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Applying Principles of Sustainability in achieving user comfort in Cultural Center design

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Abstract

The current climate crisis has created the need to regulate both indoor and outdoor comfort within the built environment adopting sustainable design principles to ensure that end-users are not physiological or psychological affected when using a facility like cultural center. The design of this center adopts sustainable measures such as passive sustainable design strategies, daylighting and natural ventilation as well as energy efficiency using renewable energy systems, green building materials and finishes. The aim of this research paper is to ensure that user comfort in the cultural center is guaranteed, having resolved all the architectural design parameters to be in sync with the sustainable goals associated with green architecture.

Keywords: sustainable, energy efficiency, renewable energy, comfort, natural

1. Introduction

Sustainability is becoming a crucial aspect of modern-day architectural practices and with the constant change in climate across the globe, the focus is increasingly pressing for the need to consider sustainability in architectural design practices will help achieve minimal environmental impact and maximize human comfort.

Sustainability entails the ability to exist and develop without depleting natural resources for the future and by using design methods, materials, energy and development spaces that are not harmful to the surrounding ecosystem or the environment.

Sustainability in architecture addresses the negative environmental and social impacts of buildings. The philosophy is to ensure that today's actions have no negative consequences for future generations and that they adhere to the principles of socio-economic and environmental sustainability. Cultural centers in Nigeria helps as a method of improving GNP and marketing the country because of its global nature allures and the language of the performing arts may be understood by people from many cultures across the country.

Traditional performances are generally held in a variety of social settings, and the performance itself takes into mind not only the procedures but also the physical comfort of the performers. As a result, user comfort and conveniences must be considered throughout the design phase.

Using a sustainable design philosophy promotes decisions at every stage of the design process that will have a positive influence on the environment and the health of the end users while without sacrificing the bottom line. This is comprehensive, integrated strategy that promotes compromise and sacrifices. Design, construction, operation, and decommissioning all benefit from an integrated approach.

With a proper interior climate, adequate daylight, acoustics, materials, and energy-efficient appliances and lighting, a sustainable Culture Center design will create a pleasant ambience both outside and within the structure. Individuals will be encouraged to stay and, as a result, interpersonal contact will increase.

2. Literature review

2.1 Sustainable development

The Brundtland Report, published in 1987, was the first to provide an "official" concept of sustainable development. Sustainable development, in particular, is a method of arranging society in such a manner that it can continue to exist in the long run. This entails taking into account both current and future imperatives, such as environmental and natural resource protection, as well as social and economic equality.

The birth of the concept of sustainable development is linked to the industrial revolution. Western cultures began to realize in the second part of the nineteenth century that their economic and industrial activities had a substantial influence on the environment and social balance. Several ecological and social catastrophes have occurred throughout the world, raising awareness of the need for a more sustainable paradigm.

Garret Hardin, an environmentalist and philosopher, produced an article called "The Tragedy of the Commons" in 1968. Individuals acting freely, logically, and focused on pursuing their own interests, he believed, will end up working against the common good of their communities and deplete the planet's natural resources. In this approach, human unfettered access to finite resources and infinite usage of those resources would deplete those same resources. Hardin argued that because humans are obliged to reproduce indefinitely, the Earth's resources will ultimately be depleted. To avert a future calamity, humanity, in his opinion, needed to drastically adjust its approach to exploiting shared resources - this, he believed, was the only way to maintain a sustainable development path.

In light of this context, it's worth noting that the well-known Brundtland Commission in the United Nations is linked to the discussion on sustainability and sustainable development. The Brundtland Commission, which was called after its president, Miss Gro Harlem Brundtland, is the World Commission on Environment and Development.

"Sustainable development may be defined as growth that satisfies the demands of the present without jeopardizing future generations' ability to satisfy their own needs," the Brundtland Commission's report on sustainable development stated in 1987. (From the 1987 World Commission)

3. Methodology

By performing case studies, the researcher employed a qualitative research technique to address the study issue. To better understand architects' perspectives on sustainable design process, this approach was used to collect, examine, and analyze data obtained during the case study process. Nigerian Cultural Centre, Valby culture center and library, are some of the best examples of cultural centers that were motivated by basic sustainability concepts.

3.1 Nigerian cultural center

The Nigerian Cultural Centre and Millennium Tower were built to fit in with the surrounding environment and address site issues. The materials chosen, the parking circulation, and climate reactions like the water ponds all contribute to efficiency. The Complex's building may result in a surge in tourism and an improvement in the city's quality of life. More people would be employed, and new structures would be constructed in the area.

Buildings within the enclosure have been carefully located on the north and east edges with cascading storeys to reduce heat gain, with the northwest boundary having the fewest floors. The north block's minor slope keeps the evening sun from reaching the northeast end. Evaporative

cooling is provided by the water ponds in the north half of the site, while the botanical garden in the south minimizes reflection from the ground and boosts humidity.



Figure 1: Exterior View of Nigerian cultural center (Source: <u>www.re-thinkingthefuture.com</u>)

The basis for understanding the building of observatory towers has been created by learning from iconic structures such as the CN tower, the Seattle needle, and others. A revolving restaurant and an observatory deck have been installed in the Millennium Tower, similar to those.



Figure 2: Exterior View of Nigerian cultural center (Source: www.re-thinkingthefuture.com)

A modern concept requires the use of modern materials. The overall excavation is projected to be 563,000 m3, with 133,600 m3 of structural concrete required, 17,030 tons of steel reinforcement, 192,000 m2 of resurfaced surfaces, and 3,690 tons of structural steel required. Steel components make it feasible to achieve such huge spans with fewer intermediate columns. Steel is also used to create the observatory's disc form. The Nigerian Cultural Center's roof is made of double-glazed glass, which not only prevents heat from entering the structure but also produces an acoustically separated setting.

3.2 Valby Culture center

Valby Culture Center and Library is a cultural meeting place for inhabitants of Valby as well as Copenhagen Municipality citizens. The new culture center is located on the corner of a key junction and wraps around it to create a softer barrier between the motorways and pedestrians. The building's undulating front will lead people around it and into the square. A tranquil atmosphere is provided by a circular square within the square, which is insulated from the busy traffic.

The culture center is adaptable for customers with self-service access to the premises, whether they need to use the culture amenities or rent a book from the library.

This gives the user the freedom to use the facilities whenever they choose.

The Valby Cultural Center's sustainability plan is built on a variety of strategies.

• Because the building surface is tiny in comparison to the volume, the circular building design reduces energy usage.

• The building's orientation is north and south, which maximizes heat uptake and thermal mass storage in the concrete floors and cores.

• To minimize excessive heat from the southern face, the majority of functions are positioned on the northern front. As a result, the corridors are on the southern facade and serve as a buffer zone.

• Natural ventilation is provided through windows on the 1-5 floors, as well as roof windows. When it gets too hot or pollution levels reach too high, the windows on the south face and the roof windows are mechanically adjusted.

• Selecting the best building envelope and window type

• Solar cells as a sustainable energy source • Rainwater collector and wastewater management for domestic water.

3.2.1 Techniques applied:

• Use of passive solutions, such as natural ventilation and solar gain, results in low energy use.

- A small-scale building design
- The best building orientation

• A suitable interior environment is accomplished by: - tailoring the temperature and ventilation to the activities taking place in the rooms.

• Ample daylight

- A room-specific acoustic solution
- In open spaces, reducing noise using soft materials and plants.

• Construct a noise barrier or contour the structure well using soft materials and plants to reduce road noise in outdoor spaces.

4. Sustainable Architecture principles (environment, energy, efficiency)

Sustainable design aims to improve building performance by reducing negative impacts on the environment as well as the health and comfort of building occupants. The primary goals of sustainability are to limit nonrenewable resource use, eliminate waste, and promote healthy, productive ecosystems. As a result, we're seeing more 'sustainable design' projects, which aim to reduce a building's negative environmental effect through efficiency and moderation in material, energy, and development area consumption.

4.1 Environmentally-friendly building materials

Environmentally friendly building materials are often chosen by a sustainable architect. Materials that are biodegradable or renewable, as well as those that need the minimum amount of energy to produce, are the most ideal. Locally sourced woods and stone are frequently utilized, reducing the distance materials travel before being used in the construction process and supporting local trades. All other materials are non-synthetic and non-toxic, with a preference for wood sourced sustainably from certified forests. The heart of a sustainable architect's design is recycling. Although it was difficult to get recycled building materials in the early 1990s, there is now a thriving market for recovered architectural salvage, facilitated by specialized firms that provide materials from demolition sites.

4.2 Energy and resource efficiency

Steps are taken to design for energy efficiency whenever possible, including the utilization of renewable energy sources like wind, geothermal, and solar. Building energy efficiency may be improved in a number of ways, according to a sustainable architect. A structure can be oriented to take advantage of seasonal variations in the sun's position, as well as energy-efficient lighting and appliances. The cost of heating and ventilation, which may account for a significant portion of the total cost, can be decreased by utilizing energy efficiently.

After a cultural center has been developed and built, lowering monthly energy expenditures is challenging. When it comes to energy efficiency, it's critical to consider where air comes from and where it's needed in the structure.

Moisture saturation or retention can occur as a result of incorrect sealing and insulating material usage or installation, creating a major health concern.

Energy cost, availability, long-term affordability, comfort, efficiency, health, and safety are all considerations to consider when it comes to energy efficiency in a cultural center.

4.2.1 Ways of achieving energy efficiency in the building

White roof surface

- 1. The white roof surface reflects the sun's heat, keeping the roof much cooler than a traditional roof.
- 2. Light or white roof tops help to reduce the amount of heat absorbed through the exposed roof surface from solar radiation.

Ridge vents

- 1. Ridge vents are crucial for roofs because they assist to reduce the temperature in the roof structure and, as a result, in the attic and the living area below.
- 2. Ridge vents aid in air circulation and help to minimize moisture problems.

Insulation

Insulation creates a barrier between the inside and the outside world. It can aid in the comfort of the inhabitants.

4.3 Efficient use of space

The sustainable architect understands the importance of indoor environmental quality in influencing how people feel in a room and concentrates on elements such as healthy internal spaces with proper ventilation, temperature regulation, and the use of non-toxic materials. Earth shelters, roof gardens (green roofs), and abundant vegetation are also urged to be used throughout

and around structures. In the United Kingdom, a study of five new academic buildings and campuses by CABE (Commission for Architecture and the Built Environment, now Design Council Cabe) found that more than 70% of staff and students thought the facilities and functions of the buildings they work in improved how they felt and behaved.

5. Conclusion and Recommendations

The adoption of sustainability architecture principles and basics, as well as resorting to sustainable building trends, is consider the most successful way to get rid of the increasing energy problems, as well as the problem of depletion. These principles also sustain on achieving comfort for building users by guaranteeing thermal comfort, natural ventilation, and natural lighting. Not only that, but it can save and will provide the building with its energy needs by fully utilizing natural energies such as: (solar energy, wind energy, and water energy), which helps to reduce energy consumption and also helps to benefit from rain water, gray water, and wastes of buildings rather than leaving it to pollute the environment.

The fundamentals of eco-friendly architecture demand reprocessing for all of these elements and using it to maintain a clean surrounding and fully benefit from new and renewable energies by studying global and local buildings that use green architecture and have obtained certificates for energy consumption rationalization such as LEED. The required goals have been extracted via the use of green natural ways and contemporary procedures that are unamortized of energy in order to achieve a commercial building that is also environmentally friendly.

Contemporary difficulties, such as the advancement of technology, lifestyle, a lack of time to spend in nature, and worldwide trends, have resulted in a new way of life. Because sustainable development is a global issue, it cannot be addressed just locally. Furthermore, national and global activities are irreplaceable and critical. The present condition of environmental and urban planning necessitates certain duties and efforts, particularly when this status is closely related to quality of life and public health. As a result, we favor natural ventilation in an urban layout where those natural procedures are preferable and may be applied, according to the conceptual findings of this study.

Furthermore, in order to implement a sustainable plan, it may be necessary to examine the use of passive cooling and ventilation, which give shade and humidity to dwelling units. According to the conceptual conclusions, human comfort can be more successful than it is now under typical yearly climate circumstances with adequate implementation of passive bioclimatic principles.

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