ABSTRACTS (MASTER THESIS)

Seismic performance of wooden houses required for continuous use after major earthquakes

(Graduate School of Agriculture,
Laboratory of Structural Function, RISH, Kyoto University)

Kotaro Sumida

Introduction

In the 2016 Kumamoto earthquakes, not only many wooden houses built according to the current standards were severely damaged, but even in houses that were deemed to be minor, their subsequent use was difficult [1]. In this study, I clarify the seismic performance required for continuous use and explore the possibility of realizing the performance.

Survey of construction situation in Mashiki town two years after the Kumamoto earthquakes

The survey was carried out again two years later on buildings that were completely surveyed just after the 2016 Kumamoto earthquake. The purpose of the survey is to quantify the relationship between damage level, construction year, structure type, etc. and the usage of the buildings after two years.

Analysis for clarification of performance required for continuous use after major earthquakes

A seismic simulation software "wallstat" were used with the purpose of verifying the possibility of continuing use of wooden houses after a severe earthquake. Three-dimensional wooden houses were modeled and time history response analysis were carried out by inputting observed seismic waves. Then, the level of expected damage was estimated from the maximum inter-story deformation.

Shake table tests and comparison with the results from the survey and analysis

Two full-scale wooden houses with different seismic performance were tested on shake table by inputting Kumamoto earthquakes waves, and seismic responses and damages were recorded. Then, obtained results were compared with those of the survey and analysis.

Results and conclusions

The survey revealed that about half of the buildings surveyed areas in Mashiki town do not exist. In addition, it was found that about half of slightly damage buildings considered to experience maximum inter-story deformation of 50 mm are also demolished.

Figure 1. shows the sufficiency ratio of the all analysis models and the maximum response deformation of the first story when 1995 JMA Kobe wave were input. It was found that the maximum response deformation tends to decrease as the sufficiency ratio increases. Against JMA Kobe wave, it is possible to keep the deformation below 50 mm or less and use it continuously if the sufficiency ratio reaches 2.0 or more.

The test building with higher performance survived against three successive Kumamoto earthquakes waves and suffered only tiny damage. This result proved the validity of the analysis.

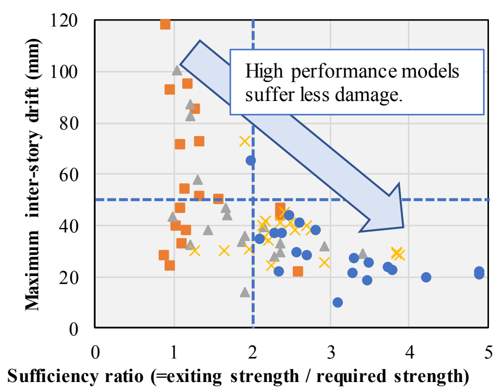

Figure 1. Maximum inter-story drift against a major earthquake (JMA Kobe wave)

Reference

[1] Architectural Institute of Japan, "Report on the Damage Investigation of the 2016 Kumamoto Earthquakes," pp. 29-53, 2018.