Editorial

Tunnels and underground spaces have been constructed since ancient times to transport people and goods and to provide shelter. First, tunnels were mostly built to overcome difficult and challenging terrain, to cross mountains, and to shorten travel times. Later tunnels were built to cross waterways as well, and built in softer and more challenging ground conditions.

As tunnel structures are at the same time supported by the surrounding soil and loaded by that same soil, the interaction between soil and structure is an important, but complex, aspect when designing and optimizing tunnel structures. With the increasing number of tunnels built in soft soils, soil-structure interaction and the detailed assessment of the loads exerted on a tunnel during its lifespan have gotten significant attention, but were still often highly simplified during design. In part these simplifications are due to the uncertainty stemming from the large natural variability that is present in soils and their behaviour, which warranted a conservative design approach with relatively large safety factors, a situation that was not inducing to develop advanced and computationally intensive modelling techniques. On the other hand, there was a lack of reliable models that capture the detailed and often highly non-linear behaviour of the soil and the structure under accidental and transient load conditions.

The need to reliably assess the stability of tunnels and underground shelters unfortunately remains ever present, certainly given the ongoing use of metro stations and shelters to provide safety for civilian populations around the world. In that light, the first article highlights the interplay between soil overburden, shock-wave propagation and non-structural behaviour for tunnels and shelters subjected to surface or near-surface explosions. The second article looks at the impact of another type of accidental load, namely large scale vehicle fires, and assesses the impact intense and extended fire loads may have on the load capacity and stability of the tunnel lining. The third article in this collection considers the inherent variability of the soil and the impact that has on the internal forces in an immersed tunnel structure during and after construction. Where these impacts have been highly schematized in the past, current models make it possible to look at the soil variability in a more detailed manner and establish whether the existing simplified design approach is actually conservative or not.

Overall, this special issue collects a number of articles that highlight the advances in modelling techniques that now allow to take incident and variable loads into account, and that consider the inherently non-linear behaviour of soils and the tunnel structure in such load conditions. It is hoped this leads to the increased use of such advanced models for the design and assessment of new and existing tunnels.

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Guest editor