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Experimental and Predictions of Pressure Distributions on the Bottom of a Prismatic Planing Hull During Wave Slamming

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The repeated wave slamming experienced by high-speed planing craft can cause structural damage and discomfort or injury to passengers and crew. The design guidelines related to structural and seakeeping considerations are still mainly determined through semi-empirical criteria that can lack physical meaning or are limited in application. The research presented here is party of a study to understand the fundamental physics of water-impact for high-speed planing hulls. The slamming loads and resulting hull motions were measured during multiple wave impact events. Sets of towed scale model experiments were conducted in regular waves to capture repeated sequences of wave impact events. These experiments, of both a 1.2 meter (4-ft) and 2.4 meter (8-ft) length planing hull model, were conducted in the 115.8 meter (380-ft) long tow tank at the United States Naval Academy. Heave, pitch, accelerations, water profile (both encountered and stationary), bottom pressures, and high-speed video were recorded during each test run. Both the large and small model were tested at the same Froude number, while the large model was also tested at a lower speed (though still in the planing region). The pressure signals during individual slam events have been isolated and the regularity of the pressures signals during the repeated wave slams will be presented.

Rosen (2005) has developed a method for reconstructing the 2D pressure distributions on the hull bottom during a hull-water impact. Morabito (2014) has developed an empirical method for calculating the pressure distribution during planing at steady speed. This method can be extended to the impact problem by substitution of an equivalent planing velocity. This paper will present the recreated pressure distributions from the measured pressures and Rosen's PDR method with the predicted pressures from the extension of Morabito's planing pressures method.

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