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EPB tunneling in long highly sensitive sections – The experience of Grand Paris Line 14 underpassing the Orly Airport

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Abstract

The correct definition and application of face confinement pressure is one of the main challenges for urban tunnels, where soil perturbation can affect the surrounding structures with undesirable, or even severe consequences. The choice of this important parameter needs to not only comply with minimal geotechnical performances, such as volume loss control, water pressure balance and front stability, but also with optimization criteria, to limit the impact on production rate and TBM components wear. It is evident that a fine, optimized and recurrently updated TBM face pressure analysis is required in difficult soft-soil contexts.

The Grand Paris Line 14 South tunnel has emphasized this concept especially on the 1.5 km section below the Orly International Airport. The main constraint was not only the limitation of deformations on sensitive structures such as airport taxiways, passenger's terminal, oil pipelines, but also to respect the tight schedule due to the Olympic Games of 2024.

The 8.83m-diameter Earth Pressure Balance TBM called 'Koumba', successfully performed this excavation at 20m-depth into Sannosien's swelling clays and Eocene's soft marls layers. The design face pressure profile, varying between 0.8 and 2.6 bar, was studied to limit volume loss during the construction as well as excess pore pressure consolidation phenomena. A complex monitoring system was also provided to validate design expectations and to update the TBM-soil interaction prediction model.

This paper focuses on the experience acquired on the EPB face confinement pressure management along this long highly sensitive section. The first part presents the comparison between reference values and thresholds given by the Designer and the real TBM drive oscillation. The second part is dedicated to the observed influence of the face pressure on the geotechnical aspect, machine mechanical parameters and production rates.

Keywords: Confinement face pressure, PAT, Correlation matrix, Grand Paris, Orly Airport

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