

Editorial: Circular materials and technologies for sustainable construction

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The transition towards sustainable construction requires a fundamental shift towards circularity, where resources remain in productive use for as long as possible through reuse, recovery, remanufacturing, and recycling. This challenge is becoming increasingly pressing as cities face growing infrastructure demand, depleting natural resources, and mounting construction and demolition waste (Soto-Paz *et al.*, 2023). Moreover, recent natural disasters and armed conflicts have generated vast quantities of war rubble and damaged infrastructure, highlighting the urgent need for technologies capable of transforming debris into valuable resources for resilient reconstruction (Hryhorovskiy *et al.*, 2026).

The scientific community has a critical role to play in developing the materials, technologies, and methodologies that will underpin the next generation of sustainable infrastructure. This vision lies at the heart of the 4th International Conference on Sustainable Building Materials (ICSBM). Hosted by Eindhoven University of Technology (TU/e) in August 2025, 4th ICSBM welcomed over 300 participants from 37 countries, with 15 keynote lectures and 160 oral and poster presentations dedicated to sustainable building materials (Savran, 2025).

The contributions of the current issue presented at the conference demonstrate the remarkable progress being made across multiple dimensions of sustainable construction. From recycling of the concrete as the most common building material, to waste valorisation and bio-based materials and digital technologies. The current issue reflects the changes in building materials science have increasingly evolved into a multidisciplinary field that integrates not only chemistry, mineralogy, engineering, but also biology and data science, enabling innovative solutions to complex sustainability challenges.

The study by Winnie Franco Santos, Jos Brouwers, and Sonal Deo investigates the technology for the selective recovery of cement-rich fines from recycled concrete, contributing to the development of circular pathways for concrete recycling and reducing dependence on virgin raw materials (Franco Santos *et al.*, 2026). Study on the influence of jaw angle in the smart crusher demonstrates how process optimisation can improve the selective recovery of cement-rich fines from demolished concrete. Such advances bring us closer to closing material loops within the concrete value chain

and highlight the importance of tailoring recycling technologies for material quality.

Digitalisation is a powerful driver of reshaping the future of materials circularity. The work by Carlos Folgoso-Bullejos and co-authors demonstrates how advanced spectroscopy and artificial intelligence can enable automated classification of fine heterogeneous construction and demolition waste, providing the digital tools needed to improve material recovery and recycling efficiency. As construction waste streams become increasingly complex, such intelligent systems are likely to become indispensable tools in resource management (Folgoso-Bullejos *et al.*, 2026).

Equally significant is the emergence of bio-based construction materials as viable alternatives to conventional mineral-based products. The special issue also explores the role of renewable and bio-based sustainable building materials. Thais Siqueira and colleagues examine bamboo bio-concrete produced with residue aggregates, demonstrating how industrial bamboo waste can be valorised as a construction material while reducing reliance on natural aggregates (Siqueira *et al.*, 2026). While challenges remain regarding strength and stiffness, the work demonstrates the potential of renewable biological resources to contribute meaningfully to future construction systems.

The integration of agricultural residues into building materials offers another promising avenue for sustainable development. Lucas Caon Menegatti and Romildo Dias Toledo Filho investigate earth composites incorporating rice husk-based phase change materials, showing how agricultural residues can be transformed into multifunctional materials that enhance thermal performance and energy efficiency (Menegatti and Toledo Filho, 2026). These contributions illustrate how renewable resources and industrial or agricultural by-products can support the transition towards a more resource-efficient and low-carbon built environment. By storing and releasing thermal energy during phase transitions, these materials can contribute to more comfortable indoor environments and reduce energy demands associated with heating and cooling.

Taken together, these contributions highlight a common objective: maximising the value derived from available resources while

minimising environmental burdens. Whether through improved recycling processes, the development of bio-based alternatives, the enhancement of thermal performance, or the application of artificial intelligence, the studies presented at ICSBM 2025 demonstrate that innovation across the entire material life cycle is essential to achieving sustainability goals.

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