

# Preface

The United Nations Intergovernmental Panel on Climate Change (IPCC) makes it clear that climate change is due to human activities and it recognizes buildings as a distinct sector among the seven analyzed in its 2007 Fourth Assessment Report. Global concerns have escalated regarding carbon emissions and sustainability in the built environment. The built environment is a human-made setting to accommodate human activities, including building, and transport, which covers an interdisciplinary field addressing design, construction, operation, and management. Specifically, sustainable buildings are expected to achieve high performance throughout the life cycle of siting, design, construction, operation, maintenance, and demolition in the following areas:

- energy and resource efficiency;
- cost-effectiveness;
- minimization of emissions that negatively impact global warming, indoor air quality, and acid rain;
- minimization of waste discharges; and
- maximization of fulfilling the requirements of occupants' health and wellbeing.

Professionals in the built environment sector, such as urban planners, architects, building scientists, engineers, facilities managers, performance assessors, and policy makers, will play a significant role in delivering a sustainable built environment. Delivering a sustainable built environment requires therefore an integrated approach and so it is essential for built environment professionals to have interdisciplinary knowledge in building design and management. Building and urban designers need to have a good understanding of the planning, design, and management of buildings in terms of low carbon and energy efficiency. There are a limited number of traditional engineers who know how to design environmental systems (services engineer) in great detail, yet, there is still a very large market for technologists with multi-disciplinary skills who are able to identify the need for, envision, and manage the deployment of a wide range of sustainable technologies, both passive (architectural) and active (engineering system), and select the appropriate approach. Employers seek applicants with skills in analysis, decision

making/assessment, computer simulation, and project implementation. An integrated approach is expected in practice, which encourages built environment professionals to think ‘out of the box’ and learn to analyze real problems using the most relevant approach, irrespective of discipline.

The *Design and Management of Sustainable Built Environments* book aims to produce readers capable of applying fundamental scientific research to solve real-world problems in the general area of sustainability in the built environment. The book contains twenty chapters covering climate change and sustainability, urban design and assessment (planning, travel systems, urban environment), urban management (drainage and waste), buildings (indoor environment, architectural design, and renewable energy), simulation techniques (energy and airflow), management (end-user behavior, facilities, and information), assessment (materials and tools), procurement, and cases studies (BRE Science Park).

Chapters 1 and 2 present general global issues of climate change and sustainability in the built environment. Chapter 1 illustrates that applying the concepts of sustainability to the urban environment (buildings, infrastructure, transport) raises some key issues for tackling climate change, resource depletion, and energy supply. Buildings, and the way we operate them, play a vital role in tackling global greenhouse gas emissions. Holistic thinking and an integrated approach in delivering a sustainable built environment is highlighted. Chapter 2 demonstrates the important role that buildings (their services and appliances) and building energy policies play in this area. Substantial investment is required to implement such policies, much of which will earn a good return.

Chapters 3 and 4 discuss urban planning and transport. Chapter 3 addresses the importance of using modeling techniques at the early stage for strategic masterplanning of a new development and a retrofit program. A general framework for sustainable urban-scale masterplanning is introduced. This chapter also addresses the needs for the development of a more holistic and pragmatic view of how the built environment performs. Urban planning tools will assist to achieve a higher level of sustainability in the built environment. The chapter, in particular, introduces how people plan, design, and use the tool. Chapter 4 discusses micro-circulation, which is an emerging and challenging area which relates to changing travel behavior in the quest for urban sustainability. The chapter outlines the main drivers for travel behavior and choices, the workings of the transport system, and its interaction with urban land use. It also covers the new approach to managing urban traffic to maximize economic, social, and environmental benefits.

Chapters 5 and 6 present topics related to urban microclimates including thermal and acoustic issues. Chapter 5 discusses urban microclimates and urban heat island, as well as the interrelationship of urban design (urban forms and textures) with energy consumption and urban thermal comfort. It introduces models that can be used to analyze microclimates for a careful and considered approach in planning sustainable cities. Chapter 6 discusses urban acoustics, focusing on urban noise evaluation and mitigation. Various prediction and simulation methods for sound propagation in micro-scale urban areas, as well as techniques for large-scale urban noise-mapping, are presented.

Chapters 7 and 8 discuss urban drainage and waste management. The growing demand for housing and commercial developments in the twenty-first century, as well as the environmental pressure caused by climate change, has increased the focus on sustainable urban drainage systems (SUDS). Chapter 7 discusses the SUDS concept which is an integrated approach to surface water management. It takes into consideration quality, quantity, and amenity aspects to provide a more pleasant habitat for people as well as increasing the biodiversity value of the local environment. Chapter 8 discusses the main issues in urban waste management. It points out that population increases, land use pressures, technical, and socioeconomic influences have become inextricably interwoven and how ensuring a safe means of dealing with humanity's waste becomes more challenging.

Sustainable building design needs to consider healthy indoor environments, minimizing energy for heating, cooling and lighting, and maximizing the utilization of renewable energy. Chapter 9 considers how people respond to the physical environment and how that is used in the design of indoor environments. It considers environmental components such as thermal, acoustic, visual, air quality, and vibration and their interaction and integration. Chapter 10 introduces the concept of passive building design and its relevant strategies, including passive solar heating, shading, natural ventilation, daylighting, and thermal mass, in order to minimize heating and cooling load as well as energy consumption for artificial lighting. Chapter 11 discusses the growing importance of integrating Renewable Energy Technologies (RETs) into buildings, the range of technologies currently available and what to consider during technology selection processes in order to minimize carbon emissions from burning fossil fuels. The chapter draws to a close by highlighting the issues concerning system design and the need for careful integration and management of RETs once installed; and for homeowners and operators to understand the characteristics of the technology in their building.

Computer simulation tools play a significant role in sustainable building design because, as the modern built environment design (building and systems) becomes more complex, it requires tools to assist in the design process. Chapter 12 gives an overview of the primary benefits and users of simulation programs, the role of simulation in the construction process and examines the validity and interpretation of simulation results. Chapter 13 focuses particularly on the Computational Fluid Dynamics (CFD) simulation method used for optimization and performance assessment of technologies and solutions for sustainable building design and its application through a series of cases studies.

People and building performance are intimately linked. A better understanding of occupants' interaction with the indoor environment is essential to building energy and facilities management. Chapter 14 focuses on the issue of occupant behavior; principally, its impact, and the influence of building performance on them. Chapter 15 explores the discipline of facilities management and the contribution that this emerging profession makes to securing sustainable building performance. The chapter highlights a much greater diversity of opportunities in sustainable building design that extends well into the operational life. Chapter 16 reviews the concepts of modeling information flows and the use of Building

Information Modeling (BIM), describing these techniques and how these aspects of information management can help drive sustainability. An explanation is offered concerning why information management is the key to ‘life-cycle’ thinking in sustainable building and construction.

Measurement of building performance and sustainability is a key issue in delivering a sustainable built environment. [Chapter 17](#) identifies the means by which construction materials can be evaluated with respect to their sustainability. It identifies the key issues that impact the sustainability of construction materials and the methodologies commonly used to assess them. [Chapter 18](#) focuses on the topics of green building assessment, green building materials, sustainable construction, and operation. Commonly used assessment tools such as BRE Environmental Assessment Method (BREEAM), Leadership in Energy and Environmental Design (LEED), and others are introduced.

[Chapter 19](#) discusses sustainable procurement which is one of the areas to have naturally emerged from the overall sustainable development agenda. It aims to ensure that current use of resources does not compromise the ability of future generations to meet their own needs.

[Chapter 20](#) is a best-practice exemplar—the BRE Innovation Park which features a number of demonstration buildings that have been built to the UK Government’s Code for Sustainable Homes. It showcases the very latest innovative methods of construction, and cutting edge technology for sustainable buildings.

In summary, the *Design and Management of Sustainable Built Environments* is the result of cooperation and dedication of individual chapter authors. We hope readers will benefit from gaining a broad interdisciplinary knowledge of design and management in the built environment in the context of sustainability. We believe that the knowledge and insights of our academics and professional colleagues from different institutions and disciplines illuminate a way of delivering sustainable built environment through holistic integrated design and management approaches. Last, but not least, I would like to take this opportunity to thank all the chapter authors for their contribution. I would like to thank David Lim for his assistance in the editorial work.

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