Modeling the sloshing problem in a rectangular tank with submerged incomplete baffles

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Abstract

Purpose: The present work is an experimental and numerical study of a sloshing problem including baffle effects. The purpose of this paper is to assess the numerical behavior of a Lagrangian technique to track free surface flows by comparison with experiments, to report experimental data for sloshing at different conditions and to evaluate the effectiveness of baffles in limiting the wave height and the wave propagation. Design/methodology/approach: Finite element simulations performed with a fixed mesh technique able to describe the free surface evolution are contrasted with experimental data. The experiments consist of an acrylic tank of rectangular section designed to attach baffles of different sizes at different distance from the bottom. The tank is filled with water and mounted on a shake table able to move under controlled horizontal motion. The free surface evolution is measured with ultrasonic sensors. The numerical results computed for different sloshing conditions are compared with the experimental data. Findings: The reported numerical results are in general in good agreement with the experiments. In particular, wave heights and frequencies response satisfactorily compared with the experimental data for the several cases analyzed during steady state forced sloshing and free sloshing. The effectiveness of the baffles increases near resonance conditions. From the set of experiments studied, the major reduction of the wave height was obtained when larger baffles were positioned closer to the water level at rest. Practical implications: Model validation: evaluation of the effectiveness of non-massive immersed baffles during sloshing. Originality/value: The value of the present work encompass the numerical and experimental study of the effect of immersed baffles during sloshing under different imposed conditions and the comparison of numerical results with the experimental data. Also, the results shown in the present work are a contribution to the understanding of the role in the analysis of the proposed problem of some specific aspects of the geometry and the imposed motion..

Keywords

FEM, Computational fluid dynamics, Baffle effects, Experimental validation, Sloshing.