Utilizing Multi-Channel Analysis of Surface Waves (MASW) for Economical Tunnel Boring in Challenging Geological Environments

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Abstract

Tunnel construction in geologically complex terrains demands accurate subsurface characterization to ensure safety, efficiency, and cost-effectiveness. Traditional methods like borehole drilling and Standard Penetration Testing (SPT) offer limited, point-based data, often failing to capture continuous ground stiffness variations critical for tunnel alignment and excavation planning. This research proposes the integration of MASW—a non-intrusive geophysical technique that maps shear-wave velocity (Vs)—to generate high-resolution 2D profiles of subsurface stiffness. By identifying zones with lower Vs values, MASW enables optimized tunnel routing, reducing excavation difficulty and construction risks. The study also investigates the impact of geophone spacing and seismic source energy on survey resolution, aiming to establish standardized MASW parameters tailored for tunneling applications. Additionally, it explores the synergy between MASW data and traditional geotechnical validation to enhance subsurface modeling. The outcomes are expected to contribute a robust framework for tunnel feasibility assessments in challenging geological settings, particularly within the Indian context.