PROPOSED APO SHOPPING MALL, ABUJA.

ASSESSING THE FIRE SAFETY MEASURES IN THE DESIGN OF SHOPPING MALLS, ABUJA.

By

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DECLARATION

I declare that the work in this thesis entitled PROPOSED APO SHOPPING MALL, ABUJA. ASSESSING THE FIRE SAFETY MEASURES IN THE DESIGN OF SHOPPING MALLS, ABUJAhas been carried out by me in the Department of Architecture. The information derived from the literature has been dully acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other Institution.

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Name of Student Signature Date

CERTIFICATION

This project thesis entitled PROPOSED APO SHOPPING MALL, ABUJA.ASSESSING THE FIRE SAFETY MEASURES IN THE DESIGN OF SHOPPING MALLS, ABUJAbyMUHAMMED BELLO meets the regulations governing the award of the degree of Masters in Architecture of the Ahmadu Bello University, and it's approved for its contribution to knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to Almighty ALLAH - the giver of wisdom - for his grace that saw me through this race, to my family - for their love and trust in me, to all my friends, to lovers of architecture and mankind.

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ABSTRACT

Shopping malls are fundamentally large complexbuildings occupied by considerable numbers of thegeneral public and shop staff. These buildings mustbe planned to be safe and in the event of an emergencyor fire, allow for fast and safe evacuation fromthe building by all its occupants. In the design ofthe practical issues, fire safety is one of the mostimportant and complex considerations. Fire safetyrequirements will be more onerous for enclosed andcovered shopping malls than for open street basedschemes. Shopping malls are characterized with various combustible materials from the merchant they sell, and as such the aim of the research is to assess the fire safety measures in shopping malls and how they are incorporated in shopping mall design. Interview and a checklist survey were used for data collection in this research. For the purpose of this research, 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. The findings from the case studies carried out shows that fire safety is prerequisite for any shopping mall design. The finding also shows that both passive and active fire safety measures should be employed in shopping mall design. The interview reveals that regular routine check of fire safety element is paramount. Some of the recommendations include; building in compliance with National Building Code (NBC) and providing a simple evacuation plan in each floor of the building.

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1.0 INTRODUCTION

1.1 Background of the Study

Shopping is an important and essential routine of urban life. Day by day the need for organized shopping mall is gaining importance in our society. These buildings must be safe and, in the event of an emergency or fire disaster, allow for fast and safe evacuation from the building by all its occupants (Peter, 2006).

In the design of the practical issues, fire safety is one of the most important and complex considerations. Shopping malls; like any retail centre, face substantial public liability for a whole host of risks, from accidents and trips to the risk of fire. From a fire protection perspective, shopping malls are generally the most complicated of retail structures, requiring a fire alarm system sufficiently enough to provide communication between active systems such as zoned sprinklers, smoke control provision, secondary power supplies, emergency lighting and manned control centers (David, 2006).

In Nigeria, the comparative advantages of location, administrative, economic and other functional factors have contributed towards a substantial increase in shopping activities. Rising on the back of demographics, rapid urbanization, changing shopping culture and a growing middle class the expansion sweeping through the retail market in Nigeria is getting bigger as the market anticipate about 200,000 sqm of real estate space (Caroline, 2014). The growth in the Nigerian retail market is a direct reflection of the growing sophistication of the Nigerian middle class, whose shopping preference has shifted from the traditional shopping in the open market, to a more organized and convenient shopping experience offered by retail malls (Odinaka, 2014). In order to achieve a convenient shopping experience, there is need for the shoppers to feel safe in

case of fire accident. This can be achieved only by providing both active and passive fire safety measures in the shopping mall.

1.2 Problem Statement

Although adequate safety and security including fire safety measures are prerequisites for enjoying a hazard free shopping environment; collectively they remain the most neglected issue in the context of total urban development (Martin & Andrew, 2005).

Shopping malls are associated with a variety of combustible materials from the merchandise they sell and the building materials themselves (Peter, 2006). As public facility, every shopping mall needs to be safe for human use. Fire safety measures must be considered right from the preliminary shopping mall design stage to finish. In Nigeria, shopping malls rely on fire fighters to extinguish fire rather than extinguishing from the fire safety instruments in the shopping mall. This trend has been a problem to the society and as such, the need for providing both active and passive fire control instrumentsin the shopping mall becomes prerequisite (Odinaka, 2014).

1.3 Justification of the Study

The study will seek to identify the key issues that can be used by scholars and designers in designing a safe shopping environment through the use of fire safety measures. This will serve as guide towards achieving comfortable and hazard free shopping environment in the Northern part of 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.

1.4 Aim and Objectives

The aim of this research is to assess the fire safety measures in shopping malls and how they are being used in shopping malls in case of emergency with the view of applying these findings in the design of shopping mall. The objectives are;

I. To investigate the causes of fire outbreaks in shopping malls
II. To determine the suitable measures taken in tackling the problems
III. To establish the best fire control and evacuation schemes by proposing shopping mall with such characteristics.

1.5 Research Questions

i. What are the causes of fire outbreaks in shopping malls and how it affects the building and the users?
ii. What fire prevention measures are required in shopping malls?
iii. What are the fire control and evacuation strategies in shopping malls?

1.6 Scope of Study

This research is restricted to findings of fire safety measures in shopping malls, especially in Abuja. There by assisting architects and other designers in providing the best passive and active fire safety measures that could be used in protecting lives and properties.

2.0 LITERATURE REVIEW

2.1 Concepts of Fire

Fire starts when a flammable and/or a combustible material, in combination with a sufficient quantity of an oxidizer such as oxygen gas or another oxygen rich compound (though non-oxygen oxidizers exist that can replace oxygen), is exposed to a source of heat or ambient temperature above the flash point for the fuel/oxidizer mix, and is able to sustain a rate of rapid oxidation that produces a chain reaction (John, 2014).

2.1.1 Fire Triangle

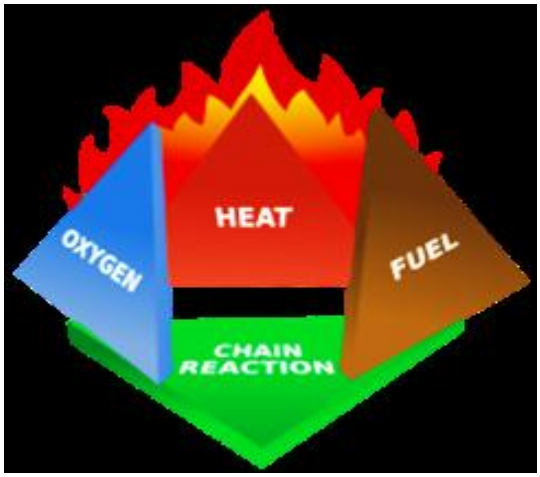


Figure 2.1: Fire tetrahedron.

Figure: 2.2: Fire triangle

Source: www.nfpa.org

Fire is a chemical reaction which requires three elements to exist: these elements are;

i. Oxygen

When Oxygen in the air combines with flammablevapoursgiven off by fuels they create a form of heat at a molecular level. Then, a source of ignition (a match or spark, say) can cause it to combust

ii. Heat

Combustion occurs when flammable vapours mix with air (Oxygen) and are ignited by a spark of flame. The flame or spark can come from a number of places.

The temperature at which a material produces a vapour, and the temperature at which vapours will burn (Vapours will self-ignite if the temperature is hot enough).

iii. Fuel

The fuel for a fire may be solid, liquid, or gas. The type and quality of the fuel will determine which method should be used to extinguish the fire.

2.2 Causes of Fire in Shopping Malls

Fire incidents are becoming rampant in shopping malls. Statistics of such suggests the necessity to determine the origin and causes of fires in buildings so as to enhance control measures. According to Saniya and Sabir (2014), most fires in multi-storey shopping centers are caused by the defaults in electrical and mechanical equipment.

2.2.1 Major causes of fire in Shopping Mall

A. Fire caused by electrical appliances

I. Electrical appliances sometimes become partially or fully faulty which might have developed due to over loading.

II. Fires may also start due to overheating of filament lamps. If the lamp is close to a highly combustible material, it may ignite.

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

IV. Defective or improperly installed and operated electrical and heating equipment and services.

B. Mechanical Causes of Fire

I. The most common source of fire from mechanical devices is due to friction which result from lack of lubrication. When there is friction between mechanical devices, it might initiate some sparks and may result to fire.

II. Overheating of mechanical devices which will also result into fire

III. Heat of Compression - The heat generated by the forced reduction of a gaseous volume. Diesel engines ignite fuel vapor without a spark plug by the use of this principle (Sabir, 2014).

2.2.2 Other (Minor) Causes of Fire

I. Fraud Fire (Arson)

The malicious burning or exploding of the dwelling house of another, or the burning of a building within the curtilage, the immediate surrounding space, of the dwelling of another. In many states, the act of burning any insured dwelling, is done with an intent to defraud the insurer.

II. Careless disposal of ash and other waste

III. Exposure from other buildings on fire (Sabir, 2014),.

2.3 Classes of Fire

The classification of fire depends mainly upon the fuel involved. There are five classes of fire.

2.3.1 Class “A”

These fires are fueled by ordinary combustible materials, such as wood, cloth, paper, and many plastics. This type of fire burns with an ember, leaves an ash, and is best extinguished by removing the heat side of the triangle. Extinguishers suitable for Class "A" fires should be identified by a triangle containing the letter "A" as shown in figure 2.3. If color-coded, the triangle will be green.*

Figure 2.3: Class A Source: John, 2014

2.3.2 Class “B**”**

These fires are fueled by flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols and flammable gases. This type of fire burns on the surface of the fuels, and is best extinguished by a blanketing or smothering action. A fire of this type is fast-spreading and capable of engulfing a large area in a very short time. Extinguishers suitable for Class "B" fires should be identified by a square containing the letter "B" as shown in figure 2.4. If color-coded, the square is red.

Figure 2.4: Class B Source: John, 2014

2.3.3 Class “C”

These fires occur in energized electrical equipment, where the electrical non-conductivity of the extinguishing media is of importance. Blanketing or smothering this type of fire with a non-conducting extinguishing agent is of prime importance. Water, or solutions containing water, is never to be used on a Class "C" fire. Extinguishers suitable for Class "C" fires should be identified by a circle containing the letter "C" as shown in figure 2.5. If color-coded, the circle is blue. Electrical fittings must be installed competently with circuit breakers and other protection devices to avoid fire hazards due to electrical appliances.

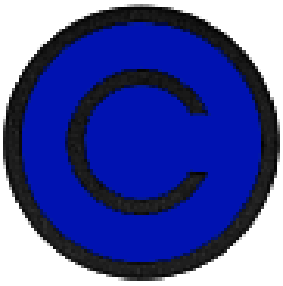


Figure2.5: Class C Source: John, 2014

2.3.4 Class “D”

These fires involve combustible metals, such as magnesium, titanium, zirconium, sodium, lithium and potassium. Generally the extinguishing agent is referred to as DRY POWDER. These extinguishers should be identified by a star containing the letter “D” as shown in figure 2.6. If color-coded, the star is yellow. Combustible building materials need to be applied with caution.

Figure 2.6: Class D Source: John, 2014

2.3.5 Class “K”

These are fires in cooking appliances that involve combustible cooking media such as vegetable or animal oils and fats. The extinguishing agent is referred to as WET CHEMICAL. These extinguishers should be identified by the letter “K” as shown in figure 2.7. Risk of fire could be minimized through proper human conduct. This require keeping fats and vegetable oils far away from sources of heat and naked fire.

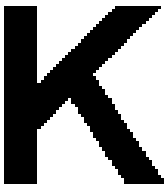


Figure 2.7: Class K Source: John, 2014

2.4 Phases of Fire

The burning process occurs in clearly defined stages. By recognizing the different phases (or stages), a fire fighter can better understand the process of burning and fighting the fire at different levels and with different tactics and tools. Each phase (or

stage) is characterized by differences in room temperature and atmospheric composition. Fire spread and its control through building compartmentalization are necessary.

2.4.1 Incipient Phase (Growth Phase)

In the first phase, the oxygen content in the air has not been significantly reduced and the fire is producing water vapour, carbon dioxide, perhaps a small quantity of sulfur dioxide, carbon monoxide and other gases. Some heat is being generated, and the amount will increase with the progress of the fire. The fire may be producing a flame temperature well above 5370C, yet the temperature in the room at this stage may be only slightly increased.

2.4.2 Free Burning Phase (Fully Developed)

The second phase of burning encompasses all of the free-burning activities of the fire. During this phase, oxygen-rich air is drawn into the flame as convection (the rise of heated gases) carries the heat to the upper most regions of the confined area. The heated gases spread out laterally from the top downward, forcing the cooler air to seek lower levels, and eventually igniting all the combustible material in the upper levels of the room. This heated air is one of the reasons that firefighters are taught to keep low and use protective breathing equipment. One breath of this super-heated air can sear the lungs. At this point, the temperature in the upper regions can exceed 7000C. As the fire progresses through the latter stages of this phase, it continues to consume the free oxygen until it reaches the point where there is insufficient oxygen to react with the fuel. The fire is then reduced to the smoldering phase and needs only a supply of oxygen to burn rapidly or explode.

2.4.3 Smouldering Phase (Decay Phase)

In the third phase, flame may cease to exist if the area of confinement is sufficiently airtight. In this instance, burning is reduced to glowing embers. The room becomes completely filled with dense smoke and gases to the extent that it is forced from all cracks under pressure. The fire will continue to smolder, and the room will completely fill with dense smoke and gases of combustion at a temperature of well over 5370C. The intense heat will have vaporized the lighter fuel fractions such as hydrogen and methane from the combustible material in the room. These fuel gases will be added to those produced by the fire and will further increase the hazard to the firefighter and create the possibility of a backdraft.

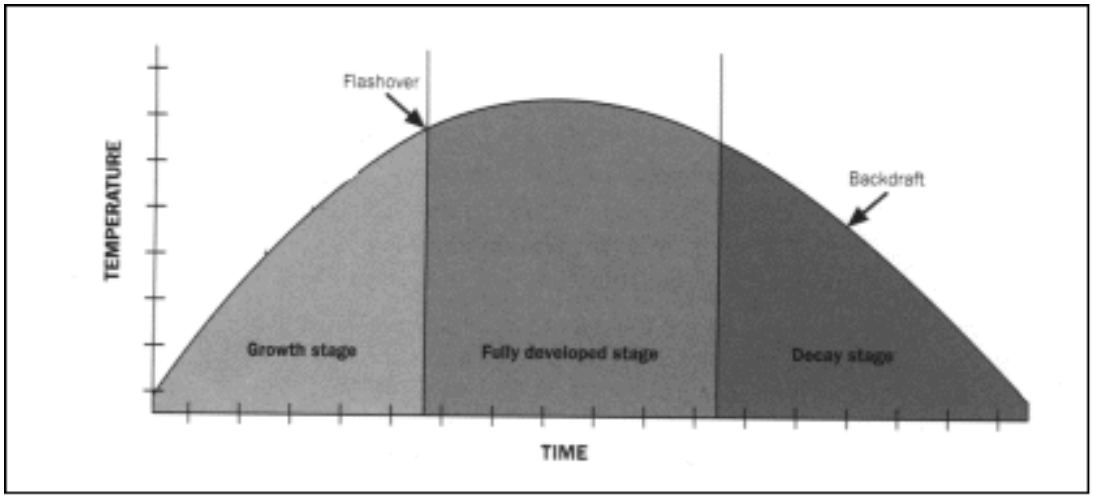


Fig 2.8: Time Temperature Curve. Source: (http://www.lbfdtraining.com)

2.5 Heat Transfer

Heat can travel throughout a burning building by one or more of three methods, commonly referred to as conduction, convection and radiation. Since the existence of heat within a substance is caused by molecular action, the greater the molecular activity, the more intense the heat. A number of natural laws of physics are involved in the

transmission of heat. One is called the Law of Heat Flow. It specifies that heat tends to flow from a hot substance to a cold substance. The colder of two bodies in contact will absorb heat until both objects are the same temperature.

2.5.1 Conduction

Heat may be conducted from one body to another by direct contact of the two bodies or by an intervening heat-conducting medium. The amount of heat that will be transferred and its rate of travel depends upon the conductivity of the material through which the heat is passing. Not all materials have the same heat conductivity. Aluminum, copper and iron are good conductors. Fibrous materials, such as felt, cloth and paper are poor conductors.Liquids and gases are poor conductors of heat because of the movement of their molecules. Air is a relatively poor conductor. Certain solid materials when shredded into fibers and packed into batts, make good insulation because the material itself is a poor conductor and there are air pockets within the batting. Figure 2.9 shows double building walls that contain an air space provide additional insulation (Runstard, 2005).

Figure 2.9: Conduction of Heat
Source: International Fire Service Training Association (1998).

2.5.2 Convection

Convection is the transfer of heat by the movement of air or liquid. When water is heated in a glass container, the movement within the vessel can be observed through the glass. If some sawdust is added to the water, the movement is more apparent. As the water is heated, it expands and grows lighter, hence, the upward movement. In the same manner, air becomes heated near a steam radiator by conduction. It expands, becomes lighter and moves upward. As the heated air moves upward, cooler air takes its place at the lower levels. When liquids and gases are heated, they begin to move within themselves. This movement is different from the molecular motion discussed in conduction of heat and is knows as heat transfer by convection.

Heated air in a building will expand and rise. For this reason, fire spread by convection is mostly in an upward direction, although air currents can carry heat in any direction. Convected currents are generally the cause of heat movement from floor to floor, from room to room and from area to area. Figure 2.10 shows the spread of fire through corridors, up stairwells and elevator shafts, between walls and through attics is mostly caused by the convection of heat currents and has more influence upon the positions for fire attack and ventilation than either radiation or conduction.

Another form of heat transfer by convection is direct flame contact. When a substance is heated to the point where flammable vapors are given off, these vapors may be ignited, creating a flame. As other flammable materials come in contact with the burning vapors, or flame, they may be heated to a temperature where they too, will ignite and burn. The architectural solution to fire spread by convection is building compartmentalization (Runstard, 2005).

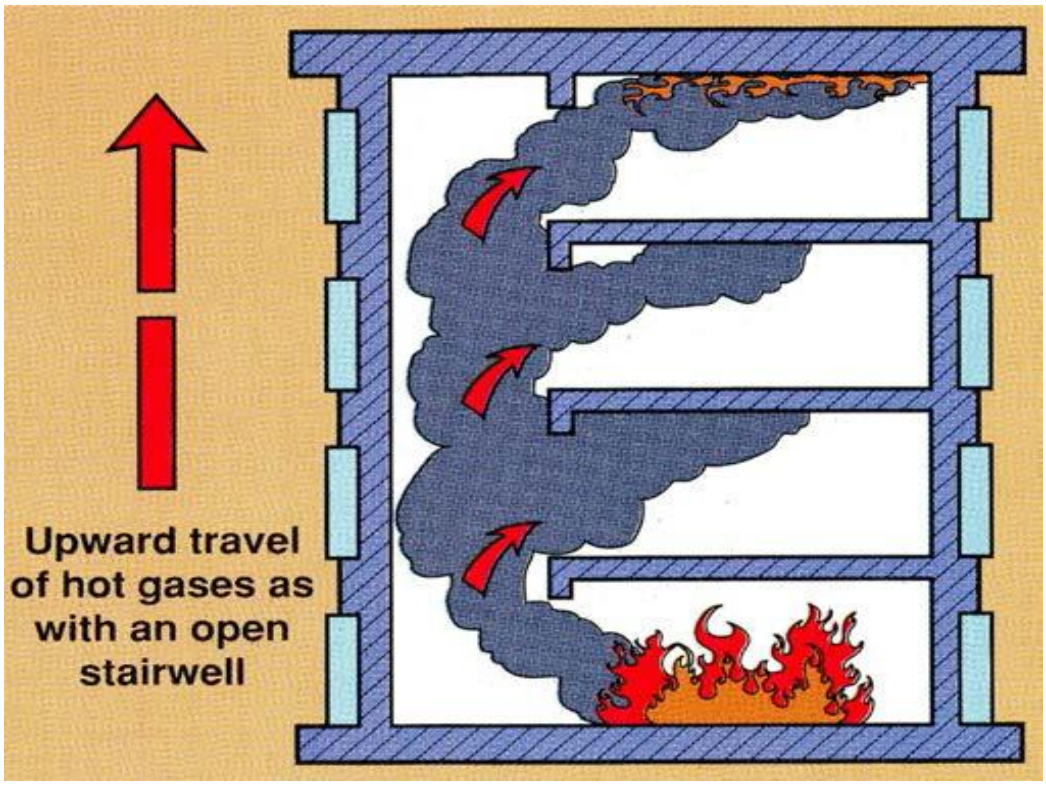


Figure 2.10: Convection of Heat Source: International Fire Service Training Association (1998)

2.5.3 Radiation

The warmth of the sun is felt soon after it rises. When the sun sets, the earth begins to cool with similar rapidity. We carry an umbrella to shade our bodies from the heat of the sun. A spray of water between a firefighter and a fire will lessen the heat reaching the firefighter. Although air is a poor conductor, it is obvious that heat can travel where matter does not exist. This method of heat transmission is known as radiation of heat waves. Heat and light waves are similar in nature, but they differ in length per cycle. Heat waves are longer than light waves and they are sometimes called infrared rays. Radiated heat will travel through space until it reaches an opaque object. As the object is exposed to heat radiation, it will in return radiate heat from its surface (Figure 2.11).

Radiated heat is one of the major sources of fire spread, and its importance demands immediate attention at points where radiation exposure is severe (Runstard, 2005).

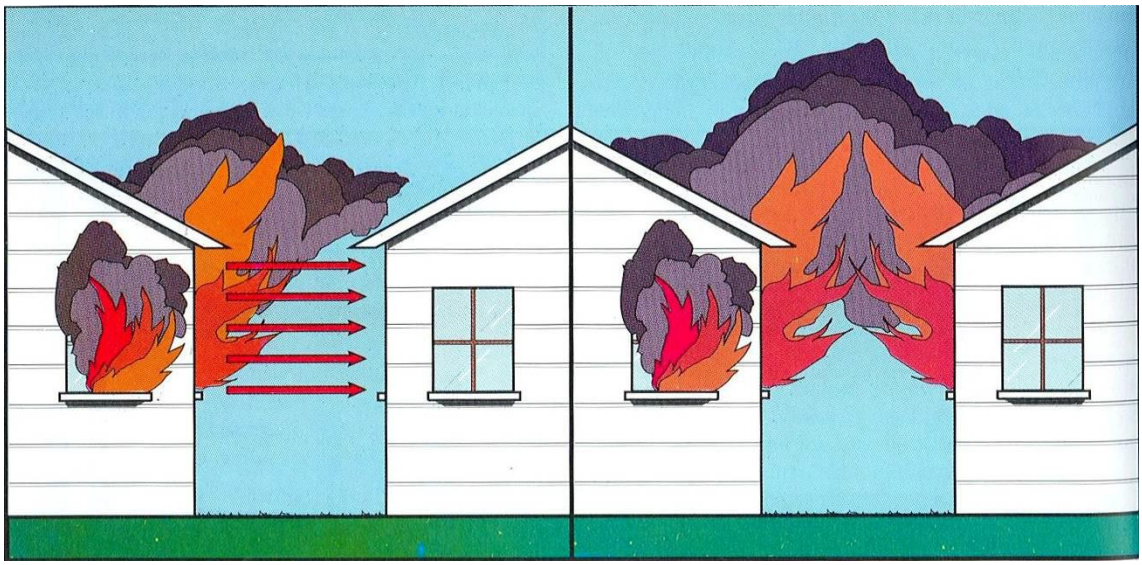


Figure 2.11: Radiation of Heat
Source: International Fire Service Training Association (1998)

2.6 Products of Combustion

When a material (fuel) burns, it undergoes a chemical change. None of the elements making up the material are destroyed in the process, but all of the matter is transformed into another form or state. Although dispersed, the products of combustion equal in weight and volume that of the fuel before it was burned. When a fuel burns there are four products of combustion:

i. Fire gases
ii. Flame
iii. Heat
iv. Smoke

The smoke encountered at most fires consists of a mixture of oxygen, nitrogen, carbon dioxide, carbon monoxide gases, finely divided carbon particles (soot), and a

miscellaneous assortment of products that have been released from the material involved.Heat is a form of energy that is measured in degrees of temperature to signify its intensity. In this sense, heat is the product of combustion that is responsible for the spread of fire. In a physiological sense, it is the direct cause of burns and other forms of personal injury. Injuries caused by heat include dehydration, heat exhaustion and injury to the respiratory tract, in addition to burns.Flame is the visible, luminous body of a burning gas. When a burning gas is mixed with the proper amounts of oxygen, the flame becomes hotter and less luminous. This loss of luminosity is because of a more complete combustion of the carbon. For these reasons, flame is considered to be a product of combustion. Heat, smoke and gas, however, can develop in certain types of smoldering fires without evidence of flame.Some materials give off more smoke than others. Liquid fuels generally give off dense black smoke. Oils, tar, paint, varnish, molasses, sugar, rubber, sulfur and many plastics, also generally give off a dense smoke in large quantities (Martin, 2005).

2.7 Fire Hazard in Shopping Mall

2.7.1 Electrical Hazards

i. Damaged wiring
ii. Damaged plugs
iii. Damp or wet wires
iv. Overloaded motors
v. Broken switches, outlets or sockets
vi. Problems with lighting fixtures
vii. Faulty heating elements
viii. Overloaded circuits

2.7.2 Mechanical Hazards

i. Hot bearings
ii. Misaligned or broken machine parts
iii. Choking or jamming materials
iv. Poor adjustment of moving parts
v. Inadequate lubrication

2.7.3 Storage Hazard

i. Materials stacked too high blocking sprinkler heads (need 18-inches clearance from head)
ii. Flammable or combustible materials stored too close to heat sources
iii. Flammable materials not stored in special containers and cabinets
iv. Inadequate ventilation in storage areas
v. Materials that might react with one another stored together
vi. Materials stored in damaged containers
vii. Materials stored in unlabeled containers
viii. Containers not tightly sealed

2.7.4 Smoking Harzard

i. Ignoring "No Smoking" signs
ii. Smoking around flammable or combustible materials
iii. Throwing matches and cigarettes or cigars on tables or workbenches
iv. Tossing butts on the floor or grass without properly extinguishing them in an ashtray or ash can
v. Tossing lighted butts or matches out windows or doors
vi. Smoking in bed

vii. Leaving a cigarette/cigar unattended

viii. Smoking in areas where there is an accumulation of sawdust, plastic or

ix. Metal powders that may become explosive(Martin, 2005).

2.8 Fire Safety Measures in Shopping Malls

Fire prevention is knowing what you can do to prevent a fire in the first place as well as what actions to take in case one happens anyway.

2.8.1 Fire Precaution and Prevention

The key elements of fire precaution policies are;

i. Building a facility in accordance with the version of the local building code

ii. Maintaining a facility and conducting yourself in accordance with the provisions of the fire code. This is based on the occupants and operators of the building being aware of the applicable regulations and advice.

Examples of these includes;

- Not exceeding the maximum occupancy within any part of the building.
- Maintaining proper fire exits and proper exit signage (e.g., exit signs pointing to them that can function in a power failure)
- Compliance with electrical codes to prevent overheating and ignition from electrical faults or problems such as poor wire insulation or overloading wiring, conductors, or other fixtures with more electric current than they are rated for.
- Placing and maintaining the correct type of fire extinguishers in easily accessible places.

- Properly storing and using, hazardous materials that may be needed inside the building for storage or operational requirements (such as solvents in spray booths).
- Prohibiting flammable materials in certain areas of the facility.
- Periodically inspecting buildings for violations, issuing Orders to Comply and, potentially, prosecuting or closing buildings that are not in compliance, until the deficiencies are corrected or condemning it in extreme cases.
- Maintaining fire alarm systems for detection and warning of fire.
- Obtaining and maintaining a complete inventory of fire stops.
- Ensuring that spray fireproofing remains undamaged.
- Maintaining a high level of training and awareness of occupants and users of the building to avoid obvious mistakes, such as the propping open of fire doors.
- Conduct fire drills at regular intervals throughout the year (Brewer, 2003).

2.8.1 Fire Control

A. Passive Fire Prevention

This has to do with the design of the building itself and the type of materials used to resist fire.Fire safety measures are installed within a building or premises to perform a vital function in protecting life and preventing injury in the event of fire (Brewer, 2003).

These basic fire prevention requirements are;

i. Path of travel to exit

ii. Evacuation plan

iii. Incombustible surface finishes and materials

iv. Emergency lifts

v. Fire control centers and rooms

vi. Smoke and heat vents

vii. Occupancy separation

Figure 2.12: Evacuation plan in a shopping mall.

Source: capenter, (2006)

B. Active Fire Prevention

Active fire prevention is characterised by items and/or systems requiring a certain degree of motion and response in order to work, unlike passive fire protection. The active fire prevention requirements include;

i. Fire dampers

ii. Automated water sprinkler system

iii. Fire hydrant system

iv. Smoke and heat detectors

v. Smoke exhaust systems

vi. Stand-by power system

2.9 Means of Escape

It is the first and chief need and the one with the most impact on building design. When designing escape routes or accessing their efficiency the following factors should be kept in mind:

i. 2.5 minutes for evacuation time is recommended by the fire grading committee (UK).

ii. Sufficient numbers of exit with adequate capacity should be located with convenient paths of access and adequate lighting of exits.

iii. During the length of fire hazard all the exits should be protected from fire and smoke.

iv. Escape routes are desirable to be direct, unobstructed, and clearly signed.

v. The exits should be same width to that of the corridors. The possible discharge rate should be the determining fact for the exit width rather than the total number to be discharged.

vi. All doors in the escape route should open in the direction of escape and should not be lockable [Fire Doors Bristol]. Final exit doors may be secured with panic bolts.

vii. The openness of the escape path affects the speed of movement and may be 12.5 meters per minute in corridors and 18 meter per minutes in unconfined spaces. This permits travel distance of 30 meter and 45 meters respectively (that is speed x evacuation time = travel distance). Travel distance is the actual distance traveled by a person from any point within the floor area to

the relevant exit that is protected doorway and rather depending on a single plan dimension it must be directly related to occupancy and the use of the floor area.

viii. Materials which might constitute a fire hazard should not be contained even temporary in any part of a protected escape route.

ix. In multistoried shopping centers along with low rise structures, the alternative escape is a must and that should be located in the opposite direction of the main route in case the main exit is blocked by smoke or fire.

x. It is not advisable to depend on fire brigade because modern traffic conditions and congestion may well delay their arrival.

However, it is apparent that smoke vents screens and means of fire escape could be achieved through architectural and engineering design.

2.10 Shopping Mall Classification

Over the years, shopping center formats have taken on a confusing array of identities, with names that include such descriptors as Centres, Commons, Crossings, Hybrids, Lifestyle Centers, Malls, Markets, Marts, Mega-Malls, Mixed-Use, Outlets, Parkways, Places, Plazas, Promenades, Shops, Strips, Squares, Super Centeres, Town Centers, Urban Retail, Vertical, and Villages. Unfortunately, there is no agreement as to how many distinct types of shopping center formats there really are, or how individual centers should be assigned to the various categories. Adding to this confusion is that shopping centers can be further differentiated by a variety of marketing and management strategies including: Convenience, Entertainment, Ethnicity, Festival, Lifestyle, Luxury, Off-Price, Theme (e.g., home improvement and furniture), Tourist, Urban, and Value (Table 2.1). When considering the possible combinations of these

types of differentiating factors, it is understandable that some consider the retail sector inherently complex and difficult to understand (James, 2005).

Table 2.1 The ICSC types of malls and shopping centers.

Type	Sub type	concept	Size range, No. of stores
Malls			Sqm
	Regional centre	General merchandise, fashion	50-100,000. (150-250)
	Super Regional centre	Same as regional: more variety & assortment	Over 100,000 (250 above)
Open-air centres			
	Neighborhood centre	Convenience	5000-12,000 (25-50)
	Community centre	General merchandise, convenience	12000-25,000 (50-100)
	Lifestyle centre	Upscale, national specialty, entertainment, outdoor	15-50,000
	Power centre	Category-dominant anchors, few small tenants	25-60,000
	Theme/festival centre	Leisure, tourist-oriented: retail & service	8-25,000

Source:Runstad Centre, ICSC, 2005.

2.10.1 Regional Centre

A shopping center typically incorporating one full line department store, a full line discount department store, one or more supermarkets and around 100 or more specialty shops. Total GLAR typically ranges between 30,000 and 50,000 square meters. (www.icsc.org)

In some instances, all other characteristics being equal, a centre with two full discount department stores, without a department store, can serve as a regional centre.

Key features:

I. Extensive coverage of a broad range of retail needs (including specialised retail), however, not as exhaustive as major regional centres;
II. Contain a combination of full line department stores, full line discount department stores, supermarkets, banks, chain and other specialty retailers; as shown in plate i.
III. Provide a broad range of shopper facilities and amenities.

Plate i: Regional Toronto Eaton Center, California. Source: James, 2005

Figure 2.13:A floor plan of regional shopping mall.
Source: James, (2005).

2.10.2 Super Regional Centre

According to the International Council of Shopping Centers (ICSC), a major shopping center typically incorporating two full line department stores, one or more full line discount department stores, two supermarkets and around 250 or morespecialtyshops. Total GLAR exceeds 85,000 square meters.

Key features:

I. one-stop shopping for all needs;

II. comprehensive coverage of the full range of retail needs (including specialized retail), containing a combination of full line department stores, supermarkets, services, chain another specialty retailers;

III. typically include a number of entertainment and leisure attractions such as cinemas, game arcades and soft play centers; as shown in plate ii

IV. Provide a broad range of shopper facilities (car parking, food court) and amenities (restrooms, seating).

Plate ii:showing Pondok Indah super regional mall, Jakarta, Indonesia.
Source: Thompson, (2007)

2.10.3 Neigbhourhood Center

A local shopping center comprising a supermarket and approximately 35 specialty shops. Total GLAR will typically be less than 10,000 square meters.

Key features:

I. Typically located in residential areas;

II. Service immediate residential neighbourhood;

III. Usually have extended trading hours; and

IV. Cater for basic day-to-day retail needs.

Plate iii: A neighbourhood center in the form of strip mall, Cornelius, Oregon.
Source: Peter, (2006)

2.10.4 Outlet Center

An outlet mall (or outlet centre) is a type of shopping mall in which manufacturers sell their products directly to the public through their own stores. Other stores in outlet malls are operated by retailers selling returned goods and discontinued products, often at heavily reduced prices. Outlet stores were found as early as 1936, but the first multi-store outlet mall, Vanity Fair, located in Reading, PA did not open until 1974. Belz

Enterprises opened the first enclosed factory outlet mall in 1979, in Lakeland, TN, a suburb of Memphis (Schoenherr, 2006).

2.10.5 Lifestyle Centers

Lifestyle centers are targeted at a specific sector of the market – the young urban professional, with a tendency towards upmarket retailing, providing shops and facilities for those with ambition and the desire to succeed.

Lifestyle centers are composed of selective elements found at the mall but arranged in an external and attractive environment. As such they attract those customers from the mall and those who would not normally select the mall for shopping. Lifestyle centres are made up from a carefully selected mix of aspirational retailers (plate iv). These retailers are a mixture of comparison fashion brands, leisure and sportswear, which reflect a hobby or interest, and household goods providing good quality furniture and housewares.

All the shops contain certain products which the shopper would aspire to and reflect their ideals. Combined with these retailers there will be a variety of cafés and restaurants allowing a visit to the center to be combined with relaxed refreshment or a meal (Peter, 2006).

Plate iv: lifestyle shopping mall, Alabama.
Source: Peter, (2006)

2.11 Shopping Mall Design Criteria

2.11.1 Optimum Size

Figure 2.14 shows how optimum size of a shopping centre is established as an amount of retail floor space that can be leased to shop tenants. It is known as the gross leasable area (GLA). The retail brief to the architect is usually expressed as an amount of GLA. It is important, for the purposes of the early site planning exercises, for the architect to convert the GLAinto the potential overall gross area. To achieve this conversion simply, an additional area needs to beadded to the GLA to allow for service access, meansof escape, supporting accommodation, structureand external walls. As a general rule the

GLA should represent about 80 per cent of the gross area. It should be noted that the GLA also excludes the public circulation space, service yards and car parking areas which will need to be allowed for. Thepublic circulation space will need to be consideredfor each project and is influenced by individual siteconditions. The inclusion of public circulation space in the gross area will differ between enclosed and open schemes.

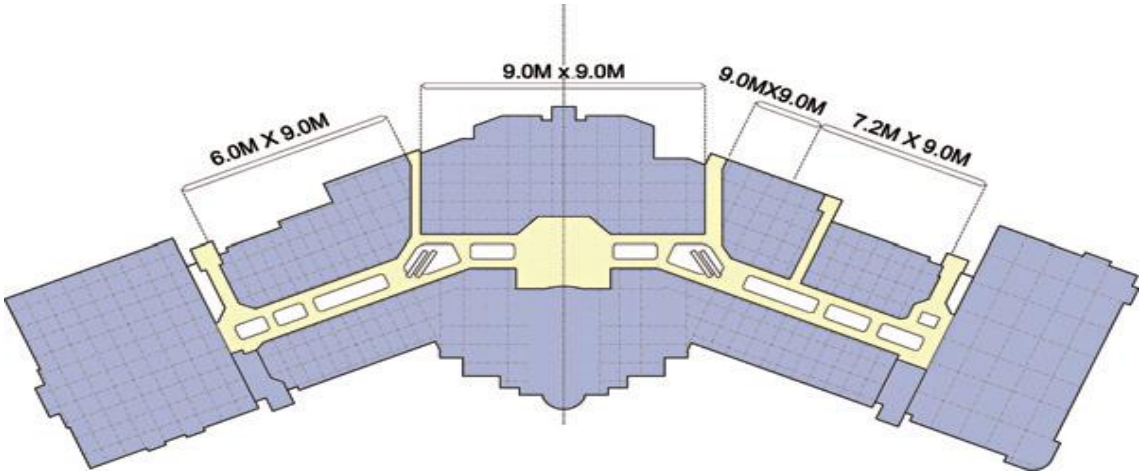


Figure 2.14:showing Plan layout of the Mall at Cribbs Causeway, Bristol, UK showing variable grids providing different shop unit sizes.
Source: (Peter,2006)

2.11.2 Site Accessibility

Site accessibility has been identified as one of the key issues for consideration when assessing the potential location of a shopping centre development. Accessibility directly affects the fundamental workings of a shopping centre. It affects how easily customers can visit and be encouraged to return, how efficiently goods can be delivered to supply the shops and the means of safety and security of the occupants. Figure 2.15 identifies how Understanding a site location provides for public transport, private cars and service vehicles is essential to establishing the brief for the new facilities in the development.

Accessibility includes an understanding of all modes of transport and access to the site which, includes pedestrian and cycle-ways.

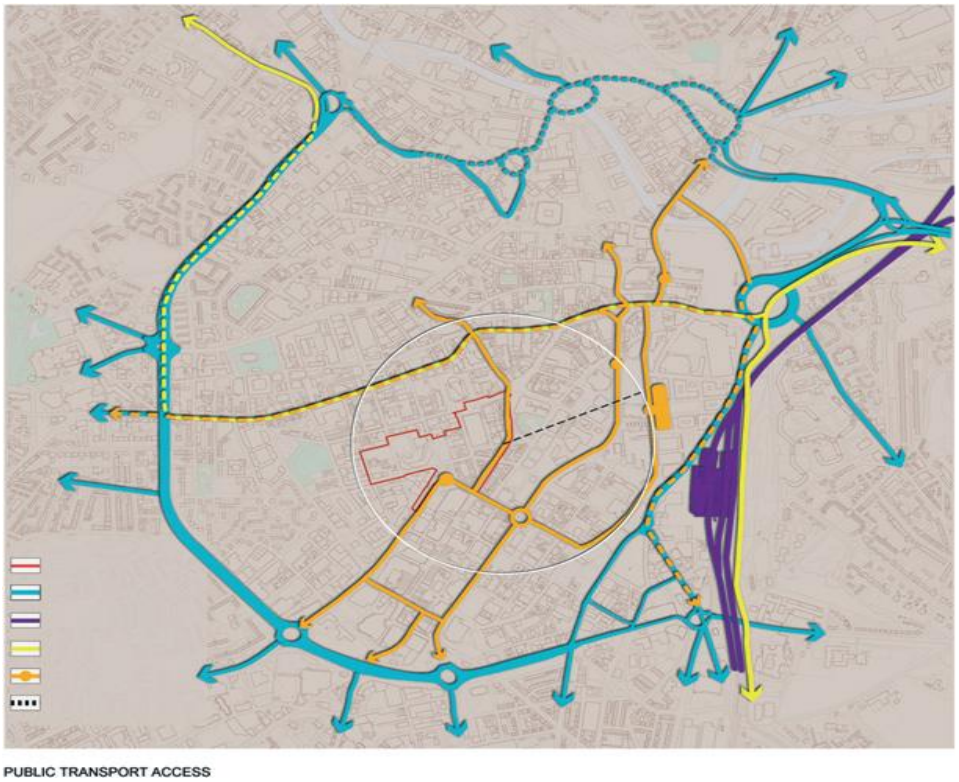


Figure 2.15:A typical immediate transport and access assessment diagram prepared for theNew Retail Quarter, Sheffield, UK (planned 2010). (Source: Peter, 2006).

2.11.3 Parking Lots

Private motor cars are the preferred means of transport for customers visiting a shopping mall. Cars provide a safe, convenient and reliable means of access and, until public transport becomes more economical and convenient, will remain the life blood of shopping centres. No doubt the eventual demise of available petrol and diesel sources will force alternative means to be considered. However, for the foreseeable future the design of shopping centres will need to accommodate the motor car as the means of transporting the majority of customers tothe centre.Accommodating the motor car first requires a suitable road network to distribute the cars to and from the mall, and secondly a means of parkin them on arrival.

Car parking to a shopping centre development can be provided in a variety of ways, or in various combinations of:

I. New car parking provided with the shopping centre
II. Existing car parking adjacent to the development
III. Off-site car parking in a park and ride facility withbuses transferring customers from perimeter carparks into the town centre.

Major anchor tenants will have minimum parkingrequirements for the number of spaces they wishto provided on site. This figure can vary, but can be as many as 1000 parking spaces for some major tenants. The British Council of Shopping Centres provides a general rule of two to four spaces per100m2 of new accommodation (British Council of Shopping Centres, 2000). For a typical centre of50 000m2 this could be as many as 1000 to 2000parking spaces.

2.11.4 Services Vehicles

Service vehicles include all the various vehicles thatservice the shops, catering and leisure facilities of the shopping centre. These vehicles represent the functional life blood of a shopping centre and should remain invisible to the customer. They are key to the business of the tenant and to the operation of the landlord/owner's premises.Along with the assessment of the accessibility ofprivate cars and public transport, an assessment willneed to be made of the capacity of the road infrastructure to distribute service vehicles to and fromthe proposed development. Although service vehicles can share the primary road network to the centre their points of access should be kept separate from those for private cars and public transport.

The type of service vehicles to be accommodated range from shop delivery vehicles, refuse vehicles and fire-fighting vehicles. As a general guideline, the British Council of Shopping Centres (BCSC)research study 'Service Areas for Shopping Centres

‘recommends the provision of 5.5– 6.5 vehicle parking bays per 9000m2 (100 000 ft2) of GLA (excluding large department stores) (British Council of Shopping Centres, 1995). Of these service parking spaces, three will be required for articulated vehicles or largerigid trucks. Additionally, large stores and major anchors will require their own dedicated service vehicle parking bays. Parking space will also be required in the unloading yard for refuse compactors and skips which accommodate compacted rubbish, along with parking spaces for the refuse vehicles that remove the skips. For an average sized shopping centre of 45 000m2 (500 000 ft2) the total number of parking spaces can be as many as 30 spaces, plus space for refuse vehicle accommodation. This can require a considerable amount of space and needs careful planning to remain discreet and accessible toall parts of the shopping centre. In some centres it may be necessary to provide several unloading areas to ensure convenience for all the shops. It is also worthbringing in a specialist highways consultant to determine the exact number of service bays to be provided so as to avoid over-sizing the service yard facilities(Schoenherr, 2006).

2.11.4.1 Fire Fighting Access

The shopping centre will need to be planned to allow for ready access of fire-fighting vehicles to predetermined points around the building or buildings. From these predetermined points of access, hose reels will be required to extend from the fire-fightingvehicles to cover all parts of the shopping centre. Early consultation with the fire service is recommended to establish the permitted maximum lengths of hose reel, in order to determine the degree of access points for the fire-fighting vehicles. Fire-fighting vehicle access must remain unobstructed and should be of sufficient width to allow for turning if not arranged on a through route. Access routes need to allow for the significant weight of a fire-fighting vehicle. The other fire-fighting facilities required

within the building can also be established from early consultation with the fire service (Peter, 2006).

2.11.5 Layout (Organisational Framework)

The layout is fundamental to the success of a shopping centre and is therefore considered here as part of the primary brief. The primary brief should start with simple objectiveswhich can evolve as the design progresses. The considerations here have been organised into general objectives for the primary brief.

2.11.5.1 General Layout Objectives

The layout should form a unique and interesting place that is convenient, safe and enjoyable to use

■ It should be legible and easy to understand

■ The arrangement should establish strong pedestrian flows which will allow customers to pass along all the retail frontages

■ Anchor stores should be positioned to generate and reinforce pedestrian flow

■ Medium space user stores should also be located to reinforce pedestrian flow

■ Other major attractions (leisure facilities and catering areas) can be located to assist pedestrian flow

■ Other generators of footfall which include entranceways from car parks, points of access from public transport, vertical circulation points including stairs, escalators and lifts, should be positioned to assist pedestrian flow

■ The arrangement of public circulation space should form natural circuits and avoid customers having to retrace steps

2.12 Horizontal Circulation Layout

One of the fundamental ways of establishing strong pedestrian flows is to position carefully the generators of footfall. The stronger retail areas are those perceived as having the most footfall. The busiest areas naturally occur on the approach to an anchor element and die away beyond the anchor, unless a new attraction, or another anchor, is perceived ahead. Hence, the generators should be consciously positioned to encourage all parts of the centre to be used and for the volume of footfall to be evenly distributed past all the shop fronts (figure 2.16).

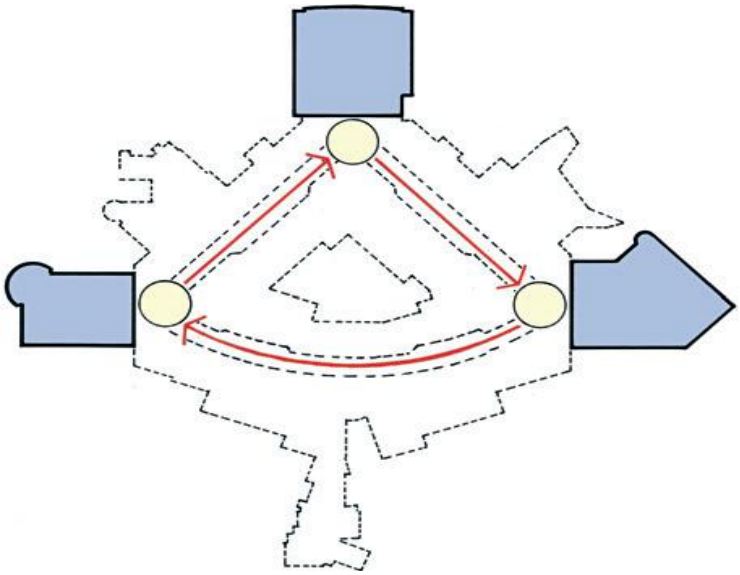


Figure2.16: Showing the strategic positioning of anchor stores are used to generate footfall around a circuit such as Bluewater, Greenhithe, Kent,UK.
Source: Peter, (2006).

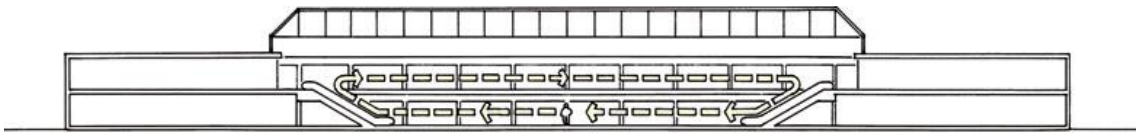


Figure 2.17:Two level dumb-bell arrangements allow circulation past all shop fronts without retracing steps.
Source: Peter, (2006).

2.12.1 Types Horizontal Layout

2.12.1.1 Linear Arrangement

The simplest organisational layout sets out the circulation space and shopping accommodation in a linear arrangement between two anchor elements. These layouts are referred to as dumb-bell, linear orgun-barrel malls and connect between two points defined by the anchors. Figure 2.18 shows that this simple arrangement can be varied by one or more points of punctuation formed by node spaces (focal spaces/knuckle spaces). The number of fluctuation points along the length of the public circulation space will depend on the amount of accommodation and size of the available site. The node space can be used

to introduce an angle into the layout or to accommodate the interconnection of an adjoining circulation route

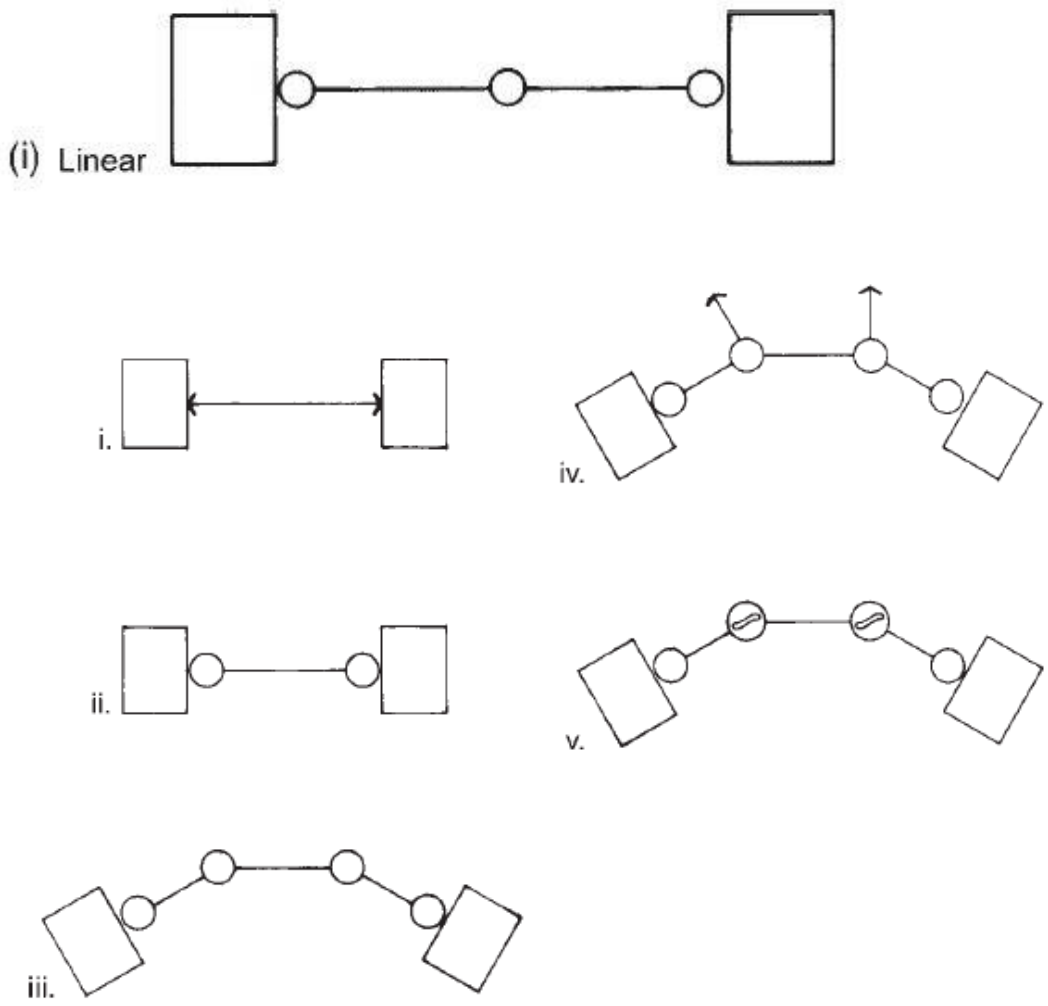


Figure 2.18: showing Linear arrangements:

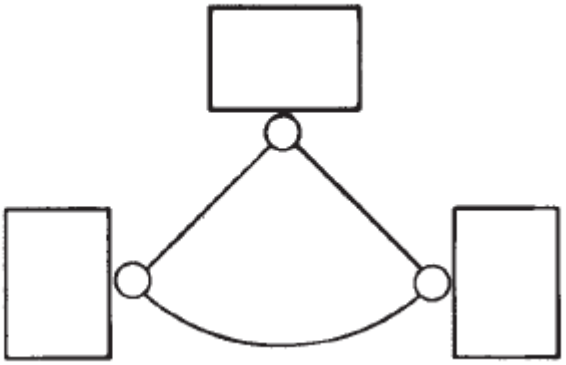
simple dumb-bell between two anchors; ii) dumb-bellwith nodes; iii) nodes used to change angle; iv) nodes to receive other routes; v) nodes including vertical circulation.
Source: Peter, (2006).

2.12.1.2 Circuit Arrangement

The shop units should be laid out in such a way that the public circulation forms a natural flow of pedestrian movement. Circuit patterns of layout encourage continuous circulation past all the shopfrontages and a return back to a point of arrival.The formation of a circuit allows the customer tovisit the whole of a shopping centre without having to retrace steps. Circuits can be formed in three dimensions by considering both

the vertical and plan arrangement of the layout. Circuits can be singular or multiple by adopting a figure of eight. Pedestrian flows in circuits are activated by the strategic positioning of an anchor element at the corners to maintain interest. The anchor element should be visible ahead to lead the customer on. Maintaining sight lines and clear visibility fromone anchor element to the next are important considerations.

(ii) Circuit



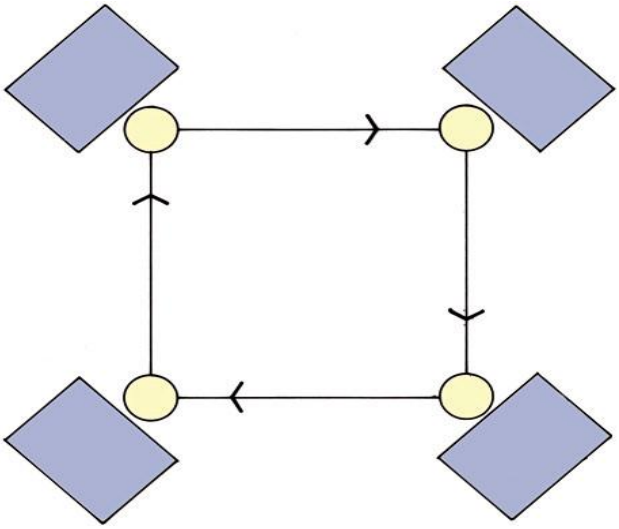


Figure 2.19:Showing the strategic positioning of anchors in a circuit generatefootfall. Source: Peter, (2006).

2.12.1.3 Keyhole Arrangement

This arrangement is based on a single point of entry and return from a high street. The focus of this type of layout is usually one or more large anchor stores located at the end

of the circulation route, which attract visitors past all the other frontages on the wait the destination. The single point of entry and return suits a multi-level arrangement of accommodation better, where visitors enter and circulate to the destination on one level and return by another level, thereby avoiding having to retrace steps past thesame shops (Figure 2.20). A means of vertical level change nearthe entrance will be required, along with the anchor stores having entrances on each circulation level, inorder to facilitate entry and return routesbeing completed at different levels.

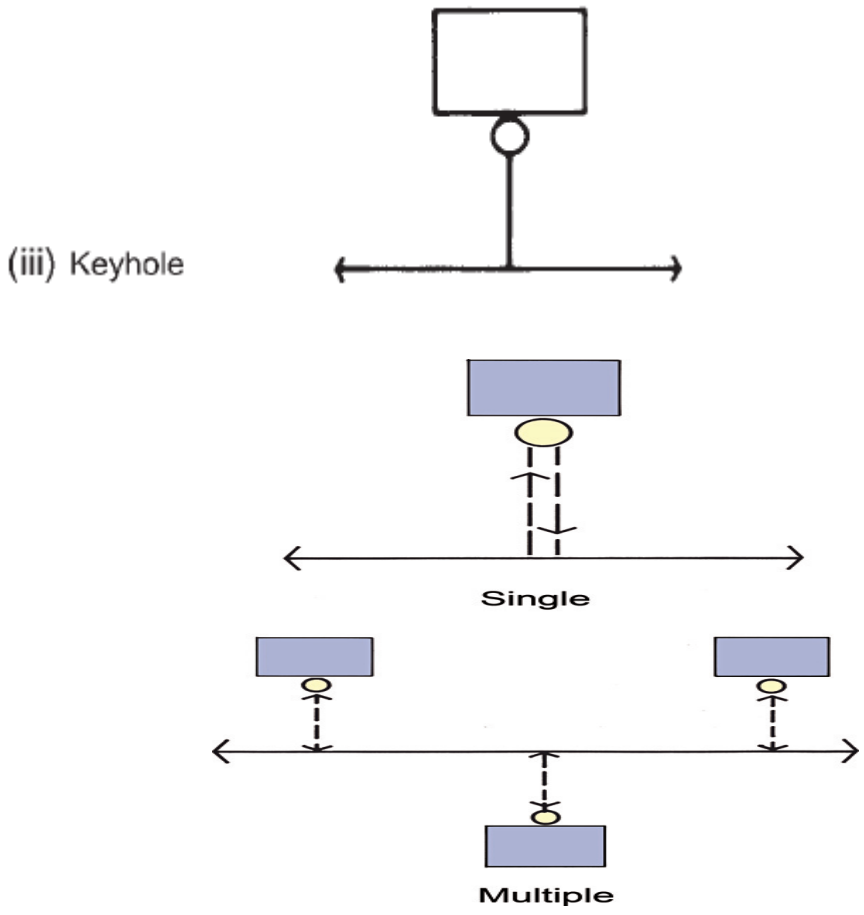


Figure 2.20: showing a single point of entry and return onto a high street can also be used in multiples to form several keyholes. Source: Steven, (2005).

2.13 Vertical Circulation Layout

The successful inclusion of vertical circulation isone of the key enablers to the operation of multilevelshopping layouts and, as such, facilitates shoppingdevelopment located on

high value land. Inmulti-level schemes, vertical circulation should be considered, equally with horizontal circulation, as themeans of structuring the layout and encouraging pedestrians to pass by all the shop units equally.Positioning of vertical circulation has to achieve a balance between facilitating pedestrian footfall andproviding a convenient means for visitors to move between different floor levels. Generally, vertical circulationshould be organised to allow visitors to passing front of a recognisable length of shops beforechanging level and returning past a further length ofshopfronts (Figure 2.21). Equally importantly, the vertical circulationshould be positioned so that it is clearly visible and understandable, allowing visitors to stop in a leisurely way having foreseen where to change level. The vertical circulation should also be positioned to encourage visitors to move forward and towards the point of changing level.Vertical circulation must be conveniently and strategically located. It should be positioned at regular intervals,which generally should not exceed 80–100m(260–325 ft). The interval positioning of vertical circulation is dimensionally similar to the positioning of punctuation spaces in horizontal circulation.

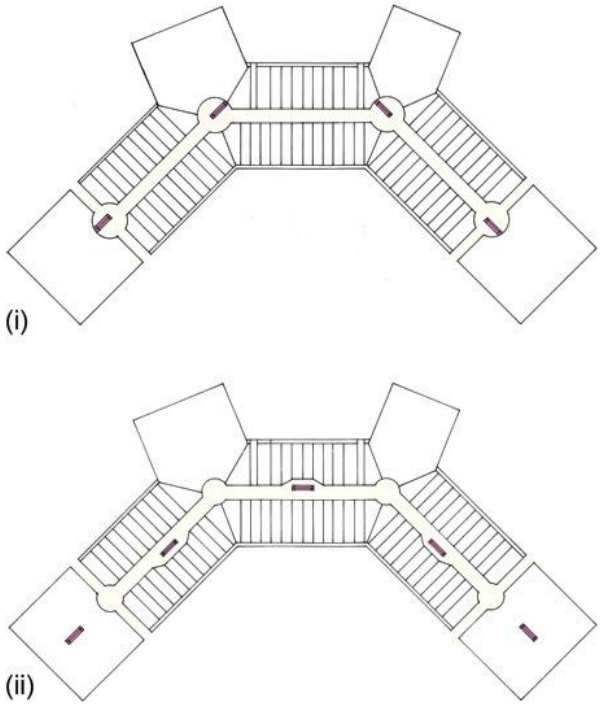


Figure 2.21: Vertical circulation: alternative escalator locations.(i) Escalators located in the node spaces; (ii) escalators located inthe malls
Source: Steven, (2005).

Plate2.5 Showing theEscalators in the node space, Brent Cross, London, UK.
Source: Martine, (2000).

2.13.1 Types of Vertical Circulation

Where vertical circulation is required to provide levelchanges in the layout, this can be provided by a varietyof means. It is usual for a combination of stairs,lifts and escalators to be used to solve the verticalcirculation requirements of multi-level shoppingfacilities. Ramps and sloping the floor are also usedreadily to accommodate small level changes.

I. Stairs

Feature stairs within the public circulation space arean appropriate and flexible way of moving visitorsvertically between levels and are commonly usedand accepted in shopping facilities. Stairs can belocated individually or positioned together withescalators in a variety of combinations. For example,plate v shows stairs can reinforce overall circulation patternsby being located at strategic positions, togetherwith

escalators, in node spaces. Alternatively, stairscan be positioned individually midway between thenode spaces in the public circulation space or inthe node space when the space is kept free of escalators.Stairs are accommodated into the layout moreflexibly than escalators and provide a convenient alternative option for allowing visitors to connectbetween floors.

Plate: vA generously wide mall accommodates a dog-legfeature stair, Metro centre, Gateshead, UK (1984–1987). Source: Martine, (2000).

Plate: vi. Feature stair in the knuckle space at the Sun Court, Bluewater, reenhithe, Kent, UK (1999).

Source: Martine, (2000).

ii. Ramps

Independent ramps and sloping the floor of thepublic space are discreet ways of makingup small level differences. Sloping the floor of the space can be used to take up the level difference between:

- Existing street level or external level at an entranceway and an internal floor level
- Finished floor levels caused by adjacent shops (beneath the circulation space) with varying floor-to-floor height requirements

Plate vi shows that Independent ramps can be used to form a deliberate level change and to help reinforce the separation of circulation space from a seating area. Careful consideration will need to be given to all ramp designs to ensure they comply with the regulatory requirements for accommodating less able persons.

iii. Escalators

Mechanical moving stairs have been adopted in retail premises for over 100 years, since Bloomingdales installed escalators in its late-nineteenth century New York department store. Since their acceptance in department stores, escalators have come into common use in shopping centres from the period of expansion in 1950s America – with the growth ofthe out-of-town regional shopping centre. These early American centres established the escalator as theprimary means of transferring large volumes of theshopping public between different shopping levels.Escalators are now accepted and adopted as theprimary means of vertical circulation in shopping facilities throughout the world (Plate vii).

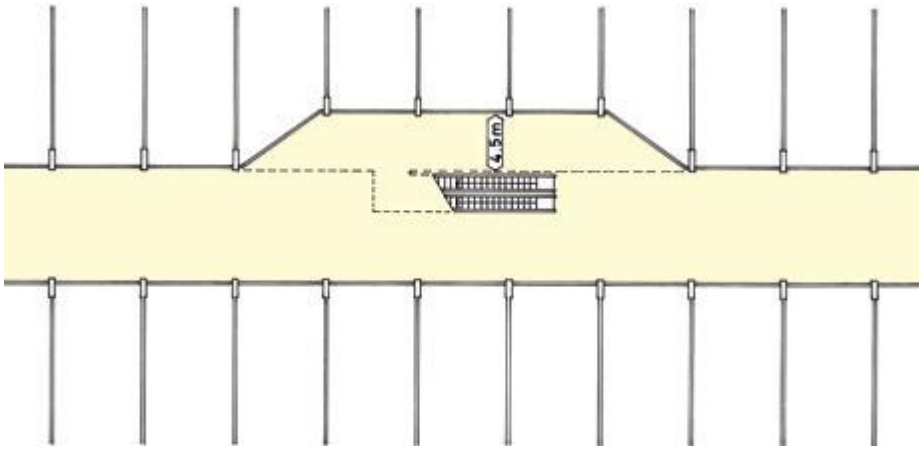
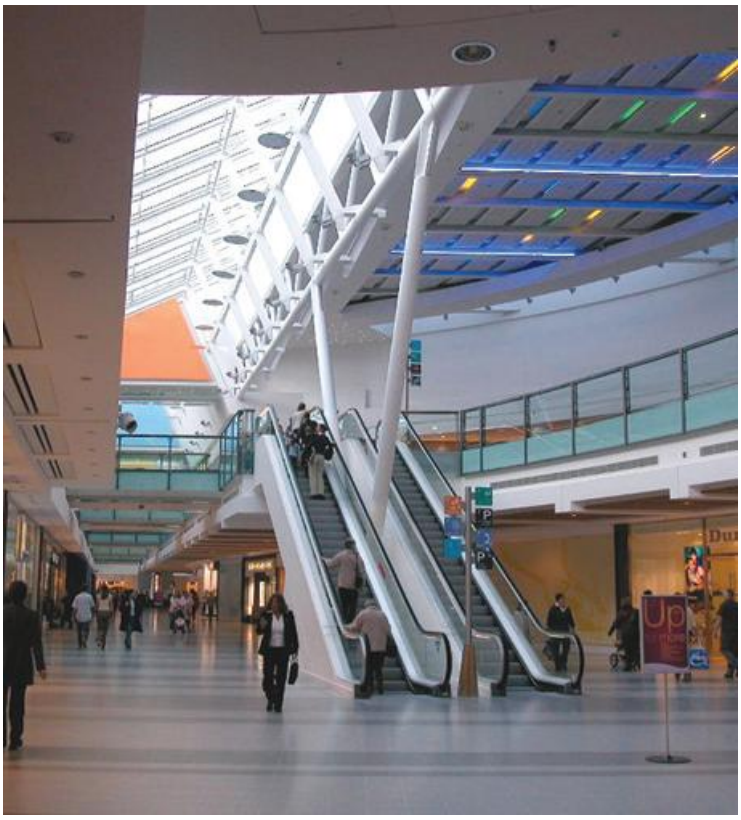


Figure 2.22: Escalators in the mall require the mall to be widened to form sufficient space between the escalators and shopfronts.
Source: Peter, (2006).



Platevii.Escalators in the widened mall space Centre West,East Kilbride, Glasgow, UK.Source: Martine, (2000).

iv. Travelators

Travelators (also referred to as passenger conveyors) are similar to escalators as mechanical means for transporting passengers vertically, except that they have flat

floors rather than steps. As a consequence, they are arranged at a shallower pitch and are longer than escalators. As identified earlier, travelators are used where there are large numbers of customers using trolleys to transfer goods to car parking arranged at a different level to the shops. Travelators are commonly provided in shopping facilities that incorporate a large food store or hypermarket.Travelators are preferably located close to where the trolleys are used to avoid them being wheeled about the rest of the centre. Travelators require longer linear spaces into which to fit the installation and are less flexible to position than escalators. In theory, travelators could be configured in the samevariety of ways outlined for escalators. However, taking into account the greater physical requirements to accommodate them, for practical reasonstravelators are usually configured in simple parallel pairs, with the up and down routes positioned sideby side (plate viii).

Plateviii:A pair of travelators span across the water feature,Blanchards Town, Dublin, Ireland.

Source: Peter: (2006).

v. Lift

Mechanical passenger lifts or elevators will be required for use by disabled persons and those with prams and pushchairs. The same lifts will also be used for the general

convenience of the shopping public. The lifts considered here are those operating between the different floor levels of public circulation space and those areas that extend to thecar parking located above or below the shopping facilities. Lifts directly connected to car parking willbe a significant generator of footfall and can be strategically located to help balance and distribute pedestrian footfall between different floor levels of a centre.Lifts limited to serving the public circulation spaces can either be conventional lifts located tothe side of the space, or free-standing feature lifts positioned in the circulation space. Conventional lifts are more practical, accommodate more passengers and can incorporate glazed vision panels to enhance customers' feeling of security (plate ix). Feature lifts within the circulation space can be extensively glazed but are less practical in that they can accommodate fewer passengers than conventional ones.

Plateix: Square lift in a circular glazed enclosure in the enclosed mall, Smaralind, Reykjavik, Iceland.
Source: Peter, (2006).

2.14 Ventilation

Ventilation in a simple term is a phenomenon that involves air movement – to remove used air to replace with fresh and new air. Ventilation will also reduce the effect of high

level of humidity prevalent in hot-humid zones. Ventilation is achieved by natural and artificial means.

a) Artificial Ventilation

As natural ventilation cannot be relied upon to provide controlled conditions, mechanical methods are often employed. This entails the manipulation of the temperature and relative humidity within a space and the movement and composition of the air mass across it. (Ernst and Neufert, 2006).

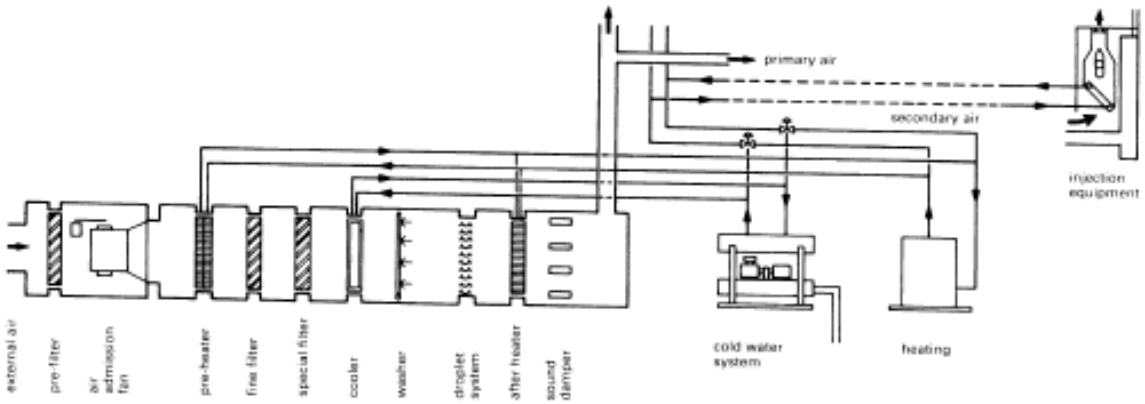


Figure 2.23: Central Air Conditioning System
(Source: Ernst and Neufert, 2000)

2.15 Facilities in Shopping Mall

The shopping mall complex shall be aimed at housing the four important sections that are viewed by the (ICSC, 1998) as the contemporary areas that a shopping centre should have to be referred to as a mall. They include

- Leisure facilities
- Entertainment Facilities
- Catering Facilities
- Retail Facilities.

2.15.1 The Retail Facilities

The unit shop form the nucleus of a shopping centre and attracts the customers to use the shopping facilities. There are three (3) principal types of shops:

- Unit shops
- Medium space users (MSU's)
- Anchor store or departmental store.

a) Unit Shops

Unit shops make up the majority of accommodation in a shopping centre. The unit shop is a standard size, which would be readily lettable to a range of potential tenants. A range of different size unit shops would also be provided to meet more closely the generic space requirements of different retailers (Coleman, 2006).

A survey by the BCSC (1998) revealed the unit shop requirement shown below

I. Majority (63%) seek floor space of 95m2 – 380m2
II. Strong Preference seek floor space of 190m2 – 325m2
III. Small proportion (19%) require less 95m2
IV. A proportion (18%) requires larger than 380m2

However, in taking account of this trend a shop unit module of 7.5m wide by 25m deep providing a normal area of 187m2 is adequate and the acceptable proportion are within the range of 3:1, 4:1, 2:1 and 5:2 (depth to width). Atleast 25-30% of the Gross Leasable Area (GLA) should be dedicated for storage.

b) Medium Space Users (MSU's)

Principles outlined for unit shops apply to medium space users (MSU) shops. They are strategically positioned in the layout to act as attraction points and to lead customer from one area to another.

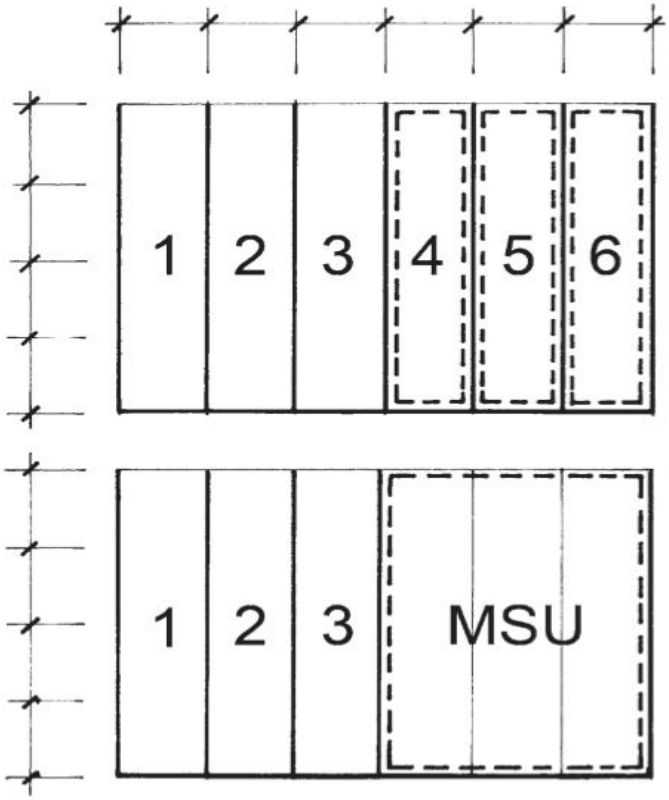


Figure 2.24: Space Requirement For Medium Space Users
Source: Ernst and Neufert, (2000)

c) Anchor Store

Anchor store are the third principal types of shop required to be accommodated within the overall layout. Store size can vary from 7000 to 23000m2. These stores are strategically located and are generally one of the very pedestrian circulation drivers. Typical location for an anchor store would be:

- At the end of a run of shops, thereby drawing customers past the shop fronts.
- Located at a change in direction in the layout in a way which is clearly visible and draw customers in from both direction
- Strategically positioned to form focus point of punctuation in a large complex layout.

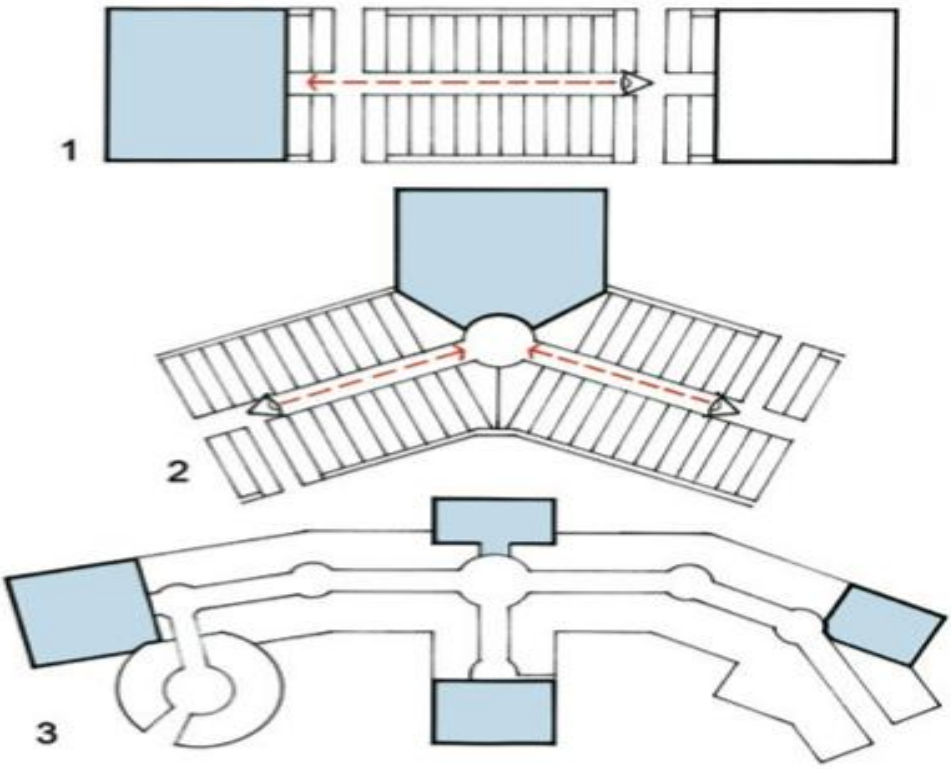


Figure 2.25: Different Positioning of Anchor Store
Source: Peter, 2006

2.15.2 Catering Facilities

Catering is an integral part of visiting a shopping malls and leisure destination and has proven not only to widen the appeal of a particular centre but also to extend the average stay time and amount of spending per customer per visit. The catering facilities make up a proportion of the total accommodation, which can range from 2-25% of the GLA.

It is preferable to locate catering facilities nearby or adjacent to the retail units in a secondary or off prime pitch location.

The wide range of different types of catering which can be incorporated into shopping mall can be categorized into three basic physical formats. They are:

a) Food Court

This format can be summarized as providing fast food, with a limited chances obtained by self-service and eaten in a communal seating area. Food courts are located as an extension of the shopping centre public circulation space.

A typical arrangement is likely to include six to eight of these offers where each unit is provided with 40-60m2 of serving a communal dining area with table for 300-400 people.

b) Restaurants Clusters

Restaurants are individual catering offers and are individually located. The size of accommodation required for a restaurant vary depending upon the type. For example, a small restaurant can be accommodated in a unit of 140m2 GLA, while a themed restaurant will require a large unit up to 560me GLA.

2.15.3 Leisure Facilities

Leisure activities associated with shopping development are commercial leisure activities where the public pays the operator for the use or enjoyment of their facilities. These activities ranges from passive to active and from mainstream to the specialist.

The most common types of leisure facilities incorporated in a shopping facility are:

a) Multi-Screen Cinemas

This cinema format is one of the most common leisure activities combined with shopping development. The multi-screen is twofold it gives the visitor a choice of programme and gives he operator the ability to judge business potential of each film. The minimum number of screens ranges between 3-6 screens. The auditorium size will

vary to give the operator necessary flexibility with smallest providing 100 seats. The standard space for a 10 screen cinema can be accommodated within approximately 4250m2 GLA.

b) Bowling Alleys

Bowling alleys are considered as part of a large leisure destination, either a regional shopping and leisure centre or a retail entertainment centre. The amount of floor space will be determined by the number of bowling lanes to be accommodated from a minimum of 4 to upward of 30 lanes. Each lane require an overall clear area of 26.7m length by 1.7m width which includes the participant's area; the bowling lane and space for pin stacking machinery.

c) Fitness Centres

Fitness centres have grown in popularity in conjunction with the general increase in leisure time and greater public awareness of the importance of physical well-being. A comprehensive facility can typically require up to 4200m2 or more.

2.15.4 Customer Care Facilities

Customer care facilities being a facility related to personal hygiene or a personal services have significant influence upon the customer's memory of a particular centre. These facilities include:

a) Public Toilet

The location of public toilets needs to be carefully balanced by being readily accessible, without taking up valuable shop frontages.

b) Crèches

The accommodation for a crèches should be conveniently located in a position which is close to the public circulation space, but which does not occupy prime retail space.

The ideal size of a crèches according to (BCSC, 1998) is one accommodating up to 40 children, with additional staff facilities, storage and toilets an area of approximately 175m2.

c) Shop mobility

Shop mobility is a term used for the facilities that assist access to a shopping centre for the mobility impaired visitors. These facilities should be located close to a main point of arrival, commonly adjacent to a car parking space.

d) Quite Room/ Lounges

e) Multi-Faith Room

2.15.5 Back of House

The back of house area of a shopping centre have to be a hidden world, which is generally not accessible to the general public, but its integral to the operation and safety of the building. Although the back of house area tends to be secondary service spaces to the principal accommodation, they are fundamental to the functioning and operation of the mall. The major items of back of house include:

a) Centre Management Facilities

Management suite's prime purpose is to accommodate the administrative and operational management functions of the shopping centre. The management suite has to balance the requirements of being publicly accessible, while retaining the operational aspect in a discrete way. The management facilities include the following:

- Management Suites (administrative office)
- Control rooms
- Staff Rooms
- Maintenance Facilities

b) Access and Deliveries

Shopping centres contain a multitude of businesses that are represented by different individual shops. Access and deliveries are the means of supplying goods to allow the retail businesses to operate. These facilities include:

- Service Yards
- Service Corridors (Deliveries)
- Service Lifts
- Interconnecting Stairs

3.0METHODOLOGY

3.1 Case Studies

According to Yin (2004), a case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context using multiple sources ofevidences.The method of study of this research involves a qualitative analysis of case studies as well as a study of published and unpublished literature. This case study is based on the evaluating the fire safety measures in shopping malls. The assessment was carried out through visual survey and checklist. Veal (2006) opines that case study involves the study of the example of a phenomenon under investigation. Case study has become a dominant method of study in architecture (Oluigbo, 2010) and in most qualitative research processes. This research will study the existing fire safety measures in shopping mall and how these measures aim to protect lives and properties.

3.1.1 Population of Study

This involves buildings relating to this research with respect to case studies. Shopping malls from Abuja were chosen for case studies: Ceddi Plaza, Silverbird galleria, these buildings were selected because they are in the same climatic region with the chosen study location. Bullring and willow shopping malls were also selected for international case studies because of the fire safety parameters they have.

3.1.2 Sampling

Case study in normally selected on the purpose it's meant to serve, cases are selected because they can provide information regarding the research problem. Due to the nature of this research, purposive sampling shall be the only means of selecting case

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

3.1.3 Instruments of data collection

Case studies will be assessed based on the visual appearance on the buildings. Even though visual perception is a subjective feeling.

Checklist will provide the basis of assessing buildings. The variables to be considered include the following.

i. Type of building materials used
ii. Availability of fire control instruments
iii. Scope of building facilities
iv. Site design
v. Circulation/layout
vi. Building construction

3.1.4 Data Collection

The case studies for theoretical research in Architecture may require the use of general methods for data collection (Oluigbo, 2011). These methods include: observation and participant observations, visual survey and checklist, interviews, questionnaire, models and simulation and scientific measuring instruments among others. For the purpose of this research, visual survey and checklist based on the fire safety features of the cases were selected.

3.1.5 Procedure of Data Collection

The procedure of data collection involves case studies of existing shopping malls by identifying and shortlisting the facilities with supporting photographs of each. Sketches and floor plans will also be analyzed in order to determine the fire safety measures.

3.2 Variables

This research focuses on assessing the fire safety measures in shopping malls. The parameters for the variables which satisfy the research questions are to be used to assess the case studies. These parameters are;

i. Type of building materials used
ii. Availability of fire control instruments
iii. Scope of building facilities
iv. Site design
v. Circulation/layout
vi. Building construction

Checklist for assessment of case studies

Table 3.1: showing 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 doors	
Site design	• Building setbacks • Service entrance and exit • Parking	
Layout/Circulation		

4.0 CASE STUDIES

4.1 Introduction

For every research work to be successful there is need to study existing works in the research area. For the purpose of this research, two local case studies were taken in the city of Abuja, Nigeria. Each shopping mall has its unique characteristics in terms of its design and the way it renders its services to the costumers. These malls have similarities, advantages and disadvantages and the researchers work is to criticize and appreciate these factors. This would help the designer to make improvements where there are pitfalls in the design and service rendering aspects of such.

4.2 Case Study One: Ceddi Plaza, Abuja.

Location - 264 Tafawa Balewa way, CBD, Abuja, Nigeria

Opening date - November, 2005

Architects - B+ITC 78

Management - Tayo Amusan

Owner - Ceddi corporation

Type- Retail

Plate x: Ceddi Plaza
Source: Field Survey

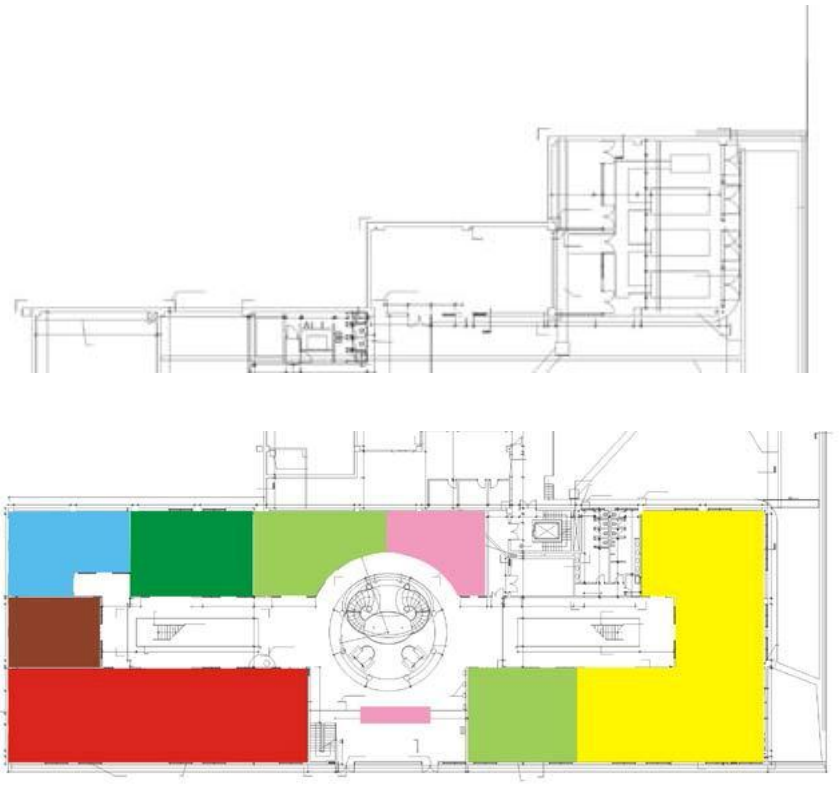


Figure 4.1: Basement Level of Ceddi Plaza, Abuja.
Source: Field Survey

Figure 4.2:Ground floor Plan of Ceddi Plaza, Abuja.
Source: Field Survey

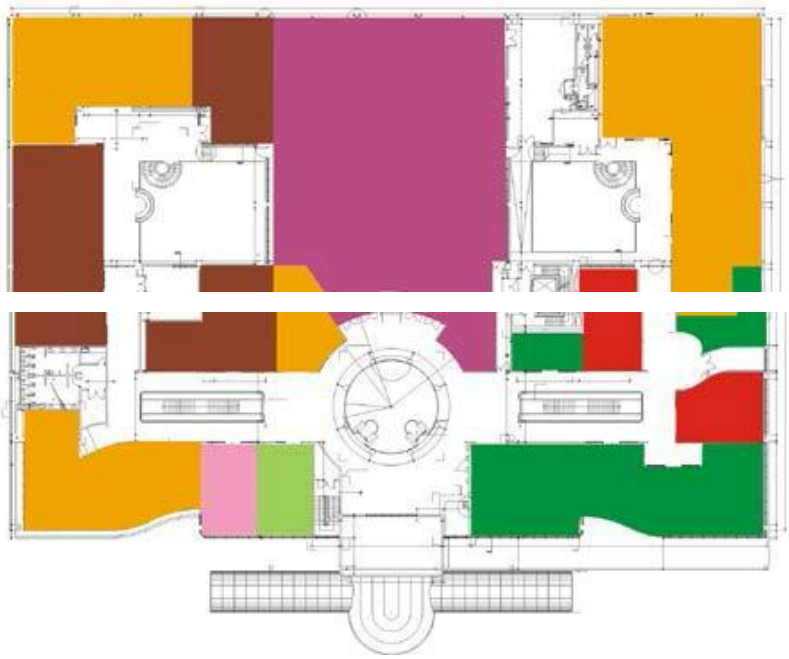


Figure 4.3: 1st floor plan of Ceddi Plaza, Abuja.
Source: Field Survey

Legend

- Wine bar
- Bookstore
- Travel agent
- Restaurants, Café
- Open
- Cinema
- Specialist retailers

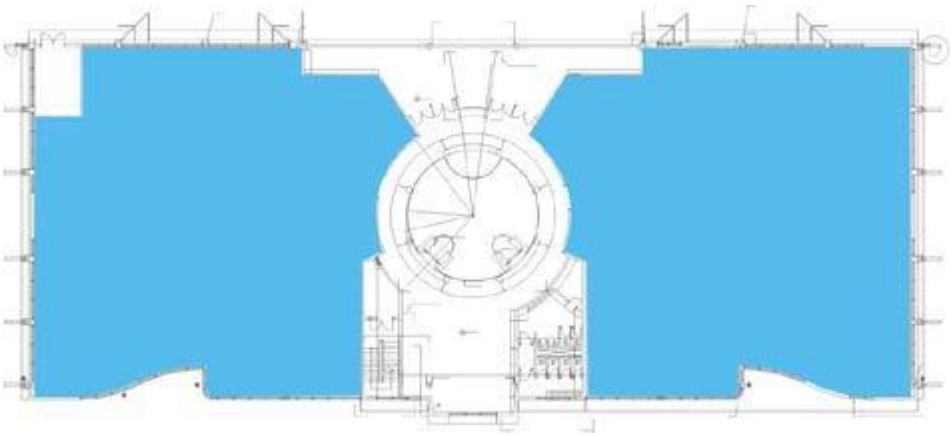


Figure 4.4: Second floor plan of Ceddi Plaza, Abuja.
Source: Field Survey

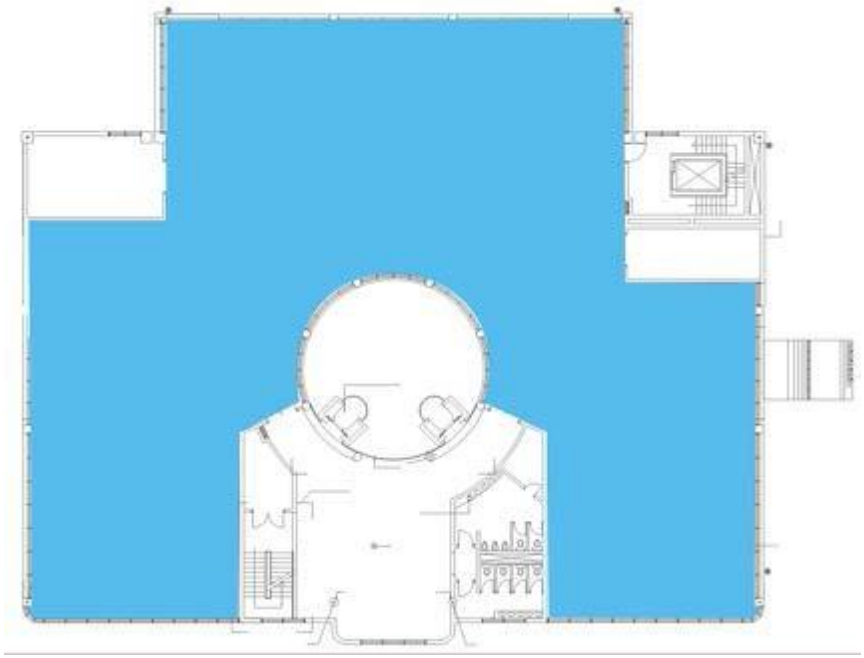


Figure 4.5: Pent house
Source: Field Survey

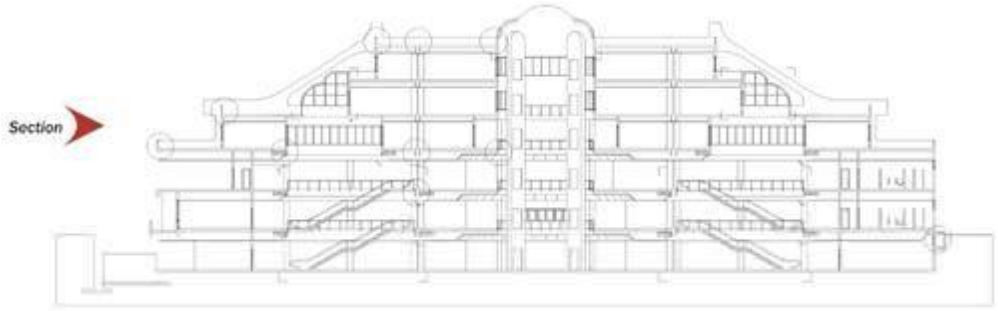


Figure 4.6: Section
Source: Field Survey

4.2.1 Background Information

Ceddi plaza consists of 10,000sqm of retail and office space. It was constructed in 2003 and opened in November 2005 (Plate x). It is managed by Broll property services Nigeria. It has a total of five floors including ground and basement floors (Figure 4.1-4.6). Apart the 55 specialist shops it houses, other secondary facilities such as a cinema, fast foods and restaurants and an internet café among others are accommodated.

4.2.2 Variables

I. Building materials:

The major building materials are dampalon canopy, masonry block and concrete. The façade of the building is covered with marble tiles. The interior of the building, mainly the commercial area has a fireproof ceiling and glass partitions.

Plate xi: fireproof ceiling.
Source: Field Survey

II. Availability of fire control instruments**:**

The shopping mall has fire control facilities visible at the entrance, emergency doors, stairways, ceiling and elevators (plate xi) (plate xii).

Plate xii: showing the fire hose, extinguisher and Alarm botton

Source: Field Survey

Plate xiii: showing the fire sprinkler and smoke detector.
Source: Field Survey

III. Building regulation/Construction

The shopping mall maintained a standard of approximately 3m from the elevator to the emergency exit. The emergency exit is 1.8m wide and not enclosed (Plate xiv).

Plate xiv: showing the exit door
Source: Field Survey

IV. Site design

The site is properly landscaped although the floor coverage area is less than the standard examples of the hard and soft landscape elements employed on the facility which includes pedestrian paved way, street level parking spaces Krebs lighting features, sculptures and water fountain the soft elements includes green areas and plants which include trees of various species.

V. Circulation/Layout

On entry into the walk ways are provided for pedestrian and this is usually arranged in the most convenient way. Vehicle owners need not to exit underground parking to the surface entrance as another equally important entrance is located on the basement floor. Vertical circulation is via staircases and two panoramic lift at central atrium. It combines both vertical and horizontal movement pattern.

4.2.3 Lessons Learned

The Simple open plan layout makes movement easy, the Use of signs and graphics to ease navigation of the shopping mall. Also the architectural problems found are inadequate parking space and also no defined service entry for vehicles.

4.3 Case Study Two: Silverbird Galleria, Abuja.

Location –plot 1161, Memorial Drive, by Musa Yar'adua center business district.Abuja, Nigeria

Opening date –May, 2004.

Architects - unknown

Owner – silverbird cooperation

Type- Retail

Plate xv: showing the front elevation of silverbird galleria.
Source: Field Survey

4.3.1 Background Information

Silverbird galleria is a shopping and recreation facility located in Abuja. It is situated in a high-brow area of the business district area which is designed to cater for the middle and high class of the society encompassing the business area. It is bounded by Umaru Musa yar'adua center by the west and NNPC building (Plate xv).

4.3.2 Variables

I. Building materials:

The major building material of silverbird is concrete, sandcrete blocks and lattice steel frames for the roof. Some parts of the building is covered with aluco bond. The front entrance is decorated with glazing. The interior has a fireproof ceiling, glass partition and terrazzo floor.

II. Availability of fire control instruments

The building has fire control facilities in each floor which are visible at every corner, entrance, and also exit to the building. There are also fire safety signs and symbols which will assist in case of fire emergency (plate xvi).

Plate xvi: showing the fire control hose reel located at the entrance of the building.Source: Authors field work

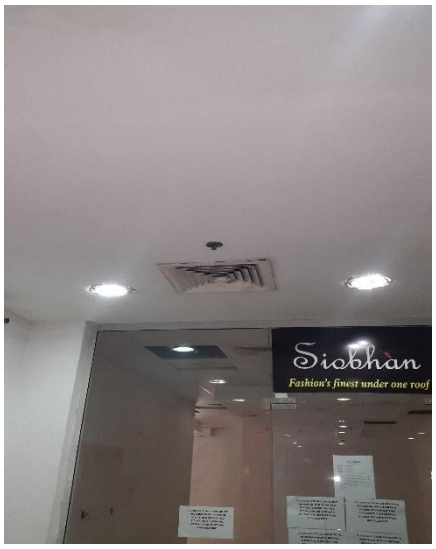


Plate xvii: showing the fire control sprinklers and the HVAC
Source: Field Survey

III. Building regulation/Construction

The shopping mall has a setback of about 6m from the access road which connect pedestrian work way to the main entrance. It has an organized drive path that leads to the parking lots. The ground floor has about 4.5m head room. The emergency exit is visible from the entrance and also emergency signs are located at different angles (Plate xvii).

Plate xviii: showing the emergency sign and exit door.
Source: Field Survey

IV. Site Design

The building is well landscaped, it has a fountain by the main entrance of the building. It has organized parking spaces. The building has its main entrance on the northern side and the service entrance on the eastern side of the building (Plate xix).

Plate xix: showing the water fountain by the main entrance of the building.
Source: Field Survey

V. Circulation/Layout

The mall adopted the circuit layout pattern in which the anchor stores are located at strategic point to assist in pedestrian traffic management.

4.3.4 Lessons Learned

The shopping mall has a Well-organized parking spaces with high level of security. The Simple layout design helps the mall in traffic control. The architectural problems found from this shopping mall is the poor maintenance of fire safety instruments and the shopping mall mostly depends on artificial lightening and ventilation.

4.4 Case Study Three: Willow Shopping Mall, Townsville.

Location –Thuringowa Dr river Road, thuringawa central QLD 4817, Australia.

Opening date –Feb, 2009.

Architects - unknown

Owner – Dexus Properties

Type- Retail

4.4.1 Background Information

Willow shopping mall, owned by the Dexus wholesale Property fund, is in Townsville, one of the fastest growing areas of regional Queensland. On average, 750, 000 shoppers pass through the mall doors every month.

At the time, willows shopping mall comprised 30, 800 square meters of lettable space accommodating three major and 90 small tenants. It would add 18,000 square meters of lettable space (Figure 4.7-4.9).

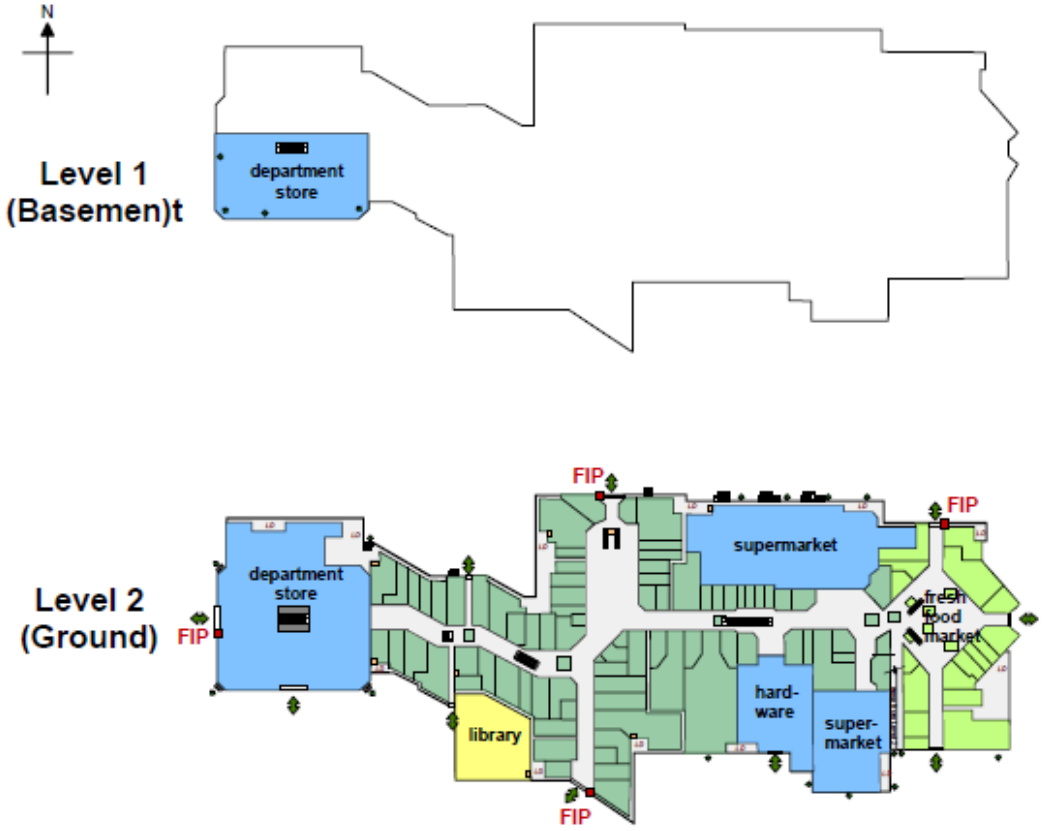


Figure 4.7: showing the basement and ground level layout.
Source: Johansson, 2011

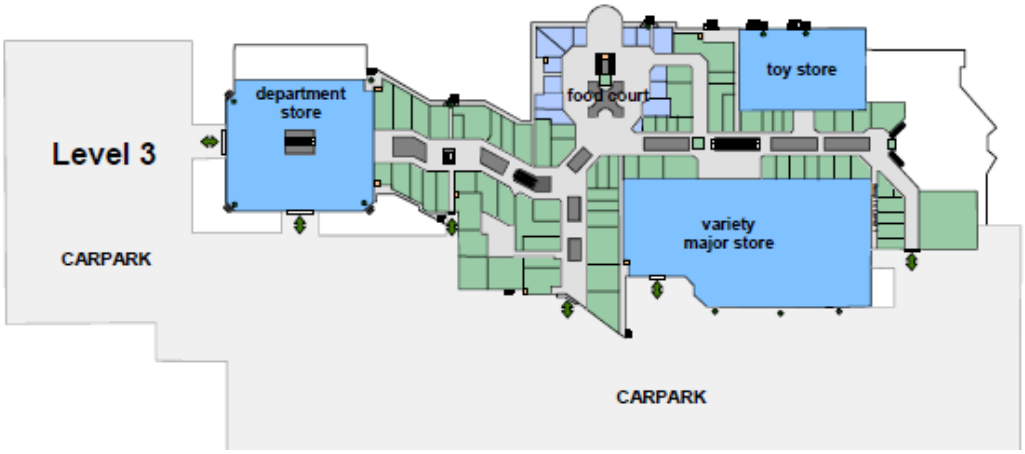


Figure 4.8: showing the level 1 layout
Source: Johansson, 2011

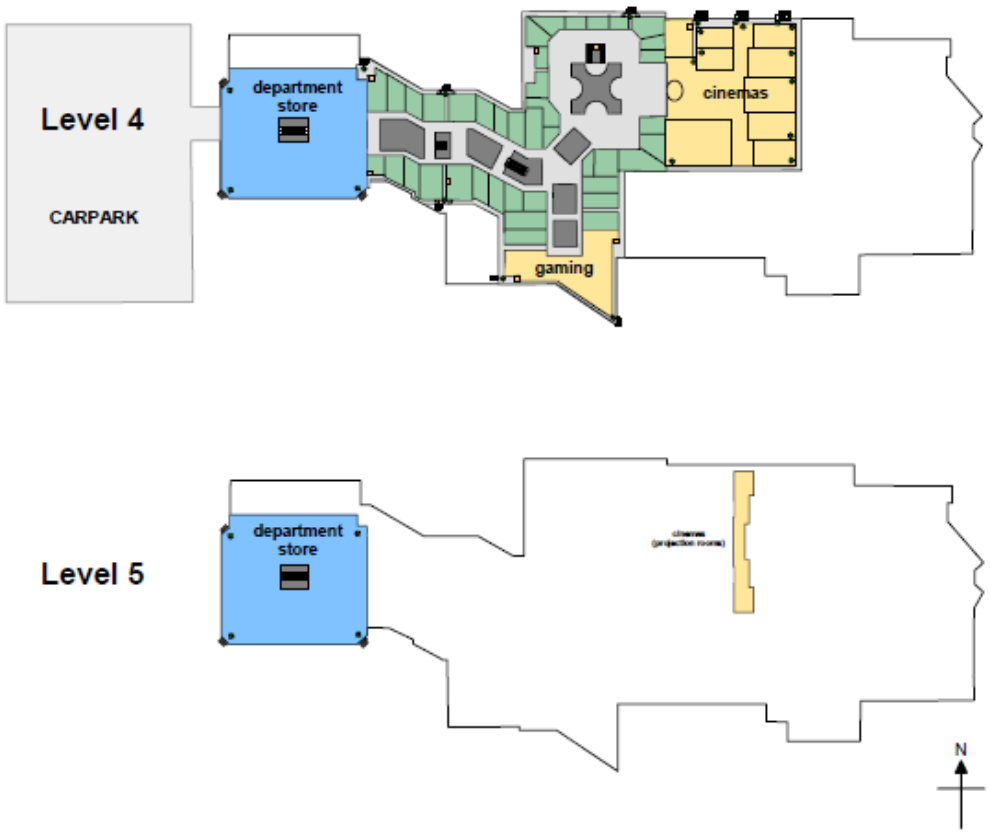


Figure 4.9: showing level 2 and 3 layout.
Source: Johansson, 2011

4.4.2Variables

I. Building Materials

The major building material used by the willow shopping mall for fire safety is the suspended torrefaction compounded high density fiberglass wool. This particular type of ceiling stops the spread of fire in case of fire outbreak. It also has steel frames which are cover by fire proof glass at the façade of the building (Plate xx).

Plate xx: showing the suspended compound high density ceiling.
Source: Johansson, 2011

II. Availability Of Fire Control Instruments

The shopping mall is well equipped with fire control instruments at strategic points which are easily accessible to both tenants and the staff. Fire alarms, smoke detectors and illuminate signs are visible. The shopping mall has three emergency exits located in-between the anchor stores.

III. Site Design

Figure 4.10: showing the site plan of the shopping mall.
Source: Johansson, 2011

The shopping mall is well landscaped with two entry gates, one from the diamond boulevard road and the other form iron horse trail road. The shopping mall has enough parking spaces and also natural landscape were maintained (Figure 4.10.

IV. Circulation And Layout

The willow shopping mall adopted the circuit horizontal layout, in which it has anchor stores at the wings, thereby making circulation easy with minimum traffic. The vertical layout consist of three elevators and six escalators.

4.4.3 Lessons Learned

The shopping mall has a well-designed layout with the availability of fireproof materials at all floors. The architectural problems found from this shopping mall

is the distance from the core of the building to escape route is relatively far and also the design solely depends on artificial ventilation and cooling.

4.5 Case Study Four: Bullring Shopping Mall, Birmingham.

Location –Birmingham B5 4BU, united kingdom.

Opening date – September 4, 2003.

Architects- Benoy

Owner – Hammerson.

Type- Retail

4.5.1 Background Information

Birmingham, England's second city, earlier represented milestone shopping environment with the original Bull Ring (1964), which started the generation of enclosed town centre shopping facilities in the UK and Europe. Within 40 years of the original, the city, known as 'the city of a thousand trades', redeveloped the same site to craft another leading-edge shopping environment by completing the new Bullring (2003). The new Bullring (Plate xxi) corrects many of the past mistakes and, with the planning door firmly closed on future enclosed shopping environments, represents one of the last enclosed town centre shopping environments in the UK.

Bullring is a denser town centre mall than its peers in Reading and Southampton. The centre occupies 10.5 ha (26 acres) and provides110 000m2 (1.2 million ft2) of accommodation with146 shops and two department stores (Figure 4.11).

Plate xxi: showing St Martin's Square looking towards Selfridges, The Bullring, Birmingham, UK.

Source: Michael Betts, 2008

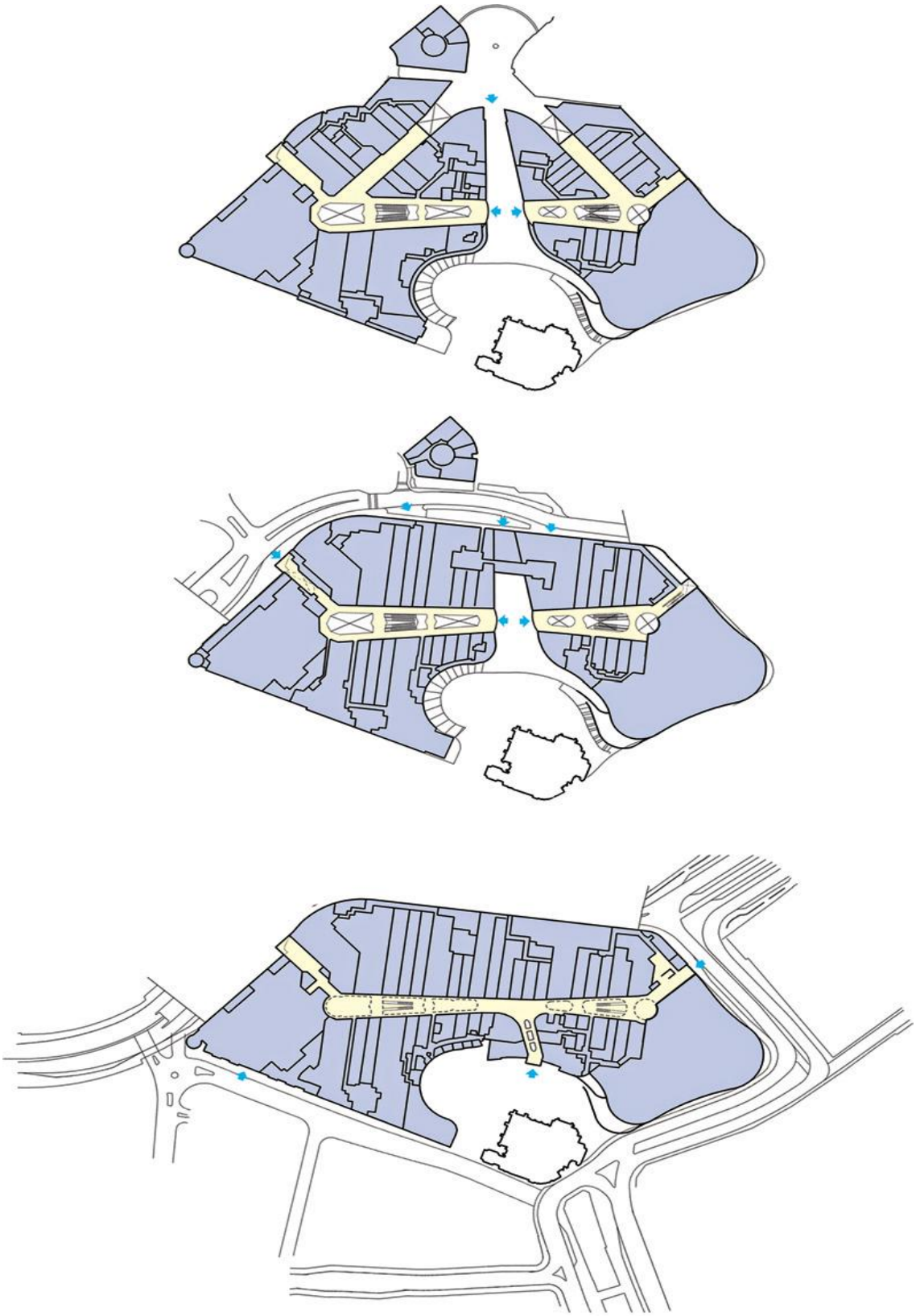


Figure 4.11:Upper, middle and lower level plans, The Bullring, Birmingham, UK.
Source: Michael Betts, 2008

4.5.2 Variables

I. Building Materials

Bullring shopping mall tried to use sustainable materials for construction. The materials used are natural stone (limestone) floors, plaster ceilings and metal balustrades. The major building material used is Sky Plane glazed roof. The ‘sky plane’ glazed roof is formed from planar glazing suspended from external, primary steel trusses (Plate xxii). The minimal roof enclosure maximises contact with the external environment. This type of roof in a shopping environment is a marked departure from the various vaulted roofs which normally enclose public spaces and, as such, marks a step towards covered streets representing the urban agenda. The resulting interior spaces are bright and predominantly naturally lit in daylight hours. The interiors are, however, mechanically heated and cooled to temper the environment.

Plate xxii: The glazed sky plane roof floats over the upper level street, The Bullring, Birmingham, UK.

Source: Michael Betts, 2008

II. Availability of Fire Control Instruments

This shopping mall considered fire safety as of the problems in the design brief. It has smoke detectors, fire alarm systems, sprinklers, and also a smoke free shelter in case of fire accident were the tenants will evacuates to before help will be rendered to them (Figure 4.12).

I. Site Design

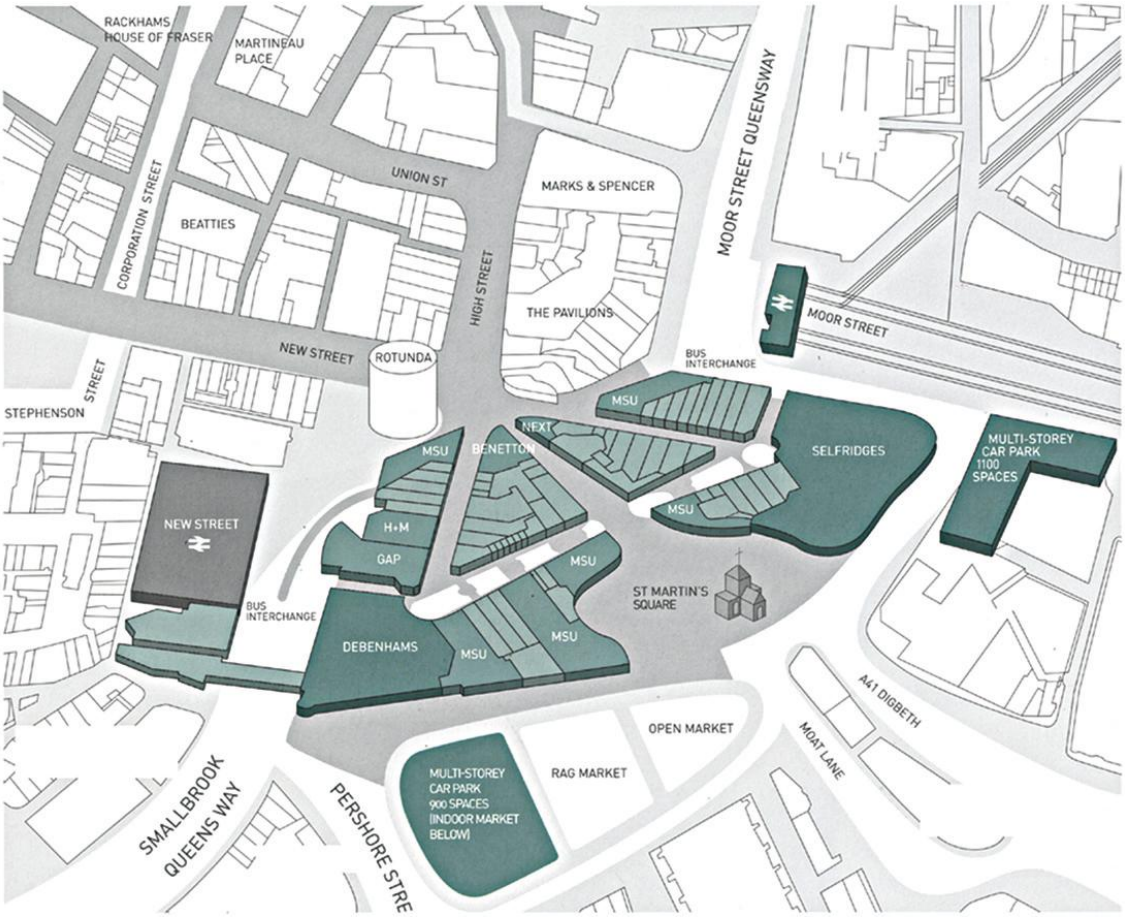


Figure 4.12: Location plan showing integration with the city, The Bullring, Birmingham, UK (2003).

Source: Michael Betts, 2008

II. Circulation/Layout

Pedestrian flows are evenly distributed between the three levels. This is achieved by the level change across the site being used to provide an effective ground floor entrance to each level. The triangular layout is an organizationaldiagram where none of the three levels individually forms the overall pattern. The triangle is formed by the combination of the three levels layered upon each other. The upper and middle levels consist of two

separate wings symmetrically arranged with an implied relationship on either side of the new open street. It is only at the lower level that the two sides are directly connected by the dumb-bell mall between the two department stores (Plate xxiii). The dumb-bell mall connects vertically between the three levels and physically pulls the arrangement together. Knuckle spaces at the end of the mall receive the different routes and provide entranceways to each of the department stores.

Plate xxiii: The three level naturally lit enclosed space looking from Debenhams, The Bullring, Birmingham, UK.

Source: Chapman Taylor, 2003

4.4.3 Lessons Learned

The shopping mall has a well-defined pedestrian route. It has skylights at the lobby and lounge which provides natural lightening for the mall. The shopping mall alsohas a

well-designed HVAC system. The architectural problems found are lack of space for future expansion, and also the population supersedes the parking spaces.

Table 4.1a: Summary of Findings From Case Studies

Variables	**Type of building material**	**Availability of fire control instruments**	**Site design**	**Layout/circulation.**
CEDDI PLAZA, ABUJA	Dampalon canopy, masonry block and concrete are the major building materials in the design of this shopping mall.	The shopping mall has water sprinklers, smoke detectors, fire extinguishers and fire hydrants.	street level parking spaces kerbs lighting features, sculptures and water fountain the soft elements includes green areas	Vertical circulation is via staircases and two panoramic lift at central atrium. It has a linear Layout pattern.
SILVERBIRD GALLERIA, ABUJA	The major building material of silver bird is concrete, sandcrete blocks and lattice steel frames for the roof.	The shopping mall has fire control instruments visible from the entrance and exit.	The shopping mall has a well-defined parking spaces. It has two entrances, main entrance and service entrance.	The shopping mall adopted the circuit layout. It has both horizontal and vertical circulation.

Table 4.1b: Summary of Findings from Case Studies

WILLOW SHOPPING MALL, TOWNSVILLE	The major building material used by the willow shopping mall for fire safety is the suspended torrefaction compounded high density fiberglass wool	The shopping mall has three emergency exits located in-between the anchor stores. It has fire control instruments at intervals. Fire alarms, smoke detectors and water reels are also visible in the shopping mall.	The shopping mall is well landscaped with two entry gates, one from the diamond boulevard road and the other form iron horse trail road. It has a dedicated service gate.	The willow shopping mall adopted the circuit horizontal layout, in which it has anchor stores at the wings, thereby making circulation easy with minimum traffic
BULLRING SHOPPING MALL, BIRMINGHAM	The materials used are natural stone (limestone) floors, plaster ceilings and metal balustrades. The major building material used is Sky Plane glazed roof.	It has smoke detectors, fire alarm systems, sprinklers, and also a smoke free shelter in case of fire accident were the tenants will evacuates to before help will be rendered to them	The shopping mall has emergency exits at different wings. Parking spaces are also located at different entrances of	It has triangular layout. Pedestrian flows are evenly distributed between the three levels. This is

			the building. the shopping mall has three different route with one service entrance.	achieved by the level change across the site being used to provide an effective ground floor entrance to each level.
conclusion	Most of the building materials used have low fire rating. Just few of the malls have coated surfaced materials against fire.	From the shopping malls studied, most of the shopping malls have fire safety instruments. But these instruments are not differentiated form one another or classified.	Some of the shopping malls don't have dedicated service entrance for fire-fighters.	Almost all the shopping malls have good layout and circulation.

5.0 SITE INVENTORY

5.1 Site Location

The site for the proposed shopping plaza is located in Garki II; phase one of the Federal Capital territory of Nigeria. The federal capital territory is centrally located, lying above the hot humid lowlands of Niger/Benue trough but below the hot dry parts of the savannah to the north. Abuja is located in the park savannah region of Nigeria between latitudes 8°25‖ and 9°20‘ north of the equator and longitudes 6°45‖ and 7°30‖ east of the Greenwich meridian. The total area of Abuja is 8000 square kilometers. It is bounded by Kaduna state to the north, Nassarawa state to the East and south east, Kogi state to the south west and Niger state to the west.

5.2 Site Analysis

The site analysis undertaken during this research involved taking an inventory of site elements and analyzing these factors relative to the research aims. Information about the properties of the site from topography to climate to wind directions and noise has been gathered, analysed and incorporated into the design.

5.2.1 Physiography

The area is characterized by undulating terrain interlaced by riverside depressions. A visual scale is created by the inselbergs protruding from the plains. The central and southern access consists of uplands and plains with numerous inselbergs and rock and grasses of various sizes.

5.2.2 Geology

The rocks underlying the FCT site itself are classified in the three categories below as documented by Koloeso, (1998)

a) Metamorphic rock: biotite – muscovite, schist, limited to four narrow outcrop bands along ridge tops at the eastern edge of the site. Migmatite underlying most of the city, porphyritic Gneiss underlying the Usman river valley in the northwest of the city and granite gneiss

b) Igneous Rock: including Biotite Granite, large intrusive masses commonly elliptical in shape forming dissected zones of the Zuma-Bwari-Aso hills and outcrops of the Gwagwa plains

c) Sedimentary Rock: alluvium located in streambeds throughout the territory, consisting largely of sand with rare gravel beds and local deposits of clay.

5.2.3 Surface Water

A network of stream valleys and depressions covering the city site when observed vertically is a rough fan shape, draining the crescent of development area. The fan converged at the Usman River south of the airport. Thus the site of the capital can be divided into small continuous watersheds, all converging at one point.

5.2.4 Soils

The soils underlying the capital city are derived from granite gneiss and magmatite underlie the Gwagwa plains. Their suitability for development land uses varies with depth, occurrence or iron pan, texture, erodability, run-off potential and drainage. Severe constraints for foundations, streets and underground utilities occur when soils are shallow, strong, locally high in swelling clays or iron pan or poorly drained.

5.2.5 Vegetation

The vegetation of the capital city is characterized by park savannah. Riverine depressions are typically skirted by fringes of thickets and high trees. There are occasional patches of forest or heavily wooded areas. Park savannah istypically a stratified community with a discontinuous canopy, shrub and grass layer. The tree stratum is less dense than that of the savannah woodland, but more substantial than that of the shrub savannah (Figure 5.1).

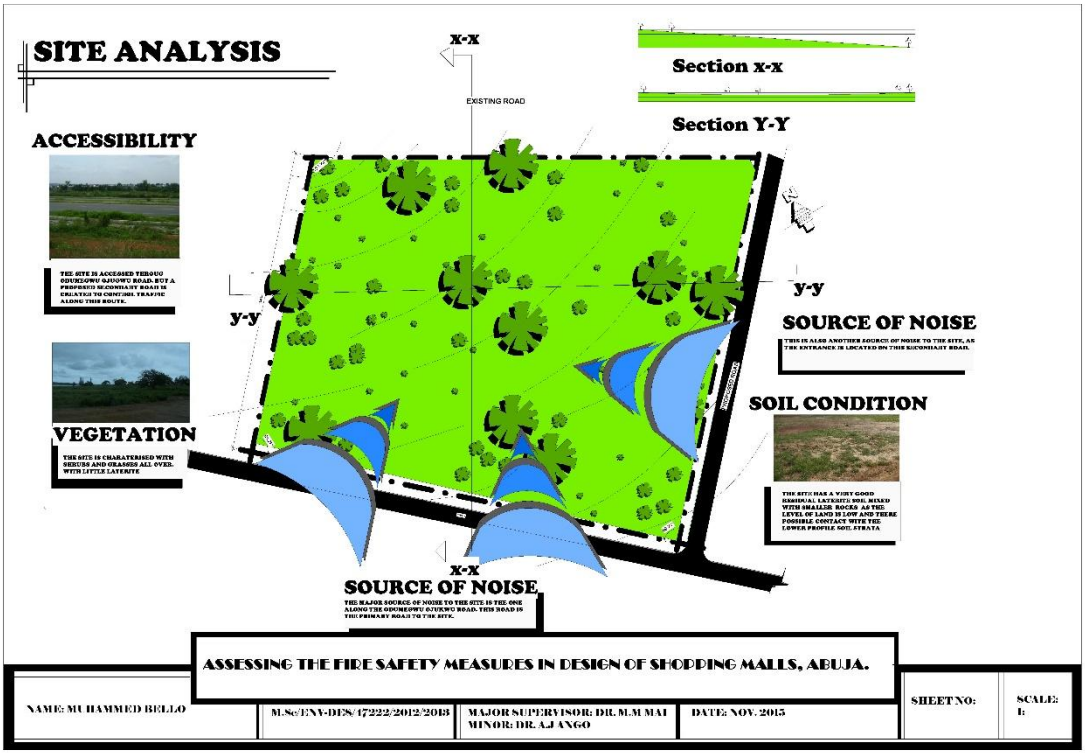


Figure 5.1: showing the site vegetation, noise, and topography.

5.2.6 Climate

The climate of the FCT is typical of the guinea savannah. The table below gives the mean monthly climatic conditions of Abuja (Figure 5.2).

a) Temperature: The highest temperatures are recorded during the dry season. Diurnal temperature change of as much as 18° has been recorded. Lower temperatures abound during the rainy season, especially the month of august due to dense cloud cover.

b) Humidity: High humidity levels are attained during the rainy season. Humidity values generally drop during the dry season, from November – March.

c) Rainfall: Rainfall begins in April and rapidly tapers off after October. The rainy season lasts for an average of 185 days.

d) Wind: Two major air masses dominate the Federal Capital Territory: the Tropical Maritime air mass and the Tropical Continental Air mass. The tropical maritime air mass is formed over the Atlantic ocean of the south of the country and is therefore warm and moist. It blows from south-west to north-east the tropical continental is developed over the Sahara desert and thus is warm and dry and blows from north-east to south-west. The tropical continental air mass comes with the dry season while the tropical maritime air mass, the wet season.

e) Sun and Cloud cover: There is a general increase in the total hours of sunshine further north of the Atlantic coast. The sunshine ranges from aminimum of 1300 hours in the Abuja to over 3200 hours in the extreme north-east of the country (Table 5.1).

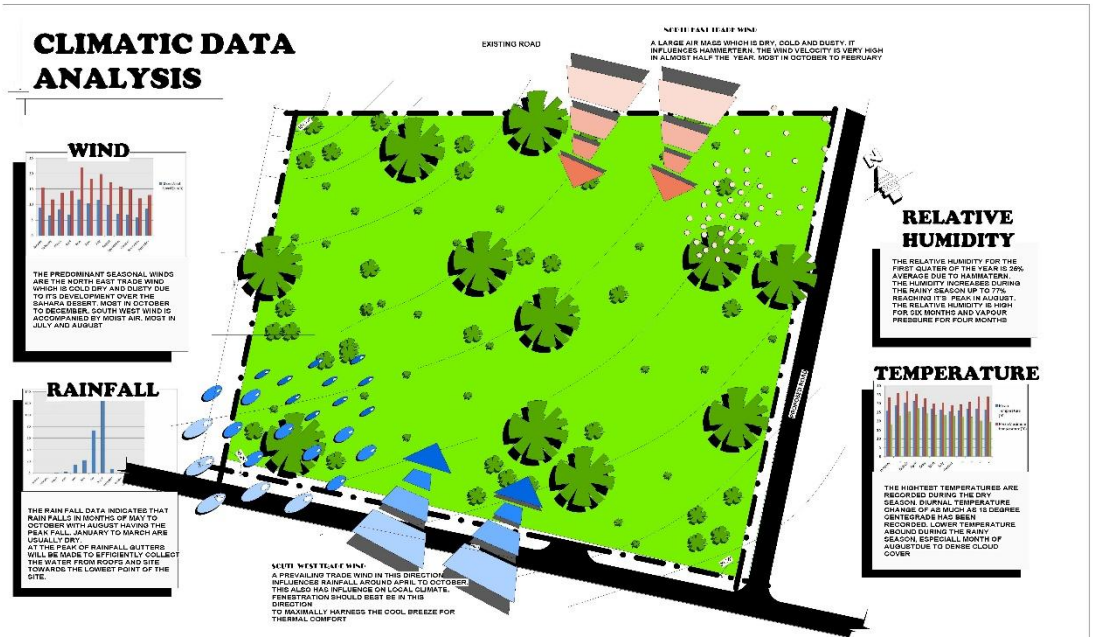


Figure 5.2:showing the climate analysis

5.3 Landuse

The selected site is located in the central business district, phase one of Abuja. The site is designated for administrative and commercial buildings (Figure 5.3). Accessed from the inner northern expressway, the site borders legislative quarters, Ajuji Greenwhich hotel and the Apo super market.

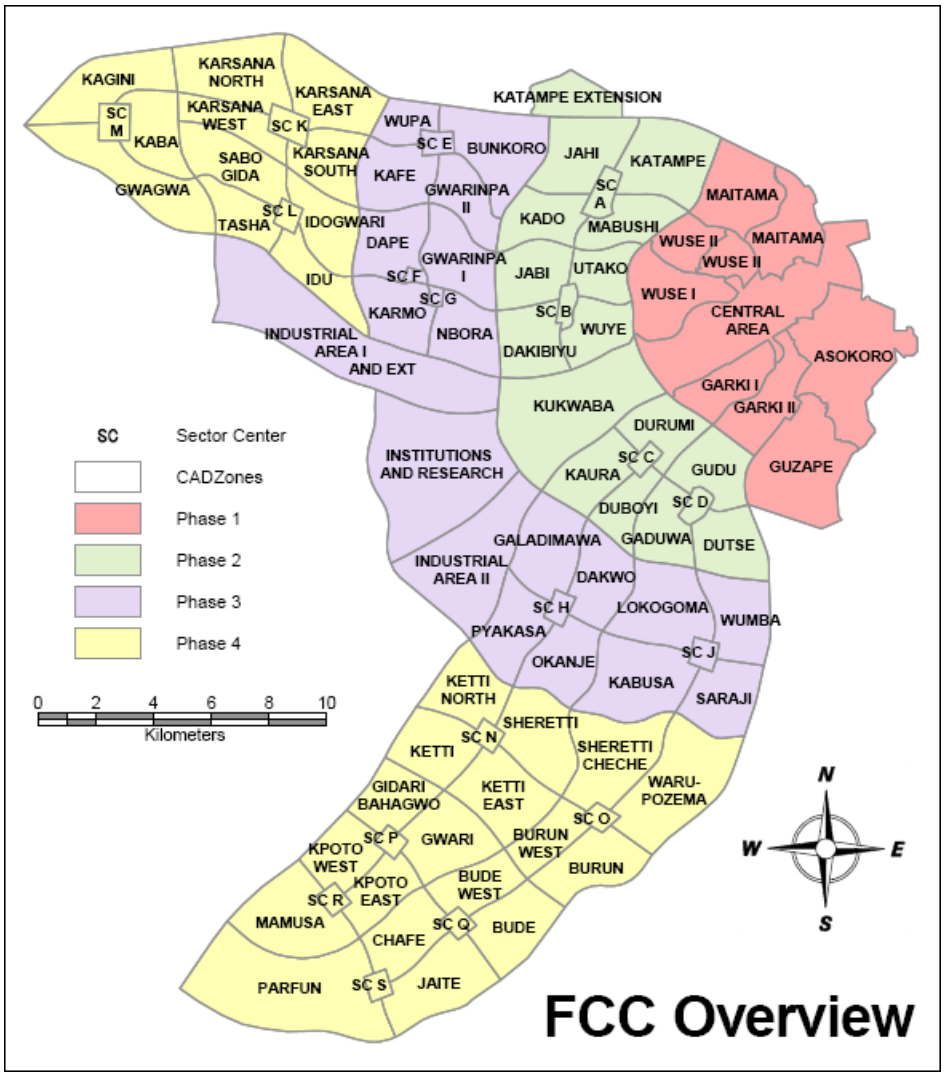


Figure 5.3: showing phase 1-4, Abuja
Source: (Abuja geographical institute, 2010)

5.4 Site Selection Criteria

Choosing a site is paramount to the development of a shopping mall, careful considerations should be taken in selecting a site. For the purpose of this study, two sites are selected. One of the site is at the central business are phase 1, Garki Abuja (Plate 5.1). The second site is also at the central business district area opposite the NNPC building (Plate 5.2).

Plate 5.1: proposed location for site 1 Apo, Abuja.

Plate 5.2: proposed location for site 2 central district area, Abuja.

According to Khan (1999) selection of shopping mall location depends on depends on a range of factors that include the physical characteristics of the site, the demographical data of the locations and so on. These factors have been established to compare the locations and check the viability of each site with regard to those criteria.

Below are the criteria outlined by Khan (1999), along with specific questions that were considered when evaluating the locations.

a) General Location

This refers to general area within the city. Physical characteristics and area characteristics should be considered. The factors related to the general location include but are not limited to population (density), market statistics and neighborhood.

b) Position of Site

Site is a specific piece of property, parking facilities, accessibility of utility and public services, conveniences and visibility are factors related to but not limited to the position of site.

c) Demographics

Information pertaining to consumers must be collected including data about age, sex, occupation, income, food preference and potentials for future growth.

d) Traffic Information

Traffic flow pattern are important for the analysis of the site. The factors related to traffic information include traffic counts and patterns and frequency pattern of traffic flow.

e) Competition

The factors related to competition include but are not limited to location and operation results of competitors and proximity to competitors.

These are the five basic factors considered in the selection of appropriate location of the proposed shopping mall.

A relative score was assigned to each criterion and summarized in the scoring sheet summary below. The scores range from 1 – 5. The location with the higher score is the most desirable location.

CRITERIA	SITE 1 (GARKI)	SITE II (C.B.D)	REMARKS
Accessibility	4	5	Site II (Satisfactory)
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	

Table 5.2: Site selection criteria.

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

From table 5.1 the most suitable location for the proposed shopping mall is the location

5.5 Schedule of Accommodation

After a series of case studies and review of related books articles of shopping mall design; in depth analysis of the brief, the brief was developed thereby forming a detail schedule requirement of individual spaces critical to the design of a shopping mall and as well the bulk spaces schedule (Table 5.3-5.11).

Table 5.3: Schedule of Accommodation of Anchor Store

S/No.	Spaces	Area (m2)	Unit	Net Area (m2)
1.	Anchor Store	545	2	1090
2.	Storages	47	1	47
3.	Toilets	8	1	8
4.	Offices	9	1	9
				1154

Source: Authors Work (2015)

Table 5.4: Schedule of Accommodation of Food court

S/No.	Spaces	Area (m2)	Unit	Net Area (m2)
1.	Dining Area	558	1	558
2.	Kitchen	39	1	39
3.	Store	14	1	14
4.	Toilets	4	1	4
5.	General Store	10	1	10
6.	Changing Room	9	2	18
7.	Serveries	12	1	12
8.	Total			655

Source: Authors Work (2015)

Table 5.5: Schedule of Accommodation of Retail Services

S/No.	Spaces	Area (m2)	Unit	Net Area (m2)
1.	Retail Shop Type A	51	15	765
2.	Retail Shop Type B	70	8	560
3.	Retail Shop Type C	95	10	950
4.	M.S.U	285	8	2280
5.	Exhibition 1	20	1	20
6	Exhibition 2	10	2	20
				4035

Source: Authors Work (2015)

Table 5.6: Schedule of Accommodation of Fitness Centre

S/No	Spaces	Area (m2)	Unit	Net Area (m2)

1.	Entrance Foyer	76	1	76
2.	Changing Room	36	1	36
3.	Refreshment Bar	9	1	9
4.	Coaches Office	15	1	15
5.	Fitness Room	406	1	406
6	Toilet	4	4	16
				558

Source: Authors Work (2015)

Table 5.7: Schedule of Accommodation of Games

S/No.	Spaces	Area (m2)	Unit	Net Area (m2)
1.	Arcade	71	3	213
2.	Children's Game Arena	406	1	406
3.	Snack Bar	12	1	12
4.	Pin Storage & Tool Area	8	1	8
5.	Toilets	8	1	8
6.	Service Aisle	15	1	15
7.	Office	6	1	6
				668

Source: Authors Work (2015)

Table 5.8: Schedule of Accommodation of Customer Care Facilities

S/No	Spaces	Area (m2)	Unit	Net Area (m2)
1.	Welcome Hall	25	1	25
2.	Concierge/ Info.	6	3	18
3.	Toilets	45	6	270

4.	luggage	26	3	48
5.	Security	12	1	12
6.	Crèches	37	1	37
7.	Lounges	9	2	18
8.	Atrium	735	1	735
				1163

Source: Authors Work (2014)

Table 5.9: Schedule of Accommodation of Centre Management

S/No.	**Spaces**	**Area (m2)**	**Unit**	**Net Area (m2)**
1.	Reception	4	1	4
2.	General Office	103	1	103
3.	Conference Room	45	1	45
4.	Staff Toilets	9	1	9
5.	Control Rooms	6	4	24
6.	General Store	12	1	12
7.	First Aid Room	6	2	12
8.	Secure Room	6	1	6
				215

Source: Authors Work (2014)

Table 5.10: Schedule of Accommodation of Access and Delivery

S/No	**Spaces**	**Area (m2)**	**Unit**	**Net Area (m2)**
1.	General Lobby	662	4	2648
2.	Service Corridor	36	3	108
3.	Service Lift	30	1	30

4.	Fireman's Lift	36	1	36
5.	Emergency stairs	30	2	30
6.	Refuge	44	8	352
7.	Fire Balcony	40	6	240
				3444

Source: Authors Work (2014)

Table 5.11: Total Gross Area

S/No.	Spaces	Area (m2)	Unit	Net Area (m2)
1.	Retail Shops	4035	1	4035
2.	Anchor Store	542	2	1090
3.	Food Courts	655	1	655
4.	Restaurant	182.2	3	546
5.	Games	668	1	668
6.	Fitness Centre	558	1	558
7.	Customer Facilities	1163	1	1163
8.	Centre Management	215	1	215
9.	Access & Deliveries	3444	1	3444
	Total Gross Area (TGA)			15374
	Gross Leasable Area (GLA)			12306
	Parking Spaces			12306*4/100=492 parking spaces

Source: Authors Work (2014)

From table 5.11 the Total Gross Area (TGA) and the Gross Leasable Area (GLA) of the bulk spaces of the shopping mall was used to calculate the number of parking spaces

requirements. According to the ICSC (2004) spaces for parking are calculated with respect to the GLA, it is estimated that 5 parking spaces per 100msq GLA.

5.6 Spatial Organisation

Spatial relationship between individual spaces shows how the spaces are linked and related in term of functionality of use and circulation. The bubble diagrams and the flow charts shows the strength of the relationship between spaces (strong to weak) (Figure 5.5).

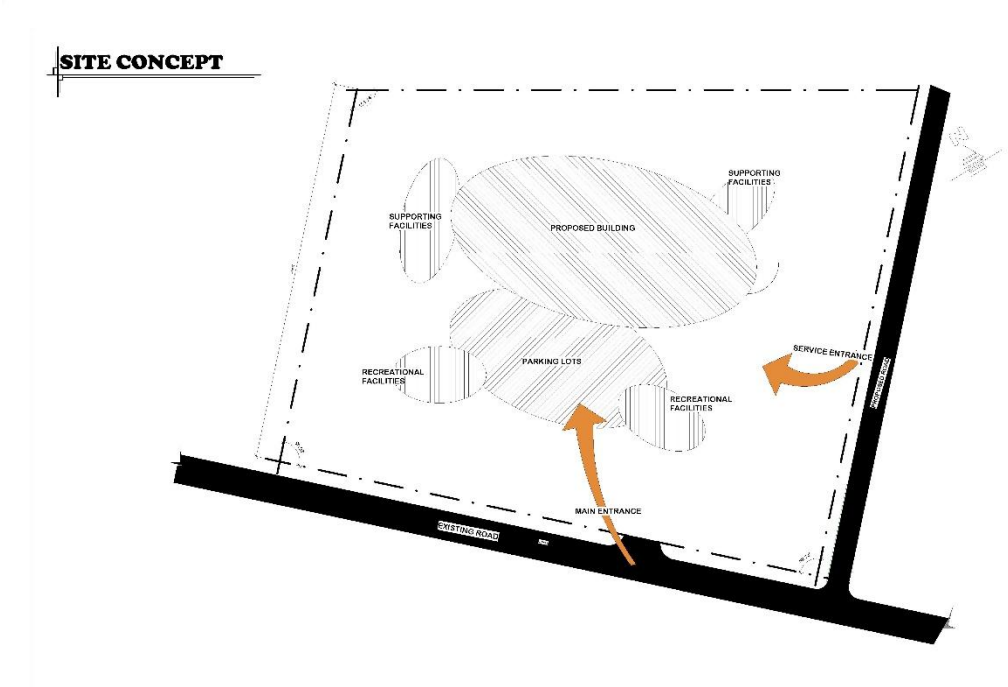


Figure 5.5: showing special organization of the design.

5.7 Design Inferences from the Site Analysis

From the site analysis conducted, the following parameters shall be used in the design proposal:

i. Access into the site shall be via the secondary road bordering the eastern part of the site, only the service entrance will be located at the northern part which links the primary road.

ii. The orientation of the building shall be done to maximize natural lighting and ventilation and minimize heat gain. Solar shading will be applied on openings. Design will incorporate natural daylight and endeavour to prevent solar heat gain and glare.

iii. Temperature on the site will be modified by providing extensive landscaping on the site which will cool the external environment and reduce solar heat gain caused by reflected solar radiation which causes glare and excessive solar heat gain

iv. walkways will be wide enough to convey visitors and also as escape route for emergency.

v. Extensive landscaping will be applied to the site in order to counter the effect of strong harmattan winds and dust arising from the windy weather which could spread fire in the case of fire outbreak.

vi. The parking will be located towards the southern part of the site to allow view.

vii. water hydrants, site lighting and other recreational facilities will be integrated in the design in order to enhance the comfort and safety of the building‘s occupants

6.0 DESIGN REPORT

6.1 Introduction

This chapter encompasses the report of the architectural design of the proposed shopping mall in Abuja. In this chapter key design requirements and how the research findings are

been incorporated into the design are discussed. The chapter is arranged under the following headings: The design framework; Site development concepts; Design Philosophy; The proposed Mall Design: Services Drawings.

6.2 The Brief

The proposed shopping mall shall be viewed as a design thesis proposal for the design of a shopping complex, which would house facilities to cater for all categories of shopping at regional level.

The proposed building shall be a single unit of integrated complex functions, which is hoped to be a manifestation of various enhancing factors to aid the economy of Kano state and to elevate the image of the city in our ever-evolving world.

The general objectives of the proposal are:

1. To incorporate the findings of the research thesis in the proposed design.
2. To provide spatial arrangements to house various retail services and other relevant services.
3. To enhance a safe shopping environment in other to protect lives and properties.

6.2.1 Clients Brief

Mangal Construction Company is a multi-national company that specializes in export and import, construction, industrial production and so on. The company has decided to construct a shopping mall in the capital city Abuja. The company while making survey noticed the major challenges facing shopping malls and decided construct a shopping that will meet all the shopping mall standards.

The clients list basic requirements or clients wish list. They include:

a) Books, card and stationeries
b) Banks
c) Fashion Mixed
d) Fashion Men
e) Fashion Women
f) Electrical
g) Health and Beauty
h) Jewelry and watches
i) Pharmaceutical Stores
j) Photography and art
k) Anchor Store
l) Accessories and Luggage

6.3 Design Framework

The general design approach of shopping malls points out that the key functions are divided in steps. This steps include the main entrance, parking lots and main building itself (Ken, 2009).

6.3.1 Conventional Design Framework

The conventional design framework for shopping malls design within Nigeria looks at aesthetics and spacial arrangements, but little attention is given to fire safety measures and other site facilities.

6.3.2 Site Development Concept

The site development concept adopts the proposed design framework concept. The key site features are basically the main building; parking facilities; service facilities and the entrances (Figure 6.1).

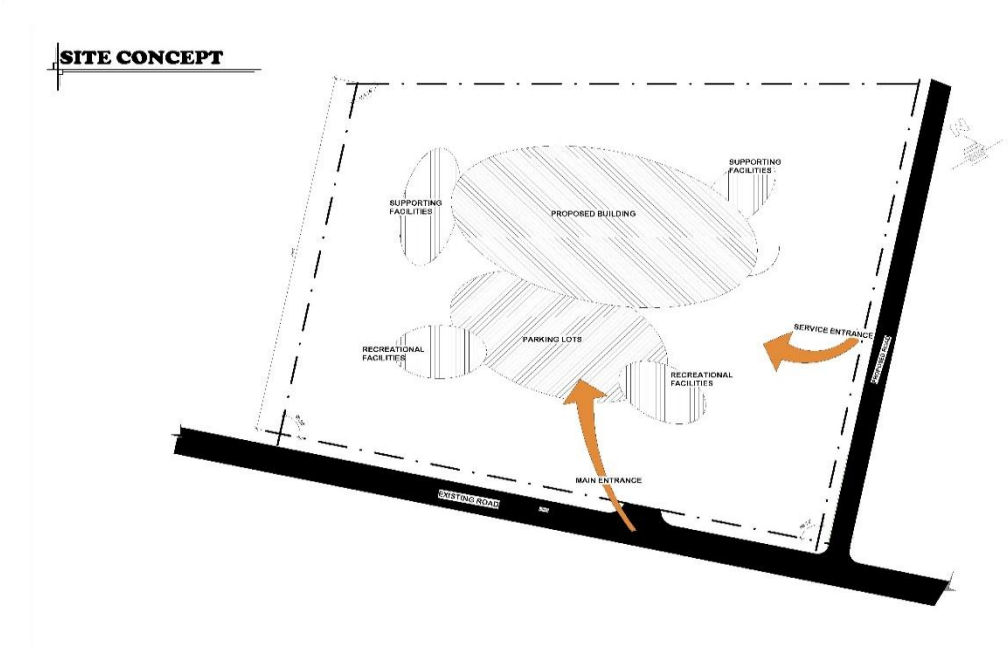


Figure 6.1: Site Development Concept

6.4 Design Concept

The concept of the shopping mall is the simple integration of two fire extinguishers and a shopping cart.

The two fire extinguishers represent the shopping mall magnet, which are the anchor stores. The plan concept has two anchor stores and a large atrium at the centre. This concept is adopted to represent the fire safety in shopping mall design (Figure 6.2).

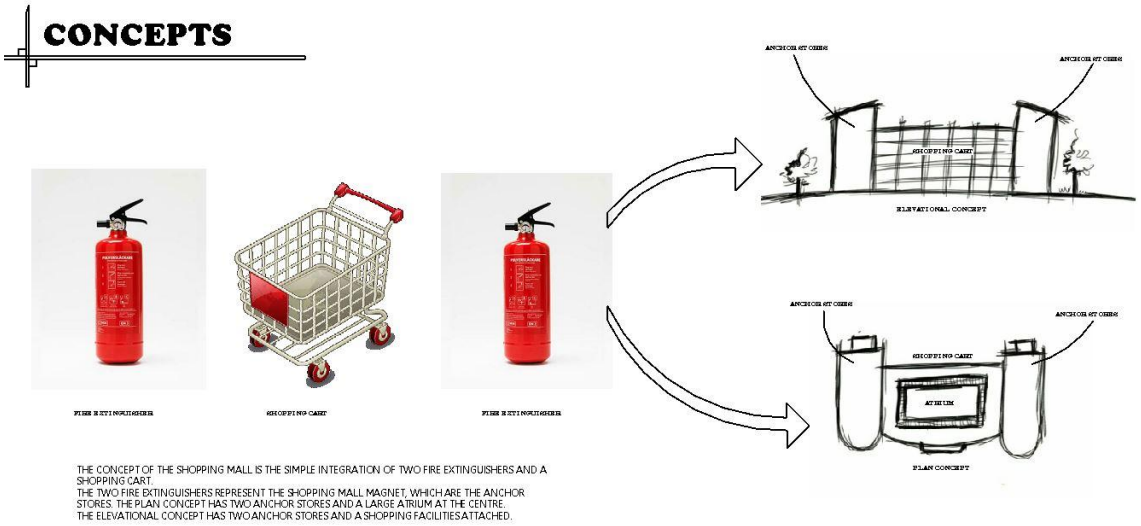


Figure 6.2: showing the plan and elevational concepts.
Source: Author's Work

6.5 Major Functional Divisions

The functional spaces in the shopping mall are grouped into various functional divisions basedon the nature of the activities carried out in the spaces. All the related spaces are groupedtogether. The major functional divisions are four, namely: home accessories; entertainment andrecreation; commercial and other activities. The divisions are arranged according to the floorlevels. The division is done as follows:

a. On the ground floor is the of Anchor store, food court, bank, furniture and other related shops. This was done in order to make the movement of goods and people in and out ofsuch stores easier.

b. The first floor consists of electronics, sports equipment and other related items.This was done in order to make the movement of goods in and out of such stores easier.

c. The second floor consists of beauty salon, retail shops, book store, boutique and other related facilities

d. The third floor consists of food court, beauty salon, barbers shop children's play area,arcade games, departmental stores. This is done in order to locate the food area midwaythe shopping mall to allow for equal distance to all customers and occupants.

e. The fourth floor are the commercial activities like bank, travel agency and leasableoffice spaces. The volume of shoppers is much less on the last two floors which makes it easy to control traffic in case of emergency.

6.6 The Proposed Mall Design

The proposed design of the shopping mall take recognition of the general consideration in design of a shopping mall and as well the issues raised from the findings of this study. Below are summary of key features in the design:

6.6.1 Site Plan Design

The site plan was designed in regards to the recommendations made from the site development concept; the site analysis and the proposed design framework developed to provide solution to the aforementioned design problem. The key elements considered are carefully discussed below.

i. Service Entrance

   The shopping mall has a dedicated service entrance at the northern part of the site, which enables firefighters and delivery vans to access with ease.

ii. Emergency Escape path

   Emergency escape path is one of the key features of evacuation plan in case of emergency. This path is well designed to direct occupants and visitors to safety points in case of emergency. The escape path is 2500mm wide and a setback of 3200mm away from the main building (Figure 6.3).

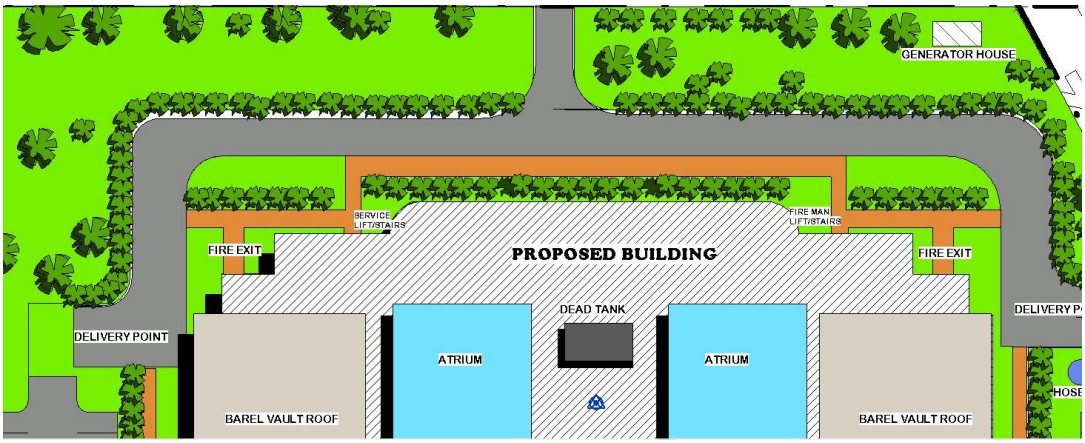


Figure 6.3: showing the escape path on the site plan.
Source: Author's Work

iii. Firefighters service point/Delivery point

Firefighter's service point is very vital in the site plan design in other to ease free movement of the firefighting van within the premises. The delivery point is connected close to the service entrance thereby making loading and offloading a lot easier (figure 6.4-6.5).

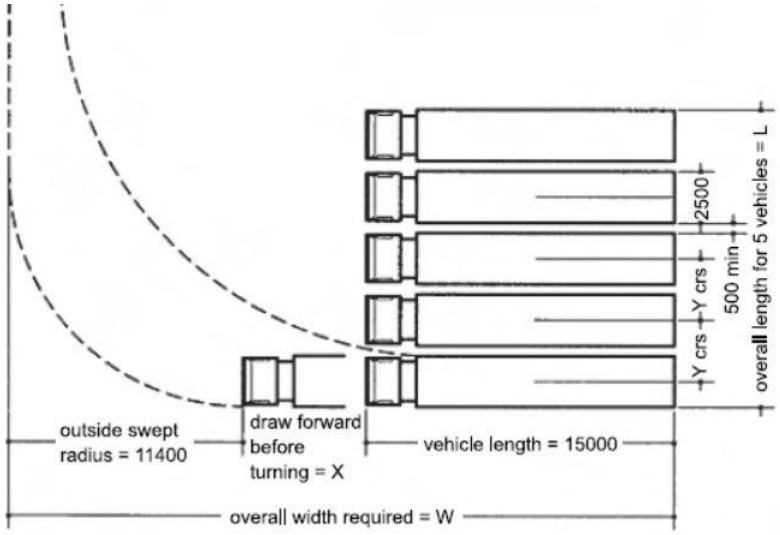


Figure 6.4: showing the parking and loading bay
Source: Author's Work

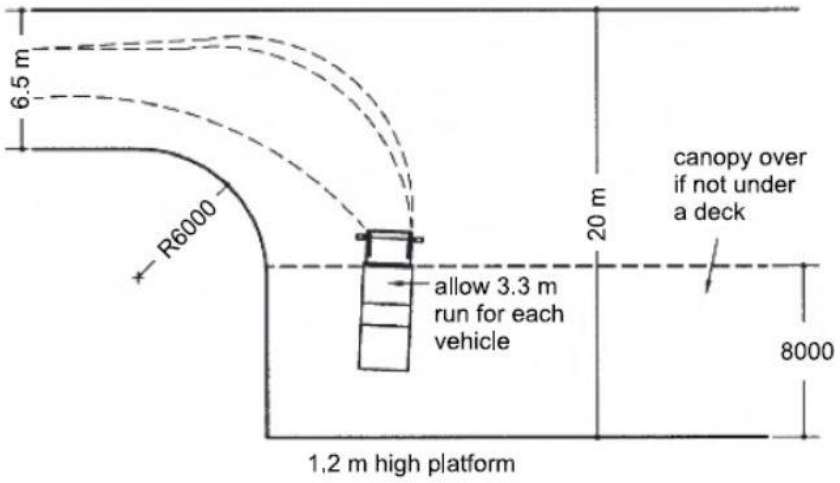


Figure 6.5: showing the turning radius of a service vehicle.
Source: Author's Work

iv. Parking

The shopping mall has three (3) categories of parking. 300 parking lots are provided in accordance with the shopping mall standards (ICSC) with dimension of 2500mm by 5000mm for customers. 4 parking lot/100m2 of GLA=Total No. 28 parking lots are provided for staff and 6 parking lots for services (Figure 6.6).

Figure 6.6: showing the parking spaces
Source: Author's Work

6.6.2 Layout/Circulation

The shopping mall has three entrances,the main entrance to the building is by the southern part. The entrance leads directly to the concourse of the mall that contains the circulation facilities and other shopping facilities. The entrance door has a clearance of 2500mm wide, the doors have an automatic sliding sensory mechanism that provides no obstruction in terms of movements.

The shopping mall has two exit doors on the opposite direction, the exit doors are 2500mm wide. They are totally free from obstruction and has a fire rating of 1/30min. The path of travel to the exit door is 38m from the extreme point of the building, which meets the requirement for the maximum distance required before any exit door. The layout of the shopping mall is in a linear arrangement which connects two anchor stores together as the magnet (Figure 6.7).

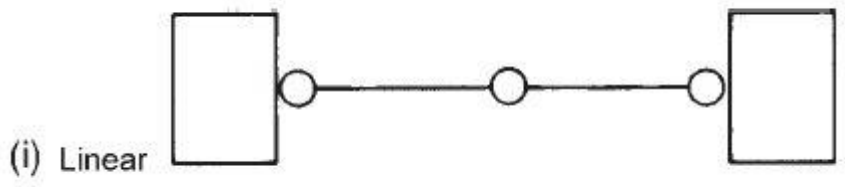


Figure 6.7: showing the linear arrangement.

This form of layout is the simplest which makes circulation in the shopping mall easy. The stronger retail areas are those with the most footfall. The busiest are those on the approach of the anchor stores. As such, provision is made in the design to accommodate the traffic along that axis.

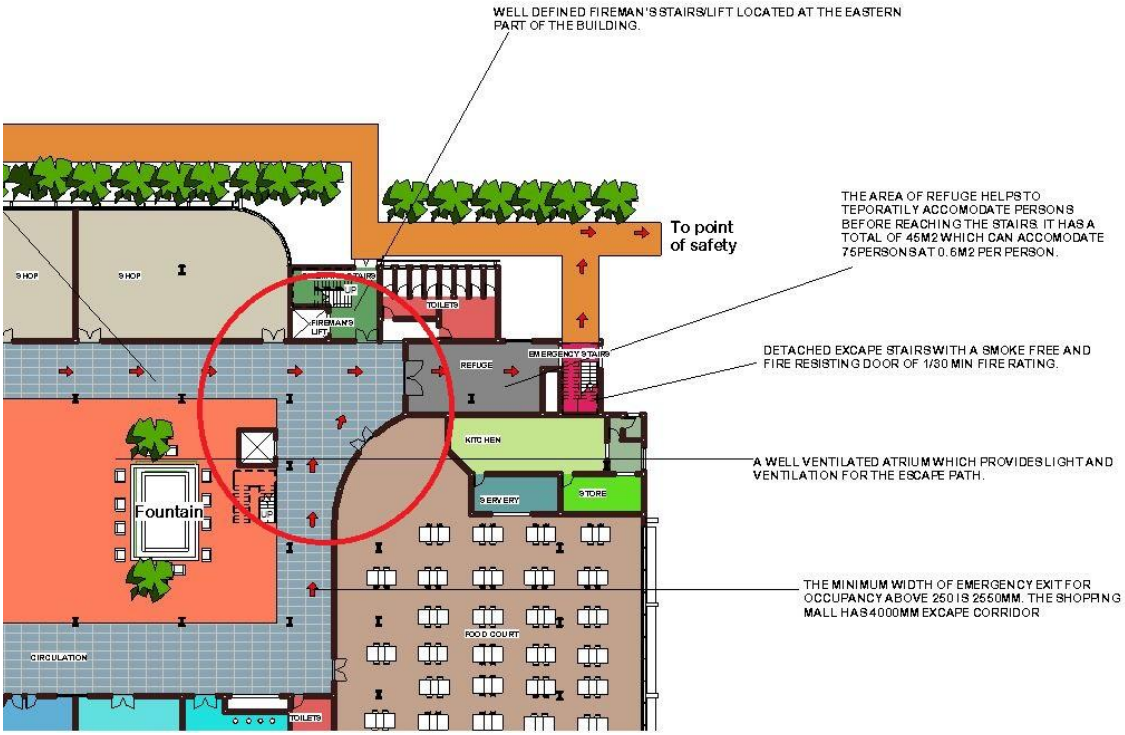


Figure 6.8: showing the highest footfall by the entrance of the anchor sore.
Source: Author's Work

The verticalcirculation in the mall is controlled by two main staircases and two lifts which connects all the floors from two wings. The shopping mall has two service lifts and a dedicated fireman's lift in case of emergency, which will be easily accessed by fire fighters.

6.6.3 Building Materials

The principal structural members are reinforced concrete and the structural frame uses Steel. Glazed panels for external cladding and gypsum board for internal partitioning, rendering and finishes. Aluminum composite panels for cladding with local spray tile finish to other masonry areas. The materials are sprayed with intumescent material (sodium silicate) which has a fire rating of 1/30min.

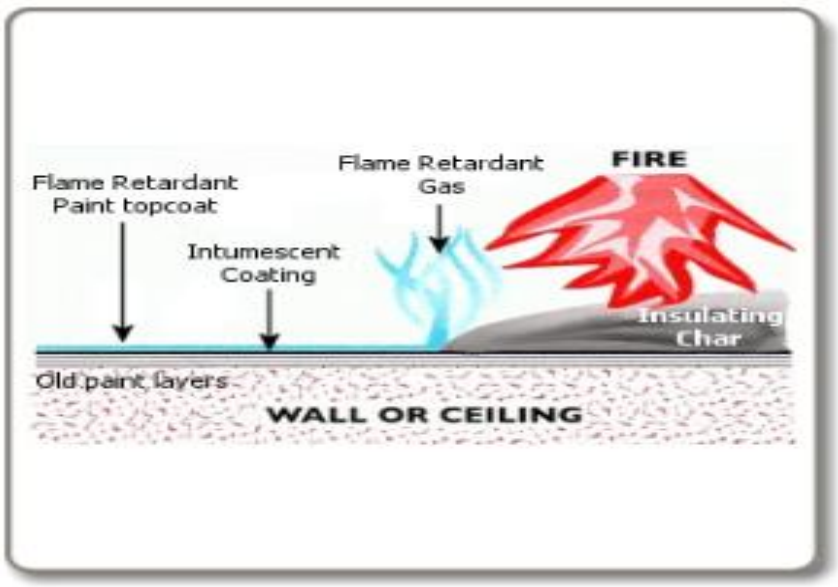


Figure 6.9: showing how the intumescent paint works.
Source: www.astroflames.com

The building has a glazed skylight for the atrium which allows natural lightening into the building. The glazed skylight makes circulation easy and provides natural lightening in case of emergency.

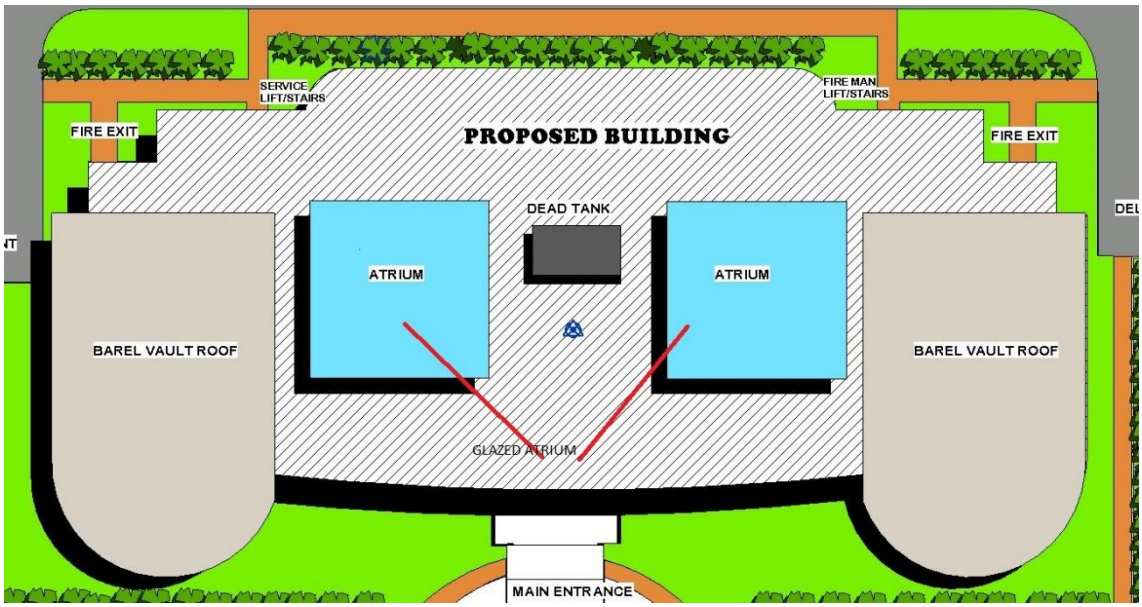


Figure 6.10: showing the glazed atrium.
Source: Author's Work

6.6.4 Fire Control Strategies

6.6.4.1Passive Fire Control Strategies

I. Compartmentalization: The shops are all in a fire-tight cells which helps to keep a fire relatively small in by means of fire resisting walls and floors in case of fire outbreak (Figure 6.11). The compartment of the shops are essential due to the nature of combustible materials of various categories in shopping mall which can make the spread of fire easy.

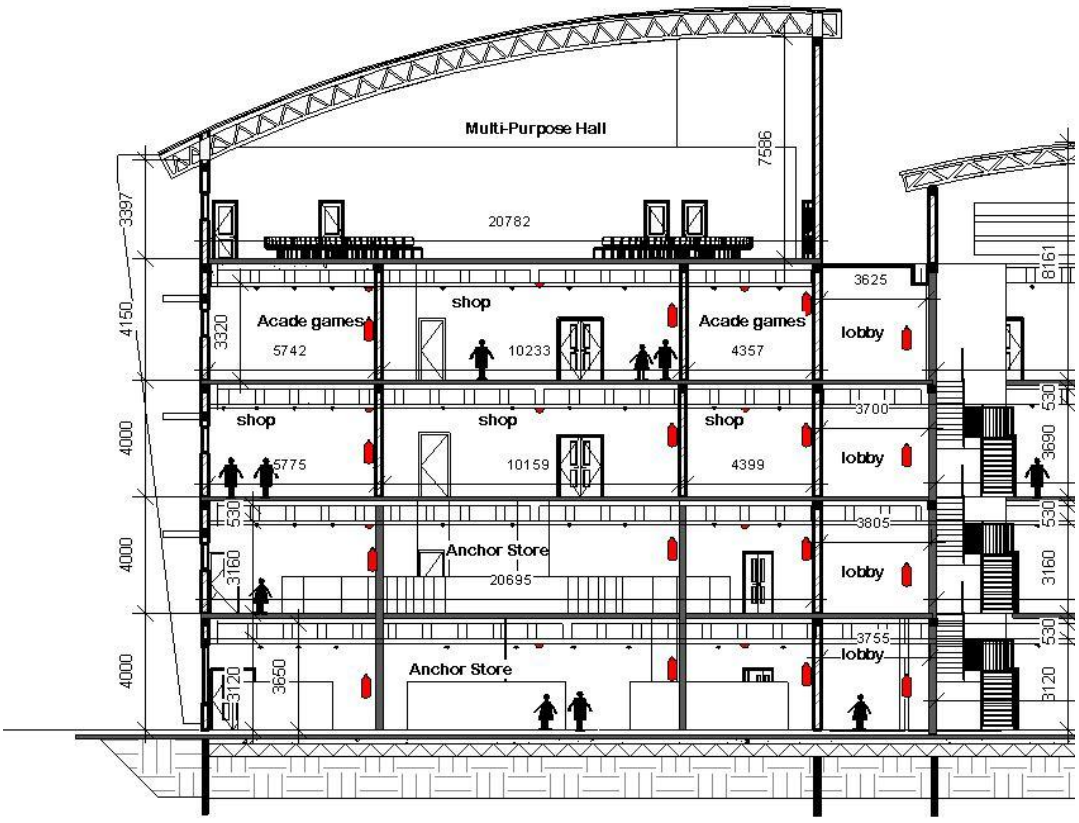


Figure 6.11: showing the compartmentalization of shops in the shopping mall.
Source: Author's Work

II. Refuge: This is a temporary space provided which is free from fire and smoke to accommodate visitors and tenant in case of emergency. It is practically impossible to evacuate all the visitors and tenants at the same time in case of emergency. The refuge

has a self-closing fire door which is 2500mm wide. The refuge links the emergency lift and stairs directly (Figure 6.12).

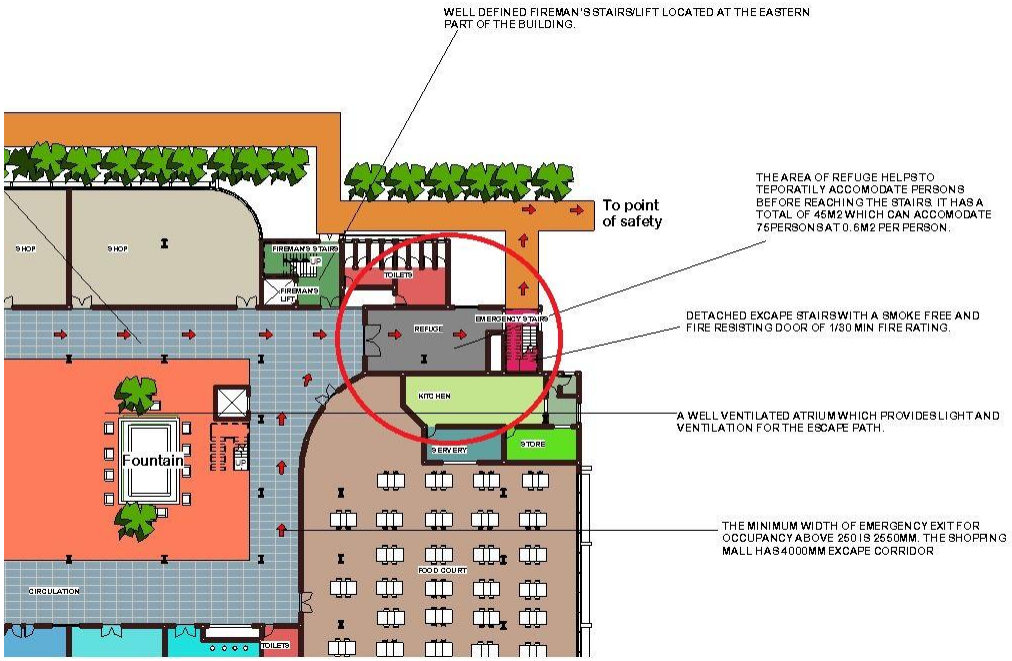


Figure 6.12: showing the area of refuge and the emergency stairs.
Source: Author's Work

III. Smoke Vents and Smoke Reservoir

It is well recorded that inhalation of smoke and hot gases are the primary causes of death in a fire. The building must therefore be designed to provide safe and smoke free escape routes. Designing the building to control smoke is especially critical where the public spaces will be used as a means of escape. In these cases, the interior space will have to be designed to control and channel away the smoke from the clear escape zone and to release it to the open air (Figure 6.13). The clear zone is achieved by the formationof sufficient space above the public space to holdthe smoke before it is extracted to the open air. Thisholding space is referred to as a 'smoke reservoir' (Figure 6.14).

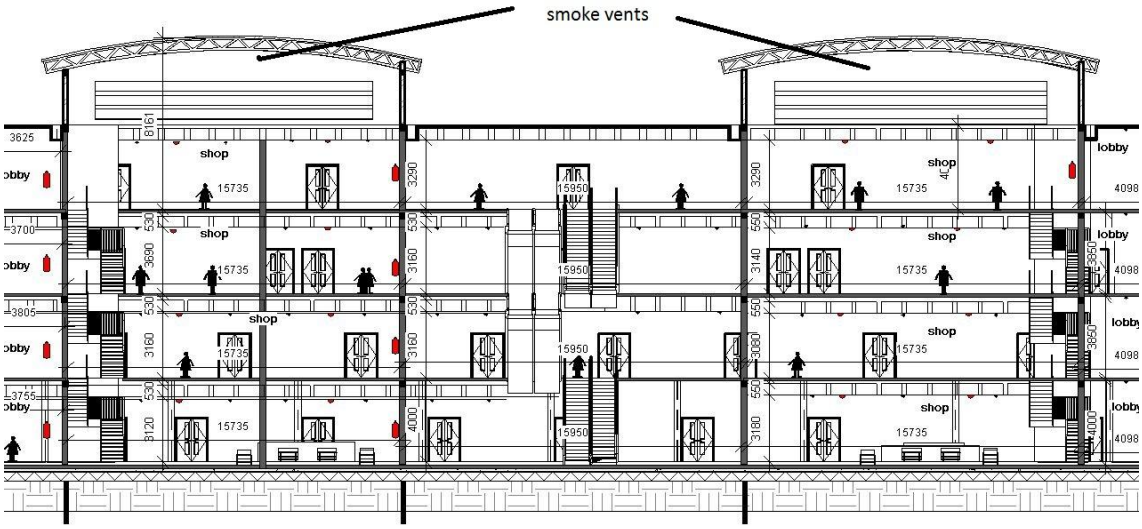


Figure 6.13: showing the smoke vents.
Source: Author's Work

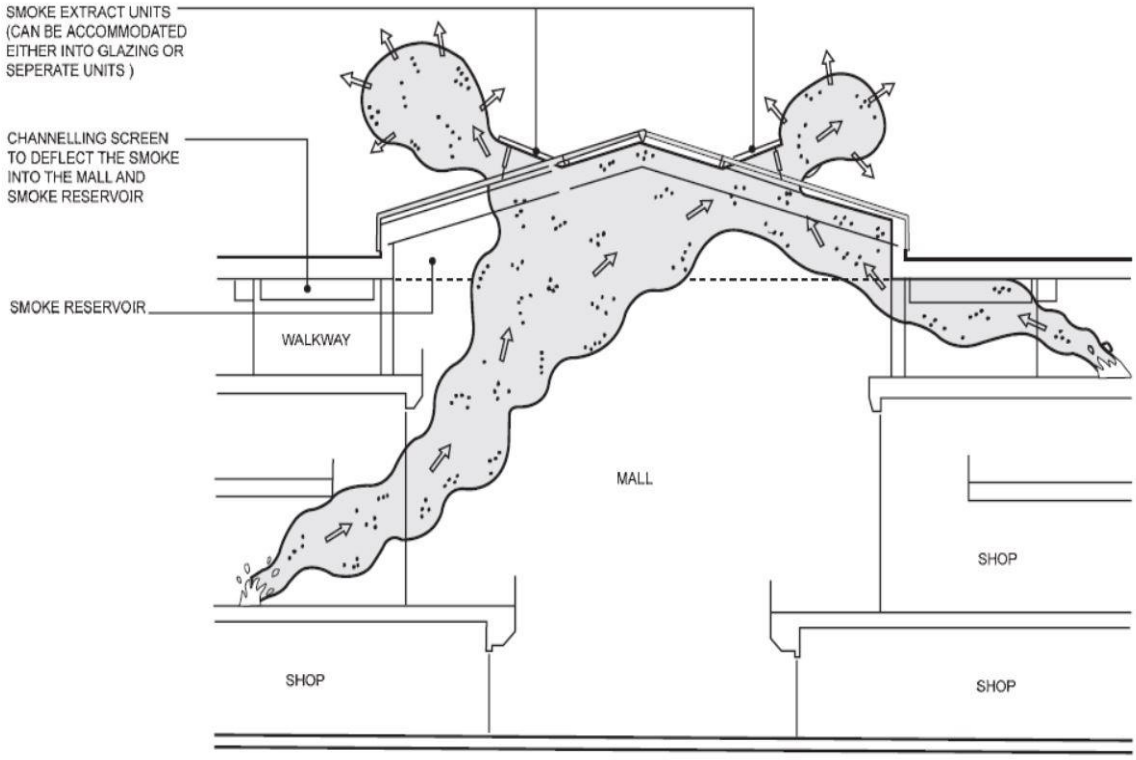


Figure 6.14: showing air vents and natural extraction of smoke.
Source: Peter, (2006).

IV.Means of Escape

This simply means the routes of escape to places of safety outside thebuildingwhich includes, purpose-made escape routes,the service corridors, interconnecting stairs and thepublic circulation spacesthemselves. The shopping mall has two escape stairs/lifts which run in opposite direction to each other, it has a circulation corridor of 3000mm wide which is totally free from obstruction and also a fireman's lift/stairs (Figure 6.16). There are factors that determines the means of escape in a shopping mall which includes;

- The distance of travel (<45m from any point of the building)
- The time taken to evacuate the building (2.5m)
- The population to evacuate the building (GLA=12304/Floor area per person=6m2)=2000 (Figure 6.15).

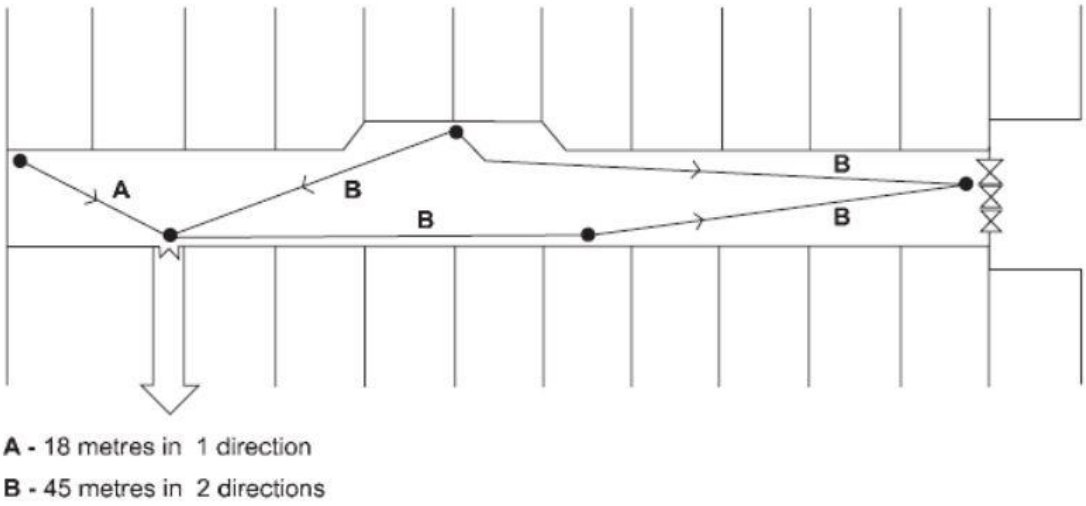


Figure 6.15: showing the maximum travel distance in a shopping mall.
Source: Peter, (2006).

Figure 6.16: showing the fire escape route.
Source: Author's Work

6.6.4.2 Active Fire Control Strategies

Extinguishing by water can be an effective means of controlling the spread of fire and can be achieved in a variety of ways. Small fires can be dealt with by hand-held extinguishers and the use of hose reels. In covered and enclosed shopping centres, sprinkler systems are likely to provide the primary means of fire control.

i. Automated water sprinkler system
ii. Fire hydrant system
iii. Smoke and heat detectors
iv. Smoke exhaust systems
v. Stand-by power system

In the shopping mall design, active fire control measures are also taken into consideration in other to control the spread of fire in case of emergency. Smoke detectors raises alarm in slightest situation which triggers the water sprinkler system to distribute water throughout the shopping mall (Figure 6.17). All these will note be

achieved if there is no standby power supply. A dead tank is also located at the top of the building in case there is failure with the main water supply system.

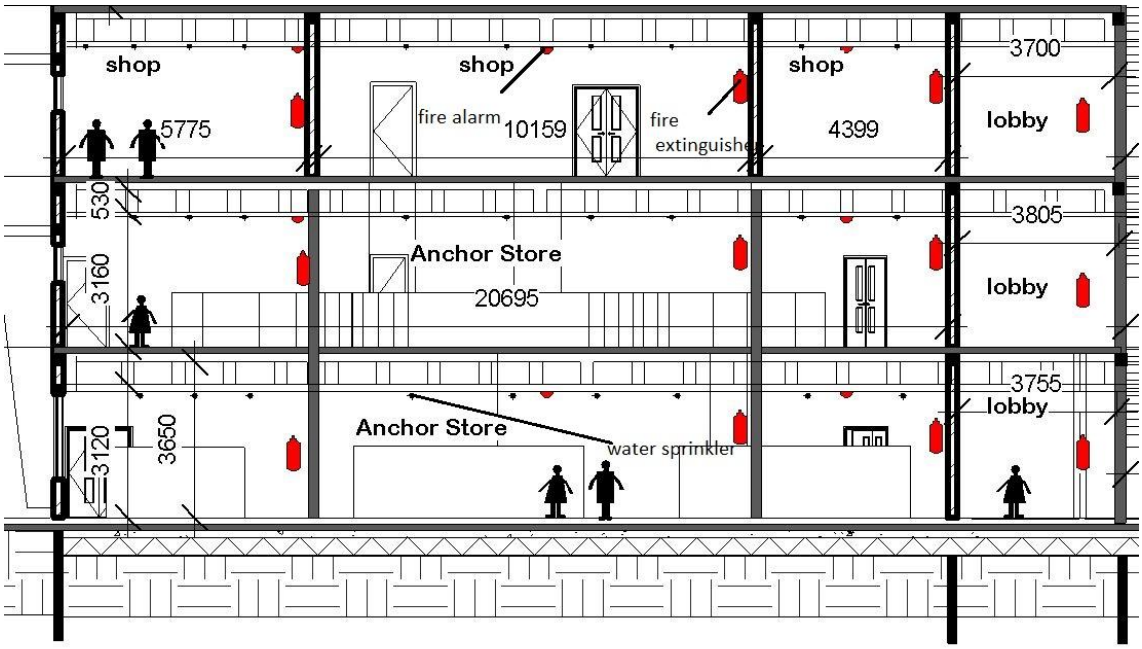


Figure 6.17: showing the water sprinkler system, smoke detector, fire alarm and fire extinguisher.

Source: Author's Work

7.0 SUMMARY CONCLUSIONS AND RECOMENDATIONS

7.1 Summary

The research focuses on the causes of fire outbreaks in shopping malls, and how the fire can be controlled and extinguished within a very short period of time, without losing lives and properties. The major causes of fire as discussed in chapter two are mechanical and electrical causes. Passive and active means of controlling these causes were discussed in chapter two. Case studies were carried out and based on the results from the findings, a shopping mall was proposed in Abuja with both passive and active elements of controlling fire in case of fire outbreak.

7.2 Conclusion

Shopping malls are fundamentally large complexbuildings occupied by considerable numbers of thegeneral public and shop staff. These buildings mustbe planned to be safe and, in the event of an emergencyor fire, allow for fast and safe evacuation fromthe building by all its occupants. In the design ofthe practical issues, fire safety is one of the mostimportant and complex considerations. Architects play a very vital role in ensuring that fire safety measures are achieved in the design of shopping malls.

Based on the findings, few of the shopping malls have the basic fire safety equipment and strategies. In Nigeria, the problem of maintenance of these equipment if available is another key issue.

This research helps to outline the fire safety problems in shopping malls and how to tackle the problems with a successful design. Most architects lay more emphasis on special arrangements and aesthetics, and neglecting the fire safety measures which are paramount in ensuring a safe shopping environment.

7.4 Recommendation

In other to achieve a safe shopping environments, these factors must be taken in consideration.

I. Building in accordance with the provisions of the fire code (National Building Code).
II. Periodically inspecting buildings for violations, issuing Orders to Comply and, potentially, prosecuting or closing buildings that are not in compliance, until the deficiencies are corrected or condemning it in extreme cases.
III. Maintaining proper fire exits and proper exit signage (e.g., exit signs pointing to them that can function in a power failure)
IV. Compliance with electrical codes to prevent overheating and ignition from electrical faults or problems such as poor wire insulation or overloading wiring, conductors, or other fixtures with more electric current than they are rated for.
V. Properly storing and using, hazardous materials that may be needed inside the building for storage or operational requirements (such as solvents in spray booths).
VI. Evacuation plan should be placed in strategic places of the shopping mall in other to assist shoppers and occupants in case of emergency.

7.5 Contribution to Knowledge

I. The study identified the major causes (Electrical and Mechanical) of fire outbreaks in shopping malls
II. The study highlighted the passive and active measures of controlling the fire outbreaks in shopping malls.

III. The research demonstrated the use of these passive and active measures in providing the best layout and evacuation strategies in saving lives and properties.

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APPENDICES

CHECKLIST FOR CASE STUDY ASSESSMENT

Name of shopping mall _____

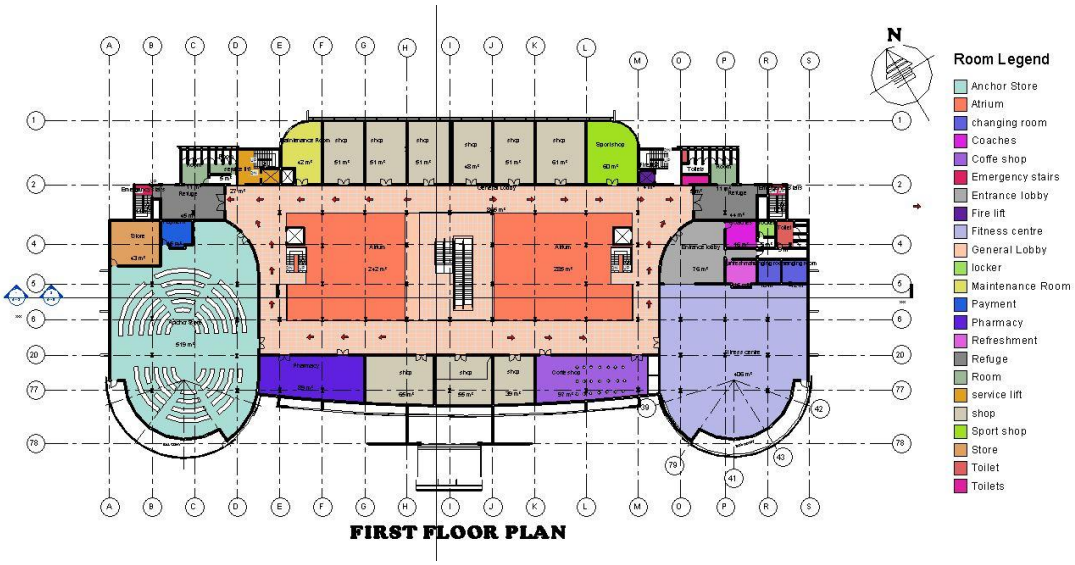
principle	Variables	Comments
Type of building material	• Fire resisting doors • Fire resisting walls • Fire resisting floors • Fireproof ceiling	
Availability of fire control instruments	• Smoke/fire detectors • Fire hydrants • Water sprinklers • Fire extinguishers	
Building regulation/construction	• Compartmentalization • Head room • Sizes of emergency exit openings • Distance to emergency exit doors	

Site design	• Building setbacks • Service entrance and exit • Parking

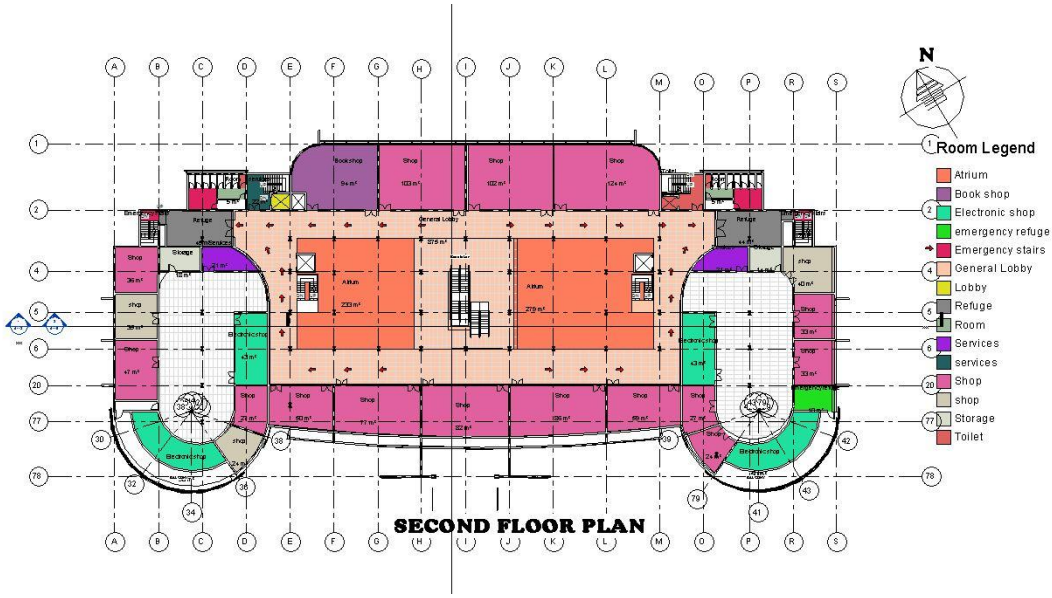
Layout/Circulation

Appendices 1.1 Site Plan

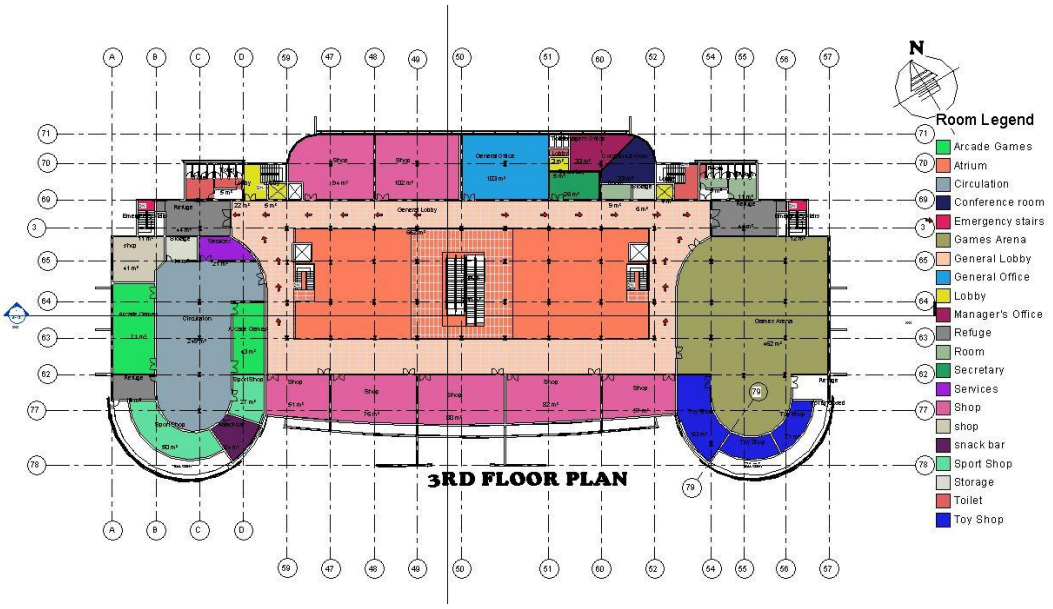
Appendices 1.2 Ground Floor Plan



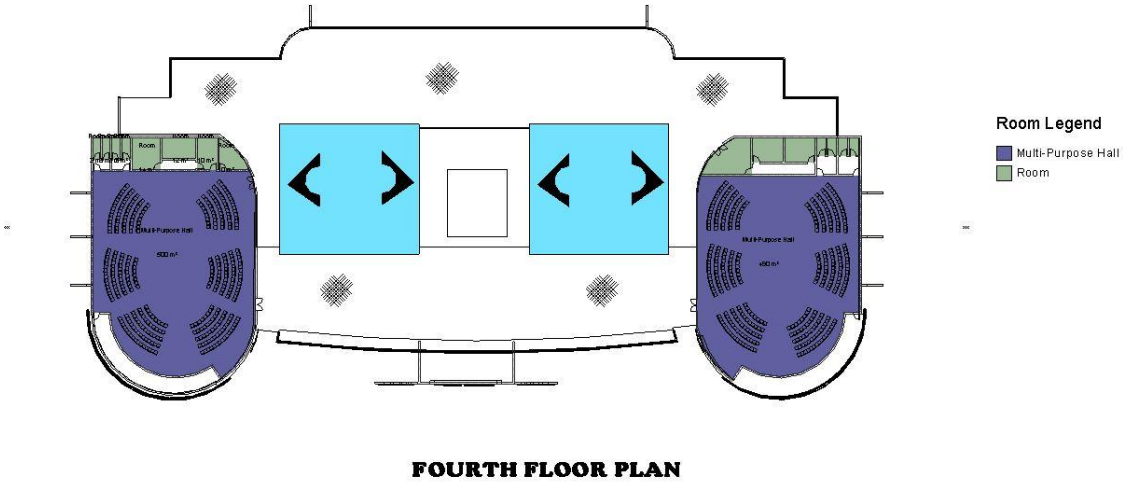
Appendices 1.3 First Floor Plan



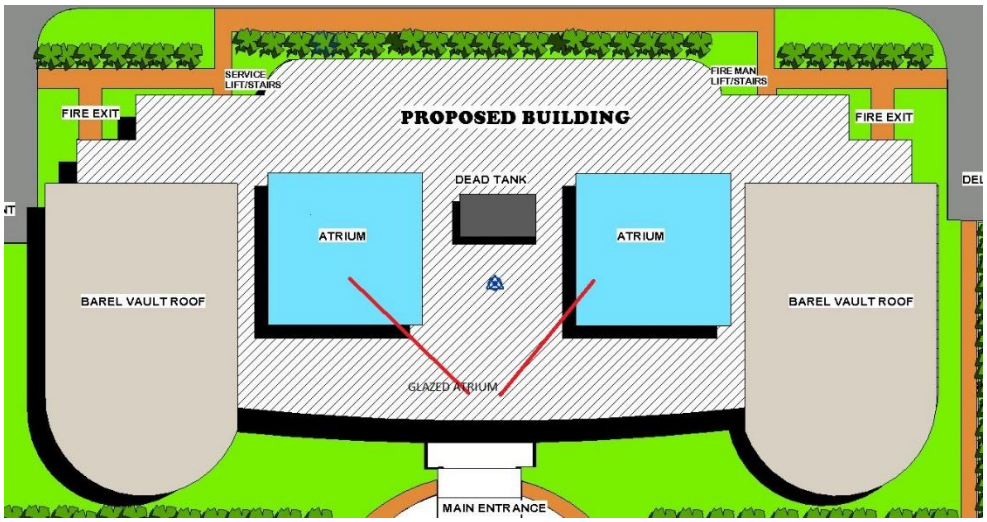
Appendices 1.4: Second Floor Plan



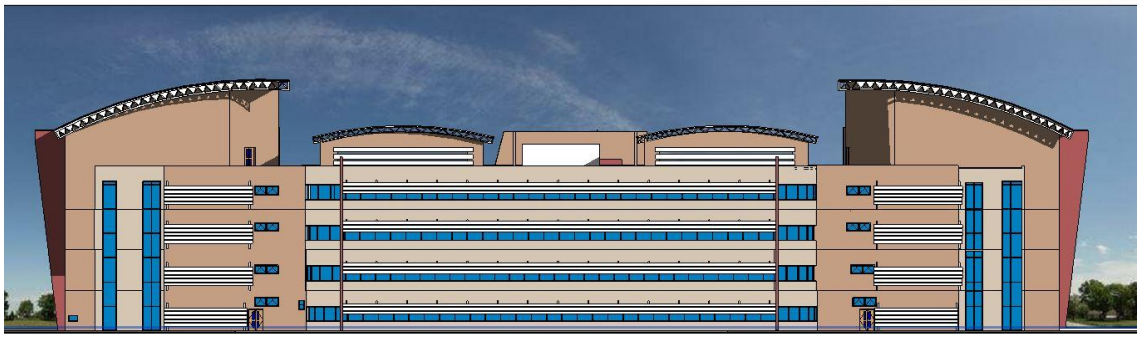
Appendices 1.5: 3rd Floor Plan



Appendices 1.6 Fourth Floor Plan



Appendices 1.7: Roof Plan



Appendices 1.8 Back Elevation

3D view