Consideration of Scale Effect in Concrete Members

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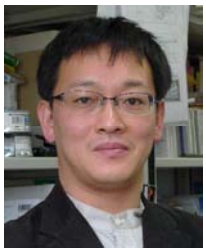

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Summary

This paper investigates the scale effect in concrete members subjected to shear loading. Some concrete structural type (RC and SRC) of different sized test specimens were prepared and tested. Moreover, a shear loading test on some geometrically similar specimens, having diameters from d=300 to 1100 mm, was conducted in the present study to investigate the scale effect in large-scaled concrete structural members. The results clearly indicate that the size effect for large scale members is clearly observed. The validity of the k_u value in Hirosawa's equation ,which is the most popular shear design equation in Japan, is verified through the comparison with the test results on 37 RC and SRC specimens failing in shear, 14 specimens were collected from this paper and 23 specimens from the works published recently. From the inverse analysis of k_u, it is important of the review of k_u for the seismic design of large scale structures.
Keywords: Scale Effect; RC Column; RC Beam; SRC Column; SRC Beam; Shear Loading Test.

1. Introduction

Scale effect has been recognized since the early 19th century and is extremely important in the design of structures to assure safety and adequate resistance to earthquake forces because it appears in fracture phenomena associated with compression, flexural and shear failure modes. The development of advanced computational analysis tools in the last decade and theoretical approaches that employ fracture mechanics to concrete structures have improved understanding of the behavior of materials and structural members. In addition, many experimental investigations on the scale effect in Reinforced Concrete (RC) structures have been carried out. However, since laboratory load devices often do not have the capacity to test full-scale specimens, researchers tend to carry out tests on relatively small-scale models. As a result, the Japanese building code has no specific provisions for the scale effect in the structural performance of RC structures.

This paper deals with the effect of the size reduction of concrete elements, including 4 structural types (RC column, RC beam, SRC column and SRC beams) in the shear performance under reversed cyclic loadings. All the experimental studies described here were performed in the authors' laboratory. Then, a rational shear strength design formula that takes into account the scale effect is formulated by applying "the size effect factor k_u" to the current Architectural Institute of Japan (AIJ formula) design formula [1]. Finally, the validity of the proposed formula is verified by comparing the predicted values with the existing test results of 37 RC members with d values ranging from 160 to 1200 mm.

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