Experimental Study on the Damping Characteristics of Steel Plate Concrete Wall by Cyclic Loading Test

Sung Gook Cho [a*], Gihwan So[a], Dookie Kim[b]
[a] *JACE KOREA Company, 30 Songdomirae-ro, 406-840, Incheon, Rep. of Korea*
[b] *Associate Professor, Dept. of Civil Engineering, Kunsan National University, Kunsan, Republic of Korea*
[*] *Corresponding author: ghso@innosetech.com*

1. Introduction

This study focuses on the evaluation of damping ratio of steel plate concrete (SC) structure by experiments. A shear wall specimen has been designed and fabricated with reference to design standard. A set of static cyclic loading test were performed to obtain the force-displacement relationship of the specimen. The damping ration of the specimen was identified by evaluation of the hysteresis loop.

2. SC Wall Specimen

SC wall specimen in 'Π' shape has been designed and fabricated with reference to JEAC-4618 2009 of Japan. It behaves in shear direction without torsion upon application of cyclic load. Specimen has 300mm wall thickness, 1500mm height, and 1500mm width and concrete slabs on its top and bottom. Walls are SC member and slabs are just reinforced concrete.

Steel plate has been combined with concrete using total 192 stud bolts which have 14mm diameter and 120mm length. Total weight of the specimen is about 12.1 tons. The dimension and configuration of the specimen are shown in Fig. 1 and Fig. 2, respectively.

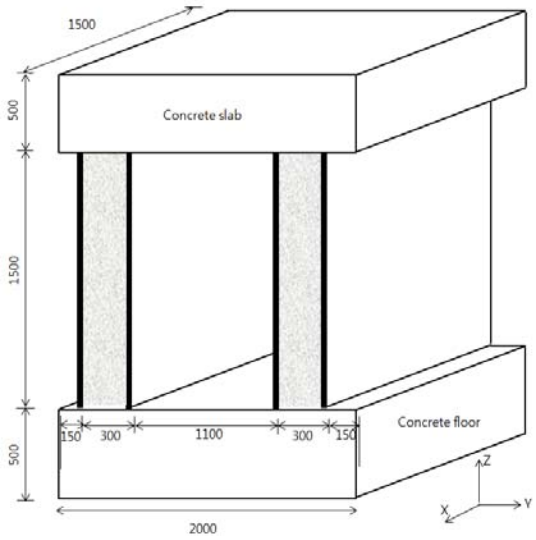

Fig. 1. Size of specimen

Fig. 2. SC Wall specimen

3. Cyclic Load Test and Results

3.1 Test Method

A set of cyclic loads were applied to the top of the specimen. An actuator with 200 tons of capacity has been used. Load was applied by incrementing gradually at every 1 cycle. Figure 3 shows preparation of cyclic test and Figure 4 shows input load with a graph. LVTD has been installed on the top of the specimen to check its lateral displacement.

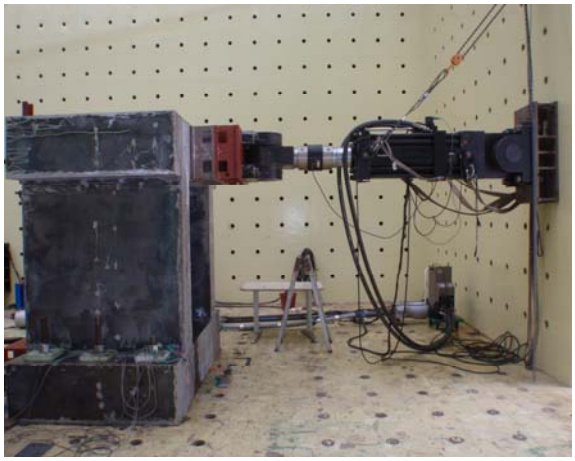

Fig. 3. Setup to Cyclic Load Test

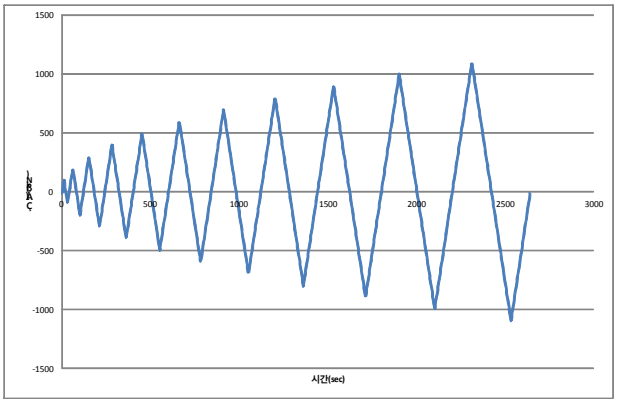

Fig. 4. Cyclic Load

3.2 Experimental Results

Load-displacement curve has been measured as shown in Fig. 5.

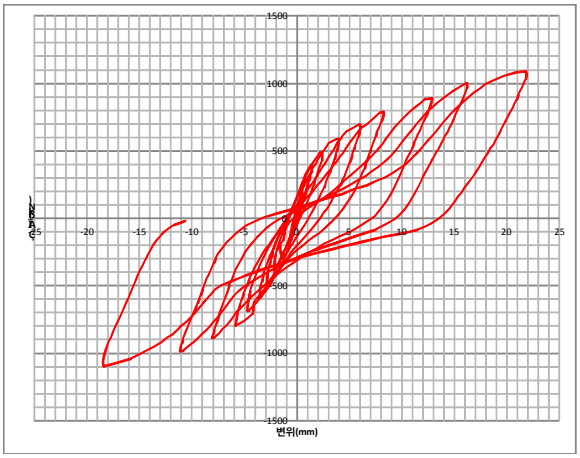

Fig. 5. P-Δ curve of SC Wall Specimen

As damping has a characteristic to dissipate energy, it is possible to evaluate the damping value using hysteresis loop. Equivalent viscous damping can be calculated by assuming that dissipation energy per a cycle (E_D) that is area of hysteresis loop acquired from cyclic load test is same as the area of elliptical as shown in Fig. 6 depicting dissipation energy by equivalent viscous damping.

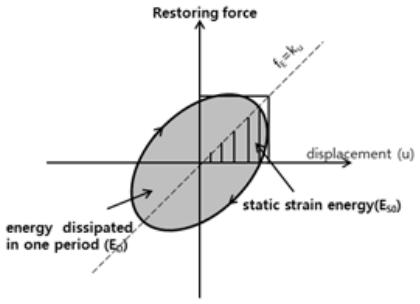

Fig. 6. Hysteresis curve of viscous damping

The entire P-Δ curve has been divided by each cycle as shown in Fig. 7. The damping values were calculated by analyzing every hysteresis loop.

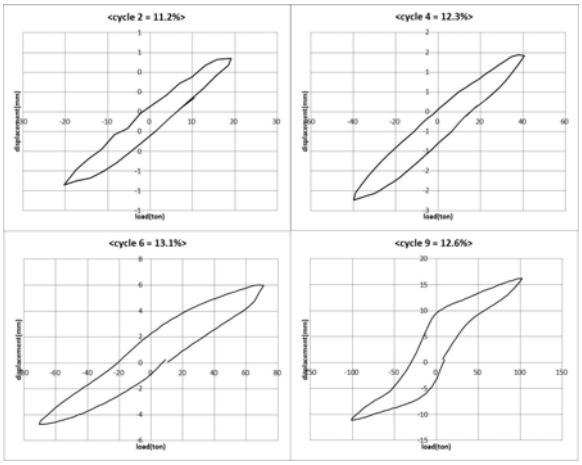

Fig. 7. Damping Ratio of Each Cycle

Table. 1 Test Result - Damping Ratio

Cycle	Damping ratio(%)	Max. Load (ton)
2	11.2	19.1
4	12.3	40.6
5	11.9	49.9
6	13.1	60.0
7	13.5	71.1
8	12.1	80.3
9	12.6	91.0
10	12.4	102.0

4. Conclusions

From results of cyclic load test, it has been identified that damping ratios are distributed between 11.2% ~ 13.5%.

This study will perform further analyses with other experimental results obtained from shaking table test to draw out a reasonable conclusion

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