

A Study on the Delineation of Soft Ground Hazard Zones through Ground Subsidence Factor Analysis

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Abstract:

In the Republic of Korea, aging underground infrastructure combined with deteriorating subsurface ground conditions has increased the occurrence of ground subsidence, particularly in highly urbanized areas. Because ground subsidence generally develops beneath asphalt pavements and concrete roads, early detection and accurate assessment remain challenging. This study proposes a methodology for delineating soft ground hazard zones using borehole information and underground infrastructure data in Goyang-si, Republic of Korea.

The proposed method utilizes borehole data, including geological strata, groundwater conditions, and Standard Penetration Test (SPT) results, provided by the National Geotechnical Information Integrated Database Center of the Ministry of Land, Infrastructure and Transport (MOLIT). In addition, underground utility information, including water supply and sewer networks obtained from the Underground Information Utilization Support Center, was incorporated into the analysis.

Ground subsidence is generally classified into two categories: natural subsidence caused by groundwater-induced soil erosion and anthropogenic subsidence caused by underground cavities generated by leakage from buried utility pipelines. Geological strata, groundwater conditions, and SPT data were selected as common factors influencing both types of subsidence. Furthermore, the installation years of water supply and sewer pipelines were incorporated to identify areas with a higher potential for leakage-induced subsidence. Geological strata were classified according to the Unified Soil Classification System (USCS), and higher weights were assigned to sandy and cohesive soils that are more susceptible to ground instability. SPT N-values were also evaluated, where values greater than 30 indicated dense soil conditions and values below 10 represented loose soil conditions, enabling the identification of weak ground conditions.

Based on these factors, a prototype soft ground hazard zone map was developed. Comparison with historical ground subsidence incidents demonstrated a high level of agreement between the predicted hazard zones and actual subsidence locations. In addition, several high-risk areas identified by the model have not yet experienced subsidence, indicating that preventive inspection and maintenance may be required. The proposed methodology is expected to contribute to proactive ground subsidence management. As additional causal factors and field observations become

available, the proposed framework can be further enhanced to improve ground subsidence prediction and reduce human casualties and economic losses.

Keywords:

Ground Subsidence, Borehole Information, Subsidence Factors, Soft Ground, Hazard Zone Mapping.

Acknowledgement:

This work was supported by the Ministry of the Interior and Safety (MOIS) and the Korea Planning & Evaluation Institute of Industrial Technology (KEIT) under the project "Development and Demonstration of a GPR-Based Decision Support System for Prioritizing Urban Ground Subsidence Investigation" (Project No. RS-2026-25523679).