Role of Green Buildings in Sustainable Environmental Management – A Review

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ABSTRACT

Since the 21st century, the concept of green building has been gradually popularized and implemented in more countries, which has become a popular direction in the area of sustainability in the building industry [1]. The real-estate and construction sector has been identified as an energy-intensive sector, with a global share of 32% of total energy usage. As a result, 19% of global greenhouse gas emissions can be attributed to the sector. Greenhouse gas emissions have an effect on global climate, resulting in increasing temperatures, higher sea levels, and shrinking artic sea-ice. However, this process can be mitigated and the real-estate and construction sector can be a great contributor to this endeavor, as energy savings in the range of 50–90% are possible to achieve using today's best [9]. The aim of this paper is to study the role of green buildings in environmental management through green/energy-efficient buildings and retrofits from economic, environmental and social perspective.

Key words: Green Buildings, green house gas emissions, environmental management, energy-efficient buildings

Introduction:

The beginning of the twenty-first century has ushered in the era of green buildings. According to some estimates, there are approximately 81 million buildings in the United States [17]. Waste in their construction and operation, and emit large quantities of pollutants and Greenhouse gases in to the environment. In contrast to conventional buildings, green buildings seek to use land and energy efficiently, conserve water and other resources, improve indoor and

outdoor air quality, and increase the use of recycled and renewable materials. While green buildings still constitute a tiny subset of existing buildings, their numbers are increasing rapidly.

With the rapid development of the economy and society, the shortage of energy and the deterioration of environment have become two major problems faced by human beings in today's society. At present, the building industry is the leading source of consumption of world energy sources and various kinds of resources like ores, wood, and so on, as well as the major source of environmental pollution [2]. Green buildings can make significant contributions to solving energy and atmosphere challenges and will require an increasingly knowledgeable workforce to design, build, and maintain.

The definition of a green building is constantly evolving, as per the Office of the Federal Environmental Executive offers, defines green buildings as follows: (1) increasing the efficiency with which buildings and their sites use energy, water, and materials, and (2) reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal—the complete building life cycle.

As per the Environmental Protection Agency (EPA), 'T he 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'.

In the context of green buildings, LCA evaluates building materials over the course of their entire lives and takes into account a full range of environmental impacts, including a material's embodied energy; the solid waste generated in its extraction, use, and disposal; the air and water pollution associated with it; and its global-warming potential.

Conventional Buildings:

A conventional building is a building constructed in accordance with the regular building code in a specific country during a particular time period [10]. The synonym “brown building” is also occasionally used.

Conventional buildings use large amounts of energy, land, water, and raw materials for their construction and operation. They are responsible for large greenhouse gas (GHG) emissions as well as emissions of other harmful air pollutants. They also generate large amounts of construction and demolition (C&D) waste and have serious impacts on plants and wildlife.

According to The United Nations Environment Programme has reported that 30–40 percent of all primary energy produced worldwide is used in buildings. In 2008, the International Energy Agency released a publication that estimated that existing buildings are responsible for more than 40 percent of the world’s total primary energy consumption and for 24 percent of global CO2 emissions. In 2004, EPA found that buildings account for 39 percent of total energy use and 68 percent of total electrical consumption.

Green House Gas Emissions and Indoor Air Pollution:

Greenhouse gases are not the only harmful pollutants that buildings emit. Indoor levels of air pollution may greatly exceed outdoor levels. Indoor air pollution is particularly important given that we spend most of our time indoors. The EPA has estimated that indoor levels of pollution may be two to five times higher, and occasionally more than 100 times higher, than outdoor air pollution levels. This pollution can come from a wide variety of sources.

One way to reduce the presence of these toxins is to ensure that indoor air is frequently replaced by outdoor air and to ensure that this outdoor air is properly filtered. Unfortunately, buildings are often poorly ventilated and do not sufficiently filter the air that is re circulated, leading to air that is potentially harmful to building occupants’ health.

Green Buildings:

A primary consideration of green buildings is the health and well-being of their occupants. Many older buildings suffer from what is commonly referred to as "sick building syndrome." The important step in eliminating the cause of sick building syndrome is building's design, construction, materials used in the building. Green buildings are typically designed to provide adequate ventilation of air into them as well as filtration of this air to remove hazardous particles. Ventilation provides for the dilution of indoor air pollutants. Building ventilation can be done by natural or mechanical means.

Construction materials and interior finish products should be chosen that emit zero or low levels of volatile organic compounds (VOCs), which are harmful to humans and can vaporize at room temperature in a process called "off-gassing." Air moves into and out of naturally ventilated buildings through windows, doors, vents, and other openings incorporated into the building design. Wastewater from buildings typically goes into municipal sewer systems rather than being treated on-site or used for non-potable purposes. Buildings also usually displace vegetation that can capture and absorb precipitation. The net result is that municipal sewer systems are often overburdened. During rainfall events, billions of gallons of water flow into these sewer systems as runoff, carrying contaminants with them.

Energy efficient / low-energy Buildings:

"Energy-efficient building" or "Low-energy building" refer to the building's energy performance. These terms put an emphasis on the building's envelope and its technical installations, underlining thermal insulation, energy-efficient windows, and technical schemes (e.g., a heat-recovery ventilation system, solar panels, etc.). Also, in order to provide good indoor comfort, a proper ventilation scheme must be installed [11] [12]. Energy efficiency and the eco-friendly nature of green buildings play a vital role in environmental management. The utilization of new technologies in construction will result in more effective building with green rating. In these days of progress and development buildings are the largest consumers of water, energy and materials. The concept of green buildings encourages use of alternate energy, and recycling.

Green buildings save water, energy and material as compared to the conventional buildings. In green buildings there are great thermal insulations, opportunities for rain water harvesting, arrangement for terrace gardening with ventilation and energy efficient appliances.

Green building consumes less water and boosts energy efficiency. It conserves natural resources, produces minimal waste and provides healthier environment for residents as compared to a conventional building. Green building design comprises site planning, design of building envelope, building design with HVAC i.e. heating ventilation and air conditioning, lighting and water heating. Green buildings also integrate alternate energy sources to produce energy onsite with well balanced water and waste management. The selection of eco-friendly materials with recycling facility is another important factor which increases the building's environmentally friendly nature. The indoor environmental arrangement with better thermal quality, nice visual comfort and excellent air quality are maintained [13].

On average, green buildings use less energy than conventional buildings, energy efficiency remains elusive. There are numerous ways to improve a building's energy efficiency, from insulating walls to installing automatic shutoff switches for lights. Energy efficiency can be and often is mandated by local and state energy codes, which require that new and substantially renovated buildings comply with increasingly stringent energy efficiency requirements. Some people prefer to use the term "high performance building" in place of green buildings. A high-performance building is a building whose energy efficiency and environmental performance is substantially better than standard practice. Improving the energy efficiency of existing buildings typically involves a process called retrofitting, which can mean anything from installing more energy-efficient fixtures to increasing the amount of insulation in a building.

Energy/Electricity:

There are many ways to improve a building's energy efficiency. Simple measures such as weather stripping, maintaining entry door closers, and installing storm windows as a low-cost alternative to replacements are usually the low-hanging fruit in weatherization, adding insulation materials to new and existing frame construction buildings is a proven and relatively inexpensive way to improve building energy efficiency with respect to heating and cooling. Insulation can

reduce the energy used in manufacturing insulation and allow insulation to be recycled or biodegradable. Mineral, fibrous, and cellulose-derived materials are now available for insulation purposes.

Green building uses lesser electricity as compared to conventional buildings. This is basically because they depend on passive structural interventions in the design of the building and greatly efficient materials and technologies in the architectural framework. Green building also comprises on-site energy production with the help of renewable energy to meet the energy demand.

Water Use and Conservation:

Green buildings use lesser water as compared to normal buildings. By implementing ultra-low-flow fixtures, dual plumbing design and opportunities for rain water harvesting. Green building not only minimizes the requirement for water use but also offers on-site supply facilities to meet the water demand. Green buildings produce little waste by implementing waste management techniques on site. They also utilize waste to energy or waste to resources procedures to reduce the load on municipal waste management strategies and other harmful techniques [14].

There are many strategies for conserving water in buildings, as well as reducing the amount of wastewater that ultimately flows into sewer systems. One of the primary uses of water in a building is for toilets, sinks, showers, and similar uses. The byproduct of these uses is wastewater. Reducing the amount of wastewater in a building chiefly depends on a change in the occupants' water usage patterns—namely, the amount of water that is used for things like flushing toilets and urinals. Improved technology and fixture changes, such as low-flow fixtures on faucets and showerheads, can reduce the consumption of water per use. Bathrooms can be installed or retrofitted with low-flow or waterless urinals and toilets that use considerably less water for flushing. Dual-flush toilets that use less water for liquid than solid waste are also available.

Water-related problem in buildings is storm water runoff. Most of the buildings exacerbate this runoff because they reduce the amount of porous surface available to absorb precipitation. However, runoff from roofs, paved areas, or other impervious surfaces can be put to beneficial use. Buildings and landscapes can be designed to maximize the amount of catchment area, and water can be collected in cisterns, barrels, or swales. The collected water can be detained, retained, and routed for use in building evaporative coolers and toilets, and for irrigation purposes.

"Gray water" can also be used in building operations. Gray water is water drained from baths, showers, washing machines, and sinks that can be captured and used again. Gray water can be collected and reused for irrigating landscapes. Gray water may actually benefit plants because it often contains nutrients such as phosphorus. A dual plumbing system is necessary for recycling gray water within a building. Dual-plumbing systems have separate lines for fresh, gray, and black water, which, because of the added cost, could make this impractical in some buildings. Gray water systems vary from simple, low-cost systems to highly complex ones that include settling tanks and sand filters.

HVAC System:

Building's heating, ventilation, and air-conditioning (HVAC) system is a another large user of energy. Properly designed and installed HVAC systems can reduce the amount of energy used for heating and cooling a building. An HVAC system includes a heater, air conditioner, and fan in one system and operates at a partial load nearly all the time. The design of the HVAC system as a whole-system mechanism saves energy by monitoring airflow and keeping the indoor temperature fairly constant. An HVAC system must have a correctly designed distribution system to minimize the amount of airflow (and thus energy) necessary to heat and cool the building.

Electric lighting consumes about one-quarter to one-third of the energy in a typical commercial building. Lighting also generates heat, so reducing the amount of energy consumed for lighting through effective and efficient lighting also reduces the size of a building's air-conditioning plant.

Land Use and Consumption:

Many millions of acres of land in this country have buildings constructed on them. Buildings that are not built in existing residential or commercial areas require the construction of new roads, sewer lines, utility poles, and other infrastructure to reach them, which can lead to, among other things, habitat destruction. In addition, many buildings are not reachable by public transportation and thus require the construction of parking lots or garages.

Construction Materials:

The design of green buildings should thus begin with the selection and use of eco-friendly materials with related or better features than traditional building materials. Building materials are usually selected through functional, technical and financial requirements. Building construction is a multibillion-dollar industry and requires the constant production and harvesting of millions of tons of a variety of raw materials to meet worldwide demand. Worldwide, construction activities consume 5 billion tons of raw materials each year, and it has been estimated that the construction industry consumes half of all products produced by volume.

Green building materials are generally composed of renewable rather than nonrenewable resources and are environmentally responsible because their impacts are considered over the life of the product. In addition, green building materials generally result in reduced maintenance and replacement costs over the life of the building, conserve energy, and improve occupant health and productivity. Green building materials can be selected by evaluating characteristics such as reused and recycled content, zero or low off-gassing of harmful air emissions, zero or low toxicity, sustainably and rapidly renewable harvested materials, high recyclability, durability, longevity, and local production. Careful selection of eco-friendly sustainable building materials may be the fastest way for builders to start integrating sustainable design concepts in buildings.

Construction, Operation and Demolition Waste:

Green buildings generally seek to minimize the amount of C&D waste they generate. One way they do this is by recycling or reusing C&D waste, such as by using inert demolition

materials as base material for parking lots and roadways. The demolition of existing structures, plans can be developed early in the design process to manage and reuse as much material as possible through the deconstruction, demolition, and construction processes. Demolition generates large amounts of materials that can be reused or recycled—principally wood, concrete and other types of masonry, and drywall. Rather than demolishing an entire building, all or part of a building can be deconstructed.

Pollution Control:

Green buildings cause minimal pollution during construction. It prevents air and noise pollution during construction and operation and offers minimized effect on the surrounding environment. Green building offers better safety, health and sanitation management for the workers and the residents after construction. Green buildings ensure greater image and prestige in the society [15].

In India there are three basic rating systems. One is GRIHA. GRIHA or Green Rating for Integrated Habitat Assessment is the country's own rating system developed by TERI and MNRE, Government of India. Few worth mentioning names like Commonwealth Games village, New Delhi, Fortis Hospital, Centre for environment sciences and Engineering Building, IIT Kanpur, Suzlon one earth architecture and various other buildings has received GRIHA rating. The other two rating system are IGBC i.e. Indian Green Building Council and BEE i.e. Bureau of Energy Efficiency [16].

Green building Education:

The 'major features of green building education' is matrix builds on previous work to propose a framework for green building literacy. The overarching goals of building "green" are to reduce the social and environmental impacts of the built environment while improving the quality of life for occupants within buildings.

The contemporary green building movement promotes buildings that lessen these environmental impacts through better building construction (e.g., less construction waste), building operation and maintenance (e.g., water and energy conservation and better indoor air quality), and lifecycle considerations (e.g., recycling and deconstruction at the end of a building's life[3]. However, the problem remains that few people outside the building industry understand the myriad benefits of building green [4]. Public green building education matters for a variety of reasons. To begin, people are life-long building consumers and occupants within buildings can be crucial agents of change for resource conservation measures such as energy efficiency and material recycling [5] [6].

Green building literacy (GBL) is the term used here to describe the hoped-for outcome of green building education [which falls within the larger movement for public "built environment education" [7] [8].

Conclusion:

Adoption of renewable energy sources can make the buildings efficient enough to sustain India's economical growth without harming the environment. A sustainable building material needs to be used properly and contextually in every community development. The application of sustainable building materials not just minimizes transport costs, carbon emissions, and in most cases materials costs, it also offers employment and skills development opportunities for community members. Green buildings save water, energy and material as compared to the conventional buildings. In green buildings there are great thermal insulations, opportunities for rain water harvesting, arrangement for terrace gardening with ventilation and energy efficient appliances. Green energy revolution can upgrade the level of living in both urban and rural areas.

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