FULL-SCALE SHAKING TABLE TEST OF TRADITIONAL TIMBER STRUCTURE WITH GABLE ROOF PLACED FREE ON FOUNDATION

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1 INTRODUCTION

There exist many timber houses built by a traditional post and beam construction method in Japan. Their columns are often placed on the stone foundation without using a ground sill. Since the bottom of column is not fixed to the ground, the building can move or slide during severe earthquake motions. In many of timber buildings, their plans are rectangular-shaped, not square. There are two ways of putting a roof purline: one way is to put it parallel with the longitudinal direction, another is to put it in the orthogonal direction. It seems that the vibration characteristics and seismic behaviors of buildings with two types of gable roof frame are different.

In the seismic performance evaluation of traditional timber buildings, many researchers have dedicated their efforts to the structural characteristics and the seismic resisting capacity of the bearing walls and the connection joints. The influences of the sliding behavior and the roof shape on the seismic performance of a whole building have not been clarified yet.

In this paper, to make clear these problems, vibration tests of timber buildings were conducted with a shaking table, E-defense, in the National Research Institute for Earth Science and Disaster Prevention.

2 OUTLINE OF TEST

The tests were performed by focusing on the sliding behavior of columns which were placed free on flat stone foundations and the influence of the roof direction. Testing specimens were one-storied timber frameworks, and their dimensions were 10.92m×5.46m in plan as shown in Figure 1. The heights of the top roof purline were 5.1m and 6.1m. The four types of the arrangement of bearing walls were tested in order to investigate the effect of eccentricity as shown in Figure 2.

3 TEST RESULTS

3.1 VIBRATION MODE

The difference of the vibration characteristics between two types of roof frame was observed: the higher specimen had the 2nd vibration mode, and the lower didn’t, as shown in Figure 3. However, the maximum story deformations of two specimens were almost same. The maximum responses were mainly related to not the roof direction but the amount and the arrangement of walls.
3.2 SLIDING BEHAVIOR

From the test results, it was found that the sliding behavior could occur in traditional timber buildings even under an earthquake motion whose amplitude of acceleration was about 0.3G, and the sliding characteristics varied according to the roof direction: the lower specimen slid in one direction, and the higher slid in two directions as shown in Figures 4 and 5.

4 CONCLUSIONS

From the full-scale shaking table tests, it was found that the way of putting a roof purlin affects a higher order vibration mode and sliding direction under large earth ground motion.

The past experimental researches like this paper are few, and the obtained results will contribute to the improvement of the seismic performance of traditional timber buildings.