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Editorial: Methods and applications in computational methods in structural engineering

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Editorial on the Research Topic
Methods and applications in computational methods in structural engineering

In the ever-evolving landscape of the built environment, the utilization of computational methods has become increasingly critical in ensuring the safety, efficiency, and sustainability of structures. The *Frontiers in Built Environment* journal and its section "Computational Methods in Structural Engineering" is delighted to present the latest advances and applications in the field. This collection of research papers highlights the transformative power of computational methods, showcasing their potential to revolutionize the way we design, analyze, and assess the structures.

Structural engineering plays a pivotal role in shaping our world, from awe-inspiring skyscrapers and innovative bridges to resilient infrastructure that withstand the test of time. Computational methods have emerged as indispensable tools in this discipline, offering engineers powerful means to address complex challenges. The six studies featured in this Research Topic encompass a diverse range of topics and provide profound insights into the future of structural engineering.

Wang et al. "*Spatial Deflection of Parallel Hydraulic Fractures and Induced Shear Stress Disturbance Under Different Perforation Cluster Spacing Considering Thermal Effects*" discusses the importance of accurately estimating the length and shape of fracture networks in hydraulic fracturing to optimize the process. They present a three-dimensional numerical model for simulating the behavior of multiple parallel hydraulic fractures during multistage fracturing. The study's findings indicate that thermal effects between fracturing fluid and rock significantly impact fracture propagation, increasing induced shear stress and promoting fracture growth.

Voyiadjis and Kattan "*Toward four-dimensional materials: The true nature of undamageable materials and bimodal self-regenerating materials*" discusses the development of theories related to undamageable materials and bimodal self-regenerating materials, which both lead to the concept of four-dimensional materials. Undamageable materials are shown to be the limit of a specific class of materials as a mathematical parameter (order "n") approaches infinity, and similarly, bimodal materials are the limit of self-regenerating materials under the same condition.

Poutanen et al. "*Excessive load*" addresses the problem of dealing with excessively high structural loads and the decision-making process regarding whether to remove the excess load or reinforce the structure. The article focuses on providing equations for calculating the probability of failure due to excessive loads for three materials: steel, timber, and concrete. The study also identifies safe excessive loads, defined as those with a failure probability less than 1/1500. The critical issue is the combination of loads, with various options discussed, including dependent vs. independent load combinations and reliability calculations, reference time, and reference reliability.

Jiménez Rios et al. "*Computational methods applied to earthen historical structures*" discusses the significance of earthen structures in the context of UNESCO World Heritage sites and their vulnerability to seismic and climate change events. It emphasizes the importance of structural analysis in assessing safety, diagnosing damage causes, and validating interventions for these structures. The paper highlights the need for effective computational methods to study both monumental and vernacular earthen structures. The paper compiles and summarizes the latest developments and implementations of such computational methods by following the PRISMA-S checklist methodology and uses a narrative synthesis to present the results. Additionally, it touches on future trends, opportunities, and challenges in this field of study.

Shabani "*A review of graphical user interfaces of OpenSees software framework*" highlights the importance of seismic vulnerability assessment for evaluating the resilience of structures and mentions OpenSees as a valuable tool for simulating the behavior of structures under seismic loads. The study reviews 15 GUIs designed for use with OpenSees, categorizing them as open-access or commercial. The study evaluates these GUIs based on factors such as open-source availability, 3D modeling and visualization capabilities, support for incremental dynamic analysis (IDA), and simplification of soil-structure interaction (SSI) modeling. The objective of this mini-review is to assist OpenSees users in selecting a suitable GUI for their projects and to encourage developers to enhance existing GUIs or create more advanced ones to better serve user needs.

Nela et al. "*Limit Analysis of Multi-Ring Masonry Arches: A Parametric Study on the Effects of Friction Angle, Geometry, Interlocking, and Ring Number*" discusses the structural analysis of multi-ring arches commonly found in large-span built heritage structures. The study focuses on how the construction techniques, geometry (size, orientation, and arrangement of masonry units), and mechanical characteristics (friction) influence the structural capacity of these arches when subjected to vertical loads at the quarter span. The research uses an in-house code based on the upper bound approach of limit analysis for masonry structures, employing a discrete model that considers factors like block size, arrangement, friction angle, number of rings, and span length. It demonstrates that both the interlocking effect from unit placement and the friction angle significantly affect the overall structural behavior, which varies based on different spans and arch shapes.

In conclusion, the "*Methods and Applications in Computational Methods in Structural Engineering*" Research Topic is a testament to the innovative spirit of the structural engineering community. It illustrates the profound impact that computational methods have on the field, transcending traditional boundaries and reshaping our approach to building safe, sustainable, and resilient structures. This Research Topic serves as a platform for the exchange of ideas, the dissemination of knowledge, and the inspiration for the next-generation of structural engineers. We extend our gratitude to the authors and reviewers whose dedication and expertise have made this Research Topic possible.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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