

A Standardization Framework for a Ground Subsidence Factor Database

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Abstract:

In the Republic of Korea, rapid urbanization and extensive underground infrastructure development, including subways, utility tunnels, underground roads, and underground parking facilities, have significantly increased the risk of ground subsidence. This trend has highlighted the need for systematic data management and database standardization to support accident prevention. However, ground subsidence-related data are currently managed by different organizations using inconsistent standards and data formats, limiting data integration, interoperability, risk assessment, and artificial intelligence (AI)-based prediction. To address these challenges, this study proposes a standardized database framework for the systematic management of ground subsidence factors.

A comprehensive review of domestic and international studies and existing databases was conducted to classify ground subsidence factors into static and dynamic categories. Based on this classification, a standardized data model incorporating data elements, attribute definitions, coding systems, and metadata was developed. Furthermore, the database schema was normalized, and table structures and key database features were standardized to improve interoperability among organizations. The proposed framework was also designed to prioritize ground subsidence factors through expert surveys and the Analytic Hierarchy Process (AHP). Its applicability and effectiveness were evaluated by verifying the influence of each factor using actual ground subsidence cases.

The proposed database standardization framework provides a consistent foundation for the collection, management, and sharing of ground subsidence-related data. It also serves as fundamental input for AI-based ground subsidence risk assessment and prediction models. Furthermore, the framework is expected to support digital twin-based underground safety management and scientific decision-making as a core enabling technology for future underground infrastructure management.

Keywords:

Ground Subsidence, Database Standardization, Database Normalization, Database Schema, Digital Twin.

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