DYNAMIC AND STATIC LATERAL LOAD TESTS ON FULL-SIZED 3-STORY CLT CONSTRUCTION FOR SEISMIC DESIGN

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ABSTRACT: In order to consider the seismic design method, the shaking table tests and static lateral load tests were conducted to the modelized CLT panel construction. As a result, it was clarified that the shear displacement and joint deformation under the seismic wave were smaller than those under the static load, and the load-deformation curves of the full-sized construction wasn’t equal to the summation of the elements’ curves.

KEYWORDS: Japanese cedar, CLT, Shaking table, Bolted joint, Full-sized, Static load, Seismic performance

1 INTRODUCTION

The Japanese domestic forests have never been maintained enough, and it was a great fear that the multiple functions of the forest such as watershed conservation, the land conservation, and so on has been declined. The construction employing the cross laminates timber (CLT) panels was offered as a method of large scale building in domestic and foreign countries. However, the seismic design method of CLT panel construction has never completed. So, in order to consider the seismic design method, the shaking table tests and static lateral load tests were conducted to the modelized CLT panel construction.

2 SPECIMEN AND TESTS

2.1 CLT PANELS

CLT panels were made from sawn laminas of Japanese cedar and formed by the inner and outer layer. The inner and outer laminas were sorted to have 3.5-6.4 kN/mm² MOE (ave. 5.0 kN/mm²) and 5.0-7.9 kN/mm² MOE (ave. 6.5 kN/mm²), respectively. The wall and floor panels had 5-ply in 5 layers with 150 mm thickness and 6-ply in 5 layers with 180 mm thickness, respectively.

2.2 MODELIZED FULL-SIZED CONSTRUCTION

The tested full-sized construction was assembled by the wall, hanging wall, and floor panels, as shown in Photo 1. The wall panels were jointed by tension bolts in the vertical. The wall and hanging wall panels were jointed by the tension bolts in the horizontal. The floor panels were connected by the wood screws with steel plates. The tested construction was 3-story, but assuming 5-story, about 400 kN weight corresponding to the dead and live load of 2 stories was put on the top of the construction.

2.3 SHAKING TABLE TESTS

The artificial seismic wave was made to be suitable for a response acceleration spectrum of the second class ground prescribed in Building Standard Law of Japan (BSL). After that, the seismic wave recorded at JMA Kobe in 1995 was input to the specimen.

Photo 1: Full-sized 3-story CLT construction tested
2.4 STATIC LOAD TESTS

The horizontal loads were input to trace the every story drifts under the shaking table tests by the 6 actuators. After that, the specimen was pushed over to fracture.

3 TEST RESULTS

3.1 COMPARISON OF SHAKING TABLE AND STATIC LOAD TESTS

The load-displacement curves of every story were shown in Figure 1. The shear forces of every story under the shaking were larger than those under the static load. So, it was clarified that CLT construction might have load velocity dependence.

![Figure 1: Load-displacement curves under seismic and static load](image)

3.2 STATIC LOAD TESTS TO FAIL

The static lateral load tests of structural elements[1] were conducted separately. The load-displacement curves of modelized construction to rupture were compared with those of the summation of structural elements corresponding to the layouts in the modelized construction, as shown in Figure 2. Under the small deformation, both of load-displacement curves were the same, approximately. However, under the large deformation, the loads of modelized construction were larger than the summation of elements, especially in the 2nd floor.

![Figure 2: Load-displacement curves of modelized construction and summation of structural elements](image)

It was thought that the deformation of floor panels or the wall panels perpendicular to the load direction affected the curves. They are issues to be solved for seismic design.

3.3 DIFFRENCES IN JOINTS DEFORMATION

Joints deformation in the modelized construction under the seismic wave and static load were compared with the deformation of the isolated joints which were tested[2] separately, as shown Figure 3. The deformations of joints under the seismic wave were smaller than those under the static load. The deformations of the isolated joints were middle of them. It was the reason why the deformation of joints depended on the load velocity, the load included the moments, and so on. They are also issues to be solved for seismic design.

![Figure 3: Comparison of joint deformation](image)

4 CONCLUSIONS

As results of shaking table and static load tests on full-sized CLT panel construction, it was clarified that the shear displacement and joint deformation under the seismic wave were smaller than those under the static load, and the load-deformation curves of the full-sized construction wasn’t equal to the summation of the elements’ curves.

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