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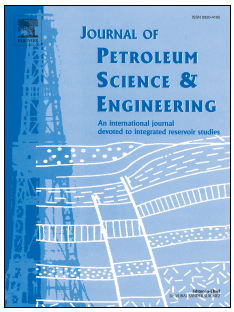

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Load Bearing Characteristics Study on Novel Deepwater Composite Drilling Conductor by Simulation and Experimental Methods

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Abstract A novel design of composite drilling conductor (CDC) was carried out for improving the vertical and lateral bearing capacity. Bearing characteristics of CDC was investigated when subjected to lateral and longitudinal loads based on the ultimate subgrade reaction method and pile foundation bearing theory. Theoretical models for lateral displacement and vertical load were established. Finite element analysis (FEA) was conducted, and bearing capacity and influencing factors of the composite structure were studied. Through laboratory experiments, the interaction between the structure and the soil as well as the regularity of soil deformation and stress variation in the surrounding soil were studied during installation, vertical and lateral load application. The results showed that the vertical bearing capacity increased with increasing depth of the bucket foundation under the combined effect of the composite structrue. Meanwhile, the depth of the embedded point of the composite conductor increased with an increased bending moment when subjected to a combined load with a constant vertical force. When the bending moment on the structure top was constant, the lateral displacement of the structure as well as the depth of the embedded point would increase with increasing vertical force. Furthermore, the bending moment change on the top of the CDC was more significant than the vertical force regarding the lateral displacement. It is also showed that the internal bucket foundation produced an "elastic plugging" effect when the CDC was subjected to vertical loading, while soil pressure transmission occurred from the upper soil to the underlying strata soil. When subjected to lateral loads, the earth pressure on the bucket sidewall was redistributed, and the bucket foundation produced a lateral supporting effect on CDC. The composite structure effectively reduced the conductor vertical and lateral displacement and improved the lateral and vertical bearing capacity. These results provide useful theoretical references for further development and optimization of the CDC structure.

Keywords: composite drilling conductor; laboratory experiment; numerical simulation; vertical bearing capacity; lateral displacement; soil pressure variation

Introduction

Deepwater shallow formations are usually poor in rock diagenetic and low in formation strength. During underwater installation of the conductor, if the pipe vertical bearing capacity is insufficient owing to lack of cementing, it will easily lead to the wellhead sinking, hole abandonment, or other accidents (Wang et al., 2014; Xu et al., 2017). Furthermore, owing to the drift of the floating drilling platform (ship) or the effect of environmental loads, flexural deformation of the conductor will occur. If the lateral displacement of the conductor is large enough, it will cause instability of the wellhead (Kanhua et al., 2008; Yinao, 2009). Therefore, it is of practical significance to develop a novel design of CDC and to study the load bearing characteristics of the structure to improve the