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Cause investigation of damages in existing building adjacent to foundation pit in construction

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ABSTRACT

This paper presents a case study of investigating damages in existing building adjacent to foundation pit in construction, in which the settlement influence of adjacent building induced by constructing foundation pit is demonstrated by means of field observation, numerical analysis and experimental investigation. This study focuses on the principal cause inducing these damages in the existing building. This work demonstrates that the stratum settlement of the existing building during excavating foundation pit are significantly influenced by not only construction task of excavating soils but also that of dewatering soil mass in constructing foundation pit, since the principal constitution of fine sand and medium sand in the sludge can be easily run off with stratum loss during the dewatering task, and the hydraulic connection between the inside and outside of the foundation pit thus can't cut off using underground continuous wall, which can probably produce structural damage of soil mass with stratum settlement.

1. Introduction

Subway system has been increasingly developed with the process of urbanization, whereas the risk of damages in adjacent building may appear during constructing subway systems, which is caused by movements of ground surface with tunneling work [1,2]. In view of previous published literatures, several approaches are developed for investigating the damaging mechanism of tunnel structure, such as model test with developed new device [3], numerical modeling [4–6] and theoretical analysis [7]. However, the cause of damages in existing building adjacent to metro tunnel in construction is not easy to be identified due to uncertainty of underground engineering, which may be caused by various influencing factors such as complicated geological and topographical conditions [8,9] as well as complex rheological environment [10,11]. Therefore, further study related to damaging in adjacent building during tunneling is thus required for providing lessons for appropriately implementing tunneling work.

In this paper, a case of damages in existing building adjacent to foundation pit in construction is studied by field observation, numerical analysis and experimental investigation, in which the settlement influence of adjacent building induced by constructing foundation pit is demonstrated. Especially, the study focuses on the principal cause inducing these damages in the existing building.

2. Profile of the foundation pit used for constructing metro station

Fig. 1 demonstrates the geological condition and typical transverse section of the foundation pit used for constructing metro

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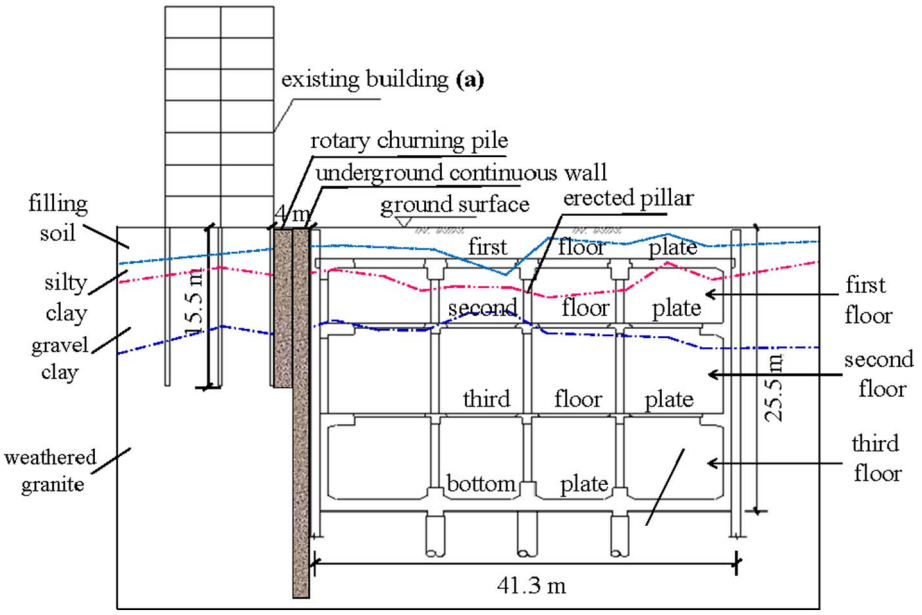

Fig. 1. Typical transverse section of foundation pit for metro station (unit: m).

station adjacent to existing building, in which the metro station is constituted of three floors supported with three columns, and the foundation pit is 246.5 m long, 41.3 m wide and 25.5 m deep, buried with four layers of plain filling soil, silty clay, gravel clay and weathered granite from top to bottom respectively. In the stratum of the foundation pit, the gravel clay with poor engineering property is unevenly distributed within 3.45 m to 7 m depth along longitudinal direction, and the weathered granite is rich in water with developed fissures, and rich ground water is buried within 0.7 m to 4.6 m depth of the stratum, which may weaken the water separating effect of underground continuous wall with hydraulic connection between the inside and outside of the foundation pit, and the underground continuous wall is thus easily collapsed with mud leakage. Moreover, rich ground water can reduce the engineering property of the stratum and pile foundation [12].

As shown in Fig. 1, friction piles with 15.5 m depth are supported on the weathered granite and adopted as foundation in the existing building (a), rotary churning piles are used to strengthen soils between existing building (a) and foundation pit for avoiding the piping effect risk around foundation pit, and underground continuous wall with 1 m thickness is adopted as underground enclosure structure. Fig. 2 demonstrates the 36 monitoring points are arranged for investigating the settlement of existing adjacent buildings induced by excavating foundation pit for metro station, since the minimum distance between foundation pit and existing building (a) is only 4 m.

The foundation pit is excavated and built with the following construction flow: step 1: building underground continuous wall and

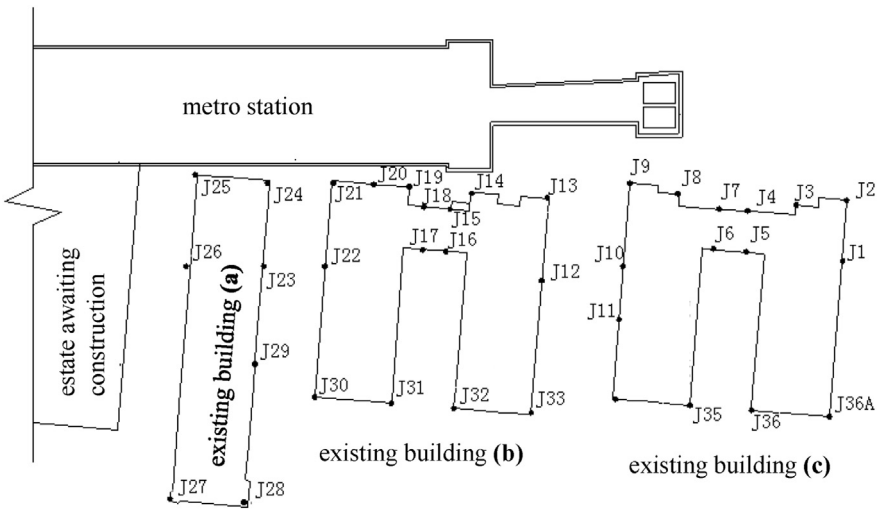

Fig. 2. Arrangement of monitoring points.