On the geometrical non-linearities of the ship load expressions

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Abstract

In the structural analysis a fundamental rule is played by the internal forces and moments: they are the only variables on which the study for the primary level of the ship structural response is based, in accordance with beam theory. First of all, based on the usual decomposition of loads general expressions for the distributed still water, inertial and restoring loads have been revisited. Additionally, the influence of the non-linearity arising from the hull geometry on loads has been studied. Particular attention has been also given to the evaluation of loads due to the dynamic pressure in wave. Finally, two numerical examples have been carried out in order to verify the aforementioned influence on loads. The results obtained have been particularly discussed.

Keywords: Loads, Dynamic Pressure, Internal Forces and Moments, Nonlinear restoring

1. Introduction

It is well known that longitudinal ship's hull strength is the most fundamental strength of a ship structure, and many researches have been done for this aspect.

Direct calculations of wave loads in structural analyses are generally based on linear theories but recently several different approaches have been developed to take into account nonlinearities in wave load predictions (Baarholm and Moan, 2001), (Beck and Reed, 2001) **.** Usually the linear frequency domain methods give reliable results at zero speed. However, significant differences can exist between different nonlinear methods (Suji Zhu and Moan, 2013), (Fonseca and Guedes Soares, 2002).

General, non-linear, expressions can be derived for the inertial, hydrostatic and restoring loads (Mandarino and Coppola, 1996), Coppola and Mandarino, 2000)**.**

In this paper the general expressions for the statical and dynamical loads, which can be opportunely reduced according to the capability of the utilized computational tools, have been carried out. The first problem is to properly define the internal forces and moments on a ship cross-section, to obtain their expressions by loads and finally to carry out the nonlinear loads functions.