Survey Report of Liquefaction Damage of Urayasu Area

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ABSTRACT

The east Japan great earthquake struck from the northeast of Japan to the whole area of Kanto with a magnitude of 9.0 and maximum seismic intensity of 7 on March 11, 2011. Seismic hazard such as liquefaction has especially affected a number of detached houses. From the results of in-situ investigation, the authors found that the liquefaction damage is apparently concentrated on newly reclaimed land, and closely related to the thickness of weak soil, soil types and groundwater level. In addition, where ground improvement method had been already carried out, damage to buildings, facilities and detached houses located even in the newly reclaimed land were found to be very small. In order to predict and prepare for liquefaction, information of the soil classification and groundwater level as well as soil strength and density are important parameters, and these kinds of information also become necessary for considering the rational countermeasures to liquefaction.

KEY WORDS: Earthquake, Liquefaction, Subsidence, Groundwater level, Detached Houses

INTRODUCTION

The east Japan great earthquake struck from the northeast Japan to the whole area of Kanto with a magnitude of 9.0 and maximum seismic intensity of 7 (Kurilhara city, Miyagi Prefecture) on March 11, 2011. Seismic hazards such as tsunami and liquefaction have especially affected detached houses. At present, in spite of announcement #1113 of the Ministry of Land, Infrastructure, Transportation and Tourism which addresses the possibilities of liquefaction, organized/systematic measure of liquefaction has hardly been accomplished for detached houses. The authors investigated the damage caused by liquefaction in the Urayasu area, Chiba Prefecture, where severe liquefaction damage has occurred.

OUTLINE OF THE EARTHQUAKE DAMAGE IN URAYASU AREA

Extensive damage has occurred in northeast Japan by the east Japan great earthquake, from Aomori to Kanagawa prefectures, especially where the seismic intensity of more than 5+ was observed. In addition, liquefaction caused severe damage in the Tokyo Bay, including Urayasu city. In Urayasu city, it is reported that the number of people who suffered damage was 96,473 (37,023 households), and the total area and the volume of boiling sand by liquefaction were assumed to be about 14km² (more than 80% of total area of Urayasu city) and 100,000–150,000m³ respectively. Among 73,000 detached houses in the city, the water service of 33,000 households and the sewer service for 11,000 households could not be used, and more than one month was needed for the temporary restoration of the lifelines. Same as the damage in Kobe bay of the Great Hanshin Earthquake, as shown in Fig.1(a), liquefaction in the reclaimed land caused extensive damage to infrastructures and detached houses in Urayasu area, and it is necessary to consider an effective countermeasure for preventing not only liquefaction but also re-liquefaction for the future in the area. By surveying locations in detail where liquefaction occurred in Urayasu bay area, the authors have estimated the possibility of liquefaction and re-liquefaction of the area as the Liquefaction Warning Hazard Map, as shown in Fig.1(b).

DAMAGE BY LIQUEFACTION IN URAYASU AREA

Although severe damage by liquefaction was observed in the reclaimed land area from Route 357 to Tokyo Bay, as shown in Fig.1(b), Photo.6 and Fig.2, very little liquefaction has been reported in the original old land area in Urayasu city. Photo 1~3 show damage of roads, sidewalks and ground surface which was covered by the boiled sand due to liquefaction. Photo.4 shows a manhole which was found to protrude the ground surface after the earthquake.

Photo.6 and Fig.2 show the boundary between Tohno area (right side; newly reclaimed land area) and Fujimi area (left side; original old residential area), and also the cross section of these two areas respectively. Right side of the road located in Tohno area was reclaimed with the same height to the old levee, and difference of road height between the right and left sides was about 80cm. As shown in Photo 6, damage level caused by liquefaction apparently depends on the ground condition where sand boiling was observed on the sidewalk.