Real-scale fire test of a Three-Story wooden School Building (final experiment)

TOMOHIRO Naruse (Dr. Eng.), Head,
NII Daisaku (Dr. Eng.) , Senior Researcher
Fire Standard Division, Building Department
ANDO Koji, Head,
TOJO Akira, Researcher,
Standard and Accreditation System Division, Building Department

(Key words) Timber construction, real-scale fire experiment, fire safety

1. Foreword

In October 2010, a law with regard to the acceleration of timber utilization in public building structures and so on was enforced. Taking this into account, NILIM collects data necessary for re-examination of fire prevention related provisions of the Building Standards Law in regard to three-story wooden school building and has been carrying out studies to prepare a basic draft based on it.

2. Objective of final experiment

To start with, with specifications presumed as a school, and in addition, using a building with the lowest level required for buildings including other usage, we carried out a real-scale fire experiment of three-story wooden school building in NILIM's site, on February 22, 2012, and fire spread to the upper floor in the early stage of fire, via external openings from the room on the ground floor where the fire broke out, then quickly spread to the next rooms through external and internal openings of fire prevention walls, and problems of the collapse of fire prevention walls to independently be erected after fire and so forth were made clear. In consideration of these problems, we carried out a real-scale fire experiment (preparatory experiment) on November 25, 2012 in Gero City, Gifu Prefecture, and confirmed the effectiveness of countermeasures such as use of fire prevention material for interior finishes, installation of balconies and canopies and changes in structure of fire prevention walls and fire prevention doors.

Based on this result, we prepared requirements for performance for three-story wooden school building to prevent the rapid spread of fire to upper floors, prevent the fall of structures during the period required for evacuation and rescues and prescribe specifications necessary for those, and we implemented an real-scale fire experiment (herein after referred to as "final experiment") in order to finally corroborate the performance, on October 20, 2013, in Gero City, Gifu Prefecture. In this experiment, in order to prevent rapid spread of fire to upper floors, we provided a specification to make the interior, from which the fire broke out, fireproof to prevent fire spread.

3. Outline of final experiment's result

After the fire broke out in the room on the ground floor, although it spread to the periphery of the combustible materials from the fire source, and continued to the extent flames reached to the ceiling, it took 48 minutes until the fire widely spread in the room where the fire broke out to confirm the effect of fire spread which was one of the objectives of the experiment. The fire spread to the inside of a room on the second floor 15 minutes thereafter via exterior openings and spread to the inside of a room on the third floor via exterior openings four minutes after that. At a point in time more than an hour after the spread of fire, fire extinguishing was carried out.

In view of this result, the fire spreading to upper floors via external openings could be prevented, fire spreading from the room the fire broke out to the stair room and fire spreading via the fire prevention wall did not occur, despite columns and beams in the room from which the fire broke out being chared to a depth up to 4-7cm, and the test body did not collapsed, and besides, in consideration of the fact that there was no disruption of fire prevention walls, effective specifications with regard to the

required performances for the standards draft could be corroborated and other data could be collected.

4. Conclusion

As a result of three real-scale fire experiments including final experiment implemented so far, and based on experiment results of relevant members, we are prepared to compile details of a standards draft.

This experiment was carried out under the collaborative studies with Waseda University, Akita Prefectural University, Mitsui Home Co., Ltd., Sumitomo Forestry Co., Ltd., Gendai Keikaku Kenkyusho Co., Ltd., Building Research Institute and National Institute for Land and Infrastructure Management.

[Reference]

In reference to the results of the three real-scale fire experiments, we would like you to refer to the following URL.

http://www.nilim.go.jp/lab/lab/bbg/kasai/h23/top.htm

Photo 1: Fire spread to the 2nd floor

Photo 2: Fire spread to the 3rd floor