Bureau Veritas Sloshing Model Tests & CFD Calculations within ISOPE benchmark

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ABSTRACT

The objective of this paper is to present the sloshing model tests and the corresponding CFD calculations carried out by Bureau Veritas (BV) within the framework of the second ISOPE sloshing benchmark.

It has to be mentioned that the first ISOPE sloshing benchmark was proposed in order to establish best practices for sloshing model tests. Therefore the major actors (universities, research institutes and industrial partners) involved in sloshing model tests campaigns decided to join this project. Carrying out its own sloshing model tests since 2006, BV decided to contribute through its expertise to this benchmark.

This paper is divided in three main sections. The first one aims at managing the inputs; the second one details the processing of the experimental data and the third one aims at giving some first comparisons between experimental results and numerical calculations (CFD and Wagner’s model).

This work follows the studies carried out by the different stakeholders of the 2012 ISOPE sloshing benchmark and points more in details, the key parameters driving the discrepancies that may occur in the results. It is thus foreseen to mainly focus on the accurate reproduction of the tanks motion by the test rig, on the tank alignment on the test platform and on the precise filling of the tank.

It has been agreed that additional outputs have to be issued for this second benchmark. Firstly, impact high speed videos will help to identify the impact types (air pocket or direct). Secondly, specific BV features such as high accuracy six-degrees-of-freedom (d-o-f) measurement, global force and crest memory cards measurements are presented.

KEY WORDS
Sloshing, benchmark, model tests.

INTRODUCTION

In the late eighties, Bureau Veritas carried out sloshing model tests in cooperation with Gaz Transport. Numerous studies have been carried out since then, together with tools development, the improvement of computation performances and full scale feedbacks. Since 2006, Bureau Veritas has launched its own sloshing model tests in partnership with Ecole Centrale de Nantes, which provides the test rig platform as well as additional devices.

During the last few years, the interest in conducting sloshing model tests increased significantly. Several yards institutes and universities, involved in designing LNG carriers and assessing cargo containment systems decided to move forward in launching sloshing model test campaigns.

Expertise has increased with each other’s feedback but conducting successfully these tests is still pending on mastering numerous key parameters. Thanks to GTT initiative, a benchmark of sloshing model tests was conducted in 2012. This first round gathered 8 entities which were committed to stick to chosen tests specifications. Several papers were published in ISOPE 2012, helping the entire sloshing community to improve their knowledge and share the main sources of discrepancies that have been raised from the results. Consequently, a second edition of this benchmark was found unavoidable together with a refinement of the specifications.

The authors have been part of both benchmarks (Baudin 2012, Fillon 2012). For this second benchmark, the setting-up was done so as to comply with the new specifications but additional BV features were included as well such as global force measurement, crest memory cards and high accuracy six d-o-f motion measurements.

The overall experimental set-up including these additional features will be first described. Then, the results from the benchmark test will illustrate the added value of the different features. Finally, some first comparisons between measurements and numerical calculations will be presented for liquid global forces and time pressure histories.

MODEL TEST SET-UP

The second sloshing benchmark is conducted within the framework of the specifications (ISOPE 2012) written by GTT, reviewed and agreed by the benchmark participants.

Before describing the set-up it has to be reminded what components or methods are shared in between participants.

First of all: the test tank. Two tanks have been built and used by the different participants. Concerning the pressure sensor pads: the outer dimensions of the modules are necessarily the same. However, the expertise of GTT has been very useful in setting-up the different mobile parts of the tank. It is thus admitted that a common target tank is used. Some differences will be afterwards mentioned in this paper (number and location of pressure sensors).