ABSTRACTS (MASTER THESIS)

Structural performance of steel frame with CLT shear wall

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Introduction

In Japan, Cross Laminated Timber (CLT) is attracting attention as the way of using forest resources that have reached the harvest season. CLT is expected to be used for middle-to-high-rise building with making use of stable in-plane shear performance. In particular, composite structure with steel frame structure or reinforced concrete structure can take advent of respective material properties, and more and more this kind of researches are reported in recent years. A previous research shows the estimation of drift-pin joint with steel plate for fastening CLT and steel frame. This research aims to confirm the structural performance of steel frame with CLT shear wall using drift-pin joint by conducting experiment, and to make analysis model which follows the experimental result.

Method

In this study, one specification of the joint is defined based on the research of Ministry of Agriculture, Forestry and Fisheries conducted in 2016. In this research, the design for this specification, prior analysis for experiment, 1/2 scale experiment, and joint and material test are conducted to understand the structural behavior. After that, analytical model which reproduces the behavior is created. It was assumed to insert CLT into a standard span steel frame at the design stage. In the analysis, finite element analysis software (SNAP) was used to model a steel frame, CLT panel, spring of drift-pin joint, and CLT compression spring, and incremental analysis was conducted. In 1/2 scale experiment, in total of four specimen in different strength grade of CLT or insertion position as parameters are tested.

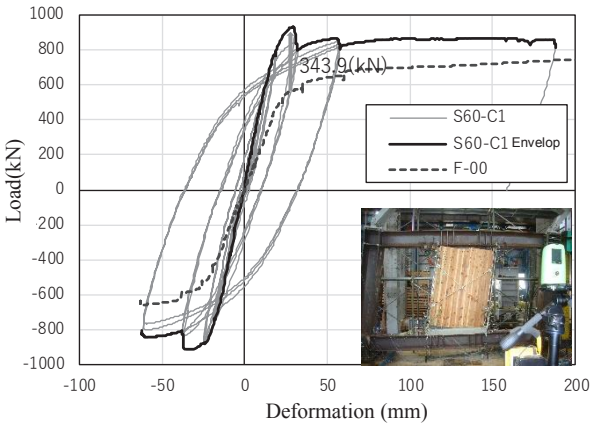

Figure 1. The result of experiment of F-00 and S60-C1

Results and consideration

Fig.1 shows the results of the experiment of steel frame specimen (F-00) and specimen of steel frame with a CLT panel of strength grade S60 inserted at the center (S60-C1). As assumed in the design stage, firstly the steel frame reached the yield point, and then, shear failure of CLT and local buckling of steel frame followed. The maximum load of S60-C1 was 931.7 kN, an increase of 343.9 kN compared to the load at the same deformation of F-00, and the initial stiffness was 1.89 times as F-00. The stiffness of the average shear stress of the CLT almost matched with the shear modulus of the CLT in the material experiment, confirming that the CLT exhibits the maximum performance as a seismic wall.

Fig.2 shows the result of analysis that material property is made from material test. The experimental results and the analytical results were in good agreement, and the behavior was able to be reproduced by the analytical model, comparing the timing of yielding of the members and the stress state at the specific deformation angle.

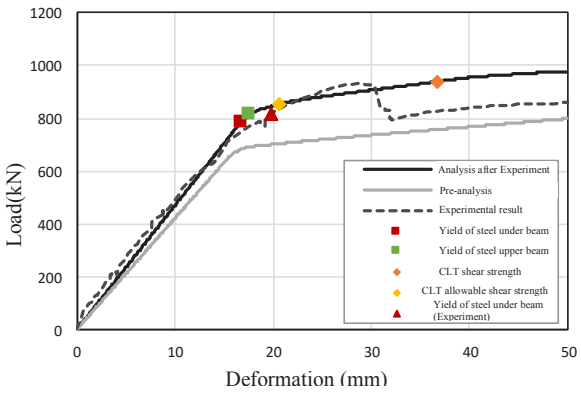

Figure 2. The result of analysis