Practical Design Strategies for a Sustainable Future

By Ron Pope
TAG International

In today's environmentally conscious world, the terms "sustainable" and "green" can be seen and heard across every aspect of our lives – from advertisements, to conversations with family and friends, to the decisions we make in our businesses and daily work lives. While there are some who are trying to profit from the "green wave" and others who are actually trying to change the world – relatively few have a clear understanding of what these ubiquitous terms mean.

"*In our every deliberation, we must consider the impact of our decisions on the next seven generations*."
-- The Great Law of the Iroquois Confederacy

A solid understanding of these concepts – their respective meanings, associations and appropriate usages – is increasingly important in the real estate and building industries, given the central role they play in the planning, design and construction of our "built environment." It is crucial that we, as individuals and building professionals, continually seek to expand our knowledge of these concepts, as well as our mastery of the latest strategies and techniques for applying them in innovative, yet practical ways.

There is growing awareness and acceptance that enhancing our built environment with sustainable design and green building practices can deliver tremendous benefits at many levels, both locally and globally. This article explores these complex, sometimes controversial, issues including a historical perspective on how we got here, the introduction of green building standards, and most importantly, practical and actionable strategies that support your organization's economic and business goals, while enabling you to work in harmony with human and environmental factors.

Sustainability vs. Green: What Does It All Mean?

Sustainability and green are highly related concepts – yet they have distinctively different meanings.

To be sustainable, natural resources must be used only at a rate at which they can be adequately replenished naturally.

In its most general sense, sustainability is the capacity to maintain a certain state of being, indefinitely. In recent years, the term has been used to refer to maintaining a balance between human needs and ecological viability. Common use of the word, in this context, began with the 1987 publication of the United Nations World Commission on Environment and Development report, *Our Common Future*, also known as the Brundtland Report, which defined the term sustainable development as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

Sustainability, as it is commonly used in reference to ecology, refers to the ability of an ecosystem to maintain its processes, functions, biodiversity, and productivity now and into the future. To be sustainable, natural resources must be used only at a rate at which they can be adequately replenished naturally. We now have clear scientific evidence that humans are consuming the Earth’s natural resources more rapidly than those resources are being replaced by nature. Humanity seems to be currently living in an unsustainable way. If not curtailed, the long-term consequences of this could be disastrous for our species and the planet.

According to the United Nations World Commission on Environment and Development, sustainable development is defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

Sustainability is a complex, sometimes controversial, term that can be applied in a wide variety of ways. It is such a broad concept that it can encompass essentially all of human activity; thus, it can have different meanings in different circumstances. Certainly, the strategies needed to address sustainability concerns will vary significantly depending on specific conditions and situations.

The term sustainable development has a more specific application. It joins together two important ideas: that protection of the environment does not necessarily preclude economic development or well-being, and that economic development must be ecologically viable both now and in the long term.

In any case, these concepts – sustainability and sustainable development – have inspired individuals all over the world, as well as public and private organizations, to become better stewards of the natural environment while promoting positive economic growth and social objectives.

Green, on the other hand, has a more direct association with nature, due to its prevalence in plant life, and has become highly symbolic of environmental protection. The color green and such terms as “green friendly” are now commonly used in advertisements and product packaging to denote environmental responsibility.

While sustainability and green are often used interchangeably, green indicates a more immediate and pressing need to protect the natural environment from humans, whereas sustainability presents a broader, potentially more hopeful, concept that applies to the long-term balance between humans and their natural environment.

In the building and construction arena, green building should be seen as a subset of sustainable development. Green building predominantly focuses on the efficiency with which buildings use resources such as energy, water and materials, while reducing negative impacts on human health and the natural environment throughout the building's lifecycle.

Green building strategies and practices are widely applicable and can be implemented in the design, construction, operation, and maintenance of all types of buildings. Sustainable development involves an even broader set of concerns at the level of urban design and regional planning, and considers such issues as appropriate patterns for humans living in harmony with the environment over long spans of time.

Building a Sustainable Future: The Need for Change

Green implies the immediate need for protection of environment, whereas sustainability implies the long-term balance between humans and the environment – both are important and necessary.

In theory, infinite economic growth is impossible on a finite planet with limited natural resources. Sustainability requires that natural resources be used only at a rate at which they can be replenished naturally. When nature's resources – or "natural capital" – are consumed faster than they can be replaced, an unstable situation occurs.

History shows that the long-term result of the degradation of natural resources in a particular locale is the inability at some point to sustain human life. On a global scale, environmental degradation could theoretically lead to the eventual failure of humanity to sustain itself. In other words, future generations could ultimately face extinction.

Over the past 50 years, the rapidly escalating global impact of human lifestyles on ecosystems has become a major source of concern. At a fundamental level, human activities are contributing to significant changes in chemical cycles that are critical to supporting life, most notably water, oxygen, carbon, and nitrogen.

Since 1950, world population has doubled, food production has tripled, energy use has quadrupled, and overall economic activity has quintupled. Such dramatic growth is cause for concern unless measures are taken to achieve a sustainable balance with the Earth's ability to replenish its resources.

The challenge ahead is to reduce consumption without sacrificing the standard of living to which we've become accustomed, while raising the standard of living in developing countries without increasing their resource consumption and environmental impact.

With the world's population projected to increase by approximately 30% over the next 40 years, the diminishing of natural resources increases the potential for "resource wars" that create national security issues for countries across the globe.

Experts believe that current per capita consumption of resources in the developing world is sustainable, but the populations and consumption patterns are rapidly increasing in those countries. In the developed world, the population is stable, yet already-high consumption levels are seen to be unsustainable.

The challenge ahead is reducing consumption without sacrificing the standard of living to which industrialized societies have become accustomed, and at the same time raising the standard of living in developing countries without increasing their resource consumption and environmental impact.

To respond to this global challenge, we need to employ strategies and technologies that decouple economic growth from resource depletion and potential environmental damage. This requires a combination of reduced consumption through better management of resources and the extension of the capacity of resources through human ingenuity and technological innovation.

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The Emergence of Standards for the Built Environment

By the late 1970s, it was widely accepted that buildings themselves were a part of the problem with the environment. However, at the time, not much consideration was being given to the “built environment” in which most humans actually spend the bulk of their time. The energy crisis of that era provided the first important galvanizing effect on public interest, specifically regarding the energy consumption of buildings. As a result, exploration began into new experimental ideas and technologies, such as solar panels and wind power.

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17% of fresh water withdrawals
25% of wood harvest
33% of CO_2 emissions
40% material and energy use

Although the perceived impetus for these explorations was diminished with the return of cheaper fuel during the 1980s, green building concepts were slowly beginning to take shape. Awareness of indoor air quality issues grew rapidly and new standards were defined for how buildings should perform in terms of air quality. At the same time, more focus was beginning to be placed on the use of recycled materials to reduce consumption.

During the 1990s, environmental awareness reached new levels and green building concepts migrated toward the mainstream. However, some type of standard was needed to define and quantify how green a building actually was. Without a definitive standard based on measurement and analysis, there was much confusion and too many opportunities for false claims.
Rather than wait for the government to try to establish a standard, various non-profit organizations began the effort on their own. Although several organizations

helped to advance the green building cause with the creation of a variety of rating systems, the U.S. Green Building Council (USGBC) has emerged as the predominant platform in North America.

USGBC is a consortium of corporations, government agencies, nonprofit organizations, and more than 91,000 professionals from the design, construction and real estate industries. The consortium is best known for its development of the Leadership in Energy and Environmental Design (LEED) rating system, which provides a framework for assessing building performance relative to sustainability goals.

The consortium's LEED certification system offers an objective, whole-building approach to quantifying and evaluating the success of building projects at implementing and adhering to sustainable design and construction practices. Both newly constructed and existing buildings are eligible for LEED certification, as are interior finish-outs.

The Leadership in Energy and Environmental Design (LEED) rating system provides a framework for assessing building performance relative to key sustainability goals. Five key areas include:

- *Sustainable Site Development*
- *Water Efficiency*
- *Energy and Atmosphere*
- *Materials and Resources*
- *Indoor Environmental Quality*

LEED projects are evaluated relative to specific sustainability goals in five key areas of human and environmental health including Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality and an additional category for other creative design solutions called Innovation and Design Process.

LEED rating systems are developed through an open, consensus-based process by volunteer committees composed of a diverse group of design professionals, industry leaders, and other experts and individuals involved in the building and construction industry. Technical advisory groups help to ensure scientific rigor and consistency. Other key elements of the consensus-based process include opportunities for stakeholder comment and review, member voting for new rating systems, and an open appeals process.

The use of LEED systems is growing rapidly internationally, with LEED projects now in progress in 41 different countries – from Latin America to Canada to India. In the US, government entities have adopted LEED standards for publicly owned and funded buildings and construction projects, as well as for Federal building projects across a variety of agencies including the GSA and Departments of Defense, Agriculture, Energy, and State. Many private sector corporations and development entities are also now seeking LEED certification as a method of improving their public image and making properties more attractive to prospective tenants and customers.

Sustainability Goals and Practical Design Strategies

With growing awareness of the fact that buildings consume a significant portion of the planet's natural resources – including land, energy and water – and contribute significantly to air and atmosphere alteration, reducing this impact is critical for future sustainability.

For example, in the U.S. alone, more than 2,000,000 acres of open space, wildlife habitat, and wetlands are developed each year. As of 2006, buildings used 40% of the total energy consumed in the U.S. and approximately 71% of the total electricity consumed. Worldwide, buildings account for 33% of total carbon dioxide emissions, 17% of fresh water withdrawals, 25% of wood harvested, and 40% of material and energy use.

Green building and sustainable design approaches seek to achieve not only ecological, but aesthetic and experiential balance between the built environment and the natural environment.

Sustainability concepts and green building principles are designed to reduce the overall impact of the built environment on natural resources and human health in a variety of ways. Effectively utilizing green building practices can lead to:

- Reduced operating costs by increasing productivity and using less energy and water.
- Improved public and occupant health due to better indoor air quality.
- Reduced environmental impact; for example, by decreasing storm water runoff and lessening the "heat island" effect.

Green building and sustainable design approaches seek to achieve not only ecological, but aesthetic and experiential balance between the built environment and the natural environment. A wide array of design strategies, best practices, material selections, technological innovations, and construction techniques can be employed to help achieve these key sustainability objectives.

Using the five key areas identified by the LEED rating system – including sustainable site development, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality – there are a variety of ways in which goals in these areas can be achieved. The following is a brief overview of strategies to be considered.

Sustainable Site Development:

- Select an appropriate site for development that does not include sensitive site elements and restrictive land types, such as prime farmland or land that has been identified as an endangered species habitat, wetlands, parklands, or previously undeveloped land within 50 feet of a water body or in a 100-year flood plain.

- Reduce environmental impact by designing the building with a minimal footprint to decrease site disruption – or select a brownfield site for re-development**.**
- Site the building to minimize disruption to existing ecosystems, conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.
- If available and appropriate for the project, select an urban site with pedestrian access to services, and/or locate the building near mass transit to reduce pollution and development impacts from automobiles. Design for amenities such as bicycle racks and shower/change rooms to encourage bicycle use.
- Minimize parking lot/garage size and consider sharing parking facilities with adjacent buildings.
- Limit disruption of natural water hydrology by reducing impervious cover, increasing on-site infiltration, reducing pollution from storm water runoff, and eliminating contaminants.
- Design the project site to maintain natural storm water flows and reuse storm water generated for non-potable uses such as landscape irrigation, toilet flushing, and custodial purposes.
- Reduce "heat islands" by shading constructed surfaces with landscape elements. Consider replacing constructed surfaces (roofs, roads, sidewalks, etc.) with vegetated surfaces, open grid paving, or high-albedo (light reflecting) materials to reduce heat absorption.
- Reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust generation. Create an Erosion and Sedimentation Control Plan during the design phase and consider strategies such as seeding, mulching, silt fencing, and sediment basins.
- Minimize light trespass from the building and site, reduce "sky glow" and glare to improve night sky visibility and reduce development impact on nocturnal wildlife. Adopt site lighting criteria to maintain safe light levels while avoiding off-site lighting ("light spillage") and night sky light pollution. Techniques to reduce light pollution include specifying full cutoff light fixtures, low-angle spotlights, and low-reflectance surfaces.

Water Efficiency:

- Reduce wastewater generation and potable water demand by specifying high-efficiency plumbing fixtures. Consider using dry fixtures such as composting toilet systems and waterless urinals to reduce wastewater volume.
- Reduce potable water consumption used for landscape irrigation by specifying appropriate native or adapted plants requiring minimal or no irrigation. When irrigation is required, use high-efficiency equipment, climate-based controllers and/or storm water, grey water, or condensate water.

Energy and Atmosphere:

- Design the building envelope, HVAC, lighting, and other building systems to maximize energy efficient performance. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures.
- Specify new HVAC equipment that uses no CFC refrigerants to reduce ozone depletion. When reusing existing HVAC systems, identify equipment that uses CFC refrigerants and create a replacement schedule for these refrigerants.
- Encourage onsite renewable energy self-supply in order to reduce the environmental and economic impacts associated with fossil fuel energy use. Consider using non-polluting and renewable energy sources such as solar panels, wind power, geothermal, biomass and bio-gas strategies.
- Utilize fire suppression systems that do not contain ozone-depleting substances such as CFCs, HCFCs, or Halons.
- Implement a Commissioning process to verify that energy related systems are installed, calibrated, and perform according to the specified project requirements. Benefits of Commissioning include reduced energy use, lower operating costs, reduced contractor callbacks, better building documentation, improved occupant productivity, and verification that the systems perform as intended.
- Provide for the ongoing accountability of building energy consumption over time by developing and implementing a Measurement & Verification Plan to evaluate building and/or energy system performance.

Snapshot: Genlyte Group

Working in conjunction with the Genlyte Group, a world leader in light fixture manufacturing, TAG International designed and implemented an energy-efficient lighting approach – using Genlyte's own products – which enabled the company to significantly reduce energy consumption and overhead costs. This lighting solution included the use of high-efficiency fluorescent lighting, lighting control systems, occupancy sensors and daylight harvesting throughout the facility.

Materials and Resources:

- Facilitate the reduction of waste generation by providing an easily accessible recycling area dedicated to the collection and storage of non-hazardous recycling materials, including paper, cardboard, glass, plastics, and metals.
- Consider reusing existing, previously occupied buildings, including structure, envelope and other elements. Remove potential contamination risks for building occupants and upgrade components that would improve energy and water efficiency such as windows, mechanical systems, lighting systems, and plumbing fixtures.

- Implement a Construction Waste Management Plan to divert construction, demolition and land-clearing debris from disposal in landfills and incinerators by recycling and/or salvaging non-hazardous materials. Redirect recyclable recovered resources back to the manufacturing process and redirect reusable materials to appropriate sites, including charitable organizations. Consider recycling cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum wallboard, carpet, and insulation.
- Identify opportunities to incorporate salvaged materials such as beams, posts, flooring, paneling, doors and frames, cabinetry and furniture, brick and decorative items into the building design.
- Use materials with high recycled content, both post-consumer and pre-consumer. Establish project goals for recycled content materials and identify appropriate material suppliers. Consider a range of environmental, economic, and performance attributes when selecting and specifying products and materials.
- Use materials or products that have been extracted, harvested, recovered, or manufactured within 500 miles of the project site to reduce environmental and economic impacts resulting from transportation/shipping. Establish project goals for locally sourced materials and identify appropriate suppliers. Consider a range of environmental, economic, and performance attributes when selecting products and materials.
- Use rapidly renewable building materials and products to reduce the depletion of finite raw materials and long-cycle renewable materials. Consider materials such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheatboard, strawboard, and cork.
- Encourage environmentally responsible forest management by using wood-based materials and products that are certified in accordance with the Forest Stewardship Council (FSC) Principles and Criteria for wood building components, including structural framing, dimensional framing, flooring, sub-flooring, wood doors, and finishes.

Spotlight: TAG International

For the relocation of the company's main office, TAG International revitalized an existing building to create a "sustainable design showcase" using cutting-edge, eco-friendly materials and processes that offered a new level of flexibility for future agility and maximum reuse. Examples include:

- *Modular "floating floor" carpet and unique TacTile installation techniques that eliminate the need for spread glues (dramatically reducing the use of VOCs) and enable individual carpet tiles to be rearranged, replaced or reused.*
- *Pre-engineered, pre-manufactured movable glass walls that create an open, highly aesthetic office environment and provide both functional agility and future adaptability.*

Indoor Environmental Quality:

- Provide increased outdoor air ventilation to improve indoor environmental quality (IAQ) for increase occupant comfort, well-being, and productivity.
- Install carbon dioxide (CO2) monitoring and airflow measurement equipment and feed the information to the HVAC system and/or building automation system for monitoring and corrective action.
- Adopt a Construction IAQ Management Plan to protect the HVAC system during construction, control pollutant sources, and interrupt contamination pathways to reduce potential IAQ problems resulting from the construction/ renovation process. Sequence the installation of materials to avoid contamination of absorptive materials such as insulation, carpeting, ceiling tile, and gypsum wallboard. If possible, avoid using permanently installed air handlers for temporary heating/cooling during construction.
- Prior to occupancy, perform a building flush-out or test the air contaminant levels in the building.
- Reduce the quantity of indoor air contaminants that are odorous, irritating, and/or harmful to the comfort and well-being of installers and occupants by specifying materials and products containing low amounts of Volatile Organic Compound (VOC).
- Ensure that composite wood and agrifiber products used on the interior of the building – and laminating adhesives used to fabricate composite wood and agrifiber assemblies – contain no added urea-formaldehyde resins.
- Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke by prohibiting smoking in commercial buildings or effectively controlling the ventilation air in designated smoking rooms.
- Minimize occupant exposure to potentially hazardous particulates and chemical pollutants by implementing the following strategies:
    - Design to limit pollutant entry into buildings and cross-contamination of regularly occupied areas.
    - Install permanent architectural entryway systems, such as grills or grates to prevent occupant-borne contaminants from entering the building.
    - Design facility cleaning and maintenance areas with isolated exhaust systems and maintain physical isolation from the rest of the regularly occupied areas of the building.
    - Install high-level filtration systems in air handling units processing both return air and outside supply air.
    - Ensure that air handling units can accommodate required filter sizes and pressure drops.
- Provide occupant controls for lighting systems to promote increased productivity, comfort, and well-being of occupants. Integrate lighting systems controllability into the overall lighting design, providing ambient and task lighting while managing the overall energy use of the building.

- Incorporate thermal comfort system controls to allow occupant adjustments to suit individual needs. Control strategies may include system designs incorporating operable windows, hybrid systems integrating operable windows and mechanical systems, or mechanical systems alone. Individual adjustments may involve thermostat controls, local diffusers, or other means integrated into the overall building thermal comfort system.
- Design to maximize interior daylighting and provide occupants a connection between indoor spaces and outdoors through the introduction of natural light and views. Strategies to consider include building orientation, shallow floor plates, increased building perimeter, lower interior partition heights, interior glazing, exterior and interior permanent shading devices, high performance glazing, and automatic photocell-based controls. Daylighting strategies can be modeled via manual calculations or with computer software to assess footcandle levels and daylight factors achieved.

There are, of course, other strategies and creative solutions that can be utilized to achieve sustainability objectives in building design and construction. The concepts described in this article are intended to provide an introductory overview.

Each project is unique and requires the collaborative effort of qualified architects, land planners, engineers, and other design professionals, along with building owners, project managers, and construction managers. The right combination of experience and expertise, as well as strong project leadership, is key to identifying and implementing the most effective sustainability strategies – and to realizing the greatest potential benefits for the project and for the environment.

About the Author: *Based in Austin, Texas, TAG International is an architecture and land development services firm that has provided design and management services for more than 70 million square feet of built space. Essential to the company's success is a core belief in helping clients achieve maximum potential value with each project. Author Ron Pope, a partner at TAG International, is a licensed architect and LEED Accredited Professional specializing in site analysis, land planning, and architectural design. He has extensive expertise in designing and managing building projects across a spectrum of market sectors including manufacturing and distribution, government and institutional, commercial and corporate, biotech, and healthcare. Long an advocate of sustainable development, Mr. Pope has been responsible for numerous green building projects.*