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Evaluation of sustainable building materials and its effect on productivity of users in an office complex

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Abstract

This study explores the impact of sustainable building materials on user productivity within office complexes. Acknowledging the pressing need for ecological and resource-efficient construction practices, it delves into the multifaceted concept of sustainability and its alignment with United Nations Sustainable Development Goals (SDGs). The research emphasizes the critical role of materials selection and construction techniques in achieving energy efficiency, reducing carbon footprints, and enhancing indoor environmental quality. Through an examination of user satisfaction parameters and facility users' needs, the study aims to provide insights into optimizing office design for improved occupant well-being and performance. By evaluating the benefits of incorporating sustainability in office buildings, this research contributes to the broader discourse on sustainable development in the built environment.

Keywords: Energy efficiency, Sustainable building materials, Office complex, Indoor air quality, User's satisfaction

1.0 Introduction

A sustainable project is one that uses little environmental impact and resources when it is planned, built, rebuilt, managed, or recycled according to Akadiri *et al.* (2012) ^[4].

Goubran *et al.* (2022) ^[18] states that Buildings are some of the largest consumers of energy, water, and raw materials worldwide. Additionally, they provide a substantial contribution to water effluents, greenhouse gas emissions, and landfill waste.

The urban environment is scattered with various degrees of segregation and discrimination as a result of several factors mitigating urban development. These factors determine the characteristics of the urban forms and what meaning is derived from the urban environment. It is therefore required to examine the various characteristics and engage in proper planning for an inclusive urban environment. (Adeboyejo, Kure, Onamade, Gbolade & Archibong).

While the environmental repercussions of buildings must be regulated and suppressed, academics are also focusing on examining the prospective roles that buildings may play in sustainable development projects, particularly in view of the predicted surge in construction activity in the years to come. Goubran *et al.* (2022) ^[18].

Akadiri *et al.* (2012) ^[4] stated that sustainability is a broad and complex term that has emerged as a key problem in the building industry. The notion of sustainability is concerned with increasing people's quality of life so that they can live in a healthy environment with better social, economic, and environmental conditions.

Sustainability should achieve a number of goals, including lower CO₂ and GHG emissions, increased resource and energy efficiency, pollution avoidance, noise reduction, improved indoor air quality, and environmental balance. An ideal project would be inexpensive to build, take little maintenance over time, and, once abandoned, totally return to the earth. Akadiri *et al.* (2012) ^[4].

Urban sustainability and inclusiveness may not have a single top-down solution, but there are numerous bottom-up alternatives. Cities in both prosperous and disadvantaged countries gain from their citizens' initiative and inventiveness. Critical thinking, non-market solutions, and active participation from all stakeholders are needed to seize this opportunity with a proper understanding that the concept of inclusive cities involves a complicated web of various geographical, social, and economic

variables capable of providing opportunities and better living conditions for everyone. (Adeboyejo, Kure, Onamade, Gbolade & Archibong) The primary purpose of the majority of research published in Materials and Structures is to expand our understanding of the materials and processes that may be used to maximize building in a sustainable manner. Such advancements in sustainable construction materials and procedures are crucial in producing lasting structures and infrastructure components that are also environmentally benign throughout construction and operation. Dabarera *et al.* (2023) ^[5].

Energy Sustainability is a crucial aspect of SDG's Agenda and therefore that of sustainable development in any megacity including Lagos. Moreover, architecture plays a significant role in promoting energy efficiency and sustainability (Adewumi, Onamade, Asaju & Adegbile, 2023) ^[1].

2.0 Literature Review

The United Nations Sustainable Development Goals (SDGs)

The United Nations General Assembly approved the 17 Sustainable Development Goals (SDGs) in 2015 with the intention of creating a framework for global peace and prosperity for people both now and in the future. Dabarera *et al.* (2023) ^[5]. The 17 goals were put forward as an action plan to fulfil by 2030.

Presently, the 17 Sustainable Development Goals (SDGs) are seen to provide a foundation of unity for researching sustainable development initiatives and have been effective in coordinating the work of researchers and practitioners in that respect. Goubran *et al.* (2022) ^[18].

Goubran *et al.* (2022) ^[18] stated that sustainable practices in the building industry are significantly impacted by published green and sustainable building and real-estate standards (GSBRES). As a result, it is critical to evaluate how these criteria help achieve the United Nations' Sustainable Development Goals (SDGs)

According to RILEM who contributes to the United Nations Sustainable Development Goals SGD 11 & 12, sustainable building materials utilizes natural resources and aids the reduction of CO2 footprints.

In order to obtain a sustainable future in the building industry, Asif *et al.* (2007) ^[6] recommend using a multidisciplinary strategy that addresses a variety of aspects, including pollution and emissions management, material waste minimization, enhanced material use, energy conservation, etc.

A structure may consume less energy if the proper building materials and construction methods are used. This is because less solar heat gain or loss means less air conditioning is required. The sustainability of a structure can be increased by using sturdy materials. Using sustainable materials reduces the quantity of natural resources required for manufacturing as well as the price of installation and associated labor.

Over the course of the building's life, durable materials that need to be replaced less frequently will use fewer raw resources and generate less trash for landfills Akadiri *et al.* (2012) ^[4].

Large amount of minerals resources is consumed in the built environment and most of these mineral resources are non-

renewable. Therefore, it is important to reduce the use of non-renewable materials. According to Abeyesundara *et al.* (2009) ^[3], this should be incorporated for consideration at the project initiative and design phases, where the selection of materials is very important and the choice should be based on the materials' environmental impacts.

Sustainability impacts of building materials

One of the greatest approaches to apply sustainability in the building industry, as per Bigrentz (2023) ^[7], is through materials that are used. Many industrial issues may be resolved with the aid of a new generation of stronger, lighter, and innovative building materials, which can also encourage the adoption of more environmentally friendly techniques.

Approximately 50% of all materials extracted from the earth's crust are manufactured into construction materials and products.

In Europe, minerals extracted for building materials amount to 4.8 tons per inhabitant per year, 64 times the average weight of a person (Zabalza Bribián *et al.*, 2009: 1133-1140) ^[22].

These materials have the added benefit of protecting the environment because they minimize the carbon footprint of the buildings that employ them, these materials also have the added advantage of helping the environment. They are also considerably more efficient and aesthetically pleasing, and they support a cleaner Earth and a sustainable future.

Benefits of incorporating sustainability in office building

Given the criteria for sustainable buildings, it can be asked: what are the benefits of incorporating sustainability into office buildings? There are obvious economic, environmental and social benefits which advantage owners and occupiers. For example, owners are said to benefit from lower running costs, higher rental and capital values (Reed *et al.* 2005) ^[16]. Depending on the actual lease structure, lessees benefit from lower running costs, less employee absenteeism due to reduced building-related illnesses and improved occupant health.

3. Conference of parties Cop 28

The 28th annual United Nations (UN) climate meeting held in Dubai, in the United Arab Emirates (UAE), governments discussed how to limit and prepare for future climate changes.

The increasing relevance of net-zero buildings in urban settings emphasized the necessity of promoting resilience and empowerment within the building industry, according to a separate side event. It pointed to the need to further raise awareness of the benefits of net-zero buildings for sustainable urban development. The event shared how different organizations are accelerating DE carbonization and resilience in the building sector, which is responsible for 30% of global emissions, through education and up skilling programs, establishing guidance and databases, and promoting relevant practices IISD (2023) ^[12].

On the opening day, the COP28 presidency scored two big wins. First, it oversaw a new agreement on the operationalization of a fund to pay for the loss and damage caused by climate change.



Fig 1: Sultan AI Jaber

At the press conference, Al Jaber also criticized the media for focusing on oil-and-gas deal allegations and his resurfaced remarks, while – in his opinion – omitting the presidency’s stated commitments to including language around fossil fuels in the negotiated texts.

The start of the second week saw the negotiations take center stage.

The COP28 presidency announced a series of ministerial pairings to take discussions forward, as usual at UN climate summits. (Unusually, the presidency appointed the ministerial pairings six months in advance in a bid to speed up progress.)



Fig 2: Conference of parties Cop 28

When the ministerial pairings produced little progress, the presidency attempted to push talks forward by holding a

“Majlis” on 10 December – an “Emirati tradition of bringing together a small, curated group to discuss specific challenges in an open, bold, and solutions-oriented way”, according to the UAE.



Fig 3: According to the UAE

General view of the Special Spotlight: Majlis Style Conversation with Dr. Sultan Al Jaber, COP28 President at the UN Climate Change Conference COP28 at Expo City Dubai on December 10, 2023, in Dubai, United Arab Emirates.

Credit: Photo by COP28 / Christopher Pike / Flickr.

(At the summit’s end, Al Jaber said the Majlis made “all the difference” in agreeing the outcome of COP28. One seasoned COP observer told Carbon Brief they had been “pointless”, with countries merely restating existing positions.)

Wim Chang, CEO, DEF, highlighted some of the over 30 DEF-supported, LEED-certified, and net-zero building projects, emphasizing DEF’s commitment to supporting the development of 100 buildings by 2030. He also discussed opportunities to rebuild climate-resilient structures, citing the use of salvaged downed timber from typhoons to reconstruct a public school devastated by a mudslide IISD (2023) [12].

Nations came to an agreement for the first time on the necessity of "transitioning away from fossil fuels in energy systems." The pact sets worldwide goals to double the rate of energy efficiency gains and increase the capacity of renewable energy sources, such as solar and wind power, by 2030.

The effect of COP28 on this project would result in the implementation of sustainable materials and new construction systems and methods that would aim at improving energy efficiency and mass reduction of carbon footprints.

3.1 User’s Satisfaction And it’s Parameters

The aim of office design is to optimize employee satisfaction with a physical environment that facilitates the organization’s workflow as much as possible. The difference between work areas that support or do not support the workflow is to what extent employees can direct their attention and energy to work instead of coping with environmental factors. Since office design determines the layout, interaction between employees, visual and auditory privacy, and distracting factors, it is an important indicator of both job performance and employee health and satisfaction. However, empirical studies on the influence of office building design on occupant

satisfaction are quite rare

User satisfaction is the performance that presents to what extent the needs and expectations of building users or occupants are met. It acts as a subjective assessment of the performance of building or service in meeting users' needs and expectations. In addition, it describes the person's feeling of pleasure and disappointment regarding the service's perceived performance/outcome in relation to users'/occupants' expectations.

However, according to Huber, *et al.* "the term user-satisfaction can hardly be described in concrete terms due to the missing of standardization for the measurement of user satisfaction". Researchers agreed on the definition of user satisfaction as the benchmark that describes what users expect in relation to what is perceived

There are six performance criteria in building performance evaluation, namely:

- Spatial (functional) comfort
- Indoor air quality
- Visual comfort
- Thermal comfort
- Acoustic comfort
- Building integrity (structural and material performance).

Indoor environmental quality (IEQ) refers to the quality of a building's environment related to the health of occupants within it. IEQ is determined by many factors, including lighting, air quality, and damp conditions.

According to (Wilkinson *et al.* 2009; GBCA 2010) [20] The underlying goal of increasing the level of sustainability in buildings is to reduce the environmental impact of the building throughout the whole building lifecycle from design and construction, through the operational phase which includes adaptations and to the end of the lifecycle when deconstruction and recycling can be undertaken (Reed *et al.* 2005; Wilkinson 2009) [16]. Many building owners and designers seek to confirm their sustainable credentials through adoption of green ratings such as Green Star in Australia, BREEAM in the UK and Canada or LEED in the US (Reed *et al.* 2009) [20].

Previous studies from the perspective of building users distinguished between the emphasis on occupants' well-being and health. Collectively these two factors constitute user satisfaction and are a measure of building performance (Roulet *et al.* 2006) [17]. In summary, occupants either feel good, healthy and comfortable or not when they are in the sustainable building (Edwards 2006; Roulet *et al.* 2006). Meir *et al.* (2009) [13] argued that building users may be either satisfied or dissatisfied with a sustainable building

3.2 Evaluation of facilities user's needs

According to Hakkinen and Nuutinen (2007) [9] Facilities users are the occupant of buildings and its amenities. Facilities users are not actually part of the design team. The interaction between the facilities and the users is what defines the users' pleasure and their assessment of the facilities' performance in their contribution, observed that if a building is designed without the basic end-users' requirements, it is unlikely to provide a suitable working environment. They agree that the process of understanding the precise functional requirements of the end-user must begin by embracing every member of the design and construction supply chain including the facilities manager. They maintain that all the

skills workers involved must have a basic knowledge of the end user's functional requirement which must be met if the completed building is to be deemed a success. It is obvious that the functional performance and morale of the occupant/end- User can only be enhanced if the design is a collaborative and integrated effort.

4.0 Methodology

This study used a qualitative approach, reviewing earlier studies published in relevant energy-related journals. A few keywords that were used were office complex, sustainable building materials, energy efficiency, and users' satisfaction. The subject of this research, Office complex development, was screened for relevancy using the keywords indicated in the research findings. They underwent additional filtering according to the publishing year's currency. Because of Google Scholar's extensive resource availability and trustworthy source materials, these papers were obtained from there. The chosen papers underwent a critical evaluation, and a theme presentation was made.

5. Conclusion

Enhancing the sustainability of office buildings is a methodical process that calls for work in the areas of design, construction, operation, maintenance, and user perception of open space utilization. An intentional effort should be made to ensure that passive techniques, such as the use of well-planned and integrated sustainable materials into building designs, do not negatively affect users' comfort. Additionally, characteristics like concrete finishes should be avoided.

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