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Perception and implementation of sustainable/ green design in India

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PERCEPTION AND IMPLEMENTATION OF SUSTAINABLE/GREEN DESIGN IN INDIA

By

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APPROVAL

PERCEPTION AND IMPLEMENTATION OF SUSTAINABLE/GREEN DESIGN

IN INDIA

Shalini Magadi

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Abstract

Profound effects of global warming, species extinction, pollution of air and water, resource depletion, and population growth demand that India, the second most populated country in the world, address the need for ecological responsibility. This phenomenological study explored awareness and perceptions of green/sustainable (G/S) design in India's design community. Architects in the five geographic regions were interviewed. All were familiar with S/G design and said knowledge was "very important." However, none felt "well-versed." They believed lack of client awareness (49%) and materials (28%) were the major problems encountered. Although the vast majority was willing to promote S/G design, none had actually promoted it. All felt there were inadequate government incentives to persuade the design community to practice and promote S/G design. The study revealed an urgent need in India for education and promotion of ecological responsibility at a micro level through green design and at a macro level through sustainable development.

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CHAPTER ONE

Introduction and Background

To an ever-increasing extent, the environment is dominated by structures that constitute the visible cultural landscape of everyday life, thus forming a complex pattern of function and meaning in which people's perception of the world, their attitudes, and sense of relationships with it are closely interrelated. With the global warming phenomena having a profound effect on planet Earth, there is a significant need in both developed, industrial countries and developing countries to address environmental concerns, so that not just the ecology but also human societies have a better chance of coping with environmental change.

While environmental protection tends to mean high-tech energy systems and recycled materials in the western world, the word has much broader implications in many of the developing nations. It evokes a hope that is organic, dynamic, and ongoing in this age of rapid globalization and modernization. It is the responsibility of the design community to not only practice design within the context of the natural environment but also to educate people from other disciplines about the adverse effect of bad design on health, safety, and welfare of people and planet Earth (Krasner, 1980).

Background

The relationship between human beings and nature is very complex. This complex interaction between humans and environment is nicely captured by the observation of architect Lars Lerup, “We design things and things design us” (Krasner, 1980, p.8). At one time nature was considered a force stronger than mankind. Today there are machines that can move mountains and technology that has the power to enhance or destroy the environment. The 20th century can be described by the technological enhancements that were developed. However, the burden it placed on the environment now threatens survival of the planet. People and technology must respect and nurture the ecology, if the progress of the 20th century is to continue (Cowan, 1995).

This concern for the global ecology was expressed by the United Nation’s Commission on Environment and Development when they stated, "humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs"(United Nations Department of Economic and Social Affairs, 1992). The responsibility of maintaining the right balance between the needs of 21st century societies and limits established by nature lies with people in various design disciplines. Design practitioners, including those in architecture and

interior design, could be taught the art and science of planning, designing, and constructing the built environment within ecological constraints.

As creative problem-solvers, design practitioners are concerned with a) how buildings function and respond to their users' needs and safety; b) how their construction impacts local building sites and geographic regions; and c) how their built environment respects the global environment and finite natural resources. The reciprocal relationship between the designed and natural environments is one of the most critical issues facing the fraternity of design professionals. This emphasizes a holistic approach to programming, planning, designing, and constructing buildings and sites that enable sustainability for both humans and the natural environment (Government of India Council of Scientific & Industrial Research, 2001).

Statement of the Problem

India is the second largest populated country in the world. With a population of around one billion and a rate of economic and technological growth of about 7%, it becomes critical to conserve and reuse the natural resources (Government of India Ministry of Environment and Forest, 2002).

A historical summary of two of India's macroeconomic indicators is shown in the following table to understand the

trend of economic growth rate in India.

Table 1.

Energy Overview of India 1995-2002 *(Government of India Ministry of Environment and Forest, 2002)*

Component	1995	1996	1997	1998	1999	2000	2001	2002
Annual gross domestic product(GDP)growth rate(percent)	7.3	7.0	4.2	5.2	6.1	5.5	6.3	5.8
End-of-Year Inflation (percent)	10.3	8.9	6.5	14.0	13.0	9.0	4.0	3.6

India faces environmental problems on several fronts. Economic development and a rapidly growing population that has taken the country from 300 million people in 1947, when it gained independence from the British, to more than one billion people today is putting a strain on the environment, its infrastructure, and the country's natural resources. Industrial pollution, soil erosion, deforestation, rapid industrialization, urbanization, and land degradation are all worsening problems. The Indian government (2002) has estimated the cost of environmental degradation at about 4.5% of GDP in recent years. India is currently the fifth greatest carbon emitter, the key component of the green house gas, in the world, behind only the United States,

Russia, China, and Japan. India's fossil-fuel carbon emissions are about the same as for all of Africa. In the past decade alone, India's carbon emissions have increased by about 60% (United States Department of Energy Office of Energy Information Administration, 2003), and are about nine times higher than they were forty years ago.

With the above mentioned serious environmental problems faced by India and affecting the entire world, it is extremely important to study the different means of creating a sustainable, ecological conservation road map in India. The United States Environmental Protection Agency (2002) has ranked sick buildings as one of the top five environmental threats to human health. The use of toxic substances and materials results in inferior, dangerous indoor air quality. Conventional buildings often exhibit sick building syndrome and because they are wasteful of water, energy, and materials.

Green buildings, both new and retrofitted, are the cornerstones of human scale neighborhoods. They are designed for passive solar heating and cooling with efficient HVAC (Heating, Venting, and Air conditioning) systems. They offer abundant natural light and a connection to seasonal rhythms. When possible, they produce and store their own renewable energy. They use non-toxic materials, furnishings, and finishes that greatly enhance indoor air quality.

Construction methods are resource efficient, and materials are chosen to be low in embodied energy, bioregional, and, where possible, certified sustainable (Stitt, 1999). Designing S/G buildings is the only rational decision from an economic standpoint. According to a study by the American Medical Association and the United States Army (Cowan, 1995), poor indoor air quality costs about 150 million lost workdays and $15 billion in lost productivity. People's health, safety, and welfare is inherently linked to the built and natural environment. Hence designing green buildings and creating sustainable development globally, especially in developing countries like India, is essential for a better world now and in the future.

Purpose of the Study

The purpose of this study was to explore the awareness and perceptions of sustainable design among a sample of architects in India. The research provided a better understanding of the various challenges faced when designing a green/sustainable building in India.

Significance of the Study

India is currently seeing vast growth in commercial and residential building construction due to job outsourcing from different parts of the world. With the job market growing so rapidly, there is an ever-increasing need for comfortable, efficient, and less expensive workplace design.

India's business process, outsourcing sector has been growing significantly every year since the last decade. With more and more service and other jobs being sent to India, there has been a boom in the construction industry to meet the demand for office spaces to accommodate the incoming workforce. It therefore becomes critical to apply sustainable design principles during the construction of various computer industry offices, customer services call centers, manufacturing plants, and residential complexes. In order to do this, the architects and designers need a clear understanding of the current environmental and health problems as an effect of not implementing green design concepts.

When buildings provide their own energy, purify their own wastes, participate in a cyclical flow of materials, and are flooded with natural light and fresh air, making people feel fully alive, there will be an improved balance between humans and nature and a much healthier planet and happier populace (Krasner, 1980).

CHAPTER TWO

Review of Related Literature

History of Sustainable Design

Earth Day in June of 1970 was a dramatic event. The basic environmental issues like resource degradation, population growth, agricultural limits leading to global famine, pollution of air and water, the disastrous potential climatic effect of the concentration of greenhouse and ozone-depleting gases in the atmosphere, and their corollaries identified on that day have since all been examined in exhaustive detail. This has been evidenced with incontrovertible facts of the irreparable damage being inflicted daily on the planet. The subtle but significant philosophical shift that has taken place since the first Earth Day has undoubtedly led to the current emphasis on the concept of sustainability (International Alliance for Sustainable Architecture, 1984).

At its root, the word “sustain” means "to give support or relief to" and "to supply with necessities or nourishment and development" (Merriam-Webster’s Dictionary, 2004). Sustainability is ecologically sound, economically viable, and socially just and humane, embodying the populace’s highest values in terms of how society treats animals, people, and the Earth (International Alliance for Sustainable Agriculture, 1984).

The World Commission on Environmental Development was established by the United Nations in 1987. The main purpose of this commission was to act as a bridge between isolated internal conservationists and the international possibilities of sustainable/green (S/G) design. Central to this commission's findings was the concept of sustainability, which the commission described as the principle that economic growth can and should be managed so that the natural resources are used in such a way that "quality of life" of future generations is ensured. Sustainable development involves the paths of social, economic, and political progress that "meet the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations World Commission on Environment and Development, 1987). Development in this context is a continuous process and is applicable to planet Earth and everything and everybody on it currently and in the future.

To accomplish this mission of sustainable, continuous development, it is important to understand the relationship between society's needs and environmental limitations. The needs include the basic amenities such as food, clothing, and housing, as well as the opportunity to have a higher standard of living over and above the basic needs. In this study, one of the important needs, the need for shelter and

housing, is considered in detail, leading to the concept of sustainable design and the development of green buildings. The word “sustain” in sustainable design highlights the need to design a productive environment with minimum impact on available natural resources. According to Merriam-Webster’s Dictionary (2004), design means to create, fashion, execute, or construct according to plan. The word "design" can be used as a verb (meaning a process or an action) and a noun (connoting the result of a process). The word "design" in this context encompasses a building’s life from preconstruction, construction, occupancy, and finally decommissioning.

According to EPA (Environmental Protection Agency, 2000):

- 42% of energy, 30% of raw materials, and 25% of water consumption can be attributed to buildings.
- 40% of air pollution, 25% of solid waste, and 20% of wastewater are building-related.

This demonstrates the significant impact buildings have on the environment. The building sector of the economy includes the acquisition of raw materials and the production of building materials, as well as the transportation, construction, and the day-to-day operation and maintenance of buildings. These activities represent the prime sources of environmental pollution and impact. Hence buildings, in

general, represent a significant opportunity to reduce the associated environmental impact and to contribute to the overall sustainable development of society (Samuels, 1994). Most cultures build to fulfill a set of needs and desires that reach well beyond simple shelter and basic sustenance. However in the process of fulfilling these needs, the introduction of S/G design concepts proposes to add environmental considerations to the design equation of cost and performance (United States Environmental Protection Agency, 2002).

After nearly two decades, S/G design as a global issue continues to garner attention and gain wider acceptance. Interest in S/G design has prompted actions by industry, along with numerous studies, articles, and reports by a wide range of organizations from state and local groups in the multiple countries of the United Nations.

Elements of Sustainable/Green Design

Sustainable/Green design is the thoughtful integration of architecture and interior design as well as electrical, mechanical, and structural engineering components. The Rocky Mountain Institute (2000) outlines five important elements for S/G design:

- Planning and design should be thorough because early decisions have the greatest impact on energy efficiency, passive solar design, day lighting, and natural cooling.

- S/G design is more of a philosophy of building than a prescriptive building style.
- S/G buildings don't have to cost more, nor be more complicated, than traditional construction.
- Integrated design, with each component considered part of a greater whole, is critical to successful S/G design.
- Promoting human health, energy conservation, and ecological systems features, the design of the building envelope, and protection of users' health and well-being through interior design, as well as mechanical, electrical, and plumbing systems, are the key elements.

Principles of Sustainable/Green Design

Sustainably designed buildings intend to lessen their impact on the environment through energy and resource efficiency. It is imperative to understand the governing principles of S/G design before analyzing its relevance and perception in different parts of the world (Sustainable architecture and building design, 1996):

- Understanding place: S/G design begins with an intimate understanding and recognition of the nuances of place. Understanding place helps determine various design practices such as solar orientation of a building on the site, preservation of the natural environment, access to public transportation, and specification of local materials for finishes and furnishings.

- Understanding the relationship with nature: The relationship of the building and the natural environment, such as urban/rural setting and connection of inside and outside, helps to create effective design.
- Understanding natural processes: In nature there is no waste, and the by-product of one organism becomes the food for another. Replicating natural cycles and processes and making them visible can bring the designed environment to life.
- Understanding environmental impact: Understanding of the environmental impact by evaluating the site, the embodied energy and toxicity of the materials, and the energy efficiency of design, materials, and construction techniques is very important to mitigate the negative effects of construction.
- Understanding co-creativity: Collaboration of systems consultants, engineers, and other experts, as well as listening to the voices of local communities, creates a synergy in designing buildings.
- Understanding people: S/G design must take into consideration a wide range of cultures, races, religions, and habits of the people who are going to be using and inhabiting the built environment. This requires sensitivity and empathy to the needs of the people and the community.

These principles can be applied universally across the planet, in all countries. However it is the responsibility of the respective governments to create the appropriate codes and regulations for their respective societies to protect the health, safety, and welfare of the populace on the micro level (i.e., green design) and the environment on the macro-level (i.e., sustainable design).

Sustainability in India

During the 1992 Earth Summit at Rio de Janeiro, one of the key issues addressed was global consensus and political commitment at the highest level regarding sustainable development and the environment (United Nations Department of Economic and Social Affairs, 1992). One hundred nations signed the Convention on Climate Change and the Convention on Biological Diversity and adopted Agenda 21, a 300-page plan for achieving sustainable development in the 21st century.

Not surprisingly, India was one of the key contributors to the convention and policymaking, since this conformed with the values that are enshrined in the Indian constitution (Part IV Directive Principles of State Policy, Section 38, 48A and 51A, from The Constitution and Environment, Government of India). However, the most crucial question raised by many eminent economists and policymakers is: How can the available land/water mass (about 2.5% of the

world) sustainably provide for a rapidly increasing population in India (about 16% of the world)? Over a period of time, India has developed its own refined mechanisms of conservation to prudently use its resources. According to the Government of India (2002), there is a dire need to provide a renewed thrust in addressing sustainable development in the wake of globalization.

Dimensions of Sustainability

Success of S/G design in any country in terms of improved perception, relevance, and application depends heavily on the economic, environmental, and social dimensions. These three dimensions affect the way people perceive and use sustainability in their environment (see Figure 1). Human well-being is dependent upon the relationships of Environmental Sustainability, Economic Sustainability, and Social Sustainability (Sustainable architecture and building design, 1996).

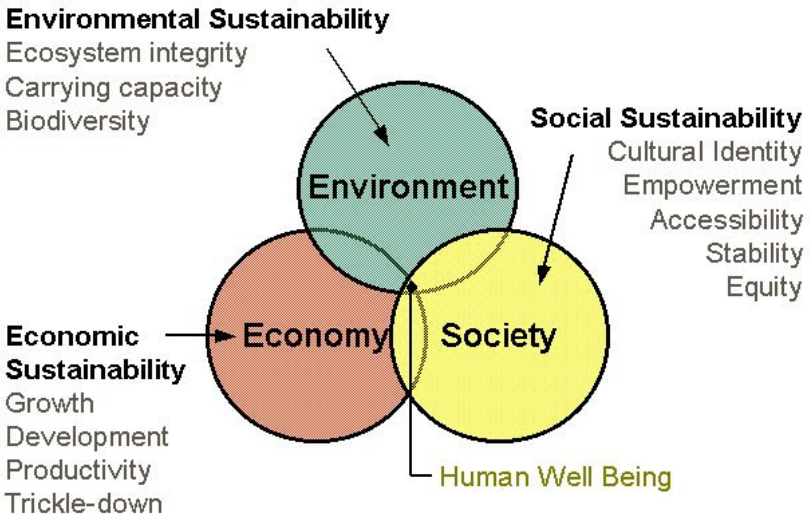

Figure 1. Model of Human Well-being (Sustainable architecture and building design, 1996)

As explained by Samuel Mock Bee of Auburn University (2002), S/G design involves a combination of values: aesthetic, environmental, social, political, and moral. The smart designer must think rationally about a combination of issues including sustainability, economic constraints, durability, longevity, appropriateness of materials, and creation of a sense of place. The challenge is finding the balance among these issues within the context of S/G cultural norms and value systems.

Stages in Sustainable Design Development

Figure 2 explains the various pre-construction and post-construction stages of building design.

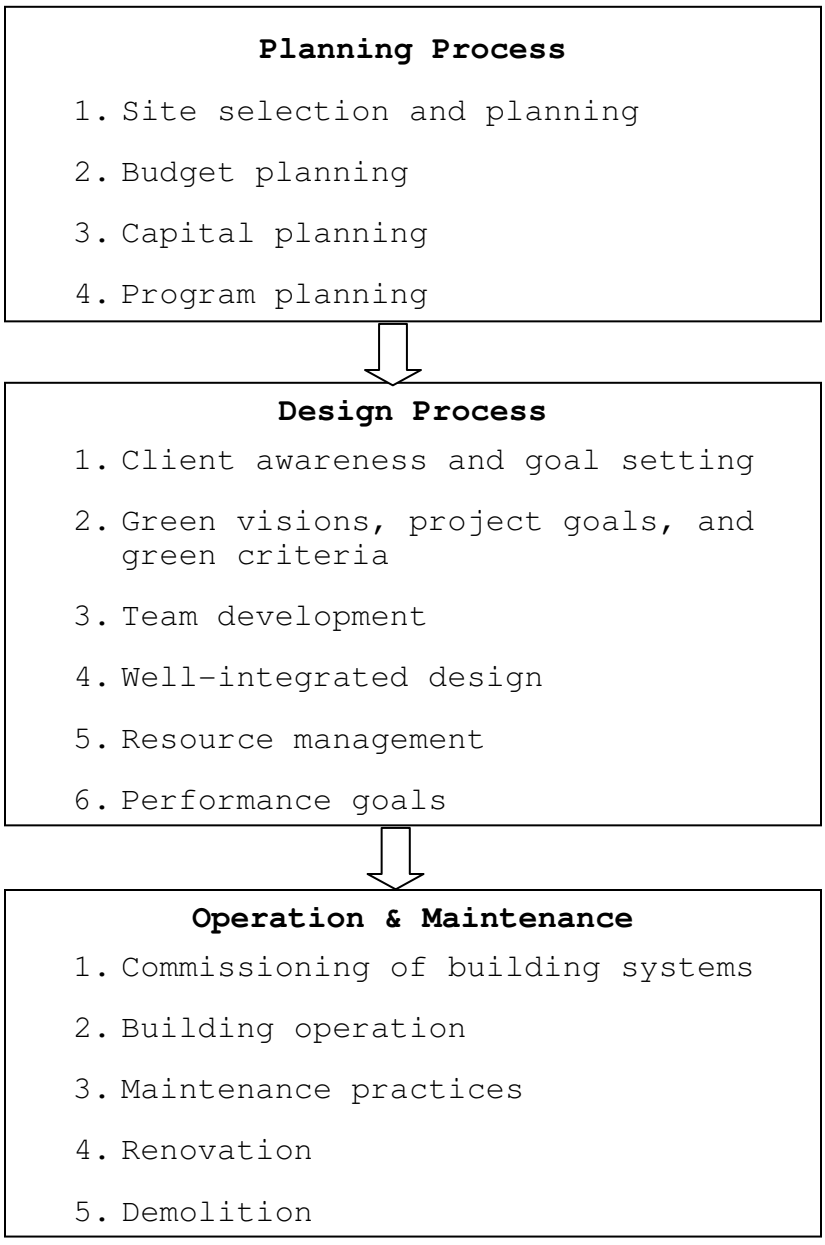

Figure 2. Tasks during each stage in the life cycle of a green building (Sustainable architecture and building design, 1996)

Factors for Sustainable/Green Design

Efficient design a S/G building must consider the following five critical factors: site, energy, materials, water, and waste (Cowan, 1995).

Site Selection. Frank Loyd Wright said that the place for an architect to study construction, before he gets into the theory of the various formulae that exist in connection with steel beams, girders, and reinforced concrete, is the study of nature. It is the study of nature that lays the groundwork for wisdom in the architect's mind (Steele, 1997).

With an appropriate relationship between the natural and built environment, solar energy can be harvested to reduce the use of non-renewable resources for energy production. A good passive solar building requires more than good design and quality construction. It also requires that the plan and site be considered during the initial stages of design, to ensure that they work together to optimize solar performance. The best-designed solar building will not work unless it is placed properly on a building site, one that allows solar access (McGowan, 1996). A passive solar house is designed and oriented in such a way as to take the maximum advantage of the sun.

These buildings are designed to maximize southern exposure. The sun's path, in the northern hemisphere, passes

through the southern sky. A good solar site is one that will allow placement of the building so that its solar surfaces face true south with the minimal amount of shading in the solar access zone. Building lots that are deep from north to south offers more control over the solar access zone, as does siting the building toward the north end of the lot. Locating the septic drainage field within the solar access zone is another way of maintaining solar access, since that area will need to be cleared of vegetation (McGowan, 1999).

Most parts of India get 300 days of sunshine a year, and this makes the country a very promising place for solar energy utilization. The Indian government is also promoting direct use of solar energy, in the form of solar water heaters and solar cookers. There has been some use of solar energy in individual residences (Lynch and Hack, 1984). Expanded use of S/G design principles in India would prove to be extremely beneficial to both people and the government of India.

Energy Efficiency. The benefits of the energy-efficient siting and design of buildings are saving money, reducing fuel poverty, and reducing resource exploitation and emissions. Ideally every new development should have an explicit energy strategy, setting out how these benefits are to be achieved (Lynch and Hack, 1984).

Throughout the history of humankind, agriculture has been the source for food and raw materials to sustain human kind. However, during the 20th century, in much of the developed world, a major shift to a petroleum-based economy led to the present dependency on fossil fuels for energy and raw materials for industry and agriculture. The Government of India Council of Scientific & Industrial Research (2001) suggested that the time is right to begin the transition to sustainability by reengineering the supply of raw materials and energy from petroleum to biobased sources.

Sustainable development involves an integration of science and engineering with an emphasis on ecological processes and socio-economic phenomena. Local communities control much of a nation's energy and resource consumption. Therefore, the challenge is to create a sustainable system that integrates energy, environmental, agricultural, and industrial innovations (Hawkes & Forster, 2002).

Total (direct and indirect) energy use of Indian households was more than 70 percent of all energy used in the country (Government of India Renewable Energy Development Agency Limited, 2001). India annually consumes about three percent of the world's total energy. The country is the world's sixth largest energy consumer, and is, in fact, a net energy importer. Continued economic development and population growth will increase the demand for energy

faster than India can produce it. India's electricity sector currently faces capacity problems, poor reliability, and frequent blackouts. Moreover, an industrial city's power supply is one of the biggest limitations to progress. The shortfall means the country will increasingly have to look to foreign sources of energy (Government of India Ministry of Environment and Forest, 2002). Design and construction of energy efficient buildings would, therefore, go a long way in solving the energy problems faced by India and other developing countries.

Materials. Since the time of cave dwellers, humans have been using building materials for shelter. The earliest buildings were made from non-toxic, energy efficient materials that could be recycled back into the natural environment after their useful life as shelter. Variation in form and selection of materials for building construction has always been dependent upon the local environment. In the early days of civilization, stone, wood, mud, and other organic materials were readily available and were used routinely. These basic techniques are still being used in developing countries (Stitt, 1999).

Until recent history, use of construction materials followed the same principle. With the advent of new manufacturing methods, during the industrial revolution, advanced societies learned to manufacture building materials

ranging from steel to plastic and could easily transport them around the world (Karolides, 2002). However, economic conditions and energy shortages are leading to a new evaluation of the raw materials required by building construction (Stitt, 1999).

Construction and operation of buildings in the US uses 3 billion tons of raw materials per year, 40 percent of total global use. Moreover, building industry by-products include air, water, and solid waste pollution that comprise 15-40 percent of U.S.landfills (Karolides, 2002).

Water. Water is an essential ingredient for human activity and an important environmental concern. Improvement of water quality and conservation of water resources is therefore of utmost concern and a crucial factor in designing S/G buildings (Karolides, 2002).

As per the Ministry of Environment and Forest (2002), India is considered rich in terms of annual rainfall and total water resources available. However, there are problems of uneven distribution of water resources and inequitable access, further compounded by deterioration in water quality.

The Central Pollution Control Board monitors water quality of national aquatic resources in collaboration with State Pollution Control Boards. There is a network of several monitoring stations covering rivers, groundwater,

lakes, canals, creeks, drains, and ponds. The water quality monitoring results obtained during 2000 indicated that organic and bacterial contaminations continue to be critical pollutants in Indian aquatic resources. This was mainly due to the discharge, from urban centers, of domestic wastewater in untreated form (Government of India Ministry of Environment and Forest, 2002).

The Indian Water (Prevention and Control of Pollution) Act was promulgated as early as 1974. The Act prohibited discharge of pollutants into the bodies of water beyond a given standard and also prescribed penalties for non-compliance. The Water (Prevention and Control of Pollution) Act of 1977 provided for a levy on excess water consumed by industries and local municipalities to augment the monetary resources for regulatory authorities (Government of India Ministry of Environment and Forest, 2002).

Waste. The first goal for more sustainable sewage systems is to reduce the amount of effluent that needs to be treated in the first place by introducing water efficient plumbing fixtures. This would significantly reduce chemical and energy use as well as operational costs in a building.

In India, governmental services and industrial waste disposal facilities have not been able to keep pace with the growing population and rapid industrialization. As a result, India faces serious challenges regarding disposal of solid

waste, hazardous waste, biomedical waste, and radioactive waste in an environmentally sound manner (Government of India Ministry of Environment and Forest, 2002).

In the last ten years, a framework of laws, rules, research, and institutions have emerged to meet this challenge. The Environment (Protection) Act has been used to issue notifications that tighten the rules for management of waste, assignment of institutional responsibility, enhancement of resources for waste disposal, and specification standards for sites and treatment of pollutants (Government of India Ministry of Environment and Forest, 2002).

The following notifications issued by the Government of India (2002) under the Environment Protection Act prescribed the guidelines for management of various types of wastes:

- Municipal Wastes (Management and Handling) Rules, 2000: Goal was to enable municipalities to dispose of municipal solid waste in a scientific manner.
- Biomedical Waste (Management and Handling) Rules, 1998: Prescribed guidelines for proper disposal, segregation, and transport of infectious wastes.
- Hazardous Wastes (Management and Handling) Rules, 1989: Produced a guide for the manufacture, storage, and import of hazardous chemicals and for management of hazardous wastes.

- Hazardous Wastes (Management and Handling) Amendment Rules, 2000: Issued a notification with the intent to provide guidelines for the import and export of hazardous waste in India.
- In addition, the Atomic Energy Act of 1982 regulated radioactive waste.

Summary of Sustainable/Green Design in India

Though the concept of S/G has thrived for many decades in India due to concerns for resource utilization, the rapidly progressing growth and modernization has led to increased problems in urban development and subsequent environmental problems (Prabhu & Rao, 1996). There are numerous books, reports, and journal articles written on the subject of overall sustainable development, resource utilization, poverty alleviation, and S/G agriculture in India. However, no information regarding the perception and implementation of S/G design or green buildings in India was identified in an extensive search of the literature.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

This chapter includes a detailed description of the research design that was used in this exploratory study. This study was intended to document India's architects' degree of understanding and implementation of S/G design. The research paradigm was qualitative. The research method implemented is a phenomenological study using unstructured interviews for data collection.

Research Design Overview

Data from a survey of architects' perception and implementation of sustainable design was gathered from phone interviews with architects in eleven cities in India. The sample was purposefully selected to include architects in cities from four chapters of the Indian Institute of Architects. Although the interview was unstructured, the following topics were addressed in each interview: Architect's perception of S/G design, clients' awareness of S/G design, and perceived barriers to S/G design and construction. The survey was conducted in spring 2004.

Research Questions

- What is the architect's perception of S/G design in India?
- Are clients aware of the importance of S/G design in

India?

- Do architects make a conscious effort to promote sustainability?
- What are the various challenges faced during the process of designing a S/G building in India?

Variables & Attributes

The following variables were identified in the literature review.

- Geographic location
- Field of concentration
- Years in profession
- Concept awareness
- Challenges in practicing S/G design
- Reason for practicing/not practicing sustainable design

See Table 2 for identification of variables and attributes.

Population & Sample Selection

The study population was 120 architects who were members of the Organization of Indian Institute of Architects. The sample included architects from five different chapters (northern, western, southern, eastern, and central chapters), thereby drawing the sample from the geographic domain.

Table 2.

Variable and Attribute Table

VARIABLE	ATTRIBUTES
Geographic Location	• North • South • East • West
Field of Concentration	• Residential • Multi Purpose • Office • Religious/Institutional Buildings
Number of Years in Profession	• 5 or less • 6-10 • 11-20 • More than 20
Degree of Concept Awareness	• Thorough Understanding • Familiar with S/G design • Aware of S/G design • Unaware of S/G design

Table 2 (continued).

Variable and Attribute Table

VARIABLES	ATTRIBUTES
Potential Challenges while designing a S/G building	• Energy Efficiency • Site • Lack of Client Awareness • Materials
Reasons for Practicing or Not Practicing Sustainable Design	• Energy Costs • Worker health and safety • Required by the law • Other (identified during data analysis)

Architects who practice in metropolitan cities in India were purposefully selected. An equal number of architects (n=5) were selected for each of 11 cities: Delhi, Chandigarh, Bombay, Pune, Ahmedabad, Calcutta, Bangalore, Mysore, Hyderabad, Madras, and Cochin. However, 15 refused to take the phone call and 20 refused to participate, indicating that they were too busy to take the time. Twenty architects completed the interview, for a response rate of 36%. It is important to note that in India, interior design is not a profession; interiors are designed by architects.

Therefore architects, not interior designers, composed the theoretical and study population.

Questionnaire Development

Research questions were drawn from an extensive review of the literature. Once the protocol for the telephone interview was developed, it was pilot tested to ensure reliability, i.e., clarity in question wording made it probable that respondents would give the same answer in a retest situation. Face and content validity were ensured through the literature review as well as review by experts in the field who served on the thesis committee. Application was made to the College Human Subjects Review Committee, and subsequently permission was granted to proceed with the study.

Data Collection

Telephone interviews were used to gather information about awareness and architects and client's attitudes and practices regarding S/G design, as well as demographic data.

A first round of phone calls was made to the members of different chapters of the Indian Institute of Architects in May 2004, to invite the architects to take part in the survey. The project was explained in detail and its importance was emphasized. Cooperation was requested and confidentiality was assured. It was made clear to them that

they could choose to not participate, to not answer any question, or to withdraw without negative consequences.

The participants were introduced to the survey as follows: “As an architect in a metropolitan city, you would have faced numerous challenges designing structures and spaces. We are interested in knowing your opinion about designing a sustainable/green building or space and the challenges faced during the process of design. Your responses will help assist educators, the design community, and the public understand the prevalence of sustainable/green design in India."

A second round of phone calls, at a time agreed upon by the participants, was made to conduct the interviews. Interviews were audio taped with the participant's approval. At the end of the interview, thanks and appreciation were expressed for their willingness to participate.

Data Analysis

Qualitative and quantitative analysis methods were used to identify similarities, differences, and frequency of responses in order to achieve an understanding of S/G design in India in 2004. Qualitative Elaboration Model (Babbie, 2003) was used as the interpretation method to understand the relationship between two variables through simultaneous induction of additional variables.

Summary

This phenomenological study explored awareness and perceptions of green/sustainable (G/S) design in India's design community. Architects in the five geographic regions were interviewed. Data collected from the respondents were coded to support analysis using the Qualitative Elaboration Model method and descriptive statistics.

CHAPTER FOUR

Presentation and Analysis of Data

Introduction

The profound effect of global warming, species extinction, pollution of air and water, resource depletion, and population growth demands human society address the need for sustainable development. In India, the second most largely populated country, the economic growth rate is alarming, and, consequently, ecological conservation has become a necessity. The United States Department of Energy (2002) has ranked "sick buildings" as one of the top five environmental threats to human health.

The purpose of this study was to explore the awareness and perception of S/G design in India. Architects in India were interviewed, and data regarding their perceptions of sustainable design and problems faced when designing sustainable buildings were collected. Data collected from the respondents were coded to support analysis using the Qualitative Elaboration Model (Babbie, 2003) method and descriptive statistics.

Descriptive Analysis of Data

Fifty-five architects from major metropolitan cities in four geographic regions in India were contacted and invited to participate in the study. A sample of 20 architects

representing all four regions and all major cities responded to the request to participate. During sample selection, it was observed that most of the members of the organization were educators belonging to major institutions in the country. Most of the young architects in the country were not affiliated with this organization.

Participants were asked the following questions in order to better understand their responses to the research questions. As indicated by the mode, the typical participant was a male architect who lived in the southern region and had been in practice for more than 20 years. The demographics of the participants were as indicated in Table 3.

Table 3.

Demographic characteristics of participants

Gender	Years in Practice	Geographic Region
95% Male (n=19)	25% <5 years (n=4)	20% North
5% Female (n=1)	15% 5-10 years (n=6)	30% South
	20% 11-20 years (n=5)	25% East
	40% >20 years (n=5)	25% West

Research Questions

1. What do you think is most important in a design equation: Environment, Cost, Performance, or Aesthetics?

Data indicated that 50% of the architects interviewed from the northern part of India said that environment was the most important factor to be considered when designing a building, 25% said that performance was the most important factor, and 25% said cost was most important. In the southern part of India, 83% of the architects considered environment to be the important factor and 17% considered performance to be the most important factor when designing a building. In the eastern part of India, 60% of architects considered cost and 40% considered the environment to be the most important factor when designing a building. In the western part of India, all architects rated environment as the leading factor to be considered while designing a structure.

When considered as a whole, 70% said environment, 25% said cost, 10% said performance, and 5% said aesthetics were most important in a design equation. See Table 4. There was no statistically significant difference among regions ($p=0.62$) as to which factor was most important. However, it is reassuring that almost three-fourths consider the environment to be the most important factor.

Table 4.

Important factors in design equation

Geographic Location	Percentage	Important Factors in Design
North	50% (n=2)	Environment
	25% (n=1)	Performance
	25% (n=1)	Cost
South	83% (n=5)	Environment
	17% (n=1)	Performance
East	60% (n=3)	Cost
	40% (n=2)	Environment
West	100% (n=5)	Environment

2. Are you aware of the concept of S/G design?

Data indicated that irrespective of the geographic location of the respondents, everyone was "familiar with the concept of S/G design" (see Table 5). However, no one indicated that they had a "thorough understanding" of S/G design.

Table 5.

Familiarity with the concept of S/G design

Chapter	Geographic Location	Familiar with the S/G design concept
1	North (n=4)	100%
2	South (n=6)	100%
3	East (n=5)	100%
4	West (n=5)	100%

3. How important do you think it is for architects to learn about S/G design?

Data indicated that irrespective of the geographic location, every respondent felt that it was very important. See Table 6.

Table 6.

Perception of importance of S/G design.

Chapters	Geographic Location	Think S/G knowledge is very important
1	North (n=4)	100%
2	South (n=6)	100%
3	East (n=5)	100%
4	West (n=5)	100%

4. What are the problems faced during the process of designing an S/G building in India?

Most architects thought the major problem they would

encounter when designing a S/G building was clients' lack of awareness (n=9; 45%). Materials used was rated as most major problem by 20% (n=4) of the architects. Energy efficiency and site selection were rated as the most major problems in designing a S/G building by 25% (n=5) and 10% (n=2) of the architects. See Figure 3.

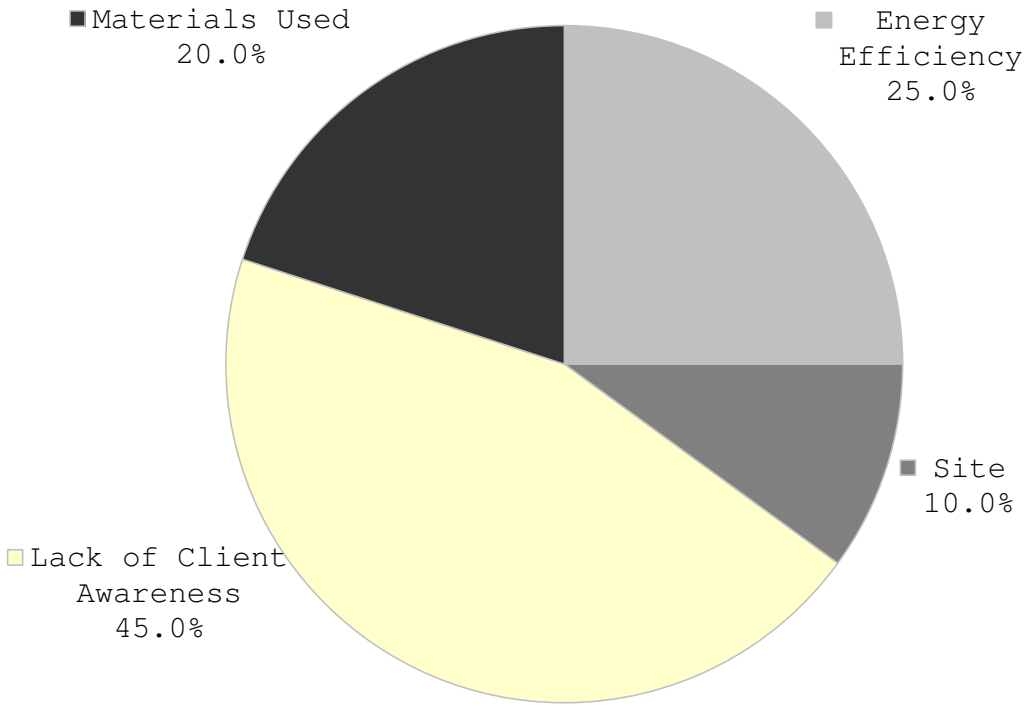

Figure 3. Major problems faced during design of S/G building

5. Does the architects' years of experience correlate with perception of challenges faced during design of a S/G building?

Four-fifths(80%) of respondents with less than five years experience said lack of client awareness was the major problem faced in the design of a sustainable building, while

one-fifth (20%) of this group said the major problem was the materials that were used for construction and/or interiors. For respondents with five to ten years of experience: two-thirds (67%) said it was the lack of client awareness and one-third (33%) said the major problem was the materials used. Half (50%) of architects with eleven to twenty years experience said lack of client awareness was the problem, and half (50%) said it was the materials used. For respondents with twenty or more years of experience: 62.5% said it was the energy efficiency, one-fourth (25%) said it was site selection that was their biggest challenge, and one-eighth (12.5%) said it was the lack of client awareness. The Chi square analysis indicated there was not a statistically significant difference between the architects' experience and perception of potential problem faced during the design of a S/G building. See Table 7.

It is interesting that only architects with more than 20 years experience consider energy efficiency or site selection to be a problem, and according to no one in this group materials used to be problematic. However, there was not a statistically significant difference among the group ($p=0.552$).

Table 7.

Potential challenge encountered in S/G design with respect to years of practice.

	Years of practice			
Challenge	< 5	5 to 10	11 to 20	> 20
Lack of client awareness	80%(n=4)	67%(n=2)	50%(n=2)	12.5%(n=1)
Materials used	20%(n=1)	33%(n=1)	50%(n=2)	–
Energy efficiency	–	–	–	62.5%(n=5)
Site	–	–	–	25%(n=2)

6. Does the architect's field of concentration correlate with perception of major challenge when designing a S/G building?

Among architects with residential design as their field of concentration, site and lack of client awareness were rated by 33% (n=2) each, 17% (n=1) thought the major problem they would encounter when designing a S/G building was energy efficiency, and 17% (n=1) rated materials used as major problem.

Among architects with multipurpose design as their field of concentration, lack of client awareness was rated as the major problem by 50% (n=2) of the respondents. Energy efficiency and materials used were rated as the major problem by 25% (n=1) each.

Among architects with religious or institutional design as their field of concentration, 50% (n=5) rated site as a major problem. Energy efficiency and lack of client awareness were rated by 30% (n=3) and 20% (n=2) respectively. See Table 8.

The Chi square analysis indicated there was not a statistically significant differences between the architects' experience and their field of concentration (p=0.05).

Table 8.

Potential challenge encountered in S/G design with respect to field of concentration.

Field of Concentration	Energy Efficiency	Site	Lack of Client Awareness	Material Used
Residential	17%(n=1)	33%(n=2)	33%(n=2)	17%(n=1)
Office	–	–	–	–
Multipurpose	25%(n=1)	–	50%(n=2)	25%(n=1)
Religious/ Institutional	30%(n=3)	–	50%(n=5)	20%(n=2)

7. How did you learn about S/G design?

The vast majority, 80% (n=16) of respondents, said that they gained knowledge of S/G design by reading books and articles. Only 20% (n=4) learned about the S/G concept from seminars. No one responded that they learned during the course of their education or from a colleague or supervisor. See Table 9.

Table 9.

Source of S/G Design Information

Geographic Location	Percentage	Source of S/G Design information
North	25% (n=3)	Articles & Books
	75% (n=1)	Seminars
South	17% (n=1)	Articles & Books
	83% (n=5)	Seminars
East	100% (n=5)	Seminars
West	100% (n=5)	Seminars

8. Are you willing to promote S/G design?

Data indicated that 100% of respondents in the Northern, Eastern, and Western parts of India were willing to promote sustainable design. Eighty-three percent of respondents in Southern India were willing. Table 10 shows the willingness of the architects in India to promote S/G design. However, although almost all of the architects were willing, none had made a conscious effort to do so. See Table 10.

Table 10.

Willingness to Promote S/G Design

Geographic Location	Architects willing to Promote S/G Design	Architects who Promoted S/G Design
North (n=4)	100% (n=4)	0%
South (n=6)	83% (n=5)	0%
East (n=5)	100% (n=5)	0%
West (n=5)	100% (n=5)	0%

9. Do you think there are sufficient government incentives to practice S/G design?

Analysis of data showed that all (100%; n=20) of the respondents felt the government incentives provided to architects to practice and promote S/G design in India were insufficient. See Table 11.

Table 11.

Government Incentives to Practice S/G Design

Geographic Location	Percentage	Government incentives	Government regulations and policies
North	100% (n=4)	Insufficient	Insufficient
South	100% (n=6)	Insufficient	Insufficient
East	100% (n=5)	Insufficient	Insufficient

Table 11. (continued).

Government Incentives to Practice S/G Design

Geographic Location	Percentage	Government incentives	Government regulations and policies
West	100% (n=5)	Insufficient	Insufficient

In a developing country like India, where there is rapid depletion of natural resources, it is clear that the government has not taken necessary steps to recognize, support, and promote sustainable/green design. All the respondants rated the government regulations and policies as insufficient. See Table 11.

Summary

The vast majority of architects in India knew about the concept of S/G design and thought it was very important. However, none of them had designed the S/G building. The majority thought the greatest challenge was client awareness of S/G design. Although almost all were willing to promote S/G, none had done so. All the architects thought government incentives, regulations, and policies regarding S/G design were insufficient, but their conclusion was that future of S/G design in India is very promising.

CHAPTER FIVE

Summary and Recommendations for Future Research and Action

Summary

The purpose of this study was to explore the awareness and perceptions of sustainable/green (S/G) design among a sample of architects in India. The research provided a better understanding of the various challenges faced when designing a S/G building in India. The research paradigm was qualitative. The research method implemented was a phenomenological study using unstructured interviews for data collection. Phone interviews with architects in eleven cities in five districts in India provided data regarding architects' perception and implementation of sustainable design. All of the respondents interviewed during this research project said that the knowledge of S/G design is a very important requirement for architects in a developing country like India. None felt that they had a "thorough understanding" of S/G design although they were all familiar with S/G design. It was clear that the respondents felt that "lack of client awareness" was the major challenges faced during the design of an S/G building. None of the participants had yet designed a S/G building. All of the architects were willing to promote S/G design. However, none of the respondents had done anything to promote S/G. All participants agreed that government incentives were

inadequate. Although it can be said that the architecture community in India has been slow to respond to the need for S/G design, the participants believed the future is more promising.

Recommendations for Future Action

The government of India could play a more effective and active role in the promotion of S/G design by recognizing the efforts of architects who practice S/G design.

Introducing various incentives to increase the number of architects practicing S/G design could hasten the adoption of the concept. Newspapers, radio, and television programs could be used to educate the public about the danger to the environment due to rapid depletion of natural resources and pollution of both air and water. Seminars and workshops could be offered to educate clients about the positive aspects of S/G design. In order to increase the number of S/G designed buildings, tax breaks could be given to clients who choose to have an S/G building built and to architects who build them. The CII Sohrabji Godrej Green Business Center located in Hyderabad, India, was awarded platinum certification by the US Green Building Council (USGBC) in October 2003. Publicity regarding this achievement could persuade others that S/G design is viable in India.

Last, S/G design concepts could be introduced and/or emphasized in the college curriculum in architectural and design schools. Competitions could showcase both innovative S/G design and the programs that consider S/G an essential part of the academic curriculum. Design students, who would later become practitioners, could acquire the required knowledge and identify the resources necessary to practice S/G design. International communication could be enhanced by encouraging joint research, academic exchanges, and practitioner symposium.

Recommendation for Future Research

The Indian Institute of Architects is an organization with approximately 120 members. To increase the scope of the study, independent architects could be interviewed. Focus groups of architects living various geographic regions, with a range of demographic characteristics, could be studied to gain a better understanding of the extent of S/G knowledge in India.

A sample of students and/or faculty from various educational organizations could be interviewed to better understand the role academic organizations are playing in the promotion of S/G design.

Conclusion

In conclusion, India, as a developing nation, needs to understand the global environmental concerns of the 21st century and be aware of the role it can play in a campaign to preserve and enhance natural resources for future generations. The general public must be educated as to current problems and potential solutions. Architects need to study S/G design and promote environmentally responsible design decisions to protect the health and welfare of the populace on a micro-level and the health and welfare of global ecosystems on a macro-level.

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APPENDIX A: SAMPLE SURVEY FORM

Survey questions

1. What type of buildings do you most frequently design?
    (a) Residential Building
    (b) Multipurpose Building
    (c) Office Building
    (d) Religious/Institutional Building
    (e) Other
2. How long have you been practicing Design?
    (a) Less than 5
    (b) 5 to 10
    (c) 11 to 20
    (d) More than 20
3. Do you agree that orientation of site, materials used for construction, energy efficiency and water use are factors considered when designing a structure?
    (a) Strongly agree
    (b) Agree
    (c) Disagree
    (d) Strongly disagree
    (e) Other comments
4. What do you think is most important in a design equation?
    (a) Environment
    (b) Cost
    (c) Performance

(d) Aesthetics

(e) Other

5. Are you aware of the concept of sustainable/green Design?

(a) Well versed

(b) Familiar

(c) Heard of the concept

(d) Not aware of the concept

6. How did you come learn about S/G design?

(a) During the course of education

(b) Read about it in articles and books

(c) From a colleague/supervisor

(d) Other

7. Do you feel it is important for all architects to learn about Sustainable Design?

(a) Very Important

(b) Important

(c) Not Important

(a) Not required

8. Do you feel your client's today know about sustainable /green design?

(a) Well versed

(b) Familiar

(c) Heard of the concept

(d) Not aware of the concept

9. What are the major problems faced during the design of a Sustainable building?

(a) Energy efficiency

(b) Site Selection

(c) Lack of Client Awareness

(d) Materials used

(e) Other

10. How would you rate government regulations and policies to promote/enforce S/G Design in India?

(a) Too many

(b) Sufficient. No change needed

(c) Moderate, could do more

(d) Insufficient

(e) other

11. What in your opinion is the future of sustainable design in India?

(a) Very Promising

(b) Good

(c) Moderate

(d) Insufficient

12. Do you think there are enough incentives to promote S/G design?

(a) More than sufficient

(b) Sufficient, just about right

(c) Moderate, could do more

(d) Insufficient, need to implement

13. Do you promote S/G design? If so, How?

(a) No

(b) Sometimes

(c) Yes

(d) Other

APPENDIX B: Human Subjects Committee Approval