NATIONAL FIRE SERVICE HEADQUARTERS, ABUJA

By

ZAKARI ABDULKADIR B. TECH (ARCH)
REG. NO.: 91/1789

A THESIS SUBMITTED TO THE DEPARTMENT OF ARCHITECTUIRE, SCHOOL OF POST GRADUATE STUDIES, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF

MASTER OF TECHNOLOGY

in

ARCHITECTURE, M. TECH (ARCH) DEGREE.

DECEMBER, 1998

DECLARATION

I hereby declare that this thesis titled **NATIONAL FIRE SERVICE HEADQUARTERS, ABUJA**, is my authentic work under the close supervision of Professor S. O. Solanke.

All borrowed ideas and quotations have been duely acknowledged.

Sign _____.

ZAKARI ABDULKADIR

December, 1998

CERTIFICATION

This thesis entitled **NATIONAL FIRE SERVICE HEADQUARTER, ABUJA** by **ZAKARI ABDULKADIR** meets the regulations governing the award of the Degree of Master of Technology in Architecture of the Federal University of Technology, Minna and is approved for its contribution to knowledge and literacy presentation.

Sign_____ Date_____

PROF. S. O. SOLANKE ***(Supervisor)***

Sign_____ Date_____

PROF. S. O. SOLANKE ***(H. O. D. Arch)***

Sign_____ Date_____

PROF. ***(Dean Post Graduate School)***

Sign_____ Date_____

External Examiner

DEDICATION

This project is dedicated to God Almighty, for His Everlasting Mercy, Blessing and Guidance in my everyday endeavour.

ACKNOWLEDGEMENT

My profound gratitude goes to God Almighty, for His mercies and for enabling me to undergo as well as complete the second phase of the study of Architecture successfully.

I am greatly indebted to my parents for their moral support; to my brothers Dr. Mohammed Zakari and his family, Shehu and Ibrahim for always been there.

To Arc. A. I. Annunobi; thank you for instilling discipline and professionalism in us; to my supervisors Professor Solanke and Dr. (Mrs.) Zubairu - our brief encounter was most rewarding, thank you for your guidance and bringing out the best in us all. Arc. Bello Mohammed; Arc. J. O. Aniya; Arc. Paul Haruna - you were all wonderful and inspiring throughout my stay in F.U.T.

My sincere appreciation goes to Mallam Muhammad Bashir Lawal for being a brother as well as a guardian to me; Uthman Yusuf, Saba Liman, Danlami Baba (Sadam), Akpomie B. K. (Guyman) and the other brothers too numerous to mention. WE ARE ONE. You were all wonderful.

My special gratitude goes to Arc. Bashir H. Adamu and Arc. AbdulRahman A. B. of Design Plus consultants, Kano, for their openness and

encouragement: To Aisha Ndanusa, you have truly been a dear sister and a friend indeed; Pauline Alkali (sister P.) my confidant, you were wonderfully inspiring. My dear friend Dewuni, you were understanding. To Sisters Becky, Funke and Kike, thanks for the good times and assistance.

To Ibrahim N. Buba (Bubonic Bubzy), John Tope, Kelani J. O. and Co. You guys were inspiring. I pray we all meet again in the real world after parting from F.U.T. to continue our much cherished friendship.

LIST OF FIGURES

		Page
Figure 2.1	Fire Extingusiher in Action	29
Figure 3.1	Structure of Fire Service	33
Figure 3.2	Fire Hydrant Layout	54
Figure 3.3	A Typical Fire Hydrant	55
Figure 3.4	Fire Hydrant Placement	56
Figure 4.1-4.4	Graph of Fire Statistics	77 - 78
Figure 5.1	Map of Nigeria	80
Figure 5.2	Map of FCT	81
Figure 6.1	Site Layout	
	Niger State Fire Service Headquarters, Minna	88
Figure 6.2	Site Layout	
	Kaduna State Fire Service Headquarters, Kaduna	93
Figure 6.3	Fire Service Training College Moreton - in - Marsh, UK	99
Figure 7.1	Gwagwalada Area Map	106
Figure 7.2	Site Location Map	107

LIST OF PLATES

		Page
Plate 3.1-3.5	Types of Training	36-38
Plate 6.1	Administrative Block, Niger State Fire Service Headquarters, Minna	89
Plate 6.2	Apparatus Bay, Niger State Fire Service Headquarters, Minna	89
Plate 6.3	Clinic, Niger State Fire Service Headquarters, Minna	90
Plate 6.4	Administration/Apparatus Bay Kaduna State Fire Service Headquarters, Kaduna	94
Plate 6.5	Control Tower/Admnistration Kaduna State Fire Service Headquarters, Kaduna	94
Plate 6.6-6.7	Administration/Apparatus Bay Fire Service Headquarters, FCT, Abuja	97

ABSTRACT

Fire is one of man's most useful servants on the one hand, and one of his most destructive enemies on the other. It wipes out thousands of lives and destroys billions of Naira in properties as well as cause great suffering. Uncontrolled fire ravages vast expense of land yearly; destroying timber and wild life, running grazing land and accelerating the likelihood of erosion.

To avoid these hazards, therefore, design of Fire Service Stations have evolved over the years in Nigeria. These stations however, have been rendered ineffective due to some inherent problems of functional planning and adjacency rating that were not considered in the design of these stations. This led to poor response of fire fighting personnel to fire incidents because it takes the fire fighting crew and the equipment longer time than necessary, needed for quick response and space provided mostly inadequate.

This project therefore, is aimed at eliminating these setbacks through the design of functionally planned spaces such that minimum amount of time is required between fire calls and response of the fire fighting crew to fire incidents.

In the light of this, the first chapter introduces the project topic; the aim and objectives of the thesis, motivation, research methodlogy, scope of the project. The need for embarking on the project is equally highlighted and

why the project is worthwhile.

The second chapter is a research into the history, causes, classes and control of fire. The Third Chapter explains the structure, the primary function and strategies employed by the Fire Service. The Fourth Chapter involves data collection on fire incidents and statistics. General analysis of the project location was carried out and explained in Chapter Five.

The Sixth Chapter is about cases studied of some existing fire service headquarters in order to acquaint oneself with the existing conditions and facilities, their merits and their demerits with a view to comparing as well as improving on them.

The Seventh Chapter is the detailed analysis of the design which consists of design brief, site and site location criteria, design philosophy and concept etc. Materials and construction techniques have equally been given due consideration in Chapter Eight. Services which forms part of the project was not left out in the design considerations. Aesthetics and general appraisal of the project was carried out in Chapter Nine.

The main theme of this design is the Architectural imagery of Fire Service with harmonization of the concept of adjacency rating. It is the process of emphasizing this harmony that the general appraisal of the headquarters is projected.

TABLE OF CONTENTS

		Page
	Declaration	*ii*
	Certification	*iii*
	Dedication	*iv*
	Acknowledgement	*v - vi*
	List of Figures	*vii*
	List of Tables	*viii*
	Abstract	*ix - x*
	Table of Contents	*xi*
	CHAPTER ONE	
1.0	INTRODUCTION	1
1.1	Project Definition	2
1.2	Motivation	3
1.3	Aim and Objectives	4
1.4	Research Methodology	6
1.5	Design Hypothesis	7
1.6	Design Scope	7
1.7	Design Limitations	9
1.8	Project Viability	10
	1.8.1 The Need	11
	1.8.2 The Worth	11

CHAPTER TWO

2.0	LITERATURE REVIEW	13
2.1	History of Fire Fighting	13
2.2	Fire Triangle	15
2.3	Causes of Fire	16
2.4	Heat Transfer	20
2.5	Classes of Fire	23
2.6	Flame and fire Spread	25
2.7	Control of Fire	26
2.8	Types of Extinguishers	28
	2.8.1 Extinguisher and Action	28
2.9	Hazards Associated with Fire	28

CHAPTER THREE

3.0	COMPONENTRS OF FIRE SERVICE	32
3.1	Structure in Fire Service	32
3.2	Entry Qualifications	34
3.3	Types of Training	35
3.4	Fire Prevention	42
3.5	Fire Fighting	47
	3.5.1 Fire Fighting Equipment	48
3.6	Apparatus And Response	51
	3.6.1 Fire Hydrants	53

3.7 Rescue 57

3.7.1 Rescue by ordinary Means 58

3.7.2 Rescue by fire service equipment 58

3.7.3 Rescue Techniques 59

3.8 Escape Routes 64

3.8.1 Requirements 65

3.8.2 Design Principle 66

CHAPTER FOUR

4.0 DATA COLLECTION 73

4.1 Fire Statistics 73

4.2 Fire/Rescue/Incidents Report - Niger State 76

CHAPTER FIVE

5.0 LOCATIONAL ANALYSIS 79

5.1 Federal Capital Territory, Abuja: Background 79

5.2 Site Characteristics 82

5.2.1 Geology and topography 82

5.2.2 Rainfall 83

5.2.3 Temperature 84

5.2.4 Vegetation 84

5.2.5 Wind 84

5.2.6 Solar Data 85

CHAPTER SIX

6.0	CASE STUDIES	86
6.1	Niger State Fire Headquarters, Minna	87
	6.1.1 Merits of the Design	91
	6.1.2 Demerits of the Design	91
6.2	Kaduna State Fire Service Headquarters Kaduna	92
	6.3.1 Merits of the Design	95
	6.3.2 Demerits of the Design	95
6.3	Fire Service Headquarters, Abuja, FCT	96
	6.2.1 Merits of the Design	98
	6.2.2 Demerits of the Design	98
6.4	Fire Service Training College, Moreton-In-Marsh, U.K.,	98
	6.4.1 Merits of the Design	100
	6.4.2 Demerits of the Design	100
6.5	Analysis of the Cases Studied.	100

CHAPTER SEVEN

7.0	THE DESIGN	103
7.1	Design Brief	103
7.2	Site and Site Analysis	105
	7.2.1 Site Location	105
	7.2.2 Site Selection Criteria	108
	7.2.3 Topography, Geology and Physiography	109

7.2.4 Climate 110
7.2.5 Soil and Vegetation 111
7.2.6 General Site Appraisal 111
7.3 Design Consideration 112
7.3. Site consideration 112
7.4 Design Philosophy and Concept 113
7.5 Functional Analysis and Site Planning 116
7.5.1 Functional Analysis 116
7.5.2 Site Planning 119
7.6 Space Schedule 120

CHAPTER EIGHT

8.0 MATERIALS, CONSTRUCTION AND SERVICES 124
8.1 Materials 124
8.2 Construction 126
8.3 Services 128
8.3.1 Electrical Services 128
8.3.2 Plumbing Services 129
8.3.3 Water Supply/Facilities 129
8.3.4 Acoustic 129
8.3.5 Fire Protection 130
8.3.6 Telecommunication 130
8.3.7 Fuel Station 131

8.3.8 Street Traffic Control 130

CHAPTER NINE

9.0 AESTHETICS AND GENERAL APPRAISAL OF THE PROJECT 132

9.1 Aesthetics 132

9.1.1 Expression 132

9.1.2 Form 133

9.1.3 Composition 133

9.2 General Appraisal of the Project 134

Conclusion 136

CHAPTER ONE

1.0 Introduction

The use and control of fire and its products involve inventions fundamental to human society and culture. Without them, contemporary technology - based society would be impossible. The ultimate movement of man over most of the earth's surface is almost directly dependent upon his ability to produce and control fire; otherwise, he would have been confined to those few geographic areas where hospitable climate prevailed. The importance of fire in human experience is further attested by the fact that it has been found in every human culture of the recent past.

Fire is one of Man's most useful servants vis-a-vis one of his most destructive enemies. Fire presents a constant threat to life and property. Out of control, fire can kill great members of persons and it can destroy on a massive scale. Fire ravages vast expanse of land yearly, destroying forests and wildlife, ruining grazing lands thereby making the land surface susceptible to erosion and flood as well as drought.

The origin of fire hazards is complex. For continuous existence of our society, state and nation in general, these hazards of fire need to be curbed. The mere striking of match is such an everyday occurence that the fact of fire is taken for granted. An understanding of what fire is; how it originates and behaves which is the key, both to controlling and to the intelligent

handling of many inflammable materials and situations today are not comprehended by users.

No matter how well building codes are enforced in order to safeguard life and property through the use of fire resistant materials in buildings, fire hazards still occur.

The most economical and effective way of curbing these hazards is through an organisation or institution which trains and has trained men with specialised equipment and effective planning to combat any occurence of fire incidents. This institution shall have the human and material resources to harmonise and co-ordinate the activities and training of its administrative staff, fire fighters and the general public the rudiments of fire outbreak before the arrival of trained fire fighters. It is the institution for training such, which will also serve as a focal point or central authority that is being proposed.

1.1 Project Definition

"A fire station is building for firemen and their vehicles and equipment"

—(Longman Dictionary of Contemporary English)

Fire service can be thus be defined as an organised team of personnel trained to put out fire, rescue as well as protect and enhance the protection of the

society in particular and the entire nation in general.

1.2 Motivation

The development and continuous existence of any state and nation in general, is integrally dependent on the preservation of her human and material resources. The present alarming rate of wanton destruction meted to both human and material resources is common knowledge. There are reports through the various news media, of various kinds of fire incidents in Residential buildings, Industrial buildings, Public buildings, Ministries and Parastatals, forest or bush fires etc. These frequent fire occurence results into loss of millions of Naira worth of goods and properties. Hundreds of lives are lost yearly and people put out of their jobs or lose their source of livelihood to fire.

The motivation to selecting this project can be enumerated thus:

i. ***Personnel Interest:*** This is derived from my Primary to Secondary School years as a membner of the Red-Cross Society. This motivation is borne out of the wage to ensure that that kind of rescue becomes a reality.

ii. ***Protection:*** This is borne out of the aspiration to enhance communal efforts in the protection of human and material resources.

iii. ***Standard Design:*** It is noteworthy that many of the existing fire

stations and institutions in the country were not designed for this purpose but rather converted buildings into stations and institutions for this purpose.

iv. ***Central Authority:*** There is need for a central institution in the country which should have adequate personnel and departments in charge of salary and fringe benefits of officers and firemen which shall be commensurate to the training or experience of the firemen. This is necessry because danger and death are never far away from the men, both in training and in service.

1.3 Aim and Objectives

AIM:

The aim of this project is to produce a central authority with good architectural infrastructure which will enhance as well as improve the efficiency of firemen, giving them a distinguished identity of competence as manifested in the institution and throughout the country.

THE OBJECTIVES INCLUDE:

i. To provide well articulated spaces for better team work and administrative control as well as brining together (on one site) the different aims of the fire service rather than scattered within towns which is the practice in Nigeria.

ii. To achieve a quick dispatch, travel and turnout times, by proper planning of the station in order to successfully contain fire.

iii. To provide facilities for positive learning and training for firemen, not only those in the Federal Capital Territory but other states, Zonal and Local Governments in the Federation.

iv. To revive the Fire Service as a competent organisation whose duty is to safeguard lives and properties.

v. To facilitate the fitness and comfort of the entire populace through the provision of support facilities to cater for all.

vi. To provide facilities for educating the public on prevention, fighting and management of fire incidents.

vii. To create an avenue for social interraction between fire service personnel and the public with a view to attaining an appreciative level of individual's moral obligations and responsibilities to fellow human beings.

viii. To provide on-the-job training for personnel on rotational basis.

ix. To provide an administrative headquarters for all fire services

departments in the federation.

1.4 Research Methodology

Two sources of information were employed for the purpose of this research:

i. Primary Sources

ii. Secondary Sources.

Emphasis was laid on the Primary sources which included;

a. Field work aimed at obtaining photographs of existing fire station to serve as case study.

b. Direct interview with a number of fire officers and other personnel on the general requirements fo a standard fire service.

c. Interview and observation of parade and drill sessions of firemen to ascertain their physical fitness, abilities and skills.

d. Direct interview with fire prevetion officers, to obtain statistical data of fire incidence report.

Secondary sources of information include:

a. Review of relevant literatures on fire fighting and prevention and the various equipment used.

b. Literature review from publication extracts, encyclopaedia,journals and magazines on fire.

c. Review of literature of fire fighting appliances and the fire classifications.

1.5 Design Hypothesis

The project is aimed at verifying the hypothesis that provision of adequate infrastructures could enhance the efficiency and competence of the fire service.

1.6 Design Scope

The design proposal is to serve as the national headquarters of fire service. To meet the objectives of the design, the following facilities shall be incorporated:

1. ***Administrative Block:*** This shall comprise among others, offices of the Fire Chief or Director; Fire Prevetion Division; Planning and Research Offices; Budget or Fiscal Bureau; Personnel Department; Fire Investigation Bureau etc.

2. ***Fire Station:*** This shall house all facilities and apparatus required for fire fighting including spaces for firemen.

3. ***Fire alarm and Communications building:*** This shall be fire

resistive construction and isolated from the other structures. It is the place where all alarms are received and transmitted and contains draughting room for plans, battery rooms etc.

4. ***Fire Training Facilities:*** This is to include an Apparatus Room where major apparatus can be brought indoors for instruction purposes; adequate classrooms and training aids. Other desirable features would include a gymnasium and a machine room printing manuals and bulletins.

5. ***Maintenance Facilities and Shops:*** These include spaces where major apparatus including ladder, trucks can be serviced and repaired. There shall also be a fire equipment shop.

Auxilliary facilities to be provided shall include:

a. ***Turn-out Gear Storage:*** Thi is a facility for storing helmets, coats, boots etc. with accommodation for washing and drying out.

b. ***Accommodation:*** Dormitory or locker Room spaces shall be provided for the firemen, while the chief's Quarters shall be located as to be readily accessible frm his response vehicle. Hostel accommodation shall be provided for trainee officers.

c. ***Television Theatre:*** The future of most training programmes

will be through the closed-circuit television and video tapes. This theatre will have desktop writing surfaces.

d. ***Outdoor Training Area:*** This shall be a large space with variety of structure for demonstrations and practice fires; Drill tower for hose and ladder evolutions, tanks, Helicopter for high altitude training etc.

e. ***Recreation Area:*** This shall include the Mess, Cateen and Snack Bar. Each component shall be planned for the level of commecial use so that the public will be better informed through contact and interaction with fire officers.

f. ***Clinic:*** This shall be designed for the purpose of serving not only the fire service personnel, but the public in general at a subsidised rate. Surgical and other specialists cases could be reffered here.

1.7 Design Limitations

The major constraints to this design proposal shall be the inherent problems of:

a. ***Turn Out Time:*** which is the arrangment of traffic flow within and outside the fire station to be as direct as possible for quick response.

b. ***Dispatch Time:*** This is the planning of the fire service by the

integration of 'Primary Adcacency' concept of planning for efficiency

1.8 Project Viability

Nigeria as a developing country needs a better protection against fire hazards to safeguard lives and properties. The tragedies of Kaduna Central MArket, Radio House, Abuja; Destitutes Home Kaduna to mention a few of the most recent, has recorded millions of Naira in losses. This incidences recorded definitely served as reminder of the seriousness of the situation, which calls for the enhancement of efficiency and competence through an institution of high quality and standard. It is such an institution that isbeing proposed.

In a fire institution like this, the Federal Government is involved in the provision of adequate fire equipment and subventions to the fire services departments.

An institution like this is meant to train and re-train officers of the Fire Services in the country as well as fire officers and personnel of the armed forces (ie. Army; Airforce and Navy within and outside Nigeria) and other organisations, corporations, ministries, parastatals and invidiuals.

From the statements above, it will be proper to say that the viability of this project is borne out of:

a. The Need

b. The Worth

1.8.1 The Need

The need for a fire service headquarters in Abuja to serve as th eNational HEadquarters, is due to the fact that, there already exist, though mostly substandard, state fire service headquarters in all the 36 states, there also exist Zonal Headquarters which are headed by Zonal Commanders; and District Headquarters which are headed by District Commanders.

In addition to this primary need, is the need for a standard fire service headquarters and personnel for the nation's capital. This is of great importance for the Federal Capital Territory which is experiencing rapid population increase. and multi-million naira investments and structures. Coupled with this is the position of Nigeria as th giant of Africa and a symbol of black Nation.

1.8.2 The Worth

The viablity of this project is not in doubt. This project shall be worth the consideration and importance due to the basic fact that Billions of Naira and properties have been expended to bring this dream capital to reality. This Federal Capital, Abuja, serves as a regional headquarters for West Africa which is evident in the location of many regional and sub-regional headquarters of organisations and institutions in Abuja.

This project shall be worthwhile because if there had existed such an institution, multi-million Naira worth of properties and equipment lost in various fire incidents, E.g. Radio House, Abuja fire which is most recent incident in the multi-million naira investment would have been saved in the Federal Capital. Such an institution would have also provided back-up support to Kaduna State Fire Service to save lives and multi-million Naira worth of properties that was totally destroyed in Kaduna Central Market.

CHAPTER TWO

2.0 Literature Review

2.1 History of Fire Fighting

History is filled with accounts of fires thathave wiped out whole cities and even set back civilization. In the 2nd century B. C. the city of Carthage was completely destroyed by fire, and in the 1st Century A.D. most of Rome and all of Jerusalem fell before flames.

Caesar Augustus formed what was probably the first Municipal fire department, in Rome. Seven squads of men were led by a fire chief called Praefectus Vigilum with his own chariot in the early years of the 1st century A.D. The Roman Vigiles were a corps of imperial servants who were equipped with fire-fighting appratus, including an early version of the face pump. They also acted as night watchmen to safeguard the palace. As early as 100A.D., Pliny the Younger wrote to the Roman Emperor Trajan, proposing the organisation of local fire departments. Pliny was governor of the province of Bithynia in Asia minor, which had been plagued by great fires in Nicomedia (now Izmit, Turkey) and other cities.

The ancient Romans were the first to organise a resistance to the terrible menace of fire. Rome was the first city to organise a regular fire-fighting force - numbering over 7000. The homes of the poorer Romans, in the

most populous area of the city, were usually built of wood and straud. Each family maintained fire on a small altar in honour of the domestic gods. Fires frequently broke out.

In those days, long before the discovery of electricity there were human alarmic boxes, officially called Nocturns. These Bocturus were strategically stationed throughout the city. The alarm was relayed from one nocturn to another until it reached the nearest castra which is the fire house. The duty of the nocturn was then to rush to the scene of the fire, driving back crowds and establishing fire lines. Then would come a centurion leading a company of firemen, complete with leather trousers, jackets and helmets. They were equipped with wooden hand pumps that worked like bellows or springes (siphons), axes, hammers, saws, iron bars and short larders, so made that the ends could be clamped together to reach the roofs of buildings.

Following these came hundreds of aquarii, carrying light eartenware jars and vases. The aquarii formed chains from the nearest cistern, supplied from the great Aqueducts leading into the city, and presently the jars would begin emptying a stream of water in the siphons for application to the fire. The Praefectus Vigilum, equivalent to the fire chief of today, would take command of the fire chief of today, would takbe in attendance. Usually, three were attached to each castra (Fire house). Also, pillow bearers in groups ofn four, carrying huge leather pillows of 1.2m^2 area and stuffed with feathers, would respond. Their purpose was to rescue people trapped

at the upper windows of building. As the forerunner of today's fire marshal, the questionarius was also on the scene. His job was to question the people and try to ascertain the cause of the fire. Roman law at that time demanded that responsibility be fixed for every fire. The questionarius established a board of enquiry before the flames had been extinguished.

In Colonial America, the first fire protection was provided by Bucket Brigade, made by hand. Water was passed in leather buckets by early settlers from water supply to the fire and back again. These people were undoubtedly the first volunteer fire fighters in America. But the first regular group of organised volunteer fire-fighters, was directed in Philadelphia by ***Benjamin Franklyn*** in 1736.

Boston established the first paid fire department in 1676. However, separate volunteer companies survived in most cities for almost 200 years.

In 1853, the city of Cicinnati introduced the first steam fire engine. This was really the beginning of the trained professional firemen. Instead of pulling the engines by hand, professionals used horses; instead of hand-pumpers, they used heavy steam pumpers.

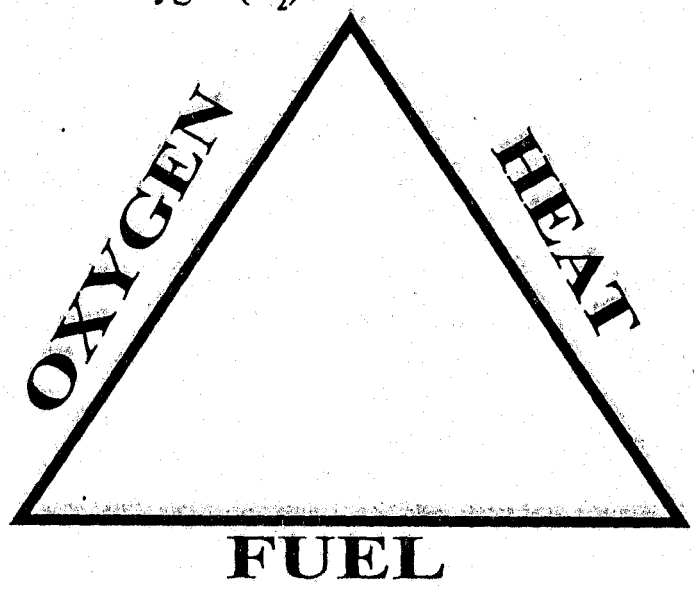
In 1908, gasoline engines began to replace the horse as a means of propelling the large steam pumpers. As th einternal combustion engine was further developed, it was soon to replace the steam engine as a means of driving

the pumpers. The romantic days of the steam pumpers, pulled by charging horses, was nearing an end. Soon other forms of modernization, such as Aerial ladder trucks, Aluminium ladders, stainless steel fittings and hose connections and a variety of chemical extinguishers replaced old-fashioned equipment.

Today, fire fighters need to undergo extensive training programme on fire protection. This education provides the key for developing leadership in fire protection. Successful training in a variety of topics ultimately provides for identification o fthe immediate fire hazard, the choice of th ebest fire-fighting tactic and extinguisher and devicing strategy for its application.

2.2 Fire Triangle

Fire = Fuel + Oxygen (O_2)+ Heat



THE FIRE TRIANGLE

for fire to occur, all the three elements must be present at certain stage: fuel must be present, Oxygen must be present and heat source must be intense enough to cause ignition.

- Oxygen; which supports combustion
- Heat; which ignites the substance
- Fuel; which is combustible material

From the triangle stated above, it is obvious that, if any of the three elements is removed, the fire will be put out.

2.3 Causes of Fire

People, Nigerians especially, hold the view that the occurence of fires are inevitable and that little can be done to reduce their incidence and effects on life and property. This is not the case. Majority of fire incidents could be prevented and the remainder could be minimised if proper effective fire safety act to control and arrangements to combat them immediately were provided.

Generally, the primary cause of fire is people's carelessness and/or ignorance about fire and fire prevention; their indsicriminate disposal of glowing cigarette and smoking while in bed; mis-handling of flammable liquids such as petrol, kerosine etc.

Other causes of fire may be attributed to the following

a. Overloading of circuit with the use of multiple adaptor

b. Children playing with matches or naked fire.

c. The use of mosquito coils without protection at the base

d. The use of candle sticks without protection at the base.

e. Defective heating and cooking equipment

f. Failure to switch of electrical appliances when or in use eg. Air Conditioner, Pressing iromn etc.

g. Naked light coming in contact with leakage or exposed gas pipes of flammable liquids.

h. Arson

i. Lightning

2.3.1 From Electrical Installation

Fire outbreak from electrical installations are a common occurence in urban life. The average dwelling is loaded with such appliances as room air conditioners, electric kettles, boiling rings, electric pressing irons etc. This is as a result of development and increasing need for convenience and comfort in the society.

Irons plugged in and thoughtlessly left standing on clothes or ironing board covers are a common cause of fire in dwellings. Metal or asbestos stands help to prevent likelihood of fire incidents.

Electric connector heaters and tubuler heaters are left to become dangerously hot if hairy clothes are drapped over or wrapped round. Thus depriving them of the free circulation of air necessary for their efficiency. This causes overheating to the point of fire.

Fire outbreaks from these electrical installations and appliances result from three kinds of faults;

i. Earth leakage current

ii. Over loading of wiring or appliances

iii. Short circuits

Faults in electrical equipment, worn wiring, faulty connections etc. are often the cause of fire outbreaks.

Overloading of supply circuits by the use of multiple adaptors could lead to fire. This misuse of an electric point by connecting several equipment such as television, iron, refrigerator, boiling ring or electric kettle to run off a single point causes overloading hence the components and the wiring are liable to get dangerously hot. The ideal thing is one appliance, one socket. Most electrical appliances should be isolated from power supply when not in use eg. T.V. Sets, Fan etc. Likewise combustible materials should not be hung near electric bulbs.

Worn flexes cause shorting (short circuit and spark) and set fire to insulating

materials. This is the sort of thing which happens in a split second inside the switch casing whenever we turn on a swicth. Sometimes, as it is in the case of certain electric drills, the contacts of the switches are exposed. Intermittent sparking will occur when there is continued making and breaking of electrical contact, such that where electrical elements are broken, or leads worn out or contacts faulty, floor coverings or furniture may be set alight. Hence it is good to examine the connecting leads from time to time and replace worn out ones immediately. Worn and defective parts are apt to cause sparking as well as overheating.

2.3.2 From Lightning

Lightning as a natural cause of fire outbreak, is a phenomenon which is brought about by a pile-up of cumulonimbus clouds which discharge enormous flashes of electric light resultantly crated from th egrowth and rupture of numberless rain-drops highly charged with electrical energy and the resultant explosive flash unleash millions of volts. When such a huge magnitude of electrical discharge strikes an un-protected structure a fire outbreak may result. An evidence in world history is the Companile, a 105 metre structure in St. Mark Square, Venice in Italy, which was repeatedly struck and seriously damaged nine time between 14th - 18th Centuries due to lightning.

It is interesting to know that the average lightning discharge contains power of the order of 50 million Kilowatts. If harnessed, an average lightning

discharge could provide electrical power for up to 5 million people.

2.4 Heat Transfer

Once fire breaks out, and is surrounded by a combustible material and an adequate supply of oxygen, the natural thing is for it to spread through heat transfer.

Heat is tranfered withn and between buildings in three ways:

i. Convection
ii. Radiation
iii. Conduction

2.4.1 Convection

Convection is the transportation of heat by movemen of heated substance. It is heat transfer by air motion. Over four-fifths of heat from a fire is carried away by air and other gases in this fashion. During a fire outbreak, heated air expands, the air becomes less dense than the surrounding atmosphere and mixed with gases produced by the fire, moves upwards forming convection currents which carry with them heat and smoke, exerting pressure against doors, windows, air ducts and the like and penetrating openings. The temperature of this rising air is likely to be very high and it will heat up all materials in its path.

Unless the supply of air is cut off, the displacement of air upwards will

draw fresh air towards the fire. This will in turn become heated and rise upwards continuing the process of convection. The increasing supplies of oxygen reaching the fire is as a result of stronger convection which intensifies the burning heat from the fire, which come together with violent turbulence and might rush upwards in sort of whirlwind. This up-rush is capable of lifting burning materials and dropping them over a wide area, starting new courses of fire. If an element such as ceiling , blocks the upward path of the convection currents, they will spread out. If they can't spread sideways owing to the presence of walls, they are then forced below a thick layer of heated air formed under the fire. Thus fire which has got hold of a third and fourth storeys of a building may be unable to be reached by firemen approaching the well of a brick-enclosed concrete staircase, due to heat being forced down it.

2.4.2 Conduction

Conduction is the transportation of heat through solid materials. Although, some metals such as steel can withstand great heat without igniting, their presence (as girders or partitions) in a burning structure will not necessarily check a conflagration. During fire, outbreaks, heat can be transferred through steel beams, metal conduit wire and ducts, and so on, which are good conductors of heat.

Metal are very good conductors of heat. A steel beam, heated at one end will carry the heat throughout its length and may cause combustible material

at its other end to smoulder until it reaches ignition point. A metal door heated by fire may ignite materials in contact with its other side.

Unfortunately, many accidental fires begin withoiut any visible flames and in confined spaces such as those existing between floor boards and the ceiling of a room below. They may go on smouldering for sometime before any sign of them is noticed. Then quite suddenly, the fire bursts out of its relatively small pockets of local heat and takes hold of a whole building in a matter of minutes with such violence that no part of it can be saved.

A smouldering fire which never actually bursts into flames is a frequent cause of death. The local oxygen is depleted, smoke and such gases as carbon monoxide seep undetected into places where people are working, eating or sleeping.

2.4.3 Radiation

Radiation is heat transfer by electromagnetic waves. During fire outbreak, hot surfaces can radiate heat, igniting combustible materials distance away. Objects in the neighbourhood of a fire are exposed directly to the radiant heat from its flames and burning fuel. The nearer these are to fire, the greater the intensity of the radiated heat reaching them and they become heated to ignition point. This is what happens when clothes drying in front of a fireguard ignite. Once a second fire starts close to the original one, the fires then radiate each other and speed up their rate of growth objects

previously at a safe distance from the first fire are not within range of the greater heat radiation. Radiant heat energy increases rapidly as the source becomes hotter.

As a general rule, the Radiant Ebergy is directly (^0F + 460 of the source).

2.5 Classes of Fire

As a means of indicating what extinguishers and extinguishing agents are suitable, fires have been classified according to the principal burning material.

2.5.1 Class 'A' Fires

These are fires involving solid materials usually of organic nature in which combustuion normally takes place with the formation of glowing embers; wood, paper, textiles etc. They are best extinguished by the combustion inhibition provided by heat absorbing effects of water - based liquids.

2.5.2 Class 'B' Fires

These are fires involving liquids or liquefiable solids, burning liquids oil, ie. flammable and combustible liquids, fats, paint etc. They are most readily extinguished by excluding air, inhibiting the release of combustible vapour or flame, or by interrupting the combustion chain reaction.

2.5.3 *Class 'C' Fires*

These are fires involving gases or liquified-petroleum gases. Eg. Methane, Propane, Butane etc. They can be extinguished by inhibiting the release of combustible vapour or flame provided by the carbon dioxide gas or dry powder.

2.5.4 *Class 'D' Fire*

These are fires involving metals E.g. Magnesium, Sodium, titanium, Zirconium etc. They can best be extinguished by the exclusion of oxygen provided by metal powder, limestone.

It is pertinent to note that, use of wrong medium would cause explosion.

2.5.5 *Fires Involving electrical Hazards*

Fires involving electrical hazards do not constitute any specific class of fire. This is so because any fire incident caused by electricity could fall into any of the classes mentioned above. To extinguished fires involving electrical hazards, the current supply must be cut off, and then any of the extinguished methods stated above could be used or suitably applied.

METHODS OF EXTINCTION

1. Smothering: Elimination of oxygen
2. Cooling: Elimination or limitation of heat

3. Starving: Removal of combustible materials.

2.6 Flame and fire Spread

To understand how fire spreads in a building, one must first consider how flame spreads durin combustion. Flame is the burning gas, especially above fire. the ability to escape a building fire depends on the rate of flame spread along conbustible surfaces.

2.6.1 Vertical Spread

Flame spread in an upward directoion can be rapid, as convected away from unburned material. As a consequence, flame spread along ceilings, is generally more rapid than along floors.

Fire spread will depend, apart from the nature, amount and distribution of the contents and the air supply, on the physical properties of the surroundings wall and ceiling surfaces.

In buildings, conduction, convection and radiation can cause a room to become super-heated once the air temperature is raised to the ignition point of the bulk of the fuel in the room, flash over occurs. The fire will continue to spread until it is stopped by the removal or lack of fuel, or by the intervention of the fighting operations. Any unprotected opening in a building will increase the flame spread and influence fire behaviour.

A building that is properly designed, constructed and maintained can aid in containing fire outbreak. This containment is enhanced if the building has additional fire protection installations such as automatic fire sprinklers.

2.7 Control of Fire

The major factors that determine the rate of burning in a building compartment or confined area, are the fuel load and the ventillation. The fuel load from building furnishing can vary from room to room and change with time. It is therefore, difficult to predict if a fire will be ventillation or fuel controlled. Consequently, fire resistance requirements for buildings should be determined by assuming that the more destructive ventillation controlled fire will occur.

2.7.1 Ventillation controlled

Where the fuel load is considerable and the ventillation poor, Eg. basementrs, buildings with small areas of fixed sealed glazing, theatres; the rate or period of burning can be prolonged as it will be controlled by ventillation. When windows break, the fire will spread and the rate oif burning will increase.

2.7.2 Fuel Controlled

Where the fuel load is small and the ventilation sufficient. E,g, buildings with very large window openings, the will be controlled by the surface area of the fuel. Fuel controlled are of short duration and the the room

temperature is not excessively high due to infilteration of cooler outdoor air. In multi-storey buildings with low ceilings, however, flames can spread from floor to floor through exterior opening with high ceilings, flames would be confined to the room.

2.7.3 Automatic Suppression

This involves:

a. Fire detection and Alarm warning

b. Automatic Sprinkler System

c. Halon System

d. Foam system.

2.7.4 Manual Suppression

This involves:

a. Fire detection and alarm warning

b. Portable fire extinguisher

c. Stand pipe fuel hoses

d. Fire department personnel and equipment

2.8 *Types of Extinguishers*

	Extinguisher	Used Specially on	Not Appropriate for
1.	Water type	Class A	Class B and C and Electrician Types
2.	Carbon Dioxide(CO_2)	Class B	
3.	Foam	Class B	Electrical Fire
4.	Dry Chemical	Class B/C/D and Electrical Fire	
5.	Dry Sand	Electrical Fire	
6.	Bromochlorodifluo romethane (BCF)		

2.8.1 *Extinguishers and Action*

Figure

2.9 *Hazards Associated With Fire*

The hazards associated with fire may be considered in order of importance as:

a. Personal

b. Damage

c. Exposure

Fig 2.1

FIRE CLASS BS4547 and EUROPEAN STANDARD EN2	EXTINGUISHING PRINCIPLES	 A.B.C. ALL PURPOSE POWDER	 MONNEX & SAPPHIRE DRY POWDER	 METAL POWDER	 CARBON DIOXIDE	 FOAM	 WATER	 B.C.F.
CLASS A Fires involving solid materials usually of organic nature in which combustion normally takes place with the formation of glowing embers. Wood, paper, textiles etc.	Water Cooling or Combustion Inhibition	YES Excellent Rapid flame knockdown and excellent protection against re-ignition	NO Will control small surface fires only.	NO	NO Will control small surface fires only.	YES Has smothering, cooling and sealing action.	YES Excellent Good penetration and rapid cooling of combustibles below fire point prevents re-ignition	YES Rapid flame knockdown
CLASS B Fires involving liquids or liquefiable solids. Burning liquids oil, fat, paint etc:	Flame Inhibiting or surface blanketing & cooling	YES Excellent Rapid flame knockdown	YES Excellent Rapid flame knockdown	NO	YES Leaves no residue Does not contaminate food.	YES Excellent Foam blanket gives protection against re-ignition & cools the liquid fuel	NO Water will spread the fire	YES Rapid flame knockdown
CLASS C Fires involving gases	Flame Inhibiting	YES	YES	NO	YES	NO	NO	YES
CLASS D Fires involving metals, Magnesium Sodium Titanium Zirconium	Exclusion of oxygen & cooling	NO Use of wrong medium could cause explosion	NO Use of wrong medium could cause explosion	YES Excellent Forms a crust over burning metal and excludes oxygen	NO Use of wrong medium could cause explosion	NO Use of wrong medium could cause explosion	NO Use of wrong medium could cause explosion	NO Use of wrong medium could cause explosion
Fires involving electrical hazards	Flame Inhibiting	YES Non-conductor	YES Non-conductor	NO	YES Excellent Non-conductor Leaves no residue	NO Foam is a conductor	NO Water is a conductor	YES Excellent Non-conductor Leaves no residue
PRESSURE SOURCE		CO_2 Cartridge	CO_2 Cartridge	CO_2 Cartridge	CO_2 Stored	CO_2 Cartridge	CO_2 Cartridge	Nitrogen Stored
STANDARD SIZES		1kg 2kg 4.5kg 9kg 12kg	4.5kg 9kg 12kg	9kg	1kg 2kg 3kg 5kg	9 litres	9 litres	0.7kg 5.5kg 1.0kg 7 5kg 1.5kg 10kg 2 5kg 12kg 3.5kg
RECHARGING		On site	On site	On site	By arrangement with supplier	On site	On site	Replacement cylinder on site
BODY COLOUR		BLUE	BLUE	BLUE	BLACK	CREAM	RED	GREEN

The right is reserved to vary or modify any specification without prior notice.

a. ***Personal:*** This refers to the hazard to the occupants of the building.

b. ***Damage:*** This refers to the hazard associated with th structure and its contents.

c. ***Exposure:*** This is hazard due to the spread of fire to other buildings

The hazards to the occupants of a building are due to the following factors:

1. Reduction of Oxygen

This is due to the consumption of oxygen by gases evolved by the fire, particularly carbon monoxide. And associated additional hazard is smoke which results from incomplete combustion. Staricases usable as means of escape and corridors giving access to them, where exposed to any particular risk, should be protected by fire-resisting partitions and self-closing fire resisting doors.

Wherever possible, staircases should be ventilated to the open air in alll storeys. The degree of hazards to occupants is influenced by the distance between points of escape, size and number of exits and stairs, and the existence or other wise of a sprinkler system.

2. *Increase in Temperature*

Breathing is difficult above a temperature of 300°F ie. 100°C and since this temperature will be reached well in advance of the path of the fire, it is essential that automatic alarms be provided; designed to operate at given temperatures say 120° - 158°F. ie. 50° - 70°C.

3. *Spread of Flame*

the risk here is of burning by physical contact with flame itself. This has led to loss of lives and caused deformities of various kinds to many victims of fire.

This hazard could be minimised by enclosing escape routes with non-combustible materials, or materials of low flame spread.

CHAPTER THREE

3.0 Components of the fire Service

The fire service is a national service which is responsible for security and welfare of the citizens. It is concerned with the general safely of the members of the public. Due to their obligation to the public, the fire service operates on common standards and methods.

3.1 Structure in Fire Service

The classification of firemen rank structure is based on qualification and experience. It is similar to that of armed forces.

The organisational rank-structure is broadly divided into three (3) different cadres and staff rank.

3.1.1 Fireman Cadre

a. Assistant Fireman (Junior Fireman)

b. Fireman

c. Senior Fireman

d. Leading Fireman

3.1.2 Station Officer Cadre

a. Sub-Officer

b. Station Officer

STAFF ORGANISATIONAL CHART

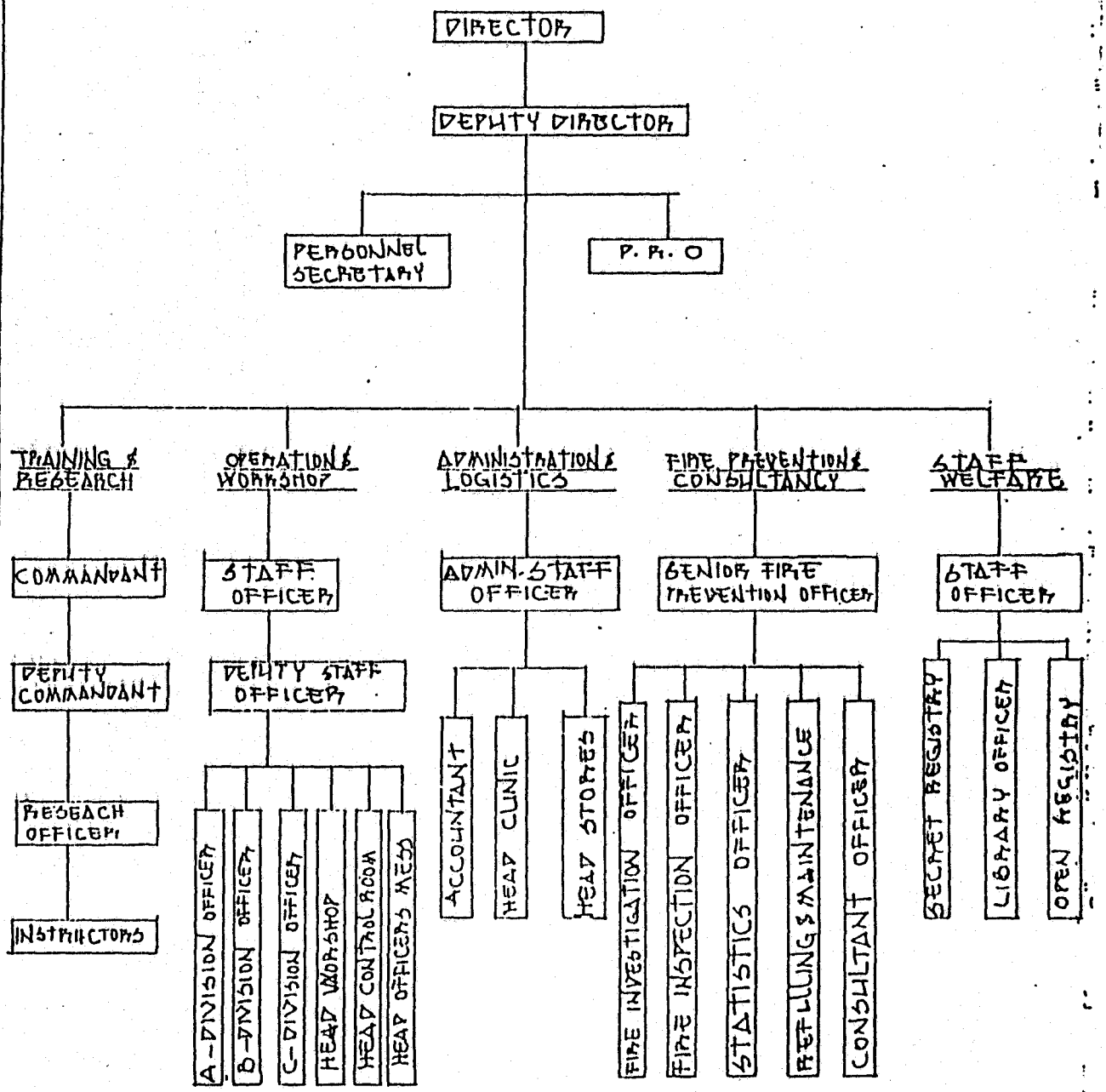


FIG. 2:2

c. Senior Station Officer

d. Assistant Divisional Officer

3.1.3 Supervisor Officer Cadre

a. Divisional Officer

b. Senior Divisional Officer

c. Principal Divisional Officer

d. Assistant Chief Fire Office

e. Deputy Chief Fire Officer

f. Assistant Director of Fire

g. Deputy Director of fire

h. Director of Fire

STAFF RANK

a. Commandant

b. Deputy Commandant

c. Sub Officers.

3.2 Entry Qualifications

3.2.1 Fireman Cadre

a. Assistant fireman - By direct entry of students with full primary schoolleaving certificate.

b. Fireman - Minimum of three years Secondary School Education.

Through training courses and examination, they are promoted to higher ranks depending on how successful they are.

3.2.2 Station Officer Cadre

a. Station Officer - By direct entry of candidates with higher School Certificates (H.Sc.)

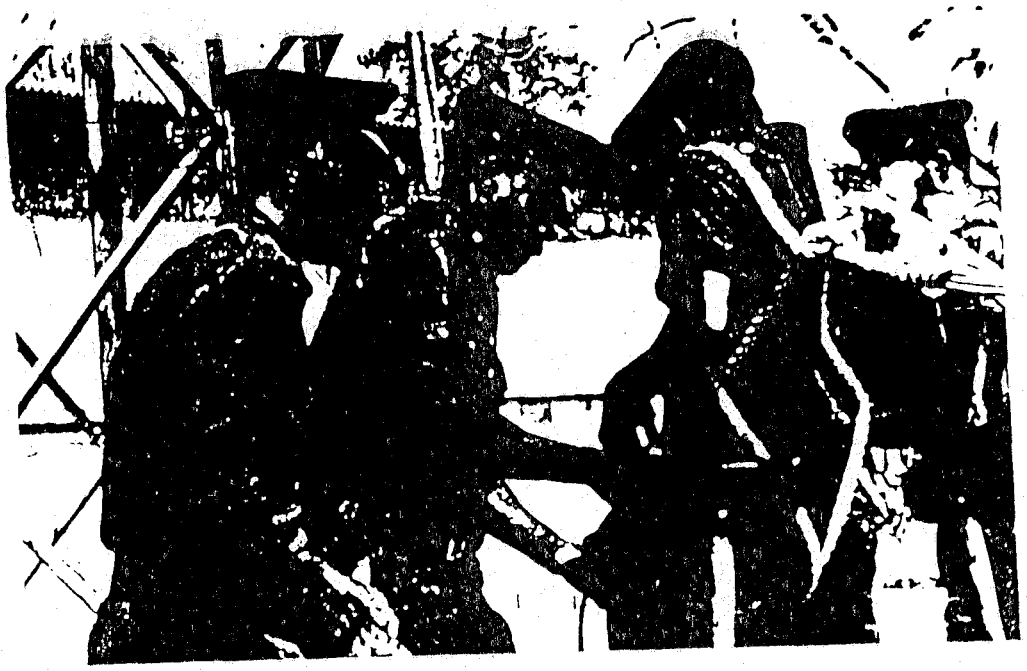
b. Senior Officer - By direct entry of candidates with degree from recognised University or any institution of higher learning in a relevant fire service subject or course

3.3 Types of Training

The learning programme is for categories of specific ranks ranging from the Fireman cade, station officer cadre to supervision officer's cadee.

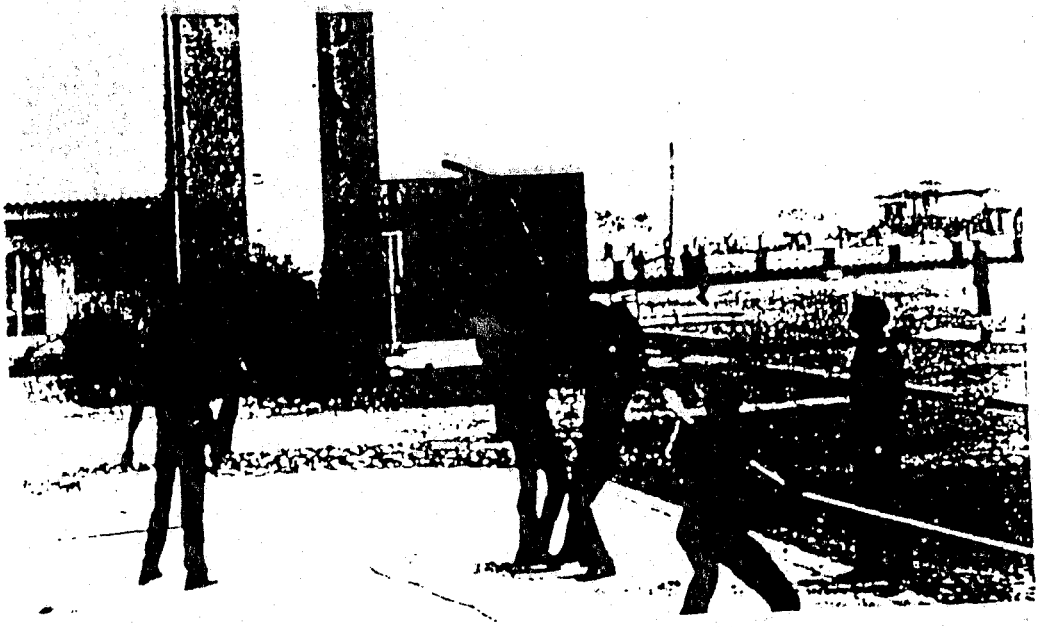
Some of the training provided by the Fire Service for various categories of staff include:

1. Pre-employment Training
2. Induction Training
3. On - the - Job Training
4. In - Service Training
5. Refresher Training
6. Re-training.

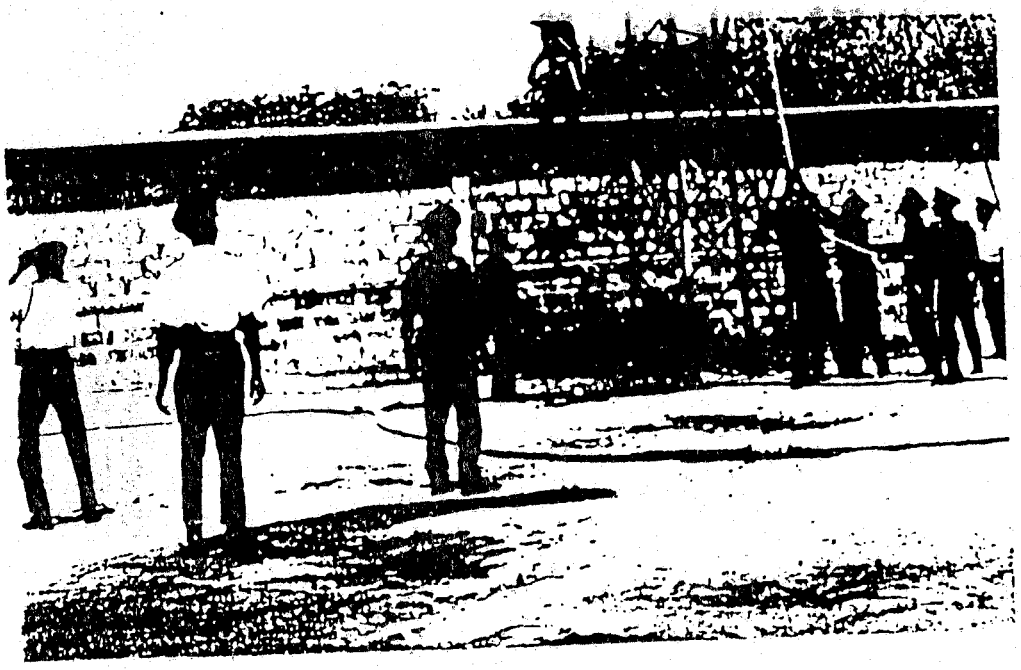


WEARING A PARACHUTE

PARADE



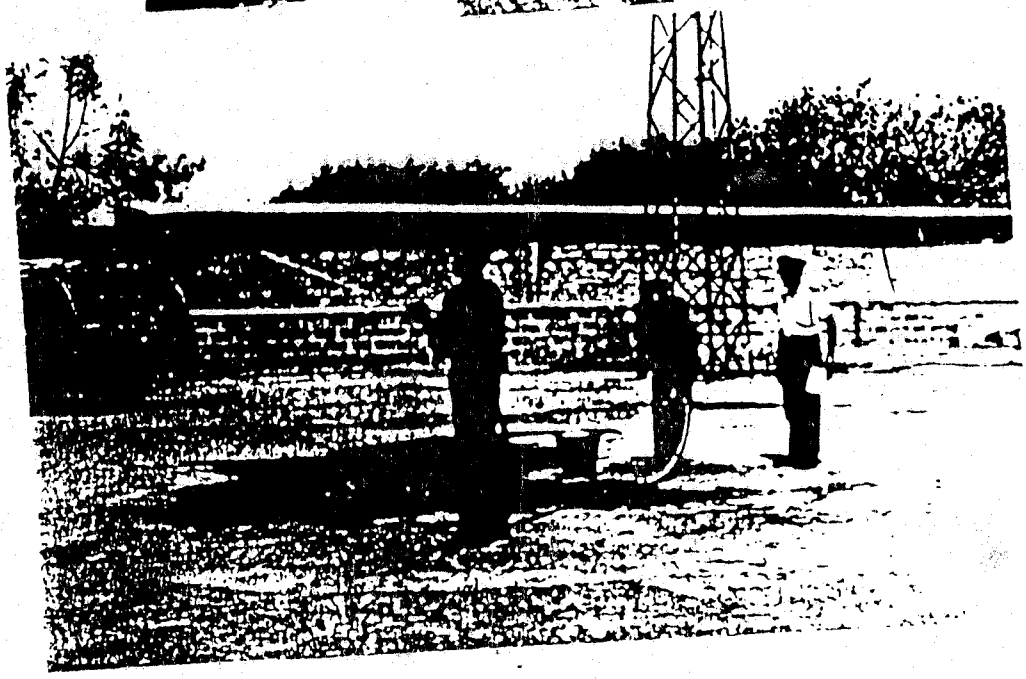
LOWERING FROM A HIGH ALTITUDE
USING A STRETCHER



LOWERING LOW WITH THE HELP OF
A LIFE ONLY

FIGURES TOC—"PICS OF TRAINING"

RESCUE FROM WELL



FIRST AID FIRE FIGHTING

3.3.1 *Pre-Employment Training*

This training mainly serves as an introductory training prior to the main fireman's training. This type of training is for trainees who have a low educational qualification. The minimum duration for this type of training is twelve weeks. After successful completion of training, the trainees can then be accepted into the fire service training proper.

3.3.2 *Induction Training*

This type of training is further sub-divided into two categories:
The first type provides the individual with a broad knowledge and familiarity with the fire service. It involves various forms of drills and fitness tests as a preparatory to the fire service occupation.

The second category acquaints the individual with the general duties and functions of the fire service such as basic training of recruits. The duration of this type of training varies from country to country, this is because of the peculiarity of needed manpower to give the instructions and the standard equipment used in doing this. But on the average, it is basically twelve to twenty (12 - 20) weeks.

3.3.3 *On - The - Job Training*

This type of training is given on the site where the individual has to work (ie. station and station ground). It has the advantage of being given without leaving th estation.

the typical on - the - job training si that provided bystation officer or sub-officer to person comprising his watch. The major feature of this type of training is that it is given at the place of work. It is k nown to be most effective type of training especially for work which have mechanical features.

3.3.4 In-Service Training

This type of training for the membes of the fire service may be distinguished from their pre-entry preparation by reference to two tests:

i. The time at which the training is given

ii. Nature or content of the instruction.

Neither of the test s is precise or capable of being applied in a wholly, objective manner. This type of training is imparted by informal guidance on the job. The instruction is regarded as being necessary for entry into the fire service profession which can also be regarded as part of the pre-entry preparation. Here, the basic knowledge imparted on them is that required to perfect the skills need in the fire service. The broad subjects remain the same, and it is meant to prepare the sound qualified members of the service to enable them perform various tasks assigned to them and to meet new responsibilities.

3.3.5 *Refresher Training*

The Refresher training is a type of training received by firemen in a speciality field. An example of this type of training is that which is received by a group of qualified Fire Protection Officers gathered together to learn a new method means of escape, say in high rise buildings etc.

The main aim of this type of training is to acquaint th eofficer with newly developed methods and materials if instruction as well as provide a professional stimulus of great value. This includes the use of Breathing Apparatus for various adverse conditions. E.g. exposure of toxic elements, heat, smoke, humidity etc. It also involves the use of various detecting means like the observation or control to view the fire grounds through the battery of electronic aids; the new methods of reducing smoke spread in fire by pressurising the staircase; the use of drenchers to protect windows in building etc.

3.3.6 *Retraining*

The retraining course is an instructional course designed to prepare an individual for anew assignment of duty. Retraining is distinguished from Refesher training in that the former i a supplementary instruction related to the old speciality of the individual, while the latter is instruction undertakes this type of training, his old speciality is taken into consideration.

Both Refreshers training and Retraining are speciality courses which

embrace advanced courses, each lasting for a duration of about three months.

The under mentioned courses are among the courses classified under the above mentioned type of training;

i. Arson detection
ii. Officership
iii. Fire fighting training
iv. Instructor Training
v. Fire Department Administration
vi. Fire Prevention
vii. Operational Commanders Course
viii. Senior Command Course
ix. Public Address etc.

3.4 Fire Prevention

Fire prevention has become an increasingly important adjunct to fire fighting. The knowledge of how to prevent fire has been accumulated steadily; most progressive stations have programmes for teaching th epublic how to observe the main precautions against the start or spread of fire.

The modern fire department engages extensively in fire prevention through lectures, demonstrations and inspection. Most of the fires in homes are caused by carelessness and can be avoided by exercising caution and good judgement. This particularly applies to smoking, the handling of matches,

and the use of electrical appliances. Through inspection of property and enforcement of fire-prevention regulations, it seeks to eliminate or minimise hazards.

The practice of making home inspections dates back to the 20th century. In their inspections, firemen frequently detect faulty electrical wiring, accumulation of flammable materials or lack of adequate fire escpapes. Corrections of these and similar hazards under a systematic programme reduces th number of fires and fire losses in a community.

It is pertinent at this stage to stress that an average human should have the knowledge of elementary principles of fire prevention and action to be taken in case of an outbreak of fire.

The National fire prevention department has not been developed enough to meet up with the enormous social, commercial, technical and industrial advances the country is undergoing. if caution is not taken early enough, the losses will keep on increasing.

Firstly, the Fire Safety Acts and Regulations should be enforced in order to give fire service a serious consideration. This will give fire service a duty to make efficient arrangements to give pieces of advice in respect of buildings and and other properties as to fire prevetion, restriction and means of escape in case of fire outbreak.

The fire safety act is to embrace fire safety in certain premises as:

- Factories
- Offices
- Shops
- Residential
- Institutions
- Recreational Areas
- Areas used for storage of highly flammable - substances e.g. Petrol

From preceding chapters, it is clear that once fire starts, it creates its own dividing force, it is important thus, that fires should not be allowed to start. The three basic vital precautions that need to be observed are:

- Stubbing out of cigarette ends
- Use of fireguards
- Disconnection of electrical equipment after use.

To elimnate possible outbreak of fires, therefore, the following points should be adhered to:

1. Good house-keeping in the sense of general tidiness is an essential safeguard against the dangers of fire outbreak. Regular sweeping and disposal of combustible rubbish.

2. The safekeeping of combustible wastes awaiting disposal: Office

records, old stationeries, waste papers and other materials should not be stored in corridors, under staircases, or any where from which fire could spread rapidly or interfere with escape routes.

3. Periodical inspection of all accommodation with a view to clearing out surplus combustible materials. This applies to carton, crates etc.

4. Lighted match stick should not be dropped in waste paper basket. Metal bins are safer than cane or cardboard waste paper baskets. Ash-trays are the best place for cigarette ends ie. non-ombustible types.

5. Candle sticks should not be lit or placed on the window where curtain hangs and the candle dhould be protcted at the base. This also applies to mosquito coils.

7. Lids must be kept on flammable liquids and stored away from liquid. Care must be taken when refilling. Never use petroleum spirit based cleaners indoors.

8. Stoves and lamps using paraffin or kerosine should be examined periodically and placed far from other combustible materials and placed in a position where accidental knocking over could be avoided. Never refill when the container is hot.

9. Cooking gas (Butane) should be kept in a ventilated place and should be shut off when not in use. Defective cylinders should be kept to the dealers for replacement.

10. Overloading of electrical supply circuits by the use of multiple adaptors could lead to fire. The ideal thing is one appliance one socket. Electrical appliances should be isolated from power supply when not in use. Combustible materials should bot be hng near electric bulbs.

11. Bush burners, agriculturalists inclusive, should ensure that fires are put out leaving the scene. In areas, where Fire Service Stations can be reached, burners should alert the brigade on their proposed action and their location so that the fire brigade will go ahead with the fire inspection.

In addition to these, there is th eneed for fire safety act covering all aspects such as Residential, Commercial, Industrail, Institution premises etc.

There also, is the need to have an effective code of practice regarding erection, re-erection, alteration etc. of any premises to be included in the fire safety act. This is to provide for the complexity in modern industrial development.

3.5 Fire Fighting

The science of fire figthing dates back to early Roman times. Hand operated pumps were first developed in Egypt during second century B.C. A crude leather hoe was devised in Holland during the 1600's. The first fire engine, with treadle - operated pumps, went into service in England about 1725. Steam-operated pumpers pulled by horses became common in Europe in 1850's. They were largely replaced by gasoline - powered pumpers in the early 1900's. Since then, fire protection or fighting has been steadily improved through the use of more poweful trucks, better pumps, heavier hoses, higher water pressures, power ladders, rescue equipment, radio communication etc.

The response of a well trained fire service to an alarm of fire and the techniques of fighting a fire vary little the world over. Upon receiving an alarm, a department goes intro rapidly. The firemen board their assigned apparatus. In the professional service rule, it is considered normal for the apparatus to leave the station within 30 to 45 - seconds after an alarm has been received.

On his way to the fire, the officer in command reviews his knowledge of th general location and the expected hazards. He takes into cognisance: Time of th eday, which indicates whether people are at work or at home and thus the extent of possible hazards to life; Traffic conditions on streets

leading to the site, which can affect response time and thus burning time of the fire before extinguishing - activities can begin; Availability and adequacuy of water supply in the area; General construction of buildings in the area, which indicates whether fire is likely to spread quickly or slowly; and the number of men and the amount and condition of the equipment under his command.

The standard plan of action is:

1. Find the precise location of the fire.
2. Rescue any endangered occupants of the building.
3. Confine the fire to the area it controls.
4. Attack and extinguish the flames.
5. Search out an extinguish all hidden flame before declaring the fire out.

The chief officer in command first determines whether any lives are endangered. If so, he orders rescue work to begins. It rescue is necessary at elevated floors, the truck company will immediately raise their aerial ladders and elevation platforms.

3.5.1 Fire Fighting Equipment

The major pieces of equipments used by the Fire Services are: the pumper; ladder truck; water-tank truck; ambulance; rescue truck and savage truck. Fire service departments in large cities often have special equipment such

as snorkels (a combination of rescue and hose towers), airport crash trucks, light trucks, fire boats and helicopters.

3.5.1.1 Pumpers

Pumpers have powerful motor-driven pumps capable of pumping 1, 900 - 6000 litres or more of water per minute. Pumpers are often called Fire Engines.

3.5.1.2 Ladder Trucks

Ladder truck carry a power - operated extension ladder that can be raised 19 - 30 metres or more, and can be turned and tilted in any direction. Portable ladders, extinguisher, life nets, axes Breathing Apparatus, rope, floodlights and clean-up equipment are also contained in this truck.

3.5.1.3 Water Tank/Truck

Tankers carry up to 30, 000 litres of water and have ladders, hoses and other fire-fighting equipment.

3.5.1.4 Ambulance

Ambulances are used to provide emergency care and transportation to hospitals, both for th egeneral public and for fire fighters themselves.

3.5.1.5 Rescue Trucks

Rescue trucks carry tools needed for extricating victims from wreckage in

damaged building or from severely damaged automobiles.

3.5.1.6 Savage Trucks

These vehicles carry shovels, mops, squeeges, brooms and sandust for cleaning along large water proof covers for protecting important items in a building from damages due to water, while fire is being extinguished.

3.5.1.7 Snorkels

These are manoeuvrable towers mounted on heavy truncks, with a nasket - like platform that can be raised to 26 metres. They are used both as hose platform and as means of rescue from upper floors of buildings.

3.5.1.8 Crash Trucks

Crash trucks are used in airports to fight fires and handle accidents that involve aircrafts

3.5.1.9 Fire Boats

Fire boats are used in fighting fires along rivers and in harbour areas. Fire boats carry several nozzles, each capable of delivering up to 9, 500 litres of water per m inute. the water is drawn from th river or harbour through pumps on the fireboat.

3.5.1.10 Helicopters

Helicopters are used in remote areas to carry water to the scene of a fire. In

large cities, helicopters are sometimes used to enable officers to view a fire incidence from air, in order to evaluate th ebest means of fighting the fire. They are also used for rescueing people trapped by fire.

3.6 Apparatus and Response

Apparatus plays a major part in the effective response to any occurence of fire hazards. The need for possession of certain type of apparatus in case of fire incidence canot be over emphasized. Before any response is made, the has to be the detection of fire. This fire detection depends on the local environment; with regard to the instrument used to enhance such detection.

The apparatus mainly used for any response to fire occurence, be it first aid or fire brigade response are:

a. Manually Operated Appliances
b. Mechnically Operated Appliances

Manually Operated Appliances include Red-Barrelled Extinguisher, hose etc. which mainly use the following fighting media:

i. water
ii. Carbon dioxide
iii. Foam
iv. Dry Chemical
v. Dry Sand
vi. Bromochloro Difluoromethane (BCF)

Mechanically Operated appliances include

i. Ladder; which consists of Aerial or Ground ladders platform

ii. Fire engine

iii. Pumper

iv. Truck

v. Ambulance etc.

Response is made with any of the above mention apparatus, when fire is detected. The first aid response is mainly effective for small fires only. This first response could be either made single-handedly or assisted by a group of people. Red-barrelled - extinguishers; Carbon dioxide, foam extinguishers etc. are the major apparatus used for this type of response.

The Fire Brigade respond to large scale fire either when summoned through the telephone or from personal detection from their observatory response is made. The response and plan of an attack by any department depend largely upon the local capabilities.

The following considerations are always taken into account before anyresponse is made or before assigning any apparatus for response. These are:

1. Estimated number of people occupying the building is taken into

cognisance.

2. The part of the building where the greater number of people occupy.

3. The structural materials with which the building is constructed.

4. The distance of the building or group of buildings from the street access in order to facilitate the stretch required of hose line.

From the above considerations, it is pertinent that from plan of attack, adequate number of response elements such as: Engine companies, Truck company and Ladder companies (Aerial or Ground) must be sent.

3.6.1 Fire Hydrant

Adequate water flow in Gallons per minute (gpm) to fire hydrants is required to provide sufficient water pressure in Pounds per Square Metre (PSCM) is needed to enable hose streams reach every part of each building to be protected. The lowest hose or pumper connection should be at least 38cm above ground level, to allow for clearance to operate hydrant wrenches.

3.6.1.1 Fire Hydrant Placement

Fire hydrant should be located 3 metres from the street or drive way access to allow rapid connection of fire apparatus suction hose line. Furthermore, to avoid damage t or from vehicular traffic, hydrants should not be located

FIG 32

FIRE HYDRANT LAYOUTS

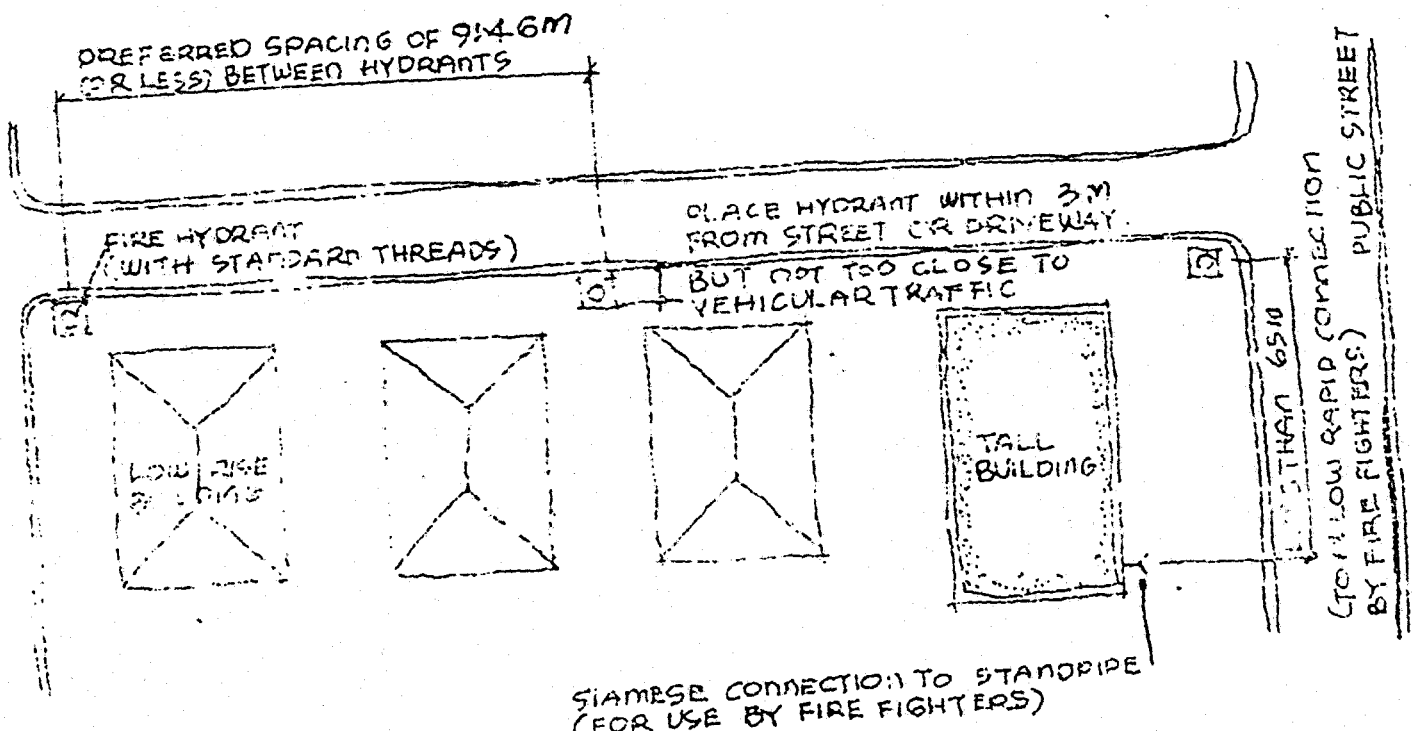


FIG 3B

FIG B.3

(1)

A – TYPICAL FIRE HYDRANT

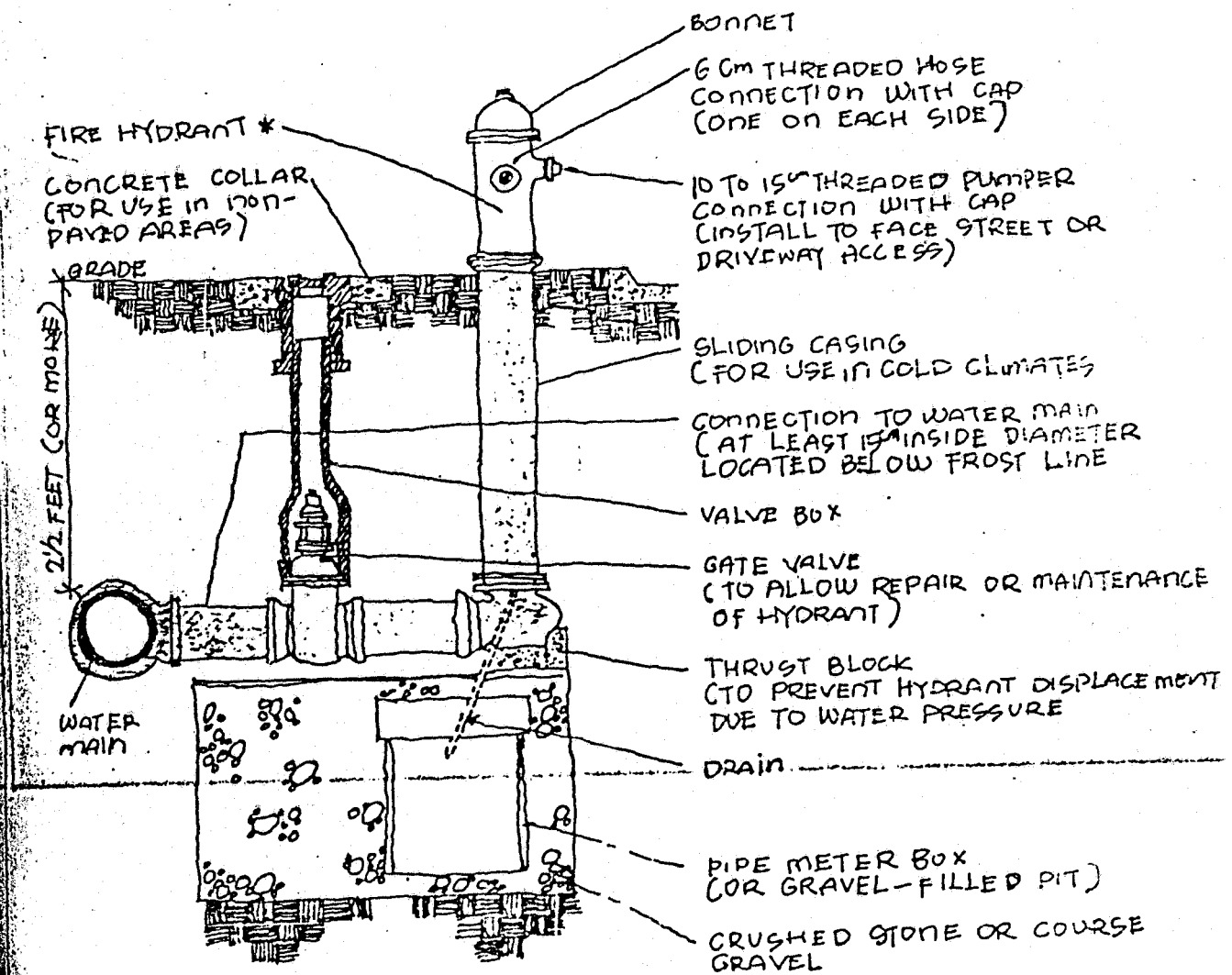
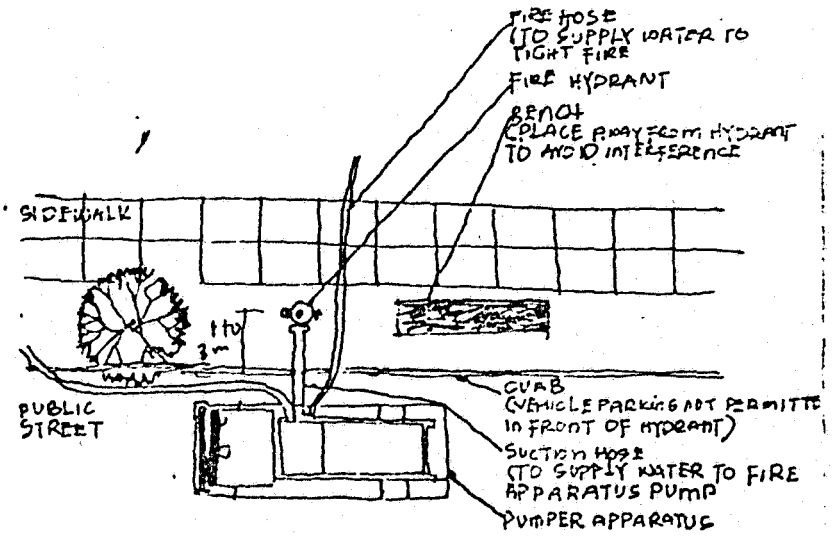
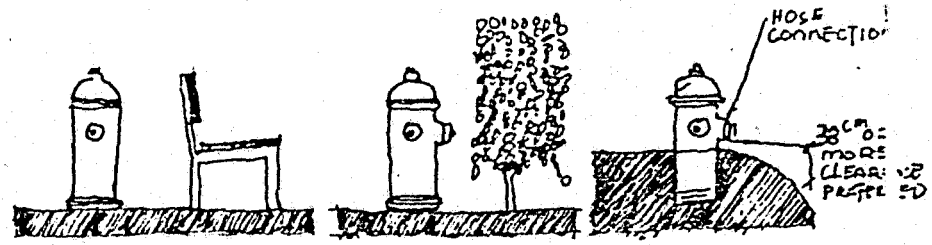


FIG 3-7

FIRE HYDRANT PLACEMENT





BENCH BARRIER
(LOCATE OUTDOOR BENCHES AWAY FROM FIRE HYDRANTS)

SHRUB BARRIER
(SHRUB AND OTHER VEGETATION MUST BE REMOVED)

BURIED HYDRANT
(HOSE CONNECTIONS SHOULD BE AT LEAST 38cm ABOVE GRADE

too close to the street or drive way.

It is advisable that where hydrants are located at street intersection, or at midpoint along streets where the distance between inersection exceeds 129m, the need for long fire hose lines will cause delay and will require high water pressure from fire apparatus pumps.

It is not advisable to place hydrants within 16m from building, miles the construction is fire-resistant or that the wall is mansory wall without openings. For remote site location, it id noteworthy that, hydrants shall not be placed further than 100m from the building.

3.7 Rescue

A distinction may be made between rescue and escape. Escape could be defined as unaided egress from a building via an accepted escape route. While Rescue could be defined as aided egress for a person who could otherwise be unable to escape from the building.

In cases where escape routes are not provided, techniques such as the use of conveniently placed drainpipes or a rope made of bed-sheets knotted together, could be considered as rescue, especially, if such escape was carried out under the direction, or with the help of police or some other responsible organisation. The majority of rescue is from dwellings, the rest being from highly populated buildings such as hotels, factories, hospitals and shops.

Rescue work can be divided into two broad-categories:

i. Rescue by Ordinary means

ii. Rescue by Fire Service Equipment.

3.7.1 Rescue by Ordinary means

Normal escape routes could be blocked by smoke making the movement of unprotected people impossible, hence, only fire service personnel using breathing apparatus might be able to reach trapped people and lead them to safety of th eopen air or some other part of the building where refuge could be taken. In buildings which have an acceptable degree of compartmentation with respect to the severity of the fire, it might be safer for people to stay in their normal location within th ebuilding than to more about. With less movement of people, there would also be less likelihood of panic.

It is important, therefore, that the fire officer has a good knowledge o fthe building, or has sufficient time to survey it enabling him to make the safest approach to the trapped people.

3.7.2 Rescue By Fire Service Equipment

One of the main features of rescue os the use of ladders or other device for gaining direct external horizontal access to people who are trapped.

If vehicular access to a building is limited, firemen may need to use book

ladders to ascend the face of the building to effect rescue by lowering people in suitable attachments by lines to ground. The mechanically operated platforms usually have a maximum vertical extension of 26m. Great difficulties could be experienced in buildings taller than 30m if adequate and properly maintained escape routes are not provided. Fortunately though, fire can be resticted to a small volumen of a building for a defined period of time.

3.7.3 Rescue Techniques

The primary operation on the Fire Brigade's arrival at a building fire location, is the pitching of ladders at those windows where people can be seen, before they panic and attempt to jump to safety. At the same time, attempts must be made to reach the site of the fire so that water or some other extinguishers suitable, can be used to confine the fire. After this is done, the building must be searched inside and outside by the fire officers. If the building is large, lives may be lost due to the rapid spread of smoke and the comparatively long time required to search the whole building. Thus, in highly populated buildings, it will be essentially beneficial to the officer in charge if someone familiary with the building and its personnel is available and can help in locating missing persons, but this is not completely misleading and could prove fatal to the brigade officers entering the building.

The search technique of a fireman wearing breathing apparatus in smoke filled room depends mainly on his sense of touch, although he might be

able to locate people listening to sounds of breathing or groans from injured persons.

The basic method for searching a room is:

- From the door way, go round the perimeter of the room, giving special attention to areas at other doors and windows until you arrive back at the entrance door.

- Make diagonal sweeps accross th efloor. Special care should be taken in searching around any obstacles. E.g. behind settees and underneath beds.

If breathing apparatus is not immediately available any search insmoke-filled room will, if possible, be carried out at floor level. All parts of a building, especially those directly affected by smoke abnd heat, should be thoroughly searched.

The officer in charge at the fire location has the authority to decide whether or not it is reasonable to send firemen into a building which is alight. Many factors affect this decision, but before firemen are sent in, it should be know that persons or victims are likely to be in te building, and that smoke and heat conditions are not too severe to be traversed; and that the building will continue to stand for a reasonable length of time.

When fire occurs during hours of darkness, it is important to supply lighting to all exposed faces of the building. This does not only aid rescue work but it also help to calm trapped peope as they will be aware of the fact that some attempt is being made to rescue them.

Bot the rescue and fire fighting are usually aided by ventilating the building to enable some o fthe entrapped smoke to be cleared. Ventilation is commnoly achieved by opening windows. In modern buildings however, automatic ventilation systems are used, or specially designed window units can be opened bu firemen at the appropriate time. The optimum time for the fire ventilation to take place is very difficult to define, but if it is attempted at the wrong time, the intensity of the fire could be be increased greatly.

3.7.3.1 Problem of Access

Modern building complexes, have open space around them which is dsigned to accommodate fire apparatus. Buildings constructed withouit considering fire brigade access (these form the majority of the existing buildings), present many problems. In some locations, there is only a narrow space, say 1m, between buildings and this may be the only access to the back of the building. Other buildings, escpecially large blocks, may have no rear access at all. these types of buildings lenghten the time required to effect rescue. Slopy ground may make it impossible to use turntable ladder even for buildings of moderate height say 3m, as only a few degrees of angular adjustment of

the ladder may not be sufficient at lesser heights.

In the common types of pattern mentioned above, the use of hook ladders may be th eonly operationable techniques for rescue and this would be much slower than direct access.

Among the other problems of rescue are those involving aged or infirm people, who require special consideration and those involving large numbers of people in such places as smoke-filled, enclosed slopping walls.

3.7.3.2 Building Design

Some of the recent developments in building design have created potentially difficult situations for rscue operations. In large, single-storey buildings, an almost complete lack of fire compartmentation and large building volumes give rise to conditions which could lead to a rapid spread of fire. Such designs are becoming in especially new factories. The high bay warehouse present a number of fire-fighting difficulties; fortunately, such, such buildings contain few, if any, people due to their storage operations being fully automated. The risks in these warehouses are due to stacked goods and the very large size of the building. The closeness o fthe goods encourage fire development and a large quantity of stored goods may give an excellent source of fuel.

Multi-storey buildings also present some problems, of which the staircase

is one. Here, doors are often left open for convenience, but in the event of fire, this allows smoke to travel to otherwise unaffected floors via the staircase. During this time, the staircase could become wholly or partially smoke-filled. The staircase being the normal entry route for the occupants of the building, much time could be lost in struggling through the smoke. Another problem in certain tyopes of multi-storey buildings, is the possibility of progressive collapse. Collapse could be initiated by the weakening of the structure, near the fire source, which may then defect grossly causing adjacent structural members to be over stressed to the point of collapse.

Urban renewal has created a large number of town centre redevelopments ranging in complexity from groups of ten, or 50, stops within an integral pedestrian way, hotels, office blocks etc. All these redevelopments present their own problems of access, rescue, escape; but one major fact which cannot be overemphasized, thus, each design must be assessed with this in mind and appropriate smoke control techniques employed. Shopping walls may present other problems such as those of rapid fire spread from shop to shop depending upon the the nature of goods for sale. Many people products may prove to be particularly dangerous as their reaction, at elevated temperatures, to extinguishers (especially water) is unpredictable.

A continuous assessment of risk tolife must be made in all types fo building, but especially in those where alterations and adjustments to the layout of the building are made frequently. Those buildings which house high hazard

process, should be constructed in such a way that the building and the processes are compatible and suitable with adequate protection for adjacent people and buildings.

3.8 Escape Routes

The primary function of any escape route in a building is that it should allow normal people to escape from that building after the outbreak of fire and reach a place of safety by their own unaided efforts and without being placed at hazard whilst doing so.

The only sound basis for designing means of escape from a fire is to attempt to locate the positions of all possible sources of out break of fire and to predict the courses which might be followed by a fire as it developed at any of these sources or, were particularly, to predict the routes which smoke or hot gases would be likely to take as it is possible to design to design and protect escape routes with some certainty that they will be safe.

The design of escape routes for people who suffer from some physical or mental deficiency or people in hospital requires special consideration and the designed escape space will be greater than in more normal occupanccies.

The term, places of safety, is capable of interpretation in a number of ways. The definition that it should be a ground level, unenclosed space sufficiently far away from the building to ensure that escapes are not exposed to any

danger, and that it should be big enough to accommodate all the occupants of the building was acceptable until high density, multipstorey buildings were constructed, it is now acceptable that it is inpracticable to evacuate completely buildings which house thousands of people because of th etime required, and a better solution is to provide a place of safety within the building; a refuge, such protected areas of the buildings are constructed so that they are free of smoke and fire.

They may be a section of any, or all, floors in the buildings or they mat be besituated in adjacent buildings each area is a fire compartment having a construction of a specific fire resistance, the actual period depending on th occupancy hazard if the building has a high fire risk it would be possible for the refuge to have a filtered air supply and its own electrical supply for lighting.

3.8.2 Requirements

When designing escape routes or assessing their efficacy, the following list of requirements should be kept in mind.

1. A sufficient number of exits of adequate capacity properly located with convinient access.
2. Protection of exits against fire and smoke durin gthe length of time may be in use.
3. Alternative exit(s) for use in case one exit is blocked by fire.
4. Sub division of areas to provide places of refuge.

5. Adequate lighting of exits and path to exit.
6. Direction signs indicating path to exit.
7. Protection of equipment and areas of usual hazard which may otherwise endanger people using escape routes.
8. Exit drill procedure to assure orderly exit (where possible)
9. Control of psychological factors condusive to panic.
10. Control of interior finish and contents of buildings to prevent fast spreading fire.

3.8.2 Principles of Design

In most buildings other than one and two-storey dwellings the provision of an escape route is necessary. An escape route is normally considered to have three main parts;

1. The horizontal path, which may be upper floor, to a protected stair case (or its protected lobby), or to open air, i.e. exit access.
2. The vertical path (usually the stair case, but may be the elevator) i.e. intermediate part of the exit, and
3. The horizontal path from the escape stair case or elevator to the final exit and the open air, or a place of refuse i.e. exit discharge.

3.8.3 Travel Distance

The horizontal path in th efirst part of the route has alength limit depending up on occupancy and the presence or absence of an automatic sprinkler

system. The greater the hazard presented by the combustible contents of the space th shorter the distance allowed, but the installation of sprinklers, which are thought to give additional protection to escapes, will enable longer travle paths to be accepted.

The table below (table 4.1) gives some example of travel distance

TABLE 4.1

Building Type (Occupancy)	Travel distance in metres	
	without sprinkler	with sprinkler
* Places of assembly	45	60
* Schools	45	60
* Hotels, apartments	30	45
* Shops (mercantile)	30	45
* Industrial premises (except high hazard)	30	45
* Industrial premise (high hazard)	25	23
* Offices	60	90

It is important that the travel path is clearly marked and is kept unobstructed at all times. In most cases the measurements of travel distance is from the door of the room being considered in low hazard occupancies such as offices, or from farthest occupied point in certain factory, office, and shop

occupancies.

3.8.4 Exit Width

Once the line of escape has been defined the exit widths have to be calculated. This requires an estimate of the numbers of people likely to be involved. In building types such as cinemas, theatres, and some educational establishments the maximum number of people cannot be predicted with maximum accuracy, other occupancy require estimates to be made. Table 4.2 gives some typical examples of maximum numbers of people, based on floor areas the buildings.

TABLE 4.2

Occupancy	Load Factors Area per person in M^2
* Assembly (no fixed seating)	0.65
* Assembly (standing space)	0.28
* Offices	9.29
* Dormitories	11.15
* Shops	2.79
* Kitchens	-
* Ware houses	9.29

This table gives the allowable area per person, the number of people being simply calculated by dividing the building area by occupancy.

The number of people who could be involved in escape is translated into exit widths which would accommodate them safely. the width of an exit is calculated on th ebasis that the total occupant capacity of a room, or storey, should also be able to discharge through the exit in two and half ($2^1/_2$) minutes when the rate of discharged is 40 persons per minute per 530mm of width of exit. Stair cases widths are estimated on a similar basis.

In general no clear way, travel path, corridor, or stair case should reduce in width along the excape route. In fact, if two streams of people are likely to converge it shoul become progressively wider. Care should be taken with door design especially in long corridors, as the frame of each side of an opening and the thickness of th edoor (or two doors, often, in a corridor) could significantly reduce the width of the escape route. Throughout the length of a corridor smoke-stop and/or fire check doors should be arranged so that the maximum unbroken length of a corridor does not exceed 61m.

3.8.5 Doors

The design function of door may be divided into three broad categories.

a. Amenity;

b. Security;

c. Fire Safety.

For a smoke stop or fire check door to perform its function effectively it

must be closed at all times, except when people are passing during the normal use of the building doors which perform no apparently useful purpose, such as the privacy, comfort, or security, are commonly found wedged open.

It is an advantage, therefore, to design fire safety doors as multifunction doors so that a reasonable chance exist of their being kept closed. It is unavoidable for doors to be designed for fire safety alone becaue of their required location, it is an advantage to incorporate effective self-closing or door release mechanicsm so that they may be kept normally but will close automatically in a emergency.

3.8.6 Stair Cases

Ramps are better than steps to overcome small changes in level as it is very easy to trip on single steps. The capacity of stair case is based on the total discharge of people from either one or two floors and, in some cases, afraction of the number of people on upper floors (if the occupancy exceeds that of lower floors) is added for calculation of stair case width. A limit of 16 stairs case in one flight is normally accepted and flights should be separated by landings whose length is not less than th ewidth of the stair case. Staircases must also change direction after th eflights or at each landing.

At each connecting floor level, doors, screens and perhaps mechanical plant

must be provided to stop smoke and fire from spreading into the stair case. Most escape stair case terminate at the external wall of a building at ground level so that safety is achieved on passing through exit doors. In some occupancies, however, especially where escape stairs are in normal use, the staircase may terminate in a central position on the ground floor (e.g. in a department store) Here it is best to site exit doors within sight of the foot of the staircase so that little time is lost by escapes wondering which way to go. Stair case may continue past the ground floor and into basements. This could be dangerous and special signs should be installed indicating the exit. Proper adn adequate illumination of steps is essential throughout the length of the escape route.

3.8.7 Composition

To be effective, an escape route need only to be capable of maintaining a smoke free atmosphere for the time require for escapes to reach a place of safety. The traditional use of corridors and staircases is perhaps based on the promise that people will tend o use a familiar route for escape, preferably the route used for entry into the building.

In addition th eroute may be used by fire brigade personnel to reach the seat of the fire. This, and the fact that a building should not collapse rapidly, results in escape routes whose enclosing structure has a fire resistance not less than that required for the adjacent occupancies. In addition the surface materials used in escape routes must have allow flame spread property.

3.8.8 *Maintenance*

The most common defect in escape routes in keeping of objects (goods, rubish, etc) in the corridors or the stairs were the escape is not normally used. Exit doors have been found locked up, barred, or with goods piled against them, and in a few instances stairs have been removed on the far side of exit access doors. These defects, and many others, could be avoided if building maintenance staff and building managers become more fire and safety conscious.

3.8.9 *Fire Drill*

Finally, no purpose is served by having escape routes in a building if its occupants do not know where these are and which should be used. Fire escape drills are useful, but can only be carried out with an essentially 'captive" occupancy (e.g. educational establishment are factories). fire escape drills in occupancies of a transient character (e.g. hotels and hospitals) and more difficult to arrange but permanent staff should be trained to help th etemporary occupants.

CHAPTER FOUR

4.0 Data Collection

4.1 Fire Statistics

The need for a greater understanding among Nigerians of the principles of fire protection in buildings of any kind, have long been sought. Since the last decade up to date, the rate of fire occurence in both public and private buildings in the country has been a subject of concern to many Nigerians. A number of fire occurences are subjected to be the handiwork of arsonists intent on covering up fraud. Others occur as a result of reckless use of flammable substances in homes and offices.

The late 70's and early 80's witnessed incessant fire outbreaks across the country. This trend gradually spilled into the 90's. Virtually every state of the federation has recorded at least one major fir disaster or another with considerable loss og properties and human lives in the process over time.

In 1980, for instance, an estimated N142 million worth of properties was destroyed by fire in Anambra State, while in 1981; Lagos State experienced a major disaster, when about 80 lives were reported lost in various fire incidents. In 1986, about 914 people were untimely despatched to the great beyond in various fire incidents throughout the country. The following year, 1987, over 379 lives were reported lost and properties estimated at

about N164 million were gulped in about 4, 381 fire mishaps. In 1988, 499 people were reported to have died and properties valued at N141 million were destroyed in a total of 3, 003 fire incidents. In 1989, the figures rose considerably when about 17 peole died and properties worth N388 million were unexpectedly rendered worthless in 2, 405 fire outbraks in about 15 States of the federation.

As if to bring the tale of fire woes nearer to the corridors of power, since 1980, there has been an unprecedented increase of fire outbreaks with public servants intent on covering up fraud; In September 1980, the then headquarters of the Federal Ministry of Education on Moloney Street, Lagos was gutted by fire; and in 1982, the Cocoa House Ibadan, undisputably, the tallets building in Oyo State had its own share of fire baptism. In the same year also, the Accounts Department of the Federal Capital DEvelopment Authority (FCDA), Abuja was set on fire; then in January 24, 1983, the Nigerian External Telecommunications Headquarters (NECOM House), a 32-storey edifice dotting the landscape of Marina Lagos, dubbed the 'Tallest building' in West Africa then, met its Waterloo in a fire incident that would compel the Federal Government to cough out more than N200 million in tax payers money for its refurbishment.

During the students riots in May 1989, two public builsings at Ikorodu road and Orile Iganmu housing the Internal Revenue Offices of the Federal Government were completely devastated by the fire. Government

propadanda blamed irate mob for the destruction, but speculatins had it than an insider migh have taken advantage of the riot to set the two buildings on fire to cover up a day prior to the now infamous April 22 abortive coup, the National Electric Power Authority (NEPA) headquarters annexe located along Awolowo road, South-West Ikoyi, depicting a touch of architectural craftmanshi was eet on fire in circumstances suspected to be sabotage.

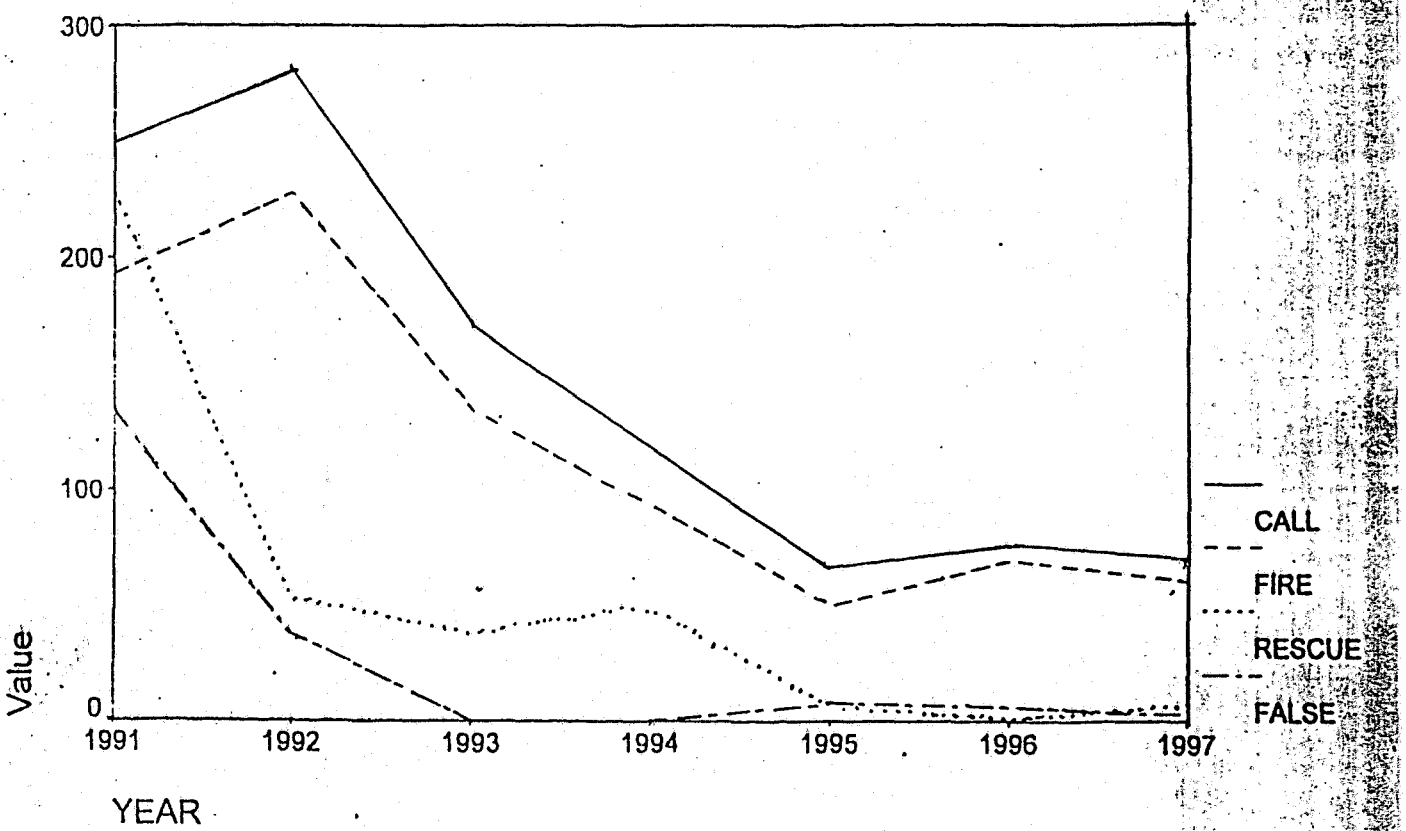
Meanwhile, between January 1, 1990 and December 31, 1990, a total of 718 fire calls was recorded in the country involving both public and private buildings. Out of this calls, eight people died and properties worth N139.6 million were destroyed. Similarly, the Federal Ministry of Defence headquarters building, and Investment House, both in Broad Stree, Lagos were gutled by fire. These are few examples.

There are catalogues of unreported fire incidences in the country. About 986 families were rendered homeless in Lagos when their homes were gutted and razed down by an early morning fire. Many unexpected losses, especially in the rural areas where fire services stations are virtually non-existent and where available, lack of equipment, is recorded. But the irony of it all is that most of the mayhem caused by fire could have been avoided. If the Federal Fire Service ahd lived up to expectations and if adequate measures were taken, on the part of the citizenry to prevent fire occurence, most of the fire incidents would not have occured.

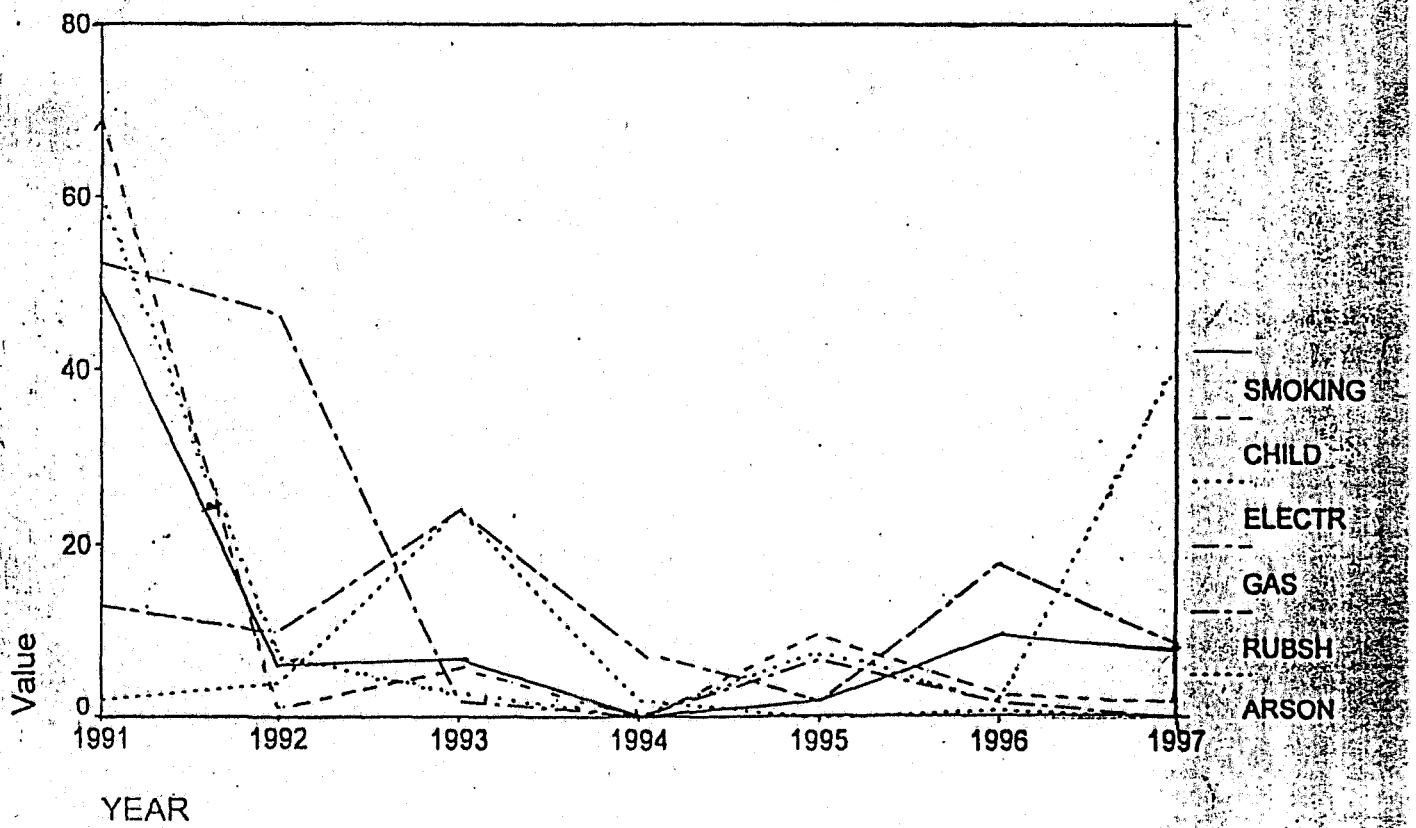
FIRE STATISTICS IN NIGER STATE, NIGERIA - 1991 - 1997

		YEARS						
		1991	1992	1993	1994	1995	1996	1997
A.	NO OF CALLS	250	281	172	117	66	96	70
	i. Fires	193	228	135	94	49	69	60
	ii. Rescue	57	52	37	48	6	1	7
	iii. False Alarm	-	1	-	-	7	6	3
	iv. Special Services	-	-	-	-	-	-	-
B.	CAUSE OF FIRE							
	i. Smoking Materials	33	51	30	12	2	10	8
	ii. Children Playing with minerals	7	10	14	7	2	3	2
	iii. Electrical Fault	86	107	41	50	22	35	41
	iv. Gas Faults	13	10	24	8	2	18	9
	v. Bush Burning	52	46	2	-	7	2	-
	vi. Suspected to be Arson	2	4	24	2	-	1	-
C	TYPE OF FIRE							
	i. Domestic Fire	78	103	46	24	19	40	33
	ii. Factory Fire	-	2	3	4	2	1	-
	iii. Public Building Fire	25	32	24	-	6	13	14
	iv. Bush Fire	36	35	29	10	10	11	7
	v. Vehicle Fire	54	57	23	13	1	4	6
	vi. Air, Rail, Sea fire	-	-	-	-	-	-	-
D	CASUALTY							
	i. No. of Lives Saved	29	44	11	6	2	18	10
	ii. Fatally Injured	18	24	14	5	-	9	1
E.	FINANCIAL IMPLICATION							
	i. Financial Loss ₦(Million)	5.34	8.4	4.9	4.2	5.3	14.8	23.4
	ii. Financial Salvage ₦(Million)	8.3	24.0	43.9	11.9	10.6	117.5	136.6

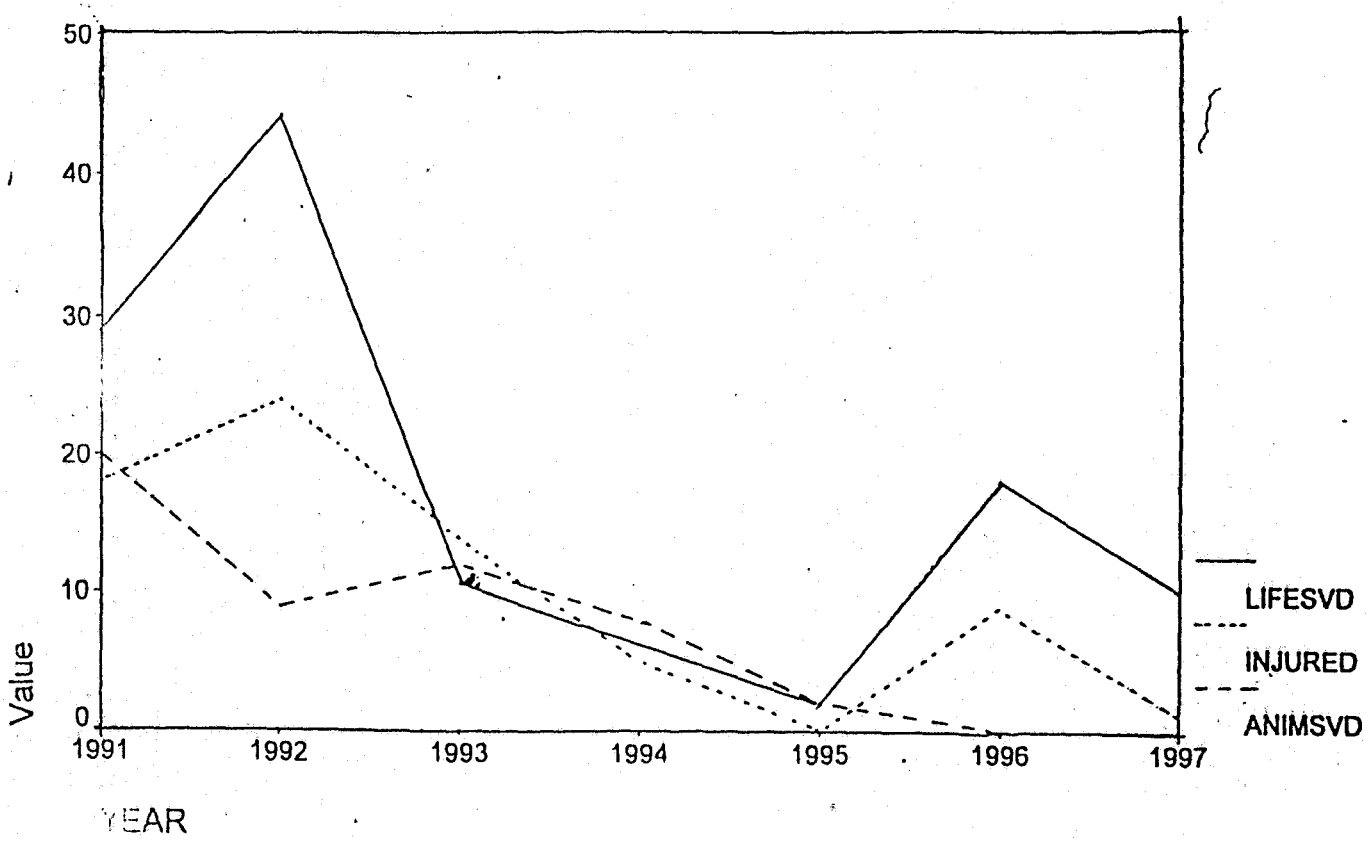
4.1


300
200
100
0
Value
1991
1992
1993
1994
1995
1996
1997
YEAR
CALL
FIRE
RESCUE
FALSE

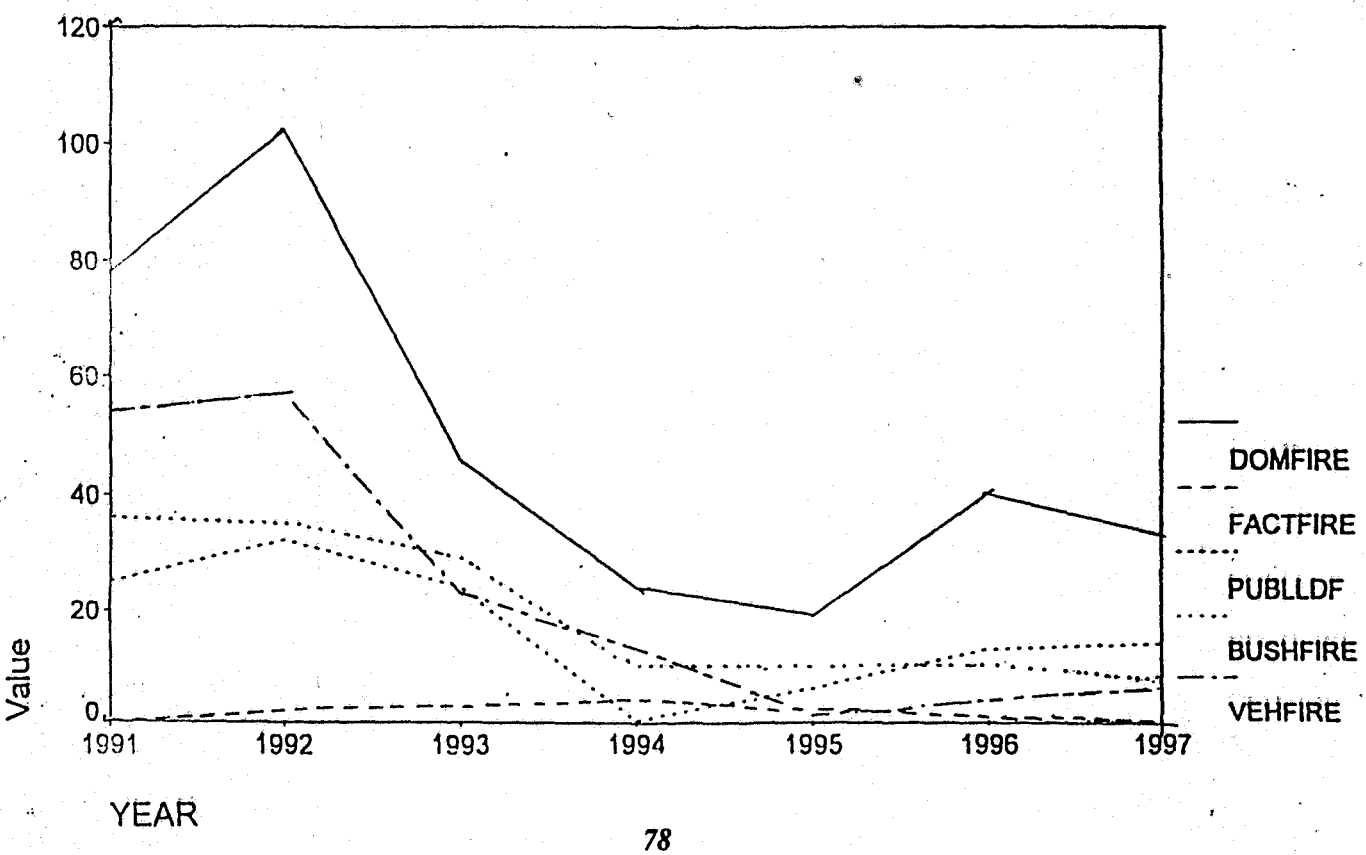
4.2


80
60
40
20
0
Value
1991
1992
1993
1994
1995
1996
1997
YEAR
SMOKING
CHILD
ELECTR
GAS
RUBSH
ARSON

4.3


50
40
30
20
10
0
Value
1991
1992
1993
1994
1995
1996
1997
YEAR
LIFESVD
INJURED
ANIMSVD

4.4


120
100
80
60
40
20
0
Value
1991
1992
1993
1994
1995
1996
1997
YEAR
DOMFIRE
FACTFIRE
PUBLLDF
BUSHFIRE
VEHFIRE

CHPATER FIVE

5.0 Locational Analysis

Abuja, the Federal Capital City is on Gwagwa plains in the northeastern quadrant of the Federal Capit Territory. It is bounded by the Abuja Hills to the West, the Zuma-Bwari-Aso Hills to the North, the Kamu-Agwari Hills to the East; and the Zango-Kuku Hills to the South.

Abuja generally, enjoys a comfortable climate. Lying above 1, 200 fet elevation, the GWagwa Plains have fewer days of rainfall, generally lower humidity and temperatures more moderate than other sections of the Capital Territory. It offers satisfactory geological and soil conditions with good surface condition for construction and landscaping.

From an aesthetic point of view, th esite has exciting visual potential. Its gently rotling terrain penetrated by occasional rounded knolls and outcropping present minimum constraints but offers variety and interesting features. The backdrop of low mountains to the north dominated by the Aso Hills presents a dramatic overall setting.

5.1 Abuja - Background

Abuja is a city that is identified by its crescent shape and the ASO Hill, and its surrounding Hills. It is only 3% of the entire Federal Capital Territory (FCT), and it is located in the North Eastern quadrant of the Federal Capital

MAP OF NIGERIA SHOWING STATES OF THE FEDERATION

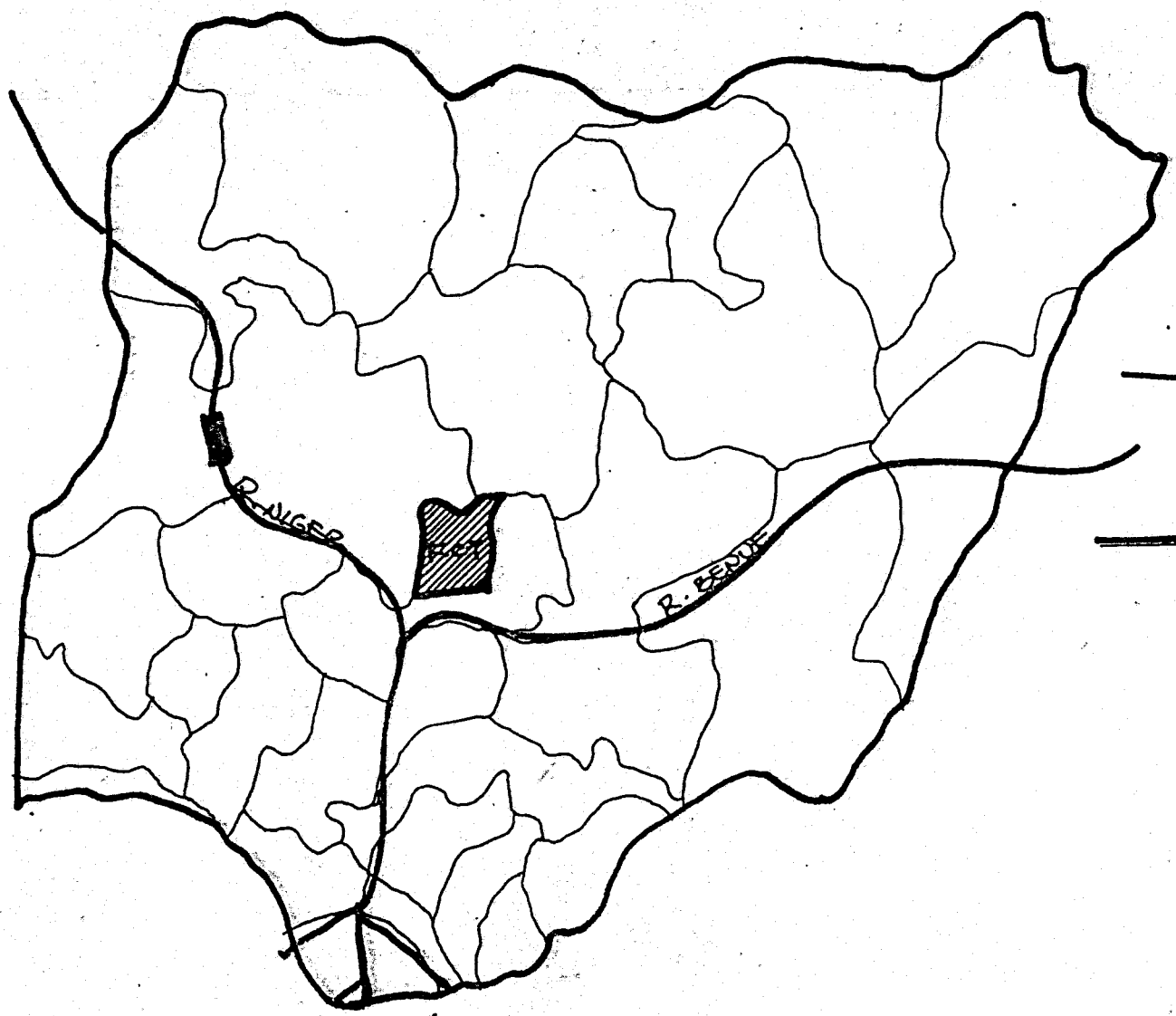


FIG. 5.1

MAP OF THE FEDERAL CAPITAL TERRITORY (F.C.T)

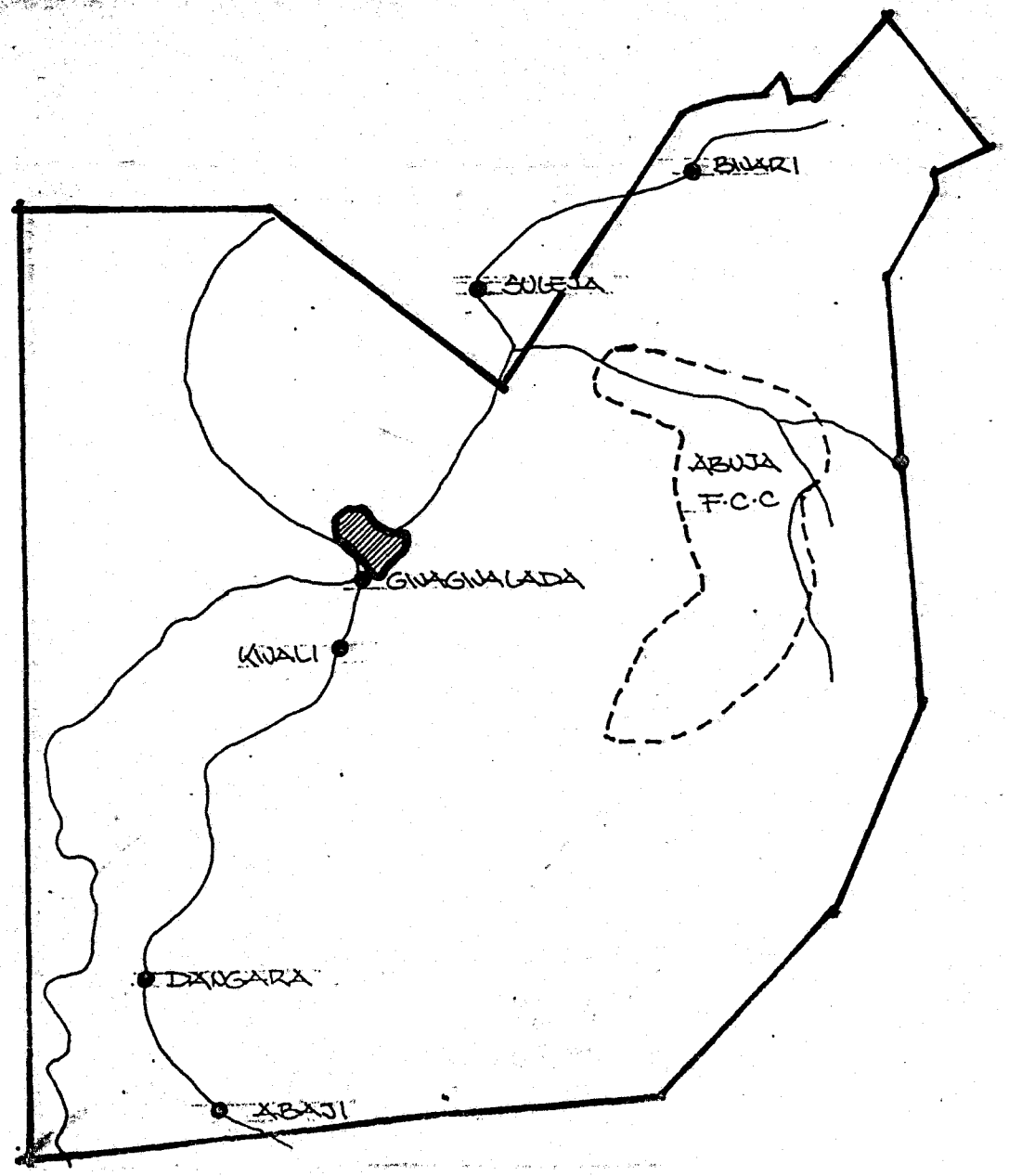


Fig. 5.2

Territory. It lies between Latitudes 8°25' and 9°20' North of the Equator, and longitude 6°45' and 7°39' East of the Greenwich Meridian.

The Internationa Planning Association (IPA) designers of the Master Plans, projected th epopulation of the Territory to hit ideally, a 3.1 million mark after completion of the Fourth and final phase o fthe Territory.

The Federal Capital Development Authority is charged with the responsibility of development of commercial, industrial, residential and infrastructural facilities, services and amenities for the Federal Capital Territory.

5.2 Site Characteristics

5.2.1 Geology and Topography

The Gwagwa Plains on which Abuja is sited, rise from an elevation of 305m in the West to 610m in the East. The better part of the city is concentrated on land with elevations of 350m to 510m. This is due to the climatic advantages of higher altitudes.

The upper Gwagwa Plains area is dotted by numrous large outcrops of rocks or near-surface bedrock around which it becomes necessary to arrange a development. They frequently form interesting and sometimes spectacular shapes which jut out from th eplain.

Topographically, the area is typified by gentle undulating terrain interlaced by riverine depressions. Inselbergs and other gigantic rocks occupy about 80% of the total plain area an are generally bare, rocky and occuring as isolated masses.

Sedimentary rock is the major rock underlying Abuja. The rock is located in stream of beds and consists of sand, gravel and clay deposits. It has medium to high strength, thus, creating minimal obstruction during construction. These rocks are also quaaied for construction works on site. The igneous rocks include Biolite granite which come in two forms, such as porphyritic rock and fine medium - grained.

The line or pattern of these outcropping contribution to the decision to develop two parallel bands of residential sectors on either side, leaving the more broken landscape as the prominent linear central park.

5.2.2 Rainfall

In the Federal Capital Territory the raining season in the Northeastern part of the city starts around 10th of april and through the Months of September the rain is heaviest around the Months of July, August and September. There is frequent occurences of squall lines, with dense, dark cumulo-nimbus clouds with thunder and lightning, this is followed by strong winds and intense rainfall th erain may last for one-half hour followed by drizzle for

several hours. This is replaced by a few days of bright and clear skies. The presence of inselbergs is another weather phenomenon which exert an influence on local weather greater than their size. This causes intense relief rain in their immediate surrounding.

5.2.3 *Temperature*

The temperature of Abuja fluctuates between 30^0 and 37^0 centigrades. The response to net solar radiation is greatly influenced by the amount of water vapour (humidity) in th eair, the highest temperature is recorded in the dry season. Dry season is cloudless, the maximum temperature lowers in the rainy season due to dense cloud cover. Diurnal annual range is lower, not more than 37^0C in July and August.

5.2.4 *Vegetation*

Vegetation of Abuja is generally characterised by park savannah, it consists of continuous canopy, shrub and grass layer, consisting of Amana, Nauclea, terminalia, these vegetation occurs on flatter plains and undulating terrain.

5.2.5 *Wind*

There are two major air masses:

a. Tropical Maritime airmass: which formed over atlantic ocean to the south of th ecountry. Wamr and Moist, moves in south-west and North-East direction which creates wet season.

b. Continental Airmass: It develops over Sahara Desert and is warm and dry. Blows in opposite direction of North-East to South-west it creates the dry seasons.

The two air masses are characterised by the presence of prevailing winds

5.2.6 Solar Data

Abuja, according to ***Mabogunje (1977),*** is exposed to 2, 500 sunshine hours annually. During the dry season, the monthly radiation in the amount of sunshine follows the general trend of increment over 275 hours. As the wet season approaches, the trend is increment in cloudness. therefore, sunshine hours decrease intensively. the amount of insolation gives room for the use of materials which can reflect or absorb solar radiation in or from buildings.

CHAPTER SIX

6.0 Case Studies

The essence of case studies in a design of this dimension is very essential. This exercise led to the critical study and appraisal through visits, that is personal contact, interview and extracts from publications of existing projects of this nature.

The objectives of the cases studied include:

i. To establish a basis for comparison.

ii. To establish a base for development on the already existing cases studied.

iii. To identify problem areas existing in the cases studied with a view to correcting them.

iv. To profer suggestions based on the effects and causes of problems identified.

v. To contribute to the pursuance of knowledge and development of a befitting project.

The cases studied are:

a. Niger State Fire Service Headquarters, Minna

b. Kaduna State Fire Service Headquarters, Kaduna

c. Fire Service HEadquarters, Federal Capital Territory, Abuja

d. Fire Service Training college, Moreton - in - marsh, U.K.

6.1 Niger State Fire Service Headquarters, Minna

The Niger State Fire Service Headquarters consists of four (4) blocks. There are however, other units which is located along Bosso road, adjacent to Saint Michael's Cathedral; the training unit located along Niteco Road, Tunga, Minna.

At the main site, facilities provided consist of four blocks: A, B, C, D with some auxiliary facilities.

a. ***Block A:*** This block consists of the apparatus bay; the control room; offices for Fire Prevention and Fire Protection Staff; Instructors' Office and Lecture room.

b. ***Block B:*** This block houses such offices like the open Registry; Deputy Director's Office; Director's Office and Store

c. ***Block C:*** This block houses administrative staff. It contains such offices like those Head of Fire Prevention; Deputy Senior Fire Prevention Officer and Accountant's Office.

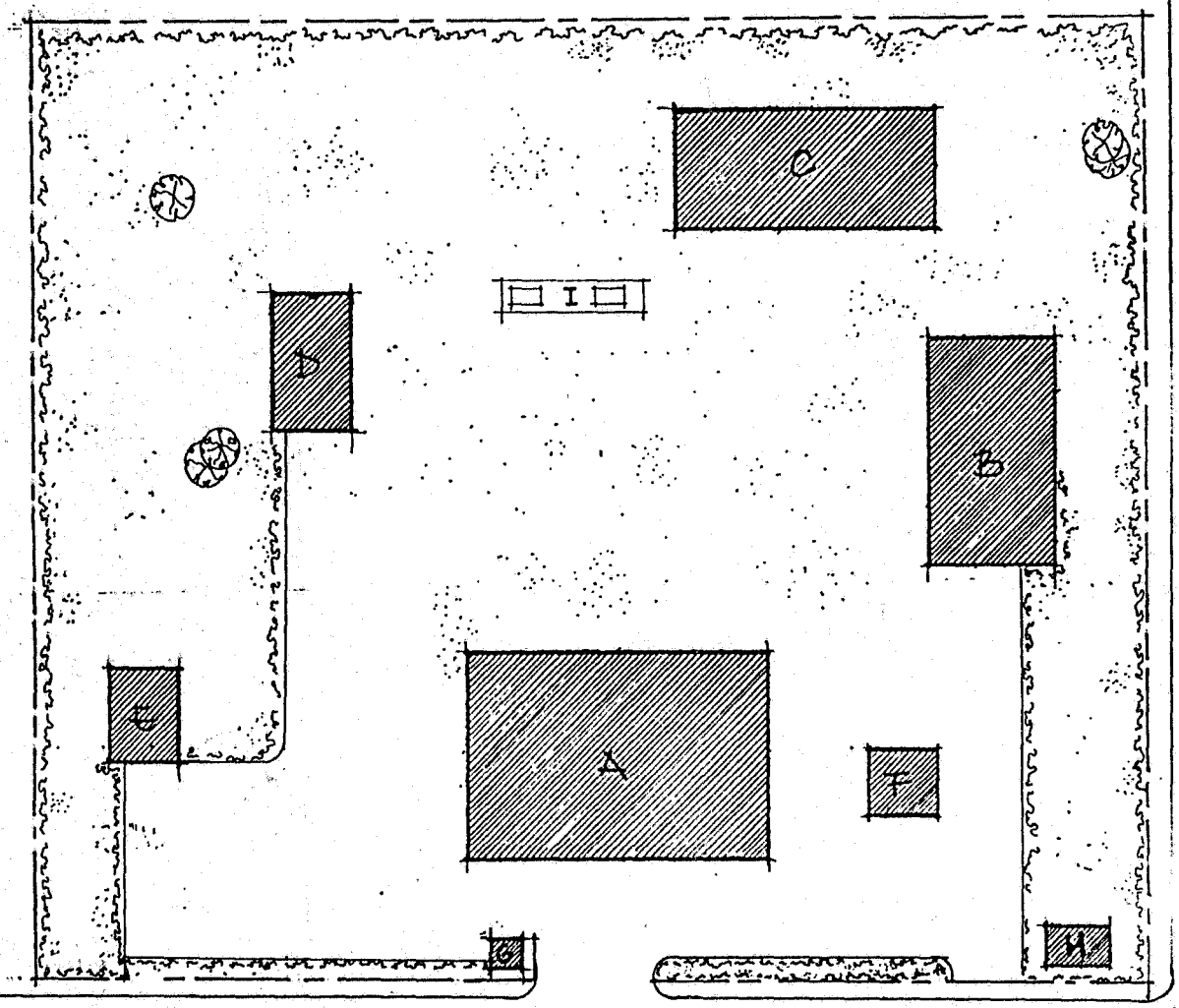
d. ***Block D:*** This block houses the clinic which consists of; consulting Room; Dressing Room; Injection/Rest Room; Laboratory and Toilets.

This block was commissioned on April 15, 1984 as a support facility

CASE STUDY 1

NIGER STATE FIRE SERVICE HEADQUARTERS, MINNA

Fig 6.1



	LEGEND
A	ADMINISTRATIVE BLOCK / APPARATUS BAY
B	OFFICES
C	OFFICES
D	CLINIC
E	CHIEF'S QUARTER
F	GENERATOR HOUSE
G	GATE HOUSE
H	MOSQUE
I	FUEL PUMP

6.1

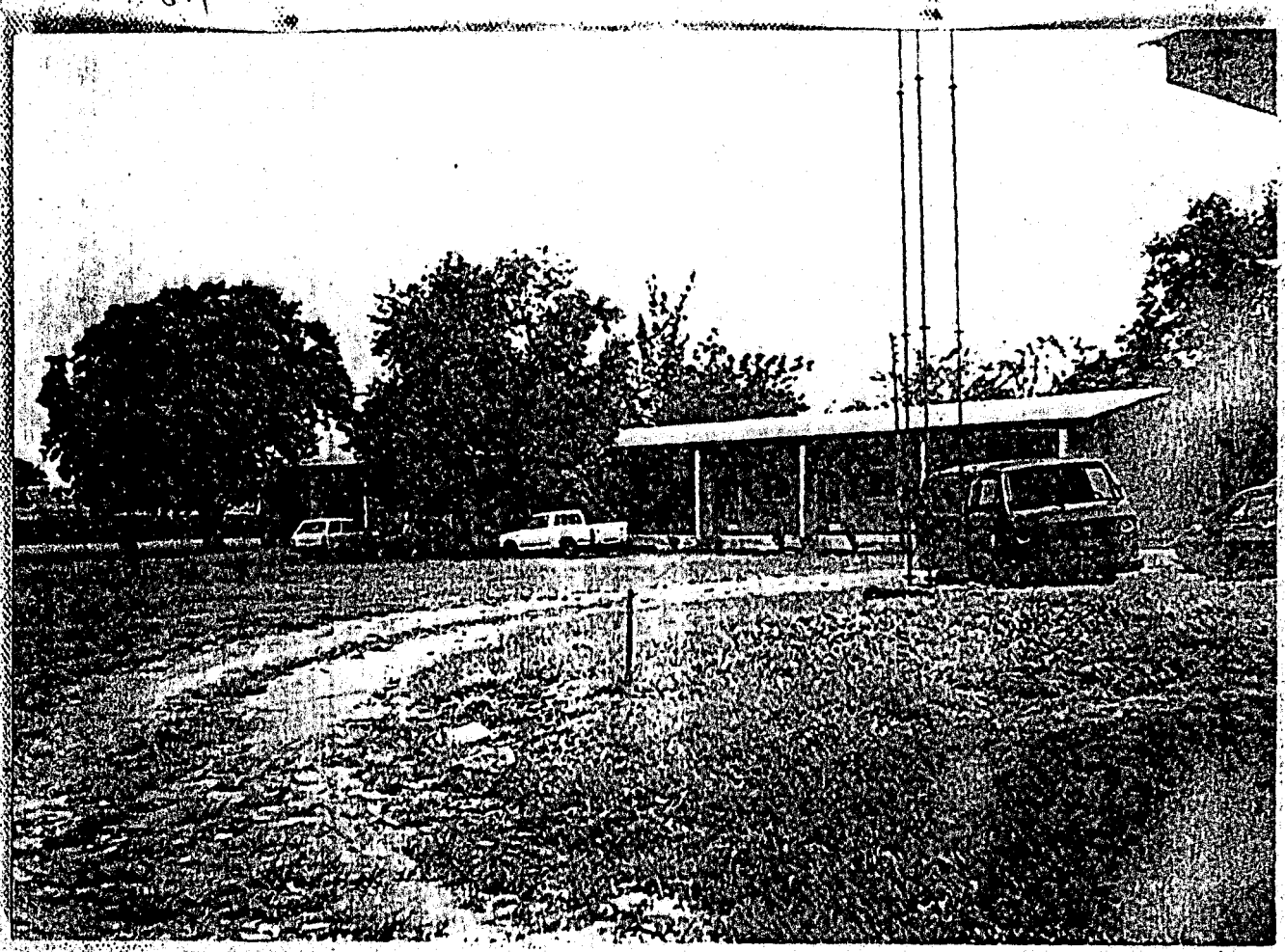


Plate 6.2

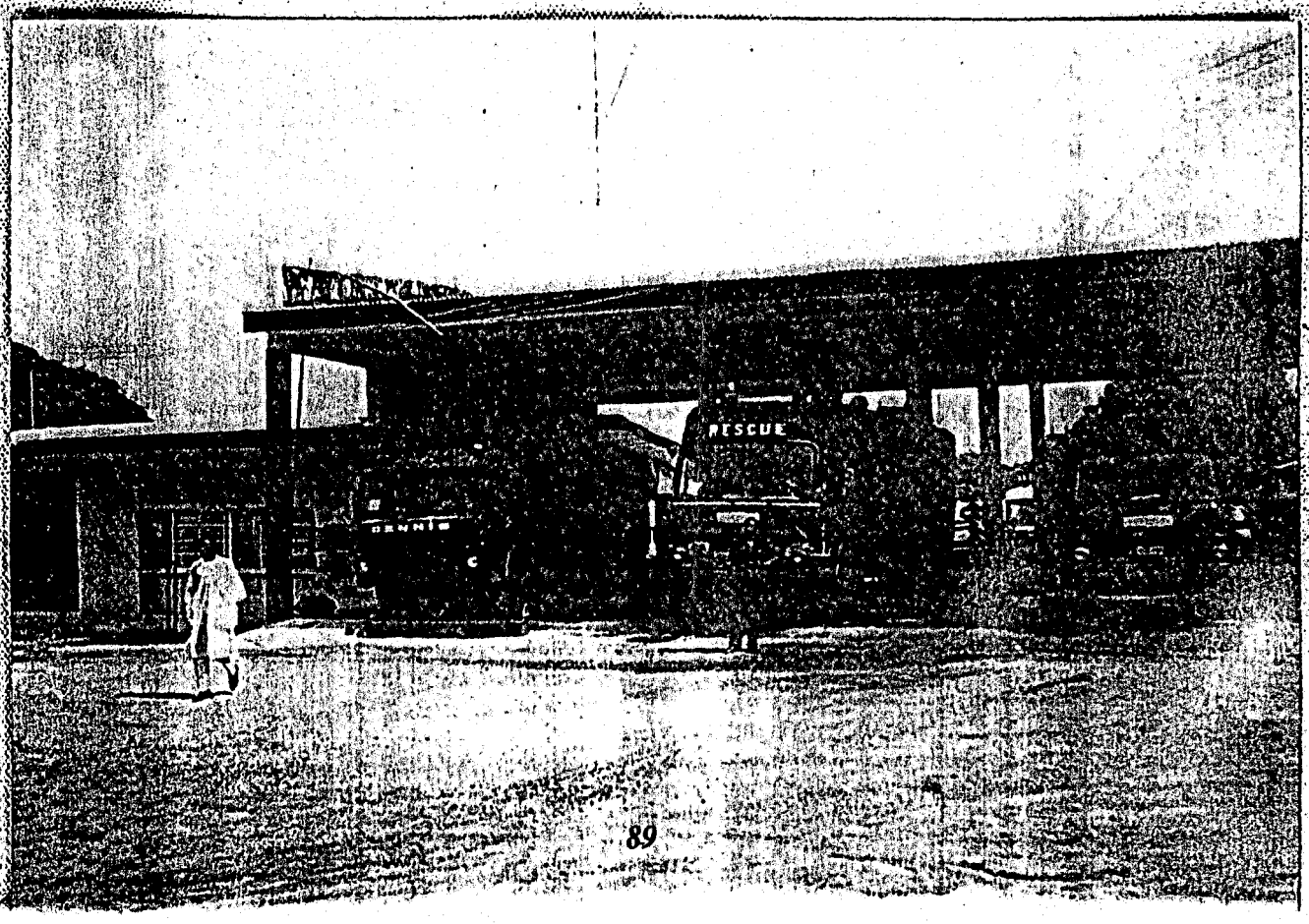
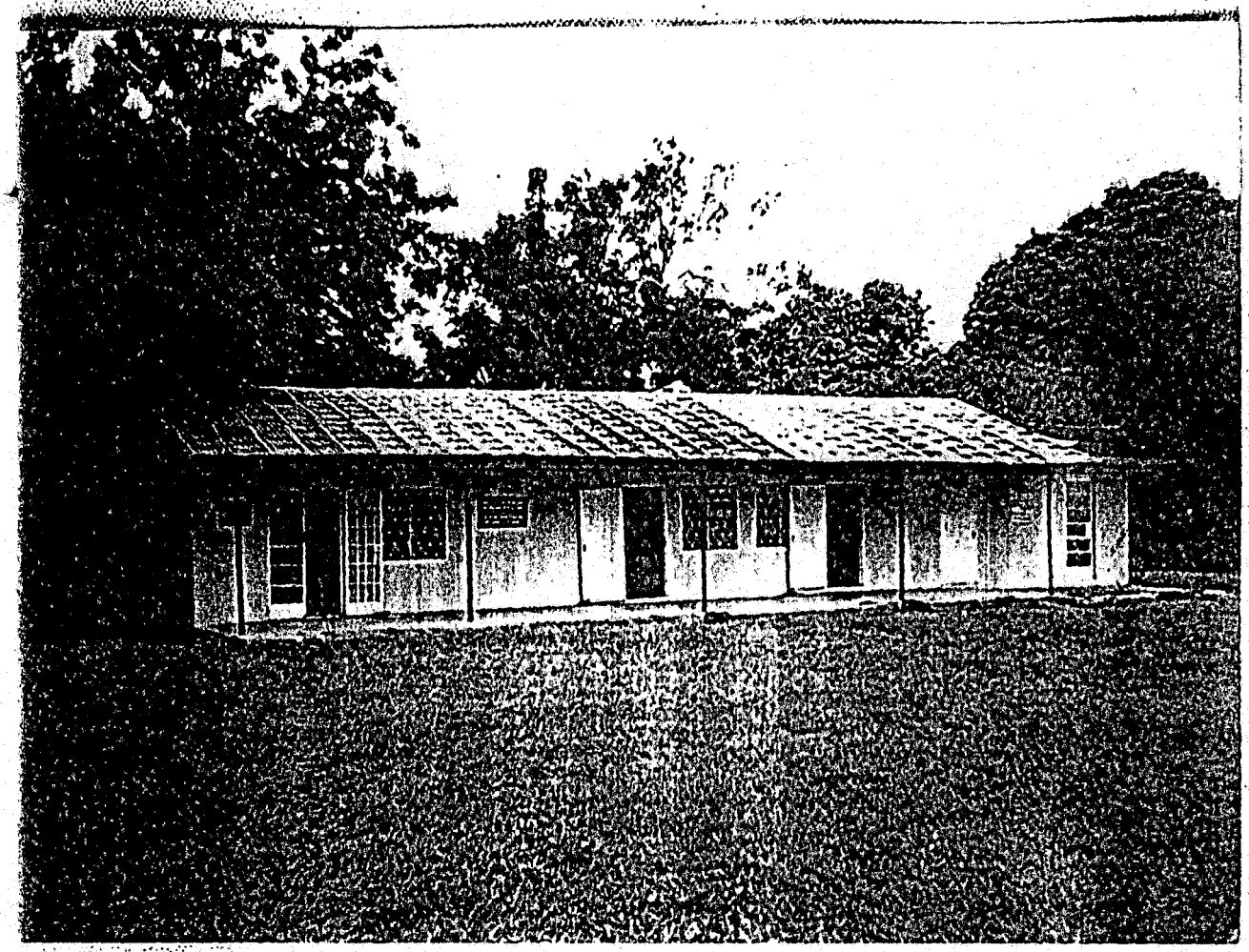


Plate 6.3



to the Fire Service Headquarters.

e. ***Block E:*** This is the chief Fire Officer or the Director's Quarter

f. ***Block F:*** This building houses the Generator or plant which serves as an alternative source of power supply.

The operation of the station is such that whenever there is a fire incidence reported at the Control room, the Apparatus unit along bosso Road is notified from the headquarters and a dispatch is made at this operation unit to go and fight the fire. Reinforcement, however, is sent from the headquarters to back-up the operations unit dispatch.

6.1.1 Merits of the Design

i. There is a large outdoor training area
ii. The Chief/Director's Quarter is within the station.
iii. The clinic is readily accessibly
iv. There is a filling station (pump station) for the fire service vehicles.

6.1.2 Demerits of the Design

i. Certain units are located in different locations other than the main site which might result to ineffective co-ordination, poor response and poor administrative control./
ii. The main site is not directly accessible from a major road.

iii. There is inadequacy of training facilities

iv. Apparatus bay is grossly inadequate as several other fire vehicles were parked inside the bay.

v. There is no conference facilities.

vi. Maintenance/Repair workshops was certainly not considered in the design of the headquarters.

vii. There is no accommodation facility for firemen on duty.

viii. There is no catering facilities for the fireman and other staff of the headquarters.

ix. There is no defined parking sopaces and vehicular traffic

x. There is only a single entry/Exit point into the station

6.2 Kaduna State Fire Service Headquarters, Kaduna

The Kaduna State Fire Service Headquarters began full operation in 1965. This headquarters, however, consists of four (4) different units A, B, C and D units.

a. ***Unit A:*** This unit consists of two floors:

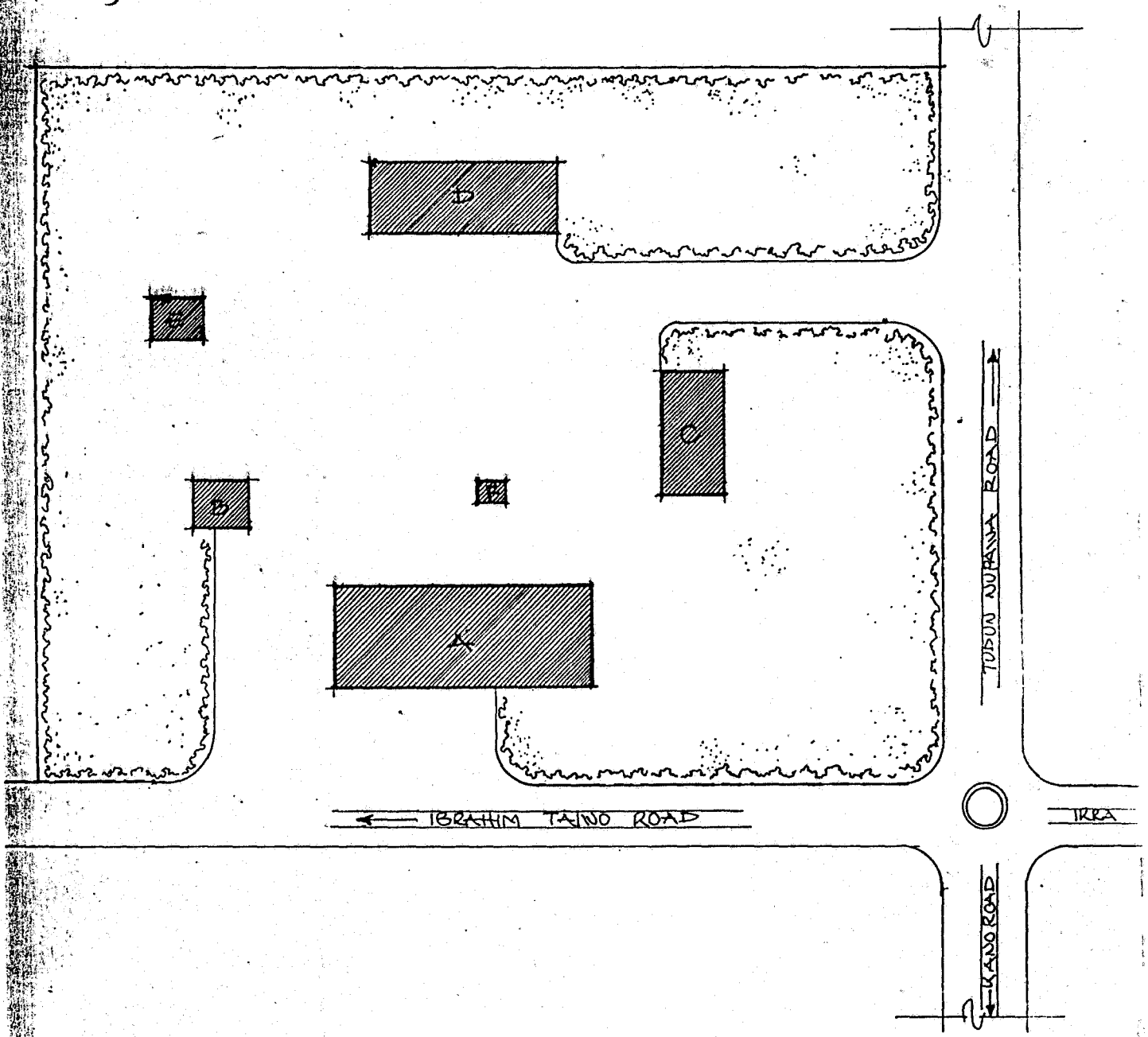
The Ground Floor - This floor houses the Apparatus bay; the Control room, which is adjacent to the bay; Director's Office, via a large space which serves both as Director's Secretary's Office as well as other administrative services.

The First Floor - This floor however, serves mainly as the training area, containing classrooms for instruction purposes.

CASE STUDY 2

KADUNA STATE FIRE SERVICE HEADQUARTERS, KADUNA.

Fig 6.2



LEGEND	
A	ADMINISTRATIVE BLOCK / APPARATUS BAY
B	CONTROL/DRILL TOWER
C	FOOD CANTEEN
D	BLOCK OF OFFICES
E	WATER RESERVOIR
F	WATER HYDRANT

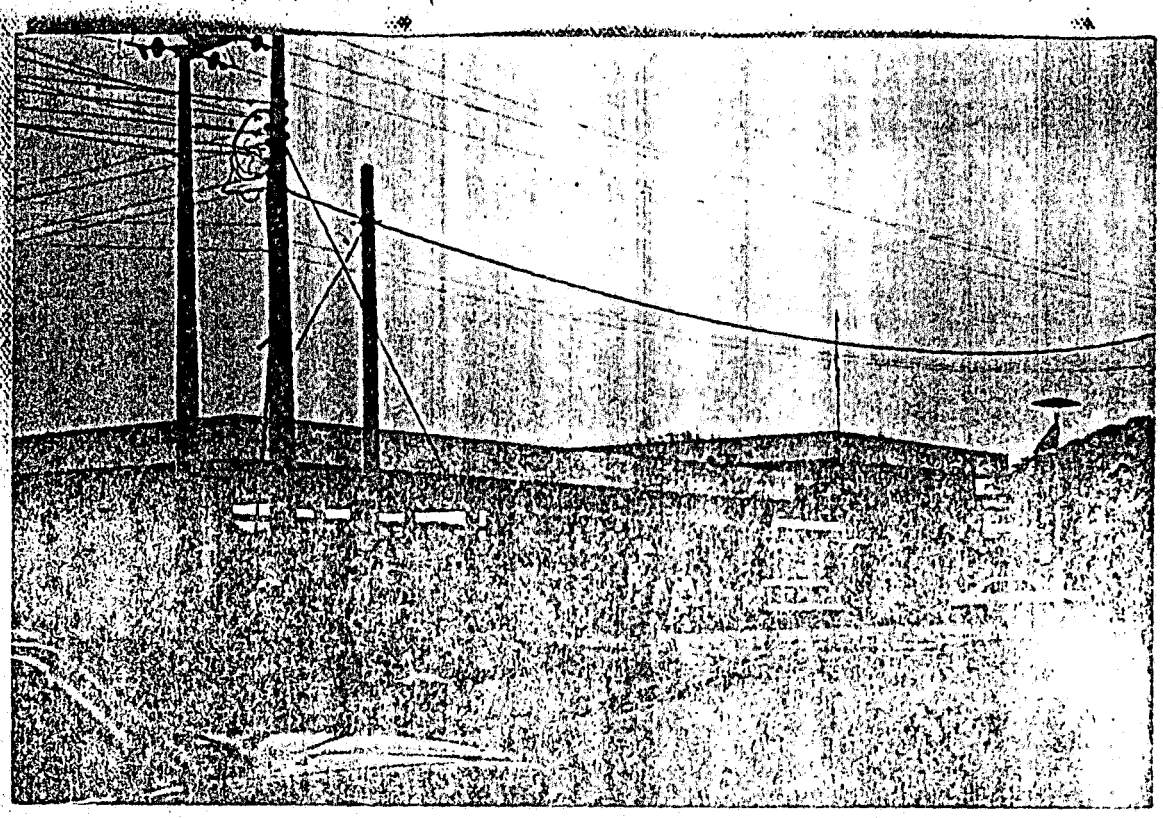
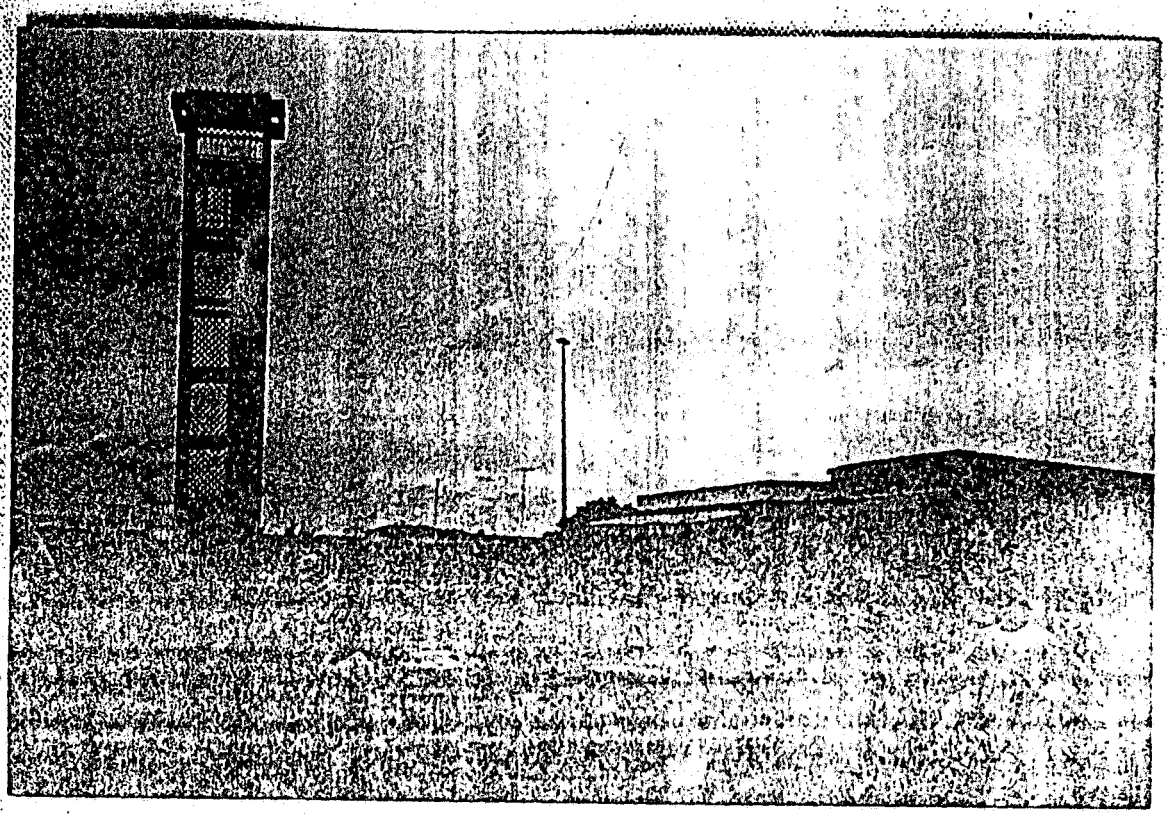


Plate 6.5



b. ***Unit B:*** This units stands elegantly higher than all the other untis that make up th eheadquarters. This unti is the Drill Tower or Control Tower. It rises about 20 metres high, and is used both as a drill tower for training, as well as for drying hoses operation or practice.

c. ***Unit C:*** this unit comprises of a Bukateria and a Kiosk to cater for the staff feeding.

d. ***Unit D:*** This unit houses the offices of the Head of Fire operation; Head of Fire Prevention; Fire Prevention Officer and Store.

6.2.1 Merits of the Design

i. the main unit (Unit A) of the administrative block is constructed with fire-resistant materials.

ii. The site is located on the highest point of elevation above sea level in the area.

iii. It is located in a high density residential area, where its services mostly required.

6.2.2 Demerits of the Design

i. There is poor planning and orientation of the structures, which might result to ineffective co-ordination between offices.

ii. There is inadequacy of functional spaces.

iii. The workshop is located in another part of the town far away from the site, thus no workshop provided for the vehicles in the headquarters.

iv. There are no training/fitness equipment provided

v. There is no clinic or dispensary on site.

vi. There is no recreational facilities on site.

vii. The outdoor training area lacks maintenance, therefore left base with no vegetative cover.

viii. There is no distinct parking spaces.

ix. There is only one entry/exit point into the station.

6.3 Fire Service Headquarters, Federal Capital Territory, Garki - Abuja

This is the headquarters of the fire service stations presently operational in the Federal Capital Territory. This station houses all the functions within the two-storey building structure.

Ground Floor: This floor houses the Apparatus Bay; the control Room; Maintenance bay and a few offices.

First Floor: this floor houses other administrative offices and classrooms for training purposes.

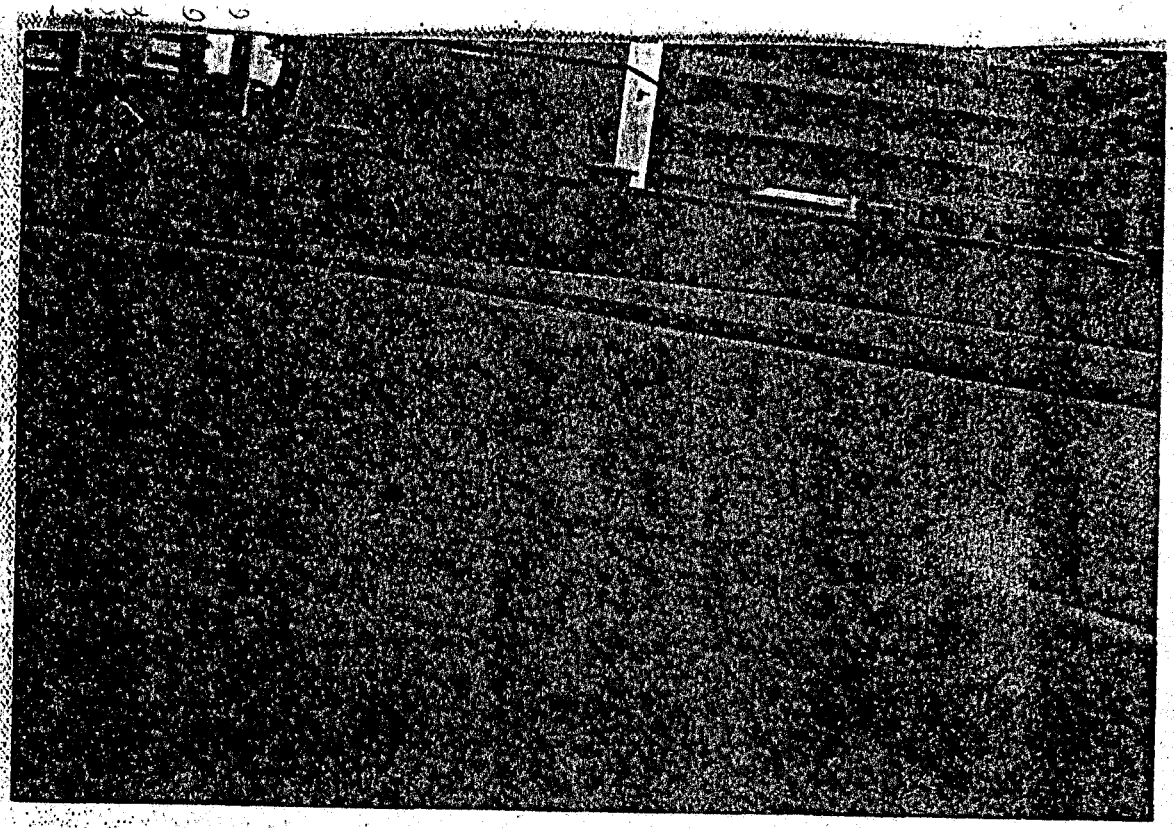
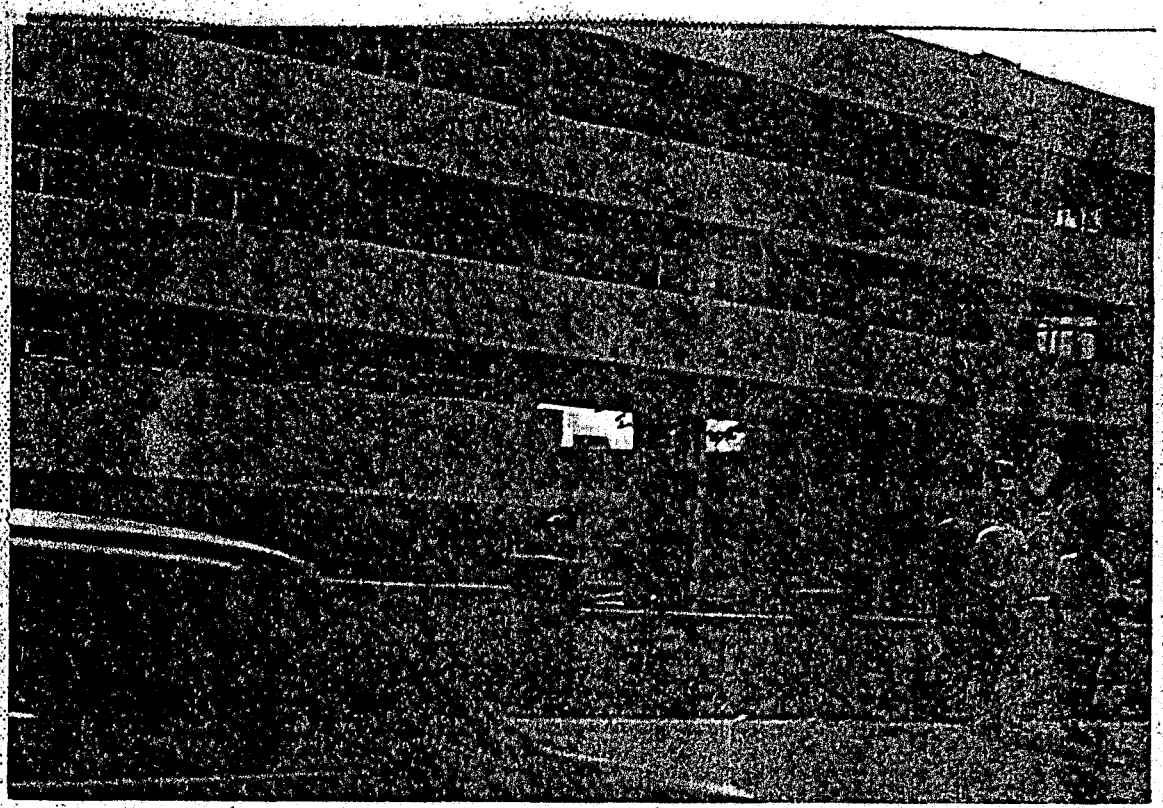


Plate 6-7



6.3.1 *Merits of the Design*

i. All facilities and spaces are housed within a single structure.

ii. The site is accessible from a major road.

iii. There is a better co-ordination of functions because of circulation within the building.

6.3.2 *Demerits of the Design*

i. The station is too close to residential houses in such a way that there is no clear cut transitory boundary between the headquarters building and the adjoining residential houses.

ii. The parking spaces are not clearly defined.

iii. There is no clear cut definition of such units or sections as the administrative area; training area; Apparatus bay and other spaces required.

iv. There is no demarcation between the Noisy areas and the Quiet areas. This will lead to interference.

v. The space provided for the vehicles in the Apparatus bay is far too small for long fire vehicles. This exposed the vehicles to weather attack.

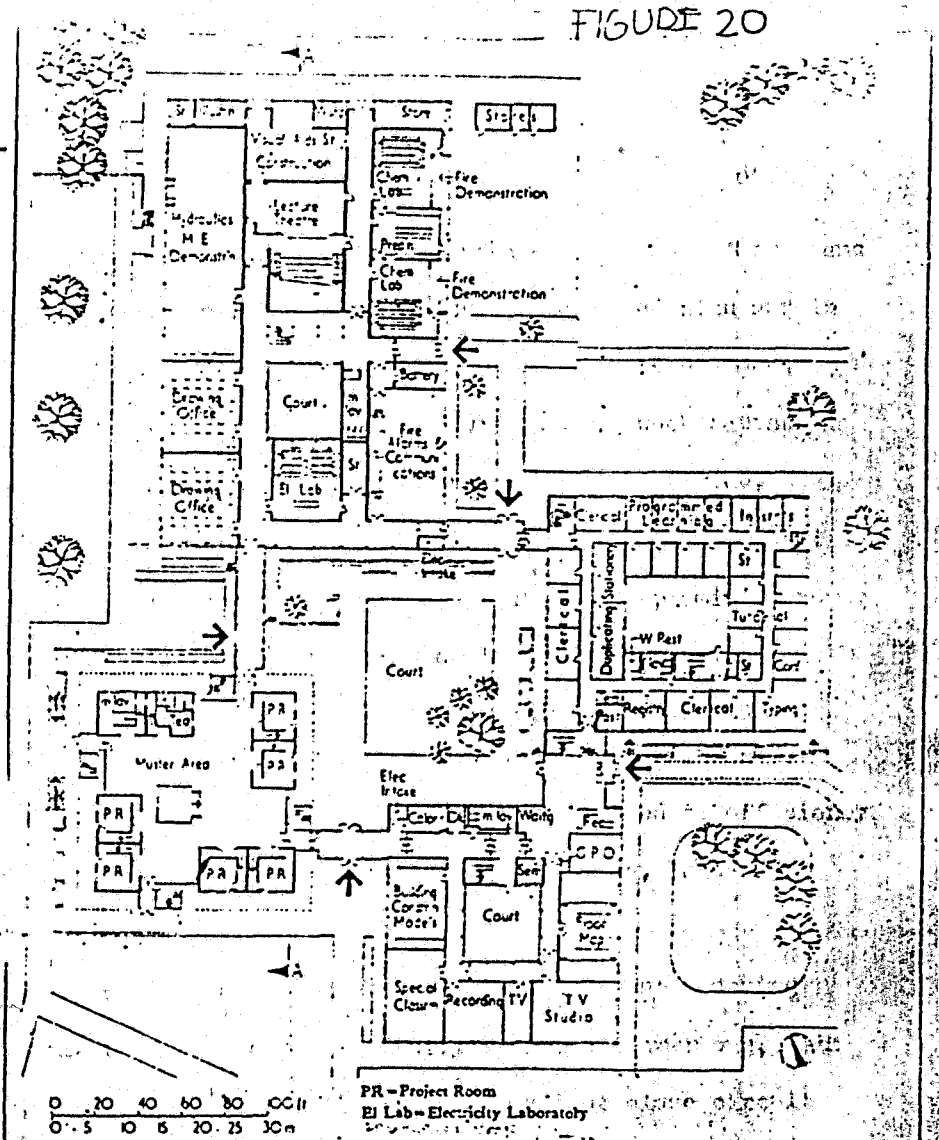
6.4 *Fire Service Training College, Moreton - In - Marsh, United Kingdom*

This is an advanced fire service college. The construction of this college commenced in 1966 and was completed on 1976. It was constructed in

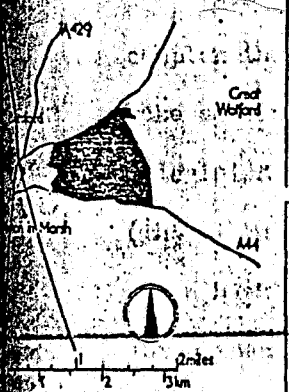
ire Service
raining
ollege
n moreton-in-
harsh

Fig 63

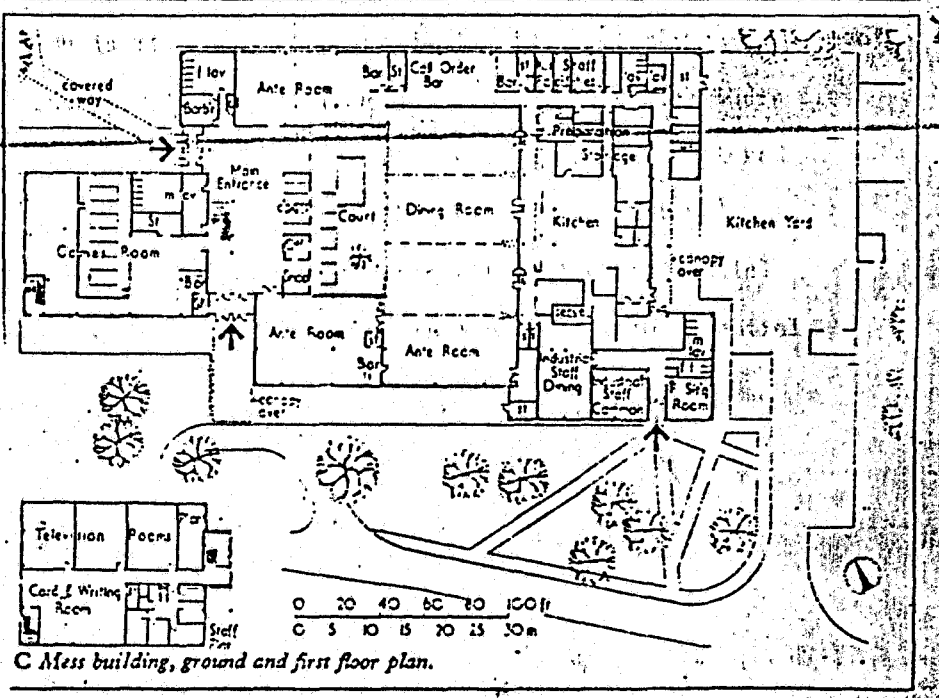
FIGURE 20



B *Training and administration block ground floor plan.*



Location plan.



C *Mess building, ground and first floor plan.*

four (4) phases.

The College is located on an old airfield in Moreton-in-Marsh. The facilities provided for the training of fire officers are probably among the most comprehensive in the world.

6.4.1 Merits of the Design

i. The classrooms in the teaching complex are fully equipped with projection facilities, close-circuit television etc.

ii. There is a variety of courses which caters for industrial students from overseas.

iii. There is an imprerssive foyer (muster area), where students go to for tea and lunch break.

iv. The libraruy is located far from residential block.

6.4.2 Demerits of the Design

i. There is a wastage of space.

ii. The relationship between one wing and an adjacent wing is rarely significant.

iii. The plan is unnecessarily dispersed.

6.5 Analysis of the Cases Studied

The overall analysis of the cases studied reveals a distinct problems inherent with existing fire service headquarters, which affect the smooth and efficient

operation of the stations.

Firstly, the general planning concept of the existing fire services headquarters is a far cry from what it ought to be, thus, there is ineffectiveness of operation. The existing trend is that several units of the headquarters are scattered around town. This leads to ineffective coordination between two distinct untis which results into slow response and administrative control.

The ideal solution is that, all the units of headquarters should be located on one site to enhance better team work and administrative control between units.

Furthermore, the Apparatus bay with its support areas and facilities, is a sensitive unit of a station, thus, it should be located in such a way that there would be little or no interference from either the public or the staff, to the smooth operation of this unit. In addition to this, the apparatus bay should be adequately provided to accommodate all the fire-fighting vehicles available in the station.

The existing practice as evident from the cases studied, is that most of the apparatus bays provided are grossly inadequate to accommodate the fire-fighting vehicles effectively. This exposes the apparatus to unfavourable weather conditions.

To avoid confusion in traffic flow, which is the case with existing cases studied, the planning should be done in such a way that there would be no interference between fire-fighting vehicles and other vehicles of either the staff or visitors. This can be achieved by providing separate entrances for the fire-fighting vehicles and for the staff and visitors vehicles.

Lastly, the various units and their functions should be clearly defined with respect to individual units. For instance, the training area being a noisy area should be clearly defined from the adminsitrative and apparatus bay which are quiet areas.

The prevalent design and operations of the Fire Services and other problems which contribute to the inefficiency of Fire Services as analysed above, and several other inadequacies evident in the cases studied will as much as possible, be appropriated and solved in this proposal.

CHAPTER SEVEN

7.0 The Design

Over the years, Fire Station Planning and Design has become increasingly sophisticated and complex. Several studies have made it apparent that by planning a fire station properly, an efficient and effective operation can be achieved.

The project therefore, is aimed at providing, among other things, efficient fire service personnel for the Federal Capital in particular and the nation in general as well as providing maintenance facilities and spare parts for the equiment in the headquarters and those from other State, Zonal and Divisional headquarters in the country.

7.1 Design Brief

This is the major facility requirement for the design upon which all available information presented have been developed. The development of the brief starts with the principal functions in a Fire Service headquarters.

This project is aimed at achieving among other things; a better team work and administrative control of and for other fire service headquarters and units within a single site. It is also aimed at achieving a safer and quicker turnout time, by proper planning of the station, such that, facilities will be located in a manner that will minimize the amount of grouping time required

for the fire-fighting personnel to respond to fire-calls. Efforts shall be made to upgrade human comfort with great emphasis on planning.

This project shall comprise of several units; of these units is Administrative unit, which as the headquarters, shall include offices of the Executive Director of Fire Service; fire Prevention Division; Planning and Research Division; Budget and Fiscal Bureau; Personnel Department; Fire Investigation Bureau; Public Relations Officer etc. The other units shall include, Apparatus bay where service vehicles are kept; Training/Education unit, for lecture and instructions, as well as a gymnasium for physical fitness purposes.

Also contained in the scope, is the Maintenance/Repair Unit where Maintenance and/or repair of service vehicles and equipment are effected. Mechanical staff of the fire service headquarters in the Federation could also be trained here.

Outdoor training facilities shall include large open space for demonstration and practice; a Drill Tower for hose and ladder evolutions; Other desirable facilities shall include fuel pumps; water reservoir; water hydrant; officer's mess; clinic; student's hostel; staff quarters; community centre etc.

A desirable policy in this project shall be to provide an apparatus bay large enough to house at least five major fire-fighting vehicles for the MainStation

and two, for the sub-station for emergency purpose. Ample space shall also be provided for reserved - Apparatus, especially in the Maintenance Workshop, to provide a replacement when needed, for not only the National Headquarters, but for all headquarters - State, Zonal or District.

Apart from the relationship of one function to another or units which was considered during the development of the brief, traffic, aesthetics and the need for a good view to easily locate fire incidence as well as security considerations were given utmost importance.

Lastly, due consideration was also given to the provision of parking spaces for the staff and the visitors to the offices. Ample space was also provided for the circulation or manoeuvre of long fire fighting vehicles.

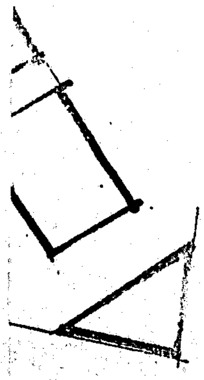
7.2 Site and Site Analysis

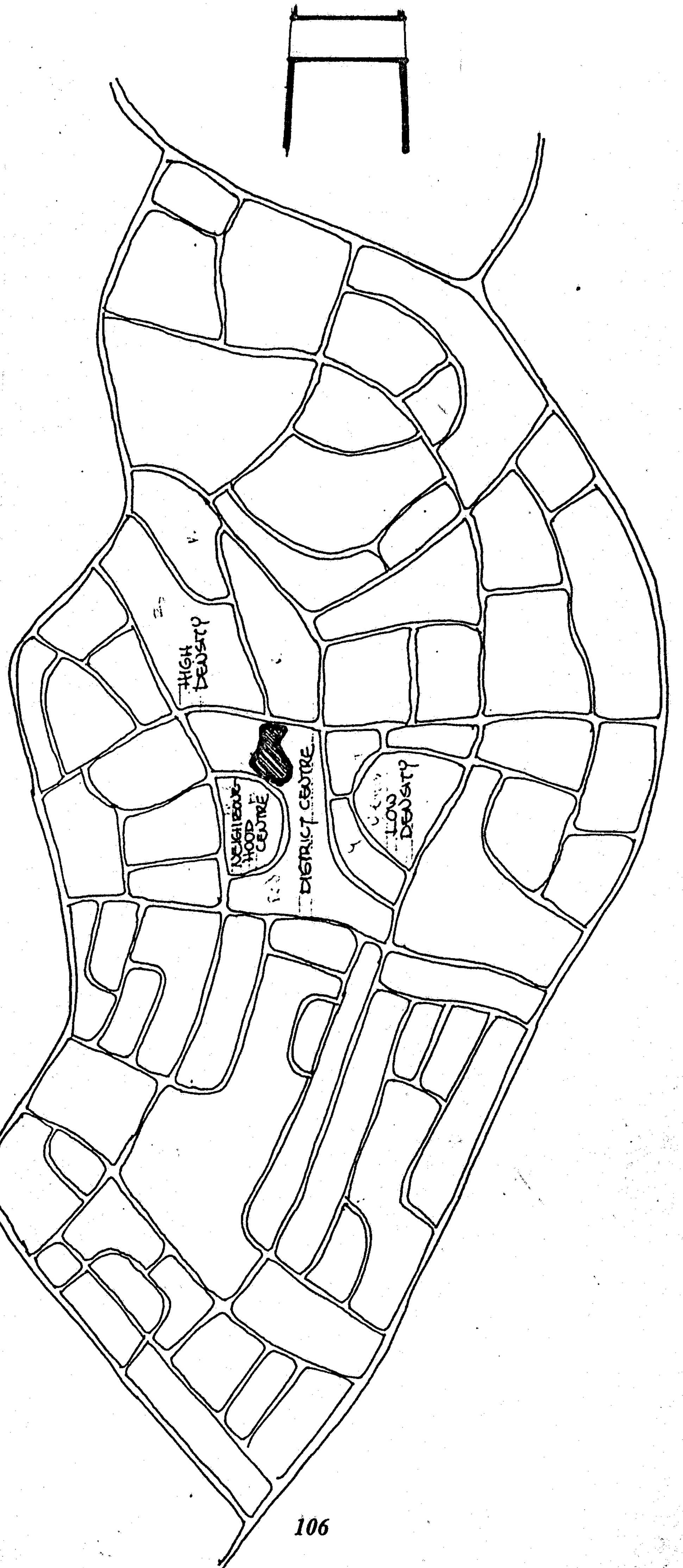
The site was selected and analysed based on the data and information received from the Federal Capital Development Authority, (FCDA), Abuja, Planning Division. The site would be analysed thus:

7.2.1 Site Location

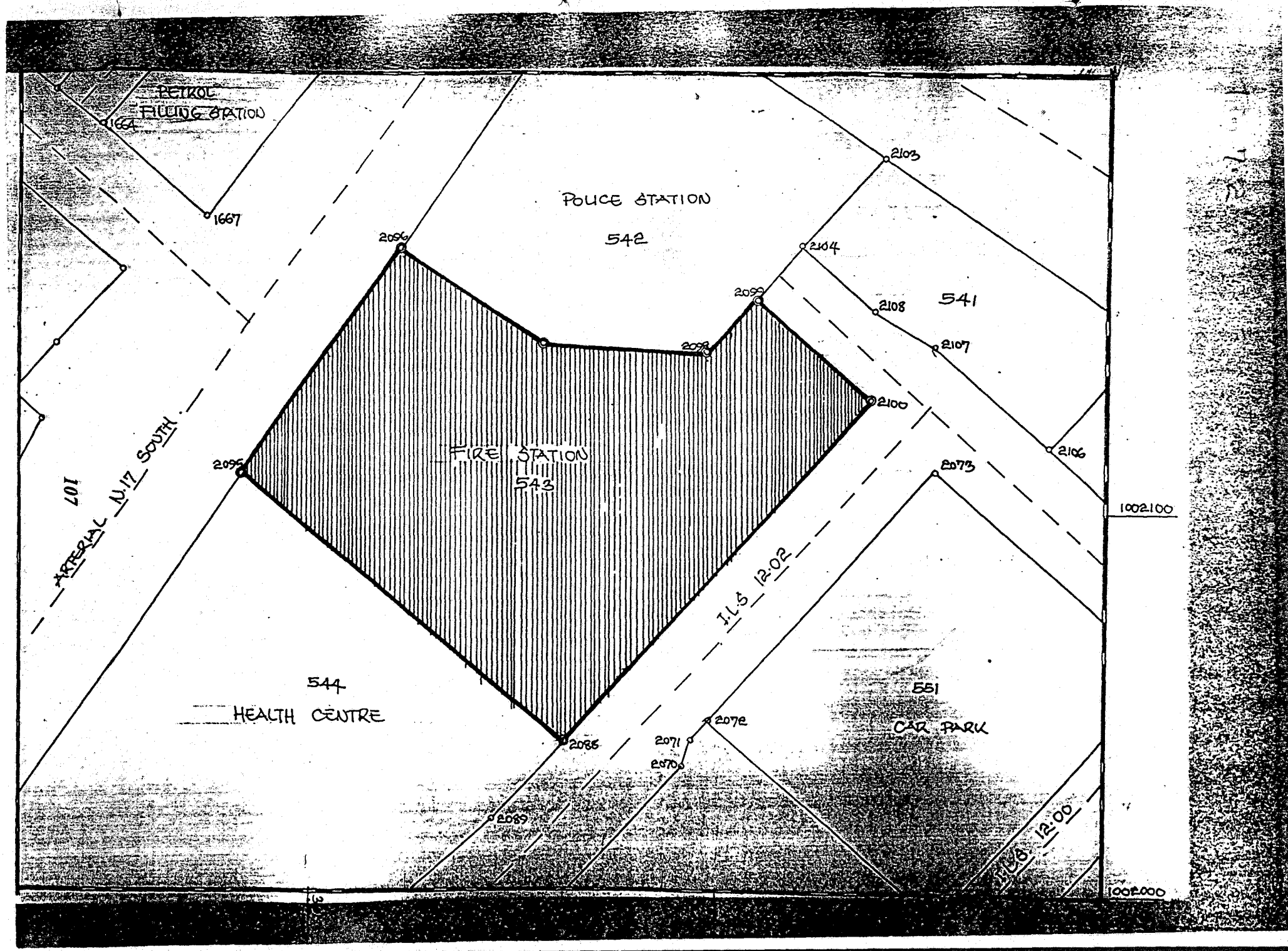
The site for this project is located in Gwagwalada (New Town). Gwagwalada new town was the first in the series of new towns to be developed within the Federal Capital Territory (FCT) as recommended by the International Planning Associates (IPA) report on the implementation of Federal Capital

Fig 7.1





GWAGWALADA AREA MAP


PETROL
FILLING STATION
1664
1667
POLICE STATION
542
2103
2104
2096
2099
2098
2108
541
2107
2100
2106
2095
FIRE STATION
543
2073
1002.100
ARTERIAL N.17 SOUTH
107
I.L.S 12.02
544
HEALTH CENTRE
551
CAR PARK
2072
2071
2070
2085
2089
I.L.S 12.00
1002.000

City. According to the Draft Regional Plan, the new town of Gwagwalada will become the biggest and most important urban, administrative and cultural centre within the Federal Capital Territory (FCT).

7.2.2 Site Selection Criteria

The site was considered for the following reasons:

1. The site is an existing site proposed for Fire Service in the Draft Regional Plan, appropriately selected by the Planning Authority of the Federal Capital Development Authority (FCDA), Abuja.

2. The new town is the proposed administrative, commercial and cultural centre for the delivery of services to all the settlements and inhabitants of the FederalCapital Territory (FCT).

3. The new town will be the centre for absorbing surplus immigrants to the Federal Capital City.

4. The new town is highly nodal, being in connection with the National and Regional road systems as well as the International Airport road.

5. The site is within an industrial and urban belt which are transversed by Regional road systems (A2 - road).

6. The site is on an elevated part of the town which is clearly visible as

one drives into the town.

7. There is ease of pedestrian and vehicular accessibility to the site.

8. There is an adequate supply of water from the Wuye river which is located on the eastern side of A2 road.

9. Telecommunication routes and lines are located along the peripheral and arterial road corridors.

7.2.3 Topography, Geology and Philosphy

A visual survey of the site reveals a typical topography peculiar to Abuja, with its aesthetic beauty of hilly terrain that surrounds the territory.

Gwagwalada area is almost predominantly underlain by precambrian magmatite, gneises, granite and schists of the crystalline basement complex. Schist belt outcrops along the South-western merging of the area and apart from this schist belt, which is a most unsatisfactory bedrock in the area, this area is ideal for building foundations and is free from geological hazards within the limits of present knowledge. Quartenary alluvium deposits are found in the Usuman river channel and this is source of fine sand which is used for buildings purposes.

Elevations within the Gwagwalada Planning Area are between 213.3 metre

to the north and 142.,2 metre to the south. Slopes in this area are generally long and gentle, ranging up to 4%. The terrain has been categorised by Mabogunje (1977), as 'Gently Undulating'. The slope of the site is about 2%. Grading of th eslope shall be done where necessary.

7.2.4 Climate

Although climatic information on the Federal Capital Territory are rather scanty, data extrapolated from adjacent weather stations revealed that the area or site has a climate synonymous with the Savannah Region in general. Temperatures are mild comparatively, ranging from 21^0 - 26.7^0C yearly. Rainfall follows the seasonal trend of April to October with a total annual rainfall of approximately 1, 650mm. Harmattan predominates the dry season period with the North East Trade Winds which blows from November to March.

This area lies within the region classified in the Site Evaluation and Site Selection Report No. 2 by International Planning Associates [IPA (1978)] as climatically ideal for human comfort.

During the Rainy Season, about 60% of the annual rain falls durin gthe month of July, August and September. This factor is of significance in the planning of drainage for the disposal of storm water.

7.2.5 *Soils and Vegetation*

The soil in the area shows a high degree of variability comprising mainly sand, silt, clay and gravel. The incidence of soil erosion is quite small because of protective vegetation cover; but any uncontrolled clearancve would result in accelerated erosion. The vegetation can be classified as Park Savannah with scattered trees and tall grasses. There are however, some wooden areas along interfluves between the Usuman river and its tributaries within the larger area. Due to this type of vegetation, the area is quite ideal for development since constraints on site clearance are very limited.

7.2.6 *General Site Appraisal*

As stated earlier in the site selection criteria, the site was originally proposed, with a size which hopefully shall be able to accommodate all the facilities required as proposed in this project.

Adequate infrastructural facilities such as electricity; water supply; sewage and waste disposal; communication network as well as telephone have been provided or rather exist to make the site functional

Access into and within the site is expected to be fast and as direct as possible, with minimal distances due to the existence of Arterial - A2 wards.

7.3 Design Considerations

The design coinsiderations were those of the climate/site and architectural requirements. Each was studied and its basic requirements for a good proposal were employed..

7.3.1 Site Considerations

The following environmental and technical factors were considered:

i. ***Micro - Climatic Effect:*** This is the sun-shading effect which is provided by an avenue of trees to be planted along the road and within the site in order to provide micro-climatic comfort from the solar radiation.

ii. ***Noise Screen:*** These are obstruction objects provided for the purpose of obstructing noise transmission as well as reducing its effects on the site. Here, fence and trees will be provided as close as possible to the source of noise especially the access road.

iii. ***Orientation:*** Buildings shall be oriented in such a way that the longer sides will as much as possible face the North and South directions, while the shorter sides of the building would face East and idest directions to minimise the effect of solar radiation and optimise air circulation within and into the buildings.

iv. ***Wind Effect:*** To avoid wind shadow effect, the distance between

buildings would exceed six time its height (6H); or high level ventilation ducts shall be provided to enhance air circulation as well as act as a means of energy conservation.

v. ***Set back:*** to prevent accidents and to aboid both children and adulsts from playing or disturbing into the road or highway.

vi. ***Roads and Walkways:*** Straight roads into the site are reduced or avoided to control sopeed of vehicles. Walkways will be used to provide linkage for effective circulations within the site.

vii. ***Bus Shelter:*** Bus stop shall be provided outside the fence to ease the movement of staff and visitors as well as students on training.

viii. ***Security:*** the site shall be fenced with three major entry and exit points efficient service and vehicular control. The gates shall aid in effective decongestion of the site, which is the philosophy of the concept of this project.

7.4 Design Philosophy And concept

Architectural concepts are a response to related design themes which come in different forms. These could be singular or a combination of forms or ideas brought together into architectural representations.

The philosophy of this design shall be use of Adjacency Rating which is the key concept in planning a fire station. This is aimed at achieving the shortest Dispatch and turnout times possible for effective fire services and efficiency of the personnel.

Architectural Design Approach can be classified into four (4) broad types:

i. ***Analogical Design Approach:*** This concept was originated by the Greeks. In order to draw analogy from any form , one must know the form effectively. E.g. onemight use the human hand as his concept. this must be identified in the design.

ii. ***Canonic Design Approach:*** This approach breaks everything down effectively into triangles. Whenever one finishes, one projects and applies it to the design.

iii. ***Pragmatic Approach:*** In this approach, materials are used without theories attached; the evolution of materials determine the theories. It is a trial and ever approach.

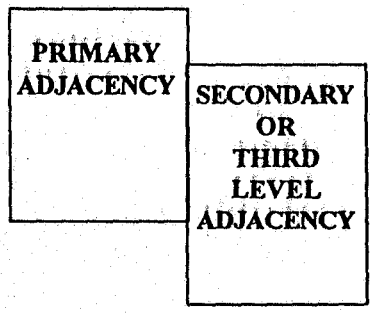
iv. ***Iconic Approach:*** This is a cultural imposition of forms, that is, it has cultural affiliation. E.g. an Arab boy would think of a tent; Hausa boy would think of a typical Hausa design; Nupe boy would think of typical Nupe architecture etc.

The design approach chosen for this project is mainly that of Canonic Design Approach which is a response to the logical sequence and hierachy of functions, of the design philosophy.

The basic concept of the design therefore, it, FORM follows FUNCTION. The main purpose of this concept is an indepth study of spaces in a fire station which requires adjacency rating for the purpose of functional planning.

Turnout, Dispatch and Travel times are the key elements inthe successful containment of fire which is the primary functions of the Fire Service.

The main aim of this concept which requires 'Adjacency Rating' is for the purpose of functional planning and verification of the units where the greatest amount of activities occur. These activity locations are then joined in such a manner that a minimum amount of grouping time is required for the fire - fighting personnel to respond to fire calls. This involves the classification of functions into Primary Adjacency and Secondary or Third Level Adjacency.



Spaces in Primary Adjacency must be directly connected in physical manner

to one another. These spaces need to be associated or close to the apparatus area so that personnel and equipment can be organised as quickly as possible, which is the key factor in turnout time in response action. Thus, the shortest distance is achieved between these activity areas and the apparatus area so that a minimum amount of time is required to gather the firemen on duty for immediate fire fighting action.

Secondary or Third level Adjacency on the other hand, involves the rating of spaces which are only complementary to the primary functions of the fire service. By this consideration, the administrative area is separated from the training area; the operation unit is separated from the administrative core etc.

7.5 Functional Analysis and Site Planning

7.5.1 Functional Analysis

The functionality of the headquarters is such that the units are effectively accessible to each other. The day-to-day functions carried out in a unit do not in any way interfere with functions or actitivies of other units. For example, there is no interference in the functional flow of activities between the Administrative area and the Training area. Moreover, the spaces in each unit are planned in such a way that there would be efficiency of workers and activities within individual units. It is noteworthy therefore, that each unit is designed with the consciouness of Dispatch, Turnout and Travel

times to enhance efficiency of personnel.

ADMINISTRATIVE AREA:

The adminsitrative unit is planned on the basis of primary adjacency rating status. The administrative unit is sectionalised; the Primary Adjacency wing and the Third level Adjacency wing. The Primary Adjacency wing consist mainly of Apparatus area and equipment and the Operation Department of the Headquarters which is charged with the primary functions of fire fighting and rescue operations.

The third level Adjancency wing, though perform its own primary function of administration and education, is a unit that complements the primary functions of the operations department. As such th erate of activities from the staff of the headquarters as well as visitors is expected to be hogh here.

The first floor is expected top be quicker and less busy when compared to th eground floor which houses the Apparatus as well as the turnout gear storage.

APPARATUS AREA/MAINTENANCE AREA/COMMUNICATIONS

The functional relationship of th espaces in these areas is very significant and one o fthe most sensitive among the entire units of the headquarters. Direct access to and from office of the firemen enhance quick actions in fire operations. Maintenance area is also directly connected to the apparatus

area so that the vehicles can be regularly or in the event of any mechanical fault, the vehicles can be reached quite easily and repairs effected.

TRAINING AREA

The training area is provided with facilities and spaces necessary for effective operation of the unit. the teaching area for example, has classrooms for instruction purposes, and in these classrooms are provided work top for demonstration purposes. Also provided is a gymnasium to further enhance the physical fitness as well as mental preparedness of the staff and students on training.

We are in the age of information Technology, computer and communications rooms have been incorporated in the design to provide trainee officers with latest information and communication skills.

TRAFFIC FLOW.

To avoid confusion and obstruction of traffic on site, access into the site is through three (3) major entrances; one of the entrances is strictly for the fire service vehicles which require unobstructed traffic control for smooth operation; one other entrance which is the main entrance is for the easement of access into the site by both the adminsitrative staff and visitors vehicles; the third entrance which could as well be regarded as the rear access is mainly for community facilities which include the officers Mess, Clinic, Training School and Workshop.

Walkways will be provided for pedestrian traffic within the site.

PARKING SPACES

Parking Spaces are provided on site with spaces allocated differently, for the staff and that for visitors. A parking space for emergency calls was also considered.

7.5.2 Site Planning

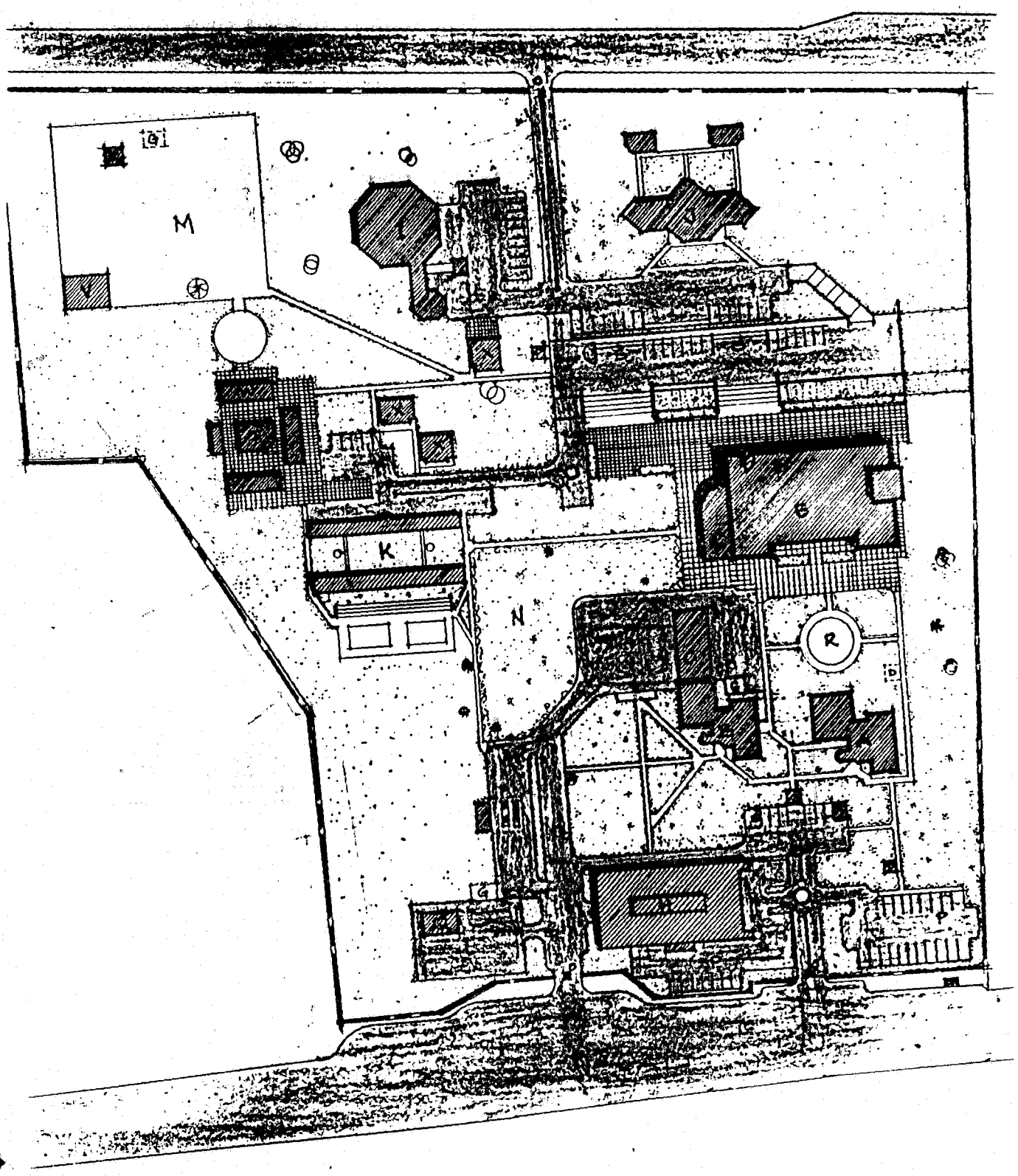
The planning of the site is based on functionality and design requirements o fthe project. this involves the identification of circulation pattern, inter-relationship of one function or activity to another accessibility, economic viability as well as general aesthetics of the headquarters.

The planning of the site took existing climatic factors into consideration. The positioning of facilities was based on the natural topography of the site.

The site is zoned into four (4) based on the concept of primary Adjacency.

i. ***Public Zone:*** This areas are less restricted areas which are opened to the public occassionally. E.g. Training School, gymnasium.

iii. ***Private Zone:*** This zone consist of the student hostels, staff residences.


M
K
N
R

iv. ***Buffer Zone:*** This zone contains the open spaces for outdoor training, drill ground.

7.6 Space Schedule

7.6.1 Administration

Ground Floor

Area (M^2)

- Assistant Director
- Accountant
- Secretary
- Reception
- Head of Stores
- Staff Lounge
- Personnel/Welfare Office
- Head of Fire Prevention
- Fire Prevention (General Office)
- Foyer
- Toilets
- Maintenance Officer
- General Office (Administration)
- Machine Room
- Kitchennete
- Public Relations Office/Lounge

Area (M^2)

- Store
- Breathing Apparatus/Kit Store
- Turnout Gear Storage (Lockers)
- General Store
- Control Room
- Sleeping Area

First Floor

Area (M^2)

- Director's Office
- Divisional Officer
- Secretary
- Machine Room
- Audio-Visual Room
- Budget/Fiscal Bureau
- Planning and Research Office
- Secretary
- Operations Offices
- Sleeping Area
- Fire Investigation Department
- Firemen's Domitory
- Shifting Leader/Transport Officer
- Operations Dept. (General Office)

Area (M^2)

- Kitchennette/Dining
- Toilets

7.6.2 Training School

Ground Floor

Area (M^2)

- Visitors Waiting Room
- Breathing Apparatus Store
- Kitchen
- Cafetaria
- Television Studio
- Deputy Commandant's Office
- Lecture Rooms (5)
- Gymnasium
- Changing Room (Male/Female)

First Floor

Area (M^2)

- Commandant's Office
- Secretary's Office
- Conference Room
- Library
- Librarian

Area (M^2)

- Computer Section
- Communication Studio
- Instructors Office
- Apparatus/Traching Aid
- Store
- Lecture Rooms (5)
- Toilets

7.6.3 Medical Centre (Clinic)

Area (M^2)

- Resting Room
- Injection Room
- Pharmacy
- Dressing Room
- Consulting Room
- Waiting Area
- Nurse Station
- Store
- Toilets
- Laboratory
- Ambulance Bay

7.6.4 *Officer's Mess*

Ground Floor

Area (M^2)

- Reception
- Administrative Office
- Staff Room
- Indoor Sports Hall (Junior Officer)
- Suya Spot
- Sport Kit Area
- Guest Rooms (6)
- Lounge
- Toilets

First Floor

Area (M^2)

- Indoor Sports Hall ((Senior Officers)
- Balcony
- Covered Bar Deck

CHAPTER EIGHT

8.0 Material Construction and Services

In any architectural design, the use of appropriate building materials is always an ideal consideration which helps in the maintenance of the building as well as achievement of desired goals.

The architect is therefore, expected to make recommendations as well as write specifications which should comply with the architectural requirements of functionality, aesthetics, economy as well as the climatological conditions of the site with reference to the materials to be used.

8.1 Materials

Materials for each element of the structures have to be analyzed; from foundation to walls, floors, roofs, and finishing. The primary considerations are economy, durability and construction technique, weather resistance, maintenance and use of locally sourced building materials.

The usage shall be explained thus:

i. ***Foundation:*** The foundation materials shall include cement; reinforcements and concrete materials; Damp-proof materials will also be considered.

ii. ***Floors:*** Floor materials shall include sancrete finishing to floors;

terrazo, granotiles; unpolished ceramic tiles etc. Granotiles shall be used for example, the foyer of the administrative block; terrazo finishing shall be done high pressure areas, such as officer's mess, hostels etc.

iii. ***Walls:*** Walling materials are basically of sancrete block or concrete blocks. Wall surfaces shall be finished generally with paint on cement sand and screed plaster with intermittent use of locally sourced bricks for mansory. However, inner wall surfaces of such areas like the Apparatus bay, toilets, clinic and kitchen shall be finished with polished glazed tiles.

iv. ***Doors/Windows:*** Doors and windows shall be timber, glass or steel, depending on the requirement and structure. Window hoods are recommended for windows of certain buildings.

v. ***Ceiling:*** Ceiling shall be of fire resistant material or coated with fire resistant materials such as suspended acoustical ceiling of aluminium panels with fibre or fire - resistant asbestos fibre board.

vi. ***Roof:*** The roofing will include pre-fabricated steel, longspan aluminium roofing sheets, roof-lights and skylights for conservation of energy.

8.2 Construction

Before construction commences, clearing or removal of unwanted element which could in one way or the other obstruct construction process is done. Next is the setting out which involves the location of proposed building with lines to conform with the site layout.

Construction will generally be of cast in-situ concrete strip foundation wall with cast in-situ reinforced concrete for columns and beams in walls. Expansion joints shall also be located appropriately. Floors shall also be of cast in-situ concrete, i.e. mass concrete of 150mm minimum thickness.

The roofing materials shall be pre-fabricated steel trustest with aluminium roofing sheets and skylight used where appropriate.

The construction shall be carried out as follows:

i. ***Foundation:*** This is refered to as the sub-structure of a building. It also serves as anchorage for the superstructures against tensional, compressive and shear forces.

The choice of foundation type and materials is determined by the type of soil which is prevalent on site. The type of foundation proposed shall be strip foundation since the site is well drained. But if the engineer's soil tests prove otherwise, then the most appropriate foundation type shall be used.

ii. ***Floors:*** Floors are horizontal structures that support live and dead loads of a building. They also provide lateral support for walls while transmitting dead and live loads through the columns, load bearing walls and beams, to the ground.

Floors shall be constructed with non-porous materials with finishes appropriately applied as proposed above.

iii. ***Walls:*** Walls are vertical planar elements that divide as well as define the interior spaces of a building. External walls serve as protective shield against harsh and precast concrete for Apparatus bay which can be removed in case of expansion. finishes shall be appriopriately applied as mentioned earlier in 8.1 No. (iii).

iv. ***Doors and Windows:*** Doors and windows provide physical, visual and light penetration into a building interior while shielding the building interior from harsh weather elements.

All windows shall be constructed with bronze-anodized aluminium frames and basically glass.

Doors shall be of standard sizes and serve as easy passage and access for both people and equipment in all buildings.

v. ***Roof and Ceilings:*** The roof functions primarily as a protective element for the building interior against rain and solar radiation. It serves as a control to the flow of rainwater, heat and wind.

The roof shall be of corrugated aluminium roofing sheets with translucent & or frosted glass skylight used in administrative block.

8.3 Services

There exist within the location area all the basic services required for smooth operation of the project. All that is required therefore, is to tap or connect the facilities from the main grid to the site.

8.3.1 Electrical Services

The electricity power supply to the site shall be from the National grid which is supplied by the National Electric Power authority (NEPA). A step-down transformer will be recommended to be located on the site to take care of the power supply required for the headquarters only, as well as avoid over-loading through multiple areas; which is one major cause of home fires.

The system of distribution of electricty shall be through conduit. Automatic control switch in form of circuit breakers will be installed in all building units. This device will trip - off in cases of abnormal supply or overloading

of circuit. The electricity supply shall be 3 - phase connection for maximum efficiency and protection. However, a standby generator will be recommended in case of power failure from NEPA.

8.3.2 Plumbing Services

Water supply to the site is to be through the water feeder mains that passes close to the site. Pipes shall be laid in the direction of slope to enhance pressure. Water storage tanks will be provided on the site, as well as reservoir and hydrants, especially for re-filling fire fighting vehicles or tankers.

For good sanitary conditions in the environments as well as proper maintenance of the plumbing facilities, service ducts have be provided to enhance maintenance/repairs and aesthetics of the structures.

8.3.3 Water Supply/Facilities

Water supply to the site shall be for two main purpose - Fire fighting and for Normal use or consumption. Water supply for fire fighting and drills is to be transported in larger diameter pipes than that for normal consumption. These pipes shall be fitted with hydrants at appropriate points on the site.

8.3.4 Acoustics

Acoustic materials to be used in each unit of the headquarters are to be in accordance with the functional requirements of the particular unit.

Noisy areas such as the Apparatus area are separated from less noisy or quiet areas in order to reduce the inherent acoustic problems of the apparatus area.

8.3.5 Fire Protection

For effective fire protection, the structures on built and finished with fire-resistant materials which will withstand fire to a high degree. Further more, for speedy evacuation of inhabitants, each unit has at least two exits and are quite easily accessible to fire fighting equipment. In addition to these, fixed apparatus such as sprinklers in roof spaces running in a grid with bulbs, shall be fixed. These spainklers will supplement the efforts of hose reel and fire extinguishers.

8.3.6 Telecommunication

One of he most important services needed in this headquarters for efficient and effective operation is telecommunication facilities such as telephone and satellite services and transmission.

The headquarters shall be connected to the Nigerian Telecommunication (NITEL) main line which is located along the arterial road which also serves as the main point of access into the site.

Satellite dish shall be installed to enable the control tower receives satellite pictures and signals of fire incident locations and to also diseminate

information via computer to other Fire Service headquarters in other states of the federation.

8.3.7 Fuel Station

Fuel station will be provided to cater especially, for the fire service vehicles in order to avoid delay or inconvenience of joining fuel cue outside the station. With available services from a fuel station, the fire service personnel and equipment will always be on alert and their efficiency will be greatly enhanced.

8.3.8 Street Traffic Control

It is essential that traffic control lights be installed at the extreme ends of the property line by the main arterial road in order to stop traffic during a response action. This is necessary in order to ease the exit of fire fighting vehicles from the site onto the main arterial road thereby avoiding accidents or confusion during a response action.

CHAPTER NINE

9.0 Aesthetic ad General Appraisal of the Project

9.1 Aesthetics

Aesthetics may be described broadly as the study of beauty. Architectural building materials describe aesthetics in terms of the materials, shape, colour, texture and their applications, in order to achieve desired goals.

Beauty therefore, has to do with harmony, clarity, proportion or rythm, making it difficult to define. Architects in their attempt to define beauty do it through Expression, Form, Composition, Patterns and Harmony.

9.1.1 Expression

Expression in architecture is the communications of ideas of quality and aesthetics. It varies with the character of culture and locality. This is refered to as style. the style of any architecture communicates the cultural outlook as well as their concept at a particular period of time.

One of the important goals of this project is to produce a building which apart from functional accomplishment through effective planning also accomplish an aesthetic standard.

9.1.2 *Form*

When an Architect aims to achieve functionality, he combines culture on one hand and technology on the other. When form is to be expressed, there is freedom of communication within his personality and concepts. Any style expressed by an architect in any form is basically aimed at creating meaningful expression. The organisation of these elements into an ordered form is called composition. The entire project employs basically two major geometric forms - vertical and horizontal forms. There is however; polygonal form employed in the clinic.

9.1.3 *Composition*

Space and mass are the basic elements of architectural form of which the architect creates an ordered expression through the process of composition. By doing this, he takes up elements relating them to the whole. He succeeds in creating harmony which is achieved through the forms that are represented. These forms are in patterns which result into certain features if the forms are in harmony with one another.

The vertical and horizontal forms employed in the design, give the buildings a linear aesthetic impression. Moreover, the use of parapet overhangs, apart from good appearance, it gives the building, also helps in reducing the destructive effect of wind to the roofs coupled with the screening effect it provides window openings.

9.2 *General Appraisal of the Project*

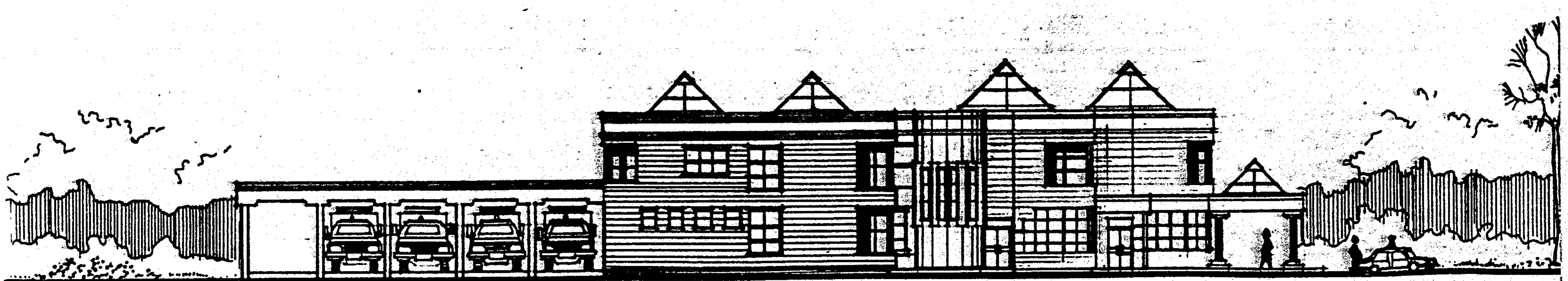
An indepth study, especially from the cases studied, have made it apparent that proper planning of a fire service headquarters with a high level of efficiency can only be achieved if the principle of primary adjacency is considered as the basis for the derivation of concept.

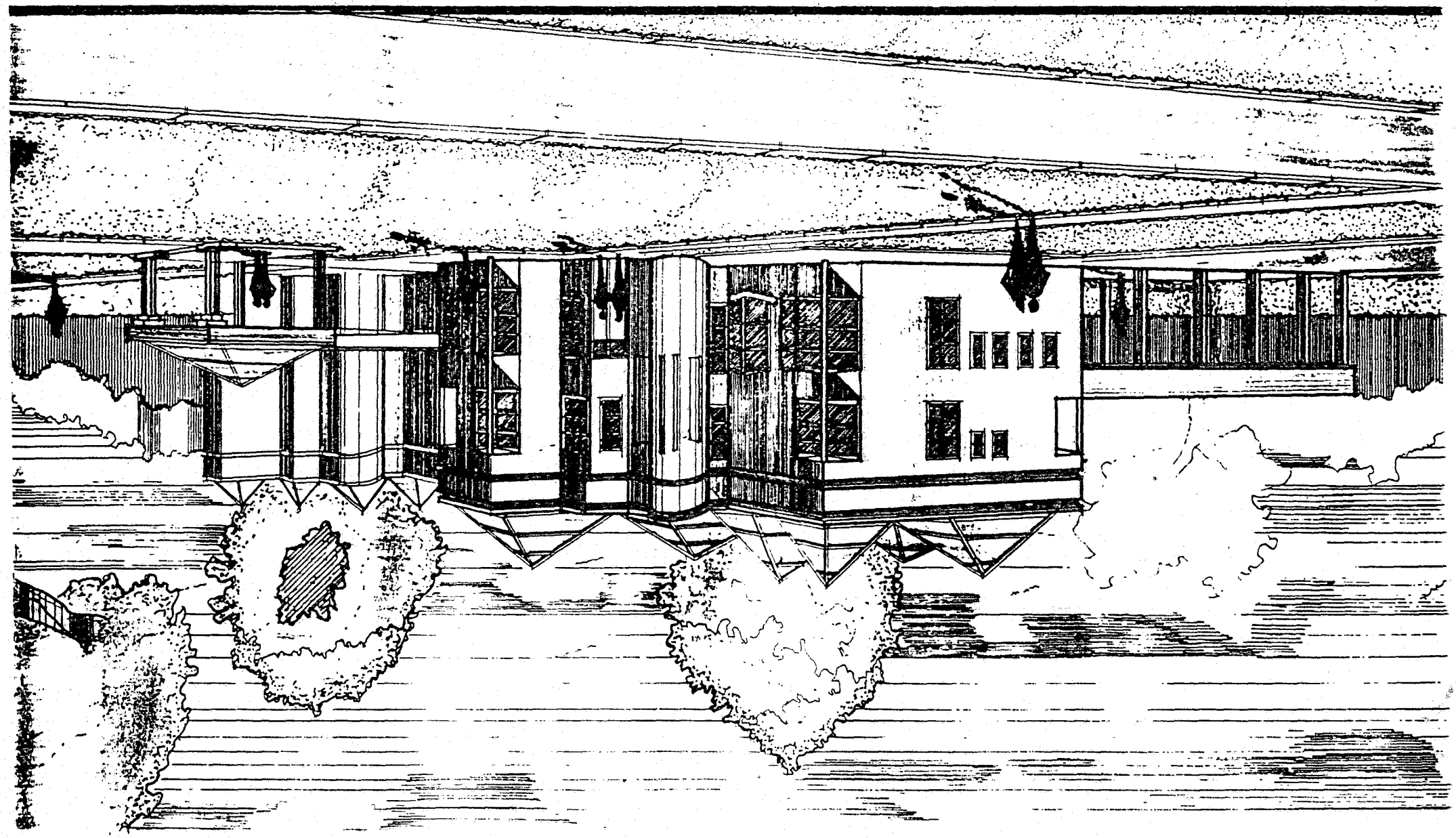
The theme of this thesis is Fire Protection and Efficiency of Response in the Fire Service. This project therefore, is an attempt aimed at providing fire and other related services; the provision of maintenance and repair facilities for fire fighting equipment as well as better team work and administrative control by bringing the different units of the fire services on one site.

Nowadays, fire fighters undergo exntensive training in the developed countries especially, in fire protection. Education which in turn provides the much needed leadership qualities expected in fire service personnel. This educational requirement was considered in the design and functionality of the Training School. Successful training in a variety of courses, ultimately provides for the identification of immediate fire hazards, the choice of the fire fighting tactic and extinguisher as well as devising a suitable strategy for its application; The fire fighter materials and strategies for coping with them when they are encountered in spills, leakage anf fires. It is only through this knowledge that available resources can be used effectively to bring materials under proper control and then lives and properties can be saved.

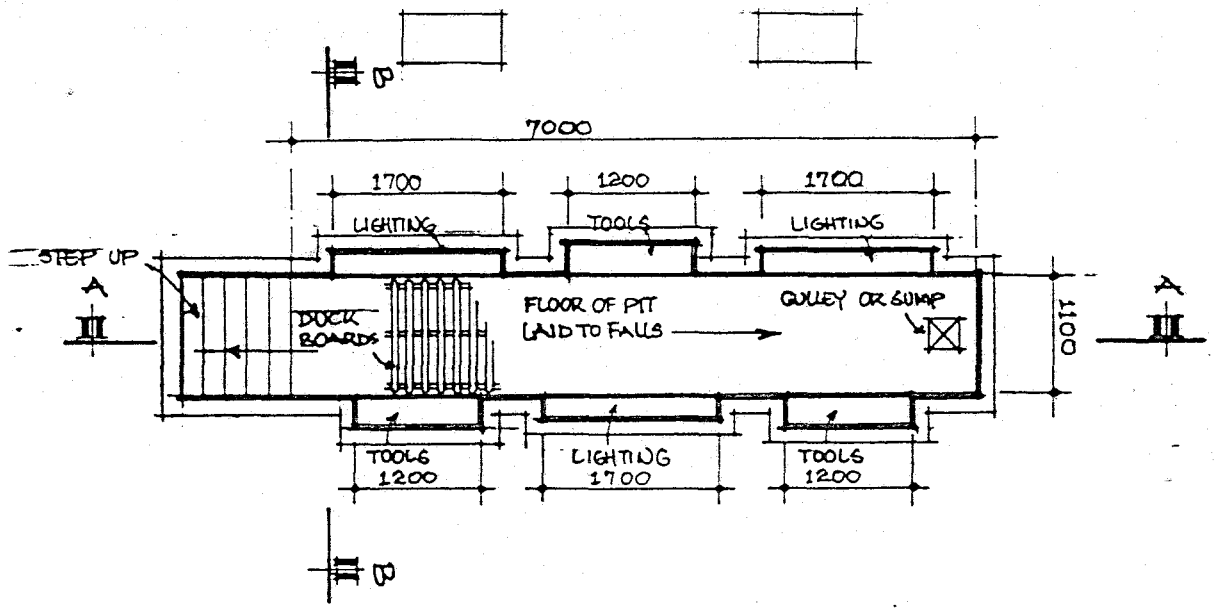
In addition to the main aim of this design proosal, the project is broadly designed to make double contribution. firstly, to the Architecture of the headquarters and environment; secondly, to the production of personnel, materials for the prevention of hazards and also educating the public on the methods of curbing the frequent occurence of such hazards.

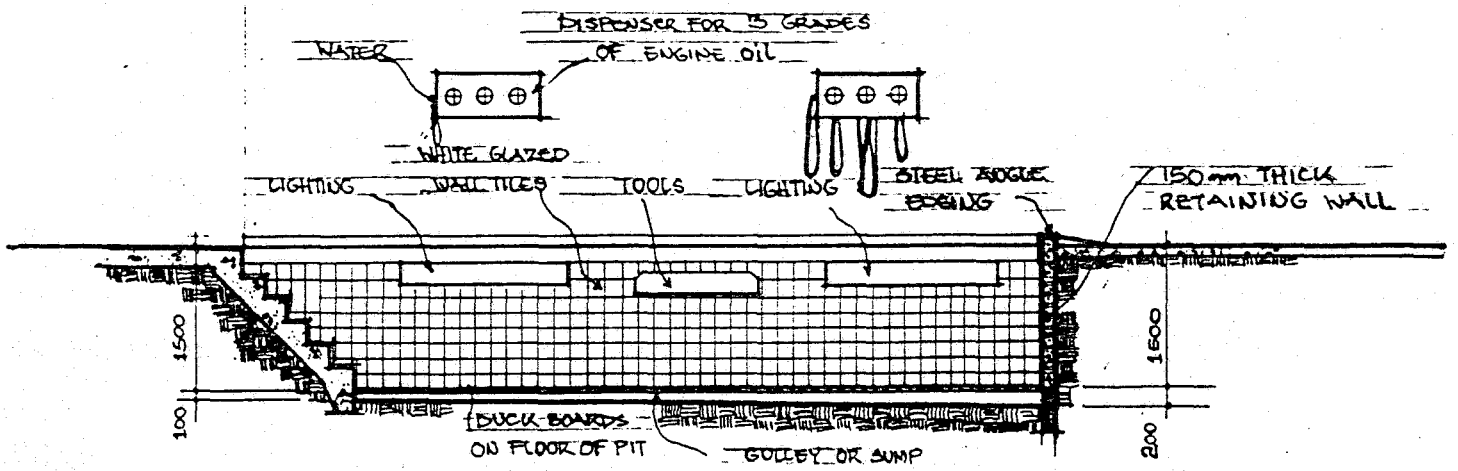
APPROACH ELEVATION

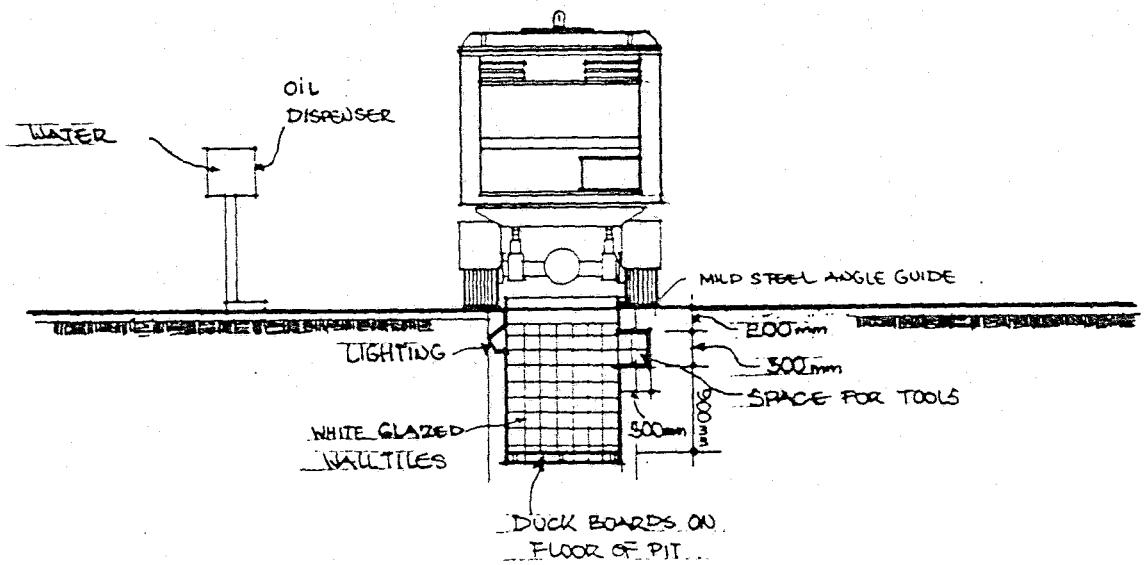




PLAN OF APPARATUS BAY SERVICE PIT

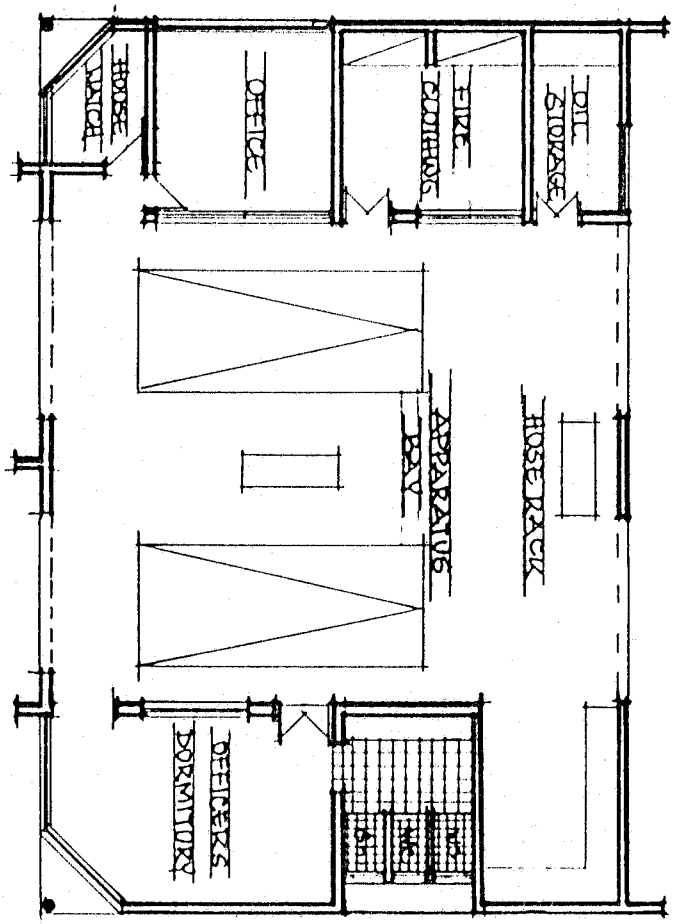




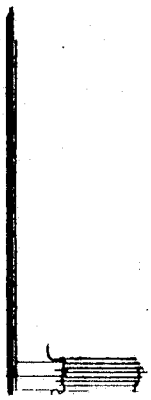


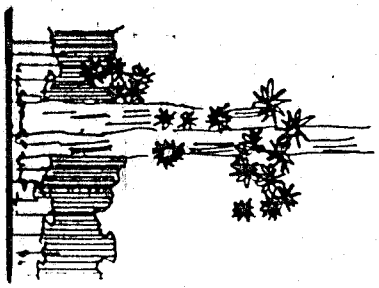
SECTION B-B

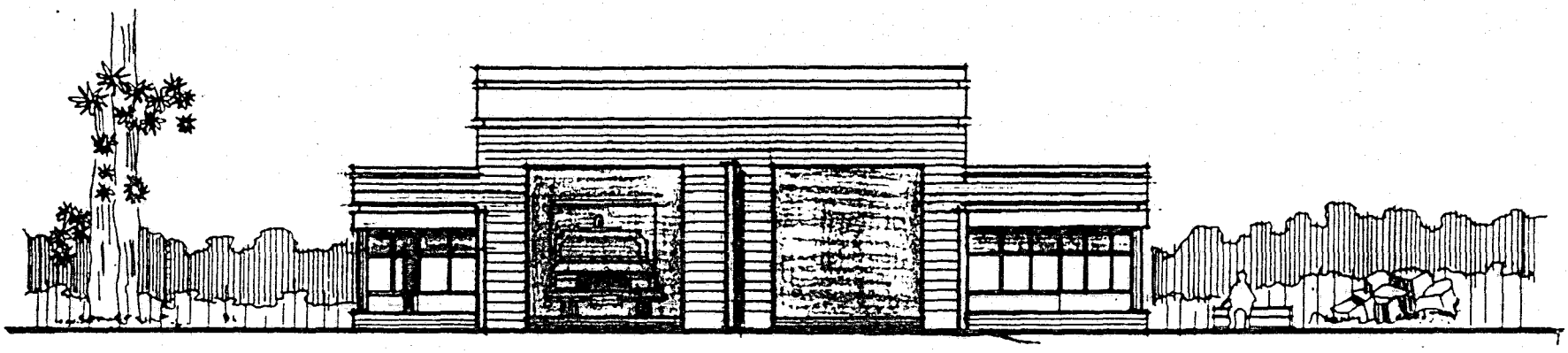
HICK
UG WALL


HORSE RACK
OFFICE
FIRE EQUIPMENT
OIL STORAGE
APPARATUS BAY
HOSE RACK
OFFICERS DORMITORY
SHOWER
WC

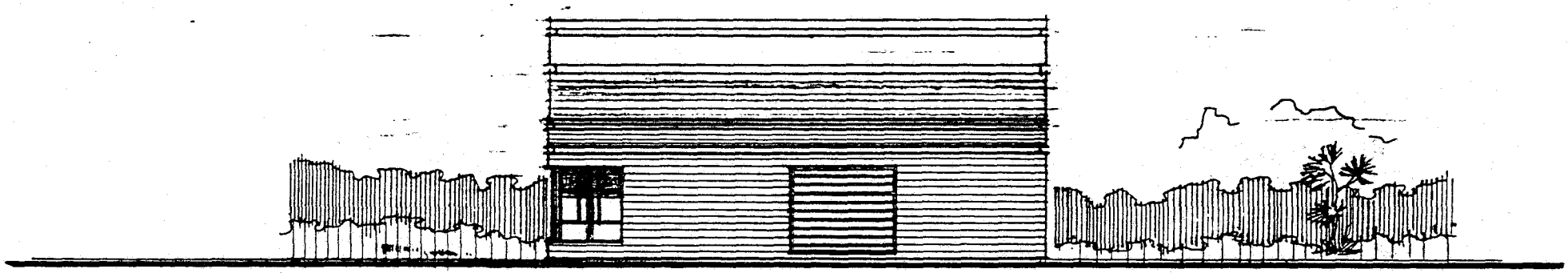
FLOOR PLAN



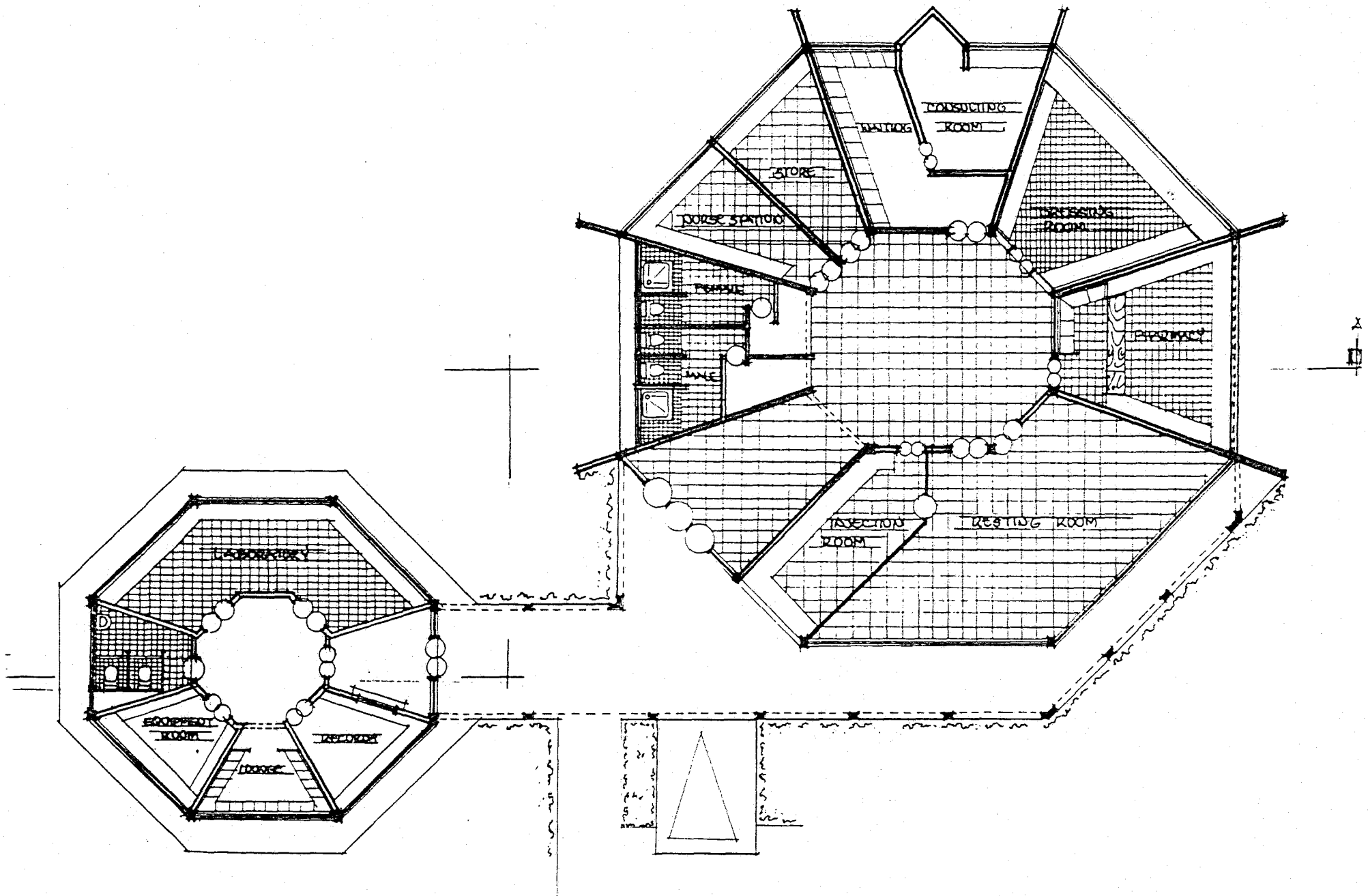


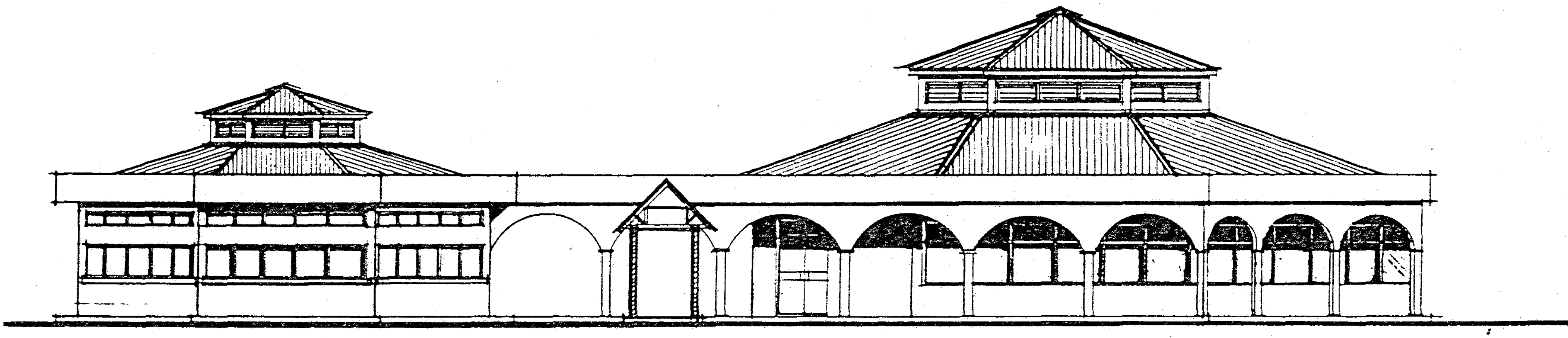


APPROACH ELEVATION

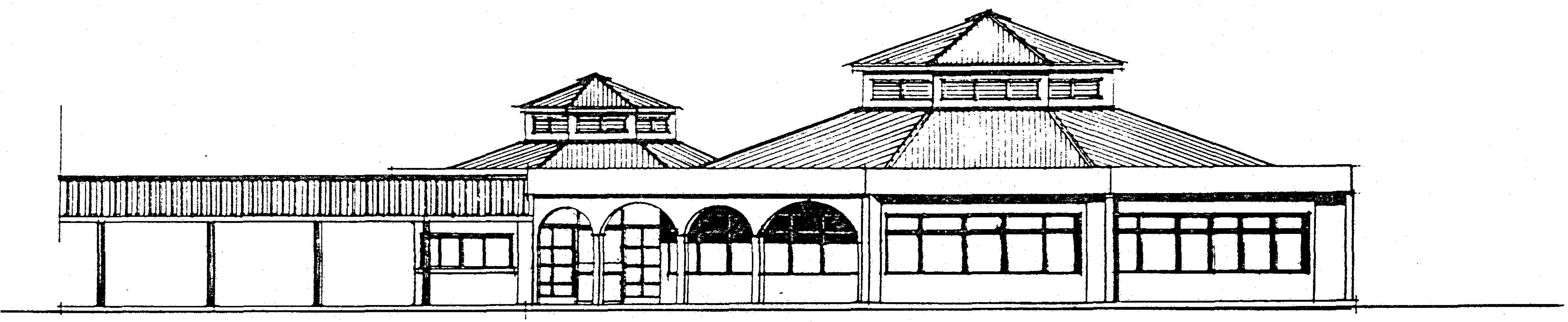


RIGHT-SIDE ELEVATION


CONSULTING ROOM
WAITING ROOM
STORE
NURSE STATION
TREATMENT ROOM
TOILET
SINK
PHARMACY
INJECTION ROOM
RESTING ROOM
LABORATORY
EQUIPMENT ROOM
RECORDS
DARKROOM

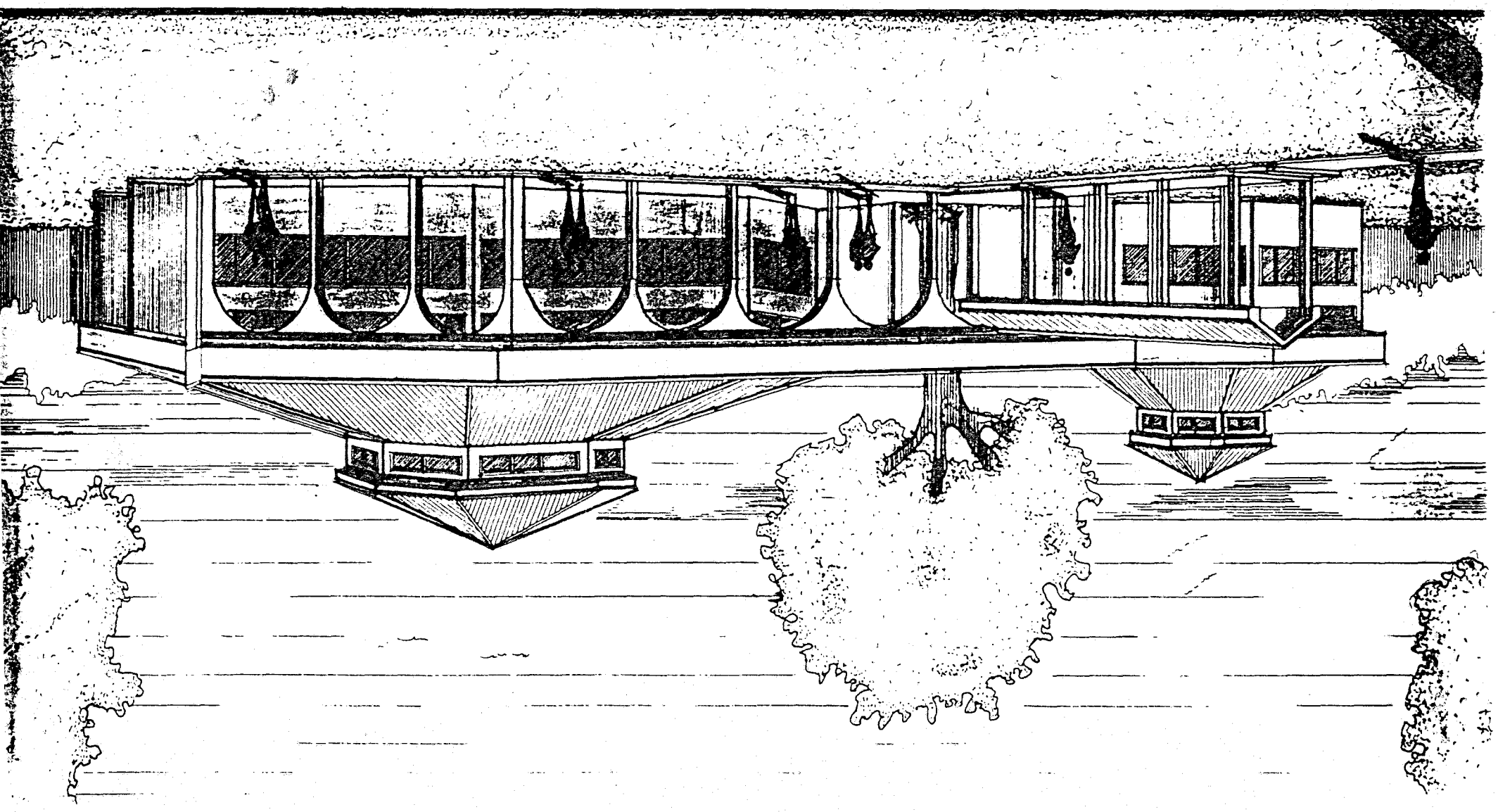


APPROACH ELEVATION



RIGHT-SIDE ELEVATION

Fire Service Headquaters, Abuja



Conclusion

The efectiveness of any fire department depends on the effectiveness of the design of the station, the training of the fire personnel; the equipment available and the the water supply to the station. Therefore, in a design of this magnitude, care must be taken to ensure that the inherent problems peculiar to Fire Service design are as-much-as possible corected or minimised, since effectiveness of a design is dependent on the design inputs that were applied in the design process.

The design and product of this project is, a headquarters of special qualities and consideration in both architectural and technical capabilities. It shall be a station of excellence and prototype design for other African countries. A prototype for Neighbourhood or District Fire Station shall be provided on site to enhance the effectiveness of the headquarters.

BIBLIOGRAPHY

1. ADAIDU O. S. **FIRE PROTECTION TRAINING CENTRE, MAKURDI**
   M.Sc. Architecture Thesis,
   Ahmadu Bello University
   Zaria, 1983

2. **ANGUS FIRE ARMOUR MANUAL, 1979**

3. COLEMAN J. R. **MANAGEMENT OF FIRE SERVICE,**
   Duxbury Press, Massachusetts, 1978.

4. **COLLIER'S ENCYCLOPEDIA VOL. 9, 1982**

5. **ENCYLOPEDIA AMERICANA VO. 9, (1982)**

6. **GWAGWALADA MASTER PLAN, 1996(REVISED)**

7. HARUNA P. **FIRE SERVICE HEADQUARTERS, MINNA**
   B. Tech, Architecture Thesis,
   Federal University of Technology, Minna,
   1992

8. JOHN C. & JOSEPH D.

TIME SAVER STANDARD FOR BUILDING TYPES,

McGraw Hill Publication, 1980

9. **NEW AGE ENCYCLOPEDIA, VOL. 7(1982)**

10. **NEW BOOK OF KNOWLEDGE, VO. 6 (1986).**