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DEVELOPING A STANDARD FOR GEOLOGICAL SUITABILITY EVALUATION OF URBAN UNDERGROUND SPACE: A CASE STUDY IN BEIJING

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Abstract: The development of urban underground space (UUS) makes a significant contribution to urban sustainability (Bobylev, 2016; Broere,2016; Hunt et al., 2016; Wang et al., 2016). The subsurface, however, constitutes a sensitive geological environment where disturbances can result in long-lasting or irreversible impacts (Sterling et al., 2012; Li et al., 2016; Zhu et al., 2016). Therefore, a scientific geological evaluation of UUS resources prior to development is essential for informing strategic planning and ensuring sustainable use (Peng and Peng, 2018). This process involves a comprehensive analysis of geological data to assess the suitability of subsurface conditions, within a given depth, for development (Liu et al., 2011). As a densely populated megacity, Beijing increasingly relies on subsurface space to address urban pressure and enhance resilience. Despite numerous geological assessments of UUS (Huang et al., 1995; Wang and Zhu, 2006; Jiang et al., 2007; Cai et al., 2010; He et al., 2020; Sun et al., 2024), challenges such as a lack of consistent criteria and insufficient integration with urban planning remain. The former issue leads to fragmented evaluations based on varying frameworks, compromising the comparability of results. The latter is evident in a reactive, rather than proactive, application of geological assessments within the planning process. This reveals a vital research gap, the absence of evaluation criteria aligned with distinct planning stages (e.g., master and detailed planning). Developing a local standard may provide an effective way to address these issues.

Keywords: geological suitability evaluation, urban underground space, evaluation standard, urban planning

1. SOLUTION AND RESULTS

To address this gap, we develop a standard for the geological suitability evaluation of UUS in the Beijing plain. This standard establishes a comprehensive framework comprising four principal components:
(1) pre-evaluation analysis;
(2) an index system encompassing both basic geological conditions and major constraints;
(3) index quantification; and
(4) the classification of overall suitability grades.

A key feature of this standard is the integration with urban planning, which is achieved by both aligning required precision of geological evaluation with different planning levels, and scaling the size of evaluation units for various planning stages. Specifically, at the master planning level, it is recommended that assessments range from city-wide evaluations using a 1 km grid (1:50,000 horizontal / 1:2,000 vertical precision) to district-level evaluations requiring a 500 m grid (1:25,000 / 1:1,000). For the detailed planning stage, the use of a 200 m grid (1:10,000 / 1:500) is suggested for general areas, advancing to a high-resolution 20–50 m grid (1:5,000 / 1:200) for specific regions.

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2. CONCLUSIONS

The standard establishes a systematic procedure for UUS geological suitability evaluation in Beijing plain and tailors the evaluation scale and precision to specific planning stages. The primary aim of this work is to enhance the consistency and comparability of evaluation results, thereby supporting their effective application.

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