

Sustainable Construction Practices for Climate Change Mitigation and Adaptation: A Review

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ABSTRACT

This comprehensive review explores the critical role of sustainable construction practices in addressing climate change challenges through both mitigation and adaptation strategies. Climate change, caused by human activities, necessitates urgent global action, given its wide-ranging impacts. Mitigation measures, encompassing transitions to renewable energy, energy efficiency, and waste management, are essential for averting severe consequences and require collaborative efforts and societal behavioral changes. Simultaneously, adaptation strategies, including resilient infrastructure and community planning, are crucial for addressing the unavoidable impacts of past emissions. The paper dedicates significant attention to sustainable construction practices, highlighting their contribution to both mitigation and adaptation. Key elements, such as energy-efficient design, renewable energy integration, and resilient construction techniques, not only reduce the environmental footprint of the construction industry but also foster socially responsible and resilient built environments. Sustainable construction practices emerge as fundamental in the global initiative to combat climate change, aligning with environmental stewardship for a sustainable and resilient future. Nevertheless, sustained research, innovation, and international collaboration are imperative to advance these practices and effectively tackle the intricate challenges posed by climate change in the built environment.

Keywords: Sustainability, SDGs, Climate Change, Sustainable Construction Practices, Mitigation, Adaptation

INTRODUCTION

Sustainability involves a system's capacity to persist and operate over an extended period, often used interchangeably with sustainable development (Behsoodi et al., 2023). The UN's 2030 sustainable development agenda, approved in 2015, outlines a transformative vision with 17 sustainable development goals (SDGs) and 169 targets. These goals, surpassing the Millennium Development Goals, address economic, social, and environmental aspects, striving for objectives like global poverty eradication and universal access to sustainable energy (UN SDGs, 2016). The 13th goal, Climate Action, focuses on combating climate change through five urgent targets, fostering collaboration among governments, non-governmental organizations, and international entities (UN SDGs, 2023). As nations collectively strive for these goals, the agenda reflects a commitment to building a resilient, equitable, and sustainable future for all. UN member countries are actively working on mitigation and adaptation measures in response to climate change and its impacts. This study reviews sustainable construction practices for mitigating and adapting to climate change. It is essential for informing and advancing sustainable practices within the construction sector to address the challenges posed by climate change.

CLIMATE CHANGE

Climate Change and Its Impacts

Climate change refers to prolonged alterations in Earth's average temperature, weather patterns, and climate factors, predominantly caused by human activities like fossil fuel combustion and deforestation, emitting greenhouse gases (GHGs). Major GHGs include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated gases (Hoppe et al., 2014). Developing countries face escalating impacts and vulnerabilities due to climate change (Chowdhury et al., 2022). The accumulation of these gases intensifies the natural greenhouse effect, leading to rising temperatures and diverse consequences such as melting ice, sea-level rise, extreme weather events, and health risks (Nyong et al., 2007). Global efforts to combat climate change

involve renewable energy projects, emission reduction policies, sustainable development, and international agreements like the Paris Agreement. The goal is to transition to a low-carbon economy, enhance resilience, and foster a sustainable future. While progress is evident, sustained and accelerated action is essential to effectively address the challenges posed by climate change (Roy and Sims, 2020).

Climate Change Mitigation (CCM)

Climate change mitigation refers to the efforts and strategies aimed at reducing or preventing the emission of greenhouse gases (GHGs) into the atmosphere to alleviate the impact of global warming. Key elements of climate change mitigation include transition to renewable energy, energy efficiency, reforestation and afforestation, sustainable agriculture, carbon capture and storage (CCS), waste management, promoting low-carbon transportation, and international agreements. Mitigation efforts are crucial for preventing the most severe impacts of climate change and creating a sustainable and resilient future. Implementing these strategies requires collaboration at the local, national, and international levels, along with technological innovation and changes in individual and societal behaviors (Wamsler *et al.*, 2013).

Climate Change Adaptation (CCA)

Climate change adaptation involves strategies and actions that help societies, ecosystems, and individuals cope with and adjust to the impacts of climate change. Unlike mitigation, which aims to reduce or prevent greenhouse gas emissions, adaptation focuses on managing the risks and addressing the challenges posed by changing climatic conditions. Key aspects of climate change adaptation include infrastructure resilience, water management, crop diversification and changes in agricultural practices, ecosystem conservation and restoration, early warning systems, community planning and governance, health preparedness, financial instruments, and insurance. Adaptation measures are essential because some level of climate change is already inevitable due to past emissions, even with effective mitigation efforts. Successful adaptation requires a combination of scientific research, community engagement, policy development, and investment in resilient infrastructure and practices. Global collaboration is also crucial to sharing knowledge and resources to support vulnerable regions in adapting to the impacts of climate change (Wamsler *et al.*, 2013).

Both, mitigation and adaptation are critical components of a comprehensive strategy to address the challenges posed by climate change, and they often complement each other in building a more resilient and sustainable future.

Sustainable Construction

Sustainable construction, also known as green or eco-friendly construction, involves designing, building, and operating structures in an environmentally responsible and resource-efficient manner throughout their life cycle. The goal is to minimize the environmental impact of construction activities and the resulting buildings (Sijakovic & Peric, 2020). Energy efficiency, renewable energy sources, resource conservation, water efficiency, site selection, and design, waste reduction and recycling, indoor air quality, lifecycle assessment, green certifications, and community engagement are the key principles of sustainable construction. So Sustainable construction practices aim to create buildings that are environmentally responsible, economically viable, and socially beneficial. These efforts not only help mitigate the environmental impact of the construction industry but also contribute to the long-term well-being of communities and the planet (Pitt *et al.*, 2009).

Sustainable Construction Practices for Climate Change Mitigation

Sustainable construction practices play a crucial role in climate change mitigation by reducing the environmental impact of building activities and improving the energy efficiency and resilience of structures (Dabaieh *et al.*, 2022). Energy-efficient design, renewable energy integration, high-performance building envelope, green roof and walls, energy-efficient lighting, HVAC systems, smart building technologies, water-efficient systems, sustainable materials and construction techniques, lifecycle assessment, carbon offsetting and sequestration, resilient design for climate extremes and community engagement and education are the key sustainable construction practices that contribute to climate change mitigation. By implementing these sustainable construction practices, the construction industry can significantly contribute to climate change mitigation, reduce greenhouse gas emissions, and create more resilient and environmentally responsible structures (Stagrum *et al* and Yang *et al.*, 2020).



Sustainable Construction Practices for Climate Change Adaptation

Sustainable construction practices play a crucial role in climate change mitigation by reducing the environmental impact of building activities and improving the energy efficiency and resilience of structures (Pasimeni et al., 2019). Energy-efficient design, renewable energy integration, high-performance building envelope, green roof and walls, energy-efficient lighting and HVAC systems, smart building technologies, water-efficient systems, sustainable materials and construction techniques, lifecycle assessment, carbon offsetting and sequestration, resilient design for climate extremes, community engagement and education are key the sustainable construction practices that contribute to climate change adaptation. By implementing these sustainable construction practices, the construction industry can significantly contribute to climate change mitigation, reduce greenhouse gas emissions, and create more resilient and environmentally responsible structures (Stagrum et al., and Yang et al., 2020).

CONCLUSION

The sustainable construction practices for climate change mitigation and adaptation emphasize their pivotal role in addressing the challenges of a changing climate. These practices, encompassing both mitigation and adaptation measures, contribute to global efforts by reducing emissions and enhancing resilience against climate impacts. Mitigation strategies focus on minimizing the environmental footprint of construction through energy-efficient design, renewable energy use, and sustainable materials. Adaptation measures, on the other hand, involve designing structures and communities to withstand and adapt to climate-related challenges. The integration of these practices aligns with environmental stewardship, promoting resilient, energy-efficient, and socially responsible built environments. Sustainable construction practices are foundational to the collective endeavor to combat climate change, ensuring a sustainable and resilient future. Continuous research, innovation, and global collaboration are crucial for advancing these practices to effectively address the complex challenges presented by climate change in the built environment.

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