

POTENTIAL REUSE OF SUSTAINABLE CONSTRUCTION MATERIALS FOR GREEN BUILDINGS PROMOTING SUSTAINABLE DEVELOPMENT

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Abstract

This study aims to show that renewable materials are simple to produce and have practical applications in society. Due to its many benefits, sustainability in construction is now given top importance. Since sustainability is becoming more and more popular on a worldwide scale, building sustainably is crucial for the construction sector. Numerous environmental problems are emerging as a result of rapid urbanization. By using sustainable building materials, pollution will be reduced, and the state of the environment's issues will also improve. The use of repurposed design goods in the building sector is covered in this paper. There is a high demand for affordable sustainable housing developments built with materials that can be found nearby. It protects the economy, energy, and natural ecosystem. This substance is also environment friendly. The investigation was conducted using observations, precedents, and a literature review method. The findings suggest that using sustainable materials, like bamboo and recycled plastic refuse, can be used to their full potential. In closing, we can learn the value of locally produced materials and the significance of using sustainable materials.

Introduction

India ranks as one of the largest and most populous countries in the globe, with 138 crore people as of 2020. India is a developing nation with numerous infrastructure projects ongoing, and the government has also declared the country's 100 Smart Cities. As a result of the present trend towards sustainability, sustainable building construction is of utmost importance in the construction sector. Numerous environmental problems are emerging as a result of extensive urbanization activities. Modern facilities and technology use more energy, which has an adverse effect on the ecosystem. In addition, urbanization causes massive amounts of materials and energy to be consumed as well as massive amounts of carbon dioxide to be released into the atmosphere, all of which contribute to pollution. These days, the condition of the planet is quite alarming, especially in light of the problem of global warming brought on by human activities like manufacturing and the use of environmentally unfriendly materials. All of that contributes to global warming, which is harmful to the planet. Reducing the effects of global warming and implementing the Sustainable Design principle are two answers. Buildings have an effect on their surroundings, which causes them to contribute to global climate. In order for the top of the groundwater to recede, it is necessary to

extract the most groundwater and waste the most water. The environment is polluted by a lot of refuse, including garbage, unclean water, and household waste. In particular, the heating from the AC unit, it is causing greenhouse gas impacts. Additionally, it has negative effects on users, such as disrupting their health and making tasks less efficient. Additionally, when construction starts, it also contributes to a number of negative environmental effects, beginning with waste products, noise, smoke, and dust, among others. A number of architects and other experts put forward and created solutions to these effects, beginning with how to make some recycled materials, build a home to expand, and construct a structure that is light and quick. Adopting the idea of green building becomes the primary remedy for achieving environmental balance. Since its inception in 1970, the activist sustainable design movement has been applied to numerous structures. There are a lot of energy-efficient buildings at that period. One implementation of sustainable materials is Ecobrick, where the material is made of plastic and used bottle waste that is combined to create various modules. At first glimpse, it appears that producing sustainable materials is simple and has the potential to lessen the effects of global warming. In light of this, study into the creation of Sustainable Material is required. As a result, we can determine whether Sustainable Material can be produced simply in order to mitigate the effects of global warming. This study aims to show that a sustainable substance is simple to produce and functional. Materials are crucial to the creation of buildings. Building mechanical strength is a result of the chemical, physical, and mechanical properties of the materials as well as a suitable design. Thus, the use of environmentally friendly materials with comparable or superior features to conventional construction materials should be the first step in the design of green buildings. Building materials are typically chosen based on their ability to meet functional, technical, and budgetary needs. The building industry, which is directly or indirectly responsible for a sizeable portion of the annual environmental degradation, can now accept the responsibility of making a contribution to sustainable development by identifying more environmentally friendly construction and building techniques.

Methods

Several instances of sustainable materials and how to manufacture and process them will be covered in this study, which used data processing techniques like data retrieval. Descriptive quantitative research attempts to explain and summarise different conditions, circumstances, or different variables that occur in the community. The case study research can be conducted in a descriptive style. We used the questionnaire as a means of distribution as well. Qualitative research aims to comprehend an event that was studied using analytical techniques. The application of sustainable design and sustainable materials to the effects of globalisation is described in this account. The descriptive method is a way to discover facts that can be properly interpreted by looking at issues in a particular community's circumstance or time period, such as the Several instances of sustainable materials and how to manufacture and process them will be covered in this study, which used data processing techniques like data retrieval. Descriptive quantitative research attempts to explain and summaries different conditions, circumstances, or different variables that occur in the community. The case study research can be conducted in a descriptive style. We used the questionnaire as a means of distribution as well. Qualitative research aims to comprehend an event that was studied using analytical techniques. The application of sustainable design and sustainable materials to the effects of globalization is described in this account. The descriptive method is a way to discover facts that can be properly interpreted by looking at issues in a particular community's circumstance or time period, such as nation's sustainable growth benefits from choosing building materials with minimal environmental impact. In order to create healthy buildings that can be sustainable for both the occupants and our ecosystem, this paper will emphasize how sustainable building materials can help to lessen the effects of environmental degradation.

Design and development of Green Buildings and Infrastructure

Green Building (GB) is a new building philosophy that promotes the use of more environmentally friendly materials, the implementation of techniques to conserve resources and reduce waste production, and the improvement of indoor environmental quality, among other things [1, 2]. Its goal is to lessen the impact of buildings throughout their life cycle. Benefits for the ecology, money, the economy, and society could result from this. For instance, installing high-efficiency insulation and lighting systems[3] or choosing appropriate materials[5,6] that take into account factors like daylight roof reflection can result in savings in operation and maintenance expenses for GBs. The decrease in health expenses and the increase in employee productivity [3, 5, 6] as a result of their perceived happiness with their workspaces [7] are additional major benefits of GBs related to improvements in indoor environmental quality. Intangible advantages like the goodwill of the building and builder and perceived added value must also be taken into account for the simple reason that they may influence the choices made by investors and prospective owners [10, 9]. Even though they have been proven to be beneficial, GBs are not yet viewed as desirable projects because most architects associate green features with pricey technologies that raise costs (such as photovoltaic panels and grey water reuse systems)[2,8]. However, rather than a significant investment in technology, a careful design process and a thorough material selection method may be adequate to achieve ideal environmental goals at a lower cost. The typical investment cost per square foot for some GBs, like academic buildings, laboratories, community centers, and ambulatory care facilities, is actually not significantly different from that of non-green buildings with the same characteristics [7]. Additionally, over time, GBs offer better dividends [3, 5, 6], recovering up to 10 times the green premium through the realization of expected benefits [6]. The effectiveness and caliber of the implemented green systems will determine a GB's accomplishments. Since the market requires that the minimum green standards have been met, GBs must be distinguished from conventional buildings using standardized, transparent, objective, and verifiable green performance measures.

On-Ground Complexities in Materials

The task of building materials can take many different shapes. As previously mentioned, the grey energy and emissions must be taken into consideration, and compared to building operations, the production of building materials uses more high value energy and resources. Additionally, there are restrictions on the extraction of resources used in many building ingredients, and there are environmental problems with the by-products of the materials used in buildings. In addition, one should think about the infrastructure that supports the built world. Numerous technical developments must be made to address the issues with resource scarcity, corrosion, pollution, durability, lifespan, etc. that are connected to building materials. First, new construction must be built more responsibly so that it not only minimises the negative effects of construction and operations, but also significantly increases building lifespan, which can be accomplished by removing design elements that will be quickly outmoded. Additionally, all necessary components should be made with short lifespans and intended for recycling or raw material recovery. To achieve a fully sustainable solution, this must be accomplished in every way by meticulously dissecting the complexity of the building into its constituent parts and understanding practically any trade-offs among systems. Understanding the rapidly expanding selection of materials that are readily accessible to construct structures, enclosures, and systems can help with this.

Green Building material Selection

The use of durable, aesthetically pleasing, and environmentally friendly construction materials is an essential component of any high-performance building project. The wellbeing of the occupants and a sense of connection with the abundance of the natural world are enhanced by the use of natural and healthy materials. Numerous building materials deplete natural resources, release pollutants, and destroy habitat, all of which

have a significant negative impact on the ecosystem. This will take place during raw material extraction and acquisition, manufacturing and production operations, and shipping. Additionally, some building materials expose employees and building occupants to toxic and dangerous chemicals, which could be harmful to their health. Therefore, the identification and choice of environmentally preferable materials for use in construction activities at the pre-building phase offer a chance to limit such effects on the environment and human health. The resources utilized to make building materials have an impact on the ecosystem because they use energy, deplete natural resources, and discharge pollutants into the air, water, and land. Materials that contain these ingredients have a negative effect on human health either directly or through the release of volatile components into the air. It is preferable to base material decisions on a thorough analysis of the environmental costs associated with the complete product or material. For the majority of building procurement choices, this procedure, known as environmental life-cycle assessment, is rarely practical. However, life cycle thinking can be used to assess the information available regarding the environmental performance of goods and help consumers make informed decisions.

Sustainability evaluation of Materials

It is preferable to base material decisions on a thorough analysis of the environmental costs associated with the complete product or material. For the majority of building procurement choices, this procedure, known as environmental life-cycle assessment, is rarely practical. However, life cycle thinking can be used to assess the information available regarding the environmental impact of goods and help consumers make informed decisions. Three phases, Pre-Building, Building, and Post-Building, could serve as a useful organizational framework for a material's life cycle [2]. These periods correspond to the phases of the building's life cycle. Instead of just accounting for initial construction expenses, the environmental impact of building materials can be evaluated at every stage, allowing for a lifetime cost-benefit analysis of a structure. The Pre-Building Stage describes a material's manufacturing and distribution procedure up to the point of installation but excluding that step. This entails locating raw materials in the natural world, as well as their discovery, extraction, production, packaging, and transfer to a construction location. This period in particular has the greatest potential to harm the environment. Making informed decisions about construction materials during the planning stage will help the environment. Environmental effects are caused by the methods used to obtain raw materials, the production procedure, and the distance between the manufacturing facility and the construction site. Understanding the origins of building materials is essential to comprehending their overall environmental effect when used in a particular type of building. The added and economic worth of bamboo is being increased through bamboo planting, bamboo processing, hitech uses, and preservation technology. One of the modern era's most advanced and frequently used building components is bamboo. Bamboo is robust, resilient, and simple to grow. Bamboo can be preserved for decades with the right techniques. Here is how bamboo products are used. The useful life of a construction material is referred to as the building stage. This stage begins at the point where the material is put together into a structure, lasts the entire lifespan of the material inside or as a component of the building, and includes care and repair of the material. On a construction site for a structure, a lot of material waste can be produced. At this point of the building process, it is important to choose building materials that will produce the least amount of construction waste and waste that can be recycled. There is little attention paid in reality to choosing content based on their potential to outgas harmful chemicals, requiring periodic cleaning with such substances, or requiring frequent replacements that maintain the exposure cycle, despite growing awareness of the environmental health problems associated with exposure to a variety of products. The construction materials that have reached the end of their useful life in a structure are referred to as the post-building stage. At this point, a substance may be recycled entirely, have components used again in other products, or may even be discarded. According to the designer, the end of a building or material's useful life is possibly the least measured and least understood

part of the building's life cycle. Building deconstruction and waste removal have a significant negative impact on the ecosystem. When combined with other materials or used alone, degradable materials have the potential to produce hazardous garbage. Waste materials progressively fill up limited landfill space. The energy invested in the materials and building of an existing structure is sustained by its adaptive recycling. If these resources are not efficiently used, the energy used in the building's creation alone and the production of it will be wasted. When one or both of these elements are present, the building material can be considered ecologically sustainable. The table 1 below contains a list of some of the more well-known elements of sustainable construction materials.

Component of Sustainable Green Building Materials		
Manufacturing Process (MP)	Building Operations (BO)	Waste Mgmt. (WM)
Waste Reduction (WR)	Energy Efficiency (EE)	Biodegradable (B)
Pollution Prevention (P2)	Water Treatment & Conservation (WTC)	Recyclable (R) Reusable (RU)
Recycled (RC)		
	Nontoxic (NT)	Others (O)
Embodies Energy Reduction (EER)	Renewable Energy Sources (RES)	
Natural Materials (NM)		
	Longer Life (LL)	

Table 1: Materials related to green building designs

Basic Principles of Green Buildings and Infrastructures

It is stated that various countries have their own unique strategies and priorities regarding the principles of sustainable construction in the CIB study on Agenda 21 on sustainable construction [22]. According to the report, ecological effect on the environment is the main focus of sustainable building and design from a global perspective. Sustainable building materials were strongly advised in Fisher's five sustainable design guidelines.

- i. It is imperative to take every precaution to prevent the interior atmosphere from being contaminated by toxic materials and construction systems. Filtration and planting are additional steps that will be taken to purify and revitalize indoor air.
- ii. It is imperative to take every precaution to limit the building's energy consumption. Systems for illumination, cooling, and heating must make use of energy-saving technologies and supplies.
- iii. Use of products and building materials that reduce environmental damage must be encouraged to the fullest extent feasible.
- iv. All reasonable steps should be made to relate the building's form to a peaceful coexistence of humans and nature.
- v. The connection between use regions, distribution, building form, mechanical systems, and construction technology must be efficient, long-lasting, and elegant.

These concepts also address societal and human long-term viability functional ecological responsibility, sustainability in the environment, and economic sustainability.

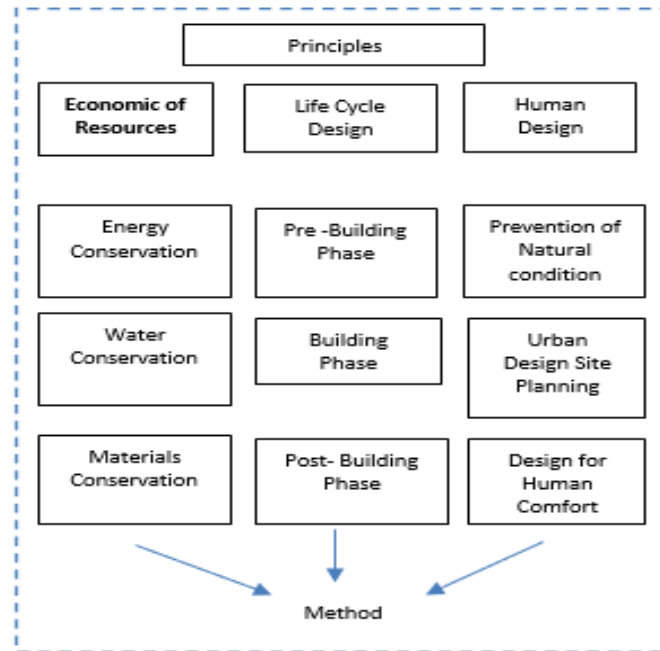


Fig 1: Basic principles of sustainable designs of green buildings

Conclusion

By definition, sustainable building materials are those that are domestically produced and sourced, reducing the cost of transportation and CO₂ emissions. They can also include recycled materials, have a lower environmental impact, are more energy-efficient than conventional materials, use renewable resources, produce fewer harmful emissions, and are economically viable. Every community development requires the correct and contextual use of a sustainable building material. Utilizing sustainable building materials not only reduces transportation expenses, carbon emissions, and, in most instances, material costs, but it also provides community members with employment and skill-development opportunities. Functional, technical, and financial criteria are typically used to select sustainable construction materials as an alternative. However, with sustainability emerging as a major issue in recent decades, especially in wealthy countries, the environmental impact of building materials has also grown as a crucial requirement. The construction industry, which is responsible for a significant portion of yearly environmental destruction, may accept the responsibility of promoting sustainable development by adopting more environmentally friendly construction and building techniques. New material applications, reuse and recycling, sustainable product manufacturing, or the use of green resources are a few of the paths for finding solutions.

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