Stress Field Test on Car Dumper Shed Underground Structure of Coal Terminal

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ABSTRACT
Stress field test is carried out on the established large-scale specialized coal terminal with the arrangement of complex car dumper unloading system. Based on geology and hydrogeological conditions of the car dumper shed foundation pit, using self-made magnetic levitation water gauge and stratified settlement gauge as monitoring apparatus, the monitoring plan of car dumper shed was carried out. Monitoring data related to water table outside foundation pit, soil pore water pressure outside foundation pit, soil pressure outside diaphragm wall, vertical reinforcement stress of diaphragm wall, circumferential reinforcement stress of diaphragm wall and concrete stress of diaphragm wall were obtained and analyzed in order to identify and evaluate the safety and stability state of the foundation pit retaining structure during the process of deep underground circular space excavation.

KEY WORDS: coastal engineering; coal terminal; car dumper shed; stress field test; underground space excavation.

INTRODUCTION
For the deep excavation, on-site monitoring is an indispensable part of information construction, especially obtaining the real-time deformation and force of the excavation during the excavation process. The deeper the excavation is, the more important their safety becomes. Many relevant factors need to be heavily considered, such as groundwater, soil spatial variability and the impact of excavation on the surrounding environment. Car dumper shed is one of the important infrastructures in coal terminal project (Paula, 2019), whose underground space excavation has the characteristics of huge depth and large scale. The established large-scale specialized coal terminal with the arrangement of car dumper is located in the North China coastal region.

How to successfully estimate the congruence between expected design blueprint and established buildings, such as space size, function, bearing capacity of soil, displacement and stress of structure, for different types of marine structures such as seawater intake structures, breakwaters, port and harbor structures, shore protection structures, submarine pipelines, open sea loading and unloading terminals, oil terminals, offshore platforms etc., are very essential from safety and economic point of view (Liu and shen, 2021a, 2021b; Shen and Liu, 2021a, 2021b). A lack of correct feedback information on the design environmental and technological conditions will result either in unsafe structures or with an over-designed and uneconomical structure. The concept of field test approaches provides convenient tools in ocean and coastal engineering activities. This paper focuses on stress field test on car dumper shed underground structure of coal terminal.

Car dumper shed, its function and characteristics determine the selection of foundation pit supporting structure, in which the spatial height of the main structure of car dumper shed influences its function, and the plane size of the main structure is related to the project scale. Car dumper shed and corridor pit supporting structure includes ground diaphragm wall under cast-in-place (car dumper shed and corridor), supporting pile (corridor), cap beam, ring beam, vertical rib, waist beam, support and other structures, whose function is to ensure that the construction conditions of car dumper shed and corridor main structure are dry condition.

CAR DUMPER SHED FOUNDATION PIT
The foundation pit of the car dumper shed in this project is a circular pit with an inner diameter of 68 m, excavated from the initial ground elevation to -15.1 m. The foundation pit supporting structure is the underground diaphragm wall, the thickness of the wall is 1.3 m, the top elevation of the wall is 2.0 m, and the bottom elevation of the wall is -27.6 m. A cap beam and three ring beams are set along the height of the diaphragm wall, and a vertical rib is set every 30 degrees along the circumference. The ring beam and vertical rib are both reinforced concrete structures. The section size of the cap beam is 2.3 m ×1.0 m, and the section size of the ring beam is 1.5 m ×1.5 m, and the concrete strength grade is C30 (CCCI, 2018).

After the construction of the circular diaphragm wall is completed and meets the design requirements, the soil within the scope of the foundation pit is excavated to the top elevation of the diaphragm wall, the cap beam poured, and then the soil in the foundation pit is excavated in layers. The ring beams and vertical ribs are poured along with excavation. When the excavation reaches the designed elevation, the underground structures of the car dumper shed are poured with concrete. The excavation is divided into four layers, and the excavation sequence is as follows: the first step is from 3.0 m to -2.4 m elevation, and the first ring beam and vertical ribs are poured with concrete; the