Advances in 21st Century Human Settlements

Rama Devi Nandineni
Susan Ang
Norwina Binti Mohd Nawawi *Editors*

Sustainable Resilient Built Environments

Proceedings of SRBE 2022, India

Springer

Advances in 21st Century Human Settlements

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This Series focuses on the entire spectrum of human settlements – from rural to urban, in different regions of the world, with questions such as: What factors cause and guide the process of change in human settlements from rural to urban in character, from hamlets and villages to towns, cities and megacities? Is this process different across time and space, how and why? Is there a future for rural life? Is it possible or not to have industrial development in rural settlements, and how? Why does 'urban shrinkage' occur? Are the rural areas urbanizing or is that urban areas are undergoing 'ruralisation' (in form of underserviced slums)? What are the challenges faced by 'mega urban regions', and how they can be/are being addressed? What drives economic dynamism in human settlements? Is the urban-based economic growth paradigm the only answer to the quest for sustainable development, or is there an urgent need to balance between economic growth on one hand and ecosystem restoration and conservation on the other – for the future sustainability of human habitats? How and what new technology is helping to achieve sustainable development in human settlements? What sort of changes in the current planning, management and governance of human settlements are needed to face the changing environment including the climate and increasing disaster risks? What is the uniqueness of the new 'socio-cultural spaces' that emerge in human settlements, and how they change over time? As rural settlements become urban, are the new 'urban spaces' resulting in the loss of rural life and 'socio-cultural spaces'? What is leading the preservation of rural 'socio-cultural spaces' within the urbanizing world, and how? What is the emerging nature of the rural-urban interface, and what factors influence it? What are the emerging perspectives that help understand the human-environment-culture complex through the study of human settlements and the related ecosystems, and how do they transform our understanding of cultural landscapes and 'waterscapes' in the 21st Century? What else is and/or likely to be new vis-à-vis human settlements – now and in the future? The Series, therefore, welcomes contributions with fresh cognitive perspectives to understand the new and emerging realities of the 21st Century human settlements. Such perspectives will include a multidisciplinary analysis, constituting of the demographic, spatio-economic, environmental, technological, and planning, management and governance lenses.

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Series Editor's Foreword

In our ever-evolving world, the built environment plays a pivotal role in shaping the very essence of our lives. As urbanization accelerates and the concomitant environmental concerns loom large, the Sustainable Resilient Built Environments (SRBE) International Conference takes on a significance that is not just symbolic, but also profound in its potential towards transforming our approaches to the spaces we inhabit. We stand at a critical juncture where our actions must be guided by foresight, innovation, and a steadfast commitment to the greater good.

I am honoured to write the Foreword to this anthology, *Sustainable Resilient Built Environments—Proceedings of SRBE 2022, India*, co-edited by Rama Devi Nandineni, Susan Ang, and Norwina Binti Mohd Nawawi.

The book is based on the 2nd SRBE International Conference 2022, organized by Manipal School of Architecture and Planning (MSAP), Manipal Academy of Higher Education (MAHE), India, in collaboration with the other four SRBE Consortium Universities, i.e. the School of Architecture and Built Environment, Deakin University (Geelong, Australia), Kulliyyah of Architecture and Environmental Design, International Islamic University of Malaysia (Kuala Lumpur, Malaysia), Moratuwa University (Moratuwa, Sri Lanka), and the Auckland University of Technology (Auckland, New Zealand).

I was deeply grateful for the opportunity to act as the 'Guest of Honour' at the 2nd SRBE International Conference and deliver a keynote address, 'Redefining Urban Sustainability in the Post-Pandemic Era'. Held in hybrid mode at MSAP, Manipal, India, during 19–21 December 2022, the Conference was jointly convened by Intercultural Dialogue through Design (IDiDe, founded in 2010) and SRBE (formed in 2019). A global mobility network for students, academicians, and industry, IDiDe-SRBE is based on five pillars: culture, collaboration, community, contribution, and continuity.

The SRBE International Conference stands as a beacon of enlightenment and progress, bringing together brilliant minds and dedicated souls from around the world to deliberate on the multifaceted challenges and opportunities that lie at the intersection of smart buildings, sustainability, community resilience, heritage sustainability, and COVID-19 pandemic-related issues within the built environment.

The *Proceedings of SRBE 2022, India* encompass a diverse array of themes, ranging from 'Environment Design and Sustainability', 'Sustainable Smart Buildings', 'Heritage and Sustainability', 'Community Resilience and Social Sustainability', to the nuanced exploration of 'Pandemic Issues and Sustainable Development'. This collection is a testament to the multidisciplinary essence of sustainability, which has undergone a paradigm shift over the years, encompassing economic growth, resource stewardship, and cultural preservation. Within these pages, the readers will find discussions on smart buildings that redefine the ways in which structures are conceived, constructed, and maintained while nurturing a higher quality of life. The discourse extends to green building rating systems and policies, poised to catalyze sustainable growth, reduce carbon emissions, and address the looming spectre of climate change.

Sustainability, the bedrock upon which responsible development rests, assumes an unequivocal prominence in the discourse of the 2nd SRBE International Conference. Our environment, a delicate web of interconnected systems, necessitates an approach that is considerate of the consequences our actions bear on Planet Earth. Through the sharing of insights, research findings, and innovative practices, the *Proceedings of SRBE 2022, India* endeavour to carve a path forward that respects ecological limits, conserves resources, and mitigates the negative impacts of our built environment on the world we share.

The dialogue surrounding community resilience and social sustainability underscores the profound impact of community engagement, inclusivity, and social equity on the trajectory of sustainable development. Community resilience—a concept that resonates deeply in the wake of unprecedented challenges, emerges as a vital theme. The global community has been tested time and again, from natural disasters to health crises, reminding us of our vulnerability and our shared humanity. The built environment, as an integral part of this tapestry, must be a bastion of strength, capable of nurturing and safeguarding its inhabitants even in times of turmoil. The conversations initiated here will explore strategies that empower communities to recover, adapt, and flourish amidst adversity.

Furthermore, the interplay between heritage preservation and sustainability unveils a poignant connection between our cultural heritage and our sustainable future. In the realm of heritage sustainability, we find ourselves at intriguing crossroads between the past and the future. Our architectural heritage, a repository of culture and history, holds the potential to inspire and guide our contemporary endeavours. The 2nd SRBE International Conference provides a platform to explore the delicate balance between preserving the past and embracing the future, as innovative ways are sought to adapt heritage structures for modern needs while safeguarding their intrinsic value.

In the light of the COVID-19 pandemic, this co-edited volume takes a bold step in examining how sustainable development can serve as a compass in navigating these unprecedented times. The contributions here reflect an unwavering commitment to excellence, as each chapter has undergone rigorous peer review to ensure a standard of academic and practical distinction. The profound disruptions brought about by the COVID-19 pandemic have exposed fault lines in our systems and spurred urgent

reflections on preparedness and adaptability. The built environment, being both a contributor and a solution to these challenges, is under scrutiny like never before. The pandemic-related issues addressed in the 2nd SRBE International Conference emphasize the need for flexible design, health-conscious planning, and dynamic responses that can withstand the unpredictable. In this context, I am delighted to join the Co-Editors and the contributing authors to reinforce our collective commitment towards creating built environments that prioritize human wellbeing above all else.

In each of the abovementioned conference themes, the common thread of sustainability emerges, weaving together the complex tapestry of environmental consciousness, cultural diversity, economic growth, and social equity. It underscores a paradigm shift that speaks to the evolving ethos of our time—a profound recognition of the need to harmonize progress with ecological and societal balance.

The chapters in the *Proceedings of SRBE 2022, India* represent the epitome of academic rigour and excellence. Methodically peer-reviewed and meticulously curated, each chapter offers valuable insights and recommendations that can guide academics, researchers, practitioners, policymakers, and students in their pursuit of sustainable and resilient practices in the built environment.

Crucially, the efforts showcased in the 2nd SRBE International Conference resonate harmoniously with the Sustainable Development Goals (SDGs), which were adopted by the United Nations General Assembly in September 2015. The SDGs provide a universal blueprint for a more equitable, prosperous, and sustainable world. By aligning our research, practices, and aspirations with the SDGs, we amplify our collective impact, forging a path that simultaneously addresses poverty, inequality, climate change, and a multitude of interconnected challenges.

I congratulate the dedicated individuals who have contributed their time, expertise, and enthusiasm to make the 2nd SRBE International Conference a reality. The collaboration and collective wisdom on display here exemplify the spirit of unity that is essential for ushering in a positive change. It is through forums like these that we foster cross-disciplinary dialogues, spark new ideas, and catalyse actions that transcend borders and disciplines.

As we embark on this intellectual journey together, I am confident that the discussions, insights, and networks formed during the 2nd SRBE International Conference will reverberate far beyond its successful completion. Our collective commitment to a sustainable and resilient built environment is not a fleeting endeavour; it is a commitment to the wellbeing of our planet and its inhabitants, both present and future.

The co-edited volume serves as a valuable source of knowledge for those involved in the field of sustainable and resilient built environments, as well as for those seeking to advance the cause of sustainability in the twenty-first-century human settlements.

I invite you all to immerse yourselves fully in the exchange of knowledge, ideas, and experiences that await within these pages. Let us harness the power of collective intellect and creative innovation to chart a course towards a world where our built environment stands as a testament to human progress, resilience, and harmony with Mother Nature!

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Preface



World is heading towards rapid urbanization which necessitates the need for assessing the impact of anthropogenic activities over their entire life cycle and developing best practices. Also, sustainable and resilient solutions have become very significant to the built environment comprising of varying scales of conurbations, urban and rural areas, buildings, parks, green spaces, infrastructure, and communities which have a profound impact on human wellbeing, economy, and the environment. To address and make a change the conference series on Sustainable Resilient Built Environments evolved in 2020 and was conducted in Kuala Lumpur, Malaysia. Its aim was to promote intercultural dialogue in design, collaborative design learning, underprivileged community participation in design and research in rural and urban built environments to find solutions for the pressing problems to mankind in the built environment while the second in the series SRBE 2022 was a collaboration between MSAP, MAHE, Manipal, Deakin University, Australia, IIUM, Malaysia University of Moratuwa, Sri Lanka and Auckland University of Technology and was based on the five pillars: culture, collaboration, community, contribution, continuity to foster the spirit of collaboration to contribute meaningful dialogue, bridge gaps, and forge new paths towards a sustainable and resilient future. This was conducted and hosted by Manipal School of Architecture and Planning, Manipal Academy of Higher Education, Manipal, India. The conference deliberated on the implications of

different approaches to planning, design, operation, management, and governance towards improving quality of life and solving environmental issues and to meet the UN sustainable development goals and mitigate climate change, while equally fulfilling and meeting developmental and environmental needs of future generation. The knowledge, experiences, and insights of experts from diverse fields towards approach to design, construction, and management of the built environment with a keen focus on sustainability and resilience, which were presented in SRBE2022 by leading experts, academics, professionals, and policymakers from around the world to exchange knowledge and explore innovative ideas towards achieving a sustainable and resilient built environment are encapsulated in this volume of Advances in 21st Century Human Settlements. The proceedings encompass, a wide range of topics and perspectives centred around the themes of Environment Design and Sustainability, Sustainable Smart Buildings, Heritage and Sustainability, Community Resilience and Social Sustainability, and Pandemic Issues and Sustainable Development. This book was initiated and introduced to SRBE 2023 by Prof. Bharath Dahiya who has been instrumental in the successful publication of the proceedings. We extend our deepest gratitude to Prof. Bharath Dahiya for his invaluable guidance and unwavering support all through our conference and publication. We would also like to acknowledge Prof. Dahiya Director, Research Center for Integrated Sustainable Development, Thammasat University, Bangkok, Thailand and who is also an extraordinary Professor at the school of public leadership, Stellenbosch University, Stellenbosch, South Africa, for gracing the conference as Guest of Honour and delivering keynote address on 'Redefining Sustainability in Pandemic Era' as the 10th lecture in the special lecture series in commemoration of the 25th Anniversary of his Global professional journey.

Sustainability, an interdisciplinary theme, which has undergone a massive paradigm shift over the years is seen to address the challenges faced by humanity and the need to strike a balance between economic growth, sustainable management of environment, natural resources, and cultural variations. While the Sustainable and Smart buildings discussed the way, buildings are designed, built, and operated for enabling an environment that improves the quality of life and also, with a focus on green building rating systems, which measure the environmental performance of a building through its life cycle Further, the requisite measures and policy framework for sustainable growth and informed decision-making aimed at reducing global carbon emissions and climate change for a sustainable future were also a part of the conference and its proceedings. Additionally, the topics in the conference and proceedings explored community resilience and social sustainability, emphasizing the significance of community engagement, inclusivity, and social equity in sustainable development. Further, the intersection of heritage preservation and sustainability highlighted the importance of preserving our cultural legacy while promoting sustainable practices. Finally, the volume addresses the unique challenges posed by the global pandemic and investigations of the role of sustainable development in navigating these unprecedented times. Each of the above themes was addressed by eminent keynote speakers, whose invaluable insights and expertise greatly enriched SRBE 2023. We extend our heartfelt appreciation to Prof. Nishant H.

Manapure, Principal, PIADS, Nagpur, India, for speaking on Community Resilience and Social Sustainability in the Built Environment, Prof. (Dr.) Tuba Kocaturk, Deakin University, Australia, for talking on Sustainable and Smart Buildings, Dr. Narein Parera, University of Moratuwa for delivering on Environment Design and Sustainability, Sri Lanka, and Ar. Ajith Andagere, Andagere Architects, Bangalore, India, for contributing to the theme of Heritage and Sustainability.

The episodes within this volume are the outcome of rigorous peer-reviewed selection, ensuring that they represent the highest standards of academic and practical excellence. Each chapter provides valuable insights and recommendations for researchers, practitioners, policymakers, and students in advancing sustainable and resilient practices in the built environment. We extend our deepest gratitude to all the contributors who have shared their expertise and knowledge in enriching this volume with their valued acumens. We would also like to express our appreciation to the conference organizers, reviewers, and the wide community for their support in making this conference and book a success. We hope that the chapters curated in this volume inspire readers to think critically, challenge conventional approaches, and actively contribute to the transformation of our built environment towards sustainability and resilience and also our cities and communities to thrive in harmony with nature, thus ensuring a better quality of life for present and future generations.

Manipal, India

Prof. Dr. Rama Devi Nandineni
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Contents

Environment Design and Sustainability

User Perception of Biophilic Design Patterns Present in a Workplace Setting for Mental Well-Being

Samarpita Sinharay, Sonali Walimbe, and Shanta Pragyan Dash

Abstract Biophilic design expedites healing, enhances creativity, and increases productivity, by restoring the connection between human and nature. Contemporary structures have lost their link with nature while trying to accommodate the growing population. Interior designs have become more about fitting than comfort, making them unsustainable. Spaces like offices suffer from less focus on human welfare, causing stress, anxiety, and other work-related health issues. Thus, suitable design patterns that improve the users' psychological and physiological health need to be incorporated, to increase their potential at work. This paper addresses the patterns of biophilic design and how they articulate a relationship between nature, the built environment, and human biology. These patterns include different attributes or experiences through which biophilic design is implemented. Through a few case study documentations, the patterns used in Indian office interiors are recognised and the impacts of the design on mood and mental health are studied from the users' perspective. Further, it focuses on awareness through the perception of these patterns, and how it has been incorporated into the workspace. Through an understanding of user perception and effectiveness of the patterns, the benefits of biophilic design patterns on the users' mental health are analysed. The discussion thus revolves around the study of the application and benefits of the biophilic design pattern, put in the context of Indian office buildings. The paper thus concludes that biophilic practices help people re-connect with nature and decreases work-related mental health issue, producing a sustainable and healthy environment.

Keywords Biophilia · Biophilic design · Connection · Mental health · Nature · Office interior · Patterns · Perception · Users · Workspace setting

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1 Introduction

The modern constructions have caused a severing relationship between people and nature as a result of growing urbanisation. Design has shifted to become more activity-centred, which damaged humans' desire for biophilia. Stress and work-related disorders are prevalent in the workplace, where living in a small space and being under constant deadline pressure are bad for one's health. It becomes typical to have physiological and psychological problems like high blood pressure, stress, anxiety, and sadness. Biophilic design patterns put into practise through numerous factors and experiences, work to restore the broken connection to nature, and hence have a favourable impact on health. Although various studies emphasise the components that biophilic design can apply, it is unknown whether office workers are aware of it. It has been shown through literature analysis that there are 15 biophilic patterns and 70 elements used in these patterns. They can be employed in a variety of indoor and outdoor environments. The focus of this article is on how biophilic design in workstations is interpreted by users. The study makes an effort to analyse user knowledge of these patterns through surveys and questionnaires in order to better comprehend their value. It is an interdisciplinary field, as it is a codification of history, field of applied science, neuroscience, and design [1]. Biophilia, a concept popularised in the 1980s by Edward O. Wilson, described in his book, the human inclination to affiliate with nature, the innate relationship between nature and humans. The idea of biophilia originates in an understanding of human evolution, where for more than 99% of our species biologically developed in adaptive response to nature and not artificial or human created forces [2].

Biophilia refers to the affinity or the liking towards 'bio' or nature. It is the attempt to translate the understanding of the inherent human affinity to affiliate with nature and natural elements [2]. It re-establishes the connection with nature though the use of elements or experiences, that can be mainly classified into three—the direct experience, indirect experience, and the experience of space and place [3]. A restorative environment that can address psychological, physiological, and cognitive problems and enhance health and well-being can be produced through design. The book that followed a 2004 conference in which more than 70 different mechanisms were identified for creating a biophilic experience and were outlined into three classifications of user experience—Nature in the Space, Natural Analogues, and Nature of the User—showed the translation of biophilia as a hypothesis into design of the built environment [1]. All of these 70 mechanisms have been grouped into the three previously mentioned categories along with 15 patterns of biophilic design. It becomes essential to discuss biophilic design when discussing sustainable interiors since it has numerous advantages in workplaces, where users are most susceptible to health problems. Additionally, the study will concentrate on office buildings in relation to India. Research primarily focuses on increasing user perception of the advantages of biophilic design and highlights those advantages.

2 Understanding Biophilia

2.1 What Is Biophilia?

Biophilia is the term used to describe an innate love of the natural world. It speaks about the connection between people and the natural world and establishes a framework for their peaceful coexistence. This connection can be made by including natural components, and these characteristics support the introduction of biophilic design into building. Biophilic planning broadens the public's understanding of the environment and its surroundings and forges a connection to changing to a sustainable way of life. It restores our connection nature and would make a shift in human consciousness, as it involves a variety of social and psychological benefits with additional economic benefits [3]. Six biophilic design components that fall into three categories: direct experience of nature, indirect experience of nature, and experience of space and place aid in fostering a bond between people and the natural world.

2.2 What Are Biophilic Design Patterns and Its Impacts?

Various components and qualities of biophilic design, merged together, result in patterns that aid in conveying the sensation of being surrounded by nature. Fourteen biophilic patterns that bridge the gap between strategy and execution emerged in order for people experience the various advantages of biophilic design [1]. As a method to address mental health, well-being, and a mind–body system, these patterns track the effectiveness of applying biophilic design. Together, many biophilia components create a system that results in these patterns that can be used in a space. These components are listed under the two dimensions of biophilia, organic and natural form, of Kellert's 70 biophilic design qualities [4]. Understanding the biology of humans' propensity to value nature and its ability to connect both is the core premise driving these components. A new pattern was later updated, making it the 15 patterns of biophilic design as discussed in Table 1 [5]. An analytical hierarchy process (AHP) was used in the research to evaluate the effects of five categories of biophilic design and discovered that some designs' elements have a greater impact when placed in a nearby or interior location. For example, with biodiversity and biomimicry, sustainable interior conditions appear to be more advantageous [6]. Given that the patterns have various traits and components, it is possible to infer that certain of the patterns are, as the study's findings indicate, more beneficial to mental health. Using biophilic design helps in creating an environment with tangible elements that provide psychological restoration, relieve stress and mental fatigue [7]. It builds a link with the natural ecosystem and creates a restorative environment.

Table 1 15 biophilic patterns [1]

No.	Patterns	Description	Features
1	Visual connection with nature	A direct view of nature, and natural process	Green spaces, view line, biodiversity
2	Non-visual connection with nature	Connection to natural systems through auditory, haptic, olfactory, and gustatory stimuli	Natural sounds, integrated aspects, experience and olfactory
3	Non-rhythmic sensory stimuli	Stochastic and empherical connection to nature, with momentary patterns	Occur in periodic gaps, multiple interventions
4	Thermal and airflow variability	Subtle change in temperature and humidity and airflow	Change in airflow conditions, thermal comfort
5	Presence of water	Seeing, hearing, or touching water	Multi-sensory, water movements/ reflection
6	Dynamic and diffuse light	Varying intensities of light creating drama in space	Dynamic light transition, sunlight
7	Connection with natural system	Awareness of natural processes, temporal changes	Rainwater capture, natural events, interactive elements
8	Biomorphic forms and patterns	Symbolic reference to natural forms, patterns	Organic and comprehensible forms
9	Material connection with nature	Natural materials that reflect local ecology	Textures, colours, patterns, and materials
10	Complexity and order	Rich sensory information, similar to natural	Algorithms and geometry, artwork and fractal quality
11	Prospect	Unimpeded view over a distance, surveillance over a distance	Views, > 20 ft focal length, elevation and orientation
12	Refuge	Place of protection or withdrawal	Lower ceiling, drop ceilings, acoustical panelling, etc.
13	Mystery	Obscured view, develop sense of curiosity	Curved edge with partially revealing spaces. Dark shadows and spatial depth
14	Risk/peril	Patterns identified as threat coupled with reliable safeguard	Deliberate interventions with elements of safety
15	Awe	Stimuli that defy the frame of reference and leads to a change in perspective	Combine reverence with fear, majestic natural features