Improving Built Environment with Sustainable Ecosystems Assistance in Hot Regions

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Abstract:

Environmental design principles in architecture have drawn increasing attention, as evidenced by many publications and research that consider environmental integration issues and design approaches. There are many ways we can preserve our environment. We build a lot of buildings that impact the environment and increase energy consumption. Careful planning and care can reduce this impact. Environmental Design is one way that encompasses several practices. Environmental design allows sustainable, pleasing design to co-exist with the natural environment. It also promotes conservation practices which save money and resources. This paper highlights the critical contribution of environmental design to improve urban communities in hot regions.

1. Introduction

The world is becoming increasingly urban. Globally, cities are growing quickly. Many are becoming primary economic drivers. But as the economic importance of cities grows, their 'quality of life' becomes a key factor in their ability to prosper.

In architecture Practice Environmental design principles have drawn increasing attention, as evidenced by the plethora of publications and research that consider environmental integration issues and design approaches. Since the 1950s, concerns about both industrial pollution and energy supplies have been reflected by increasing interest in the life cycle of nature and renewable resources. Environmental design approaches, such as those defined and analyzed by Olgyay, McHarg, and other researchers, emphasize principles for studying basic aspects of the natural environment, including climate, physiographic, hydrology, vegetation, and characteristics and habits of the inhabitants. The

importance of ecology to architects in helping to solve environmental problems is currently an intensely debated issue within the architectural community.

There are many ways we can preserve our environment. Environmental Design is one way that encompasses several practices. We build a lot of buildings that impact the environment and increase energy consumption. Careful planning and care can reduce this impact. Environmental design allows sustainable, pleasing design to co-exist with the natural environment. It also promotes conservation practices which save money and resources. This paper highlights the critical contribution of architects and designers by considering environmental design issues to improve urban communities in hot regions.

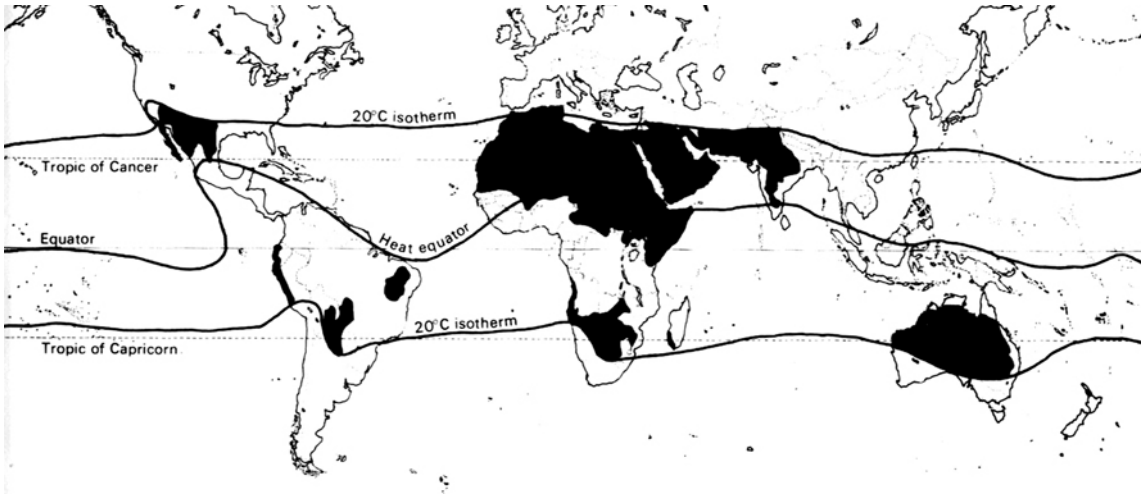

Figure 1

Hot Regions occupy over one-fifth of the earth's surface [Balwant]

2. Built Environment

Once land was populated by settlers, the shelter often comes from the immediate surroundings. However, the insensitive use of both natural and manufactured materials might have negative impacts on the environment. [Lee] (Figure 2)

Humans are fundamentally changing the global environment. The air we breathe contains significant additions of carbon dioxide, methane, and other industrial gases. The fresh water we drink has been rerouted with dams and reservoirs, and contaminated by agricultural runoff and industrial pollutants. The land we live on has been drastically modified for crops, pastures, and cities. Built environment is an important international

initiative which challenges and directs the design professions to create truly livable and sustainable built environments.

Since the 1950s, Olgyay, McHarg, and other researchers have begun the study of design theories and methods focused on the relationships between architecture and the environment, including climate, physiographic, hydrology, vegetation, and characteristics and habits of the inhabitants. Concentrating on the environment, Olgyay (1973) analyzed examples from around the world and documented his findings in Design with Climate. He notes that regional architectural characteristics could be found in response to certain climates, although in different geological locations and cultures. New urban community design decisions that affect energy performance are often difficult to quantify early in the urban design process.

Environmental sensitive urban development can be only achieved if development and environmental issues and problems are given equal emphasis in urban development. Basic habitants needs must be fulfilled, with improved living standards and ecosystems sustained effectively.

4. Sustainable Ecosystems

Sustainability is arguably the most vital concern in architectural and urban design today. As the world becomes ever more urban and densely populated, with the majority of people now living in urban areas, it is essential for architects, urban designer, planners and engineers to be fully aware of the impact of their products in the built environment on the natural environment (Figure 2).

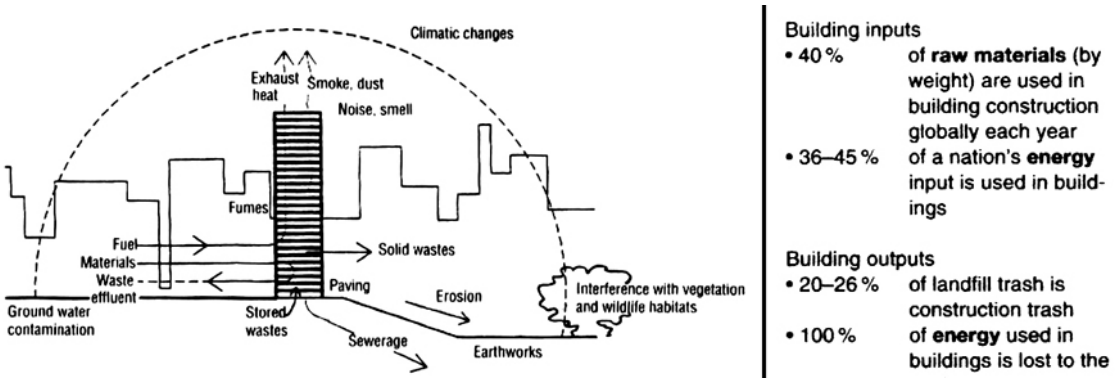

Figure 2

Built environment impact on its surrounds [Yeang]

Ecosystems (short for ecological systems) like all systems they are a combination of interacting, interrelated parts that form a unitary whole. All ecosystems are "open" systems in the sense that energy and matter are transferred in and out. The Earth as a single ecosystem constantly converts solar energy into myriad organic products, and has increased in biological complexity over time.

After agriculture, urban development is the second largest industry in the world. The manufacture of building materials consumes enormous energy, and exhaustible resources. The basic goal of sustainable Architecture is simple: attractive, comfortable, affordable shelter that does no harm to the Earth in its manufacture, or its use. In architectural practice environmental design merges the interests of sustainability, environmental consciousness, green, natural, and organic approaches to evolve a design solution from these requirements and from the characteristics of the site, its neighborhood context, and the local micro-climate and topography.

The importance of the impact of any human action on the ecology of the project site will depend on the ecological condition and value of the local ecosystem as well as on the type of action that is to be pursued. The designer must therefore examine the ecosystem where his project site is located before imposing any action upon it. *[Yeang]*

In his book The Green Skyscraper, Ken Yeang classifies the ecosystem hierarchy, site data requirements and design strategy as shown in Table (1).

Ecosystem hierarchy	Site data requirements	Design strategy
Ecologically mature	Complete ecosystem analysis mapping	• Preserve • Conserve • Develop only in no-impact areas
Ecologically immature	Complete ecosystem analysis mapping	• Preserve • Conserve • Develop in least-impact areas
Ecologically simplified	Complete ecosystem analysis mapping	• Preserve • Conserve • Increase biodiversity • Develop in low-impact areas
Mixed-artificial	Partial ecosystem analysis and mapping	• Increase biodiversity • Conserve • Develop in low-impact areas
Monoculture	Partial ecosystem analysis and mapping	• Increase biodiversity • Develop in areas of non-productive potential • Rehabilitate the ecosystem
Zeroculture	Mapping of remaining ecosystem components (e.g., hydrology, remaining trees, etc.)	• Increase biodiversity and organic mass • Rehabilitate the ecosystem

Table 1

Site Ecosystems Classifications. [Yeang]

5. Ecological Design

Since ancient times "designers" looked to nature for "solutions" to their common problems; they saw nature as the perfect model to follow. More recently, designers such as Le Corbusier and Frank Lloyd Wright, among many others, have attempted, with some degree of success, to address ecological issues through their designs. "Green Architecture," "Alternative Architecture," "Sustainable Design," and "Ecological Design," are some of the terms commonly used today to describe a special expression of environmental design that takes as its primary driving force nature's processes.

Ecological design can be defined as 'any form of design that minimizes environmentally destructive impacts. Ecological design should be sensitive to local environments and cultures and respond accordingly, taking into account a bioregional approach. Bioregionalism predicates giving importance to natural boundaries between ecosystems instead of artificially made boundaries, and it implies self-regulation, a more sustainable way of life and work.

Integration of buildings with the site should occur at the aesthetic level but most importantly at the level of ecological function. Buildings should be completely integrated with landscaping and vegetation to create an environment in functional harmony with the built form. Every building affects the climate at the very local level. Cities can affect the climate at the regional level. Ecological development requires that the built environment be used intentionally to produce desirable micro-climate changes, creating shelter when the wind blows to hot, too cold or too hard, generating local breezes or warm places to suit the needs of building occupants and so on. In hot regions, the main practices of ecological design can be summarized as follows:-

- **Enhance a sense of community.** Nurture civility and community by developing a cohesive village quality with convenient pedestrian access to neighborhood amenities and services - it is critical to a healthy, safe and sustainable community. Save and restore all site characteristics and qualities (natural, cultural, historical, etc.); and create accessible parks, activity centers and services. (Figure 3).

Figure 3

Museum of Islamic Arts project Proposal at Doha, Qatar [Wines]

- **Provide for pedestrian priority connections** between residential developments and urban services. Bike and walkways enhance a more pedestrian community. These walkways should connect to convenient transit stops and should have continuous pavement patterns across driveways and streets (Figure 4). Compact buildings helps in social interactions and walking ability through fabric or transportation by bicycles, and decreasing using cars thus avoiding harmful environment effects.

Figure 4

Sketches show some ideas to enhance a more pedestrian community. [Bianca]

- **Cluster, don't sprawl**. Increase density and land use efficiency. This will effectively reduce infrastructure costs. In an urban environment where land prices and the cost of essential urban facilities and services are increasingly becoming unaffordable, higher density housing is needed to justify the economic and social use of community amenities. Also, clustered, higher density housing is fundamentally important in reducing the many ills of sprawl.

- **Conserve energy** by quality construction, high levels of insulation, airlock entries, good southern/solar exposure, efficient lighting, equipment and appliances. Passive design strategies can dramatically affect building energy performance. These measures include building shape and orientation, passive solar design, and the use of natural lighting (Figure 5). Use a properly sized and energy-efficient heat/cooling system in conjunction with a thermally efficient building shell. Maximize light colors for roofing and wall finish materials; install high R-value wall and ceiling insulation; and use minimal glass on east and west exposures.

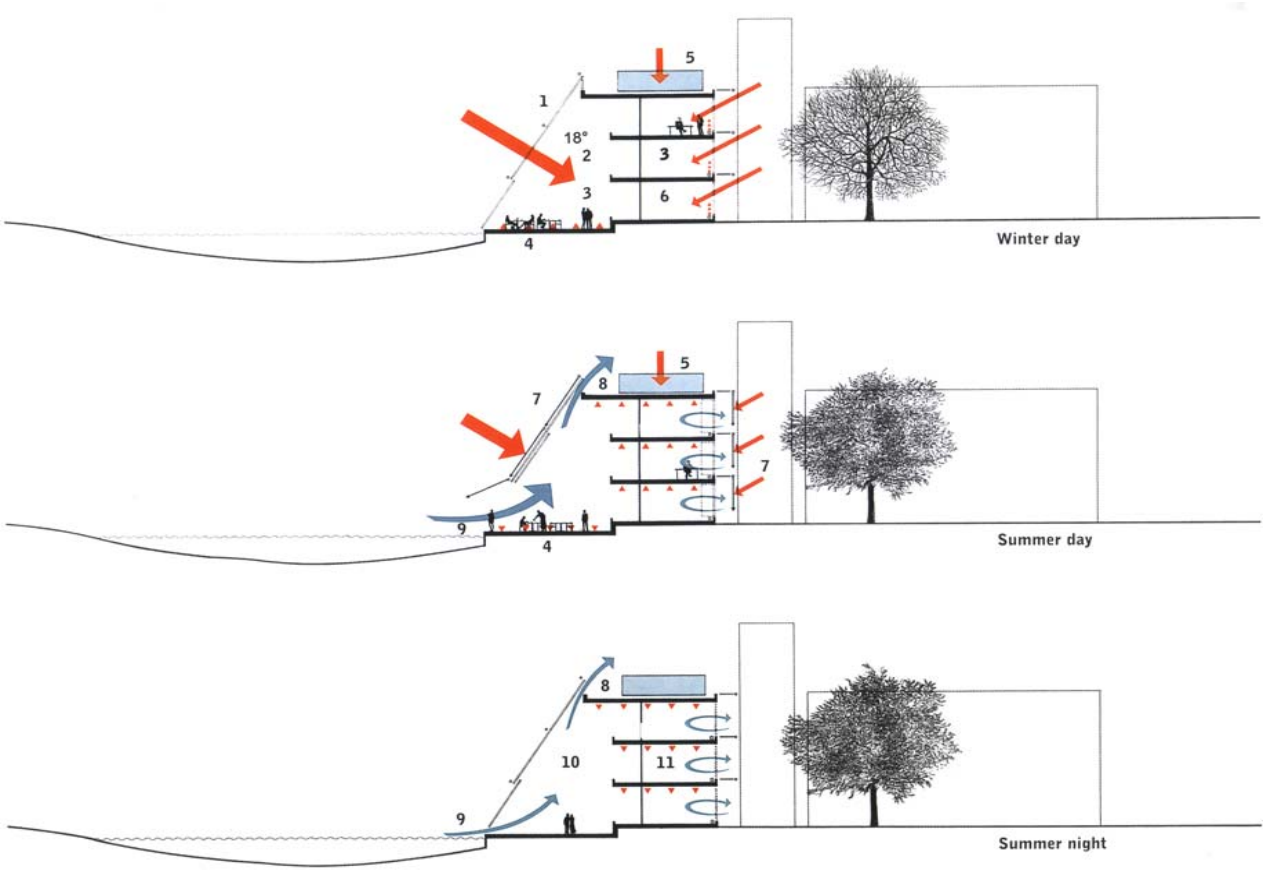

Figure 5

Schematic sections showing the ventilation strategy, the arcade acts as a thermal buffer, and the glass front can be adjusted for optimal energy conservation in different climatic conditions. [Jones]

- **Increase use of renewable energies, passive and active solar strategies** for heating, cooling and energy production. Besides shading windows, consider passive cooling methods such as clearstories, stacked or attic ventilation, drawing replacement air from the cooler north side. Consider alternative energy sources such as photovoltaic and fuel

cells that are now available in new products and applications (Figure 6). Renewable energy sources provide a great symbol of emerging technologies for the future.

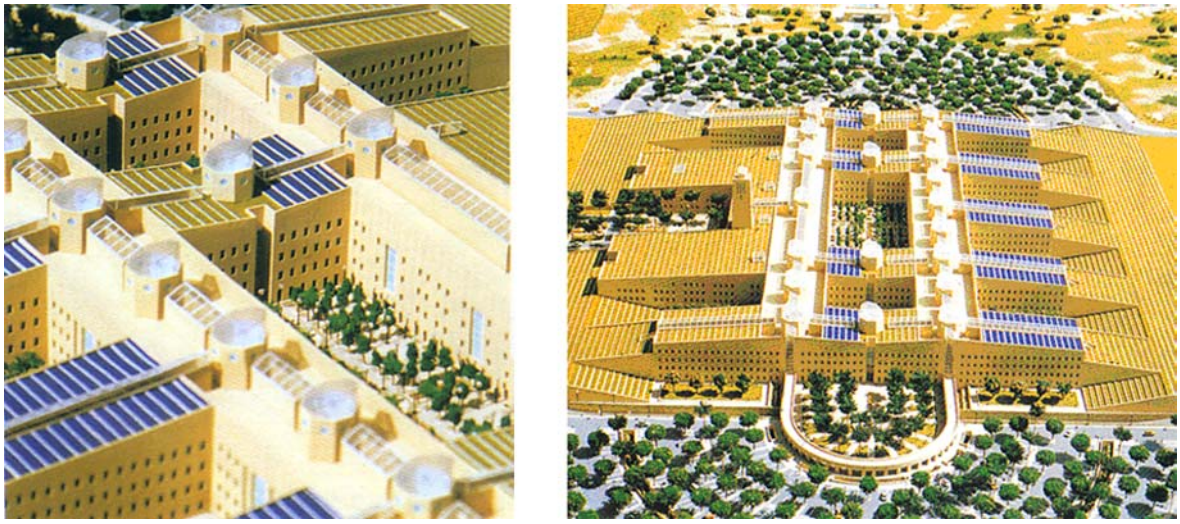

Figure 6

Ministry of Education, Riyadh, Saudi Arabia (Blue panels are photo-voltaic panels). [Asfor]

- **Select energy and resource conserving materials and construction methods.** The selection of materials is a fundamental professional decision. The chosen materials have a direct impact on man's indoor living comfort. The embodied energy in building materials is substantial. Select materials for new construction which have low embodied energies, come from renewable/sustainable resources and have the highest recycled content. Natural building materials, such as wood, stone, clay, etc., which can be obtained in their elementary state in nature and which can then be used without additional treatment that would change their properties, cause the least negative.

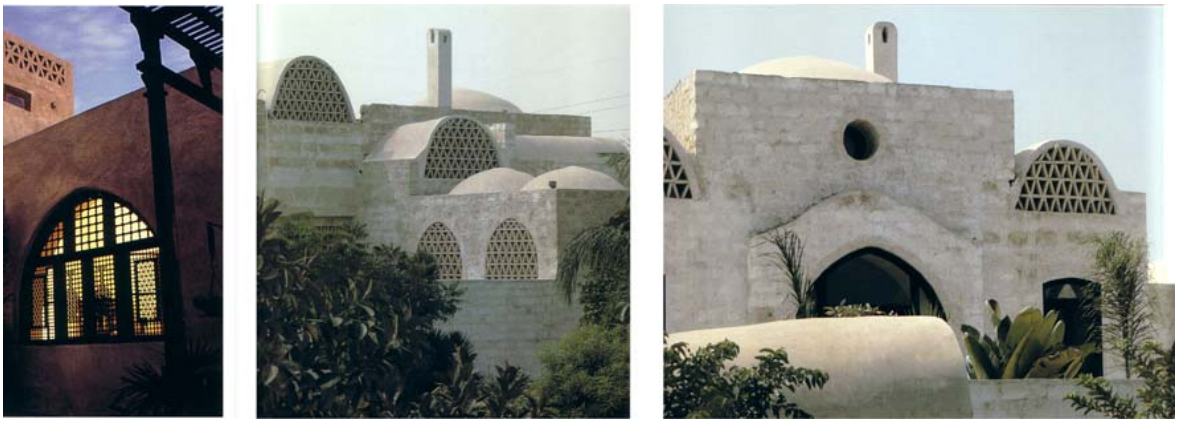

Figure 7

Murad Greiss house, Shabramant outside Cairo, a sample of building with natural stone and wood. [Fathy]

- **Go green.** Trees are critical for human comfort and help balance the carbon to oxygen cycle. Green areas, saving wetlands and creating urban forest can enhance recreation, livability and sustainability. Plants have many benefits to both the indoor and outdoor environments. They absorb toxins from the air, create oxygen, shade/cool the environment through evaporative transpiration, and add ambience and humidity of indoor and outdoor spaces (Figure 8). They produce visual and culinary delights to sustainable residential environments.

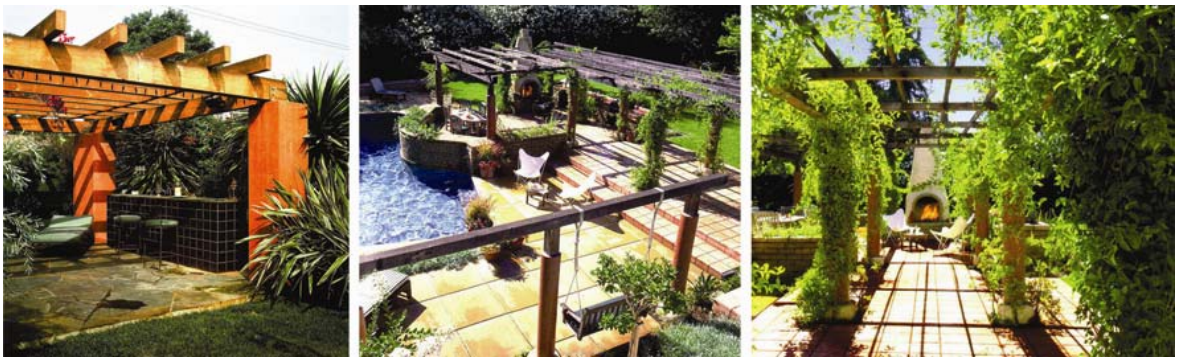

Figure 8

Outdoor spaces enhanced and shaded with planting and wooden shades. [Taylor]

6. Conclusion

People are having an ever increasing impact on local, regional, and global environments. This is particularly significant in and around urban areas, where people are often physically or psychologically disconnected from more natural ecosystems. Ecological architecture merges the interests of sustainability, environmental consciousness, green, natural, and organic approaches to evolve a design solution from these requirements and from the characteristics of the site, its neighborhood context, and the local micro-climate and topography.

Emphasizing on natural ecosystems may lead to a better understanding of the relationships between people and the natural environment, and may create more harmonious living conditions. If the applications of ecological design can be effectively analyzed using contemporary environmental theory, its principles not only can be practiced as an alternative approach, but will also lead to a new field of environmental science.

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