

The Seismic Performance Evaluation of Box-shaped Wall Structures Built with The Thick Earthen Walls

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ABSTRACT

Several traditional building group districts exist in Japan as a system for preserving the country's remaining historical villages and townscapes, along with their surrounding environment. Three such preservation districts exist in the Tochigi, Ibaraki, and Gunma prefectures of the northern Kanto region: Kauemoncho in Tochigi City, Makabe in Sakuragawa City, and Kiryu Shinmachi in Kiryu City; there are similar historical areas in surrounding districts.

In these districts and surroundings, there remain examples of many Dozo-style structures such as Misegura (Dozo-Style townhouses intended to be used as shops or dwellings with multiple uses, etc) and storehouses called "Dozo" in Japanese, forming a distinctive historical townscape. These Japanese traditional buildings built during the end of *Edo* Period and early term of *Showa* Period (about 70 -180 years ago) was constructed in rows and clustered.

Dozo-Style structure refers to a thick earthen wall with a thickness of 200 - 300 mm on the outer circumference (hereinafter referred to as "mud wall"), for fire protection measures in Japan. Although originally used as warehouses to store items, they came to be also used as stores, parlors and other kinds of buildings in modern times.

In the 2011 Tohoku Region Pacific Offshore earthquake, the traditional townscapes of the Kanto region and the Dozo-Style structures were seriously damaged [1]. Especially, the traditional Dozo-Style structures were seriously damaged. The 2016 Kumamoto Earthquake and the 2016 Tottori Earthquake occurred after that, and great damage was caused to the shear wall of the Dozo-Style structures, and restoration of it is proceeding.

Construction method and structure differ depending on the region of the mud wall, which is the main earthquake resistant element of Dozo-Style structure. Furthermore, the strength of the mud used for the mud wall varies greatly depending on the production area. Therefore, in order to properly evaluate and understand the seismic performance of existing historic buildings, it is necessary to clarify the performance of the mud walls in each district.

Therefore, we carry out horizontal loading test on full-scale walls produced based on the survey results, the specifications of mud walls around the northern Kanto region, to determine the walls' the structural performance when receiving a horizontal force, as in an earthquake. Then, the seismic performance of the entire building is evaluated for representative Dozo-Style structures existing in the northern Kanto, using the hysteresis characteristics of the earthen wall evaluated from the horizontal loading test.

REFERENCES

- [1] Joint Editorial Committee for the Report on the Great East Japan Earthquake Disaster, *Report on the Great East Japan Earthquake Disaster*, Building Series Volume4, Damage of Historic Buildings, Architectural Institute of Japan, 2015. (in Japanese)