

Case Studies of Green Building Concept for Environmental Condition

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Abstract— The building industry is one of the major energy consumers and emitters of Green House Gasses (GHG). It consumes 38% of the global energy; and this does not include the usage of other resources such as water. Globally, this has increased the crisis of global warming and has led to development of Green buildings. In the Sub Saharan Africa alone, 56% of energy used is by building operations. Green buildings are marketed as economical, resource efficient and environmentally friendly compared to the convectional buildings. This study investigated the extent of adoption of green building concepts in commercial buildings and the key challenges arising from their adoption with the aim of determining appropriate strategies for implementing them. The study was conducted through a survey method and used questionnaires, interviews, observations for data collection. The aim of a green building design is to minimize the demand on non-renewable resources, maximize the utilization efficiency of these resources, when in use, and maximize the reuse, recycling, and utilization of renewable resources. It maximizes the use of efficient building materials and construction practices; optimizes the use of on-site sources and sinks by bio-climatic architectural practices; uses minimum energy to power itself; uses efficient equipment to meet its lighting, air-conditioning, and other needs; maximizes the use of renewable sources of energy; uses efficient waste and water management practices; and provides comfortable and hygienic indoor working conditions. In sum, the following aspects of the building design are looked into in an integrated way in a green building.

Keywords: Green House Gasses (GHG), Green Building Design

I. INTRODUCTION

In the early days of mankind, the civilisation has developed along the river coursers. Sindhu valley civilisation in our country is an example of such a development along the river. The basic need for any human being is food, clothes and shelter. Now the population in the world has crossed 7.4 billion crores. Hence, it becomes a herculean task to provide shelter for the entire population with minimum damages to the environment and nature. Energy is vital for all activities Fossil fuels produce large amounts of CO₂ emissions Wind, Hydro Solar , Biomass , Geothermal Globally, the following opportunities are available for making Some of the so Installing some of these can be most useful for energy efficiency and making the environment clean and cool. Solar lighting techniques are used for natural illumination of interiors, and will reduce reliance on artificial lighting systems. The current consumption of lights are given below:

Type of bulb	Watts	Consumption/hour in unit
IC Bulb	60	0.060
CFL Bulb	13	0.013
LED LIGHT	8	0.008

Table 1: current consumption of lights

The costs of LED lights are more expensive initially, but they are truly ecofriendly and use very little energy. Unlike compact fluorescent lamps, they do not contain mercury and can be disposed properly. Green building practices aim to reduce the environmental impact of buildings. Buildings account for a large amount of land use, energy and water consumption, and air and atmosphere alteration.

II. HISTORY AND DEVELOPMENT OF GREEN BUILDING

In the past, the buildings were constructed with thick walls and more number of windows and open to sky area in the middle of the building for adequate cross ventilation and for rain water harvesting. Best examples for such buildings are Chettinadu and British buildings. The increase of fuel costs in 1970's kindled the awareness and encouragement towards Green Buildings. Architects and ecologists started looking for solutions like reflective roofing materials, triple-glazed windows to achieve energy savings. But with the decrease of fuel prices, the Green movement was slowed down and was later in 1990's that the movement got kick start and awareness began for sustainable buildings. To have Green Building Concept, the following are to be considered:

- 1) Optimum use of Energy or power
- 2) Water conservation
- 3) Solid and Water Waste management, its treatment and reuse
- 4) Energy efficient transport systems
- 5) Efficient Building System Planning etc.

III. BENEFITS AND REASON OF GREEN BUILDING CONCEPT

- Green buildings are designed to be healthier and having more enjoyable working environment. Workplace qualities that improve the environment and which help in developing the knowledge of workers and may also reduce stress and lead to longer lives for multidisciplinary teams.
- Reduced energy and water consumption without sacrificing the comfort level.
- Significantly, better lighting quality including more day lighting, better daylight harvesting and use of shading, greater occupancy control over light levels and less glare.
- Improved thermal comfort and better ventilation.
- Limited waste generation due to recycling process and reuse.
- Increase productivity of workers and machines. It is reported that productivity can be increased by about 25% while following such greenhouse norms.
- Attracting and retaining the best employees, can be linked to the benefits and qualities of workers receive, including the physical, environmental and technological aspects.

- Green building activities result in reduction of operating costs by 25-30%.

A green building is an environmentally sustainable building, designed, constructed and operated to minimize the total environmental impacts.

- Have minimum demand for electricity, water and other natural resources (in construction, Demolition and operation)
- Generate all its electricity on site through renewable means,
- Strive to cater all its water demand through sustainable processes such as rain water harvesting.
- It could also strive to grow its own food on site.
- It could recycle and re use all its waste on site.

Buildings are a major energy consuming sector in the economy. About 35 to 40% of total energy is used by buildings during construction. The major consumption of Energy in buildings is during construction and later in lighting and air-conditioning systems. This consumption must be minimized to about 80-100 watts per sqm. A large amount of waste is generated every day in each city. Waste disposal is a Herculean task and will need space for dumping and fuel costs for transportation of waste up to disposal areas. In the cities the disposal areas are outside city which are miles apart. Therefore, this waste must be processed at nearby places and reused as much as possible.

Local processing of the waste will not only keep the city clean but also generate energy and resource materials. It will also generate huge employment opportunities and give several other advantages and thus sustainable. The design and maintenance and construction of buildings have tremendous effect on our environment and natural resources. Green building is different from the other buildings because it uses a minimum amount of non-renewable energy, produce minimal pollution, increase the comfort, health and safety of the people who work in them. It also minimizes the waste in construction by recovering materials and reusing or recycling them.

IV. CLIMATE CHANGE AND ITS EFFECT

Climate is changing fast globally because of increased energy consumption and thus increase Greenhouse gases (GHG) like CO₂. This gives rise to global Warming. This impacts the climate change resulting in: Water stress and reduction in the availability of fresh water due to potential decline in rainwater. Threats to agriculture and food scarcity. Shifts in area and boundary of different forest and threat to biodiversity with adverse implications for forest dependent activities. Sea level rising on coastal areas and effect on agriculture & habitation. Reduced energy consumption, water conservation, recycling waste.

Well-designed green buildings will save money, increase comfort and create healthier environments for people to live and work, using improved indoor air quality, natural daylight, and thermal comfort. Energy use by depleting natural resources as well as CO₂ emissions is one of our most important environmental impacts. Volatile energy markets, rising energy costs and increasing environmental awareness about issues such as global warming make energy efficiency and conservation a high priority. Build Green's focus is on

reducing building energy usage and increasing occupant comfort.

V. MATERIALS PREFERRED IN MAKING THE GREEN BUILDING

Sustainable construction materials are chosen keeping in mind various characteristics like zero or low toxicity, high recyclability, zero or low off gassing of harmful air emissions, durability, reused and recycled content, sustainably harvested material. Dimensional planning and other material efficiency strategies are used to reduce the construction costs. Construction and demolition material can be reused and recycled for e.g. inert demolition material can be used as base course for landfills. Proper planning for managing materials through deconstruction, demolition and construction is done. Efficient planning of utilities to minimize Utilization of rapidly renewable materials, such as bamboo flooring, wool carpets, strawboard, cotton ball insulation (made from denim scrap), genuine linoleum flooring, or poplar oriented-strand board (OSB). Using rapid renewable helps reduce the use and depletion of finite raw material. Use of materials that are available locally is preferred over materials that need to be brought from distant places. It saves transportation costs. Also, alternative materials that can be generated from waste with lesser energy is used over conventional building materials.

For example, alternative materials for timber like MDF board, Mica Laminates and Veneers on composite boards should be used instead of natural timber. Industrial waste based bricks and blocks, aerated lightweight BPC concrete blocks, Phospho-Gypsum based blocks can be used for masonry structures. Fly ash, for bricks, outdoor paving and in concrete. Green building materials offer the following benefits to the building owner and building occupants:

- Reduced maintenance/ replacement costs over the life of the building
- Energy conservation
- Improved occupant health and productivity
- Life cycle cost savings
- Lower costs associated with changing space configurations.
- Greater design flexibility

VI. WATER EFFICIENCY

Installation of water efficient or low flow pipe line fittings in kitchens and bathrooms will reduce water consumption. Incorporating waste water management technologies like dual plumbing for using recycled water in toilet flushing or using water conserving fixtures such as low flow shower heads, self-closing nozzles on hoses, water closets with dual flush options.

Use of Micro irrigation techniques at sites instead of high pressure sprayers. Recirculation system for centralized hot water distribution. For landscaping purpose, local plants and trees are to be planted as they consume less water. Provisions for reusing and recycling water are made to ensure efficient water management. Using treated waste water, non-potable water for site irrigation. Raw sewage can be recycled using aquatic plants like duckweed and water hyacinth to

produce clean water suitable for re-use in irrigation and industry. Integrating Rain water harvesting system in building design to ensure maximum possible utilization of rain water.

VII. GREEN BUILDING MATERIALS

Recycled brickwork utilized in walls and concrete is a well-recognized benchmark for environment-friendly buildings / homes. Lead-free, non-toxic, protective coating paints for interiors and exteriors of homes are said to improve air circulation, ventilation and longevity. Solar panels save heavily on electricity expenses. Whether you have to cook food, heat water, power your fan or any other electrical equipment, solar panels can provide much-desired energy all around the year for free. Planting of garden plants and trees and building rain gardens helps reduce rain-water wastage. It also helps replenishment of ground water. A roundhouse is simply a structure that has round exterior walls and a round roof, though some parts come together to a point instead of being perfectly rounded. However, the exterior is green because there is actually less square footage to the walls because of the shape. And by using fewer materials, the house gets to become more Eco-friendly.

The less exposed surface area allows you to work with nature and not against it. Roundhouses are also designed in such a way to do very well in extreme weather, like wind storms. Because there is not ever a flat surface to build up pressure against, they are far more energy efficient and less drafty. They are also generally known for their expansive windows, which contribute by allowing in massive amounts of natural light. Above all, they become quite attractive homes.

The Green Building movement in India was started in 2003 and received a major impetus when, CII –sohrabji Godrej Green Business Centre Building in Hyderabad became the first green building in India which was awarded with the prestigious and the much covered LEED (Leadership in Energy and Environmental Design) Platinum rating by the US Green Building Council (USGBC) and also became the world’s greenest Building in 2003.

VIII. LEED INDIA CONCEPT

The Indian Green Building Council (IGBC) Designed and started. The Leadership in Energy and Environmental Design (LEED – India) system is called Green Building Rating System. It is an internationally accepted benchmark for the design, construction and operation of high performance green building. LEED certified buildings utilize less toxic materials, low-emitting adhesives & sealants, paints, carpets, and composite woods, and indoor chemical & pollutant source control.

Essential to an effective green building Concept the following steps need to be followed:

- Plan each office / home’s orientation to the sun to harness energy and shield it from heat i.e. Proper Building Orientation and Landscape and emphasis on natural light.
- High efficiency insulated glass windows can reduce requirements of energy during the operation or use of

Building. Thus it will emit minimum carbon dioxide CO₂

- Minimize Cement / concrete consumption through innovative architecture and Structural Design for optimum use of cement.
- Maximum use of waste Pozzolanic material like fly ash in Concrete Mixture along with Cement.
- Non – toxic paints should be used on the walls. These use water rather than petroleum based solvents and do not emit smog producing pollutants. This will improve Indoor Air Quality.
- Use Sewage treatment and recycle the waste water from bathroom and Kitchen.
- Organic waste, both solid and liquid, produce a large quantity of Methane which is 23 times stronger than CO₂ as green house gases (GHG). Such organic waste must be processed to tap gas which can be used as cooking gas or fuel.
- Provide Rainwater Harvesting systems on the roof of Building to collect water, which can be used to flush Toilets or for general wash or recharge the ground.
- Use Solar Panels to heat bath water and generate little electricity for use when there are power cuts instead of using Invertors.
- Install simple Wind turbines on the roof, which can be used to generate electricity for use when there is no power.
- A rain garden can help reduce storm water runoff.
- Use Drip Irrigation to water the plants or Native landscaping around building. This requires less water for irrigation and maintenance.
- Government or Municipal corporations should provide enough incentives like tax rebates or tax breaks for green buildings during approvals.

Government should make basic green norms – like gray water recycling and rainwater harvesting compulsory for all new buildings in all cities, towns and urban agglomerations in the country. The threshold criteria for certification/pre-certification levels are as under:

Certification Level	Owner-occupied Buildings	Tenant-occupied Buildings	Recognition
Certified	40 - 49	40 - 49	Good Practices
Silver	50 - 59	50 - 59	Best Practices
Gold	60 - 74	60 - 74	Outstanding Performance
Platinum	75 - 89	75 - 89	National Excellence
Super Platinum	90 - 100	90 - 100	Global Leadership

Table 2: Certification Levels

IGBC will recognize Green New Buildings that achieve one of the rating levels with a formal letter of certification and a mountable plaque.

- Green buildings may incorporate sustainable materials in their construction (e.g., reused, recycled content, or made from renewable resources).
- Create healthy indoor environments with minimal pollutants (e.g., reduced product emissions).

- And feature landscaping that reduce water usage (e.g., by using native plants that survive without extra watering).
- A green building is a structure that is environmentally responsible and resource-efficient throughout its life-cycle. These objectives expand and complement the classical building design concerns of economy, utility, Durability and comfort.

IX. THE COSTS AND FINANCIAL BENEFITS OF GREEN BUILDINGS

Integrating “sustainable” or “green” building practices into the construction of state buildings is a solid financial investment. In the most comprehensive analysis of the financial costs and benefits of green building conducted to date, a minimal upfront investment of about two percent of construction costs typically yields life cycle savings of over ten times the initial investment. For example, an initial upfront investment of up to Rs.100,000 to incorporate green building features into a Rs.5 million project would result in a savings of at least Rs.1 million over the life of the building, assumed conservatively to be 20 years. The financial benefits of green buildings include lower energy, waste disposal, and water costs, lower environmental and emissions costs, lower operations and maintenance costs, and savings from increased productivity and health. These benefits range from being fairly predictable (energy, waste, and water savings) to relatively uncertain (productivity/health benefits). Energy and water savings can be predicted with reasonable precision, measured, and monitored over time. In contrast, productivity and health gains are much less precisely understood and far harder to predict with accuracy.

X. CONCLUSION

The poverty alleviation in the developing countries can be effectively achieved by conservation of energy and creation of employment opportunities. The energy saved can be ploughed back for future development which creates a large employment opportunity. The technologies and the materials used for development should complement the use of local and waste resources. The labour forces enhancing their capability and standard of living be used to avoid the widening of gap between haves and have not. Processing of waste must be taken up at a large scale and locally. This will not only generate jobs but also give out energy & resources of material which can be usefully utilized.

It can be a blessing for the fast developing country like India that the measures called for sustainable development can be the measures of poverty alleviation as well as through sustainable development and reprocessing of waste.

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