Technical Development for Seismic Reinforcement of Deteriorating Residential Retaining Walls

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1. Introduction

With the progress of urbanization in Japan, residential land has been created with the construction of residential retaining walls in hilly areas. However, many cases of damage to residential retaining walls that have deteriorated due to earthquakes have arisen in recent years, and furthering seismic measures is now a major challenge. We began research into improving the earthquake resistance of deteriorating residential retaining walls in 2020 and briefly describe the current state of technical development.

2. State of technical development

(1) Measuring the strength of earthquake-damaged retaining walls

We tested the compression strength of concrete cores collected from retaining walls affected by the 2016 Kumamoto Earthquake. Cores were collected from retaining wall sections where we could confirm damage and from retaining walls that appeared sound.

(2) Centrifugal load testing of masonry retaining wall models

We conducted centrifugal load tests using retaining wall models to examine reinforcement methods for retaining walls. In the tests, we used models of masonry retaining walls and tested them with and without reinforcement (reinforcement by inserting reinforcing rods, by covering the wall surface with nets, and by adhering spaces in the masonry of the reinforcing walls with adhesive).

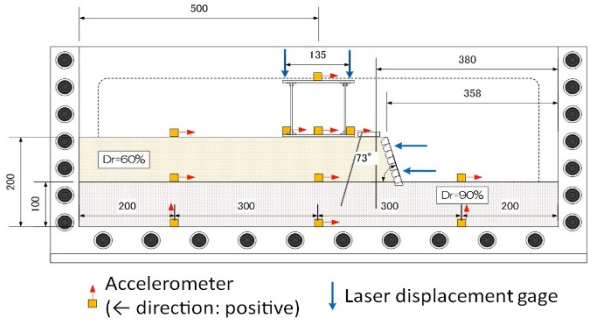

Fig. 1. Schematic diagram of centrifugal load tests (with reinforcement by inserting reinforcing rods)

The test results confirmed the collapse modes of residential retaining walls including buildings with the input of earthquakes of gradually increasing amplitude and the effects of reinforcing them.

(3) Analysis of the relationship between earthquake damage to residential retaining walls and buildings

The damage patterns in residential retaining walls and their effects on buildings in Sendai City damaged by the 2011 off the Pacific coast of Tōhoku Earthquake were examined based on the type of retaining wall, the distance between the wall and the building, the estimated seismic intensity, the microtopographic classification, and the inclination angle.

(4) Examination of estimated strength of residential retaining walls

Based on cases of residential retaining walls damaged in the 2016 Kumamoto Earthquake, we estimatied, considering the safety factor, the bending strength of the retaining wall by assuming earth pressure and the wall inertial force as external forces and the wall weight and bending strength as resistance.

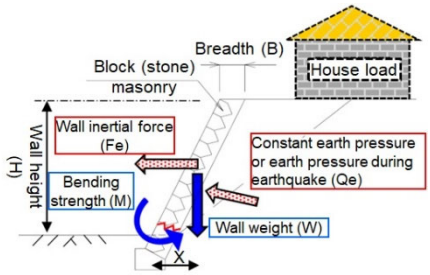

Fig. 2. Concept diagram of estimation of residential retaining wall strength

3. Conclusion

These examinations are currently being analyzed and considered in detail, and we intend to examine design examples for seismic reinforcement of deteriorating residential retaining walls in future based on the results obtained.

☞See here for detailed information

1) Outline of "Research and development for regeneration and resilience of cities by the rationalization of structural regulation related to buildings and ground"
http://www.nilim.go.jp/lab/hcg/kisojiban_hp/kisojiban.htm