Experimental Study on Bending and Shear Behavior of SC Structures under Out of Plane Load

K. J. Lee,[a] D. S. Park,[a] K. W. Ham,[a] J. H. Jeon,[a]
a Environment & Structural Lab., KEPRI, 103-16, Munji, Yuseong, Daejeon, Leekj@kepri.re.kr

1. Introduction

Comparing with RC structures, SC (Steel plate Concrete) module can shorten construction period.

This is an experimental study on the out of plane load behavior of SC (Steel plate Concrete) wall module under bending and shear loading. 4 tests were conducted to verify load-displacement relationship according to steel plate ratio, shear reinforcement ratio and the type of shear reinforcement. On the basis of test results, it is found that shear reinforcement ratio is a main factor of shear strength of SC structures.

2. Test Procedure

2.1 Specimen Shape

Beam type specimens were designed as SC walls were assumed as a 1-way structure. Case-02 was the same specimen with case-01, but it used coupler which interconnect shear bars. The properties of specimen are summarized in Table 1 and Figure 1 shows the schematic view of specimen (Case-01).

Table 1. Specification of specimen (Unit : mm)

	Case-01	Case-02	Case-03	Case-04
Length	8400	8400	8400	8400
Depth	500	500	400	400
Steel plate thickness	9	9	9	4.5
Stud diameter	16	16	16	16
Stud pitch	200	200	200	200
Shear bar pitch	400	400	200	400
Coupler		O		
Shear bar ratio	0.2	0.27	0.2	0.2
Shear span ratio	1.6	1.6	2	2
T/t	55.6	55.6	44.4	88.9

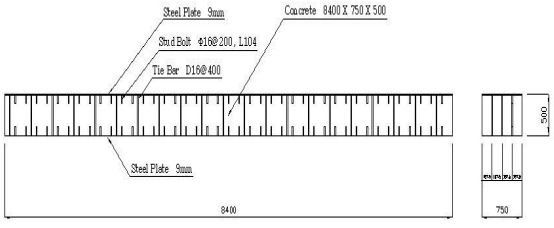

Figure 1. Case-01 specimen

2.2 Loading Frame

Loading frame was designed to apply 4 different load at the middle and edge of specimen. 6 hydraulic jacks subjected to the main frame were used for static loading. 2 pair of hydraulic jacks were installed at the center of the main frame and 1 pair of hydraulic jack was installed at both ends. Then hydraulic jacks were connected with same hydraulic line to level the entire main frame. Figure 2 shows drawing of test apparatus. Figure 3 shows load distribution at center and edge of specimen.

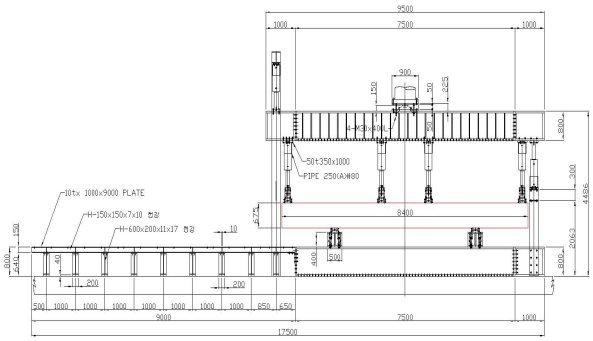

Figure 2. Loading Frame

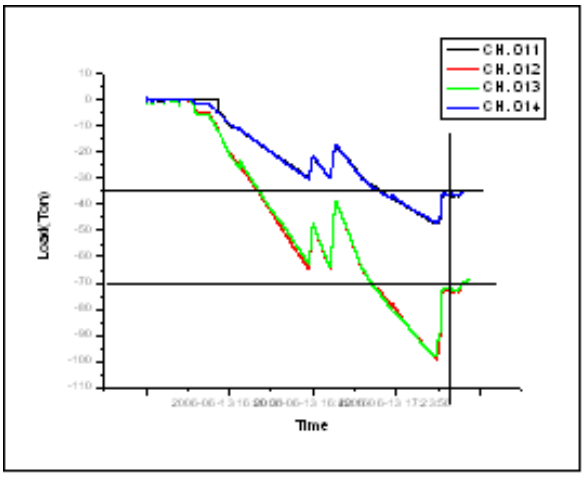

Figure 3. Load Distribution

3. Test Results and discussion

3.1 Failure Shape

On the basis of failure shapes, shear and flexural failure were mixed. As steel ratio and shear bar ratio becomes low, it has a tendency to have a flexural failure shape.

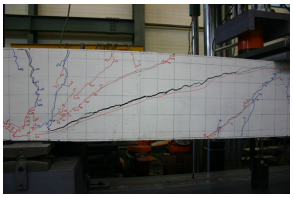

Figure 4. Case-01

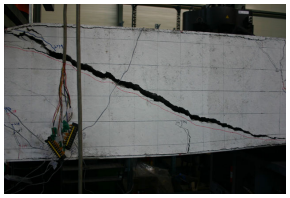

Figure 5. Case-02

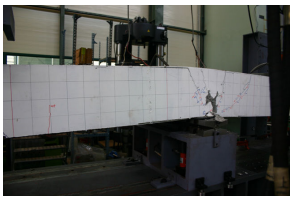

Figure 6. Case-03

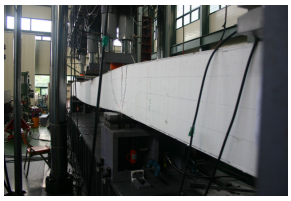

Figure 7. Case-04

Some cracks were inspected at the welding point between steel plate and stud, shear bar. With high stud and shear bar ratio, the frequency and amount of crack was increased because of increasing load capacity. Figure 8 shows crack distribution.

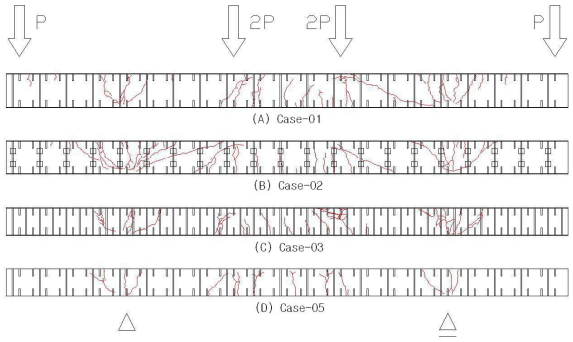

Figure 8. Crack Distribution

3.2 Load-Displacement Relationship

In the Figure 4~7, case-01 and case-02 were shear failure and case-03 was mixed failure with shear and flexural. Figure 9 show a load-displacement relation at the center of specimen.

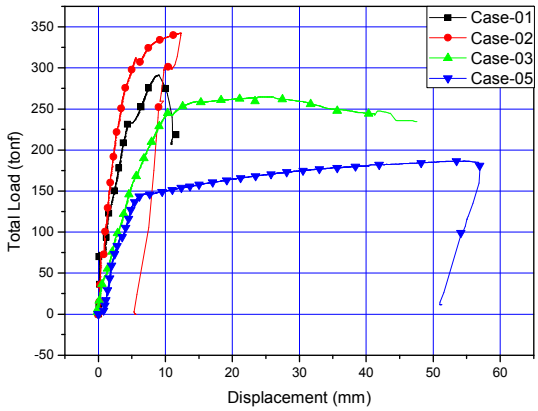

Figure 9. Load-Displacement relation

Figure 10 shows a load-strain relation at the bottom of center steel plate. Case-01, case-02, case-03 shows an elastic behavior but case-05 shows an non-linear behavior. As a result of figure 10, case-05 was to be seen as a flexural failure.

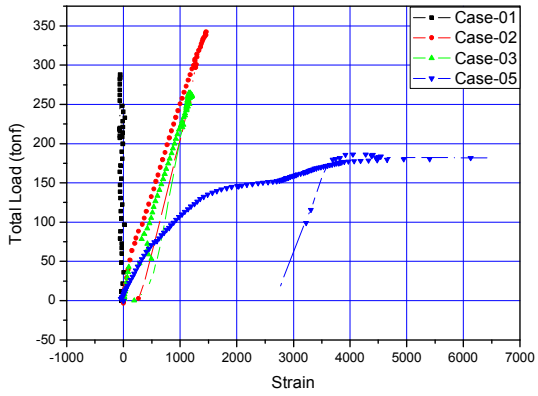

Figure 10. Load-Strain relation

4. Conclusion

Several tests were conducted to verify behavior of SC module walls under bending and shear loading.

As a result of experiments, case-02 showed larger shear capacity compared to case-01, therefore usage of coupler is desirable for construction and strength purpose. Also it is found that increase of shear bar ratio is a main factor of securing shear capacity.

ACKNOWLEDGEMENT

This research was financially supported by Ministry of Commerce, Industry and Energy and the authors are grateful to the authorities for their support.

REFERENCES

[1] B.Mckinley, L.F.Boswell, "Behavior of double skin composite construction," Journal of Constructional Steel Research 58, 2002.

[2] 日本電氣協會 鋼板ユソクリ-ト構造 耐震設計技術指針 JEAG 4618-2005