Climate Change Resilience in the Urban Environment

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This book is dedicated to my family; my lovely wife Caroline and our son Jasper, whose arrival during the writing of the book proved a major (but welcome) distraction from writing and whose little fingers were constantly reaching for my keyboard, trying to edit my work. So if you find any mistakes they are probably his fault - honest.

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Preface

For the first time in history more than half of the world's population lives in urban areas, a number that was only 30% in 1960, and this figure is set to increase dramatically over the next few decades, reaching ~70% by 2050. This rapid growth in urban populations will occur mainly in the developing world, with some countries expected to experience up to a five-fold increase in urban populations by 2050. Increasing urbanisation brings with it a series of benefits, but also challenges. Increased urbanisation and urban density allows for more efficient use of materials and infrastructure, such as fewer roads, more efficient public transport, reduced distribution losses in energy networks, and the ability to have larger more-centralised public services, e.g. police, fire services, and healthcare. However, there are draw backs. An increasing urban area typically means a loss of vegetative cover in favour of hard impermeable man-made surfaces. This can increase the risk of flooding from intense rainfall, while the dense materials used to construct our urban areas store heat from the Sun to be radiated later, altering the local climate. Even the position and orientation of our buildings can have a negative effect, isolating the urban microclimate from the atmosphere above, trapping heat and pollutants at street level.

Human civilisation and current architectural practices have evolved over the past few thousand years during a period of relatively constant climate and predictable weather. Thus, our buildings are the result of the interaction between culture, geography, and meteorology. This has allowed for architectural design and the layout of urban areas to be tailored to the local climate. Underneath the influences of culture and social interaction, the architecture of a building has two main functions: to provide shelter from the elements, and to provide thermal comfort for its occupants. At every latitude, buildings transform sometimes harsh exterior environmental conditions into a comfortable interior environment. They achieve this feat through little more than careful design and the appropriate use of materials. However, as cities have begun to grow rapidly, these traits have been lost.

Globalisation has led to the prevalence of new materials and techniques, creating a divergence between the design and construction of buildings and their local cultural, social, ecological, and environmental context. Buildings are now built more for speed of construction and cost rather than to be resilient to the local climate, as cheap energy has meant that artificial heating and cooling can be used to compensate for a climate-insensitive design.

Climate change is altering the way our buildings will need to perform. Changing temperatures, the seasonality of rainfall, and increased instances of weather that are currently classed as extreme, mean that our buildings will have to cope with different environmental conditions than previously. There is evidence, however, that vernacular architecture can be integrated into modern buildings to promote resilience to environmental stresses. But in order to combat the impacts of climate change, we will need to consider not only the vernacular architectural details from our own culture and climate, but also those of other global locations that currently have a climate that may be similar to what we can expect in the future.

Figure 1. Growing cities and expanding urban areas can provide many socioeconomic benefits but also provide many climate-related challenges.

This book aims to consider not only what the impacts of climate change are on the built environment, but also what we can do to try and mitigate the impacts of climate change.

Author biography

Tristan Kershaw

Tristan Kershaw is currently a Lecturer in Climate Resilience at the University of Bath. Tristan graduated from the University of Exeter in 2004 with a Masters degree in Physics and went on to study for a PhD in low temperature solid state physics. After completing his PhD, he joined the Centre for Energy and the Environment also at the University of Exeter as a research fellow in climate change adaptation. Over the subsequent six years, he worked on a variety of 'building physics'-related research and consultancy projects, including the creation of probabilistic future weather years for the UK for the thermal modeling of buildings, as well as the modelling and adaptation of building designs for several exemplar buildings across the southwest region. In 2014, Tristan joined the University of Bath as a lecturer in the Department of Architecture and Civil Engineering, teaching both undergraduate and postgraduate engineers and architects on the topics of building physics, sustainability, climate change, and the dynamic modelling of building designs.

This book is based primarily upon Tristan's research and consultancy work, and as such it contains many case studies from, in, and around the southwest UK, along with observations of architecture and building use from further afield.