

RECENT RESEARCH ACTIVITIES

Lateral Performance of the frame with upper mud wall in Japanese traditional residential houses

(Laboratory of Structural Function, RISH, Kyoto University)

Hiroshi Isoda and Zherui Li

1. Introduction

Facing the severe challenge from earthquakes, the lateral behavior of Japanese traditional timber structure has been highly regarded based on its long-term practical experience. In the current structural calculation method for the timber frames with upper mud wall that is applied for Japanese traditional residential houses, the shear resistance of mud wall is mainly considered. While the moment resistance of end joints between columns and beams is not taken into account in the overall lateral performance of the frame. In order to clarify the contribution of the moment resistance from each column and beam end joint, experimental study with numerical analysis have been carried out on the performance of column and Sashi-gamoi tie beam frame under both conditions with and without mud wall. Simultaneously individual joint rotation test was conducted to improve the estimating theories of traditional column-tie beam frame.



Figure 1. Experiment examples by research subjects

2. Research subjects

The research of frame with upper mud wall system is focused along following subjects for example (Figure 1).

1) **Performance of frame based on the column and beam joint rotation** is estimated by conducting the cyclic loading test of each joint type and the whole frame with same scale (as shown in Figure 2). The different moment resistance of the side T-shape joint and center X-shape joint from push to pull side due to the unsymmetrical structure and working mechanism is clarified. From this research, the lateral performance of the frame is confirmed by overlying the moment of all the joints, and it fits well with the numerical results on the elastic deformation part.

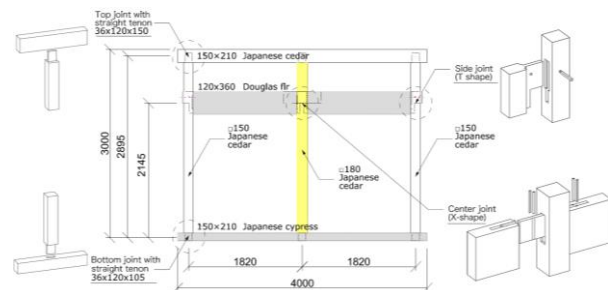


Figure 2. Structural details of joints and the frame

2) **Performance of frame with hanging mud wall.** By contrasting the lateral resistance of the frame with and without mud wall, the overall performance of frame with mud wall in practical design can be considered as the assembly of rotational resistance calculation of all the tenon-mortise joints, the diagonal compression axial force, with the addition of shear resistance of mud wall. The overlying result is a little larger in elastic deformation part, and the effect of large bending deformation of columns that bearing the shear force from mud wall is the main reason.

3. Future plan

Based on current research, the diagonal compression effect of Sashi-gamoi tie beam will be evaluated accurately, along with the influence of columns' combination including their elastic modulus and cross-sections. What's more, several different parameters, including the position and cross-section of beams, the diameter of the dowels and the dimension lost of the columns are expected to be considered in the further frame tests and numerical analysis, aimed to improve the estimating theories of Japanese traditional residential frame system with hanging wall.