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"Innovation in Transforming Of Sustainable Building to Green Building"

MRIDUSMITA MAHANTA
ANWESHA GAYAN

ABSTRACT

Implementation of sustainable practices in construction sector is not new; this concept has already gained tremendous importance worldwide. It includes manyaspects such as environmental, social, economic etc. With the increasing awareness of sustainable development in the construction industry, today's market is full of innovative green building materials and technologies. The rating systems like LEED are becoming universal so as to measure and verifythe sustainable practices employed in the design, construction, and operation of commercial real estate in the world. The driving force behind implementing green practices in existing buildings is knowledgeable and diligent. Unlike fulfilling green building requirements for new construction, converting existing buildings into green buildings requires an ongoing commitment to monitorbuilding systems, train staff, and keep up to date with certification requirements. By doing so, we can save up to 30-40% of water, 40-50% energy and 20-40%of construction material.
The study findings revealed that green buildings provide better health for building occupants due to the improved indoor quality, development of more energy efficient products and the use of less natural resources for the satisfaction and welfare of building tenants, also to protect the ecosystem.

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1. INTRODUCTION

General

A green building, also known as a sustainable building, is a structure that is designed, built, renovated, operated, or reused in an ecological and resource- efficient manner. Green buildings are designed to meet certain objectives such as protecting occupant health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing the overall impact to the environment. Green Building practices promote construction of buildings that are healthier for the occupants and healthier for the environment Sustainable or "green" building practices can reduce the tremendous impact that building design, construction and maintenance has on both people and nature.
Energy and material consumption in buildings can contribute significantly to global climate change. A green building depletes as little of the natural resources during its construction and operation. One of the most inspiring definitions of a green building is as follows – "A Green Building should create delight when entered, serenity and health when occupied and regret when departed". The aim of a green construction is to:

1. Minimize the demand on non-renewable resources
2. Maximize the utilization efficiency of these resources when in use
3. Maximize reuse and recycling of available resources, and
4. Utilization of renewable resources.

Characteristics of Green Building

Building construction and its upkeep for livable conditions requires huge energyin lighting, air-conditioning, operation of appliances etc. Green Building i.e. energy efficient building is the one which can reduce energy consumption by at least 40% as compared to conventional building. The cost of constructing energy efficient building is estimated to be 15 – 20% higher as compared to conventional building without energy efficiency. However, this is more than compensated over the period of time i.e., during life cycle cost and operation & living. Using green building materials and products, promotes conservation of non-renewable resources internationally. In addition, integrating green building materials into building projects can help reduce the

environmental impacts associated with the extraction, transport, processing, fabrication, installation, reuse, recycling, and disposal of these building industry source materials.

1.1.2 Why going Green?

Building and construction activities worldwide consume 3 billion tons of raw materials each year or 40 percent of total global use (Roodman and Lenssen, 1995). Using green building materials and products promotes conservation of dwindling nonrenewable resources internationally. In addition, integrating green building materials into building projects can help reduce the environmental impacts associated with the extraction, transport, processing, fabrication, installation, reuse, recycling, and disposal of these building industry source materials. The purpose of the case study is to expand knowledge about the concept of green buildings. This case study will help in identifying the benefits of green buildings compared to conventional buildings and their impact on environment. Green building is a relatively new field. The green building concept has been defined in various, but in related ways. The green building concept is gradually gaining momentum in India. A green building typically applies practices like harvesting energy and water and using environmentally friendly materials in its design, construction, operation and maintenance and sustains the environment. Development of green buildings has many monetary benefits such as low energy, waste disposal, water cost, and low environmental and emission costs. Another meaning of Green Structure is clean environment, water and healthy living. Building Green is not about a little more efficiency. It is about creating buildings that optimize on the local ecology, use of local materials and most importantly they are built to cut power, water and material requirements. Thus, if these things are kept in mind, then we will realize that our traditional architecture was in fact, very green. Today, we have forgotten that how to make natural environment, instead copying it from developed countries. Buildings are a major energy consuming sector in the economy.
About 35 to 40% of total energy is used by buildings during construction. Themajor consumption of Energy in buildings is during construction and later in lighting or air-conditioning systems. This consumption must be minimized.
Possibly, this should be limited to about 80-100 watts per sqm.

Fig. 1.1 Average saving of green building.

Going "Green" is the "right thing"

1. Reduce carbon consumption
2. Energy independence
3. Encourage community
4. Preserve natural systems

Buildings consume a large amount of natural resources to construct andoperate
Efficiencies by Green building

i. Structure design efficiency

The foundation of any construction project is rooted in the concept and design stages. The concept stage, in fact, is one of the major steps in a project life cycle, as it has the largest impact on cost and performance. In designing environmentally optimal buildings, the objective is to minimize the total environmental impact associated with all life-cycle stages of the building project. However, building as a process is not as streamlined as an industrial process, and varies from one building to the other, never repeating itself identically. In addition, buildings are much more complex products, composed of a multitude of materials and components each constituting various design variables to be decided at the design stage. A variation of every design variablemay affect the environment during all the building's relevant life-cycle stages.

ii. Energy efficiency

To reduce operating energy use, high-efficiency windows and insulationin walls, ceilings, and floors increase the efficiency of the building envelope, (the barrier between conditioned and unconditioned space).
Another strategy, passive solar building design, is often implemented in low-energy homes. Designers‟ orient windows and walls and place awnings, porches, and trees to shade windows and roofs during the summer while maximizing solar gain in the winter. In addition, effectivewindow placement (day lighting) can provide more natural light and lessen the need for electric lighting during the day. Solar water heating further reduces energy costs.
Onsite generation of renewable energy through solar power, wind power, hydro power, or biomass can significantly reduce the environmental impact of the building. Power generation is generally the most expensive feature to add to a building.

iii. Water efficiency

Reducing water consumption and protecting water quality are key objectives in sustainable building. One critical issue of water consumption is that in many areas, the demands on the supplying aquifer exceed its ability to replenish itself. To the maximum extent feasible, facilities should increase their dependence on water that is collected, used, purified, and reused on-site. The protection and conservation of water throughout the life of a building may be accomplished by designingfor dual plumbing that recycles water in toilet flushing. Waste-water maybe minimized by utilizing water conserving fixtures such as ultra-low flush toilets and low-flow shower heads. Bidets help eliminate the use of toilet paper, reducing sewer traffic and increasing possibilities of re-using water on-site. Point of use water treatment and heating improves both water quality and energy efficiency while reducing the amount of water in circulation. The use of non-sewage and greywater for on-site use such as site-irrigation will minimize demands on the local aquifer.

iv. Materials efficiency

Green building materials are composed of renewable, rather than nonrenewable resources. Green materials are environmentally responsible because impacts are considered over the life of the product. Depending upon project-specific goals, an assessment of green materials may involvean evaluation of one or more of the criteria listed below. Green building material/product selection criteria:
Resource efficiencyIndoor air quality Energy efficiency Water conservationAffordability

v. Resource Efficiency

Recycled Content: Products with identifiable recycled content, including postindustrial content with a preference for post-consumer content. Resource efficient manufacturing process: Products manufactured with resource-efficient processes including reducing energy consumption, minimizing waste (recycled, recyclable and or source reduced product packaging), and reducing greenhouse gases. Locally available: Building materials, components, and systems found locally or regionally saving energy and resources in transportation to the project site. Durable: Materials that are longer lasting or are comparable to conventional products with long life expectancies.

vi. Indoor environmental quality enhancement

Indoor Air Quality seeks to reduce volatile organic compounds. or VOCs, and other air impurities such as microbial contaminants. Buildings rely on a properly designed ventilation system (passively/naturally or mechanically- powered) to provide adequate ventilation of cleaner air from outdoors or recirculated, filtered air as well as isolated operations (kitchens, dry cleaners, etc.) from other occupancies.
Low or non-toxic: Materials that emit few or no carcinogens, reproductive toxicants, or irritants as

demonstrated by the manufacturer through appropriatetesting.
Moisture resistant: Products and systems that resist moisture or inhibit thegrowth of biological contaminants in buildings.
Systems or equipment: Products that promote healthy IAQ by identifyingindoor air pollutants or enhancing the air quality.

vii. Operational and maintenance optimization

No matter how sustainable a building may have been in its design and construction, it can only remain so if it is operated responsibly and maintained properly. Every aspect of green building is integrated into the O&M phase of a Ensuring operations and maintenance (O&M) personnel are part of the project'splanning and development process will help retain the green criteria designed atthe onset of the project building's life. The addition of new green technologies also falls on the O&M staff. Although the goal of waste reduction may be applied during the design, construction and demolition phases of a building's life-cycle, it is in the O&M phase that green practices such as recycling and air quality enhancement take place.

viii. Waste reduction

Green architecture also seeks to reduce waste of energy, water and materials used during construction. For example, in California nearly 60% of the state's waste comes from commercial buildings. During the construction phase, one goal should be to reduce the amount of material going to landfills. Well- designed buildings also help reduce the amount of waste generated by the occupants as well, by providing on-site solutions such as compost bins to reduce matter going to landfills. To reduce the impact on wells or water treatment plants, several options exist. "Greywater", wastewater from sources such as dishwashing or washing machines, can be used for subsurface irrigation, or if treated, for non-potable purposes, e.g., to flush toilets and wash cars, Rainwater collectors are used for similar purposes. Centralized wastewater treatment systems can be costly and use a lot of energy. An alternative to this process is converting waste and wastewater into fertilizer, which avoids these costs and shows other benefits.

ix. Cost and payoff

The most criticized issue about constructing environmentally friendly buildingsis the price. Photo-voltaic, new appliances, and modern technologies tend to cost more money. Most green buildings cost a premium of <2%, but yield 10 times as much over the entire life of the building. The stigma is between the knowledge of up-front cost vs. life cycle cost. The savings in money come from more efficient use of utilities which result in decreased energy bills. It is projected that different sectors could save $130 Billion on energy bills. Also,higher worker or student productivity can be factored into savings and cost deductions. Studies have shown over a 20-year life period, some green buildings have yielded $53 to $71 per square foot back on investment.
Confirming the rent ability of green building investments, further studies of the commercial real estate market have found that LEED and Energy Star certified buildings achieve significantly higher rents, sale prices and occupancy rates as well as lower capitalization rates potentially reflecting lower investment risk.

x. Regulation and operation

The Indian building industry is highly de-centralized with people and/ or groupsengaged in design, construction, equipment provision, installation, and renovation working together. Each group may be organized to some extent, but there is limited interaction among the groups, thus disabling the integrated green design and application process. Hence, it is very important to define and quantify sustainable building practices and their benefits. It is also important to separate the role of different participants in ensuring that the building consumes minimal resources over its entire life cycle and leaves behind a minimal environmental footprint.

Green Building

"Green" Buildings are high performance structures that also meet certainstandards for reducing natural resource consumption.
"Green" or "Sustainable" buildings are characterized by:
1. efficient management of energy and water resources
2. management of material resources and waste
3. restoration and protection of environmental quality

4. enhancement and protection of healthy and indoor environmental quality
5. reinforcement of natural systems
6. analysis of the life cycle costs and benefits of materials and methods
7. integration of the design decision-making process

Green building is the practice of creating structures and processes that areenvironment friendly and resource-efficient throughout the life span of a building right from site selection to design, construction, operation, maintenance, renovation and deconstruction. Green building (also known as green construction or sustainable building) refers to both a structure and the application of processes that are environmentally responsible and resource-efficient throughout a building‟s life-cycle: from planning to design, construction, operation, maintenance, renovation, and demolition. This requires close cooperation of the contractor, the architects, the engineers, and the client at all project stages. The Green Building practice expands complements the classical buildings design concerns of economy, utility, durability, and comfort. In doing so, the three dimensions of sustainability, i.e., planet, people and profit across the entire supply chain need to be considered.

During the past few years, there have been tremendous efforts on investigating green buildings. The awareness of the heavy effect that the building sector exerts on the natural environment is now widely recognized, leading to a wide spread of tools to control and guide towards building environmental sustainability. The natural environment is considered essentially as an asset to protect. However, nature cannot be protected easily and it is also a key factor to contribute the quality of our built environment and our well-being. Numerous attempts analyze the positive effect of the introduction of natural elements in building design. However, the use of natural elements in common building practice is still not used commonly and there is a need to promote awareness and use of the potential of the natural elements in design.

Several green rating systems have been developed to evaluate the level ofgreen of the building where there are some similarities and differences among them. Wu and Low (2010) identified the role of project management that is less associated with technology and engineering in developing green building rating systems. They performed an investigation to compare the LEED, the Green Globes, and the BCA Green Mark to find an understanding of current practices, and more specifically, to determine the contribution of project management in reaching green or sustainable construction. The findings imply that project management adopted in green building construction is associated with both the practice and the process. They suggested that the construction and engineering firms consider project management in termsof both the process and the practice when fulfilling requirements of beinggreen.

Over the past decade, people have become increasingly conscious of their impact on the environment. Home builders have noted the change in how people live and what they want from daily life and have designed spacious, comfortable new homes that reduce energy expenditure by upto 30 percent compared to older homes. 10 common green features in new homes that make new homes more efficient and comfortable.

a) Energy Star Appliances Save Water, Electricity and Money
b) improved insulation
c) Programmable Thermostats
d) Low - Emittance Windows
e) Beyond Compact Florescent Light Bulbs: Energy-efficientLighting
f) Sustainable Lumber for a Beautiful Home and BeautifulPlanet
g) Geothermal and Solar Energy
h) Cool Roofs
i) Building Small
j) Building to a Specific Lot

The ideal green building would be a building project that would allow you to preserve most of the natural environment around the project site, while still being able to produce a building that is going to serve a purpose. The construction and operation will promote a healthy environment for all involved, and it will not disrupt the land, water, resources and energy in and around the building. This is the actual definition of a green building. The U.S. EPA says "Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building‟s life- cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high-performance building." Practitioners of green building often seek to achieve not only ecological but aesthetic harmony between a structure and its surrounding of natural and built environment. The appearance and style of sustainable homes and buildings can be nearly indistinguishable from their less sustainable counterparts.

An increasing number of authorities, organizations and institutions are workingon raising consciousness about

"Green Building". It is increasingly governed and driven by standards, such as the Leadership in Energy and Environmental Design (LEED) rating system in U.S. as well as The Energy and Resource Institute (TERI). According to the CII, India - "Green" is regarded as „The voluntary pursuit of any activity which is concerned with energy efficiency, environmental management, water management, renewable energy, and waste management and recycling." Green practices ultimately leading to sustainable development and equitable growth.

While a good design is essential to green building, the actual operation, maintenance, and ultimate disposal or deconstruction of the building also have very significant effects on buildings' overall environmental impact. "Green Building" is not only related to the selected construction material but also to the long-term impact on environment and on people"s health. The characteristics of the material itself constitute points which have to be reconsidered by building professionals when planning sustainable design projects (Green Space criteria, Building Green, Inc):

a) The used materials should be natural and environmental-friendly.

b) The impact on the environment with regards to manufacturing, distribution, construction, renovation and demolition is relatively small.

c) Minimum quantity of chemicals necessary to prepare the material forconstruction is used.

d) The material can be recycled.

Fig. 1.2 Dimensions of sustainability of green building.

The nonresidential green buildings market consists of sales of nonresidential green buildings. Green Buildings, in its design, construction or operation, have minimal or no negative impacts on environment and climate but have positive impacts by preserving precious natural resources and improve our quality of life. This practice creates and uses healthier and more resource efficient models of construction, renovation, operation, maintenance etc. Living roofs or green roofs is increasingly being implemented in green buildings. A green roof is a roof of a building that is covered with vegetation and soil, or a growing medium, planted over a waterproofing membrane. Green roofs last longer whencompared to conventional roofs, they also reduce energy costs with natural insulation, reduces the temperatures (heat and cold) by absorbing and trapping them.

The philosophy of sustainable architecture is embodied in various practices that aim to reduce the negative impact of a building on its environment and to take care of the quality of life of users and neighboring

communities. Its implementation is manifested by a set of choices of techniques, management methods, materials and the internal organization of functions and spaces, in order to control the energy consumption and the living environment of users.
Sustainable construction technologies used in green construction include:

a) Biodegradable materials
b) Solar power for heating, ventilation, and air conditioning (HVAC)
c) Green insulation and lighting, smart appliances, cool roofs
d) Sustainable resource sourcing
e) Low-energy house and zero-energy building design
f) Water efficiency technologies
g) Electrochromic smart glass
h) Self-powered buildings

A Green building is nothing more than a building which is built using reusable materials and other materials which make the building efficient and environmentally friendly. And Green building technology typically covers everything from geothermal heating to energy-efficient appliances. The concept of sustainable development can be traced to the energy (especially fossil oil) crisis and environmental pollution concerns of the 1960s and 1970s. The RachelCarson book, "Silent Spring", published in 1962, is considered to be one of the first initial efforts to describe sustainable development as related to green building. The green building movement in the U.S. originated from the need and desire for more energy efficient and environmentally friendly construction practices. There are a number of motives for building green, including environmental, economic, and social benefits. However, modern sustainability initiatives call for an integrated and synergistic design to both new construction and in the retrofitting of existing structures. Also known as sustainable design, this approach integrates the building life-cycle with each green practice employed with a design-purpose to create a synergy among the practices used. Green building brings together a vast array of practices, techniques, and skills toreduce and ultimately eliminate the impacts of buildings on the environment and human health. It often emphasizes taking advantage of renewable resources, e.g., using sunlight through passive solar, active solar, and photovoltaic equipment, and using plants and trees through green roofs, rain gardens, and reduction of rainwater run-off. Many other techniques are used, such as using low-impact building materials or using packed gravel or permeable concrete instead of conventional concrete or asphalt to enhance replenishment of groundwater. While the practices or technologies employed in green building are constantly evolving and may differ from region to region, fundamental principles persist from which the method is derived: siting and structure design efficiency, energy efficiency, water efficiency, materials efficiency, indoor environmental quality enhancement, operations and maintenance optimization and waste and toxics reduction. The essence of green building is an optimization of one or more of these principles. Also, with the proper synergistic design, individual green building technologies may work together to produce a greater cumulative effect. On the aesthetic side of green architecture or sustainable design is the philosophy of designing a building that is in harmony with the natural features and resources surrounding the site. There are several key steps in designing sustainable buildings: specify 'green' building materials from local sources, reduce loads, optimize systems, and generate on- site renewable energy.

1.3. REASONS TO BUILD GREEN BUILDING

1. Reduced urban island heat effect
2. Reduced building heating and cooling effect
3. Reduced air pollution and greenhouse gases
4. Increase building durability
5. Increased health factor both inside outside building
6. Increased water conservation

The built environment has a vast impact on the natural environment, human health, and the economy. By adopting green building strategies, we can maximize both economic and environmental performance. Green constructionmethods can be integrated into buildings at any stage, from design and construction to renovation and deconstruction. However, the most significant benefits can be obtained if the design and construction team take an integratedapproach from the earliest stages of a building project. Potential benefits of green building can include:

ENVIRONMENTAL BENEFITS

1. Enhance and protect biodiversity and ecosystems

Biodiversity is more than simply the collection of plants and animals on earth;
It is about local ecosystems and promoting healthy conditions for organisms to thrive. While protecting the rainforests sounds like a daunting task, there is a lot we can do to promote and preserve local biodiversity at home. Regularly buyingfrom small local farmers at stands or markets helps to keep dollars in the local economy and supports agricultural efforts to conserve biodiversity. Bees are important to preserving biodiversity and they are increasingly under attack from varroa mites. You can help save them by planting nectar producing wildflowers in your backyard, or even building bee boxes for local bees to call home Biodiversity depends on the abundance of washing your hands, doing the dishes, or brushing your teeth are all easy ways to conserve water.

2. Reduces wastage of water and energy

Green buildings certified by the Indian green building Council (IGBC) results inwater savings of 20-30% and energy savings of 40-50% compared to conventional buildings in India Green building achieving the green star certification in Australia have been shown to save 51% less potable water and produce 62% fewer greenhouse gas emissions than if they had been built to meet minimum industry requirements Green buildings achieving the green star certification in South Africa have been shown to save between 20-30% potable water every year, and to save on average between 30-40% energy and carbon emissions every year, when compared to the industry norm.

3. Conserves Natural Resources

The building sector has the largest potential for reducing greenhouse gas emissions significantly compared to other major emitting sectors. This emissions savings potential is said to be as much as 84 gigatonnes of CO2 by 2050, through direct measures in buildings such as energy efficiency, fuel switching and the use of renewable energy. The building sector has the potential to make energy savings of 50% or more in 2050, in support of limiting global temperature rises to 2^{0}C.

4. Improve air and water quality

Research suggests that better indoor air quality that is low concentrations of co2 and pollutants, and high ventilation rates can lead to improvements in the performance of up to 8 percent.

5. Reduces costs and Increase value

These buildings lower construction costs and higher property value for building developers. Green buildings, whether new or renovated- command a 7% increase in asset value over traditional buildings.

6. Improves Occupant Productivity

Green building focuses on creating buildings that are not only good for the environment but also support healthier, happier and more productive lives. These include cost savings on utility bills for tenants or households throughenergy and water efficiency.

ECONOMIC BENEFITS
1. Reduce operating costs
2. Create, expand, and shape markets for green product and services
3. Improve occupant productivity
4. Optimize life-cycle economic performance

SOCIAL BENEFITS
1. Enhance occupant comfort and health
2. Heighten aesthetic qualities
3. Minimize strain on local infrastructure
4. Improve overall quality of life

With new technologies constantly being developed to complement current practices in creating greener structures, the benefits of green building can range from environmental to economic to social. By adopting greener practices, we can take the maximum advantage of environmental and economic performance.

Advantages of Green Building

Buildings are a very important part of everyone"s life. We live in them, we workin them, we spend free time in them and even if we are feeling unwell, we have to visit some kind of building (hospital). People are spending approximately 90% of their time indoors, so it is important to keep these spaces comfortable and enjoyable for the tenants. But not only comfort plays a big role these days, it is also important to keep the ecological footprint of real estate as low as possible. This is where the concept of a green building shows how significant it is. It can have many advantages to implement green solutions and technologies, such as a more sustainable usage of resources and also a great return on the investment.

Green Buildings have many advantages such as reduced energy consumption, reduced operating costs, sustainable usage of resources, reduced CO2 emissions, increased productivity and quality of living. On the other hand, some downsides are the initial investment, finding the right technologies and materials, finding experts, and that the success depends on the location.

1. **Green buildings are energy-efficient**
2. **Reduced Operating Costs**
3. **Sustainable Usage of Resources**
4. **Reduced CO2 Emission**
5. **Increased Productivity of Tenants**
6. **Improved Quality of Living**
7. **Enhances Indoor Environment Quality**
8. **Better Health**
9. **Reduce Strain on Local Resources10.Less air pollution**
11. **Emphasis on renewable energies**
12. **Day lighting is utilized as best as possible 13.Green Buildings Have a Marketing Advantage**

14.Green Buildings Exceed Local Energy Codes and Regulations 15.Green Buildings Qualify for More Incentive Programs

Do the Advantages of Green Buildings Outweigh the Disadvantages?

The answer is yes in some cases. To decide whether to go for green building obviously need to take multiple factors into consideration. While there are still a number of technical hurdles to overcome, the green building holds its role in the fight against the ever-worsening climate crisis. Green architectureis the future architecture to tackle the power shortage and to preserve our environment from pollution. Many government and private organizations arecoming up with new innovative ideas to boost the green architecture. These buildings will feed on renewable sources for energy and will cut down the carbon emission in huge amount. Since the demand for power is on the rise, choosing a green architecture is best idea. We can now say that it is a practical idea that can be implemented in many places and countries, due to its many benefits, taking into account the shortcomings of its construction in terms of the availability of certain environmental conditions, building materials, etc., but we cannot rely on it mainly as a basic solution to thehousing problem in many places.

Elements of Green Building Design

Following are the components of a Green Building to make it sustainable:

1. **Materials for Green Building:**

Materials for a green building are obtained from natural, renewable sources that have been managed and harvested in a sustainable way; or they are obtained locally to reduce the embedded energy costs of transportation; or salvaged from reclaimed materials at nearby sites. Materials are assessed using green specifications that look at their Life Cycle Analysis (LCA) in terms of their embodied energy, durability, recycled content, waste minimization, and their ability to be reused or recycled.

2. **Energy Systems in Green Buildings:**

Passive solar design will dramatically reduce the heating and cooling costs of a building, as will high levels of insulation and energy-efficient windows. Natural daylight design reduces a building's electricity needs, and improves people's health and productivity. Green buildings also incorporate energy-efficient lighting, low energy appliances, and renewable energy technologies such as wind turbines and solar panels.

3. Water Management in Green Building:

Minimizing water use is achieved by installing greywater and rainwater catchment systems that recycle water for irrigation or toilet flushing; water- efficient appliances, such as low flow showerheads, self-closing or spray taps; low-flush toilets, or waterless composting toilets. Installing point of use hot water systems and lagging pipes saves on water heating.

Rainwater Harvesting in Green Building Rainwater harvesting is the principle of collecting and using precipitation from a catchments surface. An old technology is gaining popularity in a new way.

4. Health Components of Green Building:

Using non-toxic materials and products will improve indoor air quality, and reduce the rate of asthma, allergy and sick building syndrome. These materialsare emission-free, have low or no VOC content, and are moisture resistant to deter moulds, spores and other microbes. Indoor air quality is also addressed through ventilation systems and materials that control humidity and allow a building to breathe.

OBJECTIVES

Buildings require air, water, energy and space for its occupants. These are provided by systems in place like the ventilation system, the water supply system and the electricity supply system. The materials which are used in the construction of the building also produce environmental impact like carbon footprint, pollution through wastes and slurry, and the consumption of water and power. Buildings are one of the major sources of pollution that cause air pollution and are responsible for climate change. A truly sustainable built environment re-integrates humanity into nature. In a natural system there is nosuch thing as waste and each individual‟s waste products become inputs for someone else. It is possible for humanity to once again become part of these natural cyclical systems. Buildings that take their cue from nature and their surroundings can support, strengthen and improve the functioning of natural systems while also improving their own functionality.

Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective of greenbuildings is to reduce the overall impact of the built environment on human health and the natural environment by: Efficiently using energy, water, and other resources.

Main fundamental objectives of Green Building

1. Conserving the natural environment

Structures and infrastructure tend to disturb the natural environment and ecosystems significantly. Topsoil, vegetation, water cycles, animal behavior andbiodiversity in general are impacted on by the built environment. All of these systems are necessary for the healthy functioning of the planetary systems that are needed for our survival.

2. Optimum use of building materials

Building materials utilize natural resources. Obtaining these materials requires timber harvesting, cultivation, mining and quarrying. Many of these activities are currently degrading the environment. Once obtained, these materials need tobe processed, manufactured and transported. Using local materials as far as possible is an easy way to be greener. It is therefore imperative to specify the most sustainable building materials possible and to use them in the most efficient way.

3. Energy efficiency

It is estimated that around 40% of the energy used on the planet is by buildings.By far the majority of energy is generated using non-renewable sources such ascoal, gas and oil. Being non-renewable, these resources will get depleted and, as they become more scarce, become more expensive and more difficult to extract. The process of converting these fossil fuels into energy in most cases produces greenhouse gases (GHGs) which contribute to global warming.

Energy efficient buildings contribute significantly to lowering humanity‟s overall energy requirements, which in turn reduces the building sector‟s carbonfootprint.

4. Water efficiency

Fresh water is increasingly being recognized as a scarce resource and water systems are becoming increasingly polluted. It is estimated that buildings consume 40% of all fresh water that is used. This water is used for drinking, cooking, sanitation, cleaning and for the industrial processes that take place in many buildings. Appropriate water harvesting, recycling and conservation canmake a significant impact in preserving this most precious commodity.

5. Waste Management

Buildings generate an ongoing amount of waste during their lifetimes and in their eventual deconstruction. This waste can be liquid, solid or gas and places a burden on the environment because it can"t be safely and healthily disposed of. Recycling is one of the best ways of managing waste. Not only can the continuous waste generated by the building be recycled but the actual building itself is able to be recycled when no longer required. In effective recycling waste from one function becomes a resource for another. The careful management of consumption, clever design and appropriate material choice can significantly reduce waste output.

6. Society and the human experience

Buildings have a profound effect on their occupants and users – influencing andshaping the way in which we live, learn, work, play, contemplate and relax. Thedesign, resolution and ongoing condition of buildings can either improve or detrimentally impact on the wellbeing of the occupants.

A built environment that promotes human dignity, safety, security, hygiene, ease of use and sound community values will promote wellbeing on an individual and collective level.

Well adjusted, balanced and cared about people and societies are sustainable.Dysfunctional ones are not.

7. Health

Buildings effectively create an internal environment which profoundly affects its occupants. Air quality, light quality, acoustics, temperature and hygiene canpromote or hinder health, depending on how they perform. It has been found that buildings that are environmentally sustainable tend to promote health, which in turn improves the wellbeing of its occupants as well their productivity.There are many case studies proving that the increased productivity of occupants has been the most lucrative result of a greening process.

8. Economic Sustainability

Sustainability includes financial and economic sustainability. Resource-hungry buildings are costly to produce and use, and this places a strain on the overall socio-economic fabric of society. The costs of energy, water and materials are going to continue to increase as they become more scarce and an efficient building can contribute hugely towards the financial sustainability of its users orowners. Poverty and financial hardship in the world are increasing and a thoughtful and efficient built environment could realize benefits for many levelsin society.

Green building design in a practical and climate conscious approach to building design. Various factors, like geographical location, prevailing climate conditions, use of locally available and low embodied energy materials and design parameters relevant to the t parameters relevant to the type of usage of the building are normally taken into consideration. Green Building over a conventional building help to retain nature to a maximum extent possible in three ways with reference to the location of the buildings.

- Retain the external environment at the location of the building.
- Improve internal environment for the occupants.
- Preserve the environment at places far away from the building.

1.7. ECONOMIC BENEFITS OF GREEN BUILDING

According to the U.S Green Building Council (USGBC), green building comes with clear environmental benefits. In the United States, building account for 40 percent of carbon dioxide emissions, but LEED-certified buildings have 34 percent lower emissions and use 25 percent less energy and 11 percent less water than other buildings. Those are some pretty significant environmental benefits. But the benefits go beyond improving sustainability. The USGBC also reports LEED-certified buildings can attract more buyers and office building owners can charge higher rents. Hats partially because these buildings are seen as desirable, but also because they have lower operating costs thanks to environmentally friendly features like energy-efficient heating and air conditioning, windows and lighting. The World Resources Institute reports that38 percent of commercial office space was certified by LEED or energy star in 2017, which is a big number, and even more notable in light of the fact that in 2005 that number was only 5 percent. This suggests building owners have seen the economic benefits of green building and many have quickly gotten on board.

HEALTH AND COMMUNITY BENEFITS

Part of the reason companies and tenants might find green buildings desirable spaces is they come with health benefits for occupants. For example, studies have found well-ventilated spaces lead to better cognitive function and performance, and healthier indoor air can reduce allergies, asthma and other common health problems. Green buildings can also attract business to communities and reduce resource use. Both those features make them desirableadditions to cities and towns.

THE ROLE OF CONTRACTORS IN GREEN CONSTRUCTION

All these benefits demonstrate that green construction is not just a trend and something contractors need to know about. The fact that Engineering News- Record publishes an annual list of the top green building contractors also supports the ascertain that green building is more than just something architects need to worry about. So, what role do contractors play in the green construction process? They are not usually responsible for driving a green building project, as that trends to lie with owners and architects. They are, however, responsible for project execution, so it"s critical they understand they understand the goals of the project from the outset. If an owner wants to achieve LEED certification, the building will need specific materials and features. Since contractors are mostoften responsible for ordering materials, they need to know right away what"s needed so timelines and budgets are not disrupted.
The population of the world is expected to increase from 7 billion to 9 billion by2050. Undoubtedly, this growth in population is associated with higher demand for water, energy, and natural resources which in return will overburden the ecosystems and increasingly deteriorates the environment.

The list of green building merits and benefits is extensive and varied and covers the three bottom-line of sustainability which are environmental, economic, and social aspects. From building life cycle perspective, advocates of green buildings contend that a green building outer forms its conventional counterpert; they identified numerous benefits associated with a green building. Financial benefits gained from reduced energy and water consumption, lower maintenance cost, in addition to improved health and productivity are 10 times higher than the additional construction cost required to meet green design criteria. Green buildings use 30%-50% less energy and water than conventional buildings.so that the productivity increased about 25% in a green manufacturing facility certified by Leadership in Energy and Environmental Buildings (LEED) green rating system.

2. LITERATURE REVIEW

THE EFFECTIVENESS OF ELECTRICAL AND ELECTRONIC WASTE RECYCLING AND ITS IMPLEMANTATION ON GREEN BUILDING.
AUTHOR: Vivian W. Y. Tam.

The service lifetime of shopper electrical and electronic (EandE) devices is comparatively short and decreasing thanks to speedy changes in instrumentation characteristics and capabilities. This creates an outsized waste stream of obsolete E&E equipment. though typical disposal strategies exist for E&E waste, these methods have each economic and environmental disadvantage.
This paper examines existing employment things and EandE waste assortment methods in Republic of India and Switzerland. Questionnaires, interviews and case studies are conducted. Their Eand E-waste situation and also the technologies applied to EandE waste are studied. India performed higher in terms of EandE intensity per unit of service and employment potential, while Schweiz performed higher in terms of activity hazards and noxious emissions. Recommendations for rising existing EandE waste employment things and theirimplications for inexperienced building also are provided. burning could be a methodology of waste disposal by combustion (Lee et al., 2007). burning typically works as an alternate to different disposal methods, particularly landfills. burning will reduce the volume of the waste stream, especially for venturous waste. It aims to scale back the toxicity of waste and other hazardouscharacteristics. it's significantly common in countries like Japan wherever land is a scarce resource (Jung et al., 2004; Okubo et al., 2007). Open Burning as a result of shoots burn at comparatively low temperatures, they unleash additional pollutants than a controlled burning method at an incineration plant (Callan and Thomas, 2006). infections and cause different issues like coughing, wheezing, hurting and eye irritation. Chronic exposure to open fire emissions can cause diseases reminiscent of respiratory disease and cancer. For example, the combustion of a premature cavity contraction releases acid which, once inhaled,mixes with water into the respiratory organs to create hydrochloric acid. this could lead to corrosion of lung tissue and varied metabolic process complications. Open fires typically burn with a lack of oxygen, forming carbon monoxide, that poisons the blood once inhaled. within the variety of ash tends to fly close and might even be dangerous if inhaled. Average time period of private computers (Darby and Obara, 2005). supported the survey results and

interviews, the subsequent strategies are prompt to boost E&E waste recycling:

- It ought to be inspired through policies and incentives: (i)take back product packaging; (ii) scale back waste volumes and toxicity for optimum reuse, recycling, and/or composting; (iii) purchase reusable, recycled and property materials and products; and (iv) eliminate waste and packaging by redesigning manufacturing. • Repair retailers for and instrumentation ought to be got wind of in convenient locations within the city. It will facilitate individuals repair their and instrumentation rather than degrading it • Hardware exchange for and equipment is suggested. It can help to employ recent EandE equipment for different organizations reminiscent of charities by getting new equipment. Resellers will sell the new EandE equipment and receive the old equipment, thatthey'll then send to the old equipment for correct employment.

GREEN BUILDING – A STEP TOWARDS ENVIRONMENTALPROTECTION.
AUTHOR: AKSHEY, SWATI AND DISHA.

These issues embody air pollution, heat islands, adverse health effects, water and noise pollution, waste disposal, social and economic. ecological issues, introducing the thought of green building in massive urban areas could be a steptowards environmental protection. In addition, inexperienced buildings provide a way of happiness to nature, save energy consumption by providing a cooling effect, reducing the warmth island effect and providing better environmental conditions. inexperienced infrastructure in the urban area leads to multi-dimensional and useful benefits in terms of ideal ecosystems and healthy environment, yet as a large vary of environmental, social, global climate changeadaptation and mitigation benefits and of biodiversity. The U.EPA defines "Green building is the act of fabricating structures and using forms that are naturally reliable and well-efficient throughout the life cycle of a building, from location to floor, of development, activity, support, remodeling and deconstruction "Green building with green wall Benefits of green building Innovative and advanced technologies with new approaches tend to incorporate current practices in building greener structures, the benefits of which can be extend from the natural to the financial and social. greener practices, we can adopt the more extreme preferred view of ecological and monetary execution.
Green development techniques, when effectively coordinated and implementedin the planning and development phase, produce many benefits.

A LITERATURE REVIEW ON DESIGNING TECHNIQUES OF AGREEN BUILDING.
AUTHOR: KUSHAGRA VARMA, MAYANK CHAURASIA, PRASENJIT SHUKLA AND TARIQ AHMED.

Green building is the practice of constructing or modifying structures that are environmentally friendly, sustainable and resource efficient throughout their lifecycle. This includes the efficient use of energy, water and other natural resources, protect occupant health, improve employee productivity, and reduce waste, pollution, and environmental degradation. Green buildings help improve the environmental footprint by reducing energy consumption by 305%, CO2 emissions by 35%, waste generation by 70% and water consumption by 40%.
ADaRSH functions as a platform for interaction between various stakeholders as well as promotes GRIHA, SVAGRIHA and other similar green building rating systems in India whereas SVAGRIHA is a recently designed system especially for small scale projects i.e., buildings with built up area less than 2500sq.mt. Center for Environmental Science and Engineering, IIT, Kanpur, India: EESC is a GRIHA (India) 5 Star Eco-Assessed Building and Research Center of IIT (Indian Institute of Technology), Kanpur over an area of 175,000 square meters. It was ecologically designed, conceptualized, and built as a sustainable "building in the garden". Key Sustainable Features:

- Building is fully ECBC (Energy Conservation Building Code) compliant
- Sustainable site planning has been incorporated to maintain a favorablemicroclimate
- the Architectural design has been optimized based on sun path and climateanalysis.

REVIEW ON CONCRETE TECHNOLOGY.
AUTHOR: Pravesh Shukla, Manish Kumar Sahu, Lokesh Singh.

Concrete is a synthetic building material obtained by mixing cement, fine aggregates, coarse aggregates and water in the correct proportions and is also a well-known heterogeneous mixture of cement, water and aggregates. The researchers categorized the mixes into three mainly named types: (i) nominal mixes (ii) standard/prescribed mixes (iii) designed mixes nominal mixes Specifications for concrete prescribed the proportions of cement, fine and coarseaggregate. However, due to the variability of the mixed ingredients, the nominal concrete for a given workability varies greatly in strength Standard / Prescribed Mixes The nominal

mixes of fixed mixes the cement-to-aggregate ratio (by volume) varies considerably in strength and can result in over-rich or under- mixes.

A RESEARCH ON GREEN CONCRETE.AUTHOR: Neeraj Agarwal, Nikhil Garg.

Green concrete is a revolutionary subject in the history of the concrete industry.It was invented in Denmark in 1998. Green concrete has nothing to do with color. It is a concept of thinking about the environment of concrete considering all aspects of raw material production, beyond mix design, structural design, construction and durability. Green concrete is very often also cheap to produce because, for example, waste is used as a partial substitute for cement, waste disposal costs are avoided, energy consumption in production is lower and durability is bigger. Green concrete is a type of concrete that resembles conventional concrete but the production or use of such concrete requires a minimum amount of energy and causes the least damage to the environment.
The other name of green concrete is for resource efficient structures with reduced environmental impact for energy saving, co2 emissions, waste water. The objective of the Green Concrete Center is to reduce the environmental impact of concrete and for this, a new technology is developed. 5) Thermodynamic properties (contribution for other properties) 6) Environmentalaspects (CO2 emissions, energy, recycling, etc.)

Energy Consumption and Efficiency in Green Buildings.
AUTHOR: Aditya Divyadarshi, Pranjal Tiwari, Basab Sharma, George Washington, Dr. Kshyana Prava Samal.

This article examines the aspect of energy efficient buildings, i.e., green buildings in India onset to reduce energy consumption in addition to climate change on greenhouse gases. The United States has been considering ASHRAE and environmental management since the first energy conservation standard in 2011 (Danielski, 2012). The Indian Green Building Council (IGBC), since 2001, has been working to advance India alongside the developed economies of the world. The IGBC Green New Buildings rating system addresses the most important national inclinations which include water sustenance, waste management, energy efficiency, reduction in the use of reliquary fuels, less dependence on the habit of virgin materials and the health and well-being of theinhabitants. Therefore, what the world is witnessing, the ultimate goal of GreenBuilding is to reduce consumption and emissions, reduce energy consumption, use of recycled materials and localization of resources to reduce costs and energy emissions.

Construction of an Eco-Friendly Building using Green BuildingApproach.
AUTHOR: Ashish Kumar Parashar, Rinku Parashar.

Raipur is the capital of the newly formed state of Chhattisgarh, the environment of Raipur city is very warm. Owing to the increasing population needs, the construction activity is at its boom, resulting in an increase in concrete structures and consequently decrease in green areas. The climate of the city is quite warm during the months of summer with temperature reaching up to 480C so proper care should be taken to avoid getting any kind of heat related ailment. Also, the phenomenon of global warming or climate change has led to many environmental issues including higher atmospheric temperatures, intensive precipitation, and increased greenhouse gaseous emission resulting in increased indoor discomfort condition. Researchers worldwide collectively agreed that one way of reducing the impact of global warming is by implementing "Green Roof Technology" which integrates vegetation, growing medium and water proofing membrane on top of the roof surface. However, none of them have ever studied as to how much the green roof could contribute to lessen the environmental problems. Therefore, this study investigates the effect of green plantation on inclined roof to the indoor temperature on any building in Chhattisgarh climate. building sustainable providing the comfort level for the residents A green building with water harvesting system utilize the natural energy to reduce temperature and increase ground water level hence it saves the additional cost required for mechanical means to reduce temperature. tiles on the outer face of the wall, we will reduce the indoor green building with water harvesting system utilize the natural energy to reduce temperature and increase ground water level hence it will save the additional cost required for mechanicalmeans to reduce temperature. of the wall will reflect sun rays therefore reduce indoor temperature of building.

A RESEARCH PAPER ON GREEN BUILDING.
AUTHOR: Sm Sajid Sayeed, Mohammad Yassir, Ekhlakh Ahmed Khan.

Green building technology is one of the most trending topics all over the world which is been put forward to reduce the significant impact of the construction industry on the environment, society and economy. The globe is in urgent need of sustainable and smart development as the problem of pollution and global warming rapidly increases all over the world. However, in the developing countries like India, China, Pakistan, Sri Lanka etc. They are far behind in achieving sustainable development and ecofriendly constructions. Also, there is lack of awareness amongst the people regarding this global issue. This document will help Indian villages and their residential buildings to develop in asustainable and green way by implementing an easy, simple and economical technique. This paper look at stated all of the technical and additionally the monetary components associated with inexperienced homes changing it right into a inexperienced or a sustainable constructing for destiny long time savings (monetary components) and concerns while evaluating the effectiveness of those inexperienced constructing score gear. inexperienced constructing principles and its necessitity to the surroundings and additionally to our wallet withinside the long time Also, this situation look at will assist in reading consciousness approximately the inexperienced constructing principles among the human beings of cities and villages of imdia and assist them expand their very own inexperienced.

GREEN BUILDING: A NEED IN TODAY'S ENVIRONMENT.
AUTHOR: Vatsal Patel, Utsav Shah, Jay Jariwala, Gautam Kumar,Prof.C.B. Mishra.

Green constructing (GB) innovation is one of the maximum inclining topics anywhere for the duration of the sector that's been superior to manipulate the specific problems the development enterprise is confronting anywhere for the duration of the sector, GB has risen as a promising method for making the sporting activities and responsibilities of the development enterprise possible tothe earth and human wellbeing. This specialized article examines the requirement for inexperienced constructing and situation of advantages of creating inexperienced constructing. In addition, authors did an green evaluated of the literature to widen the comprehension of specialists, association of coverage makers at the benefits of it with conclusions and recommendations.
GB is a technique for actualizing supportable development supplying some
social, monetary, and ecological benefits to the production business. This paper reviews a survey of the modern-day institution of facts approximately distinctive unmistakable and impalpable GB benefits. To moreover develop the appropriation of GB, authorities and backers must by skip at the benefits of GB recognized proper now pertinent gatherings withinside the business, nation funded schooling must be excessive on authorities" plan, TV and radio tasks could be a part of the possible and easy techniques to train the general populace on GB benefits to help with increasing companions' mindfulness for invigorating hobbies in GB improvement. This paper could fill in as an extensive degree for companions to increase their comprehension and help extratremendous reception of GB.

A Review on Green Building Movement in India.AUTHOR: Dibas Manna, Sulagno Banerjee.

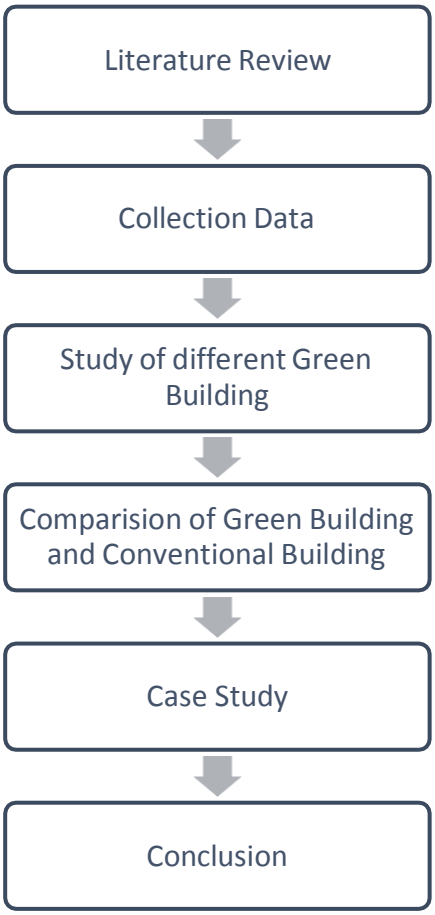
Exceptionally, India being a growing united states of America, it's far pretty superior on this thing and feature an amazing rank whilst as in comparison to all different nations. ecofriendly structures or inexperienced constructing initiatives is to lessen the widespread effect of creation enterprise at the surroundings. This paper will make human beings recognize approximately the Green Building Movement in India and how Green Buildings are designed with a view to shop the Earth from degradation. the United States of America in generating sustainable constructed surroundings whilst as in comparison to all different nations. If timber is reduced off to remedy the plot for building dangerous emissions, accounting for approximately 30 percentage of 18 percentage caused circuitously through cloth, exploitation and globally, homes are answerable for power use), forty percentage of waste generated (through volume), and forty percentage of cloth useful resource use. occupy 50 percentage or greater of landarea. Buildings are answerable for now no longer only a massive percent of the world „s water use, however a massive percent of wasted water as well. philosophy, which makes use of greater environmentally friendly environmental quality, reduces dangerous fuel line emissions etc. This may cause environmental, financial, economic etc.

3. METHODOLOGY

GENERAL:

METHODOLOGY

The methodology adopted in this study is discussed in this chapter. To achievethe objective of the study the following methodology has been adopted in this project.



4. HISTORY OF GREEN BUILDING

History of Green Building

Green building is defined by the Office of the Federal Environmental Executiveas the practice of:

1) increasing the efficiency with which buildings and their sites use energy,water, and materials, and

2) reducing building impacts of human health and the environment, through better siting, design, construction, operation, maintenance, and removal throughout the complete life cycle.

While the green building movement has gained momentum in the last decade, the origin can be traced back to the late nineteenth century. According to David Gissen, curator of architecture and design and the National Building Museum inWashington DC, structures such as London‟s Crystal Palace and Milan‟s Galleria Vittorio Emanuele II used methods that decreased the impact of the structure on the environment. Systems such as roof ventilators and underground air-cooling chambers were used to regulate indoor air temperature. In the early twentieth century, several skyscrapers such as the Flatiron Building and the New York Times Building in New York utilized deep-set windows and the Carson Pirie Scott department store in Chicago had retractable awnings. Both ofthese techniques were effective in controlling interior temperature while lessoning the buildings‟ impact on the environment. From the 1930‟s through the 1960‟s, the forward-thinking cooling methods mentioned above gave way to some new building technologies that would change inner-city building construction dramatically. The invention of air conditioning, reflective glass, and structural steel popularized the enclosed glass and steel buildings that litter the American city today. These buildings were able to be heated and cooled with massive HVAC systems that consumed huge amounts of cheap and readily available fossil fuels. The massive consumption of energy required to inhabit these buildings made their viability tenable and entirely dependent upon energy availability and cost.

4.1HISTORY OF GREEN BUILDING IN INDIA

The Green Building movement in India was started in 2003 and received amajor 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 (USGBS) and also became the world's greenest Building in 2003.

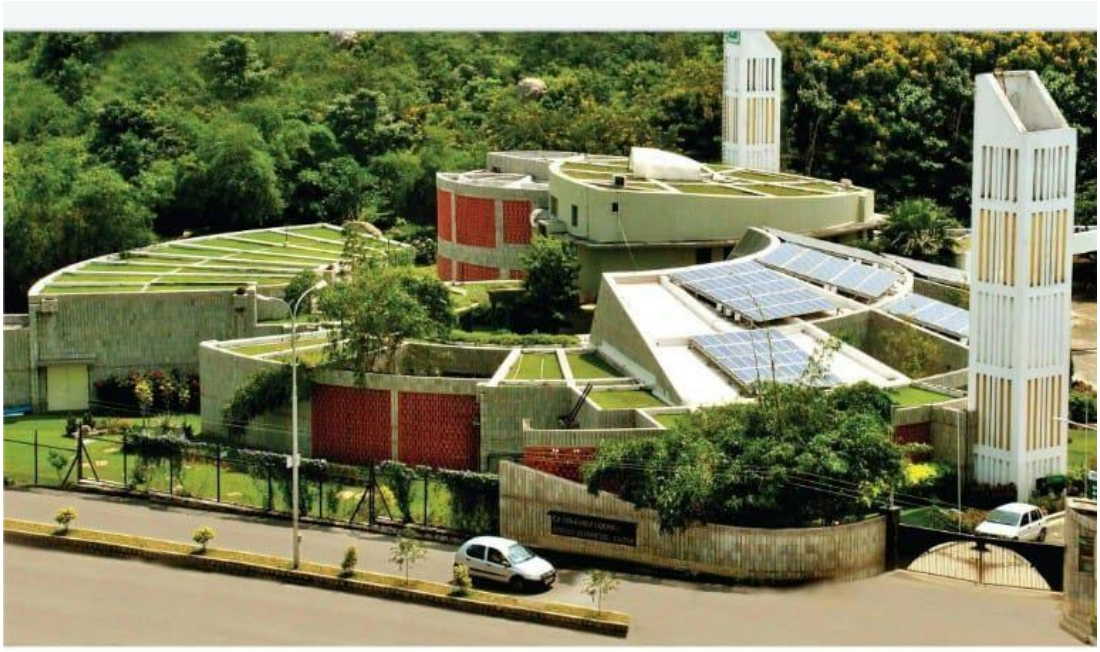


Fig. 4.1 CII- Sohrabji Godrej Green Building.

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 greenbuilding.

LEED certified buildings utilize less toxic materials, low-emitting adhesives & sealants, paints, carpets, and composite woods, and indoor chemical & pollutantsource control.

5. DESCRIPTION OF THE COLLEGE BUILDING

The college building is not just an architectural wonder but symbolizes a dream that lingers in every student‟s memory. It remains us the great minds that helpedto shape our visions of the world and how to navigate the challenges that lay ahead to carve out a meaningful career as a decent human being. Although a college is a society and not just a building, it must have a physical space of its own to carry out its work in a pleasant way.
The GIMT building is a five- story multi-tenant professional building. It was founded on 7th September 2006 as a first non-governmental engineering institute in Assam under the patronage of Srimanta Shankar Academy Society. The institute was established with approval from the All-India Council for Technical Education (AICTE), New Delhi and permission from the state government.
Initially GIMT was affiliated to the oldest and the most reputed university in thestate i.e., Guwahati University (GU). Under the policy to bring all the engineering colleges under the same umbrella, Assam Science and Technology University (ASTU) was established by Government of Assam and science August 2013, the institute has been affiliated to the university. The institute offers both under-graduate and post-graduate degree on engineering.
There are 120 well equipped lecture rooms, 50 faculty rooms and in each floor two separate set of restrooms are present. The floors are connected to each otherthrough stairs and elevators. There are 40 air-conditioner rooms and 25 well- furnished laboratory rooms are present in the building. The domicile is fully furnished with every kind of facilities followed by clean drinking water, hygienic restrooms, and an army of staff to maintain everything smoothly. It consists of well-resourced computer workroom consist of 100 functioning computers for better functionality of the resources. Additional 20 computers are present in each HOD‟s, facality‟s and principal office.

Each and every department consist of its own unique machinery and paraphernalia for smooth superintendency of the branch. The infrastructure of the college plays a vital role in development of the college as the students are mainly focused on the advanced labs, lecture halls, well-organized library etc., which psychologically attracts students to invest more time on such resources.

Each and every classroom is a smart class which include a projector and a screen for better learning of the students. Additional resources such as printers,projectors etc. are accessible to both students and facalities. The wireless internet connectivity is present round the campus for smooth running of each and every resource present.

Access to information is a vital key in developing the individual‟s potentiality. GIMT has provided a central library consisting number of volumes of books and adequate number of journals. All the latest editions of books both for reference and text are available in this library. It also subscribes to various newspaper and periodicals for the information and update of their knowledge. The journals of both national and international related to engineering and otherstuff are also subscribed.

The invention of information technology has provided a great gap in case of library automation services. The library is computerized with all the features oflibrary management system with central workshop.

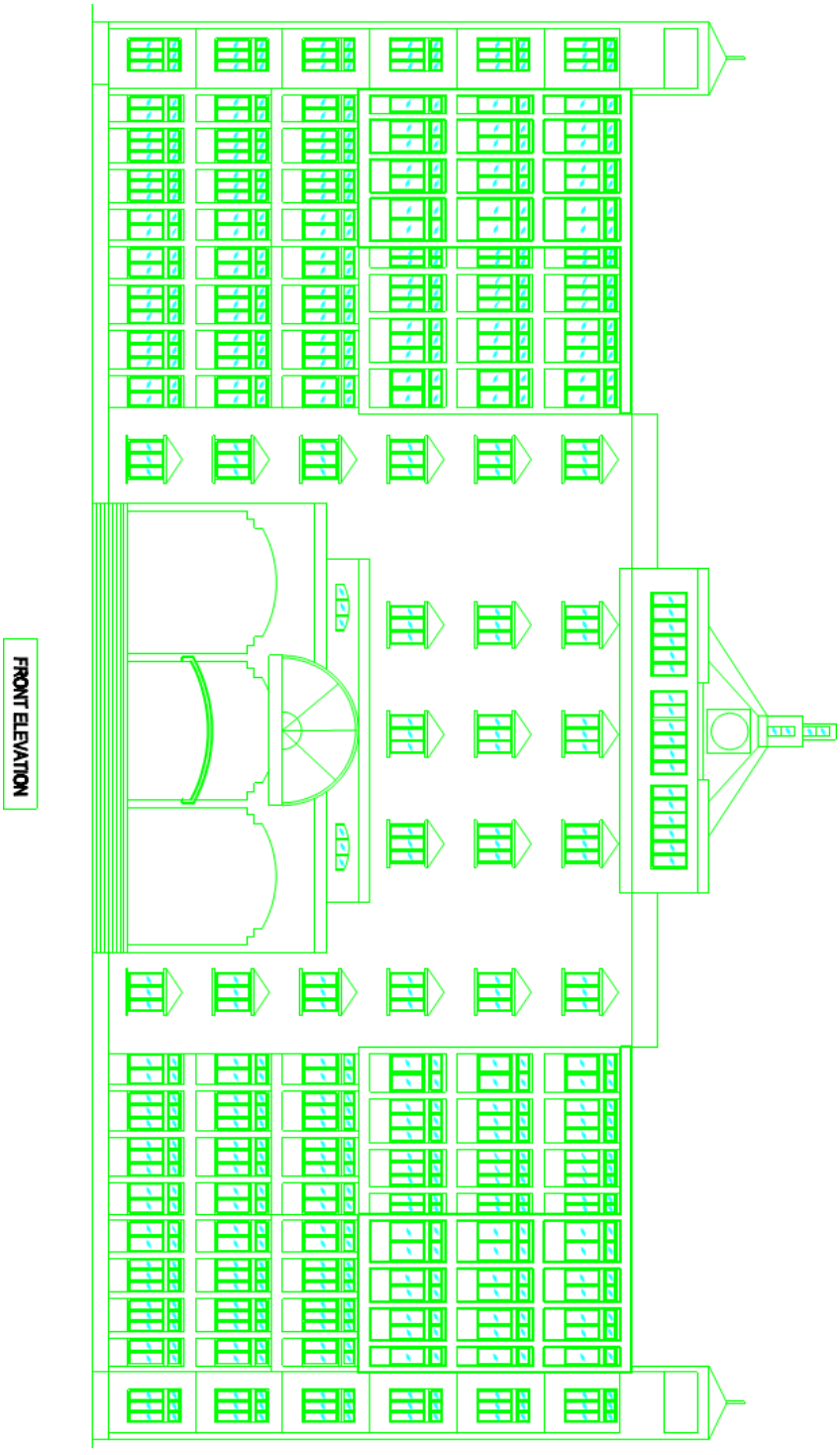
For maintaining each and every component of the building an army of staff ispresent round the clock to take care of everything for smooth running. A separate doctor chamber is also present in the college building itself with a pharmacy.

The college offers not only engineering program but also business administration followed by computer application, science and humanities.

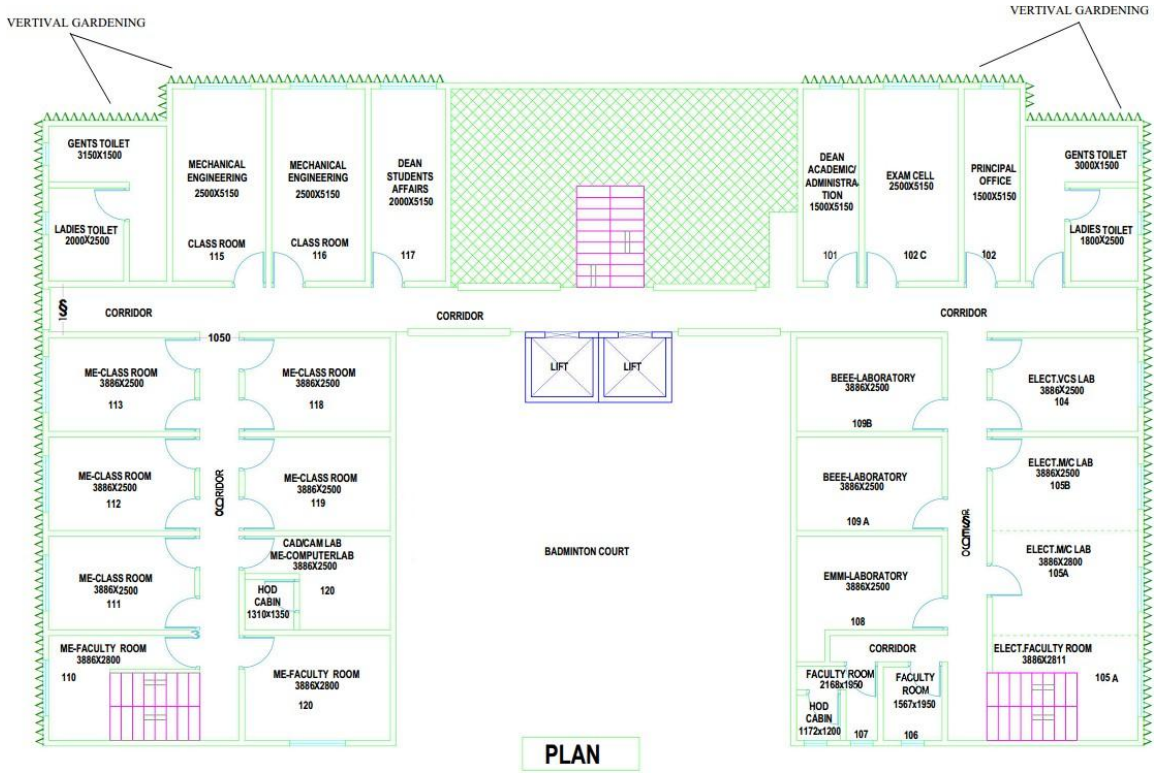
The college offers a placement cell, which is actively involved in building aninterface between academia and cooperate houses by organizing various seminars, pre-placement talks, workshops, training programs, etc.,

ARIAL VIEW OF THE COLLEGE CAMPUS

FRONT VIEW OF THE COLLEGE BUILDING



5. 3 PLAN VIEW OF A FLOOR OF THE COLLEGE BUILDING AFTER APPLYING VECTICAL GARDENING



6. COMPARISION OF THE COLLEGE BUILDING AND CONVERTING IT INTO AGREEN BUILDING

Estimated Data of the college building:
Number of total classrooms= 120 (ls)No of total faculty room= 50 (ls)
No of total lab= 30 (ls) Total no of lights= 1200 (ls)Total fan= 750 (ls)
Total desktop= 120

Energy consumed per day (Working hour)

- For fan,

1fan per hour energy consumed= 27 watt 230fan per hour energy consumed= 6216watt
230fan per day energy consumption (working hour) = 31.05kw

- For light,

1 light per hour energy consumed=10watt 250light per hour energy consumed=2500watt 250 light per day energy consumption=12.5kw

- For desktop

1 desktop per hour energy consumed= 60watt 70desktops per hour energy consumed=4200watt 70desktops per day energy consumed= 12.6kw

TOTAL ENERGY CONSUMED IN THE COLLEGE BUILDING PERDAY=56.15kwh

Calculations for College building when it converted into Green Building(Using Solar Panel)

- For fan,

1 fan per hour energy consumed= 15watt 230 fan per hour energy consumed=3450watt
230 fan per day energy consumed=17250watt

- For light,

1 light per hour energy consumed= 7watt

250 light per hour energy consumed= 1750watt250 light per day energy consumed= 8750watt

- For desktop,

1 desktop per hour energy consumed=35watt
70 desktop per hour energy consumed=2450watt
70 desktop per day energy consumed (working hour) =7.3kw

Total energy consumed in the college building per day=33.25kwh

- So, energy consumption per hour due to converting the college building into green building is 22.9kwh.

Energy consumption per month in the college building is 455kw. i.e., to provide 455kw per month that gets 5 hours of direct sunlight per day would require a 3- kW solar energy system. So, the no of solar panel needed is 14. Each panel will be about 1.8m*1m. Mechanical equipment‟s consumed an average of 15kw per day in the college building. By the use of solar panel, we can conclude that the energy consumption for the machines will be reduced to 10kw per day.

- Carbon footprint for the college building =455*24*0.21233kgCO2e/1000=2.3186 tCO2e.

Building accounts for nearly 40% of total energy usage worldwide and up to 38% of global CO_2 emissions green building uses 30% less energy than conventional buildings.

Energy efficiency is boosted by reducing the amount of air that escapes. Eco- friendly materials reduce VOC (volatile organic compound) emission. Currently buildings accounts for 35% of total energy consumption and growing at 8% annually.

WASTE WATER AND BIO-DEGRADABLE WASTER REUSE:

On an average basis, the waste water generated from the canteen, girls‟ and boys‟ hostel and college building are 1000 liters, 5000 liters, 5000 liters and 1000 liters respectively which is a huge amount. To use this waste water in aneffective way where we can reuse it for betterment of the environment.
For better use of waste water, we can implement the principle of three R‟s. The3R Initiative aims to promote the "**3Rs**" (reduce, reuse and recycle)

By reducing the amount of water get wasted in hostels and canteen to some extend we can step forward to a sustainable development.
By reusing the waste generated from them we can contribute a little to theenvironment.
And by recycling the waste in effective manner we can make the environmenteco-friendly.

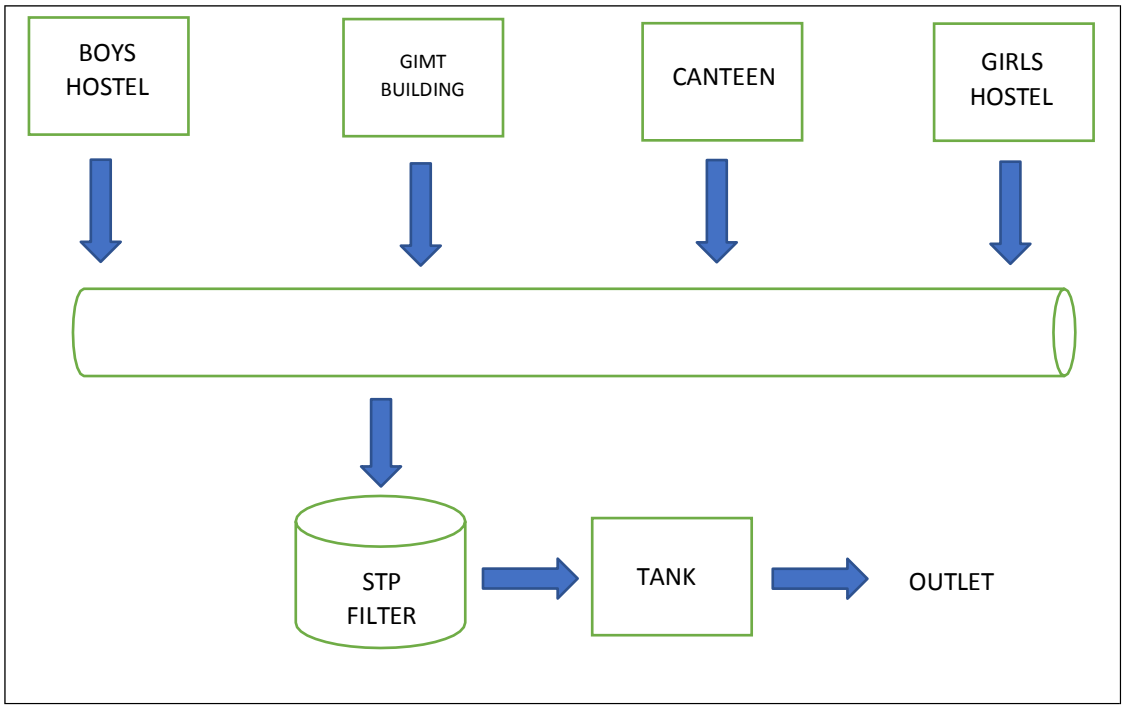


Fig.6.1 Waste water reusable process.

Furthermore, the waste generated from the college kitchen can be used to produce compost which can further be used in gardens of the college. The totalwaste generated from canteen is about 15-20 kg, which can be used as a fertilizer for the plants. Composting is the process that works to speed up the natural decay of organic materials by providing ideal conditions for detritus- eating organism to thrive. The end product of this concentrated decomposition process is nutrient rich soil that can help crops, garden plants and trees to grow.

Fig. 6.2 Mixed waste.

After the separation of mixed waste we dump the bio-degradable waste under the soil so that is starts composting.

Fig. 6.3 Bio-degradable waste in the process of composting

VERTICAL GARDENING AND GARDENING INCENTIVE:

A vertical garden keeps the building cool in summer and warm in winter thus providing a relief in saving electricity. It provides an aesthetic view and the main benefit of such garden is that it enables us to use maximize limited space and reclaim disregarded space. A green wall can transform empty space into aesthetically pleasing and creatively stimulating eye candy. The recent trend of vertical gardening is becoming increasingly wide spare as gardeners channel their inspiration to a new height of creativity. It is a great step towards green revolution in the environment. No longer limited to the ground underneath their feet, gardens are taking shape in a range of unique direction, from repurposing old furniture into planters to transforming birdhouses and teapots into thriving miniature garden spaces. The best plants for vertical gardening are bromeliads, sword fern, devil"s ivy, achiote, begonia, baby"s tear, pothos, succulents, elephant ear plant, lipstick plant, air plants (*Tillandsia*), wandering jew (*Tradescantia zebrina*), hosta (*Hostaceae*) etc.

Fig. 6.4 Vertical gardening in a building.

Plant walls break the dull monotony of concrete walls, add freshness andlightness despite space restrictions.
Outdoor Green wall will not only act as air filters but will also reduce the noisepollution by creating barriers for the noise around the surroundings.
The outdoor vertical garden creates a layer of protection on the building. Duringsummers it will absorb the heat

in the area giving you a cool environment. The Internal space between the building walls and green wall panels considerably reduces the overheating of the wall and reduces the temperature of the building.

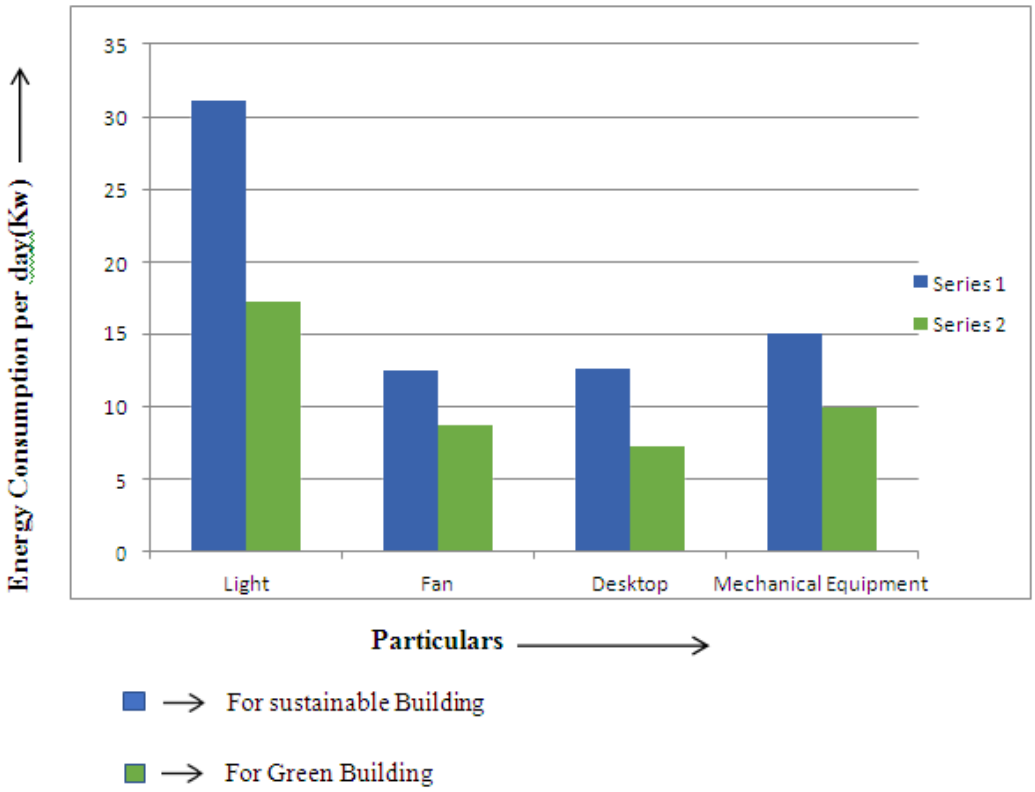
SOLAR ENERGY DECAY:

We can also use sun energy to catalyze fluorescence in the building. By enlarging the size of the windows and ventilators to penetrate the sunlight morein to the building to reduce the electricity consumption to some extent. The future of ecological sustainability in build environments relies on thoughtful development of eco-friendly and smart technologies for robust energy management. When basic maintenance is supported by network connected smart building systems, greater efficiency can be achieved without requiring a great deal of investment. Reducing electricity usages by installing more efficient lightning, including exterior solar power lightning, LED light bulbs to increase energy efficiency in green building. Automatically dimming of lights when natural light is sufficient or when building occupancy is limited helps to reduce energy use.

Fig. 6.5 Sunlight entering through a large ventilator.

The use of non-toxic materials, combined with natural ventilation and effectiveair filtration can improve indoor air quality, control indoor moisture levels.

6.1 GRAPHS OF ENERGY CONSUMPTION:



7. CONCLUSION

The philosophy of sustainable architecture is embodied in various practices that aim to reduce the negative impact of a building on its environment and to take care of the quality of life of users and neighboring communities. Its implementation results in a set of choices of techniques, management methods, materials and internal organization of functions and spaces, in order to control energy consumption and the living environment of users.

The main objective of the current study was to reduce the development footprint in buildings by the development of Green Construction Schemes. Various methods to reduce the footprint were devised and the development footprint has been reduced to an appreciable extent. Green buildings can significantly reduce carbon emissions from space heating and cooling and power more appliances and appliances. Green building is a vital step towards a healthy, sustainablebuilt environment.

The projects aim to protect the biodiversity and ecosystem of the environment in such a way that by incorporating more greenery around the places whichhelps to reduce the carbon emission to some extent. Green building resembles saving and reducing water and energy wastage. With proper management waste water can be well maintained into other resources and re-using it for sustainable development. A vertical gardening keeps the building cool in summer and warmin winter and thus saving a part of electricity wastage. Daylight design reduces a building's electrical needs and improves people's health and productivity. Appliances and renewable energy technologies such as wind turbines and solar panels Reduction of water consumption is achieved by installing collection systems that recycle water for irrigation or toilet drainage; water-saving appliances, such as low-flow showerheads, self-closing faucets, or sprayers; low-flow toilets or waterless composting toilets. Installing point-of-use hot water systems and delayed pipes saves money on water heating. Old technologyis gaining popularity in a new way. Sanitary components of the green building: the use of non-toxic materials and products will improve indoor air quality and reduce the rate of asthma, allergies and sick building syndrome. These materialsare emission-free, have low or zero VOC content and are moisture resistant to deter mold, spores and other microbes. Indoor air quality also depends onventilation systems and materials that control humidity and allow a building to breathe.

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