Countermeasures against large-scale earthquake in sewage system based on the damage of Great East Japan Earthquake

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(Key words) *Sewage system, Countermeasure of earthquake, Countermeasure of tsunami*

1. Study committee for earthquake and tsunami countermeasure techniques in sewage systems.

Tsunami and liquefaction in the Great east Japan earthquake had brought critical damages to wastewater treatment plants, pump stations in coastal areas as well as sewer pipes including the inland areas throughout the Tohoku and Kanto regions.

MLIT organized "Study committee for earthquake and tsunami countermeasure techniques in sewage system" consisting of academic experts immediately after the disaster. Then, they submitted four proposals and made a summary of committee as the last report on March 2012. In this report, NILIM investigated the protection of repeated damage and future tsunami-resistant countermeasures in sewage system facilities. In addition, we verified the efficiency of the earthquake-resistant countermeasures adopted after the Niigata-Chuetsu earthquake.

2. Checking the liquefaction countermeasure effect in sewer pipes

Earthquake preventive countermeasure guideline in sewage systems describes three backfill methods (such as compaction of the backfilling soil, backfilling by crushed stone, and solidification of the backfilling soil) as the earthquake countermeasures of the sewage pipe. Among those methods we checked the countermeasure effect of the "backfilling by crushed stone" and "solidification of the backfilling soil". As a result, no traffic trouble of road and no functional disorder of sewer flow were observed in any places that have executed such countermeasures (Photo 1). There found, however, a problem in terms of construction management as the materials or strength of some sewer pipes has not fulfilled the given standard.

(A) (B) (C)

Photo 1. Situation of roads in the disaster area. The road which had not provided earthquake-resistant countermeasure (A). The road which had provided earthquake-resistant countermeasure of backfilling by crushed stone (B). The road which had provided earthquake-resistant countermeasure of solidification of the backfilled soil (C).

3. The view of the sewage system design in consideration of tsunami protection measures.

We analyzed the characteristics of damage with the Great east Japan earthquake and made a summary of the view of the sewage system design for tsunami-resistant countermeasures. Assuming the tsunami of the worst-case scenario defined by the prefecture and city government, we summarized the functions to be maintained on a priority basis on the tsunami hit by three sections such as sewer pipes, pump stations and wastewater treatment plants as shown in Table 1. We determined that the pumping for sewer evacuation and the sterilization must be maintained even in the time of disaster. Functions to recover overall function were divided into "Recover swiftly" and "Recover earlier" based on the concept of the risk management.

Table 1. Functions to be maintained at the time of tsunami

Type of facility	Sewer system	Pump station	Wastewater treatment plant		
Functional category	Essential functions			Other functions	
	Backflow prevention	Pumping	Pumping Sterilization	Sedimentation Dewatering	Other than shown on left
Tsunami resistance	"Must be maintained" even in a disaster situation			Although functional suspension is accepted temporary, it "should be recovered swiftly"	Although temporary suspension is acceptable, it "should be recovered earlier"
Type of protection	Risk avoidance			Risk reduction	Risk retention

4. Practical use of this research and future development

This study was summarized as four proposals as well as the last report proposed by Study committee for earthquake and tsunami countermeasure techniques in sewage systems, and effectively-utilized to recover sewage system facilities in damaged areas. Moreover, this study will benefit the revision of the Earthquake preventive countermeasure guideline in sewage system and the manual of earthquake-resistant countermeasure in sewage systems.

【Reference】

1) Report of Study committee for earthquake and tsunami countermeasure techniques in sewage systems

http://www.mlit.go.jp/mizukokudo/sewerage/crd_sewerage_tk_000170-1.html