EXPLORING THE PRINCIPLES OF BIOMORPHIC ARCHITECTURE

IN THE DESIGN OF CIVIC CENTER KADUNA

BY

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DEPARTMENT OF ARCHITECTURE

AHMADU BELLO UNIVERSITY, ZARIA

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DEPARTMENT OF ARCHITECTURE,

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DECLARATION

I declare that the work in the thesis entitled EXPLORING PRINICIPLES OF BIOMORPHIC ARCHITECTURE IN THE DESIGN OF CIVIC CENTER KADUNA has been performed by me in the Department of Architecture under the supervision of Arc A.E.O.Eneh.

The information derived from the literature has duly been acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at any university or institution.

Mustapha.M.Adeshina _____ _____

Name of student Signature Date

CERTIFICATION

This thesis entitled EXPLORING PRINCIPLES OF BIOMORPHIC ARCHITECTURE IN THE DESIGN OF CIVIC CENTER KADUNA by Mustapha.M.Adeshina meets the regulations governing the award of the degree of Master of Science of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

TO ALMIGHTY ALLAH AND ADESHINA FAMILY

ABSTRACT

Biomorphism a division of organic architecture and sustainability, concerns itself with the mimicry of an organism be it a plant or animal in form as well as character. Believing that fundamental principles of structure lay hidden in the natural world art and architecture could only survive if contacts with the principles are re-established. Artists, architects, craftsmen and art historians looked to life sciences for inspiration. A review of findings from the field of environmental psychology show that humans are aesthetically attracted to natural contents and to particular landscape configurations. The aim of this thesis is to study how inspiration from nature can serve as basis for contemporary modern day design of a civic centre. This is achieved by proposing an environmentally sustainable and energy efficient building using biomorphic principles which require less energy as well as other environmental destructive elements thereby conserving the natural life cycle. The building construction industry in Nigeria pays little or no attention to the impact building structures have to the environment.

All building types consume energy. But, the proposed facility was selected as a medium to explain how energy efficiency can be conserved. This is because of the scope of the facility and long hours of operation. At the end of an in-depth research on biomorphism, four principles were identified as the fundamental basis of biomorphic architecture, these are; Inspiration, fluidity, environmental economics, and geodesic considerations. It is these principles and their philosophies that were used as parameters of data collection and assessment on the case studies carried out in both local and international levels. Findings from the case studies revealed the down side practices on issues like harnessing the sites renewable energy generation sources, overdependence on mechanical systems, limited application of indigenous building materials and design, rain and grey water harvesting, and insignificant use of recyclable energy and materials. However, it has been gathered that there is a fair degree of respect for solar and wind orientation, use of durable long lasting materials and techniques, aesthetics and expression. By adopting these principles, a design proposal is developed for a civic center, this is to observe to an acceptable degree how a facility can take form on a site a considerable amount of passive benefits without causing any damage upon the environment in a continual process, and by all means treating the environment with respect.

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DEFINITION OF TERMS

I. Biomorphism: it is derived from two Greek words “bio-” meaning nature or the mode of life and “morphe” which means to transform from one image to another or something that has a particular form, shape or structure.

II. Sustainability: Maintaining Ecological balance, exploiting natural resources without destroying the Ecology of an area. (Encarta, 2009). It is also defined as the building practice that limit or eliminates the negative aspect of the building on the environment (U. S Green Building Council).

III. Retreat Centre: this is a place of seclusion where an individual can relax, get in touch with nature and participate in activities which form the main purpose of the retreat.

IV. Ecology: this is the study of the relationship, distribution and abundance of organisms or group of organism in an environment. (Allen &co, 1998).

V. Energy Conservation: this is a process of protecting excessive energy usage to prevent loss and damage.

VI. Energy Efficiency: this is simply the principle of low-energy or zero-energy resulting in optimal energy use. (Zero-energy design, 2011). It employs the objectives of energy conservation.

VII. Civic Centre: Civic center is a focal land area within a community, containing one or more dominant public structures.

VIII. Orientation: refers to the location of a building and direction to which a building point (Umar, 2010

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

In the modern world, human exposure to nature has been drastically reduced, people often actively seek contact with nature during their leisure time (e.g. gardening, nature walk, zoo visit) and nature is often pushed back from man's daily function. Man and nature are two distinct things that cannot be separated. Several attempts have been made in this regard but hardly yield any positive results. Nature refers to the forces and processes collectively that control the phenomena of the physical world independently of human volition or intervention, (Appleton, 1975).

The understanding of life processes as driving forces behind all appearances in natures, social and culture and the new scientific exploration into the properties of microcosm and macrocosm had a tremendous impact on visual arts as well as architecture (Hagan, 2001). Believing that fundamental principles of structure lay hidden in the natural world art and architecture could only survive if contacts with the principles are re-established, artists, architects, craftsmen and art historians looked to life sciences for inspiration. A review of findings from the field of environmental psychology show that humans are aesthetically attracted to natural contents and to particular landscape configurations (Joye, 2007).

While natural objects, shapes, and processes have often acted as a source of inspiration throughout the history of architecture, Hietanen & Korpela,(2004), perhaps the most obvious example of this inspiration is ornament, which often contains representations that are closely similar to, or reminiscent of animal and plant world. Besides such literal imitations, some architects, notably Antonı´ Gaudı´, drew lessons from the structural forces governing natural structures, resulting in efficient and economically built architecture (Sweeney & Sert, 1960).

Today, there seems to be a renewed interest in the relationship between nature and architecture (Feuerstein, 2002).

Frank Lloyd Wright, in his commentary on Marin civic center design, called it a refuge place for people in an urban or sub urban setting, not only in terms of facilities, but should also inspire its user in its physical embodiment of what an urban area should be, what it should stand for and what it should aim to be. Civic centers have over the years been providing opportunities for users involvement in individual or collective activities though its physical form has changed in recent time and economical motives seem to prevail over aesthetics considerations and creation of an enhanced environment for the leisure and relaxation of its users, hence the utilization of best design approach which draws inspiration from nature in its design and planning.

Today it assumes the function of an efficient civic arena; the site for collective emotional events where people play as important a role as the spectacle itself, and where the people and the symbols conveyed by the spectacles interact. Its significance in the growth of a city results from its expression of the nature of civic life as well as from its impressive monumentality, their symbolic functions are becoming more essential to a degree that their visual significance often meets or exceeds their practical use. Hence, its design should attempt to give a development of a "uniqueness" with which its users can identify something truly different (Okoroafor, 1986).

In response to the above problem stated efforts made in the study of biomorphic architecture on the growth processes and movement capabilities associated with organisms would tend to proffer solutions. Biomorphic architecture has the capability to grow change through expansion, multiplication, division, re generation and off-setting. It can be transformed to

environmental changes and internal demands (Snyder and Catanese, 1979). In whichever aspect of applicability biomorphic architecture does not mean biomimicry / biomemetics which are more concerned with the processes/architectural metabolism from which a building comes to have a particular for depicting animate abstraction. As a form of practise biomorphism observes the simple principles of unity, rhythm, balance and harmony in natural suaveness that enables it integrate the quality of architecture.

Feurstein (2002) also stated the principles of biomorphic architecture as follows

I. Growth
II. Fluidity
III. Environmental economics
IV. Geomorphic considerations

Kellert(1996) stated that biomorphic architecture transcended from earlier architectural practises though sometimes sublimed in other philosophies but maintaining its expressive form, therefore making obvious its characteristics, such intercourse could be discovered in other philosophies such as Romanism, Renaissance to Modernism and is found in hi-tech expressions in terms of expressive forms and are found in works of Antonio Gaudi, Santiago Calatrava, Norman Forster, Zaha hadid and so on, while those of organic architecture include Frank Lloyd Wright, Luis Sullivan, although in actual practise, architecture inspired by nature had begun since the Greek civilisation as typified in columns and its ornamentation, Le Corbusier's modulor was also inspired by nature. In the early times, the civic arena sheltered all the manifestations of public life, but evolution in civic life led to a differentiation and a segregation of the several activities in city life: religious, political, social, judicial, commercial, industrial, theatrical, in course of time .The Civic Center as a

whole, or the ‘Special Centers’ individually underwent several transformations, extensions, additions and rebuilding.

1.2 PROBLEM STATEMENT

A Civic center is one of the components of city that forms and transforms throughout the history of nation in several periods, but has continue to be a reference point or symbol of the city where it is located, and has been designed to attract interest (Cullen, 1998). Hence, expression (placemaking) is one of the most paramount requirements in a civic center design. However, previous works on civic center have addressed this issue by the use of Postmodern and Deconstructive architecture which has deliberately destroys architectural coherence and deprives the senses in search for meaningful information and expressions at the heart of the modern urban setting (Salingaros, 2004).

An evolutionary-ecological approach to aesthetics suggests that the incorporation of natural shapes and forms, actual or symbolic, into the built environment should have a strong positive impact on people as well as the environment (Joye, 2007), therefore biomorphic architecture would go a long way in enhancing the architecture of civic center design in Nigeria. The capabilities that are abounding in biomorphic architecture could be explored in design of a sustainable civic center so it could behave like an organism that would respond to its internal and external environmental demands.

1.3 AIM AND OBJECTIVES

Aim of the research is to explore the means of applicability of biomorphic forms in civic centers to establish an architectural approach as a passive design solution to reduce energy consumption through the use of Eco-architecture in the design of a recreational facility.

Objectives include;

i. To study in detail the aspects of the civic center and implement modern technological trends applicable in the center through the use of nature inspired solutions to environmental and energy demands

ii. To study civic center designs and examine the need for an energy saving architecture, in the design of a civic center in Kaduna.

iii. To identify the principles behind biomorphic architecture and find how that will enhance the efficiency of civic centers.

iv. To incorporate all the research findings in the design that would enhance the usage of the civic center all well as the environment.

1.4 RESEARCH QUESTIONS

This research shall seek to answer the following questions

i. What aspects of biomorphic architecture can be applied in Civic centers

ii. To what extent have these aspects been applied in Civic centers Nigeria?

iii. Can principles of biomorphic architecture be used to design a sustainable and energy efficient Civic center?

1.5 SCOPE AND DELIMITATION OF STUDY

This study shall comprise the review of works on civic centers to study how biomorphic architecture can help improve the functions of a civic center and serve as an icon for where it would be located as well as address planning problems. The principles shall be specifically applied to the civic center, Kaduna.

1.6 JUSTIFICATION

i. ARCHITECTURAL

To inspire a distinctive architectural style for civic center design in Nigeria.

ii. SOCIAL

To create a social, education and recreational arena that will enhance human interaction in an urban setting.

iii. ECONOMIC

Direct employment creation and source of revenue to the state authority.

iv. PRESTIGE

To create an image for the Kaduna new millennium city as well as a source of pride.

v. CIVIC VITALITY

To stimulate and foster participation in the civic and individual activities by all citizens.

CHAPTER TWO

LITERATURE REVIEW

2.1 BIOMORPHISM

The word biomorphic is derived from two Greek words “bio-” meaning nature or the mode of life and “morphe” which means to transform from one image to another or something that has a particular form, shape or structure. It was first introduced as a term used to describe the visual style of the surrealist in the 1930’s, it however is an art movement which began in the 20th century that represents fluidity and transformation or evolution from one state to the other, usually governed by operating on fundamentals determining all works in different ways (Ewing, 2012). Biomorphism is the use of living organisms as an inspiration for the design of inanimate objects and environment (Snyder and Catanese, 1979).

Feuerstein (2002) argued that a building is observed to be a living thing and taking cue from Aristotle, he saw living thing as a fusion of parts and whole, hence, biomorphic architecture is the earlier era of its practise of architecture in which the building have the appearance of life in which the architect finds the soul of life in it. Biomorphism does not merely focus on the shapes of living organisms but it also looks at their functional, structural and behavioural qualities (Snyder and Catanese, 1979). Examples of these can be seen in how the structural columns of building where inspired by trees, the eggs ‘impressive strength has given designers insight to the construction of concrete vaults and arches and how bee hive has been the inspiration for the social housing structures and pre-fabricated building panels (Mandelbrot 1999).

The plant leaf is an incredibly efficient factory for converting sunshine into energy called photosynthesis and so, not surprisingly, it inspired the idea of the artificial solar energy collector, usually these collectors or cells are rectangular and looks very little like a leaf, yet the shape of the leaf is not an arbitrary form. The thin membrane spans a wide surface area because of the gentle curvature that gives structural strength. Forms clearly follow function for the most of the natural world because otherwise most of the organism will fail to survive. However the form of the organism though determined by the collective function of its parts uniquely varies between the different organisms (that is both plants and animals) and a lot can be learnt and can be a basis of inspiration for the creation of inanimate objects.

Plate 2.1: solar panel to collect sunlight and convert to electricity

Source: Steir (2009)

2.2 BIOMORPHIC ARCHITECTURE

This refers to the architecture that focuses on the growth processes and movement capabilities associated with living organisms. It has the capacity to grow and change through the expansion, multiplication, division, regeneration and off-setting, As well it can be transformed in response to environmental and internal demands (Snyder and Catanese, 1979). The search for a contemporary architectural paradigm that forms a symbiotic relationship between man-made and the natural world, has resulted in a philosophy loosely entitled organic architecture (Powell, 1995). Unlike other schools of thought, such as Classicism and the International Style which were based on the paramount concern for a universal style, organic architecture does not provide a series of ready-made forms which the architect arranges to create variations of a similar theme. There is no strict doctrine of form to adhere to because each building is an expression of its particular place, culture, and time, or '*genus loci'.* Instead, the architect looks to nature, its geological and biological forms, to create this spiritual relationship between man-made and natural. Inherent in this philosophy is the exterior expression of the interior, or form follows function. Structural expression and the inventive or creative use of structure and materials are also characteristics of organic architecture. Indigenous materials were often employed to reinforce the notion *of 'genus loci'.*

Unlike in organic architecture that is being reincarnated as a new international movement that combines architecture with a respect for the site as described by its founder Frank Lloyd Wright who believes that every building should relate harmoniously to its natural surroundings and that a building not be a static boxlike enclosure but a dynamic structure with open, flowing interior spaces further described as "listening architecture" by Portoghesi

(2001) based on the sensitive interpretation of the nature of sites; a return to the womb of historical tradition. Primitive vernacular architecture was innately organic, based on natural forms and structures and simple local materials. More deeply, it was part of a spiritual continuum of survival and fertility, life and death that linked earth to spirit (Pearson, 2001).

Egyptian and ancient Greek civilisations studied natural forms and the human body and abstracted them as geometry. They used the circle, ellipse, triangle, and rectangle to derive harmonious proportions for their shrines and temples as typified in Pyramid of Gaza and so promote harmony between themselves and their elemental gods and spirit of the earth and cosmos (Pearson, 2001). Fundamental discoveries included geometric relationships such as the Golden section generator of the logarithm spiral, a basic curve of life and growth.

Plate 2.2: Pyramid of Giza, Egypt

Source: Egypt (2005)

The pioneers of biomorphic architecture include Antonio Gaudi, Calatrava Santiago, and Rudolf Steiner while those of organic architecture include Louis Sullivan, Frank Lloyd Wright. Although the actual practice, architecture inspired by nature originated since the Greek civilization as typified in the proportion of columns and its ornamentation so also was Le Corbusier's modular architecture which was derived from the human body as well as the art nouveau movement which was inspired by nature (Leonardo, 2009).

Plate 2.3: Art Nouvaeu architecture

Source: Microsoft Encarta (2009)

2.3 BIOMORPHIC FORMS

This refers to an abstract art that uses forms having no direct reference to the external or perceived reality or whose shapes are more organic than geometric, more curvaceous than linear. It is usually synonymous with different variety of avant-garde art such as the work of

Hans [Jean] Arp (German-French, 1887-1966) was composed of biomorphic forms. The term ‘abstract’ also refers to images that were conceptualized from nature, but which in the process have been considerably altered or have been simplified to their basic geometric or biomorphic forms (Leonardo, 2009).

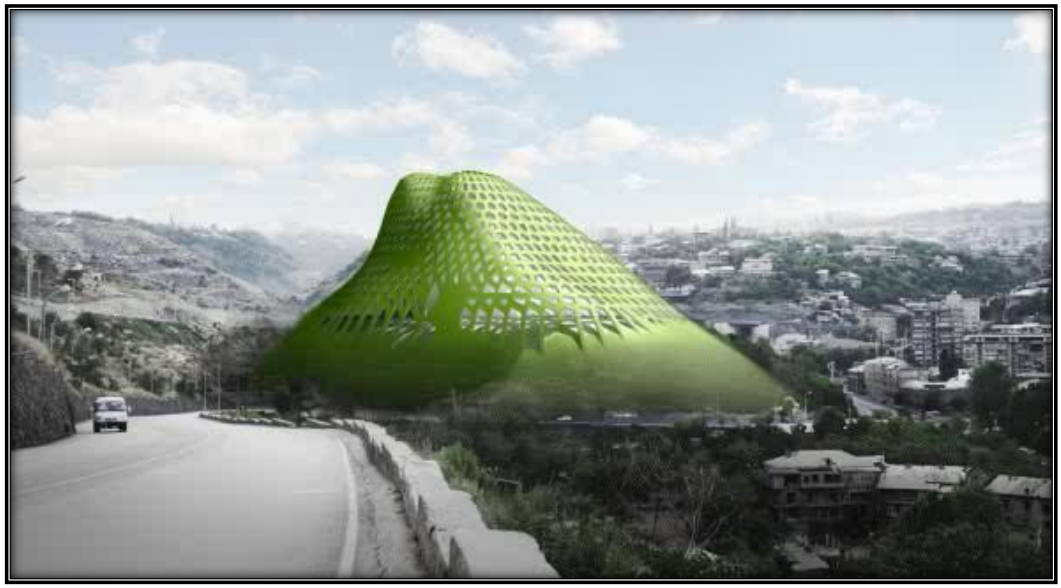

Plate 2.4: Biomorphic lace hill

Source: Fulton (2010)

Mainstream architecture is also adopting outward biomorphic forms. The stronghold of rectilinear design is under siege, free form design is on the attack. More liberated and imaginative forms which were unacceptable to major corporate clients a few years ago are now actively sought. Notable examples include the Bordeaux Law courts and London’s Millennium Dome designed by Sir Richard Rogers, the curvaceous London mayoral headquarters (sir Norman foster), the competition-winning elliptical dome for the Chinese national opera house and concert hall, Beijing (Paul Ardeau), The Media Center, Lord’s Cricket Ground, London, and the Earth Center Ark, England (Pearson, 2001).

Plate 2.5: 'The egg**',** China.

Source: Pan (2010)

However, are these projects motivated by the spirit of biomorphic design? Geometry and science are once again prime movers. The intellectual attraction of new science and purity of geometric forms have made even more dazzling via three-dimensional modelling which are stimulating their use. They are being applied as design imposed from outside rather than biomorphic design approach like life and nature, from within. Even fractal geometry, a deeper representation of natural relationships, is being applied externally, divorced from the internal functions of the building. The use of geometry and science alone does not produce organic design. Sustainable architecture is evolving fast too, but there is a danger that instead of the vanguard of a new holistic architecture, it will become engrossed in high-tech energy saving issues. Few eco-friendly design approaches go beyond these parameters to explore the deeper world of spiritual expression and organic natural forms where the wonder and

sensual beauty of the natural world are combined with the essential needs for economy, efficiency, and conservation. What is now coming as a breaking wave is a new architecture that expresses the union of inspiration from nature's forms and truly sustainable design.

Plate 2.6: Beijing birds nest stadium, China

Source: Malkin, (2008)

2.3.1 Natures forms

Patterns and forms in nature, such as the spiral and fractal, are products internal laws of growth and action of the external forces, such as the sun, wind and water. Architects learn to use natural forms from observing living structures such as trees, bones, shells, wings, webs, eyes, petals, scales, and microscopic creatures. They are the very forms of life and growth and have been key inspiration in organic architecture, whether for ornament, or an Art nouveau structure, as with Gaudi, or Metaphor, as with Makovecz. The pioneering students of nature forms whose influences would still be felt today, included Johan Wolfgang von

Goethe (1749-1832), Ernst Haeckel (1834-1919), and D'Arcy Wentworth Thompson (1860-1948). Goethe studied natural forms and coined the term morphology. He also applied ideas of metamorphosis to art and architecture, the dynamics of form active in all living organisms, whereby an orderly and cyclic transformation can be traced in all plant forms from seed to calyx to blossom to fruit (and to seed again) a concept central to the development of biomorphic architecture (Johnson,1998).

Biologist and zoologist Ernst Haeckel studied radiolarian (plankton) and was captive by their exquisite geometrical forms and complex patterns. He is best known for his work 'Art forms in Nature' with its magnificent illustrated plates by lithographer Adolf Giltsch such stunning illustrations had an immediate impact on the Art nouveau and the work of Herman Obrist, August Endell, and Louis Comfort Tiffany. Architect René Binet not only produced a book of ornament based on Haeckel's illustrations, but also designed the monumental entrance gate to the 1900 Paris World exposition, as a vast radiolarian. Haeckel himself used beautiful jellyfish forms as ceiling decoration in his former home, the "Villa Medusa". Zoologist D'Arcy Thompson also set out to define and classify form and studied an astounding range of natural forms form microscopic Radiolarian to shells, insect wings to raindrops, snowflakes to the splash of a pebble in the pond, his thoughtful results were published in his classic work on 'Growth and Form' where he concludes that we must realise that no biomorphic forms exist except such are in conformity with physical and mathematical laws (Hubert, 2009).

2.4 DORMINANCE OF GEOMETRY

According to Hubert (2009) Plato believed that all things flow and change in nature but are directed by external and immutable patterns, forms, or ideas that are the true reality.

However, the founder of the scientific approach, Aristotle, used observation to understand and classify nature. In architectural terms both contributed to key ideas and concepts that run through organic and biomorphic designs and the debate between holistic and analytical approach that continued ever since.

To many ancient societies, man's relationship with nature was a sacred experience. Building in the past was wholly a matter of following static intuitions, which were, in turn, a result of meditation, experience, and, above all, an understanding of the capacity of certain structures and materials to resist external forces (Guidoni, 1978). Nature was integral to the lives of the ancient Greeks and influenced every aspect of their life. The ancient Greeks drew spiritual as well as functional inspiration from nature, which was translated into art and architecture. The gods were representative of nature and its occurrences, including the earth, sky, water and forests. All Greek sacred architecture explores and praises the character of the gods, or a group of gods in a specific place (Scully, 1969). Nature also provided the geometry found in the decoration of temples.

Plate 2.7: Greek column

Source: Realwowz (2012)

According to Thompson (1992), the Roman, Vitruvius, agreed with his forebears that the human body, with its modular construction, is the ideal expression of nature's unity. His *homo quadratus*, shows the figure of a man with extended arms and feet that fits into what were considered the most perfect geometry figure, the square and circle.

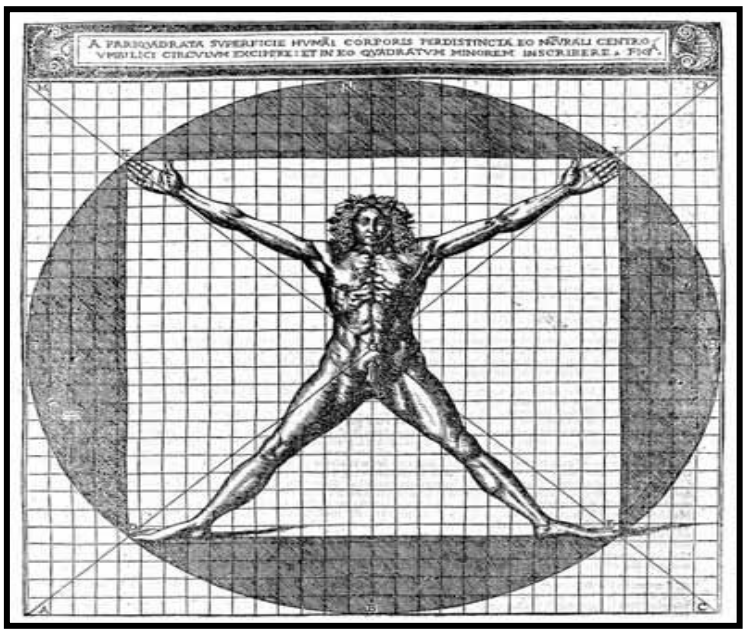

Figure 2.1: Homo quadrates

Source: Blackbone (2011)

The Romans moved on from philosophy to practice and to developed arches, vaults and domes structurally stronger and more economical of materials than earlier straight post and beam designs, however, toward the end of the Roman empire theories of proportion lost their original divine significance and became a series of secular rules applied to any building of importance. Later, in the Byzantine Empire, Christian spiritually inspired architecture with ideas of divine proportions and the mystique of numbers, and developed the roman form of the dome placed on a square to create the typical byzantine cross in square church plan (Thompson, 1992).

Divine geometry was also very alive in the Islamic world; representations of human and animal form were strictly prohibited. Mathematics and abstract geometry were the only appropriate expression of order and perfection, thus pure geometric shapes example. circle, square polygon, and star were employed to produce timeless Islamic architectural language of cupola, half dome, tunnel vault, horse shoe arch, stalactite "pendentive", and rich ornamentation. The building forms and ornaments seem to cascade, like fractals, into distance without end (Hubert, 2009).

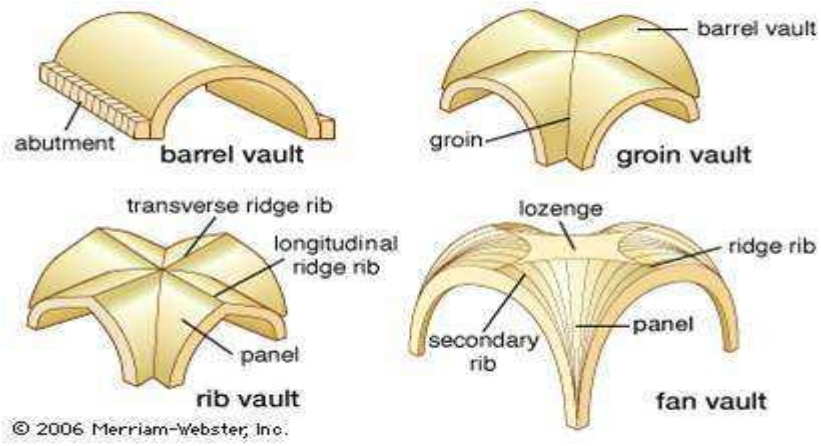

Figure 2.2: major types of vaults

Source: Webster (2006)

Early Celtic art, like nature, abhorred straight lines and preferred the organic forms of trees, plants, water and earth. Rather than representing nature as it appears, the Celtic artist expressed a mystical and ambiguous world of highly stylised abstract forms. The motifs ranged from geometric patterns to chevrons, circles, whorls, tendrils, spiral and later animals. Used as repeating and entwined patterns, they were executed with free-flowing grace and beauty and also a sense of wit and individuality. Gothic architecture absorbed elements of both Greek geometry and pagan Celtic expressions. Master masons revitalized the sacred purpose of proportion and used plant forms as decorations. The circle was the

basic controlling device of Gothic cathedral design. The whole structure derived from underlying star diagrams, subdivided by polygons (especially, pentagons and decagons, which relate directly to the Golden section), generated harmonious and heavenly proportions. The pointed Gothic arch and vault, being more similar to the parabolic arch, shed structural loads more effectively than the, massive Roman semicircular arch. These innovations allowed unrivalled building heights to be reached with an apparent lightness and delicacy never before imagined possible in stone- a real flowering of the organic nature of architecture. (Hubert 2009).

The art nouveau sprung with its wild fantasies as a result of the rejection of 19th century stylistic limitations, this movement had affinity with the natural world the universal source of inspiration, Inspired by the delicacy of living forms as sinuous vine tendrils and flower stems.

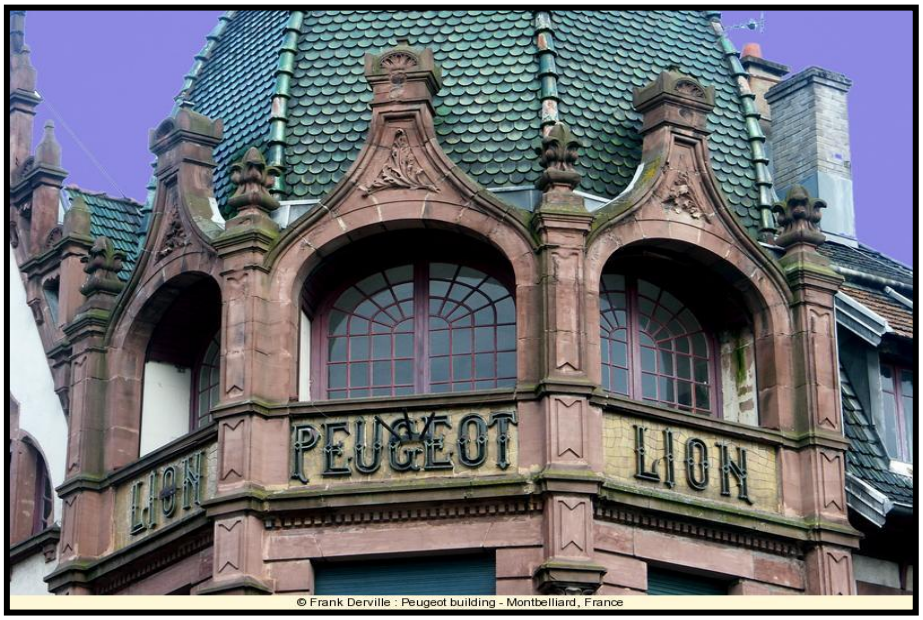

Plate 2.8: Peaugeot building, France

Source: Microsoft Encarta (2009)

Like the ancient Greeks, the indigenous people of Africa also developed an attitude of respect, gratitude and humility in relation to nature that influenced every aspect of daily life. While the architecture of the Native Nigerians was a response to social, climactic, and functional necessities, it is also subject to symbolic and cosmic interpretation. It illuminates the relationship between life and land, the processes of nature and man's role in maintaining the equilibrium through the planning and decoration of their building. In South Eastern Nigeria, the planning of buildings was inspired by nature while decorative motifs used on buildings where of 'Uli' flower and 'nsibidi' (leopards) pattern (Cole and Aniakor, 1984).

2.5 PIONEERS OF BIOMORPHIC ARCHITECTURE

A supreme and passionate master of biomorphic architecture Antoni Gaudi believed that straight line belonged to men and curved line belonged to supernatural representations. Always the bizarre a surrealist end of the organic spectrum, the early medieval, Islamic and Catalan influences gave way, in his later work such as Casa Batllo and Casa Mila (La Pedrera- the quarry), to extreme plasticity that superbly integrates structure, materials, and sculptural form. Gaudo closely observed nature and was a bold innovator of advanced structural systems. He designed the equilibrated structures that stood like a tree, needing no internal bracing and external buttressing with catenaries, hyperbolic and parabolic arches and vaults, and inclined columns and helicoidal (spiral cone) piers, first cleverly predicting complex structural forces via string models hung with weights (his results now confirmed by computer analysis). He loved to instil his projects with many levels of meaning and delighted with metaphor and symbol, overtly religious as in the church of the Sagrada Familia but more subtle and mysterious as in Guell Park with its strange mix of Catalan and

Masonic symbolism, yet, it's weird pinnacle lodges, serpentine mosaic bench, and winding music rustic viaducts all evoke the exuberance of youth (Hubert,2009).

Plate 2.9: Gaudi's Casa Milla

Source: Robert (2007)

Another key influence was Hugo Harling, although, he designed important buildings such as Garkau farm, Lubeck Germany, his real contribution lay in organic theory in approach to form, he expressed his belief that every place task implies a form, and that it is the architect's job to discover it and let it unfold. Function, he felt, was derived from nature and life whereas expression came from the human intellect. Functional forms are the same throughout the world and history, while forms are bound by Blood and Knowledge and thus dependent on the time and place (Thompson, 1992). He abhorred the trend in the 1920s, by such architects as Le Corbusier, who imposed simplistic geometric forms from the outside and then justified them by their inherent beauty. Whereas a polished metal sphere may appeal intellectually, a flower, Haring felt, is an emotional experience and a higher order of expression. He spoke of buildings as organ-like exhibiting a being-like form (Hubert, 2009).

But although this did not lead to curved rather than orthogonal shapes, it did lead away from the poverty and dominance of straight lines and right angles.

The prolific projects of Hans Scharoun, one of the chief exponents of organic building in Germany, range from individual houses, apartment blocks, and schools to large-scale post war re-developments in Berlin and other cities. He successfully translated Harling's concepts of organic functionalism into reality and went beyond this to develop new spatial experiences, as well as forms, based on the careful research into site, functional needs, and deeper social meanings. In his best-known project, the Berlin Philharmonie, the radical arena auditorium places performers in the center of the audience and embraces both within a free ranging asymmetrical auditory space. By contrast, the adjacent Musical Institute takes on a more sober orthogonal design to reflect a concern with reason and knowledge. Scharoun had considerable influence on post-war Germany and the spirit continued through the work of Bohm, Behnisch, and Fehling and Gogel (Hubert, 2009)

Plate 2.10: Hans's music hall

Source: Jeff (2009)

Wilshier, (2002) noted that Alvar Aalto brought a Scandinavian clarity, simplicity, and lightness to organic design. He was a genius at handling asymmetrical of diverse volumes and gradually moved then from earlier forms as in the Town Hall, Säynatsälo to evolve vigorous curved forms in his Finlandia Concert Hall, Helsinki. He could create fluidity if space and quality of natural lighting and colour that were poetic, and use simple natural materials, particularly wood, in new and creative ways so as to "allow the materials to express themselves". Jorn Utozn, the Danish architect who work briefly in Aalto's office, evolved his own original style based on nature, and ultimately won the design competition of the Sydney Opera house with its billowing white concrete sails.

Plate 2.11: Sydney opera house, Australia

Source: dewdrop (2010)

2.6 PRINCIPLES OF BIOMORPHIC ARCHITECTURE

Since biomorphic is born out of organic architecture or can be describes as a by product of organic architecture, its principles therefore should be spawned from that of organic architecture as deduced from the relationship between the two as earlier discussed in the origin of biomorphism.

Architect and planner David Pearson (2001) proposed a list of rules towards the design of organic architecture. These rules are also known as the "Gaia Charter" for organic architecture and design, it reads:

"Let the design:

vi. Be inspired by nature and be sustainable, healthy, conserving, and diverse.
vii. Unfold like an organism, from the seed and within.
viii. 'Grow out of the site' and be unique.
ix. Express rhythm of music and the power of dance.
x. Exist in the 'continuous present' and 'begin again and again'.
xi. Follow the flows, be flexible and adaptable.
xii. Satisfy social, physical, and spiritual needs.
xiii. Celebrate the spirit of youth play and surprise."

Bryant Mole in his unpublished dissertation (2008), further explained these principles which he referred to as a manifesto, after reviewing the written works of Frank Lloyd Wright, David Pearson, and other influential organic architects.

These principles are however further streamlined or fine tuned into the following four basic principles since biomorphism concerns itself only with the living aspects of organic architecture, these are;

- Inspiration
- Growth and evolution
- Rhythm and repetition
- Flexibility and fluidity

i. Inspiration

Inspiration is the ability to stimulate the human mind to creative thought or making of art. Therefore, let nature inspire the design, learn from it and be sustainable, healthy, conserving and diverse. The central theme is the organic architecture, which involves a relationship with nature. It should however ne noted that these buildings these building must not necessarily look like organic forms. Kellogg mentions being 'guided' by nature. The appropriate terminology here is 'inspired'. Nature is the starting point, form which architects can learn and go on to apply their learning in their own unique style.

ii. Growth and evolution

Growth is the process of becoming larger and more mature through natural development similar to the Darwinian concept which shows the hereditary evolutionary processes of transformation from a unitary cellular to a larger body, while evolution which involves both regeneration and transformation is a gradual and natural developmental process by which new and different organisms developed as a result of changes in generic material into a

more complex or better form. Regeneration represents the appearance of life and a biological presence in a building.

The topography of the site should inform the design; the building should enhance the landscape. Two central themes according to Mole are closely linked to nature: Landscape and context. So also, understanding the intrinsic qualities of materials (natural and artificial) and using them appropriately. Using natural materials help the building to look and feel as though it belongs to the environment. Bryant (2008), form his review of the philosophies of organic architecture inferred that it is not what the, material used that is most important but how its used. Consequently the key to using material appropriately lies in understanding the qualities of the different materials.

iii. Rhythm and Repetition

While rhythm is a regular recurring characteristic pattern of activity, repetition is the recurring event or situation that is same as a previous one. Consider the relationship between the building and its site; the building should appear to belong to and grow form the site. More established from the works of Kellong and Prince that 'the design should benefit the landscape' and the 'the building should appear to be of and not on the site landscape.'

iv. Flexibility and Fluidity

Fluidity with respect to the evolutionary processes taking into consideration the flow of function, the building should near non linear appearances from its design heuristics as semiotics, fluidity here, indicates that all biomorphic buildings must have non-linearity geometry. Flexibility however, is the ability to bend or be bent repeatedly without damage

or injury or the ability to adapt and or change or be changed repeatedly according to circumstances.

Therefore architects should work with nature rather than against it, natural elements on site have an influence on the building. This will be of critical importance because of the new technology and materials available and also because of a greater a awareness of the need to do as much as possible to conserve energy and use renewable energy sources as noted by Bryant (2008).

Feurstein (2002) also stated the principles of biomorphic architecture as follows;

- Growth.
- Fluidity.
- Environmental economics.
- Geomorphic considerations.

2.7 CIVIC CENTERS

Civic center is a focal land area within a community, containing one or more dominant public structures. The term civic center has also been recently used to refer to an entire central business district within a community (Robert, 2009). This study views the appearance and meaning of a civic center with some modest notes about distance countries and ancient civilization in which civic centers evolved. The psychological function of civic center is as true for the present and future as it has been for the past. Thought the needs and demands of the past may have been fewer and less complex, but they were as basic for the determination

of the shapes of civic center now. This analysis of typical examples of the past is not a mere historical discussion, but to stimulate some thoughts for civic center designs of today. While technical function and socioeconomic conditions have changed since the industrial revolution, this should not deter application of lessons from the past to conditions and needs of the present. This approach is helpful in order to define exactly what a civic center is and what it is not, and how relatively late in history, social conditions and aesthetics urges came to shape this specific spatial form within the urban community.

2.7.1 PRIMITIVE CONCEPT OF CIVIC CENTERS

In primitive settlements, these spaces mostly developed around the residence of the divine kingship. This provided focal points for the community and often were used for informal as well as formal gatherings and most cases they developed into community commercial centers, (Okoroafor, 1986) . It was only after 500BC did genuine civic centers developed in Greece. City planning as a conscious, collective and integrated action beyond the mere construction of individual houses, existed already in India and Egypt in the third millennium BC, but never the impulse to shape a void within the town into a three-dimensional area called ‘civic center’. This may be explained sociologically: only within a civilization where the anonymous human being had become a ‘Citizen’, where democracy had unfolded to some extent, could the gathering place becomes important enough to take on a specific shape. This sociological development was parallel by an aesthetic phenomenon: only when a full consciousness of space evolved.

2.7.2 GREEK CONCEPT OF CIVIC CENTER (*GREEK AGORA*)

The Agora was the heart of ancient Athens, the focus of political, commercial, administrative and social activity, the religious and cultural center, and the seat of justice.

The site was occupied without interruption in all periods of the city's history, Early in the 6th century, in the time of Solon, the Agora became a public area. After a series of repairs and remodelling, it reached its final rectangular form in the 2nd century B.C. Extensive building activity occurred after the serious damage made by the Persians in 480 B.C., by the Romans in 89 B.C. and by the Herulae in A.D. 267 while, after the Slavic invasion in A.D. 580

Plate 2.12: Athens agora
Source: Marinet (2002)

Usually, the Agora as the focal point of the town was located at the center, if topographical conditions allowed it. Though, in some towns of the early period, the Agora has been found near the gate. In the beginning, as described by Homer, the Agora was primarily the place for political gatherings and legislative assemblies. It changed gradually into a center for marketing and eventually became solely commercial, whereas the political function of the Agora was taken over by representative meetings in the sacred area of the acropolis (city). What was left of governmental, administrative and judicial activities in connection with the Agora were attended to in closed special buildings.

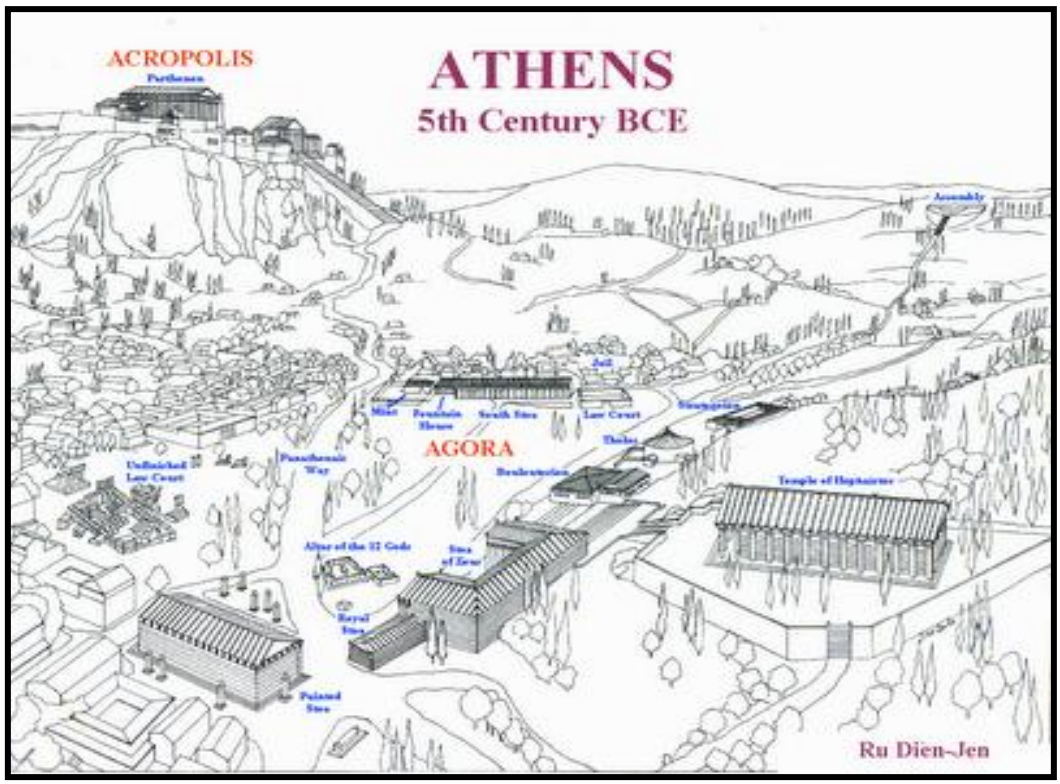

Figure 2.3: view of Greek agora

Source: Marinet (2009)

Origin and gradual change in function of the agora do not suffice to explain the change of it shape. From the end of the eight century down to the beginning of the fifth century BC, the layout of the agora was as irregular as that of the whole town and was mainly defined by topographical conditions (Martin, 2009).

2.7.3 ROMAN CONCEPT OF CIVIC CENTER (*ROMAN FORUM*)

The Roman Forum was once the center of ancient Rome, the place where the Romans used to meet, do business, politics and shop. In 46 BC Julius Caesar built a new forum because the old one was getting small for the growing population of the city. Today modern Rome is 25 feet higher than the city was when the Forum was built because of the debris that has

accumulated over the years. The Roman Forum today is an area of ruins of temples, arches and basilicas but still there is a lot to be seen.

Plate 2.13: View of the roman forum

Source: Gravity (2008)

The principal forum in Rome, the Forum Romanum Magnum (Great Roman Forum), was of this type, and above the colonnades that surrounded it were galleries for spectators. As cities grew, however, it became necessary to establish a separate forum (*forum civile*) for legal and administrative affairs, as well as mercantile forums (*fora venalia*), each devoted to the sale of an important commodity. Among the mercantile forums were the animal, vegetable, fish, grain, and wine markets. The shops were situated around the square of the mercantile forum and often on streets leading to it. In addition to the open forums, some cities also had covered markets. The term *forum* gradually became synonymous with market and was employed as a descriptive epithet in the names of many market towns, such as Forum Appii and Forum Julii,(Mellor, 2009).

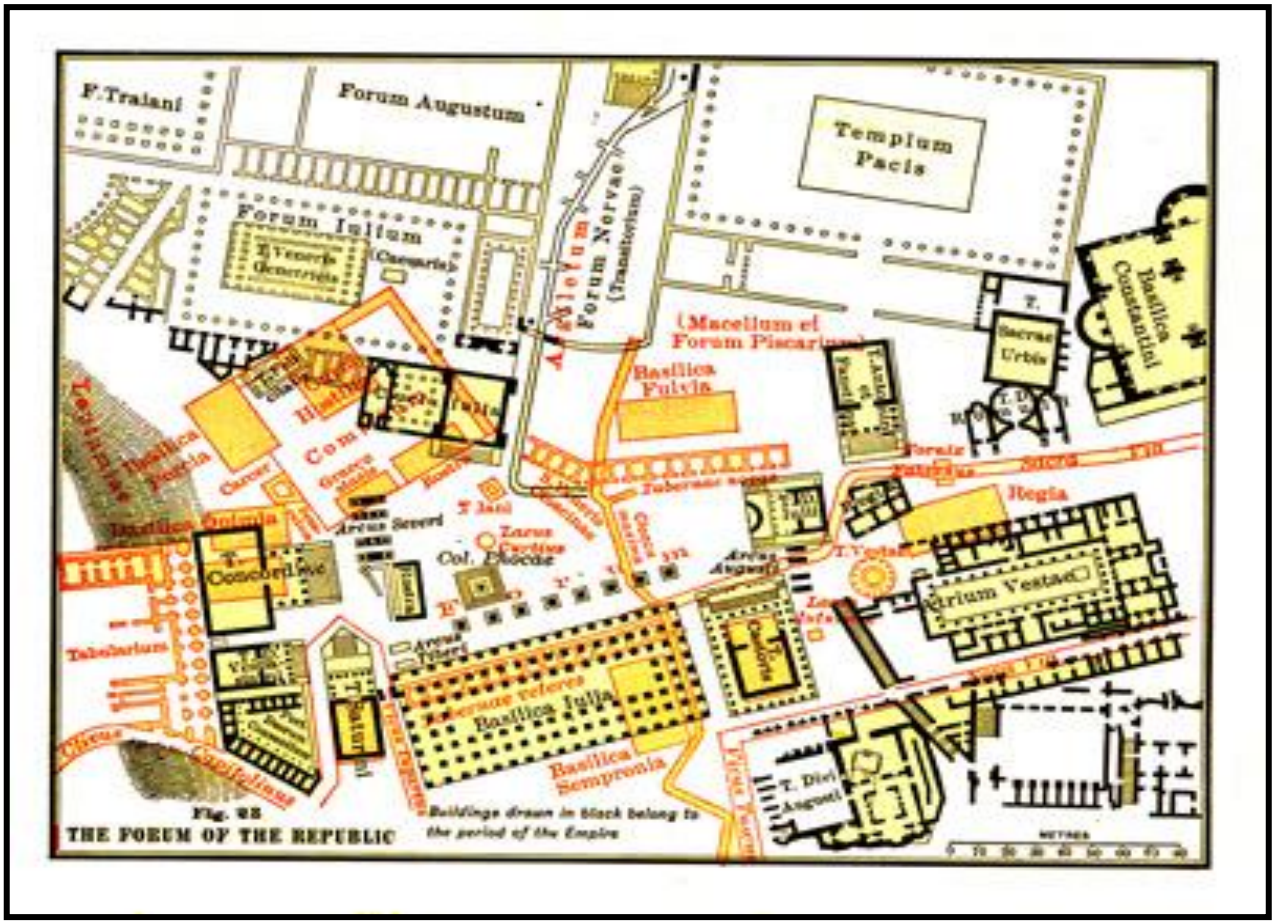

Figure 2.7.2: Map of Roman Forum

Source: Gravity (2008)

The Forums in the ancient Roman cities which corresponded to the Agoras' of the Greek cities, were central spaces used for social, commercial, recreational and political purpose. The surrounding buildings of the forum usually reflected not only religious, law and commerce, but also the busy cooperate life of the city .Contrary to the Greek's, the general layout of Roman towns and the form of their civic centers were inseparably integrated: an analogy to the centralized system of the state and the concept of strict order which pervaded Roman commercial life in general. The Roman forum was much less interspersed with status, alters and shrines than it had been on the Greek Agora. The ground plan of a forum

was in principle rectangular, but was occasionally adapted to local conditions, dependent in each instance on the importance of already existing buildings.

2.7.3 MEDIEVAL CONCEPT OF CIVIC CENTERS

Some of the Late Antique cities and towns in Italy, France and central Germany survived the fall of the Western Roman Empire and the Migration Period. In the Early Middle Ages those cities served as administrative centers, seats of royal or secular authorities, or bishoprics but eventually evolved into trade centers. The majority of medieval cities and towns were founded between 11th and 14th centuries often for defensive purposes. Medieval cities and towns were often founded near castles or manors of feudal lords and near monasteries as well as on other attractive locations like near the woods (for firewood), shores of rivers and seas, and near the ruins of Antique cities where could have been found building material.

Apart from the market place, building of public, administrative and religious institutions also needed a certain amount adjacent public space. These public spaces later developed into crowded focal points of social and commercial activities which made urban spaces a luxury .There was a high demand of urban land to provide adequate spaces for numerous businesses and also to house the large population generated by urbanization. Civic arena in medieval towns, both streets and public grounds virtually ended up as commercial spaces. It was the relationship between individual structures and the space around them rather than the expansion of space (Hinkle, 2008).

2.7.4 RENAISSANCE CONCEPT OF CIVIC CENTERS

The term ‘renaissance’ means rebirth and describes the revived interest in the scholarship, philosophy, and arts of the ancient Greece and Rome that developed at this time, more broadly, it also represented a new freedom of thought and expression, a more rational and scientific view to life, and the expansion of commerce and travel in the European life. As the fortunes of merchants, bankers and trades people improved they had more than enough to meet their basic need for food, clothing and shelter. They began to desire larger and more luxurious homes and public space, sumptuous clothing to show off their wealth in public, and exotic delicacies to eat.

During the middle ages, the need to enclose the cities within protective walls necessitated building within a compact area that left little space for public gardens and social arenas, as the Renaissance period began, European town planning was characterised by wide avenues, long approaches and monumental features as well as public squares and walks, often with decorated statuary. In some cases, religious brotherhoods built clubhouses; gardens and shooting stands for archery practise that were used by townspeople for recreation and amusement.

Plate 2.14: Madrid’s Plaza Mayor, Spain
Source: Microsoft Encarta (2009)

The Renaissance civic centers are an element of civic design of excellence. It is remarkably characterized by:

- Symmetry about one or more axis
- Space usually surrounding by important public building and unified by means of repetition of basic elevation design and articulation of details usually in co-junction with unbroken row of colonnades
- Use of limited vistas achieved by selective placement of imposing status, obelisks and monumental buildings
- Enriched with fountains, sculpture and a variety of architectural landscape elements, trees and flowers.

2.7.5 CONCEPT OF CIVIC CENTER IN ANCIENT TOWNS OF NIGERIA

YORUBA TOWN

The major factors governing the plan of typical Yoruba town are:

- Administration
- Trading
- Defence function of the town

The Oba palace was the most dominant feature of the Yoruba towns. It was centrally placed. The Oba was the head of the town administration and the symbol of urban status. The palace ground was the first organized civic spaces in Yoruba towns. The palace apart from housing the oba, also provides extensive open space for recreation, religious and social gathering, and usually enclosed by a very high wall. Opposite the palace was the most important market ground or within its own spaces was the fetish temple/ shrine or the central mosque of the town (in some cases both are present. From the city center, road radiates to other parts of the town forming the residential areas and links to neighbouring towns.

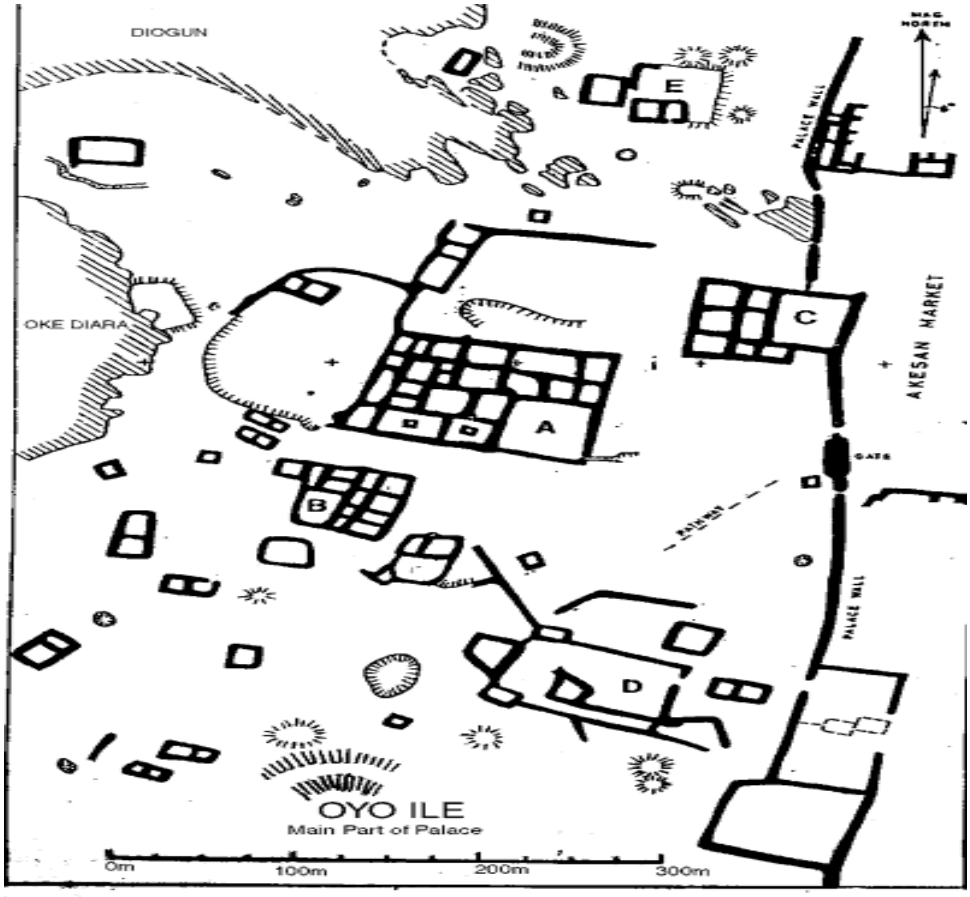

Figure 2.5: Plan of Oyo ile Palace
Source: Lakal (2011)

HAUSA TOWN

The typical characteristics of the structure of most house town are as follows:

- Presence of a fortified city wall.
- The city center which include the Palace.
- The different clans based on social stratification in terms of occupation

The civic center was the principal civic and community gathering space. It was seat for administration, social and economic activities for the surrounding rural area. The Emirs palaces were usually centrally placed within the city center with central mosques and central market close by.

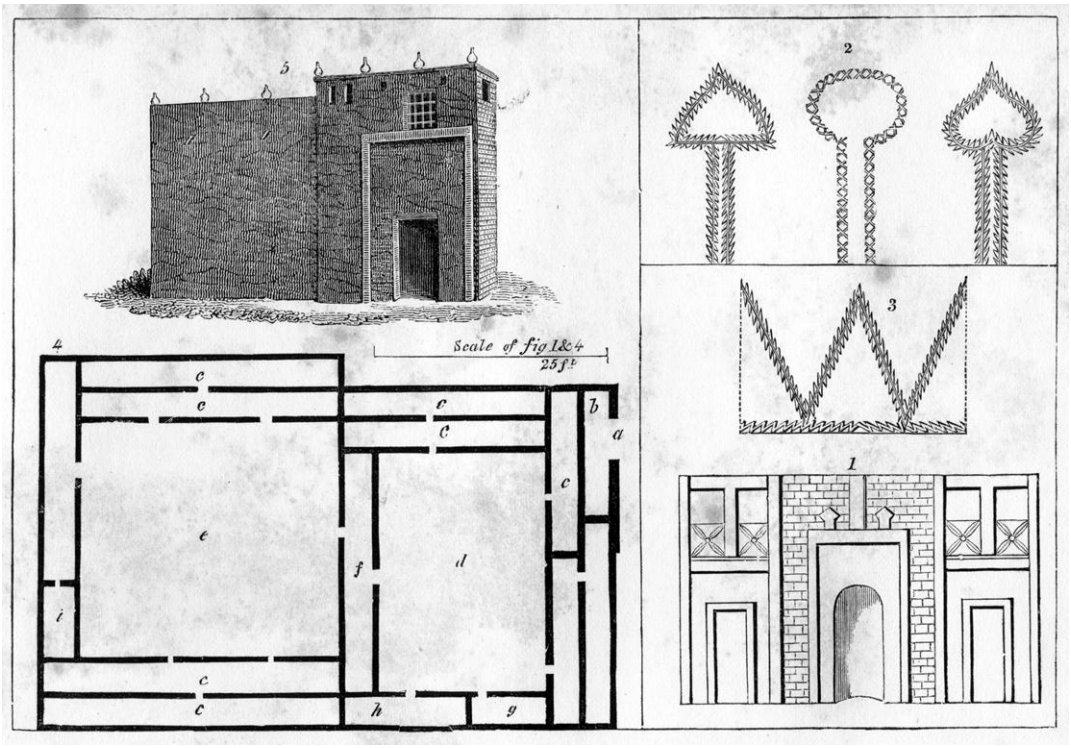

Figure 2.6: Views of Emir Palace
Source: Solver (2008)

IGBO CIVIC CENTER (Ilo)

The layout design of Igbo village as analyzed by scholars such as Ottenberg (1968), and Nsude (1987), depict Igbo villages as branching out from a circular center, Although, architecture of Igbo village center differs in various parts of Igboland, however, common themes and elements enable meaningful analyses on Igbo civic center as a whole (Onochie, 2008). Each village has an open central space, referred to as an ilo. The ilo speaks of the community and not of the individual, since it is a cooperative symbol. Being a cooperative symbol, it must also represent the community in its entirety. Both symbolically and spatially, the ilo can be seen to perform a luminal role. It is therefore no surprise to find that it is the site of most collective shrines, and on other days the site of the market, village entertainment and meetings. There is also another symbolic dimension of this village center. The linage obi ((linage civic center) are frequently found on the perimeter of the ilo, (Cole and Aniakor,

1984). Most part of ilo are sacred area referred to as Ihu Agbara (the face of god). The ilo is therefore perceived as the spatial architectural heart of a community.

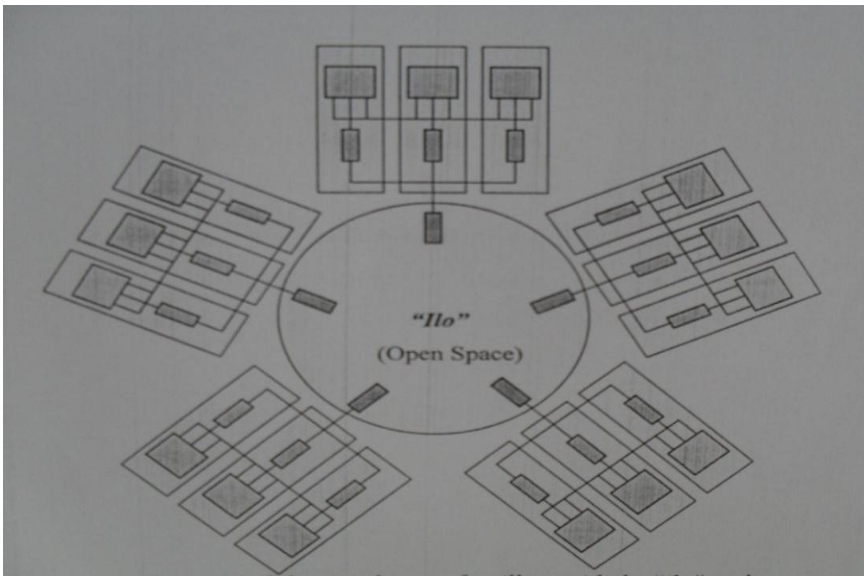

Figure 2.7: Schematic layout of an Igbo village with the ‘ Ilo’ at the Center.
Source: Osaka (2008)

Very few architectural symbols define the ‘ilo’. The ‘ikoro’, or war drum; the linage obi; meeting house and important village shrines are all located in this space. However no architectural elements defined the periphery or edge of the ‘ilo’. They are often decorated with the finest architectural details. The typical plan of an ilo is circular, although most are often marked out as ‘perfect’ geometric circles.(Onochie, 2008) It is most likely that the form of an ilo resulted from the concentric planning of Igbo villages. The concentric plans in turn are likely to be reflected of the importance of the ‘center’ in the Igbo gnosis.

2.7.6 MODERN TOWN CIVIC CENTERS

Whereas the concept of “civic centers” is not new, the complexity of contemporary urban environment requires that they be larger and grander than they have in the past. This makes the present interpretation placed on them to change and their needs keep growing. With this manifestation, these spaces have generally metamorphosed into monumental public areas, hubs

of social intercourse and public spirit, with their prior uses yielding to a host of new functions such as cultural facilities, tourist venues, recreational center, and educational centers. Their symbolic functions now are becoming more essential to the degree that their visual significance often meets or exceeds their practical use. To highlight these new uses, civic centers are being created as symbols and icons to attract interest and serve as rallying points in uniting and defining civic image. Moreover, major civic centers in the world become civic symbols not only because of their beauty of design, but because of the colourful and important civic events which takes place in them.

Plate 2.15: View from park: Scarborough Civic Center Toronto
Source: Dittwald (2000)

This symbolic expressiveness of civic center is not only important in attracting people's interest to participate in individual and civic activities. It's largely within these urban centers that the city dwellers find for themselves some variety of experience which makes life in a city great and stimulating. It is the urban space which gives a character and quality to city life, establishes its tempo and pattern. Urban spaces occupy a position of central importance within the city network and can provide for the much needed contact with the elements of

natural environment. The modern civic center tends to enclose the piazza within a singular structure and facilities located around it. The function of the civic center has being disintegrated into administration, recreational social, educational or combination of two or more functions.

2.8 CIVIC DESIGN

Bill Steiner in his presentation "understanding civic design" defined "Civic design as approaching how we use, plan, physically design, and support our communities and the public realm in a way that benefits citizens, citizenship, and the city. It means putting people first. It is an attitude, a process, a way of operating, and a mindset. Civic design asks what is best for our citizens and their citizenship, what will encourage people to spend time in the public realm enjoying them, interacting as a community, building ties to each other and the community, What is best for the collective good and the options we have, what most favours citizens, citizenship, the wellbeing of the community, a sense of place and belonging and community, which will result in a vibrant, alive, joyful, rich public realm (Steiner, 2006).

Paul Zucker (1959) in his book 'Town and Square' said that civic design, which is so closely a part of allied arts and an integral part of architecture, has a tremendous power, the power to move us deeply even to evoke the highest forms of social cooperation through its appeal to individual and to groups; and to project an image of our most cherished national traditions. He further said that civic design should be an expression of what people want, but do not know how to express for themselves.

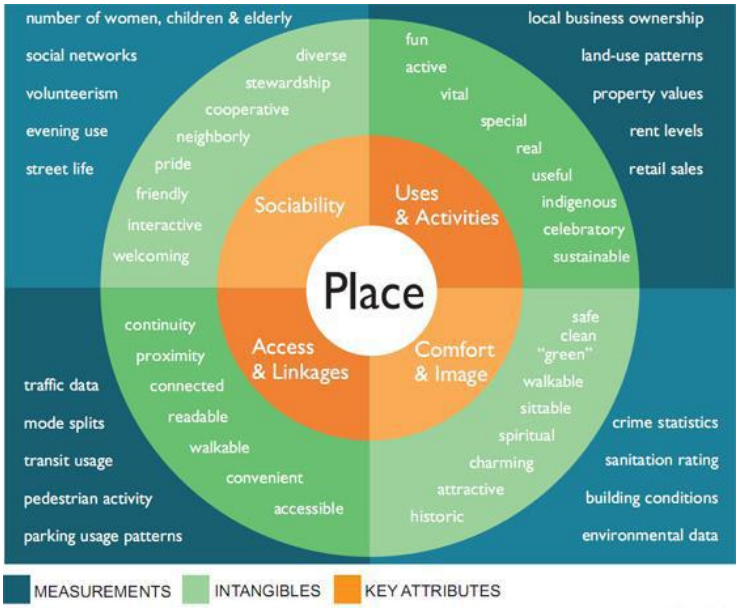

Figure 2.8: Key qualities of a successful civic design

Source: Project for public spaces (1997)

Christopher Tunnard (1970) in his book 'The City of Man' gave the following touch-stones on civic design to architects;

- The indiscriminate bringing together of buildings of different character in a place calls for strong knowledge in aesthetics.
- Learn not to create space patterns from space-flow diagrams for people to follow in their daily lives, but to create space in which people can form their own patterns…… a secret known formally to civic designers of the Renaissance. We should be at liberty to direct and channel the eye…… but not to control human activity.
- Remember that all other creative professions are open to (painting, sculpture and so on).

- Civic design must be integrated properly with all cities planning activity, where they must function as guardians and promoters of everything to do with vision.
- People must be taught a visual approach to their surroundings.
- Broaden the slogan "fitness for purpose" to include the purpose of aesthetics

Civic design has objectives: generating a sense of place that serves and symbolizes institutional values and purposes. Appropriate aesthetic expressions can be created through architectural forms and shapes, materials and colours, that celebrates their time, temperament and technology (Linsky, 2002). Civic design is about embracing a holistic approach to the work of place making and community building. Civic design is not just the act of building or fixing up a space; it is a process that fosters the creation of vital public destinations—the kind of places where people feel a strong stake in their communities and commitment to making things better. It capitalizes on a local community's assets, inspiration and potential, creating good public spaces that promote people's health, happiness, and economic well-being.

Thomas Adams (1935) in his outline of town and city planning thought that this term should be applied to the art of place making to distinguish it from the act or machinery of making plans. 'To be an art', he suggested in his introduction, 'civic design must be creative design, directed by intelligence and applied to the forms and masses of buildings and the spaces about them. It must recognize the essential unity between buildings and between architecture and engineering elements in structure'. Abercrombie (1986) says that it is a combination of architecture, planning principles and landscape design and a method of coordinating all the creative arts which must be given urban expression to achieve an integration of art and life.

2.9 PRINCIPLES OF CIVIC DESIGN

These principles are intended to inform the design of civic centers to ensure they meet community goals for attractiveness, durability, and functionality. Each project will need to be reviewed individually, and for each project, certain principles may be stressed over others, (Public Facilities Review Committee, 2008).

2.9.1 Civic values.

- Respect neighbourhood context and important historic structures.
- Take advantage of prominent sites and major civic programs to create bold architecture.
- Emphasize leadership in energy conservation and environmental sustainability through architectural design, materials, and construction methods.
- Utilize universal design to ensure open and welcoming accessibility for all citizens.
- Explore adaptive reuse of significant existing structures and building elements and consider possible future reuse of new buildings.
- Optimize open space for public relaxation and recreation, and minimize building footprint and areas used for parking, on-site roads, and service drives.
- Support joint development and use of school and county facilities when in the best interest of both entities.

2.9.2 Siting and Orientation.

- Orient the primary building entrance to the appropriate adjacent street or public space so movement and entrance to buildings are natural and intuitive.

- Emphasize pedestrians, bicycles, and mass transit over automobiles in building placement, entry, and architecture.
- Ensure building and site is functionally and spatially coherent, facilitating the flow of people to, from, and within the site.
- Create “positive” outdoor spaces with a pedestrian emphasis.

2.9.3 Building form.

- Develop massing strategies appropriately scaled to the site and neighbourhood.
- Use massing to emphasize a pedestrian, human scale to the building, breaking into smaller sub-parts that respond to site and program.
- Develop a sense of hierarchy in the massing, emphasizing and leading to the important functions and spaces in the building, including the entrance.

2.9.4 Building details and materials.

- Use design details related to pedestrian scale and provide interest, discovery, and character.
- Celebrate the civic nature of the project with public art and iconic architectural elements.
- Use durable and permanent materials to assure longevity of, and civic pride in, the project.
- Appropriately plan budgets to reduce negative design impact of value engineering.
- Explore consistent design elements with other successful Arlington civic projects.
- Design building lobbies to create a sense of place and importance.

CHAPTER THREE

METHOD OF STUDY

3.1 INTRODUCTION

This involves the assessment of the accessible approaches used to source information and the study of the proposed building type in relation to how the principles has been used to enhance the construction of building s in general with specific emphasis to civic centers and its other forms.

Both local and foreign buildings will be studied so as to give a wide range of buildings as there is just a handful found locally.

3.2 CASE STUDIES

The research method adopted in this study is a qualitative research method through case studies. it is based on evaluation of design principles that foster biomorphism in the design of communal civic center. The assessment was carried out through visual surveys, observation, and a checklist on the application of the outlined principles of biomorphism for each facility under study, thought the objective method of observation (Groat and wang, 2002).

3.2.1 Criteria for selection of Case Studies

The cases were purposively selected as suggested by Veal (2006), which he described as purposive sampling. This suggested that cases are identified for study due to their inherent qualities which were in consonance with the phenomenon under investigation. The case studies selected for this study were samples purposely based on the following conditions.

i. As a public civic space with adequate analysis in scope of facilities required to make it operate as a civic center.

ii. As a facility that represents and or depicts the application of the principles of biomorphic architecture so as to look at factors that encompass the design of nature inspired buildings.

iii. As a facility that has environmentally sustainable design features.

The method of analysis can be viewed in two aspects:

- **As a case study unit of analysis:**

  The civic centers are studied and analyzed individually by the use of field forms which have a table containing design elements broken down under the application of principles of Biomorphic Architecture to civic center design. This study is to analyze the various civic centers and how Biomorphic Architecture was applied.

- **As a case study research assessment method**.

  Based on the selected civic centers, an assessment table on application of Biomorphic elements was used to conduct a comparative analysis of all the civic center's studied in order to find out the extent to which principles of Biomorphic Architecture have been applied to the designs of civic centers.

3.3 DATA COLLECTION

Case study in architecture begins with a documentation of the physical characteristics of the case, and for theoretical research they may require the use of general methods of data collection. However, the method of data collection adopted for this study is observation, visual survey, and checklist of the level of application of principles of biomorphism on the case studied.

3.3.1 Visual survey

A visual survey was done by looking and identifying what has been achieved by the already existing civic centers with reference to the applicable Principles of Biomorphic Architecture, this was done by the use of photographs.

3.3.2 Field forms

Field forms consisting of variables of Principles of Biomorphic Architecture that were used to document on each civic center selected for this research.

3.3.3 Interview schedule

The selected civic center managers were interviewed to get more information on each of the existing civic center design.

3.4 DATA ANALYSIS AND PRESENTATION

Analysis of data collected on the visual survey and observation is based on the descriptive accounts observed, and noted via the instruments of data collection (Veal, 2006). Brief introduction, an account of independent variables: special organization, structure, form and dominant building materials, access to basic amenities and the size and provision for future

expansion. Instruments used in data presentation are plates, figures, and tables, for more explicit illustrations.

CHAPTER FOUR

CASE STUDIES

4.1 CASE STUDY SELECTION AND METHODOLOGY

The most important consideration for the selection of the case studies lies on the necessity to extract information from the selected facility. The sampling technique applied to the selection is purposive and this comprised of the domestic and international case studies. Purposive sampling, as the name implies involves sampling with a purpose in mind. In this particular kind of sampling efforts are made to verify that the object of study does in fact meet the criteria for being in the sample (Trochim W. M., 2006).

A checklist on the on the principles of biomorphic architecture were used to evaluate and access the degree of application in contemporary civic centers the principles will form the variables on which the selected case studies will be analyzed. The principles include (Feurstein, 2002)

- GROWTH

  a. Artistic form:

  Building could be monolithic or a fusion of abstracted geometry displaying life-like forms.

  b. Shading devices:

  Horizontal building overhangs, trees and landscaping.

- FLUIDITY
- ENVIRONMENTAL ECONOMICS

a. Building materials;

Roof, walls and floors should have low thermal conductivity

b. Large openings should be provided on north south walls and adequate shading on east west walls.

c. Site planning:

Large spacing of buildings is required to allow air inflow into buildings.

Staggered arrangements are also adequate.

- GEOMORPHIC CONSIDERATIONS

a. Building foot print:

There should be minimal interference with natural topography

b. Building forms and aesthetics

Integrating building to existing site features.

b. Preservation of natural characteristics:

Preservation of trees and other natural site features.

4.2 CASE STUDY ONE: CIVIC CENTER, LAGOS, NIGERIA.

Client:	Federal Government of Nigeria.
Location:	Lagos, Nigeria
Architect:	James Cubitt Architects
Construction date:	2002-2006
Civic Function:	Entertainment, Social and Educational.
Context:	Urban .
Style:	Expressionist.
Climate:	Tropical.

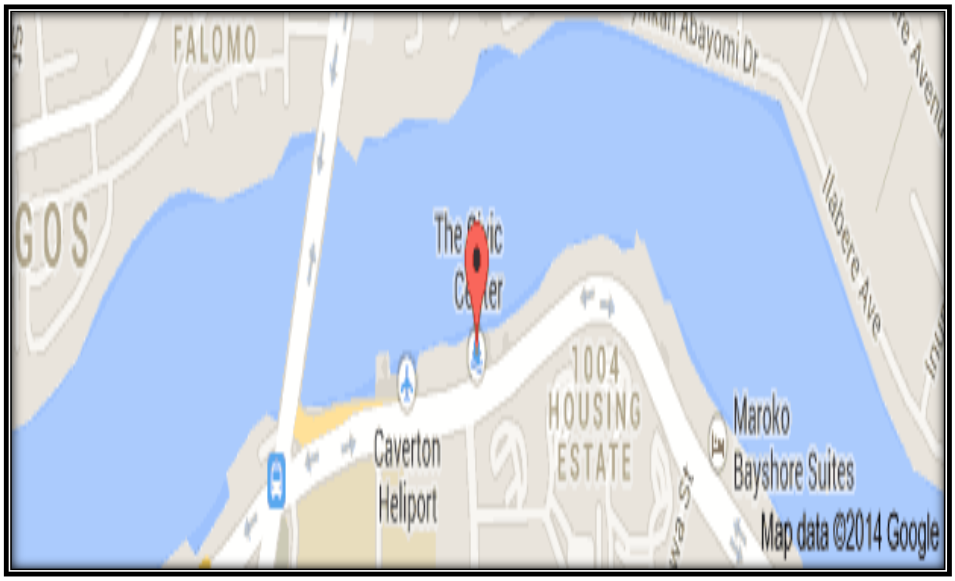

Figure 4.1: Location of Civic center Lagos

Source: Google map

Background information

The Civic Center Lagos was designed in the form of an inverted ziggurat with successive upper floors projecting beyond the floor below. This was dictated by the limited site area. The building features a tubular steel trilayer arch as structural support for double massive fins at two sides of the building with other smaller fins built on all sides.

The Civic Center Lagos was designed by James Cubitt Architects Nigeria and completed in 2006 at a contract sum of $6.2 million dollars (930 million Naira).

Plate 4.1: 3D visualization of Civic Center Lagos
Source: James Cubitt Architects (2014)

The building is a commercial development covering an area of 2,190m² providing facilities for shopping, administrative, social and cultural gatherings.The main feature being the grand banquet hall which was designed without columns to make it conducive for large events. As such the floor slab over the hall was suspended from a large steel truss flying over the roof. The center also has a panoramic view hall overlooking the lagoon and a private yacht club.

Plate 4.2: Side view of civic center, Lagos

Source: Researcher (2014)

Other consultants on the project included Civil and Structural Engineers: Ove Arup Partners Nigeria,Mechanical and Electrical Engineers: Miu-Beta Engineers and also Quantity Surveyor: Austin Onaro & Associates.

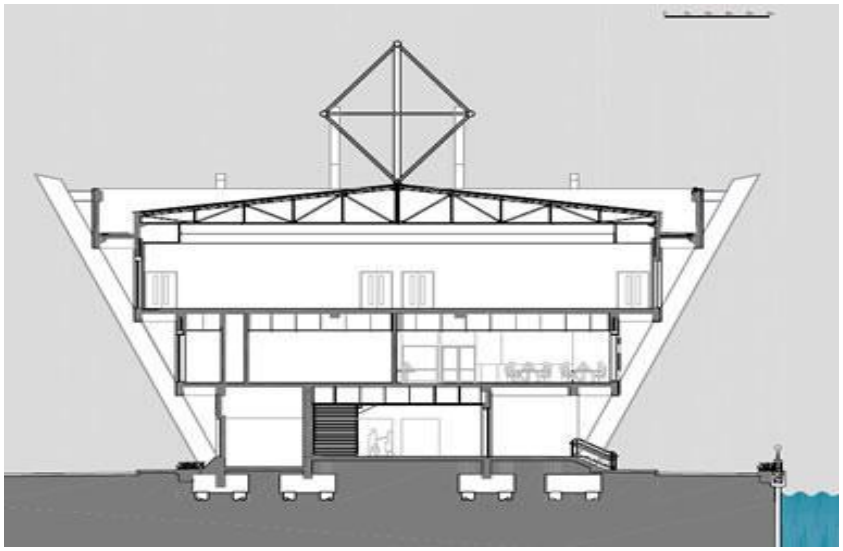

Figure 4.2: Section through Civic Center
Source: James Cubitt Architects (2014)

Major Facilities

- **Grand Banquet Hall**

  The grand banquet hall was designed for large corporate functions such as conferences or for grand social functions such as banquets and cocktail receptions. The hall can accommodate 1,000 Conference or Cocktail guests or 600 guests seated at banquet tables.

- **Panoramic view Hall**

  The panoramic hall serves for administrative and social activities. It can seat 200 guests for a conference and 150 for banquets. The spectacular view from this glass walled panoramic hall is that of the yacht club below and of the Lagos lagoon

- **Meeting Rooms**

  The meeting rooms serves as a great venue to deliver highly focused Presentations, Trainings, Seminars or Meetings. The meeting rooms are ideal for mid-size audiences of up to 500 people.

Other facilities include

I. Three conference rooms

II. Shopping facilities

III. Exclusive Yacht club

TABLE 4.1 DESCRIPTIONS OF ARCHITECTURAL VARIABLES AT LAGOS CIVIC CENTER

Architectural Variables	**Description**
Dominant building material	Reinforced concrete, glass and aluminium cladding

Main structural system	Reinforced concrete columns that support cantilevered floors and large floor slab over banquet hall suspended from steel truss over the roof
Architectural expression	the form of an inverted ziggurat with successive upper floors projecting beyond the floor below and building features a tubular steel trilayer arch as structural support for double massive fins at two sides of the building with other smaller fins built on all sides
Spatial organisation	has rectilinear planning
Environmental feature	Surrounded by other public building such as the civic towers but overlooks the Lagos lagoon
Sitting and orientation	

Source: Authors fieldwork (2014)

TABLE 4.2 ASSESMENT OF THE PRINCIPLES OF BIOMORPHIC DESIGN AT THE CIVIC CENTER LAGOS.

PRINCIPLES	**REQUIREMENT**	**DESCRIPTION**	**CONCLUSION**
GROWTH	• Use of nature as source of inspiration for form • Use of natures evolution as design concept	The building plan is rectangular with no apparent nature inspired form.	Negative
FLUIDITY	• Proper zoning of functional spaces • Proper site planning and zoning	Functional spaces are properly zoned and adequately juxtapositioned.	Positive

ENVIRONMENTAL ECONOMICS	• Use of sustainable building materials • Use of renewable energy • Use of day lighting	Heavy dependence on artificial energy source.	Negative
GEOMORPHIC CONSIDERATIONS	• Preservation of natural landscape • Minimal interference with natural topography • Minimal construction waste	Minimal interference with natural topography and landscape.	Positive

Source: Authors fieldwork (2014)

4.3 CASE STUDY TWO: YARADUA CENTER ABUJA, NIGERIA.

Client: Shehu Musa Yar Adua Foundation.

Location: Maitama- Abuja.

Architect: Julius Berger Nigeria Plc.

Contractor: Julius Berger Nigeria Plc.

Construction date: 2000 – 2002.

Civic Function: Social and Educational.

Context: Urban.

Style: Modernism.

Climate: Tropical

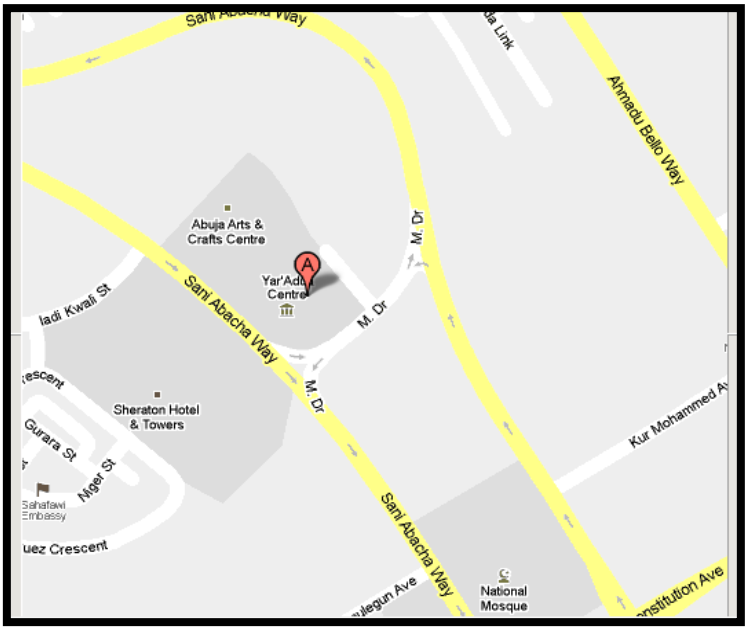

Figure 4.3: Location of Yar'Adua center, Abuja

Source: Google map (2014)

Background information

Shehu Musa Yar'Adua Center, popularly known as Yar'Adua Center, is a center dedicated to furthering the ideals for which Shehu Yar'Adua lived and died; his commitment to national unity, good governance and to building a just and democratic society for all Nigerians. The center is a single storey structure constructed of concrete, sandcrete block wall with clear storey aluminium windows. The entrance has a projected concrete canopy held up by six concrete columns. The center is a brain child of late Shehu Musa Yar'Adua Foundation. The foundation which was established by the friends, family and associates of Shehu Yar'adua to continue the ending legacy of one of Nigeria's most worthy leaders. The center was formally commissioned by General Olusegun Obasanjo in 2002.

Plate 4.3: Front view of Yaradua center

Source: Researcher (2014)

Plate 4.4: View of Yaradua center

Source: Researcher (2014)

Major Facilties

- **Exhibition Halls**

  The exhibition halls at the Shehu Musa Yar'Adua center are designed to accommodate up to 800 guests. It also showcases an inspirational multimedia presentation of the life of Shehu Musa Yar'Adua titled " A Life of Service" against the backdrop of Nigerian history, from colonialism to present day democracy.

Plate 4.5: View of exhibition hall

Source: Researcher (2014)

- **Atiku Abubakar Auditorium**.

  The Atiku Abubakar Auditorium is capable of seating 450 people comfortably in a conference arrangement and seating 250 people in the banquet style arrangement.

Plate 4.6: View of auditorium

Source: Researcher (2014)

- **Olusegun Obasanjo Research Library.**

  The collection of books, journals and periodicals and the expansive reading room serve as a resource for students and scholars engaged in research in the areas of economic development, education, gender equality, democracy, governance, conflict resolution, human rights, Nigerian, African and world history as well international and Nigerian law.

Plate 4.7: View of library

Source: Researcher (2014)

- **Garden Pavilion.**

  Footpaths around the building take visitors through carefully landscaped lawns and gardens, providing an attractive setting ideal for hosting outdoor activities.

Other facilities include

I. Catering and Banquet Services

II. Praying Area.

III. Meeting rooms

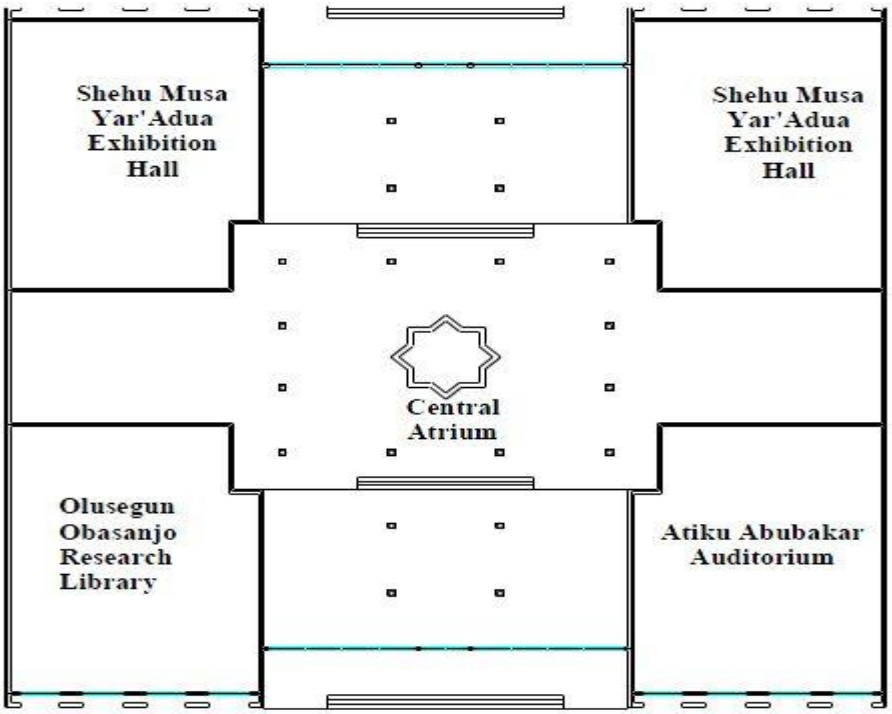

Figure 4.4: Floor plan of Yaradua center

Source: Aderibigbe (2007)

TABLE 4.3 DESCRIPTIONS OF ARCHITECTURAL VARIABLES IN YARADUA CENTER

Architectural Variables	**Description**
Dominant building material	Reinforced concrete, glass aluminium cladding, sandcrete double wall
Main structural system	Reinforced concrete double walls and a domical fibre glass which is used for lighting.
Architectural expression	Representation of the life and works of Shehu Musa Yaradua as a reminder of equality and social fairness.
Spatial organisation	The rectangular building was planned around a central core- The Atrium.

Environmental feature	Lots of trees that forms part of the building and landscape and presence of water fountain at the core of the building.
Sitting and orientation	The location of the center is in such that it can be access from two major roads; Sani Abacha Way and M.dr

Source: Authors fieldwork (2014)

` TABLE 4.4 ASSESMENT OF THE PRINCIPLES OF BIOMORPHIC DESIGN AT THE YARADUA CENTER ABUJA.

PRINCIPLES	REQUIREMENT	DESCRIPTION	CONCLUSION
GROWTH	• Use of nature as source of inspiration for form • Use of natures evolution as design concept	The building plan is rectangular with no apparent nature inspired form.	Negative
FLUIDITY	• Proper zoning of functional spaces • Proper site planning and zoning	Functional spaces are properly zoned and adequately juxtapositioned.	Positive
ENVIRONMENTAL ECONOMICS	• Use of sustainable building materials • Use of renewable energy • Use of day lighting	Use of atrium to provide day lighting to reduce dependence on artificial energy.	Positive
GEOMORPHIC CONSIDERATIONS	• Preservation of natural landscape • Minimal interference with natural topography • Minimal construction waste	Natural landscape is well preserved with trees and lawns.	Positive

Source: Authors fieldwork (2014)

4.4 CASE STUDY THREE: CEDDI PLAZA, ABUJA NIGERIA.

Client:	Federal Government of Nigeria.
Location:	Abuja, Nigeria
Architect:	Oleon Consulting
Construction date:	2001-2005
Civic Function:	Entertainment, Social and Recreational.
Context:	Urban .
Style:	Expressionist.
Climate:	Tropical.

Figure 4.5: Location of Ceddi Plaza, Abuja

Source: Google map (2014)

Background information

Ceddi Plaza is owned by Ceddi Corporation and is located in the Central Business Area of Abuja. The Plaza consists of 10,000 square meters of retail and office space. The tenant mix is made up of three floors of retail (eateries, fashion boutiques, entertainment and services) and three floors of corporate office space. Nigerian owned and designed, the mixed use facility is managed by Broll Property Services Nigeria. Opened officially in November 2005, the Plaza is celebrated as the premiere Center for Shopping & Entertainment in the City of Abuja. Ceddi Plaza is made up of 55 specialty shops, offices & service providers consisting of movie theaters, a bookstore, champagne lounge, restaurants, cafes, fashion boutiques, shoes, accessories, home interior design stores, furnishings, health & beauty salons, gift shops, telephones, banking and ATMs, dry cleaning services, a dental office, pharmacy, photo studio, children's entertainment, events hall and so on.

Plate 4.8: Front view of Ceddi Plaza, Abuja

Source: Researcher (2014)

Displaying grandeur and first-class architectural craftsmanship, Ceddi Plaza sits magnificently within Abuja Central Business Area, well secure and easily accessible. The main entrance foyer opens up to a gigantic circular atrium, transversing the entire six floors with two panoramic lifts framing the grand staircase. This atrium is connected to the other atrium on the three shopping levels through the mall.

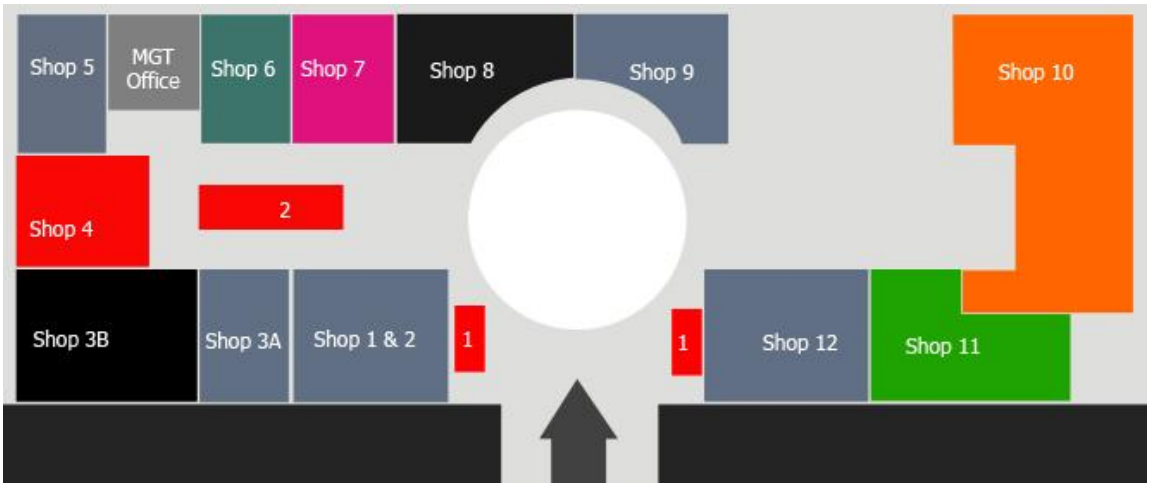

Fig 4.6: Ground floor plan of Ceddi plaza, Abuja

Source: ceddiplaza (2014)

With an underground car park, a basement and 10,000 square metres of retail and corporate space, the plaza has a tenant mix that is made up of three floors of retail businesses (eateries, entertainment, fashion boutiques and services) and three floors of corporate office space.

TABLE 4.5 DESCRIPTIONS OF ARCHITECTURAL VARIABLES AT CEDDI PLAZA ABUJA

Architectural Variables	Description
Dorminant building material	Reinforced concrete, glass aluminium cladding,
Main structural system	Reinforced concrete walls and columns that supports atrium..
Architectural expression	Expression of modern architecture and symbolism of advancement in shopping and entertainment in Abuja.
Spacial organisation	The rectangular building was planned around a central core- The Atrium.
Environmental feature	Lots of trees that forms part of the building and landscape
Sitting and orientation	The location is in the central business district of Abuja as such it can be accessed from all parts of the city.

Source: Authors fieldwork (2014)

Plate 4.9: Front view of Ceddi Plaza, Abuja

Source: Researcher (2014)

TABLE 4.6 ASSESMENT OF THE PRINCIPLES OF BIOMORPHIC DESIGN AT CEDDI PLAZA ABUJA.

PRINCIPLES	REQUIREMENT	DESCRIPTION	CONCLUSION
GROWTH	• Use of nature as source of inspiration for form • Use of natures evolution as design concept	The building plan is rectangular with no apparent nature inspired form.	Negative
FLUIDITY	• Proper zoning of functional spaces • Proper site planning and zoning	Functional spaces are properly zoned and adequately juxtapositioned	Positive
ENVIRONMENTAL ECONOMICS	• Use of sustainable building materials • Use of renewable energy • Use of day lighting	Heavy dependence on artificial energy source.	Negative
GEOMORPHIC CONSIDERATIONS	• Preservation of natural landscape • Minimal interference with natural topography • Minimal construction waste	The construction technique applied required excavations such that parking floor level was below ground level	Negative

Source: Authors fieldwork (2014)

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4.5 CASE STUDY FOUR: SCARBOROUGH CIVIC CENTER TORONTO, CANADA

Client:	City of Toronto.
Location:	Scarborough city, Toronto.
Architect:	Raymond Moriyama.
Construction date:	1973–1997.
Civic Function:	Administrative, Social and Recreational.
Context:	Suburban.
Style:	Modern.
Climate:	Mild.

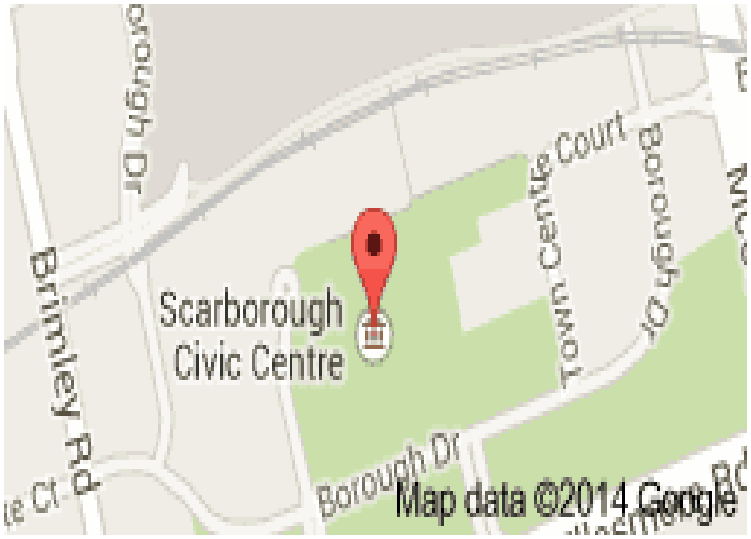

Figure 4.7: Location of Scarborough civic center, Toronto

Source: Google map (2014)

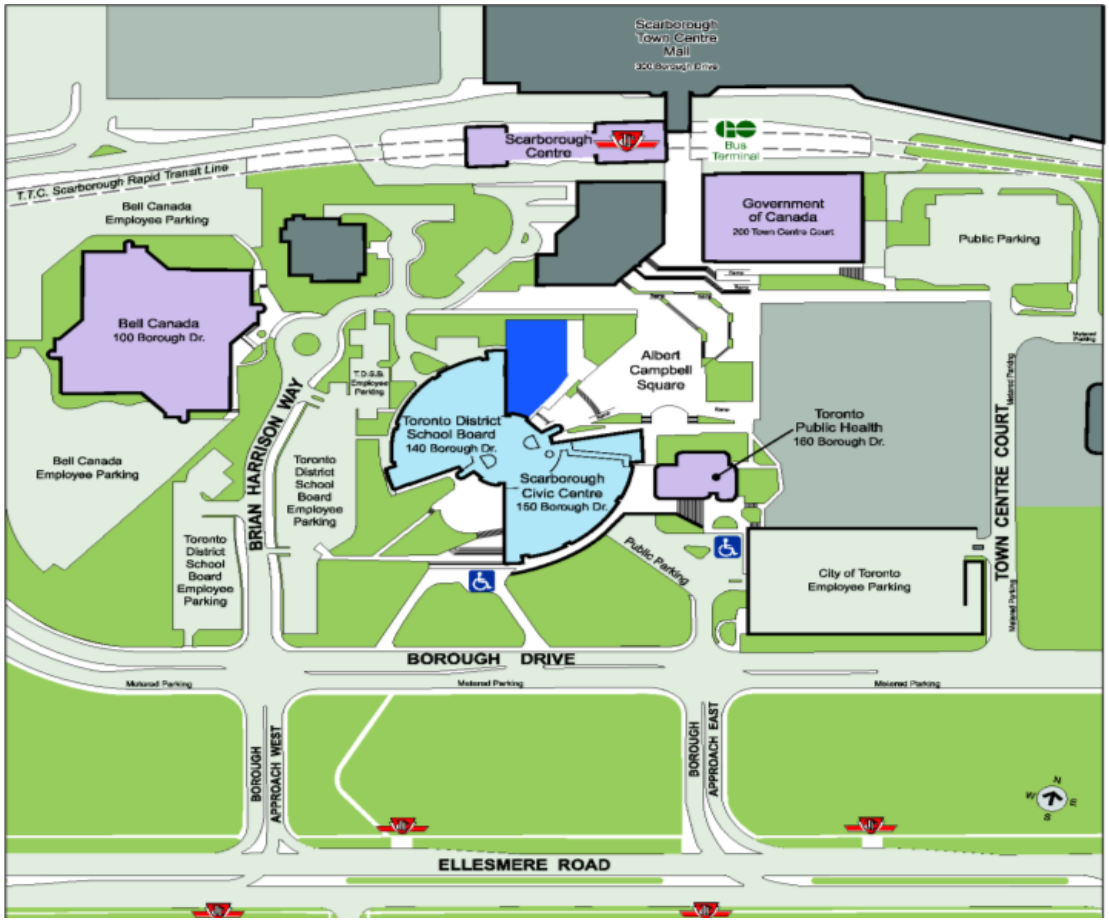

Figure 4.8: Location site, Scarborough Civic Center Toronto.
Source: wikkimedia (2014)

Background information.

Scarborough civic is located at the center of Scarborough city, on the outskirts of Toronto. Scarborough civic became an opportunity to explore the meaning of democracy at the municipal level and to celebrate its virtues with architectural form. Combining different civic functions into one building was economical for both capital and life-cycle costs, but it was also symbolic. The building is organized around an open central public gathering space, placing the City's citizens at its center. Above, open offices overlook the central space. Below and fully visible to the public is the Meeting Hall where elected politicians balance their roles as leaders and servants. Since its inception, the Scarborough Civic Center remains a lively meeting place for politicians, municipal staff, tourists, musicians, members of wedding parties, and local visitors, all partaking in the life of the City. Sculptures are found on the southwest side of the building. The Hand of God, dedicated to Albert Campbell, depicts a man held up by a hand and is mounted on a mast. Architect Raymond Moriyama designed the structure as a "people place," keeping many of the trees surrounding the building in order to create a park-like atmosphere.

Plate 4.10: Front view of Scarborough civic center, Toronto

Source: Torontoca, 2014

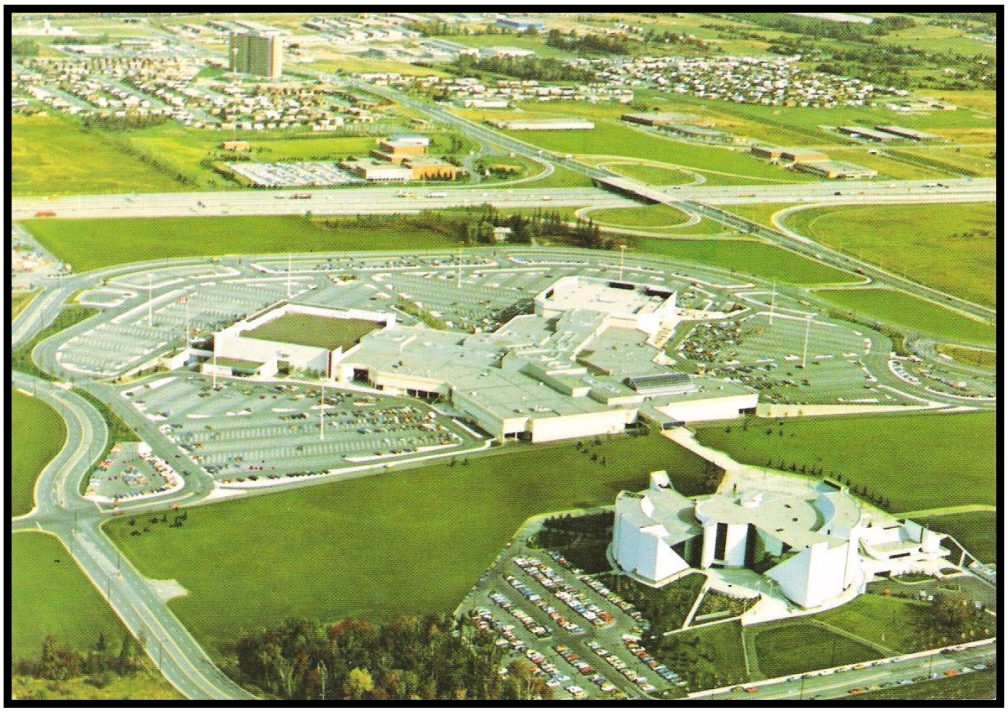

Plate 4.11: Aerial view of Scarborough civic center, Toronto

Source: Torontoca (2014)

Major facilities

- The Shopping Center: shopping mall with over 230 stores.
- The Scarborough Civic Center: contains City's Municipal, Education and Health Office. Canada Center: Government of Canada office.
- Albert Campbell Square: public plaza and public gathering area
- Galleria: a blue frame structure that creates a unique landmark in the city center.
- YMCA: mainly a recreational and fitness facility but also contains a daycare center.
- Public Transit: Scarborough Rapid Transit (currently at capacity in peak hours), TTC, GO, and intercity buses.
- Other facilities: Consilium, Trizec, and Bell Canada

TABLE 4.7 DESCRIPTIONS OF ARCHITECTURAL VARIABLES AT SCARBORUOGH CIVIC CENTER, TORONTO

Source: Authors fieldwork (2014)

Architectural Variables	**Description**
Dominant building material	Metal clad and glass.
Main structural system	Reinforced concrete wall and steel clad.
Architectural expression	The building is unique for the juxtaposition of two triangular shaped- symbolizes its dual functions (civic center and educational board). Multiple split level towers, which surround and open central area in the interior.
Spatial organisation	The half circular building was planned around a central core.

Environmental feature	Waterfall, reflecting pool, Water fountain, trees and lawns.
Sitting and orientation	The center is strategically located at the center of the city to allow easy access from major roads: rain Harrison way and Borough drive.

TABLE 4.8 ASSESMENT OF THE PRINCIPLES OF BIOMORPHIC DESIGN SCARBOROUGH CIVIC CENTER, TORONTO.

PRINCIPLES	REQUIREMENT	DESCRIPTION	CONCLUSION
GROWTH	• Use of nature as source of inspiration for form • Use of natures evolution as design concept	The building form is composition of half circular plan, triangular and box form with no apparent nature inspired form.	Negative
FLUIDITY	• Proper zoning of functional spaces • Proper site planning and zoning	Building plans are adequately zoned and postioned with large spaces to give it a 'park feel.	Positive
ENVIRONMENTAL ECONOMICS	• Use of sustainable building materials • Use of renewable energy • Use of day lighting	Heavy dependence on artificial energy source.	Negative
GEOMORPHIC CONSIDERATIONS	• Preservation of natural landscape • Minimal interference with natural topography • Minimal construction waste	Natural landscape and trees were preserved to give it a 'park feel'	Negative

Source: Authors fieldwork (2014)

CHAPTER FIVE

DISCUSSION OF FINDINGS

5.0 FINDINGS

From the case studies, it is quite obvious that civic centre sheltered all the manifestations of public life. Hence, activities in civic centre can be categorized into: Religious, Political, Social, Judicial, Commercial, Industrial, Theatrical and combination of one or more categories. The scope of this research centers on the provision of social, entertainment, educational and commercial facilities

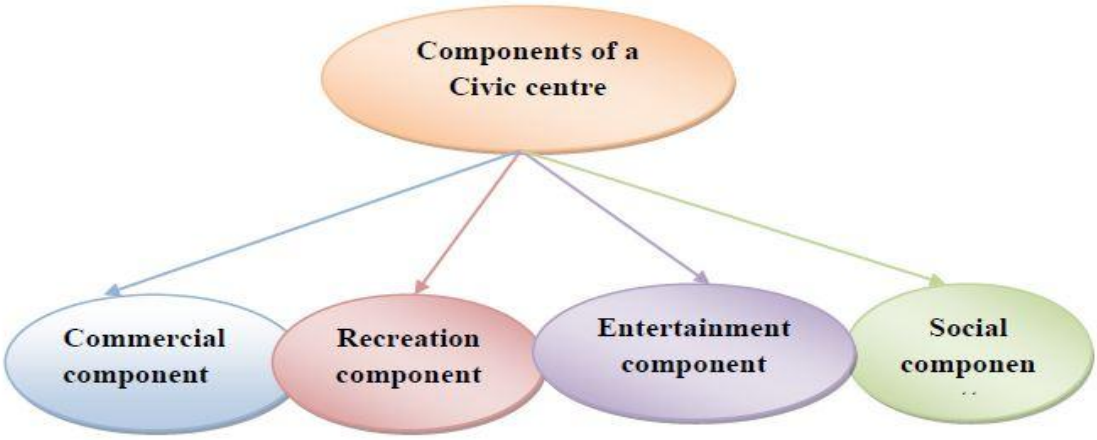

Figure 5.1: Components of civic center

Source: Researcher (2014)

Social Component

This component allows people to participate in communal and recreational activities: to see, been seen, to meet and passively enjoy the atmosphere of the civic centre with the centre landscape, and varieties of place. Social component of the civic centre basically makes it a communal meeting place. This component was found to be present in all the case studies.

Plate 5.1: Socialization in a civic center

Source: www.phototour.minneapolis.mn

Entertainment Component

The type of entertainment offered in a civic centre usually depends on the focus of the center and may include cinema, club, theater, etc, this component is what is best remembered by most users.

Plate 5.2: Entertainment in Civic centre.

Source: www.phototour.minneapolis.mn.

Retail Component

This is the most silent component of the civic centre as observed in the case studies and it includes the departmental stores, stores, kiosk etc. Some civic centre focus on a specific format to suit their area of specialization

Recreational Component

This is another dominant component of civic centre. It might include passive recreation like leisure parks and themed park or active recreation like the indoor and outdoor sports area and swimming pool. Summary

5.1 GENERAL INFERENCE

The civic centre studied are form inspired in the design process to encourage user patronage and attract interest with little considerations to thermal zoning and other climatic and energy demands.

90% of the civic centers studied organized the functional spaces around a central core to serve as the major reference point or the central area of all activities within the building.

Buildings designed using ecological architectural guidelines are usually in harmony with their surrounding either through form, planning, and climatic considerations.

This is an important factor to be considered when designing the Civic centre as this will ultimately enhance accessibility of the different functional spaces

Locally produced & readily available materials found great use in all the buildings studied but the use of concrete seem to be irreplaceable even when eco-principles are applied. This element is prominently used in buildings with complicated frame structures.

All the buildings considered did not use renewable energy sources to its fullest potential but attempted to reduce excess energy consumption through passive means.

50% of the civic centers studied exhibited the application of eco-architecture in the building materials, while all of them exhibited these principles through the use of passive ventilation, and day lightning and relied little on application of green material due to their less durable nature and the desire to achieve long lasting structures.

85% of the civic centers studied had little or no landscape features for modification of micro climate to induce comfort and improve the facilities living qualities.

These findings reveal the fact that most Civic centers employs little or no obvious energy efficient measures into the design of it structures. This is mainly due to lack of provision of alternative renewable sources of energy and use of sustainable design measures; they however try to reduce energy consumption through spatial zoning, insulation, and use of materials in the long run. Based on the case studied, application of biomorphic principles would be achieved through certain considerations to respond to the internal and external energy or environmental challenges of certain civic centers in Nigeria. These considerations include:

Eco building considerations: need for mechanically induced comfort. Respect for the user involves creating spaces that provides as much thermal and visual comfort through passive means (day lightning, passive ventilation and cooling,) or renewable energy sources (solar panels/photovoltaic panels) which have not been fully explored in the studied cases.

There is a need for facilities/amenities provided to suite the site location, and well oriented to subsequently cater for the recreational/entertainment activities to be carried out.

Natural forms: Architects learn to use natural forms from observing living structures ; trees, bones, wing webs, microscopic creatures etc. they are the forms of life and growth and have been key inspirations to organic architecture. Adapting natures form and function would provide sustainable solutions to environmental and energy needs**.**

Alternative energy: It however noted in the studies cases that an alternate source of energy was not widely explored in the design of Civic centers. But, when considering the principle of green architecture against the provided alternative energy, the facilities failed to become

environmentally friendly even if the use of the towns power grid was avoided. This should be considered however in further reduce energy consumption in the proposed facility.

Designing with climate: The use of the prevailing climatic conditions to the advantage in designing has shown to reduce excess energy consumption required in cooling, heating, ventilation, and lightning. This is displayed in the zoning (thermal zoning) and spatial relationship between the Civic facilities. This feature made passive ventilation and cooling possible in the studied civic design.

Designing with site: Depending on the ecological affordances on the site, the designs should optimize the use of vegetation and other physical features especially in civic centers so as to maintain the original site ecology as much as possible. The will reduce environmental degradation and CO2 emission thereby making the facilities environmental-friendly (a product of eco-architecture). The amount of energy consumed in construction during landfills and excavation from the site is greatly reduced by designing, planning, zoning, and landscaping in harmony to the site.

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