System integration and demonstrators

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Contents

Scope of the work 3

Attachments 3

Act 3.3 - Ships Virtual Prototyping 3

Deliverable_3.3_Global FE Strength Analysis of Double ended ferry_final 3

Deliverable_3.3_Global FE Strength Analysis of Ro-Pax ferry_final 4

Deliverable_3_3_CFD_Double_ended_ferry_final 4

Deliverable_3_3_CFD_Ro_Pax_ferry_final 5

Deliverable_3_3_Seakeeping_DE_ferry_final 5

Attachment_Seakeeping_DEF_05 5

Deliverable_3_3_Seakeeping_Ro_Pax_ferry_final 6

Attachment_Seakeeping_ROPAX_05 6

Scope of the work

The scope of this document is to collect all the studies, results, and other materials that concern the WP3 – Act. 3.3 “System integration and demonstrators” task.

Attachments

Act 3.3 - Ships Virtual Prototyping

The document describes why Virtual Prototypes (VPs) can be useful for modern and future ship design processes, and briefly depicts how the VPs of the two case study ships of the METRO project have been created. Examples pertaining the renderings, documentation, data, and other results directly obtainable by means of the correct interrogation of the ships’ VPs are briefly shown.

Deliverable_3.3_Global FE Strength Analysis of Double ended ferry_final

This document represents the second part of the structural analysis of double-ended ferry with the aim of verifying the calculated scantlings of the hull and superstructure. Main goal of the analysis is to check the global strength of the ferry exposed to still water bending moment, in order to find possible primary structural element subjected to higher stress level. To check and validate the global strength of the ferry hull structure through finite element analyses (FEA), scantlings are determined in accordance to BV rules. In order to create the geometry of the computer model, the software package *RHINOCEROS* was used, while *LS-DYNA* was used as a preprocessor, solver and postprocessor for linear static strength analysis. Three level of the structural model are produced in order to estimate the efficiency of the superstructure in the longitudinal strength. Models are meshed and three load cases are considered as most unfavourable ones from trim and stability book regard to maximum vertical bending moment. These leads to nine different calculation runs. Results, in form of displacement and stresses are presented in detail.

Deliverable_3.3_Global FE Strength Analysis of Ro-Pax ferry_final

This document represents the second part of the structural analysis of Ro-Pax ferry with the aim of verifying the calculated scantlings of the hull and superstructure. Main goal of the analysis is to check the global strength of the ferry exposed to still water bending moment, in order to find possible primary structural element subjected to higher stress level. To check and validate the global strength of the ferry hull structure through finite element analyses (FEA), scantlings are determined in accordance to BV rules. In order to create the geometry of the computer model, the software package *RHINOCEROS* was used, while *LS-DYNA* was used as a preprocessor, solver and postprocessor for linear static strength analysis. Three level of the structural model are produced in order to estimate the efficiency of the superstructure in the longitudinal strength. Models are meshed and three load cases are considered as most unfavourable ones from trim and stability book regard to maximum vertical bending moment. These leads to nine different calculation runs. Results, in form of displacement and stresses are presented in detail.

Deliverable_3_3_CFD_Double_ended_ferry_final

This document presents the Computational Fluid Dynamics (CFD) analysis of the hull form of the double-ended ferry. The CFD computations were done with the software package *FINE™/Marine, NUMECA's Flow INtegrated Environment* for marine applications. Three series of simulations were made: one for a scale model of the ferry and the other two for a full-size ferry for two different draughts (design and maximum). The simulations were done for the hulls in upright conditions, for a series of different speeds. This obtained results for the full-scale double-ended ferry show that the designed symmetrical double-ended hull would ensure the favorable resistance. For one case of the propeller design point for which it was assumed that the maximum continuous engine power is delivered to the thruster propeller at the maximum propeller speed, a speed of almost 14 knots was obtained. On the basis of the obtained results it can be confirmed that the developed hybrid double-ended ferry with the selected main engines, would meet all ferry speed requirements.

Deliverable_3_3_CFD_Ro_Pax_ferry_final

This document presents the Computational Fluid Dynamics (CFD) analysis of the hull form of the Ro-Pax ferry. The CFD computations were done with the software package *FINE™/Marine, NUMECA's Flow INtegrated Environment* for marine applications. Three series of simulations were made: one for a scale model of the ferry and the other two for a full-size ferry for two different draughts (design and maximum). The simulations were done for the hulls in upright conditions, for a series of different speeds. This obtained results for the full-scale double-ended ferry show that the designed symmetrical double-ended hull would ensure the favorable resistance. For one case of the propeller design point for which it was assumed that the maximum continuous engine power is delivered to the propeller at the maximum propeller speed, a speed of almost 18 knots was obtained. On the basis of the obtained results it can be confirmed that the developed hybrid Ro-Pax ferry with the selected main engines, would meet all ferry speed requirements.

Deliverable_3_3_Seakeeping_DE_ferry_final

This document presents the seakeeping analysis of the double-ended ferry. The numerical simulations (CAD import – meshing – computations – visualization) were performed with *Sesam*, a software suite for structural and hydrodynamic analysis of ships and offshore structures. The numerical simulations were carried out using especially the *HydroD*, a module for hydrodynamic and hydrostatic analysis of fixed and floating structures like offshore platforms and ships. With this study it was shown that the proposed design for the new double-ended ferry intended for the route in Adriatic Sea between Brestova (on mainland) and Porozina (Island of Cres) is suitable for the navigation in Adriatic Sea. Amplitudes of rolling are not significant which contributes to overall comfort onboard. Pitching and heaving is also within acceptable limits which are of great importance regarding slamming, green water and overall dynamic ferry behavior on sea.

Attachment_Seakeeping_DEF_05

This video is an integral part of the "Deliverable_3_3_Seakeeping_DE_ferry_final". It shows the double-ended ferry heave and roll response on regular waves for beam seas. The video was obtained as the result of seakeeping analysis using the *Sesam* suite.

Deliverable_3_3_Seakeeping_Ro_Pax_ferry_final

This document presents the seakeeping analysis of the Ro-Pax ferry. The numerical simulations (CAD import – meshing – computations – visualization) were performed with *Sesam*, a software suite for structural and hydrodynamic analysis of ships and offshore structures. The numerical simulations were carried out using especially the *HydroD*, a module for hydrodynamic and hydrostatic analysis of fixed and floating structures like offshore platforms and ships. With this study it was shown that the proposed design for the new Ro-Pax ferry intended for the route in Adriatic Sea between Italy and Croatia (ports of Ancona and Split) is suitable for the navigation in Adriatic Sea. Amplitudes of rolling are not significant which contributes to overall comfort onboard. Pitching and heaving is also within acceptable limits, which is of great importance regarding slamming, green water and overall dynamic ferry behaviour.

Attachment_Seakeeping_ROPAX_05

This video is an integral part of the "Deliverable_3_3_Seakeeping_Ro_Pax_ferry_final". It shows a Ro-Pax ferry heave and pitch response on irregular waves for head seas. The video was obtained as a result of seakeeping analysis using the *Sesam* suite.