Experimental Study on Axial Bearing Properties of Rock-socket Diaphragm Wall Foundation

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ABSTRACT

The vertical ultimate bearing capacity of diaphragm wall is generally very large, and the traditional method of preloading or anchor pile method is not applicable in most projects. By using a special device installed in the wall, three pieces of diaphragm walls were chosen to conduct load test by O-Cell method. The maximum bearing capacity of 313998kN is obtained which refreshes the current value of the load test record. The shaft resistance accounted for the majority (about 70%~75%) for the rock-socket diaphragm wall. And the bearing capacity per meter of rectangular diaphragm wall was about 20% larger than the “L” shape diaphragm wall. The base resistance of the rectangular shape is approximate with the theoretical calculation. The base resistance of the “L” shape was probably effected by the shape of deformed section.

KEY WORDS: Diaphragm wall; axial bearing properties; experimental study; base resistance; shaft friction.

INTRODUCTION

Since the advent of the 20th century, diaphragm wall foundations have been more and more applied in many projects because of the advantages of overall stiffness, high strength, impervious soil retaining. Currently, the diaphragm wall foundations are mainly used in large bridges, high-rise buildings such as the lighthouse, the tower and super high-rise building foundation, also widely applied in underground transportation hub. In order to study its bearing characteristics, more and more research institutions and scholars conduct some experiments. For example, Japanese second highway east-sea big mansion bridge is from Tokyo to Nagoya. In the project, two pieces of diaphragm wall foundations (named A and B) were chosen to conduct the vertical static load test by O-cell method (Cong, 2001; Maeda, 1996). The section size of the tested diaphragm walls A and B is 2.4m×1.2m, and the length is 29m and 26m, respectively. In order to receive the base resistance and shaft resistance, the load cells were installed at 0.8m above base for tested diaphragm wall A and 3.0m above base for tested diaphragm wall B, respectively. The maximum load value of tested wall A and B reached 27500kN and 23500kN, respectively. Tan Siew Ann. al et (Tan et al., 2012) introduced a tested barrette in weathering sedimentary rock area of Singapore, with a section of 1.5m×2.8m, a length of 44.5m. The load cell was installed at 11.0m above the bottom. When the load reached the value of 12500kN, the upward displacement was larger than 100mm. Then conduct grouting towards the position of load cell. And do the conventional head-down test after grouting. The applied load reached the value of 17650kN, and the pressure also could maintain stable. Besides, Bengt H. Fellenius of Urkka company had conducted a vertical static load test towards a barrette of 28m length by O-Cell method (Fellenius et al., 1999). Furthermore, L. Zhang (Zhang, 2003), Narong Thasnanipan (Thasnanipan et al., 2002) etc also completed some field test towards diaphragm wall foundation or barrette. As we all know, the width of tested diaphragm ever was mainly less than 6m.

Generally, because of the high bearing capacity and the basis of huge size of diaphragm wall foundation, it is extremely difficult to carry out the load test in field. Therefore, the existing research mainly concentrated in the model test or small size foundation test in situ, which hardly reflects the actual based load-bearing characteristics of the diaphragm wall foundation. In order to know the bearing capacity of actual diaphragm foundation, three pieces of diaphragm foundations were chosen to conduct O-Cell load test in Nanjing jinmao plaza phase II project, Nanjing city, China, including two rectangular section diaphragm and one “L” section diaphragm with the length of 56 m. The size is the same as the actual diaphragm of the project. According to the test result, the maximum bearing capacity reached more than 300 MN. It is the new record by O-Cell test method.

PROJECT SUMMARY

Overview

Nanjing jinmao plaza phase II project is located in No. 201 zhongyang road, gulou district, nanjing city, a total construction area of 265900 m², structure height is 285 m. The building includes 69 floors tower and 7 floors podium on the ground, 5 floors under the ground. Tower structure will be constructed by the steel reinforced concrete frame - reinforced concrete core tube hybrid structures, and the podium