Development of function sustaining technologies for buildings used for disaster management

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1. Introduction

Learning from the damage caused by the tsunamis and earthquakes in the Great East Japan Earthquake and tornadoes that occurred in recent years, the four-year comprehensive technological development project titled the Development of Function Sustaining Technologies for Buildings used for Disaster Management started in FY 2013. Technologies are being developed in this project so that buildings to be used as the base for emergency responses will sustain their functions immediately after being hit by a disaster. This project aims to propose design technologies and evaluation methods to sustain the functions of buildings used for disaster management to prepare for the Nankai Trough Earthquake and massive earthquakes directly hitting Tokyo, which are expected to occur in the near future.

2. Development of earthquake resistant technologies

Teams in charge of the development of non-resonant ceiling materials are developing suspended ceilings that can withstand greater seismic motion based on conventional suspended ceiling construction methods. In FY 2015, the teams created examples of trial designs for ceilings based on experiments conducted in FY 2014. The teams also worked on guidelines (draft) for ceiling designs in buildings used for disaster management. The teams also tested damage control designs using walls in an actual-scale building in FY 2015. The tested building was a 1 by 2 span, about 19-meter-high, five-story building made of reinforced concrete.

Photo 1. Damage test using an actual-scale five-story building

The developed design used the walls (wing walls, hanging walls, retaining walls) around openings that were separated from pillars because of complicated computations in conventional structural designs. The test demonstrated that the developed design could increase the strength and rigidity of frames, reduce deformation during a massive earthquake, and reduce the damage to sections that are difficult to repair, such as joints of beams and pillars and non-structural members, at low cost.

3. Development of tsunami management technologies

Hydraulic tests were conducted in FY 2015 to develop low-resistant tsunami evacuation buildings that will effectively withstand tsunamis. Tsunamis in various conditions and constant flows were applied on a low-resistant building model (1/100 scale) constructed with specifically designed shapes and pillar arrangements, and experimental data on the tsunami loads were obtained. The study found that the low-resistant buildings effectively reduced loads of tsunami force and buoyancy of water.

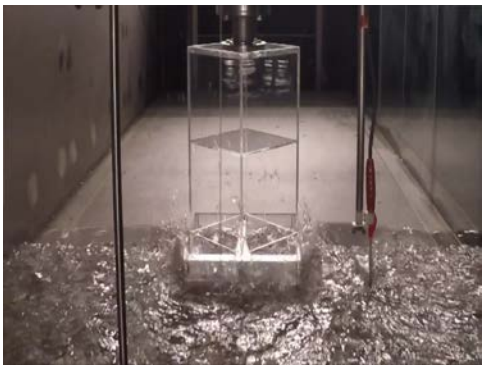

Photo 2. Hydraulic test using a low-resistant building model

4. Conclusion

Besides the studies above, the teams are also examining how facilities can sustain their functions when all lifelines are disconnected. The teams are going to prepare a designing guideline for buildings used for disaster management in FY 2016.