

The simplified method for the prediction of radiation damping coefficients

Jong-Hyun Lee and Atilla Incecik
 Marine Science and Technology, Newcastle University
 Newcastle upon Tyne, Tyne and wear, United Kingdom

ABSTRACT

This paper describes a simplified analytical procedure to predict the hydrodynamic radiation damping coefficients. In the formulation of the wave damping force due to oscillatory rigid-body motion, the use of the wave radiation component is made. At the initial stage of the development a rectangular barge form was used and the formulation is based on the strip theory. The simplified numerical procedure developed was used to predict the hydrodynamic characteristics of a prismatic barge. The hydrodynamic coefficients are developed using the Haskind-Newman relation together with the 2D energy conservation principle in the frequency domain and numerical results from the radiation damping coefficient and force calculations are compared with Vughts' experimental results.

KEY WORDS: Radiation damping; Haskind-Newman relation; wave excitation; frequency domain.

INTRODUCTION

In order to predict the ship motion in a seaway, we need to determine wave excitation forces and hydrodynamic coefficients. The influence of viscosity and surface tension is of minor importance compared to forces due to incident and diffracted waves. Presently this statement has not been disproved by model tests or full scale measurements; at least as far as ship motion problem is concerned. On the other hand, the viscous effects should be considered in the maneuvering problem.

Currently many commercial programs based on various numerical procedures are used to predict the hydrodynamic coefficients. However the use of commercial programs usually requires special knowledge and skills to model the ship geometry for accurate results.

This paper presents a simplified numerical procedure to predict the hydrodynamic damping coefficients. The coefficients are derived using Haskind-Newman relation together with the 3D energy conservation

principle in the frequency domain.

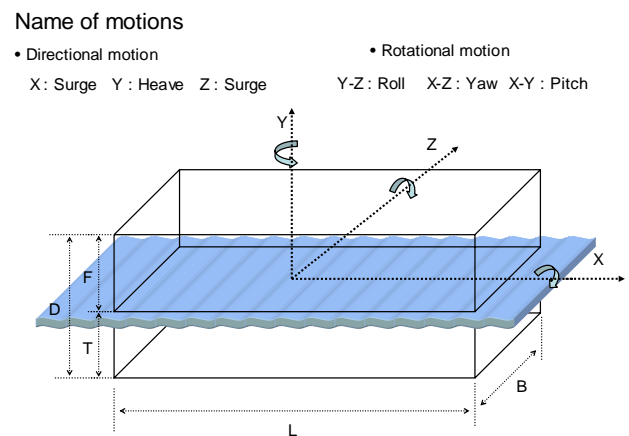


Figure 1. Coordinate of barge and direction of motion

External Force Calculation By Using Of Pressure

The general form of oscillatory forces and moments acting on the body can be inferred from Bernoulli's equation.

$$P = -\rho \left(\frac{\partial \phi}{\partial t} + gy + \frac{1}{2} \nabla \phi \cdot \nabla \phi \right) \quad (1.1)$$

If we use the linear theory, and assume that the forward speed is 0. We can ignore the velocity square term.

The velocity potential:

$$\phi(x, y, z, t) = \text{Re} \left\{ \left(\sum_{j=1}^6 \zeta_j \phi_j(x, y, z) + \xi \phi_A(x, y, z) \right) e^{i\omega t} \right\} \quad (1.2)$$