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Editorial: Recent advances in durability improvement and low-carbon strategy of engineering materials and structures

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Editorial on the Research Topic
Recent advances in durability improvement and low-carbon strategy of engineering materials and structures

Introduction

The pursuit of low carbon and durable civil engineering materials and structures is a crucial step towards achieving sustainable development in society. Currently, civil engineering faces challenges including high carbon emissions from the production of materials, complex manufacturing and construction processes for structures, and significant life-cycle management and maintenance costs. It is urgent to explore a comprehensive path to sustainability that spans material research and development, structural design, and life-cycle theoretical innovation.

It is a matter of great pride and gratification to come up with the Research Topic for Frontiers in Materials: Recent advances in durability improvement and low-carbon strategy of engineering materials and structures. The papers covering the following topics (but not limited to) were collected and published (after rigorous peer review) for this Research Topic: 1) low carbon, 2) high performance, 3) durability, 4) construction, 5) structure, 6) long-term performance, 7) strengthening, and 8) life-cycle. For low-carbon building materials, the performance of recycled concrete and cement soil was investigated (Zhao et al.; Liu et al.), and the quality grade assessment and fracture failure mechanism were analyzed within a theoretical framework. On the basis of low-carbon materials research, we must innovate current structural forms to match new materials. Therefore, a new bridge structure design method and combined structure connection system based on UHPC are proposed, and their mechanical properties are obtained through a series of well-designed tests (Li et al., Jiang et al.). With the material foundation and structural design established, engineers are increasingly focused on the reliability of health monitoring during both construction and operation. A method was proposed to enhance the longitudinal

thrust stiffness of the buckle tower by leveraging the joint effect of approach bridges, achieving full equilibrium for the horizontal component of the backstay force in cable-stayed arch bridges (Wang et al.). The monitoring method for detecting debonding between concrete beams and reinforced steel plates, based on piezoelectric smart materials, was also updated to improve the construction quality (Wang et al.). Under the long-term effects of harsh service environments, even the most robust structures will suffer performance degradation, such as cracking, spalling, and reduced bearing capacity. Among them, high temperature and salt erosion are common afflictions that can easily degrade the properties of the concrete matrix. It is crucial to understand the deterioration mechanism and design the corresponding countermeasures (Wang et al., Li et al.). At the same time, reinforcing deteriorating structures is often preferred as it is more economical than demolishing and rebuilding them. A new strengthening technique, based on multifaceted wrapping with UHPC, is proposed, and the mechanism by which it enhances damaged structures is studied (Jiang et al.). The influence of various reinforcement methods and interface treatments on the damaged RC beams reinforced with UHPC was analyzed by *in-situ* tests (Song et al.). In addition, some articles provide us with research progress related to the Research Topic, including the performance of new concrete and geomaterials, optimization of new construction machinery and equipment, and the basic performance of structural foundation systems. All the articles on this Research Topic provide reliable theoretical support for the low carbonization and durability optimization of civil engineering materials and structures.

This Research Topic has provided multidisciplinary research opportunity to present the state of the art in the development of durability improvement and low-carbon strategies for engineering materials and structures. Additionally, this platform has played a vital role in connecting prominent scientists, researchers, and scholars from around the globe.

We are quite sure that this book will play a role catalyst to have a more extensive exploration of low-carbon building materials and high-performance durable structures for various technological applications to address unresolved Research Topic in civil engineering, including bridge engineering, tunnel engineering, structural engineering, and geotechnical engineering.

Author contributions

ZZ: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing–original draft, Writing–review and editing. AL: Data curation, Formal Analysis, Writing–review and editing. ZZ: Investigation, Software, Supervision, Writing–review and editing.

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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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