STUDENTS' HOSTEL FOR ADEYEMI FEDERAL UNIVERSITY OF EDUCATION, ONDO, NIGERIA: ENHANCING FIRE SAFETY IN STUDENTS' HOSTEL.

BY

ADELAKUN ADEBAMISAYO OLU

(ARC/09/9206)

JUNE, 2015

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A THESIS/DISSERTATION SUBMITTED TO THE SCHOOL OF POST GRADUATE STUDIES, THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE, NIGERIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF M.TECH IN ARCHITECTURE.

JUNE, 2015

DECLARATION

I hereby declare that this thesis was written by me and is a correct record of my research work. It has not been presented elsewhere for the award of diploma or degree of this or other University. All citation and sources of information are clearly acknowledged by means of references.

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……..

Date:

CERTIFICATION

We certify that this Thesis entitled "**STUDENTS' HOSTEL FOR ADEYEMI FEDERAL UNIVERSITY OF EDUCATION, ONDO, NIGERIA: ENHANCING FIRE SAFETY IN STUDENTS' HOSTEL"** is the outcome of the research carried out by Adelakun, Adebamisayo Olu in the Department of Architecture, Federal University of Technology, Akure.

…….. ……..

Prof. J. A. Fadamiro **Date**

Supervisor

ABSTRACT

This study looks at the student's hostel for Adeyemi Federal University of Education, Ondo, housing is a basic necessity of life. A safe and risk free hostel is a social right of any student who had been given accommodation in any of the hostels. The increasing number of students in tertiary institution, Adeyemi Federal University of Education in particular has raised accommodation problems. The consequences of this is overcrowding of the available hostels leading to increased pressure on the available ones the infrastructural facilities making the hotels fire prone. Any building can be fire prone if from inception fire safety plans has not been designed into it. The current trend of fire is hostel building is a source of concern in our society today. There has been a lot of incidence of fire in hostels where students has lost their lives, valuable properties and is some cases the building almost totally consumed. Adeyemi Federal University of Education has had her own share of fire outbreaks in hostels and in the last major incidence even though no life was lost, the students lost all their valuables in the building. Fire issues need to be reconciled with the building codes and fire safety designs from the inception of any building project with the involvement of every professionals involved and especially the architect who proposes the design and specifies materials.

This study identified the problems associated with fire in hostel buildings and proffers solution through architectural design approach to enhance fire safety by prevention of fire, limit spread, minimize damage and maximize life safety of the users and even the fire fighters.

DEDICATION

This project is dedicated to God the Father, Son and Holy Spirit. Also, to the memories of my late father, Revd Engr. J.A. Adeyemi (1942 – 1994) and my late sister Engr Omosolabomi Adeyemi (1979 – 2011).

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY:

Housing is one of the basic needs of man. Housing which can be referred to as shelter, food and clothing are the three basic needs of man. From time immemorial, provision of quality housing has been of great interest to the human race. Housing being one of the basic human needs is an aspect of development economics and therefore of topical interest to all sectors of all societies (Ubong 2007). Aribigbola (2011) opines that, housing is very fundamental to the welfare, survival and health of individuals. He added that international concern has been growing over the deteriorating housing conditions in urban areas of the world.

According to Aluko (2011), students housing has been a major area of concern with increasing population of students in higher institutions of learning. Amole (1998) states that, a special category of housing which is rarely discussed is the house for special groups of persons and one such group is “students at the tertiary levels of education”. She added that the low level of interest shown in this group of persons may be responsible for the present quantity and quality of housing available for student. She further opines that the argument for students housing as part ‘of tertiary education was to produce intellectuals that were socially cultivated through the sharing of a common academic and social life where inequalities arising from differing home backgrounds could be compensated for by the fusion of learning and living through which common standards of culture and citizenship could be transmitted.

Education and educating people is in the real sense a lifelong project in the life of not only the individual involved but also that of the society within which the individual lives. In general terms, education involves both formal and informal aspects. Most tertiary institution of learning are concerned with making their students whole both in the formal and informal aspects. The

formal aspect of education deals with teaching and learning in a classroom, laboratory and studio while the informal deals mostly with learning outside the classroom and the extra curricula activities.

Little attention paid to students housing in most Nigerian tertiary institutions has led to inadequacy in hostel facilities which has led to overcrowding, over utilization, decay of facilities and even higher fire risks. In recent times, there has been the trend of frequent fire outbreak in hostels and this is a major source of concern. In some of these incidences, not only has properties been lost but also lives. The daily independent Newspaper of 13th, October 2014 reported a fire incident at the Madam Tinubu Hall of residence of the University of Lagos. The Vanguard Newspaper of 5th June, 2013 also reported a fire outbreak in the Tedder Hall of University of Ibadan although the cause was said to be unknown as at the time of report. Another was reported by Nigeria News to have occurred on 15th December 2014 at the Moremi Hall of the Obafemi Awolowo University which was due to electric spark.

The Punch Newspaper of 13th January 2014 also has a report of fire outbreak at a female hostel of the University of Abuja which left two students injured. The fire was said to have been caused by a gas cooker explosion. A News Agency of Nigeria online correspondent who was an eye witness also reported a fire incident at Ahmadu Bello University School of Basic Studies Hostel which occurred in December 2014 destroying 315 bed-space male block “A” hostel and burning down all properties even though no life was lost. The report stated that the incident was the seventeenth of its kind in the institution as female hostel and other administrative buildings were earlier burnt. As an eyewitness, on 26th November, 2009 a fire outbreak occurred in Abiodun hostel at Adeyemi Federal University of Education, Ondo. The fire razed the first and second floors of the hostel and was due to power surge. Even though no life was lost, the students lost all their properties to the fire.

Fire in buildings can pose a serious challenge to fire fighters. In hostels, the combinations of large number of occupants, many ignition sources, high combustible loads can create issues that can be difficult to resolve and the loss of properties and even lives are the resultant effect. Fire issues,

according to Shao-Hoong (2001) should be reconciled with building codes, fire safety design and even cost constraints of projects.

Amongst designers and users of buildings, fire safety practices seem to have suffered severe neglect and as perceived may be due to indifference and ignorance on the part of the building owner, designers or users. To realize efficiencies and effectiveness in fire safety, flexibility of design should be considered. As Architects or designers it is more expedient to think of avoiding the problem of fire outbreaks at the inception of any building design rather that cope with it if or when it occurs.

1.2 STATEMENT OF THE PROBLEM

Unlike other towns where tertiary institutions exist and the private ownership of hostels has augmented for dearth of hostels, Ondo town has not started the culture of building specifically for students.

The resultant effect of the inadequate students housing is overpopulation or overcrowding of the existing hostels. Even though the students which live on campus have to abide by set rules, especially on the use of electricity and electrical appliances, the university has not been spared from having her share of fire outbreak.

As cited by Nwabueze (2012), fire requires specific conditions to occur through a source of ignition and these conditions are inadvertently present in all building as the by-product of design choices. From this statement, it is deduced that fire can start at any time in a building and from any source depending on the cause.

Going through different literatures and also carefully studying the reports on incidences of fire outbreaks in hostels earlier cited, it is noted that not much has been done in the articulation of fire safety in the design of buildings. Most hostels which have experienced fire incidence have only one entrance and exit which gives room for stampeding and even loss of lives during escape.

Another ground for loss of lives and properties are the burglary proofs which constitute impediments during fire outbreaks.

In Nigeria as in other parts of Africa and the world, during designs of buildings it seems most designers' often pay less attention to fire safety in buildings but give attention to space requirement layout with functionality, and structural consideration and aesthetics. Unfortunately the issue of fire outbreak is a major source of concern in buildings. The height of the hostel building also contributes to loss during fire so also are the building materials used for construction, as most building materials in the hostels are not fire resistant but rather aid fire during incidences.

Studies on hostels has revealed that not much has been done in the articulation of fire safety in the building designs hence the main intent of this study is to aid in solving the problem of fire outbreaks in hostels through design.

1.3 AIM OF THE STUDY

The aim of this thesis is to design a students' hostel that ensures the safety of occupants in case of fire in order to reduce fatality and injuries to lives and properties.

1.4 OBJECTIVES OF THE STUDY

To achieve the stated aim, the objectives are to:

i. review the various causes of fire outbreaks in hostel buildings and safety measures available in line with fire regulations.
ii. analyse the existing hostels through case study especially those with record of fire incidences and
iii. propose a design of students' hostel inculcating the fire safety measures into the design.

1.5 SCOPE OF THE STUDY AND LIMITATION OF THE STUDY

1.5.1 SCOPE OF THE STUDY

The scope of the study is to provide hall of residence for students of Adeyemi Federal University of Education, Ondo with the intent of enhancing fire safety in the building. This is to ensure that fire outbreaks are prevented, if it happens the spread is curbed and if it spread, escape is highly ensured and loss of lives and properties reduced to the minimum.

The proposed hostel is expected to be a female hostel, accommodating four hundred students and the design will provide facilities that are necessary in a hostel with emphasis on both the active and passive means of fire safety. The outdoor spaces will also receive attention thereby integrating the hostel block with the terrain.

1.5.2 LIMITATION OF THE STUDY

Research studies are usually carried out with one constraints or another, especially in a country where information and relevant data are not easily sourced. Information on fire, fire outbreaks and fire safety was scarce and majority of the information and data collected online cannot work successfully in Nigeria due to difference in regulations, laws and policies of governments. (Be that as it may, as no research work can be concluded without looking into relevant existing records, the case study approach is used to access the state of hostels on tertiary campuses).

The following constraints were encountered: Lack of relevant information, low quality and inadequate recorded data, Privacy of information from schools and funding the research through travels, sourcing of data and information was not easy

To this end, the extent of the research is premised upon the relevant information and case studies.

1.6 JUSTIFICATION OF THE STUDY

In an article written by Oghifo (2012), on the early days of tertiary education in Nigeria, a slogan existed which is “as you pass through this university, let the university pass through you. He further opines that it seems the slogan is now “you are on your own; use what you have to get what you need”. The Federal Government cannot fund students’ hostels in school and even the schools administrators have not been forthcoming in generating funds to build hostels. Due to inadequacy of students’ hostels and also available housing that can enhance students living condition, the available facilities apart from suffering maintenance are overstretched. Students’ accommodation is now limited to first year, final year and in cases where postgraduate courses are offered, post graduate students. The result of this practice by schools is that students are left to “squat” with the lucky ones who got it on first come first serve basis. Squatting is illegal in any institution but the reality is there and this gives birth to overcrowding and even encourages cohabitation which is now a current trend in tertiary institutions of learning. Other students who are not lucky to get accommodated, squat or are not ready to cohabitate have to seek alternative housing near to school and at time far away depending on how lucky they are.

The current trend of fire outbreaks in students’ hall of residence where there have been loss of lives and properties call for concern and this is premised on the fact that fire safety considerations have suffered neglect among designers and users of buildings.

The need for fire safety in hostels cannot be over-emphasized since it is more often than not a matter of life and death. The hostel facility in Adeyemi Federal University of Education, Ondo is not enough to cater for the teeming population of students and overcrowding can enhance fire outbreaks where more people will be involved in case of fire incidence therefore giving room more loss.

Adeyemi Federal University of Education has desired the increase in number of hostels but like all other institutions finance has hindered the realization.

As a former College of Education, the immediate past Provost of the college encouraged private ownership of hostels in the college but the desire was never realized. The present Acting Vice Chancellor as a matter of concern is also looking for interested private hostel developers to build hostels either on Public Private Partnership (PPP) or Build Operate and Transfer (BOT).

The study therefore seeks to look into ways of reducing fire outbreaks in hostels which is a current trend in the nation of which Adeyemi Federal University of Education, Ondo is not exempt, and if it occurs reduce severe impact of loss of lives and properties.

1.7 RESEARCH METHODOLOGY:

For the purpose of this study, the major research method used is case study as it will aid in gaining a wider knowledge of hostels and fire safety strategies involved in their designs.

Other methods are:

a. Personal interview of students living in hostels.
b. Physical and direct observation by familiarizing with the hostel environment
c. Secondary sources which include: local reports, government reports, articles, published and unpublished document and online sources.

1.8 EXPECTED CONTRIBUTION OF KNOWLEDGE

The study is expected to bring to fore the current status of students' accommodation while encouraging the government and private sectors to build adequate hostels on campuses bearing in mind the current trend of fire disaster in the country and means of inculcating fire safety in designing of buildings.

1.9 CONCLUSION:

Based on the current trend of fire outbreaks in buildings especially hostels the emphasis for this type of study cannot be overemphasised. Of utmost importance is the attitude of Architects, other professionals and user's attitude to fire and fire safety consciousness.

In conclusion therefore, it may be stated that the design and development of an enhanced fire safe students' hostel in Adeyemi Federal University of Education, Ondo will be a step further into reducing the shortage of hostels amongst students and ensuring occupants safety.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 DEFINITION OF HOSTEL

According to Merriam-Webster dictionary (2015), hostel is a supervised lodging for usually young traveller called youth hostel or simply put a supervised institutional residence while the Oxford dictionary (2015) states that, it is an establishment which provides inexpensive food and lodging for specific group of people such as students, workers or travellers.

Amole (1998) opined that students housing as part of education was to produce intellectuals that were socially cultivated through sharing of a common academic and social life. Perkins & Will (2001) states that: the desire to provide spaces for students that allow active interaction, comfort and convenience, opportunities to socialise is foremost in university and college planning. They added that all these needs to be considered when designing a hostel for students along with spatial needs of furnishing, efficient and effective mechanical and electrical, and the safety requirement of building as well.

Aluko (2011) is of the opinion that, the need for effective and conducive student housing cannot be over emphasized due to the fact that students are expected to be in sound state of mind to achieve academic excellence. He added that healthy social and behavioural stability is part of the benefits of good student housing apart from physical security.

2.2 HISTORICAL DEVELOPMENT OF HOSTEL

Stephen (2011) in writing about the history of hostel for Hostelling International, states that hostels did not basically start for students' alone. Other categories of people such as travellers, backpackers, and youth can also use a hostel hence it is a lodging which can either be shared or used as private room.

In 1912, in Altena Castle, Germany, Richard Schirrmann created the first permanent youth hostel". This was borne out of the vision of the German Youth Movement who wanted poor city youngsters by managing the hostel themselves, doing chores to cut down costs in build character as well as being physically active outdoors.

According to Hostelling International, USA by 1932, Germany was said to have more than 2000 youth hostels recording more than 4.5 million overnights annually. Gradually, the hostel movement began to spread to other parts of Europe namely Switzerland, Poland, Netherlands, Norway, Denmark, British Isles, Ireland, France and Belgium and added another 600 hostels. In recent times, the concept of hostel has broadened beyond youth hostels or backpacker hostels and schools now have their own hostels.

The youth movement was begun in 1909 when Richard Shirrmann, a German school teacher and Wilhelm Munker, la conservationist saw the need for school groups wanting to experience the countryside. Schools were used for overnight sleeping during holiday and in 1912. He later founded the German Youth Hostel Association in 1919.

The movement rapidly spread worldwide leading to the founding of the International Youth Hostel Federation (IYHF) on 20 October 1932 in Amsterdam by representatives from associations in many European countries. Hostelling International (HI) which was formerly known as International Youth Hostel Federation has more than 70 National Youth Hostel Association in more than 80 countries and have over 4,000 affiliated hostels around the world.

2.3 REASONS FOR HOSTEL DEVELOPMENT IN INSTITUTIONS

Different people at different times had carried out studies on the impact of students' housing on academic and social performance. Crimmin (2008) stated the relationship between students and their living environments as "the influence of environments on persons and persons on environments".

Progress and retention were said to be higher among students' who lived in hostels (Frazier, 2009).

Hall of residence has being of immense help to students and staff of institutions. Those who live in hostels enjoy the benefit of school accommodation and attest to the usefulness of the accompanying facilities.

According to Ubong (2007) some of the benefits of hostel accommodation include but are not limited to the following:

1. Facilitating Reading/Learning – at any level of education (primary, secondary, university including postgraduate work), staying in the hall of residence or hostel does enhance the desire to read. There are fewer distractions, there can be control (as in forced 'prep' classes in secondary schools), and the activities of studious colleagues can force less serious ones to read. It is also easier to relate colleagues who are close by or teachers where a student has a difficulty on a subject matter.

2. Co-curricular Activities – Students in hostels have a greater opportunity of participating in sports, games, club, and social activities that are expected to make them more rounded individuals and citizens than those living off-campus who may find themselves forced into domestic activities once they are at home.

3. Security – Students are indeed more secured on campus than off-campus in spite of the menace of cult activities in schools. This is because institutions maintain security personnel on campus and do monitor the activities of students. Some private Universities are known to lock their gates early and to insist on students obtaining exit permits before they travel home.

4. Moral Training – Persons from TEIs are graduated based on satisfactory performance 'in character and in learning'. Moral training includes individual behaviour in group situations as in hostels. All

institutions have Codes of Conduct that guide and regulate student behaviour in hostels.

5. National Integration – One of the desires of the Federal Government of Nigeria to use education as a means of attaining national integration. This is stated in the National Policy on Education (FRN, 1998).

6. Private Relationships – Private relations in hostel rooms could blossom into lifetime positive relationships that would be beneficial to both parties.

7. Pupil Personnel Management (PPM) – Housing of students is one of the aspects of PPM, which is indeed a statutory function of schools. Not only parents but also the society at large expects the administrations of schools to provide this service to students.

2.4 STUDENTS HOUSING IN NIGERIAN TERTIARY INSTITUTIONS

Education involves both formal and informal aspects of teaching and learning. The formal aspect involves the teaching and learning in classrooms, lecture halls, laboratories, studios, conference room etc usually defined by curriculum. The informal aspect involved activities outside the classroom which hinges more on leisure or hobbies through interaction and socialization.

As earlier cited, students' accommodation is said to be one of the factors which affects the academic and social performance of students no wonder the slogan "don't just pass through the university, allow the university pass through you". The Nigerian higher education was established with the aim of giving students sound and qualitative education thereby equipping them to be able to function effectively in any environment they find themselves and attain self-actualization and self-fulfilment.

Students are the most important stakeholders in Nigerian University/College system hence students' accommodation is pertinent to the achievement of the Nigerian desire. Amole (1999) opined that student residences were the most

suitable environments for study and could be economically viable. Hence it has become a distinct form of housing and the most preferred by students.

At the inception of tertiary education in Nigeria, universities ware established with the intention of providing comfortable hostel accommodation for all students on campus. Until the early 1970's there was no problem of students' accommodation in campuses (Esenwa, 2003). Federal owned institutions were designed to house both staff and students on campus. Hence their location on large expanse of land away from developed areas or towns. Not many females were admitted then, however with current search for gender equality female students' enrolment has increased.

Akpan (1998) declares, the student population is rapidly increasing while the infrastructural amenities are declining in supply and their stock depreciating. Most hostel facilities are in deplorable condition and often overcrowded. In 2004, the then minister of education, Prof. Fabian Osuji said that tertiary institutions must immediately withdraw from the management of students' hostels and handover to private operators (Ubong, 2007). Although in recent past some institutions have witnessed construction of hostels, it cannot be said of most.

2.5 STUDENT HOUSING IN ADEYEMI FEDERAL UNIVERSITY OF EDUCATION, ONDO.

Adeyemi Federal University of Education was the first higher education institution in Ondo State. It was created out of three institutions namely: Olunloyo College of Education, Ransom Kuti College of Education and the then Adeyemi College of Education. The college was established in May 1964.

Presently, there are seven hostels in the college namely: Tinubu hall, Abiodun hall, Olunloyo hall, Oduduwa hall, Wande Abimbola hall, Kiladejo hall and ETF hostel. The Tinubu, Abiodun, Oduduwa and Wande halls are for female students while Olunloyo, Kiladejo and ETF halls are for the male students. Due to fire outbreak in Abiodun hall in November 2009, the then cafeteria

buildings were converted to hostels for the displaced students with each block housing twenty students. As at present, Abiodun hostel has been rehabilitated and the then cafeteria which is now called Abiodun Annex is a group of halls accommodating female students.

Table 1: Number of Students admitted into Adeyemi Federal University of Education per Session

SESSION	TOTAL NO OF STUDENTS ADMITTED	NO OF FEMALE STUDENTS	NO OF MALE STUDENTS
2010 – 2011	3, 542	2, 047	1, 495
2011 – 2012	2, 800	1, 622	1, 178
2012 – 2013	3, 466	1, 982	1, 484
2013 – 2014	No admission for this session, merged with 2014 – 2015	-	-
2014 – 2015	7, 703	4, 057	2, 726

Source: Division of Examination & Records, Adeyemi Federal University of Education, Ondo.

Table 2: Number of Students in Adeyemi Federal University of Education per Session

S/N	NAME OF HOSTELS	TYPE OF HOSTEL	2010 - 2011	2011 – 2012	2012 – 2013	2013 – 2014	2014 – 2015
1	Abiodun Hall	Female	78	78	78	182	263
2	Oduduwa Hall	Female	256	257	247	192	212
3	Tinubu Hall	Female	238	263	236	221	226
4	Wande Hall A	Female	175	181	179	172	168
	Wande Hall B	Female	179	149	167	174	162
5	Cafeteria Hall	Female	127	238	216	209	216
6	Olunloyo Hall	Male	182	208	170	159	136
7	Kiladejo Hall A	Male	58	81	55	58	66
	Kiladejo Hall B	Male	69	75	58	60	64
8	ETF Hall	Male	118	137	108	89	104

Source: Division of Student Affairs, Adeyemi Federal University of Education, Ondo

2.6 TYPES OF HOSTEL BUILDINGS

Day to day development of student hostel has resulted into a wide range of hostel type. Olabiwonnu (2012) states that hostels include the traditional type, flat – let type, shared double or cluster type and individual or private type.

In Nigeria, universities operate the hall system with more occupants in a room and facilities centrally placed (Oruwari, 1986). Most of the students' hostels have rooms arranged linearly and facilities (i.e kitchenette, convenience, laundry) placed towards the end of each wing. Sometimes facilities like kitchenette can be placed mid – way to be shared by the floor below and above it.

2.6.1 TRADITIONAL HOSTEL

Here student rooms are placed linearly and each room has its own study space. Facilities services minimum of twenty students are shared. This hostel type is ideal for undergraduate students especially the first year that just left home.

2.6.2 FLAT – LET TYPE

In this type, the students bedroom tend to be bigger in size as each room is provided with wash basin and cooking facilities but shares other conveniences. This can be referred to as semi – traditional because it is between traditional type and the modern style.

2.6.3 SHARED DOUBLE AND SHARED CLUSTER TYPE

This is another type of hostel where two or more students, dwelling in a self contained unit shares conveniences and kitchen within each unit. It is also referred to as “cluster flat” and those who for social or economic reasons prefer to share will be able to do as they desire. This type is usually designed for post graduate students.

2.6.4 INDIVIDUAL OR PRIVATE TYPE

It is a self contained unit where each student’s room is provided with all necessary facilities and convenience (kitchen, toilet, laundry) with high degree of privacy and independence. This hostel has greater advantage over other types especially students who desire their own privacy. Once the student can maintain the room properly, the running cost will be reduced as no special supervision is necessary. This type is also very common as post graduate hostel design with the intent that they are older and sometimes married, although more often than not, most private hostel take this form.

2.6.5 ESSENTIAL SPACES IN HOSTELS

Stated below are the essential spaces in the hostel:

ROOMS (sleeping area): Provided as sleeping area with balcony for cooking and laundry.

COMMON ROOMS: A sitting room provided for each floor shared by all members on the floor for social use of the students.

KITCHEN: A room provided on each floor for cooking activities.

LAUNDRY: A room provided for washing or ironing of clothes.

CONVENIENCES: Spaces provided for water closet and bath.

SIT – OUT: Provided within the hostel courtyard and externally.

OFFICES: Rooms set aside for the Porters, Hall advisers, Security and Cleaners.

GAMES ROOM: Space provided for indoor games.

BUTTERY: Provided for sales of basics needs of the students.

FIRE ESCAPE STAIRWAY: Provided in each hostel wing for escape from the wing in case of fire outbreak.

2.7 FIRE AND CAUSES

Based on records of fire and more, buildings in the world particularly in Nigeria have had their share of fire outbreaks. In Nigeria, quite a number of hostels have been razed by fire. According to Arnold (2005), “Fire represents the greatest single danger to buildings in most jurisdictions” and accordingly, fire safety was one of the earliest issues addressed by building regulations.

Hassan (1999) observed that the causes of fire can be grouped under three headings and they are:

2.7.1 CARELESSNESS

Failure, on the part of occupants of a building, to follow the necessary safety precautions may lead to fire outbreaks. Fire from this source starts from a point and spread around the building if not quickly controlled. Fire from this source may arise through the following means:

i) Careless handling of combustible materials

Careless handling of matches and lighters by children playing with it; they may throw it in a corner and when it comes in contact with other elements of fire results in fire outbreak.

ii) Candle sticks

Many people use candles as a substitute for electric lights in cases of power failure. Careless handling of candle light, placing candles on unstable bases, leaving candles unquenched or allowing candle to fall off to a nearby combustible agent will result in fire outbreak.

iii) Cigarette Butts

Smoking and careless disposal of butts is one of the most common causes of accidental fires. Some smokers are careless in handling cigarette stumps by not using the ash tray. Throwing them on a combustible material will result in fire outbreak.

iv) Careless Handling of Inflammable Liquid

This is one of the most common sources of domestic and industrial fire, careless handling of kerosene, fuel etc; when in contact with heat and enough oxygen will result in fire in building.

2.7.2 ACCIDENT

Accident can be said to be an event that happens without planning which result in shock, injury, damage to life and property (Hassan, 1999). Fires resulting from accidents are emergency or unlimited source of combustion; fire from this source can be as result of thunder strike, faulty electrical equipment and wiring system, fire spread.

i) Thunder Strike

This occurs when there is excessive thunderstorm and the building is not well protected with adequate lightening protector. Fire through this medium is often rare.

ii) Faulty Electrical Equipment and Wiring System

Fault arising from electrical equipment like fan, air-conditioner, lighting fittings and power fittings often cause fire in buildings when occupants do not follow all necessary safety precaution in handling electrical equipment. When there is faulty wiring system, fire outbreaks are always imminent.

iii) Fire Spread

Fire spreads from adjacent buildings can affect another and cause outbreak in the building if not properly checked. Indiscriminate burning of bushes or debris could cause fire outbreak when it is not controlled.

2.7.3 WILFUL ACT OR ARSON

These are causes of fire resulting from wilful and intentional acts of occupants or other persons. The Aqua group (1985) purports that nearly one-third of all fire resulting from arson is difficult to prevent. They include:

i) Wilful Act Due to Fraud

Due to the fraudulent act of one officer or other occupants in a building, they may wilfully ignite fire in order to cover up their fraudulent acts by destroying

valuable documents that may reveal their activity. This may be the major causes of fire in government owned buildings and commercial centres in recent times.

ii) Act of Jealousy / Revenge

This can be due to friction between the owners or other personality living in the building, they may result in wilful and deliberate action of the other rival to initiate fire in the building.

ii) Political Motives

Due to many political crises that often arise as a result of misunderstanding and misrepresentation between various political parties; many of the politicians often employ the use of Thugs to deal with their opponents. This may result in setting ablaze the buildings and properties of their opponents.

iii) Religious and Ethnic Crisis

In recent times, Nigeria experienced series of religious and ethnic crisis like the Tiv – Jukun crisis (2002), religious crises in the north (2001, 2006), the Boko haram bombings in the north (2011). Many of these crisis often result in fire attacks on their opponent, thereby causing fire outbreak in buildings.

iv) Terrorist Attack

This is most common in the Middle East where suicide bombers would detonate a bomb in a building or other places, the aftermath often result in fire outbreak. The September 11 attack on the World Trade Centre in New York (2001) is a case in point which later led to the collapse of the Twin Towers. Another example of terror attack leading to fire and building collapse is the Nairobi Shopping Mall attack of 21 September, 2013 (BBC News Africa, 2013).

2.8 THEORY OF FIRE SAFETY DESIGN

Effective fire safety in buildings goes beyond meeting codes. It requires a systematic and diligent approach on the part of the architect for fire prevention, protection and control in all the aspects of building design, construction and use. (Malven, 1997).

According to Rubaratuka (2013), the main objectives of fire precautions which includes fire prevention and fire protection is to minimize fire hazard and also minimizing the spread both within the building and without to other buildings.

Patterson (1993) states that building fire safety in its most simplified form is based on three general strategies, preventing ignition, in case of occurrence preventing spread and if spread minimizing damages to lives and properties of occupants and fire fighters.

2.8.1 Principles of fire behaviour

It is often said that fire is a good servant but a bad master, a good friend but a better enemy. Hassan (1999) describes fire as a chemical reaction of three elements. The rapid combination of the three elements: oxygen, heat and fuel results in the production of fire and light. Before fire can occur, according to the Aqua group (1984), there must be a presence of the three basic element or ingredients of fire, Oxygen, Heat, Combustible material (fuel) which is referred to as fire's own eternal triangle as shown in Figure 1.

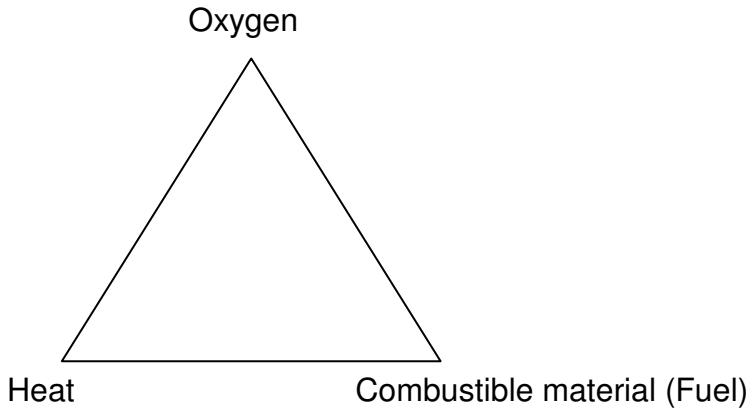


Figure 1: Fire Triangle
Source: Aqua Group (1984)

Ahiamba (1985) pointed out that if one of the elements is absent or removed, combustion will not occur: Oxygen must be at least 16% of the atmosphere to sustain combustion. If oxygen is consumed by fire and drops below this level, combustion ceases, fuel (solid, liquid, or gaseous) must be present in sufficient concentration to form combustible mixture with oxygen. Liquid and solid fuels must be pre-heated to temperatures at which they give off combustible gases. If the fuel supply is consumed, separated, or removed, combustion will cease, heat must be sufficient to produce and ignite combustible gases; solid and liquid fuels must be pre-heated to distil these gases before they will ignite. Fuels kept or cooled below their ignition temperatures will not support combustion. A fire will also self-terminate if burning fuels do not produce adequate heat to ignite fire gases or distil new fire gases from liquid and solid fuels.

2.9 TYPES OF FIRE AND SPREADING POWER

2.9.1 TYPES

Different types of fire are based on the source and the type of fuel as stated by Ahiamba (1985). They include:

1. Ordinary combustibles

This type of fire involves combustible materials such as paper cloth and wood. It can be controlled more easily and effectively by the application of water mechanically or manually.

2. Hydrocarbons

This involves liquids and chemical substances such as petrol, kerosene, oil, grease, fats and gases. Control in this case is by blanketing and smothering but those involving gases are much more difficult to control as the gases will expand and accelerate the fire expansion.

3. Electrical fires (metal fires)

This is mainly a source of heat to fuel as electrical faults result in sparks which eventually ignite. The extinguishing agents are non- conductors.

2.9.2 FIRE SPREADING POWER

According to Ahiamba (1985), the rate of spread of fire depends on the fuel and available oxygen. Also it depends on the construction of the building. The rate of fire spread depends on the following:

1. Combustibility

This is the rate at which a material burns. For example petrol has much higher combustibility than wood.

2. Flammability

Hydrocarbon gases are more flammable than hydrocarbon liquids. In the same way hydrocarbon liquid are more flammable than ordinary combustible. Example, cooking gas is more flammable than petrol or kerosene, and petrol is more flammable than wood.

3. Design and construction

A well designed and constructed building will help to reduce the rate of fire spread. For example a tall building with a badly designed and constructed stairwell and lift shafts will favour fire spread in the building from one floor to another.

4. Contents of building

The material of furnishing (fuel) to a great extent determines the rate of fire spread. Timber furnishing and finish will favour fire spreading and its sustenance unlike steel which is considerably, the reverse.

2.10 CLASSES OF FIRE AND THEIR EXTINCTION

Hassan (1999) classified fire into four classes:

Class A is a type of fire involving burning materials e.g. wood, paper, textile and other combustible materials. Fire in this class are best extinguished by water agent in form of jet or spray, this blanket (fire blanket) can be used to cover the fire in an enclosure.

Class B fire involves flammable substances e.g. petrol, kerosene, paint and other inflammable solvents. This class of fire is best extinguished with foam or dry powder, carbon dioxide (CO2).

Class C is a type of fire involving combustible gases or liquidified petroleum gases in form of liquid or gas leak e.g. propane, butane, methane, e.t.c. This can be extinguished with foam, dry powder, and CO2 water agent spray to the container.

Class D is a type of fire involving metals e.g. calcium, potassium, aluminium, magnesium block e.t.c. Powdered granite, limestone, dry sand and dried powdered extinguisher are best used for this class of fire. Hassan (1999) further reiterates that electrical fire does not constitute a class of fire since any fire involving electricity may involve one of the classes of fire mentioned above.

2.11 PRINCIPLES OF FIRE SAFETY

Every fire is somewhat unique. Still, design professionals can do a great deal to enhance their background in fire safety by knowing useful generalizations concerning the requirements of fire-safe buildings (Herbert, 1998). The fire safety principles are adopted primarily to protect life. Herbert (1998) summarized the principles as follows:

1. management of fire safety;
2. avoidance of outbreaks of fire;

3. early detection of fire and early warning to staff and guests to facilitate an adequate response;
4. compartmentation of building and provision of escape routes, which are protected from fire and smoke;
5. limitation of the development and spread of fire;
6. containment of fire and smoke to the room where the fire originates;
7. early suppression of fire, where this is feasible;
8. effective evacuation procedures; and
9. Access and facilities for the fire service.

2.12 MEANS OF ESCAPE

When fire occurs in building, large quantities of smoke and gases are produced. Smoke and hot gases may travel considerable distances within a building and will present a direct threat to life. Visibility also is considerably reduced, thereby affecting the viability of escape routes within and from the building.

It is essential that escape routes are available to enable the occupants to reach a place of safety and that they are adequate and capable of being safely and effectively used at all times (Herbert, 1998). Special consideration should be given to accommodating and providing for the safe evacuation of people with disabilities. This may include providing accommodation in appropriate parts of the building, arrangements for giving warning to persons with hearing disabilities and provision of assistance in an emergency to persons with special needs (Herbert, 1998). In addition, security arrangements should not be such as to impede the escape of persons from the building in the event of an outbreak of fire.

In examining the means of escape, it is necessary to consider the evacuation process. Herbert (1999) asserts that evacuation can be subdivided into such distinct phases as:

-Phase 1: evacuation from the room or area to a common corridor, a protected stairway or to a final exit;

-Phase 2: evacuation via a common corridor to a protected stairway or a final exit; and

-Phase 3: vertical evacuation via a protected stairway to a final exit and a designated assembly point.

Phases 1 and 2 involve horizontal movement away from the immediate danger of the fire, while Phase 3 involves vertical movement from the upper storeys.

Vertical movement will generally be by way of protected stairways to a place of safety outside the building. In limited circumstances, evacuation from the building may be by way of an external escape stairway. In the case of a single storey building, evacuation will be by way of final exits directly to a place of safety in the open air.

2.12.1 Principles of Escape Route Design

2.12.1.1 Components of Escape Routes

The means of escape consist of the following components:

- Horizontal escape route and
- Vertical escape route (Herbert, 1998).

In bungalows, the means of escape will consist of horizontal escape routes only, while multi-storey buildings will require a combination of these two components.

2.12.1.2 Number of Escape Routes

Basically, alternative escape routes should be available so that a person confronted by fire can escape in a direction which is away from the fire. Each storey of the building should be provided with at least two escape routes, except in the case of small premises which under certain conditions may be served by a single escape stairway. This provision is based on the possibility

that, in the event of an outbreak of fire, one of the escape routes may become unavailable for use. Alternative escape routes from a storey should be remote from, and independent of each other (Herbert, 1998). In addition to a minimum of two escape routes from every storey, the floor layout and occupant capacity will also influence the number of escape routes required for any situation. It is necessary to restrict the distance to be travelled along an escape route. The limitations on travel distance will depend on whether escape is possible in one direction or in more than one direction. The number of escape routes will also be influenced by the capacity of those routes to evacuate each area, taking into account the possibility of an escape route being unavailable for use as a result of the fire. A single escape route from a storey is only acceptable where there is little likelihood of this route being unavailable for use and where an alternative escape route cannot practicably be provided.

2.12.1.3 Width of Escape Routes

Escape routes should be sufficiently wide to enable evacuation of the occupant capacity of the rooms or areas they serve. The width of escape corridors should generally be not less than 900 mm (Herbert, 1998).

2.12.2 HORIZONTAL ESCAPE ROUTES

2.12.2.1 Components of Horizontal Escape

According to Herbert (1998), the horizontal escape routes may be sub-divided into the following components:

- Travel within rooms; and

- Horizontal travel from rooms to a protected stairway or to a final exit.

2.12.2.2 Travel Distance

For the purposes of escape, the travel distances along an escape route from any point in a building should be restricted to an extent which is dependent on

the availability of alternative escape routes. For this purpose, a distinction is made between:

- Travel from any point from which escape can be made in one direction only (sometimes referred to as dead-end travel); and

- Travel from any point from which escape can be made in more than one direction, by way of alternative escape routes (Herbert, 1998).

The limitations on travel distance depend on whether travel is available in one direction only or in more than one direction. The former is more restrictive due to the increased risk of a single escape route becoming unusable in a fire. Travel distances from all parts of a hostel should generally be within the maximum travel distances indicated in metres in Table 3 and Figure 2.

Table 3: The limitation of travel distance

Limitations on Travel Distance		
	Available Escape Routes	
Location	One Direction Only	More Than One Direction
Bedroom/Dormitory	10 m	20 m
Bedroom corridors	10 m	35 m
Elsewhere	20 m	35 m

Source: Fire safety in hostels

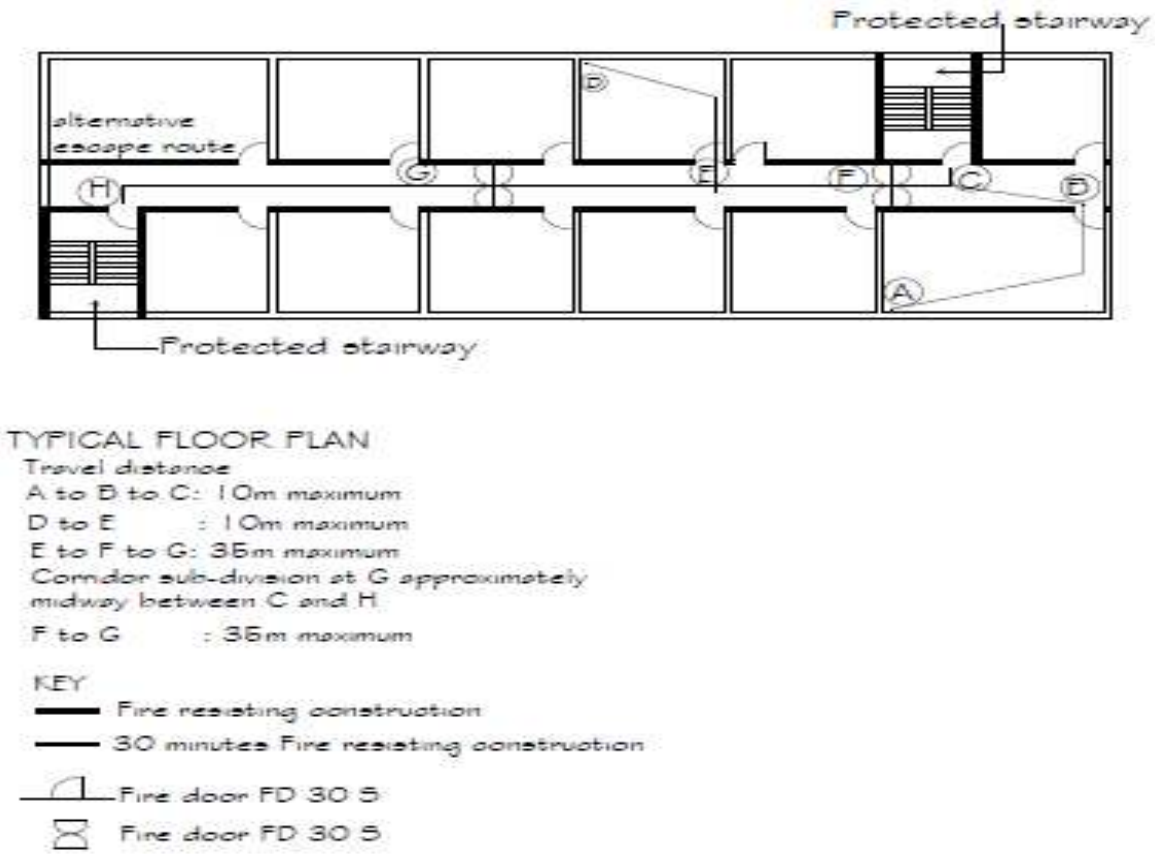


Figure 2: Limitations on travel distance for escape in one direction only and in more than one direction for a typical corridor arrangement.

Source: Fire safety in hostels (Herbert, 1998)

It should be noted that the maximum travel distances indicated above should be regarded as guidelines, rather than strict limits. Departures from the tabulated values should be on the basis of professional judgment, taking into account the existence of any compensating fire safety measures (Herbert, 1998).

Travel distance from any point is measured along the escape route to the nearest:

(a) Final exit

(b) Door to a protected escape stairway

(c) Door to an external escape route, where permitted or

(d) Door to a protected corridor (within a bedroom or dormitory).

2.12.2.3 Escape from a Room

Herbert (1999) asserts that alternative escape routes are required from a room in the following situations:

(a) From any dormitory occupied by more than 10 persons;

(b) From any bedroom or dormitory where the travel distance exceed 10m;

(c) From any other habitable room which is occupied by more than 50 persons; or

(d) From any other habitable room where the travel distances exceeds 20m.

For purposes of the number of persons that may occupy a bedroom or dormitory, the occupant capacity should be assessed by reference to the number of bed spaces provided. The maximum number of bed spaces provided in a dormitory should be on the basis of one person per 2.79m2 of floor area (Herbert, 1998)

Habitable rooms should not be inner rooms, i.e. it should not be necessary to pass through another room to reach an escape corridor. Where alternative escape routes from a room lead to the same protected corridor, they should be separated from each other by means of a self-closing fire door across the corridor and should lead to separate storey exits. Figure 3 illustrates the restrictions required for rooms provided with a single means of escape.

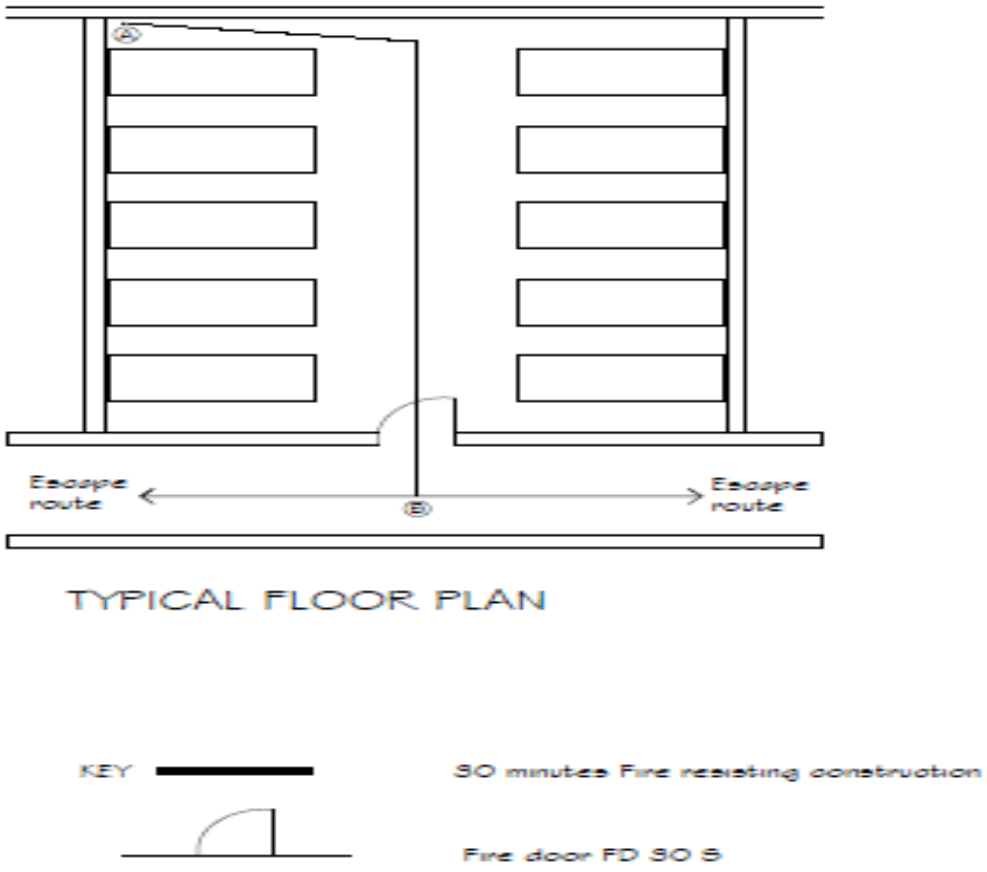


Figure 3: Restrictions required for rooms provided with a single means of escape

Source: Fire safety in hostels (Herbert, 1998)

Notes:
(1) Maximum travel distance from A to B is 10 m.
(2) Number of persons occupying a dormitory should not exceed 10.
(3) Number of occupants in any other habitable room should not exceed 50.

2.12.2.4 Escape Corridors

Corridors which form part of an escape route should be constructed with 30 minutes fire resisting elements (Herbert, 1998). Doors opening onto escape corridors, other than a door from a toilet or bathroom which is not used for the storage of combustible materials, and is separated from the remainder of the building by fire resisting construction, should be fire resisting and self-closing. Escape corridors should be effectively sub-divided by self-closing fire doors at approximately midpoint between storey exits so as to restrict the spread of smoke along their length.

Dead-end corridors are corridors where escape is possible in only one direction. Except in a building permitted to be served by a single escape stairway, dead-end corridors which lead to a protected escape stairway should be arranged so as to allow access to an alternative storey exit, without having to pass through the stairway enclosure. The dead-end part of the corridor should be separated from the remaining section by fire doors, at a position which ensures that the door to the stairs enclosure is within the dead-end section (see Fig. 4). The width of escape corridors should generally not be less than 900 mm. A lesser width may be acceptable; provided that any door which subdivides its length is not less than 750 mm and that there is adequate width for the purpose of evacuation (Herbert, 1998).

2.12.3 VERTICAL ESCAPE ROUTES

Vertical escape routes are those parts of the escape routes which lead from the upper storeys of the building to a place of safety in the open air at ground floor. Vertical escape routes are stairways which are protected from fire by means of fire resisting construction. The protection is provided to the enclosure to the stairway at all storeys and additionally by the provision of protected lobbies, where required, between the stairs enclosure and the accommodation. In some limited situations an external escape stairway may be the only practicable way of providing an alternative means of escape from a building (Herbert, 1998)

2.12.3.1 Protection of Vertical Escape Routes

The protection of vertical escape routes, by enclosing the stairways in fire resisting construction, is essential to protect the escape routes from smoke and fire. The protection of stairways also restricts the spread of fire between storeys. To restrict smoke entering a protected stairway, doors opening into it must be self-closing fire doors. In some situations it may also be necessary to provide a protected lobby between the stairs' enclosure and the accommodation, for example in the case of a building which is served by a single stairway.

In general, doors from rooms should not open directly into escape stairways. Rooms should connect to the escape stairways only by way of protected corridors or protected lobbies. Circulation routes on a storey should be excluded where possible from escape stairways. Escape stairways should lead directly to a place of safety in the open at ground floor level. The route from the base of the stairway to the final exit at ground floor level should be protected by means of fire resisting construction.

Storage of any kind should not be provided in escape stairways and signs to this effect should be clearly displayed. Also there should be restrictions on the location of some building services around escape stairways. Escape stairways should have openable windows, to allow for ventilation of smoke which may enter it from the accommodation. Stairways which are not provided with openable windows should have an appropriate smoke ventilation facility, with suitable means of opening provided at the top landing of the stairway enclosure.

2.12.3.2 Number and Location of Escape Stairways

The number of escape stairways should be adequate to safely evacuate the building. Escape stairways should be located so as to provide alternative escape routes and to reduce, to a minimum, the dead-end travel.

The number and location of escape stairways required will also be determined by the restrictions in travel distance indicated in Table 1.

2.12.3.3 Stairways serving Basements and Lower-Ground Floor Storeys

A stairway which is the only protected escape stairway in a building should not extend down to any basement storey. Where there is more than one protected stairway in a building, at least one should terminate at ground floor level.

Any permitted stairway which connects a ground floor to a basement or lower-ground floor storey should be a protected stairway. Where an escape stairway

extends to a basement or lower-ground floor storey, it should be separated from any accommodation at the lower level by a protected lobby or corridor and the section between the ground floor and basement or lower ground floor storeys should be separated from that serving the upper storeys by a protected lobby or corridor (Herbert, 1998).

2.12.3.4 Escape Stairways: General Provisions

The width of escape stairways will depend on the number of persons likely to use them but should not generally be less than 800 mm (Herbert, 1998). A stairway according to Herbert (1998) may be acceptable as an escape stairway where:

(a) It is a protected stairway and leads directly to a place of safety at ground floor level;

(b) the width of the stairway and dimensions of steps are adequate for the purposes of escape;

(c) The stairway is of sound construction and is capable of affording safe passage for the users of the building;

d) The pitch of the stairway does not exceed 38 degrees and is constant throughout its length and the number of treads in a flight is not more than 16 or less than 3.

2.12.3.5 External Escape Routes

Herbert (1998) stated that an external escape route is acceptable as an alternative means of escape only where:

(a) A suitable alternative internal protected escape stairway cannot be practicably provided; and

(b) The height to the floor of the top storey does not exceed 10 m above ground level. External stairways should also comply with the following conditions and Fig. 3 illustrates this:

(a) All doors affording access to the stairway should be fire resisting, unless it is located at the head of the stairway, leading downwards;

(b) Any part of the external walls or roofs within 1.8 m of, and 10 m vertically below, the flights and landings of a stairway leading downwards should be of fire resisting (minimum 30 minutes) construction; and

(c) Protection should be provided, by means of fire resisting construction, for any part of the building (including doors) within 3 m of the escape route from the foot of the stairway to a place of safety.

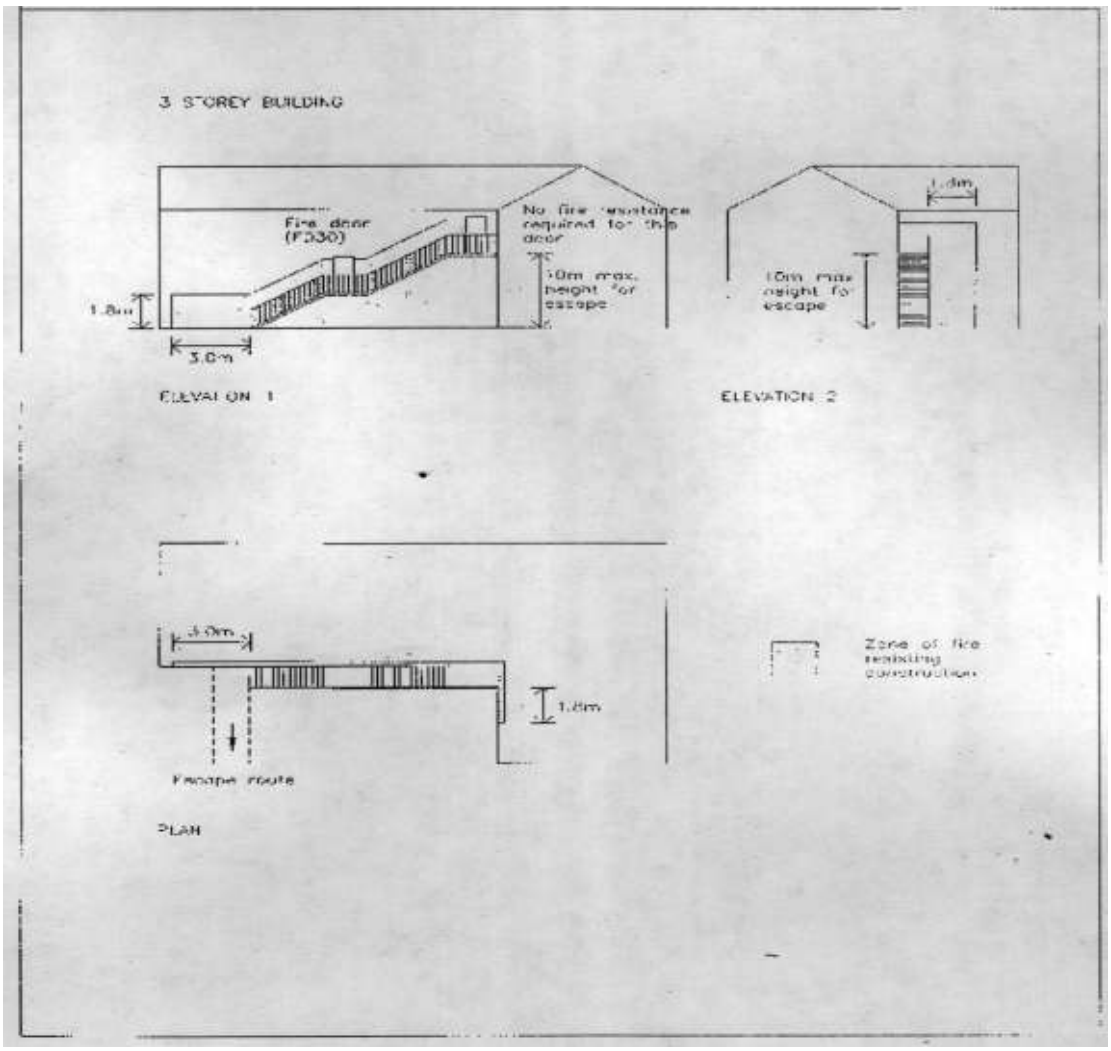


Figure 4: External escape staircase *Source: Fire safety in hostels (Herbert, 1998)*

2.12.3.7 Escape over Flat Roofs

Where an external escape route incorporates a part which is by way of a flat roof, the following conditions should be met:

-the escape route should be adequately defined, unobstructed and lit;

-the surface should be of a safe non-slip character and the route guarded with protective barriers (Stairways, Ladders, Ramps and Guards)

-the escape route across the roof and its supporting structure should have a fire resisting rating as specified in Table 4 and

-any roof or wall openings that are not fire resisting should not be located within 3m of the route (Herbert, 1998).

Table 4: Fire Resistance of Structural Elements

Location of Elements	**Fire Resistance (minutes)**
Buildings with not more than four storeys above ground level (ground storeys and up to three storeys above the ground storey)	30
Buildings with more than four storeys above ground level	60
Basement, Lower – Ground storey	60
Enclosure to place of special fire risk	60
Enclosure to protected escape stairway: Not more than four storeys above ground level More than four storeys above ground level	 30 60
Enclosure to escape corridor	30
Enclosure to small store room	30
Separation of ancillary shop, restaurants or bar from other accommodation	30

Source: Fire safety in hostels (Herbert, 1998)

2.12.3.8 Lifts

A lift which is designed for normal use only is not suitable for the purpose of means of escape in the event of fire. Persons who would be unable to use stairways for evacuation should be accommodated on the ground floor storey.

All lifts should be contained within an enclosure with fire resisting construction. A protected lobby should be provided between lift doors and corridors. Where a lift is contained within a stairway enclosure, it should be so

for its full travel and should not communicate directly with accommodation at any storey level. In a single stairway building the lift should terminate at ground floor level (Herbert, 1998). Lift machine rooms should be separated from the lift enclosure with fire resisting construction. Any openings for the operation of the lift should be as small as possible. Lift motor rooms should not be used to provide storage or other use and should be provided with automatic smoke detection.

2.13 ESCAPE ROUTES: GENERAL PROVISIONS

2.13.1 Floor Surfaces on Escape Routes

The floors of corridors, lobbies, landings and stairways forming parts of escape routes should have non-slip even surfaces. Where ramps are provided for use by physically handicapped persons, they should comply with Technical Guidance Access for Disabled People (Herbert, 1998).

2.13.2 Height of Escape Routes

Escape routes should have minimum clear headroom of 2 m and should not have an obstructions or projections except any door frame below this height (Herbert, 1998).

2.13.3 Doors on Escape Routes

All doors on escape routes should generally open in the direction of escape. Doors should not open across stairways, or obstruct the width required for escape of corridors, landings, or lobbies when open. However, doors serving rooms which accommodate less than 50 persons may open into the accommodation (Herbert, 1998). A fire resisting vision panel should be provided in fire doors which are located on corridors for the purpose of sub-division.

2.13.4 Door Fastenings

Exit doors should be readily and immediately openable at all times from the inside. They should not be dead-locked or fitted with barrel-bolts. The use of break-glass boxes containing keys for exit doors is not suitable. Fastenings should be of a type such as lever-handled latches or night latches that can be opened without use of a key. Panic-bolt type locking mechanisms should be used on doors on escape routes which may be used by 50 or more persons (Herbert, 1998). Doors which are opened by means of panic bolts should have a sign "PUSH BAR TO OPEN" displayed on them. Access to all sleeping accommodations should be available to staff, in the event of an emergency.

2.13.5 Assembly Points

All escape routes should discharge to a place of safety with clearly indicated and designated assembly points. These areas should be well clear of the building at positions which do not interfere with emergency operations.

2.13.6 Fire Detection and Alarm Systems

The provision of an appropriate fire detection and alarm system is an essential element of the fire safety measures in a hostel (Malven, 1997). It provides early warning of the occurrence of fire and thereby facilitates the activation of appropriate emergency procedures, including evacuation. Early detection also improves the chances of restricting the growth and spread of fire within the building by the use of first aid fire-fighting equipment, where safe to do so, and by early call-out of the fire services (Herbert, 1998). A fire detection and alarm system should be provided in all hostels. The system should incorporate automatic fire detection (heat or smoke type detectors, as appropriate) throughout the premises and suitably located manual activation facilities. Large buildings should be divided into fire alarm zones, as required by the standard, which will facilitate identification of the alarm source.

Control and indicating equipment should be located in positions where there is maximum supervision. A procedure should be developed to ensure that the

panel is attended immediately the alarm is raised. The fire warning system should be designed to be an integral part of the evacuation strategy. It is essential that reliable means are established for ensuring that, when an alarm occurs, the fire brigade is called with the minimum of delay. This will normally be done by telephone. In large buildings consideration should be given to the provision of an automatic facility for this purpose (Herbert, 1998).

2.13.7 Emergency Lighting

In the event of failure of electrical supply to normal lighting, emergency lighting is necessary in a hostel to provide sufficient lighting to:

-indicate clearly and unambiguously the escape routes within the building and along external escape routes where necessary;

-provide illumination along escape routes to allow safe movement towards and through exits;

-ensure that fire alarm call points and fire fighting equipment provided along escape routes can be readily located; and

-assist fire and emergency services in rescue, evacuation and fire-fighting operations. (Herbert, 1998)

2.13.8 Sign-Posting of Escape Routes

Exit and directional signs should be provided on all escape routes. If the access route to a stairway is through a long or circuitous route, exit and directional signs may be required to indicate clearly the escape route. In multi-stairway buildings, exit signs should be provided to indicate clearly the alternative escape routes available from each storey of the building. Directional signs should also be provided where alternative exit locations are not visible from any point in the common areas of the building. Exit signs should be located where they are most likely to be seen and preferably, immediately above the exit opening. Directional signs should be fixed in

conspicuous positions and wherever possible between 2m and 2.5m above floor level (Herbert, 1998).

Malven (1997) believes that effective exit marking must be:

a. Legible: visible from locations from which it might be viewed.

b. Meaningful: accurately conveying the meaning and function of access point.

c. Memorable: sufficiently distinctive to be remembered and found later, when emergency conditions may obscure its visibility.

CHAPTER THREE

3.0 CASE STUDIES: INTRODUCTION

In order to have a good and functionally aesthetic hostel design, it is important that case studies of existing student hostels be carried out. Case studies were carried out on Five (5) hostels, four in Nigeria and one international. Based on the study, two of the hostels used namely: Abiodun hall, Adeyemi Federal University of Education, Ondo and Moremi hall, Obafemi Awolowo University, Ile - Ife had experienced fire outbreaks. Other hostels used are Cafeteria hostel, Adeyemi Federal University of Education, Ondo; Jibowu hostel, Federal University of Technology, Akure and Students housing in Epinay, France.

3.1 CASE STUDY 1 – ABIODUN HALL, ADEYEMI FEDERAL UNIVERSITY OF EDUCATION (AFUED), ONDO, ONDO STATE.

3.1.1 BACKGROUND INFORMATION

Abiodun Hall is one of the female hostels in Adeyemi Federal University of Education (ACE), Ondo. It is a 2 storey building and it accommodates four (4) students in each of the sixty-five (65) rooms in the main building and two halls in the annex. The hostel is a prototype design of other three (3) hostels: Tinubu, Oduduwa which are female hostels and Olunloyo a male hostel. Abiodun hostel has had a history of fire outbreak in which the student lost everything in the hostel.

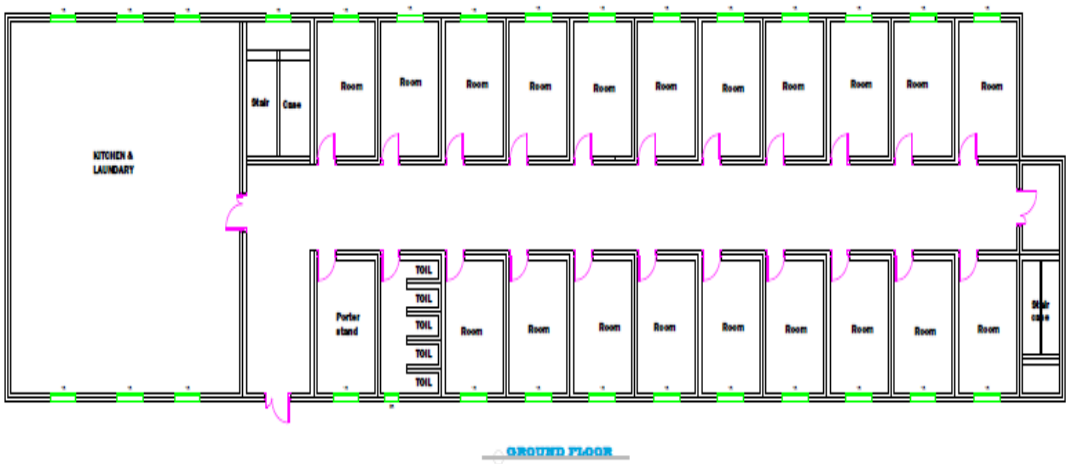


Figure 5: Abiodun Hostel Ground Floor Plan

Source: Author

Figure 6: Abiodun Hostel Typical First and Second Floor Plan

Source: Author

Plate 1: Front view of Abiodun hostel *Source: Author*

3.1.2 SITE LOCATION

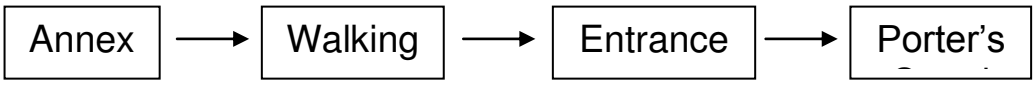
Abiodun Hall is the first hostel to the left coming from the College gate, opposite it is the Tinubu Hall and it is before Oduduwa Hall.

3.1.3 SITE PLANING

The hostel was located and planned along with other hostels not to be far from the College gate. The hostels have been arranged close to the gate in order to aid the students' access from outside the College.

3.1.4 SPATIAL ORGANISATION

The porter's stand is right at the entrance foyer. Staircase of the hostel faces the entrance, the kitchen to the left and the rooms and toilets/bathroom to the right with the exit door. The exit staircase is situated outside the building. The annex to the building has the common room and rooms on top for students.



The hostel has three floors in the main building and the annex has two floors. The main building has sixty-five (65) rooms, two (2) kitchens, toilets, bathrooms and an exit staircase outside. The annex has the common room and two rooms on the ground floor. On the first it has two (rooms) which are larger and take about six (60 bunks housing about 30 more students.

Plate 2: The Annex *Source: Author*

Plate 3: A view of the hostel *Source: Author*

Plate 4: Rear staircase of building slabbed as overhead tank *Source: Author*

Plate 5: Rear of building *Source: Author*

3.1.5 HOSTEL FACILITITES PROVIDED

1. A common room
2. Two common kitchenette and laundry area
3. Two double bunks per room in main building
4. Conveniences
5. Porter's stand
6. Eighteen double bunks in the annex for more students
7. Buttery
8. External wash area
9. External pit toilets.

3.1.6 BUILDING MATERIALS HIGHLIGHT

Table 5

BUILDING COMPONENTS	DESCRIPTION
Floor	Cement screed concrete slab floor finished with terrazzo. Tile finishes in conveniences.
Window	Projected windows in the main building. Louvers used in the annex.
Door	Steel doors for the entrances and exits. Flush doors and panel doors for rooms, kitchen and conveniences. Glass doors for common rooms.
Roof	Gable roof in parapet for the main building and hip roof for the annex.
Wall	225mm block walls. Emulsion paints for the internal walls and textured paints for external walls. Stoned pitched wall in rear of main building and also in front and rear of annex ground floor.
Ceiling	Asbestos

3.1.7 GENERAL APPRAISAL

Merits

1. It is well ventilated and lighted.
2. The walls are made of durable building materials which aided the building during fire outbreak.
3. Proper disposal of refuse around the hostel which serves as a means of reducing fire spread in case of fire outbreak.

Demerits

1. Entrances to the main building and annex are not well defined
2. Partitions along the corridor are wooden and this could pose a threat during fire outbreak.

3. All windows are blocked with screen wall which pose a danger of not being able to escape through the window in case of being trapped in the room if fire breaks.

3.2 CASE STUDY 2 – CAFETERIA HOSTEL, ADEYEMI FEDERAL UNIVERSITY OF EDUCATION (AFUED), ONDO.

3.2.1 BACKGROUND INFORMATION

The cafeteria hostel is so called because it is used to be group of building serving as cafeterias and business centres. When the Abiodun Hall got burnt, the students needed to be accommodated pending the rehabilitation of the building. The cafeteria buildings were renovated and converted to hostel blocks for the students. Since then, the buildings have been serving as hostel blocks. The common room was later constructed.

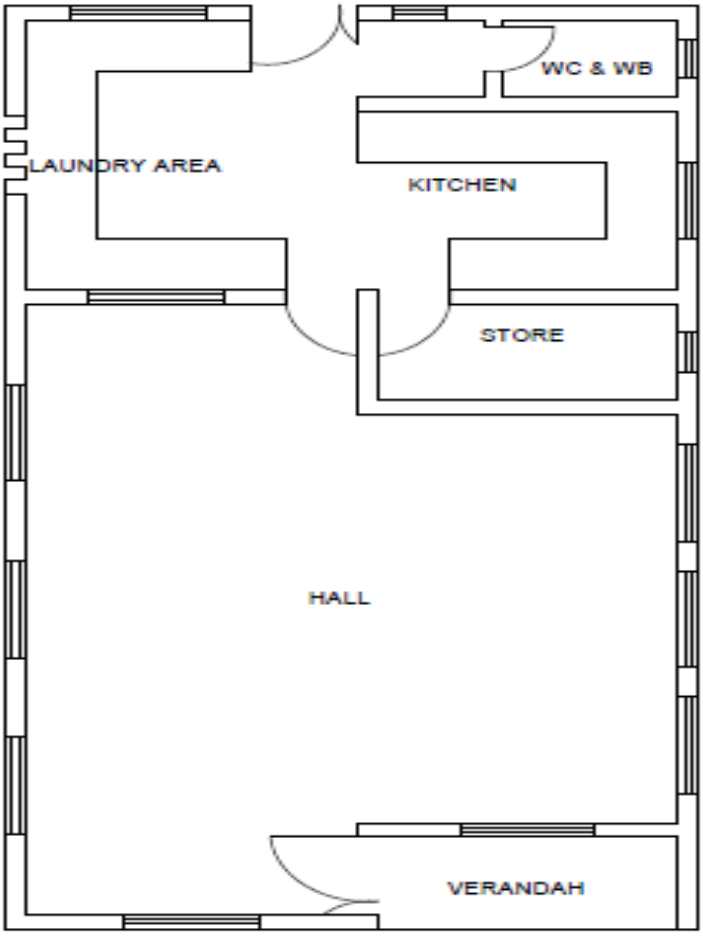


Figure 7: Cafeteria Hostel Floor Plan *Source: Author*

3.2.2 SITE LOCATION

Although the hostel was not initially planned as such, it was located close to the existing hostels to serve as cafeteria and business centres for the hostels. The location is an advantage as it made the blocks close to other hostels.

3.2.3 SITE PLANNING

The site is occupied with buildings but still have space for erection of about four more blocks or used as a landscape sit out and car park.

Plate 6: A view of Cafeteria hostel blocks *Source: Author*

3.2.4 SPATIAL ORGANISATION

The room is separated from the laundry, kitchen, store and toilet with a door. It has one entrance and exit door.

The hostel is block of flats so the common room, buttery and porter's office are constructed as a separated building.

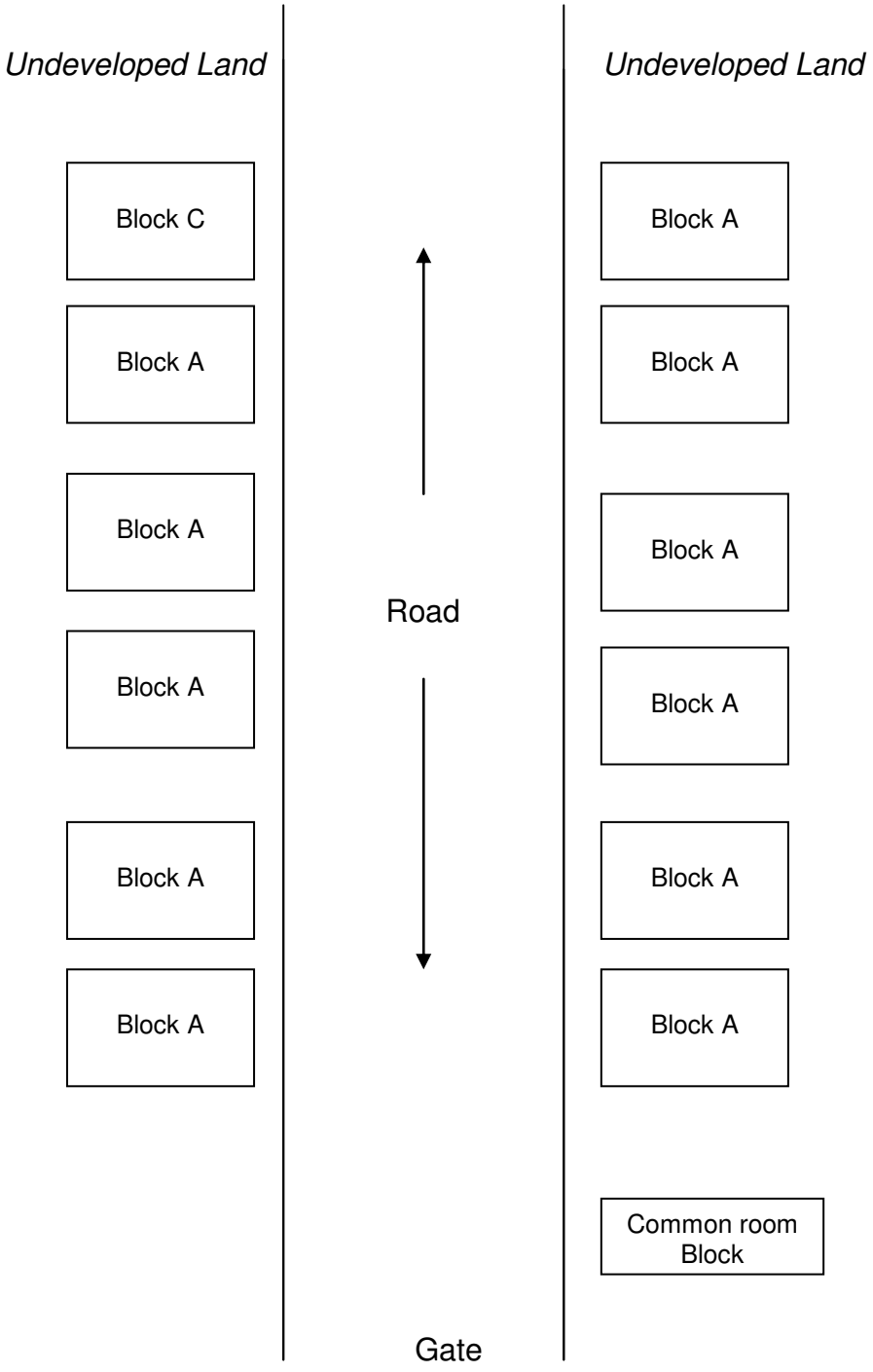


Figure 8: Spatial Organisation of the hostel blocks *Source: Author.*

Plate 7: A typical front view of Cafeteria hostel blocks *Source: Author*

3.2.5 HOSTEL FACILITIES PROVIDED

1. Porter's room
2. Buttery
3. Store
4. Students' room (hall)
5. Toilet and bathroom
6. Kitchenette
7. Laundry area
8. External toilet and bathroom

3.2.6 BUILDING MATERIALS HIGHLIGHT

Table 6

BUILDING COMPONENTS	**DESCRIPTION**
Floor	Terrazzo for the hall, kitchen, laundry and store / Vitrified tiles for toilet
Window	Sliding window/ Screen
Door	Steel door for entrance / exit. Panel door for others.
Roof	Gable roof with long Span aluminium

Wall	225mm block wall painted internally with emulsion and externally with textured paint. Tiles for convenience.
Ceiling	Asbestos

3.2.7 GENERAL APPRAISAL

Merit:

1. Good lighting and ventilation
2. Proper separation between the hall and kitchen area
3. Provision of store
4. Construction of drainage for draining excess water
5. Roof height good enough for run-off

Demerit:

1. The environment is not properly landscaped
2. The space in between the block not wide enough in case of fire outbreak in any of the blocks
3. No provision for parking space
4. The convenience attached not enough for the number of students in each block.
5. No privacy as it is a crowed hostel
6. No provision for reading area
7. The kitchenette and laundry not sufficient for the students.

3.3 CASE STUDY 3 – JIBOWU HOSTEL, FEDERAL UNIVERSITY OF TECHNOLOGY (FUTA), AKURE, ONDO STATE.

3.3.1 BACKGROUND INFORMATION

FUTA has a lot of hostels and Jibowu is among. It is one of the female hostels, it has three (3) blocks and each room accommodates four (4) students with a total of One hundred and five (105) rooms.

3.3.2 SITE LOCATION

Located at the Northern part of the institution. Bounded on the north by Abiola Hall (a male hostel), on the South by the Students' Union Shopping Complex, on the West by female hostel annexes and on the East by other hostels namely: Female forest annex, Jadesola Akande hostel and Peter Adeniyi hoste.

3.3.3 SITE PLANNING

Located at the Northern part closer to Akure-Ilesha express way demarcated from the road by wall and bushes. Planed along with all hostels at Oba Nla.

3.3.4 SPATIAL ORGANISATION

The offices are at the entrance of the building and the sleeping area as a separate entity. The two are connected by landscape elements (i.e. paved walkways and shrubs). The hostel has three blocks. Block one and block two are together as a structure while the third block is another structure. Block one and block two are called main Jibowu and the block three old Jibowu.

The main Jibowu comprises sixty-two (62) rooms with an open courtyard, common room, executive council rooms, kitchenettes, laundries, bathrooms and toilets. Block three, the old Jibowu comprises of twenty-nine (29) rooms, a big common room, two kitchenette, two laundries, five toilets and bathrooms each.

Plate 8: FUTA hostel layout plan *Source: Author*

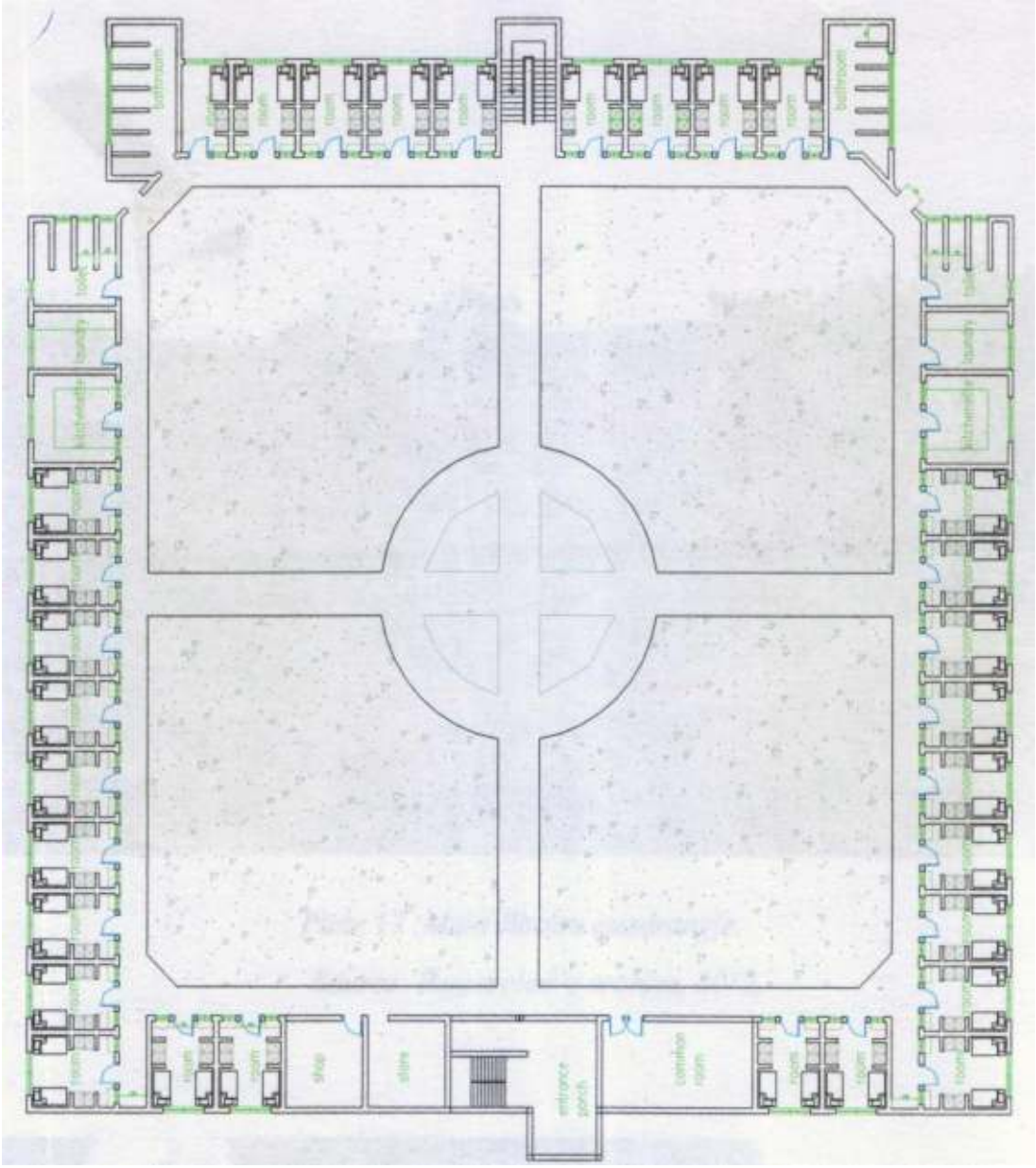


Figure 9: Jibowu Plan *Source: Author*

Plate 9: Jibowu Hostel Courtyard *Source: Author*

Plate 10: Jibowu Hostel Approach *Source: Author*

3.3.5 HOSTEL FACILITIES PROVIDED

1. One common room in each of the blocks
2. Two common kitchenette in each block
3. Two common laundry in each block
4. Two double bunks per room
5. Toilets
6. Bathrooms
7. Executive councils offices and special rooms.
8. Nearby supporting sports facilities
9. Aluta market as a supporting facility.

3.3.6 BUILDING MATERIALS HIGHLIGHTS

Table 7

BUILDING COMPONENTS	**DESCRIPTION**
Floor	Cement Screed, Terazzo and tiles
Window	Louvers
Door	Flush and Panel doors
Roof	Reinforced concrete slab
Wall	Emulsion paint for external and internal walls

3.3.7 GENERAL APPRAISAL

Merits:

1. Well ventilated and lightened
2. Provision of commercial shops to cater for needs of students
3. Well segregated spaces to prevent clashes of activities
4. Well landscaped
5. Entrances ad exit adequately provided in case of emergency

Demerits:

1. Facilities poorly maintained
2. Rooms are relatively small

3.4 CASE STUDY 4 – MOREMI HALL, OBAFEMI AWOLOWO UNIVERITY, ILE-IFE, OSUN STATE.

3.4.1 BACKGROUND INFORMATION

Moremi Hall is a female hostel in Obafemi Awolowo University, Ile-Ife, Osun State. The building was named after an ancient heroine, Princess Moremi who was once a ruler in Yorubaland. The hall was built between years 1973 and 1974 with capacity for 1,228 students. It is a three floors building. The hostel also has a history of fire outbreaks.

3.4.2 SITE LOCATION

The site is located not too far from the Department of Architecture. The Department and the hall share the car park.

3.4.3 SITE PLANNING

The site is considerably large enough to accommodate the building.

3.4.4 SPATIAL ORGANISATION

The offices are located on the ground floor with some room and the room and their conveniences are on the other floor too.

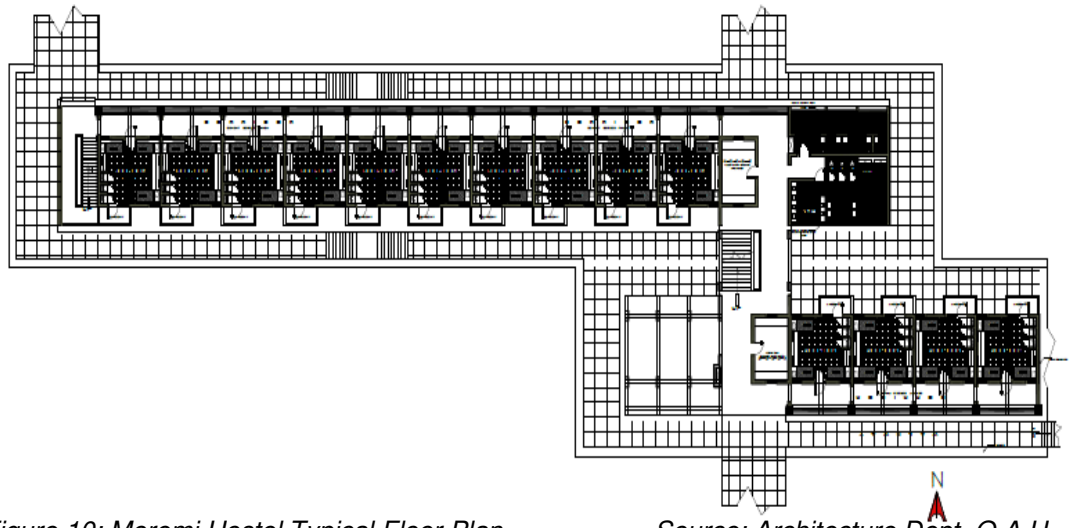


Figure 10: Moremi Hostel Typical Floor Plan *Source: Architecture Dept. O.A.U*

Plate 11: A view of the hostel *Source: Author*

Plate 12: Balconies used for cooking *Source: Author*

Plate 13: Inside one of the rooms *Source: Author*

Plate 14: Wardrobe in one of the rooms *Source: Author*

3.4.5 HOSTEL FACILITIES PROVIDED

1. Rooms
2. Water closest
3. Bathrooms
4. Kitchenette
5. Buttery
6. Porter's lodge

3.4.6 BUILDING MATERIALS HIGHLIGHTS

Table 8

BUILDING COMPONENTS	**DESCRIPTION**
Floor	Cement screed, Tiles
Window	Louvres
Door	Flush
Roof	Parapet
Wall	Emulsion, Tiles
Ceiling	Asbestos

3.4.7 GENERAL APPRAISAL

Merit:

1. Good lighting and ventilation
2. Each room has its own kitchenette
3. Well defined and adequate parking space
4. Staircase wide enough

Demerits:

1. Rooms are overcrowded which can enhance fire outbreak due to overstretch of facilities.
2. Interior spaces now dilapidating
3. Haphazard waste disposal giving rise to debus of waste which can aid fire and make the hostel prone to fire outbreak.

3.5 CASE STUDY 5 – STUDENT HOUSING IN EPINAY, FRANCE.

Project:	Student Housing in Epinay
Location:	Epinay, France
Architect:	Emmanuel Combarel Dominique Marrec
Client:	Espacil Habitat
Project Management Associate:	Beto, BET – Michel Carsonneur
Project Manager:	Aliette Chauchat
Project Year:	2003 – 2008
Constructed Area:	9,000 sqm.

3.5.1 BACKGROUND INFORMATION

The residence houses one hundred and seventy (170) resident on one hundred and fifty (150) housing, Nineteen (19) housing for researchers or invited Professors and attached housing for women in distress (www.archdaily.com). The objective is to create some social coeducation while having for each of the establishments a management with human scale benefiting from synergies between establishments.

3.5.2 SITE LOCATION

The site is located in Epinay, France by joining in a second reading of the landscape of the road of Saint Lev.

3.5.3 SITE PLANNING

The site has planned to play the role of revelation of a district in future, articulating a split up territory from a synthesis of a town planning consisted of industrial and commercial buildings, detached flags of the last century, complexes and public equipments.

3.5.4 SPATIAL ORGANISATION

The building was spatially organized as a fragmented structure of four buildings of differentiated writings.

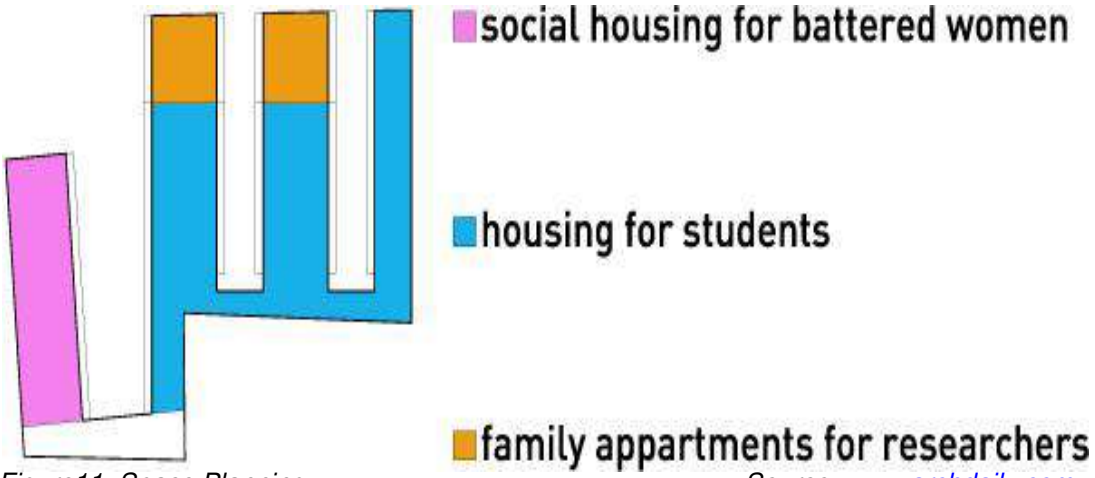


Figure11: Space Planning *Source: www.archdaily.com*

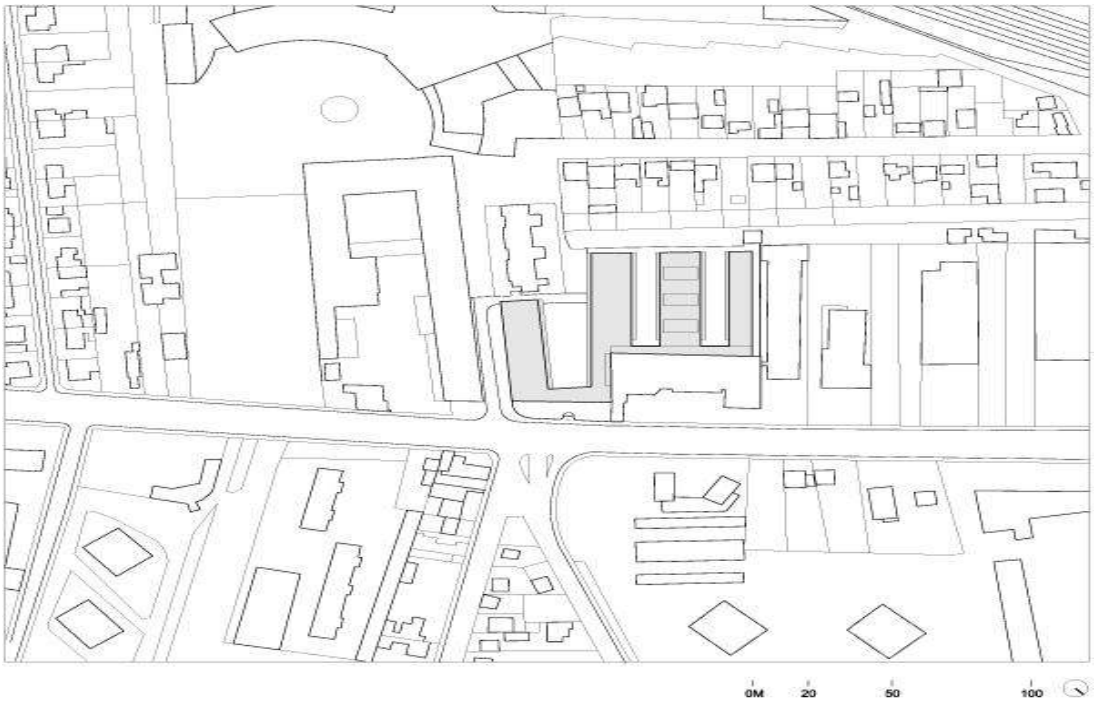


Figure 12: Site Plan *Source: www.archdaily.com*

Figure 13: Ground Floor Plan *Source: www.archdaily.com*

Figure 14: Upper Floor Plan *Source: www.archdaily.com*

3.5.5 HALL FACILITIES PROVIDED

1. Rooms
2. Private study rooms
3. Guard's accommodation
4. Laundry
5. Internal and External relaxation space
6. Gardens

3.5.6 GENERAL APPRAISAL

Merits:

1. Provision of social facilities
2. All rooms are ensuite to give room for privacy
3. Well landscaped
4. Room varieties to serve different space needs
5. Enhanced ventilation with courtyard
6. Good orientation of building to take advantage of wind direction
7. Fine resistance construction was considered in design. The fragmentation design which helps to slow down spread of fire.

Demerits:

1. Vertical means of escape provided in case of inferno but not well located.

3.6 DEDUCTIONS FROM CASE STUDIES

The overall satisfaction of students with their safety cannot be overemphasised. The consciousness of the designer and users of the buildings is very important. The following were deduced:

1. The need for escape route in a hostel building.
2. The need for fire safety consciousness in the building design and use.
3. The need to avoid waste and dirt around the hostel.
4. The use of fire safe building materials and method of design and construction
5. Provision of fire exit staircases within the hostel.

CHAPTER FOUR

4.0 ENHANCING FIRE SAFETY IN HOSTELS

4.1 FIRE PREVENTION

Fire prevention measures are a key element in the fire safety management of hostels. This involves the identification and elimination of potential fire hazards both inside and outside the building, the establishment of good house-keeping practices, periodic inspections and the diligent application of safety rules. Herbert (1998) asserts that notice outlining the main points of concern should be displayed for the information of the occupants in all appropriate areas.

4.2 POTENTIAL FIRE HAZARDS

4.2.1 Rubbish and Waste

Combustible waste materials such as waste-paper, wrappings etc. are frequently the fuel involved in starting fires, and proper arrangements should be made for collection and removal of such wastes at regular intervals. Pending removal, rubbish and wastes should be stored in suitable containers at designated locations, away from sources of ignition. Students should be made aware of the importance of keeping all areas of the premises clean and tidy. Rubbish and wastes should not be allowed to accumulate in stairways or escape routes.

4.2.2 Smoking

Smoking and careless disposal of cigarette butts are some of the most common causes of accidental fires. Where permitted, smoking should be restricted to approved areas. "No Smoking" signs should be displayed in areas where it is forbidden. Smoking should be prohibited in dormitories, bedrooms, stores, laundries and in kitchen areas. In areas where smoking is permitted, suitable ash trays should be provided. Ash trays should be emptied

frequently into metal bins, with any smouldering material extinguished beforehand.

4.2.3 Gas Cylinders/Cartridges

Any gas containers should be stored outside the building in a separate designated well ventilated and secure store.

4.2.4 Electrical Installations and Appliances

Staff should be trained to use electrical equipment correctly and safely, and to report defective electrical equipment. Defective equipment should not be used; repairs as appropriate should only be carried out by competent persons. Equipment should be switched off when not in use. Occupants of the hostels should be advised as to the correct use of electrical appliances which may be provided in their bedrooms; care should be taken with the use of such appliances as heaters, hair dryers etc.

4.2.5 Kitchens

Good house-keeping practices are essential for fire safety in kitchens. Cookers, extract fans, extraction hoods, filter ducts and ancillary equipment should be regularly cleaned of oil, grease and dust. Equipment should be serviced regularly. Gas, oil and electrical cut-off-switches and valves should be provided in clearly marked and accessible areas situated away from the equipment which they serve.

Herbert (1998) asserts that the occupants should be instructed on how to prevent fires occurring by: not leaving cooking operations unattended, taking care not to overheat fats/oils, not over-filling cooking pans; and not leaving combustible materials (e.g. towels, etc.) over stoves.

Occupants should also be familiar with the location and correct use of available first aid fire-fighting equipment in kitchens e.g. heat detectors, fire extinguishers, fire blankets and any fixed fire suppression systems.

4.2.6 Laundries

A separate room should be dedicated for use as a laundry or utility room as such rooms according to Herbert (1998) pose particular fire hazards as detailed below:

(a) Spontaneous combustion of compacted fabrics which have been tumble dried. Tumble dryers should have automatic cooling at the end of the drying cycle. Fabrics should not be over-dried and tumble dryers should be unloaded immediately after use and left empty. Tumble-dried fabrics should be separated and folded as soon as practical, but in any case should be loosened to dissipate heat on being taken from the machine. Ironing equipment should be switched off when not in use.

(b) Solvents which are highly flammable are sometimes used for spot cleaning in Laundries. Only small quantities needed for immediate use should be kept in the laundry. The main bulk of this type of liquid and general cleaning solvents should be stored outside the building in a well ventilated secure store. Containers for solvents should be kept closed to prevent the vapours leaking. Smoking should be prohibited in laundries and signs to this effect should be displayed.

(c) Fluff or lint which is extremely flammable can accumulate in laundries. A programme should be instituted to remove build-up of such materials, especially from hot areas such as electric motors, and other hidden locations.

4.2.7 Open Fires and Portable/Fixed Radiant and Convector Type Heaters

Open fires or portable heaters should not be provided in bedrooms or dormitories. Where an open fire or portable radiant type heater is provided in a common area i.e. a sitting room or lounge, it should be protected by a strong spark-proof fireguard.

Fuel and lighting materials should be stored safely. Heaters should not be used for drying clothing and appropriate notices to this effect should be

displayed beside such heaters. Clothing etc. should not be placed on or near convector or storage type heaters.

4.2.8 Storage of Luggage

Adequate facilities should be provided for the storage of luggage. Luggage should not obstruct any escape route or fire safety sign.

4.2.9 Maintenance and Repair

Adequate fire precautions should be taken when any hot work is undertaken e.g. soldering, welding, etc. and work persons should be carefully supervised.

4.3 STRUCTURAL FIRE PRECAUTIONS

Structural fire precautions in buildings are required to prevent premature structural failure and to limit fire spread (Herbert, 1998). He also asserts that for these purposes, the following provisions are necessary:

1. Sub-division of the building into a number of fire compartments;

2. Elements of structure to be provided with appropriate fire resistance;

3. Compartmentation of places of special fire risk;

4. Restrictions to linings of walls and ceilings so as to limit their contribution to the development of fire and to have adequate resistance to the spread of fire along their surfaces;

5. The provision of fire doors to limit the spread of fire and smoke; and

6. Limitation of fire spread at junctions between building components, service penetrations and in cavities.

Structural fire precautions are also necessary to protect the means of escape.

4.3.1 Compartmentation

Compartmentation is a critical part of fire control. It involves the division of a building into separate fire areas, each separated from others by a perimeter of fire resistive “barriers” (Malven, 1997). Herbert (1998) also asserts that compartmentation can be achieved by the provision of compartment walls and floors of fire resisting construction. Places of special fire risk should be separated from other accommodation by compartmentation. Furthermore, Davies et al, (2008); affirm that compartmentation is the subdivision of a building into an isolated unit surrounded by fire walls and floors to inhibit the spread of fire. The objective of compartmentation is to prevent the uncontrolled spread of fire throughout the building, thereby allowing more time for evacuation. It will also assist fire fighting operations by the fire brigade. This is particularly important in the case of large buildings. All floors in hostels, not being the lowest floor of the building, should be constructed as compartment floors. Compartment walls and floors and any doors in compartment walls are required to achieve an appropriate level of fire resistance.

Areas which present a special fire risk should be compartmented by means of construction having a minimum fire resistance of 60 minutes (Herbert, 1998).

Examples of such areas include kitchens, laundry rooms, store rooms and electrical switch rooms. Doors into such areas, except where they open directly to the outside, should have a fire resistance of 60 minutes, be fitted with self-closing devices, and should not be held permanently open (Herbert, 1998). Small store rooms, including linen presses, should be separated by means of 30 minutes minimum fire resisting construction, with 30 minutes self-closing fire doors (Herbert, 1998). A central-heating boiler should preferably be located in a separate outside building, but if it is within the building it should open directly to the outside and should ideally not communicate directly with other accommodation.

Places of special fire risk should be provided with automatic fire detection connected to a fire alarm system for the building.

4.3.2 Fire Doors

Fire doors are important part of fire defence system in hostels and should normally be kept closed. The occupants should be made aware of the vital role which such doors play, and of the importance of not propping or wedging them open. This message should be emphasised by appropriate "Fire Door-Keep Shut" signs displayed on each fire door. In situations where it is necessary for operational reasons to hold open such doors, this should be done with electro-magnetic devices linked to an automatic alarm system. Such doors should be closed at night.

Provision of Fire Doors

Fire doors are provided to restrict the spread of fire and smoke in a building and form an important part in the defence against fire. They are provided in openings to compartment walls and the enclosures of protected stairways and lifts. They are also provided along and across protected escape routes. According to Herbert, (1998), the provision of fire doors in hostels should be in accordance as in the Table 9:

Table 9: Provision of fire doors

Provision of Fire Doors	
Location of fire doors	Type of fire door
A door forming part of the enclosure to a protected stairway, a protected lobby or a protected corridor.	FD30S
A door from a bedroom or dormitory to a protected escape corridor.	FD30S
A door sub-dividing a protected corridor.	FD30S
A door to a small store room.	FD30S
A door in a wall separating an ancillary shop, restaurants or bar from other accommodation.	FD30S
Enclosure to place of special fire risk	FD60S

Source: Fire safety in hostels (Herbert, 1998)

Note: Door types FD30S and FD60S denote fire doors having minimum periods of fire resistance of 30 and 60 minutes respectively and the doors are provided with cold smoke seals.

4.3.2.1 Performance of Fire Doors

A fire door includes the door frame and associated iron mongery such as, hinges, locks, catches, seals and door-closures. The complete assemblage, often referred to as a fire door set, constitutes a fire door. The fire resistance of a fire door must be achieved when it is part of a door set in its location within a building. The performance of fire doors is an important element in fire safety provisions in buildings. It is critical therefore that a fire door set is installed correctly and in accordance with the relevant test certification.

4.3.2.2 Closing Devices for Fire Doors

Fire doors (except to a cupboard or service duct) should be fitted with self-closing devices, which are capable of closing the doors from the fully-open position, with any latches fitted. Where it is necessary to hold fire resisting doors in the open position, e.g. doors across a corridor, this should only be done by means of electromagnetic-type devices linked to an automatic fire detection and alarm system. Herbert (1998) asserts that the automatic release mechanism should release the door to close automatically in the event of any one of the following:

(i) the detection of smoke by a detector on the fire detection and alarm system which is located adjacent to the door;

(ii) the failure of the mains power supply;

(iii) the operation of the manual or automatic fire alarm system; or

(iv) the operation of any timing devices installed for that purpose.

Automatic door releases should be provided with a ready means of manual operation from a position at the door. Fire doors (except where held open by a hold-open device complying with the above) should be marked, at about eye-level, with the appropriate fire safety sign to the effect that they should be kept closed when not in use.

4.3.2.3 Markings for Fire Doors

Fire doors (excepting bedroom/dormitory doors) should be marked at about eye level with the appropriate fire safety sign according to whether the door is:

- to be kept closed when not in use;

- to be kept locked when not in use; or

- held open by an electro-magnetic device.

Fire doors to cupboards and to service ducts should be marked on the outside. All other fire doors should be marked on both sides.

4.4 ELEMENTS OF STRUCTURE

According to Herbert (1998), for the purpose of resistance to fire, the following elements are regarded as elements of structure:

(a) Any member forming part of the structural frame of a building or any other beam or column not being a member forming part of a roof structure only;

(b) Compartment floors and walls and walls separating buildings;

(c) A load-bearing wall or load-bearing part of a wall; and

(d) Any structure enclosing a protected shaft or stairway.

4.5 FIRE RESISTANCE

The fire resistance of an element of structure is a measure of the ability of that element to withstand the effects of fire for a specified duration, when it is tested to a particular standard (Herbert, 1998). Davies et al, (2008) described fire resistance as the relative non-combustibility of a material or component which restricts the spread of fire or maintains its structural properties in the event of a fire.

The fire resistance of a door is a measure of its ability to withstand the effects of fire under specified test conditions, for a specified duration. Elements of construction should not generally be treated in isolation. The interaction of one element and another should not lessen the fire resistance for the composite construction. The junction of elements, such as walls and ceilings, may present points of weakness and care should be taken to ensure the integrity of such areas in fire conditions (Herbert, 1998).

4.5.1 Fire Resistance for Elements of Structure

The fire resistance of the elements of structure in a building used as a hostel should not be less than the values indicated in Table 4. The tabulated fire resistance values (expressed in minutes) relate to the performance of the element of structure in a standard fire resistance test in terms of load-bearing capacity, integrity and insulation (Herbert, 1998).

4.6 CONSTRUCTION DETAILS

4.6.1 Junctions

Junctions between elements of construction, cavities, pipe-ducts and lifts frequently constitute points of weakness aiding fire spread and should be checked carefully. Junctions between building components should not be such as to transfer fire from one side to the other.

4.6.2 Cavities

Cavities and hidden spaces, such as hollow walls and suspended ceilings, can provide a route for fire spread between rooms and throughout buildings. Cavity barriers should be provided to restrict the spread of smoke and fire within cavities. Large cavities may also need to be protected by automatic fire detection.

4.6.3 Cables, Pipes, Ducts and Flues

Cables, pipes, ducts and flues which penetrate compartment walls, floors, protected enclosures or cavity barriers can also be potential points of weakness in fire. Such penetrations should be protected by fire-stopping so that the fire resistance of the element through which it passes is not impaired. Ventilation duct work should be provided with dampers.

4.6.4 Wall and Ceiling Finishes

4.6.4.1 Fire Performance Requirements for Wall and Ceiling Linings

Wall and ceiling linings should have adequate resistance to spread of flame over their surfaces and should not contribute significantly to the development of a fire in a room or compartment. The surface of walls and ceilings should meet the fire performance as indicated in Table 10:

Table 10: Performance of walls and ceiling linings

Performance of Wall and Ceiling Linings	
Location of wall or ceiling linings	Performance
Circulation spaces, including protected corridors, protected lobbies and protected stairways; toilets and bathrooms opening onto protected escape routes	Class 0
Habitable rooms exceeding 30 m^2 in area	Class 0
Places of special fire risk	Class 0
Bedrooms or other habitable rooms not exceeding 30 m^2 in area.	Class 1
Toilets, bathrooms and small rooms not exceeding 4 m^2 in area	Class 3

Source: Fire safety in hostels (Herbert, 1998)

Parts of walls may have a lower classification than indicated in (but not less than Class 3), provided these areas are restricted to half the floor area of the room or 20m2 (divided into 5m2 sections separated from each other by 2m), whichever is lesser (Herbert, 1998).

4.7 FIRE RESISTANCE RATING OF BUILDING MATERIALS

Fire resistance can be defined as the ability of structural elements to withstand fire or to give protection from it (Davies et al, 2008). This includes the ability to confine a fire or to continue to perform a given structural function,

or both. Fire Resistance Rating (or fire rating), is defined as the duration of time that an assembly (roof, floor, beam, wall, or column) can endure a "standard fire" (David et al, 2008).

The properties and uses of materials in building have led to recommended standards in building construction. Some of the standards in the building codes are as follows:

Table 11: Minimum overall size of metric unit of concrete wall of cement mortar

Resistance	4 hours	2 hours	$1^{1/2}$hours	1 hour
Thickness (mm)	300	225	200	150

Source: N.I.A. journal of July, 83, Page 42.

Table 12: Materials and fire endurance.

S/N	**Materials and their thicknesses**	**Endurance**
1	Hardwood 3mm thick	5 minutes
2	Synthetic resin bonded paper 3mm thick	6 minutes
3	Plywood 6mm thick	10 minutes
4	Plaster board 9mm thick	11 minutes
5	Fibre insulation board 12mm thick	15 minutes
6	Plaster board 12mm thick	20 minutes
7	15mm plaster board + 1.5mm plaster	20 minutes
8	12mm plaster board + 1.2mm plaster	40 minutes

Source: N.I.A. journal of July, 83, Page 43.

4.8 FIRE PROTECTION APPLIANCES AND INSTALLATIONS

Fire protection appliances and installations are increasingly forming a part of an overall fire protection system. Active extinguishing systems are often installed to compensate for inadequate structural protection, or to facilitate an innovative concept or design which would be hampered by protective construction or division by fire walls (Menzies, 1999).

4.8.1 Hand fire appliances

Extinguishers, fire buckets, fire blankets are the first aid appliance for use by general public. The extinguishing medium of hand-held extinguishers varies to suit the risk; they are colour coded for quick reference.

4.8.2 Hose reels

First aid appliance for use by occupants and fire-fighters; connected to a pressurized water supply. Davies et al, (2008) described hose reel as hose coiled and placed in a designated cabinet at a fire point with a connection to a main, used by occupants of the building in the event of a fire.

4.8.3 Automatic sprinkler

They provide an automatically released water spray above a fire to contain its growth and inhibit its spread. There are various types and systems for specific areas, applications and risk categories. It should be noted that some systems are meant for property protection only, and that special provisions relate to life safety (Menzies, 1999). Certain situations are not considered suitable for protection by sprinklers because of the potential water damage (art galleries, museums, and historical libraries), the risk of accidental discharge or the unsuitability of water as the extinguishing medium for certain processes and materials (Menzies, 1999). There may also be a need to provide large volumes for on-site water storage.

4.8.4 Water drenchers

A curtain of water, usually to protect the outside of a building or the safety curtain of a theatre.

4.8.5 Water spray projector systems

They are used for fires involving oils or similar flammable liquids.

4.8.6 Hydrant systems

They are sometimes known as mains which deliver water for fire fighting onto the floor of a building through landing valves. Davies et al, (2008); stated that a fire hydrant is an outlet from a fire main from which a supply of extinguishing water can be used for fire-fighting in the event of a building fire.

A wet hydrant system is a pipe permanently charged with water and is generally installed in buildings above 60 m in height; beyond the pumping capabilities of a fire service pumping appliance; it requires water storage (Menzies, 1999). A dry riser is a pipe charged by a fire service pump at ground/access level; it can be at any height but is generally provided in a building over 18 m (Menzies, 1999). Any horizontal section should not exceed 12m in length unless the delivery of the required rate of water at each outlet can be proven hydraulically (Menzies, 1999). Falling or dropping mains deliver water to low levels. Private hydrants are provided within the curtilage of a site where statutory hydrants are too distant or where the risk is such as to require large volumes of water immediately.

4.8.9 Foam installations

This is of limited application; generally for the extinction of flammable liquid fires. It may require space for on-site foam-making equipment. There are various forms; specialist advice will be needed (Menzies, 1999). A foam inlet is a fixed pipe through which foam can be pumped to protect rooms containing oil fuel, oil fired boilers etc

4.8.10 Gaseous and vaporising liquid installations

These can be: Carbon dioxide to protect enclosed area acting in the main by dilution of the atmosphere. It is not suitable for all fires but is satisfactory for electrical, computer and telephone equipment, flammable liquids, some chemicals, libraries, archives, art stores, diesel engines and textiles.

Dry powder installations are suitable for use on flammable liquid and metal fires.

4.8.11 Automatic detectors

Smoke detectors detect the presence of smoke by optical (obscuration) or ionisation methods and raise an alarm. Ionisation detectors are sensitive in the early stages of a fire when smoke particles are small; most suitable in a

controlled environment such as a computer suite. Optical detectors react to the visible products of combustion and are the most effective.

Heat detectors detect heat at a pre-selected temperature or on a rapid rise in temperature. It is used where smoke may be present as part of process or function but regard should be had to normal temperature of area where sited.

Radiation and ultraviolet detectors respond to distinctive flame flicker. It is suitable for large open areas and can detect certain chemical fires.

Laser beam detectors: rising hot air affects laser beam being projected onto receiver by obscuration or movement. It is suitable for covering large open areas but note that the receiver may be subject to building movement; beware of false alarms from falling objects or birds (Menzies, 1999).

4.8.12 Fire alarms

A fire safety system which will sound an alarm in the occurence of a building fire, triggered by a fire-detection system. The fire alarm system (manual or automatic) must be carefully chosen to meet specific needs – property or life safety; special needs of those with impaired hearing or sight; public entertainment application (possibly muted alarms) or a specific evacuation procedure (two stage/phase evacuation) (Menzies, 1999).

4.8.13 A manual system (gongs, handbells, etc)

This is only to be used in exceptional cases for very small buildings or specific areas. An automatic system in which an alarm of fire can be initiated automatically by the breaking of a call point or by a detector is the most common form. The complexity of the evacuation may require a message relayed through a public address system, initial alarms and alert signals, or the provision of fire telephones. Modern systems can be highly technical, incorporating computers and other data-processing equipment; specialist advice should be obtained at an early stage in any design (Menzies, 1999).

5.0 SITE AND ENVIRONMENTAL ANALYSIS, PROJECT ANALYSIS AND DESIGN SYNTHESIS

5.1 PROJECT TOWN

5.1.1 GENERAL INFORMATION

Ondo is one of the eighteen (18) Local Government Headquarters in Ondo State, Nigeria. As at the 2006 census, it has a population of about 288,868 and covers a land area of about 950.8 sq km (Undata, 2006). The inhabitants of the Local Government Area are Yorubas and they speak Yoruba and Ondo dialect as the native language.

The Ondo people have always sustained their economy from two major occupations; farming and trading which incidentally correspond to a form of division of labour between the male and female. The male are farmers and the female are traders. The mainstay of the economy of Ondo town is agriculture. The two seasons of the year, dry seasons and rainy seasons corresponds with the planting and harvesting periods. Besides agriculture, the people also practice brass making. Today other modern professions such as carpentry, tailoring, driving, barbing, bricklaying etc. have replaced the initial profession of the people.

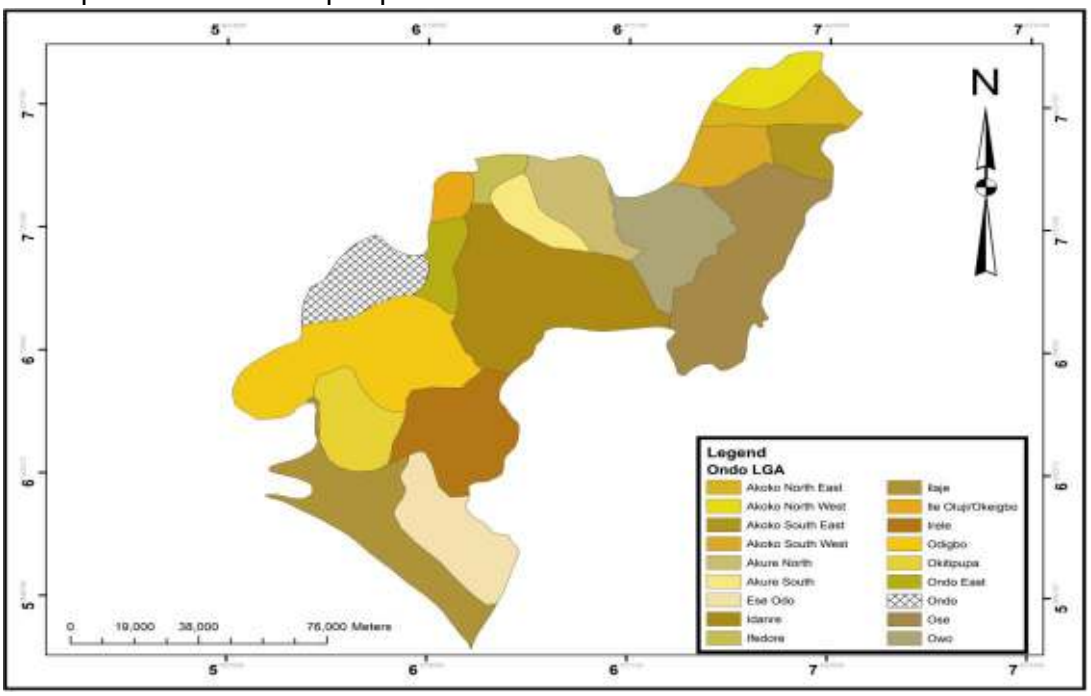


Figure 15: Map of Ondo State showing Local Government of interest in hatch

5.1.2 GEOGRAPHICAL LOCATION OF TOWN

Ondo lies in the humid tropic with tropical rain forest and south-east wind throughout most of the year. It lies on latitude $7^{o}6^{1}$ north and $4^{o}50^{1}$ east. It is bounded by Akure and Obokun Local Government Areas in the North, Ilaje/Esedo Local Government Areas in the south; in the East by the Owena River and Ifedore Local Government Area and in the west by the Ooni River. The land is low-lying in the south and borders on the creek area of Ilaje/Eseodo but rises gradually towards the North.

Ondo is situated on the central zone of the agro ecological zone of Ondo state. The town lies on the average altitude of between 533m – 583m above sea level and drain into various valleys to the east and south of the town. Ondo has unique nature as characterized by hilly terrain steep slope to the east and south of the town.

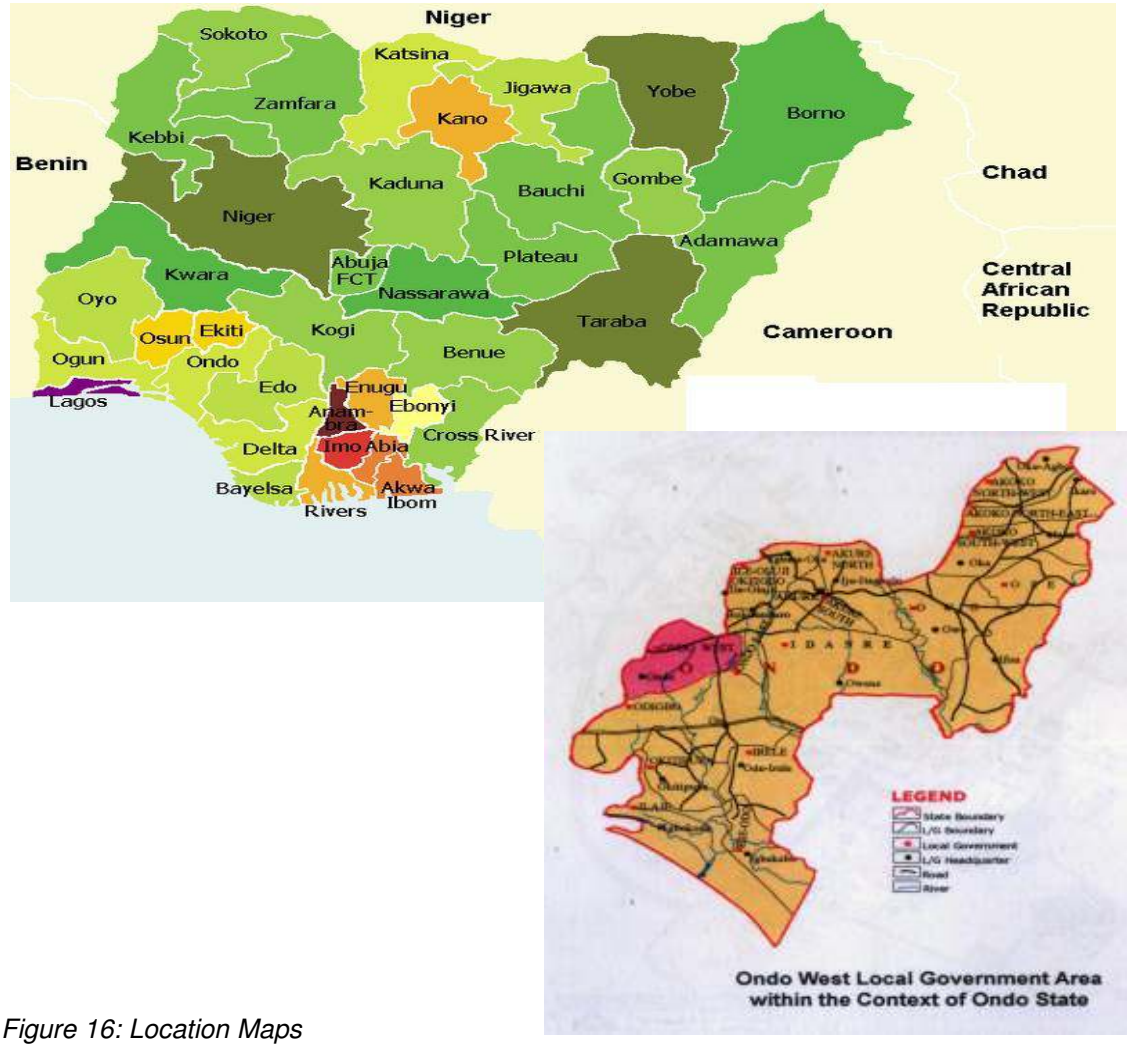


Figure 16: Location Maps

5.1.3 CLIMATIC CONDITIONS OF THE TOWN

The climatic condition of Ondo follows the pattern of south-western Nigeria with high temperatures and high humidity. Ondo town falls within the humid tropical region, the annual rainfall is about 1651mm there are two distinct seasons, the wet and dry season. The wet season covers about eight (8) months from March to October and the dry season is experienced for about four (4) months from November to February.

Climate is one of the most important factors in the crops environment as it sets broad limit for crop productions. Any given seed perform best at certain climatic limit exemplified by such factors such as cardinal temperature, optimum water use day length and relative humidity and requirement of these parameters by plant differs depending on crop type and variety.

1. Temperature

The temperature of the area ranges from 21^{o}C to 26^{o}C. The average annual is 26.5^{o}C. The hottest month is February while the coolest is August.

Table 13: Temperature Analysis of the area.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Max.	33.2	34.9	34.7	32.0	31.3	29.8	28.5	27.6	28.8	30.5	32.5	33.2
Mean Min.	19.1	20.5	22.7	22.6	22.3	21.3	21.5	21.2	21.4	21.7	22.2	19.6
Mean Range	14.1	14.4	12.0	9.4	9.0	7.5	7.0	6.4	7.4	8.8	10.3	13.6

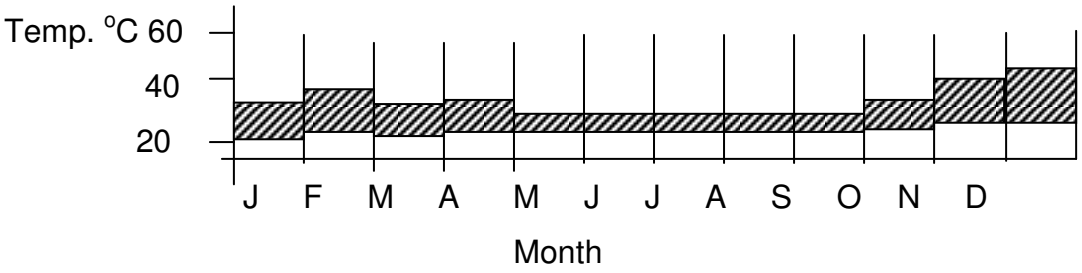


Figure 17: Temperature Analysis of the area.

Source: Nigeria Airport Authority Meteorological Station Akure (2005).

2. Rainfall

There are two distinct seasons, the rainy and dry seasons. Rainfall begins usually around March/April and reaches maximum around June decreasing thereafter till September or October when it ends. The annual rainfall is about 200mm per year with dry season that is not completely dry during the months of November to March as occasional rain falls within these months. This is responsible for its dense evergreen rain forest.

3. Relative Humidity

The humidity is relatively high with a mean annual relative humidity of about 80 percent. This relative humidity varies from season to season.

4. Vegetation

The vegetation of the area is of the high forest zone of the rain forest. It is comprised of many varieties of hardwood timber.

5. Soil

The soil is made up of ferruginous tropical soils and has an exceptional clayey textures; combined good drainage and aeration with good properties of moisture and nutrient retention.

6. Wind

There are two major prevailing winds in the area. The South-West trade wind (tropical marine air mass) which is warm, moist and more inland generally in South West to North East direction. The North East trade wind (continental

air mass) is hot, dry and blows in the North East towards the South West direction. The oscillation between the two major air masses produces the seasonal characteristics of weather in the state.

7. RELIEF AND DRAINAGE

The relief of the area is generally undulating rolling landscape with an average elevation of about 500-600 metres above sea level. However the area is dotted in some about 100 metres above sea level, there are some by ones like the Dumule Hill. The low surface decends gradually from the northern direction southward, the main river therefore flow from the northern highlands towards the sea to the south.

The area is drained by some rivers most of which are in the daily middle stages. The most prominent rivers that flow through the area take their source from places outside Ondo town. These rivers include river Mode and its tributary, river Yemeja, river Agbonjugbaro which flows from the north eastern part of the town, the Ashara and Olomitutu could be found in the eastern part of the town. Also in the southern part of the town, the following Rivers pattern the area; these include River Agore, the Egbeda, and Elemuyaju in the south eastern part of the town.

One other significant river that patterns Ondo town is the well distinct and prominent River Lisaluwa which flows from some twenty-five kilometres away from the town. This river is so distinct in the sense that, it is the only prominent river that flows in the area and almost divides the town in equal parts. The river flows right from the western part of the town and makes its way through some major part of the town.

5.2 JUSTIFICATION FOR PROJECT SELECTION

Nigeria is one of the nations that need to bridge the gap between her and other educationally developed nations.

The government has good intention in advancing education and teaching and the institution was established to professionalize the teaching profession and

also cater for the envisioned increase in the number of students in the existing secondary school.

Bearing in mind the above and the mission statement of the college, creating a conducive atmosphere where teaching, learning, research and community activities can take place, there is need to accommodate almost all students for a model of excellence in teaching and good academic performance along with other benefits attached to hostels in the college. Hostel will enhance a unique learning and social environment for students.

5.2.1 LOCATIONAL PLAN

Adeyemi Federal University of Education is located in Ondo in the Central Senatorial District of Ondo State of Nigeria which is situated between latitudes $5^{o}45^{1}$ and $7^{o}52^{1}$N and $4^{o}20^{1}$ and $6^{0}05^{1}$E. It is bounded on the east by Edo and Delta States, on the West by Ogun and Osun States, on the North by Ekiti and Kogi States and on the south by the Bight of Benin and the Atlantic Ocean. The college covers an area of hectares.

Figure 18: Master Plan of Adeyemi University of Education

1. Site Location Criteria

The site is located in the existing student residential area and will make a positive contribution to the built environment. It will enhance the integration of students into a wider community. Other reasons for the choice of site for the hostel are due to considerations such as:

i. Land form and natural setting compatible with intended use.

ii. Access to basic infrastructure

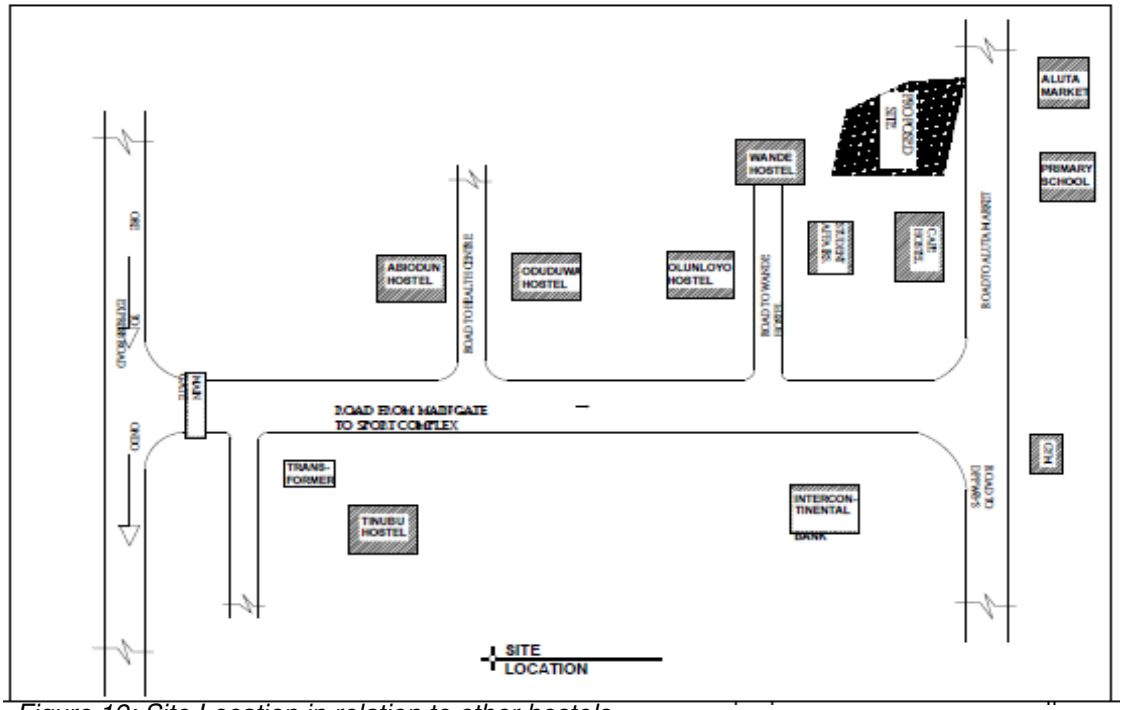


Figure 19: Site Location in relation to other hostels

2. Site Selection Criteria

A site selected for a project must satisfy basic requirements for the project to be successful. To this effect, a criterion is set to determine from site alternatives, the one best suited for the project. This helps to reduce cost, improves functionality and feasibility of the project.

Some of the factors to be considered include utilities, social amenities plus the physical and climate nature of the site. They include:

- Location
- Accessibility
- Topography
- Public services
- Expansion potential

3. Site Description:

The site is located at the southern part by the cafeteria hostel, the North by the Wande Hostel, the East by a stream and the Union Buildings, and by the West by the Access Road.

4. Site Analysis/Inventories

The site analysis and inventories as shown in Figure 20 includes the sun and shade, dry and wet areas, soil type, views, wind direction, circulation routes, spatial dimensions, architectural feature and existing facilities and services. This will help to determine the orientation of the building, functional requirements of space and the aesthetic desire of the users.

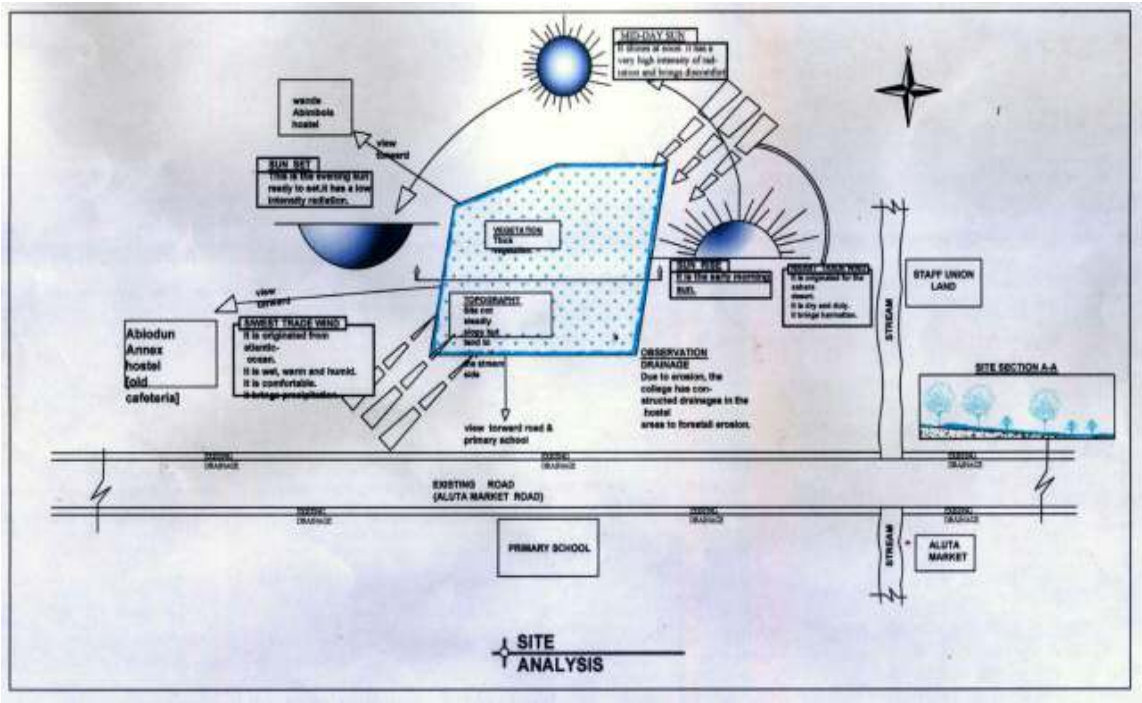


Figure 20: Site Analysis

5.3 DESIGN CRITERIA

The design criteria for the students' hostel were based mainly on the following:

1. **Environmental Control**:

a. Wide window in the building for natural light and ventilation.

b. Enclosed building form which creates courtyard as place for resting and communal activity.

c. Wide escape fire doors to enhance fire safety

2. **Economical Consideratio**n

a. Use of bricks which is locally produced building material as external facing in other to reduce maintenance cost of repainting.

b. Limiting the design to three stories only to avoid the use of lifts.

3. **Physical Consideration**:

Based on the physical characteristics of site, the following are considered:

a. **Building Orientation**: This is so to determine the user comfort in the hostel design. It will facilitate effective ventilation and natural lighting in the rooms.

b. **Circulation**: Easy movement from one space to another and in this case to the fire exit is considered.

c. **Zoning**: The zoning carried out in the students' hostel design includes residence zone (sleeping area), commercial zone (shops), recreational zone, communal zone, administrative zone (offices).

d. **Accessibility**: Easy accessibility of both vehicular and pedestrian user is also considered.

5.4 FUNCTIONAL AND SPATIAL CRITERIA

5.4.1 FUNCTIONAL REQUIREMENT

The hostel design is divided into the following spaces based on the function: administrative area, residential area, commercial area, recreational area, communal area.

a. **Administrative Area:**

1. Porter's Office
2. Porter's room
3. Hall adviser's office
4. Cleaner's room
5. Convenience
6. Security area

b. **Residential Area:**

1. Sleeping rooms (double bunks)
2. Inbuilt wardrobes
3. WC/Shower
4. Laundry
5. Reading room
6. Store

c. **Commercial Area**

1. Buttery

2. Salon

3. Cafeteria

4. Supermarket

d. **Recreational area**

1. Indoor sports

2. Outdoor sports

3. Sit-out

4. Fountain

e. **Communal Area**

1. Common rooms

2. Waste Storage

3. W.C

4. Internet area

5. Store

5.4.2 OTHER REQUIREMENTS

i. **Entrance/Exits**

Multiple entrances into the building is expedient and should be well defined. Escape stairs and fire exit must be provided. The fire exits should be easily accessible to aid fire safety.

ii. **Vision**

Where possible, the building should be free of vision obstructing columns.

iii. **Ventilation**

The hostel needs proper ventilation and students' comfort is also expedient.

iv. **Furniture, Fixtures and Equipment**

The furniture, fixtures and equipments must be designed and installed to support flexible arrangement hence it should be movable and durable and it should be such that will enhance fire safety.

5.5 STRUCTURE AND MATERIALS

Structural System: The structural system is the post and beam system. The beam transfers the load from the structure to the posts, which then transfer it to the foundation. The roof structure is steel trusses, pitched and covered with corrugated aluminium roofing sheets. Roof gutters are used.

Building Materials and Construction

There are certain functional requirements a hostel facility structure should possess. Choice of building materials for this facility shall be made reference to:

1. Fire safety requirements including the behaviour of various building materials when exposed to heat from fire.

2. Durability and strength of such building materials including their behaviour under loads and their rate of deterioration.

3. Aesthetics which shall be achieved by the use of attractive and lively finishing materials.

Construction techniques will be simple and based on standardization of building elements so as to encourage cost control through:

1. The reduction of waste of building materials

2. Mass procuring of such elements like doors, windows etc.

To achieve this, a regular interval of structural elements (columns and beams) may be maintained.

Floors and Wall Finish

The floors will generally be composed of mass concrete of adequate thickness (150mm) as the over site concrete with hardcore filing beneath the mass concrete. Below are some floor finishes used:

Terrazzo Floor: To be used in most areas for durability.

Tiles: Tiles also play an important role in modern hostels. Of all floor coverings; vitreous tiles are most resistant to water and humidity and they are easy to clean. Glazed ceramic tiles will be used wherever highly sanitary conditions are required, such as toilets, floors and walls of kitchens and bathrooms.

Walls

Block work will be used in conjunction with reinforced concrete columns. For each fire compartment the blocks will be filled with concrete to increase its resistance to fire and also reduce the spread. The walls of the kitchen will be of block work. Laundry walls and work tops will be tiled too. Facial bricks will be introduced to give the homely look required and also to reduce cost of repainting the external.

Ceiling Materials

A good ceiling material for a hostel must be durable, easily cleaned, of acceptable fire rating and acoustically acceptable. Plaster or acoustic tiles are to be used in corridors to reduce the noise generated by traffic. The acoustic materials and its wrappings must be those that are non-combustible. Cellotex ceiling boards will be used.

Roofing Materials

The roofing structure will be of steel lattice trusses, while the roof covering will be of aluminium long span roofing sheets held on to “z” purlins. This steel structure is recommended because of its high resistance to fire.

Paints

Certain things have to be considered while choosing for a hostel facility. They are:

1. The ease of cleaning

2. The paints must be psychologically reassuring

3. The paint must be non-combustible

4. It must be durable.

An inference from studies shows that a hostel facility should be painted in colours that produce a cheerful, reassuring, relieving and warm environment. Latex paint is a better alternative to gloss paint as gloss generates a lot of heat. Emulsion paints are to be used in rooms and laundry.

Doors and Windows

Hostel facility doors should possess the following qualities:

1. The doors must be easily operated.

2. Escape doors must be wide enough and capable of aiding escape in case of emergency. Escape doors will open in the direction of escape.

So generally, flush and metal doors, glass panels in aluminium frames will be used throughout. The fire exit doors and escape doors must be doors made with fire ratings to aid escape from the building casement window. Windows shall be louver blade windows and projected aluminium windows.

Others:

Landscaping elements are done with trees, shrubs, while walkways are done with precast concrete slabs and interlocks.

All the materials used will be chosen not only for their appropriateness to the locality, but also for their durability. It is the intention of this project to use good quality, traditional materials detailed for minimum maintenance and high fire safety.

5.6 SERVICES

a. Power Supply

The main source of power supply to the proposed building will be from the schools' PHCN. Due to the fluctuation in power from PHCN, it will be connected to the university independent power source to cater for the requirements of the hostel.

b. Piped Services (Water)

The main supply of water is borehole. Consequently, underground and overhead tanks are provided for adequate water storage and use in time of water shortage on campus. This will help in fighting fire in case of any outbreak. Waste water is to be channelled to the soak away while surface water is to be channelled into the College's storm water drainage. The areas in the structure that need water and waste piped service have been grouped together to ease distribution and evacuation respectively.

c. Conveniences

Conveniences have been provided in each of the compartments in order to enhance a high degree of privacy. They are provided at other service areas and convenient points within the structure.

d. **Refuse Disposal**

A covered refuse disposal unit equipped with easy evacuation feature will be provided for the kitchen and rooms. The main disposal unit will be positioned close to the service yard for easy evacuation. Proper refuse disposal is important to the hostel as improper handling of waste aid fire in any outbreak.

e. **Fire Fighting System**

These will be hose-reels situated in the lobby spaces and staircases areas of each compartment. Fire alarm points will be provided in various places with easy access and control. Smoke detectors are provided for in all the room except for the kitchen where heat detectors are installed. Adequate escape route will be provided for evacuation of people in case of any emergency. The design of the building will be done in compartments to limit the spread. Service routes have been provided to allow for movement close to the building by fire fighters in the event of fire outbreak.

5.7 DESIGN SYNTHESIS

5.7.1 SITE CONCEPT

The concept consideration for the site is organization of design elements of regular shapes of squares, rectangle and polygon flowing into each other on

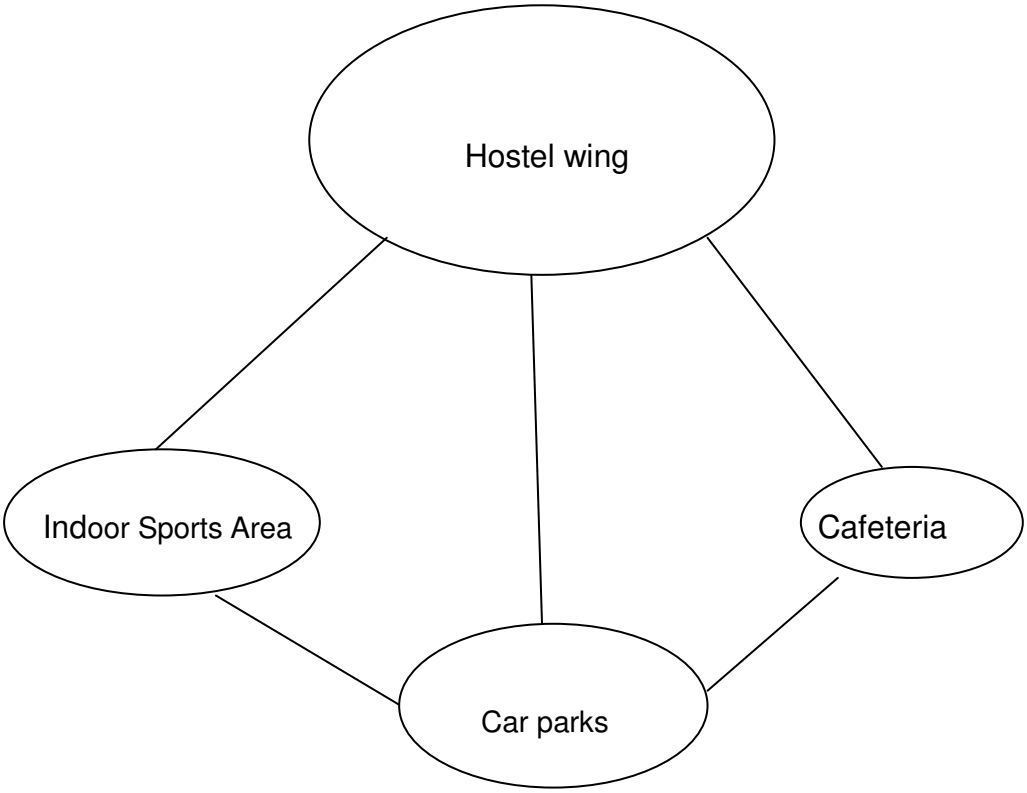


Figure 21: Site Bubble Diagram *Source: Researcher, 2015*

5.7.2 Design Concept

The design concept stems from the idea of a molecule. The American Heritage Dictionary (2011), states that a molecule is a group of like or different atoms held together by chemical forces. The hostel design is seen as a collection of students coming together to live in the same hostel as well as having different wings or compartments linked together to form one facility. In terms of fire safety, the different compartment likened to different atoms is linked together to form a building unit. The bond or link is the social interaction of the students which is achieved through circular function and form.

5.7.3 Evolution of Concept

The concept evolved from the following:

* Communal activity helps to define concept. In this case, people from all walk of life come together to interact within a space.

* The mid-point represents a point of interaction between people from different ethnic groups coming together in one fold. It symbolizes a place of rest.

* The building units are wrapped around the communal space.

* The communal space represents a point of interaction and community.

* The bond between the building units and communal spaces create a feeling of intimacy, protection and security as well as defining the residential territorial boundaries.

* The entire composition reinforces UNITY by strong special interaction.

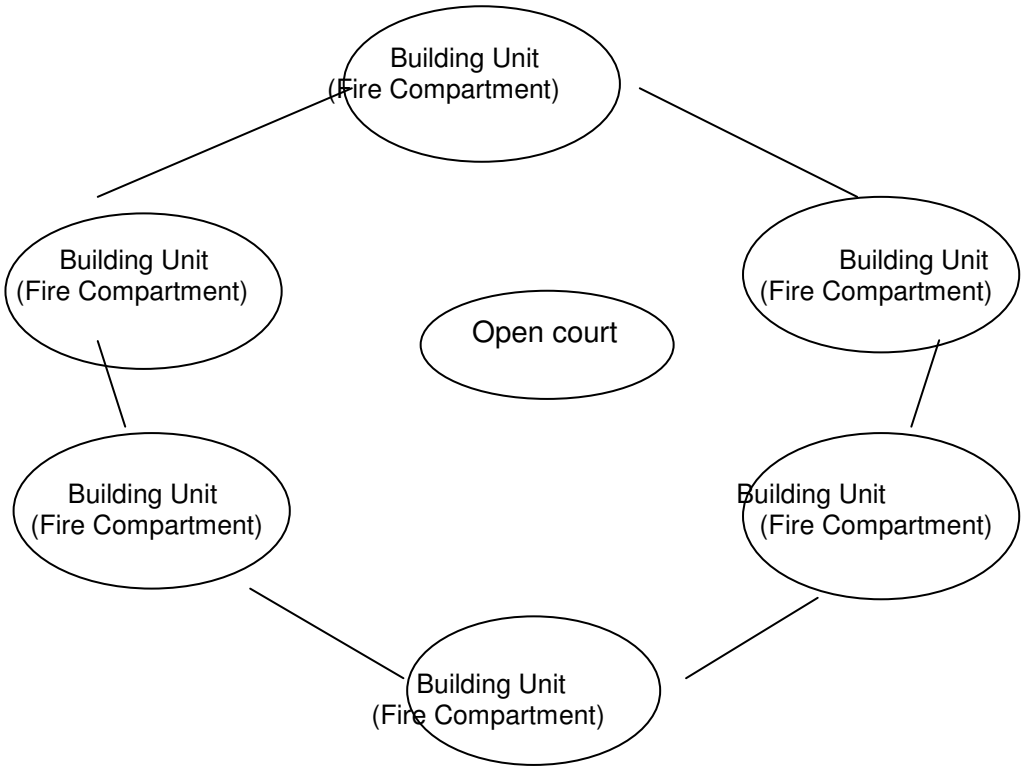


Figure 22: Evolution concept *Source: Researcher, 2015*

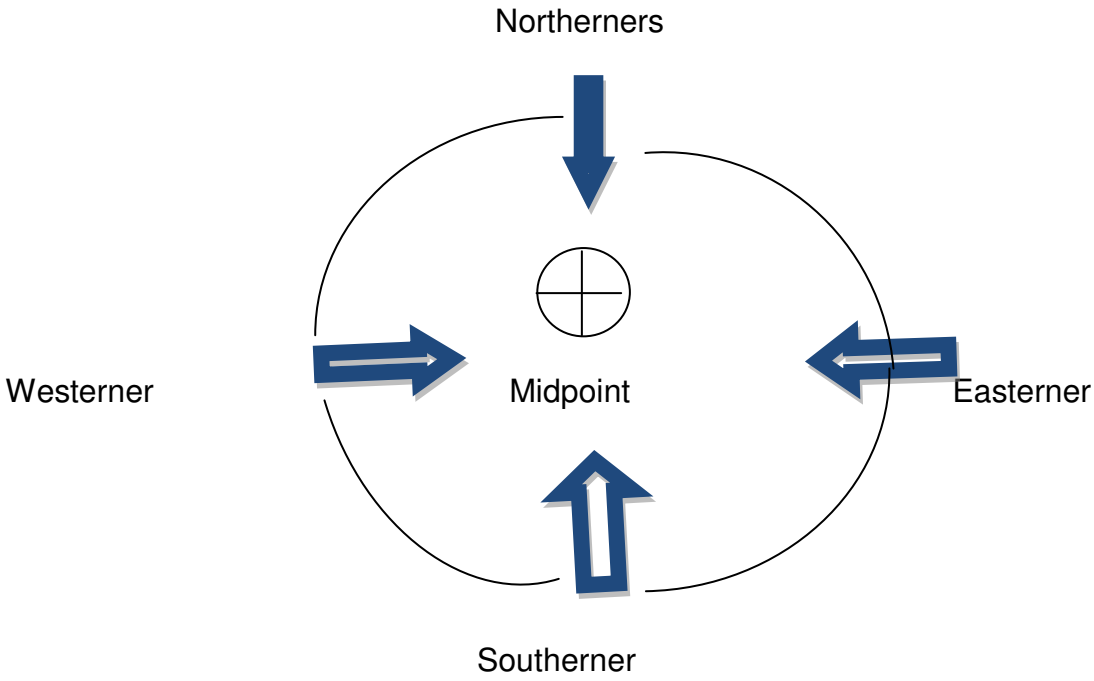


Figure 23: Evolution of Concept *Source: Researcher, 2015*

5.8 SCHEDULE OF ACCOMODATION

Table 14: Schedule of accommodation for the Hostel

S/N	SPACE	NO	DIMENSION (mm)	AREA (mm^2)
A	**SLEEPING AREA**			
1	Bedroom	100	4800 x 5400	25, 920, 000
2	Reading room	20	4800 x 6825	32, 728, 764
3	Laundry	20	4050 x 7050	28, 552, 500
4	Fire exit	20	3225 x 6825	22, 010, 625
5	WC	100	900 x 1800	1, 620, 000
6	Bath	100	900 x 1800	1, 620, 000
7	Lobby 1	40	1200 x 7500	9, 000, 000
8	Lobby 2	20	1200 x 5400	6, 480, 000
9	Terrace	100	1200 x 4800	5, 760, 000
10	Corridor	100	1800 x 22575	40, 635, 000
11	Store	20	3225 x 6825	22, 010, 625
B	**KITCHEN**			
1	Kitchen	4	13050 x 14850	193, 792, 500

2	Fire exit	4	3225 x 6825	22, 010, 625
3	Terrace	8	1200 x 14850	17, 820, 000
C	**COMMON ROOM**			
1	Common room	4	13050 x 14850	193, 792, 500
2	Terrace	4	1200 x 14850	22, 010, 625
3	Fire exit	8	3225 x 6825	17, 820, 000
D	**PORTERS' WING**			
1	Porters' office	1	4275 x 4725	20, 199, 375
2	Porters' room	1	4275 x 4725	20, 199, 375
3	Hall adviser's office	2	4275 x 4725	20, 199, 375
4	Cleaners' room	1	2025 x 4725	9, 568, 125
5	Bath	1	900 x 2400	2, 160, 000
6	WC	1	900 x 2400	2, 160, 000
7	Lobby	1	2025 x 2100	4, 252, 500
8	Shop	1	4275 x 4725	20, 199, 375
9	Entrance lobby	1	1800 x 6000	10, 800,000
10	Hallway	1	6000 x 11550	69, 300, 000

CHAPTER SIX

6.0 SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1 SUMMARY OF FINDINGS

According to Ubong (2007), accommodation of students in school halls of the tertiary institutions in Nigeria has become a topical issue. The tertiary institutions are expanding but minimal attention is being given to housing the growing number of students being admitted. Students housing and the adequate provision of it should be topical interest to all both the public and private sectors especially for students just gaining admission into the schools.

In Nigeria, the Federal Fire Service is in charge of fire issues but there is no clear cut policies concerning fire safety in Nigeria. From study, it was discovered that nationality and internationally student hostels have been prone to fire outbreaks. These outbreaks have recorded loss of lives, properties and sometimes total consumption of the whole building. Students' hostel is a place of large population and therefore fire outbreaks can be disastrous. Factors that aid fire outbreaks in hostels are sometimes premised on the design choices matters. Fire safe design entails proper understanding of how fire starts, what aids the fire, design choices that can reduce fire outbreaks or the spread and blending this information accordingly to come up with a design solution.

6.2 RECOMMENATIONS

1. The Nigerian Universities Commission (NUC) should as a matter of need incorporate into its guidelines, policies that would encourage the design of fire safety in hostels so as to safeguard the lives and properties of Nigerian students. It would also enhance the longerity of the hostel building.

2. The school authorities should set up committee comprising of students, academic and non academic staff as well as the Physical Planning Unit

through which fire safety policies can be designed for the institution. This will be the user participation.

3. Fire safety orientation should be organized for new students and older students periodically.

4. The institution should have a fire station constructed in the school.

5. The buildings and buildings should be designed and constructed such that the residences are in residential clusters to form fire compartment and are arranged such that access is available for fire services. Also the design must be such that fire exits are incorporated.

6. The Architect who designs and specifies materials and finishes should as a matter of fact avoid structural elements of the building (walls, floors, roofs, ceilings, beams etc) and finishes being potential fuel sources as they must remain in place both for structural stability and to contain fire. Also potential fire fuels like heap of waste must be avoided around the buildings.

7. The building must be designed and constructed such that the disabled can easily escape or be rescued in times of fire.

8. For fire safety, the management responsibilities and user responsibilities must be clearly defined. Also management should provide fire safe alarms and equipment and train the users on how to use them.

9. Fire exits must be clearly defined.

6.3 CONCLUSION

The student population is rapidly growing while the hostels provided are declining or not even available in supply. This has given birth to overcrowding in the available hostels. Overcrowding in residences is one of the ways in which fire outbreaks can occur.

In responding to the inherent problems associated with fire in hostel buildings, the analysis of case studies were done and positive attributes were employed in the design to enhance five safety in the hostel.

In relation to the building, the architecture is such that fire safety has been enhanced through the design of fire compartment to minimize the spread of fire in case of any outbreak while fire exits and staircases has been designed for those above the ground floors.

All users of the structure were considered especially the disabled and ramps were designed in entrances and exits also rooms in the ground floors are to be given to disabled where need be especially rooms nearer to fire exits. By designing fire safe buildings and providing fire alert and fire fighting equipment in the building, prevention of fire ignition, alert to occupants about outbreak, means of escape and limit of fire through proper use of material and construction method will enhance the safety of the occupants, fire fighters and the building.

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APPENDIX