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COMPUTATIONAL FLUID DYNAMICS ANALYSIS OF A BARGE INCORPORATED WITH AN ASYMMETRICAL BRIDLE TOWLINE MODEL

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Investigation on the configuration of a towline model incorporated with ship towing system performance is obviously necessary to attain navigational towing safety at sea. Instead of employing typical towing models such as single and symmetrical bridle towline models, an asymmetrical bridle towline configuration is then proposed to improve the ship towing performance during operation. This thesis presents Computational Fluid Dynamics (CFD) analysis on the asymmetrical bridle towline model with respect to its effect on course stability and seakeeping performance of the ship towing system in calm water and waves, respectively. Several towing parameters such as various towing angles, towing speeds and towline lengths have been taken into accounts in the simulation. Here, the course stability performance of the towed barge has been analysed in three degrees-of-freedom i.e., surge sway and yaw motions. Meanwhile, the seakeeping characteristic has been assessed at various wavelengths and wave directions involving five degrees-of-freedom i.e., surge, sway, yaw, heave and pitch motions. The results revealed that the increase of towing angle up to 40° has significantly reduced the sway and yaw oscillation motions of the towed ship, which is directly prone to improve the course stability performance. In addition, the increase

of towing speed resulted in more steady oscillation of the sway and yaw motions indicated with their less amplitude motions. Inherently, this led to have better course stability performance of the towed ship. However, those two conditions above were inversely led to sufficient increment of the magnitude of the dynamic towline tension. As well as the increment of towline length from l'=1.0 to 3.0, the dynamic towline tension has also increased. The reason is due to the stiffness of the towline that causes elongation during towing. In addition, the seakeeping performance has been improved indicated by the reduction of the heave and pitch motions within the range of $0.75<\lambda/L< 1.25$ and wave direction $45°<\theta< 90°$, respectively. The magnitude of the towline tension during towing in waves is higher compared to calm water. Here, the towline tension of towing angle, $\alpha = 20°$ at $l' = 2.0$ in calm water is 1.47N compared to the same parameter in waves which resulted in 2.95N. This shows that the course stability and seakeeping analysis of the towed ship is important to ensure a comprehensive towing navigation. The current finding simulation results are very helpful in improving the ship towing navigation system.