Non-Structural Reinforced Concrete Partition Walls with Dowel-bar Connectors Useful as Secondary Damping Devices

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Abstract

In building structural design process, the capacity of non-structural elements is not evaluated by reducing the interaction between non-structural and structural elements at their connection. However, it is possible to revaluate the existing properties through proper seismic evaluation on non-structural elements as 'secondary damping devices'. In other words, for proper seismic evaluation of buildings, it is necessary to quantitatively evaluate the capacity of non-structural elements by verifying that the connection materials of them don't reduce the structural capacity nor dis-balance the stiffness distribution but enhance the damping capacity by localizing building damage to them after early yielding induced.

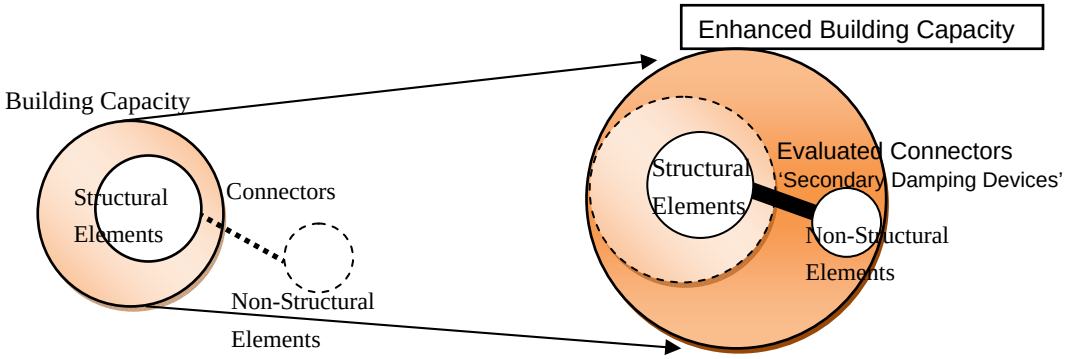
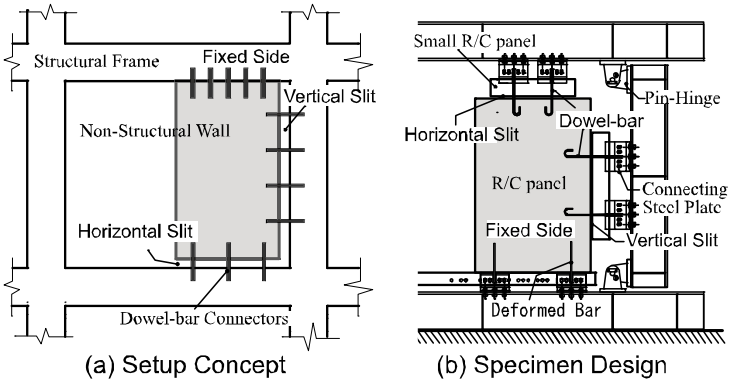


Fig1. Diagram of the motivation for this study

On this premise, authors performed full-scale static cyclic loading experiments on non-structural Reinforced Concrete(R/C) walls in R/C buildings from 2005 to 2007 and obtained fundamental data for quantitatively evaluation of damping capacity of non-structural walls. Fifteen Specimens were designed by modeling structural-slit type partitions, which were separated from the surrounding structural frame with complete structural slits and dowel-bar shear connectors.

In this test program, structural slits were set at the setting-story beam side (horizontal slits) and at column side (vertical slits). R/C partition wall panels were fixed to the upper-story beam with sufficient quantity of dowel-bar. Specimens were set up-side down for loading simplicity (Fig.2). Test parameters include: R/C panel width(600,1200,2000mm), coordination and quantity of the dowel-bar, material type of dowel-bar(normal deformed, low-yield round), bond condition of the dowel-bar(Bond, Unbond) and slit width (10,20,30mm). These partition walls are able to be set up in existing buildings by cast-in place or precast concrete method after anchoring dowel-bars and setting slit sealing material.



(a) Setup Concept (b) Specimen Design

Fig2. Test Specimen

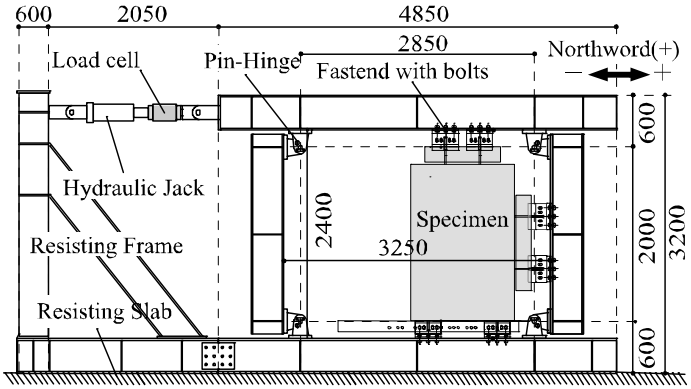


Fig3. Testing Apparatus

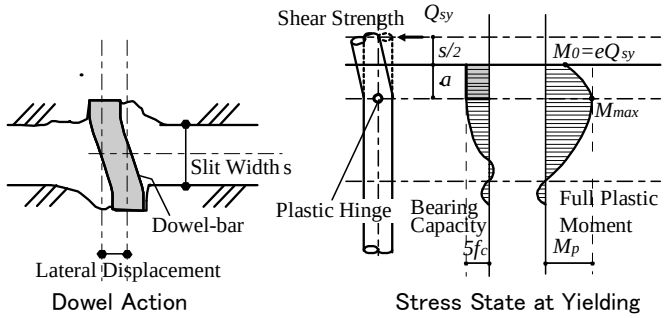


Fig4. Dowel-bar Behavior (Dowel Action)

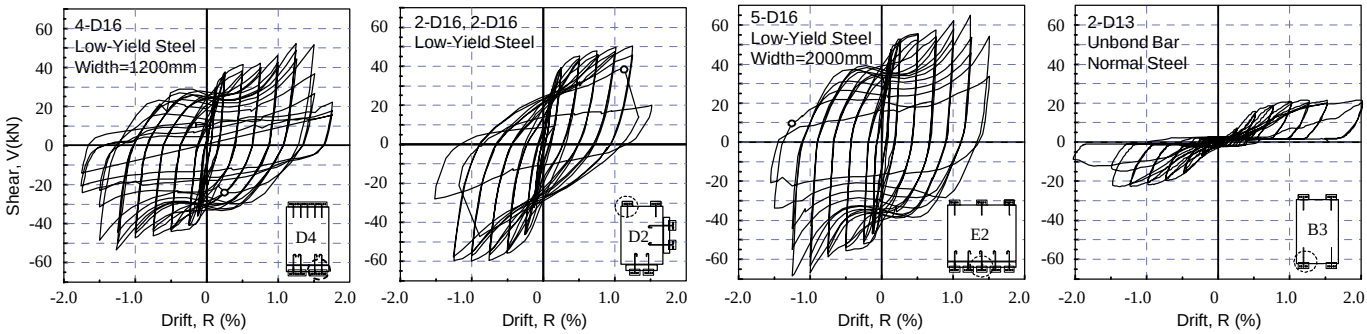


Fig5. Test Results (Hysteresis Curve Samples)

As test results, we obtained almost the same failure process of dowel-bars and different hysteresis behaviors of partition walls with different parameters. Specimen subjected to lateral displacement-control loading damaged at only around the dowel-bar connectors and no cracks were observed on the elevation of R/C panels. Dowel-bars under dowel action (Fig.4) yielded before the story drift level R =0.25% and fractured at R=0.75% to R=1.5% and it depended on the bar material. Each Dowel shear strength was calculated with moderate accuracy by the retrospective equation. Specimens with larger slit width or debonded dowel-bar conditions had a smaller effect on surrounding frame. On the other hand, specimens with smaller slit width, low-yield steel dowel-bar or a larger quantity of dowel-bar had larger damping energy at relatively small story drift level R, between 0.25% and 0.75%.

In addition, based on the test results, we will investigate the damping effect of these partition walls by structural analysis. R/C non-structural partition walls discussed in this paper are installed in a six-story R/C assembled housing building model. The damping effect will be around 2.0% by the value of the viscous damping ratio around 2.0% at R=1.0%.