FLEXIBILITY AND ADAPTABILITY IN THE DESIGN OF AN INTERNATIONAL EXPO CENTRE, ABUJA-NIGERIA

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BY

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DECLARATION

I declare that this thesis entitled 'FLEXIBILITY AND ADAPTABILITY IN THE DESIGN OF AN INTERNATIONAL EXPO CENTRE, ABUJA' has been performed by me in the Department of Architecture under the supervision of Dr.(Arc) S.N. Oluigboand Dr(Arc)M.LSagada. The information derived from other literature has been duly acknowledged in the text and a list of references provided. No partof this thesis was previously presented for another degree or diploma at any university.

.....Name of student

Signature Date

CERTIFICATION

This thesis entitled "FLEXIBILITY AND ADAPTABILITY IN THE DESIGN OF AN INTERNATIONAL EXPO CENTRE, ABUJA " by Victoria Brighten- Saagwe meets the regulations governing the award of the degree of Master of Science ofAhmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research is dedicatedto God Almighty, My husband Chief (Barr) Brighten F Saagwe JP, and my children, Bariadoora, NekaBari and Muele.

ABSTRACT

Introducing flexibility and adaptability in the design of an Expo centre, Abuja is the quintessence of the work. Expo centre, Abuja is a centre where different activities are organised on daily, weekly, bi-weekly, monthly and annual basis. The centre is multi-functional is use. Hence the study aims at examing the concept of flexibility adaptability in architectural design. Various expo centre in Nigeria and abroad were also evaluated in terms of their spatial and functional requirements which were considered as determinants to designing the existing expo centre; as well as showing their various uses in reflecting flexibility and adaptability in application. Quantitative data such an interview document (secondary data) and participant observations were practically exhibited in the methodology. The findings revealed that certain facts that the centre would be use all year round were not known by operators as some structure remained dormant and not in use forgetting that the structure is multidimensional and functional in uses. The study also came up with the design of International Expo Centre which bear a trademark of international outlook as depicted by the study.

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CHAPTER ONE

INTRODUCTION

1.1 Background of Study

In modern day business world, the importance of International Expo Centre need not be over-emphasized in view of the many uses such a centre can be put to (Aliyu, 1985). In current times an Exposition Centre is an erratic large scale gathering of nations exhibiting in most cases aggressively- their progress in science, technology and culture (Alol, 2000).It is essentially political with little commercial purpose, open to all sections of the economy (manufacturing and service industries) and participants exhibit their wares for the purpose of selling, getting supply orders or creating markets (Alol, 2000).

Word Expositions have long been established as grand events for economic, scientific, technological and cultural exchanges, serving as important platforms for exchanging innovative ideas and showcasing future trends (Chao et al, 1994). The Expo centre is made up of multiple halls and a dedicated cutting edge News and International Broadcasting Center housing radio, television, internet and programme production studios, enabling tens of thousands of journalist from around the word to broadcast live (Hesketh, 1999). The distinction between the way space is perceived and the way that it is defined is a significant determinant of the architectural experience. This distinction allows the limitations of space to be questioned visually since space may be defined differently than it is perceived(Fulmer, 2006). Numerous authors have discussed adaptability (Pulakos, 1999) in relation to different phenomena at the individual, team, and organizational levels, often using many different names and definitions for this concept. For instance, (Hesketh, 1999) referred to adaptive performance, (Murphy, 1999)

discussed role flexibility and (Mone, 1999) wrote about the proficiency with which individuals self-manage their new learning experiences. Furthermore, adaptation has been discussed in relation to many different organizationally relevant variables (such as new people and teams, novel and ill-defined problems, different cultures, new technology, challenging physical conditions), encompassing a wide range of behaviours across a variety of different task demands.Expo center need to be increasingly adaptable, versatile, and tolerant of uncertainty to operate effectively in these changing and varied environments, yet adaptability, flexibility, and versatility are elusive concepts that have not been well defined in the psychological literature (Ford, 1992). The Expo Centeris designed with innovation and reliability in mind, given that this would be an iconic building providing a long term infrastructure solution was an essential component to maintaining its status as an internationally renowned convention centre (Molex,2010). Advanced infrastructure solutions were chosen to support the Expo Centerand its image as one of most significant network infrastructure investments. As the most important building the Expo Centerwill achieved these key performance indicators for standardisation, advanced technologies, practicality, flexibility, compatibility, security, reliability and cost efficiencies(Molex,2010). It is a multi-functional venue that also caters to a wide range of social and corporate events, creates blueprints for future cities and harmonious urban life styles, providing an extraordinary educational and entertainment platform for visitors from across the globe(Mone, 1999). Employing unique types of analyses and generating new innovative ideas in complex areas; new approaches, integrating seemingly unrelated information and developing creative

solutions; entertaining wide-ranging possibilities, thinking outside the given parameters to see if there is a more effective approach(Holyoak, 1991).

The expo aims to achieve the greatest participation in the history of world expo and estimates over 200 nations taking part.

1.2 Statement of Problem

Over the years, Architects were used to designing International Expo Centres with the sole purpose of promoting trade exhibitions without giving a second thought to the fact that it could be used for other purposes. There exist no room for flexibility hence it could not be adapted for other purpose. A lot of policies have been introduced which are often aggressive towards achieving this goal by encouraging and promoting the establishment of manufacturing industries and marketing of the intended products. As a result of the diversification policy of government, it becomes necessary in modern day economy to encourage a clear vision and intent whereby international Expose Centres when constructed can be used for multi-purposely. In order to address these challenges, this study explores the concept of flexibility and adaptive performance in Expo Centerand more precisely define the adaptive performance requirements of exhibitions as well as proffer solution to identifiable gaps between the past and present trends as far as the design and construction of modern international expo centre is concerned.

1.3 Justification of Study

The benefits derivable from this study are enormous. It is germane to state explicitly that this study will be useful to Architects, Students of Architecture, Business men and women especially developers who has interest in developing International expo centres,

Researchers as well as Teachers of Architecture in the various Institutions of learning in Nigeria and abroad. Due to the lack of flexibility and adaptability of the existing International Expo Centres in Nigeria and the attendant low income profile identified as a result of these shortcomings, this study is significance as it attempts to find solutions to these shortcomings thereby contributing in no small measure to the body of knowledge in this field of study.

1.4 Aim and Objectives of Study

The aim of this study is to explore the concepts of Flexibility and Adaptability in order to develop strategies for applying these in the design of Expo Center.

This aim will be achieved through the following objectives:

i. To examine the concepts of flexibility and adaptability in architectural designs;

ii. To study the various expo centres in Nigeria and abroad so as to establish their spatial and functional requirements;

iii. To evaluate existing expo centre designs to see how the use of Flexibility and Adaptability have been employed;

iv. To design an expo centre using the concepts of Flexibility and Adaptability.

1.5 Research Questions

This research intends to answer two basic questions which are:

i. What architectural features enhance the flexibility and adaptability of expo centres?

ii. To what extent has the concept of flexibility and adaptability been applied to expo center design in Nigeria?

1.6 Scope of Study

Theresearch is focused on the aspect of flexibility and adaptive concept that makes it a viable tool for architectural expression of expo center.However, conscious efforts shall be made to understudy local and international expo centres respectively. The shortcomings identified in these centres will be improved upon in the proposed design of Abuja international expose centre which is the central theme in this project. Subject to availability of resources, it is also my desire that efforts shall be made to understudy other expo centres outside Nigeria in order to add international perspective, flavour or dimension to this work. Field studies were conducted at selected locations in Nigeria.

CHAPTER TWO

LITERATURE REVIEW

2.1 History of ExpoCentres

The history of Expocentre is directly connected with the history of exhibition activity; Exhibitions are one of the most effective tool of trade Promotion (Larsson,1999). Leading trade centres of the world provide permanent exhibition facilities to encourage buyer-seller interaction (Sergey, 1998). Expo Centre is equipped with modern facilities based on international standards creating a market and a world of its own.Expocentre makes a wide use of advanced exhibition and marketing techniques, provides an extensive range of professional solutions to organize and hold exhibitions of any scale, and offers most convenient conditions to meet for communications. It is clearly beneficial for exhibitors to attend free seminars on effective exhibiting to maximize the power of exhibitions and achieve the goals set prior to the trade show (Bednov, 2002).

It all started when the All-Union Chamber of Commerce (later renamed the Chamber of Commerce and Industry of the USSR) added a Department of Foreign Exhibitions that was later transformed into a Division of International and Foreign Exhibitions in the USSR, which became the predecessor of Expocentre. In the 1950s foreign business circles were interested in expansion of economic cooperation with the USSR. In 1959, Expocentre held the first American Exhibition in Sokolniki Park as seen in plate 2.1. On the area of 41,000 sqm visitors saw household appliances, equipment for city and public

utilities, vehicles, etc. The exhibition was opened by Nikita Khrushchev and US Vice President Richard Nixon (Shawnee, 1991).



Plate 2.1: Sokolniki Park: **Source:** (Bednov, 2002)

In 1964, Expocentre organized the first large-scale international event – the Stroydormash – that showcased the latest road construction equipment. Its figures impress even now: 377 companies from 20 countries occupied 54,000 sqm. The exhibition was co-organized by the State Committee on Construction, Road and Municipal Machine Engineering under the USSR Gosstroy.In the 1960s, the eventprogramme started taking shape (Joyce, 1990).

Two decades later it covered all main branches of the Soviet economy.Among many projects that were brought to life in the 60s and 70s, the special place belongs to the Khimia International Exhibition. It was launched in 1965 on the initiative of then Minister of the USSR Chemical Industry Leonid Kostandov. In 1975, Khimia became the first Russian event to receive the approval logo of UFI – the Global Association of the Exhibition Industry.The success of Khimia was followed by other significant and large events such as Sviaz (communications), Lesdrevmash (timber industry), Elektro (electric

industry), Neftegaz (oil and gas industries), Inlegmash (light industry), and so on (Phil, 2008).

An ever-growing number of exhibitions required extra floor area, an efficient infrastructure and organization. In the mid-1970s, Nikolai Patolichev, the USSR Minister of Foreign Trade, encouraged the USSR Chamber of Commerce and Industry to ask the Government to erect a new modern venue on the banks of the Moskva River next to KrasnayaPresnya Park.The first pavilion was opened in 1977. In 1978 it welcomed its first show, Derevoobrabotka (woodworking) ,(Shawnnee, 1990) as seen on plate 2.2



Plate 2.2: Derevoobrabotka expo centre: **Source:** (Sergey, 1998)

In the 1980s, the construction of Expocentre Fairgrounds at Krasnopresnenskaya embankment went into high gear. After Pavilion No. 1, appeared Pavilion No. 2 and Forum. Forum is a unique building that looks like a glass pyramid; it has become Expocentre's symbol.



Plate 2.3: Krasnopresnenskaya Expo Centre: **Source:** (Sergey, 1998)

In 2002, a new Pavilion No. 7 brought to life an idea of two-level exposition area with transforming halls. As seen in plate 2.3. It allowed Expocentre to expand its convention services as this pavilion accommodates a conference hall seating 300 persons. It is equipped to hold movie conventions.



Plate 2.4: New pavilion: **Source:** (Bednov, 2002)

Together with the floor area, Expocentre was increasing its annual floor space turnover. In 2008, it reached the record 18 per 1 sqm. As seen on plate 2.4. The higher number belongs only to the Shanghai Exhibition Centre that do not stop working even during quiet summer months.Expocentre's history still continues to flourish. New events – such as Photonics, Navitech-Expo (navigation) and ICA–the International Chemical Assembly – were launched. At the same time our traditional exhibitions are going strong as testified

by the visit of Russian President Dmitry Medvedev to Sviaz-Expocomm' 2009 and his high opinion of the event (Phil, 2008).

2.2 Exhibition Activity

Expocentre is an organizer of the largest international exhibitions in Russia, the CIS and Eastern Europe that has run over 6,000 exhibitions throughout its 50-year history.

Expocentre's exhibitions promote new trademarks, advanced scientific developments and technology to the national market, and provide favourable conditions to establish business contacts, present products and study innovations. Exhibition forums bring together business, trade and scientific leaders from over 100 countries (Joyce, 1990). Expocentre'sprogramme includes the company's own projects and hosted exhibitions held at Expocentre Fairgrounds by other national and foreign exhibition organizers. As seen in Plate 2.5.

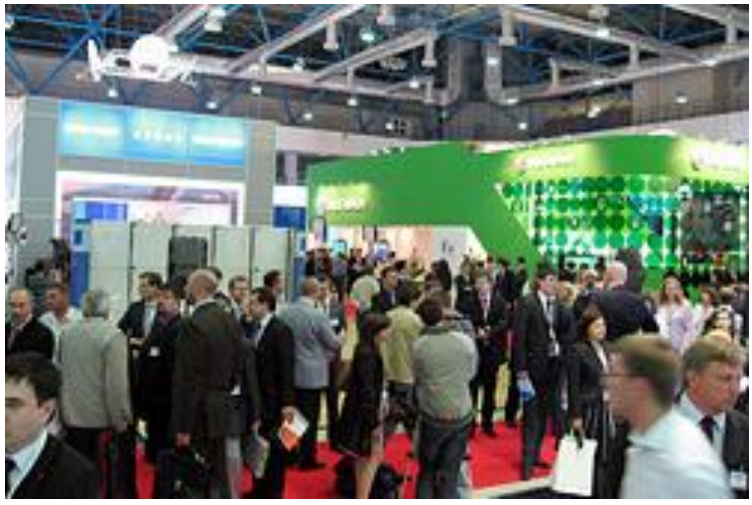

Plate 2.5: National and foreign exhibition: **Source:** (Shawnee, 1991)

Expocentre's 22 exhibitions that carry a logo of UFI, the Global Association of the Exhibition Industry, as a label of approval include Khimia (chemical industry), Consumexpo(consumer goods), Zdravookhraneniye (health care), Prodexpo (foodstuffs and beverages), Mebel (furniture), Lesdrevmash (timber industry), Metalloobrabotka (metalworking), Agroprodmash (agriculture and food processing), Sviaz-Expocomm (telecommunications), Elektro (electric industry), Inlegmash (light industry), Mir Stekla (glass industry), Neftegaz (oil and gas), Mir Detstva (goods for children), Obuv. Mir Kozhi (shoes and leather products), Reklama (advertising), and Sklad.Transport.Logistika (warehousing, transportation, logistics), Photonics. The World of Lasers and Optics, Toy and Game, Interlakokraska (paints and varnishes), CJF(child and junior fashion) and Healthy Life-style. ExpoCentre's 27 exhibitions are approved by RUEF, the Russian Union of Exhibitions and Fairs, as seen in Plate 2.6 and proudly carry the RUEF logo.



Plate 2.6: Russian Union of Exhibitions: **Source:** (Shawnee, 1991)

When arranging a plan of its own exhibitions and conventions, Expocentre specifically focuses on both the country's priority economic development areas, and development

trends of the global economy as a whole. Today one of the company's top priorities is to support innovative development of this country. More than 20% of events held Expocentre Fairgrounds (including events organized by ExpoCentre) are innovation driven. This figure is highest in the country. These exhibitions include High Technologies of the 21st Century, Lesdrevmash, Metalloobrabotka, Navitech, Neftegaz, Sviaz-Expocomm, Photonica. The World of Lasers and Optics, Elektro, Electro techno expo, EXPO and Expopriority. Taking into account the fact that innovative side of Russia's economic development is of great importance nowadays, Expocentre has come to a decision to integrate several events, previously held by Expocentre at different time, into one big event called the Innovative Russia Week. The Innovative Russia Week was successfully held at Expocentre Fairgrounds from 17 to 20 April 2012. As seen in Plate 2.7.



Plate 2.7: Russia Expo center Fairground: **Source:** (Joyce, 2012)

Most of the exhibitions are held under the auspices of the Russian Chamber of Commerce and Industry and the Government of Moscow.Hosted exhibitions run at Expocentre

Fairgrounds are organized by leading national and foreign exhibition companies that include I.T.I. Group Plc. (UK), MesseDuesseldorf GmbH (Germany), BolognaFiere (Italy), Trade Fairs Brno (Czechia), Ost-West-Partner GmbH (Germany), Messe Frankfurt (Germany), Euroexpo, Restec Event Management Technology. The most well-known hosted exhibitions include Mosbuild, Travel and Tourism, Oil and Gas, World Food, CPM. Collection Premier Moscow, Interplastika, Upakovka/UpakItalia, Metallurgy-Litmash, Interlight, Modern Bakery, just to name a few.Annually Expocentre Fairgrounds plays host to national exhibitions. The list of countries that have showcased their achievements over the last years comprises Bulgaria, Hungary, India, Thailand, Sweden, Iran, and Turkmenia.Expocentrearranges participation of Russian companies in such events held abroad as the Paris Furniture Salon, international exhibitions and fairs in Dubai (UAE), Thessaloniki (Greece), Izmir (Turkey), The International Fair of High Technologies in San Paolo (Brazil), the International Specialized Medical Exhibition in Duesseldorf (Germany), and the International Engineering Fair in Brno (Czechia). Expocentre has organized Russian collective expositions at exhibitions held in Hungary, Egypt, India, Republic of Korea, Panama, Poland, Syria, Croatia, Czechia and other countries.For many years Expocentre has been organizer of Russia's expositions at EXPO World Exhibitions (County, 1990).

Expocentre has concluded an Agreement with the Centre of Business Promotion of Moscow to reimburse the part of the exhibitors' expenses from the budget.The Agreement has been worked out as a part of the small and medium-sized businesses supporting programme of the Moscow City Government, which is aimed at promotion of their goods. The special attention is devoted to participation in exhibitions.The Moscow

exhibitors were granted subsidies of 10.3 million rubles for exhibition costs in 2011. It is about 30% of all fund allocations assigned by the Moscow City Government to support exhibition activities. Expocentre makes a wide use of advanced exhibition and marketing techniques, provides an extensive range of professional solutions to organize and hold exhibitions of any scale, and offers most convenient conditions to meet for communications.It is clearly beneficial for exhibitors to attend free seminars on effective exhibiting to maximize the power of exhibitions and achieve the goals set prior to the trade show (County, 1990).

2.3 The Concept of Flexible Space Design

When architects employ the term "flexibility," they often make distinctions betweenphysical properties internal to buildings and abstract social forces impinging uponbuilding design (Ehrenkrantz, 2000). Physicalflexibility in this case refers to the adjustability of a space to the practices of individuals,such as meeting the special sensory and/or mobility needs of users. Movable furnitureand walls, re-configurable building rooms, and passageways all represent this type ofphysical flexibility. On the abstract level however, flexibility refers to the ability of abuilt space to accommodate unforeseeable changes such as demographic shifts,community needs, or policy mandates (Moore, 1994). Flexibility could alsobe the potential for spaces to be used in a variety of ways without altering the buildingfabric. Flexibility is becoming increasingly important. It can also be understood to meanthe ability of a building to adapt to continually changing requirements and conditions ofthe environment. Flexibility is an indicator of adaptability. As clearly exposed by JohnHabraken, in his definition of Open Building, the built environment is the product of anon-going, never ending design process in which

environment transforms part by part("Flexibility in buildings,"2011). The concept of flexibility finds widespread use inarchitecture literature. For instance, Building flexibility and sustainability are closelylinked. An important feature for a sustainable building is its ability to adapt to changing requirements. The implemented measures for flexibility can only be evaluated in the longterm; therefore the dilemma arises in trying to guess the appropriate amount and nature ofthe measures to be implemented.

As long as a building meets the needs of its users, no change is needed, but soon as users'needs change, the need to adapt the building arises, and in this case, the goal is to adaptusing the least amount of effort and resources possible. During the planning phase,different scenarios should be studied to forecast space, construction needs and their consequences (Cowee, 2009).

2.3.1 (a) Flexible Properties of Space

These are the properties of space for which when considered in designs could help in achieving a more flexible building (Gonzalezi, Spain 2011), they are:

i. Fluidity

This represents the design of space for flows of individuals, sight, sound, and air.Open spaces lend themselves to fluidity, yet they can hinder fluidity if they seemoppressive in their expansiveness. For example, well-placed screens in classroomscan increase a sense of intimacy while triggering curiosity for the space that flowsaround the screen (Caudill, 1954). Such a space then becomes more engaging and lessoverwhelming. Well-placed windows can also increase a sense of flow andconnection between spaces.

ii. Versatility

This indicates the property of space that allows for multiple uses. Cafeterias, auditoriums, and "multi-purpose rooms" signal one mode of versatility, but versatilespaces such as these run the risk of homogeneity. Since all spaces afford certainactivities and flows, generic spaces without any overt indicators for specific userequire extra effort. There is need to achieve the tone or rhythm of specific uses of aparticular space. For example, performing a play in a generic auditorium requires theinvestment of added decoration and props in addition to individual suspension ofdisbelief in order for that production to succeed.

iii. Convertibility

This designates the ease of adapting spaces for new uses. Modern office buildings arecommonly preferred as models of this type of convertible space, because they possessa core with HVAC (heating, ventilating, and air-conditioning), electrical, andcommunication systems that is surrounded by a shell containing easily re-deployable space for varied activity programs (Brubaker, 1998). Space designed for convertibilityrequires an imagination for future eventualities; it should possess a degree ofmodularity and open-endedness at a structural level a design open to re-design byothers.

iv. Scalability

This describes the property of space for expansion or contraction. For expansion,buildings may require additions to meet the needs of increased functions whichmaybe in the area of living space, service space, and so on. Tightly coupled spacessuch as rooms and corridors may utilize space efficiently in the short-term but

presentcostly obstacles for later growth. For contraction, as space needs decreases, buildingsshould be able to temporarily convert spaces for other purposes. For example, surplusbuilding space can be leased out from year to year so that when space needs riseagain, the building can re-convert the spaces to serve whatever purpose (Brubaker, 1998).

v. Modifiability

This is the spatial property which invites active manipulation and appropriation.Spaces that lend themselves to quick reconfiguration are comprised of mobilecomponents such as walls, partitions, furniture, and equipment. Highly modifiablespaces invite imaginative experimentation to coordinate space and subject matter withthe specific needs of different individuals. The design of such spaces requires muchforthought, because these spaces must take into account many structuraldependencies such as ceiling configuration for lighting and air circulation, floormaterials for ease of partition movement, and so on (Leggett et al. 1977).

2.3.2 (b) Typology of Flexibility in Architecture

Based on concepts described by the Fraunhof Institute and supported by typologybasedbuilding evaluation, four main building flexibility types were identified;

i. **Extension Flexibility**: This refers to extension and modification of a buildingwhich involves analysing and classifying the positioning and structural propertiesof such extensions

ii. **Internal Flexibility**: This defines the adaptability of a building; in what capacityare modifications within an existing structure possible. What are the risks andtime requirements? How does the extension influence the building?

iii. **Flexibility of Use**: This analyses building flexibility in relation to how it reacts tochange of use.

iv. **Planning Flexibility**: This refers to the characteristics which determine whetherand how a building reacts during the entire planning and construction phase. Italso investigates which measures can be implemented during the planning phasein order to facilitate flexibility during a building's operation time, with the leastpossible cost and effort (Cowee, 2009).

2.3.3 (c) Flexibility design concepts as used in Residential Buildings

For a residential building, the process of designing for flexibility must be examined fromboth the architect's point of view and the user's point of view. In any housing design thearchitect and at times the user deals with five scales of flexibility: room, dwelling unit, building as a whole, clustering the buildings in the site, and community. The dwellingunit and building possess the most need for flexibility. The varying degrees of flexibilityof space to be considered are;

i. An absolute flexible space without restriction

ii. A space with limited degree of flexibility

iii. A space with too many limitations.

Neither one alone can leads to a successful solution. Overemphasis on a single designfactor invariably results in a less successful solution, than one based upon a number ofinterdependent factors. The scales of flexibility which will be analysed are the

dwellingunit and the building as a whole. The factors of design studied at both scales are thehousing forms, building structure, circulation, and technical service positions which arethe factors that most affect the building's flexibility **(**Moharram**,**1980). Similarly, the unittype, size, proportion, technical service positions and building structure are the factorsthat most affect the dwelling unit flexibility. A variety of plan solutions result from thedifferent combinations of design variables of each factor mentioned above. From theexamination of the most important characteristics of the plan solutions, criteria forflexible housing design are established as;

i. Grouping the services of building or a dwelling unit to free the remaining space

ii. Locating the external and internal services of a building in proximity to one another

iii. Choosing the proportion of dwelling unit and allowing for adequate flexible space

iv. Considering the structural limitations in such a design.

The method of evaluation is in itself flexible enough to be used for evaluating theflexibility of other building types. This study tries to present a workable guide of designvariables for use in the design of flexible spaces in buildings **(**Moharram**,** 1980).

2.3.4 (d) Examples of Flexibility design concepts as used in Educational Buildings

According to Torin (2002), educational architecture literature grounds itself in aconviction that the design of built spaces influences the behaviours and actions ofindividuals within those spaces. To a certain extent, these spaces embody the pedagogicalphilosophies of their designers. Built pedagogies operate along a continuum betweendiscipline and autonomy. On the disciplinary side, they can restrict learning possibilitiesby not allowing for certain movements or flows. For example, a desk bolted

to the groundmakes flexible interpretations of spatial use extremely difficult, and they imposedirections for how space should be used. At the autonomy end, open classrooms inviteand almost demand that individuals rearrange the spaces to suit their perceived needs(Torin, 2002). It can be said that like technologies, all spaces are underdetermined in that they send messages to users about appropriate behaviour yet remain open to degrees ofinterpretation. Architects can build flexible educational spaces that accommodate fortechnological changes and future needs in several ways. They (architects) can imaginelikely future learning activities and then design space to actualize such imaginations(Valiant, 1995) or they can collaborate with users through participatory design to askwhat kind of learning spaces are desirable and why, and then design those spaces. Theconcept of flexibility holds educational promise for the design of diversely enablinglearning environments thus; architects and planners are being challenged with the need tocreate flexible spaces in other to enhance learning. Evaluating designs with the flexiblecriteria of fluidity, versatility, convertibility, scalability, and modifiability requiresdesigners to imagine spaces that transcend functionality or comfort. The practice oftranslating flexibility into built form becomes a politically responsible act. Itacknowledges the politics of built pedagogies and then workshape empowering classroom practices (Torin, 2002).Ponti (2005) did an analysis of flexibility in a learning environment and the experimentfound that flexibility in the design of schools present benefits in areas of maximizinguse of space. The experiment started by designing a modular learning space suitable for holding 24/25students with a piece of connective corridor, and with a basic module of 7.2 X 7.2 m(Cisem research (Italy) on Flexible Didactic Module Prototype (DM))

The didactic model was later adjusted to include small, medium and big groupsbelow). To realize this solution, he closed some common doors, collapsed some mobileto create built spaces that-all enhancing the capacity of learning (Loor, 2002).

A number of principles have been explored, including:

i. The use of transformable furniture which encourages thespace by enabling one set of furniture to be folded away, as another is pulled out;example, a fold;

ii. Non-function-specific spaces are designed that can accommodate domestic ornon-domestic use; these functions can change over time;

iii. Sliding doors are used to close off private areas when members of the public visitthe work-home; when the building is in purely domestic use, these are opened,transforming the spaceswork-homes can be used flexibly in a variety of different waysmultifold-up bed goes away as a fold-down desk appearsmulti-functional use of space;

iv. In addition, spaces can be transformed from domestic to non-domestic by shuttingaway elements of a room, such as kitchen units, that make it specific to a particular function.

These work-homes have also been designed to maximize adaptability. They arestructurally rigid over two stories (or 6 m in height) without any requirement for internalbracing from floors or internal partitions. This means that they can be built withoutinternal partitions, or with internal walls and floors that can be removed with ease, asnecessary. None one of the internal elements are structural (Flexibility inBuilding,2011).

2.3.5 Flexibility Design Concepts as used in Hospital Design

Flexibility, as applied to the design of a hospital, means the inbuilt capacity of thathospital to adapt itself to "new, different or changing requirements." Functions change sorapidly that designers should no longer aim for an optimum fit between building andfunction. The real requirement is to design a building that will inhabit change of functionsleast, and not one that will fit specific function best. In the design of Northwick Park Hospital and Clinical Research Centre, London (see plates 2.15 & 2.16 respectively),Llewelyn-Davies Weeks placed a linear hospital which forms the backbone to which ribscan be attached with relative freedom. It is the earliest example ofdeliberate indeterminacy in post-war hospital planning (Miller *et al*, 2002). The hospital and research departments can be constructed and later altered orexpanded, independently of one another. Construction was carried out in phasesa period of nine years and during this time extensions and alterations to the originalbrief were made without disturbing the original design (Varawalla, 2004).

According to de Neufville buildingslarge hospital construction projects are planned from 10 to 20 years inadvance, and hospitals are typically designed to have a lifespan of more than 40 years. During this time, demands on the infrastructure are likely to change significantly.

Changing demands may result from new forms of medical technology, changes inregulations, the organization and funding of healthcare services, demographicchanges, or changing epidemiological patterns. Also, Miller and Swensson (2002), assert that it is common for hospital buildings to have to accommodate several ofthese changes as high

levels of uncertainty, changing technology and treatment methods will create the need, flexibility is an important concern in hospital design.

Walker and Shen (2002) studied flexibility in a hospital construction project andpointed out that the ability to utilize flexibility option is influenced both by the abilityofan organization to be flexible, but also by its commitment to being flexible.

Flexibility in hospital buildings has often been associated with the existence orabsence of interstitial spaces as intermediate service floors between primary floors. Inreality, flexibility is a more general concept. According to Pati and colleagues (2008), the three aspects of flexibility are:

i. Adaptability
ii. Convertibility
iii. Expandability

A similar classification is used by Agre and Landstad (2002) and Chow *et al* (2010),stating that adaptability can be defined as the ability of a building to meet shiftingdemands without physical changes. Convertibility can be defined as the possibility forconstruction and technical changes with minimum cost and disturbance. Finally, expandability can be defined as the ability to increase (or reduce) the size of a building.

The concept of flexibility in hospital buildings has recently been developed further, and now includes a variety of principles and solutions. According to Wright *et al*(2009), flexibility should encompass a wide range of hospital dimensions, includingbuilding characteristics, supporting infrastructure such as transport links, andrelationships to other parts of the healthcare system, and it should also occur inrelation to financing. De

Neufville and colleagues (2008) point out that flexibledesign in hospital buildings can be a matter of structural foundations that allowadditional floors to be added on top of existing buildings, or areas that are built butnot fitted out with medical equipment, or functional rooms that may be refitted formedictal purposes other than their original use. Other principles that have been used inflexible design are standard room categories, single-bed clusters, standardization ofequipment, and flexibility in terms of organization, management, and the use offacilities.

2.4 Evaluating the Adaptability of Buildings

Adaptability refers to the capacity of buildings to accommodate substantial change. Over the course of a building's lifetime, change is inevitable, both in the social, economic and physical surroundings, and in the needs and expectations of occupants. All other things being equal, a building that is more adaptable will be utilized more efficiently, and stay in service longer, because it can respond to changes at a lower cost. A longer and more efficient service life for the building may, in turn, translate into improved environmental performance over the lifecycle (Russell, 2001).

The concept of adaptability can be broken down into a number of simple strategies that are familiar to most designers:

(i) **Flexibility**, or enabling minor shifts in space planning;

(ii) **Convertibility**, or allowing for changes in use within the building; and

(iii) **Expandability**, (alternatively shrink ability) or facilitating additions to the quantity of space in a building.

In practice these strategies can be achieved through changes in design, and through theuse of alternative materials and technologies.

Adaptability is closely related to – but different from – two other design strategies thatattempt to enhance long-term environmental performance:

(iv) **Durability:** selecting materials, assemblies and systems that require lessmaintenance, repair and replacement. Since durability extends the usefullifetime of materials and technology in a building, it is complimentary toadaptability.

(v) **Design for Disassembly**: making it easier to take products and assembliesapart so that their constituent elements can more easily be reused or recycled.Designing for disassembly can reduce the costs and environmental impactassociated with adapting buildings to new uses. It is also possible to reduceoverall environmental costs by purposely designing a building for a shorter life, and for easier disassembly and reuse of components and materials – as is the casewith many temporary exhibition halls.

As the world faces resource scarcities and ecological crises, a concern for the adaptabilityof buildings is especially relevant. The existing building stock represents the largestfinancial, physical and cultural asset in the industrialized world. A sustainable society isnot possible until this key resource can be managed sustainably.

Urban areas everywhere are experiencing problems related to poor use of buildings, andhigh flows of energy and materials through the building stock. Demolition rates are rising, and due to the artificially low costs of landfill disposal and incineration, much ofthe solid waste is not being recycled (Moffatt, 2001).

Kohler2 summarizes a number of trends found in the German building stock, which alsospeak to the increased relevance of adaptable stocks:

(i) New construction levels steadily decreasing;

(ii) Refurbishment activities surpassing new construction;

(iii) Large numbers of old buildings (warehouses, industry) sitting empty;

(iv) Growing numbers of new, highly-equipped office buildings, for lease (resulting from over production and corporate downsizing and outsourcing);

(v) Flows of basic materials into the stock –for new construction and renovation – exceeding the solid waste flows by 4 to 10 times, (which indicates that thebuilding sector is still a major consumer of natural resources).While these specific trends may not yet apply to all other countries, the conclusion is clearand universal: increasingly buildings need to be designed for long-term adaptability.

If adaptability is to be a useful design concept, it must be possible to properly distinguishthose features of new buildings that will significantly increase their capacity for change.

Part of the problem is that few buildings exist today that have been intentionallydesigned for adaptability, and put to the test of time. Traditionally many designers andowners have preferred to work from the assumption that their buildings will neverexperience significant change. But even when the inevitability of change is fullyappreciated, the marketplace offers little incentive for developers and owners to investing long-term adaptability. The initial developer who invests in a more adaptablebuilding structure is unlikely to ever realize the economic benefits. For these reasonsthere are few older buildings purposefully designed for adaptability, and thus little evidence that adaptability is an effective design principle for improving environmental performance (Moffatt,

2001).

A more fundamental obstacle is the difficulty in accurately predicting futurerequirements for buildings. While it is definitely possible to identify features of existingbuildings that have enhanced their capacity to adapt, it is in no way certain that suchfeatures will function similarly in the future. The type of changes that will occur in the21st century may be wholly unlike what has occurred in the past. The computerrevolution has only just begun, the nature of work is changing, and even the climate ischanging. We are almost certain to experience major environmental disasters and largemovements of peoples. Even the pace of change may be significantly greater in the nextfew decades. In truth, the future is largely unknowable when forecasting over the 50+year life of buildings (Russell, 2001).

2.5 Benefit of Adaptability to Environmental Performance

Unless a building is capable of responding to changing circumstances it is vulnerable tobecoming poorly utilized, prematurely obsolete and unable to accommodate new, moreefficient technologies. The combined impact of such failures may be to increase resourceuse within the building sector by 20 to 30%. Depending upon the additional investment required to achieve adaptable designs and materials, it should be possible to significantlyimprove the environmental performance of the world's buildings in at least three ways, as outlined below (Larsson, 1999).

i. **More efficient use of space** - Adaptable buildings are likely to use the sameamount of space and materials more efficiently, on average, over their entire life. Forexample, increased flexibility of spaces might mean that it is easy for occupants to usefloor

area more effectively as their needs change, or as their business (or family) expands.

Convertibility may allow basements, attics, hallways, storage areas, roofs and entrancesto be used for other purposes, as new needs arise. Expandability may allow the buildingto accommodate much higher densities with the same footprint and infrastructure. Ifsuch adaptations create even small improvements in space utilization over the lifecycleof buildings, the impact on resource use can still be significant. For example, if theaverage lifetime space utilization is 10% improved, and all buildings are similarlydesigned for adaptability, then the world needs 10% fewer buildings.

ii. Increased Longevity - Adaptability is also a strategy for extending the totallifetime of buildings. Most buildings are destroyed due to technological obsolesce, notstructural deterioration. Adaptability can therefore extend lifetimes without imposing any of the significant environmental impacts associated with all the one-time investments in the building structure and infrastructure. Consider, for example, theembodied energy in reinforced concrete – probably the single greatest pollutant sourcein a typical commercial building. Or consider the other long lasting elements of abuilding like wood, metal, glass and landscaping materials. Or consider the energy usedin construction, demolition, and haulage and disposal of earth, materials and waste. Ifadaptable designs can extend the average lifetime of buildings by 10%, (and possibly much more), then we can similarly reduce the total world investment in replacing theselong-lasting elements of the building stock. The most environmentally benign building isthe one that does not have to be built.

iii. **Improved Operating Performance** - Adaptability can also mean easier changeover'sas new technology becomes available. Thus adaptable buildings benefit fromtechnological innovation sooner and at lower cost. The average efficiency of manytechnologies used in buildings – like lighting and ventilation systems - has more thandoubled over the past 10 years. Many other technologies, like combustion heatingsystems and electrical motors, have improved at least 20%. If a building has featuresthat allow easier adoption of new, efficient technology, it is reasonable to assume anincrease in average lifetime operating efficiency of 10% or more. This in turn wouldreduce the total environmental impact of operating the world's buildings by 10% – avery significant improvement.

A paper by Larsson examines adaptable office buildings, and assumes that the environmental benefits are largely related to two factors: the annualized reduction in embodied and replacement energy, and the annualized reduction in solid waste generation from renovation and demolition. Using data from research studies that document the quantities of embodied energy and demolition energy used by office buildings4 5, Larsson estimates an equivalent reduction in two categories of environmental loadings:

(i) 15% reduction in air emissions, and

(ii) 15% reduction in demolition solid waste.

If a building stock is made up of buildings that are individually more adaptable, it isreasonable to conclude that the entire stock is also more adaptable to change. For example, if a community experiences a sudden growth in population, the expandabilityand convertibility of existing buildings may contribute to relieving housing shortages at lower cost, more rapidly, and with less damage to the community character

and urbanfabric. Given the strong current trend towards mixed building uses and higher densitiesin urban planning, it is likely that the convertibility and expandability of individualbuildings will help older neighbourhoods modernize and adjust to new urban growthpatterns, with less social and economic disruption (Environmental Research Group, 1994).

It may also be possible to purposefully design infrastructure, and select building types, in ways that make the entire stock more adaptable. Some examples include:

i. **Connecting all buildings to a district heating and cooling system:**

   A district-wide system makes it easier for the entire stock to quickly switch fuels, install pollution control equipment, and upgrade to more efficient technology. Changes to a single piece of equipment can instantly adapt the network ofbuildings to changing circumstances.

ii. **Creating an appropriate level of diversity among buildings, in termsof materials, components and designs:**

   It is easier for a stock of buildings toadopt new designs and technologies if a modicum of local expertise and IAacceptance already exists. From this perspective, it may be desirable to include inthe stock at least a small percentage of buildings with alternate energy systems, or innovative envelope designs, even if these are currently not the most costeffective and environmentally appropriate.

iii. **Design buildings with more on-site, distributed infrastructure components:**

   Smaller scale, distributed infrastructure may be less vulnerable toenvironmental changes or social transformations. It may also be more amenableto incremental

growth and thus to introduction of innovative technologies andpolicies. For example, locating primary sewage treatment, and storm watermanagement systems, on the building site or block, can eliminate the need forlarge scale and expensive pipes, pumps and centralized facilities that are muchmore resistant to change. This may be at odds with item 1 above.

The difficulty with enhancing stock adaptability in these ways is the need to coordinatemany players, including many building design teams, land use planners and civilengineers. It is also difficult to convince private developers to voluntarily incur additionalcost for improving performance of the stock, if everyone shares the benefits equally. Forthese reasons the most effective approach to achieving more adaptable stocks may beto create guidelines for use by building design teams. The guidelines can be created tooptimize performance at a neighbourhood scale, or at the scale of an urban developmentproject. Evaluation procedures for rating adaptability of buildings could then includeany criteria established by such "stock" guidelines (Loughlin,2005).

Ideally the concept of adaptable design needs to be closely connected to the developer'sprofitability. It should translate into faster sales, higher occupancy rates, and reducedrefurbishment costs. If developers can be thoroughly convinced of such benefits, they willparticipate enthusiastically and add their creativity to the design concept.

Other types of regional policies may be necessary to maximize the adaptability andusefulness of the existing building stock. Often buildings stand empty, or deteriorate, dueto mismatches in zoning and land rent, or costly regulations for upgrading buildings andparking, prior to adaptive re-use. It is possible that the greatest single

improvementtowards adaptable buildings is removal of the institutional obstacles that preventaffordable transformations of the stock, and that prevent partial, low-intensity, temporary uses for unoccupied buildings (Loughlin, 1997).

The concept of adaptable design may be largely restricted to:

(i) Accommodating changes that are expected to occur in the very near future,

(ii) Applying simple 'common-sense' principles that are known to facilitate a wide range of possible changes.

(iii) Incorporating 'adaptability' features that can be justified for other reasons; or

(iv) Adopting features that enhance adaptability with little or no additional capital and resource investment.

2.6 Key Principles of Adaptability

The first step in evaluating the adaptability of a building is simply to determine whether or not a conscious effort has been made to address Key Principles of adaptability. Key Principles are design strategies that apply to all elements of a building.

Independence: Integrate systems (or layers) within a building in ways that allow parts to be removed or upgraded without affecting the performance of connected systems.

Upgradeability: Choose systems and components that anticipate andcan accommodate potential increased performance requirements.

Lifetime compatibility: Do not encapsulate, or strongly interconnect shortlifetime components with those having longer lifetimes. It also may be advantageous to maximizedurability of materials in locations where longlifetimes are required, like structural elements and thecladding. Durable claddings and foundations cangreatly facilitate adaptability, often tipping the scalein favour of conversion over demolition.

Recordkeeping: Ensure that information on the building componentsand systems is available and explicit for future use. Itwill assist effective decision making with regard to conversion options and prevent costly probingexercises.

2.6.1 Independence and the Open Building Concept

By far the most important Key Principle for enhancing adaptability appears to be theindependence of building elements. The more each feature is uncoupled from theothers, the more adaptable a building becomes. It is especially important to uncouplethose layers of a building that have significantly different lifetimes. According to Francis Duffy, co-founder ofa British firm that specialized in advance office designs, a buildingover its lifetime changes not as a single entity, but rather as four separate layers: Shell, Services, Scenery and Set. Each layer has a unique time period for repair andreplacement.

Layers Elements AverageLife time:

1. Shell o Structure of building, including skin if load-bearing >50 years

2. Services o Pipes, ducts, cables, machinery, elevators,escalators~15 years

3. Scenery o Partitioning, ceiling, finishes ~ 6 years

4. Set o Furnishings, furniture, computers monthly

Of course uncoupling layers of building for enhanced adaptability must not interferewith the integration of systems and materials at a functional level, in terms of controllingheat, air, moisture, light, and sound. If a design team subscribes to building-as-a-systemprinciples, each part and system of a building will be carefully designed to contribute ina unified manner to the overall performance of a building. The challenge is to achievefunctional interdependence, without losing the independent features that

enhanceadaptability such as redundancy, robustness, and ease of access, repair and replacement.

2.6.2 The "Open Building" Concept

Among the first to formally recognize the importance of independence in design wasN.J.Habraken of the Netherlands who espoused the advantages of the "Open Building"concept. Implied in this term is the notion of uncomplicated structures that lendthemselves to flexibility and change of use in the course of time. Most Open Buildingdesign has concentrated on flexibility within a single use category, although it can alsoapply to convertibility. A key feature of Open Buildings is the separation of 'fit-out'from structure, skin and services. Fit-out refers to all the component and elementsthat contribute to particular use of a building, but are not needed for the basic functioning of a building, The better the separation of fit-out, the more adaptable thebuilding.

Open Building is the subject of an international research association (CIB Task Group onOpen Buildings W- 26 Chaired by Stephen Kendall9). The Chairperson of the committee scribes Open Buildings as ones that distinguish between building part, which can havea long life, and those parts that can change more quickly, and organizes the buildingprocess accordingly. He further suggests that this is perhaps the most fertile, widereachingbasis for advancement in sustainable architecture.

2.7 Evaluating Elements of Buildings for Inherent Adaptability

It is possible to rate each element of a building in terms of its inherent adaptability. Inherent adaptability is assumed to relate to the inclusion in the design of the element a number of specific features. Such features may be identified through surveys of buildings that have adapted well to changes. Or common sense can be used to identify features that

are likely to work well in typical change scenarios (Moffatt, 2001).

Adaptability of buildings should increase in proportion to the number of such features that are incorporated into the design. When evaluating elements of buildings it is important to recognize that major trade-off can exist when designing elements of a building, and that neither strategy may be inherently more adaptable. Consider for example, the scale and location of HVAC systems. A centralized system can facilitate some types of changes like upgrades and conversions. A distributed system, on the other hand, may facilitate changes in primary use within a building, or the expandability of the building. Ideally a designer should strive for a hybrid system that captures the benefits of both centralized and distributed systems (Russell, 2001).Another area with major trade-off is the evaluation of complex, integrated systems in buildings. Complexity and integration are commonly employed by natural ecosystems as means for increasing the efficiency and sustainability of plant and animal communities. At the same time functional interdependence of elements can create obstacles to adaptation over specific time periods, since everything depends on everything else. Ideally indicators should be used to provide a specific, standardized method for rating inherent adaptability, in terms that can be measured and monitored. For example, a possible indicator for adaptable foundations might bePotential for vertical expansion with or without alterations to foundation (in storeys), the lack of specific indicators of this type makes it difficult to create benchmarks for comparison purposes, to establish trends within the stock, and to set appropriate targets for each type of building.

Foundation

(i) Design to allow for potential vertical expansion of the building. A

rationalanalysis should be done to arrive at a reasonable estimate for possiblefuture expansion.

(ii) Install isolation joints or other features that avoid the potential for differentialsettlements and for progressive collapse due to accidental loading.

Superstructure

(i) Give preference to use of reinforced concrete, since it enables the shiftingof internal and external elements without affecting the building's structuralintegrity

(ii) Rely on a central core for lateral load resistance. This allows localmodifications to the structure while maintaining complete structural integrity.

(iii) Use a wide structural grid upward of 6m. The slight redundancy in structuralstrength that a wide grid introduces will increase adaptability considerably.

(iv) Design the lower three floors for 4.8 kPa live load. This increased capacitywill enable the building to easily accommodate all of the likely conversions with no structural modification.

(v) Add sufficient height to the lower floor to enable a range of other uses

(vi) Choose a structural floor system that accommodates a number ofmechanical and electrical service distribution schemes based on differentoccupancies.

Envelope

(i) Make the building envelope independent of the structure. They should befunctionally discrete systems, with the interfaces designed for separation.

(ii) Provide means for access to the exterior wall system from inside thebuilding and from outside.

(iii) Design a versatile envelope capable of accommodating changes to theinterior space plan; (e.g. a modular or panellised system where transparent and opaque units can be interchanged for example).

Services

(i) Give preference where possible to using hybrid HVAC systems, with abalance between centralised components and distributed components. Thehybrid should be designed to provide the flexibility of changing the centralsystem fuel and capacity, while allowing for easy upgrading of localized conditioning units and distribution network.

Interior Spaces

(i) Design spaces for a loose fit rather than tight fit.

(ii) Include multifunctional spaces.

(iii) Install interior partitions that are demountable, reusable and recyclable.

(iv) Provide more than the minimum spatial areas and floor heights.

(v) Use adaptable floor plans, including large grids that can be subdivided.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Researchers have classified research in various ways; however one of the basic distinctions is between quantitative and qualitative methods. Quantitative research includes survey methods, formal methods and numerical methods. Qualitative research involves the use of qualitative data, such as interviews, documents and participant observation (Myer, 2007). Other classification of research includes: exploratory, descriptive, simulation and modeling, logical argumentation, as case studies (Asika, 2002) the method of study for this thesis is both quantitative and qualitative research method.

3.2 Method of Study

This research would be basically exploratory and comparative in nature, and will be mostly qualitative. The research will involve a general survey of expo centers and a detailed study of salient characteristics of flexible and adaptable spaces. The detailed study will involve case studies, and some qualitative research methods. Some of the data obtained from the survey and case studies will be compared in order to determine the extent to which expo centers relate to their settings. The data obtained from the survey of expocenters will be used to develop a scale based on which the expo centers will be accessed, and also the concept development. Logical argumentation will be applied in

charting the direction for design concepts and planning principles. The main datacollection techniques used in this research study will beinterviews and visual survey.

3.2.1 Case Studies

Case studies investigate phenomena within their real-life context (Myers, 2007). This method focuses on one or a limited number of instances or cases, and is expected to capture its complexity. The emphasis here is on depth, the results are used to make generalizations which are analytical in nature. This method involves the use of interviews and documentary materials (Myers, 2007). Cases may be studied due to special interest in them or selected purposely or analytical because of it is information- rich, relevant or unique (Stake, 1995). (Osuala, 2005) stated that the unit selected for studies must be an entity.

Most case studies are qualitative, but quantitative methods or a combination of both methods may also be used. Quantitative methods in case study entail the study of multiple cases which are then used for statistical inferences (Osuala, 2005).The adopted case studies carried out on this research were based on purposive sampling of selected flexible and adaptable spaces and identification of expo centers that have applied these concepts.The cases were purposively selected as suggested by (Veal, 2006), which he describedas purposive sampling. This suggested that cases are identified for study due to theinherent qualities which were in consonance with the phenomenon under investigation(Oluigbo, 2010). The case studies selected for this study were sampled purposely ontwo basis.

3.2.1.1 Case Study as aUnit of Analysis

The expo centers were studied and analyzed individually by the use of field forms which had a table containing design elements broken down under the applicable elements of expo center design. This study is to analyze each expo center studied and how each center has applied the elements of flexibility and adaptability.

3.2.1.2 As a Case Study Research Assessment Method

Based on the selected expo centers, an assessment table on applicable elements of flexibility and adaptability was used to conduct a comparative analysis of all the expos centers studied in order to find out the extent to which these elements have been applied to expos center designs.

3.2.2Visual Survey

To capture the complexity of cases the use of multiple sources of data collection was used in defining characteristics in carrying out case study methodology (Yin, 2004). For the purpose of this study, the instruments used for the collection and documentation of this data were Photographs, sketches, and notes.

Photographs were taken of relevant physical elements of the case studies to ascertain the extent or level of application of flexibility and adaptability, planning and construction. Sketches were used of some relevant parts of the case study where necessary to further describe some features of spatial organization, or to enhance the quality of some details that are not too clear from the pictures taken during the field visit. As an instrument, notes were also taken in the field to outline and account for the extent of application of

the independent variables on the case studies as they relate to the considerations and application of flexibility and adaptability.

3.2.3Interviews

The Procedures for data collection for the local case study involved visits to the case study sites, and making visual analysis of their architectural elements as they reflect flexibility and adaptability of design. These buildings were then critically evaluated based on the outlined criteria of analysis. The foreign case studies however, were obtained from the internet and assessed using the same criteria as used for the local case studies.

3.2.4Data Analysis and Presentation

Analysis of data collected from the visual survey will be subjected todescriptive accounts and presented in tables, figures and plates. Interview result will be subjected to content analysis. This will involve the identification and extraction of key issues and emergent themes on flexibility and adaptability as stated by the respondents.

CHAPTER FOUR

FINDINGS AND DISCUSSIONS

The findings from the case studies carried out have been discussed with regards to background, site planning and landscaping, spatial organization, structure and materials, design of an international Expo centre

4.1 CaseStudy One: Findings at J.T. Useni International Trade Fair, Abuja

4.1.1 Background

The Abuja Chamber of Commerce and Industry which is the body responsible for Abuja international trade fair was established in 1986. Abuja International Trade Fair Centre is named J.T. Useni International Trade Fair Centre(See Plate 4.1) at kilometre 8, Airport Road, Abuja. Formerly, it was at Area 10, old Parade Ground Garki,Abuja. Its main objectives are to project and protect the interest of commerce and industry and also express the opinion of the business community on questions affecting trade, industry, mines and agriculture in the Federal Capital Territory in particular and in Nigeria in general. The Chamber's aim is to encourage greater understanding, cohesion and unified sense of co-operation amongst businesses and business organisations. The Chamber is established not for profit, and all its income and property are therefore applied solely for the promotion of its above objectives. The Chamber is not only a forum for already successful businessmen and women, but also to starters. In addition it embrace all shades of businesses including manufacturing, trading, contracting, farming, importing and exporting, mining, financing and so on.



Plate 4.1: Abuja International Trade Fair.

4.1.2 Architectural Characteristics

4.1.3 Site Planning and Landscaping

The International Expo Centre (IEC) is located at Kilometre 8 Airport Road Abuja. The site consists of both vehicular and pedestrian ways; it also has large open spaces. The land is relatively flat. The few existing buildings are the Administrative Block, Security Post, Conference Centre, and Federal Capital Development Authority Office. The layout is simple and straight forward, with ingress and egress entrance into the Trade Fair Centre from the main road (See plate 4.2)



Plate 4.2: Vehicular Circulation UnderConstruction

The entire site of the buildings is rectilinear in shape and is located closed to the gate. There is good road network with adequate provision for car park. The site is covered with concrete paving, gully with sparse distributed landscape elements such as plants around the Administrative Block and Security Post.

4.1.4 Spatial Organization

The Trade Fair Centre premise consists of a number of buildings such as Security Post, Administration pavilion,a fully airconditioned multipurpose hall which accommodates theatre seating up to 700 persons and banquet seating up to 600 persons.Also, smaller hall which seat up to 100 quests. The hall is equipped with a kitchenette and a well furnished Very Important person (VIP) lounge. There are full multimedia services. Conference hall and Federal Capital Development Authority Office. The Administrative Block consists of an open courtyard design system with offices building has reception area there are people to direct guests as they visit the admin building. It has a large open space. (see fig. 4.1 and plate 1).



Plate 4.3: Administrative block



Plate 4.4: Pavilion stand

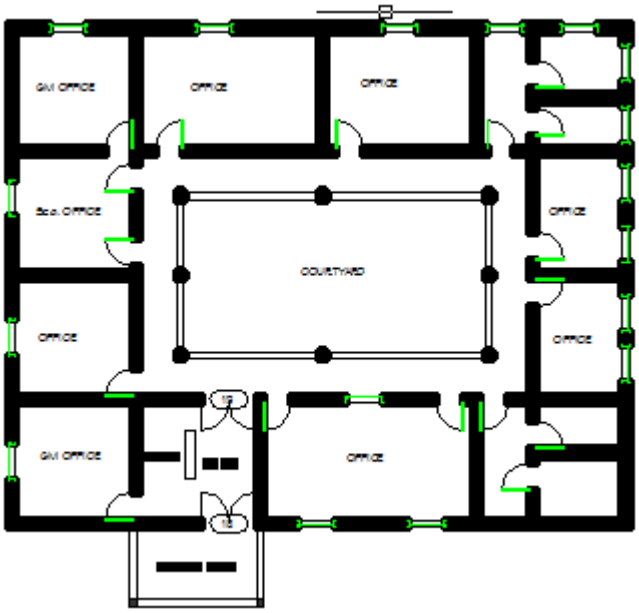

Figure 4.1: Sketch of administrative block

4.1.5 Structure and Dominant Building Materials

The main building materials used were sandcreteblocks, long span aluminium reinforced concrete and glass windows construction see plate 4.5. The use of stone, burnt bricks and rammed earth was also recorded in limited quantity on site.

4.1.6 Aesthetic and Expression

On the issue of aesthetics and expression, the building reflects post-modern style of architecture (see plate 4.3). The site over-all aesthetic quality can be said to be still under development. Fence painted green and white see plate 4.6, plate 4.7.



Plate 4.5: Federal Capital TerritoryAdministrative Block



Plate 4.6: Open Space Built by Exhibitors



Plate 4.7: Open Space Built by Exhibitors

4.1.7 Facilities

ExpoCentre Fairgrounds has nine fully equipped exhibition pavilions, halls to hold conventions, press conferences, meetings, seminars and symposia.

i. Public address system inside each hall.
ii. Raw material research office
iii. Pay Card phone.
iv. Centrally Air conditioned.
v. Security.
vi. Conference / Seminar area.
vii. Deleoye Conference hall (700 seating capacity)

viii. Small Conference hall (100 seating capacity)

ix. Pavilion

x. Information unit

xi. Press unit

xii. Administrative blocks

xiii. FCDA office

xiv. Painting display area in corridor.

xv. Ware housing facilities.

xvi. Open display area.

xvii. Podium

xviii. 32 hectares of land

4.1.8 Application of Flexibility and Adaptability Design Principles in the Design of J .T Useni International Trade Fair Abuja Shown on the Table Below

The J. T UseniInternational Trade Fair Centre, Abuja . The J,IUseni International Trade Fair Centre, this case study present a method of evaluation of the degree of achieved the design principle of flexibility and adaptability. The checklist, see table 4.1 that range from low, medium and high these are alots of spaces available for packing spaces and for participants exhibition. There are fluidity versatility, convertibility, scalability and modifiability which are highly applied. The fluidity principles are highly applied andit can be seen that the centre is still an open space under construction few structures available. Featured some design principles of flexibility and adaptability adequately.However, it can be seen that the over-all application of the principles range from low, medium, and high.(i.e. twofold) Firstly, it means that the principles of flexibility and adaptability design are indeed relevant in the design of an International Expo Centre.

As for convertibility, this very centre is easily convertible because the open spaces creates location to new uses. The Administrative building consisted of modular design system; building services were also static and could not undergo increased functions. Over all, the Conference hall was not suitable for the purpose of Convertibility. However,the J.T Useni International Trade Abuja failed to exhibit the level of usage ranged from low to absent. This is so because, the requirements such as ability to expand and contract, ability to allow for temporal conversion of space and the introduction of redundancy were available.

Modifiability requirements were met except in the areas of furniture being able to undergo quick re-configuration. Besides that, only Administrative Block, conference hall and Federal Development Authority office has and space that allow quick re-configuration. Flexibilityonly attempt to use demountable partition walls at any level. The principles of flexibility independence was also applied here, thus the level of usages was available. Then convertibility allowing for changes in use within the building were lacking. Expandability at J.T UseniInternational Expo Centre have a lot of open spaces, no exhibition halls space for fascinating addition to the availability of space in a building. Durability exist where there is structure and materials to be selected, Assembles as systems that require less maintenance, repair and replacement but not applicable. The principle of design for disassembly is not apply here, for making it possible to take product and assemblies apart so that their constituent element can move easily to reused or recycled.

Table 4.1 Assessment of application of elements of flexibility and adaptabilityJ .T Useni International Trade Fair,Abuja

PARAMETERS	RATING					
FLEXIBILITY	**Absent**	**Low**	**Moderate**	**High**	**Very high**	**Comments**
i Fluidity					√	Used for diversity of function
ii Versatility						Use for multipurpose function
iii Convertibility					√	Give room for new usage of space
iv Scalability			√			Gives room expansion and contraction
v Modifiability					√	Highly used
ADAPTABILITY						
i Flexibility				√		Used for other functions
ii Convertibility	√					Cannot be convertible
iii Expandability				√		No addition of space because of no existing building
iv Durability				√		Can use demountable material
v. Design for disassembly					√	The space are temporary structures

(Source: Author; Field work, 2013)

4.1.9 Interview Result

TheDirector General of the Abuja International Trade Fair Centre was interviewed on the flexibility and adaptability of the trade fair centre mentioned above. During the interview he gave the following response based on questions asked.

1. The facility is used annually during trade fair which usually take place in September every year.
2. They are used for exhibition, opening ceremonies, cultural display, display of their finishing product.

3. It is used for other activities like marriages, seminar, political convention, church convention, crusade.
4. The International Expo Centre (IEC) is underutilized due to lack of facilities.
5. The architect that design is the vice president Abuja chamber of commerce and industry who is an architect by name areOkoli.
6. We use open spaces for most activities
7. The environment is some how busy with other activities like wedding, bike riding e.t.c.
8. Letting spaces for activities for all round the year.

4.2 Case study two: Findings at Kaduna International Trade Fair

4.2.1 Background

The Kaduna International Expo Trade Fair was borne out of a local trade fair experience which started in 1974. When a total of 20 Nigerian companies booked 35 stands. Kaduna international Trade located km 4, Kaduna–Zaria road, Rigachikun, Kaduna –Nigeria (see plate 4.8). The second in the domestic fair series was held in 1976, 1978, and 69 local companies booked 255 stands and the last was held in February 22nd to 3rd March 2013. The Organizers of the fair, the Kaduna Chamber of Commerce decided to make the event International Trade Fair. Countries like Britain, West Germany, Japan, U.S.A, and France were some of the participants at the first international fair and sales were estimated at over N18 million. The fair has since been held annually and the volume of trade, participants and visitors has increased and thinned consistently with the boom and slump of the economy respectively. The number of foreign participants has fluctuated between 10 and 15 countries. However at last fair (2012) the highest ever number of participants

was recorded with 52 local participant with 20 foreign participant because of the insurgent of the country.



Plate4.8: Kaduna International Trade Fair Sign Board

4.2.2 Architectural Characteristics

4.2.3Site Planning and Landscaping

The site is located on an uneven ground with different ground level, it has both vehicular and pedestrians way. The buildings are of different design for different purposes. The layout is simple and straight forward, with a single gate into the Centre from the turning road. The entire site has a tarred road and gully covered with concrete paving with sparsely trees and shrubs.There are open spaces for recreations, well landscaped distributed landscape elements such as plants and large parking spaces.

4.2.4 Spatial Organization

The Centre consists of a number of buildings such as Administration block, Conference Centre with three small halls and VI P room with different entrance. There are buildings with portal structure and geo domes structures and rectangular shapes. Also demountable

structures made of ply woods and aluminium elements .there are solid concrete blocks of different design. The Administrative block internal is partitioned with aluminium component. Design is that of Simple rectilinear shape with windows scattered everywhere on the building which further enhances day-lighting and natural ventilation. The building has reception area to direct guests to where they are going as they visit the building. Also, entrance to the main building is not celebrated see Plate 4.9 and Plate 4.10). There are two pavilions for seminar. The information block and press units are apart. Presence of mini stadium closely by Fulani ladies bloc for changing up during opening ceremony,Clinic, Police post and ticket booth are all available.Other stands such as photographic studio, restaurant and cyber café are free standing units.



Plate : 4.9: Kaduna State International Trade Fair Press Centre



Plate : 4.10: Dismountable Structure

4.2.5Structure and Dominant Building Materials

The dominant building materials found were sandcrete blocks, reinforced concrete lattice steel trusses, and glass windows also the geodesic domes with steel strussas seen in plate 4.1.1 and fidelity bank built with an demountable wall in an open space as seen in plate 4.1.4. Prevalent on site employs current trend of building construction with wall cladding also serving in load bearing capacities.





Plate 4.11: DilapidatedGeodesic DomesPlate 4.12: Open Space

4.2.6Aesthetic and Expression

On the issue of aesthetics and expression, the building reflects modernist style also the application of the traditional of the Arabic art work design on the entrance columns to the mini stadium.

4.2.7 Facilities

i. Administrative block

ii. Three pavilions

iii. Car parking spaces

iv. Stadium

v. Two podium for seminars

vi. Stadium for opening ceremony

vii. Conference Centre with big auditoriums, Very Important Person (VIP) room and three small halls

viii. Press unit

ix. Information unit

x. A block where the Fulani ladies dressed and re-dressed

xi. Security gate

xii. Clinic

xiii. Ticket offices

4.2.8 TheLevel of Flexibility and Adaptability Design Principles in the Designof Kaduna International Trade Fair shown on the Table below

Kaduna International Trade Fair did incorporate the design principles of flexibility and adaptability design as can be seen in terms of fluidity scored moderate to high on the level of usage. There areseveral open spaces availability and there are a lot of spaces parking spaces and the spaces can be easily accessible. There are a lot air movement around the environment. Over-all, Kaduna International Trade Fair scored high based on fluidity principle.

Versatility are spaces that allow for multiple use, and spaces that are general yet specific to different uses large structural grids, provision of spatial area and floor height higher than minimum. All the exhibition halls serve in a versatile capacity. For instance, floor height was double volume and offices are sizeable. This is adequate for the purpose of versatility. Also, structural grids such as the geodes domes which encouraging the ability of the spaces to serve in a versatile capacity. Convertibility required spaces that can were met on a very high level with many of the spaces being able to undergo conversion. This is so because building change use easily and design are open to redesign by others, the centre can be adapted for the purpose of exhibitions

The trade fair ground also consisted of modular design system and could accommodate increased services as demanded.Scalability design requirements are ability of space to expand and contract, ability of service to accommodate increase function and ability to allow for temporal conversion of spaces further put the building at a position where it

can be seen clearly that it apply flexible design approaches. For instance, the building are expand and contract without damaging some of its elements.It also designed to cater for increased loading whether dead or life loads. In the area of modifiability, the facility meet up with the requirements as can be seen there are demountable partition walls, the ability to expand services such as lighting without causing damages to the building fabric.

Flexible allow the use of demountable partition walls at any level. The principles of flexibility independence was also applied here, thus the level of usages was available. Then convertibility allowing for changes in use within the building is available because there are enough halls. Expandability at Kaduna International Trade Fair has a lot of open spaces and pavilions, for seminar. Durability exist where there is structure and materials to be selected, assembles, as systems that require less maintenance repair and replacement but here is applicable. And the principle of design for disassembly is apply here for making easier to take product and assemblies apart so that their constituent element can move easily to reused or recycled.

In conclusion, it can be seen that the over-all application of the established principles is present. What this means is that, the building is suitable for the purpose of exposition because most of the key attributes of an Expo Centre of this building serve its functions properly due to professional design.

Table 4.2Assessment of Application of elements of flexibility and adaptabilityKaduna

PARAMETERS	RATING					
FLEXIBILITY	**Absent**	**Low**	**Moderate**	**High**	**Very high**	**Comments**
i Fluidity				√		There is diversity in functions.
ii Versatility					√	Multipurpose of functions
iii Convertibility			√			Not common
iv Scalability				√		Lack of space for expansion and contraction
v Modifiability						Space for mobile component
ADAPTABILITY			√			
i Flexibility					√	Serve other purposes
ii Convertibility				√		It allows for conversion
iii Expandability		√				Facilitate addition to the quantity of space
iv Durability				√		Use for multipurpose function
V Design for disassembly					√	Space can reuse or recycle for various purposes

4.2.9 Interview Result

The Director General of the Kaduna International Trade Fair was interviewed on the flexibility and adaptability of the Trade Fair Centre mentioned above. During the interview he gave the following response based on questions asked

a. The facility is used annually, usually February – March for the Trade Fair and it is also used all year round.
b. They are used for exhibition, opening ceremonies, cultural display, display of their finishing product.

c. It is used for other activities like marriages, seminar, political convention, church convention, crusade.
d. The International Expo Centre (IEC) is underutilized due to lack of facilities.
e. The architect that design is the vice president Abuja chamber of commerce and industry who is an architect by name areOkoli.
f. We use open spaces for most activities
g. The environment is some how busy with other activities like wedding, bike riding e.t.c.
h. Letting spaces for activities for all round the year.

4.3 Case study three: Lagos International Trade Fair Complex

4.3.1 Background

The Lagos International Trade Complex is located at Lagos Badagry Expressway, Ojo-Lagos, the complex was built in 1977 by the Federal Government with the lofty aim of turning the place into a Centre of Commerce for Trade Exhibitions and Investments Promotion but this purpose was never achieved due to neglect and gross mismanagement by those into whose hands the edifice was entrusted. Before the complex was concessioned, the entire asset was in a sorry state. It has become a National embarrassment as all the structure put in place to support business activities were overtaken by weed. Little or no meaningful activity takes place in the premises. So, the asset which was designed to be a National monument become a National menace as criminals, touts and drug addicts took advantage of the situation and turn the complex into a haven for illegal anti-social activities.



Plate 4.13: Over view of Lagos International Trade Fair Complex

4.3.2 Architectural characteristics

4.3.3 Site Planning and Landscaping

Lagos International Trade Fair Centre was built on a relatively flat land with well grid road pattern within the Centre as shown on Plate 4.13. It consists of open spaces with a lot of trees, flowers and shrubs scattered at strategic areas, green areas, parking lots and trade fair symbols as seen in plate 4.14, sculptural forms and fountain. The centre is planned where by the Administrative block; Auditorium, Antagan, Banquet hall and open spaced area are located at various points away from the Exhibition Centre.





Plate 4.14: Pictorial View of Landscape Features Plate 4.15: Walk Way to the Expo Hall

It also has tarred roads and paved walk-ways madeof interlocking tiles throughout the main core of the Centre. It consists of a mini-stadium for out-door activities such as the sports ground with multiple facilities and concrete seat at the pavilion.

4.3.4 Spatial Organization

The structure consists of twelve halls; HALL 1 which consist of eleven satellite halls and hall four surrounded by several markets namely; balogun ,aspandanmarket, Glmarket, progressive market, and brown house. The HALL 1 is linked tothe eleven satellite halls through long paved walkways. The HALL 1 has a lot of sculptures at the entrance which is the main entrance. There are also tickets booths through which one gain access into the halls. There are restaurant, let able offices and bar.Most of the walkways as seen in plate 4.15 are covered and linked to the various spaces. The window openings are hidden in a horizontal shading device in a recess manner to prevent direct exposure to sunlight.

4.3.5 Structure and Dominant Building Materials

The main structures are of two storeys consist of glass, concrete slabs (dpc), glazed walling, steels, aluminium components, cladding with brown metallic slates. However the dominant materials used as seen in plate 4.16 includes the following; reinforced concrete, columns, glass, wooden particles panels, masonry walls, steel trusses among others. There is a proposed bounding terminal for off loading of container from the wharf to be at the front of Hall 4.



Plate 4.16: Structural Grid Display in the Exhibition Hall

4.3.6 Aesthetics and Expression

The incorporation of brown metallic tiles used around the external structures to act as wind breakers and also to enhances the aesthetic of the building are modern type of architectural design. (See plate 4.17 below).



Plate 4.17: The use of Metallic Slates Aroundthe Building

4.3.7 Facilities

The Facilities at the Lagos International Trade Complex include:

i. Conference Halls/Galleria of Different sizes for rent/lease

ii. Office space of difference sizes for rent/lease

iii. Shopping complexes for rent/lease

iv. Modern exhibition, facilities

v. Relaxation and leisure facilities

vi. Serene environment for socio-culture activities

vii. Land space for rent/lease.

viii. Hotel and catering services

ix. Tourism guide

x. Travelling agencies

xi. Business consultancy/advisory services

4.3.8 The Level of Flexibility and Adaptability Design Principles in the Design of Lagos International Trade Fair shown on the Table below

Lagos International Trade Fair did incorporate the design principles of flexibility and adaptability design as can be seen in terms of fluidity which scored very high on the level of usage. There are connections among the spaces and the existence of corridors in-between the offices. There are lots of open spaces available for parking and for participant's exhibitions. Access to these spaces was relatively easy, also the perception of view and air movement is adequate. Over all, Lagos International Trade Fair scored very high based on fluidity principle. There is versatility in the Lagos trade fair. There Versatility concerns space that allow for multiple use, and spaces that are specific to some uses. Versatility encompasses building element such as large structural grids and provision of spatial area, and floor height higher than minimum. All the Exhibition halls serve in a versatile capacity. For instance, floor height was double volume and offices sizes quite big. This is adequate for the purpose of versatility. Also, structural grids were much hence encouraging the ability of the spaces to serve in a versatile capacity. Convertibility required spaces that can be met on a very high level with many of the spaces being able to undergo conversion. This is so because, the building change use easily, and designs are open to redesign by others. The building was adapted for the purpose of exhibitions. The building also consisted of modular design system and could accommodate increased services as demanded.

Scalability design requirement is ability of space toexpand and contract, ability of service to accommodate increase function and ability to allow for temporal conversion of spaces. This further puts the building at a position where it can be seen clearly that it applies

flexible design approaches. For instance, the building could are expand and contract without damaging some of its elements; it is also designed to cater for increased loading, whether dead or life loads. In the area of modifiability, the facility meet up with the requirements as can be seen thatthere are demountable partition walls. This makes for the ability to expand services such as lighting without causing damages to the building fabric.

Flexibility includes the ability to use demountable partition walls at any level. The principles of flexibility independence was also applied here, thus the level of usages was available. Then convertibility allowing for changes in use within the building was available because there are adequate halls. Expandability at Lagos International Trade Fair Centre has a lot of open spaces, twelve's exhibition halls, exhibition halls space for fascinating addition to the quantity of space in a building. Durability exists where there is structure and materials to be selected, assembled, as systems that require less maintenance repair and replacement.The principle of design for disassembly is applied here for making it easier to take product and assemblies apart so that their constituent element can be moved easily to be reused or recycled

In conclusion, it can be seen that the overall application of the established principles was present. What this means is that, the building is suitable for the purpose of exposition because most of the key attributes of an Expo Centre of this building serve its functions properly and also are professionally designed. This goes to show that Lagos International Trade Fair is of standardand anExpo Centre.

Table 4.3Assessment of application of elements of flexibility and adaptabilityLagos

PARAMETERS	RATING					
FLEXIBILITY	**Absent**	**Low**	**Moderate**	**High**	**Very high**	**Comments**
i Fluidity					√	High used for diversity of functions
ii Versatility					√	Can be used for multipurpose functions
iii Convertibility					√	It a very common phenomenon
iv Scalability				√		The space can easily be Expansion and contract
v Modifiability					√	Spaces are always modified
ADAPTABILITY						
i Flexibility				√		Highly applied
ii Convertibility					√	Not easily applied
iii Expandability					√	There is facilitating addition to space
iv Durability					√	Usage of durable materials attained
V Design for disassembly				√		Usage of selected materials

4.3.9 Interview Result

The Director General of the Lagos International Trade Fair was interviewed on the Flexibilityand adaptability of the Trade Fair Centre mentioned above. During the interview he gave the following response based on questions asked:

1. It is used weekly, monthly and trade fair its used annually by November.
2. They are used for exhibition, Easter sale bonanza, children day, Church Bazaar, ICAN used for seminars, Customs use it for seminars/workshop, educationist use for conference, wedding ceremony, acting of films.

3. It is used for other activities like marriages, seminar, political convention, church convention, crusade.
4. It is adequately utilized due to availability of facilities.
5. Because there is no maintaining the facilities on ground.
6. It can enhance its usage for other activities when there is no expo activities by using mobile structure or demountable structures at the open spaces and within.
7. It was not an architects but group called energo project engineering and contracting co. Beograd an Yugoslavia consultant.
8. Circulation and zoning
9. It does, because expo area are different from administrative area, conference, e.t.c.
10. We lease for exhibitors at cheap rate for exhibiting of their wares or product

4.4 Conclusion from Case Studies

The case studies led to some findings which are of importance to the aim of the study. Such findings include the flexibility and adaptability in the design of Expo Centre in Nigeria.Abuja International Trade Fair Centre do not have much facilities since it s a new site with very few structures on ground such as Administration Block, Security post, Conference hall, podium and stage and Federal Capital Development Authority office, more of vast open space.. This is widely adequate for flexibility and adaptability .where the principles of fluidility has displayed such as open spaces, unobstructed views air movements, sound and seamless connection between spaces.

However, Kaduna and Lagos International Trades Fair Centre,was properly designed given adequate considerations for flexibility and adaptability in the design. I make bold to conclude that given what is on ground, both met international best standard expected of a centre of this nature.

CHAPTER FIVE

DESIGN REPORT

5.1 The Site

The site is divided into three headings such as site location, site selection criteria and site analysis.

5.1.1 Site Selection

Three sites were selected for the International Expo Centre which areWuye. District,, Central business district, Cadastral zone C00, but after considering the characteristics of the three sites, we considered and found site B suitable.

Site A

The siteis located at Central Business District, along TafewaBelewaWay after Ceddi Plazaplot 1611see in fig. 5.1.

The characteristics of the site are:

i. small size ,2000sqm
ii. closeness to high tension line.
iii. It has 12-18% very steep slope.
iv. The site is also constrained by rock out –crop

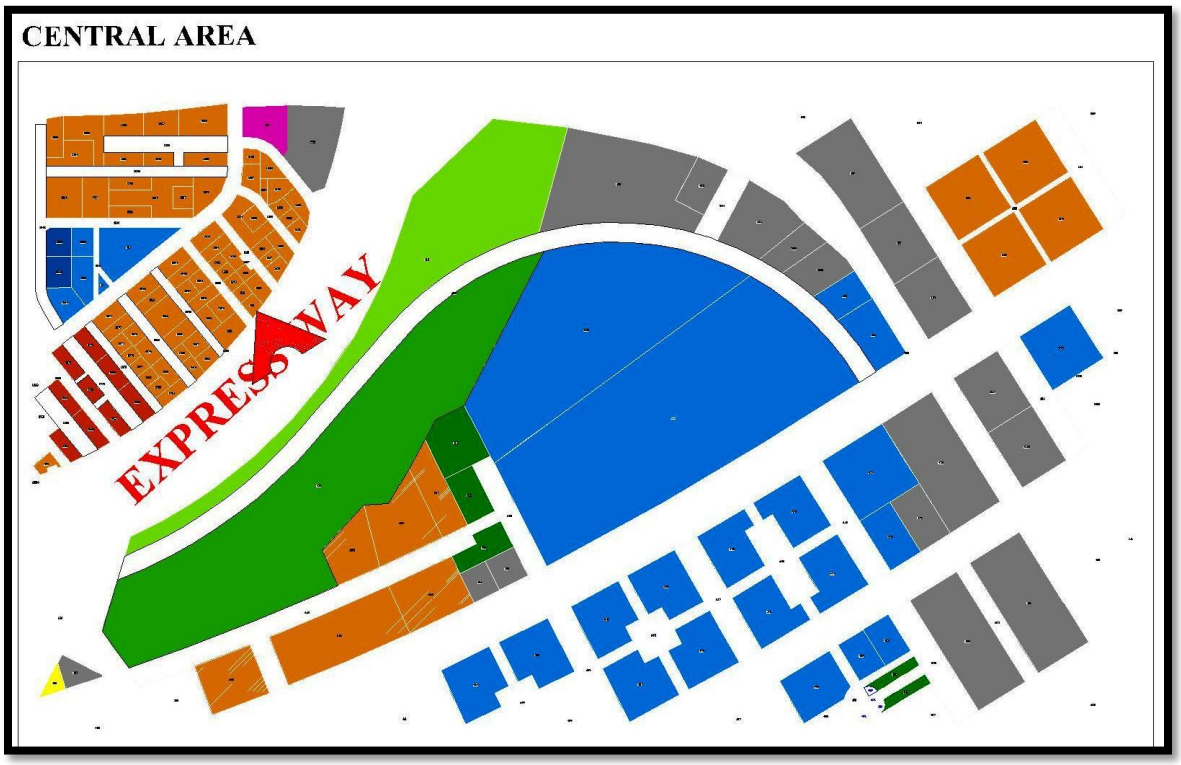

Figure 5.1:Land used Map Site ATafewaBelewa Way Central Business District

Source: Federal Capital Development Authority, Urban and Regional Planning Printing Section

Site B

Site B is located at Cadastral zone C00 along Airport road after MRS petrol station byPiwoyi road see fig. 5.2.The characteristics are as following,

i. The land is relatively flat.

ii. The nature of land is well drained.

iii. The soil conditions at that the site is not constrained by rock out –crop, swamp, or any adverse soil condition.

iv. The site is rich reddish –brown soil conditions.

v. Closeness to airport road.

vi. The site is very large.

vii. The site has accessibility

viii. There are possibilities for expansion.

ix. Access to light.



Figure 5.2:Cadastral Zone C00 Along Airport road Plot No.47 Institution and Research of Site B

Source: Federal Capital Development Authority, Urban and Regional Planning Printing Section

SITE C

It is located at Wuye District far plot 219 away fromWuyemodel market see fig. 5.3.

The site characteristics are as followings;

i. The slope is steeply.

ii. The site is water logged/marshy.

iii. The site is swampy

iv. There is no access road.

v. It is far from the main road.

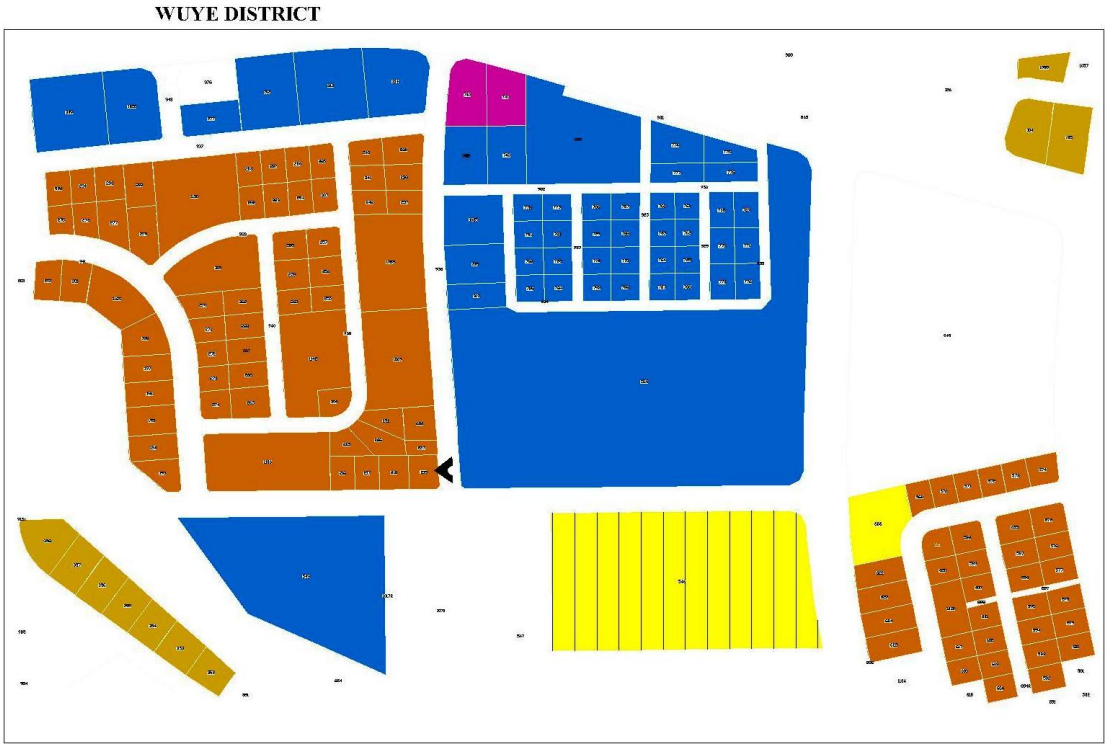

Figure 5.3:Wuye District of site C

Source: Federal Capital Development Authority, Urban and Regional Planning Printing Section

5.1.2Site Selection Criteria

Choosing an appropriate site for an International Expo Centre is of paramount importance. This is because grooming the Expo Centre of vast business under commercial zoning and certain criteria, one have to put into consideration the following:

Table 5.1 Site Criteria

Criteria	Site A	Site B	Site C	REMARKS
Distance from location accessibility	3	5	2	Site B directly accessible through Piwoyi road
Closeness to neighbour resources.	2	3	1	Site B is very close
Size of sight possible for expression and adaptability.	1	4	2	Site B positive
Size of site for expansion and availability.	2	5	2	Site B given in hectre
Land use compliance.	2	5	3	Site B is more complaint
Visual aesthetic potential.	3	5	2	Site B Positive
Access to basic amenities and services.	2	4	3	Site B positive
Location accessibility.	3	5	3	Site B highly accessible positive
On-site energy resources.	2	4	1	Site B positive

5.1.3 Site Location

The site falls within institutional and Research District Layout Phase 3 area of the Federal Capital Development City under the Abuja Municipal Area Council of the Federal Capital Territory. It is identified as Plot number 47 and has a size of 19hectres. The land is shapeless, it is in an inclined angle.

The site for the proposed International Expo Centeris located in the Federal Capital Territory,Abuja, Nigeria (see figure 5.1 below). Abuja is Nigeria Federal Capital and it iscentrally located, in the geographical centre of the Nation with co-ordinates 9 4 o N 7 29 O E/ 9.066667 N7.483333 Erespectively, and occupies a total area of about 8000sq.km A section of the territory known as the Federal Capital City (FCC) is situated at the North-east quadrant a covers an area of about 250sq.km.

The city was designed in a concentric pattern and having a crescent shaped outlook affording its populace the opportunity to access the city from all parts of the territory and below shown the Abuja map and site location in fig.5.4

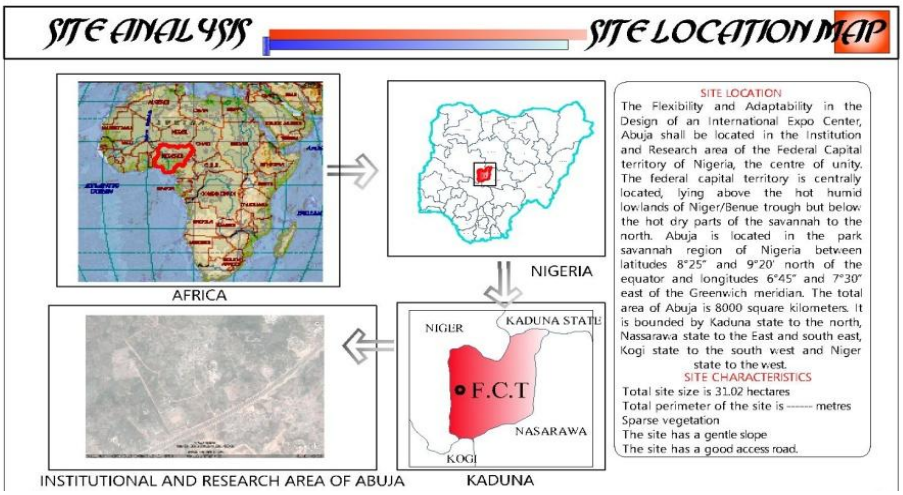

Figure 5.4: Nigeria map, Abuja map and Site Location

5.1.4 Abuja Zoning

The site was chosen in line with the Federal Government's plan to make Abuja the central zone for International Expo Centre, thus the proposal for the Abuja International Expo Centre which is along the Abuja Airport Road, sited at cadastral zone C00 of institution and Research of the Federal Capital Territory (FCC). The site is proposed for the International Expo Centre design.The chosen site best suited for the proposed International Expo Centre is sited at cadastral zone C00.This is because of its natural attraction and scenery (the Airport Road) and added advantages on the ground is that coming from Airport is a straight way and easier for those coming into Abuja and those routing through Lokoja ,also those from Kaduna through Zuba then linked to Airport road. Abuja is the zone shown in (figure 5.5).

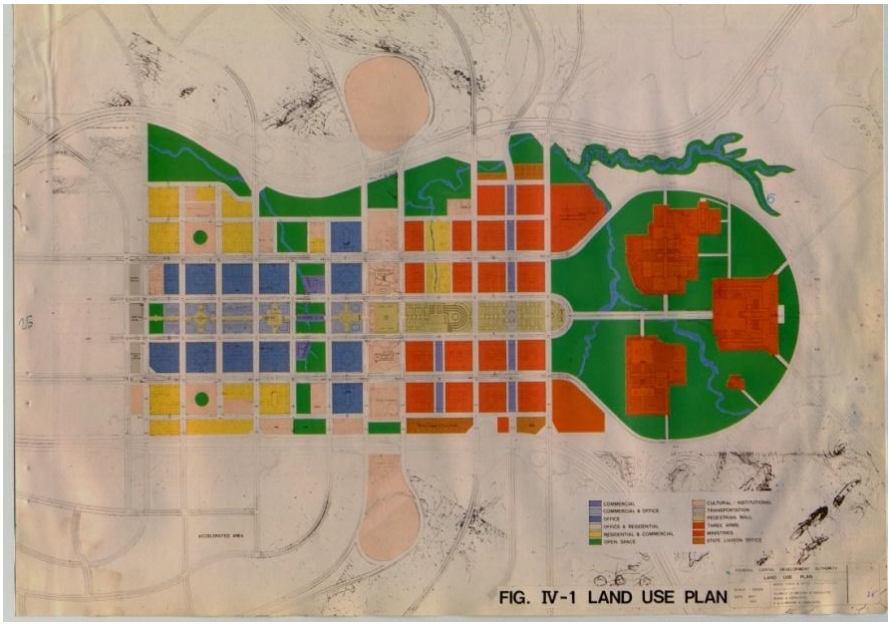

Figure 5.5: Abuja Zoning

The site chosen has the following characteristics:

i. The site falls under general land use for commercial purposes and it is under Institutional and Research District which has an estimated slope below 5% relatively flat and well drained.

ii. It is bounded to the western and northern part by Chinese building, to the western no development still bush. At eastern is a regional road passes through the site at end of the site. At the southern view is major road to the Airport. Niger. The site is not constrained by rock out –crop, swamp, or any adverse soil condition, soil type gotten from the site is a rich reddish – brown loamy soil in corporate amongst others.

5.1.5 Site Analysis

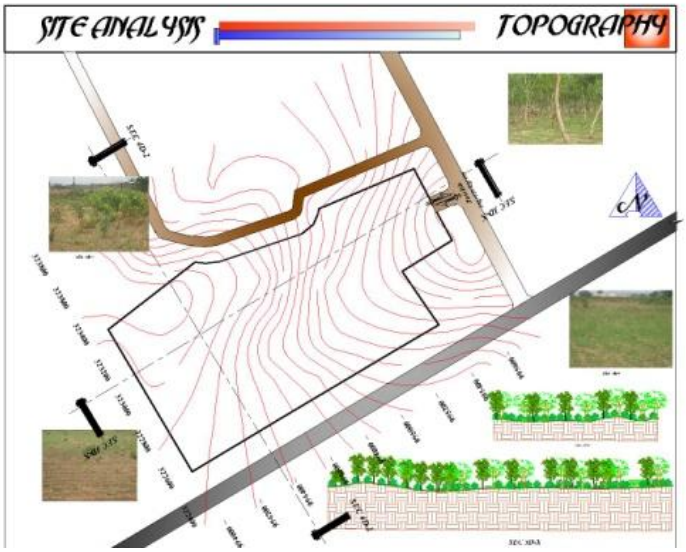

Figure 5.6:Topography

i. **Access**: The site is accessed through Piwoyi Road Way on the Eastern part of the site. This will be met with a newly created road specially to connect with the proposed roads that lead to Chinese building.Shown in fig. 5.6 above.

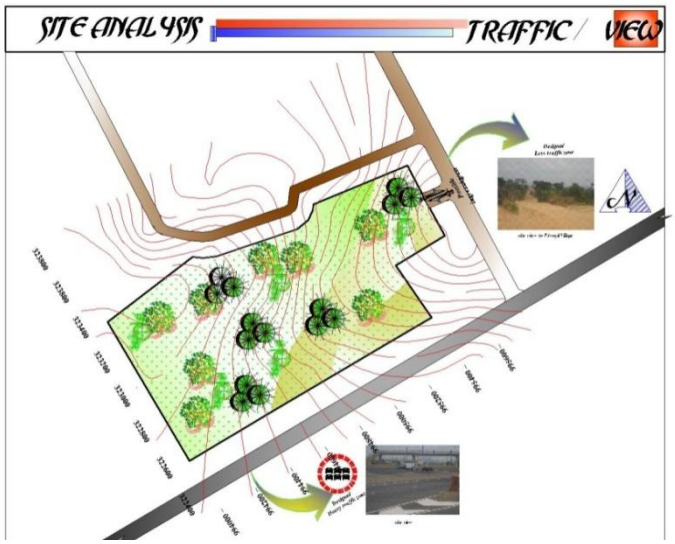

Figure 5.7: Traffic View

ii. **Vegetation**: The vegetation is characterized by a few grasses with shrubs, cassava crops, grasses, trees etc., vegetation is mostly ever green gaining altitude. Site to be well landscaped and trees planted and reduce solar radiation and avoid soil erosion (see figure 6.3 below).

iii. **Utilities**: There is existing of setbacks and airspaces for distances of site to existing building and roads which is 10m to the road. High Tension line, electricity poles, sewer line, waterline, telecommunications network available on site.

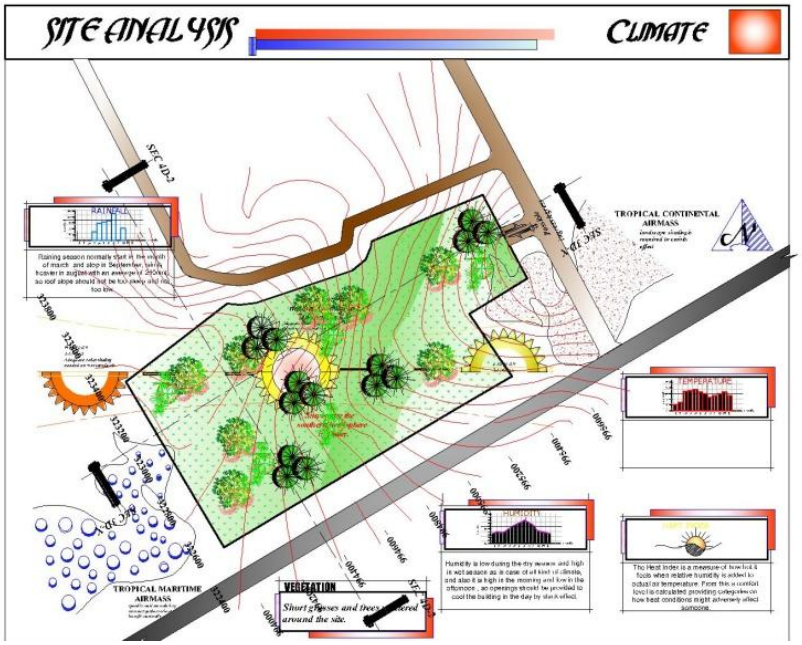

Figure 5.8:Air Movement

iv. **Wind:** Two major air masses dominate the Federal Capital Territory: the Tropical Maritime air mass and the Tropical Continental Air mass. The Tropical Maritime air mass is formed over the Atlantic ocean of the south of the country and is therefore warm and moist. It blows from south-west to north-east.The tropical Continental is developed over the Sahara desert and thus is warm and dry and blows from north-east to south-west.

The Tropical Continental air mass come with the dry season while the Tropical Maritime air mass come with the wet season shown in fig. 5.8 above.

i. **North East Trade Winds**: Tropical Continental air mass which is dry, cold and dusty, influences harmattan. The wind velocity is very high in almost half the year mostly in October to February.A proposal to apply soft landscape (Trees and shrubs) to be used as shield and air filter so as to curb the dust effect.

ii. **South West Trade Winds**: Tropical Maritime air mass which influences rainfall around April to October. This has influence on local climate as it is moist due to its development over Atlantic Ocean. Fenestration should best be in this direction to maximally harness the cool breeze for thermal comfort.

iv. **Orientation of Buildings**: The Longer side of the building should face northeast direction to reduce hot discomfort. Due to solar radiation, shorter sides of the building should then be on the east- west sides.

v. ii. **Vegetation**: The vegetation is characterized by a few grasses with shrubs, cassava crops, grasses, trees etc., vegetation is mostly ever green gaining altitude. Site to be well landscaped and trees planted and reduce solar radiation and avoid soil erosion (see figure 6.3 below).

vi. iii. **Utilities**: There is existing of setbacks and airspaces for distances of site to existing building and roads which is 10m to the road. High Tension line, electricity poles, sewer line , waterline, telecommunications network available on site see fig. 5.9 below.

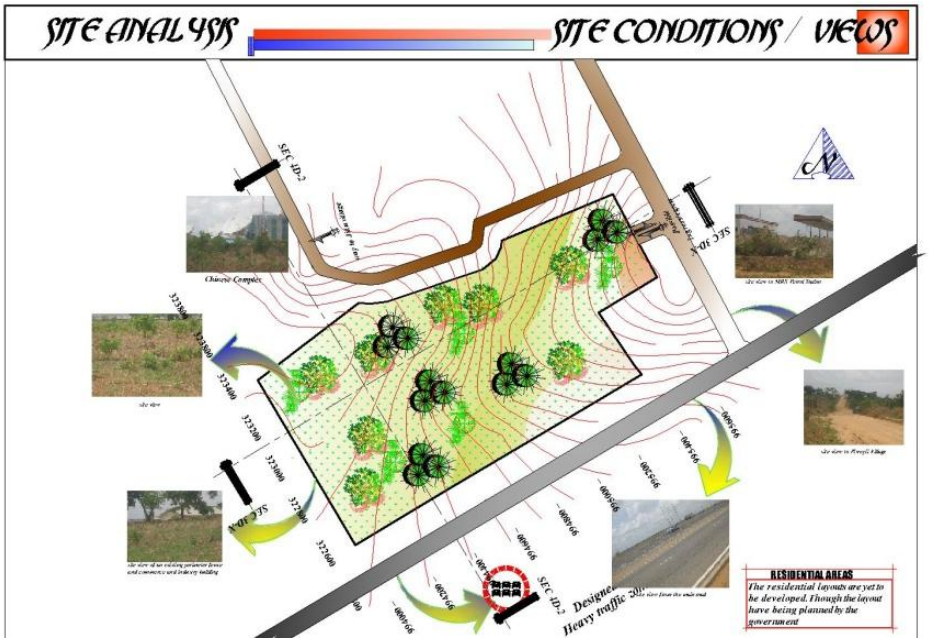

Figure:5.9:Site conditions

Temperature:

Abuja is characterised by high temperature variations between the day and night. Temperature ranges from 25°C to 31°C as shown below with the highest temperatures recorded during the dry season and Lowest abound during the rainy season shown on fig.5.10 below.

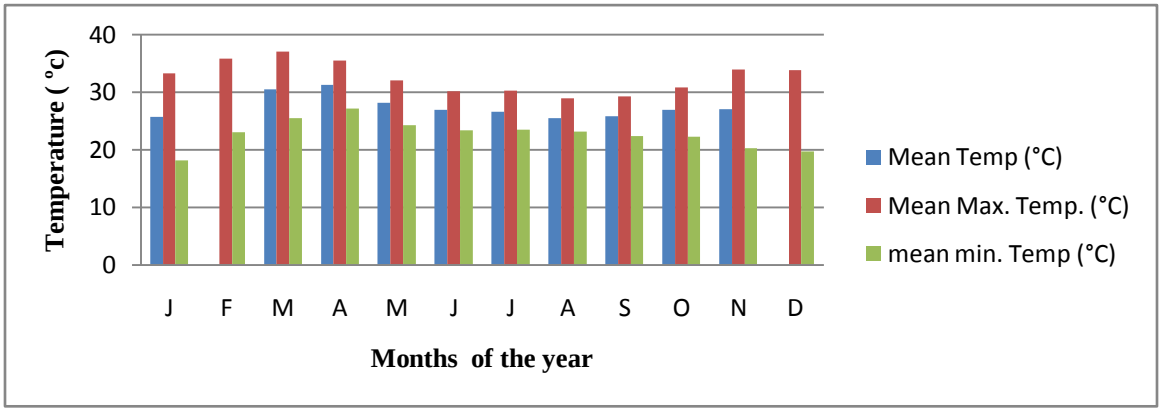

Figure 5.10: Mean temperature for Abuja. Source:www.tutiempo.net

5.1.6 Humidity

Humidity values from the figure 5.4 are high almost all through the year with a lesser amount during the dry season shown in fig. 5.11 below.

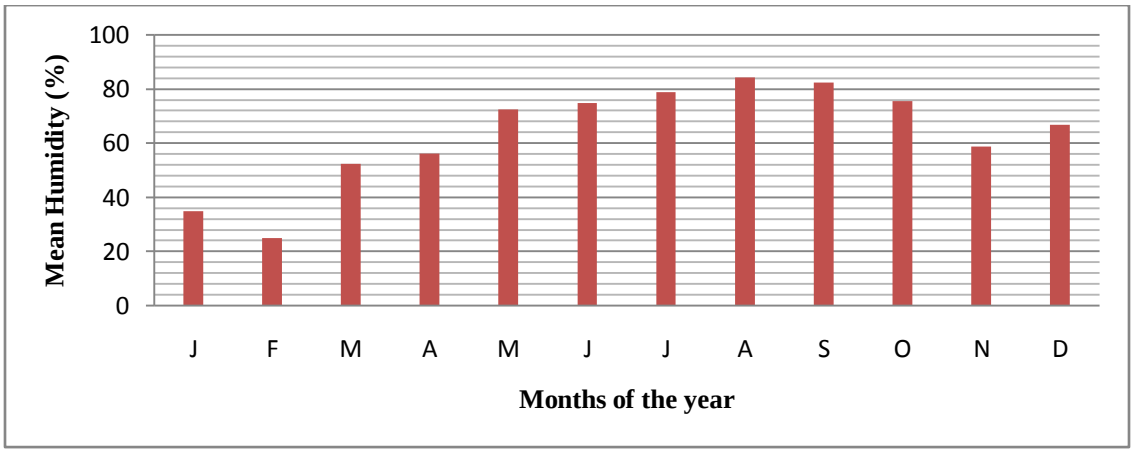

Figure 5.11:Mean relative humidity. **Source:** www.tutiempo.net

5.1.7Rainfall

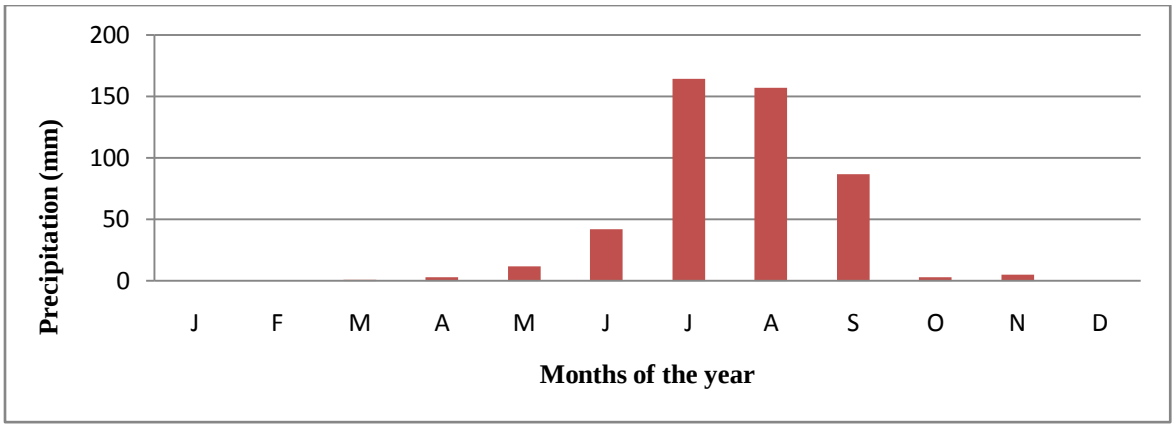

Figure 5.12:Monthly precipitations for Abuja. Source: www.myweather2.com

5.1.8 Prevalent Wind

The two dominant winds are the tropical maritime air mass and the tropical continental air masses of the FCT. The Tropical Maritime air mass is warm and moist, forming over the Atlantic Oceanmoving inland, in a Southwest to Northeast direction. The Tropical Continental air mass is developedover the Sahara desert, therefore warm and dry and blows in the opposite direction northeast tosouthwest.

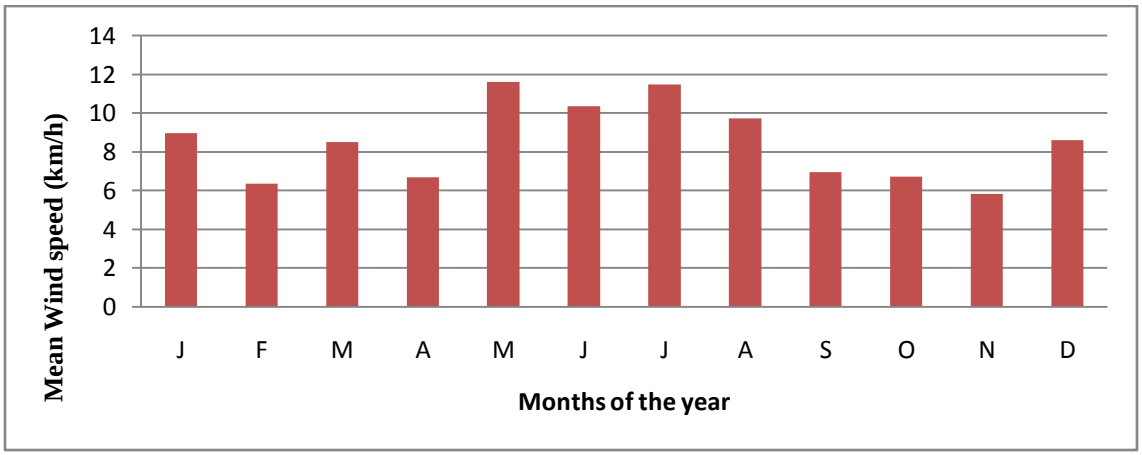

Figure 5.13: Mean wind speed. Source: www.tutiempo.net

5.2 Design Brief

The International Expo Centre Abuja is a centre with no regular period of exhibition and will be usually known for events, politics and achievement, of the country. Due to it nature of design, it possesses flexibility and adaptability. It has positioned itself as a revenue generating entity within the economy of nation, the global world and also for individuals, corporate bodies and the entire Federal Republic of Nigeria. This ensured that all hands are on deck watching the happenings of the Centre closely as a means of protecting their invested interests. It generates revenues through sales of tickets, exhibition of goods, renting of halls, event happening and advertising of goods, Standard international expo centre of this nature has laid down policy that emphasises the way and manner the Exhibitors and business people how to displayprofessionalism in their deeds will follows. To this effect, some business people and the Federal Government have come together to support a plan to build a flexible and adaptable standard International Expo Centre that will befit the country and will ensure the high standard building for exhibitions and showcasing of finished goods that can compete with other international counterparts around the world. ThisInternational Expo Centre must possess facilities of standard values, such as sophisticated facilities,moveable, collapsible facilities of modern design and must function properly and efficiently for the purpose of attracting human aesthetics worthy of exhibitionism, learning and showcasing of all products.

5.2.1 Brief formulation

This section describes spatial requirements of the proposed International Expo Centre. To ease the categorization of these requirements, six main functional spaces have been identified, namely. Main hall , three small halls, Open spaces, Administrative spaces;

Exhibition and Events spaces; Conferences Centre and parking lot spaces; podium and information unit and press unit spaces; ticket room, security, Ancillary facilities; and Services facilities. Specific spatial requirements of each of the identified categories are outlined below:

i. Administrative Spaces

The Administrative spaces are those empowered to run the activities of the International Expo Centre. Personnel hierarchy plays a vital role in such administration.

The spaces shall include the following;

a) Entrance/Reception: The Entrance hall provides a reception point, and an information display point (IDP). Adequate circulation space is provided to ease traffic particularly at peak periods. Easy access to stairways, elevators, and toilets (for public use) from the reception hall.This is emphasized in the design.

b) Offices: Offices of different sizes should be provided based on hierarchy of personnel, theManaging Director being the over-all head should be provided with the largest en-suite office which should contain adequate space for Executive table, storage cabinets and office sofa seating. The Director's office should also be attached to a secretary and a Conference room while the other offices should also have direct or near direct connection to the conference facility.

c) Conference Rooms: More than one conference room of different sizes should be provided to serve as an avenue for Board meetings and other administrative duties.

ii. Exhibition and Events facilities are also held. Theses spaces include the following;

a) hall 1(one): This consists of a large hall with offices, toilets, stores open spaces for provisions of demountables structures and provision of large grid structures, storage stairs case , escalators spaces technical controls and conveniencefacilities.

b) small hall 1-3 (hall one –three): The small hall serves in the same capacity as the hall one with the exception being that it serve smaller occasion unlike the hall one which is meant for big event .It surrounds the hall one but open on all sides for easy accessibility .

c)storage room: This room is where goods, chairs, materials to be used to partition the inside of the structure are kept.

d)escalator: This is an area link that connects you to the next level with electronic device.

The hall is special space dedicated to the exhibition, functions, wedding, political rally, They comprise of highly technical facilities which include the following:

a) Open hall this is an environmentally controlled grid-like structure meant for exhibition activities such as the displaying of the goods package. It should provide spaces for cast and crew members for activities,but it is required for the efficient running of the centre.

b) The facilities include: Pavilions: The pavilion is probably the single most important ancillary space for the proper functioning of the Expo Centre. The Expo Centre should provide space for Exhibition; Seminar. It should also provide stands or space for those that cannot afford paying huge amount of money for space but display their wares outside or in their pavilion.

c. Restaurant: This space is vital to International Expo Centre. A restaurant within the Centre will enhance efficiency in terms of reduced wasted time in search for food

during breaks and also serve as a revenue generating entity for the centre. It should comprise of a dining room, food storage and preparation, and cloak room facilities.

d. shops: An on-site shop will further enhance the effectiveness of the International Expo Centre by providing shops for participants store rooms: storerooms should be provided for storing wares or goods, demountables .

e) ticketbooth: The ticket booth is a small controlled space comprising of high-speed computer for the purpose of giving tickets. This space will also need high amount of electrical services.

iv. Conference centre

a)halls: These halls are dedicated for Meeting, Conference, Seminars ,Workshop, reception for wedding ceremony. The rooms should be large enough to contain about 500-5000 participants with adequate circulation space.

b)meeting room: This is a space dedicated solely for meeting and for presentations of papers. It should provide spaces such as kitchenette, toilets,store.

c) Seminar rooms: This space is meant for seminars and should be spacious enough to adequately carry out seminar activities.

d)open space: The open space should provide spaces for general opening day ceremony of the Expo, seminars. Spaces for letting, pavilion for states, open spaces for company.

v. Ancillary facilities

These are support facilities that the International Expo Centre can function independently ofmaterials, and equipments.

Convenience: Adequate WCs should be provided for the Centre and for visitors alike.

Green areas: These spaces will serve as green belts within the Centre for visual purpose, landscape elements and as area or places to be share forExhibitors for showcasing their wares .

Parking: adequate parking must be provided for staff, Exhibitors, and visitors to the Expo Centre.

vi. ServicesFacilities

The services facilities to be provided on site should include electrical services (alternative source and National grid), water supply and waste disposal (sustainable waste disposal).

5.2.2 Design Considerations

For the purpose of design flexibility and adaptability of an International Expo Centre, certain design considerations must be addressed. These considerations are inherent from the principles or design strategies to be adopted in order to achieve the design goals.

In order to design a fully functional International Expo Centre, other design considerations such as the ones listed below must be addressed

The principles in the design of an International Expo Centre.

Table 5.2Design considerations and solutions

Principles	What it means	Where is use or apply
Fluidility	This is a free flow of spaces	Fluidility entails the presence of open spaces, interconnection among spaces and the use of free flow forms
Versatility	Where basic characteristics of a space to be use for several activities	Provision of spatial area and floor heights higher than minimum, and the use of structure grids
Convertibility	The ability of the spaces to be converted to a new used or purposes	It adopted service system that permit for enlargement, design spaces that are to redesign by others and make use of modular design system. This is apply inside the main hall
Scalability	The innate quality of a building to expand and contract	The use of demountable wall, the use of larger grids that can be sub divided adoption of service system that allows for expansion e.g those demountables wall used
Modifiability	It is ability to allow for quick and easy change	The use of mobile partition wall, the use of moveable furnisture, and the use of suspended ceiling
Independence	The capacity of the building element to be separated easily	Adoption of a frames building structure use of secondary cladding materials, demountables building elements
	ADAPTABILITY	
Flexibility	It is a minor shifts of space planning	Is a design of building that will in habit change of function and not one that will fit specific function best e.g healthcare service, demographic shapes
Convertibility	Where their change in use within the building and converting it for another purpose	Adapted service system that permit for enlargement, design spaces that are to redesign by others and make use of modular design system. This is apply inside the main hall
Expandability	This is ability to increase or reduce the size of a building or space within the building	The use of larger grids that can be sub divided adaption of service system that allows for expansion e.g demountable wall used
Durability	Using selecting materials that required less maintenance and repair and durable materials	The used structural grid, spatial area flood height higher than minimum
Design for disassembly	It means where material or component can be reassembly after used and materials can be reuse	It is mostly used in temporary spaces or exhibition halls

i. Accessibility

Created access all round the centre for connecting corridors balconies within and around the Expo Centre.

ii. Acoustics

Within the Exhibition hall, acoustics should be controlled. Functional zones should be provided with surface or sub-surface material to interrupt the structural transmission of sound, noise levels should be controlled within zones by appropriate choices of material finishes onfloors, walls and ceilings, and the shaping of in spaces to prevent flutter and unwanted amplifying effects.

iii. Accessibility: Various means of access within and around the building are, escalators, staircases, hallways, will serve in enhancing access.

iv. Zoning: The incorporated walls are cavity panels to absorb reflect them. Wooden panels on walls, also strive to achieve a balanced acoustic property. Consideration should be given to whether the floors of thesespaces should be flexible to account for acoustic variability. Also acoustics upholsteries are to be used to satisfy the acoustic requirements, usually the level of absorbency when the space is unoccupied.

v. Visual considerations: every member of the audience should be able to see and hear clearly whatever is happening on every part of the hall. .

vi. Lighting: Effort towards achieving natural lighting minimizing artificial lighting should beencouraged. Experiments carried out in America indicate that there has been a steady increase in the use of artificial lighting instead of day-lighting. (Architects' Data).

vii. Flexibility in seating: Seats can be made flexible in order to use the same space for other activities. They can be retractable, foldable, sliding walls can be curtain material or demountable partitions.

Table 5.3 Schedule of accommodation

	Space	**Units**	**Floor area (m^2)**
	ADMINISTRATIVE SPACES		
1	Entrance porch	1	28
2	Entrance hall	1	40
3	Secretary's office	1	20
4	Director general office	1	56
4	Head of marketing	1	35
5	Bursa's office	1	35
6	Head of admin. Office	1	20
7	Admin offices	1	30
	CONFERENCES BLOCK		
	Auditorium	1	20
8	Toilet units	1	30
9	Personal we's	1	6.8
10	Offices for letting	1	1.6
11	Restaurant	1	40
12	Reception hall	1	20
13	Security unit	1	30
	Office for letting	12	3500
	Hall for letting	4	27,648
14	Security post	2	160
15	Ticket booth	4	160
16	Toilet	4	48
17	Changing room	2	36
	Exhibition and events facilities		
	FROM GROUND FLOOR TO THIRD FLOOR		
	Main hall (multipurpose hall)	6	21000
	Janitors room	2	9
18	Toilets	6	90
19	Offices	10	90
20	Store	2	8
21	Small hall	3	105
22	Open spaces	4	1084
23	Parking spaces	3	3000
	Alternative Usage		

	CHURCH		
	Church auditorium	1	35
	Altar	1	20
	Changing room	4	36
25	Pupil pit	1	9
	Toilet	4	
	Seats	3000	21000
	Vetting room		
26	Basket ball	2	
27	Change room	4	
28	Stores	2	
29	Toilet	4	
30	Lawn tains	2	
31	Changing room	4	
32	Wardrobe	4	
	Make-up room	2	
	Office	5	
	WCs		
	Pavilion room (seminar room)		
	Information and Press unit		
	Briefing room	1	
	Offices	5	
	Toilet		
	Chief information officers		
	Secretary		
	Ancillary facilities		
	Open spaces		
	Pavilion		
	Restaurant		
	Parking space		
	Opening ceremony ground		
	Kitchen		
	Clock room		
	Escalators room	2	
	Stacase	6	

5.2.3ConceptDevelopment

This is based on the axiom that any expo centre function hinges on exhibition, buying and selling.

And the figure represents the following:

- The round object represents countries currency/ money the rest represent space where the exhibition and exchange or buying selling takes place.

  Money changes so diamond changes the system, economics changes.

The concept chosen for the design is DIAMOND. This is because it undergoes changes theExpo Centre is a place that attracts alot of peoples for business purpose orshowcases their products. The centreis centrally located with all the other associated facilities radiating from it. This provides easy access to the exhibition area from all parts of the site and vice versas. The diamond undergoes changes as it develops and is relevant to the focus of the thesis that is ability to change. The diamond is also clear in appearance and hence clarity and eye openers for exposition shown the fig. 5.14 below.

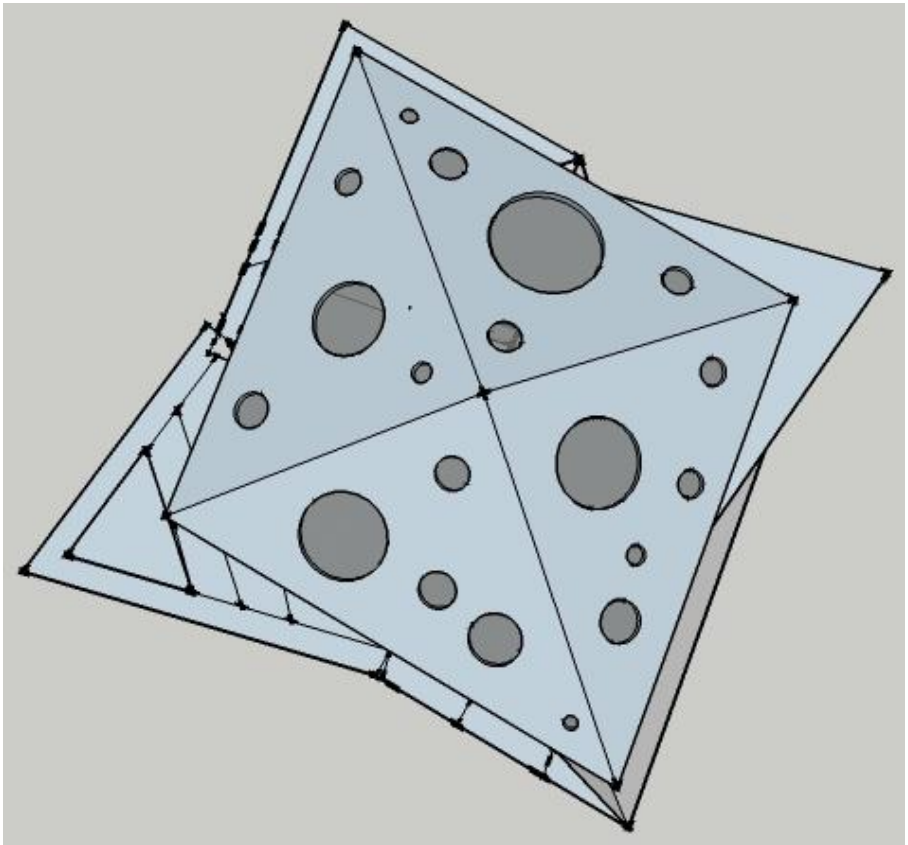

Figure 5.14: Concept of the Expo Centre

5.2 .4Site Planning and Landscaping

The site planning considerations evolved from both the vehicular and circulation with vast areas of lawns, green area and trees sparely planted away from the building. The main building which however consist of two major hexagonal shape at both end and an rectangular hall at the middle as the entrance to the main hall which stand out on an incline site. The Administrative building shown in fig.5.15below is surrounded by the support facilities in a radial manner maintaining their center points with that of parking space, water fountain, recreational area, conference block, open space, and the main hall and the small surroundingthus making setting out during construction relatively easy The site also consists of pockets of green belts, parking spaces, between and around buildings which enhances the landscape aesthetics of the site.

5.2.5 Spatial Organization

The building consists of both vehicular and pedestrian circulations with vast areas of lawns and trees sparsely planted away from the building. The building which however consist of two major hexagonal shape with a rectangular entrance comprises of two lift two escalators and toilets, janitors shown in fig.5.16 below. It consists ofAdministrative block, Conference hall, small hall and some packing spaces and the main hall surrounded by three small halls link with pedestrian and open spaces.

The design is described to be hexagonal at both end with an rectangular entrance to the main building The main hall which is the most prominent feature of the centre. The design of the centre also consist of the big courtyard and opening spaces. The building

consist of the main hall consists of other facilities such as the exhibition spaces, changing room, offices, administration block, conference, small halls sores offices,

janitors etc.

Floor Plan

The floor plans of the main building are hexagonal at both end with rectangular entrancein between the hexagonal design the plan is on a basic grid of 10m and the halls seem apparently into eight long strips. The building planare four floor plans as seen in fig 5.15 below, spaces are created on each floor which serves many purposes such as thepossibility for vertical expansion, green roof gardens and most importantly additionalspaces are created when exhibition activities are on.When demarcated, spaces are enough. These spaces can be converted to serve new functionsboth on temporal and permanent basis. The floor plans also consist of an atrium whichserves to provide lighting and enhanced ventilation.The supporting buildings' floor plans are adaptations and modification of the administrativebuilding's plan. These forms were incorporated so as to break monotony and create a bitof contrast whiles maintaining harmony among the buildings. The aesthetics of the structure are glazing,waffle ceiling, precast concrete hood, pipe gigantic column,,long walkway around the main hall to the third floor where exhibitors will equally display their wares. Thesupporting facilitiesinclude thestores, janitors, offices, workshop, a multi-purpose hall and conference centre.The Administrative building is designed to be flexible and multi-functional in nature, thussome strategies were employed to achieve it; these strategies include: the use of mobilepartition walls, the use of cladding as skin for the building, the use of wider grids, double volume,provision of higher headroom with capabilities for

suspended ceilings; the use of largewindows which fosters fluidity and a host of other strategies employed to make that thebuilding serves its intended functions of a flexible and adaptable building.

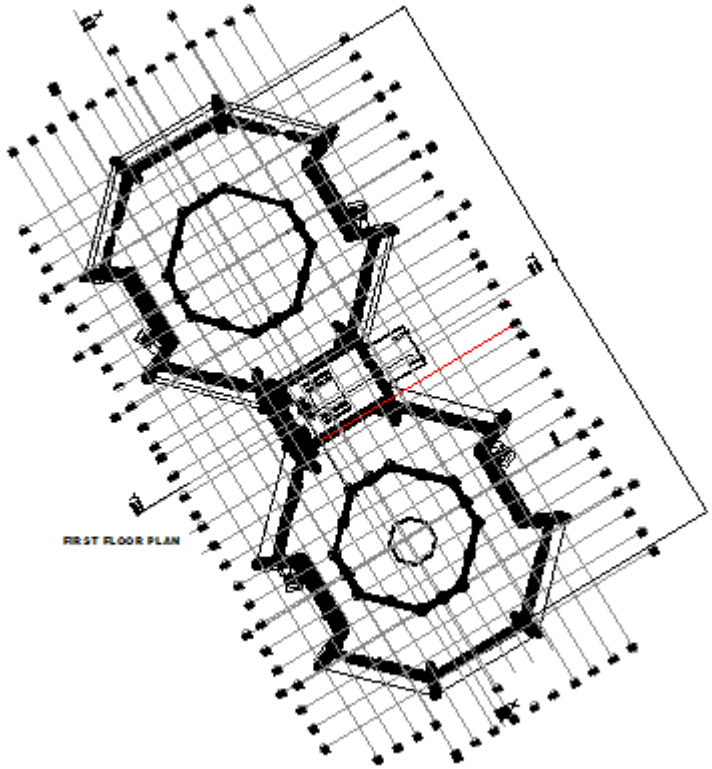

Fig. 5. 15: Ground Floor for the Main Exhibition Hall

Form and Elevations

The form of the building is derived from the vertical stacking of the individual floors to create a structure that is aesthetically pleasing and one that functions well for the purpose of an International Expo Centre A conscious attempt was made to make the façade symbolic of theExpo Centre concepts for achieving the desired result as seen in fig. 5.16 below.



Figure 5.16: Main Hall Elevation

5.2.6Building Form and Architectural Expression

The materials used for the construction of the proposed International Exposition Centre consists of a wide variety ranging from steel and concrete which serve as the major structural materials,glazing, pretcast concrete hooduse for aesthetics prevent aluminum composite panels which serve as external cladding materials, Titanium cladding, deflect the sun's rays helping to aluminum roofing sheets, laminated glass for windows, sound baffles for sound absorption within the sound stage, fiber glass for atrium cover, polystyrene panels for interior partitioning and a host of other specific materials for specialist functions as determined by experts from the different fields of construction.

The structural system adopted for the administrative building is a steel and concretecomposite frame structure. This structural system will best suite the design by providing optimum support for the building's dead and imposed loading. The addition of concrete to cove the steel members is an added advantage in terms of additional strength and for the protection of the steel members against conditions such as fire.



Figure 5.17: Elevation for Admin Block

In conclusion, the design of an International Expo Centre presented some challenges especially in the area of achieving flexibility, but after careful study of the research findings, I was able to come up with a design that reflected the principle of flexibility and adaptability in the design of an International Expo Centre

5.2.7 Alternative Uses

Based on the sub-topic, flexibility and adaptability of a design of an Expo Centre Abuja which is said to be flexible and adaptable for other used such as church and indoor games chosen are the alternatives uses on this proposed design.

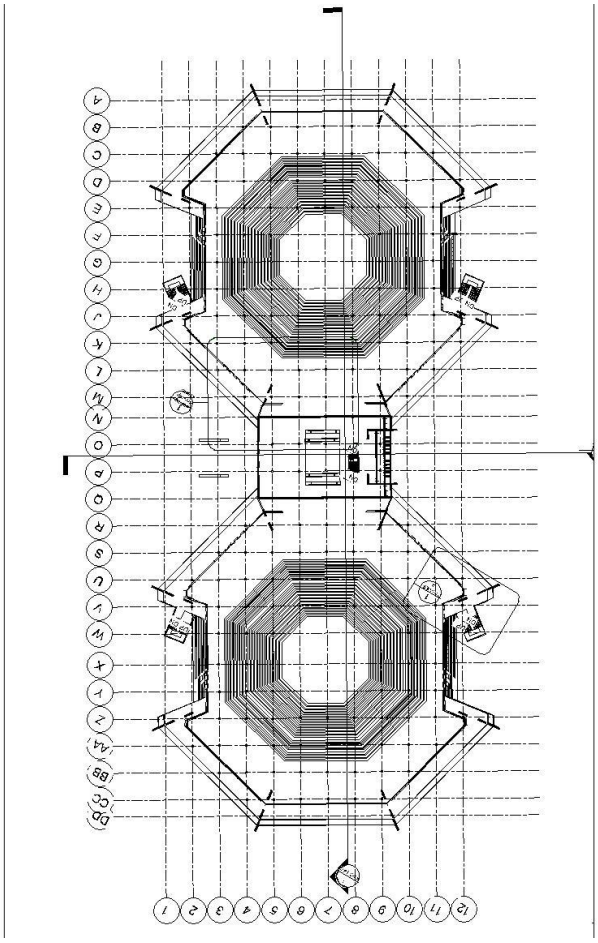

Fig. 5.18:Alternative Floor Plan for Other Purposes

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

The research set out to examine the application of flexibility and adaptability in the design of an International Expo Centre.It is an exercise in both exhibition and market design since the Expo Centre combined pure exhibitionism with buying and selling. The exhibition aspect is givenhigh considerations. It is endowed with a variety ofplanning possibilities and also other exercises in design of open spaces or open field. The problems identified in the beginning to which this research aimed at addressing was the complex nature of the Expo Centre whichpresented difficulty in the management of available spaces at the International Expo Centre and the lack of technical know- how which was as a result of inadequacies of spaces. This lead to various findings emanating from a concise literature review in which the answers to the problems identified were studied and provided accordingly. The literature review provided aids and guidelines under the shell of design strategies and principles to which when adopted in the design of an International Expo Centre, better efficiency would be recorded as well as increased skills acquisition which in turn would lead to greater level of standard within the centre. It was not enough however to just study literature and preceded to design the expo centre as was established.Thus,live case studies were also under taken to determine what existed in order to be better informed on what needed to be done or provided for, in designing a flexibility and adaptability design of an International Expo Centre. The results of these case studies were inciting and played very vital roles in the over-all end product (International Expo Centre).For instance, from the case studies reviewed, it was gathered

that flexibility adaptability design principles were employed in relatively and that the lack of it, resulted in less efficient learning environments for the Centre .The Internationalcases employed more of the design principles than the local cases even as results gathered included the fact that expo centre were grossly inadequate within the country; the few that existed also lacked mostly two things; infrastructural facilities and the skilled man power to impart the knowledge of management that was acceptable by the relevant governing bodies. It was also established that indeed flexibility was solution for many design problems. For instance the innate quality of a building to allow for change would make a building more efficient, would increase the lifespan of the building and foster content among users of the particular building. The study was also able to establish that flexibility and adaptability design principles were employed in not just the design of an International Expo Centre,but also in the design of other building types such as schools, hospitals and office buildings. The study also revealed that adequate research has not been done in the areas. The fact that the federal government and stakeholders have taken measures to address the inadequacies of centers both in terms of facilities and expertise with the proposal for the erection of standard International Expo Centre within the Federal Capital Territory a project that must be embraced and must be encouraged forthe over- all best interest of the country. For the purpose of this research however, the understanding of these terms fluidity, versatility, convertibility, scalability, modifiability and independence as they concern architectural designs proved most important in achieving the set goals of the research.

6.2 Recommendations

After carrying out all necessary research on flexibility and adaptability of design of an International Expo Centre,the following recommendations are put forward:

i. Architect professionals should be more enlightened in the aspects of flexibility and adaptability when designing an Expo Centre. Even though the concept is not new in the International community, it has not been fully embraced within the Nigerian context of architecture.

ii. Expo centers should be built in the six political zones while already existing ones should be upgraded, maintained to meet with international standards.

iii. The design of an International Expo Centre should adopt the principles of flexibility and adaptability design in order to achieve maximum efficiency of both the building and its usersalike.

iv. Architects should adopt with these principles in other building types for improved functioning of such building.

v. Further studies should be done in this area to improve on available resources as adequate and substantial information are not readily available; this may discourage those intending to fully understand and apply its principles on a wider scale.

6.3 Contributions to Knowledge

It is hoped that the application of the research findings has revealed certain facts that were not common knowledge; these facts include the following;

i. A building that is flexible and adaptable and can allow a lot of activities to take place at the centreall year round because it can be restructure. It helps users to personalize their

work space which improves efficiency because it removes constraints that may put a strain on the psyche of an individual making him less happy and less productive.

ii. A building with flexible designed elements such as demountable walls, larger structural grids, higher headroom can undergo change at any time ,thereby allow for multifunctional uses.

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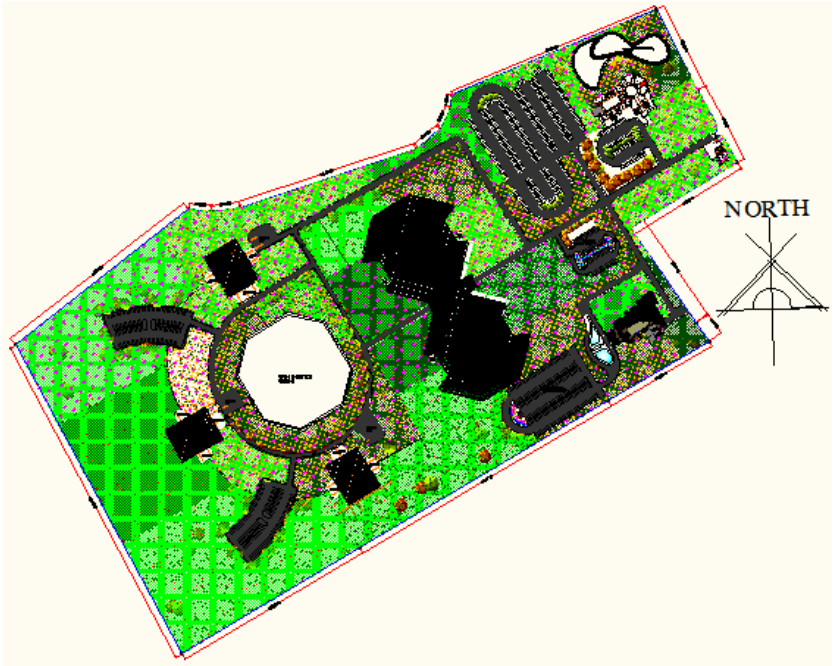
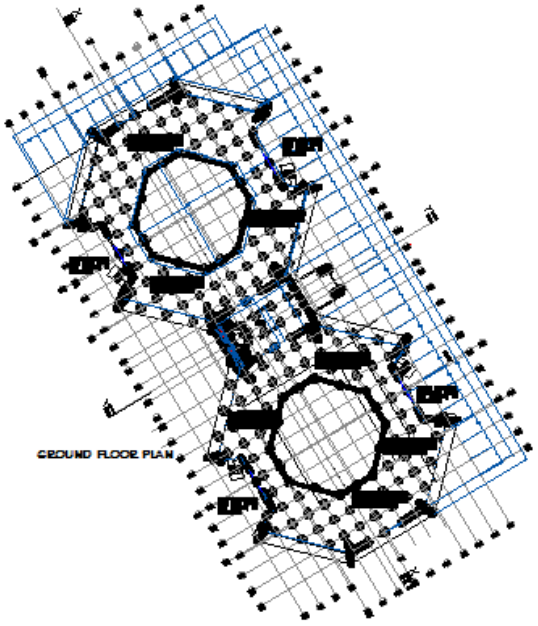
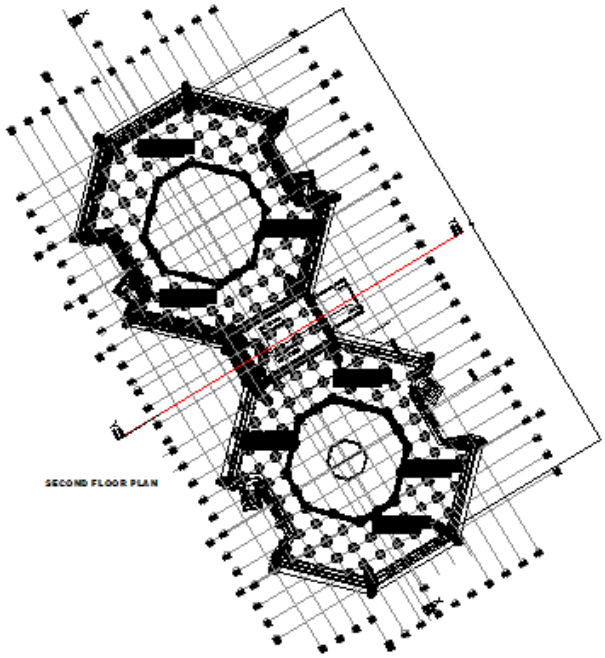
APPENDICES



APPENDIX I: SITE PLAN



APPENDIX II: FIRST FLOOR



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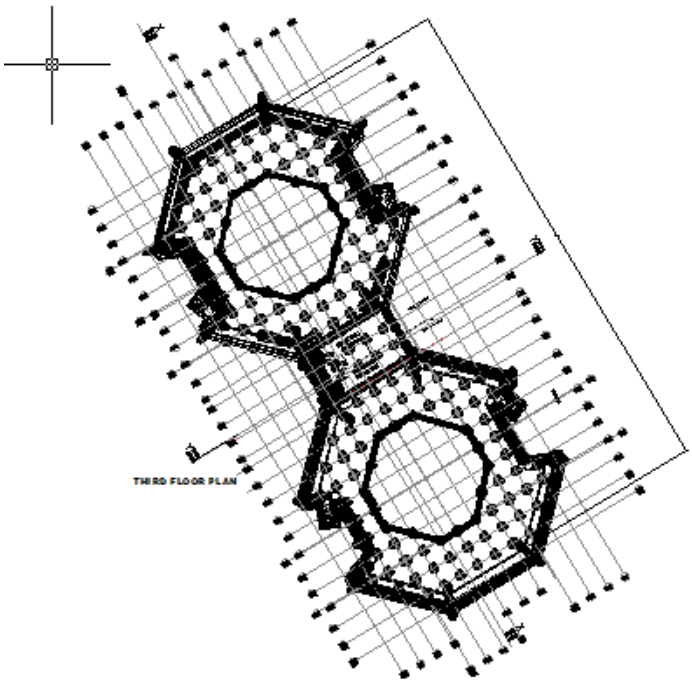

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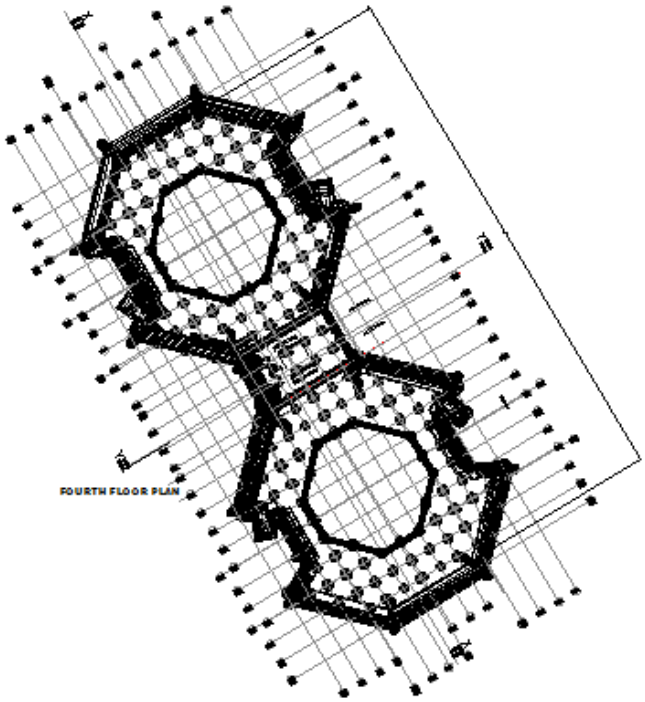

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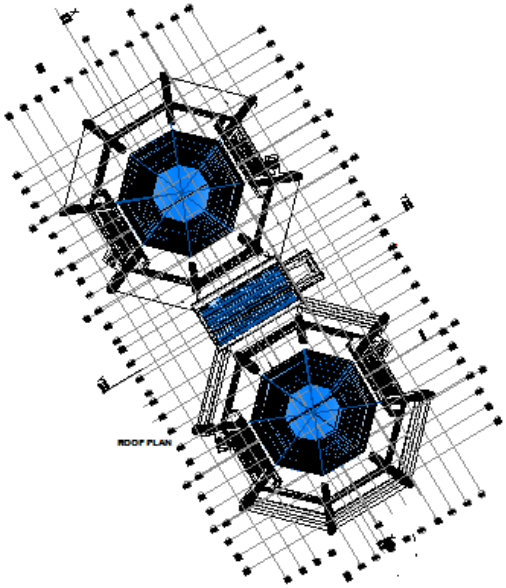
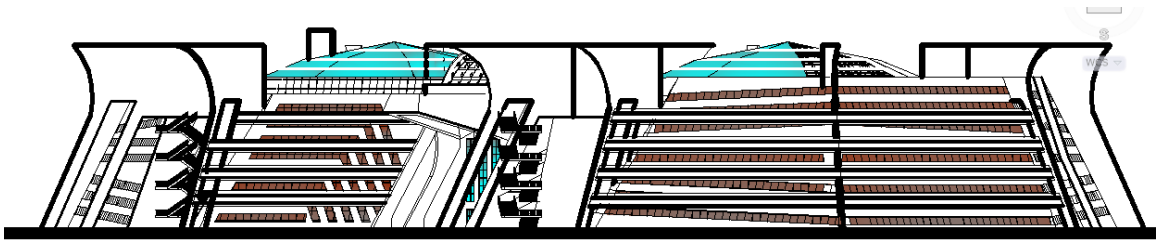
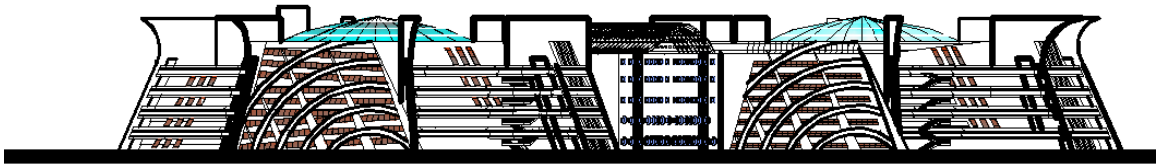


APPENDIX VI:ROOF PLAN



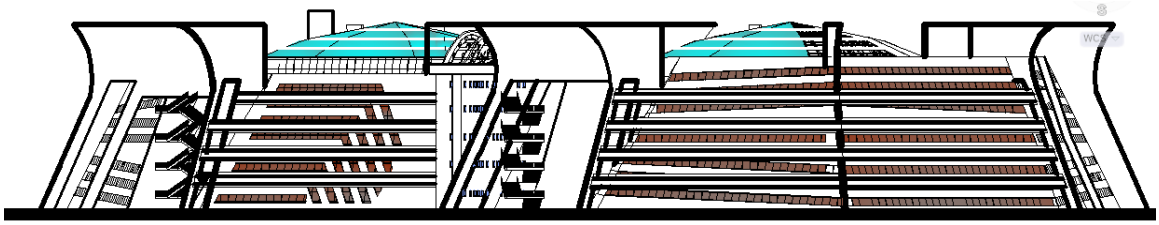
NORTH ELEVATION (VIEW)

APPENDIX VII:SOUTH-WEST ELEVATION



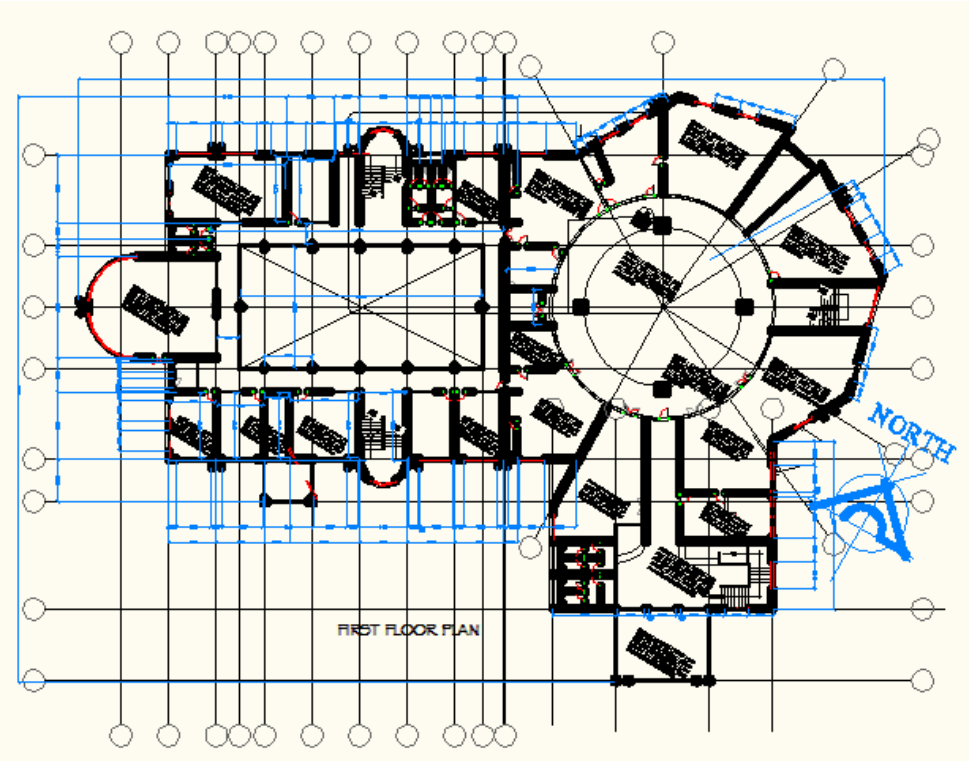
WEST ELEVATION (VIEW)

APPENDIX VIII: SOUTH-EAST ELEVATION

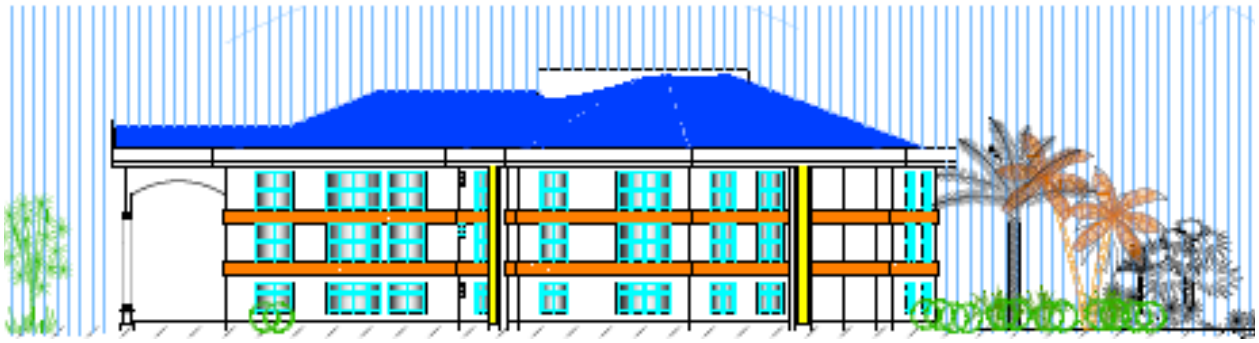


SOUTH ELEVATION (VIEW)

APPENDIX IX: SOUTH NORTH ELEVATION



APPENDIX X: ADMINISTRACTIVE BLOCK FLOOR PLAN



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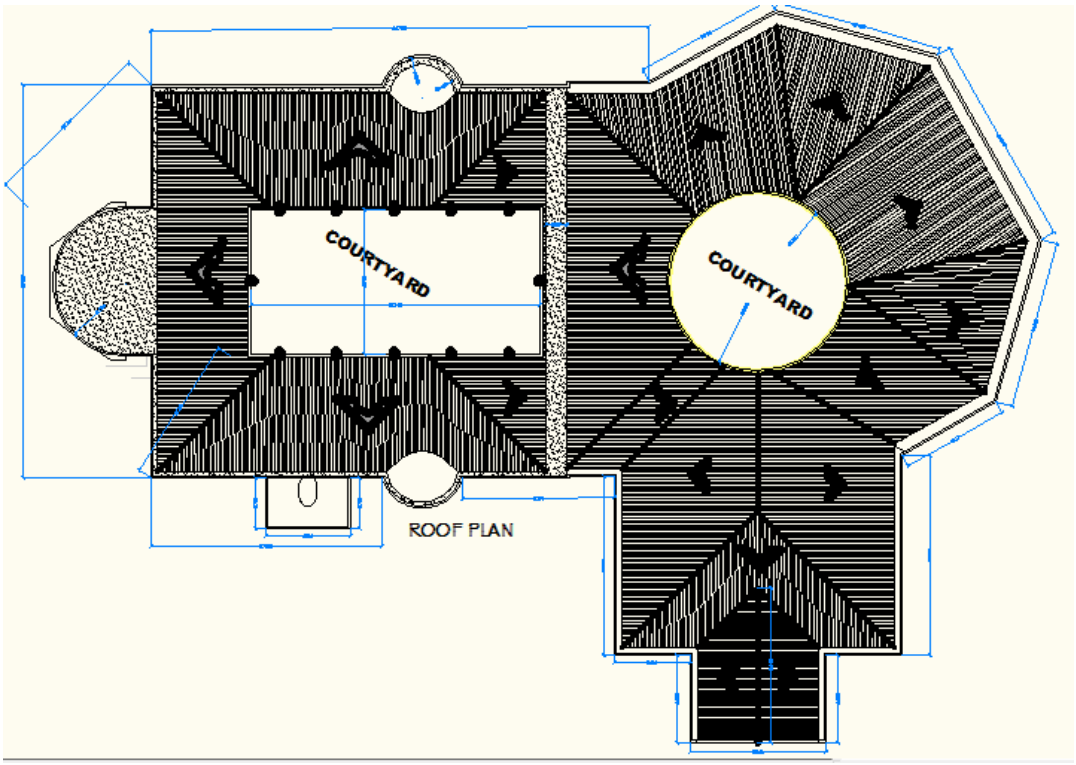
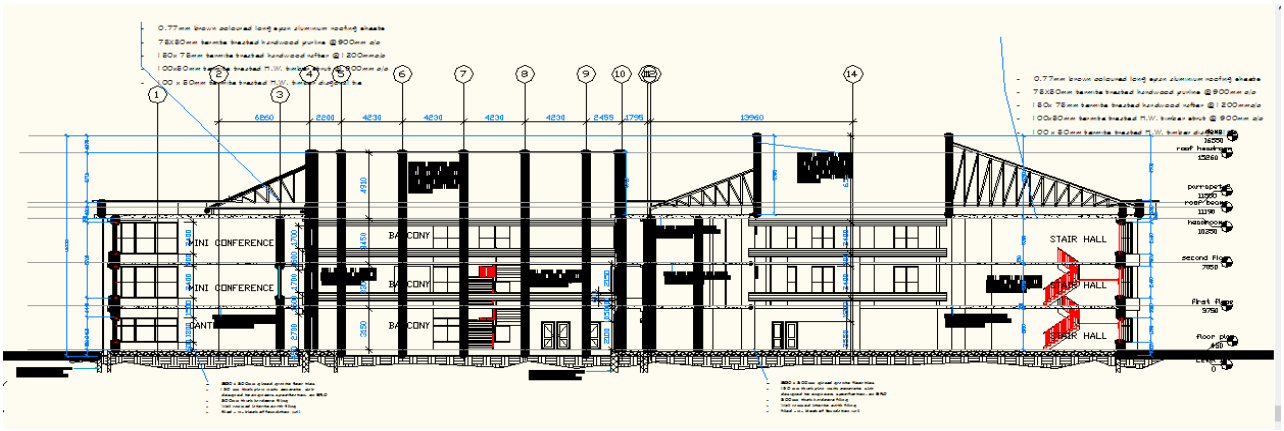
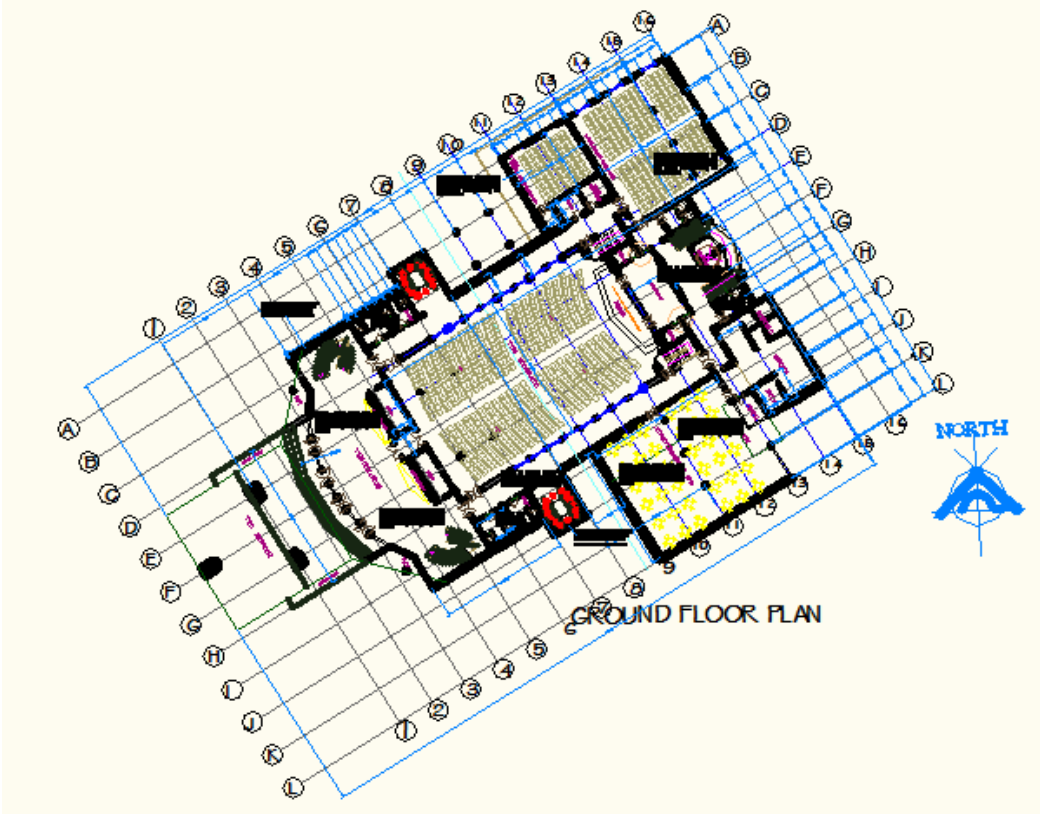


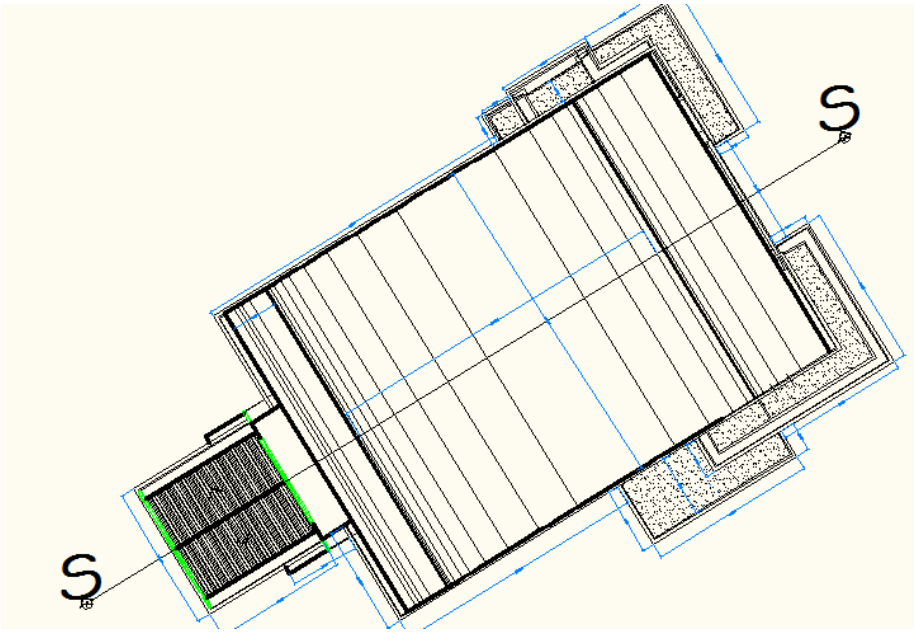
APPENDIX XII: ROOF PLAN ADMINISTRACTIVE BLOCK



APPENDIX XIII: SECTION X-X ADMINISTRATIVE BLOCK



APPENDIX XIV: GROUND FLOOR PLAN CONFERENCE CENTRE



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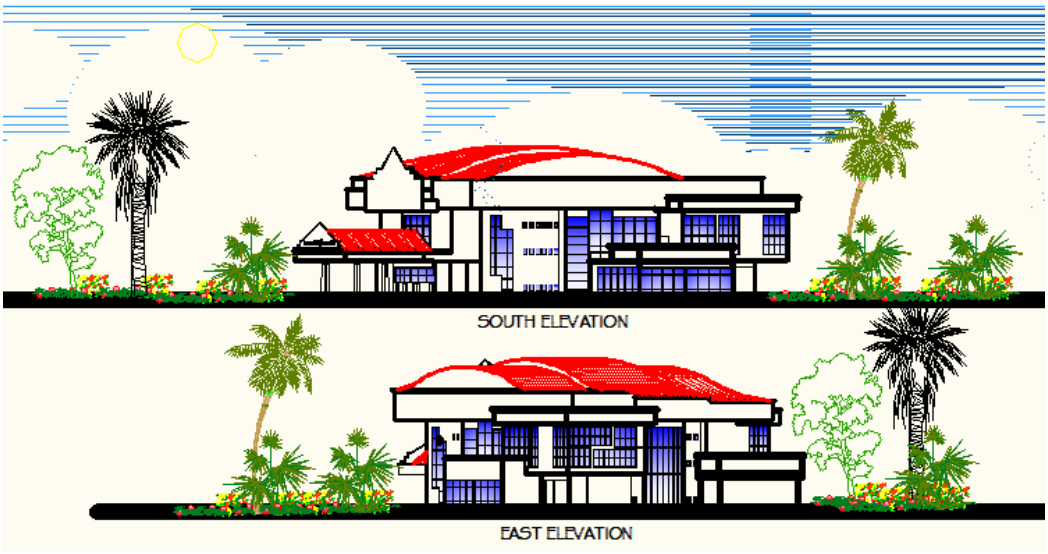

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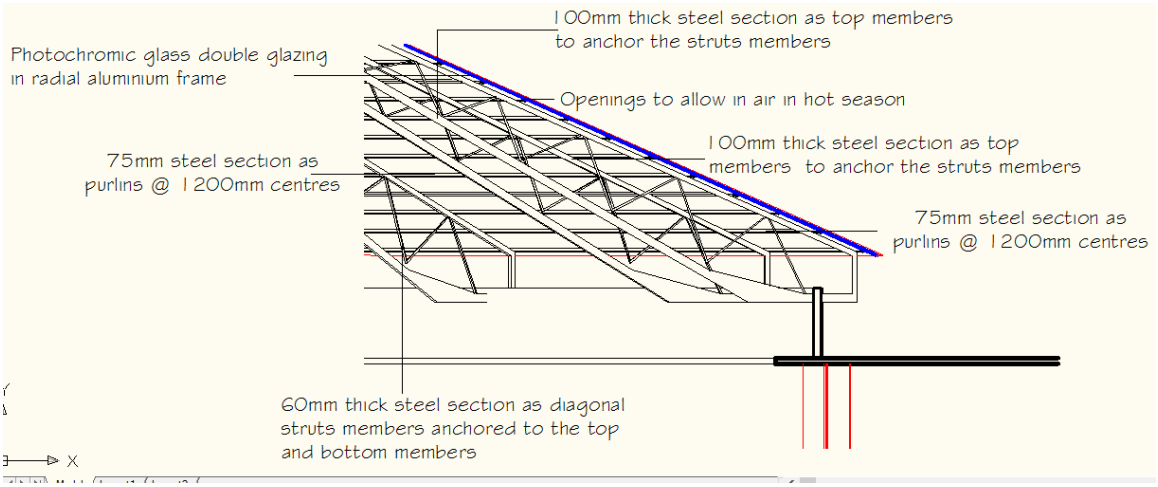

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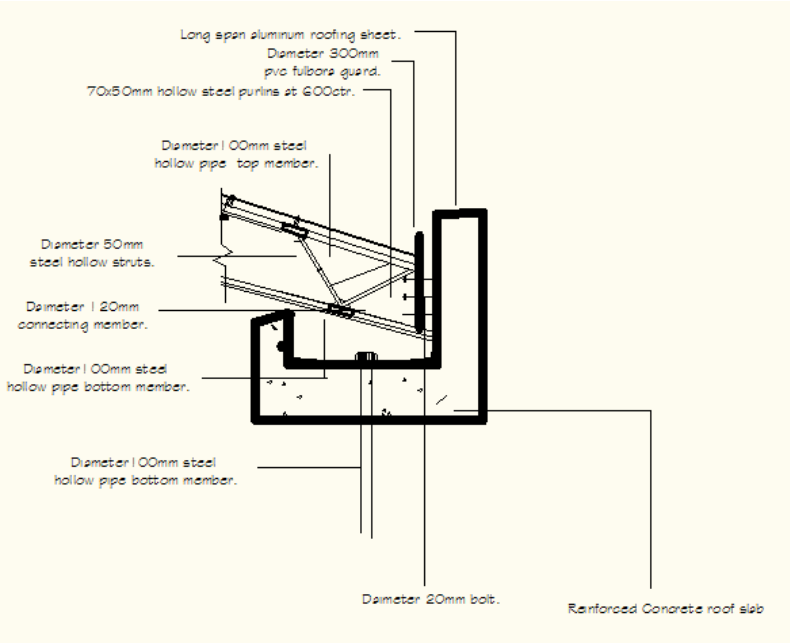

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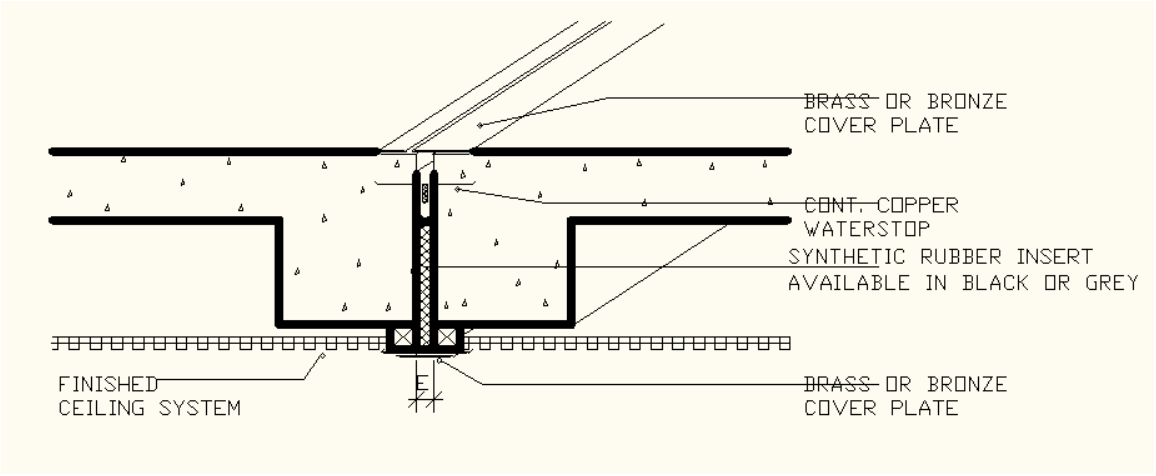

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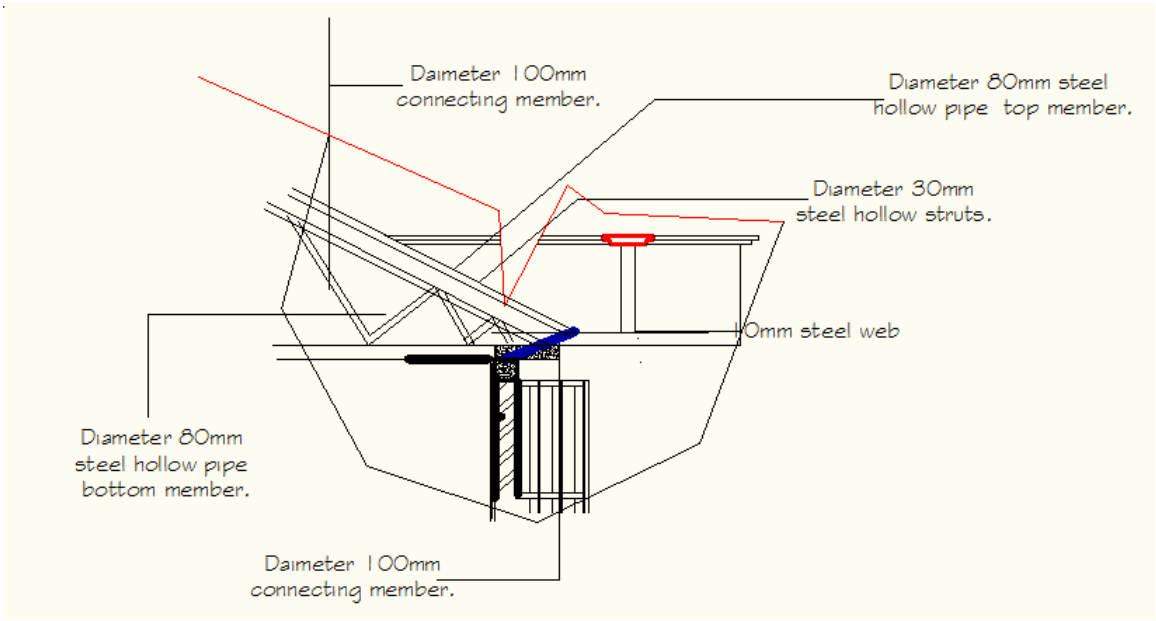
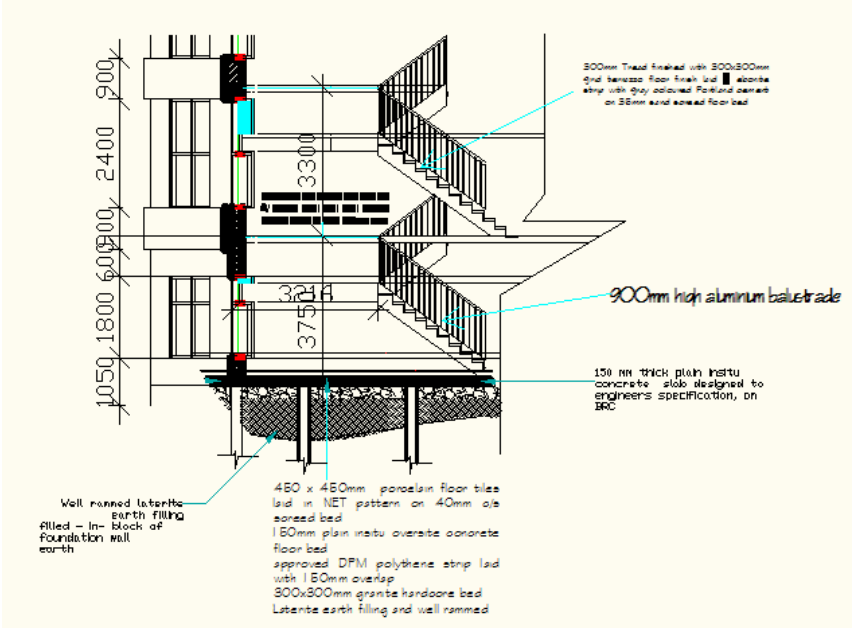


APPENDIX XX: DETAIL 04



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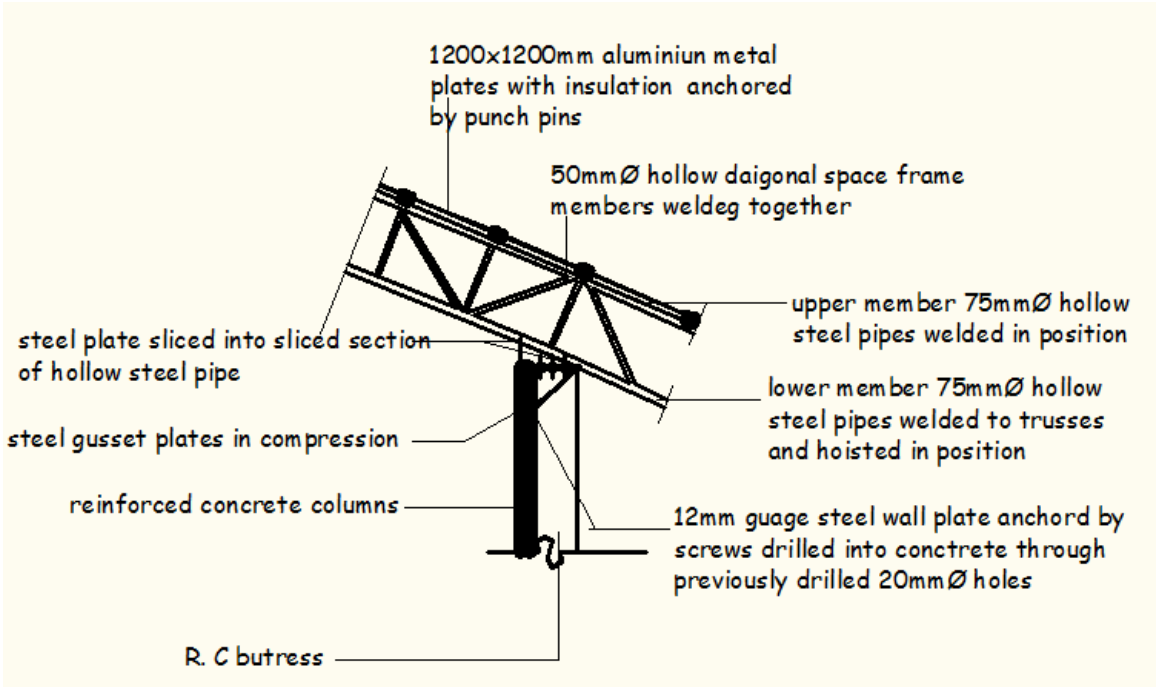

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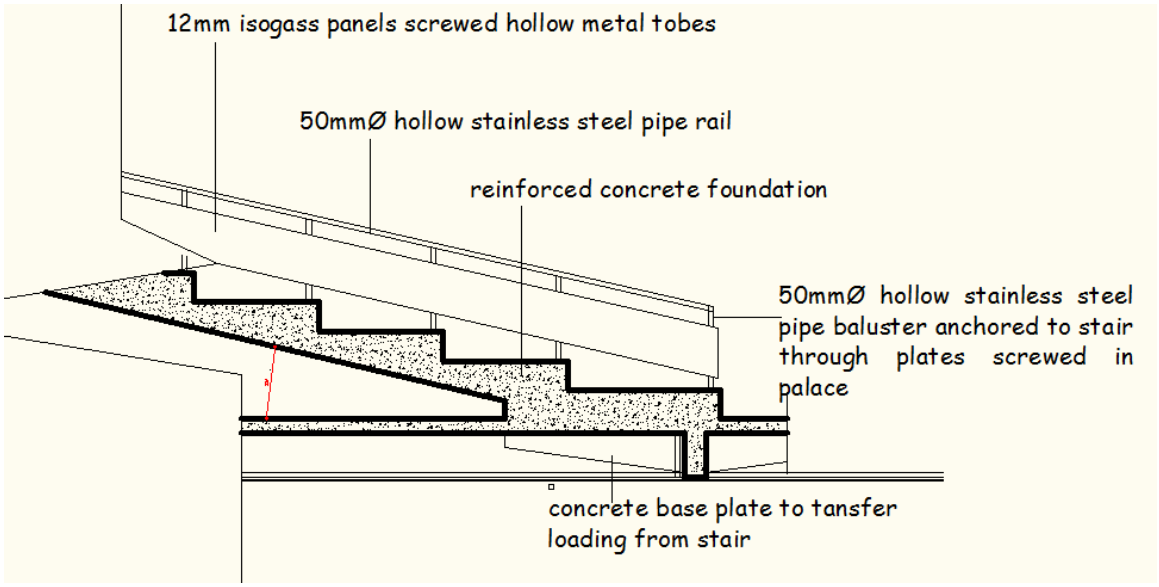

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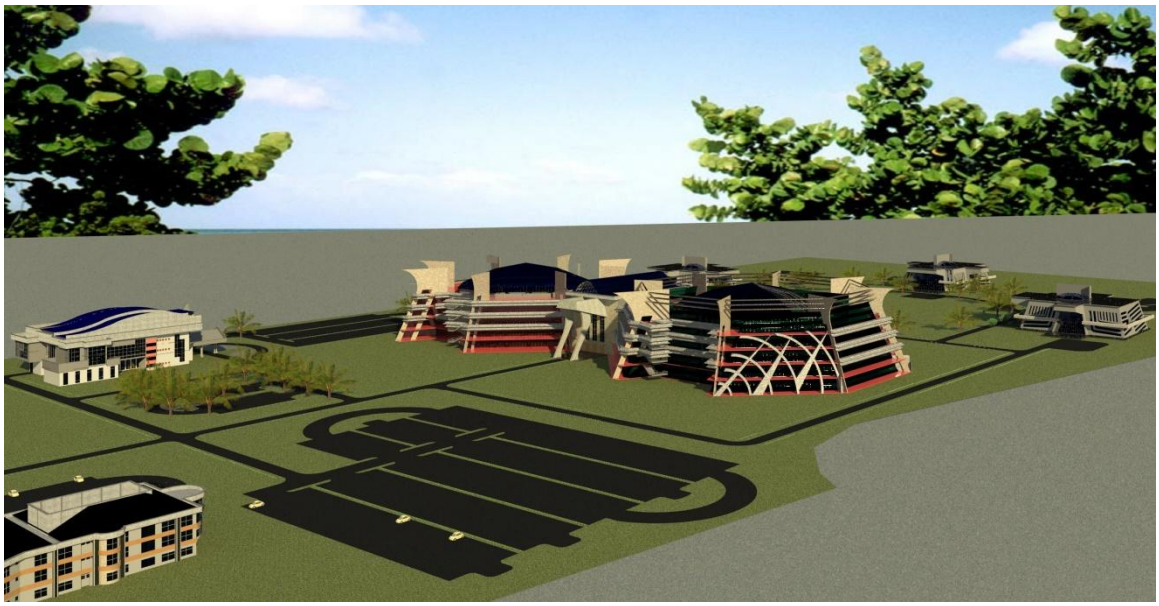
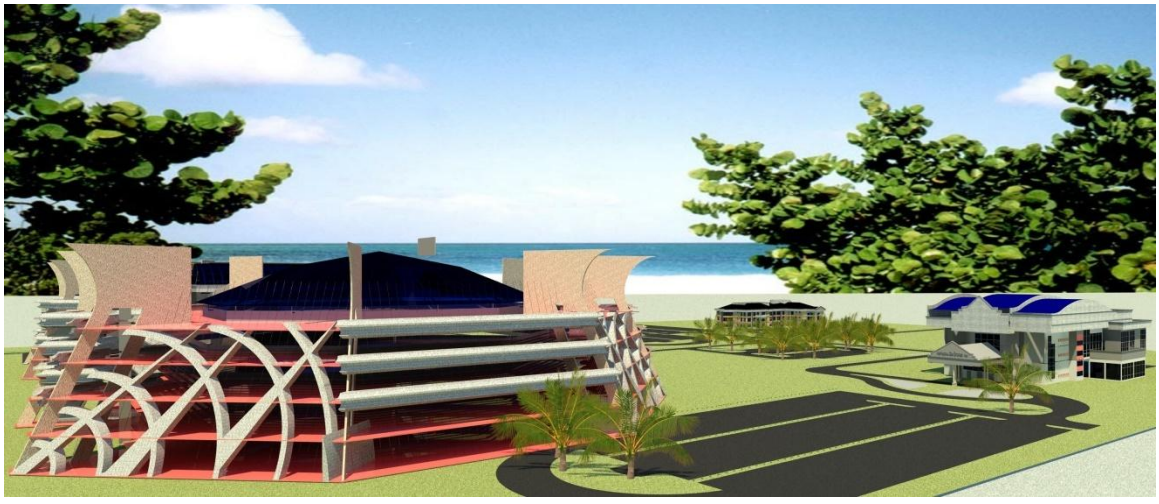
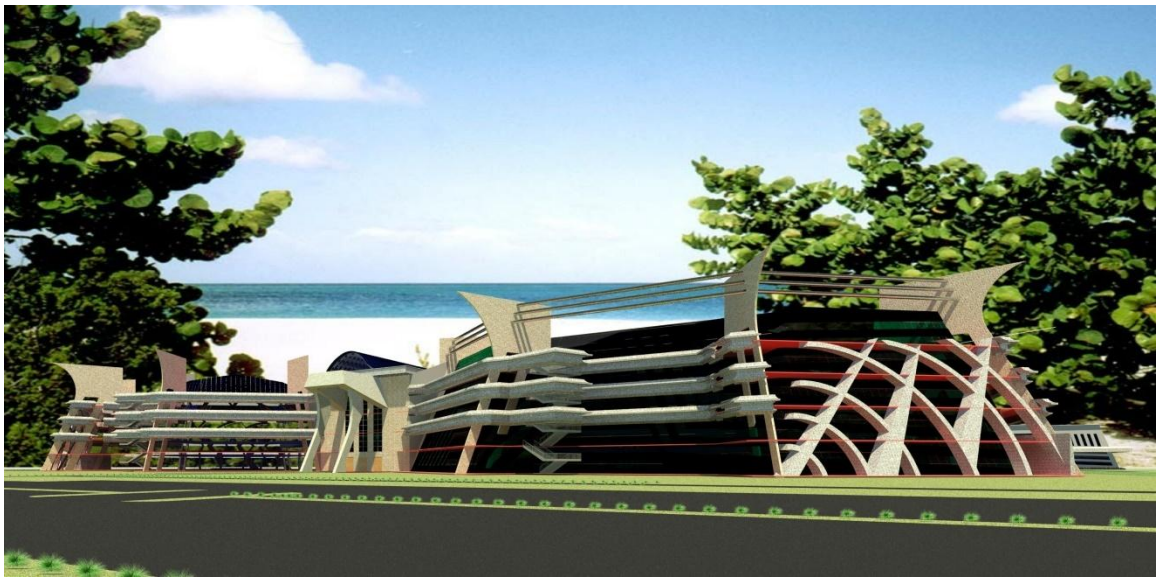


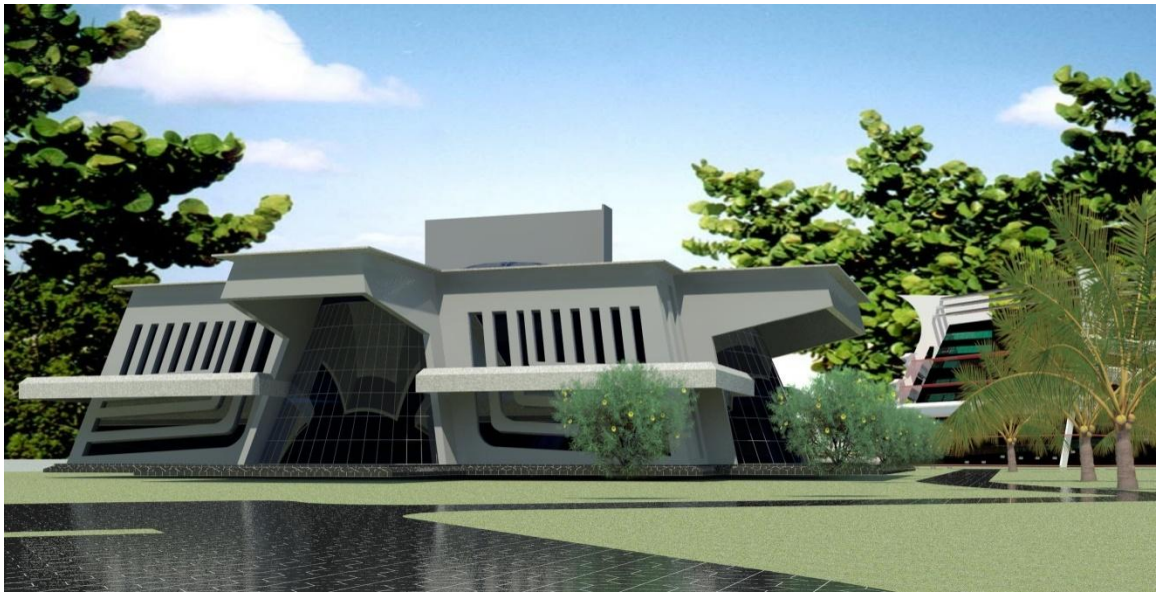
APPENDIX XXIV: OVER ALL VIEW OF 3D OF SITE



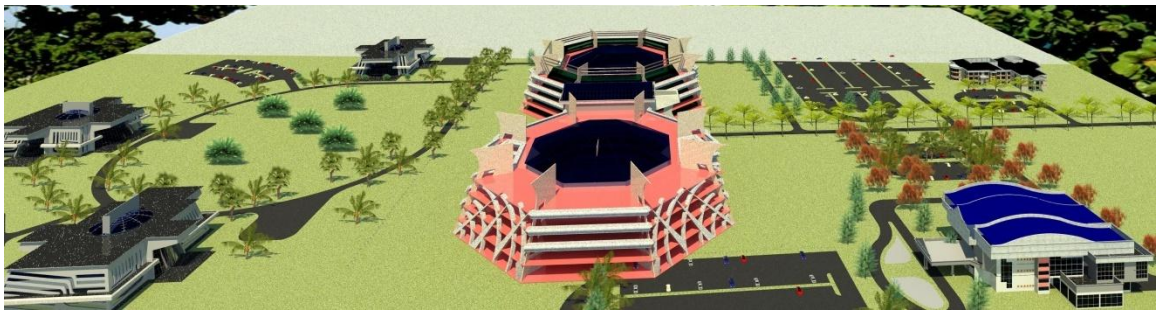
APPENDIX XXV: 3D MAIN EXHIBITION HALL AND SMALL EXHIBITION HALL



APPENDIX XXVI: 3D MAIN EXHIBITION HALL



APPENDIX XXVII: 3D CONFERENCE CENTRE



APPENDIX XXVIII: 3DOVERVIEW OF THE SITE

APPENDIX XXIX: INTERVIEW SCHEDULE

1. When last do you used the centre and how often do you used it?
2. What do you do in the centre when there is no trade fair?
3. What next do you there?
4. What next do you do there?
5. It is fully utilized?
6. What is the name of architect that did the design?
7. What do you do were there is no trade fair?
8. While it is that some structures are dilapidated?
9. There a lot of open spaces what do you do with it?
10. How is the environment when trade fair is on?