

**Beyond LEED:
From Low Environmental Impact to
Restorative Environmental Design**

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Most sustainable design has focused on reducing harm to natural systems and human health by avoiding, minimizing, and mitigating the adverse effects of modern construction and practice. These efforts are, of course, important and critically needed given how much the modern built environment has consumed and degraded the natural environment as well as increased human health risks. Indicative of the scale of these environmental impacts, the built environment today consumes 40% of energy, 25% of freshwater, and 30% of other natural resources, in addition to generating 40% of air emissions, 20% of freshwater effluents, and 25% of our solid wastes. This impact has been exacerbated by our becoming an increasingly urban society, almost 80% of Americans and residents of most industrially developed countries now residing in urban areas, and the greatest migration in human history now in process as hundreds of millions of developing world citizens, particularly Asians, migrate from the countryside to the city. The development impact of this massive population growth, increase in consumption, and urbanization is suggested by William Shutkin when he observes, “land use and development in the 20th century [is] so extensive... 80% of everything built in the United States has been constructed within the last fifty years.”

The objective of minimizing and mitigating these various adverse environmental impacts of the modern built environment can be thought of as “low environmental impact design.” Its emphasis is reflected in most sustainable design guidelines such as the much-acclaimed U.S. Green Building Council’s “Leadership in Environmental and Energy Design” or LEED. Efforts at low environmental impact design have achieved considerable good and increased dramatically in an extraordinarily short period of time.

Yet, I will argue in this presentation that a low environmental impact design approach by itself cannot achieve sustainable development over the long-term.

William McDonough alluded to this deficiency of a conventional low environmental impact design approach when he distinguished “eco-efficiency” from “eco-effectiveness”. He described eco-efficiency – his term for low environmental impact design – as primarily focusing on diminishing the environmental harms caused by modern construction and practice, a necessary and challenging objective. But, McDonough argued a broader and more sustainable design approach must move beyond simply avoiding environmental damage, seeking to generate ecological health as well, one he described as: “Designing a building that’s a net [ecological] exporter, producing more energy than it needs to operate and becoming fecund, giving back...[i.e.,] one that produces food and energy, creates no adverse wastes, and fosters beauty and diversity.”

Yet, I believe we need to extend McDonough’s concept of ecological health to include humans in this ecological equation, recognizing how people’s physical and mental well being and productivity in the built environment is also contingent on the quality and quantity of their experiential connections with natural systems and processes. Prevailing approaches to sustainable design rarely if ever address the human biological and ecological need for contact with nature that has been increasingly identified as a prerequisite of human physical and mental health and productivity. This inherent human need for positive contact with nature has been referred to by myself and colleagues as “biophilia” (Wilson 1984, Kellert and Wilson 1993, Kellert 1997). An ultimately successful approach to sustainable design must accomplish more than just avoiding or minimizing harmful impacts on natural systems and human health as important and

difficult as this objective may be. It must also produce a valued and beneficial human experience rooted in our species innate affinity for the natural environment as an essential source of physical and mental well being and productivity.

Modern especially urban construction and development in addition to resulting in adverse impacts on natural systems and human health has also tended to increase people's separation, isolation, and alienation from beneficial contact with the natural environment. Yet, a growing body of theory and evidence suggests human contact with nature is a prerequisite for physical and mental health and productivity. As mentioned, the human body and especially mind evolved in a biological not machine-oriented or artificial world. Consequently, positive contact with nature affects human health and productivity, as the following findings illustrate:

- Research in psychophysiology has revealed contact with nature enhances human physical health and healing, even passive viewing of nature in hospital rooms influencing the course of recovery from surgery.
- Research of people living in or near parks and other green spaces has found statistically fewer health problems in comparison to people with little or no access to the natural environment.
- Research in outdoor urban settings with natural amenities has revealed these areas are more likely attract neighbors and foster stronger social ties and networks than areas lacking these environmental features.
- Research in office settings has found natural lighting and ventilation improves the quality of work and reduces stress.

- Research of people with views of nature and enhanced daylighting has linked these conditions to improved cognitive performance on tasks requiring concentration and memory.
- Research in schools with enhanced natural lighting and ventilation has found higher test scores, improved attendance, and greater teacher satisfaction, retention, and productivity.
- Research on contact with nature has demonstrated it can promote a restful state that maintains levels of psycho-physiological activation necessary for complex work.
- Research in neuroscience on the functioning of the human brain has found it to be intricately tied to the sensory features and patterns of the natural environment.

These effects can also result in significant economic benefits. Improved natural lighting and cooling has been found to increase worker comfort and productivity with gains from energy-efficient design ranging from 6% to 16%. Improvements in natural lighting and ventilation have also been correlated with improved work quality, reduction in errors, and fewer manufacturing defects. Direct and indirect contact with nature has additionally been linked to reductions in stress, absenteeism, and sickness, all resulting in economic savings.

Yet, conventional approaches to design and development in especially urban areas has tended to exacerbate the separation and isolation of people from contact with the natural environment. Consequently, most people today spend the majority of their waking hours in buildings devoid of daylight, sunlight, fresh air, outdoor views, or other

natural amenities such as indoor or outdoor green spaces. As Judith Heerwagen observes in especially the modern work place:

“Nowhere is the absence of sensory experience more vivid than in modern buildings that minimize contact with anything natural – whether air, daylight, views, green vegetation, materials, patterns, or color. Modern workplaces are often seas of bland cubicles that isolate rather than integrate people with anything natural – not unlike the cages in the old style zoo.”

Her concluding comment reflects on the fact that we are no longer allowed to place large sensitive animals like tigers or bears in barren and confined enclosures because it is ironically considered “inhumane”. Yet, it is perfectly acceptable to do so with our own species, an apt reflection of how far removed we see ourselves from nature and as no longer subject to our biological needs and origins.

This design and development paradigm is neither desirable nor necessary and I believe is certainly not sustainable. I would argue instead for the reformation of not only our conventional development paradigm but also prevailing approaches to sustainable design. In their place, I would advance the development of a new paradigm I call Restorative Environmental Design, or its acronym, RED, rather than green design. The fundamental objective of restorative environmental design is to achieve a harmonious relationship between humanity and the natural environment. Two basic goals guide this approach – one, avoiding, minimizing, and mitigating the adverse effects of modern design and development on natural systems and human health; and, second, promoting a more positive relation between people and nature in the built environment. These complementary objectives address the two major ways modern development has

contributed to the contemporary environmental crisis – impairing the health and integrity of natural systems and human health, and compromising people’s capacity to derive a host of benefits from ongoing contact with the natural world. To reiterate, a framework of development that combines the objectives of avoiding adverse environmental impacts while also promoting positive connections between people and nature in the built environment is the paradigm of Restorative Environmental Design. I prefer this term because it avoids the ambiguity of the label green design or the focus on merely avoiding negative environmental impacts characteristic of much current sustainable design.

The environmental crisis of damaged natural systems and impoverished human-nature relations is fundamentally a design crisis that can only be resolved through constructing more efficient and environmentally benign buildings and landscapes. Restorative Environmental Design goes beyond avoiding harm and damage to natural systems and human health to also seeking the restoration of positive and beneficial contact between nature and humanity. Lacking this more affirmative dimension of design and development, sustainability will rarely if ever be achieved no matter how much improvement occurs in resource conservation, energy efficiency, waste minimization, or pollution abatement. Absent the positive human experience of nature, people will not commit the energies, emotions, and resources necessary over time to sustain buildings and landscapes no matter how technologically sophisticated. James Wines alluded to the limits of an exclusively low environmental impact approach when he suggested:

“There is much talk of sustainable architecture as an alternative to industrialized societies’ wasteful legacy of short-term construction. People will,

however, never want to keep an aesthetically inferior building around no matter how well stocked...with cutting edge thermal glass, photovoltaic cells, recycled materials, and zero emissions carpeting. The mission of [sustainable design] is [also] to recover those fragile threads of connectedness with nature.”

This perspective does not deny the fundamental goal of avoiding and minimizing adverse environmental impacts as a first and arguably most important objective of sustainable design and development. Major aspects of a low environmental impact design objective include efficient energy and resource use, pollution and contamination avoidance, waste minimization, using environmentally benign products and materials, protecting indoor environmental quality, and more. Moreover, adequately mitigating these impacts over the long-term must occur at multiple spatial scales from the building to the immediate site to more distant landscapes and even the biosphere. The notion of “embodied energy” or the amount of energy required to extract, manufacture, process, transport, dispose, use, and reuse building resources and materials underscores the additional importance of a temporal focus in mitigating the adverse environmental impacts of construction and development. A comprehensive approach to low environmental impact design must further seek to convert waste into a resource, transforming both biologically degradable and industrial byproducts into future stocks of material and ecological productivity.

A listing of environmental effects of building and development that need to be considered at these varying spatial and temporal scales includes:

- Atmospheric and other environmental damage associated with the consumption of fossil fuels, particularly the generation of heat trapping gasses and acidification of the atmosphere.
- Toxic and chemical contaminants dispersed into air, water and soils.
- Pollution resulting from the discharge of nutrients and fertilizers into soil and aquatic systems.
- The depletion of stratospheric ozone from the release of atmospheric contaminants.
- Photochemical smog generated by construction, energy use, and transportation.
- Loss of biological diversity and natural habitats resulting from construction, land use practices, and resource extraction.
- Depletion of renewable and non-renewable resources from the manufacture of building products and materials.
- Generation of liquid and solid wastes beyond the capacity of natural systems to assimilate and absorb.
- Release of noxious chemicals and microbes into the indoor environment.

Clearly, these and other low environmental impact objectives constitute immense technological, socioeconomic, and political challenges. Volumes have been written about the complexities of energy and resource efficiency, producing non-harmful products and materials, pollution avoidance, indoor environmental quality, and other aspects of low environmental impact design. Yet, as indicated, accomplishing these low environmental impact goals will not by itself sufficiently heal the existing breach

between the natural and human built environments characteristic of modern urban society. Reducing adverse environmental impacts of contemporary construction and development represents a basic first priority, but we need to go much further and deeper toward identifying ways people can achieve lives of meaning and satisfaction through nurturing their dependence on the natural world to achieve a truly sustainable society.

Unfortunately, most sustainable design has been pursued with little or no consideration of how to foster satisfying and beneficial contact between people and nature in the modern built environment. Low environmental impact design has become instead the default position for sustainable design and development. This inordinate emphasis is reflected in manuals and guides to sustainable design and, for example, is largely characteristic of the LEED rating system. This emphasis is illustrated by the University of California's Donald Bren School of Environmental Science and Management in Santa Barbara, the recent recipient of LEED's highest Platinum rating. This building includes many admirable low environmental impact features, but few positive environmental impact design elements, despite the building being located alongside the Pacific Ocean, a site that would have cost more than the entire building if the university had to purchase it.

The goal of positive impact or biophilic design is to achieve direct, indirect, or symbolic contact between people and nature in the built environment. Is this an important objective? Isn't the main challenge of sustainable design that of lessening the damaging environmental effects of modern construction and development, all else being of limited, marginal, and even trivial significance by comparison? I would contend otherwise. Few exclusively low environmental impact designed buildings will over the

long-term prove to be sustainable in the dictionary sense of “keeping in existence and maintaining”. To be motivated to sustain constructions over the long-term, people must be both emotionally and intellectually attached and committed to the value and importance of these buildings and landscapes. Innovative low environmental impact design in a rapidly changing world will inevitably become conventional and then obsolete. When this occurs, will the occupants and users of these structures be sufficiently motivated to retain and restore these buildings or will they neglect, abandon, and discard them? If buildings and landscapes are experienced as oppressive and unattractive because they lack positive experiential connection with the natural environment, they will rarely be retained over the long-term.

Low environmental impact design fails to address basic human needs for physical, emotional, intellectual, and even spiritual connection with the natural world. Low impact design mainly relies on negatively motivating people to avoid environmental harm or damage, failing to provide a more positive vision of how to achieve lives of greater meaning and satisfaction through enhancing relation to nature. Low environmental impact design avoids destructive impacts on natural systems and human health, but it fails to offer a means for achieving net benefits from positive contact with nature that enhances well being and productivity. As William McDonough’s remarks, the absence of problems is not the measure of success in a personal relationship or in the area of sustainable design. Our goal must instead be one of fostering a fuller, more satisfying, and productive existence through our creations. The rhetorical question in the pursuit of sustainability must be: What is more sustainable, a technologically sophisticated low environmental impact building isolated from the natural world and likely abandoned once

its high technology systems are no longer novel or cutting-edge, or constructions people revere and recycle generation after generation because they affirm our enduring affinity for connection with the natural environment? The challenge of restorative environmental design is to mend our diminished and tattered connections with nature through both avoiding harm to natural systems and human health, as well as fostering beneficial contact between people and the natural environment.

Positive impact or what I prefer to call biophilic design reflect building and landscape constructions that enhance people's physical and mental well-being through positive connections to the natural environment in places of ecological and cultural meaning and familiarity. This design concept derives from the concept biophilia, the idea that people possess an inherent affinity for nature revealed in nine basic values that confer adaptive benefits. Biophilic design elements can be encountered directly, indirectly, and symbolically in building façades, interiors, and landscapes. Because biophilic features tap into inherent human affinities they are sometimes experienced in ways people hardly recognize. Grant Hildebrand alludes to this subjective dimension of biophilic design when he notes:

“We are biologically predisposed to liking buildings and landscapes with prominent natural elements. When we cannot actually place ourselves in a natural setting, we make some effort to provide ourselves with substitutes. There is evidence that we like to have around us natural archetypes or simulations of them. The point is not that a building or landscape resembles nature but that some architectural scenes accord (e.g., in form and space, in light and darkness) with an archetypal image of the natural world.”

Similarly, Judith Heerwagen observed:

“Most of the world’s most revered buildings contain biophilic features. That is, they contain the ‘essence’ of natural objectives without being exact copies. They draw on design principles of natural forms.”

As noted previously, two broad organic and vernacular dimensions of biophilic design can be identified. Organic design consists of shapes and forms in the built environment that directly, indirectly, or symbolically elicit a human biocultural affinity for natural process and diversity. Direct experience refers to encounters with natural features and processes that are largely self-sustaining – e.g., a wooded landscape, a natural stream, a mountain vista. Indirect contact involves aspects of nature that depend on continuous human input, intervention, and control to exist – e.g., potted plants, manicured and managed landscapes, an aquarium. Symbolic or vicarious contact involves no actual contact with nature, but rather with the ornamental, metaphorical, or vicarious representation of the natural world – e.g., decorations simulating natural shapes and forms, interior furnishings employing materials like wood and stone, pictures and symbols of mountains and landscapes. The direct experience of nature can occur in buildings, but more often indirect or representational contact with nature is characteristic of the built environment.

Vernacular design is reflected in buildings and landscapes that affirm the natural and cultural history and ecology of the localities where they occur. Successful vernacular design evokes what has been called by the great landscape architect, Fredrick Law Olmsted, and the Nobel prize-winning biologist, René Dubos, a “spirit” of place. Dubos described a sense or spirit of place as follows:

“People want to experience the sensory, emotional, and spiritual satisfactions that can be obtained only from an intimate interplay, an identification with the places in which they live. This interplay and identification generate the spirit of the place. The environment acquires the [spirit] of a place through the fusion of the natural and human order.”

John Brinckerhoff Jackson further identified various features of a sense or spirit of place including: a heightened awareness of familiar environments, a strong sense of fellowship based on shared experience, repetitive and reinforcing customs, habits, and rituals.

Effective vernacular design occurs when buildings and constructed landscapes are characterized by:

- A comfortable and engaging connection to the cultural and historical heritage of a place.
- A keen sensitivity to and understanding of how buildings and landscapes are connected with the ecology of their natural settings.
- An effective fusion of culture and ecology within a biogeographical context reflecting a spirit of place.
- The ability to avoid tendencies that subvert or degrade an area’s distinctive culture and ecology or what has been called “placelessness.”

The phenomenon of “placelessness,” Jackson described as the “weakening of distinctive...experiences and identities of places.” When buildings and landscapes lack a connection to the places where they occur, people rarely exercise responsibility or stewardship to preserve, protect, or restore these structures over the long-term. As Wendell Berry has observed: “Without a complex knowledge of one’s place, and without

the faithfulness to one's place on which such knowledge depends, it is inevitable that the place will be used carelessly, and eventually destroyed." Designs deficient in an effective fit with their cultural, historical, and ecological context tend to be transient, ephemeral, and ultimately unsustainable. As Mark Sagoff has suggested:

"The concept of place...is an idea of surroundings that arises from harmony, partnership, and intimacy. Much of what we deplore about the human subversion of nature – and fear about the destruction of [the natural and human built] environments – has to do with loss of security one has when one relies upon the characteristic aspects of places and communities one knows well. What may worry us most is the prospect of becoming strangers in our own land."

Vernacular and organic dimensions of biophilic design can be fostered by a number of design elements such as natural lighting, natural ventilation, natural materials, shapes and forms that mimic natural systems and processes, ornamentation that reflects natural features, views and prospects of nature, and others. A list of common features of biophilic design are summarily identified below:

- Natural lighting
- Natural ventilation
- Natural materials
- Natural and indigenous vegetation
- Ecological landscape design
- Open space
- Water
- Views and vistas of nature
- Shapes and forms that mimic organic forms
- Vistas characterized by refuge and prospect
- Natural features that evoke mystery, exploration, and enticement
- Natural features characterized by Order and complexity
- Natural rhythms
- Natural processes and change
- Aesthetic and recreational values of nature

Informational and intellectual values of nature
Emotional and spiritual values of nature

This description of biophilic design hopefully does not suggest a subjective aesthetic favored over more objective and rational standards of technical efficiency characteristic of low environmental impact design. Indeed, the purpose was quite the opposite. The occurrence of biophilic design features in buildings and landscapes can reduce stress, improve physical health, enhance emotional satisfaction, increase motivation, reduce absenteeism, improve grade scores, foster creativity, facilitate problem solving, and promote productivity. Significant stress reduction and physical and mental health outcomes have been related to even the passive viewing of nature, such as workers with window views who report less frustration, greater satisfaction, and better health than workers lacking natural lighting or outside views; or workers in windowless rooms with plants being more efficient, having lower blood pressure, and greater attentiveness than persons in the same room without plants. The most ambitious study to date of the impact of biophilic design has been an investigation of office and factory workers at the Herman Miller furniture company in central Michigan before and after a major renovation that included such biophilic features as increased day lighting and natural ventilation and a restored wetland and prairie landscape. This investigation found a 22% increase in productivity nine months following the biophilic design changes, as well as significantly improved worker motivation, emotional satisfaction, and sense of well being at work. These and other results suggest that low environmental impact design that satisfies only a narrow range of material and physical needs, but falls short of many improvements in human performance and well being that can be achieved if all biophilic affinities for the natural environment are satisfied.

The most sustainable designs combine both the technical efficiencies of low environmental impact design, and the enhanced connections to nature characteristic of biophilic design. Low environmental impact and biophilic design are the complementary components of Restorative Environmental Design. Combined, they represent the promise of development that can help heal the prevailing malaise of modern society in adversarial relation to the natural world. Restorative Environmental Design stands in marked contrast with contemporary construction that favors anonymity over distinctiveness, barrenness in favor of life, artificial creation over biological and cultural connection. Environmental and cultural destruction is the inevitable consequence of a modern development paradigm that relies on fabricated materials, artificial lighting, controlled climatic environments, straight-line geometries, an indifference to culture and ecology, and the tendency to substitute the synthetic for the natural. If architecture is a form of pedagogy as David Orr suggests, much of modern architecture teaches us that:

“Most buildings reflect no understanding of ecology or ecological processes. Most buildings tell its users that knowing where they are is unimportant. Most buildings tell its users that energy is cheap and abundant and can be squandered. Most buildings are provisioned with materials and water and dispose of their wastes in ways that tell its occupants that we are not part of the larger web of life. Most buildings resonate with no part of our biology, evolutionary experience, or aesthetic sensibilities.”

The extraordinary promise of Green Roofs is how much opportunity is afforded to combine both low environmental impact and biophilic design objectives of restorative

environmental design in especially an urban context. From a low environmental impact design perspective, green roofs can mitigate heat island effects, reduce storm water runoff, improve energy efficiency, lessen heating and cooling loads, diminish air and noise pollution, enhance biodiversity, and provide opportunities for renewable energy production. But, green roofs can also enhance biophilic design objectives by creating habitats for terrestrial and aquatic plant and animal species that produce varied aesthetic, naturalistic, ecological, and educational benefits. Moreover, this potential can be especially pronounced in cities where high quality, attractive, and stimulating natural settings are often lacking. Rooftops are likely the largest unutilized habitat in most metropolitan areas for capturing the photosynthetic benefits of sunlight, thus, offering an enormous biophilic design opportunity. By providing park-like settings attractive to butterflies, birds, and even aquatic organisms, green roofs can provide people with various emotional and intellectual benefits that enhance their health, well being, and productivity. Green roofs can further help people to connect to their local ecology and communities through utilizing indigenous, culturally relevant, and eco-systemically linked plants and animals.

By the year 2010, an estimated 38 million more buildings will have been constructed in the US in mainly urban areas. The scale of the built environment has simply become too extensive and environmentally destructive to seek anything less than a positive impact on both natural and human systems. Restorative environmental design can help transform conventional design practice by enhancing people's connections to nature in the built environment. The application of restorative environmental design principles to the development of green roofs can contribute not only to a healthier natural

environment but to a more contented and productive humanity as well. As the great ecologist Aldo Leopold remarked many years ago:

“There must be some force behind conservation, more universal than profit, less awkward than government, less ephemeral than sport, something that reaches into all times and places...something that brackets everything from rivers to raindrops, from whales to hummingbirds, from land-estates to window-boxes...I can see only one such force: a respect for land as an organism...out of love for and obligation to that great biota...By and large, our present problem is one of attitudes and implements. We are remodeling the Alhambra with a steam shovel, and we are proud of our yardage. We shall hardly relinquish the shovel, which after all has many good points, but we are in need of gentler and more objective criteria for its successful use.”