HYSTERETIC BEHAVIORS OF REINFORCED CONCRETE MEMBERS SUBJECTED TO BI-AXIAL BENDING MOMENTS

by

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This study deals with static tests on twenty-six specimens subjected to bi-axial bending moments and with the analysis of the test results. Most part of the experiments and some part of the analysis have been published in Trans. of A.I.J. No.229 and No.249.**

Sixteen specimens with 10cm square cross section and six specimens with 15cm square cross section were tested under the loading condition of constant bending moment about one axis (2-axis) and monotonic or reversed cyclic bending moment about the other axis (1-axis) orthogonal to 2-axis. Reversed cyclic bending moment was applied by a rule of incremental deformation amplitude loading or constant deformation amplitude loading. In addition to twenty-two specimens mentioned above, four specimens with 10cm square cross section were tested under the more complicate loading conditions.

Loading and measuring arrangements were newly developed, by which two bending moments about two axes were applied independently and the specimens were tested to a large deformation of about twenty times the yielding deformation.

Restoring force characteristics about 1-axis and deformation about 2-axis became stable during cyclic loading with constant deformation amplitude when both constant bending moment about 2-axis and constant deformation amplitude about 1-axis were small. In another case, however, constant bending moment about 2-axis had considerable influence on the restoring force characteristics about 1-axis and deformation about 2-axis became very large during cyclic loading.

The experimental results were followed by sectional analysis in which Bernoulli's principle was used and stress-strain hysteresis rules of concrete and reinforcing bar were postulated according to recent experimental studies on them. Experimental and analytical results coincide quite well. It is found, besides, that the relationship between total bending moment and equivalent deformation with respect to the total bending moment is better than the relationship between total bending moment and the maximum stress or strain in the section as a base to evaluate the capacities of the section.

The influence of bending moment about one axis due to dead load on hysteretic characteristics about the other axis should be taken into consideration when conventional aseismic design method in which lateral forces are applied independently in two directions orthogonal to each other is used for reinforced concrete columns.

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