Aesthetics of Sustainable Architecture originates from the project Sustainable Brainport, a collaboration of the Municipality of Eindhoven, the Design Academy Eindhoven and the Eindhoven University of Technology. For all three institutions, sustainability in architecture and urban design has been very important for many years. We are grateful to the Municipality of Eindhoven for supporting and engaging the Design Academy and the University in this effort through the initiation of the Sustainable Brainport project.

On a broader perspective, Sustainable Brainport ushers in a new stage for Eindhoven, the leading knowledge center of the Netherlands and once the city of Philips. For over a century, many groundbreaking innovations have emerged from Eindhoven, benefiting society and culture worldwide. Sustainable Brainport indicates Eindhoven’s transition from industrial manufacturing toward a city of knowledge. It also lays a foundation for the city's new innovations in order to meet the challenges of a sustainable future.

In the course of the Sustainable Brainport project, we found it essential to confront questions on how the sustainable design of buildings and cities may shape the aesthetics of a society in economically and culturally appropriate ways. With the Aesthetics of Sustainable Architecture, we finally have a volume that will help us understand the substance of what it means to design and to build in a sustainable way, one that will contribute to the aesthetic constructs of the twenty first century.

On behalf of Sustainable Brainport, Sang Lee was invited to lead the project and to serve as the editor of this volume. Here he gathered a distinguished panel of architects and scholars, bringing together for the first time a collection of writings that specifically involves sustainable architecture from an aesthetic perspective. We believe this book presents a valuable source for the development of theory and practice in sustainable design for architects, urbanists and designers.

As sustainable design and development have emerged as one of the most compelling in the architecture of our time, as well as in society and politics at large, it is important to explore the changes that have occurred in the architectural profession as a result. Given the level of attention that is paid to sustainable design and development today, it is relevant to ask whether sustainability has become an intrinsic part of the discipline as a whole. Accordingly, we may ask if the heightened awareness of sustainability functions simply as an addendum to the practice of architecture, or if it affects the discourse of the profession in a more fundamental way. And finally, we may ask how these trends change the way we situate the built environment in relation to the natural one, if at all.

As a first step toward addressing these questions, Aesthetics of Sustainable Architecture attempts to trace the key concepts that underlie what it means to design in a sustainable way. At their very core, the principles of sustainable design are rooted in the building’s relationship to the site and its environmental conditions such as topography, vegetation and climate. These principles are common to the consideration of the built environment as a whole, and to a large extent, architecture as praxis already includes specific propositions of how the artificial, man-made environment may be designed and constructed in relation to the natural environment. What varies from project to project is how well, and to what degree, these relationships are maintained.

Since the beginning of the twentieth century, not only what we regard as the disciplinary discourse of architecture but also the techniques of design and construction have undergone rapid, extensive transformations in terms of sophistication as well as complexity. These transformations are linked to the rapid pace of industrial and technological development that has characterized the current age and its prevailing market economy model. These developments underlie many of the world’s most serious environmental problems, and have greatly impacted our approach to the design of the built environment and its operations in ways that have moved us farther away from a sustainable position in nature. However, these same trends may be harnessed to offer new approaches to sustainable design. What then is the role of architecture in responding to current environmental problems? The chapters in this collection will present historical, theoretical and technical positions in order to confront this question, and address how the renewed consciousness of environmental concern in architecture may develop, given the challenges of the current age.

At the same time, as the overarching title of this book may suggest, the aesthetic dimension is intrinsic to any impetus that brings about great transformations in the design of the built environment. If one were to consider sustainability as such an impetus, would it transform the aesthetics of architecture and the built environment in any substantive way? Or is sustainability simply incongruous

Foreword
— Kees Doevendans

Introduction
— Sang Lee
to, and to be shunned by, the aesthetic apparatus of architecture? The chapters in this collection will also attempt to address these questions while proposing thoughts on how sustainability is indeed an aesthetic issue, and how the notion of sustainability may provide a form of aesthetic thinking that is fundamentally implicit to the discipline. Therefore, the primary intent of this book is to offer certain views on how the issues of sustainability and aesthetics may be related together in architecture.

In recent years, the so-called greening of architecture has produced a new class of experts and professionals. Sometimes they work in parallel with architects, while other times they perform in the background the work of effectively making a building design green after the architect’s work is done. Given these trends, it is important to ask whether sustainability is indeed an area that is best left to this new class of experts and professionals or if every architect should engage it as an integral part of the design process. Alternately, should every architect become familiar with sustainability simply in order to become more marketable and to get more work? Current trends – including the implementation of evaluation standards such as LEED, BREEAM and C2C certification, and the increasing commodification and marketing of anything green as sustainable – suggest that it is an opportune moment to reconsider and reevaluate what sustainability means to the discipline of architecture, while clarifying some of the core issues that surround it.

Any one of the above questions could form a substantial volume in itself, in order to do justice to the weight and scope of the subject matter. Despite the danger of becoming superficial and glossing over crucial issues, this collection is meant to function as an opening or a springboard, so to speak. As the title suggests, the book draws together a collection of diverse articles that relate to aesthetics while dealing with sustainability and the underlying thoughts that connect the two. In many instances, it is clear that the central ideas behind the environment, sustainability and the design of architecture have often been oversimplified and increasingly misrepresented, hampering discussion and debate in the field.

The greening trend may be attributed to the extremely rapid commodification of everything green, a development motivated by the kind of economic opportunities that tend to appear with new, desirable technology in the current age that is centered on providing product services rather than production. On one hand, environmental problems are increasingly viewed within a narrow set of lifestyle choices, and on the other hand, in reference to our prevailing market economy model that is taken for granted as the de jure standard. Environmental problems are seen in aggregates that are composed of parts to be improved upon and replaced, while the structure or the kind of complex, intertwined compositions that make up the problems are often not considered. The fundamental position underlying sustainable development appears to be that the current model of unbridled production and consumption may be sustained as long as we do not destroy our environment in the process. In a sense, it appears that sustainability is increasingly becoming part of the apparatus that is dedicated to the maintenance of the status quo, ultimately supporting actively the maintenance of a wasteful, consumption-intensive economic superstructure.

Many debates on sustainability and environmental issues center around the suggestion that we can alleviate our problems by replacing a selection of materials and technological components, such as the fuels for electricity and transportation, the kind of engines in our cars or the kind of light bulbs in our homes, swapping them out with more efficient versions. Certainly these changes would help in some respect, but fundamental questions remain in regard to architecture: What are the structural issues of sustainable development and how do we address them in the design of the built environment? Can we simply replace the bits and pieces that make up the built environment in order to make it sustainable? And what kind of aesthetic changes and potentials do we find in a structural revision of the industrial capitalist model, a model where architecture and design are often at the receiving end of the causal relationship?

In response to these questions, we can turn to the work of various institutes, thinkers and advocates who have been frontrunners in the field of sustainability. For example, the Rocky Mountain Institute (RMI) founded by L. Hunter Lovins and Amory Lovins in 1982 proposes a design intensive, productivity-oriented approach emphasizing maximized efficiency of the systemic structure under the framework of Natural Capitalism (NC).\(^1\) The RMI declares that its vision is ‘a world thriving, verdant, and secure, for all, for ever.’ Furthermore its mission is ‘to drive the efficient and restorative use of resources’ in a manner that is “non-adversarial and trans-ideological, emphasizing integrative design, advanced technologies, and mindful of markets.”\(^2\) Implementing the visions of NC would have real, concrete implications for the discipline of architecture, as well as for the society and the economy at large. It is important to ask what the discipline and aesthetics of architecture would be when it is produced under such a framework.

In addition, another recent highly influential contribution to the sustainability debate is the book by William McDonough and Michael Braungart, Cradle to Cradle (C2C).\(^3\) In this book, the authors examine and illustrate the inherent problems in the existing industrial economy which they call a ‘cradle to grave’ model and attempt to propose an alternative that is centered on closed-loop services of production, delivery and reclamation.\(^4\) Both NC and C2C propose a fundamental revision of our current model of industrial development, moving away from the patterns of disjunctive production and consumption toward a cyclical process where nothing is discarded or wasted. The idea of a cyclical system of production, use and re-production, as opposed to a linear, dead-end process of production, consumption and discard, is a key consideration of both propositions. With NC and C2C, we can glimpse what it would mean to address the structure of the complex, intertwined compositions that underlie today’s environmental problems instead of addressing them on an ad hoc basis.
Then there are the lessons of the vernacular that profess returning to the kind of living that used to be more intimate and less intrusive to nature as the way to mitigate our current environmental problems. In line with the vernacular traditions, we find the arguments for localization and self-sufficiency of production and consumption. In this scenario, the built environment will sustain itself within what would be considered a local scope. However, one crucial issue is whether or not and how the vernacular traditions are applicable and relevant to today's context. Or for that matter, is it feasible to simply pick and choose the kind of useful elements from the vernacular catalogue regardless of their cultural and environmental origins? In regard to the vernacular being equated with the sustainable, the vernacular is thought to have maintained a harmonious existence in relation to a region's natural resources and climate, and therefore, that the vernacular building process was local, thereby sustainable.

Against such a complex backdrop, many of the articles in this collection discuss emerging models of design and production that incorporate ideas for replacing existing technologies with more efficient ones as well as ideas for new innovations and inventions. However, they are not purely technological and attempt to locate themselves within the broader discourse of the field. It is undeniable that we must develop appropriate technological means to address the environmental problems attributable to architecture. However, typically, this approach has overlooked the kind of research and investigation needed to situate sustainable innovations within the wider aesthetic framework of the discipline, a framework which, in itself, has become a moving target with rapid changes in the discipline's technological and economic superstructure. This approach has also overlooked the structure of today's complex environmental problems while focusing on the development of single components and elements. Therefore, this volume also attempts to address how to locate sustainable thinking – as well as sustainable technology, innovations and mechanical systems – in perspective within the discipline of architecture, while incorporating them in a way that is concurrent with disciplinary aesthetics.

For this book, the notion of aesthetics – a vast area for which this is in no way an adequate venue – starts with a general question: How do we sense and perceive our world and further develop an appreciation of it? Departing from this very basic question, one could say that aesthetics in itself is a discipline of reflecting on art as mediation between culture and nature. Without extending the question of what aesthetics may mean in general terms, it would be useful to cite a couple of key notions that may be pertinent to architecture and sustainability; these notions address the relationship between sensory perception (the subjective) and quantifiable measures (the objective), and furthermore, they address the role of architectonics in informing the relationship between the expression of material culture and the environment.

The 18th century philosopher who coined the term aesthetics, Alexander Gottlieb Baumgarten describes aesthetics as a form of knowledge that is gained from that which is sensed.3 Baumgarten first develops a position that sensory perception can produce a valid form of knowledge, and later formulates aesthetics as an investigative work on art and beauty. In essence, Baumgarten proposes that what we sense and perceive, the exteriority of an object, is a manifestation of the invisible or intangible qualities of its interiority, and therefore, that studying the connection of the two presents a meaningful approach to gain a certain kind of knowledge. Subsequent to Baumgarten, in the work of Immanuel Kant, we find the artist who exercises his freedom of material and technical choice in producing a work of art that leaves an imprint on nature. And this way, a work of free art does not possess an end other than to itself. But here the beauty is found in the work's purposiveness, and the experience of beauty arises from the sense that a given object serves and fits a given purpose.6

In the 19th century, Karl Bötticher and Gottfried Semper provide tectonics as a form of aesthetics.7 For Bötticher (a student of Schinkel) architectonics is an interplay of social and cultural as well as material and physical forces. The coalescence of these forces determines the purpose of architecture. For Bötticher, the balance of such forces is embodied in the structural order (Kernform) and expressed by the spatial enclosure (Kunstform).8 After Bötticher, Semper (a student of Gauss) discusses ‘Four Categories of Raw Materials’ and the kind of construction that is inherent in each one, categorized in four classes of ‘tiles, ceramics, tectonics (carpentry) and stereotomy (masonry).’ For example, he describes the textiles combined with plasticity (ceramics) and lattices (tubular construction) as giving shape.9 Here, the weaving of narrative, structural, material and environmental aspects serves the purpose of architectural enclosure as mediation that is indivisible from its composition.

In the 20th century, from the work of modern masters to the work of today's theorists and practicing architects, the extent of aesthetics in architecture is indeed overwhelming. Without delving into the aesthetics and architecture of this dense century, for the purpose of this book, let us suffice it to propose that: Aesthetics of architecture refers to the expressions in built form that closely relate to the way in which the form is not only conceived but also produced in relation to a certain purpose and its context. In regard to the relationship among form, function and context, a built form should inform and express the principles of its programmatic, structural, material and spatial qualities. And an aesthetic is supposed to emerge from, as well as be embodied in, the order that ties them together as an indivisible whole. Therefore, in short, if a building or an environment is designed and built to be sustainable, it should inform how it was conceived and situated, and what makes it be so under what kind of conditions. And in the presence of such a work, it should be perceivable and/or understandable that it serves and fits such purpose.

With this scope of architectural aesthetics in mind, the idea of environmental consciousness is framed in this volume by two complimentary concepts: sustainability and durability. Sustainability refers to a process that can be main-
tained and continued for a certain duration, or hypothetically speaking, indefinitely. Being sustainable means that the conditions needed to drive the process can be met, allowing the process to continue into the future. Durability refers to the state of an object. Being durable means that the way an object is made allows it to function for the duration of the purpose it is intended to serve (and possibly beyond) without breaking down irreparably.

Being sustainable, ideally, means that the structures and relations necessary to sustain the process will be available so that it does not exhaust itself or come to a halt due to degradation or some form of failure. On the other hand, durability stands for a method of building that maximizes an object’s span of usefulness. In this case, durability is more focused on materials, techniques and assemblies of production in relation to the supposed use of the object. Obviously, the two distinctions, while contrasting, are also complimentary. They may even be characterized as one and the same: a process cannot be sustainable if one cannot foresee how well and how durably the aggregate of various constituents will perform over the course of the supposed lifespan, while no durable measures can be accomplished if one cannot sustain the continuity of materials and techniques without interruption.

In order to provide a concrete and substantive approach for designing architecture in a sustainable and durable manner, these concepts may be combined with the three main strategies of ecological thinking, namely, conservation, efficiency, and regeneration. First, conservation attempts to reduce the amount of resources and materials that are spent in the processes of production and consumption, thereby extending the reserves of limited resources. In architecture as well as in daily life in general, this translates to minimizing waste and saving materials through the strategies of reclamation and recycling. Next, efficiency is directed at maximizing the output or production that can be obtained from a given unit supply of materials, resources or energy. With a strategy of efficiency, we can expect to extract more use from each unit that we consume. In architecture, efficiency may be expressed in the kinds of machines and devices that we use in buildings, such as the furnaces or radiators for heating that are designed to output more heat energy per unit of energy spent. Another common example of efficiency is the km/liter rating for cars. By definition, the strategies of conservation and efficiency form a duality, and they serve a common goal: that of slowing down the depletion—and therefore extending the useful lifespan—of our existing supplies of materials and resources.

The third strategy, that of regeneration, attempts to return materials and energy back to the sources from which they came in order to compensate for what we extract, use and consume in our industrial processes, thereby replenishing limited natural reserves. This strategy includes, for example, the regeneration of such resources as forests for timber, aquifers for water and other natural resources that are necessary for farming and food supplies. Obviously all three aspects—conservation, efficiency and regeneration—must be seen as complimentary to one another and dealt with simultaneously on a comprehensive scale in order to produce architecture that is both sustainable and durable.

Ultimately this book offers a look at the connective territories that exist in current design practice that includes aesthetics, material economic logic and the quality of life it is supposed to provide. All design practices, however small or large they may be, attempt to create certain values by locating their production within a context of users and their cultures. These values also spring from social, political and economic environments in place among private businesses and are imprinted in public policies and directives. These two parallel value tracks influence many levels of design, from small ordinary objects to the scale of urban or regional planning. While the work of individual architects or designers may be focused on the practice of aesthetics and the functionality of the everyday objects and buildings they produce, in this collection, the primary question is placed on how such practice may be situated within the principles of designing for sustainability. Given the current debates on sustainability in the design of the built environment, how can one approach the question of what we consider beautiful and useful, and how do we evaluate and judge such objects or processes? In essence, what value track is created with the pursuit of sustainable design?

Published within the past few years, one can easily find countless books dedicated to sustainable design and sustainability. The topics they deal with range from ethical and philosophical issues, to technical manuals and DIY guides for sustainable lifestyles. However, what are the actual ramifications of sustainable design on the aesthetics of architecture and how we construct our built environments? Is sustainable design adequately represented by technical issues and devices that are supplementary and to be hidden and covered? Can sustainability be implemented as a patchwork of remedies on an ad-hoc basis as we move on? Is the urgency for sustainable design perhaps a call to Arcadia, for a return to a kind of simplicity in our civilization and for a way of living in tune with the laws of nature? Or as some do argue, does sustainability have little to do with the aesthetics of architecture?

One major obstacle to the understanding of sustainability in architecture is the dominant perception—generated through media snapshots and certification processes such as LEED—that sustainable design may be accomplished by putting together a set of prescriptive parts and measures. There is no doubt that media exposure, evaluation and certification measures have helped to raise general awareness and consciousness of sustainable design. However, this has also promoted an intense marketing of the sustainable before the actual substance of the term could establish a firm footing in common architectural practice. In today’s culture of commodification, the appearance of sustainability has become as important, if not more than the actual substance of a given design. Therefore, one of the most fundamental challenges in the practice of sustainable architecture is to develop content that emphasizes a more holistic construct of sustainability, to contain the focus on marketable bits and pieces that often do not add up.
Today, the common view of sustainable design may suggest that a range of mechanistic parts and measures can be put together in a way that is similar to selecting appliances from a catalogue. These may be thought of as environmental appliances. The problem with this appliance logic is that, in reality, it is isolated and detached from the consideration of the production-delivery-consumption chain that is currently in place, which has clear environmental problems. In this sense, the widespread view that sustainable design can be accomplished through a form of mechanistic assembly presents yet another obstacle to approaching a more substantive perspective of the subject matter.

The chapters in this book point to a set of interrelated and fundamental issues of our current approach to the use of energy, materials, water and technology. The first issue, regarding the kind of energy we use and how we use it, has remained at the forefront of environmental and sustainability debates since their inception. It is well understood that our current environmental problems arise, by and large, from the extensive use of fossil fuels such as coal and petroleum, and from the resulting mass emission of greenhouse gases such as carbon dioxide, nitrous oxide and methane that occur with their use. In addition, the release of solid particles, the byproducts of energy consumption and industrial production, pollute the atmosphere and pose health threats to humans and all living organisms.

Due to the atmospheric changes that have resulted from our energy use, it is expected that catastrophic climatic events will occur more frequently, the most serious of which will be an increase in the temperature and acidity of ocean waters. Clearly, the connection between design and energy use is evident in the production and operation of individual buildings, and in the larger built environment with its extensive networks for utilities and transportation. If we were successful in changing our patterns of energy use on a widespread scale, how would this affect the practice of architecture from a design standpoint? What role could architecture play in making these changes come about? And what aesthetic potentials are present in the consideration of sustainable or renewable energy, its use and conservation for the field of architecture?

The second issue concerns the extraction, production and assembly of various materials that are used in architecture, detailing the span of their useful lifecycles. As the issue of materials is directly connected to that of energy use, concepts such as embodied energy and potential recyclability represent two energy-related aspects that are important in determining material qualities. Aesthetic features and potentials have come to be measured in relation to materials’ visual qualities, but also in relation to their performance, durability and potential hazards. Within the context of the propositions in C2C, for example, the use of certain materials represents a selection process that includes a given material’s prospects to fit within a cyclical model of use and reuse: its production and use should foresee and incorporate the potential for continued iterations in the future.

Furthermore, in relation to materiality, recent technological developments have made it possible for architecture to incorporate various so-called high-tech materials with attractive performance properties – such as those with high strength-weight ratios and insulating capabilities, and those that are environmentally inert. As the selection and assembly of materials are intimately tied to the aesthetics of architecture, what aesthetic potentials can be found in these current trends of materiality? How can materials be used and approached in a way that improves the sustainability of architectural design? And in the end, can architecture have a positive impact on the way that materials are extracted and produced?

The third issue concerns water sources and consumption, directly translated in terms of drinking water, sanitation and irrigation. Obviously, the way our buildings and cities are designed has immediate impacts on the amount of water we use, how our aquifers, rivers and streams are diverted and how rapidly we deplete or pollute our supplies. Many regions of the world are faced with diminishing aquifers, leading to food shortages from declining crop production, as well as health impacts attributed to water pollution. These include the spread of waterborne diseases due to poor sanitation, and the destruction of fish and wildlife due to the release of industrial chemicals and everyday urban run-off. In some geographical contexts, the lack of clean water for drinking, bathing and agriculture poses perhaps a more immediate threat to human life than the one posed by other environmental changes. In order for architecture to be sustainable, it must regard water renewal cycles from a conservation standpoint. Can architecture and urban development be designed in a way that conserves water, using as little as possible, while ensuring that clean water is returned to replenish our aquifers, rivers and streams?

The fourth issue deals with technology and its role in the design process, touching on how the latest design technologies and tools affect architectural thinking and approaches toward a new materiality and architectural aesthetics. Given the recent advances in software and hardware engineering, we have access to more rigorous and accurate means of design and simulation. We use advanced technologies in order to design more efficiently, to produce designs that are optimized for specific uses and performance as well as for the discovery of previously unknown forms. However, the codification schemes and procedures inherent in these technologies not only impact how efficiently we design and produce, but perhaps more importantly, how the historical canons of architecture may change in regard to the discipline’s aesthetic foundations. Whether the latest means of design and simulation are implemented in order to increase the efficiency of labor, to increase economic return or to maximize the pure performance of the project, it appears certain that what we use to design has changed the way we conceive of the design process and its objectives in a profound way.

In this regard, what is the relationship between the use of new technologies in design and environmental consciousness? Do we simply use these tools in order to design and manufacture more products, more cheaply, in less time?
Do we fuel and accelerate the rampant excesses in consumerism as a result? What potential does the latest digital technology offer for the design and production of both space and objects in regard to the sustainability of our built environment? Is there an inherent logic in the relationship between efficiency and form, as for example the proponents of the biomimetic process would suggest? For this category, the chapters are focused on the fundamental changes in design, manufacturing and use brought on by technological advances, and how such changes influence and reinforce the practice of sustainable design and its aesthetics.

While addressing this set of interrelated and fundamental issues, the chapters in the book can be grouped in terms of historical cases (Nezar Alssayad, Gabriel Arboleda and Vinayak Bhave); theoretical positions (Glenn Hill, Kenneth Frampton, Sang Lee, Stefanie Holzheu, Daniel Jaulin and Matthew Skjonsberg); design and use (Ralph L. Knowles, John Brennan, Keith Bothwell, Marie Antoinette Glaser, Minna Sunikka-Blank and Elisabetta Pero); emerging technologies (Luca Finocchicaro, Anne Grete Hestnes, Giancarlo Mangone, Patrick Teuffel and David Briggs); and personal reflections (Matthias Sauerbruch, Louisa Hutton, Kengo Kuma and Harald N. Røstvik).

In the first chapter of the book, The Aesthetics of Architectural Consumption, Glen Hill argues that the modern era has ushered in a damaging scenario in which architecture must increasingly participate in the endless search for new aesthetic trajectories. In doing so, the already existing architecture is subject to what he describes as aesthetic obsolescence, where the architecture is viewed as waste long before its functional life is over. Hill considers that sustainable architecture is not immune from this pressure to become an aestheticized commodity with an ever-decreasing life span. Hill argues that the early radical environmental architecture of the 1960’s and 1970’s often focused less on aesthetics and more on changing people’s ways of living. However, more recent sustainable architecture has shown a greater interest in participating in the aesthetic economy, rather than focusing on changing people’s ways of living. It has instead focused on developing technological strategies to maintain unsustainable ways of living for the lowest resource and energy cost. It is now common to claim that all architecture should be technologically sustainable, and with this claim the potential radicalism of sustainable architecture is blunted as it is brought within the mainstream aesthetic economy. One potential way out, Hill suggests, might be found in the poetic aspect of architecture. Because architecture, like all of the arts, has the capacity to reveal its world, architecture with its poetic capability may yet be able to reveal and respond to how unsustainable the commodification process has become.

In What Does Sustainability Look Like? Matthias Sauerbruch and Louisa Hutton, who have focused their practice on environmentally engaging yet aesthetically rigorous buildings, present their views on the state of architecture in relation to environmental problems and on how to approach them. They open the discussion by stating that the West, with its culture of excessive consumption, is largely responsible for the state of ecological damage on the planet. In response they suggest that developed countries have to lead in the creation of efficient energies, and at the same time, to change their wasteful patterns of behavior and lifestyles. They argue that changing lifestyles is the most effective way to reduce energy and carbon emissions, and suggest producing the kind of carbon-free products that are so attractive that people will want to use them. In their view, people will accept such products when they demonstrate that a reduction in consumption does not necessarily mean a reduction in quality. This approach might be an opportunity ‘to create a new rapport with society at large and to respond to the needs and imaginations of normal people without falling into the traps of cliché and kitsch’ while addressing environmental problems.

Sauerbruch and Hutton call for architects to express this changed paradigm by using an appropriate and positive architectural language that signifies a new beginning in relation to the environment. They believe that the challenge for architects is to develop a language in order to create spaces that communicate with people on an intuitive level. To this end, they argue, when architects employ space, surface and light intelligently, they will be able to fulfill more than just the goals of efficiency and economy, while moving toward the creation of architecture that is both sensuous and sustainable.

In the chapter entitled Solar Aesthetics, Ralph L. Knowles, a pioneer of the solar envelope zoning method, chronicles and reflects on the experiments and research projects he has focused on for the past fifty years. His chapter begins with the idea that solar cycles can inform the production of natural forms for building, while introducing his pioneering work on the solar envelope zoning method. He argues that solar cycles have shaped human civilization and its rituals for millennia, and that designing around these cycles and their rhythms presents one way to create architecture that is engaged ‘in a dialogue with nature.’

The chapter, composed of three parts, demonstrates how building forms can be derived from observing the sun’s path and how such forms can be applied in different contexts and configurations. In the first part, Knowles describes the experiments conducted at Auburn University in 1962. These experiments plotted the formal potentials of sunlight, gravity and the combination of the two. In the second part, Knowles explains the subsequent developments from his work at the University of Southern California. In this phase, he explains how the study focused on ‘the aesthetic consequences of generating uniquely adaptive forms by following the sun’s path to satisfy specified conditions of incident solar energy’ by working ‘directly with earth-sun geometry to generate form.’

In the third part of the chapter, Knowles introduces the concept of Interstitium that is the culmination of his work on finding the space formed by the sun’s trajectory. The concept, he explains, ‘supports the design of dynamic architectural elements that connect directly to the rhythms of nature.’
In *The Architecture of the Passively Tempered Environment*, Keith Bothwell discusses how buildings that work passively to regulate the environment have historically provided comfort for living and a haven against the extremes of the natural climate. He argues that the principles of the passive approach were established as far back in history as the Renaissance architectural treatises, and that even today, they provide a valid basis for the design of sustainable architecture. Despite this legacy of passively conditioned architecture, Bothwell finds that the knowledge and principles that underlie the approach are regularly compromised by unnecessary aesthetic and personal prejudices with no apparent rationale. This results in buildings that do not perform as well as they are supposed to in terms of regulating the environment and climate, while expending more energy than expected. Therefore in his article, Bothwell explores the field of passive environmental design, focusing on the fault lines that occur between knowledge, understanding, intention and achievement in the process of designing sustainable buildings, fault lines that prevent recent buildings from reaching their full capacity to reduce carbon emissions.

Next, John Brennan positions his chapter *Qualitative and Quantitative Traditions in Sustainable Design* from the perspective of the home, where he finds a historically definable narrative for ecologically conscious domestic design, approaching the topic with theoretical discussions and examples from his own practice. Brennan’s chapter addresses the relationship between architecture and deployment of technology, as underscored by sustainable principles. At the core of his chapter is a differentiation between scientific reason and technological control, citing the work of the social theorist Jürgen Habermas. Based on these propositions, he seeks to situate the so-called trends of *eco-design* within the quantitative traditions of domestic architecture.

In the context of his article, Brennan sketches out some persistent and fundamental questions: What exactly constitutes sustainable architecture? Should the definition be divorced from the notion of technical performance? Can any kind of architecture be sustainable if it meets defined quantitative, technical benchmarks? He states that he has come to believe that external variables such as landscape, climate and response to social and economic criteria for sustainability are more important than measurable performance and stylistic appearance. Based on his understanding of established scholarship, Brennan attempts to determine how the quantitative and qualitative traditions may exist together in sustainable architecture in both historic and practical terms. The chapter concludes with the notion that there is no seamless clarity from theory to practice, and that sustainable design should discount neither scientific empiricism nor the rich, qualitative experience in architecture.

In the chapter, *Urbanization and Its Discontents: Megaform and Sustainability*, Kenneth Frampton regards the fundamental environmental problems that are inherent in our current patterns of automobile-based suburban sprawl, and in our current model of architectural academia. In response, he proposes the theory of the megaform. His argument begins with a criticism of the excess typical of contemporary societies, especially in the US, and of the subsequent failure to create more equitable, environmentally coherent urban conditions. In his criticism, he cites a series of apparent problems and dangers that the current model of development faces, and sets out the basis of sustainability as nature-culture interplay. This interplay, he argues, may be established through the place making potentials of the megaform, and here, Frampton distinguishes between object-forms and place-forms. He continues with the idea that the current model of architectural academia is detrimental to the discipline’s full engagement with the issues of sustainability, due to its emphasis on individual creativity. This may led to the production of forms that, while aesthetically pleasing, tend to miss the potentials of sustainability on a fundamental level.

Frampton concludes that there is no inherent disconnect between environmentally responsive and sustainable design, and the kind of design that is culturally stimulating and aesthetically expressive. Sustainability can be framed as an inspiration to enrich and deepen the aesthetics of architecture, rather than as a restriction upon its aesthetic potentials.

Daniel Jauslin, a practicing architect and researcher focused on landscape, opens his chapter *Landscape Aesthetics for Sustainable Architecture* by citing three of the most prominent architects today in regard to sustainable architecture and its aesthetics. They express their skepticism as to whether or not there is such a thing as aesthetics in sustainable architecture, or for that matter, if architecture can indeed be sustainable. Against such a setting, Jauslin illustrates what he believes to be the landscape perspective’s inherent relationship to the natural environment, the principles behind it as well as the potentials that the landscape perspective holds for sustainable design.

In this chapter, Jauslin first discusses the kind of professional and political impetuses that have made sustainability one of the most compelling changes to face the profession of architecture. He argues that the mandate for a sustainable environment did not come about by choice of the architects and planners, but rather, that sustainability is imposed on the profession by the necessary external forces that influence it. To bridge the gap that exists from current practice to sustainability, Jauslin traces the thoughts and principles of landscapes and territories that have developed since the 1960’s, highlighting how they are indeed highly pertinent to sustainable architecture. This approach views the landscape as a human interface with nature, as a basis for the design of sustainable architecture and a new context for sustainable aesthetics.

The chapter *Building Envelope as Surface* by Sang Lee and Stefanie Holzheu first traces the role that building envelopes play in terms of their functional and presentational qualities, while drawing from a deep historical perspective of what enclosure has meant from the earliest times. They cite three models of building envelopes, namely, the modernist, the Venturian and the mimetic as examples of how the notion of building envelopes has evolved over time, with changes in the architectural discourse. Next, they propose a conceptual construct of building envelopes as *surface*. This discussion is based on the *Leonardo*
a Myth, an appreciation of its superficial appearances rather than of its actual sustainable vernacular and its equation with sustainability may be simply characterized as building techniques. They suggest that the contemporary fascination with the historic context of the present day, they analyze a series of case studies that focus sustainability by default warrants a critical re-evaluation.

In the chapter entitled The Sustainable Indigenous Vernacular: Interrogating a Myth, Nezar AlSayyad and Gabriel Arboleda, in response to the advocates of vernacular architecture, argue that vernacular and indigenous traditions are often assumed to be grounded in the types of practices that produce sustainable built environments. They describe how the theoretical tradition that connects climate and the vernacular has often held that architecture originated as a product of necessity and not as a product of aesthetic requirements. It was this tradition that nurtured the myth that vernacular architecture is sustainable per se, while contributing to the maintenance of this myth to the present day.

They recognize the need to learn from vernacular traditions that optimize local building materials to provide culturally specific climate comfort, while simultaneously finding an ecological balance of appropriate resource consumption. It is true that many vernacular buildings provide effective and cheap ways of dealing with climate, and that the use of natural and local building materials has been the most distinguished element of these traditions. However, AlSayyad and Arboleda argue that the widely held claim that equates the vernacular with sustainability by default warrants a critical re-evaluation.

To further understand what sustainability means within the regional and historic context of the present day, they analyze a series of case studies that focus on vernacular buildings in different continents, citing four distinct vernacular building techniques. They suggest that the contemporary fascination with the vernacular and its equation with sustainability may be simply characterized as an appreciation of its superficial appearances rather than of its actual sustainable qualities.

After AlSayyad and Arboleda, in the chapter The Qanats in Yazd: The Dilemmas of Sustainability & Conservation, Vinayak Bharne discusses the situation in the ancient city of Yazd in Iran, proposing that the re-emergence of sustainable prerogatives in architecture and urban design has re-surfaced the potential importance of vernacular infrastructure traditions. While metropolitan regions rely on modern infrastructure and rural habitats continue to depend on indigenous systems for economic reasons, it is in the transitional layer of expanding historic towns such as Yazd where the issue becomes explicit. Overall, the spread of modern conveniences and modern approaches for water extraction, including dams and mechanized pumps, has contributed to the abandonment of vernacular systems, and to the abandonment of their strategic preservation and reuse.

In this chapter, Bharne explores the dilemmas of sustainability and strategic conservation surrounding the historic qanats (subterranean water channels) and ab anbars (reservoirs) of Yazd in Iran. He includes the traditional roles of this 3,000-year old arid water system and the reasons for its decline within the socio-political changes of the country. Furthermore, he speculates on the alternatives for preserving qanats and ab anbars, weighing them against the realities of Yazd today. In so doing, Bharne's article addresses the cultural, ethical and practical dimensions of conserving vernacular infrastructure in a time of looming global water crisis, while seeking to locate a place for such infrastructure within the context of contemporary city making.

With the provoking title, The Vernacular, the Iconic and the Fake, Harald Røstvik presents his personal observations and reflections as they relate to sustainable architecture. In this chapter, Røstvik criticizes the state of what he characterizes as indifference and misrepresentation in the profession of architecture in relation to sustainability, as well as the kind of romantic views of the vernacular and the celebration of the iconic that, taken together, may limit a true engagement with sustainability. He argues that despite the palette of advanced digital design tools at hand, architects often resort to repeating and replicating familiar aesthetic forms instead of pursuing innovations toward sustainability; he finds that the very coding systems of these tools encourage repetition. Røstvik goes on to discuss sustainability in the context of various aesthetic traditions including the tight box, the glass box and timber construction. He finds that such trends often miss the substantive issues, and furthermore, that their continued application hinders the search for aesthetic potentials that are inherently present in designing buildings in a sustainable manner.

In Natural Architecture, Kengo Kuma provides personal reflections on some of the pointed question he comes across often. First, his central position as a practicing architect is that it is not meaningful to discuss whether a given material is good or bad for the environment without considering the context within which it is used. Therefore, for him, being natural does not automatically mean that a material is good or for that matter sustainable. And being artificially produced or petroleum-based does not automatically mean that a material should be avoided.

Originally published in a collection of his essays sharing the same title, Kuma discusses a few examples of his own work and argues that the materiality and the so-called scientific measures in sustainable design are meaningless if they are not considered in a culturally-specific context. A given culture determines the way certain material parameters are set up and therefore affects the way they are understood; the approaches, materials and designs that may lead to energy conservation and other sustainability measures in one context may
not be applicable in another. He argues that this is the kind of complex background in which the concept of sustainable architecture should be framed.

Minna Sunikka-Blank, in the chapter drawn from her research work, *The Concept and Aesthetics of Sustainable Building in Japan*, sets up a question: If most environmental technologies are not visible or relate to a building envelope only, which sustainability measures really do have an impact on architecture? Based on her policy analysis and research visit to Japan, Sunikka-Blank describes the concept and aesthetics of sustainable building in the Japanese context. This includes the material-as-concept approach, based in terms of timber, structure and adaptability in both vernacular and contemporary architecture. This also includes her finding that despite the lack of insulation typical in Japanese homes, the average household consumes around a third as much energy for heating and cooling compared to that in the UK or Germany. Here Sunikka-Blank describes the energy strategies of Japan in relation to the passive approach and in relation to the behaviors of home energy use, discussing how these may inform sustainability.

In the chapter, Sunikka-Blank goes on to discuss the conceptual differences that exist between the Western and Japanese principles of sustainable building. She speculates whether the Japanese examples, based on the use of raw materials, minimalist aesthetics, passive solar strategies, filigree construction and visual connections to nature, could offer contrasting ideas to our usual ways of using architecture, as we perceive architecture through its demonstrable relationship to context and precedent.

Marie Antoinette Glaser, a social anthropologist, lays out in *Durability in Housing – The Aesthetics of the Ordinary*, the case of a housing complex in Zürich where it is evident that the notions of durability, conservation and long-term use are crucial in the development of a sustainable environment. She begins with the idea that housing is an everyday cultural practice, and it is not possible to separate aesthetics from the perspective of use in a residential building. Use is defined as a physical situation of being, located in a place of specific identity. Glaser argues that enduring, sustainable buildings are dynamic and durable, able to change and adapt over time rather than being limited to one kind of use. With her study of the housing complex in Zürich, Glaser observes that residents enter into a relationship and identify with the living space, potentially changing it, while simultaneously, there are constants that remain little changed over the course of time, namely, the building elements, spatial structures, and some usages and functions.

She states that peoples’ lives leave traces in the houses they occupy, and these traces of usage can provide important information about the prerequisites and conditions for the longevity of residential buildings. In her view, therefore, usage forms the primary *modi* of architecture, as we perceive architecture through use in a way that is synonymous with tactile engagement. Glaser proposes an aesthetic position that defines beauty as a process of long-term use and *habitus-*

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**Introduction**

Sensuous Ecologies: Beyond The Energy Efficiency And Zero-Carbon Argument.
propose that designing for the sensuous aspect of human interaction with the environment is a key issue in sustainable architecture. In their view, contemporary buildings are designed in a static way with respect to the ecosystem, typically unable to respond to dynamic environmental changes. As a result, they develop detrimental and parasitic relationships to the ecosystem. This condition leads in significant performance losses for the local natural environment, productivity and creativity, communal and individual wellbeing, as well as for the overall fiscal costs of the building itself. Mangone and T euffel assert that a more productive approach is to redefine buildings as constructed habitats that engage the local ecosystem and its dynamic processes in an active and interconnected way. This perspective shifts the focus from designing an object, that engage the local ecosystem and its dynamic processes in an active and interconnected way. This perspective shifts the focus from designing an object, that a more productive approach is to redefine buildings as constructed habitats.

In this chapter, Mangone and T euffel argue that the concept of sensuous ecologies helps produce innovative and optimally performing designs. The sensuality-based design approach encourages the exploration of intrinsic performance potentials and results in the development of multi-sensory and engaging constructed habitats, where the built environment can sustainably evolve the social, economic and natural ecologies of the contextual site.

In Symbiosis and Mimesis in the Built Environment, Luca Finocchiaro and Anne Grete Hestnes explore thoughts surrounding the application of advanced digital modeling technology in architecture. They emphasize that digital tools have modified the creative process in which architecture is conceived, influencing the aesthetics of the resulting project. In their view, the quantitative comparison between the exterior and the desired internal conditions determines the spatial composition and thermal behavior of the building. In this comparison, nature can inspire new models of environmental behavior and form through biomimetics. The forms of nature express aesthetic manifestations of specific needs, while helping to establish the building's symbiotic relations with the exterior environment.

On the basis of physical principles, Finocchiaro and Hestnes assert that the aesthetics of sustainable design can be captured as an equation of forms and dimensions in relation to environmental variables. Constructing based on such equations contains in itself the notion of beauty; and in order to access these equations, mimesis and symbiosis can play crucial roles in informing the internal logic of the artificial environment. They conclude that the aesthetics of sustainable design is an evolving process in which biomimetics points to a coherent evolution of both form and function. This embodies the processes of evolution, and ultimately, may allow architecture to achieve symbiosis with nature.

In the last chapter of the book, Aesthetic Potentials in an Open Network Inventory System, David Briggs proposes that there is an opportunity to explore the aesthetic choices that architects make in the design process, and to understand the way that global and local environmental systems are impacted. To this end, and to help mitigate environmental problems, Briggs argues that architects must aggressively find ways to influence industrial processes. This includes taking responsibility for various building materials and their measurable impacts on the environment, with the idea that ultimately, architectural design can feed back and shape the systems of resource extraction, manufacture and supply. Briggs argues that architects are responsible for the materials they use; they do not just sit at the receiving end of the line.

In this perspective, Briggs proposes integrating the creative process with an open network that responds to market forces and environmental consequences, so that the architect can incorporate both creativity and the conditions that define a building’s sustainability. With poor oversight of manufacturing processes in developing nations, as well as the challenges inherent in resource management and extraction worldwide, this chapter is aimed at highlighting the technical and software tools that are currently available – and those that could be developed further – in order to reach a more comprehensive approach to sustainable design.

In this time of heightened environmental consciousness, it is crucial to rethink our material way of life for which architecture is indeed a large measure. As we shall see in the discussions that follow, sustainable and durable architecture does not simply consist of discrete changes and replacements that can be checked off of a punch list or selected from a catalogue. It is apparent that architecture, as the most distinctive form of human work, will only be able to contribute to the sustainability of the built and natural environment by changing its fundamental position within the apparatus that defines the present model of material economy and culture. In this, architecture occupies a unique place as not only an expression of civilization and its aspirations, but also as what situates us in the natural world. This is inherently an aesthetic position. I hope that this book will serve to establish a closer look at the relationship between sustainable architecture and its aesthetics.