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# ON THE LINEAR AND NON-LINEAR DYNAMIC HYDROELASTIC RESPONSE ANALYSIS OF AN OFF-SHORE DRILLSHIP ELASTIC STRUCTURE

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## ABSTRACT

*This paper is focused on the short-term hydroelastic dynamic response analysis of an off-shore drillship, under irregular waves. The drillship has a length of 210 m, with elastic hull girder having the first natural vibration frequency around 0.725 Hz, according to the loading case. The hydroelastic analysis is carried out with the authors' program DYN, for one trial speed and two loading cases, under head irregular wave excitation Longuet-Higgins model with first order ITTC spectrum. The dynamic response includes oscillations and global vibrations, linear and non-linear, being modelled also the hydroelastic phenomena of springing (steady state response) and whipping (transient response) induced by slamming (bottom and side). Based on numerical results, in average, the vibration components represent 15%, on linear analysis, and 30%, on non-linear analysis, from the oscillation components. Also, there are obtained significant differences between the two loading cases on total stress level, being higher in the case of larger ship displacement. The short-term dynamic response analysis of the drillship has pointed out that the hydroelastic components are significant and have to be considered on long-term fatigue analysis for realistic structural safety assessment.*

**Keywords:** linear and non-linear hydroelasticity analysis, irregular waves, off-shore drillship elastic structure

## REFERENCES

[1]. **Bertram, V.,** *"Practical Ship Hydrodynamics"*, Butterworth Heinemann, Oxford, 2000.
[2]. **Bishop, R.E.D., Price, W.G.,** *"Hydroelasticity of Ships"*, University Press, Cambridge, 1979.
[3]. **Domnisoru, L., Domnisoru, D.,** *"The Unified Analysis of Springing and Whipping Phenomena"*, Transactions of the Royal Institution of Naval Architects London 140(A), pp. 19-36, 1998.
[4]. **Domnisoru, L., Domnisoru, D.,** *"Experimental Analysis of Springing and Whipping Phenomena"*, International Shipbuilding Progress Delft 47(450), pp. 129-140, 2000.
[5]. **Domnisoru, L.,** *"Ship Dynamics. Oscillations and Vibrations"*, Technical Publishing House, Bucharest, 2001.
[6]. **Domnisoru, L., Rubanenco, I., Mirciu, I.,** *"The DYN programs package for the analysis of ship dynamic loads from oscillations and global vibrations"*, Naval Architecture Faculty, "Dunarea de Jos" University, Galati, 2009-2013.
[7]. **Faltinsen, O.M.**, *"Sea loads on ships and offshore structures"*, Cambridge University Press, 1993.
[8]. **GL,** *"Hull Structures Rules"*, Germanischer Lloyd's, Hamburg, 2013.
[9]. **Hirdaris, S.E., Chunhua, G.,** *"Review and introduction to hydroelasticity of ships"*, Report No.8, Lloyd's Register, London, 2005.
[10]. **Ozsoysal, R.,** *"A Review of Recent Ship Vibration Papers"*, The Shock and Vibration Digest 5(36), pp. 207-214, 2004.
[11]. **Park, J.H., Temarel, P.,** *"The Influence of Nonlinearities on Wave-induced Motions and Loads Predicted by Two-dimensional Hydroelasticity Analysis"*, PRADS-American Bureau of Shipping Houston 1, pp. 27-34, 2007.
[12]. **Perunovic, J.V., Jensen, J.J.,** *"Non-linear Springing Excitation due to a Bi-directional Wave Field"*, Marine Structures 18, pp. 332-358, 2005.

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# RESEARCH ON THE NEW CONCEPT OF DANUBE PUSHBOAT

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## ABSTRACT

*Part of EU Strategy for the Danube Region, priority area 1a, Mobility / Inland Waterways, the program "Innovative Danube Vessel" includes the investigation of the level of performance for different ship types and ship concepts under realistic conditions of navigation on Danube. One of the most common ship types on Danube is represented by pushers. The scope of the present research is to set the main characteristics of a new push boat concept, well adapted to the navigation on Danube River. The research is focused on main dimensions in relation with the actual and predicted conditions of navigation (length, breadth, draught, air draft), propulsion solutions for a better efficiency (type of propeller, propeller diameter in relation with draught, number of propellers, type of transmission), LNG (Liquefied Natural Gas) fuelling (emission requirements, regulations, gas / dual fuel engines, gas storage and processing, safety requirements, approval procedure) and ship arrangement (arrangement of different types of pushers, classic, azimuth gas-electric, dual fuel and solutions for the improvement of ship aspect).*

**Keywords:** pusher, Danube, navigation, main dimensions, propulsion, LNG fuel

## REFERENCES

[1]. **ECE**, *"Directive 2006/87/EC"*.
[2]. **Bureau Veritas,** *"Rules for the Classification of Inland Navigation Vessel"*, 2011.
[3]. **Germanischer Lloyd,** "*Guidelines for the Use of Gas as Fuel for Ships*".
[4]. **COMMISSION CENTRALE POUR LA NAVIGATION DU RHIN**., *"Règlement de visite des bateaux du Rhin (RVBR) - Projet de prescriptions pour les bateaux de la navigation intérieure utilisant du GNL pour leur propulsion"*, 2013.
**[5].** **ECE,** *"ADN Carriage of liquefied natural gas (LNG)-UN No. 1972"*.
[6]. **IMO,** *"IGC code"*.
[7]. **IMO**, *"MSC.285(86) Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships"*.
[8]. **AFDJ Galati,** *"RIS information"*, http://www.afdj.ro.
[9]. **Via Donau,** *"RIS information"*, http://www.via-donau.org/
http://www.doris.bmvit.gv.at/en/.
[10]. **Caterpillar,** *"Product information"*, http://www.cat.com/.
[11]. **Scania,** *"Product information"*, http://www.scania.com/.
[12]. **Mitsubishi,** *"Product information"*, http://www.mitsubishi.com.
[13]. **Danube Comission,** *"Danube Navigation"* http://www.danubecommission.org/.
[14]. **Hamworthy Gas Systems AS,** *"LNG Fuel Gas Systems"*.
[15]. **Wartsila Oy:** *"2xLNGPac H60 for a 39m River Pusher, equipped with 2xW6L20DF Engines"* .
[16]. **ProDanube Int., "***On cost and energy efficiency of innovative Danube vessels"*, Duisburg, November 2013.
[17]. **Ship Design Group, "***Propulsion design software*".
[18]. **Ovidiu Ionas**, *"Technical ships"*, Lectures notes, 2013 (in Romanian).
[19]. **Ovidiu Ionas, Octavian Dumitriu**, *"Analysis of 1500 t barge for performance enhancing", T*he Annals of "Dunarea de Jos" University of Galati, Fascicle XI – Shipbuilding, Galati University Press, ISSN 1221-4620, pp. 27-34, 2012.
[20]. **Ovidiu Ionas,** *"Naval Architecture*", Lectures notes, 2013 (in Romanian).

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# SEAKEEPING ANALYSIS: A KEY FOR THE FUTURE YACHT DESIGN

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**ABSTRACT**

*Motion sickness aboard ships has always been a concerning issue for people prone to this and to those seating next to them as well. The pleasure crafts as maritime yachts are presenting a particular combination of aggravating factors because they mix the relatively small size, the light weight and high speed, thus resulting in higher values for vertical accelerations as compared to conventional ships. This paper presents a comparative preliminary study performed for the Black Sea area using three maxi-yachts designed in Italy and a completely new design that has been conceived for a new hull form. The starting point of the new design comes from the already existing mega yacht "Yacht A".*

**Keywords:** seakeeping, yacht design, accelerations, comfort aboard.

## REFERENCES

[1]. **Bâzâc**, **C**., *"Studiul regimului vânturilor în zona litoralului românesc al Mării Negre"*, Institutul Național de Meteorologie și Hidrologie, Raport intern, (in Romanian), București, Decembrie 1988.

[2]. **Bhattacharyya**, **R**., *"Dynamics of Marine Vehicles"*, John Wiley & Sons Publishing House, New York, 1982.

[3]. **Bondar**, **C.**, *"Studiul regimului hidrologic al Mării Negre în Zona Lebăda"*, Institutul de Meteorologie și Hidrologie, Raport intern (in Romanian), București, Decembrie 1988.

[4]. **Caramatescu**, **A**, *"Seakeeping Analysis: A Key for Passenger's Comfort Evaluation. Application for a Typical Maritime Yacht", Master Thesis* 23rd ITTC, Universitatea Dunarea de Jos din Galati, 2013.

[5]. **Domnișoru**, **L**., *"Dinamica navei oscilații si vibrații ale corpului navei"*, (in Romanian), Editura Tehnica, București, 2001.

[6]. **Nabergoj**, **R**., *"Passenger comfort and seakeeping: a new challenge for high-tech ship design"*, Proceedings of SMALL CRAFT, An International Conference on Small Craft Related Sciences & Technology, 16–18 November 2006, Bodrum, Turkey.

[7]. **Obreja**, **D**., *"Teoria navei. Concepte și metode de analiză a performanțelor de navigație"*, Editura Didactică și Pedagogică, București, 2005.

[8]. ******* "Criteria for merchant ships, vertical and transverse accelerations, roll, slamming and deck wetness", NordForsk, ISBN 87-982637-1-4, 1987.

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# RESISTANCE TESTS IN A SMALL TOWING TANK WITH KCS MODEL

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## ABSTRACT

*The accuracy of ship resistance experimental model tests is a complex problem that involves a number of factors. One of the most important ones is the modelling scale which implicitly imposes the dimensions of the experimental model. The Towing Tank of the Faculty of Naval Architecture from Dunarea de Jos University of Galati has a small length, its main dimensions being 45 x 4 x 3 m, and is equipped with an automated towing carriage that can tow ship models with about 4 m maximum length. In the present research, a comparative analysis is made for the ship resistance experimental results that were obtained in the Dunarea de Jos University of Galati basin for the 3.502 m KCS container ship model and the ship resistance experimental results that were determined in the KRISO institute large size towing tank for a 7.279 m KCS model. The comparison proves that the average percentage differences are smaller than 2% and confirms the possibility to obtain satisfactory results for the experimental ship resistance estimation problem for similar types of ships in small length towing tanks.*

**Keywords:** ship resistance, experimental test, small model

## REFERENCES

[1]. **ITTC Recommended Procedures and Guidelines 7.5-01.01.01**, *"Ship models"*, 26th ITTC, 2011.
[2]. **ITTC Recommended Procedures and Guidelines 7.5-02.02.01**, *"Testing and Extrapolation Methods. Resistance Test"*, 23rd ITTC, 2002.
[3]. **Bertram**, **V.**, *"Practical Ship Hydrodynamics"*, Butterworth Heinemann, Oxford, 2000.
[4]. **Pechenyuk, A.W.**, *"Computation of perspective KRISO container ship towing tests with help of the complex of the hydrodynamical analysis Flow Vision"*, Digital Marine Technology.

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# STRESS CALCULATION IN THE HELICOPTER PLATFORM AND SUPPORTING STRUCTURE ON THE FPSO UNITS

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## ABSTRACT

*The present paper focuses on the numerical integration calculation of the helicopter platform and supporting structure (for the SIKORSY S92 helicopter) on the Floating Storage and Offloading (FSO) unit. The numerical analysis presented in this paper aims at optimizing and assessing the yielding and bucking of the supporting lattice structure for a helicopter platform of a FSO unit designed to be permanently moored in the North Sea. Due to the loads from the environmental conditions and to the PSA regulation, the positioning and the design of the helicopter platform and supporting structure are a complex issue. The numerical analyses are carried out with NASTRAN NX for FEMAP ver. 10.2 Finite Element Modelling and Post Processing and DNV Nauticus Hull – Buckling of Bars and Beams. The numerical results point out that the selected design of the helicopter platform and the supporting structure for the FSO unit will support all the loads transmitted by the operation of the SIKORSY S-92 helicopter.*

**Keywords:** numerical analysis, helicopter platform, FSO units, PSA regulations

## REFERENCES

[1]. **API 2A-WSD,** "*Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design*", Health & Safety Executive, 2007.
[2]. **Bertram, V.,** "*Practical Ship Hydrodynamics*", Butterworth Heinemann, Oxford, 2000.
[3]. **Bidoaie, I., Ionas, O.**, "*Naval architecture complements*" , Porto-Franco, Galati, 1998.
[4]. **CAP 437,** "*Offshore Helicopter landing Area - Guidance on Standards*", Civil Aviation Authority, 2010.
[5]. **Classification Notes No.30.1,** "*Buckling Strength Analysis of Bars and Frames, and Spherical Shells*", 2004.
[6]. **Domnisoru, L.,** "*Structural Analysis and Hydroelasticity of Ship*", The University Foundation "Dunarea de Jos" Publishing House, Galati, 2006.
[7]. **DNV-OS-C102,** "*Structural Design of Offshore Ships*", 2011.
[8]. **DNV-OS-E401,** "*Helicopter Deck*", 2012.
[9]. **DNV-RP-C205,** "*Environmental Conditions and Environmental Loads*", 2007.
[10]. **HSE,** "*Offshore Helideck Design Guidelines*", Health & Safety Executive, 2001.
[11]. **HSE,** "*The structural design of helideck for offshore installations*", Health & Safety Executive, 2013.
[12]. **Lehmann, E.,** "*Guidelines for Strength Analyses of Ship Structures with the Finite Element Method*", Hamburg: Germanischer Lloyd., 1998.
[13]. **OTH 92 379,** "*A Criterion for assessing wind induced cross flow vortex vibrations in wind sensitive structures*", 1992.
[14]. **Owen, F., Hughes, Jeom, Kee, Paik.,** "*Ship Structural Analysis and Design*", The Society of Naval Architects and Marine Engineers, New Jersey, 2010.
[15]. **Stoicescu, L., Domnisoru, L.,** "*Global-local strength analysis in head waves, for tanker with longitudinal uniform structure*", Taylor & Francis Group, London, 2007.
[16]. **Voitkunski, Y.I,** "*Ship Theory Handbook*", Sudostroenie, Sankt Petersburg, 1985.

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# NUMERICAL ANALYSIS OF A SHIP SIDE COLLISION STRUCTURAL RESPONSE, BASED ON THE FINITE ELEMENT METHOD

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## ABSTRACT

*This paper is focused on the collision structural damage numerical analysis, that can been encountered in the crash case between the bow structure and the side structure of two ships moving on collision course. In the first part of this study, there is included the preliminary evaluation of the structural side panel higher risk domains from an already designed ship engine room part, under equivalent quasi-static crash loads resulting from the collision case. There are analysed several scenarios, considering that the striking ship has a standard bulb and sea axe type bow. The equivalent quasi-static crash pressure has been applied on the ship side contact pattern corresponding to the striking bow shape, using a linear FEM analysis solution, and the structures are evaluated based on the strain energy values. In the second part, it is considered a crash analysis for a simplified side panel model, with single and double shell, developed with Siemens NX Nastran program and compared to experimental data and other numerical models from the reference literature. The striking bulbous bow shape is the same as in the experimental data reference, and the numerical crash analysis is carried out by a non-linear FEM solution. This study is delivering a simplified method for preliminary crash risk evaluation of the side structural panels and also the non-linear FEM results are pointing out the influence of the analysis parameters on the accuracy of the numerical crash simulation.*

**Keywords:** ship structures, collision scenarios, crash analysis, finite element method, benchmark analysis

## REFERENCES

[1]. **Bathe, K.J.**, *"Finite Element Procedures"*, 1996.
[2]. **Bathe, K.J. , Chapelle, D.**, *"The Finite Element Analysis of Shells. Fundamentals"*, Springer Publishing House, 2nd ed, 2011.
[3]. **Bathe, K.J., Bucalem, M.L.**, *"The Mechanics of Solids and Structures. Hierarchical Modelling and the Finite Element Solution"*, Springer Publishing House, 2011.
[4]. **Crisfield, M. A.,** *"Non-linear Finite Element Analysis of Solids and Structures"*, John Wiley & Sons Publishing House, 1991.
[5]. **Domnisoru, L.,***"The Finite Element Method in Shipbuilding"*, Technical Publishing House, Bucharest, 2001.
[6]. **Ehlers, S., Broekhuijsen, J., Hagbart, S., Alsos, Biehl F., Tabri K.,** *"Simulating the collision response of ship side structures. A failure criteria benchmark study"*, International Shipbuilding Progress, Vol. 55, No. 1-2, pp. 127-144, 2008.
[7]. **Eurocode 3**, *"Design of steel structures - General rules & rules for buildings"*,CEN, Brussels 2005.
[8]. **Germanischer Lloyd**, *"Rules for classification and construction, I-ship technology, part 1—seagoing ships"*, Germanischer Lloyd, 2013.
[9]. **Hinton, E,** *"Introduction to Nonlinear Finite Element Analysis"*,NAFEMS, Glasgow 1992.
[10]. **Hinton, E., Ezatt, M.,** *"Fundamental Tests for Two and Three Dimensional, Small Strain, Elastoplastic Finite Element Analysis"*,NAFEMS, Glasgow 1987.
[11]. **IACS,** *"Shipbuilding standard"*, 2008.
[12]. **Lehmann, E., Peschmann, J.**, *"Energy absorption by the steel structure of ships in the event of collisions"*, Marine Structures 15, 429–441, 2002.
[13]. **Kulzep, A., Peschmann, J.**, *"Side Collision of Double Hull Tankers (Seitenkollision vonDoppelhüllenschiffen)"*, Final Report of Life Cycle Design, Part D2A, Hamburg University of Technology, 1999.
[14]. **NAFEMS**, *"Nonlinear analysis"*, 2009.
[15]. **Odefey, M.**, *"Simulation of Collisions between RO-RO Vessels with Improved Double-Hull Designs – Influence of Modelling Parameters in Explicit Finite Element Analysis"*, 2011.
[16]. **Siemens**, *"SIEMENS NX 8.5, NX Nastran Documentation"*, 2012.
[17]. **Peschmann, J, Kulzep, A.** *"Seitenkollision von Doppelhullenschiffen (Side Collisions of Double Hull Ships)"*,Developments in Ship Technology, BMBF Status Seminar 1999, Verlag TUV Rheinland, 1999.
[18]. **Peschmann, J.**, *„Berechnung des Energieaufnahmevermogens der Stahlstruktur von Schiffen bei Kollisionen und Grundberuhrungen (Calculation of the energy absorption capability of the steel structure of ships during collisions and groundings)"*, PhD Thesis, Technical University of Hamburg, 2000.
[19]. **Wevers, LJ, Vredeveldt, AW**, *"Full scale ship collision experiments"*, 1998. TNO-report 98-CMC-R0359, TNO, Delft, 1999.

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# ENERGY EFFICIENCY IN SHIP DESIGN

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## ABSTRACT

*Although the shipping sector is the most economical and the most fuel efficient mode of freight transportation, the International Maritime Organization (IMO) scenarios show that, with the lack of serious measures, by 2050 the shipping greenhouse gases emission will have risen by about 150% - 250% compared to 2007. In order to control the $CO_2$ emission from shipping, IMO has developed the global $CO_2$ reduction index, known as the Energy Efficiency Design Index (EEDI). The EEDI for two ships is calculated and presented. As $CO_2$ depends on fuel consumption and fuel consumption depends on the total power requirements, measures must be taken to comply with the IMO regulations.*

**Keywords:** energy efficiency, EEDI, $CO_2$ emissions, greenhouse gases

## REFERENCES

[1]. ***,http://people.hofstra.edu/geotrans/eng/ch8en/conc8en/ch8c1en.html.

[2]. **United Nations Framework Convention on Climate Change**, *"Kyoto Protocol Reference Manual"*, 2008.

[3]. **International Maritime Organization**, *"Second IMO GHG Study", Phase1*, MEPC 59/INF.10, 2008/2009.

[4]. **International Maritime Organization**, *"Second IMO GHG Study", Phase2*, MEPC 59/INF.10, 2009.

[5]. **International Maritime Organization**, *"Study of Greenhouse Gas emissions from Ships"*, 2000.

[6]. **International Maritime Organization**, *MEPC, Circ. 471*, 2005.

[7]. **International Maritime Organization**, *MEPC 62nd session*, 11-15 July, 2011.

[8]. **Bureau Veritas**, *"Energy Efficiency Design Index-EEDI, Update on New Statutory Regulations From IMO MEPC 62"*, 2012.

[9]. **Kessler, J.,** *"Use of the wake equalizing duct of Schneekluth design on fast container vessels of medium size"*, Schneekluth Hydrodynamik Entwicklungs-und Vertiebs- GmbH, http://www.schneekluth.com/en/.

[10]. **Kim, K**., *"Energy Saving Devices – designby CFD and Model Testing"*, SSPA Sweden AB, 2010.

[11]. **Mewis, F**., *"A Novel power-Saving Device for Full-Form Vessels"*, First International Symposium on Marine Propulsors, SMP'09, Trondheim, Norway, June 2009.

[12]. **Chen, B.Y.H., Reed, A.M., Kim, K.H.,** *"A Vane-Wheel Propulsor for a Naval Auxiliary"*, Symposium on Hydrodynamic Performance Enhancement for Marine Applications, Newport, Rhode Island, 31 October - 1 November, 1988.

[13]. **Dang, J., Chen, H., Dong, G., van der Ploeg, A., Hallmann, R., Mauro, F.,** *"An Exploratory Study on the Working Principles of Energy Saving Devices (ESDs)"*, Symposium on Green Ship Technology (Greenship'2011), Wuxi, China, October 2011.

[14]. **G. Wursig, B. Scholz**, *"MSC.285(86) and Code for gas-fuelled ships (IGF-Code)-technical challenges and perspective"*, Germanisher Lloyd, 2011.

[15]. **AEA Energy & Environment**, *"Green-house gas emissions from shipping: trends, projections and abatement potential"*, Report, 2008.

[16]. **Det Norske Veritas**, *"Assessment of measures to reduce future CO2 emissions from shipping"*, 2010**.**

[17]. **Ionas, O.,** *"Natural gas as fuel for river going ships"*, The Annals of "Dunarea de Jos" University of Galati, Fascicle XI-Shipbuilding, pp 97-102, 2012.

[18]. **Ockels, W.J., Ruiterkamp, R., Landsorp, B.,** *"Ship propulsion by Kites combining energy production by laddermill principle and direct kite propulsion"*, Kite Sailing Symposium, Washington, USA, September 28-30, 2006.

[19]. **Naaijen, P., and Koster, V.,** *"Performance of auxiliary wind propulsion for merchant ships using a kite"*, The 2nd International Conference on Marine Research and Transportation, Naples, Italy, June 28-30, 2007.

[20]. **Erhard, M., Strauch, H.,** *"Control of Towing Kites Seagoing Vessels"*, arXiv preprint arXiv: 1202.3641, 2012.

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# EXPERIMENTAL MODEL RESISTANCE TESTS ON A GAS CARRIER BARGE

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## ABSTRACT

*In this paper are presented the resistance tests results obtained in the Towing Tank of "Dunarea de Jos" University of Galați, using the model of a gas carrier barge with goose-neck bulb. The experimental results are extrapolated to the full-scale ship by using the ITTC 1957 ship-model correlation line, without blockage corrections. A comparison between the experimental results and numerical computation based on Holtrop-Mennen method is performed and a satisfactory agreement is observed.*

**Keywords:** ship resistance, model test

## REFERENCES

[1]. **Obreja, D.**, *"Barge 10800 t. Experimental model resistance tests"*, Research Project no. 594, 2011.
[2]. **Pacuraru, F.**, *"Barge 10800 t. CFD lines plan and bulbous bow optimisation"*, Research Project no. 594, 2011.
[3]. **ITTC Recommended Procedures and Guidelines 7.5-01.01.01**, *"Ship models"*, 26rd ITTC, 2011.
[4]. **ITTC Recommended Procedures and Guidelines 7.5-02.02.01**, *"Testing and Extrapolation Methods. Resistance Test"*, 23rd ITTC, 2002.
[5]. **Bertram**, **V.**, *"Practical Ship Hydrodynamics"*, Butterworth Heinemann, Oxford, 2000.
[6]. **Holtrop, J.**, *"A Statistical Re-analysis of Resistance and Propulsion Data"*, International Shipbuilding Progress, Vol. 31, No. 363, 1984.
[7]. **Holtrop, J., Mennen, G.J.,** *"An Approximate Power Prediction Method"*, International Shipbuilding Progress, Vol. 29, No. 335, 1982.

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# THE EXPERIMENTAL AND NUMERICAL LINEAR AND NON-LINEAR ANALYSES OF OSCILLATIONS RESPONSE, BASED ON A SCALED ITTC TYPE SHIP MODEL

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## ABSTRACT

*This paper is focused on the experimental and numerical analyses of the heave and pitch coupled oscillations under regular head wave condition. The analyses are carried out on a scaled ITTC type ship model, with 2.918 m length, made of wood which can be considered as a rigid body, having the natural vibration frequencies higher than 10 Hz. The experimental analyses are carried out at the towing tank Galati Naval Architecture Faculty, considering a full loading case and two trial speeds 0 and 1 m/s. The experimental head regular waves generated at the towing tank are namely covering the resonance conditions with the ITTC model eigen heave and pitch oscillation modes. The linear and non-linear heave and pitch coupled oscillation numerical analyses are carried out with the authors' DYN_OSC program code, modelling the same ship hull characteristics and trial conditions as in the experimental analyses. This study is a first validation of the own program code for coupled heave and pitch ship oscillations analysis, being obtained a good correlation between the numerical and experimental results.*

**Keywords:** ITTC model, ship oscillations, towing tank, experimental, linear and non-linear numerical analysis

## REFERENCES

[1]. **Bertram, V.,** *"Practical Ship Hydrodynamics"*, Butterworth Heinemann, Oxford, 2000.
[2]. **Bertram, V., Veelo, B., Söding, H., Graf, K.,** *"Development of a freely available strip method for seakeeping"*, Proc. 5th International Conference on Computer and IT Applications in the Maritime Industries, Leiden, 2006.
[3]. **Bidoaie, L, Ionas, O.**, *"Nava architecture complements"* , Porto-Franco, Galati, 1998.
[4]. **Bhattacharyya, R.,** *"Dynamics of marine vehicles"*. John Wiley & Sons Publication, New York, 1978.
[5]. **Cussons**, *"Marine Research. Towing Tanks Modernisation"*, www.cussons.co.uk, Cussons Marine Technology Ltd, Manchester, 2009-2010.
[6]. **Domnisoru, L., Domnisoru, D.,** *"Experimental analysis of springing and whipping phenomena"*, International Shipbuilding Progress, Marine Technology Quarterly, Delft, 47 (450), 129-140, 2000.
[7]. **Domnisoru, L.,**"*Ship dynamics. Oscillations and vibrations"*, Technical Publishing House, Bucharest, 2001.
[8]. **Domnisoru, L., Rubanenco, I., Mirciu, L.,** *"The DYN programs package for the analysis of ship dynamic loads from oscillations and general vibrations"*, Naval Architecture Faculty, UGAL, Galati, 2009-2013.
[9]. **Faltinsen, O.M.**, *"Sea loads on ships and offshore structures"*, Cambridge University Press, 1993.
[10]. **ITTC**, *"Testing and extrapolation methods, loads and responses on seakeeping experiments, Recommended procedures and guidelines 7.5-02-07-02.1"*, International Towing Tank Conference, 2005.
[11]. **ITTC**,*"The Seakeeping Committee. Final report and recommendations"*, Proceedings 25th ITTC, Fukuoka, 2008.
[12]. **Obreja, D.**, *"Ship theory. Concepts and methods for the navigation performances analysis"*, Didactic and Pedagogic Publishing House, Bucharest, 2005.
[13]. **Rubanenco, I.,** *"Studies concerning the behaviour of optimized ship structures under extreme waves"*, PhD Thesis, Naval Architecture Faculty, Galati "Dunarea de Jos" University 2013.
[14]. **Shacham, I., Weller, T.**, *"Vertical ship motions and sea loads considering nonlinear effects"*, Technion Israel Institute of Technology, Haifa, 1986.
[15]. **Schlachter, G.,** *"Hull girder loads in a seaway including nonlinear effects"*, Schiffstechnik, Hamburg, 1989
[16]. **Söding, H.,** *"Bewegungen und Belastungen der Schiffe im Seegang"*, Institut für Schiffbau der Universität Hamburg, 1982.
[17]. **Söding, H.,** "*Hydrodynamische Massen und Dämpfungen*", Institut für Schiffbau der Universität Hamburg, 1983.
[18]. **Voitkunski, Y.I,** "*Ship Theory Handbook*", Sudostroenie, Sankt Petersburg, 1985.
[19]. **Xia, J., Wang, Z., Jensen, J.J.**, *"Non-linear wave loads and ship responses by a time-domain strip theory"*, Marine structures, 11, 101–123, 1998.

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# ANALYSIS OF THE ENDURANCE STRENGTH AND CALCULATION OF THE CUMULATIVE DAMAGE FACTOR FOR DOUBLE BOTTOM STRUCTURE

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## ABSTRACT

*This paper highlights the following objectives, namely: presentation of the effects of varying loads acting upon structures; the positioning modes of the stress concentrators; determining the factor of stress concentration; establishment of fissures scenarios in order to determine the main characteristics of the crack.*

**Keywords:** fissures, stress concentrators, normal stress

## REFERENCES

[1]. **ABS**, *"Rules for building and classing steel vessels"*, American Bureau of Shipping, TX-Houston, 2012
[2]. **Baik M. -C., s.a.,** *"Determination of Stress Intensity Factors by the Method of Caustics in Anisotropic Materials"*, In: Experimental Mechanics, June 1995
[3]. **Domnisoru L., Gavan E., Popovici O.**, *"Analiza structurilor navale prin metoda elementului finit"*, Editura Didactica si Pedagogica, Bucuresti, 2005
[4]. **Domnisoru L.,** *"Analiza structurilor navale prin metoda elementului finit. Aplicatii numerice"*, Editura Fundatiei Universitare "Dunarea de Jos", Galati, 2009
[5]. **Dumitru I., Marsavina L.,** *"Elemente de mecanica ruperii"*, Universitatea "Politehnica" Timisoara, 2000
[6]. **Goanta V., Palihovici V.,** *"Experimental Determination of Cracking Strength"*, Buletinul Institutului Politehnic Iasi, Tom XLV(IL), Fasc. 1-2, 1999
[7]. **Pana T.,** *"Mecanica ruperii materialelor"*, Editura Tehnica, Bucuresti, 1992
[8]. **Rice, J.R.,** *"Path Independent Integral and the Aproximate Analysis of Strain Concentration by Notched and Cracks"***,** Journal of Applied Mathematics, 35, 1968
[9]. **x x x – SRAC -Cosmos/M User Guide**, *Structural Research and Analysis Corporation*, Los Angeles (CA), 1998-2001.
[10]. **x x x – User Manual COSMOS /M.**

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# CALCULATION OF THE STRESS CONCENTRATION FACTOR IN CASE OF T-SHAPE PROFILE MADE OF GRP

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## ABSTRACT

*Fiberglas-reinforced polyester (GRP) is the most widely used composite material in the ship building industry and requires careful study in point of mechanical characteristics and their resistance to fatigue. In general the study of the fatigue phenomenon occurring in multi-layered composite materials requires effort and a long time for research. Taking into account the numerous applications of these materials in naval architecture and not only, the topic is of utmost importance nowadays. The main objective of this work was to calculate the stress concentration factor, using FEM program. Has been determined the stress concentration factor in case of T-shape profile, with fine and coarse mesh.*

**Keywords:** cumulative deterioration factor, FEM, fatigue, composite materials

## REFERENCES

[1]. **Tong, L., Mouritz, A.P., Bannister, M.K.**, *"3D Fibre Reinforced Polymer Composites"*, Elsevier Science Ltd, London, 2002.
[2]. **Domnisoru, L.,** *The finite element method in shipbuilding*,Technical P.H.,Bucharest,2001.
[3]. **American Bureau of Shipping (ABS),** *Guide for - Spectral-based fatigue analysis for floating production, storage and offloading (FPSO) installations*, Section 7, Structural Modelling Analysis, 2010.
[4]. **Tocu, F., Mocanu, C.I., Donu, O.A.,** *The determination of the cumulative deterioration factor in the composite materials fatigue strain*, ModTech International Conference, Tom. II, pp.961 – 965, Sinaia, 2012.
[5]. **Tocu, F.,** *Contributions to the study of component plates cooperation in a naval structure made of composite materials*, PhD-thesis, Galati, Romania, 2012.

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# ON THE NAVIGATION ROUTE SAFETY ANALYSIS OF A TANKER SHIP IN THE BLACK SEA AREA, BASED ON SEAKEEPING CRITERIA

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## ABSTRACT

*The objective of the present work is to perform an analysis for the selected shipping routes between various destinations, taking into account the seakeeping safety criteria. The analysis of navigation conditions in rough sea situations, when extreme seakeeping conditions occur in terms of amplitudes and accelerations on vertical, pitch and roll oscillations, is done based on scenarios for three navigation routes of an oil tanker ship of 15000 dwt. The navigation routes scenarios include eight significant points in the Black Sea area, being selected the reference period 03.02-08.02.2005, with every three hours records, when extreme sea state conditions occur. The study concluded that for the ship's service speed of 10 knots, the routes can be selected without any navigation restrictions. At the ship speed increase from 10 to 15 knots, on the analysed routes occur navigation restrictions, mainly due to the limit seakeeping criteria on the roll oscillation amplitude.*

**Keywords:** navigation route scenarios, seakeeping safety criteria, oil tanker ship, Black Sea area

## REFERENCES

[1]. **Bosneagu R.,** *„Navigation and Marine Hydrometeorology"*, Naval Academy "Mircea cel Batran" Publishing House, Constanta, 1997.

[2]. **Domnisoru,L.,***"Ship Dynamics. Oscillations and Vibrations"*, Technical Publishing House, Bucharest, 2001.

[3]. **Domnisoru, L., Gasparotti, C.,** *„Program modules for short-term significant statistical parameters computation at hull oscillations for the power spectral density functions of the Black Sea area"*, Naval Architecture Faculty, "Dunarea de Jos" University, Galati, 2012-2013.

[4]. **Domnisoru, L., Rubanenco, I., Mirciu, I.,** *"The DYN programs package for the analysis of ship dynamic loads from oscillations and global vibrations"*, Naval Architecture Faculty, "Dunarea de Jos" University, Galati.

[5]. **Georgescu S., "***Navigation. Lecture notes"*, Vol.2, Constanta, 2004.

[6]. **Jagite G., Gasparotti C.**, *"NBS Program modules to analyze the ship capacity to move on different routes in the Black Sea in order to streamline and organize the assessment of ships' seakeeping performance*", Faculty of Naval Architecture, University "Dunarea de Jos", Galati, 2012-2013.

[7]. **ITTC**, *"The Seakeeping Committee—Final Report and Recommendations to 26th ITTC"*, Proceedings 25th ITTC, Fukuoka, Japan, 2011.

[8]. **Rusu E.**, *"Strategies in using numerical wave models in ocean / coastal applications"*, Journal of Marine, Science and Technology- Taiwan, 19 (1), pp.58-73, 2011.

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# INFLUENCE OF AFT MODIFICATIONS ON MANOEUVRABILITY CHARACTERISTICS OF A TANKER BASED ON FULL SCALE TRIALS

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## ABSTRACT

*The present paper is a first attempt in order to investigate the influence of some aft part modifications on manoeuvrability characteristics of a 37000/40500 tdw chemical tanker. All observations and conclusions are based on a large set of sea trials results carried out for a series of 21 sister ships built between 2005-2013 by Constanta Shipyard Romania.*

**Keywords:** manoeuvrability, sea trials, chemical tanker

## REFERENCES

[1]. **Bosoanca, R.**, *"Evaluation of Aft Modifications on Manoeuvrability Characteristics of a 37000/40500 tdw Tanker Based on Full Scale Trials Measurements"*, Master Thesis, "Dunarea de Jos" University of Galati, July 2013.

[2]. **Obreja, D., Nabergoj, R., Crudu, L., Păcuraru, S.**, *"Manoeuvring Performances of a Mediterranean Fishing Vessel"*, Proceedings of the 5th International Congress on Maritime Technological Innovations and Research, 2005, pp. 201-210, Barcelona, Spain.

[3]. **Obreja C. D., Nabergoj R., Crudu L., Păcuraru S.,** *Indentification of Hydrodynamics Coefficients for Manoeuvring Simulation Model of a Fishing Vessel"*, Ocean Engineering, vol. 37, Iss, 8-9, pp. 678-687, June 2010, ISSN 0029-8018**.**

**[4]. Obreja, D., Crudu L., Pacuraru S.**, *"Manevrabilitatea Navei"*, 2008, Galati University Press, Galati, ISBN 978-973-88711-9-9, 221 pag, (in Romanian).

[5]. **Rawson, K.J., Tupper, E.C.,** *"Basic Ship Theory"*, Fifth edition, Volume 2, Longman Scientific & Technical, 2004.

[6]. ***** ITTC** – *"Recommended Procedures, Testing and Extrapolation Methods Manoeuvrability. Validation of Manoeuvring Simulation Models"*, 2002.

[7]. ***** IMO MSC/Circ.1053**, *"Explanatory Notes to the Standards for Ship Manoeuvrability"*, 16 December 2002.

[8]. ***** IMO A 751(18),** *"Interim Standards for Ship Manoeuvrability"*, 4 November 1993.

[9]. ***** IMO A 601,** *"Provision and Display of Manoeuvring Information onboard Ships"*, 19 November 1987.

[10]. ******* "Sea trials report for 37000/40400 tdw tanker ship no. 1-21", 2005-2013.

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# MATHEMATICAL MODEL OF THE INLAND PUSHED CONVOY MANOEUVRES

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## ABSTRACT

*The increase of the speed and size of barge convoys, as well as the traffic density on the river routes, contributes to a greater interest in the scientific concern related to the inland navigation safety. The present article describes a modular mathematical model which may be used to develop a computer code able to simulate the manoeuvres of an inland pushed convoy in the time domain, and to analyse the manoeuvrability performance in the case of inland navigation.*

**Keywords:** inland pushed convoy, mathematical model

## REFERENCES

[1]. **Korotkin, A.I.,** *Prosoedinjonnye massy sudna - Spravochnik*, Sudostroenie, Sankt-Petersburg, 1986.
[2]. **Vasiliev, A.B.**, *Upravliamost sudov*, Sudostroenie, Sankt-Petersburg, 1989.
[3]. **Voitkounski, Ia.I.,** *Spravicinic po teoria korablea*, Sudostroenie, Sankt-Petersburg, 1985.

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# EXPERIMENTAL INVESTIGATION ON SEAKEEPING CHARACTERISTICS OF AN ORE CARRIER IN REGULAR WAVES

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## ABSTRACT

*The paper describes an experimental investigation into the seakeeping characteristics properties of an ore carrier. A ship model was tested in head regular waves at two Froude numbers and over a range of different wave frequencies. Measurements of heave motion and pitch angle were made. Response transfer functions have been calculated from regular waves experiments and were compared to the theoretical results obtained by using Frank method.*

**Keywords:** seakeeping, experimental measurements, regular waves**,** Frank method

## REFERENCES

[1]. **Pacuraru, S.,** *„Prediction of ship response in ir-regular waves"*, The Annals of "Dunarea de Jos" University of Galati, Fascicle XI – Shipbuilding, ISSN 1221-4620, pp. 167-172, 2012.

[2]. **Proceeding of 25th ITTC Commitee** Vol. III, Fukuoka, 2008.

[3]. **Salvesen, N., Tuck, E. O., Faltinsen,** O., *„Ship Motion and Sea Loads"*, The Annual Meeting of Society of Naval Architects and Marine Engineers, New York, 1970.

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# THE DESIGN OF SHIP RING DRINKING WATER SYSTEM

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## ABSTRACT

*In the paper we propose a way to design the drinking water system in a form of a ring. The water needs on board respect the Classification Society rules. We have calculated the flows and pressures in the network nodes with Hardy Cross method. The dimensions of pipes were adjusted to respect flow laws. The advantage of this design is safety of the work system and accuracy of flows and pressure values.*

**Keywords:** design system, flow, pressure, Hardy Cross, network, analysis.

## REFERENCES

[1]. **Jeppson, R.,** *"Steady Flow Analysis Pipe Networks "*, An Instructional Manual, Utah State University , 1984.
[2]. **Hwang, N., Houghtalen, R.**., *"Fundamentals of Hydraulic Engineering Systems"*, Prentice Hall, Upper Sadde River, New York, 1996.
[3]. **Larock, B., Jeppson, R., Watters, G.,** *"Hydraulics of Pipeline Systems"*, CRC Press , ISBN 0-8493-1906-8, pp 43-96 New York, 2000.
[4]. **Mun-Fong L.,** *"Pipe Network Analysis"*, Publication No.77 University of Florida Gainesville , 1983.

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# A BRIEF COMPARISON OF SHIPS EXHAUST GAS SCRUBBER SYSTEMS

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## ABSTRACT

*The diesel engine is one of the most efficient power-generating machines but it produces high levels of air pollution. For this reason the main focus in recent years has been placed on the environmental aspects of marine industry. Very stringent regulations for the reduction of emissions for shipping operations in Europe were compiled and approved in Marpol Annex VI (Tier II, Tier III) by the IMO. However, for Emission Control Areas (ECAs) stringent rules will apply from 1st of January 2016 for new ships - Tier III and basically only secondary (after treatment) methods allow complying with IMO Tier III requirements. The choice of compliance are by using expensive low sulphur, by cleaning exhaust gases thus enabling ships to use cheaper traditional marine fuels or by switching to alternative fuels like LNG. The article provides a brief comparison of the main technologies of exhaust gas cleaning, which have the potential to play leading part in the future pathway to comply with all the increasingly strict requirements.*

**Keywords:** marine diesel engine, exhaust emission, scrubber, $SO_X$, $NO_X$

## REFERENCES

[1]. **Clausen, N.B.**, *"Developments in Engine Technology for Green Ship Designs"*, MAN Diesel & Turbo, October, 2010.
[2]. **Dobrucali, E.**, *"A brief review on examination of exhaust gas dispersion on marine ships"*, Journal of Marine Science and Engineering, Vol. 8, No. 2, pg. 46-56, 2012.
[3]. **Goldsworthy, L., Galbally, I.E.**, *"Ships Engine Exhaust Emissions in waters around Australia – an overview*", Air Quality and Climate Change Vol.45 No. 4, Nov, 2011.
[4]. **Henriksson, T.**, *"SOx scrubbing of marine exhaust gases"*, Wärtsilä Technical Journal, February, 2007.
[5]. **Karle, I.M., Turner, D.R.** *"Seawater Scrubbing – Reduction of SOX Emissions from Ship Exhausts"*, The Alliance For Global Sustainability, Gothenburg, 2007.
[6]. **Mysków, J. et al.**, *"Marine engine exhaust gas emission after treatment system concept"*, Journal of KONES Powertrain and Transport, Vol. 18, No. 4, 2011.
[7]. **Panasiuk, I., Lebedevas, S.**, *"The comparison of technologies to reduce the toxicity of ship exhaust gas"*, Transbaltica 2013 - the 8th International Conference, Vilnius, Lithuania, May, 2013.
[8]. **Schnack, S.**, *"35.000 dwt bulk carrier exhaust gas emission reduction concept study"*, Green Ship of the Future, 2009.
[9]. **Wright, A.A.**, *"Exhaust Emissions from Combustion Machinery"*, Marine Engineering Practice Series, Volume 3 Part 20, IMarEST, 2000.
[10]. *** *"Understanding exhaust gas treatment systems - Guidance for ship-owners and operators"*, Lloyd's Register, www.lr.org, June, 2012
[11]. *** *"Exhaust Gas Scrubber Systems - Status and Guidance"*, ABS Exhaust Gas Scrubber Systems Advisory, www.eagle.org, 2013.
[12]. *** *"Guidelines for Exhaust Gas Cleaning Systems"*, MEPC 184(59), 2009.
[13]. *** *"IMO Tier III solutions for Wärtsilä 2 stroke engines – Selective Catalytic Reduction (SCR)"*, www.wartsila.com
[14]. *** *"The DryEGCS"*, Couple Systems Brochure, www.couple-systems.com
[15]. *** *"Tier III Compliance. Low Speed Engines"*, MAN Diesel & Turbo, www.mandiesel.com
[16]. *** *"EU policy on ship emissions"*, http://ec.europa.eu/environment/air/transport/ships.htm, http://ec.europa.eu/environment /air/transport/ sulphur_standard_shipping.pdf

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# EXPERIMENTAL RESEARCHES REGARDING POWER SAVING USING NOVEL ADDITIONAL SYSTEM FOR SHIPS WITH FULL FORMS

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## ABSTRACT

*Power saving is an important target because it can be converted into fuel cost saving. For ship-owners the cost saving is a very important element when a novel additional system is planned to be mounted onboard ships. In addition, this power saving means less marine pollution lowering the ship's emissions ($CO_2$, NOx, SOx, soot, smoke and particulate matter). The best way to measure the efficiency of an additional system is power – ship's speed trial. The paper shows the results and the conclusions after a power saving device has been mounted onboard a tanker of 165.000 dwt.*

**Keywords:** additional system, power saving device, cost saving, oil tanker.

## REFERENCES

[1]. **Hunday Maritime Research Institute**, *"Model tests for 165000 dwt class crude oil carrier (S125-8)"*, Technical Department, 2000.
[2]. **Lackenby, H.**, *"The effect of the shallow water on ship speed"*, Shipbuilder and Marine Engine Builder, Vol. 70, 1963.
[3]. **Blendermann, W.**, *"Wind forces"*, Manoeuvring Technical Manual, Schiff & Hafen, Helft 2, 1990.
[4]. **ITTC**, *"Recommended procedures and guidelines full scale measurements. Speed and power trial. Preparation and conduct of speed/power trials"*, 2005.
[5]. **ITTC**, *"Recommended procedures and guidelines full scale measurements. Speed and power trial. Analysis of speed/power trials"*, 2005.
[6]. **DMG Galati**, *"Power-ship's speed technical report onboard 165000 dwt oil tanker"*, 2011.

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# CALCULATION OF FOUDATIONS FOR EQUIPMENT

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## ABSTRACT

*This paper presents a method for the yielding strength of the foundations and supporting structure of the equipment in the context of increasing offshore market.*

**Keywords:** foundations equipment, FEA, 3D, beam.

## REFERENCES

[1] **ABS** *"Rules for Building and Classing Mobile Offshore Drilling Units"*, Jan 2012
[2] **ABS** "*Guide for Building and Classing Drillships"*, Jan.2012;
[3] **ABS** " *Rules for Building and Classing Steel Vessels"* , Jan.2013;
[4] **ASTM** A36/A36M-12, ICS Number Code77.140.10.

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# THE INFLUENCE OF HIP RADIUS PERFORMED ON STIFFENERS USED IN SHIPBUILDING WITH EFFECTS OPENED ON STRUCTURE STRESS WHICH MAY APPEAR AROUND BOUNDARIES

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## ABSTRACT

*In order to increase the ships transport capacity, efforts are made to reduce hull weight. To this extend, this study highlights the research of the ways to reduce the floor's weight as a component of the ships hull. Thus we studied the variation of the stress state surrounding the cut outs from these structural elements regarding the weight reduction. The variation of the fillet radius of the cut outs represents a source of weight reduction. Using FEM the stress state surrounding the cut outs was studied with the variation of its fillet radius. The numerical study was undertaken on a scaled model of a double bottom structure.*

**Keywords:** numerical analysis, cut out, finite element, stress state

## REFERENCES

[1]. **Owen F. Hughes, Jeom Kee Paik.,** "*Ship Structural Analysis and Design*", The Society of Naval Architects and Marine Engineers, New Jersey, 2010

[2]. **Lehmann, E..**, "*Guidelines for Strength Analyses of Ship Structures with the Finite Element Method*", Hamburg: Germanischer Lloyd., 1998

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# INVESTIGATION REGARDING THE FEASIBILITY OF A TECHNOLOGY FOR SHIP ASSEMBLY IN FLOATING CONDITIONS

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## ABSTRACT

*The Romanian Shipyard intend to build and launch a ship partly assembled – one side is missing in launching condition – and to continue the assembly of the missing sections with ship in floating conditions. The idea is to build a pontoon and use it as watertight cofferdam between ship and water. The pontoon shall be handled with a crane, immersed, attached to the ship, sealed, the water between pontoon and ship is extracted and a space is created for arranging and welding a new section. The purpose of this study is to establish the geometry of the pontoon and to investigate the possibility of handling and creating a watertight space using rubber seal. Meanwhile, the ship shall be kept on even keel using available ballast tanks. In addition, the structural strength of the pontoon and seal under water pressure using FEM analysis with contact elements has been verified. Unfortunately, the result was that the method cannot be used mainly due to the non-watertight contact between pontoon and ship, produced by pontoon and seal deformations.*

**Keywords**: Ship assembly, cofferdam pontoon, trim/heel control, pail, FEM analysis, contact simulation

## REFERENCES

[1]. **VARD Shipyard**.,*"Project N800"*
[2]. **Van Vlack, L.H.** *"Materials for Engineering"*, Addison-Wesley Publishing Company, Reading, MA (1982) p. 588
[3]. **NAPA** software
[4]. **CARENA** software
[5]. **COSMOS/M** software

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# THE IMPACTS AND BENEFITS OF ECO-FRIENDLY RIVER CRUISES ALONG THE DANUBE IN THE ROMANIAN SOUTH-EAST REGION

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## ABSTRACT

*River cruises and events on inland ships have been enjoying a growing popularity. The benefits that emerge from these forms of river tourism, through the expenditures of passengers, crew and operators are largely flowing to the ports, cities, and regions where the ships moor. Understanding the economic impacts of river tourism may however develop its potential and legitimize investments in these activities by ports, governments and private actors. This paper provides some tentative estimates of the impacts and benefits of cruise tourism in the Romanian South East Region as part of the Pan-European Corridor VII. The results of the analysis have shown that the Corridor VII cruises have positive impact on the Romanian South East Region, primarily the riparian area of the Danube, especially the Danube Delta. The benefits are noticeable within the following segments: tourism promotion (broadening the region as a receptive area for the foreign market through its cultural heritage and natural values); increase in foreign tourist turnover, visitors' expenditures; new job opportunities (adequate infrastructure and superstructure – rendering services to ships, crew and passengers) – harbours, carriers, souvenir shops, etc. / new products, business net, exchange money, invisible export, etc. By using literature study and desk research, some ways of sustainable development of river vessels technologies were also exposed that can contribute to an eco-friendly navigation and tourism.*

**Keywords:** tourism, river cruise, the Danube, South-East Region, vessel technologies, PACSCAT

## REFERENCES

[1]. **Clements, R.J. et. all.**, *"The potential for the use of a novel craft, PACSCAT (Partial Air Cushion Supported Catamaran), in inland European waterways"*, International Conference on Fast Sea Transportation FAST'2005, St. Petersburg, Russia, June, 2005.
[2]. **Coroban, C.**, *"Some considerations on the EU Danube Strategy and the Black Sea Region"*, Eastern Journal of European Studies, Volume 2, Issue 1, June, 2011.
[3]. **Damian, N., Dumitrescu, B.**,*"Sustainable development prospects for the Danube Delta rural communities"*, Rev. Roum. Géogr./Rom. Journ. Geogr., 53, (2), p. 153–163, Bucuresti, 2009.
[4]. **Dragin, A.S. et. all.**, *"Economic impact of cruise tourism along the Pan-European Corridor VII"*, Ekonomska istraživanja, Vol. 23, No. 4 (127-141), 2010.
[5]. **Dwyer, L., Forsyth, P.**, *"Economic impacts of cruise tourism in Australia"*, Journal of Tourism Studies, 7:36-43, 1996.
[6]. **Evans. A.**, *"River of Life: River Danube"*, Rivers of the World - a Thames Festival project delivered in partnership with the British Council's, www.riversoftheworld.org, 2009.
[7]. **Hasenbichler, H.P. et. all.**, *"Manual on Danube navigation"*, Grasl Druck & Neue Medien GmbH, Vienna, ISBN 978-3-9502226-2-3, January, 2013.
[8]. **Martin, E.**, *"International Waterway in Crisis: the case of the River Danube"*, IAME Panama 2002 Conference Proceedings, 13 – 15 November, 2002.
[9]. **Peisley,T.**, *"The world cruise ship industry in the 1990's"*, Special Report No. 2104, London: Economist Intelligence Unit, 1992.
[10]. **Tigu, G.**, *"New Challenges for Tourism Destination Management in Romania"*, Strategies for Tourism Industry - Micro and Macro Perspectives, Dr. Murat Kasimoglu (Ed.), ISBN: 978-953-51-0566-4, InTech, 2012.
[11]. **Torbianelli, V.**, *"The local economic impact of cruises: from figures to the active policies of the European harbor cities"*, POMORSTVO , Scientific Journal of Maritime Research, No 26/1, pp. 139-150, 2012.
[12]. **Van Balen, M. et. all.**, *"The economic impact of river tourism on ports: The case of Brussels"*, International Association of Maritime Economists (IAME) Conference, Taipei, Taiwan, 5-8 September, 2012.
[13]. **Ward, D.**, *"Complete Guide to Cruising and Cruise Ships 2004"*, Berlitz Publishing, London, 2005.
[14]. *******, *"Danube Delta: a natural gateway to Europe. Ecology and Economy in Harmony"*, WWF International, Danube-Carpathian Programme, Vienna, January, www.panda.org/dcpo, 2007.
[15]. *******, *"Danube Delta: a natural gateway to Europe. Ecology and Economy in Harmony"*, WWF International, Danube-Carpathian Programme, Vienna, January, www.panda.org/dcpo, 2007.
[16]. *******, *"Romania - The Impact of Travel & Tourism on Jobs and the Economy"*, World Travel & Tourism Council, U.K., 2006.
[17]. *******,*"The EU Strategy for the Danube region - a united response to common challenges"*, Panorama Inforegio No. 37, 2011.
[18]. *******, *"Worldwide Cruise Ship Activity"*, World Tourism Organization, Madrid, 2003.

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# NEW RULES IN MARINE POLLUTION FIELD

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## ABSTRACT

*Noise pollution is an undesired effect of human activities on sea and on shore. On sea, this pollution agent acts on crew and passenger onboard ships; on shore the port activities act upon population living in the vicinity. The legislation in this field has the target to reduce the noxious influence both by imposing maximum permissible levels and introducing the necessity of noise mapping. New Rules are introduced in 2012: IMO Resolution 337(91) and HG 1260 which is a step forward in the limitation of the noxious effect of noise.*

**Keywords:** noise pollution, permissible levels, noise map, IMO Resolutions

## REFERENCES

[1]. **IMO Resolution A 468 (XII)**, *"Code on noise levels onboard ships"*, 1981.
[2]. **IMO Resolution 337(91)**, *"Code on noise levels onboard ships"*, 2012.
[3]. **HG 321/2005**, *privind evaluarea și gestionarea zgomotului ambiant*, 2005 (in Romanian).
[4]. **HG 1260/2012**, *pentru modificarea și completarea Hotărârii Guvernului nr. 321/2005 privind evaluarea și gestionarea zgomotului ambiant*, 2012 (in Romanian).
[5]. **Environmental Noise Directive 2002/49/EC**, European Parliament, 2002.

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# A SHIP PROPULSION SYSTEM DESIGN APPROACH

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## ABSTRACT

*The paper presents aspects on the design of a bulk carrier propulsion system. Fundamental for the design was for selection and integration of the main components (main engine, shaft line and propeller) into the functional system. The propulsive power has been estimated and a low speed diesel engine directly coupled to a fixed pitch propeller was used. Special attention was paid to propeller design. A wake-adapted propeller has been designed using an in-house code based on lifting line theory. Hydrodynamic performances of the designed propeller have been analysed using CFD tools and quasi-steady methods. Finally, the shaft line has been designed according to classification society rules.*

**Keywords:** bulk carrier, propulsion system, propeller

## REFERENCES

[1]. **Harrington, R.,** Editor *"Marine Engineering, Propellers, shafting, and shafting system vibration analyses"*.
[2]. **Broberg, L., Orych, M.,** *"An Efficient Numerical Technique To Simulate The Propeller Hull Interaction"*, www.ijird.com November, 2012.
[3]. **Sasajima, T.,***"Usefulness of quasi-steady approach for estimation of propeller bearing forces"*, Propellers'78 Symposium, Virginia, 1978.
[4]. *** GL Rules and regulations for the classification of ships, Part 5, Chapter 6, July 2008.
[5]. ***ITTC, 16th ITTC Report of Propeller Committee, 1981.
[6]. ***ANSYS FLUENT UDF Manual, November 2011.
[7]. **Amoraritei, M.,** "*Complements in the hydrodynamic of ship propeller in unsteady flow*", Galati University Press, 2008.

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# NUMERICAL INVESTIGATIONS ON THE FLOW AROUND AN ELLIPSOIDAL ROV BODY

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## ABSTRACT

*This paper deals with the numerical simulation of the turbulent flow around a fully submerged Remotely Operated Vehicle (ROV) with ellipsoidal body using the commercial CFD code FLUENT. This ROV has as propulsion system four ducted propellers, two for horizontal displacement and two for vertical displacement. Propellers were substituted by active disks for which the pressure jump is defined as boundary conditions.*

**Keywords:** ROV, turbulent flow, separation flow, verification and validation

## REFERENCES

[1]. **Montagne, J.L.**, *"The submersibles session"*, 20th ITTC Session Chair, 1993.
[2]. **Korde, U.A.,** *"Study of a jet-propulsion method for an underwater vehicle"*, Journal of Ocean Engineering, 31, pp. 1205–1218, 2004.
[3]. **Eng, Y., Lau, W., Low, E., Seet, G., Chin, C.**, "*Estimation of the Hydrodynamics Coefficients of an ROV using Free Decay Pendulum Motion*". Engineering Letters 16.3, 2008.
[4]. **Taamneh, Y.**, *"CFD Simulations of Drag and Separation Flow Around Ellipsoids"*, Jordan Journal of Mechanical and Industrial Engineering, Vol. 5, No. 2, pp. 129 - 132, April , 2011.
[5]. **Sakthivel, R., Vengaddesan, S., Bahattacharyya, S.K.**, *''Application of non-linear κ-ε turbulence model in flow simulation over underwater axisymmetric hull at higher angle of attack''*. Journal of Naval Architecture and Marine Engineering, December, vol. 7, no. 2, pp. 149-163, 2011.
[6]. **Skorpa, S**., *"Numerical Simulation of Flow Around Remotely Operated Vehicle (ROV)"*, Master thesis, Norwegian University of Science and Technology, 2012.
[7]. **Ungureanu, C., Lungu, A.**, *''Unsteady 3D Turbulent Flow Separation around ROV body''*, *AIP Conference Proceedings* 1168, pp. 685-689, 2009.
[8]. **Obreja, D., Domnisoru, L.**, *"Theoretical and experimental investigation on the total resistance of an underwater ROV remotely operating vehicle*", Sustainable Maritime Transportation and Exploitation of Sea Resources – Rizzuto & Guedes Soares, 2012.
[9]. **Roache, P. J.**, *"Quantification of uncertainty in computational fluid dynamics"*, Annual Reviews Fluid Mech., 29: 129-60, 1997.
[10]. ***ASME V&V 20**, *"Standard for Verification and Validation in Computational Fluid Dynamics and Heat Transfer*", American Society of Mechanical Engineers, 2009.
[11]. **Celik, I.**, *"Numerical Uncertainty in Fluid Flow Calculations: Needs for Future Research"*, ASME JOURNAL OF FLUIDS ENGINEERING, 115, pp. 194-195, 1993.
[12]. **Roy, C. J.**, "*Review of the code and solution verification procedures for computational simulation*", Journal of Computational Physics, 205, 131-156, 2005.
[13]. **Roy, C.J., Oberkampf, W.L.**, *"A Complete framework for verification, Validation, and Uncertainty Quantification in scientific computing"*, AAIA, 124, 2010.
[14]. **Eça., L., Hoekstra, M.**, "*On the Influence of the Iterative Error in the Numerical Uncertainty of ship viscous flow calculations*", 26 th Symposium on Naval Hydrodynamics, Rome, Italy, 17-22 September, 2006.

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# NUMERICAL COMPUTATION OF HYDRODYNAMIC FORCES AND MOMENTS ON KVLCC2 HULL

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## ABSTRACT

*The paper proposes a numerical investigation based on RANS computations for solving the viscous flow around the KVLCC2 scaled model to provide a detailed insight into the critical flow regions and to predict the manoeuvring performances. The SHIPFLOW code is employed to evaluate, not only the hydrodynamic parameters of flow, but also the forces acting on bare hull and rudder. Numerical calculations and model tests(MOERI) have been compared to validate the technique used in the current work.*

**Keywords:** ship resistance, manoeuvring, potential flow, RANS, Chimera techniques

## REFERENCES

[1]. **Larsson L., Bertram V., Stern F.,** , Proceedings of GOTHENBURG 2000, *"A Workshop on CFD in Ship Hydrodynamics"*, Gothenburg, Sweden, 2000.
[2]. ******* *"Xchap Theoretical Manual"***,** FlowTech International**,** 2007.
[3]. **F. Stern and K. Agdrup,** *"SIMMAN Workshop on Verification and Validation of Ship Manoeuvring Simulation Methods"*, Danemark, 2008.
[4]. **L. Fabbri, L Benedetti, B. Bouscasse, F.L.Gala and C.Lungni,** *"An experimental study of the manoeuverability of a blunt ship: the effect of the water depth"*, 9thNutts Numerical Towing Tank Symposium, France, 2006.
[5]. **Toxopeus, S.,** *"Practical application of viscous-flow calculations for the simulation of manoeuvring ship"*, Thesis (Ph.D). Universiteit Delft, 2001.
[6]. **Chislett, M.S., Strom-Tejsen, J.,** *"Planar Motion Mechanism Tests and Full-Scale Steering and Manoeuvring Predictions for a Mariner Vessel"*, Report No. Hy-6, Lyngby, Denmark, 1965.