Full-scale Fire Tests of a 3-Storey Wooden School Building

Building Research Institute *Contact: Koji KAGIYA, Ph.D., kagiya@kenken.go.jp*

Introduction

Overview of the Japanese national R&D program for full-scale fire tests on 3-storey wooden school building is introduced. In the program, three full-scale fire tests using buildings designed to verify fire behavior and effectiveness of fire safety countermeasures have been conducted.

These tests were carried out based on a joint research among Waseda Univ., Akita Prefectural Univ., Mitsui Home Ltd, Sumitomo Forestry, Gendai Keikaku Kenkyujo, Architects and Associates, National Institute for Land and Infrastructure Management (NILIM) and Building Research Institute (BRI). This R & D program was financially supported by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT).

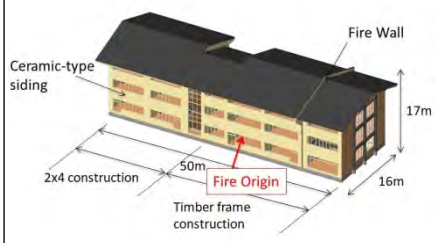
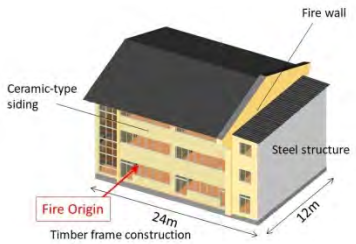
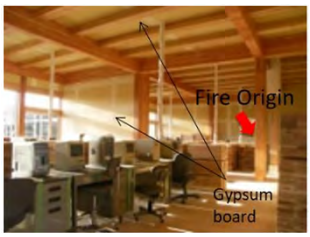
1st Feb. 22, 2012
Preliminary (benchmark) Test in order to clarify the issues of wooden buildings

2nd Nov. 25, 2012
Preparatory Test in order to verify the effectiveness of measures against fire

3rd Oct. 20, 2013
Final Test in order to specify the requirement of measures against fire

Three Full-scale Fire Tests

Characteristics of the Test Buildings

	Preliminary (1st, Benchmark) Test February 22, 2012	Preparatory (2nd) Test November 25, 2012	Final (3rd) Test October 20,2013
Exterior view			
Construction	Heavy timber + 2x4 construction	Heavy timber	Heavy timber
Fire separation	Fire wall (attached to the structure, overhang of 50cm), staircase & floor slabs	Fire wall (self-standing, overhang of 200cm), staircase & floor slabs	Fire wall (Self-standing, overhang of 50cm), staircase & floor slabs
Fire doors	Steel (conventional, 1 hour)	Wood + inorganic panels (1 hour)	Steel (conventional, 1 hour) with reinforced frame
Balconies/eaves	None	Overhang of 1.5m on each floor	None
Interior lining View of the fire origin	Wooden ceiling and walls Timber girder, joist & column visible 	Noncombustible ceiling and walls Timber girder, Joist & column visible 	Quasi-noncombustible ceiling and wooden walls Timber Girder & Column visible 
Furniture and live load	Wood crib of equivalent total weight and surface area	School desks and chairs, wood crib for other combustibles	School desks and chairs, wood crib for other combustibles
Sprinklers	None	3rd floor and staircase, activated manually at the event of fire invasion	3rd floor and staircase, activated manually at the event of fire invasion

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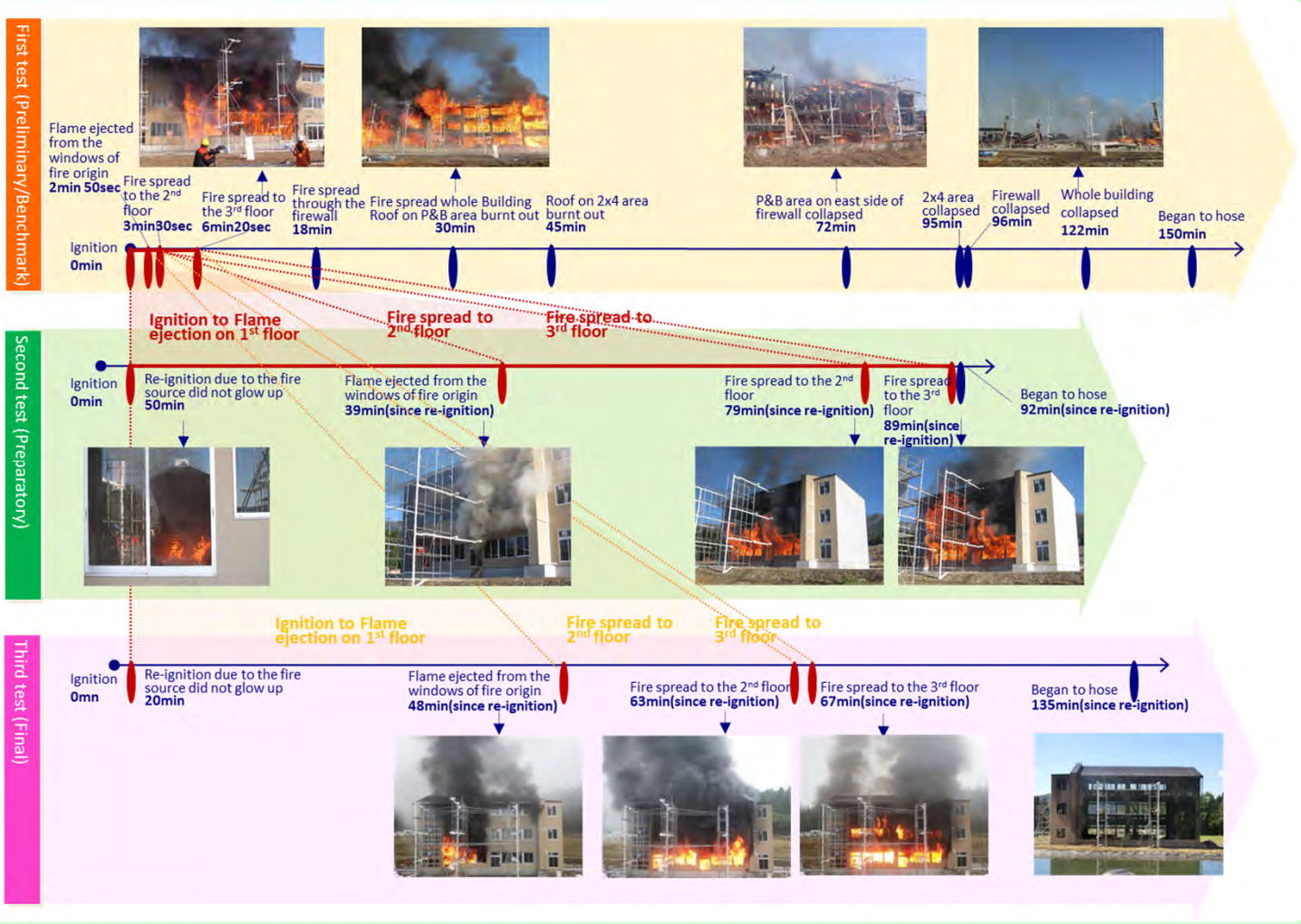
Time-series Overview of the Result of the Tests



Conclusion

For the preliminary (1st , benchmark) test, following items were found:

- Upward fire spread by external flame from window in the early stage of fire
- Early fire penetration of 1 hour quasi-fire resistive wall
- Fire spread through fire door on the fire wall of fireproof construction
- Collapse of fire wall of fireproof construction in the last stage of fire

For the preparatory (2nd) test, the effectiveness of the measures was demonstrated:

- To control external flame height by fireproofing of interior finishing materials
- To prevent upward fire spread by installing eaves or balconies
- To withstand fire exposure structurally of fire wall by separating other structure
- To prevent horizontal fire spread by widening fire wall by 2m from external wall surface

For the Final (3rd) test, the effectiveness of measures was Verified for developing regulations which ensure the fire safety that will be required of a wooden 3-story school building:

- Effectiveness of fire wall (to prevent fire spread and collapse)
- Effectiveness of fireproofing of ceiling material for safe egress (to prevent fire spread and smoke spread)

Eaves (Preparatory test)

Fire wall (Final test)