To account for the viscous effects of damping devices, for instance, bilge keels or bilge boxes, on the motions of ships and offshore structures, Morison’s equation is often adopted as an empirical but practical approach in the design process. In order to combine the standard engineering panel method with the drag term in Morison’s equation, and remain in the frequency domain, the drag term has to be linearized based on, for instance, stochastic linearization. In this paper, the stochastic linearization scheme is implemented in an in-house code and verified through the comparison with the DNV GL software WADAM.

The model test results of a large cylindrical FPSO with bilge box are used to calibrate the drag coefficients in the Morison’s equation. When the linearized drag forces are included, heave motion RAOs correspond better to the model test results. However, the predicted natural periods of heave motions are seen to be smaller than those obtained from model tests. It is suspected that the viscous flow separation around the bilge box increases the added mass of the unit beyond what is predicted by potential flow alone. Discussions are made on the effect of viscous added mass on the heave natural period. It is quite common to only include the damping effects in the motion analysis for large offshore structures and ignore the contribution of the viscous effects on the excitation force. For the considered cylindrical FPSO, this paper demonstrates that the viscous excitation force can be important in survival conditions.