The 2016 World Congress on
The 2016 Structures Congress (Structures16)
Jeju Island, Korea, August 28-September 1, 2016

Buried Pipe and EPS detection by Ground Penetration Radar

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ABSTRACT

Nowadays in Seoul, Korea, the ground subsidence caused by sewage leaks has occurred frequently. The purpose of this study is to collect the basic data of subsidence detection by ground penetration radar (GPR) equipment. GPR detection variables are depth and distance of cast iron pipe and expanded polystyrene (EPS) which were buried in the test bed. Based on detection results, possible EPS detection depths were found to be 0.5m and 1m. The detection of EPS at a depth of 1.5m was not possible. Furthermore, if the EPS was closely located below or at side of the cast iron pipe, its detection was impossible due the high-intensity signal of the cast iron pipe. Furthermore the efficiency of developed program GPRiPP was verified based on the comparison of the GPR detected images, generated by commercial program RADAN 7 and GPRiPP.

1. INTRODUCTION

The ground subsidence that occurred in January 2016 at the driveway caused by the underground subway construction in Yongsan-gu, Seoul, and that occurred at the entrance of Seoul city hall subway station in March 2016 caused sewage damages. Fortunately, there were no casualties. After the subsidence that occurred at the Jamsil underpass in 2014, many other subsidence cases occurred and continue to. Therefore, the anxiety and fear of Seoul's inhabitants are heightened. The main cause of the ground subsidence that occurred in Seoul was a cavity that was formed as a result of the soil erosion owing to a sewage leak. In this study, the cavity detection range was evaluated using ground penetrating radar (GPR) equipment that is extensively used in Korea.

2. TEST BED AND GPR DETECTION PLAN

The test bed for GPR detection was defined in the field to have a width of 5m, depth of 4m, and cast iron pipe, that has a diameter of 300 mm, was buried at a depth

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Note: Paper to be submitted to "Computers and Concrete, An International Journal" for the purpose of Special Issue.

of 1m from the surface of the ground. The cavity was formed using expanded polystyrene (EPS) with a cubic length of 500mm in the test bed. In addition, each of the EPS was embedded at depths of 0.5m, 1.0m, 1.5m, and the horizontal length between EPS and the cast iron pipe was 0.75m. After the burying of the cast iron pipe and EPS in test bed, the general soils were used for landfills. Fig.1 shows a test bed in detail. Moreover GPR image processing results elicited by the existing GPR image processing program (RADAN 7) and the developed program (GPRiPP) in this study were compared. The GPR equipment used included the SIR-3000 systems of Geophysical Survey Systems, Inc. and a 400 MHz antenna that was used for cavity detection. Fig.2 shows the GPR detected lines, and Fig. 3 shows the installation pictures of test bed.

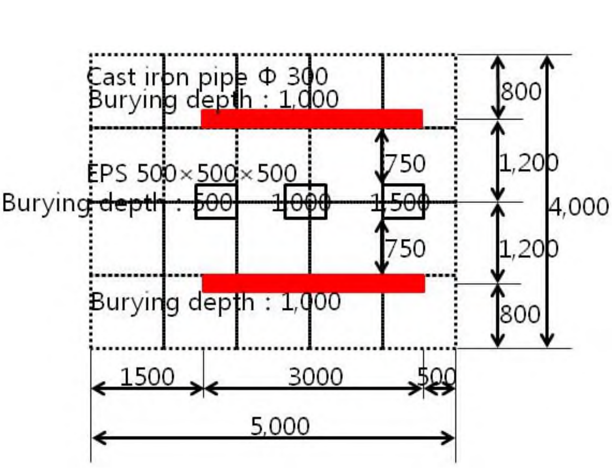

Fig. 1 Test bed plan (unit:mm)

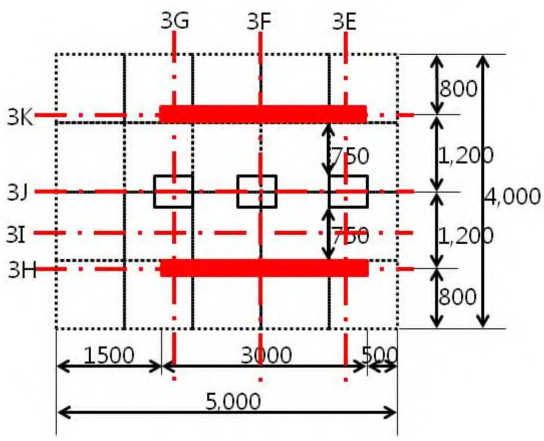

Fig. 2 GPR detection lay out (unit:mm)

(a) EPS (b) Cast iron pipe (c) Compaction

Fig. 3 Test bed construction

3. GPR DETECTION RESULTS AND GPR IMAGE PROCESSING PROGRAM

Fig. 4 summarizes the detected GPR results according to the detection lines. The X-axis and Y-axis in Fig. 4 shows the horizontal distance and detection depth,