# EVALUATING THE IMPACT OF MULTI-USER SPACE IN THE EVOLVING NEW DESIGN CONCEPT FOR FACULTY OF SCIENCE:

**FEDERAL UNIVERSITY KASHERE GOMBE.**

**BY**

**AMOS IBRAHIM Bsc (ABU 2010)**

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**NIGERIA.**

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## DECLARATION

I declare that this thesis entitled ‘‘EVALUATING THE IMPACT OF MULTI-USER SPACE IN THE EVOLVING NEW DESIGN CONCEPT FACULTY OF SCIENCE: FEDERAL UNIVERSITY KASHERE GOMBE.. Is the outcome of my research work and has been written by me in the department of Architecture under the supervision of Dr. M. D. Ahmed . The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this project report/thesis/dissertation was previously presented for another degree or diploma at any university.

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| **Amos Ibrahim** | _____ | _____ |
| Name of Student | (Signature) | (Date) |

## CERTIFICATION

This thesis entitled ‘‘EVALUATING THE IMPACT OF MULTI-USER SPACE IN THE EVOLVING NEW DESIGN CONCEPT FOR FACULTY OF SCIENCE: FEDERAL UNIVERSITY KASHERE GOMBE’’ by Amos Ibrahim meets the regulations governing the award of the Master of Science degree in Architecture of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

| | | |
|---|---|---|
| **Dr. M. D. Ahmed** | | |
| (Chairman, Supervisory Committee) | (Signature) | (Date) |
| **Dr. M. L. Sagada** | | |
| (Member, Supervisory Committee) | (Signature) | (Date) |
| **Dr. M. D. Ahmed** | | |
| (Head of Department) | (Signature) | (Date) |
| **Prof. A. Z. Hassan** | | |
| (Dean Post Graduate School) | (Signature) | (Date) |

## DEDICATION

This research is dedicated to my late father Mr Amos K. Ma'ori

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To the entire Staff of the departement, I thank you all. To the students, the struggle must continue.

## ABSTRACT

Faculty of science in a higher institution of learning can be seen as an academic unit containing a number of related disciplines which are concern with specific phenomena such as technological milieus, laboratory culture and other science policies. And because faculty of science is multidisciplinary and interdisclinary the need for a multi-user space design becomes paramount, because a multi-user space design reduces wastefulness space usage, provides flexibility to the design and also provides great improvement of interaction between the various disciplines in the faculty of science. Therefore this thesis is aimed at identifying spaces that are suitable to being multi-user amongst the various disciplines in the faculty of science. To achieve this aim, substantive findings as well as theoretical and methodological contributions that are related to the topic were carried out, case studies of some selected universities with faculty of science was carried out, and instrument of data collection such as questionnaire was also employed. From the review and the study, it was established that most of the faculties of science are not designed to being multi-user, they are discretely designed and not properly linked together with no full range of shared facilities. The study tends to make a passionate call to Architects and other designers to consider the incorporation of multi-user space as a necessary requirement for design.

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# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of Study

Faculty of science is a complex within a university where teaching and research on science takes place. Science Studies is concerned with the history of scientific disciplines, the interrelationships between science and society and the alleged hidden purposes that underlie scientific claims. While it is critical of science, it holds out the possibility of broader public participation in science policy issues (Bauchspies, 2005). Furthermore Science studies can be understood as a moment in a steadily widening conversation, in which scholars with interests in the social, historical, and philosophical analysis of science and technology have achieved a succession of wider integration.

Science study provides a conceptual tool for thinking about technical expertise in more sophisticated ways. It tracks the history of disciplines, the dynamic of science as a social institution, and the philosophical basics of scientific knowledge. In short science study provides a forum where people who are concerned with science and technology in a democratic society can discuss complicated technical issues (John Hess 1997).

The fact that most of the disciplines in faculty of science are related and complementary, the need for a multi-user space becomes imperative so that there will be flexibility of space usage to reduce wastefulness in the faculty design  improve interaction among the various discipline and also ease the usage of space within the faculty, better the spatial organization and enhancing the economical approach to the orientation and layout of the

faculty of science. And with this multidisciplinary collaboration amongst academics and students in the faculty of science will reap immeasurable dividends in terms of professional competence, improved problem solving abilities, effective communication among professionals (Aminu Kano,2006),

This evaluation of new space standard will tend to optimize space standard for effective usage so that disciplines with common point of intersection should be placed close to themselves and specific aspect of convergence to be integrated as well. Furthermore, a study of some existing Sciences faculties in selected Nigerian universities reveals that this aspect of design for multidisciplinary collaboration is lacking. This follows the assertion by Afama (2004), that faculties in many Nigerian universities, especially the older generations, are not collectively designed but they are a mere collection of discreet disciplines.

Practically, the result of this thesis shall be applied in the design of the proposed Faculty of Sciences, Federal University Kashere Gombe. The proposed faculty is to contain four departments namely Biological science, Chemistry, Mathematics and Physics.

**1.2 Problem Statement**

Despite the fact that that faculty of science play an important role or remains pivotal to a lot of faculties such as engineering, pharmacy, veterinary medicine, environmental design, and education little attention has been given to its design thereby approaching it through traditional method. This faculty is usually discretely designed with no full range of shared facilities and no flexibility of space and environment, this trend has been found to be both cumbersome and wasteful thereby hindering or jeopardizing its chances or ability to allow

for future expansion and integration of other departments (Jantsch,1971). As such, the need for to address this challenge in faculties of science which has characterised many Nigerian tertiary institutions is paramount.

### 1.3 Aim and Objectives

The aim of the study is to examine the place of multi-user space in the design of faculty of science.

Objectives of this study include;

I. To study existing science faculties that were designed along the traditional concept.

II. To identify teaching and research spaces that are amiable to being mult-user

III. To analyze how adopting teaching and research spaces above as multi-user spaces will impact on physical design concept of faculty of science.

IV. To evolve a design model a design model using the multi-user approach.

V. To demonstrate the model in the design proposal of science faculty kashere Gombe

### 1.4 Motivation

The most productive and successful scientists are intimately familiar with both the substance and style of each other's work. They display an astonishing capacity to adopt new research approaches and tools as quickly as they become available. Therefore Buildings and interior spaces need to be flexible to anticipate and support this changing nature of work. And this is will be achievable through evaluating new space standard that will be flexible and effective in its usage.

## 1.5 Research Questions

- What is the spatial structure of the existing faculties of science that are designed along traditional concept?
- How does this impact on teaching and learning in the existing faculties of science?
- What teaching spaces are amiable to being multi-user in the faculty of science?
- How suitable are the design models of the selected faculties of science to being multi-user?

## 1.6 Scope of Study

The extent of this thesis is a comprehensive evaluation of new space standard concept, how it can be use to improve space efficiency, flexibility and effectiveness. The theoretical aspect of this study will include reviews of studies on space evaluation, and study of some existing faculties of science will be carried out.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.0 Introduction

This chapter gives an account of related works that has been published concerning the aspect of multi-user design, the chapter tends to define and limit the problems of the research work by placing the study in an historical perspective by relating the findings of the research to previous knowledge

## 2.1 Space and Architecture

Architecture has to do with the planning, designing and constructing form, space and ambience to reflect functional, technical, social, environmental and aesthetic considerations (John, 1989). A modern definition taken from behavioral psychology is that architecture is the manipulation of space to accommodate the movement of people. Behavioral psychology itself being the manipulation of people to accommodate an existing space is an idea that is behind a large portion of building construction economics (Jensen, 2006). Space on the other hand is a basic tool readily available to be manipulated in the field of environmental design. Because of the environment; man evolved the principle of creating shelter as early as the Stone Age. The architect, apart from creating shelter against climatic element, also reduces the scale of the space to an appreciable human level so as to improve on the quality of the perceived environment of context (Samirah, 2011).

## 2.2 Concept of Multi-User Space

The concept of multi-user space is brought about by the complex nature of humans whose activities keep changing over a period of time. Multi-user space design can sometimes be

related to flexible space design concepts which is also very closely related to adaptability, universal space and mixed use building design (vernay, mulder and Hemmes, 2009). The concept of adaptability is described by Russell and Moffatt (2001), to mean 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. According to Wilkinson (2011), the term 'universal space' was first proposed by Mies van der Rohe to describe a kind of long-span single volume flexible enclosure that can accommodate a host of activities. In order to explain the concept, he used an interior photograph of the Glenn Martin Aircraft Assembly Building, designed by Albert Kahn in 1937, which he superimposed a number of free standing planes to represent walls and ceilings that could be moved to suit changing requirements. It created a space that can house a wide variety of uses, ranging from industrial to transport, sports and leisure activities.

### 2.3 Principle of Multifunctional Space Design

The first step in evaluating the multi-functionality of a building is simply to determine whether or not a conscious effort has been made to address the key principles of multifunctional design. The key principles are design strategies that apply to all elements of a building and they are as described by Russell and Moffatt (2001) to be:

#### i. Independence

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

**ii. Upgradability**

This allows for the selection of systems and components that anticipate and can accommodate potential increased performance requirements.

**iii. Lifetime compatibility**

This is a strategy that does not encapsulate, or strongly interconnect short lifetime components with those having longer life times. It also may be advantageous to maximize durability of materials in locations where long lifetimes are required, like structural elements and the cladding. Durable claddings and foundations can greatly facilitate adaptability, often tipping the scale in favor of conversion over demolition.

## 2.4 The Concept of Flexible Space Design

When architects employ the term "flexibility," they often make distinctions between physical properties internal to buildings and abstract social forces impinging upon building design (Ehrenkrantz 2000; Fiske 1995 and Leggett et al, 1977). Physical flexibility 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 furniture and walls, re-configurable building rooms, and passageways all represent this type of physical flexibility. On the abstract level however, flexibility refers to the ability of a built space to accommodate unforeseeable changes such as demographic shifts, community needs, or policy mandates (Moore and Lackney 1994). Flexibility could also be the potential for spaces to be used in a variety of ways without altering the building fabric. Flexibility is becoming increasingly important. It can also be understood to mean the ability of a building to adapt to continually changing requirements and conditions of the environment.

Flexibility is an indicator of adaptability. As clearly exposed by John Habraken in his definition of Open Building, the built environment is the product of an ongoing, never ending design process in which environment transforms part by part ("Flexibility in buildings,"2011). The concept of flexibility finds widespread use in architecture literature. For instance, Building flexibility and sustainability are closely linked. 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 long term; therefore the dilemma arises in trying to guess the appropriate amount and nature of the measures to be implemented, as shown in figure 1. 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 adapt using 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 (Schwehr and Cowee, 2009).

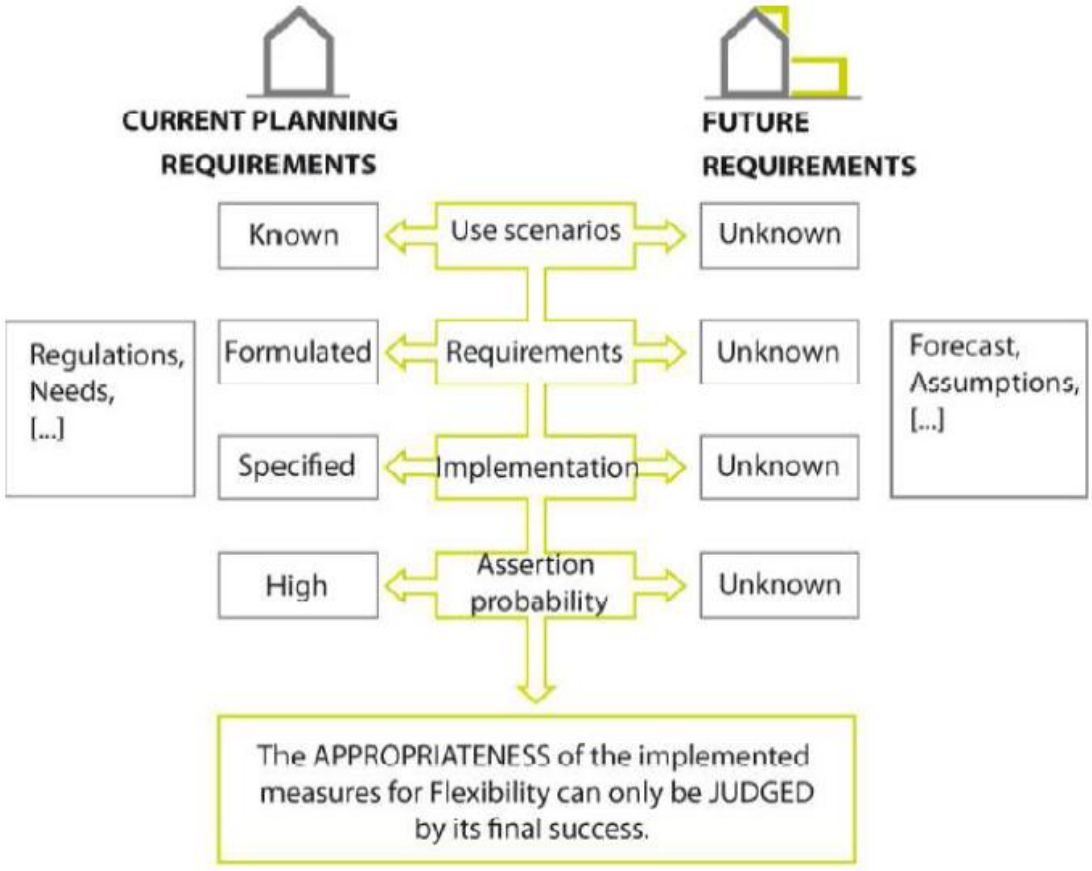



**Figure 1:** Dilemma of determining the appropriate measures for flexibility

### 2.4.1 Flexible Properties of Space

These are the properties of space for which when considered in designs could help in achieving a more flexible building (Leggett et al. 1977), 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 seem oppressive in their expansiveness. For example, well-placed screens in classrooms can increase a sense of intimacy while triggering curiosity for the space that flows around the screen (Caudill

1954). Such a space then becomes more engaging and less overwhelming. Well-placed windows can also increase a sense of flow and connection 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 versatile spaces such as these run the risk of homogeneity. Since all spaces afford certain activities and flows, generic spaces without any overt indicators for specific use require extra effort. There is need to achieve the tone or rhythm of specific uses of a particular space. For example, performing a play in a generic auditorium requires the investment of added decoration and props in addition to individual suspension of disbelief in order for that production to succeed.

**iii. Convertibility**

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

**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 which maybe in the area of living space, service space, and so on. Tightly coupled spaces such as rooms and corridors may utilize space efficiently in the short-term but present costly obstacles for later growth. For contraction, as space needs decreases, buildings should be able to temporarily convert spaces for other purposes. For example, surplus building space can be leased out from year to year so that when space needs rise again, the building can re-convert the spaces to serve whatever purpose (Brubaker1998).

**v. Modifiability**

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

**b) Typology of Flexibility in Architecture**

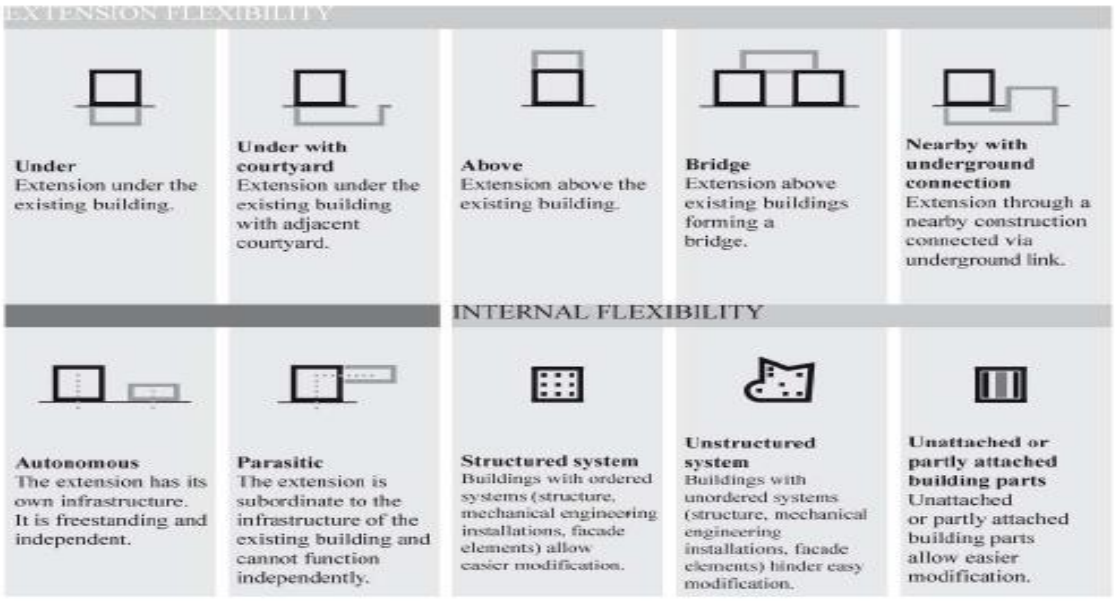
Based on concepts described by the Fraunhofer Institute and supported by typology based building evaluation, four main building flexibility types were identified;

i. **Extension Flexibility**: This refers to extension and modification of a building which involves analyzing and classifying the positioning and structural properties of such extensions

ii. **Internal Flexibility**: This defines the adaptability of a building; in what capacity are modifications within an existing structure possible. What are the risks and time requirements? How does the extension influence the building? As illustrated in figure 2.

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

iv. **Planning Flexibility**: This refers to the characteristics which determine whether and how a building reacts during the entire planning and construction phase. It also investigates which measures can be implemented during the planning phase in order to facilitate flexibility during a building's operation time, with the least possible cost and effort (Schwehr and Cowee, 2009).



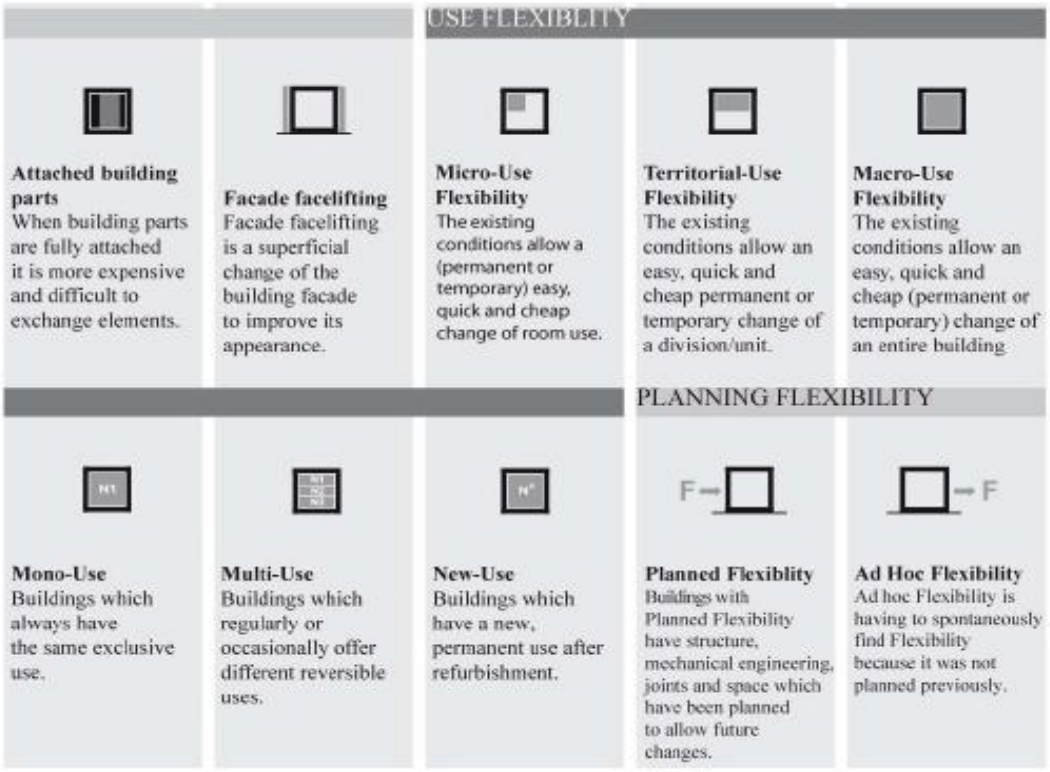



**Figure 2**: Extract of a typological overview of flexibility in buildings

### 2.4.2 Examples of Flexibility design concepts as used in Educational Buildings

According to Torin (2002), educational architecture literature grounds itself in a conviction that the design of built spaces influences the behaviors and actions of individuals within those spaces. To a certain extent, these spaces embody the pedagogical philosophies of their designers. Built pedagogies operate along a continuum between discipline and autonomy. On the disciplinary side, they can restrict learning possibilities by not allowing for certain movements or flows. For example, a desk bolted to the ground makes flexible interpretations of spatial use extremely difficult, and they impose directions for how space should be used. At the autonomy end, open classrooms invite and 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 behavior yet remain open to degrees of interpretation. Architects can build flexible educational spaces that accommodate for technological changes and future needs in several ways. They (architects) can imagine likely future learning activities and then design space to actualize such imaginations (Valiant, 1995) or they can collaborate with users through participatory design to ask what kind of learning spaces are desirable and why, and then design those spaces. The concept of flexibility holds educational promise for the design of diversely enabling learning environments thus; architects and planners are being challenged with the need to create flexible spaces in other to enhance learning. Evaluating designs with the flexible criteria of fluidity, versatility, convertibility, scalability, and modifiability requires designers to imagine spaces that transcend functionality or comfort. The practice of translating flexibility into built form becomes a politically responsible act. It

Acknowledges the politics of built pedagogies and then works shape empowering classroom practices (Torin, 2002). Ponti (2005) did an analysis of flexibility in a learning environment and the experiment found that flexibility in the design of schools present benefits in areas of maximizin use of space and over-

**The experiment**

The experiment started by designing a modular learning space (as shown in figure 3) suitable for holding 24/25 students 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))

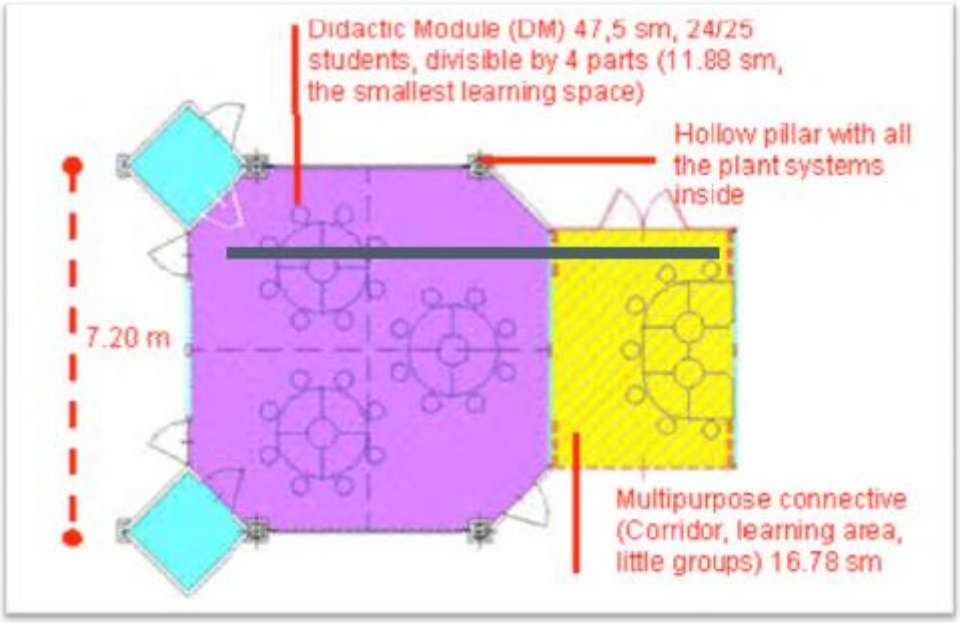



**Figure 3:**Floor plan concept of a didactic module

**Source**: Torin, (2002).

He later adjusted the didactic model to include small, medium and big groups(see fig below). To realize this solution, he closed some common doors, collapsed some mobile partitions and the result was an increase in the number of students by about 50% more than the previous Traditional Didactic Organization.

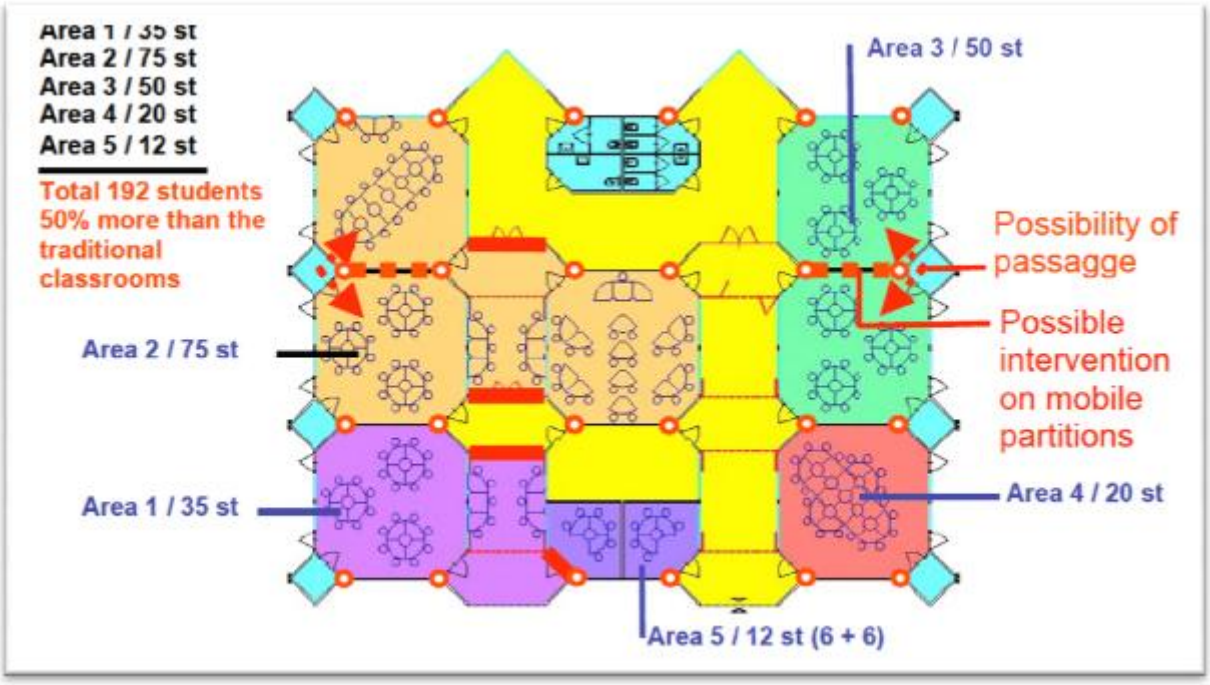



**Figure 4:**A modified floor plan concept of a didactic module**,**

**Source:** Torin, (2002).

Through a flexible space design it is then possible to change very quickly the purpose of the spaces when the need arises. This experiment shows clearly how flexible design principles can be employed to enhance efficiency of the teaching and learning process of a school.

### 2.5 Space Evaluation

Evaluation is a systematic collection and analysis of data in order to assess the strengths and weaknesses of programs, policies, and organizations to improve their effectiveness (NORAD, ND). Evaluations assess whether one is doing the right thing, not only if one doing things right (as planned). Whereas space as defined by Longman Contemporary Dictionary is the amount of an area, room, container etc that is empty or available to be

used. The idea of space stands for everything that widens or removes any existing limitations and for everything that opens up more possibilities (Herman, 2010). The educational value of a space is mainly determined by the teaching or learning activities that it supports, potentially and actually. Most spaces are under-utilized, i.e., faculty and students often don't realize that there are attractive, effective activities that could be carried out in that space, or those activities are unnecessarily difficult or discouraged by the space or the ways in which its users are educated or supported, Therefore the value of almost any learning space can be increased if those barriers are identified, analyzed, and reduced. Those same kinds of inquiry into the matches and mismatches between goals, activities and spaces can help programs plan for renovations and for creation of new kinds of learning spaces.

Individuals have a right to a quality educational facility, a physical space that supports multiple and diverse teaching and learning programmes and pedagogies, including current technologies; one that demonstrates optimal, cost-effective building performance and operation over time; one that respects and is in harmony with the environment; and one that encourages social participation, providing a healthy, comfortable, safe, secure and stimulating setting for its occupants.

### 2.6 Space Efficiency

According to Space Management Group(SMG) Space efficiency seeks to determine how design can maximize efficient and effective space usage for the full range of higher education functions. The assumption behind the study is that more efficient space is essential in the contemporary climate in the higher education sector.

### 2.6.1 Definitions

- **MEASUREMENT**

Advice on improving space efficiency must be accompanied by clarity in measuring than efficiency. Measurement is necessary so that targets can be set and space efficiency attained. Space efficiency measurements depend on floor area, which must be measured using agreed definitions. There are several valid ways to measure space and analyse the total area within a building. They are based on the principle of distinguishing the areas used for different functions, including the structure of a building. The concept of usable space and its relationship to 'balance' areas (ie, areas that enable a building to function, such as lifts and toilets) and or net internal area, is critical when seeking space efficiency.

- **Space efficiency- building**

The space efficiency of any building relates to three factors:

I. The quantity of space, generally calculated in terms of floor area though occasionally volume may also be relevant.

II. The number of users, potential and actual

III. The amount of time the space is used.

A building can be said to be 'designed for space efficiency' when it provides:

**1.** The minimum necessary space for the desired functions to be properly accommodated, with minimum 'waste' between net internal area and gross internal area (NIA:GIA, commonly expressed as the ratio net:gross) or between net usable area and net internal area (NUA:NIA). These measures are normally expressed as percentages.

2. The minimum space necessary for effective learning and research per FTE student

3. A high level of space utilization because the space is used for the maximum possible amount of time. This concept is generally applied to utilization of teaching space, though it can also be applied to office space utilization. It is usually expressed as of hours of use compared to a benchmark multiplied the percentage of occupied seats.

- **Space efficiency-site**

Considering briefly the site on which the building stands, a space efficient building is one that makes most use of the site, and therefore has a maximum gross external area in relation to the site area (GEA: site area). This concept can be extended to an entire campus.

- **Resources and cost efficiencies**

Other efficiency measures incorporate concepts of lifetime cost and use patterns over time.

Efficient space in this term is:

- Space that can be modified cost-effectively when functional requirements change, thus permitting reuse of buildings in the long term.

- Space that has been specified and detailed to give reasonable cost in use
- Space that is built to last and will have a long life.

**2.7 Key To Space Efficiency Through Building Design**

- Optimizing space standards for effective work
- Specifying design features that allow different activities at different times
- Providing versatile space, furniture and fittings that can be used for different activities

- Providing for wireless data access to enable occasional use of common space.
- Capturing balance areas for active use where possible

### 2.8 Learning Space Evaluation

Learning spaces are defined as ‘‘those spaces which encompass the full range of places in which learning occurs, from real to virtual, from classroom to chat room’’ (Brown 2005). The literature relating to learning spaces is diverse and ranges on a continuum from general to more detailed in conceptualization and analysis with various perspectives explored architecture, space design, pedagogy, staff and student needs, and stakeholder involvement in the design process. Across this literature there is a consistent view that universities should be more innovative and creative in the ways that they use, reconfigure and or build new learning spaces to meet the expectations of tomorrow’s students. There is broad agreement that learning spaces should be student-centered rather than teacher-centered; have the necessary technology and furnishings to meet student and ‘‘subject’’ needs; support pedagogic, multidisciplinary, multimedia formats that engage the student; and be flexible, ergonomically comfortable, functional and multi-usable. Importantly, embedding technology into teaching and learning spaces is ‘‘more of an evolutionary process than a revolutionary one’’ (Joint Information Systems Committee,6: 2006).

#### 2.8.1 Trends in learning space

Significant trends in learning space design, both in new construction and in renovation, are related to learning theory and technological advances. Three major trends inform current learning space design:

- Design based on learning principles, resulting in intentional support for social and active learning strategies.

- An emphasis on human-centered design.

- Increasing ownership of diverse devices that enrich learning. These trends have been catalyzed by constructivism, digital technology, and a holistic view of learning.

These trends have been catalyzed by constructivism, digital technology, and a holistic view of learning. The emergence of the constructivist learning paradigm has led to a focus on learning rather than teaching. It allows the re-evaluation classrooms and to consider informal learning spaces as loci for learning (Malcom, 2006). If learning is not confined to scheduled classroom spaces and times, the whole campus anywhere and at any time is potentially an effective learning space. That holistic view of learning presents challenges, however. First, the demands on student time and attention continue to grow; even residential institutions have over-scheduled students.

Second, learning doesn't just happen in classrooms; learning also occurs outside the lecture hall. New strategies for enabling learning and accommodating the multiple demands on student time have led to rethinking the use, design, and location of learning spaces. The emphasis on learning means that we must also think about the learner. Learning spaces are not mere containers for a few, approved activities; instead, they provide environments for people (malcom and Philip, 2006). Factors such as the availability of food and drink, comfortable chairs, and furniture that supports a variety of learning activities are emerging as critical in the design of learning spaces evidence of the second trend, giving consideration to human factors as integral to learning space design. The rapidly increasing

accessibility of digital technology also has changed learning space design. Digital technology continues to advance at a frenetic pace, offering greater capability while simultaneously becoming more mobile and more affordable. Five years ago, most students purchased desktop computers; two years later, most purchased laptops. The implications are significant: more affordable and mobile technology facilitates greater access to content and

resources. This enhanced access, in turn, has made it possible to implement a learning paradigm that emphasizes active learning, formative assessment, social engagement, mobility, and multiple paths through content. Although specific technologies may come and go, the enduring trend is technology becoming more capable, affordable, and mobile.

### 2.8.2 Active and social learning strategies

Today, facilities that encourage learner participation are increasingly important in learning space design. Active learning, interaction, and social engagement will be significant in the future.

Over the years, a great deal of research has focused on how people learn. Previously, teaching was most often a kind of "broadcast" of course content at regularly scheduled intervals, from an expert to student "receivers (Malcom and Philips, 2006)." The learning literature agrees that learning can be enhanced, deepened, and made more meaningful if the curriculum makes the learners active participants through interactivity, multiple roles (such as listener, critic, mentor, presenter), and social engagement (such as group work, discussion boards, wikis). Hence, it is no surprise that learning spaces classrooms as well as informal spaces have an increasingly important role in catalyzing this type of learning.

### 2.8.3 system design requirement

An initial prerequisite to building a space that increases learning effectiveness is understanding what kinds of teaching and learning activities the space should enable. This entails identifying the demands for curriculum, learning, laboratory, and workshop activities that the space must meet. With a clear definition of the learning goals, space design becomes grounded. Critically important is identification of the clients who will use the space, a process made easier when the space is designed for a specific department's needs. When the college or university claims the space, an analysis of the pattern of use becomes essential. In many cases a small number of departments habitually use the same classrooms simply because of common seating requirements for their courses, without regard to the amenities or technology available in the rooms. Building classroom spaces without a defined client based results in a design that meets no one's needs optimally.

### 2.8.4 learning activity analysis

Determining what activities the space must support is perhaps key to distinguishing a well designed learning space from a room in which activity happens. Learning mode analysis (LMA) characterizes learning activities in terms that affect space design. Knowing what students should learn permits defining the learning activities necessary to achieve mastery of critical subjects; this generates learning mode analysis description. Once the activities and their consequences for space design are known and prioritized, architects can design spaces for these activities.

### 2.9 Facilities Evaluation and Planning

According to space management in higher education physical facilities are used effectively and efficiently in their support programs and activities and to test with the planning of new construction or remodeling. The facilities evaluation and planning will be an important and effective tool in these roles, but persons using it should endeavor to maintain a balance between optimal planning and actual condition. The facilities evaluation and planning contains planning guide lines which are useful in determining overall space needs, but which are not intended a design standards for a specific facility projects.

#### 2.9.1 Classroom facilities

This category aggregates classroom facilities as an institution wide resources, even though these areas may fall under different levels of organizational control. The term "classroom" includes not only general purpose classroom but also lecture halls, recitation rooms, seminar rooms, and other rooms used primarily for scheduled non laboratory instruction. Total classroom facilities include any support rooms that serve the classroom activity. A classroom may contain various types of instructional aids or equipment(example, multimedia or telecommunication equipment) as long as these do not tie the room to instruction in a specific subject discipline. Institutions may use extension code to distinguish control over classroom areas, discipline use, type of instruction, contained equipment or other classroom variables (example departmental classroom).

- **Classroom utilization assumptions and guidelines**

Only formally scheduled hours of instruction are reflected in the utilization standard for classrooms. These standards provide an allowance for nonscheduled and informal use of classroom facilities.

- Utilization Assumption

- Classroom facilities are usually scheduled by a central scheduling office
- The assignable square feet per student station in any particular classroom is determined by the type of instruction(lecture, seminar) and seating (example movable tables, armchair, fixed pedestal tablet armchair, table and chairs).
- the utilization of rooms may fluctuate due to room size or campus location

- Utilization guidelines

The following guidelines are indicators of fullness in classroom facilities. Utilization levels that reach or exceed these levels on a campus-wide basis may signal a need for facilities to accommodate regularly scheduled classes

- Average standard room use: 30 hours of scheduled weekday, daytime use per week (based o a 9-hour period beginning with the first hour for regularly scheduled classes).
- Average standard room fullness: 60 percent of stations occupied during hours of scheduled daytime use
- average weekly hours per station: 18hours of scheduled weekday, daytime use per station per week. (30 hours x 60 percent fullness = 18hours per station)

### 2.9.2 Laboratory facilities

A laboratory is a facility characterized by the special purpose equipment or a specific room configuration which ties instructional and research activities to a particular discipline

or a closely related group of disciplines(Wikipedia) . These activities may be individual or group in a nature, with or without supervision. Laboratories may be found in all fields of study including letters, humanities, natural science, social science, vocational and technical disciplines, etc. laboratory facilities can be subdivided into three categories;

- Class Laboratory: Used for scheduled instruction
- Open Laboratory: This supports instructions but is not formally scheduled
- A Research or Nonclass Laboratory: Is used for research, experimentation, observation, research training, or structured creative activity which support extension of a field of knowledge. Institutions may wish to further distinguish various types of class, open, and research laboratories through the use of extension or special codes

The complexity of research and how it may affect room use classification decisions needs discussion at the institutional level. In general, there are three categories of research activities;

- Externally budgeted or funded projects and centers
- Separately organized centers or projects that are funded from institutional resources
- Departmental research activities that are neither separately budgeted or organized

When this complexity exists, institutions may decide to use code laboratories, office space, etc, and rely open the actual activities of the faculty and the staff housed within the space to determine the distinction between instruction and research. The room inventory data elements include a designation of function as a separate code for each room. If combined with financial and activity information, the combination of function and room use code can accurately represent allocations of space for research more effectively and accurately than reliance upon only the room use code.

### 2.9.3 Office facilities

Office facilities are individual, multi-person, or workstation space specifically assigned to academic, administrative, and service functions of a college or university. While some institutions may wish to classify all office as office, others may wish to differentiate academic, administrative , staff, secretarial, clerical, or even student assistant offices, by applying additional codes .

### 2.9.4 Library/study facilities

Study space is classified into five categories;

- study room
- Stack
- Open Stack study room,
- Processing room
- Study service

Offices used for library activities are coded as office facilities. A study room may contain equipments or materials which aid the study or learning process (example, microcomputers, computers terminals, multimedia carrels typewriters, records and tapes) and which do not restrict the room to a particular academic discipline group. whereas a study room may appear in almost any type of on campus( example, academic, residential, student service), Stack,, open-stack study rooms, and processing rooms are typically located in, but not limited to, central, branch, or departmental space through the combined use of academic discipline and function codes.

### 2.9.5 Special use facilities

This category includes several room use categories that are sufficiently specialized in their primary activity or function to merit a unique room code. Areas and rooms for athletic activity, media production, clinical activities ( outside of separately organized health care facilities), demonstration, agricultural field activities, and animal and plant shelters are included here. Although many of these special use facilities provide service to other areas, their special use or configuration dictates that these areas cannot be coded as service rooms.

### 2.9.6 General use facilities

General use facilities are characterized by a broader availability to faculty, students, staff, or the public than are specially use facilities, which are typically limited to a small group or special population. General use facilities comprise of a campus general service or functional support system ( assembly, exhibition, dining, relaxation, recreation, general meetings, day care) for the institutional and participant community populations.

## 2.10 University Faculty

A faculty is an administrative unit containing a group of related courses in a higher institution (Microsoft Encarta 2005). This means that courses with similar curriculum are brought together to form a faculty. A faculty complex usually has a deanery, which is the administrative arm and departments, which represents the academic aspect.

## 2.11 Departments

These are the specialized section of a higher institution of learning (Microsoft Encarta2005). They are the basic units of higher institution of learning. A department is

made up of staff both academic and non academic as well as students. It has an administrative head as well of heads of various academic sections. A department offers a degree in one course. However, it is not unusual to find some departments awarding more than one degree.

### 2.12 Multidisciplinary Collaboration in Faculty Science

Multidisciplinary collaboration as defined by Klein (1990) is a mutual cooperation between two or more disciplines, establishing a new level of discourse and integration of knowledge. It is a process for achieving an integrative synthesis that often begins with a problem, question, or issue. It is also a means of solving problems and answering complex questions that cannot be satisfactorily addressed using single disciplinary approach. Thus the Multidisciplinary collaboration paradigm is used variably as a concept, a methodology, a process, a way of knowing, and even a philosophy. In this regard, the term refers to a process to construct knowledge in which students and instructors come together from different disciplines to analyze differences in disciplinary approaches to a problem and to work toward a synthesis - a new, more comprehensive view than allowed by the vision of any one field. The mission of Multidisciplinary collaboration concept is to ensure better integration of educational approaches in the areas of science studies, It is the importation of some basic aspects of other related field(s) to clarify another disciplinary perspective. It is believed that the major problems of our time, from the environmental safety to built environment, from environmental degradation to building collapse problems, cannot be studied effectively within any single discipline; all involve integrative and cross-disciplinary thinking.

Multidisciplinary collaboration seems inevitable as we are living in times of rapid change (University of Michigan, 2007). In order to prepare for a life of productive endeavour in the twenty first century, students in sciences must learn problem-solving techniques across disciplines and launch inquiries in uncharted territories of knowledge and practice. This they need so as to acquire the ability to communicate with, and more fully appreciate the roles of specialists in other related fields. Multidisciplinary collaboration concept is not new of course, what is new is the intentionality with which these initiatives seek to promote connected learning beyond the discipline as a primary goal thereby pursuing knowledge that integrates and synthesizes the perspectives of several disciplines into a construction that is greater than the sum of its distinctly disciplinary parts (DeZure, 2004). Furthermore, Beheler and Malar, (1995) postulated that in order to aid students in learning how to integrate themselves into interdisciplinary system development environments, instructors should utilize capstone experience courses where students work on small teams for a particular project. The students also need to examine the assumptions that inhere in a disciplinary perspective and integrate material outside the patterns they are taught. The students must locate issues within larger frameworks of thought, negotiate multiple perspectives, and develop habits of critical questioning and creative problem-solving. In addition, they must learn how to find their way through disconnected bodies of information and perspectives and create their own path to a coherent education.

### 2.12.1 Purpose of multidisciplinary education

The main purpose of multidisciplinary collaboration is to promote teamwork and communication which are among the top skills needed in solving emerging problems in environmental sciences.

objectives of Multidisciplinary education to include the following:-

1. Help participants learn some of the alternative ways of thinking and conducting research across the lines demarcated by the traditional disciplines and be able to evaluate the alternatives.

2. Enable participants to explore a complex topic by seeing it from multiple perspectives and in relation to other topics and to integrate information and concepts from a variety of sources.

3. Provide participants the skills and resources to learn the key concepts, literature, practices, and issues of their area of concentration in order to encourage lifelong learning.

4. Enable professionals to acquire Communication skills necessary for interprofessional interaction.

**2.12.2 design for multidisciplinary collaboration**

Multidisciplinary education is the synthesis of two or more disciplines, establishing a new level of discourse and integration of knowledge for the purpose of solving problems in a real world situation. It requires students to formulate questions, structure unstructured problems and draw on and integrate different disciplines as well as motivating students and helping them learn effectively. Collaborative education on the other hand is a philosophy which entails working together, building together, learning together, changing together and improving together in order to solve real world environmental problems that a single discipline cannot solve satisfactorily.

According to DeZure (2004), Multidisciplinary collaboration is not new to education; all disciplines have imported aspects of other fields to clarify their own disciplinary perspectives. What is new is the intentionality with which these initiatives seek to promote connected education beyond the discipline as a primary goal thereby pursuing knowledge that integrates and synthesizes the perspectives of several disciplines into a construction that is greater than the sum of its distinctly disciplinary parts.

Building on this idea, professionals in sciences studies must have the opportunity for a broader exposure to other areas of art, science and apart from the traditional scope so as to foster multidisciplinary and collaborative research.

Communication skills of all types - oral, written, computer, and group dynamics - must be more heavily stressed. In addition, 'Soft Skills' must also be more strongly incorporated into the curriculum. These areas include the environment, team working, economics and the university structure.

### 2.13 Chapter Summary

To achieve an effective multi-user space design in a university faculty, There should be openness and fluidity in the layout and planning of the structure and infrastructure must be designed and constructed in a way as to foster free movement and participation across disciplines. Care should also be taken not to compromise safety, security and privacy of the distinct disciplines. The structures should be erected in a way that movements in and around disciplinary buildings and facilities is encouraged, and at the same time each discipline maintaining its autonomy.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1 Introduction

The research methodology in this chapter gives an overview of what, why and how the research will be conducted base on the type of research in question. Descriptive research like this one will require basic tools for data collection and analysis which include conduction of multiple case studies in different regions. Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying his research problem along with the logic behind them (Harold, 1958). It is necessary for the researcher to know not only the research methods/techniques but also the methodology

## 3.2 Research Approach

A multiple research strategy will be adopted in the course of this study as used in other researches (Omanukwue, n.d;Becker2009; Le, 2010) is considered to be the most preferable as this will allow for research triangulation and ample data collection. The data to be collected will be subjected to rigorous qualitative and quantitative analysis to arrive at the findings.

## 3.3 Population of Study

Noheli, (2011) explained that population is the set of people or items under consideration in a study. The research population of the study in this context will be made up of student, lecturers and non academic staff of the science faculties to be used as case studies.

### 3.4 Sampling Technique and Sampling Size

Purposive sampling technique will be use in the cause of selecting cases to be studied as well as the respondent. This method of sampling is considered more suitable due to the allowance for the easy selection of cases in order to allow for sufficient collection data which is critical, rich in information and useful to the study.

### 3.5 Case Studies

Case studies form an integral aspect of data collection. As such, selected cases are to be based on purposefulness and criticalness of the cases to the research. This research will study of some selected institutions that have similar faculties with the one being proposed. The aim is to find out the possible multi-user spaces and there integration as well as the design approaches used by the designers of such institutions.

#### 3.5.1 Case studies selection criteria

Cases to be studied will be based on purpose and analytical with respect to cases which will provide vital information uniqueness and give insight into the present state of science faculties.

#### 3.5.2 Case studies assessment criteria

Assessment will be based on research questions and parameters which will be surveyed visually and through other instruments of data collection which will outline the variable in questions.

### 3.6 Research Instruments

This refers to all the tools used in a research to collect the necessary data (Kleiven, 2003) hence three basic instruments will be utilised in the research and are as follows: visual survey, data from relevant authorities, literature reviews and questionnaire survey. These research instruments are considered suitable for data collection. The choice of the instruments is adopted from the previous research mentioned above to allow for the ample and uniform collection of data so that each of the selected tools can corroborate and complement one other.

#### 3.6.1 Literature reviews

A literature review of available material about space measurement, utilization and efficiency in university buildings. All sources consulted will be duly recognized and presented in the references.

#### 3.6.2 Questionnaire survey

Questionnaires will be designed and administered to respondents through delivery method. This will enable respondents to respond to the questions and data will be collected quantitatively.

#### 3.6.3 Visual Survey

A survey of the site, spatial organization and circulation will be made and other relevant data that are equally to be collected. This will be carried out using check list, sketches, photographs, note taking and the use of related variables.

### 3.6.4 Data from relevant authorities

This is the collection of codes and standards that will aid in the analysis and subsequently design of the proposed project. Climatic data of the study area will be obtained. In the same way data concerning academic program structure, space requirements, students to staff ratio and overall students' enrolment capacity will be obtain from Nigerian University Commission (NUC) Guidelines. Likewise information relating to site and other aspects of Gombe federal university will be collected from the institution's planning .

## 3.7 Variables of Study

The variables to be considered in the course of this research will include the following:

1. Faculty content and development
2. Planning and layout
3. Functionality
4. Flexibility
5. Effective space utilization
6. Multi-user space design

## 3.8 Procedure for Data Collection

The data collection procedure entails an onsite visitation to the selected cases to be studied and where the questionnaire will be administer and visual survey be carried out. A guided walk through the facility courtesy of a staff or representative from the case studies will

aid during the course of the field survey. The instruments of data collection will be administered during this procedure.

**. 3.10 Ethical Considerations**

A prior notification will be given to the management of schools to be visited. Respondents of the questionnaire survey will be properly informed about essence of the data collection, which is meant for academic purpose. Anonymity and confidentiality of the respondent was equally emphasized.

# CHAPTER FOUR

# DATA PRESENTATION AND ANALYSIS

## 4.1 Introduction

This chapter focuses on data presentation, analysis and interpretation of the findings relating to this research topic, based on the data generated from the field survey, it also presents descriptions and explanations of the findings driven by the research questions of this study of the architecture of selected schools. The results focused on the variables as described in the methodology of this study.

Case studies were carried out on some various existing federal universities that have faculties of science or related discipline. A total number of three case studies were carried out. The faculties of science selected are as follows;

- Faculty of science Ahmadu Bello university zaria,
- Faculty of natural science university of Jos and
- Faculty of science Abubakar Tafawa Balewa University Bauchi

## 4.2 Selection Criteria

I. Universities with accredited faculties of sciences by the National University Commission (NUC)

II. Universities with permanent Faculties Of Sciences

III. Each of the Universities is chosen from the first generation Universities

IV. Each one of them from Federal Universities in Nigeria

### 4.3 Faculty Of Science University of Jos, Plateau State Nigeria

#### 4.3.1 Historical background

University of Jos was first established in November 1971 as a satellite campus of the University of Ibadan. In October 1975, the Military government under General Murtala Mohammed, established the University of Jos as a separate institution, plate I shows the view of university of Jos main campus entrance. Classes began at the newly recognized University of Jos in October1976 with 575spread over the existing four Faculties of Arts and Social Science, Education, Natural Science and medical sciences. Post-graduate programs were added in 1977. By 1978 Faculties Of Law and Environmental Sciences were established and the faculties of Art and Social Science are separated,.

**Plate I :**A view of University Of Jos main entrance gate

**Source:** Author work (2014)

### 4.3.2 Faculty content and development

The Faculty of natural science started during the 1974/75 session, as The Faculty of Science in the Jos Campus of the University of Ibadan. It moved to its present site at the Bauchi Road Campus during the 1975/76 session as shown in Plate II. The foundation departments in the Faculty were Botany, Chemistry, Geography, Mathematics, Physics and Zoology. In 1975 the University of Jos was established out of the Jos Campus of the University of Ibadan. During the 1976/77 session, the Faculty of Science was renamed The Faculty of Natural Sciences, and the first Dean, Prof. G. K. Berrie was appointed. Over the years, 1976/77 and 1977/78, the foundation departments were consolidated. Experienced staff were recruited while both undergraduate and postgraduate programmes were developed. During these sessions, staff members were recruited for the Department of Geology and Mining, which emerged in the 1979/80 session. The first Medical students were admitted to pre-medical courses in the faculty in 1975 and proceeded for their 1st Professional Examinations in the Faculty of Medical Sciences in1976. A department of Preliminary Science Studies was established and attached to the Faculty for supervision during the 1977/78 session and is now renamed the Remedial Studies Department. It was made up of students from the catchment area (Bauchi, Benue and Plateau States) who had insufficient credits to undertake a degree programme. The catchment states have since been redefined and include Bauchi, Benue, Nassarawa, Kogi and Plateau States. From the inception of the faculty, the various departments grew steadily in quality and quantity until the mid 1980's when decline set in. The student and staff populations increased and thousands of graduates were turned out into different sectors of the Nigerian Economy and the world. In 1990, the National Universities Commission sent teams on the

first visit, for the accreditation of undergraduate programmes and only the Zoology Department attained full accreditation status. The other five departments failed to obtain full accreditation due to different combinations of inadequacies with staff, space, equipment and funding.


**Plate III :** View of Faculty complex University of Jos, Nigeria

**Source:** Field Survey

### 4.3.3 Planning and layout

The faculty has a complex which houses all the offices in the faculty and most of the offices at the departmental level within the faculty, it was initially designed to cover all the activities within the faculty that is including both learning and administrative activities but was later converted into mainly an office building this due to lack of defined buildings or space for most of the departments. The faculty has the following departments,

chemistry, computer science, geology and mining, mathematics, physic plant science tech, remedial science, and science lab tech, Plate IV shows a walk way linking  department of physics and a lecture hall in the faculty.

One of the major problem the faculty is facing is the lack of class rooms and lecture halls within the various departments in the faculty and so most of the lectures are held in the laboratories which constituted a huge percentage of the learning spaces amongst the departments. The departments are discretely designed and are linked with covered walkway at the end. Figure 5 give an overview illustration of planning and layout of faculty of science in university of Jos.


**Figure 6:** Ariel view of  Faculty of Natural Science University of Jos**,**

**Source:** Google Earth 2014

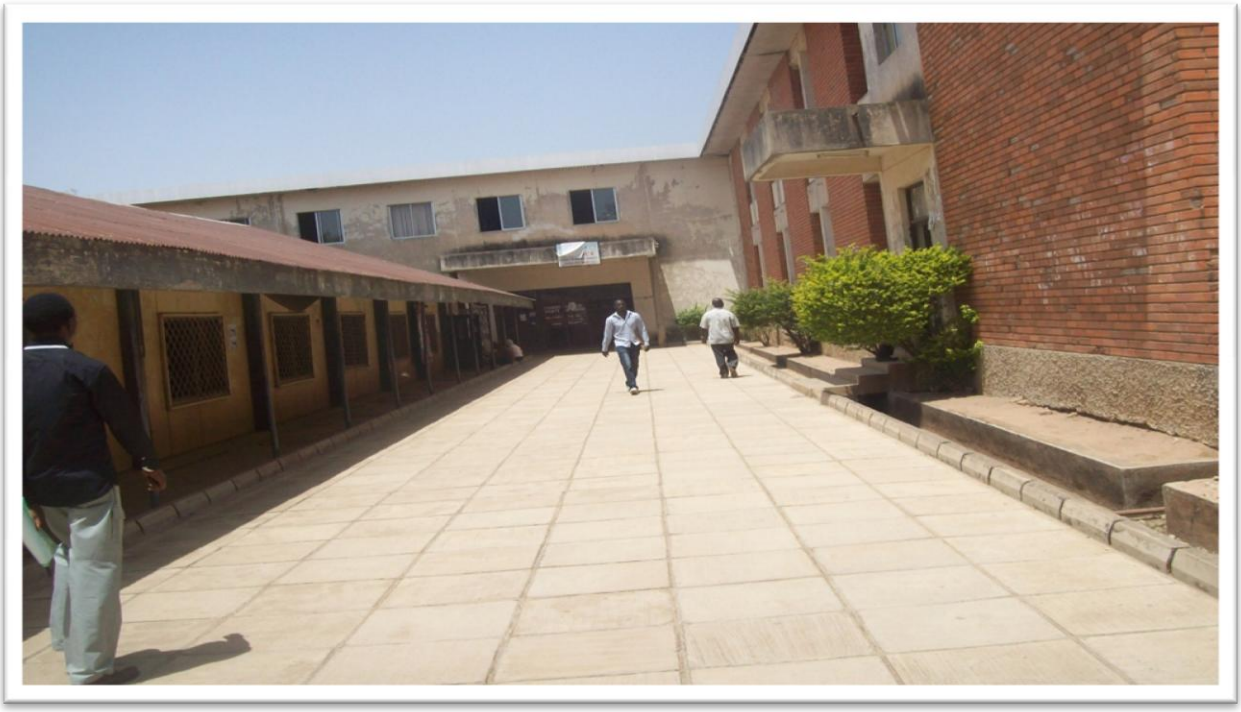


**Plate V:** View of a walkway between department of physics and a lecture hall

**Source:** Field Survery

### 4.3.4 Functionality

The faculty building itself is not properly linked to the constituent buildings, this make movement between the faculty tiresome and also between the departments. Even in parts , the lack of consciously provided academic and staff defined space limit within the departmental buildings seem not to have been properly designed. this can be seen in the scattered arrangement of spaces without any definite order. Other areas within the departmental building have no internal connection between them. The main faculty complex also lack defined parking space, the cars are parked haphazardly

**Plate VI:** View of a walkway between department of physics and a lecture hall

**Source:** Field Survey

### 4.3.5 Flexibility

The main faculty complex is a massive structure with columns all around it suggests a framed construction. Laboratories constitute most of the spaces (Plate VII) within the faculty inferring inflexibility of functional learning spaces, though in size they are open to an extent. The single banking of some of the other structures within the faculty makes fluidity of space almost impossible as one has to out to the external corridor before accessing another space can be done. There is also sharing of offices for multi use.

**Plate VIII:** An array of laboratories, evidence of single banking

**Source:** Field Survey

### 4.3.6 Effective space utilization

The size and volume of spaces provided for the faculty will be enough to cater for staff and students if well managed. Students' enrolment should be controlled to satisfy the National Universities Commission's space per student arrangement. Most of the offices for academic staff and administrative are located within the main faculty complex with few office located within the departments, and the number of office seem to be inadequate thereby crowding a number of staff in one office making space per staff inadequate. Also the number of classes and other lecture halls are very inadequate and because of that most of the lectures are held in the laboratories.

### 4.3.7 Multi-user space design

This is the functional link of the constituent disciplines within the faculty. The faculty of natural science was designed in a discrete way with most of the buildings independent of each other with no shared facilities, therefore there's not much multidisciplinary collaboration. The only place that facilities are shared is the main faculty building which houses most of the offices for majority of the departments. Some of the other multi-user spaces are the laboratories that been used as class rooms but that due to inadequacy in the number of classes and lecture halls.

## 4.4 School Of Science Abubakar Tafawa Balewa University Bauchi Nigeria

### 4.4.1 Historical background

Abubakar Tafawa Balewa University (ATBU), is a federal university of technology located in Bauchi, northern Nigeria**.** The university is named after the first Prime Minister of the Federal Republic of Nigeria**,** Sir Abubakar Tafawa Balewa**.** The motto of the university is DOCTRINA MATER ARTIUM, which literally means "Education is the mother of the practical arts". The university is known for having one of the best Engineering programme in Nigeria.

The Abubakar Tafawa Balewa University was established in 1980 as Federal University of Technology, Bauchi, Nigeria. The institution's first set of students were admitted in October 1981 for pre-degree and remedial programmes while the degree courses of the School of Science and Science Education began in October 1982. On 1 October 1984, the University was merged with Ahmadu Bello University Zaria, Nigeria with a subsequent change of its name to Abubakar Tafawa Balewa College, Ahmadu Bello University, Bauchi Campus. The University regained its autonomous status in 1988 following a

general demerger of such institutions. This was followed by a subsequent change of its name to Abubakar Tafawa Balewa University, Bauchi.

The Academic pattern of the University was formulated in 1980 after consultation with invited subject experts from Nigeria, United Kingdom and the United States of America. The solid foundation upon which the curriculum of the former Federal University of Technology was built was responsible for its sustenance all through the years of its existence and in particular after the merger. The curriculum adopted was purely applied in nature, for a technologically based institution and it is this theme that is being maintained in all the units of the University.

Over two decades in existence, the University has come a long way in addressing some of the engineering, agricultural, scientific, environmental and technological challenges common to third world nations like Nigeria having been adjudged the fifth best University with one of the best engineering programmes in Nigeria.

The University offers degrees through six schools: the School of Engineering, Science, Environmental Technology, Agriculture, Management Technology, School of Science and the School of Technology Education. The University offers entry level bachelor's degrees as well as both Masters and Doctorate degrees.

### 4.4.1 Faculty content and development

The school of science Abubakar Tafawa Balewa University was first established in october 1982, Plate VI shows the building complex for the school of science. The faculty constitute of the following departments;

I. Biology

II. Chemistry

III. Geology

IV. Mathematics

V. Physics


**Plate IX :**View of the School of Science Abubakar Tafawa Balewa Bauchi

Source: Field Work

**4.4.2 Planning and layout**

The faculty complex is an ultramodern school design which house almost all the departments in one big building. The integration of the faculty in one big building structure enhances flow and inter-departmental activities . Cantilevered parapet walls were used to keep driving rain away from the openings. In all the faculty has three major buildings, the

main faculty building complex which houses four departments out of the five departments, then the geology department joint with some office space and an auditorium which are all separated by a court yard and third building is the building that contains the laboratories.

### 4.4.3 Functionality

There are no proper linkage between the three main building in the faculty with each building standing on its own. The space within the faculty were not scattered but were properly arranged for ease of usage. the parking within the faculty is not defined.


**Plate X:** Courtyard between department of Geology and a lecture hall

**Source:** Field Work

### 4.4.4 Flexibility

The faculty complex has large offices for the staff and the building is double banked which encourages fluidity and convertibility of space.

### 4.4.5 Effective space utilization

The school of science complex seems excellent in form and function. Each department is given a space for staff and its student. The design of the faculty may seem commendable but the functional content is grossly inadequate for use by all the department. The lecture hall and class rooms are shared by the various departments


**Plate XI:** A view of a classroom in the science complex

**Source:** Field Survey


**Plate XII:** Interior view of the lecture hall

**Source:** Field Survey

### 4.4.6 Multi-user space design

School of science Abubakar Tafawa Balewa University Bauchi complex houses four out of the five departments and multi-user space design is a function of the compactness or functional link of constituent disciplines, therefore the school seem to have a high level of cooperation amongst the departments due to their proximity to one another and shared facilities.

## 4.5 Faculty Of Science Ahmadu Bello University Zaria

### 4.5.1 Historical backgound

Ahmadu Bello University Zaria is the largerst university in nigeria and the second largest in Africa after Cairo University Egypt. It was founded on october 4, 1962 as the University of Northern Nigeria, Plate XIII shows view of main gate of the school. Ahmadu Bello University operates two main campuses: Samaru and Kongo. The samaru campus houses

the administrative offices, science, social sciences, arts and languages, education, engineering, medical science, agriculture science, and research facilities. The kongo campus hosts the faculties of law and administration. The university is named after the sardauna of Sokoto, Alhaji sir Ahmadu Bello, first prime minister of Northern Nigeria

**Plate XIV:** Ahmadu Bello University main gate entrance

**Source**: Field Survey

### 4.5.2 School content and development

The Faculty of Science is located within the core of the Main Campus, Samaru, Plate XV shows the approach view of the faculty. It was established at the founding of the Ahmadu Bello University in 1962. The Faculty started with six departments and has grown over the past forty nine years into not only one of the largest faculties in the University with nine degree awarding departments, but also one of the largest faculties of science in any Nigerian University. The foundation Departments were Botany, Chemistry, Geography, Mathematics, Physics and Zoology. The Departments of Botany and Zoology were later merged into the Department of Biological Sciences. The Departments of Geology and

Microbiology were created in 1969 followed by Biochemistry in 1975 and Textile Science and Technology in 1980. It is of interest to note that the present Faculty of Pharmaceutical Sciences as well as the Department of Chemical Engineering were conceived and nurtured in the Faculty of Science. The Centre for Energy Research and Training and the Computer Centre were also formerly part of the Faculty of Science. Now the faculty has the following department

I. Biochemistry department

II. Biological science (Biology, Botany, and Zoology)

III. Chemistry department

IV. Geography department

V. Mathematics department ( Mathematics, Computer, Statistic)

VI. Microbiology department

VII. Physics department

VIII. Textile Science and Technology


**Plate XVI :**View of Faculty of science zaria

**Source:** Field Survey

### 4.5. 3 Planning and layout

Faculty of science Ahmadu Bello University zaria each department is separately build. Apart from the solitary standing of the departments, the individual buildings were consciously designed taking into consideration human and environmental factors. The buildings are properly oriented in the direction to minimise solar radiation as well as to attract enough ventilation. In terms of movement within the faculty, defined and well separated human and vehicular circulation are adequately provided.

**Plate XVII** :A well landscaped area between the department of chemistry and biology

**Source:** Field Survey

### 4.5.4 Functionality

The functionality of the faculty of science radiates on the non-centrality of activities. In each of the departments facilities are provided adequately to satisfy staff and students such as defined walkways, provision for vehicular parking space, provision for academic space. other functional spaces like class rooms, library, laboratories, and staff offices all are allocated to each department.

### 4.5.5 Flexibility

In the whole faculty, buildings are rigidly designed, creating an impression of heavy structures. In details the buildings walls can easily be remove to give way for another space since they are constructed of concrete framed structures.

### 4.5.6 Effective space utilization

Size and volume of spaces provided for the faculty are enough to cater for staff and students if well managed. Student enrolment should be controlled to satisfy the national university space per student arrangement. In contrast to overcrowded classes, staff offices are generally in excess of the National Universities Commission's spatial specification. Space use is to a large extent bad in that while staff offices are too luxurious, students' facilities can hardly attend to their needs effectively due to over population.

### 4.5.7 Multi-user space design

The departmental buildings within the faculty of science Ahmadu Bello University Zaria are discretely designed with no multi-user spaces making the faculty very big and cumbersome. But despite the fact of the inadequacy of shared facilities few can be spotted out which are; the gardens within the faculty for recreational and leisure and the lecture theatre which only two where provided and shared by all the departments within the faculty. And of recently a multi-user research laboratory has been introduced in the faculty where students from various departments from the faculty can go and carry out their research.

### 4.6 Summary of Findings from Case Studies

This is the analysis of data obtained from the various case studies conducted in three(3) different federal universities , the result of which will be used in setting a flexible multi-user space for a science faculty design, below shows the result drawn from the finding,

| VARIABLES | FACULTY OF SCIENCE UNIVERSITY OF JOS, PLATEAU STATE, NIGERIA | SCHOOL OF SCIENCE ABUBAKAR TAFAWA BALEWA UNIVERSITY BAUCHI, NIGERIA | FACULTY OF SCIENCE AHMADU BELLO UNIVERSITY ZARIA |
|---|---|---|---|
| PLANNING AND LAYOUT | -The departments are discretely designed with no full range of shared facilities | -The faculty complex houses almost all the departments in one big building.<br>-The integration of the faculty in one big building structure enhances flow and inter-departmental activities . | -Each department is separately build.<br>-The buildings are properly oriented in the direction to minimize solar radiation as well as to attract enough ventilation. |
| FUNCTIONALITY | - No proper linkage of the faculty building with constituent buildings<br>-Lacks of consciously defined space for academics and staff. | - There Is no proper linkage between the three main building in the faculty | - Adequate provision of facilities in each of the department In each of the departments |
| FLEXIBILITY | - inflexibility of functional learning spaces,<br>-No fluidity of space | -The double banking faculty complex encourages fluidity and convertibility of space. | - faculty buildings are rigidly and discretely designed, creating an impression of heavy structures.<br>- buildings walls can |

| | | | |
|---|---|---|---|
| | | | easily be remove to give way for another space since they are constructed of concrete framed structures. |
| EFFECTIVE SPACE UTILIZATION | -The size and volume of spaces provided for the faculty will be enough to cater for staff and students if well managed. | -The school of science complex seems excellent in form and function.<br>-Functional content is grossly inadequate for use by all the department. | -Size and volume of spaces provided for the faculty are enough to cater for staff and students if well managed |
| MULTI-USER SPACE DESIGN | -Buildings are independent of each other with no shared facilities. | -The school seem to have a high level of cooperation amongst the departments due to their proximity to one another and shared facilities | -The departmental buildings are discretely designed with no multi-user<br>-Few facilities can be spotted out which are; the gardens within the faculty for recreational and leisure and the lecture theatre |

**Table** 1Comparism on findings from the three (3) case studies

Source: Author's Work

| | VARIABLES | UNIVERSITY OF JOS | ATBU BAUCHI | ABU ZARIA | SUMMARY |
|---|---|---|---|---|---|
| 1 | **PLANNING AND LAYOUT** | Bad | Good | satisfactory | Satisfactory |
| 2 | **FUNCTIONALITY** | Satisfactory | satisfactory | Good | Satisfactory |
| 3 | **FLEXIBILITY** | Bad | Good | Good | Good |
| 4 | **EFFECTIVE SPACE UTILIZATION** | Bad | Satisfactory | Good | Satisfactory |

| | | | | | |
|---|---|---|---|---|---|
| 5 | **MULTI-USER SPACE DESIGN** | Bad | Satisfactory | Satisfactory | Satisfactory |
| | **SUMMARY** | Bad | Satisfactory | Good | Satisfactory |

**Table 2** Summary from case studies

Source: Author's Work

The above table shows the researcher's assessment of some of the selected faculties of science in Nigerian universities, using some defined design parameters. Each school is assessed under each of the parameter and inference obtained. Verticals columns in the table represent the schools while horizontal rows stand for the parameters.

From the results obtained from the analysis on the table, it can be deduced that faculties of sciences in Nigerian universities are operating on average level of poor flexibility, space management and multi-user space design.

### 4.6 Data From Questionnaire Survey

Out of the 300 questionnaires distributed to respondents, 275 were returned and found useful for this analysis, as such, analysis was based on this 275 responses. The data from the questionnaire were coded and presented in Statistical Package for Social Scientists (SPSS) software version 20.0. Preliminary analysis was carried out then the data is subjected to descriptive statistics.

### 4.7 Presentation of Results

The results of this analysis are presented using bar chart graphical presentation, the use of bar chart is necessary because it gives visual representation of the qualitative evaluation of the impact of multi-user design concept for faculty of science of an existing federal university.

The first part of these results is the demographics of the respondents while the second part of the result is the inferential statistics as represented using bar charts and tables of analysis of variance.

### 4.8 Demographics

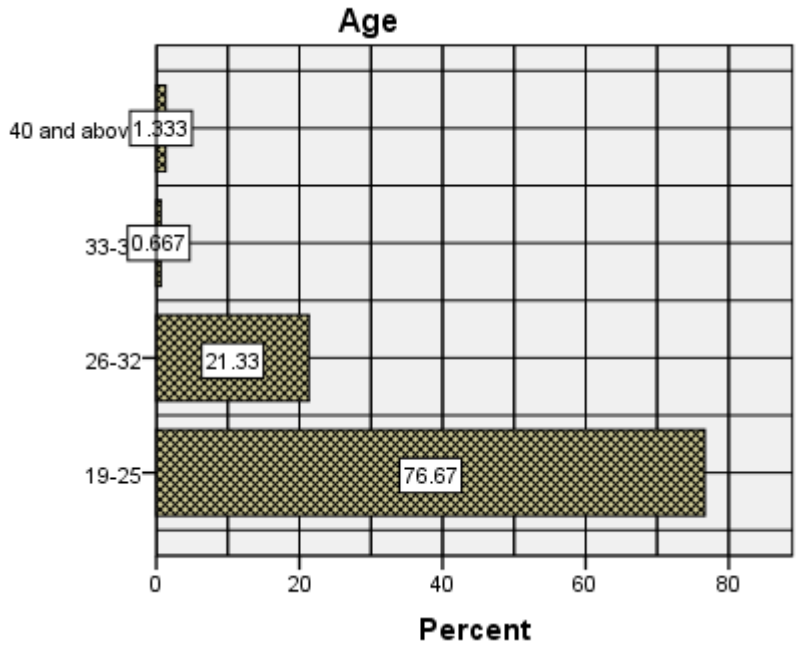



**Figure 7:**Graphical representation of the age distributions of the respondents

The figure above shows that majority of the respondents, 76.67% are of age bracket 19-25 years, 21.3% of the respondents are of age bracket 26-32 years while less than 1.8% of the respondents are of age bracket 33 years and above.

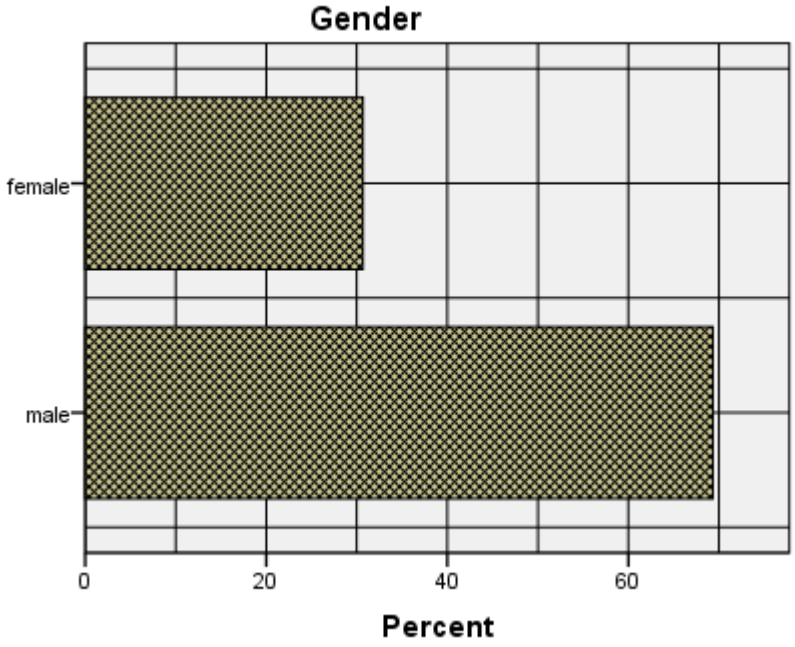



**Figure 4.2:** Graphical representation of the gender distributions of the respondents

Figure 4.2 shows that 30% of the respondents are female while 70% are male

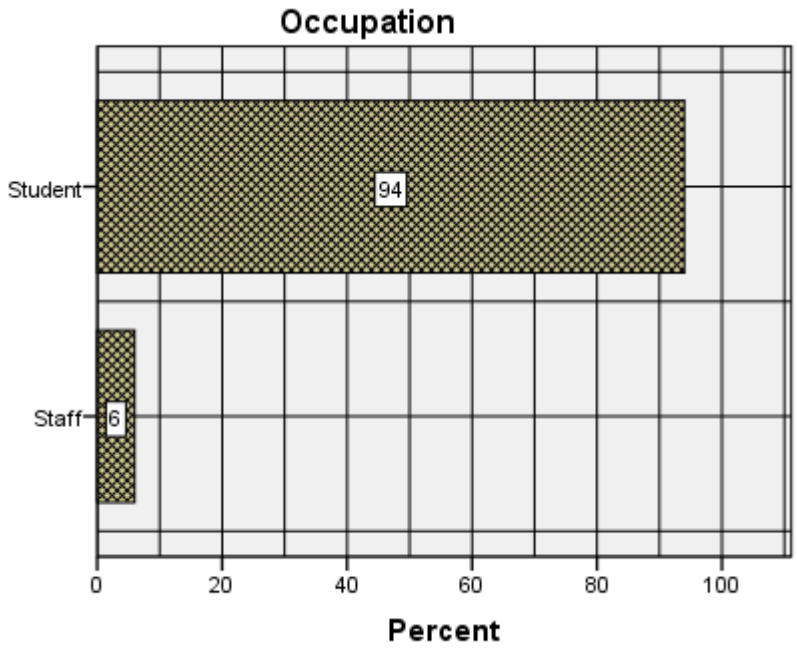


**Figure 8:** Graphical representation of the occupation status of the respondents

The figure above shows that 94% of the respondents are students while 6% are staff

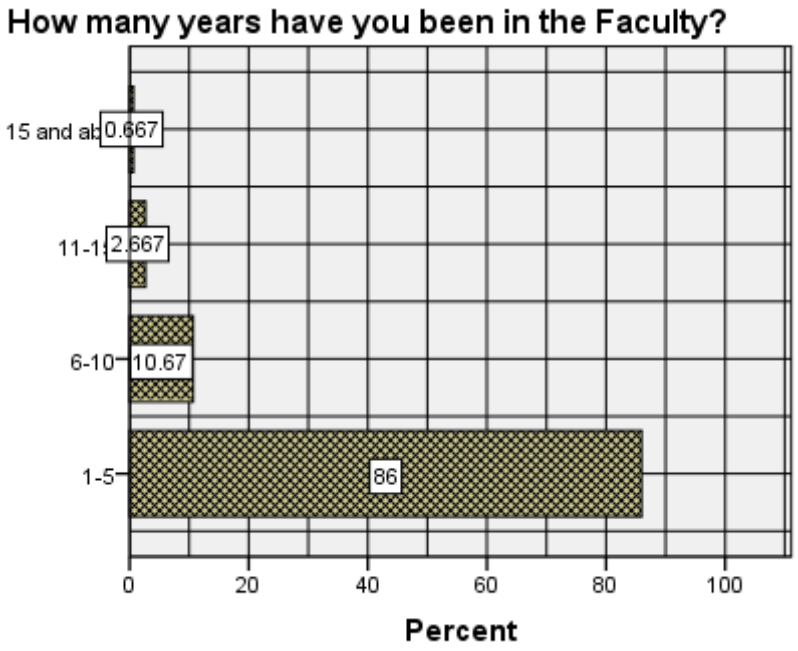



**Figure 9:** Graphical representation of duration of the respondents in the faculty

Figure 4.4 above shows that 86% of the respondents have been in the faulty for age bracket 1-5years, 10.67% of the respondents have been in the faculty for age bracket 6-10years while less than 3% of the respondents have been in the faculty for more than 11 years.

## 4.3 Inferential Statistics

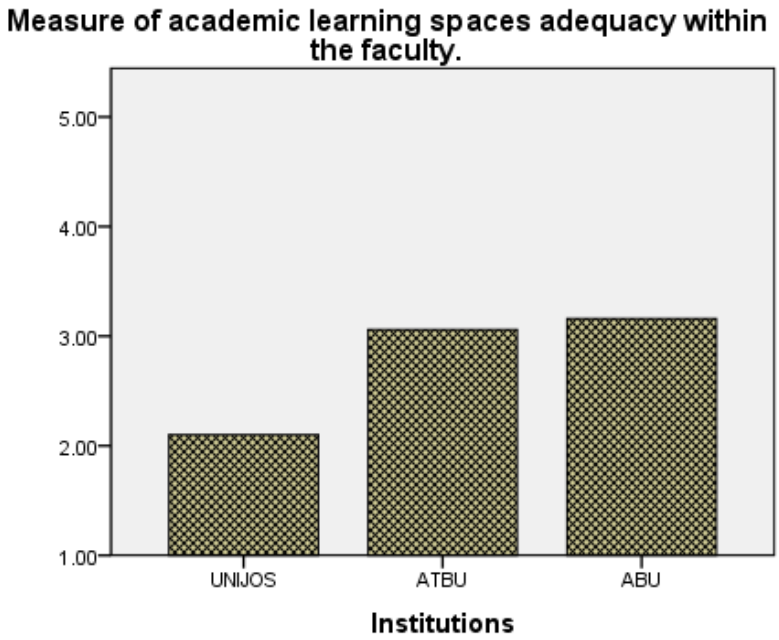



**Figure 10**:Measure of academic learning spaces adequacy within the faculty**.**

The figure above shows that ATBU and ABU have adequate learning spaces within the faculty of science while UNIJOS has inadequate space, as depicted by the scales of the chart. It shows that there is statistically significant difference between the academic learning spaces adequacy within the faculty between the selected schools for this survey.

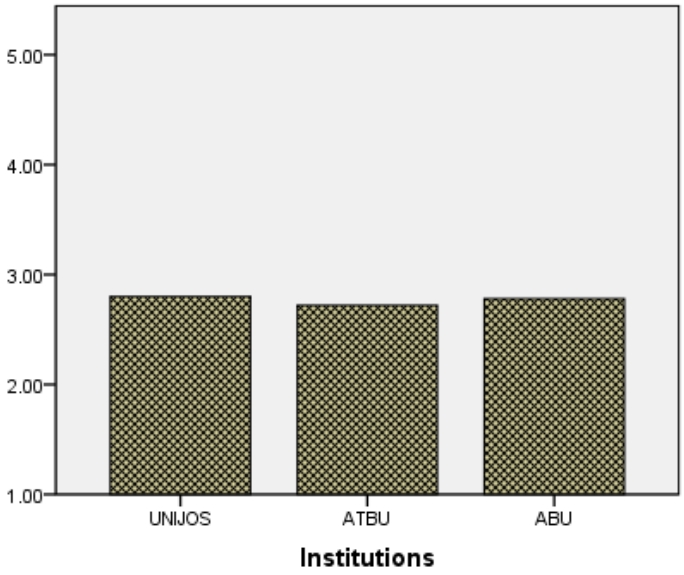


**Figure 11:**Measure of how the faculty design enhance and promote social interaction.

The figure above shows that all the respondents in the three institutions agree to the fact that the faculty of science design enhance and promote social interaction. The figure shows that there is no statistically significant difference between the response of the respondents within the faculty between the selected schools for this survey.

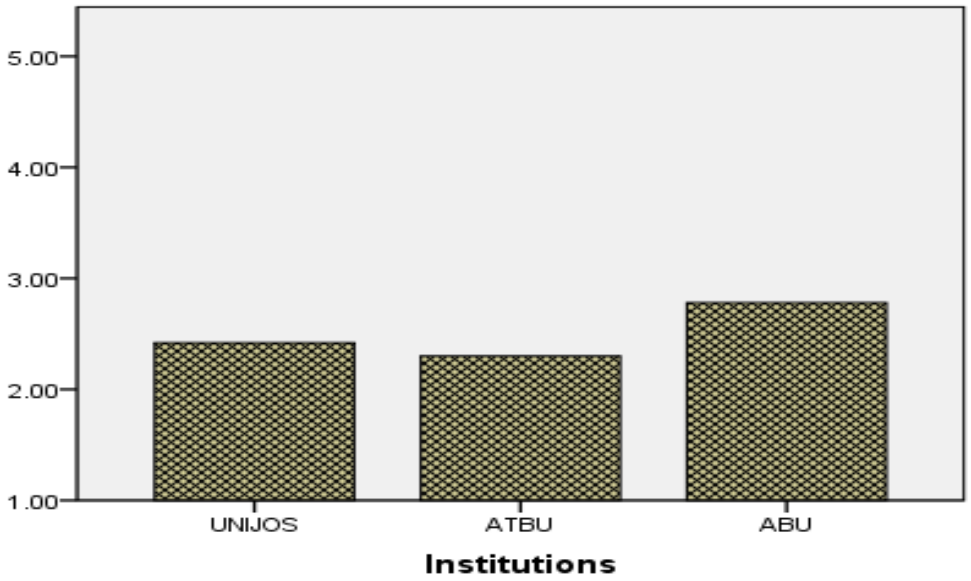



**Figure 12**:Assessment of faculty of science in terms of aesthetic values.

The figure above shows the analysis of variation of faculty design in terms of aesthetic values within the faculty between the selected schools in this survey. It shows that all the respondents in the three institutions agree to the fact that the faculty of science designs have poor aesthetic value.

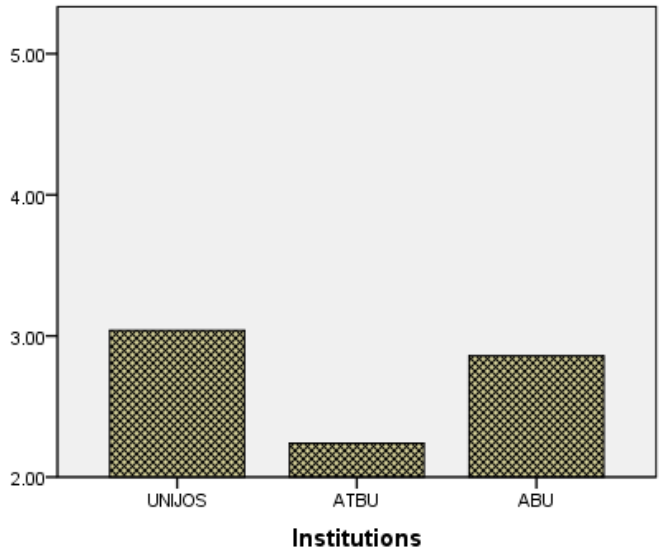



**Figure 13**:Measure of how faculty of science design incorporates interesting landscape with prominent natural elements.

The figure above shows that UNIJOS and ABU faculty of science fairly incorporate interesting landscape within natural elements while ATBU shows poor incorporation of interesting landscape with prominent natural elements. This shows the analysis of variation of faculty design in terms of incorporation of interesting landscape with prominent natural elements within the faculty between the selected schools in this survey.

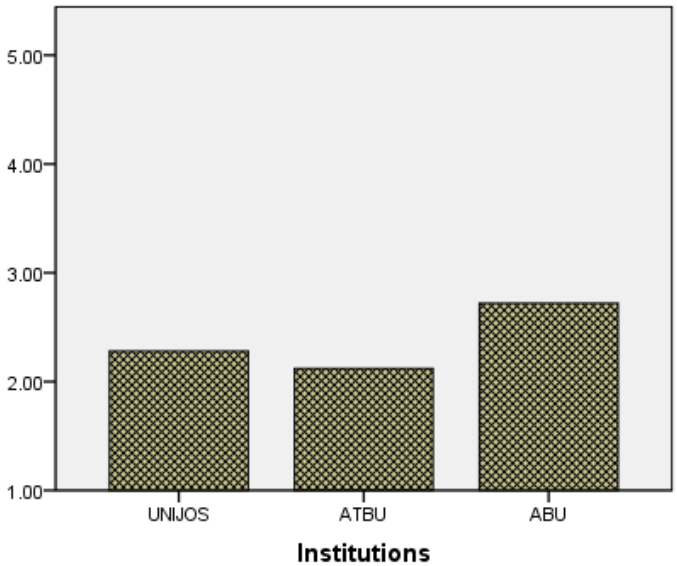



**Figure 14:**Measure of space flexibility within the faculty buildings to allow for changes

The above figure shows that there is statistically significant difference between the flexibility index for the selected schools in this survey. The figure shows that ABU has fairly flexible faculty design for changes while UNIJOS and ATBU has poor flexibility.

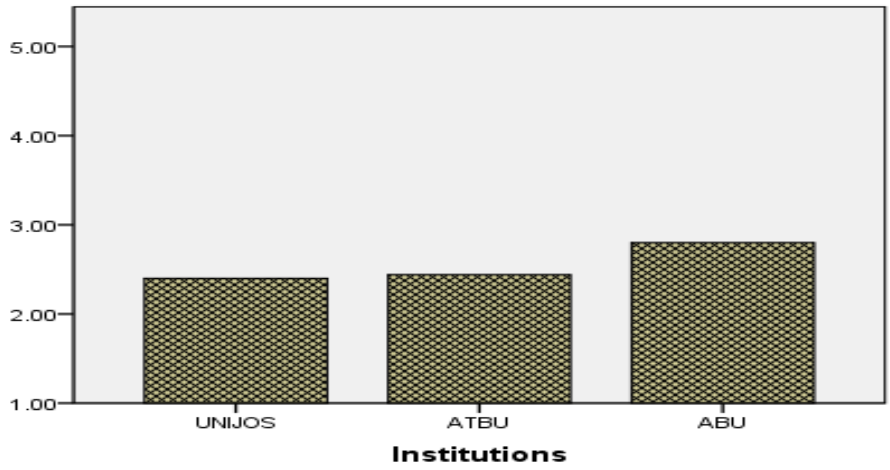



**Figure 15:**Measure of faculty surrounding space in terms of positive environment for studying, socializing and leisure activities.

The above figure shows that there is statistically significant difference between the surrounding spaces for the selected schools in this survey. The figure shows that ABU has fairly positive environmental surrounding space for studying, socializing and leisure activities while UNIJOS and ATBU have poor value.

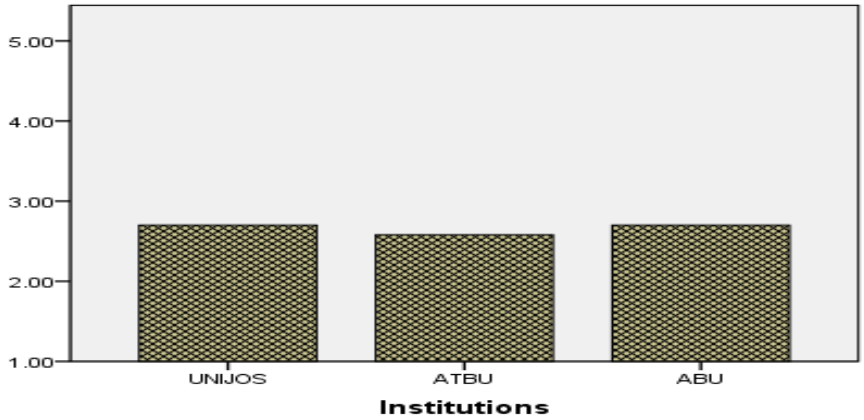


**Figure 16**:Measure of overall quality and performance of buildings within the faculty

The a figure above shows the analysis of variation of faculty design in terms of overall quality and performance of buildings within the faulty between the selected schools in this survey.

The figure above shows that the overall quality and performance of the buildings within the faculty is averagely moderate.

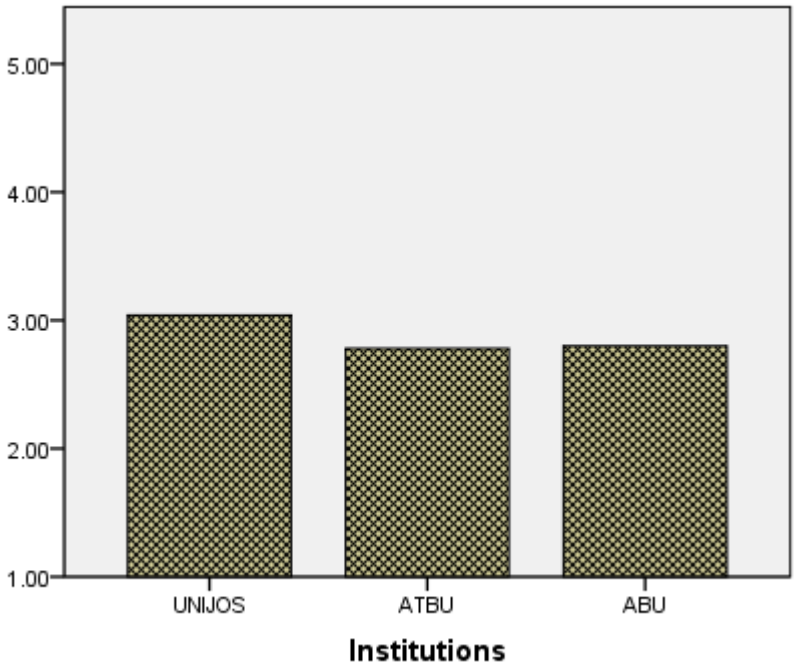



**Figure 17:** Measure of space adaptability and support for learning activities within the faculty

The above figure shows that there is statistically significant difference in the Measure of space adaptability and support for learning activities within the faculty in the various selected schools. It shows that the three institutions have moderate adaptability and support

for learning activities within the faculty, however, UNIJOS has a greater scale than other schools.

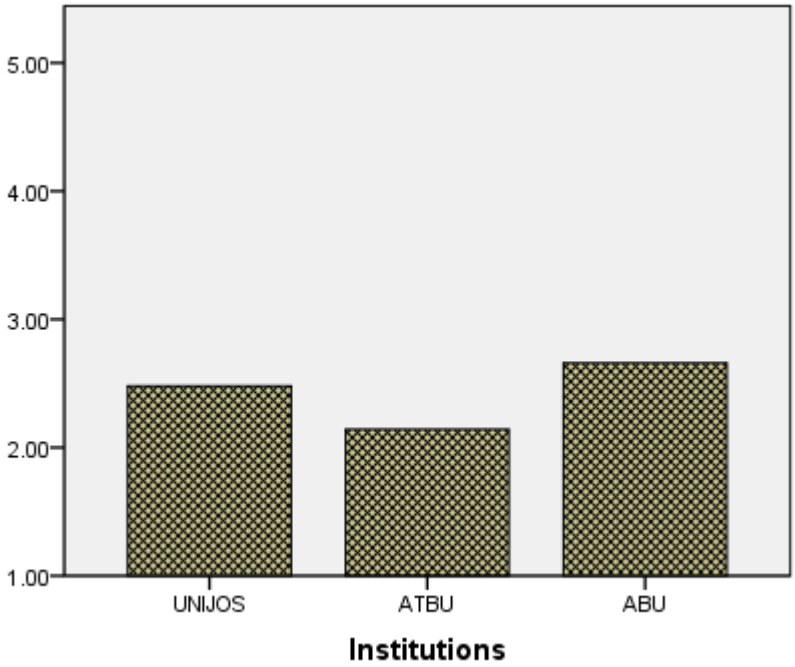



**Figure 18:**Measure of spatial organization of spaces within the faculty

The above figure shows the analysis of variation of faculty design in terms of spatial organization of spaces within the faulty between the selected schools in this survey. The figure above shows that UNIJOS and ABU have moderate spatial organization of spaces within the faculty while ATBU has poor spatial organization.

### 4.10 Summary of Findings From questionnaire survey

I. The faculty of science Academic sizes are moderate in space
II. The faculty design enhances and promotes social interactions.
III. The aesthetic value is poor.
IV. The faculty design partially incorporate interesting landscape with prominent natural elements.

V. Respondents are not satisfied with the flexibility of space within the faculty buildings.

VI. Faculty space comfort, visual taste and meetings the needs is fairly satisfactory

VII. The quality and performance of the buildings is averagely satisfactory.

**VIII.** Respondents are not satisfied with the spatial organization of the space within the faculty.

### 4.10 Discussion Of Findings

The study has led to some findings which are important and critical to the aim of the study and which has answered some of the research questions.

From the literature it has been discovered that learning spaces should not be just confined to classrooms but ant space should a potential for an effective learning space, and as mentioned by Malcolm (2006) that classrooms should be re-evaluated and other informal spaces be considered, therefore the new strategy should enable learning and accommodate multiple demands on students. And for this research which is considering the concept of multi-user spaces another aspect which is very important is the multidisciplinary collaboration which provides a vital information for the research and the design of faculty, it says to achieve an effective multidisciplinary collaboration in a university the infrastructures should be designed and constructed in a way that it will foster free movement and participation across various disciplines, whereby there should be openness and fluidity in the layout and planning of the structure, and the structure should be erected in such a way that movements in and around the disciplinary buildings and facilities be encouraged and at the same time each discipline maintains its autonomy.

From the case study carried out and the questionnaire survey answers were gotten to the questions raised at the beginning of the research, such findings include;

I. The spatial structure of the selected faculties of science which are found not to be adequate base from the results gotten from the analyses of questionnaire where the respondents are found not to be satisfied with the spatial organization of the faculty and from the visual survey it has been found to be averagely satisfactory, and therefore needs to be improved.

II. The impact of having an averagely satisfactory spatial organization of each of the faculties has been discovered to have a great effect on the quality of performance of learning by also been averagely satisfactory of which from the various literatures studied such should be able to improve great learning environment so as to improve the performance of the students.

III. From the study space that suitable to being multi-user were discovered and they are as follows;

- Lecture rooms
- Theaters
- Libraries
- Laboratories
- Eateries/ Cafeterias
- Seminar rooms
- Recreation and leisure gardens

Apart from Abubakar Tafawa Balewa University Bauchi which has a complex that houses most of the departments in the faculty and share some of the facilities, and in Ahmadu Bello University Zaria which has little shared facilities like the lecture theater and the multi-user research laboratory, It has been discovered that most of these facilities are not designed to be multi-user or shared but rather as independent facilities for each and every department.

From the findings carried out on the research a design model was formulated which was derived from the analysis of the various activities to be carried out in the proposed faculty of science. Design for effective multi-user spaces across the components of disciplines in environmental sciences entails close link to all disciplines concerned and this link can be extended to location of identified areas of possible collaboration close to adjoining collaborators as much as possible. For all the concern disciplines to participate actively in team work there should be a continuous flow of movement with little or no dead end.

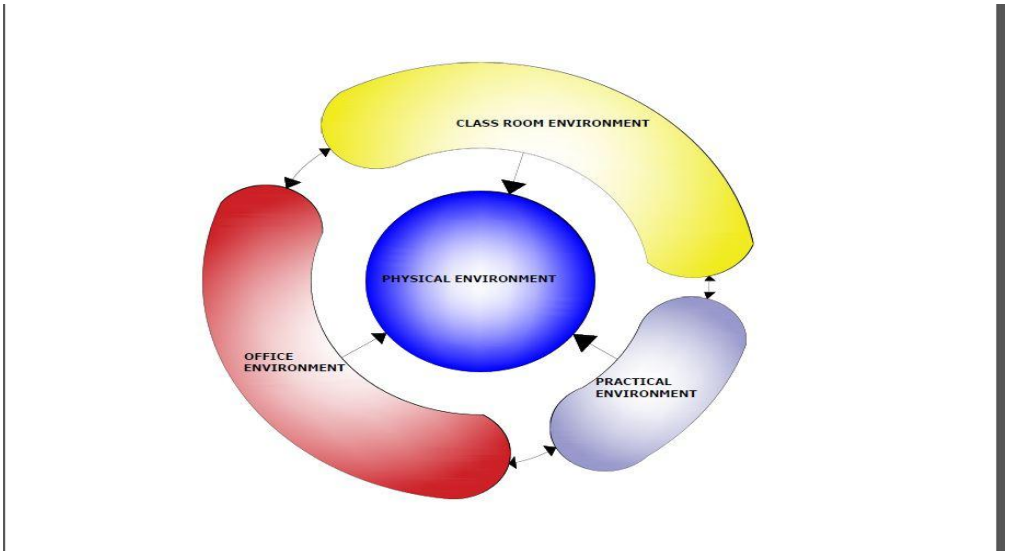



**Figure 19 Proposed design model**

Source: Author's work

# CHAPTER FIVE

# DESIGN FRAME WORK

## 5.0 Introduction

The project site is located within the main campus of Federal University Kashere Gombe. The University is located. The university in turn is located in Kashere Akko Local Government area of Gombe State.

## 5.1 Gombe State

Gombe State, located in the northeastern part of **Nigeria**, is one of the country's 36 states; its capital is Gombe. The boundaries of the state roughly correspond to those of the Tangale-Waja Chiefdom and **Gombe Emirate**, a traditional state. The State, nicknamed *the Jewel of Excellence*, was formed in October **1996** from part of the old Bauchi State by the Abacha military government. Being it located in the north eastern zone, right within the expansive savannah allows the state to share common borders with the states of **Borno**, **Yobe**, **Taraba**, **Adamawa** and **Bauchi**. The state has an area of 20,265 km² and a population of around 2,353,000 people as of 2006. It is located at an elevation of 380 meters above sea level, Its coordinates are 10°15'0" N and 11°10'0" E in DMS (Degrees Minutes Seconds)C or 10.25 and 11.1667 (in decimal degrees).


**PLATE 5.1:** Map of Nigeria showing Gombe State

**Source:** www.wikipedia.com

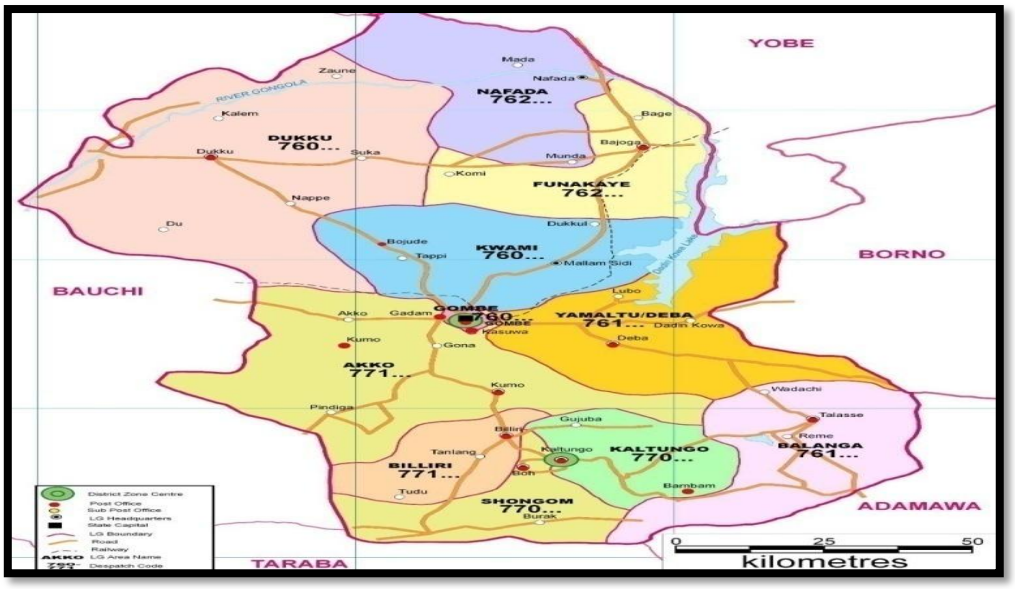



**PLATE 5.2:** Map of Gombe State

Source: www.wikipedia.com

## 5.2 Educational Development in Gombe

Gombe has been a citadel of learning from early times. It is among the early recipients of Islamic culture and teachings, in the wake of the Islamic jihad of the 1800's. It has by no small means played a key role in the propagation of the teachings and practice of Islam. That early status has played out in the town's subsequent emergence as a key resource centre for Islamic teaching and scholarship.

A little afterwards, missionary activities took a stronghold in the predominantly Christian areas, South East of Gombe. In those areas, the teaching of Christianity was also to be well integrated alongside western education. Since State creation in 1996, the total Secondary School population of Gombe State has increased at an annual rate of 2% to 38,000 in 2003; a quarter of whom are regularly in the terminal class; with aspiration to proceed to high levels of education.

The state has in its kitty several institutions of higher learning which include the following;

I. School of Nursing and Midwifery Gombe

II. School of Health Technology Gombe

III. Federal College Of Education Gombe

IV. College of Education Kaltungo

V. School of Legal Studies Kumo

VI. Gombe State University

VII. Federal University Kashere

These various tertiary institutions have the mandate to train skilled manpower in various disciplines for the state and the country in general .

### 5.3 Physical Characteristics of Gombe

**Geology and Relief:** Gombe State is part of the central Nigeria highlands, but the flat landscape in the northern and southern parts of the state have isolated hills. While the elevation of the plain is at about 600m above sea level, the hills reach between 700m and 800m. The Gongola River is the main drainage system, running approximately northsouth towards the Benue River Basin, but with principal tributaries draining from west to east into River Gongola. Gombe State is geologically a part of the Upper Benue Trough, although the state is an entity of its own, the Gongola Trough. As such, the state constitutes a major sedimentary basin, with a fill of about 6,000m of Cretaceous Tertiary Sedimentary rocks. These rocks are well exposed throughout the state and have been recently explored for oil and gas, but without success. The eastern part of Gombe State is geologically older than the west. At Nafada, the Gongola bends in a loop southward and flows through much of the eastern border of the State before it joins River Benue at Numan, outside the state. It is the sixth longest river in Nigeria, being about 530km, much of which is within Gombe State. It has numerous tributaries and smaller streams in the state includ ing Rivers Dukul and Ruhu in the north (Dukku LGA). In the westcentral part, there are some trib utaries of River Guji, while in the southern parts of the state (including Balanga, Billiri, Kaltungo and Shongorn LGAs) the headwaters of several minor tributaries of River Benue characterise the land scape. They include Rivers Balanga and Dadin kowa. The state is within the wider Benue Drainage Basin, with the dominance of the western part of the Gongola (sub) basin. As a result of its geological and geographical features, Gombe State

has a large and wide variety of solid mineral deposits, abundant grazing fields and fertile agricultural land.

**Soils And Vegetation:** The neoloav of Gombe State has exerted an enormous influence on soil development; hence over half of the state (central) that is underlain by the Kerri Kerri Formation has shallow to moderately shallow impoverished soils, with sandy loams on iron pan. On the Chad Formation in the northern part of the state, the soils are deep but sandy, and developed on clays and silty clays; but are mostly blanketed by sand dunes.

Soils in the eastern part of Gombe State are shallow to deep loamy, sandy clay, loam and vertisols with cracking clays that have weathered from shales. Vegetation in Gombe State is predominantly wooded shrubland in the central part, with the plant community comprising Anogeissus/ Combretum/ Affrormosia/Detarium.

The northern part of the State exhibits a mosaic of shrubbed grassland and grassed shrubland with the preponderance of Acacia. In the hilly southern areas, the vegetation is shrubbed woodland with mostly Affrormosia and Detarium. Gombe State has the cultivated and urban areas constituting over 35 per cent of the land use/land cover.

### 5.4 Kashere Gombe

Kashere is a populated place in Gombe State Nigeria with the region font code of Africa/Middle East. It is located at an elevation of 431 meters above sea level and its population amounts to 77,015. Its coordinates are 9°46'0" N and 10°57'0" E in DMS (Degrees Minutes Seconds) or 9.76667 and 10.95 (in decimal degrees).

### 5.5 Federal University Kashere Gombe

Federal University Kashere Gombe is one of the new federal universities established by the Federal Government of Nigeria to increase access and ensure equity among all the states of the federation and the Federal Capital Territory in terms of the presence of federal tertiary institutions. Despite the rich culture of learning in the state, there was never to develop any conscious attempt towards articulating those early backgrounds, into the science of modern educational developments. Those early advantages of scholarship have therefore not been exploited towards develop needs, since in any case, the State lacked any visible tertiary institution for that purpose. Federal University Kashere once established therefore, strive and survive on a fertile terrain, in which scholarship can be sustained from legacy and culture of teaching and learning. The University is an institution of higher learning that is committed to excellence and integrity in the pursuit of knowledge within an environment that respects diversity, the worth of the individual, academic freedom, a commitment to service learning, and a shared responsibility for applying knowledge and skills to address the interrelated issues that affect the local, national, and global communities.

#### 5.5.1 aim and objectives of establishment

The aim of Federal University Kashere is to become a world-renowned centre of learning where students are prepared with the knowledge, skills, and dispositions they need in order to serve their community, state, nation, and the world through excellence in teaching, research, and service. Some of its objectives are;

1. Truth and integrity in the pursuit, generation, dissemination, and application of knowledge

2. Freedom of thought and expression

3. Respect for diversity and the dignity of the individual

4. Responsibility as stewards of the environment and citizens of the world

5. Excellence in intellectual, personal, and operational endeavors

6. High standards of morals and ethics and

7. Efficient resource management based on the need for cost effectiveness.

Because the school wants to serve as a world-renowned centre of learning through excellence in teaching, research and scholarly or artistic activities, and service to the community, state, nation, and the world, it has the following faculties for a start; Faculty of Agriculture, Faculty of Education, Faculty of Humanities, Management, and Social Sciences, Faculty of Science, School of General and Preliminary Studies.

**5.6 Site Selection Criteria**

Although, the university's master plan clearly indicated the proposed site for the project, a comparison with another site was desirable so as to ascertain the suitability or otherwise of the proposed site. The assessment is carried out to explore the salient qualities of the site that qualifies it to be selected by the institution amidst other alternatives. To do this exercise, some examination parameters were set out, ranging from human, climatic and environmental factors to be used as standards for comparison. For the purpose of this selection exercise, the experimental site was named **SITE A** and the proposed one **SITE B** respectively.

| **Parameter Site A Site B** | **Site A** | **Site B** |
|---|---|---|
| | | |
| Accessibility of site | 4 | 5 |
| Centrality of site | 3 | 5 |
| Expansiveness of site | 4 | 3 |
| Ground cover | 3 | 4 |
| Landscape | 3 | 5 |
| Pleasant views | 3 | 5 |
| Proximity to facilities | 2 | 4 |
| Slope of site | 3 | 4 |
| Soil structure | 5 | 3 |
| Drainage of site | 4 | 3 |
| **Total** | **36** | **46** |

**Table 3:** COMPARISM OF SITES ATTRIBUTES

### 5.7 Site Analysis: Site Features

The analysis of features on and around the site undertaken during this research is to bring out the mpact most relevant sites characteristics and determine how such features will eventually impact the proposed design. Such features studied during this design are; access, site topography, soil type, site vegetation and sources of noise.

#### 5.7.1 Access

The site is located within the main campus of the University. It has two possible access with the primary access been preferred because it offers greater site visibility and a more direct access into the site.

#### 5.7.2 Site topography

The site slopes gently towards the north eastern part of the site. This feature can be use to dictate the mechanical works on the site. Drainage design and the water supply system to the building will have to be sited at south western part of the site to take advantage of gravity in discharging waste away from site.

#### 5.7.3 Soil Type

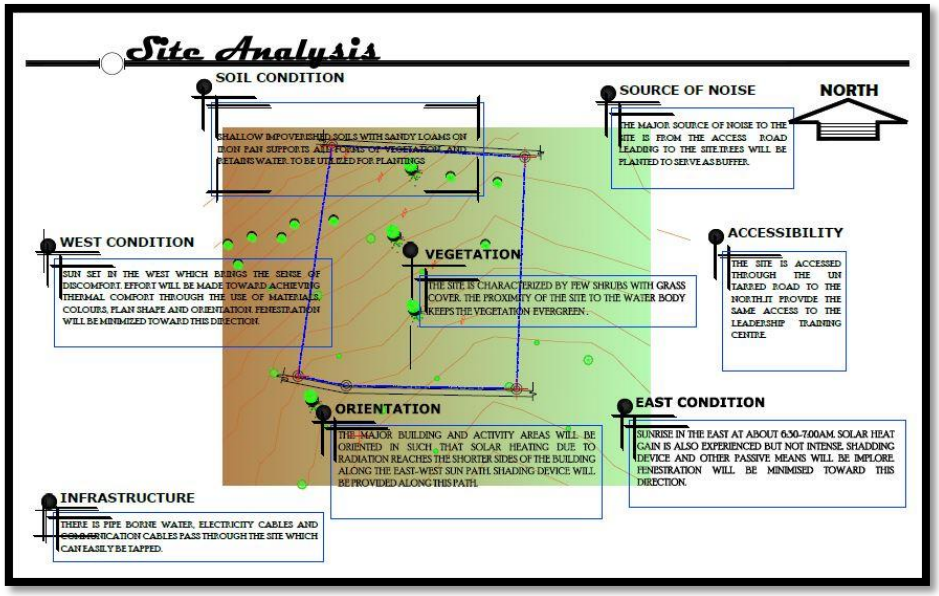
The soil type on the site is a shallow impoverished soils with sandy loams on iron pan. These type of soil supports all forms of vegetation and it retains water which can be utilized for plantings.

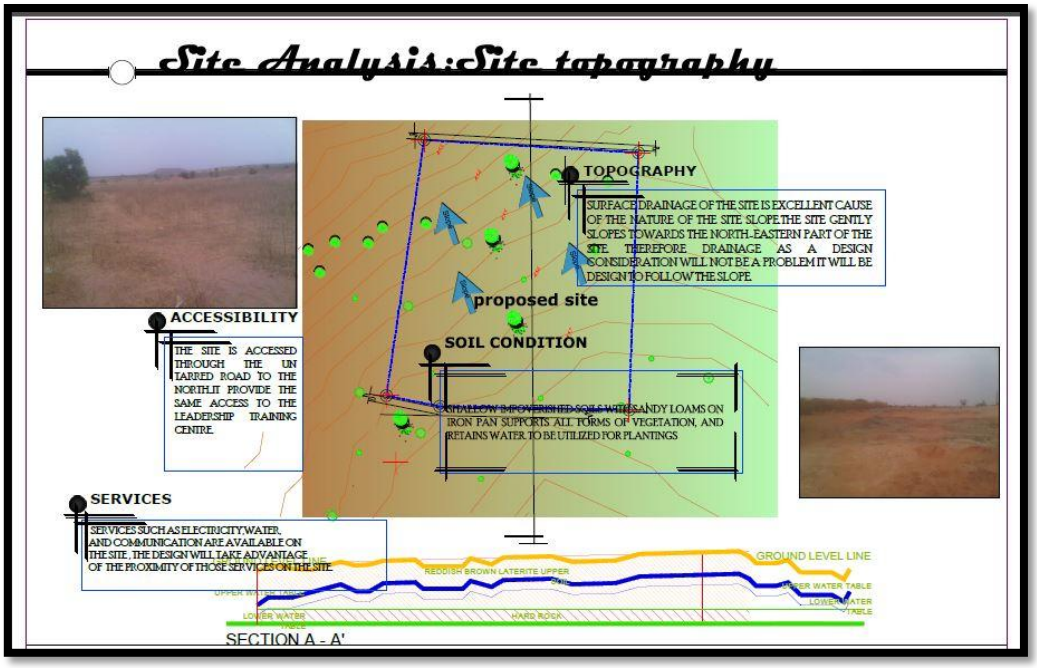
#### 5.7.4 Vegetation

Trees and shrubs are scattered randomly across the site. Some of the shrubs and trees are to be maintained unless where it obstruct access or development, but more of the need to be provided to reduce site temperature and loss of nutrient.

### 5.7.5 Source of noise

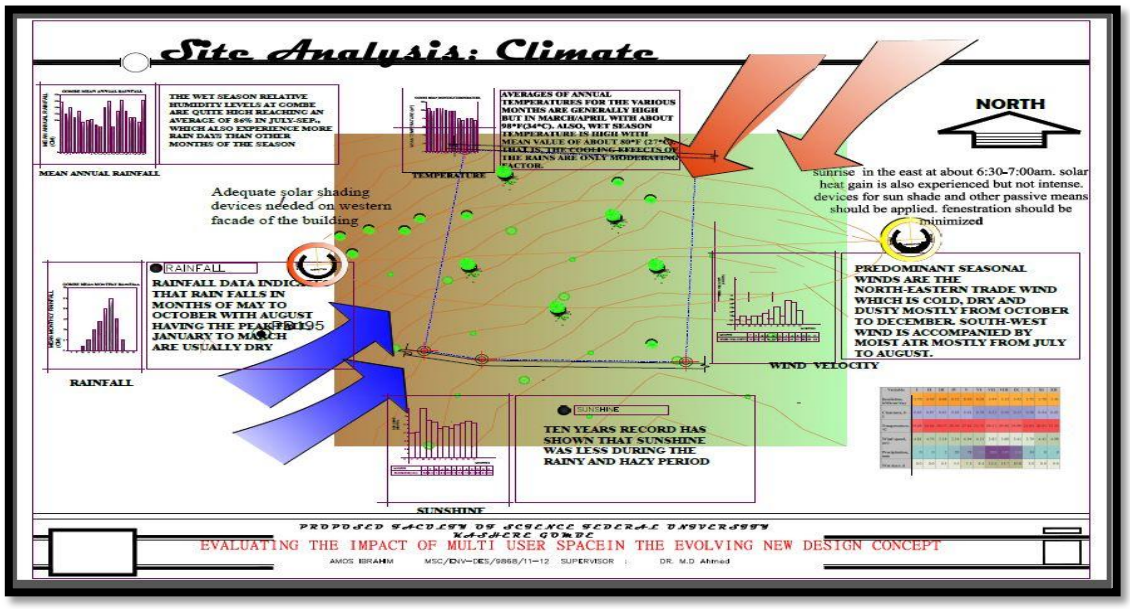
The site greatest sources of noise are from the two access road which are secondary roads. Buffer zone of large trees are be created to reduce this effect. Also, auxiliary facilities could also be placed close to the main roads and acoustic materials will also reduce the effect of the noise.






## 5.8 Site Analysis: Climatic Condition

The climate is tropical in Kashere. Throughout the year there is little rainfall in Kashere. with abundant sunshine and dryness during the dry season and rain during the rainy period. The site as climatic characteristics the same as that of Gombe state.



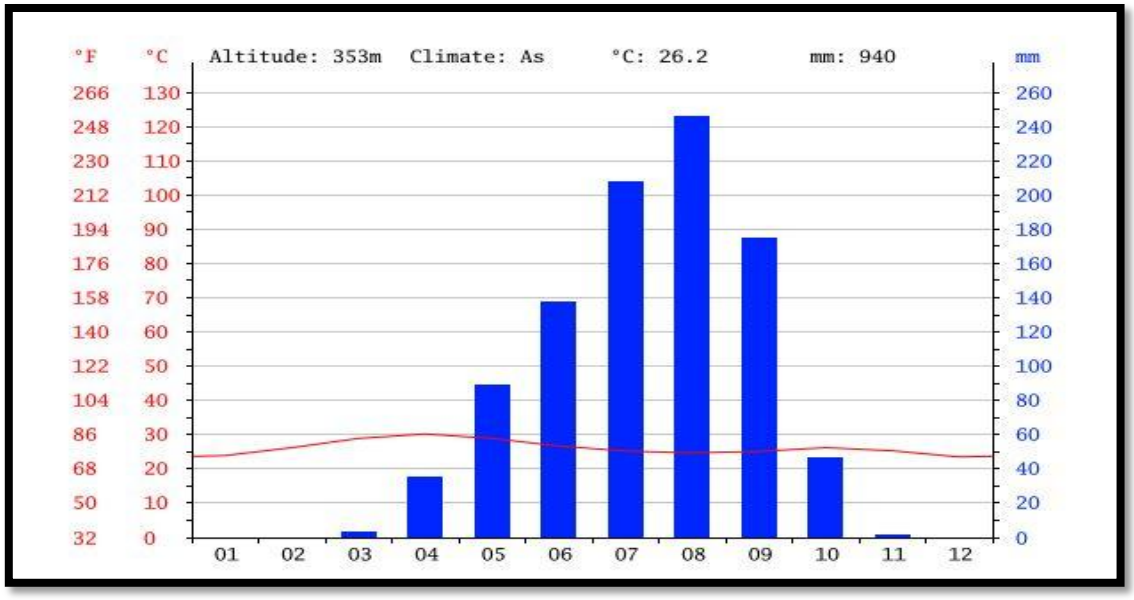



**Figure 20:** Showing climatic condition

### 5.8.1 Temperature

The warmest month of the year is April with an average temperature of 30.2 °C. In December, the average temperature is 23.5 °C. It is the lowest average temperature of the whole year.

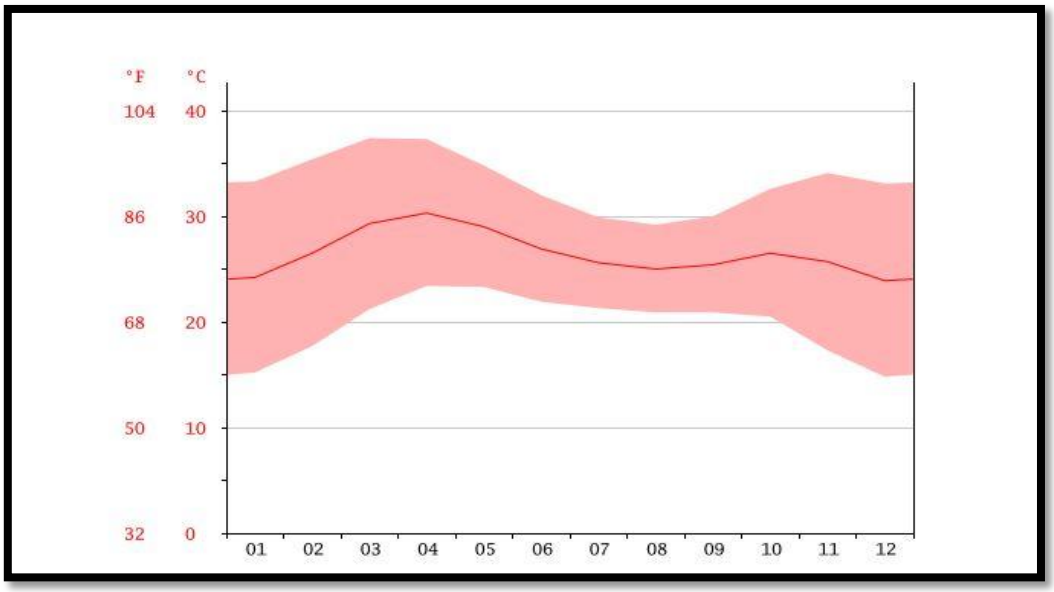



**Figure 21:** Showing Temperature chart

### 5.8.2 Wind speed

The wind speed on the average reaches up to about 3.7-4.0m/s. During the Harmattan season, it is characterised as dry and carries dust from the desert. Proper barriers should be provided to protect the building and its material content from the harsh conditions. The building should be oriented to make use of the south-western trade wind


**Figure 22:**Showing wind speed Chart

### 5.10 Design Brief

Federal University Kashere been a new university is undergoing construction to attain status of every good university standard. This is partly due to the growing demand for a qualitative standard of education. To effectively satisfy this requirement means to provide a design that is multi-user and flexible enough to cater for multidisciplinary collaboration, as well as satisfying the immediate and future requirements of the university. This design

has put into consideration natural environment factors as well as human factors concerning students, staff and circulation.

The physical design of any school should encourage and support a factory model of teaching and learning with row upon row of standardized classroom and amenities. Learning opportunities rarely exist for interdisciplinary learning, project based learning, naturalistic learning and collaborative learning. School building design should inspire intellectual curiosity and also promote social interaction.

The proposed Faculty of science will be a single unit of combined different functions , which is hoped to be a manifestation of the various enhancing factors to support science education and student productivity. The facilities will provide a spatial arrangement to cover different fields of science and also increase productivity to enhance social interaction within and around the various departments.

**5.11 General and Specific Requirement**

The proposed faculty of science shall aimed at housing four (4) departments which are the departments that are fully functional. They are as follows;

- Biological Science
- Chemistry
- Mathematics
- Physics

This section describes the various space and the spatial requirement for the proposed faculty of science. To ease the categorization of these requirements, four function spaces

have been identified, namely; Teaching space, administrative space, ancillary spaces and external spaces. Specific spatial requirement of each of the identified categories are outlined below.

**Teaching spaces**

i) Lecture Theatre

ii) Seminar rooms

iii) Laboratories

iv) Library

**Administrative Spaces**

i) Deans Office

ii) Deputy Dean’s Office

iii) Heads' of Department Offices

iv) Board Room

v) Photocopy Room

vi) General Offices

vii) First Aid Room

**Ancillary Spaces**

i) Toilets

ii) Electrical switch room

iii) Circulation(lobbies, Stairs)

iv) Snack Spot

v) General Stores

**External Spaces**

i) Car Parking

ii) Outdoor Learning Garden

iii) External Stores

### 5.12 Population Of Faculty

The population of the faculty will be composed of both staff and students. The number ratio will follow the minimum requirement ratio stated by the Nigerian university commission for faculties of science. However, an additional percent shall be added to the size of the student facilities to cater for unforeseen circumstances experienced in the educational aspect like fluctuating number of students admitted.

**Student Population**

The proposed facility will cover for a two separate educational programs, the first is the bachelor of science followed by a professional master's degree in science.

| S/No. | Department | 100 level | 200 level | 300 level | 400 level | M.Sc I | M.Sc II | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 1. | Biological Science | 50-60 | 50-60 | 50-60 | 50-60 | 30-40 | 30-40 | 260-320 |
| 2. | Chemistry | 50-60 | 30-40 | 30-40 | 30-40 | 30-40 | 30-40 | 260-320 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3. | Physics | 50-60 | 30-40 | 30-40 | 30-40 | 30-40 | 30-40 | 260-320 |
| 4. | Mathematics | 50-60 | 30-40 | 30-40 | 30-40 | 30-40 | 30-40 | 260-320 |

**Table 4:** PROJECTED STUDENT POPULATION

The total departmental population shall be projected between 300 to 360 students each, while the total faculty population is projected between 1560 to 1920 students, facilities, however, shall be provided to cater for the upper projections.

**Staff Population**

The minimum bench mark stated by the Nigerian university commission for architectural education states that the staff student ratio should be 1:15

| S/No. | DEPARTMENT | RATIO | STUDENT POPULATION | STAFF POPULATION |
|---|---|---|---|---|
| 1. | Biological Science | 1:15 | 260-320 | 20-22 |
| 2. | Chemistry | 1:15 | 260-320 | 20-22 |
| 3. | Physics | 1:15 | 260-320 | 20-22 |
| 4. | Mathematics | 1:15 | 260-320 | 20-22 |

**Table 5:** PROJECTED ACADEMIC STAFF POPULATION

The total projected staff population to be catered for per department are between 20-22 persons, making a total faculty staff population to be 128 persons.

### 5.13 Design Consideration

In order to meet up with the requirement of a comfortable and functionally designed building, some design issues have to be put into consideration. The considerations are as follows;

#### 5.13.1 Accessibility

Various means of access within and around the building will be created . Lifts, staircases, connecting corridors and balconies will serve in enhancing access within and around the faculty. The facility should provide a clear, simple and exciting circulation for student amd staff, thi can be achieved through the following;

a) The clear separation of public and private spaces, through hierarchy of spaces and separation of ground level entrance.
b) All the main circulation areas should be easily accessible for physically challenged persons.

#### 5.13.2 Conducive learning environment

The facility should provide a learning environment that the students are more likely to be task oriented and reflective, and hence, more likely to engage in higher order thinking. All this can be achieved through the following;

a) The building form should encourage reflecting and by being visually interesting
    - Creating niche to allow for reflecting
    - Mix of curve and straight walls
b) Work spaces, classrooms should have access to natural light in more than just direction

c) In common spaces, views of the surrounding landscape should be provided for visual relief and variety by placing windows at eye level and placing common spaces together

d) Exterior and interior building forms should reveal themselves to observers , though curve pathways

e) Each learning space should provide and promote easy follow of the academic activities conducted within it by arranging work stations.

### 5.13.3 Visibility

The facility and all the activities that are within it should be highly visible to. Visitors should have a sense of being in a school by the virtue of seeing things around them.

### 5.13.4 Promote social interaction

The facility should promote spontaneous social interaction between students, faculty, and visitors. This can be done through the following;

1) Focal point to attract students and staff
    - A place to have snacks
    - Sunny spot with a Gallery at the Center
2) Spaces should encourage high incidence of chance meetings and conversations

### 5.13.5 Site features

The building should be incorporated with site features, and this can be achieved through

a) Creating outdoor learning environment

b) Taking advantage of the south and west exposure

### 5.13.6 Acoustic and Zoning

The transport of sound through structure should be controlled. Noise levels should be controlled within zones by appropriate choices of material finishes on floors, walls and ceilings, and the shaping of interior spaces to prevent flutter and unwanted amplifying effects. . To generalize and simplify, the penetration of low-frequency sound is lessened by structural mass, of middle frequencies by diffusing and absorbing surfaces, and of high-frequency sound by the elimination of small scale air gaps in doors, windows and partition walls. Acoustic ceiling panel and also walls are to be cavity panels to absorb sound and not reflect them. Wooden panels on walls. Also the theatre interior shape is to achieve a balanced acoustic property. (Metric hand book).

### 5.14 Design Concept

Design concept is a broad abstraction of an idea or a guiding principle that determines how nature and reality or event are perceived. Science study provides a conceptual tool for thinking about technical expertise in more sophisticated ways, and also faculty of science plays a pivotal role to a lot of faculties that are science based such as engineering, pharmacy, veterinary medicine, environmental design, and education.

Therefore since science is viewed as the origin or base of most of these disciplines the concept of the design is gotten from a cell as shown in Plate XVIII which is the smallest unit of life and life began from a cell. A cell

- Finds the origin of life
- Build everything that will be
- Works as a whole
- Its sophisticated

Four parts of cell were chosen of which there functions is used to illustrate how some part of the whole faculty building design works. These parts are;

1. The cell membrane, which functions as a semi-permeable barrier, allowing a very few molecules across it while fencing the majority of organically produced chemicals inside the cell. This cell membrane is been related to the exterior walls of the building which serves as a semi-permeable barrier by controlling movements in and out of the building and also controls air movement and solar radiation.
2. The cytoplasm: Is the material between the plasma membrane (cell membrane) and the nuclear envelope, it maintains the shape of the cell as well as anchoring organelles, moving the cell and controlling internal movement of structures. The cytoplasm in the design is seen as the interior walls of the building which controls movement inside the building.
3. Nuclear membrane: is a double membrane composed of an outer and an inner phospholipid bilayer, it is a routes that is permeable to small molecules up to the size of the smallest proteins. The nuclear membrane is related to the exterior walls from the courtyard which has openings that allows for movement of people, air flow and lighting into the building.
4. The Nucleus: The nucleus controls and regulates the activities of the cell, the nucleus here is seen as the courtyard of the building

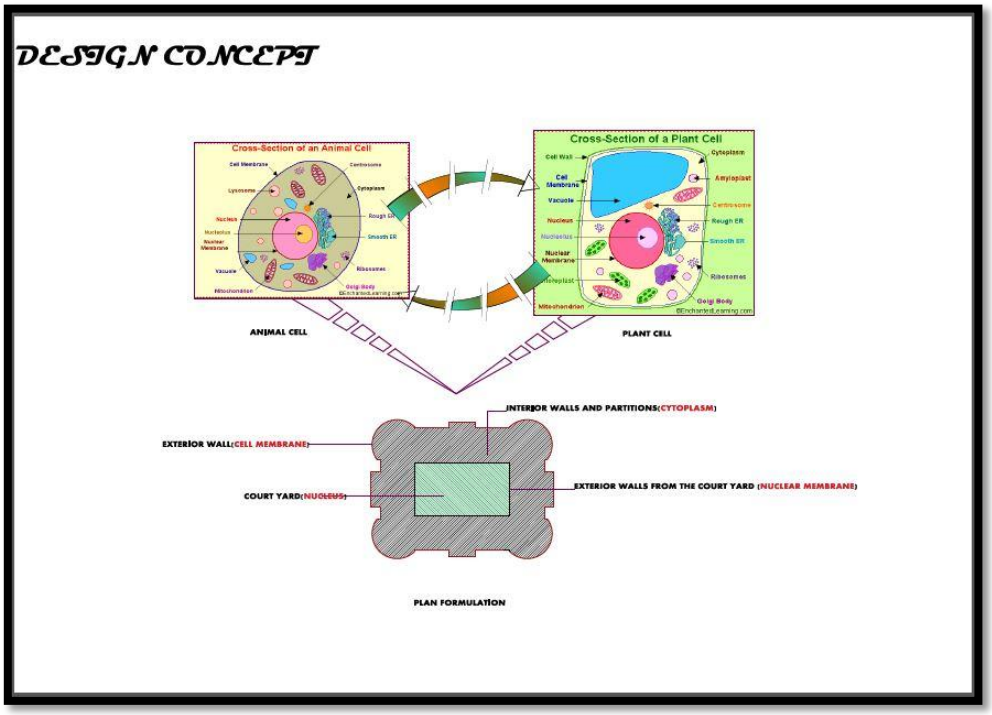



**Plate XIX:** Showing concept development

### 5.14.1 Site planning

The site is planned in a way that adequate landscape was incorporated in the design to achieve a functional balance, environmental control and aesthetic appeal. The site has two access road located on it, one from the north and the other from the south, the access road from the south was chosen to be the site entrance because of the advantages it carries which allows the building to be well appreciated by the visitors, staff, and the student of the faculty. The site is made up of three structures, the main faculty building and two lecture theatres which are located on left and right side of the main building. Trees were planted to provide shade against adverse effect of solar radiation as well as garden for relaxation and also outdoor learning.

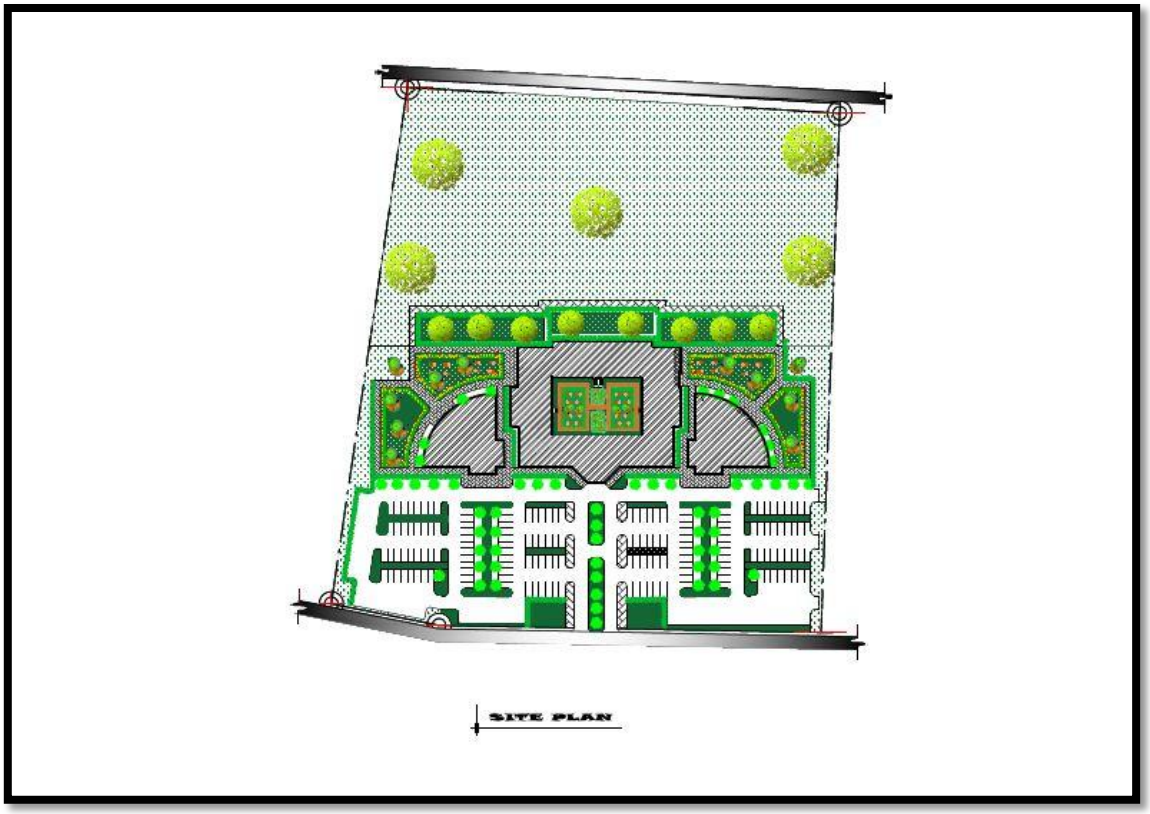



**Plate XX:** Showing Site Plan

**Source:** *Authors Work (2014).*

### 5.14.2 Building form

The building is designed in such a way that it offers abundant natural light and enough ventilation, with a strong connection between the outside and the inside. Some space were created in the building for chance meeting between around the balconies, this chance occurrences increases communication and interaction among students and staff of the faculty. The building also brings people together through the use of interior courtyard, which also brings good lighting, ventilation and thermal comfort into the building.

**Floor Plan**

The floor plan is a three storey, it is designed in such a way that each of the floors is shared by all the departments either directly or indirectly and its divided into four

- The ground floor which has the deanery
- The first floor occupies the main departmental offices
- The second floor occupies the offices for lecturer
- The third which is the last floor occupies the classes and some of the laboratories

The ground floor being the first point of contact contains the administration of the faculty which is the deanery, and the faculty library and also some multi-user laboratories. The first floor plan has all the departmental offices for each of the various departments, the second floor is the floor where most of the offices for the lectures for the various departments are located, the third floor is the last floor it contains the lecture rooms and some laboratories for all the departments and a reason why it is placed on the last floor is for the student to perform a form of exercise before reaching the floor in order for their brain to be stimulated and be ready to assimilate. All the lecture rooms are design in such a way that there widow openings coming from two opposite direction to help harvest day lighting and ventilation. The main floor plan is designed with a court yard in the middle which fosters communal living, also serving as a meeting point and a place for outdoor learning. The idea of space sharing on each of the floor is gotten from the concept of multi-user space design which has a significant impact on learning activities within the faculty. The building has two major staircases which are centrally located on two opposite sides of the building which provides a considerable walking distance from any point of the

building, the staircases are also placed towards the court yard therefore they are also serving the purpose of escape staircase.

Also there are two large lecture theaters which are located on the left and right side of the main faculty building


**Plate XXI:** Showing Ground Floor Plan

**Source:** *Authors Work (2014).*

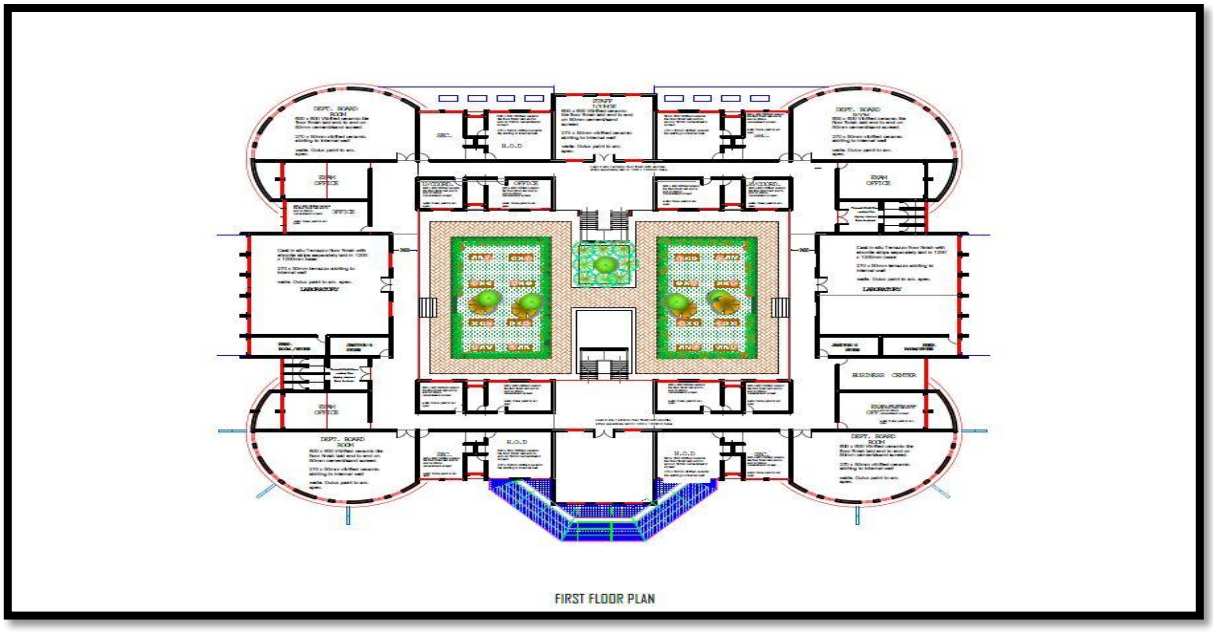



**Plate XXII:** Showing First Floor Plan

**Source:** *Authors Work (2014).*

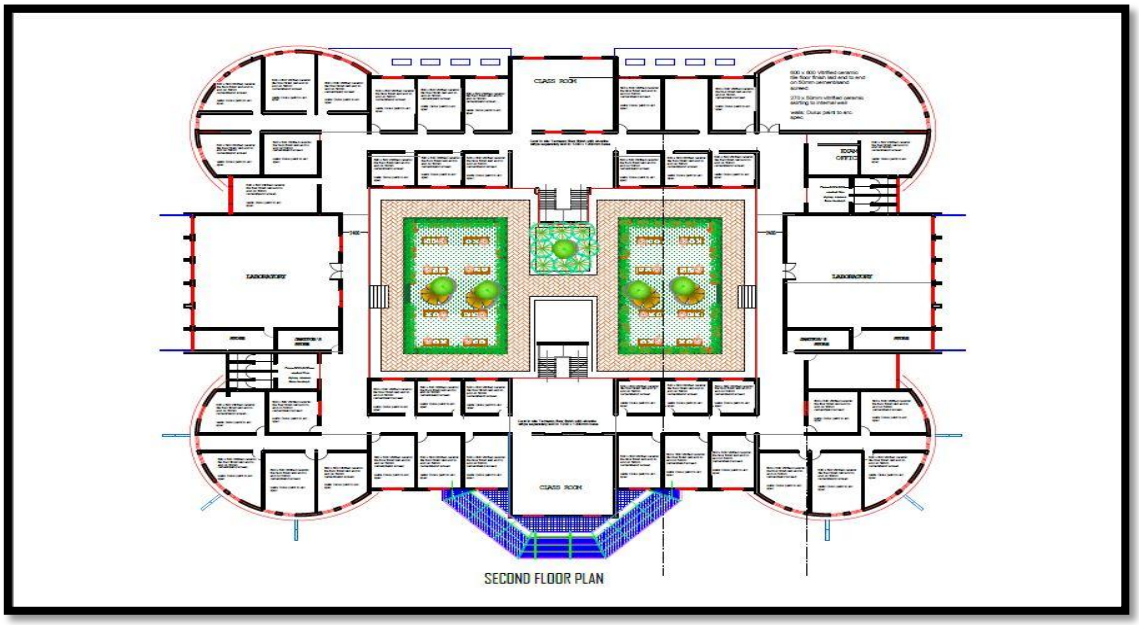



**Plate XXIII:** Showing Third Floor Plan

**Source:** *Authors Work (2014).*

**Elevation**

The elevation of the building displays the use of fins on the walls which serves both for structural support and for aesthetic purpose, as well as the use of shading devices on both the east and western sides of the elevation

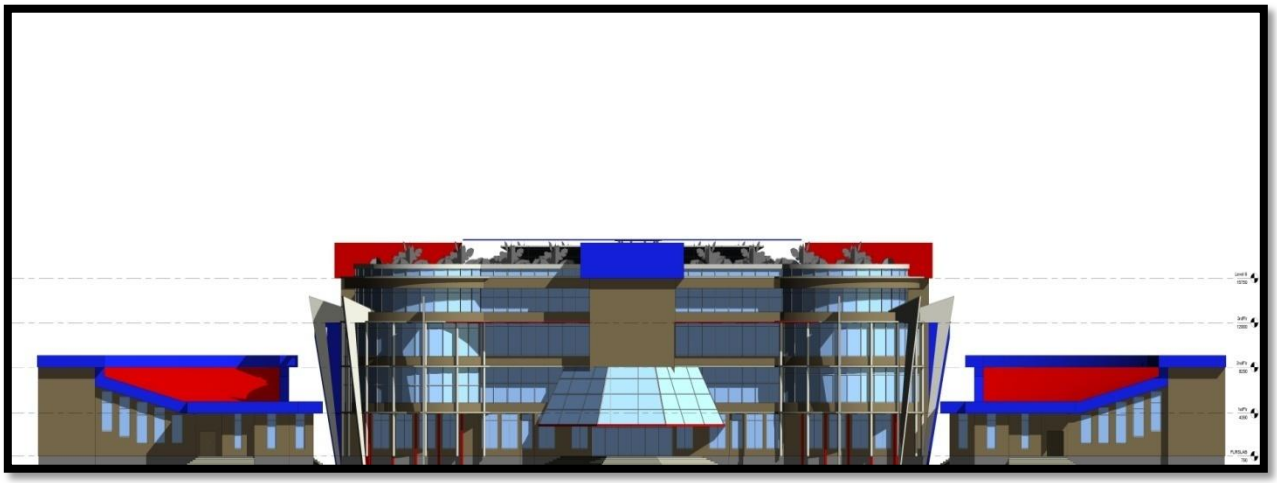


**Plate XXIV:** Showing Approach Elevation

**Source:** *Authors Work (2014).*

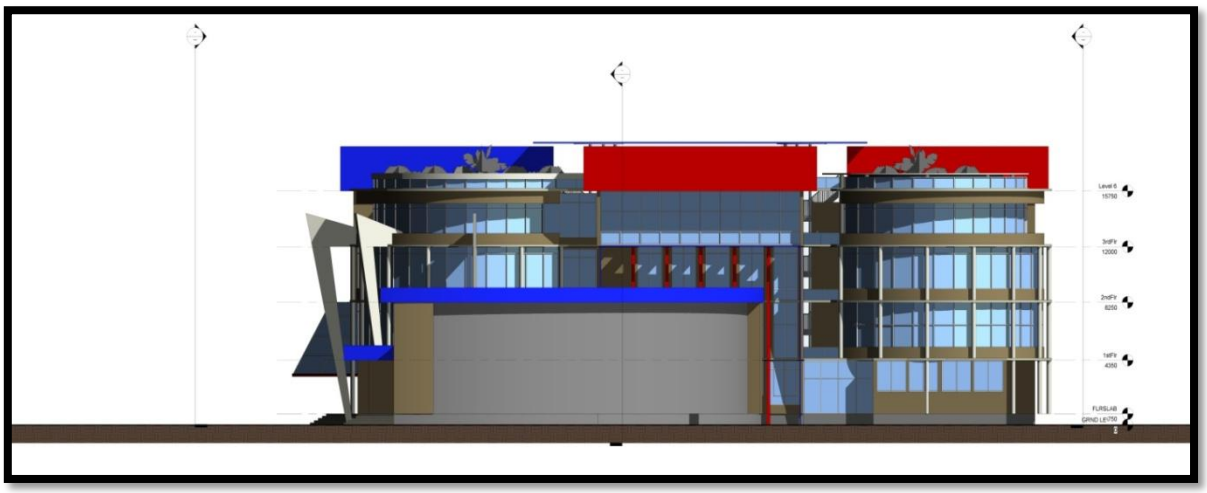


**Plate XXV:** Showing Approach Elevation

**Source:** *Authors Work (2014).*

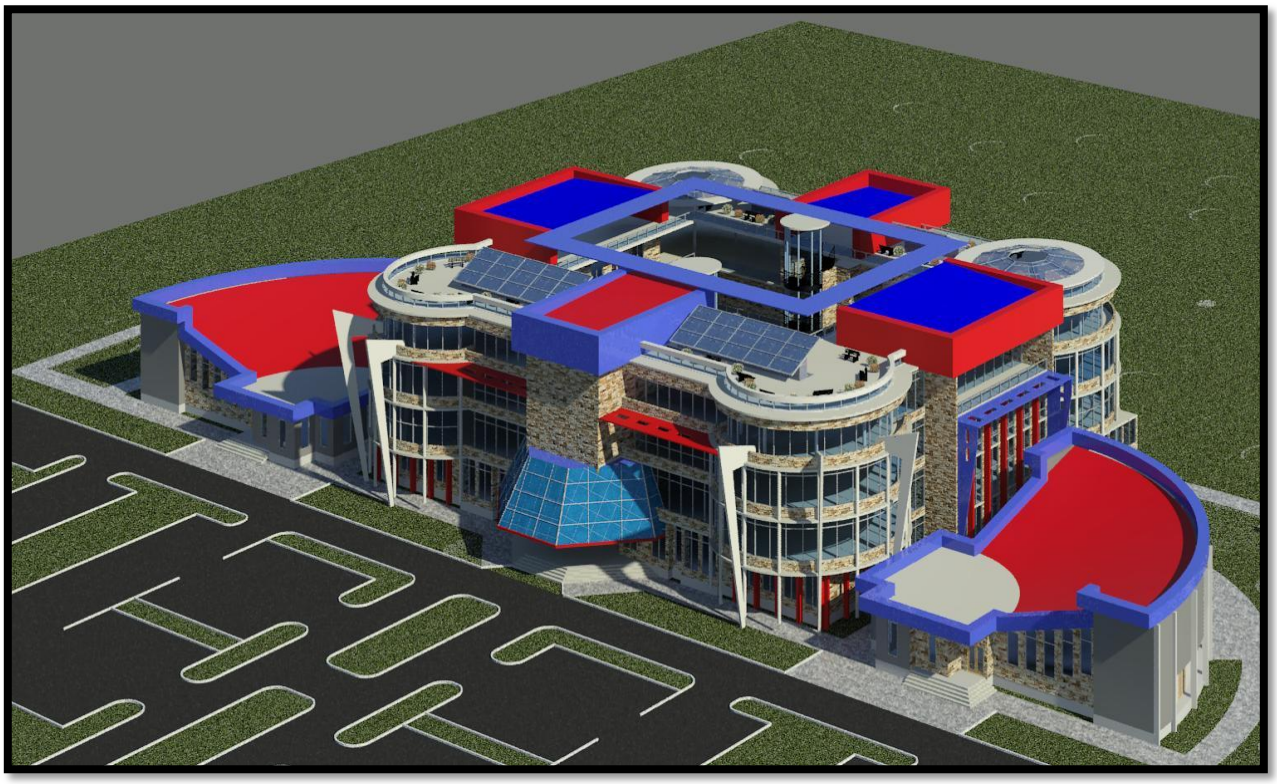


**Plate XXVI :** Showing 3D of the design

**Source:** *Authors Work (2014).*

**Building Materials And Technology**

The building materials are mostly glass, concrete. other materials used for finishes are ceramics, terrazzo, these materials provide a good blend of interior with the taste of interior design. Some of the other elements used in the design which are mostly sustainable are as follows;

a. Roof garden, which provides area for student to study plants and nature while lowering the school maintenance cost by keeping the building cooler during the heat season
b. Solar panels, this is a renewable energy solution that are can be use in a building construction
c. Shading devices, this is a special care taken to shade windows to reduce the incoming heat and risk of overheating, and these shading devices are selected according tp the orientation of the windows.

### 5.15 Schedule of Accommodation

**Table 6 (a):** Faculty Office/Office of the Dean

| S/No. | Space | No. Req. | No. of Users | Area/Users ($m^2$) | Space Area ($m^2$) | Total Area ($m^2$) |
|---|---|---|---|---|---|---|
| 1 | Dean | 1 | 1 | 34 | 34 | 34 |
| 2 | Secretary | 1 | 1 | 24 | 24 | 24 |
| 3 | Deputy dean | 1 | 1 | 34 | 34 | 34 |
| 4 | Secretary | 1 | 1 | 24 | 24 | 24 |
| 5 | Faculty office | 1 | 1 | 24 | 24 | 24 |
| 6 | Gen. office | 1 | 6 | 9 | 55 | 55 |
| 7 | Board Room | 1 | 30 | 1.5 | 151 | 151 |
| 8 | Faculty Theatres | 2 | 260 | | 1162 | 1162 |
| 9 | Storage space | 2 | - | - | 30 | 60 |

**Table 7 (b):** Administrative Spaces per Department

| S/No. | Space | No. Req. | No. of Users | Area/Users ($m^2$) | Space Area ($m^2$) | Total Area ($m^2$) |
|---|---|---|---|---|---|---|
| 1 | Head of dept. | 1 | 1 | 34 | 34 | 34 |
| 2 | Secretary | 1 | 1 | 24 | 24 | 24 |
| 3 | Head, under-grad. | 1 | 1 | 24 | 24 | 24 |
| 4 | Head, post-grad. | 1 | 1 | 24 | 24 | 24 |
| 5 | Secretary | 1 | 1 | 24 | 24 | 24 |
| 6 | Exam officer | 1 | 1 | 24 | 24 | 24 |
| 7 | Gen. office | 1 | 10 | 9 | 90 | 90 |
| 8 | Meeting room | 1 | 30 | 1.5 | 45 | 45 |
| 9 | Storage space | 1 | - | - | 40 | 40 |

**Table 8 (c):** Academic Spaces per Department

| S/No. | Space | No. Req. | No. of Users | Area/Users ($m^2$) | Space Area ($m^2$) | Total Area ($m^2$) |
|---|---|---|---|---|---|---|
| 1 | Professor office | | | | | |
| 2 | Doctor office | | | | | |
| 3 | Lecturer -1 office | | | | | |
| 4 | Lecturer –II office | | | | | |
| 5 | Snr. Tech. staff | | | | | |
| 6 | Jnr. Tech. staff | | | | | |
| 7 | Multi-user lab. | | | | | |
| 8 | Classroom | | | | | |
| 9 | Library | | | | | |
| 10 | Laboratory | | | | | |

# CHAPTER SIX

# CONCLUSION

## 6.1 Summary

This research set out to study the impact of multi-user space in the design of faculty science. The problem identified in the beginning to which the research aimed at was the little attention given to the design of this faculty which usually discretely designed with no full range of share facilities. This leads to various findings emanating from a concise literature review in which answers to the problem 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 the faculty of science will create more flexibility to the design and reduce the wastefulness in the design. It wasn't just to study literature and precede to design of the faculty of science, thus live case studies were undertaken to determine what existed in order to be further informed on what needed to be done or provided for the purpose of designing a multi-user faculty of science. The results of these case studies were inciting and played a vital role in the over-all final design, and it was also established that flexibility was a solution for many design problem.

Design of faculty buildings should be carried out to satisfy not only the physical needs of conveniences and safety but also cater for the sociological aspect of the inhabitant of the structure.

## 6.2 Conclusion

Multi-user space design tends to optimize space usage thereby reducing the wastage of space in a building design, and this can be achieved through the application of various aspects of flexibility design principles. And also multi-user space design bring together various disciplines that are interrelated together. DeZure (2004) brought forward two important points to note if multidisciplinary collaboration is to be productive. First, if we want students as well as staff to engage in complex intellectual tasks to integrate the insights of different disciplines, then we must all join hands in that task, modelling it and sharing the difficulties and the richness of its possibilities. Second, multidisciplinary education is not a rejection of the disciplines.

## 6.3 Recommendation

Upon carrying out all the necessary research on the impact of multi-user space in the design of faculty of science, the following recommendations are put forward.

a) To ensure the use of multi-user space in the faculties of science first and foremost, architects and other designers should always make serious effort to reconcile both physical and sociological requirements for the faculty.
b) New faculty designs for new universities should be designed with the intended purpose and population, where it become absolutely necessary to make provision for further structural development, suitable site should be selected and incorporated into the original design so as to ensure coherence and functional flow.

c) Building professionals should also be enlightened in the aspect of flexible design strategies, even thought the concept is not new to the international communities. It has not been fully embraced in the context of Nigerian architecture.

d) Further studies should be done in this area to improve on available resources as adequate and substantial information are not readily available as this may tend to discourage those intending to fully understand and apply the knowledge on a wider scale.

### 6.4 Contribution to Knowledge

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

1. The research was able to establish that this evolving new design concept which is the multi-user space design promotes understanding, effective communication between professionals and is cost effective has not been fully embraced into Nigeria's system of federal schools design.
2. The research was also able to established that most of science faculty facilities are not designed to promote multi-disciplinary collaboration through flexible education space.

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## APPENDICES

### Appendix A: Questionnaire

Dear Respondent,

I am a postgraduate student from the Department of Architecture, Faculty of Environmental Design, Ahmadu Bello University Zaria, undertaking a research on **Evaluating the impact of multi-user in the evolving new design concept for faculty of science: federal university kashere Gombe .** Your maximum co-operation is highly needed and will be appreciated. Note that all information given will be treated with utmost confidentiality.

Please tick the appropriate option of your choice and write your responses where necessary.

**SECTION A: BIODATA**

1. Age

a) 19-25 ☐ b) 26-32 ☐ c) 33-39 ☐ d) 40 and above ☐

2. Gender

a) Male ☐ b) Female ☐

3. Occupation……..

4. How many years have you been in the Faculty?

a) 1-5 ☐ b) 6-10 ☐ c) 11-15 ☐ d) 15 and above ☐

**SECTION B: FACULTY DESIGN**

1. How adequate are the sizes of academic learning spaces within the faculty

a) very adequate ☐ b) Adequate ☐ c) Inadequate ☐ d) Very inadequate ☐

2. Indicate your level of agreedness on how the faculty of science design enhance and promote social interaction.

a) Strongly agree ☐ b) Agree ☐ c) Disagree ☐ d) Strongly Disagree ☐

3. How will you assess the faculty of science in terms of aesthetic values

a) Excellent ☐ b) Average ☐ c)Poor ☐ d) Very poor ☐

4. The faculty design incorporates interesting landscape with prominent natural elements

a) Strongly agree ☐ b) Agree ☐ c) Disagree ☐ d) Strongly Disagree ☐

5. How satisfied are you with the flexibility of space within the faculty buildings to allow for changes

a) Very satisfied ☐ b) Satisfied ☐ c) Unsatisfied ☐ d)Very unsatisfied ☐

6. How will you rate the faculty of science and its surrounding space in terms of positive environment for studying, socializing and leisure activities?

a) Excellent ☐ b) Average ☐ c) Poor ☐ d) Very poor ☐

7. How will you assess the spaces and buildings within the faculty in terms of comfort, visual taste and meeting its user needs?

a) Excellent ☐ b) Average ☐ c) Poor ☐ d) Very poor ☐

8. How will you rate the overall quality and performance of buildings within the faculty

a) Excellent ☐ b) Average ☐ c) Poor ☐ d) Very poor ☐

9. How do the learning spaces adapt and support learning activities within the faculty

a) Excellent ☐ b) Average ☐ c) Poor ☐ d) Very poor ☐

9. How satisfied are you with the spatial Organisation of spaces within the faculty science

a) Very Satisfied ☐ b) Satisfied ☐ c)Unsatisfied ☐ d) Very unsatisfied ☐

**SECTION C: CONCLUSION**

Given the opportunity to design a faculty of architecture,

1. In your own suggestion how should a modern faculty of science of look like?……

……
……...

2. What can be done or provided to the existing faculty of science……
……

……
……

3. What can be maintained in a future design of faculty of science……
……

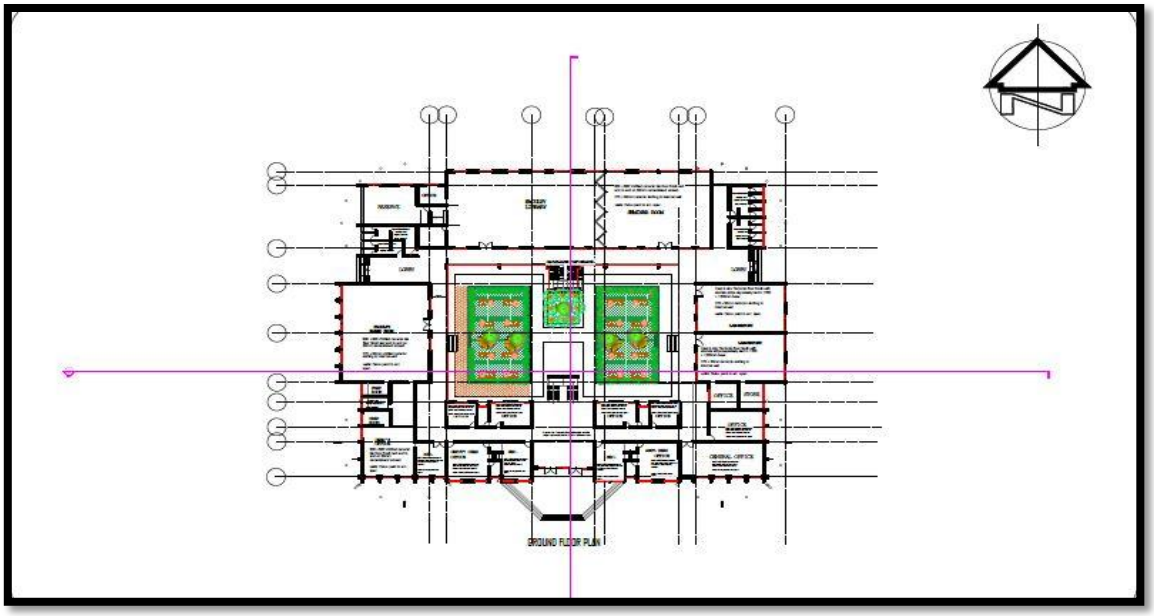
……
……

4.Any other additional comment regarding the faculty of science……
……
……

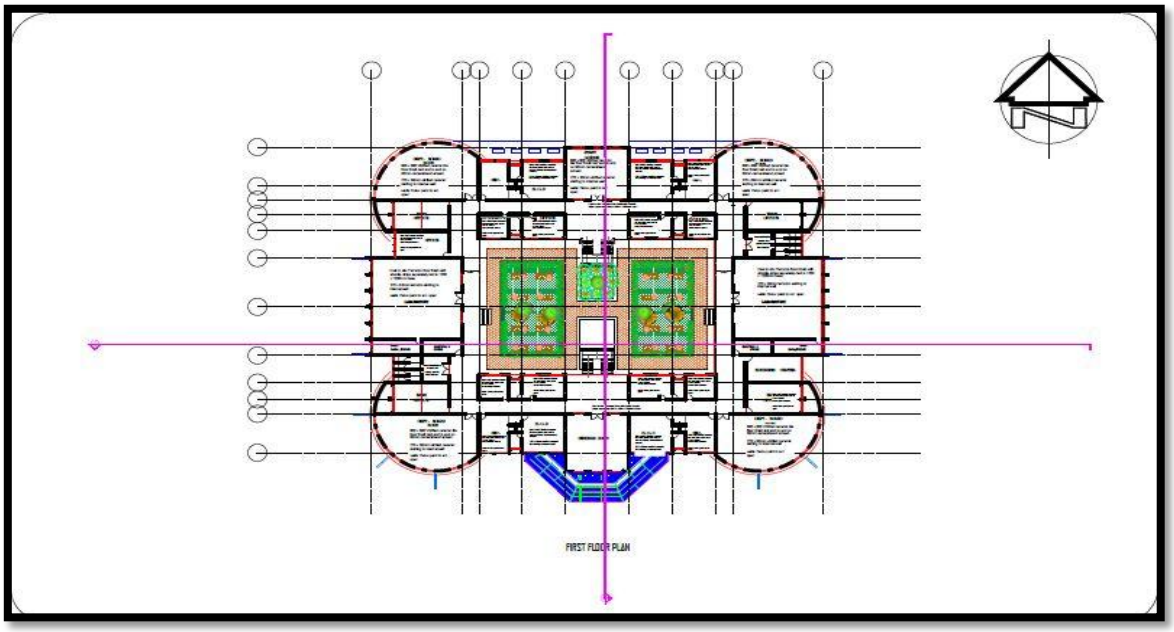
## Appendix B: Design


Site Plan

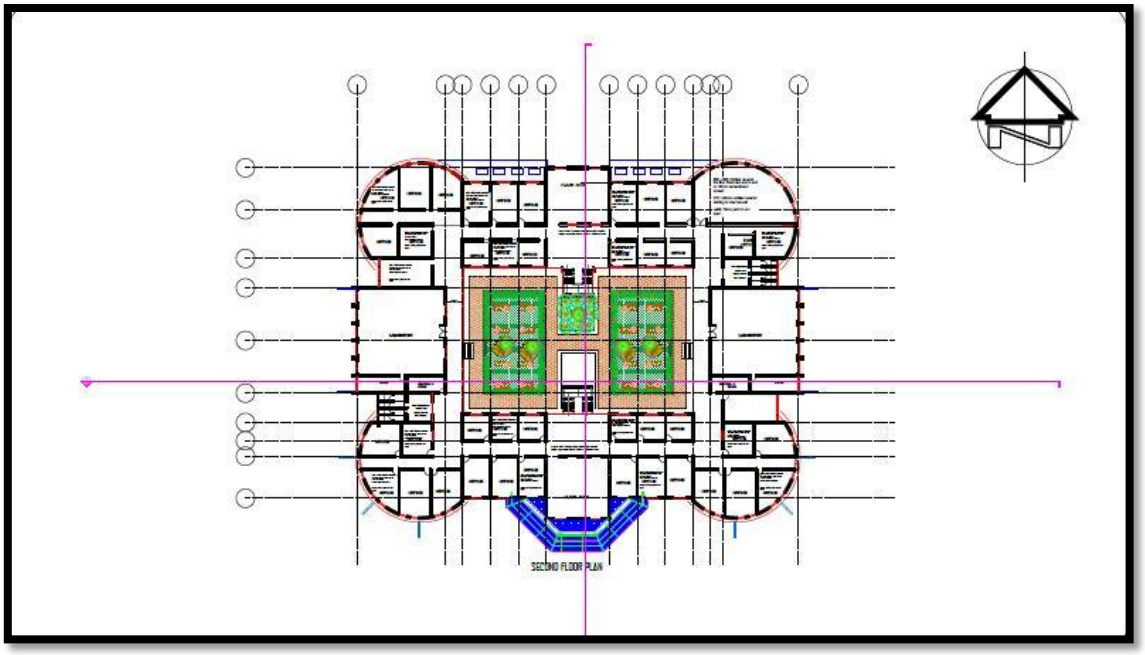
Plan on site



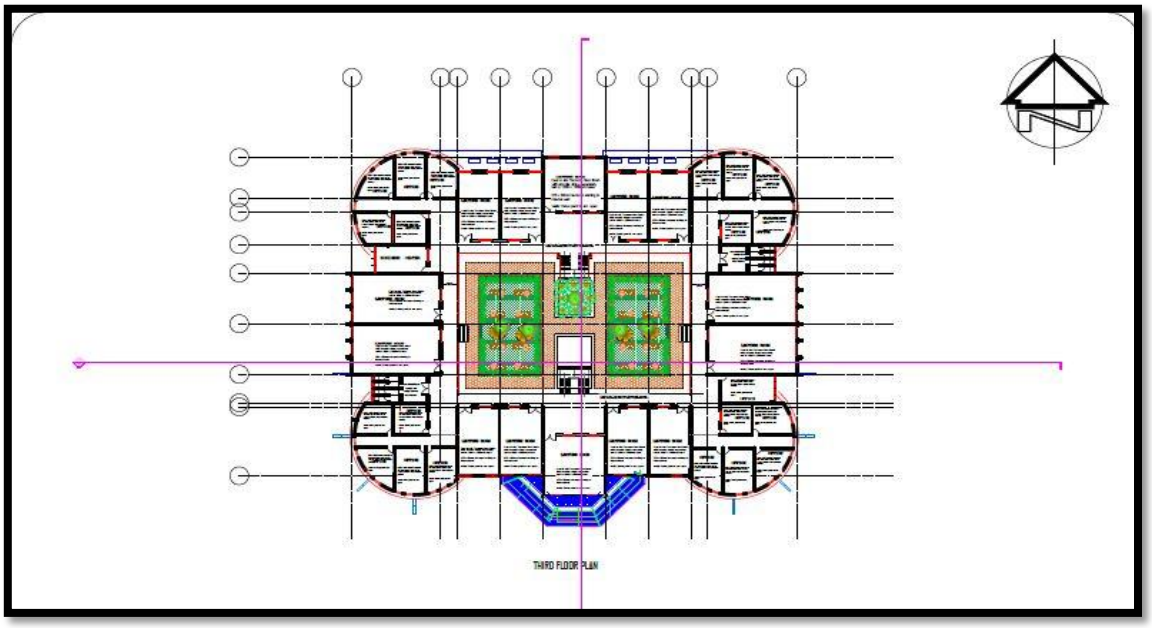

Ground Floor Plan



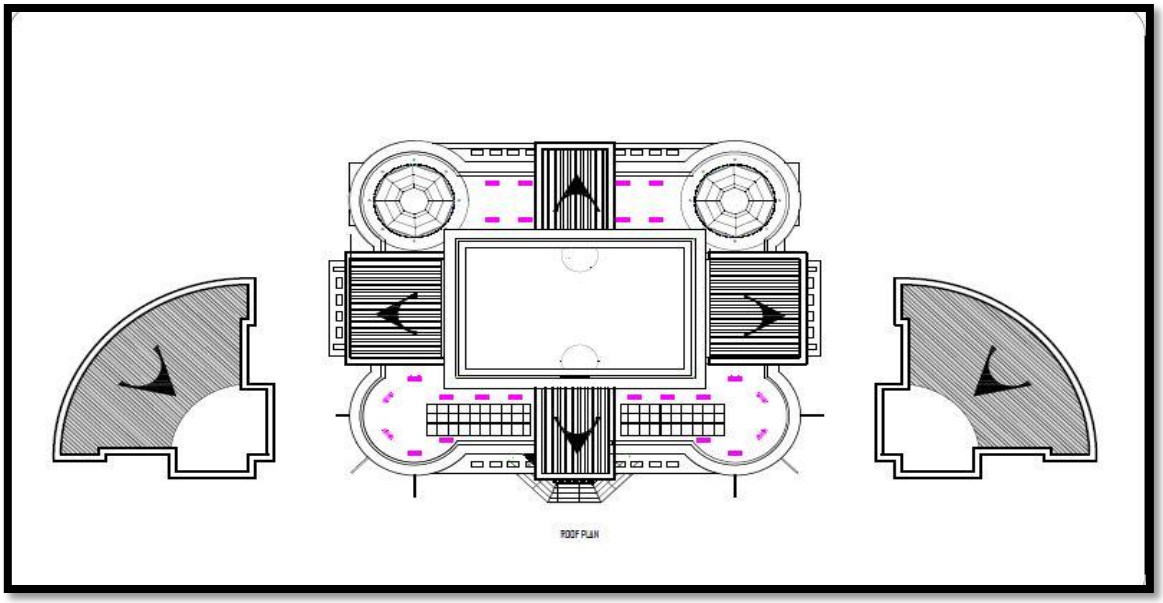

First Floor Plan



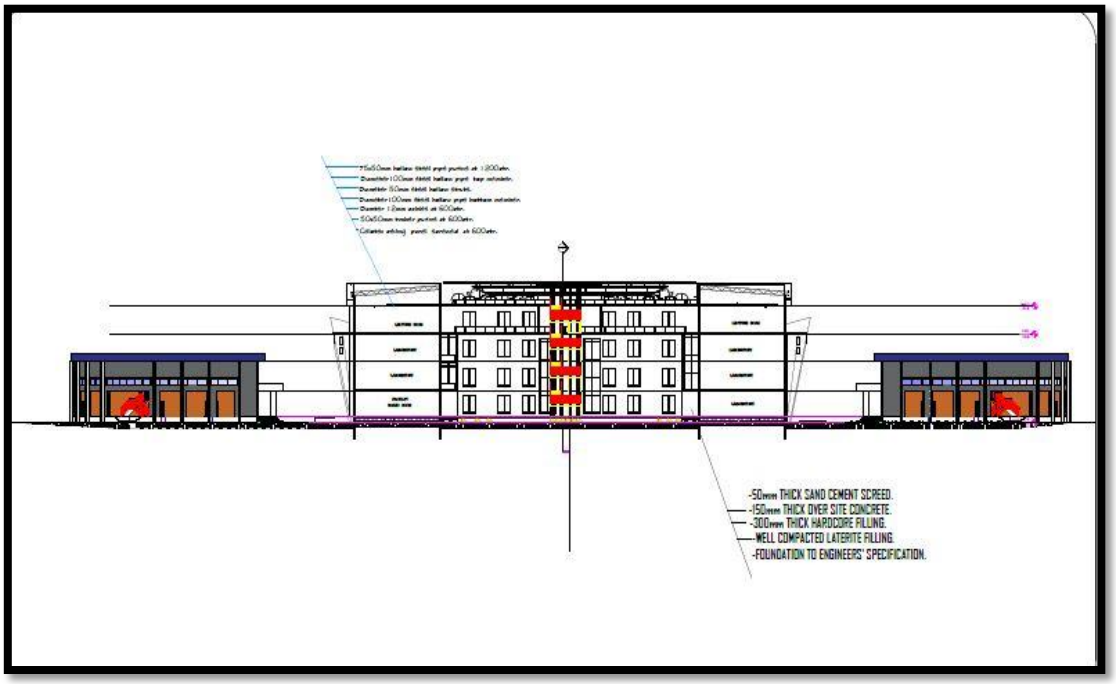

Second Floor Plan



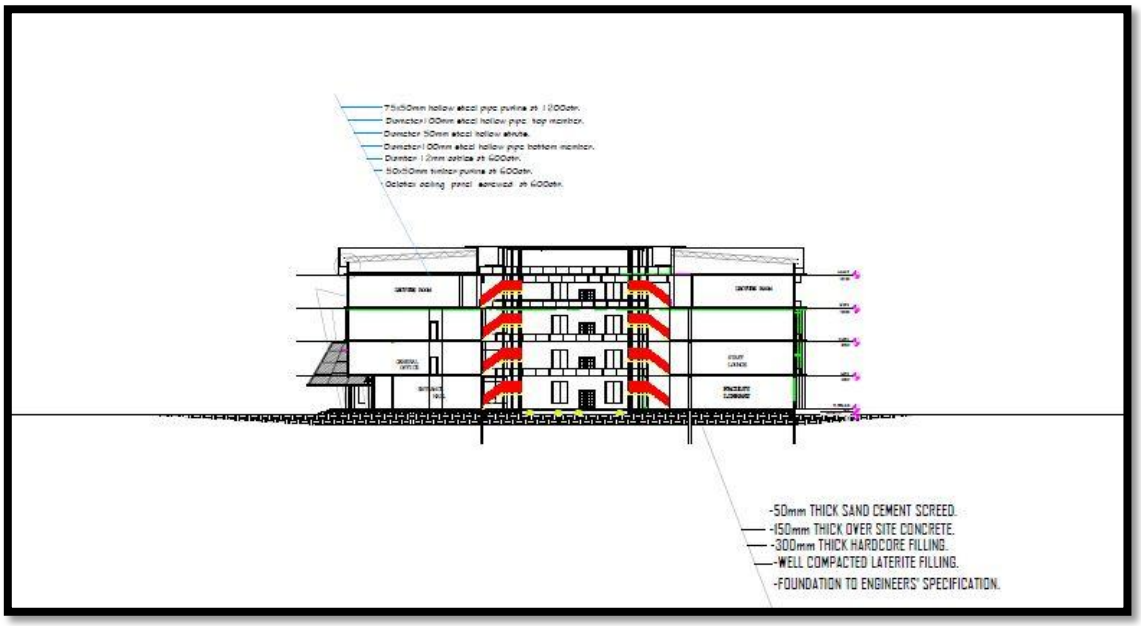

Third Floor Plan




Roof Plan




Section

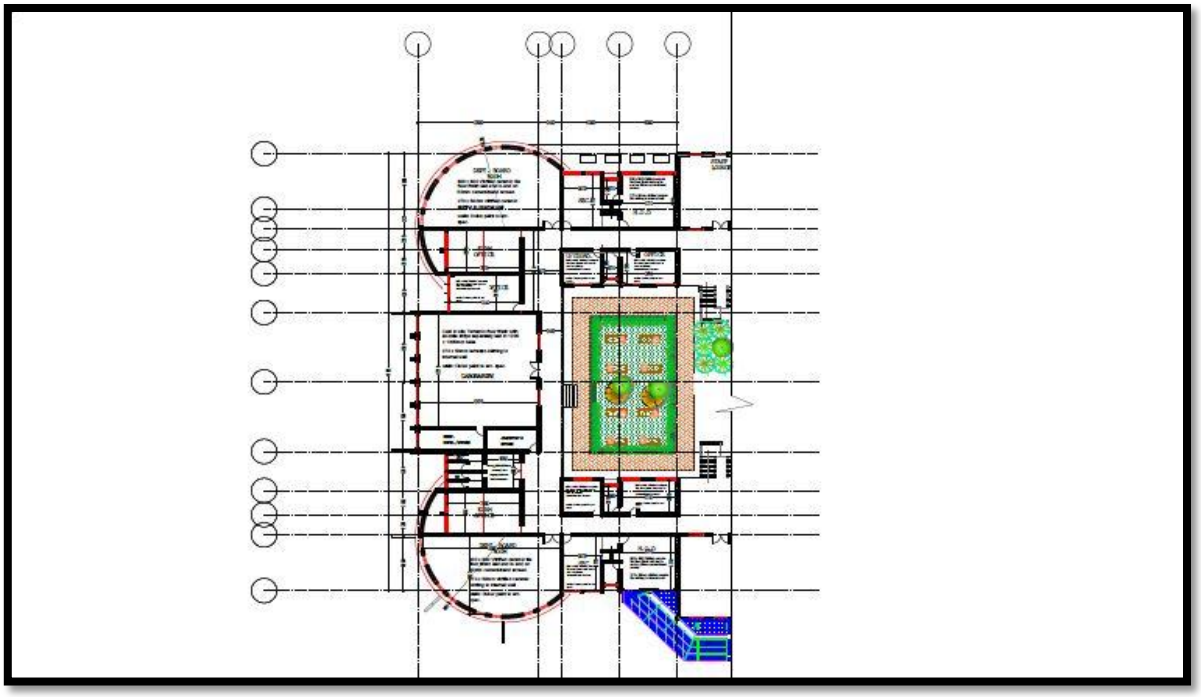



Section

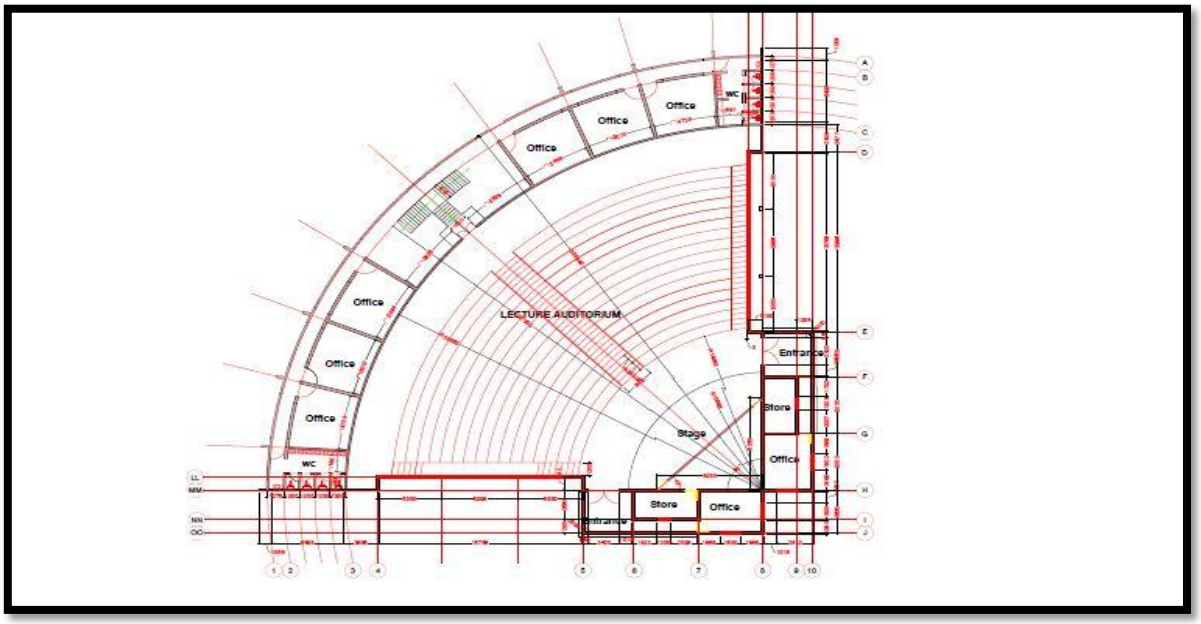

Approach Elevation


Rear Elevation

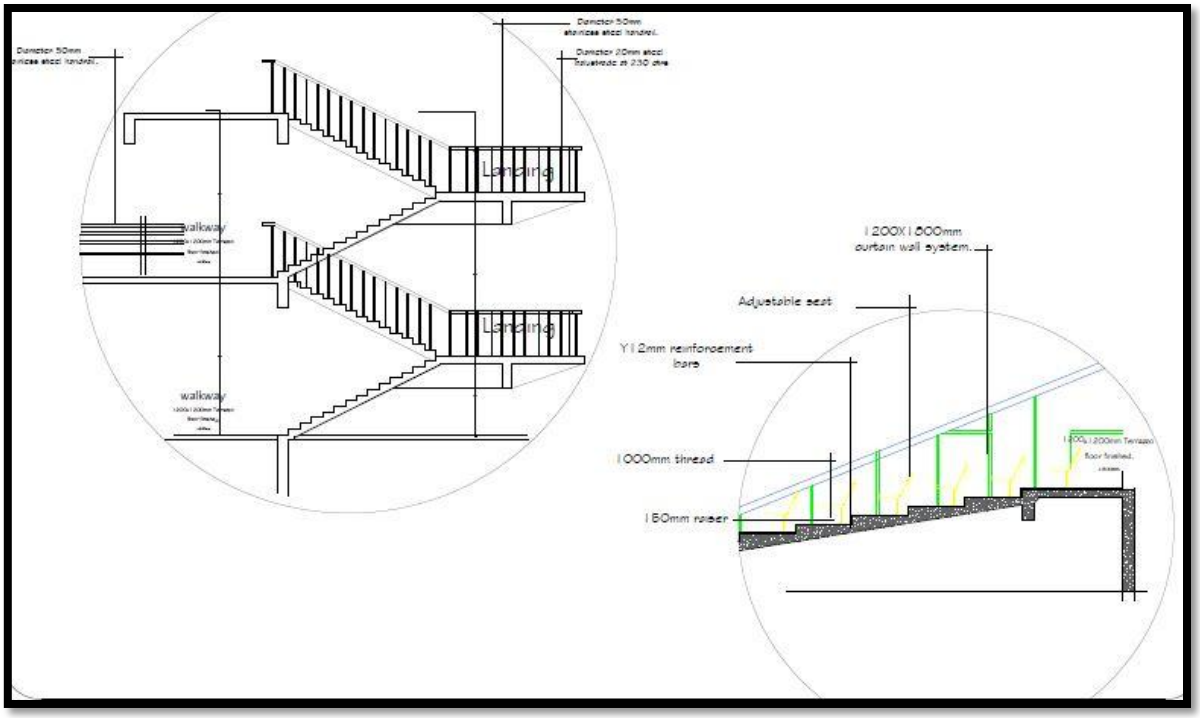

Side Elevation



Working Drawing




Working Drawing


Landing
walkway
Landing
walkway
1200X1800mm
curtain wall system.
Adjustable seat
Y12mm reinforcement
bars
1000mm thread
150mm raiser

Details