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S448

DYNAMIC PERFORMANCE EVALUATION OF BRACED SHEAR WALL WITH NEW BRACE FASTENER FOR WOODEN HOUSES

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1. INTRODUCTION

A new brace fastener, as shown in Figure 1, was developed, which includes damping mechanism. Though ductility and damping of a braced shear wall are relatively low compared to a nailed plywood shear wall, the new brace fastener absorbs relative displacement between the end of a brace and a column due to the plastic deformation of "Bridge" of the new brace fastener.

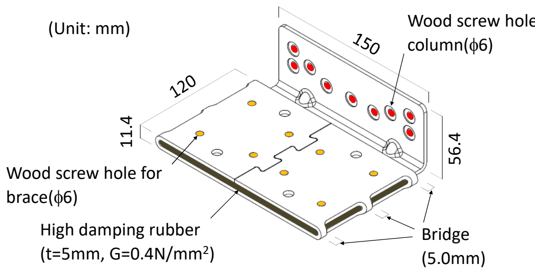


Figure 1: Schematic of the new brace fastener

2. SHAKE TABLE TEST

Shake table test of the braced shear wall specimen with the new brace fasteners and conventional brace fasteners was conducted to evaluate the dynamic performance. The specimen was constructed by Japanese Post and Beam construction. Wall length of the specimen was 2,730mm and it has four columns. Weight which was 15.8kN was loaded on the beam. Figure 2 shows the test apparatus and the specimen. JMA Kobe NS wave and Mashiki EW waves as shown in Figure 3 were input to the specimen in one direction.

Figure 4 shows the end of a wood brace with a conventional brace fastener and the new brace fastener after JMA Kobe 100% input. For the braced shear wall with conventional brace fasteners, buckling of a wood brace occurred and wood screws on the column were pulled out. On the other hand, the braced shear wall with the new fastener showed no damage.

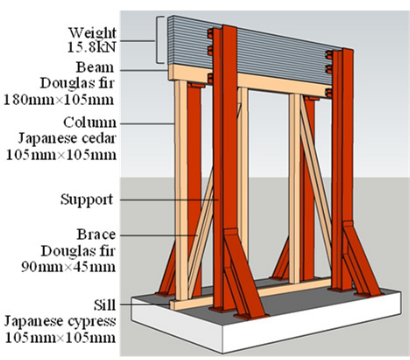


Figure 2: Test apparatus and specimen

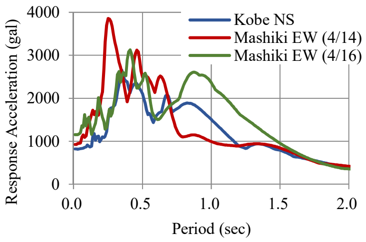
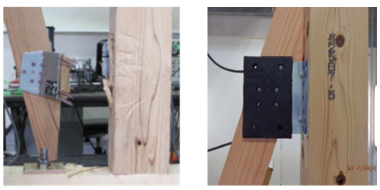


Figure 3: Response acceleration spectra



(a) Conventional fastener (b) New fastener
Figure 4: After JMA Kobe 100% input

Figure 5 and 6 show relationships between the shear force and the story displacement. The maximum story displacement of the braced shear wall with the new brace fasteners was approximately 10mm while the one with conventional brace fasteners was about 50mm under 60% of JMA Kobe wave. Even under 100% of JMA Kobe wave, the shear stiffness of the braced wall with the new brace fasteners did not decrease while shear force of the one with conventional brace fasteners dropped significantly and the wall collapsed.

Though maximum story displacement of the braced wall with conventional brace fasteners was over 300mm, the one with the new brace fasteners was approximately 50mm under 100% of JAM Kobe wave. After following three 100% JMA Kobe waves were input to the specimen, the maximum displacement increased to 150mm.

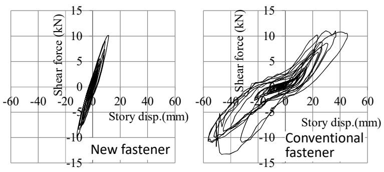


Figure 5:
Shear force-story disp. relationship under Kobe 60%

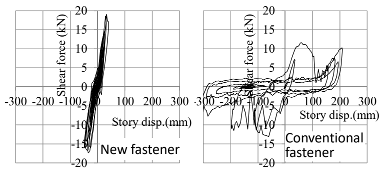


Figure 6:
Shear force-story disp. relationship under Kobe 100%

3. EARTHQUAKE RESPONSE ANALYSIS OF TYPICAL WOODEN HOUSES

Earthquake response analysis of two-storied wooden houses which have braced shear walls with the new brace fasteners and conventional brace fasteners was performed.

Parameters of the analysis model were a ratio of existing wall length to required wall length (*Re*), a ratio of *Re* of second floor to *Re* of first floor (Re_2/Re_1), a ratio of the second floor area to the first floor area and a ratio of wall length of nailed plywood shear walls to whole wall length. Number of analysis model was 1,320. Input earthquake wave to the analysis models was BCJ L2.

Figure 7 shows the maximum response story displacement obtained from the analysis. When Re_1 is 1.5, it is from 84mm to 87mm with conventional brace fasteners which is from 1.2 to 1.9 times of the ones with the new brace fastener.

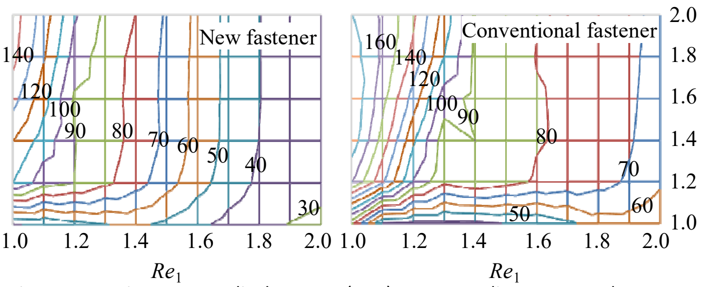


Figure 7: Maximum story displacement(mm) corresponding to Re_1 and Re_2

4. APPLICATION FOR TWO STORIED WOODEN HOUSE

The object building was built in 1988, whose floor area of the first floor and the one of the second floor were 85.29m² and 33.95m², respectively. According to seismic diagnosis, the seismic index of the building was below 1.0, which means "there is strong possibility of collapse under large earthquake."

Considering the result of seismic diagnosis, heavy roof tiles were replaced with lightweight roof tiles and wood braces with the new brace fasteners were installed in the first floor. The seismic index after these seismic rehabilitation increased to above 1.0, which means "there is no possibility of collapse."

5. CONCLUSIONS

Seismic performance of the braced shear wall with the new brace fastener was examined by shake table test. Using the test results, earthquake response analysis was conducted to build database of earthquake response displacement of two-storied wooden houses. Finally, seismic performance of an existing wooden house with the new brace fastener was evaluated using the database.

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