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STUDY ON GREEN BUILDING CONCEPT AND MATERIALS

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ABSTRACT

Due to India's rapid urbanization, a slew of major environmental issues are surfacing in the building industry. Increased demand for housing leads to increased consumption of energy, resources, and raw materials, resulting in an increase in carbon content in the air, which is hazardous to the environment and human health. We are currently dealing with a number of environmental issues, which necessitates the use of more environmentally friendly products in order to reduce environmental consequences. We are already seeing changes in weather patterns in towns like Nagpur, with hotter summers, shorter winters, and insufficient monsoons. As a result, it is now more vital than ever to take the city's ecology and scarce energy supplies seriously. To lessen their negative environmental impact, developers must identify better, more sustainable methods of building design. As a result, it is critical to employ more sustainable and locally available materials that are environmentally beneficial and set the standard for a brighter tomorrow. Taking into account all of these factors, this paper includes a list of five green construction materials, along with their benefits, drawbacks, durability, and cost-effectiveness in the construction sector, that can be used as a viable alternative to traditional materials.

Keywords: Green Material Cost Efficiency, Durability, Environmentally Friendly Construction Materials, Energy Efficiency, And Sustainability.

I. INTRODUCTION

According to various studies, a Green building can be defined in a variety of ways. It's also worth mentioning that the term "green building" has become synonymous with "high-performance buildings" or "sustainable buildings or structures." The notion of green building is based on four fundamental points:

1. Reduction of the structure's effects, or rather side effects, on the environment.
2. Improving and increasing the health of the people who live in a building
3. Investment savings and returns to investors and the community.
4. Considering the life cycle during the planning and development process.

The construction sector has substantial good and negative environmental, economic, and social implications in any part of the world. Construction operations give job chances for a huge number of individuals in addition to supplying the requisite number of buildings and amenities for human beings. In 2001, the Confederation of Indian Industries (CII) established the International Green Building Council (IGBC) in collaboration with the USGBC and the World Green Building Council. When the first green building, the Sohrabji Godrej Green Business Centre, was opened, it was a watershed moment for the country. The Indian green construction market is expected to be worth $40 billion by 2020, and it is expected to continue to develop.

In India, the IGBC has created 13 green building rating systems that are in line with the country's national objectives. Sustainable site planning, energy efficiency, water savings, material selections, and indoor environmental quality are all factors that are taken into account while evaluating the building's performance. We are currently confronted with a number of environmental issues, necessitating the use of more environmentally friendly products that will reduce environmental impacts. Changes in weather patterns, such as hotter summers, shorter winters, and insufficient monsoons, are already being noticed in towns such as Nagpur. To lessen their negative environmental impact, developers must identify better, more sustainable methods of building design. As a result, it is critical to employ more sustainable and locally available materials that are environmentally beneficial and set the standard for a brighter tomorrow.

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II. LITERATURE REVIEW

1. Sustainable building material for green building construction, conservation and refurbishing (2012). The purpose of this paper is to highlight how sustainable building material can contribute to lessen the impact of environmental degradation to the occupant as well as our environment.
2. Construction of an Eco-Friendly Building using Green Building Approach (2012). This study investigates the effect of green plantation on inclined roof to the indoor temperature on any building in the experiment showed a promising result where by the average indoor temperature dropped between 0.6°C to 2.7°C as recorded during the observation for bare roof.
3. A Review on Sustainable Building Green Building (2013). The aims of this study were to understand the sustainable building, and its advantages as well. From the study, it was concluded that the sustainability can minimize the harmful impact of the conventional buildings on environment, economy and people in using green materials, technologies.
4. Green building research current status and future agenda (2014). This study reported a critical review of existing studies related to green buildings worldwide. The results shows that these studies can generally be classified into three categories i. e. the definition and scope of green buildings.
5. Green building materials - A way towards sustainable construction (2015). This study explains features of all construction material which are socially, economically benefits for construction industry and human health.
6. A review paper on green building research (2017). This study reported all the technical and also the economic aspects related to green buildings worldwide. Also, this case study will help in studying awareness about the green building concepts amongst the people of towns and villages of India and help them develop their own green home and promote them to after building it.
7. Eco-Friendly Building Materials and Construction Technique in India (2017). The study shows that which is use of eco-friendly building material rather than convectional building material and techniques sustainability can be attained which is less harmful for the surrounding environment. A large variety of green building material are available within the subcontinent of India which can be replaced from convectional building material at different stages of construction of building.
8. Research on the Application of Green Building Materials in (2018). Results revealed greater willingness of developers to implement sustainable green building practices in their projects.
9. Research on sustainability of building materials (2018). This resurrect proposes. The selection of suitable building materials is an integral part of architectural design as the key point of design is to meet the users' health and comfort needs and to coordinate it with the materials' inherent characteristics.
10. Research on the Application of Green Building Materials in China (2018). This paper describes the concept, advantages and different types of materials of GBM. It also describes the obstacles encountered in the development of green building materials, and proposes corresponding counter measures.
11. Research on Green Building Materials Management System Based on BIM (2019). This article provides a theoretical basis for the application of BIM in the green building materials management system. Based on BIM, this paper explains the green building materials management and supply chain systems, and establishes the green building materials management evaluation method.
12. A Critical Research of Green Building Assessment Systems in Malaysia Context (2019). This study analyzed the green building assessment systems and criteria used to evaluate the sustainability of green building project
13. Research on the Literature of Green Building Based on the Web of Science: A Scient metric Analysis in Cite Space (2002–2018) (2019). The purpose of this paper is to systematically analyze and visualize the status of green building.
14. A comprehensive review on green buildings research: bibliometric analysis during 1998–2018 (2021). These resources reviewed the current research status and future development direction of GBs, focusing on connotation and research scope, the benefit-difference between GBs and traditional buildings, and various ways to achieve green building development. Zhao et al. (2019) presented a bibliometric report of studies.

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III. CASE STUDY

To study the minimal impact on the local infrastructure

Several studies have shown that green construction can save money by increasing employee productivity. Green construction increases the value of a home. Because of covid-19, a large portion of the world's population has stayed at home. We've seen a significant reduction in emissions all around the world, and green building has proven to be a better solution for lowering pollution.

To upgrade the house in maintaining a good thermal comfort inside the building

The building's objective is to give living space for people to live, work, and live. Green buildings, in contrast to traditional architecture, are meant to provide a more acceptable living environment for humans, combining both artificial and natural settings.

The organic combination of artificial and natural environments in a green building represents the harmonious relationship between humans and nature, making the building sustainable and closely integrating the building and the ecology. This is a broad definition of "livable," which includes not just the structure in which humans live, but also the natural environment in which humans live.

Use of energy efficient materials which consume less energy

Low-e-glass: Low-emissivity glass is referred to as low-e-glass. This type of glass has a specific metal coating that allows it to reflect a large percentage of the infrared spectrum while transmitting the majority of visible light. Low-e glass reduces heat from the sun by filtering short-wave radiation. This reduced the quantity of solar heat gain into the structure. As a result, low-e glass has a higher energy efficiency than standard transparent glass.

Window: It's also a key source of heat gain and loss, as well as visual and thermal discomfort. Energy-efficient windows are now available, which can reduce building energy use significantly. Multiple glazing, a customized clear coating, and an improved frame are all features of the high-performance window. All of these characteristics limit heat transfer, allowing you to lower the amount of energy you use due to window openings.

PVC Flooring: Synthetic flooring, such as PVC vinyl flooring, is a type of synthetic flooring. Natural materials such as wood and marble are used to create floors, while PVC vinyl flooring is constructed of a synthetic plastic known as polyvinyl chloride. PVC vinyl flooring is inexpensive, simple to install, water resistant, and long-lasting. PVC vinyl flooring is also more customizable than real flooring due to its synthetic nature. Vacuum and polish PVC vinyl flooring on a regular basis to keep it in good shape. Rough-surfaced cleaning equipment should never be used on the floor since they cause scratches.

Lime: Our primary building ingredient is lime, which is used to substitute cement in construction. By collecting carbon and expelling oxygen into the environment, it provides good air quality. We can see the durability of lime in terms of quality and life by looking at ancient structures, since it becomes stronger through time.

Sand Lime Bricks: Sand Lime Bricks have taken over the construction industry's market from traditional bricks. Sand, lime, fly ash, and water are the major ingredients of sand lime bricks. We can get the adhesiveness needed to keep the particles together by using sand. Because of its brittleness, we can recycle it and reuse it in new projects.

Eco-Friendly Tiles: Traditional flooring is replaced with eco-friendly tiles, which require less energy to manufacture. Compared to traditional tiles, it is less expensive. They come in a variety of patterns to suit the needs of the client and are also simple to install. The quality of the indoor atmosphere is improved by this tile.

Colored Lime Plaster: Though low VOC (Volatile Organic Compounds) paints are available, utilizing colored lime plaster as a paint minimizes the need for painting over the life of the structure. It's low-maintenance, washable, and water-resistant. As time goes on, it gets shinier and glossier. It has a more pleasing visual appearance than traditional painting.

IV. CRITERIA FOR GREEN BUILDING MATERIAL SELECTION

Despite the fact that numerous studies are seeking to tackle the problem of material selection, there is currently no universal definition of "green building materials." Green building materials, according to Esin (2007) and Franzoni (2011) [6], are materials that are resource and energy efficient in the manufacturing process, and they

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should emit little or no pollution and have no detrimental influence on human health. The following characteristics are primarily grouped into design standards for green building materials.

To begin with, green construction materials are often natural materials with low energy consumption and minimal maintenance costs, as well as being readily dismantled and recyclable following demolition. Initial and recurring energy use are included in the embodied energy consumption of construction materials. The former refers to the energy consumed during the construction phase, while the latter refers to the energy consumed during the operating phase, which includes material replacement, repair, and maintenance procedures during the course of the effective life cycle. However, the energy consumption of building materials is linked to construction energy and transportation energy during on-site construction, as well as the embodied energy consumption of raw materials recycling and building materials processing. The amount of energy in building materials varies depending on the type of energy used, the technology used, and the production procedures used, and it varies from region to region and manufacturer to manufacturer. Low maintenance requirements could be addressed by extending the life cycle of buildings through design durability or by repairing existing building materials.

Second, green materials should be ecologically benign and reduce environmental dangers without emitting toxins or other emissions that have an impact on human health and comfort over the course of their lives. People nowadays spend more than 90% of their time indoors, thus interior circumstances have a significant impact on their health, wellbeing, and performance [7]. Building materials are clearly an essential element in determining indoor air quality, with formaldehyde and other volatile organic compounds (VOCs) emitted from building materials having serious negative consequences on human health, comfort, and productivity, according to the research [8]. Pollutant-containing materials can have negative consequences throughout their life cycle, impacting employees throughout the manufacturing process, building occupants during the usage phase, and polluting the environment during recycling and terminal treatment. Green construction materials, then, are those that emit few or no carcinogens, do not regenerate noxious compounds or irritants, and have no detrimental influence on the structure or the environment.

Furthermore, green construction materials are primarily made from renewable energy sources rather than non-renewable energy sources. They should also be environmentally friendly throughout their whole life cycle and consume less energy during production.

V. THE MAIN ASPECTS OF GREEN BUILDING CONSTRUCTION

The use of green materials is an important part of green construction. It is critical to understand that the construction business nowadays consumes a significant amount of natural resources. Construction operations use 60% of the nation's raw materials, and 60% of the nation's surplus and non-hazardous solid waste belongs to the construction industry in the United States [9]. Some materials, such as widely recognised green materials, can be employed in the construction of structures. These materials are reusable and recyclable, and they help to reduce energy waste in homes [10]. Similarly, recovering and reusing building materials can save energy and reduce greenhouse gas emissions by reducing the need to collect and process raw materials and ship new materials from afar to construction sites. Furthermore, the use of green materials reduces the cost and environmental impact of waste management [9]. A green substance, according to Milani [11], is one that does the most with the least, fits most harmoniously within ecosystem processes, helps to avoid the use of other materials and energy, and contributes to the development of a service-based economy. According to Torgal and Jalali [9], the majority of construction materials are not green, and green materials can be classified into the following categories:

- Resource efficiency: This can be accomplished by using materials that match the following requirements:

a) Content that has been reused

b) Renewable or abundant natural resources

c) A resource-conserving manufacturing method

d) Available in your area; e) Salvaged, reconditioned, or re-manufactured

e) Recyclable or reusable

f) Product packaging that is recycled or recyclable.

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- Improving indoor air quality (IAQ) by employing materials that meet the following criteria:

a) Low or non-toxic

b) Low chemical emissions

c) Low-Voc assembly

d) Moisture resistance

e) Well-maintained

- Energy efficiency can be improved by adopting materials that reduce energy waste (insulating materials)
- Water conservation: It can be achieved through the use of materials that conserve and restore water (water harvesting and natural refinery for water)

VI. THE GREEN BUILDING MATERIALS CONCEPT (GBM)

The term "green building materials" was first proposed at the first International Conference on Materials Science by the academics. Green materials were defined by the international academic community in 1992 as recycling of raw materials, product manufacture, application processes, and post-use recycling, with the least negative impact on the world's environment and human beings. Following that, China classified green building materials as: sophisticated science and technology, no or limited use of natural resources, extensive use of solid waste in industry and agriculture, pollution-free, low-level radioactive elements, and recyclable construction materials; The MOHURD issued "Administrative Measures for the Evaluation of GBM and Markings" till 2014, which formally defined green building materials as follows: The use of natural resources and the impact on the environment over the course of a person's life can be decreased. It is a type of building material that has the properties of "energy conservation, decrease of emissions, safety, convenience, and recycling ability." We can see from the definition of the above-mentioned GBM that the researchers' main attention is on the manufacturing process, technology, emissions, recycling, and health benefits.

VII. THE BENIFITS OF USING GREEN BUILDING MATERIALS (GBM)

When compared to traditional construction materials, according to certain reliable research on a variety of GBM presently widely used around the world, they usually have the following advantages:

a) Reduce energy consumption: Use waste slag and domestic waste as raw materials for production, or use renewable environmental protection materials, to achieve the goal of reducing water and land resource consumption, and use more advanced production technologies to increase energy efficiency, resulting in energy savings and emission reductions in the manufacturing process, as well as green environmental protection.

b) Sustainability: Qualified materials can be reused and recycled multiple times, reducing energy consumption and pollution emissions caused by repetitive material manufacturing or replication.

c) Safe and healthy: Unlike traditional building materials, green building materials are not damaging to human health while meeting functional requirements. This is due to the material itself or the introduction of certain chemical components.

d) Good material attributes: The majority of GBMs have high strength, water resistance, and light weight capabilities, which can reduce material handling costs and improve building quality. In conclusion, the use of green building materials may not only increase the efficiency of production and construction quality, but also meet the needs of sustainable development by avoiding health dangers. As a result, the government should encourage its use and inject green life into the construction industry.

VIII. CONCLUSION

Effective land use:

When selecting sites for urban and rural planning building land, the requirements for the construction of cultural relics and other protected places must be implemented for the conservation of land resources. Furthermore, natural disasters, pollution, or other things that influence physical health are not a threat to human life in the chosen site. There are a few specific measures that can be considered:

1. Land usage:

a) minimizing intense land use

b) reasonable green land for the location

c) reasonable development and use of subsurface space

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2. By considering outdoor environment:
a) We can design a structure that is light pollution-free.
b) We must take measures to reduce the intensity of the heat.
3. For the purpose of transportation:
a) We should make pedestrian access easier.
b) Commercial construction shall take into account convenient public transit and these transportation services.
4. Site design and site ecology:

a) Integrate the topography of the terrain, the site's architecture and layout, and apply ecological compensating techniques such as surface soil to conserve the original ecological water body, wetland, and vegetation.

b) Design rainwater special programmer for sites greater than 20h m2 and fully and affordably install green rainwater infrastructure on the site.

c) Surface runoff and rainwater runoff on the roof should be planned rationally, and entire discharge management of site rainwater should be implemented.

From the above said points it can be seen, the Green Building Evaluation Standard puts the safety of site selection as first, and improves land use efficiency by developing underground space and transforming abandoned sites. However, the standard lacks guiding indicators on the impact of the building on the surrounding environment. Therefore, the measures taken are relatively simple, and usually rely on the greening measures adopted within the building to maintain the stability of the ecological environment as much as possible.

Efficient use of energy:

1. Structure of construction and containment:

a) To maximize the design, consider the natural circumstances of the site, the shape of the building, the direction of the building, the distance between the building and the window-to-wall ratio.

b) Users can enjoy natural ventilation thanks to the thoughtful design of architectural, glass-curtained windows.

2. HVAC (heating, ventilation, and air conditioning);

a) The energy consumption of heating and air conditioning systems used to maintain a comfortable temperature and ventilation environment in a building must meet energy-saving design requirements and national standard energy efficiency limit values.

b) The energy consumption of the hot water circulating pump and the air conditioning system fan used in central heating complies with the relevant provisions of the "Energy-saving Design Standards for Public Buildings" 17 GB 50189, in which the energy consumption of circulating water pumps of air-conditioning hot and cold-water systems is higher than that of "heating, ventilation and air for civil buildings. Regulatory Design Specification" GB 50736.

3. Utilization of all available energy:
a) Use waste heat to meet the steam, heating, or domestic hot water needs of the building.
b) Select a renewable energy source that is appropriate for the local climate and natural resources.

From the above said points it can be seen, The Green Building Evaluation Standard minimizes building energy consumption by logically selecting building equipment and household appliances, as well as taking external resources into account during the design stage. To accomplish energy conservation, increase the proportion of renewable energy used and restructure the energy composition of buildings optimally. The standard focuses on the amount of resources utilized rather than the cost of utilizing energy, however the energy consumption unit is not predictable. There is no consistency in the types and uses of renewable energy in the evaluation, hence the results aren't scientific or accurate.

Efficient Water Use:

1. System for conserving water:

a) The building's average daily water use meets GB 50555, the national standard "Water saving standard for water conservation design of civil buildings."

b) Prevent network leakage by taking proper precautions.

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c) In the water supply system, there are no over-pressure leaks.
d) Installing a water meter
e) Water-saving measures will be implemented in a shared bathroom.
2. Appliances and equipment that conserve water:
a) Water-saving sanitary appliances and equipment should be used.
b) Selecting a water-saving irrigation system for landscape greening
c) Air-conditioning equipment or systems using water-saving cooling technology
d) Sanitary ware, green irrigation, cooling towers, and other features all require water conservation strategies or procedures.

From the above said points it can be seen, The Green Building Evaluation Standard maximises water conservation by creating sensible water use plans, installing efficient drainage systems, and incorporating water-saving equipment. The following three aspects are particularly well-represented: To begin, greening garden irrigation water advocates the use of drip irrigation, rainwater harvesting, water facilities, and other technologies to improve garden water use efficiency and reduce potable water consumption for greening landscape; second, water metering water management to effectively control water use; and third, save water and reduce water consumption through measures such as improved sanitary ware.

Efficiency in Materials:

1. Design:
a) Use architectural shapes to your advantage.
b) From the foundation to the structural system and structural components, optimise and improve the design.
c) Civil engineering and decorative engineering combined in a single design
d) Reuse of partitions in public buildings that were previously employed in a convertible interior space
e) Prefabricated component manufacturing in industry
f) Integrated kitchen and bathroom design
2. Material selection:
a) Using locally sourced construction materials
b) Ready-mixed concrete with cast-in-place concrete
c) Using ready-mixed mortar to construct mortar
d) Use of high-strength building materials in a reasonable manner
e) Adopting high-durability building materials is a good idea.
f) When feasible, use reusable and recyclable materials.
g) Using garbage as a source of raw resources to create construction materials
h) Adopting restoration building materials that are cost-effective, durable, and easy to maintain

From the above said points it can be seen, the green building evaluation standard assesses the performance of building materials in the design and construction stages. The indications for architectural design optimization, prefabrication, and reuse revolve around material selection, manufacturing and reuse of building materials, and optimal material design. Following the interpretation of the indications, construction materials are advised to be prefabricated in order to reduce waste of materials and quality issues produced by on-site cast-in-place. It is vital to assess whether new building materials are within the building's service life.

Quality of the Indoor Environment:

1. acoustic environment within a building:
a) Level of noise in the main function room
b) In the main function room, there is excellent sound isolation.
c) Reduce noise interference by taking the necessary steps.
d) Important spaces in public buildings for acoustic requirements, such as multi-purpose halls, reception halls, huge conference rooms, and so on, must be built to meet the associated functional requirements.
2. Light and eyesight in the indoor environment:
a) The building's main functional area provides a nice view.
b) The main function room lighting factor is compliant with GB 50033, the current national "architectural lighting design guidelines."

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c) Increase the amount of natural light in the building.

3. Indoor hot and humid environment:

a) To lessen the heat emitted by summer solar radiation, use adjustable sunshades.

b) The heating and cooling system's end can be adjusted independently.

4. Air quality in the home:

a) By logically structuring the building area, planning layout, and structural design, you may improve the natural ventilation effect.

b) There is adequate air dispersion.

c) Indoor air quality inspection system for main function halls with high crowd density and considerable time variability

d) In an underground garage, a carbon monoxide detector is coupled to exhaust equipment.

From the above said points it can be seen, both good outside vision and indoor environmental quality are assessed using a little arbitrary threshold. The building provides a nice view of the outdoors, which not only helps with visual tiredness but also increases productivity. As a result, a nice view can influence the quality of the indoor environment. This standard's indoor environmental indicators emphasize orientation, illumination, ventilation, and noise reduction, with indoor air quality receiving less consideration. To avoid unfavorable human health impacts, only indoor ingredients like formaldehyde, benzene, and ammonia are needed.

We looked into the characteristics of all construction materials that are socially and economically beneficial to the construction sector as well as human health. Green construction materials limit environmental side effects to create efficient, long-lasting structures while also lowering pollution levels, such as greenhouse gas emissions, resource depletion, soil pollution, health risks, and ozone depletion. As a result, there is a strong desire to employ environmentally friendly products for a better tomorrow and a healthier living for future generations.

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