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

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ABSTRACT

On-site monitoring is a key issue to ensure the safety of the foundation excavation, especially the monitoring of the lateral displacement of the structure. Displacement 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 the settlement of diaphragm wall top, horizontal displacement of diaphragm wall top, deep horizontal displacement of diaphragm wall section, and soil settlement outside foundation pit 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; displacement field test; underground space excavation.

INTRODUCTION

Coal, as an indispensable fossil energy, is a vital energy resource for many thermoelectric power plants. Coal is usually transported by railway from coal ores to the aimed export coal bulk cargoes terminals and then is loaded on bulk carries moored in the coal terminals (Paula, 2019). In order to effectively unload coal from railway wagon to the terminal storage yard, complex car dumper system plays an important role in this technological process. Coal in several railway carriages can be dumped into hopper at a time by car dumper, then is transported by conveyor system mounted on the underground tunnel. 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 displacement field test on car dumper shed underground structure of coal terminal.

Car dumper shed is one of the important infrastructures in coal terminal project. Its function is to dump and unload the coal wagons arriving at the port by railway. This project is composed of a car dumper shed and supporting corridors. There are three unloading lines in the car dumper shed, and each unloading line is equipped with a triple car dumper. The car dumper is provided with the receiving funnel and other equipment, the bottom of the car dumper shed and the underground coal transport corridor is provided with the coal conveyor belt, the upper part of the car dumper shed is also mounted with positioning car, clamp rail and other vehicle positioning facilities and dynamic rail metering system. In addition, the car dumper shed is equipped with supporting facilities such as control, ventilation, dust removal, maintenance, water supply, and power supply.

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 (CCCC, 2018).