Guest editorial

Building performance and measurement: its place within a variable climate

With a reluctance to take appropriate action, the IPCC have warned that the net cost of global climate change is considerable and increasing over time. For many, the implications are devastatingly severe, with anticipated fires, floods, droughts and extreme winds that will permanently reshape the environment. The recently reported loss of 219bn tonnes of ice, per year, and sea levels rising considerably faster than previously predicted is set to displace millions of people and, with the loss of the heat sink, the lack of ice will further contribute to global warming (Shepherd *et al.*, 2019; IPCC, 2019). The built environment has a critical role to play, if we are to slow down the change. Until now, as a major emitter of greenhouse gases, the sector has done relatively little to reduce emissions. Decarbonising energy supply is part of the process and this is progressing with countries like the UK, Denmark, the USA and China reducing the carbon intensity of the electrical supply (Assirati, 2019), yet the demand in these countries remains unsustainably high and set to increase. Relatively, the changes to the buildings are static and the inefficient building stock is a major consumer. The international targets for new buildings that are net zero by 2030 and all of the existing stock following suit by 2050 are but a vision, unless we have the measures, checks, processes and technology in place to advance change.

The pace of change in the performance of the building stock has been remarkably slow. Almost without question, today's buildings are not fit for purpose; even new buildings often fail to perform against current standards, resulting in the infamous performance gaps (Gorse, 2016). The real concern is that the enhanced performance standards required to transform towards zero and net plus buildings has not materialised. Developments that offer net zero contribution are limited almost to prototypes around which research is sporadic. A better understanding of new and existing buildings is required. Buildings are part of an integrated living system and all of the parts of the system need to be assessed to ensure optimum performance can be achieved. The built environment needs to adapt to one with the ability to function under changing climatic conditions and, in some cases, buildings must be capable of withstanding extreme environments while at the same time must drastically reduce associated emissions.

In some areas, the moderate environments may mean that less stringent requirements can still produce buildings that when integrated with green energy can provide a net zero habitat. Following on from this, there is a need to be considerate of the whole energy system: the local environment, climate, characteristic building behaviour and occupant behaviour to make appropriate use of renewable energy. Models and simulations of future environments, and iterations of different buildings, occupant and weather scenarios have a significant role to play in designing sustainable environments that we aspire to occupy.

The built environment research community are not be distracted by disputes over the variability of climate, but fully embrace the fact that the changes are not uniform. Human induced warming is superimposed on a naturally varying climate; conditions do fluctuate and do change with local peculiarities. Some areas can potentially benefit from climate change, resulting in habitable areas and with changes to the built environment, these areas may prosper. However, on aggregate most will suffer, with many areas requiring adjustment to survive. Those cities and homes that are not displaced by flooding and coastal erosion will need to change, becoming more resilient to weather extremes and, at the same time, being part of the net zero solution. Buildings will be contributing, and responsive, to a flexible energy network.

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Research into the performance of buildings and the energy systems has increased and there is much to understand from findings that are emerging from the field and laboratories. The *IJBPA* journal is well placed to capture and disseminate Building Performance and Evaluation research. Many of the leaders in the field have contributed to this special edition providing insights based on research conducted in laboratories, the field, through simulations and models. In this issue a framework for evaluating building performance is provided; with papers on thermal analysis, air permeability and air tightness, heat transfer coefficients from in-use data, sensitivity analysis of net-energy and integrated facades, assessment methodologies for energy demand, the impact of materials and elements under freeze thaw cycles, understanding building performance in different climatic conditions and visualising building performance within our models, simulations and twins. There is much to understand in our ever-changing environment. The work exposed in this special edition represents the tip of a rapidly melting iceberg, further research and action is needed to ensure that this is not the pinnacle of our academic endeavour.

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