DESIGN PROPOSAL FOR AN ULTRA MODERN RAILWAY STATION KAFANCHAN, KADUNA STATE, NIGERIA

WITH EMPHASY ON CONTEMPORARY BUILDING MATERIALS

(*POLYURETHANE*)

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF TECHNOLOGY IN ARCHITECTURE

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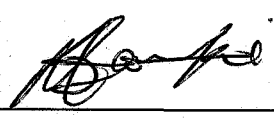
DECLARATION

I, SARKI C. MUSA, with matriculation number 2001/12464VA of the department of Architecture, Federal University of Technology, Minna, Niger State do solemnly declare that the research and work presented for the Bachelor of Technology in the department of Architecture has been solely carried out by me under the close supervision of Arc A. I. ANUNOBI of the department of Architecture, school of Environment Technology, Federal University of technology Minna, Niger state.



STUDENT

SARKI C. MUSA

DATE

CERTIFICATION

This thesis (B.Tech Degree) entitled an **"Ultra Modern Railway Station"** by Sarki c. Musa is an original work and meets the regulations governing the award of the Bachelor degree of Technology in Architecture, and is approve for its contribution to knowledge and literary presentation.

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DEDICATION

First and foremost to my almighty GOD, who has granted me mercy and the strength to push on till this very day. Next is to my dearly beloved parents **Dr and Mrs. Usman Sarki,** and also to my family

ACKNOWLEDGEMENTS

My endless gratitude is to my Almighty God who has been my strength and provider, and to my parents Dr and Mrs. Sarki, who have given me support both financially and morally may the Almighty God bless and reward you abundantly, and also to my project supervisor Arc A. I. Anunobi, I shall always remember with envy and affection for your patience, advice and constructive criticism of this script, amidst other teaching of yours. I pray that almighty God reward all of you abundantly. You are indeed a veritable asset. My siblings: Ashyya, Bariyat, Essua, Yakubu, Blessing, David, Asher, you guys are something else, my Uncles, Aunties, Colleagues, Friends, and The Authors of material used to form this thesis, my Mentor and lecturers and staff of Department of Architecture, School of Environmental, Federal University Technology, Minna. Whom patience, love and sacrifice have brought me this honor, with gratitude in my heart I want say than you and God Bless you all.

ABSTRACT

The history of transportation is largely one of technological innovation. Advances in technology have allowed people to travel farther, explore more territory, and expand their influence over larger and larger areas.

Throughout history, the economic wealth and advancement of different developing nations have been closely tied to efficient methods of transportation. Transportation provides access to natural resources and promotes trade, allowing a nation to accumulate wealth and power.

Transportation systems and the routes use have great influence on both how and where people live. Reliable transportation allows a population to expand throughout a country's territory and to live comfortably in remote areas far from factories and farms. The growth and expansion of most developed nations e.g. U.S.A was directly related to the means of transportation available at the time.

Even in ancient times, new tools such as foot coverings, skis, and snowshoes lengthened the distances that could be traveled. As new inventions and discoveries were applied to transportation problems, travel time decreased while the ability to move more and larger loads increased. Innovation continues today, and transportation researchers are working to find new ways to reduce costs and increase transportation efficiency.

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CHAPTER ONE

1.0 INTRODUCTION

The railway system is virtually a form of road transportation which consist of locomotive engine or a self propelled motor dragging a series of cars (wagons) over two parallel rail lines placed adjacent to each other at a specific distance on a permanent road way.

Thus the railway station or terminal is place were the train loads or off-loads passengers, goods, or were repairs and refueling is done, and it could also be a place were more coaches or wagons could be added or subtracted. Generally the railway transportation system has contributed immensely to developing countries as a whole as it plays a very large part in the transportation sector of most of these developing countries.

1.1 BACKGROUND TO STUDY

Railway construction in Nigeria was started by the British colonial government in Nigeria in 1898 from Lagos in the Southern Protectorate. Railways were seen by the administration as a better way of consolidating power in the newly acquired territory. Also, railways were developed to gain access to the rich agricultural and mineral resources in the hinterland, hence the diagonal orientation of the network running inland from the two major seaports of Lagos and Port Harcourt The Nigerian Railway Corporation (NRC) was established by an Act of Parliament in 1955 for the main purpose of carriage of passengers and freight in a cost-effective manner.

The development of railways in Nigeria in the early 20th century contributed to the growth of many towns that ultimately became large industrial commercial cities, such as Kaduna, Bauchi, Kano, Oshogbo, Ibadan, Lagos, Enugu, Kafanchan, and Port Harcourt. The railway also helped develop the early potential of tourism.

Railway transport in Nigeria is inefficient though and has hardly developed at all over the past 100 years compared to railways in the developed world. This is due both to maladministration by successive governments and to the lack of a functional transport policy ensuring a constant pattern of railway development. The 100% ownership by the national government has contributed greatly to this neglect. This project suggests public–private partnership as a remedy for the ailing railway system in Nigeria with a view to developing the nation's railway system to international standards for the next millennium.

Information from Nigerian railway cooperation, Nigeria covers 923,768 km² but there is still only 3505 route-km of railways, of which 1788 km are sharp curves. They are all single-track 1067-mm gauge with either steel or timber sleepers. A short 75-km standard-gauge section is under construction between Ajaokuta and Warri and there are plans to extend this line to the new capital of Abuja. By comparison, in 1992, there were 32,180 km of all-weather federal roads not including state and rural roads. Concurrent with the progressive increase in the total length of all roads from about 72,000 km in 1962 to about 150,000 km in the mid 1980s, the number of airports increased from 2 in 1970 to 16 in 1990. By contrast, the length of railway network stayed constant at 3505 route-km over the last 100 years. For comparison, the Japanese railway network expanded progressively from 0 to about 27,000 km between 1872 and 1998.

These shocking statistics point out the urgent need to redesign, expand and renovate the

Nigerian railway into an efficient nationwide network serving both industrial and agricultural zones and facilitating development of the cash-crop economy in the hinterlands as well. A similar far-sighted approach is needed for dealing with the traffic snarls and urban sprawl in the new industrial and commercial zones across Nigeria.

1.2 AIM AND OBJECTIVES

1.2.1Aims

The aim of these proposal for the design of an ultra modern railway station located in kafanchan, Kaduna south, Kaduna, is to meet up demands according to international standards as regards the transportation of passengers as well as goods in and around Kaduna state and the country, there by increasing commercial, economic and most importantly to explore the rich tourist activity located in area.

1.2.2 Objectives

- To ensure the most efficient use of the railway transport sector.
- To meet up demands according to international standards.
- To promote commuter service between Kaduna and other economically related states
- To promote a transportation system that is more efficient and less costly to other modes of transport.
- To promote an effective transport system that can carry a large number of passengers thus reducing traffic congestion.

1.3 RESEARCH METHODOLGY

Pertinent information for this project was gotten from two main sources; primary and secondary sources.

The **primary sources** of information were from case studies and interviews. Case studies was done covering some existing, similar centers in and outside the country such as Kaduna city railway station, Minna city railway station, Zaria city railway station, and also the Frankfurt main hauptbahnhof railway terminal, Germany. The information and materials gotten from these case studies and the problems identified would be helpful in the design of the intended project which is suppose to be a solution to the existing problems.

The **secondary sources** of information were from literature reviews, and consultation of journals, magazines, books, past thesis of related projects and area of emphasis etc.

1.4 SCOPE AND LIMITATIONS

1.4.1 SCOPE OF STUDY

The study is to cover the current problems facing the railway transportation sector as a whole and the possible solutions to such problems. The railway station complex will include the following

- Administrative department
- 1st class. 2nd class. and 3rd class ticket booking
- Parcel and telegram department

- Security and surveillance
- Restaurant
- Mini-shopping mall
- Mini-exhibition,
- Multipurpose hall

The proposal will comprise of other structures on site such as

- Workshop
- Warehouses
- Staff quarters
- Guest lodge
- Staff club house

1.4.2 LIMITATIONS

Some of the restrictions encountered in the course of carrying out the project include:

i. Restrictions in getting relevant materials and information

ii. Cost of transportation from one place to another

In addition, some of the areas this project does not cover include:

i. The propose project does not manufacture or assemble automobile or its parts.

ii. It does not serve and repair all kinds of vehicles.

1.5 DEFINITION OF TERMS

i. **Ultra:** extreme; exceeding or going beyond all others of the same kind.

ii. **Modern**: of the latest, most advanced kind, or using the most advanced equipment and techniques available.

iii. **Railway**: permanent railroad with rails fixed to ties providing tracks for locomotive engines and .wagons.

iv. **Station**: a regular stopping place on a transportation route.

v. **Depot**: a building for railway or bus passengers

vi. **Junction**: a place or point of meeting

vii. **Terminal**: either the end of a transportation line (as a railroad) with its offices and freight and passenger station.

viii. **Freight**: loading and carrying of goods, or cargo

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 TRANSPORTATION

Transportation is the movement of people and goods from one location to another. Throughout history, the economic wealth and advancement of different developing nations have been closely tied to efficient methods of transportation. Transportation provides access to natural resources and promotes trade, allowing a nation to accumulate wealth and power. Transportation also allows the movement of manpower, equipments, and supplies so that a nation can have an efficient workforce war.

Transportation systems and the routes use have great influence on both how and where people live. Reliable transportation allows a population to expand throughout a country's territory and to live comfortably in remote areas far from factories and farms. The growth and expansion of most developed nations e.g. U.S.A was directly related to the means of transportation available at the time. The more compact cities of the U.S. eastern seaboard are the result of early human- and animal-based transportation systems that allowed only short trips. The more sprawling cities of the western United States are the result of an automobile-based transportation system that permits much longer travel distances.

Transportation is vital to a nation's economy. Reducing the costs of transporting natural resources to production sites and moving finished goods to markets is one of the key factors in economic competition. The transportation industry is the largest industry in the

world. It includes the manufacture and distribution of different means of transportation vehicles, the production and distribution of fuel, and the provision of transportation services.

The same transportation systems that link a nation can also be used in the nation's war efforts. The rapid movement of troops, equipment, and supplies can be a deciding factor in winning a battle or a war. Just as mobilizing a nation's military strength is critical to success, disabling an enemy's transportation system is usually an early strategic objective of any armed conflict.

2.2 PROBLEMS ASSOCIATED WITH TRANSPORTATION

In the later 20th century, people became more aware of how transportation systems affect the environment. For example, the burning of petroleum-based fuels for motor vehicles and smoke released from burning coal of locomotive engines creates pollution that can be harmful to human health. In the United States, the Environmental Protection Agency (EPA) estimates that three-quarters of all carbon monoxide and one-half of all oxides of nitrogen come from motor vehicles. In addition, petroleum-based transportation is responsible for approximately one-third of carbon dioxide emissions in the United States, an important contributor to global warming. Other environmental effects of transportation systems include impacts on noise levels, water quality, hazardous materials, natural habitats, and wetlands. Many Nations now require that before a new transportation project is begun a detailed study called an environmental impact statement must be prepared to anticipate how the project will affect the environment

2.3 TYPES OF TRANSPORTATION

There are three major types of transportation known to man, these methods of transportation include:

2.3.1 Land Transportation:

Land transportation is the dominant form of transportation in the world. People can move about land under their own power, either by walking or by other forms of human-powered transportation such as the bicycle, auto-mobiles, rail, e.t.c. People also use domestic animals as a means of transportation, both for riding and for pulling wheeled wagons or carts. The most common forms of land transportation combine the wheel with electric or fuel-powered engines to move people and freight quickly and efficiently.

2.3.2 Air Transportation:

Air travel has revolutionized global transportation by dramatically reducing the time needed to travel great distances. Journeys across nations or oceans that might have taken weeks or months can now be made in a matter of hours. With large numbers of people traveling in airplanes, air transportation has become a major part of the world's transportation system.

2.3.3 Water Transportation:

Some of the greatest achievements in transportation relate to methods of crossing water. Two-thirds of Earth's surface is covered by water, so the progress of civilization is naturally tied to the ability to move over water. Water transportation has progressed from

early rafts and canoes to more-complex sailing ships to today's large passenger and freight ships

2.4 RAILWAY TRANSPORTATION

Railroads are paths of parallel metal rails that allow a wheeled vehicle (usually called trains) to move more easily by reducing friction. Iron rails were first used in the early 1800s to guide horse-drawn wagons. After the invention of the steam locomotive in 1804, steam engines replaced horses as the primary means of power. Modern locomotives commonly use electric motors or diesel engines and pull long trains of passenger or freight cars.

The railway transportation sector is one of the most important sectors in the world, affecting not only the economy but also the cultures of the world. It provides jobs for millions of people, generates billions of dollars in worldwide revenues, and provides the basis for a multitude of related service and support industries. Railway transportation revolutionized transportation in the 20th century, changing forever the way people live, travel, and do business.

The railway has enabled people to travel and transport goods farther and faster at a cheaper rate, and has opened wider market areas for business and commerce. The railway industry has also reduced the overall cost of transportation by using methods such as mass production (making several products at once, rather than one at a time), mass marketing (selling products nationally rather than locally), and globalization of production (assembling products with parts made worldwide).

As a result of easier and faster transportation, the world economies have become dependent on the mobility that has allowed remote populations to interact with one another, which increased commerce and even tourism. The transportation of goods to consumers and consumers to goods has become an industry in itself. The railway transportation system has also brought related problems, such as air pollution (carbon gases released by diesel and coal combustion engines), and highway fatalities (usually due to sharp bends and bad topography). Nevertheless, the railway transportation industry continues to be an important source of employment and transportation for millions of people worldwide.

2.5 EFFECT OF THE RAILWAY TRANSPORTATION SECTOR ON WORLD ECONOMY

2.5.1 Economic and social impact

The railway transportation system has become a vital element in the economy of the industrialized nations that many companies and government agencies provide transportation to the public and to businesses; such agencies are known as service providers. They are classified into two major groups: freight and passenger. Freight service providers transport cargo, such as manufactured products, raw materials, and food, and are generally hired by businesses. Passenger service provider's move people from place to place and are usually hired by individuals. Both freight and passenger service providers often operate out of a facility known as a terminal. Terminals are

centralized meeting points where service providers can manage the flow of trains, serve customers, and efficiently load and unload freight and passengers

2.5.2 Railroad development

Modern rails evolved from the edge rails used in northern England at the beginning of the 19th century. Wagons were held on this type of track by flanges extending downward from the inner edges of the wheels. (Many authorities define railroads and railways, in distinction from tram roads, as lines on which the rails are raised above the roadbed.) After the practicability of the locomotive was demonstrated in 1829, and as locomotives replaced horses, mules, and the occasional stationary engines used to pull cars up grades by means of cables, edge rails came into general use.

Rails of various shapes were devised. The prototype of those used today throughout the world, except in Great Britain, was the flat-footed T rail designed in 1830 by the American inventor Robert Livingston Stevens, who was the chief engineer and president of the newly established Camden and Amboy Railroad in New Jersey. In this type of design the T-shaped rail stands on a base broader than the head of the T, forming flanges at each side that permit the rail to be spiked directly to the ties. In the United States today the rail is mounted on metal plates, called tie plates, which are wider than the rail's base and prevent it from cutting into the ties.

2.5.3 Recreational travel

One of the conspicuous impacts of the railway transportation is encouraging nearly everyone to travel for recreation or leisure. Trains allow many people to increase the excitement of recreational their travels.

2.6 ADVERSE EFFECTS OF RAILWAY TRANSPORTATION

The mass use of trains or locomotive engines has also brought about undesirable consequences such as, air pollution (combustion of coal and diesel in locomotive engines), and railroad accidents (not common in Nigeria) etc.

Exhaust released from these locomotives contains substances that contribute to acid rain, smog, and global warming. The oxides in the exhaust combine with water vapor in the air to form acids, which return to the ground as acid rain. Smog irritates the eyes, throat, and lungs and also damages plants. Carbon dioxide, produced from the burning of fossil fuels including gasoline, is the leading cause of the greenhouse effect, a phenomenon thought to be responsible for rising global temperatures.

Another problem associated with railway transportation, though not so common in Nigeria is railway accidents.

2.7 THE NIGERIAN RAILWAY TRANSPORTATION INDUSTRY

Railway construction was started by the British colonial government in Nigeria in 1898 from Lagos in the Southern Protectorate. Railways were seen by the administration as a better way of consolidating power in the newly acquired territory. Also, railways were developed to gain access to the rich agricultural and mineral resources in the hinterland,

explaining the diagonal orientation of the network running inland from the two major seaports of Lagos and Port Harcourt.

The Nigerian Railway Corporation (NRC) was established by an Act of Parliament in 1955 for the main purpose of carriage of passengers and freight in a cost-effective manner.

The development of railways in Nigeria in the early 20th century contributed to the growth of many towns that ultimately became large industrial commercial cities, such as Kaduna, Bauchi, Kano, Oshogbo, Ibadan, Lagos, Enugu, Kafanchan, and Port Harcourt . The railway also helped develop the early potential of tourism.

Nigerian Railway Corporation operates a network of 3,505 kilometers (2,178 mi) of single track lines, all have 1,067 mm (3 ft 6 in) gauge. The network comprises the following lines:

- Lagos - Agege - Ifaw - Ibadan - Ilorin - Minna - Kaduna - Zaria - Kano, 1,126 kilometers (700 mi)
- Ifaw - Ilaro, 20 kilometers (12 mi)
- Minna - Baro, 155 kilometers (96 mi)
- Zaria - Kaura Namoda, 245 kilometers (152 mi)
- Kano - Nguru
- Kaduna - Kafanchan - Kuru - Bauchi - Maiduguri, 885 kilometers (550 mi)
- Kuru - Jos, 55 kilometers (34 mi)
- Kafanchan - Makurdi - Enugu - Port Harcourt, 737 kilometers (458 mi)

There are a few extensions of the 1,067 mm (3 ft 6 in) gauge network planned, but none of these have ever materialized since 1980, from Gusau on the branch to Kaura Namoda to Sokoto, 215 kilometers (134 mi), from Kano to Katsina, 175 kilometers (109 mi), and from Lagos to Asaba.

in the centre of the country a 1,435 mm (4 ft 8½ in) gauge (standard_gauge) network is very slowly progressing, its main line extends over 217 kilometers (135 mi) from Oturkpo to the Ajaokuta steelwork. A further 51.2 kilometers (32 mi) line of standard gauge is operational between the Itakp mines and the Ajaokuta steelworks. There are plans to add more standard gauge lines to these ones: Ajaokuta to Abuja and Ajaokuta to the Port of Warri, together 500 kilometers (311 mi) and from Port Harcourt to Makurdi over a distance of 463 kilometers (288 mi).

in the past a 762 mm (2 ft 6 in) gauge line operated between Zaria and Jos over a distance of 194 kilometers (121 mi), but this line has been closed and lifted long ago

All these trains are offering relatively new rolling-stock consisting of Couchette-type sleepers, air-conditioned first class sitting coaches and non-air conditioned economy class coaches. Trains to/from Lagos are also offering buffet cars. Between Lagos and Ifaw, a distance of 48 kilometers (30 mi), a local service is operating on working days on behalf of the city of Lagos.

All trains are diesel_locomotive operated. The railways owns theoretically nearly 200 locomotives, of which up to 75% are not operational, there are also about 54 shunters,

480 passenger coaches and over 4900 freight wagons, less than 50% of the coaches and wagons are in serviceable conditions.

At all 576 kilometers (358 mi) of main lines are controlled by panel interlocking and token less_block. Rail_tracks are mainly of the 29.8 kg/m, 34.7 kg/m and 39.7 kg/m types fixed by Pandrol K Type fastenings on steel sleepers (cross ties).

2.7.1 Railways and Politics

At independence in 1960, Nigerians inherited a vibrant, buoyant, flourishing and efficient railway system from the colonial administration. Although the single-track narrow-gauge network ran diagonally across the country, it was well able to haul all the agricultural products grown in the far north to the seaports at Lagos and Port Harcourt. The contribution of groundnuts from northern Nigeria, palm oil from eastern Nigeria and cacao from western Nigeria to the flourishing Nigerian economy at the time is reminders of the good old railway era.

However, further development of the railways was abandoned in favour of road transport by successive governments. Roads were expanded without any consideration of the attendant effects such as road traffic accidents, pollution, congestion, parking, etc. Some highways were constructed parallel to railway lines, resulting in competition rather than a complementary role between road and rail transport. The differences in allocation of funds for railway and this trend still haunts railway development today.

Similarly, at independence in 1960, Nigerian Railway Cooperation had 257 locomotives, 339 carriages and 3885 freight wagons to serve an estimated population of about 21 million people over 3505 route-km. However, by 1995, the rolling stock levels had

dropped to 70 locomotives (with 50% daily availability from 1995–96), 150 carriages and 1500 freight wagons to serve an estimated population of about 88.5 million people.

2.7.2 Status in 2008

According to the critique by Mazi Jetson Nwakwo, acting managing director of the NRC the rail system is suffering from the lack of political will by the nation's politicians. While the NRC had employed about 45,000 people between 1954 and 1975, current employment is only 6,516. He pointed out that no new wagons had been bought since 1993, and some wagons date back to 1948. Track condition limit trains to a speed of 35 km/h

2.8 PROBLEMS FACING THE INDUSTRY

Nigerian Railway Cooperation went more than once into bankruptcy during the last 20 years. Lack of maintenance on infrastructure and rolling_stock and a high number of employees the railway produced huge deficits, not taen over by the state. In 2005 after several re-organizations of the system passenger transport was reduced to four departures weekly from Lagos of which two went to Kano, one to Jos and one to Maiduguri; from Port Harcourt four trains every week ran to Kano (two weekly), one weekly to Jos and one to Maiduguri.News from Nigerian railway transportation system is indicating that the government in 2006 wanted to rebuild more or less the entire existing 1,067 mm (3 ft 6 in) network to standard gauge.

Other problems are listed as follows:

1. Technical problems such as tight curves, steep gradients, rail buckling with associated track/speed limits

2. Poor communications

3. Government interference with management structure

4. Lack of freedom to set tariffs

5. Lack of freedom to set tariffs

6. Falling rolling stock levels Plummeting traffic levels (freight and passenger)

7. Inflexible bureaucracy

8. Volatile and militant labour union

9. Irregular staff training

10. Irregular staff training

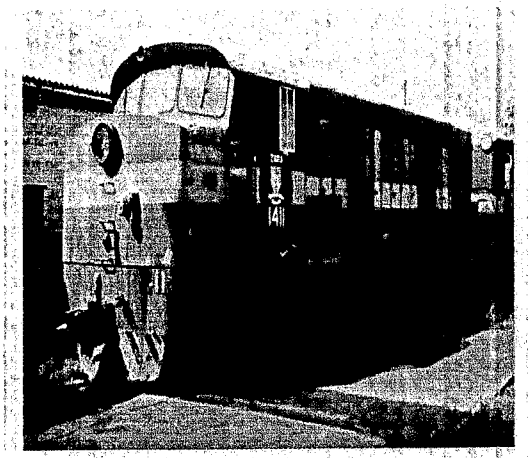
11. Lack of maintenance

OUTDATED LOCOMOTIVE ENGINES USED IN NIGERIA

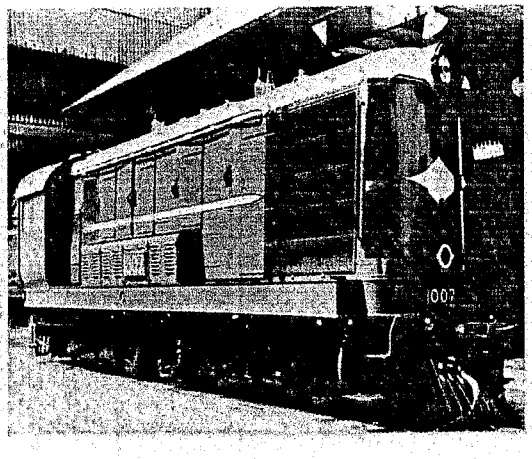
Dalian Locomotive and Rolling Stock Works, Speed - 120 kph (75 mph)

ALCO 8.25IE - 1500 hp

GE FDL-8 - 1820 hp

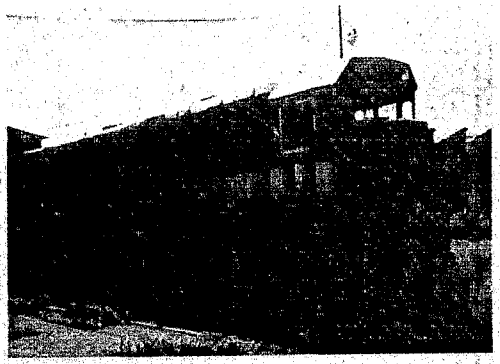


Sulzer LDA28C - 1300 hp



English Electric SRKT - 676 hp

EMD 12-645E3B



MAN 6V 22/30ATL - 1500 hp

2.8.1 Downward Trend in Railway Traffic in Nigeria

In 1983, NRC carried 15.11 million passengers, generating more than N29 million (80 naira = US$1), but the levels had nose-dived by 1993 to about 1.50 million passengers, generating less than N15 million. In 1993, NRC hauled only 106,000 tonnes of freight to earn N25. 84million.

This disheartening downward trend, which reached an all-time low in 1993, was the result of government neglect—almost no government funds were released to the railways

during this period. Operations were paralysed and Nigerian Railway Cooperation was forced to prune its workforce from 40,000 staff in 1984 to 23,800 in December 1992, but even this smaller number of staff was owed 9 months salary! The system was on the verge of total collapse, Nigerian Railway Cooperation properties depreciated greatly in value and some were vandalized beyond repair. This marked the beginning of the end of an effective railway network. Presently, Nigerian Railway Cooperation has staff strength of about 14,000

2.9 POSSIBLE SOLUTIONS TO SUCH PROBLEMS

2.9.1 Need for Private Participation in Nigerian Railway Business

Because railways are very capital intensive, the Nigerian govemment should encourage competition by allowing private sector participation in ownership, funding and operations. This will help intensify the effort to modernize railway infrastructure and services as we start the next millennium.

It is much easier for private businesses than govemment to raise funds via the stock market, especially in developing economies. Permitting private corporations and individuals to fund railway operations will usher in modern technologies in specialized areas like information technology, rolling stock and locomotive manufacturing, rail network design, etc.

Moreover, it will encourage healthy competition between various companies, thereby offering the populace the best services along with options. Creation of an environment for developed countries such as Japan, the USA, and Canada, etc., to invest in railway

development in Nigeria will enhance both railway development and the economic growth of Nigeria.

2.9.2 Railway Investment Opportunities in Nigeria

The government should encourage private participation in railway network development and expansion in the following areas:

1. Opening access from Onne to Port Harcourt. Only two seaports (Apapa Quay and Port Harcourt) out of seven are linked to the railway network at present.

2. Solving Abuja–Kaduna gridlock

3. Linking Minna–Abuja–Lagos

4. Serving emerging industrial/commercial zones in suburban areas and urban centres by rail

5. Building air–rail links; none of the 20 airports are served by railways.

2.9.3 Creating Favorable Environment through National Transport Policy

The existing national transport policy was signed into law in 1993 but has since remained almost a secret document that is poorly circulated. This dysfunctional policy framework has gravely incapacitated development in the transport sector of the Nigerian economy. The ad hoc approach to addressing vital and urgent transport issues has not contributed to

positive railway development. In view of the foregoing, Nigeria needs a functional national transport policy to guide investment and involvement of public and private entrepreneurs.

2.9.4 Concept of Public–Private Participation

According to study there are few available avenues in most African countries for raising sufficient revenue to fund urban infrastructure … they are, however, restricted by their national governments to a narrow range of revenue'. This has been the true state of railway funding in Nigeria since 1898. Railways have been funded by only government. The government has never encouraged 'partnering' whereby multinational corporations could participate and invest in development of the rail transport system.

There should be a proposal for 'municipal bonds which allow people to invest their savings—particularly through institutional investors such as banks, pension funds and insurance companies to build public infrastructure. In view of this, private transport companies with a strong financial base should be allowed to invest and participate in Nigeria's rail transport business, alongside Nigerian Railway Cooperation. They should be encouraged to invest in the railway through the stock market to increase efficiency, regularity, adequacy and reliability of railway services in Nigeria.

However, this idea contravenes the 1955 Act incorporating Nigerian Railway Cooperation as the only body allowed to operate rail services in Nigeria, meaning that the 1955 Act will need to be revised.

CHAPTER THREE

3.0 CONTEMPORARY BUILDING MATERIALS

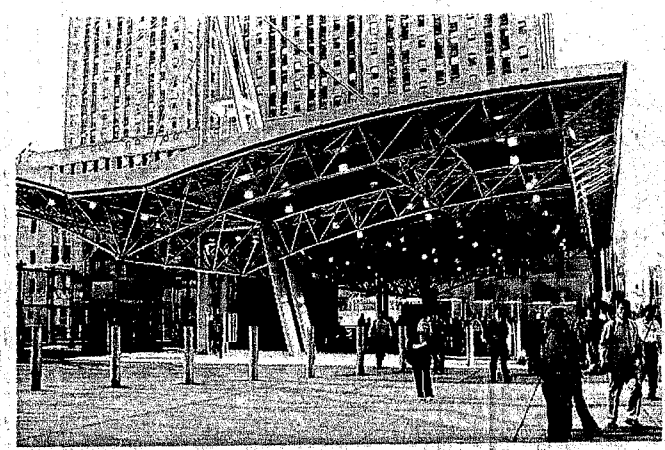
Introduction

Contemporary building materials, in architecture refers mainly the use new building materials which have come to existence thanks to new design concepts and new construction methods. Back in the 16th and 17th century very few building materials such as brick, stone, timber, steel, and concrete eventually were used, but things changed since 18th century.

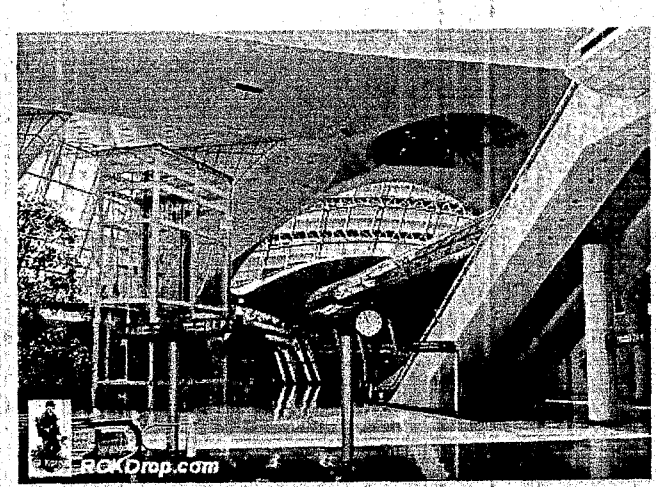
Many materials and methods, developed for wartime needs, were converted to the building industry. For example the United States Rubber Company's airplane de-icer was converted into a radiant heating element. The membrane, which can be attached to walls or ceiling, consists of a rubber sheet impregnated with carbon particles. Voltage is passed across the sheet by the carbon particles. Resistance to the passage of the current produces heat which is radiated to objects in the room. Metal entered more fully into building operations, particularly aluminum, which appeared as window frames, siding, heating ducts, hardware, awnings furnished in baked-enamel colors, and other building units. Significant also was the metal-clad, insulated wall sheathing developed to replace the heavy walls of masonry now used on steel and concrete-framed buildings. Designed by William Lescaze, well-known modernist, and Robert L. Davison, designer, it promised to lighten the weight of tall buildings and reduce the cost of such structures.

Soon enough a five-room, all-plastic house to sell for $4000 was promised by two Boston architects, who claimed that the plastic panels to be used would be fireproof, vermin-proof, weatherproof and self-insulated. Production of the new house, which was to be complete with plumbing and electrical kitchen including refrigerator, washing machine and garbage disposal unit, was to get underway as soon as the manufacturers could secure factory accommodations. Only one model, 24 by 40 feet, was at first proposed. All panels were to be in multiples of four feet so that later additions can be made. No nails were to be used, the panels being interlocked with aluminum clips. All interior surfaces were to be of specially treated plastic, offered in various colors and guaranteed for long life. The surface can be washed without damage.

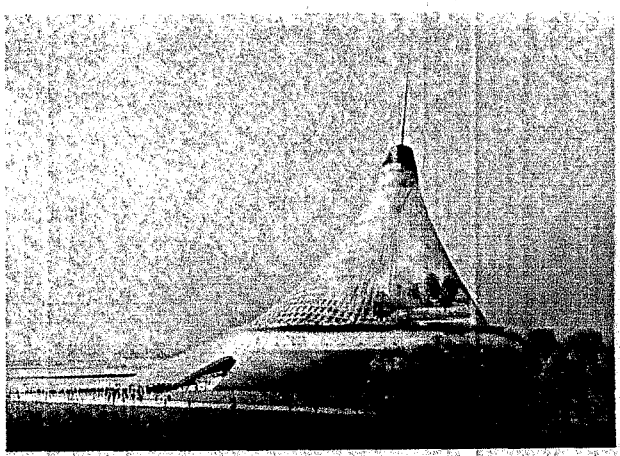
Generally due to advancement in science and technology better building materials were discovered, materials that were lighter in weight, easier to install during construction, increased speed in construction, and were more efficient / economical. In the 18th century more materials were experimented upon from which materials like reinforced fiber glass panels, reinforced concrete panels with insulating properties, polyurethane panels, treated aluminium clad panels, treated steel bars of different shapes and sizes, polystyrene-concrete panels, e.t.c. with this industrial development of new materials came different innovative ideas of architectural designs, and new systems of construction, out of which were the shell and dome designs. Examples of innovative design and forms due to industrial advancement are:



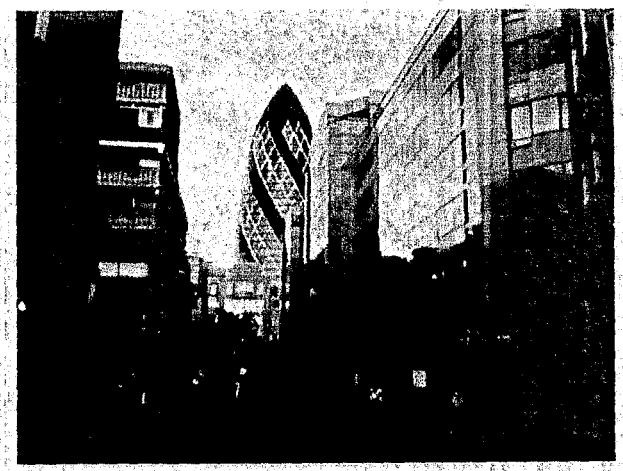
Paddington railway station



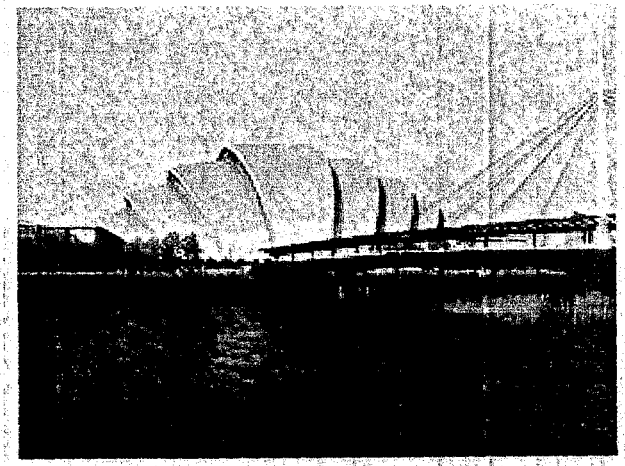
Paddington railway station interior



Building, by architect Norman Forster



Building, by architect Norman Forster



Building, by architect Norman Forster

Sigler residence, by Jonathan Zimmerman

3.1 POLYURETHANE

Polyurethane, commonly abbreviated PU, is any polymer consisting of a chain of organic units joined by urethane links. Polyurethane polymers are formed by reacting a monomer containing at least two isocyanate functional_groups with another monomer containing at least two alcohol groups in the presence of a catalyst.

Polyurethane formulations cover an extremely wide range of stiffness, hardness, and densities. These materials include:

i. Low density flexible foam used in upholstery and bedding,

ii. Low density rigid foam used for thermal_insulation and e.g. automobile dashboards,

iii. Soft solid elastomers used for gel pads and print rollers, and hard solid plastics used as electronic instrument bezels and structural parts.

Polyurethanes are widely used in high resiliency flexible foam seating, rigid foam insulation panels, microcellular foam seals and gaskets, durable elastomeric wheels and tires, electrical potting compounds, high performance adhesives and sealants, Spandex fibres, seals, gaskets, carpet underlay, and hard plastic parts.

Polyurethane products are often called "urethanes". They should not be confused with the specific substance urethane, also known as ethyl_carbamate. Polyurethanes are not produced from ethyl carbamate, nor do they contain it.

3.1.1 History of Polyurethane

The pioneering work on polyurethane polymers was conducted by Otto_Bayer and his coworkers in 1937 at the laboratories of I.G. Farben in Leverkusen, Germany. They recognized that using the polyaddition principle to produce polyurethanes from liquid diisocyanates and liquid polyether or polyester diols seemed to point to special opportunities, especially when compared to already existing plastics that were made by polymerizing olefins, or by polycondensation. The new monomer combination also circumvented existing patents obtained by Wallace Carothers on polyesters. Initially, work focused on the production of fibres and flexible foams. With development constrained by World War II (when PU's were applied on a limited scale as aircraft coating), it was not until 1952 that polyisocyanates became commercially available. Commercial production of flexible polyurethane foam began in 1954, based on toluene diisocyanate (TDI) and polyester polyols. The invention of these foams (initially called *imitation swiss_cheese* by the inventors) was thanks to water accidentally introduced in the reaction mix. These materials were also used to produce rigid foams, gum rubber, and elastomers. Linear fibres were produced from hexamethylene_diisocyanate (HDI) and 1, 4-butanediol (BDO).

The first commercially available polyether polyol, poly (tetramethylene_ether) glycol, was introduced by DuPont in 1956 by polymerizing tetrahydrofuran. Less expensive polyalkylene glycols were introduced by BASF and Dow Chemical the following year, 1957. These polyether polyols offered technical and commercial advantages such as low cost, ease of handling, and better hydrolytic stability; and quickly supplanted polyester

polyols in the manufacture of polyurethane goods. Another early pioneer in PU's was the Mobay Corporation. In 1960 more than 45,000 tons of flexible polyurethane foams were produced. As the decade progressed, the availability of chlorofluoroalkane blowing agents, inexpensive polyether polyols, and methylene diphenyl diisocyanate (MDI) heralded the development and use of polyurethane rigid foams as high performance insulation materials. Rigid foams based on polymeric MDI (PMDI) offered better thermal stability and combustion characteristics than those based on TDI. In 1967, urethane modified polyisocyanurate rigid foams were introduced, offering even better thermal stability and flammability resistance to low density insulation products. Also during the 1960s, automotive interior safety components such as instrument and door panels were produced by back-filling thermoplastic skins with semi-rigid foam.

In 1969, Bayer AG exhibited an all plastic car in Dusseldorf, Germany. Parts of this car were manufactured using a new process called RIM, Reaction Injection Molding. RIM technology uses high-pressure impingement of liquid components followed by the rapid flow of the reaction mixture into a mold cavity. Large parts, such as automotive fascia and body panels, can be molded in this manner. Polyurethane RIM evolved into a number of different products and processes. Using diamine chain extenders and trimerization technology gave poly(urethane urea), poly(urethane isocyanurate), and polyurea RIM. The addition of fillers, such as milled glass, mica, and processed mineral fibres gave arise to RRIM, reinforced RIM, which provided improvements in flexural modulus (stiffness) and thermal stability. This technology allowed production of the first plastic-body automobile in the United Sates, the Pontiac Fiero, in 1983. Further improvements in

flexural modulus were obtained by incorporating preplaced glass mats into the RIM mold cavity, also known as SRIM, or structural RIM.

Starting in the early 1980s, water-blown microcellular flexible foam was used to mold gaskets for panel and radial seal air filters in the automotive industry. Since then, increasing energy prices and the desire to eliminate PVC plastisol from automotive applications have greatly increased market share. Costlier raw materials are offset by a significant decrease in part weight and in some cases, the elimination of metal end caps and filter housings. Highly filled polyurethane elastomers, and more recently unfilled polyurethane foams are now used in high-temperature oil filter applications.

3.1.2 Properties and Characteristics of Polyurethane

Polyurethane foam is one of the major components of pre-insulated pipe supports manufactured at Piping Technology & Products. Polyurethane is different from most plastic materials in that it can be tailored to meet various load requirements of varying applications. Polyurethane foams are produced by reacting an equal ratio of di- or polyisocyanurates with polyols, in the presence of water, which acts as the blowing agent. Polyisocyanurates are formed when a higher ratio of di- or polyisocyanate are mixed with the polyol. All rigid foams made from polyisocyanrate systems have some form of polyurethane in them and can be called polyurethane foam. The physical
Properties differ very little at high densities. Polyisocyanurate foams are used in applications where dimensional stability over 200 deg F is required. However, for cryogenic applications, where your

Pipeline insulation is not exposed to high temperatures, PUF is an acceptable substitution. A common method used to obtain a change in load capacity is a

change in density. At Piping Technology and Products, we offer 10 lbs. / ft3, 14 lbs. / ft3, and 20 lbs. / ft3 densities. Density can be varied by changing the amount of blowing agent (water content). The density of polyurethane decreases with increase in water content.

In addition to density, the strength of rigid urethane foam is also influenced by many factors such as catalyst, surfactant, type of mixing, and the type of foaming system: base polyol and isosyanate, and the influence of each of these on the foam cell structure. Rigid urethane foams generally have an elastic region in which stress is nearly proportional to strain. They do not exactly follow Hooke's Law (stress is proportional to strain) because the curve is very slightly "S" shaped. Fig. 1 shows this in detail.

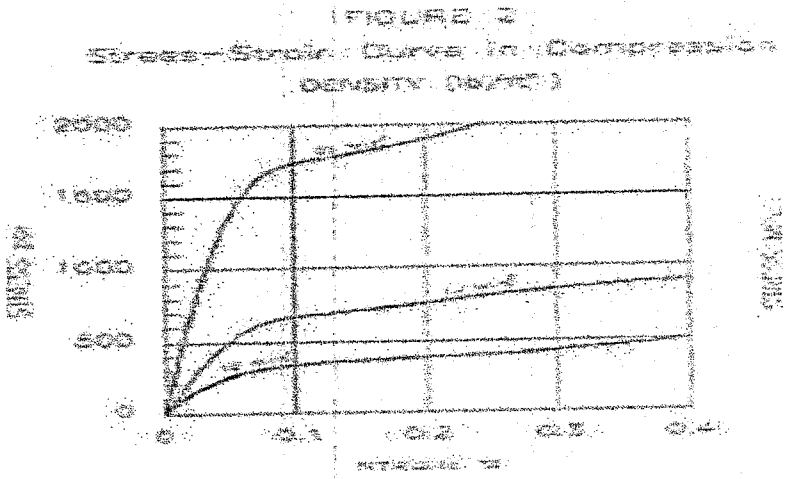


Fig. 1 STRESS-STRAIN CURVE

Polyurethane is anisotropic, or polyurethane is stronger in the direction of foam rise. At Piping Technolo and Products, the anisotropic character or directional properties of our polyurethane is reduced l overloading the mold used to form the polyurethane. By overloading the mold, we can control the c structure and provide uniform physical properties.. Polyurethane is a thermosetting material; however, does soften slightly with increased temperature and hardens somewhat at very low temperatures. Softeni at high temperatures affects the polyurethane in two ways: (a) loss of strength properties and (b) change foam dimensions (particularly low density foams). Low temperatures generally have very little effect polyurethane properties other than to make them a little harder and more brittle.. Rigid polyurethane foa have a relatively large amount of cross-linking as the foam expands. Our suppliers of the raw chemic control the degree of cross-linking by functionality (higher functionality produces more cross-links) a molecular weight of the components in the blend. The rigid cells provide the poured foam with strength a the interior space provides low thermal conductivity. Water is used as the blowing agent for foam in this 10 to 40 lb-density range.

density	Compressive strength	Flexural strength psi	Tensile Strength Psi	Modulus of elast. Psi	Closed cell content	Temp. contious operation	k-factor	Thermal Conductivity (btu/hr m^2 of)	Shear psi	Density (lb/in^3)	Water Absorb. %
PUF (10pcf)	200.00	400.00	300.00	6,000.00	95.00	-300.00	0.08	0.1600	180.00	0.0057	0.22
PUF (14pcf)	300.00	600.00	500.00	11,000.00	95.00	-300.00	0.12	0.2000	200.00	0.0081	0.18
PUF (20pcf)	500.00	1,100.00	600.00	20,000.00	95.00	-300.00	0.14	0.2500	400.00	0.0115	0.13

TABLE 1: SHOWING STRENGTH OF POLYURETHANE

3.2 POLYURETHANE, AS A BUILDING MATERIAL

Today's homes demand high-performance materials that are strong, yet lightweight; that perform well, yet are easily installed; and that are durable, but also versatile.

Polyurethane has been developed and used over the past two decades in developed countries like the U.S.A, as building materials due to its better construction and structural properties, when compared to conventional materials like concrete, steel and glass. Due to its innovative character polyurethane has been used by architects such as Jonathan Zimmerman in his design and construction of dome and shell houses for his clients and his works have been well recognized over the world. Polyurethane has a wide range uses, from shell coverings to wall panels, insulating materials, door and window frames, roofing materials, e.t.c.

Polyurethane Shells and Domes

The polyurethane shell or dome is simply defined, as a super-insulated, steel-reinforced concrete structure that can be designed for virtually any use: office or business complex; school; church, synagogue or temple; gymnasium or sports arena; theater or amphitheater; airplane hangar; factory; bulk storage facility; house or apartment complex; military installation, etc.

3.2.1 Applications of Polyurethane

Polyurethane is used all over the world in different ways the table below shows the percentage in usage of the material.

Application	Amount of polyurethane used (millions of pounds)	Percentage of total
Building & Construction	1,459	26.8%
Transportation	1,298	23.8%
Furniture & Bedding	1,127	20.7%
Appliances	278	5.1%
Packaging	251	4.6%
Textiles, Fibers & Apparel	181	3.3%
Machinery & Foundry	178	3.3%
Electronics	75	1.4%
Footwear	39	0.7%
Other uses	558	10.2%
Total	5,444	100.0%

TABLE 2 USAGE OF POLYURETHANE

SOURCE: www.polyurethane.com

Polyurethane has wide of uses in the building industry, amongst many a few are listed below:

1. Wall panels

2. Stair cases

3. Shell and dome coverings

4. Foundations

5. Beams and Columns

6. Floor slabs

3.2.2 Economy in Construction

Generally, the construction cost of a Monolithic polyurethane shell structure is less than that of a conventional building of the same size with similar fittings and fixtures. A streamlined construction process and the use of only four major ingredients contribute significantly to the dome's economy. Those principal ingredients or materials are the formwork, polyurethane foam, rebar and concrete.

In the construction of a Monolithic polyurethane shell, a thickness of polyurethane foam is sprayed on the inside of the formwork. Polyurethane foam is a superior insulator. When sprayed in place, it expands to thirty times its original size, sets in seconds and fills every nook and cranny, completely sealing a structure. This foam is virtually waterproof, forms its own vapor barrier and adds structural strength.

Rebar is a steel bar with ridges that is used to strengthen concrete. In polyurethane shell construction, rebar hangers that will hold the rebar are placed into the foam, following a pattern predetermined by the shell's size and shape. As in the construction of bridges, tunnels and roads, rebar reinforces the shell's concrete.

Concrete used in the building of a polyurethane shell structure is called Shot-Crete. It's a special mix of concrete that is spray-applied to a specific thickness, depending on the dome's size. Shot-Crete covers the foam and embeds the rebar on the inside of the dome.

3.2.3 Economy in Operation

Every structure requires care. But polyurethane shells usually require less maintenance because there's less potential for problems. The dome's curvilinear design, its straightforward building process and its superior materials keep maintenance to a minimum.

3.2.4 Security

Polyurethane shells have a proved ability to survive tornadoes, hurricanes and earthquakes. They therefore meet the Federal Emergency Management Agency's criteria for providing near-absolute protection. During a natural disaster, a polyurethane shell or dome protects its occupants from injury or death.

Tests conducted by the Monolithic Dome Institute have shown that shells and domes can easily tolerate some man-made hazards, such as rifle fire and small explosives. They make suitable, safe housing for military personnel, supplies and equipment.

3.2.5 Fire Resistance

The Polyurethane foam core has a Class 1 fire resistance rating-the best available for combustible materials. A polyurethane shell or dome provides fire proper protection. If a fire attacked the outside of a polyurethane shell, it might damage the formwork and even

melt the foam after a lengthy period of time, but the concrete would survive, and the fire would not burn through.

3.2.6 Water Resistance

Both polyurethane shells and panels provide 100% water resistance thus it survives in conditions that will appear harsh for buildings constructed with Concrete and steel.

3.2.7 Strength and Durability

A polyurethane shell ages better than do most other types of structures. Virtually unaffected by time, weather, termites, mold or mildew, the dome has a lifespan of not just years, but centuries.

3.2.8 Sound and Thermal Insulation

Polyurethane has been discovered to be one of the best materials used for both sound and thermal insulation, it has been used in industrial buildings in between wall panels, and claddings, also soft polyurethane foams are used as vehicle engine gaskets, insulants for refrigerators e.t.c.

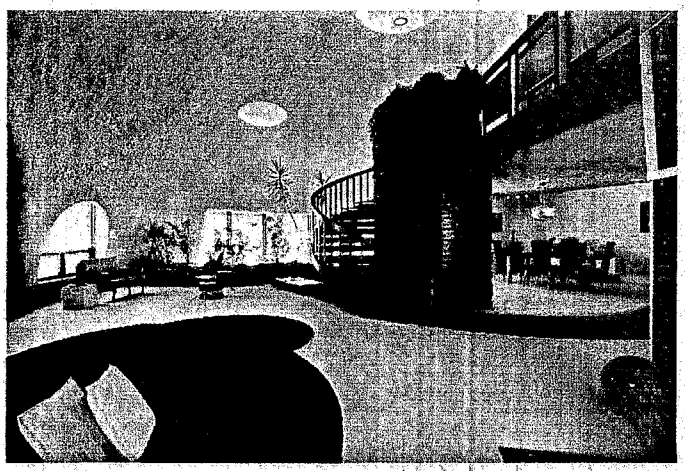
3.2.9 Energy Conservation

Polyurethane shells are energy-efficient. They are super insulated with polyurethane foam sandwiched between a finish on the outside and concrete on the inside. Thus, they use 50% less energy for heating and cooling. With superiorR-values per inch of thickness and consistent insulation through composite construction, Polyurethane buildings

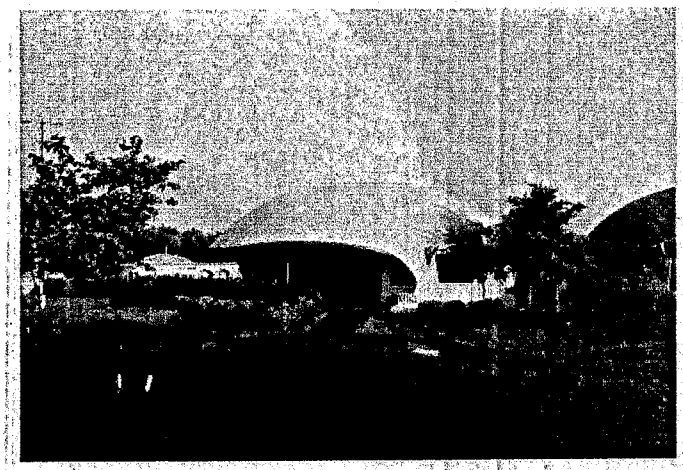
envelope will offer significant savings on heating and cooling energy, and perform better than other building systems in which air infiltration andthermal bridging and breaks are inherent.

EXAMPLES OF SHELL BUILDINGS CONSTRUCTED WITH POLURETHANE

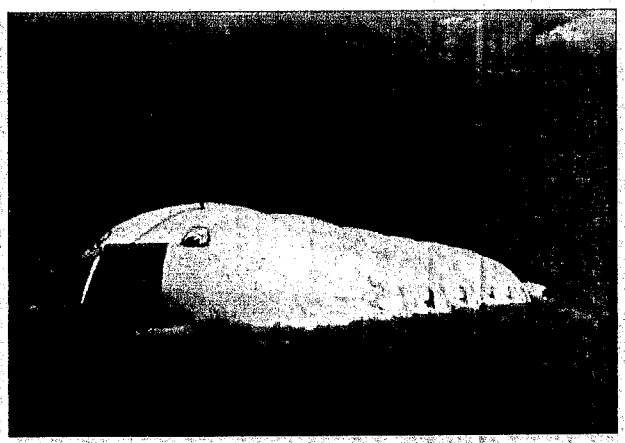
The Sears residence



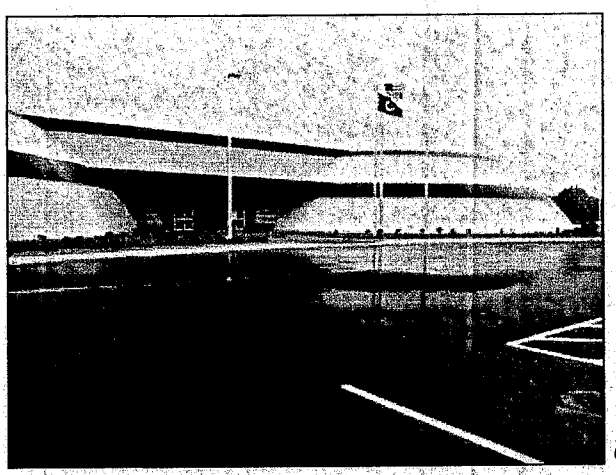
Interior of Sears's residence



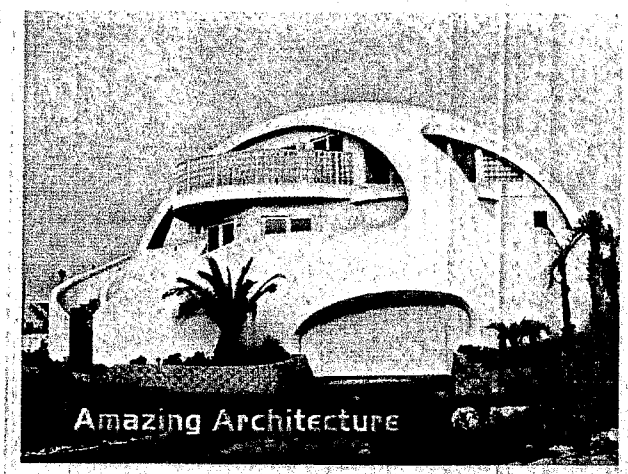
The DSCF Television Station



Brucco, the Grain tarp. Italy



Green Meadow School, Minnesota



The Sigler residence

3.3 DEDUCTIONS

This generation of young Architects in this country graduates from universities and architectural schools, with no knowledge these new materials. This chapter seeks to study the different properties, strengths, flexibility, and innovative characters of these new materials, so as to be able come up with more interesting architectural concepts in design and selection of forms.

CHAPTER 4

INTRODUCTION

CASE STUDY ONE

4.1 The Kaduna Main Railway Station (Junction)

4.1.1 Introduction

The railway station complex is located along Ahmadu bello express way just the station round-about. The station complex houses the administrative offices, and other train offices.

4.1.2 Architecture

The architecture, not as exiting as any modern building, the structure is rectangular in shape and constructed mostly of sand-Crete block with steel columns, the building is glazed just at the approach (aesthetically has a dull approach). The building structure houses the administrative offices, cafeteria, security offices, train offices. Outside the structure is a well defined parking arrangement for both staff and visitors. All structures are constructed on raised platform called "concourse".

4.1.3 Facilities

This site apart from station complex has provision for the workshop, passenger waiting, parcel and telegram office block, man-o-war office block, warehouses, and public conveniences and staff accommodation

\

4.1.4 Merits

i. Adequate parking area.

ii. Proper workspace within the station complex.

iii. Passenger waiting area is also adequate

iv. Located away from the city centre and residential area.

v. Good orientation of structures on site.

4.1.4 Demerits

i. No defined loading and off-loading point.

ii. No security checking of both passenger and freight.

iii. No provision of clinic or medical services on site.

iv. No provision of guest lodges on site

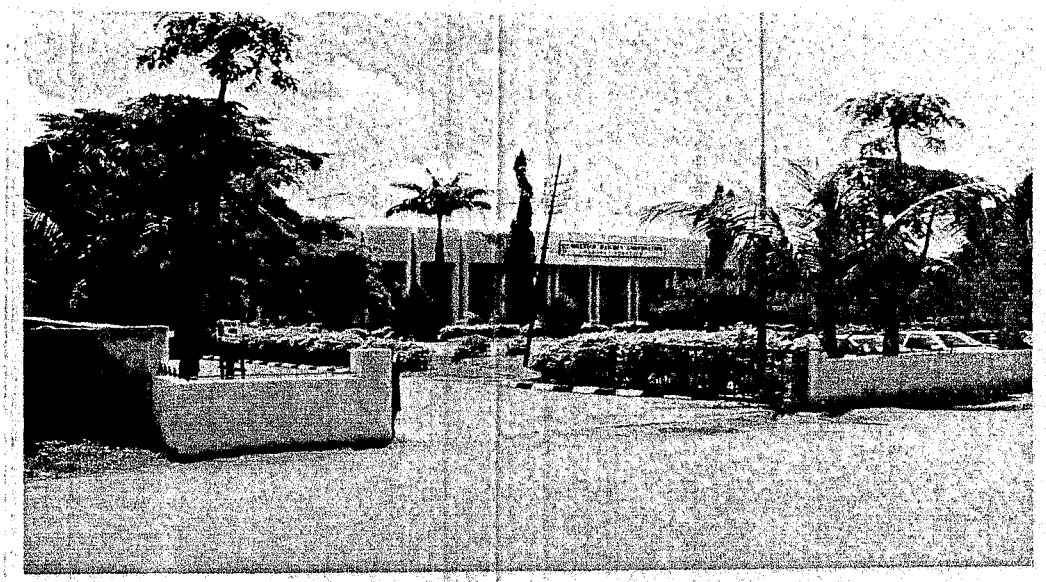


PLATE 4.1: A view of the station complex showing car parking and landscaping

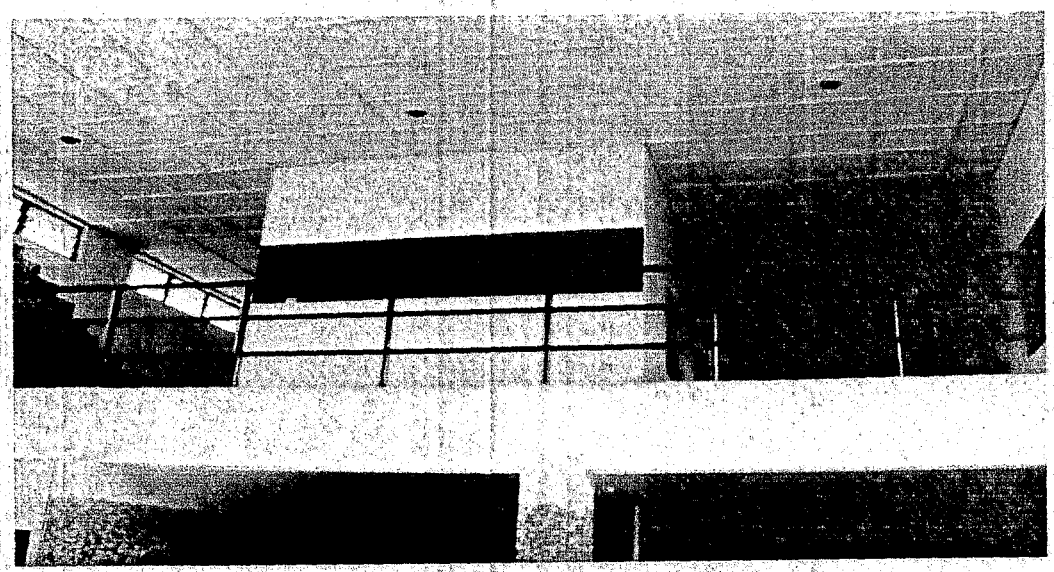


PLATE 4.2: A view of the interior of the station complex showing security offices, and ticket booking

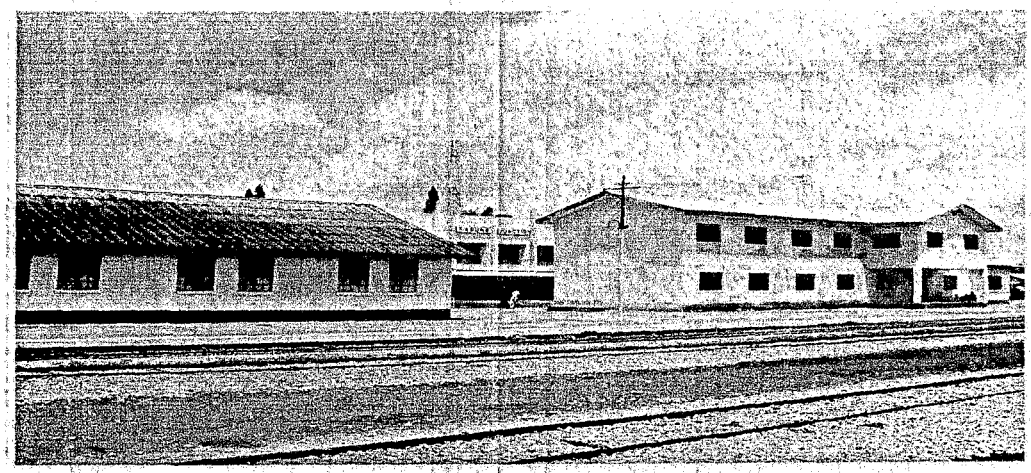


PLATE 4.3: exterior view of the parcel and telegram office block and also the man-o-war block

PLATE 4.4 A view of the passenger waiting area

CASE STUDY TWO

4.2 The Zaria Main Railway Station (Junction)

4.2.1 Introduction

The railway station is located in off Major General Ibrahim Gummel road, Sabon-Gari, Zaria. Unlike the Kaduna junction complex, the structures are separated, with the administrative office block, the 1st class ticket booking and waiting block, the 2nd and 3rd class ticket booking and waiting all in separate blocks. Some of the structures are worn out and not used due to inadequate maintenance.

4.2.2 Architecture

The architecture, any railway station here in the north the structures are mostly regular (rectangular), the structures appear dull aesthetically. Constructions are made mostly with sand-Crete blocks; there are no defined parking spaces for both the visitors and staff. Structures are also constructed on raised platforms.

4.2.3 Facilities

This site has provision for about four different workshops out of which three are not functional, about two warehouses, staff accommodation, administrative offices, computer institute, security block, electrical and engineering maintenance block, passenger waiting which are long open but covered sheds.

4.2.4 Merits

i. A good number of workshops on site for the Technicians

ii. Proper orientation of structures on site

iii. Well remove from city centre and residential area.

iv. Adequate passenger waiting area.

4.2.5 Demerits

i. No defined parking spaces.

ii. No provision for clinic or medical services on site.

iii. All structures are aesthetically dull.

iv. Very poor maintenance of facilities.

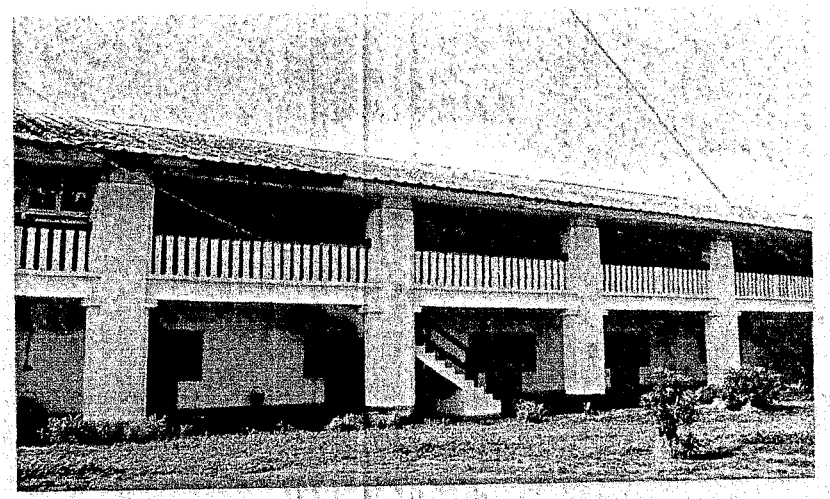


PLATE 4.5: A view of the administrative block

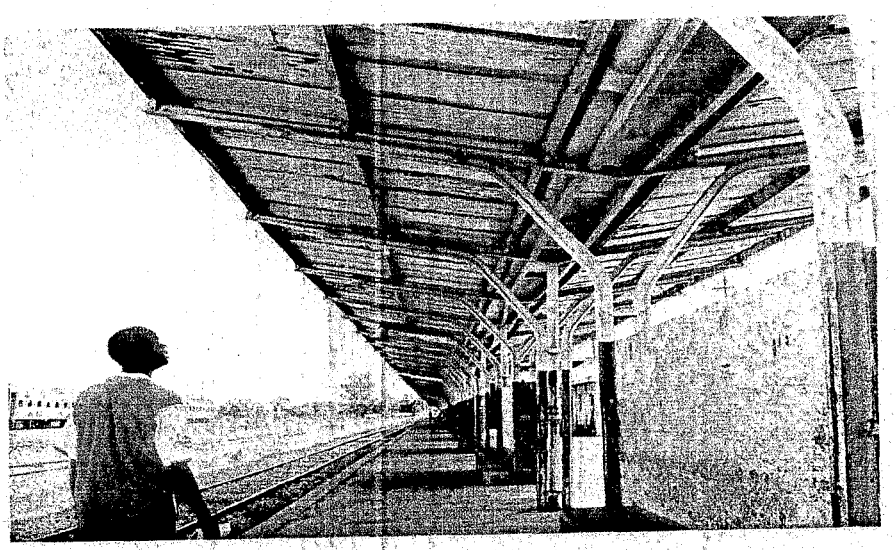


PLATE 4.6: A view of the passenger waiting sheds

PLATE 4.7: A view of the 1st class passenger ticket booking and waiting

PLATE 4.8: A view of one of diesel workshops

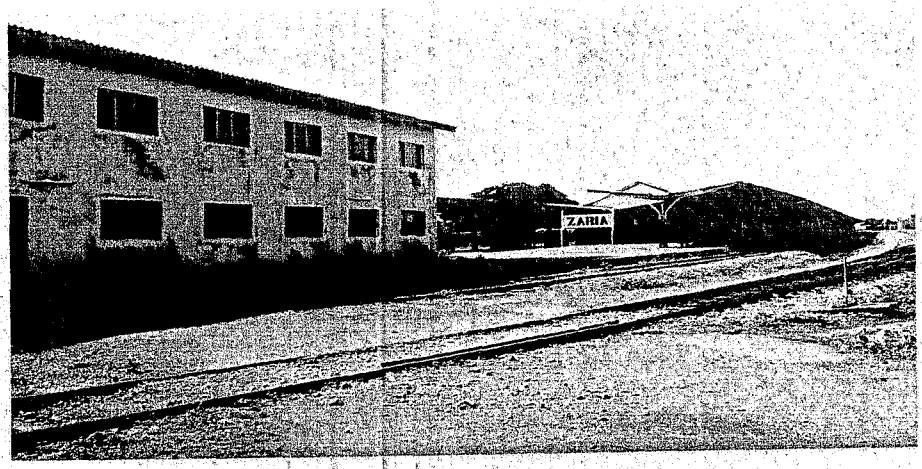


PLATE 4.9: A view of security block, and 2nd /3rd class ticket booking.

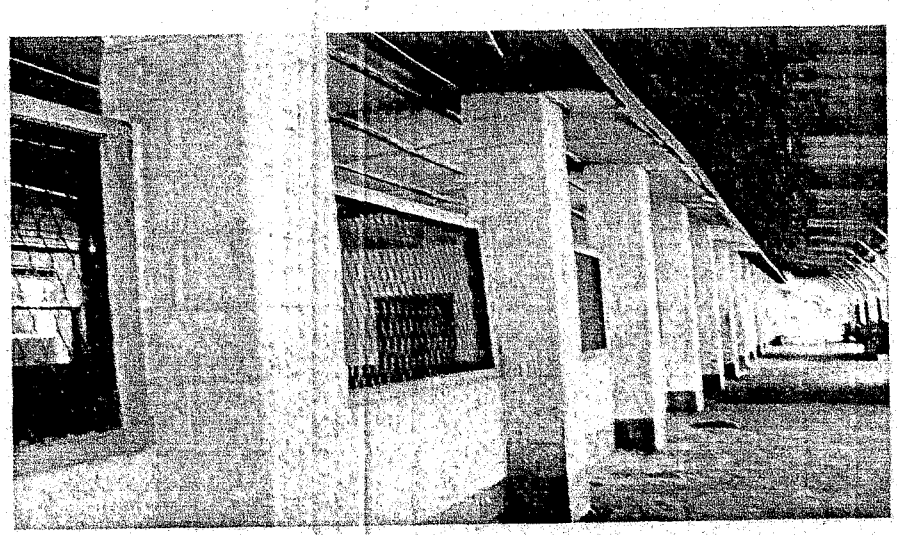


PLATE 4.10: A view of the 2nd /3rd class ticket booking.

CASE STUDY THREE

4.3 The Minna State Main Railway Station (Depot)

4.3.1 Introduction

The railway station is located off the Mobil-Tunga road, near minna central market. The station is a depot, thus making it smaller in size, and it has fewer structures on site. when compared to the first two case studies. The station office block houses offices like the control office, parcel office, communication office, telegram office, e.t.c. the administrative block here not on site rather in a different location.

4.3.2 Architecture

The architecture, a rectangular shaped plan with columns surrounding the corridors. Sand-crete blocks mostly used with steel columns, no form of glazing thus making the buildings appear aesthetically dull.

4.3.3 Facilities

This site has provision for one warehouse, security block, staff accommodation, and the main station block.

4.3.4 Merits

i. the structures well organized or arranged on site.

ii. structures are well oriented on site.

4.3.5 Demerits

i. No security checking of both passenger and freight

ii. No provision of clinic or medical services on site

iii. No defined loading or off-loading point.

iv. No defined parking spaces

CASE STUDY FOUR

4.4 Kaduna North sub-station (Depot)

4.4.1 Introduction

The railway station is located behind A.P. Filling station off Ahmadu Bello way, Kurmin Mashi, Kaduna. It is also a depot, and hence very small when compared to the first two case studies.

4.4.2 Architecture

The architecture consists of a rectangular design with columns on side of the building. Construction consists of mostly Sand-crete blocks with steel columns. The structure is aesthetically dull and archaic and architecturally uninteresting.

4.4.3 Facilities

This site has provision for just a warehouse, conveniences, and the station office block which houses ticket booking parcel, telegram office, train and control office, also there's provision for staff accommodation.

4.4.4 Merits

i. Orientation of the structures on site is good.

ii. Accessibility to the station to the station is also good

iii. located away from the city area and residential area.

4.4.5 Demerits

i. Structures are aesthetically dull and archaic.

ii. No provision for workshop.

iii. No provision of clinic or medical services.

iv. No defined loading or off-loading point.

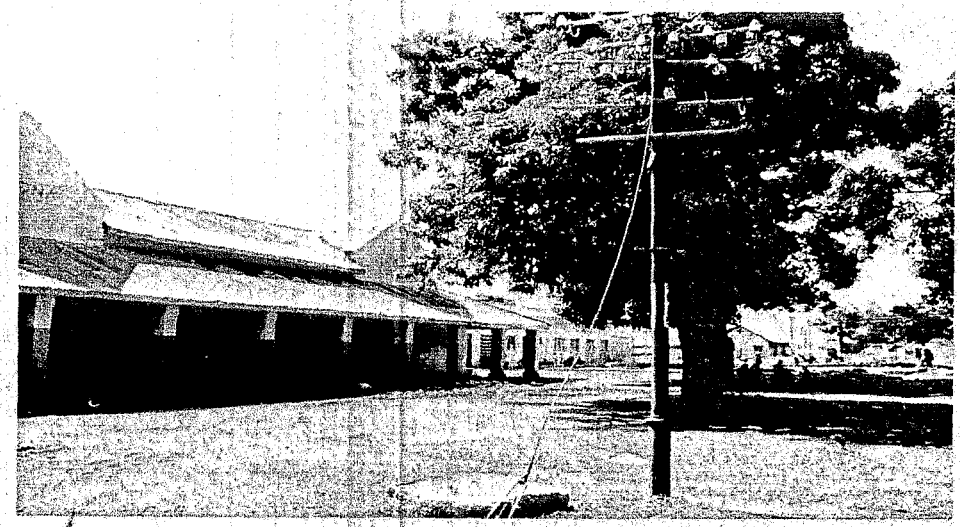


PLATE 4.11: A view of the station office block.

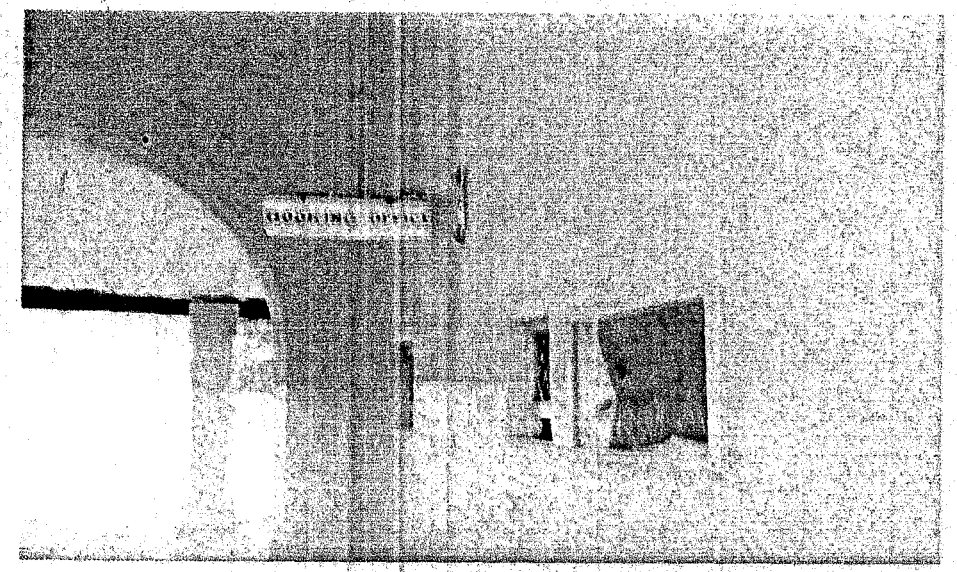


PLATE 4.12: A view of the ticket booking counter.

PLATE 4.13: A view showing part of the station office block and staff accommodation.

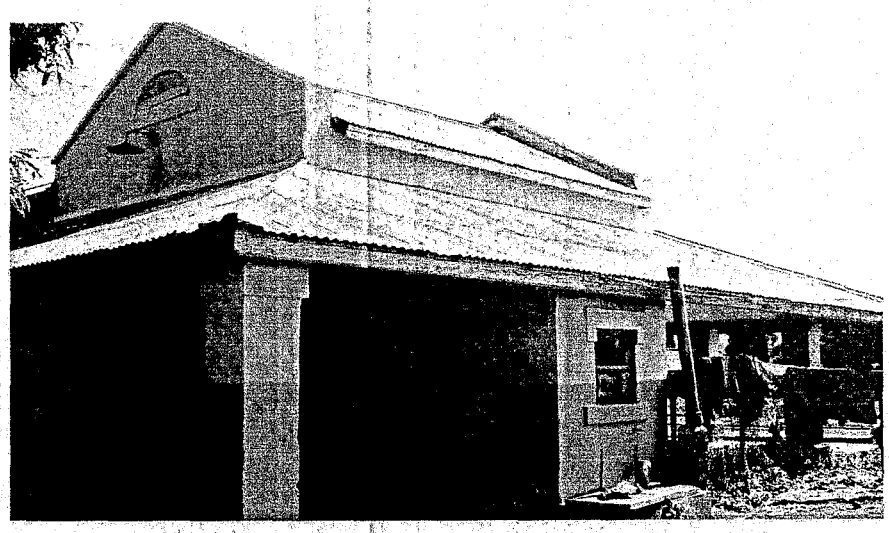


PLATE 4.14: A view showing part of the station office block

CASE STUDY FIVE

4.5 Frankfurt Main Hauptbahnhof Train Station. (Terminal)

4.5.1 Introduction

The huge monumental railway station building is located in city area of Frankfurt in Germany. It is actually the largest railway station in whole of Europe. From an aerial view it is seen as three huge cylinders connected side by side. The station which was opened in 1888, houses a total number of to 120 tracks passing through it, some of which are underground tracks. Passengers reach up to 350,000 daily.

4.5.2 Architecture

The architectural design is also simple rectangular shapes joined together, but it is the form of the building which gives its expression. The architect used semi-circular forms which appear like three cylinders joined side by side, he used massive steel columns at intervals to support the large steel and glass building. The was designed to roof about one hundred trains, and also house other facilities like the workshop, administrative block, passenger waiting, exhibition, restaurant, shopping mall, e.t.c.

4.5.3 Facilities

There are no other structures on the site as the railway terminus roofs all possible facilities that would required on the site, such as the workshop, administrative block, passenger waiting, exhibition, restaurant, shopping mall, e.t.c.

4.5.4 Merits

i. Orientation of the structures on site is good.

ii. Accessibility to the station to the station is also good

iii. Located away from the city area and residential area.

iv. The design is architecturally very interesting.

v. the structure is aesthetically beautiful.

4.5.5 Demerits

i. Due to the size of the structure, cost of maintenance tends to be a problem.

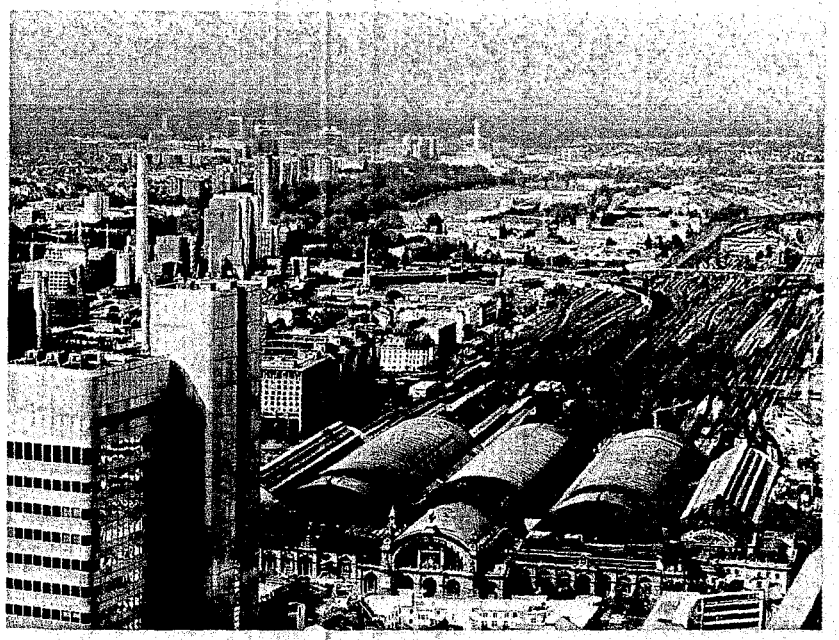


PLATE 4.15: An aerial view showing the hauptbahnof railway station

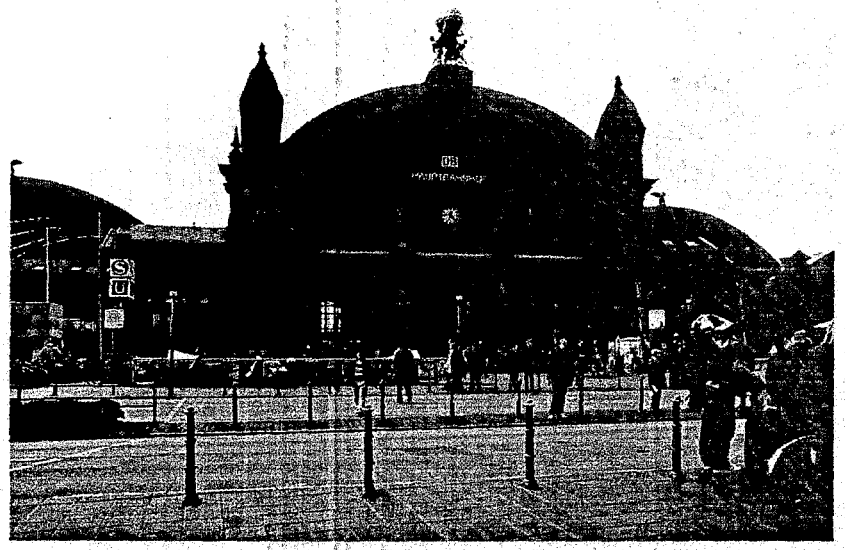


PLATE 4.16: A view showing the approach of the railway station

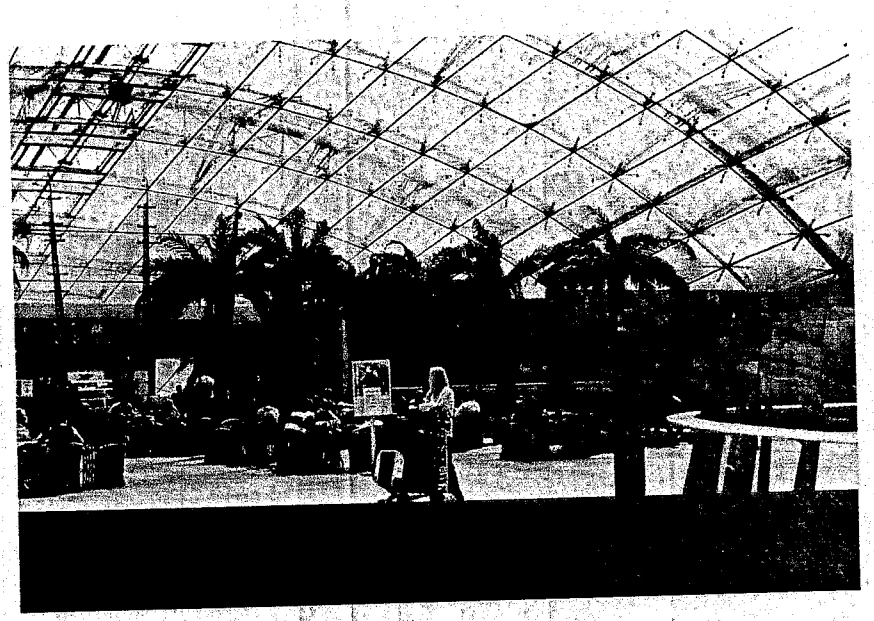


PLATE 4.17: A view showing interior of the railway passenger waiting

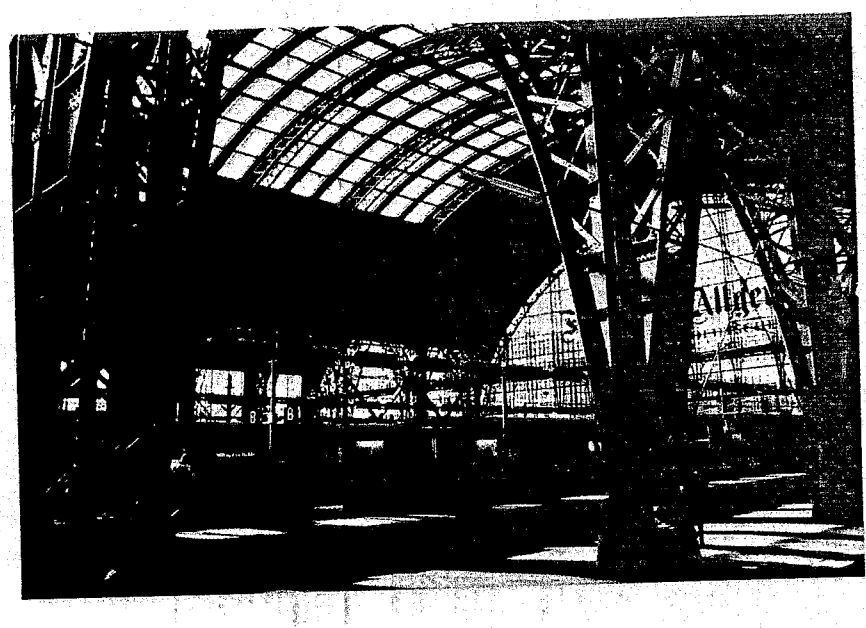


PLATE 4.18: A view showing area were the trains dock.

CHAPTER FIVE

5.1 HISTORICAL BACKGROUND

Kaduna state is a historical town, located in the north central area of Nigeria. Kaduna which is the city capital is located on the Kaduna river, is a trade center and a major transportation hub for the surrounding agricultural areas with its rail and road junction. The town nicknamed as "garin kada", which means crocodile city. Kaduna was founded by the British in 1913 and became the capital of Nigeria's former Northern region in 1917. It retained this status until 1967. it is also known for its religious and ethnic diversity. Presently the state has developed to commercial and economic giant.

5.2 CLIMATIC CONDITIONS

Kaduna state lies in the northern region of Nigeria between longitude 7° 5" East and 10° 30" North of ' the Green which meridian and above the equator between latitude 80 001 and 11° 301 North. In what is referred to as the north central part of Nigeria. The climatic condition of Kaduna state is basically a shift between dry and wet seasons. There are basically two seasons which corresponds to the prevailing air masses blowing over the country at different times of the year. The north-east trade winds which originates from the Sahara desert brings dry season which is noted by dry air, dust, usually hamathan, This occurs during November to March. While the south-west humid maritime air blowing from the Atlantic Ocean brings the wet or rainy season, which occurs around April to October

5.3 RAINFALL

After an exceptionally long period of time, a mean Rainfall of 850-1015mm was arrived at for the city of Kaduna. August providing highest mean monthly rainfall amount to almost 450mm (16 inch). The rainy season in this area start between 11th to 20 April last for about six months.

5.4 TEMPERATURE

The period from January until the onset of the rains, provide the state with both daily maximum (30degrees), and minimum (25degrees) temperature and these rises to this maximum peak in March, before the raining season. During the raining period, the daily maximum is noticed to drop to a low level and this happens mostly in august. This town has a minimum temperature of about 25°C but begins its rise once more after the rains reduces which usually happens between late October and early December and this raise is sustained until it attains its peak well after January so the cycle continues.

	Yr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
F	78	75	78	82	84	82	78	76	76	77	78	76	75
C	25	23	25	27	28	27	25	24	24	25	25	24	23

Table 1: Average Temperatures.

YEAR CHART 8 SOURCE: International station meteorological climate summary.

5.5 SUNSHINE

There is a general increase on the total hours of sunshine further from the Atlantic coast due to global warming of the earth surface. During the dry periods, which cover from November to April, there is a monthly variation in the amount of sunlight which follows a general trend of increase form 215 hours. The amount of sunshine ranges from 1300hrin Niger delta to over 3700hr of sunshine in the extreme north-east of the country, Kaduna is exposed to approximately 2500hr of sunshine every year. As the rainy season approaches there is a gradual decline in the sunshine hours with its lowest in August.

Variable	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Isolation KWh/m2day	5.66	6.49	6.72	6.63	6.41	6.03	5.44	5.03	5.47	5.76	5.80	5.40
Clearness 0-1	0.65	0.69	0.66	0.63	0.61	0.58	0.53	0.48	0.54	0.60	0.66	0.64
Temperature c	23.31	25.17	27.67	27.36	26.1	24.6	23.6	23.5	24.2	24.9	25.6	23.8
Wind speed m/s	3.99	3.86	4.30	4.31	4.21	3.60	3.43	3.24	2.96	3.17	3.69	4.17
Precipitation mm	0	1	7	56	120	160	210	275	243	71	2	0
Wet days, d	0.1	0.1	0.7	3.6	8.2	11.8	15.3	16.8	13.8	4.6	0.0	0.0

Table 2, Solar Energy and Surface Meteorology.

Source: www.Kadunastate.com

5.6 HUMIDITY

Human sensitivity to temperature is greatly influenced by the relative humidity. In Kaduna the relative humidity during the dry season falls between 35-55% (between October and march), these low relative humidity coupled with the afternoon temperatures account for the desiccating effects of the dry season in state. However during the rainy season the relative humidity is between 75-95% which is very high. It is noted that humidity increases over the first six months and decreases gradually as the year runs out.

	Yr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
F	78	75	78	82	84	82	78	76	76	77	78	76	75
C	25	23	25	27	28	27	25	24	24	25	25	24	23

TABLE 3 Average Morning Relative Humidity

YEAR CHART 3, SOURCE: international station meteorological climate summary

	Yr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	De
F	78	75	78	82	84	82	78	76	76	77	78	76	75
C	25	23	25	27	28	27	25	24	24	25	25	24	23

TABLE 4 Average Afternoon Relative Humidity

YEAR CHART 3, SOURCE: international station meteorological climate summary

5.6 VEGETATION

Kaduna state falls within the guinea savannah vegetation region of the country, hence it follows the same characteristics that vegetation zone has, i.e. it is covered mostly with sparsely scattered trees, shrubs and smaller grasses. Denser groves of taller trees species occur along depressions and water paths such as streams and rivers.

5.7 GEOLOGY AND TOPOGRAPHY

5.7.1 Geology

The basic geological structure on which Kaduna resides is mostly a magma-tic of streaky rocks, granite in parts with darker softer bands and much varied. Over most of the area, the surface is covered with decomposed laterite. Erosion is mainly by the small streams that cut deep gullies leaving residual laterite caps to be gradually eaten away at the edges by natural forces such as rain, wind and vegetation. The water table in Kaduna is usually quiet high and walls settle to a comparatively shallow bore depth of about fifty feet.

5.7.2. Topography

Kaduna regional topography has a rolling-part like terrain with relief situated about 100ft above the 2000ft contour line. The solid granite "inselbergs" rises sporadically and dramatically like great domes as much as a thousand feet above the general level of the plain which is to the east and south-east wards from Kaduna abruptly ends in the escarpment to the Jos plateau. The whole area is crossed by mature wooded streams, flowing in broad, shallow valleys separated by inconspicuous water sheds.

5.8 SOCIO-CULTURAL FACTORS

The indigenes of Kaduna state earn their living mainly from farming and trading. The main crops produced by people from Kaduna state are maize, millet, sorghum, cotton, groundnut, guinea corn, and recently cassava. Besides farming people from these city indulge in works of art and crafts, products of which are musical instruments, masks, motar and pestles and hand-made weapons.

The traditional type of architecture is not known to e exact due to due to the diverse tribes and religion that reside in the state, but the most common were the round huts which are fast becoming extinct and are replaced by rectangular shapes, signifying the presence of modern architecture. There are two major religions recognized in Kaduna state, these are Christianity and Islam.

5.9 ECONOMY AND COMMERCE

5.9.1 Economy

Kaduna state has been economically stable over the past twenty years as a result of the location, and nature of the state, as it has been a trade center and also a place for tourist activities. It is the major military center of northern Nigeria, home to large army and air bases and the Nigerian Defence Academy (1964). Kaduna Polytechnic (1968), the Nigerian Institute for Trypanosomiasis Research (1951), and the National Museum, Kaduna (1975) are also located here. The British selected Kaduna as the capital of their colony of Northern Nigeria in 1913 and developed an expansive layout for the city. An industrial and administrative center, Kaduna has drawn migrants from all over Nigeria, making it one of the country's most ethnically diverse cities. The city's political and

economic elite has exerted great influence in national affairs since Nigeria gained independence in 1960. Population (1995 estimate) 333,600.

5.9.2 Commerce

The expanding market and commercial activities mostly within and around Kaduna state have the support of some wealth established commercial Institutions in the likes of different textile industries, the petroleum refineries. A major rail and road junction, the city is a center for trade in cotton, livestock, durra sorghum, corn, shea nuts, and ginger. Kaduna is one of Nigeria's leading manufacturing centers, specializing in textile production, petroleum refining, vehicle assembly, brewing, food processing, and printing and publishing.

5.10 TRANSPORTATION AND TRAFFIC FLOW

The town of Kaduna has just one major means of transportation; this includes which is Road transport. The four major roads leading into the city are; the Kano-Zaria route, Kachia-Kafanchan route, Abuja-suleja route, Jebba-Birnin Gwarri route. These routes make city accessible from all parts of the country. The of Kaduna provides an elaborate transportation network which enhances effective functioning of the city and its interaction with the rest of the country. The use of buses for public transportation and other smaller vehicles for individual and personal transportation is the most common means of transportation especially in the city center which is mostly of commercial activities. Other means are by means of bicycles, and motor-cycles.

Presently the central part of Kaduna metropolis is getting overcrowded thus problems of traffic control is gradually becoming dominant in Kaduna. In other to supplement the efforts of the private operators, the state government and the Nigerian Labour Congress now run small transport garages which companies such as the Kaduna state taxis, cross-rivers Cross-line transportation, Lagos cross-country and other labour vehicles occupy. These private and state owned outfits all ply the main streets of Kaduna and to parts of the country as such commuter in have no problems in transporting themselves from one place to another.

CHAPTER SIX

6.1 DESIGN CONSIDERATION

It is a well known fact that building cannot tender machines but can do much as to providing' a means of creating a more secured environment for physically mental and spiritual comfort for the workers and this has a direct impact on the overall output of workers. The above mentioned comfort could be advised through control of environmental condition through proper planning by the Architect. It should always be remembered that the intercultural environment has a great impact on workers and must be considered at the planning stage,

This question always arises, what is the comfortable or good space for people? Very important, the concept of "Comfort" is both physiological and psychological and it changes from person to person; from place to place and situation to situation.

6.2 PHYSIOLOGICAL COMFORT

An uncomfortable condition arises from extreme heat, dryness cold, dampness, and so on. What needs to be understood is when the condition provides negative response from the system it is term uncomfortable. in Nigeria, with a tropical climate, uncomfortable condition are caused by the extreme heat cold and dryness, sometimes the brightness of the sun's light.

Comfort constitution certain thermal condition which over 50% percent of the people are unaware of their climatic environment. The human thermal comfort temperature lies between or within 80^0 {31.1^0C} and 93^0 {33.9^0C}.

A body is considered comfortable when it is able to dissipate to its surrounding all heat it receives, including heat lost by evaporation from the skin and from the respiratory system. As regard building, body temperature relates to air temperature, mean radiant temperature, humidity and air movement, and the person's clothing, physical activity, and state of health. If the balance of these parameter is not achieve then a state of discomfort is reached, which affects work output and efficiency and in extreme cases heat stroke and/or intense fatigue.

6.3 PSYCHOLOGICAL COMFORT

A comfortable body is no guarantee, of a comfortable mind. The design the building help or aid psychological comfort. This approach should pay special attention to issues of emotion via, auditory, olfactory -visual and other stimuli-factors that influences both the way a person feels and his ability to work.

The emotional state of individual is affected by stimulation received through sensory receptors and action of the nervous pathway. Character and surrounding Of rooms, the colour scheme, size, proportion, the filling of being secured and even the views from window have great psychological effect, whereas the combine effect of the sun, fresh air, and providing greenery impinges favorable sense of impression during period of physically activity and rest.

6.4 INTERNAL ENVIROMENTS

This aspect deals with area within the station complex, workshop, warehouses, and other structures which the workers are constantly and continuously exposed each and everyday the report for work. It is noted that this area has a great impact on the workers as such to reduce work tension and fatigue, proper planning of the external environment is essentially a factor to improve efficiency and workout put, and a reduction in eternal accidents.

The following make up the major elements that could affect a conducive internal environment departed on how they are applied;

i. Lighting and ventilation

ii. Acoustic condition

iii. Thermal comfort condition

iv. Safety condition

6.4.1 Lighting

Lighting inside a building fulfills two base functions, according to Neufert (1980), namely.

(i). Illuminate the interior of he building and its content

(ii). Illuminate the task inside the building

The most important factors include the illuminate, glance and the reflectance of the surface being lit.

The quantity and quality of incident light are a great determinant in visibility of task, this have been given prior consideration through the employment of artificial lighting system. Building lighting is divided into two types. These includes:-

(i). natural lighting

(ii). Artificial lighting

Natural Lighting

Like all other countries of the tropic Nigeria has enough natural light almost the whole year round. This is maximally utilized through the like of translucent roofing material (sheet) and provision made out the walls. This is in consideration of the fact that good daylight is essential and vital for working movement and feeling fresh and relaxed.

Natural lighting provided by the sun is also essential in determining the natural appearance and character of material colour and building interior.

Artificial lighting

As the name implies, 'artificial'-or unnatural, lighting created as result of science and technology. This light is employed for the purpose of continuation work when the natural lighting is gone and where it is inadequate.

6.4.2 Ventilation

Ventilation within and around a building has to do' with the quantity and quality of fresh air in and around the building and consist of Nitrogen, Oxygen, Water Vapour and .small amenities of other gasses, which are due to human activities.

Fresh air can be maintained in a building by:

1. Controlling the production of confinements

2. Ventilating any residue to open air, and contaminants by bringing in outdoor air through windows and the use of ventilators e.g. extractor fans.

3. Replace used air through mechanical system of air conditioning.

6.4.3 Acoustic Conditions

In Terminal and public buildings, noise level is of equal importance to thermal comfort. Noise impairs work and can result to physical disabilities, which also limit work efficiency and output.

6.4.4 Thermal Comfort

Temperature requirement for thermal comfort depends on the following factors.

i. Activity of the occupant of the building

ii. The nature of clothing used by those occupants

iii. The speed of air in and out of the building

iv. Air humidity

Excessive heat has always impaired work even in machines as such constitute, itself a serious environmental problem. Apart from the heat produced by the workers, heat is also generated from the vehicle engines and instrument of work when they collide with each other. Also heat comes in from outside in the form of heat penetration through opening and through the building materials.

6.5. EXTERNAL FACTOR

According to research by the National Economic Development Council, - if a building looks softy and run-down, it signifies on economically unattractive area and puts off investors, employees and potential staff. To these extent, the external environment which given the first impression as one approaches the workshop shall be well taken cared off.

These external environment results from the combine effect of:

Man-made (Artificial) macro-environment:- These are the environment surrounding the building which are the out come of the architect design consideration.

CHAPTER SEVEN

7.0 DESIGN BRIEF

The brief is aimed at providing through design an Ultra Modern railway Station that reflects a workable, economically, functional and secured site for workers and comfortable places for passengers. It must succeed in providing an arrangement that shall offer solution to the present problems that plight the Nigerian railway transportation sector.

The station shall apart from providing ticket booking servicing, make provision for other support and essential facilities like mini-shopping mall ,restaurant, mini-exhibition, guest lodge, Fire services, workshop for locomotives, administrative offices, among others.

7.1 DESIGN PHILOSOPHY AND CONCEPTUAL OBJECTIVES

Every design as a conceptual task that involved the attainment of given objectives through a delicate balance of trends dispersion and integrating bearing in mind the dominant principles of Architectural design as the approval of it. In this cases, an ultra-modern railway station design, the following principles where given eminence.

1. Functionality and functionalism
2. Organic approach to design from within to the outside.
3. Emphasis of security and environmental safety.
4. shell concept in the choice of form.
5. Symmetry is the composition of the façade elevation.

These principles were most helpful to reach the bulk of conceptual objectives. We set to achieve amongst these are worthy of mention, the following:

i. Simplicity

ii. Beauty

iii Straight forwardness

iv. Maintainability

v. Durability

vi. Flexibility

7.2 SITE SELECTION

The choice of a site for any project has the purpose of such project as its primary factor. Whatever type or class of project, its location is factor determined. It should be understood that the proposed station is an investment which must be viable enough to warrant it been established, hence it must be sited in a good location that will enhanced its total fulfillment of basic functions. For factors that affect the location of projects,. Most prominent amongst this are:

7.2.1 The Project Nature

This factor is very important in determination of where the said project should be sited. Take for instance an agricultural research institute; it will be highly unreasonable to site it where this kind of services will not be needed. There is only one major railway station in kafanchan which is outdated and not in use, therefore it will not only be reasonable to try and supplement the existing station.

7.2.2 Expansion Possibilities

The society is not static but dynamic, it increases in size. As the society increases in size, there will be a need for increase in the satisfying transportation. As such it is idea to make provision for future expansion at the initial stage of planning.

7.2.3 Proximity to Intended User

It is one thing to site a project and it is another for it to be within reach of the intended user. It will be counter productive to have it sited beyond there reach.

7.2.4 Site nature (Topography)

The nature of this project is one that requires a relatively flat site, if these would be any possible diversion from this, the site most not be rocky or mountainous.

7.2.5 Accessibility

Easy movement must be noted in and out the site for not only the staff, but the customer likewise. The site lies beside the Kagoro-Kafanchan highway thereby providing solution the problem of accessibility.

7.2.6 Available Service

Services such as that of Telephone communications, Electricity and Water are usually expensive and these are part of the life wire of most projects, the ultra modern railway station, will not an exception.

7.3 SITE SELECTION

The site for the ultra modern railway station shall be along the Kagoro-Kafanchan highway, Kafanchan, Kaduna State, Nigeria. The site also has the advantage of the kafanchan-jos railway line that passes by the side.

7.4 SITE ANALYSIS

Site Analysis is one aspect of planning that cannot be overlooked. The analysis determines the type of building especially the foundation type, which form the centre of stability of a building; building orientation, height to mention but a few. The site relatively flat covered with small grasses, shrubs and sparsely scattered trees, the soil type present on the site is made up of loam with a bit of clay, there's an existing railway line passing just by the side of the proposed site. Also the existing access road branches from the Kagoro-Kafanchan highway.

CHAPTER EIGHT

8.0 MATERIALS, CONSTRUCTION, AND SERVICES

This chapter examines the performance and the expected efficiency of the individual composition to the overall functionally of the projects. The selection of the project, the selection of the components could make overall efficiency.

The report will be based on the main components of the building namely foundations floors, walls and the roofs.

8.1 BUILDING MATERIALS

During the selection of construction materials, the Architect must avail himself of and take into proper account the physical characteristics of these materials. These characteristics include the density, modules of elasticity (including the tensile and compressive strength), moisture movements, thermal expansion and conductivity, and sound absorption coefficients. The physical attributes for most materials are obtained from professional or specialists manuals.

The foundation footing for each building in this complex is made of reinforced or plain concrete. The wall composes of Polyurethane wall panels, concrete blocks. Researchers have proven that polyurethane and concrete to be the most handy and economic materials for this purpose

The long span asbestos roofing sheets are proposed as the covering materials for some the buildings, while polyurethane will be use as a shell to cover both station complex and the cargo block. The ceiling which is one to two hours fire resistance (e.g. P.V.C, and

Polystyrene ceiling board) are proposed for the offices, staff accommodation and guest lodge.

The steel stanchion columns and beams are treated for fire protection by 45mm aesbestolux with a fire rating of 4 hours.

8.1.1. Materials

The choice of materials is determined by consideration of efficiency, and durability in equatorial climatic conditions and the wear and tear of daily uses by staff and visitors. This choice is depended on the availability of the materials. To achieve a reliable building which is stable and aesthetically appealing, test construction materials are recommended for foundation wall and roof construction. The material employed for the building components are thus enumerated as follows:

a. Polyurethane:

Polyurethane which is a new construction material would bring interest from architects and builders, on the construction methods and concepts, due to its versatility, flexibility, strength and durability this project intends the use of this material for the construction of the station complex and cargo block.

b. Concrete

Concrete is one of the most important building materials employed for this project. It is used in almost every type and size of architectural structure. In roofing and foundations,

in exterior and interior walls, floor and roof systems and walkways, concrete is a major materials employed. The plastic quality of concrete leads itself to ultimate design possibilities in form, pattern and texture. Handed concrete is durable, needs little maintenance and can be sued in many ways. Concrete is a mixture of four basic materials in proper;

I. **Cement: -**

This material is hydraulic because it sets and hardens by recreating with water. This chemical reaction is called hydration and it forms the cement into stone-like mass.

II. **Fine aggregate/sand or finely crushed stone:**

fine aggregate contains sand or other acceptable fine materials. Desirable concrete sand should contain particle varying uniformly in size; fine particles are necessary for good workability and smooth surface. These fine particles help to fill the spaces between the large partakers.

III. **Coarse aggregate (grave; or crushed stone):** Course aggregate consist of grave; crushed stone or other acceptable materials, coarse aggregate suitable for use in concrete should be sound, hard and durable. It should be clean and free of vegetable matter. The larger size aggregate could be used in thick foundation wall or footing. The use of the maximum allowance particles size usually results in less drying shrinkage and lower cost.

IV. **Water:** The primary base for using water is to cause the hydration of the cement. Water constitutes form 14 to 21 percent of the total volume of concrete. Concrete mixing water should be clean and free of oil, alkali and acid.

c. Reinforced Concrete

Steel reinforcing is frequently used in footing and foundation, slab and other concrete work to add strength and stresses. Reinforced concrete is a complete material, which utilizes the concrete in resisting. Compression forces from some other materials, usually steel bars or wires, to resist the tension forces. Steel is regarded as the best reinforcing materials for concrete it has almost the same construction rate due to temperature changes as concrete and also may be purchase in many sized and forms.

d. Timber and Steel Trusses:

Timber trusses are used in the roofing of the mini-clinic, staff, accommodation, guest lodge, warehouse, and workshop but where the span is too much for timber. Steel trusses are employed. Green colour long-span aluminum roofing sheets and used as the roofing materials because of its durability, precaution are taken to prevent corrosion caused by content with other materials.

e. Asphalt – (Bituminous Felt):

This is one of the cheapest and most commonly used roof covering that was employed in the project, bitumen felt is applied in layer of three into the rain water quitter of the parapet to ease the flow of water.

Other material employed in the project include as best of ceiling board, ceramic tiles, nails, clay tiles, and glass etc.

f. Glass panels (Glazing):

To provide light into most of buildings on site the use of reinforced glass panels would incorporated, it also increases aesthetic beauty of such structures.

g. Danpalon:

For sky-lighting purposes on station complex block, danpalon, which is a strong but light building material, is used.

8.2 BUILDING CONSTRUCTION

The selection of site marks the beginning of construction after the decision and feasibility has been completed. The construction phase culminates the period of site investigation/exploration to the completion and handling over of the building including services.

8.2.1 Site Clearance

On acquisition and/or allocation of site the investigation and exploration is commenced. The nature and type of soil on the site is ascertained for the purpose of foundation design and construction. During site visitation, proper inventory of the vegetation, subsoil nature, landform and topography, rivers and stream. Base on this tree and grass hedges are left for proper landscaping scheme.

This investigation will establish the actual location of the buildings, services and planning. Site expiration and investigation must be done even before the inception of the design phase.

Site clearance/demolition commenced immediately the contract for construction has been signed. Ours is a partly virgin land and requires proper clearance. The Guinea Savannah vegetation is simple and easy to clear. The land form is relatively spreading a wide area. The excavation for foundation construction commences. The trench must be dug up to the level of firm soil, which lies at depth of 500mm and above.

8.2.2 Foundation construction

The foundation of a building bears and transmits loads to the ground. The foundation is that part of the walls, piers and columns in direct contact with and transmitting loads to the firm ground. The main types of foundation are proposed for the project. Uniform or no settlement of the structure to a limited extent is the theme to be pursued in the foundation design and construction concrete is the materials principally used today for foundation as it can really be placed, spread and leveled in foundation benches, to provide a base for the walls columns or piers and it develops adequate compressive strength as it hardens to support the load on the foundations.

(i). Strip foundation

These made up of continuous reinforced concrete strip under load bearing walls. The wide reinforced concrete strip foundation is built and spread the loads on the foundation to an area of sub-soil capable of supporting the load without undue compaction.

(ii) Pad foundation

Since the frame construction has been adopted for this design, all points for columns has been proposed for reinforced concrete paid foundations, supporting reinforced concrete ground beams (strip foundation) and turn supporting walls and floors.

The isolated reinforced concrete pad foundations are spread in the base of excavation on which reinforced columns and walls are raised to support floors. The spread of the pad foundation should be determined by the loads on it the bearing capacity of the sub soil. The spacing of the columns was determined by most economic construction.

8.2.3 Floors

Bartony (1989) described the floor as the surface in a room on which walls and are division vertically between one storey yard and another. When used in the latter sense, floor implies a structure consisting of load bearing elements, such as slabs, girders, beams and joints, and space enclosing members.

Highly reinforced concrete floor slabs would be use for the station Complex, warehouse and the workshop due to vibrations that would be caused by trains. Being both bearing and space-enclosing elements, the floor system selected is sufficiently strong, rigid, and durable, have adequate sound and heat insulating properties, and fire resistance. The floor finishes in each building is geared towards achieving the most economic floor system.

(I). Floor Wearing Surface

Apart form the appearance, comfort, noiseless, sanitation and general criteria, floor surfaces in individual buildings are to meet quite strength, heat and chemical resistances. The project floors are designed to meet this requirement.

Floors in terminal buildings consist of base and wearing surface. Underpayments are used for strength reasons, water proofing, and better resistance's to chemical and wears. In addition, the floor surface is provided generally with slopped in the direction of the drains and gutters. The thickness and strength of the floor depend on the load and floor structural strength.

8.2.4 Walls

A wall can be described as continuous usually vertical, solid structured of brick, stone, concrete, timber or metal, thin. In proportion to its length and height it enclosed and protects a building or service to divide buildings in top compartments or rooms. It also serves as one of the oldest architectural component the bearing walls. Walls are classified according to functions, positions, and methods of constructions. Two-main types of wall exist.

(a). The **load-bearing** walls are those that carry imposed loads e.g. floor and roof, and their own weight.

(b). The **Non Load-bearing** are those that support only their own weight.

8.2.5 Roofs

A roof is essentially covering to throw-off weather (rain, clod, snow, etc) from building. It consists of a supporting structure, and space-enclosing element. The roof cladding is laid on a supporting base called roof trusses, for shells, a continuous material e.g. concrete, covers the whole structure, usually called monolithic material. Roofs must meet the basic requirements of durability, adaptability to industrialized manufacture, economy of materials, easy and inexpensive to erect and maintain.

The Shell roof has been adopted for this station complex and cargo block while the gabled roof for staff accommodation, mini-clinic, and warehouse. This roof surface is given a slope to facilitate removal of rain and smelting snow dusts.

(I). Roof trusses: Rafter is laid on wall plates or supporting steel bars form reinforced concrete base.

The rafters carry the purling. To properly secure the roof against the wind, the rafters are anchored with 5-mm diameter tie wire to barb bolts built into the walls. Parapet walls/gutters are conceived for this purpose, too.

Roof trusses are bearing elements of a roof, which is support at two points. It consists of a frame work of straight members lying in the same plane and connected only at the ends. It is made up of walls plates, tie beams, rafters, purling and struts.

(II) Roof covering: It must be impregnable to water, have light mass and long services life, and be inexpensive to maintain or repair, and have appreciable fire resistance. Polyurethane and Long span aluminum roofing sheets, are the two materials involved for

this project, meets these conditions. Glass-reinforced plastic sheets can be sued in alternative. Appropriate size should be used for the roof light monitors and smoke/heat vents.

8.2.6 Fenestrations

These constitute the openings and entrances into the building or complex. That is, doors and windows.

(I) Door: Like civil buildings, terminal public buildings, are largely equipped with standard doors but customs-built ones are used. For the workshop/warehouse rolling metal doors are proposed while stand (fire door resistance coated) metal and wooden doors are used at strategic locations on the building.

(II) Windows: These in station complex are intended to admit light and air like those in civil building but have far greater dimension. The windows in this project are growing. The windows basalt may be fixed or operable. The operable ones are top-hinged. The glazings has suitable fire resistance rating.

8.3 BUILDING SERVICE

Architecture and building services engineering together constitutes man's attempts at environmental control. Together they seek to provide the most suitable environment for the people to work, play and have their being. They seek to minimize the physiological and psychological stresses imposed by the natural ambience. This section will postulate the main services for the plastic industry.

8.3.1 PLUMBING AND SANITARY SYSTEM

1. Water Distribution System:

Water is delivered to the building site from the public mainly, which supplies constant and wholesome water by service pipe. The branches are taken from the service pipes to various supply points or to the storage cistern. The drinking water is obtained directly from the service main at the kitchen sink.

2. Service Pipe:

All services pipes are laid at the depth of 0.762mm (762mm). The pipe enters the building of this depth. The service pipe is run to a stop value near the site boundary of the station complex and the tariff meter is also installed here.

3. Sanitary System:

Sanitary systems consist of all fixed sanitary appliances or fittings in which water is used either for flushing foul waste away or in which water is used for cleaning, culinary and drinking purposes. The fittings used for discarded foul meters (Soil water) include water closet (W.C) and urinals are called soil appliances while the fitting used in finishing other water wastage's include washing hand basins, baths, showers, sinks and bidets. The soil water is discharged from W.C pan through the underground systems of inspection chambers, via the septic tank to the soak away tank. In the officer's areas, the discharged from the soil first floor to the underground septic tanks. The main stack is house in a service duct behind the office block. The effluent discharges from finish section of the

station complex, through the primary services, pipe to the main secondary pipes. The effluent is discharged into the main storage tank and treatment processing include homogenization, neutralization, aeration and filtration bed and the filtrate is discharged to the drainage.

4. **Roof and Surface Drainage:**

Due to curved and streamlined shape of the monolithic, polyurethane shell, solves the problem of roof drainage, because water drains from the smooth surface of the shell down into drainages, provided around the circumference of the shell structures which are laid to gradients or gullies that collect surface water and discharge through drains to soaks ways. The drain from the station complex and cargo block is delivered to the effluent plant while other structures are collected to another drain across the site. The surface drainage from the site is channeled through the main gutter.

CONCLUSION

In order to make it possible to offer services with an acceptable investment cost outlay in this building, without any restriction to the useful area to the scope of the servicing, all the facilities for the various functions are being integrated to achieve a more organized system of operation and gives a sense of security. Hence people in this area can easily without any hesitation come here to access this entire facilities one centre thereby making life easier and comfortable.

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