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Tunnel Structural Health Monitoring with Brillouin Optical Fiber Distributed Sensing

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Safety during the whole tunnel life is one of the main challenges of underground construction. Traditionally, the life cycle of a tunnel is divided in four parts: 1) conception and design based on numerical modelling, rock sample measurement and analysis, 2) tunnel construction, 3) exploitation and maintenance, 4) repair.

This paper deals with Structural Health Monitoring (SHM) during tunnel construction, and especially continuous monitoring of soil movements while tunnelling, with Tunnelling Boring Machine (TBM). Maintaining the ground surface undisturbed passes by the challenge of avoiding confinement losses, that remains an important risk for public works. Unfortunately, usual surface instrumentations cannot be set up in many overcrowded cities due to high building density.

A new concept is proposed which consists in very early ground settlement detection, close to the tunnel vault and before any detectable trouble reaches on the surface, thanks to an innovative optical sensing cable inserted into a directional drilling excavated above the foreseen tunnel. The sensing methodology is based on the Brillouin Optical Time Domain Reflectometry (B-OTDR) in single mode optical fibres and on a special cable dedicated to both strain and bending profile measurements. Basically, Brillouin measurement deals with the continuous measurement along a standard singlemode telecom fibre with a typical spatial resolution of 1 m. This sensing solution was developed and tested in laboratory, as well as on job site at the beginning of 2009.

Ключевые слова:

Содержание.

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