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Review on Living Material as a Building Facade the effect of Moss Growth on Building

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ABSTRACT: Moss concrete, also known as green concrete, is an innovative and sustainable building material that incorporates plant life within its structure. It is created by embedding moss or other small plants within the concrete mixture during the casting process. The moss grows and thrives within the concrete, providing numerous benefits both aesthetically and functionally. This paper reviews the properties of moss concrete as a green building material, including its environmental benefits, durability, and thermal properties. Additionally, it highlights the potential for moss concrete to reduce the urban heat island effect, enhance air quality, and provide insulation. The use of moss concrete in architectural and landscaping designs is also discussed, showcasing its versatility and adaptability in different settings. Moss concrete has the potential to change the way we design and construct buildings, offering a sustainable alternative to traditional construction materials. With its unique combination of functional and aesthetic properties, it is a valuable addition to the green building movement, and a promising solution for a more sustainable future.

I. INTRODUCTION

Moss concrete, also referred to as living concrete or green concrete, is a recent innovation of modern sustainable buildings that offers a durable, renewable, and environmentally friendly option instead of traditional concrete. It is a unique and innovative material that integrates natural moss and other plant life into a concrete surface, providing an aesthetically pleasing and eco-friendly solution that utilizes biophilic design elements. Moss concrete is made of Portland cement, water, sand, and an organic additive, which is a vital component for the growth of the moss. The concrete mixture is spread on the surface of the structure, and then a mixture of moss and other types of growth is applied on top of the concrete before it dries. After the concrete has set, moss starts to grow, creating a natural-looking and functional surface. Moss concrete can be installed on vertical and horizontal surfaces, including walls, pavements, roofs, and facades.

As a green building material, moss concrete holds several benefits over traditional concrete. By allowing moss and other plant life to grow, it provides thermal insulation, filtering air pollutants, reducing urban heat island effects, and absorbing rainwater, which helps reduce the runoff and improve water quality. The live moss serves as a natural insulator which helps in regulating the temperature in buildings, thereby reducing energy usage during both summers and winters. Moss also absorbs carbon dioxide, helping to reduce greenhouse gases and improve the air quality in urban areas.

II. LITERATURE REVIEW

Materials in architecture visualize design concepts and ideas into forms that influence spatial experience and provide a lively building (Farely, 2009). Building materials come from natural materials such as wood, bamboo, rattan, etc., which can be directly used in building construction. Building materials are also derived from earth materials such as minerals and stones that are used to mix materials such as concrete, marble, iron, steel, and glass (Deplazes, 2005). This study focuses on a material that is a hybrid between living material and a growing or planting medium (Trafton, 2014).

Mosses have a negative influence on building materials because they produce oxalic acid that can cause hydration in the material. Moss grows on historical buildings and causes erosion in the building materials. The erosion of building materials occurs due to the influence of weather and lack of maintenance (Lisci et al., 2003).



Research on overgrown moss on carved rocks in Wyoming showed that moss has both a negative effect (damage to the surface of material) and a positive effect (protection from rainwater and light) on the material. Positively, moss on the stone that provided by water and light become moss habitat, moss then fills cracks in the rock and indirectly coats the stone surface. Moss growth can be categorized as a negative value depending on the material properties—in this case, the size of the holes, which are directly proportional to the increasing porosity and absorption of water leading to cracking of the rock material (Chiari & Cossio, 2004; Lisci et al., 2003).

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According to Yeang (2011), sustainable ecological architecture is architecture that is integrated with nature in all parts of building construction. Therefore, sustainable buildings consist of living and non-living material as components capable of forming ecosystems or maintaining existing habitats. Ecological architecture focuses on how ecological factors affect buildings, their inhabitants, and the surrounding environment, explaining the influence of ecological building design and its balance with nature. There are three components that influence ecological architecture, and one of them is an ecological element (technology and material) (Attmann, 2010).

symbiosis with photosynthetic organisms (cyanobacteria and green algae) (Hale, 1974). Host plants in a symbiotic process, such as fungi (mycobiont) and algae (phycobiont), help thallus growth in moss. Thallus is the root of moss that can grow in conditions where algae and fungi cannot survive (Lisci et al., 2003). The spread of moss occurs mostly through wind, birds, or insects. Moss can breed on a variety of substances such as tree trunks, dead wood, weathered wood, soil, and rocks (Windadri, 2009). Materials that are hollow, broken, or filled with holes that allow water to flow allow for moss to grow (Garty, 1992). That has led this research to study moss growth on cementitious material more deeply.

III. OBJECTIVES

The objective of moss concrete is to create a sustainable building material that promotes biodiversity and reduces the overall carbon footprint of construction.

1. Moss concrete incorporates living moss into the concrete mixture, creating a natural and self-sustaining green surface that can absorb carbon dioxide and provide a habitat for insects and other small organisms.
2. The use of moss concrete in construction projects also helps to reduce the need for artificial cooling systems, as the moss naturally cools the surrounding air as it evaporates water.

Overall, the goal of moss concrete is to combine the benefits of natural ecosystems with the practical needs of modern construction to create a more sustainable and environmentally-friendly building material.



IV. PROPERTIES

General properties of moss concrete

- 1. Eco-friendly:** Moss concrete is made using natural materials such as recycled glass, fly ash, and moss. It is a sustainable and environmentally friendly material that reduces carbon footprint.
- 2. Aesthetically pleasing:** Moss concrete has a unique and attractive appearance that adds a natural touch to any design. The moss in the concrete grows and changes colour over time, creating a living, green surface.
- 3. Absorbent:** Moss concrete has high absorbency and can absorb and retain water up to 20 times its weight. This makes it ideal for use in landscaping, green roofs, and urban design projects.
- 4. Insulative:** Moss concrete has high thermal insulation, which helps to regulate temperature and reduce energy consumption in buildings.
- 5. Durability:** Moss concrete is strong and durable, with high resistance to wear and tear, freeze-thaw cycles and erosion.
- 6. Low maintenance:** Moss concrete requires minimal maintenance and can self-repair over time. The moss can grow back if damaged, making it a low-cost, low-maintenance option for landscaping.

Overall, moss concrete is a sustainable, aesthetic, and durable material that offers numerous benefits in terms of insulation, absorbency, and low maintenance.

V. BENEFITS

- 1. Natural air purification:** Moss has the ability to filter pollutants and toxins from the air, effectively purifying the air around it.
- 2. Improved thermal insulation:** Moss possesses natural insulation properties, which make it an effective material for insulating buildings and improving their energy efficiency.
- 3. Sustainability:** Moss is a renewable, sustainable resource, and its growth rate is much faster than that of trees. Using moss as a building material reduces the dependence on non-renewable resources.
- 4. Noise reduction:** Moss has the ability to absorb sound, making it an effective material for soundproofing walls and ceilings.
- 5. Low maintenance:** Moss requires very little maintenance once it has been installed, meaning that it will continue to provide the same benefits for years to come.
- 6. Aesthetically pleasing:** Moss concrete is visually striking and adds a natural aesthetic to buildings, making it an ideal choice for eco-friendly projects.



7. Reduced urban heat island effect: Urban heat island effect is the phenomenon of cities being significantly warmer than rural areas. Incorporating moss into building design can help to reduce the effect, by absorbing heat and cooling the surrounding air.

VI. APPLICATION

These are some applications of moss concrete as a green building material:

- 1. Green roofs:** Moss concrete can be used as a green roofing material which helps in reducing the heat island effect, promoting biodiversity, and reducing stormwater runoff. It can also improve air quality and create a natural habitat for birds and insects.
- 2. Sidewalks and pavements:** Moss concrete is ideal for creating walkways or pavements. It can help prevent erosion, improve the appearance of the surrounding environment, and absorb carbon dioxide from the atmosphere.
- 3. Building façades:** Moss concrete can be used to create unique and visually attractive building facades. This application not only enhances the aesthetic appeal of the building but also helps to reduce the energy consumption of the building by regulating temperature and improving air quality.
- 4. Landscaping and garden design:** Moss concrete can be used in landscaping and garden design to create natural-looking pathways, write garden walls, and sculptures. It is a lightweight and easy-to-care-for material that can tolerate various weather conditions.
- 5. Interior design:** Moss concrete can also be used indoors as wall coverings, flooring, and decorative accents. It brings the benefits of nature indoors, creating a more relaxing and calming atmosphere.

VII. CONCLUSION

In conclusion, the use of living materials such as moss as a building facade can have numerous positive effects on the building's sustainability, aesthetics, and functionality. Mosses are hardy plants that can help regulate temperature, improve air quality, reduce noise pollution, and increase energy efficiency. However, it's important to consider the potential drawbacks such as increased weight and the need for proper maintenance. Overall, incorporating living materials such as moss into building facades can be a sustainable and innovative design choice that can improve the overall quality of life for building occupants and contribute to a more environmentally friendly built environment.

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