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On the Morison equation and heave plate hydrodynamics[1] CURTIS RUSCH, University of Washington, BENJAMIN MAURER, University of Washington Applied Physics Laboratory, BRIAN POLAGYE, University of Washington — Ocean wave energy converters often use a submerged reaction body, such as a heave plate, to generate electricity from wave motion. Analysis of heave plate hydrodynamics typically utilizes the Morison equation to estimate the contributions of drag and inertia to hydrodynamic force, neglecting further components, such as the vortex force discussed extensively by Sarpkaya. We perform laboratory experiments to evaluate the representativeness of a Morison decomposition over a range of operational and survival states, representing Keulegan-Carpenter (KC) numbers of 0.5 to 4. Driving a hexagonal conic heave plate in regular sinusoidal motion with 17 combinations of period and amplitude, we measure force at the plate and visualize the surrounding flow. Using the Morison equation, we calculate both constant coefficients of drag and added mass and phase-dependent variable coefficients. We find that constant coefficients adequately describe hydrodynamic force at low KC number, but this accuracy decreases with increasing KC number. Variable coefficients accurately reconstruct hydrodynamic forces over the full range of KC numbers investigated. We discuss this discrepancy in the context of the vortex term using dye visualization, and discuss implications for wave energy converter design.

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