THE ARCHITECT'S CONTRIBUTION TOWARDS THE DEVELOPMENT OF SUSTAINABLE CITIES IN NIGERIA

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ABSTRACT

The quality of life in cities is found to be gradually declining as a result of the immense human interaction with the natural environment. One of the eminent factors that is contributing to the decline in the quality of life in the cities is the effect of building construction activities. These developments collectively affect the efficiency of not just the immediate environment but the city as a whole. Sustainable development however encourages developments that have the most minimal impact on the environment. This implies that the architect on whose blue print other professionals rely on in the development of these buildings will require to put into consideration a sustainable strategy towards reducing the impact of buildings on the city environment. The choice of building material and the reliance on mechanical cooling equipment especially in tropical climate which is found in Nigeria will need to be reduced so as to trim down the green gas effect in the cities. The concept of sustainable development once put in to consideration at the design stage by the Architects, will go a long way into making the cities a better place to live and work in. This paper highlights the strategies that can be explored through the choice of appropriate building material, choice of sources of energy, and methods of water conservation in buildings towards the attainment of sustainable cities in the developing economy of Nigeria.

Keywords: *Architects, Cities, Development Environment, Sustainable.*

1.0 INTRODUCTION

The world population is moving towards settling in cities because of the social amenities, infrastructure, employment, and good health care delivery. The 21st century is the century of cities as more people will live in the cities of the developing world. The UN-HABITAT (2002), report projected that 98 percent of the projected global population growth during the next two decades will occur in developing countries and that the vast bulk of this increase will be in the cities of developing countries. This implies that more buildings will be required to accommodate the projected population growth.

The goal of every nation is also to have an improved economy and as the economy improves so does the demand on architectural activities, this activities transcends down to demand on land, building products and energy. The Clinton Climate Change Initiative (CCI) 2010 observed that cities occupy only two percent of the world's land mass but yet contribute more than two thirds of global greenhouse gas emissions.

It is observed by Zubairu, (2007) that Architects are now designing buildings that are inevitably contributing to the environmental problems most especially global warming. It is his view that for a sustainable urban development to be attained the professionals in the building industry would need to share the same destiny, the destiny of sustainable development. It has been projected that the massive development in the building construction industry will double by the year 2030, (Kofo, 2010). It has therefore become imperative for the

developed and developing countries to move towards the development that would have minimal impact on the environment.

The increase in migration to cities increases the interference of human activity with nature, as more building and construction related activities will increase, (Samson, 2010). Buildings are the primary human elements of the city fabric and they contribute to a great extent to the ecological impacts which are associated with their construction and material application. The operation of these buildings on the other hand constitutes 50% of the world energy consumption, (Ogunsote, Peter, and Ola, 2010). The more energy consumed in individual building, the more the impact on the environment.

The principal actor in the design of buildings is the Architect, the architect's specifications serves always as the premise upon which other professionals in the building industry act upon. The environmental strategy is to minimise the impact which these individual buildings pose on the environment. This can be achieved through design, wise choice of materials and construction methods. The concentration of buildings in the cities therefore offers opportunities through design to minimise the various environmental impacts buildings pose to the environment. The buildings will require to be designed in such a way that they blend well with the environment, (Vivienne, Crea, John and Owen, 2000). In this way the development will function without too much hindrance to the eco system.

2.0 SUSTAINABLE DESIGN

Sustainable development has been referred to as the development that ensures minimal impact to the environment and also involves such a development that does not affect the sustenance of the future generation, (Energie, 2000).

Sustainable design is the symbiosis between the built environment and the natural environment. Amongst the underlining principles for sustainable designs are the understanding of place, connection with nature and the understanding of natural process, (Haruna, 2007). The understanding of the natural process gives an insight into how nature operates and also to see if that can be mimicked. Each environment or site has its unique signature and that is why site analysis is carried out. A site with a water body will definitely have a microclimate that is different from that which does not have. Similarly a site that has trees will have a micro climate that is different from that which does not have. It is therefore important to tap and utilise the natural landscape towards the attainment of maximum comfort for the occupants of buildings through passive cooling and natural lighting. This will effectively reduce the dependence upon fossil fuelled air conditioning and also lightning, with the aim of indirectly reducing the impact of these activities on the natural resources.

Resources are grouped into two, renewable and nonrenewable. A renewable resource is one that may be replaced over time by natural processes, such as fish populations or natural vegetation, or is inexhaustible, such as solar energy. Nonrenewable resources such as crude oil, coal and gas are in limited supply and can only be replaced over extremely long periods of time.

3.0 SUSTAINABLE ENERGY IN BUILDINGS

Solar energy has been found to be the most fundamental of all other types of sustainable energy sources. It is clean and therefore has little or no negative effect on the environment (McEvoy & Gratzel, 2008). The raw material for the generation of this renewable energy is the sun and Nigeria which is situated in the tropics is blessed with this source. Nigerian's position on the global landscape is capable of

generating between 160 to 280 watts per meter square of a photovoltaic cell, in a scale of measurement where the lowest unit of energy that can be generated per meter square of photovoltaic cell is 60 watts and the highest being 320watts (*Ibid*).

The use of renewable solar energy through photovoltaic panels serve dual purpose of providing roof cover for the building and also a source of energy, this is illustrated in plate 1.

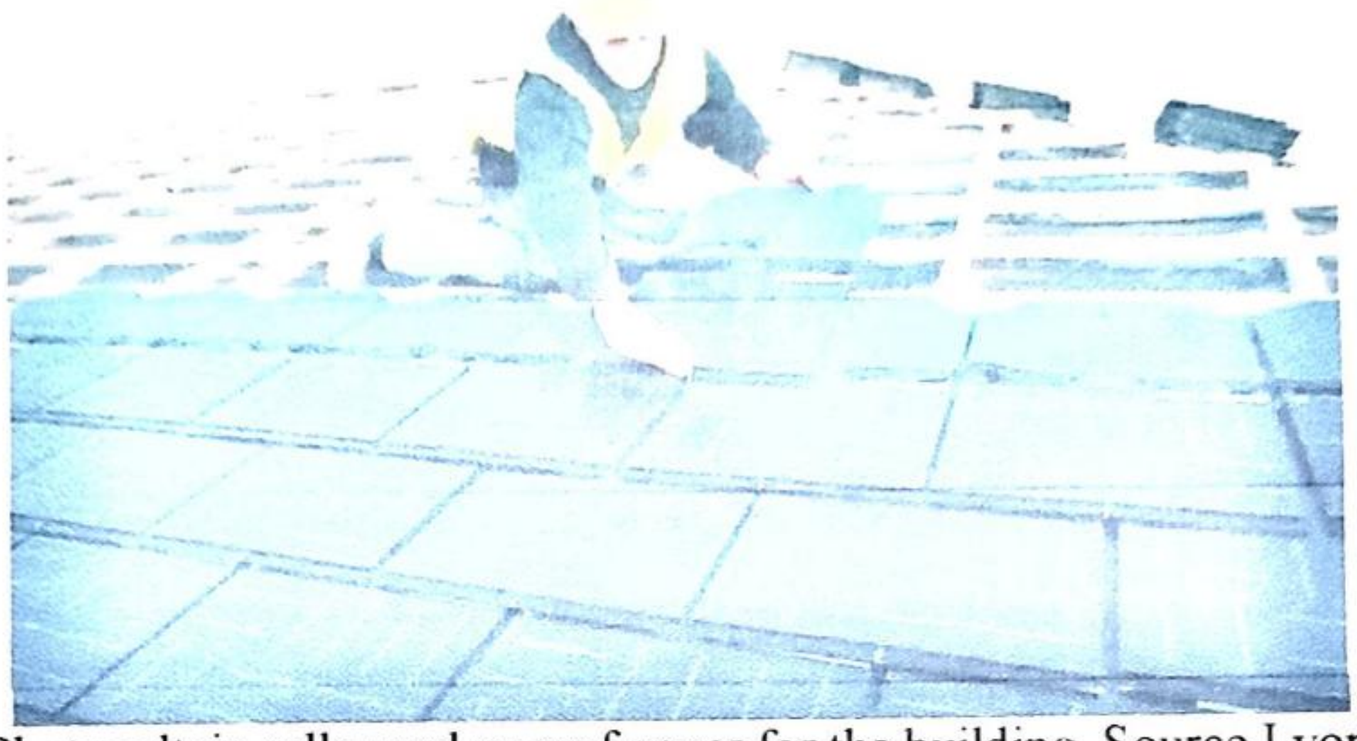

Plate 1: Photovoltaic cells used as roof cover for the building. Source Lyons (2007)

The use of non renewable energy should therefore be the last in chain of energy supply to the building as illustrated in figure 1, and if it will be used then, the choice of appliances should be based upon those that will give the maximum output with less energy demand.

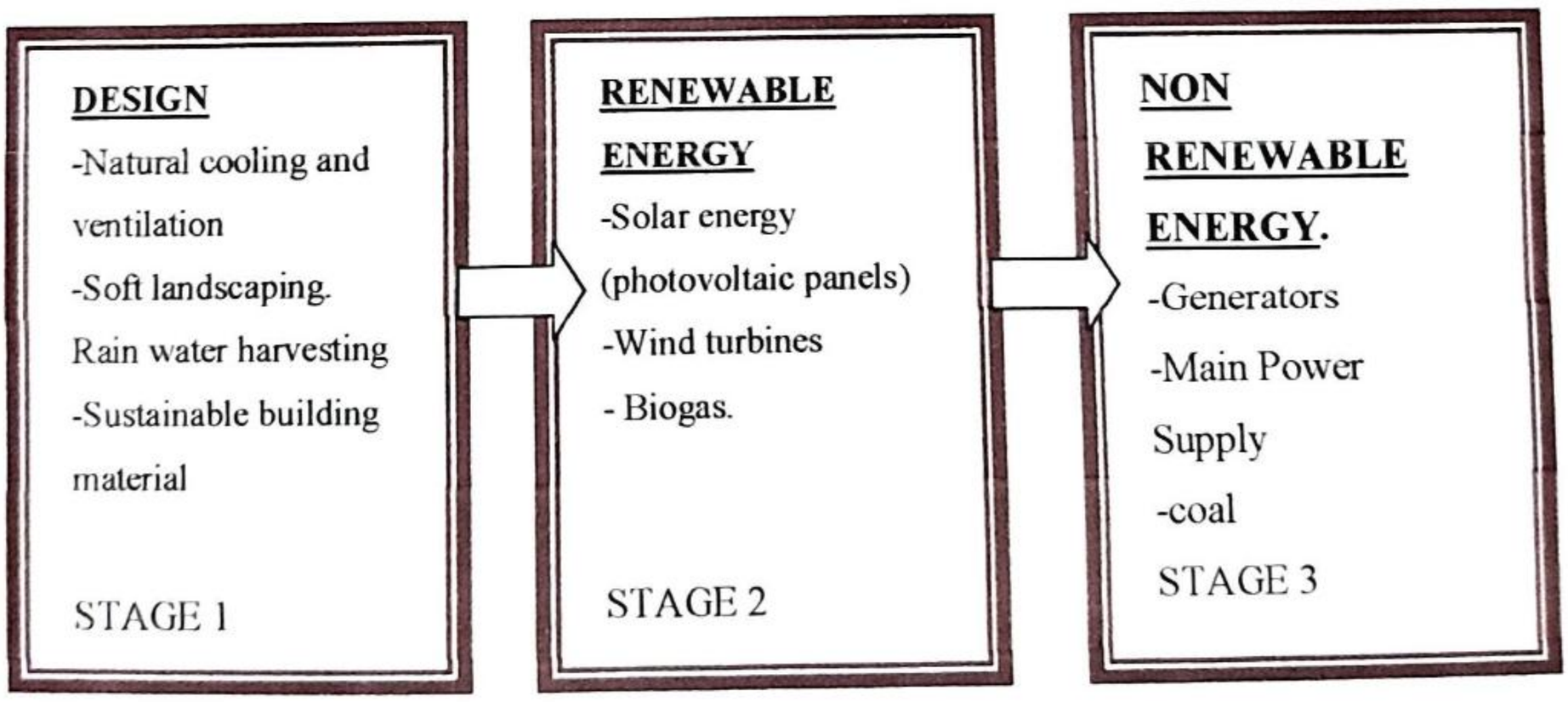

Fig 1: Sustainable energy design stages. (Author, 2011)

The figure 1, suggest that a good sustainable strategy can be attained when at the design stage (stage 1) the Architect puts into consideration the possibilities of having a natural cooling and ventilation , the use of soft landscaping to reduce the effect of heat and the use of sustainable building material. The next stage (stage 2) in the chain of sustainable design strategy will be to choose a renewable source of energy such as solar panels, wind turbine or biogas. The use of non renewable source of energy such as generators, main

power supply and coal should be the last option and should be minimized as much as possible.

The principle of sustainable design in buildings is based upon how resources are utilised and used wisely. It requires the wise utilisation of water and energy, with consideration also given to the choice of building material and waste management (Kim, 1998). The utilization of water and energy constitutes the main function of the running of the building envelop and as such would require the choice of equipment that are efficient.

4.0 THE CHOICE OF BUILDING MATERIALS

The 21st century development in science and technology has turned the world into a global village, where technology, design and material applications are not limited to a particular region. The Architects as designers are always keen to try out new materials without much consideration given to their effect on the local environment. However building materials cannot act the same way in all the weather conditions and as such if wrongly used would result into unsustainable development.

Sustainable approach to the choice of building material lies on the availability of such material locally and also how it relates with the environment. Its adaptation to the immediate environment gives the advantage of minimal energy that would be required to cool or heat up the built envelope. Climate is the single most important seasonal constant in the environment and therefore it should be considered while the choice of material is made (Derek, 2002).

The sustainable choice of building material also looks at the energy expended in the course of manufacturing and transportation to it site. It is always wise to choose materials that are available locally, because this goes a long way in reducing the carbon blue print. The farther the material is from the site the more the cost of transportation and the more the fossil fuel that is burnt to transport to site. Materials such as mud, stone and wood are found locally in Nigeria.

The base line study by, the Federal Ministry of Mine and Steel shows that Nigeria is blessed with abundant dimensioned stones that are comparable with what is obtainable in the international market as illustrated in table 1. However the importation of such foreign building material into the country is still going on due to the non development of the mining sector. The study carried out in 2009 by Federal Ministry of Mines and Steel shows that 95% of the domestic market of finished dimension stone products is through importation. This suggested that apart from the capital flight that is being experienced a lot of energy is expended through transport to get these dimensioned stones into the country. The more the distances covered to get any material into site, the more the ecological foot prints.However, the study carried out by the same Ministry also found marble to be over 20 million metric tons, while the bluish quartzite is found in abundance in south west Nigerian states. Marble stone is also available in Kwara, Kogi, and Eboyin state. It therefore behoves on the Nigerian government to develop the dimension stone industry in order to reduce the dependence on importation.

Table 1: Nigerian dimensioned stone materials and reference with dimensioned stones materials in the international market.

Geological name of the source rock	Commercial name of the studied Nigerian material	Commercial name of the potential reference in the international market.
MIGMATIES	Al awel pink Balmore black and white Multicolour Ivory white Ivory gold Balmore ganjuna yellow	Kashmir white(India) Kinawa(brazil) Paradise (India) Jacaranda (India) Tropical green (brazil) Gran violet (brazil)
GNEISS	Miya pink Miya yellow Elegance Zaria red	Imperial white (brazil) Tiger skin (India) Giallo veneziano (brazil) Samba white.
MARBLES	Rainbow Nassarawa white marble Abuja light grey marble	Carrara marble Norwegian rose marble
QUARTZITE	Indicated to be available in The south west.	Azul marcaubas (brazil) Azul boquira (brazil) Marinace (brazil)
AMPHIBOLITES	Bauchi dark green	--
OLD GRANITE SERIE	Al awel gray Obudu gray granite	Baltic brown (Finland) African red (south Africa)
CAL ALKALINE YOUNGER GRANITE	Balmore gray granite Balmore Ikara gray Balmore Ikara yellow Kano red Lumbakungi pink Bauchi pink royal Leopard skin (charnockite) Balmore blue star (charnockite) Bauchi olive green(charnockite	Rosa porrino (Spain) Sardinian white (Italy) Blanco Cristal (Spain) Blue pearl syenite (Norway) Orissa blue (charnockite India) Green Bahia(charnockite brazil) Ubatuba green (charnockite brazil) Olive green (RSA)

Source: Federal Ministry of Mines and Steel Development, 2009

The table 1 suggest that, Nigeria is blessed with abundant and also variety of dimension stones and as such for it to contribute its quarter towards the attainment of sustainable development of cities, it will be required to have the Nigerian dimensioned stone industry developed into full capacity in order to reduce the distance covered by the importation of these materials. The more the distance covered the more the energy expended and the resultant effect is the increase in ecological foot print on the environment.

5.0 SUSTAINABLE CONSTRUCTION

Sandy (2008), referred to sustainable construction to include the choice of materials that are renewable over the non renewable ones and also the material chosen should be used as efficiently as possible to allow for their eventual future reuse.

Wood on the other hand has been found to be the most environmentally friendly building material, Muhammad & Eze, (2010). It is the only building material that does not undergo much refinement when compared to steel, aluminium and concrete. It has the least carbon release into the atmosphere. The use of wood as a walling material is still not found to

be in common use in Nigeria. It is abundant; it has low thermal conduction thereby reducing the energy that will be required for cooling.

6.0 ENERGY CONSERVATION FROM DESIGN AND SPECIFICATION

After the completion of a building it requires energy for the day to day running. It will be in the interest of the universe and humankind to see that Architects radically decrease the energy consumption of buildings and to rely on the renewable sources of energy, and most especially on solar energy, (Kunszt, 2003).

The design also should be made such that passive cooling strategies are explored in order to reduce the energy that would be expended in cooling of the building envelop. The strategy for reduction in energy spent on cooling of the building envelop will be through landscaping with trees and shrubs. It has been observed that the microclimate of any given environment is most of the time lower by 1 to 2 degrees Celsius when compared to the neighbouring environment without soft landscape, (Richard, 2008).

Soft Landscaping aside from its aesthetic value creates a resistance against weather elements such as prevailing winds and sun radiation. It is therefore necessary for the building professionals especially the Architects to incorporate the use of trees as part of the strategies of improving the microclimate condition. The improvement of each site collectively would result into energy savings to the entire community and the city as a whole.

Lighting of buildings contributes significantly to energy demand in buildings as such it is advisable to have all spaces lighted naturally during the day. However in situations where the use of artificial lighting cannot be avoided especially at night, there should be a wise choice in the specification of electrical fittings. Table 2 shows the comparison of cost, in the running of incandescent lamp of the same luminous capacity with that of compact florescent lamps (energy bulbs).

Table 2. Comparison between incandescent lamps and compact florescent lamps.

Sn		**Incandescent Lamps ₦**	**Compact Florescent Lamp (energy lamp) ₦**
1	Electric power (watts)	100	20
2	Life time (hours)	1000	8000
3	No. of lamps needed	8	1
4	Price of each	75	1500
5	Total Initial cost	600	1500
6	Consumption in 8000 hrs	800	160
7	Cost 6 naira/kwh	7200	1400
	Total annual cost	**N7800**	**N2940**

Source: Akanmu, 2007

The table shows that the choice of Compact florescent lamp has more economic value than incandescent lamp. It also shows that more incandescent lamps would be required for the output that would be given by one compact florescent lamp.

7.0 WATER CONSERVATION IN BUILDINGS

The occupants of each building require water for the day to day running of the building in activities such as bathing, washing cooking and watering of plants. A lot of resources and energy are explored especially in cities

towards the supply of water to each house hold. It is therefore necessary through design and specification of water reticulation equipment to reduce wastages through proper management with the view towards reducing an ecological foot print in the environment.

Rain water collection and storage is another sustainable means of reducing the reliance on municipal water supply especially in Nigeria. The Library of Congress Country Studies on Nigeria climate (1991) shows that Nigeria is blessed with significant precipitation which varies from one region to another. The greatest total precipitations is generally in the southeast where mean annual rainfall is more than 4,000 millimetres, followed by western regions in Nigeria with mean annual range of 1,200 to 1,300 millimetres. The north has an annual average rain fall range from 500 to 750 millimetres. This shows that rain water harvesting and storage can be incorporated into the concept of Nigerian architectural design towards the attainment of sustainable water supply.

CONCLUSION

The architect is posed with a great opportunity of contributing to the sustainable city development through design. The sustainable strategies include the wise choice of material, energy conservation and water management.

The use of soft landscape such as trees and hedges is another avenue that is yet to be explored in the attainment of conducive microclimatic condition in the built environment. It is cheaper, and more environmentally friendly to use landscape as a means to attaining comfort. The demand on the dwindling power generation in Nigeria would also be reduced. If each building in the city is designed with sustainable building strategy, then the whole city would be a better place to live in.

RECOMMENDATIONS

The Federal government should enact laws that would encourage architects to design buildings that are sustainable with the aim of reducing the negative impact on the environment. This sustainable design is attainable through the wise choice of building material, the management of renewable and non renewable sources of energy.

The use of local building material such as stone, mud and wood should be explored in order to have a sustainable built environment. The choice of Aluminium, PVC and steel should be minimised as much as possible because such materials create a lot of negative impact to the environment.

Soft landscaping has been found to improve the bioclimatic condition of any given environment and therefore the government should put the provision of soft landscaping as part of the requirement for the approval and construction of buildings especially in Nigerian cities.

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