RAILWAY TERMINUS - ABUJA

(A MODERN APPROACH TO RAILWAY STATION DESIGN IN NIGERIA)

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ON

RAILWAY TERMPNUS - ABUJA

(A MODERN APPROACH TO RAILWAY STATION DESIGN

IN NIGERIA)

IN

NOVEMBER, 1997

DEDICATION

THIS WORK IS DEDICATED TO ALL THE PIONEERS OF RAILWAY

STATION DESIGNS WHO HAVE SOUGHT FOR A DEFINITE

EXPRESSION OF STYLE IN THEIR WORK THROUGH THE

CENTURIES.

DECLARATION

I hereby declare that this thesis's a complete product of a study undertaken by me, which has not been submitted else where for a higher degree. Due references are made to sources of transferred materials



Icha, E. Eunice

17/12/22

Date

CERTIFICATION

THIS THESIS TITLED; **RAILWAY TERMINUS - ABUJA** (A MODERN APPROACH TO RAILWAY STATION DESIGN IN NIGERIA) BY ICHA, EUNICE EYEHOMO MEETS THE REGULATIONS GOVERNING THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN ARCHITECTURE OF AHMADU BELLO UNIVERSITY, AND IS APPROVED AS A CONTRIBUTION TO KNOWLEDGE AND LITERARY PRESENTATION.

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ABSTRACT

The nature of the transportation system of any Country in the world determines the standard of social life of its people Similarly, the economy of any nation also depends largely on its transportation network and efficiency

The need for transportation as an important and essential ingredient for human existence cannot be overemphasised The demand for transportation for various purposes is ever on the increase in the modern world Experts in the area of transportation technology are working ceaselessly to meet up with these demands by improving on the design and engineering of various modes of transportation

Comfort, safety and speed have become important factors in the choice of the mode of transport by the individual traveller, therefore, intermodal competition is also on the increase as transport sectors are trying hard to use various techniques and modern innovations to attract passengers (or travellers)

Rail travel has entered a new age of high speed Sleek trains with unsurpassed levels of comfort and efficiency are needed to meet the new world demand for enhanced steel wheel technology.

Everyday train move people, products, equipment, fuel and food in an efficient, economical and environmentally desirable manner Unfortunately, this statement is not very true of Nigeria today. The essential requirement for a modern and efficient railway system is lacking in the Nigerian Railway Corporation (NRC), and thus, the present predicament.

The NRC is currently making moves towards revitalising and mordenising its entire system To ensure a viable railway transport system in Nigeria, there is need for a general improvement of rolling stock, locomotive stock, passenger and goods services, signalling and communication techniques, maintenance and management skills, tracking and traction and other infrastructure

One way for the NRC to achieve its goal towards maximising its economic and operational capacity is by diversification of its activities as practised in other railways of the world The design of a modern Railway Terminus for Abuja is a modest contribution in this direction.

The station is an essential part of a new system of transportation, it reflects the impact of the technology and mobility of the masses It played its part in opening up the frontier, it is associated with conurbation, the spread of suburbs and the development of tourism.

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GLOSSARIES

Ballast	Gravel used to make a foundation bed for railway.
Bay	Side line and platform in a railway station, used as a starting point and terminus for trains, separate from the main lines.
Bogie	Four wheeled under carriage fitted under a railway engine or wagon to enable it go round curves.
Branch line	Line other than main lines (see main lines). Branch lines extend between main lines and various places not served by main lines such as farming communities and mining sites.
Carriage	Wheeled vehicle for passengers on a railway train.
Classification yard	Consist mainly of a number of closely spaced parallel tracks where each track is reserved for cars assigned to a particular route.
Concourse	Large hall of railway station where Goods gather. Serving as a vast mixing chamber and a self adjusting traffic center.
Coupling	Joining together of railway coaches.
Crussties	Heavy metal or wooden beams across the rails of a railway track, giving them support (also known as sleepers).
Engineering yard	Place where rails, sleepers, bolts and other tools are kept.
Fouling Mark	Safety gadget between two converging or diverging tracks indicating the limit after which wagons on the two tracks will touch.
Freight	Carriage of goods from place to place.

Gauge	Distance between the rails of a track. The guage is said to be standard when it is 1435mm and broad if greater than the standard and narrow if smaller.
Goods	Loads other than parcels and luggages carried from Goods shed.
Goods shed	Store for goods in a railway station.
Junction	A point where two or more lines from different directions meet. This could be an administration center or station located beyond the converging point of the lines.
Locomotive	The powered engine used for hauling railway carriages and wagons.
Loop line	A railway line laid away from the main line, runs in a curve and made to join the main line again a distance away.
Luggage	All such articles as a passenger may take with him for convinience and use during the journey. Such articles should not include the ones intended for business trade or profit (except in the case of commercial travellers).
Main line	The primary line of a railway main line routes linking major cities.
Marshalling yard	See classification yard.
Platform	Flat surface built at a higher level than the railway track in a station used by passengers for getting in and out of the train.
Rail	Steel bar, or continuous line of such bars, laid on the ground as one side of a railway track.

Railway terminus	The station at the end of a main line or branch line There are terminus where the lines, instead of terminating in a buffer stop, continue to service points for other purposes such as goods yards, sidings for factories among others. It could continue past station to engine sheds as the case may be.
Rolling stock	All railway stock that are on wheels for example, coaches and wagons
Run combined	A system where trains for different destinations run together only to be separated in a later station.
Running shed	Locomotive maintenance service shed.
Section	Distance between two operating stations.
Shunting	The process of sending railway coaches and wagons from the track to another, especially to keep a track clear for important traffic.
Siding	A short railway track along side a main or branch line to which one of two meeting trains is switched, until the other train passes.
Sleepers	See Crossties.
Terminal	End of a railway line.
Through stopping traffic	That part of the total traffic which has origin and destination outside the survey station, but has an intermediate stop within that station.
Traction	Power used in hauling trains along the tracks.
Unit train	Is a freight train whose cars all carry the same kind of freight and are all headed for the same destination.

Wagon	Wheeled vehicle for goods on a railway (freight car U.S)

ABBREVIATIONS

BR	British Railways
C&W	Carriage and Wagon
NR	Nigerian Railways
NRC	Nigerian Railway Corporation
UNCTAD	United Nations Conference on Trade and Development

CHAPTER ONE

1. INTRODUCTION

Intercity transportation in Nigeria as in most Countries, is multi-modal, roads, railways, airways and waterways take care of the demand for transportation services in various degrees. It provides ease of movement for work, trade and commerce, leisure and tourism. Nevertheless the ever-increasing demand for safe, quick and cheap transportation in Nigeria today is an issue to be given prompt attention.

Aside the steady rise in price and scarcity of Petroleum products which in turn have caused the fares on road and air transportation to hike in recent years, these modes of transportation have more disadvantages, than the advantages they may seem to offer. Road accidents and the menace of heavy trucks on our high ways are on the increase daily, lots and lots of lives and property are lost as a result.

The high risk of air travel particularly in the harmattan season is a major disadvantage and of course heavy freight cannot be transported via this means. Air fares are not affordable by an average Nigerian.

Thus the only alternative is the railway. In the developed and in some developing Countries of the World, particularly Asia and Europe, Railways have gone a long way in solving the problem of transporting large numbers of passengers and freight over long distance and have also provided rail links between sources of raw material and industries- consequently, most railway companies are wealthy and own landed property and other assets and sometimes provides the largest percentage of employment either directly or indirectly in some countries (e. g India).

It is therefore ironical to note that in Nigeria the railway industry has virtually

collapsed and the programme for revitalising it seems like an impossible task for the Federal Government due to the enormous financial investments involved.

It is only logical to consider a modern railway terminus for a model capital city like Abuja with its present rate of development and rate of growth in population. It is fast becoming a national centre for political, socio-cultural, commercial, educational and recreational activities. As such a railway connection from the other parts of the country to Abuja is the only rational solution to the problem of mass transit of passengers and heavy goods, in the near future

The commencement of the development of phase II and subsequent phases will involve shipment of heavy construction materials and equipment particularly for the industrial sector and the railway in the best means to employ for this purpose.

From the foregoing, it is apparent that extension of the rail line to the Federal Capital Territory - Abuja is necessary. And a total over hauling - modernisation and revitalisation of the railway system in Nigeria shall be given due attention, the Nigerian Railway Corporation should aim at international standards and the only way to get there is to start now.

1.1 Problem Statement

A new Federal Capital is expected to provide a transport service aimed at integrating it with the rest of the country - as well as with rest of the world.

A railway system aiming at international standards shall require appropriate, adequate and functional facilities to enhance performance and reliability.

With the present trends on International Railway Development, railway services in Nigeria as a developing country should also be modernised Abuja is a good place to begin. Improvements on rolling stock, track and traction, modern equipment, techniques and management (of course) require a modern station to operate properly.

1.2 Motivation, Goals and Objectives

1.2.1 Motivation

The next phase of development in Abuja shall include among other, Industrialisation, Tourism , Recreational and Sporting facilities Hence large shipments of freights of industrial materials and equipment and mass movement of passengers to the Territory will be on the increase Consequently, political, religious, social convention, sports and cultural festival will begin to attract large numbers of people to the Federal Capital - therefore the railway, which offers the cheapest, safest and comfortable mode of mass transit must be provided to prevent traffic congestion in the rapidly expanding capital city.

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1.2.2 Goals and Objectives

The conceptual aims and objectives of this thesis are as follows:-

- To improve the quality and standard of railway stations.
- To programme the facility for maximum utilisation by the community and addition to conventional use.
- To provide an office environment within the station that will adequately accommodate the necessary facilities that will enhance management.

- To create a conducive environment for railway travellers, staff and private rail companies.

- To provide comfort for passengers on transit and for those on business, leisure or short holidays.

1.2.3 Objectives as Architect

From the architectural point of view the thesis objectives include the following:

- To present in the architecture of railway stations the image of quality and sophistication.

- To design a facility that will conform with modern standards of public building which will serve as a reference material in phasing out the present over-used structures of our railway stations.

- To design a facility that will support and encourage constant use.

1.3 Scope, Constraints and Limitations

1.3.1 Scope

This proposal will make provision for the following facilities in a railway station (terminus); the head house and the platforms which includes:-

- Booking/waiting areas
- Passengers and staff conveniences

* Lettable shops
* Platforms
* Offices
* Lettable spaces
* Stores
* Station lodge accommodation
* Parking spaces

1.3.2 Constraints and Limitations

Finance was a major constraint to data collection, since it became impossible to travel far to appraise the Railway stations that would have been good case studies for this project, especially foreign ones.

Another constraint was getting information generally due to bureaucratic nature of the Nigeria Civil Service.

The major limitations on this project are:

1. The Nigerian Railway Corporation (NRC) at the lime of working on this thesis was performing at its lowest, therefore facts and figures are based on previous data and projected figures.

2. A project of this magnitude should involve other members of the building team right from planning stage before the architect can come out with his final proposal, but for the purpose of this thesis, the proposal is considered solely from the architectural point of view.

1.4 Research Methodology

Designing a modern railway station will of course require that the designer should be familiar with modern trends in the development of the railway industry. As such, research procedure will follow thus:

- Obtain background knowledge and information on the subject (international railway) through literature review - from books, journals and magazines.

- Case studies

- Obtain other relevant data

Data source shall include library, official document from government departments, as well as oral questionaire.

CHAPTER TWO

2. HISTORY OF THE RAILWAY

2.1 Evolution of the Railway

The history of the railway dates as far back as to the year 1830. This was when all the essential elements of the railway were first combined. These various elements each have their origins much earlier. The idea of the railway comprising the track and wheeled vehicles to run on them is found to be in the ancient world in Babylonia, Greece and Roman Empire. In the sixteenth century A.D. wooden tracks, on which four wheeled wagon ran, were in use in the mines of Germany, Dlsace and Romania. Shortly afterward, the railway appeared in Britain mainly serving as a means for transporting coal from pit head down to navigable water. The construction of one of such railway started in 1604 by Wollaton, near Nottingham and became functional by 1609.

This and other lines that soon sprang up were short land simple in construction. The railway themselves were of timber, these were sometimes overlaid with thin coats of iron to reduce the effect of wear from the friction of the wheels. By the year 1767 at Coalbrookdale in Shropshire, Rails wholly of iron were first made as a result strengthening the track to carry heavier loads. This was a major step forward. The wagon wheels themselves were made of iron with flanges as we have them today.

Wagons were hauled on rail tracks by horses, human power or by the force of gravity. In 1804, Richard Trevithick, the Cornish Engineer invented the first locomotive (steam engine) designed for railway- This proved unsatisfactory with series of tests. The locomotive was later improved upon by some other pioneers such as Blenkinsop, Hedley and George Stephenson. The latter is generally acclaimed the

inventor of locomotive and even railways as a whole, whereas the very first practical engine was designed and built by cornishman Thomas Newcomer (1663-1727) in 1712. George Stephenson - an English man , constructed the world's first public railway. The Stockton and Darlington railway opened in England on 27 September 1825. It was the largest and most elaborate railway of this period, and the first to secure power of British parliament to run both passenger and goods service by means of locomotives. The railway drew the interest of Engineers and industrialist from the other parts of Britain and beyond. It's success brought about investment into similar ventures and within the period of 1826-1828. Some 25 new railways were authorised. One outstanding development of this time was the underground railway which by 1860 was already under construction in London.

Railway development spread rapidly from England through out all Europe. By 1870 most of Europe's rail system had been built. During the late 1800's and early 1900's, additional main and branch lines were built. Some of these lines required creating of tunnels through the mighty Alps to connect France Switzerland and Italy.

Several important invention after the mid-1800's helped to improve railway safely. In 1869, the American inventor George Westinghouse patented a railway air brake. Trains could stop or slow down much more quickly with air brakes than with the earlier hand brake. Another American inventor named Eli Janny in 1873 patented on automatic car coupler which brought an end to the accidents caused through manual brake and coupling operations before then.

Communications and signalling through electric telegraph lines invented in the mid 1800's became possible. By the end of the 1800's, manual block system were in common use. William Robinson patented the track circuit used in automatic block signalling in 1872. But tract circuit were not widely used until after 1900.

In 1883, the Orient Express, one of the most famous European passenger trains, started operating between Paris, France and Istanbul, Turkey and by 1982 began to operate luxury services.

In the late 1880's, railways extended to other parts of the world to settlements and trade zones. France, Germany and Great Britain built railways in their African and Asian colonies.

During the early stages of development of the railway, it met with a lot of oppositions from the public. It was viewed as an instrument deterrent to progress. All the oppositions could not stop the railways in the face of public need and demand. The railways in Britain for example brought about enormous changes. The social and economic status of the people changed for good. By 1900, Britain had the densiest rail network. Modern systems were introduced to the railway as far back as 1875 when competition between different companies compelled them to adopt new standards of speed, comfort and safety.

Advancement in railway technology and management has taken new dimension as we have them today. Bogie carriages have been gradually phased out, four wheeled and six wheels carriages, diesel electric locomotive and powered cars have taken over steam engines, also better signalling and communication systems mainly computerised has improved rail safety. All these innovations have brought about high transport performance at reasonable fares, high speeds, greater comfort and operating economies. The most recent trend in terms of high speed performance is the magnetic rail suspension system which could attain a speed of 400km per hour.

2.2. The Inception of the Nigerian Railway

Background history of railway construction in Nigeria shows that between 1879 and 1892 various applications for concession to construct railways in Nigeria were made to the office by private colonial interests. A condition precedent to approving such schemes was that, the government of colony of Lagos meet the guarantee of interest on capital sum required for the railway construction. Since the colony government was unable to offer such guarantee, such scheme to construct railways were them shelved.

By 1892, the then British Secretary of state for colonies, Lord Knutsford directed that preliminary survey should be conducted to establish an estimate of the cost of railway construction. The survey, conducted by Mr William Shelford (M.I.C.E), revealed great potential for trade: plans were subsequently made for a reconnaissance survey to explore alternative routes.

It was not until 1895 that the Secretary of state for the colonies, Mr Chamberlain, sanctioned the construction of 1067mm (3ft 6in) gauge railway from Iddo, Lagos to Otta, a distance of 32km.

2.2.1 Early Development

After fourteen years of conflicting interest, railway construction commenced in Nigeria in 1898 with sanction for 32km as earlier mentioned. At that time, little was known about land form and topography of the wide expanse of land which later constitutes a country now called 'Nigeria'. As such, there was the fear of potentials of this country that was just been formed. As a result, the colonial government (of that time) adopted the strategy of economic construction and avoided as far as possible deep cuttings, high embarkments, long bridge spans, tunnels and viaducts.

Between 1898-1927 rail lines were constructed connecting the ports of Lagos and Port-Harcourt with the agricultural and mining areas of the North and North-East respectively. These two lines were almost paralled to each other.

The primary purpose for constructing the railway during this period was to maintain link between the colonial headquarters - Lagos, at that time with other parts of the country as one part and on the other to facilitate the exploration and evacuation of agricultural and mineral resources for export, mainly to the United Kingdom.

The table in Appendix II shows the progress of rail construction in Nigeria. On the whole there is a total of 3,505 route kilometres of rail (single track) network on Nigerian Railway.

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2.2.2 Development Till Date

The Nigerian Railways (NR) was constituted on October 3, 1912, by the amalgamation of the Lagos Government Railway (L G R) and the Baro - Kano Railway (B K R) and was operated as a civil service department designated, the Nigerian Government Railway (NGR).

The Nigerian Railway Corporation(NRC) as it is known today was established by an Act of Parliament - Nigerian Railway Corporation Act. 1955 as amended No 20 of 1995. By the authority of this Act, the perpetual succession and common seal with power to sue and to be sued in its corporate name and to acquire, hold and dispose of movable and unmovable property for the purpose of its function under the Act. Up till today, the Nigerian Railway Corporation holds the autonomy of all railway operations.

2.3 The Nigerian Railway Corporation (NRC)

2.3.1 Objectives of the Corporation

The general duties of the Nigerian Railway Corporation as defined by section 15 of the Amended Act earlier mentioned, states that, "It shall be the duty of the Corporation to manage and operate in accordance with the provision of this Act the railway undertakings transferred to the corporation by virtue of the provisions of this Act and any expansion or extension there of and any new railway, and to provide all reasonable facilities for carriage by the corporation of passengers and goods"

The general objectives of the corporation as summarised in the NRC handbook (1990) includes carriage of passengers and goods in a manner that will offer full value for money, meet cost of operation, improve market share and quality of service, ensure safety of operations and maximum efficiency, meet social responsibility in a manner that will meet the requirements of rail users, trade commerce, industry, government and general public.

The strategic plan of the corporation is directed towards, "efficient maintenance of way and works and fixed installations, locomotives, rolling stocks, plant, machinery and equipment, others include improvement of human resources and technology, development of local manufacturing capacity, and to encourage growth of supporting local industries.

2.3.2 Administration

The Nigerian Railway Corporation has it's headquarters at Ebute Metta in Lagos. To allow for efficiency in administration of the entire system, the NRC is

divided into six divisions throughout the country. Each having a divisional headquarters headed by a Divisional Director (RDD). The six divisions as shown in fig. 1 are:-

1. The Lagos Division with Headquarter at Ikeja.

2. The Western Division with the Headquarter at Ibadan.

3. The Northern Division with Headquarter in Zaria

4. The North central Division just carved out of the North-Eastern Division. Its headquarters is at Kafanchan.

5. North-Eastern Division with headquarter at Bauchi and

6. The Eastern Division with headquarter at Enugu.

These Divisions are, each a conglomeration of the different departments which the whole Nigerian railway corporation is comprised of. These departments have a national head and the head of departments in the Divisions are his surbodinates. The departments making up the NRC are:

* Audit department
* Accounts
* Medical
* Railway police
* Operating and Commercial
* Electrical and Mechanical
* engineering
* Civil Engineering

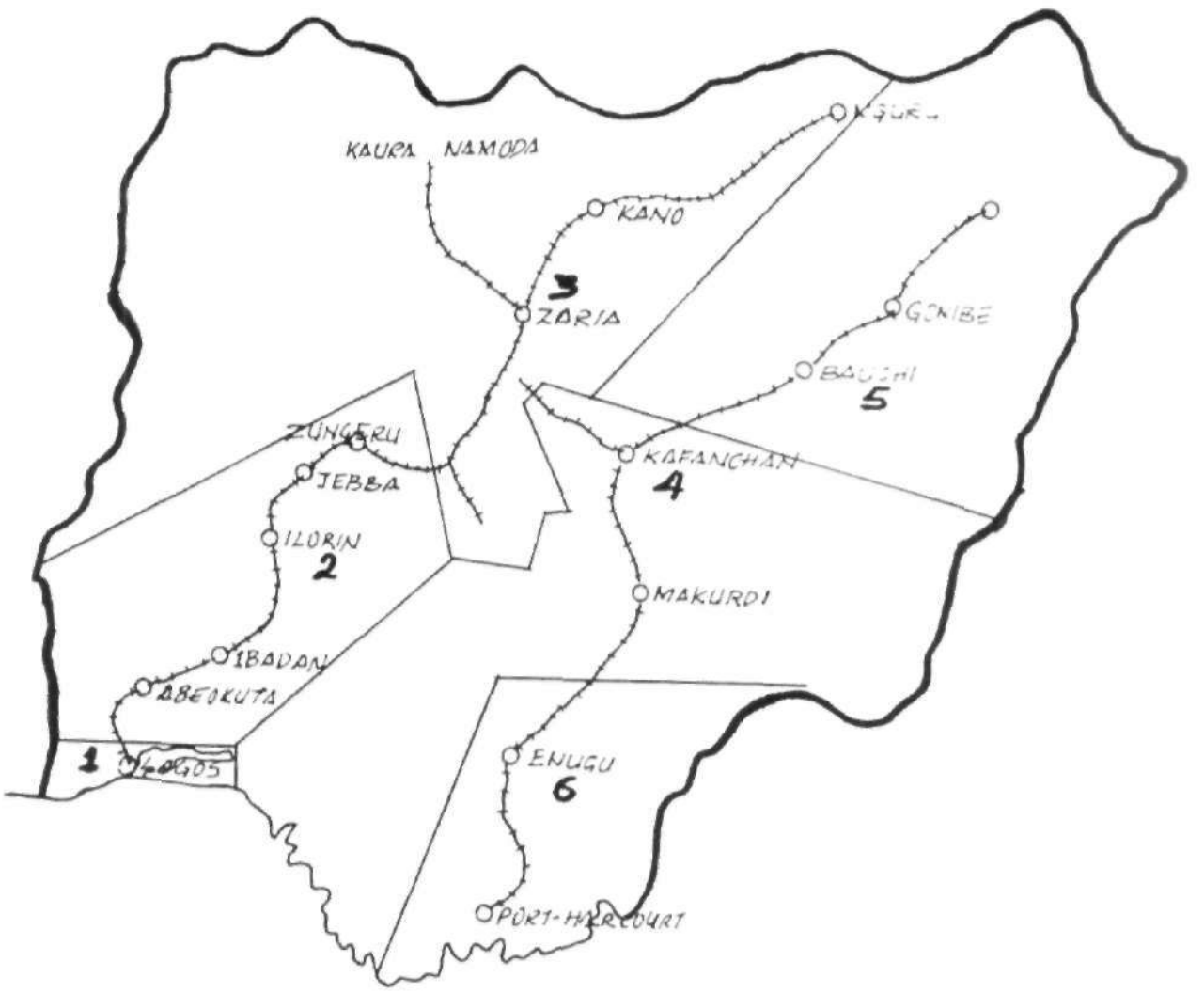


FIG 1 NIGERIAN RAILWAYS PRINCIPAL STATIONS, ROUTES AND ITS SIX DIVISIONS

Of all these departments, it is the operating and commecial department and particularly the commercial sections that deal with the public.

2.4 Modern improvement in the Railway Industry

In recent years the railway industry has been greatly improved upon to meet up with the competition posed by other modes of transportation, namely Highway, Airway and Water way. The word modern shall be used to refer to the last two decades of the twentieth century.

Globally, virtually every aspect of the railway has been improved, this includes, the rolling stock, track, traction, signalling and communication systems, maintenance equipment, management techniques and the station building.

Generally, these improvements have produced high speed performance trains and efficient handling of other railway operations which in turn has given rise to increased patronage both in passenger and freight services, in most developed and developing countries around the world.

2.4.1 Rolling Stock

The rolling stock includes all railway stock that is on wheels - that is locomotives and cars (carriages and wagons). Locomotives: Most trains are pulled at the head of the train by a locomotive. This is the power engine that hauls the passenger coaches or the freight wagon. Some locomotives can push as well as pull.

Locomotives can be classified into two groups by the work they do. Road locomotives, haul freight or passenger trains, switching or shaunting locomotives, can move cars from track to track in rail yards.

Almost all locomotives can also be classified into three groups according to how they are powered. Steam locomotives burn coal or fuel oil to produce steam. The force of the steam runs the locomotives. Diesel-electric locomotives use oil-burning diesel engines to turn electric generators. The electric power produced by the generators run the driving mechanisms that turn the locomotive wheels. Electric locomotives work as much as diesel-electric do, instead of producing their own electric power they get it from wires suspended above the tract or from an electrified third rail.

Two other kinds of locomotives are used to power some few trains - Gas turbine electric locomotives which use the force of hot gases to run turbines which in turn operate electric generators. Like in diesel-electric locomotives, the electric power produced by the generators run the trains. Diesel - Hydraulic locomotives use diesel engines to produce energy that is transmitted by the driving mechanism by means of fluids under pressure.

Steam locomotives were in popular use in the 1940s up till three decades after, when diesel locomotives were introduced. Since then, there has been a gradual displacement of diesel locomotives by electric locomotives and in some countries by full electrification.

Choice of Motive Power

Despite the fact that full electrification is the most recent in modern development of motive power, there are several other factors used for determing the choice of motive power depending on the country. They are:

- Thermal efficiency
- Characteristics of the railroad plant in any given nation

- Nature of service offered and effects on the national economic policy.

Consequently, countries with abundant hydro-electric resources like Switzerland, Norway and the former Soviet Union - were the first to move toward full electrification Countries that relied on overseas resources of oil like Britain, France, West Germany and Japan were often reluctant to dieselise Countries with ample local resources and absence of domestic oil continued to operate and build steam locomotives for example India and Rhodesia. .

In Nigeria, though both oil and hydro-electric resources are available, recommending full electrification is appropriate for the fact that incessant oil shortage in recent times poses serious threat for the future of oil dependant industries.

Carriages and Wagons

Railways carriages are passenger cars, while the wagons are freight cars Each has a coupler at each end. This device links the cars together.
Improvement on carriages or passenger cars include:

- Relative safety measures which are designed to resist crushing and heavy impact in collision and derailment.

- Increased passenger capacity through double deck cars and seating arrangement.

Cars propelled by four traction electric motors (each having a rating of 150-300 hp) and individual cars of the multiple unit luxury trains weighing 50-90 tons. In this type of trains an operator can produce the same effect in any number of coupled cars.

The new generation trains sets features many major improvements not only in design, but also in terms of engineering, achieved through the combination of latest technology and world wide operational experience.

Streamline design conceived by train design experts improve aerodynamics, re-designed interior and outstanding fittings, new diving cab and overall optimisation of space and functionality have been realised. Also service areas, business areas facilitates for the disabled, pressure tightness and sound insulation have improved comfort standards. See Fig 2 & 3.

In train engineering, innovative body to bogie connection tilting system and tilt actuators entirely under frame, electronic tilting control with master slave architecture and active lateral suspension system have been devised.

In terms of flexibility, aluminium extrusion technology allows different height and widths, different traction equipments, including multi-voltage ones.

Train 2000, that is tomorrow passenger train must be quieter, faster and cheaper to build and run than their predecessors. Design engineers and striving to develop rolling stock for the next century, but the above requirement is tempered by demands for greater comfort, lower noise levels and less environmental intrusion. Reconciling these demands ranks among the biggest challenges facing rolling stock engineers.

Freight Cars: These differ in shape and size according to the type of freight they are designed to haul. Freight cars are hauled by locomotives. They range from box cars for carrying general freight, to specially designed cars for shipping new automobiles. See Fig. 4.

Basic type include, box car, refrigerator car, flat car, hopper car, (self

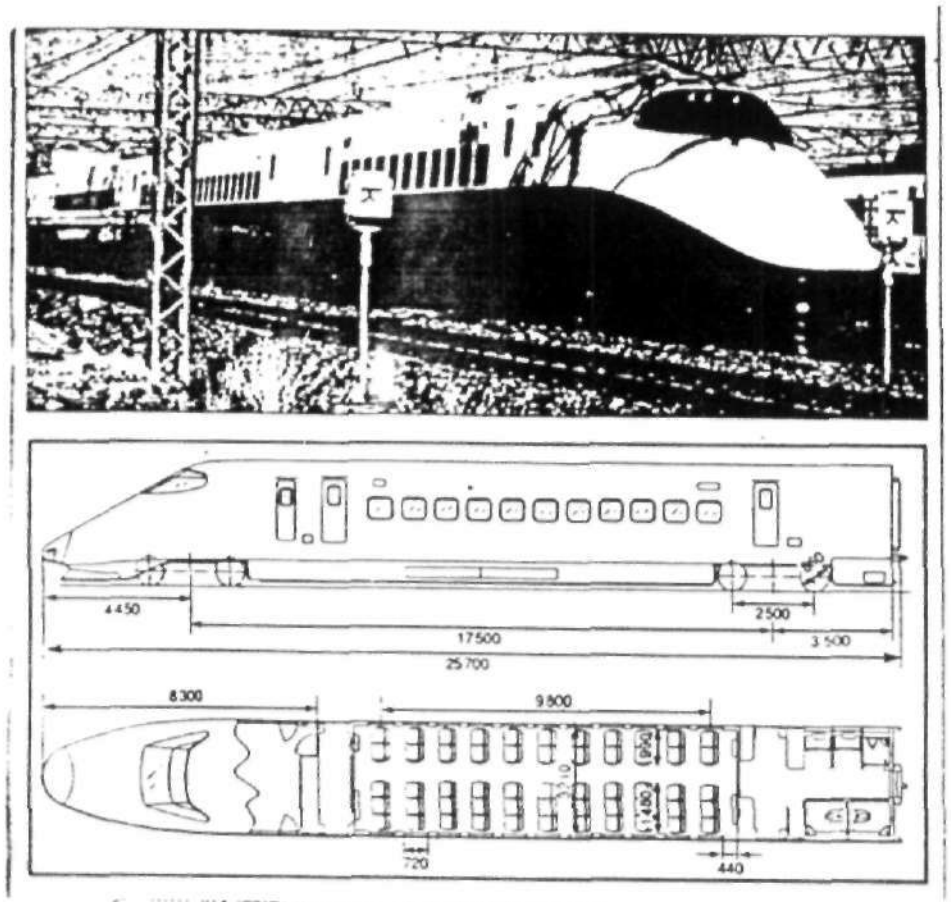


Fig 2 - Streamline designed train set.

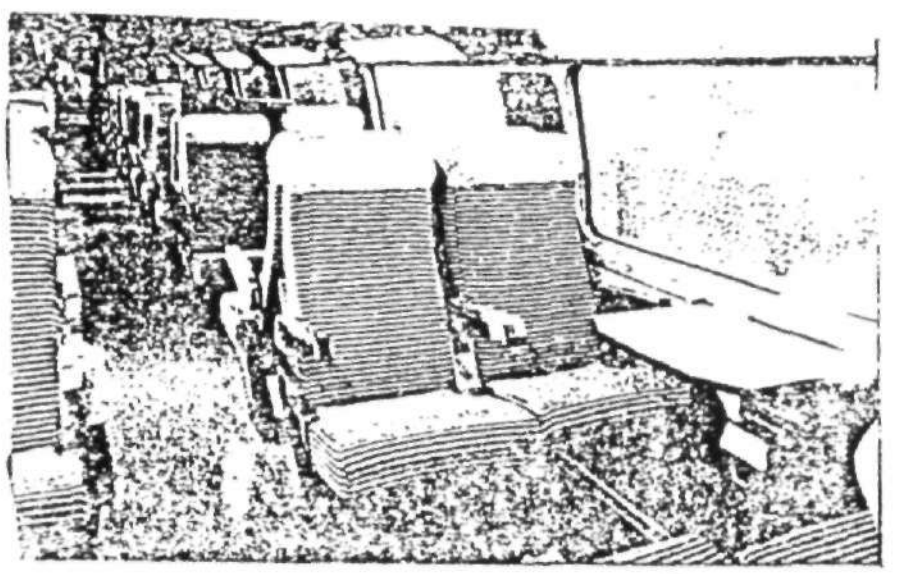
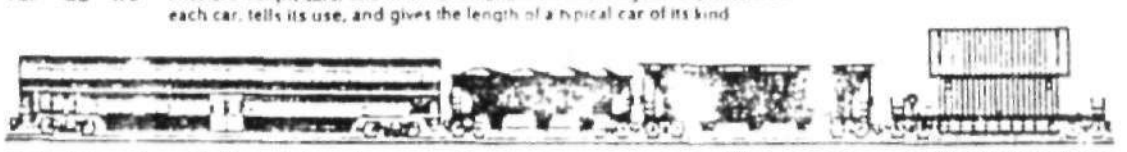


Fig 3 - Redesigned Interiors with outstanding comfortable fittings

Kinds of rail·road·ers These drawings show some special cars used on trains. All except the Superliner are freight cars. The information under the drawings briefly describes each car, tells its use, and gives the length of a typical car of its kind.

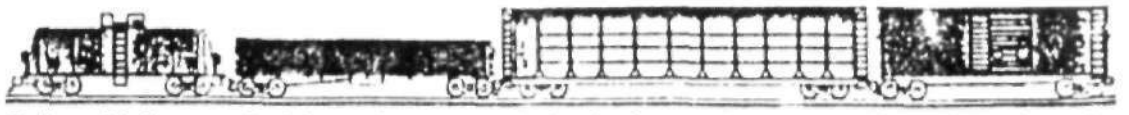


Amtrak Superliner: Double deck, long distance coach carries 75 passengers on two levels; baggage stored on lower level; 85 feet (26 meters) long.

Open-top hopper car: Hauls such bulk freight as coal; 44 feet (13 meters) long.

Covered hopper car: Protects bulk freight from the weather; 54 feet (16.5 meters) long.

Double-stack container car: Hauls general freight in stacked containers; 51 feet (16 meters) long.

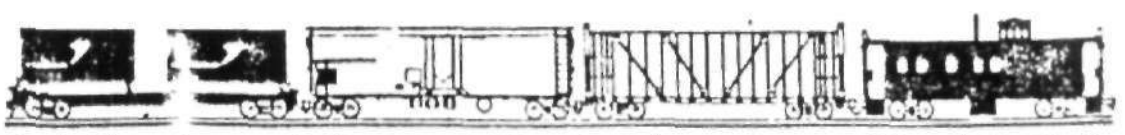


Tank car: Cylinder-shaped car; carries oil and other liquids; 50 feet (15 meters) long.

Gondola car: Open-top or covered car; hauls metal products and bulk freight; 52½ feet (16 meters) long.

Enclosed rack car: May have two or three enclosed decks for transporting vehicles safely; holds up to 18 automobiles; 90 feet (27 meters) long.

Boxcar: Enclosed car with sliding doors in the sides carries general freight; 44 feet (13 meters) long.



Piggyback flatcar: Common flatcar with devices to hold two truck trailers or containers in place; 92 feet (28 meters) long.

Refrigerator car: Cooled enclosed car; hauls fresh and frozen fruits, vegetables, and meats; 60 feet (18 meters) long.

Center-beam car: Has open sides for carrying lumber and other large loads; 73 feet (22 meters) long.

Caboose: Last car on train; serves as conductor's office and as living quarters for train crew; length varies.

Fig A – Railway Wagons / Cars

unloading) gondola car (flat bottom)and tank car. Many newer freight cars are similar to older types except that they are longer and have been designed to carry different kinds of freight. Piggy back cars, for example are common flat cars specially equipped to hold truck trailers or containers. Other flat cars are fitted with two or three level tracks for hauling new automobiles. These cars have been designed to reduce packaging inconveniences and expenses

2.4.2 Tacks and Traction

Higher speed and load of modern rail travel require better track and structure. Maintenance of permanent way become particularly critical when trains operate at very high speed (over 100 kph)

Traditional track construction consists of 11.85m (39ft) rails bolted together and spiked to crossties (sleepers), which are bedded in a layer of rock ballast that serves as a resilient base for the track structure and provide drainage.

Modern approach to track design features German Railway, In their search for low maintenance high-quality track for its high speed lines has installed test sections of ballatless tracks using six different super structure techniques. Initial result suggest that
solid track structure will meet the key goals, but long term service trials are needed to confirm the life cycle performance.

Tests on ballastless track are being conducted in areas like - loading and deformation, Geotechnical substructure and load bearing layers, noise reduction measures are also being studied energetically.

The most significant advancement in track technology so far in the 20th century has been the elimination of joints through the use of welded rail.

Traction: Is the power used in hauling trains along the track. In modern development,
electric traction is used. Electric locomotives use this system and do not need to carry their own fuel. They derive power from plants through catenaries or contact line. They require constant and efficient electric current grid. They are relatively neat, and best suitable for large traffic even though high initial cost is involved in eletricfication.

The working principle of electric traction is basically thus: current is taken from
contact wire. The A/c (alternating current)/ is routed via a transformer in the engine and drives the motors at the wheels or axles directly. An immediate control system ensures that current can always be supplied according to power required at any given time.

2.4.3 Signalling and Communication Systems

Railways use signals and other communication systems to control traffic. The chief purpose of traffic control is to prevent accidents. But it also helps make railway operations speedier and more efficient.

Most railway signals consists of coloured lights alongside or over the tracks. Each colour has a different meaning for example red means stop and green means proceed. At places along the track, semaphore signals are used instead of lights. A semaphore is a movable arm on top of all post. Each position of the arm gives a signal that corresponds to a coloured-light signals.

Most railways have adopted some form of block signal system. There are two types of this system. i). The Manual block signal and ii) The Automatic block signals

system. The later allows trains to follow one another safely on the same track, the track is divided into blocks about 1.6 to 3.2 kilometres long. An electric current flows through the rails and is short circuited when a train is in a block. The short circuit causes the signal for that block to turn red and the preceding block signal to turn yellow. Other signals show green. A train may proceed through a green signal but must slow down at a yellow signal and stop at a red one.

One of the most advanced signal systems is called 'Central Traffic Control' (CTC). CTC makes use of automatic block signals. CTC makes it possible for railroads to eliminate most multiple track and use single tracks instead. If two trains are headed toward one another on the same track, CTC operator switches on one of the trains to a sliding until the other passes.

Apart from the two systems mentioned above, there are other train controls such as signals providing same information on panels in the locomotives as the one indicated by signal lights alongside of the tracks. The signals may also work in connection with certain safety devices. One of such device is the Automatic Train Stop (ATS). The ATS puts on a train's brake automatically if the engineer fails to notice a stop signal. Another safety device, called Automatic Train Control (ATC), automatically controls train's speed. If engineers fails to notice a caution signal, the ATC puts on the brakes to slow the train to the required speed. The device also stops the train if necessary.

Advanced communication systems are now being used by many railways of today to help control the movement of trains along the track, two way radio systems are used to allow train crews to communicate from one end of the train to the other. More powerful two way radio systems are used to allow train crews to communicate with distant train yards and stations. Some railways have experimented with advanced

train control systems. The systems use satellites or track based transponders (electronic transmitting devices) or both to track the exact location of train.

2.4.4. Maintenance

Regular Maintenance of Rolling stock and track is essential to their over all life span and efficiency or performance. Modern workshop equipment are now available to ease the work of reprofiling, car/bogie washing, internal car dust removal and so on. Equipment are also available for lifting cars or engine for servicing.

Modern techniques have also been introduced in track upgrading programmes. Carriage and wagon refurbishing is also being embarked upon by many railways around the world, this helps to cut down investment on purchase of new rolling stock.

2.4.5 Management Techniques

Most railways in developing countries like Nigeria have simple traffic pattern, traditional operating procedures and low traffic density. However, they often operate in difficult circumstances. This of course is a typical reflection of the financial and economic situation, the physical environment, the poor state of rolling stock and inadequate human resources. They also face severe competition from road transport and need to improve dramatically the management of their operations and service to customers.

An efficient operations management computer system is one of the obvious modern means of addressing these problems and probably one of the most cost-effective, as many feasibility studies have shown. Computer based management information systems have long been recognised as essential for the efficient operation of the railways, especially in freight movement where there is need to track

consignment as well as matching wagons and other resources to demand for the movement of specific commodities.

Rail tracker has been developed by UNCTAD (United Nations Conference on Trade Development) as a standard 'entry-level' railway operation monitoring system to support the ACIS (Advanced Cargos Information System) programme. It targets small and medium-sized railways wanting to introduce computers into their daily operation or replace main frame computer systems coming to the end of their life.

Rail tracker can provide detailed status report to managers so that they can monitor performances, all basic functions of wagon control, rolling stock management, freight monitoring and collection of statistics are catered for in a way that is well adapted to the current needs of most developing countries' railways.

2.4.6 Station Building

The station building like any other building in the history of architecture has been celebrated through the ages and had made remarkable impact on urban structure as well. A deliberate attempt to give the railway station an expression in the new modernism era to which we now belong, as given interpretation by Kenneth Powell that is to say that even station building are not left out of the improvements and modernisation schemes of the railways.

CHAPTER THREE

NEED FOR TRANSPORTATION IN GENERAL

Movement from one point to another has been and will continue to be an essential aspect of human existence Activities of production and communication will be totally grounded without efficient mobility Transportation therefore means conveying or carrying of goods or persons from one place to another fover a distance (which could be short or very long) for various purposes which are either social or economical.

3.1 Causes and Classification of Transportation

Day to day activities which require some sort of transportation fall into two main categories: Social or Economical. The social factor embodies transportation to places of entertainment, festivals (religious or cultural) recreation, sport, leisure, tourism, wedding engagements, parties, visitations and errands. others include educational, medical, political, religious rallies and conference The economic factor on the other hand are related to business and commercial engagements, industrial and construction works.

Since the main factor generating need for transportation are social an economical activities, the direction of traffic tends towards major towns and cities these activities are concentrated.

It is certain, therefore that one of such cities would be the capital city, next likely are the state capitals and sometimes local government headquarters and some commercial centres with the advantage of location.

Therefore the national traffic in Nigeria is observed to be from one state capital to another, or between important cities or town centres. On the other hand the international traffic concentrates on the border towns (along the frontiers) of the country.

Transportation range can be classified generally as within the 'city', from 'city to city' or 'from country to country'. When transport destination falls within the country, it is known as internal movement, while it is known as external movement when it involves going outside the country. Transport movements are classified as interward or metropolitan, intercity or local, interstate or national and inter-frontier or international.

3.2 Modes of Transportation

The basic concept of utilising a means for transportation which started simply with the use of four footed Beasts, has been largely improved upon over the years. The factors that motivated these improvements include time, comfort, protection from weather, and national barriers to movement. It is sufficiently clear that one mode of transportation cannot cater for all these factors. As a result, the various modes of transportation as we have them today are designed to meet peculiar needs.

Iloeje (1965) considers transportation as consisting of five modes. They are, 'Human porterage' and transport by Animals, Water Navigation, Rail Tranport, Road Transport and Air Transport. These modes of transport come in varied forms, shapes and sizes.

3.2.1 Human Porterage and Transport by Animals

This is by all means the safest, cheapest but the slowest means of transportation that ever existed. The most ancient, dates back to the beginning of human existence itself. This mode employs direct human effort given by the natural ability to move from one place to another with or without a burden.

Human porterage is still effectively used where short distances are involved, particularly in localities where there is poverty and little or no civilisation.

Animal transportation is still being used in localities where 'beasts of burden' are readily available. The most common are Donkeys and Camels, the later has been used for long distances across the Sahara, while the Donkey is used for transporting agricultural products, building sands, firewood and disabled leper, especially in the northern part of the country.

This is another relatively cheap means - no maintenance is involved except feeding the animals, but a lot of human energy is expended in the course of travel, And, of course there is a limit to which this means can go in terms of distance and crossing of barriers like deep water.

3.2.2 Water Navigation

Before civilisation reached the stage were by bridges were constructed across streams and rivers or ever before planes were invented, the only means by which certain settlement could be reached was through water ways. By this means also, countries along the coastline interacted easily and later on, moving across continents was made possible through large ocean liners.

This mode of transportation has existed for long. It ranges from small short distance sailing ships. Navigation is also used for agricultural purposes and fishing. Ferries, boats and rickets are used for inland water navigation along major rivers and creeks while ocean navigation mainly covers international journeys. About 40 shipping lines operate passenger, mail, export and import cargo services in Nigeria using the ports of Lagos and Port-Harcourt

The river Niger in Nigeria is navigable at high water seasons by shallow draft boats as far as Baro.

3.2.3 Rail Transport

The railways have no match anywhere in the would when it comes to shipping to bulk loads over long distances. With the present advancement in the railway it is clearly the fastest land transport and safest means so far It is relatively cheap among modern modes of transportation. It also offers passenger service or mass transit service across major routes that large numbers of people travel daily.

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In Nigeria, the rail lines cover more than 3440 kilometres (2140 miles), making use of express trains, local trains, goods train and municipal train available only at Port Harcourt and Lagos presently.

Transportation by rail is achieved by the used of rail cars coupled together and hauled over rail lines by diesel powered locomotives or by electric traction.

3.2.4 Road Transport

This is the most readily mode of transportation for goods and passenger service and has the highest number of private ownership and investment world wide.

Apart from providing comfort and convenience for individual owners, it has also continues to monopolise the advantage of doors to door service, and factory to factory service; which the railways cannot hope to offer.

It is ideal for connecting small communities with large ones, for short distance travels, for transporting small mixed loads to be delivered at various points.

Roads are easier to construct and maintain and even small communities embark on road construction to open up links for transaction with other airlines. This is about the most efficient and reliable means of transportation at the moment. The International Airport in Lagos has been built to acceptable international standards.

3.2.6 Percentage Distribution of Total Traffic

This distribution includes only modern modes of transportation. The highest percentage goes to road transportation, followed by rail, water navigation and lastly air transport. The table below shows this distribution in percentage of previous volumes and future projected volumes. Note that, current data of the railway will be unrealistic since it is not performing at its best, the whole system is almost grounded at the moment. Hence the 1987 figures serves better as reference to base a future projection.

Table 1 **Percentage Distribution of Total Traffic**

Modes of Transportation	Road	Rail	Water	Air
1987 Volume	65%	30%	4.80%	0.20%
Future Projected Volume	50%	42%	6.00%	2.00%

These rates show that road transport in Nigeria will be on the decrease in the near future, while the other modes, particularly rail transport will be on the increase.

This, of course is subject to consistency in providing regular and efficient service.

3.3 Socio-Economic Importance of Transportation

A transport intra-structure is by all means a pre-requisite to economic development, but is no necessarily a guarantee. The intensive efforts of many developing countries to expand agricultural out-put, for example require timely availability of seeds, fertilizer and other Agro-Allied materials, and farmers should have reasonable access to their markets. Increased industrial out-put also requires the efficient transport of raw materials for example, as well as the distribution of finished products. These requires adequate post facilities and land transport connections to them - particurlarly rail connections. The cost of imports are increased if ship are delayed unduely in the ports.

In the early stages of economic development it is usual to find that traffic growth in two or three times as large as the rise in National income, and since the ratio of capital to output is high, investments in transportation often account for as much as 15 to 30 percent of public investment.

Because of the strategic role of transportation, the large investments required, and heavy foreign exchange frequently involved, it is necessary to make a careful economic appraisal of these investments. Specialised agencies, government or private are usually involved in this kind of project appraisal. It must be realised that failure to do this may cause a government to embark on huge road projects where, of course railway investments would serve more economically and provide more adequately for social needs.

The success of a railway system in contemporary times cannot always be measured in terms of a net operating profit or the absence of it. This is because railways have come increasingly to be viewed as instruments of national economic policy and their services are often deliberately provided on below cost terms. In Mexico for instance, Minerals and other raw materials are hauled at rates that range from 35% to 50% below the cost of services, similarly passenger services are operated at below cost fares as social service. The U.S and the Soviet Union are two of the few countries operating at a profit. A number of factors enter the profitability picture to a greater or lesser degree according to local conditions. These include Government regulations and control, labour cost, taxes and competition from other modes of transportation.

CHAPTER FOUR

PROSPECTS OF RAIL TRANSPORT IN NIGERIA

4.1 How Railways serve the public

Railway is one of the most important means of transportation. Thousands of trains cruise along railway tracks daily throughout the world. There are passenger trains while others are freight trains that haul coal, grains, timber, machineries and other products that people depend on. What makes the railway unique is that only ships carry heavier cargoes for longer distances, and only air planes provide faster means of public transportation. A freight train can haul thousands of tons to goods across a continent. In freight hauled, leading countries are the Soviet Union, the United States and Canada. Altogether the railways of the world transport more than 3.5 trillion ton miles of freight per year (a ton-mile is one ton hauled one mile).

The very fast passenger trains in regular service travel at speeds up to 275 km per hour (kph) or 170 miles per hour (mph). These trains have reached up to 370 kph (230 mph) during test runs. In passenger service the leading countries are Japan, the Soviet Union and India. Altogether the world's railways provide more than 700 billion passenger miles of service annually. (A passenger mile is one passenger carried one mile source: world book encyclopaedia vol. 16

There is at least one railway in almost every country in the world. The longest line in the world is in the Soviet Union. It covers a distance of about 9,010 kilometres (5,600 miles) and connects Moscow and Vladivostok, other leading countries in total kilometres of main routes are United State, Canada, India and Australia. The tracks of the world's railway route laid end to end (i.e total world trackage) will stretch about

1,207,000 kilometres (750,000 miles), about $3^{1/4}$ times the distance from the earth to the moon.

Railway - consists of two parallel heavy steel rails fastened to wooden crossties (sleepers) that commonly rest on beds of crushed rock (ballasts), the two railed track, guide trains of cars along a permanent way. Unlike airplanes and ships, trains are not steered, but rather powerful diesel electric or electric locomotives move most trains along the track. In some parts of the world steam locomotives earlier invented are still used in hauling trains.

The word "railway" also embraces the fleet of flanged-wheel locomotives, freight cars, and passenger cars that ride over the rails as well as the vast supporting complex of signalling and communications facilities, terminals, yards, repair shops and other fixed installations. In a broader sense still, railways are the privately owned or state owned companies that provide transportation over the rail.

As mentioned earlier in the introductory chapter, the first public railways began in England in the 1820s and 1830s, and since then railways have provided two main types of service:

1. Passenger service and
2. Freight operations

The importance of each type varries from country to country

4.1.1 Passenger Service

Railways operate two types of passenger trains, commuter trains and inter-city trains. Commuter trains carry passengers between large cities and surrounding

suburbs. These types of trains are usually equipped only with comfortable seats inside coaches, with no additional services, such as meals.

In Nigeria commuter trains are not available yet, the closet is the municipal train serving Lagos and Port-Harcourt metropolis. Where as in countries like U.S.A, U.S.S.R, Japan, France, commuter trains carry hundreds of thousand of sub-urban residents to and form large cities.

One commuter train can carry the number of people it takes as many as 1,000 automobiles to carry. Hence they help relieve rush hour traffic jam in city expressways. Some advantages derived from using commuter trains are; they help to conserve fuel and also help to reduce pollution caused by exhaust fumes.

On the other hand, inter-city trains usually move from city to city at very high speeds, some travel at the average speed of 160 kph (100 mph). Most Japanese trains travel at this speed. The faster trains in the world operate in France. See fig. 5. These trains can travel faster than 370 kph (230 mph).

High speed trains also serve cities in Great Britain and other European countries. Many of these trains offer a number of luxury services, including beauty and barber shops, gift shops, telephones and meals served at passenger seats.

In Nigeria inter-city passenger service has been in operation since 1901, the NRC lines cut across 20 states of the 30 which now exist. The speed of these trains were designed ridiculously slow. They move at a speed limit of 65 kph, even though these trains were designed for the average speed of 110 kph. The imposed speed limit became necessary because of the many dangerous curves and steepy grades of the NRC lines. These trains do not run to schedule either, due to inefficiency in control

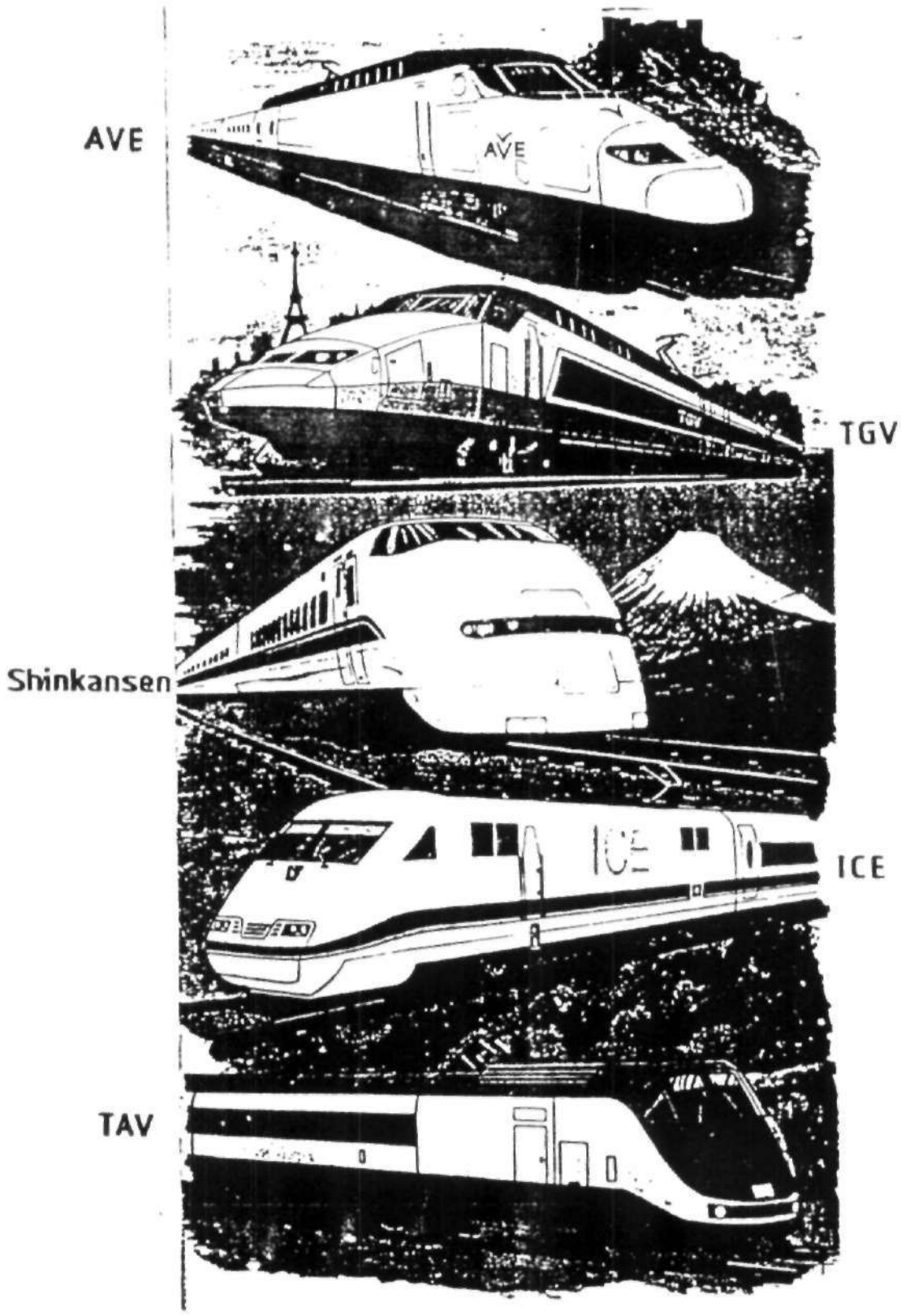


Fig 5 – THE WORLDS FASTEST TRAINS

systems and breaking down of rail vehicles. These are the other reasons why most people prefer to travel by other means in Nigeria.

4.1.2 Freight Operations

The bulk of the money realised from train operation come from freight services. This is true mainly of countries where inter-city passenger services perform less because other means are preferred. For example, in the U.S country side, as many as 10,000 freight trains roar across daily; loaded with everything from coal and iron ore to television sets and new automobiles. They handle almost 75 percent of all freight carried between U.S cities. The longest of these freight trains have up to 200 cars or more. The average freight train has about 70 cars and can carry about 2,300 metric tons (2,500 short tons) of goods. Some of the cars on freight train are empty cars being transported to locations where they will be re-loaded.

All over the world, more and more countries now depend on railway for transporting mails and bulk freight, but the reverse is the case in Nigeria. The reason is that the NRC is seriously 'crippled' and at the moment are only running skeletal services. Freight cars are in a state of dis-repair or completely grounded; diesel locomotives are performing below capacity due to old age and lack of proper maintenance such that they cannot possibly meet the demand for freight service. The popular alternative in Nigeria today are the 'roadway' trailers and trucks which travel at very slow speeds and on many occasions never get to their desired destination, because of road traffic accidents.

Here in lies the challenge - we must go back to the railway!

4.1.3. Services of the Nigerian Railways (N.R)

Despite problems faced by Nigerian Railways at the moment, it must still be recognised as the nations one time most important inter city freight carrier. And, due to the many inter relationships between transport and production, it is obvious that rail transport importance extends deep into the nations economic system. Over the past eight decades, NR played this major role amongst other inclined towards cultural and political development.

The Nigerian Railways founded and developed sources of supply for consumer goods and new markets for producers of all types of goods and services. It activated agricultural production and served as a means for evacuating the products, and mineral resources from interland to the coast for exportation. The railways opened up new towns and fostered the development of commerce and industries. It has been responsible for the transportation of industrial and technical equipments for construction and materials as well. It served as a means for supply of raw materials to industries as well as for distribution of finished products to various depots. It was at a time the main venue for transporting petroleum products from refineries. The N R was also heavily patronised in the past by large companies like Peugeot plant at Kaduna, for conveying parts and cars to various destinations. Ashaka cement company at Gombe, Assembly plant on Ojo road near Lagos, Fertiliser company in Kaduna and so on. Somewhere along the line shippers started shifting to road trucks and trailers see table 2

Railways in Nigeria have also contributed to social interaction between various groups, they link up important cities with each other and facilitate the movement of people and goods between them. It also provided mass transportation of passengers from one corner of the country to another. Occasionally it had conveyed groups of people for religious trips, sports and culture festivals on special arrangement. They

were also used for mass movement of military troops and supplies in times of emergency.

Trains passenger growth was observed then to be 13% annually when operations were regular between 1961 -1972, see table 2

Table 2Statement of Passengers and goods transported between 1961 and 1972 in Nigeria

	PASSENGERS	TRAFFIC	GOODS	TRAFFIC
PERIOD	NO. OF PASS. CARRIED ('000)	PASS. MILE ('000)	TONNAGE HAULED ('000)	NET TON MILE ('000)
1961	9822	433606	2722	116110
1962	11061	481755	3003	1412165
1968	12006	515905	2760	1410950
1964	11288	326213	2960	1554993
1965	10630	830830	2834	1221025
1966	11621	533637	2884	1215058
1967	10051	330568	2841	1004000
1968	6916	866539	1863	986000
1969	8007	364094	1614	1094000
1970	8369	152612	1523	950147
1971	9942	611282	1804	981795
1972	12102	501592	945	1482914

Source: 1973 - 74 Annual report of NRC

Table 3: Statement of Passenger Volume at principal stations for the year 1968.

PERIOD	PASSENGERS NO. OF PASS. CARRIED ('000)	TRAFFIC PASS. MILE ('000)	GOODS TONNAGE HAULED ('000)	TRAFFIC NET TON MILE ('000)
1961	9822	433606	2722	118110
1962	11061	481755	3003	1412165
1968	12006	515905	2760	1410950
1964	11288	326213	2960	1554993
1965	10630	830830	2834	1221025
1966	11621	533637	2884	1215058
1967	10051	330568	2641	1004000
1968	6916	866539	1863	986000
1969	8007	364094	1614	1094000
1970	8369	152612	1523	950147
1971	9942	611282	1804	981795
1972	12102	501592	945	1482914

Source: 1968 NRC Annual report

* Civil war was on and data was not recorded.

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The cumulative effect expected was that rail traffic potential will be very high for the future even though this is not the case today.

4.2 Causes of Instability in the Nigerian Railway

4.2.1 Existing Situation

The existing facilities in the Nigerian Railway stations are far too inadequate; trains, locomotives and equipments are outdated and in poor conditions, ticketing is done in the crudest form possible and security checks and train control systems lack efficiency. Multi-exit situation in most stations encourage trespassing, hawking, begging and similar undesirable activities within and around station premises.

Other major problems facing the NRC today include:

* De-railment, usually caused by unsatisfactory track conditions defective wagon wheels, worn out flange and human errors.

* Narrow gauge 1.064m ($3^{1/2}$ ft); sharp curves and gradients that keep speeds as low as 32 kph - 48 kph (25-30 mph)

* Inefficient signalling and communication system

* Inadequate locomotives and rolling stock

These problems further gave rise to long delays in the delivery of freight and other mail services, passenger trains not running on schedule overcrowding conditions, creating fowl environments inside the few trains available, and dirty shabby, uninviting station environments.

The overall effect is that nothing works to plan-passengers lose confidence in the system - patronage drops - and the whole system gradually degenerates to shambles as we have it today.

4.2.2 Root causes of Railway problems

Having drawn out a brief outline of the existing situation of the Nigerian Railway as above, it is necessary to identify the root causes of the problems which led to them. The causes are both external and internal to the system. The major external factors include: trends in inter-model competition, especially the relative competitive vigour of the trucking industry, and unbalanced Federal Government Investment polices. The main internal factors include: Capital and operating difficulties, inflexibility to necessary change by both management and Labour, and lack of

technological, marketing and pricing innovations. These points are expanciated below:-

Trends in Intermodel Competition: As intermodel competition developed, the railway freight and passenger markets suffered, particularly because of the growth of the intercity trucking industry and the increase bulk commodities transported primarily by pipe line, especially oil, all these took their toll on the railway. Table 2 shows this gradual decrease in tonnage hauled between 1967 to 1972 and from 1972 till date freight operations have amounted to almost nothing.

Unbalanced Federal Policies: Over the past two decades, major federal transportation policies have been unbalanced in favour of the competing modes. Its negative impact on the railways have been serious. Federal funds have helped build the interstate Highway system, and helped finance construction of airports (many of which are not functioning to capacity), where as the national rail network of the colonial days planned mainly to service agriculture, forestry and particularly mining cities, linked up with channels for export have since remained un-improved. This, of course placed restriction on passenger services which are run on these same lines such that bulk of passenger traffic are carried on roads.

Capital and Operating Difficulties. The Nations rail system faces the problem of raising money to operate efficiently.

Capital: Because of poor earnings, poor prospects, high debt ratio, the N.R face a limited and high-cost capital market. The lack of capital has impeded modernisation of plant and equipment.

Management:- Unlike management in other major industries, rail management in Nigeria has been relatively inflexible to change and innovation, this of course has been

largely affected by government regulatory restriction and the non-existence of a private competitive railway sector.

Labour Operating procedures in terms of labour management has been modified to meet changing market need. Since labour cost represent more than one-half of the industry's total expenses, a flexible, long term relationship must be maintained to ensure the future viability of the industry.

Rail Networks: Most freight shipments require inter connections with major industries, virtually all rail networks and branch lines were in place in early part of the century, this situation renders the rail system trackage uneconomic. Interconnecting terminals are generally out dated and inefficient and they have been relocated with shifts in demand centres. Innovations such as intermodal piggy back, rail track and containerised system to serve branch line areas are not available.

4.3 Potential Rail Traffic Projection

There are various factors that affect the demand for rail transport for passenger, they are, quality of service together with fares and cost comparism. Mayer, kain et al (1965) proposed four other considerations which might influence the travellers choice of mode; they are, overall trip speed, convenience, availability and frequency of service, waiting time, comfort and privacy. All these aspects on consideration for choice differ for individuals depending on trip purpose. Of all these cost in the most significant.

4.3.1 Factors Influencing Demand for Public Passenger Transport include:

- Growth and shifts in population
- Improvement in standard of education

- Changes in standard of living
- Degree of industrialisation or stage of economic development (community trading pattern)
- Availability of private means of travelling

Others includes.

Social factors such as family sizes, religious practices and sporting activities. Another factor that is likely to increase demand for passenger trains in the future are railway journeys for leisure. The future generation of Nigerians are likely to engage more in leisure activities because of the influence of western civilisation and culture.

Railway travel as practised in Britain epitomised by the excursion train at cheap fares was in itself a new form of leisure activity, providing opportunities to sample the pleasures of the cities, to spend a day at the sea side or in the country, or to attend variety of sporting and social events.

A Nigerian Railway advert states thus:

"It is cheap, safe, pleasurable and comfortable to travel by train. Remember you haven't seen Nigeria if you haven't travelled by train."

One approach to solving the growing problem of the leisure of masses, particularly youth on holiday, industrial workers who somewhat spend their free time idling or engaging in traditional pursuit, vice or potentially riotous gatherings is the railway excursion, which seem to offer an important counter attraction. These excursions have many advantages of social benefits, some of which are greatly conducive to health.

4.3.2 Rail Traffic Volume Forecast

A forecast of demand for railway freight and passenger transport for 1970-1990 was made after a detailed study by CANAL, a team of Canadian Consultants. The forecast was done for both conservatives and optimistic conditions See table 4. Total demand was determined by a number of variables such as economic, social, political and technological factors.

Table 4: Future potential of railway traffic quantified in passenger miles

	MODERATE		OPTIMISTIC	
Year	Passenger Miles (millions)	% Increase (5 years)	Passenger Miles (millions)	% Increase (5 years)
1970	453		453	
1975	655	45	733	52
1980	625	42	1115	52
1985	1318	42	1592	52
1990	1525	45	2526	49

Assumption: It is assumed that efficient operation, adequate capacity of relationship between rail and bus fares remain approximately same as at the time of this forecasting.

Pre-requisites to making forecast of the future railway traffic a reality includes:

i. Terminals equipped with modern facilities
ii. Electrification of express lines to achieve high speed.
iii. The use of modern safety installation and telecommunications systems and the use of radio for shunting purposes at big depots, and the installation of

telephone system giving a direct link with each operating post to check the regularity of trains

4.4 Strategies for Reviving and Sustaining the Nigerian Railway System

The Ministry of Transportation in conjunction with the NRC has made a comprehensive programme which should assume Nigeria of future viable natural rail system capable of meeting the commerce and energy needs of the country.

4.4.1 N R C Programme of Action

Programmes of the Nigerian Railway Corporation in the 1990s as published in the April, 1990 hand book on NRC, will aim at

i. Revitalisation, modernisation and development of Railway facilities and infrastructure.
ii. More efficient, effective, commercial and business like Railway which will offer improved services to its customers, giving value for money.
iii. Self-sustaining railway with new marketing strategy to enhance revenue earnings.
iv. Re-organising and re-structuring the N R C by introducing business orientation into the managerial.

4.4.2 Mass Transit Programme

The whole idea of mass transit is the baby of the past military administration.
The following objectives were highlighted:

a. Reduction of hardship suffered by commuters and improvement on traffic flow;

b. Improvement and modernisation of the urban transit services and

c. Laying the foundation of developing a comprehensive and integrated mass transit system in Nigeria.

Contrary to the understanding of many Nigerians that mass transit only embraces road transportation, government no doubt is also addressing the rail and water transportation system. Over concentration on road development led to the neglect of rail development which is the most essential means of mass-transit world-wide.

4.4.3 Other Proposals of the NRC for Improvement

Since the construction of the 2,680 track miles, no additional line has been added to the main line network, and even the tracks themselves have not been improved upon. Remodelling of stations were last done in 1969. However, plans are under way to standardise all technical aspects of the NRC. These plans include:

- Adopting standard size gauge of 1.435m (4ft 8")
- Laying dual carriage way between certain sections.
- Replacement of light rails with heavier ones
- Improvement on grades by bringing them to 1% maximum.
- Elimination of curves and provision of tunnels through hilly landscapes that obstruct straight routes.
- Construction of new tracks, from Port-Harcourt to Makurdi through Akwa-Ibom state, form Makurdi to the steel industry of Aladja, from Kaduna to the Federal Capital Territory- Abuja, etc.
- Improvement on depot stations

- Improvement on signalling and communication through the entire system - in short these means a total overhauling of the absolute rail network and infra-structure of the N.R.C.

These proposals are essential requirements for a modern and efficient railway system Nevertheless, one way for the NRC to achieve its goals in maximising its economic and operational capacity is by diversification of its activities as practised in other railways in the world. They may not be seriously profit oriented but should serve as a bait for attracting passengers.

CHAPTER FIVE

RAILWAY STATION INSTALLATION

5.1 Historic Development of Railway Station Architecture

Railway Station Architecture started to be recognised in the western world since 1800 AD. Mainly in Europe and America continuous effort was made in solving new problems functionally and architecturally in all essential respects before the end of 19th century. These developments of the railway station could be viewed from three perspectives, as:- Architecture (serving new functions), Engineering (construction of huge roofs in new materials), and work of Art (expressing taste).

Meeks, 1956, used three methods to demonstrate the trend in development, a definition of the new aesthetics- the picturesque, an appraisal and demonstration of the creative and positive side to the then current concept of eclecticism, and a definition of style according to three phases, which for the 19th century may be called early, middle and late picturesque eclecticism. The first phase ended about 1860, the second about 1890, and the last about 1914. Each of these methods was distinct from the other, though they tend to reinforce each other. Then of course the twentieth century style from 1914-1956, post world war era with its significant phenomenon of the emergencies of wholly new, non electric style called "functionalism" or "International style" or merely "modern architecture". The late 20th century style tends to be more volatile in its approach. One major feature is the taste for transparency. These various eras and their taste styles are discussed briefly below.

5.1.1 The Picturesque Aesthetic

Christopher Hussey in his pioneering work to find a unifying factor in the 19th century architecture made an observation, he held that the picturesque was not in itself a style but rather a method of combining and using styles.

The first picturesque quality is 'variety'-typified by an obvious striving for varied silhouette, the grandeur, richness and variety of the summit these were most commonly displayed in chimneys towers and gables sprouting from elaborate roofs of palaces and prisons.

The second picturesque quality, 'Movement' corresponds in a general way to Wolfflin's "plane and recession". Robert Adam says, movement is concerned with 'the rising and falling, advancing and receding, with convexity and concavity, and other forms of great parts'. The new central station in Detroit of 1883 shows in detail how the effect of movement were achieved by C.L.W Eidlitz the late Victorian architect. The main motive is the leading up to all its parts from both directions to the main tower.

The third quality, 'Irregularity', is related to Wolddlin's theory of 'openness'. To achieve irregularity the designers preferred spontaneity and accident to calculation. This did not have much application to the railway station to that time.

The forth picturesque quality is 'intricacy', which is related toWolfflin's 'multiplicity and unity'. Intricacy signifies that the relationships of theparts are complex, not to be discerned immediately. Some striking examples of this style used lin station design are most numerous in the High Victorian times an example is the Broad street station at Philadelphia.

The fifth picturesque quality 'roughness, is related to Wolfflin's 'clearness and unclearness'. It is indirectly opposed to the smooth surfaces, carefully finished joints and precise clarity of classic practice.

5.1.2 Creative Electism

A creative elective building should be judged first by whether the exterior is an expression of the interior in either and idea or literal sense, third whether the forms have been employed with freedom and independence rather than with literal exactness, forth, by whether the reminiscences have been wisely co-ordinated and placed in perfect agreement with each other, fifth, by whether it serves the conditions and uses the materials dictated by the age, sixth, by whether the result is simple and comprehensible. Upjohn 1949 has said that the electics were guided only by associations (symbolic eclecticism), national prejudice, training and whim, and seems to imploy that for the eclectic 'form follows fancy'.

The relation of creative eclecticism to the earlier phase of eclecticism may be summed up in pairs of example. Henry Austin's railway station in New Haven combines eclectic detail and original massing; far flung horizontal extension, flaring eaves; low, hipped roofs and a floating detached superstructure - anticipating similar feature in sullivan's New Orleans station of 1892.

5.1.3 The Middle Phase - Sophistication; 1860-1890

This was a period of world-wide prosperity marred only by a serious depression in 1873, this prosperity was reflected in lavish building projects characterised by opulence. This was the time railway technology was directed principally towards increased luxury, safety and speed, reflected in costly bridges and tunnels, and also in more comfortable passenger cars.

This was an era when the engineers grew bolder in designing metal train-shed - see fig 6, while the architects became more timid in designing the head house of the railway stations Also some interesting attempts were made, however in a new field of railway hotels in particular, each of the London stations had them usually as the fore building.

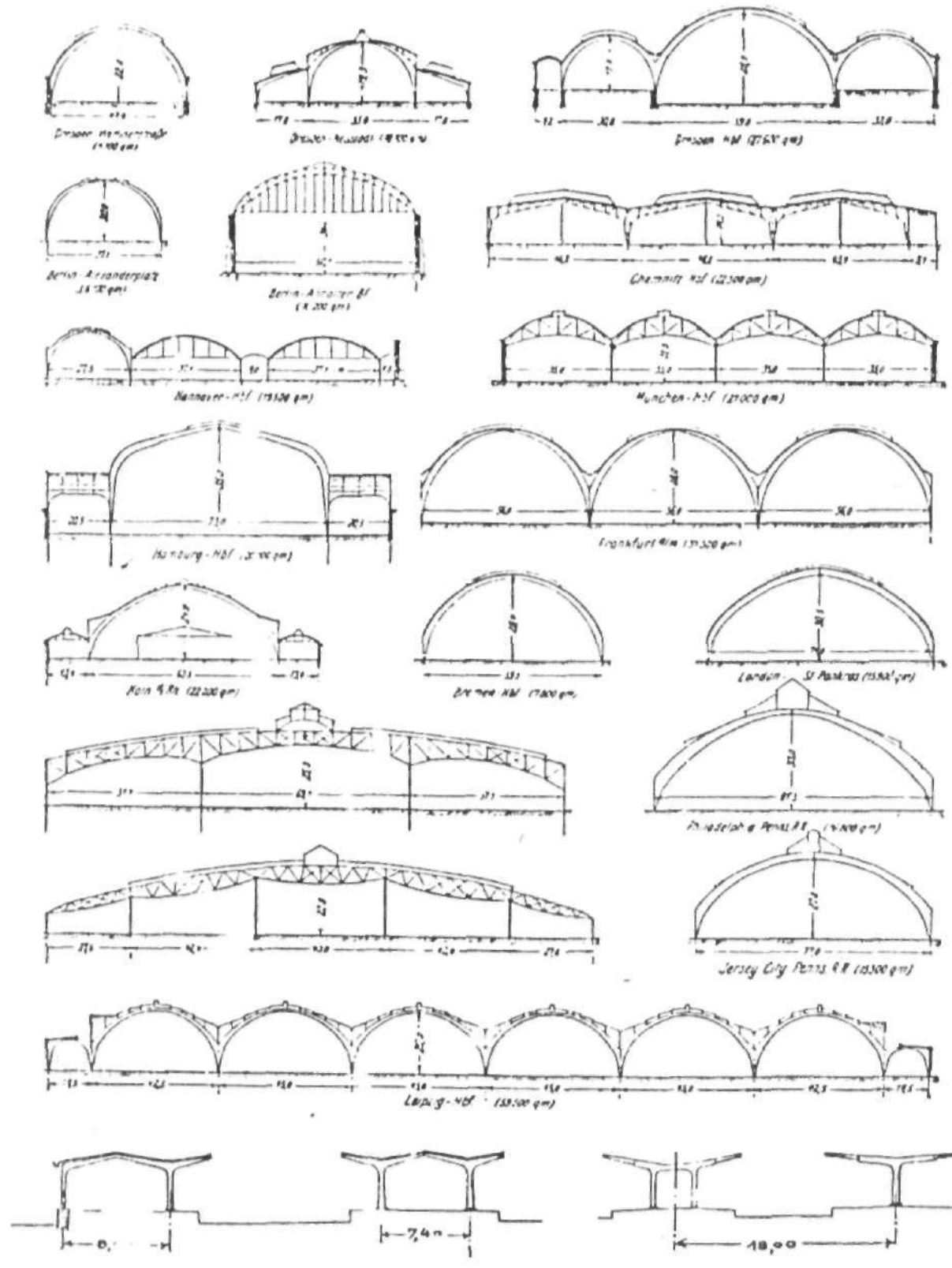
The increased desire for the expression of verticality found opportunities for fulfilment in what amounted to a rage of towers. These were simply regarded as Victorian. The wave of 19th century form took a new turn exploring the classical and Italianate round arched motive when it first started, to the thin, pointed arches of the Victorian Gothic and later back to the round arched motives, but this time derived from Romanesque sources. An example of the Romanesque station is Bradford Gilbert's Illinois Central Station in Chicago.

5.1.4 The Third Phase - (1890-1914) (Megalomania)

At this point in time the railway shed which has been the largest element, was becoming old fashioned, the tradition of vast interiors was transferred to the concourse as reflected in the Grand Central station at New York , 37.5 m wide 112.5m long, 36m high.

The chief modifications to station design at this time was toward multiplication in depth, going beyond the simpler two level scheme of Hanover to three or four levels. Worthy of note is the extensive use of glass cages: for train sheds- iron and glass roofed enormous areas. These were the characteristics of other notable German station of this period. Romanesque, external effectiveness of a shed that is stretched out recalled the baroque delight in apparently infinite perspectives. Other features were the use of complicated composition of pavilions domes and towers.

Sections of train sheds.



a, b, c

d, e, f

g, h

i, j

k, l, m

n, o

p, q

r

s, t

Masqueray, attempted to design an ideal station in which flowing curves- Art Neuveaux and beaux-arts influences were inter mingled. His attempt resulted in a successful expression of the conception of a station as a vast vestible.

From 1906-1911, Atwood and Burnham greatly influenced the use of Arches. both triumphal and postal, they also sponsored a third major motive the - colonnade - expressed in various styles during this period. Although colonnades are amenable to different expressions, they are symbolically less appropriate to stations than to court houses or libraries, rather the arch and its portal association more adequately express the daily flow of multitudes.

Stations of these times were easily criticised on a variety of counts, the derivatives forms and detail, the extravagant dimensions, the colossal scale, the wasteful use of land, the prolonged distances, the sacrifice of conveniences for ostentions. Architects and corporation influenced by the ideal of the "City Beautiful", a movement geared towards contributing splendid monumental structures to the Urban ?y scene deliberately introduced colossal scale, ample sites and vast interiors. The designers accepted as valid the classical conception that public buildings should be supremely impressive. They adopted the classic means - fine materials, uniform colour, colossal scale, and a comparatively narrow range of form. They gave long and careful though to the refinement and perfection of design and eschewed self expression.

The arched and colonnaded stations of this era represent a reaction against engineering. The potentials of the train shed had been rejected in favour of monumental head - houses.

5.1.5 The Twentieth Century Style (1914-1956)

The significant phenomenon of the post war years was the emergence of a wholly new, non-ecletic style called functionalism or the international style or merely modern architecture At this point picturesque eclecticism had run its course and had been succeeded by another aesthetic movement

This new style can be categorised into three phases in the first phase the elimination of eclectic movement was accomplished, this is the period in which buildings became bare apparently solid cubes In the second phase the absolution of the cube was modified into two ways: the cubical block became rectangular and enclosing plans were perforated and that they could be clearly understood enclose space. In the third stage, the structural frame was fully revealed Structural means were exploited to heighten expressiveness.

A manner of design which flourished briefly, during the second stage was known as the carton style. The buildings of this style look as though their designers had proceeded by standing assorted up-ended containers in front of one another until the agglomeration met their standards of balance and massiveness.

The formal characteristics of the three phases of this new movement as witnessed by propagandist of modern architecture stressed it rationalism more than its aesthetics, which nevertheless also played on important role. The quantities sought after in this movement were, planarity space-time, transparency, interpretation and simplicity.

During this period, psychologically satisfying devices were introduced. The public address system borrowed from airports, permits the passenger to relax while

waiting for his train, he could get busy with other activities around the station while waiting.

5.1.6 Nigerian Railway Stations

The Nigerian Railway station building in general have no semblance to the style of any of these era's particularly with respect to the head house. Though, mostly built during the colonial era, it appears, that these stations were designed to serve mainly functional purposes according to the need of its location and not for expressing any form of architectural taste style or character.

Over the years most of these stations have undergone major renovations and some were redeveloped The Iddo terminus in Lagos is a typical example. Nevertheless some identifiable elements of some of these colonial stations are the high pitched gable roof rounded arches and colonnades - this is quite prominent of the Ibadan station. These features were greatly explored by the architects Atwood and Burnham in the late 18th century to the early 19th century.

Another common feature of the Nigerian Railway station is the Butterfly roof over the train sheds which was designed also in the early 19th century by New Haven Rail road. This was an economical solution to problems associated with other methods used prior to this time. But this covered only the platform and made no attempt to cover the lines or to exclude driving storms.

5.2 Types of Railway Stations

Railway stations building through the years have varied in size and function, from small country halts to large main line stations. These stations were built to

handle all forms of local, national and international traffic that passes through them. Stations are normally located along the line, at a junction or at the end of a main line.

5.2.1 Terminals and Junctions

Terminals could be along the line, beginning or end of the line or completely away from the line, while junctions are always along the line- where the workshops are located. Sometimes, the station building itself could be sighted from the line

5.2.2 Passenger Stations

This type of station is exclusively meant for passenger service and it is expected to possess such facilities that are necessary for their comfort and convenience. Unobstructed movement is highly desired. Properly co-ordinated flows of arriving and departing passengers is essential. Adequate provision for easy-time saving method of boarding and de-boarding of the train is absolutely necessary.

Separate routes for movement of lugagges manually or mechanically is normally considered while the safety of travellers baggage is ensured. Baggage lockers are provided for travellers who which to keep their baggage safe while shopping or taking refreshment. Waiting room and related areas are obviously necessary.

Easy access to other modes of transportation should be provided, bus and taxi parking spaces should be as near as possible to station exits. Private parking spaces should be provided for car owners - including security parking areas for those who wish to keep their cars for a period of time while they are away on a journey.

5.2.3 Terminal Stations (Terminus)

A railway terminus is a kind of terminal station at the end of a main rail line This is the point for initiating and ending of a journey. The moment passengers unboard at a terminus, they all disperse for business within or outside the station This means that a new set of passengers are expected to board the next train to leave the terminus. Therefore two major functions associated with arrival and departure of large number of travellers are carried out simultaneously and several times within a day. This of course is an enormous task which requires an efficient system to cope with demand

5.2.4 Location of a Terminus

A railway terminus should be easily accessible bearing in mind the convenience required for changing of mode particularly for people carrying heavy luggage and those transporting large freight. It most therefore be sited close to concentration of the city population properly connected with the industrial zone and probably within an interchange centre if one exists. Apart from large cities where travel demand is usually very high, some towns engage in servicing commercial activities may also be a good place to locate a railway terminus.

5.2.5 Functions of a Terminus

A terminus has four main functions

i. Concentration or converging point for departure of passenger and goods.
ii. Dispersion or distribution point for arriving passengers and goods
iii. Passenger service
iv. Vehicle service and interchange. These are functions that deal directly with the public.

5.3 Types of Railway Stations' Design

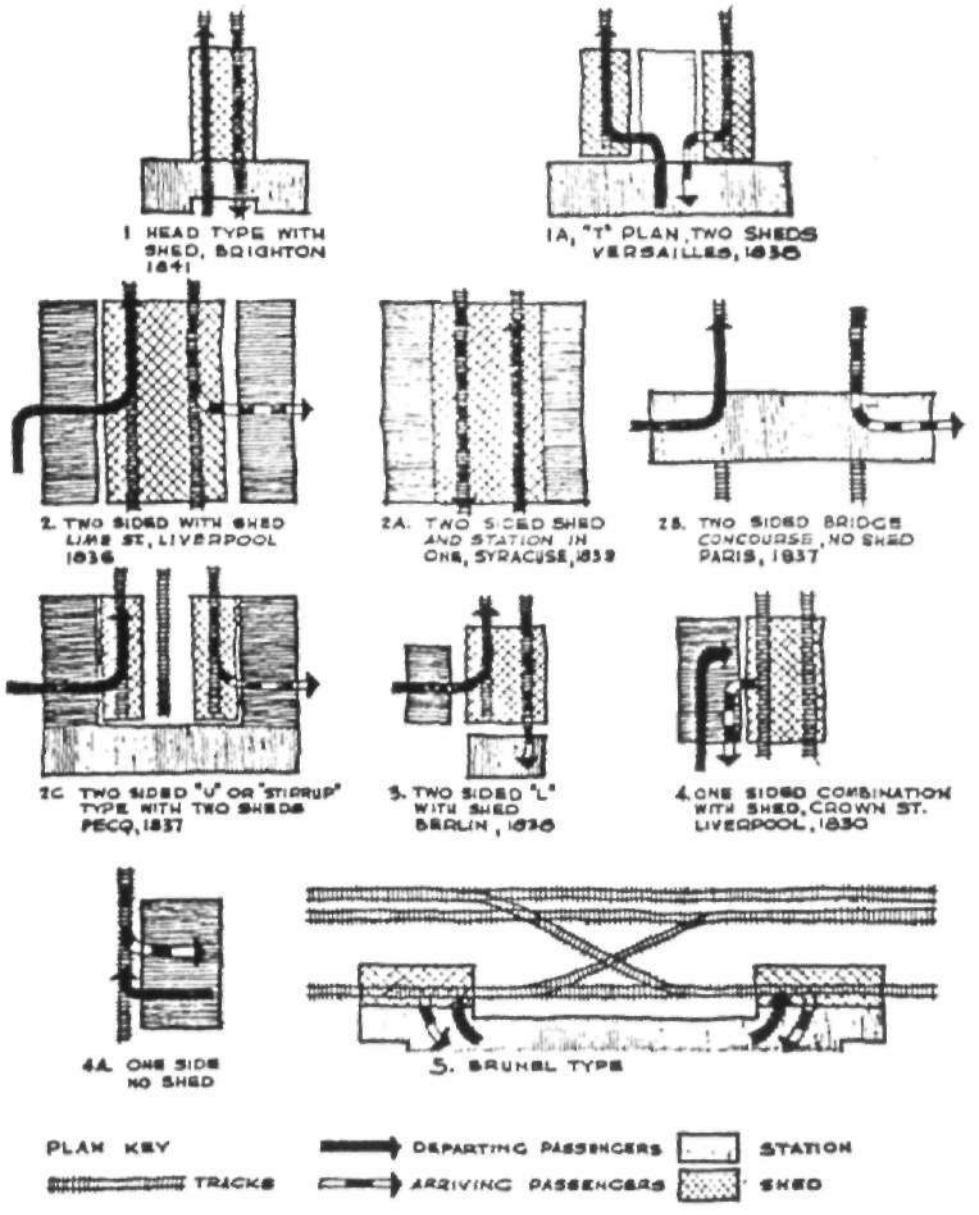
During the first few decades of the station development, so many ingenious experiments were being conducted which resulted into varied station types which could not be easily classified. Even at this early stage some stations already bore in them the patterns for the great terminals of the future, others were a disaster. There has really been no end to the approach adopted for station design even at contemporary times, some definite patterns have been observed but there are no strict rules.

5.3.1 The First Approach

Caesar Dally editor of the Revenue Ge'ne'rale de l'architecture made the first attempt in 1846 to reduce or order the proliferating chaos of station types. He claimed there were only four types of stations to be classified according to the arrangement for entering and leaving them. Fig. 7 shows the early types of station plan.

1.	Head Type:	Arrival and departure in a single building across the end of the tracks.
2.	Two sided or Twin Type	With arrival and departure handled on opposite ends of the tracks.
3.	"L" Type one	With arrival at the end of the tracks and departure at one side or vice versa.
4.	One sided Combination type	With arrival and departure on one side of the tracks. The one sided combination type was used at first everywhere in the world, and till date is still used for most designs of small stations.

FIG 7— A. EARLY TYPES OF STATION PLAN



5.3.2 The Second Approach

In contemporary times classification of types of station designs were related to the arrangement of the station building in relation with the rail lines themselves - seven types were identified as follow:-

i. **Through Railway station type A**

The station is situated on one side of the rail, and the trains are either going on the real platforms above the level of the station building on the same level with the building under the station. The passage in this case is underground (fig. 8)

ii. **Through Railway Station type B**

This is similar to type A except that the passenger's passage is the overhead bridge type (fig. 8).

iii. **Terminal or End type**

As the name implies, this type is normally used at terminals where the rail lines end. This type of station building usually takes the form of 'U', enclosing the ends of the rails (fig. 9)

iv. **Island Station type**

In this case, the station is situated as an Island between the stream of rails and their platforms, and is accessed either by overhead or underground passages (fig. 10).

v. **Station Building Under Rail**

The main building in this case is situated under the rails (fig. 11)

vi. **Station Building over and above the Rails**

This type of station is the exact opposite of the type in (V) The building is situated above and over the rails (fig 12).

vii **Combination of Through and Island type**

This combines two types of station design concepts, the 'Through' type and the End type - in this case bay platforms are used as the end tracks (fig 13).

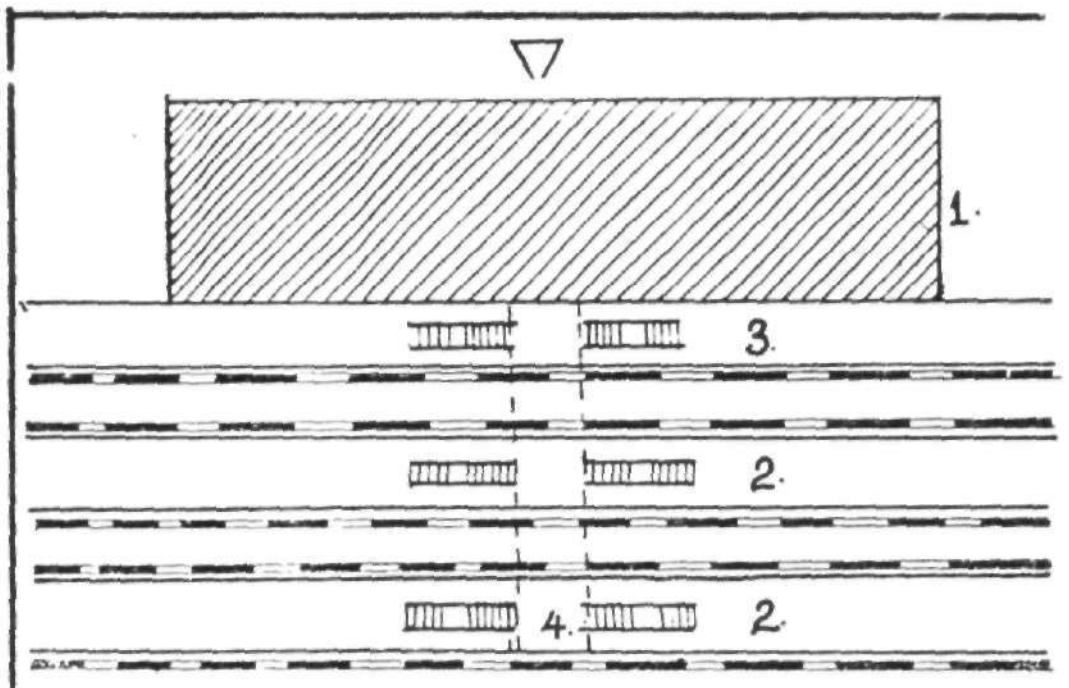


FIG 9 B. THROUGH RAILWAY STATION.
KEY 1 STATION BUILDING ABOVE OR BELOW THE LEVEL OF THE RAILS
2 ISLAND PLATFORMS 3 ADJACENT PLATFORM
4 OVERHEAD OR UNDERGROUND PLATFORM PASSAGE

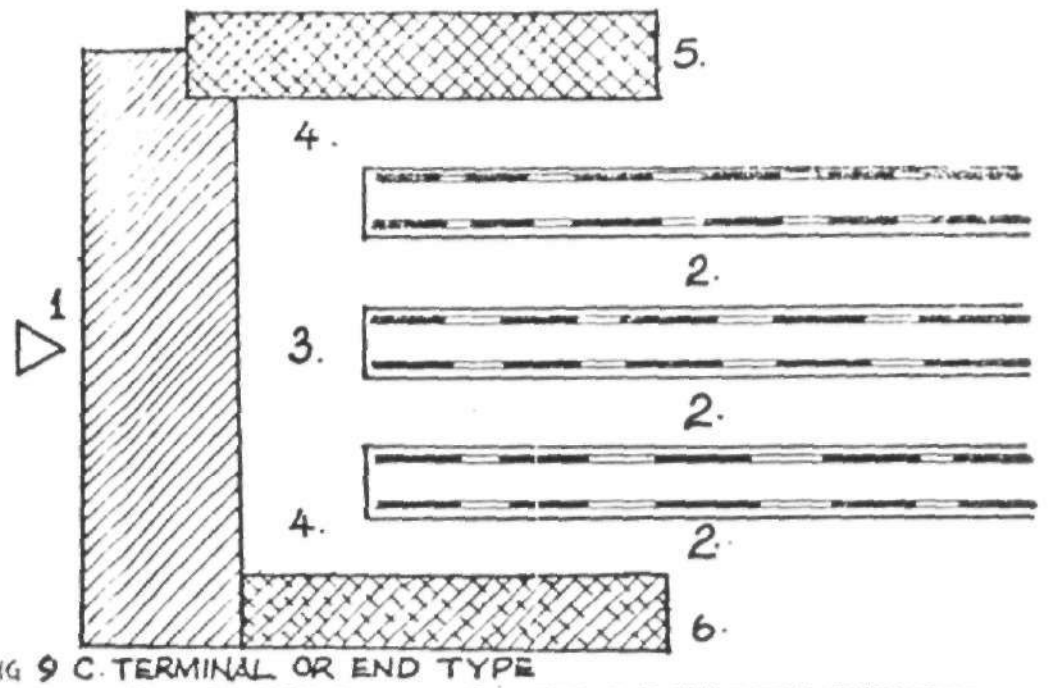


FIG 9 C. TERMINAL OR END TYPE
KEY: 1 STATION BUILDING 2 PLATFORMS 3 COLLECTING PLATFORMS.
4 EXITS 5 HOTEL 6 TECHNICAL ADMINISTRATION

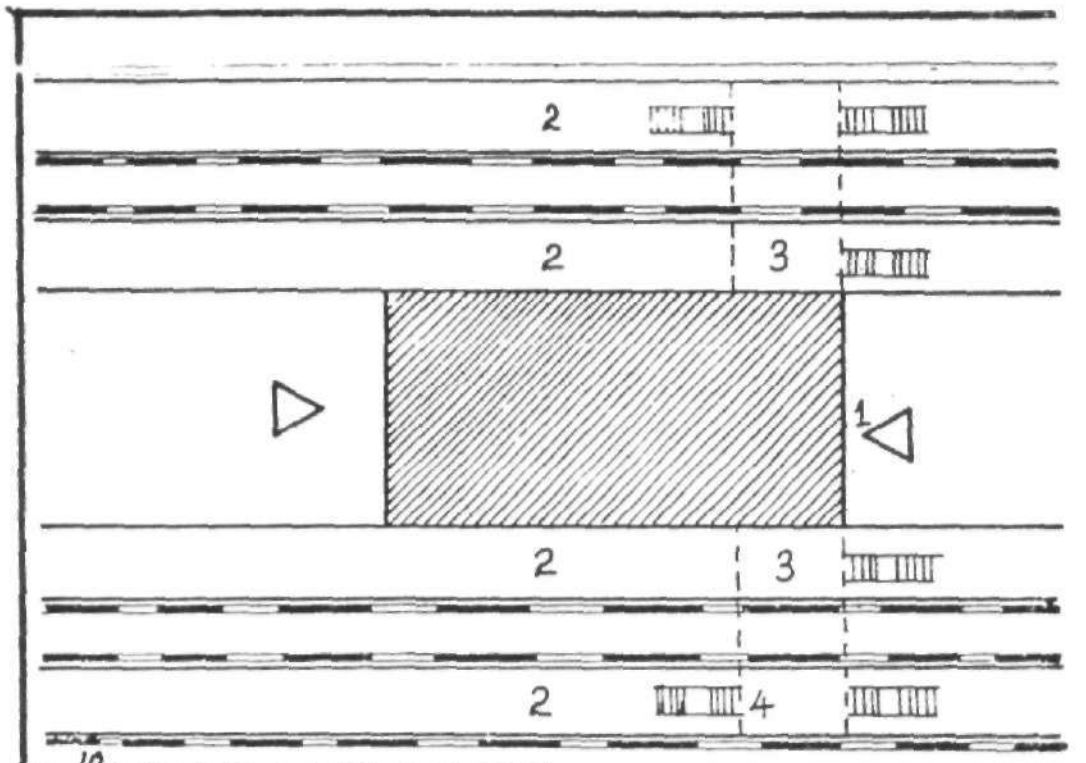


FIG 10 D. ISLAND TYPE STATION.
KEY 1 BUILDING. 2 PLATFORMS 3 UNDERGROUND PASSAGE. 4 STAIRCASE

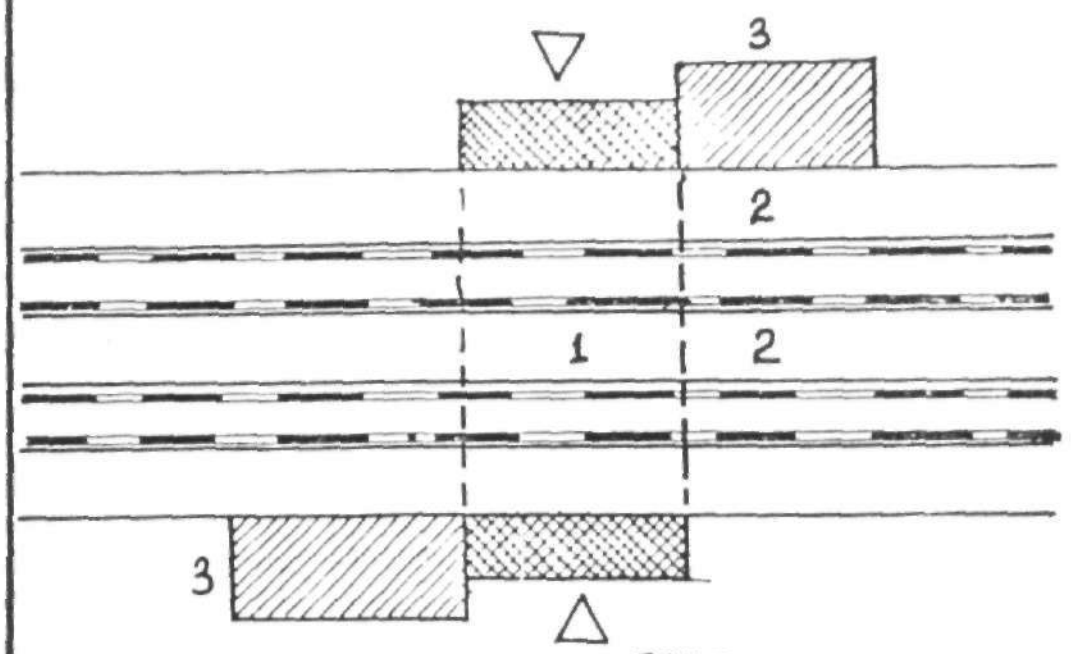


FIG 11 E. STATION BUILDING UNDER RAILS.
KEY. 1 BUILDING. 2 ISLAND PLATFORMS. 3 TECHNICAL MANAGEMENT & ADMIN.

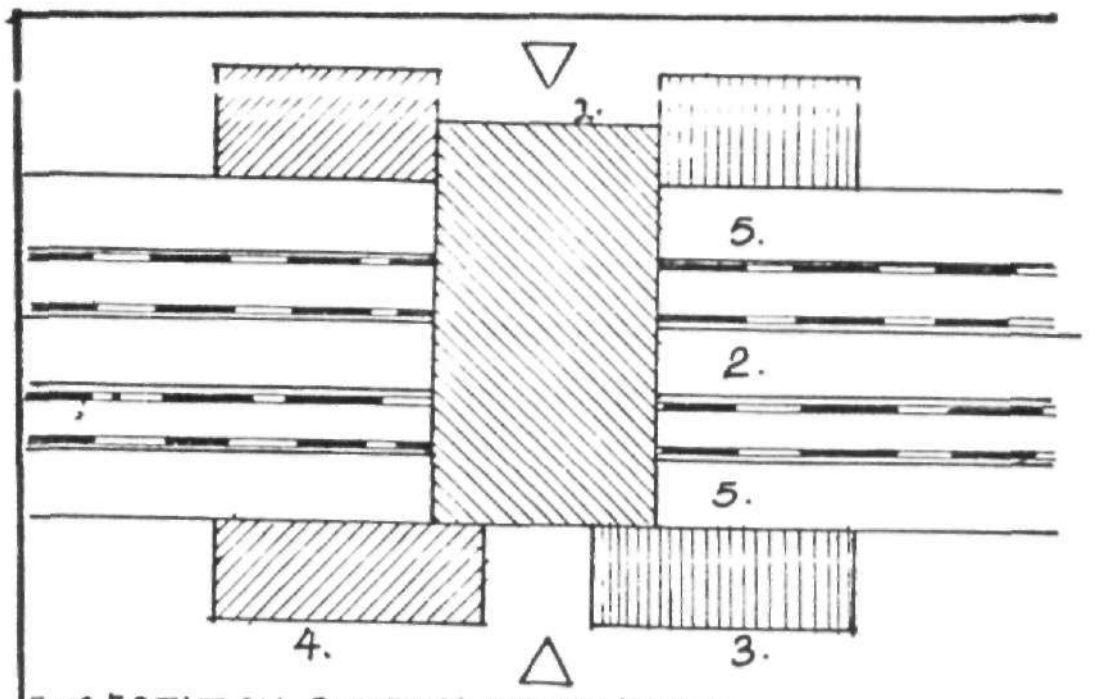


FIG 12 F STATION BUILDING ABOVE RAILS.
KEY: 1 STATION BUILDING 2 ISLAND PLATFORM 3 TECHNICAL MANAGEMENT.
4 ADMINISTRATION 5 COLLECTING PLATFORMS

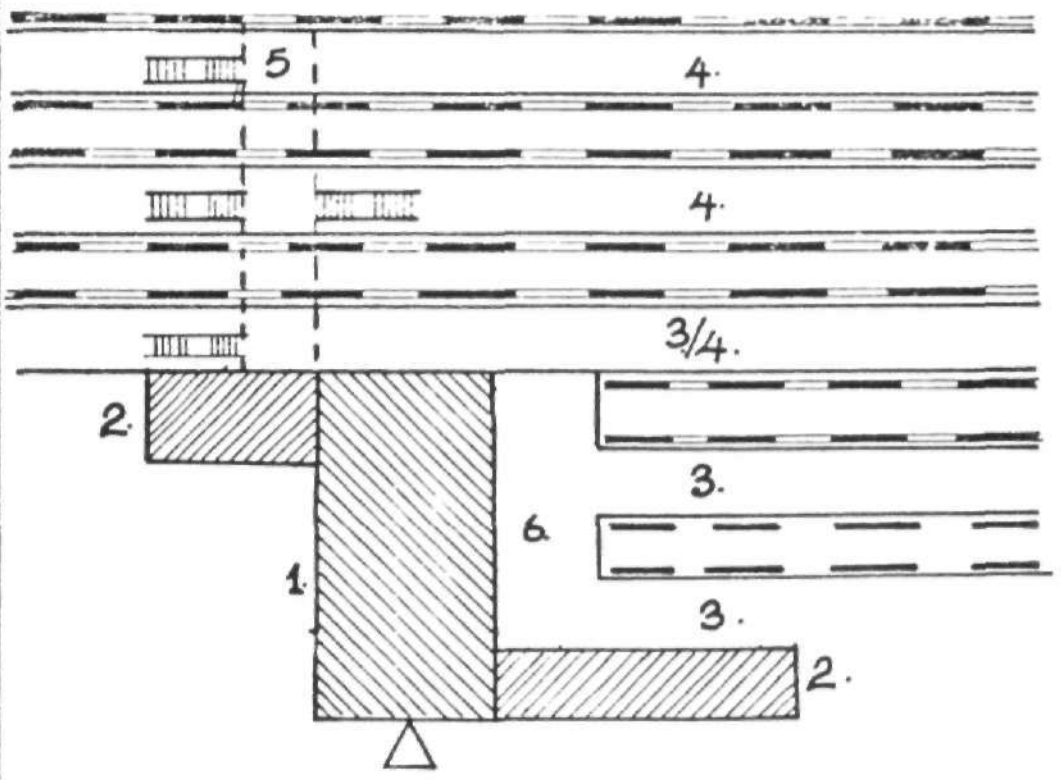


FIG 13G. COMBINATION OF THROUGH AND END TYPE
KEY: 1 BUILDING 2 TECHNICAL MANAGEMENT 3 BAY PLATFORMS 4 PLATFORMS
5 PASSAGE 6 COLLECTING PLATFORM.

5.4 Functional Requirement of a Railway Station

5.4.1 General Operations:

Operations within a railway station can be categorised into two parts, the active and the passive. The active consists of movement areas, circulation spaces and activity areas such as passenger services and conveniences. The passive consists of waiting areas and storage facilities. Illustration below.

	Movement	-	Passenger/goods
ACTIVE	Circulation	-	Passenger/Staff/Vehicle
	Services	-	Passenger & Staff refreshment/ Conveniences
	Waiting Areas	-	Departure waiting/Arrival waiting
PASSIVE	Storage	-	Departing luggage/mails
			Arriving luggage/mails
		-	Lost and left luggages

For a passenger station to function properly, the general layout and traffic flow should be designed to permit the most efficient, prompt and quick handling of passengers and related operations in terms of conveniences, comfort, checking in and out of platform area; And the safety of passengers and their luggage must be duly considered. The sketch in page 111 shows the functional relationship of the main spaces of a railway station building classified under 'big frequency' station in table 5.

Table 5 Showing categories of station building

Station Building	Peak Frequency (Passenger/Hour)
Small	1 - 500
Medium	501 - 1000
Big	1,001 - 1,500
Central	1,501 & above

5.4.2 Active Operations

Active operations as shown involves movement of people and goods, which in other words can be termed 'traffic flow'. The inter-relationship between the various spaces of the public area of the station building is derived from the four basic flow patterns which are; flow of departure, flow of arrival, transit passengers and flow of baggage or express goods. There are some other peculiar flow patterns associated with these basic flows depending on their locations.

Flow of Departure

This is the local (or concentration) point which generates a departure flow pattern in the Departure Hall. This hall should be easily accessed from the main entrance of the station building and should also be directly linked with the main departure axis-checking out which leads to the platforms.

Flow of Arrival

Movement of arriving passengers is usually direct from platform to the outside but in big high frequency stations arrival halls are provided with luggage collection points and other facilities.

Flow of Transit Passengers

Passengers on transit utilise the facilities for arrival and departure. Frequency of transit passenger may influence the dimensioning of waiting spaces. Easy movement of passengers from arrival to departure hall is essential. In the case of a terminus this provision is not necessary since it is the end of a line there are no passengers on transit

KASU.M IBRAHIM LIBRAK

Flow of Luggage and Express Goods

In and out counters for luggage should be attached to passenger flow axis, but this must be separated such that there is no crossing between passenger and goods traffic flow. In medium to large stations, luggage is conveyed to the platforms through separate tunnels.

Special Flow

In big central stations provision should be made for the VIP such that their reception and waiting areas are situated close to the first platform. This arrangement enables the guest to enter each carriage across the first platform without having to use an under or over-pass.

5.4.3 General Circulation

Aside from defining a complete segregation of in bound and out bound traffic so that there is no conflict between lines of travel in opposite direction; it is also necessary to provide a common place for interaction A very large, spacious and voluminous area known as 'concourse' is usually created to serve this purpose. It can be defined as a vast mixing chamber or a self - adjusting traffic centre. All other activity areas are easily accessible if not visible from the concourse.

The final waiting place - the ingress and egress to the platforms provide a flow in a direction peculiar to the station type. At a dead end or terminus, the passenger flow to train's parallel. The 'through' station requires a waiting area from which passengers can cross the rail tracks, through underground tunnels or overhead bridges.

5.4.4 Vehicular Traffic

The movement of cars trucks and parking around the station building is never taken for granted. As much as possible, crossing of vehicular and passenger traffic should be avoided at planning stage. An un-interrupted flow of passengers (pedestrians) right from access street to the station building should be ensured particularly for safety purposes.

5.4.5 Goods Traffic

Goods traffic are in categories depending on the bulk and number of rail vehicles (wagons) it has to occupy. The process of segregating goods is known as classification. The various categories are:-

- Train load - wagon/freight cars are loaded with similar goods which have probably the same origin and destination.
- Truck load or wagon load - in this case the goods occupy a whole wagon.
- Less than truck load
- Small load
- Freight liner traffic

Some stations termini combines passengers and goods services including mail services.

CHAPTER SIX

CASE STUDIES

6.1 Introduction

The various aspects considered in the case studies include, general site layout, planning concepts, structures, construction materials and overall appearance (aesthetics) with particular attention given to the platform area.

Overseas case studies are taken from station built within the new era. Inferences drawn from these studies would reflect in the proposal for the Modern Railway Terminus at Abuja in Nigeria.

6.2 Iddo Terminus, Lagos, Nigeria

The remodelling of this station was handled by Architect F.A Collard in 1953 and was commissioned in 1955. It is one of the few Railway stations in Nigeria in which all commercial and passenger related activities are carried out within a single building.

6.2.1 Location

The station is located in the heart of Lagos to the Lagoon/Lagos Island which is the commercial nerve centre of the State and Nigeria in general. It is bounded along the north-eastern side, round to the south-western side by Ebute-Metta-Ijara dual carriage way.

6.2.3 General Site Layout

Fig 14 shows the general site layout of Iddo-Terminus and view towards surrounding features. The rails terminate at the station building which has an East-West orientation. The main access to the site is on the south, from Iddo-Lagos way.

6.2.4 Planning Concept

The concept used for the station design is the 'U' type commonly used for terminus (end line) station.

Both vehicular and pedestrian approach to the site is at platform level. Approaching the station from the main entrance of the southern side, a centralised entrance porch leads to a double volume hall. The ticket centre is situated right at the entre of the hall, while the information centre is to the left of the hall close to the arrival exit. Waiting rooms are to the left of the main entrance, while the post office, police and shop are to the right. See fig. 15

6.2.5 Overall Appearance

Some attempt was made by the designer to express symbolism both in the interior and exterior parts of the building. For instance, the ticket office and the information centre were made to appear like a railway coach, the same goes for the approach elevation of the station building itself. The common butterfly shell roof stretches over the platforms. Plate 1.

Fig 15a - Iddo Terminus, Lagos

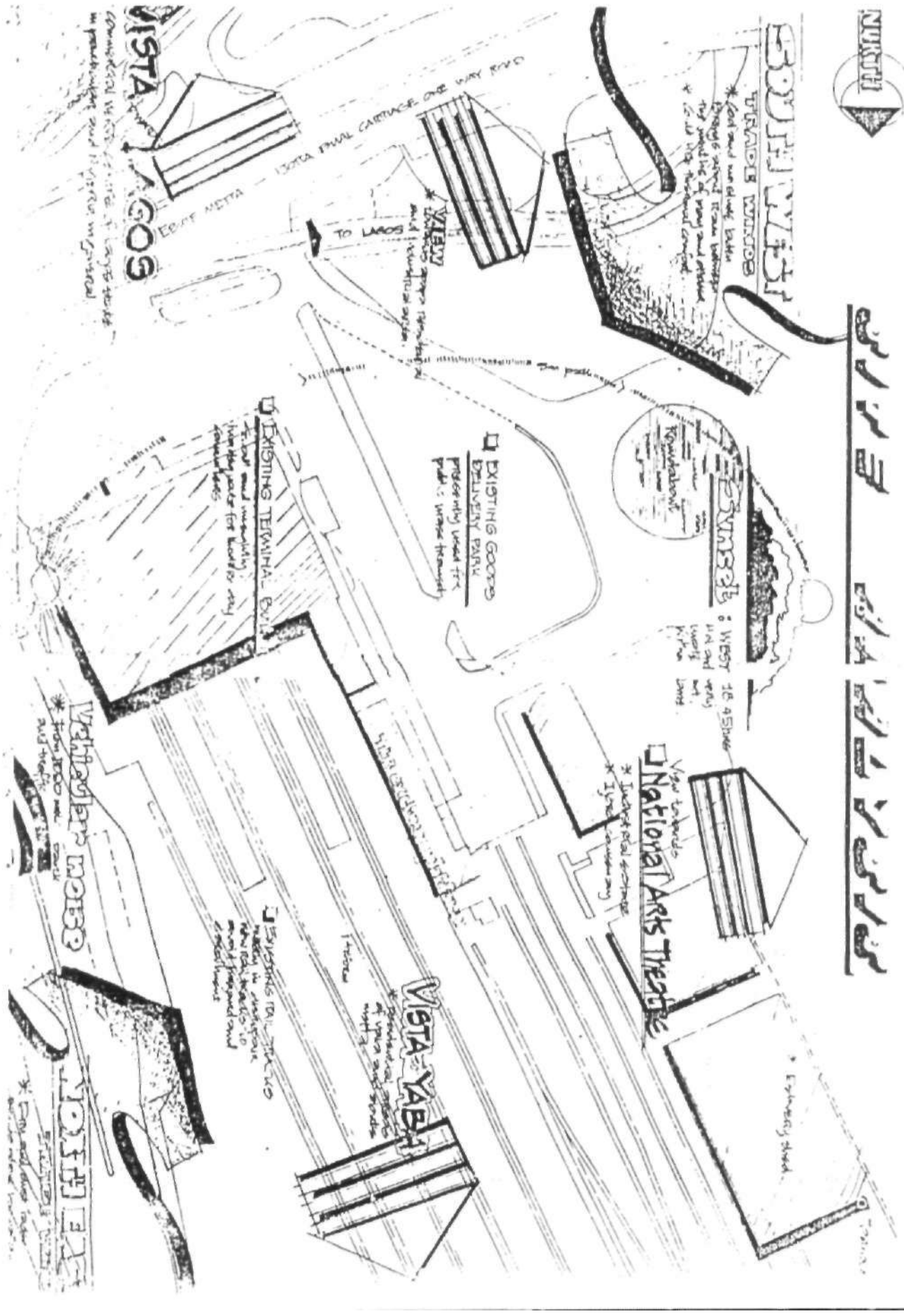
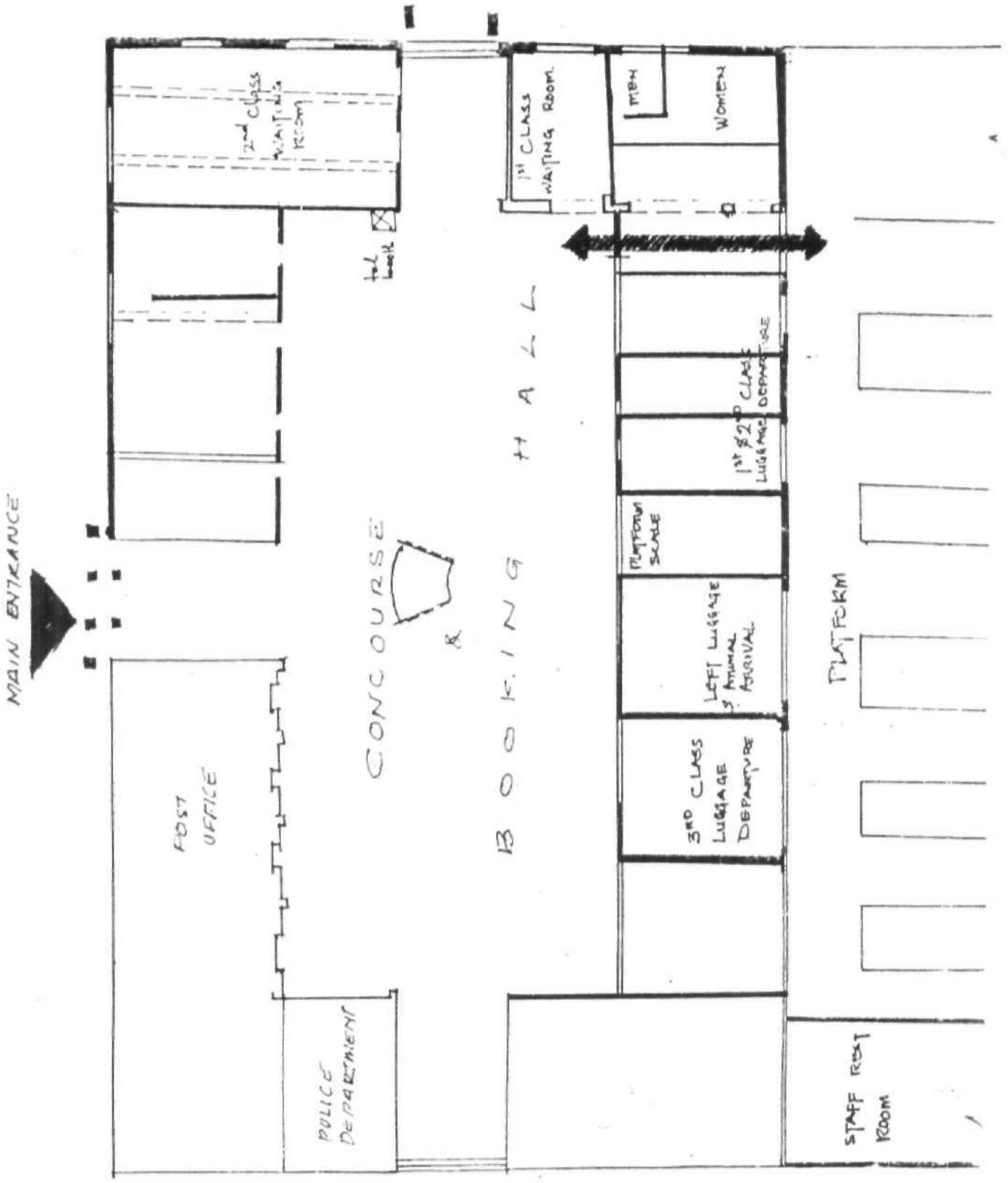


FIG -15b - IDDO TERMINUS - LAGOS

PLATFORM LEVEL - FLOOR PLAN.



IDDO TERMINUS - LAGOS



plate 1a
Iddo Terminus
- Lagos
showing passenger
platform and
abandoned, crippled
Coaches

plate 1b
Showing Butterfly
roof-shed over
platform

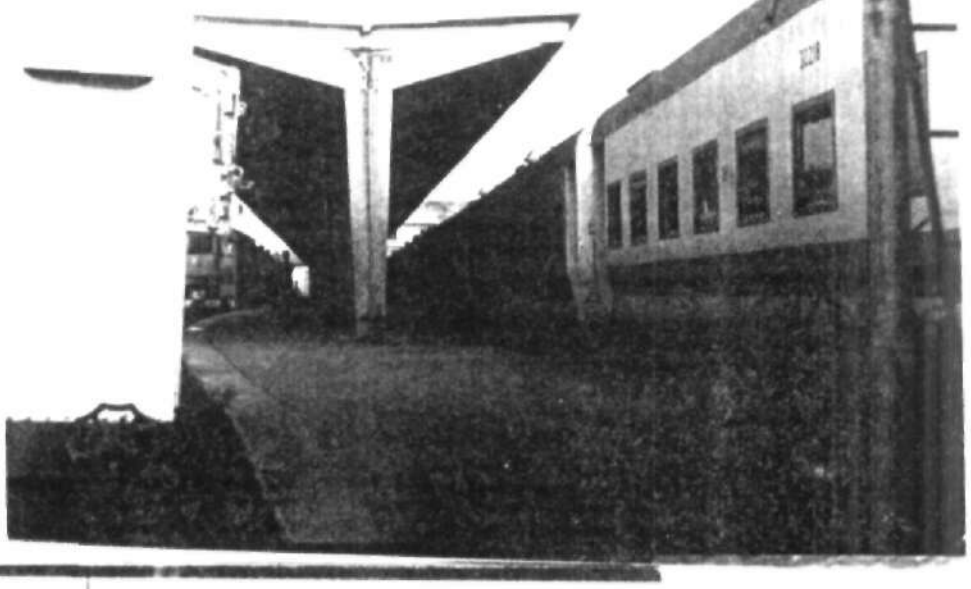




plate 1c
showing the
control cabin

6.2.6 Merits

- Unobstructed and direct movement of passenger from outside to booking hall
- Clear separation of public from administrative area by Vertical grouping
- Luggage storage and handling facilities.

6.2.7 Demerits

- No passenger concourse
- No clear separation of departing and arriving passengers
- Passages and entrances to and from platform area not well defined
- Building is generally inadequate
- Support system for platform roof restrict free movement of passenger

The general impression created by the design is that more attention was giving to the handling of goods and very little to passenger activities and conveniences. More demand must have come from goods shipping at the time the station was designed.

6.3 Jos Terminus, Nigeria

This railway terminus is a very small one with only two rail lines terminating at the station building. It was originally meant for mainly goods services.

6.3.1 Location

The station is located close to the central business district of Jos city, along Murtala Mohammed Way, between Jos central market and the Teaching Hospital.

The site is easily accessible but two close to the busy road, with very small space for parking.

6.3.2 General Assessment

It is obvious that this station was not designed for serious passenger service. Passenger facilities are inadequate. For instance (see Plate 2) the platform waiting area is small and wrongly positioned, the covered position is grossly inadequate. Ticket office and booking hall was really meant for a small station capacity. There are not separate routes for passenger and goods movement.

As such this station is rather inadequate as a case study required for this thesis. Nevertheless it was selected rather than the other larger stations in the country because of its peculiarity as a Terminus.

6.3.3 The Building

The building itself does not seem to have any definite architectural expression other than that it was designed mainly for functional purposes. The stone faced facade gives an impression of solidness which is further reinforced by the vertical columns (fins) which also serves as window hoods.

Plate 2b shows, passenger waiting shed. This structure is similar in construction (butterfly) to the Iddo Terminus train shed. In this case the support is steel instead of concrete.

One major problem of this station is the uncovered platform. This is most unsuitable for a modern railway staion for obvious reasons that passengers need to be protected from rain and sunshine when boarding or de-boarding a train.

JOS TERMINUS - NIGERIA



plate 2a
JOS Terminus perspective View of Approach and Side Elevation



plate 2b
showing End of rail line and way to Station Building.

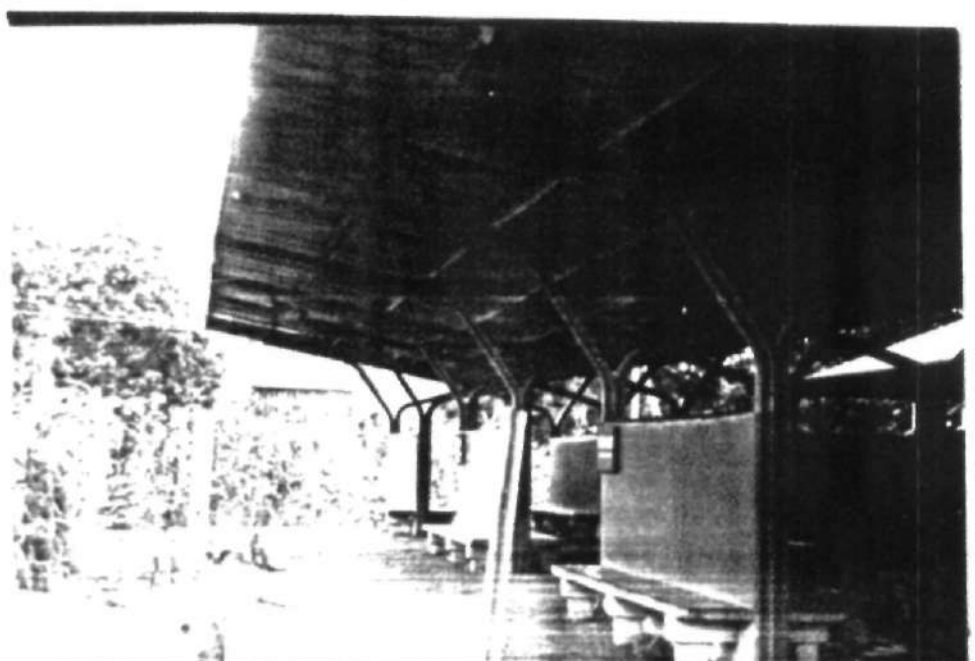


plate 2c
showing Covered shed for passeng waiting.

6.4.3 Structure

The structural system is a combination of the portal frame system and the reinforced concrete deck at first flour with simple supported post and beams spanning about 20m centres across the breath and 10m centres along the length of the building.

The roofing system used is steel space deck suspended from the portal frames by steel hangers as can be seem from the sketches in 16c.

6.4 Central Station, Belfast, Northern Ireland

This railway station was designed by Mc Alioter Armstrong and partners. The consulting engineers are Rendel Palmer and Tritton. The construction of this station lasted four years between 1972 and 1976 when it was commisioned.

6.4.1 Location

The station is situated quite close to the river Lagoon and the commercial centre of Belfast. A delibrate attempt was made to separate Vehicular and Pedestrian access by level, the former is at platform level while the latter is mainly by a high level overpass of East bridge street under which the railway passes.

6.4.2 Planning Concept

The station is actually are 'Through' type and the building itself is in two levels. The upper floor is at the East bridge level, with facilities for passenger activities and conveniences including the main concourse provided at this level. The lower floor which is at platform level was then utilized for the accommodation required by station staff, store and plant rooms. The rail tracks pass through about half the area of the lower flour which is utilized as the concourse above it. Fig. 16a

This concept clearly segregates passengers movement from staff and other station operations; However it necessitated the use of Ramps escalators stairs and lifts to change levels. The unsightly long ramps (fig. 16b) provided links with the booking office and passenger concourse on the upper floor to the platform area.

6.4.3 Structure

The structural system is a combination of the portal frame system and the reinforced concrete deck at first flour with simple supported post and beams spanning about 20m centres across the breath and 10m centres along the length of the building.

The roofing system used is steel space deck suspended from the portal frames by steel hangers as can be seem from the sketches in 16c.

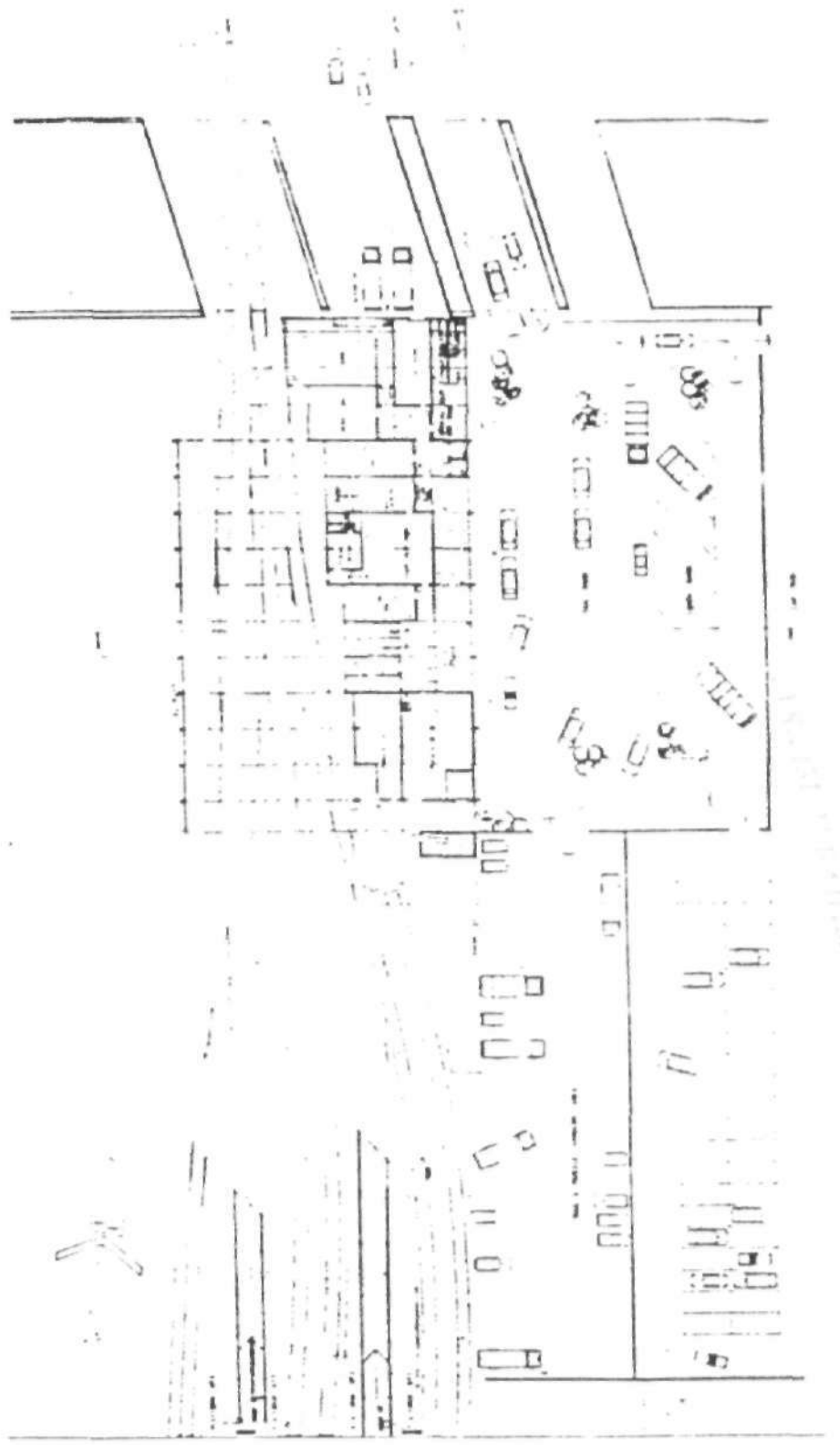


FIG 16a - CENTRAL STATION, BELFAST.
FLOOR PLAN AT PLATFORM LEVEL.

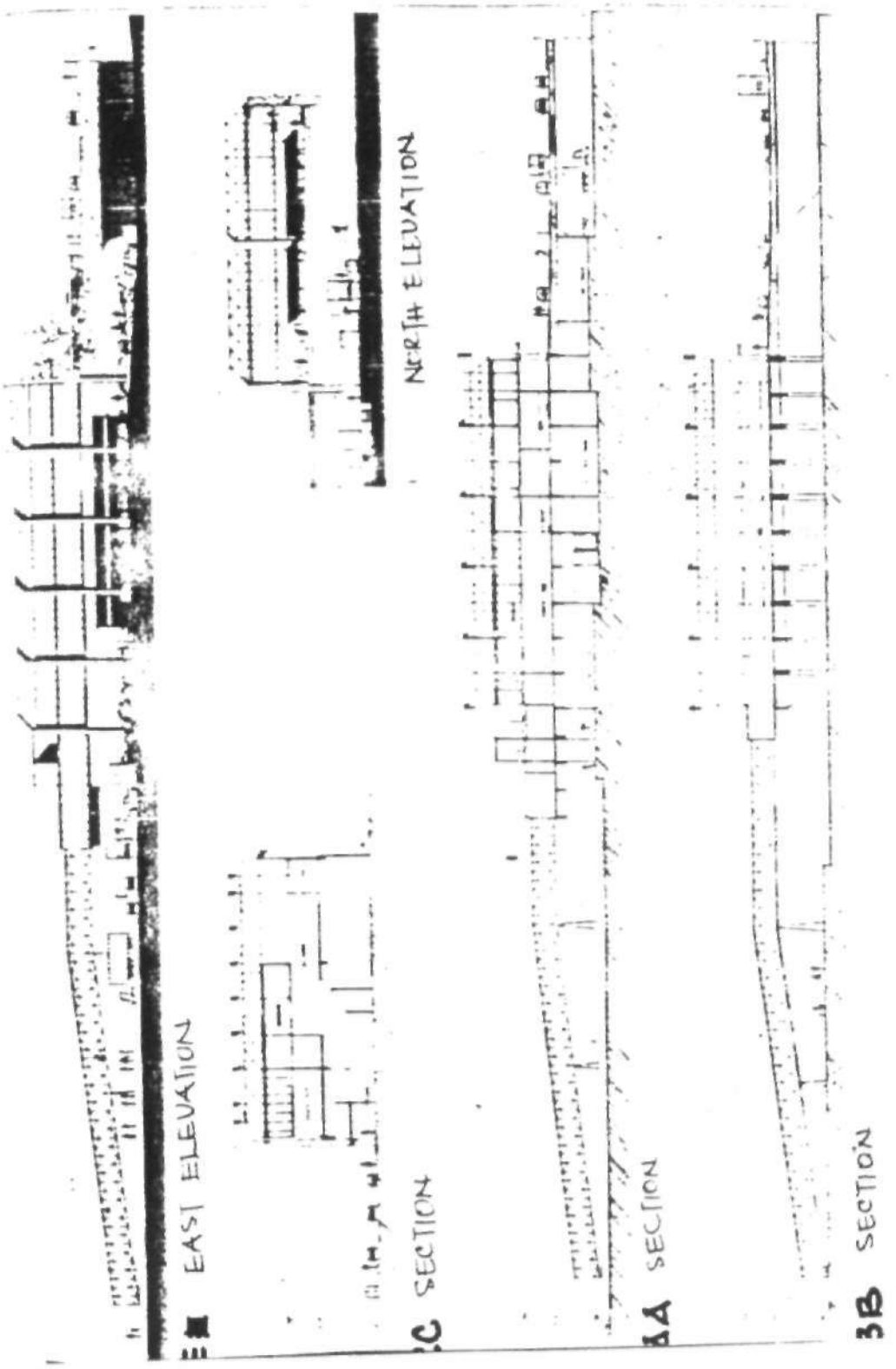


Fig 166 - CENTRAL STATION, BELFAST
ELEVATIONS AND SECTIONS

6.5 Lelystad Central Station, Netherlands

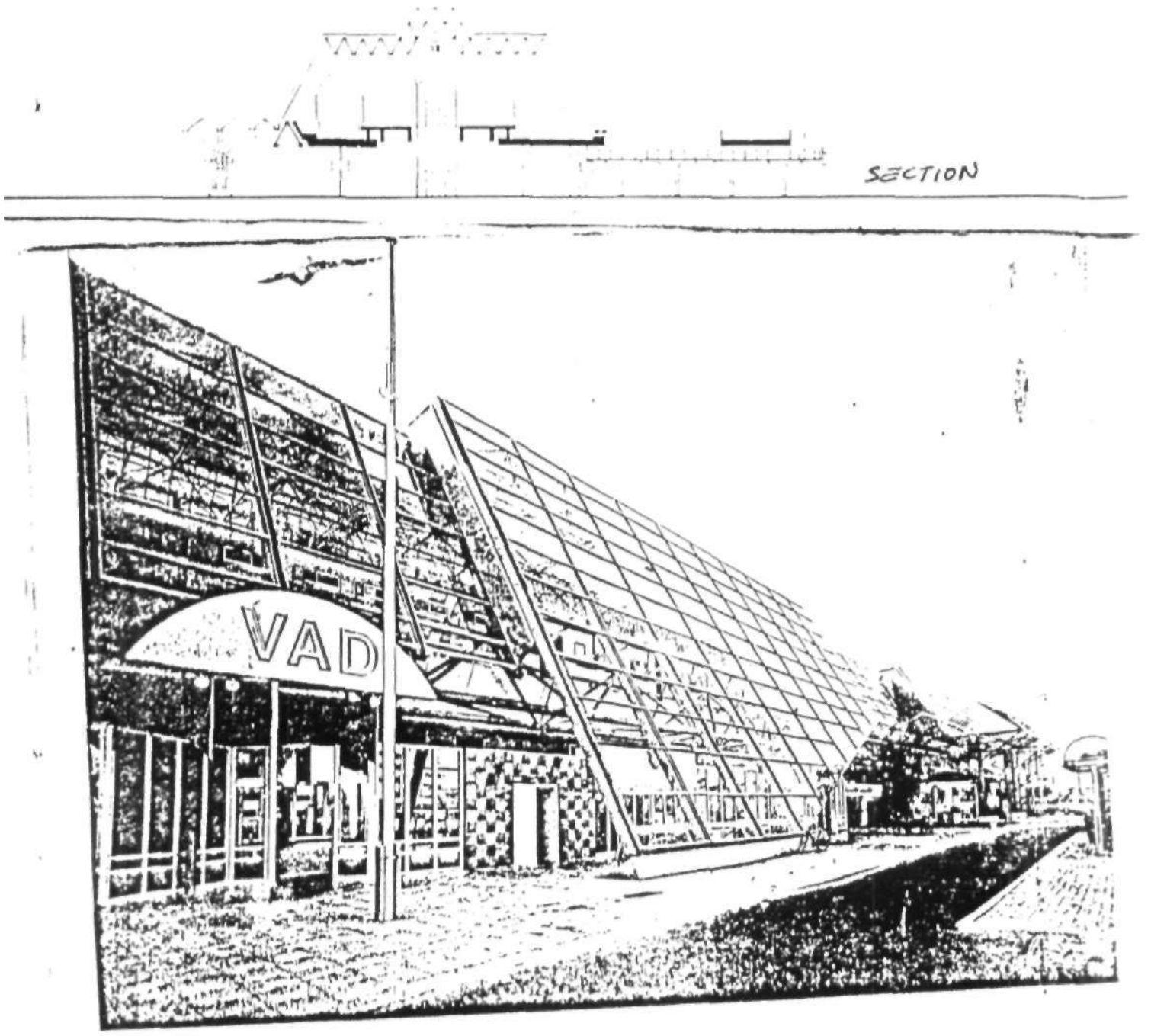
This station is a typical example of the recent trend in railway station architecture as conceived by the Netherlands Railway Architecture's office who approached each project with the novel philosophy that the people who use the trains are more important than the train themselves.

6.5.1 Basic Design Concept

As can be seen in the picture and sketches in plate 3a. The basic idea is to separate the platform from other station activities by vertical grouping. The platform occupies the top level while all other station activities occupy the lower level.

6.5.2 Construction Elements

Considering the passenger with a 'see and be seen' attitude, the designers sought to make the building a free standing urban element that would delight the eye from the outside, and uplift the spirit within. Glass was the obvious choice of material to provide the kind of visibility and transparency; elegantly fitted together by delicate steel frames and enhanced by vibrant colours and original works of art.



LEFT, ABOVE AND RIGHT Peter van Kilsdonk, elystad Central Station, view of atrium and latform, exterior view and sections

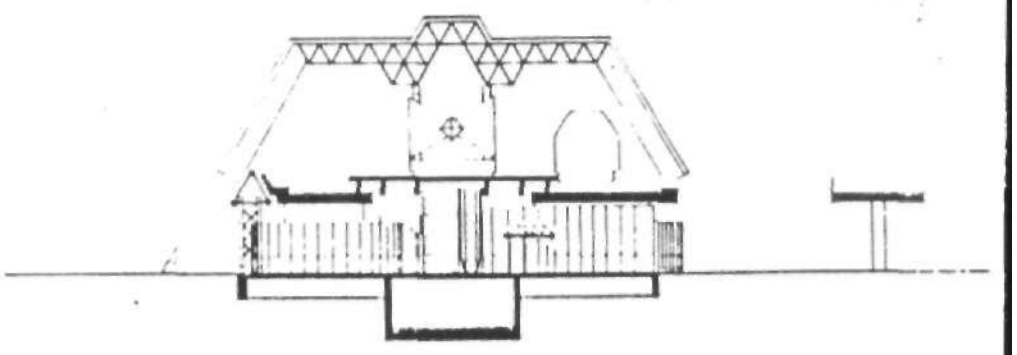


plate 3a – LELYSTAD CENTRAL STATION · SECTION ·

6.5.3 Structure

Plate 3b shows the detailed section of stationbuilding. The pictures show an intricate network of space frame construction, slightly different from the conventional system but based on the same principle of force distribution. The whole roof is supported by steel (slanted) columns hinged at first floor level and supported at the centre by steel girders which also helped to support the platform floor.

6.6 Others

Plate 4 shows another Dutch railway station, storerdijk station, Amstardam, showing the service column and overall exterior view.

An interesting element here, is the suspended glass caged platform and the extensive use of steel portal frame construction and glass.

Plate 5 shows the platform concourse of the Ibadan Railway station, Nigeria. A reasonable attempt was here to provide a landscape and open concourse where arriving and departing passengers can interact.

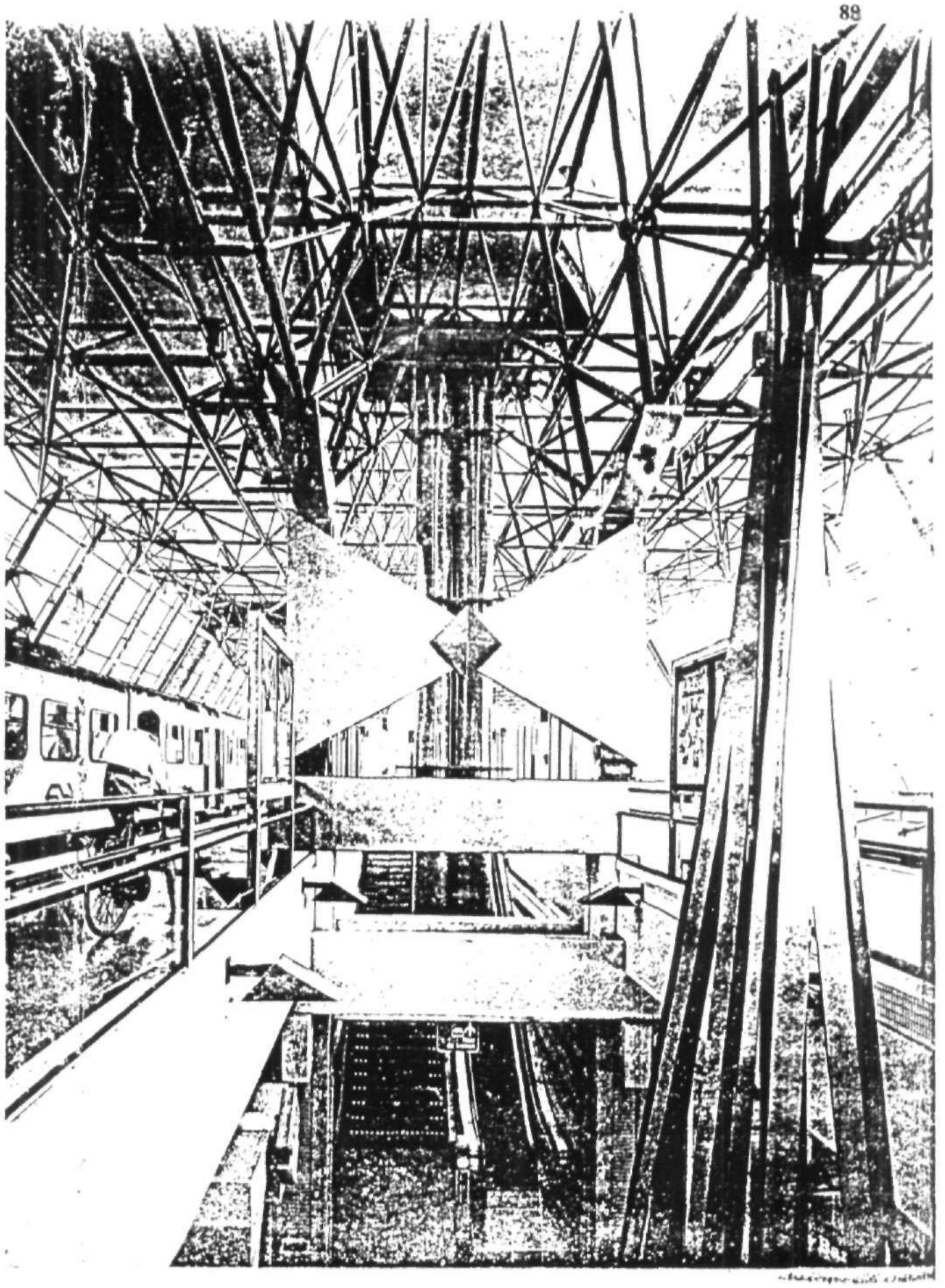


plate 3b- LELYSTAD CENTRAL STATION
DETAIL OF ROOF STRUCTURE

plate 4 - Stoleradji Station, Amstardam
View of service column and overall exterior view

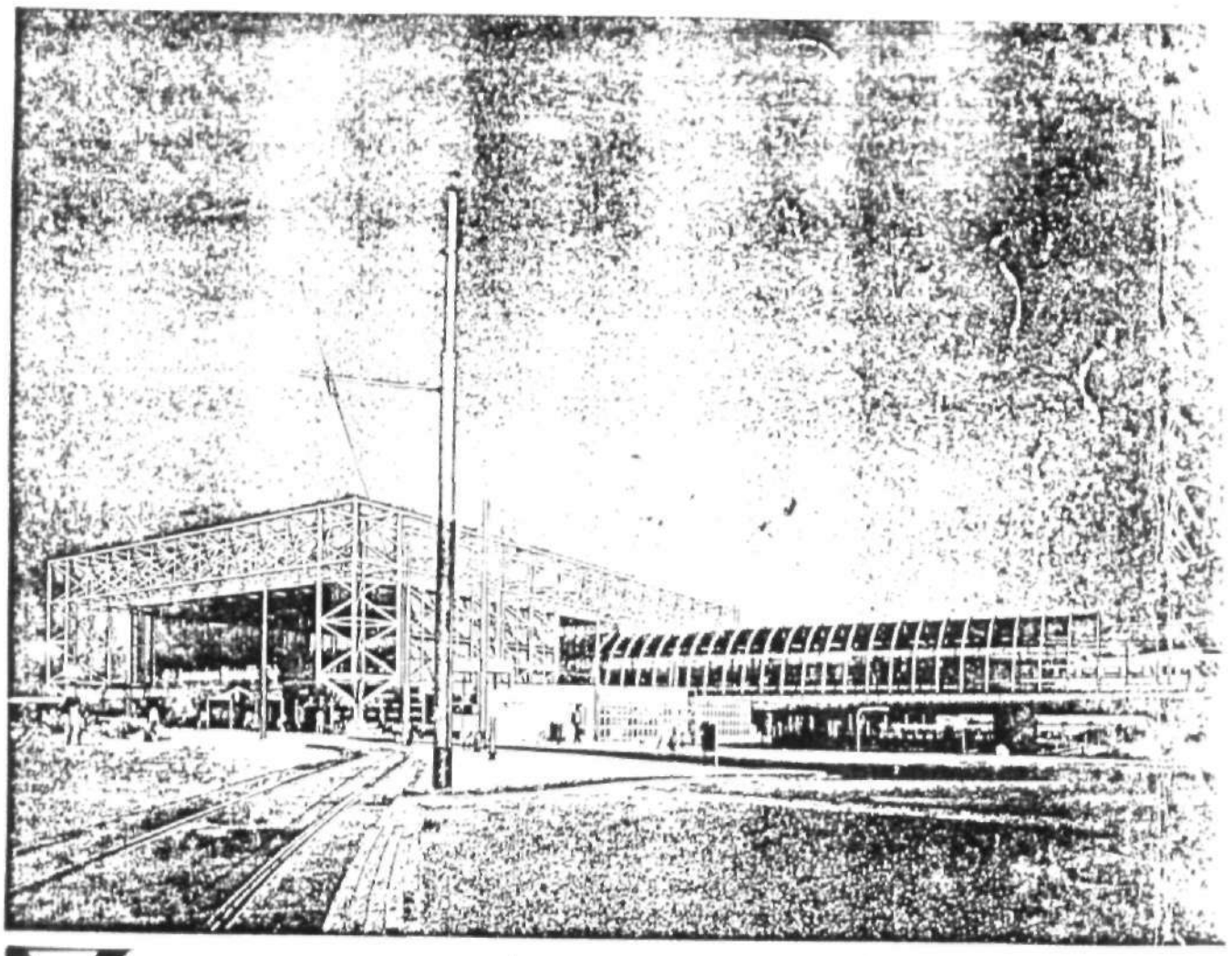
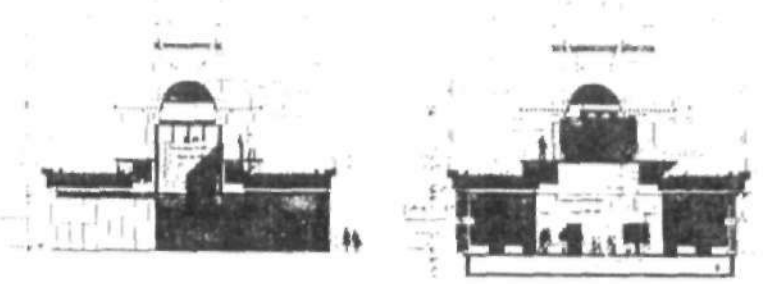




plate 5
NR - station
Ibadan.
showing platform and open concourse



LEFT, ABOVE AND RIGHT Rob Stevenhaus
Lelylaan Station, Amsterdam, view under canopy, overall exterior view, elevation and sections



CHAPTER SEVEN

7. SITE AND LOCATIONAL CHARACTERISTICS

7.1 Site Location

The proposed Railway Terminus is to be located at Abuja, the Federal Capital Territory (FCT). The FCT itself is the new administrative centre of Nigeria. It is bounded to the North by Kaduna State, to East/South-East by Plateau State, to the South West by Kogi State and to the West by Niger State See fig. 17 - Map of Nigeria showing the FCT, existing Railway lines, possible connection to the FCT and NRC Terminus cities and towns.

7.2 Site Selection

Selecting a site for the proposed Railway Terminus at the FCT - Abuja, did not pose much problems because the master plan for Abuja of 1979 reveals the fact that there are plans to link the Federal Capital with a rail line from Minna, Niger State. See fig. 18.

After a comprehensive study on Urban Transportation for the new Federal Capital, completed in June, 1981 a portion of the area in the district marked out for phase II development was selected for a transportation center. see fig. 18. The transportation centre will serve as a terminal for the proposed metro-line, inter-city and intra-city bus/taxi service. Adjacent to the transportation center is the site ear marked for a future Railway (station) Terminal. The transportation center is at the hub of the Federal Capital City. Here the city transit buses interchange.

* Optional Rail Alignment Corridors were considered, (see fig 19)



Fig. 17

MAP OF NIGERIA SHOWING

▣ THE FEDERAL CAPITAL TERRITORY—ABUJA SHOWS ITS CENTRALITY IN THE NATIONAL CONTEXT

—— EXISTING RAILWAY LINES WITH STRONG COASTAL INTERIOR ALIGNMENT - WITH TWO MAIN LINES EXTENDING FROM THE PORT CITIES NORTHWESTLY TO THE INTERIOR OF THE COUNTRY. ABOUT TWO THIRDS OF ALL KILOMETER GOODS CARRIED ON ENTIRE SYSTEM ARE CARRIED ON THE LAGOS—NGURU LINE; WHILE THE REMAINING ONE THIRD IS CARRIED ON THE PORT-HARCOURT-MAIDUGURI LINE

---- POSSIBLE RAILROAD CONNECTION TO THE FCT

• NRC TERMINI CITIES AND TOWNS

-----STATE BOUNDRIES

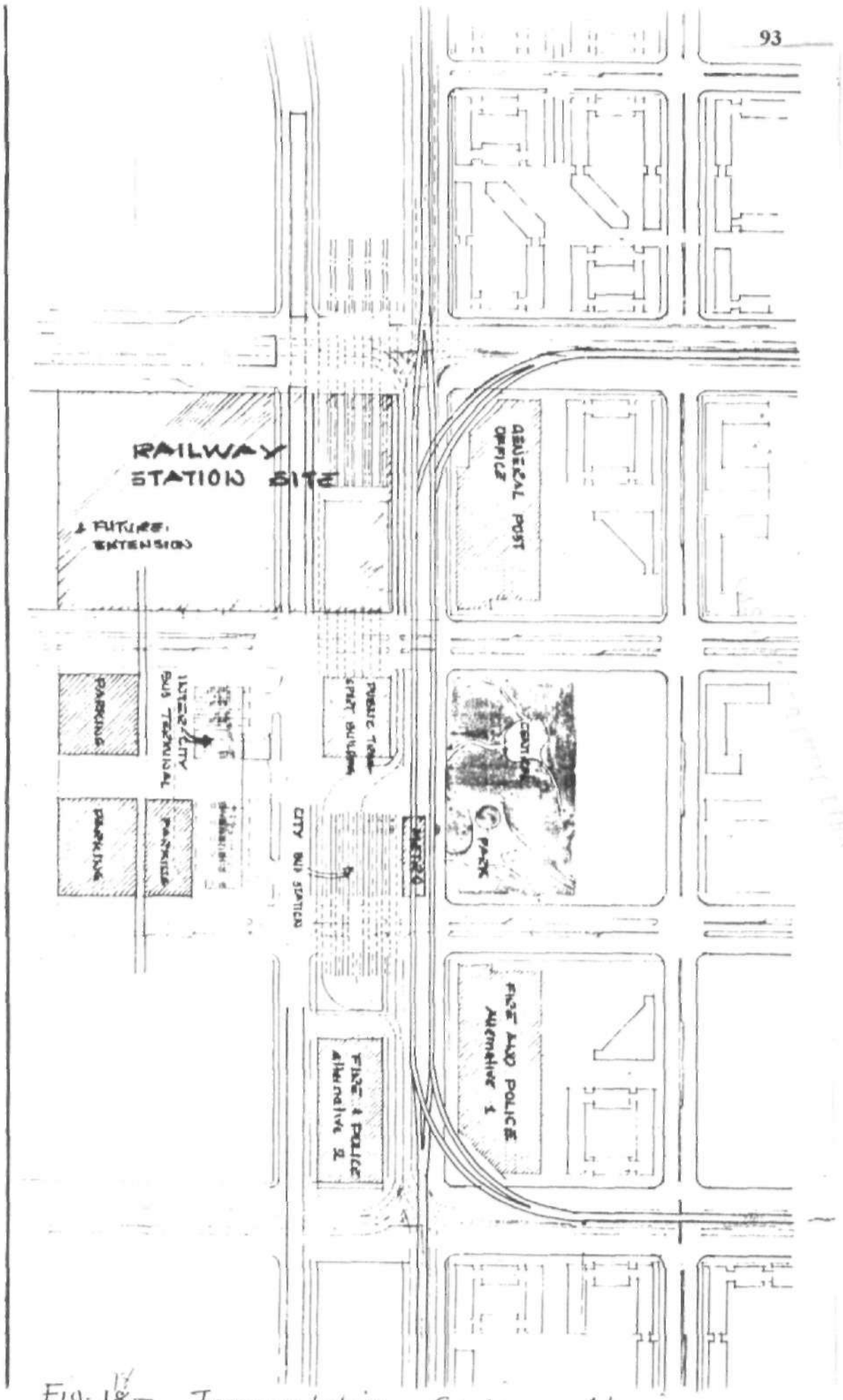


Fig. 18 — Transportation Centre - Abuja

MAP OF F.C.T. – ABUJA

SHOWING

CAPITAL CITY SITE

OPTIONAL RAIL ALIGNMENT CORRIDORS

A – A CONNECTION FROM BARO TO F.C.T CROSSING THE CENTRAL PART OF F.C.T.

B – A CONNECTION ACROSS THE NORTHERN PART OF F.C.T., JOINING THE MAINLINE AT MINNA.

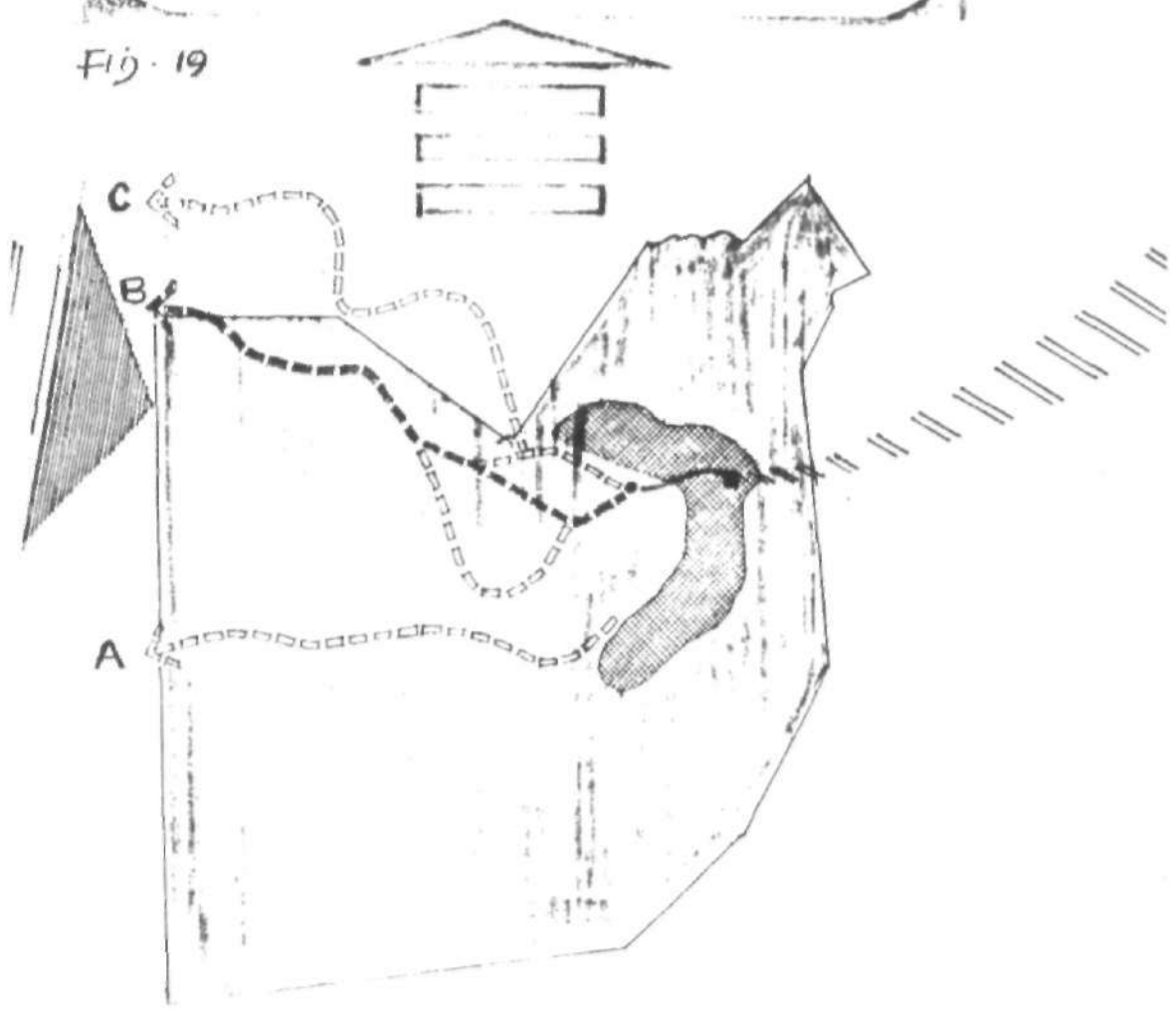
C – AN ALIGNMENT ALONG THE EXISTING ROUTE A-124 TO MAIN LINE AT MINNA

--- SELECTED ROUTE – B

DICTATED PRIMARILY BY THE TOPOGRAPHY OF THE N-WESTERN PART OF THE F.C.T. – POSSIBLE RAILWAY DE

■ TRANSPORTATION CENTRE

Fig. 19



A - is a connection from Baro to the FCT crossing the central part of FCT.

B - is a connection across the Northern part of FCT, joining the main line at Minna.

C - is an alignment along the existing route A - 124, to main line at Minna.

The selected route-13, was dictated primarily by the topography of the North Western part of the FCT which is suitable for railway development.

7.2.1 Merits of Selected Site

Fig. 20 shows the Central Area of the FCT highlighting the public transport system. The Transportation Center which is located just by the Central Area is served by all major city roads and by the transit spines and it is to be connected to the regional system. The selected railroad route 13, crosses the airport express and terminates at the transportation center.

The location of the site in terms of its relationship with road circulation patterns has such advantages as:

i) Easy and convinient access route.

ii) Location facilitating passenger/goods transfer of mode of travel.

iii) Suitability for a possible future rail link with the Abuja International Airport as indicated by the plan in fig. 20 taken from the 1979 Master Plan for Abuja.

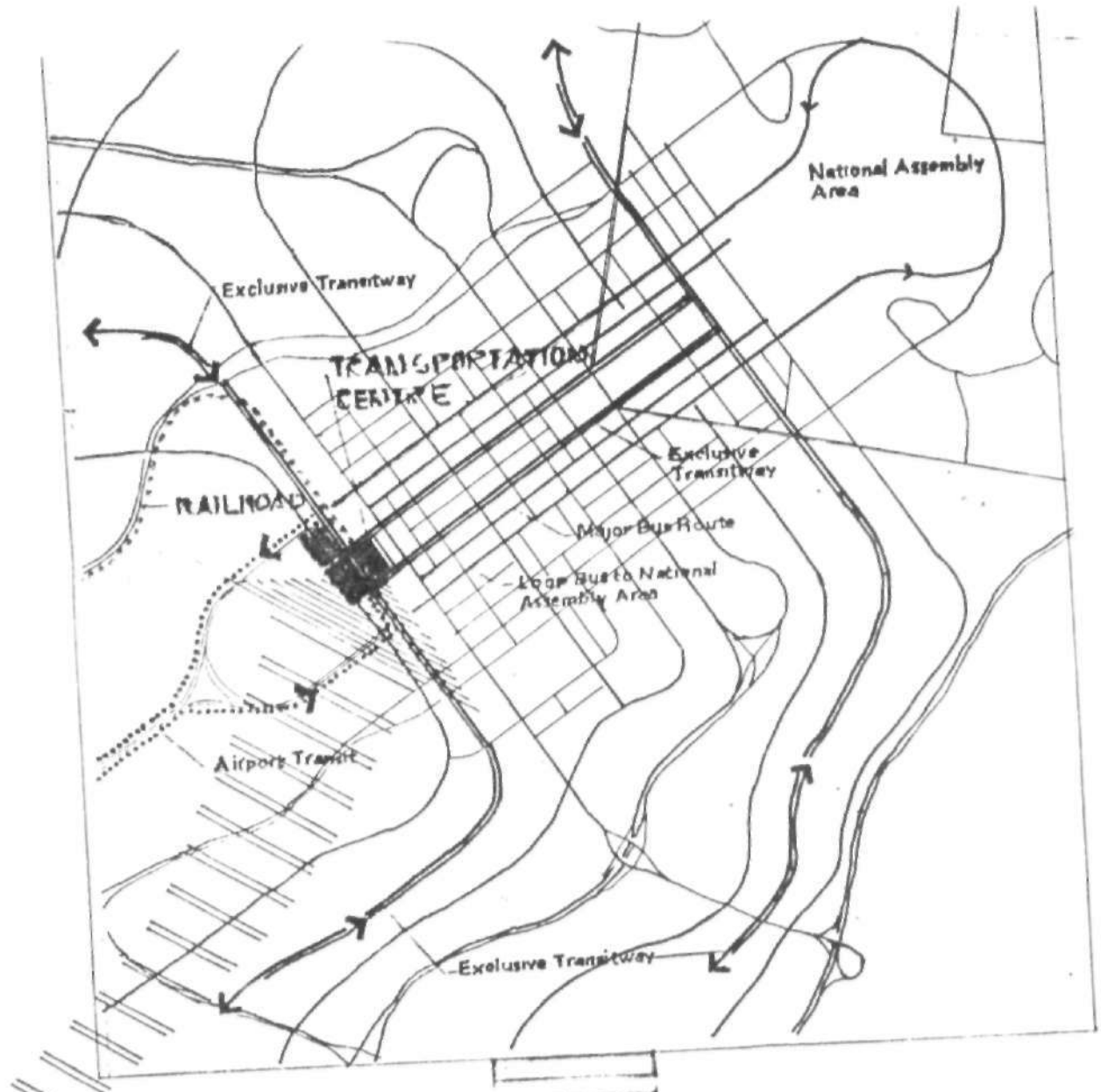


Fig 20

CENTRAL AREA - FCT

- SHOWING PUBLIC TRANSPORT SYSTEM

TRANSPORTATION CENTRE
LOCATED IN THE CENTRAL AREA WHICH IS SERVED BY ALL MAJOR CITY ROADS AND BY THE TRANSIT SPINES AND IS TO BE CONNECTED TO THE REGIONAL SYSTEM.

RAILROAD ACCESS
SELECTED ROUTE TERMINATES AT TRANSPORTATION CENTER CROSSING THE AIRPORT TRANSIT EXPRESS

RAILWAY STATION SITE
ADJACENT TO TRANSPORTATION CENTER – FACILITATES PASSENGER/GOODS TRANSFER OF MODE OF TRAVEL

7.3 Site Analysis

7.3.1 Climate

The FCT - Abuja has two main seasons, the Wet and Dry seasons. The wet season extends from April to October and the dry season from November to April. Each of the seasons are characterized by specific types of prevailing winds. The wet season brings with it the South West track winds originating from the equatorial rain belt and blowing from the high pressure zones which come over the atlantic during this period. It is the same wind that brings rainfall to Abuja. The dry season is accompanied by harmattan - a dust laden wind, blowing from the North East. See fig. 21 a, b.

7.3.2 Observations from Prevailing Winds

1) The North East winds prevails in the months of;
   - November - March
   - Bring with it Dust and
   - Hot air.

2) The South West winds prevails in the months of;
   - April - October
   - Brings with it Rain and
   - Cool Breeze

Generally, Abuja has Hot - Humid semi wet climate. Highest temparatures are recorded during the dry season with low relative humidity. Rain fall is also moderate.

NIGERIAN CLIMATE : SHOWING ABUJA



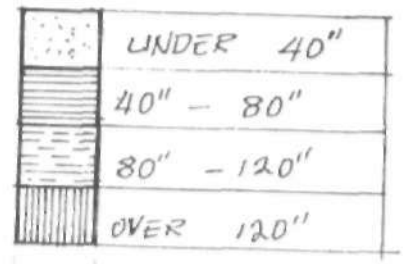


FIG 21 WET SEASON WINDS AND RAINFALL – TROPICAL MARITIME AIR-MASS (SW-TRADES)



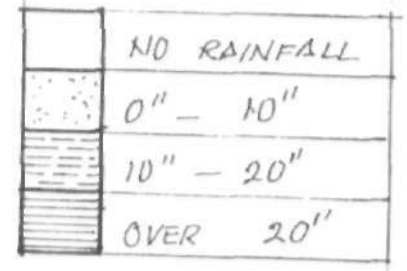


FIG. DRY SEASON WINDS AND RAINFALL – TROPICAL CONTINENTAL AIR-MASS (HARMATTAN WIND)







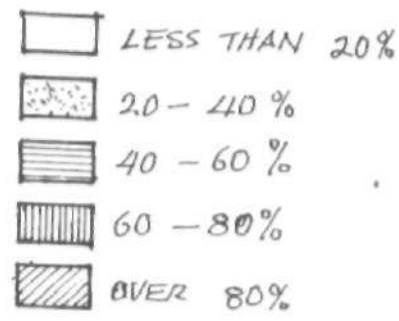


FIG RELATIVE HUMIDITY FOR THE MONTHS OF JULY & JANUARY.

The presence of relief features around Abuja may alter its climatic characteristics, this does not call for diverse architectural requirement except in situations where micro climatic conditions forms a significant part of the design data.

7.3.3 Radiation

In the human environment radiation is felt as air temparature. Response is usually influenced by humidity in the air. In the FCT, the difference between the highest and lowest temparatures during each season may be as high as $17^{o}C$.

7.3.4 Recommendations

Comfortable living environment will depend on the designers ability to maximise the use of environmental elements capable of reducing the effect of heat, humidity and protection from rain and dust. Planning with climate is therefore essential.

Due to the wide disperity in temparature changes throughout the year, building materials used on this project should be able to withstand thermal stress, that is expansion and contraction. Particularly large fenestration which are needed for the purpose of lighting up of the vast interior of the station building would need a material other than ordinary glass. Fibre glass could be recommended.

Buildings should be placed in a way that its large openings face North East and South West. Reasons are;

i) To help reduce the force of wind against the building.

Fig 22 a
MEAN MONTHLY TEMPERATURE AND HUMIDITY

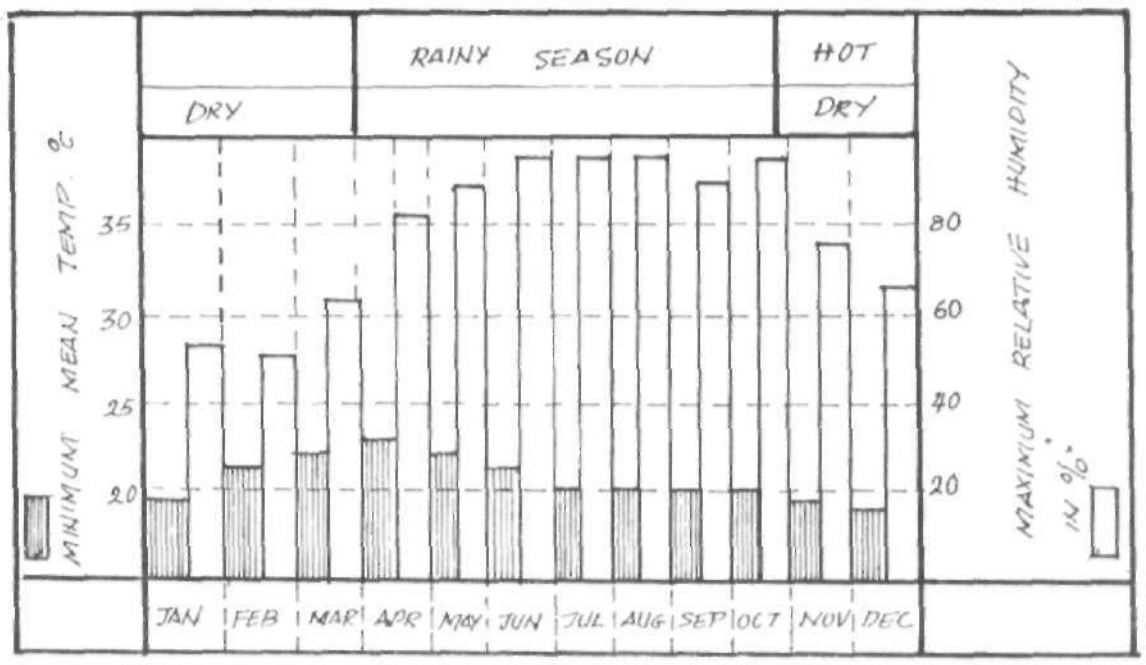
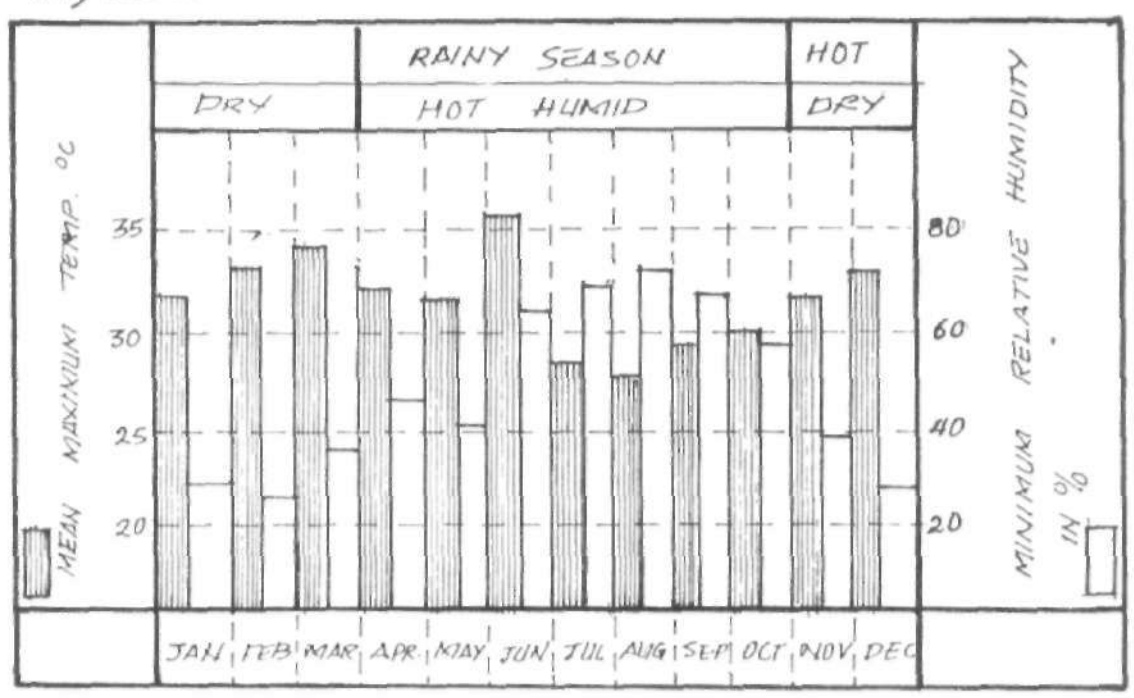


Fig 22 b



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Fig 22 c
MEAN MONTHLY RAINFALL

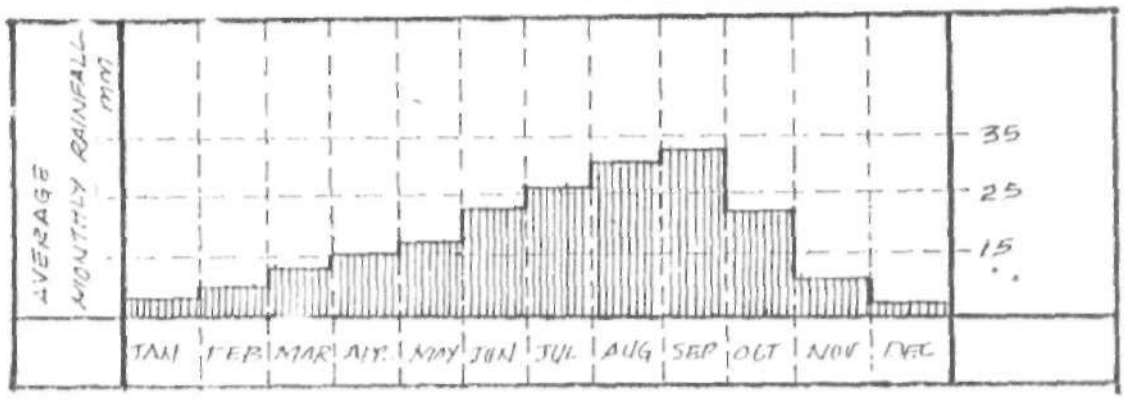
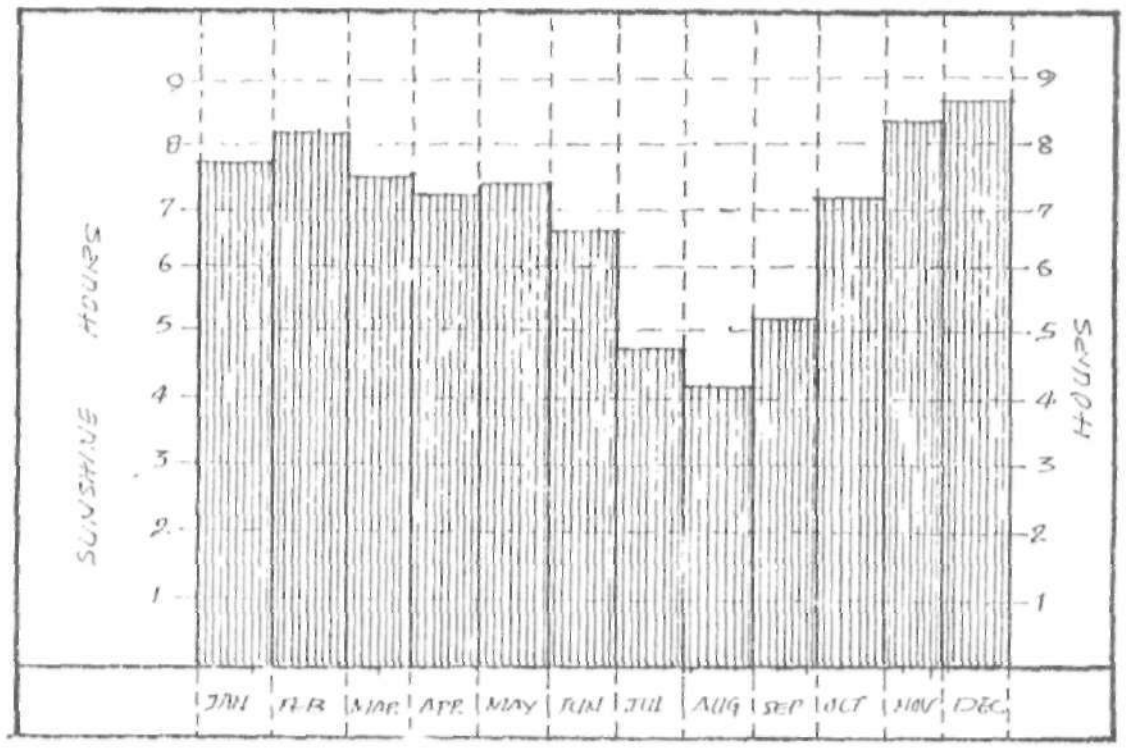


Fig 22 d
MEAN MONTHLY SUNSHINE DURATION



RECEIVED

ii) To allow free flow of air through the building all year round.

Since rain can be sudden, heavy and wind borne, well constructed gutter with good run-off should be constructed for flat roofs, and deep over hanging eaves for pitched roofs.

7.3.5 Vegetation

The general vegetation of the FCT - Abuja falls within the Guinea Savannah region which is generally grassland with a few scattered trees. Towards the South, it has a little forest and total grassland towards the North, with a little forest along the bank of the river Niger. See fig. 23. This type of vegetation poses no development constraints.

7.3.6 Topography and Soil Structure

The elevation of the site above sea level is about 495m. The slope is about 0.5% and therefore can be considered as flat ground at the northern part. The Eastern part is much lower at 490m above sea level. This will enhance split level development which is most suitable for station design. A greater part of the site as it is now has been cleared, ready for development.

Soil structure is classified stony (gravel), with slight concretion of sandy loam. It is well drained with moderate run-off potential and erodibility.

7.3.7 Surrounding Features and Site Constraint

Development is already going on all around the proposed railway station site. Features surrounding the site at the moment are shown in plate 6.

Fig 23 - MAP SHOWING THE VEGETATION OF ABUJA

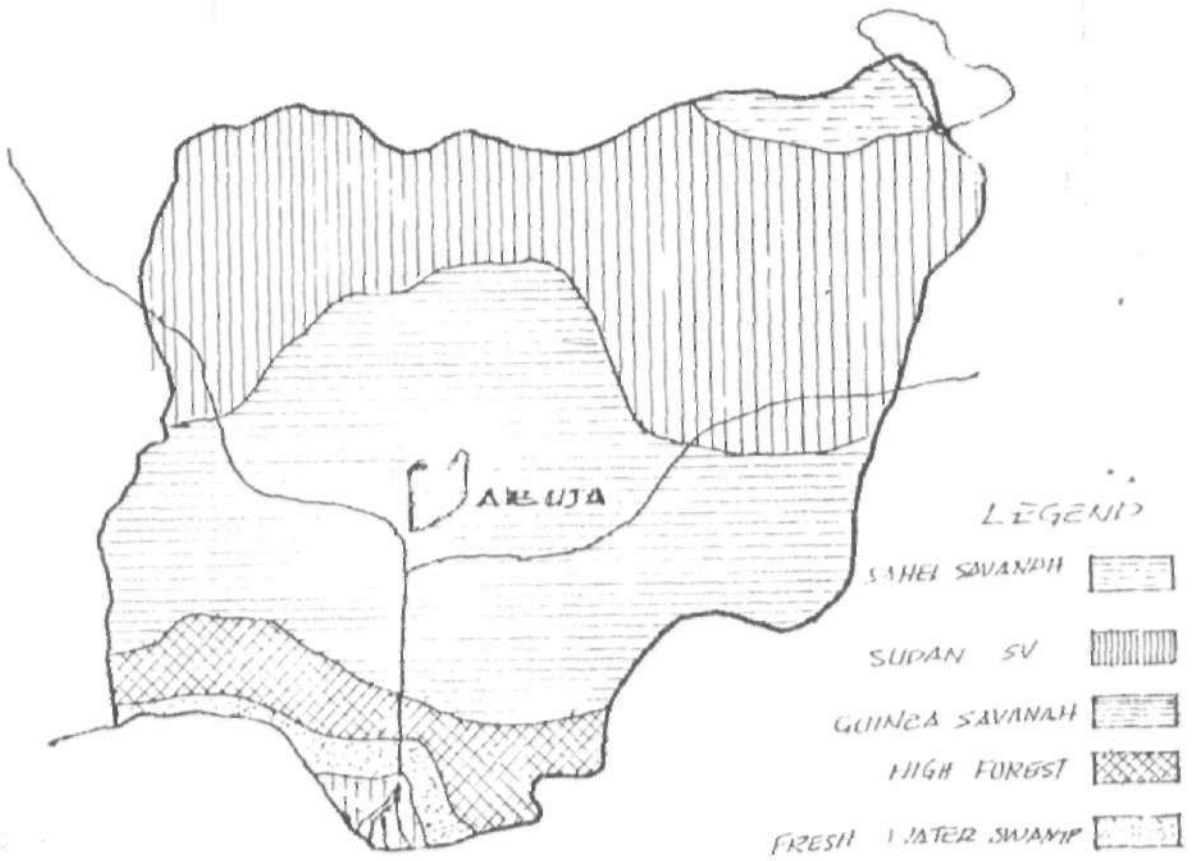
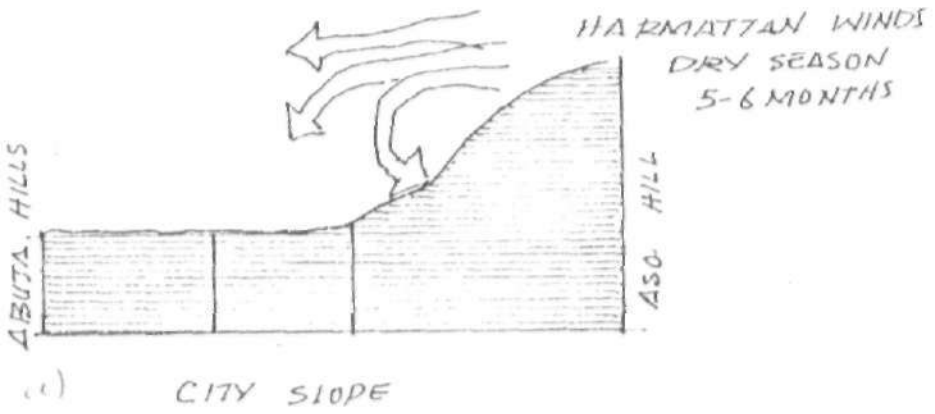
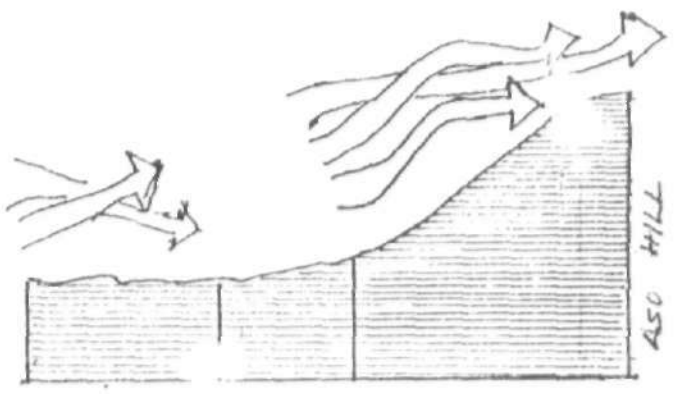


Fig 24
SEASONAL WIND PATTERNS



(a) CITY SLOPE



(b) CITY SLOPE

Plate 6a

SITE : SHOWING SURROUNDING FEATURES



plate 6a
View Towards The North - showing Wuse Road and Airport Express to the left.



plate 6b
View towards North-East showing Wuse Road and development across the Road.

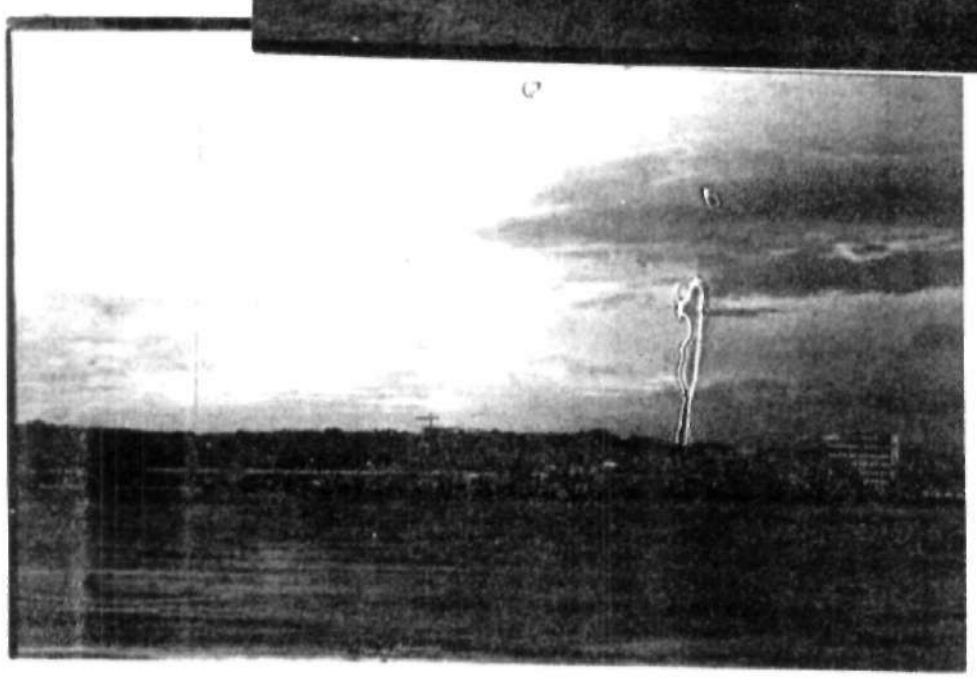


plate 6c
View towards East - showing Depressed portion of site and Bolingo Hotels.

The only constraint on this site is the size. This goes for all plot within this zone where land conservation is very important.

CHAPTER EIGHT

DESIGN ANALYSIS

8.1 Design Brief

The scope of this thesis as earlier stated in limited to the design of a passenger railway station, classified under "Big frequency station with a capacity to accommodate 1,500 people at peak periods. The design brief as issued by the authorities of the NRC are as follows:-

- Departure Axis
- Arrival Axis
- Waiting Rooms
- Concourse
- Social Facilities (T.V Room)
- Staff Offices
- Postal Agency
- Bank, Insurance etc
- Parcels Office
- Platforms
- Station Police
- First Aid/Clinic
- Accommodation
- Lounge/Bar
- Restuarants
- Arts and Crafts shop
- Souvenirs Craft shop
- Lettable Shop

- Lettable Offices
- Circulation Spaces
- Parking Spaces
- Services

8.1.1 Railway Accommodation

Volume of trafffic expected to be handled by private railways cannot be estimated now, since it has never existed. This of course should affect the total areas required for the functions of : i) Administration ii) Passenger and baggage handling, iii) Train crew and train operations planning. Train and workshop services, light freight and mail handling. For the purpose of this work a general open office space shall be provided for administration of the private railways.

8.1.2 Management

Separate office accommodation is to be provided for Nigerian Railway Corporation, Station Manager and staff (accountancy, maintenance, operations, press and Public Relations).

8.1.3 Divisional Headquarters

It is expected that Abuja will become one of one of the divisional headquarters of the NRC. This office can be sited within the same premises at the Railway station but may not share the same building. This does not fall within the scope of this work.

8.1.4 Laison Office

All policy and high administrative decisions come from the NRC headquarters at Ebute-Metta Lagos. It is anticipated that this headquarters will eventually move to Abuja - but meanwhile a liason office shall be located in the proposal.

8.2 Design Parameters

The Parameters considered in the process of providing a design for the proposed terminus indicate Circulation Functionality, Safety, Security, Climatic Control, Aesthetic lighting and Ventilation.

8.2.1 Circulation:

Vehicular and pedestrian traffic, Goods delivery and staff shall be properly segregated.

- Conflict in cross or opposing flows shall be avoided.
- A logical flow of passengers from ingress through to the platform is desirable.

8.2.2 Safety:

It is expected that trains are controlled by automatic signals and stop devices. Automatic sprinkler and other active fire control devices should be installed particurlarly within the platform area. Five proof, resistant, retardant, nmaterials should be specified for construction and finishes. Automatic fire door/shutters should be used at escape stairs and exists. Planning should not encourage crossing over rails by passengers, rather an under pass or over pass should be provided where necessary.

8.2.3 Security:

Safe-guarding life and property of the corperation as well as those of passengers and other station users is important. This can be achieved by,

- Fencing the station premises
- Introducing checking point at strategic points
- Policing within and around the station.

This willl ensure control of movement of all unauthorised persons and prohibited commodoties (including explosives) within the terminus or from being carried on board the train.

8.2.4 Functionality:

This is a very important aspect of design. The following should be duely observed.

The concourse which is the first port of call for most passengers should be centrally located and other activity areas properly linked to it. Easy visibility of principal passenger facilities from this point is necessary - Information boards on train arrival and departure, Railway commercial facilities as well as directions as to how to obtain travel tickets for air, bus etc and public inter-change must be well displayed.

Optimization of space utilization and the elimination of dead spaces are important factors for cost effectiveness.

Objects or elements like columns should not be placed in way that would obstruct flow of passengers.

Sufficient space must be allocated to important activities like queing for tickets.

8.2.5 Aesthetics:

This basically depends on the taste of the designer. It is an embordiment of non technical laws in design meant to give elegance and dignity of an edifice It involves the use of technique of design (form and massing). material (construction) and finishes (coats and paints).

8.2.6 Lighting and Ventilation:

Natural and Artificial lighting are both required and required land essential in station building. Particularly within the enclosed platform area, Natural lighting is required in qualitative and quantitative variety, manipulated to give varying effects by controlling quantity transmission medium and direction of incident light. Solar reflective and transluscent plastic or fibre glass could be specified.

Artificial lighting, directed with a pin pointed individual light or indirect, using ceiling reflectors, or diffused through transluscent membrane or selected on technical and aesthetic bases.

Large concourses and public halls within the station shoiuld be adequately illuminated all day, localized or flood lights should be provided to create dramatic effect on special features.

8.2.7 Natural Ventilation (Cross Ventilation):

Natural Ventilation is highly required in public buildings especially the tropics, where ACs and other artificial methods tend to be ineffective during extreme heat conditions; and where continous power supply cannot be guranteed.

8.2.8 Comfort:

Proper circulation of air particularly at the platform concourse and waiting areas should be ensured. As much as possible protection against train noise, vibration and blast should be provided, by the use of sound proofing materials, cavity wall, double glazing and floated flows.

Blast and vibration levels should be taken into consideration in rail terminal construction

8.2.9 General Features of a Modern Station

The General Features of a Modern Station Building are; Transparency, Flexibility, Unrestricted movement and Vast Interior Volumes.

Transparency: Extensive use of glass on both the external and interior of building is a common feature integrating the outside with the inside and also enhances security.

Flexibility: Free interlocking of spaces allows for easy future structural expansion and re-adaption of functional spaces to meet required need.

Un-Restricted Movement: Free flow of large numbers of people is highly desirable. Movement area is usually free of coloumns.

Vast Interiors: Large volumes such as Atriums are common features in the modern railway station. This plays on the psychology of the users as it helps to neutralise the effect of crowdedness.

8.3 Zoning of Activities:

Grouping of activities should as much as possible encourage segregation of unrelated and conflicting activities and movement of passengers, staff and goods. Ticketting, which is a very essential activity, and luggage facilities should go together and should be easily accessed and placed at a level convenient for departing passengers. Police and other common facilities should be centrally located for easy reach of both departing and arriving passengers.

The bubble diagram in fig 25 shows the functional grouping of activities.

8.4 Determination of Population of Users

A number of factors shall be considered in trying to determine the number of users expected at peak period on which to base the design of this station. They are:

i. The size and projected population of Abuja and the FCT as a whole

ii The administrative, commercial and political functions of Abuja as the Capital City of Nigeria

iii The nature of the railway station: as a terminus it should be able to cater for departing and arriving passengers on long distance, and also for commuter and local trains.

iv It should meet the needs of the people escorting or welcoming friends and relatives at the station.

v That departing or arriving passengers shall spend a maximum of 30 minutes to complete all formal proceedings at the station.

vi That trains shall visit the platforms at Abuja hourly

vii That the public using common facilities provided within the station shall form 3% of the population at peak periods.

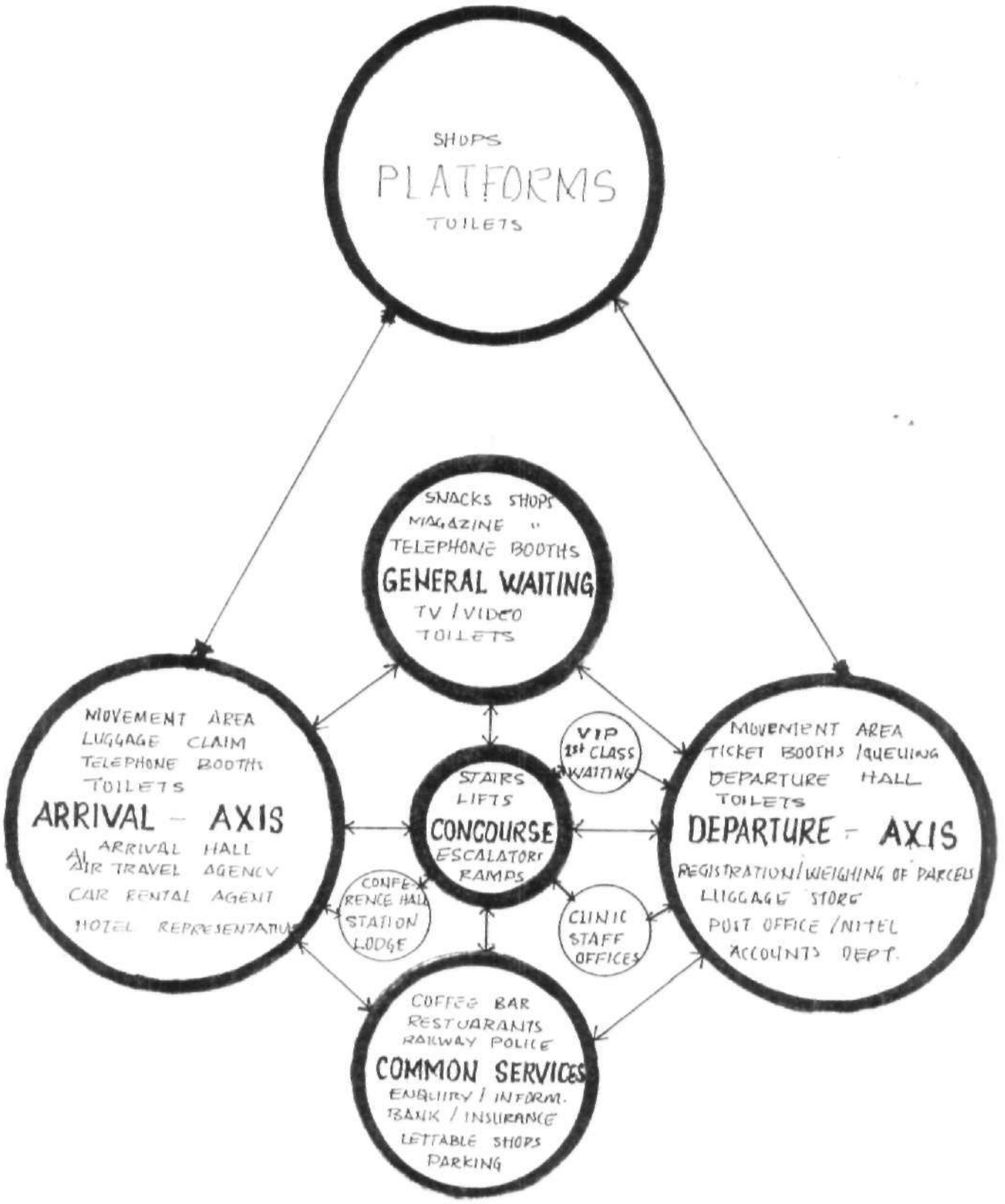


Fig 25 - FUNCTIONAL GROUPING OF ACTIVITIES

8.5 Special Requirements Area Dimensions

The type of services and sizes of passengers handled by a station, the class of traffic and other local conditions determine the kind of facilities and the sizes of same provided.

8.5.1 Egress and Ingress

Should be planned in such a way to allow free movement of large volume of human traffic. The egress should be approximately the width of the platforms so that bottle neck possibilities are avoided

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Passenger movement would require:

i. Turnstiles of 1.60m in diametres allowing 50 passengers per minute

ii Single swing doors of 0.9m width allowing 77 passengers per minute

iii Double swing doors of 1.8m width allowing 117 passengers per minute

8.5.2 Ramps, Stairs and Escalators

Ramps: Gradient should not exceed, 10% for passengers in foot and 6.5% for trucking.

Minimum: Clear width for trucking ramps are:

i. for one line traffic, the width should be 1.8m

ii. for two lines traffic, the width should be 3.05m

Stairs: The carring capacity of stairs increase and decrease with height. For traffic in one direction for a height of about 6 1m, the carring capacity is as follows:-

i For long distant passenger
12 passnegers per foot per minute or
33 passengers per metre per minute

ii. For sub-urban passengers
18 passengers per foot per minute or
59 passenger per metre per minute

Escalators: Have a carring capacity of approximately 108 passengers per minute. They are most suitable for sub-urban traffic.

For height less 7.62m, under normal conditions, passenger escalators and elevators are not recommended as approaches to individual passenger platforms. They may be desirable as suppliments to stairs for the aged and infirmed.

8.5.3 Concourse, Office and Lodge

Concourse: The main concourse should be large enough to accommodate a full train load in standing position. The train concourse should also be sufficiently broad to permit the gathering of a full train laod at the gate. A minimum width of 6.09m is required.

Offices: Areas designed for office use should meet the requirements of the railway, and that of other tenants. Therefore flexibility should be a major consideration. The open office design would be most

appropriate where by movable partioning can be adopted wherever desirable.

Station Lodge: Provision shall be made to accommodate passengers, particularly for the conveniece of strangers. The Station lodge shall be designed to function like any graded standard hotel with facilities like banquet hall, lounge and bar, which can be used by the railway passengers, staff as well as the public.

8.6 Schedule of Accommodation

Departure Axis		**Waiting Area**	
Movement Area	**Req. Dimension**	**Movement Area**	**Req. Dimension**
Width	5m	VIP Lounge	$25m^2$
Escalators	1.6m	Press Secretary	$20m^2$
Stairs	1.5m	First class waiting	$70m^2$
Ramps	6% slope	Second class waiting	$180m^2$
Luggage Lift	2.1m X 2.1m	Phone booths 4 No.	1m X 1.5m
		Travel agency	$36m^2$
Active Area		**Arrival Axis**	
Information/Enquiry	$30m^2$	Car Rental services	$30m^2$
Ticket booth (8 No.)	1.5m X 2.5m	Hotel Representative	$30m^2$
CPBA/Files	$1.2m^2$	Enquiry Information	$25m^2$
Queing Area	$150m^2$	Phone booths 4 No.	1.0 X 1.5m
Luggage/Parcel storage	$75m^2$	General waiting	$125m^2$
Weighing/Registration	$50m^2$	Toilets	$125m^2$

Passive Area

Restaurant	$98m^2$
Kitchen	$20m^2$
Servery	$8m^2$
	$50m^2$
Security	$12m^2$
Coffee Bar	$48m^2$
Storage Area	$25m^2$
Bank hall	$60m^2$
Workplace/counter	$48m^2$
Other	$12/8m^2$
Insurance	$15m^2$
Waiting	$12m^2$
Clerk Counter office	$15m^2$
Clinic wards	$40m^2$
Waiting/Dressing	$24m^2$
Records store	$10m^2$

Shops

Gift shop	$36m^2$
Arts and crafts shop	$48m^2$
Gift shop	$36m^2$
Snacks bar	$48m^2$
Cigar shop	$12m^2$
Coblers	$36m^2$
Hair saloon	$36m^2$
Barbing saloon	$36m^2$
Magazines/Newsp.	$12m^2$
Shops to let	$48m^2$

Common Area

Main Concourse	$576m^2$
Mails-Telegraph (Nipost)	

Police counter	$36m^2$
Police Officer	$12m^2$
Store/files	$6m^2$
Guard rooms	$8m^2$

Bank hall	$60m^2$
Workplace/counter	$48m^2$
Other	$12/8m^2$
Insurance	$15m^2$
Waiting	$12m^2$
Clerk Counter office	$15m^2$
Clinic wards	$40m^2$
Waiting/Dressing	$24m^2$
Records store	$10m^2$

Railway Staff Offices

G.M's office	$36m^2$
Trains office	$20m^2$
Chief station master(csm)	$12m^2$
Information section waiting	$12m^2$
Senior Station Master (ssm)	$10m^2$
Station Master	$10m^2$
Asst. Station Master	$10m^2$
Gen. Off. Supervisor	$20m^2$
Yard Supervisor	$12m^2$
Principal Traffic commercial officer	$24m^2$
Secretary to PTCO, STCO	$12,10m^2$
PTC Inspector	$24m^2$

Secretary to PTCI, STCI officers	12,10m^2
Station Superintendent	12m^2
Gen. off. C&W HTO, STO	24,12,10m^2
Gen. off. Tel/Comm, HTO, STO	24,12,10m^2
Train movement Monitors	15m^2
Control runs	48m^2
Manager's office	30m^2
Secretary	12m^2
Asst. Manager	24m^2
Reception/waiting	12m^2
Engine crew	12m^2
Electronics, store	12, 16m^2
Gen. Off. Admin.	48m^2
Meeting Room	60m^2
Staff Restaurant	72m^2
Staff common room	36m^2
Toilets	24m^2
Accounts office	36m^2
Accountant	12m^2
Asst. Accountant	12m^2
Platform Area Width/ Length	40/250m^2
Staff parking	480m^2
Private/Rental car parking	480m^2

8.7 Planning Concept, Form and Development

8.7.1 Planning Concept

A large railway station like this is normally crowded with activities, essentially the movement of passengers, luggage and goods in relation to the platforms are mainly the determining factor in evolving a planning concept. Fig 26a and 26b shows the basic flow of passenger and the passenger - luggage movement alternatives respectively. Fig. 27 show the overall planning concept centralising the main entrance and the concourse with other activity areas surrounding them. A clear segregation of departing and arriving passengers and separate routes for luggage movement can be seen.

8.7.2 Form Development Concept

Maximisation of space utility is a very essential consideration in station planning and as such outrageous use of forms may constitute a problem.

The linear grid pattern is often used as this would usually harmonise with the linear nature of the train platform. The basic unit 'U' and 'I' in combination gives of well defined spaces and movement axis (indicated by arrows) linking up all parts of the complex as shown in fig 28.

The focal point where the main concourse is best located forms the nucleus and distribution point of dispersing and converging passengers and users, within the commercial block and to the other blocks. This takes the form of a rectilinear grid to cater for cross movement.

Fig 26a

BASIC FLOW DIAGRAM

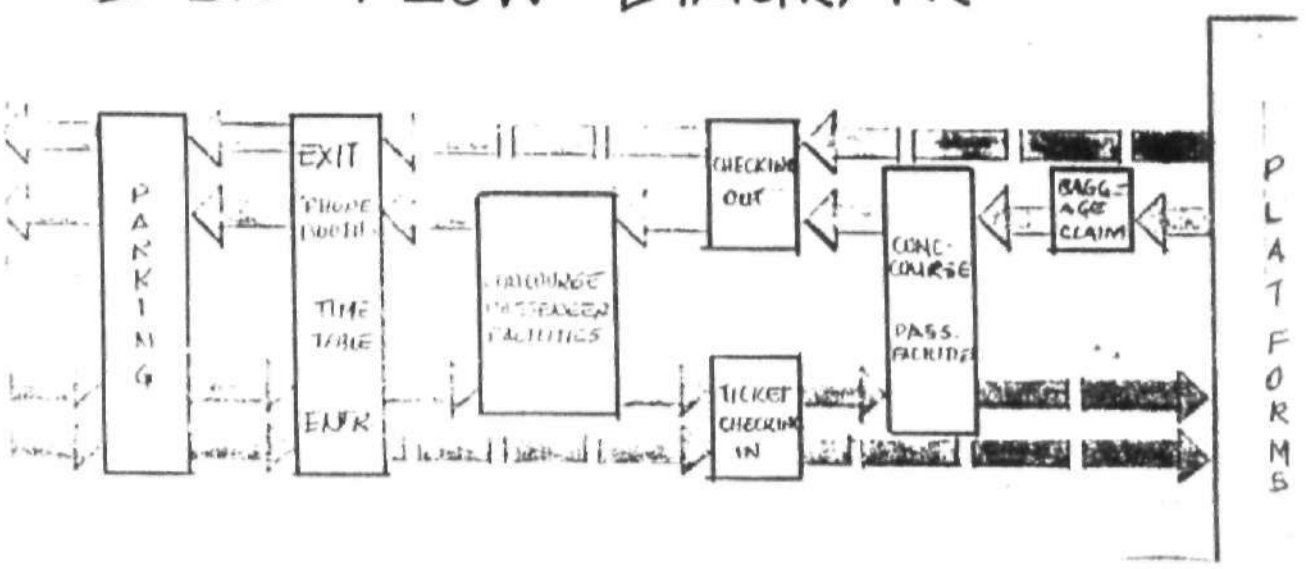
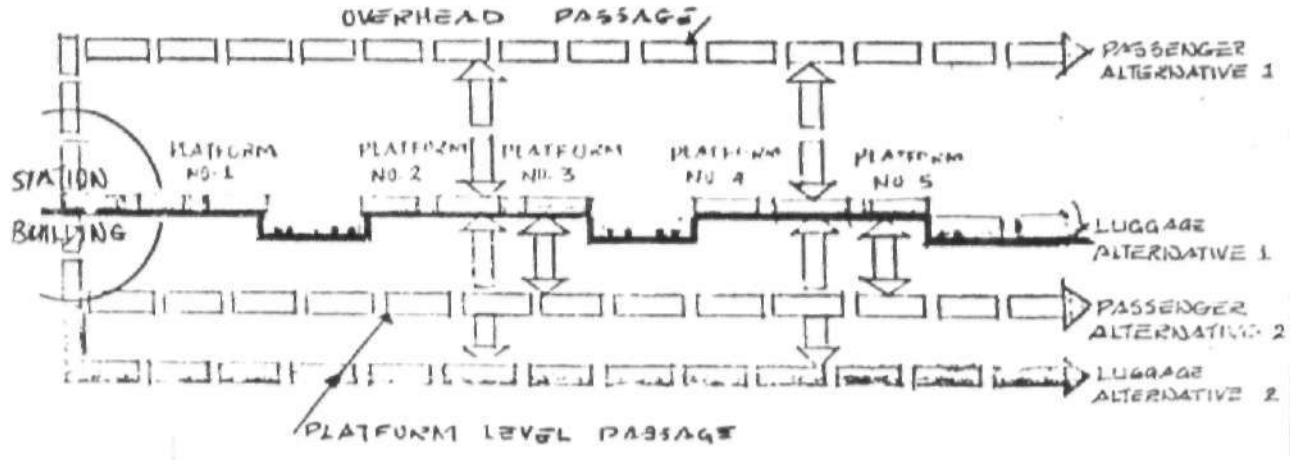
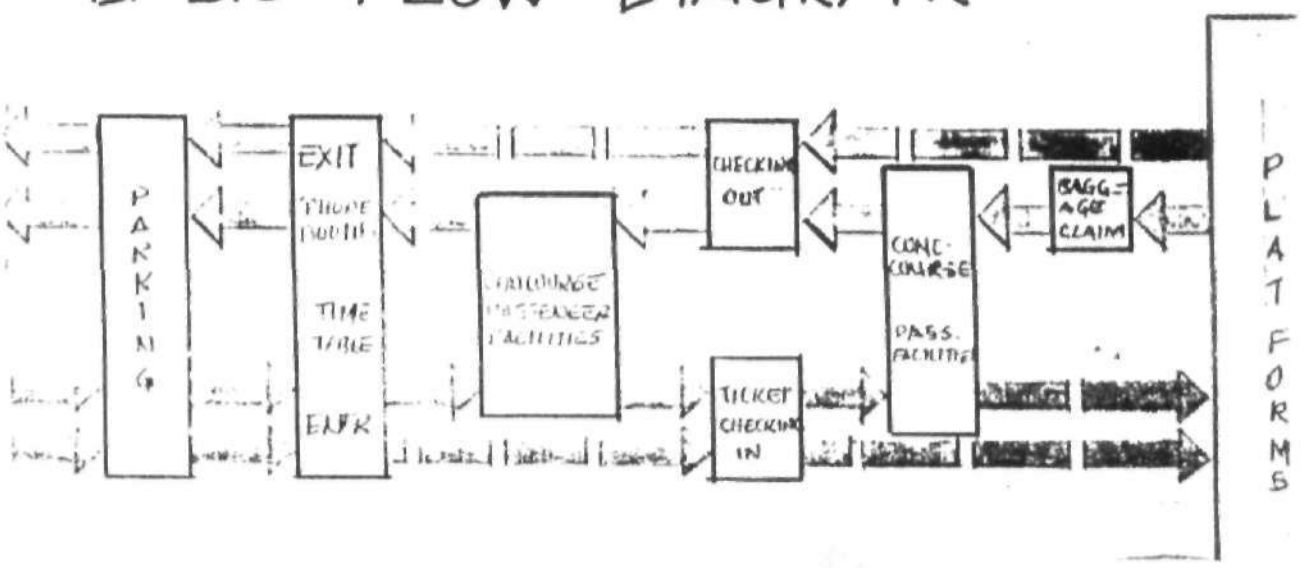


Fig 26b

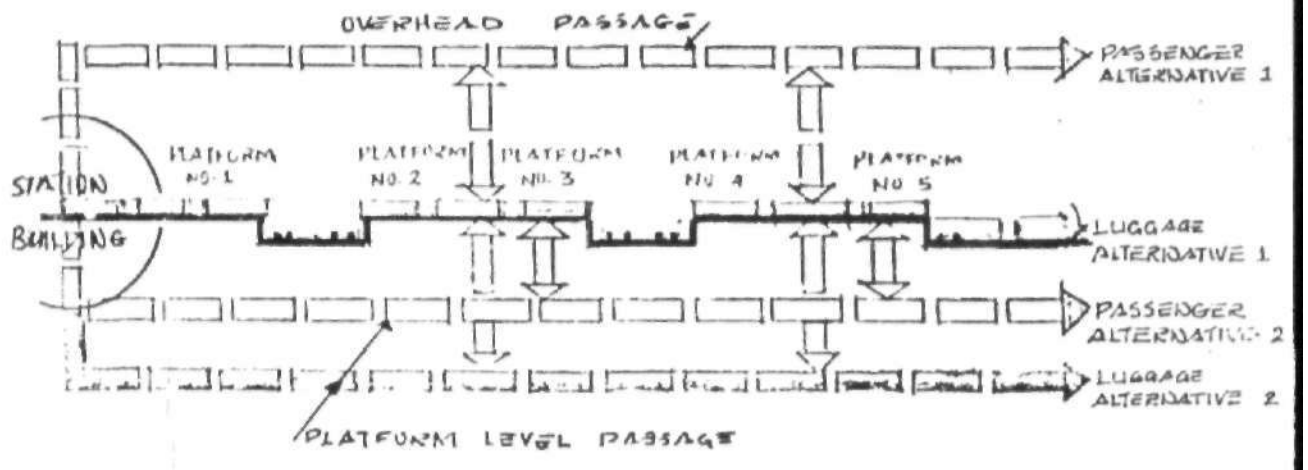
PASSENGER-LUGGAGE MOVEMENT ALTERNATIVES



BASIC FLOW DIAGRAM



PASSENGER-LUGGAGE MOVEMENT ALTERNATIVES



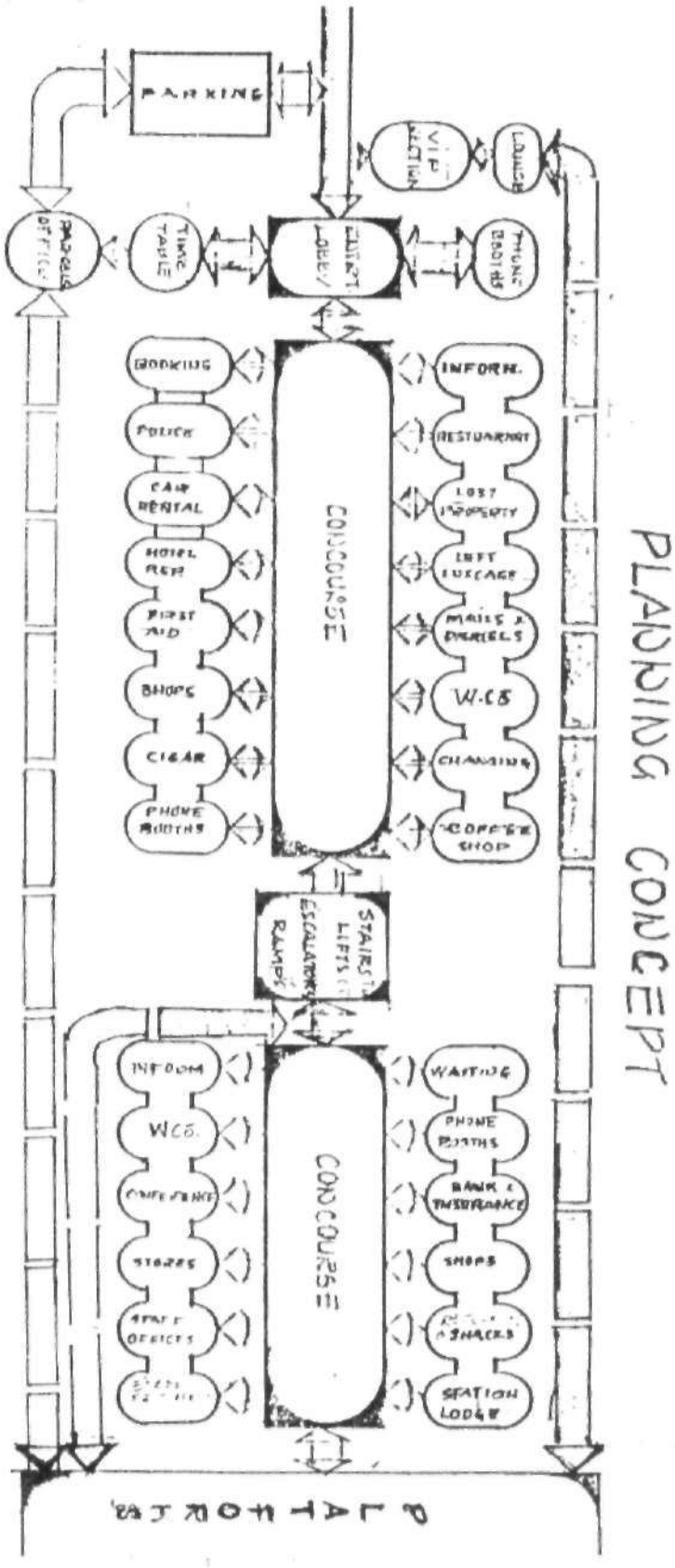

PLANNING CONCEPT
LEVELS 1 & 2
LEVELS 3 & 4
PARKING
VIP SECTION
LOUNGE
PASSPORT OFFICE
TIME TABLE
ENTRANCE LOBBY
TRUNK BOOTHS
BOOKING
POLICE
CAR RENTAL
HOTEL RES.
FIRST AID
SHOPS
CIGAR
PHONE BOOTHS
CONCOURSE
INFORM.
RESTAURANT
LOST PROPERTY
LEFT LUGGAGE
MAILS & PARCELS
W.C.S
CHANGING
COFFEE SHOP
ESCALATORS
STAIRS
LIFTS
RAMPS
INFORM
W.C.S
CONFERENCE
STORES
STAFF OFFICES
CONCOURSE
WAITING
PHONE BOOTHS
BANK & INSURANCE
SHOPS
SNACKS
STATION LODGE
PLATFORMS

Fig 27

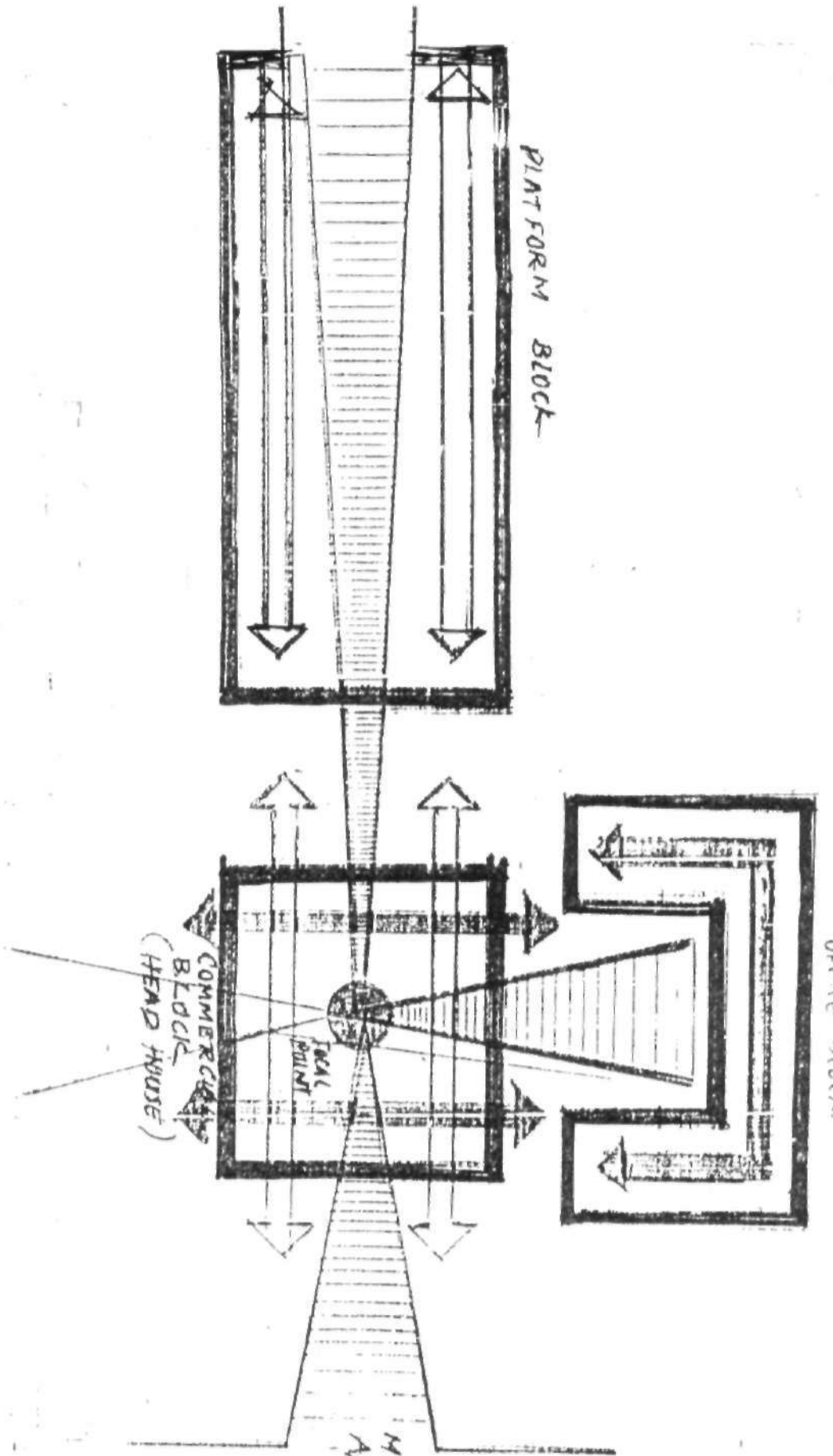


Fig 28 - FORM DEVELOPMENT CONCEPT.

The platform takes a rectilinear form, while the office/lodge blocks take a kind of curvilinear form derived from a grid pattern to reduce distance of movement, create usable secured space for parking while still maintaining the focus on the nucleus.

One important element given consideration in this design is flexibility, in order to give room for elements of the system to grow as desired. Free inter-locking of spaces to allow for the accommodation of unusual numbers that may result in changes in pre-established schedules which may sometimes lead to over crowding.

Also, the grid pattern gives room for easy physical expansion of structure which may be desired in the future.

8.7.3 Site Concept

Due to the nature of the existing condition of the site, and for the purpose of this design, four ground levels have been determined. The split level design is most suitable for a railway station of this standard - which makes this site an advantage.

Fig. 29 shows two alternatives to this approach as it relates mainly to the platform and the segregation of both pedestrian and vehicular traffic.

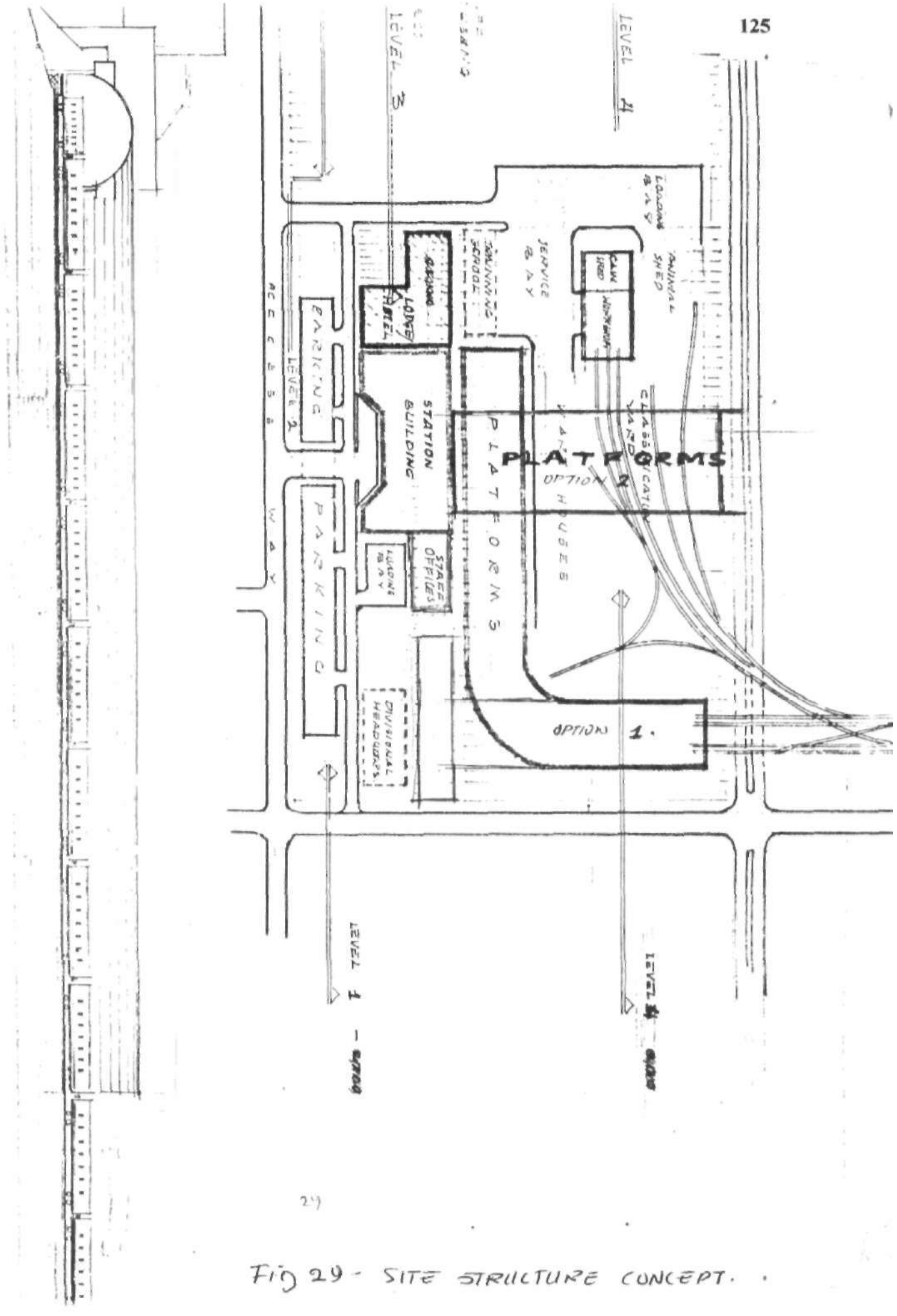


Fig 29 - SITE STRUCTURE CONCEPT.

CHAPTER NINE

9. CONCLUSION AND RECOMMENDATION

9.1 Conclusion

Virtually every Nigerian suffers some consequences of our railway affliction. Employment in the railway has declined drastically in the past 20 years, laying off of staff has been on the increase while salaries are delayed and paid in arrears of months.

Action by the Federal Government for the railways to regain their health, will require an accurate understanding of the problem and its causes to be able to prescribe remedies. The Chinese Government has already been informed about this need and towards the end of this year experts have been sent down to study and plan a programme for revitalising the NRC.

If the nation is to realise its economic growth potential during the remainder of the twentieth century and beyond. The railways must be in a condition to move significantly increased freight and passenger volumes quickly and safely.

Rail transportation is the most energy efficient of all modes, both in freight and passenger services. With regard to freight transportation, research indicates that railways are significantly more energy efficient than trucks - their ubiquitous competitor, or airlines, and slightly more efficient than even barge movement. A study has shown that to move 100,00 tons of freight between New York and San Francisco requires 43,416 man days by high way, 11,151 by water and 3,220 by rail. The actual surface contact of the steel wheel on the steel rail is less than the area of a 50K coin - so friction is very small. Therefore the force required to move a particular amount of

load by rail is about 7.5 times less than that for the same load hauled on rubber tyres on the highway. (Source: Encyclopaedia Britanica, Vol. 23, 19).

As for passenger service, research indicates that railroads, when properly utilised are substantially more energy efficient than either automobiles or air lines in moving passengers, approached in efficiency only by inter-city bus

The summary of this is that a healthy, progressive, strengthened railroad system is absolutely essential to our national objective of energy conservation.

The revitalised railway industry should therefore differ both in physical appearance as well as in the satisfaction it brings to employers, investors, shippers and the public.

9.2 Recommendation

Certain measures have to be taken if the NRC be resuscitated and for it to be able to sustain its own economy. The aspects concerned include:

- Stock improvements
- Services
- Policy
- Management
- Infrastructure and
- Fixed installation

In the light of this study, the recommendations include the following:

Improved Rolling Stock

The NRC must improve its fleet of rolling stock. Electric locomotives, modern freight cars and fast moving passenger train sets should be purchased.

Railway technologists and engineers should be trained so that they can work on re-modelling of old stock

Services

Aside from the general freight and passenger service, the NRC should introduce commuter service, fast, safe and comfortable inter-city services with buffet, coffee bars attached. Railway leisure/escortion trips should be provided.

Policy

Federal subsidies and federally guaranteed loans (such as World Bank Loan) is vital to the recovery and survival of the railway industry. In the same vein, government should invest huge sums of money on modern day technologies or purchasing of ultra-modern stock.

Government should take measures to reverse preferential treatment of competing modes.

Privatisation of the railway has become necessary as this will give room for healthy infra-modal competition which helps to generate efficiency within the system.

Management

In terms of operations management can be improved by introducing Computers into the system, automated signalling and computerised communication systems should be installed.

Infra-structure and Fixed Installation

Electrification of lines as an alternative to dieselization is recommended. This will of course involve installing a 50 c/o single phase A C system with 25kv contact wire

voltage. Fixed installation for power supply (sub stations) and power transmission (contact wire system) as well as cabling of telecommunication lines running along side railway line, and reconstruction of all NRC station buildings.

Others

Introduction of commercial and social activities within the station building will help to generate revenue, attract users and encourage constant patronage.

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APPENDIX I

SOME IMPORTANT DATES IN RAILWAY HISTORY

1804 - Richard Trevithick of England invented the steam locomotive

1825 - The stockton and Darlington Railway, built in England by George Stephenson became the first railway in the world to offer regularly scheduled steam- powered train service.

1831 - The South Cardinal Canal and railway Company began the first regularly scheduled steam powered rail service in the United State.

1869 - The World's first trans-continental rail line was completed across the United States.

1895 - The Baltimore and Ohio Railway started the World's first electric train-line service in Baltimore.

1964 - Japanese passenger trains began operating between Tokyo and Osaka at speeds up to 209 km per hour (130 mph)

Source: The World book Encylopedia, Volume 16, 1990

APPENDIX II

TABLE SHOWING PROGRESS OF RAIL CONSTRUCTION IN NIGERIA

SECTION			YEAR			DISTANCE
Lagos	-	Ibadan	1898	-	1901	193 km
Ibadan	-	Jebba	1901	-	1909	295 "
Kano	-	Baro	1907	-	1911	562 "
Jebba	-	Minna	1909	-	1915	253 "
P/Harcourt	-	Enugu	1914	-	1916	243 "
Enugu	-	Makurdi	1916	-	1924	220 "
KDJ	-	Kafanchan	1922	-	1927	179 "
Kafanchan	-	Jos	opened to traffic in			
					1921	101 "
Kafanchan	-	Bauchi	1958	-	1961	238 "
Bauchi	-	Gombe	1961	-	1963	166 "
Gombe	-	Maiduguri	1963	-	1964	302 "