SUSTAINABLE ARCHITECTURAL DESIGN PRACTICE IN NIGERIA: AN EVALUATION OF THE 'PRE-BUILDING PHASE' IMPLEMENTATION IN LAGOS

Stephen Nwabunwanne OLUIGBO MNIA, PhD
Department of Architecture, Ahmadu Bello University, Zaria, Nigeria
Email - snoluigbo@abu.edu.ng

ABSTRACT
The need for architects to focus on the achievement of sustainable built environment in Nigeria has been the theme of many professional and academic forums in recent times. However, there is little evidence of the implementation of recommendations and strategies emanating from these deliberations. Sustainable design begins with intentions and decisions taken right from the conception of a project - the pre-building phase. This study aims at determining the extent to which sustainable design requirements are considered in the pre-building phase by architects in Lagos, Nigeria. Questionnaires were administered on architects present at a Lagos state chapter meeting of the Nigerian Institute of Architects (NIA). The data was subjected to descriptive analysis. The result shows generally high mean scores, with energy efficiency (4.19), and design integration (3.96) scoring highest. However, the key sustainable design features applied by the respondents in their works were passive design features such as; building orientation, natural lighting, and natural ventilation. There appears to be very little innovation. There is therefore the need for architects in Lagos, and Nigeria in general, to exploit the ingenuity which architects are noted for, and explore innovative approaches and technologies for sustainable design, right from the pre-building phase of a project.

Keywords: Architects, built environment, life-cycle, pre-building phase, project, sustainable design.

1.0 INTRODUCTION

Sustainable design has become a major concern in the building industry. This is because building activities poses a great threat to the global environment and resources. The built environment is the biggest contributor to Green House Gas (GHG) emissions and accounts for up to 50% of global carbon dioxide emissions (Raynsford, 1999). Building construction accounts for 24 per cent of global raw materials removed from the earth. In addition, the extraction, processing, transport and installation of materials associated with construction consume large quantities of energy and water (European Commission (EU, 2010). The embodied environmental impacts generated by the building during its whole life-cycle, can be of the same order of magnitude as those generated during the utilization stage (Citherlet, 2001). The building construction industry consumes 40% of the materials entering the global economy and generates 40–50% of the global output of GHG emissions and the agents of acid rain (California Integrated Waste Management Board, 2000).

In Nigeria, sustainable architectural design has become one of the regular themes or focus of presentations and discussions in architectural forums. Such forums include the annual architects' colloquium organized by the Architects Registration Council of Nigeria (ARCON), Annual and Biennial General Meetings of the Nigerian Institute of Architects (NIA), and academic conferences. It has also become a regular feature in many academic publications. Despite all these, there appears to be little visible evidence of a move towards this direction in practice. However, studies by Oluigbo (2013) raises some level of optimism about the recognition of sustainable design as an important concern by architects. The questionnaire survey conducted at three schools of architecture in Nigerian universities showed that 51.50% of architectural educators considered themselves to be more aligned to the green/ eco/ sustainable architecture ideology, this at least signifies some level of awareness on the necessity for sustainable design. However, there is little knowledge on the steps taken by practicing architects in Nigeria towards integrating sustainable design principles into their works.

Sustainable design should begin with a decision or intention. Such intentions must be made at the conceptual or pre-building phase of a project, and decisions taken at this stage affects the entire life-cycle of the building. It is in view of this that this study was embarked on in order to determining the extent to which sustainable design principles are considered at the pre-building phase by architects in Lagos, Nigeria.

The objectives of the study are:

(i) To determine the level of consideration given by architect, to sustainable design at the pre building phase; and

(ii) To determine the aspects of sustainable design which are considered.

2.0 THE CONCEPT OF SUSTAINABLE DESIGN

Definitions of sustainability fall into two groups. The first group focuses on humans and their existing and future needs. The second group – the systems definition - focuses on how systems can, and should be maintained and developed (Gibberd, 2003). Gibberd's study concluded that all developments can be evaluated based on their ability to fulfil needs without increasing limitations. Similarly, Hui (2002) noted that sustainability was based on two concepts; the concept of needs, comprising of the conditions for maintaining an acceptable life standard for all people, and the concept of limits; the capacity of the environment to fulfil the needs of the present and the future. The concept of needs was clearly visible in the World Commission on Environment and Development's (WCED) (1987) definition of sustainability as meeting present needs without compromising the ability of future generations to meet theirs. This connotes the maintenance and enhancement of environmental, socio-cultural and economic resources, in order to meet the needs of current and future generations (Gilbert *et al.*, 1996, Commonwealth Association of Architects (CAA), 2006 *op cit*; Del Matto, 2007). Other definitions of sustainability have also been offered. These include: Improving the quality of human life while living within the carrying capacity of supporting ecosystems (International Union for the Conservation of Nature and Natural Resources (IUCNNR) *et al.*, 1991); the capacity of development projects to endure organizationally and financially (Bread for the world, 1993); use of natural renewable resources in a manner that does not eliminate or degrade them or otherwise diminish their renewable usefulness for future generations while maintaining effectively constant or non-declining stocks of natural resources such as soil, groundwater, and biomass (World Resources Institute (WRI), 1992).

3.0 SUSTAINABLE DESIGN AND THE PRE-BUILDING PHASE

Achieving sustainable design requires critical consideration of the entire life-cycle of a building, and design decision taken at the inception affects all phases of a building project. Kim (1998) categorized the life cycle of a building into three phases - pre-building, building, and post-building phases. Sustainable design requires an understanding of the building processes in each of these three phases and requires a broad view of how a building's design, construction, operation, and disposal affect the larger ecosystem. However, decisions taken at the pre-building phase is critical since it largely determines what becomes of the other phases (building and post-building).

The pre-building phase includes site selection, building design, and building material processes, up to but not including installation (Kim, 1998). Seattle Department of Planning and Development (SDPD) (2006) stated that sustainability should be clearly articulated as a guiding principle and incorporated from the earliest stages of a project. Key considerations in the design include the following: Design integration; energy efficiency; water efficiency; site characteristics; materials selection; and, local built heritage (Kim, 1998; Bristol City Council, 2006; SDPD, 2006; Bunz, *et al.*, 2011).

3.1 Design Integration

Sustainable building design begins right from the initial pre-design meetings with the client, case studies of similar projects with sustainable features, and definition of initial goals for the performance of the sustainable building throughout the design process (Bunz *et al.*, 2011). SDPD (2006) listed the following measures for sustainable design integration:

(i) Apply a whole systems approach to design, balancing social, economic, and environmental factors;

(ii) Incorporation of sustainability into the earliest design discussions;

(iii) Inclusion of input from user groups, tenants, maintenance staff, and stakeholders, to confirm design criteria;

(iv) Exploration of opportunities for innovation with a collaborative, multi-disciplinary design team;

(v) Familiarization of design team members with sustainability concepts and basic sustainable building practices and philosophy.

3.2 Energy Efficiency

Energy efficiency issues includes energy conservation and improved building performance and comfort through effective use of controls and technologies, efficient lighting strategies and presence of on-site renewable energy systems (Williams, 2007). Rajapaksha and Hyde (2005) observed that the need to minimize operational energy in the running of active systems has focused attention on two sets of factors, the demand side and supply side efficiency. The supply side efficiency comes from the elements of the building that drive the need for power in the building whilst the demand side efficiency is related to elements that use power. Sustainable design of energy features incorporates supply side and demand side efficiencies through low energy technologies and passive design strategies in building. In particular, the use of passive design strategies aims at minimizing operational energy demand in buildings and therefore optimizing demand side efficiency whilst the use of low-energy technologies aims at optimizing the increased use of renewable, thus reducing the circumstances for greenhouse gas emissions and resource depletion (Kim, 1998; Rajapaksha and Hyde, 2005). Passive design strategies are based on site climate and are therefore environment friendly. They reduce operating costs by relying on the site's natural features thus downsizing mechanical systems through smart and efficient energy systems.

3.3 Water Efficiency

Water usage and efficiency demands the provision of guidelines and definition of targets. This should also include a description of various methods and means by which these targets can be achieved. Consideration should be given to the avoidance of disturbance of the water table, reduced water consumption, and reuse/ recycling of water on site. (Kim, 1998; Bunz *et al.,* 2011). The reuse of water applies to both within the buildings and for site irrigation and other purposes.

3.4 Site Characteristics

Sustainable site location and selection considerations are evaluated in a number of sustainable building guidelines and methodologies. The various areas concerning sustainable sites include urban sprawl, brownfield redevelopment, effects of proposed project on local ecosystems, and interaction with the surrounding natural and built environment (Bunz *et al.*, 2011). With regards to the natural environment, consideration should be given to the respect for natural drainage and topography, and preservation of existing flora and fauna (Kim, 1998).

3.5 Material Selection

Material usage includes the selection of materials with recyclable properties, reusable products, and the implementation of recycling procedures throughout building operation. Recommendations for the amount of materials with recycled content are provided in various sustainable guidelines as well as the amount of products that are being functionally reused in a building; use of renewable materials, use of local materials, specification of long life and low maintenance materials;

specification of materials harvested or extracted without ecological damage, and selection of materials with low embodied energy (Kim 1998; Bunz *et al.*, 2011).

3.6 Local Built Heritage

International Committee on Monuments and Sites (ICOMOS, 1999) listed the following as characteristics of the built vernacular heritage:

i. A manner of building shared by the community;
ii. A recognisable local or regional character responsive to the environment;
iii. Coherence of style, form and appearance, or the use of traditionally established building types;
iv. Traditional expertise in design and construction which is transmitted informally;
v. An effective response to functional, social and environmental constraints;
vi. The effective application of traditional construction systems and crafts.

4.0 METHOD OF STUDY

Literature study was conducted to establish key considerations for sustainable design at the pre-building phase as contained above. This provided the basis for the development of the data collection instrument (questionnaire). The questionnaires were administered based on judgement sampling, to all present at a general meetings of the Lagos state chapters of Nigeria Institute of Architects (NIA). A total of 18 questionnaires were validly completed and returned. The questionnaire contained largely closed-ended questions based on a five-point Likert scale. The last question in the questionnaire was open-ended, and was aimed and determining the aspects of sustainable design which were applied in the respondents' works. Analysis was based on descriptive statistics.

5.0 RESULTS

5.1 Consideration for Design Integration

The result shows that consideration for design integration has a group mean of 3.96 on a five-point scale. Also, respondents paid the most attention to balancing environmental, economic, and socio-cultural sustainability concerns, with a mean of 4.22, while the least consideration was given to exploration of opportunities for sustainable design innovation, with a mean of 3.56 (Table 1).

Table 1: Consideration for Design Integration

Item	Mean	Group Mean
Familiarization of design team with sustainable design principles and strategies	4.11	3.96
Incorporation of sustainability into the earliest design discussions and conceptualisation	4.17	
Balancing environmental, economic, and socio-cultural sustainability concerns	4.22	
Exploration of opportunities for sustainable design innovation	3.56	
Collaborative/multi-disciplinary design team for sustainability	3.72	

5.2 Consideration for Energy Efficiency

The result shows that consideration for energy efficiency has a group mean of 4.19. Also, respondents laid the most emphasis on natural lighting, and ventilation, each with a mean of 4.78, while the least attention was given to renewable energy options, with a mean of 3.50 (Table 2).

Table 2: Consideration for Energy Efficiency

Item	Mean	Group Mean
Emphasis on natural heating and cooling	4.06	4.19
Emphasis on natural ventilation	4.78	
Emphasis on natural lighting	4.78	
Materials with low embodied energy	3.83	
Renewable energy options	3.50	

5.3 Consideration for Building Materials

The result shows that consideration for building materials has a group mean of 3.71. Also, respondents laid the most emphasis on long life/low maintenance, with a mean of 4.33, while the least attention was given to reuse and recycling, with a mean of 3.06 (Table 3).

Table 3: Consideration for Building Materials

Item	Mean	Group Mean
Reuse and recycling	3.06	3.71
Reduction of waste	4.06	
Long life/low maintenance	4.33	
Low environmental impact	3.89	
Renewable materials	3.22	

5.4 Consideration for Water Efficiency

The result shows that consideration for water efficiency has a group mean of 3.77. Also, respondents laid the most emphasis on minimising flooding, with a mean of 4.50, while the least attention was given to reducing water consumption, with a mean of 3.28 (Table 4).

Table 4: Consideration for Water Efficiency

Item	Mean	Group Mean
Minimise flooding	4.50	3.77
Avoid disturbance of water table	4.11	
Reuse onsite water	3.33	
Reduce water consumption	3.28	
Minimise wastage of water	3.61	

5.5 Consideration for Site Characteristics

The result shows that consideration for site characteristics has a group mean of 4.04. Also, respondents laid the most emphasis on preserving topography, and preserving visual quality of site, each with a mean of 4.22, while the least attention was given to preservation of flora and fauna, with a mean of 3.72 (Table 5).

Table 5: Consideration for Site Characteristics

Item	Mean	Group Mean
Preserve flora	4.00	4.04
Preserve fauna	3.72	
Preserve topography	4.22	
Preserve visual quality	4.22	
Avoid erosion	4.06	

5.6 Consideration for Local Built Heritage

The result shows that consideration for local built heritage has a group mean of 3.76. Also, respondents laid the most emphasis on reflection of indigenous spatial concept, with a mean of

4.00, while the least attention was given to indigenous ornaments and decorations, with a mean of 3.33 (Table 6).

Table 6: Consideration for Local Built Heritage

Item	Mean	Group Mean
Reflection of indigenous spatial concept	4.00	3.67
Use of local materials	3.61	
Indigenous architectural expression	3.78	
Indigenous ornaments and decorations	3.33	
Indigenous skills and technology	3.61	

5.7 Reflection of Sustainable Design in Respondents' Works

The open-ended section of the questionnaire was used to obtain data on some of the sustainable features of the works of the respondents. While some of the respondents did not give any concrete response to this section, others itemized the features as follows:

i. Introduction of courtyards;

ii. Orientation of buildings to reduce exposure to solar radiation;

iii. Adoption of simple building forms;

iv. Extensive reliance on natural lighting and ventilation;

v. Preservation of site topography;

vi. Integration of building with site;

vii. Reflection of local architectural heritage;

viii. Use of local materials, ornaments and decorations;

ix. Extensive use of soft landscape elements;

x. Water conservation through use of grey water for landscape irrigation;

xi. Use of prefabricated building components to minimise waste;

xii. Use of low-maintenance materials;

xiii. Use of heat insulating building materials for wall finishes, roofing and ceilings; and

xiv. Use of solar panels.

6.0 DISCUSSION

A look at the result suggests that majority of the respondents believe that they have reasonably considered sustainable design at the pre-building phase of their architectural works. The group mean scores showed that consideration for design integration has a group mean of 3.96 (Table 1), consideration for energy efficiency has a group mean of 4.19 (Table 2), consideration for building materials has a group mean of 3.71 (Table 3), consideration for water efficiency has a group mean of 3.77 (Table 4), consideration for site characteristics has a group mean of 4.04 (Table 5), and consideration for local built heritage has a group mean of 3.76 (Table 6). When all these are added together, the overall mean is 3.91. This gives an indication of an above-average score.

While these results appear to be positive, ironically, under the consideration for design integration, two out of the five items scored the least. These are; exploration of opportunities for sustainable design with a mean of 3.56, and collaborative/multi-disciplinary design team for sustainability, with a mean score of 3.72 (Table 1). This suggests that many of the respondents did not set out to explore sustainable design options, and neither have they recognised the importance of collaboration to sustainable design. Therefore, whatever achievements they made in this direction may have been unconscious.

While the fact that energy sources for building operations is one of the greatest contributors to GHG emissions has been globally recognised, on the local scene, Nigeria is faced with the challenge of providing adequate energy for its citizens. The result shows that under consideration for energy efficiency, exploration of renewable energy options had the lowest mean score of 3.50 (Table 2). Architects appear not to have adequately taken advantage of the abundance of renewable energy options to power buildings. Two key potentials are the use of building integrated photovoltaic panels and wind turbines. Other areas which scored low and calls for concern are renewable materials, with a mean of 3.22 (Table 3), and consideration for reuse of onsite water, with a mean of 3.33 (Table 4). These call for concern, considering the long standing recognition that extraction of materials have caused enormous damage to our environment, and the challenge of portable water provision which is persistent all over Nigeria.

The result also shows that the respondents considered aspects such as building orientation, natural lighting and ventilation, and use of courtyards among others. These appear to be basic climatic design consideration for tropical climates such as Nigeria. That does not take away the fact that they are perhaps some of the most important requirements of eco-centric sustainable design requirements.

7.0 CONCLUSION

This paper is the outcome of a study conducted in Lagos, Nigeria, and aimed at determining the extent to which sustainable design principles are considered at the pre-building phase by architects in Nigeria. The result shows that there is an above-average level of consideration for sustainable design at the pre-building phase by the respondent architects. Whether there is a correlation between these results and the works of the respondents can only be determined by case studies of the works. This has been identified for future studies. However, the features of sustainable design listed by the respondents as being applied in their works such as building orientation, natural lighting, and natural ventilation, are basic requirements for climatic design in the tropical climatic zone, under which the study area falls. None of the respondents listed any innovative design feature. There is therefore the need for architects in Lagos, and Nigeria in general, to exploit the ingenuity which architects are noted for, and explore innovative approaches and technologies for sustainable design, right from the pre-building phase of a project.

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