World Journal of Innovation and Modern Technology, Vol. 6, Issue 6, (Dec) 2023
ISSN 2682-5910
DOI: 10.53469/wjimt.2023.06(06).11

On the Application of Green Building Materials in Construction Technology of Building Projects

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Abstract: ***The application of green building materials in construction engineering technology has become increasingly important for solving environmental problems and promoting sustainable development. This article first explores various examples of green building materials, including recycled, renewable, and low emission materials. Then, in-depth research was conducted on the practical applications of green building materials in construction engineering, such as sustainable site development, energy-saving design, water efficiency, and indoor environmental quality. However, it is necessary to consider challenges such as cost impact, material availability, and compatibility with existing practices in order to promote green and sustainable development in the construction industry.***

Keywords: Green building materials; Construction engineering; Application; challenge.

1. INTRODUCTION

The integration of green building materials into construction projects is crucial for reducing the environmental impact of the construction industry. There are many types of green building materials, including recycling, renewable, and low emissions, and attention should be paid to the practical application of green building materials in construction. At the same time, the adoption of these materials and technologies faces challenges, so it is necessary to actively address and solve them. Ultimately, the construction industry can take a significant step towards a more sustainable and ecologically conscious future.

2. TYPES OF GREEN BUILDING MATERIALS

Green building materials play a crucial role in sustainable building practices by reducing environmental impacts and promoting healthier living spaces. These materials can be divided into three categories: recycled materials, renewable materials, and low emission materials.

2.1 Recycling materials

Recycled materials are products made from post consumer or industrial waste. They reduce the demand for raw resources and transfer waste from landfills. Common recycled materials include:

(1) Recycled wood

Recycled wood originates from old buildings, barns, or other structures planned for demolition. After cleaning, refurbishment, and reuse, it can be used for various applications in buildings, such as floors, wall panels, and furniture. The use of recycled wood not only protects forests, but also adds a unique rustic charm to interior decoration.

(2) Recycled steel

Recycled steel originates from scrap metal, usually from old cars, appliances, or dismantled structures. It undergoes a melting and refining process to manufacture new steel products. The use of recycled steel in construction can reduce energy consumption and greenhouse gas emissions related to steel production, and also contribute to the disposal of steel waste.

(3) Recycled glass

Recycled glass is obtained from consumer glass containers such as bottles and cans. It can be used for various building materials, including countertops, tiles, and insulation materials. Recycling glass can save raw materials, reduce energy consumption in the manufacturing process, and reduce the amount of glass waste in landfills.

2.2 Renewable materials

Renewable materials come from rapidly replenishing natural resources harvested in a sustainable manner, and they are environmentally friendly alternatives to traditional building materials. Common examples include:

(1) Bamboo

Bamboo is a fast-growing grass that can be harvested for construction purposes in just a few years. It is very sturdy and versatile, suitable for floors, cabinets, and even structural components. Bamboo is considered renewable because of its fast regeneration speed, which reduces the pressure on traditional wood resources.

(2) Cork

Cork is obtained from the bark of cork oak trees and will naturally regenerate after harvesting. It is a lightweight and durable material used for flooring, wall coverings, and insulation materials. Cork is sustainable because its extraction does not harm trees, and the bark will regrow over time.

(3) Straw bales.

Straw bundling is a natural building material made from agricultural by-product straw. They are commonly used for walls and insulated straw bundling structures. Straw bales are renewable, biodegradable, and have excellent insulation properties, which can improve the energy efficiency of buildings.

2.3 Low emission materials

Low emission materials refer to materials that release the least harmful substances or volatile organic compounds (VOCs) to the indoor environment, which help improve indoor air quality and resident health. The main examples include:

(1) Low VOC coating

Low VOC (volatile organic compounds) coatings contain fewer chemicals that can evaporate into the air, leading to indoor air pollution. This type of coating has less toxicity and less impact on the environment. They come in a variety of colors and finishes to choose from, suitable for indoor and outdoor applications.

(2) Formaldehyde free insulation material

Traditional insulation materials, such as fiberglass, may contain formaldehyde, a known indoor air pollutant. Formaldehyde free insulation materials use alternative materials such as cotton, recycled denim, or wool, which can provide effective insulation without affecting indoor air quality.

(3) Natural fiber carpet

Natural fiber carpets are made from renewable plant materials such as sisal, jute, or wool. Unlike synthetic carpets, they do not release harmful volatile organic compounds and are biodegradable. Natural fiber carpets add a touch of warmth and sustainability to indoor spaces.

3. THE PRACTICAL APPLICATION OF GREEN BUILDING MATERIALS IN CONSTRUCTION PROJECTS

3.1 Sustainable Site Development

Sustainable site development involves responsible planning and design of construction sites to minimize environmental impacts and improve overall sustainability. This stage lays the foundation for environmental construction practices and includes various strategies.

3.1.1 Use of permeable paving materials

Permeable paving materials are an important component of sustainable site development, allowing rainwater to seep into the ground instead of flowing into rainwater ditches or causing erosion. These materials include permeable concrete, porous asphalt, and interlocking permeable pavers. For example, permeable pavers, which can be made from recycled materials such as broken glass, tires, or concrete aggregates. Design to allow rainwater infiltration, reduce flood risk and pressure on municipal rainwater systems [2].

3.1.2 Rainwater collection system

Rainwater collection is a practice of collecting and storing rainwater for various non drinking water purposes, such as landscape irrigation, flushing, and cooling systems. This technology reduces the demand for drinking water sources and lowers water costs. Specific application of green building materials: (1) Recycled rainwater buckets. Rainwater buckets used for collecting rainwater can be made of recycled plastic or reused food grade containers to reduce waste. (2) Green roof substrate. Green roofs can be integrated into sustainable site development, typically using lightweight, recyclable materials as a substrate for plant growth, which helps with rainwater management.

3.2 Energy saving design

The focus of energy-saving design is to minimize energy consumption and promote the use of renewable energy to power buildings. Green building materials play a crucial role in achieving this goal.

3.2.1 Thermal insulation and weather resistance technology

Appropriate insulation and wind and rain protection technologies are the foundation of energy-saving design, as they help maintain constant indoor temperatures, reduce heating and cooling needs, and ultimately save energy. The application of green building materials includes: (1) recycled insulation materials. Insulation materials can be made from recycled denim, cotton, or other sustainable sources. (2) Weather resistant barrier. These barriers are applied to the exterior of buildings, preventing air and water infiltration, and can be made of sustainable materials.

3.2.2 Solar panel installation

Solar panels are usually made of renewable materials such as silicon, which are used to generate electricity from sunlight. They are a symbol of energy-saving design and sustainable renewable energy. Specific application: (1) BIPV (Building Integrated Photovoltaic). These solar panels are integrated into building materials such as roof tiles or exterior walls, reducing the demand for traditional building materials and generating clean energy. (2) Sustainable installation system. The installation system of solar panels can be made of recycled steel or aluminum, thereby enhancing the overall sustainability of installation.

3.3 Water saving measures

3.3.1 Efficient pipeline installation

Efficient plumbing systems, including low flow toilets, faucets, and shower heads, aim to minimize water waste while maintaining functionality. Specific applications include: (1) Low flow pipeline devices. These devices can be manufactured using recycled brass or other environmentally friendly materials to reduce their impact on the environment. (2) Water saving frother. The faucet aerator is designed to reduce water flow and can be made of recycled plastic or other sustainable materials.

3.3.2 Grey water recovery system

The grey water recovery system captures and treats wastewater from sinks, showers, and washing machines for reuse for irrigation or flushing. This not only saves water, but also reduces the pressure on sewage treatment plants. The application of green building materials includes: (1) recycled plastic cans. Grey water storage tanks can be

constructed using recycled plastic to transfer waste from landfills. (2) Natural filtering materials. The grey water treatment system can use natural filtering materials such as sand and gravel to reduce the demand for energy intensive treatment processes.

3.4 Improving indoor environmental quality

3.4.1 Appropriate ventilation system

An appropriate ventilation system can ensure a continuous supply of fresh air while effectively removing indoor pollutants such as volatile organic compounds (VOCs) and allergens. Specific applications include: (1) energy-saving fans. The ventilation system can include energy-saving fans made of sustainable materials, thereby reducing energy consumption. (2) Recycle the air filter. Air filters can be made of recycled materials and are designed to effectively remove allergens and pollutants [4].

3.4.2 Natural light strategy

The natural lighting strategy maximizes the use of sunlight in indoor spaces, reduces the need for artificial lighting, and improves the overall indoor environment. Specific application: (1) Energy saving windows. Windows with low emissivity coatings can control the increase and loss of heat, while allowing natural light to enter. (2) Diffuse materials. The skylight and lamp holder can be made from sustainable sources, evenly distributing sunlight and reducing the need for artificial lighting.

4. 4 CHALLENGES AND REFLECTIONS ON USING BUILDING MATERIALS

4.1 Cost Impact

One of the main challenges related to green building materials is their cost. Many green materials, such as recycled wood, recycled steel, and high-efficiency insulation materials, often have higher upfront costs than traditional materials. This cost difference may prevent some construction projects from choosing green materials, especially those with tight budgets.

However, long-term cost savings related to green building materials must be considered. For example, energy-saving insulation and weathering technologies can significantly reduce the heating and cooling costs throughout the entire lifecycle of a building. In addition, the incentives and rebates provided by government departments for the use of green materials can help offset initial costs. As the demand for green materials increases, economies of scale may also drive future cost reductions.

4.2 Availability of Green Building Materials

The availability of green building materials may be a major issue, especially in areas where such materials are not easily accessible. Sustainable materials such as bamboo, cork, and natural fiber carpets may not be purchased or manufactured locally, resulting in environmental costs related to transportation.
To address this challenge, it is crucial to prioritize local procurement and regional manufacturing of green materials, which reduces carbon footprint related to transportation and supports local economic development. In addition, encouraging the development of sustainable materials industries in areas with insufficient services can help improve transportation convenience and reduce reliance on traditional building materials.

4.3 Compatibility with existing construction practices

Integrating green building materials into existing building practices may pose compatibility challenges. Traditional construction methods and standards may not meet the unique performance and requirements of green materials, which may lead to delays, additional costs, and potential conflicts with building codes.
To overcome this challenge, it is necessary to promote education and training within the construction industry. Construction professionals need to be familiar with the characteristics, installation techniques, and maintenance requirements of green materials. Building codes and regulations should also be updated to adapt to the use of sustainable materials and ensure they meet safety and performance standards. In addition, early involvement of all stakeholders in the project can help identify potential challenges and find innovative solutions.

5. CONCLUSION

In summary, the application of green building materials represents a crucial step towards environmentally responsible building practices. By utilizing recyclable, renewable, and low emission materials as well as sustainable building technologies, the ecological footprint of buildings can be reduced while improving their energy efficiency and indoor comfort. Overcoming obstacles will pave the way for the construction industry, not only meeting current needs but also ensuring a sustainable and eco-friendly future.

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