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NEW ALGORITHMS TO SPEED UP RANSE COMPUTATIONS IN HYDRODYNAMICS

Alban Leroyer
Laboratoire de Mecanique des Fluides,
Ecole Centrale de Nantes
UMR-CNRS 6598, 44321 Nantes Cedex 3, France
E-mail:Alban.Leroyer@ec-nantes.fr

Patrick Queutey
Laboratoire de Mecanique des Fluides,
Ecole Centrale de Nantes
UMR-CNRS 6598, 44321 Nantes Cedex 3, France
E-mail:Patrick.Queutey@ec-nantes.fr

Emmanuel Guilmineau
Laboratoire de Mecanique des Fluides,
Ecole Centrale de Nantes
UMR-CNRS 6598, 44321 Nantes Cedex 3, France
E-mail:Emmanuel.Guilmineau@ec-nantes.fr

Ganbo Deng
Laboratoire de Mecanique des Fluides,
Ecole Centrale de Nantes
UMR-CNRS 6598, 44321 Nantes Cedex 3, France
E-mail:Ganbo.Deng@ec-nantes.fr

Michel Visonneau
Laboratoire de Mecanique des Fluides,
Ecole Centrale de Nantes
UMR-CNRS 6598, 44321 Nantes Cedex 3, France
E-mail:Michel.Visonneau@ec-nantes.fr

ABSTRACT

This article describes two algorithms which enables to speed up computations for reaching a dynamics equilibrium position when they are used together. A test-case was shown, demonstrating that the results are similar to a classical approach. These tech-niques have been applied on various kinds of hulls. A *time-splitting method with a classical time step to reduce the Courant number and improve the accuracy of the interface capturing is proposed.*

Keywords: free-surface flow, numerical simulation, URANSE, time-splitting method

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INVESTIGATION OF PROPELLER WAKE INSTABILITY USING LES

Mattias Liefvendahl
Swedish Defence Research Agency, FOI, Stockholm, Sweden. 147 25 Tumba.
Tel: +46 8 5550 4170. Fax: +46 8 5550 4144.
E-mail:mattias.liefvendahl@foi.se

ABSTRACT

The propeller wake instability, for a generic submarine propeller in open water condition, with computational methods based on Large Eddy Simulation (LES) is numerically investigated with OpenFOAM. The numerical results are compared with Laser Doppler Velocimetry experimental data fields.

Keywords: propeller wake, numerical simulation, LES, OpenFOAM

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PREDICTION OF SHIP MANOEUVRING HYDRODYNAMIC COEFFICIENTS USING NUMERICAL TOWING TANK MODEL TESTS

Sheeja Janardhanan
Department of Ocean Engineering
Indian Institute of Technology Madras, Chennai, India
E-mail: sheejaphdoe_iitm@yahoo.co.in

Krishnankutty P
Department of Ocean Engineering
Indian Institute of Technology Madras, Chennai, India
E-mail: sheejaphdoe_iitm@yahoo.co.in

ABSTRACT

This paper brings about the detailed mathematical formulation and numerical procedure for simulating dynamic manoeuvrs of a container ship model. The computations of flow coupled with rigid body motions have been carried out using a RANSE based CFD solver employing finite volume technique for solving viscous flow equations. All the twentyone hydrodynamic derivatives appearing in the mathematical model have been determined and have been compared with published experimental results.

Keywords: hydrodynamic derivatives, numerical simulation, RANSE, HPMM

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NUMERICAL STUDIES ON THE WAVE BREAKING PHENOMENA AROUND HYDROFOILS

Costel Ungureanu
"Dunarea de Jos" University of Galati
Faculty of Naval Architecture
Domneasca Street, No. 47, RO-800008, Romania
E-mail:costel.ungureanu@ugal.ro

Adrian Lungu
"Dunarea de Jos" University of Galati
Faculty of Naval Architecture
Domneasca Street, No. 47, RO-800008, Romania
E-mail:adrian.lungu@ugal.ro

ABSTRACT

Unsteady free surface flow around a submerged hydrofoil and a surface one is studied. The wave breaking is numerically simulated by an interface capturing technique. The unsteady Reynolds-averaged Navier-Stokes (URANS hereafter) and the continuity equations are numerically solved by using the Fluent commercial solver. Closure to the turbulence is achieved through the together with the k-ω SST two-equation turbulence model. Both 2D and 3D flow cases are considered. Comparisons with the available experimental data provided by the literature are performed to prove the accuracy of the investigation method proposed in here.

Keywords: numerical simulation**,** free-surface flow, breaking waves, URANSE,

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NUMERICAL OPTIMISATION OF RESISTANCE AND WAKE QUALITY FOR A VLCC

Martin Kjellberg
University "Dunarea de Jos" of Galati,
Department of Shipping and Marine Technology,
Chalmers University of Technology, SE-412 96,
Göteborg, Sweden
E-mail:martin.kjellberg@chalmers.se

Carl-Erik Janson
FLOWTECH International, PO Box 24001,
SE-400 22, Göteborg, Sweden
E-mail:janson@flowtech.se

ABSTRACT

The work done on numerical stern shape optimisations based on the computed viscous flow is presented in this paper. A potential flow method which computes the inviscid flow and provides input for a boundary layer method used on the forward half of the hull, a Reynolds Averaged Navier-Stokes code used to predict the viscous flow aft of mid ship and the solutions from the potential flow method and the boundary layer method used as boundary condition for the viscous domain are the three methods involved in computation. After initial sensitivity studies and validation of the CFD codes on three different hulls, two optimisation rounds were carried out, enabling the second to make use of the knowledge gained from the first round.

Keywords: optimisation, numerical simulation, RANSE, resistance, wake

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VALIDATION OF RANSE RIGID BODY MOTION COMPUTATIONS

Marek Kraskowski
Ship Design and Research Centre S.A., Poland
E-mail:marek.kraskowski@cto.gda.pl

ABSTRACT

In the present paper, experimental validation of the free drop simulation is presented, as well as the validation of the simulation of the hull motion in waves, based on the strip theory results. The final goal of the work is to elaborate the complete tool and method for simulating the hull motion in waves, and the attempt on such simulation for a container ship hull is presented here

Keywords: numerical simulation, RANSE, experimental validation

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EFFECTS OF THE INCIDENCE RUDDER ANGLE ON THE FLOW AROUND A SINGLE PROPELLER SHIP MODEL

Oana Marcu
"Dunarea de Jos" University of Galati
Faculty of Naval Architecture, Galati,
Domneasca Street, No. 47, RO-800008, Romania
E-mail:costel.ungureanu@ugal.ro

Adrian Lungu
"Dunarea de Jos" University of Galati
Faculty of Naval Architecture, Galati,
Domneasca Street, No. 47, RO-800008, Romania
E-mail:adrian.lungu@ugal.ro

Florin Pacuraru
"Dunarea de Jos" University of Galati
Faculty of Naval Architecture, Galati
Domneasca Street, No. 47, RO-800008, Romania
E-mail:florin.pacuraru@ugal.ro

ABSTRACT

A viscous flow investigation around the KVLCC2M ship model with propeller and rudder is described in the present work. A special attention is paid to the effect of the incidence rudder angle on the hydrodynamic forces and moments developed on hull and rudder. The wake structure in the propeller plane as well as the pressure distribution on the two sides of the rudder are solved using the Reynolds-averaged Navier-Stokes equations accompanied by the Explicit Algebraic Stress Model (EASM hereafter) turbulence model.

Keywords: KVLCC2M, RANS, hydrodynamic forces

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SIMULATION OF A SHIP'S ROLL DECAY WITH OPEN-FOAM

Jens Hopken
University of Duisburg-Essen,
Norbert Stuntz, Howaldtswerke-Deutsche,
Werft GmbH
E-mail:jhoepken@gmail.com

ABSTRACT

Roll motion predictions were carried out using OpenFOAM's extended solver, shipFoam. The equations are discretised in space by a Finite-Volume formulation. Pressure correction follows the PISO scheme, combined with a relaxation factor for the pressure and the velocity. The simulations were performed at calm sea and zero speed. Results are represented for several grids and compared with experimental measurements show promising results.

Keywords: roll motion, numerical simulation, RANSE, OpenFOAM

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INVESTIGATING THE FLEXIBILITY OF TWIN SCREW VESSELS WITH VARIOUS PROPULSION CONCEPTS USING CFD

Tobias Huuva
Berg Propulsion Technology
E-mail:tobias.huuva@bergpropulsion.com

Magnus Pettersson
Berg Propulsion Technology

ABSTRACT

Single and a multi screw propulsion systems are compared from an efficiency and flexibility point of view. The RANS equations are solved using the open source library OpenFOAM and a realizable k-epsilon model. Measurements were where performed on the ship STENA Freighter. The CFD computations are a very important tool to perform this type of investigations since it is not always the exact values which are required, but rather the trends.

Keywords: propulsion system, RANSE, numerical simulation, measurements

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NUMERICAL SIMULATION OF THE WAKE FIELD PRODUCED BY A HIGH BLOCK COEFFICIENT SHIP HULL

Viorel Gabriel Maria
"Dunarea de Jos" University of Galati
Faculty of Naval Architecture, Galati,
Domneasca Street, No. 47, RO-800008, Romania
E-mail:viorel.maria@ugal.ro

Adrian Lungu
"Dunarea de Jos" University of Galati
Faculty of Naval Architecture, Galati,
Domneasca Street, No. 47, RO-800008, Romania
E-mail:adrian.lungu@ugal.ro

ABSTRACT

The present work describes a series of numerical simulations for the flow around a 37000dwt chemical tanker. The focus of the study is on the effect of a wake equalized duct (WED) on the ship wake. A computer code used solves the Reynolds Averaged Navier Stokes (RANS) equations for the primitive variables to describe the 3D turbulent flow with a finite volume method. For the domain discretization an O-H type grid is used with a refined area in the stern area, covering the semi duct position and the propeller position. Comparisons of the numerical solution with available experimental data are given for the bare hull and the appended hull to validate the theoretical approach. Although the comparisons prove a good overall agreement between the computed and measured physical parameters, a fact that sustains the correctness of the numerical investigation, more work is necessary to carry out in the future to better clarify the influence of various geometric parameters such as the semi-ducts position in respect to the stern position, global dimensions and inclination of the ducts, and so on.

Keywords: numerical solution, turbulent flow, RANS, overlapping grid, WED

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EFFECTS OF BREAKING INTENSITY ON WAVE BREAKING

Alessandro Iafrati
INSEAN, Rome, Italy,
E-mail:a.iafrati@insean.it

ABSTRACT

The wave braking phenomenon is characterized by a broad range of length scales. Accurate analyses of the early stage after the onset of breaking are rather challenging because of the light scattering operated by bubble clouds. The numerical approach is based on a Navier-Stokes solver coupled with a Level-Set technique for the interface capturing. The results are limited to a two dimensional space and a lower Reynolds number.

Keywords: wave breaking, level set, vorticity

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MANEUVERING SIMULATIONS OF UNDERWATER VEHICLES

Lars Ole Lübke
Postdam Model Basin
E-mail:luebke@sva-postdam.de

ABSTRACT

Numerical PMM-tests were carried out for two subsea vehicles, one DSV and one AUV, and hydrodynamic forces and moments are presented. The incompressible URANS equations are solved with the commercial software package ANSYS-CFX by a finite volume technique. Closure to the turbulence is attained trough the two equations model, k-ω SST.

Keywords: ROV, DSV, AUV, numerical simulation, URANSE.

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NUMERICAL SIMULATIONS OF UNSTEADY CAVITATION USING OPENFOAM

NaiXian Lu
Department of Shipping and Marine Technology, Chalmers University of Technology, SE 412 96 Gothenburg, Sweden
E-mail:naixian.lu@chalmers.se

Rickard Bensow
Department of Shipping and Marine Technology, Chalmers University of Technology, SE 412 96 Gothenburg, Sweden
E-mail:rickard.bensow@chalmers.se

ABSTRACT

Numerical simulation of unsteady cavitation is an area that receives increasing attention, both from an industrial design point of view as well as for an increased understanding of cavitation physics. The industrial need, concerning the design of e.g. marine propellers or hydro turbines, is easily understandable since the cavitation behavior often is the limiting design phenomena; improved prediction tools can increase efficiency and reduce nuisance like erosion, noise and vibration.The unsteady cavitating flow around a 2D NACA15 hydrofoil based nt Large Eddy Simulation techniques, combined with a volume of fluid implementation in OpenFOAM is numerically investigated. The locking effect between the shedding frequency of the oscillators and cavity is to be studied. Vortex cavity interaction and the transport downstream is also investigated.

Keywords: unsteady cavitating flow, LES, OpenFOAM

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THEORETICAL STUDY ON PROPULSIVE PERFORMANCES AND EXCITING FORCES INDUCED BY SHIP PROPELLER

Mihaela Amoraritei
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail: mihaela.amoraritei@ugal.ro

ABSTRACT

The paper presents aspects concerning the hydrodynamic analysis and design of a bulk carrier propeller. Firstly, a wake-adapted propeller has been designed using lifting line theory with lifting surface corrections. The open water characteristics and the hydrodynamic performances of the wake adapted propeller have been numerically investigated using the commercial code FLUENT. In the following stage, the designed propeller has been analysed as a source of noise and vibrations. Two categories of propeller exciting force: hull pressures forces and bearing forces have been predicted using in-house codes.

Keywords: propeller, hydrodynamic performance, hull pressure forces, bearing forces

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THE USE OF THE KÁRMÁN METHOD IN DETERMINING THE VELOCITY AND PRESSURE DISTRIBUTION AROUND A SHIP'S HULL

Nicoleta-Gabriela Rodicichin
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail:nicoleta.rodicichin@ugal.ro

Viorel Andrei
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail:viorel.andrei@ugal.ro

ABSTRACT

This paper presents the demonstration of the Kármán method using the ITTC model of "Dunărea de Jos" University. The Kármán method helps to accurately calculate the velocities quasiplan domain and the pressures around the ship's hull for each model waterline, starting from the current function in "n" continous sources superposition on an axial current case calculation. The result obtained is the diagrams for each velocity components and pressures around the waterline.

Keywords: velocities, Kármán method, pressure, current function, ITTC model.

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MOVEMENTS OF AN A.C.P.M. - SHIP SYSTEM IN REGULAR AND RANDOM ENCOUNTERING WAVES

Daniel Pitulice
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, , 800008, Romania,
E-mail:daniel.pitulice@ugal.ro

ABSTRACT

This paper presents an analysis of the movements of a crude oil storage system made up of an articulated column and a moored storage tanker in regular and random encountering waves. The hydrodynamic loads on the column were assessed by the strip theory and the articulated column was considered to be a hydro-dynamically transparent structure. Starting from the assumptions of ideal waves and linearity, the surge and pitch oscillating movements of the ship and the angular oscillations of the column were calculated. The values of the pitch angle of the moored ship were compared to the ones obtained in the case of the free floating ship. The response spectra of the dynamic system were calculated for the 5 Beaufort degree sea, which corresponds to the operating conditions of the storage system. Finally, the values of the parameters of the movements in survival conditions in the Black Sea were calculated.

Keywords: articulated tower, buoyant tower, articulated loading platform

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CAD-FEM MODELLING OF A ROV STRUCTURE

Dumitru Dragomir
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: leonard.domnisoru@ugal.ro

Leonard Domnisoru
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: dumitru.dragomir@ugal.ro

Alexandru Ioan
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: ioan.alexandru@ugal.ro

ABSTRACT

This study is focused on the analysis of the steps used in the CAD and FEM modelling of a ROV submerged vehicle. The paper presents three single shell ROV with different shapes, two of them having wings. The ROV design depth is 50 m, the material structure being a fibreglass composite. The numerical results are used for finding the maximal stress and displacement, as a measure of the structure performances related to the carrying mass capacity and the vehicle displacement.

Keywords: ROV submerged vehicle, geometric modelling, finite element method

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COMPARATIVE ANALYSIS OF A COMPOSITE MATERIAL ROV STRUCTURE WITH SINGLE AND DOUBLE SHELL

Leonard Domnisoru
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: leonard.domnisoru@ugal.ro

Dumitru Dragomir
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: dumitru.dragomir@ugal.ro

Alexandru Ioan
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: ioan.alexandru@ugal.ro

Daniela Domnisoru
The Naval Transport High-School of Galati,
Department of Physics, Galati, Portului Street, No. 56, 800211, Romania,
E-mail: ddomnis@yahoo.com

ABSTRACT

This study includes the comparative analysis of a ROV submerged vehicle with two design solutions for the hull structure, with single and double shell. The analyses of the single shell ROV include five main hull geometric solutions, with 123 sub cases. The double shell ROV has an internal watertight pressure cylinder and a non-watertight external shell. The analyses of the double shell ROV include three main hull geometric solutions, with 72 sub cases. The ROV design depth is 30 m, with a fibreglass composite material structure. The 3D-FEM structural analyses are based on the following criteria: permissible stress and deformation, buckling factor limit. The numerical results are pointing out the best structural design solutions, according to the ratio between the carrying mass capacity and the vehicle displacement.

Keywords: ROV submerged vehicle, composite material, finite element method

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TORSION MODELING OF THE COMPOSITE SHIP HULL

Raluca Ion
University "Dunarea de Jos" of Galati,
Faculty of Mechanical Engineering
Domneasca Street, No. 47, 800008, Romania,
E-mail: ralucachirica@yahoo.com

Sorin Dumitru Musat
University "Dunarea de Jos" of Galati,
Faculty of Mechanical Engineering
Domneasca Street, No. 47, 800008, Romania,
E-mail: sorin.musat@ugal.ro

Ionel Chirica
University "Dunarea de Jos" of Galati,
Faculty of Mechanical Engineering
Domneasca Street, No. 47, 800008, Romania,
E-mail: ionel.chirica@ugal.ro

Doina Boazu
University "Dunarea de Jos" of Galati,
Faculty of Mechanical Engineering
Domneasca Street, No. 47, 800008, Romania,
E-mail: doina.boazu@ugal.ro

Elena-Felicia Beznea
University "Dunarea de Jos" of Galati,
Faculty of Mechanical Engineering
Domneasca Street, No. 47, 800008, Romania,
E-mail: elena.beznea@ugal.ro

ABSTRACT

A new methodology based on a macroelement model proposed for torsional behaviour of the ship hull made of composite material is proposed in this paper. A computer program has been developed for the elastic analysis of linear torsion. The results are compared with the FEM based licensed soft COSMOS/M results and measurements on the scale simplified model of a container ship, made of composite materials.

Keywords: layered composites, thin-walled macroelement, torsion, FEM

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OPTIMIZATION ANALYSIS FOR THE CENTRAL PART STRUCTURE OF A FERRY SHIP

Ionica Rubanenco
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: ionicaru@yahoo.com

Leonard Domnisoru
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: leonard.domnisoru@ugal.ro

ABSTRACT

In this paper is presented the optimization for a FF fast ferry central part structure. The numerical analysis is carried out using LBR-5 software, developed by ANAST, University of Liege. The optimization is done for two loading cases, global bending sagging and hogging condition, including also local water pressure. The design variables defined for the optimization analysis are: plate thickness, frames web height, frames web thickness, frames flange width, stiffeners web height, stiffeners flange width and stiffeners spacing. The optimization objective function is defined as the minimum weight for the central part of the ship structure, taking into account the ship constructive and strength restrictions.

Keywords: structure optimization, minimum weight objective function, strength restrictions

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THE STRENGTH ANALYSIS FOR A SUPPLY VESSEL, BASED ON 3D-FEM FINITE ELEMENT MODEL

Alexandru Chirica
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: alexchirica@yahoo.com

Cosmin Giurgea
Ship Design Group Ltd.,
Galati, Dogariei Street, No. 51, 800225, Romania,
E-mail: cosmin.giurgea@shipdesigngroup.eu

Leonard Domnisoru
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, RO-800008, Romania
E-mail: leonard.domnisoru@ugal.ro

ABSTRACT

In this study is included the global-local ship strength analysis, based on 3D-FEM finite element model, full extended over the ship length. The analysis focuses on the structure for a supply vessel with over all length of 162.4 m, at full load condition. The numerical FEM analysis is carried out with SolidWorks Cosmos/M program and user subroutines developed with the GEO macro-commands language, in order to apply the external water pressure load. The numerical results are pointing out the risk structural domains, based on the stress distribution in the ship girder structure.

Keywords: initial design supply vessel, finite element method, global-local strength analysis

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NUMERICAL AND EXPERIMENTAL STRESS STUDY ON RESONANCE IN AN OFFSHORE PLATFORM LEG

Oana Mirela Dobrot
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail:oana.dobrot@ugal.ro

Costel Iulian Mocanu
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail:costel.mocanu@ugal.ro

ABSTRACT

The present paper presents studies using FEM and experimental verification for dynamic tests on a model leg of the marine drilling platform. Loads were dynamically applied, the experiment aiming at exploring the self vibration mode of the structure. To analyze the dynamic state of stresses, an experimental leg model reduced to geometric scale was considered. The structure has been analyzed numerically using FEM. The program used was COSMOS. Numerical modelling results were validated by experimental measurements using the strain gauge method.

Keywords: FEM method for dynamic analysis, strain gauge method for experimental analysis

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BILOBE CARGO TANK STRENGTH ANALYSIS UNDER EQUIVALENT QUASI-STATIC SLOSHING PRESSURE

Iulia Mirciu
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: imirciu@ugal.ro

Leonard Domnisoru
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: leonard.domnisoru@ugal.ro

ABSTRACT

The purpose of this study is to analyse the local strength for a cargo pressure vessel of a 10000 tdw LNG, under quasi-static sloshing pressure loads, calculated according to ABS and GL rules. The analysed bilobe cargo tank has a specific geometry, with two joint cylindrical tanks. The analyses take into account different filling levels of the tanks. The maximum sloshing pressure loads are considered for ship hull pitch and roll oscillation modes, with natural periods calculated with statistical expressions from ABS and GL rules. The cargo tanks structure strength is analysed based on a 3D-FEM models, developed with FEMAP NX-Nastran program. The numerical results are focused on the supplementary stresses induced in the cargo tanks structure by the supplementary quasi-static sloshing loads.

Keywords: bilobe cargo tank, rules defined quasi-static sloshing pressure, finite element analysis

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DETERMINATION OF THE INDUCED STRESSES AT THE LEVEL OF A FLOOR USING THE FINITE ELEMENT METHOD

Anişoara-Gabriela Cristea
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47Domneasca Street, 800008, Romania,
E-mail:anisoara.cristea@ugal.ro

ABSTRACT

The purpose of this paper is to verify the induced stresses of a framework element in the central area of the chemical tanker ship type.
This static calculation was performed by the finite element method with Femap software as modeler and NX Nastran as solver.

Keywords: mechanical structural stress calculation, hogging, sagging

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PRESSURE VESSEL EVALUATION LOCAL STRENGTH ANALYSIS UNDER CARGO THERMAL LOADS

Iulia Mirciu
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail:iulia.mirciu@ugal.ro

Leonard Domnisoru
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail:leonard.domnisoru@ugal.ro

ABSTRACT

In this paper, pressure vessels are subject to an inside temperature of -104º C and an outside temperature of 35ºC (ambient value), on the external area of insulation for a 10000 tdw LNG ship. The temperature will be calculated at each node in the model, using the Steady-State Heat Transfer capability of NX Nastran. The nodal temperatures are used as loads for a static analysis, in order to determine the thermal stress in the pressure vessel. The results of the thermal analysis are used as thermal loads for plates at static analysis, in order to obtain the stress values. The temperature variation in the steel structure of pressure vessel depends on thermal properties of insulation and wood supports. The resulting stresses are also function on the selected boundary conditions.

Keywords: cargo pressure vessel, thermal analysis, static analysis, finite element model

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EXPERIMENTAL STUDY ON THE INFLUENCE OF CYCLE NUMBER AT VARIABLE LOAD ON THE MECHANICAL CHARACTERISTICS OF GRP

Florentina Tocu
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail: florentina.tocu@ugal.ro

Costel Iulian Mocanu
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail: costel.mocanu@ugal.ro

Viorel Silviu Lefter
Engineer, Ph.D. candidate, SC Metchim SA Galati, Galati,
12 Calea Prutului Street, Phone 0040732640857,
E-mail: viorel.lefter@metchim.ro

ABSTRACT

Fiberglass- 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. The main objective of this work was to study the influence of the cycle number at variable load on the mechanical characteristics of GRP. It was observed that the tests made for fatigue and then traction had a considerable influence on these mechanical characteristics. The force break for traction is much higher in unsolicited specimens than in the specimens tested for fatigue.

Keywords: composite materials, mechanical characteristics, fatigue - variable load

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EXPERIMENTAL INVESTIGATION ON THE LIQUID PISTON EFFECT OF THE SEAWATER

Dan Obreja
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca
Street, No. 47, 800008, Romania,
E-mail:dan.obreja@ugal.ro

ABSTRACT

The potential of wave energy to become a fully commercially developed energy resource is very large.The results of the experimental model tests performed at the Towing Tank of the University "Dunarea de Jos" of Galati, in order to investigate a new solution of capturing and accumulating wave energy are presented in this paper. The solution was proposed by engineer Dan Costas, using the effect of "liquid piston" of the seawater.

Keywords: wave energy, liquid piston effect, experimental model tests

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EXPERIMENTAL STUDY OF THE WATER HAMMER PHENOMENON

Alexandru Ioan
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail:Ioan.Alexandru@ugal.ro

Florin Popescu
"Dunarea de Jos" University of Galati,
Faculty of Mechanic, Galati,
47 Domneasca Street, 800008, Romania,
E-mail:Florin.Popescu@ugal.ro

Leonard Domnisoru
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail:Leonard.Domnisoru@ugal.ro

Dumitru Dragomir
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, , 800008, Romania,
E-mail:Dumitru.Dragomir@ugal.ro

ABSTRACT

The paper presents the results of the Water Hammer experimental simulation performed by means of a stand placed in the Mechanical Fluids Laboratory in the "Dunarea de Jos" University of Galati. It focuses on the mathematical model that takes into consideration the compressibility of the fluid and the elasticity of the pipeline wall.

Keywords: Water Hammer, flow, system, stand, pipeline, pulse pressure

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PISTON IMPACT SHOCK – THE MAIN CAUSE OF THE BEGINNING OF CAVITATION IN NAVAL DIESEL ENGINE COOLING SYSTEMS

Mihai Simionov
"Dunarea de Jos" University of Galati,
Faculty of Mechanical Engineering, Galati, 47
Domneasca Street, 800008, Romania,
E-mail:mihai.simionov@ugal.ro

Mugurel Salvadore Burciu
"Dunarea de Jos" University of Galati,
Faculty of Mechanical Engineering, Galati, 47
Domneasca Street, 800008, Romania,
E-mail:mugurel.burciu@ugal.ro

ABSTRACT

Destruction by cavitation of cylinder liners and cylinder block on the Diesel engine cooling water washed surface occurs as a result of the simultaneous action of a combination of mechanical, chemical, thermal and electrochemical processes. The main cause of the damage caused by cavitation is the variable pressure caused by vibration cylinder liners. These conclusions were based on the direct dependency between the cavitation phenomena and the processes carried out in the engine cylinder, and also on the identity of the character and appearance sulphides (craters) on the external surface of the cylinder liners ([1], [3]). In this sense, Polipano's research [3] is quite significant. It resorted to radioactive isotopesto study the mechanical factor role, and established a direct link between vibration and wear of cylinder liners with cavitation. The use of cooling water pump motor were proven to stop the processes of cavitation completely.

Keywords: diesel engine, cylinder liner, crosshead, impulse, impact shock, cavitation, cooling systems water, ultrasonic oscillations , longitudinal and transversal vibrations

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ANALOGIES BETWEEN FLOW FLUID IN PIPES AND ALONG PLANE PLATES, WITH BOUNDARY LAYER APPLICATIONS

Viorel Andrei
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail:viorel.andrei@ugal.ro

Nicoleta-Gabriela Rodicichin
"Dunarea de Jos" University of Galati,
Faculty of Naval Architecture, Galati,
47 Domneasca Street, 800008, Romania,
E-mail:nicoleta.rodicichin@ugal.ro

ABSTRACT

The paper attempts an analogy between real fluid flow in a variable section pipe and the same fluid flow in the transition boundary layer developed by a parallel current in a plane plate. It is a new approach to the modality of the mixed boundary layer related issues.

Keywords: boundary layer, Kármán method, tangential effort, friction drag

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OPEN WATER TESTS ON A ROTOR WITH DOLPHIN PROFILE BLADE

Dan Obreja
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, 47
Domneasca Street, 800008, Romania,
E-mail:dan.obreja@ugal.ro

Liviu Crudu
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, 47
Domneasca Street, 800008, Romania,
E-mail:liviu.crudu@ugal.ro

Alexandru Andoniu
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, 47
Domneasca Street, 800008, Romania,
E-mail: alexandru.andoniu@gmail.com

Dorin Iulian Chiracu
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati,
47Domneasca Street, 800008, Romania,
E-mail:dorin.chiracu@gmail.com

ABSTRACT

Recovering water energy is of utmost importance. The article contains the results of the experimental tests performed in the Towing Tank of the Naval Architecture Faculty in the "Dunarea de Jos" University of Galati, in view of investigating a new solution for the conversion of flowing water energy, proposed by GLM IMPEX COMPANY Bucharest. The solution is based on using a rotor with "dolphin" profile blades. The results confirmed the possibility of using the proposed solution in order to recover water energy, although some constructive improvements are necessary in the experimental system, in order to increase its hydrodynamic efficiency.

Keywords: water energy conversion, rotor with "Dolphin" profile, model experimental tests

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BULK CARRIER GENERAL STRENGTH – STOWAGE FACTOR AND DAMAGE CONDITIONS INFLUENCES

Andreas Ioannou
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: and_ion@hotmail.com

Mircea Modiga
University "Dunarea de Jos" of Galati,
Faculty of Naval Architecture, Galati, Domneasca Street, No. 47, 800008, Romania,
E-mail: mircea.modiga@ugal.ro

ABSTRACT

On bulk carriers, stowage factor significantly influence the load of cargo holds and thus the distribution of weight on ship length. The Purpose of this Study is to present the influence of the cargo's stowage factor on the bending moments and maximum stresses that occur in a bulk carrier. Have been considered also damaged cases in which some compartments have been flooded but the vessel is still able to navigate. Are simulated and presented results from 36 scenarios that combines all types of cargoes with all damaged cases.

Keywords: bulk carrier general strength, stowage factor

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EXPERIMENTAL MEASUREMENTS FOR THE SUPERCHARGED DIESEL NAVAL ENGINE MB836Db IN UNSTEADY WORKING CONDITIONS

Mugurel Burciu
"Dunarea de Jos" University of Galati,
Faculty of Mechanical Engineering ,
Department of Thermal Systems and Environmental Engineering,
111 Domneasca Street, 800201,
Galati, Romania,
E-mail:Burciu.Mugurel@ugal.ro

Mihai Simionov
"Dunarea de Jos" University of Galati,
Faculty of Mechanical Engineering ,
Department of Thermal Systems and Environmental Engineering,
111 Domneasca Street, 800201,
Galati, Romania,
E-mail:Simionov.Mihai@ugal.ro

ABSTRACT

The paper presents some graphic results representing the notable parameters of the supercharged Diesel naval engine MB836Db in unsteady working conditions as specified, which have been obtained on the basis of private experimental measurements. The authors formulate a number of conclusions referring to the influence of supercharger units time response on the engine's performances in the case of unsteady working conditions.

Keywords: supercharged engine, time response of supercharger units, unsteady working conditions

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