



GREEN BUILDING TECHNOLOGY DESIGN AND ADOPTION: OCCUPANTS PERSPECTIVE

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ABSTRACT

Green technologies that can be incorporated into buildings to make them sustainable and energy efficient and conservative are being adopted into construction in developing countries. The behavior of the occupants in a work place can accelerate or slow the process of adoption of these technologies. This paper aimed at identifying the behavior of occupants towards the use of water and energy consumption in a workplace environment. The data for this research was obtained from questionnaires distributed to the occupants of the workplace and the findings showed that occupants did not maximize the uses of the available utilities, and occupants were relatively knowledgeable of the green building technology and alternatives available. It was recommended that education of occupants was a good way to utilize the available resources in a manner that will better improve the comfort and durability of the facilities and even transform the user's behavior regarding green buildings.

Keyword: Green Building technology, Sustainable construction, Occupants behavior.

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1. INTRODUCTION

Sustainability, the need to manage our resources so as not to exhaust them is necessary in the world today. Quite a good number of construction projects are handled from design to erection without concern for the effects of the sustainability of these projects and their effects on the environment [1]. In the construction and building industry, there is no need to relent in the pursuit of sustainable practices because researches have shown that it has been identified as the one of the most significant destroyer of our natural habitat [2], [3]. The construction industry is known to consume significant quantities of resources, and release pollutants to the atmosphere [4]. According to the International Energy Agency (IEA), construction industry is responsible for the consumption of over 40% of the total global energy and is also responsible for releasing over 40% of the total greenhouse gas (GHG) that is released to the environment.

While comforts are provided for the occupants of buildings, these comforts should not come at the cost of the environment (IEA). Nigeria, a member of the class of developing countries has the characteristic of construction industry struggling with a lot of challenges, ranging from; inadequate technical infrastructure and managerial operations to insufficient financial, material and equipment capital base [5]. An observation of the trends indicates that GHG emissions and energy demand associated with the construction industry will double by the year 2050 [6], [7]. When a building is developed for being resource efficient and environmentally friendly, it is referred to as a green building. A more detailed definition is given by the world council of green building defining green buildings as “a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment”. Moreover, not only do green buildings preserve precious natural resources, but they also improve human quality of life”. Therefore, the design and construction of green buildings are based on the principles of sustainable development since sustainable development involves development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ [8], [9]. A major global challenge in the twenty-first century is how to tackle the challenge of climate change and the action of chloro-fluoro carbons (CFC), and reducing greenhouse gas emissions. This could be achieved by introducing or using green technology in buildings. It will be significant to primarily understand what green technology is. Green building technologies include technologies like energy efficient Heating, ventilation, and air conditioning (HVAC), solar technology, and other technologies to improve the general sustainable performance of the buildings [10], [11], [12]. Green technology involves the use of knowledge for practical purposes but with preserving the environmental attributes as the main objective of the technology. Green technology has the goals of minimizing waste, reducing pollution, Green building technology is also referred to as green construction or sustainable building technology and a typical green building technology project has the objective of conserving and restoring the habitat that is vital for the sustenance of life. The protection of the environment is the primary reason green building technology should be practiced because the priority is the need for preserving the resources available thereby encouraging sustainable development practices. Another reason it is necessary to practice green building technology is to reduce the demand for electric because there is a wide deficit when the demand is compared to the supply. In Nigeria, the demand for electricity is estimated at 16,214 MW against a supply of about 13603 MW which indicates that there is a deficit of – 2,611 MW [13], [14], [15] It therefore is understood that a proper practice of green building technology will lead to the reduction or even erasure of this power deficit.

There are two major ways green buildings can be achieved. This first is from the design stage. The properties and functions of the building is studied and the materials to be used are decided upon and the choice of materials and provision of services are done with the best sustainable choice as the goal. However, there is a scenario where the building was not initially designed for sustainability but over time the need to make it sustainable arises. Deconstructing the structure is usually not an option but retrofitting it with the state of the art green technology is still possible. According to the Miriam-Webster Dictionary, retrofitting means “to furnish (something, such as a computer, airplane, or building) with new or modified parts or equipment not available or considered necessary at the time of manufacture” [16] There is no question about the benefit of green building technology because research has shown that the adoption of this technology has a three-dimensional benefit such as economic, environmental, and social [17]. Even though the construction industry has been cited as the largest destroyer of the environment and consumer of nonrenewable resources [2], [18], this perception can be changed by the proper use of green technology.

2. MATERIALS & EXPERIMENTAL PROCEDURES [AHEAD]

2.1. Methodology

The research study was based on survey approach such that the primary data was collected through structured questionnaires distributed to occupants of the existing College of Science and Technology building in Covenant University Ogun State, Nigeria. The occupants were chosen because of their experience and familiarity with their offices and the office complex. Some professionals were also surveyed to get their technical opinions on the subject matter.

2.2. Population of the Study

The population of the study was Covenant University College of Science and Technology. A survey of 170 persons was carried out from a population obtained from a portion of Staff and Students in fields of Architecture, Building technology, Estate Management, Chemistry, Biological sciences, Mathematics, and Physics, amongst others that work or study in Covenant University Ogun state, Nigeria (especially) and professionals with specializations in the built-environment.

They responded to the questionnaires thereby giving the researcher an idea of their perceptions about green building technologies and how they use the existing services. The study surveyed 170 Professionals, Staff and Students combined. 162 questionnaires were retrieved giving a response rate of 95.3% The research design employed in this study is the case study approach. Rowley in 2002 stated the importance of Case studies as they help analyze modern events in new research or existing theories which seem inadequate. To this end, a case study was also deemed appropriate.

This research is based on the administration of structured questionnaires with closed and open-ended questions which were designed to answer the research questions and help the researcher proffer the best solution to the identified problems and hence, to aid fulfillment of the objectives of the study.

3. FINDINGS

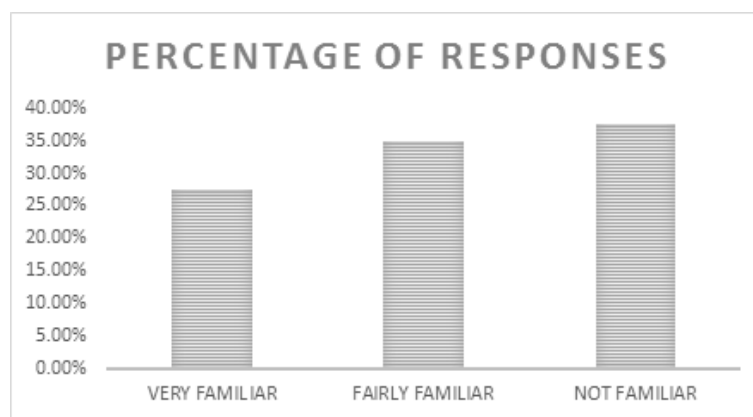


Figure 1 Familiarity of respondents with Green technology methods and concepts

Figure 1 shows the level of knowledge or awareness respondents have Green technology methods and concepts. Most respondents are not familiar with Green technology methods and concepts and they account for 37.5% of the total population percentage. 35.0% possess a vague knowledge of green technology and only 27.5% of respondents are aware of concepts and methods of green technology.

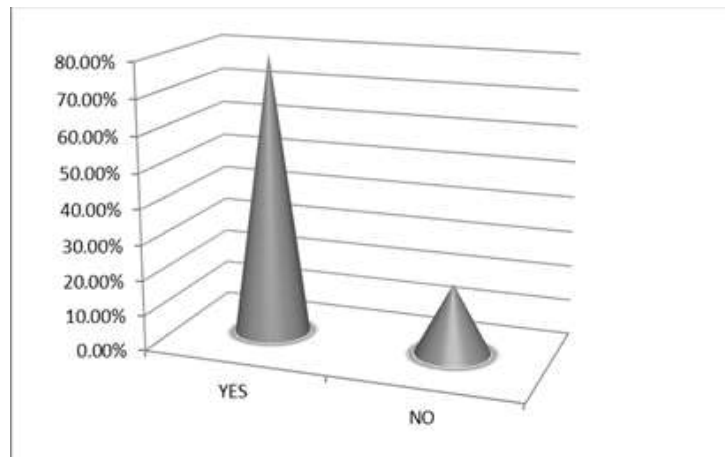


Figure 2 Professionals' awareness of alternative sources of energy used in buildings

When the response of the professionals in the construction industry were considered, it was discovered that majority of the professionals have reasonable of knowledge of green technology. Figure 2 shows the level awareness on alternative sources of energy used in buildings. Most respondents are aware of the different alternative sources of energy used in buildings and they account for 80.0% of the total population percentage. The remaining 20.0% are unaware of alternative sources of energy used in buildings. This is probably because there might have been some level of exposure that their respective disciplines afforded them.

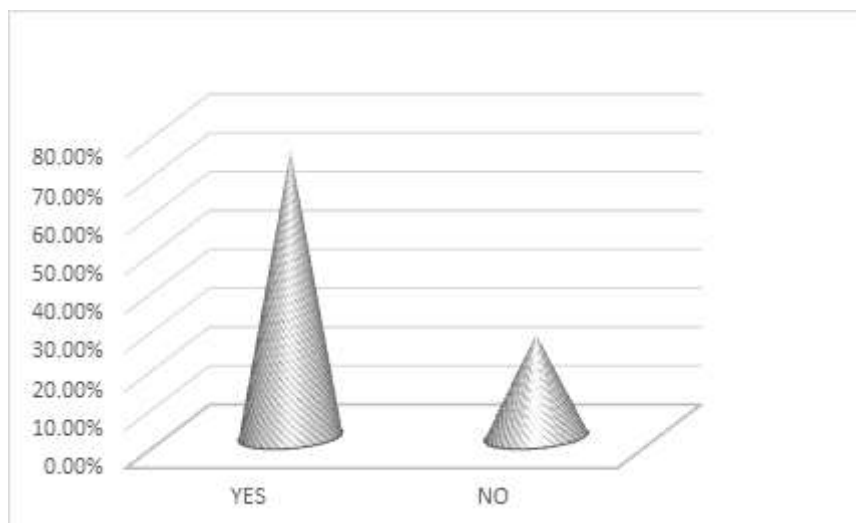


Figure 3 Occupants response on the benefits of artificial source of lighting employed in CST

From Figure 3, 73.7% of the occupants' respondents agree that the use of artificial sources of lighting in CST presently is beneficial to the energy consumption of the College building, the remaining 26.3% disagree. This result shows that the occupants do not have an adequate knowledge of sustainability in buildings in terms of provision of lighting in the offices. When natural lighting is used, it reduces the need for artificial lighting and is usually a good sustainable practice. Optimizing energy and natural lighting will enable less dependence on artificial sources.

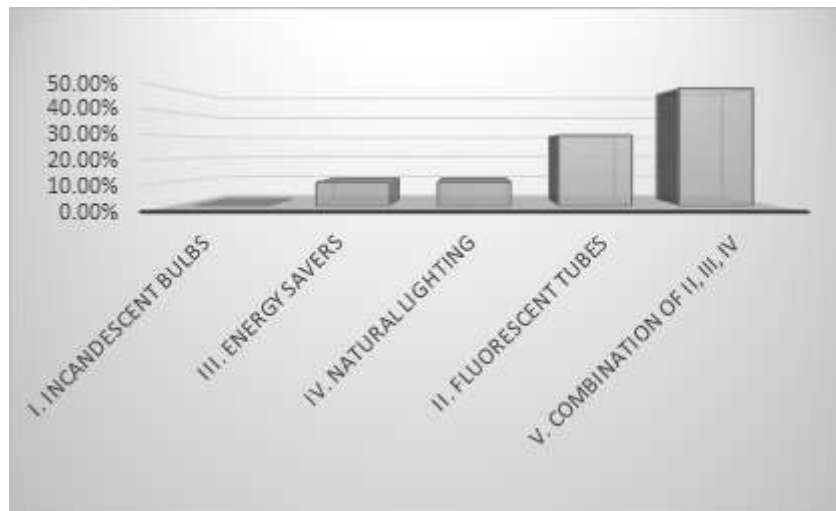


Figure 4 Preferred choice of illumination in building

From Figure 4, 50.0% of the respondents had a combination of the energy saver bulbs, natural light, and fluorescents tubes in their offices. 30.0% of the respondents had only fluorescent tubes and 10.0% of the respondents made use of energy savers light bulbs. About 10.0% of the offices maximized natural light as an illumination option. There was no office where the use of incandescent bulbs was found hence the 0.0%. this result implied that while some offices were already practicing some form of green technology without knowing it, there was still room for improvement.

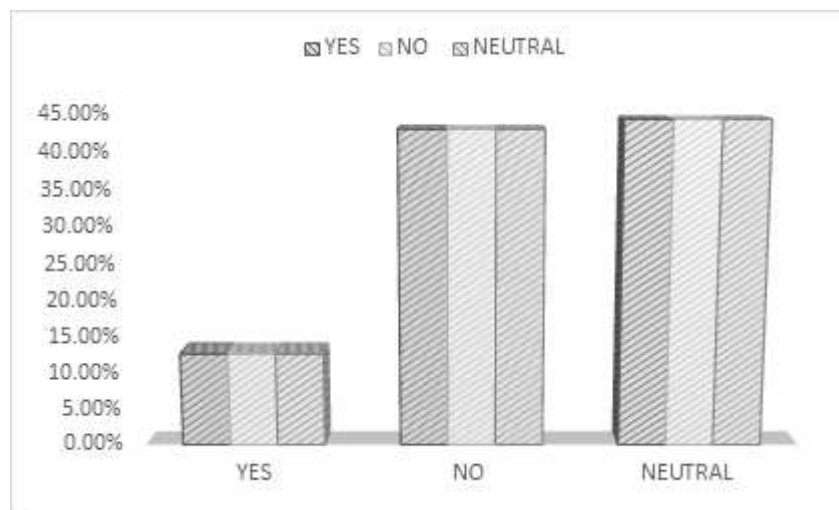


Figure 5 Thermal comfort within the CST building

From Figure 5, it can be observed that 43.0% of respondents disagree with the adequacy of thermal comfort being adequate in their offices. It was observed that the ventilation system was mainly dependent on the use of air conditioning and in the absence of electricity, the office spaces became unbearably hot. Only about 12.7% of the occupants agreed that the thermal comfort was adequate for them. The remaining 44.3% indifferent.

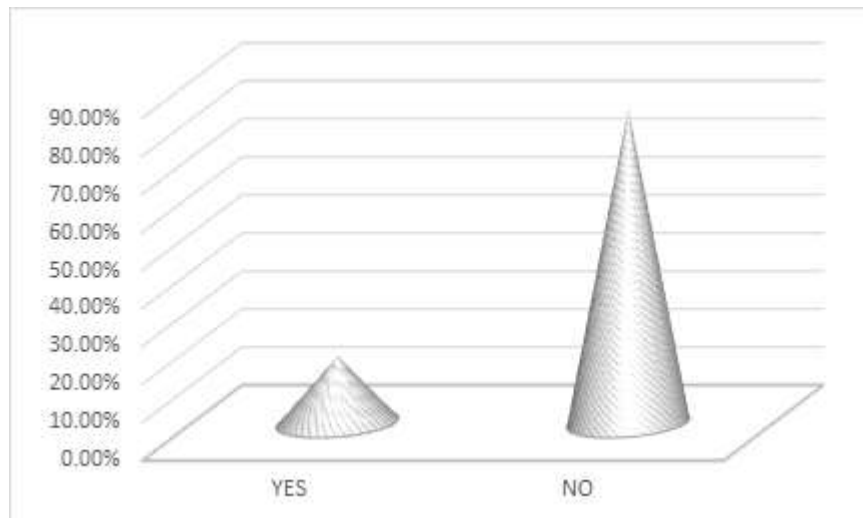


Figure 6 Use of alternative sources of energy in CST (solar, wind etc.)

From Figure 6, 17.5% of the offices were connected to alternative sources of energy being used in CST currently. The alternative source of energy available was solar panels. The remaining 82.5 % were solely dependent on the grid. In the event of blackout or temporary power failures, these offices which constitute majority of the office spaces are affected. This shows that alternative sources of energy are currently being employed for use in CST building in Covenant University but they are not maximized.

4. CONCLUSION AND RECOMMENDATION

From the results, the following conclusions can be drawn

It is shown that most respondents do not know about Green technology concepts and methods especially as pertaining construction, although most people claim to have heard about it. Hence, the place of enlightenment and awareness from all platforms should not be underestimated because, it is what people know and understand they will be willing to apply the College of Science and Technology (CST) requires adequate retrofitting adjustments. Maximization of natural lighting at various times of the day. As expressed and desired by persons that occupy the building, energy optimization and natural lighting will enable less dependence on artificial sources.

From Figure 4.9, the two major determinants of the choice of lighting systems for use by professionals (Personal choice and Price) can be seen. In this part of the world emphasis is not placed on the appliance ratings or capabilities before installation in most cases.

Alternative sources of energy (wind, solar thermal, biomass energy etc.) are currently not employed for use in CST building in Covenant University.

Therefore, these recommendations are made;

Platforms for encouragement, awareness and publicity should be made on Green technology, Green construction and ultimately, sustainable practices and the importance in Covenant University and Nigeria.

A suitable recommendation for heat and ventilation is the ventilated wall system. A large percentage of persons could not ascertain the thermally conduciveness of the College of Science and technology building in Covenant University, therefore it hints that there is a challenge to be addressed. Also, the water infiltrations and leakage issues can be redressed by the ventilated wall system.

Installing ventilated wall for solar reflection, hence aiding thermal comfort within internal spaces.

Energy rating and energy star rated appliances should be encouraged for sales and in use in Covenant University and Nigeria. Also, alternative energy (wind, solar thermal, biomass energy etc.) can be developed even via further studies and adopted for use in CST building in Covenant University and Nigeria. Solar power generation can be explored to the maximum in Nigeria as there usually is abundant sunlight generated for most of the day.

Nigeria has in 2017 launched the very first National Building Energy Efficiency Code. This will be a big step towards ensuring compliance to sustainability practices that could also include retrofitting in Buildings within Nigeria. With the launch of this code, Nigeria is well on the way to establishing a green building council.

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