

## Quality Evaluation of Backfill Grout in Tunnel Boring Machine Tail Void Using Impact-Echo (IE): Short-Time Fourier Transform (STFT) Numerical Analysis

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**Abstract :** During Tunnel Boring Machine (TBM) tunnel excavation, backfill grout should be injected after the installation of segment lining to ensure the stability of the tunnel and to minimize ground deformation. If grouting is not sufficient to fill the gap between the segments and rock mass, hydraulic pressures occur in the void, which can negatively influence the stability of the tunnel. Recently the tendency to use TBM tunnelling method to replace the drill and blast(NATM) method is increasing. However, there are only a few studies of evaluation of backfill grout. This study evaluates the TBM tunnel backfill state using Impact-Echo(IE). 3-layers, segment-grout-rock mass, are simulated by FLAC 2D, FDM-based software. The signals obtained from numerical analysis and IE test are analyzed by Short-Time Fourier Transform(STFT) in time domain, frequency domain, and time-frequency domain. The result of this study can be used to evaluate the quality of backfill grouting in tail void.

**Keywords :** tunnel boring machine, backfill grout, impact-echo method, time-frequency domain analysis, finite difference method

**Conference Title :** ICSRD 2020 : International Conference on Scientific Research and Development

**Conference Location :** Chicago, United States

**Conference Dates :** December 12-13, 2020