

**EVALUATION OF SAFETY DESIGN CONSIDERATION FOR CRIME
PREVENTION THROUGH ENVIRONMENTAL DESIGN OF MIXED-USE
BUILDING, ABUJA, NIGERIA.**

BY

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SEPTEMBER, 2023

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**A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL, FEDERAL UNIVERSITY OF
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FOR THE AWARD OF THE DEGREE OF MASTER OF TECHNOLOGY (MTech) IN
ARCHITECTURE**

SEPTEMBER, 2023

DECLARATION

I hereby declare that this thesis titled: “**Evaluation of Safety Design Consideration for Crime Prevention through Environmental Design of Mixed-use Building, Abuja.**” is collection of my original research work and it has not been presented for any other qualification anywhere. Information from other sources (published or unpublished) have been duly acknowledge.

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CERTIFICATION

The thesis titled: **“Evaluation of Safety Design Consideration for Crime Prevention through Environmental Design of Mixed-use Building, Abuja.”** by DALHAT, Nazifi, MTech/SET/2019/9639 meets the regulations governing the award of the degree of MTech of Federal University of Technology, Minna and it is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This dissertation is dedicated to ALLAHU (SWA), the source of all works of inspiration.

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First and foremost, I am deeply grateful to almighty Allah the source of all knowledge for his wisdom, guidance and provisions during the course of this study. My heartfelt appreciation goes to my father, Dalhat Ibrahim, and my mother, Habiba Dalhat, your unwavering support, love, and encouragement have been the bedrock of my achievements. To my beloved wife, Makiyyat Nazifi, and daughter, Fatima Nazifi (Nasreen), your patience, understanding, and motivation have been my constant inspiration. Your presence has illuminated my path and fueled my determination.

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ABSTRACT

People across the world face growing insecurity, violent conflict spreading and intensifying and the natural systems on which human life depends on, is in jeopardy. In recent time, Architectural designs have emerged worldwide as one of the most promising and currently effective approaches to reducing opportunities for crime. This study set out to proffer solutions to the rising insecurity challenges in mixed use buildings in the Federal Capital Territory, Abuja. This was achieved through the development of a framework from CPTED, on architectural strategies used to deter crime from thriving in mixed use buildings. The research employed a descriptive approach, utilizing mixed-methods to delve into the application of Crime Prevention through Environmental Design (CPTED). A user perception survey was carried out using case study to identify safety and security inadequacies in six mixed use development spanning Abuja municipal area council. This was achieved through the use of observation schedules and a total of 400 structured questionnaire administered to users and building professionals. Responses was analysed using the Base Statistical Package for the Social Sciences (SPSS). Findings highlighted the significance of perimeter demarcation in establishing a robust first line of defense and deterring potential intruders. Among the observed mixed-use buildings, 30% had proper site demarcation, while 70% lacked site boundaries. Drop-off procedure designs exhibited a substantial level of planning, recording a notable 72% implementation rate. Zoning for security strategies was implemented at a commendable 71% across the case studies. However, an absence of natural surveillance mechanisms, such as watch towers, was observed, emphasizing a critical area for improvement. This shows that designers and developers play important role in enhancing the safety and security of the community. Hence, confirming the need to improve the impediment of variables like Natural Access control, Landscape for Security, Natural Surveillance, Activity Support, Zoning for Security, and Tour guide and Watch tower, in respect to CPTED principles in the design of Mixed-use building in Abuja.

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CHAPTER ONE

1.0

INTRODUCTION

1.1 Background to the Study

Crime itself is an unavoidable act that became the major source of social concern in most countries of the world today. National Crime Prevention Council (2003) revealed that, the outcome of crime in the world today can restrict people interaction and management of public spaces and keep them away from accomplishing their task, most especially in an occasion that gather individuals as the aged or elderly, guardians, ladies or young people with insufficient power and have full fear for crime. In the world today, crime is often describe by Ukoji and Okolie (2016) as a harmful and dangerous resource to the community. Nevertheless, the whole world is viewed to have been confronting high criminal rate, with Nigeria being among the countries with high crime rate in Africa, after South Africa with 67.78 crime index. Nigeria has currently been included as part of the countries with least peace index in the world. According to the Global Peace Index (2011), Nigeria ranks 17th least peaceful globally, 3rd in terrorism impact. It faces major mass killing risks due to a 200 million population, child mortality, ongoing battles, historical instances, and ethnic fractionalization (Duarte *et al.*, 2011).

Katyal (2002) outlines methods to address complex crime and fear issues. Strategies encompass design, law enforcement, and public involvement for prevention understanding. Architects and planners contribute significantly to societal safety, if engaged early. Contemporary societies trust police and courts for safety, self-defence awareness gaps lead

to varied safety perceptions, influenced by government and insurance roles in vandalism and burglary.

A study by Dragu *et al.*, (2013) revealed that, safety and security is crucial for community quality of life. Katyal (2002) emphasized architectural methods to reduce security risks in facilities or environments, feasible during initial design. Design elements like building layout, space configuration, and the built environment all contribute to these efforts. Architect as a professional consider building as a product meant for people, and every building must meet specific practical criteria. Furthermore, design often has a considerable effect in controlling crime in today's world. Architect is a problem solver to most serious issues in today's society (Charney, 2010).

Crime prevention through environment design (CPTED) was described by Duarte *et al.*, (2011) as an essential path to deal with design and management solution to crime. Some principles and rules of CPTED implemented in the design play a vital role in the minimization of crime in the society and promoting safety of a community (Hopper, 2010). In fact, CPTED approach encourages proper utilization of some certain design principles and application of built environment and operational organisation will help in the greatest way in the reduction of risk of crime, fear and provide safety (Parnaby, 2006). Kelloway and Cooper, (2011); Fennelly (2012), revealed that, several organization that has the record of CPTED principles application experience a very notable reduction in crime. Katyal (2002) highlights Architecture's role in crime control. Recognizing crime-Architecture link is vital for improved crime prevention.

Crowe (2000), described the term CPTED as the abbreviation of crime prevention through environment design, that states the proper utilization of the built environment can resolved to minimise in the fear of crime and advancement in the quality of life. According to Cozens (2002), CPTED blends planning, psychology, criminology. Linked to environmental criminology, it spots crime catalyts, cuts opportunities, aiming for proactive prevention, replacing reactive justice. Katyal (2002) shows designers shape lives via architecture. Elevators limit eye contact with overhead floor indicators, round fast-food chairs speed service, narrow supermarket aisles deter chatting, promoting shopping. Architects control via space, sending messages.

Mixed-use buildings, combining diverse activities within limited space due to urban land scarcity and people's desire for interconnected spaces, are a prevalent trend in developing cities today (Batagarawa *et al.*, 2011; Alabi, 2017). However, the erection and management of this type of development brought about elaborate environmental issue, which effects the comfort of the occupant and in term effect the entire surrounding environment (Chau, 2016). Consequently, this study examines how architectural elements solve crime in mixed-use residential buildings, suggesting federal involvement in environmental planning. It proposes Six-CPTED principles: enhance natural surveillance, define territories, limit isolated gathering, control access, maintain spaces, and protect potential targets.

1.2 Statement of the Research Problem

According to Idike *et al.*, (2017) the increasing rate of crime in Nigeria has raise the overall feeling of insecurity and resulting to increase in government spending to support Nigerian force in the way personal, logistics, and fire-arm to handle the security issues, hence the circumstance tends to be the other way round, instead of decreasing the system, yet increasing

every year. With these current trend of insecurity in the country, residential development are no longer safe for peaceful living, following violence and thefts that has claimed lives and properties of individuals all over the country, due to negligence of designers that result to small or no consideration for security and crime prevention in most public development (National Crime Prevention Council, 1997).

Recently, crime is often describe by Ukoji and Okolie (2016) as a harmful and dangerous resource to the community. Nevertheless, the whole world today is confronting high criminal rate, with Nigeria being among the countries with high crime rate in Africa, after South Africa with 67.78 crime index. Nigeria has currently been included as part of the countries with least peace index in the world. According to the Global Peace Index (2011), Nigeria is the 17th less peaceful country in the world and the third country most affected by terrorist. Furthermore, Nigerian National Bureau of Statistics (2016) recently listed Abuja among the top ten states in Nigeria with high crime rate. A study by Dragu *et al.*, (2013) revealed that, among the essential criterion for qualifying the quality of life of people in a community is safety and security. Katyal (2002), further explained that, various efforts can be carried out through Architectural approach to minimised security risk within a facility or the environment at large.

Katyal (2002) in his study, argued that, at the commencement of the 21th century, Architecture has been undergird in the form of crime control and there is need to understand the important of relationship between crime and Architecture in order to enhance the effectiveness of the fight against crime. This research will therefore give an overview of the best practice in securing mixed used residential development and other public spaces against

crimes of various form through the application of CPTED principles in other to equipped designers, researchers and planners in the building industry with the awareness of CPTED and have knowledge of the importance of CPTED.

1.3 Aim and objectives

1.3.1 Aim of the Study

This study aims to evaluate safety design considerations for crime prevention through environment design (CPTED) of mixed-use residential building in Abuja, through the utilisation of Architectural Principles to minimise chances of crime and effectively provide solution to crime in mixed-use residential development.

1.3.2 Objectives of the Study

The objectives of the study are:

- i. To examine the application of Crime Prevention through Environmental Design (CPTED) strategies in mixed-use building.
- ii. To determine users perception of the use of Crime Prevention through Environmental Design (CPTED) strategies in mixed use building.
- iii. To identify and determine Crime Prevention through Environmental Design (CPTED) strategies applicable to mixed-use building design.
- iv. To incorporate Crime Prevention through Environmental Design (CPTED) strategies in mixed use residential development in Abuja.

1.4 Scope and Limitation of the Study

The study is limited to the contribution and application of crime prevention through environment design CPTED strategies in mixed-use residential development in Abuja. This will provide a more detail study and improvement dependability of findings. This research will exclusively depends on precious research work and data acquire to propose sufficient solutions that are not base on simulations.

Furthermore, the facilities to be provided in the propose design would be based on the studies on existing mixed-use building within and outside the country, in order to achieve standard services provided in a mixed-use residential development, yet, there will be possible addition from the existing services. Some adjustment will be required on the foreign studies in order to suite the locality of the proposal.

1.5 Justification of the Study

Security is an utmost need of people. The increase in crime rate all over the world is currently alarming, resulting to insecurity and fear, most particularly in a large gathering such as a mixed-use buildings. Today in Nigeria, the escalating crime rate has led to heightened insecurity, causing a surge in government spending to support security forces. However, this increased investment has not effectively curtailed the crime surge. The growing insecurity has rendered residential developments unsafe due to violence and theft, sometimes attributed to designers' negligence towards security considerations. Nigeria currently ranks among high-crime-rate countries globally, with a prominent position in Africa, the nation suffers from significant lack of peace. To worsen an already fragile situation, the Nigerian legal system is virtually inaccessible and ineffectual, failing to fulfil its civic responsibilities while personnel are susceptible to bribe and other corrupt practices. Nigerian National Bureau of

Statistics (2016) highlighted Abuja's prevalence among the top ten states in Nigeria with a high crime rate. Research has underscored safety and security as vital components of community well-being. Architectural strategies, like CPTED, can help mitigate security risks.

1.6 Study Area

The study area Abuja, the Federal Capital Territory is located in the north central part of Nigeria and covers a land area of about 1,728 km² with an estimated population of 2,406,239 in 2015.

The propose site for this study is situated in Umarawa along Kano-Kastina express way on the Periphery of Abuja metropolis in the Federal Capital Territory with latitude 10.637N, longitude 10.0807E and 628m linear meter above sea level.

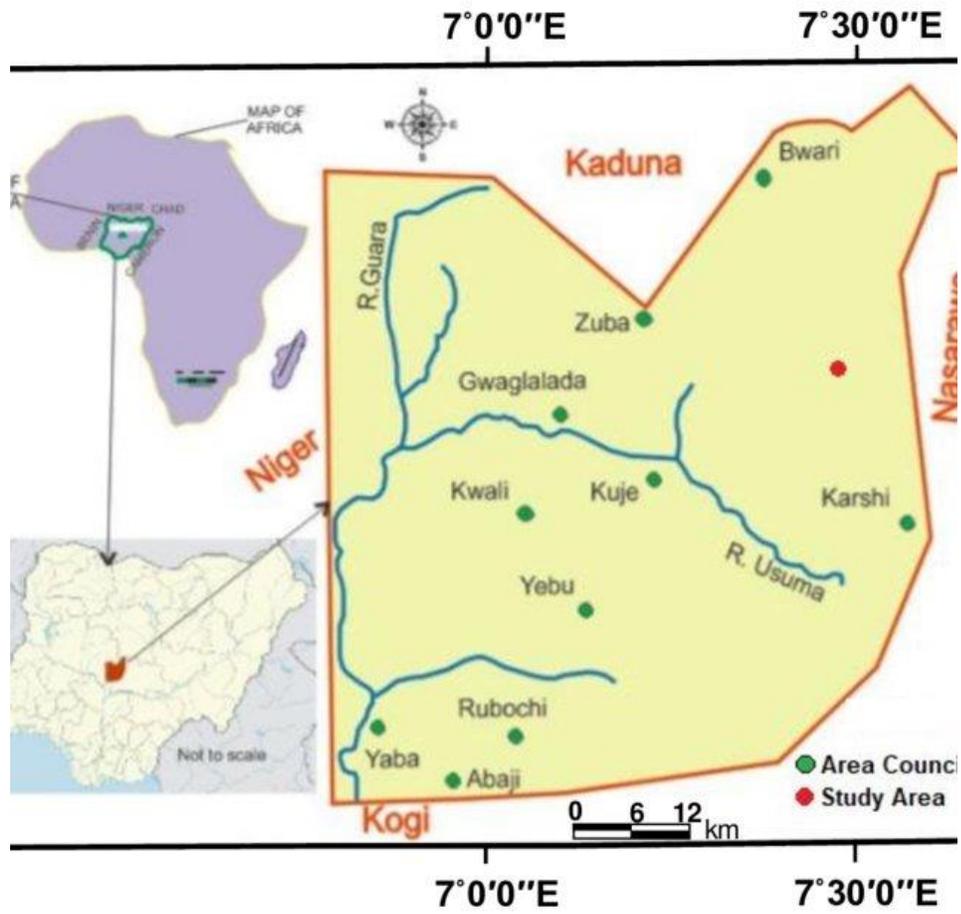


Figure 1.1: Nigeria showing Abuja, Federal Capital Territory
 Source: Akande *et al.*, (2019)

CHAPTER TWO

2.0

LITERATURE REVIEW

2.1 Mixed use Building

Throughout history, it was natural to build homes next to markets, eateries, taverns, places of worship and various shops. Here in Nigeria for instance, the earliest cities and towns sprouted around a “Main Street” a passage lined with ground floor for businesses and upper floor for dwellings. Only with the advent of zoning laws did we start to regulate where buildings of a specific function can be placed. Then, overtime inner-city decline, land use became more distinct and large swathes of residential homes and enormous retail plazas became the 20th-century zoning model. A few decades ago, things changed. The younger generation embraced city living and everything it represented - diversity, authenticity, vibrant social life, walkability, and proximity to venues. Mixed-use developments combine several activities such as; residential, commercial, institutional and/or industrial uses into one building. The uses vary but commonly include dwelling units, retail spaces, cultural, and entertainment venues, among others (Alabi, 2017).

Buildings with several numbers of floors on a small footprint usually referred to as mixed use buildings, have become a trend in our contemporary world and now booming in cities of developing countries due to unavailability of land and land scarcity (Batagarawa *et al.*, 2011; Alabi, 2017). In the view of Gan *et al.*, (2017), mixed use buildings have been explored as an effective solution to meet housing needs in cities such as Abuja the capital city of Nigeria where there is scarcity and relative high price of land.

Mixed-use building according to the International Building Code and The Building Construction and Safety Code is a building of height equal to 75feet (22.5 meters) or greater, measured from the lowest level of fire department vehicle access to the floor of the highest habitable storey. In Nigeria, factors encouraging the sprouting-up of mixed-use buildings include urban needs, constraints, and a booming economy (Asiedu, 2012).

Mixed-use buildings in Nigeria are each day growing in prominence. In Lagos, the commercial capital of Nigeria there is a high number of tall buildings with some dating as far back as the 1970s (Alabi, 2017). According to Asiedu (2012), the shift of Federal Capital Territory (FCT) from Lagos to Abuja in the late 1980's is a key factor that led to the decline in the state of these mixed-use buildings in Lagos, shifting the focus to the new federal capital, Abuja. The scarcity and staggering cost of land had led to the necessity of mixed-use buildings within the capital city of Abuja (Alabi, 2017).

2.1.1 Mixed use building envelope

According to Ahsan (2009), the building envelope includes all the building components that separate the indoors from the outdoors. Building envelopes include the exterior walls, foundations, roof, windows and doors. The performance of the building envelope is impacted by a number of sub-systems, such as Security system, heating, cooling and ventilating equipment, plumbing and electrical systems Cheung *et al.*, (2005).

The building envelope is an important component of a building that affects the general security of the building, energy consumption and thermal performance of a building. The building envelope must balance ventilation and daylight requirements while providing moisture and thermal protection appropriate to the climatic conditions of the site. It is a major factor in determining the operational energy use, and therefore the lifecycle costs, of a

building. The success of the building envelope depends upon the selection of appropriate materials and components, and how these are brought together. Also, increasingly important today is the source and manufacturing processes of the materials involved.

The design and construction of secure and safe buildings continues to be the primary goal for architects, engineers, project managers, and other stakeholders. There must be a balance between the security and safety goals of the building and its other purposes and design elements. Keeping the build within budget, on time, safe, up to code, all while satisfying the building purpose requirements is a challenging task, but with careful planning it can be achieved. This proactive planning approach involves ensuring protection of building occupants, resources, structure, and continuity of critical operations despite numerous varied hazards. Planning for security should include a plan for fire protection using a systems approach to ensure the whole building is included. Occupant health and safety should also be given highest priority. Unsafe or poorly constructed building design can lead to unnecessary injuries or jeopardy to human life. Preventative measures should include plans for optimal air quality, electrical safety, fall prevention, ergonomics, and accident prevention. Buildings should also be constructed to plan for various kinds of major natural hazards. Not only do the elements pose a potential threat, but also human aggressors can cause damage to building occupants or assets. Limiting hazards of all types should be the goal when planning for building security and safety.

2.1.2 Challenges and benefit of mixed-use building

Designing, owning, or managing a mixed-use facility especially considering the slowing economy and an ever-growing concern about the environment means there is an opportunity for multiple challenges, but also opens the door to multiple opportunities. The biggest

concerns anybody has about a mixed-use building in this economy are getting and keeping the space leased (Breshears, 2009). Depending on how developers gauged their projects over the past few years, they may end up with a surplus of spaces that are not renting very quickly. Diversification of uses in mixed-use facilities aids greatly in efficiency. To begin, the land is used more efficiently. "If we were to separate the uses, the traditional, 'horizontal' mixed-use communities (where they're not integrated in one component), are much more land consumptive," (Davis, 2011). "You're able to get a higher density from a residential and commercial retail standpoint by vertically stacking the uses. Davis (2011) also adds that vertically mixed-use facilities can be beneficial because they reduce long-term maintenance costs of individual buildings. "If able to stack apartments over retail or an office, then is going to be able to share in some of the maintenance of that building between the two uses." Mixed-use facilities, particularly those that serve as town centres or are in the heart of urban areas, not only conserve valuable land resources, but also brighten communities and present opportunities for building efficiency, energy efficiency, and sustainability. "This kind of diversification has an urban component, which keeps the space vital and occupied 24 hours a day," (Breshears, 2009). "People are coming and going at different times to do different things. That's a good thing from a variety of points of view. You can keep the space, and your property, working and occupied; as you add urban vitality, you can also leverage and make it work harder. It might level out your utility demand, for example, or flatten out demand curves."

Financing and cost are issues that owners and managers of mixed-use buildings face when upgrading for greater energy efficiency. "That's the biggest struggle," says Joel Feinberg, a philosopher of social and moral excellence (Arneson, 2005). "Financing is more difficult,

and it may be a more expensive outlay to put in new systems or a more sophisticated system. They do want to accommodate energy savings, but they're struggling with how to work out the finances." Additional problems that arise involve trash, smells, traffic, and noise transferring from one use of the building (a bustling restaurant or store) to another (apartments). Parking is another common issue that arises for mixed-use facilities. "We're finding that shared parking, whether it's on-grade or in the building, has to be separated, and you have to be vigilant about policing" says Feinberg, (Arneson, 2005). Too often, people come into a restaurant and want to park as close as they can, and a resident comes home from work, goes out shopping, and comes back, and, all of a sudden, he or she has lost his/her parking space, even though there's a big sign that says, 'Residents Only.' If you don't have a relationship with your own security, depending on the size of your facility, or accommodations with local police force, that's one of the things you have to put into place." Parking is just part of the relationship between residences and retail that can be a challenge. Davis (2011) of Morris & Ritchie Associates opined that, balance is the key in managing these relationships. "It's the right mixture in the right locations and the right types of retail and residential uses.

2.2 Safety Design Consideration

Safety and security measures or controls as a physical, psychological, procedural, electronic, or other structure that executes or contributes to one or more security functions by dividing physical space into zones (Nunes-Vaz, *et al.*, 2011). Most safety and detection measures, according to the Whole Building Design Guide (2021), have to do with a balance of organizational, mechanical, and physical safety approaches. A primarily operational approach, for example, would emphasize the round-the-clock deployment of guards; a

primarily electronic approach would emphasize video monitoring and warning sirens; and a primarily physical approach would emphasize closed doors and vehicle barriers to secure a given facility from unwelcome intruders. It is critical to implement certain specific security measures outside and inside the facility in order to minimize danger. Trees, thick plantings, heavy structures such as huge sculptural objects, giant boulders, and concrete shapes could be used as defense precautions. Passive measures for a working protection infrastructure, according to the National Capital Planning Commission (2002), are a permanent protective function provided by both the location and the structure that necessitates the effective application of architecture and engineering to increase protection by removing potential threats. According to Randall (2003), protective precautions can be addressed using words like perimeter and exterior security, entrance security, interior security, security preparation, and crime reduction by urban design (CPTED). His steps included both passive and active methods, as well as the types of plants to be used during the design process. Parking areas and monitors, CCTV surveillance, lighting with emergency backup, and physical barriers are all part of perimeter and exterior protection. Perimeter protection is the most important first line of defense in a facility's physical security strategy. Intrusion warning systems, upgrades to existing life protection requirements, video mail, individual and parcel inspection, entry control with CCTV and electronic door hits, and high-security locks are all examples of entry security. According to Brown (1995) property crimes has been less due to the impact of CCTV.

Zahner (2017) stressed the importance of building for protection without losing aesthetics. He clarified that landscaping sculpture, secondary structures, and camouflage barriers could all be used to do this. Security is so important in building design that it reminds us why we

began building in the first place; security is so important in building design that it should be taken seriously. Passive security is about using good design strategy to incorporate a layer of protection, secrecy, and security, rather than existing as a product to be defined. According to Zahner (2017), the most effective passive interventions are; Landscape art should be used to protect structures. Protection and artistic perforation are added by secondary building annexes, and lastly Art can be used to mask obstacles. Perforated metal with designs and artwork will include a lot of security details that aren't obvious. People are less likely to note that a wall or divider is being used to block entry when it is rendered artistically, and are more likely to believe that it has a primary artistic purpose. Physical obstacles are so important in general that they explain why natural geological characteristics like rivers, mountains, and thick forest were once seen as barriers between humans and the outside world (Stuart, 2004). Soft landscaping can also be used to soften, reinforce, and give a pleasing effect to perimeter fences and other hard security elements (FEMA, 2007). Thorny hedges and tall hedgerows can be used as a perimeter fence in these soft environments. Security techniques such as proper identification of employees at tourist location, protective barriers, surveillance and alarm system are essential as a remedy to security threats (Nwokorie, 2014). Security measures mainly passive measures are static bollards, elevated concrete planters, walls and trees of ample girth, standoff zone distance, integrated in the architecture from the stage of inception, according to the Physical Security Design Manual (2007) for veteran's affairs facilities. According to Art Council England (2013) on a practical guide for security, design considerations have been deduced and listed for the purpose of the intended study.

- i. Since the building's shell is also considered the security perimeter, the number of openings should be reduced to those required for entry, ventilation, and natural light.

- ii. All doors, windows, and roof lights must be secured during the quiet hours to reduce the chance of significant volume failure and to withstand a concerted physical assault for as long as it takes for responding forces to arrive.
- iii. The presence of pipes, ledges, and buttresses may provide an attacker access to windows, roof lights, and doors.
- iv. Emergency escape routes that are not guarded internally during closed hours or properly covered during open hours will often make access/exit simpler.
- v. Good design will also reduce the likelihood of criminals hiding inside premises during open hours in order to sneak in after closing time. By eliminating empty rooms, dead ends, vulnerable ducts, and panels where anyone might conceal threats to the collections from theft, threats to the collections from theft may be limited.
- vi. A protected division between areas that are open to the public and those that are inaccessible to the public must be made, with an intruder detection device planned accordingly.
- vii. Paying attention to the outside will help you avoid hiding places like vegetation, porches, heavily recessed doors, and neighbouring houses.

According to the Whole Building Design Guide (2021), it is possible to strike a balance between security and safety priorities and the facilities other design requirements and needs. Establishing an organized planning process in which all members of the design team are aware of each other's objectives will help overcome these obstacles and contribute to the implementation of a solution that meets all of the criteria. Early in the design process, understanding the interrelationships with the other WBDG design goals such as Sustainability, Aesthetics, Cost-Effectiveness, Historic Preservation, Accessibility,

Functionality/Operationality, and Productivity is critical to addressing the challenges that often arise in the pursuit of a secure and safe building.

The most effective and commonly used controls, according to Karam (2015), are linked to two dimensions: "Detectors and Access Control." He also stressed the importance of medical preparedness, guest room security, and emergency preparedness, which he believes has been overlooked in certain cases.

2.3 Crime Prevention through Environmental Design (CPTED)

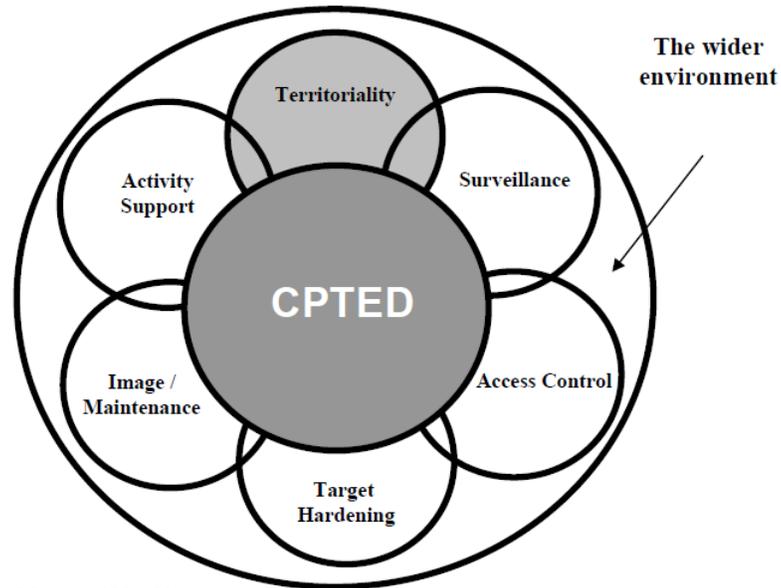
Some architects have highlighted some measures for Crime Prevention through Environmental Design. CPTED is a way of critical thinking that examines and use environmental conditions and functional opportunities to control crime or undesirable and unintended behaviour (Zahm, 2007). CPTED measures are utilized to recognize and unite design features that will minimize the opportunity for crime. CPTED was conceived from diverse field of studies that is concerned with the relationship between individual and the physical environment (Schneider and Kitchen, 2007). According to Silverstein (2011) C. Ray Jeffery who is criminologist and Oscar Newman who is an architect first conceived it. Through clearly defined boundaries with recommended utilization within such space, creating and maintaining a positive imagery and opportunities for clear visibility, the urban design can discourage offenders, National Crime Prevention Council (2013). This can be justified by the fact that potential offenders are seen to be more law-abiding under surveillance for the reason been that they perceive themselves at the risk of being apprehended under observation. To add to this, an appropriate and a very much-maintained environment depict a feeling of ownership and property possession in the community. Some

researchers have presented a triple gathering of physical features; prospect (for the user), asylum (for the potential offender) and escape (for the user and potential offender) into CPTED hypothesis and Taylor and Harrell (1996) conclude. Study have shown that fear (of crime) is higher in areas that offer great shelter for the potential offenders, however low prospect and escape for the user. CPTED instruments are not surely knew by all designers and building professionals. Numerous overlook crime prevention on the grounds that their clients are sufficiently affluent to manage the cost of extraordinary insurance, from burglar alarm cautions to door person. The most well-known design base crime prevention techniques are CPTED. It gives a methodology for an arrangement of configuration approaches that can be made to suit a specific site or movement in view of that space's particular necessities and problem. CPTED gives a rich limit of striated space and updates the use of room to fuse obstructions, to plan space, to expand surveillance, to put safe exercises in safe areas and to defeat separation by correspondence (Wortley and Mazerolle, 2011). CPTED cannot stop crime however it can lessen the open doors for crime in the built environment, which in this manner affects the degree to which crime acts are probably going to happen. CPTED tries to control crime by territorial reinforcement, natural access control, natural surveillance, activity support, maintenance management and target hardening (Vellani, 2007; Sennewald and Christman, 2008). In any case, a broad survey of the building writing uncovers six essential ideas as shown in figure 2.1.

2.3.1 Six principles of CPTED

- 1) Natural Surveillance
- 2) Territorial Reinforcement
- 3) Natural access control

- 4) Activity support
- 5) Target Management
- 6) Maintenance and management



Adapted from Moffat (1983, p23)

Figure 2.1: The principle of CPTED
Source: Cozens (2002)

2.3.1.1 Natural surveillance

Natural surveillance directs the utilization of design to make spaces that are effectively seen by occupants, neighbours, and observer. It bolsters great visibility in and around the structures to restrain covering of criminal exercises. On the off chance that offenders see that they can be watched (regardless of whether they are not), they might be more averse to offend, given the expanded potential for intercession, apprehension and prosecution. The most popular type of this approach was that of Jane Jacobs, who contemplated that "eyes in the city" would stop crime. Jacobs' objective was to examine why crime rates contrasted among urban areas. She disposed of the regular speculations of design and crime and stressed the thickness and decent variety of city life. The essential point of surveillance isn't to keep

intruders out (in spite of the fact that it might have that impact) but instead, to hold intruders under perception of being watched (Richards, 2013). Natural surveillance can be accomplished by various methods. This should be possible by putting more individuals (observers) close to a potential crime zone, the situation of windows and lighting and the evacuation of obstruction can be put to enhance sight lines from inside the structures (Vellani, 2007). Different types of surveillance include formal (e.g. police and security watches) and mechanical surveillance systems (e.g. road lighting and CCTV). The design teams shall introduce the following design procedures and strategies when planning or remodelling an office.

- i. Orientate travel routes opposite to structures.
- ii. Develop passer-by pathways and hallways with clear observable pathways.
- iii. Parking lot lines ought to be opposite to structures to enhance visibility.
- iv. Architectural landscaping that are in line with security requires an outline that coordinates video surveillance, natural access control and natural surveillance
- v. Avoid building large blank walls that limit visibility and can progress toward becoming focal point for graffiti, rather utilization walls with windows, architectural subtle elements, or foliage.
- vi. Place office faculty where they have clear observable pathways of walkways and parking areas through windows and entryways.
- vii. Use puzzle write bathroom passageways to help visual and perceptible reconnaissance and position bathroom doorways to be unmistakable from pedestrian regions however far from outside ways out and pay phones.
- viii. Avoid deadlock halls, separated stairwells, and open zones under stairs. Incorporate expected assembling territories where down to earth to increment honest to goodness

utilization of hallways and entryways hence expanding normal observation (ECU, 2011). Observational investigations of theft affirm that the surveillability of an area is a noteworthy indicator of its crime rate. Violations at workplace will probably happen in places with poor visibility, expansive shrubs, and no structures over the road. Plate 2.1 and figure 2.2 demonstrates the use of natural surveillance in buildings



Plate 2.1: Use of large openings and glazing for natural surveillance
Source: Planning and Development Services (2016)

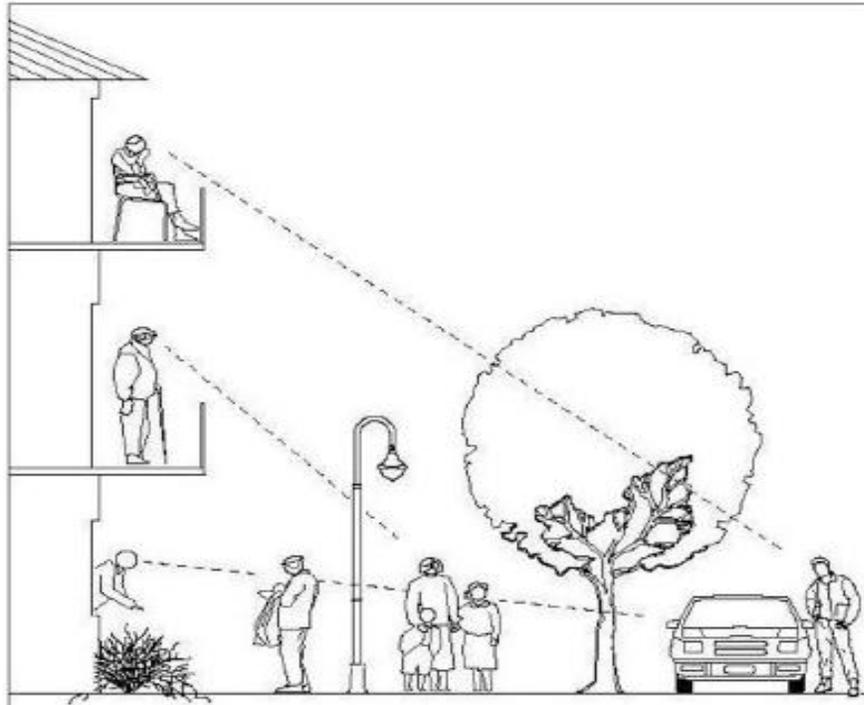


Figure 2.2: Use of balcony to view happenings in the street
Source: CPTED Handbook (2017)

2.3.1.2 Territorial reinforcement

Territorial reinforcement is a design idea coordinated at advancing thoughts of restrictive concern and a feeling of ownership in genuine use of space in this manner lessening open doors for offenders by disheartening illegitimate users. Territoriality clearly decides a district by utilizing the physical and psychological features to give an empowering situation that depicts ownership where abnormal conduct is demonstrated, for example, unapproved exercises and distorted standing around. This physical feature incorporates the utilization of art and signs, good maintenance and landscape, fences and treatment of pavement to express ownership. Diverse structures incorporate symbolic boundaries (e.g. signage) and genuine boundaries (e.g. fences or outline that obviously characterizes and portrays between private, semi-private and open spaces). Plate 2.2 and figure 2.3 shows the use of territorial

reinforcement in buildings. Designers can establish territoriality by controlling both the interior and exterior elements of structures by:

- i. Providing a defined boundary around the building.
- ii. The use of barriers to educate a person that he/she is going from an open to private space, this may incorporate dwarf wall, plantings, open gateways and light gauges
- iii. The utilization of signage to support way finding or reinforce the establishment of territoriality
- iv. Selecting vegetation, pavement pattern, site features or low wall to shape a mental or physical detachment of an area (ECU, 2011).



Plate 2.2: The use of iron rails for territorial reinforcement
Source: CPTED Manual (2013)

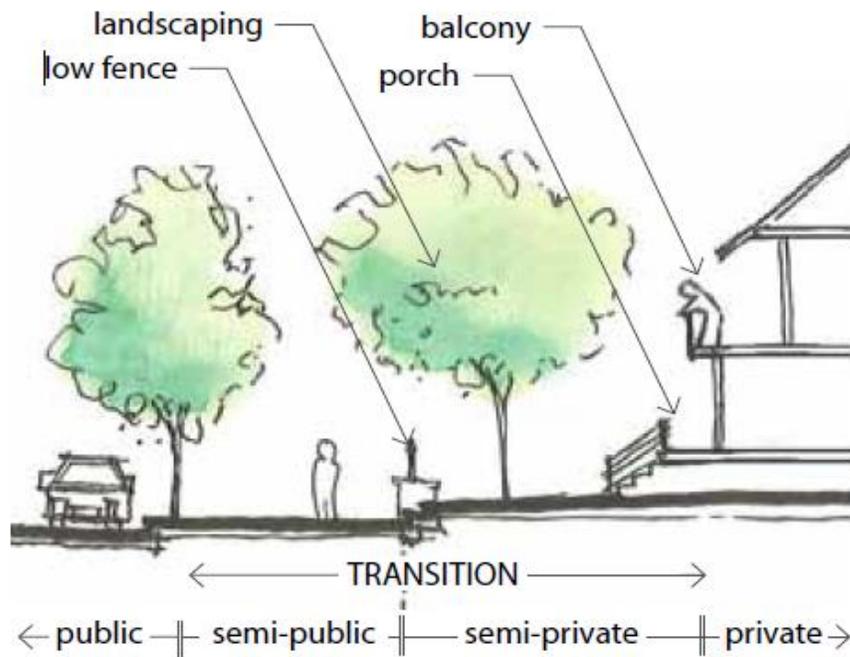


Figure 2.3: Showing territorialism by defining public, semi-public and private space
 Source: CPTED Manual (2013)

2.3.1.3 Natural access control

Natural access control alludes to controlling access to entrance and departure areas at a site (Tipton and Krause, 2007). Natural access control is a CPTED idea concentrated on reducing opportunity for crime by utilizing spatial definition to deny access to potential targets and making an uplifted impression of hazard for offenders (Fennelly and Crowe, 2013).

Natural access control is about utilizing layout and design components to effectively coordinate site users in a systematic manner starting with one area then onto the next while strengthening territoriality and enhancing natural surveillance. By denying access to targets and making an impression of risk to offenders, this idea diminishes the open door for criminal movement. The backbone of natural access control is restricting the quantity of proposed passages to the best degree conceivable without contrarily influencing activities and in

addition to direct individuals through a space by design strategy. This promotes natural surveillance by expanding activity stream at every one of those areas hence expanding the open doors for surveillance. Formal or organized access control (e.g. security faculty) and mechanical access control (e.g. bolts and jolts).

Natural access control relies upon shrubs, fences, doors, wall and a few other physical components to restrict certain people out of specific spots particularly places they are not allowed to be as shown in plate 2.3. In the most essential frame, access control can be realised in individual and commercial establishment by the utilization of window and door locks. This can also be achieved through the following ways

- a. Use site elements, building plan, and pathways to channel people on foot and vehicles into intended hallways.
- b. Limit the quantity of doorways into a building without repressing its usefulness or activities
- c. Develop pedestrian traffic corridors between high utilize regions, for example, between parking areas and main building entrance.
- d. Limit the quantity of pedestrian and vehicle entrance to building offices.



Plate 2.3: Use of physical barriers for access control
Source: CPTED Handbook (2017)

2.3.1.4 Activity support

Activity support includes the utilization of design and signage to support proposed patterns of use of open space. Crowe (2000) takes note of how activity support seeks to put naturally unsafe activities, (for example, those including cash exchanges) in "safe" location (those with several activities and with opportunities for surveillance). In addition, safe activities fill in as magnets for common persons who may then act to discourage the presence of crime. This approach plainly contains components of access control, surveillance and territoriality. Increasing quantities of pedestrians may give extra "eyes in the city" and possibly demoralize a few offenders; this may likewise really support and give potential focuses to crime (e.g. pick-pocketing). This idea can decrease criminal or unusual conduct by giving social gathering and other architectural element that support the proper utilization of a space by expected users. This can minimize crime since criminals don't regularly intermix with proposed offenders. Activity support may be external and interior around campuses which may include picnic tables, barbeque grills, basketball courts and outdoor eatery. Interior

elements can be TV game room, staff and students lounge and billiard or Ping-Pong tables.

Plate 2.4 and 2.5 show activity support principle in use in public areas.



Plate 2.4: the use of play area to keep an eye on intruder
Source: CPTED Handbook (2017)



Plate 2.5: The use of pedestrian mall to provide an opportunity to sit, observe and interact
Source: CPTED Handbook (2017)

2.3.1.5 Target hardening

One of the more evident manners by which design can forestall crime is by reinforcing target against assault. Target hardening builds the efforts that offenders must use in the commission of a crime and is the most long established and conventional way to deal with crime prevention. Some of these methods are not difficult to exploit, for example, putting deadbolts

lower on door-frames, having entryways in vulnerable areas to swing outward, raising emergency exits to put them out of simple reach, and decreasing the span of letter-box openings. Present day innovation grants targets to be hardened in ways that are not clear to the public. Solid plastics, graffiti resistance paints and doors with steel centres are a couple of examples. These advances enable designers to camouflage their efforts by fortifying targets and hence abstain from giving out ideas that crime is common. This idea is for long depicted as a vital element that recognizes different models of crime prevention. In any case, there is much difference regardless of whether target hardening ought to be considered as a part of CPTED. It is directed at denying or constraining access to a crime target using physical barriers like electronic alarms, security watch, gates, fences and wall (Hall and Giglio, 2010) as depicted in plate 2.6 and 2.7. Reasonable numbers of proof uncover that such safety efforts diminish crime in convenient stores, post offices and banks.



Plate 2.6: Window sensor
Source: CPTED Handbook (2017)



Plate 2.7: The use of fence to avoid an intruder
Source: CPTED Handbook (2017)

2.3.1.6 Maintenance management

Advancing a positive picture and routinely maintaining the built environment condition guarantees that the physical condition keeps on working adequately and transmits positive signs to all users. The essentialness of the physical condition and "picture" of the built environment condition and the impact this may have on crime and the dread of crime has for quite some time been recognized Hall and Giglio (2010) and a broad assortment of research currently exists (Eck, 2002; Ross and Jang, 2000). Undoubtedly, empty premises have been found to replace crime "magnets". There should be need to consider maintenance management at the design stage when selecting finishes and materials for the building as it will go a long way to affect the type of maintenance can be sustained (Walsh, 2003). For instance, plant material ought to be chosen with regards it sizes during development to abstain from hindering of sight lines. Urgently, much research proposes that the normal upkeep of the urban condition will altogether help with reducing crime (Wilson and Kelling, 1982; Ross and Mirowsky, 1999; Ross and Jang, 2000). The visual or genuine boundaries isolating

numerous new building evolvments from the surrounding neighbourhoods may disconnect occupants from the more extensive community.

- i. **Use of materials:** Materials utilized for regular offices ought to be vandal safe with the goal that support is negligible. Road furniture ought to be vandal safe and made of solid materials.
- ii. **Maintenance priorities:** Graffiti that are Offensive as shown in plate 2.8 ought to be expeditiously evacuated through property supervisor or by public figure head. Reaction to removal of absorbent and repairs ought to be immediate. A very much kept space generates an impression of possession and upkeep.
- iii. **Maintenance enforcement:** Properties ought to be all around kept up to make an impression of possession and security. The basic step in cultivating the feeling of ownership is by enforcing building maintenance
- iv. **Maintenance report:** clearly written phone digits or sites to report or call for repair vandalised properties particularly in broad daylight regions are attractive. For instance, a broken bolt, entry way or light or window can be accounted for.



Plate 2.8: Large blank wall attracts graffiti
Source: CPTED Manual (2013)

2.3.2 The "Three D" approach

CPTED includes the development of the physical space regarding the typical and expected utilization of that space by the users as well as the anticipated conduct of individuals around the space. CPTED accentuates the connection between the practical objective of the use of space and the behavioural management. The 3-D approach is a basic space appraisal guide that helps the user in deciding the suitability of how a space is planned and utilized. Theoretically, the six CPTED principles are connected through the 3-D approach, For instance, Designation, Definition and Design. The 3-D idea depends on the three functions or measurements of human space:

- i. All human space has cultural, social, legitimate or physical definitions that specify interest worthy practices
- ii. Every space for human is intended to help regulate the coveted practices
- iii. All human space has some assigned reason.

By utilizing the "Three D's" as a guide, space might be assessed by asking the accompanying inquiries:

2.3.2.1 Designation

- i. For what reason was it initially proposed?
- ii. What is the assigned motivation behind this space?
- iii. Is there a contention?
- iv. How well does the space support its present use or its proposed use?

2.3.2.2 Definition

How is the space differentiated?

- i. Where are its borders?
- ii. Is it clear who own it?
- iii. Are legitimate or administrative rules plainly set and fortified in policy?
- iv. Are there cultural or social definitions that influence how space is utilized?
- v. Is there conflict or perplexity amongst purpose and definition?
- vi. Are there signs?

For instance, in a given space, certain conduct or activity might be socially or culturally demoralized while others might be obviously denied by show of written guidelines or standards. Then again, what isn't satisfactory in a particular space might be adequate in others.

2.3.2.3 Design

- i. To what degree do acknowledged practices or the physical plan bolster the coveted?
- ii. How well does the physical design support the intended function?
- iii. Is there conflict or perplexity in the manner in which design is meant to influence conduct?
- iv. Would the design strive to hinder the beneficial utilization of space or be at the best possible working expectation for human movement?

The intent for these questions may uncover some aspect that requires changes or upgrades. For instance, a space may need an assigned objective, it might require to be more plainly characterized, or it must be better intended to help the proposed building. Once these questions have been reflected upon, the data got might be utilized as a method for directing decisions about the design or change of the space so that the objective of the destinations of space can better be accomplished.

2.3.3 CPTED strategies for designing mixed use residential building

The six CPTED strategies can be converted into different planning and design methodologies that would upgrade security in Mixed use Building. These systems can be stated as follows:

- i. Provide sufficient lighting
- ii. Allow for clear sight lines
- iii. Avoid entrapment
- iv. Use of activity generators
- v. Minimise isolation
- vi. Encourage Land use mix
- vii. Minimize concealed and isolated routes
- viii. Provide signs and information
- ix. Improve general plan of the constructed condition.

2.3.3.1 Lighting

Adequate lighting is fundamental for individuals to see and be seen. From a security perspective, lighting that is deliberately put can substantially affect by decreasing the fear of crime. An essential level of lighting ought to permit the distinguishing proof of a face from a separation point of around 10 meters for a man with ordinary vision (NCPC, 2003).

i. Minimum standards

In the event that the zone is planned for night-time use, lighting ought to give satisfactory visibility. Pedestrian walkways, back paths and access courses open to public spaces ought to be lit so that a man with ordinary vision can recognize a face from a separation of around 10 meters. Inset spaces, signs, entrance and exit out ought to be satisfactorily lit. Then again,

lighting of various wattage, shading temperature and version may likewise be utilized to make certain open regions "less cordial" to social event for significant periods (NCPC, 2003).

ii. Paths not Intended for night time use

Lighting is not desirable in an isolated region or for a path prompting to some dark spots. Lighting such territories may give a misguided feeling of certainty for individuals for night use. Places not planned for evening use could be fenced off and stayed dim to abstain from giving an incorrect feeling its secured or impression of being utilized (NCPC, 2003).

iii. Consistency of lighting

Lighting ought to be consistently spread to lessen contrast between shadows and lit up territories. A larger number of installations with fewer wattage instead of less fixtures with higher wattage help diminish profound shadows and maintain a strategic distance from over the top glare. Figure 2.4, 2.5 and 2.6 various illustrates lighting forms and shows the best forms to be implemented.

iv. Protection of lighting

Light installations ought to be secured against easy-going vandalism through the use of vandal resistance materials and designs.

v. Building materials

Light shading completes on walls and roofs ought to be utilized for spots such as car parks and isolated courses prompting to it. This might be preferable to utilize lights of higher power that expend more vitality and are costlier to keep up (NCPC, 1997).

vi. **Maintenance**

Lighting requires up keeping ensuring good visibility. Trees and shrubs that interfere with lighting ought to be trimmed. Lighting installations ought to be situated at reasonable height for simple maintenance. Light installations ought to be kept up in a spotless condition and speedily replacement if damaged or broken. Placing information indicates who is available to be contacted in the case of broken or vandalized lights is necessary (NCPC, 2003).

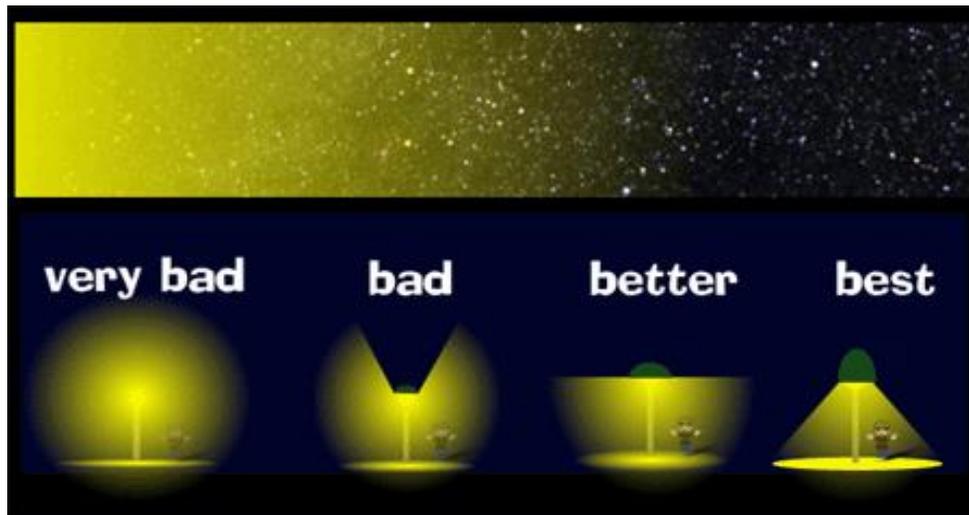


Figure 2.4: Different forms of lighting
Source: CPTED Handbook (2017)

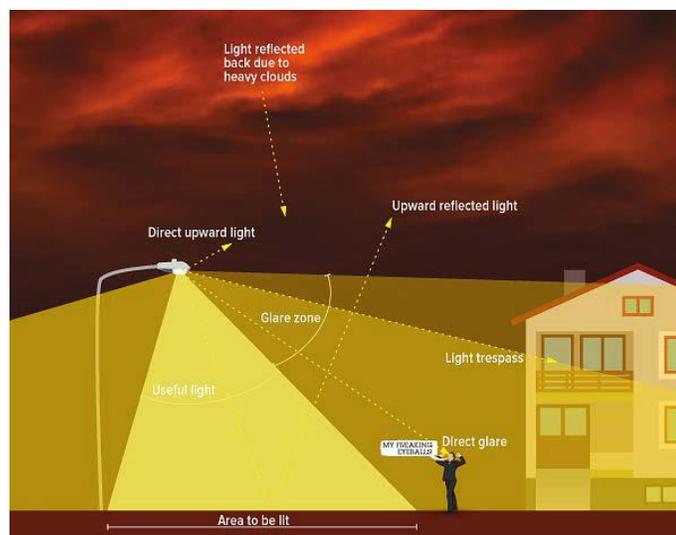


Figure 2.5: Lighting designed to provide safe levels of visibility for all users
Source: CPTED Handbook (2017)

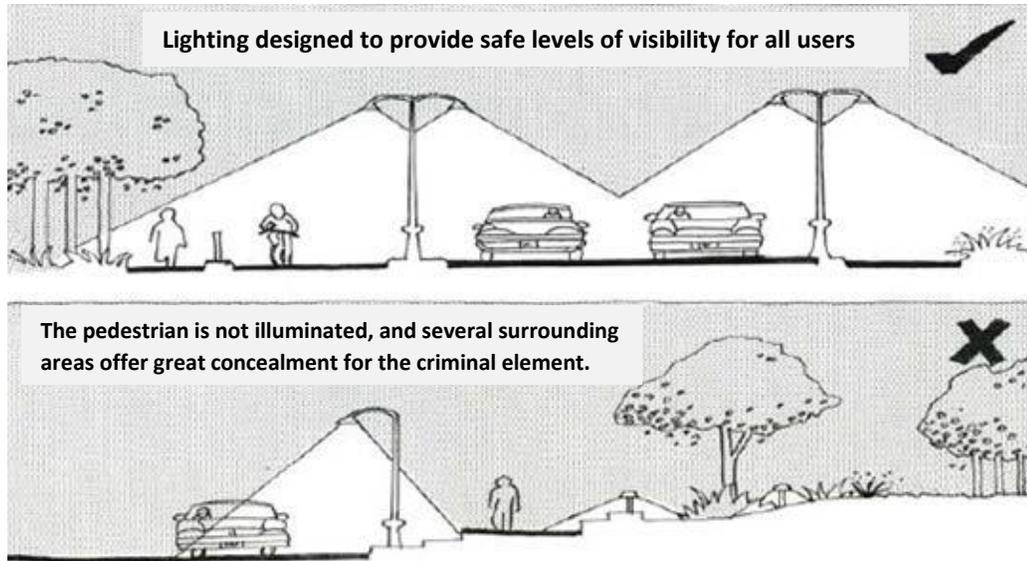


Figure 2.6: Proper lighting position
Source: CPTED Handbook (2017)

2.3.3.2 *Sight lines*

Sight line is described as the desired viewable pathway to the extent both extensiveness and significance. The inability to see what is descending the street along a course as a result of dividers, earth berms sharp corners, fences or segments can genuine blocks or give the assumption of being protected. Broad fragments, tall divider, over created greenery and distinctive hindrances discouraging sight lines adjacent walk-ways could shield an aggressor. Then again, straightforward strengthened glass, low fences or cultivator, seats, little trees, cast iron or steel dividers, garden or sprout beds empower clients to see and be seen and as a rule dispirit wrongdoing and vandalism (NCPC, 2003).

a. **Design visibility**

Plan visibility in the built environment suggests taking for clear sight lines and keeping away from isolates or disguised spaces. Recessed doorways can result in corners that are hidden away from people's observations. Sharp blind corners on lobbies or stairs where there may

be no alternative courses of escape, sudden changes of direction on walkways can similarly make blind sides. Visibility can moreover be upgraded through change, for instance making of windows and diverse openings in a blank wall and elimination of protrusion along walls. Improving visibility through such modifications will permit natural surveillance. In this manner, the location and design of fence, greenery and berms ought to be carefully considered when designing visibility is essential. In blind sides where no adjustment to the building is possible, the use of security mirrors or other security devices, for instance, video cameras would be important regardless of the way that these are not perfect solutions (NCPC, 2003).

b. Future sight line impediments

As the landscape matured after some time, unintended screens, hidden places or barrier spots could be made. In this way, planting in a site must think about the final growth height for plants. Plantings are best made with due considerations to the resource to be put in place for their upkeep so as to ensure that the primary sight lines design don't get obfuscated after some time. This is exemplified in plate 2.9.

c. Problematic spaces

Visibility should especially be considered when planning or designing spaces where hazard to personal safety is supposedly high, for instance, stairwells in multi-story car parks, underpasses and anteroom entries to tall structures (NCPC, 2003).



Plate 2.9: Over grown landscape can serve as hiding place or barrier
Source: CPTED Handbook (2017)



Plate 2.10: Shows how over grown tree can obscure sight line
Source: CPTED Handbook (2017)

2.3.3.3 Entrapment areas

Entrapment areas are small, confined zones close or adjacent to an all-around travel course that are shaded on three sides by some barriers, for instance, bushes or fences. Examples are lifts, bridges and tunnels, covered and isolated stairwells, diminished recessed entryways that may be closed at night, gaps in tall vegetation, a vacant site close from three sides by obstacles, deep narrow recessed areas for emergency escape, audit separated parking spaces or loading/offloading areas off a pedestrian walkway. Parking lots, filling stations and school structures isolated by school yards can in a likely manner push toward getting to be entrapment areas, especially when there is less activity after working hours (NCPC, 1997).

i. Elimination of entrapment area

On the off chance that there is an entrapment area, for example, a concealed zone underneath or over the ground, a private dead alley, a walled region or a storage area nearby a principle pedestrian route, it ought to be eliminated (NCPC, 2003).

ii. Closing of entrapment area after operating hours

On the off chance that an entrapment area is not conceivable, it ought to be closed or shut after working hours. For example, a passageway connecting a building ought to be locked also (NCPC, 2003).

iii. Visibility

It is desirable to have natural surveillance. Nevertheless, if an entrapment zone is unavoidable, the zone ought to be sufficiently bright with some type of formal observation. On account of lifts, the use of glass windows in the design of lift doors would be useful (NCPC, 2003).

iv. **Escape route and help**

Designs ought to accommodate a chance to escape and find help. For instance, fenced parking area can have in excess of one pedestrian exit points. Profound recessed emergency exit could act as an entrapment in spite of being lit and in this way it ought to be eliminated (NCPC, 2003).

2.3.3.4 Activity generators

Activity generators are usages or workplaces that attract people, make activities and add life to the street or space and along these lines help diminish the open entryways for bad behaviour. Activity generators consolidate everything from extending recreational facility in an amusement park, to setting lodging in the central business district or adding an eatery to a position of business. They can be given on a little scale or be incorporated as supporting region use, or uplifting a particular use (NCPC, 2003).

i. **Complementary uses**

Integral uses ought to be presented, to give observation to conceivably disconnected zones, e.g. by finding organization office, relax, TV room looking back paths or side passageways.

ii. **Reinforcing activity generators**

Action generator ought to be situated along a functioning edge or along maybe a couple of persons on foot-ways in substantial parks or on the limit of extensive improvements. A "functioning edge" makes a limit of room that is welcoming instead of debilitating to passers-by. Suitably authorized road merchants or sustenance sellers ought to be energized

in parks and the delicate situation of seating regions casually creates movement along the edge of a way.

iii. **Ground-level activity**

Person on foot-situated exercises ought to be energized at ground level in high and medium thickness regions. Expanded thickness mostly pulls in more individuals and may make greater secrecy and a feeling of dread. This feeling of dread can be moderated by making more ground level exercises, for example, retail which can include eye on the road.

2.3.3.5 Isolation

The vast majority feel insecure in secluded territories particularly if individuals judge that indications of pain or yelling won't be seen or heard. Individuals may shy far from isolated zone and thus such places could be seen to be considerably more unsafe. Natural surveillance from adjoining residential and commercial structures mitigates the feeling of seclusion, as does designing or planning activities for a more intense and varieties of uses. Surveillance by the police and other security work force to see all spots constantly isn't down to earth, nor conservative. Some dangerous or confined regions may require formal observation as security equipment, i.e. sound and monitoring system. Beside its cost, staff prepared for emergency must observe the equipment productively and mindfully. The following activities should also be observed:

i. Natural surveillance of isolated routes and public spaces

Natural surveillance of open spaces, for example, squares, open green spaces, segregated pedestrian routes and car parks ought to be empowered through designing and planning.

Blank walls or structures set far back at road level ought to be avoided as they can make a feeling of seclusion.

ii. Problematic routes

Isolated routes to and from car parks ought to ideally be ignored by surrounding buildings. In a low-rise development, it is alluring to give parking so that there is characteristic observation from the inhabitants of the structures or surrounding areas.

iii. Formal surveillance

Phones, emergency telephones or panic alarm ought to be satisfactorily demonstrated by signs. Cameras and observers could help screen secluded zones.

iv. Increasing activities

Compatible land uses and activity generators create activities, in this way permitting visibility by users.

2.3.3.6 Land use mix

A balanced land use mix is vital for natural, economic, aesthetic and safety reasons. Mixed use must be compactable with each other and with the needs of the community. For a residential apartment, various utilizations could be incorporated by having a major road, a town square or park, unmistakable city structures and above all the capacity of inhabitants to stroll to the work environment and to shops. The social estimation of frequenting nearby organizations gives a feeling of safety and security as the neighbourhood agents "watch" the

road. Generally, any design idea that empowers a land use mix will give more connection and a more secure place (NCPC, 2003).

i. Compatible mixed uses

Mixed use ought to be compactable to encourage activity, natural surveillance and contact among individuals for the duration of the day. The main reason for mixed uses is to give sufficient and proper services to the essential users of the region. Example includes, retail shops, convenience, workplaces in primary residential area and individual service shops, particularly on the off chance that they give nearby business openings. Health and fitness clubs, childcare centre and supermarkets in office areas including the likelihood of including residential uses at a later date, are different cases of compatible mixed use (NCPC, 2003).

ii. Balancing land uses

Land uses for example, bars, clubs and pubs are unavoidable components of urban life. Nevertheless, they can be seen as negative or undesirable relying upon their areas in the neighbourhood. Keeping in mind the end goal to limit their effects on the network, such uses ought to be adjusted with positive measures via deliberately choosing their areas in connection to its surrounding uses (NCPC, 2003).

2.3.3.7 Concealed or isolated routes

Concealed and isolated routes are often obvious routes that does not offer alternative for pedestrians. An aggressor can envision where a pedestrian will twist up once they are headed. Examples are lifts, staircases, underpasses and pedestrian overhead bridge. Unsurprising

courses are of particular concern when they are disconnected or when they end in entanglement areas (NCPC, 2003).

i. Visibility of concealed or isolated routes

In the event that there is a requirement for the isolated or concealed routes, it ought to be designed to consolidate visibility. On the off chance that there is a current disguised or confined course and security is being referred to, it ought to be modified or eliminated. Concealed or isolated routes can be made more secure by bringing more activities guaranteeing clear sight lines, enhancing lighting, introducing emergency telephones and electronic cameras (NCPC, 2003).

ii. Location of concealed or isolated routes near entrapment areas

On the off chance that there is an entrapment area or isolated area inside 50 to 100 meters of the finish of a hid or secluded course, it ought to be modified or eliminated. An entrapment area situated close to a concealed or isolated routes, for example, a tunnel or a secluded path equipped the aggressor with a chance to take on victims to a close-by entrapment area where a more serious crime could be committed (NCPC, 2003).

iii. Natural surveillance

Natural surveillance of a concealed or isolated course ought to be encouraged. A stair or a ramp might be located with the end goal that it has external or open areas and has a view from the surrounding properties.

iv. **Sight lines**

In the event that a pedestrian can't perceive what is on or toward the finish of a concealed or isolated route, the visibility ought to be enhanced by lighting as well as the utilization of a reflect such as mirror.

v. **Surveillance through hardware**

In the event that a concealed or isolated route is encased and prone to crime, for example, passageway or stairwell, surveillance through security cameras ought to be considered and the cameras ought to be appropriately checked (NCPC, 2003).

vi. **Access to help**

Emergency telephones, radios, security alarms ought to be introduced to a concealed or isolated route to enable users to summon help in emergency (NCPC, 2003).

vii. **Alternative route sign**

Signs ought to be set at the passages to show alternative well-lit and well-travelled routes. Certain pedestrian walkways, in the city for instance, might be ideal only during the daytime hours. All things considered, an alternative way ought to be indicated for night times and ends of the week at the passageway (NCPC, 2003).

2.3.3.8 Signs and information

Well designed, strategically positioned signs and maps add to the feelings of security. Signs should be standardized to give consistent, clear, brief and understandable messages from the street as shown in plate 2.11 and 2.12. Having addresses lit up amid the night will make them extensively more visible. Where it is difficult to find one's way around; signs with maps may

help. Signs must be self-evident, successfully grasped and well maintained. Graffiti and other vandalism can make signs mixed up. In the occasion that signs are in haggardness or vandalized, it gives an impression of lack of ownership and in this way adds to a sentiment of fear.

i. Sign design

Signs ought to be extensive, clear and identifiable. The utilization of solid hues, standard images, straightforward shapes and designs is prescribed for indications of washrooms, phones, data and help.

ii. Sign location

Signs ought to be deliberately situated at doorways and close action hubs (e.g., crossing points of halls or ways) and set for visibility at an appropriate height.

iii. Message

Signs ought to pass on the message with sufficient information. For instance, it ought to demonstrate where to go for help or help, or where the phones and washrooms are, or the duration of task of an underpass. The message ought to be passed on in an understandable language(s) or pictographs.

iv. Maps

In large parks and structures, maps or hand-outs containing information proper to the diverse needs of different gatherings of users ought to be available.

v. **Maintenance**

Signs ought to be kept up all the time to guarantee that they are obvious. This may include trimming any landscaping growth or cleaning the sign. Clear signs in car park assist users with identifying their location.



Plate 2.11: Signs showing access control

Source: CPTED Handbook (2017)



Plate 2.12: Signs showing access control

Source: CPTED Handbook (2017)

2.4 Site Planning and Design for Mixed Use Development

Architects, planners, and landscape designers assume a vital part in recognizing and actualizing important resource security measures while considering site selection, land

utilize, the orientation of mixed use building on the site, and the establishment of vehicle access control points, physical barriers, parking, landscaping and the protection of utilities to checkmate dangers (ECU, 2011). To achieve the ideal considered above in mixed use building, the design group must work intently to coordinate security requirements at the early stage in the design process are at the minimum expensive and at its best.

2.4.1 Site layout

The design of a mixed-use building (for example the placement and form of its building, infrastructure, and amenities) is the first stage for this implementation. Decisions made amid this phase of the design procedure will control decision-making for alternate components of the site. Clashes now and then emerge between security site design and traditional site design. To maximize wellbeing, security, and sustainability, designers should execute an all-encompassing way to deal with site design that integrate form and function to accomplish a harmony among the different design elements and objectives. Regardless of whether assets are constrained, noteworthy esteem can be added to a project by incorporating safety considerations into the more traditional design tasks in such that they supplement, rather than to contend with the other components.

2.4.2 Building placement of mixed-use building

The perfect building position of a mixed-use building from a security outlook consolidates CPTED standards.

- i. The position of the building ought to give territorial reinforcement of the possession by making a qualification between the general public space and that of the building. This can be expert using clear space to isolate the two substances. Research has demonstrated

that the situation, fenced in area, or directing of roadways and movement can change the idea of a specific zone and decrease miscreant action.

- ii. The building ought to be situated with a specific end goal to wipe out or if nothing else limit zones that easy-going eyewitnesses can't see.
- iii. Provide layers of security. (ECU, 2011).

2.4.2.1 Circulation

The circulation system decides the movement of individuals and materials into, through and out of building and sites. Designing a system is to amplify proficiency while limiting clashes between vehicles and pedestrians. Designers should start with a comprehension of the site's transportation requirements in light of how to plan and to utilize the site and building. This incorporates the essential parking volume, pedestrian patterns and the methods of transportation they will utilize, and the number and types of access routes required.

2.4.2.2 Vehicular

Control of vehicular movement all through the site is essential in alleviating vehicle related dangers. Local traffic patterns, sight distance, and the vehicle type and volume entering the site affect the area of passages. Essential targets for onsite circulations are to isolate vehicles from basic assets, control vehicle speed and approach, give way finding, design of safe street and parking area arrangements, and give sufficient emergency access. The following criteria should be incorporated into the site design.

a. Site Access:

- i. Limit number of vehicular passages to the site.

ii. Utilize symbolic site features to distinguish entrances and set up territoriality.

b. Internal Roads:

i. Parking and Roadways ought to keep up at least 33 feet detachment from every single occupied structure.

ii. Equip roadways with activity calming measures and drop-off areas.

iii. Provide parking lot access road in a way that limits the requirement for pedestrian intersections.

2.4.2.3 Parking

A wide range of parking facilities has security worries to ensure both individuals and properties are safe. A lot require committed pedestrian pathways to build up natural surveillance and access control of the parking spaces and to keep pedestrian activity from intermixing with vehicular movement. Remote or segregated parking facilities may require additional electronic safety efforts, for example, video camera coverage and emergency call boxes.

Utilize the following criteria in outlining parking spaces:

a. Orient travelling paths perpendicular to structures to help natural surveillance and recognize crosswalks to guarantee pedestrian safety to structures.

b. Create isolate guest/ short-term parking with fitting signage close to the main building entrance.

i. foot-light minimum horizontal (Illuminating Engineering Society of North America (IESNA) standard)

ii. 0.8 foot-light minimum vertical with consistency ratio not more than 4:1 (IESNA standard)

- iii. Investigate approaches to decrease parking spaces for lighting amid times of limited use to diminish energy utilization while keeping up a safe environment.
- iv. Avoid putting light shafts inside the 10-year growth of canopy of trees.
- v. Provide minimum brightening for successful task of surveillance cameras.

2.4.2.4 Pedestrian

Building's safety and aesthetic is reliant on key pedestrian circulation design (ECU, 2011). The objectives are to focus action to help observation, limit activity intersections and channel movement through the grounds. The capacity to distinguish an unapproved individual on the property is a need. Use the following criteria when outlining the pedestrian circulation:

- a. Define linkages from the parking spaces to the building main entrances that compare to favoured pedestrian courses and limit street intersections.
- b. Provide a drop-off zone central to the main entrance to the structures.
- c. Provide unhampered views of pedestrians travel by abstaining from concealing spots along pedestrian courses and around illumination as follows:
 - i. 1 foot-light minimum horizontal (IESNA standard)
 - ii. 0.8 foot-light minimum vertical with consistency proportion close to 4:1 (IESNA standard)
- iii. Provide change lighting inside 15 feet of building passage of a base 5 foot-candles.
- iv. Avoid setting lighting inside 10-year growth canopy of trees.
- v. Provide minimum lighting for effective operation of surveillance cameras.
- vi. A least of 33 feet between pedestrian walkway and sensitive zones, for example, the day cares' outside play area, generators, HVAC gear, and loading docks ought to be kept up.

- vii. Appropriate signage ought to be accommodated warning and way discovering (site passage, delivery traffic, visitor parking, and drop-off).
- viii. The utilization of pavement strategies ought to be considered to upgrade territoriality and way finding.
- ix. Funnel pedestrian walkways to main doorways as a method for supporting natural access control.

2.4.2.5 Space planning and design

The security of the building interior is centered on the functional layout of spaces and separating open territories, for example, the Shopping Mall, Shops, facilities, stacking docks, mailrooms, carports, and retail zones from the more private regions of the office, for example, workplaces, local locations, and utility regions upgrades security by defining area and consolidating user groups. Accomplish this detachment by creating internal "hard lines" or cushion zones, utilizing optional stairwells, lift shafts, halls, and capacity territories amongst open and private regions. The accompanying outline measures ought to be considered when spreading out inside spaces:

- i. Defined main entrances
- ii. Limit secondary entrances
- iii. Align inside passages
- iv. Limited recessed or shrouded territories
- v. Clearly define public and private spaces
- vi. Group spaces with similar exercises together
- vii. Provide open inside plan
- viii. Do not detach common area, for example, bathrooms, play areas, gathering regions.

- ix. Promote great natural surveillance by giving chances to observation through the situating of windows in connection to stairs, passageways, or outside territories, consistent normal perception will be kept up and crime will be stopped.
- x. Locate key resources as far into the inside of a working as would be prudent.
- xi. Place territories of high guest movement far from key resources.
- xii. Locate resources in territories where they are noticeable to more than an individual.
- xiii. Use inside boundaries to separate levels of security inside a building.
- xiv. Stairwells required for crisis departure ought to be situated as remotely as conceivable from territories where high-hazard episodes may happen and, wherever possible, ought not to release into halls, parking, or loading areas.
- xv. No departure ways from open space will go through private spaces.
- xvi. Clearly defined separation points between public and private areas built up territoriality by characterizing who ought to be in what region of a building.
- xvii. Consider shielding set up and get together territories in space planning.

2.4.2.6 Public and private separation points

Spaces can regularly be characterized as public areas and private areas. Public areas are those that are proposed to be utilized by the overall public of a region, in mixed use buildings this would incorporate entryways, Receptions, corridors, consider zones, and retail spaces. Private areas are those that are expected to be utilized by just a select gathering of individuals, for example, office spaces, utility rooms, and a few facilities. Gathering private zones is a powerful way to diminish gets to control necessities, for example, dividers, entryway, or card peruses. The gathering of private spaces incorporates both vertical and level access controls to empower sufficient partition (ECU, 2011).

2.4.2.7 Shelter-in-place

Shelter-in-Place is the way toward anchoring and securing individuals and resources in the general territory in which an emergency occurs. Shelter-in-place can be response to a natural hazard (for example, a tornado, sea tempest, sever storm), a criminal demonstration, (for example, working place violence, terrorist attack). Shelter-in-place prerequisites ought to shield people from potential risks, for example, flying glass from a broken window. Safe house set up area necessities include:

- i. Gathering territory that is protected from potential hazards, for example, flying debris or glass from a broken window
- ii. Space is normally on the inside of a building.
- iii. Avoid carports, anterooms, lifts, and stairwells
- iv. Have emergency communications
- v. Space to store for medical aid hardware, sustenance, and water.

2.4.2.8 Landscape design

The ramifications of security for landscape design influence everything from plant species and building material choice to landform development and way finding. Elements, for example landforms, water highlights, and vegetation are among the building blocks of attractive and inviting spaces, and can be ground-breaking apparatuses for upgrading security in a mixed use building. These features can be utilized to characterize or assign a space, as well as to deter or avert unfriendly observation and unapproved access. In any case, landscape can likewise have adverse effects for wellbeing and security. Practitioners ought to consider the extraordinary prerequisites of the landscape design to guarantee the scene outline components they pick will be suitable and powerful. With careful selection, situation, and

maintaining a landscaping elements can give visual screening which ensures delicate tasks, for example, gathering areas and different exercises from observation without creating concealment for clandestine movement. Likewise, evade thick vegetation in closeness to a working as it can screen unlawful. Select and keep up vegetation because of taking out concealment in mind. Additionally, measures to screen outwardly detractive parts, for example, transformers, junk compactors, and gathering units ought to be intended to limit camouflage open doors for individuals and weapons (ECU, 2011). Figure 2.7 and 2.8 illustrates landscape design for optimum view and security

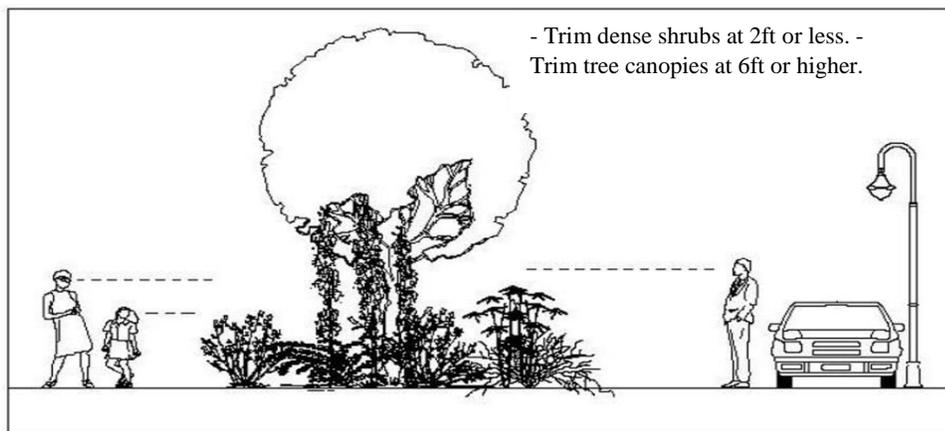


Figure 2.7: Required height for landscape
Source: CPTED Handbook (2017)

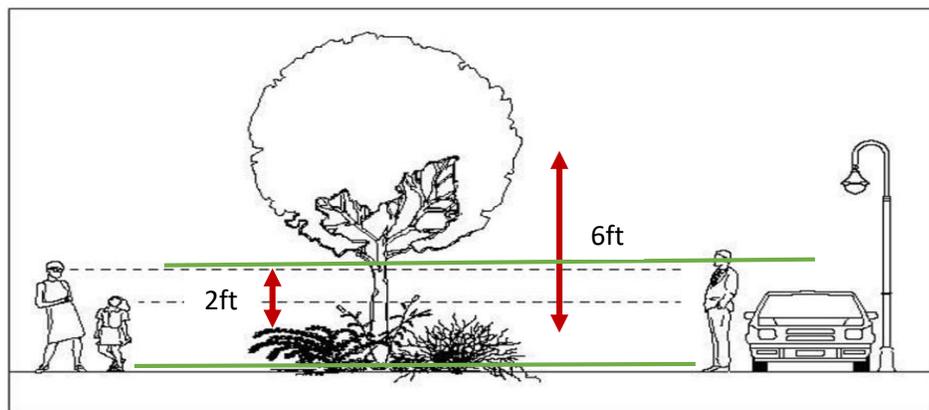


Figure 2.8: Required height for landscape
Source: CPTED Handbook (2017)

2.5 Review of Past Related Research Works

A number of previous studies including but not limited to (Katyal 2002, Duarte. *et al.*, 2011, Dragu. *et al.*, 2013, Hopper 2010, Parnaby 2006, Crowe 2000, Vellani 2007, Sennewald and Christman 2008) have all proffered solutions to the problem of Security in public buildings through the application of diverse design and landscape design models. Majority of these previously named studies concentrate on the solutions to mitigate this exposure of mixed-use buildings to insecurity using different design elements through the application of Crime Prevention through Environmental Design (CPTED). The concept of CPTED is not particularly a new one, there are a number of studies conducted in this field of enquiry. There are various architectural theories that proffer different but similar solutions for providing solution to insecurity in various building typologies especially in public buildings such as mixed use developments. A thesis presented by Alabi (2017) to the department of architecture, Covenant university, Ota titled “Designing High Rise Housing for Lagos, Nigeria with Focus on Sustainable Building services 2017” is a study carried out to investigate sustainable building services. This thesis researched and related the application of sustainable building services to the design of a mixed-use residential building in Lagos, establishing from literature the relationship between sustainable building services and security measures and then applying it in the context of a proposed mixed-use residential building in Lagos. Furthermore, the study took a case study approach as the research method with computer simulation as a tool for data collection, investigating existing mixed-use residential buildings to check these principles explored by the research and then finally proposing a mixed-use residential building that optimally incorporates the principles into its design. Another similar study is a thesis presented by Jatto (2017) to the department of architecture, Federal University of Technology, Minna. Titled “*Safety design consideration*

for crime prevention in Islamic centres in north central Nigeria". This study took the case study approach with questionnaire as a tool for data collection, with a specific end goal to address the aim and objectives of the study. An in-depth study of the literary work was carried out at the first stage of the research to gain an insight to the research problem, aim and objective of the research. Survey of applicable literary works gave the bases to complete hypothetical foundation of the research. The research writing survey gives foundation data and the key debate discussions and issues encompassing CPTED. The data assembled utilized to set up suggestion for crime prevention and safety measures involved in institutional structures.

Security measures as discussed by various authors in building design and public spaces, and discussed under various themes, principles, and theories based on their individual views. Nevertheless, the elements or measures in these theories remains similar and alike, indicating the fact that these measures may have different theories but geared towards achieving the same purpose. According to various security bodies, departments, programs and even guidelines these measures were defined in details. Zoning according to Randall (2013) is the initial point for security implementation as it defines areas even before other elements of security designs are considered. From the literature, security measures such as physical barriers, use of landscape elements, escape routes, nature of perimeter fencing or site boundary, availability of tour guide and even ensuring that homes of residents are designed such that occupants have a sense of responsibility towards the property have been established (defensible space theory). Zahner (2017) emphasized that in addition to designing for security with all these measures, beauty should not be sacrificed and hence, his measures revolved mostly around the use of landscape art. Security measures can be grouped in two

dimensions, which are “Access Controls and Detectors” (karam, 2015). The demarcation or division of space in other to achieve security as defined by Nunes-Vaz, *et al.* (2011) indicates the fact that security has to do with restraining or allowing of movements. Access control indicates or describes the use of these measures for channelling of movements and Detectors refers to measures that creates platform for observance and monitoring.

2.6 Deductions

Based on the listed objective of this research, the research has done an in-depth study and after a careful examination of the literature has summarized the following deductions.

- i. Study into the basic principles of designing a mixed-use building, the researcher has deduced that in designing a mixed-use development, certain product are vital such as: Attraction, Access, and Services.
- ii. Concerning the security and safety measures in mixed-use, the researcher has deduced variables, which can be categorize into two headings, The Access Control and Detectors. This study seeks to analyse CPTED strategies that can be implemented in architectural design and so access control is fully taken into cognizance for analyses.

Table 2.1 General deductions of security and safety measure

Access Control	Detectors
Natural Access Control	Natural Surveillance
Territorial Concern	Activity Support
Target Hardening	Maintenance and Management
Zooning for Security	Tour guide and Watch tower

Source: Researchers' Field work (2021)

The variables considered as it relates to safety design consideration for crime prevention includes; Natural Access Control (AC), Territorial Concern (TC), Target Hardening (TH), Zoning for Security (ZS), Natural Surveillance (NS), Activity Support (AS), Maintenance and Management (MM), Tour guide and Watch Tower (WT).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Research Design

This study addresses the escalating crime challenges in Nigeria by employing a descriptive research design. It utilizes a mixed-method approach, combining case studies and questionnaires, to investigate the application of Crime Prevention through Environmental Design (CPTED) principles in enhancing security within mixed-use buildings in Abuja. Six mixed-use developments in Abuja were scrutinized, with 400 questionnaires distributed and analyzed using the Base module SPSS software. The research focuses on factors such as entrance sizes, fence heights, and other security elements. The research design approach was selected to assist the researcher in collecting necessary data to examine possible association between the factors and study the present condition of mixed-use buildings in Abuja. The researcher employed both qualitative and quantitative research approach and was descriptive in nature. A descriptive research simply refers to the description of the state of affairs as it exists at present (Kothari, 2004). This involves the use of fact-finding missions and field surveys.

3.2 Research Strategy

Quantitative data provides objective data and fact Maina *et al.*, (2016) while the Qualitative data provides a more in-depth explanation and reasons behind established phenomena. The purpose of this study was to assess safety design considerations for crime prevention through environment design (CPTED) of mixed-use buildings in Abuja, Nigeria. To achieve this aim, the study employs quantitative and qualitative methods. The quantitative technique

investigates and clarifies whether and what numbers of individuals hold a specific conclusion (Immy, 2005); it is actualized by studying a substantial number of members. On the other hand, unlike quantitative method of research, qualitative research offers a comprehension of the foundation to problem (Humphrey and Lee, 2008; Cottrell and McKenzie, 2011).

Case study research approach is one of the main tools for the qualitative study (Yin, 2014). Therefore, the case study approach is capable for the qualitative part of the research method. A case study is also relevant to research strategy when focusing on a real-life situation. The research will find the data from different mixed-use buildings and there relation to different CPTED strategies. To this end, the case study is suitable to draw a comparison of multiple cases (Crewsell, 2013). Moreover, the case study is flexible to modify the design and data collection on the research (Johansson, 2019).

3.3 Instrument for Data Collection

Information identifies with the investigation were gathered primary and secondary data collection techniques, through the following means;

i. **Literature review:**

The primary phase of the data collection includes an extensive survey of existing literatures on CPTED theories and hypothesis. This was accomplished through an exhaustive examination and talk on literary sources, which are identified with the research subject. These include journals, books, insightful articles, diaries, government reports and the web. The survey set up the hypothetical foundation of the study and recognized holes in existing knowledge and giving way to promote more investigation (Kumar, 2011). This survey

assumed an essential part in the assurance of the research problem and the definition of research point and targets.

ii. Case study

The contextual analysis was completed on existing mixed-use buildings. The principle objectives of completing a case study was to have a superior perspective of what a mixed-use building configuration is to gaining from the current buildings and furthermore inclining toward how to enhance them. The destinations are to distinguish the current issues and discovering approaches to explain them. Six Mixed-use building were purposefully chosen based on their large number of facilities, users and their location, which makes them more vulnerable to crime.

iii. Direct observation:

Direct observation was utilized on the field to measures a few factors of the investigation, for example, sizes of openings at the entrance, height of wall fences, stand-off distance and height of plantings, sight line impediment in the examination territory

iv. Survey questionnaire

Questionnaires were utilized to finish the quantitative phase of the investigation. The Interview questions were created from key subjects and discoveries from the underlying written literatures. The questionnaires comprised of two sections with 41 questions: the primary section included demographic variable and the second comprised of 34 questions.

3.4 Method of Data Collection

This study used both primary and secondary method of data collection strategies with a specific end goal to address the aim and objectives of the study. An in-depth study of the literary work was carried out at the first stage of the research to gain an insight to the research problem, aim and objectives.

I. Primary data collection

Primary data are the crude information acquired by the researcher through his/her field overview. Primary information was sourced from the field by utilizing expressive study strategy that included the utilization of perception.

II. Secondary data collection

Survey of applicable literary works gave the bases to complete hypothetical foundation of the research. Data acquired were investigated and given the bases to the research topic. The writing survey gives foundation data and the key debate discussions and issues encompassing CPTED. The data assembled will be utilized to set up suggestion for crime prevention and safety measures involved in institutional structures.

3.5 Population of the Study

Population of study is made up of all the subjects that have the characteristics that are of interest to the researcher and to whom the result obtained can be generalized. The population of this study comprises of mixed-use buildings in Abuja. The selection of this population of study is appropriate because it captures a specific range of data required for the study and represents similar social-cultural elements of the area while comparing them to internationally accepted standards.

3.6 Sample and Sampling Procedure

The sampling technique adopted in this research was purposive in nature; identifying the mixed-use buildings in the city studied and screening, those according to the case study selection criteria. While for the international case studies, mixed-use buildings that optimally incorporated CPTED strategies in their design were studied. This procedure is supported by past studies carried out in this field, and the nature of the research.

3.6.1 Case study selection criteria

The case studies selected for this research were sampled purposely to at least possess two amongst the following criteria:

1. Mixed-use building that are located within Abuja, Nigeria.
2. Building with adequate coverage in scope and facilities required to operate as a standard mixed-use building.
3. Mixed-use building that represents a region, to look at factors involving regional and technological diversities.
4. Mixed-use buildings that optimally incorporated CPTED strategies in their design.

3.7 Data Analysis and Presentation

The techniques used for data analysis in this research will include; descriptive, statistical and parametric analysis. The study adopted 5-point measurement scale (1-strongly disagree to 5-strongly agree) to allow individual expression on how much they agree or disagree with a statement, and to rank qualitative data numerically for ease of analysis. Tables and charts

will be used to present the data from the questionnaire survey while photographs, sketches and written reports will be used to present case study data.

3.8 Method of Data Analysis and Presentation

Burns and Grove (2007) defined data analysis as a strategy used to limit, arrange and to give meaning to the data collected. The data collected through questionnaire from the respondent would be analyze with MS Excel tools. Percentages, tables and cross tabulation will be used to analyze quantitative data.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Demographics

The study employed a descriptive analysis research approach using a mixed-method technique through two-survey research, which involved case studies using field observation schedule and self-administered questionnaire developed and used to gather research data for analysis and presentation in this chapter. The research data was collected base on the study objectives as stated above in the previous chapters of this research. Charts, tables, graphs, and statistical instruments were used to analyze the collected data. Six samples of mixed-use developments were selected for this study, to analyze the application of Crime Prevention through Environmental Design CPTED strategies in the study area. 400 number of questionnaires were distributed to draw out the overall users' perception and factors that influenced their satisfaction in the application of CPTED strategies. Equal number of respondents were recorded in each of the six selected areas and questionnaires were distributed, representing 100% of the total questionnaire shared. Six major axis in the study area were selected for this research work that includes; Abuja municipal area council, Bwari area council, Kuje area council, Gwagwalada area council, Kwali area council and Abaji area council.

4.2 Objective One: To examine the Application of CPTED Strategies in Mixed-use Building (Case Studies).

Case studies are established research design that involves an indebt study of a specific subject or subjects within a real world. The basic importance of case studies is that it provides a platform for critical analysis of existing structure that are similar to the proposed design. In this proposed design, six existing Mixed-use buildings both national and international were examined and studied. Case studies were conducted and the deductions gotten have been analysed using Microsoft excel software, based on the following variable; Zoning for security, nature of site boundary, drop off procedure, hard landscaping for security, soft landscaping for security, physical barriers, escape route, availability of tour guide and watch tower.

As part of the objectives of this study was to propose a design of mixed-use development that, integrate Crime Prevention through Environmental Design CPTED strategies. Before incorporating the idea of CPTED strategies into the design, case studies were carried-out and the findings were apply in the design of mixed-use development to demonstrate the suitability of CPTED strategies.

The case studies selected are listed and discussed in the next section;

- i. World Trade Centre (Tower 1), Abuja, Nigeria.
- ii. Nestoil Tower, Victoria Island, Lagos, Nigeria.
- iii. Via Vallejo Cinopolis Building, Mexico City, CDMX, Mexico.
- iv. Zeitz Museum of Contemporary Art, Cape Town, South Africa.
- v. Parque Toreo, Naucalpan de Juarez, Mexico.
- vi. JR Towers, Nagoya, Central Japan.

4.2.1 Case study one: World Trade Centre (Tower 1), Abuja, Nigeria.

I. Background Study

The World Trade Centre in Abuja is a mixed use project which include retail, residential, office and hospitality elements developed in an effort to create a vibrant cityscape in the country's capital. It comprises 6 residential and office towers ranging from 18 – 23 floors, a large modern shopping centre called the Capital Mall and a high-rise mixed-use tower, (up to 45 floors) with leisure and hospitality elements (see figures 4.1 and plate 4.1). The Centre will provide over 20,000sqm of flexible 'AAA Grade' office space for corporate occupiers. The glass facade on the building will be thermally efficient and the building aims to offer adequate parking.

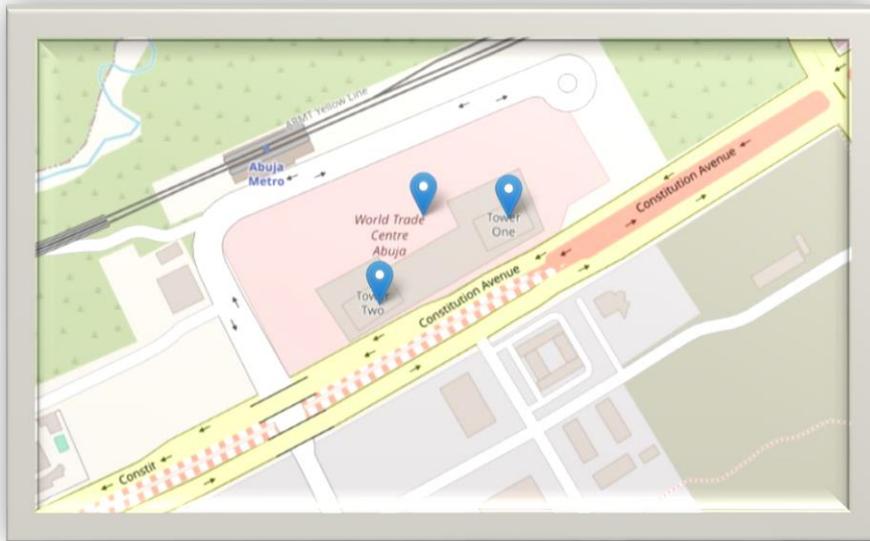


Figure 4.1: Cross Location of World Trade Center (Tower 1)
Source: WTC Abuja (2021)

Project Name: World Trade Center

Location: Plot 1113, Constitution Avenue, Central Business District, Abuja, FCT

Project Architect: Woods Bagot

Project Type: Mixed-use Office, Residential, Retail, Hospitality



Plate 4.1: 3D Site view of World Trade Centre Abuja
Source: WTC Abuja (2021)



Plate 4.2: Perspective view of the World Trade Centre
Source: WTC Abuja (2021)

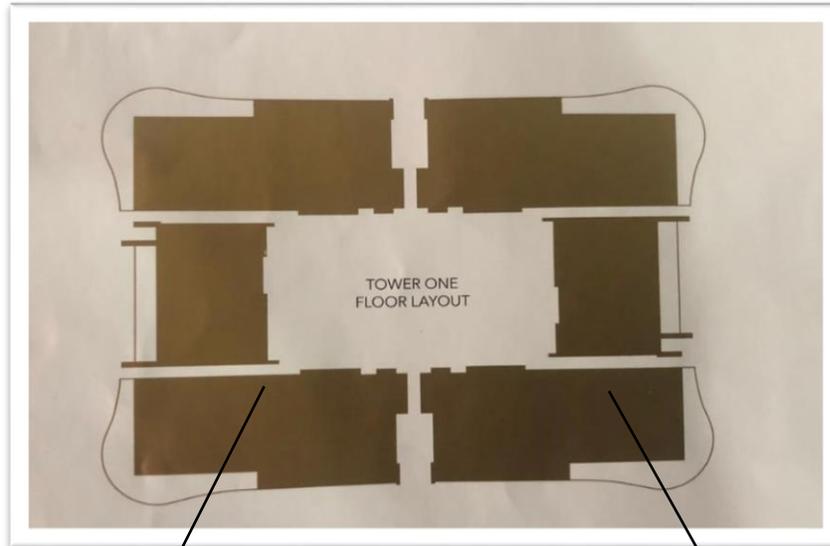


Figure 4.2: Layout plan for Tower1
Source: WTC Abuja (2021)

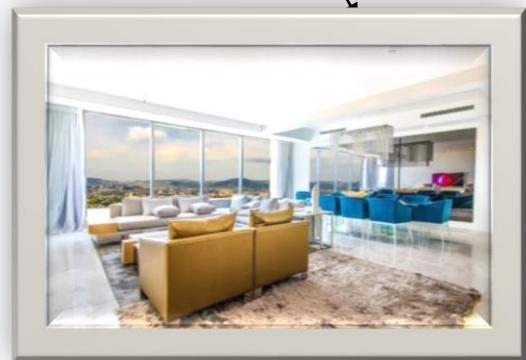


Plate 4.3: Interior View for Tower1
Source: WTC Abuja (2021)

The tower contains 120 apartments, which range in sizes from 1 to 6 bedrooms, duplex, 2 exquisite penthouses and pool villas, with a rectangular building form. Figure 4.4 shows a typical floor plan of the building. The world trade centre is a High-Tech architectural design

that uses new advance technology and building materials as seen in figure 4.2. It made extensive use of steel, glasses and concrete as seen above in figure 4.3.

4.2.1.1 Findings at World Trade Centre (Tower 1), Abuja, Nigeria.

The study reveal that, Abuja World Trade Centre (Tower 1) is the Tallest residential building in Nigeria with 24 floors, 120 Super-luxury apartments with balconies, 9 apartment types - 1 to 6 bedrooms, 2 stunning Penthouses and Pool Villas, Sound and shatter proof glazing, and provision of Controlled Card Access in all areas.

Base on the study carried out, the following observation were made;

I. Zoning for Security

World Trade Centre covers a very large expanse of over 440,580sq meter, making it one of the biggest and finest mixed use building in Nigeria. This large expanse of land has been zoned into segments based on the attraction within such segments. The site offers attraction as; mountains in the cloud, natural pool. All these attractions are at different locations thereby making the zoning nature in segments. The site is zoned from public to private areas, with the twin towers aligned with the rectangular street grid and therefore have North (N), South (S), East (E) and West (W) faces in these street-grid coordinates.

II. Nature of the Site Boundary

The tower is bordered to the north by Abuja metro train station, on the east by the Independence Corrupt Practices Commission ICPC headquarters, and on the south by the Debt management office of the Federal Capital Territory. The site boundary of any facility is first line of defense indicating a restriction and giving a keep off warning to

passerby. This boundary could be done with block fencing, metal fencing, and wood fencing and with the use of vegetation. A definite perimeter all around the site does not exist, only at some areas or points were metal barricade used.

III. Drop off Procedure

The world trade center (Tower 1) adopt play drop off procedure, making the building more sensitive for both entry and exit of personal in and out of the building. However, drop off procedure ensures or prevents encroachment of any sort without proper identification or protocol. It ensures that visits by tourists are fully coordinated and arranged, such that provisions and directions are made towards a general parking after which transportation throughout the site is done via shuttles. This creates a level of restrictions and protocols to deter or restrict attacks, including generation of fund for the facility.

IV. Landscaping for Security

The use of both hard and soft landscape in the design for security is of utmost significance and importance. The hard landscape includes; floor coverings, sitting units, lighting elements, sign and information plates, bollard, water elements, shelter items (pergolas, shade, gazebo, and bus stop), and art objects (sculptures). The soft landscape involves the usage of all kinds of vegetation from flowers and trees to shrub and ground cover appropriately for achieving safety and security. Clearly defined paths or walkways, pavements, sign and info plates, bollard, shrubs, and ground covers were clearly used in World trade center (Tower 1). Also, the use of narrow trees which give clear sightlines as compared to broad leaved trees were considered at certain areas such as palm trees. Nevertheless, there were several usage or presence of broad-leaved trees

around the site which hinders sightlines and hence affect observation, monitoring, and surveillance leading to security issues.

V. Number of Entry Points to the Site, Availability of Tour Guide and Watch Tower

The world trade center (Tower 1) has only a single route for entry and exit. However, the site has no definite boundary indicating that any passerby to a considerable level can maneuver his/her way into the site. Tour Guides are available as assistance to help Tourist navigate their ways through the site. In addition, the usage of watch-tower or any other passive 24-hour surveillance was found totally absent.

4.2.2 Case study two: Nestoil Tower, Victoria Island, Lagos, Nigeria.

I. Background Study

The Nestoil Towers is a fifteen storey mixed-use development consisting of 7,500 m² of office space, 3,500m² residential space, a multi-storey parking facility as well as a recreational facility. The building form was created using gentle curved surfaces of high performance glass with horizontal tubular details, which accentuate the sweeping effect of the curved façade. The arced curtain walls were further defined by a surrounded solid white metal panels to complete the contemporary composition of the building (see Plate 4.4 to 4.6).

Project Name: Nestoil Tower

Location: Victoria Island, Lagos.

Project Architect: ACCL Architects

Project Type: Mixed-use Building

Building Size: 3,900sqm.

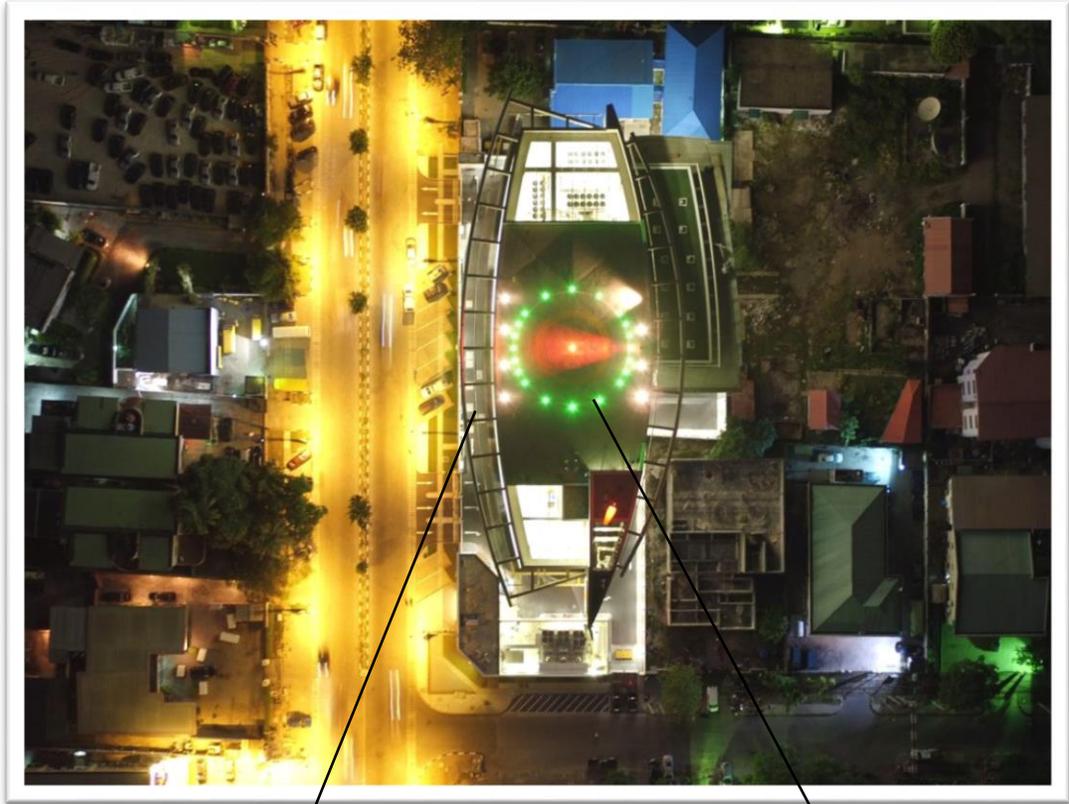


Plate 4.4: Overview street view of Nestoil Tower
Source: Nestoiltower.com (2021)



Plate 4.5: Nestoil Tower Rear View
Source: Nestoiltower.com (2021)



Plate 4.6: Nestoil Tower Entrance
Source: Nestoiltower.com (2021)

Completed in 2016, and the only LEED certified building of its kind in West Africa, the Nestoil Tower, with its panoramic view of the Atlantic Ocean and the whole business district of Victoria Island, Lagos and beyond, is the business address to be. Sitting on a land size of 39000sq. meter with 10,000sq. Meter leasable commercial spaces on 15 floors, the Nestoil Tower with its technologically advanced facilities is an ideal space for corporation seeking to be at the cutting edge of their industries.



Plate 4.7: Street side view of Nestoil Tower
Source: Nestoiltower.com (2021)

4.2.2.1 Findings at Nestoil Tower, Victoria Island, Lagos, Nigeria.

The study reveal that, Nestoil Tower comprises of 4,110 square meters of commercial/office spaces, and 10 units of 1 and 2 bedroom apartments with two floors of Preferred Minimum Leasable Space.

Base on the study carried out, the following observation were made;

I. Zoning for Security

Nestoil tower covers a total area of 12,200sqm. The effective use of zoning laws for security offers a first form of defense to the facility, which makes zoning a number one criterion for the security of any property. The site has been zoned with clear separation between the private and public facilities.

II. Nature of the Site Boundary

Nestoil tower is located on the corner of Akin Adesola Street and Saka Tinubu street making it in close proximity to other developments such as: Number One, Unity Bank Towers, Victoria Mall Plaza, Pension Custodian Limited HQ, and Pactum Towers amongst others. The site boundary of any facility is first line of defense indicating a restriction and giving a keep off warning to passerby. This boundary could be done with block fencing, metal fencing, and wood fencing and with the use of vegetation. A definite perimeter exist around all the site boundaries, in addition with metal barricade at some areas.

III. Drop off Procedure

A drop off procedure ensures or prevents encroachment of any sort without proper identification or protocol. It ensures that visits by tourists are fully coordinated and arranged, such that provisions and directions are made towards a general parking after which transportation throughout the site is done via shuttles. This creates a level of restrictions and protocols to deter or restrict attacks, including generation of fund for the centre. The Nestoil Tower has a drop off procedure in play making the centre more sensitive to entry and exit of personal in and out of the centre.

IV. Landscaping for Security

Application of both hard and soft landscape in the design for security is of utmost significance and importance. The hard landscape includes; floor coverings, sitting units, lighting elements, sign and information plates, bollard, water elements, shelter items (pergolas, shade, gazebo, and bus stop), and art objects (sculptures). The soft landscape involves the usage of all kinds of vegetation from flowers and trees to shrub and ground cover appropriately for achieving safety and security. The Nestoil Tower is designed and constructed according to the latest standards, inside the building as well as outside. The result is a working environment with the highest level of security and safety. Also, the use of narrow trees which give clear sightlines as compared to broad leaved trees were considered at certain areas such as palm trees. Nevertheless, there were several usage or presence of broad-leaved trees around the site which hinders sightlines and hence affect observation, monitoring, and surveillance leading to security issues.

V. Number of Entry Points to the Site, Availability of Tour Guide and Watch Tower

The safety of the people working in and visiting the Nestoil Tower is one of the top-priorities when designing and constructing the building. Of course, we can expect advanced security measures, but also the safety and health of the people using the building are as much important. The Nestoil has separate route for entry and exit.

Tour Guides are available as assistance to help Tourist navigate their ways through the site. In addition, the usage of watch-tower or any other passive 24-hour surveillance was found totally absent.

4.2.3 Case study three: Via Vallejo Cinopolis Building, Mexico City, CDMX, Mexico.

I. Background Study

Via Vallejo Cinopolis is a mixed-use project that integrates the following areas: commercial, residential, health services and a hotel. The building was made with 3-levels out of plumb and complement it with an important area of public space, an outdoor park surrounded by terraces and restaurants with different specialties (see figures 4.3 and plate 4.8 to 4.11).

Project Name: Via Vallejo Cinopolis Building

Location: Mexico City, CDMX, Mexico.

Project Architect: Grow Arquitectos

Project Type: Mixed-use Commercial

Building Size: 200,000sqm.

Completion Year: 2016

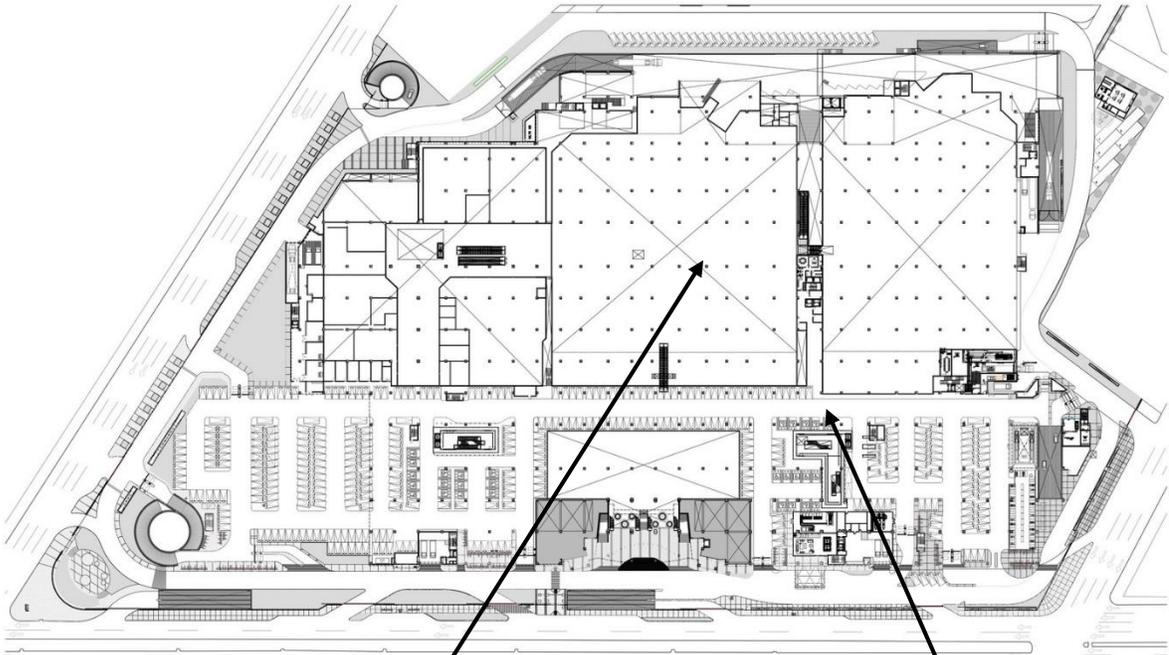


Figure 4.3: Overview Site Layout of Via Vallejo Cinepolis Building.
Source: www.Archdaily.com (2022)



Plate 4.8: Courtyard view of Via Vallejo
Source: www.Archdaily.com (2022)



Plate 4.9: Side view of Via Vallejo
Source: www.Archdaily.com (2022)

The project seeks to be an alternative space for the zone as well as meeting its housing needs. It offers a wide variety of services and entertainment options both for residents and visitors of this important industrial and commercial core of Mexico City (see plate 4.10).



Plate 4.10: Overview of Via Vallejo Cinepolis Building Interior.
Source: www.Archdaily.com (2022)

Pedestrian and vehicular access and large parking lots have been considered as an integral part of this development. Comfort and safety are a priority and the most important goal is that all users enjoy the highest quality of life standards (see plate 4.11).



Plate 4.11: Overview of Circulation Area in Via Vallejo Cinepolis.
Source: www.Archdaily.com (2022)

4.2.3.1 Findings at Nestoil Tower, Victoria Island, Lagos, Nigeria.

The 10-floor building had been designed to not only withstand the effects of the severe earthquakes in Mexico City, but also to ensure the serviceability of the building during and after the seismic event. To do this, the engineers have chosen to use seismic isolation as a protective strategy.

Base on the study carried out, the following observation were made;

I. Zoning for Security and Nature of the Site Boundary

Via Vallejo Cinopolis Building covers a total area of 200,000sqm. The site has been zoned into two wing the leisure wing and the business wing making a clear distinction from business and leisure resort since it offers both to its visitors. The building is zoned based on noisy areas to quiet areas. The site has a block wall serving as the site boundary.

II. Drop off Procedure

Via Vallejo Cinopolis Building has a well-planned drop off procedure having a general packing space of about four thousand in a relation to a welcoming building that stand as the reception. The employment of both hard and soft landscaping has been carefully planned and designed meeting security and safety issues. Only a few issues of wrong tree placement were observed as shown in figure 4.11.

III. Landscaping for Security

Application of both hard and soft landscape in the design for security is of utmost significance and importance. The hard landscape includes; floor coverings, sitting units, lighting elements, sign and information plates, bollard, water elements, shelter items

(pergolas, shade, gazebo, and bus stop), and art objects (sculptures). The soft landscape involves the usage of all kinds of vegetation from flowers and trees to shrub and ground cover appropriately for achieving safety and security. Nevertheless, the facilities has all major human necessity in one thus reducing the need for movement, though the soft landscaping was poorly done.

IV. Number of Entry Points to the Site, Availability of Tour Guide and Watch Tower

Via Vallejo Cinopolis Building has separate route for entry and exit, also Tour Guides are available as assistance to help Tourist navigate their ways through the site. In addition, the usage of watch-tower or any other passive 24-hour surveillance was found minimum.

4.2.4 Case study four: Zeitz Museum of Contemporary Art, Cape Town, South Africa.

I. Background Study

The Zeitz Museum of Contemporary Art Africa (Zeitz MOCAA) was unveiled today ahead of its public opening on 22 September 2017 at Cape Town's V&A Waterfront. It will be the world's largest museum dedicated to contemporary art from Africa and its diaspora and is designed by internationally acclaimed designers Heather wick Studio, based in London (see figures 4.4 and plate 4.12 to 4.13).

Project Name: Zeitz Museum of Contemporary Art, Africa (MOCAA)

Location: Cape Town, South Africa.

Project Architect: Heather wick Studio

Client: V & A Waterfront

Project Type: Mixed-use Cultural, Hospitality, Entertainment

Building Size: 102,257sqm.

Completion Year: 2017

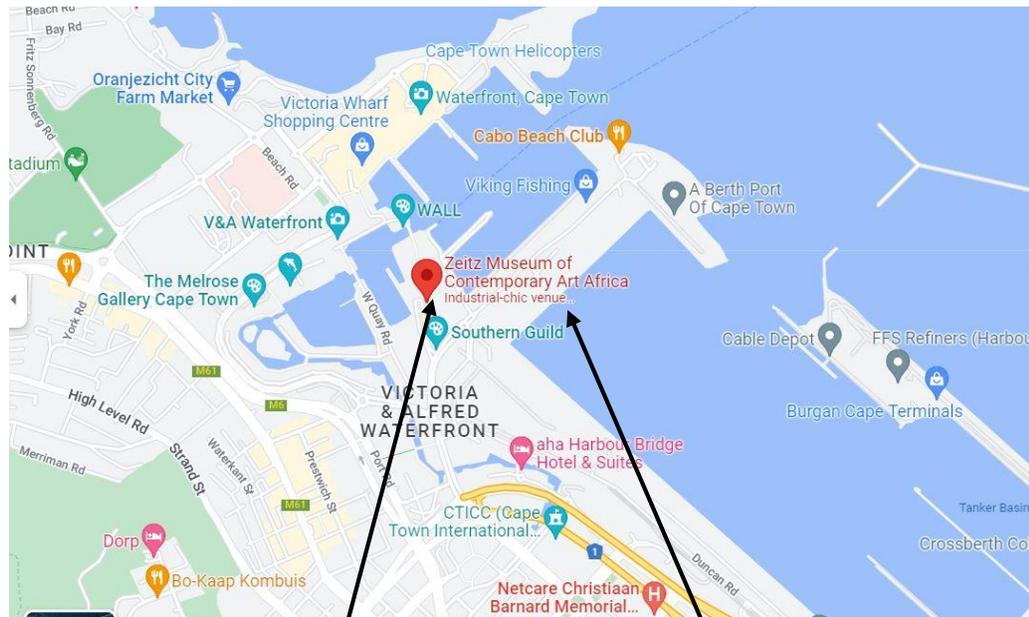


Figure 4.4: Zeitz Museum of Contemporary Art, Africa Location Map.
Source: Google Map (2022)



Plate 4.12: Perspective View of Zeitz Museum
Source: www.Archdaily.com (2022)



Plate 4.13: Approach View of Zeitz Museum
Source: www.Archdaily.com (2022)

The museum is housed in 9,500sq. metres of custom designed space, spread over nine floors, carved out of the monumental structure of the historic Grain Silo Complex. The silo, disused since 1990, stands as a monument to the industrial past of Cape Town, at one time the tallest building in South Africa, now given new life through the transformation by Heather wick Studio (see plates 4.14 to 4.26).



Plate 4.14: Street View of Zeitz Museum
Source: www.Archidaily.com (2022)

The galleries and the atrium space at the centre of the museum have been carved from the silos' dense cellular structure of forty-two tubes that pack the building. The development includes 6,000 sq metres of exhibition space in 80 gallery spaces, a rooftop sculpture garden, state of the art storage and conservation areas, a bookshop, a restaurant, bar, and reading rooms. The museum will also house Centres for a Costume Institute, Photography, Curatorial Excellence, the Moving Image, Performative Practice and Art Education



Plate 4.15: Atrium View of Zeitz Museum of Art.
Source: www.Archidaily.com (2022)



Plate 4.16: Showing Gallery in Zeitz Museum of Art.
Source: www.Archidaily.com (2022)

4.2.4.1 Findings at Zeitz Museum of Contemporary Art, Cape Town, South Africa.

Is a cultural institution in the heart of learning activities one of most visited cultural and historical hubs in Africa, set on the edge of a natural, historic working harbour, with the iconic Table Mountain as its backdrop, and sweeping views of the ocean, city bowl and mountain peaks, V&A Waterfront attracts up to 100,000 people a day.

Base on the study carried out, the following observation were made;

I. Zoning for Security and Nature of the Site Boundary

Zeitz Museum of Contemporary Art covers a total area of 9,500sqm, which consists of nine floors with 6,000sqm of dedicated exhibition space^s as well as a sculpture garden on the lower roof, restaurant, retail shop and coffee shops. Zoning laws have been barely considered at this center making every part of the center accessible and opened for any movements without proper restrictions. There exists no definite perimeter around the center.

II. Drop off Procedure

Zeitz Museum of Contemporary Art drop off procedure is simply poor owing to the fact of poor and very minute defined parking areas. A drop off procedure ensures or prevents encroachment of any sort without proper identification or protocol. It ensures that visits by tourists are fully coordinated and arranged, such that provisions and directions are made towards a general parking after which transportation throughout the site is done via shuttles or leg movement.

III. Landscaping for security

Application of both hard and soft landscape in the design for security is of utmost significance and importance. The hard landscape includes; floor coverings, sitting units, lighting elements, sign and information plates, bollard, water elements, shelter items (pergolas, shade, gazebo, and bus stop), and art objects (sculptures). The soft landscape involves the usage of all kinds of vegetation from flowers and trees to shrub and ground cover appropriately for achieving safety and security. Nevertheless, the facility was poorly landscape.

IV. Number of Entry Points to the Site, Availability of Tour Guide and Watch Tower

Zeitz Museum of Contemporary Art has no define exist and entry access. However, Tour Guides are available as assistance to help Tourist navigate their ways through the site. In addition, the usage of watch-tower or any other passive 24-hour surveillance was found absent.

4.2.5 Case Study Five: Parque Toreo, Naucalpan de Juarez, Mexico.

I. Background Study

Parque Toreo was designed as a mixed-use complex and as a prime example of this phenomenon of urbanization. The site is located in Naucalpan, State of Mexico, and the most developed suburban area with significant commerce to the north of Mexico City. It measures 51,753.60 sq meter and includes access to main roads such as: Periférico Norte, Av. Río San Joaquín and Av. Parque de Chapultepec. From the start, the master plan was conceived as “a great park,” an urban space that comprehensively unites different uses. This project contains a shopping mall, a hotel and three corporate

buildings, covering 440,580sqm of built area (see figures 4.5 to 4.6 and plates 4.17 to 4.19).

Project Name: Parque Toreo

Location: Perif. Blvd. manuel Avila Camacho 5, Residential Lomas de Sotelo,
Naucalpan de Juarez, Mexico

Project Architect: Sordo Madaleno

Client:

Project Type: Mixed-use Commercial

Building Size: 440,580sq. Meter.

Completion Year: 2014

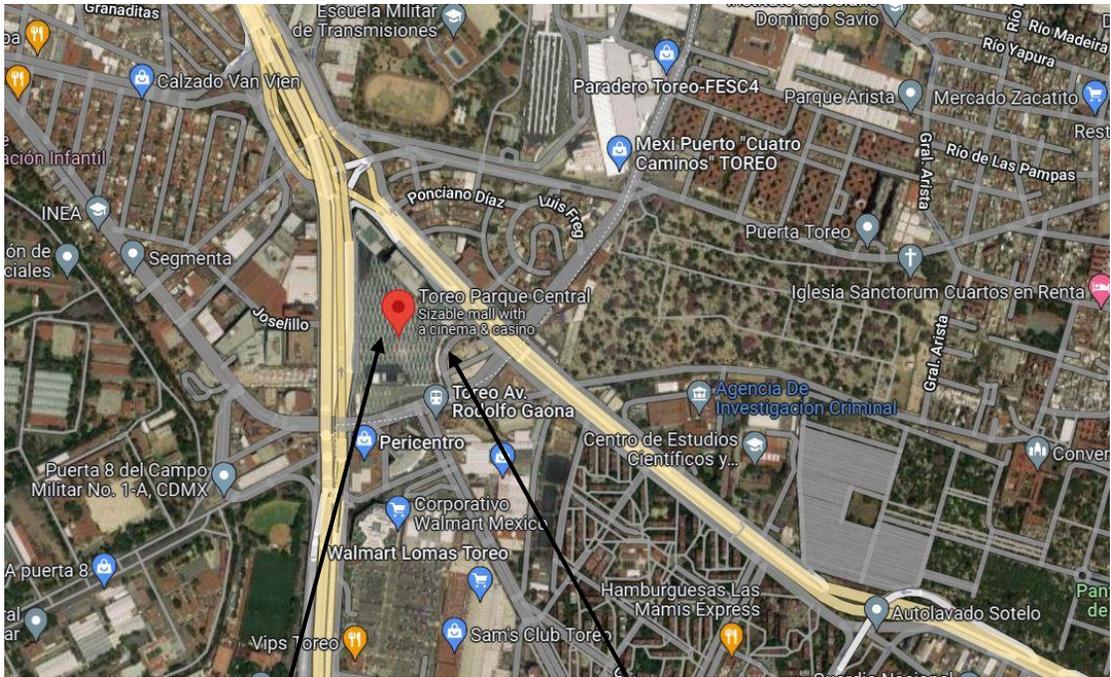


Figure 4.5: Parque Toreo Location Map
Source: Google Map (2022)



Plate 4.17: Street View of Parque Toreo
Source: www.Archidaily.com (2022)



Figure 4.6: Plan Layout of Parque Toreo
Source: www.Archidaily.com (2022)

From the start, the master plan was conceived as “a great park,” an urban space that comprehensively unites different uses. This project contains a shopping mall, a hotel and three corporate buildings, covering a total of 440,580 sqm of built area (see plate 4.18).



Plate 4.18: Showing Connection between facilities.
Source: www.Archidaily.com (2022)

In the shopping mall the user is at the center circulating among fountains, trees and open spaces, with the aim of enjoying a public space and providing a site for social encounter and interaction for the zone and the city as a whole. The rich vegetation with big trees over the shopping mall generates a balanced atmosphere with the retail spaces (see plate 4.19).



Plate 4.19: Showing Circulation Area.
Source: www.Archidaily.com (2022)

4.2.5.1 Findings at Parque Toreo, Naucalpan de Juarez, Mexico.

Parque Toreo project includes six floors of underground parking to meet the parking needs. The “transfer” area located between the floors occupied by the shopping mall and the ground floor of the offices serves as a distributor and filter for the good operation of the different uses. This area houses a business club with attractive spaces that generate new experiences such as exhibitions, cultural events, training halls, and an auditorium, among others.

Base on the study carried out, the following observation were made;

I. Zoning for Security and Nature of the Site Boundary

The effective use of zoning laws for security offers a first form of defence to the facility which makes zoning a number one criterion for the security of any property. Parque Toreo has been zoned with clear separation between attractive spaces and other facilities. The structure on the other hand has define entry and exist route, hence often no provision for barriers from each boundary.

II. Drop off Procedure

Parque Toreo often has a proper drop off procedure which ensures or prevents encroachment of any sort without proper identification or protocol. It ensures that visitors are fully coordinated and arranged, such that provisions and directions are made towards a general parking after which transportation throughout the site is done via shuttles. Nevertheless, the facility has a general parking serving as the first point for visitors and dwellers.

III. Landscaping for Security

As shown in figure 4.24, Parque Toreo incorporate a well-planned and maintained vegetation within the site perimeter. The presence of long trees on the other hand have not been planned and considered carefully as dense and broad-leaved trees are found around various facility causing a hindrance or blockage to clear sightlines and also serving as a harbor for potential threats. Though, clearly defined paths or walkways, pavements, sign, info plates, and bollard, have been incorporated in other to achieve safety and security.

IV. Number of Entry Points to the Site, Availability of Tour Guide and Watch Tower

Parque Toreo has no define exist and entry access to the site premises. However, Tour Guides are available as assistance to help visitors navigate their ways through the site. In addition, the usage of watch-tower or any other passive 24-hour surveillance was found absent.

4.2.6 Case study six: JR Towers, Nagoya, Central Japan.

I. Background Study

The JR Central Towers are in Nakamura-ku in the city of Nagoya, central Japan. It is located at Nagoya Station and serves as the headquarters of the Central Japan Railway Company. Built in 2000, it is the second-tallest building in Nagoya, and eighth-tallest overall in Japan as of 2015. It is the world's largest train station complex by floor area. The contrast between the towers and their shared base also reflects the desire to integrate the building into the urban context. The uninterrupted vertical expression of the towers combined with the siting of the complex forms a monumental gateway into the city (see plates 4.20 to 4.21).

Project Name: JR Towers

Location: 1 Chome-1-4 Meieki, Nakamura Ward, Nagoya, Aichi 450-0003, Japan

Project Architect: Sordo Madaleno Arquitectos

Client:

Project Type: Mixed-use Commercial

Building Size: 440,580sq. Meter.

Completion Year: 1999.

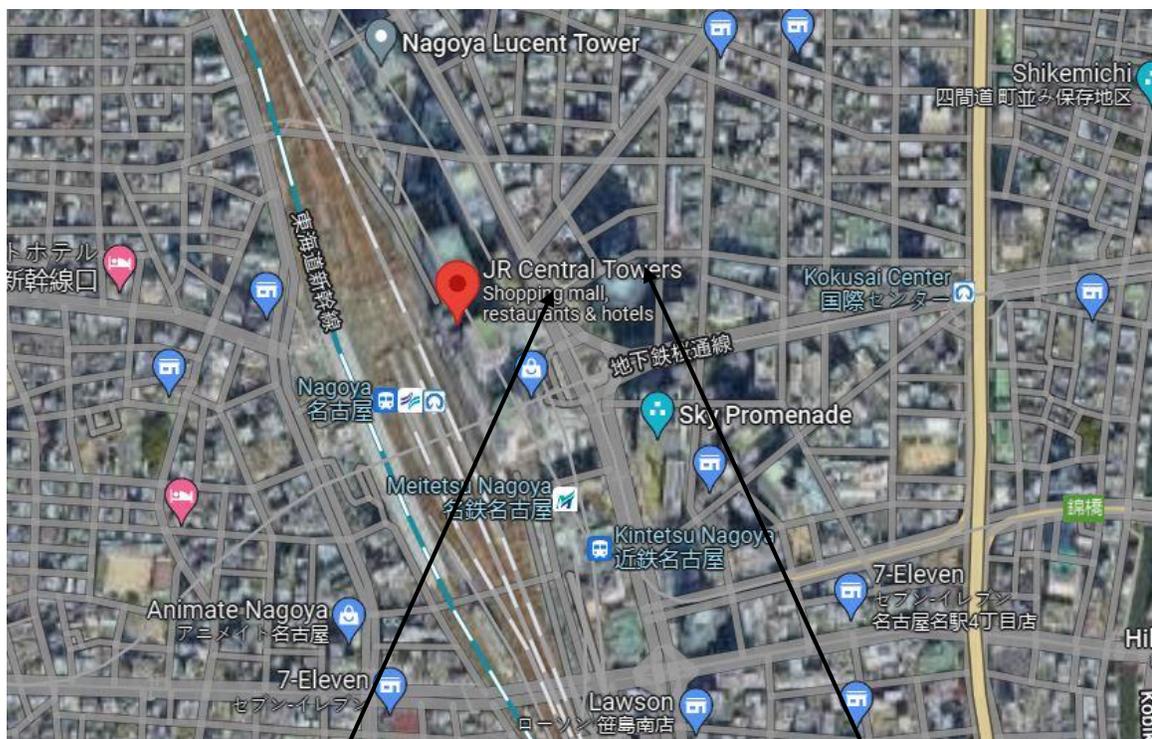


Figure 4.7: JR Towers, Nagoya, Central Japan Location Map.
Source: Google Map (2022)



Plate 4.20: Street View of JR Tower Nagoya
Source: www.Archidaily.com (2022).



Plate 4.21: Night Street View of JR Tower Nagoya
Source: www.Archidaily.com (2022)

What interests' people more is the “Nagoya Station bus terminal” on the 1st floor. It serves as a central information point for all the bus services in Nagoya. Here you can check the traveling information easily by using the touch panel LCD monitors (see plate 4.22).



Plate 4.22: Showing Nagoya Bus Terminal in JR Tower.
Source: www.Archidaily.com (2022)

The tower consist of 245 meters tall office tower and slightly shorter and slimmer hotel tower. The buildings lower floors are shared between the two towers and they house a large departmental store, shopping mall and Nagoya station. The hotel tower houses the hotel, lounge and restaurants while the office tower provides thirty (30) lettable office spaces. The

top floor of the office tower was converted to a panoramic saloon featuring wine lounge, beauty saloon and health spa (see plate 4.23).



Plate 4.23: Showing JR Tower Visitors Interaction.
Source: www.Archidaily.com (2022)

4.2.6.1 Findings at JR Towers, Nagoya, Central Japan.

JR Gate Tower is the northernmost building among the 3 high-rise towers above Nagoya Station. It is to the north of the JR Nagoya Station Sakuradori exit and has 44 floors. The shopping area is from underground to the 11th floor. The Takashimaya department store rises from underground to the 7th floor, the Sanseido bookshop is on the 8th floor, the Bic Camera shop takes up the 9th and 10th floors, and the UNIQLO and GU shops are located on the 11th floor. Elsewhere, the 12th and 13th floor comprise the “restaurant street” where you can try many delicious foods from Japan and other countries.

Base on the study carried out, the following observation were made;

I. Zoning for Security and Nature of the Site Boundary

The JR Tower in Nagoya city, central japan covers a total area of 440,580sq. meter. The effective use of zoning laws for security offers a first form of defence to the facility which makes zoning a number one criterion for the security of any property. The facility

has been zoned with clear separation spaces. The structure on the other hand has define entry and exist route, hence often no provision for barriers from each boundary.

II. Drop off Procedure

JR Towers often has a proper drop off procedure which ensures or prevents encroachment of any sort without proper identification or protocol. It ensures that visitors are fully coordinated and arranged, such that provisions and directions are made towards a general parking after which transportation throughout the site is done via shuttles. Nevertheless, the facility serves as a central information point for all the bus services in Nagoya, where you can check the traveling information easily by using the touch panel LCD monitors.

III. Landscaping for Security

Plate 4.24, shows a well-planned and maintained plantation within the site premises.

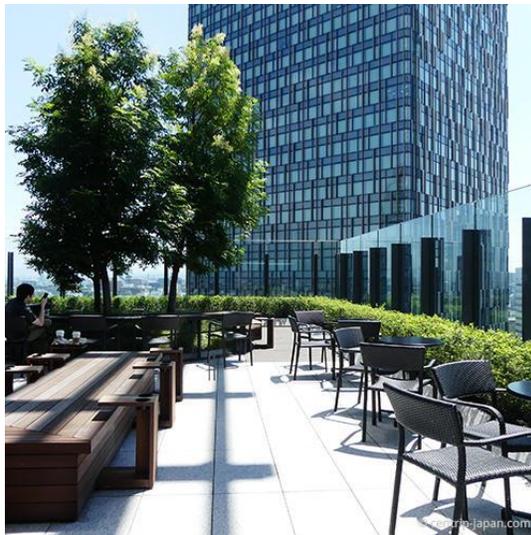


Plate 4.24: Shows un-planned and maintained vegetation.
Source: www.archidaily.com (2022)

The presence of long trees on the other hand have not been planned and considered carefully as dense and broad-leaved trees are found around various facility causing a hindrance or

blockage to clear sightlines and also serving as a harbour for potential threats. Though, clearly defined paths or walkways, pavements, sign, info plates, and bollard, have been incorporated in other to achieve safety and security.

IV. Number of Entry Points to the Site, Availability of Tour Guide and Watch Tower

JR Tower has a well-defined exist and entry access to the site premises. However, Tour Guides are available as assistance to help visitors navigate their ways through the site. In addition, the usage of watch-tower or any other passive 24-hour surveillance was found functional.

4.2.7 Summarized observation of variables across case studies

As previously outlined in chapter two part of these thesis white-up, the listed variables for the execution of safety and security in a particular environment are grouped in to Access Control and Detectors. The variable ‘Access Control’ highlighted on the passive means which are taking into consideration on the design. The variable comprises of Zoning for Security, the pattern of the Site Boundary, Drop-off Procedure, Soft landscaping for Security, Hard landscaping for Security, Number of entry point to the site, Availability of tour guide and Natural Surveillance.

4.3 Objective Three: To Identify Crime Prevention through Environmental Design Strategies Applicable to Mixed-used Building Design

In line with the above research objectives and the nature of the research data gotten from the study have been analysed using qualitative data analysis principles. The data gotten by the

researcher using the observation guide outlined was analysed using Microsoft excel software. Henceforth, the result was presented using plates and figures.

4.3.1 Assessment of passive security design measures

Table 4.1: Measurement Scale, Assessment Value and Scores

S/n	Assessment Value	Score
1	Very Good	5
2	Good	4
3	Acceptable	3
4	Poor	2
5	Very Poor	1

Table 4.1 above shows the measurement scale of the variables used to collect data for the research work. A 5-point Likert measurement was employed to rank qualitative and numerical data for ease of analysis.

i. Zoning for Security

The Zoning for security of any facility is done in order of privacy, from the parking to residential units. The effective use of zoning laws for security offers a first form of defense to the facility. Table 4.2 below shows that 71% zoning planning to a very consideration level as compared to the other variables.

Table 4.2. Zoning Design Consideration

Name	Indicators					Point
	Good Lighting	Cleared Sight Line	Surveillance Camera	Activity Support	Access Control	
World Trade Centre (Tower 1)	5	3	4	2	1	
Nestoil Tower	5	4	4	2	3	
Via Vallejo Cinapolis	5	2	4	1	4	
Zetz Museum of Contemporary Art	4	4	5	2	2	
Parque Torea	5	2	4	4	4	
JR Tower	5	4	5	4	5	

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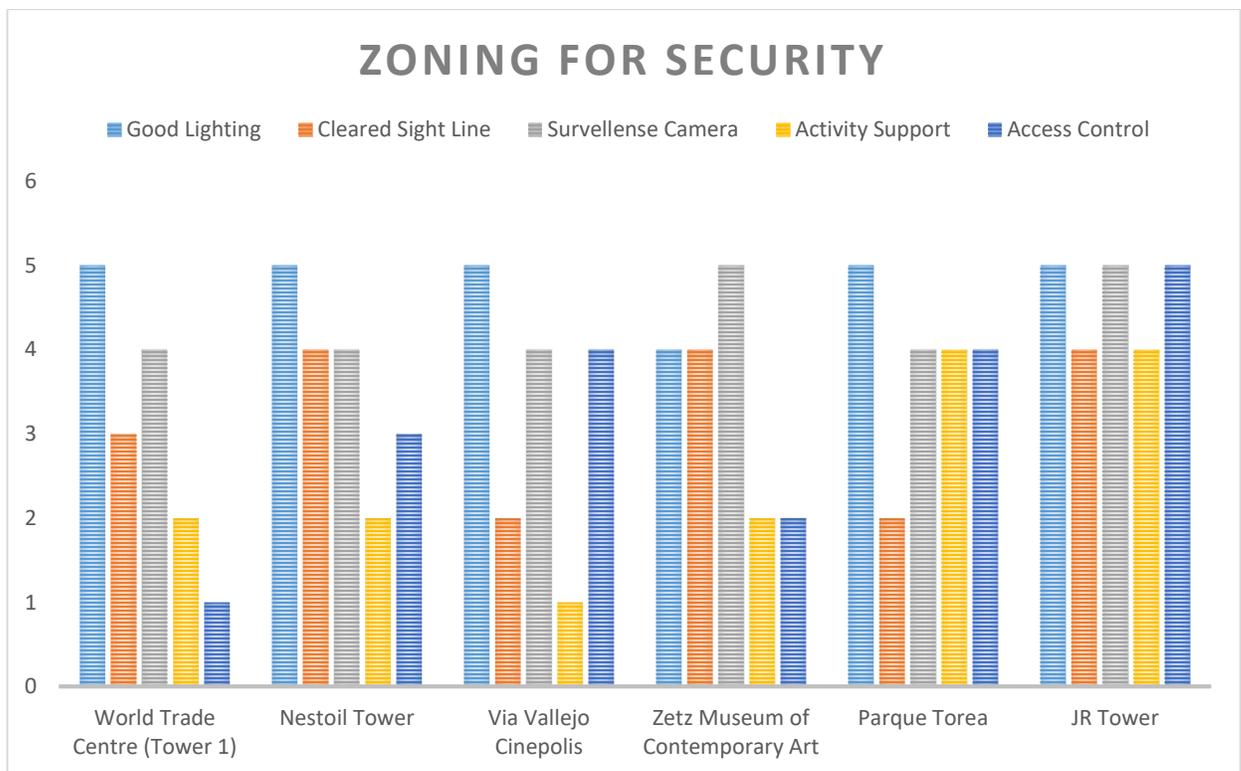


Figure 4.8: Zoning Planning within the Observed Mixed-use Facilities.

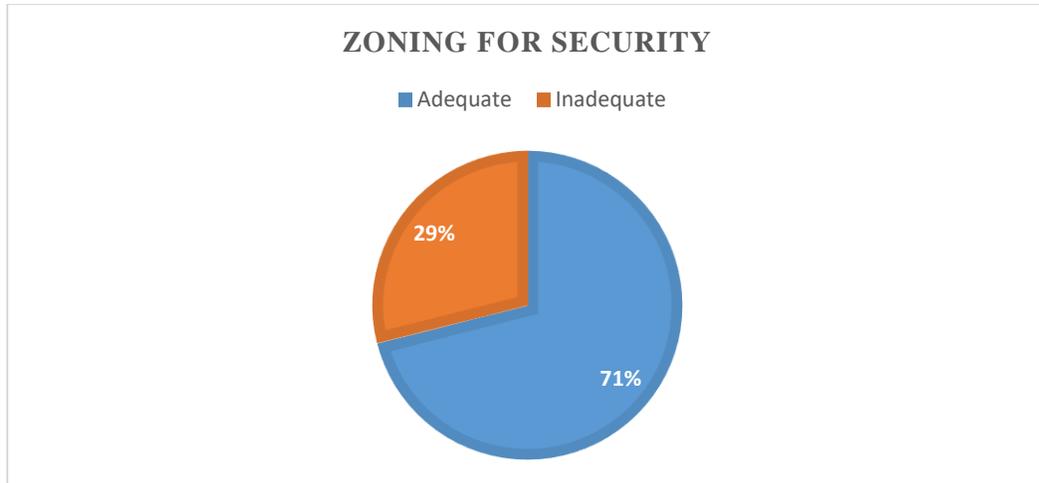


Figure 4.9: Zoning Planning within the Observed Mixed-use Facilities.

ii. Nature of Site Boundary

Provision of adequate perimeter demarcation goes a long way in illustrating the first line of defense, while still serving as a deterrent to passers-by. The Mixed-use buildings observed showed that four (4) had a site demarcation and five (2) had no site boundary, representing 30% as shown in Table 4.3 and Figure 4.10. The observation across the mixed-use buildings showed that the elements were implemented on a percentage level of 30 percent.

Table 4.3. Nature of Site Boundary

Name	Indicators		Points
	Perimeter Fencing	Reinforcement for Security	
World Trade Centre (Tower 1)	2	1	
Nestoil Tower	4	1	
Via Vallejo Cinopolis	4	1	
Zetz Museum of Contemporary Art	2	1	
Parque Toreo	3	1	
JR Tower	4	2	

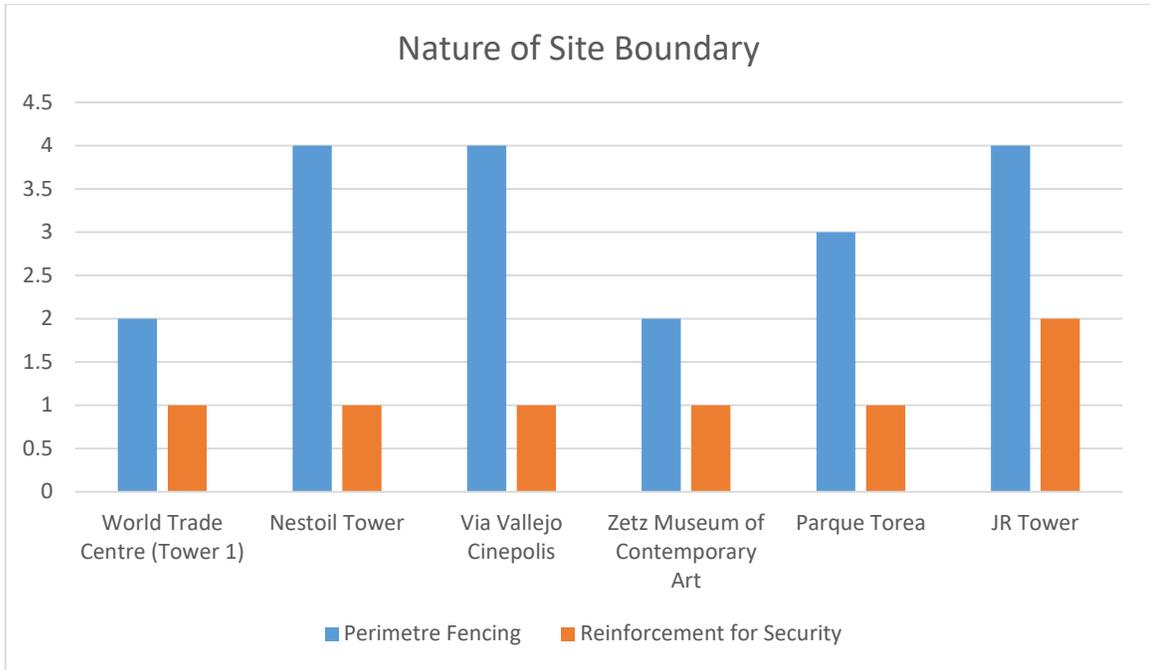


Figure 4.10: Nature of Site Boundary within the Observed Mixed-use Facilities.

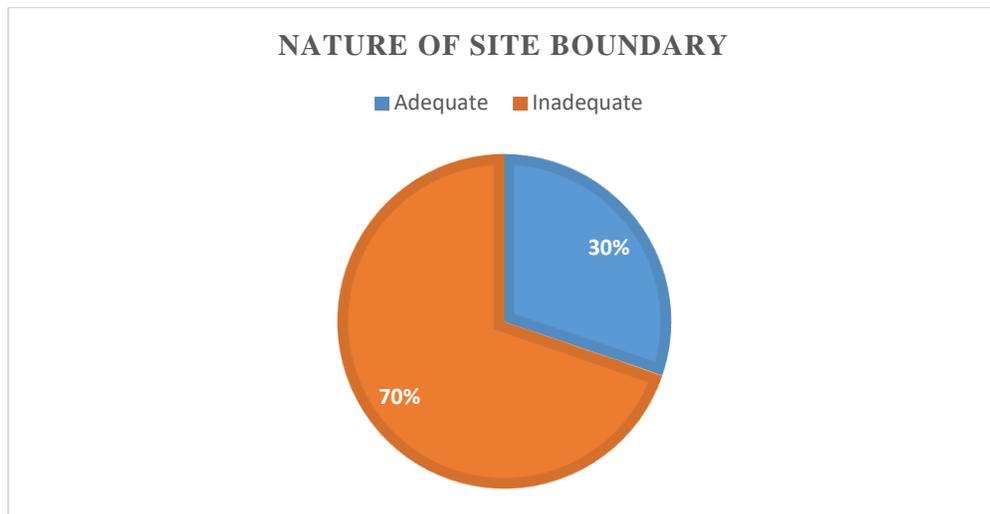


Figure 4.11: Nature of Site Boundary within the Observed Mixed-use Facilities.

iii. Drop off Procedure

A drop off procedure ensures or prevents encroachment of any sort without proper identification and protocol. Drop off procedure ensures that visitors upon visit to any developed attraction and being directed where to park and usually are been transported via shuttles which in turn generates fund for the facility. This is also a line of defense or a good security strategy that goes a long way to control accessibility and in turn ensures security. The mixed-use buildings observed in the case studies showed that four (3) had a planned parking procedure only one (1) had an unplanned parking procedure, while two (2) among the study area are marked satisfactorily as shown in Table 4.3 and Figure 4.12. The observation across the facilities showed that the elements were implemented on a percentage level of 72% percent.

Table 4.4. Drop off Procedure for Security

Name	Indicators		Points
	Adequate Drop off Procedure	Proper Parking Location	
World Trade Centre (Tower 1)	3	1	
Nestoil Tower	4	2	
Via Vallejo Cinopolis	4	1	
Zetz Museum of Contemporary Art	3	2	
Parque Toreo	4	3	
JR Tower	5	5	

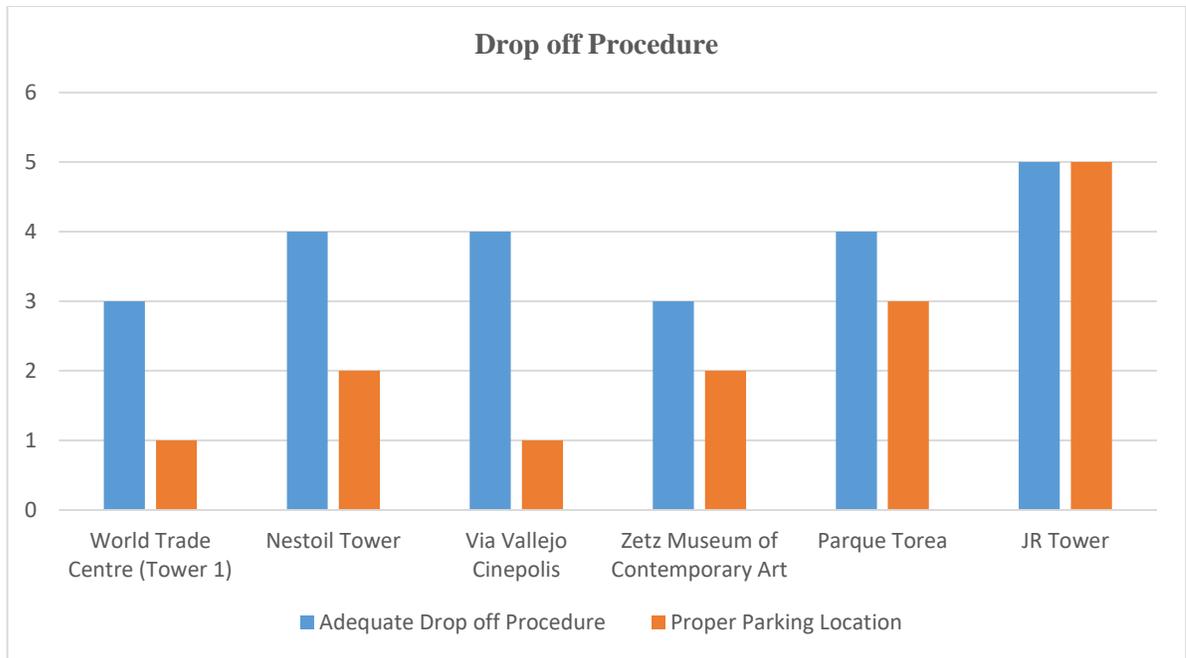


Figure 4.12: Drop off Procedure within the Observed Mixed-use Facilities.

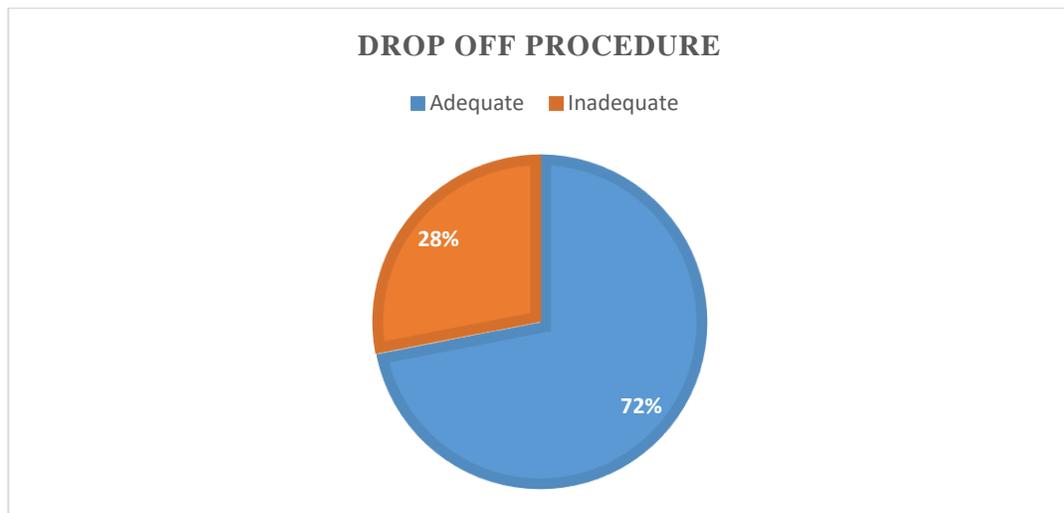


Figure 4.13: Drop off Procedure within the Observed Mixed-use Facilities.

iv. Landscape for Security

Application of both hard and soft landscape in the design for security is of utmost significance and importance. The hard landscape includes; floor coverings, sitting units, lighting elements, sign and information plates, bollard, water elements, shelter items (pergolas, shade, gazebo, and bus stop), and art objects (sculptures). The soft landscape involves the usage of all kinds of vegetation from flowers and trees to shrub and ground cover appropriately for achieving safety and security. The mixed-use observed in the case study showed the common form of hard landscaping employed for security and safety were commonly signs. Three (3) out of the observed centres had planned walkway for channeling movements and offering restrictions as shown in Table 4.5. The observation across the mixed-use buildings showed that the elements were implemented on a percentage level of 42% percent.

Table 4.5. Landscape for Security Design Consideration

Name	Indicators					Point
	Use of Raised Hedges as Bollards	Spiky and Thorny Shurbs Before cill of Windows	Avoidance of Heavy Dense Trees around Facilities	Usage of Conifers and Long Stem Tress around Facilities	Planned walkways and Pavements	Signs
World Trade Centre (Tower 1)	2	4	3	3	3	5
Nestoil Tower	4	3	5	4	3	4
Via Vallejo Cinapolis	5	4	4	2	4	5
Zetz Museum of Contemporary Art	4	5	2	3	3	4
Parque Toreo	3	3	1	4	4	5
JR Tower	5	4	3	5	4	4

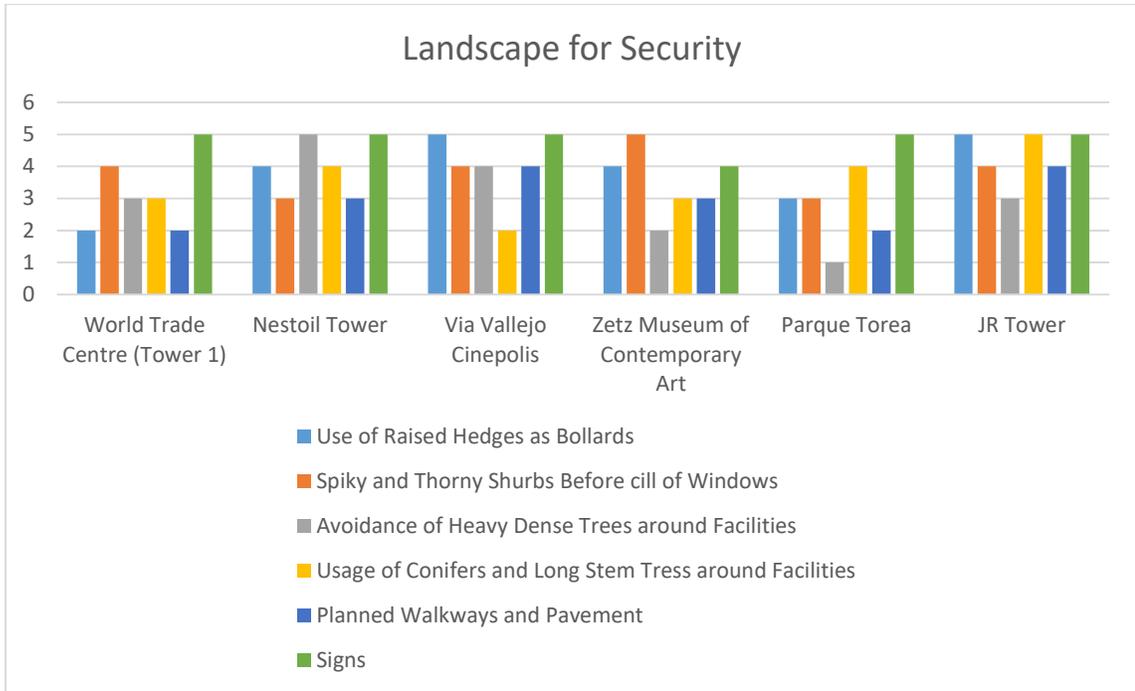


Figure 4.14: Landscape for Security within the Observed Mixed-use Facilities.

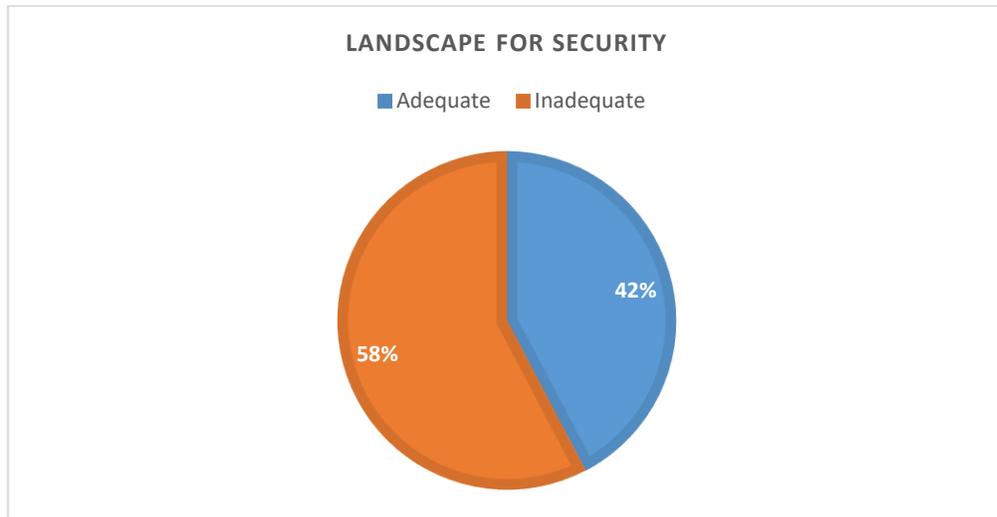


Figure 4.15: Landscape for Security within the Observed Mixed-use Facilities.

v. Availability of Watch Tower and Tour Guide

The usage of watch tower as outlined by CPTED is a good passive security measure that can be adopted for general overview in a large gathering or large space. The mixed-use buildings observed showed that the usage of watch towers was not considered in the design as shown in Table 4.6 and Figure 4.16 respectively. Hence, five (5) of the observed facility incorporate the application of Tour guide to some extent.

Table 4.6. Availability of Watch Tower and Tour Guide

Name	Indicators				Points
	Tour Guide		Watch Tower		
	Present	Absent	Present	Absent	
World Trade Centre (Tower 1)	✓			✓	
Nestoil Tower	✓			✓	
Via Vallejo Cinapolis		✓		✓	
Zetz Museum of Contemporary Art	✓			✓	
Parque Toreo	✓			✓	
JR Tower	✓			✓	
					41.6%

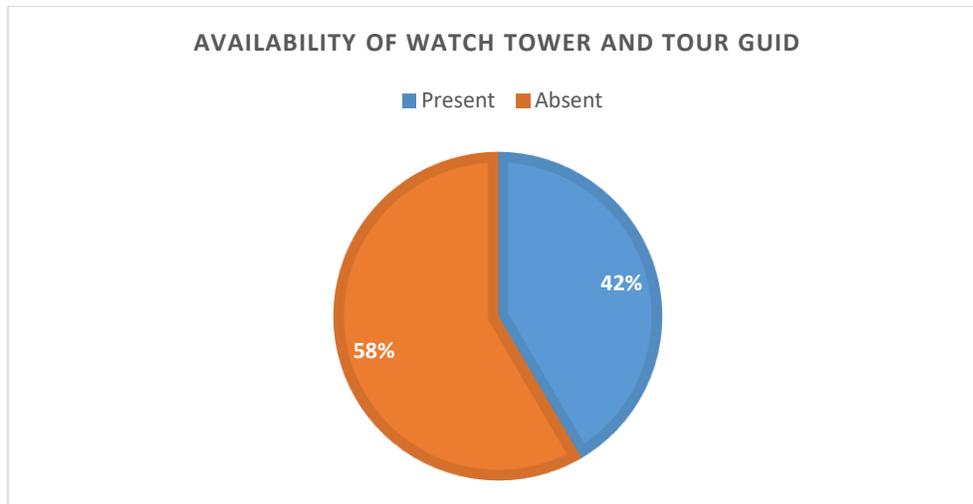


Figure 4.16: Availability of Watch Tower and Tour Guide within the Observed Mixed-use Facilities.

4.3.2 Deductions

The importance of security and safety in Mixed-use building cannot be over emphasized.

The concept of mixed use makes building design flexible and can be adapted for re-use as time changes.

- i. The findings showed that a planning for single route entry had the highest level of consideration.
- ii. The design consideration for the drop off procedure has been considered and planned to a considerable level of 72% percent.
- iii. Zoning for security showed an implementation of 71% percent across the case studies while natural surveillance for security through mediums like a watch tower was completely absent.
- iv. Also, the level of importance given to a definite site boundary and landscaping for security was really poor.

4.4 Objective Four: To Incorporate Crime Prevention through Environmental Design (CPTED) Strategies in Mixed use Development, Abuja.

4.5.1 The design brief

In recent years, sustainable development has gained favour in various disciplines, most especially in the field of urban design and planning. As part of this progress, researchers and designers' introduced the concept of Crime Prevention through Environmental Design (CPTED), hoping to minimise chances of crime and effectively provide solution to crime in mixed-use residential development and achieve sustainable development for cities. The design will focus upon the Consideration for security combining the structured and non-structured, formal and informal, the expected and unexpected, and physical with a vital, all within an uplifted environment characterized by Safety, comfort and natural lighting, that seeks to both enable and inspire users.

4.4.2 Site selection criteria

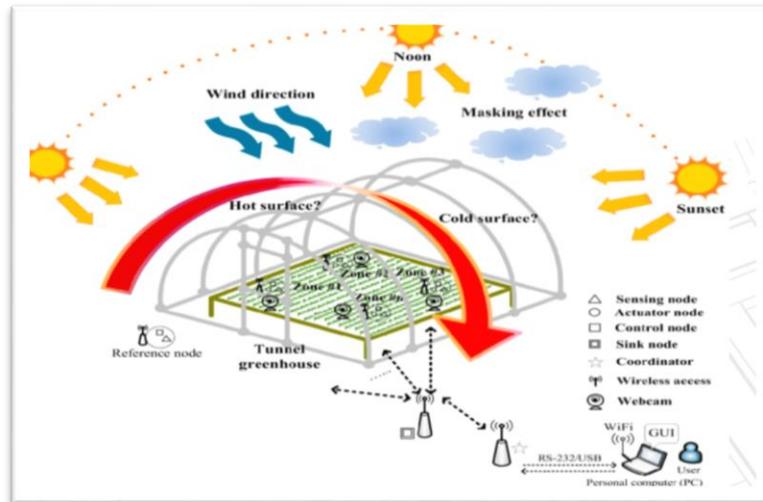
Site selection is the process of finding location that suite desired conditions set by the selection criteria. The following are the variables used in selecting the proposed site.

I. Accessibility:

The site selected should be located in a locality from which various activities of the site would be accessible by both foot and vehicle. The selected site is located at coordinates 9.049731N, 7.476963E. A notable building around the site is the world trade center and its residential high-rise apartments.

II. Environmental Condition:

The site should be available in a locality where natural beauty and man-made environment create healthy living and working condition (see figure 4.17).



NNNN

Figure 4.17: Climatic Element and Environment.

III. Government Laws:

A site which comes within the limits of an area where the by-laws of the local development authority enforced restriction regarding proportions of plots to be build up, setbacks and air spaces to be left in front and sides, height of buildings, should be preferred (see plate 4.25).



Plate 4.25: Local Development Authority Permit

IV. Nature of the Ground Soil:

The ground soil of the site should be good enough to carry the load of such structure type and maintain stable for a lifetime (see plate 4.26).



Plate 4.26: Ground Soil Type

V. Available Facilities:

The site should be in a locality where various standard facilities are available, which includes community services such as, police and fire protection, cleaning of waste and street cleaning, utility services such as water supply, gas, electricity and drainage system (see figure 4.18).

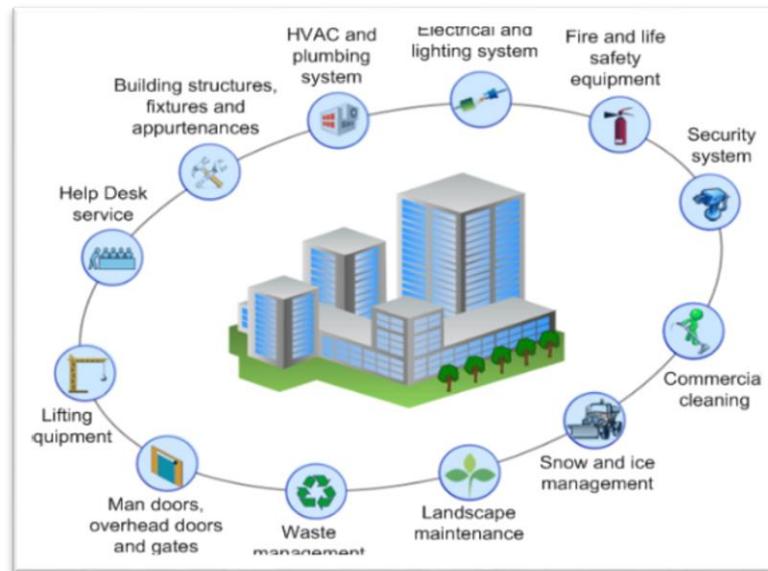


Figure 4.18: Standard Environmental Facilities

4.4.3 Site location

The site is situated on the latitude $9^{\circ}5'25.711$ and longitude $7^{\circ}28'43.7711$, in the Federal Capital Territory of Nigeria, Abuja. The site is located at Plot 1113, Constitution Avenue, central business district, adjoining Federal Ministry of Education Headquarter, Ministry of Foreign Affairs, Eagle Square and Head of Service FCT Abuja (see figure 4.19).

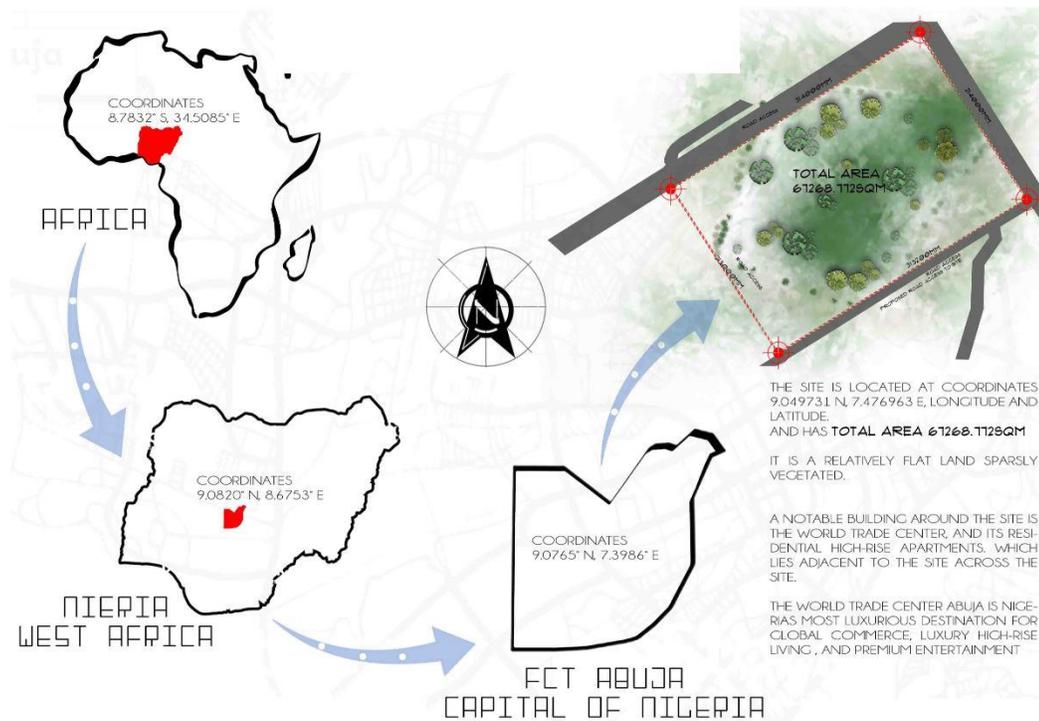


Figure 4.19: Site Location Layout

4.4.4 Site climatic condition

The Federal Capital Territory, Abuja witness a tropical climate. The summer period have much rainfall than the winter period. The city usually experiences an average temperature of 25.7°C annually. Precipitation usually falls in September, making December the driest month of every year with 1mm of rain, averaging 284mm, showing a difference of 283mm annually. The warmest month of the year is usually experience in April with a recorded temperature of 28.5°C, while the coldest temperature is usually recorded in August, averaging 23.9°C, often haven 4.6°C difference every year (see figure 4.20).

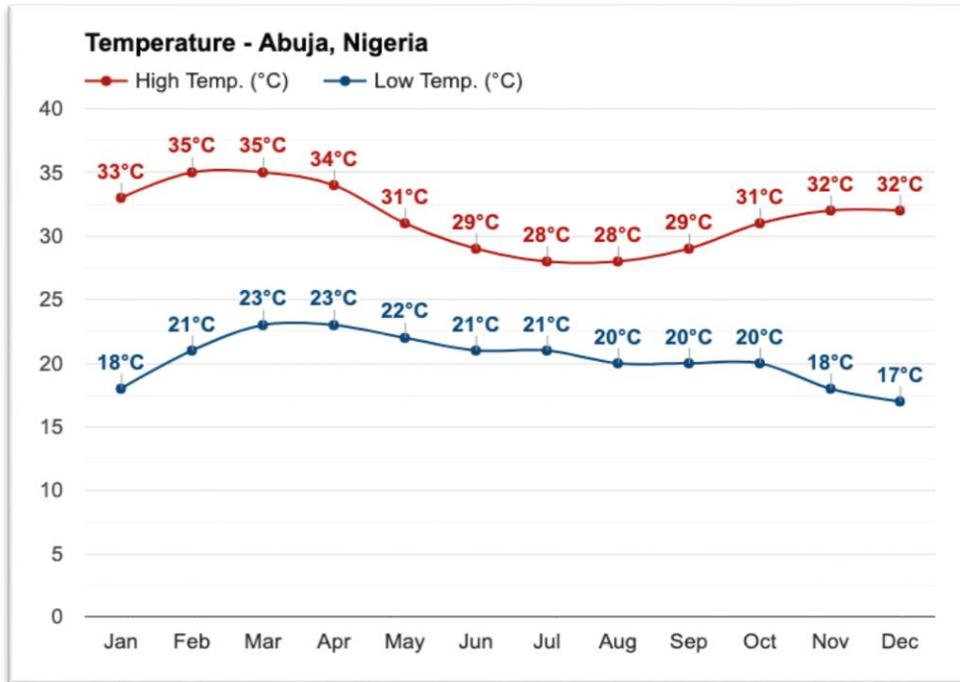


Figure 4.20: Detail Abuja Climate Graph
Source: Skyscanner.net (2022)

4.4.5 Site analysis

Every site irrespective of its terrain, shape, size and topography offers itself to be taken advantage of in the design process. Hence, the need for environmental and site analysis is necessary, as a principle of design apply to ensures that building is design as an integral part of the site regardless of its terrain and shape (see figure 4.21).

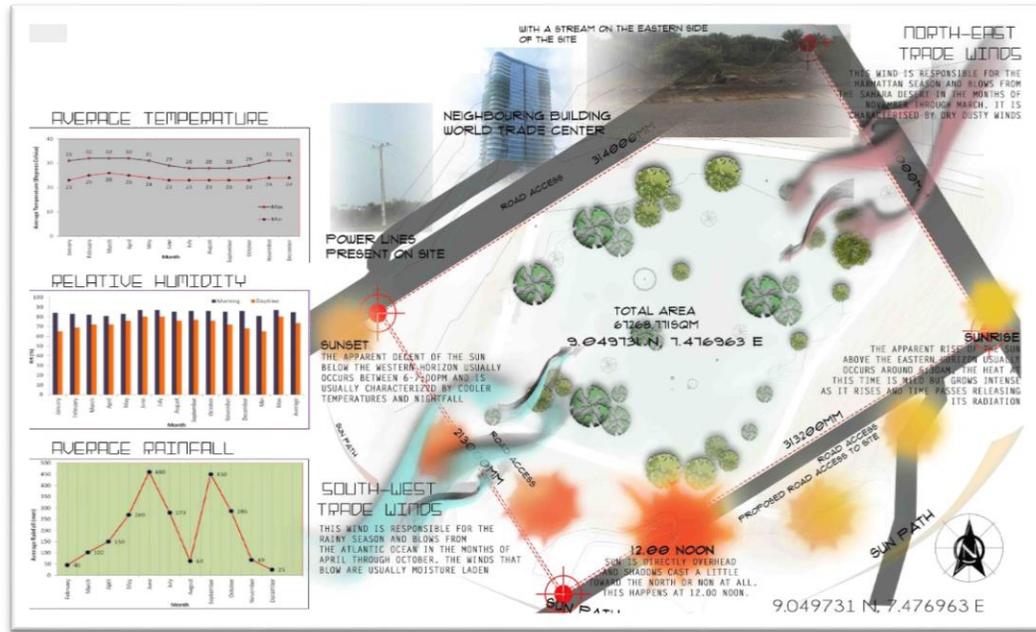


Figure 4.21: Site Analysis

4.4.6 Design concept

The concept implies the balance between Private and the Metropolitan “Public” life of an individual, and also the balance interior and exterior spaces. The public/private balance is achieved through the strong division between public and private spaces in the programmatic elements. The glass on all side of the rectangular shaped structure “brings in” the Exterior happening in to the interior (Natural Surveillance). With this iconic structure, the embedded exterior spaces will become visible from the interior.

The site location map on figure 4.19 above was use as a guide to design the site plan shown on figure 4.22. The site zoning was use in the determination of the position of the spaces shown in the site plan.

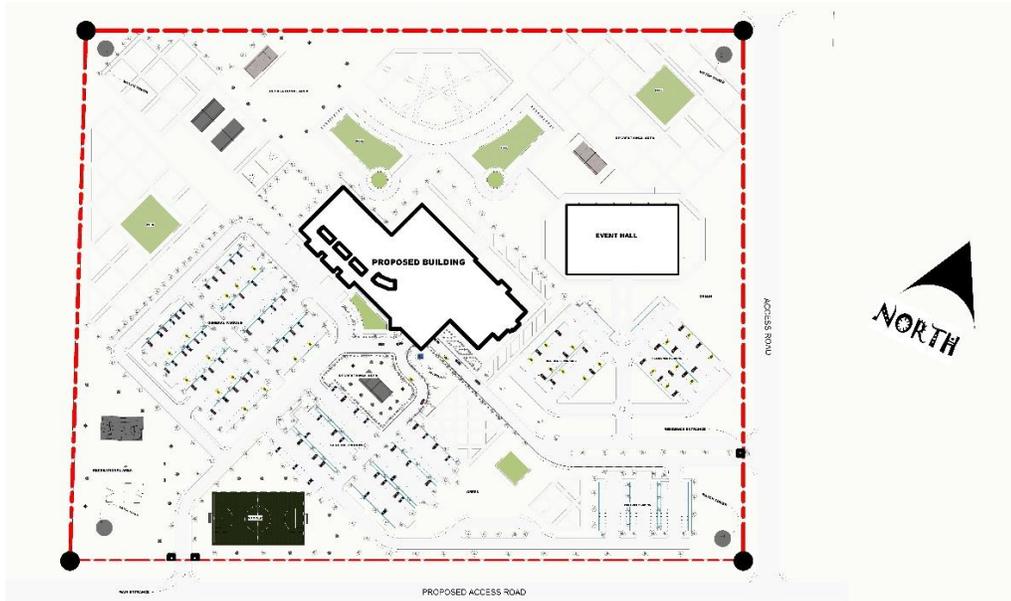


Figure 4.22: Proposed Design Site Plan

The plan was positioned on the site as illustrated on figure 4.46 above. Parts of the site were highlighted at the ground level of the design and blow-up of some sections to show more details view of the plans (see figures 4.21 to 4.25).

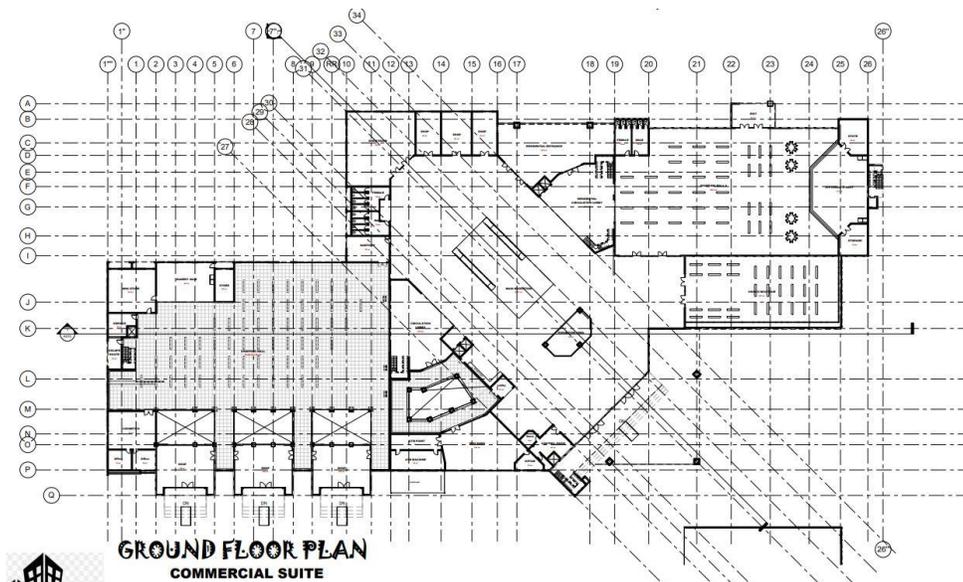


Figure 4.23: Proposed Ground Floor Plan

The facility was design to accommodate Commercial suite on ground and first floor, hotel accommodation on third floor, followed by office spaces on the fourth floor, with and outdoor gallery to create activity within as one of the major elements of natural surveillance.

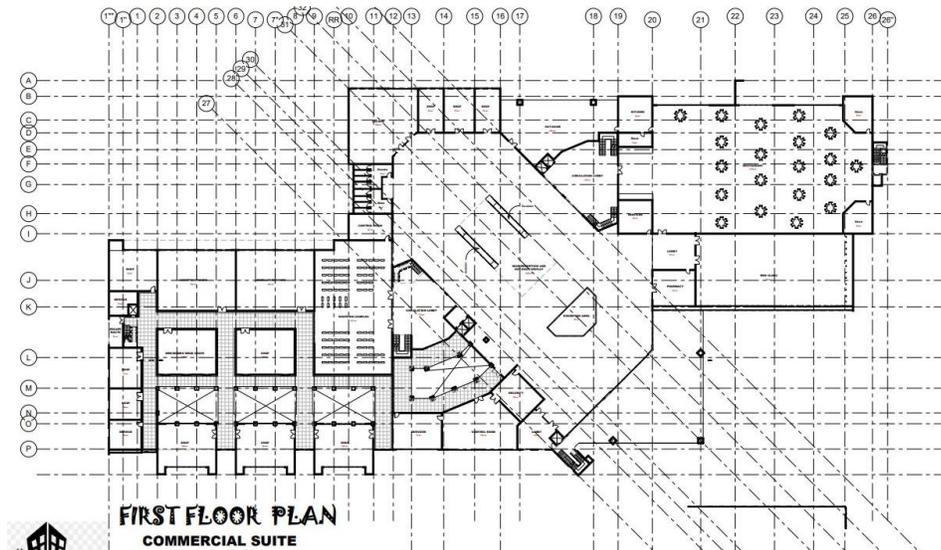


Figure 4.24: Proposed First Floor Plan
Source: Authors Work (2023)

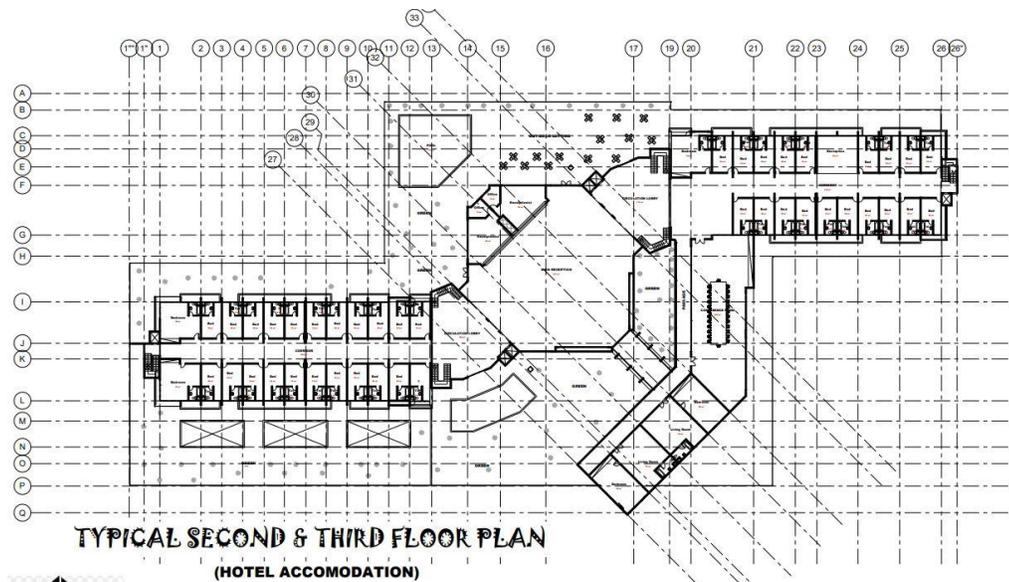


Figure 4.25: Proposed Second Floor Plan
Source: Authors Work (2023)



Plate 4.27: Proposed 3D View.
Source: Authors Work (2023)

4.4.7 Construction

The design employed the use of modern construction materials comprises of steel, coated glass panel, and undulating roof design.

The following construction method and materials are employed for the proposed project.

4.4.7.1 Structural system

For the purpose of this project, the design employs a steel portal frame structural system comprising column and horizontal or pitch rafters, connected by moment resisting connections. A very common structural system that provide a clear span un-obstructive by brazing. A Roof pitch of 12° would be adopted with frame spacing of 7.5m, and Haunches in the rafters at the eaves and apex (see figure 4.27).

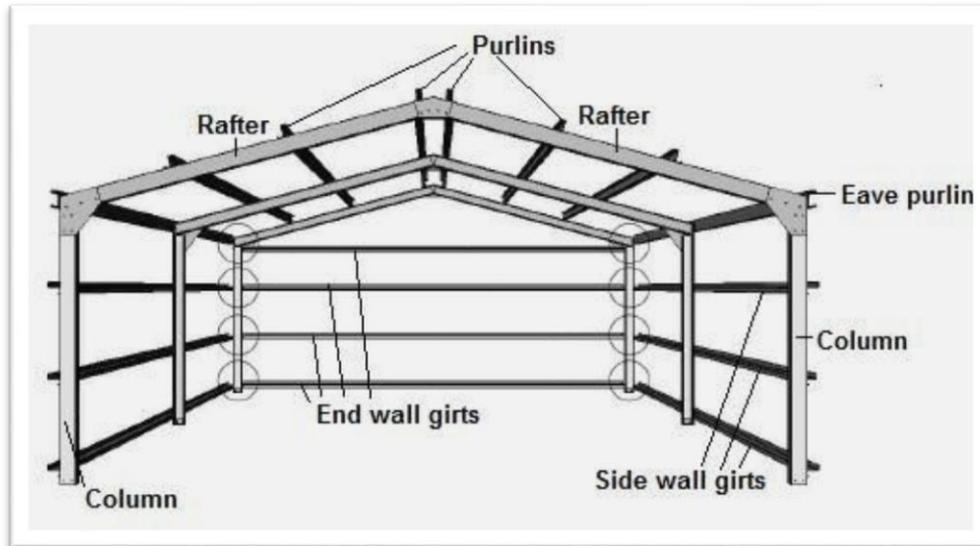


Figure 4.26: Typical Portal Frame Structure.
Source: Steelconstruction.info (2023)

4.4.7.2 Floors

For the purpose of this proposal, reinforced concrete cast in-situ floor slab 150mm thick, at 6:4:1 aggregate, water and cement mixing ratio, with reinforcement size subject to engineers' specification, finished with stone and ceramic base floor finishes such as marble and granite.

4.4.7.3 Walls

Composite materials comprise of Reinforced concrete and masonry, Composite wood (Plywood), Reinforced plastic (Fiber reinforced polymer and fiberglass), Ceramic matrix composite (Composite ceramic and metal matrices), Metal matrix composites and Plastic-coated paper were employed for both load and non-load bearing partition. These materials were made from two or more constituent materials with significantly different physical and chemical properties that when combined produced a material with characteristics different from the individual components.

The choice of these materials was due to their thermal and chemical resistance as well as electrical insulation properties. Unlike the conventional materials, while composite materials are lighter they can also be stronger than other materials. For instance, reinforced carbon fiber can be up to five times stronger than 1020 grade steel and only one-fifth of the weight, making it perfect for structural purposes (see figure 4.28).



Figure 4.27: Typical Composite Walling Materials.
Source: Compositebuild.com (2020)

4.4.7.4 Roof

For the purpose of this proposal, a composite roofing system with long span steel roof framing which provides the terminal with open spaces was employed. The roof was designed to accommodate both welded and bolted connections, with an exposed structural steel roof-framing member that creates a dynamic rhythm of light and shadow inspired by tree-lined streets. Provision of Architectural exposed structural steel (AESS) would enhance the unique Architectural expression of the structure and was used prominently throughout the waiting spaces to achieve the desired visual quality.

In the concourse, the tapered steel plate girders span over 18m and include complex double curvature geometry to sculpt a roof structure that corresponds to the surrounding environment (see plate 4.28).



Plate 4.28: Example of a Typical Composite Roofing System
Source: Compositebuild.com (2020)

4.5 Summary of Findings

As previously outlined in chapter two part of these thesis white-up, the listed variables for the execution of safety and security in a particular environment are grouped in to Access Control and Detectors. The variable ‘Access Control’ highlighted on the passive means which are taking into consideration on the design. The variable comprises of Zoning for Security, the pattern of the Site Boundary, Drop-off Procedure, Soft landscaping for Security, Hard landscaping for Security, Number of entry point to the site, Availability of tour guide and Natural Surveillance.

The importance of security and safety in Mixed-use building cannot be over emphasized. The concept of mixed use makes building design flexible and can be adapted for re-use as time changes.

- i. The findings showed that a planning for single route entry had the highest level of consideration.

- ii. The design consideration for the drop off procedure has been considered and planned to a considerable level of 72% percent.
- iii. Zoning for security showed an implementation of 71% percent across the case studies while natural surveillance for security through mediums like a watch tower was completely absent.
- iv. Also, the level of importance given to a definite site boundary and landscaping for security was really poor.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The increasing issues of terrorism, violent crimes, robbery, kidnapping in the country is becoming alarming and disturbing as it continues to rise, going a long way to affect even the patronage of both domestic and international visitors to mixed-use facility. During the cause of this research the researcher discovered that the major issues of security can be tackled through zoning for security, definite site boundary, a proper drop off procedure, landscaping for security, a single-entry point, and presence of a natural surveillance system. The findings showed that most mixed-used buildings in Nigeria have not been fully designed with consideration on security and safety. A definite site boundary, landscaping for security and the presence of watch towers for natural surveillance were poorly considered in the development of these centers.

There is clear proof that well planned crime prevention strategies forestall crime and exploitation, as well as advance network security and add to the practical improvement of a nation. Conventional law would be at its best in crime prevention if architectural considerations for building safety and security ought to be incorporated into law rather than to be left as a segregated train.

5.2 Recommendations

In line with the findings of this study, the following recommendations were made as measures to improve the security of properties and safety of lives of people particularly in Nigeria.

- a. Professionals in the built industry should take a keen look at designing with respect to security for mixed-use development.
- b. Defining the property line of a mixed-use facility should be placed in high consideration.
- c. There is also a need to provide clear signage indicating exit routes, footpath treatment, safe road crossings, assembly points and location of fire safety equipment. This signage should be made of materials which glows even in the dark.
- d. Design of watch towers for natural surveillance should be incorporated even in existing mixed-use buildings.
- e. Regulators ought to include architects and other building professionals through integration of CPTED principles and techniques at the early stage of design concept.

5.3 Contribution to Knowledge

This study lays down a guide to assist designers to explore and evaluate safety design consideration for crime prevention through environmental design as a tool to enhance safety and security of mixed-use building in Abuja, the capital city of Nigeria. The resulting CPTED-based framework offers tailored architectural strategies to counteract the escalating security challenges prevalent in these buildings. Vital variables such as Zoning for Security, Site Boundary Patterns, and Natural Surveillance were examined extensively, underlining their pivotal roles. Notably, findings showcased that Zoning for Security registered a commendable implementation rate of 71%, demonstrating the practical integration of this vital security aspect. However, the study's results also brought to light a disconcerting disconnect between theoretical security concepts and their real-world application, emphasizing a compelling need for transformative action.

The outcomes of this research shed light on the pressing imperative to address prevailing security challenges within the context of mixed-use buildings in Abuja. A singularly significant revelation is that a planning approach prioritizing a single-route entry boasts the highest consideration, reflecting a practical implementation rate of 72%. This underscores the practical relevance of this strategy in enhancing security. Moreover, the design considerations surrounding the drop-off procedure garnered a notable level of attention, with a commendable planning rate of 72%. In contrast, the incorporation of natural surveillance mechanisms, notably watch towers, was conspicuously absent, pointing to a considerable scope for improvement in this area. Similarly, the study exposed a deficiency in prioritizing definitive site boundaries and landscaping for security, with a notable lack of emphasis evident in these aspects. These revelations highlight a vital discrepancy between theoretical security ideals and their tangible realization, serving as a clarion call for proactive changes.

In light of these insights, a series of actionable recommendations emerges to fortify security measures in the Nigerian context. First and foremost, industry practitioners are urged to accord security paramount importance in the design phase of mixed-use developments, integrating CPTED principles cohesively. The necessity to distinctly demarcate property boundaries also arises, to deter unauthorized access effectively. Furthermore, the implementation of clear and illuminated signage indicating exit routes, road crossings, assembly points, and fire safety equipment locations is recommended. However, it is essential to bridge the gap by introducing design elements such as watch towers to promote natural surveillance, both in new structures and retrofitting existing mixed-use buildings. Regulatory bodies are urged to collaborate closely with architects and other building

professionals during the early stages of conceptualization, guaranteeing the seamless application of CPTED principles.

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APPENDICES

APPENDIX 1: Observation Schedule

EVALUATION OF SAFETY DESIGN CONSIDERATION FOR CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN OF MIXED-USE BUILDING, ABUJA.

This is an observation schedule which was carried out for the effective assessment of Safety Design Consideration for Crime Prevention through Environmental Design of Mixed-use Building, Abuja.

Observer: Researcher

Location: Abuja, Nigeria.

Variable One: Zoning for Security

i. Quite/Private Spaces

Good Lighting..... Cleared Sight Line.....

Surveillance Camera.....

ii. Noisy/Public Spaces

Activity support..... Access Control.....

Variable Two: Nature of Site Boundary

i. Boundary Material

Sandcrete Block Fence..... Metallic Rails.....

Wooden Fence..... Others.....

ii. Reinforcement for Security

Variable Three: Drop off Procedure

- i. Adequate Drop off Procedure.....
- ii. Parking Location in relation to the Facility.....

Variable Four: Landscaping for Security

i. Hard Landscape for Security

- Type of hard landscape measures.

Floor Covering..... Sitting Units.....

Lighting Element..... Signs.....

Information Plates..... bollard.....

Water Elements.....

ii. Soft Landscape for Security

- Type of soft landscape element

Flowers..... Tress..... Shrubs.....

Ground Cover.....Proportion of the Landscape elements.....

Variable Five: Nature of the Entry/Exit points

i. Number of Entry/Exist Point

Single entry..... Double Entry..... Multiple Entry.....

ii. Defined Entry/Exist Point

Variable Six: Availability of Tour Guide and Watch Tower

- i. Availability of Tour guide.....
- ii. Availability of Watch tower.....

Observer: Researcher

Location: Lagos, Nigeria.

Variable One: Zoning for Security

- i. Quite/Private Spaces

Good Lighting..... Cleared Sight Line.....

Surveillance Camera.....

- ii. Noisy/Public Spaces

Activity support..... Access Control.....

Variable Two: Nature of Site Boundary

- i. Boundary Material

Sandcrete Block Fence..... Metallic Rails.....

Wooden Fence..... Others.....

- ii. Reinforcement for Security

Variable Three: Drop off Procedure

- i. Adequate Drop off Procedure.....

ii. Parking Location in relation to the Facility.....

Variable Four: Landscaping for Security

i. Hard Landscape for Security

- Type of hard landscape measures.

Floor Covering..... Sitting Units.....

Lighting Element..... Signs.....

Information Plates..... bollard.....

Water Elements.....

ii. Soft Landscape for Security

- Type of soft landscape element

Flowers..... Tress..... Shrubs.....

Ground Cover..... Proportion of the Landscape elements.....

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Single entry..... Double Entry..... Multiple Entry.....

ii. Defined Entry/Exist Point

Variable Six: Availability of Tour Guide and Watch Tower

- i. Availability of Tour guide.....
- ii. Availability of Watch tower.....

Observer: Researcher

Location: Mexico City, Mexico.

Variable One: Zoning for Security

- i. Quite/Private Spaces

Good Lighting..... Cleared Sight Line.....

Surveillance Camera.....

- ii. Noisy/Public Spaces

Activity support..... Access Control.....

Variable Two: Nature of Site Boundary

- i. Boundary Material

Sandcrete Block Fence..... Metallic Rails.....

Wooden Fence..... Others.....

- ii. Reinforcement for Security

Variable Three: Drop off Procedure

- i. Adequate Drop off Procedure.....

ii. Parking Location in relation to the Facility.....

Variable Four: Landscaping for Security

i. Hard Landscape for Security

- Type of hard landscape measures.

Floor Covering..... Sitting Units.....

Lighting Element..... Signs.....

Information Plates..... bollard.....

Water Elements.....

ii. Soft Landscape for Security

- Type of soft landscape element

Flowers..... Tress..... Shrubs.....

Ground Cover.....Proportion of the Landscape elements.....

Variable Five: Nature of the Entry/Exit points

i. Number of Entry/Exist Point

Single entry..... Double Entry..... Multiple Entry.....

ii. Defined Entry/Exist Point

Variable Six: Availability of Tour Guide and Watch Tower

- i. Availability of Tour guide.....
- ii. Availability of Watch tower.....

Observer: Researcher

Location: Cape Town, South Africa.

Variable One: Zoning for Security

- i. Quite/Private Spaces

Good Lighting..... Cleared Sight Line.....

Surveillance Camera.....

- ii. Noisy/Public Spaces

Activity support..... Access Control.....

Variable Two: Nature of Site Boundary

- i. Boundary Material

Sandcrete Block Fence..... Metallic Rails.....

Wooden Fence..... Others.....

- ii. Reinforcement for Security

Variable Three: Drop off Procedure

- i. Adequate Drop off Procedure.....

ii. Parking Location in relation to the Facility.....

Variable Four: Landscaping for Security

i. Hard Landscape for Security

- Type of hard landscape measures.

Floor Covering..... Sitting Units.....

Lighting Element..... Signs.....

Information Plates..... bollard.....

Water Elements.....

ii. Soft Landscape for Security

- Type of soft landscape element

Flowers..... Tress..... Shrubs.....

Ground Cover.....Proportion of the Landscape elements.....

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Single entry..... Double Entry..... Multiple Entry.....

ii. Defined Entry/Exist Point

Variable Six: Availability of Tour Guide and Watch Tower

- i. Availability of Tour guide.....
- ii. Availability of Watch tower.....

Observer: Researcher

Location: Juarez, Mexico.

Variable One: Zoning for Security

- i. Quite/Private Spaces

Good Lighting..... Cleared Sight Line.....

Surveillance Camera.....

- ii. Noisy/Public Spaces

Activity support..... Access Control.....

Variable Two: Nature of Site Boundary

- i. Boundary Material

Sandcrete Block Fence..... Metallic Rails.....

Wooden Fence..... Others.....

- ii. Reinforcement for Security

Variable Three: Drop off Procedure

- i. Adequate Drop off Procedure.....

ii. Parking Location in relation to the Facility.....

Variable Four: Landscaping for Security

i. Hard Landscape for Security

- Type of hard landscape measures.

Floor Covering..... Sitting Units.....

Lighting Element..... Signs.....

Information Plates..... bollard.....

Water Elements.....

ii. Soft Landscape for Security

- Type of soft landscape element

Flowers..... Tress..... Shrubs.....

Ground Cover..... Proportion of the Landscape elements.....

Variable Five: Nature of the Entry/Exit points

i. Number of Entry/Exist Point

Single entry..... Double Entry..... Multiple Entry.....

ii. Defined Entry/Exist Point

Variable Six: Availability of Tour Guide and Watch Tower

- i. Availability of Tour guide.....
- ii. Availability of Watch tower.....

Observer: Researcher

Location: Nagoya, Central Japan.

Variable One: Zoning for Security

- i. Quite/Private Spaces

Good Lighting..... Cleared Sight Line.....

Surveillance Camera.....

- ii. Noisy/Public Spaces

Activity support..... Access Control.....

Variable Two: Nature of Site Boundary

- i. Boundary Material

Sandcrete Block Fence..... Metallic Rails.....

Wooden Fence..... Others.....

- ii. Reinforcement for Security

Variable Three: Drop off Procedure

- i. Adequate Drop off Procedure.....

ii. Parking Location in relation to the Facility.....

Variable Four: Landscaping for Security

i. Hard Landscape for Security

- Type of hard landscape measures.

Floor Covering..... Sitting Units.....

Lighting Element..... Signs.....

Information Plates..... bollard.....

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