Carbon-positive Architecture: Buildings that Absorb More CO_2 than They Emit

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Abstract:

The built environment, considered one of the major contributors to greenhouse gases and the global climate crisis, needs to rethink its core concepts. In contrast, carbon-positive architecture is a new paradigm in which buildings have a positive effect on the environment, rather than minimizing harm. By design, these buildings absorb more carbon dioxide over their life cycle than they produce, turning them from passive consumers of energy into active contributors in the restoration of the environment.

This research explores how this could be realized by looking at the innovative materials and systems that make carbon-positive design possible: bio-based materials, facades integrated with algae, and new types of low-carbon concrete capable of capturing carbon. Design strategies like green roofs, vertical forests, and energy-producing facades contribute to enhancing a building's carbon balance and, generally, performance. Further, the inclusion of renewable energy sources, such as solar and wind power, heightens a building's positive contribution toward offsetting its emissions.

The paper also discusses policies and assessment methods that support the global adoption of carbon-positive architecture. Through case studies, new technologies, and life cycle assessments, this research will help establish that the transition from "net-zero" to "net-positive" is one of the most important steps toward more responsible and regenerative architecture, wherein buildings are configured as living systems - as agents capable of ecosystem restoration, supporting biodiversity, and aiding civilizations on a greener pathway forward.

Keywords:
bio-based materials, carbon-positive architecture, carbon sequestration, environmental regeneration, life-cycle assessment, sustainable design.