Research on Bearing Characteristics of Suction Bucket Foundation under Double-point Cyclic Loads for Offshore Wind Turbine

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ABSTRACT
Among a variety of basic forms of offshore wind turbines, the suction bucket foundation has the advantages of simple installation, short construction cycles, and cost-saving. This work aims at complicated sea condition that occurs in practical situations. Different simulation calculation models are designed and analyzed based on the previous experimental results. Based on the simulation results, the bearing characteristics of the suction bucket foundation structure under different working conditions are compared, and it can be found that the resistance load is weakened when the angle between two loads is 5°. The results provide a reference for the design of the suction bucket foundation structure and offshore wind farms.

KEY WORDS: Suction bucket foundation structure; double-point cyclic loads; horizontal bearing capacity; offshore wind turbine

INTRODUCTION
In order to reduce the burden of land resource usage and cope with environmental deterioration, countries around the world have turned their attention to the ocean. In the past 30 years, with the increasing total consumption of renewable energy, the development of Marine science and technology and the exploitation of Marine resources have become the inevitable strategic trend of the countries bordering the sea. The suction bucket foundation is a new type of foundation for offshore structures, which has been gradually applied to offshore wind power in recent years. The suction barrel is buried in the soil depending on the pressure difference generated by the suction. After installation, the pressure difference will gradually disappear, and it still relies on the resistance of the surrounding soil to carry the load. Because of its low cost, simple structure, easy installation, short construction time, and suitability for all kinds of soil, the bucket foundation has attracted the attention of research scholars, and there is a trend of large-scale application in offshore wind farms, the common style of the bucket foundation is shown in Fig. 1.

At present, the study of the suction bucket foundation mainly focuses on the bearing performance and penetration construction process of the bucket foundation, the structural dynamics, erosion, and cyclic load of the foundation are also been continuously concerned. Pouyan (2019) established a finite element model to study the mechanical characteristics of the barrel foundation in dense and medium-dense sandy soil under static load, and the numerical results are verified by model tests. Shen (2012) made a modal analysis of the vibration characteristics of the structure of bucket foundation structure and expounded on the vibration characteristics of the bucket foundation. And the dynamic implicit analysis algorithm is used to obtain the dynamic response characteristics of the structure under different wind load conditions. Based on the stiffness degradation model proposed by Martin Achmus, Lian (2016) studied the long-term cyclic characteristics of a single pile foundation by using the three-dimensional finite difference model and quantitatively analyzed the influences of cyclic load characteristics on the long-term cumulative deformation of a single pile. Using experimental research, Ma (2022) introduced in detail the experimental research method and process of double-point cyclic load, aiming at the two types of cyclic loads that offshore wind structure foundation mainly receives during operation, and compared the bearing capacity difference of the foundation under two typical working conditions, and the cyclic bearing performance of foundation under the working conditions is analyzed.