

Research of the Building Department to realize a safe, reliable, and comfortable living environment

SAWACHI Takao (Ph.D. in engineering)
Director of Building Department

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1. Overview of Building Department

The Building Department is aiming to satisfy the needs of citizens and societies and realize a safe, reliable, and comfortable living environment. In order to realize this goal, the Building Department set a mission to provide administrative support based on scientific and technical perspectives for plans, proposals, development and revisions in various aspects of building including structure, fire control, facility, and material in technical standards such as the Building Standards Act and the Housing Quality Assurance Act. The Department is conducting relevant researches and establishing standards with Building Research Institute. The Department is also providing technical instructions to promulgate the technical standards.

This paper introduces the following activities of the Building Department: (1) main research theme; (2) establishment of technical standards; and (3) other activities such as fire investigation.

2. Main research theme

1) Development of function-sustaining technologies of buildings used for disaster responses (Comprehensive technology development project: FY2013-2016)

Government facilities which should have been used as disaster response base lost their functions as they were damaged in the Great East Japan Earthquake because of (i) structural damage caused by tsunami and (ii) damage to non-structural members (e.g. non-structural walls and ceilings). Tornadoes that occurred in areas including Tsukuba City in May 2012 damaged windows and doors of buildings with flying objects. If such damage occurs to the disaster response base, continuous use of the bases will probably be difficult. The Building Department is developing technologies for buildings which are used as bases of emergency responses and restoration activities to sustain their functions immediately after a disaster by setting the following themes.

- Development of tsunami-resistant design method to prevent exfoliation of external walls
- Development of tsunami evacuation building which will not be damaged by tsunamis
- Investigation and analysis of technologies to deal with tsunami debris
- Development of method to test resistance of exterior materials against the impact of flying objects

- Investigation and analysis of technologies to sustain the functions of facilities and systems
- Development of non-resonant ceiling materials
- Development of damage-controlling design method using non-structural walls (Photo 1 shows a test piece of load test using an actual-scale five-layer reinforced concrete structure.)
- Establishment of a design guideline for sustained use of buildings used as disaster response bases



Photo 1. A test using an actual-scale five-layer reinforced concrete structure to propose structures that will not require repairing columns and beams after a massive earthquake

2) Study of a method to evaluate the safety and reusability of buildings damaged by earthquake-triggered fire (factual study: FY2015-2017)

A massive earthquake directly hitting Tokyo and the Nankai Trough earthquake are expected to cause damage and trigger fires, and up to 410,000 to 750,000 buildings are expected to be damaged by the fires triggered by the earthquakes. Most of the damaged buildings are expected to be wooden buildings. Yet, estimating from damage in the Great Hanshin Earthquake and other earthquakes, tens of thousands of mid-to-high-rise fireproofed buildings will likely be damaged as well. Thus, research teams are conducting this research targeting mid-to-high-rise fireproofed buildings that are damaged by earthquake-triggered fire focusing on the following: (i) establishment of method to judge risks to secure

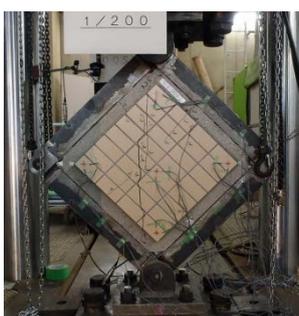
evacuation shelters immediately after an earthquake, reduce the number of people who cannot reach their destinations, and prevent secondary damage; and (ii) establishment and systematization of technologies to reuse buildings to quickly and efficiently recover from earthquakes using damaged buildings

3) Study of the fire safety of wooden, three-story school buildings (National Institute for Land and Infrastructure Management project research: FY2011-2014)

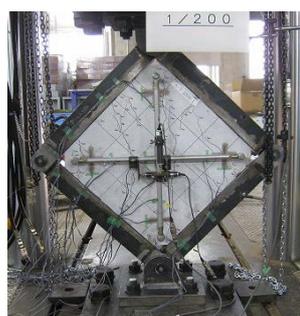
The aim of this study was to enable the construction of wooden, three-story school buildings. The team gathered necessary technical perspectives for revising the Building Standards Act and prepared proposals for standards to ensure safety by ensuring safe evacuation from fire, low effect of fire to nearby areas, such as effects of heat, sparks, and collapsed buildings, and reduced number of obstacles, such as collapsed buildings that slow down firefighting activities. The team also prepared examples of specifications using parts with enough performance. (Photo 2 shows an actual-scale fire experiment to verify the proposed standards.)



Photo 2. Actual-scale fire experiment to verify the adequacy of specifications to set standards for three-story wooden school buildings



[Lined with tiles with two layers of mortar base layer]



[Concrete on the back side]

Photo 3. Diagonal evaluation test conducted for verification

4) Study of evaluation method and standard of seismic safety of exterior materials (factual study: FY2012-2014)

Wet-tile exterior materials that are widely used on the outer walls of apartment buildings must be prevented from falling off and injuring people beneath during an earthquake. Thus, this study aimed to develop standard test methods to evaluate the performance to prevent exfoliation and technical references to evaluate the

intactness of wet-tile exterior materials after an earthquake. The study verified the effect of an evaluation and test method using two types of small test pieces (Photo 3) based on conditions of tile exfoliation caused by inter-layer displacement (deformation) using a test wall lined with large tiles.

3. Activities related to the establishment and revision of technical standards

Building Structure Standard Committee (chairman: KUBO Tetsuo, professor emeritus of Tokyo University) and Building Fire Control Standard Committee (chairman: TSUJIMOTO Makoto, professor of Tokyo University of Science) and Building Department as a secretariat examined the draft of standards written based on Building Standards Act and other laws with the Housing Department of Ministry of Land, Infrastructure, Transport and Tourism. The former committee examines the prevention of long-period ground motion in super-high-rise buildings and the overall proposal of the technical standard of architectural structure. The latter examines the draft of technical standards concerning fire control and evacuation from buildings and revised proposal of the fire control standard for wooden three-story school buildings.

4. Other activities including the investigation of damage in disasters

In FY2015, the team investigated damage to the buildings affected by the overflow of the Kinu River (joint investigation with the River Department, September 2015) and damage from the fire at a multipurpose, multi-tenant building in Hiroshima (October 2015). The team also provided technical support for the investigation and examination of the Ministry of Land, Infrastructure, Transport and Tourism on unlawful practices involving anti-seismic building materials.

In terms of international activities, the team sent researchers to Technical Committee 43 for the International Standard (ISO), 92 (fire safety) and 163 (thermal environment and energy consumption of buildings) to examine standards to make them consistent with standards and specifications used in Japan and also propose international standards based on standards and specifications of Japan.

5. Conclusion

This paper introduced the overview of research themes that the Building Department was implementing or recently completed, and the establishment of technical themes and other activities such as fire investigations.

Details

- 1) Report of damage to buildings caused by the overflow of Kinu River that occurred in Joso, Ibaraki on September 10, 2015 (in Japanese) http://www.nilim.go.jp/lab/bbg/saigai/h27/20150910kinu_gawa.pdf