



Dynamic Response of a Floating Bridge Structure

Thomas Hansen Viuff, Bernt Johan Leira, Ole Øiseth

Norwegian University of Science and Technology, Trondheim, Norway

Xu Xiang

Norwegian Public Roads Administration, Stavanger, Norway

Contact: thomas.h.viuff@ntnu.no

Abstract

A theoretical overview of the stochastic dynamic analysis of a floating bridge structure is presented. Emphasis is on the wave-induced response and the waves on the sea surface are idealized as a zero mean stationary Gaussian process. The first-order wave load processes are derived using linear potential theory and the structural idealization is based on the Finite Element Method. A frequency response calculation is presented for a simplified floating bridge structure example emphasising the influence on von Mises stress in the pontoon from low- and high frequency waves and frequency dependence in hydrodynamic added mass and damping coefficients.

Keywords: Floating bridge; frequency response; linear dynamics; von Mises stress.

1 Introduction

Floating bridges have been around for many thousands of years and throughout the years, they have been used as temporary supply lines or for military purposes. However, it is only during the last three decades or so that floating bridges are being developed to the degree of sophistication, so they can be applied as a critical part of modern infrastructure. Still, compared with land-based bridges, including cable-stayed bridges, limited information [1] is currently available on floating bridges and even less on submerged floating tunnels for transportation. This information is especially true regarding construction records, environmental conditions, durability, operations and performance of the structure.

The limited amount of floating bridges currently in the world is a statement to this fact. Depending

on the landscape in the proximity of the floating bridge and on the sea state conditions different types of floating bridges are used. Only three long span floating bridges are currently located in difficult sea state conditions and allows for cars to pass. These are:

- i. Hood Canal Bridge (1961) in USA a 2,398 meter long pontoon bridge with a 1,988 meter long anchored floating portion, it is the longest floating bridge in the world located in a saltwater tidal basin, and the third longest floating bridge overall.
- ii. Bergsøysund Bridge (1992) in Norway a 931 meter long pontoon bridge with the longest span of 106 meters.
- iii. Nordhordland Bridge (1994) in Norway is a combination of a cable-stayed and pontoon bridge. It is the longest free floating bridge without anchorage.