

# REALIZATION AND EXECUTION OF SUSTAINABLE GREEN BUILDING DESIGN IN CHHATTISGARH

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**Abstract** - Rapid increase in population and growth in Gross State Domestic Product (GSDP), has given rise to a vast demand for buildings in Chhattisgarh, with a subsequent pressure on convenience of resources. To be sustainable, the environmental pressures of inflated demand for resources coupled with a rapidly changing climate are need to be addressed. With an overall objective to optimize resource consumption, minimize greenhouse gas emissions, enhance renewable and recycle resources by the building sector. TERI has developed the national rating system GRIHA (Green Rating for Integrated Habitat Assessment) for green buildings, approved by Government of India in 2007. Apart from GRIHA, Confederation of Indian Industry formed IGBC (Indian Green Building Council) in the year 2001. IGBC (itself a LEED certified Green building) is the non-profit research institution, and has licensed the LEED Green Building Standard from the USGBC. This phenomenological study, explores awareness and realization of sustainable green building design in Chhattisgarh. Architects from various geographical regions were interviewed. All were familiar with sustainable green building design. However, none felt "well-versed." They believed lack of client awareness and materials were the major problems encountered. Although, a vast majority of them willing to promote sustainable green building design. This study revealed an urgent need in Chhattisgarh for education and promotion of ecological responsibility at a micro level through green design and sustainable development at a macro level.

**Key Words:** Sustainable, TERI, GRIHA, Green Building, IGBC, LEED, BEE.

## 1. INTRODUCTION

Ever-increasing extent of the environment is dominated by structures that constitute visible cultural landscape of everyday life, 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/developing areas 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 efficient systems and

recycled materials. 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.[1]

### 1.1 Background

The relationship between human beings and nature is very complex. This complex interaction between humans and environment is nicely taken by the observation of architect Lars Lerup, "We design things and things design us" [1]. Nature was considered a force stronger than mankind. However, the burden technology placed on the environment now threatens survival of the planet. People and technology must respect and nurture the ecology, if the progress of the 21st century is to continue.

This concern for the global ecology was expressed by the UN'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 interfering with the ability of future generations to meet their own needs" [2]. The responsibility of maintaining the right balance between the needs of 21st century societies and limits established by nature lays 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?
- 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 [3].

### 1.2 Statement of the Problem

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, new or 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 & store their own renewable energy. Use non-toxic materials, furnishings, finishes that greatly enhance indoor air quality.

Designing Sustainable Green buildings is the only rational decision from an economic standpoint. According to a study by the American Medical Association and the United States Army [4], poor indoor air quality costs about 150 million lost workdays and \$15 billion in lost productivity. People's health, safety, and welfare are inherently linked to the built and natural environment. Because of this designing green buildings and creating sustainable development globally, especially in developing countries like India, is essential.

### 1.3 Significance of the Study

India's business process, outsourcing sector has been growing significantly every year since the last decade. These gives business opportunities to its state (like Chhattisgarh). With more and more service and other jobs being sent to Chhattisgarh, 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 based industries, commercial offices, customer services, manufacturing plants, and residential complexes, etc. In order to do this, the architects and designers need to have 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 [1].

## 2. REVIEW OF RELATED LITERATURE

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 design. 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" [5].

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 [6], 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, production of building materials, 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.

### 2.1 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 [7], outlines five important elements for sustainable green 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.

- Sustainable green design is more of a philosophy of building than a prescriptive building style.
- Sustainable green design 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 sustainable green design.
- Promoting human health, energy conservation, and ecological systems features, the design of the building envelope, and protection of user's health and well-being through interior design, as well as mechanical, electrical, and plumbing systems, are the key elements.

## 2.2 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 sustainable green design before analyzing its relevance & perception in different parts of the world [8]:

**Understanding place:** Sustainable green 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 site, preservation of the natural environment, access to public transportation, and specification of local materials for finishes and furnishings.

**Understanding the relationship with nature:** Buildings relationship with natural environment helps to create effective design, such as urban/rural setting and connection of inside and outside.

**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 can bring the designed environment to life.

**Understanding environmental impact:** By evaluating site, embodied energy and toxicity of the materials, energy efficiency of design, materials, and construction techniques, we can 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:** Sustainable green 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.

## 2.3 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 [2]. 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).

## 2.4 Dimensions of Sustainability

Success of sustainable green 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).

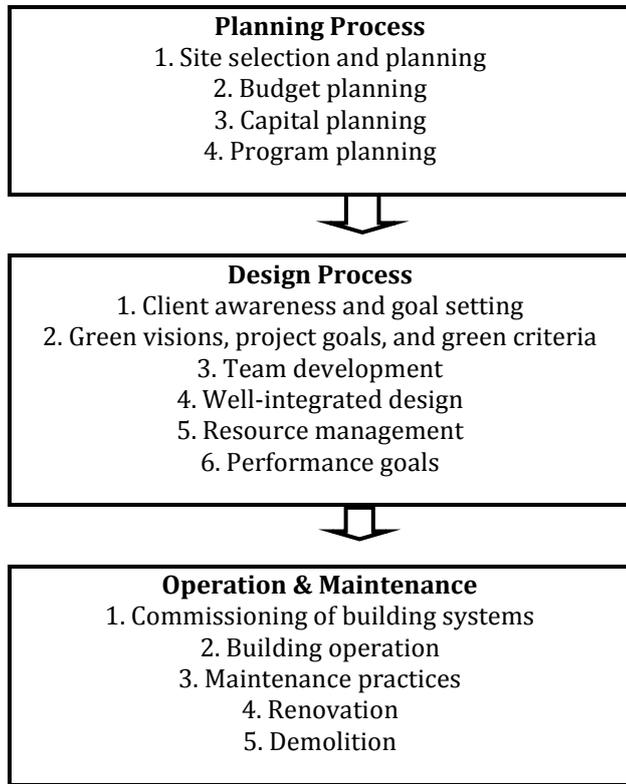


Figure 1: Model of Human Well-being

Human well-being is dependent upon the relationships of Environmental Sustainability, Economic Sustainability, and Social Sustainability [8].

As explained by Samuel Mock Bee of Auburn University (2002), sustainable green 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 sustainable green cultural norms and value.

### Stages in Sustainable Design Development



**Figure 2:** Tasks during each stage in the life cycle of a green building

Figure 2, [8] explains the various pre-construction and post-construction stages of building design.

### 2.5 Factors for Sustainable Green Design

Efficient design, in sustainable green building must consider the following five critical factors: site, energy, materials, water, and waste [4].

**Site Selection:** 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. The best-designed solar building will not work unless it is placed properly on a building site, one that allows solar access [9]. A passive solar house is designed and oriented in such a way as to take the maximum advantage of the sun.

Most parts of India (Chhattisgarh) get 300 days of sunshine a year, and this makes the state 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, solar cookers, solar pump and solar pv system. There has been some use of solar energy in individual residences [10]. Expanded use

of sustainable green 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 [10].

Total (direct & indirect) energy use of Indian households was more than 70 percent of all energy used in the country [11]. India annually consumes about three percent of the world's total energy. The country is the world's third largest energy consumer (Global Energy Statistical Yearbook 2017), 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 [12]. 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 [13]. 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 [14]. However, economic conditions and energy shortages are leading to a new evaluation of the raw materials required by building construction [13].

**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 sustainable green buildings [14].

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

noncompliance. 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 [12].

**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 [12].

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 [12].

### 2.6 Summary of Sustainable Green Design in Chhattisgarh

Though the concept of sustainable green has thrived for many decades in India due to concerns for resource utilization, rapidly progressing growth & modernization has led to increased problems in urban development and subsequent environmental problems [12]. There are numerous books, reports, and journal articles written on the subject of overall sustainable development, resource utilization, poverty alleviation, and sustainable green agriculture in India. However, no information regarding the realization and execution implementation of sustainable green design in Chhattisgarh was identified in an extensive search of the literature.

## 3. RESEARCH AND METHODOLOGY

The research method implemented is a phenomenological study using unstructured interviews for data collection.

### 3.1 Research Overview

Data from a survey of architects' realization and execution of sustainable green design in Chhattisgarh was gathered from phone interviews with architects in major cities in Chhattisgarh. 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 realization of sustainable green design, clients' awareness of sustainable green design, and perceived barriers to sustainable green design and construction. The survey was conducted in May 2018.

### Research Questions:

- What is the architect's realization of sustainable green design in India?
- Are clients aware of the importance of sustainable green design in India?
- Do architects make a conscious effort to promote sustainability?
- What are the various challenges faced during the process of designing a sustainable green building in India?

**Table 1** Identification of variables and attributes

S No	Variable	Attributes
1	Geographic Location	- North - South - East - West
2	Field of Concentration	- Residential - Multi Purpose - Office - Religious/Institutional Buildings
3	Number of Years in Profession	- 5 or less - 6-10 - 11-20 - More than 20
4	Degree of Concept Awareness	- Thorough Understanding - Aware of sustainable green design - Unaware of sustainable green design - Familiar with sustainable green design
5	Potential Challenges while designing a sustainable green building	- Energy Efficiency - Site - Lack of Client Awareness - Materials
6	Reasons for Practicing or Not Practicing Sustainable Design	- Energy Costs - Worker health and safety - Required by the law - Other (identified during data analysis)

### 3.2 Population & Sample Selection

The study population was 55 architects who were members of the Organization of Indian Institute of Architects or reputed civil engineer. The sample included architects from four different regions (northern, western, southern, and eastern), thereby drawing the sample from the geographic domain. Architects who practice in major cities of Chhattisgarh were purposefully selected. An equal number of architect (n=5) were selected for each of 11 cities; Jagdalpur, Rajnandgaon, Durg-Bhilai, Raipur, Raigarh, Bilaspur, Ambikapur, Korba, Champa, Kondagaun, Baikunthpur. However, 15 refused to take the phone call and 20 refused to participate, indicating that they were too busy to take the time. 20 architects completed the interview, for a response rate of

36.36%. It is important to note that in Chhattisgarh, interior design is not a profession; interiors are designed by architects. Therefore architects, not interior designers, composed the theoretical and study population.

### 3.3 Data Collection

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

A first round of phone calls was made to the members of the Indian Institute of Architects in May 2018, 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: "As an architect in a major 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 Chhattisgarh."

A second round of phone calls, at a time agreed upon by the participants, was made to conduct the interviews. And at the end, thanks and appreciation were expressed for their willingness to participate.

### 3.4 Data Analysis

Qualitative and quantitative analysis methods were used to identify similarities, differences, and frequency of responses in order to achieve an understanding of sustainable green design in Chhattisgarh. Qualitative Elaboration Model [15] was used as the interpretation method to understand the relationship between two variables through simultaneous induction of additional variables.

### 3.5 Descriptive Analysis of Data

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 2.

**Table 2.** Demographic characteristics of participants

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

### Research Questions

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

Data indicated 50% of the architects interviewed from the northern part of Chhattisgarh said that environment was the most important factor to be considered when designing a building, 25% said performance was the most important factor, and 25% said cost was most important. In the southern part, 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, 60% of architects considered cost and 40% considered the environment to be the most important factor when designing a building. In the western, 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 3.** Important factors in design equation

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

*Are you aware of the concept of sustainable green design?*

Data indicated that irrespective of the geographic location of the respondents, everyone was "familiar with the concept of sustainable green design" (see Table 4). However, no one indicated that they had a "thorough understanding" of sustainable green design.

**Table 4.** Concept of sustainable green design

Geographic Location	Familiar with the sustainable green design concept
North (n=4)	100%
South (n=6)	100%
East (n=5)	100%
West (n=5)	100%

*How important do you think it is for architects to learn about sustainable green design?*

Data indicated that irrespective of the geographic location, every respondent felt that it was very important. See Table 5.

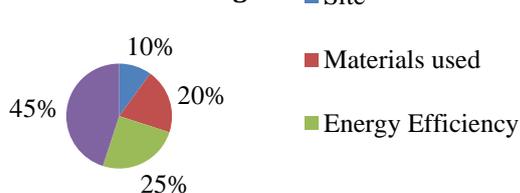
**Table 5.** Importance of sustainable green design

Geographic Location	Importance of sustainable green designs
North (n=4)	100%
South (n=6)	100%
East (n=5)	100%
West (n=5)	100%

*What are the problems faced during the process of designing a sustainable green building in Chhattisgarh?*

Most architects thought the major problem they would encounter when designing a sustainable green 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 sustainable green building by 25% (n=5) and 10% (n=2) of the architects. See Figure 3.

**Problems of sustainable green building design**



**Figure 3.** Problems of Sustainable green building designing

*Does the architects' years of experience correlate with realization of challenges faced during design of a sustainable green 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, 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 realization of potential problem faced during the design of a sustainable green design building. See Table 6.

**Table 6.** Potential challenge encountered in sustainable green design with respect to years of practice.

Challenges	Years of practice			
	<5	5 to 10	11 to 20	>20
Site				25% (n = 2)
Materials used	20% (n = 1)	33% (n = 1)	50% (n = 2)	-
Client Awareness	80% (n = 4)	67% (n = 2)	50% (n = 2)	12.5% (n = 1)
Energy Efficiency	-	-	-	62.5% (n = 5)

It is interesting that only architects with more than 20 years experience consider energy efficiency or site selection to be a problem and consider materials to be non-problematic. However, there was not a statistically significant difference among the group (p=0.552).

*Does the architect's field of concentration correlate with realization of major challenge when designing a sustainable green design 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 sustainable green 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 7.

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 7.** Potential challenge encountered in sustainable green design with respect to field of concentration.

Field of Concentration	Energy Efficiency	Site	Client Awareness	Materials used
Residential	17% (n - 1)	33% (n - 2)	33% (n - 2)	17% (n - 2)
Office	-	-	-	-
Multipurpose	25% (n - 1)	-	50% (n - 2)	25% (n - 1)
Religious/ Institutional	30% (n - 3)	-	50% (n - 5)	20% (n - 2)

*How did you learn about sustainable green design?*

**Table 8.** Source of sustainable green Design Information

Geographic Location	Percentage	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

The vast majority, 80% (n=16) of respondents, said that they gained knowledge of sustainable green design by reading books and articles. Only 20% (n=4) learned about the sustainable green concept from seminars. No one responded that they learned during the course of their education or from a colleague or supervisor. See Table 8.

*Are you willing to promote sustainable green design?*

Data indicated that 100% of respondents in the Northern, Eastern, and Western parts of Chhattisgarh were willing to promote sustainable design. Eighty-three percent of respondents in Southern Chhattisgarh were willing. Table 9 shows the willingness of the architects in Chhattisgarh to promote sustainable green design. However, some had made a conscious effort to do so.

**Table 9.** Willingness to promote sustainable green Design

Geographic Location	Architects willing to Promote sustainable green Design	Architects who Promoted sustainable green Design
North (n - 4)	100% (n - 4)	25%
South (n - 6)	83% (n - 5)	16%
East (n - 5)	100% (n - 5)	40%
West (n - 5)	100% (n - 5)	20%

*Do you think there are sufficient government incentives to practice sustainable green design?*

Analysis of data showed that all (100%; n=20) of the respondents felt the government incentives provided to architects to practice and promote sustainable green design in Chhattisgarh were insufficient. See Table 10.

**Table 10.** Incentives to Practice sustainable green 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
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 respondents rated the government regulations and policies as insufficient.

#### 4. SUMMARY & RECOMMENDATION FOR FUTURE RESEARCH WORK

##### Summary

Purpose of this study was to explore the awareness and realizations of sustainable green design among a sample of architects in Chhattisgarh. The research provided a better understanding of the various challenges faced when designing a sustainable green building. 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 of Chhattisgarh provided data regarding architects' realization and execution of sustainable design. All of the respondents interviewed during this research project said that the knowledge of sustainable green design is a very important requirement for architects in a developing country like India. None felt that they had a "thorough

understanding" of sustainable green design although they were all familiar with sustainable green design. It was clear that the respondents felt that "lack of client awareness" was the major challenges faced during the design of a sustainable green building. All of the architects were willing to promote sustainable green design. However, none of the respondents had done anything to promote sustainable green. All participants agreed that government incentives were inadequate. Although it can be said that the participants believed the future is more promising.

### Recommendations for Future Action

The government of Chhattisgarh could play a more effective and active role in the promotion of sustainable green design by recognizing the efforts of architects who practice sustainable green design. Introducing various incentives to increase the number of architects practicing sustainable green design could hasten the adoption of the concept. Newspapers and Digital media 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 sustainable green design. In order to increase the number of sustainable green designed buildings, tax breaks could be given to clients who choose to have a sustainable green building built and to architects who build them.

Lastly, sustainable green design concepts could be introduced and/or emphasized in the college curriculum in architectural and design schools. Competitions could showcase both innovative sustainable green design and the programs that consider sustainable green an essential part of the academic curriculum. National & 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 more than 20,000 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 sustainable green knowledge in India & its states (like Chhattisgarh). 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 sustainable green design.

### 5. CONCLUSION

The Department of Energy, United States [16] has ranked "sick buildings" as one of the top five environmental threats to human health. In conclusion, India, as a developing nation, needs to understand the global environmental concerns of the 21<sup>st</sup> 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 sustainable green 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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