Ground damage caused by the Noto Hanto Earthquake in 2007 (Mj=6.9),and its relation to the original landform

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1. Introduction

The Noto Hanto earthquake having a magnitude of the Japan Meteorological Agency Scale (Mj) = 6.9 and Mw=6.7 occurred around 9:42 (LST) on March 25 in 2007. The area in and around Monzen Town, Wajima City and Nanao City in Ishikawa Prefecture suffered to strong ground motion of Seismic Intensity (SI) = 6 Strong, and serious damage was generated in this area.

2. Occurrence of earthquake damage and the original landform

Ground motion of SI = 6 Strong was observed in Hasiride region, Monzen Town, which was encompassed in the aftershock region of the Noto Hanto earthquake. River Hakkagawa, a second-class river, flows in and around the Touge and the Kaiso regions, Monzen Town 2 km west from the Hashiride region. The river has been progressively improved since 1965. By a comparison of topographical maps edited at different ages and old and new aerial photographs, landform before and after the river improvement and the change of the land use can be clarified. Rollover of retaining walls and a number of cracks on asphalt paving roads were observed along the right bank of the old course of River Hakkagawa round a wood product plant in Kaiso region (Photograph No.1). The plant was severely damaged by the house collapse. The road ground having cracks was composed of dune sediments, and distribution of the dune was identified in the old topographic map published in 1953.

Low concrete wall of a levee revetment subsides at the intersection between old and new courses (Photograph No.2). Deformation of the wall is clearer in lower than upper side of the stream at the intersection, suggesting that water underflows from the new to the old river course. The deformation was probably generated by porosity increase of the ground due to the outflow of fine particles.

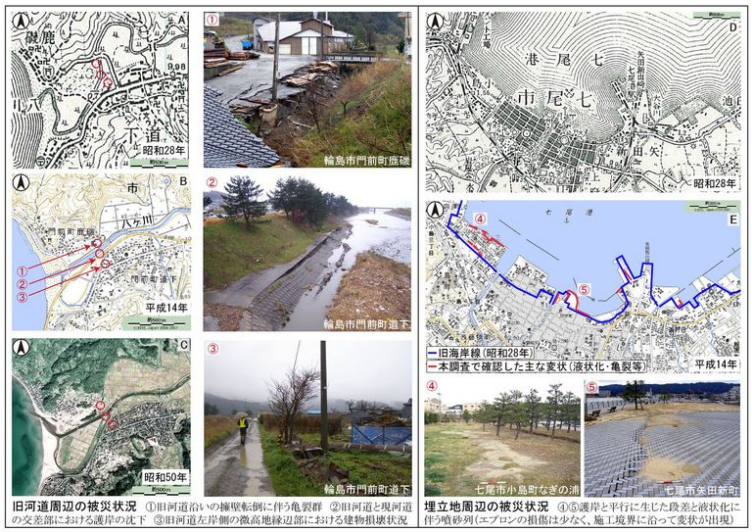
On the other hand, a settlement is located on a small highland along the left bank of the old course. Although the small highland may have been a natural levee, the boundary between the levee and the old river course is presently unclear. House damage is more remarkable at the margin of the small highland than inside it (Photograph No.3).

Port Nanao was assigned as a port for foreign trade in 1900. Improvement of the port wall and channel dredging has been conducted since 1955. As earth filling and land reclamation are commonly conducted step by step, it is important to clarify topography and changing history of the land use at a reclamation site in checking earthquake damage.

Large deformation sites in and around Port Nanao are ploted in the 2002 topographic map. The deformation is mainly caused by sand eruption due to liquefaction, ground stepping and surface cracks. Most damaging sites concentrate on relatively new reclamation land. Step-like cracks formed to be parallel to the direction of coastal revetment, and arrays of the sand eruption could be found along the crack. As shown in Photographs Nos 4 and 5, aprons of the revetment was less damaged, but the deformation appeared along the boundary between constructions of different ages. Among them, road surface surges in Naginoura region as shown in Photograph No.4. This surge suggests that the ground subsidence occurred before the Noto Hanto earthquake. In contrast, sites reclaimed before the World War II and earthquake-strengthening revetments are rarely damaged. Accordingly, it is point out that the generation of the ground damage by an earthquake is related to reclamation age, kinds of materials, and design manner of the reclamation site.

3. Concluding remarks

As has stated in this report, it is effective to use and apply information of old and new topography in checking generation sites and their degree of ground damage. Especially, in artificially-modified regions and their adjacent areas, it has been shown that the degree of damage depends mainly on the original landform, kinds of reclamation materials, and type of earthquake-proof design.



旧河道周辺の被災状況 ①旧河道沿いの擁壁転倒に伴う亀裂群 ②旧河道と現河道の交差部における護岸の沈下 ③旧河道左岸側の微高地縁辺部における建物損壊状況

埋立地周辺の被災状況 ④⑤護岸と平行に生じた段差と液状化に伴う噴砂列（エプロンの損傷は少なく、施工境界に沿って変状が出現）