

Editorial: Building resilience and sustainability in transport engineering in challenging times

Debiao Meng PhD

Associate Professor, School of Mechanical and Electrical Engineering,
University of Electronic Science and Technology of China (UESTC)

It is an immense honour and opportunity to write this month's editorial. As a member of the Editorial Advisory Panel, I have read much fascinating information and witnessed the diversity of topics and perspectives in the field of engineering sustainability.

As we stand at a cross-roads where rapid technological advances and growing environmental concerns converge, the civil engineering community faces the daunting task of creating infrastructure that is both sustainable and resilient. The Editorial Board's choice of the theme of sustainability and resilience in transport infrastructure reflects the urgency and importance of these issues in our profession. Particularly in the evolving field of civil engineering, the intersection of resilience and sustainability has become a key focus. At a time when global challenges have never been greater, from the new crown epidemic to the increasing impacts of climate change, the engineering community is at a turning point. It is against this backdrop that we review five insightful articles from recent discussions in the field that underscore the urgency and multifaceted nature of our task.

The article on large-scale deformation in weathered carbonaceous slate tunnels by Cui *et al.* (2024) describes field experiments on deformation control in weathered carbonaceous slate tunnels under high geological stresses. It highlights the innovative measures taken to minimise large-scale deformation and demonstrates the industry's commitment to advancing advanced technological solutions for sustainable infrastructure. The findings echo a wider theme: the need for proactive and adaptive strategies in engineering practise to ensure long-term stability and resilience. I was most impressed by the article's proposal of advanced drilling measures and advanced guideway measures to control deformation during tunnel construction, which is of great benefit for practical engineering applications, and which provides effective technical support for deformation control in tunnels under high geological stress. The results of this study have important reference value for the design and construction of tunnels under similar geological conditions.

The transport sector is the cornerstone of modern society, supporting economic growth, social interaction and the daily commute of billions of people. However, it is also an area that contributes significantly to greenhouse gas emissions and environmental degradation. This paradox is at the heart of why the sustainability of

transport infrastructure is critical. It is a challenge that requires innovative thinking, collaborative efforts and commitment to change. Liu *et al.* (2024)'s research on the structural optimisation of transport equipment introduces an adaptive approximation model, an approach that significantly reduces computational costs while maintaining optimisation efficiency. This approach exemplifies the power of innovation in solving complex design challenges and is in line with the principle of sustainable engineering by minimising resource consumption. One of the highlights is the use of Generational Projection Genetic Algorithm (IP-GA) to find potential optimal solutions and update the sample points based on the error assessment of the optimal solutions, the use of optimisation algorithms in engineering is important and it solves the challenges of engineering with a wide range of hyper-parameters and miscellaneous parameters. Eventually the effectiveness of the method in real engineering applications is verified by numerical tests and traffic equipment engineering examples.

For complex traffic environments, deep learning in artificial intelligence has been a hot method, which has an important application prospect thanks to its flexible network architecture and excellent generalisation ability. In this setting, Yao *et al.* (2024) focus on a deep learning framework for traffic travel time prediction considering multiple modes, demonstrating an example of combining AI with traffic engineering. A Multi-modal Graph Convolutional Recurrent Neural Network (M-Motif-GCRNN) is used to improve prediction accuracy. By considering multiple modes in its prediction model, it captures the complex patterns of urban traffic flows, providing a glimpse into the potential of data-driven solutions to improve the efficiency and sustainability of transport systems. Overall this article has important applications for transport planning and management, especially in dynamic traffic flow control and guidance.

Especially in the last decade or so, the world as a whole has been developing rapidly, with rapid advances in a variety of engineering fields, and coordinated development has become a top priority for sustainable development. The article on changes in the modulus of elasticity of roadbeds in the design of low-traffic roads in north-eastern Brazil takes us back to the fundamentals of engineering – understanding the behaviour of soils in order to create durable and cost-effective pavements (Almeida *et al.*, 2024). It demonstrates the

importance of adopting localised, context-specific solutions in achieving the SDGs. Its innovative presentation and simulation using MeDiNa software considers different roadbed types and pre-defined pavement structures. It provides a scientific basis for the design of low-traffic roads, especially in terms of material selection and structural design. Finally this study, validated by simulations and experiments, ensures the reliability and economy of the road design, which is instructive for the construction of road infrastructures in Brazil and beyond. On this basis, the sharing economy is also booming. Sun and Lu (2024) applied data envelopment analysis to the study of the efficiency of the coupling of shared bicycle demand and land use for the actual situation in Beijing. It reveals the spatial heterogeneity of the efficiency of the bike-sharing system and highlights the importance of aligning urban planning with sustainable transport choices. The findings argue for a nuanced approach to infrastructure development that considers both environmental and social needs.

Taken together, these articles paint a picture of a field that is not just reacting to challenges, but actively seeking innovative, resilient and sustainable solutions. As engineers, we have a unique opportunity – and responsibility – to shape a better future. Sustainability is relevant to everyone, wherever we are. Let's answer the call to action and use our expertise to create a legacy of

sustainable and resilient infrastructure that can stand the test of time.

Until next time!

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