ABSTRACTS (MASTER THESIS)

Full-scale shaking table test of high-strength CLT structure with framework and verification of performance by analysis

(Graduate School of Agriculture,
Laboratory of Structural Function, RISH, Kyoto University)

Akira Takise

Introduction

The 2016 notification of the General Design Law for Buildings Using CLT is expected to increase opportunities to use CLT in buildings for a variety of uses, including non-residential buildings. I focused on a construction method that enables a rational design by reducing the amount of CLT walls by using stronger hardware than the existing joining method, and by compensating for the vertical load with axial members such as columns and beams instead. However, it is not clear how they will be joined together or how they will perform as a building in terms of earthquake resistance1). Therefore, this study verifies the performance of the CLT with framework structure by analyzing the seismic behavior and load bearing elements.

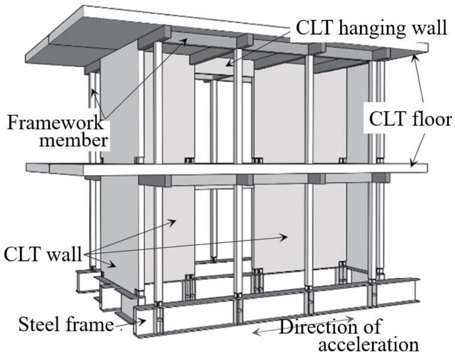

Figure 1. Specimen perspective view.

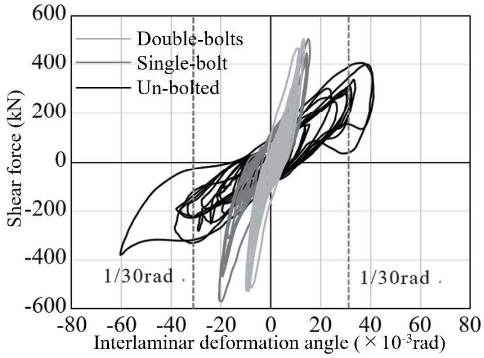

Figure 2. Interlaminar deformation angle relationship of shear force under 135% excitation of BSL wave (1st layer).

Methods

In this study, a shaking table experiment is conducted, and then the behavior is tracked using a numerical analysis program. The perspective view of the test specimen used in the experiment is shown in Figure 1. The test specimen is a two-story full-scale structure that resists seismic forces by a centrally located CLT wall. In order to effectively demonstrate the performance of the CLT, original high-yielding hardware was used for the joint, and three types of specifications were set depending on the type of joint between the test piece and the foundation. The seismic waves used for excitation were unidirectional waves in the longitudinal direction and were input at several magnifications. There are two types of ground motions: the seismic motion observed during the south part of Hyogo prefecture Earthquake in 1995 (JMA Kobe wave) and the artificial seismic motion (BSL wave), which was created to correspond to a major earthquake under the Building Standards Law.

Results and conclusions

Figure 2 shows the relationship between layer shear force and interlayer deformation under 135% excitation of BSL waves for each specification. In the double-bolts specification (two bolts installed at the bottom of the first floor CLT quake-resistant wall) and the single-bolt specification, the deformation angle between the layers was less than 1/30 rad, which is the safety limit for wooden construction, and there was no major damage to the test specimens. In the un-bolted specification, the interlaminar deformation exceeded the safety limit, and the maximum damage was about 1/17 rad. The damage to the CLT included compression cracking at the wall legs and shear failure at the drift pin joint, but none of the damage was minor enough to collapse.

It is considered that this test specimen can withstand large earthquake inputs with fewer seismic elements than the existing CLT structure and has high seismic performance. In order to make use of this information in the actual design, it is necessary to study in detail the mechanism of force manifestation.