

Green Buildings: The Need of The Hour

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Abstract- Buildings not only provide us shelter but also protect us from nature's extremes. However, the buildings have adverse effects on human health and the environment during their life cycle. As the environmental issues are gaining importance, the concept of green building design is also gaining momentum. Green buildings are those structures that make use of processes which are environmentally accountable and resource economical throughout a building's life cycle. Selection of the right materials can make a significant contribution to the reduction of the greenhouse gases and the use of energy without adding any significant costs to the construction of the building. The construction of conventional buildings involves usage of energy generated by burning of fossil fuels. Thus, there is an urgent need to replenish and conserve our natural resources. Green building concept is to increase the efficiency of resource utilization such as energy, water and building materials and to minimize the impact of buildings on the environment and human health. The purpose of the paper is to explore the concept of green building, its benefits and how it will be a step forward in contributing to sustainable construction, ensuring protection of the surrounding environment and conservation of natural resources. Furthermore, the paper will look into numerous green methods available to develop a green building and the adaptability to the concept.

Keywords- CO2 Emissions, Fossil Fuels, Green Buildings, Greenhouse Gases, Renewable Resources, Sustainability

I. INTRODUCTION

With urbanization and increasing population, the buildings contribute to one-third of the overall energy used. Being part of a growing society, it is our duty to conserve the natural resources for the future generations. Green buildings are planned structures that consume less energy, use sustainable materials and make optimum use of renewable energy resources like solar energy and wind energy. This not only aids in environment preservation but also provides healthy living conditions to the inhabitants.

The US Environmental Protection Agency defines sustainability as the principle where "humans depend on the

natural environment for survival and well-being, and that humans and nature can exist in productive harmony" [1].

Buildings provide multiple advantages to the society such as a place to stay or work, multiple jobs in the construction industry and contributing towards the economy. But they also have considerable amounts of negative impacts on human health and the environment as a whole. The built environment impacts our health through various factors such as inadequate ventilation, poor lighting or material compositions. According to studies, people tend to spend 90 percent of their life indoors [2]. Building's material contributes to indoor air pollution on various levels through either the materials used or its application [3]. For example, studies conclude that particular types of granite used on the floors and stairs increase chances of lung cancer due to the excessive radon they release. Radon is a radioactive gas that gets accumulated in confined areas of the building due to poor ventilation. Materials such as plywood, fiberboard and particle board constitute of phenol formaldehyde adhesives which can lead to respiratory track disorders [4].

Negative impacts of the building and construction industry play a huge part in the environmental perspective also, along with these human health consequences. Climate change poses a threat not only to human health but to mankind as a whole. Rapid urbanization and overpopulation have paved the way for global warming. Earth receives radiations from the sun of which some are absorbed, and some are reflected back. The greenhouse gases like Carbondioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O), Chlorofluorocarbons (CF₄), and Ozone (O₃) absorb the sun radiations which are reflected back. This results in trapping of heat on the Earth resulting in the rise in temperature of Earth's atmosphere and warmer climate. This is known as global warming. Figure 1 shows the percentage of greenhouse gas emissions.

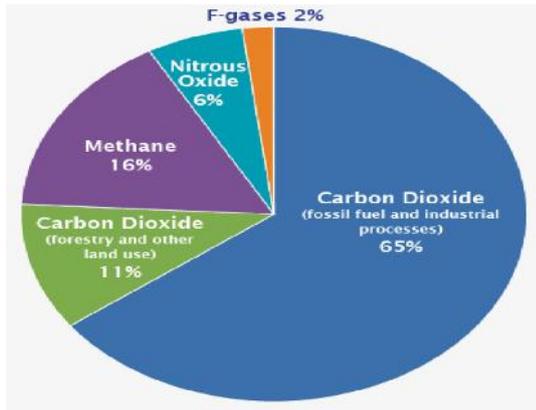
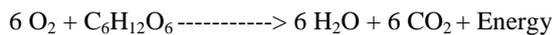


Figure 1: Greenhouse Gas Emissions

Buildings are responsible for producing greenhouse gasses which trap the heat radiating from Earth leading to warming of the climate. Construction of buildings, operation and maintenance consume 15% of the total freshwater resources, 40% of the total energy and produces 30% of the world’s greenhouse gas emissions [5]. According to reports, the greenhouse gas concentrations will double surpassing that of the “pre-industrial times” by 2035, which will subject the Earth to an average rise of the temperature by over 2 degrees Celsius [6]. Greenhouse gas emissions produced by the buildings are majorly from the consumption of fossil fuel-based energy, both directly and indirectly through electricity generated by this [7]. These CO₂ emissions are also created through construction materials such as insulation materials, refrigeration and cooling systems [8]. The following equation describes the process of combustion or burning of fossil fuels with emission of CO₂:



Cement is a significant construction element; however, its production makes 2.4% of global CO₂ emissions from industrial and energy uses. Cement manufacturing is extremely energy demanding because extreme heat conditions are required to make it [9]. Hence, the responsibility of reducing the greenhouse gas emissions also lies with the building sector.

Responding to climate change reflects the fierce urgency of today. Thus, improvement of the traditional existing and new buildings is a priority in not only tackling the issue of climate change but also for enhancing public health. Sustainable architecture or “green” building strategy is a medium to achieve a solution for this and maintain “productive harmony” among humans and nature.

II. GREEN BUILDING AND ITS BENEFITS

What is a green building? According to the World Green Building Council, a green building is a building that “in its design, construction or operation, reduces or eliminates negative impacts on our climate and natural environment” [10]. Green building is a combined effort of all stake holders such as the Architects, the engineers and the interior designers. It reduces the negative effects of the building for its entire life cycle, that is starting from planning, design, construction, operation and maintenance till even demolition [11].

The benefits of green building can be categorized into environmental, economic and social [12] [Figure 2]. Social benefits such as better indoor environment quality leads to improved public health and higher productivity. Economic benefits include lower operating and maintenance costs due to more efficient utilities, higher property value and lower life cycle costs. Environmental benefits include protecting flora and fauna, reducing if not eliminating pollution, avoiding extra waste production and preventing depletion of natural resources [13]. Achieving these three goals of sustainability defines a green building.

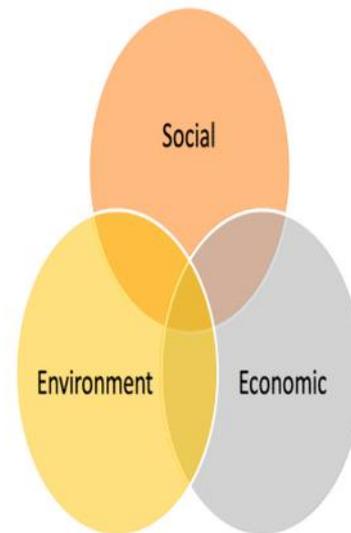


Figure 2: Benefits of Green Building

Indian Green Building Council (IGBC) certified buildings result in 40-50% more total energy savings and 20-30 % more total water savings as compared to conventional buildings in India [14]. They also produce 33% less greenhouse gas emissions in comparison to the conventional buildings [15].

Site selection in sustainable practices considers factors like community, connectivity, accessibility to mass transit, parking, land remediation, waste and pollution

reduction from construction activities as well as water and energy efficient systems [16]. The only disadvantage of green buildings is the initial cost which is 2% more than the traditional building design but return is 10 times more over the whole life cycle of the building [17].

Green building techniques use sustainable materials which produce less pollution and waste during manufacturing and construction. Natural raw materials are less toxic as compared to artificial materials with higher recyclability and biodegradability rate making them sustainable [18]. Examples of sustainable building materials include rammed earth which is a mixture of gravel, clay, sand, cement and waterproofing additives and contributes in building energy consumption and thermal comfort [19]. Another example is triple glazed windows where the three-layer glass acts as better insulation and avoids air infiltration, keeping the building warm in winters and cool in summers [20]. In addition to these, there are many other emerging low carbon products available and under development.

Furthermore, green buildings use an integrated project delivery method which in contrast to the traditional building design project delivery method promotes the collaboration among key stakeholders and design professionals at the early design stage itself and set sustainability goals [21].

III. GREEN METHODS

The methods or techniques that help to make a building green are called green methods. There exist numerous green methods that can be adopted ranging from structural and electrical techniques to special systems [22].

A. Structural Techniques

Some of the structural techniques include

1. Insulated walls: In order to reduce energy consumption by air conditioners.
2. Green cement: It is made using fly ash and other eco-friendly materials.
3. Transparent roof: It helps to ensure sustainable lighting and reduces the energy consumption.
4. Green paints: Paints emit harmful chemicals deteriorating the indoor air quality. Green paints are free of volatile organic compounds (VOCs) like benzene and toluene and lead resulting in less exposure to toxics.
5. Green Roof: Growing a vegetative layer on the rooftop helps in natural insulation.

B. Electrical Techniques

Furthermore, electrical techniques comprise optimum use of natural light, use of LEDs and energy conserving appliances. Instead of burning of fossil fuels, renewable resources should be used to generate energy like solar energy, wind energy and biomass energy. These days, solar panels can be easily installed on the rooftops of the buildings. This reduces the emission of greenhouse gases.

C. Special Techniques

Lastly, some of the special techniques that can be used are:

1. Rain Water Harvesting: The designing of the rooftop must be such that it ensures proper collection of rainwater for future utilization.
2. Grey Water Management: All the wastewaters from the building except from the toilets can be treated, recycled and utilized in the toilets and for irrigation.
3. Afforestation: It involves planting of deciduous trees surrounding the building. During winters, they shed their leaves allowing sunlight to enter the building whereas in summers they provide shade and help in natural insulation.

There are various green building rating systems in the world. The aim is to encourage building owners to make use of green building designs which are environment friendly. In India, Green Rating for Integrated Habitat Assessment (GRIHA) is the green rating system developed by TERI. There are 34 criteria that have been allotted 104 points for the evaluation of a building [23].

IV. ADAPTABILITY

The World Green Building Council (GBC) in September 2019 came out with a vision entailing how buildings can decarbonize the infrastructure sector by eliminating the embodied carbon emissions. Adoption of the green building strategies, the global infrastructure can contribute approximately 40% less to the carbon emissions by 2030 and 100% zero emissions building by 2050 [24]. The World Green Building Council (GBC) has set up certain guidelines that the architects, designers, manufacturers, investors and government should follow in order to accelerate the decarbonization. The manufacturing companies are also adopting strategies to achieve zero carbon goals. For instance, Dalmia Bharat Cement has committed to become carbon negative by 2040 [25]. A commitment has been made by the residents of Oslo to use fossil free fuel [26].

In developing countries like India, the speed of rapid urbanization has an adverse effect on our ecosystem. The heavy construction consumes massive green area which further leads to environmental degradation, resource depletion and climate change. Though the concept of 'green building' is relatively new, it has been taken positively all over the globe as we have reached a stage where it has become imperative to not only protect the environment but also the control the increasing health issues. Over the years, the benefits of using sustainable and eco-friendly products has prompted the manufacturers as well as the consumers to switch to such items. Despite adoption of green buildings, it will take time for acceptance on a large scale as the cost of green building is relatively high. However, it must be noted that in the long run, the returns are much higher in comparison to a regular structure. As a result, green buildings must be encouraged. According to The Energy and Resource Institute (TERI), if all the Indian buildings adopt the concept of green buildings, India could save 8400 megawatts of power which can light approximately 5,50,000 homes in a year [27]. In order to increase the adaption to such a concept, apart from spreading awareness about it and its benefits, incentives must also be provided. Especially in a country like India, the government must provide tax benefits, rebates and subsidy to those creating green buildings and adopting green methods.

V. CONCLUSION

Adaptation of sustainable architecture and green building techniques is beneficial not only for healthy living but for the environment as well. As cities get bigger and population increases, more buildings are built. Changing and modifying the way we design and maintain the built environment is essential if we want to make a remaining impact. Consumer awareness towards conservation of the environment has a great impact on the adaptation of the concept of green buildings. Despite the acceptance of sustainable living, the use of eco-friendly and green products in the construction sector will take time. Expensive initial cost and the rare availability of sustainable building materials has posed a great challenge for the consumers and investors to invest in. Irrespective of such problems, no one can deny that green buildings are the need of the hour. The concept of green building is the logical step to address the growing sustainability concern. This approach enables us to use all-natural resources in an optimum manner thus reducing the negative impact on the environment and our health.

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