

# Development of Technologies to Support the Continuation of the Functions of Buildings That Serve as a Base for Disaster Response Centers

(Period of Study: From FY 2013 to FY 2016)

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## 1. Foreword

In light of the extensive damage to buildings caused by the earthquakes and tsunamis of the Great East Japan Earthquake and tornado damage in recent years, among other things, we established and launched the four-year general technology development project entitled “Development of Technologies to Support the Continuation of the Functions of Buildings that Serve as a Base for Disaster Response Centers” in FY 2013. Through this project, we developed technologies that enable buildings that serve as a base for an emergency disaster response center, such as local government office buildings, to continue to function in the wake of a natural disaster.

## 2. Development of Technologies for Buildings that Serve as a Base for Disaster Response Centers

As an earthquake-resistant technology, in order to control the deformation and distortion of building frames during an earthquake, we proposed a design method (damage control design method) that utilizes walls (wing walls, hanging walls, spandrel walls) around the opening, which are detached from columns in conventional structural design methods. To confirm the viability of this proposal, we carried out a full-scale static loading test on five-storied buildings to verify the effect of the reinforced strength and rigidity of building frames to reduce deformation and distortion and damage to column-to-beam joints, etc. (**Photo 1**)

In addition, in order to prevent the falling of ceilings, etc., during an earthquake, we developed and proposed a design method utilizing horizontal force resistant members that transmit forces generated on the ceilings during an earthquake to structural frames, which provides greater freedom for the use of under-roof space than the conventional design method utilizing sloping members.



**Photo 1. Full-scale static loading test on five-storied building**

As a tsunami-resistant technology, based on case examples of tsunami damage at the time of the Great East Japan Earthquake and the results of hydraulics model tests (**Photo 2**), we proposed a tsunami-resistant design method with consideration given to the exfoliation of external wall materials and a design method of low drag type buildings with special consideration given to the shape of buildings and the arrangement of columns.

In addition, in order to prevent exterior walls or window glasses from being damaged or broken by flying objects from tornadoes or typhoons, we developed a method for evaluating the impact resistance of exterior wall claddings, and we developed and proposed the countermeasures based on the results of tests using an impact testing machine for exterior wall claddings.

Furthermore, we carried out a wide-ranging investigation and studied advanced case examples, concerning the maintenance of the functions of facilities for essential utilities, such as electricity, water supply, and sewage, at the time of the disruption of lifeline systems. We also organized countermeasures to mitigate damage to buildings and facilities, as well as operation and management technologies to ensure the continuation of the functions of buildings and facilities, among other things.



**Photo 2. Hydraulics model test in which exterior wall claddings are destroyed by water pressure**

## 3. Proposed Design Guideline for Buildings that Serve as a Base for Disaster Response Centers

Based on the results of this study, we will develop the proposed Design Guideline for Buildings that Serve as a Base for Disaster Response Center (Draft),” which summarizes matters that need to be taken into consideration when designing such buildings to enable them to continue to function during and after a large-scale disaster.