INTEGRATION OF PASSIVE FIRE PROTECTION MEASURES IN THE DESIGN OF A SHOPPING MALL IN ABUJA, NIGERIA

BY

NINALOWO, Raphael Oluwasegun

MTech/SET/2018/8640

DEPARTMENT OF ARCHITECTURE,

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA

MARCH, 2023

INTEGRATION OF PASSIVE FIRE PROTECTION MEASURES IN THE DESIGN OF A SHOPPING MALL IN ABUJA, NIGERIA

BY

NINALOWO, Raphael Oluwasegun

MTech/SET/2018/8640

A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF TECHNOLOGY IN ARCHITECTURE

MARCH, 2023

DECLARATION

I hereby declare that this thesis titled: Integration of Passive Fire Protection Measures in the Design of a Shopping Mall in Abuja, Nigeria is a collection of my original research work and it has not been presented for any other qualification anywhere. Information from other sources (published or unpublished) has been duly acknowledged.

_____ _____

NINALOWO RAPHAEL OLUWASEGUN SIGNATURE/DATE

MTech/SET/2018/8640

FEDERAL UNIVERSITY OF TECHNOLOGY

MINNA, NIGERIA

CERTIFICATION

The thesis titled: “Integration of Passive Fire Protection Measures in the Design of a Shopping Mall in Abuja, Nigeria” by Ninalowo, Raphael Oluwasegun (MTech/SET/2018/8640) meets the regulations governing the award of the degree of Master of Technology (MTech) of the Federal University of Technology, Minna and it is approved for its contribution to scientific knowledge and literary presentation.

_____

Prof. (Mrs) S.N. Zubairu — Signature & Date
SUPERVISOR

_____

Dr. A.D Isah — Signature & Date
HEAD OF DEPARTMENT

_____

Prof. O.A. Kemiki — Signature & Date
DEAN, SET

_____

Engr. (Prof.) O.K. Abubakre — Signature & Date
DEAN OF POST GRADUATE
SCHOOL

ACKNOWLEDGEMENTS

I will like to acknowledge first and foremost the Almighty God for His love, protection provision, and divine guidance over my life from the beginning of this programme till now.

My profound gratitude goes to my mentor Prof. (Mrs.) S.N. Zubairu, the Dean of the School of Environmental Technology Prof. R.E Olagunju, the Head of Department of Architecture Dr. A.D Isah, and all other lecturers in the Department of Architecture for their immense contributions to this thesis.

My big praise and thanks go to my Parents Mr. and Mrs. Olarenwaju Jacob Ninalowo. My siblings, Mrs.Temitope Oguntola, Mrs Yemi Joel, Mr. Ninalowo Samuel and Mr. Ninalowo Odunayo. my lovely aunty, Alhaja Bashirat Ninalowo and my friend, Alade Priscilla for their invaluable contributions to this project. I could not have done it without you all. And also many thanks go to my closest friends and all my course mates who contributed in one way or the other to the success of this work.

ABSTRACT

Shopping malls are fundamentally large complex buildings occupied by considerable numbers of the general public and shop staff. These buildings must be planned to be safe and in the event of an emergency or fire, allow for fast and safe evacuation from the building by all its occupants. In the design of shopping malls, fire safety is one of the most important and complex considerations. Fire safety requirements will be more onerous for enclosed and covered shopping malls than for open street based schemes. Shopping malls are characterised with various combustible materials from the merchandise they sell. This study assessed the passive fire safety measures in shopping malls and how they are incorporated in shopping mall design. Descriptive method was employed for the assessment of this research. The first phase of the research included desk study of relevant literatures or materials on shopping mall design as a whole including the fire safety measures as it applies to it. This phase brought about the deduction of variables as; types of building materias, availability of fire control equipment, building construction and regulation and site design and layout. Data was collected with the use of an observation schedule after selecting samples using a purposeful sampling procedure. Four case studies were carried out both locally and internationally which are: Silverbird Galleria, Abuja**,** Ceddi Plaza, Abuja, Willow Shopping Mall, Townsville, Australia, and Bullring Shopping Mall, Birmingham and the deduced variables were carefully observed across them. The findings from the case studies showed that both passive and active fire safety measures should be employed in shopping mall design, the level of importance given to the usage of fireproof building materials in Nigeria shopping mall is low, taking less than 50% remarks. The findings also showed that active fire protection measures had the highest level of consideration in shopping malls. The survey revealed that regular routine check of fire safety elements is paramount. Some of the recommendations include; providing a simple evacuation plan in each floor of the building and placing exit and movement signage at key locations around the shopping mall to assist consumers and tenants in the case of an emergency.

TABLE OF CONTENTS

CHAPTER TWO

LIST OF TABLES

TABLE **PAGE**

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Shopping is a common and necessary part of living in cities. The requirement for a well-organised shopping mall is becoming increasingly important in today's culture. In the event of an emergency or a fire disaster, all buildings must be secure and allow for prompt and safe evacuation of all residents (Peter, 2006)

When it comes to planning public buildings, fire safety is one of the most important and difficult considerations. Shopping malls, like other shopping centre, bear a large amount of public liability for a variety of risks, ranging from accidents and trips to the risk of fire. From a fire safety standpoint, shopping malls are often the most complicated of retail complexes, necessitating a fire alarm system capable of coordinating active systems such as zonal sprinklers, smoke detectors, auxiliary power sources, emergency lighting, and human control centers (David, 2006).

Nigeria has seen a large increase in shopping activity due to its comparative advantages in terms of geography, administrative, economic, and other functional variables (Oladokun, 2010). Nigeria's retail business is expanding, with the industry anticipating roughly 200,000 square meters of real estate space, because of demography, increasing urbanization, developing shopping culture, and a growing middle class (Odinaka, 2014). The expansion of the Nigerian retail market reflects the growing sophistication of the Nigerian middle class, whose shopping preferences have shifted from open market purchasing to a more organized and easy shopping experience given by shopping malls (Odinaka, 2014). Customers must feel protected in order to have a pleasant shopping experience, especially in the event of a fire. This can be done by equipping malls with both active and passive fire-safety measures.

1.2 Statement of Research Problem

While sufficient safety and security, including fire safety measures, are necessary for enjoying a risk-free retail environment, they remain the most ignored concern in terms of whole urban development (Barry, 2012). Shopping malls are linked to a variety of combustible materials from the merchandise they sell and the building materials themselves (Peter, 2006). As a public facility, each shopping mall must be safe for human use. Fire safety precautions must be taken into account from the beginning of the conceptual shopping mall design to the conclusion. In Nigeria, shopping malls rely on fire fighters to extinguish fire rather than adopting fire safety measures in the design of malls and extinguishing from the fire safety instruments in the shopping mall. This act has led to fire outbreaks in some commercial centres in Nigeria (Table 1.0) as most of these shopping malls were not properly designed against fire outbreak and do not have adequate fire safety equipment (NEMA, 2015). This occurrence has been a concern for society, and as a result, the demand for active and passive fire control equipment in shopping malls is becoming a requirement (Odinaka, 2014).

Table 1.1 Fire Outbreak in Shopping Malls in Nigeria

S/N	Date of Incident	Name of Mall	Location
1	17th Dec. 2014	Woji Shopping Centre	Port Harcourt, Rivers state
2	19th Dec. 2014	Ahoada Shopping Centre	Ahoada, Rivers state
3	10th May 2015	Ijora Commercial Centre	Ijora Olopa, Lagos state
4	25th July 2015	Ibereko Shopping Centre	Badagry, Lagos state
5	6th March 2015	Iponri Shopping Complex	Surulere, Lagos state
6	10th Feb. 2015	Bauchi Shopping Complex	Bauchi, Bauchi state
7	20th Jan. 2013	Ikeja City Mall	Ikeja, Lagos state
8	25th June. 2014	Abuja Shopping Mall	Wuse, Abuja
9	28th March 2014	Shagari Plaza	Garki, Abuja
10	10th Jan. 2015	Heritage Mall	Ibadan, Oyo state

Source: National Emergency Management Agency, (2015)

1.3 Aim and Objectives

1.3.1 Aim of the study

The aim of this study is to assess the passive fire protection measures in shopping malls with the goal of integrating them into shopping mall design.

1.3.2 Objectives of the study

The objective of this study is to:

i. Investigate the causes and consequences of fires in shopping malls.

ii. Determine the appropriate passive fire protection measures that can be taken to ensure safety in shopping malls.

iii. To integrate the best fire safety and evacuation strategies for shopping malls design in Abuja.

1.4 Justification of the Study

The study will seek to identify the key issues that can be used by designers in designing a safe shopping environment through the use of passive fire safety measures. This will serve as guide towards achieving comfortable and hazard free shopping environment in Nigeria. This research will also aid in increasing the shopping activities in shopping malls than in open air market because of adequate safety that will be achieved.

1.5 Scope of Study

The scope of this study is confined to identifying fire-safety precautions at shopping malls, particularly in Abuja. Designers are helped in creating the passive fire safety measures which includes building compartmentalization, provision of evacuation routes, uses of non-

combustible building materials and other active fire safety measures to safeguard lives and property.

1.6 Study Area

Abuja is located between 8 ° 25 and 9 ° 20 "latitudes north of the equator and 6 ° 45 and 7 ° 30 lengths east of the Greenwich meridian in the Nigerian savannah park. The city of Abuja has an area of 8000 square kilometers. It is bordered on the north by the state of Kaduna, on the east and southeast by the state of Nassarawa, on the southwest by the state of Kogi, and on the west by the state of Niger.

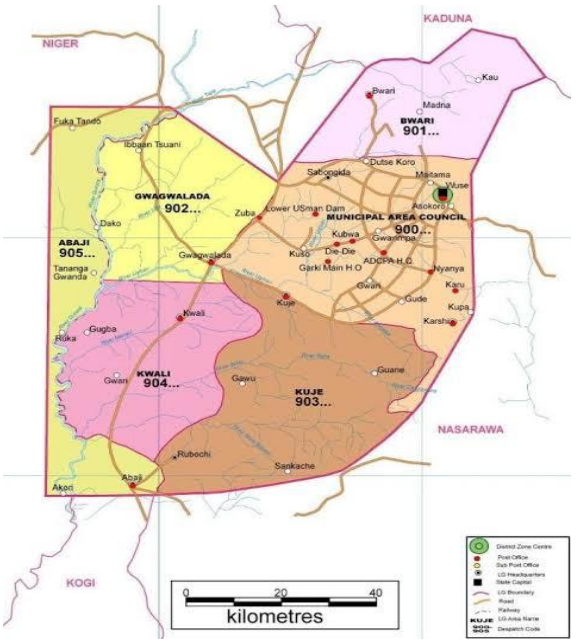


Figure 1.1: Map of Abuja.

Source: Adebowale, (2010).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Concepts of Fire

When a flammable and/or combustible material is exposed to a source of heat or ambient temperature above the flash point for the fuel / oxidizer mixture and is capable of sustaining a rapid oxidation rate that prods combustion, a fire is started (John, 2014).

2.1.1 Fire Triangle

Fire is a chemical process that occurs when three components are present:

i. Oxygen: When oxygen in the air is mixed with flammable vapours emitted by fuels, it generates a source of heat at the molecular level. Then it may explode due to an ignition source such as a match or spark. (Figures 2.1 and 2.2).

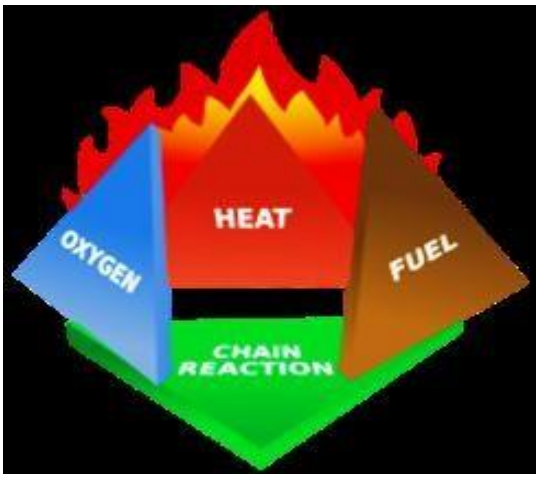


Figure 2.1: Fire tetrahedron.

Figure: 2.2: Fire triangle

Source: John, (2014).

ii. Heat: When combustible vapors are mixed with air (oxygen) and ignited by a flame-spark, combustion occurs. The flames or sparks might emanate from a variety of places. The temperature at which a material becomes a vapor and at which vapors burn (when the temperature is hot enough, vapors will become self-igniting).

iii Fuel: For a spark, it might be solid, liquid, or gas. Which fire extinguishing system should be used depends on the kind and consistency of the fuel.

2.2 Causes of Fire in Shopping Malls

Shopping mall fires are becoming increasingly common. These figures point to the necessity to determine the sources and causes of building fires in order to improve control methods. According to Saniya and Sabir (2014), most fires in multi-story retail malls are caused by electrical and mechanical system failures.

2.2.1 The Major Causes of Shopping Mall Fires

A. Fire Caused by Electrical Equipment

i. Electrical appliances might become partially or fully faulty as a result of overloading that has occurred.

ii. Fires can also start when filament lights get too hot. It is possible that the lamp will ignite if it is placed near a highly flammable item.

iii. Ignition of flammable liquids and gases by electrical energy from leaking of pipes and ducts, etc.

iv. Faulty or poorly built and operated electrical and heating equipment and facilities

B. Fires Caused by Mechanical Factors

i. The most prevalent cause of mechanical device fire is friction caused by a lack of lubrication. When there is friction between mechanical equipment, it can generate sparks, which can lead to a fire.

ii. Mechanical equipment overheating, which can lead to a fire.

iii. Compression heat is the heat generated by the forced decrease of a gas volume. Diesel engines use this idea to ignite gasoline vapor without the use of a spark plug. (Saniya and Sabir, 2014).

2.2.2 Other (Minor) Fire Causes

i. Fraud Fire (Arson) The malicious burning or explosion of another's residence, or the burning of a structure inside the curtilage, or immediate surrounding area, of another's residence. In several places, the act of burning any insured house is done with the aim of defrauding the insurer.

ii. Careless delivery of ash and other trash.

iii. Many structures are at risk of fire (Saniya and Sabir, 2014)

2.3 Clasess of Fire

The type of fuel used in a fire determines its categorization. There are five types of fires.

2.3.1 “A” Class

Combustible items like wood, cloth, paper, and plastics ignite these fires. This type of fire burns with an ember, produces ash, and is best put out by removing the heat side of the

triangle. Extinguishers for Class "A" fires are identified by a triangle featuring the letter "A." If the triangle is color-coded, it will be green.

2.3.2 “B” Class

Flammable liquids, gasoline additives, coal greases, tars, fats, oil-based paints, solvents, lacquers, alcohols, and flammable gases all contribute to these fires. This type of fire burns on the surface of the fuel and is best extinguished by smothering or blanketing. This type of fire spreads quickly and may devour a big area in a short period of time.

Extinguishers suited for Class "B" fires will be classified by a square bearing the letter "B." If the square is color-coded, it will be red.

2.3.3 “C” class

Such fires occur in powered electrical equipment, where the electrical non-conductivity of the extinguishing medium is critical. It is critical to use a non-conductive extinguishing solution to cover or smother this sort of fire. A Class "C" explosion must never utilize water or water-containing chemicals. Extinguishers suited for Class "C" fires are designated with a circle bearing the letter "C." If the circle is color-coded, it is blue. Electrical fittings must be designed properly with circuit breakers and other safety measures to avoid fire dangers caused by electrical equipment.

2.3.4 “D” class

Fuel metals such as magnesium, titanium, zirconium, sodium, lithium, potassium, and others are used in such flames. DRY POWDER is the common name for the extinguishing agent. Such extinguishers will be identified by a star with the letter "D" on it. If the star is color-

coded, it is yellow. Construction materials that are combustible should be handled with caution.

2.3.5 “K” class

These are fires caused by fuel cooking medium in cooking equipment, such as vegetable or animal oils and fats. WET CHEMICAL is the name of the extinguishing agent. Such extinguishers will be labeled with the letter "K." Proper human behavior might help to reduce the risk of fire. Fats and vegetable oils should be kept away from heat sources and open fires.

2.4 Phases of Fire

The burning process is divided into distinct stages. Understanding the different phases can help a firefighter better comprehend the process of burning and combating a fire at different levels and with different tactics and equipment (or stages). Each process is characterized by differences in room temperature and air composition (or stage). It is critical to spread fire and control it through the use of building compartmentalization. (John, 2014)

2.4.1 Initiation phase (Growth phase)

The fire creates water vapour, carbon dioxide, perhaps a tiny quantity of sulfur dioxide, carbon monoxide, and other gases because the oxygen concentration in the air was not considerably decreased in the first stage. Some heat is created, and as the fire progresses, the quantity of heat produced rises. The fire may reach a combustible temperature of much above 5370C, although the ambient temperature may only rise little at this stage.

2.4.2 Burning phase with no restrictions (Fully developed)

All of the fire's free-burning actions are covered by the second burning step. During this process, oxygen-rich air is pulled into the flame as heat is transferred to the highest portions

of the restricted space via convection (heated gases ascending). The hot gasses disperse laterally from the top downwards, causing cooler air to seek lower levels and finally burning all flammable stuff in the upper chamber. One of the reasons firefighters are urged to stay low and utilize breathing apparatus is because of the hot air. The lungs may be searched with a breath of such super-heated air. At this time, the temperature in the higher areas can reach 7000°C. As the fire advances through the last phases of this process, it consumes more free oxygen until there is insufficient oxygen for the fuel to react. As a result, the fire is reduced to a smoldering state, requiring only an oxygen source to swiftly burn or erupt. (John, 2014)

2.4.3 Smouldering Phase (Decay Phase)

If the containment enclosure is airtight enough, flames can be extinguished in the third phase. In this scenario, burning is reduced to glowing embers. The air is totally packed with dense smoke and fumes to the point that it is put under pressure from all crevices. The fire will smolder, and the air will be dense with thick smoke and combustion gasses at temperatures far exceeding 5370C. The lighter fuel fractions, such as hydrogen and methane, will be evaporated from the room's fuel content due to the extreme heat. (John, 2014)

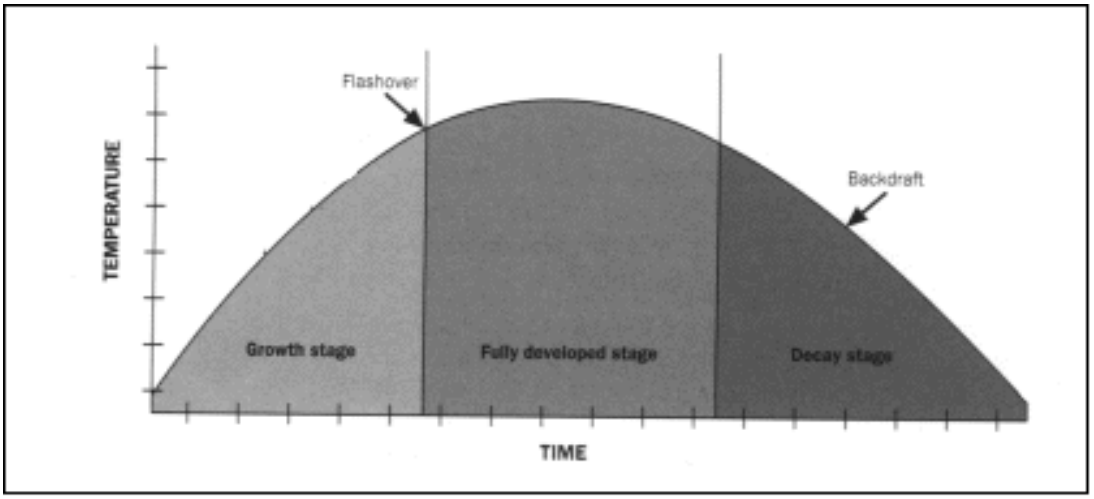


Figure 2.3: Time Temperature Curve.

Source: John, (2014).

2.5 Heat Transfer

Heat can spread throughout a burning structure by one or more of three methods: conduction, convection, or radiation. Because molecular action causes heat to exist within a substance, the higher the molecular activity, the hotter the material. The heat transmission process is governed by a number of natural physics principles.

The Heat Flow Law is one of them. This indicates that heat flows from a hot to a cold condition. The cooler of two bodies in touch will absorb heat until both things are the same temperature.

2.5.1 Conduction

Heat can be transferred from one body to another by direct contact or through the use of a heat-conducting medium. The amount of heat transmitted and the rate at which it moves is determined by the conductivity of the material through which it passes. Not all materials have the same thermal conductivity. Aluminium, copper, and iron are better conductors. Fibrous materials like felt, cloth, and paper are poor conductors. Because their molecules move, liquids and gases are poor heat conductors. Air is a poor conductor of electricity. Other solid materials, when chopped into fibers and packed into batts, provide effective insulation since the substance is a poor conductor and the batting contains air spaces. Figure 2.9 depicts a double-walled structure with extra insulation provided by an air gap (John, 2014).

Figure 2.4: Conduction of Heat

Source: John, (2014).

2.5.2 Convection

The distribution of heat via air or liquid movement is known as convection. When water is heated in a glass container, the movement inside the tank may be seen through the glass. When sawdust is added to the bath, the movement becomes more noticeable. The upward movement widens and becomes lighter as the water warms. Similarly, air near a steam radiator is heated via conduction. It is growing, becoming lighter, and ascending. Lower layers of cooler air take the place of the hot air as it goes higher. When liquids and gases are heated, they start to move around inside their own bodies. In a home, heated air rises and spreads. As a result, convection-based fire spreads mostly upward, while air currents can transfer heat in any direction. Converted currents are the most common source of heat transfer from floor to floor, room to room, and area to area. Figure 2.10 demonstrates that heat currents convection causes fire to travel down corridors, up stairwells and elevator shafts, through walls, and through attics, and has a greater impact on fire attack and ventilation locations than either radiation or conduction.

Direct contact with flames is another form of convectional heat transmission. When a substance is heated to the degree that flammable vapors are released, the fumes may ignite, resulting in a flame. Other flammable materials may be heated to temperatures where they will burn and ignite if they come into touch with the burning fumes or flames. The architectural answer for fire propagation by convection is to create a compartmentalization (John, 2014).

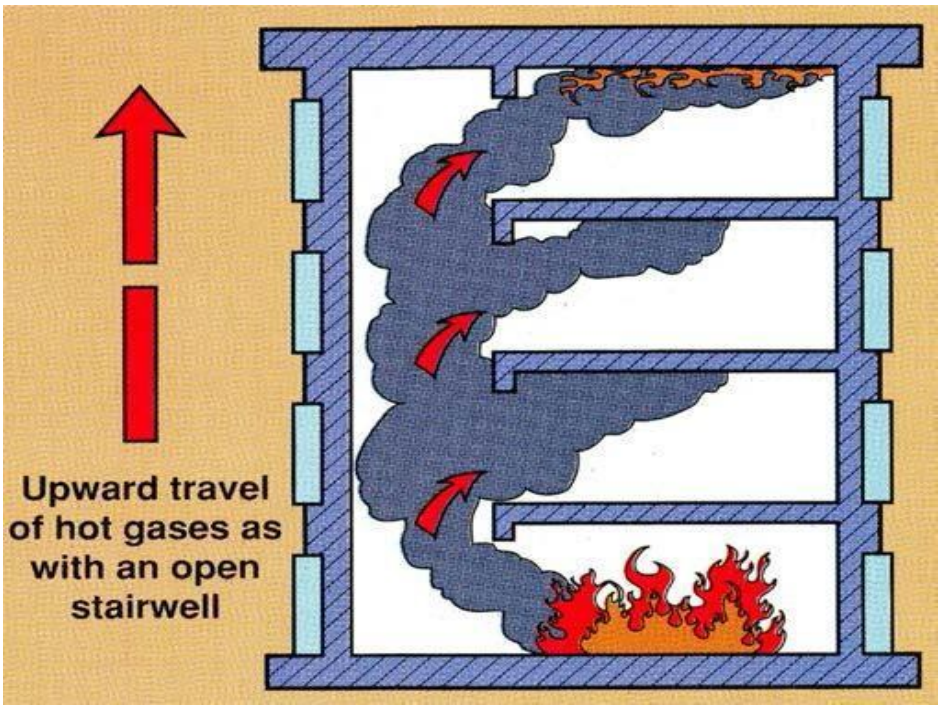


Figure 2.5: Convection of Heat

Source: (John, 2014).

2.5.3 Radiation

The warmth of the sun is felt immediately after it rises. When the sun sets, the planet begins to cool at a similar rate. We shield our heads from the sun's rays using an umbrella. When a fireman sprays water on a fire, the heat that strikes the firefighter is reduced. Despite the fact that air is a poor conductor of heat, it is clear that heat will go when there is no matter. Heat

wave radiation is a technique of heat transport. Heat and light waves are identical in nature, but their duration varies every cycle. Heat waves are longer than light waves and are also known as infrared rays. Radiated heat can travel through vacuum until it reaches an opaque target. Heat will be emitted from the body's surface when it is exposed to heat radiation (Figure 2.6).

Radiated heat is one of the most common causes of fire spread, and its significance necessitates quick attention in areas where there is a lot of it (John, 2014).

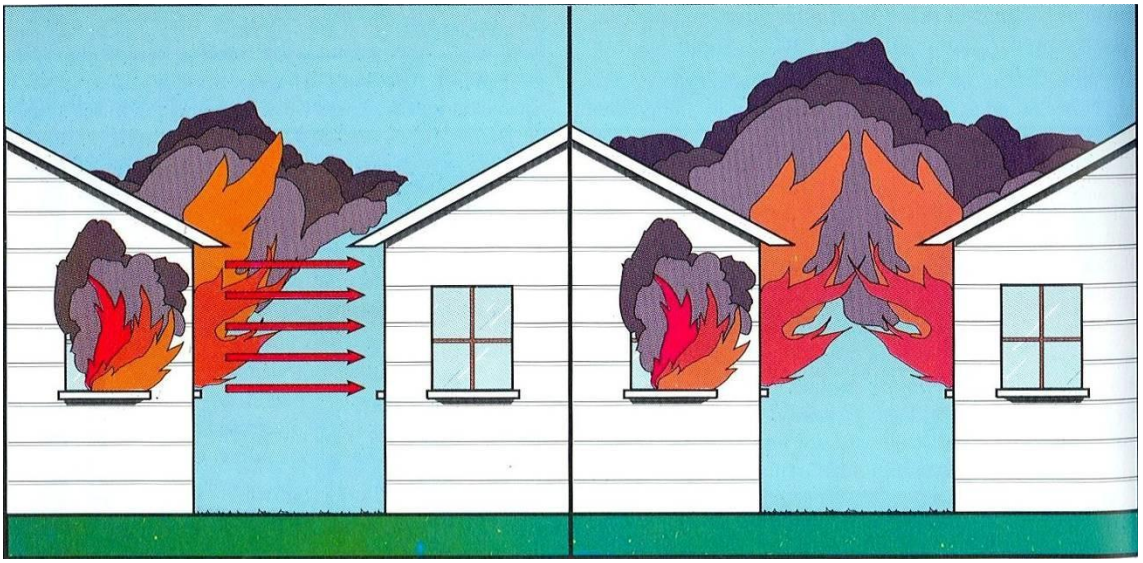


Figure 2.6: Radiation of Heat

Source: John, (2014).

2.6 Combustion Products

When a material (fuel) burns, it undergoes a chemical change. The procedure does not eliminate any of the elements that make up the material, but it does change the form or condition of the entire thing. The combustion products are the same weight and volume as the fuel before they are burned, notwithstanding their dispersion. When a fuel burns, it produces four combustion products:

i. Combustion gases

ii. Flame

iii Heat

iv. Smoke

Most flames produce a mixture of oxygen, nitrogen, carbon dioxide, carbon monoxide gases, finely broken carbon particles (soot), and a variety of compounds released by the substance engaged in the fire. Heat is a kind of energy that is measured in temperature grades to determine its intensity. Heat is the combustion product responsible for spreading the fire in this situation. It is the direct source of burns and other forms of human harm in medical settings. Dehydration, heat exhaustion, and respiratory tract damage are all examples of heat-related injuries. The visible, light body of a gas that burns is called a flame. When a burning gas is mixed with the appropriate amounts of oxygen, the flame becomes colder and less brilliant. The loss of brightness is due to more thorough combustion of the carbon. Flame is referred to be a combustion product for these reasons. In other types of smoldering flames, however, heat, smoke, and gas can build without indication of flame. Certain substances produce more smoke than others. Liquid fuels usually produce dense black smoke. Large amounts of thick smoke are commonly produced by oils, tar, paint, varnish, molasses, sugar, rubber, sulfur, and various polymers (Martin & Andrew, 2005).

2.7 Fire Hazards in Shopping Mall

2.7.1 Electrical Hazards

Electrical hazards in a shopping mall are majorly caused by defective wiring, defective plugs, damp or wet wires, overloaded motors, defective switches, outlets or sockets, faulty heating components, overloaded circuits, lighting fixture issues.

2.7.2 Mechanical Hazards

Mechanical hazards in a shopping mall are majorly caused by hot bearings, misaligned or damaged machine components, choking or jamming materials, inadequate lubrication, poor adjustment of moving parts.

2.7.3 Storage Hazard

Major causes of storage hazard in a shopping mall include some materials piled too close to heat sources, obstructing sprinkler heads (require 18-inch head clearance), flammable or fuel materials processed too close to heat sources, materials that are flammable and are not confined in separate containers or cabins, storage rooms with insufficient ventilation, materials that may interfere with one another are kept together, fragile-container-contained products, materials found in viii unlabeled containers, containers that are not firmly sealed.

2.7.4 Smoking Harzard

Major causes of storage hazard in a shopping mall include the ignoring "No Smoking" signs, smoking near flammable or combustible items, tossing asses on the ground or grass without fully extinguishing them in an ashtray or ash bin, throwing matches, cigarettes, or cigars on workbenches or tables, throwing lit cigarettes or matches out of open windows or doors, rolling about in bed, leaving a cigarette / cigar unattended, smoking in locations where

sawdust or plastic is present, metal powders have the potential to be explosive (Martin & Andrew, 2005).

2.8 Shopping Mall Fire Safety Measures

Understanding what you can do to prevent a fire from occurring in the first place, as well as what measures you may take if one does occur, is key to fire prevention.

2.8.1 Precaution and Prevention of Fire

The following are key fire prevention policy elements:

i. Construct a structure in accordance with the current edition of the Local Building Code.

ii. Maintaining an installation and executing your duties in accordance with the rules of the fire code. This is based on tenants' and operators' understanding of the applicable regulations and guidelines.

These include:

i. Not exceeding the maximum occupancy in any part of the property; ii. not exceeding the maximum occupancy in any part of the property; iii. not exceeding the maximum occupancy in any section

ii. Keeping adequate fire exits and exit signage in place (e.g. exit signs pointing at them that could work in a power failure) Electrical code compliance is necessary to avoid overheating and combustion caused by electrical flaws or difficulties such as insufficient wire insulation or overloading cables, conductors, or other equipment with more electrical current than they are rated for.

iii. Fire extinguishers of the appropriate type are placed and maintained in conveniently accessible locations.

iv. Dangerous items, such as solvents in spray booths, are appropriately kept and utilized inside the building for storage or operating purposes.

v. In some areas of the structure, flammable items are prohibited.

vi. Periodically inspecting buildings for flaws, issuing Orders to Comply, and finally penalizing or shutting non-compliant structures until the problems are remedied or, in the worst-case scenario, condemned

vii. Keep fire alarm detection and warning systems in good working order.

viii. Keeping a complete inventory of fire extinguishers.

ix. Making sure the fireproofing spray is not damaged.

x. Maintaining a high level of training and awareness among building occupants and users in order to avoid obvious mistakes like fire door opening.

xi. Practice fire drills at regular times throughout the year (Brewer & Bennetts, 2003).

2.8.1 Fire Control

A. Passive Fire Prevention

This has to do with the structure's design and the kind of fire-resistant materials employed. Fire safety devices are meant to play a critical role inside a facility or property in protecting lives and preventing fire harm (Brewer & Bennetts, 2003).

For fire protection, such fundamental criteria are:

i. Travel road up to exit

ii. Disposal plan

iii. Finishes of incinerable surfaces and items

iv. Rescue lifts

v. Fire Control Centres and Rooms

vi. Smoke and fire vents

vii. Occupation classification

Figure 2.**7:** Evacuation plan in a shopping mall.

Source: Brewer and Bennetts, (2003).

B. Active Fire Prevention

Unlike passive fire protection, active fire prevention is defined by things and/or systems that require a specific amount of movement and response in order to function. The following are active fire protection requirements:

i. Fire dampers

ii. Fire hydrant system

iii. Automated water sprinkler system

iv. Smoke and heat detectors

v. Smoke exhaust systems

vi. Back-up power system

2.9 Means of Escape

It is the first and most important requirement, as well as the one that has the most influence on building design. The following criteria should be considered while developing escape routes or assessing their effectiveness:

i. The fire grading committee recommends a period of 2.5 minutes for escape (UK).

ii. There should be a sufficient number of exits with enough capacity, as well as accessible access pathways and adequate exit illumination.

iii. All exits should be secured from fire and smoke throughout the duration of the fire hazard.

iv Direct, unobstructed, and well-marked escape routes are preferred.

v. Exits and corridors should have the same width. Rather than the overall number of people to discharge, the possible rate of discharge should be the decisive factor in the width of the exit.

vi. Both doors in the escape path should open in the direction of escape and should not be locked [Fire Doors Bristol]. The final escape doors will be secured with panic bolts.

vii. The openness of the escape path influences movement speed, which can range from 12.5 meters per minute in corridors to 18 meters per minute in wide places. This results in a trip distance of 30 meters and 45 meters, respectively (speed x evacuation time= travel distance). The actual distance a person goes from any place inside the floor area to the proper exit that is a covered doorway is known as travel distance, and it must be closely connected to the occupation and usage of the floor area rather than a single architectural feature.

viii. Products that might cause a fire should not be included in any section of a safe escape path, even if it is only for a short time.

ix. In multistory retail malls and low-rise structures, an alternate exit should be located in the opposite direction of the primary route in case the main exit is blocked by smoke or fire.

x. Calling the fire department is not recommended, since current traffic conditions and congestion may delay their arrival.

Even yet, it is clear that the architectural and engineering design will result in smoke venting screens and fire escape routes.

2.10 Shopping Mall Classification

Over the years, shopping centre formats have assumed a confusing array of identities, including names such as Centres, Commons, Crossings, Hybrids, Lifestyle Centres, Malls, Marts, Mega-Malls, Mixed-Use, Outlets, Parkways, Places, Plazas, Promenades, Shops, Strips, Squares, Centres, Town Centres, Urban Retail, Vertical, and Villages.

Unfortunately, there is no agreement on how many various types of shopping centre designs there are, or how to categorize individual shopping malls. A variety of marketing and management methods, such as convenience, entertainment, racing, festival, lifestyle, luxury, off-price, theme (e.g. home improvement and furniture), retail, commercial, and value, can help to differentiate shopping malls (Table 2.1). When contemplating the probable mix of these sorts of distinguishing variables, it's natural that some people perceive the retail sector to be very dynamic and difficult to comprehend (James, 2005).

2.10.1 Regional Centre

A shopping centre with one full-line department store, one full-line discount department store, one or more supermarkets, and around 100 specialized stores. The total GLAR is generally between 30000 and 50000 square meters. (www.icsc.org) In some cases, a centre with two full discount department shops will serve as a regional centre without a department store if all other criteria are equal.

Key features:

i. Provide extensive coverage of a wide range of retail needs (including specialty retail), but not as comprehensive as major regional centres;
ii. Include a mix of full-line department stores, full-line discount department stores, supermarkets, banks, chain, and other specialty retailers; as shown in plate

Figure 2.8**:** Regional Toronto Eaton Centre, California.

Source: James, (2005).

Figure 2.9: A floor plan of regional shopping mall.

Source: James, (2005).

1.10.2 Super Regional Centre

A large shopping centre, according to the International Council of Shopping Centres (ICSC), consists of two full-line department stores, one or more full-line discount department stores, two supermarkets, and about 250 or more department stores. The total area of the GLAR is more than 85,000 square meters.

Main Characteristics:

i. One-stop shopping for all of your need;

ii. A combination of full-line department shops, supermarkets, restaurants, and various specialized retailers; comprehensive coverage of all shopping requirements (including niche retail);

iii. As illustrated in Plate ii, it usually feature a variety of entertainment and leisure activities such as theaters, game arcades, and soft play centers.

iv. Provide a diverse selection of shopper services and amenities (vehicle parking, food court, etc). (restrooms, seating).

Figure 2.10: Pondok Indah Super Regional Mall, Jakarta, Indonesia.

Source: James, (2005).

2.10.3 Neighbourhood Centre

A neighborhood retail complex with a grocery and around 35 specialized stores. GLAR will be less than 10,000 square meters in size.

Key characteristics include:

i. Being located in residential locations;

ii. Serving the immediate residential neighborhood;

iii. Having longer trade hours;

iv. Catering to basic day-to-day retail needs.

Figure 2.11**:** A neighbourhood centre in the form of strip mall, Kinkos Cornelius, Oregon.

Source: Peter, (2006).

2.10.4 Outlet Shopping Centre

An outlet mall (also known as an outlet centre) is a retail mall where manufacturers sell their items directly to the public through their own businesses. Many shops at outlet malls are managed by retailers selling recycled items and abandoned brands, sometimes at drastically discounted prices. Outlet stores were found as early as 1936, but the first multi-store outlet mall, Vanity Fair, in Reading, Pennsylvania, did not open until 1974. In 1979, Belz Enterprises constructed the first covered factory outlet mall in Lakeland, Tennessee, a suburb of Memphis (Schoenherr, 2006).

2.10.5 Lifestyle Centres

Lifestyle centers cater to a specific market segment: the young urban professional. With a growing tendency toward upscale retailing, lifestyle centers provide stores and services to people with a drive for success. Lifestyle centers are made up of items that may be found in a mall but are placed in a more appealing external setting. As a result, they attract both retail consumers and people who would not normally shop at a mall. Lifestyle malls are a carefully curated collection of aspirational merchants (Figure 2.12). Fashion brands, leisure and sportswear that reflect a passion or interest, and home products that give excellent quality furniture and household equipment are examples of such merchants.

Every business has a few products that the consumer should strive to and that reflect their beliefs. There will be a variety of cafés and restaurants in addition to these businesses, allowing visitors to combine a visit to the center with pleasant refreshments or a meal (Peter, 2006).

Figure 2.12**:** Lifestyle Shopping Mall, Alabama.

Source: Peter, (2006).

2.11 Design Criteria for Shopping Malls

2.11.1 Optimal Dimensions

The ideal size of a shopping centre is determined as a quantity of retail floor space that may be rented to shop tenants, as shown in Figure 2.13. The term for it is "leasable gross area" (GLA). In most cases, the architect's retail brief is represented as a total of GLA. The architect must convert the GLA into the potential gross total area for the purposes of early site planning exercises. To make this conversion as simple as possible, an

additional space must be added to the GLA to provide access to service, escape routes, lodging amenities, framework, and exterior walls. The GLA will typically account for about 80% of the gross region. It's worth noting that the GLA doesn't include required public circulation space, service yards, or parking lots. The amount of space available for public circulation will have to be evaluated for each project, and it will be decided by the specific site circumstances. The amount of public circulation space included in the gross area varies depending on whether the scheme is enclosed or open.

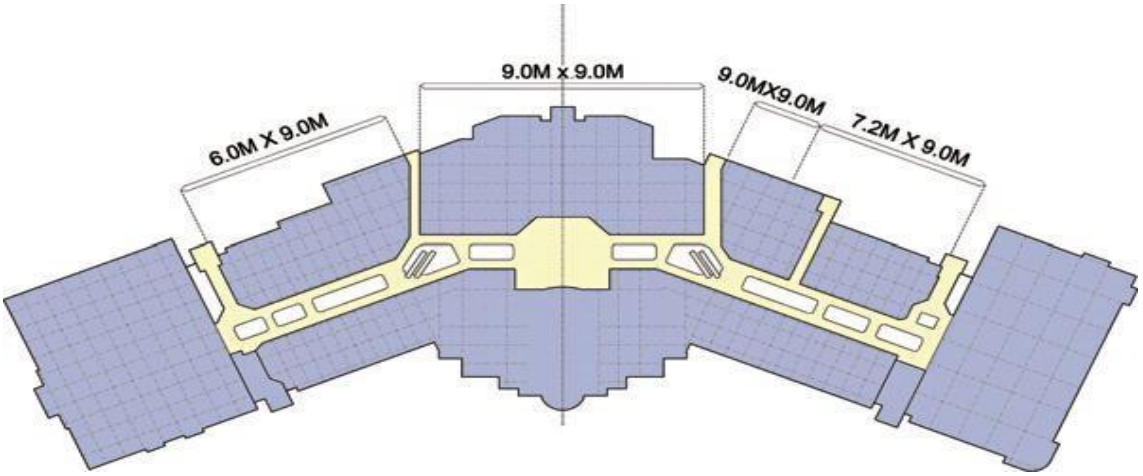


Figure 2.13: Plan layout of the Mall at Cribbs Causeway, Bristol, UK showing variable grids providing different shop unit sizes.

Source: Peter, (2006).

2.11.2 Site Accessibility

Accessibility at the site has been regarded as one of the most important factors to consider when deciding where a retail mall should be built in the future. The essential operations of a retail mall are directly affected by accessibility.

This has an impact on how soon customers can come and anticipate to return, as well as how efficiently products can be distributed to keep the stores stocked and the inhabitants safe. Figure 2.14 shows how understanding where a site is located in terms of public

transit, private cars, and service vehicles is essential for developing a brief for new development facilities. All modes of transportation and site access, including pedestrian and cycling routes, must be considered for accessibility.

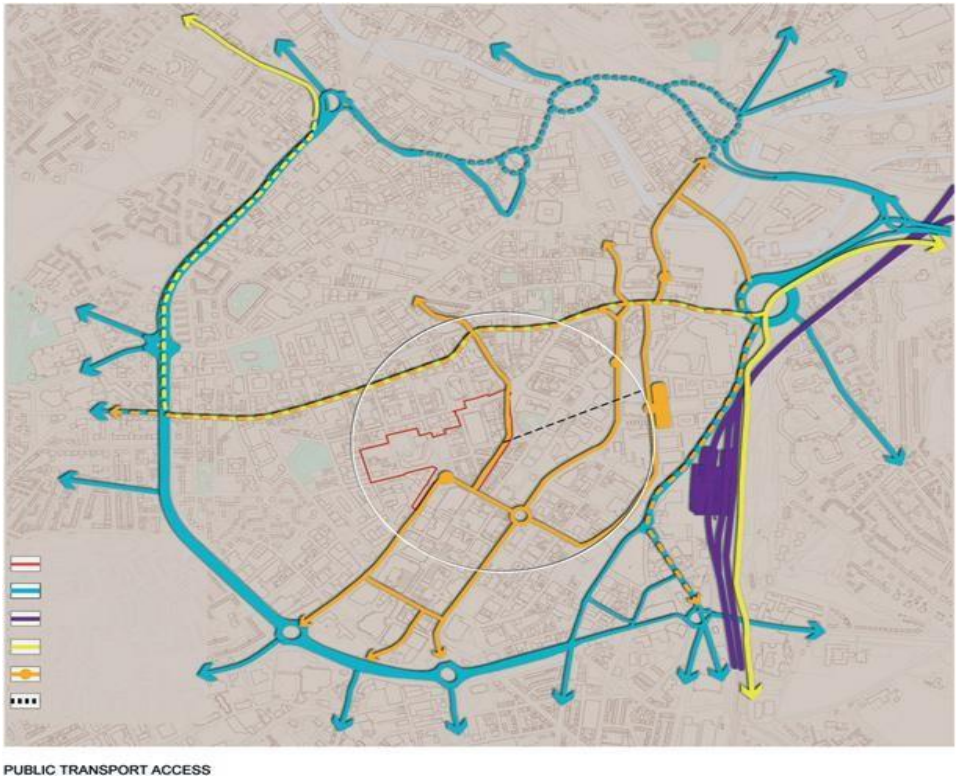


Figure 2.14: A typical immediate transport and access assessment diagram prepared for the New Retail Quarter, Sheffield, UK.

Source: Peter, (2006).

2.11.3 Parking Lots

For clients visiting a shopping mall, private motor vehicles are the preferred mode of transportation. Cars provide a safe, inexpensive, and efficient mode of transportation, and they will continue to be the lifeblood of shopping malls until public transportation becomes more cost-effective and convenient. Without a doubt, the ultimate extinction of

accessible sources of gasoline and diesel would require alternate methods to be considered. For the foreseeable future, however, shopping centre development will need to accommodate the automobile as a mode of transportation for the majority of customers.

The motor car must be accommodated in two ways: first, there must be an appropriate road network to convey the automobiles to and from the shop, and second, there must be a place to park the cars once they arrive.

A shopping centre development can be provided with parking in a variety of methods, or in various combinations of:

i. Construction of a new parking lot with a shopping complex.

ii. Off-site parking in a park-and-ride facility, with buses transferring consumers from outer parking lots to the city center.

Large anchor tenants will have minimum parking requirements for the number of spots they want to supply on site.

This number can fluctuate, but for some large renters, it might be as high as 1000. The British Shopping Centre Council recommends two to four new housing places per 100m2 as a general guideline (West, 2006). For a typical 50000m2 shopping centre, this may range from 1000 to 2000 parking spots.

2.11.4 Services Vehicles

All of the vehicles that operate the shopping centre's businesses, restaurants, and leisure facilities are considered service vehicles. These cars represent the mall's useable lifeblood and should be hidden from the customer. They are critical to the tenant's

business as well as the landlord's / owner's property's operation. In addition to assessing the accessibility of private automobiles and public transportation, the capability of the road infrastructure to carry service vehicles to and from the planned development must be assessed.

Shop delivery trucks, trash vehicles, and fire-fighting vehicles are among the service vehicles that must be accommodated. The British Council of Shopping Centres (BCSC) recommends 5.5–6.5 car parking bays per 9000m2 of GLA as a general guideline in its research report "Service Areas for Shopping Centres" (excluding large department stores) The British Council of Shopping Centers (West, 2006) Three of the service parking spots will be required for articulated vehicles or bigger trucks. As a result, bigger businesses and anchors would require their own service vehicle parking bays. In the unloading yard, there will be parking for refuse compactors and skips that handle compacted trash, as well as parking for refuse vehicles that remove the skips. For a typical shopping mall of 45 000m2 (500 000 ft2), the total number of parking spots might be as high as 30, plus space for trash vehicles. Shops in department stores) To make all parts of the retail centre safe and accessible, this might necessitate a lot of room and careful planning. To guarantee convenience for all stores, several unloading spaces may be required in certain shopping complexes. It's also recommended hiring a professional road consultant to figure out the exact amount of service bays needed to prevent oversizing the service yard's facilities (Schoenherr, 2006).

2.11.4.1 Access to Firefighting Equipment

Firefighting trucks will require quick access to designated places around the structure or buildings, thus the retail center will need to be constructed accordingly. Hose reels will need to stretch from these permanent access points to reach all parts of the retail

complex from the fire-fighting trucks. To be able to establish the degree of access points for fire-fighting equipment, early communication with the fire service is advised to define the maximum allowable hose reel lengths. If the fire truck is not configured on a passing route, the entrance must be unobstructed and of sufficient width to facilitate turning.

A firefighting truck must be able to carry a considerable amount of weight on its access routes. The various fire-fighting facilities accessible within the structure may also be identified by early contact with the fire department (Peter, 2006).

2.11.5 Layout (Organisational Framework)

Because architecture is so important to a retail center's success, it is included in the principal brief. The basic brief should start with modest objectives that may be expanded upon as the project proceeds. The concerns were categorized into general objectives for the primary summary.

2.11.5.1 Layout Objectives in General

i. The design should be a distinctive and fascinating space that is easy to use, safe, and pleasant.

ii. It should be legible and simple to comprehend. iii. The design should establish obvious pedestrian flows that allow customers to pass through all of the storefronts.

iv. Anchor stores should be strategically placed to encourage and increase pedestrian traffic flow. Medium-sized room. Consumer stores should be strategically placed to improve pedestrian traffic.

v. Other significant attractions (leisure centres and catering areas) can be strategically placed to enhance pedestrian movement. Other footfall drivers, such as car park exits, public transportation access points, and vertical circulation points such as staircases, escalators, and lifts, should be designed to make pedestrian traffic flow more smoothly.

vii. The layout of public circulation areas will create natural loops, preventing consumers from repeating their steps.

2.12 Horizontal Circulation Layout

The placement of footfall generators is one of the most fundamental strategies to create optimal pedestrian movements. The retail locations with the highest traffic are regarded to be the most powerful (Veal, 2013). The busiest regions naturally arise while approaching an anchor feature and fade away beyond the anchor unless a fresh attraction or other anchor is sensed ahead. The generators should be strategically located to allow all areas of the centre to be utilised and to evenly distribute foot traffic across all storefronts.

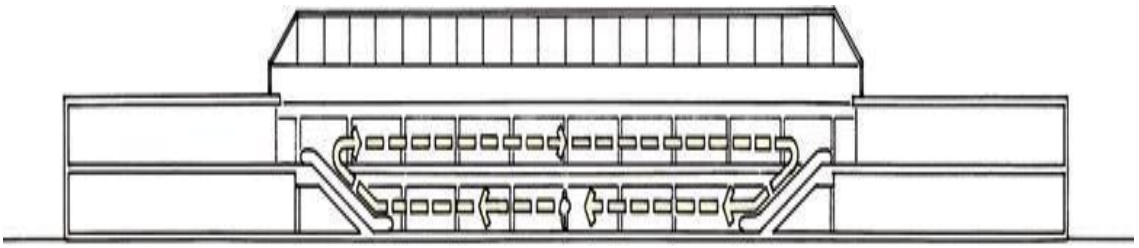


Figure 2.15: Dumb-bell layouts on two levels allow circulation through all store fronts without having to retrace steps.

Source: Veal, (2013).

2.12.1 Types of Horizontal Layout

2.12.1.1 Linear Arrangement

The easiest organisational arrangement establishes the circulation room and shopping accommodation for a linear construction with two anchor parts. Dumb-bell, linear, or gun-barrel malls are examples of this type of layout, and they connect two places that the anchors designate. Figure 2.16 demonstrates how node spaces (focal gaps / knuckle spaces) can change the straightforward layout by adding one or more punctuation marks. The number of fluctuation sites throughout the length of the public circulation area will be determined by the quantity of available space and the size of the place. The node space can be utilized to allow a neighboring circulation path connector or to integrate an angle into the plan.

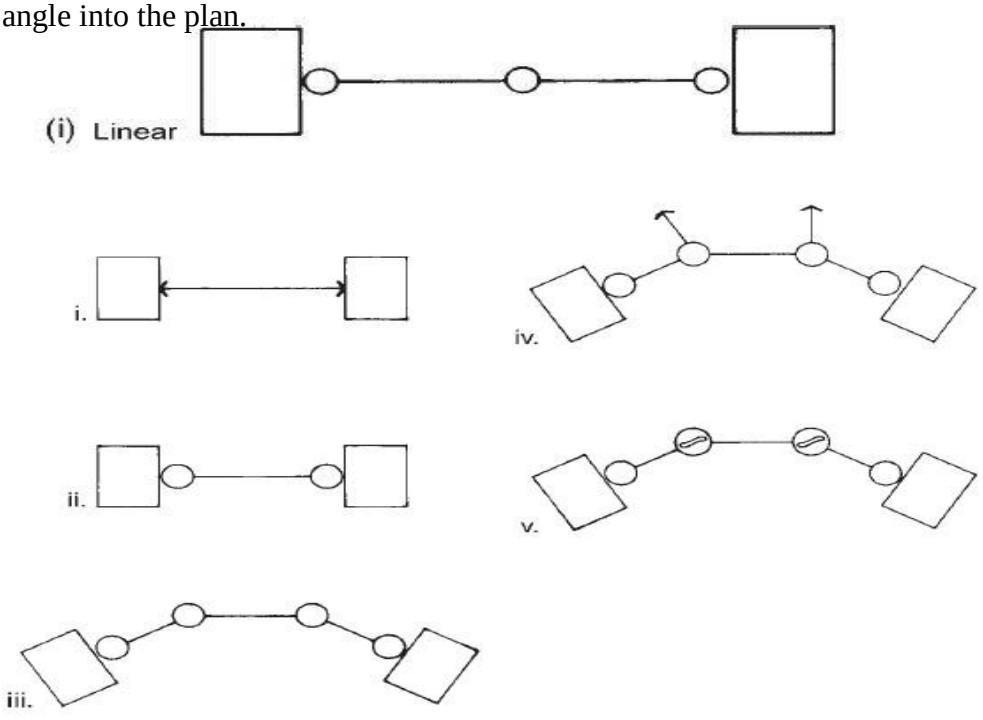


Figure 2.16: Linear arrangements.

Source: Veal, (2013).

i) A basic dumbbell between two anchors; ii) a dumbbell with nodes; iii) nodes for changing angles; iv) nodes for receiving alternative routes; v) nodes for vertical circulation.

2.12.1.2 Circuits Arrangement

The retail units should be put up in such a way that the public circulation is shaped by a natural flow of pedestrian movement. The circuit layout patterns encourage continuous travel through all of the storefronts, as well as a return to a starting place. A circuit design allows a customer to walk around the whole retail complex without having to retrace their steps. Circuits can be designed in three dimensions, taking into account the structure's vertical layout as well as its plan layout (Scott, 2000). Circuits can be single or numerous when following a figure of eight. Pedestrian flows to circuits are achieved by strategically placing an anchor element at the corners in order to sustain interest. The anchor element should be visible ahead to guide the client. Maintaining sight lines and good vision from one anchor piece to the next are important concerns.

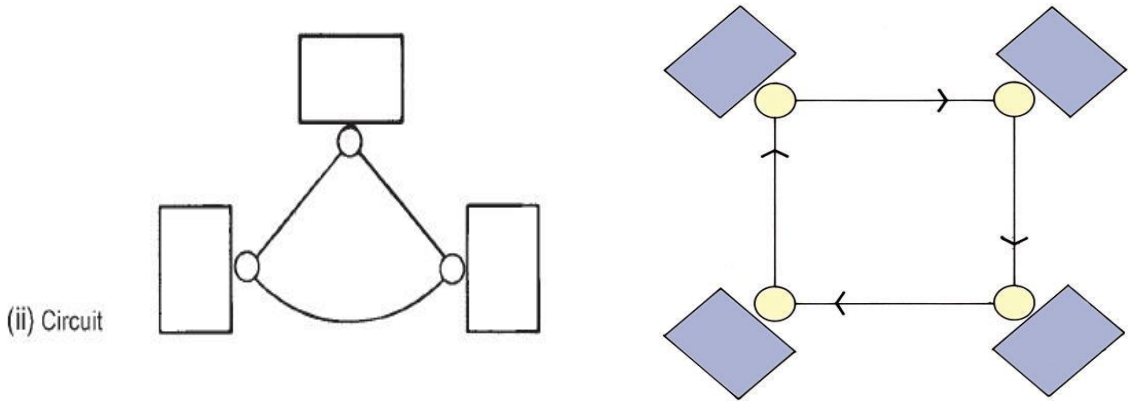


Figure 2.17: The strategic positioning of anchors in a circuit generate footfall.

Source: Scott, (2000).

2.12.1.3 Keyhole Arrangement

The concept is built on a single point of entry and exit from a main thoroughfare. The goal of this sort of plan is usually one or more major anchor businesses at the end of the circulation route, which attracts tourists past all other frontages to the destination. The single point of entrance and exit is more suited to a multi-level lodging system, where guests enter and go to their destination on one floor and return on another, reducing the need to retrace their steps through the same shops (Figure 2.18). A method of vertical level change at the entrance, as well as anchor retailers with entrances at each circulation level, will be required to allow the entry and return routes being completed at different levels.

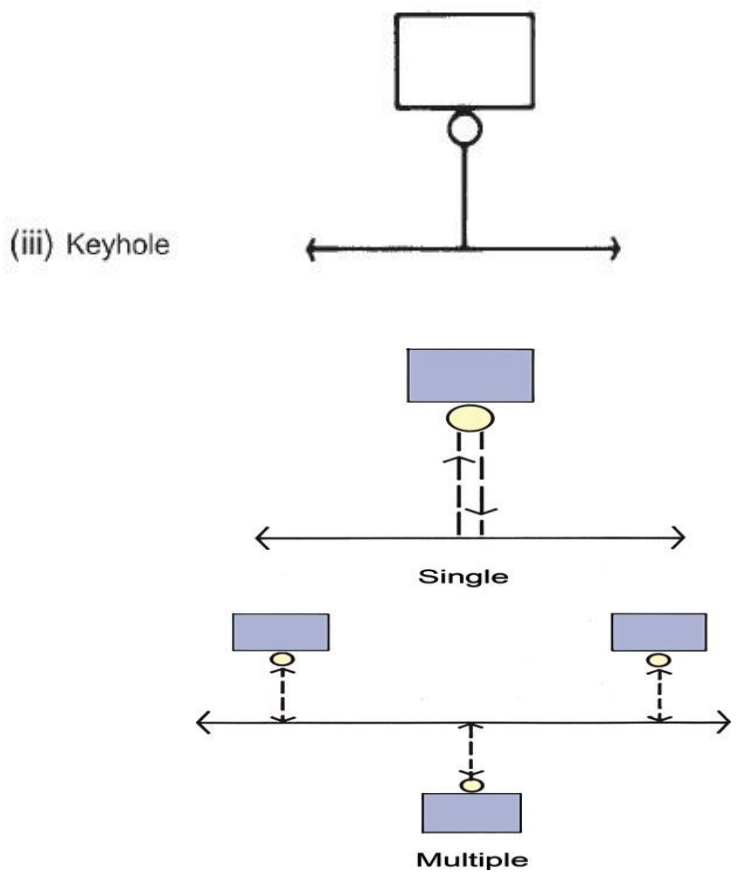


Figure 2.18: Multiple keyholes can be formed by using a single point of entrance and return onto a high street in multiples.

Source: Scott, (2000).

2.13 Vertical Circulation Layout

One of the major accelerators for the functioning of multilevel retail formats is the successful integration of vertical circulation, which supports the establishment of high-value land shopping sites. Vertical circulation, along with horizontal circulation, should be considered in multi-level systems as a method of organizing the layout and allowing customers to flow similarly across all of the store units (Robert, 2002). The location of vertical circulation must strike a balance between encouraging pedestrian traffic and giving visitors with a simple way to move between floors. Visitors will often pass through an identifiable length of stores before changing floors and returning through another length of shop fronts (Figure 2.19). Equally essential, the vertical movement should be placed in such a way that it is clearly apparent and identifiable, allowing visitors to avoid anticipating where rates will change in a calm manner. Tourists should also be able to step forward and reach the point where the level changes by using the vertical movement. Vertical movement must be placed in a comfortable and strategic location. It should be installed at regular intervals and not exceed 80–100m (260–325 ft) in length. Vertical circulation's interval positioning is dimensionally similar to the punctuation gaps' horizontal circulation location.

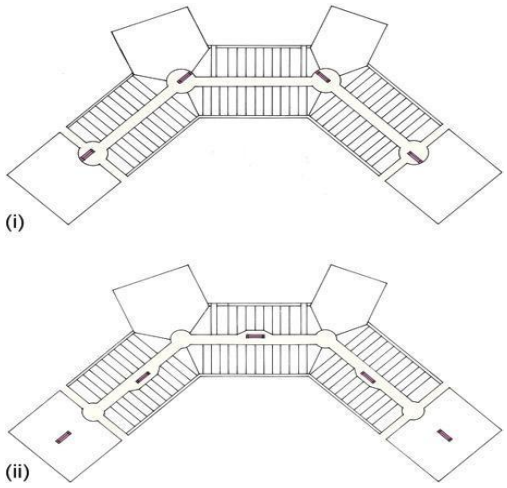


Figure 2.19: Alternative escalator locations include: i. escalators located in node spaces; ii.escalators located in malls.

Source: Robert, (2002).

Figure 2.20: The Escalators in the node space, Brent Cross, London, UK.

Source: Robert, (2002).

2.13.1 Vertical Circulation Types

A variety of methods can be employed to generate vertical circulation in order to induce level changes in the building. Stairs, elevators, and escalators are commonly utilized to meet the vertical movement needs of multi-level retail malls (Martine, 2004). To accommodate slight variations in height, ramps and sloping the floor are frequently utilized.

i. Stairs

Feature stairs are a popular and adaptable technique to transfer people vertically between levels within a public circulation area, and they are commonly utilized and accepted in retail malls. Stairs and escalators can be installed singly or in a variety of configurations. Figure 2.21, for example, demonstrates how placing stairs in node locations and strategically placing escalators may improve overall circulation patterns. Instead, if the room is maintained clean of escalators, individual steps in the general circulation space or in the node area might be

placed midway between the node areas. Stairs may be accommodated more easily in the plan than escalators, and they give a more comfortable alternative for travelling between levels.

Figure 2.21: A dog-leg feature stair, Metro centre, Gateshead, is housed in a substantially large mall., UK (1984–1987).

Source: Martine, (2004).

ii. Ramps

Specific ramps and sloping the public area floor are two different approaches to compensate for minor height differences. Sloping the floor of the room can be used to bridge the gap between:

i. At the entry, the current street or outside level, as well as the interior floor level

ii. Finished floor levels caused by varying floor-to-floor height restrictions in neighboring stores (under the circulation area).

Individual ramps can be utilized to provide a slight change in level and assist enhance the separation of circulation space and seating areas, as shown in Plate vi. Both ramp designs

will need to be carefully studied in order to fulfill the regulatory standards for accommodating individuals with disabilities (Scott, 2000).

iii. Escalators

After Bloomingdales built escalators in their department store in New York in the late 1800s, mechanical moving steps have been utilized in retail for almost a century. With the growth of the regional shopping center outside of the city, escalators have been commonplace in shopping centers since their debut in department stores in the 1950s. These early American shopping malls pioneered the escalator as the principal way of transporting big crowds of people between different retail shops. Escalators are now well known and used as the principal mode of vertical circulation in shopping malls across the world (Figure 2.22).

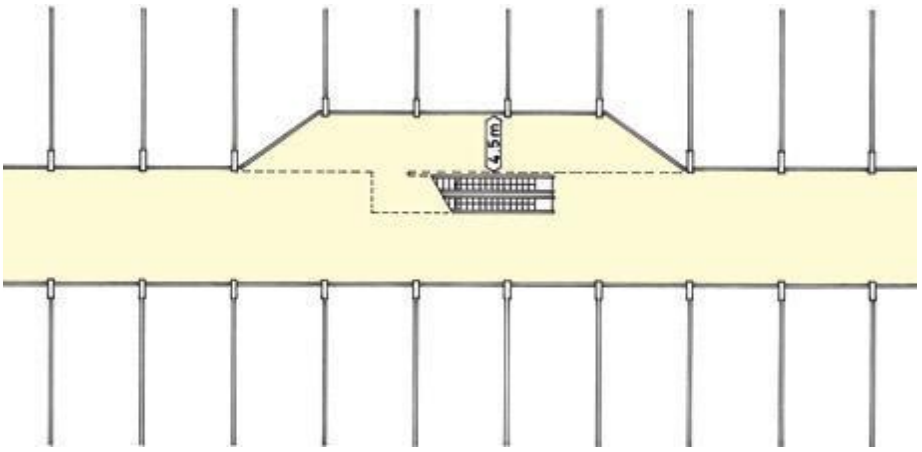


Figure 2.22: In order to provide enough room between the escalators and the storefronts, the mall must be enlarged.

Source: Scott, (2000).

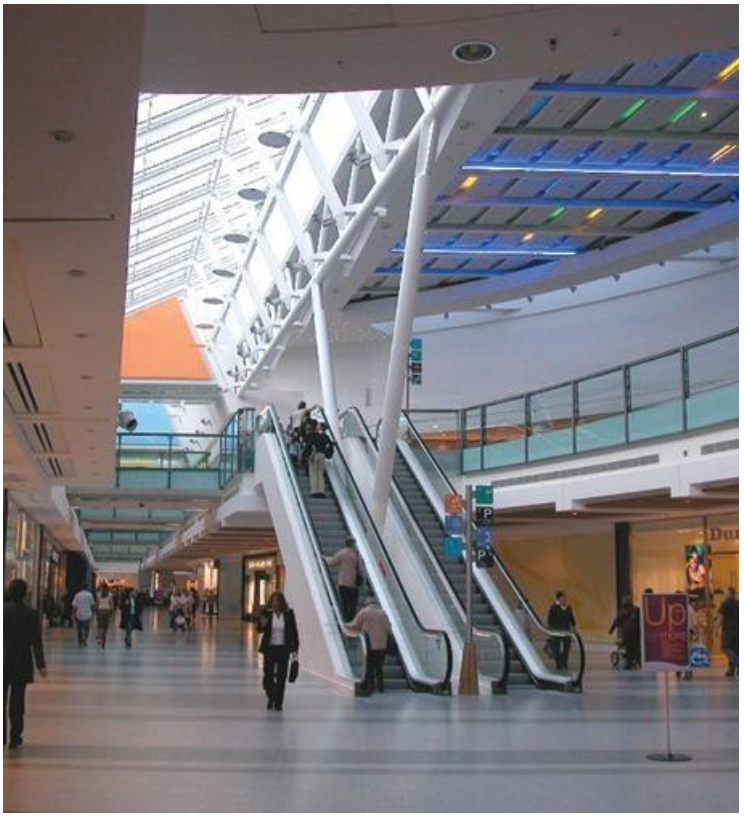


Figure 2.23: Escalators in the widened mall space Centre West, East Kilbride, Glasgow, UK. Source: (Martine, 2004).

iv. Travelators

As mechanical methods of vertically conveying passengers, travelators (also known as passenger conveyors) are identical to escalators, except that they feature flat floors instead of stairs. As a result, they're shorter and have a shallower pitch than escalators. When a big number of customers are utilizing trolleys to transport products to vehicle parking that is located on a different level than the stores, travelers are utilized. Travelers are usually offered shopping facilities, such as a large grocery store or hypermarket. Travelers are conveniently situated near the trolleys, allowing them to skip wheeling around the remainder of the mall. Travelers require more linear area to fit into the plan and are less compact to position than escalators. Travelers may theoretically be connected to escalators in the same variety of

methods mentioned. For practical reasons, however, passengers are generally arranged in simple parallel pairs, with the up and down routes positioned side by side, taking into consideration the increased physical demands to support them (Figure 2.24).

Figure 2.24: Blanchards Town has a pair of travelators that bridge the water feature. Dublin, Ireland.

Source: Peter, (2006).

v. Lift

Mechanical passenger lifts or elevators will be necessary for handicapped people and those with prams and pushchairs. The same lifts will be utilized to make shopping more convenient for the general public. The lifts mentioned below link the different levels of public circulation space on the floor to sections that connect to the parking garage above or below the shopping facilities. Lifts that are immediately connected to the parking garage will be a major source of pedestrian traffic, and they can be carefully placed to assist balance and distribute pedestrian traffic between different floors of a shopping center. Traditional lifts situated on the side of the building or freestanding feature lifts located in the circulation area might be used to serve the public circulation spaces. Traditional elevators are more practical, can accommodate more people, and may be equipped with glass viewing screens to provide

consumers a greater sense of security (Figure 2.25). Inside the circulation space, feature elevators can be substantially glazed, but they are less practical in that they can accommodate fewer people than regular lifts.

Figure 2.25: In the enclosed mall, there is a square elevator in a circular glass cage. Smaralind, Reykjavik, Iceland.

Source: Peter, (2006).

2.14 Ventilation

Simply said, ventilation is the act of removing old air and replacing it with fresh and new air. In hot-humid locations, ventilation can also help to mitigate the effects of high humidity levels. Natural and artificial ventilation are used to accomplish ventilation.

a) Artificial Ventilation

Natural ventilation cannot be depended upon to produce regulated conditions, thus mechanical techniques are frequently used. This include adjusting the temperature and relative humidity of a place, as well as moving and composing the air mass (Pevsner, 2004).

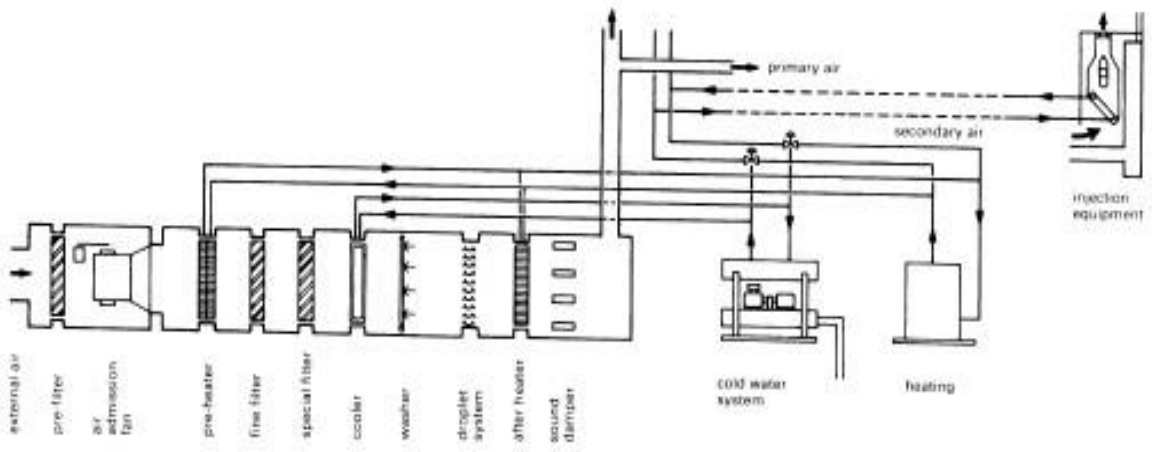


Figure 2.26: Central Air Conditioning System

Source: Pevsner, (2004).

2.15 Shopping Mall Facilities

The shopping mall complex is designed to house the four key portions that the International Council on Shopping Centres believes to be the modern regions in which a shopping center should be referred to as a mall. They also contain the following:

i. Recreational facilities

ii. Entertainment facilities

iii. Catering facilities

iv. Retail facilities.

2.15.1 The Retail Facilities

The nucleus of a shopping complex is the unit shop, which encourages consumers to use the facilities. The following are the three (3) main types of stores:

a) Unit stores

b) MSUs (Medium Space Users)

c) Anchor or department store

a) Unit Stores

The majority of a retail center's housing is made up of unit shops. The unit store is a conventional size that may be rented to a variety of different tenants. It would also enable a variety of unit sizes to better satisfy the common space requirements of diverse retailers (Cohen, 2003).

The demand for a unit store was disclosed by Martine (2004) as follows:

i. The majority (63 percent) desire floor space of 95msq – 380msq
ii. Strong Preference seek floor space of 190msq – 325msq
iii. A small percentage (19%) requires less than 95msq
iv. Whereas a bigger percentage (18%) requires more than 380msq iv.

Taking this pattern into consideration, a 7.5 m long by 25 m deep shop unit module with a typical size of 187m2 is sufficient, and the suitable proportion is between 3:1, 4:1, 2:1, and 5:2. (depth to width). At the very least, 25-30% of the Gross Leasable Area should be dedicated to storage (GLA).

b) MSUs (Medium Space Users)

The same rules apply to businesses with medium space users as they do to shops with units (MSU). They're carefully placed throughout the layout to serve as focal points and guide clients from one section to the next.

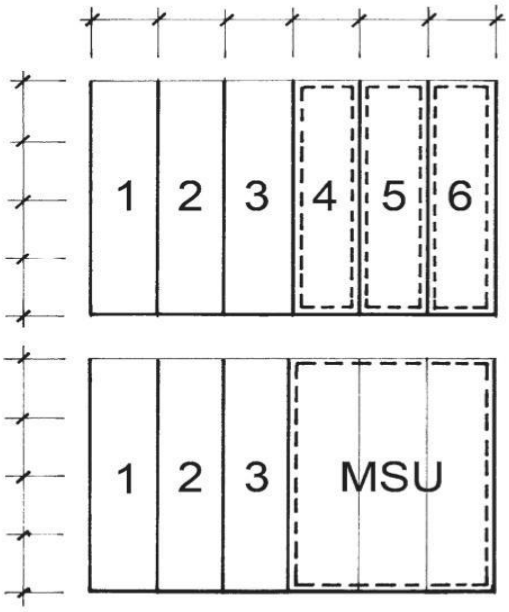


Figure 2.27: Space Requirement For Medium Space Users

Source: Pevsner, (2004).

c) The Anchor or Department Shop

The third primary shop type that must be included in the overall plan is the anchor store. The shop will be between 7000 and 23000 square meters in size. Such stores are usually strategically situated and are one of the main sources of foot traffic. The typical placement for an anchor store is:

i. At the end of a shopping trip, this drives people through the storefronts.

ii. Located at a layout change at a prominent location that attracts consumers from both directions.

iii. Strategically placed to provide a focal point in a vast complicated arrangement.

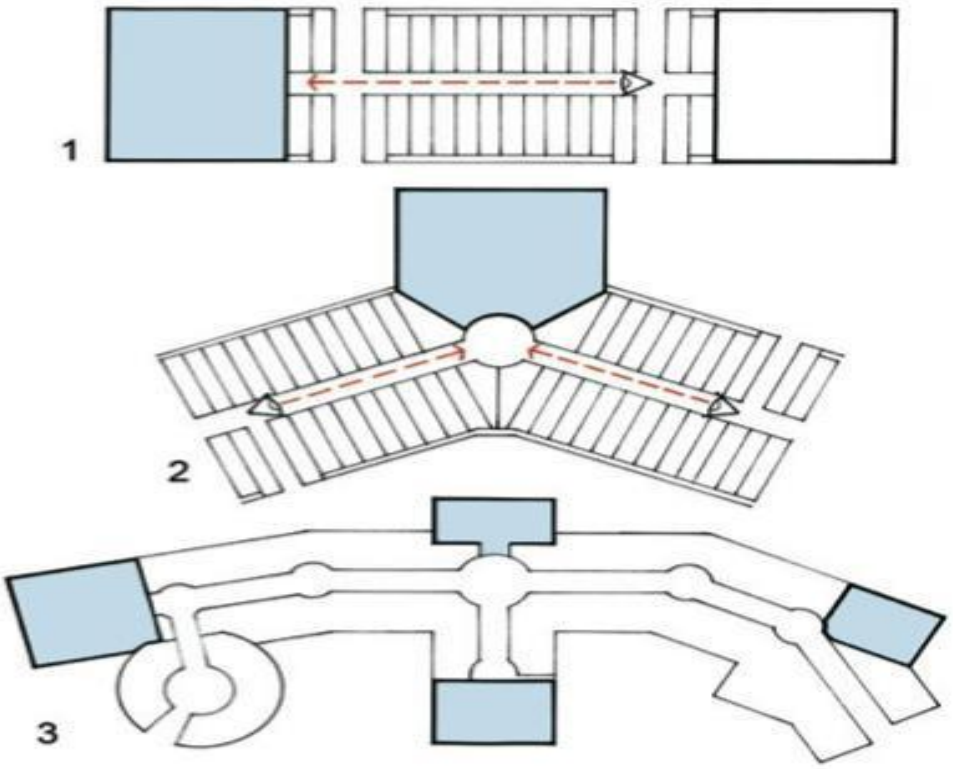


Figure 2.28: Different Positioning of Anchor Store.

Source: (Peter, 2006).

2.15.2 Catering Facilities

Catering is an important element of visiting a shopping mall or a leisure location, and it has been shown to enhance not just the appeal of a centre, but also the average length of stay and the amount of money spent per client each visit. Catering facilities account for a percentage of total accommodation that might vary from 2 to 25% of GLA.

Catering facilities should be located close or adjacent to retail units in a secondary or off-prime pitch position.

The many catering types that may be implemented within a shopping mall can be categorized into three physical formats. The following are the details:

a) Food Court

This concept may be described as a quick food outlet with limited self-service options and sitting in a communal space. Food courts are placed as an extension of the retail center's public circulation space.

A typical layout would have six to eight of these deals, each with 40-60m2 of space and a shared eating room for 300-400 people with tables.

b) Restaurant Groupings

Restaurants are distinct catering arrangements that are placed separately. The amount of space needed for a restaurant varies depending on the kind. A modest restaurant, for example, can fit into a 140m2 GLA unit, but a themed restaurant will need a larger unit with a GLA of up to 560 m.

2.15.3 Leisure Facilities

Commercial leisure activities are recreational activities in which the public pays the user for the use or enjoyment of their services. These methods might range from passive to forceful, as well as from traditional to professional.

The following are the most frequent types of recreational amenities found in shopping malls:

a) Multi-Screen Cinemas

This movie format, when combined with retail creation, is one of the most popular leisure activities. The multi-screen is twofold, giving the visitor a software choice and allowing the operator to assess each film's commercial viability. The maximum number of displays varies between 3-6. The auditoriums will vary in size, with the smallest having 100 seats to provide

the operator the flexibility he or she needs. A standard 10 screen cinema may be housed within roughly 4250m2 of GLA.

b) Bowling Alleys

Bowling lanes are part of a larger recreational area, such as a regional shopping and leisure center or a retail entertainment center. The quantity of floor area required will be determined by the number of bowling lanes to be accommodated, which can range from four to thirty. Each lane requires a total clear area of 26.7 m long by 1.7 m wide, which comprises the participant's area, the bowling lane, and the pin stacking apparatus space.

c) Gyms and Fitness Centres

Fitness center popularity has risen in parallel with an increase in leisure time and a greater public awareness of the importance of physical fitness.

2.15.4 Customer Care Facilities

Customer care facilities, like a personal hygiene facility or a personal service, have a major impact on the customer's recall of a certain centre.

a) Public Restrooms

Public restrooms must strike a delicate balance between being easily accessible and not obstructing valuable storefronts.

b) Crèches are places where children are cared for.

Housing for a kindergarten should be easily situated near the public circulation area while not taking up key shop space.

According to (BCSC, 1998), the optimal size of a nursery is one that can accommodate up to 40 children and has extra staff facilities, storage, and toilets spanning an area of around 175m2.

c) Mobility in the store

The phrase "shop mobility" refers to services that assist persons with mobility limitations in navigating a shopping center. These facilities should be close to a primary arrival point, which is generally next to a parking area.

d) Quiet Areas/Lounges

e) Room for People of Different Faiths

2.15.5 Back of House

The home area at the back of a shopping centre must be a hidden world that is not typically accessible to the general public but essential to the building's function and health. Despite the fact that the back of the home seems to be supplementary service areas to the main lodging, they are critical to the mall's activity and operation. The following are some of the most important back-of-house products:

a) Centre Management Resources

The management suite's major duty is to handle the financial and operational management duties of the shopping centre. The management suite must harmonize publicly visible standards while maintaining a separate organizational dimension. The Control Facilities must include the following:

i Administrative offices (management suites)

ii. Control rooms

iii. Staff Areas

iv. Maintenance Services

b) Delivery and Access

Shopping malls have a variety of companies, each of which is represented by a different store. The means of delivering items that allow retail firms to function are access and logistics. Among the installations are:

i. Service Yards

ii. Service Corridors (Deliveries)

iii. Service Lifts

iv. Interconnecting Stairs

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Case Studies

A case study, according to Yin (2004), is an empirical investigation that employs various sources of data to investigate a contemporary phenomena in its natural setting. This study's methodology involved a qualitative examination of case studies as well as a review of published and unpublished material. This case study examined the procedures taken to ensure fire safety in retail malls. The assessment was carried out using a visual survey and a checklist. According to Veal (2013), a case study necessitates the investigation of a specific example of the phenomena being studied. Case study has become a prominent kind of study in architecture (Oluigbo, 2011), as well as in most qualitative research methodologies. This study examined fire safety measures in shopping malls and how they operate to safeguard people and property.

3.2 Study Population

The following Abuja shopping malls were selected for the case studies: Ceddi Plaza and Silverbird Gallery. These buildings were selected base on their location which is the same climatic zone as the research location and have experienced a fire outbreak in the past. Bullring and Willow malls were also picked for worldwide case studies due to their fire safety standards.

3.3 Sampling Method

The purpose of a case study is to offer information about the research topic. Typically, selected instances are picked because they can provide knowledge about the research subject. Because of the nature of this study, the only way to choose case studies will be by purposeful

sampling. Case studies were chosen because of their relevance, uniqueness and the information they are expected to provide.

3.4 Instruments for data collection

Case studies were assessed based on the visual appearance on the buildings. Even though visual perception is a subjective feeling, the checklist served as the foundation for evaluating the building. Major variables which were considered in each case study are: type of building materials used, availability of fire control devices, scope of building facilities, site design, circulation/layout, building construction

3.5 Data Collection

The case studies for theoretical research in architecture may require the use of general methods for data collection. Participants' observations and perceptions, visual evaluations and checklists, interviews, surveys, models and simulations, and scientific measuring equipment are all examples of such techniques (Oluigbo, 2011). For the purposes of this study, a visual survey and checklist centered on the cases' fire safety characteristics were used. The data collecting method include conducting case studies of existing shopping malls, which entails identifying and shortlisting amenities, as well as providing supporting pictures for each. In order to establish the fire safety measures, sketches and floor plans were examined.

3.6 Method of Data Analysis and Presentation

Data gathered form the observation guide or checklist was analysed through content analysis. It entailed the researcher quantifying and analysing the meaning of words or text and making deductions from it. The data was organized with the use of excel spreadsheets and results were presented using tables and plates.

Checklist for assessment of case studies

Table 3.1: The checklist for assessing the case studies

Name of shopping mall

Principle	Variables	Comments
Type of building materials in the shopping mall	• Fire resisting doors • Fire resisting walls • Fire resisting floors • Fireproof Ceiling	
Availability of fire control instruments in the shopping mall	• Smoke/fire detectors • Fire hydrants • Water sprinklers • Fire extinguishers	
Building regulation/construction	• Compartmentalization • Head room • Sizes of emergency exit openings • Distance to emergency exit door	
Site design	• Building setbacks • Service entrances and exit • Parking	

Source: Author's work, (2021)

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Case Study One: Ceddi Plaza, Abuja.

Cceddi Plaza is located along Tafawa Balewa way, CBD, Abuja, Nigeria. The shopping plaza is own by Ceddi Corporation and managed by Tayo Amusan. It was designed by B+ITC 78 and opened for public use in November, 2005.

Plate I: Ceddi Plaza, Abuja

Source: Author's work, (2021).

4.1.1 Historical Background

Ceddi plaza has 10,000 square meters of business and retail space. It was completed in 2003 and inaugurated in November of 2005, (Plate I). Broll, a Nigerian property services business, manages it. It comprises a total of five storeys, including ground and basement levels. It also houses various secondary amenities such as a theater, fast food and restaurants, and an internet café, among others, in addition to the 55 specialized stores.

4.1.2 Variables

i. Building materials: The primary construction materials are dampalon canopy, masonry block, and concrete. Marble tiles adorn the building's exterior. The inside of the building, particularly in the commercial portion, features a fireproof ceiling and glass walls (Plate II).

Plate II: Fire-resistant ceiling

Source: Author's work, (2021).

ii. Fire-fighting equipment: The shopping mall's entry contains fire-fighting equipment, emergency doors, stairways, ceiling, and elevators (Plate III, IV).

Plate III: The fire horse, extinguisher and alarm button.

Source: Author's work, (2021).

Plate IV: The fire sprinkler and smoke detector.

Source: Author's work, (2021).

iii. Construction/Building Regulations: The shopping centre maintains a 3m height between the elevator and the emergency escape. The emergency exit is 1.8 meters long and not enclosed (Plate V).

Plate V: The exit door.

Source: Author's work, (2021).

iv. Design of the website: Although the floor coverage area is less than typical, the site is well landscaped. Examples of hard and soft design elements used on the facility include a pedestrian paved path, street level parking spaces, Krebs lighting features, sculptures, and a water fountain. Soft elements include green areas and plants, which include trees of various species.

v. Circulation/Layout: Pedestrians are assigned walking paths upon arrival, which are usually in the most convenient location. Vehicle owners do not need to depart subterranean parking through the surface entry since there is another significant access on the basement floor.

Stairs and two panoramic elevators provide vertical circulation in the central atrium. This includes both vertical and horizontal movement patterns.

4.1.3 Deduction

The shopping mall's navigation was made easier by the simple open plan architecture, which uses signage and graphics to aid mobility. Inadequate parking space and a lack of a clearly defined vehicle servicing door were also discovered as architectural issues.

4.2 Case Study Two: Silverbird Galleria, Abuja.

Silverbird Galleria is located at Plot 1161, Memorial Drive, by Musa Yar"adua center business district, Abuja, Nigeria. The shopping plaza is own by Silverbird Corporation and opened for public use in May, 2004.

Plate VI: The front view of Silverbird Galleria, Abuja.

Source: Author's work, (2021).

4.2.1 Historical Background:

In Abuja, the Silverbird Gallery is a retail and recreational institution. It is located in a posh portion of the commercial centre, built to appeal to the middle and upper classes of the community (Plate VI).

4.2.2 Variables

i. Construction materials: The major construction materials for Silverbird are concrete, sandcrete blocks, and steel lattice frames for the roof. Alucobond is used to cover several portions of the structure. Glazing is used to decorate the front entryway. The inside has a fire-resistant ceiling, a glass divider, and terrazzo flooring.

ii. Availability of firefighting instruments: The building includes fire control facilities on each story that are visible from every corner, entry, and exit. In the case of an emergency fire, there are additional fire safety signs and indications to help (Plate VII).

Plate VII: The fire control horse reel and water sprinkler with HVAC.

Source: Author's work, (2021).

iii. Building Codes/Construction: The shopping centre is set back from the access road by 6 meters, which connects the pedestrian walkway to the main entrance. There is a well-planned driving way that leads to the parking lots. The ground level has approximately 4.5 m of headroom. The emergency escape is visible from the entry, and the emergency signs are positioned at various angles (Plate VIII).

Plate VIII: The emergency sign and exit door.

Source: Author's work, (2021).

ix. Site Layout: The home is well-landscaped, including a fountain at the front entrance. Parking spots have been organized. The main entrance is on the north side of the building, while the service entrance is on the east side (Plate IX).

Plate IX: The water fountain by the main entrance of the building.

Source: Author's work, (2021).

v. Circulation and Design: The mall used the circuit layout paradigm, in which the anchor stores are strategically placed to aid in pedestrian traffic control.

4.2.3 Deduction

There are well-organized, high-security parking lots at the retail center. The mall's traffic can be controlled because to the layout's simple design. Poor fire safety instrument maintenance is one of the architectural issues discovered at this retail mall, and the shopping center is heavily reliant on artificial lighting and ventilation.

4.3 Case Study Three: Willow Shopping Mall, Townsville.

Willow Shopping Mall is located along Thuringowa Dr river Road, thuringawa central QLD 4817, Australia. The shopping plaza is own by Dexus Properties and opened for public use in February, 2009

4.3.1 Historical Background

Willow retail mall is located in Townsville, one of Regional Queensland's fastest developing cities, and is owned by Dexus Wholesale Property Fund. A total of 750,000 customers pass through the mall's doors each month.

Willows' shopping mall had 30, 800 square meters of lettable space at the time, with three big tenants and 90 minor shops. It would result in a total of 18,000 square meters of lettable area (Plate X).

Plate X: The layouts for level 1, level 2, level 3 and level 4.

Source: Johansson, (2011).

4.3.2 Variables

i. Construction Materials: The concentrated high density fiberglass wool suspended torrefaction is the principal building material utilized by the willow retail mall for fire protection. In the case of a fire, a certain style of ceiling stops flames from spreading. It also features steel frames that are covered by bulletproof glass on the building's façade.

Plate XI: The suspended compound high density ceiling.

Source: Johansson, (2011).

ii. Availability of Fire Control Instruments: The retail mall is well-equipped with fire-control equipment that are easily accessible to both tenants and employees at key locations. Fire alarms, smoke detectors, and blinking indicators are all available. Between the major stores, the retail complex includes three emergency exits.

iii. Site Design: The shopping center is attractively manicured, with two access gates, one from the diamond boulevard road and the other from the iron horse path. There are plenty of parking places at the retail center, and the natural scenery has been conserved as well.

Plate XII: The site plan of Willow shopping mall.

Source: Johansson, (2011).

iv. Layout And Circulation: The willow shopping mall follows the circuit's horizontal structure, with anchor businesses at the apex, allowing for easy circulation and minimum traffic.

4.3.3 Deduction

The retail center features a well-thought-out layout, with fire-resistant materials on all floors. The distance from the building's core to the escape route is relatively long, and the architecture relies only on artificial ventilation and cooling, according to the architectural difficulties discovered in this retail mall.

4.4 Case Study Four: Bullring Shopping Mall, Birmingham.

Bullring Shopping Mall is located in Birmingham, United Kingdom. The shopping plaza is own by Hammerson and it was designed by Benoy. It was opened for public use in September, 2003.

Plate XIII: Looking towards Bullring Shopping mall from St. Martin's square.

Source: Michael Betts, (2014).

4.4.1 Historical Background:

The original Bull Ring (1964), which started the century of shopping facilities in the United Kingdom and Europe, was formerly located in Birmingham, England's second largest city. By constructing the new Bull Ring in 2003, the region known as "the city of a thousand firms" rebuilt the same land to produce another cutting-edge shopping environment less than 40 years after the first. With the planning door firmly shut to future enclosed retail settings, the newest Bullring corrects many of the prior mistakes and represents one of the last enclosed shopping environments in the UK town centre. Bullring is a larger town center mall than its counterparts in Reading and Southampton. The shopping complex covers 10.5 hectares (26 acres) and provides 110 000m2 (1.2 million ft2) of space with 146 businesses and two department stores.

4.4.2 Variables

i. Construction Materials: The Bullring retail complex intended to develop with recycled materials. The materials utilized include natural stone (limestone) flooring, plaster ceilings, and metal balustrades. The primary construction material is a glass roof with Sky Plane. The "sky plane's" glass roof is made out of planar glazing hanging on main steel trusses on the exterior (Plate XIV). The roof's tiny enclosure allows for the most engagement with the outside world. This type of roof, in a retail setting, is a break from the different vaulted roofs that often surround public areas, and so represents a move toward covered streets that reflect the urban agenda. The resulting interior areas are vibrant and mostly illuminated organically during daytime hours. Despite this, the interiors are manually heated and refrigerated to maintain a comfortable temperature.

Plate XIV: The glass sky plane roof floats over the street on the top level.

Source: Michael Betts, (2014).

ii. Instruments for Fire Control Availability: One of the concerns identified in the design brief for this retail complex was fire prevention. It features smoke detectors, fire alarm systems, sprinklers, and a smoke-free refuge where occupants may leave before receiving aid in the case of a fire.

iii. Circulation and Layout: Between the three floors, pedestrian traffic are evenly divided. This is accomplished by utilizing the site's level fluctuation to create an effective ground floor entry to each story. The triangle layout is an organizational design in which none of the three levels create the overall pattern independently. The triangle is created by layering the three layers on top of each other. On either side of the new open roadway, two distinct wings symmetrically placed with an implied relationship make up the top and middle floors. Only on the lower level, where the dumb-bell mall connects the two department shops, are the two sides physically connected. The dumb-bell mall unites the three stories vertically and

literally binds everything together. The knuckle areas at the mall's end receive several paths and offer access to each of the department stores. The dumb-bell mall connects the three stories vertically and physically connects the building. Knuckle areas at the mall's end receive numerous paths and serve as entrances to each of the department stores.

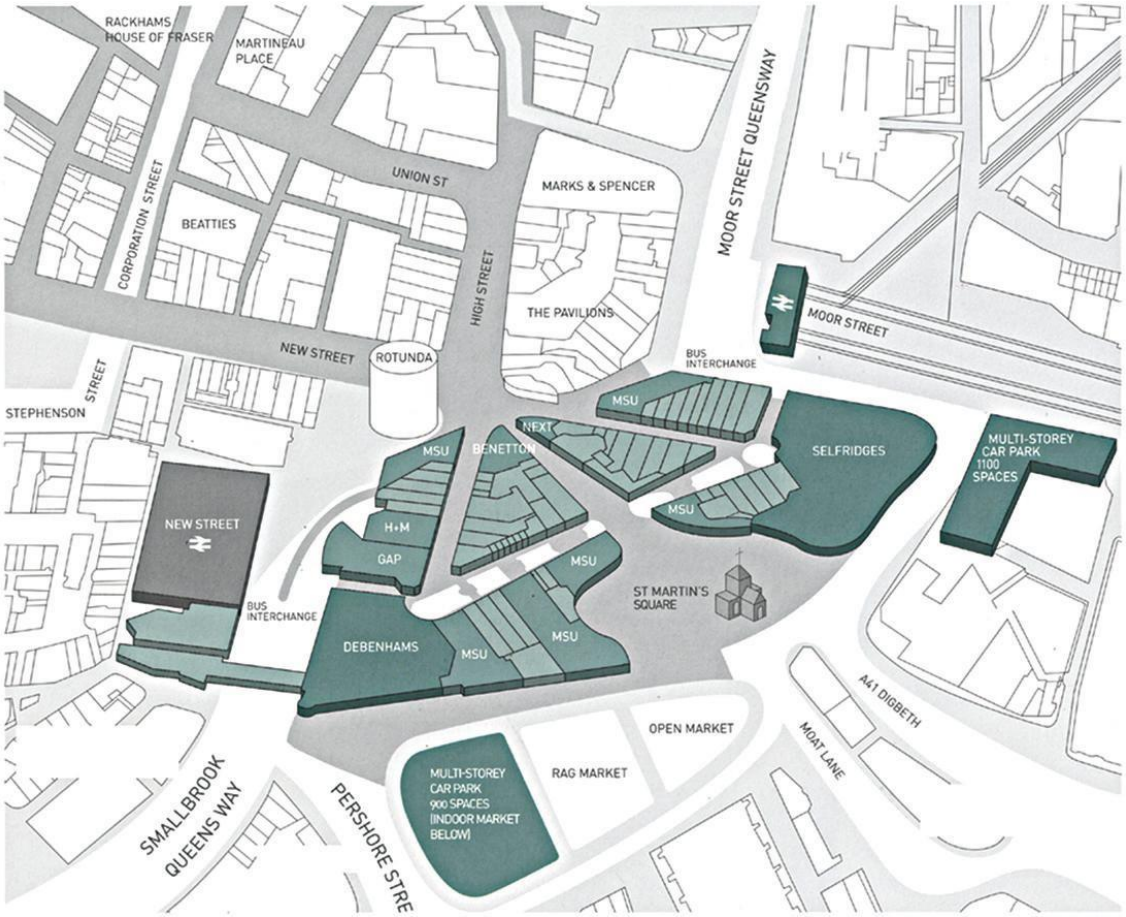


Plate XV: Integration with the city is depicted in this location plan.

Source: Michael Betts, (2014).

Plate XV: The three level naturally lit enclosed space looking from Debenhams.

Source: Michael Betts, (2014).

4.4.3 Deduction

The shopping center has a well-defined pedestrian walkway. It includes skylights in the lobby and lounge that offer natural mall lighting. The shopping center also has a well-built HVAC system. Lack of capacity for future development and overcrowding of parking spots are among the design issues discovered.

4.5 Summarized Observation of Variables Across Case Studies

As established earlier the listed variables for fire safety measures in a shopping mall can be grouped into passive and active factors. The passive variables include the types of building material, design layout and circulation and site design while the active variable is the availability of fire control equipment the mall.

4.5.1 Types of Building Material

Table 4.1 Types of building material

S/N	**Name of Shopping Mall**	**Fire Resistant Wall**	**Fire Resistant Door**	**Fire Resistant Floor**	**Fireproof Ceiling**
1	Ceddi Plaza, Abuja	25%	50%	50%	75%
2	Silverbird Galleria, Abuja	50%	50%	75%	75%
3	Willow Shopping Mall	100%	75%	75%	100%
4	Bullring Shopping Mall	100%	75%	100%	100%

Remarks: 0% - Very Poor, 25% - Poor, 50% - Fair, 75% - Good, 100% - Very Good

Source: Author's work, (2021).

4.5.2 Availability of Fire Control Equipment

Table 4.2 Availability of Fire Control Equipment

S/N	**Name of Shopping Mall**	**Smoke/Fire Detectors**	**Fire Hydrant**	**Water Sprinkler**	**Fire Extinguisher**
1	Ceddi Plaza, Abuja	75%	75%	75%	75%
2	Silverbird Galleria, Abuja	75%	75%	75%	75%
3	Willow Shopping Mall	100%	100%	100%	100%
4	Bullring Shopping Mall	100%	100%	100%	100%

Remarks: 0% - Very Poor, 25% - Poor, 50% - Fair, 75% - Good, 100% - Very Good

Source: Author's work, (2021).

4.5.3 Design Layout and Circulation

Table 4.3 Design Layout and Circulation

S/N	**Name of Shopping Mall**	**Compartmenta-lization**	**Head Room**	**Size of Emergency Exit Opening**	**Distance to Emergency Doors**
1	Ceddi Plaza, Abuja	50%	50%	75%	50%
2	Silverbird Galleria, Abuja	75%	75%	75%	75%
3	Willow Shopping Mall	75%	100%	100%	50%
4	Bullring Shopping Mall	100%	100%	100%	75%

Remarks: 0% - Very Poor, 25% - Poor, 50% - Fair, 75% - Good, 100% - Very Good

Source: Author's work, (2021).

4.5.4 Site Design

Table 4.4 Site Design

S/N	**Name of Shopping Mall**	**Soft Landscape**	**Building Setbacks**	**Service Entrance & Exit**	**Parking**
1	Ceddi Plaza, Abuja	50%	75%	75%	50%
2	Silverbird Galleria, Abuja	50%	75%	100%	50%
3	Willow Shopping Mall	75%	100%	100%	100%
4	Bullring Shopping Mall	75%	100%	100%	75%

Remarks: 0% - Very Poor, 25% - Poor, 50% - Fair, 75% - Good, 100% - Very Good

Source: Author's work, (2021).

4.6 Summary of Findings

The importance of fire safety in shopping mall cannot be over emphasized. Proper consideration of fire protection measures in shopping malls design would save lives and properties.

i. The finding showed that active fire protection measures had the highest level of consideration. Foreign case studies are 100% equipped with fire-fighting tools.
ii. The level of importance given to the usage of fireproof building materials in Nigeria shopping mall is low, taking less than 50% remarks.
iii. The design consideration for the service entrance and exits was adequately considered and planned to a level of 95% remarks.
iv. Compartmentalization and wide size of emergency exit openings are another passive measures taken in all case studies.

CHAPTER FIVE

5.0 PROPOSDE SHOPPING MALL, ABUJA

5.1 Geographical Information

5.1.1 Proposed Site and Location

The planned shopping mall is located in Garki II, Nigeria's Federal Capital Territory's first stage. The federal capital territory is situated above the hot, humid lowlands of the Niger/Benue valley, but below the hot, dry savannah areas to the north. Abuja is located between 8 ° 25 and 9 ° 20 "latitudes north of the equator and 6 ° 45 and 7 ° 30 lengths east of the Greenwich meridian in the Nigerian savannah park. The city of Abuja has an area of 8000 square kilometers. It is bordered on the north by the state of Kaduna, on the east and southeast by the state of Nassarawa, on the southwest by the state of Kogi, and on the west by the state of Niger.

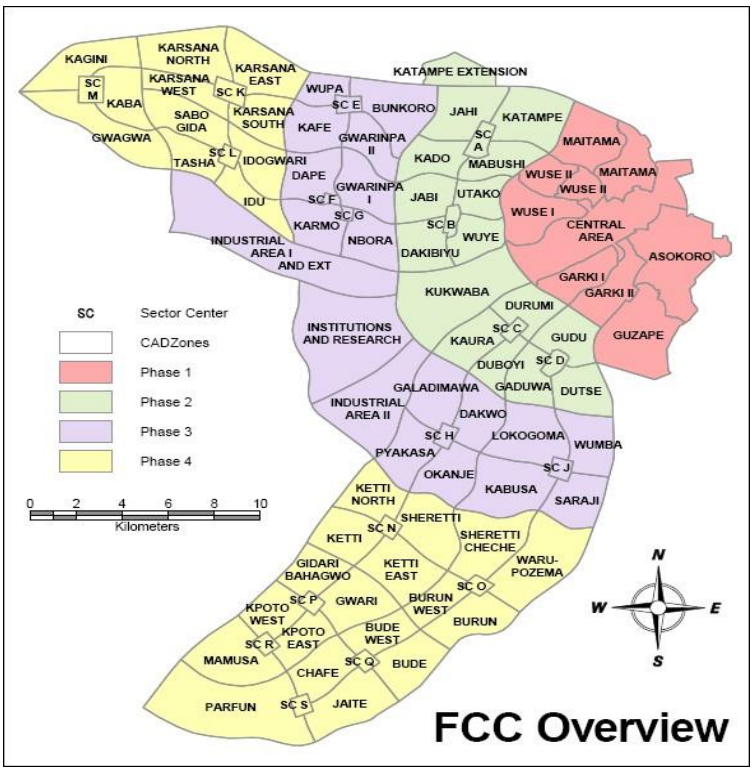


Figure 5.1: Phase 1-4, Abuja.

Source: Frank, (2008).

5.1.2 Site Analysis

Taking an inventory of site features and assessing these aspects in relation to the research goals was part of the site analysis for this study. The site's characteristics, including terrain, climate, wind directions, and noise, were acquired, analyzed, and included into the design.

5.1.2.1 Physiography

Undulating topography is interspersed by riverfront depressions in this location. The inselbergs jutting from the plains provide a visual scale. Uplands and plains with numerous inselbergs, rock, and grasses of varying sizes make up the central and southern access.

5.1.2.2 Geology

The rocks under the FCT site are divided into three types, as defined by Frank (2008):

a) Metamorphic rock: biotite–muscovite, schist, confined to four short outcrop areas along ridge tops near the site's eastern border. Porphyry, migmatite, and migmatite underpin the majority of the district. The Usman River Valley in the northwest of the city is underlain by gneiss, as is granite gneiss.

b) Igneous Rock: massive intrusive masses, generally elliptical in shape, that create dissected portions of the Zuma-Bwari-Aso hills and outcrops of the Gwagwa plains, similar to Biotite Granite.

c) Sedimentary rock: alluvium deposited in streams over the area, mostly sand with some unique gravel beds and small clay deposits.

5.1.2.3 Surface Water

When seen vertically, a network of stream valleys and depressions encircling the city site forms a rough fan shape, draining a crescent of the building area. The fan converged on the

Usman River south of the airport. As a result, the capital's location may be divided into tiny continuous watersheds that all meet at one point.

5.1.2.4 Soils

Granite gneiss underpins the capital's soils, whereas magmatite lies beneath the plains of Gwagwa. The appropriateness of different sizes, occurrences of iron pans, form, erodability, run-off capacity, and drainage for building land uses varies. When it comes to foundations, roadways, and underground utilities, severe restrictions occur when soils are shallow, solid, locally rich in swelling clays or iron pan, or poorly drained.

5.1.2.5 Vegetation

The flora of the capital city is distinguished by savannah parks. The riverine depressions are usually surrounded by thicket fringes and tall trees. Occasionally, there are forest pastures or densely wooded regions. A layered environment with a discontinuous layer of tree, shrub, and grass is typical of a Savannah park. The tree stratum is less thick than a savannah forest, but it is larger than a savannah shrub (Figure 5.2).

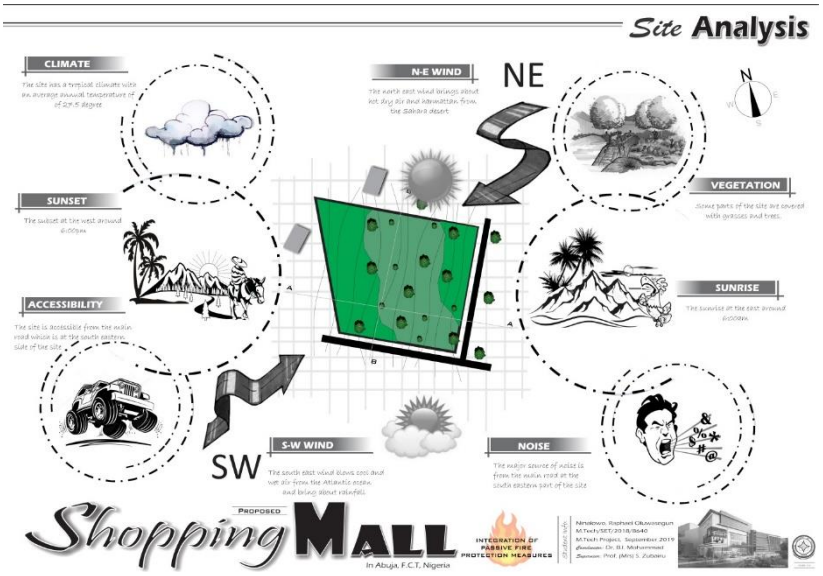


Figure 5.2: The site vegetation, noise, and topography.

Source: Author’s work, (2021).

5.1.2.6 Climate

The climate of the FCT is similar to that of the Guinean savannah. The table below depicts the average monthly weather conditions in Abuja (Figure 5.2).

a) Temperature: During the dry season, the highest temperatures are recorded. Temperature changes of up to 18 degrees have been observed during the day. Due to extensive cloud cover, cooler temperatures occur throughout the rainy season, especially during the month of August.

b) Humidity: During the rainy season, high levels of humidity are common. Humidity levels generally decline during the dry season, which lasts from November to March.

c) Rainfall: The rainy season begins in April and ends in October. On average, the rainy season lasts 185 days.

d) Wind: There are two primary air masses that affect the Federal Capital Region: tropical maritime air masses and tropical continental air masses. The tropical sea air mass forms over the Atlantic Ocean to the south of the nation, making it warm and humid. The tropical continental stretches from south-west to north-east over the Sahara desert, making it warm and dry, and blowing from north-east to south-west. The dry season brings the tropical continental air mass, whereas the wet season brings the tropical sea air mass.

e) Sun and Cloud Cover: As you go north of the Atlantic coast, you'll notice an increase in overall sunlight hours. The amount of time spent in the sun varies from a minimum of 1300 hours in Abuja to more than 3200 hours in the country's far northeast (Table 5.3).

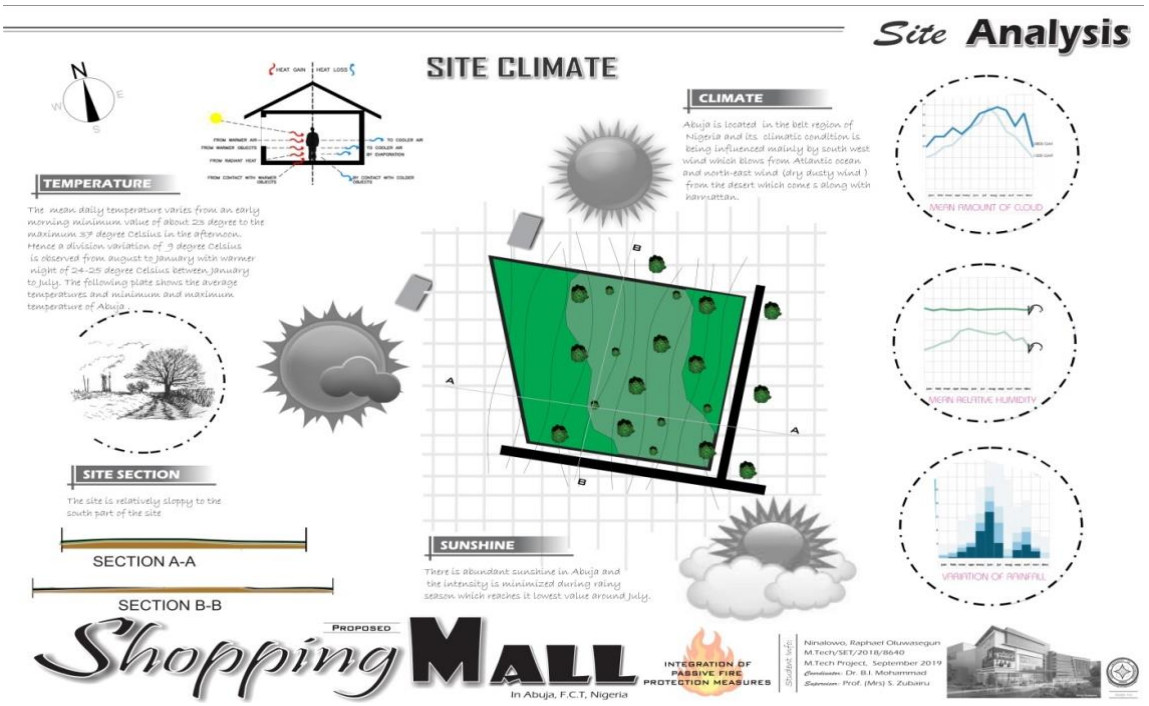


Figure 5.3: The climate analysis

Source: Author's work, (2021).

5.2 Landuse

The chosen location is in Phase 1 of Abuja's core business area. The area is set aside for commercial and administrative structures. The area is bordered by legislative quarters, the Ajuji Greenwhich hotel, and the Apo mega market, and is accessible through the inner northern highway.

5.3 Site Selection Criteria

When it comes to the development of a shopping mall, site selection is critical, and great attention should be given. For the purposes of this study, two sites were chosen. Phase 1, Garki Abuja (Figure 5.4) in the central market is one of the locations. The second location is located in the core business center, near the NNPC headquarters (Figure 5.5).

Figure 5.4: Proposed location for site 1 Apo, Abuja.

Source: Author's work, (2021).

Figure 5.5: Proposed location for site 2 central district area, Abuja.

Source: Author's work, (2021).

According to Odinaka (2014), the placement of a shopping mall is determined by a variety of criteria such as the physical qualities of the site, the demography of the surrounding region, and so on. Such criteria were established in order to evaluate the sites and determine the viability of each site in relation to those characteristics.

Odinaka (2014) detailed the prerequisites, as well as the particular considerations that were addressed while considering the location.

a) General Location

It is applicable to all metropolitan areas. It is critical to examine both physical and geographical factors. Population (density), company data, and neighborhood are only a few of the broad location factors.

b) The location of the site

The site is a specific piece of property; parking facilities, utility and public service accessibility, amenities, and visibility are all aspects that are connected to, but not limited to, the site's location.

c) Statistics on the population

Consumer data, such as age, gender, occupation, employment, dietary preferences, and future growth potential, must be acquired.

d) Traffic Pattern

Flow patterns of traffic are crucial for site analysis. Traffic counts and trends, as well as the frequency pattern of traffic flow, are all variables that affect traffic.

e) Competition

Competition factors include, but are not limited to, the results of rivals' positions and activities, as well as their closeness to other competitors.

These are the five most important criteria to consider while deciding on a good location for the planned shopping mall.

A relative score was assigned to each criterion, as shown in the scoring sheet described below. The ratings range from 1 to 5. The position with the highest score is the most appealing.

Table 5.1: Site Selection Criteria.

CRITERIA	**SITE 1 (GARKI)**	**SITE II (C.B.D)**	**REMARKS**
Proximity to Firefighting service	5	3	Site 1 (satisfactory)
Traffic information	4	3	Site 1 (Satisfactory)
Competition	2	3	Site II (Satisfactory)
Proximity to market targert	5	2	Site 1 (satisfactory)
TOTAL	20	16	

Source: Author's work, (2021).

Weighing scale: Excellent 5, Very good 4, Strong 3,Weak 2, Very Weak 1.

5.4 Organization of Space

In terms of utilization and circulation functions, the spatial relationship between separate areas demonstrates how the spaces are connected and interconnected. The bubble diagrams and flow charts depict the strength of the link between spaces from strong to weak (Figure 5.6).

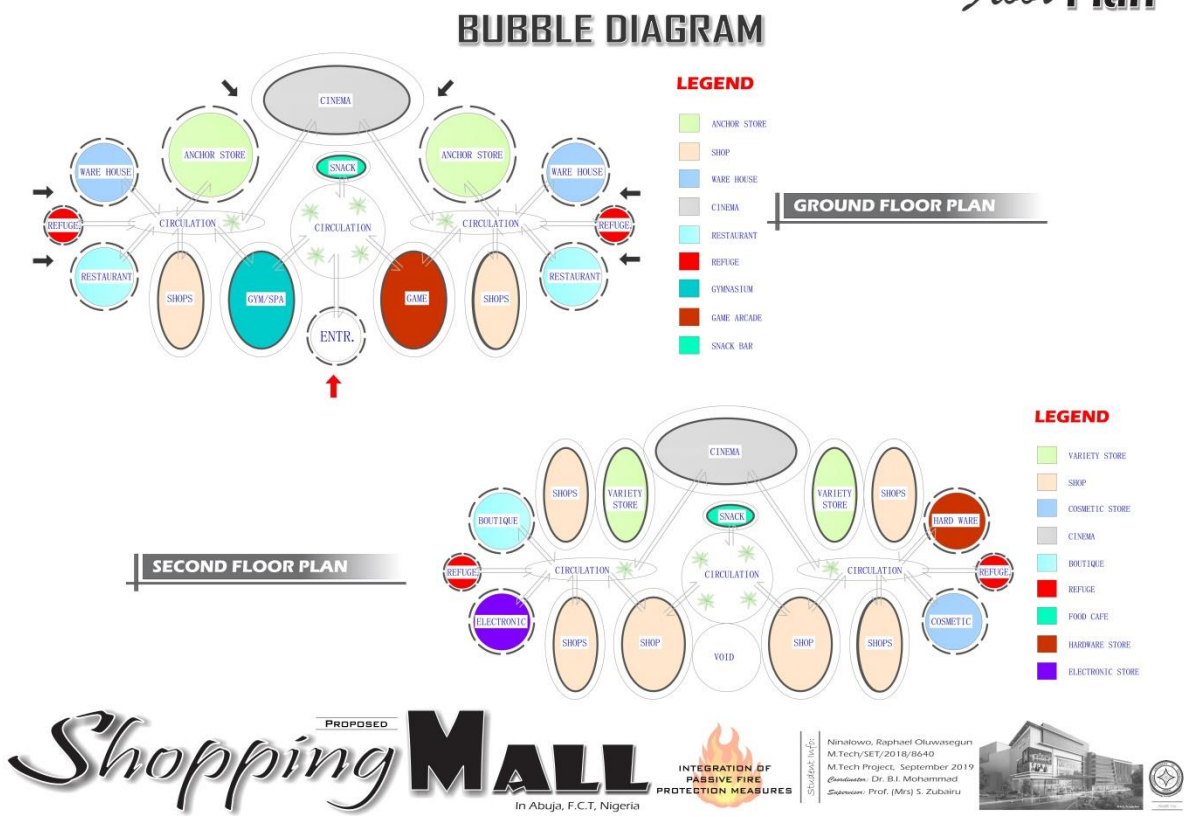


Figure 5.6: Special organisation of the design.

Source: Author's work, (2021).

5.5 Design Inferences from the Site Analysis

The site study completed in the design proposal will be utilized to determine the following criteria.

i. Access to the site is through the secondary road that surrounds the eastern portion of the property; the facility's entrance will be on the northern side of the secondary road that connects to the main road.

ii. The structure was designed to maximize natural sunlight and ventilation while minimizing heat gain. Openings must be shaded from the sun. The project must use natural sunshine and make an attempt to prevent solar heat gain and glare.

iii. The temperature of the site will be controlled by extensive site landscaping, which will chill the outside environment and decrease solar heat gain from reflected solar radiation, which causes glare and excessive solar heat gain.

iv. The walkways will be large enough to accommodate visitors as well as serve as an escape route in the event of an emergency.

v. The site will be landscaped extensively to mitigate the effects of strong harmattan winds and dust from windy weather, which might spread fire in the case of a fire.

vi. To allow for views, the parking space will be located in the southern section of the property.

5.6 Design Report

5.6.1 Design Brief

The proposed shopping mall should be viewed as a design thesis for a shopping complex that would have amenities to cater to all shopping categories on a regional level.

The suggested structure will consist of a single unit with integrated complicated functionalities, hoped to be a manifestation of different boosting aspects to aid Abuja's economy and improve the city's repute in our ever-changing globe

The basic goals of the proposal are to:

i. Incorporate the research thesis results into the suggested idea.

ii. Constructing physical facilities to house a variety of shops and related services.

iii. Improving a healthy shopping experience in order to save lives and property in another.

5.6.2 Design Framework

The overall design strategy of shopping malls emphasizes that the major roles are divided into stages. The main entrance, parking spaces, and the main building itself are among the stairs (Schoenherr, 2009).

5.6.3 Site Development Concept

The basis of site development is based on the current design system concept. The main structure houses the site's primary features, such as parking, service facilities, and entrances (Figure 5.7).

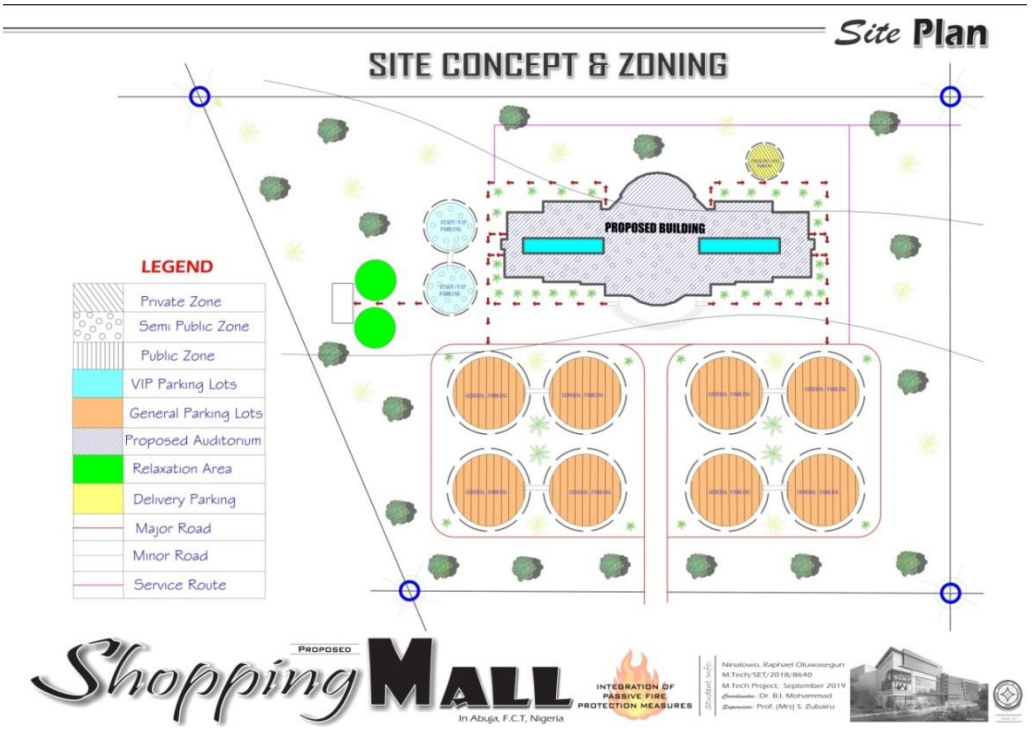


Figure 5.7**:** Site Development Concept

Source: Author's work, (2021).

5.6.4 Design Concept

The suggested commercial mall's idea is analogous to the form of a "HAND SHAKE" (Figure 5.8). Handshakes signify agreement or satisfaction in a transaction. A feeling of pleasure or a bargaining agreement between the seller and the buyer is required for a trade transaction to be regarded successful. A handshake between the buyer and the seller is used to communicate this feeling of pleasure in the western manner.

Figure 5.8: The design concepts.

Source: Author's work (2021).

5.6.5 Major Functional Divisions

The functional spaces of the shopping mall are separated into several functional divisions based on the type of the activities that take place there. All of the affected areas are grouped together. Home accessories, recreation and leisure, industrial and other activities are the four

primary functional classes. The divisions are organized by land level. The following is how the group works:

a. The bottom floor houses the anchor shop, food court, bank, furnishings, and other associated stores. This was done to make moving goods and people into and out of such stores simpler.

b. Electronics, sports equipment, and other relevant products are on the first level. This was done to make it easier for items to flow in and out of such businesses.

c. The second level houses a beauty salon, retail stores, a bookstore, a boutique, and other amenities.

d. The third level has a food court, a beauty salon, a barbershop, a children's play area, arcade games, and department stores. This is done in order to place the food court in the middle of the shopping mall, giving all customers and inhabitants an equal distance.

e. Commercial operations such as a bank, travel agency, and leasable office spaces are located on the fourth level. The latter two levels have a significantly lower amount of shoppers, making it easier to regulate traffic in an emergency. The latter two levels have a significantly lower amount of shoppers, making it easier to regulate traffic in an emergency.

5.7 The Proposed Shopping Mall Design

The suggested shopping mall design incorporates both the common worry about establishing a shopping mall and the difficulties presented by the study's conclusions. The following is a list of significant design features:

5.7.1 Design of the Site Plan

The site plan was created to answer the site development principle suggestions, while the site analysis and conceptual design structure were created to address the design issue indicated earlier. The important factors to consider are outlined in more depth below.

i. Service Entrance: In the northern side of the mall, there is a dedicated service door that allows firemen and delivery vehicles quick access.

ii. Evacuation Plan in Case of Emergency: One of the most important aspects of an emergency evacuation plan is the emergency escape route. In the event of an emergency, this path is well-planned to direct inhabitants and tourists to safe areas. The escape path is 2500 mm broad and 3200 mm from the main structure (Figure 5.9).

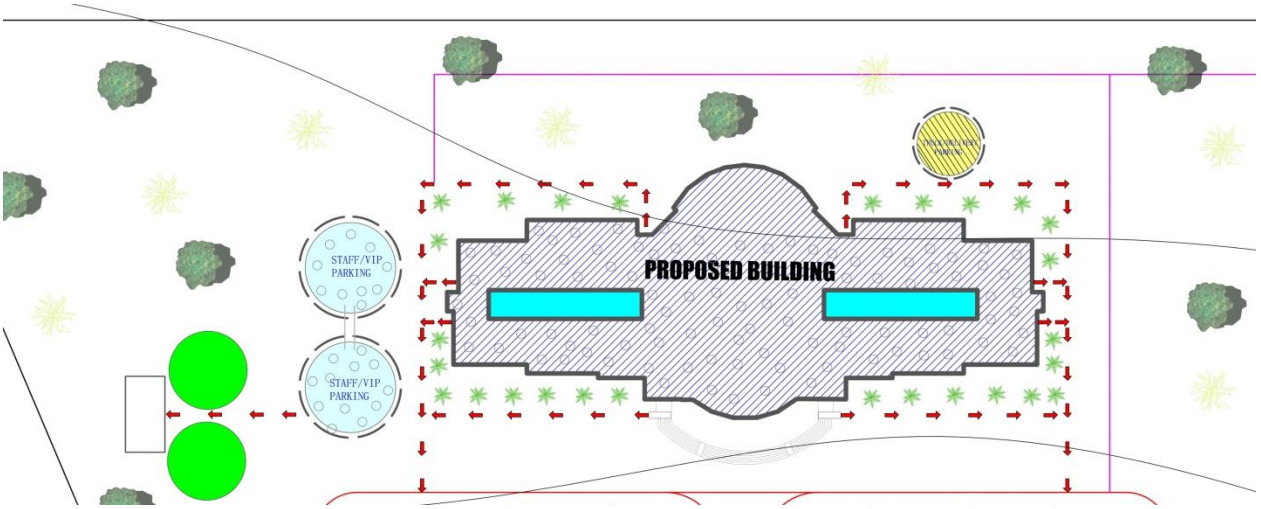


Figure 5.9: The escape path on the site plan.

Source: Author's work, (2021).

iii. Firefighters' service station/delivery station: The Firefighter Service Point is critical in the site design to allow for unrestricted mobility of the firefighting vehicle throughout the premises. The delivery location is adjacent to the service door, making loading and unloading considerably easier (Figure 5.10 – 5.11)

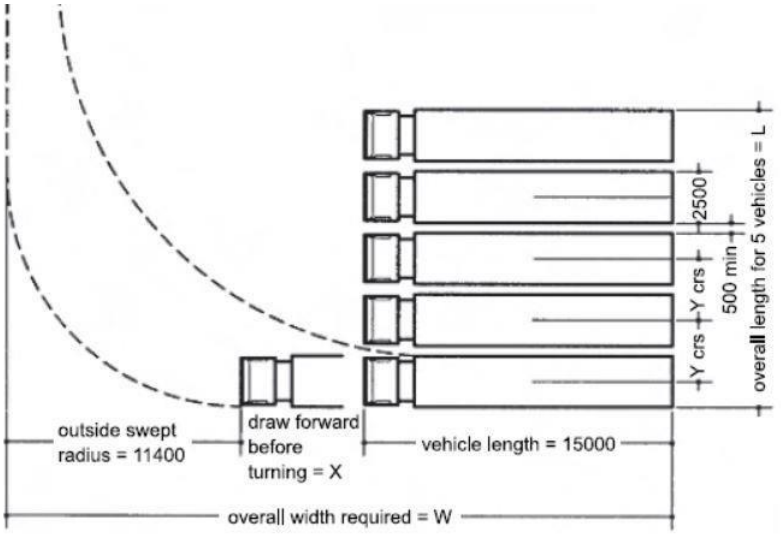


Figure 5.10: The parking and loading bay.

Source: Nuefert, (2002).

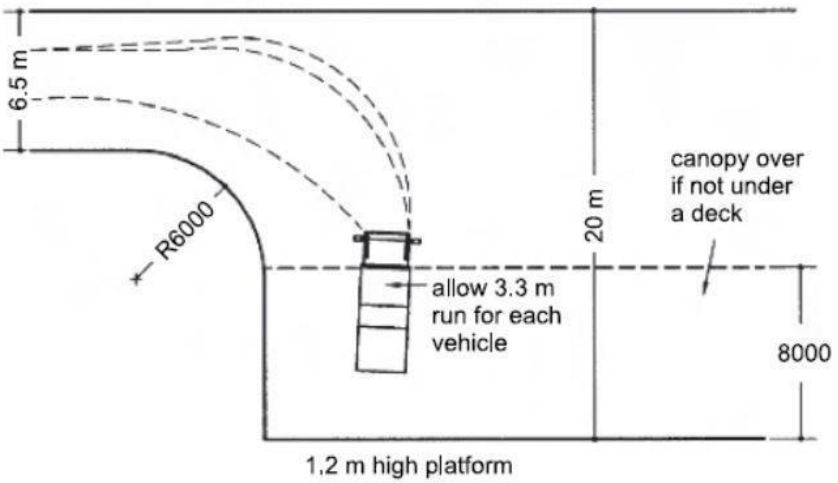


Figure 5.11: The turning radius of a service vehicle.

Source: Nuefert, (2002).

iv. Parking: There are three (3) parking options available at the retail center. Customers will have access to 300 parking spots with dimensions of 2500 mm by 5000 mm, designed in accordance with the International Shopping Mall Standards (ICSC). There are 4 GLA parking spots per 100m2= a total of 28 parking spaces for employees and 6 service parking spaces (Figure 5.12).

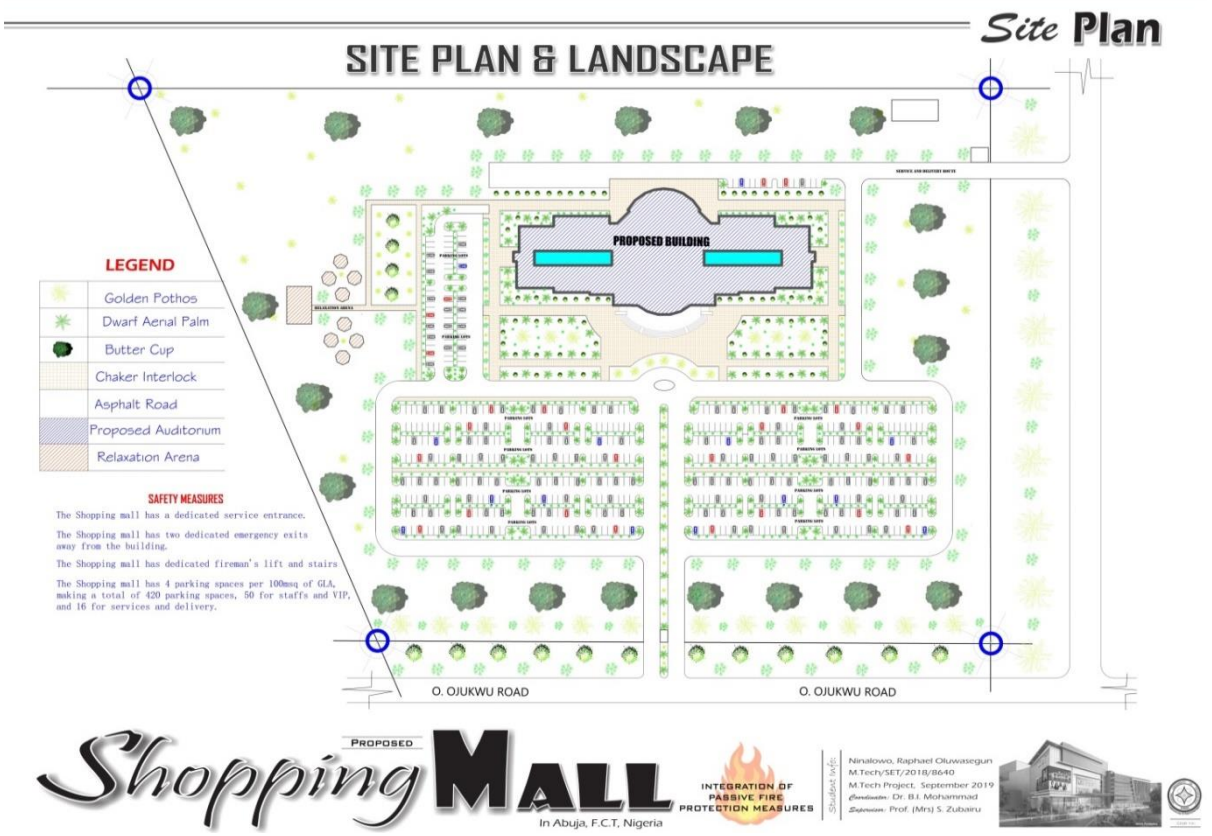


Figure 5.12: The parking spaces

Source: Author's work, (2021).

5.7.2 Circulation/Layout

The shopping complex has three entrances, with the main entrance on the southern side of the structure. The entry leads immediately to the mall's concourse, which houses the mall's circulation and shopping areas. The entry door has a 2500 mm broad clearance and is equipped with an automated sensing sliding mechanism that prevents movement blockage.

The shopping center has two exit doors that are 2500 mm wide and face the opposite direction. They are entirely obstruction-free and shoot at a rate of 1/30 second. The distance from the building's extreme point to the escape door is 38 meters, which satisfies the criteria for the maximum needed distance before any exit door. The arrangement of the retail mall is linear, with two anchor businesses acting as a magnet (Figure 5.13).

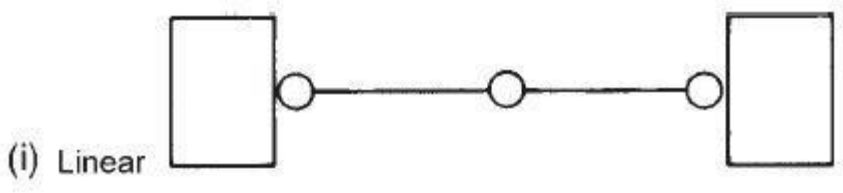


Figure 5.13: The linear layout

Source: Nuefert, (2002).

This is the most basic plan, allowing the retail mall to move about freely. The retail districts with the most footfall are the ones with the most strength. The ones with the anchor stores approaching are the busiest. As a result, the design includes provisions for accommodating traffic along that axis.

The mall's vertical circulation is managed by two major stairs and two lifts that link all of the levels from two wings. In the event of an emergency, the shopping mall includes two service elevators and a specialized fireman's lift, all of which are easily accessible to fire fighters.

5.7.3 Construction Materials

Reinforced concrete is used for the main structural elements, while steel is used for the structural frame. External cladding with glazed panels and interior partitions, rendering, and finishing with gypsum board. Other masonry sections are coated with aluminum composite panels with a local spray tile finish. Intumescent substance (sodium silicate) is sprayed over the materials, which has a fire rating of 1/30min.

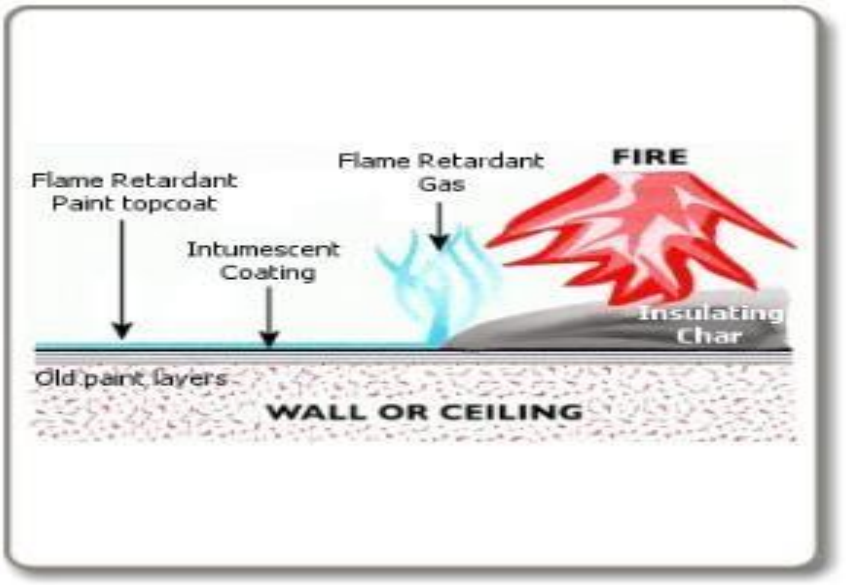


Figure 5.14: The intumescent paint works.

Source: www.astroflames.com

The structure features a glass skylight in the atrium that allows natural light to enter the space. In an emergency, the glass skylight allows for better circulation and natural lighting.

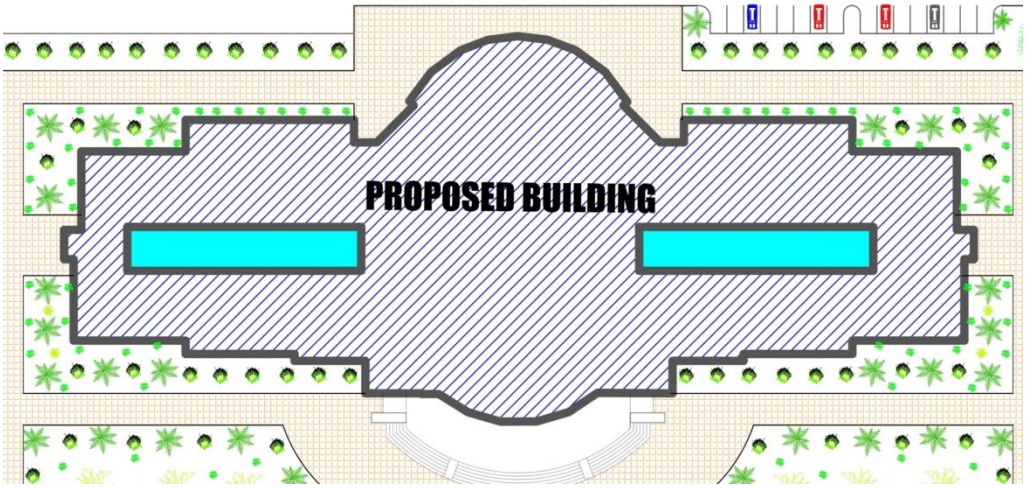


Figure 5.15: showing the glazed atrium.

Source: Author's work, (2021).

5.7.4 Fire Control Techniques

5.7.4.1 Passive Fire Control Techniques

i. Compartmentalization: In the event of a fire, the shops are all housed in fire-tightened cells that help keep a relatively modest fire in through fire-resistant walls and flooring (Figure 5.16). Because a shopping mall has a variety of flammable products of various types, the division of the stores is critical to preventing fire spread.

Figure 5.16: The compartmentalization of shops in the shopping mall.

Source: Author's work, (2021).

ii. Refuge: In the event of an emergency, a temporary space free of fire and smoke is provided for visitors and renters. It is nearly difficult to evacuate both guests and renters at the same time in the case of an emergency. The fire door of the shelter is 2500 mm

wide and self-closing. The emergency elevator and the stairwell are immediately connected by the shelter (Figure 5.17).

Figure 5.17: The area of refuge and the emergency stairs.

Source: Author's work, (2021).

iii. Smoke Reservoirs and Vents

Inhalation of smoke and hot gases are well-known to be the major causes of mortality in a fire. As a result, the structure must be designed to enable safe and smoke-free escape pathways. Where public areas will be used as a method of escape, it is extremely important to design the building to handle smoke. In these cases, it will be necessary to construct inside space to monitor and filter smoke from the clear escape zone before releasing it into the open air. The clean zone is created by allowing enough space above the public space for smoke to be retained before being collected outside. The "smoke reservoir" is the name given to this storage area.

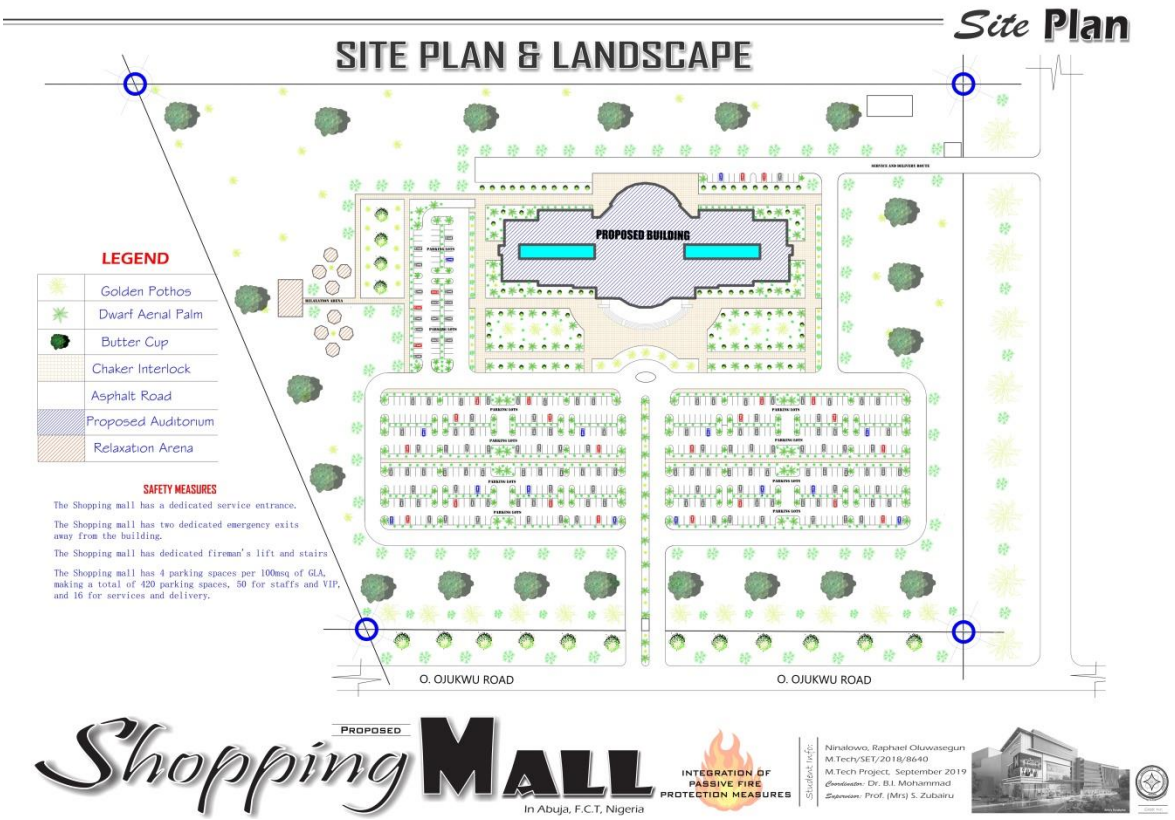


Figure 5.18: The fire escape route.

Source: Author's work, (2021).

5.7.4.2 Active Fire Control Techniques

Water extinguishing is an effective technique to control the spread of a fire and can be done in a variety of ways. Small fires can be put out with portable extinguishers and the use of hose reels. In covered and enclosed retail malls, sprinkler systems are likely to be the major source of fire suppression.

i. Fire sprinkler system

ii. Fire hydrant system

iii. Smoke and heat detectors

iv. Smoke exhaust systems

v. Standby power system

Active fire control methods to restrict the spread of fire in the case of an emergency are also taken into account in shopping mall architecture. Smoke detectors sound an alert in the event of a fire, which triggers the water sprinkler system, which disperses water throughout the mall. When there is no backup power supply, all of these will be noted. If the main water supply system fails, there is also a dead tank at the top of the building.

CHAPTER SIX

6.0 CONCLUSION AND RECOMENDATIONS

6.1 Conclusion

Shopping malls are enormous, complex constructions that house a great number of people, both customers and employees. In the case of an emergency or a fire, such structures must be built to be secure and allow all of the building's occupants to leave swiftly and securely. One of the most important and dynamic aspects in the design of practical concerns is fire safety. Architects play a critical role in ensuring that fire safety requirements are met when shopping malls are built.

According to the data, few retail malls have basic fire safety equipment and methods. The question of how to preserve such facilities, assuming they exist, is the most pressing one in Nigeria. This study explains the challenges with fire safety in shopping malls and how to solve them via smart design.

6.2 Contribution to Knowledge

The study focused on both passive and active strategies for preventing fire in shopping malls and identified the primary sources of fire breakouts in mall, which includes electrical and mechanical faults. The study also revealed how these passive and active techniques may help save lives and properties by offering the optimal layout and evacuation procedures.

6.3 Recommendations

In order to establish a healthy shopping environment, it is recommended that the following aspects be taken into account.

i. Construction in accordance with the criteria of the fire code (National Building Code).

ii. Checking buildings for flaws on a regular basis, issuing Orders to Comply, and perhaps penalizing or shutting non-compliant structures until the problems are remedied or, in severe circumstances, demolished.

iii. Keeping adequate fire exits and exit signage in place (e.g. exit signs pointing at them which may function in a power failure)

iv. Adherence to electrical regulations to prevent overheating and ignite caused by electrical flaws or difficulties such as insufficient wire insulation or overloading wiring, conductors, or other electrical-current fixtures above their rated capacity.

v. Safe storage and handling of hazardous items that may be necessary for storage or operational needs inside the structure (such as solvents in spray booths).

vi. An evacuation plan should be posted in other key locations around the shopping mall to assist consumers and tenants in the case of an emergency.

REFERENCES

Adebowale, E. (2010). Map of Abuja: Abuja Geographical Institute. Retrieved July 5, \ 2011 from http://www.fcda.gov.ng

Barry, M. (2012). *The New Architecture of the Retail Mall.* London: Architecture Design and Technology Press. p155.

Brewer, P.F, and Bennetts, I.D. (2003). *Review of Fire Safety in Shopping Centres: The key Issues* (Fire Code Reform Centre Project 6), BHPR/SM/6/060, Feb 2003

Cohen, E. (2003). *America's Marketplace: The History of Shopping Centres.* New York: Greenwich Publishing Group. p127

David, B. (2006). British Council of Shopping Centres. Retrieved March, 2011 from http://www.bcsc.org.uk

Dewey, J. & Bentley, A. F. (1949). *Knowing and the Known.* Beacon, Boston: MA, 334.

Harrison, M. (2007). *People and Shopping: A Social Background.* New York: Greenwich Publishing Group. p79

James R. DeLisle. (2005). *Shopping Centre Classifications: Challenges and Opportunities.* Retrieved September 14, 2014 from www.reuw.washington.edu

John R. H. (2014). *Fires Starting with Flammable Gas or Flammable Liquid or Combustible Liquid.* Retrieved February 23, 2014 from www.nfpa.org

Martin, M., and Andrew, O. (2005), *Introduction to Fire Safety Management.* Architectural Press, Cambridge, England. p56.

Martine, H. (2004). *British Council of Shopping Centres.* Retrieved March, 2011 from http://www.bcsc.org.uk

NEMA (2015). Fire Disaster: *Fire outbreaks in Nigeria Shopping Malls*. Retrieved July 5, \ 2014 from http://www.nema.gov.ng

Odinaka, M. (2014). *Retail boom spikes as investors develop malls in 10 cities*. Retrieved August, 2015 from www.businessdayonline.com/2014/05/retail-boom-spikes-as- investors-develop-malls-in-10-cities

Oladokun V.O, (2010). A Risk Analysis Model for Fire disasters in Commercial Complexes in Nigeria: *Pacific journal of science and technology, Volume 1.*

Oluigbo, S. N. (2011). Case studies in Architectural context, paper presentation in the department of Architecture, Ahmadu Bello University, Zaria

Opara, N. L. (1988). A Modern Shopping Complex Victoria Island, Lagos. *Unpublished M.Sc (Architecture) Thesis ABU, Zaria Nigeria.*

Peter, C. (2006). *Shopping Environments Evolution, planning and Design.* Architectural Press, oxford, London, England. p.423.

Pevsner, N. (2004). *A History of Building Types.* Architectural Press, Cambridge, England. p56.

Robert, D. (2002). *Shopping Centres Futures*. Future Foundation Press. p.9

Saniya, T. and Sabir, A. (2014). An Investigation on Fire Safety of Air- conditioned Shopping Centers at Dhaka City. *Asian Journal of Applied Science and Engineering,* p. 17

Schoenherr, S.E. (2006). *Evolution of the Shopping Center.* Retrieved October 12, 2008 fromhttp://history.sandiego.edu/gen/soc/shoppingcenter.html

Scott, N. (2000). *Shopping Centre Design, Van Nostrand Reinhold*. Retrieved March, 2011 from http://www.bcsc.org.uk

Suleiman, J. (2000). *A modern shopping complex: A study of the impact of recreation on the design of shopping complex.* Unpublished MSc. Thesis, Department of Architecture, A. B. U. Zaria, Nigeria.

Tutt, P, and Adler, D (2008). *New Metric Handbook: Planning and Design Data.* Architectural Press, oxford, London, England. p. 113.

Veal, F. (2013). *Mall Centres: A Study of the Mall Shopper Space Development, Design and Spatial Requirements*. New York. Touch stone:

West, M.(2006). *British Council of Shopping centres*. Retrieved March 2011 from http://www.bcsc.com

Yin, H. (2004). *Making Asia Environmentally stable:* Retrieved May 2020 from http://www.asiaplace.com

APPENDICES

Appendix A: An observation schedule on integration of passive fire protection measures in the design of shopping mall in Abuja.

PART A - ABOUT THE SHOPPING MALL

1. Name of the shopping mall

   ……..…….....

2. Location of the shopping mall

   …….…….....

3. Year of construction

   ……

4. Number of floors

   ……

5. Type of design adopted for the mall

   ……..……

PART B

Types Of Building Material

a) Fire resistant Wall

   ……..…….....

b) Fire resistant Door

   …….…….....

c) Fire resistant Floor

   ……

d) Fire-proof ceiling

   ……

Further observation on the building material if the above does not fully explain the materials

……

……

Availability of fire control equipment

a) Smoke/fire detector

……

b) Fire hydrant

……

c) Water sprinkler

……

d) Fire extinguisher

……

Further observation on the fire control equipment if the above does not fully explain the equipment

……

……

Design Layout and Circulation

a) Compartmentalisation

……

b) Head room

……

c) Size of emergency exit opening

……

d) Distance to emergency doors

…….

Further observation on the design layout and circulation if the above does not fully explain the layout

……..……

……..……

Site Design

a) Soft and hard landscape

……..…….....

b) Building setbacks

…….…….....

c) Service entrance and exits

…….

d) Parking area

…….

Further observation on the site design if the above does not fully explain the design

……..……

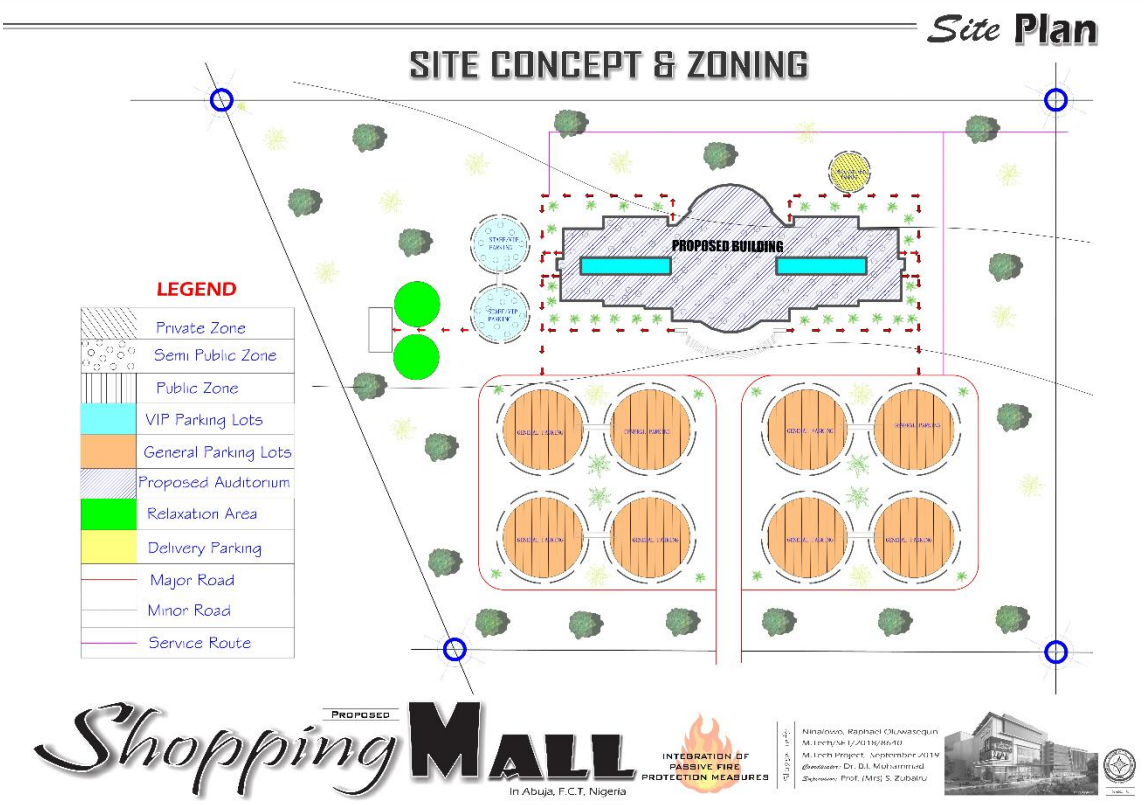
……..……

Summary of Case Study…….

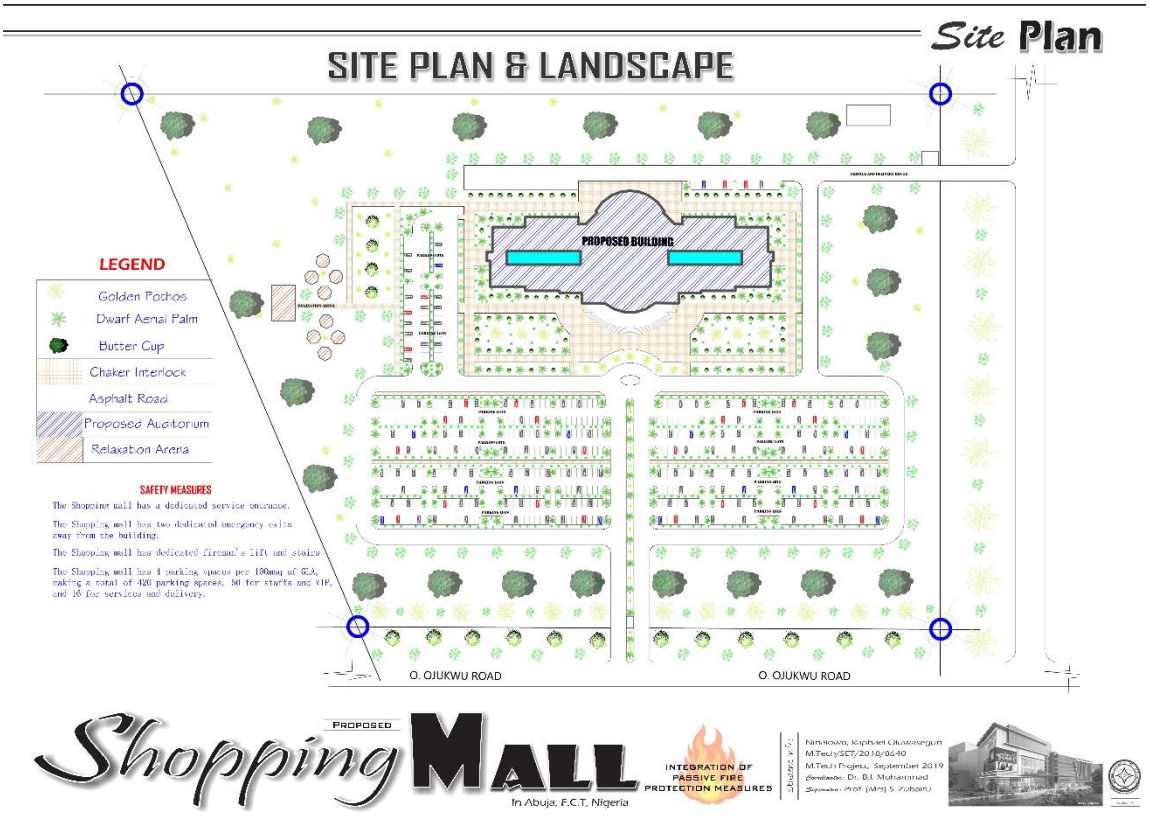
……..…….....

……..…….....

……..…….....

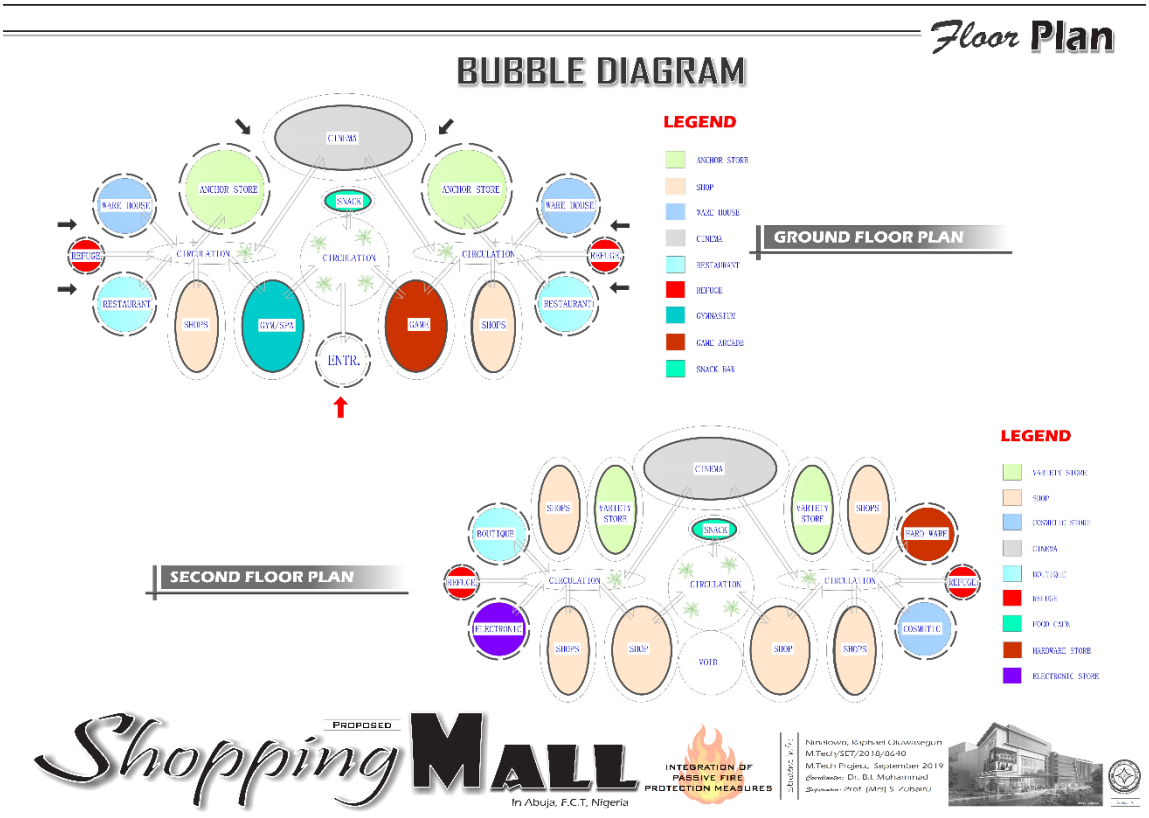


Appendix B: Site Concept and Zoning



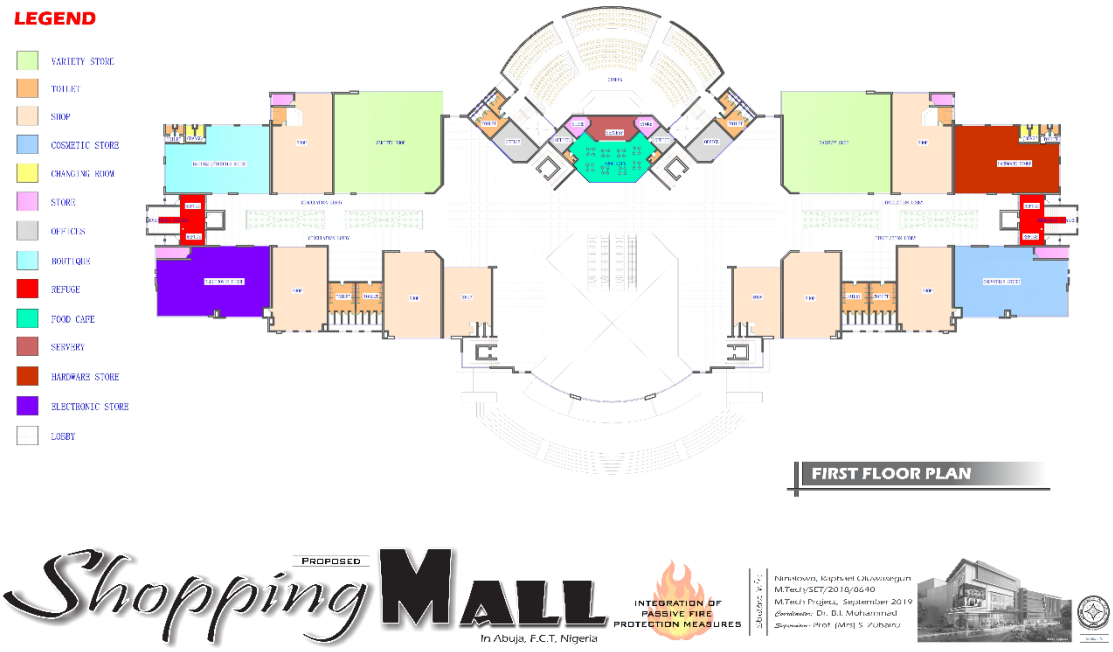
Appendix C: Site Plan and Landscape

Appendix D: Design Concept

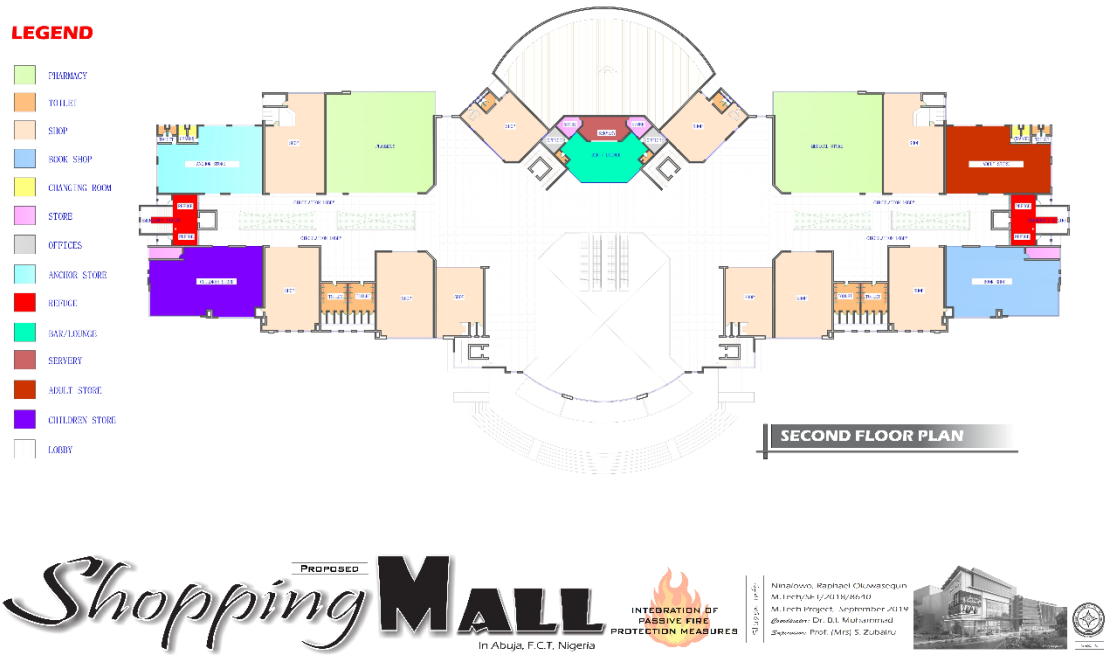


Appendix E: Bubble Diagram

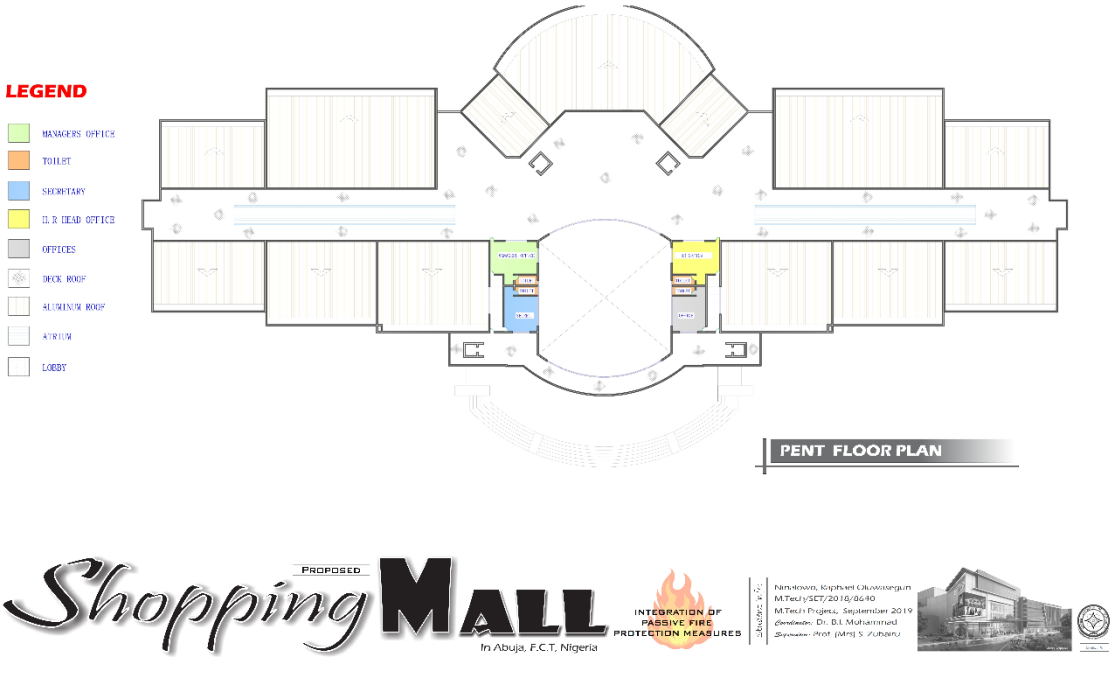
Appendix F: Ground Floor Plan



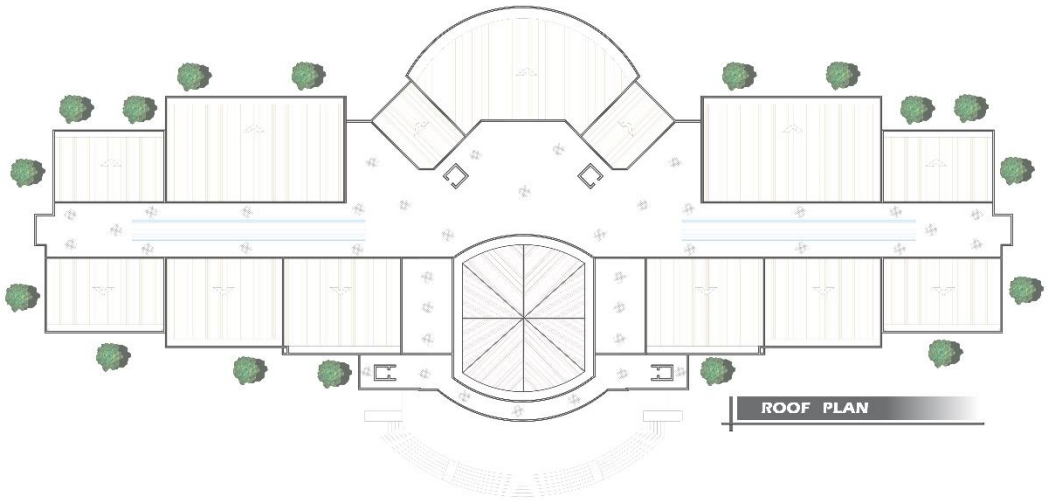
Appendix G: First Floor Plan



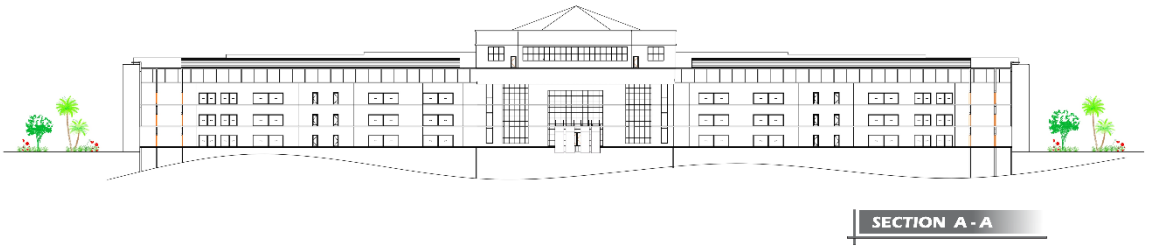
Appendix H: Second Floor Plan

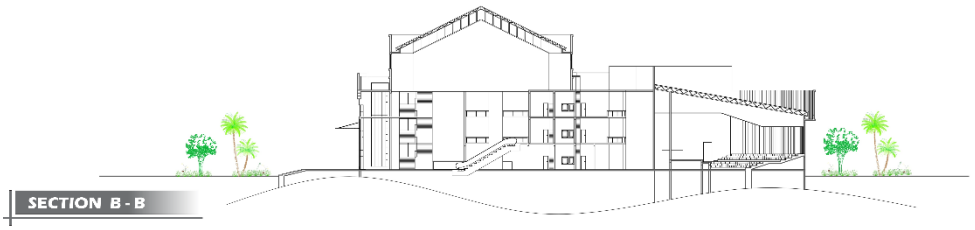


Appendix I: Pent Floor Plan



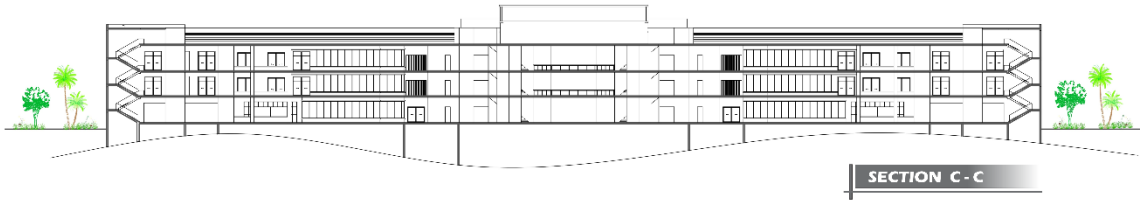
Appendix J: Roof Plan

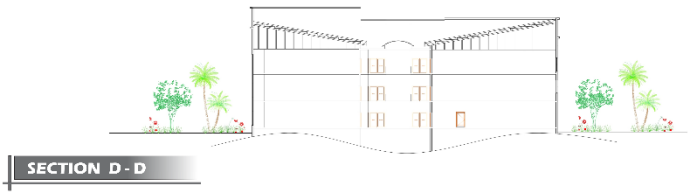




Appendix K: Design Section

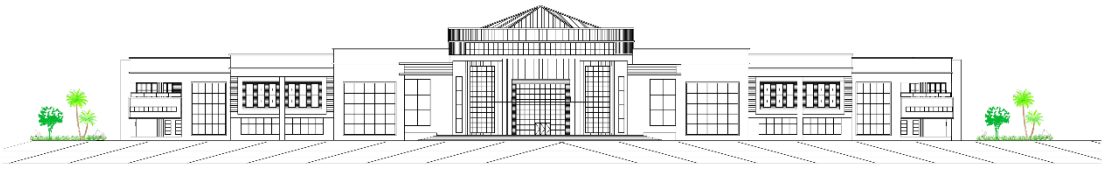
Design Section

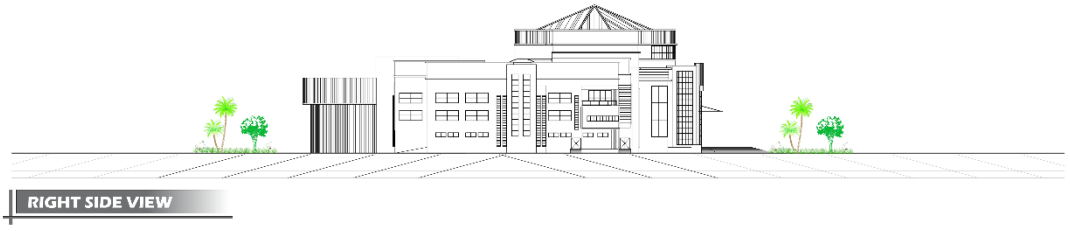




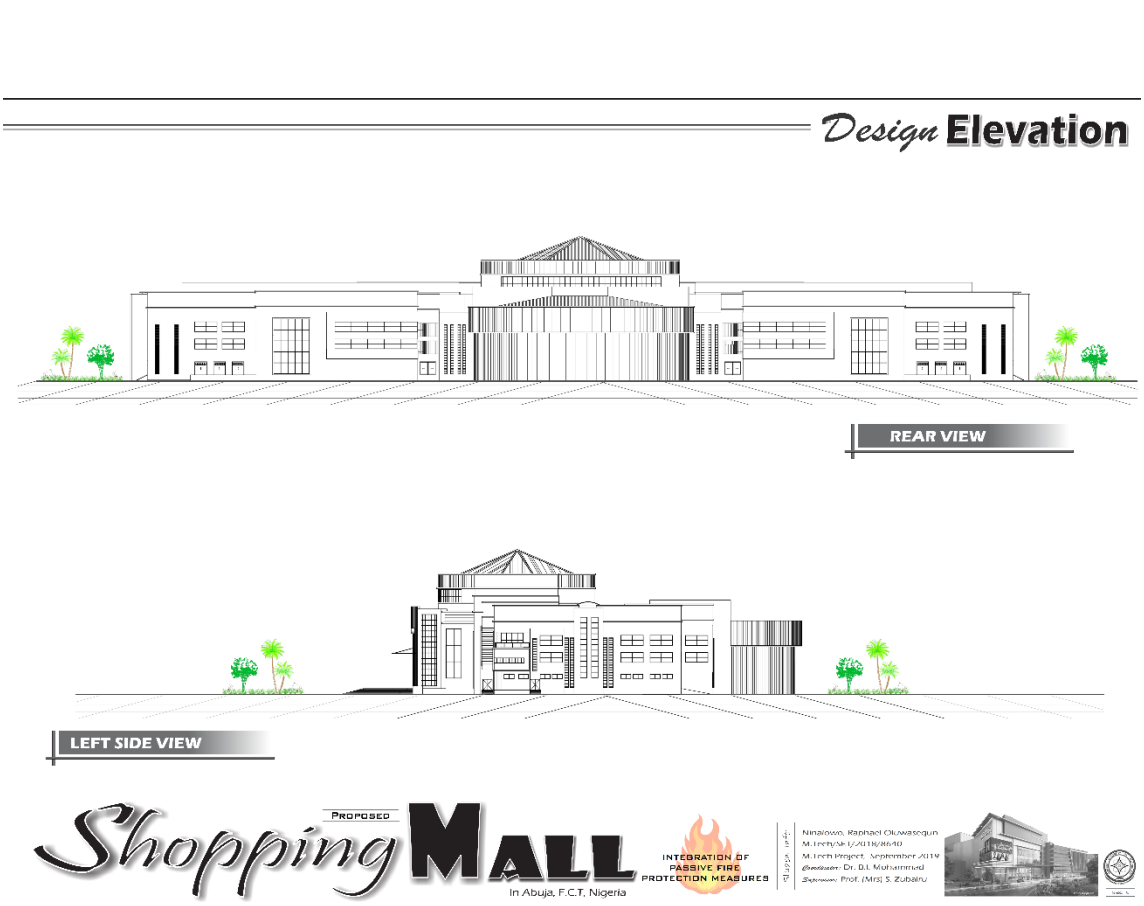
Appendix L: Design Section

Design Elevation

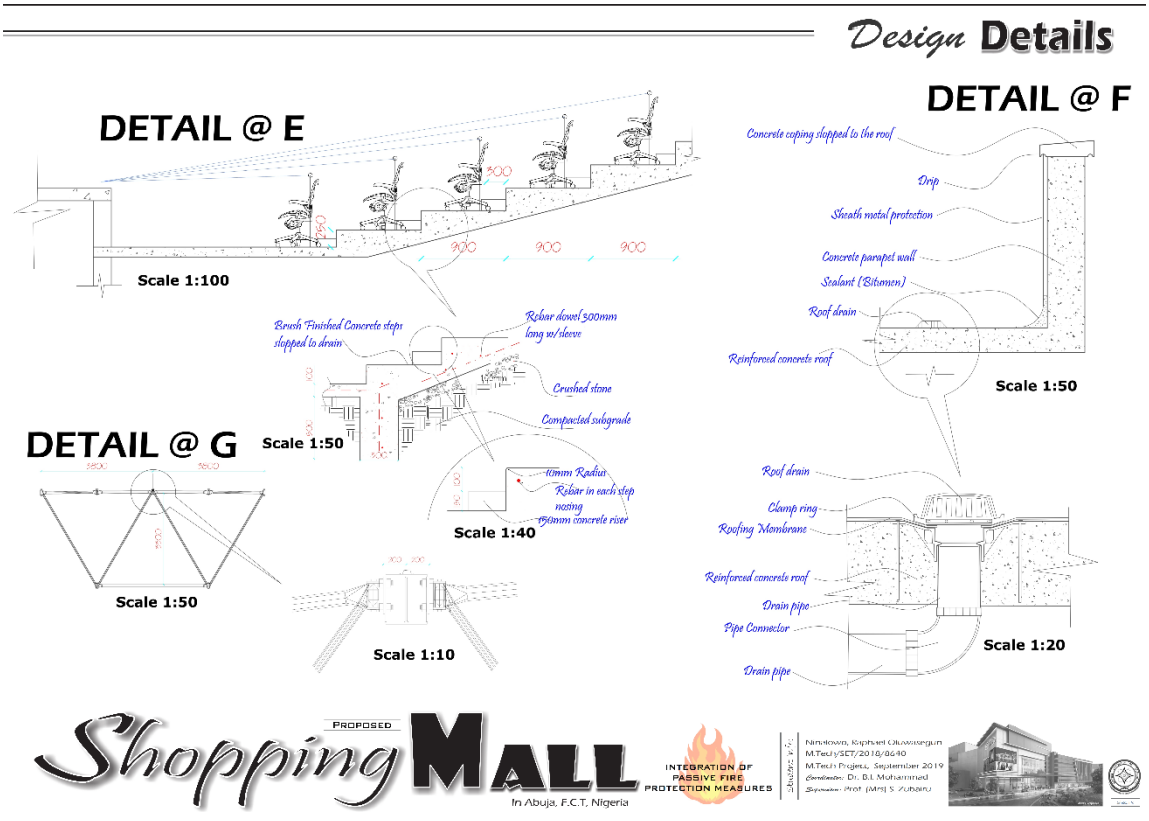




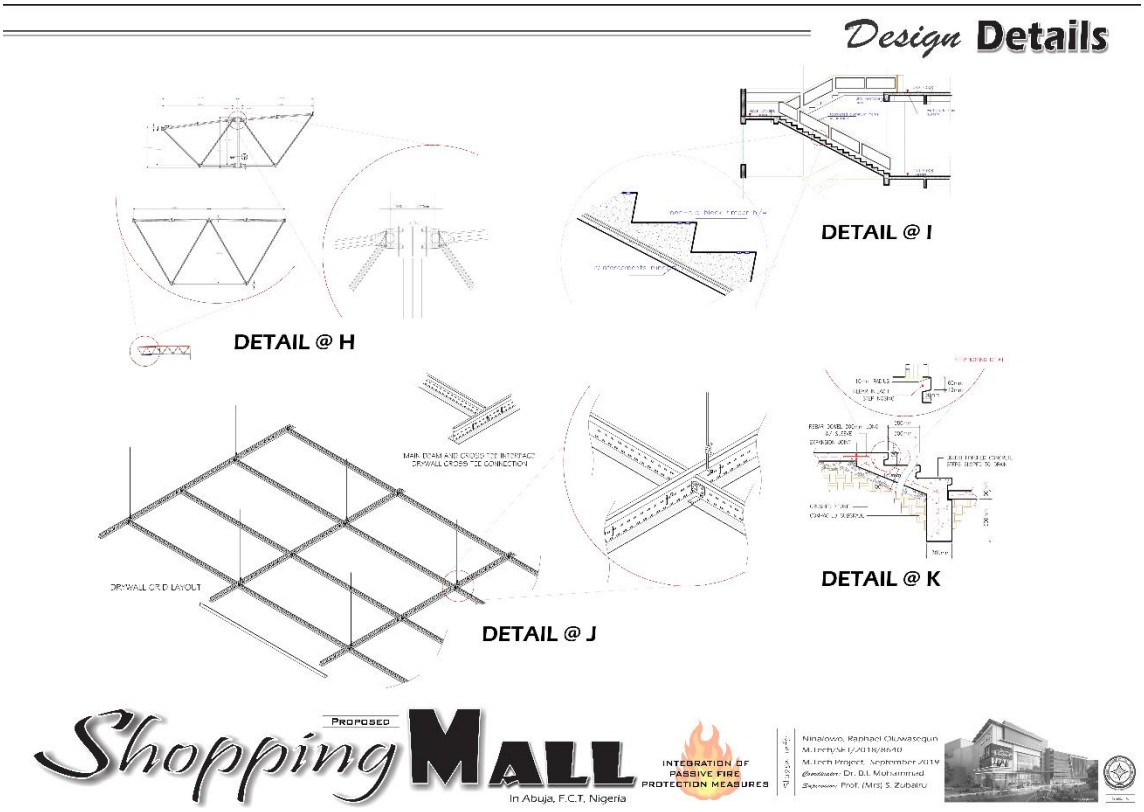
Appendix M: Design Elevation



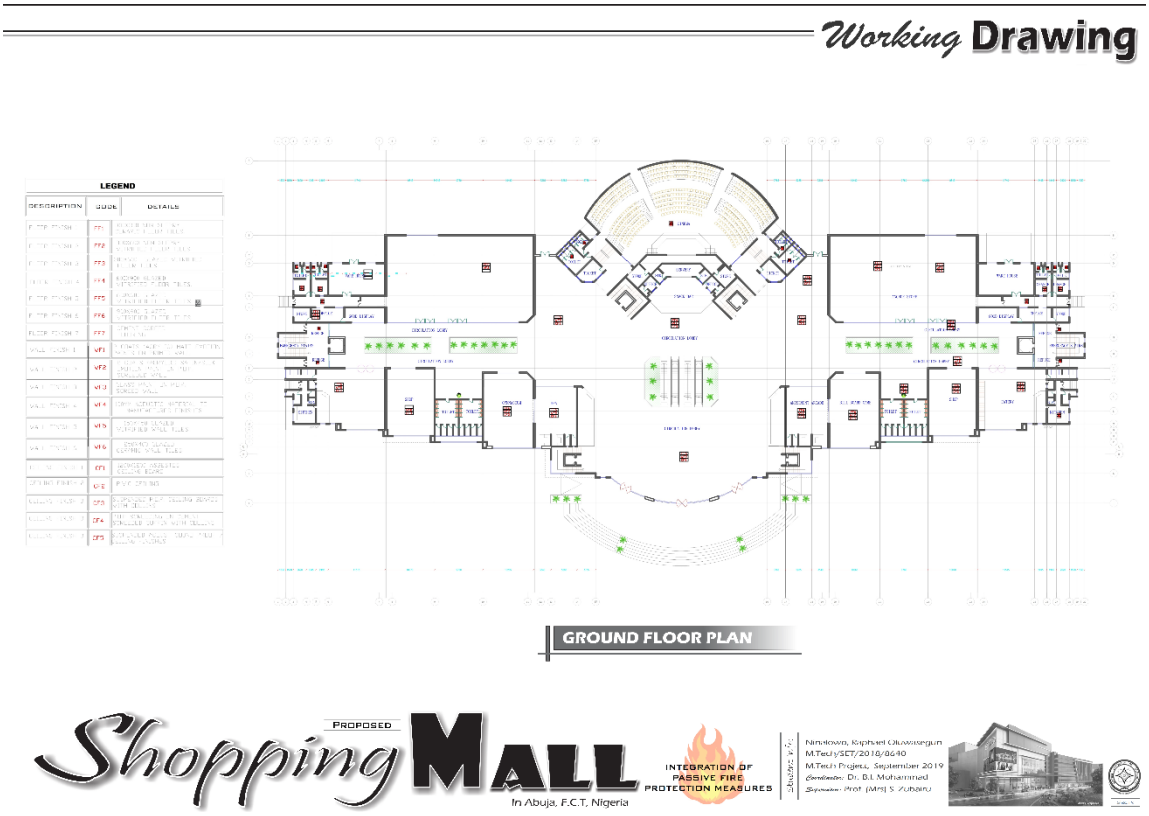
Appendix N: Design Elevation



Appendix O: Design Details



Appendix P: Design Details



Appendix Q: Working Drawing