Research Activities of Building Department Toward the Realization of a Safe, Secure, and Comfortable Living Environment

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1. Outline of Building Department

For safe, secure, and comfortable lives, buildings need to fulfill a variety of demands, such as preparations against an earthquakes and fires, long-term retention of functions and performance, countermeasures against noise and vibrations, and environmental considerations. These are required for buildings to realize better lives for residents.

The Building Department has been conducting research to prepare technical proposals and to respond to various issues related to buildings in order to disseminate the standards on performance into society and to meet new demands.

In addition, for the continuous review of the technical standards of the Building Standards Act and the laws concerning the promotion of quality assurance of residences, we have been setting goals for the projects to establish and promote building standards (http://www.mlit.go.jp/jutakukentiku/house/jutakukentiku_house_fr_000016.html) in collaboration with this Ministry in order to collect proposals to review the technical standards according to technical development by private enterprises through contact points set up on the website (http://www.icba.or.jp/) with the help of concerned bodies, as well as to accumulate technical information to establish and review standards through active utilization of the capabilities of private enterprises. Based on the standards, we are examining a draft of the review of the standards while also making reference to the opinions collected from a committee of external intellectuals.

2. Typical Research Issues

1) Development of the technologies for maintaining the functions of anti-disaster center buildings (Comprehensive technological development project: FY 2013–2016)

In light of the lessons learned from the building damage caused by the Great East Japan Earthquake in 2011 and the ones caused by the tornado broke out in the cities, such as Tsukuba in Ibaraki, in 2012, this development was conducted for the purpose of providing the latest technical findings for buildings, such as government facilities whose functions are required to be maintained even after a disaster and for realizing a more accurate and rational plan, design, and control for maintaining functions even after a disaster through the utilization of existing standards together with such findings.

The technologies examined included (1) a technology that enables a significant reduction in damage to reinforced-concrete structures in the event of an earthquake through the utilization of walls, (2) a technology for preventing the collapse of ceilings that provides flexibility for the layout of equipment in the ceiling, (3) an anti-tsunami design technology considering a reduction in tsunami wave power by the collapse of exterior materials, (4) an anti-tsunami design technology for low-drag buildings, (5) an anti-fragment design technology for exterior materials in anticipation of tornado, etc., and (6) a technology for maintaining the function of building equipment. In order to contribute to the future realization of anti-disaster center buildings, we have summarized the design guidelines for anti-disaster center buildings (draft) to show the overview of the plan, design, and control based on the relationship between individual technologies developed and other technologies (Figure 1).

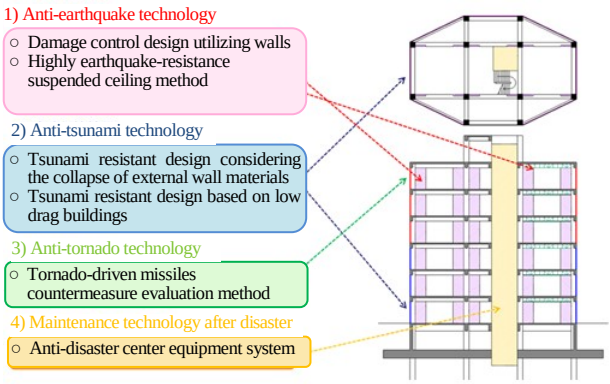


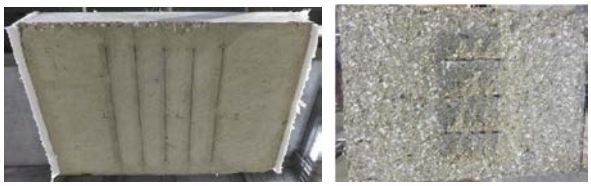
Figure 1 An image of anti-disaster center building for which the design guidelines (Draft) were prepared

2) Research on the method for evaluating the safety and reusability of buildings damaged by seismically induced

fire (Itemized research: FY 2015–2017)

After a large earthquake occurs, there is a high possibility that buildings are damaged not only by the earthquake but also by fire, and it is also expected to be too difficult to perform general firefighting activities. Although an emergency safety check is conducted immediately after an earthquake from the perspective of preventing secondary disasters, there is not a sufficient method to check the safety of buildings damaged by both earthquake and fire.

In this research, we conducted experiments and analyses to determine the influence of heat penetration when members or covering materials were cracked with the aim to establish a method for evaluating the safety of buildings damaged by fire after an earthquake.



a) Immediately after fire b) Several days after fire

Figure 2 Conditions of concrete after fire

3) Technical development contributing to the utilization of existing buildings through the rationalization of fire protection and evacuation rules (Comprehensive technological development project: FY 2016–2020)

Setting 2015 as the first year of regional revitalization, the government places significance on the securing of the safe, secure, and spiritually rich future lives by solving issues according to area characteristics toward the overcoming of the contraction of the local economy, as well as utilizes existing buildings, which are useful local properties, such as local historic buildings as accommodation facilities and restaurants toward the realization of such regional revitalization, aiming to lead to regional activation and the promotion of international tourism. Under such circumstances, this technological research and development is intended to be the technical development required for the rationalization and smooth operation of fire prevention and evacuation rules and application restrictions to achieve smooth utilization of existing buildings, aiming at the following: (1) Preparation of the draft of technical standards related to the revision of fire prevention and evacuation rules, (2) preparation of the draft of technical standards for securing fire-prevention and evacuation performances of historical buildings, which are difficult to conform to general fire-prevention and evacuation rules, (3) preparation of the draft of the guidelines for securing fire-prevention and evacuation safety in regions where historical townscape is conserved, and (4) preparation of the draft of the guidelines contributing to the judgment on variances and operation of city planning project, etc., related to application restrictions.

4) Development of the design and construction technologies concerned with mixed structure buildings utilizing new woody materials (Comprehensive technological development project: FY 2017–2021)

Wood buildings of four or more stories need to be fire resistant, which is a barrier to realization. In our country, it can be said that the needs for exposing wooden materials are very high. On the other hand, new woody materials, such as CLT, LVL, and laminated wood panels, as well as new joint parts, are developed, so there is a pressing need to establish structural design methods for wooden structures meeting the required performance, such as CLT, as well as mixed structure buildings containing fire-resistant members, such as reinforced-concrete and steel structures. Therefore, we must advance technological development, which contributes to the establishment of design and construction technologies for wooden buildings utilizing woody large panels, such as CLT, as well as for mixed structure buildings based on other structure types and construction methods (laminated wood structure, 2x4 construction method), in order to realize various goals, such as the promotion of utilization of wooden materials, expansion of variability utilizing the characteristics of materials, and reduction of construction period.

5) Development of technologies for repairing facilities to ensure the health and safety of disaster victims at evacuation centers (Itemized research: FY 2017–2019)

This is aimed at suggesting specific approaches to secure the living environment and safety at evacuation centers (such as obtainment of electricity, privacy, noise environment, light environment, restroom and hygienic environment, and thermal environment) set up in the event of various disasters, to repair and maintain evacuation centers considering residential environment, and for the reduction of physical and mental health disorders due to evacuation.

3. Other Activities such as Disaster Investigation

The 2016 Kumamoto Earthquake occurred on April 14, 2016 and later caused damage to many buildings, such as collapses mainly in Kumamoto. Therefore, we conducted an investigation on the damage to buildings and publicized the results. In addition, an earthquake occurred on October 21 in the same year in the central area in Tottori Prefecture, and a large scale fire occurred on December 22 in the same year in Itoigawa City in Niigata Prefecture where 144 buildings and the total area of approximately 40,000 m^2 were burnt out. We also conducted the investigations on them and publicized the results.