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MULTI-STOREY CAR PARK COMPLEX,

MARINA, LAGOS

AN M.Sc (ARCHITECTURE) THESIS REPORT

BY

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MULTI-STOREY CAR PARK COMPLEX,

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CERTIFICATION

A project research report presented, in partial requirements for the award of Master of Science (M.sc) degree in architecture.

This project report is original and has not been submitted in part or full for any other diploma or degree of this or any university.

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DEDICATION

To the Almighty God for his Grace, Mercy and wisdom.
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All over the world, architectural education requires intelligence, emotional stability and financial resources.

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ABSTRACT

Transportation systems and the routes they use have greatly influenced both how and where people live. Reliable transportation allows a population to expand throughout a country’s territory and to live comfortably in remote areas far from factories and farms.

Transport in one form or another is a basic and essential part of the daily rhythm of life. At different stages of development, however, and in different sets of circumstances, the nature of the demand for transport is likely to vary a great deal. With the increase in population and economic activities in Nigerian cities, the number of motor vehicles is growing at a faster rate than the proportion of urban space devoted to roads.

In urban areas particularly, but also in suburban areas, the growing commercialization of available land has produced rapid and large increase in land values, to the extent that the use of large areas of land for parking automobiles and other vehicles is uneconomical. Unfortunately, the very commercialization which enhances the land values creates an increased demand for vehicle parking space. It is obvious therefore, that optimum economic use of the land can only be achieved through the use of multi-storey car parking garages.
A multi-storey car park or a parking garage is a building (or part thereof) which is designed specifically to be for automobile parking and where there are a number of floors or levels on which parking takes place. It is essentially a stacked car park.

The peculiarity of Lagos in terms of shortage of land for expansion purposes cannot be overlooked, hence the congestion in terms of housing, shops and markets, traffic and other land uses competing for limited land space. The dominance of Ikoyi, Lagos and Victoria Islands as the major residential areas of the elites and the dominant commercial, business administrative Industrial areas is responsible for the unidirectional movement of vehicles to and from work daily resulting in unprecedented traffic congestion. Lagos as a commercial centre will continue to play a very unique role in the development of Nigeria. Its problems are the creation of all the states of Nigeria, and as such every sector has a role to play in finding solutions to them. For example, some towns in Ogun State particularly Ota, Ifo and Agbara and some others have merged with Lagos City forming an expansive conurbation thereby complicating the planning and management problems. As most people perceive Lagos as a land of opportunities, job seekers from every state of the Federation migrate into Lagos every day thereby complicating the housing, traffic and infrastructural problems.
TABLE OF CONTENTS

Title Page.................................................................i
Certification...........................................................ii
Dedication..............................................................iii
Acknowledgement......................................................iv
Abstract.......................................................................vi
Table of Contents.....................................................viii
List of Tables...........................................................xiii
List of Figures...........................................................xiv
List of Plates............................................................xviii

CHAPTER ONE: INTRODUCTION

1.0 Introduction.........................................................1
1.1 Project Definition..................................................2
CHAPTER TWO: HISTORICAL BACKGROUND

2.1 History of Automobile..............................................11

2.2 History of Car Parks..................................................13

2.2.1 Before World War II..............................................14

2.2.1.1 The Mechanical Garage.................................18

2.2.2 After World War II..............................................21
2.2.2.1 The Multi-Storey Car Park………………………………..22

2.2.3 Proliferation of Automobile Use in Nigeria………………25

2.2.3.1 Pre-Colonial Nigeria……………………………………25

2.2.3.2 Post Colonial Nigeria……………………………………25

CHAPTER THREE: CASE STUDIES

3.0 Local case study I………………………………………………28

3.1 Murtala Mohammed Domestic Airport Multi-Storey Car Park………………………………………………………………28

3.2 Mega Plaza Multi Storey Car Park; Victoria Island, Lagos………38

3.3 Trinity Center Multi-Storey Car Park; Gatestead, North-East England……………………………………………………………44

3.4 Buttercrane Centre Multi-Storey Car Park, Newry…………….50

CHAPTER FOUR: DESIGN PRINCIPLES AND PLANNING CONSIDERATION

4.1 Design Principles and Planning Consideration………………….60
CHAPTER FIVE: THE SITE
CHAPTER SIX: GENERAL DESIGN CONSIDERATION

6.0 General Design Consideration.................................106

6.1 Choice of Site Location...........................................106

6.2 Design Requirements.............................................107

6.3 Consideration before the construction of multi-storey

car parks.................................................................114

6.4 Design Brief.........................................................118

6.5 Equipment and Operational Requirements...............129

6.6 Planning Regulations.............................................132
CHAPTER SEVEN: DESIGN APPROACH

7.0 Design Approach ..................................................133

7.1 Site Space Usage .................................................133

7.2 Zoning .............................................................135

7.3 Spatial Relationship .............................................137

7.4 Design Philosophy ..............................................138

7.5 Design Concept ..................................................139

7.6 Prevalent Architectural Style .................................141

7.7 Structure and Grid pattern ....................................142

7.8 Flooring ...........................................................142

7.9 Construction Techniques and Cost .......................143

Conclusion ..............................................................144

References ..............................................................145
LIST OF TABLES

Table 4.1: Space requirement for various parking angles

Table 4.2: Turning radius for various vehicles

Table 6.1: Analysis of kitchen space requirement

Table 6.2: space programming table
LIST OF FIGURES

Figure 2.1:  (a) Plan of the garage lift system (b) Cross-section (c) Transverse stacking

Figure 2.2(a) Vehicle being pushed on pallets (b) A view of lift area

Figure 2.2: (c) Elevator system for mechanical car park

Figure 3.1: Site plan sketch plan

Figure 3.2: Typical floor plan sketch plan

Figure 3.3: Site plan of Santa Monica civic center parking structure.

Figure 3.4: Floor plan and south elevation of Santa Monica civic center parking structure.

Figure 3.5: North sectional elevation of Santa Monica civic center parking structure.

Figure 3.6: East sectional elevation of Santa Monica civic center parking structure

Figure 4.1: (a) Dimensions of a standard car

Figure 4.1: (b) Standard car space requirements

Figure 4.2: Dimensions of the large American cars
Figure 4.3: In-line Parking

Figure 4.4: 30° Oblique spaces

Figure 4.5: (a) 45° Oblique spaces

Figure 4.5: (a) 45° Oblique spaces

Figure 4.5: (a) 60° Oblique spaces

Figure 4.5: (a) 90° Head-on parking

Figure 4.5: (b) 90° Head-on parking with double passageway

Figure 4.5: (c) 90° Head-on parking with minimum space for double passageway

Figure 4.5: (d) 90° Head-on parking with minimum space (extreme use)

Figure 4.5: (e) 90° Head-on parking with minimum space for double passageway

Figure 4.6: (b) 360° or U-turn

Figure 4.6: (c) 360° turn

Figure 4.6: (d) 3-Point turn

Figure 4.7: (a) Ramp slope for split level

Figure 4.7: (b) Ramp slope for full level
Figure 4.8: (a) Full ramps with no loss of space

Figure 4.8: (b) Spiral ramp car park

Figure 4.8: (c) Multi-storey structure with full ramps(d) Half-storey ramp car park

Figure 4.9: Split level layout

Figure 4.10: Split level ramps with one way traffic

Figure 4.11: Split level ramp with two way traffic

Figure 4.12: Split level ramp with separated traffic flow

Figure 4.13: Split level ramp for mixed use

Figure 4.14: Parking requirements for disabled

Figure 4.15: Drop-off points for disabled

Figure 5.1: Map of Nigeria and Lagos State, showing Local Government Divisions

Figure 5.2: Map of Lagos Island

Figure 5.3: Map of marina

Figure 5.4: Map of Lagos Island

Figure 5.5: Map of Nigeria showing the various Climatic zones.
Figure 5.6: Map of Nigeria showing the Rainfall distribution across regions

Figure 5.7: Map of Nigeria showing soil type distribution

Figure 5.8: Climates and Daylight Chart for Lagos, Nigeria

Figure 5.9: Map of Nigeria showing relief and topographical units

Figure 5.10: Map of Nigeria showing relief and topographical units

Figure 5.11: Site analysis

Figure 5.12: Site Existing Features

Figure 5.13: Site location and existing buildings

Figure 6.1: Seating analysis for Restaurant

Figure 6.2: Functional layout of a small restaurant

Figure 6.3: Space requirement for snack bar

Figure 6.4: Stair Case with Three People Climbing Side-By-Side

Figure 6.5: Diagrammatic illustration of function of ticketing system

Figure 7.1: Total site area

Figure 7.2: Total site area
Figure 7.3: Zonal Relationship

Figure 7.4: Ancillary facility Bubble diagram

Figure 7.5: Multi storey car park bubble diagram

Figure 7.6: Conceptual formulation

Figure 7.7: Elevation conceptualisation I

Figure 7.8: Double beam floor
LIST OF PLATES

Plate 1.1: Parking situation in Lagos

Plate 2.1: Automobiles through the years.

Plate 2.2: Downtown Parking in New York

Plate 2.3: Street-side parking in Detroit

Plate 3.1: (a) Exterior view of the Murtala Mohammed Airport Multi-Storey Car park

Plate 3.1: (b) view of Murtala Muhammed Airport Multi-storey car park

Plate 3.2: Views of Stairwell around the Murtala Muhammed Airport Multi-storey car park

Plate 3.3: Views showing various fire-safety features within the car park

Plate 3.4: Interior views of Murtala Muhammed Domestic Airport

Plate 3.5: Flooring of Helipad of the Murtala Muhammed Airport

Plate 3.6: A view of column Arrangements and the driveway

Plate 3.7: Front view of the Mega-Plaza Multi Storey Car park.
Plate 3.8: Column support for Multi Storey Structure

Plate 3.9: (a) View of pedestrian access to stairwell

Plate 3.9: (b) External view of overall stairwell

Plate 3.10: View showing the inculcation of fire hydrant pipes along stanchions

Plate 3.11: (a) Ground floor of parking showing the lighting system

Plate 3.11: (b) Another view showing the lighting system and arrangement

Plate 3.12: (a) Elevational view of the Trinity centre Multi-storey car park

Plate 3.12: (b) Elevational views of the Trinity centre Multi-storey car park

Plate 3.12: (c) Elevational view of the Trinity centre Multi-storey car park

Plate 3.13: Interior view of parking bays and stall

Plate 3.14: Perspective view of Santa Monica civic center parking structure

Plate 3.13: Perspective view of Santa Monica civic center parking structure

Plate 3.15: Perspective of Santa Monica civic center parking structure showing the side view.

Plate 5.1: View of the busy Marina Street
Plate 5.2: Different view of the busy activities in Marina Street

CHAPTER ONE

1.0 INTRODUCTION

An automobile is a road vehicle, usually with four wheels and powered by an internal-combustion engine, designed to carry a small number of passengers (Microsoft Encarta, 2007)

Automobiles changed the world during the 20th century, particularly in the United States and other industrialized nations. From the growth of suburbs to the development of elaborate road and highway systems, the so-called horseless carriage has forever altered the modern landscape. The manufacture, sale, and servicing of automobiles have become key elements of industrial economies. But along with greater mobility and job creation, the automobile has brought noise and air pollution. Automobile accidents rank among the leading causes of death and injury throughout the world. But for better or worse, the 1900s can be called the age of the automobile, and they will no doubt continue to shape our culture and economy well into the 21st century. (Microsoft Encarta, 2007)

In the words of Jane Holtz Kay 2001 “In repose, as well as in motion, it took space.” One outward and most unpredictable thing the motorcar brought was the need for its own storage, especially in the city centers where this new-found love was vastly used in everyday life. Since architecture in its true sense deals in space management, and a new space occupying element had been introduced by man for his convenience without
thinking of its consequences, it thus follows that architecture has to adapt or respond to this new space occupant. According to Jonathan Glancey (2005) “…the automobile evolved in tandem with modern architecture, it created myths, legends and new building types”.

As a result of the problem of parking, the role of the sidewalk has been diminished with its attending destruction of the vibrant city street life for which Lagos is known for. With time, diminishing pedestrian congestion became a missing character on the streets and thus the loss of the lively sidewalk activities that supported a real sense of urbanity. The automobile and the parking lot dominated the pedestrian and the sidewalk spaces, whose diminished vitality further encouraged widespread automobile use. As a result, the parking lot or lack of it became one of the defining features of Lagos city. (“History of Lagos”, 2008)

The parking lot is the North American term that refers to a cleared area that is more or less level and may be paved with asphalt, bitumen or gravel, intended for parking vehicles. Usually, the term refers to a dedicated area that has been provided with a durable or semi-durable surface it is known as car park to the British (Wikipedia encyclopedia). It is also an area in which motor vehicles can be parked temporarily.

Parking spaces have traditionally been an overlooked element of development projects by governmental oversight and the recent trend has been to provide regulations for the
configuration and spacing of parking lots, their landscaping, drainage and pollution abatement issues.

1.1 PROJECT DEFINITION

The project title is ‘Multi-storey Car park Complex: Marina, Lagos’.

The reason for taking the issue of parking into research especially in the Lagos Central business district is because of the sprawl which the automobile has brought in the region. The Lagos state government before now has failed to put car parking into consideration during the cause of urban planning and zoning until recent times due to the litter of the environment with indecent parking along roadside and in empty fields. The manner in which cars are parked along the roadside does not allow for free pedestrian movement. At some point in the central district, cars are actually parked on the roads preventing the free flow of vehicles moving. (“History of Lagos” 2008)

Furthermore, these spaces which the automobiles occupy on the ground could be more useful in beautifying the urban spaces by planting trees and allowing a flow-through of vehicular and pedestrian movement.

Storey according to Microsoft Encarta dictionary can be defined as a floor or level in a building. It can also be defined as volume between floors in a building. Multi-storey can be defined as having several stories. A multi-storey car park can be defined as volumes
of floors in which automobile can be parked temporarily. This project will not only create a framework for the construction and utilization of multi-storey car parks to reduce open land space use allowing for more open areas for landscaping, but will also integrate other functional ancillary spaces into the multi-storey building, each working together in harmony to form the complex. The ingenious use of materials and adequate space planning along with the aesthetics making it an architectural work not just structural.

1.2 STATEMENT OF ARCHITECTURAL PROBLEMS

The peculiarity of Lagos in terms of shortage of land for expansion purposes cannot be overlooked, hence the congestion in terms of housing, shops and markets, traffic and other land uses competing for limited land space hence a multi-storey car park complex is proposed.

This research will consider three (3) major architectural problems associated with a multi-storey car park complex not entirely neglecting the physically challenged.

1.2.1 Circulation:

The entry and exit must be separate and properly planned to permit one-way traffic and to avoid congestion at peak hours and for emergency evacuation in cases of fire outbreak. The parking system should encourage motorist to use the car park and avoid
the side walks.

The arrangement of the stalls should be planned to ensure proper circulation of vehicles, pedestrians and handicapped. Similarly, parking stalls should be marked to enable drivers remember the location of their vehicles.

1.2.2 Ventilation and lighting

Parking is now more of a challenge, where every individual wants to own a car for convenience, flexibility, easy mobility and for some a symbol of prosperity. And this need for the automobile is being satisfied by the car manufacturing companies through various innovations in their designs and thus the cost of the cars such that every individual, cut across classes, can own their own car. With the magnitude of privately owned car, parking in a multi-storey complex of this nature should be sufficiently lit and naturally ventilated to diffuse fumes from vehicles.

1.2.3 SECURITY

The problem of security of a multi-storey car park should not be overlooked. Automobile and especially the users must have a feeling of safety. The structure must be able to sustain the live and dead load imposed on it not neglecting the aesthetic value it adds to the environment.
Plate 1.1: Parking situation in Lagos

Source: Field study survey

1.3 MOTIVATION

Lagos is one of Nigeria's most prosperous cities in terms of population, infrastructural opportunity, and much of the nation's wealth and economic activity are concentrated
there. More than half of Nigeria's industrial capacity is located in Lagos mainland suburbs, particularly in the Ikeja industrial estate. A wide range of manufactured goods are produced in the city, including machinery, motor vehicles, electronic equipment, chemicals, beer, processed food, and textiles. The commercial, financial and business centre of Lagos and of Nigeria remains the business district of Lagos Island, where most of the country's largest banks and financial institutions are located.

Because of its importance, the Lagos State Government proposes the conversion of all open spaces and abandoned buildings on the Central Business District (CBD) of Lagos Island into shopping malls and multi-storey car parks in order to attract investment into the Island. (Honourable Oyinlomo Danmole, Special Adviser to the State Governor on Central Business Districts in the State). The proposal is also meant to restore sanity and aesthetic beauty of the Island which has, over the years, suffered a high level of environmental abuse and infrastructural degradation and vandalism by street traders, urchins and loafers. “It is regrettable that the island; the central business district (CBD) has no proper car parks befitting her status”. (Honourable Oyinlomo Danmole, Special Adviser to the State Governor on Central Business Districts in the State)

1.4 AIM AND OBJECTIVES

The aim of this research is to effectively manage space by the design of a multi-level car parking decks to curb the automobile litter in the high density central cores with
particular reference to Marina-Lagos, in a quest to effectively manage what is left of the spaces in urban centers.

A study of the traffic situation of the Marina-Lagos including the volume of cars going to business areas, market and also offices which is quite high is made to provide an insight into how an architectural solution can be arrived at, so that parking problems can be greatly reduced.

Furthermore the objectives could be stated as follows:

- To create awareness that the traditional urban fabric which was prevalent in the Lagos central business district has been destroyed.

- To design a multi-storey car complex which would cut down the amount of open land space used as parking through vertical arrangement of parking stalls in storey above each other.

- To make the complex a public building through the proper integration of ancillary activities this, will ensure the proper functioning of the multi-storey car complex.

- To properly integrate the building structure into the surrounding environs
through its proper articulation and aesthetics, beautifying the streetscape.

- To create free space around the building structure this could be landscaped.

- To provide a garage that will improve parking system in Marina-Lagos and relieve the roads of automobile.

- To direct the flow of arriving and departing motorist to eliminate conflict and reduce usage of signboards etc.

- To provide a garage that will ensure safety of automobile and their user.

- To design an economical viable garage.

- To provide a garage that will restore sanity and aesthetic beauty to Lagos state.

- To provide a garage that will enhance the effective movement of automobile and their users.

1.5 SCOPE OF THE PROJECT

The scope of this research shall be restricted to space planning and management in the design of a multi-storey car complex. The design shall cover a detailed planning proposal for construction by the Lagos State Government as a part of the ongoing Mega City project embarked upon for upgrading Lagos State.

The project is based on analysis of the case studies, interviews, journals, questionnaires etc. The scope of work is based on the population it is intended to serve. Marina (Lagos
island) is the central business district (CBD) serving the banks and offices, the population of cars are between 1500 to 2000.

As a multi-storey complex, it will serve as a commercial building, public building as well as a car park generating revenue. Thus the scope shall include: ancillary facilities such as let-able shops, restaurant, lounge/ relaxation area, cybercafé, mini-garage, and car wash. Other facilities such as ticketing booths, arrivals, departure, and information counters, and offices spaces

**1.6 RESEARCH METHODOLOGY**

Information for this research work shall be obtained by a combination of methods classified under the descriptive methodology and divided into both the primary and secondary sources

**1.6.1 Primary sources**

The primary sources for data include those methods whereby information is gathered direct from source for this work by the following methods:

A. **Interviews:** This method covers the collection of information from people directly involved or affected by the research problem. This is to include a random sample of car owners who work daily within the Marina district, car park security men who monitor the cars parked within the car parks and the movement pattern of these cars, local
government officials for Lagos Island who may be able to give out information.

**B. Case studies:** This involves the on-site collection of data through field survey of how previous designs have been able to achieve similar solution to this research problem and the problems they have come across. It also includes the areas of problem study, getting down to the affected area of the central business district to see how the problem really affects.

**C. Secondary sources**

Secondary sources of information shall be from already collected data by other researchers through books, journals, published and unpublished literatures, and also the internet.

1.7 ARCHITECTURAL SIGNIFICANCE

The importance of such research work architecturally is the ability of buildings to adapt to new challenges that increase in technology posses on it. Before now, buildings only had the function of housing man and his other valuables. Increase in technology and the advent of the automobile, ushering in the mass use of the automobile to the extent that it begins to litter the environment, can be solved by adapting our building to house this mess. This research work would create a framework for the design of buildings that would house not only man, but the monster he has created for himself in a bid to ease his
activities on the planet, creating the awareness that architecture should adapt to various changes in function over time, providing solution to environmental problems in the society.

1.8 PROJECT LIMITATION

The major constraints encountered in the course of this research was refusal of government and private officials to provide necessary assistance in areas of taking of photographs and provision of information necessary for the research.

Also, the multi-storey car parks visited had heavy security which discouraged easy and better study of the building all in the bid to prevent loitering and theft in the complex.

Due to lack of funds, foreign case studies will not be visited to be appreciated first hand.

1.9 SOURCES OF FINANCE FOR THE PROJECT

This project would be financed through a joint venture arrangement. The state government, local government, other governmental organization and banks such as UBA bank, Intercontinental bank, Union bank, Wema bank, Eco bank amongst others, would be major financiers.
CHAPTER TWO

2.1 HISTORY OF AUTOMOBILE

The history of the automobile actually began about 4,000 years ago when the first wheel was used for transportation in India. In the early 15th century the Portuguese arrived in China and the interaction of the two cultures led to a variety of new technologies, including the creation of a wheel that turned under its own power. By the 1600s small steam-powered engine models had been developed, but it was another century before a full-sized engine-powered vehicle was created.

In 1769 French Army officer Captain Nicolas-Joseph Cugnot built what has been called the first automobile. Cugnot’s three-wheeled, steam-powered vehicle carried four persons. Designed to move artillery pieces, it had a top speed of a little more than 3.2 km/h (2 mph) and had to stop every 20 minutes to build up a fresh head of steam.

As early as 1801 successful but very heavy steam automobiles were introduced in England. Laws barred them from public roads and forced their owners to run them like trains on private tracks. In 1802 a steam-powered coach designed by British engineer Richard Trevithick journeyed more than 160 km (100 mi) from Cornwall to London. Steam power caught the attention of other vehicle builders. In 1804 American inventor
Oliver Evans built a steam-powered vehicle in Chicago, Illinois. French engineer Onésiphore Pecqueur built one in 1828. (Microsoft Encarta, 2007)

British inventor Walter Handcock built a series of steam carriages in the mid-1830s that were used for the first omnibus service in London. By the mid-1800s England had an extensive network of steam coach lines. Horse-drawn stagecoach companies and the new railroad companies pressured the British Parliament to approve heavy tolls on steam-powered road vehicles. The tolls quickly drove the steam coach operators out of business.

During the early 20th century steam cars were popular in the United States. Most famous was the Stanley Steamer, built by American twin brothers Freelan and Francis Stanley. A Stanley Steamer established a world land speed record in 1906 of 205.44 km/h (121.573 mph). Manufacturers produced about 125 models of steam-powered automobiles, including the Stanley, until 1932.

Most automobiles at the turn of the 20th century appeared more or less like horseless carriages. In 1906 gasoline-powered cars were produced that had a style all their own. In these new models, a hood covered the front-mounted engine. Two kerosene or acetylene lamps mounted to the front served as headlights. Cars had fenders that covered the wheels and step-up platforms called running boards, which helped passengers get in and out of the vehicle. The passenger compartment was behind the engine. Although drivers
of horse-drawn vehicles usually sat on the right, automotive steering wheels were on the left in the United States. (Microsoft Encarta, 2007)

In 1903 Henry Ford incorporated the Ford Motor Company, which introduced its first automobile, the Model A, in that same year. It closely resembled the 1903 Cadillac, which was hardly surprising since Ford had designed cars the previous year for the Cadillac Motor Car Company. Ford’s company rolled out new car models each year, and each model was named with a letter of the alphabet. By 1907, when models R and S appeared, Ford’s share of the domestic automobile market had soared to 35 percent.

By 1920 more than 8 million Americans owned cars. Major reasons for the surge in automobile ownership were Ford’s Model T, the assembly-line method of building it, and the affordability of cars for the ordinary wage earner. (Microsoft Encarta, 2007)
2.2 HISTORY OF CAR PARKS

The early cars, being objects of ostentation for the rich, dwelled in old carriage houses or stables which were miniature replicas of the main house as the shelter for automobiles was not a thing for design consideration. Over time, the carriage house evolved into a form of its own as the then rich would have it: a wash and waxing shop for their expensive toys, often with a lowly chauffeur-cum-mechanic living above or by its side sometimes appearing with a gas pump out at the front (Holtz, 2001).
As middle-class suburban dwellers bought their own cars, their smaller houses developed wooden or brick garages - detached from the house to avoid dangers that the new loved machine might pose to the family. This more modest homeowner's garage might still be built to match the architecture of the parent house. Soon, a more stylish home for the new vehicle emerged when Frank Lloyd Wright, as enthralled with the motorcar, brought not only architectural modernity but mobility to one of his Oak Park homes in the form of a built-in garage and sketched a design for a service station (Holtz, 2001).

A clearer view of the history of public parking in the United States would have to be broken down to before and after the World Wars I&II.

### 2.2.1 BEFORE WORLD WAR II

The period between the World War I and II found car parks to be a vital element of the cityscape. Developed nations such as the United States recorded car parking to have reduced downtown street area by one third to one half. Against this, the increase in technology and mass production techniques further increased the number of cars in use worldwide to an extent whereby parking at the curbs met only a small percentage of the total parking requirements for the average city. At this point, efforts began to be made to ban or limit curb parking and to increase off-street parking to relieve congestion and to house vehicles during the busiest times of the day.
As early as 1917, the first noted commercial car park in the United States was established by Max Goldberg in Detroit, Michigan, although some attribute this to Herman R. Schmitt in Dusquense Pennsylvania in 1914 (Jackle, John and Sculle, 2004). During this period, parking lots were usually vacant lands converted for such use by land owners so as to finance property taxes, especially in the United States where companies such as the Ford Motor Company ensured that the motor car was made available to the general masses. With time and the increase in automobile use, land owners found the business of parking cars on their properties to be a very profitable one with little or no liabilities attached. Land owners found that parking lots required little or no site renovation, maintenance or operating fees. It was also discovered that in some areas, renting a parking stall on an hourly or daily basis proved to be more advantageous than leasing square footage in a building on a monthly or yearly basis. The early car parks were so profitable and easy to manage that owners began tearing down unsuccessful buildings to pave more surfaces for parking. The parking lot was beginning to assume a key role in the definition of the city’s landscape.

As the use of motorcars continued to increase in the urban centers, the government began developing car parks between road lanes and by the sides of the roads in places such as New York. This solution only solved the problem for the moment, but the increasing car use soon simply overwhelmed the solution.
As early as 1922, New York and Philadelphia banned parking on their major streets, with other cities following their lead. Also in the 1920s, “No Parking” areas were designated by distinctive painted lines and curbs giving way to the first stipulated parking related law in Columbus, Ohio State in the United States, in August 1923, where requirements were composed which prescribed that off-street parking spaces be provided in connection with multiple-family dwellings. This period also saw the emergence of “Traffic
engineering” as a profession, and with it came off-street parking’s first appearance in zoning.

Plate 4 below, probably from the 1930s, shows a new parking system in Detroit: the lane of cars against the curb to the right is parked, but those cars in the lane next to it must have the driver at the wheel.

![Plate 2.3: Street-side parking in Detroit](http://www.autolife.umd.umich.edu/Environment/E_Casestudy/ParkingAtCurb.htm#close)

More effective was the introduction of the parking meter in Oklahoma City in 1935, with almost 3,000 towns and cities (world-wide) utilizing them by 1950s. In recent years,
central city parking in the United States has been generally more available than in European and Asian cities, but the problem has not disappeared. It is compounded by the fact that not only motorists, but merchants, property owners, commercial fleets, taxis, and mass transportation all have needs and responsibilities for adequate parking.

By 1925 in the United States, 20% of commuters drove to work in a private automobile. This increasing statistics of the motorcar led inventors into relentless works on mechanical solutions to ease the congestion of car parks. The United States Conference of Cities declared parking, “the most widely discussed and relevant issue in cities today”, and the House of Tomorrow featured a two-car garage.

(http://www.autolife.umd.umich.edu/Environment/E_Casestudy/ParkingAtCurb.htm#close)

2.2.1.1 The Mechanical Garage

The first mechanical garage in the United States was built in Cincinnati in 1932. It was designed to accommodate nearly 400 cars and used a converted elevator system to hoist individual vehicles from a central receiving area to any one of its 24 floors. As soon as the vehicle reaches the appropriate floor, dollies and/or a live attendant pushed the vehicle into its parking space. This garage was in constant use until it was shut down and demolished to make room for new buildings in 1979. (http://www.roboticparking.com/productline.html).
The advantages of the mechanical garage included the fact that it offered a pollution free alternative. No cars are running inside, so there are no choking car emissions to have to deal with inside the garage. Also, because cars do not have to circle around and around the block looking for spaces, there are less pollution and less traffic from cars driving at slow paces for extended periods of time. Cars get off the street faster.
The mechanical garages function such that a car is driven onto a pallet at the entrance. This pallet is transferred to the desired floor for storage on stacking lifts from which the cars are then moved to compartments on the pallets.
Figure 2.2(a) Vehicle being pushed on pallets  
(b) A view of lift area  

Figure 2.2 (c) Elevator system for mechanical car park

Source: http://www.narpac.org/intho.htm
The mechanical garage idea was not so vast in United States for a long while basically due to the fact that there was plenty of land and parking spaces, whereas in Europe, Asia and Japan, where land is so scarce, hundreds of mechanical garages were built between the mid 1950's and the late 1980's. Most are still in operation. The largest of these garages, accommodating 849 cars, is an underground garage built by the former Krupp Manufacturing.

By the mid-1930 the mechanical garage, which seemed so full of promise a decade earlier, was being replaced by the multi-story “cage garage”. This change was due to the imperfections of these early technologies, which eventually proved unsatisfactory, as installation costs were high, mechanical and electrical malfunctions were common, and, perhaps most damning, these mechanical garages did not satisfy the demand for speedy service during peak traffic flows (Jackle, John and Sculle, 2004). The principal advantage of the cage garage was its open deck design. The “Cage Garage” was the first open-deck parking garage, developed in 1933 by Sam Elliot in Boston, Massachusetts (Jackle, John and Sculle, 2004). There was no envelope, and subsequently, no ventilation or fire protection systems. This in turn considerably lowered construction and maintenance costs, making the cage garage an attractive option for parking developers. The 1930’s saw two other critical events in parking: the appearance and widespread use of the parking meter, and a legal construct of parking.
Shortly before the World War II there were vast changes in the way car parks were viewed in the United States which brought tremendous change to the parking industry.

2.2.2 AFTER WORLD WAR II

With the increased need for speedy economic growth and stability after the world war, clearly a lot of things changed. The open spaces which were previously used for parking was no longer adequate to house the large numbers of the automobiles being used by the city dwellers. A 1981 transit study hypothesized that if an automobile is in use for every two people, then each automobile in a city might need two off-street parking spaces of 250 square feet per space. This would mean that for every 10,000 people, fifty acres would be required for parking alone, which adds 15 to 25 percent to urban land requirements or street space.

By 1946 over 90% of Americans were traveling by car. Downtown parking was in such demand that it was estimated 30% of traffic during shopping hours was devoted to the quest for a parking space. The gradual revelation of these facts made the government in its planning to begin passing into legislation the expansion of the roles of the car and the parking lot rather than restraining them. In response to the increasing demand, more land and municipal funds were devoted to parking. By 1948, parking had become the most important single problem facing the Central Business Districts of large cities and was the subject of numerous publications.
By 1951 a National Parking Association had been formed in the United States, nearly 200 cities had adopted minimum off-street parking requirements in their zoning, an increase of over 275% over six years, and a variety of multistory parking types had begun to develop. The distinguishing feature of the multistory park was its ramp system or vertical circulation. At this time there were already three primary ramp systems in use: spiral, continuous and opposed, and modified split level.

2.2.2.1 THE MULTI-STOREY CAR PARK

“A multi-storey car park is a building (or part thereof) which is designed specifically to be for automobile parking and where there are a number of floors or levels on which parking takes place. It is essentially a stacked car park.”


The vertical movement of cars between floors is possible by either of the following means

- **Interior ramps** - the most common type
- **Exterior ramps** - which may take the form of a circular ramp
- **Vehicle lifts** - the least common

The multi-storey car park is a feature that had already come into existence even before World War II, but was not so commonly used. The mechanical garage seemed to be the
preferred technology at that period. Due to several failures and maintenance challenges, the multi-storey car park was chosen as an alternative.

The earliest known multi-storey car park was built in 1918. It was built for the Hotel La Salle in Chicago, IL at 215 West Washington Street in the West Loop area of downtown. It was designed by Holabird and Roche. The Hotel La Salle was demolished in 1976, but the parking structure remained because it had been designated as preliminary landmark status. The Hotel LaSalle multi-storey was demolished in 2005 after failing to receive landmark status from the city of Chicago. Jupiter Realty Corp. of Chicago is constructing a 49-storey apartment tower in its place, with construction to begin in September 2007.

Relative economic and domestic stability thrived in the United States during the 1950s probably due to the stable political and international relations platform that the country operated from at that period. This made the single family detached home with a two car garage away from the troubles of the city become a reality for millions – the America dream, due in part to new suburban infrastructure created through the Federal Highway Acts of the 1940s and 1950s. One of the most popular of this acts passed in 1956 was often referred to as “the greatest public works project in history”. This act differed from its predecessors in terms of the scale. The then President, Dwight Eisenhower, envisioned broad ribbons of roadway crossing the country and his idea was in complete accord with many Americans who were coming to value individual mobility as a cornerstone of the
American way of life. This act included the provisions of parking spaces at every
destination off the interstate.

This act was seen to have had tremendous effects in solving the problems of parking in
the United States. It calls for all new buildings to make ample provision for parking space
required for its own uses. At this time automobiles had grown since their introduction at
the turn of the century, necessitating larger stalls, and more maneuvering room. Wide
aisles, ample berths, and convenient footways resulted in greater ease, efficiency and
safety in entering and leaving (Mayer, 2005).

A good comparison can be set between the year 1925 and 1954, the percentage of early
morning commuters in an automobile was 20% in 1925 and doubled to 40% by 1954. In
1946, 12 states had specific provisions in their zoning for off-street parking; by 1953 the
number had grown to 33.

A remarkable development in multi-storey car park was in The Republic of Ireland,
though with a population of just over 4 million, it had almost 1.3 million private cars up
from 800,000 in 1990. The development of multi-storey car parks did not seriously begin
until about 1980, and now currently possesses above 70 purpose-built public multi-storey
car parks which date back to the last 15 years (Keilthy, 2001).
2.2.3 PROLIFERATION OF AUTOMOBILE USE IN NIGERIA

2.2.3.1 Pre-colonial Nigeria

Societies in pre-independence Africa countries have been predominantly rural for the most part of their history. By the mid-20\textsuperscript{th} century, most Africa countries began to gain independence from their colonial masters which led to apparent changes in their social and economic lives. The emerging independent countries experienced a rapid and profound reorientation of their social and economic lives that caused attraction towards cities leading to urbanism. Urbanization was first noticeable in the state capitals and later in various expanding cities and trade routes.

2.2.3.2 Post Colonial Nigeria

Nigeria has experienced a phenomenal growth in population and urbanization, but its experience has also been unique in scale, in pervasiveness, and in historical antecedents. Nigeria became an independent country on October 1, 1960 with her capital in Lagos. It became a republic on October 1, 1963, thus breaking all the ties with British colonialist.

The “oil boom” of the 1970 and 1980 brought about an unprecedented prosperity and development of the nation with primary focus being on Lagos State, the then Federal Capital. There were massive improvements on infrastructural development. New roads were constructed with bridges linking the Lagos Mainland with the Island to ease
accessibility of people. There were also growing manufacturing industries, large construction companies, and governmental institutions, along with a great variety of small business enterprises, many in the informal sector.

These negative effects of transport manifest in different degrees in the urban centers of Nigeria. Because most Nigerian cities pre-date the automobile, houses and activity space have to be destroyed to give room for parking lots and right of way for the automobile. The expansion of roads and the building of flyovers in various parts of metropolitan Lagos led to the destruction of residential houses and the displacement of many families. Also in the new Federal Capital territory, a large number of houses were destroyed recently in Nyanya to give room to the dual carriage way being constructed between Nyanya and Abuja city. Although in these cases, such displaced persons are relocated and/or compensated, there is usually a permanent break in friendship that has been cultivated over a long period of time. Traffic congestion is another major transportation problem of Nigerian cities. The chaotic situation is observable in virtually all the streets of metropolitan Lagos. The streets of Ibadan, Abuja, Kano, Kaduna, Onitsha, Aba, and Port Harcourt depict various levels of traffic congestion. Even the medium urban centres like Ilorin are beginning to witness congestion problems. The cost of congestion in urban centres of Nigeria if computed will be enormous. In a study on the contribution of freight vehicles to congestion problems along Wharf Road in Apapa, Lagos, Ogunsanya (1983a) estimated that the cost of congestion on that route alone amounted to N22.4 million in 1984 or N3.3 billion at 2002.
Nigeria’s urbanization rate is put at a conservative estimate of 5% (Sada, 1973). Automobiles have had the most far reaching effects on the physical growth of cities. They essentially remove the past limitations on urban expansions. Nigerian cities like other cities in the world are becoming more and more dependent on the use of the automobile and this, in turn, is responsible for a high proportion of the fuel consumption in the country. Although the level of private car ownership is still very low, for example the number of automobiles per 1000 population of Lagos is only 22.8 in 1970 as compared to 316 and 248 per 1000 population in Washington and Paris respectively (World Bank, 1975). The rate of growth of automobile use in Nigeria has been phenomenal. Whereas the rate of growth of population of Lagos between 1960-1970 was about 7.9% the rate of growth of automobiles was 15.5% in the same period (World Bank, 1975).

Lagos is an urban complex that embodies tremendous contrasts. As the former national capital and the major port of one of the largest country in Africa, it is a powerful magnet for migrants from all over Nigeria. The rapid urban growth which Nigeria has experienced is well manifested in Lagos, the major parts of which are the product of modern economic, social and political forces in interaction with traditional culture which was the factor that distinguished life in the city from that in the countryside.

Consequent upon that, the vast majority of salaried jobs, the increased opportunity to connect with the rich and powerful, opportunity for great varieties of informal sector
business enterprises, and the excitement of night life that was non-existent in most rural areas, were some of the factors that made the city lively and attractive. The pull into Lagos State became increasingly phenomenal that the State has become legendary for its congestion and other urban problems.

In a bid to keep congestion under control the government in urban centers such as Lagos began implementing some laws such as the Lagos Traffic Edict that placed bans on certain types of cars or certain categories of cars plying certain routes in the congested zone, regulation of parking spaces and amounts charged for it.

CHAPTER THREE

3.0 CASE STUDIES

3.1 MURTALA MOHAMMED DOMESTIC AIRPORT’S MULTI-STOREY CAR PARK. IKEJA, LAGOS.

3.1.1 Source of Information

Visit to the multi-storey car park, interviews conducted, sketches and photograph taken.

3.1.2 Client

The management is between the Federal Government of Nigeria and Bi-Courtney Consortium in a Build-Operate-and-Transfer contract with for a period of 35 years.
3.1.3 Architect

The multi-storey car park was designed and built by construction giant Stabilini Visioni in Nigeria and commissioned on the 7th of April, 2007 by the then president Olusegun Obasanjo.

Plate 3.1(a) Exterior view of the Murtala Mohammed Airport Multi Storey Car park
Plate 3.1(b) view of Murtala Muhammed Airport Multi-storey car park

Source: Field survey (2008)

3.1.4 Structure/Description

The multi-storey car park is within the Murtala Mohammed Domestic airport (terminal II) of Lagos. It consists of four floors, having the roof top as a helipad. Each floor of the multi-storey car park is designed to accommodate about 164 cars parked conveniently. The helipad on top, which also has vehicular access could also serve the overflow of vehicles if the need be. At each corner of the multi-storey car park, there are stairwell for vertical transport between floors bringing the total number of stairwells throughout the building to six, having four on the external and two within the structure. The stair
cases have artificial lighting with the use of backup power fluorescent lamps for security especially at night.

Plate 3.2: Views of Stairwell around the Murtala Muhammed Airport Multi-storey car park

Source: Field survey (2008)

At every level and on every floor, there are sprinklers which line up the entire soffit. Each floor has six rows of fire-sprinkler water-piping running its entire length at equal spacing. The sprinkler discharge outlets are fitted to the pipes at regular intervals of
about four meters spacing. Along with the sprinklers are various fire alarm points are fitted at the entrances to the stairwell.

Plate 3.3: Views showing various fire-safety features within the car park

Source: Field Survey (2008)

3.1.5 Ventilation techniques

The building is designed to have maximum natural ventilation as is required to remove all exhaust fumes from the vehicles. This is achieved by having the exterior walls 1m high all through the building with hand rails.
3.1.6 Flooring

The entire structures of this building are made of in-situ cast concrete without an exception in the flooring. The floors are made up of reinforced concrete supported on a system of cross beams supported on large circular columns of 800mm diameter. The floor is finished with cement-sand screed except for the helipad floor which happens to be finished with inter-locking tiles of 150*150mm.
Plate 3.5: Flooring of Helipad of the Murtala Muhammed Airport

Source: Field Survery (2008)

The floor of the helipad is designed to slope towards drain points just beneath the concrete paving stones. These drains are piped along the supporting columns down to the ground floor and out of the structure into the adjacent gutters.

The structural floor just below the concrete paving stones of the helipad is treated against water by having several coats of bituminous felt applied.
Plate 3.6: A view of column Arrangements and the driveway

Source: Field Survey (2008)
Figure 3.1: Site plan sketch plan

Source: Field survey (2008)
3.1.5 MERITS

- The ramp at the east and west side of the car park are for entry and exit which separates traffic and reduces congestion during rush hours.
- Sign and direction boards are at every point to ensure that drivers can get direction easily.
- The multi-storey car park is linked to the airport terminal for easy pedestrian access to and from the airport.
- The stair cases are at strategic positions to aid vertical movement.
- Payment for parking is efficient. Drivers pay depending on the amount of hours their automobile will be parked.
- Sprinklers are at the soffit of each floor in event of fire outbreak.
- The walls are dwarf for free flow of air and lighting

3.1.6 DEMERITS

- Lack of ancillary facilities for effective functioning of the car park.
- Lack of provision for the disabled.
- Separation of the parking stalls for long and short stay users was not considered.
CASE STUDY II

3.2 MEGA PLAZA MULTI STOREY CAR PARK VICTORIA ISLAND, LAGOS.

3.2.1 Source of Information

Visit to the multi-storey car park, interviews conducted and photograph taken.

3.2.2 Client

Mega Plaza shopping mall

3.2.3 Architect

The multi-storey car park was designed by DHT Architects and completed in 2007.

3.2.4 Structure/Description

The Mega Plaza multi-storey car park is located directly opposite the Mega Plaza shopping mall on Victoria Island, Lagos. The purpose of the design was to provide adequate and safe parking spaces for the shoppers while in the mall, a feature which is a scarce feature with shopping centers in the Lagos environs.
Plate 3.7: Front view of the Mega-Plaza Multi Storey Car park.

Source: Field Survey (2008)

The multi-storey car utilizes a split level ramp system in its design consisting basically of four floors, with the fifth also designated for parking. The entire structure is basically concrete and steel, having its structural frame in steel sections and the floors of precast concrete.

3.2.5 Construction

The main frame work of the multi-storey car park is built in steel sections. Other features such as the floors, stairwell etc is in concrete, though the steel is the dominant construction material. The stairwells are located at the corners of the structure. The stair
system is the continuous dogleg revolving around a central load bearing core wall. The stairwells are open to the air, having hollow tubular steel baluster.

Plate 3.8: Column support for Multi Storey Structure

Source: Field Survey (2008)
Plate 3.9 (a) View of pedestrian access to stairwell

Plate 3.9 (b) External view of overall stairwell

Source: Field Survey (2008)

3.2.6 Fire Safety Features
The entire structure is designed to have fire safety features. Along the steel stanchions are fire hydrants attached for high pressure water supply in the case of a fire outbreak. The stairwells are also well distributed for this reason.

Plate 3.10: View showing the inculcation of fire hydrant pipes along stanchions

Source: Field Survey (2008)

3.2.7 Lighting

The multi-storey car park is open on all sides so that lighting is not a problem except at areas towards the middle of the building mass. These are taken care of with the use of mechanical lighting which are regularly distributed all through the building hanging to the soffit of the floor.
3.2.8 Merits
• The multi-storey car park is well lit and open on all sides.
• Sprinklers are at the soffit of each floor in event of fire outbreak.
• The stair cases are at strategic positions to aid vertical movement and for emergency exit.

3.2.9 Demerits

• During peak hours, the split ramp system used causes traffic congestion.
• Lack of sufficient direction/sign board for better movement of drivers.
FOREIGN CASE STUDY

Case study III

3.3 TRINITY CENTER MULTI-STOREY CAR PARK; GATESHEAD, NORTH-EAST ENGLAND

3.3.1 Client

E. Alec Colman Investments Ltd (a developer)

3.3.2 Architect

The multi-storey car park was designed by Owen Luder in 1962 and opened for operations in 1969
Plate 3.12(a): Elevational view of the Trinity centre Multi-storey car park
3.3.3 Structure/Description

Trinity Centre Multi-Storey Car Park is an iconic concrete structure located in Gateshead, north-east England. The car park is a prime example of Brutalism in architecture having been built at a period when the brutality style was regarded as the cutting edge of architecture. By the time that it opened for operations in 1969, interest in the brutalism architecture movement had begun to decline. The building's raw concrete weathered poorly, and within the space of one year, the car park had already become an emblem for decline.

In 1964 the centre was under construction by the firm of Sir Robert McAlpine. The car park was commissioned as part of the redevelopment of the established market square of Gateshead's town centre and hence is also referred to as the Inner Market Car Park.
Plate 3.12(b): Elevational views of the Trinity centre Multi-storey car park

Plate 3.12(c): Elevational view of the Trinity centre Multi-storey car park

The building was made special because of its modernist design and its minimal use of steel. The complex was made of grey brick and reinforced concrete and was a little ahead of its time; it was hailed as a contemporary design classic. It had seven tiers of parking decks which are raised above the adjoining shopping centre by a "forest" of piloti columns. The decks on the north face have a slight curve creating a wave effect.

3.3.4 Construction

There are two supporting towers containing stair access. Each level of car park is therefore uninterrupted, so that when viewed from a distance the sky is visible through the structure. A cafe unit in a contrasting box structure sits above the top tier of the car
park connected to the access towers by an expressed glazed 'bridge' and an open walkway. The cafe has large windows providing views across the Tyne Valley.

Plate 3.13: Interior view of parking bays and stall

Source: [www.wikipedia.org](http://www.wikipedia.org)
3.3.5 Disabled parking

There are 6 designated disabled bays in this car park. These are located on Level 2 (2no.), Level 3 (2no.) and Level 4 (2no.). Vehicles displaying a valid disabled blue badge may park free of charge in these disabled bays.

3.3.6 Stairs and Lifts

Stairs are located at the end side of the entire parking structure running from the 7th floor right to the ground. A fully accessible lift is available which operates between floors 1 to 7.

3.3.7 Other facilities

Motorcycles may park free of charge in this car park; There is one lift in operation; There is CCTV in operation and also on foot security.

3.3.8 Merits

- The multi-storey car park has provision for parking of motorcycles.
- The security system is efficient
- Vertical movement through stair and lift accesses all the floors

3.3.9 Demerits
• The landscaping ultimately created an exposed and unattractive shopping precinct on two levels with poor access.

• The roof top cafe failed to find a tenant due to its poor location for business, and was deemed unsafe and never opened.

• Insufficient parking for the disabled.

3.3.10 Conclusion

In recent years the building has been regarded by some as quite an eyesore. This is mainly due to its poor construction. There have been long standing problems of spalling of the concrete in places, mainly on the concrete facing of the car park decks and service towers. This is where the concrete has broken away from the steel reinforcing underneath it. From time to time, contractors have had to examine the building and carry out patch repairs to these areas.

At the top of the car park is a 5.500 sqft room which was originally designed as a restaurant. The space was marketed but never occupied, and was closed to the public from the buildings completion.
Case study IV

3.4 SANTA MONICA CIVIC CENTER PARKING STRUCTURE: SANTA MONICA, CALIFORNIA

Plate 3.14: Perspective view of Santa Monica civic center parking structure

Source: http/archrecord.construction.com
3.4.1 Client

Santa Monica's civic center; California.

3.4.2 Architect

Santa Monica's civic center parking structure was designed by Moore Ruble Yudell Architects & Planners. They developed a lively parking garage that simultaneously cloaks and celebrates Southern California's car culture.

3.4.3 BACKGROUND

For better or worse, Los Angeles invented car culture. For the late academic Reyner Banham and his continuing, devoted band of theory-mongers, ostensibly every building, public space, and fragment of architecture in Los Angeles is really about the car. Moore Ruble Yudell Architects & Planners' new parking structure for Santa Monica's civic center is but the latest shout-out to Banham's influential thesis, set forth in 1971 in the book Los Angeles: The Architecture of Four Ecologies. There is always a new example to reaffirm Banham; his book is now unanimously understood as the first honest (and perhaps most gushing) critique of Southern California's freeway culture—because the trashy, flashy, global architecture culture that has emerged in Los Angeles from the late 1960s onward took the critic seriously.
Plate 3.13: Perspective view of Santa Monica civic center parking structure

Source: http/archrecord.construction.com
Parking garages, generally excluded from the categories of architecture and urbanism, have typically been bland utilitarian boxes or podiums for superstructures. In a nod to Venturi, Scott Brown’s super-graphics and decoration sheds, the parking garage for Frank Gehry’s 1979 Santa Monica Place mall, north of the civic center, presented a scrim of chain link printed with dim white letters spelling out the mall’s name. Gehry’s chain link may have been tolerated more than loved, but the parking garage is a landmark, if not a touchstone for architects pondering such building types.

3.4.4 DESIGN CHALLENGE

Santa Monica wanted this 900-car garage in order to redevelop adjacent land currently used as surface parking. A new master plan for the civic center placed the garage at the existing east entrance to the center, so the city, which is well-known in the area for its aesthetic fussiness, didn’t want to build a concrete box in such a prominent location. The architects were, in effect, hired to decorate the nearly 300,000-square-foot structure—to wrap it in visual interest—as well as to tease more use out of what could have been a dead box by planning 10,000 square feet of street-level retail to enliven the neighborhood and introducing sustainable design strategies.
Plate 3.15: Perspective of Santa Monica civic center parking structure showing the side view.

Source: http/arc/record.construction.com
3.4.5 CONSTRUCTION METHOD

Except for the addition of 25 percent fly ash to the cement mix, the 8-storey concrete structure (two stories are below grade) is entirely conventional. Befitting a firm founded by the late Charles Moore, the architects designed a porous skin of multicolored, laminated, U-shaped glass channels that hang off the primary concrete structure and keep the garage open to fresh air and views. Coupled with ribbed, precast-concrete panels and stainless-steel mesh on the corner stair towers, the exterior cladding addresses the varied urban contexts of the four elevations. For example, the west elevation’s glass strikes green and blue colors for the ocean, while reds, greens, and blues respond to the eastern freeway side. The designers also solved a long-standing problem in Southern California by adding a dramatic, cantilevered, 19,200-square-foot, 181-kilowatt installation of solar photovoltaic on the roof, which also provides shading for the top floor of parking.
Figure 3.3: Site plan of Santa Monica civic center parking structure.

Source: http/archrecord.construction.com
Figure 3.4: Floor plan and south elevation of Santa Monica civic center parking structure the side

Source: http/archrecord.construction.com
Figure 3.5: North sectional elevation of Santa Monica civic center parking structure.

Source: http/Archrecord.construction.com
3.4.6 Merits

- The solar photovoltaic system on the roof provides shading for the cars parked on the topmost floor as shown in figure 3.6.
- The designer married the architectural character of the building with the environment.

3.4.7 Demerits

- Ramp circulation is limited and increases traffic congestion.
3.4.8 DEDUCTION FROM CASE STUDY

The above study and analysis of some existing multi-storey car park in Nigeria, U.S.A and England reveal that they possess facilities that satisfy the multi-storey requirements. The design of their physical structure also meets the same standard.

An assessment of the existing facilities will serve as a guide to the attainment of the following standards:

- Using a ramp system that is most effective to choose from.
- Free flow of traffic: the pedestrian movement will be separate from the vehicular movement.
- Aesthetics of the structure should not be neglected.
- Provision of adequate parking for the disabled.
- Achievement of natural lighting.
- Achievement of adequate natural ventilation.
- Zoning of the ancillary facilities without interrupting vehicular movement.
- Central positioning of elevators and stair cases in relation to the parking bay, in such a way that they can be assessed directly from the lounge or lobby.
- Creating a natural environment by using element peculiar to the environment.
- Maximum attention to fire protection.
CHAPEL FOUR

4.1 DESIGN PRINCIPLES AND PLANNING CONSIDERATION

This research work aims to reduce the amount of open spaces that are daily being converted to parking spaces for the automobiles especially in the urban centres. It is therefore imperative at this point to properly examine the issue of space management through proper spatial planning techniques.

When designing a multi-storey car park for public use as this, two areas of space planning have to be sought out. The first area of research interest is the multi-storey car park, the second being the other public facilities accommodated by the building structure.

4.2 MULTI-STOREY CAR PARK ANALYSIS

The chosen ramp method is dependent on the nature of traffic accommodated by the multi-storey car park. A field survey identifies two types of vehicular traffic constituent on the Marina environ, the short stay and the long stay traffic.

The long stay traffic consists mainly of the workers within the office spaces of the high rise building along the Marina and Broad Street. This traffic is the largest and begins arrival from 6.30am till about 9pm. These users park their car hurriedly in any available stall and rush to start their working day up until 5pm, which is the general closing time of
most offices on the island. These users are the constituent of the 8am and 5pm rush hour around the Marina.

The short stay traffic constitutes users who come around the Marina to use facilities such as banking, consultancy, market shopping including those who come in for corporate visits and business discussions/transaction. The period of stay of these users is averagely 30 minutes at a stretch, but may usually extend to as long as an hour or two at the most for such cases that involve meetings.

The minimum acceptable plot size for the multi-story parking is 25 square meters to allow for the structure and an economical aisled layout. The activities that require space utilization in these areas include the following:

- The parking stalls
- Circulation paths (vehicular and pedestrian)
- The ramp (to ascend or descend)
- Conveniences
- Ticketing
- Security stands/offices

4.2.1 THE PARKING STALL

Parking stall should be built to accommodate the larger cars frequently used, although not necessarily the very largest. Planning in hopes of just medium and compact cars invites
difficulties. The larger cars have an over-all length of 5.8m, over-all width of 2.0m with a wide open door projecting 1.9m beyond the over-all width.

A single strip of 0.1m-0.2m wide, can be used to mark the parking stalls. Better results in centering the car are obtained by using two 0.1m stripes, separated by 0.5m, to mark the stalls. The stripes, about 5.5m long are joined by a semicircular arc at the incoming end to form an elongated U.

![Figure 4.1 (a) Dimensions of a standard car](image)

From the above diagram, the minimum parking space requirement for a vehicle could be deduced as follows:
The minimum space requirement for a standard vehicle to move is 5.0*2.3m. Using this space requirement for a vehicle, we can then analyze the various forms of parking that are possible.

It is also necessary to examine the spatial requirement of the large American cars that are occasionally used on the Nigerian roads including Coaster buses used by various companies.
This includes:

a. **In-line parking**

This type of parking is very efficient in functionality and reduces obstruction to a minimum along the passage way because cars do not have to reverse onto the road to leave. This method of parking and circulation consumes 23.8 square metres, usually taking a minimum of 2.3 square meter of space than is necessary per car for parking. This extra space is provided to allow the manoeuvre of the car out of the parking space.
b.30° Oblique spaces

This method of parking and circulation allows for easy entry and exit for use only with one way traffic. This method is the most favourable and also has its own share of waste space created just above the parking space.
b. 45° Oblique or echelon parking

This method is a little more difficult to exit than the previous but has less waste space. This method is for one way traffic only. This type of parking usually consumes 22.1 square meters per car or 19.2 square meters where interlocking in adjacent rows.
Figure 4.5 (a) 45° Oblique spaces


Figure 4.5 (a) 45° Oblique spaces

Source: Neufert (2000)

C. 60° Oblique echelon parking
c. 90° Head-on to parking

This is one of the most space-efficient methods existing as it consumes only 18.8 square meter of space per car, though, it is very tedious to manoeuvre in and out of the parking space. Also, the process of one car exiting a parking space temporarily disturbs the movement of another along the passage way. This type of parking is suitable for two-way traffic. There are two types in this category:
The first category provides a parking space width of 2300mm. This reduced space allowance consequently affects the width of the two-way traffic road to allow for adequate manoeuvring. Here, the allowance for the passage way is 6500mm.
The second category provides a parking space of 2500mm width. This increased space allowance allows for a reduced passageway width of 5500mm while still supporting adequate circulation and manoeuvring.
Figure 4.5 (c) 90° Head-on parking with minimum space for double passageway

Source: Neufert (2000)
Figure 4.5 (d) 90° Head-on parking with minimum space (extreme use)

Source: Neufert (2000)
d. 45° Angled parking

This type of parking is for one way traffic only.

Figure 4.5 (e) 90° Head-on parking with minimum space for double passageway

Source: Neufert (2000)

The table 4.1 below shows the space requirement to be provided for depending on the angle of the parking spaces.
<table>
<thead>
<tr>
<th>parking space arrangement</th>
<th>area/space (inc. open doors)</th>
<th>possible no. of spaces/100 m² area</th>
<th>possible no. of spaces/100 m of road (one side only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>· ① 0° - parallel to road. Entry and exit to parking bay difficult - suitable for narrow roads</td>
<td>2</td>
<td>4.4</td>
<td>17</td>
</tr>
<tr>
<td>· ② 30° -angle to access road. Easy entry to parking bay and exit. Uses a large area.</td>
<td>26.3</td>
<td>3.8</td>
<td>21</td>
</tr>
<tr>
<td>· ③ 45° -angle to access road. Good entry to parking bay and exit. Relatively small area/parking space. Normal type of layout</td>
<td>20.3</td>
<td>4.9</td>
<td>31</td>
</tr>
<tr>
<td>· ④ 60° -angle to access road. Relatively good entry and exit to parking bay; small area/parking space. Arrangement often used</td>
<td>19.2</td>
<td>5.2</td>
<td>37</td>
</tr>
<tr>
<td>· ⑤ Right-angles to road (parking spaces 2.50 m wide). Sharp turn needed for entry and exit</td>
<td>19.4</td>
<td>5.1</td>
<td>40</td>
</tr>
<tr>
<td>· ⑥ Right-angles to road (parking spaces 2.30 m wide. Small area needed/parking space. Ideal for compact parking layouts, used frequently</td>
<td>19.2</td>
<td>5.2</td>
<td>37</td>
</tr>
</tbody>
</table>

Table 4.1 Space requirement for various parking angles

Source: Neufert (2000)

4.2.2 CIRCULATION PATHS
Since space management is of paramount importance in this research work, it is then necessary to properly analyze the circulation of the vehicles within the building as circulation is also a space occupant within buildings.

For vehicles, there should be an efficient path around the car park to locate a space, then to proceed quickly to the exit. Clear signing is required, usually combining ground route markings and mounted signs.

For pedestrians, the location of exits, whether stairs or lifts should be visible from any point within the car park. Standard green and white or illuminated signs must be provided. Space is required around exit positions and pay machines safe from vehicle flows.

4.2.1 Stairs and Lifts

The number and location of escape stairs is subject to minimum distances from any point within the car park. They should be of generous width, open balustrade, well lit (preferably with natural light), ventilated and fitted with glazed doors top and bottom for user safety. Installation of lifts (average eight person size) is required if there are two floors or more.

4.2.2 Vehicular circulation
For design purposes, the standard car is taken to have a width of 1800mm and tire tracks that are 1400mm apart. The height of the average car is about 1650mm as shown in the diagrams below.

4.2.3 Vehicular turning requirements

The turning radius for vehicles is described in the diagrams below as shown based on the standard car.

Figure 4.6 (a) 90° turn
Figure 4.6 (b) 360° or U-turn

Figure 4.6 (c) 360° turn

Figure 4.6 (d) 3-Point turn

Source: Neufert (2000)
The above diagrams show that for a vehicle to turn, a considerable amount of space is required. This is due to the fact that the front wheels usually go through a larger turning arc than the rear wheels. The internal turning radius for any vehicle is dependent on the turning of the rear wheels while the external turning radius is the path described by the front wheels.

The following tables show the types of vehicles, their sizes and the required turning radius.

<table>
<thead>
<tr>
<th>type of vehicle</th>
<th>length (m)</th>
<th>width (m)</th>
<th>height (m)</th>
<th>turning circle radius (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>motorcycle</td>
<td>2.20</td>
<td>0.70</td>
<td>1.00(^{2})</td>
<td>1.00</td>
</tr>
<tr>
<td>car</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- standard</td>
<td>4.70</td>
<td>1.75</td>
<td>1.50</td>
<td>5.75</td>
</tr>
<tr>
<td>- small</td>
<td>3.60</td>
<td>1.60</td>
<td>1.50</td>
<td>5.00</td>
</tr>
<tr>
<td>- large</td>
<td>5.00</td>
<td>1.90</td>
<td>1.50</td>
<td>6.00</td>
</tr>
</tbody>
</table>

**Table 4.2: Turning radius for various vehicles**

*Source: Neufert (2000)*

### 4.2.3 RAMP ARRANGEMENT AND TRAFFIC FLOW

A two parallel bin system is normally used to provide a sensible circulation arrangement, with one-way traffic flows having upward and downward routes separated. This allows for maximum traffic capacity. Dynamic capacity is reduced if two-way traffic flows exist or mixed upwards and downwards circulation is used. Economy is achievable by using
the longest practicable aisle lengths. The downward routes should be short to expedite exit, with upwards routes devised to give the best possible search pattern for vacant stalls.

A number of different inter-floor ramps systems can be used to enable automobile to transverse the approximate 3.0m elevation between parking levels. Some of these systems provide separate and exclusive ramps, while others make use of continuous sloping floors that accommodate both parked vehicles and inter-floor travel.

Ramps may be straight, curved, or a combination. No single ramp system is best for all applications. The choice should be based on site shape and dimensions and parking demand characteristics.

Double ramps result in a two-way traffic system. This should only be preferred when there are extreme “rush hours” in a multi-storey car park, like in office car parks. Using scissor ramps results in a one-way traffic system on the ramps, though incoming and outgoing cars are directed along the same driving lane. The scissor ramps should have the width of two parking spaces for more user friendliness. The longitudinal distance between bearers and girders will be determined according to the dimensions of the parking spaces. Normally, this distance corresponds to the width of two parking spaces.

The multi-storey parking in itself may take various design shapes, but basically consist of a slab and column structure all through. When considering space management, it would be very necessary to look into the economic width of ramps.
The width of the ramps is worked out according to the width of the parking spaces. For one-way traffic the ramp will have the width of two parking spaces, for two-way traffic it is the width of three parking spaces. Split-level parking is the most preferred ramp system, because it offers the possibility to decrease the ramp length whilst still offering a normal degree of slope. This guarantees an economical use of the parking space.

Ramp Dimensions in Different Storey Heights:

Figure 4.7 (a) Ramp slope for split level
Figure 4.7 (b)  Ramp slope for full level

Source: www.schreiberstahlbau.de

4.2.3.1 ANALYSIS OF RAMP MOVEMENT

A ramp system includes any portion of storage floors used by automobiles moving between levels. Nearly every successful ramp system requires automobile to follow an approximately circular path when travelling between parking levels. The number of 360-degree rotations required to circulate through the garage and parking structure height are major concerns.

It is generally desirable to limit the maximum number of complete rotations to five or six. Depending on ramp system type, this will control the maximum desirable number of parking levels and limit the number of parking spaces a driver must pass during garage travel.
Drivers are sometimes distracted or disturbed by the awareness of the height when travelling on upper parking levels, a condition that can be accentuated if parking levels extend higher than adjacent buildings. To reduce driver distraction, parapet walls along driving ramps should be designed to limit the driver’s view of surroundings outside the parking structure.

Figure 4.8 (a) Full ramps with no loss of space   (b) Spiral ramp car park

(c) Multi-storey structure with full ramps   (d) Half-storey ramp car park

(Source: Neufert, 2000, p441)
Above shows various ramp systems for gaining access to different levels in multi-storey car parks. The gradients of the ramps should generally not exceed $15^\circ$-$20^\circ$. A horizontal run of more than 5m must be included between an area carrying general traffic and ramps with more than $5^\circ$ gradient.

Typical arrangements for multi-storey floors include

**4.2.3.1 SPLIT LEVEL LAYOUT**

This arrangement is more widely adopted than the rest. It basically consist of two bins arranged in such a way that adjacent parking levels are separated by half-storey height. Short interconnecting ramps are use between levels.

![Figure 4.9 Split level layout](image)
4.2.3.2a One-Way Traffic Flow

Using scissor ramps will result in a one-way traffic flow on the ramps, though incoming and outgoing cars are directed along the same driving lane. This is the usual construction.

Figure 4.10a Split level ramps with one way traffic
**Figure 4.10b** Split level ramps with one way traffic

Source: [www.schreiberstahlbau.de](http://www.schreiberstahlbau.de)

### 4.2.3.2b Two-way traffic

Double ramps result in a two-way traffic system. This should only be preferred when there are extreme “rush hours” in a multi-storey car park, like in office car parks.
Figure 4.11a  Split level ramp with two way traffic

Source: www.schreiberstahlbau.de

Figure 4.11b  Split level ramp with two way traffic

Source: www.schreiberstahlbau.de
4.2.3.2c  Separate Traffic Flow

Here, the lanes for incoming and outgoing cars are separated. The number of parking spaces, along which the incoming cars are led, is high; the traffic flow is simple and clear.

Figure 4.12a  Split level ramp with separated traffic flow
4.2.3.2d Mixed Traffic Flow

This approach is suitable for a one-way traffic flow, as the traffic is led along all parking spaces. However, this kind of traffic flow can cause jams during rush hours, as the lanes for incoming and outgoing cars are not separated.
4.2.4 PARKING FOR THE DISABLED

Figure 4.13  Split level ramp for mixed use

Figure 4.13b  Split level ramp for mixed use

Source: www.schreiberstahlbau.de
Wherever public or private parking facilities are to be provided for, appropriate arrangements for disabled people, as driver or passengers, should be made. At least 5% of all car parking bays must be reserved for disabled visitors (Sport England, 2002). These dedicated parking bays must comply with the minimum standards for disabled people. They must be clearly identified, both on the bay surface and with a vertical sign immediately adjacent to the bay. Disabled parking bays should be as close as possible to the place that the user needs to go, and preferably under visual supervision to discourage misuse by others. Bays should be at least 800mm wider than standard, to permit manoeuvring of wheelchairs for transfer, and any kerbs should be ramped.
Generally, main walkways and corridors should be wide enough to allow two wheelchairs to pass by comfortably. The norm is 1.8m and 1.0m is an absolute minimum at pinch points. Junctions with other corridors or walkways should be splayed or rounded for ease of manoeuvre and to reduce wear. Routes across roads or parking areas must include dropped kerbs, and tactile surfaces should be used to warn people with visual

**Figure 4.14 Parking requirements for disabled**

*Source: Sport England (2002)*
impairment of impending dangers such as vehicular routes. Walkways should have a maximum gradient of 1:20 with flat pauses at intervals of no more than 8m. If a walkway is steeper it must be classified as a ramp. This means that a gradient between 1:20 and 1:15 should have a slip-resistant surface and handrails. A maximum gradient of 1:12 can be used if the length is not greater than 5m.

![Diagram of a drop-off point for disabled individuals]

**Figure 4.15 Drop-off points for disabled**

*Source: Sport England (2002)*
CHAPTER FIVE

5.0 THE SITE

The site for this project is cited according to the requirement for this design and the available open space available in the area. The Lagos Island is and already congested area, with scarcely any undeveloped punctuation. This site is an area marked out by the planning authority for parking spaces and is currently in use.

5.1 GEOGRAPHY OF LAGOS STATE.

The city of Lagos lies in south-western Nigeria, on the Atlantic coast in the Gulf of Guinea, west of the Niger River delta, located on longitude 3° 24’ E and latitude 6° 27’ N. Lagos is the most populous conurbation in Nigeria with more than 8 million people (Federal Republic of Nigeria Official Gazette May, 2007). Lagos State is bounded in the North and East by Ogun State of Nigeria, in the West by the Republic of Benin, and in the South by the Atlantic Ocean. It has four administrative divisions of Ikeja, Ikorodu, Epe and Badagry. Territorially, Lagos State encompasses an area of 358,862 hectares or 3,577sq.km.

On this stretch of the high-rainfall West African coast, rivers flowing to the sea form swampy lagoons like Lagos Lagoon behind long coastal sand spits or sand bars. Some
rivers, like Badagry Creek flow parallel to the coast for some distance before finding an exit through the sand bars to the sea.

5.1.1 CLIMATE

The climate in Lagos is similar to that of the rest of southern Nigeria. There are two rainy seasons, with the heaviest rains falling from April to July and a weaker rainy season in October and November. There is a brief relatively dry spell in August and September and a longer dry season from December to March. Monthly rainfall between May and July averages over 300 mm (12 in), while in August and September it is down to 75 mm (3 inches) and in January as low as 35 mm (1.5 inches). The main dry season is accompanied by harmattan winds from the Sahara Desert, which between December and early February can be quite strong. The average temperature in January is 27°C (79°F) and for July it is 25°C (77°F). On average the hottest month is March; with a mean temperature of 29°C (84°F); while July is the coolest month. (BBC - Weather Centre - World Weather - Average Conditions - Lagos)
The three major urban islands of Lagos in Lagos Lagoon are Lagos Island, Ikoyi, and Victoria. These islands are separated from the mainland by the main channel draining the
lagoon into the Atlantic, which forms Lagos Harbour. The islands are separated from each other by creeks of varying sizes and are connected to Lagos Island by bridges. However the smaller sections of some creeks have been sand filled and built over.

5.1.2 LAGOS ISLAND

Lagos Island is the principal and central local government area of the Metropolitan Lagos in Nigeria. It is part of the Lagos Division. As of the preliminary 2006 Nigerian census, the LGA had a population of 209,437 in an area of 8.7 km². The LGA only covers the western half of Lagos Island; the eastern half is under the jurisdiction of the LGA of Eti-Osa.

Lying in Lagos Lagoon, a large protected harbour on the coast of Africa, the island was home to the Yoruba fishing village of Eko, which grew into the modern city of Lagos. The city has now spread out to cover the neighbouring islands as well as the adjoining mainland.
Lagos Island is connected to the mainland by three large bridges which cross Lagos Lagoon to the district of Ebute Metta. It is also linked to the neighbouring island of Ikoyi and to Victoria Island. The Lagos harbour district of Apapa faces the western side of the island. Forming the main commercial district of Lagos, Lagos Island plays host to the main government buildings, shops and offices. The Catholic and Anglican Cathedrals as well as the Central Mosque are located here.
Historically, Lagos Island (Isaleko) was home to the Brazilian Quarter of Lagos where majority of the slave trade returnees from Brazil settled. Several families lived on Broad street in Marina. (Website: http://www.lagosstate.gov.ng/)

5.2 SITE ANALYSIS

5.2.1 LOCATION

The site is located on the Marina Street by the Lagos lagoon on the Lagos Island. Lagos Island is the principal and central local government area of the Metropolitan Lagos covering an area of 8.7 km². The LGA only covers the western half of Lagos Island; the eastern half is under the jurisdiction of the LGA of Eti-Osa. Forming the main commercial district of Lagos, Lagos Island plays host to the main government buildings, shops and offices. The Catholic and Anglican Cathedrals as well as the Central Mosque are located here.
Figure 5.3: Map of marina

Source: Google map.com
Figure 5.4 Map of Lagos Island

Source: Lagos Island Local Government (2007)
5.2.2 ACCESSIBILITY

The site of the project is opened to Marina Street and has short connecting routes with Broad Street. Both vehicular and pedestrian movements are profound around the site and is easily accessible from all the high rise buildings with an average walking time of 4 minutes. Marina street, which connects the site is also open at both ends, one end having access to the main Ring Road.

Lagos Island is connected to the mainland by three large bridges which cross Lagos Lagoon to the district of Ebute Metta. It is also linked to the neighbouring island of Ikoyi and to Victoria Island. The Lagos harbour district of Apapa faces the western side of the island.

5.2.2.1 HUMAN TRAFFIC

Marina Street is very busy, continuously bustling with high human traffic constantly moving along the streets. This is because of the vast variety of commercial activities that takes place here. At peak hours, the sidewalks are maximally utilised by pedestrians, because of the connection of Marina street to the bus stops and other exit points.
5.2.3 DRAINAGE

The site has no natural relief drainage as it is already in steady use and has a generally flat topography. Though, it has already has some man-made drainages by the sides of the road.

5.2.4 SOIL TYPE

The soil type on the site is loose lagoon sharp sand and of natural inability to retain water. This soil has loose grains and generally tiny particles and therefore classified as sandy
soil. Due to the low strength of sandy soils, it would be of necessity to make use of a good raft foundation or piles for high rise buildings, as the soil would not adequately support multi-storey structures all by itself.
5.2.5 STREET CHARACTER

All the buildings along the Marina street are high rise with an average of 12 storey. This character is indicative of a central business district for which this project is perfectly suited for.

5.2.6 ELECTRICITY AND WATER SUPPLY

The street is well equipped with all electricity facilities, from poles to transformers, though, due to the erratic supply of electricity in Nigeria and as a need for backup, all buildings in this area have their own private power generating plant.

5.2.7 ROADSIDE TRADING ACTIVITIES

A broad view down Marina and Broad Street cannot omit the strong presence of roadside petty traders. These people have found their businesses lucrative – selling goods to the ever busy office workers, especially after work hours, shortly before they retrieve their cars around the existing parking facilities.

These traders trade in almost any thing, from clothing to food, stationery, art etc.
Plate 5.2 different view of the busy activities in Marina Street

Source: Field Survey (2008)

5.3 PHYSICAL FEATURES

5.3.1 Temperature

Lagos is a warm place with little change from month to month. It has the warmest months between February and April and the coolest from July to August.
Nigeria can be classified into four major climatic zones for which Lagos state falls into zone 4 – Subequatorial south which is a zone of warm humid climate.

Figure 5.5: Map of Nigeria showing the various Climatic zones.

Source: Iloeje (1977)
This comprises areas of mean daily maximum dry bulb temperature during the dry season exceeds or equal 30°C and relative humidity lies between 70 to 100%. The daily range of temperature is less than 8°C.

5.3.2 Rainfall

Lagos climate generally has a high average rainfall during the year at 1185mm. Records over the years have shown that the average rainfall each year fluctuates. Lagos has two main seasons, the dry season (from November to February) and the wet seasons (from March to October) when high rainfalls are experienced.
Figure 5.6 Map of Nigeria showing the Rainfall distribution across regions

Source: Iloje (1977)

5.3.3 Soil type

Generally, Lagos has a sandy soil. This is characterised by loose sand grains and tiny particles. Some areas have alluvial soils which are as a result of its proximity to the
coasts. The alluvial plains are formed as a result of the gradual deposition of sand formed by the flowing water.

Figure 5.7  Map of Nigeria showing soil type distribution

Source: Iloeje (1977)
Figure 5.8 Climates and Daylight Chart for Lagos, Nigeria

Source: http://www.climate-charts.com/Countries/Nigeria.html

5.3.4 Humidity
Due to the location of Lagos State on the globe, it experiences damp weather for most of the year. The damp air usually blows hinterland from the Gulf of Guinea. This damp air does not always result to rainfall.

The average humidity experienced is about 80% during the wet season. During the harmattan, the air becomes very dry and the humidity fall as low as 50%.

5.3.5 Relief

Lagos is located on the narrow coastal lowland of south-western Nigeria along the Atlantic Guinea of West Africa. This region is part mainland, part lagoon stranded behind sandbars, and part Island separated by creeks. It is low lying and marshy and lies about 15 meters above the sea level. It is only along the sandy beaches and on elevated area inland that dry patches occur.

Much of Lagos and its metropolis is characterized by swamps, marshes and lagoons on which reclamation work had been done to make the expansion of the city possible.
Figure 5.9: Map of Nigeria showing relief and topographical units

Source: Iloeje (1977)
5.3.6 Wind

The climate of Lagos state is affected by the two main air currents predominant in the West African region.

5.3.6.1 The North-East Harmattan bearing trade winds

This wind is responsible for the dry season that Lagos State experiences which reaches its harshness at its minimum in December. This wind carries along with it numerous particles and dust bringing about dry dusty weather and cool nights.

5.3.6.2 The Predominant South-West Trade winds

This wind is responsible for the wet seasons experienced in the area. It is a rain bearing wind bearing substantial moisture content which could precipitate as rain when heavily laden. It blows in the North-Eastern direction on the map over the Gulf of Guinea, bring rain hinterland.
Figure 5.11 Site analysis

Source: Author’s Research (2008)
EXISTING FEATURES

KEYS
- Pink areas denote building structures which would be retained.
- Red areas indicate areas with existing structures which would be demolished or relocated.
- Black lines outline fences or other demarcating features.
Figure 5.12 Site Existing Features

Source: Author’s Research (2008)
6.0 GENERAL DESIGN CONSIDERATION

As has already been discussed, a good parking system helps to clear the urban spaces of the indecency and waste of large areas of open land being daily converted to parking spaces that are not aesthetically pleasing with reduced functional efficiency. The overall increasing population of Lagos state over the past years, with the attending increase in business activities within the Lagos Island central business district, basically within high rise buildings along the Marina and Broad streets led to the execution of certain measures. Under the United Nations standard of rating, Lagos state is to be classified as a Megacity with its population of 17,552,942. The United Nations also estimates that at its present growth rate, Lagos state will be third largest mega city in the world by 2015 after Tokyo in Japan and Bombay in India.

6.1 CHOICE OF SITE LOCATION

The Lagos State government after analysing these alarming statistics and with the rate of decline in the city decided to launch a series of individual city rejuvenation programmes which are to touch areas such as transportation and urban planning.
Lagos Island, being at the hub of the Lagos economy has grown in population and level of prosperity over the years to a population of 859,849. The number of business operating on the island has also seen great increase with the attending increase in the work force and the need for transportation to and from their work places. This has gradually led to the inability of the existing car parking spaces to accommodate the car users and the gradual conversion of large open spaces into car parks creating an ugly urban experience in these areas.

Attempts have been made previously to begin a multi storey car park projects for the Marina. In front page publication in the Financial Times of August 30th 2007, the chairman of the Lagos Island Local Government Council announced that construction would soon begin on a N300,000,000 'Multi-storey car park' structure on the Marina projected to accommodate 4500 cars. The announcement associated Messrs Bouygues Construction with this project, possibly as a turnkey contractor (David Aradeon, 1996).

The duty of the architect that differ him from the engineer is his ability to make his inventions enhance the social life of the people’s everyday life. As such, it would be very inappropriate to have a rigid structure just serving one function, but rather versatile to accommodate facilities that would make life more sociable and functional for human while meeting its aesthetic demands on the outlook. In serving these, the need for other public space arises.

6.2 DESIGN REQUIREMENTS
Parking as part of an overall transportation system is one of the crucial issues of our times. As the number of automobiles increases exponentially, the need to house them in close proximity creates a challenging design problem. Although car parks can take many forms as stand-alone or part of a mixed-use structure, self-park or valet, and automated in urban or rural settings, all car parks should seek to meet the following basic criteria:
6.2.1 Functional Requirements

The car park or lot must foremost deal with the Functional/Operational need - as in providing for safe and efficient passage of the automobile. This is a very complex challenge as automotive, engineering and traffic issues relative to site locations must be integrated to create the appropriate solution. Therefore designing the parking garage requires an integrated design approach of many professionals. Parking has often been reduced to the construction of the most minimal stand-alone structure or parking lot without human, aesthetic or integrative considerations. This has given parking a poor public perception and has frequently disrupted existing urban fabric. However, many architects, engineers, and planners have envisioned and constructed far more complex, aesthetic, and integrative structures. This should be the goal of good parking design.

The car park should account for the complex spatial needs of the driver and the automobile:

- The size, height, and turning radius of current automobiles as well as past and future trends of automobile size and statistical quantity must be taken into account these are called parking geometries.
• There are many ramp design configurations and different ones are appropriate for the primary purpose of the facility to insure that your intended use is compatible with ramp design.

• The streets surrounding the garage and their traffic flow must be taken into consideration when planning entrances and exits and deciding on ramp designs.

• The entrances and exits are very important to the smooth functioning of the garage, with the type of use again determining the length from the opening and placement of the entry booths, as well as the quantity of entrances and exits.

• The type of equipment and the necessity of a booth and office are also determined by the garage use.

• Optimizing site potential, by choice of site and its relationship to walking, driving, other transportation linkages and good design opportunities.

• The operation and maintenance of a garage is very critical. Revenue control equipment and other issues related to the smooth functioning of the garage must be taken into account during the design process.

• Provide for appropriate work space for the staff, such as cashier and monitoring equipment.

• Provide an area or room for the storage and maintenance issues. This area should be heated/air-conditioned and contain a mop sink.

• Accommodate technological tools for future upgrades of operational systems and facility expansion.
• Plan for a back up power system.

• Ventilation is an issue within some types and some areas of parking garage design. New technologies are increasing the effectiveness in design and monitoring of these areas for concern. Natural ventilation is always a good method however detailed study is required in some areas and types of parking garage design to determine its effectiveness.
6.2.2 Structural Integration

The efficient integration of structure is crucial to maximum functioning of the garage:

- The parking garage is typically an exposed structure and must be designed to withstand all aspects of environmental conditions.
- There are ideal structural bays that allow for maximum number of parking spaces and flow of automobiles dependent upon site and structure.
- Cast in place concrete, pre-cast concrete and structural steel can be used for the structural design.
- Typical construction issues such as natural hazards in the location of construction apply and compound the solutions in designing a structure that is completely exposed to the weather and constant movement from automobiles.
- Size and length of some structures compound the expansion and contraction issues already of key importance in garage design.
- The surface of the "floor" of the garage is important to slippage issues as one must always design a garage as a fully exposed building for the safe use by both the automobile and pedestrian.
- Drainage and floor slope is very important, as ponding water can create long term maintenance problems.
6.2.3 Safety and Security

Safety and security of the people using the garage are of paramount importance:

- Open, glass stairwells and glass-backed elevators.
- Security devices such as video, audio and emergency buttons that call into the booth or local police station.
- Public telephones
- Eliminate potential hiding places, such as under open stairs.
- Handicap accessibility with vehicles close to stair and elevator cores having a direct path to key movement patterns of the garage.
- To avoid carbon monoxide build-up, air flow is adequately designed for through mechanical and/or natural ventilation.
- Non-slip floor surface
- Design for the points of intersection between man and the automobile for adequate safety of movement.
- Energy efficient lighting is very important in garage safety but can pose problems with spillage out of the garage onto neighbouring communities. A balance between day lighting, interior lighting and exterior control can be addressed in many ways on the exterior design of the façade while providing adequate lighting within. Lights should be vandal resistant and easy to maintain.
6.2.4 Signs and direction

- Color-coding, numbering, visual cues, music, and even machines for marking your ticket with your exact location to locate your car for easy retrieval.
- Locate signs in areas where driver can read in a timely fashion.
- Clear, simple, and direct messages.
- Floor coding can be useful.
- Signage should locate all major internal pedestrian access points as well as external major roads and buildings.

6.2.5 Aesthetics

Aesthetics of garage design has become very important to communities across the country:

- Recently garage design has become part of an architectural style of the surrounding architecture, respecting the language of design and using the design process.
- The historic preservation movement was one of the key issues in garage design as garages were needed to revitalize dense older urban fabrics without destroying the architectural context. Many excellent examples can be found across the country solving these contextual issues.
- The Parking garage itself is now also part of the historic preservation movement as some older existing structures can and should be designated for preservation.

- The Parking Facility has played an important role in design evolution throughout its history often being the leader in many crucial design issues; it is truly a unique and important civic building. Perhaps one of the most important design laboratories of the 20th century it has become the gateway to our buildings and cities.

- Maintain the urban street front by having the sidewalk condition of the garage contain stores or provide a safe and pleasant walk experience.

- Using landscaping and changes in architectural materials forms, and scales to enhance the garage façade along the street. Use landscaping to shied and enhance parking lot design.

- Architecturally breaking down the scale of the large structure along its façade.

- Designing beautiful stairs and elevator cores to enhance the community and walking experience.

6.2.6 Integrated and Mixed-Use Design

Multi-Storey car parks are often connected to other uses:

- The garage has always been a mixed-use structure combining and often connected with all other building types.
• Plan for any loading or unloading conditions required by mixed-use, so as not to interfere with garage traffic.
• Separate roofing and structural system for any human-occupied space within garage.
• Provide for simple and well-designed movement systems for pedestrian and automobiles.
• Many garages are combined with almost any use imaginable such as a playing surface on the roof requiring green architecture, so enjoy the possibilities of integrating a fully functional structure requiring many technological advances.
• Surface parking lots can be designed to become mixed-use plaza spaces.
• The garage has often in its history been part of a multi-modal system linking different forms of transportation.

6.2.7 Environmental Issues

The car in its' early years was the environmental saviour of our cities and towns, eliminating animal waste and carcasses in our streets, part of the cause of many health and environmental hazards at the beginning of the century. But as their numbers and use have increased dramatically they have become part of the current environmental problems. New fuel sources for the automobile can eliminate these air pollution hazards and automobile manufacturers are working on the solutions. Parking lots as large areas of paved surfaces contribute to warming trends in cities and have altered local weather
patterns. Large areas of paving that have absorbed oils, fuels, road salts, and other materials contribute to problems in water runoff and pollution. Garages and parking lots need to address these issues exploring porous paving in lots and best practices of water run-off issues.

6.3 CONSIDERATION BEFORE THE CONSTRUCTION OF MULTI-STOREY CAR PARKS.

a. Proximity
Annual customer surveys indicate proximity to destination is by far the dominant issue in the parking decision of users. All other aspects of the car park, including design, are secondary to convenience, but this is no excuse for poor design.

b. Accessibility
The car park should be easy to find in the street network. The entrances should be located by main roads where they can be more easily utilised. Where entrances are hidden there is an absolute requirement for high visibility on-street signage taking motorists from the street directly to the car park entrance. Similarly for departing cars, signage should lead them smoothly back to the main streets with clear directions to major landmarks or destinations to avoid disorientation.
External signage should indicate where the entrance is and once at the entrance the control system should be self-explanatory. The car park should be easy to enter and should be clear from the earliest possible point.

c. Navigation and way finding

Navigation of the structure and location of vacant spaces should be easy for all motorists. Clear internal signage and floor markings directing cars to "parking" are fundamental but frequently neglected features of new car parks. It is recommended to have fluorescent lamps as directional aids e.g. along the spine of the decks. They should be installed lengthways while at crossing points/ramps (min. 3m wide), junctions etc., and they can be at right angles to the traffic. The biggest challenge here is to convince structural engineers/developers of the merits of column free construction in car parks. Structural columns and mass concrete walls make a car park interior into a nightmare for many drivers.

d. Pedestrian circulation

Pedestrian routes, walkways, stairways, lobbies, lifts (min. 2 x 13 person) should all be easy to follow and use. It is easy to forget that for every car that park in a facility, there are likely to be twice as many pedestrian movements. These pedestrians are fragile compared to the cars they arrived in and may have young children, infants in prams or hyper active teenagers, or they may be older or mobility impaired; returning to their cars,
they may have heavy shopping in bags or trolleys. All of these factors have to be considered. In half deck designs it is common to have lifts and stairs on one side of the structure only with the consequence that patrons have to navigate from one half decks to another and frequently this is done via the vehicle ramps.

e. Lighting

A major issue for pedestrians is the impact of design on their sense of well being and personal security. It is easy to address many of the facets that impact on this lighting levels are critical, with a minimum standard of 100 lux at 1m now the norm. Lighting levels at lobbies and entrances/exit should be a minimum of 250 lux.

f. Safety and security

It is recommended that all doorways be of clear glass so that patrons can see through the obstacle. Lift lobbies should be enclosed only as a last resort and then with glass filled walls/doors. Lift doors should be of glass. Stairways accessible to the public should be wide and bright. All pedestrian routes should be clearly signposted in both directions and levels should be clearly numbered.

The lobby should be clean, clear and bright with no corners or alcoves where troublemakers might hide. The lobby should have close contact with the staff office and be overlooked at all times.
g. **Internal finishes**

Floors should be tamped or stippled concrete with only pedestrian walkways painted. Painted floors are impossible to maintain to any high standard. Walls, columns, doors and ceilings should be painted and decorated to brighten the car park. Walls should be painted black to about 450mm to camouflage soot marks from car exhausts.

Seek the provision of well located car parking spaces, multi storey car parking being the preferred option and to ensure that adequate and convenient car parking spaces are provided

- a. To ensure, through price control measures, that the city centre car parking spaces are for short stay purposes;
- b. To reserve suitable locations in the Environs of the City for park and ride facilities
- c. To ensure suitable parking for long-stay;
- d. To locate strategically disabled car-parking bays.

h. **Pedestrian and ramp edge restraint specification**

Restraints should be provided to a height of 1.1m above the highest foothold. This retains the current requirements for pedestrian guards and ramp guards. These should restrain 1.5kN/m on the balustrade handrail, 1.5kN at any point location, should resist the passage of a 100mm diameter ball, and be of adequate height to restrain children. The
specification clarifies the need to take account of the attraction for children of climbing on vehicle restraints. (Jolly, 2001).

i. **Stairwell edge protection**

The same requirements should apply to stairwell edge protection, as at the edge of the deck. This recognizes that the risk to pedestrians within stairwells of vehicles or dislodged masonry falling on them is the same as at the edge of car park decks. (Jolly, 2001).

**6.4 DESIGN BRIEF**

To design a multi storey car park that would park 2500 cars conveniently and add social and aesthetic values for the Lagos State Government.

A detailed field study of the existing problems in the Marina area has led to the development of the need for certain spaces within the multi-storey car park to accommodate certain activities. These activities include:

**MULTI-STOREY CAR PARK**

1. The parking stalls
2. Parking stall for the disabled
3. Auto-mechanic workshop
4. Vulcanizer’s workshop/garage
5. Security posts
6. Ticketing areas
7. Stairwell
8. Lifts
9. Ramps
10. Conveniences

PUBLIC AREAS

1. concourse
2. smoker’s lounge
3. periodicals
4. management offices
5. lettable shops and offices
6. restaurant/canteen
7. snack bar
8. drinks bar
9. conveniences

6.4.1 Concourse
This space is to serve those who have to wait for one reason or the other within the car park. This may be especially for drivers who have to hang around during their work hours. They could relax and keep busy in these areas instead of hanging around.

6.4.2 Smokers’ lounge

When designing any public building, a place should be kept for smokers. The space should be well furnished with sofas and should include a bar. It should also have spaces for board games and pool.

6.4.3 Periodicals

This is an area where people can purchase and read newspapers, magazines and journals. This space should be designed with shelves and racks to display the sales items and a lounge for people to sit and read various materials. It should be located around the main concourse, but sectioned off by glass partitions, giving a through view into the concourse.
6.4.4 Management offices

These are offices to be used by the staffs in charge of the car park facility. These offices should include a head security office, manager’s office, secretary, asst. Manager, and maintenance office. Usually, the space requirement for an office ranges from 9.0m$^2$ to 24m$^2$

6.4.5 Lettable shops

These shops are designed to be rented out. They would be designed to have good views and accessibility from the concourse and outside the building as marketing for the goods to be sold.

6.4.6 Restaurant/Canteen

Within the existing parking space are small eateries. This serve the drivers who await their bosses and the bosses during their break and for those who may like to eat after the day’s work before their drive home.

The restaurant is a very important feature in any public building and should be ideally located to have a good visual relationship with the public spaces and concourse for the purposes of self advertisement and convenience. The restaurant would have two sections, and area that would be serviced by waiters and another which would take the form of a cafeteria layout, having a servery and ticketing space.
The four seat table arrangement shown below would be used in the restaurant because of the convenience and ease of movement it affords.

Figure 6.1 Seating analysis for Restaurant

Source: Neufert (2000)
The capacity of a restaurant kitchen is basically dependent on the number of customer seats, customer expectations and the proportion of raw materials which have to be freshly prepared. Usually, a restaurant kitchen uses up between 15 – 35% of the overall restaurant space or more depending on the storage requirement and cooking variety. Considering a small restaurant with seating capacity of 80, the amount of spaces for various kitchen functions can be calculated using the table below:
<table>
<thead>
<tr>
<th>restaurant size/seats</th>
<th>small (up to 100)</th>
<th>medium (up to 250)</th>
<th>large (&gt; 250)</th>
</tr>
</thead>
<tbody>
<tr>
<td>goods receipts</td>
<td>0.06–0.08</td>
<td>0.05–0.07</td>
<td>0.04–0.06</td>
</tr>
<tr>
<td>empties</td>
<td>0.05–0.07</td>
<td>0.05–0.07</td>
<td>0.04–0.06</td>
</tr>
<tr>
<td>waste/refuse</td>
<td>0.04–0.06</td>
<td>0.04–0.06</td>
<td>0.03–0.05</td>
</tr>
<tr>
<td>office – stores manager</td>
<td>–</td>
<td>–</td>
<td>0.02–0.03</td>
</tr>
<tr>
<td>supplies/waste disposal</td>
<td>0.15–0.21</td>
<td>0.14–0.20</td>
<td>0.13–0.20</td>
</tr>
<tr>
<td>pre-cooling room</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cold meat store</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dairy products store</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cold vegetable/fruit store</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>deep-freeze room</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>other cold stores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(patisserie/cold meals)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chilled goods storage</td>
<td>0.04–0.31</td>
<td>0.21–0.26</td>
<td>0.16–0.21</td>
</tr>
<tr>
<td>dry goods/food store</td>
<td>0.13–0.15</td>
<td>0.12–0.14</td>
<td>0.10–0.12</td>
</tr>
<tr>
<td>vegetable store</td>
<td>0.08–0.10</td>
<td>0.06–0.08</td>
<td>0.04–0.06</td>
</tr>
<tr>
<td>daily supplies</td>
<td>0.04–0.06</td>
<td>0.03–0.04</td>
<td>0.02–0.03</td>
</tr>
<tr>
<td>ambient storage</td>
<td>0.25–0.31</td>
<td>0.21–0.26</td>
<td>0.16–0.21</td>
</tr>
<tr>
<td>vegetable preparation</td>
<td>0.08–0.10</td>
<td>0.05–0.08</td>
<td>0.04–0.06</td>
</tr>
<tr>
<td>meat preparation</td>
<td>0.06–0.09</td>
<td>0.04–0.07</td>
<td>0.03–0.05</td>
</tr>
<tr>
<td>hot meals</td>
<td>0.26–0.33</td>
<td>0.19–0.24</td>
<td>0.15–0.21</td>
</tr>
<tr>
<td>cold meals</td>
<td>0.13–0.15</td>
<td>0.09–0.12</td>
<td>0.07–0.11</td>
</tr>
<tr>
<td>patisserie</td>
<td></td>
<td>0.07–0.10</td>
<td>0.06–0.09</td>
</tr>
<tr>
<td>container washing</td>
<td>0.05–0.08</td>
<td>0.04–0.06</td>
<td>0.03–0.05</td>
</tr>
<tr>
<td>office – kitchen manager</td>
<td>0.03–0.05</td>
<td>0.02–0.03</td>
<td>0.02–0.03</td>
</tr>
<tr>
<td>kitchen area</td>
<td>0.60–0.80</td>
<td>0.50–0.70</td>
<td>0.40–0.60</td>
</tr>
<tr>
<td>dishwasher</td>
<td>0.10–0.12</td>
<td>0.09–0.11</td>
<td>0.08–0.10</td>
</tr>
<tr>
<td>servery/waiters’ equipment</td>
<td>0.06–0.08</td>
<td>0.08–0.10</td>
<td>0.10–0.15</td>
</tr>
<tr>
<td>staff washing facilities and WC</td>
<td>0.40–0.50</td>
<td>0.30–0.40</td>
<td>0.28–0.30</td>
</tr>
<tr>
<td>= in total</td>
<td>1.60–2.10</td>
<td>1.50–2.00</td>
<td>1.30–1.80</td>
</tr>
</tbody>
</table>

Table 6.1 Analysis of kitchen space requirement
Source: Neufert (2000)
6.4.7 Snack bar

Snack bars would be located at strategic points around the building. They would be designed as lettable spaces to snack operating companies, such as Mr. Biggs, Chocolate Royale. To be able to eat comfortably on a counter top, a user requires a space of 600mm by 40mm. It is very necessary to leave spaces for thoroughfare around the snack bar.

6.3 Space requirement for snack bar

Source: Neufert (2000)
6.4.8 Drinks bar

These are bars which are to sell alcoholic drinks. They would be located at reserved areas, not completely open to the concourse. The space requirement for the drinks bar can be estimated on an almost equal basis to that for the snack bars. This is because of the similarity in counter top and stool dimensions.

6.4.9 Conveniences

All conveniences would be located at areas with high pedestrian traffic to prevent acts of crime in and around it.

6.4.10 Parking bays

This is the area marked out within the building where cars are to be parked. Field estimates require the facility to be able to park above 2,500 cars. The estimated requirements for disabled people in parking lots is usually 5%, as such 600 parking spaces would be required to serve the disabled persons.

6.4.11 Security post

These are spaces which are to be designated as points where security personnel would be positioned. This space is supposed to be at a vantage point visually so as to see a wide area of the parking. This space should be able to accommodate a chair, a table to write upon and a hanging rack for coveralls/uniforms.
6.4.12 Stairwells and Lifts

These are spaces designated for vertical movement within the building structure. They are to be well distributed around the building for ease of movement around. The stairwells are to be well lighted and open to prevent crimes. Average stair riser height should not exceed 150mm as the building has mixed users. The building facility would have rush hour periods on an almost daily basis on various hours and as such, the stairwells must avoid turn along their lengths. This makes wide straight flight stairs the most suitable for use. Also, because of the rush hour traffic, the stairs must be wide enough to be able to accommodate at least three people walking side by side. As shown.
Figure 6.4: Stair Case with Three People Climbing Side-By-Side

Source: Neufert (2000)

6.4.13 Ramps
This is the space which provides vertical transport within the building for the vehicles. It should slope at about 15% and link directly with from one level to another or an intermediate level.
6.4.14 Conveniences

This must be located on the ground floor. Avoidance of this space on the upper floors is generally for security reasons. The location would be along the generally busiest area where there is constant human activity for safety. Experience over time has shown that unless the toilets are staffed and closely monitored they become magnets for a wide range of anti-social activity. A key controlled toilet operated in the way that many petrol stations do is an option except where it is in a public area.

6.4.15 Lettable shops and Offices

These shop spaces are to accommodate activities that hang along the street. These activities thrive in this area because of the patronage of the workers who use the vehicles car parks. Some may want to make a brief shopping or chore immediately after work each day. It would therefore be very convenient to locate such service and goods, by creating spaces for them.

6.4.16 Auto-Mechanic workshop

The auto-mechanic workshop normally must be able to cater for at least six vehicles at a time and requires only a front access. This workshop would be capable of carrying out day to day maintenance and repairs, including and equivalent of MOT testing, standard servicing and body repairs. They are not expected to replace engines or crankshafts or do
other heavy repairs and/or body works. Finishes for workshop space must be use robust and durable floor non-slip surfaces.
## SPACE PROGRAMMING

<table>
<thead>
<tr>
<th>Space description</th>
<th>Area (m²)</th>
<th>Quantity</th>
<th>Total (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking stall</td>
<td>22.1</td>
<td>2,375</td>
<td>52,487.5</td>
</tr>
<tr>
<td>Disabled parking</td>
<td>25.6</td>
<td>125</td>
<td>3,200</td>
</tr>
<tr>
<td>Auto-mechanic</td>
<td></td>
<td>1</td>
<td>132.6</td>
</tr>
<tr>
<td>Car wash</td>
<td></td>
<td>1</td>
<td>132.6</td>
</tr>
<tr>
<td>Vulcaniser</td>
<td></td>
<td>1</td>
<td>44.2</td>
</tr>
<tr>
<td>Security posts</td>
<td>4</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>Ticketing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stairwell</td>
<td>8.64</td>
<td>12</td>
<td>103.68</td>
</tr>
<tr>
<td>Ramps</td>
<td>60.9</td>
<td>10</td>
<td>609</td>
</tr>
<tr>
<td>Conveniences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concourse</td>
<td>1</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Smokers’ lounge</td>
<td></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>Periodicals</td>
<td></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>Management offices</td>
<td>12</td>
<td>5</td>
<td>60</td>
</tr>
<tr>
<td>Lettable shops</td>
<td>54</td>
<td>10</td>
<td>540</td>
</tr>
</tbody>
</table>
### Restaurant/canteen

<table>
<thead>
<tr>
<th>Area</th>
<th>Space (m²)</th>
<th>Seats</th>
<th>Cost (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dining area</td>
<td>1.495</td>
<td>300</td>
<td>448.5</td>
</tr>
<tr>
<td>convenience</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Kitchen

<table>
<thead>
<tr>
<th>Area</th>
<th>Space (m²)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation area</td>
<td></td>
<td>180</td>
</tr>
<tr>
<td>Wet storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry storage</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Day store</td>
<td></td>
<td>75</td>
</tr>
<tr>
<td>Waste disposal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changing rooms</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Dishwashing</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Waiters’ area</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area</th>
<th>Space (m²)</th>
<th>Seats</th>
<th>Cost (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snack bar</td>
<td>50</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>Drinks bar</td>
<td>50</td>
<td>1</td>
<td>50</td>
</tr>
</tbody>
</table>

**TOTAL** 69532.98

**Table 6.2: space programming table**

**Source:** Authors’ research (2008)

6.5.1 **EQUIPMENT AND OPERATIONAL REQUIREMENTS**

6.5.1 **Close circuit cameras**
This is a very important feature in car parks. It helps to monitor the parking areas to help prevent crimes. Lot crimes are known to be committed in car parks on a daily basis. Statistics show that the mere presence of CCTV reduces crime by 35%. Cameras would be mounted at angles which would give a wide range of visibility. All cameras would be connected to the security office where images are being recorded and stored in safes.

6.5.2 **Electronic parking system**

The multi-storey car park is going to be designed as an automated parking system. The automation would be in the ingenious use of electronic systems to inform the users before entering the parking bays of available car parking spaces available. The system would also be able to indicate the available parking stall which are vacant and allocate spaces to coming users. This automation helps to reduce the time usually spent in most car parks searching for a vacant stall. The user simply identifies the vacant stall and moves straight on to park.

6.5.3 **Electronic ticketing system**

The ticketing system to be used would be completely electronic. It would function in such a way that it calculates the actual time spent on the parking stall and bill the user as required. This electronic system would also help to check irregular parking by billing fines from the users or refusing them exits.
These two electronic systems would work hand in hand to achieve best results. For proper monitoring and control, two variants systems would be put in place, one to take care of the everyday users (long stay users) and the other to take care of occasional users (short stay).

a. **Long stay users – ticketing**

Long stay users who come to work everyday and spend longer times would have to obtain a prepaid parking card. The unit parking time for the long stay users would be cheaper than that for short stay to encourage users to book for long stay cards. On entry, the cards would be swiped at the card collection point, the timer begins to count. On exit, the cards again swiped, stopping the timer and deducting the cost of parking accordingly from the card.

b. **Short stay users**

These are users who come in occasionally to carry out business transaction, visitation, interviews, meeting etc. On entry, these users would collect a card which would be automatically dispensed by the electronic device. The timer then begins to tick. On exit, the card is slotted into a collection device which prints a bill of the time spent and the attending cost. The user pays the appropriate amount to the staff stationed for this purpose at the exit point.
All the above mentioned electronic equipments require constant power supply for their efficient function. It thus requires having a backup power supply or UPS (uninterrupted
power supply) that would be able to last at least 30 minutes. This would help to cover the periods between switching of power supply from the mains to standby generators and also help to cater for short periods of technical discrepancies in the power supply.

6.6 PLANNING REGULATIONS

The following planning laws are those relevant for commercial developments from the Lagos Island Urban and Physical planning department.

- The set back for commercial areas are as follows
  
  From front   6m
  From sides   6m
  From back    3m

- For buildings with ground floor area of 1000m² could go up to heights of 4-5 floors.

- Buildings with ground floor area of above 2000m² could go up to heights of 10 floors.

- The ground floor area for all storey buildings should be open for parking.

- The set back for any development from the lagoon is 50m
CHAPTER SEVEN

7.0 DESIGN APPROACH

The architecture of any building structure is a complex embodiment of the various conclusions of different thought process. As such, it is easier to deal with these thought processes individually and then synthesize them into an overall design. The issue to be dealt with is single for this design are as follows below.

7.1 SITE SPACE USAGE

Since the aim of the design is space management to free up the amount of land used up as parking, it would therefore be necessary to know which part of the site is to be utilised for the purpose of the design and which is to be freed up.

The figure below shows the total amount of space that has been allocated to solve the parking problems along the Marina Street. The scope of this design shall utilise the space marked out in the figure below between bordered by Oando petrol station to the West and the CMS road to the East.
Figure 7.1: Total site area

Source: Lagos Island Local Government
Figure 7.2: Total site area

Source: Lagos Island Local Government

7.2 ZONING
The peculiarity of this design is that it is to cater for humans and most especially automobile. Consequently, the zoning considerations are in a different perspective. The site functions are divided into three:

(a) The multi storey car park

(b) Public areas

(c) Ancillary facilities

The zones would be arranged such that the multi-storey car park is situated at the rear end of the building. The public area would have the main pedestrian access and would be situated at the front close to the ancillary facility area of the building to ease accessibility by pedestrians.
Figure 7.3: Zonal Relationship

Source: Author’s Research
7.3  SPATIAL RELATIONSHIP

The spaces are going to be related in their respective zones as shown in the bubble diagram below. The spatial relationship would be to enhance the circulation of the pedestrians within and around the building. The most related spaces are to be closely linked.

The traffic flow is such that it enhances security of pedestrians within the building.
Figure 7.4: Ancillary facility Bubble diagram

Source: Author’s Research
Figure 7.5: Multi storey car park bubble diagram

Source: Author’s Research

7.4 DESIGN PHILOSOPHY

In the process of evolving a design, an approach is taken which must employ a system of thoughts or underlying set of principles. The utmost purpose of a building is to serve a function. In addition to function, buildings are designed to create an impression,
expressed through forms. No wonder it is said that every architectural object has a communicative power. Through symbolism, buildings express their function to the onlooker. This is important in the design of a multi-storey car park complex since the building is meant to advertise itself.

While giving the building a communicative ability, the designer applies the programmatic concept in which he responds to the pragmatic requirements of the multi-storey car park complex.

7.5 DESIGN CONCEPT

The concept of this design is:

“To enhance smooth circulation of automobile from the access road; (off traffic) into and out of the complex, back unto the access road in a manner reminiscent of the ant’s escape when the ant hill is attacked. The ants move out from a core and move down in different direction; the ant finding its escape through every possible exit unto level ground again.”

The formulation of this concept is based on the need for ceaseless traffic into the building and bearing in mind that there are daily rush hours especially after work when there needs to be a mass exit possibility. The evolution of this concept can be expressed in sketch as shown.
7.5.1 Evolution of Elevation Form

The form of the elevation is also derived from the functional concept of the design. The elevation is to be a form in abstraction of the original ‘ants escaping from an ant hill’ idea in two places.
7.6 PREVALENT ARCHITECTURAL STYLE

The prevalent architecture in the location of the site is the international style in architecture. The international style in architecture was the principal architectural trend of the 1920s and 1930s, which began in Europe. The style consists of geometric and asymmetrical forms expressed in modern materials as concrete, steel, and glass and arose out of the desire of such architects as the Germans Walter Gropius and Ludwig Mies van der Rohe and the Swiss-French Le Corbusier to break with architectural tradition and to design simple, unadorned buildings that served the basic needs of their users and the demands of urban planning.
All buildings along the Marina Street are high rise structures in the international style with the use of concrete and glass being predominant.

In designing any building form within the vicinity of this project, it is very necessary to consider styles that would be perfectly integrated into the surrounding in the use of materials and form.

7.7 STRUCTURE AND GRID PATTERN

A multi storey car park requires a lot of structural details as it is supposed to withstand very heavy loads during its lifetime without failing.

A careful consideration of various factors leads to the use of a grid of 10.2m * 7.2m. This grid was arrived at due to the consideration of space between columns and the accommodation capacity. Using 7.2m from column to column would enable three cars park conveniently between columns. The grid dimensions were also considered on the bases of the material use. The material to be used is concrete. Concrete can handle this dimension structurally only with the use of special floors supported on massive columns which have already been given allowance for in the grid choice.

7.8 FLOORING

The need to have large span of floors supporting heavy loads develops the need for special floors. A careful consideration of the various floors leads to the use of double
beam floors. Double beam floors usually have main beams distributing load from beam to beam and the auxiliary beams which run from beam-end to beam-end of the main beams to transfer load from the mid-span of the floor to the main beams and onto the columns.

![Figure 7.8 Double beam floor](image)

**Figure 7.8 Double beam floor**

*Source: Ching (2001)*

## 7.9 CONSTRUCTION TECHNIQUES AND COST

Construction of a massive building as this is very challenging and expensive. Because of these, the building is to be designed in modules. The module system is such that every unit of a module has similar facilities and its own exit points. This enables a phases-by-
phase construction process. The module system could also ensure safety: it is easier to curtail damage into a module than an entire structure.

The entire parking structure would be in concrete steel and glass. The main advantage of using concrete is fire safety, the high compressive strength, and the flexibility of uses it offers makes it a good choice. Glass is used mainly for security reasons to create see-through open spaces.
CONCLUSION

The Multi Storey car park complex for Marina, Lagos is a project which has been embarked upon as an academic exercise but not withstanding its potential for full execution. As a result, in-depth analysis and study of the project is very essential in order to get a good grasp of the design and what it entails as well as what is involved.

The study of the existing situation, analysis of the case study, other materials and professionals brought the realisation of the design. The design is going to successfully house the mass of cars parked on open ground surfaces along the Marina Street, allowing for more free open spaces. For the research, it can be seen that multi storey car parks are so important to urban areas that various governments in foreign countries are beginning to place legislation on them in the form of standards and requirements they must meet.

It is recommended that in managing the spaces left of our urban areas, a solution to the parking menace has to be proffered. A way out of this is through the use of multi storey car parks and parking legislations which will be functional and add to the aesthetics of the environment.

In conclusion, recognising the peculiarity of Lagos in terms of shortage of land for expansion purposes and the congestion in terms of housing, shops, markets, and other land uses competing for limited land space, it is necessary to accept that automobiles
have changed the city. It is hoped that this project will serve as a solution to various problems of parking and be used as a model in the development of multi-storey car parks.

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OTHERS


TYPICAL 1\textsuperscript{st}, 2\textsuperscript{nd} AND 3RD FLOOR PLAN

ROOF PLAN
TYPICAL FLOOR PLAN SHOWING ESCAPE ROUTES, WATER SPRINKLERS AND POSSIBLE CAMERA POSITION.
PERSPECTIVE VIEW