GREEN ARCHITECTURE AND SUSTAINABLE DEVELOPMENT IN NIGERIA

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Abstract
Green Architecture is a concept developed to encourage sustainable development. It brings transformation to design and construction in both developed and developing economy. The paper analyses the nature of design and construction in Nigeria on the basis of green and sustainable practice. It surmises that the concept of green architecture will affect the nature of architecture and design which depends on the choice of materials, the construction techniques, the calculated cost of construction and the climatic conditions in Nigeria. It posits that the developmental concept of green architecture in Nigeria will encourage sustainable development and environmental protection.
Keywords: Sustainable development, green architecture, environmental protection, construction and design.

Introduction

Every building responds according to its composition and of its design. The International Energy Agency released a publication that estimated that existing buildings are responsible for more than 40% of the world's total primary energy consumption and for 24% of global carbon dioxide emissions (Howe, 2010). Architecture is responsible for about 45% of the carbon dioxide (greenhouse gas) emissions in the UK (RIBA, 2012). The designs of architects are very important in mitigating the problem of climate change. This calls for the concept of sustainable architecture. This invariably form the major concern of the architects in seeking sustainability in design.

The concept of organic architecture which was the fundamental concept of great architects like Frank Lloyd Wright (1867–1959) has now been identified under the current climatic challenges as a most relevant approach amongst the schools of thoughts in architecture (Wikipedia, 2012a).

Today, architects are facing increasingly tougher regulation about how energy efficient buildings must be, have ever-more environmentally aware and demanding clients, and themselves want to play their part through their work. The current focus of major schools of architecture is aimed at providing member-focused guidance on the principles, tools and techniques necessary to design and build low carbon buildings, and adaptive, flood resilient design, and to advise clients on what is possible (RIBA, 2012).

The architects today have come to terms with the fact that rapid and significant reductions in global carbon emissions are necessary to reduce climate change, and supports a minimum of an 80% cut in CO_2 emissions by 2050 (RIBA, 2012 and Brown et al, 2008). The Royal Institute of Architects (RIBA) in its commitment to meeting the challenges of climate change, developed a Climate Change Policy which adopts the philosophy of Contraction and Convergence (RIBA, 2012). The theory points towards significantly tougher international reductions in emissions, and seeks a globally equitable solution. In

realizing the set objectives, RIBA was very active in pushing for a fair but strong international agreement in the run-up to the UN's Copenhagen Summit in December 2009.

To further achieve this, there is a strong need to promote greater public awareness of the climate change threat, stressing the significant roles buildings and design play in creating and reducing climate change. To achieve this, there is a need for a synergy between core professions in the building industry working together in collaboration with other institutions to encourage the government and the construction industry to raise their standards and play their part to combat climate change.

The concept of green architecture or building throughout society has five varying visions which include the ecological, smart, comfort, aesthetics and community visions with each having competing discourses (Guy 1997 in Boyle, 2004). Another important aspect of green design is the strategic placement of windows around the facing of the building (Wisegeek, 2012). Ideally, the windows are placed so that the most efficient use of sunlight during the day takes place. In addition to decreasing the demand for artificial light during the daytime, the windows can also serve as a means of allowing the natural sunlight to provide a degree of warmth to the interior of the building (Wisegeek, 2012). This in turn makes it possible to utilize less of the stored solar or wind energy to keep the space at an equitable temperature.

Green architecture is otherwise known as eco-design, eco-friendly architecture, earth-friendly architecture, environmental architecture and natural architecture. The concept takes into consideration the orientation of the building in relationship to the sun and wind direction in order to take absolute advantages of the movement. Green architecture also entails studying the human activities within the space to allow for spaces with activities at different period of the day. The building may be recessed partially into the side of a hill, providing natural insulation and composting toilets may be the ideal solution in areas where water is harder to come by (Wisegeek, 2012). Finding ways to use whatever elements are native to the area also help to keep the structure in balance with nature, such as creating blocks using local sand rather than shipping in bricks constructed elsewhere.

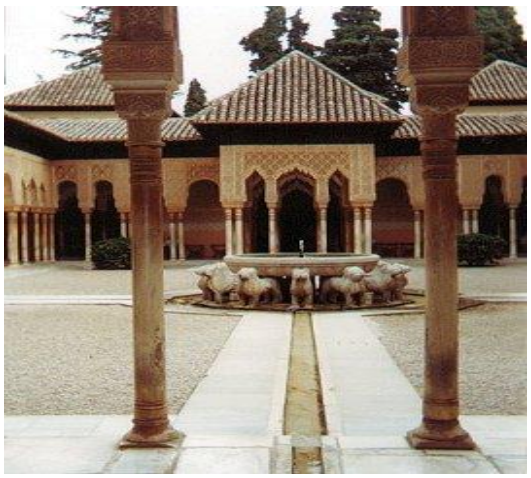
This paper shall be exploring green architecture as one the process of attaining sustainable development. It shall analyse the courtyard system in the tropics in line with concept of green architecture. It identifies the importance of energy and environmental sustainability in green architecture and process of sustainable development.

Green Architecture and Courtyard System

Green architecture, or green design, is an approach to building that minimizes harmful effects on human health and the environment. The "green" architect or designer attempts to safeguard air, water, and earth by choosing *eco-friendly* building materials and construction practices. Green architecture entails adequate natural ventilation systems designed for efficient heating and cooling, appropriate energy-efficient lighting and appliances, adequate and appropriate landscapes that ensures maximum passive solar energy. Generally green architecture ensures minimal harm to the natural habitat. Location of building on site, including access, and utility supply routes; Arrangement of internal rooms, and doors and windows; Dimensions of building and environmental components Finally it takes into consideration the Color, texture, ornamentation of building in relationship to the environment.

A Court or **courtyard** is an enclosed area, often a space enclosed by a building that is open to the sky and areas in inns and

public buildings were often the primary meeting places for some purposes, leading to the other meanings of court (Wikipedia, 2012c). Courtyards have always been part of residential architecture for a very long time. It has been historically used for many purposes which included cooking, sleeping, working, playing, gardening, and even places to keep animals (Wikipedia, 2012c).



Picture 1. The Court of the Lions, Alhambra, Granada, Andalusia (Wikipedia, 2012c and www.alhambra-patronato.es)

One of the great attributes of courtyard design concept is that it allows for good fenestration and privacy. It allows for good flow of indoor and outdoor activities thereby removing the pressure of activities within a given space. Courtyard regulates the micro climate within the enclosure through the free use of vegetation. In densely populated areas, a courtyard in a home can provide privacy for a family, a break from the frantic pace of everyday life, and a safe place for children to play. With space at a premium, architects are experimenting with courtyards as a way to provide outdoor space for small communities of people at a time.

Picture 2. Chinese Courtyard in Beijing (Wikipedia, 2012c).

In contemporary African setting like in Nigeria, one of the finest aspects of cooking and dining outside is to enjoy the nature with friends and family which is accommodated in a courtyard.

Courtyard design accommodates the requirements of the permanent resident, whilst offering the flexibility required by the transient occupation of holiday accommodation. In traditional houses, courtyards perform an important task as a modifier of climate. It allows outdoor activities to occur with protection from wind, dust, and sun (Petherbridge,1995).

Courtyards serve as light-wells in a building type that restricts exterior windows (Wikipedia, 2012c). They also serve as air-wells into which the cool, dense night air sinks. Since the courtyard is usually protected by walls, loggias, or galleries sun rays do not heat it until later in the day. When the sun reaches the court and heated air rises, convection current set up airflow that ventilates the house and keeps it cool Abarkan and Salama (2000).

Architecture and Culture

Detailed analysis by Rapoport (1969) emphasized that every building is first a product of cultural phenomenon; hence the environmental and climatic factors must be given preeminence. Over the years, it has been recorgnised that cultural rituals have evolved top adapt to climate conditions and vernacular architecture embodies some of these adoption in their plan and design features (Hawkes, 1996 in Bay and Ong, 2004). Thus, cultural components in line with climate condition will encourage green architecture.

Nigeria and tropical traditional architecture before the invasion of foreign concepts of architecture at most times were using mostly sustainable green construction materials in its operations. Except that the now architecture in tropics like Nigeria are now unadulterated transplants from temperate countries in the name of international style (Bay and Ong, 2004).This has incorporated mostly unsustainable construction materials in its operations as compared to the old tropical traditional concept of architecture that were practiced.

Green architecture supports mostly green construction materials for its operation. These are materials that tend to be derived from the earth that are more safely and naturally assimilated by the earth at the end of their service lives (Milani, 2005). Therefore, traditional building materials such as stone, earth, bamboo and wood commonly used in tropics such like Nigeria are essential for green construction. These materials because of capillary effect could absorb water which can then evaporate from their surfaces and thus hinder the interior air from being re-warmed by convection (Salam, 2003).

Green Architecture and Energy Sustainability in Nigeria

Green technology is gaining force in several forms across the world. Energy management is essential in green architecture. Green architecture supports the principle of sustainable energy development. Sustainable energy development encourages the use of alternative and renewable energy. Green architecture thereby must revolves around energy saving.

Energy saving and efficiency associated with green architecture enables cost saving which is one of theme of sustainable development paradigm. Therefore the energy analysis of Nigeria as a country is essential in green architecture and its processes of attaining sustainable development. Therefore, countries energy needs and management are essential in green technology and sustainable development.

Nigeria as a country depends mostly on crude oil and electricity for its energy fulfillment. Even though, the consumption of electricity actually declined by 13.4% between 2002 and 2006, the overall or

total electricity consumption showed a marginal increase of 1.8% from 5.63GWh in 2002 to 7.47GWh in 2006 (Sambo, 2009).

Sustainable energy will be a considerable feasible energy solution to Nigerians energy challenges mostly in the rural areas especially with the challenge of connecting most rural areas to national grid for its energy use. Therefore, its consideration may be essential in the practice of green architecture and environmental sustainability both in urban and rural societies in Nigeria.

Biomass resources available in the Nigeria include fuelwood, agricultural waste and crop residue, sawdust and wood shavings, animal dung/poultry droppings, industrial effluents/municipal solid waste (Sambo, 2009).

Sambo (2009) in the article Strategic Developments in Renewable Energy in Nigeria in the International Association for Energy Economics (Third Quarter, 2009) analyzed the daily needs of the rural populace for heat energy as follows

Table 1: Biomass Resources and the Estimated Quantities in Nigeria

Resource	Quantity Energy (million tonnes)	Value ('000 MJ)
Fuelwood	39.1	531.0
Agro-waste	11.244	147.7
Saw Dust	1.8	31.433
Municipal Solid Waste	4.075	-

(Source: Sambo, 2009).

The table 2 below contains recent estimates of energy potentials apart from hydropower in Nigeria

Table 2: Energy Potentials apart from Hydropower in Nigeria

Reserves/Potentials (2005) Resource Type	Reserves	Reserves (BTOE)(1)
Crude Oil	36.0 billion barrels	4.896
Natural Gas	166 Trillion SCF(2)	4.465
Coal & Lignite	2.7 billion tonnes	1.882
Tar Sands	31 billion barrel of Oil equivalent	4.216
Sub-Total Fossil	15.459	
Hydropower, Large Scale	10,000 MW	
Hydropower, Small Scale	734 MW	
Fuelwood	13,071,464 Hectares(3)	
Animal Waste	61 million tonnes/yr	
Crop Residue	8.3 million tonnes/yr	
Solar Radiation	3.5 – 7.0 KWh/m2-day	
Wind	2 – 4 m/s (annual average)	

Source: Bayo (2008)

The two tables above (tables 1 and 2) depict the potential of Nigeria as whole for sustainable energy. The sustainable energy potential of Nigeria encourages the adoption of green architecture concept.

Also, the primary energy loads in buildings are created by lighting, space heating, cooling equipments and domestic hot water while the production and consumption of this energy contributes to air pollution, acid rain and global climate change (Otegbulu, 2011). Therefore, creating a low carbon design in architecture, seeking energy efficient ventilation, appropriate design ergonomics as well as good consideration and blending of outdoor environment with the indoor would enhance the attainment of sustainable development in developing economy like Nigeria. Since, building has been estimated to contribute about one third of the total global annual greenhouse gas emissions primarily through the use of fossil fuel during their operational phase (Adeleke, 2010). This makes consideration of energy efficiency as a priority in green architecture. Environmental sustainability is a primary goal in green architecture and design.

Conclusion

The practicable use of courtyard system in planning and design would enhance the quality and efficiency of most tropical architecture. To achieve this, both developing and industralised world should set a carbon target.

Green architecture ensures that no part or component of the building poses a threat to the surrounding environment. This requires the use of natural building materials with organic compounds like wood, bricks, or other elements rather than synthetics.

The paper through literatures analysis identifies the energy needs of Nigeria. It recognizes that sustainable energy is essential to green architecture in Nigeria. It affirms that sustainable approaches to designs and construction such as the introduction of sustainable construction materials, alternative and renewable energy will encourage the principles of green architecture and sustainable development in Nigeria.

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