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Erosion caused by propeller jets in harbour basins

Summary of the final report, ref:BIA2012-38676-C03-01

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Abstract

The present report offers a translation from Spanish to English language of the final report of the coordinated project funded by the Spanish Government and dealing with erosion caused by propellers jets in harbours. The main information of the project is summarized in this report. For detailed information on the topic and the experimental campaign that has been carried out, one is referred to journal papers recently published in peer-reviewed international journals.

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1 Introduction

Ship manoeuvring can cause morphodynamic changes inside harbour basins . The increase in the size of vessels has given rise to those morphodynamic changes causing two different but linked problems: scouring near structures affecting the stability and sedimentation of the scoured material reducing the depth of the basin elsewhere in the harbour basin.

Physical model test have been carried out at Maritime Engineering Laboratory (LIM) of the Technical University of Catalunya (UPC), in Spain, to analyse the flow related to twin propellers and the caused erosion. In addition, numerical modelling with OpenFoam and the DualSPHysics model has been carried out also.

A final report of the study is available in Spanish [BIA2012-38676-C03-01]. Two journal papers have been recently published as a result of the project (Gironella *et al.*, 2017; Mujal-colilles *et al.*, 2017).

The project was sponsored by MINECO (the Ministry of Economy and Competition) and FEDER (European Union – the European Regional Development Fund "Una Manera de hacer Europa)" by the Spanish Government through the projects [BIA2012-38676-C03-01], [TRA2015-70473-R], Secretaría de Estado de Investigación, Desarrollo e Innovación.

2 Summary of the project

A literature review has been conducted to analyse the existing methodologies for the assessment of the erosion caused by ship propellers during the manoeuvring phases inside harbour basins. Special focus was on the berthing and casting-off. It turn out that only three of the exiting formulas could be recommended to the harbour authorities to study the erosion during berthing and casting-off. Many of the semi-empirical formulas in literature are derived from scale models and are affected by scale effects.

Physical model tests have been carried out at LIM. The model scale was 1/25. The velocity field generated by twin propellers has been measured. Then, the changes of the bed profiles following erosion caused by twin propellers have been measured, in confined as well as unconfined conditions. In the latter case, a different response was observed between the berthing and the casting-off. In total 6 Acoustic Doppler Velocitymeters have been used, in total measuring at 108 locations in different phases.

During the project, new functionalities have been developed for the SPH-based DualSPHysics model, such as: double precision; variable time-step to cope with the high propellers speed; variable resolution (i.e. splitting and coalescing); a multi-phase code to study the interaction between water and sediments and a new discretization of the boundaries to represent the propeller geometry appropriately. However the project activity related to numerical modelling was finally not completed.

All experimental details and main conclusions of the literature review and of the campaign carried out at Lim, can be found in (Gironella *et al.*, 2017; Mujal-colilles *et al.*, 2017).

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Gironella, X.; Crespo, A.J.C.; Asce, M. (2017). Study of the Bed Velocity Induced by Twin Propellers *143*(*5*): 1–8. doi:10.1061/(ASCE)WW.1943-5460.0000382.

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