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Editorial: Resilience of the built environment to climate change

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Editorial on the Research Topic
Resilience of the built environment to climate change

Built environment refers to the human-made physical surroundings in which people live, work and play which include buildings, roads, bridges, parks and other infrastructure. The built environment is responsible for a significant portion of greenhouse gas (GHG) emissions and uses vast number of natural resources. Therefore, combating Climate Change (CC) requires addressing the built environment. To achieve this, focus must be made on reducing the carbon footprint of new and existing buildings through energy-efficient designs, renewable energy (RE) sources, and sustainable materials as well as retrofitting the existing buildings.

On the other hand, the resilience of the built environment refers to its ability to withstand and recover from adverse events or stresses, such as natural disasters, climate change, and other disturbances. The resilience of the built environment is a multifaceted approach that encompasses structural integrity, adaptability, risk assessment and mitigation, sustainable design, community engagement, and continuity planning. By addressing these aspects, governments and policy makers can create more resilient communities that can bounce back stronger from adversities. Key points about the resilience of the built environment are the structural integrity, redundancy, Adaptability, risk assessment and mitigation, sustainable design, community engagement, and education and continuity planning.

Furthermore, Climate Change (CC) refers to long-term shifts in temperature and weather patterns on Earth. It is primarily caused by human activities that release greenhouse gases (GHG), such as burning fossil fuels, deforestation, and industrial processes. Climate change results in various impacts, including rising sea levels, extreme weather events, altered ecosystems, and disruptions to agriculture and water supplies. According to the Mauna Loa Observatory in Hawaii, which measures atmospheric CO_2 levels continuously, the global monthly average for CO_2 concentration reached 419 ppm in May 2021 which is larger than the previous year's average of 416 ppm. It is predicted that if current global emissions continue, the concentration of CO_2 may surpass 450 ppm by 2030.

The global surface temperature in 2022 was 0.86°C warmer than the 20th-century average of 13.9°C and 1.06°C warmer than the pre-industrial period (1880–1900); now Earth temperature is about 14.9°C.

This edition covers part of key points in the resilient built environment. The result of surveys farmers in Ethiopia (like other middle African countries) showed that households who adopted small-scale irrigation had higher levels of resilience across various indicators, such as access to food, income, assets, agricultural production, stability, and adaptive capacity. The results also indicates that households with higher resilience were better able to withstand the impacts of climate change (Dawid et al.).

Among ways to build resilience is promoting sustainable lifestyles, developing climate-smart infrastructure, strengthening emergency preparedness, protecting natural resources, and investing in green technologies. The latest point is significant since energy is major source for comfort and prosperity. Integrating PV and wind turbines to buildings will assure sustainability, resilience and combating CC. For example, it was found that installing a 7.8 kW PV installation on a rooftop of a domestic house in Bahrain (a country in the Arid Zone in Arabian Peninsula) will provide maximum solar electricity of 1,228.9 kWh with maximum daily specific yield of 6.12 kWh/kWp. The average performance ratio of the PV system was 73.0%. The author reported that such PV installation will cut 4.637 tons of CO_2 per house (Alnaser).

According to a report by the International Energy Agency (IEA), renewable energy capacity is expected to grow by 50% in the next 5 years, with solar and wind leading the way. By 2025, it is projected that the world's total RE capacity will reach around 10,000 GW (10 TW), and solar and wind energy alone could account for two-thirds of this capacity. PV installation can improve the built environment in reducing carbon emissions, contributing in energy efficiency, cost savings, increasing property value, and Aesthetics, i.e., especially Building Integrated Photovoltaic (BIPV).

PV installation can provide multiple benefits to the built environment, making it more sustainable, efficient, valuable, and attractive. For this reason, one review article is incorporated in this edition (Kazem et al.). It is dedicated to provide researchers, policymakers, and practitioners with information on how Photovoltaic/thermal systems (PV/T) can contribute in CO_2 mitigation, reduction, and promoting sustainable building design. The environmental and economic aspects of PV/T systems, as well as their potential for GHG mitigation in various applications such as residential, commercial, industrial, and agricultural sectors, were critically analyzed. This paper is important since improving the performance of PV have several positive impacts on the built environment and making it more resilient, sustainable and energy-efficient.

Meanwhile, wind turbines can be integrated into building environments through the use of rooftop turbines, integrated through the use of building-integrated turbines (BITs), install large size wind turbine (1 MW or more), either offshore or inshore, and then distribute the wind electricity to the built environment via the national grid. This can provide a source of RE for the local community while also helping to reduce greenhouse gas emissions. To clarify such significance of combined wind and solar utilization and allows comparison which of both has more electricity yield in arid—wet region (such as Bahrain, Qatar, United Arab Emirates, Sultanate of Oman) an article was dedicated in this edition (Alnaser et al.). The authors reported that each kW installed of wind turbines produces, annually, 1,058 kWh (Specific yield of 2.9 kWh/kW/day) and will give an annual wind electricity in Bahrain of 1,057 MWh, i.e., alleviating 461 tons of CO_2. Meanwhile, the annual solar electricity from 1 MW solar PV was 1,632 MWh which in turn alleviate 654 tons of CO_2. The authors concluded that a 1MW of solar PV gives more electricity than a 1 MW of wind by 42% and subsequently alleviate CO_2 by 42% more than wind turbines' installation.

Advances in resilient built environments are important for creating safer and more sustainable communities. Advances encompass various aspects, including, **Building materials** (materials help mitigate damage and ensure the safety of occupants), **Design considerations** (set measures such as flood-resistant building techniques, green roofs to reduce urban heat island effects, and the integration of RE systems to reduce dependency on traditional power grids), **Smart technologies** (technologies can provide valuable real-time information, allowing for early warning systems and effective response during emergencies), **Community engagement** (Stakeholders and government authorities collaborate to identify vulnerabilities, prioritize needs, and develop solutions that address their specific challenges), and finally **Policy and regulations** (setting guidelines and standards for construction practices, encourage the adoption of green building techniques, and incentivize investments in resilient infrastructure development).

This Research Topic addresses how farming, PV rooftop installation, PVT technology and wind technology are all contributing in harmony toward making the built environment more resilient and combat climate change. Hopefully contributing in filling some of the missing gaps in such a topic and added to the existing knowledge on resilient built environments.

Hopefully, after COP28 in November 2023, which is striving to limit global warming to $<2°C$ above pre-industrial levels, another edition will be published covering more topics on the "*Resilience of the built environment to climate change*" by inviting more researchers, worldwide, to contribute and give their valuable thought in such an important topic.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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