

Editorial: Leveraging numerical modelling to understand complex physical phenomena

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I am pleased to be writing the editorial for this issue of the *Engineering and Computational Mechanics* (ENCM) journal, which is unique as a platform for disseminating fundamental scientific advances in applied mechanics with relevance to real-world engineering applications. Adhering to the focus of the journal, this issue presents three innovative contributions that demonstrate how numerical modelling underpinned by sound principles of mechanics can be deployed for solving challenging engineering problems, such as in fire safety engineering and oil drilling.

- In ‘Numerical study on the smoke spread length in full-transverse ventilated underground traffic link tunnel (UTLT)-like tunnels’, Xiaojun Yan, Qingwen He, Xu Li, and Xiang Fang investigate the computational modelling of the smoke layer in UTLT. The paper addresses a key knowledge gap by focusing on tunnels where the logarithmic law of smoke spread does not apply and undertakes a systematic numerical study to reveal the dynamics of smoke spread in these structures. The study is rigorous, including a dimensional analysis to inform experimental design, validation of the fire dynamics simulation based on computational fluid dynamics with previous measured data in the literature, and subsequent expansion of the modelling to a range of fire scenarios arrived at from the experimental design. The study presents interesting findings on the influence of ventilation and air supply on temperature fields and volumetric flow rates, which can have implications for the design of UTLT and their fire protection systems.
- In ‘Heat transfer analysis of rectangular concrete-filled steel sections’, Rwayda Kh. S. Al-Hamd and Asad S. Albostami present a detailed parametric study on the thermal behaviour of concrete-filled steel sections (CFST) subject to a range of fire conditions. The study aims to enhance our currently limited understanding of the influence of cross-section geometry and fire duration on the fire performance of CFSTs. The study, which uses the Abaqus software for thermal analysis using finite element modelling, highlights the importance of adopting appropriate modelling choices by demonstrating how factors such as element type choices can influence model predictions, such as temperature distributions and heat flux. A unique aspect of this study is its investigation of the influence of factors such as concrete cover, section aspect ratio, and fire exposure direction on internal thermal gradients and heat flux. The results and conclusions have the potential to identify regions of mechanical instability within CFST column sections under fire exposure conditions and

inform the design of CFST columns from the perspective of optimising fire resistance.

- In ‘Mechanical model and lateral force factors of lower drilling tools’, the authors propose a novel modelling approach to reliably capture the behaviour of drilling tools commonly used in the oil and gas industry. Relying on assumptions clearly outlined in the paper, this approach approximates drill mechanical behaviour using a three-span beam subject to longitudinal and transverse loading. This approach suitably incorporates the rotational and vibrational effects of the actual drilling process and has been implemented in a drilling mechanics simulation platform. The research uses the modelling to characterise the influence of drilling parameters such as inclination angle and weight on bit on the azimuthal and inclination forces. Its findings help understand the structural performance of drilling tools and can support their design and analysis for practical drilling applications.

I refer our readers to the full papers to find out more about these three novel contributions and to have a glimpse of the critical role that applied mechanics plays in helping understand complex physical phenomena across engineering disciplines.

New themed issue on ecohydraulics

I would also like to take this opportunity to inform our readers that the journal is planning a themed issue on *Advances in Ecohydraulics: Integrating Ecology and Hydraulics for Healthy Aquatic Ecosystems*. Interested readers are encouraged to visit the linked webpage for further details, including how to submit abstracts (deadline: 31 October 2025).

REFERENCES

- Al-Hamd RKS and Albostami AS (2025) Heat transfer analysis of rectangular concrete-filled steel sections. *Proceedings of the Institution of Civil Engineers Engineering and Computational Mechanics* **178(3)**: 106–123, [10.1680/jencm.24.00136](https://doi.org/10.1680/jencm.24.00136).
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