EXPERIMENTAL STUDY ON SEISMIC PERFORMANCE OF MORTAR FINISHING EXTERNAL WALL

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ABSTRACT: To improve the durability and prevent falling off of the mortar under earthquake motion, ventilation method for the mortar finishing external wall has been introduced. This research project was conducted to evaluate the seismic performance of the mortar finishing external wall with ventilation space. Specimens with 4550mm of wall length which had various openings were manufactured and static shear loading test of them was carried out. It was found that falling off of the mortar did not occur during the loading up to 10% of story drift, moreover, it showed good seismic performance. Furthermore, FEM analysis model of this mortar finishing external wall was proposed to evaluate the seismic performance of the one with various openings. It is expected that the good structural performance of this external wall contributes to improve wooden buildings’ seismic capacity.

KEYWORDS: Mortar, External wall, Ventilation method, Seismic performance, Opening

1 INTRODUCTION

Mortar finishing external wall is constructed using sophisticated plasterer’s technics, it is able to be given various texture on the surface. The external wall shows good fire resistant performance, however, not a few mortar layer of the external walls fell off under earthquake motions. From the fact, it has been considered that seismic performance of mortar finishing external wall is not good. The reasons of the falling off of the mortar layer were use of inadequate materials, decay of timber, corrosion of metal materials, etc. To improve its durability and prevent falling off of the mortar layer, ventilation method for the mortar finishing external wall has been introduced to Architectural Standard Specification of AIJ(Architectural Institute of Japan). With the ventilation space, since moisture is vented out of a wall, it is able to be kept dry.

There were several experimental researches on seismic performance of a mortar finishing external wall in the past, but the external wall specimens had no ventilation space. This research project was conducted to evaluate the seismic performance of the mortar finishing external wall with ventilation space.

2 OUTLINE OF THE CONSTRUCTION METHOD

A schematic of the mortar finishing external wall dealt with in this paper is shown in Figure 1. Vertical furring strips are attached to the out face of columns and studs with 15mm thick to keep ventilation space. Wooden laths are fastened with 65mm long nails(N65). Sheathing membrane is applied on the wooden laths. Thereafter metal lath is fixed with 19mm long staples(1019J) on it. Light weight mortar is plastered on the substrate with 15mm thick. To avoid shrinkage crack, glass fiber mesh is applied on the surface of the mortar.

Figure 1: Schematic of the mortar finishing external wall with ventilation space

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3 STATIC SHEAR LOADING TEST

For better understanding of the seismic performance of the mortar finishing external wall, specimens with 4550mm of wall length and 2730mm in height which had various openings were manufactured because the mortar is plastered monolithically on one vertical plane in a building.

There are two kinds of opening, namely, door type opening and window type opening. Each type has three opening widths, 910mm, 1820mm and 2730mm. In addition to these six specimens with opening, three specimens with no opening were also prepared.

Static shear repeated load was applied to the beam of the specimen until 3.3% of story drift and after that one directional loading until 10% of story drift followed.

Average maximum shear force of the specimens with no opening was 42.8kN at 2% of story drift. No crack on the surface of the mortar layer was observed, pull-out of 65mm long nails and staples occurred around 3.3% of story drift. Splits of vertical furring strips were also observed.

Figure 2 shows shear force-story drift relationships of the specimens with door type opening. The maximum shear force decreased with the opening width. The maximum shear forces were at 2% of story drift. Cracks around corners of the opening were observed and full-height walls beside the opening rotated as the story drift increased. Staples around left and right ends of the specimen were pulled-out while no pulling-out of 65mm long nails occurred. Picture 1 shows a specimen with 2730mm width opening at 10% of story drift.

Maximum shear forces of the specimens with window type opening were remarkably higher than the ones with door type opening as shown in Figure 3. The maximum shear force decreased with the opening width except for the specimen whose opening width was 910mm. In this specimen, though relatively small cracks were observed around corners of the opening, similar failure modes to the specimen with no opening were observed. Other two specimens with window type opening showed cracks around corners of the opening and pulling-out of staples the same as the specimens with door type opening, while the rotation of full-height walls beside the opening was not observed.

During the loadings, falling off of the mortar layer did not occur. From the test results, it is considered that the mortar finishing external wall with relatively small opening is capable of acting monolithically and shows good seismic performance.

4 FEM ANALYSIS

FEM analysis models of the static shear loading test specimens were built using material testing data and static nonlinear incremental analyses was conducted. The analysis model is composed of three layers, a wood frame, wooden laths and mortar layer. Each layer is connected by fasteners such as 65mm long nails and staples. Since analysis results of the FEM analysis model showed good agreement with the static shear loading test results, the analysis model is considered to be adequate.

5 CONCLUSIONS

Static shear loading test of the mortar finishing external wall with ventilation space was carried out. Falling off of the mortar layer did not occur during the loading up to 10% of story drift, moreover, the external wall showed good seismic performance. FEM analysis model proposed in this paper is expected to contribute the improvement of wooden buildings’ seismic capacity.

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