Current Journal of Applied Science and Technology

Volume 43, Issue 10, Page 84-95, 2024; Article no.CJAST.125349
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Revolutionizing Global Infrastructure: Integrating Sustainable Construction Practices and Safety Standards for a Resilient Future

Samson Oluyomi Akintola [a*]

[a] *University of Ibadan, Nigeria.*

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: https://doi.org/10.9734/cjast/2024/v43i104438

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/125349

Review Article

Received: 15/08/2024
Accepted: 17/10/2024
Published: 23/10/2024

ABSTRACT

Aim: To examine how global infrastructure can be revolutionized through the integration of sustainable construction practices and safety standards for a resilient future.
Problem Statement: In the past, the traditional methods of construction have been attributed with different problems such as depletion of natural resources, degradation of the environment and global warming. There is need to embrace sustainable construction via the use of innovative materials to tackle these problems.
Significance of Study: Sustainable construction is a fast increasing area in the construction industry to ameliorate the negative influences of the industry on the natural environment, such as depletion of natural resources, degradation of the environment and global warming. Innovative materials are transforming sustainable construction as an area of specialization in Engineering field,

**Corresponding author: E-mail: akintolayomi@yahoo.com;*

Cite as: *Akintola, Samson Oluyomi. 2024. "Revolutionizing Global Infrastructure: Integrating Sustainable Construction Practices and Safety Standards for a Resilient Future". Current Journal of Applied Science and Technology 43 (10):84-95. https://doi.org/10.9734/cjast/2024/v43i104438.*

providing new prospects for the improvement of building performance and reduction of environmental impact.
Methodology: Recent relevant published articles in the area of sustainable construction were consulted.
Discussion: This technical review indicated the key advantages, challenges, and future prospects of using innovative materials in sustainable construction. The discussed key points include the adoption of innovative materials such as recycled aggregates, engineered wood products and bio-based materials in sustainable construction projects. These materials possess numerous benefits over the conventional traditional building materials. These include reduced lifecycle costs, improved energy efficiency and lower environmental impact. The observed challenges include market acceptance, regulatory barriers and cost considerations. However, these shortcomings can be tackled via collaboration, regulatory support and education which will pave way for the extensive use of innovative materials in construction projects. Regarding the future prospects, several emerging opportunities and trends are in existence for advance innovation in the area of innovative materials. The few trending examples of nanotechnology are smart materials, 3D printing and recyclable materials existing in sustainable construction.
Conclusion: In conclusion, implementation of innovative materials in sustainable construction is a necessity.

Keywords: Sustainable construction; global infrastructure; innovative materials; engineered wood products; bio-based materials.

1. INTRODUCTION

"Historically, since the First International Conference conducted in 1994 in the United States of America, Florida and Tampa on Sustainable Construction, studies on sustainability in the construction industry have been thriven" [1]. "From the perspective of technical sustainability, sustainable construction is a fast increasing area in the construction industry to reduce the negative influences of the industry on the natural environment, such as depletion of natural resources, degradation of the environment and global warming. Therefore, the implementation of sustainable construction approaches and concepts to generate a reliably built environment leads to the establishment of high performance green buildings. Generally, various research themes and areas have arisen to thoroughly investigate sustainability in the construction industry. The yardstick for the evaluation of sustainability in the construction industry is that the outputs delivery is by way of programs or projects. Research on sustainability in construction projects varies from the construction projects sustainability performance assessment and value management for sustainability in construction, to considerations of policy impacts on infrastructure projects and social sustainability in the design and planning phases of construction projects" [2]. The assessment of social sustainability in construction is executed via sustainability and equity theories and social network analysis. Nonetheless, information and communications technology (ICT) can be of help in the achievement of sustainability via externalization of control, media substitution and process optimization in construction projects.

"About 13% has been contributed by the construction industry ecosystem to the global gross domestic product. Equally, 39% of energy-related carbon dioxide (CO_2) emissions and 36% of global energy use were respectively accounted by construction and building. It is not amazing that sustainability practices in the construction industry are on the high side with respect to the agenda placed by practitioners, government and the academia. However, sustainable construction does not only require social (such as local community needs, health and safety,), economic (such as competition, construction time and costs), and technical matters to be addressed but also ecological or environmental sustainability" [3]. "The technical sustainability addresses issues pertaining to a building's quality, performance and service life. Mechanisms for the evaluation of sustainability success in construction projects are also needed. Thus, sustainability in construction is usually handled based on the tripartite domains of the society, environment and the economy. The construction industry is stated to be a group of organizations and firms that execute interrelated activities to construct real estate, buildings and infrastructure" [4].

"Generally, sustainable construction is an eco-friendly construction or green building which

adopts the approach to construction, building design and operation purposely to conserve resources, reduce environmental impact and establish energy-efficient, healthy buildings and infrastructure" [5]. "It is enhanced via the significant social impacts and environmental recognition of the construction industry, including waste generation, carbon emissions and resource depletion. Sustainable construction addresses these challenges via the integration of sustainable practices throughout the whole lifecycle of a building, from construction after design to demolition and operation. In sustainable construction, the utilization of innovative materials can be traced back to ancient civilizations, which used locally available materials such as straw, mud and stone in building structures that were well-adapted to their environment" [6]. "These early builders depended on natural materials that were abundant, renewable and had less environmental impact. In more recent history, the revolution of industry influenced the extensive use of materials such as steel, glass and concrete in construction causing resource depletion and increase in environmental impact. This encouraged a renewed concern about construction practices and sustainable materials in the 20th century. Significant advancements were observed during this era in the establishment of modern sustainable materials for construction. One of the most prominent instances is the development of recycled materials such as plastic, glass and recycled steel which can be adopted in reducing the environmental impact of construction projects. Another significant development is using sustainable wood products such as engineered wood and bamboo, which are fast-growing, renewable and possess a lower carbon footprint compared to traditional timber" [7]. Fig. 1 represents the frame work for sustainable construction showing the principles, resources and phase involved.

"Recently, the interest in using innovative materials in modern construction projects has been on the high side. Builders and architects are increasingly moving towards using materials such as aerogels, bio-based composites and phase-change materials, which offer durability, improved energy efficiency and thermal performance when compared with the traditional materials. For instance, bio-based composites synthesized from agricultural waste products can be utilized as insulation materials which thus reduce the buildings' energy consumption. Aerogels have been used in making walls, windows and roofs in order to improve energy efficiency because of their high porosity and excellent thermal insulating properties. Many case studies have indicated the successful application of innovative materials in sustainable construction projects" [8]. "A net-zero energy building has been executed in Bullitt Center in Seattle and featured a timber frame made from a high-performance envelope and sustainably harvested wood which combines innovative glazing systems and insulation materials. The Crystal in London is another sustainable building that features a facade made from a roof covered in photovoltaic panels and recycled glass. These typical samples demonstrate the prospective of innovative materials to change the way we live and build offering sustainable substitutes to traditional construction materials" [3].

"The utilization of innovative materials has been one of the major pillars of sustainable construction. These are materials that provide sustainable options to traditional building materials usually via reduction of energy consumption, lowered lifecycle costs and improved durability. They are vital for the advancement of sustainable construction practices and achieving the objectives of environmental impact reduction and building performance enhancement. Innovative materials have played a vital role in the advancement of sustainable construction practices, offering choices to conventional building materials that are more energy-efficient, environmentally friendly and durable. The significance of innovative materials in sustainable construction cannot be exaggerated" [9]. "Traditional building materials such as steel, concrete and brick have significant environmental routes due to their high carbon emissions and energy consumption during production. In contrary, innovative materials provide more sustainable options that can assist in the reduction of environmental impact of construction. Innovative materials also play an important role in the improvement of buildings energy efficiency. Buildings can minimize their energy consumption for cooling, heating and lighting via the usage of materials that can store and capture energy or have high thermal insulation properties. This does not only reduce operating costs for building occupants and owners but also reduces carbon emissions" [10].

Furthermore, innovative materials can enhance the general resilience and sustainability of infrastructure and buildings. Materials that are

sourced regionally or locally are generated from renewable or recycled materials that can assist in natural resources conservation and reduction of waste. Additionally, materials that are structured to withstand natural disasters or large weather events can help infrastructure and buildings resilience to climate change impacts. Numerous significant challenges that are related to carbon emissions, resource depletion and waste generation are faced by the construction industry. These are worsened by the extensive usage of traditional construction practices and building materials. Addressing these challenges is vital to the creation of a more environmentally friendly and sustainable construction sector as the need for new infrastructure and buildings continues to increase exponentially [11].

"Another major challenge being faced by the construction industry is the resource depletion resulting from the contribution of use and extraction of raw materials such as timber, minerals and fossil fuels to biodiversity loss and environmental degradation. Large amounts of natural resources are required to be produced by traditional building materials, such as steel, concrete, and asphalt causing increased pressure on habitats and ecosystems. Innovative materials provide sustainable choices to traditional building materials, minimizing environmental impact and reducing the need for resource extraction" [12]. "For instance, engineered wood products like cross -laminated timber utilize little energy and generate fewer emissions than traditional building materials and thus make them a more sustainable option for construction projects. Furthermore, recycled aggregates generated from recycled asphalt and concrete minimize the demand for virgin materials and assist in the reduction of waste generation in the construction industry" [7].

"Nonetheless, construction industry is also faced with the carbon emissions problem as the transportation and production of traditional building materials enhance climate change and greenhouse gas emissions. The construction sector accounted for a substantial quota of global carbon emissions, with only concrete production accounting for almost 8% of global CO_2 emissions. Innovative materials can assist in the reduction of carbon emissions in the construction industry through offering of additional sustainable options to traditional building materials. For instance, bio-based materials, such as hempcrete and bamboo, sequester carbon dioxide during their growth and can assist in offsetting the carbon emissions linked with construction activities. Furthermore, the utilization of recycled materials such as recycled glass and steel minimizes the need for energy-intensive production practices which further lower the carbon emissions" [4].

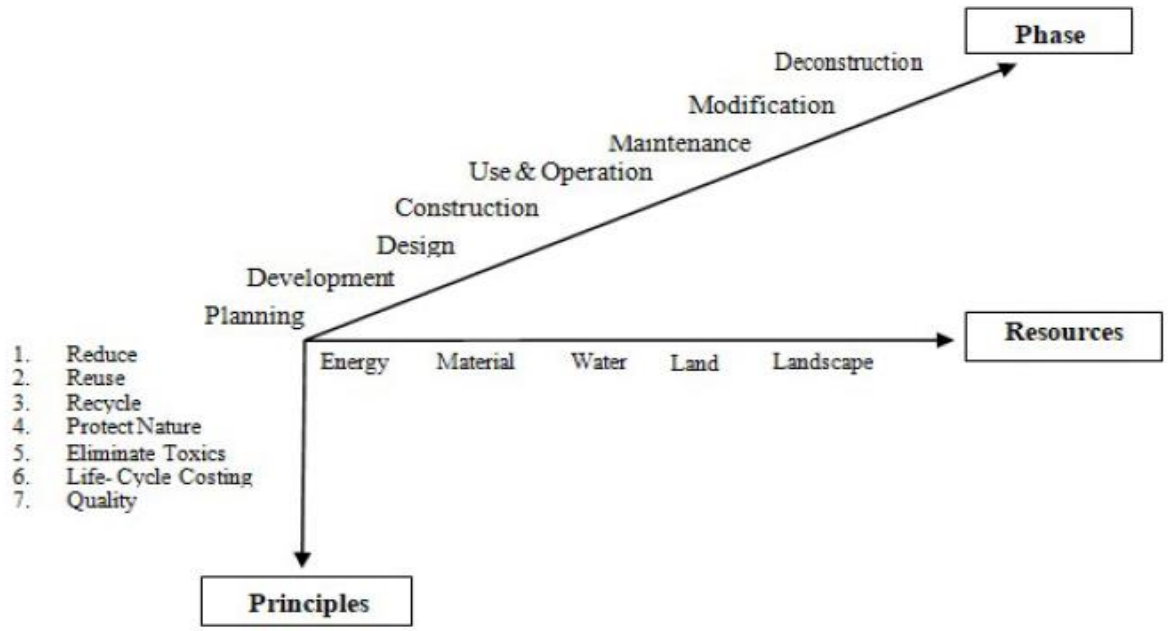

Fig. 1. Frame work for sustainable construction

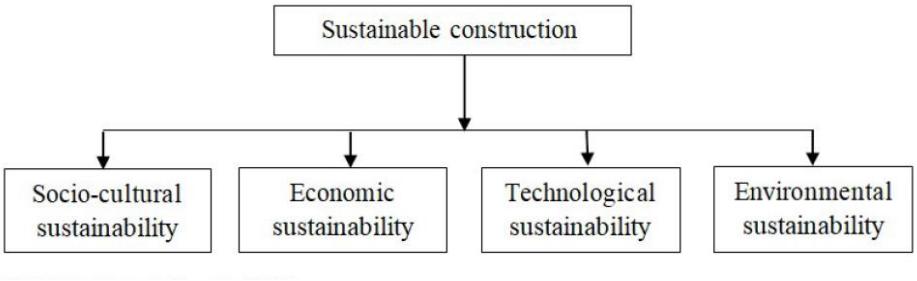

Fig. 2. Sub-objectives of sustainable construction

Waste generation is also a major problem in the construction industry because construction and demolition waste amount to aportion of total waste produced worldwide. Traditional construction practices usually lead to the disposal of huge volume of waste in incineration or landfills causing resource depletion and environmental pollution. Innovative materials can aid waste generation reduction in the construction industry via the promotion of the use of sustainable and recycled materials [13]. For instance, the utilization of prefabricated construction methods minimizes the volume of waste generated during construction, as components can be assembled on-site and manufactured off-site. Additionally, using recycled materials such as recycled steel and concrete assists in closing the loop on material cycles and minimizes the demand for virgin materials. This review paper critically examines the integration of sustainable construction practices and safety standards for a resilient future in order to revolutionize global infrastructure. Fig. 2 represents the block diagram showing the various sub-sections of sustainable construction which include socio-cultural, economic, technological and environmental sustainability. Each of these has been introduced in the previous paragraphs [9]. This technical review article examines revolutionized global infrastructure via the integration of sustainable construction practices and safety standards for a resilient future. Consideration is given to the fundamental knowledge in this area revealing functions of innovative materials in sustainable construction, types of innovative materials needed for sustainable construction, case studies, challenges and future prospects.

2. FUNCTIONS OF INNOVATIVE MATERIALS IN SUSTAINABLE CONSTRUCTION

Innovative materials cover a broad range of materials that are applied in building design and construction. These materials are described by their sustainable properties, such as low environmental impact, high durability and energy efficiency.

- Engineered wood products are examples of innovative materials. These include laminated veneer lumber (LVL) and cross-laminated timber (CLT) which are sustainable options to traditional wood products. These materials are generated from wood fibers that are joined together under high pressure causing durable and strong building materials that can replace concrete and steel in many applications [5].
- “Recycled aggregates are other forms of innovative materials in sustainable construction gotten from demolition and construction waste such as asphalt, concrete and bricks that are crushed and processed for utilization as building materials. These sets of materials minimize the need for virgin aggregates and assist divert waste from landfills. Bio-based materials, such as straw, bamboo and hempcrete are gotten from renewable sources and possess low embodied energy when compared with traditional building materials. They provide sustainable replacements to traditional building materials and can assist in the reduction of carbon emissions within a construction industry” [3].
- High-performance insulation materials like vacuum insulation panels and aerogel provide superior thermal performance when compared with the traditional insulation materials. They help in the reduction of energy consumption for cooling and heating resulting in reduced carbon emissions and operating costs. They are usually obtained from recycled or renewable sources and thus

reduce the environmental impact of construction activities [9].

"Numerous innovative materials provide superior thermal performance when compared with traditional materials which reduce the necessity for cooling and heating while lowering the energy consumption. Innovative materials possess more resistance to wear and tear and durability than traditional materials resulting in reduced maintenance costs and longer lifespans. Some innovative materials may possibly possess higher upfront costs while their long-term advantages such as reduced maintenance costs and energy consumption can lead to general cost savings in the entire life of a building" [14].

One of the key advantages of innovative materials is their ability to reduce the environmental influence of construction activities. There can be reduction in the construction industry reliance on finite resources and minimization of waste generation via the use of materials sourced from recycled or renewable sources. Additionally, innovative materials can assist in the reduction of carbon emissions via sequestration of carbon dioxide or through the reduction of energy consumption needed for cooling, heating and lighting of buildings. Also, innovative materials play a major role in the improvement of energy efficiency of buildings and reduction of lifecycle costs. The energy consumption of buildings for cooling and heating can be reduced through the use of materials that provide superior thermal performance resulting in carbon emissions and operating costs reduction. Lastly, the longevity and durability of innovative materials can lead to lowering of maintenance costs over the entire life of a building which may further contribute to cost savings [15].

2.1 Types of Innovative Materials Needed for Sustainable Construction

"Innovative materials are designed to reduce energy consumption, minimize environmental impact and lower lifecycle costs which placed them as essential components of sustainable building construction and design. The various kinds of innovative materials adopted in sustainable construction include recycled aggregates, engineered wood products, bio-based materials and other related innovative materials" [12].

- Recycled aggregates are derived from demolition and construction waste such as concrete, bricks and asphalt that are processed after crushing for utilization as building materials. Several advantages attached to these materials include conservation of natural resources, reduction in virgin aggregates demand and minimization of landfills waste. Recycled aggregates can be utilized in different areas of construction as a base material for pavements and roads, as aggregate for asphalt and concrete and as backfill for drainage trenches. The use of recycled aggregates in construction projects assists in the promotion of circular economy via reusing materials that would have been discarded as waste and also reduction of construction activities environmental impact [6].
- "Engineered wood products are a collection of innovative materials which are manufactured through binding wood strands or fibers together with adhesives to order to create structural elements. These materials provide several benefits over traditional wood products, including increased durability, strength and dimensional stability. They are also more sustainable than traditional wood products because they can be manufactured from renewable and fast-growing sources such as plantation-grown timber. Cross-laminated timber is one of the most prominent types of engineered wood products and it comprises multiple layers of wood panels glued together at right angles. It is increasingly being applied in sustainable construction projects due to its versatility, strength and environmental benefits. Glued laminated timber and laminated veneer lumber are other types of engineered wood products used for columns, beams and other structural elements" [9].
- "Bio-based materials are gotten from renewable sources such as animals, plants and microorganisms, and provide sustainable replacements to traditional building materials. These materials possess low embodied energy when compared with traditional materials and can assist in the reduction of carbon emissions in the construction industry. One of the renewable and fast-growing resources used as a building material in numerous regions of the world is bamboo" [9]. "It is strong, lightweight and durable and this makes it to be an ideal material for construction projects. Hempcrete is a bio-

composite material gotten from lime, hemp fibers and water. It is insulating, lightweight and fire-resistant and this makes it to be an environmentally friendly option to traditional building materials. Straw bales are applied as a building material in straw bale construction which is a sustainable building technique that utilizes straw bales as insulation in walls. Straw bale construction is environmentally friendly, cost-effective and energy-efficient" [14].

- "Several other kinds of innovative materials applied in sustainable construction asides recycled aggregates, engineered wood products and bio-based materials are in existence. Recycled plastics are applied in construction applications such as fencing, decking and roofing, as a sustainable option to traditional materials. Green concrete is a kind of concrete that utilizes recycled materials such as slag and fly ash as partial substitutes for cement. It has lower environmental impact and carbon emissions than traditional concrete. Photovoltaic glass is a type of glass incorporated with solar cells to generate electricity from sunlight. It can be applied in building windows, facades and roofs to reduce reliance on fossil fuels and generate renewable energy" [11].

3. CHALLENGES AND OPPORTUNITIES OF SUSTAINABLE CONSTRUCTION

"Despite the aforementioned benefits of innovative materials in relation to sustainable construction practices, there are some key opportunities and challenges associated with innovative materials application in sustainable construction together with regulatory barriers, cost considerations, research and development, and market acceptance needs. Cost is one of the major challenges linked with using innovative materials in sustainable construction. Innovative materials usually have outrageous costs when compared to traditional building materials. This can discourage builders and developers from integrating them into construction projects. However, it is essential to give consideration to the long-term cost savings that are linked with innovative materials, such as lower maintenance costs, reduced energy consumption and longer lifespan. It is expected that there can be offset of the initial higher cost of innovative materials via savings over building life" [14].

"Stakeholders in the construction industry should cautiously evaluate the economic advantages of innovative materials and give consideration to them as investments rather than expenses. This gives room for addressing the cost considerations. Additionally, the financial burden linked with innovative materials adoption can be reduced by government subsidies and incentives which thus make them to be more accessible to builders and developers. Another challenge being faced for adopting innovative materials in sustainable construction is the regulatory barriers" [10]. "Building regulations and codes usually prioritize durability and safety which can make it hard for innovative and new materials to gain approval for execution in construction projects. Additionally, the deficiency of standardized certification and testing processes for innovative materials can generate uncertainty for builders and developers. Collaboration is essential between government agencies, industry stakeholders and research institutions in order to overcome regulatory barriers via the development of standardized certification and testing processes for innovative materials. Establishment of clear standards and guidelines can assure regulators that innovative materials meet the performance and safety requirements for adoption in construction projects" [15].

"For the general acceptance of innovative materials in sustainable construction, market acceptance is vital. Builders, developers and consumers should be committed with the advantages of innovative materials and be ready to invest in them. However, there is usually a deficiency of understanding and awareness regarding the purposes of innovative materials which can affect their adoption. It is imperative for stakeholders in the construction industry to enlighten decision-makers and consumers regarding the advantages of innovative materials via educational programs, marketing campaigns and demonstration projects in order to improve market acceptance. Nonetheless, incentives and government policies can assist in the creation of demand for innovative materials via incentivizing or requiring their adoption in construction projects" [4].

"Research and development are crucial for improving the area of innovative materials in sustainable construction. There are opportunities for unrelenting research and development to increase the durability, performance and cost-effectiveness of innovative materials. Additionally, research is required to explore new

technologies and materials that can further improve construction practices sustainability. To be in accordance with research and development in this specialization, collaboration and funding should be improved between academia, industry and government" [9]. By investing in research and development, Stakeholders in the construction industry can initiate innovation and develop new technologies and materials that can aid addressing sustainable construction challenges.

3.1 Case Studies of Sustainable Construction Practices

"Numerous projects around the globe have effectively executed innovative materials which demonstrate their effectiveness in minimizing environmental impact and increasing building performance. The Edge is a sustainable office building in Amsterdam which has been addressed as one of the greenest buildings around the globe. The building displays innovative materials like a smart façade having integrated solar panels that regulate natural light and produce electricity. Innovative materials usage has assisted the building in achieving a BREEAM rating of Outstanding which is the optimum sustainability buildings rating. Another case study is One Central Park which is a mixed-use development in Sydney that exhibits a vertical garden on its façade. This was made possible via the utilization of innovative materials like hydroponic planting systems. The building also integrates energy-efficient lighting and recycled water systems which thus reduce its environmental impact and create additional sustainable urban environment" [15-16].

"In London, the Crystal is a sustainable building which showcases the newest sustainable construction innovations. The building exhibits innovative materials like photovoltaic glass which produces electricity from sunlight together with a rainwater harvesting system which lowers water consumption. The Crystal has attained several sustainability certifications, including BREEAM Outstanding and LEED Platinum. The adoption of innovative materials has greatly assisted in the reduction of construction activities environmental impact including reduced resource depletion, lower carbon emissions and less waste generation" [11].

3.2 Future Prospects of Sustainable Construction Practices

"Several emerging opportunities and trends are in existence for further innovation and development in the field of sustainable construction practices and innovative materials as the construction industry continues to evolve" [17]. "Nanotechnology is progressively being utilized to improve innovative materials with enriched properties, such as durability, improved strength and thermal performance. Nanomaterials such as graphene and carbon nanotubes have the prospective to transform the construction industry via offering high-strength and lightweight materials that can be adopted in various applications. 3D printing technology is being applied in creating innovative building components and materials such as architectural elements and concrete structures. 3D printing creates room for higher design customization and flexibility, as well as minimized construction time and material waste" [18-23].

"Smart materials such as thermochromic coatings and self-healing concrete, are being established to increase buildings sustainability and performance. These materials have the potential to respond to environmental situations such as temperature variations and repair themselves, minimizing the necessity for repairs and maintenance. There is an advancing focus on the development of materials which are recyclable in nature and can be simply recycled or reused at the termination of their lifecycle. These materials assist in the reduction of waste generation and enhance a circular economy in the construction industry" [24-26].

"There is an improving interest in the development of materials possessing a net negative carbon footprint which have the ability to absorb additional carbon dioxide than they emit during their lifecycle and production. These materials possess the ability to assist in the mitigation of climate change via the sequestration of carbon dioxide from the atmosphere. Researchers are now working on nature for inspiration in advancing innovative materials that resemble natural structures and processes. Bio-inspired materials possess the ability to provide sustainable solutions for construction, such as biodegradable composites and self-healing materials" [27-29].

"In another prospect, waste materials are transformed into high-quality building materials via the adoption of advanced recycling technologies such as upcycling and chemical recycling. These technologies possess the ability to considerably minimize waste generation and encourage a circular economy in the construction

industry. Knowledge sharing and collaboration are vital for promoting sustainable construction practices and driving innovation in the area of innovative materials. Via collaboration with manufacturers, researchers and other stakeholders, the adoption and development of innovative materials can be accelerated by the construction industry" [20].

Furthermore, best practices and sharing knowledge can assist in ensuring that innovative materials are safely and effectively utilized in construction projects. In conclusion, there is brighter future of innovative materials in sustainable construction. There are opportunities and emerging trends for more innovation and a rising emphasis on knowledge sharing and collaboration. The construction industry can continue to be at the front in sustainable building practices and establish a more sustainable built environment for future generations if the future directions are embraced [19-21]. Table 1 presents previous studies on sustainable construction practices. It was generally observed that sustainable construction practices should be implemented.

Table 1. Previous studies on sustainable construction practices

Studies	Observation	Conclusion	Reference
Integrating sustainable design principles into construction practices: A comprehensive review	Their findings led to the development of a conceptual framework that incorporates specific indicators and criteria across sociocultural, economic, technical, and environmental dimensions.	The framework offered a structured approach to assess the sustainability of construction practices.	[29]
Innovative materials in sustainable construction: A review	Bio-based materials, such as bamboo and hempcrete, offer renewable alternatives to conventional building materials and have low embodied energy.	The industry can reduce its environmental footprint and create buildings and infrastructure that are more resilient, efficient, and environmentally friendly by embracing these materials and integrating them into sustainable construction practices.	[30]
Sustainability in Construction Projects: A Systematic Literature Review	It was observed that while 'sustainability' was the leading keyword in the first cluster, i.e., evaluating sustainability, it was the second top keyword with the eigenvector centrality of over 0.94 in the other two clusters.	Previous researchers used a variety of statistical and mathematical techniques such as structural equation modelling and fuzzy decision-making methods to study sustainability in construction projects.	[31]
Project feasibility study: The key to successful implementation of sustainable and socially responsible construction management practice.	Sustainable construction typically introduces a focus on the reduction of harm to the environment, and might incorporate elements such as the prevention, reuse, and management of waste, with direct benefits to society, and with less focus on profitability.	There is need to work more technological innovations in the area of sustainable construction.	[32]
Driving forces for green building technologies adoption in the construction industry: Ghanaian perspective	Construction industry has influenced all dimensions of sustainability, i.e., environmental, social, and economic, because of high amounts of energy usage and consumption of other resources.	Green building technologies have greatly influenced sustainable construction positively.	[33]

Studies	Observation	Conclusion	Reference
Project feasibility study: The key to successful implementation of sustainable and socially responsible construction management practice	Sustainability should seek a win–win outcome that promotes environmental benefits for society on the one hand, whilst seeking competitive advantages and economic benefits for construction companies on the other.	Project feasibility study is essential for a successful implementation of sustainable construction.	[34]

4. CONCLUSION

Sustainable construction is a fast increasing area in the construction industry to ameliorate the negative influences of the industry on the natural environment, such as depletion of natural resources, degradation of the environment and global warming. Innovative materials are transforming sustainable construction as an area of specialization in Engineering field, providing new prospects for the improvement of building performance and reduction of environmental impact. This technical review indicated the key advantages, challenges, and future prospects of using innovative materials in sustainable construction. The discussed key points include the adoption of innovative materials such as recycled aggregates, engineered wood products and bio-based materials in sustainable construction projects. These materials possess numerous benefits over the conventional traditional building materials. These include reduced lifecycle costs, improved energy efficiency and lower environmental impact. The observed challenges include market acceptance, regulatory barriers and cost considerations. However, these shortcomings can be tackled via collaboration, regulatory support and education which will pave way for the extensive use of innovative materials in construction projects. Regarding the future prospects, several emerging opportunities and trends are in existence for advance innovation in the area of innovative materials. The few trending examples of nanotechnology are smart materials, 3D printing and recyclable materials existing in sustainable construction. In conclusion, implementation of innovative materials in sustainable construction is a necessity. There is need for advancement of the utilization of these materials for sustainable construction in future studies.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Dozie UW, Benjamin WI, Innocent DC, Anyanwu EC, Chukwuocha UM, Innocent RC, Mary OO. Knowledge, acceptability and willingness to receive HPV vaccine among women in Owerri municipal Imo state. Acad J Health Sci: Medicina Balear. 2024; 39(2):37-45.
2. de Andrade Salgado F, de Andrade Silva F. Recycled aggregates from construction and demolition waste towards an application on structural concrete: A review. J Build Eng. 2022; 52:104452.
3. Adekanmbi AO, Ani EC, Abatan A, Izuka U, Ninduwezuor-Ehiobu N, Obaigbena A. Assessing the environmental and health impacts of plastic production and recycling. World J Biol Pharm Health Sci. 2024; 17(2):232-241.
4. Adekanmbi AO, Ninduwezuor-Ehiobu N, Izuka U, Abatan A, Ani EC, Obaigbena A. Assessing the environmental health and safety risks of solar energy production. World J Biol Pharm Health Sci. 2024; 17(2):225-231.
5. Ahmed Ali K, Ahmad MI, Yusup Y. Issues, impacts, and mitigations of carbon dioxide emissions in the building sector. Sustainability. 2020; 12(18):7427.
6. Ajiga DI, Adeleye RA, Tubokirifuruar TS, Bello BG, Ndubuisi NL, Asuzu OF, Owolabi OR. Machine learning for stock market forecasting: a review of models and accuracy. Finance Account Res J. 2024; 6(2):112-124.

7. Akomolafe OO, Olorunsogo T, Anyanwu EC, Osasona F, Ogugua JO, Daraojimba OH. Air quality and public health: a review of urban pollution sources and mitigation measures. Eng Sci Technol J. 2024; 5(2):259-271.
8. Al-Taie A, Yaghoubi E, Gmehling E, Fragomeni S, Disfani M, Guerrieri M. Recycled aggregate blends for backfilling deep trenches in trafficable areas. Constr Build Mater. 2023; 401:132942.
9. Aridi R, Yehya A. Review on the sustainability of phase-change materials used in buildings. Energy Convers Manage: X. 2022; 15:100237.
10. Boukhelkhal D, Guendouz M, Bourdot A, Cheriet H, Messaoudi K. Elaboration of bio-based building materials made from recycled olive core. MRS Energy Sustain. 2021; 8:98-109.
11. Chen S, Zhang G, Xia X, Setunge S, Shi L. A review of internal and external influencing factors on energy efficiency design of buildings. Energy Build. 2020; 216:109944.
12. Chen T, An, Y, Heng CK. A review of building-integrated photovoltaics in Singapore: Status, barriers, and prospects. Sustainability. 2022; 14(16):10160.
13. Chen W, Yang S, Zhang X, Jordan ND, Huang J. Embodied energy and carbon emissions of building materials in China. Build Environ. 2022; 207: 108434.
14. Contreras-Llanes M, Romero M, Gázquez MJ, Bolívar JP. Recycled aggregates from construction and demolition waste in the manufacture of urban pavements. Materials. 2021; 14(21):6605.
15. Dada MA, Obaigbena A, Majemite MT, Oliha JS, Biu PW. Innovative approaches to waste resource management: implications for environmental sustainability and policy. Eng Sci Technol J. 2024; 5(1):115-127.
16. Emeka-Okoli S, Otonnah CA, Nwankwo TC, Nwankwo EE. Review of carbon pricing mechanisms: effectiveness and policy implications. Int J Appl Res Soc Sci. 2024; 6(3):337-347.
17. Goh CS, Chong HY, Jack L, Faris AFM. Revisiting triple bottom line within the context of sustainable construction: A systematic review. J Clean Prod. 2020; 252:119884.
18. Hertwich EG, Ali S, Ciacci L, Fishman T, Heeren N, Masanet E, Wolfram P. Material efficiency strategies to reduce greenhouse gas emissions associated with buildings, vehicles, and electronics—a review. Environ Res Lett. 2019;14(4):043004.
19. Emeka-Okoli S, Nwankwo EE, Nwankwo TC, Otonnah CA. Navigating non-technical risks in the oil & gas industry: insights and frameworks- A review. Int J Appl Res Soc Sci. 2024;6(3):348-359.
20. Ding Y, Pang Z, Lan K, Yao Y, Panzarasa G, Xu L, Hu L. Emerging engineered wood for building applications. Chem Rev. 2023; 123(5):1843-1888.
21. Ebolor A, Agarwal N, Brem A. Sustainable development in the construction industry: The role of frugal innovation. J Clean Prod. 2024; 380:134922.
22. de Andrade Salgado F, de Andrade Silva F. Recycled aggregates from construction and demolition waste towards an application on structural concrete: A review. J Build Eng. 2023; 52:104452.
23. Hossain MU, Ng ST, Antwi-Afari P, Amor B. Circular economy and the construction industry: Existing trends, challenges and prospective framework for sustainable construction. Renew Sustain Energy Rev. 2020; 130:109948.
24. Ibrahim I, Eltarabishi F, Abdalla H, Abdallah M. 3D Printing in sustainable buildings: Systematic review and applications in the United Arab Emirates. Buildings. 2022; 12(10):1703.
25. Hossain MU, Ng ST, Antwi-Afari P, Amor B. Circular economy and the construction industry: Existing trends, challenges and prospective framework for sustainable construction. Renew Sustain Energy Rev. 2022; 130:109948.
26. Ibrahim I, Eltarabishi F, Abdalla H, Abdallah M. 3D Printing in sustainable buildings: Systematic review and applications in the United Arab Emirates. Buildings. 2022; 12(10):1703.
27. Keena N, Raugei M, Lokko ML, Aly Etman M, Achnani V, Reck BK, Dyson A. A life-cycle approach to investigate the potential of novel biobased construction materials toward a circular built environment. Energies. 2022; 15(19):7239.
28. Iqbal M, Ma J, Ahmad N, Hussain K, Usmani MS, Ahmad M. Sustainable construction through energy management practices in developing economies: an analysis of barriers in the construction sector. Environ Sci Pollut Res. 2021; 28:34793-34823.

29. Islam MM. Integrating Sustainable Design Principles into Construction Practices: A Comprehensive Review. J Artif Intell Gen Sci. 2024;4(1):81-95.
30. Iluyomade TD, Okwandu AC. Innovative materials in sustainable construction: A review. Int J Sci Res Archive. 2024; 12(1):2435-2447.
31. Kiani Mavi R, Gengatharen D, Kiani Mavi N, Hughes R, Campbell A, Yates R. Sustainability in Construction Projects: A Systematic Literature Review. Sustainability. 2021; 13:1932.
32. Shen LY, Tam VWY, Tam L, Ji YB. Project feasibility study: The key to successful implementation of sustainable and socially responsible construction management practice. J Clean Prod. 2010; 18: 254-259.
33. Darko A, Chan APC, Gyamfi S, Olanipekun AO, He BJ, Yu Y. Driving forces for green building technologies adoption in the construction industry: Ghanaian perspective. Build Environ. 2022; 125:206-215.
34. Shen LY, Tam VWY, Tam L, Ji YB. Project feasibility study: The key to successful implementation of sustainable and socially responsible construction management practice. J Clean Prod. 2022;18:245-259.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the publisher and/or the editor(s). This publisher and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/125349