EXPERIMENTAL INVESTIGATION OF BRB FRAMES

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Introduction

Buckling-restrained brace (BRB) generally comprises a steel core element that carries the entire axial load and a restraining exterior element that prevents the core from buckling in compression. BRB is characterized by the ability of bracing elements to yield inelastically in compression as well as in tension. Frames using the BRBs, named as buckling-restrained braced frames (BRBFs), can be designed as an effective and efficient seismic resisting system [1] .
In this study, the subassemblage tests of the buckling-restrained braced frames were performed to examine their behavior under simulated seismic loading. Based on the test results, the seismic performance for BRBFs was discussed.

Experimental Program

The dimensions and detail descriptions of the test specimens are presented in Table 1 and Fig.1. Three test specimens were planned to analyze the subassemblage behavior according to the connection types as well as whether or not concrete filling was used. The B1 specimen and B2 specimen were designed with the general bolted connection, whereas the B3 specimen was designed with an 80 mm-diameter pin connection. Fig. 1 also shows the test setup for the specimens wherein buckling-restrained brace was installed on a subassemblage frame of 2.8m × 2.3m. The loading protocol prescribed the quasi-static cyclic pattern with stepwise incremental displacement amplitude.

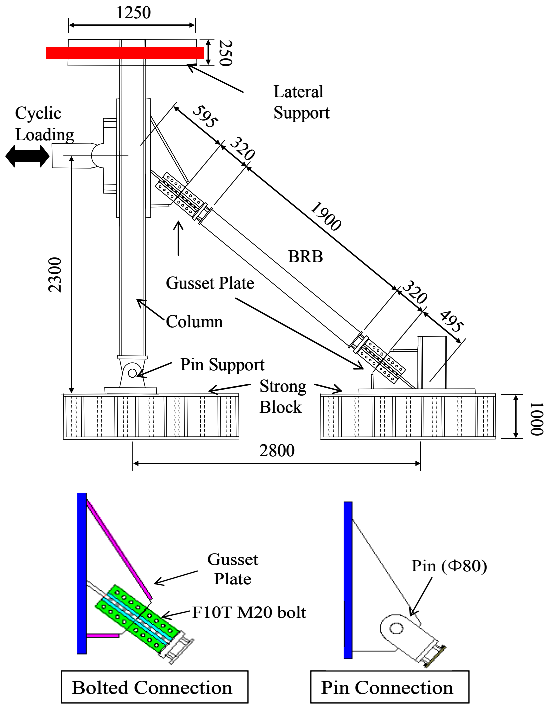

Fig.1 Test specimen and test setup

Table 1 List of test specimen

Specimen	Core	External tube	Connection type	Composite
B1	H-150×150 ×7×10 (SS400)	□-175× ×11 (SM490)	Bolt	-
B2			Bolt	Yes
B3			Pin	-

Results and Discussion

The lateral load-story drift ratio relationship of frames (Upper) and the axial load-axial deformation of buckling-restrained braces (Lower) are plotted in Fig.2, respectively. While all test specimens displayed a stable hysteretic behavior without buckling-restrained brace damage, a slip occurred in the gusset plate connection part at an inter-story drift ratio of 0.62% for the B1 and B2 specimens that used bolted connection. The slip developed repeatedly during successive loading, resulting in a decrease in the load.

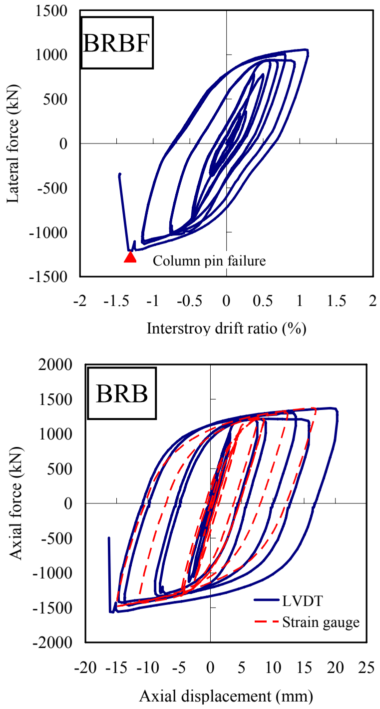

Fig. 2 Cyclic response of B3 specimen

The strength adjustment factor is used to compute the unbalanced force imposed on a girder in chevron-braced frames when they subjected to a large seismic loading. AISC recommends [2] that the compression-strength adjustment factor which refers to the ratio the maximum compressive strength to the maximum tensile strength should not exceed 1.3. It can be observed that the compression-strength adjustment factor (β) ranged from 0.83-1.19, satisfying the upper limit of 1.3 specified in the seismic provision.

The cumulative plastic ductility (η) is defined to be the yield deformation ratio of cumulative plastic deformation for BRB. The cumulative plastic ductility required by AISC/SEAOC [3] and by AISC seismic provision [14] is 140 and 200, respectively. Fig. 3 shows a plot of the cumulative plastic ductility at each story drift ratio. It can be observed that the cumulative plastic ductility of all specimens reached 190, which exceeded the value of 140 required by the AISC/SEAOC recommended provision but which was slightly lower than a value that is demanded by the AISC seismic provision.

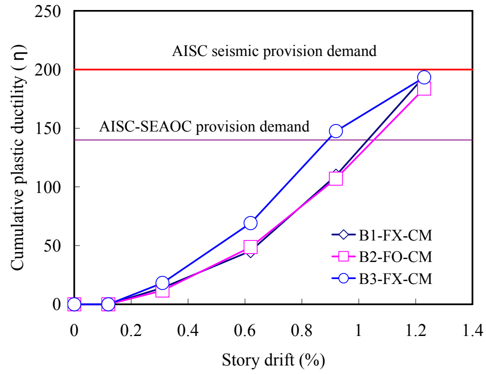

Fig. 3 Ductility capacity (η)

Conclusion

All specimens were effective in resisting the axial forces, showing symmetric hysteretic curves without fracture under cyclic quasi-static loading. The ductility for all specimens was slightly lower than the value of AISC seismic provision. The β factor satisfied the seismic provision. Test result shows that the effect of the bending moment due to the out-of-deformation at the end of the core is insignificant, regardless of the connection types.

Acknowledgement

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References

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