Analysis of the Influence Mechanism of Subway Tunnel Thermal Environment: Postprint

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Abstract

To investigate the factors influencing the thermal environment within subway tunnels, field measurements were conducted on Changsha Metro Line 2. The results indicate that the tunnel thermal environment is primarily governed by train operation frequency and heat generation from trains, while exhibiting weak correlation with outdoor air temperature. During train operation, higher frequencies lead to increased heat transfer from the tunnel to the surrounding rock mass. In the vicinity of a passing train, heat transfer from the tunnel to the surrounding rock mass consistently occurs; however, during intervals without train passage, the direction of heat transfer varies: during the heating season, heat is predominantly transferred from the surrounding rock mass to the tunnel, whereas during the transition and cooling seasons, heat is transferred from the tunnel to the surrounding rock mass. Similarly, when train operations cease, the thermal environment within the tunnel tends toward stabilization.

Full Text

Analysis of the Influence Mechanism of Thermal Environment in Subway Tunnels

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Abstract

To investigate the influencing factors of the thermal environment in subway tunnels, a field measurement campaign was conducted on Changsha Metro Line 2. The results demonstrate that the tunnel thermal environment is primarily governed by train operation frequency and heat generation, while exhibiting weak

correlation with outdoor air temperature. During train operations, increased running frequency enhances heat transfer from the tunnel to surrounding rock. When trains pass through, the heat flux consistently directs from tunnel to surrounding rock. However, distinct patterns emerge during non-operational periods: in heating seasons, dominant heat transfer reverses from surrounding rock to tunnel interior, whereas transitional and cooling seasons maintain tunnel-to-rock heat dissipation. Notably, the thermal environment stabilizes significantly during train service suspensions.

Keywords: Subway tunnel; Thermal environment; Air temperature; Train heat generation; Train operation frequency

Note: Figure translations are in progress. See original paper for figures.