Sustainable Building Design
Sustainable Building Design: Principles and Practice

Edited by

Miles Keeping
Hillbreak, Oxford

David Shiers
Oxford Brookes University, Oxford

WILEY Blackwell
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**List of Contributors**

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<th>Name</th>
<th>Company</th>
<th>Address</th>
<th>City</th>
<th>Postcode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ann-Marie Aguilar</td>
<td>Arup Associates</td>
<td>London W1T 4BQ</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>Jane Anderson</td>
<td>Thinkstep</td>
<td>Sheffield S1 2BJ</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>Michael Beavan</td>
<td>Arup Associates</td>
<td>London W1T 4BQ</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>Mick Brundle</td>
<td>Arup Associates</td>
<td>London W1T 4BQ</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>Tim Chatterton</td>
<td>University of the West of England</td>
<td>Bristol BS16 1QY</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>Paul Dickenson</td>
<td>Arup Associates</td>
<td>London W1T 4BQ</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>Mark Fisher</td>
<td>Arup Associates</td>
<td>London W1T 4BQ</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>Francesca Galeazzi</td>
<td>Arup Associates</td>
<td>London W1T 4BQ</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>Hugo Hodgson</td>
<td>Carter Jonas</td>
<td>London W1G 0BG</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>Miles Keeping</td>
<td>Hillbreak Ltd.</td>
<td>Buckinghamshire HP18 9TH</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>Katharine Marsden</td>
<td>Strutt &amp; Parker</td>
<td>London W1J 5LQ</td>
<td></td>
<td>UK</td>
</tr>
<tr>
<td>David Pearce</td>
<td>Arup Associates</td>
<td>London W1T 4BQ</td>
<td></td>
<td>UK</td>
</tr>
</tbody>
</table>
List of Contributors

Robert Pugh
Arup Associates
London
W1T 4BQ
UK

Malcolm Smith
Arup Associates
London
W1T 4BQ
UK

David Shiers
School of the Built Environment
Oxford Brookes University
Oxford
OX3 0BP
UK

Kristian Steele
Arup Associates
London
W1T 4BQ
UK
Whilst this book will be of obvious interest to designers, it will also help those in other disciplines to understand how buildings can be made to lessen their environmental impact and yet provide high-quality, valuable space.

Sustainability has to be at the heart of 21st century design – but is informed by, and will, in turn, inform, other associated technical, conservation, aesthetic and financial considerations. Bringing these building blocks of any incipient scheme to the notice of designers and students is sometimes difficult, but nevertheless rewarding when achieved. This book by David Shiers and Miles Keeping provides not only an extremely comprehensive catalogue of useful references and methods, but also illuminating sections tracing the progress of projects from early design onwards through the realisation process. Here, architectural and engineering solutions are analysed from first sketches to provide evidence of the underlying science against the more elusive, but necessary quotient of inspirational design.

This process, part practical, part intellectual (as evident in Arup’s strong research base) never loses the thread of the necessity to take environmental impact, in both resourcing and construction, absolutely seriously from generative thoughts through to completion.

As a textbook, this volume excels – using case studies as exemplars, brings the design process into focus by providing a tantalising insight into how a factual knowledge base can be utilised to provide a backbone to the excitement of actual design.

The research and the many digital learning links used here are arranged within a constructed academic framework and so will be of great help to students of the built environment as an easy-to-access source of information. Perhaps more importantly, many of the ideas and projects presented here will, for the property professionals of today and tomorrow, provide inspiration. This book is to be recommended to students and practitioners alike.

Foreword by Dave King:
Architect and Founder of Shed-KM

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At Arup: Ann Marie Aguilar, Michael Beaven, Mick Brundle, David Pearce, Mark Fisher and Malcolm Smith.
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1

Introduction

Miles Keeping¹, David Shiers², Ann-Marie Aguilar³ and Michael Beavan³

¹ Hillbreak Ltd., Buckinghamshire, HP18 9TH, UK
² School of the Built Environment, Oxford Brookes University, Oxford, OX3 0BP, UK
³ Arup Associates, London, W1T 4BQ, UK

The term ‘Total Architecture’ implies that all relevant design decisions have been considered together and have been integrated into a whole by a well organised team empowered to fix priorities. This is an ideal which can never - or only very rarely - be fully realised in practice, but which is well worth striving for, for artistic wholeness or excellence depends on it, and for our own sake we need the stimulation produced by excellence.


Achieving excellence in design and construction is, arguably, an even greater challenge today than when Ove Arup first began practice as an engineer and architect in the 1920s.

Now, as then, each project design and construction team must tackle what is a unique combination of variables, particular to an individual building or piece of infrastructure. Site-specific technical and aesthetic considerations, the functional needs of the eventual users, financial and contractual constraints, macro-economic conditions, Building Codes and legal requirements (all of which are subject to constant change), mean that every new project is, in effect, a prototype.

But as awareness has grown of the potentially devastating effects of contamination, atmospheric emissions and the finite nature of many natural resources, now, at this point in the 21st century, designers and project managers must also help to achieve the international community’s wider goals of reducing negative environmental impacts arising from human activity. The increasing interconnectedness of societal systems around the world means the design and management of buildings and infrastructure must respond not only to local and national ecological issues but also to global environmental concerns.

It could be said that the principles of sustainability have long been at the heart of the best architecture and engineering projects. Even before the term ‘green’ was applied to buildings, many designers tried hard to strike a responsible balance between the natural and the built environments and to meet the needs of the present, whilst leaving a
positive legacy for future generations. However, today there is an expectation that all property professionals put sustainability at the heart of their projects and indeed, there is legislation in many parts of the world to ensure that this is the case. But how is the environmental impact of property to be minimised whilst at the same time ensuring that buildings also meet the high aesthetic, practical and financial expectations of stakeholders?

In order that Built Environment students and practitioners can better understand how to meet today’s sustainability objectives, this book sets out to explain some of the techniques used by leading architects and engineers.

Sustainable or ‘green’ building can be defined as ‘design and construction which seeks to minimise negative environmental impacts in an integrated and holistic way over the whole life-cycle of the project.’ Green projects will commonly have the following features:

- Maximised opportunities to re-use existing buildings, structures and materials through recycling, refurbishment, conversion, adaptation and extension.
- Utilised and/or enhanced existing public transport networks to reduce dependency on fossil-fuel-powered vehicles as part of a carefully planned transport strategy.
- Minimal negative site impact through sensitivity to site ecology, flora and fauna.
- Minimal consumption of energy from non-renewable sources both during construction and post-occupancy through the use of energy-efficient lighting, heating, ‘natural’ ventilation and cooling systems and by careful orientation and façade treatments.
- The use of materials which have the lowest possible environmental impact and which have been responsibly sourced as part of a carefully planned maintenance, repair, reuse and replacement strategy.
- Responsible water management both in use, through ‘grey water’ capture and in disposal, through Sustainable Urban Drainage Systems (SUDS).
- Carefully planned waste management strategies during both construction and after occupation.
- Minimal use of harmful chemicals in the construction and post-occupancy management of the project through careful specification of construction material preservation treatments, cleaning fluids, paints and solvents as well as substances which may harm human health, wildlife and insects.
- High standards of air quality and natural lighting to ensure healthy indoor environments for living and working.
- Respectful, transparent and inclusive engagement with local community and stakeholder groups and a positive contribution to the public realm.

Environmental Assessment

Low environmental impact projects would also normally have an independently certified ‘green badge’ which measures and verifies good practice. Licensed assessors evaluate energy efficiency, levels of carbon emissions, transport impacts, the use of low impact materials etc. against a set of metrics derived from Life Cycle Assessment (LCA) data by leading environmental researchers, architects and engineers within organisations such as the Building Research Establishment (BRE) and the US Green Building
1. Waste heat from the studio lights rises through the studio ventilation chimneys.
2. As waste heat rises, a small negative pressure is set up in the studios.
3. This pressure drop overcomes the resistance of the sound attenuators, drawing in fresh cool air from the exterior.
4. Exterior intake grilles.
5. When external conditions are in appropriate for natural ventilation, mechanical ventilation and cooling of the studio spaces can be implemented using the same chimneys.
6. Office natural ventilation chimney follows similar principles.


Council (USGBC). Assessment programmes including BREEAM (the Building Research Establishment Environmental Assessment Method), LEED (Leadership in Energy Efficient Design) in United States and Green Star in Australia are now widely used with some 538,200 BREEAM certified developments globally and almost 2,230,600 buildings registered for assessment since its launch in United Kingdom in 1990 (BRE, 2016).

Commonly used green design and assessment tools:

- BREEAM: http://www.breeam.com/
- LEED: http://www.usgbc.org/leed
- Passivhaus: http://www.passivhaus.org.uk/
- The Home Quality Mark: http://www.homequalitymark.com/
- SKA: http://www.rics.org/uk/knowledge/ska-rating-

Other sources of guidance for practitioners and clients include:

- Blue Angel Ecolabelling: http://www.ecolabelindex.com/ecolabel/blue-angel
The use of environmental scoring systems has become a popular way of marketing the ‘green credentials’ of the buildings and master plans of property owners, occupiers and other stakeholders. Such badging is seen increasingly as an indicator of, and is synonymous with, high-quality design and a progressive, responsible approach to social and environmental concerns.

Users of these tools should be aware that although their methodology strives to be objective and robust, as with any scoring system, marking criteria, parameters, performance standards, the reliability of the underpinning data used and the level of importance attributed to particular issues are subject to debate. For example, when scoring the ‘greenness’ of a building project, is resource use (say, of water) more or less important than waste management issues?

No environmental design tool will be without its critics, but as long as methodologies are transparent, the ways of measuring green performance will remain useful and, at the very least, will encourage designers, engineers and constructors to move in the right direction.

Typical BREEAM Categories against which the environmental performance of a project are assessed:

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<th>Management</th>
<th>Health and Wellbeing</th>
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<td>Indoor air quality</td>
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<td>Safe containment in laboratories</td>
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<td>Commissioning and handover</td>
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<td><strong>Energy</strong></td>
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<td>Reduction of energy use and carbon emissions</td>
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<td>Energy-efficient cold storage</td>
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<td>Energy-efficient transportation systems</td>
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<td>Energy-efficient laboratory systems</td>
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<td>Energy-efficient equipment</td>
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<td>Drying space</td>
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<td><strong>Water</strong></td>
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<td>Water consumption</td>
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<td>Water monitoring</td>
<td>Hard landscaping and boundary</td>
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<td>Water-efficient equipment</td>
<td>Responsible sourcing of materials</td>
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<td>Insulation</td>
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<td>Designing for durability and resilience</td>
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