
ABSTRACTS (MASTER THESIS)

**—Proposal of new reinforcing method on existing wooden traditional dwelling house
without big change on superstructures.—**

**(Graduate School of agriculture, Forest science dev.
Laboratory of Structural function, RISH, Kyoto University)**

Makiko (Miki) Yokozeki

How should we reinforce existing traditional wooden houses against earthquake without changing internal atmosphere of the building? It's not appropriate to add much amount of shear walls for reinforcement. In general, high performance shear wall needs the strong leg joints against pull-out force. But the columns in Japanese traditional timber structure are simply put on the stone base on the ground without metal joint. This makes it difficult to set high performance shear walls in such old timber structure. Thus we tried to invent a frame system to make shear walls work effectively by utilizing the space under the floor level in combination with less amount of shear wall.

1. Concept of reinforcement by frame system: The purpose of research is to develop the high performance shear wall and to reinforce existing timber frames. We developed a shear wall by combining lattice and board elements which satisfied the performance of high strength and deformation ability by taking the advantages of each element. This wall was set in the frame in which top and bottom beams were turned into boxed beam. Thus the pull-out force on the shear wall can be transmitted to the distant column by bending and shear resistance of the box beam and can be held down by smaller self load of the building.

2. Experimental: The height and width of the frame was almost 3015mm each as shown in Figure 2. The specimen consists of the hanged wall, the boxed beam with under the floor, shear wall and frame structure. Three types of shear wall, 1P, 2P and 1P×2 were set in the frame as parameters; here 1P wall means 1005mm in width. The each type of specimen was tested in 5 steps; gradually adding the structural elements such as lattice, board and top or bottom beam into the frame. The shear wall was composed by lattice made of Japanese cedar and the fibers mixed calcium silicate board nailed at each circumferences as well as at each intersection point of lattice members. We evaluated its mechanical properties by static horizontal cyclic loading test. The interaction of vertical and horizontal load was simulated by using wire-pulley system to give constant vertical force of 10, 20, 30kN while applying cyclic horizontal force by oil-jack.

3. Results and discussions: The maximum strength of the frame was about 30kN in condition over vertical load of 30kN as shown in Figure 3. The stress analysis showed the contribution of the only frame element was about 10kN. This high performance was achieved because the shear wall had enough strength as expected, and the whole frame structure worked well against the force in conjunction with hanged wall and boxed beam by virtue of the strong joints of the each part of the frame. The self-load sufficiently held specimen down against lifting up. In conclusion, we would say that it is possible for high performance shear wall to work effectively in the frame without leg joints by appropriately reinforcing the beams and joints. Based on the results, we adopted the system to reinforce a 200 years old timber building in traditional preservation district.

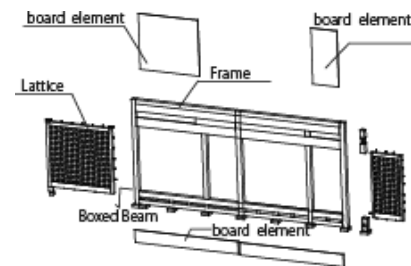


Figure 1. Outline of the frame system

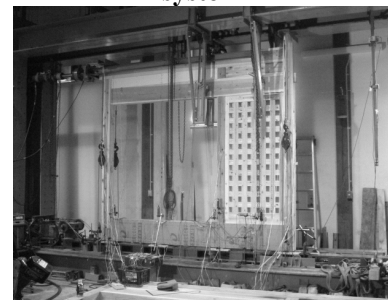


Figure 2. Test setup

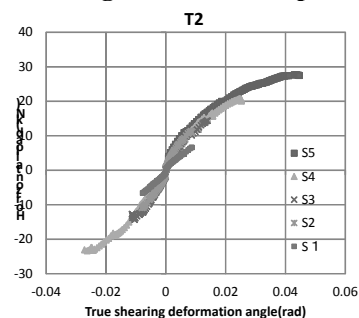


Figure 3. Load-deformation curves of test results.