Engineering Notes

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Bilge Keels with Discontinuous End Plate

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Introduction

BILGE keels are effective devices to reduce rolling of ships. Normally, they can reduce rolling amplitude by about 20 to 50%.[1] The initial cost of the bilge keel is minor, and the construction is simple. Many theoretical as well as experimental results regarding configuration, performance, and construction methods of bilge keels have been published. This Note is intended to present some experimental results of flanged bilge keels with and without slots in the end plate. It was found that flanged bilge keels without slots in the end plate yield less reduction of roll than those which are unflanged. However, the performance of flanged bilge keels can be improved by cutting slots in the end plate.

Description of Experiments

Experimental studies were carried out in a small towing tank at the University of Singapore. A ship model with rounded sections of 46-cm length and 12-cm beam was fitted with bilge keels of 20-cm length along a 45-deg line to the vertical measured from the center of the arc of the immersed rounded hull. The depth of the bilge keel was fixed at 2 cm. With such a depth, the bilge keel and end plate are within the baseline and the extreme breadth of the model. The center of gravity of the model was approximately at the center of the arc, as shown in Fig. 1. The sway motion of the model was minimized by tying two long nylon strings at the two ends of the model to two ends of the tank. The rolling angle was measured by pen and drum recorder. A miniature motor was placed inside the drum, and the drum, together with the motor, was fixed to the carriage. The pen was mounted on the ship model, bearing and bush were used to insure free tracing of the roll angle variation. The model draft was kept constant, and all tests were conducted in water having a temperature of 27°C.

Results

Figure 1 shows the declination curves of rolling angle ratio ϕ/ϕ_m vs N for bilge keels with different width of end plates, where: ϕ = angle of roll at the time t; ϕ_m = maximum angle of roll (inclined angle before the model was released), and

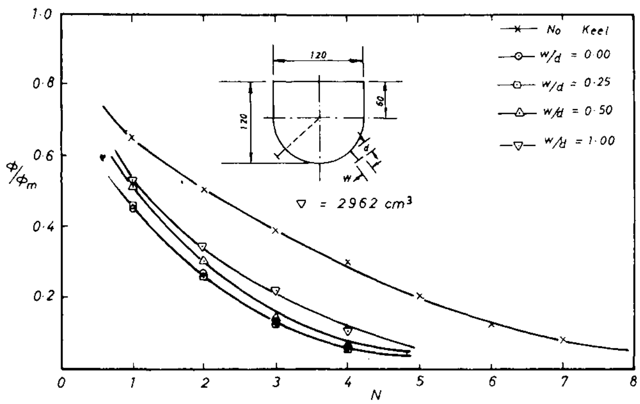

Fig. 1 Effect of width of end plate on the damping amplitude of roll.

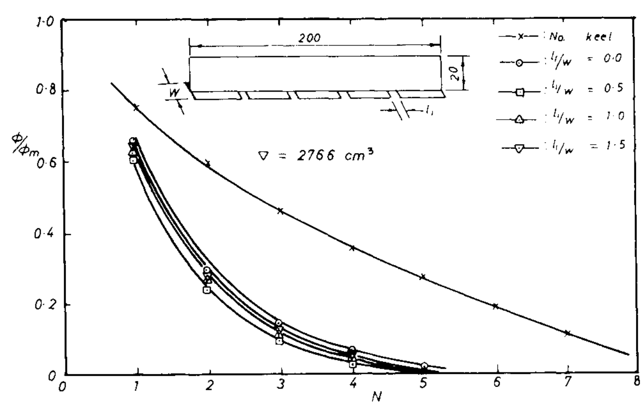

Fig. 2 Effect of width of slot on the damping amplitude of roll.

N = swing number. It is obvious that the keels with $w/d=0$ and 0.25 yield the highest damping on rolling, where w is the width of the end plate, and d is the depth of the bilge keel. As the width of the end plate was increased, the damping effect became less. It is conjectured that the streamlines may flow along the end plate and thereby provide less disturbance or dissipation. The fitting of the end plates clearly degrades the damping effectiveness of the bilge keels.

Figure 2 shows similar curves of ϕ/ϕ_m vs N for the case of $w/d=0.25$ with various sizes of slots cut in the end plate. It is evident that all the slotted cases have larger damping effect on rolling as compared with that of the nonslotted cases. During the rolling motion, the flow through the slots yields greater dissipation of energy. The best width of slot as regard to increased damping, may depend upon many factors. For this particular configuration, the best ℓ_l/w ratio equals 0.5, where ℓ_l is the width of the slot and w is the width of the end plate.

Reference

[1] Giddings, A.L., "A Survey of Ship Motion Stabilization," *Fifth Symposium, Naval Hydrodynamics*, Office of Naval Research and the Skipsmodelltanken, Sept. 1967, pp. 747-813.

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