Development of technology to quickly evaluate the robustness of core facilities damaged by an earthquake

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1. Introduction

Government buildings often become the core base of disaster management to facilitate quick restoration from earthquake damage. In the past earthquakes, it took too long for experts to check whether government buildings were robust enough for people to enter (Figure-1), which slowed down restoration processes.

This study aims to present technical references about structures and non-structural members of buildings that are necessary for building administrators to judge whether people can enter the building.

Figure 1: Robustness is unclear immediately after an earthquake

2. Contents of the study

This study aims to solve the following two points.

a) The use of devices, such as the accelerometer, is a possible option in quickly judging the robustness of a building structure immediately after an earthquake without depending on experts. Yet, there are no common engineering evaluation criteria to use.

b) Technical references used in the visual inspection of the robustness of non-structural members immediately after an earthquake are not yet available.

The following studies are going to be implemented to address these issues.

(i) The engineering criteria for structural robustness evaluation using accelerometers (Figure 2) will be presented by the structural analysis of the building model. Technical precautions are also organized for practical applications.

(ii) Visual inspection guidelines for non-structural members are prepared (including the evaluation of damages on suspended ceiling materials [Figure 3]).

In (i), standards are going to be prepared for the robustness judgment of a structure by using acceleration sensors installed in the structure to numerically capture properties that go through rapid changes during an earthquake. Specifically, the robustness of a structure is estimated based on level of changes in the natural period of a structure during an earthquake. In (ii), current situations of earthquake damage evaluations of non-structural members are organized. Then, standards for robustness judgment are prepared after conducting experiments on the evaluation of damage in suspended ceilings where there is a shortage of knowledge and insights.

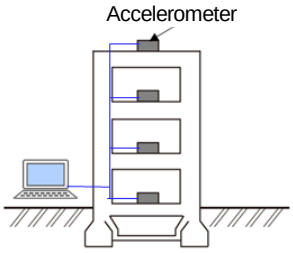

Figure 2: Practical application of the robustness judgment system in a building

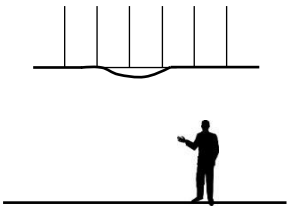

Figure 3: Damage to a suspended ceiling

3. Examinations in FY 2020

Regarding (i), the relationship between the residual performance of the entire building and the degree of change in the natural period was grasped by simulation as in the previous fiscal year, and the judgment criteria were examined. Regarding (ii), the relationship between dislodgement and deflection of the joint fittings (clips) of the base of the suspended ceiling was ascertained through experiments.