Literature review on environmental engineering aspects of a Green Building- Special Reference to a Hospital Building

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Abstract: This study was designed to do a case study on a small number of healthcare facilities. These facilities were visited, and it was found that they lacked things like thermal insulation, water collecting systems, and a complete reliance on fossil fuels, among other things. Due to these limitations, they are unable to reduce GHG emissions, are less energy efficient, require more natural resources, are less sustainable, etc. These problems will be solved in future research projects with the use of certain technology. Some technologies may be more expensive at first, but they will end up being more affordable in the long run. As they will be utilised by the majority of users, they must be user-friendly, and their upkeep must be simple and inexpensive.

Key words–Sustainability, Green Hospital, Efficiency

INTRODUCTION

The building sector is expanding along with the population growth and lifestyle changes that are taking place. A significant portion of infrastructure development and construction involves building. After agriculture, the construction sector is India's second-largest industry. It involves more than just creating a structure; it also involves a number of processes, including design, construction, use, maintenance, repair, and destruction. The actions taken to produce the built environment have a significant effect on both the local and global environments.

Any building has an effect on the neighbourhood through requests for materials for building construction and maintenance, water supply and waste water disposal, solid waste disposal of all types, electricity supply, etc. In the form of the climate change phenomena, it also aids in the degradation of the environment on a worldwide scale. Due to population expansion and higher requirements for thermal comfort, the building industry has experienced tremendous development. This increased demand for primary energy raises the amount of greenhouse gases (GHG) released into the atmosphere. [1] Building requires energy from the very beginning of construction through the dismantling stage. [5] According per the website architecture2030.org Almost 40% of yearly worldwide CO2 emissions are produced by buildings. Building activities account for 28% of those total emissions yearly, while building materials and construction (often referred to as embodied carbon) account for an additional 11%.

The goal of green building is to lessen the negative effects of the construction industry on the environment, society, and economy [2]. "A 'green' building is a facility that, in its design, construction, or operation, reduces or eliminates negative affects, and can produce positive ones, on our climate and natural environment," according to the International Green Building Council. Green structures protect priceless natural resources and enhance our standard of living. There are several definitions of green building that may be found nowadays. Green building is a term that encompasses a variety of approaches and best practises [1]. It is the result of design philosophy, which places emphasis on optimum resource consumption and boosts resource utilisation efficiency [1]. Green building also referred as sustainable building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from sitting to design, construction, operation, maintenance, renovation, and deconstruction [1]. This practice expands and complements the classical building design concerns of economy, utility,

durability and comfort. The basic objectives of these kinds of buildings are;

- Efficient use of energy, water and other resources.
- Protecting occupant health and improving employee productivity.
- Reducing waste, pollution, environmental degradation and better waste management.

High performance building or structure has taken the place of the phrase "green building"[3]. The study of the literature on studies and research based on the design and construction of Green Hospital Buildings is the special subject of the current work. The review's findings are provided in the paragraphs that follow.

LITERATURE REVIEW

Energy Conservation in Hospital Buildings

The usage of energy derived from fossil fuels or minerals has a well-known detrimental effect on the climate owing to the production of tonnes of greenhouse gases. In order to move closer to achieving the goal of net zero carbon emissions, it is necessary to analyse the energy used during construction and operation of buildings. According to a research cited by [4], the energy auditors must take a few easy steps to increase the hospital building's energy efficiency. Although there are numerous technological ways to increase energy efficiency, monitoring and controlling the energy situation would be the greatest practise and the secret to success. The research recommends free actions including adjusting thermostats, time switches, and temperature controls, as well as turning off equipment (lights, heaters, etc.) while rooms are empty. In order to increase the energy efficiency of hospital facilities, a project of the United States Agency for International Development in 2009 [5] conducted a thorough assessment of Indian hospitals to learn about their energy use. The Indian hospital industry has never seen a report like this one before. According to a study by [6], 73 buildings from 13 different nations, including both residential and commercial ones, had their energy life cycle analyses completed. They come to the conclusion that the operational demand for buildings ranges from 80 to 90%, while the embodied demand ranges from 10 to 20%. To reach the GB Goal, a lot of effort may be done at both levels. One of the most important features of any building is the lighting, which uses a significant amount of energy to illuminate a large portion of the structure. Schneider Electric and S.L. Raheja Hospitals, who surveyed 23 hospitals for the Confederation of Indian Industries (CII), also underline the need for energy saving in the Indian hospital sector. They underline that hospitals work 24 hours a day and have lots of equipment for varied procedure. Also, a hospital facility needs considerable lighting and ventilation, which uses a lot of power. They provide several strategies for conserving power at the report's conclusion. [7] Healthcare planning firms should create healthcare facilities that make the best use of natural light as opposed to artificial lighting. [8] They go on to say that lighting may be considered in both the architectural design itself and in the fixtures and types of electric lights that are utilised in a structure. An investigation into how conventional building energy efficiency measures can affect occupant health in the federal sector through the Healthy Buildings initiative has been published by the U.S. Department of Energy's Federal Energy Management Program (FEMP), in collaboration with the General Services Administration. [9] The Federal Energy Management Program (FEMP) toolset helps the identification of indoor environmental quality (IEQ) and energy efficiency enhancements to strengthen business cases by leveraging savings from increased productivity and decreased utility costs. The paper notes that occupant health and energy efficiency are frequently perceived as conflicting goals. A crucial component of developing a sustainable infrastructure that promotes occupant wellbeing is holistic building planning.

HOSPITAL SOLID WASTE MANAGEMENT

The solid waste that comes out of a hospital is quite dangerous in terms of biology, physics, and chemistry. If handled improperly, it might result in diseases and bodily injury to both people and animals. Also, it has a negative impact on the ecosystem. The majority of nations, particularly emerging nations, are dealing with a dire predicament brought on by environmental contamination from pathological waste generated by growing populations and the ensuing rapid expansion of hospital units. [10] It is now well recognised that some medical waste is among the most dangerous and potentially fatal waste that accumulates in

communities. The World Health Organization has long urged that certain types of rubbish should be used to dispose of medical waste. There are many organisations that harm the environment, but recently emphasis has been focused on one that harms people's health as well. [11]

A research released in [10] has overviewed the hospital waste management techniques in India, as well as the environmental concerns that are linked with them. Examining medical waste management practises and how well they adhere to legal criteria was the goal of this study. For proper waste disposal, they cite the Biomedical Waste (Manage and Handling) Regulations 1998. They show that substantially less research has been done in India on the management of biomedical waste. They draw the conclusion that hospitals lack the resources necessary to manage medical waste. In 2016, changes were made to the 1998 Biomedical Waste (Manage and Handling) Rules. The Bio-Medical Waste Management Rules, 2016, define a "bio-medical waste treatment and disposal facility" as any establishment that treats bio-medical waste or disposes of it, or engages in processes related to such treatment and disposal. This definition includes conventional bio-medical waste treatment facilities. and "operator of a common bio-medical waste treatment facility" refers to a person who owns or manages a Common Bio-medical Waste Treatment and Disposal Facility (CBWTF) for the gathering, receiving, storing, transporting, treating, disposing, or managing bio-medical waste in any other way. [12]

GREEN HOSPITAL BUILDING

According to the Indian Green Building Council, a green hospital building is one that improves patient wellbeing, assists in the healing process, and makes effective use of natural resources without harming the environment. When it comes to giving patients the highest level of care while maintaining the safety of their surroundings, hospitals should be setting the standard. The greenest structures should be reserved for those who are ill. [15] A green hospital improves patient wellbeing while using renewable resources, protecting the environment, reducing waste, and using green practises. [8] A green hospital is a hospital that operates on the principles of environmental protection. Green hospitals not only offer medical services, but they are also places that are less harmful to the environment and our world. [13] When properly constructed, Green Hospitals not only reduce significant expenditures like those for energy and water, but they also aid in patient rehabilitation by making greater use of natural light, facilitating access to the outdoors, and enhancing hygiene and security. Assuring protection from diseases, epidemics, and natural catastrophes, Green Hospital helps its employees, patients, community, and visitors. The following are some advantages of green hospitals:

Reduction in recovery time of patients.

1. Elimination of Sick Building Syndrome (SBS) for both patients and staff.
2. Stress level in hospital workers are reduced which improves the quality of care.
3. Lower energy and water consumption.[24]

According to research, the ecosystem is being progressively and confidently harmed by subpar waste disposal practises, extended and excessive usage of hazardous items, poisonous chemicals, and medical technology that generate dangerous radiations in healthcare facilities. [7]

The methods for managing solid waste, managing trash, and conserving energy have been thoroughly surveyed for a number of hospitals in Taiwan and Singapore. [13] They describe how other hospitals will develop environmental management policies, establish objectives and indicators for a greener hospital, allot sufficient resources, engage in staff education, and set up environment monitoring systems to become environmentally friendly hospitals using the experiences gained and published in the manual. To comprehend the significance of "Green Hospital," identify the numerous ways that the health industry contributes to climate change, investigate options for reversing this severe trend, and lastly search for institutions that are leading change, a review given by [14] was carried out. In order to deliver high-quality treatment, it was discovered that hospitals, which are resource-intensive enterprises, use enormous amounts of power, water, food, and building materials. It was also shown that certain healthcare facilities might significantly minimise their environmental impact by using easy, shrewd, and sustainable methods. However given the local limitations and rising customer demands, building green hospitals can be difficult. The study on green hospital buildings from

across the world has been evaluated by the authors of [15]. The authors' article sought to comprehend the fundamentals of green hospitals, their various functions, the necessity of implementing these concepts in hospitals to make them patient- and environment-friendly, to identify the variables that affect the quality of green hospital design, and to provide guidance for future green hospital designs.

FACTORS WHICH HELPS TO ATTAIN A GREEN HOSPITAL

1. Site Selection- The site chosen should not have a lot of vegetation, but if it does, it should be managed properly, the top fertile soil should be separated, soil erosion should be controlled by taking deliberate steps, buildings should be oriented to receive the most sunlight possible, the site's wind rose diagram should be taken into consideration for effective ventilation, the site should be accessible, and visitor accommodations should be considered, among other things. Garden space should be preserved throughout construction.
2. Construction Materials- Green materials like green concrete, timber crete , reclaimed wood, reclaimed steel, reclaimed plastic and etc.
3. Energy- Limiting the reliance on non-renewable energy sources is advisable. Energy is mostly utilised for thermal insulation and lightning protection. Using solar power and wind turbines can lessen this. The use of porothermbricks—which have been certified as being 100 percent eco-friendly by GRIHA and IGBC—can offer the insulation needed to keep a room cooler in the summer and warmer in the winter. The use of natural light should be maximised, and artificial lighting needs should be kept to a minimum.

1. Water use- Improve plumbing fixture efficiency to lessen the need for potable water, design the landscaping to use as little water as possible, process and recycle waste water, utilise green roofing, and regulate storm water release to increase ground water table and decrease municipal water demand.
2. Indoor Air Quality- It plays a leading role in spreading Hospital Acquired Infections (HAI). IAQ can be maintained by proper sanitization, central air cleaners, ultraviolet germicidal irradiation, photocatalytic oxidation and etc.
3. Waste Management- Health facilities can cut waste and emissions through composting, recycling, better purchasing (minimizing packaging, using reusable rather than disposable productand buying recycled products), and minimizing waste transport.[25]

BARRIERS TO CREATE “GREEN HOSPITALS”

Greg L Roberts, in his article “shades of green” has cited different barriers to green health facilities, which are as follows:

1. System redundancy: Requirement of secondary and tertiary backup systems to make sure that operations do not cease during emergencies.
2. Regulatory compliance- Health and safety regulations and building codes became a barrier for hospitals to adopt sustainable practices.
3. Operational hours: Health facilities function uninterruptedly throughout the year.
4. Infection control: Hospitals require strict infection control protocols which often are against sustainability practices.
5. Ventilation rates: More frequent air changes are required in a hospital as compared to other commercial office spaces.
6. Accreditation and licensing demands: Compliance with central, state and accreditation standards might prevent facilities to make environmentally sound choices.
7. Intense energy and water use: Health care uses 2.1 times more energy per square foot than commercial buildings, and hospitals typically use 80-150 gallons of water per bed per day.
8. High-volume waste stream: About 0.5 Kg of hazardous waste is generated per bed per day.
9. Chemical use: Hazardous chemicals used to clean and disinfect, sterilize equipment, treat certain diseases and for laboratory research and testing can be toxic and hazardous.
10. Life cycle: The exteriors of hospital buildings can last long, but interiors require renovations every few years. [15]

CONCLUSION

During the past ten years, there has been a growth in the need for health facilities. Patients from other

nations are also drawn to India's medical facilities because of their affordable costs. Hospitals and health facilities have a significant negative influence on the environment because of their high energy needs, production of infectious, poisonous, and hazardous solid waste, as well as wastewater. The tools used in therapy are improving along with technological advancements. The majority of the energy used in hospitals is used by the HVAC (Heating, Ventilation, and Air Conditioning) systems. Use of LED lights, solar energy and solar heaters, water-efficient plumbing fixtures, indoor plants, window glazing, and other strategies can all help cut down on energy usage. The health centres produce a significant quantity of garbage. A hazard to the environment will result from improper handling of this material, from segregation through final disposal. The necessity for Green Hospital is evident when considering all of these factors. Every phase of a building's construction, from planning the structure through its final destruction, should be carefully planned in order to increase energy efficiency. For many years, the cost of building green facilities has decreased, and the long-term advantages are enormous. It's not essential for a building to be built from the ground up to be green; older buildings may also be turned green by utilising specific technology, such as solar power, terrace gardens, LED lighting, and so on. Hence, it may be inferred that a green hospital building is now essential.

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