An Efficient Hydro Structure Interface for Mixed Panel-stick Hydrodynamic Model

F.X. Sireta, Š. Malenica, F. Bigot, Q Derbanne, X.B. Chen, V. Bonniol
Research Department - Marine Department Bureau Veritas
Paris, France - Houston TX, USA

ABSTRACT

An efficient procedure for hydro-structure interactions for semi-submersible platforms exposed to sea waves is presented. The structural response is assumed to be quasi static and the wave loading linear. The hydrodynamic problem is solved using the potential flow linear theory for the columns and pontoons while a Morison type loading is applied on the bracings. The structural model is a classical 3D finite element model. The proposed interfacing method ensures the perfect balance of the structural model.

KEY WORDS:
Hydro-structure; Semi-submersible platform; Potential flow; Morison.

INTRODUCTION

The hydro-structure interfacing in seakeeping is an important problem in the context of the direct calculation approach for approval of floating systems. Both fatigue and extreme structural response calculations need to be performed. An efficient tool ensuring the perfect transfer of the loadings issued from hydrodynamic analysis is a key element in the overall procedure. The seakeeping calculations are usually done within the potential flow assumptions, using the Boundary Integral Equation (BIE) techniques. Within this approach, the fluid flow is represented by a distribution of singularities over the 3D wetted part of the body which is subdivided in a certain number of panels. In that case an efficient procedure of load transfer was presented in Malenica, Stumpf, Sireta and Chen (2008) and Tuitman, Sireta, Malenica and Bosman (2009). For some applications, such as semi-submersible platforms, the hydrodynamic model includes not only the parts modeled by the panels but also some slender elements (bracings) which are usually modeled using the Morison formula (e.g. Leblanc, Petitjean, Le Roy and Chen (1993)). The Morison formula uses the information from the undisturbed fluid flow at the position of the element and applies explicit expressions which give the drag force and the added inertia forces. The use of the Morison formula in combination with the BIE method implies several changes in the hydro structure coupling procedure and these changes are discussed in the present abstract.

GENERAL METHODOLOGY

First we briefly describe the basics of the hydrodynamic and structural modeling principles. Typical hydrodynamic and structural meshes are shown in Figures 1 and 2.

Figure 1: 3D hydrodynamic panel model of a semi submersible

Figure 2: 3D FE model of a semi-submersible

Hydrodynamic model

As stated in the introduction the hydrodynamic model is composed of two parts: the 3D panel model and the Morison model. We discuss them separately in the following sections.

3D hydrodynamic panel model