Review on the Role of Sustainability Techniques in Development of Green Building

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ABSTRACT: ***Because of the world community's focus to sustainable development during the past 10 years, sustainable building construction has become more important at the international level. This article, which is focused on the use of environmentally friendly methods in the construction of green buildings, the trash produced at various phases of building is a major impediment to sustainable construction. Waste generation creates a number of issues, including soil infertility and degradation of the environment via air and water pollution. Old building materials may be recycled and reused in the construction of new structures. Sustainable building is defined as construction that costs less, uses fewer natural resources, and causes less environmental damage. Sustainable building is the responsibility of the architect and contractor. In sustainable construction, an architect creates a structure based on the client's vision, yet using sustainable methods. The contractor is in charge of putting the sustainable design into action. The selection of materials is a crucial stage in the building of a sustainable structure. Steel is an excellent sustainable material that is minimal in waste, efficient, and long-lasting. It has a high compressive strength and is less harmful to the environment. The creation of Green Roofs, which make the inside of a building pleasant at a cheap cost, is the latest technology in sustainable construction. The goal of this review article is to provide methods and material choices for green building construction. Following a thorough examination of the building materials, appropriate adjustments to the project's construction were recommended. Sustainable construction is low-cost, produces less environmental damage, and meets current and future needs.***

KEYWORDS: ***Green building material; Sustainable construction; Waste material.***

1. INTRODUCTION

After World War II, when infrastructure was totally destroyed, the idea of civil engineering became popular. Civil engineering technology has been developed to build infrastructure and solve economic difficulties while also meeting existing challenges. With the passage of time, the construction sector grows and strengthens the economy. Sustainable building not only addresses today's issues, but also anticipates future needs. Across 10 billion tons of concrete are produced each year around the world, necessitating a significant quantity of building material. For every ton of cement produced, about one ton of carbon dioxide is produced. Large amounts of water and energy are used in the manufacturing of concrete, indicating that building is not environmentally friendly. Environmental sustainability may be accomplished through conserving natural resources and improving quality. Waste deposition is a major issue, since it causes landslides and renders soil infertile. More waste is produced when materials are selected uniformly. The waste output of various building materials is roughly divided into three categories: stone (28%), foundation concrete (14%), and roof tiles (10%). Inappropriate material selection and management results in significant waste generation, ranging from 1 to 10% of each component [1], [2].

In the contemporary age, waste-to-brick manufacturing is utilized to address long-term issues such as pollution. The strength and water absorption capacity of bricks are factors in their selection. Normally, bricks with compressive values of up to 10 MPA are used for load bearing structures, while bricks with compressive strengths of up to 5 MPA are used for non-load bearing structures. There are eleven different types of bricks. Brick is utilized in the construction of sustainable green buildings because it has a high compressive strength, low density, and poor thermal conductivity.

The Dutch government has adopted a policy for sustainable construction, under which every contractor must pay a modest fee for trash disposal and recycling of obsolete building materials. Because there is little knowledge of trash recycling on a wide scale, waste generates more than 10%. After examining the three main components of material, such as blocks, timber, and sheetrock, it was discovered that demolition and construction trash accounts for more than 22% of municipal garbage. Blocks 85 percent, lumber 90

percent, sheetrock 90 percent, improper technique 10%, and packaging 35 percent are the waste production increasing order. Waste produced during building is reduced in sustainable development, which improves productivity. Environmental deterioration caused by building waste is becoming more difficult to manage all around the globe. The only method to minimize environmental deterioration is to limit waste generation during building operations by adopting reuse, recycling, and reducing construction materials. Reduce, reuse, recycle, compost, and landslides are the six types of waste, in in ascending order. During the demolition and construction of the building, a significant amount of trash is generated. It may also exert control by repurposing them via the recycling process. Aggregate can be made by reusing old construction materials, although it's only suitable for tiny buildings [3].

2. SUSTAINABLE BUILDING MATERIAL

Concrete is often produced from a combination of water, aggregate, and binding material, which is not environmentally beneficial due to waste creation and heat generation. Any material that produces less environmental degradation and conserves energy resources, yet has a high initial cost but low development cost, such as steel or glass, is a sustainable material. Structure sustainability may be accomplished in concrete by altering the binding material or adding a combination that controls the heat transfer from the building to the environment. Green mark or LEEDS are examples of worldwide standards for sustainable building [4]–[6].

2.1. Design Phase:

2.1.1. Design standard:

The “Green Mark” for sustainable building was introduced in the same way as the “Concrete Construction Standard” was. This standard was first introduced in Singapore in 2005. The construction sector gains awareness as a result of this norm. The phrase "green building" refers to three essential elements of construction at this time: cost-effectiveness, environmental friendliness, and natural resource preservation in order to satisfy present demands without jeopardizing future generations' needs. Different standards, like as LEED and BREEAM, have been established for the construction of green buildings throughout the globe. Sustainable building is mostly practiced in the United Arab Emirates, the United States, and Qatar.

2.1.2. Implementation of the green mark:

Construction industry players, including government and private sector businesses, must submit an application to obtain permission from green marks. The members of the Green Mark team will be appointed, and a meeting with the applicant will be conducted. Following the submission of the design and other pertinent papers, the green mark team visits the site and makes appropriate design suggestions before granting authorization to the host team. After the design has been approved, the building process begins. On most multinational projects, this norm is followed.

2.1.3. The Green Mark's Benefits

- Green construction is effective at conserving energy, but a well-chosen household appliance may also save fresh water and other natural resources.
- The inside of a green building is made more comfortable by the use of natural light and natural ventilation via windows.
- Sustainable buildings are cost-effective in the long run, not only in the short term. It minimizes the need of artificial lights while also conserving electricity and water.
- It raises people's living standards; a green roof not only creates a nice interior, but it also lowers air pollution via photosynthesis.

2.2. Construction:

This phase determines the project's quality, although it is reliant on the designing phase. During the design process, professionals must keep sustainable methods in mind and ensure that the design is long-lasting. The contractor is responsible for putting the design into action on the ground, according to the specifications. However, a significant impediment to sustainable growth is a lack of competence and understanding in the field of sustainable building. From the beginning until the conclusion of the project, appropriate monitoring is required. Steel is utilized as a sustainable building material in the contemporary

age because of its long life, little waste generation, and low cost. During the design process, the designer attempts to use as few natural resources as possible, such as sand and aggregate, in order to conserve them for future generations. Use recycled aggregate instead of new material if it is available. Steel, metal, glass, and claddings are the most often utilized sustainable materials.

2.3. Substance:

Material is the most important aspect of any building. From a sustainability standpoint, their appropriate selection and availability are critical components. The materials are chosen depending on the design, and their availability on site is determined by the supplier. There are many different kinds of materials on the market, and recycled materials may also be used in building.

2.3.1. Start with the basics:

Through the foundation, all of the building's weight is transferred to the earth. The foundation strength is critical for both heavy and light weight construction. Its failure leads the structure to be demolished in a short period of time, unless the structure is very robust. It is critical in sustainable building to offer insulation on the foundation's outside side rather than the inside. Although it is more expensive, the contemporary formwork, which is constructed of steel or plywood rather than wood, is preferred. The absence of a drainage system is the leading cause of foundation collapse. Moisture should not be allowed to accumulate on the foundation. Concrete with flash is used in foundations because it improves strength, durability, and water resistance. Insulated foundations have no negative impact on the environment and can adapt to changing climates.

2.4. Long-Lasting Materials (Steel):

Steel is a better choice for construction than concrete because of its high compressive strength, durability, stiffness, and shorter building time. It generates a tiny quantity of reusable trash without the need of any large recycling equipment. Steel may also be used to create multi-story buildings that can be recycled without distortion. Because of its low weight construction, which is one-third the weight of concrete, steel structures are excellent from a seismic standpoint. Steel construction is more efficient and takes less time to complete. It is widely accessible on the market, in a variety of shapes and sizes, for use in a wide range of structures. Another advantage of steel is that it does not need additional manpower or heavy equipment for installation; just a few experienced individuals are required. In a concrete construction, a beam or column must be installed at regular intervals to sustain the load, but steel has a great strength, and one component is utilized for long spans that can easily withstand the weight. The waste generated during construction caused a slew of environmental issues, from transportation to deposition, including air pollution, soil infertility, and so on. Steel construction generates relatively little trash that is readily reused without the need of heavy equipment or a time-consuming recycling procedure. It is a building material that is beneficial to the environment.

3. PROPERTIES OF SUSTAINABLE MATERIAL

3.1. Waste material recycling:

Because of numerous environmental issues, trash deposition is now the most significant obstacle to sustainable growth. Although waste production cannot be completely stopped, it can be managed to some degree. Every material used in construction generates trash, whether it's concrete or steel, but only a few can be recycled quickly, while others need heavy equipment and a lengthy process, such as concrete. Sand blasting generates copper slug, which is mixed with sand to a percentage of up to 10% and utilized in non-structural members such as partition walls [7], [8]

3.2. Aggregate Made from Recycled Materials (CRD Waste)

The building sector disposes of trash in excess of 120 million tons across the globe. The majority of trash is made up of old construction materials that are dumped into rivers when buildings are demolished, causing marine and environmental issues. Due to a lack of knowledge in developing nations, materials are being dumped into rivers instead of being recycled. Material may be recycled in sustainable building utilizing modern equipment such as crushers. These crushers are used to turn waste into aggregate. It is difficult to remove cement from aggregate, and aggregate generated after crushing old material has a lower

compressive strength than new aggregate. However, recycling aggregate may be utilized in low-load structures such as partition walls or runway bases. Transportation of waste is also a significant issue. Instead of transporting the materials, a crusher is built, which converts them back into aggregate, which may then be delivered to another building site. Portable crushers are both environmentally friendly and simple to set up on the job site. Another issue is reinforcement separation, which may be accomplished by splitting slabs or beams into tiny pieces or using magnets. Recycled aggregate cannot be utilized in structures that withstand external loads due to its high water absorption capacity and poor strength carrying capability [9], [10].

3.3. Material Security:

Steel structures have robust characteristics, however they have the flaw of mechanical deterioration when temperatures are high. To address this flaw, a fire-resistant steel grade was developed, which also cuts down on building time. Mostly via fire-resistant concrete encased steel, although it increases the weight on the member by making it bulkier. There are a number of additional fire-fighting techniques mentioned below.

3.3.1. Spritz:

Any kind of insulating material may be sprayed over the member as a best option for protecting steel from any external response. Few insulating materials can be applied to the surface, therefore this method is employed, which is mainly for ceilings.

3.3.2. Application of the coating:

It's pricey, but it's worth it for the smooth surface. We paint the member normally in this kind, and a thin film layer of paint forms on the member as a consequence. As a consequence, when a member is exposed to fire, this layer expands and protects the member by preserving their temperature. It also improves the member's durability.

3.3.3. The demand for steel:

Steel is a one-of-a-kind element with a variety of characteristics, including steel type, strength, cost, time, and durability. Steel is readily accessible on the market in a variety of forms, and it is simple to move from one location to another.

The construction sector is now the world's biggest steel user, accounting for about half of all global steel consumption. The second biggest user is the transportation industry (shipbuilding, aircraft, armored vehicles, trucks, and rail). Around 14 percent of the world's steel is used by the equipment and metal goods industries.

3.4. Anti-corrosion protection:

Corrosion is the most serious issue with steel, although it may be readily remedied by using various materials and processes such as painting or galvanization. The most popular technique is to paint steel with red oxide paint, which is readily available on the market and may be used to protect it against corrosion. Galvanization is a contemporary technique of protecting steel that involves dipping steel members in zinc at 450°C, where zinc and iron react to create three zinc iron layers that grow tougher and protect the steel. It also defends itself against sulfide-chloride assaults. It's a pricey procedure, but it'll last a long time.

3.5. Cost and efficiency of steel:

Every individual on the planet has a desire to get maximum output with little expenditure. Steel is more expensive than aggregate, and most building is done using concrete, which is made up of aggregate, water, and cement. Steel is the most cost-effective building material than concrete from a financial standpoint. In most cases, only the initial construction cost is addressed during the design process. While the initial cost of steel is higher than that of cement or aggregate, it offers a number of advantages. Steel is long-lasting, generates little waste, and has a low environmental impact. Instead of considering the initial cost, the entire development cost is taken into account in sustainable building. In terms of development costs, steel structures are less expensive and more efficient than concrete structures. The following parameters may be used to estimate development costs:

3.5.1. Duration of Construction:

Steel as a construction material allows structures to be constructed in a short amount of time, while concrete construction takes time. Steel does not require a time period, curing, formwork, or plastering. In medium-rise buildings, it may save construction time by up to 40%.

3.5.2. Cost-effective characteristics:

Because steel building takes less time, it also saves money on construction costs. Concrete has a cheap initial cost, but it requires a lot of upkeep. Plaster, curing, and formwork are required to create a specific shape concrete structure, which is a time-consuming procedure that also consumes a significant construction cost. Concrete building also requires experienced personnel and sophisticated equipment, both of which are expensive. In the case of a commercial building, the customer wants to recoup their investment as quickly as possible, since a heavy construction requires a large amount of money. When a customer gets a loan from a bank and wants to pay it back to avoid paying interest, they may do it with steel construction in a matter of days rather than months with concrete building. Steel structures are low in weight, take less time to build, and put less strain on the foundation. Steel structure design is simple since it considers the whole design process from the commencement of construction to the project's completion, including cladding, finishing, and so on. Concrete construction is a time-consuming procedure that requires additional time, effort, and expense for curing and finishing, while steel construction saves these factors.

3.5.3. Roof that is Long-Lasting:

A roof structure that is covered with a few plants or flora is referred to as a sustainable or green roof. The kind of plants that may be placed on a roof vary depending on the location and temperature. Grass is utilized in agricultural regions, while in urban areas, plants such as sedum or succulents are used using a multiple layer method.

3.6. Green Roof Classification

3.6.1. In-depth:

This kind of roof requires a strong covering of earth ranging from 1 to 15 feet thick. Lawns and bushes may be utilized in these kinds of roofs, but they have implications for the construction, requiring a robust surface layer to withstand the roof's high weight. These roofs may be placed on big, hefty multi-story structures that are not suited for residential use, and they also require a sufficient drainage system to sustain plant life. This roof is expensive since it requires a substantial framework to sustain the weight of the roof.

3.6.2. Comprehensive:

Green roofs with a thickness of 2 to 6 inches are appropriate for residential buildings. The plants used on this roof have a tiny fiber structure, so they don't add much weight to the roof. Because of the light weight of the plants, a solid foundation is not needed; a few inches of soil is sufficient to sustain the weight of the plants. These kinds of roofs do not need a good maintenance system; simple upkeep is all that is required to keep plant life alive.

3.7. Plants for Green Roofs:

Plants play a significant function in a green roof, and their selection is critical. Fibrous plants are preferred in residential structures, but only to a certain degree. Plants with a lot of roots put a lot of pressure on the roof, which may lead to structural collapse.

3.7.1. The sedum:

Stone crop, commonly known as sedum, is one of the best plants for green roofs. Sedum is the green roof's oldest and most basic component. Because of the small roof and pleasant atmosphere, little tiny succulents are usually utilized in the roof.

3.7.2. Grassland

Plants that are drought resistant and have the ability to withstand sunshine and wind storms are utilized in the event of an extensive roof system. Grasses placed in front of homes, such as lawns, packs, and so on, can't handle weather fluctuations, which is why grass isn't a good choice for a green roof system. To

address this problem, grass-like plants are employed, but they are not the same as the grass used in lawns. Potentilla, Armeria, and Carex Nigra are grass-like plants that bloom in purple and pink throughout the summer. It is sometimes used in conjunction with sedum to create a nice atmosphere. It is essential for the structure to be robust enough to sustain the roof load.

4. DISCUSSION

Because of the contaminated environment, the idea of a green roof is the most recent and widely adopted. Heavy industry and motor transportation are significant sources of pollution in developed nations. CFCs have also degraded the ozone layer. Ozone has been depleted as a result of dealing with dangerous radiations, which has a negative impact on human health. Green roofs make the atmosphere more pleasant, clean, and green for the people who live there. Plants on the roof assist to enhance air quality by lowering pollution levels. Photosynthesis, in which plants release oxygen into the atmosphere, cleans the air, making it better for people to breathe. The use of plants in roof systems helps to collect carbon dioxide and convert it into oxygen, resulting in a clean and green atmosphere. The green roof system is effective in reducing noise and sound, as well as acting as a strong thermal insulator. Green roofs also adapt to changing climates; in the summer, they serve as a heat barrier, and in the winter, they act as a cold barrier. It keeps the building's interior temperature constant and maintains a comfortable level regardless of the season.

5. CONCLUSION

The needs of society and the future generation must be met, but it is also essential to conserve natural resources while minimizing environmental damage via sustainable building. It also benefits the economy by lowering building costs and reducing trash production. Future generations' needs will be met in design by adhering to standards such as the green mark, and natural resources will be preserved throughout construction. By using environmentally friendly materials such as glass and steel, for example. By following the Green Inside guidelines, the interior of the building becomes more comfortable and appealing while also conserving energy. Waste is a significant impediment to sustainable construction, but it may be mitigated by repurposing existing building materials via recycling. Because it produces less environmental damage, the idea of green roofs is contemporary and appealing all over the globe. From the planning phase through the completion phase of a project's development, sustainable building methods must be used. Not only in building, but also in socioeconomic growth, it is essential to alter existing policies by using sustainable methods. Because technology is always changing, researchers should stay up with current events. For a better social and economic side of sustainable building, they should follow and apply the newest methods in the construction sector.

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