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Reinforcement against Shear Failure of Connection-Panel

Armatures contre la rupture au cisaillement de panneaux d'assemblage

Bewehrung gegen Schubversagen in Verbindungsscheiben

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1. INTRODUCTION

Composite steel and reinforced concrete structures have been widely used in Japan. The arrangement of reinforcing bars is the same manner as that of a conventional reinforced-concrete structures. In a beam-to-column connection, therefore, the hoops are arranged as a reinforcement against shear failure. Arranging the hoops needs holes in the steel beam web so that the hoops can pass through. Moreover, because of existence of steel shapes and a lot of main reinforcing bars in the connection, the arrangement of hoops usually becomes troublesome. If a simpler method of the reinforcement against shear failure of the connection-panel is available, it seems that an economical and easy design is possible.
This paper presents the results of an experimental work carried out to study the strength and behavior of frames with a new type reinforcement against the shear failure of connection-panel.

2. TEST PROGRAM

Cruciform frame specimens are tested under a constant axial compressive load on the column and cyclic loads on the beam as shown in Fig.1. Total six specimens are tested. The detail of beam-to-column connection is shown in Fig. 2. All specimens are designed so that they fail in shear at beam-to-column connection. Three specimens with the conventional hoops (H0, H1, H2), and three specimens without them (W0, W1, W2) are tested. The specimens (H0, H1, H2) have different value of amount of the hoops pw (H0;0%, H1;0.5%, H2;1%) in the connection-panel. The panel of steel portion of the specimens (W0, W1, W2) is strengthened by welding a doubler plate at a steel web in order to make the shear strength to be equal to that of specimen H1. Two specimens (W1, W2) have the bracing bars which is set so as to prevent the column reinforcing bars from buckling.

3. TEST RESULTS AND DISCUSSIONS

Figure 2 shows the load-deflection relation together with the detail of connection-panel. In each loading cycle, negative slope does not appear in the hysteresis loop. Even specimens without the hoops have equivalent maximum strength and deformation capacities to those of conventional connections (see H1 and W0). As to the effect of bracing to column reinforcing bars on the behavior, explicit difference is not observed (see W0, W1 and W2).

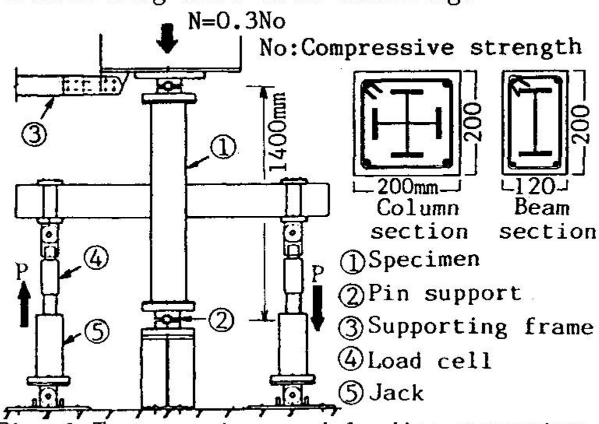

Fig. 1 Test specimen and loading apparatus

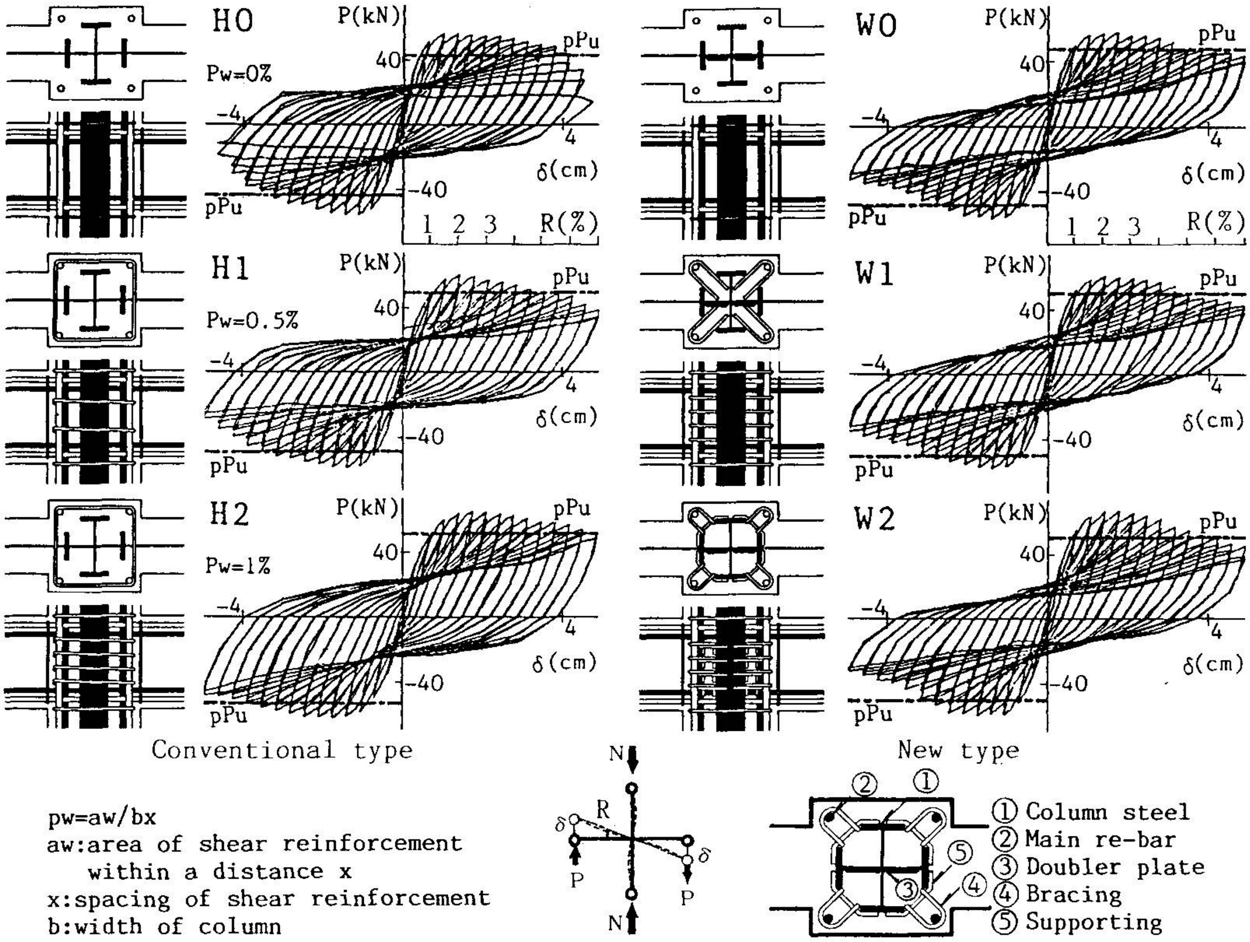

Fig. 2 Load-deflection relation

In Fig.2, dash-dot line indicates the ultimate shear strength of connection-panel obtained by using the strength formula specified by AIJ[1]. Table 1 shows the comparison of strength. The ratio of (experimental maximum strength) / (predicted strength) ranges from 1.2 to 1.3. Strength pPu is fairly well and conservatively predict the experimental strength of specimens.

Specimen	Experimental strength(1)	Predicted strength(2)	(1)/(2)
H0	55.6	42.1	1.32
H1	59.4	48.5	1.22
H2	63.8	51.5	1.24
W0	57.5	47.7	1.21
W1	59.3	49.5	1.20
W2	65.6	50.1	1.29

Table 1 Comparison of strength (Unit:kN)

4. CONCLUSIONS

It has become clear from test results that :

1)Regarding the load carrying capacity and deformation capacity, a connection-panel without the hoops has the same performance as that with the conventional one if the panel of steel portion is strengthened by doubler plates. An economical design is possible by using this connection type which is easy to be manufactured.

2)Regarding the effect of the bracing to column reinforcing bars, there is no difference between with and without bracing.

3)The maximum strength of beam-to-column connections both with and without the hoops can be predicted fairly well by the AIJ strength formula.

REFERENCES

1. Architectural Institute of Japan, Standard for Structural Calculation of Steel Reinforced Concrete Structures, June 1987