6. Damage to Buildings by Earthquake Motions

6.1 Policy on Earthquake Damage Investigation for Buildings

The 2011 Tohoku earthquake brought about building damage in a wide area of various prefectures on the Pacific coast in eastern Japan such as Iwate, Miyagi, Fukushima, Ibaraki and Chiba prefectures.

The epicentral area of this earthquake has a length of about 450 km and a width of about 150 km, almost in parallel with the Pacific coast in eastern Japan. Distance from the fault plane of the earthquake to the above prefectures is almost same. As indicated in Chapter 5, observed earthquake motions in Sendai City close to the epicenter are not much different from those in cities far away from Sendai, for instance, Tsukuba City.

Based on these circumstances, NILIM and BRI decided to widely survey damaged wooden buildings as a primary damage investigation in the northern part of Miyagi (Kurihara City) where JMA Seismic Intensity 7 was observed, and in a wide area of Miyagi to Ibaraki including inland Tochigi prefecture that suffered larger damage than coastal prefectures. In addition, as a secondary investigation, it was planned to select affected areas from those subject to the primary investigation to conduct a more detailed survey on buildings collecting building plans and wood-shear-wall layout.

In order to conduct a damage investigation of steel buildings, it was decided that mainly a primary visual inspection would be done in Sendai City since a large stock of steel buildings is accumulated, and also in Fukushima and Ibaraki prefectures. As mentioned later, severer damage to structural elements seemed to be limited, while there were so many types of damage to nonstructural elements such as falling of exterior cladding. Consequently, focusing not on private buildings that are difficult to investigate in detail but on school gymnasiums in Ibaraki prefecture where many damage cases were reported that enabled interior investigations, it was decided to continue the primary investigation. For reference, the school gymnasiums can be seen to be similar to factories and warehouses. If the structural damage in interior building is clarified in future, more detailed secondary investigation on buildings other than the gymnasiums will be considered.

Concerning damage investigation for reinforced concrete buildings, in addition to an investigation of reportedly collapsed buildings, a primary investigation was conducted on city halls and other public buildings that are located in a wide area of the north to the south as done in the damage investigation for wooden buildings, and damage patterns whether they are similar or different from previously grasped patterns are examined. If there are characteristic damage patterns that should be incorporated into technical standards, the secondary investigation will be considered.

A primary investigation for damage of building lands and foundations was conducted in Itako City, Ibaraki, and in Urayasu City, Chiba and its peripheral areas that

were subject to severe liquefaction in the region of Kanto. The areas that had been affected by the 1978 Miyagi-Ken-Oki Earthquake were damaged again. In these areas, also a primary damage investigation that focuses on developed housing lands was conducted in some areas of Miyagi, Fukushima and Tochigi prefectures.

In order to survey the damage of nonstructural elements, a primary investigation was performed, altogether with damage investigation for steel and reinforced concrete buildings including a requested investigation of ceiling falls in the Ibaraki Airport Building as an administrative support.