

PROPOSED IKORODU BUS TERMINAL
(EFFECTIVE CIRCULATION IN URBAN BUS TERMINAL)

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DECLARATION

I, JOSEPH, OLUSOLA OLADIMEJI (ARC/13/5730) of the Department of Architecture, School of Postgraduate studies, Federal University of Technology, Akure hereby declare that the information contained in this thesis is the result of honest research work undertaken and in its entirety, has been a personal academic exercise executed by me under the supervision of my supervisor Dr. A.A. Taiwo, and has not been presented either wholly or partially for any degree or diploma elsewhere before.

All sources of information and materials consulted have been duly acknowledged.

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.....
Date

CERTIFICATION

This thesis titled “**PROPOSED IKORODU BUS TERMINAL**” (Effective Circulation in Urban Bus Terminal) was in its entirety carried out by JOSEPH, Olusola Oladimeji as part of the requirements for the award of masters of Technology (M. Tech) in Architecture.

It also meets the prerequisite governing the award of the degree of masters of Technology, in The School of Postgraduate studies, Federal University of Technology, Akure and is approved for its contribution to knowledge and literary presentation.

.....

Dr. A.A. Taiwo
(Project Supervisor)

.....

Date

.....

Dr. A.A. Taiwo
(Head of Department)

.....

Date

DEDICATION

This thesis is dedicated to **God Almighty**, my source and maker, the one who gives me life in abundance.

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DECLARATION.....	ii
CERTIFICATION.....	iii
DEDICATION.....	iv
ACKNOWLEDGMENT.....	v
LIST OF FIGURES.....	xi
LIST OF PLATES.....	xiii
LIST OF TABLES.....	xiv
ABSTRACT.....	xv
CHAPTER ONE.....	1
1.0. INTRODUCTION.....	1
1.1. BACKGROUND OF STUDY.....	1
1.1. STATEMENT OF THE PROBLEM.....	2
1.2. JUSTIFICATION FOR THE PROJECT.....	3
1.3. AIM AND OBJECTIVES.....	3
1.4. LIMITATION OF THE STUDY.....	4
1.5. SCOPE OF THE STUDY.....	4
1.6. RESEARCH METHODOLOGY.....	4
1.7. EXPECTED CONTRIBUTION TO KNOWLEDGE.....	5
1.8. DEFINITION OF TERMS.....	5
CHAPTER TWO.....	7
2.0. LITERATURE REVIEW.....	7
2.1. HISTORY OF TRANSPORTATION (WORLD WIDE).....	7
2.1.1. LAND TRANSPORT.....	9
2.1.2. WATER TRANSPORT.....	10
2.1.3. AIR TRANSPORT.....	11
2.1.4. SPACE TRANSPORT.....	11
2.1.5. FUTURE OF TRANSPORTATION.....	12
2.2. THE NIGERIAN EXPERIENCE IN HISTORICAL PERSPECTIVE.....	15
2.2.1. THE NIGERIAN TRANSPORT SYSTEM IN PERSPECTIVE.....	16
2.2.2. ROAD NETWORK DEVELOPMENT (1960 TO 2006).....	17
2.2.3. CHALLENGES AND OPPORTUNITIES FACING NIGERIAN TRANSPORT SYSTEM.....	19

2.2.4.	ROAD DEVELOPMENT	20
2.2.5.	THE NATIONAL TRANSPORT POLICY OBJECTIVES	21
2.2.6.	CONSTRAINTS TO THE DEVELOPMENT OF PUBLIC TRANSPORT IN NIGERIA.....	22
2.2.7.	THE ROLE OF THE PRIVATE SECTOR IN ROAD TRANSPORT SUB SECTOR.....	23
2.2.8.	GOVERNMENT MASS TRANSIT INITIATIVES.....	24
2.2.9.	PRIVATE SECTOR INITIATIVES	25
2.3.	TYPES OF BUS TERMINAL	25
2.4.	TERMINAL FUNCTIONS.....	29
2.5.	TRANSPORT AND THE ENVIRONMENT	30
2.5.1.	THE BUS TERMINAL ENVIRONMENT	31
2.5.2.	ENVIRONMENTAL IMPACT OF TRANSPORT SYSTEMS.....	31
2.6.	TERMINAL OPERATION ENVIRONMENT IMPACT	33
2.7.	PHYSICAL REQUIREMENTS OF A BUS TERMINAL	34
2.7.1.	SITING AND ORIENTING A BUS TERMINAL	35
2.7.2.	USER WALKING DISTANCE.....	36
2.7.3.	GENERAL PLANNING AND DESIGN.....	36
2.8.	PEDESTRIAN CIRCULATION CONCEPTS	37
2.8.1	FACTORS IN PEDESTRIAN CIRCULATION	37
2.8.2.	PEDESTRIAN LEVEL OF SERVICE	38
2.9.	PEDESTRIAN CIRCULATION ON WALKWAYS	39
2.9.1.	SPEED.....	39
2.9.2.	DENSITY.....	40
2.9.3.	EFFECTIVE WALKWAY WIDTH.....	40
2.10.	SITE LOCATION AND ORGANIZATION.....	40
2.10.1.	SITE EVALUATION.....	40
2.10.2.	PEDESTRIAN FACILITIES PROVISION	41
2.10.3.	AUTO FACILITIES PROVISION.....	42
2.10.4.	BUS FACILITIES	43
2.10.5.	SERVICE ACCESS.....	43
2.11.	ACCESS AND ROAD GRADING	44
2.12.	PARKING	44
2.13.	BUS LOADING AREA	44

2.13.1.	TYPES OF BUS LOADING CONFIGURATION	45
2.13.2.	DESIGN CONSIDERATIONS	46
2.14.	PUBLIC AREAS IN A BUS TERMINAL	47
2.14.1.	PASSENGER WAITING.....	47
2.14.2.	PASSENGER AMENITIES.....	48
2.14.3.	SHORT TERM PARKING (KISS AND RIDE).....	49
2.15.	SAFETY AND SECURITY.....	49
2.15.1.	DEFENSIBLE SPACE.....	50
2.15.2.	OTHER SECURITY MEASURES	51
2.16.	BUS GEOMETRICS AND SPACE REQUIREMENTS.....	52
2.16.1.	STANDARD BUS DIMENSION AND TURNING RADIUS.....	53
2.16.2.	GENERAL TURNING RADII FOR LARGE BUSES.....	57
CHAPTER THREE	58
3.0.	CASE STUDIES	58
3.1.	CASE STUDY ONE: EKENE-DILI-CHUKWU TRANSPORT COMPANY, LAGOS..	58
3.1.1.	INTRODUCTION.....	58
3.1.2.	LAYOUT AND ORGANISATION.....	59
3.1.3.	STATION SERVICES	61
3.1.4.	CONSTRUCTION AND MATERIALS.....	62
3.1.5.	APPRAISAL	65
3.2.	CASE STUDY TWO: IFESINACHI MASS TRANSIT LTD, LAGOS.....	67
3.2.1.	INTRODUCTION.....	67
3.2.2.	LAYOUT AND ORGANISATION.....	67
3.2.3.	STATION SERVICES	69
3.2.4.	OPERATION SERVICES	70
3.2.5.	CONSTRUCTION AND MATERIALS.....	71
3.2.6.	APPRAISAL	75
3.3.	CASE STUDY THREE: EDO TRANSPORT SERVICE (EDO LINE) BENIN CITY....	76
3.3.1.	INTRODUCTION.....	76
3.3.2.	LAYOUT AND ORGANIZATION	76
3.3.3.	STATION SERVICES	81
3.3.4.	CONSTRUCTION METHODS AND MATERIALS.	82
3.3.5.	APPRAISAL	83

3.4.	CASE STUDY FOUR: BUS TERMINAL AND OFFICE IN DUBLIN	84
3.4.1.	INTRODUCTION.....	84
3.4.2.	LOCATION/ PLANNING.....	84
3.4.3.	STATION SERVICE	88
3.4.4.	APPRAISAL	88
3.5.	CASE STUDY FIVE; GEORGE WASHINGTON BRIDGE BUS TERMINUS, NEW YORK.....	89
3.5.1.	INTRODUCTION.....	89
3.5.2.	LAYOUT AND ORGANIZATION	89
3.5.3.	CONSTRUCTION AND MATERIALS.....	90
3.5.4.	APPRAISAL	93
3.6.1.	LOCATION.....	93
3.6.2.	CIRCULATION	94
3.6.3.	PROVISION OF FACILITIES/ARCHITECTURAL CONSIDERATION	94
CHAPTER FOUR	95
4.0.	ANALYSIS OF SITE AND DESIGN SYNTHESIS.....	95
4.1.	STUDY AREA / SITE SELECTION	95
4.1.1.	HISTORY OF IKORODU	95
4.1.2.	SITE LOCATION / DESCRIPTION	96
4.1.3.	SITE SELECTION CRITERIA	98
4.2.	SITE ANALYSIS.....	99
4.2.1.	PHYSICAL SITE ANALYSIS	100
4.2.1.	INFRASTRUCTURAL SITE ANALYSIS.....	100
4.2.2.	ECOLOGICAL SITE ANALYSIS	101
4.2.3.	ACOUSTIC SITE ANALYSIS.....	101
4.3.	CLIMATIC DATA OF IKORODU	102
4.4.	PROJECT ANALYSIS AND DESIGN SYNTHESIS	106
4.4.1.	DESIGN CRITERIA	106
4.4.2.	PROJECT BRIEF.....	107
4.4.3.	FUNCTIONAL/SPATIAL CRITERIA OF MASS TRANSIT TERMINAL.....	107
4.5.	SPACES, THEIR SIZES AND RELATIONSHIPS	116
4.5.1.	SPACES	116
4.5.2.	SPATIAL SIZES	119

4.5.3. SPATIAL RELATIONSHIPS.....	121
4.6. DESIGN CONCEPT / CONCEPTUAL APPROACH TO DESIGN	123
CHAPTER FIVE	124
5.0. PROJECT APPRAISAL	124
5.1. APPRAISAL OF PROPOSED SCHEME	124
5.1.1. CONSTRUCTION METHODS AND MATERIALS	125
5.1.2. SERVICES REQUIRED.....	128
5.2. SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION	130
5.2.1. SUMMARY OF FINDINGS.....	130
5.2.2. RECOMMENDATIONS	131
5.2.3. CONCLUSION	131
REFERENCE	133

LIST OF FIGURES

Figure 1: Showing Linear (curb side).....	45
Figure 2: Showing Sawtooth pattern of bus parking.....	45
Figure 3: Showing Angle berth	46
Figure 4: Showing Drive through berths.....	46
Figure 5: Showing length and door position of varying transit buses.....	52
Figure 6: Showing standard bus dimension	53
Figure 7: Standard bus turning radius	54
Figure 8: Showing articulated bus dimension	54
Figure 9: Articulated bus turning radius.....	56
Figure 10: General bus turning radii	57
Figure 11: Showing Site Layout.....	59
Figure 12: Showing Ground Floor Plan	60
Figure 13: Showing First Floor Plan.....	60
Figure 14: Showing Front Elevation	61
Figure 15: Showing Ground Floor Plan [Terminal Building].....	68
Figure 16: First Floor Plan [Terminal Building]	68
Figure 17: Showing Roof Plan [Terminal Building].....	69
Figure 18: Showing Site Plan (Terminal Building).....	77
Figure 19: Showing Floor Plan (Terminal Building)	77
Figure 20: Showing Approach View (Terminal Building)	78
Figure 21: Showing Floor Plan (Administrative building and Maintenance workshop)	78
Figure 22: Approach view (Administrative building and Maintenance workshop).....	79
Figure 23: Showing Section (Maintenance workshop)	79
Figure 24: Showing Ground Floor Plan	85
Figure 25: Showing First Floor Plan	86
Figure 26: Showing Second Floor Plan.....	86
Figure 27: Showing Temperature graph.....	103
Figure 28: Showing combined climate graph.....	105
Figure 29: Showing Relationship diagram for the layout	122
Figure 30: Flow chart diagram for Terminal Building.....	122

Figure 31: Showing Relationship diagram for the Terminal Building..... 123

LIST OF PLATES

Plate 1. Showing Maglev trains.....	13
Plate 2: Urban transport pods.	14
Plate 3: Front view of the Terminal Building.....	62
Plate 4: Showing Bus Yard.	63
Plate 5: Showing Generator House and Private Car Park	63
Plate 6: Showing Booking Office.....	64
Plate 7: Showing Passenger Lounge	64
Plate 8: Showing Bar Served	65
Plate 9: Showing Front View of the Terminal Building	72
Plate 10: Showing Bus Yard	72
Plate 11: View showing Departure Concourse and Restaurant behind.....	73
Plate 12: View showing Generator House and IFEX Motor Cycle Yard	73
Plate 13: Showing Passengers waiting at the Departure Lounge	74
Plate 14: Showing Booking Office.....	74
Plate 15: Showing Main Administrative building.....	80
Plate 16: Ticketing and Departure with buses ready for Loading Passengers and good.....	80
Plate 17: Showing Bus/Car Yard.....	81
Plate 18: Approach view of Terminal Building	87
Plate 19: Showing A view of the office Complex.....	87
Plate 20: View of the Terminal from the West at 178th St	91
Plate 21: View of the Terminal from the East at 179th St.	91
Plate 22: Showing Passenger Lounge	92
Plate 23: Showing Bus Concourse	92
Plate 24: Showing the map of Ikorodu	96
Plate 25: Showing Site Location Map of lagos	97
Plate 26: Showing Site Location Map.....	97
Plate 27: Site view showing Vegetation and Soil conditions.....	100
Plate 28: Showing access to the site.....	101

LIST OF TABLES

Table 1: Showing standard bus dimension.....	53
Table 2: Showing dimension of articulated transit bus	55
Table 3: Showing climatic data of Ikorodu	102
Table 4: Showing spatial sizes for Terminal Building.....	119
Table 5: Showing spatial sizes for Transit Accommodation for Travelers.....	120
Table 6: Showing spatial sizes for Maintenance Workshop	120
Table 7: Showing spatial sizes for Restaurant and Bar	121
Table 8: Showing spatial sizes for Security Facility	121

ABSTRACT

Traffic congestion as an urban mobility problem has been well documented. It is perceived to be a result of rapid increase in population, in the face of poor growth in transport facilities such as good road, transport complimentary facilities, transport services and traffic management techniques. This thesis is an attempt to solve the said problem which prevails in the study area, by proposing a contemporary Bus Terminal that will meet the population demand for mobility, as well as decentralize traffic by ensuring effective circulation within and around the facility. The research relied on explorative literature review, knowledge mining interviews and case study of existing Bus Terminals within and outside Nigeria, in an endeavour to gather fact that led to the design synthesis. Based on the findings from this study, it is established that provision of necessary passenger facilities, their location in space both indoors and outdoors, and effectiveness of circulation within them, will go a long way in solving the problem in question.

CHAPTER ONE

1.0. INTRODUCTION

1.1. BACKGROUND OF STUDY

Transport or transportation is the movement of people, animals and goods from one location to another. Modes of transport include air, rail, road, water, cable, pipeline and space. The field can be divided into infrastructure, vehicles and operations. Transport is important because it enables trade between persons, which is essential for the development of civilizations. Good transportation system is a pre-requisite for development and this could only be possible through the aid of purpose built, well-coordinated terminals which will serve as distribution points for goods and townspeople (Wikipedia, 2009).

Mass transportation concerns itself with facilities that move many people at once and from which operations are regulated by time tables, fixed routes and stops. Transportation is regarded as the pivot, which binds efforts at initiating and sustaining economic growth, it also provides the platform for political integration of a country. Transport infrastructure consists of the fixed installations including roads, railways, airways, waterways, canals and pipelines and terminals such as airports, railway stations, bus stations, warehouses, trucking terminals, refueling depots (including fueling docks and fuel stations) and seaports. Terminals may be used both for interchange of passengers and cargo and for maintenance (Wikipedia, 2009).

Passenger transport may be public, where operators provide scheduled services, or private. Freight transport has become focused on containerization, although bulk transport is used for large volumes of durable items. Transport plays an important part in economic growth and globalization, but most types cause air pollution and use large amounts of land. While it is heavily subsidized by governments, good planning of transport is essential to make traffic flow and restrain urban sprawl political integration of a country (Wikipedia, 2009).

The bus terminal is a building with various facilities at the end or beginning of a bus/car route where passengers arrive and depart; an inter-change point for mass transit operations system. It is a relatively new development brought about by a general increase in public transport service traffic and also due to the desire to increase public safety by reduction of obstructions in the

streets by avoiding traffic delays arising from vehicles stopping along the road to pick up or set down passengers or change crew.

The sites for bus terminal are commonly located in the city centre, outside the city centre or at the fringe of the city centre. Wherever the sites may be located, the terminal should serve or provide its basic function, which is to render safety and convenience to the traveling public while waiting, alighting or boarding the bus (Ahmad and Abdul Rahman 2003). A well planned and managed bus terminal will act as catalyst to the social and economic development of the surrounding areas. Moving the terminal to the fringe of the central business district but easily accessible may help in reducing the current problems of traffic congestion and other related road traffic problems in city Centre (Ahmad and Abdul Rahman 2003).

This research is an attempt to solve the problem associated with urban mobility in Ikorodu area of Lagos state. It investigates, through a morphological study, the effectiveness of six bus terminals [four locally in Nigeria and two international] in terms of circulations within them, in an endeavor to design a bus terminal with emphasis on effective circulation, to ameliorate traffic congestions and other problem of urban mobility in Ikorodu and Lagos state at Large.

1.1. STATEMENT OF THE PROBLEM

Urban mobility problems had been on the increase since independence. This is due to rapid increase in population in urban areas, which is not matched with growth in transport facilities such as road network, transport complimentary facilities, transport services and traffic management techniques. Thus urban transport problems have increasingly been characterized by inadequate and inefficient services, long waiting time at bus stop, environmental pollution, traffic congestions, and bad roads, shortage of vehicles and the use of motorcycle as a means of urban passenger transport system (Ogunbodede, 2008).

In Ikorodu and its environs, improper planning of road networks, unavailability of car parks, accompanied with large volume of vehicles arriving and departing, has given rise to heavy traffic congestion in the heart of the city, which has overtime extended to other parts of Lagos state. This has become so pathetic as the traffic situations is such that road users and commuters are held back for several hours, leading to paralysis of economics

activities and also aggravated environmental, social, health and psychological problems of the area.

1.2. JUSTIFICATION FOR THE PROJECT

In Ikorodu today, it is common practice to see people trekking along the express way, in an endeavor to get to their destination quicker than the vehicles which are most times held back in traffic, a consequence of inadequate parking facilities. This project is therefore justified as it would afford such vehicles a properly planned facility for parking and meet the transit needs of passengers, while ameliorating the problem of traffic congestion in Ikorodu and its environs. Moreover, this project (to be funded by the State Government) would encourage development of the area where it would be sited, leading to the springing up of tourist concerns, recreation-oriented businesses, commercial activities, development of road networks etc. around the terminal. Job opportunities will, no doubt, be created for the unemployed. At the end, this design work would have gone a long way in achieving a lot with regards to the Federal Government policy on “TRANSPORT FOR ALL BY THE YEAR 2020”.

1.3. AIM AND OBJECTIVES

The aim of this study is to design a functionally effective and aesthetically appealing contemporary bus Terminal, with emphasis on effective circulation.

The objectives for realizing the above stated goal are to:

- i. appraise the infrastructural and architectural design in the existing bus Terminal facility and operations;
- ii. determine peak hours of traffic to be considered in the design, to counter sudden increase that may result in congestion and overcrowding of the terminals in Festival periods;
- iii. design a bus terminal that ensures effective circulation of passengers and vehicles within it;
- iv. achieve a good and welcoming environment through an effective integration of outdoor and indoor public areas and through good landscaping; and

- v. achieve a good security control system by separating the vehicular path and loading bays from unwanted visitors to the terminal.

1.4. LIMITATION OF THE STUDY

The limitation encountered during the course of this research work is the difficulty in accessing vital information such as measurements and documentations of existing building types visited for case study. This is due to the uncooperative attitudes on the part of the terminal managements.

1.5. SCOPE OF THE STUDY

The scope of this work is primarily shaped and limited to its user requirements and emphasize facilities that would afford effective circulation of passengers and vehicles within the bus terminal .This will lead to the design of Terminal Building (administrative and main concourse facilities), Transit accommodation for travelers, Maintenance workshop, Filling station, Restaurant and bar, Vehicle washing, Car park, Security Facilities and Landscaping.

1.6. RESEARCH METHODOLOGY

The research will rely on the application of two basic sources to achieve the data required for the thesis. These include: Primary data and Secondary data

- i. **The Primary Data:** These are data and information extensively collected using the instrumentalities of questionnaire and checklist. This happen to be the most difficult to collect but more useful and reliable to the user and researchers. Under the data, the soundness of the procedure determines the overwhelming degree of the usefulness of the data obtained.
- ii. **The Secondary Data:** These are data and information obtained from existing published and unpublished sources such as government and non-government agencies, magazines, newspaper, post graduate research works and other documentaries like surveys, relevant seminar papers and monographs. Base maps, street guides and other drawings from ministry will be used in the study. Photographs will also be used to document visually some of the information needed.

However, the following methods will be used.

- i. **Interviews:** - Individual interview will be carried out randomly especially with respect to passengers at different existing bus terminals.
- ii. **Observation:** - Direct observation will be made on different bus terminals. The architectural merits and demerits will be considered.

1.7. EXPECTED CONTRIBUTION TO KNOWLEDGE

In the planning/analysis of a transit terminal it is essential, that the aesthetics structural and functionality of the terminal is of utmost importance. This will help to a large extent in stimulating public interest, which will make the terminal more viable. The study will be useful in terms of information availability to architect and planners who design and plan road and transport facilities. The transportation engineers will equally find the study useful because transport and terminal points are inseparable and as such terminal facilities should be given due consideration in the location of roads. The study will also be important to the Federal and State Government who are currently embarking on an aggressive massive road transportation program, the Federal and State assisted mass transit.

1.8. DEFINITION OF TERMS

1. **Kiss-and-Ride:** A place where commuters are driven and dropped off at a terminal. To board a public transport vehicle.
2. **Park-and-Ride:** These are parking spaces provided for automobile drivers, who want to board transit vehicles from this location.
3. **Ridership:** The number of rides taken by people using public transport system in a given period of time.
4. **Transit System:** an organized (public or private) providing local or regional multi-occupancy vehicle passenger service.
5. **Modal Split:** A term that describes how many people uses alternative forms of transportation. It is frequently used to describe the percentage of people using private automobiles as opposed to the percentage using public transportation.
6. **Crosswalk:** A place marked on a street on a street where pedestrians can cross the street safely.

- 7. Pedestrian Density:** Average number of persons per unit of area within a walkway or queuing area, expressed as persons per square foot or meter.
- 8. Sidewalk:** A paved path for pedestrian along a street.
- 9. Loading bay:** A parking bay partly enclosed by a raised platform, at which buses are loaded and unloaded in transit terminals.
- 10. Curbside:** The edge of a street or a sidewalk bordered by a kerb.

CHAPTER TWO

2.0. LITERATURE REVIEW

2.1. HISTORY OF TRANSPORTATION (WORLD WIDE)

The History of Transportation covers the entire history of man. Early Paleolithic and Neolithic man walked through his world on his own legs, and couldn't transport more than he was able to carry on his back. In the late Neolithic, Beasts of Burden began to be used after animal's domestication, but even then they could only carry what could be loaded or tied to animal's backs. After some times the early man wanted to move large stones and other heavy objects and invented the log roller for this task. There is evidence that many cultures in many geographic areas used simple log roller technology, but dating this is difficult and extensively used log rollers eventually inspired the development of the wheel (Trivedi, 2010).

However, even then humans could only carry what could be loaded onto or tied to their animal's backs. It was only around 4000-3500 BC that the very first step towards man-made transportation was taken – the wheel was invented. What followed thereafter still continues to make history (LifeStyle Lounge, 2009).

A lot of the early information is theoretical and not documentable for History as such, and is really more in the domain of Archeology or Anthropology, but is the preface to the History of Transportation. The history of road transport started with the development of tracks by man and his beasts of burden. Animal-drawn wheeled vehicles probably developed in the time of summer. The chronological development of transport can be classified in the following manner: (Trivedi, 2010):

- The Sledge: 7000-4000 BC, The Wagon: 3000 BC
- Horse and Chariot: From 2000 BC
- The Great Canal Of Darius I: 6th Century BC
- Roman Roads: 2nd Century BC – 2nd Century AD
- The Grand Canal: 3rd Century BC – 13th Century AD

- Junks and Caravels: 12th – 15th Century Ad
- Inca Roads: 15th Century AD
- European Canals: 12th - 17th Century AD
- Carriages: 17th Century AD
- Bridgewater Canal: AD 1759-1761
- Tracks and Trails: AD 1775
- The Balloon - Hot Air: AD 1783
- The Balloon - Hydrogen: AD 1783
- Mail Coach: AD 1784 - 1797
- The Roads of Telford and Mc Adam: AD 1803-1815
- The National Road: AD 1811-1852
- Transport in the 19th Century
- Transport in the 20th Century

LifeStyle Lounge, (2009) divides the history of transportation into four classes namely:

1. Land transport
2. Water transport
3. Air transport
4. Space transport

2.1.1. LAND TRANSPORT

Sometime around the late Neolithic age, man learned how to domesticate animals. He used horse and other beasts of burden to not only help him till the soil but also for transportation purposes. However, the invention of Wheel, around 4000-3500 BC, entirely changed man's outlook towards life. Transportation became faster. Not only could man himself travel faster but also take loads of goods along with him to distant places. Thus, was also born the idea of trade and exchange (LifeStyle Lounge, 2009).

The land mark inventions that followed are as under:

- Two-wheel chariot - world's first form of wheeled transportation - invented in Sumeria, around 3500 BC. This eventually led to invention of four-wheel chariot in due course.
- Cart driven by a steam turbine, build by a Jesuit missionary in China– 1670 AD
- Modern bicycles invented – 1790 AD
- Richard Trevithick invented the first steam powered locomotive (for roads) -1801 AD
- George Stephenson invented the first practical steam powered railroad locomotive – 1814 AD
- Jean Lenoir made a gasoline engine automobile – 1862 AD
- Invention of Internal Combustion Engine by a Frenchman named Jean Joseph Etienne Lenoir – 1860 AD
- 1867- First motorcycle invented
- 1885 - Karl Benz builds the world's first practical automobile to be powered by an internal combustion engine
- First experiment of electric powered trains – 1895 AD
- Henry Ford improves the assembly line for automobile manufacturing – 1908 AD

During World War II, the diesel engine came into widespread use, and steam was almost completely forgotten. Advancements have continued to be made in the time since. (LifeStyle Lounge, 2009)

2.1.2. WATER TRANSPORT

It is interesting to note that man had developed means of traveling on water even before he had domesticated the horse. Though the origin of the dugout boat still remains one of history's great mysteries, but it does indicate that man had known how to travel on water long before other means of transport developed. This historians point may have been due to an accidental invention. Nevertheless, the addition of the boat changed the face of water transportation (LifeStyle Lounge, 2009).

At first, Simple boats evolved to include a large square of cloth mounted on a central pole. This cloth was called a sail. The sail aided in navigation and wind pressure propelled the boat. Soon this gave way to sail-propelled ships. Later, these sail-propelled ships grew bigger in size while sleeker in design. First the oars and rudders and then the deck covers were also included in the ship's design (LifeStyle Lounge, 2009).

With the advent of automation in 19th century, water transportation changed forever. Ships shed their sails. Now more goods and people could be transported faster.

The landmark inventions in water transportation are as under:

- Cornelis Drebbel invented the first submarine in 1620 AD
- First practical steamboat demonstrated by Marquis Claude -1783 AD
- Steamboat invented – 1787 AD
- First diesel-powered ship – 1912 AD
- Hovercraft invented – 1956 AD
- First nuclear powered ship launched – 1958 AD

2.1.3. AIR TRANSPORT

Although many people had toyed with the idea of flight, but the first sustained, controlled flight took place only in December 17, 1903, at Kitty Hawk, North Carolina. The inventors of this new flying machine were brothers Orville and Wilbur Wright, two bicycle makers. They invented a bicycle propelled contraption which later evolved into jet-propelled aircraft capable of world-wide mass transfer. It came to be called the airplane. Airplane made it easier for people to travel great distances in less time (LifeStyle Lounge, 2009).

The land mark inventions in air transportation are as under:-

- Leonardo da Vinci -first to seriously theorize about flying machines - with over 100 drawings that illustrated his theories on flight – 1492 AD
- The Montgolfier brothers invent the first hot air balloons – 1783 AD
- The Wright Brothers invent and fly the first engine airplane – 1903 AD
- Very first helicopter – though an unsuccessful design – 1907 AD

2.1.4. SPACE TRANSPORT

Man's next stride in transportation looked not to the land, or even to the seas, but to the sky. Man wasn't yet satisfied and set his gaze towards the night sky, and the stars. United States, in 1955, announced the formation of the Vanguard Satellite Program and began exploring what it would take to break away from the Earth's gravitational pull and thus followed a series of experiments in aerospace engineering (LifeStyle Lounge, 2009).

The landmark events in space transportation are as under:-

- USSR's Sputnik I.- first earth-orbiting satellite – 1957
- USSR's Vostok I - first manned space-flight – 1961
- Man Lands on moon – American astronaut Neil Armstrong became the first man to set foot on the moon - 1969

- USA's Enterprise -first reusable space shuttle - 1977

Every development that followed made history. Recently, USA's NASA has also launched its unmanned expeditions to other planets like Mars and Pluto. With the pace of developments in aerospace engineering, that day is not far when we will see man travel as far as Pluto or maybe further (LifeStyle Lounge, 2009).

2.1.5. FUTURE OF TRANSPORTATION

According to Proost (2011) Key goals of the European Union by 2050 include:

- No more conventionally fuelled cars in cities (and 50% less in 2030)
- 40 % use of sustainable low carbon fuels in aviation
- 50% shift of medium distance intercity passenger and freight journeys from road to rail and waterborne transport (30% shift by 2030)
- Triple length of HSR network by 2030– Near zero road casualties (and 50% less by 2020)
- Move towards full application of user pays and polluter pays principles

Brandon, (2013) itemized five future transportations technologies that will actually happen. They include:

1. Hyperloop

One of the most exciting innovations in transportation has to be the Hyperloop train. Rising on nearly airless tubes at 800 mph, the train will transport you from LA to San Francisco in just 30 minutes. Elon Musk announced a design scheme back in August, but FoxNews.com has learned the concept is more than a pipe dream -- it is now a real technology in development.

2. Maglev trains

“Magnetic levitation” trains are not just a lofty dream held over from the '50s. They are already in operation in Shanghai and Japan. South Korea is building a maglev train that will operate

within the Incheon Airport, and China reportedly has a second maglev train in development. A magnetic force lifts and propels the train using a minimal amount of energy compared to diesel-powered or electric-powered trains. The trains whisk passengers along at up to 310 miles per hour.



Plate 1: Showing Maglev trains.

Source: www.foxnews.com

A planned maglev train will transport passengers over 200 miles between Nagoya and Tokyo in just 40 minutes, helping to free congested roads, reduce air pollution, and reduce accidents.

3. Autonomous vehicles

A robotic driver can think faster and smarter than a human driver -- and look in all directions at once. That's the idea behind autonomous driving, where you take your hands off the wheel and let the car do the driving for you. Ford has already announced a project called Traffic Jam Assist and Cadillac is working on something called Super Cruise that lets the car take over.

4. Smart cars

One way to solve transportation problems in major cities is to make the cars much smaller and smarter. So-called “smart cars” have been around for many years. But there are signs of progress. Many automakers, including BMW and Nissan already offer compact electric cars. The BMW i3, already available in Europe, can brake automatically when you take your foot off the accelerator, consumes no gasoline and operates for 80-100 miles per charge.

5. Urban transport pods

The pods seat one person and move on their own over a pre-described route. The idea is that the human operator interacts with the pod using a touchscreen in the windshield. You swipe to select a destination, and you can read the daily news, check your e-mail or even play a video game during the trip. There will be a built-in wireless hotspot to connect your gadgets. The pod operates on its own, showing its current route.



Plate 2: Urban transport pods.

Source: www.foxnews.com

(Similar pods are already being used in Masdar City in Abu Dhabi and at the London Heathrow airport, but both are used in tightly controlled areas.)

2.2. THE NIGERIAN EXPERIENCE IN HISTORICAL PERSPECTIVE

What is now regarded as the Nigerian Nation came into existence in 1914, when the two Protectorates of Northern and Southern Nigeria were amalgamated under the Governor-Generalship of Sir Frederick Lugard. The country became independent in 1960 and a republic in 1963 after more than half a century of British rule. According to Udo (1978), “the relics of British rule have since remained in every aspect of Nigeria life”. Prominent of such relics are transport, education and the pattern of governance in the country. In 1963 and 1991, the population of Nigeria stood at 56 and 88.9 million respectively with a land area of about 923,773 km (Ogunbodede, 2008).

According to Ogunsanya (1998), Nigeria had a rate of urbanization that was ranked as one of the highest in the world. Available statistics, as at that time, indicated that by 1988, more than 30% of the country’s population lived in urban centers of 100,000 and above. It was also estimated that by the year 2000, the proportion of population living in cities would have increased to 50% from its 1990 rate of 35%.

The pattern of Nigerian urbanization has many implications on various areas of the country including determining the areas of road traffic origination and destination. Associated with these implications are various urban problems such as unemployment, housing problems, environmental pollution, transportation problems and general inadequacy of infrastructural facilities. This study however is interested in the aspect of urban transportation and its growth over a period of not less than 45 years in the country. Urban transport system can be viewed from two major areas, which are the intra-urban and interurban transport systems (Ogunbodede, 2008).

According to Federal Government of Nigeria (2010), the evolution of modern transport system in Nigeria can be categorized into two distinct phases. These are:

- The colonial period marks the origin of modern transport system. The networks of rail, water and road developed then were geared essentially to meet the exportation of cash crops, such as groundnuts, cocoa, cotton and palm products and to the importation of cheap, mass produced consumption goods. These early transport Systems were planned

in the most economic way possible, as typified in sub-standard road and rail alignments and a sub base, which later proved inadequate to accommodate heavy vehicles.

- The post-colonial period/attainment of independence. With a re-orientation of goals, transport became one of the instruments of unification of the country and an important tool for social and economic development. The development of petroleum resources from the 1950's had significant impact on the nation's social and economic growth, putting increasing demands on the transport system.

2.2.1. THE NIGERIAN TRANSPORT SYSTEM IN PERSPECTIVE

Goods and passenger movements in Nigeria are performed mainly by road, with the railway and inland waterways playing significant, but less important roles. International freight movement is principally by sea while air transportation is the main passenger carrier (Federal Government of Nigeria, 2010).

All the transport sub-sectors suffer from the effects of past shortages of resources, and this inadequacy has consistently been reflected in inadequate maintenance. In the road transport sub-sector, the lack of road maintenance often necessitates subsequent reconstruction. The inadequate replacement and the poor maintenance of vehicles, contribute to high social costs of atmospheric pollution, and results in high operating costs. In the case of the railways, the lack of necessary resources to keep tracks, rolling stocks and maintenance facility in reasonable working condition produced a serious deterioration of the railway system. Similar problems affect the inland waterways, resulting in its inability to perform useful functions (Federal Government of Nigeria, 2010).

The long-term shortages are growing, becoming seemingly insoluble. For transport operators, these problems create a feeling of despondency, decline in morale and exacerbate management/employee tension. Feeling of despondency and low morale cause further deterioration and growing problems of the system, creating a vicious circle. Breaking this circle is the overriding immediate objective of the country's national transport policy (Federal Government of Nigeria, 2010).

2.2.2. ROAD NETWORK DEVELOPMENT (1960 TO 2006)

The history of road transport development in Nigeria dated back to the period before 1910 when the existing bush paths were developed into “motorable” routes. According to Stanford Research Institute (1963), the growth of road transport in Nigeria was a later development, which did not evolve through the stage of animal–drawn carts. According to this Institute, roads were not developed until the advent of motor vehicles in the 1920s and 1930s. The end of Second World War (1945) actually marked the period when the country was served with adequate network of all season roads for lorry and passenger car traffic (Ogunbodede, 2008).

According to Onakomaiya (1978), the roads were designed to serve two major objectives. First, they were meant to extend the commercial hinterlands opened up by the government railways by linking up the nearest urban centers with the major railway stations. The second was to reduce the strains thrown on the inland provinces in the provision of porters for the British Colonial Officers. The initial growth of road network was slowed down by the financial and labor constraints. However, the total length of road constructed and maintained by the government and native authorities rose to about 51,000km in 1946 and 74,000km in 1960 (Onokomaiya, 1978).

The need to open up the economic and settlement frontiers of the country was the major factor that influenced road network development in Nigeria. This began with the introduction of feeder road services to the Nigerian Railways to link the major railway stations along the Lagos-Kano line with the neighboring settlements, thereby increasing the supply of export products such as cocoa, palm produce, cotton and groundnuts that were moved to the ports by the railways and helping the rural settlements realize their productive potentials. As at 1960, roads linked all parts, although the concentration of roads is much heavier in the two Southern Regions than in the more sparsely populated Northern Region. The roads in Nigeria were classified into three (3) groups. Federal Roads or Trunk A – 8,800km (5,500mls), this represented the skeleton on which the country’s road system was built. This trunk represented the main North-South arteries and five East-West arteries. The Trunk B roads, of which there were 7,360km (4,600mls), connected the provincial network with the skeleton trunk to a road system. Provincial roads of which there were 57,480km (35,925mls) form the main network linking up with other trunk roads in the country.

As at 1960, the percentage of trunk A roads tarred to the total road surface in Nigeria was highest in the Western part of Nigeria with 82% followed by Eastern region with 30%. However, Lagos, which acted as the Federal Capital had the entire surface tarred. Similarly, 98% of trunk B roads in the Western region was tarred, 34% of that of Eastern region was tarred while 19% of that of Northern region was tarred. The period between 1976 and 1970 witnessed no growth in road network because of the Nigerian civil war, which took place during that period. This period and the financial resources of the country were devoted to the execution of the Nigerian civil war. Since 1975 and through the 3 and 4th Development plans and rolling plans, the Federal Government used road construction as instrument to gain political points because its structures were better appreciated aesthetically and spatially. Thus, the military and civilian governments at center, state and local government levels embarked on many road constructions that culminated in the present dense nature of Nigeria's road network (Ogunbodede, 2008).

The administrative system of Nigeria has changed many times since the creation of the country. The changes were due to a number of factors among which were those connected with the social systems, administrative convenience, spatial problems, economic considerations, official policies such as indirect rule, military and democratic rules. The creation of States, which was intense, therefore had many implications to transport facilities as well as the traffic management techniques adopted in the city centers. Thus, as the States increased, the administrative headquarters also increased thereby influencing roads, that were rehabilitated and constructed. Thus by 1996, road networks in 36 major urban centers in Nigeria had undergone series of transformation in terms of construction and reconstruction. Similarly, commuting distance within the cities continued to increase because of rapid growth in population, housing and area extent. For example, commuting distance of Akure increased from 5.2km in 1966 to 6.4km in 1976, to 10.5km in 1986, 13kms in 1996 and 19kms in 2006 for the major artery (Ogunbodede, 2006). Similarly, the commuting distance in the city of Lagos increased from 20km in 1970 to 35km in 1995 while that of Kaduna increased from 6km to 10km during the same period (Ikya, 1993). The increase in commuting distance has impact on trip generation, attraction and the public transport services that facilitated movement from one point to another.

2.2.3. CHALLENGES AND OPORTUNITIES FACING NIGERIAN TRANSPORT SYSTEM

Federal Government of Nigeria, (2010) stated the great challenges facing Nigerian Transport system and also offers several opportunities. The predisposing factors include:

- 1. The size of the country:** With area coverage of 923,768.64 km², spanning longitude 30E-160E and latitude 40N-14 Nigeria is a comparatively large country. It is inhabited by over 140 million people. Transportation is a crucial instrument for linking the country economically, socially and politically.
- 2. Nigeria's vast natural resources:** Nigeria is endowed with petroleum, gas and solid mineral resources. The country is also blessed with abundant agricultural and forest resources, which vary by the three ecological zones of the country. The country is endowed with a highly productive open sea with abundant and diverse marine resources within her coastline of 852km bordering the Atlantic Ocean in the Gulf of Guinea and her maritime area of 46,000 km. This variation is a factor in spatial interdependence. Transport plays an important role in the exploitation and distribution of these resources and in the reduction of spatial inequality and in poverty alleviation.
- 3. The Growth of the Nigerian Economy:** Until the current decade, economic growth posed significant challenges to the Nigerian economy, especially during the decades of the 1980s and 1990s. However, between 1999 and 2008, the performance of the Nigerian economy improved significantly. Real Gross Domestic Product (GDP) grew at an annual average rate of 5.6% and was the highest in three decades. The economic growth rate of almost two times the estimated 3% growth rate of the population ensured a real per capita output growth of 2.6%. The oil sector tended to constitute a drag on growth. The composition of national output for the 1999 – 2008 decade shows that there is still the challenge of achieving broad-based growth. Three large sectors – crop production, oil and gas, and wholesale and retail trade contributed the most to GDP. The defective structure of the nation's economy make her heavily dependent on export earnings from crude oil and on import of consumer and capital goods, thereby increasing the country's cargo

throughput and boosting the overall maritime trade. The huge volume of cargo generated by Nigeria places her at an economic advantage in South-Saharan Africa.

4. **Strategic Location of Nigeria:** by its location, Nigeria has an extensive coast washed by the Atlantic Ocean and a geographically conducive shore which provide the opportunity of port services to landlocked countries in West Africa and particularly Chad and Niger Republic, as well as serve as a hub for transshipment for the West and Central African sub-region.

2.2.4. ROAD DEVELOPMENT

The creation of an extensive road network is one of the major national achievements of the last three decades; since independence, the road network has more than doubled in length and significantly improved in terms of capacity (FMT, 1993). The responsibility for the road system, in construction and maintenance is shared between the three levels of Government with the federal Government being responsible for the following classes of roads:

1. Interstate Roads connecting two or more states;
2. International roads serving as links between Nigeria and her neighbors and forming parts of the African highways System, namely:
 - a. Trans-saharan highways (Lagos-Kongolam-Algiers)
 - b. Trans-Central-African Highways (Lagos-Mombassa)
 - c. Trans-West-African Highways, inland route (Dakar-Jibiya-Ganboru-Ndjamena)
 - d. Trans-West-African Highways, coastal route (Nouakchott-Sami-Podgi-Badagry-Lagos (FMT, 1993).

The state government are responsible for intrastate and feeder routes while the local government takes care of rural roads. According to Filani, (1993) in terms of road length, the Federal Government is responsible for 22% of the roads, while the state and local government take up 27% and 51% of road kilometers respectively (FMT, 2001).

2.2.5. THE NATIONAL TRANSPORT POLICY OBJECTIVES

The very first National Transport Policy in Nigerian came into being only in 1993 about a decade ago. Before then statements concerning national objectives of the transport sector in the country appeared in such main official sources as:

- a. The 1962-68 First National Development Plan;
- b. The J 965 Statement on Transport Policy;
- c. The 1968 Policy on Statutory Corporations and State-owned Enterprises;
- d. The 1970-1974; 1975 - 1980, and 1981 - 1985, Second, Third and Fourth National Development Plans respectively; and
- e. The various Rolling PIII. between 1992 – 1996

A critical review of the transport policies as contained in all the documents examined above exhibits certain consistencies. First, it would appear that the stated objectives of the transport sector fell within general long-term national goals, which have been characterized by attempts to mobilize all productive resources of the country in order to ensure rapid economic growth and to facilitate a more equitable distribution of the fruits of such growth. Throughout the period 1960 to early 1990's coordination and rationalization of transport modes features prominently in all the preambles to transport development. "Much emphasis was placed on minimum costs of services and elasticity of such services to demand through the dependence of inter and intra-modal operations on the market mechanism "(Ekong, 1984).

Given the current condition of much of the transport sector, the rate at which the goals can be achieved will be subject to the realities of resource availability and practical implementation constraints. It will take some considerable time to make the scale of improvements needed across each of the transport modes to achieve these policy goals. It is therefore essential that the implementation of policy is based on a careful prioritization of goals and objectives and that plans in each of the transport modes are realistic and consistent. All transport investment should be subject to careful analysis to ensure that the benefits, net of the costs, meets appropriate investments criteria and represent value for money; and that policies and plans are practical and

sustainable. The Government's policy objectives for the sector are (Federal Government of Nigeria, 2010).

- a. To promote economic development, expand trade, and improve Nigeria's competitiveness through an efficient and affordable integrated transport system;
- b. To encourage and remove all barriers towards the private sector participation in the development, provision, maintenance, operation, and upgrading of transport infrastructure and services;
- c. To promote the use of public transport over private cars.
- d. To promote a culture of maintenance and continuous upgrading of transport infrastructure and services;
- e. To promote competition and efficiency and cost reduction of transport services in Nigeria.
- f. To improve the safety, security, reliability, quality, and speed of movement of goods and people, at local, national, and international levels;
- g. To develop transport infrastructure that ensures environmental sustainability and internationally accepted standards; and
- h. To support States and the Federal Capital Territory in the development and promotion of urban transport systems and local governments in developing and promoting rural accessibility.

2.2.6. CONSTRAINTS TO THE DEVELOPMENT OF PUBLIC TRANSPORT IN NIGERIA

The general downward in Nigeria nation's economy which was part of the global depression of 1980's affected all sectors in which transport system was one of them. Majority of Nigerians living in cities felt this impact more than those in the rural areas. This was because the commuting distance of people in cities increased considerable than it used to be before 1980 as stated earlier. This example shows that it was becoming increasingly difficult and inefficient to

trek in cities because of the area expansion of the city. The glut of 1980 further compounded the mobility problems of commuters since most of the commercial vehicles in cities went off the road because of poor servicing and lack of spare parts. The Structural Adjusted Programs (SAP) of the federal government further compounded the importation of vehicles and spare parts such that the shortfall in public transport had to be augmented by interested private individuals in different forms (Ogunbodede, 2008).

The attitude of some professional drivers also scares private investment in the area of transport service delivery. Some private rich individuals who were interested in investing in public transport system because it was a lucrative business decided not to do so, because most drivers were found to be insincere and economic with the truth. This is because vehicles given to them are often run at a loss whereas; they break even when they run them on their own. These experiences as noted in the past made would-be-investors to leave these areas of investment to the drivers. The drivers on the other hand have no financial wherewithal to buy vehicles except they buy through the hire-purchase system. This however limited the number of people going into public transport business (Ogunbodede, 2008).

The role played by the Nigerian Union of Road Transport Workers (NURTW) in allowing investors to invest in public transport system still remain as an obstacle to private individuals. The union, in addition to registration fees also collects different types of daily fees, which reduces and sometimes renders the profit margin of the owner of such vehicle to nothingness. This is because, the driver would buy fuel, engine oil, eat, pay the conductor and himself before thinking of remitting the rest to vehicle owners. Thus, it pays the professional drivers to invest in public transport system than private investor who will still need to hire the services of a professional driver (Ogunbodede, 2008).

2.2.7. THE ROLE OF THE PRIVATE SECTOR IN ROAD TRANSPORT SUB SECTOR

Private sector participation has been very significant in the road transport industry in Nigeria. Today, the vast majority of road transport operations belong to the private sector. It accounts for more than 90 percent of urban and non-urban road transport services. These services are provided by thousands of individual operators of small vehicles ranging from motorcycles (the

Okadas), taxis, the "Kabukabus", minibuses to the adapted big buses, such as the "Molues" and the modern highly sophisticated buses of the likes provided by well-organized operators such as the Associated Bus Company (ABC) Ltd., the Ekene Dili Chukwu, The Young Shall Grow and Iyang Ette, among others. Certain factors have, hitherto, encouraged private participation in the road transport industry in Nigeria. In matters concerning other sectors of the transport industry, (the railways, airways, national shipping and the ports) the Federal Government exercises some measure of control in the provision of services, pricing and investment policies (Filani, 1996).

Thus, in the Nigerian context, while the provision of the right of way has always been the responsibility of the public sector, i.e., the government, the operation and management of the equipment - the vehicles have largely been the responsibility of the private sector especially prior to 1988. This was so in both the intra-urban and inter-urban mass transit system. Public sector participation, until the inception of the Federal Urban Mass Transit Program in 1988 was limited to the municipal and state government levels. In the pre-1988 era, provision of public transport in the country's major urban centers was mainly in the hands of private operators. However, in a few states such as the then Lagos, Kaduna, Bendel, Oyo and Rivers, there were public-owned transport operators. For example, there had been an organized bus system by the Ibadan City Council and later as a joint venture between the City Council and the State Government. This involved the operation of about 20 Mercedes Benz buses in about 12 different routes in the city by early 1964. At the peak of its operations in the early 1970s, 50 buses were in use in the intra-city and inter-city systems. However, by 1976 there were only 6 buses in operation and by 1977 the system had collapsed (Filani, 1996).

In Lagos state, the Lagos State Transport Corporation (LSTC) operated mass transit services before 1988. But the traffic carriage of the LSTC declined from 82 million passengers in 1979 to 53 million passengers in 1983 before rising to an estimated 60-65 million in 1987.

2.2.8. GOVERNMENT MASS TRANSIT INITIATIVES

Bolade (1995) had summarized the important deficiencies in the Nigerian urban transport system prior to 1988 as follows:

- a. General inadequacy of public transport service relative to demand

- b. Inadequately funded and deficient public-owned transport operators.
- c. Proliferated, disorganized and uncontrolled operators of para-transit;
- d. Traffic congestion resulting from haphazard land use, disorderly driving habits, poor road designs and conditions, inadequate complementary road schemes, and traffic management measures; and
- e. Lack of comprehensive and integrated urban mass transport system

In general, therefore, prior to 1988 a serious gap had been created between demand and supply of means of mobility among the Nigerian urban populace. The inability of the private sector to continue its erstwhile role as a major provider of transit services led to the Federal Government's direct intervention in the urban transport sector. The government's program was, therefore, meant to relieve the burden of the suffering traveling masses in the country. (Filani, 1998). In spite of these laudable achievements, by 1998, just 10 years after its inception, the FUMTA program had so declined in performance that the initial enthusiasm that greeted it at the beginning had dampened. Today, many of the state-owned mass transit agencies have collapsed (Omotola, 2011).

2.2.9. PRIVATE SECTOR INITIATIVES

Owing to the obvious failure of Public sector driven mass transit initiatives, the private sector has, therefore, once again been challenged to rescue the situation because of the dismal performance of the public sector in the provision of transit services. But for the new initiatives of the private-sector transit providers, especially in injection of new bus stock, construction of modern terminals and improvement in freight services, perhaps the mass transit situation might have reverted to the pre-1988 level of urban immobility. However, fresh and effective actions must be taken to provide the enabling environment for these private operators in order to avert the imminent and consequent mobility crisis and its attendant social chaos. (Omotola, 2011)

2.3. TYPES OF BUS TERMINAL

According to Wikipedia (2008), there are two types of bus terminal otherwise called "Termini", they are the One stop and the Two stop.

1. One Stop:

Many routes avoid the need to accommodate turning by having the end of the route form a small circuit as an official part of the route. The terminus is designated as one stop on this circuit, with the bus starting and finishing in the same orientation. This is often necessary in many town centers with one-way traffic systems. Space permitting the terminus may be a purpose built run-around Bus turnout, which allows the bus to change direction simply by entering and leaving the turnout. Often the infrastructure for this remains from a previous tram or trolley bus system. In rare cases, to allow a one stop terminus, routes may be arranged to start and finish at the same terminus, with buses arriving as one scheduled route, and leaving as a different route. This can also be done to allow a formal midpoint to split up a long route, reducing the knock-on effect of delays.

2. Two Stop

As opposed to a one stop arrangement, some routes that need to reverse direction at a terminus will start and finish in different stops, and the pair of stops locations forms the terminus. This necessitates running the bus out of service along other streets in order to position in the bus for the reverse direction. In the UK this is often achieved by locating the terminus near a roundabout. In this case, the arrival point can be designated as a 'set down only' stop, where passengers are not permitted to board.

Over the years, bus terminals and services have evolved into several general operational categories and distinctive terminal types as discussed below (Omotola, 2011):

1. Intra-City Bus Terminals

These are terminals located at various strategic points within a given urban environment serving as nodes to those particular sectors of the city. They facilitate transit between the various areas used for living, working, recreating and moving around the city

2. Airport-City Bus Terminals

The airport-city bus terminal provides primarily for the transportation of airline passengers from an urban center to the major airports it serves. Usually located in the urban center, the terminal is

accessible by local transit systems, taxis, and autos. Oriented to departing and arriving flights, the terminal normally has provisions for arrival and departing flight information as well as pre-ticketing and check-in-facilities.

3. Urban-Suburban Commuter Bus Terminals

This type of facility may be located within the downtown core, as a central passenger collection and distribution node, or on the periphery of the core, as a rapid transit feeder station. It is characterized by a diversified bus route structure and high-turnover commuter-type bus operations. Bus accessibility is an important consideration. Grade separated access by underpass or over pass connections and exclusive bus lanes on connecting highways are common and are desirable to maintain schedule efficiency

4. Intercity Bus Terminals

The intercity terminal is usually found in the downtown core and is accessible directly by local transit, taxi, and auto. It differs from other terminal types in that it includes long-haul service in excess of several hundred miles and provides for a much greater number of bus movements. Land costs normally dictate vertical expansion capability in the denser city areas. More elaborate "package express" facilities are provided in the intercity terminal and a greater amount of concession and rental space is provided to defray higher terminal construction and operating.

5. Intermodal Transportation Terminals

The word "intermodal" refers to those issues or activities which involve or affect more than one mode of transportation including transportation connections, choices, cooperation and coordination of various modes. Intermodal transportation centers although in existence for several years in selected European cities are relatively new in the United States. Supported by Federal law, their major purpose is to serve as transit links between trains, bus, and airline systems thereby facilitating the improved movement of passengers from one system to another in as "seamless" a manner as possible. To effectively realize this, the centers must be able also to meet the diverse needs of the traveling public while in transit. This requires that the centers not only provide essential services, but amenities for passengers as well depending on the specific needs of a center. Where possible, intermodal transportation centers are designed in such a

manner as to take advantage of existing structures. The development of the intermodal concept typically pays much attention to utilizing existing infrastructures, for instance, old railway stations or bus terminals which are normally located in central cities. Thus the use of a centrally located station or terminal supports the view that an intermodal transportation center not only forms an integral part of the urban scene, but has the potential for also becoming a tourist center. This trend has already begun in several cities in both Europe and North America where existing railway stations have been converted to intermodal transportation centers.

6. Suburban Interstate Bus Terminals

The suburban interstate terminal is a peripheral type designed to avoid the traffic congestion and heavy landed property investment associated with central city and/or airport terminal facilities. The terminal is usually located adjacent to interstate highway connections with major cities or regional airports and in many instances serves the increasing outlying "urban sprawl" areas. In an increasing number of cases, terminals of this type serve a commuter-type function where the daily journey to work in the central city may take as long as 2 hours.

Ahmad and Abdul Rahman (2003) classified the types of bus terminals into five classes.

1. Terminal Building Complex

Terminal bus in the form of building complex has the added advantage that bus bays where alighting and boarding of passengers are under one roof. Normally the bus bays are at ground level while as passenger waiting area and other terminal facilities are at first floor level. This type of terminal may incorporate shopping arcade.

2. Partial Housed Terminal Complex

Terminal of this type usually the counter for selling tickets and passenger waiting area are within the single story building. Bus bays are located "infront" of the building platform and not covered.

3. Open space terminal

This is an open space bus terminal and there is no specific designated bus bay. Tickets are selling from ticket stalls located within the vicinity of the terminal. This type of terminal lack or have no proper facilities for passenger.

4. “Infront” of shop houses

This type of terminal is temporary terminal where the buses stop to take and drop passengers “infront” of shop houses. Normally tickets are sold through agents and sometimes among through the shop owners. This type of terminal does not provide any facilities for the passengers. Quite commonly, the terminals are located “infront” of restaurants.

2.4. TERMINAL FUNCTIONS

There are six basic functions of a bus terminal. These are

- 1. Concentration:** the terminal provides a point of consolidation and concentration of transit activity. This is true for both freight and people. People from different destinations load themselves onto one vehicle for onward transport to the same destination. Conversely, in order to gain economies of lower costs and use of each vehicle, each element must be concentrated to some degree, and not moved, until all preparations to make the movement successful have been made.
- 2. Dispersion:** the function of dispersion is the opposite of concentration and is also, performed for both goods and people. In intercity/interstate travel, the terminal thus becomes both an origin and a destination from which people and goods disperse to their ultimate destinations.
- 3. Shipment services:** terminals provide valuable shipment service functions. For passengers, these include waiting rooms, ticketing, and a wide plethora of comfort services such as conveniences, shopping, restaurants etc. for freight it includes services such as routing, waybilling, weighing, collation etc. which are also somewhat akin to the ticketing of passengers.

4. **Vehicle services:** terminals provide among others for vehicles: A safe haven until needed; A space for maneuvering, A place for cleaning, repairing and servicing of said vehicles. The terminal has repair shops for maintaining and readying buses for departure, it may also be site for carriers' executive offices, safes offices, accounts, and workers auxiliary services such as restrooms, canteen, conveniences etc.
5. **Interchange:** terminals provide a place for Interchange of passengers and freight this may involve transshipment of people and freight from bus - bus, bus- other modes or between vehicles of different lines.
6. **Monitoring Services:** the terminal affords a space from where the movement of various vehicles can be monitored. The conditions and quality of services to passengers and other users can thus be easily monitored and regulated. Inspection of roadworthiness for transit vehicles and operators can also be carried out.

2.5. TRANSPORT AND THE ENVIRONMENT

Transport has significant detrimental effects on the built and natural environment, and hence on individuals' lives. It also contributes significantly to global warming. On both these counts, transport will be unsustainable in the medium to long term without mitigation measures. The environmental aspects of transport sustainability are concerned with atmospheric and noise pollution, land take, resource use, the effects of waste disposal on the natural environment, and the effects of the above on humans, flora and fauna. These environmental aspects of transport cover the full life-cycle of transport. The largest impacts come from transport use, but the effects from development and construction of infrastructure and vehicles, as well as the waste from their disposal, add to the environmental costs of transport (European Commission, 2009).

Transportation facilities are part of a larger community, and Improvements to these transit facilities should benefit the community at large. Integrated facilities of a transit center include those features not directly related to the transfer process or the center's environment. These facilities can include shopping, child care, and community centers. However, the sum of all these facilities including the terminal and its facilities (directly involved in the transfer of goods and property) exert some definite pressure and impact on the surrounding environment (Omotola, 2011).

2.5.1. THE BUS TERMINAL ENVIRONMENT

The environment of a transit center is important in creating a positive experience for the traveler. Attention to details such as personal safety, general aesthetics, amenities and conveniences will encourage the use of public transit. Several factors must be present which make such environment pleasing, safe and capable of attracting patrons. Some of these are (Omotola, 2011):

- **Safety (and perceived safety).** The design of the facility needs to include adequate lighting, clearly marked exits and accessible transit employees and security officers.
- **General aesthetics.** It is important to keep the transit center and vehicles clean. Air temperature, architecture, and distinguishing decor and artwork make any public space more comfortable and inviting.
- **Amenities and conveniences.** All transit centers should include benches and appropriate shelter. In addition, larger centers should additionally include telephones, restrooms, drinking fountains, and possibly food services. Each additional service provided will increase the attractiveness of the center and increase ridership.

2.5.2. ENVIRONMENTAL IMPACT OF TRANSPORT SYSTEMS

1. Climate change

Research on climate change for the UK government from the Tyndall Centre for Climate Change Research (Bristow et al., 2008; Banister and Hickman, 2006) has shown that limiting carbon emissions from transport in order to achieve sustainability targets will be extremely difficult to achieve. There is a clear view that any forthcoming technological advances in transport (especially aviation) will at least partially be offset by increases in demand and intensity (Bows et al., 2006). The potential implications of climate change on biodiversity, health, society and the economy have been well documented (IPCC, 2009).

2. Waste

Existing cars contain materials such as lead, mercury, cadmium, hexavalent chromium and other environmentally harmful substances. By weight, about three-quarters of a car is steel and aluminum, which is recycled. The rest, which is mainly plastics, is disposed of by incineration or in landfills. Cars also contain dangerous liquid substances (anti-freeze, brake fluid, oil, etc.) that are harmful to the environment if not handled properly (EEA, 2003). There has been relatively little recent research on this problem.

3. Air pollution

Over 100,000 deaths are brought forward each year by transport-related pollutants, of which over 70% are generated in urban areas (CEC, 2007). Research has shown that most local air pollutants have been reduced significantly through technological improvements (driven by regulation) since the mid-1990s, though some, in particular particulates and NO_x, are still a source of considerable ill health and premature death, especially among vulnerable groups of the population. Future projections show that some emissions can be decreased with the aid of technology, but especially in urban areas the increasing demand for travel will cause more problems with pollutants such as NO_x and PM. Air pollution 'hot spots' are highlighted by Australian research (Greaves, 2006) that points to locations such as street canyons, tunnels and intersections as areas where pollutant load levels are much higher than the recorded averages for the area. These findings show that an area average is not effectively measuring the exposure that different groups of people are receiving (European Commission, 2009).

4. Noise

There is increasing evidence of health effects from noise, particularly through aggravation of heart conditions. Recent estimates of noise-related health impacts in the Netherlands suggest that current noise levels may be associated with annoyance in 1.5 - 2 million people (out of a population of 16 million), disturbed sleep in 0.5 - 1 million and about 220,000 cases of hypertension (European Commission, 2009).

5. Land take

Between 1990 and 1998, it is estimated that 30,000 hectares (ha) of land (about 10 ha every day) were taken for motorway construction alone in the EU-15 (EEA, 2004). On average about half of designated nature areas in Europe are affected by transport (EEA, 2004). Research has been conducted to identify best practices towards land use and transport policy, in order to achieve a sustainable pattern of transport and land use in European cities and regions, promoting environmental as well as economic and social improvement. Trends in land use and transport planning have been analyzed and likely future trends have been considered. Best practice case studies relating to integrated land use and transport policies and to overcoming the barriers to successful implementation of such policies have been disseminated (European Commission, 2009).

2.6. TERMINAL OPERATION ENVIRONMENT IMPACT

Omotola, (2011) stated that Construction and indeed the Operation of bus Terminals result in some forms of environmental impact. He stated two major impacts which include the following:

1. Noise:

Noise is almost always a challenge in transportation terminals. For this project, 'noise' is either: short term construction noise or long term Increases in noise generated by vehicles using the terminal; noise generated in the process of maintaining plant and machinery. These are based on predicted future noise levels for a time 10 years from the construction of the terminal project in relation to the existing ambient noise level. Noise levels are measured 1m from the most exposed facade. These also apply to teaching areas in educational facilities and residential buildings excluding garages, short-term accommodation (such as hotels and motels) and residential accommodation in buildings that have other uses.

2. Pollution:

According to AJK-EPA, (2000), various types of environmental aspects are associated with the design, construction and operation of the bus terminals. These are discussed below:

- a. Improper siting of the terminal resulting in inconvenience to the surrounding population;
- b. Conflict with the existing land-use, for example locating the bus terminal next to a hospital or very close to a residential area;
- c. Parking of the buses outside the terminal either due to inadequate capacity or for lack;
- d. Traffic congestion due to other public transport that carry passengers to the bus terminal for onward journey in the buses.
- e. General filth in the area due to improper solid waste disposal;
- f. Lack of proper sanitary facility resulting in people urinating against the walls that apart from defacing the wall and creating filth and stench can also be a source of spread of disease vector;
- g. Lack of sewerage system resulting in overflowing drains and sewers and in creation of pools of dirty water;
- h. Dust pollution from unpaved surfaces in the driveways and parking lots;
- i. Air pollution from exhaust of buses and other vehicles;
- j. Safety hazards due to poor design. or inadequate facilities for passengers, or poor management of facilities;
- k. Noise pollution due to inadequate control on vehicle noise emission, poor design and management;
- l. Oil and grease stains and spread of workshop waste due to repairs of buses within the premises of the bus terminal or leakages from the POL dumps.

2.7. PHYSICAL REQUIREMENTS OF A BUS TERMINAL

The term transit center (or bus terminal) is normally applied to facilities where multiple bus routes converge, offering transfers between lines. The term can also apply to intermodal stations

that may combine local bus services with other transit services, intercity bus or rail, and associated services such as taxi stands, concessions, and ticket sales. Both types of facilities are normally located wholly or partially off-street and frequently include a more elaborate and extensive shelter and more passenger amenities than ordinary bus stops (USAF, 2007).

2.7.1. SITING AND ORIENTING A BUS TERMINAL

Darnell & Associates, (2006) stated that “each new bus stop location should take into consideration a number of factors including:”

1. Spacing along the route,
2. Location of the expected passenger traffic generator, either based on population density and/or specific use (i.e. major employment centers, regional shopping centers, hospitals, etc.), for the stop,
3. Traffic safety,
4. Pedestrian safety and access to stop, pathways leading to and from bus stop areas should be level, have a firm surface, and be free of obstacles,
5. Availability of adequate right-of-way to ensure that the bus stop meets the disability standards.
6. Curb clearance – adequate space for buses to stop, and return to the traffic flow,
7. Operational effectiveness issues (including relation to the nearest intersection, bus turning requirements, and re-entering the travel lane).

Some other criteria as outlined by USAF, (2007) include:

1. Minimizing excessive grading operations and balancing cut and fill
2. Integrating adequate parking spaces with surrounding facilities and existing circulation patterns
3. Locating parking areas convenient to building entrances

4. Using topography and trees to mitigate negative visual impacts
5. Separating customer and employee parking areas
6. Preserving sight lines to entries and significant landscape and architectural features
7. Minimizing negative impacts to the natural environment such as unnecessarily removing mature vegetation or degrading soil stability
8. Preserving and integrating existing mature trees in future parking

To create safe and convenient parking areas, the orientation and configuration of the parking area must be considered early in the siting process.

1. Align rows of parking spaces perpendicular to the facility minimizing the number of pedestrian aisle crossings
2. Provide access points and crosswalks from parking areas to facility entries (USAF, 2007).

2.7.2. USER WALKING DISTANCE

Long term users, such as employees, will generally accept longer walking distances from parking areas to their workplace. Short term users such as customers or visitors expect shorter walking distances. Parking spaces for a specific facility should not be more than 75 meters from the facility entrance. (USAF, 2007)

2.7.3. GENERAL PLANNING AND DESIGN

Some common parking area planning and design guidelines are:

1. Use 36 square meters per vehicle (includes entry, circulation, and parking spaces) as a typical planning and cost estimating factor
2. Minimize parking area entrance and exit curb cuts
3. Locate separate visitor and reserved parking at the front entry of the facility

4. Eliminate dead-end parking areas
5. Locate entrances and exits away from busy intersections
6. Locate aisles and rows of parking parallel to the long dimension of the site with parking on each side of an aisle
7. Use rectangular parking areas to minimize land area requirement

2.8. PEDESTRIAN CIRCULATION CONCEPTS

An important objective of a transit stop or station is to provide adequate space and appropriate facilities to accommodate projected peak pedestrian demands while ensuring pedestrian safety and convenience. Early efforts involved designing transit stations based on maximum pedestrian capacity without consideration of pedestrian comfort and convenience. Research has shown, however, that capacity is reached when there is a dense crowding of pedestrians, causing restricted and uncomfortable movement (Transportation Research Board, 2003).

2.8.1 FACTORS IN PEDESTRIAN CIRCULATION

- 1. Pedestrian capacity:** the maximum number of people who can occupy or pass through a pedestrian facility or element, expressed as persons per unit of area or as persons per unit of time. Both a maximum capacity reflecting the greatest possible number of persons who can pass through and a “design” capacity representing the maximum desirable number of pedestrians are applied in appropriate ways. Higher “theoretical” capacities are sometimes identified (e.g., for escalators and moving walkways), but are not based on practical experience and are not generally applicable in analysis or design.
- 2. Pedestrian speed:** average pedestrian walking speed, generally expressed in units of feet or meters per second.
- 3. Pedestrian flow rate:** number of pedestrians passing a point per unit of time, expressed as persons per minute, 15 minutes, or other time period; “point” refers to a line across the width of a walkway, stairway, or doorway, or through a pedestrian element such as an escalator or fare control gate.

4. **Pedestrian flow per unit width:** average flow of pedestrians per unit of effective walkway width, expressed as persons per inch, foot, or meter per minute.
5. **Pedestrian density:** average number of persons per unit of area within a walkway or queuing area, expressed as persons per square foot or meter.
6. **Pedestrian space:** average area used by or provided for each pedestrian in a walkway or queuing area, expressed in terms of square feet or meters per pedestrian; this is the inverse of density, but is a more practical unit for the analysis of pedestrian facilities. The space normally required by people varies according to the activity they are engaged in and increases with walking speed. It is important to consider the type and characteristics of the pedestrians. For example, the area required by a person using a wheelchair or transporting luggage or packages is greater than for a person standing without items. **Pedestrian time-space:** the space normally required by pedestrians for various activities (walking, queuing, conversing, shopping, etc.) multiplied by the time spent doing the activity within a specific area.
7. **Effective width or area:** the portion of a walkway or stairway's width or the area of a space that is normally used by pedestrians. Areas occupied by physical obstructions and buffer spaces adjacent to walls and obstructions are excluded from effective width or area (Transportation Research Board, 2003).

2.8.2. PEDESTRIAN LEVEL OF SERVICE

Pedestrian levels of service provide a useful means of evaluating the capacity and comfort of an active pedestrian space. Pedestrian LOS thresholds related to walking are based on the freedom to select desired walking speeds and the ability to bypass slower-moving pedestrians. Other considerations related to pedestrian flow include the ability to cross a pedestrian traffic stream, to walk in the reverse direction of a major pedestrian flow, and to maneuver without conflicts with other pedestrians or changes in walking speed (Transportation Research Board, 2003).

Levels of service for queuing areas are based on available standing space, perceived comfort and safety, and the ability to maneuver from one location to another. Since pedestrian LOS is based on the amount of pedestrian space available, the LOS thresholds can be used to specify desirable

design features such as platform size, number and width of stairs, corridor width, and so forth(Transportation Research Board, 2003).

2.9. PEDESTRIAN CIRCULATION ON WALKWAYS

The capacity of a walkway is controlled by the following factors:

1. Pedestrian walking speed;
2. Pedestrian traffic density;
3. Pedestrian characteristics, bikes or strollers present, and wheelchair users; and
4. Effective width of the walkway at its narrowest point.

2.9.1. SPEED

Normal walking speeds of pedestrians vary over a wide range, depending on many factors. Walking speeds have been found to decline with age. Studies have also shown that male walking speeds are typically faster than female walking speeds. Other factors influencing a pedestrian's walking speed include the following (Transportation Research Board, 2003):

- Time of day;
- Weather and temperature;
- Pedestrian traffic composition, including wheelchair users;
- Trip purpose; and
- Reaction to surrounding environment.

Free-flow walking speeds have been shown to range from 145 ft/min (45m/min) to 470 ft/min (145 m/min). On this basis, speeds below 145 ft/min (45m/min) would constitute restricted, shuffling locomotion, and speeds greater than 470 ft/min (145 m/min) would be considered as running. A pedestrian walking speed typically used for design is 250 ft/min (75 m/min) (Transportation Research Board, 2003).

2.9.2. DENSITY

Perhaps the most significant factor influencing pedestrian walking speed is density. Normal walking requires sufficient space for unrestricted pacing, sensory recognition, and reaction to potential obstacles. Increasing density reduces the available space for walking and increases conflicts between pedestrians, and therefore, reduces walking speeds. This is an even greater concern for people who use mobility aids such as crutches, canes, and wheelchairs (Transportation Research Board, 2003).

2.9.3. EFFECTIVE WALKWAY WIDTH

The final factor affecting a walkway's capacity is the effective width available. Studies have shown that pedestrians keep as much as an 18-in. (0.5-m) buffer between themselves and adjacent walls, street curbs, platform edges, and other obstructions, such as trash receptacles, sign posts, and so forth. In practice, the width of the unused buffer depends on the character of the wall or obstruction, the overall width of the available walkway, and on the level of pedestrian congestion. In general, 18 in. (0.5 m) should be deducted next to walls and platform edges and 12 in. (0.3 m) should be deducted next to other obstructions, including walls up to about 3 feet (1m) tall (Transportation Research Board, 2003)

2.10. SITE LOCATION AND ORGANIZATION

The site location and site development of Passenger are critical to the successful operation of the facility whether building a new terminal or adapting an existing structure (Air Mobility Command, 2011). In designing a terminal, the issue of the site organization is also very important. Some of the factors to be considered are explained below.

2.10.1. SITE EVALUATION

In many instances, however, that selection is not possible due to the constraints of other existing facilities and must be adjusted to the realities of limited available space. The following criteria will help in determining the most suitable locations (Air Mobility Command, 2011):

1. Location

Select a site adjacent to the airfield that is both visible and has direct access from the main base roadway system. Locate the site in the vicinity of the Terminal to share resources and operational efficiencies. Coordinate the use of parking lot areas with neighboring facilities where possible (Air Mobility Command, 2011).

2. Site Determination

Passenger Terminals require areas for the following exterior functions in addition to the facility itself (Air Mobility Command, 2011):

- Setbacks
- Entry and exit drives for site access
- Service drives and loading areas for deliveries
- Short-term parking for privately owned vehicles (POVs) and government-owned vehicles (GOVs)
- Ground transport pick-up/drop off zones
- Frontage or access to the airfield
- Long-term parking

2.10.2. PEDESTRIAN FACILITIES PROVISION

Terminal users usually include a large number of pedestrians. Therefore, special attention must be paid to connecting a transit station to the surrounding pedestrian network. The simplest way of increasing the use of public transportation facilities is to establish an environment where pedestrian access is safe, convenient, and comfortable. Pedestrian facilities connecting the terminal to the surrounding pedestrian network include sidewalks, cross-walks, pedestrian bridges ramps, and curb cuts. Sidewalks are pedestrian facilities along streets. Sidewalks in terminal areas should be sufficient width for two people to walk abreast comfortably, or a

minimum of 1.5m wide. Sidewalks directly leading to transit facilities (including bus stops) should be at least 1.8m wide. Sidewalks in commercial or urban areas must be considerably wider, based on projected patronage.

Crosswalks should be provided at all intersections along the primary pedestrian routes to transit facilities. Crosswalks should be as wide as the adjacent sidewalks or walkways and the clearly marked so as to be easily visible to auto traffic. Contrasting or textured paving may also be employed to clearly delineate a cross walk from the roadway and provide a traffic calming effect. Crosswalks at high-volume or congested intersection should be signalized. Pedestrian bridges should be designed as dual-use facilities to accommodate bicycle riders. Two-directional, dual-use facilities should be a preferred minimum of 3m wide; 2.4m wide where constrained, as noted earlier (see the illustration at right). Grades should not exceed 1.15 (6.66 percent) for pedestrian facilities. Grades exceeding 1.15m must meet code requirements for pedestrian ramps. Ramps may not exceed a slope of 1.12 (8.33 percent) (Omotola, 2011).

2.10.3. AUTO FACILITIES PROVISION

Provisions for automobiles at transit' facilities include kiss- and-ride, park-and-ride and parking areas. Kiss-and-ride facilities consist of short-term parking spaces located in close proximity to the terminal entrance, intended for passengers being dropped off or picked up by automobile. Kiss-and-ride facilities may be combined with taxi facilities depending on the volume of curbside service (drop off and pick-up) anticipated at the station. High volume stations usually functions best with separate taxi facilities. Park-and-ride facilities are intended for commuters who drive to the terminal; they provide all-day parking, usually for a fee. Park-and-ride facilities should be conveniently located relative to the station entrance but should be located beyond bus, shuttle bus, kiss-and-ride and taxi facilities vying for the curb at the station entrance. Park-and-ride facilities may be configured as parking structures or surface lots, depending on site constraints, land acquisition, walking distances, and other factors (Omotola, 2011).

2.10.4. BUS FACILITIES

Bus facilities serving transit stations range from single stops along adjacent streets serving one or two lines, to off-street depots serving multiple lines. Articulated buses can also be accommodated within these dimensions. The minimum clearance between the roadway and any overhead obstruction where buses operate should be 4.5m. Some vehicles operating on natural gas or other alternative fuels may require additional clearance overhead. The curbside lane at a bus stop should be a minimum of 3.0m wide (4.2m preferred). Where the curbside lane is also used for parallel on-street parking, the minimum width should be 4.8m (6m preferred). Near-side bus stops preceding an intersection in the direction of travel-should be at least 30m long, measured from the Curb line of the intersecting street to the nearest on-street parking space. Far-side bus stops-following intersection in the direction of travel-should be at least 24m long. Where it is anticipated that more than one bus may use a stop at the same time, the stop length should be increased by 15m for each standard bus and 21m for each articulated bus (Omotola, 2011).

Turnouts should be a minimum of 3m deep (3.6m preferred), measured from the edge of the curb travel lane, Where it is anticipated that more than one bus may use a turnout stop at the same time, the length of the berth area should be increased by 15m for each standard bus and 21m for each articulated bus. Sidewalks at bus stops should be a minimum of 3m wide (4.5m wide in urban and commercial areas). Shelters should be provided to protect waiting passengers from the weather. Where practicable, continuous shelter should be provided from the bus to adjoining transit facilities, to allow weather-protected intermodal transfer (Omotola, 2011).

2.10.5. SERVICE ACCESS

Station site design should provide access for transit staff and service vehicles to perform routine service and maintenances without interrupting normal station operations. Provisions should also be made for the periodic replacement of station equipment. Requirements for service access should be determined in coordination with the development of the station operations and maintenance plan (Omotola, 2011).

2.11. ACCESS AND ROAD GRADING

There must be smooth and easy access to the terminal facility from the existing road network. These accesses have to be of it diminishing graduation so as to ensure proper service of the intended zones of the terminal complex while discouraging over speeding within the complex. Since there will be movement of both vehicles and passengers with the same level and time, provisions must be made for obvious safety reasons, to separate the two as much as possible. Circulation patterns should be created that form a convenient, safe, and accessible network for all types of transportation that interconnect the surrounding residential, commercial, and employment areas, and that provide direct connections to the stations. Grading of roads, right from the highway access, must be employed so as to ensure that buses, cars, and indeed all other vehicles operate within safe speed limits for movement within the facility (Omotola, 2011).

2.12. PARKING

The suburban interstate terminal is perhaps the simplest of the terminal types. The most significant planning requirement is adequate provision for parking. Many, if not most of the passengers drive to the facility and park their cars until their return, while others may be driven to the facility and discharged. In many instances access to the terminal may also be via local bus service and taxi. It is essential, therefore, that the parking facilities be located so as to minimize the walking distance to the terminal and that egress and ingress be planned to avoid traffic congestion along nearby arteries. If possible, some covered walkways should be provided leading from the parking field to the terminal building (Omotola, 2011).

2.13. BUS LOADING AREA

The bus loading area is where transit vehicles dock and circulate and where passengers board and alight. Design of the bus loading area must incorporate both vehicle and passenger needs. In most stations, the bus loading area integrates the bus bays with the platform area to facilitate the loading and unloading of passengers near or adjacent to the station building. Sizing of the bus bays will depend on the transit operation, including independent or dependent vehicle arrival and departure requirements of buses. For small transit stations, the number of bus bays is relatively low, ranging anywhere from 2 to 4 bays, with a fairly simple access and layout configuration.

For larger terminals, numerous bays and more sophisticated designs are applied (Fuhs and Brinckerhoff, 2002).

2.13.1. TYPES OF BUS LOADING CONFIGURATION

1. **Linear (curb-side):** these bays can operate in series and have capacity characteristics similar to on-street bus stops.

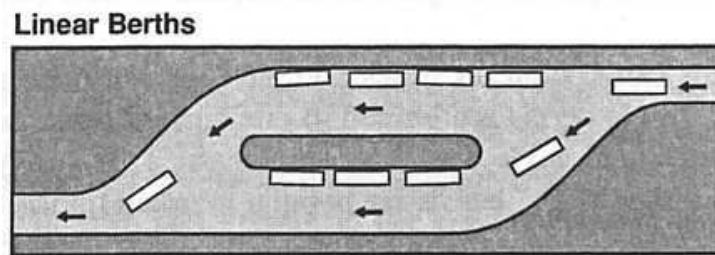


Figure 1: Showing Linear (curb side)

Source: Fuhs and Brinckerhoff, (2002)

2. **Sawtooth:** This loading configuration is popular in urban transit centers, and designed to permit independent movements into and out of each bay.

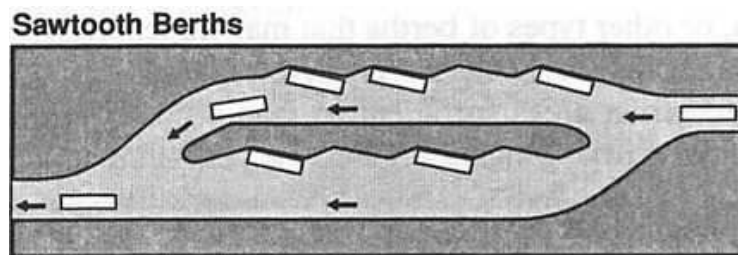


Figure 2: Showing Sawtooth pattern of bus parking

Source: Fuhs and Brinckerhoff, (2002)

3. **Angle:** This loading type is limited to one bus per bay, and requires buses to back out. This is often used for inter-city coach terminals, with long dwell times, single-door entry, and luggage loading requirements.

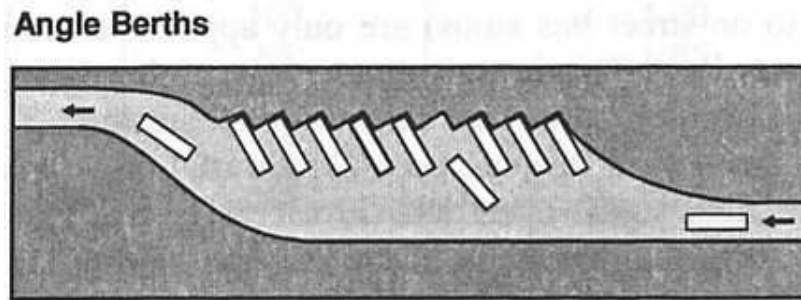


Figure 3: Showing Angle berth
 Source: Fuhs and Brinckerhoff, (2002)

4. **Drive Through:** Drive-through angle bays do not require buses to back out of the bay and may accommodate multiple vehicles (Fuhs and Brinckerhoff, 2002).

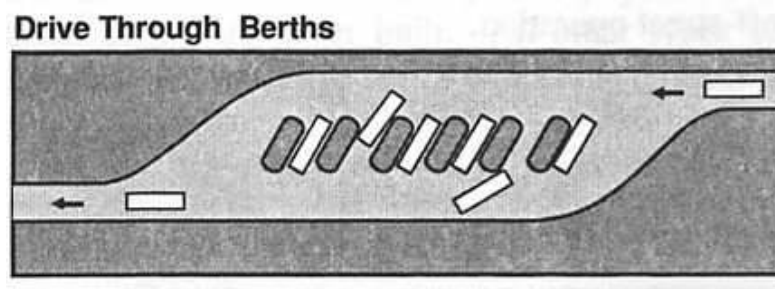


Figure 4: Showing Drive through berths

Source: Fuhs and Brinckerhoff, (2002)

2.13.2. DESIGN CONSIDERATIONS

1. Bus loading zones should be flexible and designed to accommodate potential future growth.
2. Passengers should be accommodated at a reasonable level of service.
3. The facility should accommodate a range of bus types depending on the intended facility program, e.g., spaces for articulated coaches, standard coaches and smaller vehicles or vans.

4. Bus loading zones should reinforce safe pedestrian movements and easy vehicle operation.
5. All loading zones should be located in a common area within the facility.
5. All buses owned by the agencies using the facility should be able to operate within the bus roadway, with the understanding that the types of vehicles that will operate in the loading area may vary depending on system changes and growth (Fuhs and Brinckerhoff, 2002).

2.14. PUBLIC AREAS IN A BUS TERMINAL

Public areas are places in a transit facility where customer-related activities occur. All features provided to the public need to be accessible, such as seating, kiosks, vending machines and parking. Public areas include:

1. Passenger Waiting
2. Passenger Amenities
3. Short-Term Parking (Kiss and Ride)

2.14.1. PASSENGER WAITING

The passenger waiting area is where a majority of passengers congregate within the facility, where queuing for transit vehicles occurs and passengers wait. The passenger waiting area should (Fuhs and Brinckerhoff, 2002):

1. Efficiently, conveniently organize space and provide customer amenities.
2. Provide a safe and well-lit place that is readily observable for security reasons.
3. Provide area/spaces for customer information.
4. Include provisions that allow customers to sit or lean.
5. Adequately protect customers from undesirable weather. Refer to “Weather

6. Protection” for specific requirements.
7. Be sized to consider future expansion.

Certain spaces are recognized as important for passenger accommodation. These include:

1. The general waiting area for people waiting to board the transit vehicle
2. An amenity core in which customer services and amenities are concentrated
3. Pedestrian paths and entrances that connect spaces within the facility and with surrounding areas.

2.14.2. PASSENGER AMENITIES

An amenity is defined as a customer-oriented service that makes a passenger’s journey more enjoyable. Common amenities include machines that dispense goods, vendors selling food and drink, customer information/service booths, ATMs, public telephones, and security offices. Amenities are generally located in a central location within the facility. By centralizing most amenities in the core, passengers will intuitively know where to find any amenity. The amenity core must be easily monitored by security personnel. CCTV surveillance is desirable to provide security and monitoring of operation (Fuhs and Brinckerhoff, 2002).

- 1. Food and Beverage Vending Machines:**One machine per fifty people present or a minimum two per facility.
- 2. Newspaper Vending Machines:** One eight-unit array and new vending tie down area of 10 square meters per 50 people, or a minimum of one per facility. At on-street or freeway bus stops one array should be provided.
- 3. Kiosks/Information Display:** One location per 100 people present.
- 4. Convenience Shop:** One per 200 people present.
- 5. Public telephones:** One phone per 50 people present or a minimum of two per facility. Although the use of cell-phones has certainly reduced the need for public telephones, at

least 1 public telephone in the passenger waiting area is recommended for passenger safety.

- 6. Patron phones:** One phone per 50 people present or a minimum of two per facility.

2.14.3. SHORT TERM PARKING (KISS AND RIDE)

Short-term parking is a location for automobiles to drop off and pick up passengers close to the transit loading area. These areas are especially important at facilities where there is no park-and-ride area, or where the park-and-ride area is not large enough to meet demand. Drop-off zone layout can vary widely, from on-street loading zones to multi-island pick up points. Some short-term waiting space should be available for cars to wait to pick up arriving passengers (Fuhs and Brinckerhoff, 2002). The following design issues may warrant consideration, depending on individual facility characteristics and needs:

1. Passenger drop-off zones' ability to accommodate a wide range of vehicle types and operations, including standard and compact automobiles, vans and shuttles.
2. Sizing drop-off zones to accommodate the number of waiting vehicles expected to be present during the PM Peak period. Signage or enforcement to ensure a short vehicle stop at drop-off zones should be considered.
3. Conveniently locating drop-off zones with respect to the transit loading zones.
4. Conveniently locating drop-off zones with respect to vehicular access to the facility.

2.15. SAFETY AND SECURITY

An important concept in providing for the transit user is to assure a safe and secure environment within the park-and-ride facility. Safety and security are essential if a park-and-ride facility is to be successful. Both safety for the passengers accessing the facility, and security for parked vehicles during the day, are crucial to success. Numerous techniques for assuring a level of real and perceived safety are available, ranging from design approaches to surveillance and control (Fuhs and Brinckerhoff, 2002).

Providing a “defensible space” is a concept that encourages public areas to be designed in a manner that provides a sense of personal safety, while discouraging opportunities for criminal activity. A defensible space design can be achieved through specific design options, as well as through policy implementation, such as increasing police presence and community activity within the lot (Spillar, 1997).

- **Natural Surveillance:** The placement and design of physical features to maximize visibility. This includes building orientation, windows, entrances and exits, parking lots, walkways, guard gates, landscape trees and shrubs, fences or walls signage and other physical obstructions. The placement of persons and/or activities to maximize surveillance possibilities. Lighting that provides for nighttime illumination of parking lots, walkways, entrances and exits.
- **Natural Access Control:** The use of sidewalks, pavements, lighting and landscaping to clearly guide the public to and from entrances and exits. The use of fences or landscaping to prevent and/or discourage public access to or from dark and/or unmonitored areas.
- **Territorial Reinforcement:** The use of physical attributes that express ownership of property, such as Off-Line Transit Facilities: pavement treatments, landscaping, art, signage, screening and fences
- **Maintenance:** The use of low maintenance landscaping and lighting treatment to facilitate principles of natural surveillance, natural access control and territorial reinforcement.

2.15.1. DEFENSIBLE SPACE

In the broader sense, important concepts in developing a defensible space include to:

1. Provide a direct and unobstructed view of major destination points.
2. Encourage adjacent land uses and businesses to maintain large windows facing the park-and-ride facility, creating a perception of the lot being under visual inspection at all times.

3. Choose landscaping and street furniture that do not obstruct the view of the lot from the street.
4. Minimize the expanse of the lot, so that the entire lot can be seen from the transit interface location.
5. Locate or design the park-and-ride facility to be an integral part of the surrounding community so that it does not become isolated.
6. Provide adequate illumination on-site.
7. Locate on-site passenger amenities so that they maximize the comfort and accessibility for the patron while not obstructing sight lines from adjacent streets.
8. Provide adequate signage, both on-site and on surrounding streets, to identify the facility and the regulations protecting it.

2.15.2. OTHER SECURITY MEASURES

Other means to ensure security include:

- 1. Encourage a Police/Security Presence In and Around the Park-and-Ride Facility:** This can be achieved if designer Provide space for a police substation or police information and community outreach center within the design of the park-and-ride facility or Provide emergency and/or pay telephones within the facility, with clearly identified emergency procedures
- 2. Increase Activity Within the Facility:** This can be achieved if designer: Provide activity-generating services on-site; Concentrate activity into defined visible areas; Establish off-hour waiting areas; Provide windows to look onto pedestrian pathways; Encourage employees in surrounding businesses to maintain surveillance of the site; Encourage round-the-clock service
- 3. Consider implementing security devices:** This can be achieved if designer: Consider providing surveillance cameras, protected from tampering and linked to a remote

surveillance site; Consider providing on-site security patrol during peak and off-peak periods; Establish a strict enforcement policy of arresting and removing unauthorized users of the park-and-ride facility, based on local trespass laws.

2.16. BUS GEOMETRICS AND SPACE REQUIREMENTS

Transit buses vary in length from a 12.5m standard bus to an 18m articulated bus.

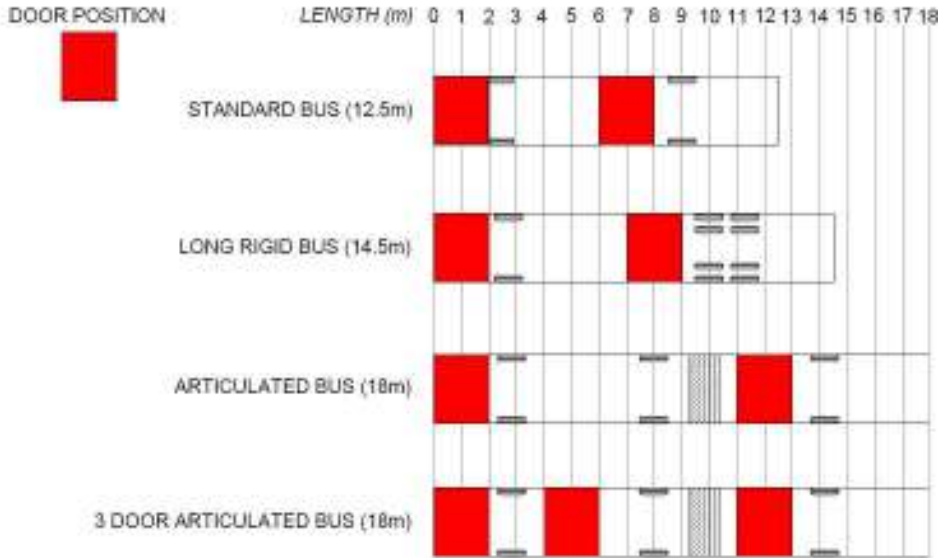


Figure 5: Showing length and door position of varying transit buses.

Source: State Transit, (2011)

Traditionally used in urban transit service, large transit buses are 40-feet long and seat approximately 43 to 50 passengers. Some buses, such as Commuter Link equipment, are slightly smaller (32 feet long) and seat 27 passengers. The Riverside Transit Agency uses large transit buses on most of its local and commuter services throughout Riverside County (River Transit Agency, 2004).

2.16.1. STANDARD BUS DIMENSION AND TURNING RADIUS

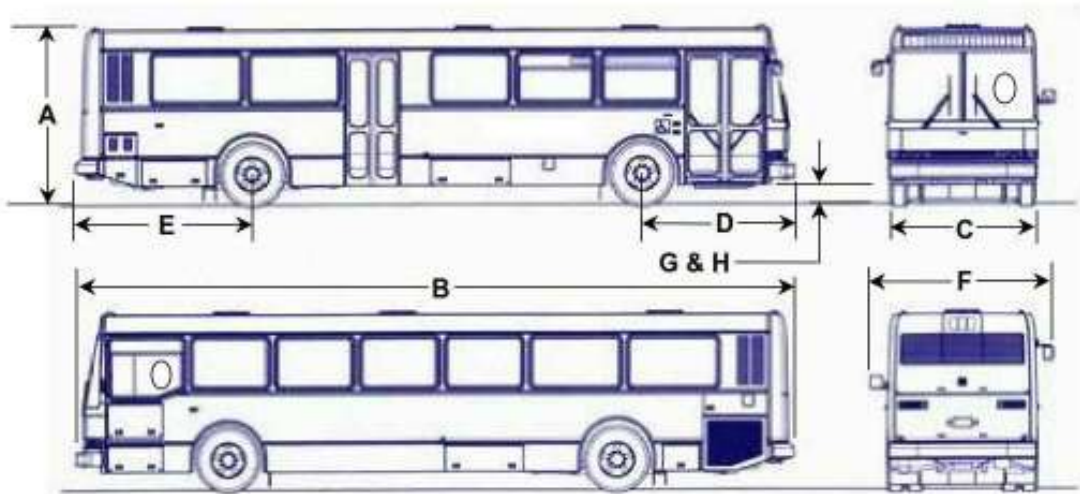


Figure 6: Showing standard bus dimension

Source: River Transit Agency, (2004)

Table 1: Showing standard bus dimension

Symbol	Vehicle Feature	Large Bus Maximum Dimensions
A	Overall Height, incl CNG tanks	11 Feet, 3 Inches **
B	Overall Length, w/bumpers	40 Ft, 7 In *
C	Overall Vehicle Width	8 Ft, 6 In
D	Front Axle to Front Bumper	7 Ft, 7 In
E	Rear Axle to Rear Bumper	10 Ft, 3 In
F	Edge of Outside Mirror-to-Mirror	10 Ft, 6 In
G	Step to Ground, Front Entrance	1 Ft, 1 In
H	Step to Ground, Rear Entrance	1 Ft, 3 In
*	(Add 2 ft for buses with a front-mounted and occupied bicycle rack)	
**	(Typical roof-mounted CNG tanks not shown in above diagram)	

Source: River Transit Agency, (2004)

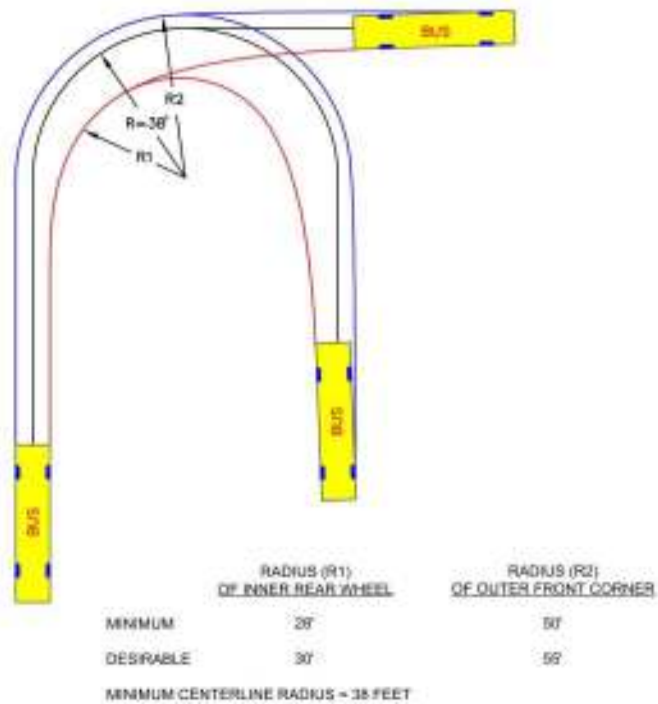


Figure 7: Standard bus turning radius

Source: Fuhs and Brinckerhoff, (2002)

ARTICULATED BUS DIMENSION AND TURNING RADIUS

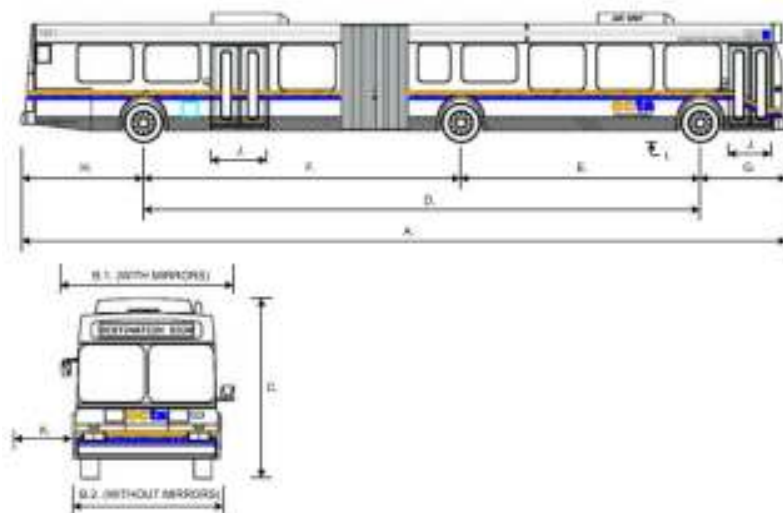


Figure 8: Showing articulated bus dimension

Source: Fuhs and Brinckerhoff, (2002)

Table 2: Showing dimension of articulated transit bus

VEHICLE CHARACTERISTICS (A)		Type of Vehicle
		New Flyer Articulated Bus
A.	OVERALL LENGTH	61'4"
B1.	Overall Width (with mirrors)	10'4"
B2.	Overall Width (without mirrors)	8'6"
C.	Overall Height	10'3"
D.	Wheelbase Length - Front axle to rear axle	44'3"
E.	Wheelbase Length - Center axle to front axle	19'0"
F.	Wheelbase Length - Center axle to rear axle	25'3"
G.	Front Overhang	7'0"
H.	Rear Overhang	10'1"
I.	First Step Distance to Ground	1'3"
J.	Wheelchair Lift Width	2'6"
K.	Wheelchair Lift Extension (Edge of Bus)	3'9"
	Minimum Turning Radius	42'6"
	Gross Vehicle Weight (Pounds)	62,630
	Front Axle Capacity:	13,230
	Center Axle Capacity:	24,700
	Rear Axle Capacity:	24,700

Source: Fuhs and Brinckerhoff, (2002)

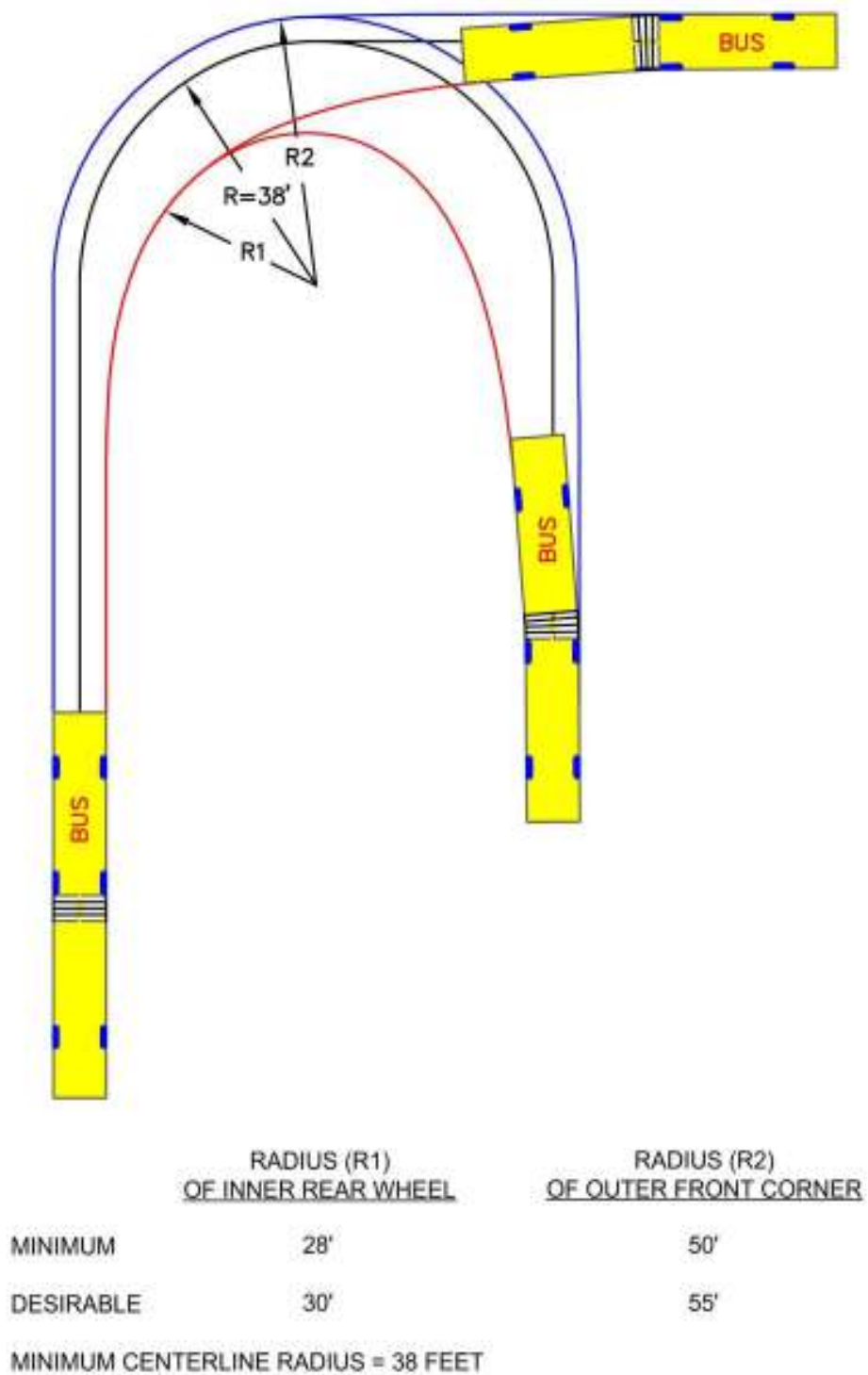


Figure 9: Articulated bus turning radius

Source: Fuhs and Brinckerhoff, (2002)

2.16.2. GENERAL TURNING RADII FOR LARGE BUSES

	Radius (R1) of inner rear wheel	Radius (R2) of outer front corner
Minimum	28'	50'
Desirable	30'	55'

For 40' vehicles and articulated vehicles

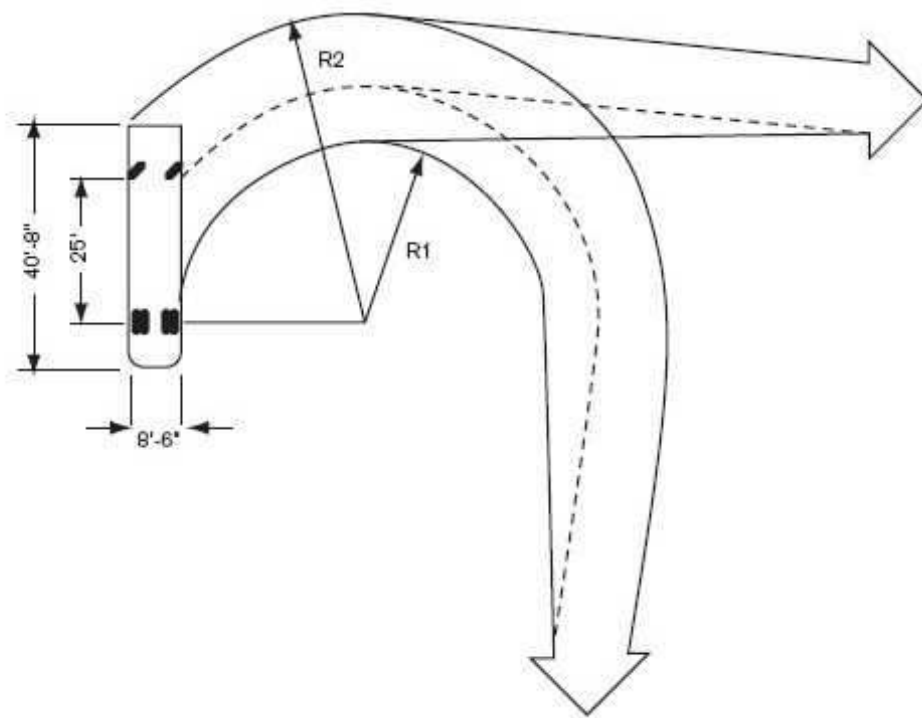


Figure 10: General bus turning radii

Source: River Transit Agency, (2004)

CHAPTER THREE

3.0. CASE STUDIES

Euro Saarinen, on the importance of case studies in project summarized thus: “Naturally I do not believe in eclecticism or Imitation, but I think it is very important everyone and then to look carefully at the architecture of other times so that we can test the degree of fulfillment of our architecture against the fulfillment of others”. The principal objective of these case studies is to get useful information and knowledge on how some properly designed terminals are organized and operated; to be acquainted with the facilities and equipment provided and how they are used; to study the functional layouts of facilities from an architecture point of view. For proper execution of this project a series of case studies were carried out on existing bus terminals both locally and internationally, in order to assess facilities provided as well as to determine required ones for workable design proposal for this project.

Existing bus terminals analyzed during the period of study include the following;

- Ekene Dili-Chukwu Transport, Lagos
- Ifesinachi Mass Transit Limited, Lagos
- Edo Transport Service, [Edo Line] Benin City.
- Bus Terminal and office in Dublin.
- George Washington Bridge Bus Terminus, NewYork.

3.1. CASE STUDY ONE: EKENE-DILI-CHUKWU TRANSPORT COMPANY, LAGOS

3.1.1. INTRODUCTION

Ekene-Dili-Chukwu Transport Company is a subsidiary of Ekene-Dili-Chukwu Group of Company, which comprises of independent Companies; Ekene-Dili-Chukwu Steel Company, Ekene-Dili-Chukwu imports trailers. The company stands as s fore-runner in the Nigeria Private Transport industry. It was established over 15years ago. Presently, Ekene-Dili-Chukwu Transport Company has 120 luxurious buses and has continued to grow and set pace for most private company to follow. It is located along Ikorodu road, Jibowu, Lagos and the Terminal is in proximity with major intra-city Bus Terminals.

3.1.2. LAYOUT AND ORGANISATION

The station covers a land area measuring approximately 40m x 36m. The orientation of the site is as seen from the layout plan. Access to the Terminal building is through Ikorodu road and by the adjacent road to it. The Transport Station basically has four departments namely; Administration Department, Public Relations, Department, Estate Department and Engineering Department. The layout comprises of the Terminal building, Maintenance yard, Bus yard, Car parks and the Generator house.

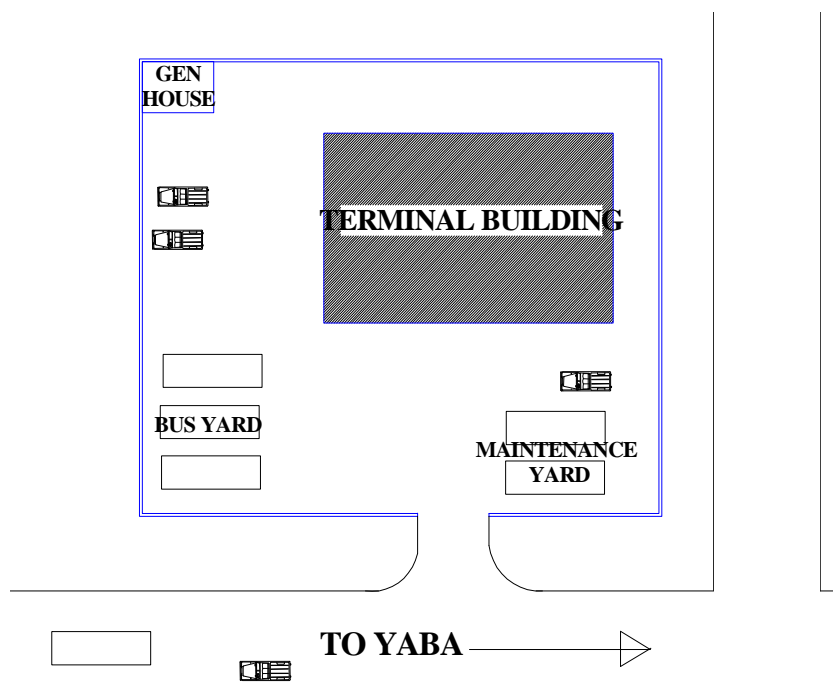


Figure 11: Showing Site Layout

Source: Author's Field Survey, 2015.

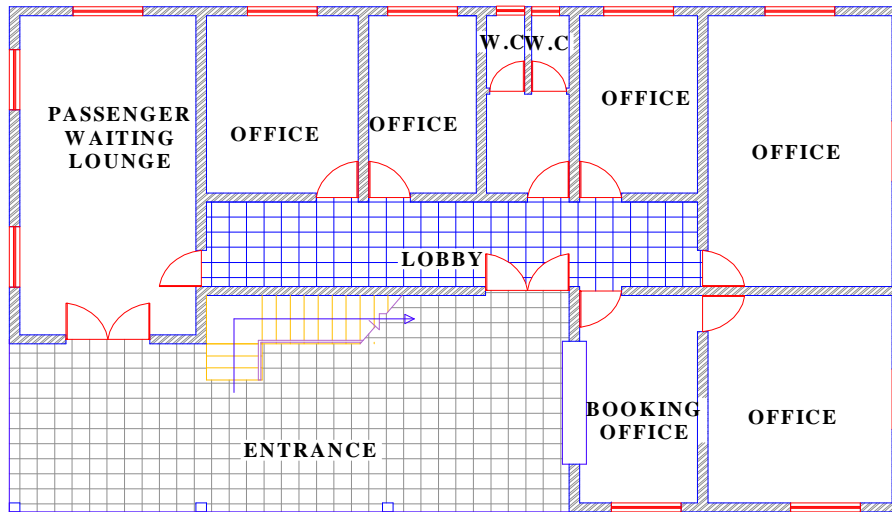


Figure 12: Showing Ground Floor Plan

Source: Author's Field Survey, 2015.

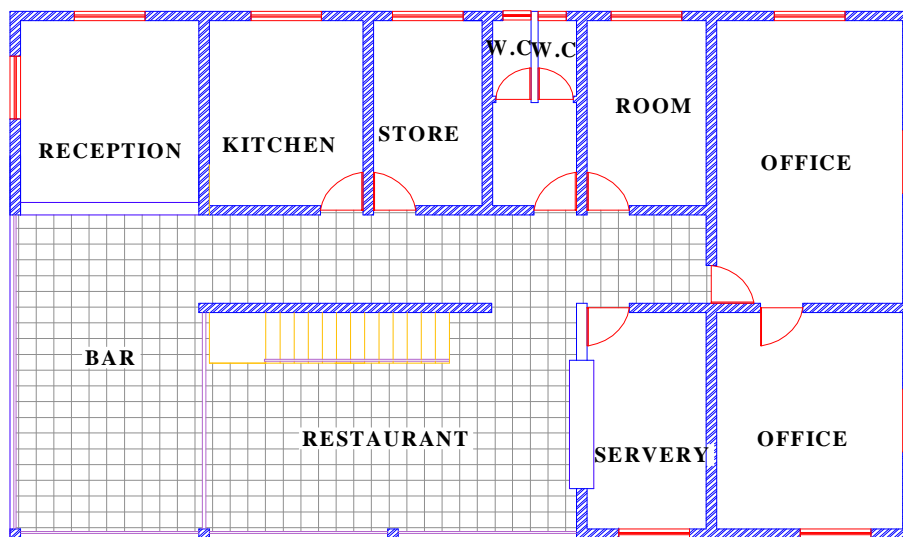


Figure 13: Showing First Floor Plan.

Source: Author's Field Survey, 2015.

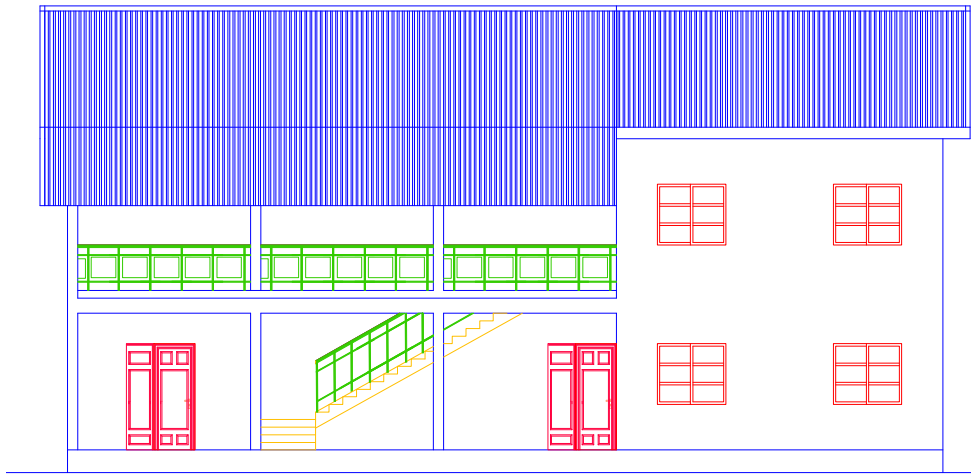


Figure 14: Showing Front Elevation

Source: Author's Field Survey, 2015.

3.1.3. STATION SERVICES

The station provides transport services to intending passengers from Lagos to major cities in the country. Two types of transport vehicles are employed by the station, luxurious buses [city buses] and mini buses [midi-buses]. Also provision is made for maintenance and repair as well as fueling services. The terminal has the following support facilities; restaurant and bar, shops, ticketing and information and lost luggage facilities.

The transport services currently provided caters for passenger needs in the following route;

- Lagos-Benin-Lagos
- Lagos-Port-Harcourt-Lagos
- Lagos-Jos-Lagos
- Lagos-Kano-Lagos
- Lagos-Abuja-Lagos

- Lagos-Warri-Lagos
- Lagos-Onitsha-Lagos

3.1.4. CONSTRUCTION AND MATERIALS

The terminal building was built of hollow sandcrete blockwall, and was rendered with cement-sand plaster. The resultant wall surfaces were then finished with white and blue emulsion paint. The Roof was made of blue long span aluminum roofing sheets on timber roof members. Asbestos ceiling boards were used as the ceiling materials. Concrete cantilevering hoods line the top of windows externally. These windows are essentially louvered, guarded by steel burglar proofs. Doors are paneled, made from well-seasoned hardwood timbers, and are painted in blue emulsion paints. The whole facility is defined by perimeter fencing made up of hollow sandcrete blockwalls and intermittent piers together with decorative steel bars. Little or no attention was paid to landscaping, except that the whole outdoor space was paved with concrete flooring. Though solid, the concrete floors are rough surfaced, thus suggests a cautious effort on the part of the designer to reduce the risks of accident that is associated with the use of such facilities.



Plate 3: Front view of the Terminal Building

Source: Author's Field Survey, 2015.



Plate 4: Showing Bus Yard.

Source: Author's Field Survey, 2015.



Plate 5: Showing Generator House and Private Car Park

Source: Author's Field Survey, 2015



Plate 6: Showing Booking Office

Source: Author's Field Survey, 2015.



Plate 7: Showing Passenger Lounge

Source: Author's Field Survey, 2015.



Plate 8: Showing Bar Server

Source: Author's Field Survey, 2015.

3.1.5. APPRAISAL

1. Location

The location of Ekene-Dili-Chukwu Transport Company is such that it is easily accessible to passengers who can easily walk to the station. In an attempt to leave the station, vehicles sometime cause traffic conflict, which is a disadvantage for locating such facility in a central point in the city. The space allocated for fueling purpose is inadequate and allows for only one vehicle to fuel at a time.

2. Site Planning/Orientation

The site is planned in such a way that a number of facilities are accommodated on Site-Terminal building which includes Workshop, Bus yard, passenger concourse, Canteen, Fuelling services and bar. Orientation of the terminal building is adequate to some extent; the terminal building is oriented along the East-West direction with openings provided along the North-South direction which is in response to climatic requirements.

3. Circulation/Traffic

The location of the station conflicts with the traffic flow of the city. Vehicular and pedestrian accesses are not defined

3.1.5.1. Merits

1. Location of the Terminal is in proximity with major Intra-city bus terminals.
2. Location of the Terminal along major road which links Lagos state to Inter-state highway.
3. There is provision for eating and shopping activities for intending passengers.
4. Facility activities are visible to the surrounding area.

3.1.5.2. Demerits

1. Indiscriminate parking of vehicles outside the terminal premises during peak periods.
2. Long queues by passengers willing to obtain tickets.
3. Poor planning and definition of circulation for both pedestrians and vehicles.
2. Lack of proper landscaping in outdoor spaces.
3. There is virtually no space for expansion.

3.2. CASE STUDY TWO: IFESINACHI MASS TRANSIT LTD, LAGOS.

3.2.1. INTRODUCTION

The Ifesinachi Transport Company was established in the year 1973 by his Royal Highness Igwe J.O Mamah at Onitsha and thus commenced operation at the same period with the view to run a Modern Road Transportation system in Nigeria. The Transport Company as subsidiary of Ifesinachi Group of Companies, the parent Company and is involved in other business activities under the following trade names; Ifesinachi Company, Ifex Service (courier services), Ifesinachi Industries

In the early 1990's, Transport industry in Nigeria saw the emergence of privately owned transport companies, a direct result of increasing demand for good and efficient transportation which Government owned transport outfits have fail to provide.

The Ifesinachi Transport limited commenced operation on highway linking the Eastern and Western part of Nigeria and had its first terminal, the Western part of Nigeria located at Jibowu along Ikorodu road with 207 Small Buses and 88 Luxurious Buses. It has since extended its services to other big cities in the country including cities of Kaduna, Abuja, Kano the Northern part of the country The company is located along Ikorodu road, Jibowu, Lagos and the Terminal is in proximity with major Intra-City Bus Terminals.

3.2.2. LAYOUT AND ORGANISATION

The station covers a land area measuring approximately 50m x 46m. The orientation of the site is as seen from the layout plan. The Site has one entrance. Access to the Terminal building is by two points, one located along Lagos – Ikorodu road and other access is by the side of the terminal.

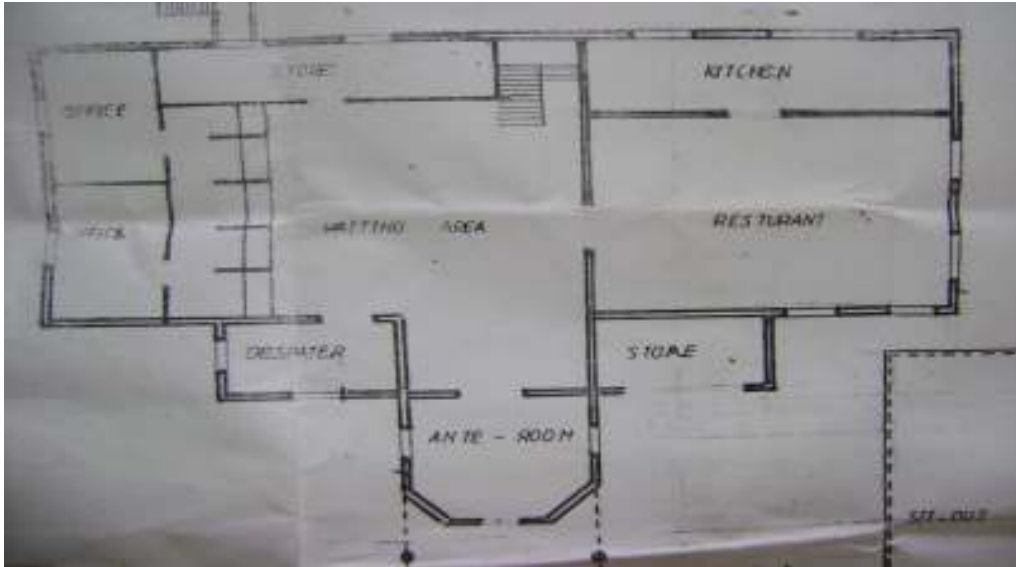


Figure 15: Showing Ground Floor Plan [Terminal Building]

Source: Author's Field Survey, 2015.

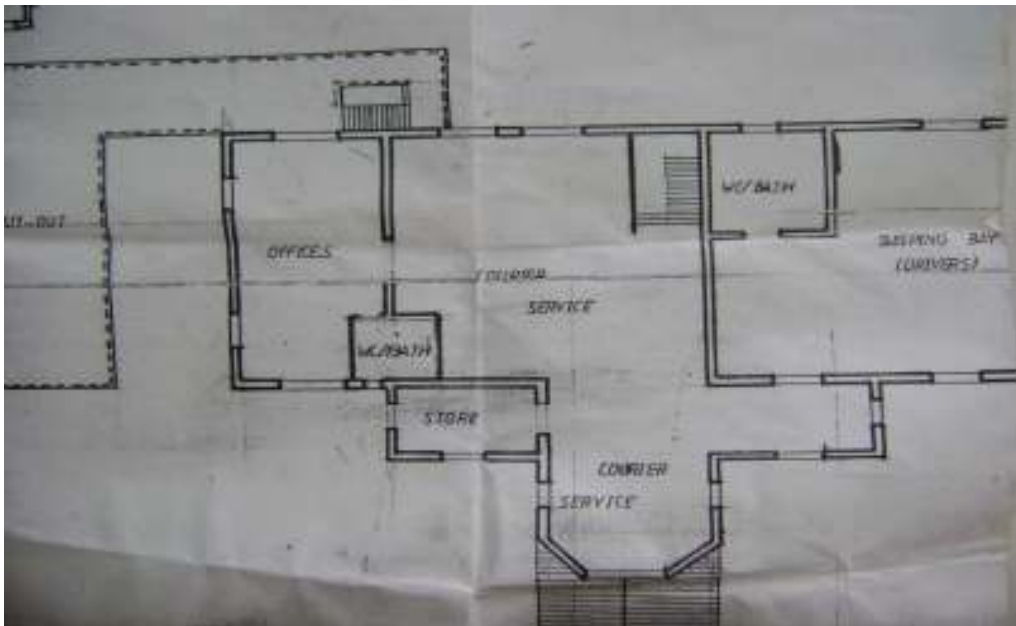


Figure 16: First Floor Plan [Terminal Building]

Source: Author's Field Survey, 2015.

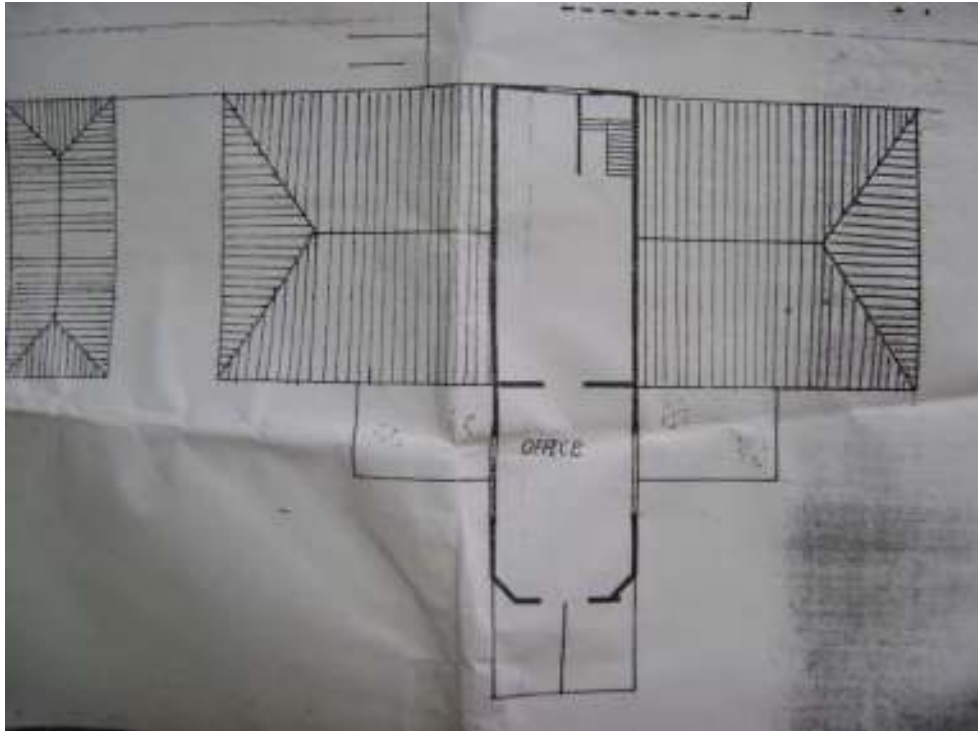


Figure 17: Showing Roof Plan [Terminal Building]

Source: Author's Field Survey, 2015.

3.2.3. STATION SERVICES

The station provides services for intending passengers traveling from various urban towns. Two types of transport vehicles are employed by the station, luxurious buses [city buses] and mini buses [midi-buses]. The facilities provided in the station are fuel dump, Maintenance yard, Restaurant and bar, and IFEX courier service.

The routes plied by this transport station include:

Western-Eastern Routes

- Lagos-Enugu
- Lagos-Abakaliki
- Lagos-Port-Harcourt

- Lagos-Owerri-Aba
- Lagos-Nsuka

Western-Northern Routes

- Lagos-Jos
- Lagos-Abuja
- Lagos-Markurdi

Cross Country Routes

- Lagos-Accra
- Lagos-Lome

3.2.4. OPERATION SERVICES

1. Cargo Express

This service offers non travelling customers the opportunities of sending mails, parcel and goods to consignees who pick them up at Ifesinachi Transport Terminal. Unaccompanied goods are carefully handled and delivered to the consignee on paper identification. This service is not a door-to-door delivery service

2. Cargo Services

For handling bulky goods, Ifesinachi Transport also offers cargo service. The Company efficiently carries out haulage activities nationwide. The Company is presently in contract with major courier companies in Nigeria including the Nigeria Postal service

3. Cash Transfer Services

Ifesinachi Transfer Express takes full advantage of the Ifesinachi Transport network which includes an efficient communication network. Features of cash transfer include the following:

- Cash paid out daily
- Beneficiary collection within 24 hours
- Cash point open up till 6.00pm daily
- Fully security; password protected
- Free fund rates no hidden cost
- Lower charges
- Local cash transfer

3.2.5. CONSTRUCTION AND MATERIALS

Arrivals and the departure bay is an open canopy, the canopy is large enough to take four Midi-buses. The Terminal Building is covered with Asbestos Roofing Sheets, and was built of hollow sandcrete blockwall, and was rendered with cement-sand plaster. The resultant wall surfaces were then finished with white emulsion paint. The Roof was made of blue asbestos roofing sheets on timber roof members. Asbestos ceiling boards were used as the ceiling materials. Shading devices were conspicuously missing on windows externally. These windows are essentially aluminum sliding sashes guarded by steel burglar proofs. Doors are paneled, made from well-seasoned hardwood timbers, and are painted in blue emulsion paints. Little or no attention was paid to landscaping, except that the whole outdoor space was paved with concrete flooring. Though solid, the concrete floors are rough surfaced, thus suggests a cautious effort on the part of the designer to reduce the risks of accident that is associated with the use of such facilities.



Plate 9: Showing Front View of the Terminal Building

Source: Author's Field Survey, 2015.



Plate 10: Showing Bus Yard

Source: Author's Field Survey, 2015.



Plate 11: View showing Departure Concourse and Restaurant behind

Source: Author's Field Survey, 2015.



Plate 12: View showing Generator House and IFEX Motor Cycle Yard

Source: Author's Field Survey, 2015.



Plate 13: Showing Passengers waiting at the Departure Lounge

Source: Author's Field Survey, 2015.



Plate 14: Showing Booking Office

Source: Author's Field Survey, 2015.

3.2.6. APPRAISAL

1. Location

The location of Ifesinachi Transport Company is such that it is easily accessible to passengers who can easily walk to the station. It is very close to Ekene-Dili-Chukwu transport and other transport company. In an attempt to leave the station, vehicles sometime cause traffic conflict which is a disadvantage for locating such facility in a central point within the city.

2. Site Planning/Location

The site is planned in such a way that a number of facilities are accommodated on Site-Terminal building which includes Workshop, Bus yard, passenger concourse, Canteen, shops, Fuelling services, IFEX courier service and bar.

Orientation of the terminal building is seen to be proper to some extent; the terminal building is oriented along the East-West direction with openings provided along the North-South direction which is in response to climatic requirements.

3. Circulation/Traffic

The location of the station conflicts with the traffic flow of the city. Vehicular and pedestrian accesses are not defined

3.2.6.1. Merits

1. There is good relationship between the various department; booking-tickets, administrative area-departure.
2. The site is easily accessible by passengers.
3. Shopping facilities are provided though minimal.

3.2.6.2. Demerits

1. Workshop is not shielded.
2. Booking and cash office have poor lighting and ventilation due to position of openings.
3. Security provision is poor
4. The landscape quality of the site is poor
5. Fuel service is located close to parking lots, stands risk of fire outbreak
6. Uncontrolled parking spaces for buses.
7. There is no provision for customers' luggage.

3.3. CASE STUDY THREE: EDO TRANSPORT SERVICE (EDO LINE) BENIN CITY

3.3.1. INTRODUCTION

The Edo line formerly the Midwest-line and then Bendel line and on the creation of the states in August 1991 was changed to Edo Line, was established in 1970 by the state Government and till date has remained one of the few legacies that still endear the “Ogbemudia regime” to the majority of Edolities. The company premises is situated at the inter section of James Watt and Mission Roads as, Mission road is a very popular and busy road in Benin City linking the Ring Road to Akpakpava Road. The site is transversed by Ovoramen Lane which form the public parking space (Motor-Cycle and Taxi)

3.3.2. LAYOUT AND ORGANIZATION

The station covers a land area measuring approximately 120mx 80m. The orientation of the site is as seen from the layout plan. The layout consists of the Administrative Building, Booking and Departure Block, Workshop, Shops, and the Canteen. It is mainly accessible from Mission road and other along James Watt Road.

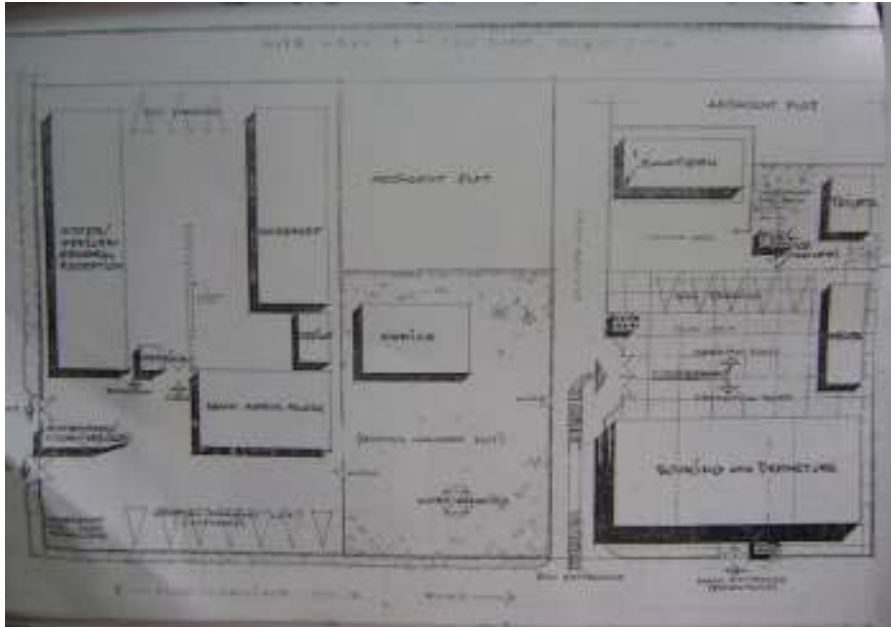


Figure 18: Showing Site Plan (Terminal Building)

Source: Author's Field Survey, 2015.



Figure 19: Showing Floor Plan (Terminal Building)

Source: Author's Field Survey, 2015.



Figure 20: Showing Approach View (Terminal Building)

Source: Author's Field Survey, 2015.

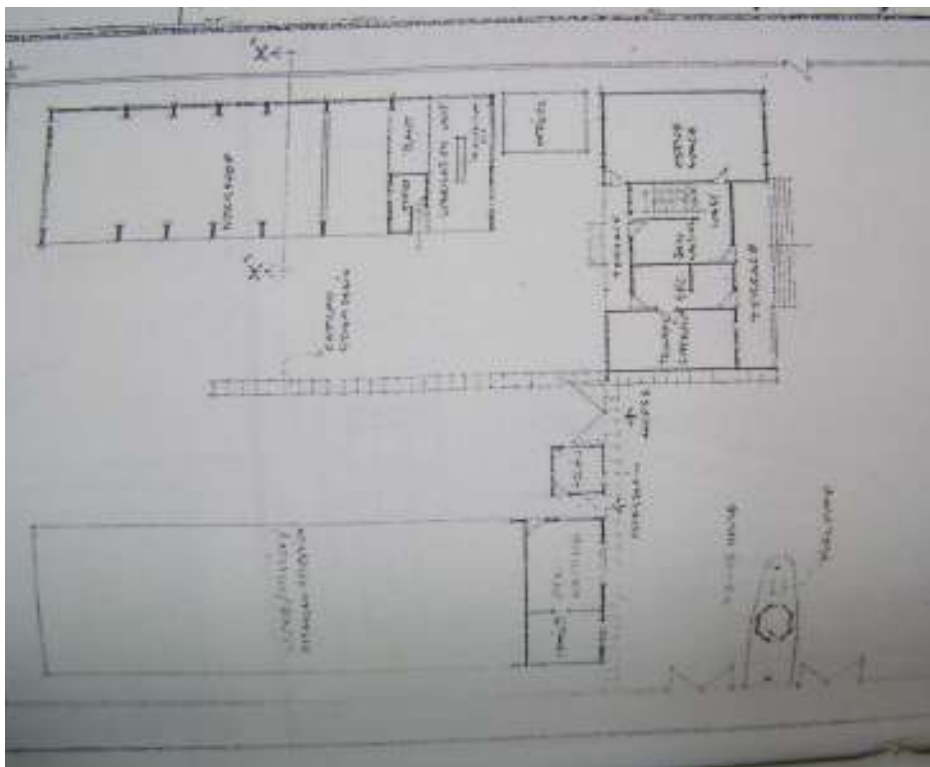


Figure 21: Showing Floor Plan (Administrative building and Maintenance workshop)

Source: Author's Field Survey, 2015.

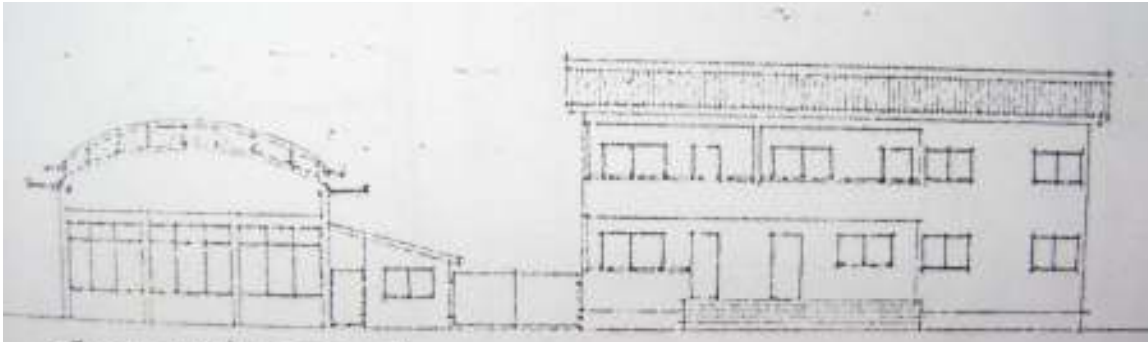


Figure 22: Approach view (Administrative building and Maintenance workshop)

Source: Author’s Field Survey, 2015.

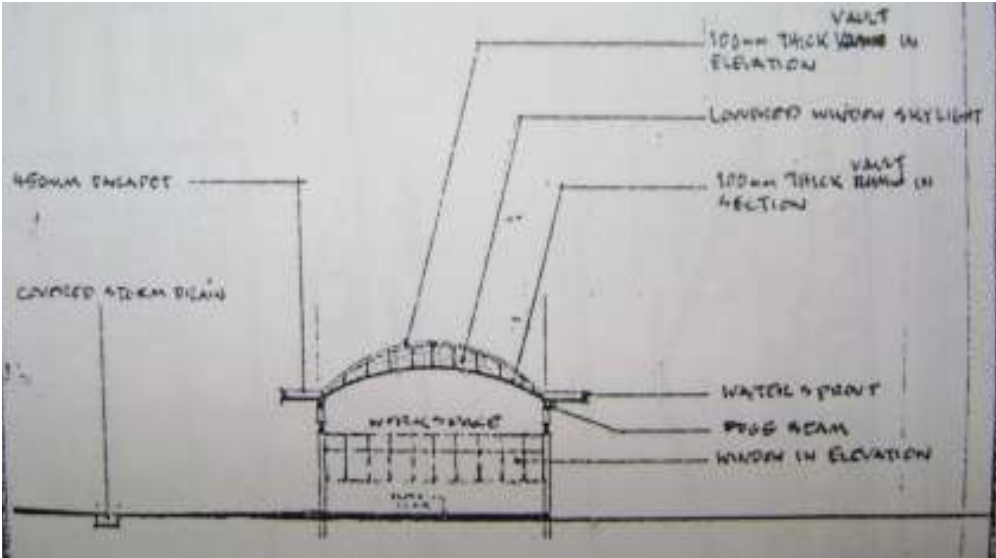


Figure 23: Showing Section (Maintenance workshop)

Source: Author’s Field Survey, 2015.



Plate 15: Showing Main Administrative building

Source: Author's Field Survey, 2015.



Plate 16: Ticketing and Departure with buses ready for Loading Passengers and good

Source: Author's Field Survey, 2015.



Plate 17: Showing Bus/Car Yard

Source: Author's Field Survey, 2015.

3.3.3. STATION SERVICES

As previously stated, the station provides transportation services to intending passengers from Benin City to major urban centre within and outside Edo States. Two types of transport vehicles are employed by the station, cars [station wagons] and mini buses [midi-buses]. Provisions are also made for maintenance fuelling facilities for its fleets of buses and wagons. The terminal hall seats an approximate capacity of about 500 persons and support facilities such as bar, restaurant, shops are also provides in the passenger waiting/concourse. The transport stations basically have six departments namely:

- Administration
- Public Relations
- Accounts
- Estate
- Engineering

The transport service currently provides By Edo Transport Services caters for passenger needs in following routes:

- Benin-Lagos-Benin
- Benin- Warri-Benin
- Benin- Onitsha-Benin
- Benin-Kaduna-Benin
- Benin-Jos-Benin
- Benin- Kano-Benin
- Benin-Port-Harcourt-Benin
- Benin- Abuja- Benin.

Presently, the transport service has a total of 56 buses on road and 35 “station wagon” 504s.

3.3.4. CONSTRUCTION METHODS AND MATERIALS.

The administration building is built of concrete materials with glass windows. The construction system consists of composite construction, made up of reinforced concrete structural frame, and non-load bearing sandcrete block walls. Reinforced concrete structural frame supporting concrete barrel vault shells with open spandrel glazing is the construction of the passengers’ concourse. Steel portal frame with non-load bearing Sandcrete blocks walls at the side is used for the construction of the passengers’ concourse. The roofing material used in the roof covering is principally corrugated aluminum roofing sheets.

3.3.5. APPRAISAL

1. Location

The location of Edo Transport Services is such that it is easily accessible to passengers who can easily walk to the station onwards movements to their destinations. However, in an attempt to leave the station, vehicles sometimes cause a traffic conflict which is a disadvantage for locating such facility in a central point. There is no room for expansion which is also a disadvantage of location in a central area around neighborhoods where area around sites is fully built-up. The location of the fuelling facility leaves much to be desired. By virtue of its proximity to Mission road, one would think that these vehicles leave the station after fueling from the gate at the mission road end. But the gate to the Mission end of the station is always locked to prevent traffic congestion /hazards. The space allocation for fueling purpose is inadequate and allows for only vehicle to fuel at a time.

2. Site Planning/Orientation

The site is planned such that a number of facilities area accommodated on site-Terminal building (Workshop, bus yard, WagonPark, passengers' concourse, canteen, shops and fueling facilities). Terminal building is oriented along the East-west direction, with opening provided only at the North –South Facades. This is in response to climatic requirement and with a view to achieving comfort for users.

3. Circulation

The location of the station conflicts with the aim of allowing smooth local traffic flow in the city. Vehicular and pedestrian accesses are not clearly defined or separated. This causes conflicts and there is the like hood that persons (s) could be knocked down by vehicles.

Merits

1. The station is easily accessible because of its central location.
2. There are adequate and functional workshops facilities for maintenance and repairs purposes.

3. There is provision for eating and shopping activities for intending passengers.

Demerits

1. There is a traffic conflict with local flow because of its central location
2. Parking spaces are not adequate.
3. There is no clear separation of vehicular and pedestrian traffic
4. The architectural/spatial integration of facilities is poor.
5. There is virtually no space for expansion
6. Proper landscaping is lacking.

3.4. CASE STUDY FOUR: BUS TERMINAL AND OFFICE IN DUBLIN

3.4.1. INTRODUCTION

The Dublin's bus terminal is a large and conspicuous contemporary structure in the city of Dublin. It was initially intended to concentrate the offices and services of Coras Lompair Elran (National Transport Services). The building was subsequently taken over by the Department of Social Welfare, which have leased out part of it for a bus terminal, for which is well suited by its very central site and the new street which is intended to link to new bridge over the Liffey. In spite of these improvements in traffic, the setting of the bus terminal is primarily Georgian even now and in these surroundings it will retain for many years the quality of bold architectural edifice.

3.4.2. LOCATION/ PLANNING

The Dublin bus terminal is located in a very central site almost adjacent to Gandon's in Dublin city. The organization of arrivals and departure is directed by loud speaker from control tower at Mezzanine level cantilevered over the loading platform and the concourse. The restaurant and bar are located at the mezzanine level. The restaurant and bar are located at the Mezzanine level, while the shopping arcade, kiosks, baggage and freight rooms are provided at ground level. The lavatories and new cinema is located in the basement. The L-shape four and six storey office

blocks has the third floor of the six storey block designed as a suite for the Ministry of Social Welfare, his secretary and three assistant secretaries. Vertical access is by three lifts and a staircase at the junction of the two blocks. The officers are served from the lift hall by central internal corridors. The open terrace on the south side of terminal is designed to be used during summer for outdoor dining in the shade of the projecting canopies. The North wall inside the Restaurant is planned as a series of dining both with small windows at the end of each table of looking north. Dublin. The two number ventilating plant rooms are located above the restaurant floor.

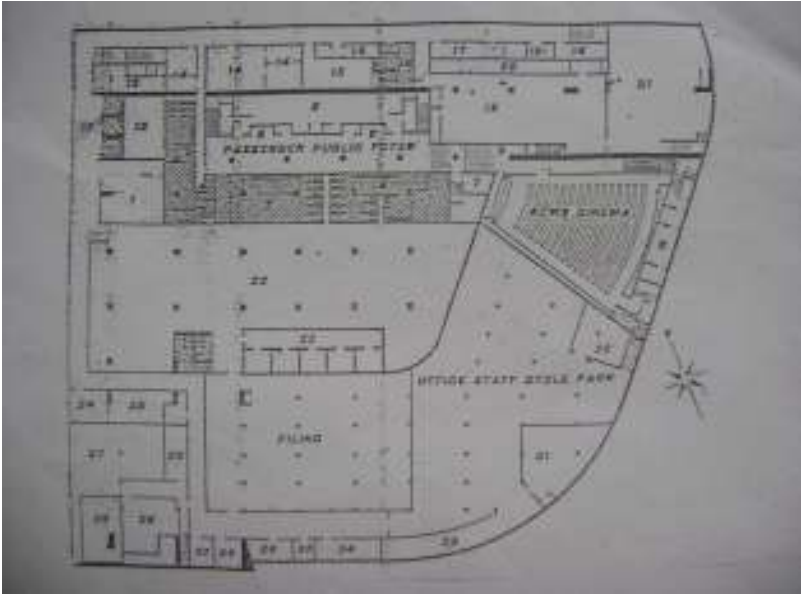


Figure 24: Showing Ground Floor Plan

Source: *Architectural Review*, volume 168, No. 971, January, 1978

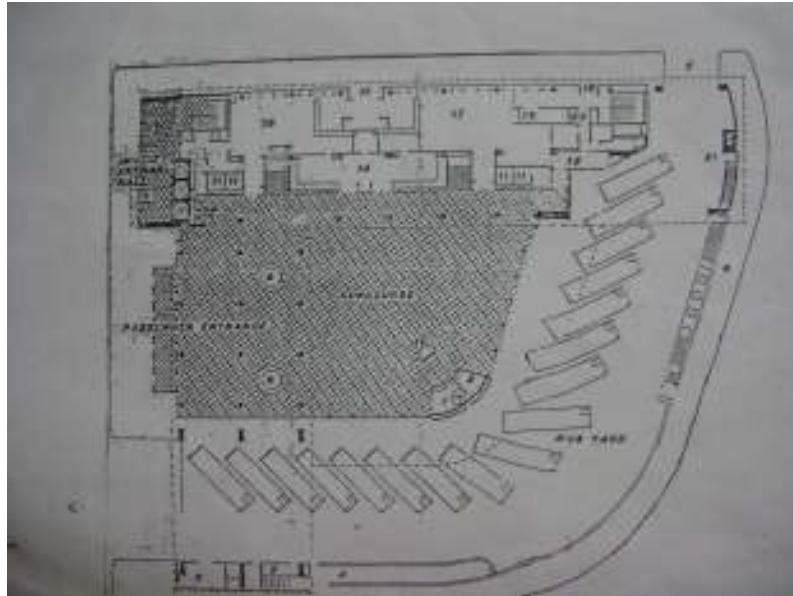


Figure 25: Showing First Floor Plan

Source: Architectural Review, volume 168, No. 971, January, 1978

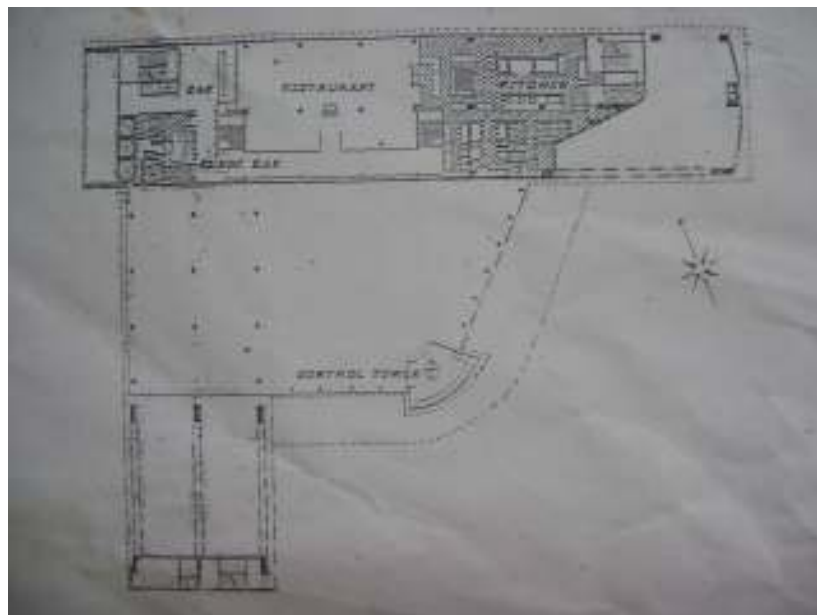


Figure 26: Showing Second Floor Plan

Source: Architectural Review, volume 168, No. 971, January, 1978



Plate 18: Approach view of Terminal Building

Source: Google images, 2015.



Plate 19: Showing A view of the office Complex.

Source: Google images, 2015.

3.4.3. STATION SERVICE

The Dublin's bus terminal offer transportation service to passengers traveling out of Dublin. To be able to perform those functions effectively the station houses some essential facilities these include:

1. A central concourse, parking space for 17 buses.
2. A restaurant and bar, a shopping arcade, kiosks, baggage and freight room and lavatories as well as new cinema

3.4.4. APPRAISAL

3.4.4.1. Merits

1. The station is easily accessible to passenger due to its central location
2. There is an architectural/design success in the planning of the bus terminal, as it allows commuters access to the passenger concourse directly from the main pedestrian entrance.
3. There is functionality in the placement of the shopping arcade, kiosks baggage and freight room at the ground level, with direct access from the passenger concourse.
4. The location of the control tower, such that it cantilevers over the concourse is ideal for easy visual communication.
5. Adequate provision was made for protecting passengers boarding buses against inclement weather.

3.4.4.2. Demerits

1. There is no adequate space for horizontal expansion and adequate set-back and hence no forecourt due to land constraints.
2. The provision of the restaurant at the mezzanine is too small for the size of kitchen that services it.

3. The provision of a circular column in the transudation via the flight of stairs from the passenger public foyer in the basement to the news cinema causes obstruction and thus undesirable.
4. The number of shops provided is inadequate considering the number of passenger that uses the station.
5. There is no provision for maintenance/ repairs and fueling facilities
6. There was virtually no provision made for natural lighting

3.5. CASE STUDY FIVE; GEORGE WASHINGTON BRIDGE BUS TERMINUS, NEW YORK.

3.5.1. INTRODUCTION

The building was designed by Dr. Pier Luigi Nervi and is one of only a few buildings he designed outside of Italy. It opened January 13, 1963. The building is constructed of huge steel-reinforced concrete trusses, fourteen (14) of which are cantilevered from supports in the median of the Trans-Manhattan Expressway, which it straddles. The building contains murals as well as busts of George Washington and Othmar Amman, the Civil engineer who designed the bridge. The building received the 1963 Concrete Industry Board's Award.

The bus station is owned and operated by the Port Authority of New York and New Jersey. On a typical weekday, about 15,000 passengers on some 730 buses use the bus station. The subway station, operated by the New York City Transit Authority, was part of the original line which opened in 1932.

3.5.2. LAYOUT AND ORGANIZATION

The George Washington Bridge Bus Terminal or George Washington Bridge Bus Station is a commuter bus terminal located at the east end of the George Washington Bridge in Washington Heights, Manhattan occupies two-block site of between 121-127m length and 56.4m width in Washington height. The station is built over the Trans-Manhattan Expressway (Interstate 95) between 178th and 179th Streets and Fort Washington and Wadsworth Avenues and features direct bus ramps on and off the upper level of the bridge. The Complex includes the 175th Street

station of the IND Eighth Avenue Line of the New York City Subway, located at Fort Washington Avenue and 175th Street.

It accommodates over 200 buses and 10,000 passengers at peak hours. The organization of arrivals and departure is directed by loud speaker from control tower. The first floor of the bus terminal has shops and a waiting area. There is also New York City Off-track betting parlor located on the first floor

3.5.3. CONSTRUCTION AND MATERIALS

- 1. Structural Elements:** Burly tress work comprising of 26 giant slices of cast-in-place concrete pie; each 92ft by 66ft (27.8 x 19.8).14 slices are raised on regular bents to let fresh air through the fumy bus deck, giving the roof its winged aspect. The column sculpted by load they carry, rise 5.25m from slender, space-saving base to wide bearing trip. There is much craftsmen ship in the roof structure. The triangular openings initially meant for ventilation were glazed up as a result of freezing winds experienced and also erection of wind breakers: fashioned of blue enamel with plastic blue canopies.
- 2. Finishes:** In the lower floors; decoration of enclosed spaces; the walls and sculptural columns are covered with very bright and shining materials, as a result, the interior has the quality of public rest room. Blue and white colour scheme on a glass mosaic tiles.
- 3. Elements**
 - a. Entrance: An upswept canopy issues a chic welcome at the entry
 - b. The narrow street sides: Block-long walls, muscular concrete diagonals engaging in a bravura balancing act giving support to wing tips of roof height overhead.



Plate 20: View of the Terminal from the West at 178th St

Source: Microsoft ® Encarta ® 2008. © 1993-2007 Microsoft Corporation.



Plate 21: View of the Terminal from the East at 179th St.

Source: Microsoft®Encarta®2008.©1993-2007MicrosoftCorporation.



Plate 22: Showing Passenger Lounge

Source: Microsoft ® Encarta ® 2008. © 1993-2007 Microsoft Corporation.



Plate 23: Showing Bus Concourse

Source: Microsoft ® Encarta ® 2008. © 1993-2007 Microsoft Corporation.

3.5.4. APPRAISAL

Merits

1. Easily accessible to travelers by virtue of its central location.
2. Provision was made for alternative pedestrian entrance.
3. Adequate railing was provided in the passenger islands to keep queuing orderly.
4. Adequate road width was provided between passenger islands to allow buses going in opposite direction to pull out simultaneously without difficulty.
5. The Concourse is well lit and quiet with rubber floors and deeply coffered ceiling carrying the immense weight of the buses above.

Demerits

1. Lack of possibility for horizontal expansion due to land constraint.
2. Size of pedestrian main approach is inadequate for the estimated number it serves.
3. The Concourse which is 220m in length is too long and calls for duplication of facilities to avoid long walk from one point to the other.
4. No provision was made for kiosks such as heel bar, chemist, street or florist shop.

3.6. SYNTHESIS FROM CASES STUDIED

The issues synthesized from the cases studied are viewed under three subdivisions:

(Location, Circulation and provision of facilities/ architectural consideration).

3.6.1. LOCATION

Accessibility to passenger is the major determinant for the location of bus terminal. This often results in the location of terminal in the city center as would be seen from the cases studied.

Location in central area was found to conflict in most cases with the aim of allowing traffic to flow smoothly in the city. There was virtually no space due to location in the central area with its inherent scar land and their high value. In this regard, therefore, mass transit terminal should be located in an area which is accessible to the public, has adequate space for horizontal expansion and well sited so as not to disrupt local traffic in the city

3.6.2. CIRCULATION

The site should be big enough to accommodate a fairly large forecourt and parking space. Concrete design effort is required to separate pedestrian and vehicular access. Effort should be made to integrate soft and hard landscape elements in the design so as to achieve effective circulation as contrast to concrete, machines and engines prevalent in the station environment. Road and walkway width should be adequate to accommodate the anticipated traffic. In the same vain circulation spaces and element within and without the facility should be adequate and effective. There should be no conflict in terms of circulation, particularly traffic flow within and around all facilities provided within the terminal.

3.6.3. PROVISION OF FACILITIES/ARCHITECTURAL CONSIDERATION

Concerted effort should be made towards architectural/spatial integration of the numerous facilities provided. There is also the need for all facilities provided to be functionally interrelated to achieve a precise and coherent architectural and constructional relationship.

CHAPTER FOUR

4.0. ANALYSIS OF SITE AND DESIGN SYNTHESIS

4.1. STUDY AREA / SITE SELECTION

This section gives brief information about the study area. It also describes the proposed location of the site, the criteria for selection of such site, the climatic data of the area, as well as analyzes the site for the purpose of designing the proposed Bus Terminal.

4.1.1. HISTORY OF IKORODU

"Ikorodu" was derived from the two words OKO-ODU Meaning the farm (OKO) of (ODU) a kind of plant. The word ODU; means something that blackens, and since it was discovered that the plant had blacking power and it was in effect used in dyeing cloth- the name ODU was applied to it. It's significant to note that the trade of Ikorodu early women was cloth dyeing, which followed from the discovery of the dyeing power of ODU plant. The area in question - initially a massive forest that lies on a few kilometers North of the Lagos Lagoon and less than 10 kilometers North of the Atlantic Ocean was once a walled City. Ikorodu, Lagos, Nigeria, lies between Latitude 6° 37' 0" and Longitude North, 3° 31' 0" East. By itself, Ikorodu was bounded in the East by both sides of Ota-Ona, Awolowo Road, including Ojoru and Agbele up to Itamaja. On the west side are Aiyeluja, both sides of Ayangbure road up till Oke-Oriya extending to Solomade, Etunrenren, Lowa and Olori and both sides of Lagos Road up to Owutu junction. Extension to the North covers both sides of Sagamu Road up to Sawmill and beyond to Odogunyan. Southwards covers Gbasemo in Aga linking up with Ipakorodo-Igbogbo road up to Owode, Oriwu road and Solafun (in Ijomu ward). Traditionally, Ikorodu is divided broadly into 3 for ease of representative democracy IJOMU, AGA & ISELE which are represented in OSUGBO - the highest administrative office in the town headed by Olisa as Chairman of IWAREFA while (OLUWO is the administrative head). Ikorodu is a collecting point for locally produced fish, poultry, cassava [manioc], corn [maize], vegetables, palm oil and kernels, okra, cabbages, tomatoes, pineapples, bananas that are shipped to Lagos. The town is mainly served by highways between Lagos and Sagamu and between Lagos and Epe.



Plate 24: Showing the map of Ikorodu

Source: Google Map 2015,

4.1.2. SITE LOCATION / DESCRIPTION

Lagos is a huge metropolis which originated on islands separated by creeks such as Lagos island that fringe the southwest mouth of Lagos Lagoon protected from the atlantic ocean by long sand spits such as Bar Beach which stretch up to 100km east and west of the mouth. Areas on Lagos Mainland include Ikeja, Agege, Ojota, Oshodi, Ikorodu e.t.c. The proposed site is located between Isiu and Imota area of Ikorodu, along Epe-Ikorodu Expressway, adjacent to the famous Ikorodu-Sagamu Expressway. It is at about 10km from the junction between these roads, and about 2km from Caleb University. The site location overlooks the Lagos Lagoon at the opposite side of the road, and is in close proximity to areas like Ode Lemo, Ijede, Ilado and Ofin.



Plate 25: Showing Site Location Map of Lagos

Source: Google Map (2015)



Plate 26: Showing Site Location Map

Source: Google Map (2015)

4.1.3. SITE SELECTION CRITERIA

The proposed terminal is intended to serve intercity buses/cars and travelers and in this vein provide services to state owned intercity mass transit vehicles and travelers on a brief stop-over. There is the need therefore to completely isolate it from local traffic to avert unnecessary traffic congestion rather than compound it.

1. Accessibility

The site should be easily accessible to motorists and passengers alighting from intra-city buses/cars. It should be located along the major roads. Where it is located near the city periphery; it should be along the main access route to the city centre. The access to the site should however be taken from secondary road off the major road, to avoid possible traffic problems. To this effect the site selected is along Ikorodu-Epe road, adjacent to the Lagos-Ikorodu-Sagamu road, which is the major traffic axis. This is done to ensure that the facility is easily accessible to major highways systems.

2. Population density

The site should be situated in a lower density area with adequate infrastructure, like light, proper drainage or an area undergoing speedily infrastructural development. Terminals are discouraged in city centres except in rare cases if they support or bolster (and do not undermine) existing walk-up express transit services. Bearing this in mind the site was selected in Imota, a lower density area of Ikorodu, and as such will ensure that traffic in and around the facility will be minimal.

3. Topography

The site topography should be relatively flat and should not be marshy or liable to floods. The soil should be firm and compact so that it can safely carry the combined load of vehicle, passengers and their baggages. As such the soil on site selected is firm enough to be able to withstand such loads. It is well drained, thereby reducing the likelihood for flooding.

4. Expansion

The site should be big enough to accommodate a considerable number of facilities with the possibility for future expansion. This is given utmost consideration as the site is ample enough to accommodate the required facilities and also the ones that might be needed in the nearest future.

5. Circulation

Circulation in and around the Terminal facility should be adequate and effective, so that it can avert unnecessary traffic congestion rather than aggravating it. To ensure that circulation is not an issue, the site is located where there will be direct vehicular access to the site. This will prevent traffic enroute or at adjacent intersections.

4. Routes Location

The site is strategically located so that it can serve its intended purpose of being the beginning and ending of scheduled Bus routes. Major highways to different destinations across the nation can easily be connected from the site selected.

4.2. SITE ANALYSIS

Site analysis is an integral part of pre-design analysis and may involve physical infrastructure ecological, cultural, aesthetics, acoustic and climatic site analysis.

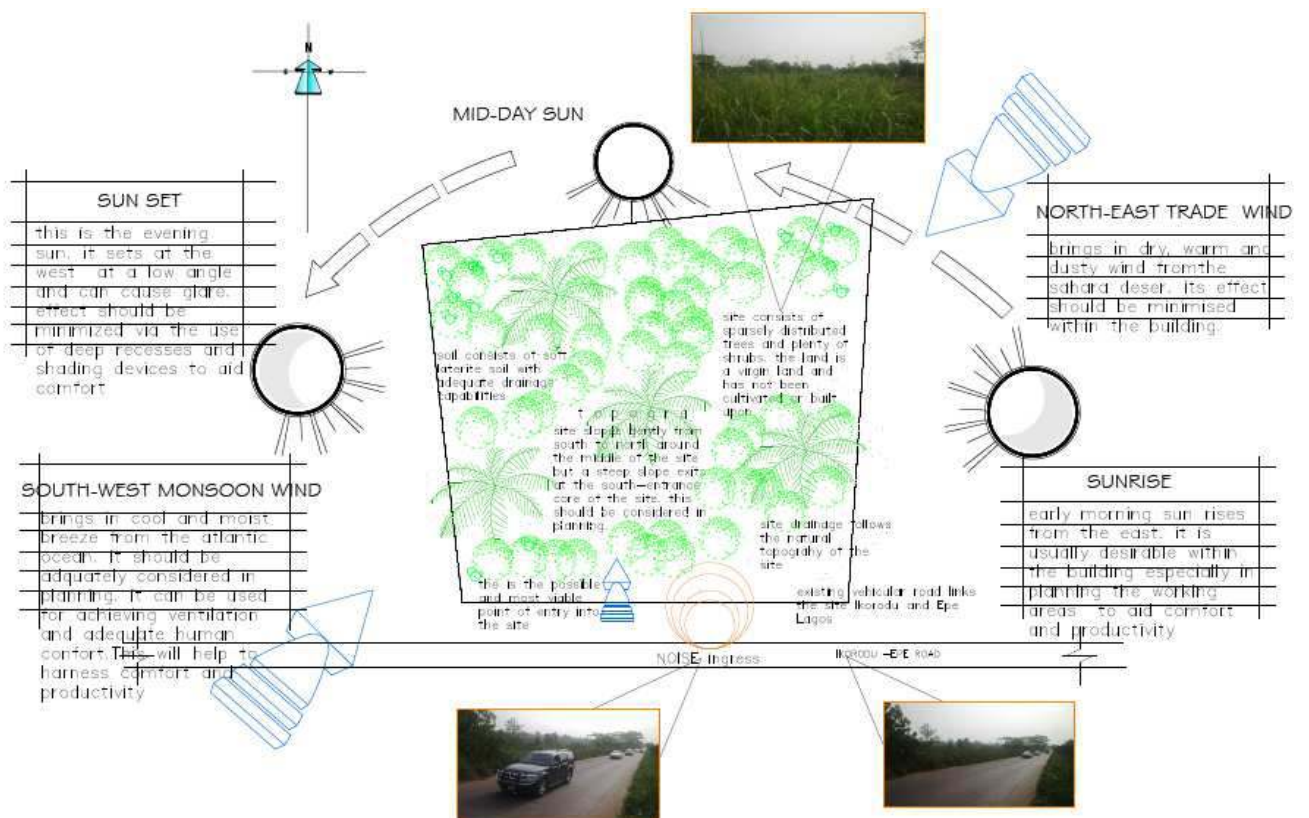


Figure 26: Showing Site Analysis
 Source: Author's Field Survey, 2015.

4.2.1. PHYSICAL SITE ANALYSIS

This involves analysis of the site and depth of the soil and substructure for foundation design. The site is of an almost flattened terrain with mild slope towards the front of the site, i.e. from north to south towards the middle of the site. The site is located on a virgin land as it has not been cultivated, and is without any sign of construction activities. However there are signs of foot path across the site suggesting it has been made a thorough fare by passers-by such as hunters and farmers. Consequently, the soil is firm and compact, thus will likely be good for construction purposes. Although it will be advisable to conduct an extensive subsoil geotechnical investigation in order to determine precisely the soil bearing capacity and its other properties



Plate 27: Site view showing Vegetation and Soil conditions

Source: Author's Field Survey, 2015.

4.2.1. INFRASTRUCTURAL SITE ANALYSIS

Ikorodu-Epe express road constitutes the access road that runs along one of the sides of the site to provide ingress and egress. The Electrification Scheme supplying light to nearby neighbourhood also makes electricity available to the site while water mains from Lagos State Water Corporation Supply Scheme to the area can be tapped into site. The site is also within the field of coverage of most GSM telephone services.



Plate 28: Showing access to the site

Source: Author's Field Survey, 2015.

4.2.2. ECOLOGICAL SITE ANALYSIS

The flora on the site is mainly overgrown weeds and small shrubs with sparsely distributed trees, interspersing with woody forest towards the outer ring of the site. The site offers satisfactory geological and soil. The site has a firm latent soil with good sub-surface conditions for construction and landscaping. These will be integrated into the landscape design. It was observed that flies and mosquitoes abound on the site indicating potential hazards to health. They will need to be kept out of the interior while their external effects will need to be mitigated by landscape planning and maintenance.

4.2.3. ACOUSTIC SITE ANALYSIS

Apart from the external air borne noise emanating from road traffic (which in this case will be very light) the only potential source of noise is from Imota, which is about two kilometers away from the site. The surrounding vegetation, planned landscape and planning will help in noise filtration and thus make it inconsequential. Site planning will need to strategically take care of functional spaces requiring noise consideration.

4.3. CLIMATIC DATA OF IKORODU

Ikorodu has a tropical climate. According to Köppen and Geiger, this climate is classified as Aw. The temperature here averages 26.9 °C. About 1670 mm of precipitation falls annually. There are two seasons in this kind of climate these are:

Table 3: Showing climatic data of Ikorodu

month	1	2	3	4	5	6	7	8	9	10	11	12
mm	25	39	91	139	239	356	251	93	178	176	66	17
°C	27.4	28.3	28.6	28.1	27.4	26.2	25.5	25.1	25.6	26.2	27.4	27.4
°C (min)	22.9	24.4	25.0	24.4	23.9	23.0	22.8	22.4	22.9	23.0	23.5	23.3
°C (max)	31.9	32.2	32.2	31.9	30.9	29.5	28.2	27.8	28.4	29.5	31.3	31.5
°F	81.3	82.9	83.5	82.6	81.3	79.2	77.9	77.2	78.1	79.2	81.3	81.3
°F (min)	73.2	75.9	77.0	75.9	75.0	73.4	73.0	72.3	73.2	73.4	74.3	73.9
°F (max)	89.4	90.0	90.0	89.4	87.6	85.1	82.8	82.0	83.1	85.1	88.3	88.7

Source: Microsoft ® Encarta ® 2008. © 1993-2007 Microsoft Corporation.

The difference in precipitation between the driest month and the wettest month is 339 mm. The average temperatures vary during the year by 3.5 °C.

a. Wet Season:

This starts in mid March and lasts until July, a period of high rainfall and high humidity. Interrupting this is the "August break", which is a short dry season lasting a month. The short wet season follows the August break from September to October, but the rain fall is not as torrential as in the preceding months.

b. Dry Seasons / Harmattan

Starts in November and lasts through to early to mid March. Mornings are cool and misty, but afternoons are hot and full of haze due to the dust particles in the air, which is brought by the North - East trade winds blowing from the Sahara.

c. Temperature

Diurnal and annual temperature ranges are quite narrow. The average annual temperature in Lagos, Nigeria is 26.4 °C (80 °F). The range of average monthly temperatures is 3.5 °C. The warmest average max/ high temperature is 33 °C (91 °F) in February & March. The coolest average min/ low temperature is 21 °C (70 °F) in August.

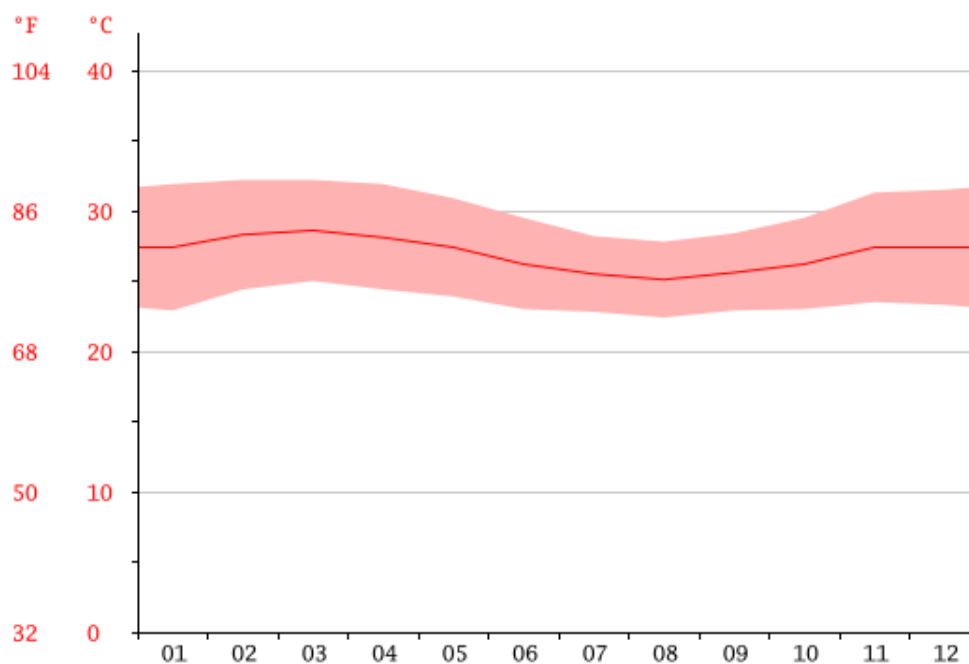


Figure 27: Showing Temperature graph

Source: Microsoft® Encarta® 2008. © 1993-2007 Microsoft Corporation.

The warmest month of the year is March, with an average temperature of 28.6 °C. In August, the average temperature is 25.1 °C. It is the lowest average temperature of the whole year.

d. Humidity

Relative humidity remains very high varying from between 80% to 100%, although it may drop to about 70% during the hot dry season. Atmospheric vapor pressure is at an average of 29 millibars. Mean relative humidity for an average year is recorded as 84.7% and on a monthly basis it ranges from 80% in March to 88% in June, July, September & October.

e. Precipitation

The average annual precipitation is 1830mm recorded in areas adjacent to the site. The highest recorded rain fall is 420mm and it falls in the month of July, and the lowest recorded rainfall is 40mm and it is recorded in the month of December. The month with the driest weather is January when on balance 40 mm (1.6 in) of rain, sleet, hail or snow falls across 2 days. The month with

the wettest weather is June when on balance 336 mm (13.2 in) of rain, sleet, hail or snow falls across 20 days.

f. Winds

The predominant winds in the area are the South Western trade winds, monsoon, which are predominant during the rainy seasons. The North - easterlies, originating from Sahara are predominant during the harmattan months.

g. Solar Radiation

Solar radiation is partly reflected and partly scattered by the cloud blanket or the high vapour content of the atmosphere, therefore the radiation reaching the ground is difficult, but strong, and can cause rainfall and sky glare.

h. Vegetation

Because the site lies in the middle of an area formerly used for sourcing laterite, it has been cleared of its primary vegetation. However, over 70% of it is covered with secondary vegetation such as elephant grass, shrubbery of medium height and some under growth. There are still a few trees left at the periphery of the site which may be retained as part of the buffer, incorporated into the overall landscape plan.

i. Topography and Soil

The site has a gradual descent from the Ikorodu road end, petering out into a somewhat flat terrain devoid of any rock outcrops whatsoever as is characteristic of the Lagos landscape. The natural drainage pattern follows this, flowing in a south-easterly direction toward the Majidun River. The soil is primarily lateritic clay, with an admixture of sedimentary gravel grains. The bearing capacity is deemed satisfactory for construction. However, for a facility such as that of the subject design, extensive geotechnical investigation is recommended to precisely determine the actual properties and behavior under load of the soil.

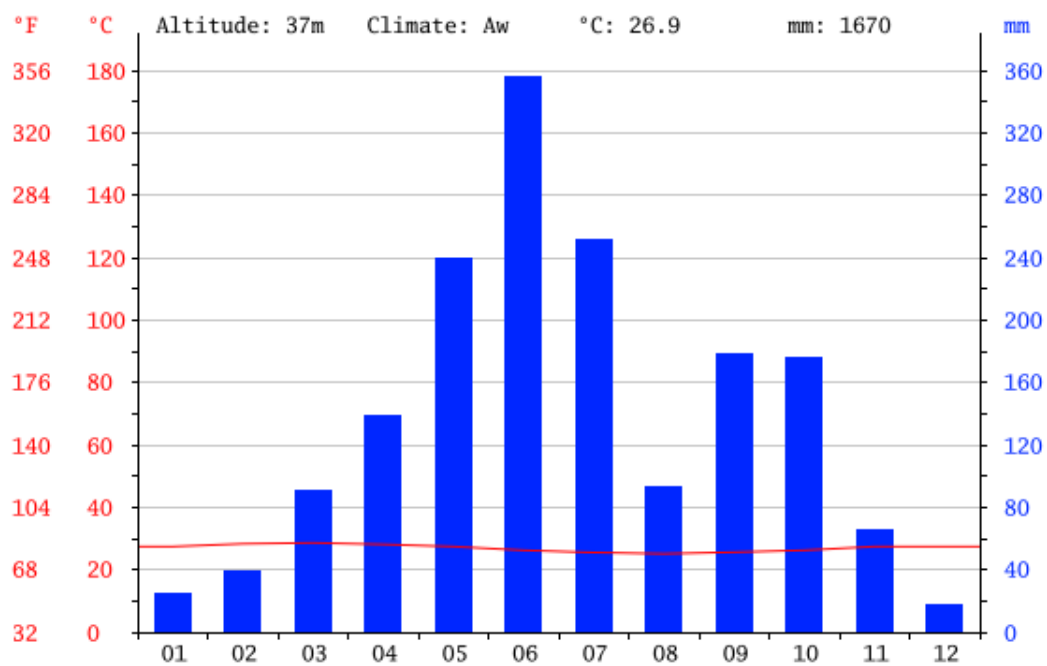


Figure 28: Showing combined climate graph

Source: Microsoft® Encarta® 2008. © 1993-2007 Microsoft Corporation.

The driest month is December, with 17 mm of rainfall. Most precipitation falls in June, with an average of 356 mm.

4.4. PROJECT ANALYSIS AND DESIGN SYNTHESIS

4.4.1. DESIGN CRITERIA

Bus Terminals basically have an ambivalent character; on one hand they are commercial ventures in which success is measured with business efficiency and revenue generating potentials on the other hand, they are regarded as public buildings, a gateway to the community. With this mind the proposed Ikorodu Bus Terminal for was designed with flexibility in e internal spaces (self supporting character) which make it economically viable and functional in (sage.

The design was done taking into cognizance the following criteria:

- I The site configuration;
- ii. Volume and type of bus operation;
- iii. Separation of pedestrian from vehicular traffic circulation; which are my basic criteria for bus terminal design; and
- iv. The provision of adequate supporting services for both buses and passengers The terminal complex is provided with a terminal building with passenger handling and other facilities, a covered bus concourse (integral with the terminal building), a transit inn, cargo handling services and maintenance services. Provision of parking lots was made for passengers as well as bus aid for Luxurious buses and mini buses. The site design was informed by:
 - i. The nature and shape of the site;
 - ii. Position of the existing Ikorodu road;
 - iii. Bus pathway within the site, organized to give passengers a general overview of the complex and to facilitate easy access, both to bus services and back to the Ikorodu road;
 - iv. The need to separate pedestrian from bus and other vehicular traffic flow in order to Avoid conflicts and or accidents;
 - v. The need to separate public parking from bus and staff parking; and their accessibility to and from the Ikorodu road; the underlying design rationale should also include:
 - I. Maximizing provision for short lines of flow and communication between ticketing and baggage function and the bus interface;
 - ii. Parking to be so located as to minimize walking distance to the Terminal while adequately assuring security, while egress and ingress must be planned to minimize traffic congestion.

4.4.2. PROJECT BRIEF

A brief is a statement of desired requirements usually spelt out by the client to the designer. Different stages constitute brief-taking considering the fact that it is the starting off point of any design programme. It is usually tailored to suit the client and/or the users of the project and also having at the back of one's mind its cost implication. This project is to be designed for Ikorodu area of Lagos state. The Bus terminal development is expected to be sponsored and managed by the Ministry of Transport under the Lagos State Government. The participation of private and corporate investors is equally anticipated. Facilities at the terminal will be opened for use to all passengers within and outside Lagos state. It is therefore expected to serve as Inter-state and also Intra-state Bus Terminal.

4.4.3. FUNCTIONAL/SPATIAL CRITERIA OF MASS TRANSIT TERMINAL

In planning Transport Terminal, the basic consideration should necessarily include:

- Services offered by The Terminal;
- Component space of The Terminal
- Functional layout of component
- Necessary equipment and
- Size of the terminal.

To achieve a high degree of efficiency in operational performance in a mass transit terminal certain component should as a matter of priority, be present in the terminal irrespective of type. Not all the function, facilities and component of a proto-type Mass Transit Terminal are available in every existing situation. This is a result of circumstantial diversities both in economy, needs and culture of the place where the terminal is located. However, the inclusion depends on the size, scope and the category of Mass Transit operation and Terminal type. In the same vein, the capacity or interrelationship of those functions depends equally on the mass transit operations and the passenger strength.

These components will be discussed under the following groups

- Passenger facilities
- Administrative facilities
- Staff facilities
- Maintenance/Services facilities

- Support facilities
- Repair facilities

1. PASSENGER FACILITIES

These are facilities provided for the safe and convenient use of passenger from the time they enter the terminal, to the time they depart. These facilities are within the entry/waiting hall, arrival/departure hall, and the passenger concourse, these facilities includes the following:

- Public entrance
- Waiting Area
- Information Facilities
- Ticketing Facilities
- Arrival/Departure Lounge
- Check-in Facilities
- Passenger Concourse
- Public Toilet
- Baggage Handling Facilities
- Package Express Facilities
- Left and Lost Luggage Facilities
- Rental Shop/Offices and other concession;
- Dispatch Office
- Public Lockers
- Loading Platform
- Restaurant
- Accommodation

a. PUBLIC ENTRANCE

The entrance in a public building is a very vital element. It should be architecturally outstanding, identifiable, and should be as a matter of priority by a point of focus, so that the pedestrian can easily know the direction they are heading. This means that it should be strategically located in relation to the major pedestrian access in order to perform its function satisfactorily and effectively. For a Mass Transit Terminal, it is essential that the entrance should be able to direct passenger from the outside through the door into the positive space of the building usually the

entry hall. For purpose of efficiency of operation and safety there should be a high degree of separation between pedestrians and vehicular traffic, this is to avoid pedestrian crossing vehicular routes.

b. WAITING AREA

This is a public space where passenger may wait for reason ranging from information booking/tickets check-in. There is an advantage in the separation of Passenger arrivals from the passenger waiting. This advantage is the avoidance of congestion and confusion in the waiting area. However, arrival lounge need to be separated from departure lounge. This is because it has been observed that arriving passengers do not need to wait for anything except for those that have to wait for their luggage. This public space may be in the form of central waiting area as part of the general public space immediately on entry, or in form of separate waiting room. They are usually provided with drinking fountain and trash basket clocks. Sometimes Arrival and Departure Lounge are provided in addition to the central waiting or arrival departures lounge and separate waiting room in the alternative. For a central waiting space which is often directly accessible form the main entrance, there is usually an open planning arrangement, forming an integral part of the general public area which serves as the hub of all passenger activities such as Booking/Ticketing, Shopping, Enquires and Baggage Handling among others. The central waiting space normally has access to the concourse through “door-ways or gate” so located as to distribute passenger traffic uniformly. The amount of space provided for waiting normally depend on individual circumstances, terminal types, economic consideration and consideration of peak period. As a general rule of thumb, however, and allowance of one seat for every three passenger is adequate for an intercity terminal. The passenger quantity is calculated by multiplying in the number of loading berth by an average bus capacity of 42 passengers. Space allowance range from 1.3-3.0m per person, but 1.7-2.1m may be considered satisfactory. In fact Passenger waiting space accounts for about 20 to 30 per cent of the total covered area of the building, the smaller the building the bigger the percentage. Seating is based on an allowance of 530mm per person commonly of straight place settees with or without arms, and the under seat kept as clear as possible for easy cleaning.

c. INFORMATION FACILITIES

These are facilities for the dissemination of travel information to passenger. These information consist mostly travel schedule, announcement of arrival, schedule, announcement of arrival and departure of vehicles, and any other specialized information that may be deemed necessary. This information dissemination is achieved by means of loud-speakers fixed at strategic position in the terminal, especially in all public area. Other means are by display of charts and other graphical system; the use of computer and television sirens and control room(s) for closed circuit television(s). In most cases, information facilities consist of counters, and back-up room and offices. The Reception area is located in such a manner as to make it conspicuously visible on entering the general public space.

d. TICKETING FACILITIES

These are facilities provided for the sale of tickets to passenger and for the collection of payment for freight services rendered to the passenger, or for packages express services to them. Due to the essential and public nature of this function, its location should be immediately obvious from whatever direction the passenger may be approaching. It should be highly conspicuous and visually interconnected with the major pedestrian entrance door(s). This will enable intending passengers to know exactly where to obtain tickets without any period's assistance. It should be dependent and well away from the waiting area. Where there is a central concourse, the ticketing facilities should form all part of it. Ticketing Facilities in modern terminal, regardless of type consist of open counters with back-up offices. Passenger spends a relatively longer time on the ticketing counter than on the information area. As a result more space is needed by passenger waiting to buy tickets. This is to avoid congestion in this area of disrupting free flow of traffic to nearby passenger's facilities. However, reasonable space is needed behind the counter for "package express items". The ticketing office need not necessarily be connected to the other offices and cage windows in counter should be avoided. Since this facility involves temporary storage of money, adequate burglary facilities for people in or of alternatively police pool should be provided to oversee the place.

e. ARRIVAL/ DEPARTMENT LOUNGE

There are public spaces where passenger stay briefly for further processing before entering the concourse (for departing passengers), or from concourse before entering the public waiting area. These are semi-public area for passengers alone. Sometime these spaces may be combined

depending on the operations policy and security involved. Like other public areas, the space requirements of the lounge depend on the passengers' peak condition. Other facilities found in the space may be toilets.

f. CONCOURSE

The passenger concourse is regarded as the most significant space in a Transit Terminal. It is the meeting point for arriving and departing passengers. It is the last waiting area before passengers board the Bus/Car. The Concourse should be accessible from the Arrival and Departure Lounges. Baggage room is usually connected to the vehicles stands through the loading decks by glass partition. Where the concourse is the main hub or focus of the terminal as in small concerns, it serves as the main waiting area. It also houses all passenger facilities such as drinking fountains, clocks, trash basket. In Intercity Terminal where separate waiting areas are provided, the concourse serves only as the collection point for arriving and departing passengers. The space requirement depends on the strength of passenger at peak periods and the planning of the terminals whether the concourse is used as the main hub of activities containing passengers waiting space or just as a collection point for arriving and departing passengers. However, an allowance of 1.7m to 2.1m per passenger is satisfactory and about 20-25% of covered floor area may be adequate.

g. PUBLIC TOILETS

Separate Public Toilet Facilities for male and female are imperative and should be provided at necessary location such as public waiting area, concourse and lounge. An allowance of one toilet to every 30 to 40 passenger is considered adequate. The proportion of male and female toilets would naturally vary at different location. Since greater proportion of the passenger is likely to be male, from experiences, it is expected that more toilets would logically be provided for male than female.

h. BAGGAGE FACILITIES

Baggage Handling is a very vital function in any terminal. The sooner the departing passenger and his baggage are separated the better. This function is done at the ticketing counter. The Baggage could be carried by hand directly into the bus/car or to the baggage rooms, from where it is transferred to the bus/car. The baggage room should be accessible from both the public area and the concourse and directly into the loading platforms. About 10% of the total area 5m^2 per

bus/car loading berth, whichever is higher, is allowed for the Baggage room. It should also be equipped with standard metal racks.

i. PACKAGE EXPRESS FACILITIES

Packages Express Services are becoming increasingly popular in Transit Terminals. This is due to the fact established from survey that it takes relatively shorter time for parcels and registered packages to reach their destination and also very reliable. A portion of the baggage room may be used for this purpose in such a way as to function without interfering with the concourse traffic. However, a separate packages express counter, the length which depends on the scope of operation could be provided. Parcels are light-weight, but need rack for easy storage based on keeping parcels for same route together, and to avoid unnecessary damage. Space for weighing machine(s) and desk space for the clerk in addition to the counter, which is normally 450mm wide, and preferably 600mm run is also needed.

j. LEFT AND LOST LUGGAGE FACILITIES

Facilities in form of office space for few clerks with a counter and storage racks are provided for lost and left luggage. In most cases, these articles are claimed within two days and very few are unclaimed for longer period in which case they may be sent to the media house for a wider publicity. The counter space is usually 450mm wide and 600mm high as all luggages have to be lifted into or over the counter. Due to the fact that few clerks work in this area, the counter should not be too long. However, a reasonable passenger waiting space is needed in front of the counter. Racks in multiple units of 600mm x 600mm are desirable.

k. SHOPS AND OTHER CONCESSION

Shops and other forms of concession are usually provided in terminal and managed by person, other than the terminal authorities. These people in turn pay rents to the terminal authorities which constitute a considerable source of revenue. This rental space mostly shops, vendor stall, concession, and kiosk, e.t.c are usually located so that they are easily seen by arriving and departing passengers. The shopping arcade is therefore preferably located near the passenger entrance and overlooking the waiting area. Sometimes kiosks are located at other places other than the shopping arcade for the sale of confectionaries, tobacco and newspapers or magazines. Shutters are necessary to secure the shops and kiosk when required. Individual sizes of the shop may vary, but a shop 2.50m x 3.00m is adequate and kiosk can be as small as 1.20m x 1.50m in

size. No separate sanitary facilities may be required by shops except where there are fruits shops and such shops requiring washing up.

l. RENTAL OFFICES

The inclusion of rental offices in Transit has been a common act. The amount of space provided depends on the earning potential of the site. These offices let to bank(s), Post Office e.t.c

m. DISPATCH OFFICES

This is the office that controls all vehicles movement and thus should be located at a point where it would be able to observe activities at the loading or offloading berths. The office space should be such that it would be able to contain necessary electrical gadgets for the dissemination of information to all parts of the terminal. It is usually connected by telephone and inter-call to the ticket office. It is connected to public address systems and screens. The size of dispatch office may vary from 5.00m² to 14.00m².

n. RESTAURANT

Restaurant is very important unit in any Transit Terminal particularly in an intercity type which implies long distance journey. Ideally the restaurant should be located to have a visual relationship with the public waiting space for self-advertisement. For convenience purpose, there is the need for a separate service route from the public route. The restaurant should have a bar with separate counter if possible; a kitchen with enough facilities, wash hand basins and other conveniences for users. Counter space should be long enough to allow more than one servery point to be able to cope with peak periods.

Generally, about 15 to 25 percent of the covered area of the building is provided for restaurant, and 15 to 35 percent of this area is set aside for kitchen depending partly on the storage facilities. Where the store becomes an integral part of the kitchen, an allowance of 50 percent of the dining area of the restaurant is reserved for the kitchen. About 50 percent of the total area of the dining and kitchen spaces is comfortable as bar, and about 30 percent of this area is reserved strictly for circulation. Normally the local density varies from 0.8 to 1.5 depending on the method of seat arrangement used. 1.40-1.70m² per person with long self-service counter is appropriate for a Transit Terminal. 1.50-2.30m² for person including counter and cooking spaces is sufficient for a snack bar service.

o. ACCOMMODATION

The provision of temporary accommodation in transit terminal is becoming increasingly popular these days. The provision of these accommodations is for intending passengers who wish to travel very early the next day and for those passengers who arrive very late and sometimes still traveling further than that City or Terminal City. The accommodation could be single or double rooms, with inbuilt toilet facilities. (i.e. En-suite rooms).

2. ADMINISTRATIVE FACILITIES

These are facilities provided to ensure the successful day to day running of the terminal, in form of administrative spaces.

a. OFFICES

All terminals require a certain amount of office space regardless of type. However, the specific area to be provided depends on the terminal size and type. Usually, “the space requirement for an office ranges from 9.00m² to 24.00m²”. Administrative spaces are mostly suited to upper floors location in the terminal building.

b. CASHIERS ROOMS AND ACCOUNTING OFFICE

Administratively and for convenience and proper communication, the cashiers’ room is better aligned and accessed from the Accountant’s Office with minimal effort. As a result of large sum of money left in the room, adequate security measures should be made for safe keeping of money.

3. STAFF FACILITIES

These are facilities provided for the convenience and exclusive use of the members of staff. They may not necessarily be restricted to a particular place in the terminal. They are distributed in response to necessary demand in order to be within each reach of the category of staff for which they are designed.

This facility includes:

- ❖ Staff Lounge;
- ❖ Staff changing and sanitary facilities.
- ❖ Temporary accommodation for drivers and their conductors;
- ❖ Staff car park; etc.

4. SUPPORT FACILITIES

These facilities, although not considered so fundamental, to the running of a terminal, their inclusion will improve the operational standard of the terminal.

These facilities differ in types and functions may include:

- Fore-court
- Taxi Rank
- Local Car/Bus stand;
- Parking lots for short and long stay.
- Security Facilities
- Bus/Car Yard
- Plant house
- Landscaping.

a. BUS/CAR YARD

The vehicle yard is a facility provided for parking of Buses/Cars leaving the maintenance workshop and the vehicles are also temporarily parked here, prior to their turn before berthing at the loading deck. The size of the yard is dependent on the number of Buses/Cars and the system of parking; the number of loading berths; and the bus/car geometrics. There are three major types of parking layout.

- 1) Parallel parking to direction of arrival which requires a minimum of 11.00 widths per drive way and about 6.00m clearance from a bus directly in front or behind it.
- 2) 45⁰ Oblique parking to direction of arrival with a minimum of 3.5m width per parking lot, and usually 8.0m from scratch kerbed.

In most of these parking layouts, a drive through system is preferable. The bus/car yard should be ideally being connected to the loading deck.

b. BUS/CAR GARAGE

This is a covered space for parking of buses/cars. These vehicles are parked for a longer time in this place as against the temporary parking at the bus/car yard. The design principle is to obtain a lathe uninterrupted space using long span members. The floor is usually of hard core, and fire resistance materials such as granolithic or reinforced concrete, and asphalt tar. Minimum headroom depends on the type and height of vehicles. However, an average of 4.08m is considered adequate.

c. PLANT HOUSE

In a public place like a terminal, it is desirable to have a plant house may be detached and provided with an operators' office and a store. However, where basement is available in the building, it is a common practice to locate the plant room in the basement.

5. MAINTENANCE AND SERVICE FACILITIES

These are facilities provided for the general upkeep of buses/cars. The work of inspection, maintenance, servicing and repairs of an integral part of a bus/car is an operators' responsibility. Usually, such work is taken to a local depot with repair workshops, fuelling washing and other facilities. The inclusion of these maintenance facilities within the terminal premise, although unusual, is nevertheless worthwhile. Apart from the difficulty and the time consumed in driving to and from the station and depot, the inclusion of a maintenance workshop will also enhance the commercial viability of the terminal. This is particularly so when it is realized that the terminal authorities will make a lot of money for repair services rendered, if self-operated; or if let out to individual mechanics and technicians, from the subsequent rents that these will in turn pay to the authority. That maintenance and other allied services are usually not carried out within the terminal premises does not in any way mean that they are not needed. The main reason for their omission is high cost of land, associated with the central areas of most cities where these terminals are usually cited.

This facility comprises the following element:

1. Fuelling Facilities
2. Water Facilities for washing radiators and batteries.
3. Inspection facilities
4. Offices
5. Storage
6. Shop for petroleum products

4.5. SPACES, THEIR SIZES AND RELATIONSHIPS

4.5.1. SPACES

The whole layout have been categorized into different zones, these are;

- Terminal Building (administrative and main concourse facilities),
- Transit Accommodation for Travelers,
- Service station

- Security Facility
- Circulation

1. TERMINAL BUILDING

- Departure
- Entrance
- Booking/Ticketing area
- Enquiry
- Store
- Queuing area
- Public waiting area for intending passengers and arriving passengers
- Left/lost luggage room
- Travel agency
- Insurance Office
- Departure Lounge
- Departure Concourse
- Baggage Room
- Banking hall
- Staff Lounge
- Accountant's Office
- Transport Manager's Office
- Store /tea room
- Conference room
- Director's Office
- Public Relation Officer's office
- Lettable shops
- Lettable space
- Human resources manager's office

2. RESTAURANT AND BAR

- Dining
- Kitchen

- Dry store
- Cold store
- Servery area
- Kitchen yard
- Male and female changing room
- Bar
- General store

4. TRANSIT ACCOMMODATION FOR TRAVELLERS

- 65 Bedrooms(single, double bed and three men room)
- W.C./Shower
- Travelers' Lounge
- General Reception
- Manager's office
- Game room
- General office

5. SERVICE STATION

- Car washing area
- Mechanical department
- Lubricant bay
- Waiting area
- General office
- Offices
- Store
- Changing rooms
- Tools/Equipment store

6. SECURITY FACILITY

- Offices
- Reception
- Changing room

7. CIRCULATION

- Staff parking
- Visitors'/Passengers' parking
- Short stay parking
- Long stay parking
- Bus yard

4.5.2. SPATIAL SIZES

Table 4: Showing spatial sizes for Terminal Building

SPACES	DIMENSION(M)	AREA(M ²)
Concourse	42 x 3.6	151.2
Enquiry room	4 x 5	20
Store	3 x 3	9
Ticketing/Booking area	1.5 x 2	15
Public waiting area	6 x 6	36
Drivers' Lounge	6 x 6	30
Unclaimed baggage room	7 x 6	45
Travel agency	6x 6	36
Baggage processing area	5.7x 6	34.2
Insurance office	4 x 6	24
Departure lounge	18x18	324
Arrival lounge	18x18	324
Departure concourse	39.0x 42	1632
Baggage room	9.8x9.5	93.1
ATM area	14.4x6	86.4
Staff lounge	6 x 6	36
Accountant office	6x3.6	21.6
Transport manager's office	4 x 4	16
Tea room	3.6 x6	21.6
Conference room	6x12	72

Director's office	3 x 4	12
Human resource manager's office	3 x 4	12
Public relation manager's office	3 x 4	12
Lettable offices	4 x 5	20
Lettable shops	6x6	36
Café	6x6	36
Drivers' Lounge	6x5	30
Telephone service area	3x4	12
General Store	3x3	9

Source: Author's Survey, 2015.

Table 5: Showing spatial sizes for Transit Accommodation for Travelers

SPACES	DIMENSIONS(M)	AREA(M ²)
Single bed	2.7x 3.6	9.72
Double bed	3.6 x 3.6	12.96
Three bed	4.6x3.6	16.56
W.C/Shower	1.5 x 1.8	2.7
Travelers' Lounge	6.8 x 6.8	46.24
Genera reception	6 x 6	36

Source: Author's Survey, 2015.

Table 6: Showing spatial sizes for Maintenance Workshop

SPACES	DIMENSIONS(M)	AREA(M ²)
Car washing area	7.6x12	91.2
Lubricant bay.	7.6x12	91.2
Tools and Equipment store	9.8x5.5	53.9
General office	6x5	30
Workshop manager's office	4x6	24
Mechanical workshop	7.6 x 12	91.2
Office	3 x 4	12

Store	3 x 3	9
Changing room	3.6 x 3	10.8

Source: Author's Survey, 2015.

Table 7: Showing spatial sizes for Restaurant and Bar

SPACES	DIMENSIONS(M)	AREA(M ²)
Dining	12 x 12	144
Kitchen	4 x 5	20
Dry store	4x3.3	13.2
Cold store	4 x 5	20
Servery	2.4x 8	19.2
Kitchen yard	6x6	36
Male changing room	6x2.7	16.2
Female changing room	6x3.3	19.8
Bar	12x12	144
General store	3 x 3	9

Source: Author's Survey, 2015.

Table 8: Showing spatial sizes for Security Facility

SPACES	DIMENSIONS(M)	AREA(M ²)
Office	3 x 4	12
Reception	4 x 5	20
Changing room	2.7 x 3	8.1

Source: Author's Survey, 2015.

4.5.3. SPATIAL RELATIONSHIPS

Having identified and determined the various space requirements as well as the major grouped area in the terminal complex for purposeful and efficient planning, these areas must of all be functionally related to each other. These relationships are functional considerations of the overall design.

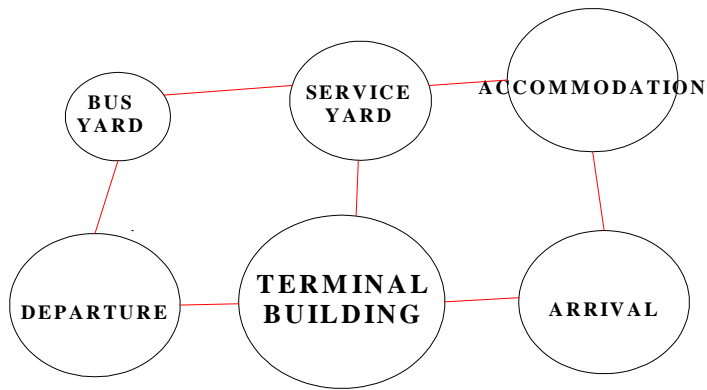


Figure 29: Showing Relationship diagram for the layout
 Source: Author's Survey, 2015

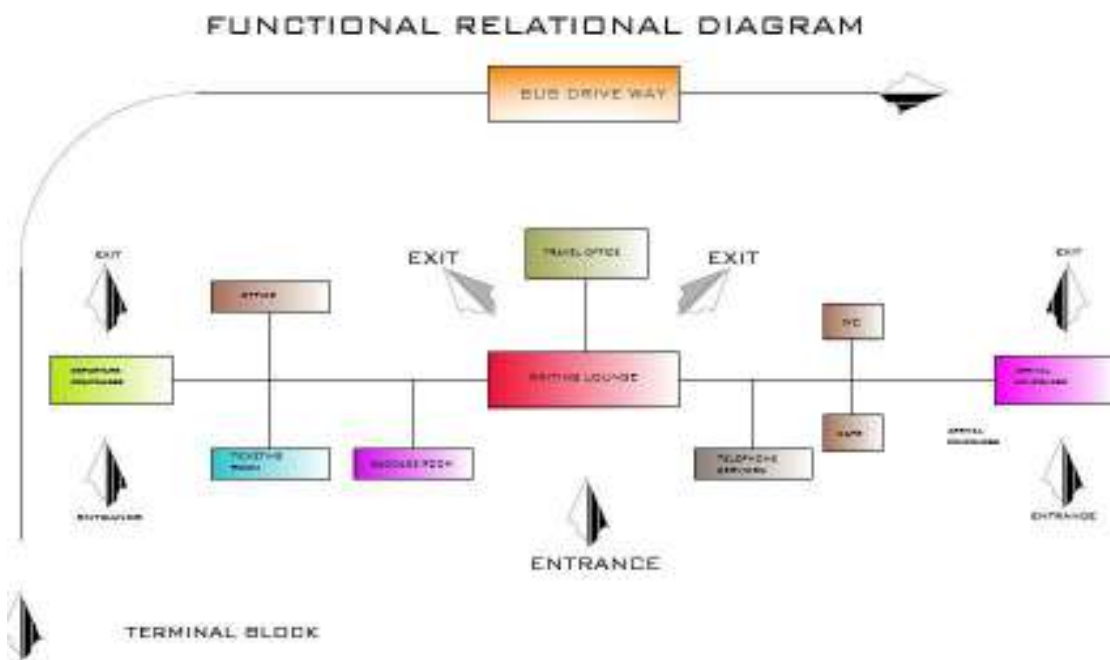


Figure 30: Flow chart diagram for Terminal Building
 Source: Author's Survey, 2015

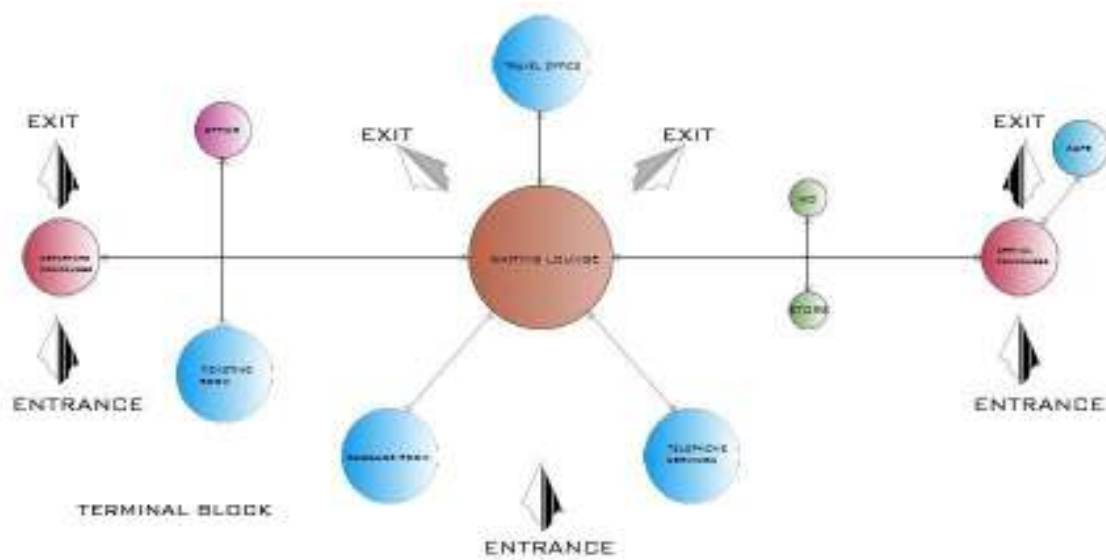


Figure 31: Showing Relationship diagram for the Terminal Building

Source: Author's Survey, 2015

4.6. DESIGN CONCEPT / CONCEPTUAL APPROACH TO DESIGN

The concepts adopted for the design is based on the philosophy that form follows function. This implies that the function of a building will determine the form it assumes after design. A Bus terminal is to provide a civilized and logically planned shelter with modern amenities for staff and passengers. The scheme should be able to accommodate the flow of people and vehicles and protect nearby housing from noise and pollution. The design was synthesized by achieving functionality through effective spatial integration, which then defines the form of the design. The Walshall bus station is an example of this conceptual approach to the design of a bus terminal, in the sense that its designers Alford Hall Monaghan Morris had a major challenge of reconciling the complexities of vehicle and pedestrian circulation and making sense of a fragmented landscape.

CHAPTER FIVE

5.0. PROJECT APPRAISAL

5.1. APPRAISAL OF PROPOSED SCHEME

The proposed building as described in chapter four is located along the Ikorodu-Epe Road, adjacent the Ikorodu-Sagamu Expressway. The facade facing the road is very attractive and inviting to the passers by. It embraces a simple yet profoundly appealing elevation with glass panels, steel work, and structural concrete, all arranged to light and ventilate the interiors, beautify the exterior, and provide a functional yet aesthetically valid ambience. The terminal site is designed with the tropics in mind using bioclimatic design techniques. The terminal connects visually and functionally to the urban fabric and is a focal point in its ambient environment. Suited roofs and lofty structural elements create a sense of grandeur in this facility. Structure and hard wearing exterior ground floor finishes combine to convey strength and durability, structure projecting through the building envelope offers a modern appeal by day and a light-emitting sanctuary by night. The deployment of various features helps to keep the terminal operating at a high level of functionality and efficiency. These features include:

1. Active use of hard and soft landscaping elements including roads, to define and separate vehicular and pedestrian circulation so as to minimize areas of conflict;
2. Location of facilities in a logical process manner so as to ensure ease of circulation and accessibility to those facilities within the central concourse area, the bus/passenger concourses and the upper floors;
3. Building is oriented away from the East-West sun as shield against solar heat gain and glare. Sun-shading features include the low-emissive double-glazing glass panel facade;
4. A large internal courtyard is provided in the terminal building to help ventilate and light its interiors, tall openings of concrete louver elements provided at every bus concourse to aid natural ventilation and evacuation of bus exhaust. Extractor fans are also provided for this;
5. All water used in the building is collected into the sump under the building for storage processing and re-reticulation for re-use.
6. In a bid to ensure the building is stable, expansion joint was introduced almost at the half way of the total length of the building.

The terminal Complex is organized on four (4) floors. The ground floor houses the Central lounge Flanked on both side by Arrival and Departure Concourses. It is a centralized form of spatial organization. These contain operational/interchange facilities like, arrival/departure halls, ticketing, baggage handling, unclaimed luggage area, shopping, restaurants, toilets, and enquiries etc., specialty areas such as cybercafés, police offices and other workspace for operations staff, storage space, bus concourses, travel agency, postal and telephone services etc. The first floor houses the offices for staff of the transit company i.e the, Managing director, General Manager, managers in large of Operations/sales, Human resources/Corporate affairs, Finance/Treasury and the maintenance manager, storage space, lettable office space, conveniences etc, while the second and third floor houses lettable office spaces for banks, and high profile firms. Terminal users can access the building through a large and well celebrated entrance foyer. Adequate steps and ramps are provided at the entrance to enable both the physically challenged and able-bodied users' access the building. The entrance is decorated with shrubs in order to improve its esthetic value. The other entrances into the building include those at the arrival and departure concourse f and the escape stair hall. Conveniences are distributed across all the floors. There are two doors at entrance of building to control movement. Stair halls are strategically located to ensure effective circulation within and consequently around the Facility.

5.1.1. CONSTRUCTION METHODS AND MATERIALS

1. CONSTRUCTION METHODS

The building is based on a combination of horizontal and vertical grids for simplicity of erection of the central courtyard, concourse area and the bus/passenger concourses on the flanks. These are adopted based on the size of the building and the degree of flexibility required. The building is a framed structure, which requires a degree of expertise for its construction. The structural details required will be designed by a structural engineer for the specification of elements such as the sizes of columns, beams, foundation and their reinforcements and the type of foundation to be used will be a combination of column pad and cellular raft, especially at the sump.

*** Substructure**

The foundation of the columns will be excavated to firm strata and properly blinded. The sump area will however be of cellular raft construction, in a water retaining format so as to withstand the imposed weight and action of stored water and the mini-recycling plant.

Reinforced concrete of ratio 1:2:4 cast-in-situ will be used. The details of the sub-structure will be to the structural engineer's detail.

* **Superstructure**

Reinforced concrete frame structure cast-in-situ to structural engineer's detail and specifications will be used. All external walls between columns will be 225mm sandcrete hollow blocks as infill. Some of the interior walls as specified in the drawing will be 150mm partition walls constructed of acoustic materials and glass to allow transmission of light to the enclosed spaces.

* **Roof Structure**

The main roof will be constructed of structural steel frames to be covered with 0.7mm gauge industrial long span aluminum combined with translucent Perspex roofing sheets laid on z-purlins appropriately spaced while the roof of the main entrance area will be of reinforced concrete. The roof slabs in-between the roof will be laid with three (3) layers of nesplaspruf bituminous felt on 150mm thick R.C slab according to the structural engineer's detail. Roof gutters are provided as appropriate as overhang and also to collect stormwater and piped thereafter into the sump for recycling and reuse.

* **Floors**

The floor loading capacity is 932kg/m^2 and the slab itself should be of sufficient dimension to the structural engineers' specification. The entire floor will be of reinforced concrete of hardcore and oversite concrete of 300mm and 150mm respectively. The ground and upper floors areas above the central concourse area will be in waffle floor to the Structural Engineer's specification as those are the only areas to be elevated. The waffle floor is used to enable higher column span widths, tighter slabs and easier concealment of services. High traffic areas like concourses, waiting areas, lobbies etc would be finished in suitable granolithic terrazzo while the office areas would be finished in unglazed vitrified tiles; the entire second floor management offices would have circulation spaces finished in unpolished marble while the offices would be finished in large size polished vitrified tiles.

* **Floor Slabs**

The floor slab of the ground and second floors will be made up of waffle floor slab laid over 400mm diameter circular columns at a natural span of 12m between columns and inbuilt beams at sizes ranging from 450mm to 900mm per the Structural Engineer's specification.

2. Construction Materials

Substructure: Reinforced concrete and Blockwork.

Suspended Floors: Waffle floor slab top finished in granolithic terrazzo, bottom rendered smooth and finished in white-colored textured paint. Floor finish however varies with traffic volume and space type. This includes ribbed rubber tiles and unpolished vitrified tiles in areas of high traffic.

Walls: Sandcrete hollow blocks for exterior walls; glass panels, glass block and hollow sandcrete block for interior walls. The wall finish should be in colours that reflect light at the same time, complementing the furnishings. Curtain walls were used in certain areas of the building. The main entrance area is finished in marble wall tiling, the toilets in glazed ceramic tiling. The concourse areas on the flanges however do not require a waffle floor as they are terminated at the ground floor, though of double volume to accommodate bus geometries.

Roof: A curved structural steel frame, symbolic of the shape of a bus is used, with cladding of 0.7mm gauge industrial long span aluminium roofing sheets for the roof over the bus concourse areas. The central area is also roofed in steel carcassing and aluminum covering. The roof slabs in-between the roof gutter will be laid with three (3) layers of nesplaspruf bituminous felt on 150mm thick R.C slab. The roof structure consists of long span aluminum roofing sheets carried by steel members, perspex in areas of sky lighting. For the roof area that is of reinforced concrete, mastic asphaltic coating over reinforced concrete slab with asphalt skirting is used. Also rain water outlet is included and piped into collectors encased in walls and leading to the basement sump: (Mastic asphalt is a mixture of crushed natural limestone and

bitumen for an effective barrier to the penetration of water).
Internal partitioning is of aluminum panels and glass/fibre board.

Doors and Windows: Polished hardwood doors and glass with aluminum panels for windows

Ceiling: Acoustically proofed celotex ceiling board.

External Works: Grass, trees and shrubs, plain in-situ concrete and asphaltic paving.

5.1.2. SERVICES REQUIRED

A number of basic utility services are essential to support capacity performance. These services are well conceived and incorporated in this proposal.

1. Water Supply

The project site offers water supply advantage to the project. Lying along the route of the main water supply to the Locality, a reliable water supply is to supplement in times of public supply failure.

2. Electrical Installation

Conduit pipes will be used for all electrical installation which will be inserted in the wall. The availability of electric power supply in the area is of great advantage. Notwithstanding, a stand by generator will be provided for.

3. Circulation

Pedestrian and vehicular circulation will be well articulated. There will be harmony in movement and also having interesting views at various spots.

4. Refuse Storage and Disposal

Provision of garbage collection from all units in the complex and an organized dispose system to achieve a hygienic and pollution-free environment is incorporated in the planning. The public collection facility is to be exploited unit such times that the centre will be able to acquired dumping truck for its use.

5. Lighting

Good lighting makes for good vision inside the building. At the same time, lighting is used to enhance the beauty of the architecture, create different moods and to focus attention on important features. Thus adequate lighting is ensured by generous openings and liberal use of glasses. Well-planned artificial lighting is also integral in the concept of lighting for the centre. It is used

to lit the landscape and focus enrichment artifacts for positive effects. Appropriate levels of illumination are ensured for all spaces.

6. Plumbing

All plumbing works will be invisible after the completion i.e. they will be inserted in walls and underground so that they will disfigure the building.

7. Acoustics

To reduce the reflection of sound especially in the larger spaces, soft finishes will be used for the walls, the furniture's and the floor so that instead of the sound being reflected fully, part will be absorbed and a little portion reflected. The roof also will be design to reduce the reflection of sound.

8. Waste Disposal

The black water (wastes from toilets) will be channeled to soil pipes running down the slope terminating in a septic tank. Inspection chambers are introduced where there is a critical joint of more than two pipes. Grey water wastes (from wash hand basins, baths, and sinks) will also be channeled into a waste pipe which runs parallel to the soil pipes but terminates into a soak away pit.

9. Fire Services and Protection

Fire outbreak in public buildings of this nature must be prevented. For effective control, the causes and possible growth must be identified.

Fire is often caused by:

- Carelessness and negligence
- Equipment failure and deficiency
- Chemical reaction
- Arson

Growth of fire depends on the amount, disposition of combustible materials within the building and the fire protection measures in the building. Fire protection measured includes the following systems:

- Fire alarm system
- Fire prevention measures
- Fire extinguishing system
- Timely smoke removal

This proposal employs the use of automatic flame detector for fire prevention while it also provides for portable extinguishers within the buildings.

10. External Works

This project involves a lot of external works particularly as it seeks to express and impart deep meanings to complement those of the physical structures. Thus it proposes detailed plans to facilitate this goal. The overall quality of the environment rests in the actualization of the external works.

5.2.SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

5.2.1. SUMMARY OF FINDINGS

The findings in this research work start by analyzing parameters for enhancing effective circulation and by investigating ways through which the spatial organisation could be optimally coordinated in terminal complexes with references to case studies. Based on the analysis of the case studies, a number of pertinent measures which were neglected in the case studies were brought into play in this work. These include:

1. Facilities provided far outstrip what was seen in the case studies. In this bus terminal, spaces such as restaurants, cybercafes, sports bars and lounges, travel agency, gymnasium, police and lettable office and shop space, extensive shopping areas, banking services including ATM services, etc are provided generously. Adequate parking is provided so the facility does not turn into a nuisance to its neighbours.
2. A clear separation is provided between vehicular and pedestrian circulation. Even in the vehicular, a clear separation is afforded between bus and car movement. Pedestrian walkways are provided by design alongside all roads and parking areas, in between the buildings and other spaces in the terminal complex. All of these are done to ensure effective circulation within and around the facility.
3. Most of the existing terminals studied, actively created extensive pollution by dumping used vehicle oils and water from washing vehicles directly on the soil. Provision is made in this design for collecting all wastewater, recycling and reusing it.
4. Noise is an ever present problem in terminal complexes. Virtually all terminal floor activities generate noise and as such, landscaping is carefully provided to both ensure absorption of noise generated by the terminal operation. This includes trees and shrubbery.

5.2.2. RECOMMENDATIONS

Transit terminals are expected to protect the users from environmental and climatic phenomena such as rain, wind, temperature, and visual discomfort. More attention should be given to enhancing effective circulation between the various activities occurring in different spaces which could be achieved through spatial coordination. This should be achieved in a bid to using Bus terminals to solve the problem of traffic congestions rather than compounding it. To be able to achieve these functions effectively, the following recommendations are hereby made:

1. Potentialities of the site to offer opportunities such as expansion in the future, this must be evident in its size, location and other characteristics, the whole site should not be developed for immediate use.
2. It must be ensured that all circulation interfaces between pedestrian and vehicular show optimal separation so as to ensure a conflict-free terminal operation.
3. The building environment should be critically viewed for its potentials to support the activities within the building being designed.
4. Adopt plan shapes, design concepts and site zoning that will enhance maximum integration of all spaces provided so as to enable accessibility and improve circulation.
5. Ensure that in all terminals, bus concourses are in close proximity to and have strong connection with the passenger concourse, thus all bus loading operations are fully protected from the sun and inclement weather.
6. Introduction of well designed sun signage and other information devices both within and outside the terminal to guide all users as to directions.

The above recommendations, when applied to terminal buildings, will produce optimal functionality in terms of efficient spatial and circulation coordination. In pursuance of these appropriate design implications, it is strongly recommended that the criteria employed in achieving facilities synthesis for effective circulation coordination as outlined in chapter four be reflected in the proposed design.

5.2.3. CONCLUSION

Designing a new functional bus terminal cannot be achieved without effectively coordinating circulation networks that tie spaces and required facilities together. Moreover, the design of the bus terminal involves solving various related problems, ranging from addressing environmental psychology of passengers, the need to encourage social interaction and the exchange of ideas,

satisfying basic requirements of architectural design and planning and also satisfying the client by providing a complex that is viable and capable of attracting customer patronage with the overall expectation to make profits. This project was conceived and necessitated by the need and dependence on long distance road transportation by large number of the populace and consequently the need to reduce traffic congestion in the central core of the study area. This thesis has therefore had an in depth study of the design of this building, the problems associated with it and approaches to solving them are proposed in order to create an appropriate environment for pedestrians, buses and other vehicles. Also, the design aim of protecting the passenger from inclement weather as soon as he arrives the terminal to the point of departure from the terminal, coupled with the provision of necessary passenger facilities, their location in space both indoors and outdoors and effectiveness of circulation within this spaces, for effective usage have been the focal point of the design.

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