Framework Development for Workability Assessment of Conditioned Soils in EPB Shield Tunnelling

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ABSTRACT

Earth Pressure Balance (EPB) shield tunnelling is widely used in Singapore. Effective soil conditioning is essential for successful EPB operations — it protects cutterhead components, transforms excavated material into a flowable paste, and ensures face stability. A key parameter in this process is workability, which describes how easily conditioned soil can be transported through the pressurised chamber and screw conveyor without clogging or excessive resistance.

To assess workability, EFNARC (2005) recommends two primary test methods: the slump test and the standard flow test. However, most studies focus on the slump test, with limited attention to the standard flow test. The standard flow test offers several advantages: it requires smaller sample volumes, is quicker to perform, and is less susceptible to human error, as automated flow tables can commonly be used. In contrast, the slump test relies entirely on manual lifting, where variations in lifting speed, strength, and verticality may affect results.

The smaller sample volume for the standard flow test allows multiple tests to be conducted using the same soil volume typically needed for one slump test. This enables a more robust assessment of repeatability and increases confidence in workability measurements.

This study investigates the correlation between slump and standard flow tests using Old Alluvium (OA) soils, representative of Singapore's Cross Island Line. Commercially available foam-based conditioning agents were tested to assess the feasibility of adopting the standard flow test as a practical and reliable alternative. Wider adoption of this method could improve quality control and operational decision-making in EPB tunnelling

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