基于 FLAC^{3D} 的大型沉井基础地基沉降研究

摘要

沉井基础为一种应用广泛的深基础，在下沉至指定标高后，其作为上覆构筑物的深埋基础，需要满足建筑物长期使用的要求，地基沉降是影响其稳定性的重要因素。尤其是对于桥梁等要求具有持久稳定的高平顺性的线性工程，地基沉降引起的变形和偏移会严重地影响运行与安全。而随着工程建设不断发展，沉井基础的规模也越来越大，截面面积和埋深深度都在不断增大，基础承担的荷载也越来越大，引起的沉降变形也变得更加不可忽视。

本文基于某大型沉井基础工程，采用三轴试验对地基土样进行处理，通过试验数据的处理获得地基土的弹性模量和泊松比。然后采用数值模拟的方法，运用 FLAC^{3D} 软件建立模型，并计算该沉井基础的地基在设计的使用荷载下产生的沉降情况。主要内容和结论如下：

①沉井整体的刚度较大，荷载作用下，整体向下发生均匀的沉降，沉降量为 37.5-40.0cm；②土体的沉降变形以沉井为中心，呈现斗状，俯视则呈现同心圆状，越靠近沉井，沉降量越大，位移等值线的形状与理论推测符合，远离沉井区域的土体沉降变形基本呈层状；③土体的最大沉降量为 45.0-45.5cm，出现在沉井侧壁和沉井底部附近，土体的最小沉降量为零，即模型的零位移边界；④荷载作用下，土体表面出现差异沉降，最大的差异量大约为 10cm 左右，相对模型尺寸来说为一较小的值。

关键词：沉井；沉降；三轴试验；FLAC^{3D}；数值模拟

Abstract

The sinking foundation is a kind of deep foundation with a wide range of applications. After sinking to a specified elevation, it is used as a deep foundation for overlying structures and needs to meet the requirements of long-term use of buildings. So foundation settlement is an important factor affecting its stability, especially for linear projects such as bridges that require long-lasting stability and high smoothness. With the development of engineering construction, the scale of the sinking foundation is getting larger, the cross-sectional area and the depth of the buried depth are increasing, and the load on the foundation is getting larger, for which the settlement deformation caused by the foundation can't be ignored.

This paper was based on a large-scale sinking foundation project. The foundation soil was processed by triaxial tests, and the elastic modulus and Poisson's ratio of the foundation soil were obtained through the processing of test data. Then, with the method of numerical simulation, this paper established the model by using FLAC^{3D} software, and calculated the settlement of the foundation under the designed load. This paper also discussed the influencing factors in the modeling process. The main contents and conclusions are as follows:

(1) The overall stiffness of the sinking well is large. Under the load, the whole settlement occurs uniformly, and the settlement is 37.5-40.0cm. (2) The settlement deformation is centered on the caisson and presents a bucket shape and shows to be concentric when overlooked. The closer to the sinking well, the larger the settlement will happen. The shape of the displacement contour is in line with the theoretical prediction, and the settlement of the soil away from the sinking foundation is basically layered. (3) The maximum settlement of soil is 45.0-45.5cm, which appears near the side wall of the caisson and the bottom of the caisson. The minimum settlement of the soil is zero, which appears on the zero-displacement boundary of the model. (4) There is differential settlement on the surface of the soil. The maximum difference is about 10cm, which is a small value relative to the model size.

Key Words: Sinking foundation; Settlement; Triaxial test; Numerical simulation