A GUIDE FOR **DESIGN PROFESSIONALS**

MODERN SUSTAINABLE RESIDENTIAL DESIGN

William J. Carpenter, FAIA, PhD

FOREWORD BY ALLISON ARIEFF

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Foreword

IT IS MY HOPE THAT WITHIN TEN YEARS, ideally less, green will not be the new black but will simply be *normal.*

This paradigm shift won't be easy to make. Currently, 50 percent of new construction is residential yet less than 5 percent is green building. That's a statistic that doesn't jibe with popular perceptions of green as the new black. Rather, it seems clear that it's not easy being green at all, as evidenced by the tragically small number of green homes standing today. Depending on your definition, there are as few as 592 (according to the U.S. Green Building Council) and as many as 750,000 (according to ENERGY STAR) or somewhere in between (around 100,000), if you're listening to the National Association of Home Builders.

Misperceptions of green building, whether related to perceived costs, complicated construction, or level of consumer interest, are legion. In a 2008 study by RCLCO Research and Development, fully 96 percent of builders surveyed believed that green building translates into increased costs; 63 percent believed that green was more "complicated" to build; and 71 percent cited a lack of contractors experienced in green buildings. Where builders had a grasp on basic green elements, such as low-flow fixtures or ENERGY STAR appliances, their familiarity with local, recycled, and salvaged materials was low, and their understanding of more complex systems like solar and natural HVAC was minimal at best.

The obstacles inherent in these stats are dismal but not insurmountable thanks to major cultural and economic shifts around the idea of sustainability. "Going green" is no longer a matter of altruism; it has become an economic necessity. Once the realm of wacky visionaries and yurt-inhabiting hippies, it's now the focus at exclusive summits like TED and Davos, and the pet project of celebrities, politicians, and policymakers. As the economy struggles and venture capital money seems to disappear, clean tech remains poised for explosive growth.

But the change isn't only about dollars. What's also changed is the framing of the debate. The pursuit of sustainability can help save the planet, true, but savvier messaging allows us to understand how organic, low-VOC, renewable, and so on are good not just for the world but, more specifically, for our communities and families. A focus on local—whether it's the decision to grow food in your backyard or to limit the miles construction materials need to travel before being used to build your new dwelling—literally brings the issue of climate change home.

Homebuyers are helping to drive changes and demonstrate demand through increased knowledge, awareness, and purchasing power. And more forward-thinking architects and builders are offering innovative and attractive options in green building. House labels that spell out the relative health and efficiency of homes, similar to the Food and Drug Administration mandates for food packaging, are under consideration by the

American Institute of Architects, and at least one architect has made them standard in the houses she produces.

The success of these new ways of thinking about sustainability have resulted in changes once thought to be out of reach both emotionally and economically. Higher gas prices and heating/cooling costs are rather quickly altering the way people think about the location and square footage of the homes they are living in. A bigger, less expensive house further from your workplace might have seemed a better deal until the combined costs of commuting and utilities cancelled out any savings you might have been enjoying on your mortgage, for example—a reality that has resulted in recent months to a swift exodus back toward city centers and into smaller homes.

The world of residential building is poised to do great things. The guidance, information, materials, and technology, while ever evolving, are in place. Now it's the hearts and minds that must follow. *Modern Sustainable Residential Design: A Guide for Design Professionals* is a comprehensive, user-friendly guide that can help. So let's get started.

—Allison Arieff

Preface

IN MY PROFESSIONAL LIFE, I HAVE HAD the good fortune to work closely with two of the world's most talented residential architects: Norman Jaffe, FAIA, and AIA Gold Medalist Samuel Mockbee, FAIA. Under their guidance, I first realized the extraordinary opportunities that lay in the interconnections between design and construction, a realization that led to my first book, *Learning by Building* (Wiley, 1997). In my ensuing work as a teacher, as well as a practicing architect, I have been gratified at how stimulating such a book can be—both to students and to seasoned practitioners. I also have continued to explore design-construction interconnections, even as we all have increasingly recognized the need to step lightly on the earth. In the process, I have become aware of new needs and opportunities. Books and articles celebrating so-called green design have become almost commonplace, yet I am unaware of any book written for design professionals that provides a how-to approach to the fundamentals of sustainable residential design. This book is an attempt to meet that need.

For the purpose, I recruited as contributors some of the most talented professionals in sustainable design. Each of the chapters in the book presents vanguard concepts for the creation of contemporary green houses, concepts that not only draw on historical principles but also illuminate new opportunities for further exploration. As such, this book is not only a record of the current best thinking in the field, it is also an invitation to our present and future colleagues to help us push the boundaries of our critically important professions, and provides a tool for doing just that.

Acknowledgments

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I was inspired by working for luminaries Samuel Mockbee, FAIA, and Norman Jaffe, FAIA. They informed my thinking, and I hope their profound spirits in some small way live on through this book.

I am grateful, too, for the support and encouragement of Gregory K. Hunt, FAIA, Jaan Holt, William Quatman, FAIA, Robert Fisher, Robert Ford, FAIA, Thomas Muir, RIBA, Will Draper, Michael and Donna Waterhouse, Alan Greene, Anne Brown, Dr. Bart Lester, Fisher Paty, Cathy and Bill Carpenter, and James Fausett, FAIA.

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And, finally, I'd like to thank my beautiful daughters Esme and Mirette Carpenter for always being there for me—you both always bring light into every room you enter.

PART ONE

The Sustainable Modern Home: Process and Design

Contents

1

Sustainable Modern Homes: Historical Context

AROUND THE WORLD THERE IS growing recognition that our lives are intricately connected with the natural world and that its fate and ours are inseparable. In response, we have begun to focus our attention not only on halting the damage we are causing to the environment but also on developing new ways of living in it, ways that may save us both. To borrow from Dylan Thomas, we have lit a green fuse. As it burns, it is igniting explosions of creativity that may prove to be the primary sources of a bright and sustainable future. And yet, if we allow this burning fuse to fizzle as an eco-chic fad, we will surely find ourselves in another dark age. At this critical point in the history of the earth and in the history of our built environment, it is encouraging to note signs that our green fuse is burning with increasing luminosity.

Many former antagonists in the ecology wars now agree that what is good for the earth can also be good for the economy, including the corporate bottom line. GE, Google, and even Shell are among what some call the "corporate greens," joining activists, innovative designers, and the so-called Green Glitterati in pursuit of a more ethical and earth-friendly way to live. This partnership is in its fragile infancy, and the debates will no doubt continue. But we have begun to explore a variety of paths leading away from the unacceptably wasteful habits of the past to an incompletely imagined way of living that can protect the future—that of our planet and ourselves. This book is about one of those paths, the process of designing the sustainable eco-modern house.

By "modern," I mean something not only current but also a collection of design strategies rooted in the Modernist principles of early twentieth-century architects. It is instructive to note how many of these principles support the basic tenets of eco-friendly design and how, in a largely unacknowledged fashion, they are being incorporated in the most successful approaches to a carbon-neutral residence. It may be that Modernist architecture, now relegated to the past, may find a celebrated and enduring place as the foundation of sustainable residential design. Indeed, the convergence of modernism and sustainability, what we may term Eco-modernism, is now emerging as one of the most important design movements in history.

I am not advocating a uniform look; nor am I saying that a sustainable house should be a green version of Mies van der Rohe's Farnsworth House or Pierre Koenig's Case Study House #22. What I am suggesting is that the blend of modern and green is a natural one. Modernist principles cohere to a remarkable degree with green design and can help guide our explorations of the varieties of expression possible in the evolving green house.

Frank Lloyd Wright has not been celebrated as an environmentalist, but the architectural record, so to speak, reveals him as the father of the modern house and a revolutionary pioneer in sustainable design. As early as 1935, Wright had promoted "an Organic Architecture" where "the ground itself predetermines all features; the cli-

The force that through the green fuse drives the flower
Drives my green age; that blasts the roots of trees
Is my destroyer.

DYLAN THOMAS
"The Force That Through the Green Fuse Drives the Flower" (Modern Poetry, Volume VII, Prentice-Hall, 1961)

mate modifies them; available means limit them; function shapes them" (*Frank Lloyd Wright's Usonian Houses*, 1984). Modern sustainable design has its roots in his Usonian Houses, beginning in 1936 with the Herbert Jacobs House in Madison, Wisconsin. The Jacobs House and other Usonian homes incorporate thoughtful site planning and an elegant economy of means. They also offer innovative and enduring ideas within residential architecture as they combine affordability and functionality with low-tech energy-conserving strategies. These homes pushed the envelope of residential architecture in a way that had never been done, until recently not equaled.

With the first Jacobs House, we have a prototype for a sustainable modern house some 30 years before the first energy crisis; here was an instructive attempt to develop a low-cost, low-energy architecture deriving from a lyrical form. This gave clients comfortable and efficient homes where aesthetics were not forgotten. With Wright's second Jacobs House, we have a design that ushers in—however unacknowledged—the notion of sustainability with the first solar hemicycle home, accommodating the warming winter sun and screening out that of the punishing summer. Until recently, too few designers have tapped into the resources and strategies exhibited in these projects. With open planning, cost-efficient slab designs, and radiant heated floors, the Usonian houses comprised a model of efficiency and responsible design. The open plans blurred the line between indoor and outdoor space, and interior rooms flowed into one another. This universal spatial strategy not only created wonderfully modern space but also brought in the natural landscape, seamlessly. The result was cool and comfortable indoor spaces that spilled out onto warm and pleasant exterior patios, even in the most extreme summer heat.

Wright, in his brilliant 1954 manifesto *The Natural House* (Horizon Press), noted, "If the dictum, 'form follows function,' has any bearing at all on building, it could take form in architecture only by means of plasticity when seen at work as complete continuity. So why not throw away entirely all implications of post and beam construction? Have no posts, no columns, no pilasters, cornices or moldings or ornament; no divisions of the sort nor any fixtures whatsoever to enter as something added to the structure. Any building should be complete, including all within itself. Instead of many things, one thing. The folded plane enters here with the merging lines, walls and ceiling made one." Clearly this statement is alluding to a simplification of the building plan and envelope, a move toward a more universal space and a reduction of inefficient complexities.

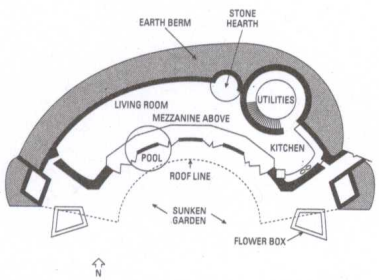
I'd like to see what Philip Johnson's energy bills were for his Glass House.

SIM VAN DER RYN
Dwell Magazine, November 2007

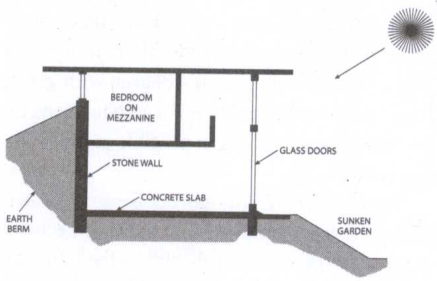
Wright's attention to site brings to mind the work of Alvar Aalto, whose projects clearly have site-specific characteristics in line with the Scandinavian architectural tradition. His Villa Maria, for example, blends a sod roof with corrugated metal and wood, design strategies now becoming increasingly familiar. Along with Aalto, Rudolf Schindler and Richard Neutra produced projects that explored the concept of universal space. With overlapping rooms and primary living quarters dissolving into a much more open planning strategy, both employed ideas they learned while apprenticing in Wright's office, and simplified them to a level he never achieved.

In one of Schindler's first designs, the Kings Road House, in West Hollywood, California, he created what some consider the world's first modern house. Known today as an architect of materiality and novel construction techniques, he crafted the home as a design for living. If ever universal space was present in design theory and in practice, this is the place. Sleeping quarters spill outside onto patios; sliding panels create spatial variety, while deliberate landscaping extends the spatial experience outside. Inventive construction methods reduced costs, and tilt-up slab construction reduced the need for excavation, thus limiting the impact on the site while significantly reducing the construction footprint. The house is rather large at just 2,500 square feet, but its open planning and passive cooling strategies make what would have been an energy glutton an early model of energy efficiency.

Neutra built on the notion of universal space with a West Coast regionalist attitude and aesthetic. His architecture emphasized the interpenetration of interior and exterior space, and his contributions to architecture were groundbreaking. Here we are particularly concerned with the availability of good design to people of modest means. These ideas made him an ideal contributor to the Case Study Houses of the 1940s, projects that emphasized thoughtful construction, passive cooling systems, and the flow between indoor and outdoor rooms. These designs were sparked by the challenge of introducing inexpensive and efficient homes to the masses, and the goal of their architects was to create quintessential models of the modern house. Along with Neutra, Alfonso Soriano contributed to the



The second Jacobs House plan shows the berm and hemicycle incorporating passive solar principles.



The section shows sun angles in winter and summer sun angles, allowing the home to respond to passive solar energy.

collaborative effort. The emerging designs became immensely popular, but they were largely unsuccessful in tapping into the mainstream market. The model was scrapped as a feasible approach to mass housing programs as inflation grew and prices soared while standardized elements did not reduce costs. At the same time these architects should be celebrated for their prescience it is important to note they did not recognize the need to forge relationships with industry, alliances that would have helped them to achieve their goal of economic efficiency.

Whereas Modernism championed simplicity in design, the Modernist design gods did not keep things simple. Or sustainable. A case in point is Soriano's 1950 Case Study house: Although beautiful, it was a model of inefficiency. Universal space and other Modernist principles were evident, but single-pane, western-facing glass and other inefficient strategies left fully half of the Case Study goals unresolved. Modernist icons like Mies' Farnsworth House or Philip Johnson's Glass House are other obvious examples—lacking overhangs, insulated glass, or operable windows. Other Case Study projects, such as the Lovell House, were also ridden with cost overruns, a factor that also made the designs unmarketable to the general public.

Today, these projects would be considerably cheaper to construct, with prefabrication becoming more widely used and markets shifting toward environmentally conservative designs with Modernist sensibilities. Notable architects such as Morphosis and Pugh + Scarpa have been influential in this shift, employing Modernist principles to promote green thinking. The latter's Solar Umbrella House, for example, uses both high-tech and low-tech solutions, including photovoltaic panels that double as a roofing system, shielding the interior from the harsh California sun. Not only do the panels reduce the heat gain within the interior, they enable the building's electricity meter to essentially run in reverse. The panels generate more electricity than the building uses and so actually supply power to the grid. Universal spatial strategies continue here, as Scarpa takes cues from other early California modernist architects like Neutra, conceiving of exterior spaces as interiors. This blurs the line between indoor and outdoor space and combines flexible design with sustainable approaches.

Morphosis, too, has been on the forefront of environmental design with the San Francisco Federal Building, a daring approach in a large-scale building project with 70 percent of the building area naturally ventilated and cooled without the use of conventional heating and air-conditioning systems. The building's façade in essence breathes as computer monitoring systems track building temperatures and allow for mechanical windows to open at a moment's notice when the building begins to overheat. The building's narrow width also allows for it to be cooled by daily breezes and for light to filter into the entire space, negating dark interiors usually evident in typical office towers.

Energy conservation, energy generation, low environmental impact, and affordability are only a few of the goals of green design. The wise selection of materials is, of course, another. And by that I mean not only the use of eco-friendly and recyclable materials but also partnering with industry to create new materials. As noted previously, the Case Study projects tell an instructive tale in the failure of their designers to collaborate with manufacturers on materials and standards. Fortunately, a remedial tale became available in the 1960s with the evolution of the green movement.

Rachel Carson's 1962 best seller *Silent Spring* (Houghton Mifflin) is often cited as sparking the environmental movement. The book raised the consciousness of Americans and helped usher in necessary challenges to widespread industrial practices. Many now argue, however, that the resulting adversarial relationship between ardent environmentalists and defensive corporations created a model of activism that has, ironically, retarded change. While the movement blossomed, a lesser-known but more collaborative model of approaching industry also came into play. In the early sixties, Buckminster Fuller declared that the Bell Telephone kiosk was his archetype for the successful building, citing its prefabricated, sustainable nature and the varying locales in which it was effective. The prefabricated capsule provided equal comfort in the

We need a new industrial revolution.

WILLIAM MCDONOUGH
Vanity Fair, May 2008

The exterior street view of Beals' residence in Atlanta, Georgia, designed by Lightroom Studio, shows the entry trellis and roof overhangs, which protect the low-e glass during the harsh Atlanta summers.