Material Health Considerations for Low-Carbon Concrete

Habitable (formerly Healthy Building Network)
Perkins&Will

Concrete is the world’s most consumed substance, aside from water, and its use is projected to grow in the coming decades.[1]

Concrete is the largest contributor to embodied carbon emissions in the building sector.[2] Portland cement, the binder used in concrete, typically makes up 10–15% of concrete by weight, but accounts for the majority of its carbon footprint. It is well known to be one of the largest contributors to global carbon emissions, accounting for 7% of CO_2 emissions globally.[3,4]

Health Trade-offs and Data Gaps

As awareness over the concrete sector's contribution to greenhouse gas emissions has grown, a number of strategies have emerged to lower the embodied carbon of concrete. Some strategies to reduce the carbon impacts of concrete may have health co-benefits (like reducing inhalable particulate emissions), while some may have critical trade-offs.[5]

In order to better understand these potential co-benefits and trade-offs, we interviewed experts in the low-carbon concrete field, focusing on U.S. production of portland cement and concrete. Through the interviews we discovered that some research has been conducted on the public health impacts of concrete and cement production, but some large questions remain. **For instance, notable data gaps exist in our understanding of the potential health co-benefits and trade-offs of different strategies including:**

- Lowering embodied carbon through inclusion of traditional or emerging supplementary cementitious materials (SCMs)
- Incorporating longer cure times in order to reduce the amount of cement needed in the mix
- Developing carbon capture, utilization, and storage (CCUS) technologies
- Scaling up production of alternatives to ordinary portland cement

In addition, we do not fully understand how different strategies may disproportionately impact communities of color and low-wealth communities.

These data gaps should be filled to provide more comprehensive material health guidance on concrete. Notably, the best strategies for addressing material health may differ outside of the U.S. due to regional variability in factors related to cement and concrete production. In the meantime, here are a few steps that can be taken to reduce greenhouse gas emissions from concrete in building projects that are likely to have health co-benefits. As we learn more, we will update this guidance.

Approaches to carbon that deliver health co-benefits

Reduce concrete use through optimized design.[6]

The production of portland cement and concrete both are associated with emissions that can impact the health of nearby communities.[5,7,8]

Invest in research to understand the health impacts of low-carbon concrete technologies.

Stakeholders investing in these new or emerging technologies should aim to understand and reduce human health impacts throughout the life cycle of these materials by striving for supply chain transparency and, by considering cumulative impacts faced by nearby communities.[5,9–12]

Design concrete materials for reuse and repurposing.

Opportunities to reuse concrete structural elements have already been explored.[13] Seek out opportunities to innovate by using concrete materials designed for deconstruction and reuse.[14]

Credits and Acknowledgements

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Acknowledgements

Thank you to all of the people who either facilitated connections or who were interviewed for this factsheet, including experts at the American Council for an Energy-Efficient Economy (ACEEE), California Nevada Cement Association, University of California Davis Department of Civil and Environmental Engineering, ClimateWorks, Industrious Labs, and Oak Ridge National Laboratory.

About the Authors

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Perkins&Will, an interdisciplinary, research-based architecture and design firm, was founded in 1935 on the belief that design has the power to transform lives. The firm is committed to creating a better, beautiful, more equitable world through Living Design, an approach that integrates environmental, social, and design considerations to advance ecological health and well-being. *Architizer* named Perkins&Will the world's "Best Sustainable Firm" in 2023, and *Metropolis* named it "Firm of the Year" in 2022 for its industry leadership in advancing climate action and social justice. *Fast Company* named Perkins&Will one of the World's Most Innovative Companies in Architecture three times, and in 2021, it added the firm to its list of Brands That Matter—making Perkins&Will the first architecture practice in the world to earn the distinction.

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Habitable (formerly Healthy Building Network) believes that all people and the planet will thrive when the materials economy is in balance with earth's natural systems. Our team of researchers activate science to reduce pollution, mitigate climate change, and create a healthier and more equitable future for all. Our Informed™ initiative supports the built environment practitioners in selecting products with safer chemicals to improve the health of humans and the environment.

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