

Practicing Green Building Techniques in Reducing Greenhouse Gases: An Overview

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Abstract: The large amount of greenhouse gasses is emitted during the process of manufacturing, transporting of a building material, constructing and erection of buildings that have a very huge impact on the environment and wellbeing. Practicing Green building techniques will reduce and eliminate the impacts on the environment and human health. Sustainable green architecture philosophy and design will maintain harmony with the nature and conserve nature resources in and around the site. There are several methods in designing of sustainable buildings that including 'green' building materials from local sources, reducing HVAC loads, optimizing systems, and generate on-site water and energy harvesting. This paper overviews reduction of possible GHG produced during process of building construction.

Keywords: Green Building; Greenhouse gases; environment and human health

I. INTRODUCTION

Climate change has caused in release of greenhouse gases into the atmosphere with a great threats to the 21st century. Construction industry being one of the largest primary energy consumers, it makes a significant impact on energy use and degradation of environment. Construction of buildings, its operation and deconstruction consumes world's freshwater resources (15%), worlds all energy (40%), moreover it produces 30% of the world's greenhouse gas emissions [1]. A Compound Annual Growth Rate (CAGR) of Indian construction sector 9.6% during the period 2016-2020 is forecasting by the Global Market [2]. Indian construction sector is one of the top 10 spending nations in the world with an estimated assessment of \$100 billion during 2012-17 [3]. It is also estimated India to be 3rd largest global construction market [4]. As a result government, private and foreign direct and indirect investment have made India number one of the top ten spending nations on construction in the world [5]. A recent report estimates that India will be the third largest global construction market after China and USA (Fig: 1). In order to improve the standard living conditions, India has to overcome the challenge of infrastructure. Eight percent of the gross domestic product (GDP) is spent on infrastructure projects by India's government. The 13th Five year plan (2017-2022) projects have an investment of 10% of the national GDP into infrastructure which is a staggering \$1 trillion [3]. In the recent times concerns towards increasing renewable energy production and reducing Greenhouse Gas has gained momentum with a backdrop of the committed governments across the globe in response to International treaties such as the Kyoto Protocol Treaty, Basel Convention and the Rio Declaration have compelled leading industrial countries to form environmental rules and regulations.

II. THE CONTRIBUTION OF BUILDINGS TO CLIMATE CHANGE

World studies have acknowledged that the buildings are major attributors for all energy-related CO₂ emissions worldwide and these emissions are expected to grow to 11Gt (B2 scenario) or 15.6Gt (A1B scenario) by 2030 [6]. Greenhouse gas emissions (GHG) from buildings primarily arise from their consumption of fossil-fuel based energy, both through the direct use of fossil fuels and use of electricity which has been generated from fossil fuels. The primary demand of the building sector is the consumption of energy which increases the CO₂ emission [4]. Nowadays, buildings are responsible for use of more than 40 percent of the global energy and release of one-third of global GHG emissions in both developed and developing countries. Inter-governmental Panel on Climate Change (IPCC) has estimated on building-related GHG emissions are around 8.6 million metric tons CO₂ eqv in 2004 [7]. The growth rate of carbon dioxide emissions recorded between year 1971 and 2004 through use of electricity in commercial buildings estimated as 2.5% per annum whereas for residential buildings is 1.7%. In this process, GHG emissions are also generated through construction materials, in particular, insulation materials, refrigeration and cooling systems. Generally, energy is consumed during manufacturing of building materials; transport of materials from production plants to building sites; construction and operation of the buildings; and demolition of the buildings (Fig:1). As a result, the largest responsibility lies with the building sector in reducing the greenhouse gas emission compared to the other major emitting sections.

If energy reduction methods adopted in both new and existing buildings with commercially available technologies then the savings will be achieved during its lifespan of the building as estimated is 30% to 80% [1]

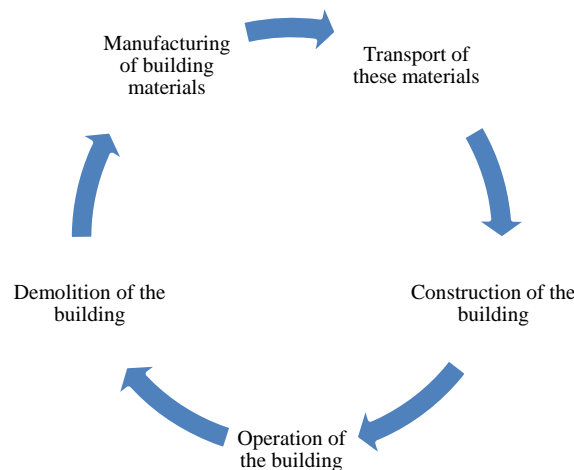


Fig. 1: Greenhouse Gas emission life cycle

A study reveals that over 80 percent of the GHG emissions released during the operational phase of a building. Although these figures may vary from building to building to meet various energy needs such as heating, ventilation, air-conditioning, lighting, heating, telecommunication and entertainment. Material manufacturing and transport sector generally contribute a very smaller percentage of 10 to 20 percent of energy consumed in addition to construction, maintenance, and demolition [*loc.cit*]. The greatest reduction in GHG emission can, therefore, be achieved by targeting the operational phase of building by any government.

The United States Environmental Protection Agency and the United States Green Building Council (USGBC) opined that the construction and operation of the buildings consumes 72 percent of electricity resources; 39 percent of total energy used; 17 percent fresh water flows and raw materials. In addition, it generates municipal solid waste 25% to 40%; chlorofluorocarbons 50%; CO₂ emission 35% and other air emissions and water discharge [8].

III. THE GREEN BUILDINGS

The construction processes of the building to be energy and resource efficient and throughout life cycle, it must be an environmentally friendly and have no negative impacts on the health and well-being of its workers during the construction and the occupants from operation, maintenance and renovation of structure(s) are known as Green building. Green buildings use natural resources efficiently and less in quantity and reduce wastage, this leads to lower both utility bills and impact on the environment. Eco-construction also referred to as sustainable construction or green building, proposes various possibilities of reducing the environmental impact of building. Green building is not a specific construction method, but it brings together a set of techniques, materials and technologies which when suitably integrated in a construction project, contribute to enhancing its environmental performance. Moreover, it optimizes energy efficiency, limits water consumption, and makes maximum use of recycled, recyclable and non-toxic materials.

Green building's structural interpretation processes respect the environment and make use of resources efficiently. This practice is complementing the conventional concerns of designing of buildings that are economical in energy, sustainable and comfortable. Moreover less, a green building is designed to reduce the overall impact of the built-up environment on human health and the natural environment, through the efficient use of energy, water and other resources; protecting occupant health and improving employee productivity; and reducing waste, pollution and harm to the environment. A green building can incorporate sustainable materials (reuse, recycled, recyclable, or from renewable resources) in its construction effectively, create a healthy interior environment with a minimum of pollutants and functional landscape planning that requires less water.

The green buildings benefits in reduction of energy consumption to 30 to 40%; use of decreased natural resources; protect existing natural spaces, enhance existing ecology; reduce 30% of water consumption; 33 percent lesser greenhouse gas emissions; improves in indoor air quality; reduced volumes of solid waste by 50 percent; reduce material use and allow to use low-impact materials; and reduce use of high-energy material in interiors.[9]

IV. GREEN BUILDING ASSESSMENT PRACTICES

The international and national agencies like Leadership in Energy and Environmental Design (LEED-India), Indian Green building Council (IGBC) and Green Rating for Integrated Habitat Assessment (GRIHA) are Green building assessing agencies in India to promote construction of green buildings with a view to reducing the carbon footprint by optimizing energy utilization, environmentally friendly designs, using locally available material and recycling and has set for itself a target of creating 10 billion sq ft of certified green space by 2022 as kept by IGBC. Henceforth, this provides good sunlight, better insulation, fresh air, less exposure to outdoors and more exposure to shaded areas are needed to make green homes and generated waste should be sorted out for recycling or converted into energy is the main motto of this assessment and rating system. This programme resulted around 4077 projects registered with IGBC, built over 4.53 billion sq ft and 1.18 billion sq. ft with 900 registered projects under GRIHA, the country's green building footprint has emerged as the second largest in the world, and going by the trend in the last three years and will grow by 30percent in the next three years [10].

V. CHALLENGES

The concept of environmental effectiveness is important aspect to mitigate GHG. A policy is needed to reduce rather than displace emissions, as leakage of carbon or other GHG will have no global benefits. Reducing energy demand in designing of green buildings will play a key role in the building sector while choosing good energy sources. The right policies are to be designed to cater in for the reduction of carbon emissions in the building sector. The governments should target for reducing GHG emissions from buildings in respective countries by increase the energy efficiency through energy systems for heating, ventilation and other appliances in new and existing buildings; Increase the energy efficiency of appliances; encourage energy and distribution companies to support emission reductions in the building sector; change attitudes and behavior and substitute fossil fuels with renewable energy.

VI. CONCLUSION

Built environment is contributor of one third of total global greenhouse gas emissions and has a larger impact on the natural resource. Adaptation of sustainable building concepts and techniques is largely benefits on eco-efficiency and healthy living. It should be noted that simply reducing negative impacts by a certain percentage is not going to solve the world's GHG problems; though it can certainly help if it becomes standard practice by all stakeholders. This includes moving towards true sustainability by utilizing holistic measures. The buildings bring together a lot of techniques and practices to eliminate and reduce the impact of buildings on human health and environment as the result show most of the greenhouse gas emission that amount from 82 to 87 percent while 6 to 8 percent are from transportation of building materials and energy consumption of construction equipment amounts to 6 to 8 percent. Green buildings bring together a vast array of practices and techniques to reduce and ultimately eliminate the impacts of buildings on the environment and human health. Reforms in emissions of local pollutants and arrest the deterioration in air quality is one of the major effort to be tackled. The barriers such as lack of stringent regulations and political will; business case and financing; lack of awareness and familiarity for design professionals; difficulty in finding trained contractors; insufficient knowledge base; lack of suitable variety and competitive market for high performance products; lack of awareness of passive design and benefits; lack of experts capable of doing quality assurance; high initial cost; product information and sourcing; lack of client knowledge and absence of compulsory standards or guidelines shall overcome for greenhouse gas emissions free environment.

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