

THE FUTURE OF CONSTRUCTION FROM A SUSTAINABLE MATERIALS PERSPECTIVE

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ABSTRACT

In the context of a growing global concern for the environment and sustainability, the construction industry is facing a key shift in the use of materials to reduce impact on the planet. The future of construction is increasingly taking shape under the imprint of material sustainability, a direction aimed at creating and using environmentally friendly and sustainable materials in the construction process. Today, the future of construction is closely linked to the use of sustainable materials and environmentally friendly practices. This paradigm shift in construction is driven by concerns about environmental impact and the need to reduce the carbon footprint of the construction industry. A sustainable approach is not just an option, but a necessity to ensure a better future and protect the environment for future generations. The future of construction under the imprint of material sustainability is a key topic in the context of global concerns about the environment and the limited resources of our planet.

KEYWORDS: the future of construction, sustainable materials, environmental impact

1. Introduction

In recent decades, the construction industry has increasingly shifted towards using sustainable materials and eco-friendly practices to reduce negative environmental impacts and improve the energy efficiency of buildings.

The materials used in construction have a significant impact on the environment and natural resources. Thus, the global trend towards the use of sustainable materials in construction is becoming more and more obvious and relevant for the future of this field [3]. From recyclable and renewable materials to technological innovations and concern for environmental impact, change in this direction is essential to build a sustainable and environmentally friendly future for future generations (Fig. 1) [6].

2. The importance of using sustainable materials in construction

In the context of climate change and sustainability concerns, the use of sustainable materials in construction has become a topic of prime importance.



Fig. 1. *The sustainable and environmentally friendly future of building materials [6]*

Sustainable materials in construction are those materials that have a low impact on the environment during the production, use and disposal process. This includes recyclable, biodegradable, low-carbon and renewable materials [4].

Below are some key aspects that highlight the importance of using sustainable materials in construction:

- *Reducing carbon footprint:*

The production and use process of traditional building materials generates significant greenhouse gas emissions [1]. Sustainable materials, such as

certified wood or recycled materials, often have a much smaller carbon footprint, helping to reduce the impact on climate change (Fig. 2) [5].



Fig. 2. Reducing carbon footprint [5]

- *Energy efficiency:*

Sustainable materials can contribute to better thermal insulation and improved energy efficiency of buildings. This reduces dependence on heating and cooling systems, thereby reducing energy consumption and associated carbon emissions (Fig. 3) [12].



Fig. 3. Energy efficiency [12]

- *Conservation of natural resources:*

The use of recycled or renewable materials contributes to the conservation of limited natural resources. Materials such as recycled concrete, recycled steel or plant-based building materials can relieve pressure on natural ecosystems (Fig. 4) [21].



Fig. 4. Recycled or renewable materials in construction [21]

- *Indoor air quality:*

Certain traditional building materials can release harmful chemicals into the indoor air of buildings, affecting air quality and the health of residents. Sustainable materials, such as organic paints or natural wood tiles, can contribute to a healthier indoor environment (Fig. 5) [10].



Fig. 5. Sustainable and sustainable materials [10]

- *Durability and wear resistance:*

Sustainable materials, when chosen and used correctly, can often offer superior durability compared to traditional materials. This helps reduce the need for maintenance and replacement, thereby reducing the long-term environmental impact (Fig. 6) [21].



Fig. 6. Durability and wear resistance of materials [21]

The use of sustainable materials in construction is an essential choice to minimize negative environmental impacts and contribute to the development of more resilient and environmentally and economically sustainable communities [2].

3. Sustainable materials used in construction

Sustainable materials in construction are an essential component of an environmentally friendly

and sustainable approach in the construction industry. These materials are selected and used to minimize environmental impact throughout their life cycle, from production to disposal.

Here are some examples of sustainable materials used in construction:

- **Wood:**

It is a sustainable option for construction, as wood is considered a renewable material and can be used instead of other, less durable or less environmentally friendly materials (Fig. 6) [11].



Fig. 7. Sustainable building with recycled or processed wood [11]

- **Bamboo:**

Being a fast-growing plant, bamboo is a great alternative to traditional wood. It is durable, resilient and has a low ecological footprint [11].



Fig. 8. Sustainable building with bamboo [11]

- **Recycled materials:**

The use of recycled materials, such as glass, recycled plastic, recycled metal or recycled concrete, helps reduce waste and reduce the impact on natural resources [20].



Fig. 9. Sustainable building with glass [20]

- **Eco-friendly insulation:**

Eco-friendly insulation materials such as sheep's wool, recycled cellulose, hemp or recycled cotton are more environmentally friendly alternatives compared to traditional insulation containing harmful chemicals [19].



Fig. 10. Sustainable building with wool [19]

- **Solar tiles and roofing materials for renewable energy:**

Integrating solar elements into the building structure can provide a sustainable energy source and help reduce the carbon footprint of the building [9].



Fig. 11. Sustainable building with solar tiles [9]

- **Traditional materials such as:**

Cob, which uses earth as a base, are sustainable options, being natural and recyclable materials [11].



Fig. 12. Sustainable building with clay [11]

The use of these materials in construction helps reduce the carbon footprint of buildings, conserve natural resources and promote a more sustainable approach to construction.

4. Trends and innovations for the future of construction from the perspective of using sustainable materials

The use of sustainable materials in construction is a major trend that will continue to develop in the future, given growing concerns about climate change and environmental sustainability. Here are some trends and innovations in the use of sustainable materials in construction for the future:

- *Recyclable and renewable materials:*

Increasing the use of recyclable materials such as recycled wood, metal, plastic and glass will reduce dependence on new materials and help reduce waste and associated carbon emissions.

- *Green concrete:*

Replacing part of concrete cement with alternative materials, such as sugar ash, rice ash or power plant ash, can reduce the carbon footprint of concrete without compromising its strength and durability.

- *Bio-based building materials:*

The use of biomass-based materials such as bamboo, hemp or straw can significantly reduce the carbon footprint of construction. These materials are renewable and can be grown quickly, making them a sustainable alternative to traditional materials.

- *Use of environmentally friendly insulating materials:*

Replacing traditional insulation with environmentally friendly materials such as cellulose wool, straw or sheep's wool fibres can improve the energy efficiency of buildings and reduce energy consumption for heating and cooling.

- *Advanced construction technologies:*

The use of advanced technologies such as digital manufacturing and 3D printing can enable buildings to be constructed quickly and efficiently using sustainable materials. These technologies can reduce construction waste and associated carbon emissions.

- *Performance monitoring and optimization buildings:*

The use of sensors and building performance monitoring systems can help to effectively identify and correct deficiencies and excessive energy consumption, helping to increase the sustainability and efficiency of buildings.

- *Circular economy in construction:*

Promoting the circular economy in construction, through the reuse and recycling of building materials and construction waste, can reduce environmental impact and conserve natural resources.

These trends and innovations demonstrate the construction industry's ongoing commitment to sustainability and responsible use of natural resources, contributing to building a more sustainable and climate-resilient future [17].



Fig. 13. Sustainable building, trend and innovation [17]

In the future, the use of innovative technologies such as 3D printing of structures is expected to increase, which can reduce waste and optimize resources. Advanced materials and smart building technologies will also be developed, which will improve energy efficiency and reduce the carbon footprint of buildings.

5. Buildings made with sustainable materials

There are many examples of buildings using innovative sustainable materials to reduce environmental impact and promote energy efficiency. Here are some examples:

- *Landform House, Singapore:*

A residential project that used recyclable materials and advanced technologies for energy efficiency, including innovative water management systems [13].



Fig. 13. Landform House, Singapore [13]

- *BedZED (Beddington Zero Energy Development), London, UK:*

It is a residential project that focuses on energy efficiency and reducing the carbon footprint, using recyclable materials, rainwater collection systems and solar panels for energy generation [8, 16].

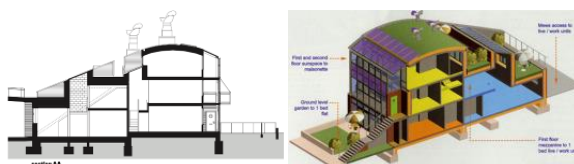


Fig. 14. BedZED (Beddington Zero Energy Development), Londra, Marea Britanie [8, 16]

- *Bamboo Sports Hall for Panyaden International School, Chiang Mai, Thailand:*

This sports hall is built entirely from bamboo, a sustainable and renewable material. Bamboo is strong, lightweight and has a low environmental impact compared to traditional materials [14].



Fig. 15. Bamboo Sports Hall for Panyaden International School, Chiang Mai, Thailanda [14]

- *Floreasca Park in Bucharest, Romania:*

Includes office buildings, green spaces and facilities designed to create a pleasant working environment. The complex is known for its contemporary architecture and is part of the city's ongoing urban development [7].



Fig. 16. Floreasca Park in Bucharest, Romania [7]

- *The Office Cluj ensemble:*

On an urban scale, evolved into a small "city within a city". The ensemble obtained the Breeam classification, thus fulfilling a series of conditions, including: an integrated system specific to a "smart" building offered by the BMS system, green terraces, passive shading systems at the most exposed facades, ventilated underground parking and naturally smoked [15].



Fig. 17. Cluj Office Ensemble [15]

6. Conclusions

The importance of using sustainable materials in construction today cannot be underestimated. It not only protects the environment, but also contributes to energy efficiency, saving resources and promoting sustainable development.

With responsibility and innovation, the construction industry can play a crucial role in creating a more sustainable future for future generations. Improving existing technologies and developing new construction methods will play a crucial role in achieving this goal. By implementing sustainable materials, buildings will become not only greener, but also more resilient, energy efficient and adapted to environmental requirements.

References

- [1]. Lin Chen, Lepeng Huang, Jianmin Hua, Zhonghao Chen, Lilong Wei, Ahmed I. Osman, Samer Fawzy, David W. Rooney, Liang Dong & Pow-Seng Yap, *Green construction for low-carbon cities: a review*, Environmental Chemistry Letters, vol. 21, p. 1627-1657, 2023.
- [2]. Stanca S., *Refurbishment of Decommissioned Buildings in the Context of Sustainable Development*, Bul. Inst. Polit. Iași, 62 (66), 1, p. 61-71, ISSN: 1224-3884 (p), ISSN: 2068-4762 (e), 2016.
- [3]. Stanca S., *Sustainability in construction*, The Annals of "Dunarea de Jos" University of Galati Fascicle IX Metallurgy and Materials Science, ISSN 2668-4748 (Print), 2668-4756 (Online) Journal volume & issue, vol. 46, no. 1, p. 10-15, 2023.
- [4]. Stanca Simona, *Improving energy efficiency in a building using passive energy-saving measures*, Journal of Applied

Engineering Sciences (JAES), ISSN: 2247-3769, e-ISSN: 2284-7197, vol. 13(26)2, 2023.

[5]. ***, <https://envirocons.ro/amprenta-de-carbon/>, accessed in 2.02.2024.

[6]. ***, <https://financiarul.ro/utile/5-materiale-ecologice-pentru-constructii-sustenabile-si-durabile/>, 2.02.2024.

[7]. ***, <https://floreascapark.ro/>, 2.02.2024.

[8]. ***, <https://inhabitat.com/bedzed-beddington-zero-energy-development-london/>, 4.02.2024.

[9]. ***, <https://mansarda-mea.ro/panourile-fotovoltaice-bramac-economiseste-astazi-pentru-un-viitor-mai-bun/>, 5.02.2024.

[10]. ***, <https://noboring.design/materiale-ecologice-si-durabile-materialele/>, 5.02.2024.

[11]. ***, <https://roxanaid.ro/constructie-sustenabila/>, 5.02.2024.

[12]. ***, <https://www.agerpres.ro/ots/2023/11/20/eficienta-energetica-si-solutii-avansate-pentru-cladiri-sustenabile-652298>, 5.02.2024.

[13]. ***, <https://www.archdaily.com/804408/landform-house-a61architects-plus-yydesign>, 7.02.2024.

[14]. ***, <https://www.archdaily.com/877165/bamboo-sports-hall-for-panyaden-international-school-chiangmai-life-construction>, 7.02.2024.

[15]. ***, <https://www.archdaily.com/888983/the-office-cluj-andreescu-and-gaivoronschi>, 7.02.2024.

[16]. ***, <https://www.architectural-review.com/buildings/bedzed-in-beddington-uk-by-zedfactory>, 8.02.2024.

[17]. ***, <https://www.blogintandem.ro/misiunea-eco-sfaturi-simple-pentru-un-stil-de-viata-sustenabil/>, 8.02.2024.

[18]. ***, <https://www.eesc.europa.eu/ro/news-media/news/constructiile-din-lemn-pot-contribui-la-reducerea-emisiilor-de-co2>, 12.02.2024.

[19]. ***, <https://www.isofoamsistem.ro/termoizolatie-cu-lana-de-ovae>, 12.02.2024.

[20]. ***, <https://www.spatulconstruit.ro/articol/o-casa-deosebita-din-sticla-si-materiale-reciclate/19138>, 12.02.2024.

[21]. ***, <https://www.styleandnature.ro/beneficiile-utilizarii-materialelor-sustenabile-in-constructii/>, 12.02.2024.