Green Architecture: Green Building Concepts to Ensure a Green Future

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Abstract. The present study involves an examination of the concept of green architecture, which is related to the search for and determination of the most appropriate methodology for constructing green buildings and, correspondingly, green spaces. This connection is rooted in the fact that any form of green building is inherently linked to the initial step - the development or planning of a specific area, which, in turn, enables the design and construction of green buildings, followed by the development of green spaces. Together, green building and the surrounding green spaces for constructed buildings and structures ensure the safety and protection of the ecological system. Furthermore, this study unveils the social aspect of green building in relation to the urbanization of areas, internal migration, and the resolution of environmental issues. In this context, through an analysis of various case studies and real-life examples, the study explores the economic, social, and environmental impacts of green buildings and discusses key strategies for their design and construction.

INTRODUCTION

The relevance of the topic under study is determined by the essence and functionality of green architecture in the context of globalisation processes on a global scale. These processes are associated with the restoration of market relations, the revival of private property, and, as a consequence, the growth of internal and external migration in each individual country and, more broadly, in the global community. This, in turn, implies the introduction of green architecture as a factor for environmental safety in developed, post-industrial, and developing countries [1, 2].

The aim of the study is to uncover the social nature of green architecture as the foundation for green construction. This endeavor involves analyzing the process of urbanization, which is linked to the increasing role of cities in societal development, along with the rise in internal migration from rural areas to major cities in various countries. Additionally, the task of this study is to justify the prospects of green construction within the context of ensuring the ecological balance of nature and the social well-being of urban populations. Consequently, there arises a societal demand for the design and implementation of a green building model, regarded as ecological construction itself (or eco-building, eco-development). This model represents a
type of architecture and construction that simultaneously maximizes ecological safety for both nature and the urban population of the country.

The problem of providing green buildings is dialectically connected to the process of urbanization in the conditions of increasing industrialization in the modern world. This, in turn, has led to the emergence of an environmental crisis in the natural and social systems of large cities worldwide. This crisis is manifested in negative global-scale phenomena such as resource depletion, environmental pollution, and climate warming.

The process of urbanization itself is associated with the industrialization of the economy, as it is a prerequisite for the creation of advanced technical means of production in large industries. This shift emphasizes the crucial role of urban construction in ensuring urban planning and architecture that prioritize ecological considerations. Urbanization is driven by factors like the industrialization of production processes in large urban areas, internal migration of young people from rural to urban areas, and the deepening of territorial division of labor. Urbanized territories encompass administrative or private land areas within cities and urban-type settlements [3, 4].

**METHODS**

Based on the specific characteristics of urbanization, the implementation of green architecture takes place [5]. This involves the selection of rational methodological approaches for developing and designing models and projects for constructing green buildings. These approaches consider the preservation of both the natural environment and the well-being of the urban population. Green buildings are constructed in alignment with this philosophy, and it's worth noting that the raw materials for green building come from natural and renewable sources [6, 7].

Within the context of green architecture, the practical significance of green building lies in the development of innovative technologies aimed at implementing planned environmental programs and activities. This ensures not only the development and implementation of Green City Action Plans but also the ongoing protection of both the natural and artificial environments for city residents [8, 9].

**RESULT**

**Concept and Characteristics of Green Building**

The concept of green building has evolved in response to various environmental and socio-economic concerns of society. While history is replete with examples of sustainable and environmentally practical building principles, the modern green building movement as we know it today began to take shape in the second half of the 20th century. Today, green building continues to evolve due to ongoing research, technological advances, and a growing global awareness of the importance of sustainability and environmental stewardship in the built environment. The aspect of combating climate change and creating a more sustainable future remains important.

A green building, also known as a sustainable building, is a structure designed to minimize its impact on the environment while enhancing the health and well-being of its occupants. Green building focuses on creating environmental and technical conditions that benefit the inhabitants throughout the design, construction, and operation phases.

Green buildings aim to reduce energy consumption by adopting energy-efficient technologies and features such as LED lighting, energy-efficient windows, insulation, and...
high-efficiency HVAC systems. These measures not only reduce the carbon footprint but also lower operating costs.

Characteristics of Green Buildings:

1. Energy Efficiency: Green buildings prioritize minimizing energy consumption through the adoption of energy-efficient technologies, including LED lighting, energy-efficient windows, insulation, and high-efficiency HVAC systems. These measures significantly reduce the carbon footprint and operating costs.


3. Integration of Renewable Energy Sources: Many green buildings incorporate renewable energy sources such as solar panels, wind turbines, or geothermal systems. On-site renewable energy generation reduces dependence on fossil fuels and indoor greenhouse gas emissions.

4. Environmental Quality: Green buildings prioritize the health and well-being of their occupants. They ensure good indoor air quality by using low-emission materials, appropriate ventilation systems, and natural lighting. Sufficient sunlight and access to outdoor views contribute to creating a comfortable living environment, defining the performance of building projects.

5. Waste Minimization and Recycling: Green buildings aim to minimize waste during construction and operation. They include recycling programs and use materials that are easily recyclable or biodegradable, reducing the amount of waste sent to landfills.

Impacts of Green Building

Environmental Impacts. Green buildings reduce greenhouse gas emissions and energy consumption by improving energy efficiency and integrating renewable energy sources. They also conserve water resources, reduce water consumption, and prevent water pollution through efficient water management. Additionally, they protect the natural ecosystem through the selection of environmentally friendly materials and recycling techniques.

Social Impact. Green buildings have a positive impact on indoor air quality and occupant health. They enhance the comfort and well-being of building occupants while promoting community responsibility for environmental protection. Moreover, green buildings often foster social interaction and a sense of community through the design and creation of sustainable public spaces and amenities. These buildings also play a significant role in creating local green jobs and supporting the sustainable development of related manufacturing industries. As beacons of sustainable living, green buildings raise awareness of the importance of environmental responsibility, inspiring individuals and organizations to adopt more environmentally friendly practices. This, in turn, contributes to the collective effort to build a more environmentally and socially conscious society.

Economic Benefits. Green building offers numerous economic advantages that make it an excellent choice for individuals, businesses, and communities. One of its primary benefits is long-term cost savings. Through energy-efficient design, the integration of renewable energy sources, and water conservation measures, green buildings can significantly reduce utility bills and operating costs, leading to overall savings. Additionally, these buildings tend to have higher market values and command higher rents, thus contributing to increased property values and competitiveness in the market.

Green buildings also enhance indoor air quality and improve the health of their occupants. They promote occupant comfort and well-being, as well as community development that fosters...
a sense of responsibility for environmental protection. This is achieved through the provision of public spaces and amenities within green buildings, as mentioned earlier, which facilitate social interaction among the building's communities. Furthermore, green buildings play a pivotal role in creating local green jobs and supporting the sustainable development of the green building industry.

**Barriers to Green Buildings**

Despite its numerous benefits and the potential positive environmental, social, and economic impacts, green building still faces several barriers to widespread adoption.

**Challenge 1: Higher Initial Costs for Sustainable Technologies and Environmentally Friendly Materials.** The initial investment required for green buildings can be higher compared to traditional construction methods, which can discourage some developers and property owners.

**Challenge 2: Lack of Awareness and Understanding of Long-Term Benefits.** A lack of awareness and understanding regarding the long-term benefits of green building practices can lead to skepticism and resistance to change. Inadequate government incentives and policies to support green building initiatives can also act as barriers, as they may not yet effectively promote or reward sustainable practices. Particularly in less developed regions, the limited availability of skilled labor and expertise in green building technologies can further hinder the adoption of green building technologies.

**Challenge 3: Prejudicial Perceptions.** Prejudicial perceptions that green buildings may compromise aesthetic and functional aspects can discourage potential stakeholders from choosing green designs.

**Challenge 4: Regulatory Barriers, Lack of Political Support, and Inadequate Standardized Building Codes.** Regulatory barriers, a lack of political support, and the absence of appropriate standardized building codes can pose significant challenges to the widespread adoption of green building practices.

**Case Studies: Green Building Success Stories**

**Case 1: Bullitt Centre, Seattle, USA.** Built in 2013, the six-story commercial office building has earned recognition as one of the world's best. It is renowned as the "greenest and most energy-efficient" office building, consuming approximately 83% less energy than the average office building in Seattle, achieving zero energy and water consumption. The Bullitt Centre has garnered international acclaim for its exceptional sustainability performance and zero-energy status.

Designed to meet the rigorous standards of the Living Building Challenge, the Bullitt Centre incorporates a variety of advanced technologies and environmentally friendly design elements.

The Bullitt Centre features rooftop solar panels that produce more energy than the building consumes, along with an innovative rainwater harvesting system that fulfills all of the building's water needs.

It provides exemplary sustainable resource management. Its efficient envelope design maximizes natural light while minimizing heat loss, and its bio-toilets ensure zero wastewater discharge.

The Bullitt Centre's commitment to sustainability is further underscored by the low environmental impact of its building materials. Not only does the Bullitt Centre minimize its ecological footprint, but it also creates a healthier and more productive working environment for its occupants. This landmark building serves as a globally influential example of green architecture, demonstrating to the world that it is indeed possible to construct buildings that seamlessly integrate sustainability, energy efficiency, and human well-being.
Case 2: One Angel Square, Manchester, UK. The 14-story building, completed in 2013, houses the Co-operative Group's headquarters. It has achieved the highest possible BREEAM rating, recognizing its superior quality and environmental performance. The building's energy-saving features include an advanced mixed ventilation system, advanced heat recovery mechanisms, and a state-of-the-art building management system that optimizes energy use. One Angel Square has been designed to maximize the use of natural light while minimizing solar heat gain, and photovoltaic panels are used on the facade and roof of the building to generate renewable energy. Additionally, the building incorporates rainwater harvesting and wastewater recycling to significantly reduce water consumption. With a focus on sustainability, this green building sets a new standard for sustainable construction in the UK and serves as a prime example of how innovative design and technology can create greener, more efficient, and aesthetically pleasing buildings.

Case 3: Shanghai Central Tower, China. Shanghai Central Tower is an extraordinary green building success story that has won global recognition for its pioneering sustainable design. Completed in 2015, this 127-story, 632-meter-high skyscraper is one of Shanghai's tallest and most iconic buildings. The tower takes a holistic approach to sustainability, utilizing advanced technologies and strategies to minimize its impact on the environment. Its striking double-layer facade acts as a thermal buffer, providing improved insulation and reducing energy consumption for heating and cooling. The tower features an energy-efficient lighting system and advanced water conservation measures that significantly reduce energy and water consumption. Additionally, Shanghai Central Tower has an extensive rainwater harvesting system, which not only conserves water but also helps irrigate the building's lush vertical gardens. The harmonious balance between modernity and sustainability makes it clear that this green building symbolizes China's commitment to sustainable urban development and has ushered in a new wave of eco-friendly buildings worldwide.

Case 4: Oasis School in Kyrgyzstan. The Oasis School in Kyrgyzstan serves as an outstanding green building success story, demonstrating the power of sustainable buildings in an educational environment. This innovative school, built in 2019, is a model of environmental care and community empowerment. The building is designed to harmonize with the surrounding landscape, using local, sustainable materials with minimal impact on the environment. The school's energy needs are met through a combination of solar panels and installed wind turbines, ensuring a supply of clean and renewable energy. Additionally, passive design strategies such as natural ventilation and daylight optimization reduce the school's energy consumption while providing a comfortable and supportive learning environment for students. The Oasis School also promotes water conservation through rainwater harvesting systems and efficient plumbing fixtures, thereby reducing water consumption. Besides its sustainability features, the school fosters environmental education by instilling in students a sense of environmental responsibility and empowering the local community to adopt sustainable practices. The Oasis School serves as a testament to the transformative potential of green buildings to positively impact the environment, student life, and the surrounding community.

Key Strategies for the Design and Construction of Green Buildings

Green building site selection and landscaping play a crucial role in sustainable design, significantly enhancing the environmental performance and livability of these structures. During the site selection process for green buildings, various environmental factors, such as solar orientation and prevailing winds, are carefully considered. This thoughtful approach to site location maximizes the utilization of natural light, reduces the dependency on artificial lighting and heating, and enhances indoor air quality.
Additionally, green building landscaping should prioritize the use of native and drought-tolerant plants that require less water and maintenance. Incorporating permeable surfaces and implementing rainwater harvesting and retention systems can effectively manage stormwater runoff, lessening the load on municipal infrastructures. Green roofs and walls can further boost energy efficiency and biodiversity in urban areas, providing insulation as well. By adopting well-considered green building solutions, harmony with the environment is achieved, sustainability is promoted, and contributions are made to the overall well-being of residents and the planet.

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Energy efficiency guidelines are essential for green buildings to minimize their environmental impact and maximize energy efficiency. Prioritizing efficient design strategies is crucial in this regard. This includes optimizing the building's orientation to utilize natural light and passive solar heating. Additionally, incorporating energy-efficient windows with low-emission coatings and double or triple glazing can reduce heat transfer and enhance thermal comfort within green buildings.

Consider the impact of construction on the life cycle of materials and choose sustainable and environmentally friendly materials that require less energy during production and are recyclable or biodegradable at the end of their useful life. For instance, high-performance insulation should be used to maintain a stable room temperature, thereby reducing the constant need for heating or cooling. High-performance insulation materials such as spray foam or cellulose can significantly enhance a building's energy efficiency.

**Configuration Management and Evaluation Systems**

Configuration management and evaluation system strategies are pivotal in successfully designing and constructing green buildings that promote sustainability and environmental responsibility. These strategies encompass meticulous planning, organization, and monitoring of
all elements involved in the building process to ensure seamless integration and sustainable practices.

Key elements of this process include conducting a comprehensive life-cycle assessment to evaluate environmental impacts, establishing clear sustainability goals, and adhering to recognized green building standards and certifications, such as LEED (Leadership in Energy and Environmental Design). Effective collaboration among architects, engineers, and contractors is facilitated through robust configuration management techniques, including design and document version control, to ensure compliance with environmental goals. Moreover, continuous monitoring and evaluation during the construction phase identify any deviations from green practices, enabling timely corrective action.

DISCUSSION

If an efficient ventilation and air conditioning system is adopted, the choice of HVAC system should prioritize energy efficiency and proper sizing to meet the building's needs. Utilizing advanced technologies like variable refrigerant flow (VRF) or geothermal heat pump (GSHP) systems can significantly reduce energy consumption [10].

The implementation of smart building and energy technologies in the control system enables real-time monitoring and optimization of energy use, allowing better management of climate control, lighting, and other energy-intensive systems. Regular commissioning and monitoring of building systems ensure they operate at peak efficiency, identifying areas for improvement.

CONCLUSION

Green buildings mark a transition toward a more sustainable and environmentally conscious future. By leveraging innovative design, resource-efficient technologies, and sustainable building materials, green buildings significantly reduce their carbon footprint while fostering a healthier and more comfortable living environment. These structures exemplify the harmonious coexistence between humans and nature, striking a balance between human needs and the conservation of Earth's precious resources.

As the imperative to combat climate change and protect the environment becomes increasingly evident, and as awareness and acceptance of green building practices continue to grow, investing in these practices is no longer merely an option but a responsibility and a strategic investment in shaping a greener and healthier world. Through collaborative efforts spanning builders, architects, and society as a whole, sustainable green building practices should be championed as a top priority, ensuring a greener and more sustainable future for generations to come.

REFERENCES

4. I. Krasnikova, O. Mudrakova, E3S WoC 515, 02024 (2024)