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A Discrete Element Method Centrifuge Model of Monopile under Cyclic Lateral Loads

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Abstract : This paper presents the data of a series of two-dimensional Discrete Element Method (DEM) simulations of a large-diameter rigid monopile subjected to cyclic loading under a high gravitational force. At present, monopile foundations are widely used to support the tall and heavy wind turbines, which are also subjected to significant from wind and wave actions. A safe design must address issues such as rotations and changes in soil stiffness subject to these loadings conditions. Design guidance on the issue is limited, so are the availability of laboratory and field test data. The interpretation of these results in sand, such as the relation between loading and displacement, relies mainly on empirical correlations to pile properties. Regarding numerical models, most data from Finite Element Method (FEM) can be found. They are not comprehensive, and most of the FEM results are sensitive to input parameters. The micro scale behaviour could change the mechanism of the soil-structure interaction. A DEM model was used in this paper to study the cyclic lateral loads behaviour. A non-dimensional framework is presented and applied to interpret the simulation results. The DEM data compares well with various set of published experimental centrifuge model test data in terms of lateral deflection. The accumulated permanent pile lateral displacements induced by the cyclic lateral loads were found to be dependent on the characteristics of the applied cyclic load, such as the extent of the loading magnitudes and directions.

Keywords : cyclic loading, DEM, numerical modelling, sands
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