Examination of the Effect of Removal of Existing Piles on Geotechnical Properties

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1. Introduction

Approximately half of the non-residential buildings in Japan were constructed more than 30 years ago. While there are high expectations for the renewal of cities, in order to promote the renewal of buildings corresponding to a variety of needs, the reorganization of the rational structural regulation in response to issues related to existing piles is desired. The purpose of this research project is to develop methods for the safe and rational use of construction site that includes existing piles. In FY2021, we conducted the following research, analyses, and other examinations.

2. Overview of Our Technological Development

(1) Research for Grasping the Changes in the Physical Property of the Ground Following the Demolition of a Building

To accumulate examples of the verification of the changes in the geotechnical property in cases where several piles are removed, on sites where existing piles that used to be in actual use (cast-in-place piles) were removed and reinstalled, soil investigations were conducted before, during, and after the removal. Specifically, a standard penetration test, an electric cone penetration test, and other tests were conducted to compare and verify the changes in the geotechnical property before and after the removal of existing piles. In addition, during removal (photo), the specifications of the piles and the condition of various managements were investigated, and concrete core samples etc. were obtained.

(2) Analysis of the Structure of the Building Based on the Assumed Use, and the Usage of Existing Piles

We set up a detailed structural analysis model for the buildings that use existing piles, and conducted a time history response analysis under an earthquake. We set up analytical cases in consideration of the existence/non-existence of eccentricity and the structural property of footing beam in addition to the vertical spring coefficient and the performance of the piles (Table 1). We grasped the degree of influence on the load effect of footing beam, the vertical displacement of the pile tops, and the horizontal displacement of the upper structure from the specified conditions of the existing piles etc., and then extracted remarks for the structural design.

Photo. How the piles were removed on our investigation site

Table 1. Cases that we examined

Case	Existing pile		[3] Characteristics of upper structure		Remarks
	[1] Perpendicular spring *1	[2] Pile *2	(1) Base beam on existing pile side *2	(2) Eccentricity	
1	1 time	Coping with ultra-scarce earthquake vibration	Coping with ultra-scarce earthquake vibration	None	Basic base
2	3 times				Load history of existing pile
3	1 times	Proof force lower than new ones			Pile performance of existing pile
4	3 times				Compared with 5, 6
5				Center of gravity of existing pile	Eccentricity of upper structure
6				Center of gravity of newly installed pile	
7			Proof force lower than newly installed side	None	Compared with 8, 9
8				Center of gravity of existing pile	Base beam proof force reduced and eccentricity of upper structure
9				Center of gravity of newly installed pile	

*1. 1 time for newly constructed piles.
*2. The footing beam on newly constructed piles and newly constructed pile sides to correspond to earthquake vibration that occurs extremely rarely

3. Plans for Our Next steps

We continue to collaborate with the relevant departments and bureaus of the Ministry of Land, Infrastructure, Transport and Tourism, the Building Research Institute, other experts, and other relevant associations (associations in the industrial fields related to building foundation and/or soil), and are planning to advance our technological development.