



Journal of the Japan Society of  
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ONLINE ISSN : 1881-1760

PRINT ISSN : 1880-3717

**Journal of the Japan Society of Naval Architects and Ocean Engineers**

Vol. 3 (2006) pp.147-155

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## **Cruising performance of ships with large superstructures in heavy sea -2nd report: Added resistance induced by wind and waves, and optimum ship routing-**

[Toshifumi Fujiwara](#), [Michio Ueno](#) and [Yoshiho Ikeda](#)

(Received February 27, 2006)

**Summary:** The steady-state cruising performance of a large passenger ship and a PCC under heavy wind and waves are presented in this paper. These kinds of ships have specifications with very large hull and superstructures above sea level. Strong wind causes large drift, heel and rudder angles to ships and exerts great influence on the ships' cruising performance. From safety and economical aspects the assessment of added resistance under such wind and wave loadings is very important for those ships. Formulation of the steady-state equations is based on the MMG model for a ship manoeuvring simulation to obtain the steady ship condition. The wind and wave loads on the ships are calculated using the latest methods proposed by the authors. From this analysis, the special specifications of the steady condition for the large passenger ship and the PCC are clearly understood. Moreover, speed loss and DHP increase of those ships in the sea around Japan are revealed in this paper. It is cleared in the calculated results that wind effect has a very important role for the ships with large superstructures. Finally using the results of steady-state cruising performances, the optimum ship routing in wind and waves is presented by the dynamic programming method in order to find the route for reducing the navigating time of the ships.

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Toshifumi Fujiwara, Michio Ueno and Yoshiho Ikeda: Cruising performance of ships with large superstructures in heavy sea : -2nd report: Added resistance induced by wind and waves, and optimum ship routing- , Journal of the Japan Society of Naval Architects and Ocean Engineers, (2006), Vol. 3, pp.147-155 .

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