:00	End of Plenary Session

Session 6

Intact Stability

Chair: Dr Atsuo Maki,
Osaka University
maki@naoe.eng.osaka-u.ac.jp

Evacuation, Salvage & Emergency Response

Chair: Prof Nikolaos Ventikos,
National Technical University of Athens
niven@deslab.ntua.gr

Human Factors

Chair: Prof Özcan Arslan,
Istanbul Technical University
arslano@itu.edu.tr

Time (UTC+1)			
12:00	<p>“Investigation on broaching detection parameters and their influence on broaching risk assessment” Christian Lena et al., <i>MARIN</i></p>	<p>“Reducing ship evacuation time: The case of a rail platform for integrating novel lifeboats on ship architectural structures” Prof Nikolaos Ventikos et al., <i>National Technical University of Athens</i></p>	<p>“Automatic collision avoidance for ships, conceptual perception and numerical validation” Hesham Ahmed Abdushkour, et al., <i>King Abdulaziz University</i></p>
12:15	<p>“Critical wave group implementation with computational fluid dynamics and neural networks” Kevin M. Silva et al., <i>Naval Surface Warfare Center Carderock Division</i></p>	<p>“Norwegian tools for maritime emergency response, planning and operation phases” Tor Einar Berg et al., <i>SINTEF Ocean</i></p>	<p>“Analysis of maritime accidents due to poor situational awareness” Mohammad Emad Gommosani et al., <i>University of Strathclyde</i></p>
12:30	<p>“Characteristics of roll damping of pure car carrier and liquefied natural gas carrier and applicability of Ikeda’s method with some modifications” Prof Toru Katayama et al., <i>Osaka Prefecture University</i></p>	<p>Discussion & Break Prof Nikolaos Ventikos, <i>National Technical University of Athens</i></p>	<p>Discussion & Break Prof Özcan Arslan, <i>Istanbul Technical University</i></p>
12:45	<p>Discussion & Break Dr Atsuo Maki, <i>Osaka University</i></p>	-	-
13:00	End of Session 6		

Session 7

Intact Stability

Chair: Prof Nikos Themelis,
*National Technical
University of Athens*
nthemelis@naval.ntua.gr

Fire Safety

Chair: Mr Antoine
Breuillard, *BV Marine &
Offshore*
[antoine.breuillard@bureau
veritas.com](mailto:antoine.breuillard@bureauveritas.com)

Innovative Safety Concepts, Theories & Methodologies

Chair: Dr Vadim Belenky,
DTMB
vadim.belenky@navy.mil

Time (UTC+1)			
13:00	<p>“Broaching-to of sailing yachts” Manolis Angelou et al., <i>National Technical University of Athens</i></p>	<p>“Video image oil mist and fire detection” Rick Jeffress, <i>Fike Corporation</i></p>	<p>“Stability assessment of the river-sea vessel train” Stefan Rudaković et al., <i>University of Belgrade</i></p>
13:15	<p>“Experimental study on the water-on-deck effect for an offshore supply vessel running in regular and irregular stern quartering waves” Sreenath Subramaniam et al., <i>Osaka University</i></p>	<p>“Method for the definition of fire ignition frequency based on type of ro-ro spaces in ro-ro ships” Eric De Carvalho et al., <i>BV Marine & Offshore</i></p>	<p>“A computer program for lifecycle flooding risk assessment according to the FLARE framework process” Romain Michalec et al., <i>University of Strathclyde</i></p>
13:30	<p>“On extreme properties of impact-induced VBM” Themis Sapsis et al., <i>Massachusetts Institute of Technology</i></p>	<p>“Design fires for vehicle decks of ro/ro passenger ships” Ioanna Koromila et al., <i>National Technical University of Athens</i></p>	<p>“BE OPEN project – European forum and oBsEratory for OPEN science in transport (BEOPEN): TOPOS observatory for individuals” Ioannis Ergas, <i>WEGEMPT</i></p>
13:45	<p>Discussion & Break Dr Nikos Themelis, <i>National Technical University of Athens</i></p>	<p>Discussion & Break Mr Antoine Breuillard, <i>BV Marine & Offshore</i></p>	<p>Discussion & Break Dr Vadim Belenky, <i>DTMB</i></p>
14:00	End of Session 7		

Session 8

Intact Stability

Chair: Prof Ermina Begovic, *University of Naples Federico II*
begovic@unina.it

Damage Stability

Chair: Prof Dimitris Konovessis, Singapore Institute of Technology
dimitrios.konovessis@singaporetech.edu.sg

Operational Safety

Chair: Prof Toru Katayama, Osaka Prefecture University
katayama@marine.osaka-pu.ac.jp

Time (UTC+1)			
14:00	<p>“Computation of parametric roll amplitude using energy method considering non-linear GZ in resonance condition” Vivien Luthy et al., <i>CMA CGM</i></p>	<p>“On the estimation of collision frequency and generation of collision scenarios from AIS big-data analysis” Mingyang Zhang et al., <i>Aalto University</i></p>	<p>“Turning maneuver as a potential cause of the next stability failure mode for a ship in operation” Tomasz Hinz et al., <i>Aalto University</i></p>
14:15	<p>“Continuation analysis of ship motions in Bi-chromatic following/quartering seas” Ioannis G. Tigkas et al., <i>University of West Attica</i></p>	<p>“Design methodology for realising unsinkable ships” Dracos Vassalos et al., <i>University of Strathclyde</i></p>	<p>“Operational measures for intact ship stability” Vladimir Shigunov et al., <i>DNV</i></p>
14:30	<p>“Critical analysis of stability tests on models carried out at the «Bassin d’essais descarènes» in the 1950’s: Contribution, addition and modern interest” Paul Creismeas et al., <i>DGA Hydrodynamics</i></p>	<p>“On the roll damping of intact and damaged ships” Petri Valanto et al., <i>Hamburg Ship Model Basin HSVA</i></p>	<p>“Increase safety of vessel operations by next minutes ocean wave and vessel motion predictions” Svein Olav Halstensen et al., <i>Norwegian Research Centre AS</i></p>
14:45	<p>Discussion & Break Prof Ermina Begovic, <i>University of Naples Federico II</i></p>	<p>Discussion & Break Prof Dimitris Konovessis, <i>Singapore Institute of Technology</i></p>	<p>Discussion & Break Prof Toru Katayama, <i>Osaka Prefecture University</i></p>
15:00	End of Session 8		

Workshop 3

TrAM Project

Chair: Prof Evangelos Boulougouris, *University of Strathclyde*
evangelos.boulougouris@strath.ac.uk

Time (UTC+1)	
15:00	Welcome Mikal Dahle, Project Coordinator, <i>KOLOMBUS AS</i>
15:10	“Risk assessments related to the design and construction of electric vessels” Edmund Tolo, R&D & Sales Manager, <i>Fjellstrand Yard</i>
15:20	“HAZID identification study of the world’s first electric fast ferry” Evangelos Boulougouris, <i>University of Strathclyde</i>
15:30	“Driving safety further” Roman Stoiber, Senior Vice President Product Management, <i>Corvus Energy</i>
15:40	Discussion & Break Prof Evangelos Boulougouris, <i>University of Strathclyde</i>
16:00	End of Day 3

Day 4 – Thursday, 10th June 2021

Keynotes

Keynote Presentations

Chair: Prof Gerasimos Theotokatos

University of Strathclyde

gerasimos.theotokatos@strath.ac.uk

Time (UTC+1)	
11:00	Keynote 10 "MCA perspective and activities for enabling MASS operations" Ruth Taylor, Autonomy Technical Specialist, <i>Maritime & Coastguard Agency</i>
11:15	Keynote 11 "JUST culture in maritime and aviation industries" Barry Kirwan, Safety Research Coordinator, <i>Eurocontrol</i>
11:30	Keynote 12 "Advances in the safety and assurance of autonomous ships" Prof Ingrid Bouwer Utne, <i>Norwegian University of Science and Technology</i>
11:45	Discussion & Break Prof Gerasimos Theotokatos, <i>University of Strathclyde</i>
12:00	End of Plenary Session

Session 9

Intact Stability

Chair: Prof Kevin Maki,
Michigan University
kjmaki@umich.edu

Design for Safety, Risk- Based Design, Lifecycle Risk Management

Chair: Prof Apostolos
Papanikolaou,
*National Technical University
of Athens*
papa@deslab.ntua.gr

Operational Safety

Chair: Dr Frans van Walree,
MARIN
F.v.Walree@marin.nl

Time (UTC+1)			
12:00	<p>“Model tests of amphibious operations in breaking waves” Eelco Harmsen, <i>MARIN</i></p>	<p>“Probabilistic damage distribution and risk modelling of collision and grounding accidents for large passenger ships” Mujeeb Ahmed Mughadar Palliparambil et al., <i>University of Strathclyde</i></p>	<p>“Operational measures in second generation intact stability criteria: Effect of source of environmental data” Gabriele Bulian et al., <i>University of Trieste</i></p>
12:15	<p>“Critical assessment of the limits of intact stability criteria applied to an ocean transport barge” Claudio Alexis Rodriguez-Castillo et al., <i>Federal University of Rio de Janeiro</i></p>	<p>“Model-based approach on the safety of a fuel cell ammonia supply system” Evangelos Boulougouris et al., <i>University of Strathclyde</i></p>	<p>“Comprehensive assessment method of course stability and minimum propulsion power of ship in adverse conditions” Xingyu Zhan et al., <i>Wuhan University of Technology</i></p>
12:30	<p>“Influence of ship ice accretion on the vulnerability of dead ship stability” Zhiyu Wan et al., <i>Dalian University of Technology</i></p>	<p>“On the use of a dynamic damage stability tool for assessment of structural ULS analysis and liquid cargo outflow in the SHARC project” Martin Schreuder, <i>Chalmers University of Technology</i></p>	<p>Discussion & Break Dr Frans van Walree, <i>MARIN</i></p>
12:45	<p>Discussion & Break Prof Kevin Maki, <i>Michigan University</i></p>	<p>Discussion & Break Prof Apostolos Papanikolaou, <i>National Technical University of Athens</i></p>	-
13:00	End of Session 9		

Session 10

Intact Stability

Chair: Prof Ning Ma,
*Shanghai Jiao Tong
University*
ningma@sjtu.edu.cn

Cyber Physical Systems & Autonomous Vessels

Chair: Prof Osiris Valdez
Banda,
Aalto University
osiris.valdez.banda@aalto.fi

Damage Stability

Chair: Prof Dimitris
Konovessis,
*Singapore Institute of
Technology*
[dimitrios.konovesis@
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Time (UTC+1)			
13:00	<p>“Time-domain simulation of the manoeuvring performance of ships in regular waves and shallow water” Christos Pollalis et al., <i>National Technical University of Athens</i></p>	<p>“Fault tree analysis of autonomous navigation for marine autonomous surface ships” Paul Lee et al., <i>University of Strathclyde</i></p>	<p>“Conception and evolution of the probabilistic method for damage stability assessment” Dracos Vassalos et al., <i>University of Strathclyde</i></p>
13:15	<p>“Case studies of SGISC operational limitations for pure loss of stability and excessive acceleration” Ermina Begovic et al., <i>University of Naples Federico II</i></p>	<p>“Improving safety of interactions between conventional and autonomous ships” Ørnulf Jan Rødseth et al., <i>SINTEF Ocean</i></p>	<p>“Damage stability index potential revealed by direct time-domain flooding calculations of intermediate cases” Katja Aschenberg et al., <i>Hamburg University of Technology</i></p>
13:30	<p>“Study on the numerical model of direct stability assessment under dead ship condition” Zeng Ke et al., <i>China Ship Scientific Research Centre</i></p>	<p>“Introduction to artificial immune Systems: A literature review on autonomous navigation applications” Nikolaos Ventikos et al., <i>National Technical University of Athens</i></p>	<p>“Unified Viscous and Potential Prediction Method of Damaged Ship Motion Coupled with floodwater in regular waves” Shuxia Bu et al., <i>China Ship Scientific Research Center</i></p>
13:45	<p>Discussion & Break Prof Ning Ma, <i>Shanghai Jiao Tong University</i></p>	<p>Discussion & Break Prof Osiris Valdez Banda, <i>Aalto University</i></p>	<p>Discussion & Break Prof Dimitris Konovessis, <i>Singapore Institute of Technology</i></p>
14:00	End of Session 10		

Session 11

Intact Stability

Chair: Dr Vadim Belenky,
DTMB
vadim.belenky@navy.mil

Human Factors

Chair: Prof Osman Turan,
University of Strathclyde
o.turan@strath.ac.uk

Damage Stability

Chair: Prof Apostolos
Papanikolaou,
*National Technical
University of Athens*
papa@deslab.ntua.gr

Time (UTC+1)			
14:00	<p>“A stochastically precluded Karhunen-Loève representation for recovering extreme statistics in ship dynamics” Stephen Guth et al., <i>Massachusetts Institute of Technology</i></p>	<p>“A comprehensive analysis of human factors in maritime accidents by applying SHIELD HF Taxonomy” Beatriz Navas de Maya et al., <i>University of Strathclyde</i></p>	<p>“A steady and unsteady internal flooding model utilizing a network and graph solver” Riaan van 't Veer, et al., <i>MARIN</i></p>
14:15	<p>“A new stochastic framework for ship capsizing” Luminita Manuela Bujorianu et al., <i>University of Strathclyde</i></p>	<p>“Human reliability analysis (HRA) using fuzzy cognitive reliability and error analysis method” Esma Strait Uflaz et al., <i>Istanbul Technical University</i></p>	<p>“Evolution of the damage stability calculations from a software perspective” Rodrigo Perez Fernandez, <i>SENER</i></p>
14:30	<p>“Calibrating multifidelity ship motion codes through regression” Vladas Pipiras et al., <i>University of North Carolina</i></p>	<p>“Creation of an occurrence analysis & learning centre for maritime (OALC-M): Results from EU funded SAFEMODE Project” Beatriz Navas de Maya et al., <i>CalMac Ferries Limited & University of Strathclyde</i></p>	<p>“Numerical methods and concepts for ship damage stability and flooding risk assessment” Dracos Vassalos et al., <i>University of Strathclyde</i></p>
14:45	<p>Discussion & Break Dr Vadim Belenky, <i>DTMB</i></p>	<p>Discussion & Break Prof Osman Turan, <i>University of Strathclyde</i></p>	<p>Discussion & Break Prof Apostolos Papanikolaou, <i>National Technical University of Athens</i></p>
15:00	End of Session 8		

Workshop 4

Autonomous Ships

Chair: Prof Gerasimos Theotokatos,
University of Strathclyde
gerasimos.theotokatos@strath.ac.uk

Time (UTC+1)	
15:00	“Developing the convoy method for autonomous vessels” Daria Minakova et al., <i>Novia University of Applied Sciences</i>
15:10	“Towards a holistic approach to autonomous collision avoidance and stability control” Stein Haugen et al., <i>Norwegian University of Science and Technology</i>
15:20	“Autonomous ships – Regulatory scoping exercise on safety and security related instruments” Henrik Tunfors, <i>Swedish Transport Agency</i>
15:35	Discussion & Break Prof Gerasimos Theotokatos, <i>University of Strathclyde</i>
16:00	End of session

Meeting of the International Standing Committee

Time (UTC+1)	
16:00 – 18:00	Members of the ISC only

Day 5 – Friday, 11th June 2021

Session 12

Intact Stability

Chair: Prof Hirotsada
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Osaka Prefecture University
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Fire Safety

Chair: Mr Alessandro
Maccari,
RINA
alessandro.maccari@rina.org

Cyber Physical Systems & Autonomous Vessels

Chair: Mr Ørnulf Jan
Rødseth,
SINTEF Ocean
OrnulfJan.Rodseth@sintef.no

Time (UTC+1)			
11:00	<p>“Investigation on wave surging forces under surf-riding condition using CFD method” Haichun Zhang et al., <i>Ocean University of China</i></p>	<p>“A quantitative criterion to assess early detection for fire safety” Antoine Cassez et al., <i>BV Marine & Offshore</i></p>	<p>“Aboa Mare remote operation center” Johanna Salokannel et al., <i>Novia University of Applied Sciences</i></p>
11:15	<p>“Numerical simulation of VBM extreme values” Kenneth Weems et al., <i>David Taylor Model Basin & Naval Surface Warfare Center Carderock Division</i></p>	<p>“Experimental study of radiation attenuation using water curtains in a reduced-scale deck of a ro-ro ship” Davood Zeinali et al., <i>LEMMA</i></p>	<p>“Ships traffic encounter scenarios generation using sampling and clustering techniques” Victor Bolbot, <i>University of Strathclyde</i></p>
11:30	<p>Discussion & Break Prof Hirotsada Hashimoto, <i>Osaka Prefecture University</i></p>	<p>“An application of the FRAM methodology on maritime incidents: A resilience approach to look on risks during expected and unexpected situations” Georgios V. Lykos et al., <i>National Technical University of Athens</i></p>	<p>Discussion & Break Mr Ørnulf Jan Rødseth, <i>SINTEF Ocean</i></p>
11:45	-	<p>Discussion & Break Mr Alessandro Maccari, <i>RINA</i></p>	-
12:00	End of Session 12		

Session 13

Damage Stability

Chair: Prof Luis Perez Rojas,
Universidad Politécnica de Madrid
luis.perezrojas@upm.es

Operational Safety

Chair: Prof Toru Katayama,
Osaka Prefecture University
katayama@marine.osakafu-u.ac.jp

Mixed Session

Chair: Dr Frans van Walree,
MARIN
F.v.Walree@marin.nl

Time (UTC+1)			
12:00	<p>“Adding damage zones to a nonzonal damage stability approach” Stefan Krueger et al., <i>Hamburg University of Technology</i></p>	<p>“On rudder-roll stabilization autopilot system based on response models” Daisuke Terada et al., <i>National Defense Academy</i></p>	<p>“Method for automated safe seakeeping guidance” Michael Levine et al., <i>David Taylor Model Basin & Naval Surface Warfare Center Carderock Division</i></p>
12:15	<p>“A damage sampling method to reduce A-index standard deviation in the probabilistic assessment of ship survivability while using a non-zonal approach” Francesco Mauro et al., <i>University of Strathclyde</i></p>	<p>“Selection of model-based system engineering language for ship pilotage” Sunil Basnet et al., <i>Aalto University</i></p>	<p>“On the practical determination of the roll-axis” Lars Johnsen et al., <i>Hamburg University of Technology</i></p>
12:30	<p>“Development of damage stability criteria based on dynamic performance” Federico Prini et al., <i>QinetiQ</i></p>	<p>Discussion & Break Prof Toru Katayama, <i>Osaka Prefecture University</i></p>	<p>Discussion & Break Dr Frans van Walree, <i>MARIN</i></p>
12:45	<p>Discussion & Break Prof Luis Perez Rojas, <i>Universidad Politécnica de Madrid</i></p>	-	-
13:00	End of Session 13		

Session 14

Operational Safety

Chair: Hendrik Bruhns,
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Human Factors

Chair: Prof Özcan Arslan,
Istanbul Technical University
arslano@itu.edu.tr

Damage Stability

Chair: Mr William Peters,
USCG
William.S.Peters@uscg.mil

Time (UTC+1)			
13:00	<p>"Enhancing vessel's operational safety using convolutional neural networks and big data techniques"</p> <p>Panayiotis Theodoropoulos et al., <i>Prisma Electronics SA</i></p>	<p>"Insights from review and analysis of occupational accidents on board ships"</p> <p>Ramirez Marengo et al., <i>University of Strathclyde</i></p>	<p>"Flooding risk assessment for passenger ships"</p> <p>Dracos Vassalos et al., <i>University of Strathclyde</i></p>
13:15	<p>"Evaluation of preventive and protective measures against collision risk to bridge piers in 1915 Çanakkale bridge"</p> <p>Muhammed Fatih Gulen et al., <i>Istanbul Technical University</i></p>	<p>"Prediction of human error probability for conventional buoy mooring (CBM) cargo operation under interval type-2 HEART approach."</p> <p>Seher Suendam Arici et al., <i>Istanbul Technical University</i></p>	<p>"The effectiveness of crashworthiness as a damage stability risk control option"</p> <p>Hongseok Bae et al., <i>University of Strathclyde</i></p>
13:30	<p>"Application of operational limitations to the parametric rolling failure mode"</p> <p>Hirotsada Hashimoto et al., <i>Osaka Prefecture University</i></p>	<p>Discussion & Break</p> <p>Prof Özcan Arslan, <i>Istanbul Technical University</i></p>	<p>Discussion & Break</p> <p>Mr William Peters, <i>USCG</i></p>
13:45	<p>Discussion & Break</p> <p>Hendrik Bruhns, <i>Herbert Engineering Corp.</i></p>	-	-
14:00	End of Session 14		

Workshop 5

Accident Investigation

Chair: Dr Rafet Emek Kurt,
University of Strathclyde
rafet.kurt@strath.ac.uk

Time (UTC+1)	
14:00	<p>"Application of SAFEMODE Projects barrier-based risk models to support accident analysis process"</p> <p>Dr Clementina Ramirez Marengo, <i>University of Strathclyde</i></p>
14:10	<p>"Development of a risk parameter for industrial fishing vessels port state control related to accidents and loss of life"</p> <p>Dr Miguel J Nunez-Sanchez et al., <i>Universidad Politecnica de Madrid</i></p>
14:20	<p>"CalMac's approach on learning from accidents and near misses"</p> <p>Ms Francesca Wade, <i>Calmac</i> Mr Louis De Wolff, <i>Calmac</i></p>
14:30	<p>"Maritime accident investigation: challenges and opportunities"</p> <p>Will Tutton, <i>MAIB</i></p>
14:40	<p>Discussion & Break</p> <p>Dr Rafet Emek Kurt, <i>University of Strathclyde</i></p>
15:00	End of Session

Closing

Time (UTC+1)	
15:00	Invitation address Chair of STAB 2022 Workshop
15:15	Invitation Address Chair of STAB&S 2024
15:30	Address to the conference New Chair of STAB&S
15:45	Closing remarks Prof Dracos Vassalos, <i>University of Strathclyde</i> Prof Kostas Spyrou, <i>National Technical University of Athens</i>
16:00	End of Day 5

Special Issues

Papers were accepted based on quality and relevance to the conference themes. All accepted papers will be published as the conference proceedings (online PDF format), while the best/selected papers will be recommended for publication consideration on the following special issues:

- Special Issue in Ocean Engineering Journal (Elsevier).
- Contemporary Ideas on Ship Stability Book (Springer).
- Ongoing discussions with other Journals and Publishers.

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Prof Apostolos Papanikolaou and Dr Pierre Sames

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Innovative Safety Concepts, Theories and Methodologies

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UNIVERSITY of STRATHCLYDE
**MARITIME SAFETY
RESEARCH CENTRE**

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The Naval Architecture, Ocean & Marine Engineering Department ([NAOME](#)) has a strong workforce of 24 fulltime academic staff, 20 postdoctoral researchers and 80 PhD students, one of the largest research resources in the maritime engineering field. The name of Strathclyde is synonymous with maritime engineering/marine technology research with more than five decades of sustained research and development at the highest of levels and with over 100 large-scale projects, instigated and/or led by NAOME. The Department continues to spearhead numerous initiatives with a pivotal role in promoting innovation and pioneering research supporting industry and the regulatory process.

The Maritime Safety Research Centre ([MSRC](#)) was established at NAOME with substantial funding from the industry. The vision, long-term and short-term goals and objectives are set, shared and served through close collaboration between industry and academia to target a truly interdisciplinary, common-threaded R&D in maritime safety.

Strathclyde's campus is in the centre of Glasgow, one of the UK's largest and most dynamic cities. Glasgow has been named as one of the top 20 'Best of the World' destinations for 2016 by National Geographic Traveller, the city has also been voted the 'friendliest city in the world' in a Rough Guides poll and named a must visit destination by leading publications like the New York Times, The Guardian and Wanderlust!

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Standard Fee: £100

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Excessive Acceleration Criterion Applied to an Indonesia Ro-Ro Ferry

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ABSTRACT

Most Indonesian ro-ro ferries may vulnerable to excessive acceleration because the metacentric height generally more significant than 8% of ship breadth, and the passenger accommodation is located in a high position on superstructure above the vehicle deck. This paper discusses applying the Second Generation Intact Stability Criteria (SGISC) excessive acceleration criterion to an Indonesian ro-ro ferry. The results show that the ship complied with vulnerable to level 1 of excessive acceleration criteria. The ship was vulnerable to criteria level 1. The metacentric height for the ship passes level 1 was 1.60 meters for the crew accommodation and 1.70 meters for the executive passenger accommodation. The ship passes level 2 of excessive acceleration for all passengers and crew accommodations even using the wave scatter recommended by IMO if the metacentric height smaller than 5.89 meters.

Keywords: *excessive acceleration, ro-ro ferry, stability criteria, metacentric height*

1. INTRODUCTION

The new generation intact stability criteria address five stability failures in waves: dead ship condition, parametric rolling, pure loss of stability, surf riding/broaching-to, and excessive acceleration. A physical model was developed for each phenomenon, and a multi-layer approach was used to assess the vulnerability of a ship in three levels. A ship should not fail at least one of the three levels assessments for each loading condition. If the ship fails in level 1, the ship should be tested for the vulnerability criteria level 2. If the ship does not pass level 2 of vulnerability, then a direct stability assessment must be performed with a six-degree freedom simulation of ship

behaviour in a seaway. The next step of the Second Generation Intact Stability Criteria is to provide operational guidance or operational limitation (Baccadamo and Rosano, 2019).

The investigation result of the accident triggered the excessive acceleration criterion onboard container ship CHICAGO EXPRESS in 2008 and CCNI Guayas in 2009 (Federal Bureau of Marine Casualty Investigation of Germany, 2008; 2011). The investigation of the accidents showed that a small roll period due to large metacentric height and low roll damping due to speed loss in waves lead to a large lateral acceleration of more than 1.0 of gravity acceleration, causing injuries and fatality. After the accidents, Germany submitted a document

to IMO to include the excessive acceleration as a part of the SGISC (IMO, 2009). Sample calculations based on the draft criterion of excessive acceleration have been conducted for different ship type and dimension with different standard values for level 1 and level 2 criteria (IMO, 2015a; IMO, 2016). Some inconsistencies between level 1 and level 2 were found. Therefore, IMO determined the standard values for level 1 and level 2 to be adopted in the excessive acceleration criterion (IMO, 2018). The criterion was also determined the ship characteristics should be tested, namely a ship with passengers and crew accommodations located more than 70% of ship breadth above the waterline or to a ship with metacentric height larger than 8% of ship breadth (IMO, 2015b) for each loading condition. This requirement means that a ship with a high location of passengers and crew accommodations and a large metacentric height should be tested against the excessive acceleration criterion.

The Indonesian ro-ro ferries were characterized by breadth-to-draught ratio ranges between 3.0 to 8.0 (Paroka et al., 2020a). Most of the ships have a breadth-to-draught ratio larger than 3.50 that used a maximum ratio to develop the weather criterion. The ships were designed with a large breadth to fulfil the required deck area for vehicles. The ship's draught was smaller than the other ship type because most ferry ports in Indonesia with shallow water. As a result, the metacentric radius of the ships becomes larger. However, the vertical centre of gravity was large because all payload located above the main deck (the main deck is used as vehicle deck, and the passenger accommodation is located on the superstructure above the vehicle deck), the metacentric height of Indonesian ro-ro ferries mostly larger than the other ships types with similar dimension. Most Indonesia ro-ro ferries have a metacentric height larger than 8% of ship breadth. Some ships have a metacentric height larger than 30% of ship breadth. As a result, the natural roll period could be smaller than the minimum natural roll period given in

the weather criterion of the International Maritime Organization (IMO), mainly for small ro-ro ferries (Paroka et al., 2021).

The Indonesian ro-ro ferries may vulnerable to excessive acceleration, mainly in the resonance frequency of roll motion. With a large metacentric height, the natural roll period becomes smaller. When the ship experiences a large roll angle, the angular velocity of roll motion could be largely due to the small roll period. The ship may lead to a large lateral acceleration lead to excessive acceleration. Cargo damage such as a car shift in the vehicle deck, which could lead to a significant static heeling angle, could occur due to the lateral acceleration. Excessive acceleration could also affect passenger comfort, mainly if the passenger accommodation is located in a higher position on the ship. Some cases of furniture damage on the passenger accommodation deck and a truck at the vehicle deck overthrown have been found in some accidents. Therefore, excessive acceleration becomes essential to evaluate to avoid cargo damage, a static heeling angle that can induce unstable condition to lead to capsizing and passenger comfort.

This paper discusses the measurement of the excessive acceleration of an Indonesian ro-ro ferry based on the Second Generation Intact Stability Criteria of IMO. The purpose is to identify whether the Indonesian ro-ro ferries vulnerable to excessive acceleration. This identification is important because mostly the Indonesian ro-ro ferries have large metacentric height. The height of passenger accommodation from the waterline may be larger than 70% of the ship breadth because passenger and crew accommodations of Indonesian ro-ro ferries are mostly located above the main deck (used as vehicle deck). The obtained results could be used to develop operational guidance, including a fastening method to avoid car movement at vehicle deck and designing the ships in the future, mainly to determine passenger and crew accommodation.

2. METHODOLOGY

2.1 Ship Data

An Indonesian ro-ro ferry built in an Indonesian shipyard was used as a sample ship in this paper. The principle dimension and the ship's general arrangement are shown in Table 1 and Figure 1, respectively. The ship was designed to load 15 trucks and six small cars on the vehicle deck with distribution, as shown in Figure 1. The passenger accommodation for 212 passengers was divided into three different locations of accommodations. An economic class with a sleeping bed facility for 96 passengers is located at a distance from the after perpendicular of 6.65 meters to 19.35 meters. An economic class with chairs for 84 passengers is located with distance from the after perpendicular between 21.41 meters and 30.05 meters. There is also an executive class with a sleeping bed for 32 passengers located between 35.18 meters and 39.65 meters from the after perpendicular. The superstructure for passenger accommodation is located above the vehicle deck with a height of 5.96 meters from the waterline. This distance is smaller than 70% of ship breadth. Detail about the location of passenger accommodation was shown in Figure 1.

Table 1. Ship principle dimension

Item	Dimension
Length (L_{pp})	47.25 m
Breadth (B)	13.00 m
Depth (D)	3.40 m
Draught (d)	2.40 m
Metacentric height (GM)	4.72 m
Service speed	12 knot

The crew accommodation was located in the superstructure above the passenger's accommodations with a height of 8.34 meters. This distance is also smaller than 70% of ship breadth. The distance from the after perpendicular ranges between 27.26 meters to 41.49 meters. Twenty-four persons of ship crew occupy this space.

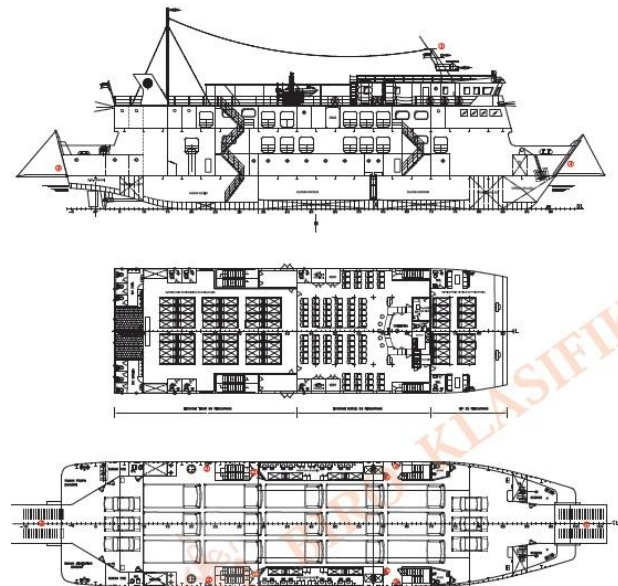


Figure 1. General arrangement

The natural roll period and the damping coefficients consist of linear and quadratic damping coefficients were determined by model experiment (Paroka et al., 2021). The non-dimensional logarithmic decrement of roll decay could be determined with two approaches. Here, the formulae proposed in the SDC 3/INF.11 (IMO, 2015b) was used even the result of roll decay test for the subject ship available. The effective wave slope coefficient for variation of wave frequency is calculated using the simplified Froude-Krylov moment with the assumption of a rectangular section of the ship hull. The cosine and sine parts of the Froude-Krylov wave exciting moment are determined under the assumption that the ship hull form is laterally symmetric (IMO, 2015b). The wet moment of inertia of roll was determined based on the radius gyration coefficient obtained by using the formula in the weather criterion (IMO, 2008). The equivalent linear damping coefficient was stochastically determined based on the linear and quadratic damping coefficients.

The vulnerability criteria level 1 and level 2 for excessive acceleration were calculated for

3. RESULTS AND DISCUSSION

The vulnerability level 1 of excessive acceleration criteria for each passenger accommodation and crew accommodation is shown in Figure 2. The legend indicated by Pass_1 corresponds to the economic class of passenger accommodation with sleeping bed, Pass_2 designate the economic class of passenger accommodation with chairs, and Pass_3 corresponds to the executive class of passenger accommodation. The legend indicated by Crew is location crew accommodation. Here, the non-dimensional logarithmic decrement of roll decay was determined based on the formulae recommended by IMO (IMO, 2015b). The subject ship was vulnerable against level 1 criteria for all passenger accommodations and the location of crew accommodation. The ship would comply with the criteria if the metacentric height for full loading condition were 1.60 meters or 12.3% of ship breadth for the crew accommodation and 1.70 meters or 13.1% of ship breadth for VIP passenger accommodation with a sleeping bed. For the others passenger accommodations, the metacentric height corresponds to vulnerability criteria level 1 was larger than 1.70 meters. These metacentric heights were larger than the minimum metacentric height of ships recommended by IMO (IMO, 2015b) to test against excessive acceleration. This metacentric height is larger than that obtained by the vulnerability criteria level 1 for dead ship condition (Paroka et al., 2020b).

For the metacentric height of the subject ship in full loading condition, the lateral acceleration corresponds to the level 1 criteria was 7.92 for the crew accommodation and 7.33 for VIP passenger accommodation with a sleeping bed. These results show that the ship could vulnerable to excessive acceleration level 1 even the height of crew or passenger accommodations from the waterline is smaller than 70% of ship breadth, but the metacentric height of the ship is larger than 8% of ship

breadth, mainly if the accommodation rooms are located in the forepart of the ship. The metacentric height of the subject ship was 36% of ship breadth.

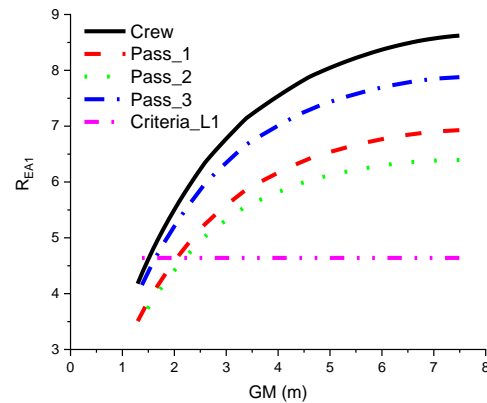


Figure 2. Vulnerability level 1 for passenger and crew accommodations

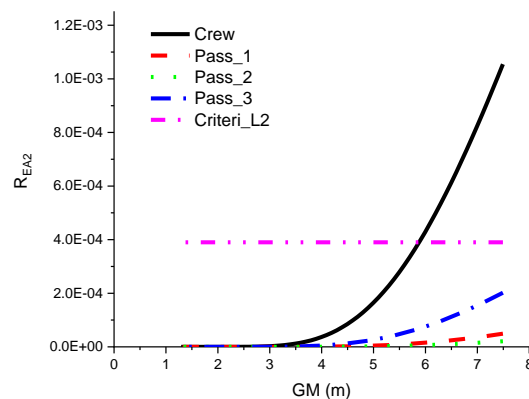


Figure 3. Vulnerability criteria level 2 for passenger and crew accommodations with wave data of IMO

Based on these results, the ship should be tested for the vulnerability criteria level 2 with results shown in Figure 3 for each crew and passengers accommodations, respectively. The ship complies with the criteria in full loading condition with a metacentric height of 4.72 meters. The minimum metacentric height for the crew accommodation vulnerable to level 2 is 5.89 meters. The long-term probability index for the passenger's accommodations is smaller than the minimum value of the long-term

probability index for which the ship vulnerable to excessive acceleration for all tested metacentric height. These results showed consistency of level 1 and level 2 criteria.

A smaller value of the long-term probability index for excessive acceleration was obtained if the scatter wave data of the operational area of the ship shown in Table 2 is used. The long-term probability index with this wave data was shown in Figure 4. The ship was not vulnerable to excessive acceleration, even for the crew accommodation. The long-term probability indexes are very small compared to the minimum requirement values correspond to vulnerability due to excessive acceleration. A significant difference of long-term probability index due to wave data between the IMO recommended wave data, and the wave data of the ferry route was obtained. These results mean that the wave data play an essential role regarding the excessive acceleration criteria.

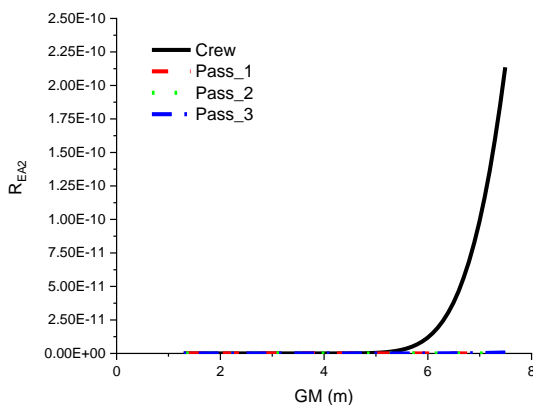


Figure 4. Vulnerability criteria level 2 for passenger and crew accommodations with wave data of Lombok Strait

Even the long-term probability index of excessive acceleration is smaller than the value determined in SGISC, excessive acceleration could occur in a particular wave characteristic, but the occurrence probability of such wave is very small. Therefore the long-term probability becomes small. Even the obtained probability

is small, a short-term probability analysis for each combination of wave height and wave period seems to be essential to obtain the operational limits of the ship.

Figure 5 shows that the maximum wave height for each metacentric height with short-term probability is the same as the standard value of the long-term probability index for ship vulnerable to the excessive acceleration criteria level 2. Here, the mean wave period was calculated using Pierson-Moskowitz's formulae (Umeda and Yamakoshi, 1994).

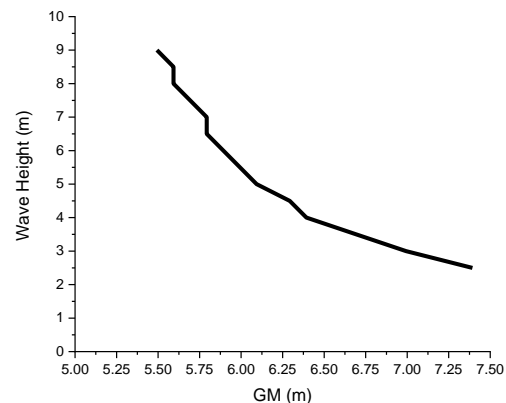


Figure 5. The limit of significant wave height corresponds to metacentric height.

The ship could be vulnerable to excessive acceleration when the significant wave height is larger than 2.0 meters if the ship's metacentric height becomes 7.39 meters. The wave height for the ship vulnerable due to excessive acceleration increases when the metacentric height decreases. The ship's metacentric height with a short-term probability of excessive acceleration larger than the standard value of long-term probability index given in SGISC is smaller than the metacentric height for full loading condition even for a significant wave height of 9.0 meters. Nevertheless, the ship may not be operated in such wave condition because the ship does not comply with other criteria, namely dead ship condition.

The non-dimensional logarithmic decrement of roll decay in criterion level 1 could be smaller than that obtained by a model experiment. Therefore, the metacentric height for the ship that complies with the level 1 criterion seems to overestimate compared to the metacentric height corresponds to the level 2 criterion. Therefore, the level 1 criterion should be tested using the non-dimensional logarithmic decrement of roll decay obtained by a model experiment. The other factor that should be considered regarding stability evaluation that corresponds to excessive acceleration is the effective wave slope coefficient and the damping coefficient, mainly for a ship with a small draught and large metacentric height. Figure 6 showed the effective wave slope coefficient for the level 1 and level 2 criteria obtained by the model experiment for resonance frequency.

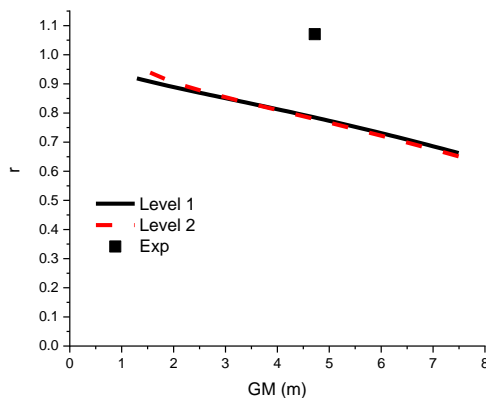


Figure 6. The effective wave slope coefficient

The effective wave slope coefficient for the level 1 and the level 2 criteria was smaller than that obtained by a model experiment. The minimum metacentric height for ship comply with the excessive acceleration criteria becomes smaller when the effective wave slope coefficient obtained by the model experiment is used (Paroka et al., 2021). However, the model experiment is impossible to conduct for all wave frequencies as required to calculate the long-term probability index of excessive acceleration in level 2 of the vulnerability criterion.

4. CONCLUSIONS

The excessive acceleration criteria of Second Generation Intact Stability Criteria has been applied to an Indonesian ro-ro ferry. Level 1 and level 2 of vulnerability to excessive acceleration have been calculated for three passenger accommodation and crew accommodation locations. The ship was vulnerable against the level 1 criterion, but the ship complies with the level 2 criterion. The minimum metacentric height for the ship complies with the level 1 criterion was 1.60 meters. This metacentric height is larger than 8% of ship breadth. The location of passengers and crew accommodation plays an essential role in the excessive acceleration criteria. Therefore, the placement of passengers and crew accommodation in the design of the Indonesian ro-ro ferry should consider the excessive acceleration criterion.

The ship could be vulnerable to excessive acceleration in a particular wave characteristic. Maximum wave height for the ship complies with the excessive acceleration criteria increases when the metacentric height decreases. The ship in full loading condition will vulnerable due to excessive acceleration if the ship operates in a significant wave height of 9.0 meters or larger, but it is impossible for the subject ship because the ship could fail in the other criteria.

The scatter wave data has a significant effect on the long-term probability of excessive acceleration. Therefore, scatter wave data correspond to Indonesian seas should be developed in the future considering the application of Second Generation Intact Stability Criteria to Indonesian ro-ro ferry. The present used scatter wave data were provided only for one route of the ro-ro ferry.

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6. REFERENCES

- Baccadamo, G., and Rosano, G., 2019, "Excessive Acceleration Criterion: Application to Naval Ships", *Journal of Marine Science and Engineering*, Vol. 7, pp. 1 – 17.
- Berrisford, P., Dee, D.P., Poli, P., Brugge, R., Fielding, K., Fuentes, M., Kallberg, P.W., Kobayashi, S., Uppala, S., and Simmons, A., 2011, "The ERA-Interim Archive Version 2.0. Report Series 1", <http://ecmwf.int/en/elibrary/8174>.
- Federal Bureau of Marine Casualty Investigation, 2009, "Fatal Accident on Board the CMV CHICAGO EXPRESS during Typhoon "HAGUPIT" 24 September 2008 off the coast of Hong Kong", Investigation Report 510/08, Germany.
- Federal Bureau of Marine Casualty Investigation, 2011, "Fatal Accident on Board the CMV CCNI GUAYAS during Typhoon "KOPPU" 15 September 2009 in the Sea Area of Hong Kong (Including Analysis of Serious Marine Casualty 520/09 Pilot Injured on Board the CMV FRISIA LISSABON on 16 October 2009 West of Bokum on the Westerems)", Investigation Report 391/09, Germany.
- IMO, 2008, "The International Code on Intact Stability", MSC.267(85), London.
- IMO, 2009, "Development of New Generation Intact Stability Criteria: Proposal with Regard to the Scope of New Generation Criteria", SLF 52/3/5, London.
- IMO, 2015a, "Information Collected by the Correspondence Group on Intact Stability Regarding Second Generation Intact Stability Criteria", SDC 3/INF. 10, London.
- IMO, 2015b, "Finalization of Second Generation Intact Stability Criteria: Information for Criteria and Explanatory Notes for Excessive Acceleration Stability Failure Mode", SDC 3/INF. 11, London.
- IMO, 2016, "Finalization of Second Generation Intact Stability Criteria: Information Collected by the Correspondence Group on Intact Stability", SDC 4/INF. 4/Add. 2, London.
- IMO, 2018, "Report of the Correspondence Group (Part 1)", SDC 6/5, London.
- Ogawa, Y., 2015, "An Investigation of a Safety Level in Terms of Excessive Acceleration in Rough Seas", *Proceedings of 12th International Conference on the Stability of Ships and Ocean Vehicles*, pp. 251 – 260.
- Paroka, D., 2014, "Indonesian Seas Characteristics: A Basis for Developing Local Stability Criteria", *Jurnal Teknik BKI Propulsion*, Vol. 1, pp. 31 – 40 (in Indonesia).
- Paroka, D., Muhammad, A.H., and Rahman, S., 2020a, "Estimation of Effective Wave Slope Coefficient of Ships with Large Breadth to Draught Ratio", *KAPAL: Jurnal Sains dan Teknologi Kelautan*, Vol. 17, pp. 40 – 49.
- Paroka, D., Muhammad, A.H., and Rahman, S., 2020b, "Minimum Requirements Righting Arm Characteristics Regarding Stability of a Ship in Beam Waves", *Proceedings of the 12th International Conference on Marine Technology*.
- Paroka, D., Muhammad, A.H., and Rahman, S., 2021, "Hydrodynamics Factors Correspond the Weather Criterion Applied to an Indonesian Ro-Ro Ferry with Different Weight Distribution", *International Journal*

of Technology, Vol. 12, pp. 126 – 138.

Umeda, N., and Yamakoshi, Y., 1994,
“Probability of Ship Capsizing due to Pure
Loss of Stability in Quartering Seas”, Naval
Architecture and Ocean Engineering, Vol.
30, pp. 73 – 85.

