THE NEW ARCHITECTURE OF THE SUN AND WIND: An Ecological Aesthetic and Ethos of Design

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DESIGN FOR THE NEXT GENERATION

A Global Context
Throughout history, human lives and the built environment have been shaped by the ancient and persistent forces of sun and wind. These forces have informed the fundamentals of design, from the scale of regional planning to the organization of cities, streets, neighborhoods, and buildings. Whether a town square or a modest dwelling, the essential elements of massing, form, plan, section, and detail were designed to regulate the sun and the wind to heat and cool and to define the character and quality of the human relationship to place. Not until the mid-20th century, with the widespread construction of roads, distribution of fossil fuels, and use of electric lighting and mechanically ventilated buildings, were architects able to turn their backs on the forces of sun and wind as primary form-givers and means to naturally harvest heat, light, and air. Our current dependence on fossil fuels, electric lighting, and mechanical systems for comfort and control reflects but a brief moment in human history. In just a few decades we have witnessed an exponential growth in the consumption of resources, production of pollution and waste, and increasing alienation from the natural world. Despite advances in sustainable design and high-performance systems, the design professions remain caught in a fossil-fuel paradigm that measures ecological progress through incremental reductions in energy use.

The recent call by architect Ed Mazria in the Architecture 2030 Challenge to move toward carbon-neutral design dramatically raises the bar for energy performance and demands profound changes in design thinking and practice. In light of climate-change, global warming, and the alarming prospect of destructive environmental consequences, the profession must take on the challenge of redefining architecture to help alleviate ecological problems and enable new ways for humans to dwell on Earth. To accomplish this, the next generation of sustainable design needs to develop an aesthetic and an ethos that will inspire and move both the profession and the broader society to a greater ecological consciousness. A true architecture of the sun and wind is more than the sum of passive strategies, technological systems, and ecological engineering. As both the art and science of building, architecture embodies beauty and aesthetic
values that can promote the social and ecological good. An architecture that is deeply shaped by the sun and responsive to the wind fosters an ecological relationship to place and site and expresses an aesthetic based on the form-giving attributes of these forces. When truly used as generative sources of design, the sun and wind define the boundaries of ecological and formal limits. An architecture of the sun and wind has an inherently thin profile that optimizes light and air; an ecological envelope that mediates the site-harvested illumination, heating, and cooling; strives for a low- or zero-energy profile; reduces or eliminates dependence on fossil fuels; is renewable; and promotes climate justice. Above all, a true architecture of the sun and wind is beautiful and fosters health, well-being, and a connection to the local site and ecosystems. As Sim Van der Ryn explains in Designing for Life: “Architecture is ‘re-membering’—putting back together our collective dreams… The building should tell a story about place and people and be a pathway to understanding ourselves within nature.” Designing with the sun and wind exceeds reducing energy and resource consumption and goes on to awaken, or re-member, our ecological relationship to the world. The shift to an ecological ethos is as likely to be inspired by an architecture that connects to the beauty of the seasons, the weather, and cycles of place as it is to be achieved through engineering, new technologies, and performance goals.

Today, perhaps more than ever, architects need to call themselves to a future that reengages the forces of sun and wind to inform design and foster an ecology-based future. A glimpse of this next generation of ecological thinking can be found in the emerging body of zero-energy and zero-emission architecture. At one end of a continuum, zero-energy design is merely a set of technical performance standards that elevate buildings to a new threshold of energy efficiency. At the other end, the essence of zero-energy and zero-emission design is a radical proposition; radical in the word’s root sense (from the Latin radix, meaning arising from the root or source, fundamental). Zero-energy design takes us back to very fundamental questions, such as how much energy and resources are appropriate to consume. Zero-energy design challenges us to frame a vision of architecture for the 21st century that asks how we might live differently in the future. Zero-energy design asks us to reconsider our daily lives. It requires change; the status quo will not move us to a zero-energy, zero-emission, and carbon-negative future. A new architecture of the sun and wind can provide direction for the profession to gain a new way of thinking and greater performance standards, while at the same time developing an ecological ethic and an aesthetic of design capable of shaping a new social consciousness.

The following discussion explores a number of principles to elevate next-generation thinking about the sun and wind, using recent AIA Committee on the Environment (COTE)—award winning projects that aspire to zero-energy and low-energy design.
AN ECOLOGICAL ETHOS OF DESIGN: INSPIRE CHANGE: FOSTER HIGHER ECOLOGICAL GOALS

Z6 House, LivingHomes with Ray Kappe Architects

Can architecture address serious ecological concerns and also show people that we must live differently if we are to move to a new level of sustainability? To go beyond the current limits of “best practice,” the profession must reframe the fundamental questions that inform design thinking. A good example of such thinking is the Z6 House in Santa Monica, Calif., designed in partnership by LivingHomes and Ray Kappe Architects. Their first and most critical design decision was to establish robust ecological intentions and project goals.

This model single-family home was designed around the concept of a dramatically reduced ecological footprint, with “six zeros” as the performance target: zero waste, zero energy, zero water, zero carbon, zero emissions, and zero ignorance. The Z6 House does more than raise the bar, it defines a completely new standard for sustainable design excellence and performance in housing. Rather than aspiring to incremental change over typical high-performance goals and energy codes, the team challenged the fundamental paradigm of housing design by elevating the goals to zero. This change at the earliest phase of design provided the opportunity to establish an innovative and deep ecological approach to the project.

In the Z6 House we can see how the goal of six zeros inspires and gives form to sustainable performance and design excellence. While the project’s success is based on the interaction of diverse design strategies and concepts, the response to sun and wind is fundamental to meeting several of the ambitious “zero” targets while also creating an aesthetically beautiful home. First, the initial energy loads were dramatically reduced through the integration of programming, design, and high-performance systems. Rather than depending on electric lighting, mechanical heating, and air conditioning, the building reduces energy loads by harvesting daylighting and natural ventilation in the overheated seasons and by using passive solar heating in the winter. To make the design work, the occupants must interact with the house and the site throughout the seasons, thereby coming to an understanding of the moods and changes of the wind and sun, and tuning the house as necessary for comfort.

Z6 House exterior view
Photo by CJ Berg Photographics/Sunshine Divis Photography
Rigorous attention to the site and climate gave shape to a house that responds to the seasons by providing access to and control of sun and wind. The building section, high ceiling heights, and window, skylight, and clerestory placements optimize daylight and cross and stack ventilation. Material details and finishes ensure daylight penetration, solar control, and airflow, resulting in full daylighting and natural ventilation throughout the living spaces. Natural ventilation significantly reduces summer cooling loads and eliminates the need for air conditioning. Passive and active solar systems combine to meet winter heating loads, while an active solar radiant floor heating system supplements the passive heating. A 2.4 kilowatt photovoltaic system generates electricity. While the sun and wind are used to meet rigorous technical and performance standards for light, heat, and air, the house also fosters a strong relationship to the environment by providing views and experiences of the changing seasons.

The Z6 House project also strives to replicate and disseminate its ecological strategies into the general housing market. As a model home, the intention is to make zero waste, zero energy, zero water, zero carbon, zero emissions, and zero ignorance the new model for living.

These ecological goals enable occupants and owners to live more lightly by dramatically reducing their initial energy consumption and ecological footprint. Of equal importance is the dissemination of this knowledge into the broader community, which fosters higher ecological expectations in the general housing market. The goal of “zero ignorance” emphasizes the importance of educating the occupants and elevating a new vision for homes. Benjamin Franklin said, “The definition of insanity is doing the same thing over and over and expecting different results.” To achieve new results, designers have to challenge and question the most basic premises of program and activity, and the notion of how much we need. From its initial conception to its final details, the Z6 House uses the sun and wind to achieve its ambitious ecological goals. Environmental forces are welcomed into the house to provide beauty and the experience of nature, along with a new level of sustainable design performance and excellence.
PRIORITIZE PASSIVE AND RENEWABLE DESIGN: STRIVE FOR ENERGY PRODUCTION

Steinhude Sea Recreation Facility, Randall Stout Architects et al., and the City of Steinhude

Can designers go beyond net-zero energy targets to create an architecture that actually produces rather than consumes energy? Can architecture help meet the energy needs of the building, the community, and the world beyond? To achieve environmentally benign energy production, designers need to optimize passive strategies and harvest free site energy for lighting, ventilation, and heating, while also integrating renewable energy systems. The Steinhude Sea Recreation Facility, located on a small island in Germany, meets ambitious energy goals while also supporting the site’s ecology and enriching the user’s experience. The compound includes a lifeguard station, boathouse, storage facility, and public building with a café, restrooms and showers, exhibitions, and an observation area.

Designed by Randall Stout Architects, a team of German architects and engineers, and the city of Steinhude, the facility is energy self-reliant, with 100 percent of its needs met on-site through passive and active solar systems and other renewable energy technologies. Passive systems are used for natural ventilation and daylighting, while active systems provide domestic hot water, space heating, and electricity via solar hot water collectors, photovoltaic panels, a ground-source geothermal heat pump, and a seed oil–fueled cogeneration microturbine. The microturbine is used for backup power on overcast days. An annual 60,000 kilowatt hours of energy is produced, with an equivalent 60,000-kilogram yearly reduction in carbon dioxide emissions. Surplus energy is used to run a fleet of solar-powered boats, and the remainder is sold back to the utility grid. Reducing initial loads and overall energy consumption through programming, design, and efficient systems were fundamental to the project’s success.

During the coming decades architecture will have to adopt new methods of energy production at the site, local, and regional scale. Steinhude provides an...
example of how to integrate passive design strategies and active renewable energy systems while respecting the importance of aesthetics and beauty, so that users are inspired and educated by the architecture. Contrary to the classic solar diagram of the 1970s, the building is rotated 180 degrees and opens to the north. The northern view of the sea was a particular challenge for passive solar heating. Although the recreational facility operates year-round, the design’s passive aspects favor the cooling season when the facility receives its greatest number of visitors. Daylighting and natural ventilation are used throughout the facility, with abundant quantities of indirect light gathered from the large north-facing façade. In contrast to the expansive north glazing, the south façade is more opaque and steps upward to accommodate layers of photovoltaic panels and clerestory windows that surround an upper observation space. At Steinhude it was a design challenge to respond to the northern views and air, optimize indirect daylight, produce electricity, and provide passive solar heating. The design team chose to use a ground-source heat pump to meet winter-heating loads and to optimize indirect northern light and air to reduce summer cooling loads. The building siting, orientation, massing, and section balance seasonal needs for both the passive and active systems. While the project elevates the potential challenges facing designers in the integration of passive design and renewable energy technologies, it also illustrates the expressive formal and experiential potential of architecture as a net-energy producer. There is no single or simple solution to the integration of passive and renewable energy design because each project has unique opportunities and challenges. As Steinhude illustrates, a successful response integrates passive and renewable energy into a design that is beautifully shaped by the sun and wind.
Modest Matters: Define an Ethic of Enough

Government Canyon Visitor Center, Lake Flato Architects

What are the design opportunities of setting voluntary limits and working within a context of restraint? What is a “modest architecture,” and how can it help move design to a new level of sustainability? To dramatically reduce architecture’s ecological footprint designers need to take a fresh look at energy and material consumption. The Government Canyon Visitor Center in Helotes, Tex. is an elegantly simple yet innovative building designed by Lake Flato Architects. The project’s overall goal was to protect and restore the landscape while creating an ecological and economical interpretive facility that would meet the program’s educational needs. Initial project and program reframing enabled the team to reduce energy and resource consumption, costs, and maintenance by moving a significant portion of the original interior circulation, exhibits, and classroom spaces to the outdoors. At Government Canyon, the designers emphasized the concept of “reduced sizing” in lieu of “rightsizing.” By reconsidering programmatic needs and reducing interior space, air conditioning was eliminated and the size of the space to be cooled was reduced by 35 percent, with related reductions in energy consumption and ecological impacts. A commitment to harvesting daylight and natural ventilation helped to shape the project’s overall site design, massing, and form. Drawing on the language of regional vernacular architecture, two simple gabled building wings embrace an exterior garden and classroom to provide intimate on-site learning experiences. The facility demonstrates that it is possible to reprogram activities, provide flexibility and adaptability, downsize, and create design and space innovations while also decreasing energy and resource consumption, reducing maintenance, and reallocating funds to improve the quality of space.

Increasing material consumption is a global challenge, and the industrial countries are responsible for turning
around these trends. According to the U.S. Energy Information Administration, U.S. architecture annually consumes nearly 50 percent of the world’s energy and produces corresponding percentages of greenhouse gas emissions. The design professions have a great opportunity to challenge our current levels of consumption. The concept of a modest architecture (from the Latin modestus, “keeping due measure”) provides a means to seriously challenge how much energy and resource consumption is appropriate and ethical. At the Government Canyon Visitor Center, the underlying theme of “doing more with less” can be found in the ingenious ways that building design and details serve multiple purposes to optimize natural ventilation and daylighting while preserving the site and fostering a connection to the natural environment and views.

The straightforward approach to the building form, extensive use of sidelighting, large overhangs and solar control, exterior porches, and adjustable and layered envelope (including rolling doors and operable windows) result in a modest and thoughtful project that is uncompromising in terms of environmental quality, performance, and design excellence. Mahatma Gandhi said, “There is enough for everyone’s need, but not for everyone’s greed.” To take on the serious issues of energy, resources, and waste, the profession has to deeply challenge our current standard of consumption in all aspects of design and operations. The Government Canyon Visitor Center takes leadership in defining an ethic of responsible consumption. It demonstrates that the sun and wind are forces that profoundly reduce energy and resource consumption, while revealing that modest can be both beautiful and enough.
Can architecture become more ecologically relevant and help create a sustainable future and society? While the themes of ecology, economy, and equity (the “three Es”) and planet, prosperity, and people (the “three Ps”) are common frameworks that embrace a holistic interpretation of sustainability, the economic bottom line still drives most sustainable design projects and decisions. To mainstream the next generation of sustainable design, we need to address not only ecological effectiveness, but also a deeper understanding of green economics, equity, and social justice. Unless this is done, there is a risk of creating a sustainable architecture predominately for the elite. This risk can be counteracted by balancing all Es, and in particular elevating sustainable design’s affordability and justice dimensions. The Colorado Court Affordable Housing Project in Santa Monica, Calif., by Pugh Scarpa Kodama, thoughtfully integrates all three issues. As the first energy-neutral affordable housing project in the United States, the Colorado Court has ambitious goals: to optimize ecological benefits, building performance, social and human factors, and economic considerations. In addition to bioclimatic and site-responsive design features that harvest free light, wind, and passive solar energy on a seasonal basis, the project employs a broad cross-section of renewable and low-carbon-emitting technologies, including photovoltaic panels and a gas-fired microturbine to produce 100 percent of required electricity on-site. The microturbine also generates hot water for domestic use and hydronic radiant heating. Air conditioning is eliminated as a result of the well-designed natural ventilation, which is achieved through careful attention to the site, massing, and window design. The project is more than a technical endeavor; the attention to the overall building and site design create pleasing spaces that foster connections to community and nature. Each unit has an exterior balcony and a central landscape court provides outdoor living spaces.

Climate change caused in part by carbon dioxide emissions has disproportionately impacted nonindustrial (and low-carbon-emitting) regions of the world through related problems such as drought and flooding. Increasingly we are also seeing climate-related changes throughout the world, evidenced by extreme weather patterns, modified growing seasons, and shifting ecosystem and habitat boundaries. The moral
responsibility to mitigate global impacts falls most heavily on those consuming the most fossil fuels. Yet today we have little global ecological accounting for these social and environmental costs. Renewable energy and passive design are direct ways that designers can reduce carbon footprints and enable occupants to control future energy costs while eliminating the negative environmental impacts of fossil fuel consumption. At Colorado Court, the passive design strategies for daylighting and natural ventilation and the on-site electrical production and solar water heating reduce annual energy consumption and thereby provide affordability for the future as the costs of fossil fuels continue to increase.

In addition to economic affordability, the project sets high standards for human comfort and design quality. The studio units were designed with 10-foot-high ceilings, daylighting, operable windows, cross ventilation, and environmentally friendly and healthy materials. The project balanced critical ecological and economic issues with solutions to equity and the social dimensions of affordable housing quality and livability. In his article “A New Green Bauhaus” (Greensource, April 2007, 92), Michael Braungart proposes that the three Es be considered as a “triple top line” rather than as a “triple bottom line.” The triple top line elevates design thinking and sets new economic standards: “Unlike the Triple Bottom Line, which tries to minimize social and environmental damage through economic responsibility, the Triple Top Line supports all three from the very beginning of the design process.” The design profession needs to shift from the notion of minimizing social, environmental, and economic damage to elevating the environmental, economic, and public good.
Create Deep Beauty: Foster an Ecological Aesthetic

Solar Umbrella House, Pugh + Scarpa

What is an ecological sense of aesthetics and beauty? Can architecture embody design excellence if it devastates habitat, pollutes the environment, creates waste, or ignores occupants’ well-being? To realize its full potential, sustainable architecture must embody an ecological aesthetic and ethos. The Solar Umbrella House in Venice, Calif., by Pugh + Scarpa, is an extraordinary expression of both design excellence and ecological aesthetics. Underscoring the importance of beauty, the architect explains that “…a lovable energy hog is more sustainable than an unloved building that uses no energy. The goal was to create a beautiful, low-maintenance, high-quality building that is also sustainable.” The project was intentionally designed as a precedent for the next generation of modernist architecture, with “Design” (capital D) and sustainability embodied in the most essential concepts of the site and building. Inspired by Paul Rudolph’s 1953 Umbrella House, the Solar Umbrella beautifully expresses the essence of an architecture of the sun and wind. As the name suggests, the roof is a literal umbrella, or more accurately a parasol “against the sun” (from “para,” against and “sol,” sun). The roof’s form controls the sun’s admission into the house and collects solar radiation to generate electricity through roof-mounted photovoltaic panels. In this moderate climate, all scales of the design were considered to respond to seasonal needs to either gather or mediate sunlight and wind. The building massing, section, and plan are designed to control the sun, provide shade, create indirect daylight, and optimize natural ventilation, while also providing space heating during the underheated period. Passive design is more than an energy reduction strategy; it fundamentally shapes and gives form to the design. The integration of passive solar heating, natural ventilation, and daylighting was the design priority, although the house includes active solar hot water heating for domestic hot water use and the swimming pool, as well as photovoltaic panels for electricity generation.

While sustainable design can be realized through any architectural style, it embodies fundamental aesthetic opportunities and dimensions that are unique to ecological thinking. There are formal design implications in the forces of sun, wind, and site that give unique
bioclimatic expression to design. The Solar Umbrella House, which is distinctly shaped by the sun and wind, illustrates that the building’s resulting quality and experience and its relationship to the site are equally as important as the building’s performance. The relationship between inside and outside is permeable and adaptable, providing opportunities to connect the building’s interior with the landscape throughout the seasons. Great attention is given to the building envelope’s design and detailing, to provide a high degree of transparency while managing solar gains and flexibility to respond to seasonal change. The house’s skin is a dynamic and adaptable threshold that mediates the boundary between inside and outside and enables a fluid interaction between occupants and site. Interior spaces are filled with changing qualities of light and air, exterior views, and garden connections that enhance the experience of place, time, and seasons. The Solar Umbrella House elegantly integrates high-performance standards with a place-based and ecological sense of aesthetics and beauty that is more than skin deep.
DESIGNING A NEW FUTURE

This selection of recent AIA COTE award–winning projects reveals that the next generation of design thinking has already emerged, and it is one that calls the profession to a more ambitious and inspired level of leadership to meet the urgent ecological issues of our time. Edward Tufte, information designer and author of Beautiful Evidence, suggests that the “commonality between science and art is in trying to see profoundly—to develop strategies of seeing and showing.” Today’s design challenge is to meet new standards of sustainable performance and cause a shift in social consciousness that will enable people to “see profoundly” into a new future. Buildings alone can not solve our ecological problems, the way humans live on this Earth also has to change and evolve. Architecture can reveal tangible ways of living more lightly, connecting more deeply with place, and honoring all forms of life. Architecture is a critical means of integrating sustainability into our daily lives and actions; it can help us practice new ways of dwelling on Earth. The greatest lesson from these projects is the vision of a future that solves ecological problems with design integrity and beauty and provides solutions to living more respectfully within our local ecosystems. Architects are called to integrate both the art and science of an architecture of the sun and wind as means to awaken the heart and enable our society to embody a new ecological ethos that is both hopeful and promising.

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