Demonstration on Practical Application of Deep Underground Cavities Detection System Using Towing Vehicle (B-DASH)

(Research for FY 2015-17)

1. Purpose

This study deals with the underground cavities detection system using a towing vehicle to verify the system's detectability of the underground cavities in the depth of 1.5m and over, and demonstrate the cavities detectability in the various extent caused by damaged sewers.

This demonstration is adopted as B-DASH Project[*1] 2017 of MLIT[*2]. The consortium of Kawasaki Geological Engineering Co.,Ltd.; JS and Funabashi City conduct the demonstration as an entrusted research project of NILIM[*3].

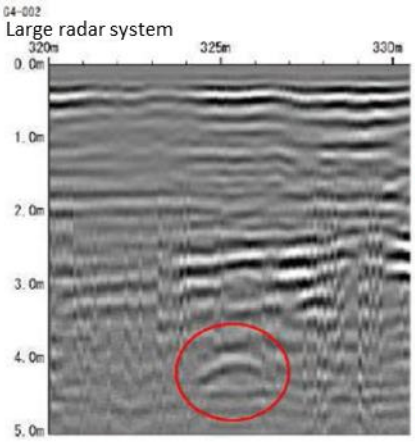
*1.B-DASH Project: Breakthrough by Dynamic Approach in Sewage High Technology Project
*2.MLIT: Ministry of Land, Infrastructure, Transportation, and Tourism
*3.NILIM: National Institute for Land and Infrastructure Management

2. Achievement of the past years

2015: The system detected a cavity in the depth of 2.2m that the conventional techniques used to have difficulty in detecting.

2016: Newly adopted multiband antenna enabled cavities detection around lateral sewers.

3. Achievements of this year



*** Conventional systems can neither provide an image or detect loosening with the equivalent performance to the demonstration system.**

The detected loosening in the demonstration
- Length: 1.95m
- Width: 0.5m
- Height: 1.3m
- Depth from the ground surface: 3.7m

* Conventional system is not capable

Figure 1: Loosening detected this year

(1) The researchers carried out underground cavities detections of 1.5m or less in K City. The system demonstrated the equivalent detectability to the conventional underground cavities detection systems in the accuracy and probing range in the depth of within 1.5m.

(2) The system showed its innovative feature of the detectability in depth beyond the capability of conventional technologies. The detected depths of a cavity, loosening, and unidentified abnormalities were 2.2m, 3.7m, and 4.2m, respectively. Figure 1 shows a loosening in the depth of 3.7m, detected this year.

Table 1: Cost comparison

	Cost
Inspection system	81,625,000
Demonstration system	20,971,875
Difference	60,653,125
Reduction rate	74%

(3) Table 1 describes the cost comparison of cavities (screening) inspection between the demonstration system and an inspection system by using a pipe opening camera and a TV camera. The demonstration system can be expected to reduce cost by 75% and sinkage risks compared to investigation with the inspection system only.

(4) A simple penetration test was carried out to verify the loosening between cavities and sewers. If there were no loosening from just below cavities to sewers (Hume pipes), it is considered that no abnormality occurs inside sewers.

4. Future issues

This year, researchers implemented the demonstration also in K City in addition to Funabashi City where they have already done for recent some years. As a result, the new system showed the equivalent detectability within the depth of 1.5m to conventional systems. It is also considered that the new system has better detectability than the conventional method because it could recognize loosening in the depth of 3.7m not found in the conventional system.

Besides, the demonstration shows the possibility that grasping the cavities' growth (moving velocity to shallow part) and the loosening conditions between the cavities' bottom and sewers may distinguish cavities caused by damaged sewer from other causes.

The demonstration still has the following issues:

(1) In the demonstration field, the system could detect loosening in the maximum depth of 3.7m; however, the detectability for cavities and loosening in the deeper than that has not been demonstrated.

(2) Enough data about cavities' moving velocity could not be acquired in the demonstration. It is desirable that the demonstration should accumulate more data to indicate a precise frequency of detection.

Keywords: Cavities detection, Deep cavities, Sewer, Detection depth, Monitoring