連層耐震壁下層部分における地震時水平力の抵抗機構の解明

SEISMIC FORCE RESISTING MECHANISM OF A MULTI-STORY SHEAR WALL SYSTEM

○坂下雅信・河野進・田中仁史

1. Introduction

In current design procedures [1][2], cantilever structural walls are normally assumed to stand on a solid foundation, and the foundation beams, slabs and piles are designed separately without considering their interactions. This is because their interactions have not been thoroughly studied for its complexity. Also neglected in the practical design is the fact that shear transfer mechanisms along the wall base vary depending on the crack patters and inelastic deformation levels at the shear wall base. This study aims to experimentally clarify the variation of the lateral load resisting mechanisms considering the interaction between a shear wall, foundation beams, slabs and piles, and to establish more rational design procedures for each structural component.

In the experimental program, the specimen configuration was determined from typical six story residential buildings in Japan. They normally have multiple spans of a RC moment resisting frame in the longitudinal direction and a single span of shear wall system in the transverse direction. In this study, the assemblage consisting of the lowest two floors of shear wall with a foundation beam, the first floor slab, and two piles in the transverse direction was scaled to 1/5 to make model specimens. The shear wall was designed to fail in flexure and the shear span ratio of the piles was fixed as 2.2 although the shear span ratio is supposed to vary depending on the soil, axial force, and lateral force under earthquakes.

2. Main conclusions

The foundation beam resisted by itself and the contribution from the piles and shear wall was less than expected. This caused unexpected shear cracking to spread extensively over the foundation beam. However, longitudinal bars in slabs worked together with the upper longitudinal reinforcement in the foundation beam. Transition of shear transfer mechanisms at the shear wall base was observed from the strain distribution of longitudinal reinforcement in foundation beams and those strain distributions of different loading stage were predicted accurately. The lateral load–drift relations obtained experimentally was simulated well with a simple superposition of flexure and shear elements.

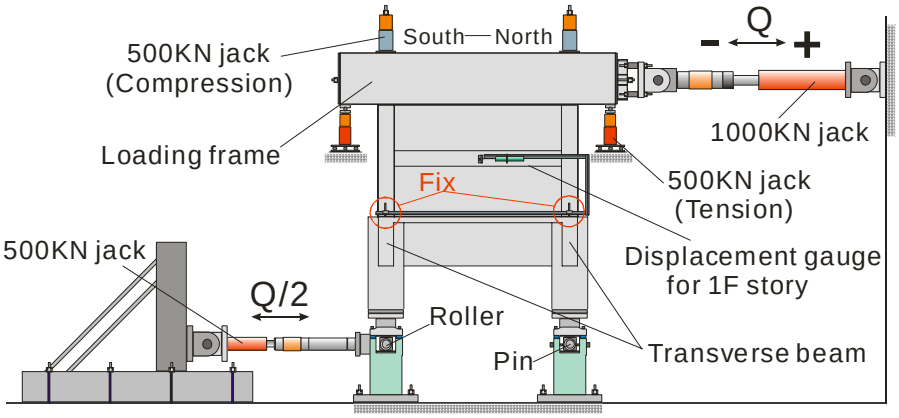

Figure 1 Test specimen and loading setup

【References】

[1] Architecture Institute of Japan, “AIJ Standard for Structural Calculation of Reinforced Concrete Structures Based on Allowable Stress Concept,” 1999, pp218-241.

[2] Paulay, T. and Priestley, M.J.N., “Seismic Design of Reinforced Concrete and Mansonry Buildings,” John Wiley & Sons, 1992, pp. 362-499.

[3] Hirata, M., Naraoka, S., Kim, Y., Sanada, Y., Matsumoto, K., Kabeyazawa, T., Kuramoto, H., Hukuda, T., Kato, A., Ogawa, M., “Dynamic Test of Reinforcement Concrete Wall-Frame System with Soft First Story Part 1-Part 4” Summaries of technical papers of annual meeting architectural institute of Japan, 2001,pp705-712 (in Japanese).