BEHAVIOUR OF REINFORCED CONCRETE MEMBERS USING MECHANICAL SPLICES OF STEEL BARS UNDER CYCLIC LATERAL LOADING

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I. INTRODUCTION

In large scale RC structures, pre-assembly of steel bars is sometimes used due to construction workability. Most of common rebar joint methods available are lap splice joint, gas pressure welding joint and mechanical splice methods.

The JSCE Guidelines for Concrete No.15 stipulates that "Splices shall not be clustered at the same cross-section of the members". However, if splices are clustered at the same cross section, construction work can be improved.

The objective of this study is to make clear the influence of mechanical splices arranged at the same cross section on the behaviour of RC members subjected to cyclic lateral load.

II. OUTLINE OF EXPERIMENT

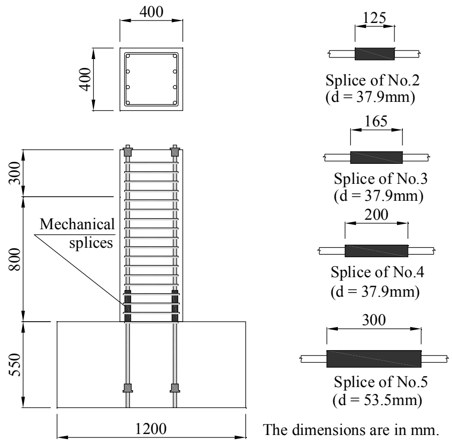

Fig.1. Geometry and dimensions for test specimens

Table 1. Material properties

No.	Longitudinal bars		Mechanical splices		Concrete strength f'_c (N/mm^2)
	Type	f_y (N/mm^2)	Length/ Diameter (mm)	f_y (N/mm^2)	
1	8-D22 (SD345)	378.4	-	-	23.9
2			125/37.9	376.7	28.2
3			165/37.9	374.2	25.3
4			200/37.9	374.2	27.0
5			300/53.5	374.2	28.7

Five RC columns were designed to fail in flexure by yielding of longitudinal bars and constructed, all having the same size and reinforcements details (Fig.1). Different mechanical splices were used as shown in Table 1: rebar without splice for Specimen No.1; rebar with mechanical splices for the other four specimens.

The cyclic lateral load was applied by a 300kN capacity actuator (Fig.2). The amplitude of cyclic loading was based on the yield displacement. Before yielding, the incremental increase in displacement was 4mm for each cycle. After the yield displacement (δ_y), an integral multiple of yield displacement was applied three cycles to the specimen.

Basic data for each test was obtained from load cells, displacement transducers set up along the column height and strain gages attached along the longitudinal bars. All the data were logged into a computer through a TDS Data Logger device.

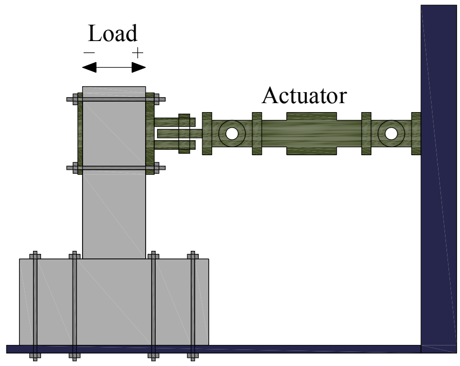

Fig.2. Test schematic

III. RESULTS AND DISCUSSION

1. Load – displacement curves

The hysteretic curves obtained from the tests are shown in Fig.3. As can be seen in Fig.3, an improvement of strength and deformation capacity was observed in the specimens No.2, 3, 4, 5 with mechanical splices compared to the specimen No.1 without mechanical splice. Fig.3 also shows envelope curves of load – displacement of five specimens. The ultimate strengths increase with the increase of sizes of mechanical splices. Failure of specimen occurs when the load carrying capacity is less than 80% of the maximum load. The failure occurred $5\delta_y$ in specimen No.1 while they did at

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about 6δ_y in the other specimens. From the experimental results, it can be concluded that the energy dissipation capacities of specimens with mechanical splices were better than that of the specimen without mechanical splice.

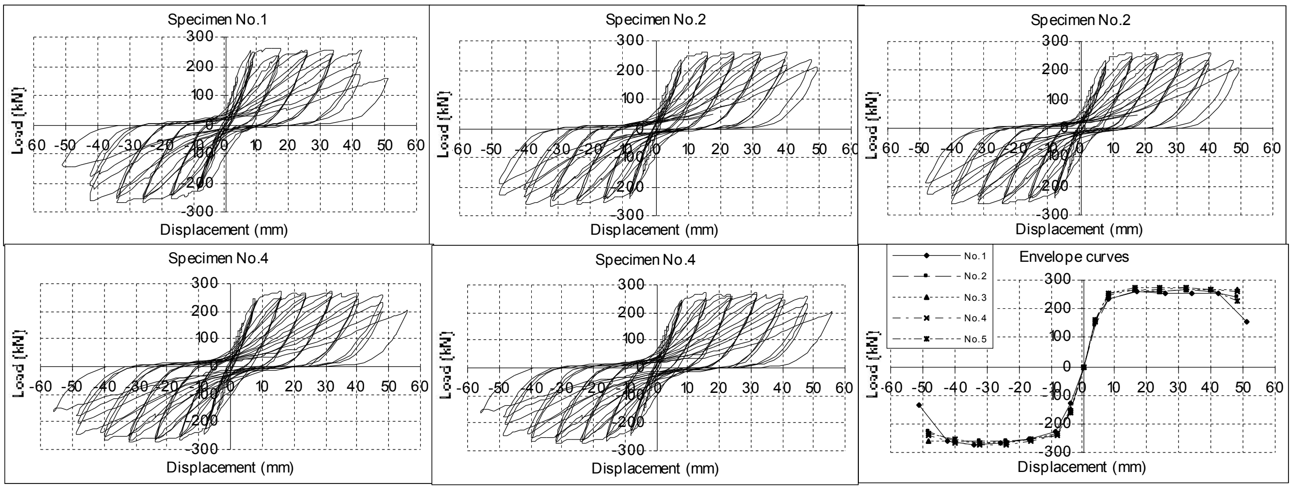

Fig.3. Load – displacement curves

2. Strain distribution

Fig.4 shows the peak strain distribution of steel bars along the column height 4mm, 1δ_y and 2δ_y.

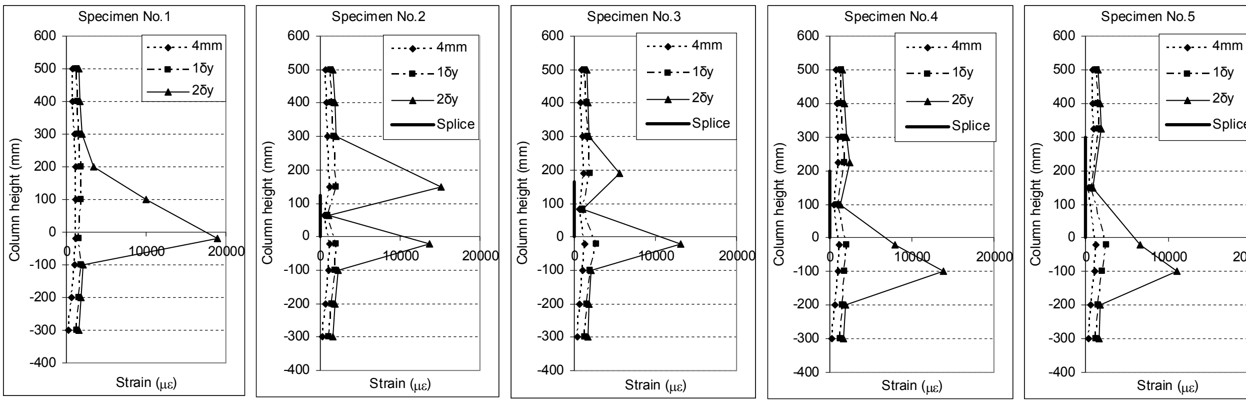

Fig.4. Distribution of longitudinal steel bars strains along the specimen height

As we can see in Fig.4, maximum strain values of specimens No.2, 3, 4, 5 with mechanical splices were much smaller than specimen No.1 without mechanical splice. Thus, mechanical splices provide a good characteristic for specimens in resisting lateral load. This property was depended on the quality of the mechanical splice. At 2δ_y displacement level, specimen No.2 with the smallest size of mechanical splice yielded at the footing and at the connection of mechanical splice. Specimen No.5 with biggest size of mechanical splice yielded only at footing.

Strain profiles of specimens also indicate that specimens with mechanical splices will have two plastic hinges at the top and the bottom of splices. Thus, they will absorb and dissipate energy better than the specimen without mechanical splice.

IV. Conclusions

Five RC cantilever column specimens were tested using some types of mechanical splices arranged at the same cross section under cyclic lateral loading. Comparing behaviour of specimen No.1 without mechanical splice and specimens No.2, 3, 4, 5 with mechanical splices through load – displacement curves and strain distributions, it was found that specimens with mechanical splices had a better performance than the specimen without mechanical splice: higher strength and deformation capacity, better energy dissipation characteristic.

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