NEU Releases Comprehensive Guide on Materials for Low-Carbon Concrete

NEU: An ACI Center of Excellence for Carbon Neutral Concrete released *The Low-Carbon Concrete Guide: Materials* in December 2025. The guide will be presented at World of Concrete from January 20-22, 2026, at the ACI booth C6382.

The guide is structured to accommodate various levels of expertise. Part I is designed to serve as an introduction to low-carbon concrete, while Parts II and III are tailored for practitioners seeking specific material options. Part IV covers advanced strategies.

The guide is organized into the following sections:

- Part I: Understanding the Carbon Footprint of Concrete. This section provides the foundational knowledge required to understand concrete's carbon emissions, its life-cycle stages, and the primary levers for reduction;
- Part II: Exploring Low-Carbon Alternatives to Portland Cement. This part focuses on binder-level strategies, such as supplementary cementitious materials (SCMs), mineral fillers, low-carbon portland and blended cements, and alternative cements. Materials are classified as proven, emerging, or experimental;
- Part III: Exploring Low-Carbon Alternatives to Non-Binder Concrete Materials. This section addresses aggregates, reinforcement, and water, assessing their availability, performance, and carbon impact. As in the previous part, options are categorized by readiness level to prioritize practical, near-term solutions while highlighting future innovations; and
- Part IV: Advanced Design Strategies for Low-Carbon Concrete. This part examines how material selection intersects with advanced mixture optimization and advanced concretes, such as high-performance concretes, to achieve greater carbon reductions at the structural and project levels.

Understanding the scope

Reducing the carbon footprint of concrete requires more than a single decision or material choice. Concrete is a composite material where every constituent—binders, aggregates, reinforcement, water, and admixtures—interacts to influence both performance and emissions. This guide examines each material individually, detailing its origin, processing, properties, and availability. It also emphasizes that the full impact depends on how these materials are proportioned and combined within a mixture.

The scope of the guide includes:

- The role of concrete in global carbon emissions;
- Life-cycle analysis and tools for carbon quantification and reporting;
- Binder-level carbon reduction strategies, including SCMs, mineral fillers, blended cements, low-carbon portland cement, and alternative cements;
- Aggregate- and reinforcement-level carbon reduction strategies;
- Chemical admixtures as enablers for low-carbon concrete; and
- Mixture proportioning strategies and advanced concretes as supporting approaches for efficiency and durability.

This publication does not provide comprehensive coverage of all concrete technology or structural design aspects. Instead, it focuses on the material-level decisions most directly linked to embodied carbon. The guide also includes essential background information on concrete behavior, hydration, microstructure, and life-cycle frameworks to ensure accessibility for readers who may be new to either concrete or low-carbon construction. The objective is to equip readers with the foundation and framework needed to evaluate low-carbon material options and understand their implications for performance and sustainability. The guide also provides lists of abbreviations and chemical formulas.

About the author

The Low-Carbon Concrete Guide: Materials is authored by ACI member Mary Christiansen, an Associate Professor in the Department of Civil and Environmental Engineering at the University of Minnesota Duluth, Duluth, MN, USA. She teaches courses in concrete materials, structural design, and sustainability. Her research concentrates on the development and characterization of low-carbon concrete and high-performance materials to improve the sustainability and resiliency of concrete infrastructure. Christiansen is past Chair of ACI Committee 242, Alternative Cements, and is a member of ACI Committees 232, Fly Ash and Bottom Ash in Concrete, and 240, Pozzolans.

The Low-Carbon Concrete Guide: Materials is available for purchase online at the ACI store at **https://www.concrete.org/store/productdetail.aspx?ItemID=LCCGM**.

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