

Gravity survey around Furukawa, Osaki, Japan, where is severely damaged by 2011 Tohoku earthquake

SRIPUNYAPHIKHUP, Sakrawit^{1*}, MORIKAWA, Hitoshi¹, GOTO, Hiroyuki², INATANI, Masayuki², OGURA, Yumiko¹, TOKUE, Satoshi¹, ZHANG, XINRUI¹, IWASAKI, Masahiro³, ARAKI, Masayuki⁴, SAWADA, Sumio²

¹Tokyo Institute of Technology, ²Kyoto University, ³Osaki City Government, ⁴aLab Co.Ltd.

The 2011 off the Pacific coast of Tohoku earthquake have brought destructive damage to huge area of Japan. Sever damage were found in huge area around Kanto and Tohoku region, where are mid and northern area of Japan, respectively. Tsunami has attacked to the Pacific coast of Tohoku region and the damage caused by liquefaction were found at very large area around Kanto and southern Tohoku region.

On the other hand, damage caused by earthquake ground motions was fewer than damage by Tsunami and liquefaction, though very large accelerations were recorded at many sites. They seem to pay few attention to damage by ground motions. However, sever damage by motions was recognized at some limited areas, such as Furukawa, Tome, and so on.

After the earthquake, we have carried out the detailed survey of damage in Furukawa, where is located in northern part of Miyagi prefecture. Although the downtown of Furukawa is not so large, that is, only about 2 km x 2 km, the damage distribution was not uniform. Severe damage of wooden structures was found mainly in the southern part of the downtown and few damage in northern part. Of course, we have to consider the differences of structural ages, but the anomaly of damage distribution had enough persuasive to suggest anomaly of earthquake ground motions.

To understand the anomaly of damage distribution, we began observation of earthquake ground motions using very dense sensors in Furukawa. In the area of 2 km x 2 km of downtown, we have installed 19 sensors by the end of 2011. As a result, the anomaly of ground motions is large beyond our consideration. It is very difficult to explain them using a simple physical model such as one-dimensional ground model.

The anomaly of ground motion must be caused by anomaly of ground structure. Thus, to know it, we carried out the gravity survey around the Furukawa area. In this area, it seems to be estimated that soft soil sediments is not so thick: the depth to engineering basement is less than 50 m. This means that very high resolution of gravity anomaly is required. The intervals of observations are less than a few hundred meters in the downtown.

The Bouguer anomaly shows different features from anomaly of ground motion and predominant period of response spectra. This suggests that the ground structure seems to be very complicated in Furukawa area.

For the further study, we have to carry out the gravity survey with shorter interval of sites. Furthermore, other kind of physical parameters may be necessary to obtain more accurate model of ground structure, such as magnetic survey and so on.

Keywords: Furukawa, Osaki, Miyagi, 2011 Tohoku earthquake, gravity survey, ground structure, dense seismic array observation