*Proceedings of the Eighth (2008) ISOPE Pacific/Asia Offshore Mechanics Symposium*
*Bangkok, Thailand, November 10-14, 2008*

*ISBN 978-1-880653-52-4*

# Hydroelastic Response of Interconnected Floating Beams over Varying Seabed Profile

*Muhammad Riyansyah*, C. M. Wang, and Y. S. Choo*
Center for Offshore Research and Engineering
Department of Civil Engineering, National University of Singapore
Singapore

## ABSTRACT

This paper is concerned with the hydroelastic response of multiple floating beams connected together by mechanical joints with rotational spring stiffness under wave action. A frequency domain approach is developed for the hydroelastic analysis. The fluid is assumed to be incompressible, inviscid and its motion irrotational so that a velocity potential exists and thus the fluid motion is governed by the Laplace's equation. The floating beams are modelled by the Timoshenko beam theory which allows for the effects of transverse shear deformation and rotary inertia. The boundary element method (BEM) is used to solve the governing equation and boundary conditions of the fluid domain. The finite element method (FEM) is employed for solving beam equation of motion. The study investigates the effects of shear deformation and rotary inertia, relative beam stiffnesses, rotational stiffness of mechanical joints, and the varying seabed profile on the hydroelastic responses of the interconnected floating beams.

KEY WORDS: VLFS; hydroelastic response; boundary element method; finite element method; frequency domain; timoshenko beam.

## INTRODUCTION

Pontoon-type, very large floating structure (VLFS) technology is considered as an alternative for creating land from the sea. They appear like giant plates resting on the water surface. In contrast to land reclamation which is considered as a traditional way for creating land from the sea, VLFSs have several advantages under certain conditions. They are more cost effective when the water depth is large, environmental friendly, easy and fast to construct (and to be removed if needed), inherently base isolated from seismic shocks, and they provide readily available interior space.

A typical VLFS has large horizontal dimensions ranging from several hundred meters to several kilometers. For example, the Mega-Float project (which tests the feasibility of VLFS for use as a airplane runway) has a length of 1,000 meters and a width of 121 meters (at the widest part) with a depth of only 3 meters which means that it has a small depth-to-length ratio or small bending rigidity. Considering that a VLFS has relatively small bending rigidity and has large size when compared to the wavelength, the wave-induced motion of a VLFS is significantly affected by its elastic deformation. The global response of a VLFS thus cannot be solely described by rigid body dynamics but it must involve the interaction between its elastic deformations and the flow field around it, which has been referred to as a hydroelastic interaction.

In the design of VLFS, it is important to satisfy the functional and operational requirements. Some applications require stringent tolerance on the motion of the floating structure. Therefore, hydroelastic analysis of a VLFS is important in order to assess the safety and serviceability of a VLFS.

In the previous works, hydroelastic analysis of a VLFS as a single continuous floating structure on a constant water depth has been extensively studied (Andrianov and Hermans, 2003; Hermans, 2000; Kashiwagi, 2000; Kyoung et al, 2006; Liu and Sakai, 2002; Syed and Mani, 2004). However, due to its large size, it is unlikely that the water depth will be constant under the entire structure. Furthermore, it is likely that a huge VLFS is constructed by connecting several smaller size modules to form a complete VLFS. The presence of connections in a VLFS may introduce non-uniformity in term of structural rigidity. Therefore, the hydroelastic response of a VLFS consists of several floating modules on a varying seabed profile will be studied in this paper.

Hydroelastic response of floating structure on a varying seabed profile has been studied by Wang and Meylan (2002), Kyoung et al (2005a, 2005b), and Belibassakis and Athanassoulis (2004). They observed that the seabed profile affects the hydroelastic response of a VLFS, and hence should be considered when the VLFS is constructed in the coastal area. However, they only consider a single continuous VLFS.

Khabakhpasheva and Korobkin (2002), Kim et al (2005), and Fu et al (2007) studied the hydroelastic reponse of interconnected multiple floating structures. Khabakhpasheva and Korobkin (2002) studied the