Study on the Bearing Capacity of Grouted Connections with Shear Keys

Ruiqi Deng, Tao Chen, Zhuxuan Li

Key Laboratory of Performance Evolution and Control for Engineering Structures (Ministry of Education), Tongji University, Shanghai, China

Contact:1051893019@qq.com

Abstract

Grouted connection (GC) is an important part of the offshore wind turbine (OWT) support structure. There are a lot of axial compression tests of GCs. But in order to thoroughly study the effects of different parameters on GCs, it is necessary to carry out the numerical study with the finite element method (FEM). In this study, the local models of GC were established by using the FE software ABAQUS. The numerical results were verified by the experimental results. A parametric study was carried out to investigate the influence of grout thickness, lateral compressive stress, shear key spacing, and the number of shear keys. The study shows that increasing the lateral pressure and the number of shear keys can significantly improve the bearing capacity. While increasing the grout thickness within a certain range will reduce the bearing capacity. And increasing the shear key spacing within a certain range will improve the bearing capacity.

Keywords: grouted connection; axial bearing capacity; finite element simulation; parameter analysis.

1 Introduction

Wind energy has a huge scope of utilization and value utilization. The connection is an important part of the OWT support structure. Because of its many advantages, a large number of OWT support structures are currently connected by grouting.

There were many experimental studies on the axial load capacity of the GCs. The experiments can be divided into scaled-down experiments and local experiments. Due to the large size of the OWTs, it is difficult to conduct prototype experiments. So, the scaled-down experiments were widely used. Billington[1][2] conducted about 60 static load loading experiments of scaled-down models based on five factors. Lamport[3][4] conducted six sets of scaled-down experiments to study the effect of four factors. Since the scale-down experiments have many limitations in the process of physical reduction, they cannot simulate the real force states of large diameter OWTs, so local experimental studies are needed. Under the premise of large pile diameter, the local equivalence of the circular tube can be a flat plate, which can be directly simplified to a double shear experiment of flat plates by symmetry. Wang et al.[5] used this model for the test.

In addition to experiments, many scholars have carried out FE simulation studies. Two typical models are still used for the establishment of the FE model. Wang et al.[6] used the flat plate double shear model to develop FE analysis of GCs. Chen et al.[7] used FE analysis to investigate the compression-bending performance of the GCs.

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