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Cyclic tests of two spans RC frame with wing-type masonry infill walls

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ABSTRACT

In the SESF manual (2019), masonry infill wall is designed as a structural element when it is closely constructed with a structure. Many experimental and analytical studies have been conducted on masonry infilled panels and masonry partial infill walls. However, studies on wing-type masonry infill walls, which were used in long span of school buildings, are very limited. In this study, two spans RC frames with wing-type masonry infill walls were tested by lateral cyclic loading to evaluate the seismic performance of the wing-type masonry infill walls.

1. INTRODUCTION

Recently, earthquakes of magnitude 8.0 or higher occurred several times worldwide (Haiti 2010, Japan 2011, Chile/Nepal 2015), and in Korea, Ulsan/Gyeongju (2016) and Pohang (2017) with a scale of 6.0 Strong earthquakes close to, occurred in succession. Accordingly, there is a significant increase in social interest and demand for ensuring sufficient safety of structures in case of earthquake. In order to promote the seismic reinforcement project for existing school facilities, Ministry of education revise and guide the seismic performance evaluation and retrofit manual for school facilities.

2. MATERIAL TEST

Prior to the masonry wall test, compression tests were conducted on concrete bricks and mortar specimens, which are masonry objects.

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2.1 Concrete brick test

Concrete brick material experiment used second kinds of bricks (basic bricks). The material test method is not the method of immersing the test sample bricks suggested in KS F 4004 in clear water for more than 2 hours and then testing it in a dry state for actual strength evaluation.

Fig. 1 Concrete brick compressive strength test
(Left: Before the test, Right: After the test)

2.2 Mortar test

The specification of the mortar specimen is 50mm x 50mm x 50mm (width x length x height), and in order to make the mixing ratio of the mortar the same as that of the actual school site, the mixing ratio of 1:3 ~ 1:5 was requested by masonry experience.

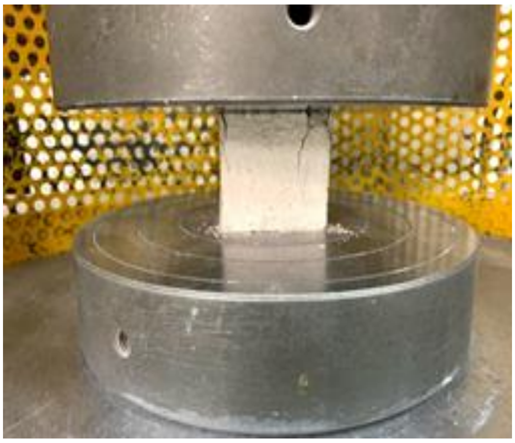

Fig. 2 Mortar compressive strength test

3. MASONRY INFILL WALL TEST

3.1 Pre-analysis (ATENA)

The masonry wall is subjected to the compression of the diagonal strut and the tensile force in the vertical direction at the same time, and the strength is generally determined by the diagonal tensile failure. Therefore, the boundary conditions were set so that diagonal struts can be simulated in single modeling of masonry walls

Fig. 3 Single masonry wall modeling and boundary conditions (ATENA)

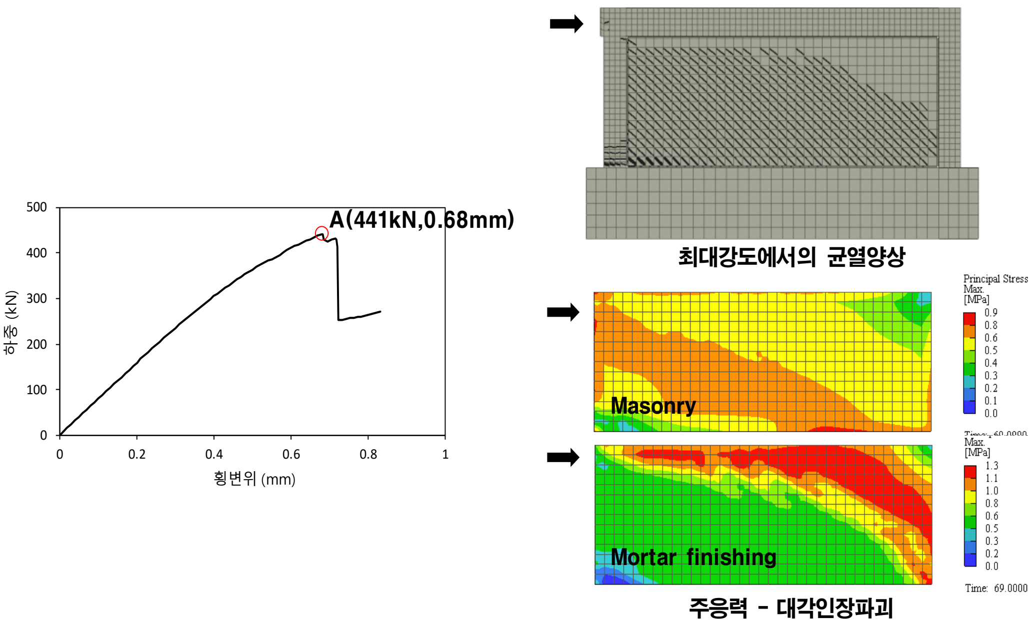

Fig. 4 Analysis results (ATENA)

3.2 MAIN TEST

The test object was connected to a 150tonf actuator and repeatedly applied static lateral load by displacement control. The loading protocol is repeated 3 times for each step based on the inter-floor displacement ratio according to ACI.

Fig. 5 Cyclic test results of the specimen

The strength of the test specimen continued to increase according to the loading stage of S1, an amorphous red wall tester made as a control. In step 8 (2.2%), the maximum strength in the negative (-) direction reached 151.4 kN, and in step 9 (2.86%) the maximum strength in the positive (+) direction reached 154.5 kN. It shows the test strength of 97% compared to the plastic moment strength = 158.6 kN calculated by the side-sway mechanism. This means that the yield of the lower part of the column was sufficiently maintained until the yield of both ends of the column occurred.

3. CONCLUSIONS

■ 36%~62% higher strength than bare frame specimen (S1) due to masonry filling

■ Comparing the results of the S2 specimen with poor workability and the S3 specimen with good workability, the maximum strength of the S2 specimen was found to be lower than that of the manual (2019) (=0.78). Although the workability was good, the strength of the masonry filling wall was slightly lower than that of the manual (=0.93), but the maximum strength increased by 19% due to the improvement of workability due to vertical mortar filling.

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