DESIGN PROPOSAL FOR ULTRA-MODERN FIRE SERVICE STATION, ABUJA, NIGERIA, WITH EMPHASIS ON FIRE SAFETY IN BUILDINGS.

BY

OKON, VICTOR ESSIEN
M. TECH\SET\878\2001\2002

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THE
AWARD OF M. TECH. DEGREE IN ARCHITECTURE.

AUGUST, 2003.

DECLARATION

I, OKON, VICTOR ESSIEN (M. TECH\SET\878\20012002) HEREBY DECLARE THAT THIS THESIS TITLED "DESIGN PROPOSAL FOR ULTRA-MODERN FIRE SERVICE STATION, ABUJA, NIGERIA, IS AN ORIGINAL PRODUCT OF MY OWN RESEARCH WORK UNDER THE SUPERVISION OF **ARC. B.N.MOH'D.**

10TH NOV '2003

OKON, VICTOR ESSIEN

(M.TECH\SET\878\2001\2002)

CERTIFICATION

THIS IS CERTIFY THAT THIS THESIS TITLED "DESIGN PROPOSAL FOR ULTRA-MODERN FIRE SERVICE STATION, ABUJA, NIGERIA, IS AN ORIGINAL WORK UNDERTAKEN BY OKON, VICTOR ESSIEN (M. TECH\SET\878\2001\2002) OF THE DEPARTMENT OF ARCHITECTURE, POSTGRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF M.TECH. DEGREE IN ARCHITECTURE AND IS APPROVED FOR ITS CONTRIBUTION TO KNOWLEDGE AND LITERARY PRESENTATION.

OKON, V. E
.....
STUDENT'S NAME

.....
SIGNATURE

10TH NOV' 2003.
.....
DATE

ARC. BELLO, W M
.....
SUPERVISOR'S NAME

.....
SIGNATURE

17-02-04
.....
DATE

DR. S. N. ZUBAIRU
.....
HEAD OF DEPARTMENT'S NAME

.....
SIGNATURE

17/2/04
.....
DATE

Professor J. A. Abalaka
.....
DEAN OF POSTGRADUATE SCHOOL'S NAME

.....
SIGNATURE

.....
DATE

.....
EXTERNAL EXAMINER'S NAME

.....
SIGNATURE

.....
DATE

DEDICATION

I would like to dedicate this work to my ALMIGHTY GOD, HIS son, JESUS CHRIST, by whom all things are made possible.

To my sweet mother, MRS E.E. OKON, my Gem of inesteemable value, I Love You.

To my sisters, Felicia, Lydia, Geraldine, Bridget, Victoria. I love you all.

To my brothers, Richard, and Charles, keep it real.

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ABSTRACT

Fire is combustion of substances with oxygen giving out light and heat. Fire is very useful for man; it can be used for cooking, heating and for a variety of industrial purposes. However, when fire goes out of control it becomes a highly destructive force, destroying lives and property.

We looked at fire as a destructive force, and how man has tried to fight this force, and the machinery that has been put in place over the years, and how it has evolved to be what it is today with Nigeria in the context.

The research area of this study, is fire safety in buildings, and this was examined in detail; to first of all prevent fire, in the case of the inevitable, it can help to reduce to the barest minimum the loss of lives and property. Case studies of fire stations in Nigeria and outside the country were taken, to aid as a basis for the functionality of the design.

Data was collected on the chosen site, which would aid the design of the station in the context of the area. A detailed site analysis was carried out, and maximum benefits of the prevailing site conditions were utilized.

The design showcases, a functional design, to meet the needs of fire fighting demands in the 21st century as well as the requirements for fire safety in buildings. Each space was intricately designed to accommodate its functions

The federal fire service station, Abuja, Nigeria is an architectural masterpiece and a symbol of fire safety in Abuja the nation's capital.

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1.0 GENERAL INTRODUCTION

1.1 INTRODUCTION

Fire can be defined as heat and light resulting from the rapid combination of oxygen or in some cases, gaseous chlorine, with other materials. The light is in the form of a flame, which is composed of glowing particles of the burning materials and certain gaseous products that are burning materials. The conditions necessary for the existence of fire are the presence of a combustible, ignition temperature and presence of oxygen (usually ignition temperature) usually provided by air or chlorine to enable rapid combustion to continue; fire has been produced by two principal methods; friction and percussion. In the friction method, friction raises the temperature of a combustible material (kindling) to ignition temperature. While in the percussion method, a spark is produced to set kindling a fire.

While fire is an essential part of our lives, providing heat for warmth, cooking and certain industrial purposes. Uncontrolled fire however, can be a destructive force; it can destroy in a matter of minutes all that has been built over years. Fire outbreaks have destroyed buildings and lives in countless numbers.

To forestall these destruction of lives and property; fire departments are an essential part of our daily lives. They are set up by the government of a country, state or area or even in some cases, volunteer groups.

Many modern fire departments spend a decreasing amount of overall activity fighting fire instead; fire fighters typically respond to all kinds of emergencies.

For example, in the United States of America, approximately 70 percent of all emergency medical calls are handled by the fire service. The same is obtainable in many other Countries. This is what is obtainable in developed Countries of the world, to check problems of fire outbreaks and other emergencies. In these Countries, professional fire services are operated in large cities, while volunteer services serve the small towns.

In Nigeria, the Federal fire service is run from the main headquarters, this headquarters then controls the States fire service, which then controls the smaller departments in the various areas of the State. The fire services has its own problems, most of which are fundamental such as poor remuneration and welfare package, lack of necessary equipment and communication gadgets and inadequacy of water; in a country where water supply for domestic use is grossly inadequate imagine the case of needing water for fire fighting. This is totally different from the situation seen in developed nations.

The fire service has to be prepared for challenges to fire fighting and rescue operations as is required for modern day situations, The fire service has advanced more than just fighting fire, but is now involved in medical calls, emergency and rescue operation. Firemen played a very active role in the rescue operation after the September 11 terrorist attacks on the World Trade Centre in New York.

In Nigeria today, fire outbreaks and emergency situations are the order of the day. In the last one year, Jos main market, Araria market, Aba, Wuse new market, Abuja and very recently Minna main market have all been engulfed in fire, with property worth millions of Naira being totally lost. The fire service has not been able to do anything about it. On the other hand, there have been

serious emergencies in which life and property have been lost, examples include the January 27, 2002 bomb blasts in Lagos, which thousands of lives were lost, buildings collapsed and some were even affected by fire due to the effect of bomb blasts, another example is the May, 2002 EAS plane crash in Kano, where hundreds of lives were lost and properties worth millions of Naira were destroyed. On both Occasions, the fire fighters were unable to cope with the demands of modern day fire fighting emergency and rescue operations.

A well-organized fire service would be up and alive to the responsibilities of modern day fire fighting.

A fire department operates from a fire station; this is where firemen on call duty stay, and houses all the equipment needed for modern day fire fighting. The equipment range from fire vehicles to communication gadgets and even protective clothing.

In Abuja today, there is no modern fire service station, most are old buildings of the 1980's. For the fire service to perform effectively, the first step would be to provide an ultra modern fire service station, to meet the needs of the city in terms of fire safety and other rescue operations. The fire station is to be centrally located for easy access to both government, private and commercial buildings in the city in the case of fire and also aid in the case of emergencies should the situation arise.

1.2 **JUSTIFICATION AND MOTIVATION**:

The motivating factor for this study is quite clear, the alarming rate of loss of lives and property resulting from fire and other emergency incidents are of great concern. A large number of abandoned buildings

destroyed by fire, high rate of casualties especially those that are permanently disabled becoming a burden or our communities. Markets, government and institutional buildings such as schools are destroyed causing economic, social, cultural, political and environmental and human resources losses retarding the progress of our society and nation at large. The loss of jobs due to fire and the destruction of the natural environment and vegetation as a result of bush or forest fires.

The area of prevention is utmost, but also the availability of effective communication.

Should a fire or emergency occur, and the availability of equipment to take care of the situation, and a standard base (fire station) from which operations can take place is also of utmost importance.

When these have been effectively tackled, it would provide the required security to lives and property in our communities.

1.3 **AIM AND OBJECTIVES:**

The aim of this project is to provide an "architectural masterpiece" to aid fire fighting services and rescue operations, to enhance security of lives and property through a coordinated and highly efficient service equipped for modern day fire fighting and rescue operations, and to be a symbol of fire safety in the nation's capital, Abuja.

The objectives of the project include the following:

(i) Provision of a centre, which will effectively enhance the carrying out of fire fighting functions at grassroots level.

(ii) To provide a centre whose priority shall be in fire prevention and to aid in fire-fighting and rescue operations.

(iii) To provide the mobilization and sensitization of the general public to realize the importance of fire precautions, regulations and control, and also on fire hazards and the immediate actions by occupants of a burning environment.

(iv) To provide a centre that can effectively train, co-ordinate and give orientation to fire men to enable them carry out their services effectively.

(v) To review the fire service by the effective use of architecture, by providing a centre that would positively affect the psychology of the firemen and to make them efficient.

1.4 RESEARCH METHODOLOGY

Generally, for the course of this project two major sources of data collection were used.

This includes the primary and secondary sources, the primary source of data during the research include, direct observation and direct oral interview with members of the public as well as officers of the fire services were taken. An insight to existing stations and the staff and the equipments were taken.

The secondary source of data during the research was obtained from the World Wide Web (Internet) and other computer aided information services such as Microsoft Encarta encyclopedia (1999). Literature review from books, publication extracts, encyclopedia, journals and magazines on fire and also literature review of fire fighting equipment and fire classifications.

resources, which would affect us economically, socially, politically, environmentally and otherwise, because it would retard our developmental programmes.

The location of the site in Abuja is because that is the nation's Capital city, there are a lot of government, institutional, commercial and industrial buildings, which are necessary for the development of the country, so a fire station well located would take care of such problems, should the situation arise. Ministries, government parastatals, schools, markets and commercial complexes are to be protected from fire and to aid in emergency and rescue operations. Many government buildings have been destroyed by fire, examples include Ministry of Defence, Lagos, Net building, Lagos, recently Radio house, Abuja was damaged by fire. A large area of the Wuse new market Abuja was recently destroyed by fire as well as many other markets/commercial centers across the country.

This facility will also help to uphold fire regulations in building practices as well as to sensitize members of the public on fire hazards and how they can be tackled. This would help secure lives and property against destruction by fire and aid rescue operations as well. The government and people of Nigeria have invested a lot of lives and property, for all these to be destroyed in one day by fire or some kind of emergency would be very bad.

The fire service can also assist other personnel and armed forces like the Navy, Army, Air force and Police, in the execution of some of their secondary duties.

1.5 SCOPE AND LIMITATIONS OF STUDY

The scope of the study is to take a look at the fire service and how a proper fire station in Abuja can be designed to meet the daily needs of modern day fire fighting and rescue operations in Abuja.

The scope will include the provision of the following facilities.

1.5.1 ADMINISTRATIVE BLOCK

This will comprise of offices to house the various departments of fire service such as fire chief's office, fire prevention department, planning, research department, finance and budget/fiscal department, personnel/records department, fire investigation/alarm department and communications department.

1.5.2 FIRE STATION/TRAINING AREA.

This building is to house the fire men on call duty, equipment and apparatus for fire fighting and rescue operation: as indoor training area would be provided in the basement of the building to include an area for maze/gas/burn props within the building

1.5.3 AUXILIARY FACILITIES:

This would be back up services for the main facilities:

(i) Maintenance facility: This would be for maintenance of the building, equipment and apparatus for effective running of the services.

(ii) Restaurant: To cater for feeding needs of the firemen.

(iii) Outdoor training/ Recreational facilities: This would be area for outdoor training and recreation for the firemen on the site.

(iv) Water retention pond: This would be a pond that collects rainwater of forestall unavailability of water for fire fighting services.

(v) Accommodation: This would provide accommodation for firemen on call duty as well as provide dormitory/locker room area, where fire hats and protective wear would be kept.

1.5.4 The limitations of the project include the unavailability of some data required for carrying out of the research, the search for international case studies were also not easy, as this was done on the Internet.

However, a few were found after along search. Some of the information however gotten were either incomplete or several years old.

In the design, limitations that could be encountered are the following:

(i) Turnout time: This is how the traffic flow system can be planned within and outside the fire station so that it's as direct as possible for easy guide response to distress calls.

(ii) Dispatch time: This is the use of the primary "adjacency concept" for the planning of the fire operation for efficiency in the carrying out of its duties.

1.6 **IMPORTANCE OF STUDY:**

The importance of this study looks at the viability of the project. The viability of this project can be clearly seen; it is to provide security against loss of lives and property due to fire and other emergencies such as earthquakes, typhoons and so on, either natural or man-made. The loss of lives and property due to fire and other emergencies has been phenomenal, thousands of lives and billions of Naira.

Developing countries such as Nigeria need better protection against fire hazards and also tackle them efficiently if such fires and other emergencies should occur. This is because we would lose both human and material

1.7 DEFINITION OF TERMS

1.7.1 FIRE:

This is defined as a rapid, chemical change, that release heat and light and is accompanied by flame, especially the burning of a combustible material or a burning fuel or destructive burning.

1.7.2 FIRE STATION:

This is a building for fire equipment and fire fighters; it is also called a firehouse.

1.7.3 FIRE SERVICE:

This is an organized team of personnel trained to put off fire, rescue as well as enhance the protection of the society in particular and the entire nation in general.

1.7.4 FIRE ESCAPE:

An outside stairway for emergency exit in the event of fire outbreaks.

1.7.5 FIRE FIGHTER:

One who fights fire especially for a living, also known as "FIREMAN"

1.7.6 FIRE HYDRANT:

An upright pipe with nozzle or spout for drawing water from a water main also called a "FIRE PLUG"

1.7.7 FIRE ENGINE:

A large truck that carries fire fighters and equipment to a fire point.

1.7.8 FIRE EXTINGUISHER:

A portable apparatus, which contain chemicals that can be discharged in a jet to extinguish a small fire.

1.7.9 FIRE PROOF:

This is defined as making a material impervious to damage by fire.

1.7.10 **FIRE TOWER:**

A tower in which a lookout for fires is posted and is also used for fire drills.

1.7.11 **FIRE WALL:**

This is a wall used as a barrier to prevent the spread of fire.

1.7.12 **FIRETRAP:**

This is a building that can catch fire easily or is difficult to escape from in the case of fire.

1.7.13 **FIRE CLAY:**

A type of heat resistant clay, especially to used to make fire bricks.

1.7.14 **FIRE BRICK:**

This is a re-factory bricks, usually of fire clay, used for fireproof construction.

1.7.15 **FIRE CHIEF:**

A government official in charge of a department or an administrative head of a department also known as "fire commissioner"

1.7.16 **FIRE ALARM:**

This is a device that signals a warning of fire outbreak.

1.7.17 **FIRE FIGHTING:**

This is defined as techniques and equipments used to extinguish fire and limit the damage caused by them

SOURCE; VISUAL DICTIONARY OF ARCHITECTURE (1997)

CHAPTER TWO - LITERATURE REVIEW

2.0 LITERATURE REVIEW

2.1 CHALLENGES OF MODERN DAY FIRE FIGHTING:

In the modern sense, fire department constitutes a comparatively recent development. "In America a structure fire occurs every 55 (fifty-five) seconds" (Vince steano/corbis, 1998). Modern fire fighting now has to focus more on prevention, in America most fire fighters are trained in basic fire prevention methods, fire departments are now assigned to inspection in which they attempt to prevent or correct unsafe conditions, they are also charged with enforcement of fire prevention codes, fire laws and regulations.

Modern day fire department spends a decreasing amount of over-all activity in fire fighting fires. Instead, fire fighters respond to all kinds of emergencies. "For example in America, approximately 70 percent of all emergency medical calls are handled by the fire service". (Microsoft encyclopedia Encarta 1999). The same is true in many other countries of the world.

The enormous increase in transportation of hazardous materials or dangerous goods has resulted in intensified training for fire fighters and their fire departments often provide them with protective clothing and monitoring equipment.

Fire departments also prepare and equip their members to handle emergencies that result from plane crashes, earthquakes and violent storms. In addition, firefighters handle incidents that require additional cases such as extricating trapped people from fallen structures, from cave-ins and from other situations.

In Nigeria, the case has been significantly different; the fire service can hardly contain fire not to talk about handling emergency situations or rescue operations.

Hence the need to change the orientation of the Nigerian fire service to meet the challenges of modern day fire services.

2.2 HISTORY OF FIREFIGHTING

The Roman Emperor Augustus is credited with instituting a corps of fire fighting "vigiles" (Watchmen) in 24BC, History is filled with accounts of fire that have wiped out whole cities and set back civilization. In the 2nd century B.C the city of Carthage was completely destroyed by the fire and in the 1st century A.D most of Rome and all of Jerusalem was destroyed by fire.

Regulations for checking and preventing fire were developed. In the pre-industrial era most of the cities had watchmen who sounded alarms at signs of fire. In Rome, these watchmen comprised of seven squads of men led by a fire Chief called "Preafactus". They also acted as night watchmen to safe guard the palace.

The principal piece of fire fighting equipment in ancient Rome and into modern times was a bucket, passed from bucket to bucket to deliver water to fire. Another important tool was the axe, used to remove fuel and prevent spread of fire as well as to make opening that would allow heat and smoke to escape a burning building. In major conflagrations long hooks with ropes were used to pull down buildings in the path of an approaching fire to create firebreaks. When explosive were available, they would be used for this same purpose.

2.1HISTORY OF FIRE FIGHTING IN BRITAIN

Following the great fire of London in 1666, fire brigades were formed by insurance companies. The government was not involved until 1865, when these brigades became London's metropolitan fire brigade. The first modern standard for the operation of a fire department was established in 1830 in Edinburgh, Scotland. These standards explained for the first time, what was expected of a good fire department.

2.2.2 HISTORY OF FIREFIGHTING IN AMERICA

In colonial America, following a major fire in Boston in 1631, the first fire regulation was established in 1648 in New Amsterdam (now New York) fire warders were appointed, thereby establishing the beginnings of the first public fire department in North America, Boston established the first paid fire department in 1676. Benjamin Franklin at Philadelphia in 1936 organized the first regular group of volunteer fire fighters. In Cincinnati, in 1853, the first steam engine was introduced, instead of pulling engines by hand, the use of horse was introduced. Instead of hand pumpers they used heavy steam pumpers. This marked the beginning of trained professional firemen. In 1908, the gasoline engine replaced the horse as a means propelling steam pumpers, soon other forms of modernization were introduced such as aerial ladders truckers, aluminum ladders, stainless steel fire fighting equipment, hose connections, and a variety of chemical extinguishers replaced old fashioned equipment.

Today, firefighters need to undergo extensive training on fire protection and rescue operations. Successful training in a wide diversity of topics ultimately provides for identification of the immediate fire hazard, and the

hoice of the best firefighting techniques and tactics are then employed to chieve positive results.

.3 FIRE SERVICE AS AN INSTRUMENT IN FIRE PREVENTION, FIRE FIGHTING AND RESCUE OPERATIONS.

The role of the fire service today has gone past the normal role of just fighting fires. The modern day fire service is activities involved in other auxiliary activities; this is due to recent developments in the nature of our lifestyle.

Recently, we have had chemical fire, which is one of the most hazardous fires to fight because the burning chemicals are frequently caustic and volatile. We have had serious emergencies such as bomb blasts, terrorist attacks, and plane crashes which need quick evacuation of people who may also require some medical attention.

The basic tactics of fighting a fire can be divided into the following categories: rescue operations, protection of the buildings exposed to the fire, confinement of the fire, extinguishing the fire and salvage operations. The officer in-charge surveys the area and evaluates the relative importance of these categories; he also estimates what additional assistance or apparatus that may be needed. Rescue operations are always given priority. Fire safety has assumed increasing importance, before beginning to fight fires; the first step is to try to prevent them. This can be done by successfully evaluating the lifestyles of the people, and the come out at the end of the day with fire safety regulations, codes and laws that would be enforced to the letter if fire prevention were to work. These would be statutory investment that would ensure minimum performance standards of building in the event of fire.

This is why a fire prevention bureau should be part of any fire service epartment; this bureau usually directs fire – prevention activities. It handles he highly technical aspects of fire prevention, it maintains approximate nformation records, grants licences to agencies whose activities involves fire risk problems, and also issues permits for similar activities, investigates causes of fire, and multiple dwelling buildings are inspected at regular intervals, and orders are issued for the correction of violations of fire laws. If necessary, court action is taken to compel compliance.

However for effective fire fighting, provision of adequate apparatus is a necessity, personnel management; training, welfare, motivation, payment and fringe benefits, supervision, discipline and communication are important.

2.4 STRUCTURE OF THE NIGERIAN FIRE SERVICE

The structure of the Nigerian fire service is based on the structure got from our British colonial masters, this methods of structuring the fire services is based primarily on qualification and experience, and is similar to the organization rank structure used in the Nigerian police and armed forces.

The organizational rank-structure is broadly classified into three (3) cadres and staff rank.

i. Firemen cadre
ii. Station officers cadre
iii. Supervisor officer cadre.

- **Firemen cadre:**
    a. Assistant firemen (junior firemen)
    b. Fireman
    c. Senior firemen

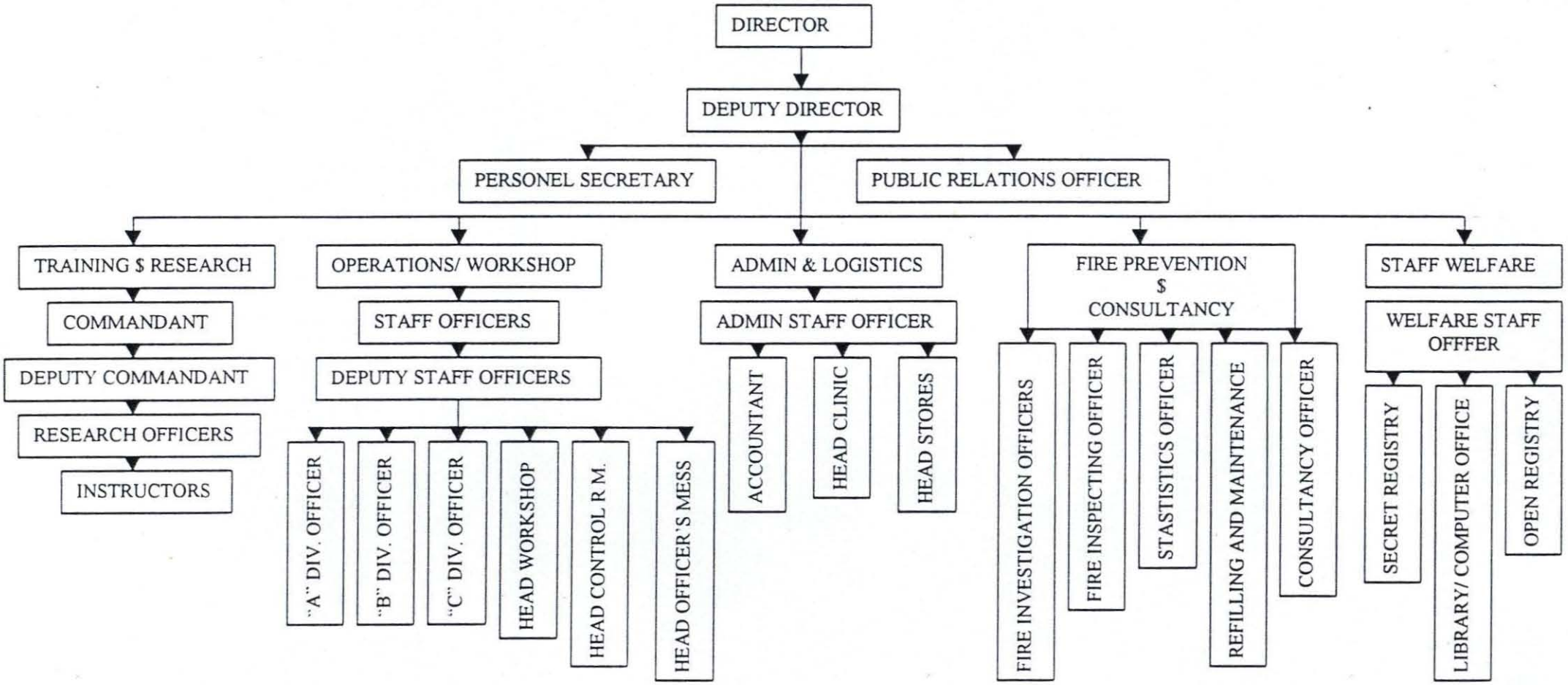


FIG. 1.1.

ORGANISATIONAL STRUCTURE OF NIGERIAN FIRE SERVICE. SOURCE: FIRE SERVICE HQ, ABUJA. (2002)

d. Leading firemen

- **Station officer firemen:**

a. Sub- officers

b. Station officer

c. Senior station officer

d. Assistant divisional officer

- **Supervisor officer cadre:**

a. Divisional officer

b. Senior divisional officer

c. Principal divisional officers

d. Assistant chief fire officer

e. Deputy chief fire officer

f. Chief fire officer

g. Assistant director of fire

h. Deputy director of fire

i. Director of fire.

2.4.1 ENTRY QUALIFICATIONS

2.4.1.1 FIREMAN CADRE

- **Assistant Fireman:**

Must posses a minimum of primary school leaving certificate, must be of good behavior, for qualification to direct entry.

- **Firemen:**

Must posses a minimum of three (3) years secondary school education and must be of good behavior for qualification to direct entry.

2.4.1.2 STATION OFFICER CADRE

- **Station officers:**

Must possess a minimum of west African school leaving certificate (WASC) or higher school certificate (H.S.C) to qualify for direct entry.

- **Senior officer:**

Must posses a minimum of a pass degree from a recognized university or any institution of higher learning in a relevant fire services course, for qualification to direct entry.

2.4.1.3 SUPERVISOR OFFICER CADRE

This has no direct entry qualification for entry to this cadre is from the other two proceeding cadres or a transfer from other agencies with similarity to fire service operations, but would need prior training to enhance fire service operations and techniques.

2.5 FIRE SERVICE TRAINING:

Training has been defined in the new lexicon websters dictionary of English language as the "instruction and practice in a particular skill" in the development of any agency training is one of the most important departments. The function of training in the fire service is to make members of the agency effective in the achievement of organizational goals.

2.5.1TRAINING IN THE NIGERIAN FIRE SERVICE:

Training in the Nigerian fire service has not been exceptional. In Nigeria today, the fire service has located at Western Avenue at Ojuelegba in Lagos. This facility however, is not up to standard as it has little to offer in terms of training its personnel. Training is usually organized for firemen by oil companies operating in Nigeria such as chevron, shell and the others because they have up to standard fire fighting training facilities.

.5.2 TYPES OF TRAINING

The kinds of training provided for various cadres of staff of the fire services nclude:

i. Pre-service training
ii. Induction training
iii. On the job training
iv. Refresher courses and training
v. Re-training.

- **Pre-service training:** This is introduction training that precedes the main fireman training. This is usually of trainees that have low educational qualifications. The minimum duration or this training is three (3) months. After this they can become proper members of the fire service:

- **Induction training:**

This is divided into 2 categories; this first involves 2 broad knowledge and familiarity of the fire service, various forms of fitness tests and drill as preparatory to fire occupation. The second acquaints the individual with general duties and functions of the fire service, such a basic training of recruits. The duration of this kind of training varies due to the peculiarity of the manpower needed to give instruction and the standard equipment used in doing to give instruction three (3) to five (5) months.

- **On the job training:**

This type of training is given on the site where the individual has to work it has the advantage of being given at the fire state itself. It is known to be most effective type of training especially for work that has to do with the use

of mechanical means. The main feature of this type of training is that if is given under the supervision of the officer in charge.

- **In service training:**

This is distinguished from pre-entry preparation by two tests. (1) The time of at which the training was given (2) the nature or content of instructions. This training is imported by informal means. This is regarded as being necessary for entry into the fire service profession.

- **Re-fresher training:**

This is offered to firemen in a specific field or for jobs that require special skill such extricating trapped people from burning a collapsed buildings.

The aim of this training is to try to acquaint the firemen with newly developed methods and materials for instruction wells as provide a high level of professional motivation. This may include the use of breathing apparatus for various adverse condition e.g. exposure to toxic elements, heat and smoke, and other related factors.

- **Re-training:**

This is an instruction course that is designed to an individual for a new task or form of duty. Retraining can be distinguished from refresher training on the grounds that retraining is to prepare an individual for a new task, taking into consideration his old specialty, while refresher training improved the efficiency of an individual in his specialty field. Both are advanced courses, each lasting for a duration of 3 months.

5.3 COURSES FOR FIRE SERVICE TRAINING

- The course include:
- Arson detection
- Officership
- Fire-fighting training/rescue operations
- Fire department administrations
- Fire prevention
- Instructors training
- Operational commanders course
- Senior commanders course
- Public enlightment course
- Fire regulatory course.

2.6 CAUSES AND EFFECTS OF FIRE

Fire is caused basically by a combination of three (3) elements oxygen, heat and fuel. Oxygen support combustion, heat ignites the substance and fuel is the combustible material.

2.6.1 MAN-MADE CAUSES OF FIRE

People especially in developing countries like Nigeria are of the opinion that the outbreak of fire is inevitable and little can be done about them and their resultant effect on lives and property. Most fire incidents could be avoided and their occurrence minimized. If effective fire prevention and control were immediately available to tackle them.

The main however is ignorance and careless about fire and fire prevention, mis-handling of flammable liquid and gases such as petroleum and liquefied petroleum gas (LPG) other causes may be attributed to the following: -

Over loading of circuits with use of multiple plug adaptors.

Children playing with naked fires or flammable materials.

3 Arson.

4 Use of candlestick mosquito coil without protection at the base.

5 Naked light/fire coming in contact with leaking or exposed gas pipes and/or flammable liquids.

6 Lightning

7 Failure to switch off electrical appliances not in use such as air conditioners, pressing irons etc.

8 Defective cooking and heating equipment such as electric cooker, stove, and pressing iron.

2.6.2 EFFECTS OF FIRE INCIDENTS:

The effect of fire has been stated in the course of this study, which includes destruction of lives and property and in some cases can hamper social, economic, political and environmental development.

2.6.3 DAMAGES BY FIRE:

Lots of cities around the world have been destroyed by fire, according to Microsoft Encarta encyclopedia (1999), "12 cities have been damaged by fire in the last century". Big cities like Chicago, sanfrancisco have all been damaged by fire, in Asia, Osaka and Tokyo have been, also in Norway and Lisbon in Portugal have all been damaged by fire.

2.6.4 ARCHITECTURAL LANDMARKS DAMAGED BY FIRE:

A lot of architectural landmarks have been damaged by fire, example includes.

FEDERAL FIRE SERVICE STATISTICS AT FCT, ABUJA AREA
(JAN-DEC, 1999)

S/NO	TYPES OF SERVICE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	Total No. of emergency calls	14	10	17	13	3	6	4	16	5	7	13	3	111
2	Total No. of victims rescued from domestic fire accident										6			6
3	Total No. of victims rescued from wells				1		2				1			4
4	Total No. of victims rescued from crashed vehicle			1	1							16		18
5	Total No. of victims rescued from other hazards		1	1						7				0
6	No. of fire outbreak in private alfended to	1	3	7	4	3	4	1	6	1	2	7	1	40
7	No. of fire outbreak in pubic building	6	2	3	2		1		1	3	3	3		24
8	No. of lives lost			1			2		30					33
9	No. of false alarms													0
	TOTAL	21	16	30	21	6	15	5	53	16	19	39	4	245

FEDERAL FIRE SERVICE STATISTICS AT FCT, ABUJA AREA
(JAN-DEC, 2000)

S/NO	TYPES OF SERVICE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	Total No. of emergency calls	10	12	9	6	6	3	2	2	3	4	7	2	66
2	Total No. of victims rescued from domestic fire accident													0
3	Total No. of victims rescued from wells					2					1			0
4	Total No. of victims rescued from crashed vehicle	1		36										37
5	Total No. of victims rescued from other hazards	1		1					3					5
6	No. of fire outbreak in private alfended to	2	8	2	6	2	2			1	1		1	25
7	No. of fire outbreak in pubic building	5	2	3		1		1		1	2	2		17
8	No. of lives lost	1	1	31		2					1			36
9	No. of false alums													0
	TOTAL	20	23	82	12	13	5	3	5	5	9	9	3	189

FEDERAL FIRE SERVICE REPORT

FIRE INCIDENTS IN STATES : 2000 - 2001

State	Date	Type of Building	Fire Quenched By	Use of Premises	Causes	Fire Category	Injured Victims	Live Lost	Accident	Property Lost (=N=)
Adamawa										
	30-Apr-00	Tent	Wellwishers	Residential	Accident	Domestic Fire				300,000.00
	05-Jul-00	Bungalow	Wellwishers	Residential	Electrical Defect	Domestic Fire				6,000,000.00
	17-Mar-01	Bungalow	Wellwishers	Residential	Electrical Defect	Domestic Fire				13,455,749.00
	20-Sep-01	Not Stated	Wellwishers	Commercial	Wilful Act	Public Fire				0.00
	No. of Fire Incidents : 4									
Albom										
	25-Jun-01	Bungalow	SFS	Residential	Carelessness	Domestic Fire				1,500,000.00
	No. of Fire Incidents : 1									
Benue										
	18-Oct-01	Warehuose	SFS	Commercial	Accident	Domestic Fire				2,550,000.00
	No. of Fire Incidents : 1									

State	Date	Type of Building	Fire Quenched By	Use of Premises	Causes	Fire Category	Injured Victims	Live Lost	Accident	Property Lost (=N=)
Borno										
	27-Feb-01	Motor Park	Wellwishers	Commercial	Accident	Domestic Fire				6.112.500.00
	08-Mar-01	Farmland	Wellwishers	Commercial	Carelessness	Bush Fire	1		Fire Hazard	0.00
	17-Apr-01	Hospital	Wellwishers	Institution	Electrical Defect	Domestic Fire				2.500.000.00
	21-Apr-01	Police Station	SFS	Public Service	Electrical Defect	Domestic Fire				1.854.618.00
	No. of Fire Incidents : 4									
Kano										
	25-Apr-00	Bungalow	SFS	Residential	Carelessness	Domestic Fire				450.000.00
	No. of Fire Incidents : 1									
Rivers										
	11-May-00	Storey Building	Employees	Commercial	Electrical Defect	Domestic Fire				80.000.00
	26-Jun-00	Market	SFS	Commercial	Carelessness	Public Fire				549.178.20
	05-Jan-01	Civil Lab. Office	Employees	Commercial	Carelessness	Office Fire				0.00
	24-Jan-01	Bungalow	SFS	Residential	Unknown	Domestic Fire		1	Fire Hazard	0.00
	02-Mar-01	Bungalow	Wellwishers	Residential	Carelessness	Domestic Fire		1	Fire Hazard	100.000.00
	13-Mar-01	Zinc House	Police	Residential	Accident	Domestic Fire		5	Fire Hazard	0.00
	09-May-01	Stall	Wellwishers	Commercial	Accident	Domestic Fire				3.292.950.00
	No. of Fire Incidents : 7									

powerful pump that can supply water in a large range of volume and pressures; several thousands feet of fire hose, with short length of large diameter hose for attachment to hydrants; a water tank for the initial attack of the fire while the fire fighters connect the pumps to the hydrant. For area where there is no water; In rural areas pumpers carry sections of hose to draw from rivers and ponds. Current standards for fire pumper apparatus require that a fire pumper must have a minimum capacity of 2840liters (750 gallons.) per minute at a pump pressure of 10.35 bar (150 p.s.i) they also call for water capacity of at least 1893 litters (500 gallons)"(Microsoft Encarta encyclopedia 1999)"

AUXILLARY EQUIPMENT:

Auxiliary vehicles are equipped with equipment for effecting rescue, ventilating buildings and salvage. Aerial ladders that typically extends to 30.5m(100ft)' are carried on hook and ladder vehicles that also holds various kinds of tools and equipment, including heavy duty jacks airings, extricating tools, oxyacetylene torches, self contained breathing apparatus, resuscitators. Other more basic equipments includes, axes shovels, picks, battering rams, power saws, hooks and wrenches.

Elevating platform trucks can raise firefighters and equipment and even water delivery system to a height of 30.5m (100ft), rescue trucks carry in wide assortment of specialized emergency equipment, that can be used in building collapse and cave ins. Fire communication units carry sophisticated equipments that can be used in managing fire and emergency operations salvage trucks carry implements for reducing water damage, including large waterproof coverings, dewatering devices, and tools for shooting off water flows from sprinkler heads.

Hazardous materials response units are staffed with specially trained personnel equipped with protective clothing and monitoring devices for use at chemical spills and other similar incidents.

FIRE BOATS:

These are boats used for fire fighting, small fires from cabin cruisers to tanker fires involving thousand of metric tones oil. They used for marine fire fighting and water rescues.

2.8 FIRE SAFETY REGULATIONS:

This are measures that are taken to prevent fire or minimize the loss of life, including limiting fire loads and hazards, confining the spread of fires with fire resistant construction, it also specifies the use of detection systems (smoke detectors, etc.), extinguisher systems (sprinklers, fire extinguishers.), the establishment of adequate fire fighting services (use of fire hydrants), and finally the education and training occupants of fire safety and evacuation procedures. This can be easily achieved by proper consideration during the design process.

2.9 DEDUCTIONS:

In this chapter, I have been able to define modern day fire fighting; we took look at the organizational structure and training of firemen. The remote causes and effects of fire, the equipments that are used to combat fire. Finally, also examined was the importance of fire safety regulation in buildings generally.

CHAPTER THREE-RESEARCH AREA

3.0 FIRE SAFETY IN BUILDINGS.

3.1 FIRE SAFETY:

This can be defined as measures taken to prevent fire or minimize the loss of life or property resulting from a fire including limiting fire loads and hazards, confining the spread of fire with the use of fire resistant construction, the use of extinguishing systems, the establishment of adequate firefighting services and the training of building occupants in fire safety and evacuation.

As an Architect, fire safety is very important in the design of all buildings. The research focus of fire safety in a fire service station might look superfluous, but the essence is to design it in such a way that it can offer training for individuals as well as Companies interested in fire safety and this building would serve as a case study in fire safety for the trainees and as a symbol of fire safety in Abuja.

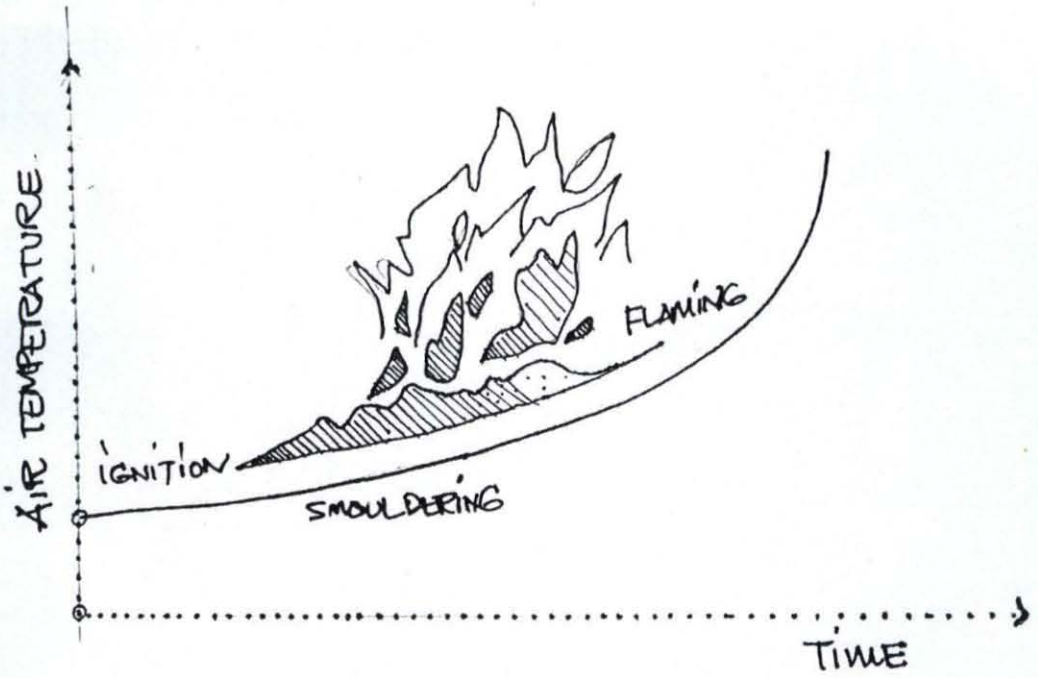
3.2 FIRE RATINGS:

This refers to how fire is started, spread and the material cause of the fire. There are 4 classes of fire. Classes A-D.

(i) Class A fire: - This is a fire involving ordinary combustible materials, as wood, paper and cloth on which the quenching or cooling effect of water is of primary importance. This kind of fire usually occurs at home.

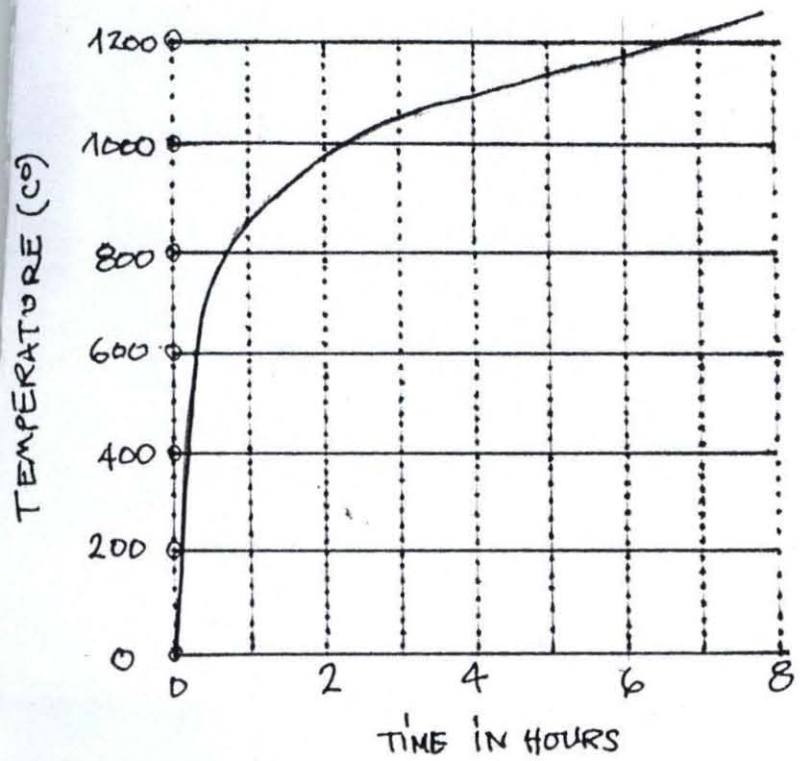
(ii) Class B fire: - This is a fire involving flammable liquids such as gasoline, oil and grease. This fire can only be extinguished by excluding air and inhibiting the release of combustible vapour. This can occur at petrol stations, oilrigs and so on.

FIRE CURVE



SOURCE: A VISUAL DICTIONARY OF ARCHITECTURE (1997)

FIRE RATING CURVE



SOURCE: A VISUAL DICTIONARY OF ARCHITECTURE. (1997)

(iii) Class C fire: - This is the fire that is usually caused by electrical faults. It involves live electrical equipment, which requires a non-conducting extinguishing medium, this kind of fire could occur often at office, market and even in some homes.

(iv) Class D fire: -This is a fire involving certain combustible materials or metals such as magnesium or sodium, which requires a non-reactive, heat absorbing extinguishing medium. This kind of fire could occur at laboratories.

3.3 FIRE ASSEMBLY RESISTANCE RATINGS:

A fire Assembly is the assembly of a fire door, fire window or fire damper, including all required hardware, anchorage, frames and sills used in a building to enhance fire safety it can be a protected opening in a wall, floor or roof – ceiling construction that is fitted with a fire assembly having the required fire resistance rating for its location and use. These are 2 basic types of fire assembly;

(i) **Self – Closing assembly:**

This is a fire assembly that is normally kept in a closed position and is equipped with an approved device to ensure closing and latching after having been opened for use.

(ii) **Automatic – Closing Fire Assembly: -** This is a fire assembly that may remain in an Open position and will close automatically if subjected to an increase in temperature or actuated by a smoke detector.

3.3.1 CLASSES OF FIRE ASSEMBLY RATING:

(i) **Class A:** This is a fire assembly that has a 3 hour fire resistance rating for protecting openings in 3-hour or 4hour fire walls and occupancy separations.

(ii) **Class B:** This is a fire assembly that has a 1-hour or $1^{1/2}$ hour fire-resistance rating for protecting openings in 1 hour or 2-hour fire separations, exit stairways and vertical shafts.

(iii) **Class C:** This is the classification for a fire assembly having a ¾ hour-fire resistance rating for protecting openings in 1-hour walls corridors and hazardous areas.

(iv) **Class D:** This is a classification for a fire assembly having a $1^{1/2}$-hour fire resistance rating for protecting openings in exterior walls subject to severe fire exposure from other buildings, this is to check fire spread from other buildings.

(v) **Class E:** This is a classification for a fire assembly having a ¾-hour fire resistance rating for protecting openings in exterior walls subject to light or moderate fire exposure from outside the building

3.4 DESIGN CONSIDERATIONS FOR FIRE SAFETY IN BUILDINGS.

There are several factors that are to be considered in design of Buildings. These factors cannot be overlooked if there has to be any form of fire safety in the building. These design factors are put in place primarily to salvage occupants of the building and property in the case of fire. These factors are discussed below as to how they relate to the building itself under various sub-headings.

3.4.1 **Means of Egress:**

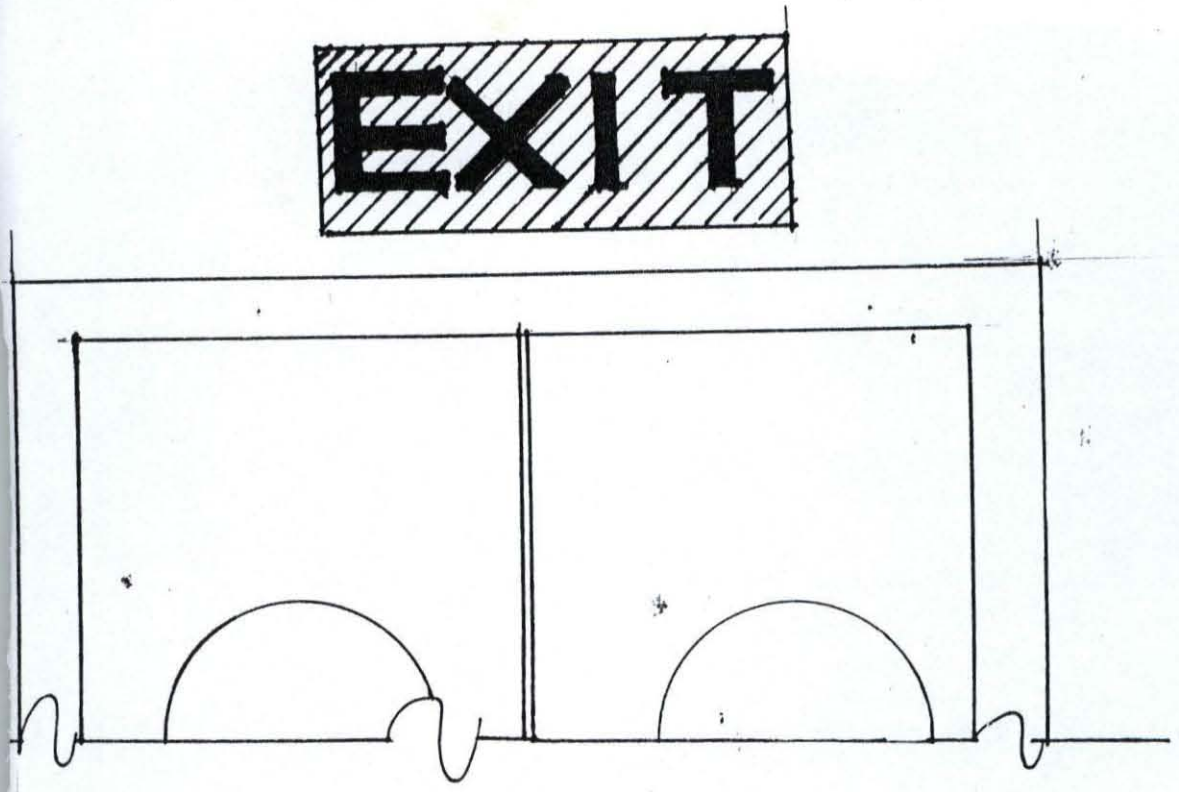
This is a continuous path of travel from any point in a building to the outside at the ground level. This is a very important consideration in the design of buildings, because this is the means that leads occupants of buildings to safety in the case of fire, it could be an exit stairway or a fire escape, or an exit balcony.

This means of egress must be a smoke-proof, enclosed by fire-resistive construction, accessible by a vestibule or by an exterior balcony and ventilated by natural or mechanical means to limit the penetration of smoke and heat, all doors must be self-closing fire doors that swing in the direction of exit travel. Building codes specify the maximum distance of travel to a means of egress and the minimum distance between the means of egress when two or more are required. Building codes also require that there is always more than one exit stairway in a high-rise building.

3.4.2 **Exits:**

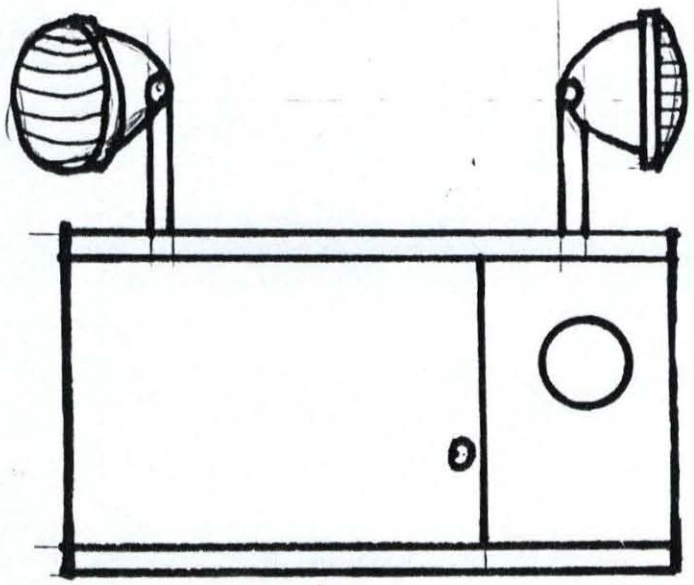
These are the portions of a building that lead to a means of egress. It is a passage through or around a wall constructed as required for an occupancy separation, protected by an automatic closing fire door and leading to an area of refuge in the same building or on approximately the same level in an adjacent building. It must be an enclosed and protected path of escape for the occupants of a building in the event of a fire. It should have an illuminated sign for easy identification; all exits should have an emergency lighting system to apply illumination required for safe

OCCUPANCY SAFETY MEASURES.



EXIT LIGHTING.

SOURCE: AUTHOR (2003)



EMERGENCY LIGHTING.

SOURCE: AUTHOR (2003)

egress from the building in case of power failure. There should be adequate exits depending on the number of occupants of the building.

3.4.3 **Fire Hazards:**

Fire hazards must be avoided in the design of buildings. A fire hazard is any condition that increases the likelihood of a fire, obstructs access to fire fighting equipments, or delays the egress of occupants of a building.

In the planning of buildings there must be easy access to fire fighters into the building or site, and availability of fire hydrants proximate to site in the event of fire.

Fire-fighting vehicles must not be obstructed and must have an easily accessible link to the building or site to be able to function properly.

3.4.4 **Deep Volumes:**

In the design of buildings deep volumes should be avoided, the buildings should be more of horizontal pavilion than vertical, Deep volumes in a building include voids, atriums, courtyards, stairs and elevator shafts that run vertically through the floors of a building. These shafts aid the rapid flow of fire and the density of smoke, which makes a fire fighting difficult in high-rise buildings. This is why deep volumes are a design consideration where fire safety is of high priority. Fire can be more easily controlled in a building without deep volumes.

3.4.5 **Occupant loads:**

This should be prime consideration as regards the safety of the occupants of a building in the case of fire. The occupant load refers to the total number of persons that can occupy a building or portion thereof at any one time, determined by dividing the floor area assigned to a particular use by the

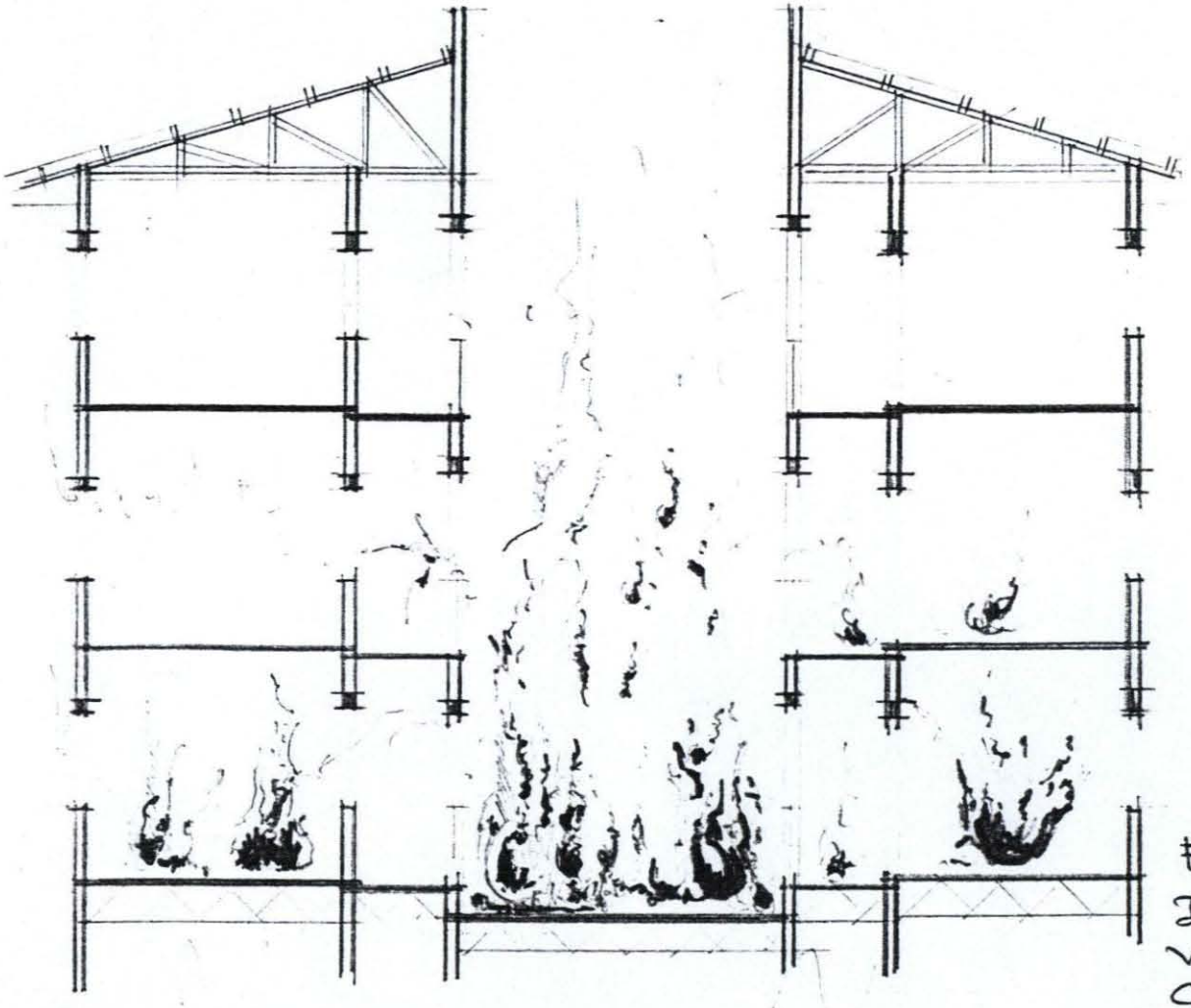


FIG.
DEEP VOLUMES, SUCH AS VERTICAL SHAFTS AND COURTYARD AID RAPID FIRE SPREAD.

square feet per occupant permitted in that use. Building codes use occupant load to be able to establish the required number of people and the width of exits of a building. This is particularly important, in the design of corridors, passages exits and escape routes, to determine the number of people that can use these routes for evacuation in the case of fire, so as not to cause a stampede.

3.4.6 **Materials:**

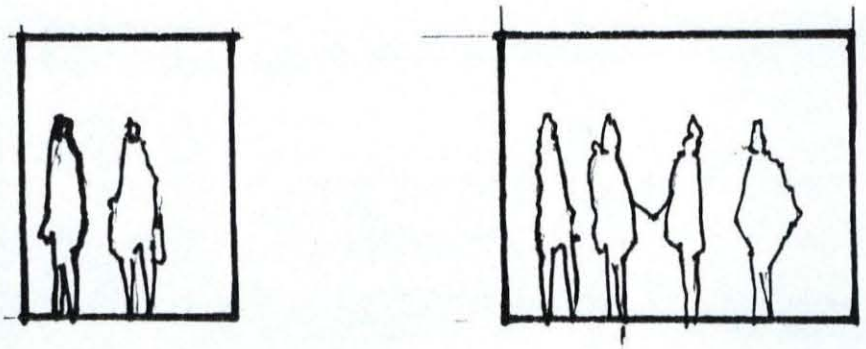
This is another important factor, the materials that would be used in the interior of the building must be carefully chosen where safety is of prime importance.

Materials with suitable fire resistance rating must be used. This is used so as to reduce the fire loads in the building. A building with a high fire load is more susceptible to fire than buildings with lower fire loads.

Fire loads refer to the amount of combustible materials in the building and are usually measured in pounds per square foot of floor area.

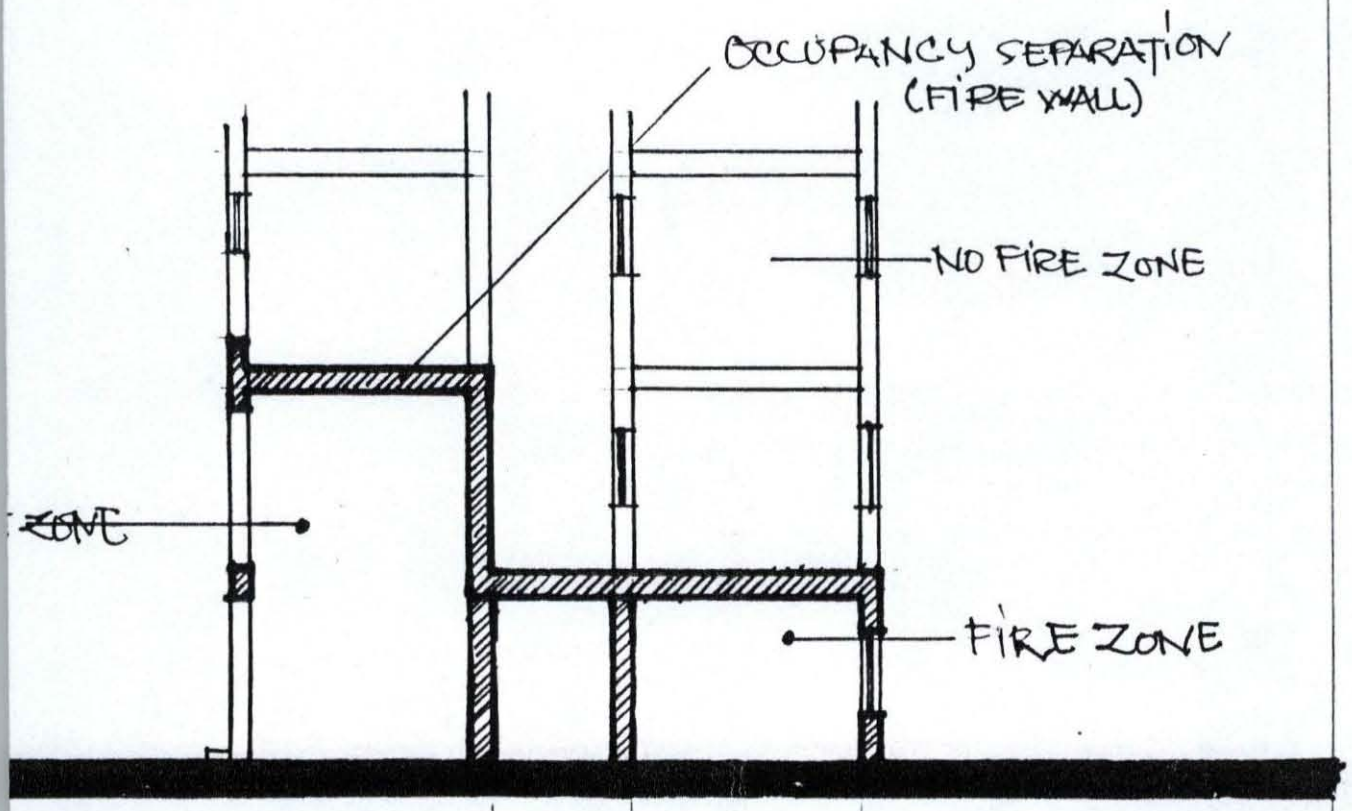
3.4.7 **Fire areas:**

A fire area is a portion of a building enclosed by fire rated construction capable of confining the spread of fire. This can be achieved by the use of a floor, wall, or roof - ceiling having the required fire resistance rating to confine the spread of the fire. In an area where a fire wall is need, it must start from the foundation and having all openings restricted to a certain percentage of the wall length and protected by a self closing or automatic – closing fire assembly. For instance in my design, there is a gas room, for training of firemen in the basement, this area is fire prone, so a fire area was established and occupancy separation was used. This is illustrated in the figure below.



OCCUPANT LOADS FOR BUILDINGS.

SOURCE: A VISUAL DICTIONARY OF ARCHITECTURE



OCCUPANCY SEPARATION IN MULTIPLE OCCUPANCY BUILDING.

SOURCE: A VISUAL DICTIONARY OF ARCHITECTURE. (1997)

3.5 FIRE PROOF CONSTRUCTION:

This can be defined as the construction of a building by making any of the various materials used in the construction, such as concrete, steel, gypsum or mineral fiber, used in making a structural member or system, such as beams, girders, columns resistant to damage or destruction by fire.

For these members to become fire resistant, they must undergo various forms of treatment. These treatments are discussed briefly below.

3.5.1 Spray On Fireproofing:

This is a mixture of a mineral fibre and an inorganic binder, applied by air pressure with a spray gun to provide a thermal barrier to the heat of a fire.

3.5.2 Intumesscent Paint:

This is a coating that, when exposed to the heat of a fire, swells to form a thick insulating layer of inert gas bubbles that retards flame spread and combustion. This can be used on structural members, like trusses, beams, girders and columns, and help to avoid a break down of the system or structure.

3.5.3 Liquid Filled Members:

This is used for hollow structural columns or beams; the members are filled with water to increase ifs fire resistance. If exposed to flames, the water absorbs heat, rises by convection to remove the heat, and is replaced with cooler water from a storage tank within the building or from the city mains.

3.5.4 Material Assembly Members:

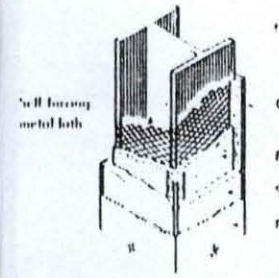
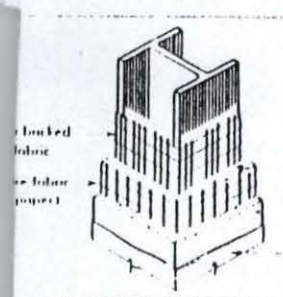
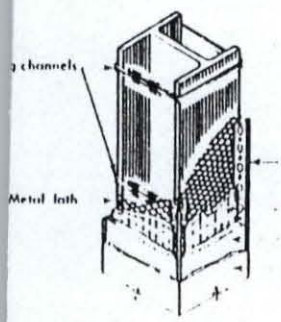
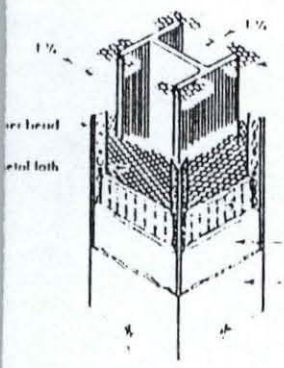
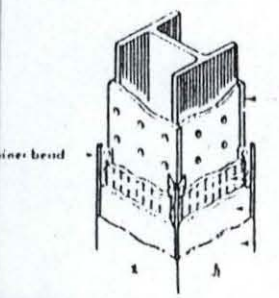
This is when a structural member is made by an assembly of various material such as tie wires, gypsum lath, wire mesh, paper, metal lath and even

Columns

Table 1. Fire-resistance ratings of various assemblies

Superscript numbers refer to notes at the end of this table. This table is from Fire-resistant Construction in Modern Steel-framed Buildings, *published by American Institute of Steel Construction (1959).*

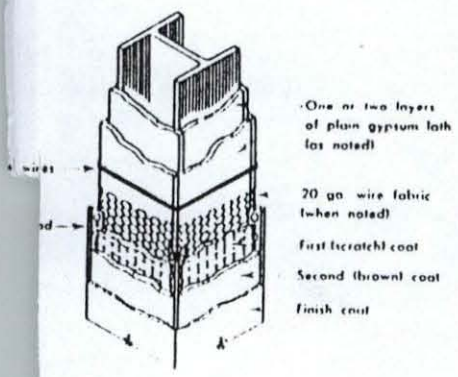
Columns

	No.	Description	Rating (Hours)	Authority [1]
	1	1¼" vermiculite- or perlite-gypsum plaster [2] on self-furring metal lath [3]	4	Underwriters' Lab., Inc. Rel. 3187-4 (Design 6-4 hr.) Rel. 2851-6 (Design 9-4 hr.)
	2	1⅛" vermiculite- or perlite-gypsum plaster [2] on self furring metal lath [3]	3	Underwriters' Lab., Inc. Rel. 3187-7 (Design 6-3 hr.) Rel. 2851-5 (Design 8-3 hr.)
	3	1" perlite-gypsum plaster [2] on self furring metal lath [3]	2	Underwriters' Lab., Inc. Rel. 3187-5 (Design 2-2 hr.)
	4	2" vermiculite portland cement plaster [4] on paper-backed wire fabric,[5] with an additional layer of wire fabric (no paper) [6] over scratch coat	4	Underwriters' Lab., Inc. Rel. 3653-3 (Design 10-4 hr.)
	5	Same as No. 4 above, except 2⅛" perlite portland cement plaster [7]	4	Underwriters' Lab., Inc. Rel. 3329-2 (Design 8-4 hr.)
	6	1½" perlite gypsum plaster [2] on metal lath [8] spaced from column flanges by ¼" steel furring channels. No back fill plaster required between metal lath and column flanges.	4	Underwriters' Lab., Inc. Rel. 3187-6 (Design 7-4 hr.)
	7	Same as No. 6 above, except ⅜" ¼" sand gypsum plaster [9] or 1" portland cement plaster [10] on metal lath [11]	1	Nat'l Bureau of Standards BMS 92—Table 40
	8	1½" vermiculite- or perlite-gypsum plaster [2] on metal lath [8]. Lath spaced 1¼" from column flanges. Space behind lath on flange faces filled with plaster	4	Underwriters' Lab., Inc. Rel. 2851-2 (Design 1-4 hr.) Rel. 3187-3 (Design 2-4 hr.)
	9	Same as No. 8 above, except 1" vermiculite- or perlite-gypsum plaster [2]	2	Underwriters' Lab., Inc. Rel. 2851-1 (Design 1-3 hr.) Rel. 3187-1 (Design 3-3 hr.)
	10	Same as No. 8 above, except 1½" vermiculite-gypsum plaster [2] with no plaster fill behind lath.	3	Underwriters' Lab., Inc. Rel. 3422-2 (Design 9-3 hr.)
	11	Same as No. 8 above, except: 1" perlite-gypsum plaster [2] with no plaster fill behind lath.	2	Underwriters' Lab., Inc. Rel. 3187-2 (Design 1-2 hr.)
	12	1⅜" perlite gypsum plaster [2] or 2" sand-gypsum plaster [12] on one (1) layer of ⅜" perforated gypsum lath	3	Nat'l Bureau of Standards Test 321 and Test 344
	13	1" perlite gypsum plaster [2] or 1⅜" sand gypsum plaster [12] on one (1) layer of ⅜" perforated gypsum lath	2	Nat'l Bureau of Standards BMS 135—Test 275 Test 351
	14	½" sand-gypsum plaster [13] on one (1) layer of ⅜" perforated gypsum lath	1	Nat'l Bureau of Standards BMS 135—Test 273

SOURCE: TIMESAVER STANDARD FOR ARCHITECTURAL DESIGN DATA (1983)

Table 1. (Cont.) Fire-resistance ratings of various assemblies

Superscript numbers refer to notes at the end of this table. Asterisks identify tests conducted 5 hours or more without reaching critical limits. This table is from Fire-resistant Construction in Modern Steel-framed Buildings, *published by American Institute of Steel Construction (1959).*



No.	Description	Rating (Hours)	Authority [1]
15	1½" perlite- or vermiculite-gypsum plaster [2] on two (2) layers of ½" thick plain gypsum lath wrapped with one (1) layer of 20 ga. wire mesh fabric, 1" mesh (poultry netting).	4	Nat'l Bureau of Standards BMS 135—Tests 278, 279, 280, 294
16	2⅛" (⅝" scratch coat and 1½" brown coat) perlite-gypsum plaster [14] on one (1) layer of ½" thick plain gypsum lath. 17 ga. wire mesh fabric, 1" mesh (poultry netting) over scratch coat; no fabric over lath.	4	Underwriters' Lab., Inc. Rel. 3329-1 (Design 4-4 hr.)
17	1½" (¾" scratch coat and ¾" brown coat) perlite-gypsum plaster [2] on one (1) layer of ½" thick plain gypsum lath. One (1) layer of 20 ga. wire mesh fabric, 1" mesh (poultry netting) over scratch coat; no fabric over lath.	3	Nat'l Bureau of Standards BMS 135—Test 277
18	Same as No. 15 above, except 1" perlite-gypsum plaster [2]	3	Nat'l Bureau of Standards BMS 135—Test 276
19	1⅛" perlite-gypsum plaster [2] on two (2) layers of ½" thick plain gypsum lath; no fabric over scratch coat or lath.	3	Nat'l Bureau of Standards BMS 135—Tests 289, 293
20	2½" sprayed mineral fibers [15] applied directly to column coated with special adhesive.	4*	Underwriters' Lab., Inc. Rel. 3749-4 (Design 11-5 hr.)
21	2" sprayed mineral fibers [15] applied directly to column coated with special adhesive.	3	Underwriters' Lab., Inc. Rel. 3705-2 (Design 7-3 hr.)
22	1½" sprayed mineral fibers [15] applied directly to column coated with special adhesive.	2	Underwriters' Lab., Inc. Rel. 3705-3 (Design 4-2 hr.)
23	Concrete encasement. Grade "A" concrete [16] x 2" / x 1½" / x 1"	4, 3 / 2 / 1	Nat'l Bureau of Standards** BMS 92 Table 39 TP 184
24	Concrete encasement. Grade "B" concrete [17] x 2½" / x 2" / x 1½"	4 / 3 / 2, 1	**Listed ratings are not tested ratings, but are based on the results of standard tests described in these references.[19]
25	Concrete encasement. Grade "C" concrete [18] x 3" / x 2½" / x 2" / x 1½"	4 / 3 / 2 / 1	
26	Gypsum concrete encasement. 4" x 4" wire mesh reinforcement wrapped around column. x 2"	4 [20]	Nat'l Bureau of Standards Research Paper No. RP563
27	Brick; 3¼" thick; reentrant spaces filled with brick and mortar. No plaster.	4*	Nat'l Bureau of Standards BMS 92—Table 40
28	Same as No. 27 above, except 2¼" thick.	1	

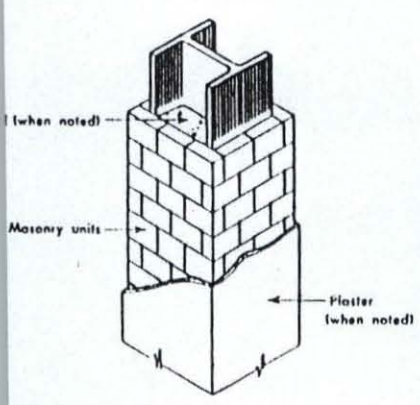
(See drawing, next page.)

SOURCE: TIMESAVER STANDARDS FOR ARCHITECTURAL DESIGN DATA (1983) 525

Columns

Table 1 (Cont.) Fire-resistance ratings of various assemblies

Superscript numbers refer to notes at the end of this table. Asterisks identify tests conducted 5 hours or more without reaching critical limits. This table is from Fire resistant Construction in Modern Steel-framed Buildings, *published by American Institute of Steel Construction (1959).*



No.	Description	Rating (Hours)	Authority [1]
29	2" gypsum block, solid, plus ½" sand gypsum plaster.[9] Cramps at horizontal joints. Mortar on flange only at horizontal joints. No fill. Minimum area of solid material to be 105 sq. inches.	4	
30	Same as No. 29 above, except: 3" gypsum block, hollow, plus ½" sand-gypsum plaster.[9] Minimum area of solid material to be 120 sq. inches.	4*	
31	Same as No. 29 above, except: No plaster. Minimum area of solid material to be 85 sq. inches.	2	
32	Same as No. 30 above, except: No plaster. Minimum area of solid material to be 95 sq. inches.	2	
33	2", 3" or 4" hollow clay or shale tile; reentrant spaces filled with concrete. Wire mesh in horizontal joints; Mortar between tile and column flanges. No plaster. Minimum area of solid material to be 225 sq. inches.	4	Nat'l Bureau of Standards BMS 92—Table 40
34	4" hollow clay tile in two 2" layers; Mortar between tile and column flanges. Wire mesh in horizontal joints. Reentrant spaces filled with tile and mortar. No plaster. Minimum area of solid material to be 250 sq. inches.	4	
35	Same as No. 33 above, except: Minimum area of solid material to be 180 sq. inches.	3	
36	Same as No. 33 above, except: Minimum area of solid material to be 110 sq. inches.	2	
37	Same as No. 33 above, except: Reentrant spaces not filled. Minimum area of solid material to be 70 sq. inches.	1	
38	3" cinder block, hollow. Reentrant spaces filled with block and mortar. No plaster. Minimum area of solid material to be 240 sq. inches.	4[21]	

Beams, girders, and trusses: individually fireproofed

39	1½" vermiculite- or perlite-gypsum plaster[2] on self-furring metal lath.[3]	4*[22]	Underwriters' Lab., Inc. Rel. 2689-5 (Design 19-4 hr.) Rel. 3413-4 (Design 8-4 hr.) Rel. 4197-1
40	1⅛" vermiculite-gypsum plaster[2] on flat expanded metal lath[8] furred from flanges by ¾" furring channels.	4	Underwriters' Lab., Inc. Rel. 3372-3 (Design 16-4 hr.)
41	1¼" perlite-gypsum plaster[2] on flat expanded metal lath[8]	3	Underwriters' Lab., Inc. Rel. 4197-1

(See drawing, top of next page.)

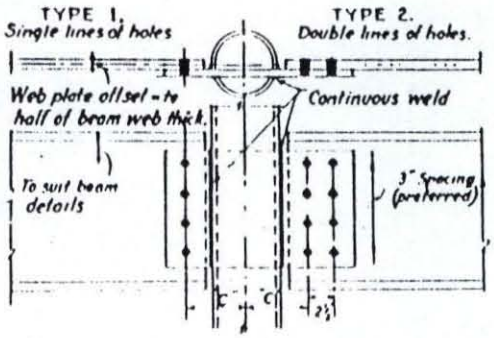
SOURCE: TIMESAVER STANDARDS FOR ARCHITECTURAL DESIGN DATA (1987)

NDARD AND FIREPROOF LALLY OLUMNS

proofing is furnished in the specified ess required for any fire rating by building codes. To ensure that new pipe of the proper thickness is fur- , always specify the weight in pounds oot of every column as given in the (for example, "SIHW 8¾ in. ▽ 81

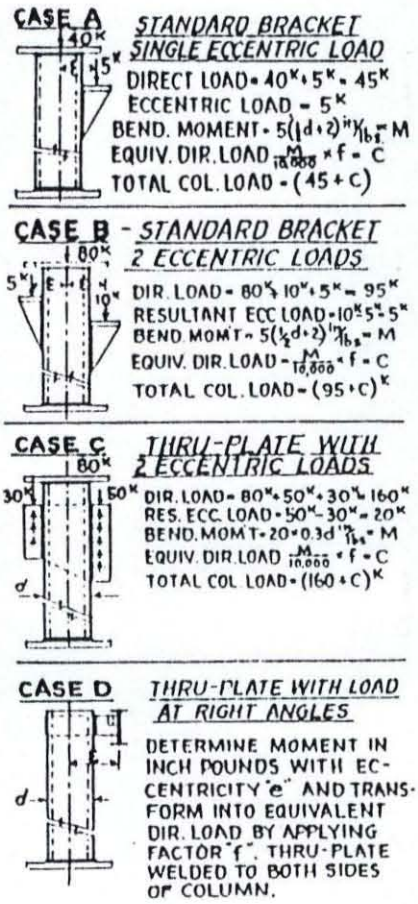
UTRIC LOADING

e concentric loads in Tables 18 and nly to Lally columns and are based oads being applied axially. The of Lally columns under eccentric determined as follows: For each lb bending moment due to eccen- pplied loads, add the factor f in tables to the sum of all vertical ips.



C LOAD MOMENTS

llowing illustrations indicate the f determining equivalent direct each 10,000 in. lb bending mo the use of the factor f given in olumn of the tables for safe con- ds.



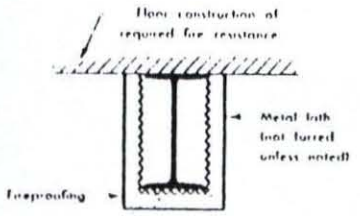
ITY IN STEEL STRUCTURES

re exceptions, the conventional ling has been designed with sim- le connections. This practice has despite the fact that the notable s of continuity have long been f. Depth of sections and weight rs, for example, are invariably n continuous structures and thus vings in material cost. The argu- inst their employment is that the igid connections entail an addi- ricating expense that more than vings in weight of members and re not economically justifiable. ance has gradually lessened in rs as a result of economical and use of continuous steel structures opment of plastic design in steel idespread acceptance of welding factors that will increase the use ous structures.

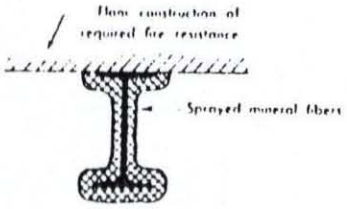
SOURCE: TIMESAVER STANDARDS FOR ARCHITECTURAL DESIGN DATA (1983)

Table 1 (Cont.) Fire-resistance ratings of various assemblies

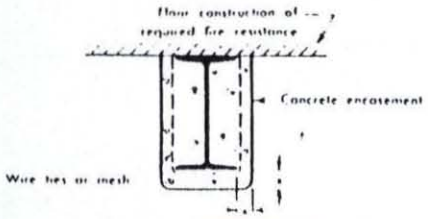
Superscript numbers refer to notes at the end of this table. Asterisks identify tests conducted 5 hours or more without reaching critical limits. This table is from Fire-resistant Construction in Modern Steel-framed Buildings, *published by American Institute of Steel Construction (1959).*



No.	Description	Rating (Hours)	Authority [1]
42	1" vermiculite-gypsum plaster [2] on flat expanded metal lath [8]	2½ [23]	Underwriters' Lab., Inc. Ret. 3413-10 (Design 3-2 hr.)
43	Same as No. 42 above, except ⅛" vermiculite-gypsum plaster [2]	2	Underwriters' Lab., Inc. Ret. 3413-9 (Design 7-3 hr.)
44	2" vermiculite or perlite acoustic plaster [15] on self furring metal lath [3] or flat expanded metal lath [8]	4	Underwriters' Lab., Inc. Ret. 3413-7 (Design 10-4 hr.) Ret. 3983-1
45	1¼" perlite acoustic plaster [15] on flat expanded metal lath [8]	3	Underwriters' Lab., Inc. Ret. 3413-11 (Design 7-2 hr.)
46	Sprayed mineral fibers,[15] 1¼" thick on sides of beam, 1½" thick below beam on ribbed metal lath [24] No adhesive	4*	Underwriters' Lab., Inc. Ret. 3705-3 (Design 20-4 hr.)

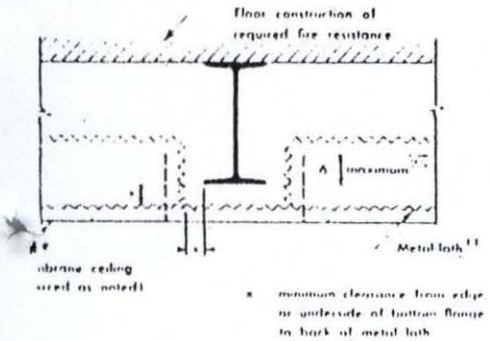


No.	Description	Rating (Hours)	Authority [1]
47	1⅛" sprayed mineral fibers [15] applied directly to beam coated with special adhesive.	4	Underwriters' Lab., Inc. Ret. 2923-4
48	1⁵⁄₁₆" sprayed mineral fibers [15] applied directly to beam coated with special adhesive.	3	Underwriters' Lab. of Canada Ret. 193-2 (Design C9-3 hr.)
49	1⅛" sprayed mineral fibers [15] applied directly to beam coated with special adhesive.	2	Underwriters' Lab. of Canada Ret. 193-3



No.	Description	Rating (Hours)	Authority [1]
50	Concrete encasement. Use same ratings and constructions designated for column protections in Fire Resistance Ratings Nos. 23, 24 and 25 listed on Sheet 4	4,3,2,1	Estimated ratings based on column tests.

Beams, girders, and trusses: fire-protected by a membrane ceiling



No.	Description	Rating (Hours)	Authority [1]
51	1" vermiculite-gypsum plaster [28] x 0"	4	Nat'l Bureau of Standards BMS 92—Table 43
52	⅞" perlite-gypsum plaster [2] x 2¼" Note: Ceiling pierced with duct openings (70 sq. inches in each 100 sq. feet of ceiling area) and electrical outlets (one in each 90 sq. feet of ceiling area). Duct openings protected with fusible link dampers	4	Underwriters' Lab., Inc. Ret. 3724-1 (Design 8-3 hr.)
53	¾" perlite-gypsum plaster [2] x 3½" Note: Ceiling pierced same as No. 52 above, except duct openings 113 sq. inches in each 100 sq. feet of ceiling area	4	Underwriters' Lab., Inc. Ret. 3574-6 (Design 11-3 hr.)
54	⅝" vermiculite-gypsum plaster [2] base plus ½" finish vermiculite acoustic plaster.[15] (Total thickness 1⅛" over face of lath) x 2½"	4	Underwriters' Lab., Inc. Ret. 2773-5 (Design 4-4 hr.)

SOURCE: TIMESAVER STANDARDS FOR ARCHITECTURAL DESIGN DATA.

masonry units, concrete and steel. Fire – proofing of beams, columns, girders are shown in the following figures.

3.6 MECHANICAL/ELECTRICAL FIRE SYSTEMS:

This refers to a combination of mechanical and electrical systems or just mechanical or just electrical systems that are used in fire safety operations within a building. If these systems are not put in place if would be very difficult to detect a fire, let alone putting it out these systems aid in early fire defection as well as extinguishing the fire, and ensuring the safety of occupants of the building as well as the property. A number of these systems are discussed below.

(i) Fire Alarm System:

This is an electrical system installed in a building to automatically sound an alarm when actuated by a fire detection system.

(ii) Fire Detection System:

This is a system of thermostats or other approved sensors for detecting the presence of a fire and automatically signaling to the fire-alarm system, that is installed in the building.

(iii) Fire Hydrant:

This is also known as the fireplug, it is an upright pipe with one or more nozzles or sports where a fire hose is connected. It is used to draw water from a main and is especially used for fighting fires. They must be adequately provided at well-spaced intervals, properly

arranged and not cause an obstruction for its effective use in fire fighting.

(iv) **Fire Extinguisher**:

This is a portable apparatus for putting out a small fire by ejecting pressurized water or special chemicals, classified according to the type of fire it is able to extinguish. These are to be located at strategic locations around the building, along corridors, in lobbies and must be easily accessible to anyone.

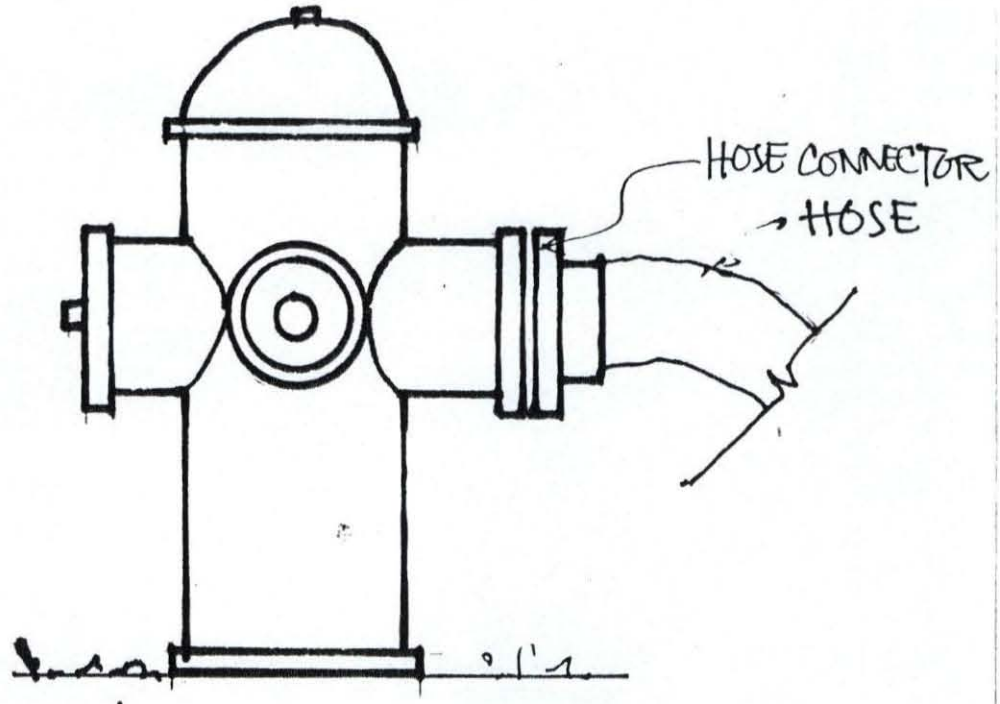
(v) Sprinkler Systems:

`This is an apparatus for automatically extinguishing fires in a building, consisting of a system of pipes in or below the ceilings, connected to a suitable water supply, and supplied with valves or sprinkler heads made to open automatically after a certain temperature has been reached within the building. The sprinkler system could be triggered off by a smoke detector, the fire detection system, then the fire alarm system, before the sprinkler system goes off. There are various types of sprinkler systems such as

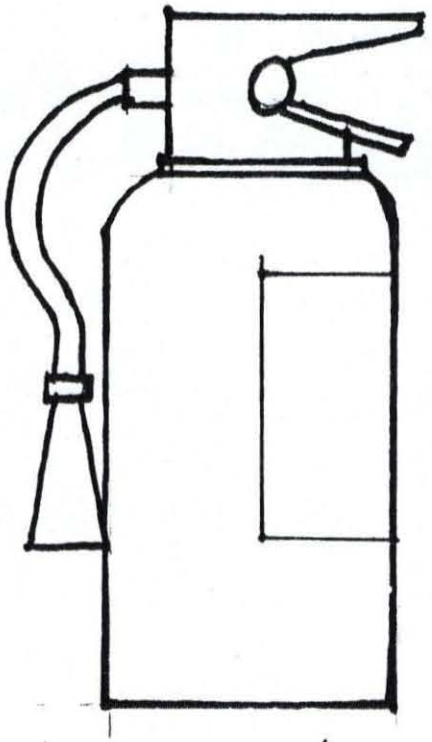
a. **Wet-Pipe System:**

Contains water at sufficient pressure at all times, to provide an immediate, continuous flow of water through the sprinkler heads in the case of fire.

MANUAL FIREFIGHTING SYSTEMS.



FIRE HYDRANT.



FIRE EXTINGUISHER

b. **Dry-Pipe System:**

Contains pressurized air that is released when a sprinkler heads opens in the event of fire. Dry pipe systems are used where the piping is subject to freezing.

c. **Deluge Systems:**

A sprinkler system having sprinkler heads open at all times, through which water flow is controlled by a valve operated by heat, smoke or flame sensing device.

(v) Automatic Fire Extinguishing System:

This is a system of devices and equipment, which automatically detect a fire, and discharges an approved fire-extinguishing agent onto or in the area of a fire.

3.7 DEDUCTIONS:

The chapter deals with the research focus of the thesis, fire safety in buildings. Fire safety was looked at, what it means and how it can be achieved. The various classes of fire and fire rating were looked at with a view to establishing how the fire problems can be solved for specific building use and time of resistance in the case of fire. The design considerations in terms of planning of the building to enhance fire safety were looked at and also in terms of occupancy and property safety in the event of fire. Fire proof construction, so as to avoid the breakdown of the building system were looked at in terms of beams, columns and girders, and how they can ensure safety of the structure in the event of a fire. Mechanical and electrical systems used for fire detection and fighting were also looked at, and how they can be effectively used in buildings for fire safety.

CHAPTER FOUR – CASE STUDIES

4.0 CASE STUDIES:

To aid in the design of the ultra- modern fire Station, Abuja, case studies of fire service stations and training facilities for firemen within and outside the country were taken. This gave a basis for the standards of fire stations and the necessary facilities needed for training of firemen, which would be incorporated into the proposed design, also taken into consideration are the merits and demerits of the case studies. The merits were incorporated into the proposed design while the demerits were improved upon to give a highly functional design. Four case studies in all were taken, two case studies were taken within the country, Lagos and Abuja and two outside in the country, the Netherlands particularly.

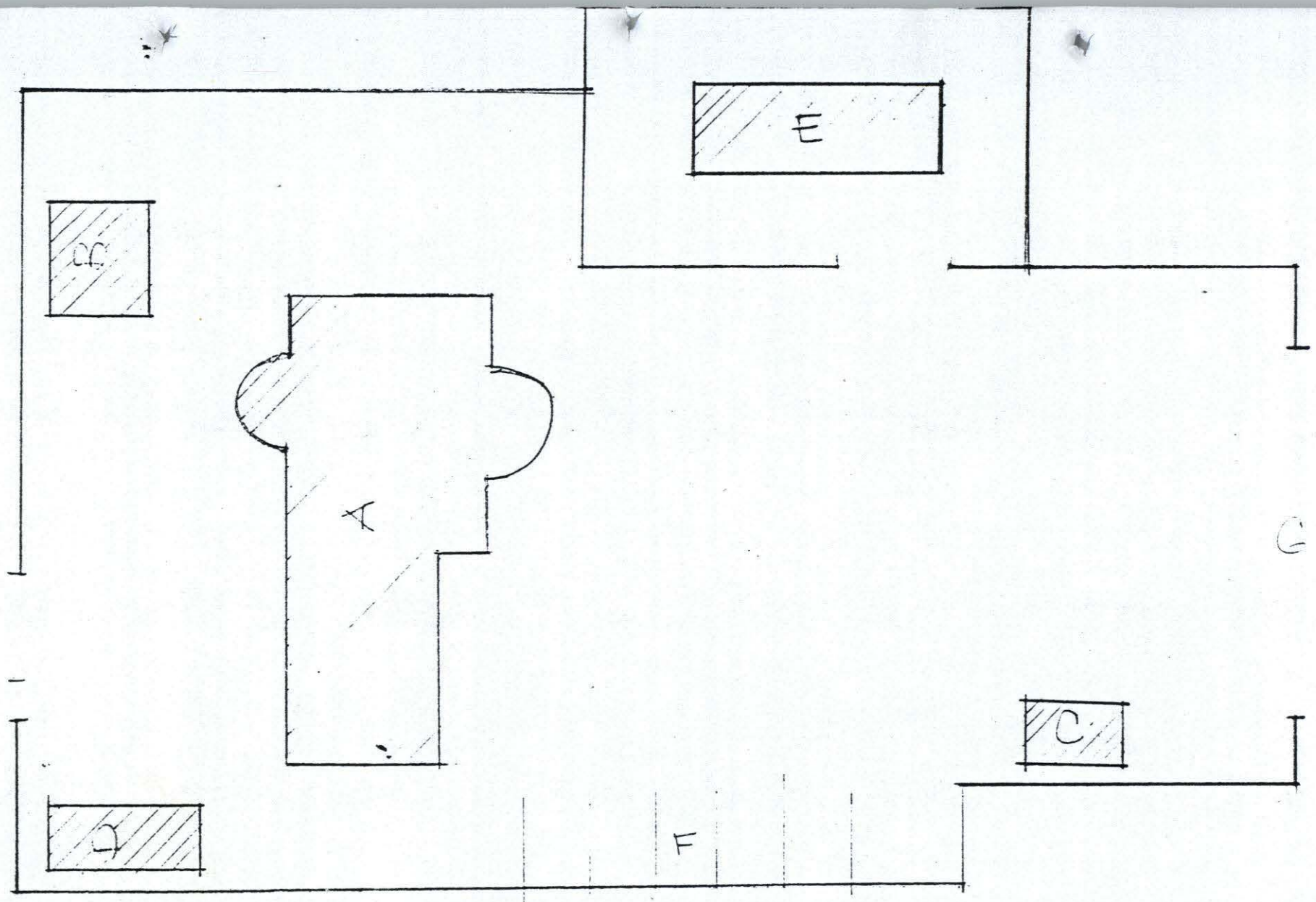
4.1 CASE STUDY ONE; WUSE FIRE STATION; ZONE 3, ABUJA

4.1.1 Historical Background:

This fire station was constructed in the early 1980s. It was solely for fire fighting activities, to take care of the wuse area of Abuja metropolis. It started full operations in fire- fighting in 1984.

4.1.2 Site and Location:

This fire station is located in the wuse zone of Abuja; precisely at zone 3, very near the neighborhood center, Abuja shopping mall, Nigeria Customs Service Headquarters, Ministry of Foreign Affairs, The Civil Service Commission, and bound by the Wuse General hospital and the Division Police headquarters at Wuse. It is strategically located to be able to take care of all these buildings noting also that the Wuse old market is not too far from the location; being a high fire prone area.



FEDERAL FIRE SERVICE STATION, AXUSE ZONE 3, ABUJA

A — FIRE STATION
B — DRILL TOWER
C — SECURITY POST
D RESTURANT (MAKESHIFT)
E LIVING QUARTERS
F PARKING AREA
G - FIRE VEHICLE EXIT.

4.1.3 Scope of Case Study:

The scope of this facility is quite small relative to the area the fire station is to cover; it has no training facilities on ground, for use by firemen for drills. The facilities on ground at the fire station include; offices, restaurant, staff area, security room, machine room and drill tower

4.1.4 Design and Planning:

The design of the facility was done in the late 70s and the building constructed in the early 80's. The fire station exhibits good planning, and construction. It also shows some sophistication in terms of contemporary architecture considering the time of construction; this can be seen in the design and construction of the drill tower, it is a 3-bay fire station.

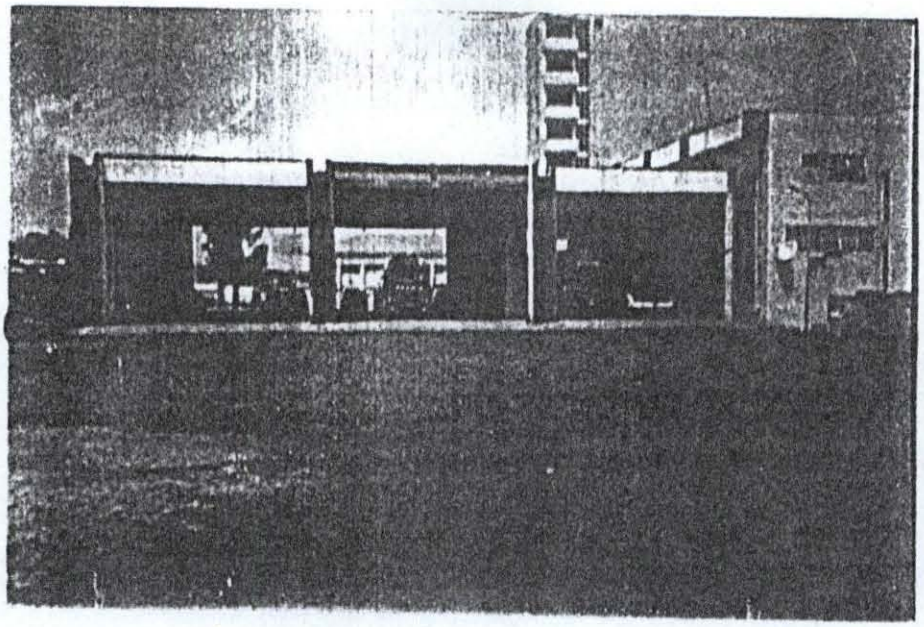
4.1.5 Evaluation of case study;

Merits.

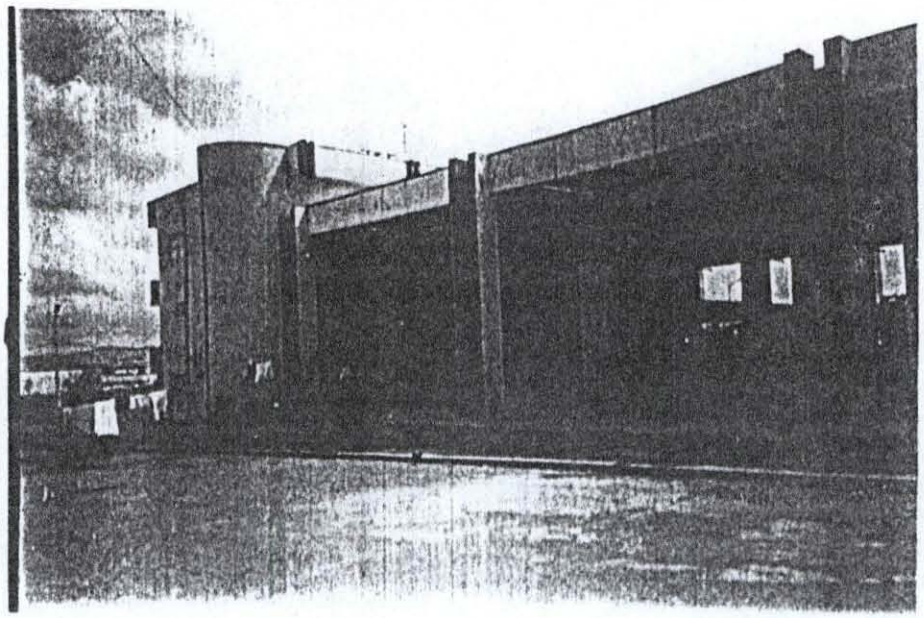
1. Good planning of fire station.
2. Aesthetically sound buildings.
3. Good traffic flow within site.
4. Adequate parking.
5. Adequate equipment storage.
6. Provision of restaurant, though makeshift.

Demerits

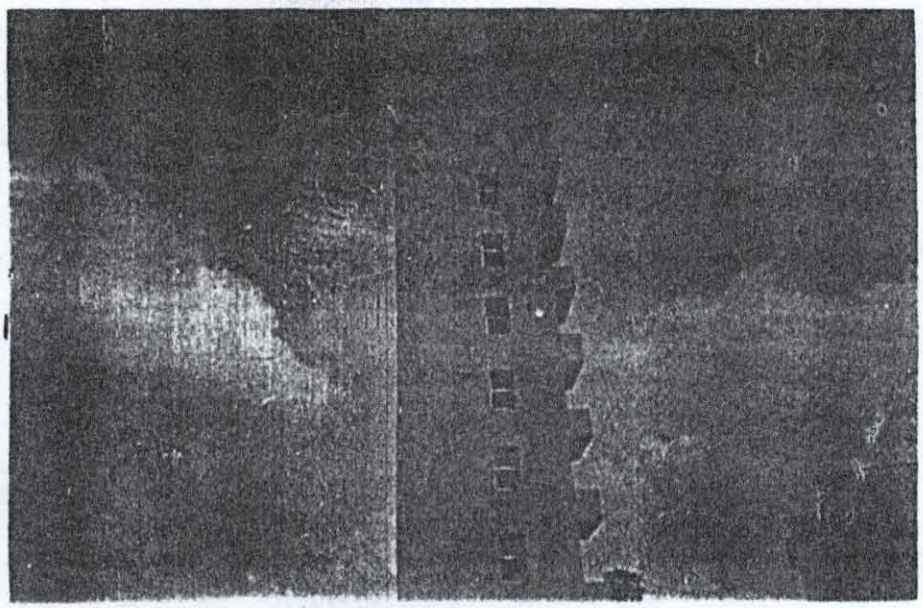
1. Poor sanitation on site.
2. Inadequate accommodation for operations staff.
3. Poor landscaping of the site.
4. No maintenance unit or facility.
5. No ancillary facilities.



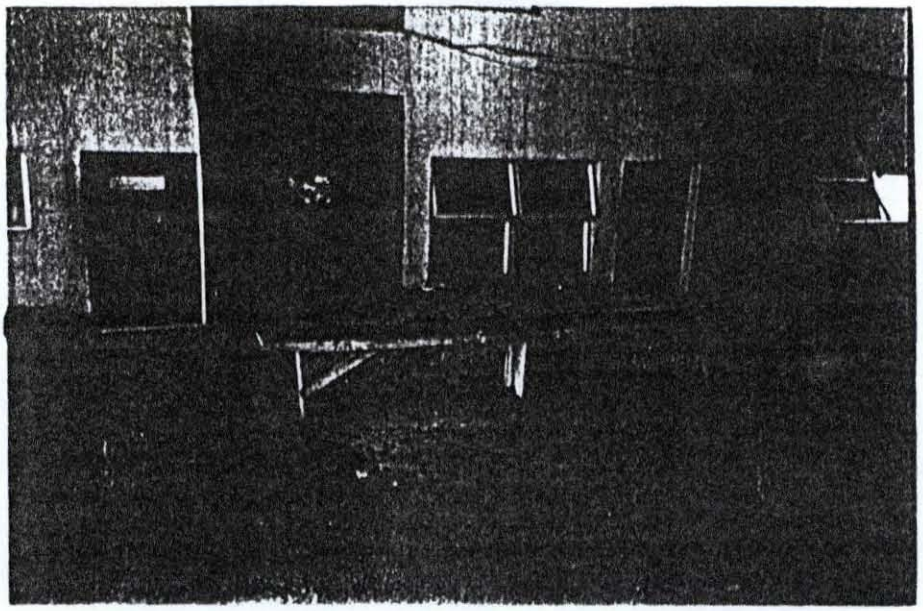
FEDERAL FIRE SERVICE, WUSE ZONE 3, ABUJA - FRONT VIEW



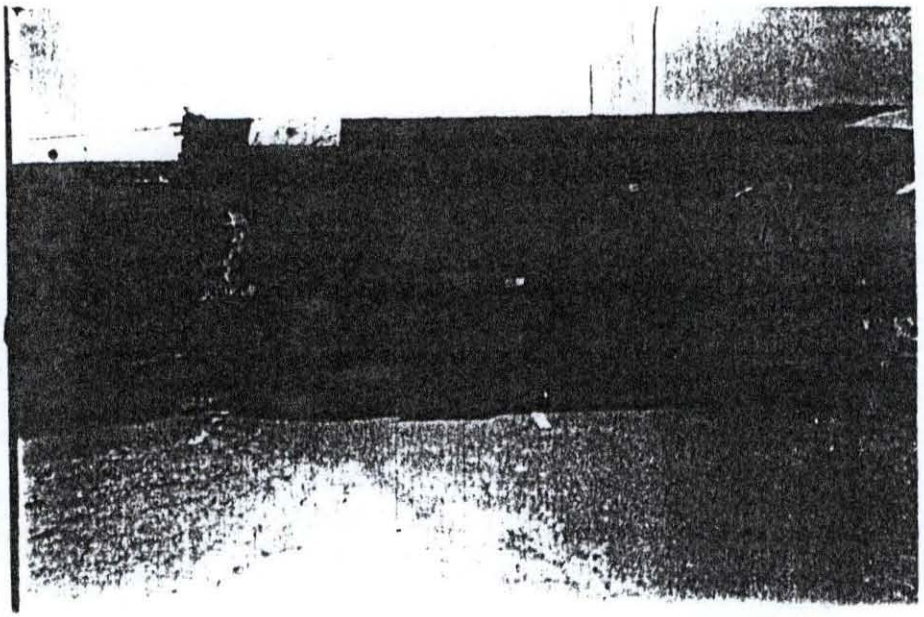
FFS, WUSE ZONE 3, ABUJA - BACK VIEW



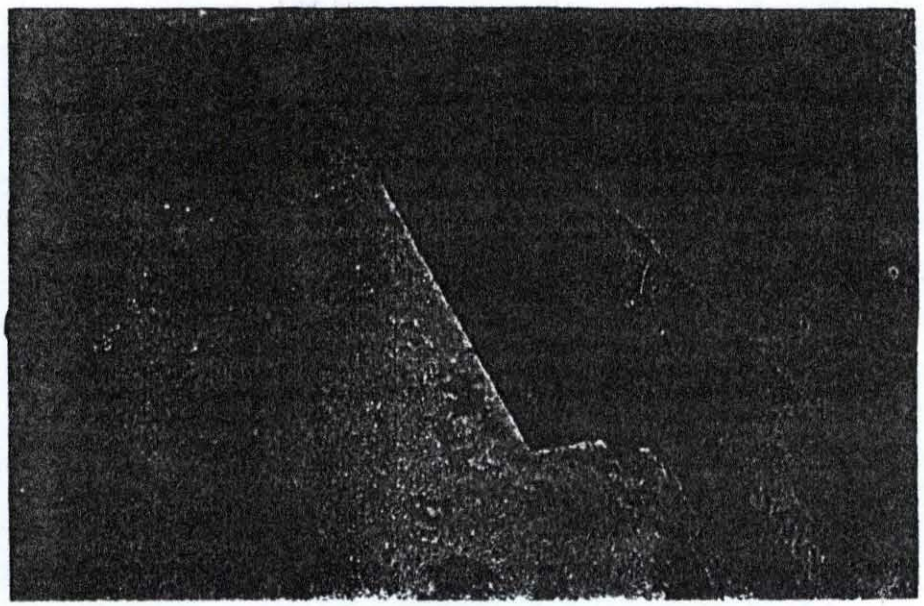
FFS, WUSE ZONE 3, ABUJA - DRILL TOWER



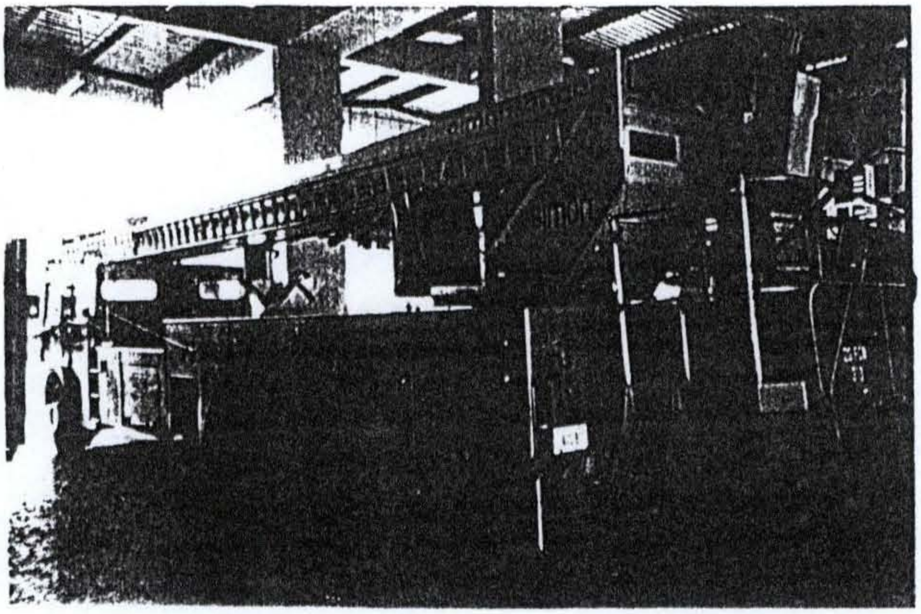
FFS, WUSE ZONE 3, ABUJA - [illegible] ROOM



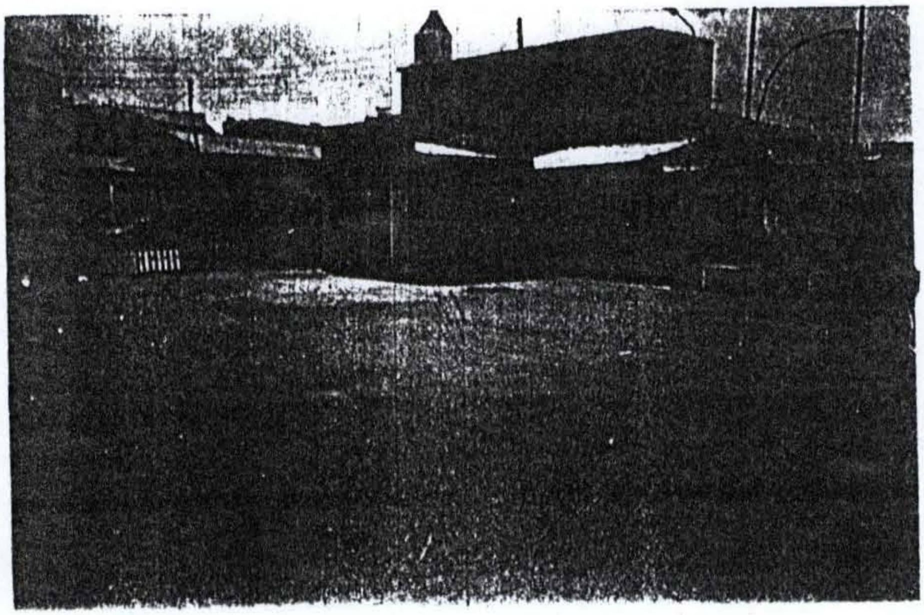
FFS, WUSE ZONE 3, ABUJA - MAKESHIFT RESTAURANT



FFS, WUSE ZONE 3, ABUJA - TIRE BAY SERVICE PIT.



FEDERAL FIRE SERVICE STATION, WUSE ZONE 3, ABUJA, - SHOWING FIRE ENGINES IN BAY - PLATFORM [illegible]



FFS, WUSE ZONE 3, ABUJA SHOWING FIRE VEHICLE EXIT ROAD WITH [illegible] POST.

6. Poor security of site.

4.2. CASE STUDY TWO; FEDERAL FIRE SERVICE; STATION AND TRAINING SCHOOL, WESTERN AVENUE, OJUELEGBA, SURULERE, LAGOS.

4.2.1 Historical Background:

This is one of the first full-fledged fire service stations in the country, if was built in the 1950's to take care of the mainland area of Lagos. It is a federal fire service station.

4.2.2 Site and Location:

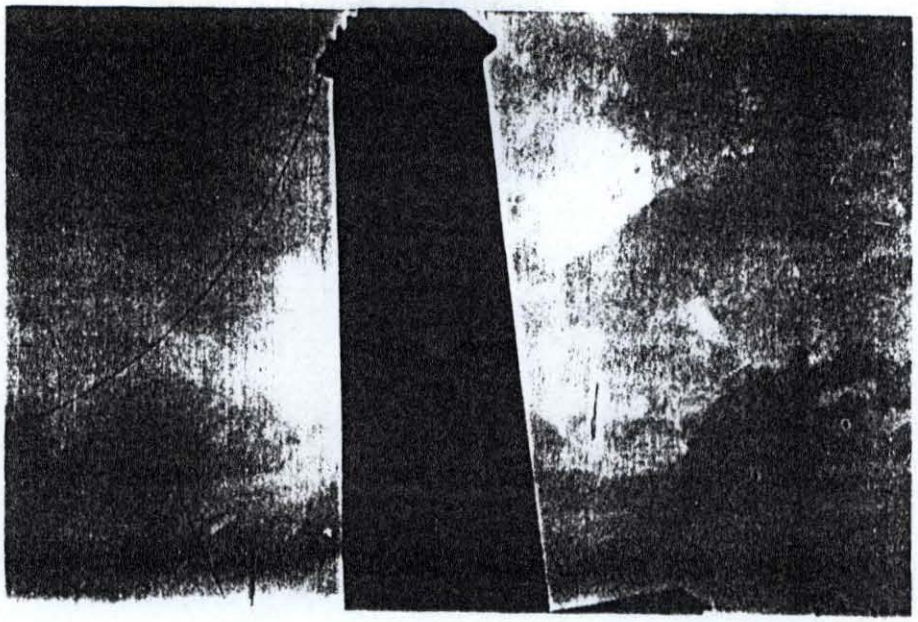
This fire station is located on Western Avenue, in the Surulere area of Lagos. The station is located in the central business district (CBD) of the mainland of Lagos. The area provides a link to all other parts of the Lagos metropolis; it is not very far from the famous Tejuosho market at yaba. It was strategically located to take care of the buildings in the area, housing numerous businesses and offices. The area is a high prone fire area.

4.2.3 Scope of Study:

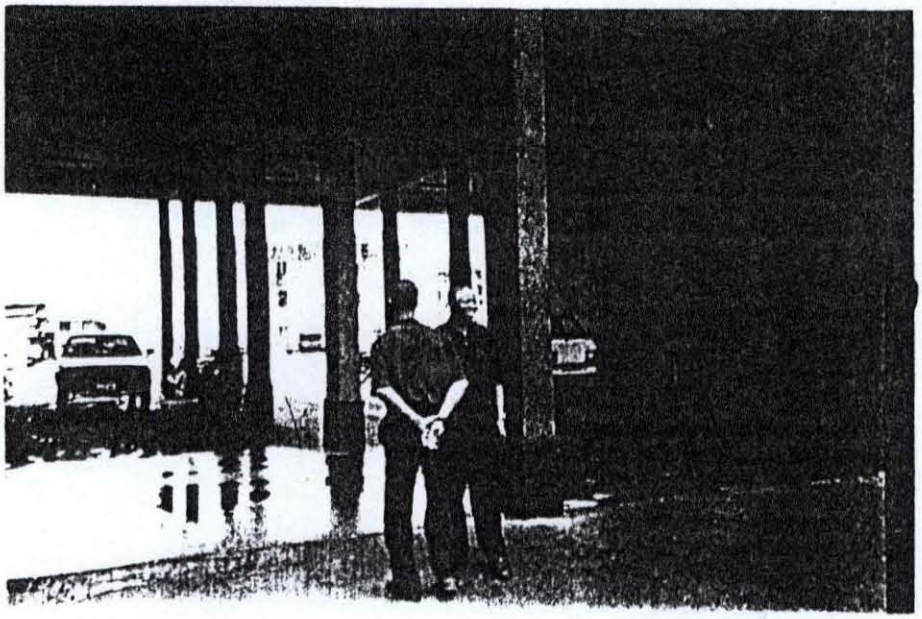
The scope of this facility is quite large compared to the station at Abuja. The fire station covers for fire fighting services as well as a training school for the training of firemen. The facility has a training school, fire service station, adequate drill area, a drill tower, maintenance section and a barracks for firemen. Like the fire station at Abuja if is just beside the area "C" divisional police headquarters at Surulere Lagos.

4.2.4 Design and Planning:

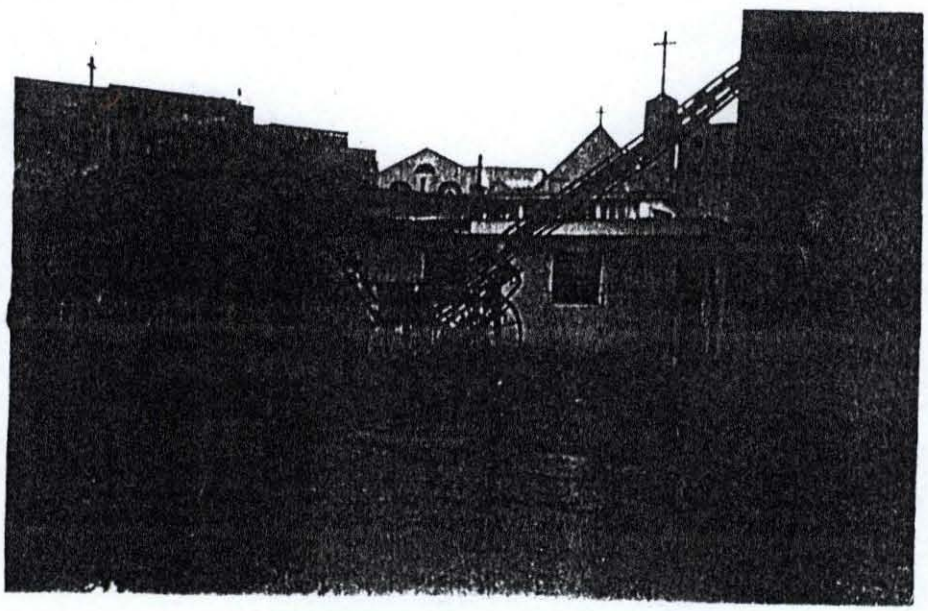
The design was excellently executed, considering the time the building was design. Though the building was constructed during the colonial/exit of the



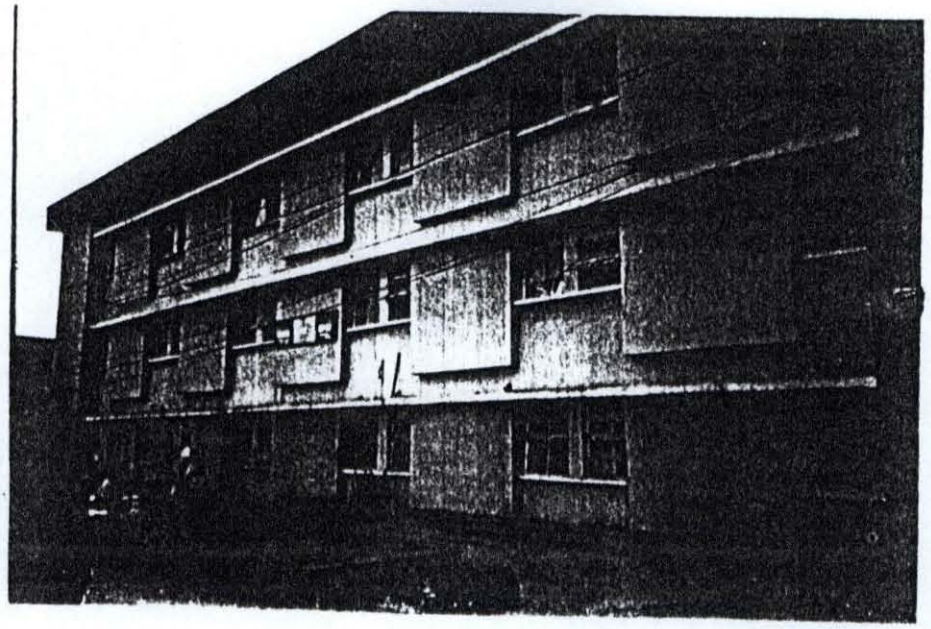
FISHER HILL, LAGOS - DRILL TOWER



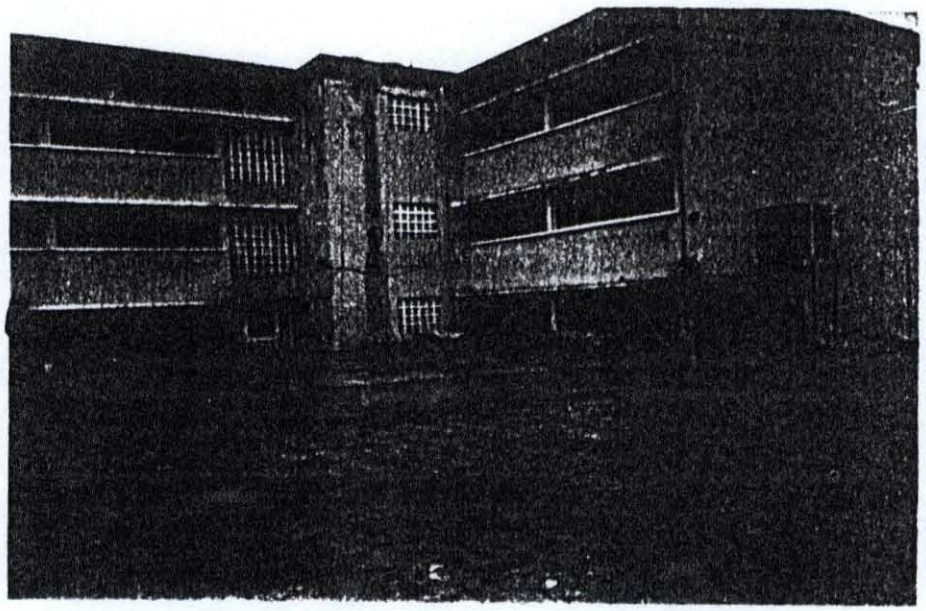
FISHERMEN ON DUTY ON THE 3-BAY.



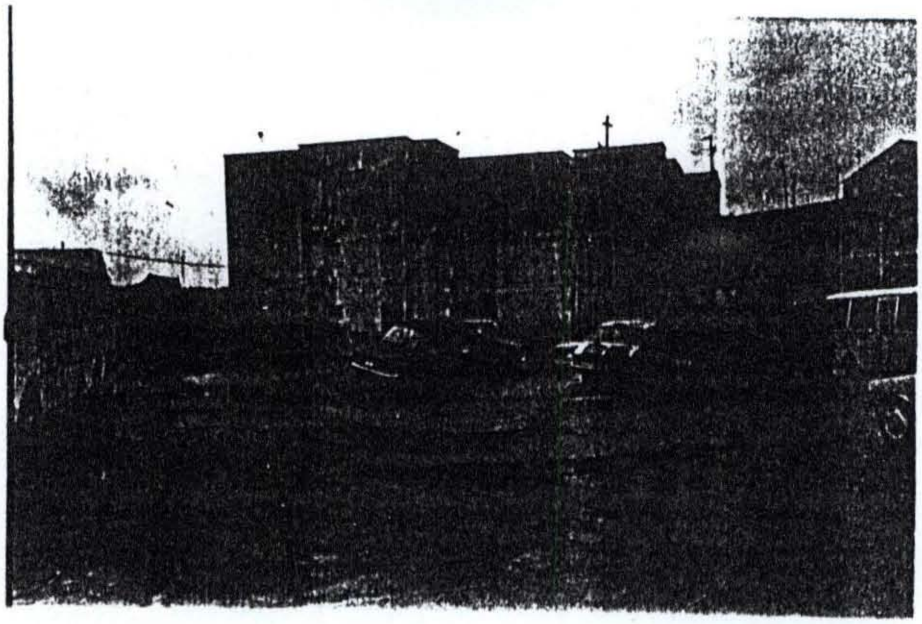
OLD FIRE FIGHTING EQUIPMENT, BARRACKS.



FRONT VIEW; FEDERAL FIRE SERVICE
TRAINING SCHOOL, SURULERE, LAGOS.



BACK VIEW; FFS TRAINING SCHOOL
SURULERE PARADE GROUND/GRANDSTAND.



[illegible] QUARTERS, [illegible], SURULERE LAGOS, SHOWING DILAPIDATED STRUCTURES

JUNIOR [illegible] QUARTERS, [illegible], SURULERE LAGOS, SHOWING DILAPIDATED STRUCTURES

fire station, opens directly to the western avenue, which is good for accessibility, and turnout time in the event of a fire. The construction was also in high quality, considering ifs correct shape keeping in view the time the building was constructed. It is a 3 – bay fire station, with a high drill tower.

4.2.5 Evaluation of Case Study;

Merits.

1. Good planning of site.
2. Provision of training facilities.
3. Good construction of buildings.
4. Aesthefically okay.
5. Provision of ancillary facilities; maintenance, canteen.
6. Adequate accommodation for staff.

Demerits.

1. Poor landscaping of site.
2. Inadequate parking areas.
3. Poor security of site.
4. Poor equipment storage area
5. Poor sanitation on site.
6. Poor maintenance causing dilapidation of structures on site.

4.3 CASE STUDY THREE; FIRE STATION. MAASTRICHT, NETHERLANDS.

4.3.1 Historical background:

This is an ultramodern fire station designed by **NEUTELINGS RIEDIJIK** architects. It was designed and planned between 1996-1998 and constructed between 1998 and 1999, for geemeente Maastricht.

4.3.2 Site and Location:

It is situated in the northern periphery of the southern Dutch city of Maastricht, Netherlands.

4.3.3 Scope of Case Study:

The scope of this fire station includes a garage with a workshop and storage area, living and sleeping quarters for the firemen and offices.

4.3.4 Design and Planning:

It is intricately designed to reflect contemporary architecture. It has double volume hall with ample natural light. The patterning of the concrete exterior seems to have a been inspired by truck tyres. A roof garden with a pond, designed to catch rainwater, also adds a more natural element to the composition. The building has a floor area of about 4000 m^2. The rainwater-collecting pond serves as both to make the building more environmentally friendly and to play on the fire/water opposition that is inscribed in the function of the station.

4.3.5 Evaluation of case Study:

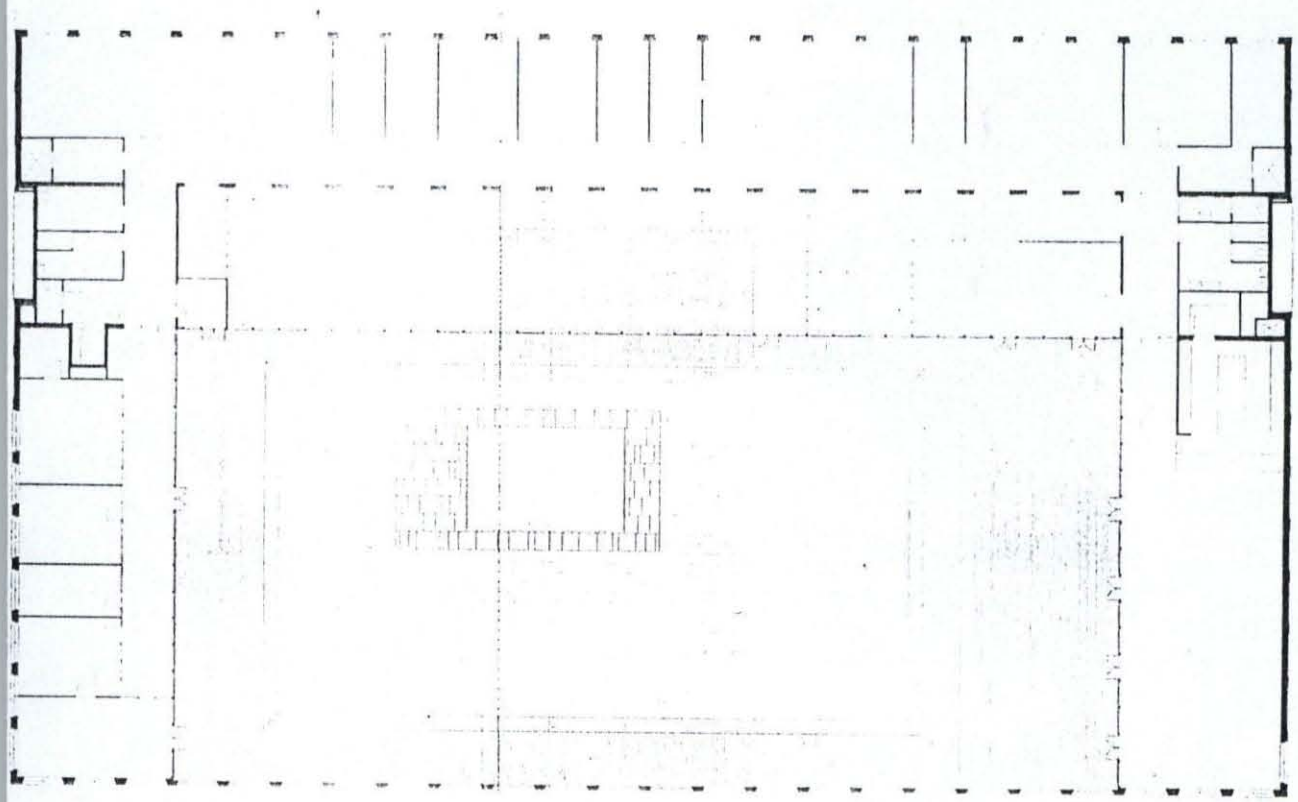
Merits

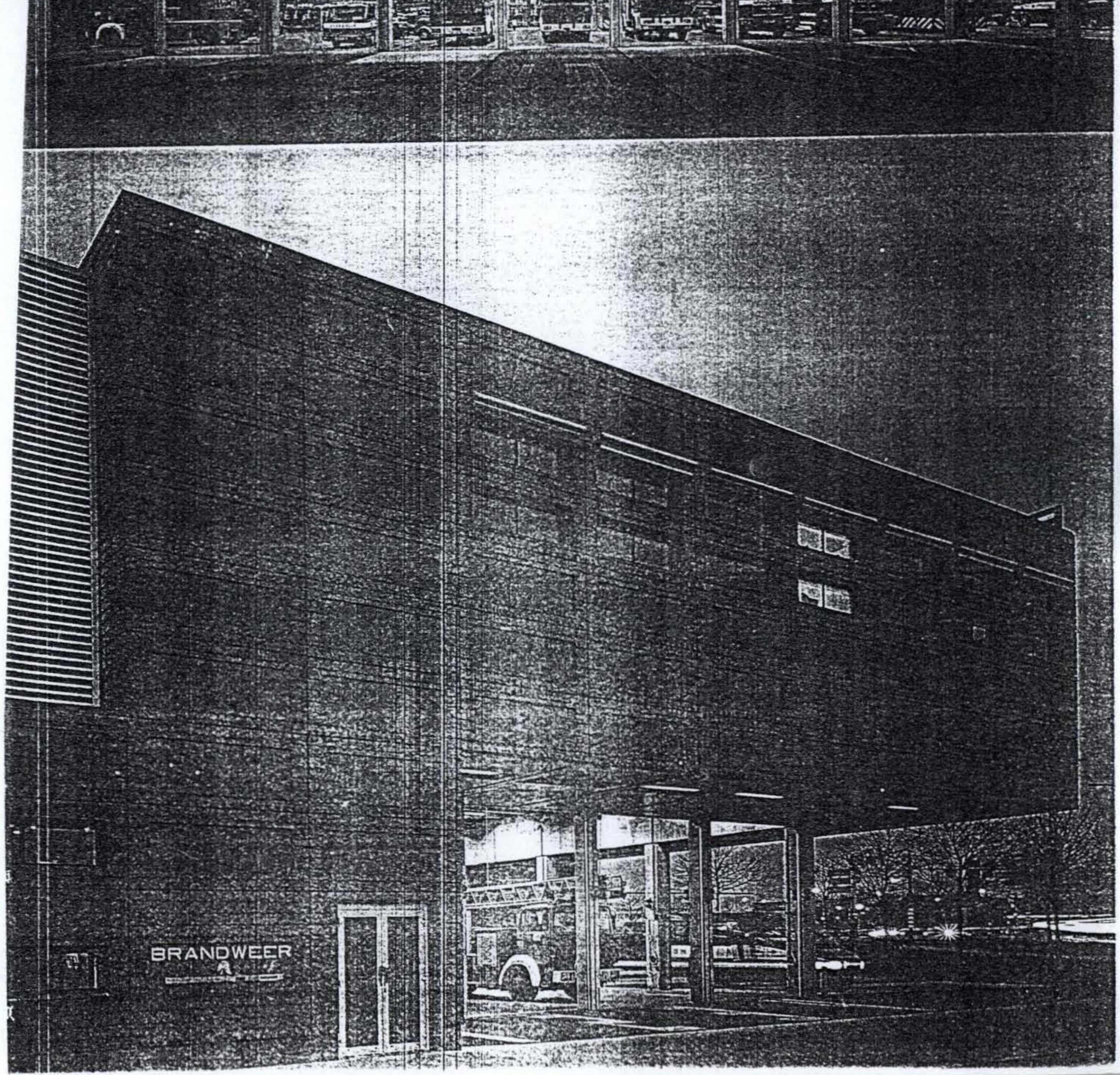
1.Duration Construction of Building.

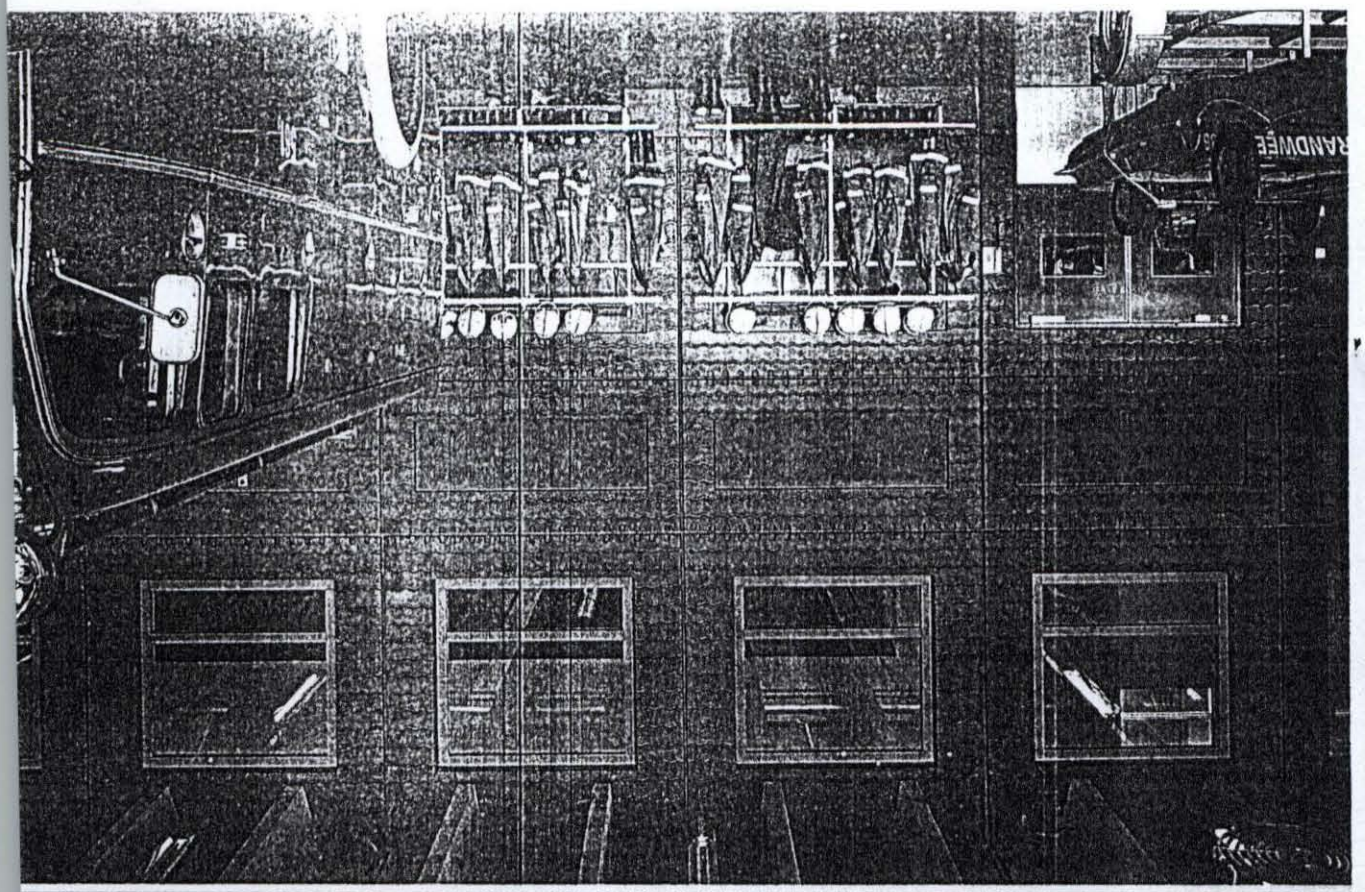
2.Aesthetically Sound building.

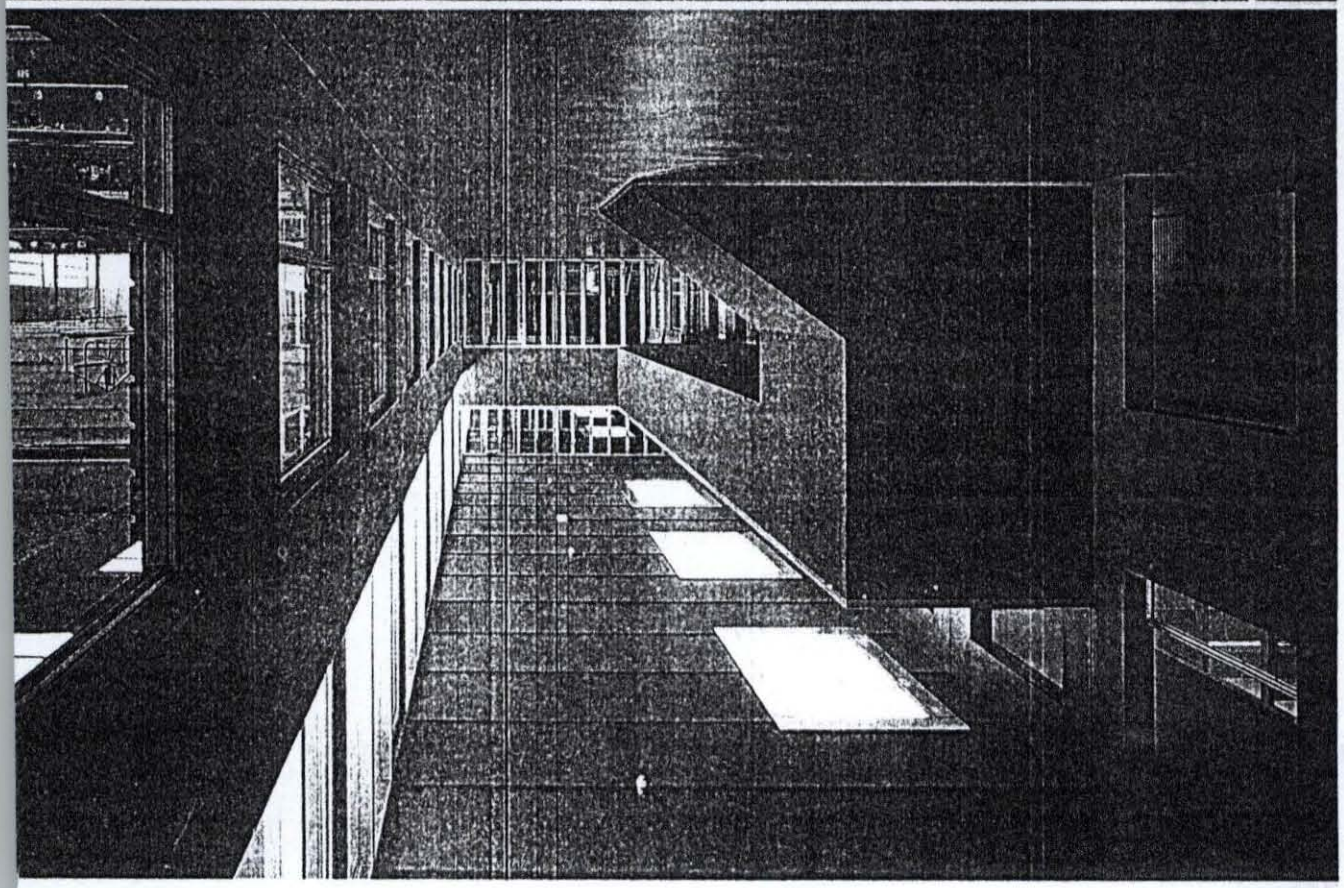
3.Good land scaping of site.

FIRE STATION

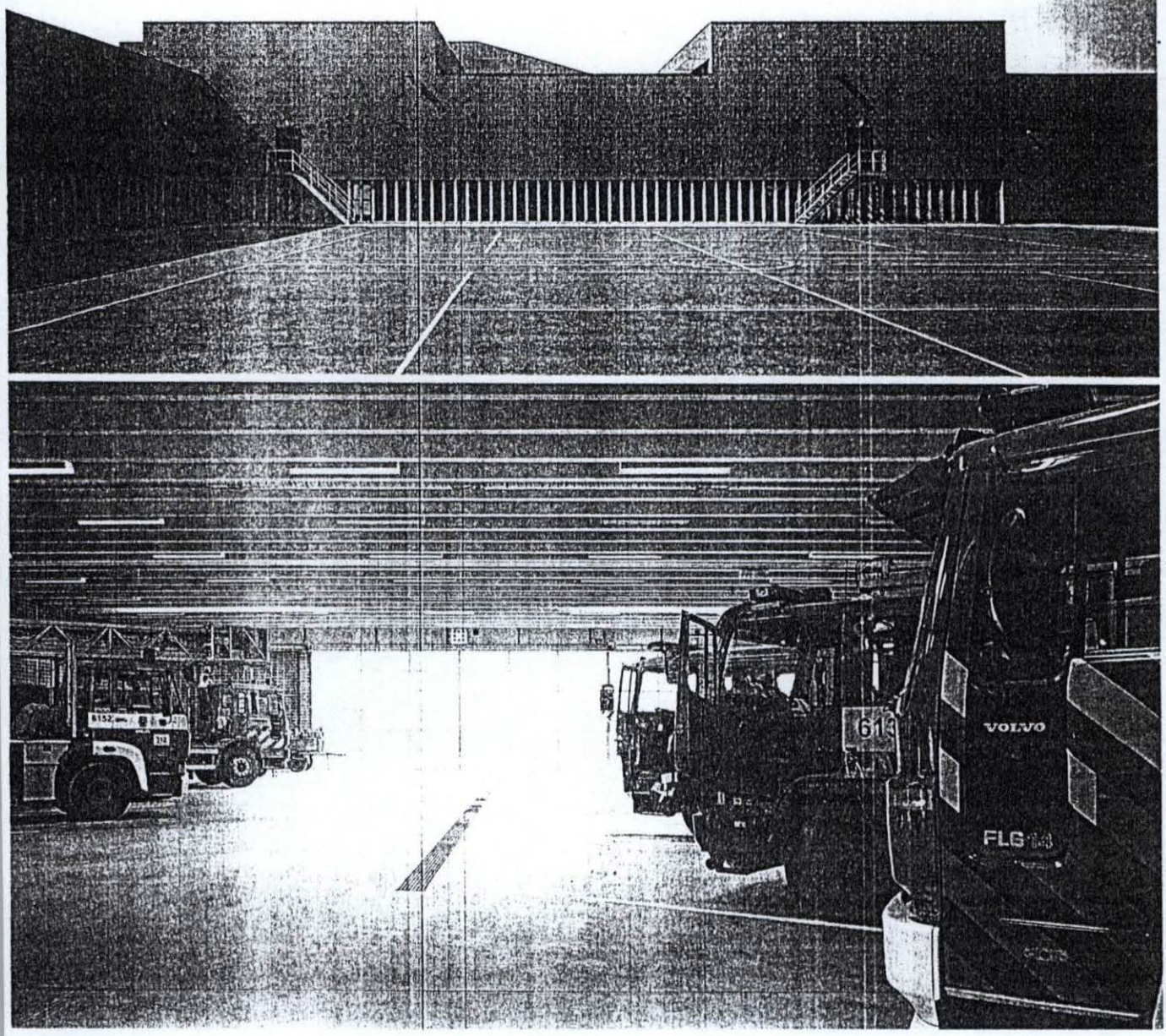



BRANDWEER





FIRE STATION



4.Provision of Pond for collecting rainwater for fire-fighting purposes.

5.Good lighting within the building.

6.Good use of materials.

7.Good ventilation.

8.Provision of living quarters for firemen and other ancillary facilities.

9.Good planning of building and sites.

10.adequate equipment storage facilities.

Demerits

1.No training facilities on the sites for fire men

2.Poor security, too many opening to the outsides of the building.

3.Expensive to construct; not cost effective.

4.No parking spaces provided on site.

5 No drill tower provided on site.

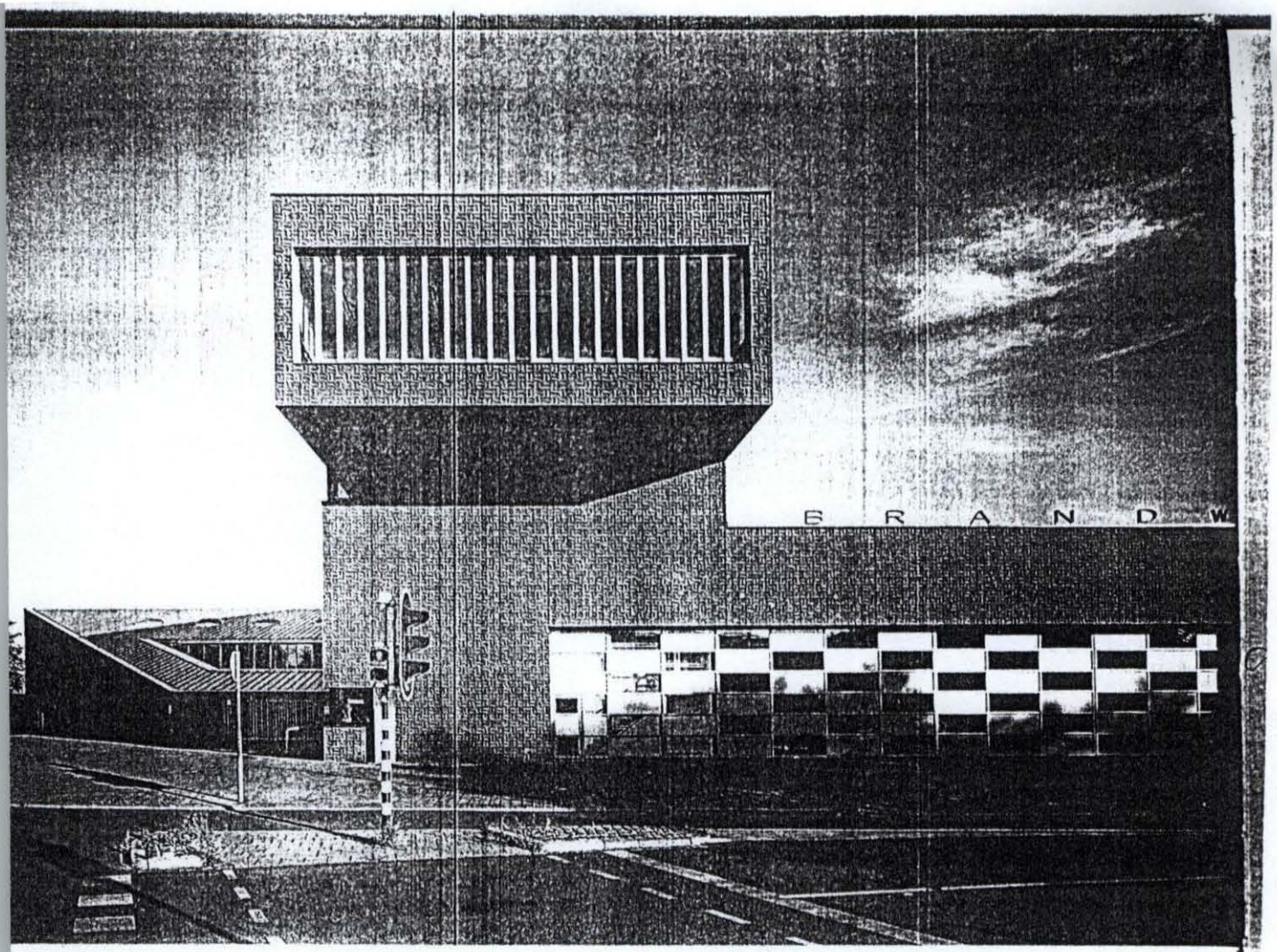
4.4.CASE STUDY FOUR; FIRE STATION BREDA, NETHERLANDS.

4.4.1 Historical background:

This is another ultramodern Fire station design, by **NEUTELINGS RIEDIJK** architects. It was designed and planned between 1996 and 1997and constructed from 1997-1999.It was designed and for the city of Breda in the Netherlands.

4.4.2 Site Location:

The building is located in an oval site near the former rampart of the city of Breda .The site is located near a major road leading to the city



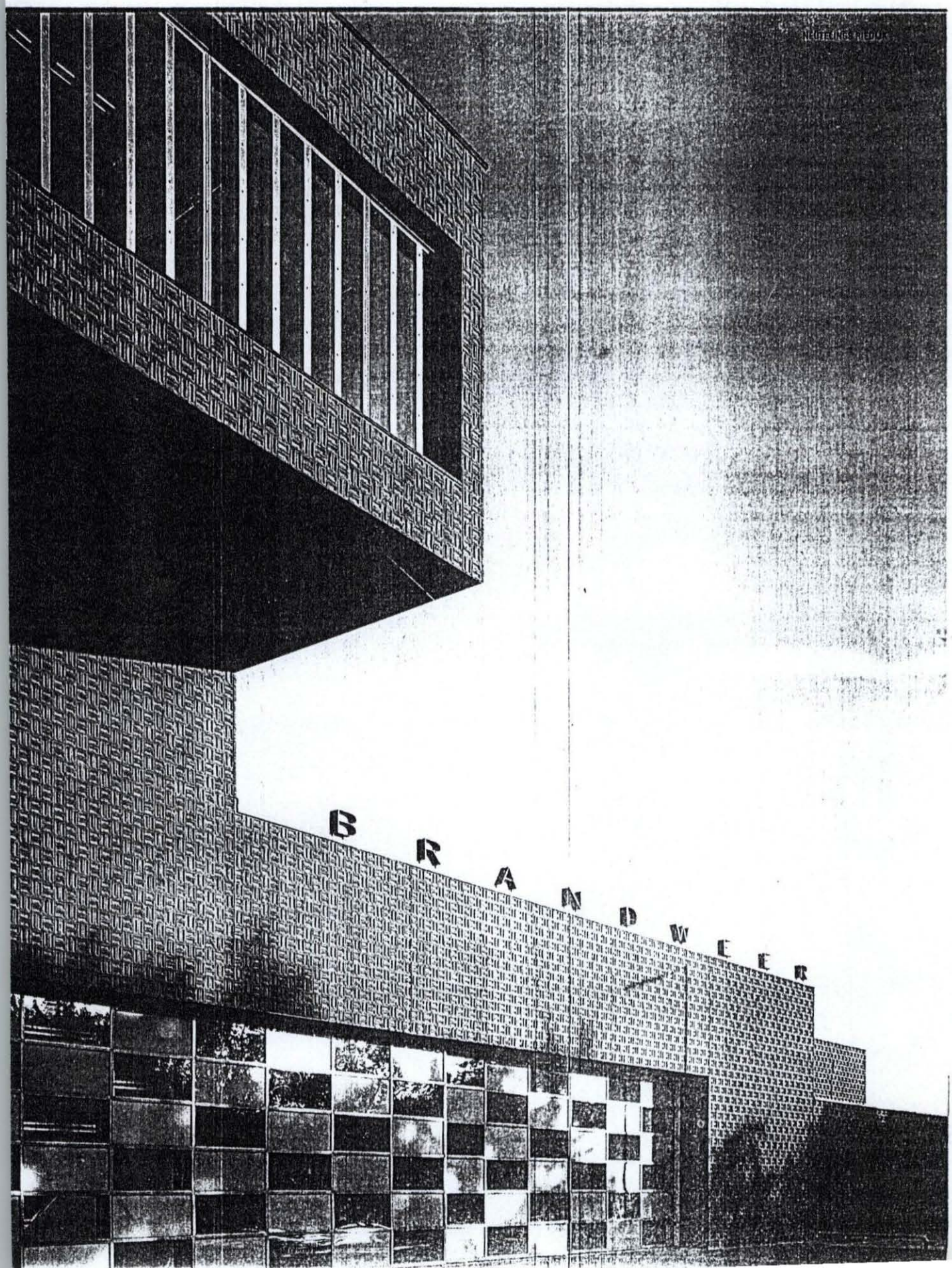
1999 **Breda, Netherlands**

Fire station

Another textured facade, this time bricks laid like a Hessian weave, wraps around the 6,000-m² complex making disparate building shapes and outdoor spaces such as a sports field part of the same building mass. Offices are housed in the elongated section that protrudes from the southern edge of the site like a giant eye keeping watch. Bedrooms form two bridges over the garage, minimising the time taken to reach the fire engines, and separated by verdant roof-gardens. Public activities such as the canteen and classrooms are housed in a triangular building next to the offices but with a clear route through to the garage. The oval floor plan helps address Dutch regulations that it should take less than a minute for the fire-fighters to reach their vehicles.

Die Backsteinfassade der 6.000 m² großen Feuerwache von Breda, deren Struktur an Sackleinen erinnert, umhüllt unterschiedliche Gebäudeformen und bezieht auch Außenräume wie die Sportplätze in den Bau ein. Am Südrand des Geländes ragt ein langgestreckter Bürotrakt vor, der einem riesigen wachsamen Auge gleicht. Zwei Brücken mit Schlafräumen überspannen die Garage, was der holländischen Vorschrift Rechnung trägt, nach der die Löschfahrzeuge in weniger als einer Minute zu erreichen sein müssen. Zwischen den Brücken liegen begrünte Dachgärten. Gemeinschaftsräume wie Kantine und Unterrichtssäle sind in einem dreieckigen Bau neben den Büros untergebracht und innerhalb des ovalen Grundrisses durch eine klar erkennbare Route mit der Garage verbunden.

Une autre façade texturée, cette fois en briques dessinant un motif de tissage, entoure cette Caserne de sapeurs-pompiers de 6.000 m², intégrant des formes architecturales disparates et des espaces extérieurs tels que le terrain de sports dans une même masse architecturale. Les bureaux se trouvent dans la section longue et basse qui s'avance du côté sud du site, tel un œil géant montant la garde. Les chambres forment deux ponts surmontant le garage, dont ils sont séparés par des toits-terrasses verdoyants, ce qui permet de gagner rapidement les véhicules. Les espaces collectifs comme la cantine et les salles de cours, réunis dans un bâtiment triangulaire proche des bureaux, sont reliés au garage par un itinéraire direct. Le plan ovale contribue au respect du règlement, qui prescrit que les pompiers doivent mettre moins d'une minute pour gagner leurs véhicules.


NEUTELINGS RIEDIJK
BRANDWEER

4.4.3 Scope of Case Study:

The facility has workshops, offices, garages, training and recreational facilities and a staff restaurant, the scope seems to be less severe than that of the fire station in Maastricht.

4.4.4 Design and planning:

The fire station showcases an intricate design patterned with bricks that covers most of the exterior part of the building, a central hall and inner courtyard and that brings light and air into interior of the complex, defying rather closed exterior appearance. The raked metal roof and checkered garage door form the strong architectural elements.

4.5 Evaluation of Case Study;

Merits

1.Aesthetically sound building.

2.Good landscaping of site.

3.Good lighting within the building.

4.Good ventilation.

5.Durable construction of building.

6.Provision of training facilities.

7.Provision of ancillary facilities, workshops, eatery.

8.Good planning of site.

9.Adequate equipment storage facilities.

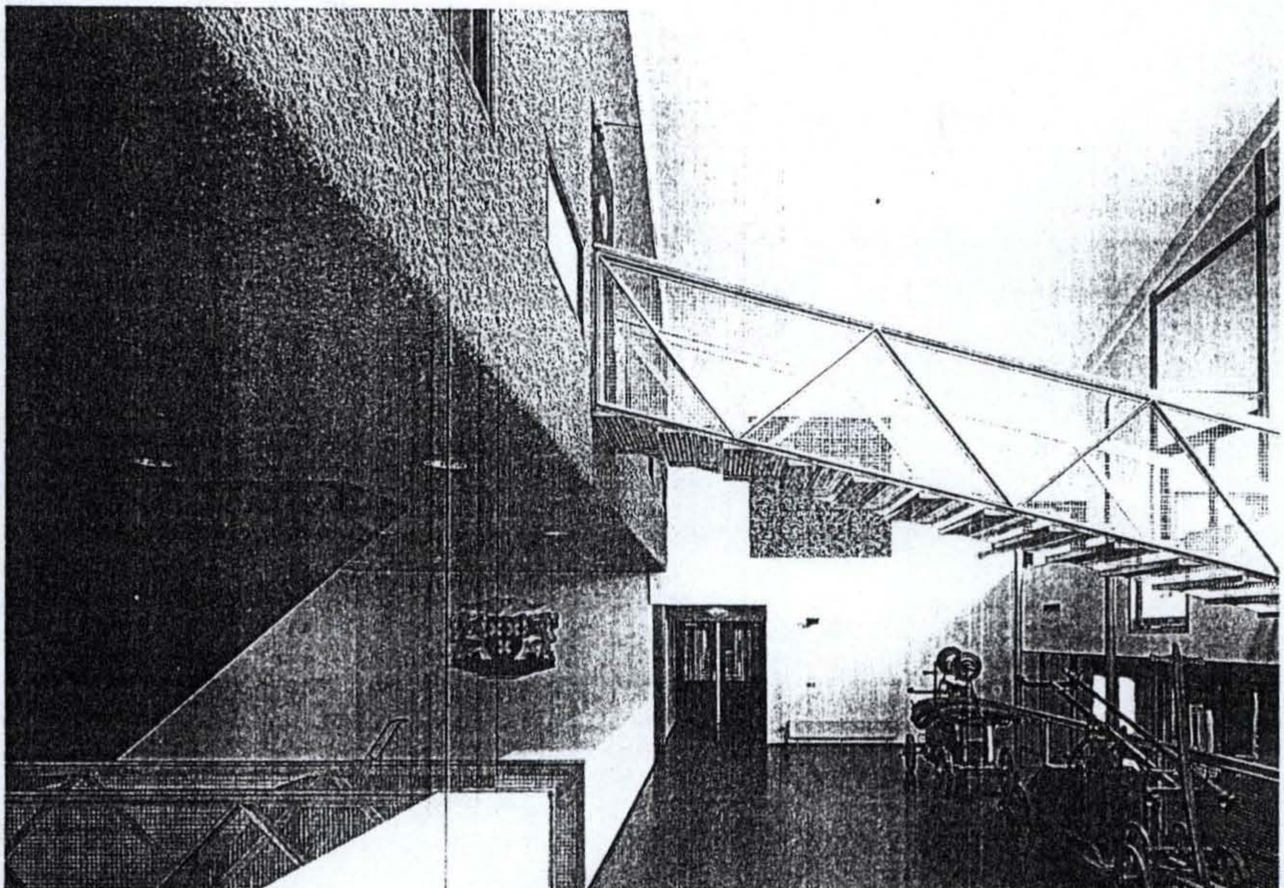
10.Good accessibility: Good for turnout time, near a major road.

Demerits

1.Expensive to construct; not cost effective.

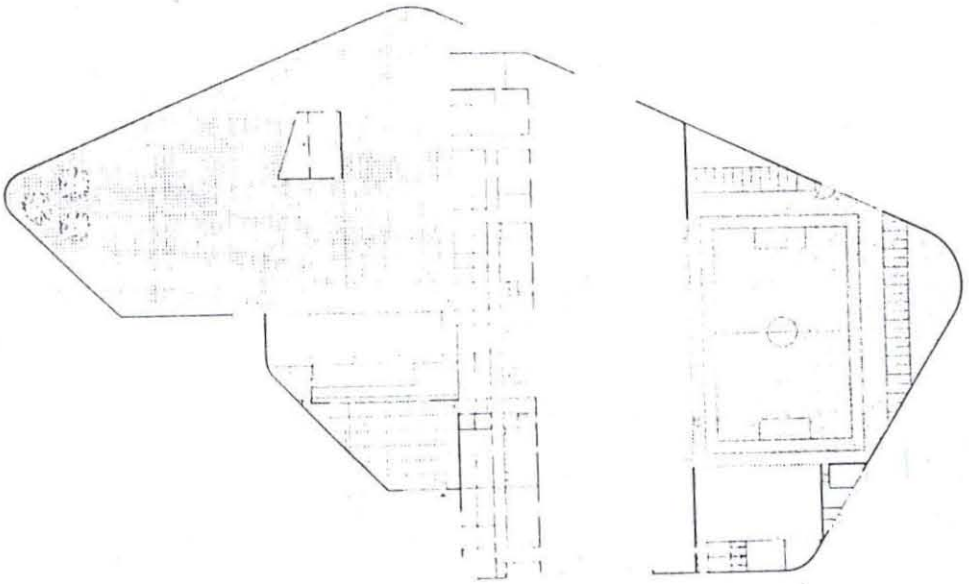
Das **FEUERWEHRHAUS** [illegible] Befestigungsanlagen der Stadt. In einem dekorativen Muster angeordnete Backsteine [illegible] überhängende Bauteile der Feuerwache ihre Strenge nehmen. Der Komplex ist [illegible] zu dem sehr geschlossen wirkenden Äußeren bilden die zentrale Eingangshalle [illegible] auf die »hochgezogene Augenbraue« des Gebäudes hin, die an diesem Standort nahe [illegible] Eine geneigte Metallfläche und die schachbrettartig gemusterten Garagentore sind weitere ausdrucksstarke [illegible]

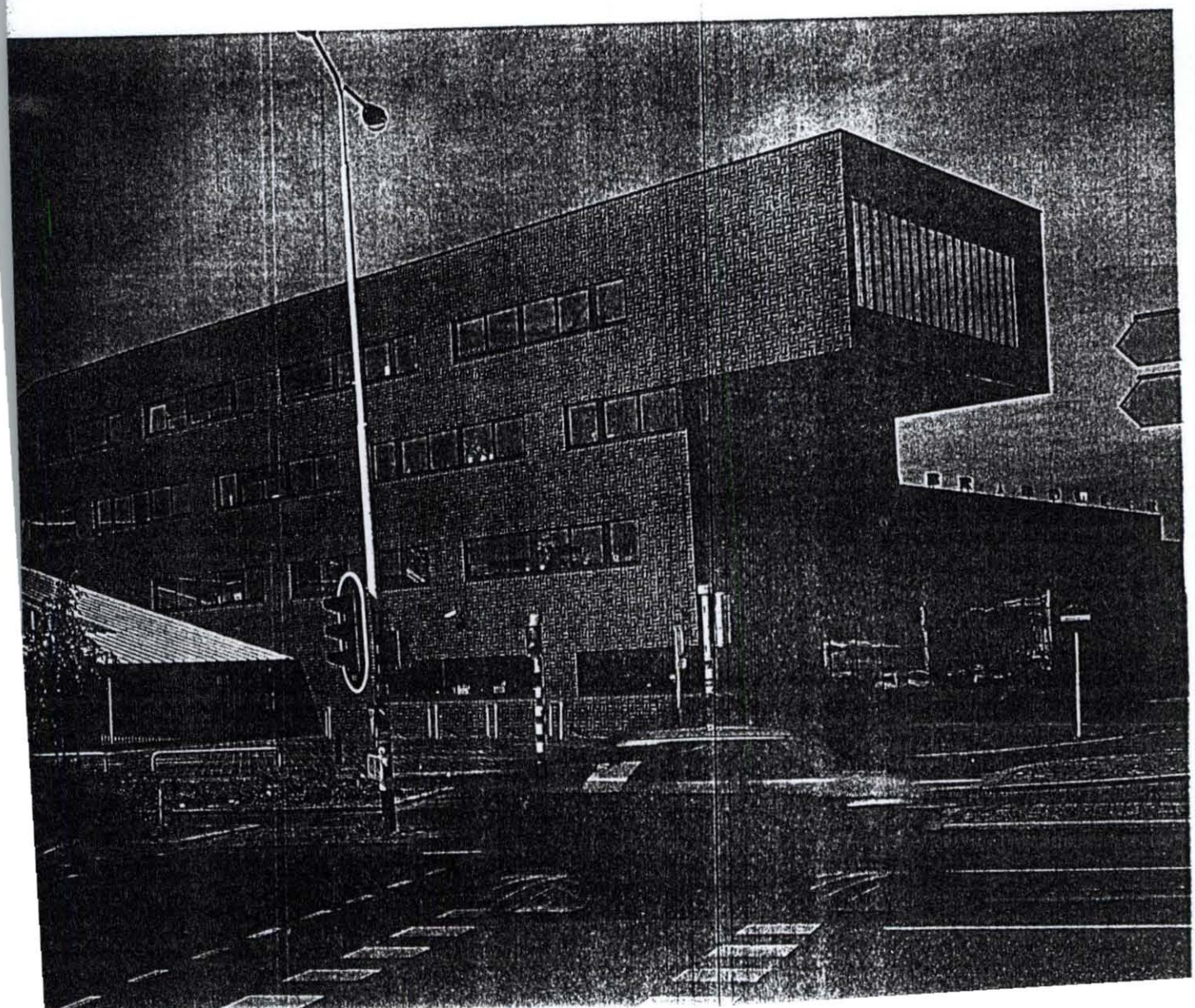
Sur un terrain [illegible] **CASERNE DE POMPIERS** est agrementé d'un parement de briques formant un motif décoratif. La répartition [illegible] de Maastricht. Elle est divisée en quatre zones pour l'entraînement, les ateliers, [illegible] aspect fermé de l'extérieur, font entrer air et lumière au sein de l'edifice. Le [illegible] passe à proximité. Un plan de metal gratté et des portes de garage à carreaux [illegible] des éléments architecturaux forts.



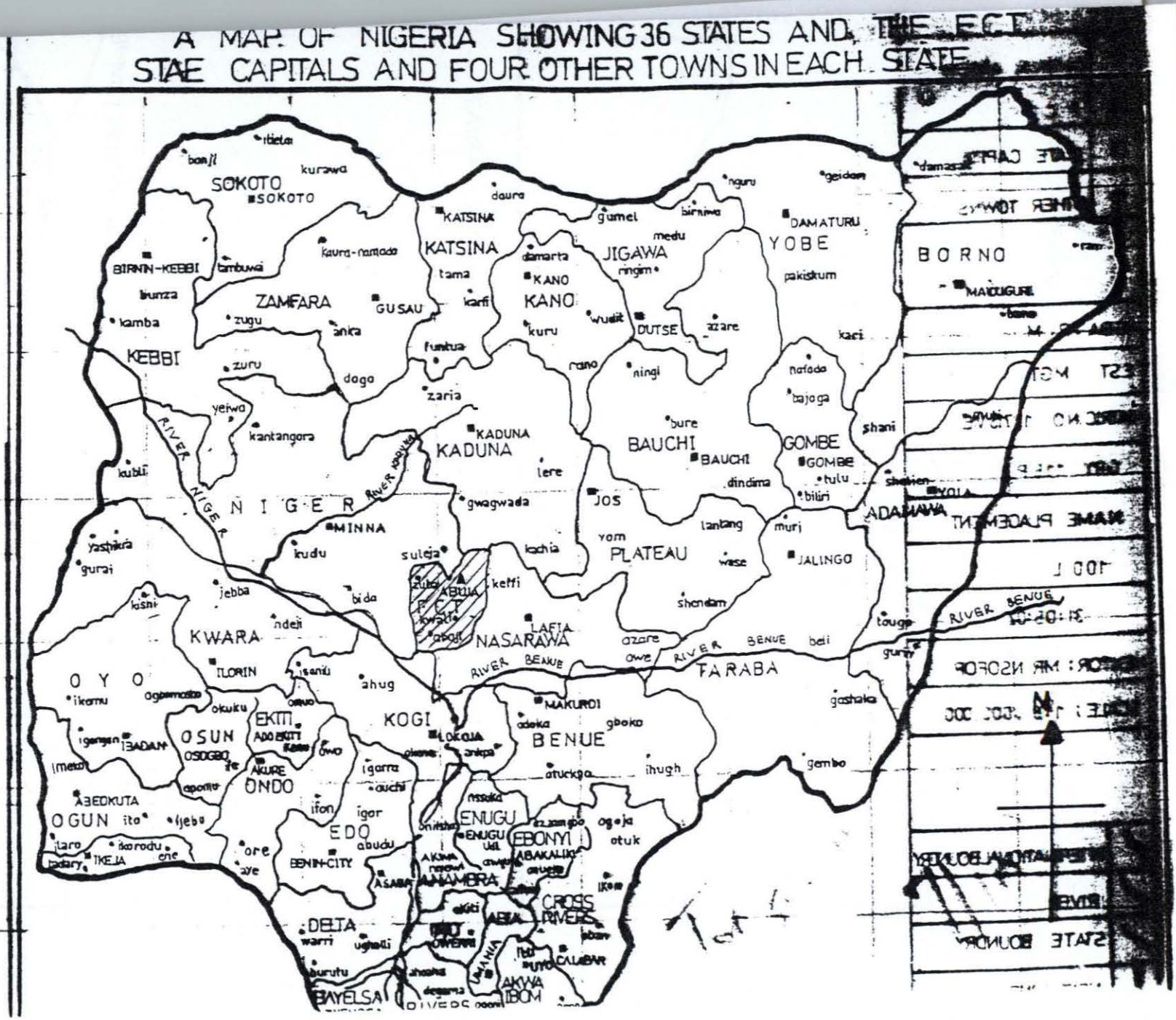
[illegible] Bauteile und schräge [illegible] Rampen sind immer [illegible] Elemente in der Ar[illegible] van Neutelings Riedijk

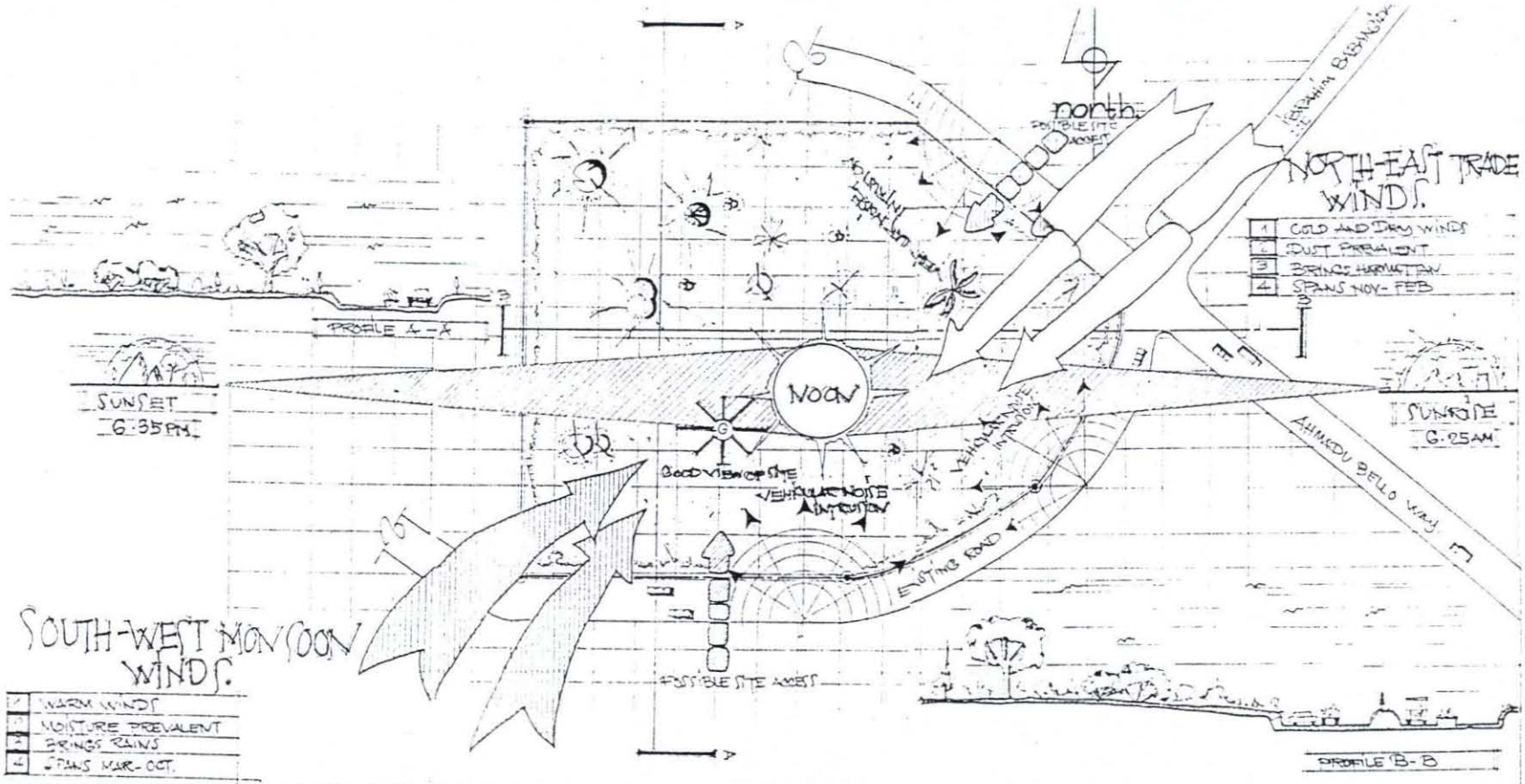
Les volumes suspendus, les plafonds en pente, les rampes et le fonctionalisme sont des éléments [illegible] du vocabulaire architectural de Neutelings Riedijk.





A MAP OF NIGERIA SHOWING 36 STATES AND THE FCT STAE CAPITALS AND FOUR OTHER TOWNS IN EACH STATE





DESIGN PROPOSAL FOR ULTRA - MODERN FIRE SERVICE STATION, ABUJA, NIGERIA, WITH EMPHASIS ON FIRE SAFETY IN BUILDINGS.

SHEET NO	10	NAME	OKON, VICTOR E.
REG NO	M.TECH/PT/873/2001/2002	DEPT	ARCHITECTURE
LEVEL	900	MOTTO	ARC B.N. MON'D
SCALE	1:100	DRWG	SITE ANALYSIS
DATE	AUGUST '03		

6.2 LOCATION OF SITE:

The site is located in the Wuse II /central business district of Abuja precisely at the intersection between Ahmadu Bello Way and Ibrahim Babangida Way. The suitability of this site for the fire station is because of its direct link to central business district, ministries zone and the Maitama district. It is located near the mobile telecommunication exchange of Nitel the Nicon Hilton hotel and just behind the Shehu Musa Yar'Adua centre and the neighbourhood centre. Ahmadu Bello Way is one of the arterial roads of the city and leads directly to the Mabushi district of Abuja, and the ring road of Abuja.

6.3 SITE INVENTORY:

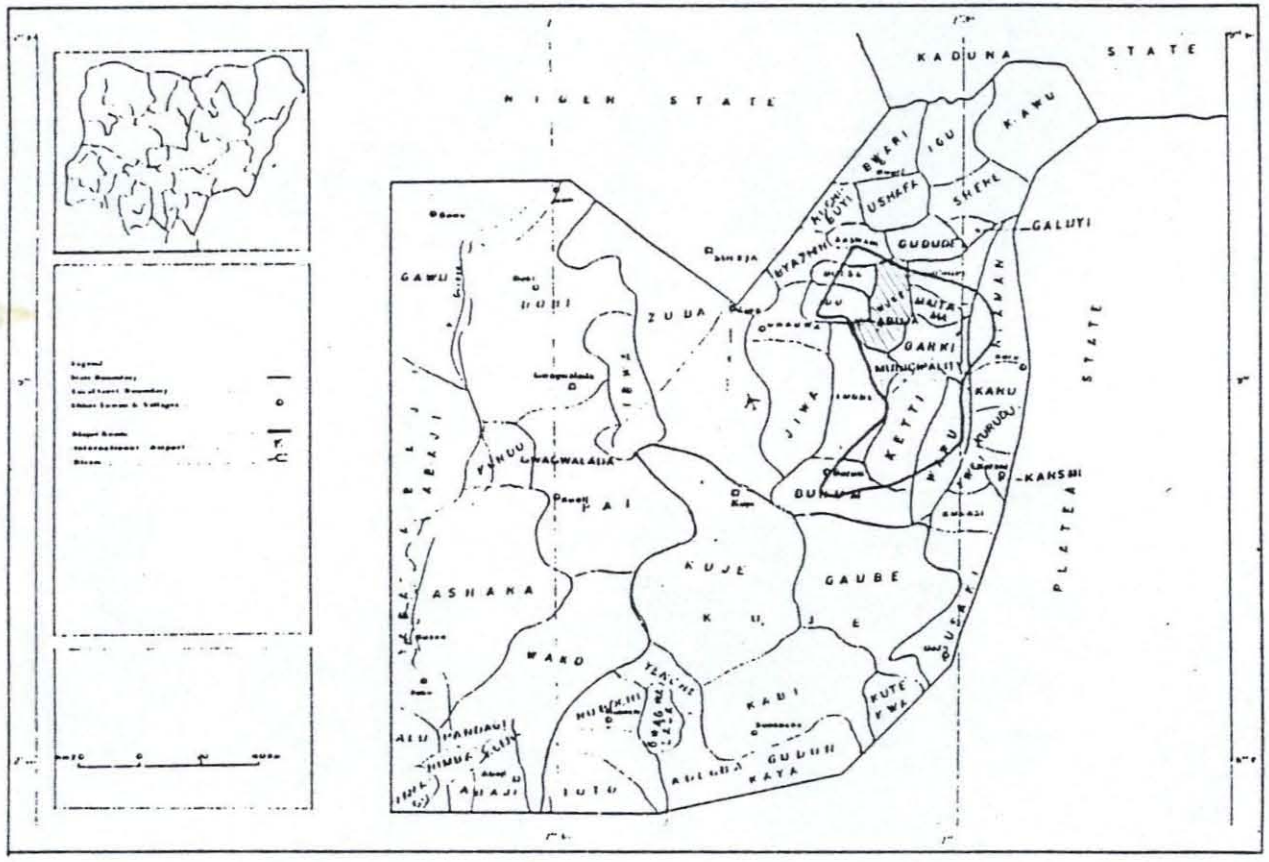
An appraisal of the site; above, on and below the ground was done with a view to establishing the following characteristics;

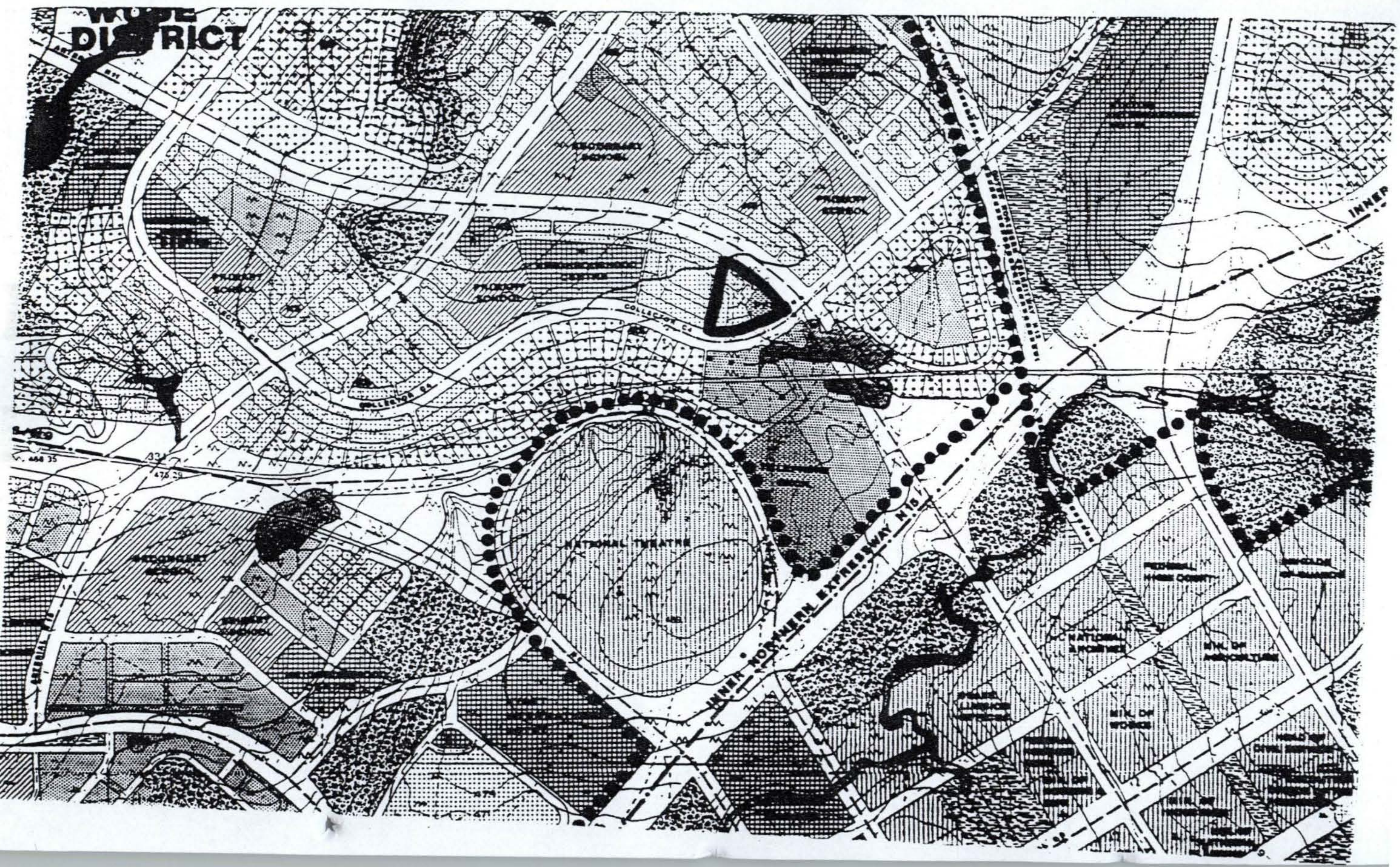
(1) Topography: The site is relatively flat, though it has slight natural slope, the construction on this site will be relatively easy.

(2) Vegetation: The vegetation is the park Savannah type, with few trees and the grasses cover most of the site except for a few patches of sandy soil.

(3) Climate: The climate of Abuja has an effect on the site; the temperature varies between 21^0c and 34^0c anomaly and a total annual rainfall of about 1,600mm. These factors are important in the planning of drainage for the disposal of the rainwater, in this case, which is going to be in a pond for use for fire fighting. Also to be considered are the strong winds

33.1.1 FEDERAL CAPITAL TERRITORY – POLITICAL MAP




DISTRICT
NATIONAL THEATRE
INNER NORTHERN EXPRESSWAY N16
INNER

that are prevalent in the city and provision against this phenomenon be made during the design of the building.

(4) Geology: The geological composition of the site is also of importance, as it affects construction a great deal, the site is underlain by granite and a crystalline complex basement rocks. Due to these factors, the site is ideal for foundation building and is free from geological problems and hazards.

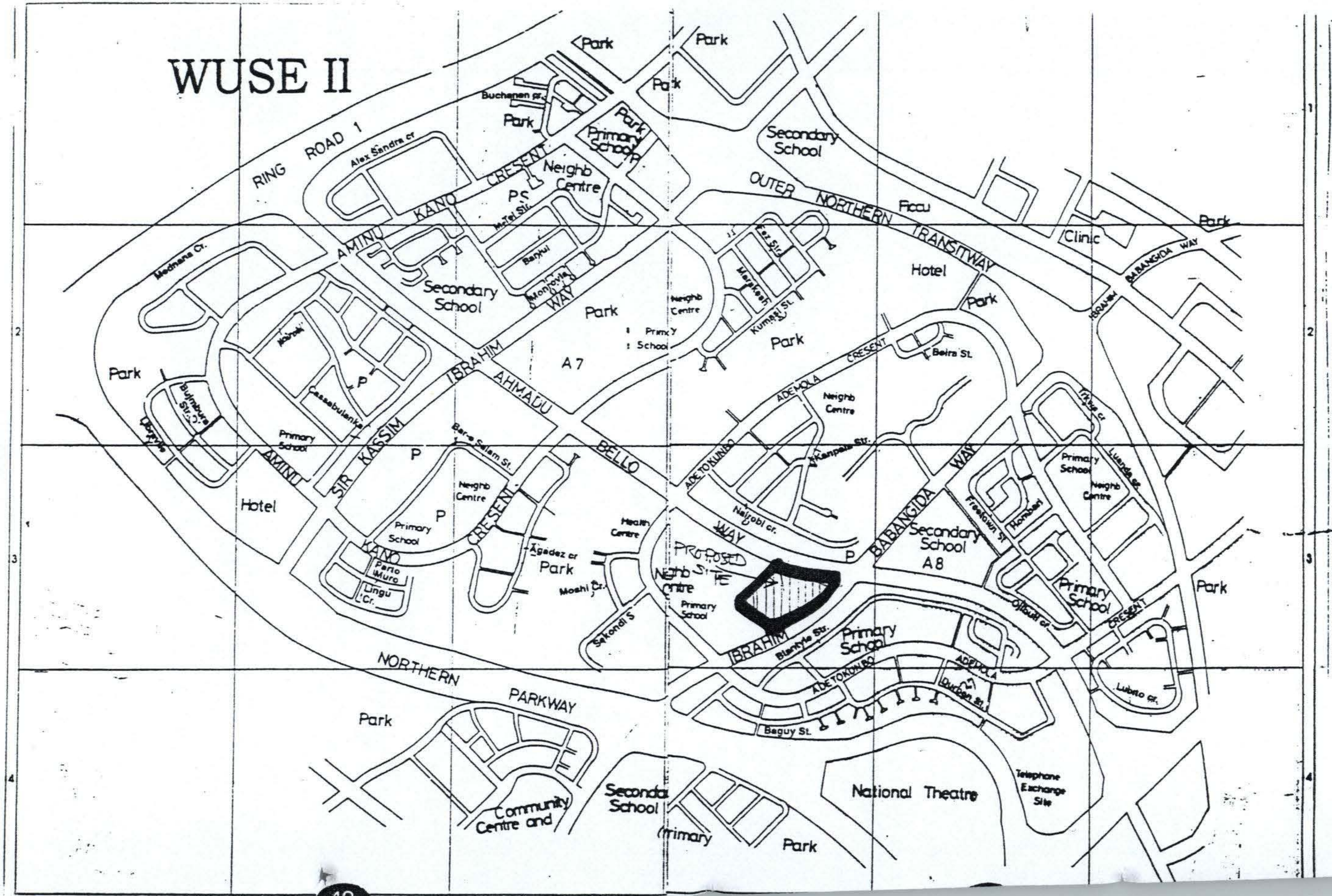
(5) Utilities: Such as water, electricity, sewage should be present on site or in a case where they are not present could be brought in at minimum cost.

(6) The topography and shape of the site should be such as can allow easy planning and permit construction at an economical level.

(7) Existing land zoning must permit fire station zoning: or could be zoned in the future for this purpose; to service buildings in the area.

6.4 ACCESS ROUTES AND CIRCULATION:

The site for the proposed ultra-modern fire station can be accessed from two sides; from ring road 1, through the Ahmadu Bello Way, and from the Northern parkway, through the Ibrahim Babangida way. These access routes are well linked to other roads throughout the city, there by making the site easily accessible, noting that most roads in Abuja City are well constructed and planned. Circulation within the site is very important, and can be achieved with proper planning. The topography of the site also permits easy road construction and planning. A service entrance\exit for the


WUSE II
RING ROAD 1
AMINU KANO CRESENT
SIR KASSIM IBRAHIM
AHMADU BELLO WAY
OUTER NORTHERN TRANSITWAY
NORTHERN PARKWAY
BABANGIDA WAY
IBRAHIM BABANGIDA WAY
KANO CRESENT
ADEMOLA CRESENT
ADETOKUNBO
IBRAHIM
Alex Sandra cr
Buchanen cr.
Madhana Cr.
Casabulanka
Bar-e Salem St.
Agadez cr
Moshi Cr.
Sakondi S
Lingu Cr.
Nairobi cr.
Kenpala Str.
Kumasi St.
Beira St.
Blantyle Str.
Baguy St.
Durban St.
Djibouti cr.
Freetown St
Luanda cr.
Lubito cr.
Secondary School
Primary School
Neighb Centre
Health Centre
Hotel
Park
Clinic
Ficcu
A 7
A 8
National Theatre
Telephone Exchange Site
Community Centre and
PROPOSED SITE

fire vehicles is a possibility because of the nature of the site access routes, to enhance a higher turnout time.

6.5 UTILITIES ON-SITE:

The site being located in the developed area of the city of Abuja, Wuse II/CBD has made it possible for it to benefit from the entire infrastructure already put in place. The water supply is provided via an underground trunk pipeline, which can be tapped from.

The master plan of the city provides for central sewage disposal systems for the whole city including some satellite towns. This central sewage system is designed to make sure that the sewage\wastewater does not pollute the streams, rivers and the environment in the city.

Electricity is provided to the site from power stations operated by the national electricity power authority (N.E.P.A). N.E.P.A runs its power station with the use of gas and water (hydro-electricity) from the shiroro dam in the city and most parts of Abuja.

6.7 ENVIRONMENTAL PROBLEMS:

These are problems that are caused by natural factors and man's activities around the site. There are no serious environmental problems on the site, except for slight run-off during heavy rains, due to the natural slope of the site this problem can be solved by the use of retaining walls after construction has commenced.

6.8 DEDUCTIONS:

After a thorough appraisal of the site, in terms of terrain, topography, climate, access routes and location; shows that the site chosen is suitable for a fire station, meeting most of the criteria used for selection of site.

CHAPTER SEVEN - THE DESIGN

7.0 **THE DESIGN:**

This is the chapter that we would look at how the buildings are conceived, designed, constructed and made to function with the use of building services.

7.1 **CONCEPTS AND DESIGN**

The concept of the ultra- modern fire service station, Abuja, Nigeria is a fire hydrant, though this is not very common is this part of the world; but is acknowledged firefighting and fire protection equipment. The concept is analogical in nature, function follows form. The hydrant viewed in elevation is what was adapted to bring about the plan of the main building in the Fire Station, a hydrant usually has a hose connector which is used to connect hose extensions in fighting fires; this extension was introduced into the plan, which took care of the restaurant of the building.

7.1.1 Another factor that greatly influenced the design, was my design philosophy for the ultra modern fire service station, Abuja, Nigeria is based on the three principal schools of thought;

1. "Every great architect ..... must be a great original interpreter of his time, his day and his age."

FRANK LLOYD WRIGHT.

2. "I must design what pleases me in a way that is naturally linked to my roots and the Country of my origin"

OSCAR NIEMEYER

3. "Now that is why the Architect should have a capital " A"; he is the form giver of his people, his civilization and if he is empty; GOD HELP THEM"

FRANK LLOYD WRIGHT.

These philosophies has given the basis of my design, it is to be an interpretation of the present day, age and time; and also to be well designed and linked to my Country Nigeria, giving the complex it's identity.

7.1.2 The buildings have been designed to meet with the ever-changing technology and the advancement in architecture, this can be seen clearly in the construction of the facility. The fact of the building being linked to roots and the Country of my origin can be seen in the form of my general concept; horizontally pavilion. Nigeria has a poor maintenance culture, the problem of power supply and infrastructure. The horizontal pavilion concept entails the building being spread more on the land, than in height above the ground, representing the large landmass of the Country. To stop the problem of poor maintenance and poor power supply resulted in the resolve for the use of large courtyards to aid both ventilation and lighting and reduced the over dependence on mechanical means for achieving these elements.

Notable architects such as Frank Lloyd Wright, and Walter Gropius of the Bauhaus School developed the Prairie School, which is also a basic type of the philosophy of the design, it was started in the 20th Century.

7.1.3 To achieve the design in whole; in terms of the form, structure and features of the building plans diagrams and other graphical means the design concept can be broken down as follows;

1. General Concept; Horizontal Pavilion

2. Canonic/ Functional Concept; Grid Modular, avoids deep volumes; gives room for future expansion, fire safety and aid lighting and ventilation, and structural stability.
3. Site Concept; Here the zoning principle was used. Taking each building on site and how it relates to the other site function to active at a suitable zoning principle.
4. Analogical Concept; this was used in arriving at the form of the main building which is the Fire Station itself.

7.1.4 The brief for the design is to design a modern Fire Service Station at Abuja, Nigeria, that would be a symbol of fire safety in Abuja. The facility was to undertake the firefighting services, emergency and fire rescue operation, on the job - training and training of staff, Administration and other related functions to modern – day fire fighting.

The buildings and facilities include:

1. Main Complex; To house the following functions
    (a) Administration (offices)
    (b) Fire engine hall
    (c) Trainee accommodation
    (d) Clinic
    (e) Restaurant
    (f) Operations
    (g) Indoor training facilities
    (h) Helipad
2. Fire / Drill Tower
3. Maintenance /Works Section

4. Recreational Facilities
5. Parade Grounds
6. Other Ancillary Facilities

(i) **Main Complex:**

This is a building design to house administrative, training, firefighting operations, clinic, restaurant, it has a library, computer section, communication center, lecture rooms, training accommodation for junior and senior staff; on two levels, the lower levels for the junior staff has four occupants per room, while that of the senior staff has two occupants per room.

The number of rooms per level is twelve (12), on each level, there are toilets and baths and a laundry for the trainees and a mess room. On the highest level there is a helipad, a clear space on the roof for the landing and taking off of the helicopters to be used for surveillance, emergency and rescue operation of the fire service.

In the basement there is a gas room for training a firemen on fire spread and a flame testing, Fireproof Construction separates this basement from the other parts of the Complex. A restaurant for junior and senior staff and trainees is in extension of the complex.

(ii) **Fire / Drill Tower;**

This tower is used for surveillance by the fire station; spotting of fire and guidance of fire vehicle drivers, to scene of fire. The building is also used for fire drills for fire fighters, to help them overcome the fear of height and also as a means of drying wet hoses after firefighting operations, the hoses are

dried by stretching the hose from the top of the tower to the bottom using the cat ladder.

(iii) **Maintenance/ Works Section:**

This is designed to maintain the facility, it has vehicles repairs and services sections, offices, store, changing rooms and fuel dump.

(iv) Recreational Facilities:

These are for general recreation and physical training for firemen. It is located on the site

(v) **Parade Grounds:**

This design as an assembly area, for parade and other activities, it is also located on the site.

(vi) There are other general ancillary facilities on the site like, security post, water tanks, and a rainwater-collecting pond to add a more natural element to the whole composition and to play on the water fire opposition that is inscribed in the function of the fire station. This water pond will also serve as a reservoir for water to assist in firefighting operations giving no more room for the unavailability of water as an excuse to poor response to fire alarms.

7.2 MATERIALS AND CONSTRUCTION

7.2.1 Construction Materials;

These are the materials that are used in construction of the building, the emphasis of this building is fire safety so the materials used in the construction, have to be non – combustible materials, heat resistant glass and reinforced concrete. These materials are use effectively to achieve this purpose. The materials used in the building are discussed briefly below;

(i) **Concrete**:

This a mixture of cement, soil aggregates, the nature of the concrete and its strength is usually determined by the ratio of cement, sand aggregates in the mixture. However, concrete is weak in tension but strong in compression. For concrete to carry very heavy loads, it has to be reinforced, this is done with the use of steel, which is strong in tension but weak in compression, this balances up for the weakness in tension of concrete. Concrete and reinforced concrete are used extensively in construction of the various units on the site.

(ii) Sandcrete Blocks:

These are blocks that are made from a mixture of cement, sand, aggregates, and water. It is used for non – load bearing walls and are used as in – fill for the grid – modular (frame) structure, as well as other elements of the building. It is usually hollow, and is a singular masonry unit.

(iii) Glass;

this is a brittle, hard, usually translucent or transparent substance, that is produced by fusing Silica, a flux and stabilizer with the use of Kiln at a very high temperature about 1000°c, into a mass that cools to a rigid condition without crystallization.

Glass is used extensively in the construction of buildings, for glazing in windows and doors. Laminated, tinted glass and glass blocks are specified for certain area to avoid shattering from impact and or force, and also for privacy.

As a result of the emphasis of the thesis, for fire safety purposes, heat – resistant glass in used.

(iv) **Steel;**

This is a combination of various iron – based Alloys having a carbon content that is less than that of cast iron but more than that of wrought iron, having qualities of hardness, elasticity and strength varying according to the level of heat treatment.

Steel can be used for a wide range of building elements like roofing members, reinforcement, door and windows.

(v) **Wood;**

This is a tough, fibrous, cellular substance that makes up most of the stems and branches of trees beneath the bark. There are basically two kinds of wood; the hard wood and the soft wood. The hard wood is from deciduous, broad-leafed flowering trees such as maple, cherry and oak. They shed their leaves at the end of the growing season. The soft wood on the other hand is from a conifer, which is an evergreen cone – bearing tree such as the fir and birch.

Wood is a combustible material and very susceptible to fire, but for the issue of its fire safety, where it was utilized in the construction, it was treated with chemicals to increase its fire resistance rating, as well as to secure the wood from insect attack. Hard wood is used for roof members and furniture, while soft wood is used for formwork and a variety of other things in construction.

(vi) **Aluminium;**

This is a ductile, malleable, silver – white metallic element used in forming many light, hard alloys. It is often anodized for better corrosion resistance, colour, surface and hardness. It is used extensively in this

design as a roofing material, and it other places as panels/ frames for doors and windows.

(vii) **Marble and Tiles;**

Marble is a metamorphic rock of crystallized limestone, consisting mainly on dolomite or calcite, capable of taking a good polish. It is very strong (as strong as steel), durable, has a good appearance, but is quite expensive, and it can be slippery when used on the floor. It was used in the specific areas in the design.

Tiles however, are modular units that are used for facing floors, walls and counter tops. For this design, ceramic tiles were basically used; they were made from fined clays and were also used in fencing walls, for counter tops in the kitchen and restaurants, and for toilet walls and floors. They are relatively cheap, easy to clean and resistance to water, oil and greases. They also have good fire resistance as regards fire safety in the building.

(viii) **Paints;**

This is a mixture of solid pigment suspended in a liquid vehicle applied as a thick, opaque coating for protection and decoration. Paint was used for the entire finishing of the entire project, both internal and external. Painting was done with texcote, gloss and emulsion; wooden materials are finished with oil-based paint. Iron bars and fitting are also preserved with a protection of a few coats of paints. As regards fire safety, the structural members are coated with lutumesicent paint, so that when exposed to the heat of fire, swelling to form a thick insulating layer of inert gas bubbles that retards flame spread and

combustion, and therefore avoiding a breakdown of the structural system of the building.

7.2.2 CONSTRUCTION TECHNIQUES USED

This deals with the techniques, which were used, in the construction of the building in the facility. It is a logical process that can be approached from foundation level to the roofing level and also includes, landscaping of the site and the external works to arrive at a fully completed facility. The logical process is discussed below and the construction of each item is also elaborated.

(i) **Site Investigation and clearance**;

Before work can actually start on the site, the site must be free from all encumbrances. It has to be investigated and cognizance is taken of the features above, on and below the site. The site is then cleared, and then the actual construction work can start.

(ii) Foundation and Structural System;

The foundation is the lowest part of the building, which can be partially or wholly bellow the ground, it is designed to support and anchor the super structure, and transmit the live and dead load of the building down to the soil, this has to be properly calculated so as to avoid building subsidence. The foundation has to be dug to a depth suitable enough for it to carry the loads of the building.

The structural system consists of a grid – modular system of structural elements (beams and columns) designed and construction so that it can function as a whole. It supports and transmits applied loads safely to the ground without exceeding the allowable stresses in the members. The

structural system is constructed in a skeletal form, and the non – load bearing walls and partitions are used to "clothe" the skeleton.

(iii) **Floors;**

The floor is made up of either concrete or reinforced concrete as the case may be. Waffle grid was also employed for the construction of the floors. These floors are usually 150mm thick. The floor above the basement is a fireproof construction to enhance fire safety.

(iv) Walls;

The walls for this facility are usually non – load bearing, and are used to enclosed, divide or protect space within the building. The loads bearing walls perform the same function in addition to carrying load and transmitting the loads to the foundation. The walls in fine prone areas were built with fireproof construction to avoid spread to other part of the building, such as the basement in the main building (occupancy separation/ compartmentation).

(v) **Doors and Windows;**

It is used for access in and out of the spaces within the buildings, they can also aid fire safety in exits, such as automatic and self-closing fire doors as was used in the building on the site.

The windows are to allow light and air into the building and also to create view to the outside; casement windows are used, with heat resistance glass, in aluminium casements to enhance the fire safety within the building.

(vi) **Roof and Ceilings:**

Most of the roofs have a combination of gables and slabs; this is due to the extensive used of courtyards, the roof also has gutters where the gables are to drain the waters into the channel that leads to rainwater collection pond. Where

there is no roof like the fire / drill tower, the slab is screed to slope to allow the water drain.

The ceilings are suspended at about 600mm from the slab above or roof as the case may be. This is done so as to accommodate services; suspended ceilings are made of plasterboard with a fire resistance rating.

(vii) **Details;**

Details are necessary in construction because it makes clear areas that are difficult to construct, how the designer wants a specific constructions carried out. Several areas have been detailed in the design, to show how they can be constructed. The details are attached along with the design drawings in the appendix.

7.3 **Space Requirements;**

The space provided in the design were determined based on certain parameters; (i) what is the nature of the activity to go on in that space. (ii) How many people can used that space at a particular time. (iii) The space must be adequate for the peculiar nature of the space to be utilized. The space requirements for this facility are broken down based on the unit located on the site; they are as follows;

7.3.1 **Main Complex**

Basement floor	**Area (m^2)**
(i) Gas room/ office and store;	$336m^2$
(ii) Staircase	$30m^2$
Ground Floor; (WING A)	
(i) Staff room	$60m^2$
(ii) Enquires	$30m^2$

(iii) Offices (3)		$90m^2$
(iv) Communication Centre		$113m^2$
(v) Pharmacy		$30m^2$
(vi) Ward 1 and 2		$60m^2$
(vii) Doctor's room		$30m^2$
(viii) Nurses room		$60m^2$
(ix) Doctor in charge's office		$107m^2$
(x) Exit lobby		$30m^2$
(xi) Staircase		$30m^2$
(xii) Toilets		$107m^2$
(xiii) Circulation lobby		$187m^2$
	TOTAL	**$1300m^2$**
Ground floor (wing B)		
Fire engine hall		$615m^2$
Equipment storage		$60m^2$
Engine room		$60m^2$
Locker Room		$60m^2$
Drivers' office		$30m^2$
	TOTAL	**$825m^2$**
Restaurant (Wing C)		
Eating room 1		$238m^2$
Eating room 2		$168m^2$
Kitchen		$90m^2$
Cold store		$18m^2$
Dry store		$30m^2$

Toilets		36m^2
	TOTAL	**580m^2**
Central Circulation Core;		
Lobby (Entrance)		35m^2
Staircase		195m^2
	TOTAL	**230m^2**
Ground Floor Area (Total)		**2935m^2**
Main Complex		
1st and 2nd Floor		
14 Offices (Wing A)		420m^2
Toilets		187m^2
Staircase		30m^2
Circulation lobby		147m^2
Computer room		251m^2
Library		251m^2
	TOTAL	**1286m^2**
12 Rooms (Wing B)		360m^2
Toilets/Bath		60m^2
Laundry room		30m^2
Staircase		30m^2
Circulation lobby		204m^2
	TOTAL	**684m^2**

Central circulation core

Lobby		$155m^2$
Mess room		$80m^2$
Staircase		$35m^2$
	TOTAL	**$270m^2$**
TOTAL (1st and 2nd Floor)		**$2240m^2$ x 2**
	TOTAL	**$4480m^2$**

Main Complex

Third floor (Wing A)

8 offices		$300m^2$
Deputy commandant		$52.8m^2$
Commandant		$105.8m^2$
Secretary's office/waiting area		$50m^2$
Boardroom		$83m^2$
Staircase		$30m^2$
Toilets		$201.4m^2$
	TOTAL	**$823m^2$**

Main Complex

Helipad		$177m^2$
Lobby		$155m^2$
Meeting room		$80m^2$
Staircase		$35m^2$
	TOTAL	**$347m^2$**

(B) MAINTENANCE/WORKS SECTION

5 offices		$150m^2$
Equipments store		$30m^2$
2 Changing rooms		$75m^2$
Circulation		$82m^2$
Service bay		$225m^2$
	TOTAL	**$562m^2$**

(C) FIRE/DRILL TOWER

GROUND FLOOR

Communications room		$22.75m^2$
Hall entrance		$8.4m^2$
Staircase		$24m^2$
Lobby		$25.8m^2$
Elevator		$4m^2$
	TOTAL	**$84.95m^2$**

1st – 10th Floor

Lobby		$41m^2$
Balcony		$8.75m^2$
Staircase		$24m^2$
Elevator		$4m^2$
	TOTAL	**$77.75m^2$**

TOTAL for 1st – 10th Floor = **77.75*10**

= **777.5m²**

TOTAL SPACE AERA FOR FIRE TOWER =777.5+84.95

TOTAL = **862.45 M²**

TOTAL SPACE FOR ALL UNITS = **10,109.45m2**

7.4 ELECTRICITY AND LIGHTING: -

Electricity is important in buildings for them to function property. For this facility, electricity is to be supplied to the site by the National Electric Power Authority (N.E.P.A). The electricity would be supplied from the NEPA national grid to a sub station to be located on the site the Direct current (D.C) would be converted to alternating current (A.C) by the sub - station and stepped down before distribution to the buildings on the site. In the event of a power outage by NEPA, a standby generator is also installed to instantaneously and automatically supply power to the whole site.

Lighting is very important in buildings. The lighting of spaces was a high consideration at the design stage with the use of courtyards and glass as solution to enhancing natural lighting. However, artificial lighting will also be needed to compliment the natural lighting, and also for the performance of tasks (task lighting) accent lighting would be required to make the building functional, natural and artificial lighting has been effectively blended to achieve both functional and aesthetic effects. Artificial lighting however, cannot function without the use of electricity.

7.5 HEATING, COOLING AND VENTILATION: -

At the design stage, ventilation was a prime consideration, due to the tropical nature of the region. This can be seen from the use of courtyards, large windows and the orientation of the buildings to have maximum benefit of the winds and the use of cross – ventilation within enclosed spaces. Centrifugal fans and air conditioners were used in living areas, offices, lecture rooms, and many other spaces to provide a cooling effect for this space. Exhaust fans were used in toilets the kitchen in the restaurant and the basement to draw hot from the interior spaces, expel it outside and keep the interior spaces cool.

Heating was not a major consideration, since that is mostly needed in the temperate regions. However the air conditioning can be adjusted to heat up the spaces.

7.6 **WATER SUPPLY, DRAINAGE, SEWAGE AND REFUSE DISPOSAL: -**

Water supply is to be supplied to the site from the city mains of the Abuja water board, which has pipes already laid in the area. Water is essential on this site since it is a major requirement for fire fighting. A borehole is also to be sunk as an additional source of water as well as the rainwater-collecting pond. The water supply to the buildings on site is going to be from water towers located on the site. After the water has been treated it is then pneumatically supplied to the various buildings on site. The other from is a down feed distribution system due to location of the tank on the building.

The drainage system of the site is designed in such a way that the storm water is separated from the sewage. The storm water is drained into the rainwater collecting pond while the sewage is drained by emptying into the main drainage sewage channel. The building drain receives the discharge from the soil and stacks inside the building, and conveys it by gravity to the main

sewer, which then conveys it to main public sewer channel of the Abuja city. Refuse disposal on the site is to be effected by carrying out periodic picking of refuse, by refuse collecting trucks of the Abuja environmental protection board (AEPB). Refuse bins are to be located a strategic locations on the site. The refuse from offices, and other interior spaces, would then be emptied into the refuse dump, located on the site, which would eventually be picked up by the refuse collecting trucks. Incineration is another method of refuse disposal, but is not environment friendly and does not aid recycling, that is the reason it was not used, since it is actually a cheaper option.

7.7 **ACOUSTICS: -**

Acoustics was used effectively in the design of the building in the design of the building. A detailed evaluation of the location and the orientation of the spaces, possible noise sources and the desirable acoustical environment in each usable area the acoustical design of each space involved the planning, shaping, finishing and furnishing of the enclosed spaces so as to establish an acoustically sound environment necessary for distant hearing. The lecture rooms, offices, conference area and board room were acoustically treated by the use of acoustical doors and acoustical treatment to the ceiling and the walls to avoid sound intrusion from inside the space to the outside and vice versa. The basement floor also has acoustical treatment, its location below ground level aids the acoustical design of the area because, the noise from the area would be easily absorbed by the surrounding earth of the foundation.

7.8 **SECURITY AND COMMUNITY RELATIONS: -**

Security is a high consideration is the design of buildings and the site due to the nature of the facility, there is a need for about two (2) entry/Exit points

i. Main entrance/Exit

ii. Fire vehicle exit/Entrance (To enhance quick turn – out time)

Each entrance has a security check point, the fire/drill tower also provides additional for the site, as the whole site can be viewed from here. The buildings have security points at different levels from which traffic in, out and around the buildings are monitored. A fire service station should necessarily have a positive relationship with the community within it is located. The community can also aid in fire fighting activities, emergency and rescues operations, and can also provide information on matters of mutual interest.

7.9 **Maintenance: -**

Maintenance is a very importance aspect of everyday life. In this case it sustains and prolongs the life of the buildings in developing countries of the world like Nigeria, the maintenance culture is poor. This was a major consideration at the design stage; vertical shaft and deep volumes were avoided because they require a high level of mechanization for the building to function properly in terms of lighting and ventilation. The horizontal pavilion however requires less intensive maintenance, because of its lesser dependence on mechanization. The buildings on the site would be maintained by the works/maintenance section located on the site. This is to operate aid rum a planned maintenance programme as formulated by the management of the facility. They would also engage in corrective maintenance. The maintenance of the site, vehicles and other equipment used for fire fighting and other purposes.

CONCLUSION

This facility has been designed so as meet the challenges of modern-day firefighting, which is not limited to putting out fires alone, but is involved emergency and rescue operations. It has facilities for Administration, training, living and sleeping quarters, restaurant, rainwater collecting pond, Fire\Drill tower, maintenance section\fuel dump, security posts, Clinic, outdoor training areas, recreational facilities, paredeS grounds with spectator areas and a grand standard a helipad got landing and taking off helicopters used for surveillance, emergency and rescue operations.

The site had been well chosen for its location and is well designed to be functional, having a high aesthetic value and visual impact, and is well landscaped to produce a serene and balance environment.

The facility is to reflect the country and be a symbol of fire safety in the Nation's Capital city, Abuja. It is recommended that this facility is built since the site used in the thesis is actually earmarked for the purpose. This would help to reduce the problems that arise from fire outbreaks and other emergencies and disasters.

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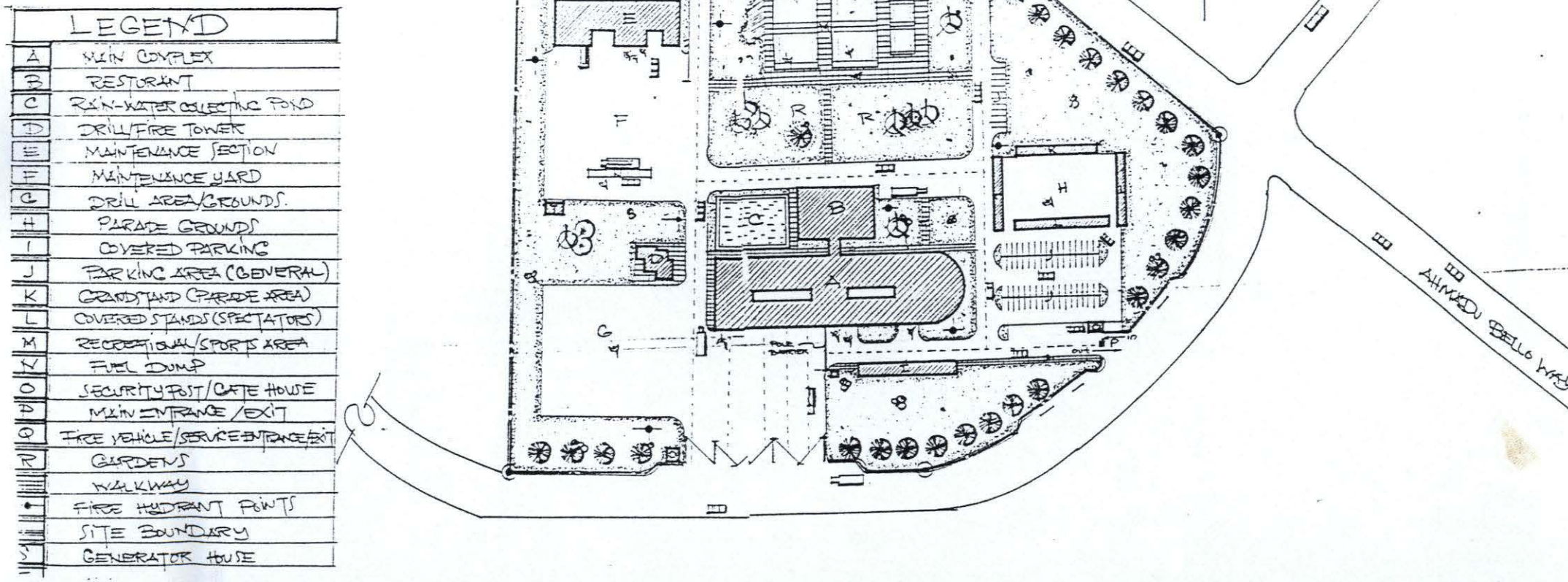
LEGEND
A MAIN COMPLEX
B RESTAURANT
C RAIN-WATER COLLECTING POND
D DRILL/FIRE TOWER
E MAINTENANCE SECTION
F MAINTENANCE YARD
G DRILL AREA/GROUNDS.
H PARADE GROUNDS
I COVERED PARKING
J PARKING AREA (GENERAL)
K GRANDSTAND (PARADE AREA)
L COVERED STANDS (SPECTATORS)
M RECREATIONAL/SPORTS AREA
N FUEL DUMP
O SECURITY POST/GATE HOUSE
P MAIN ENTRANCE/EXIT
Q FIRE VEHICLE/SERVICE ENTRANCE/EXIT
R GARDENS
WALKWAY
FIRE HYDRANT POINTS
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GENERATOR HOUSE
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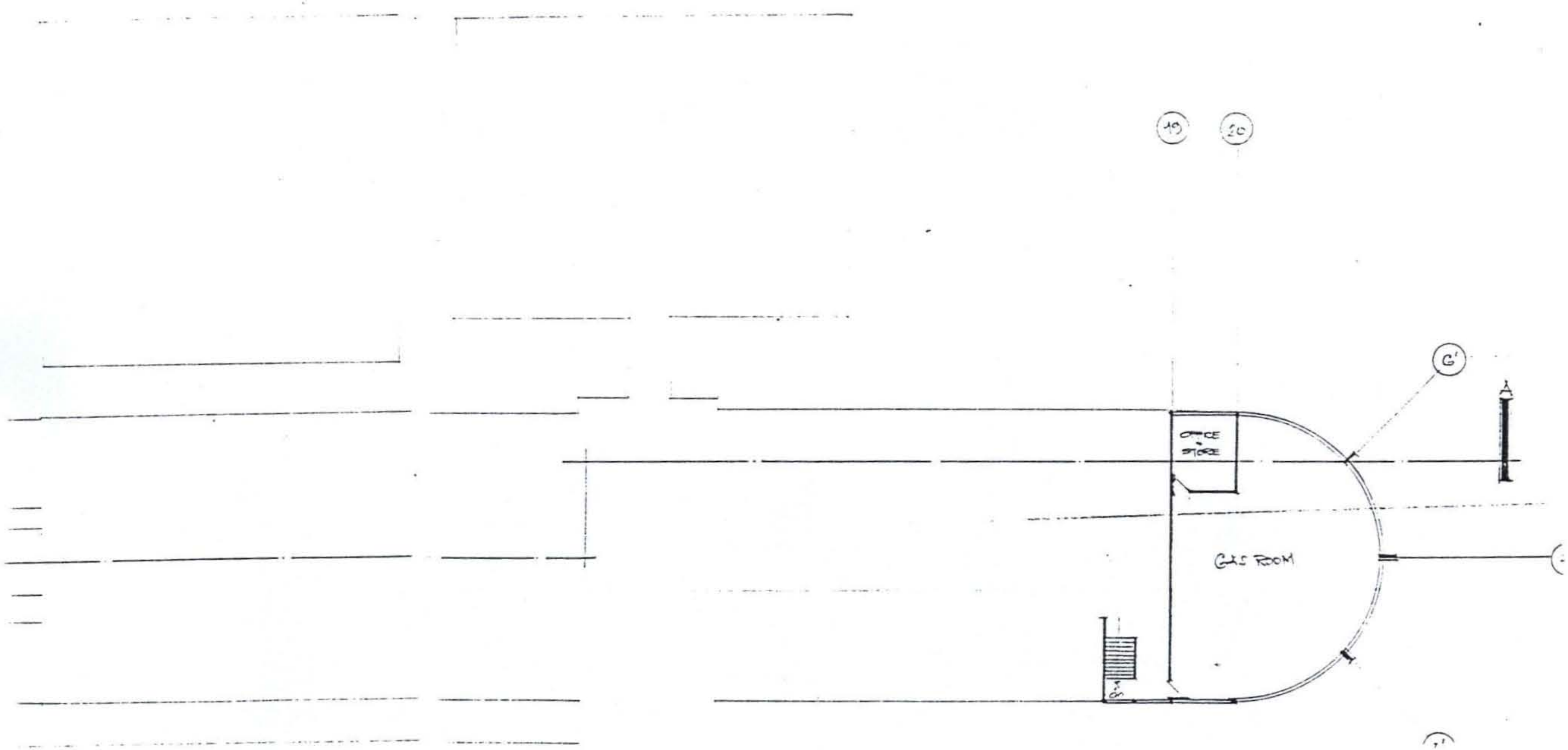
ABUBAKAR BALLA WAY
AHMADU BELLO WAY



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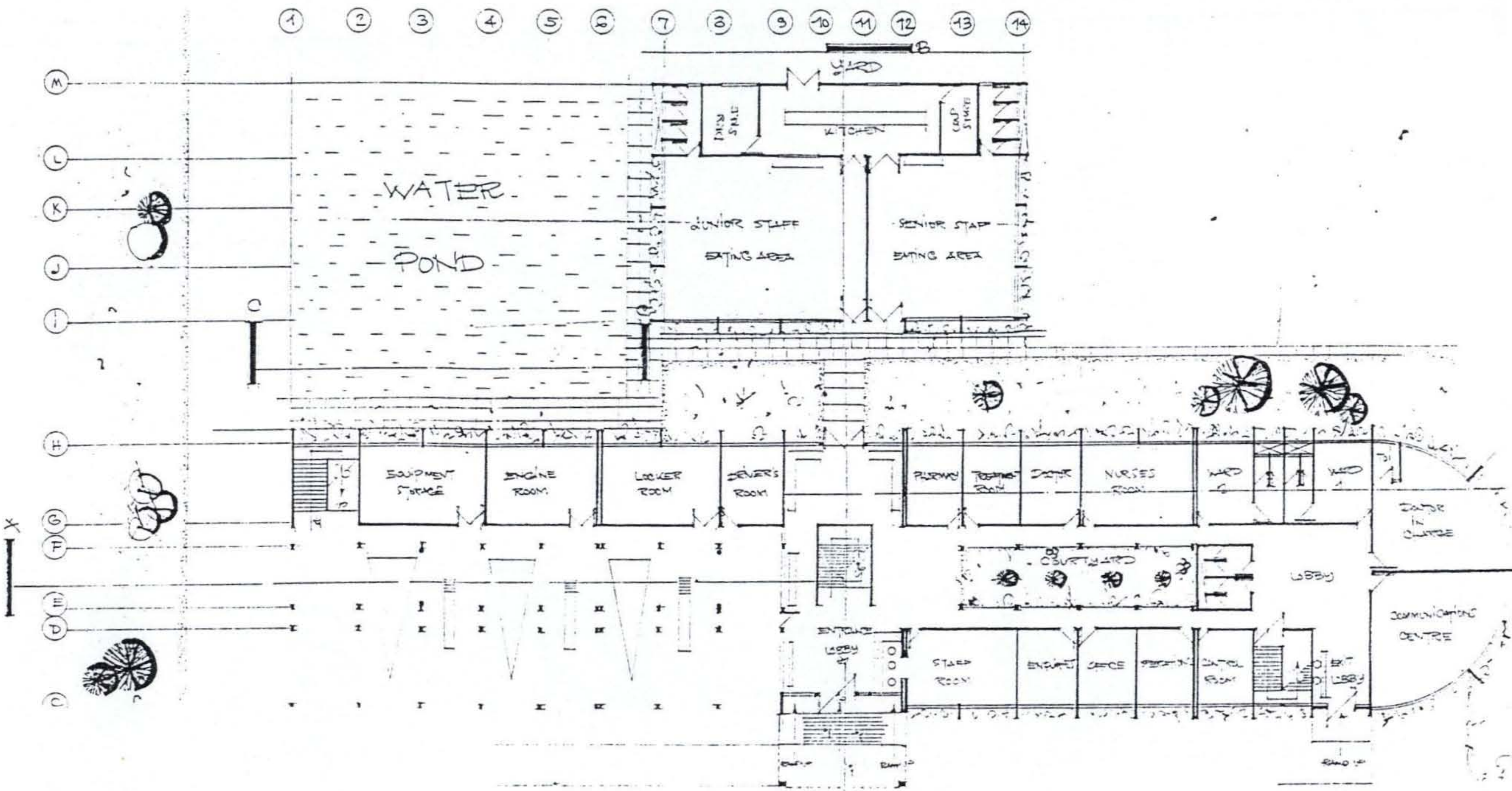
WATER
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JUNIOR STAFF EATING AREA
SENIOR STAFF EATING AREA
EQUIPMENT STORAGE
ENGINE ROOM
LOCKER ROOM
DRIVER'S ROOM
NURSES ROOM
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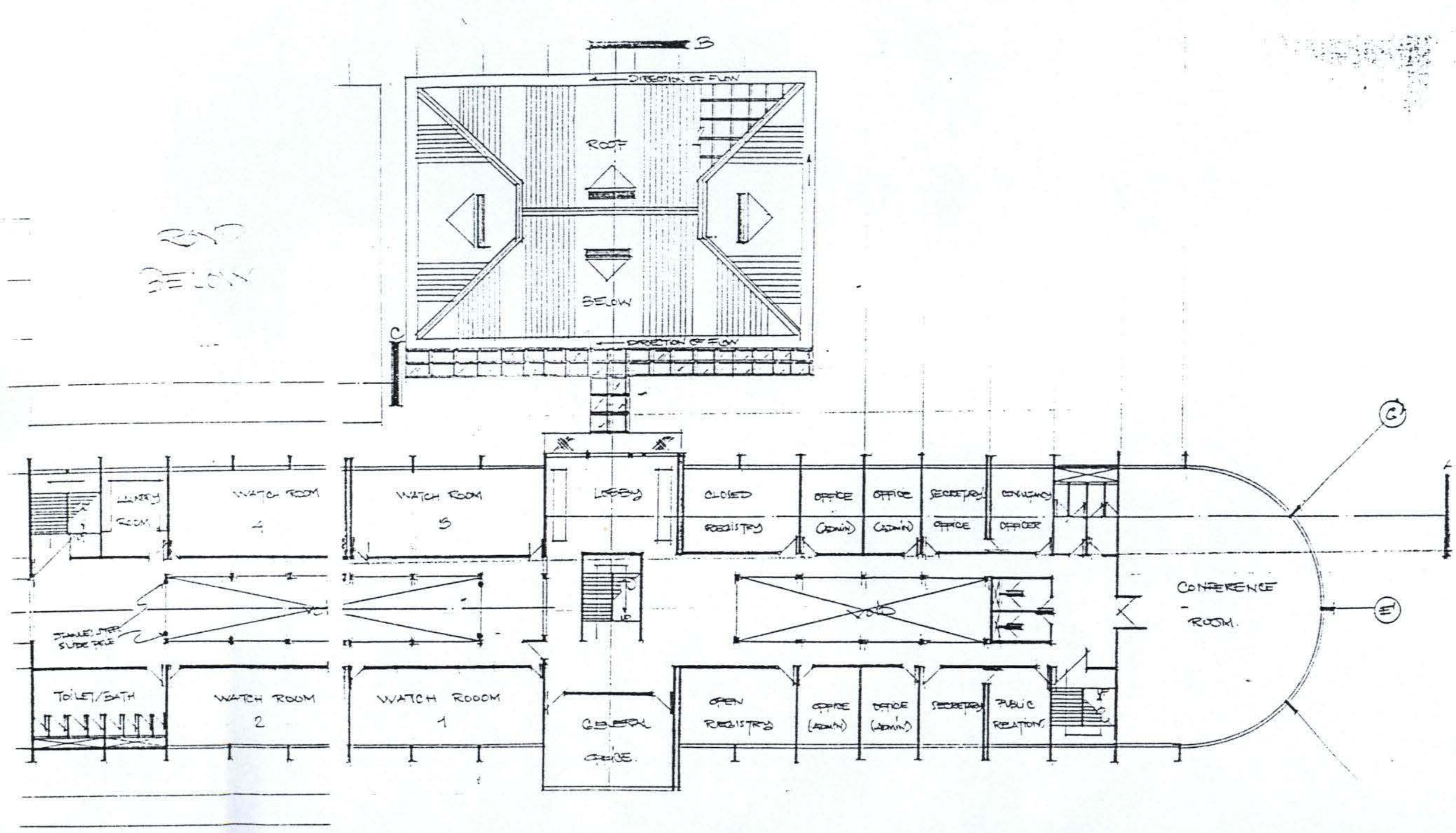
COMMUNICATIONS CENTRE
ENTRANCE LOBBY
STAFF ROOM
OFFICE
EXIT LOBBY



ROOF
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DIRECTION OF FLOW
ROOF BELOW
LAUNDRY ROOM
WATCH ROOM 4
WATCH ROOM 5
LOBBY
CLOSED REGISTRY
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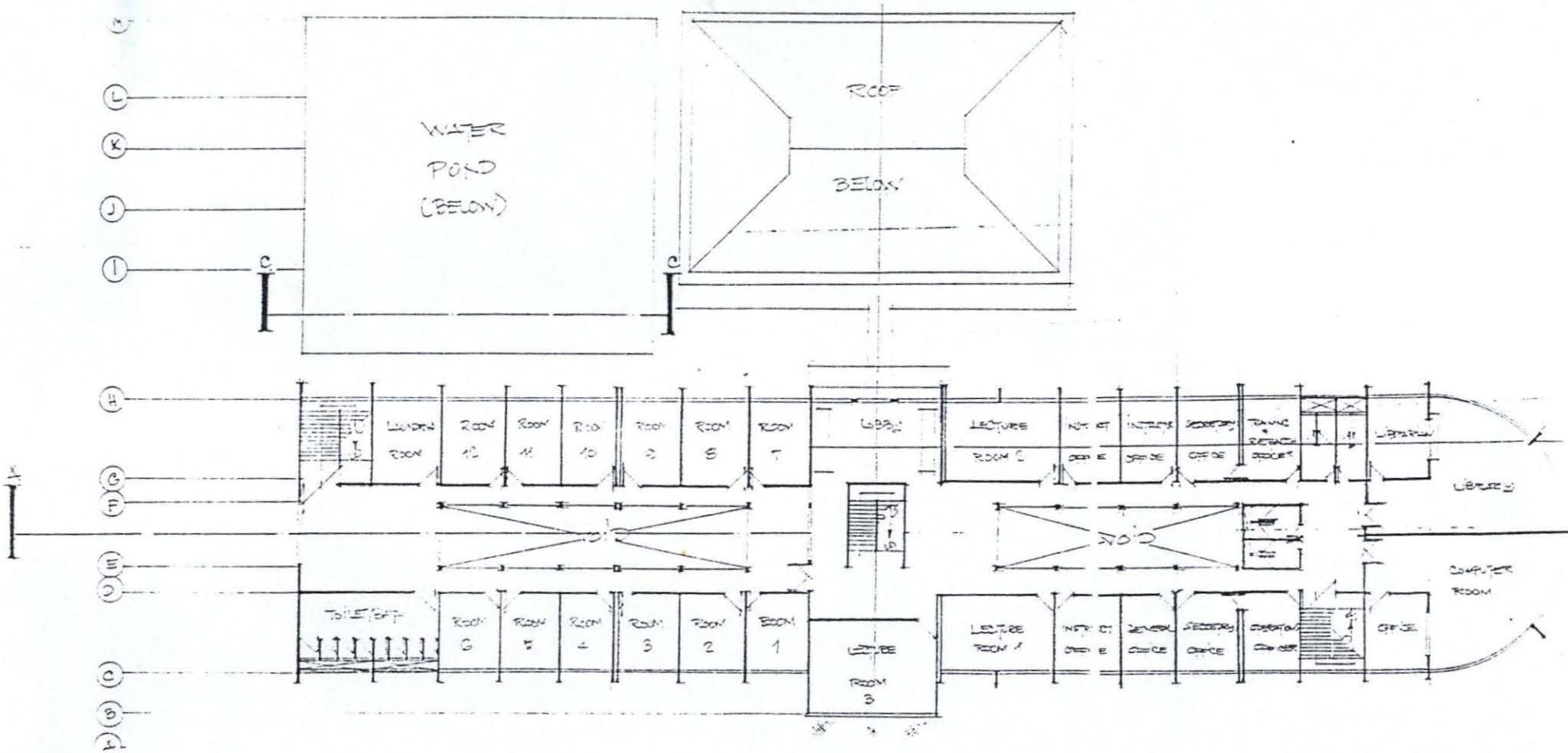
OFFICE (ADMIN)
SECRETARY OFFICE
CONSULTANCY OFFICER
CONFERENCE - ROOM.
STAINLESS STEEL SLIDE POLE
VOID
TOILET/BATH
WATCH ROOM 2
WATCH ROOOM 1
GENERAL OFFICE.
OPEN REGISTRY
OFFICE (ADMIN)
OFFICE (ADMIN)
SECRETARY
PUBLIC RELATIONS


WATER
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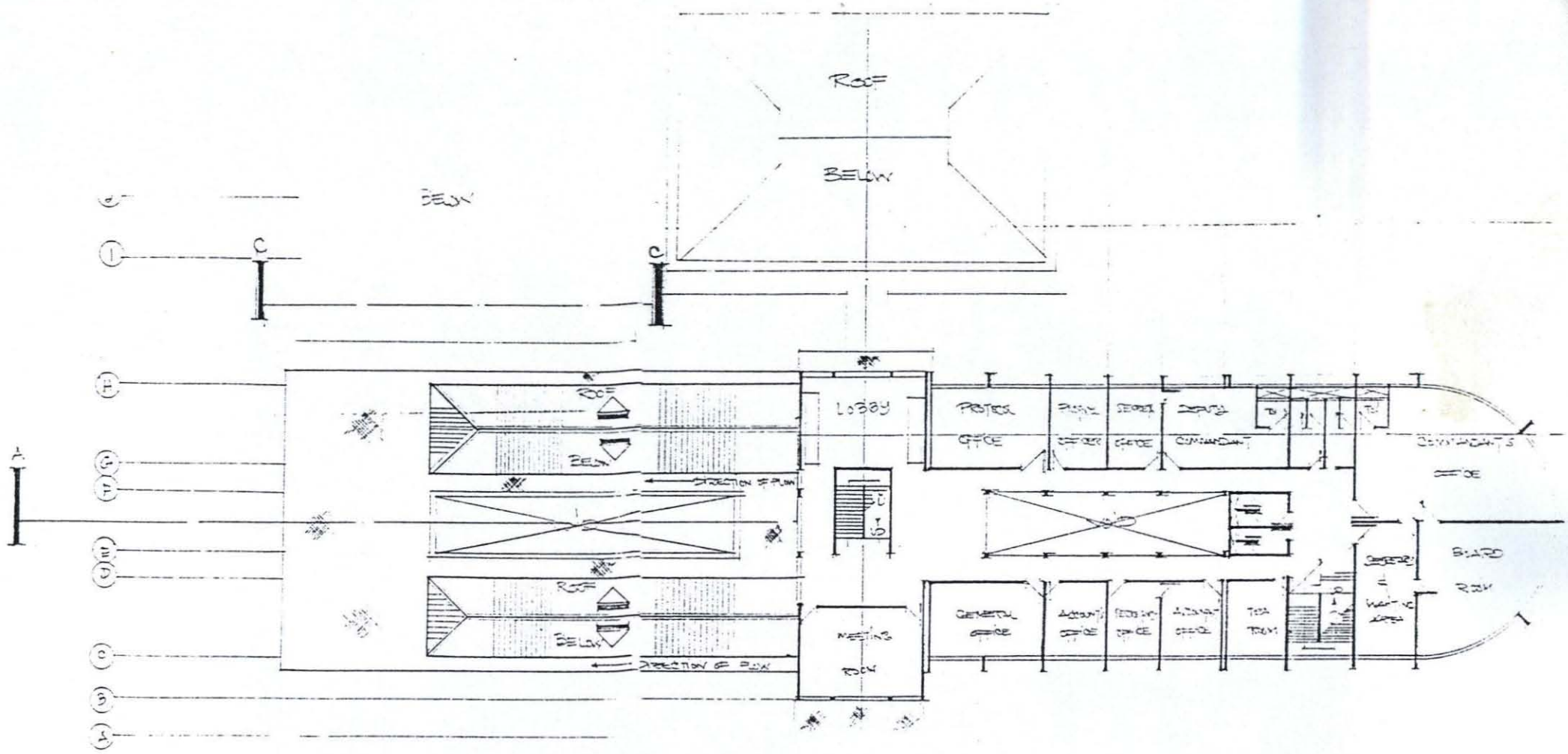
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COMMANDANT'S OFFICE
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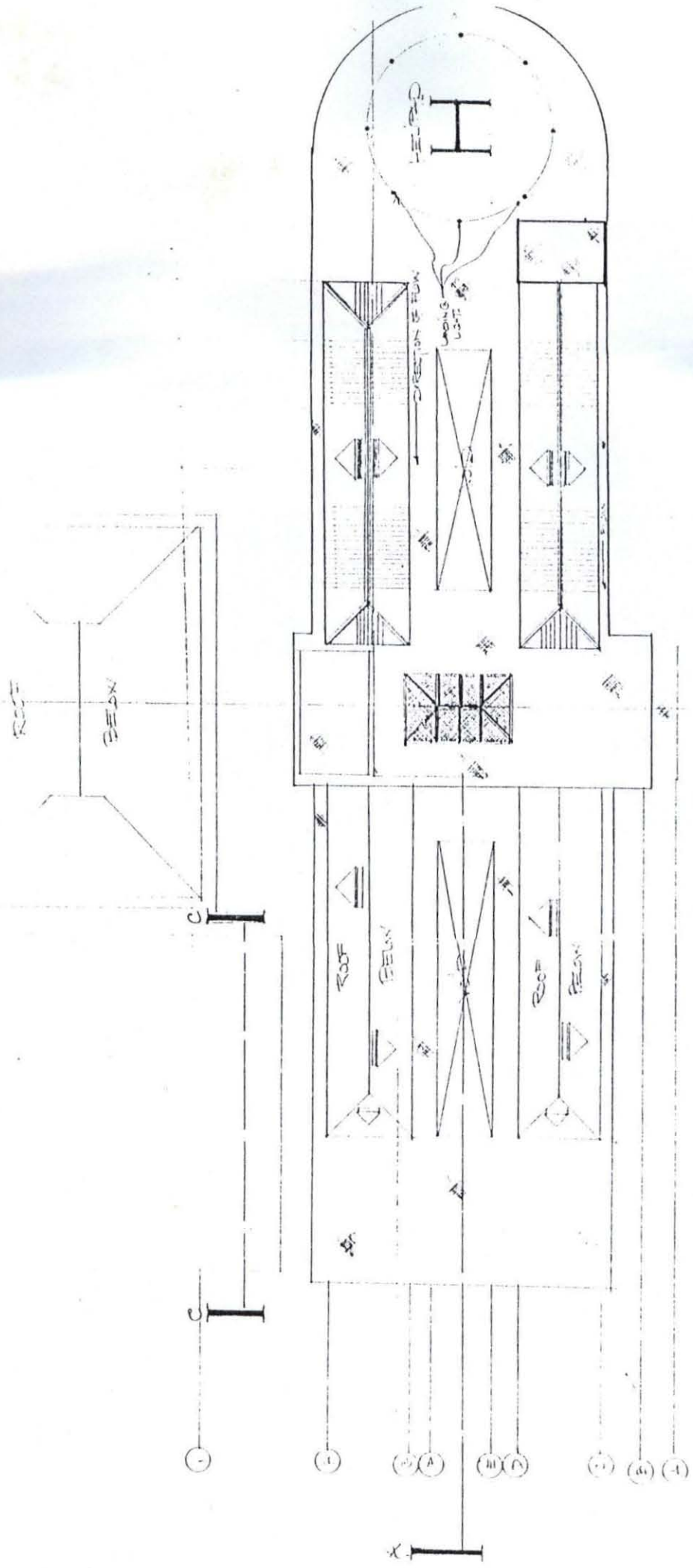
GENERAL OFFICE
ADMIN OFFICE
TECHNICAL OFFICE
ADMIN OFFICE
TEA ROOM
BOARD ROOM


HELIPAD
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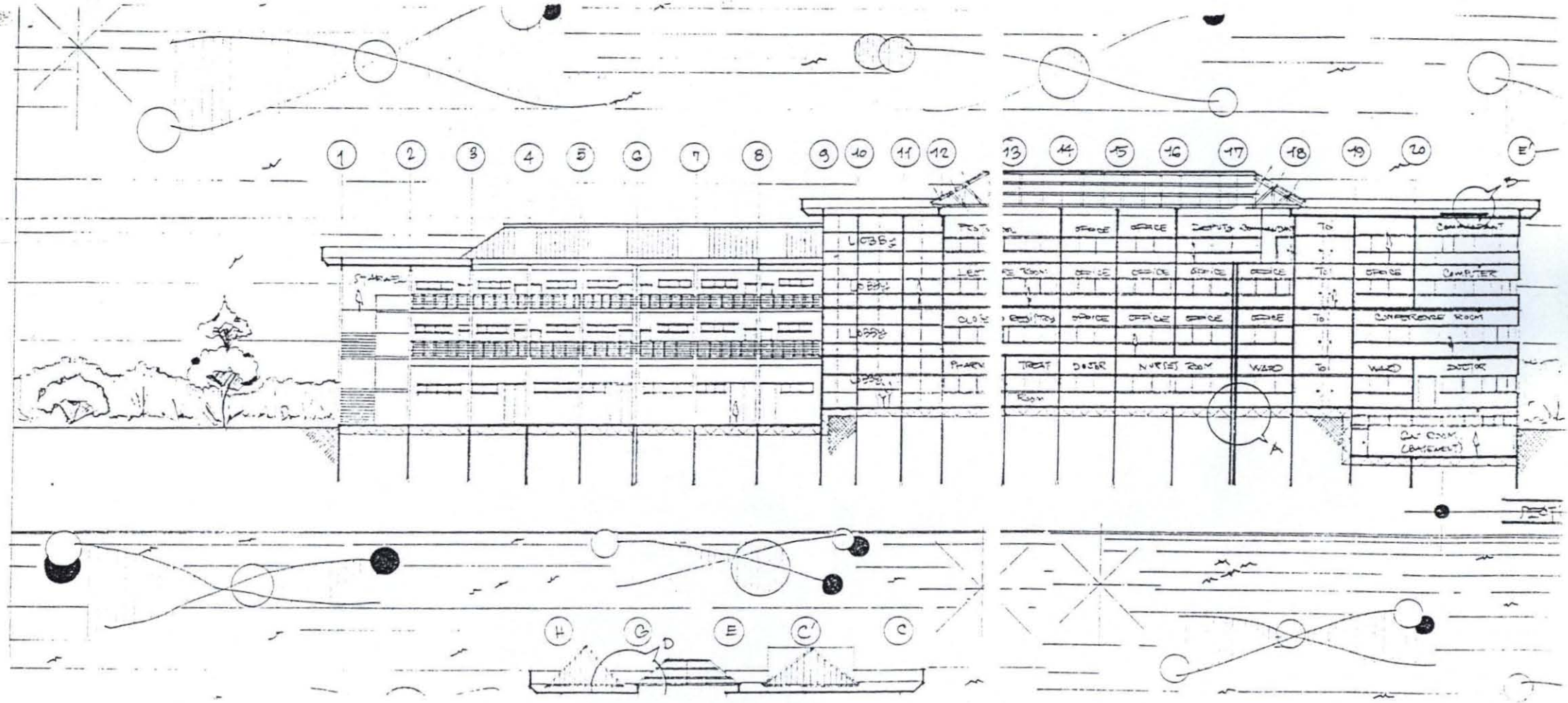
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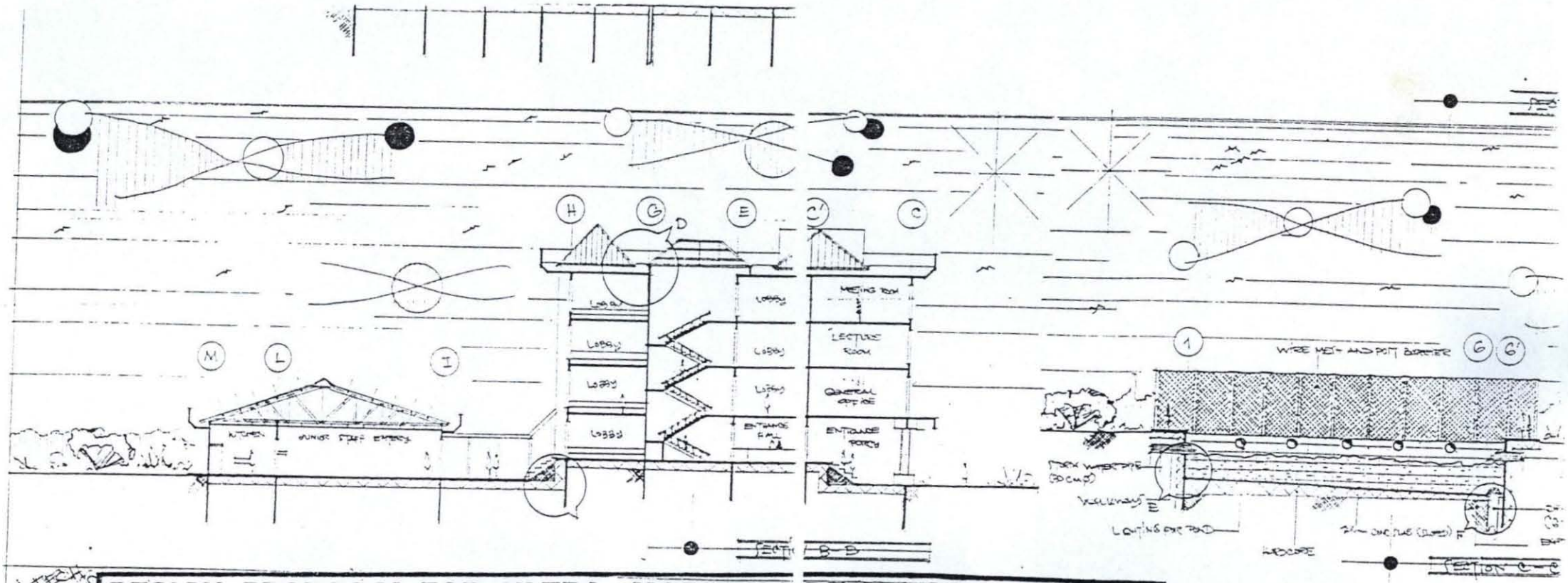
DOCTOR



DESIGN PROPOSAL FOR ULTRA - MODERN F RE SERVICE STATION, ABUJA, NIGERIA, WITH EMPHASIS ON FIRE AFETY IN BUILDINGS.

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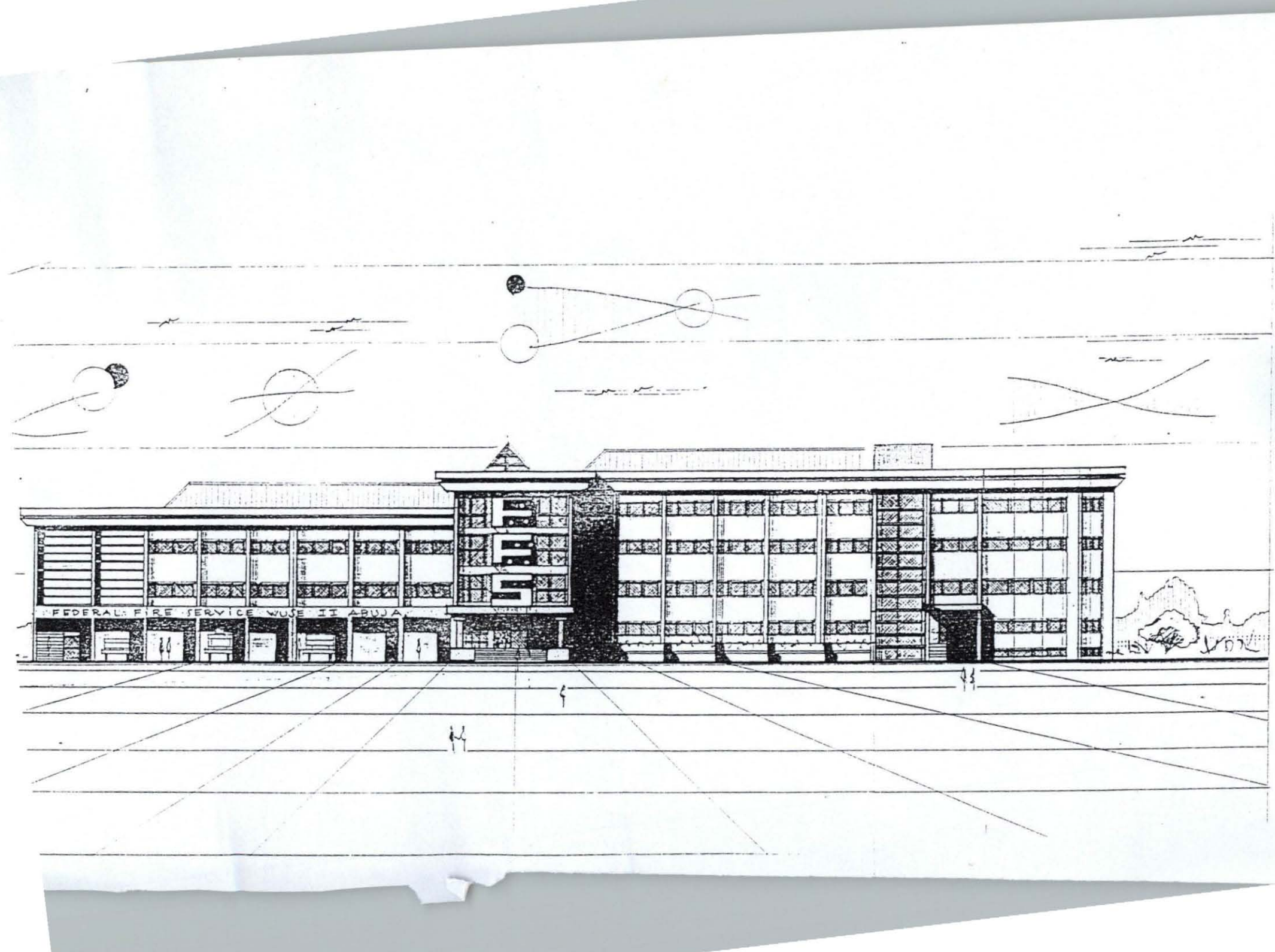
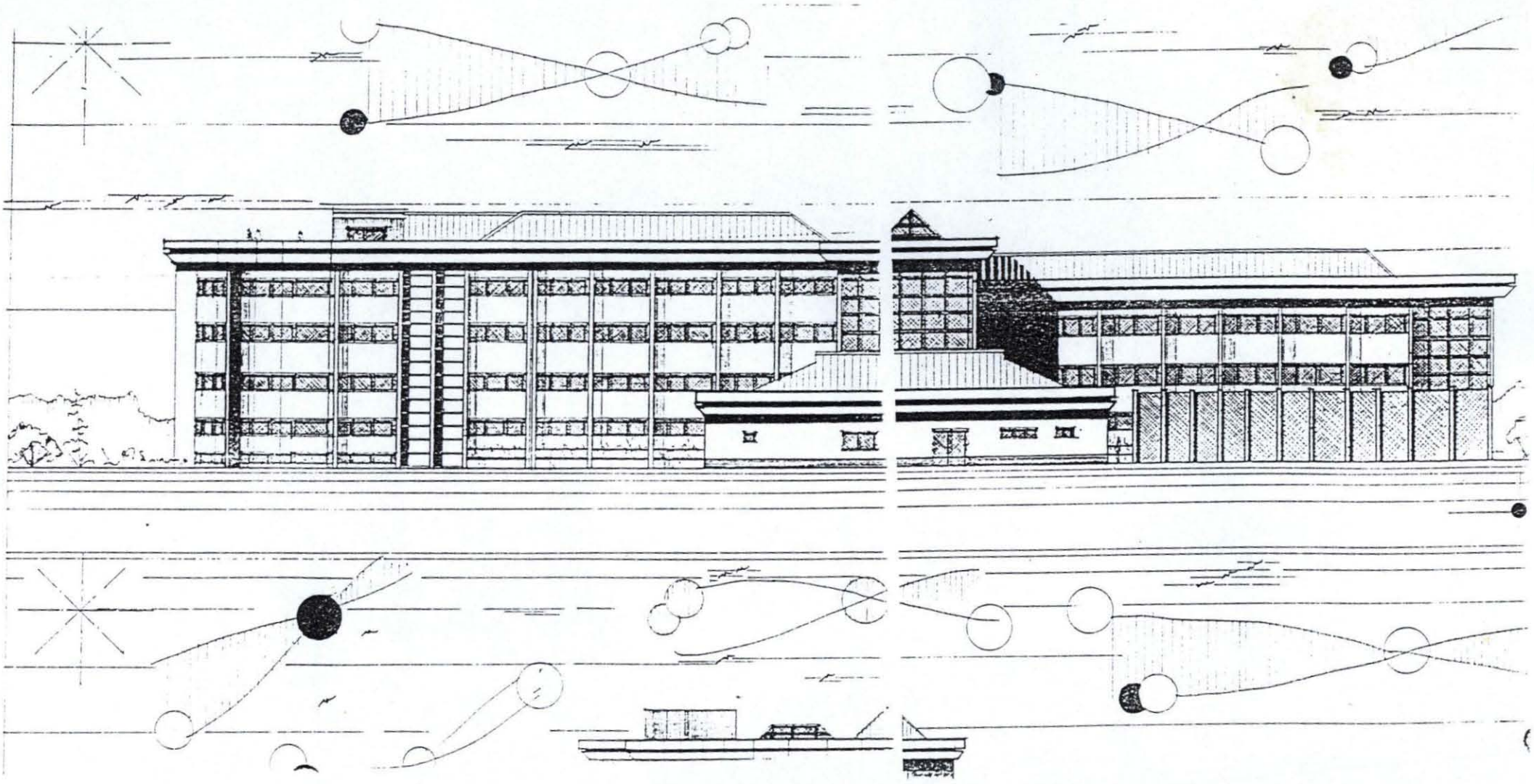
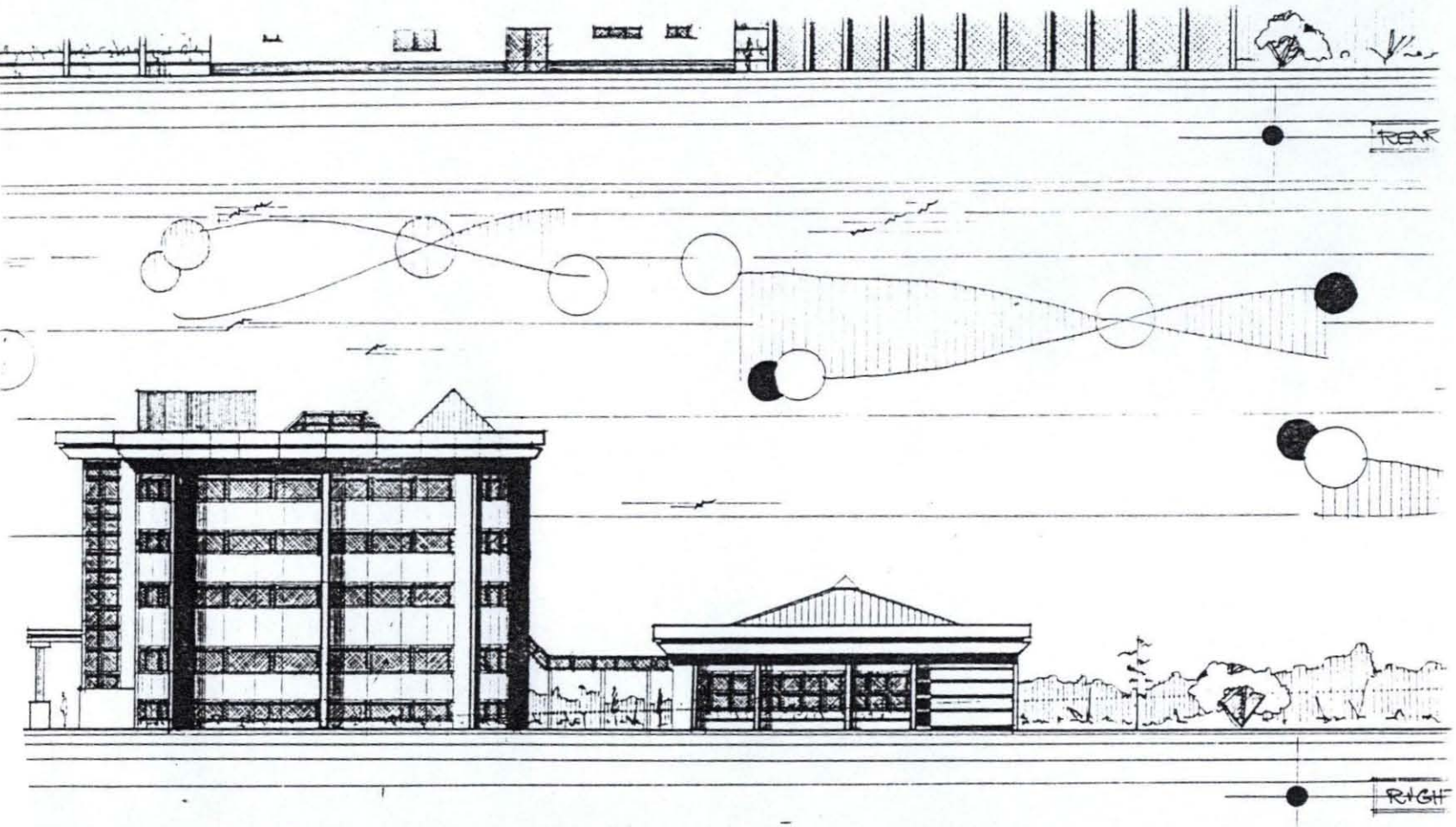

FFS
FEDERAL FIRE SERVICE WUSE II ABUJA





LTRA - MODERN FIRE SERVICE STATION,
PHASIS ON FIRE SAFETY IN BUILDINGS.

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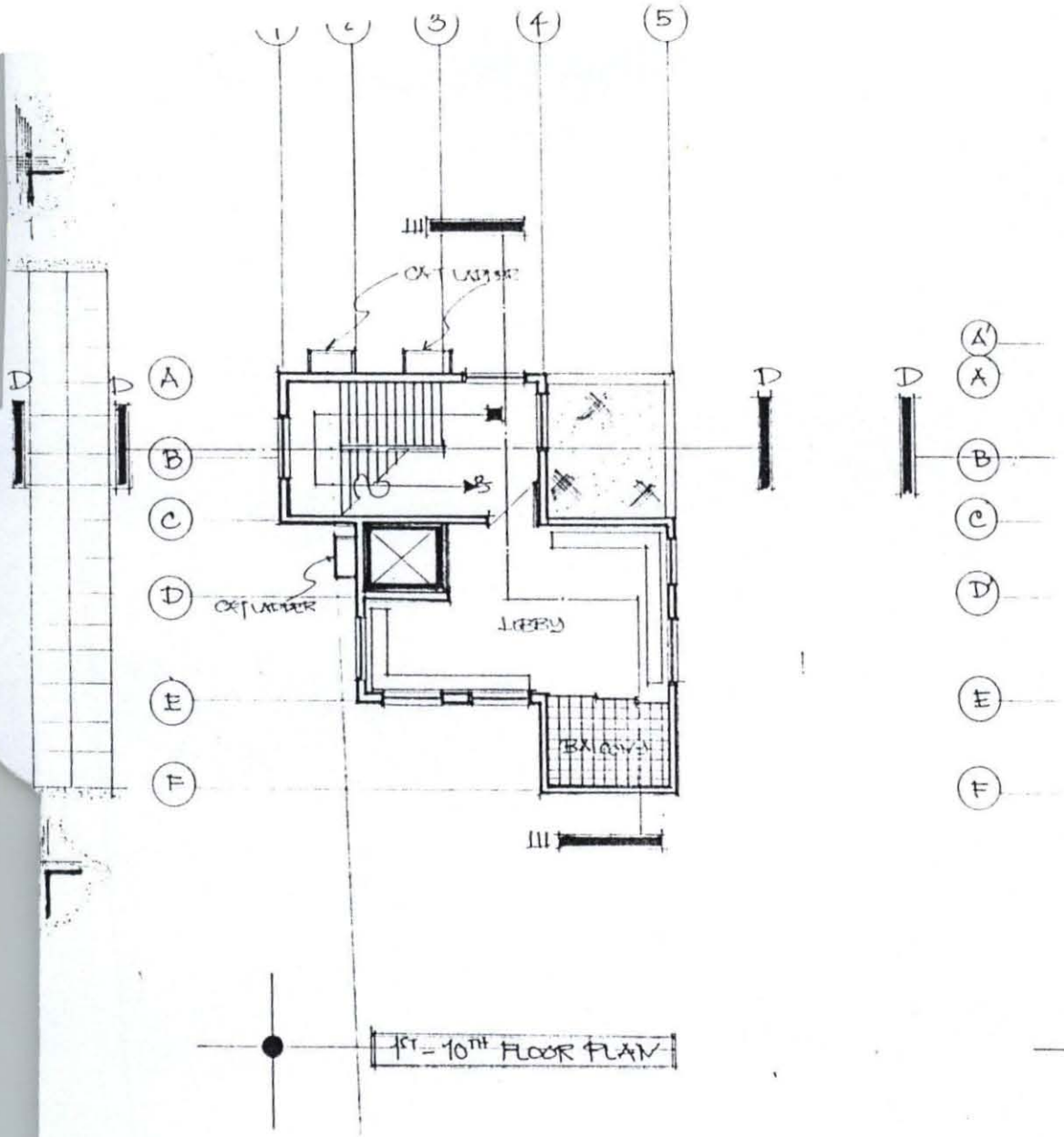

ULTRA - MODERN FIRE SERVICE STATION,
EMPHASIS ON FIRE SAFETY IN BUILDINGS.

SHEET NO
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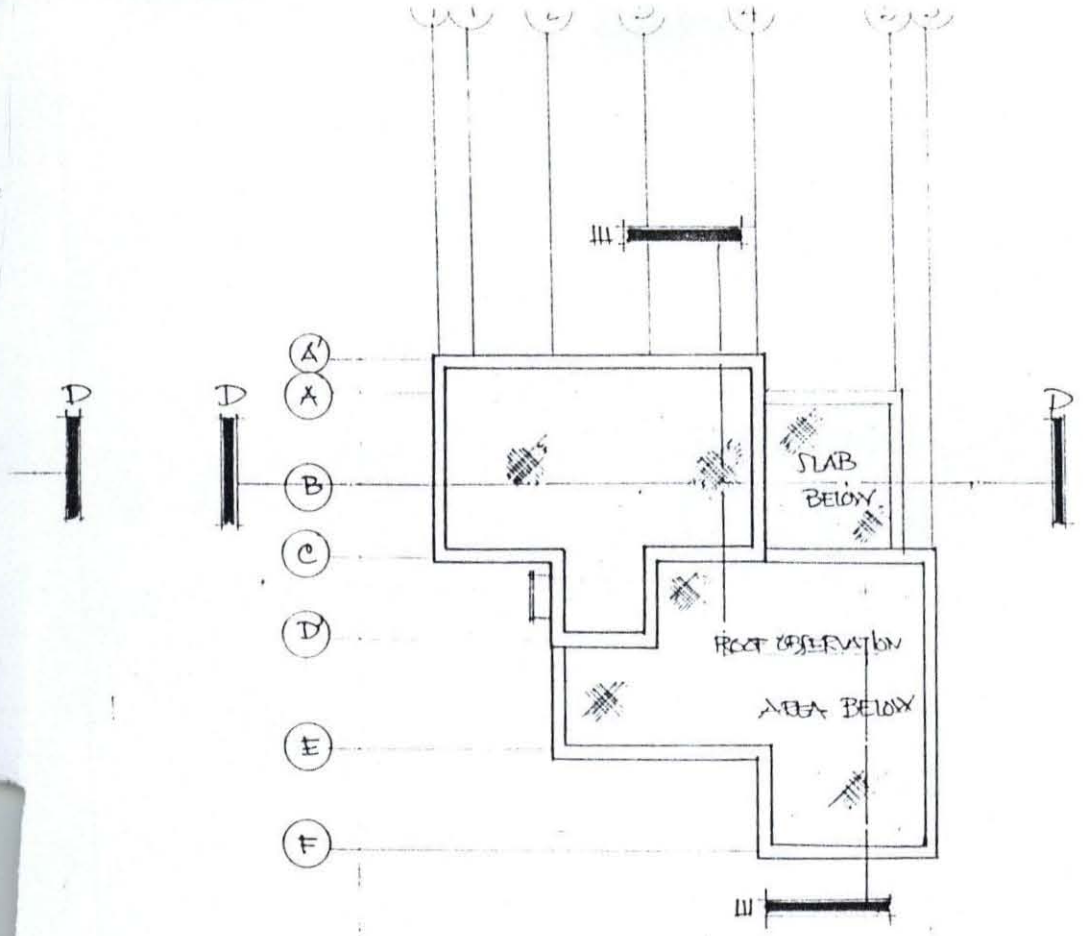

ROOF PLAN.

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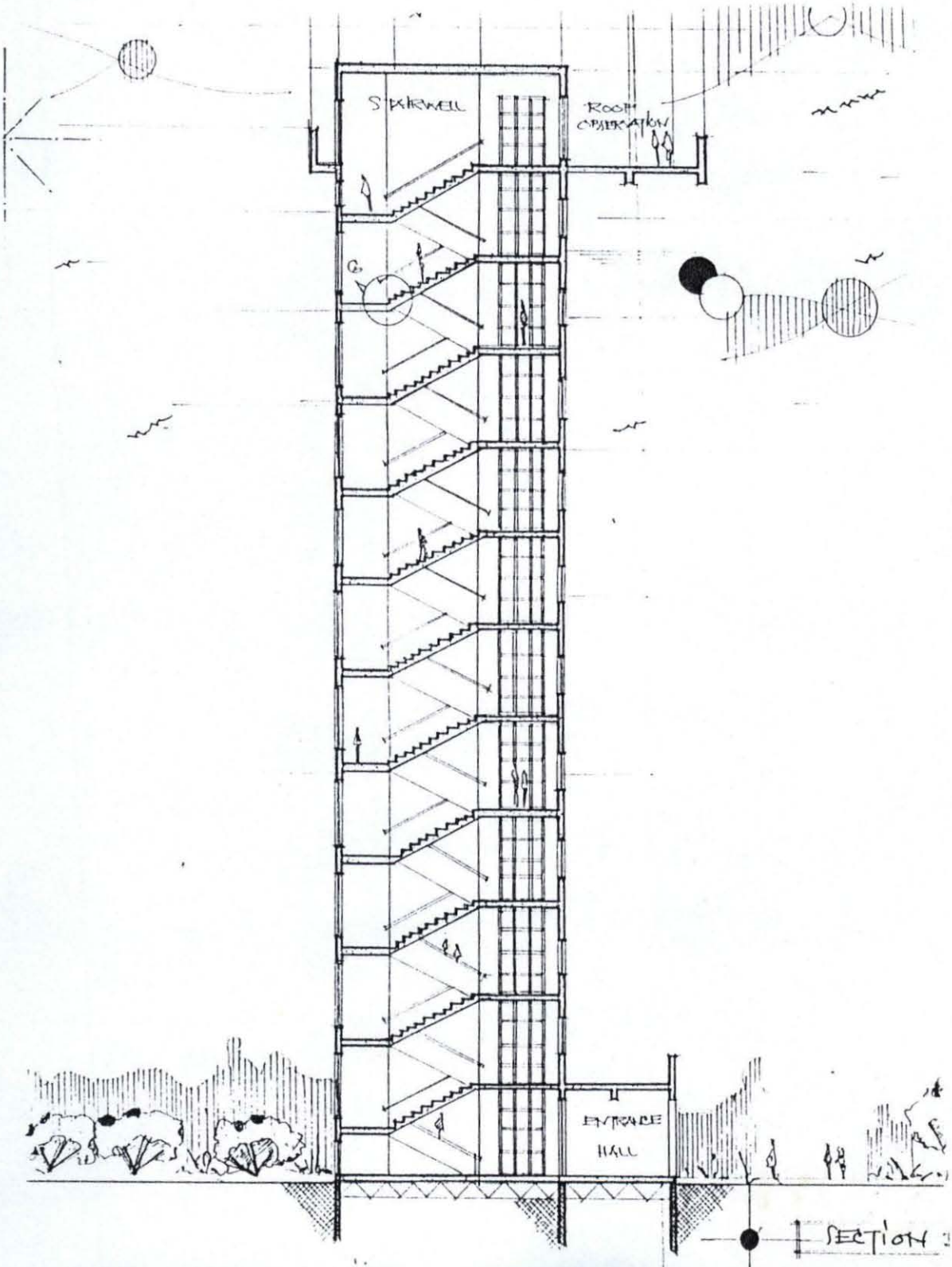
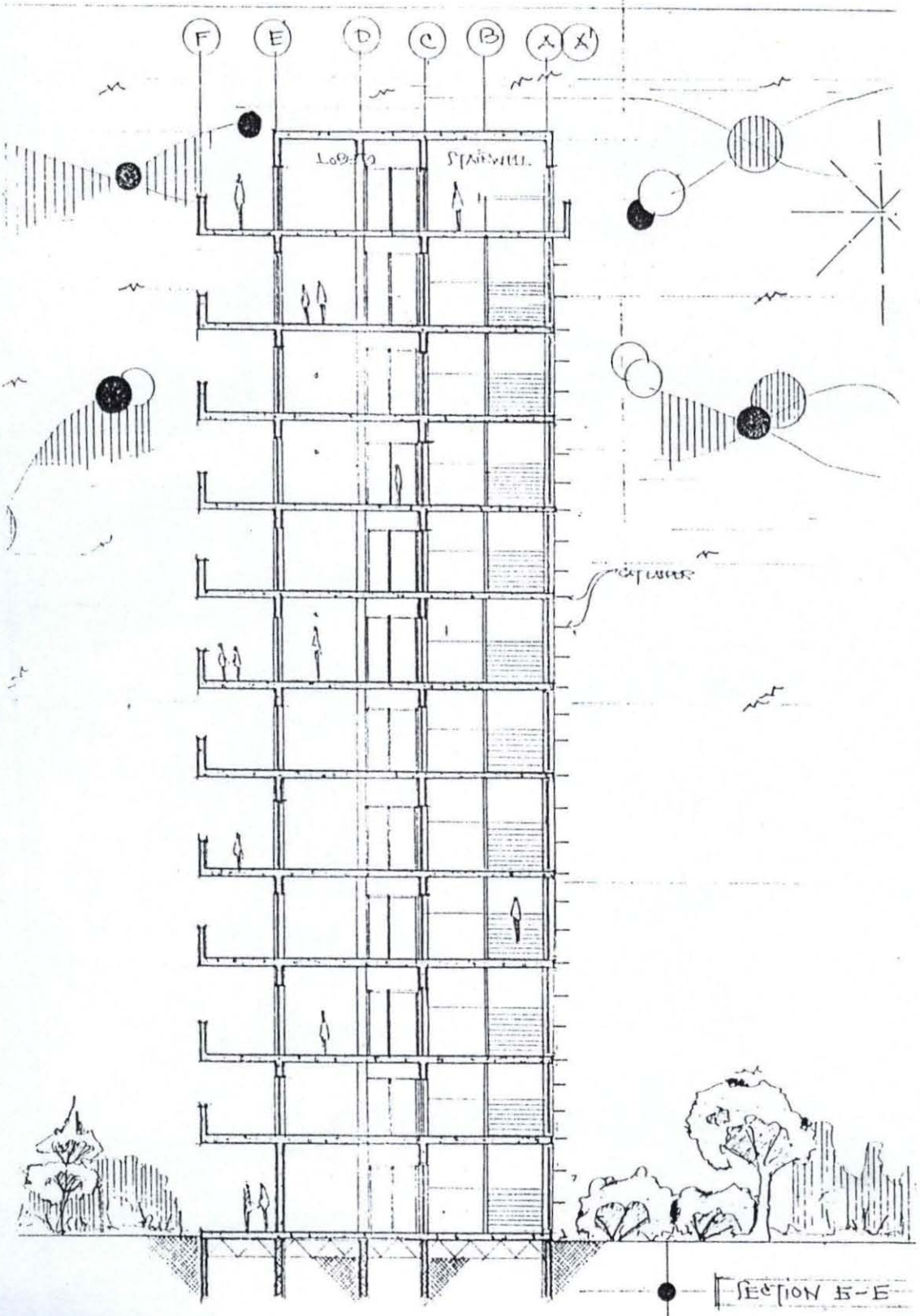
		DEPT.	ARCHITECTURE	DRWG	DRILL/FIRE T
		LEVEL	600	DATE	AUGUST '03



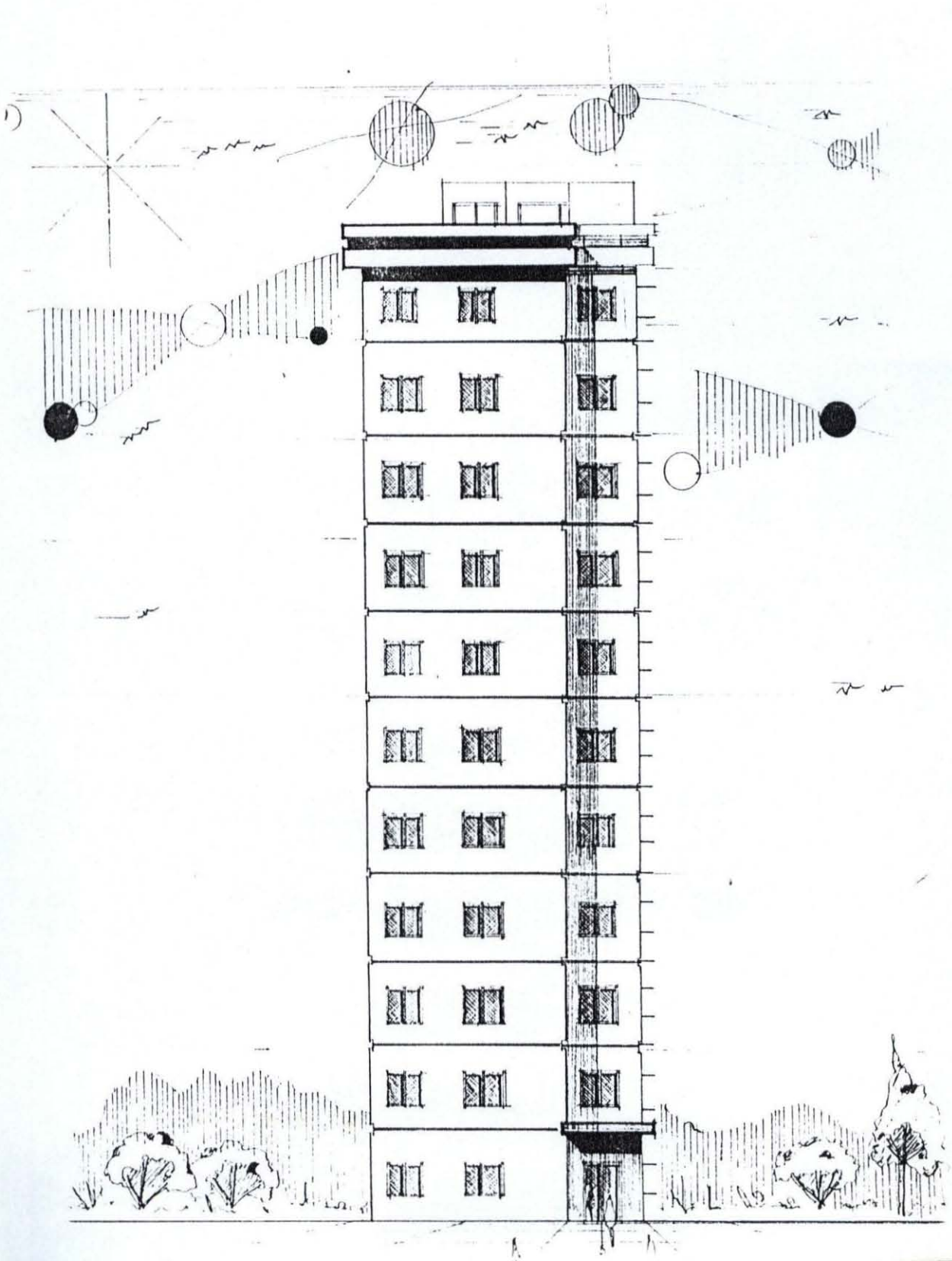
SECTION

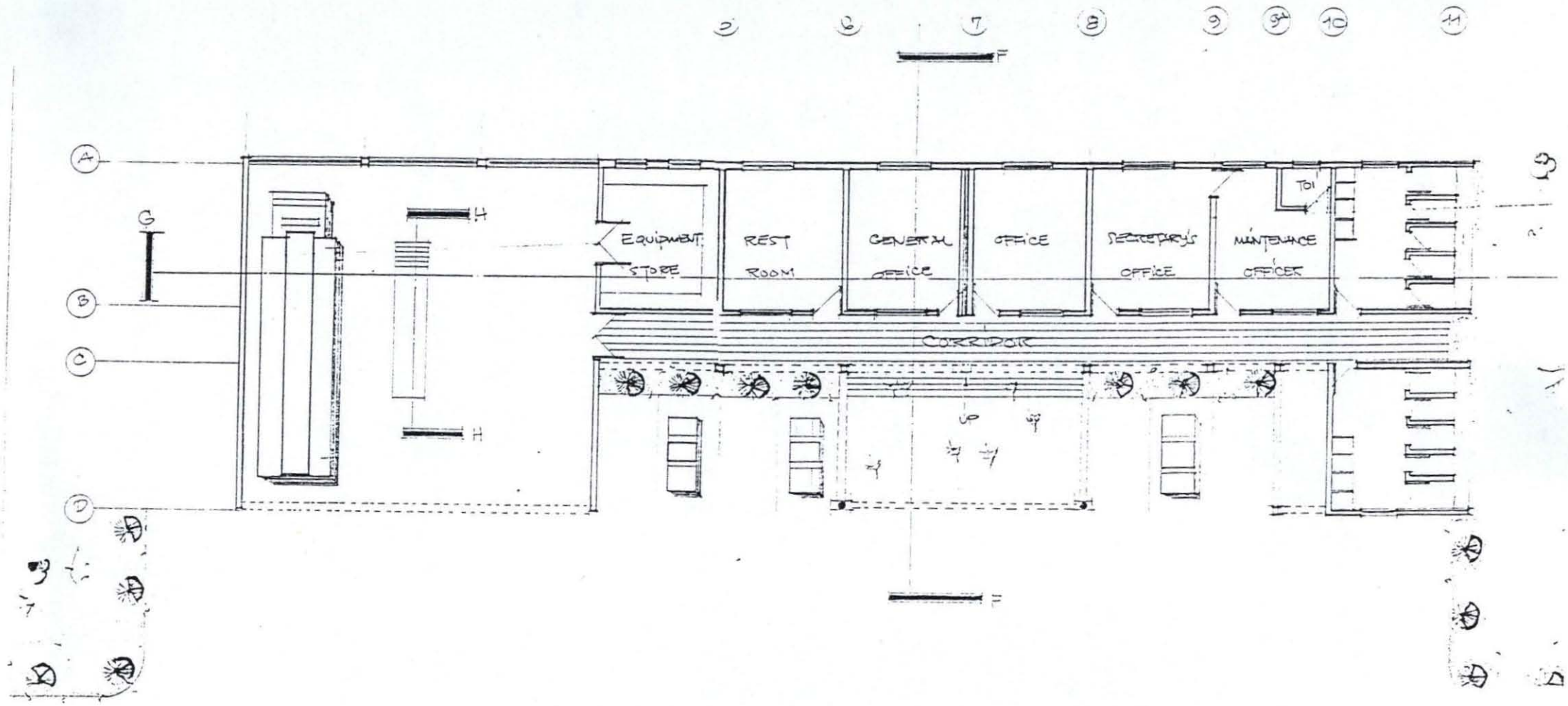
DESIGN PROPOSAL FOR ULTRA - MODERN

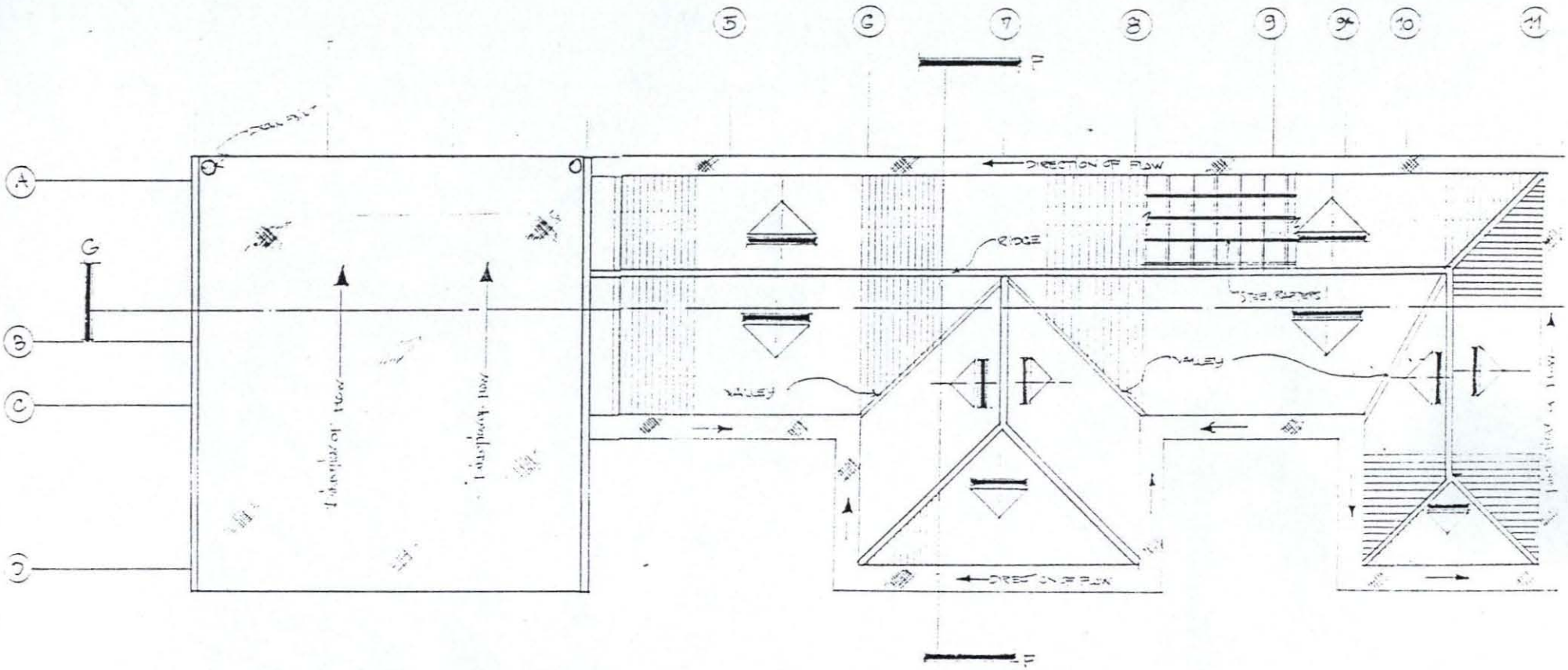


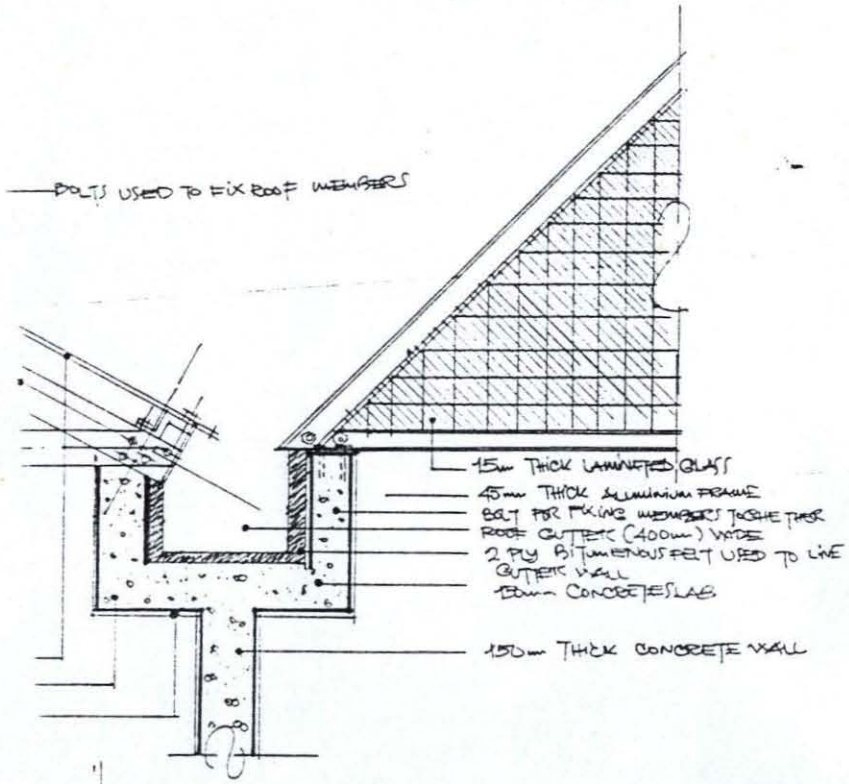
SECTION E-E

E STATION, BUILDINGS.	SHEET NO 24	NAME	OKOH, VICTOR E	MENTOR	ARC. B.N. MOH'D
		REG NO	M.TECH/SET/96/2003/02	SCALE	1:100
		DEPT	ARCHITECTURE	DRWG	DRILL/FIRE TOWER
		LEVEL	800	DATE	AUGUST '03

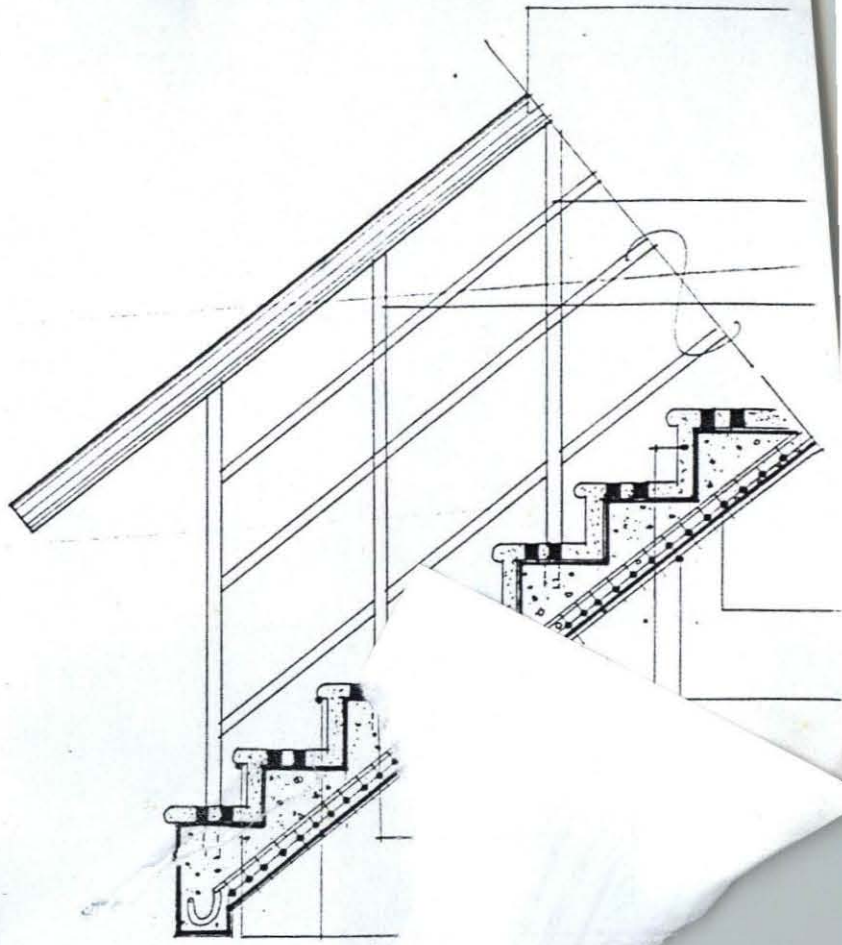



EQUIPMENT STORE
REST ROOM
GENERAL OFFICE
OFFICE
SECRETARY'S OFFICE
MAINTENANCE OFFICER
TOI
CORRIDOR

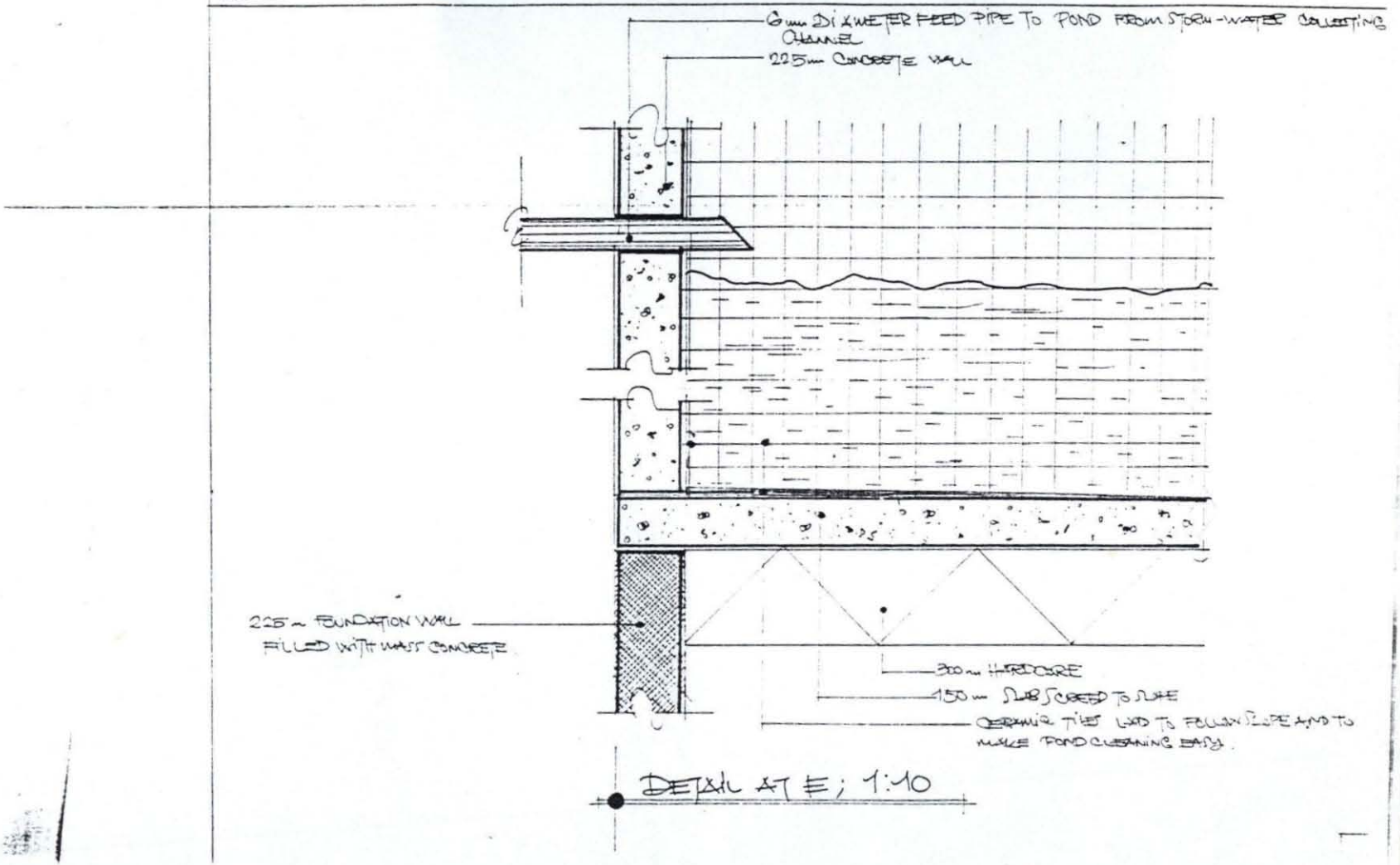

5
6
7
8
9
10
11
A
B
C
D
DIRECTION OF FLOW
RIDGE
VALLEY
VALLEY
DIRECTION OF FLOW

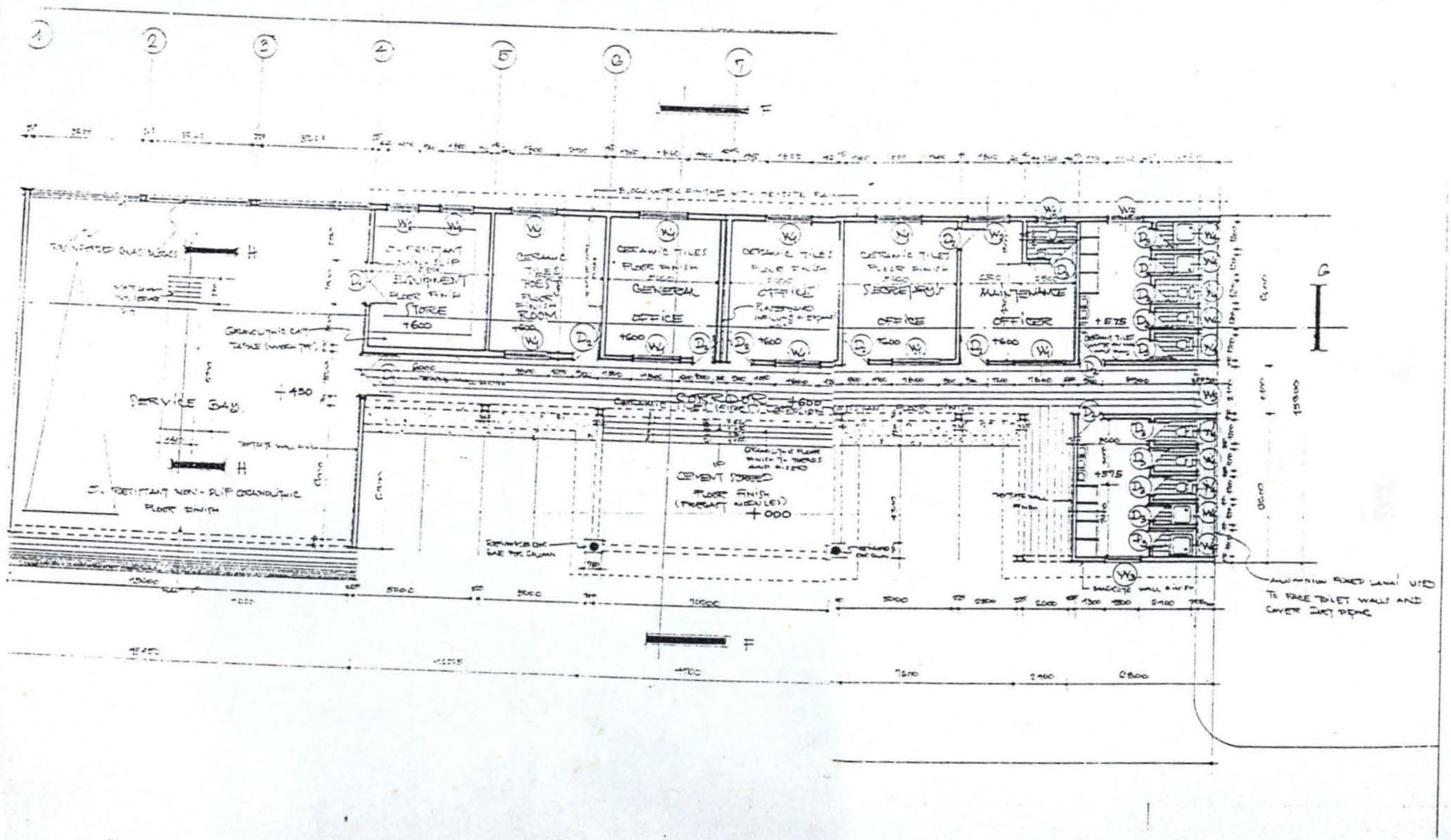


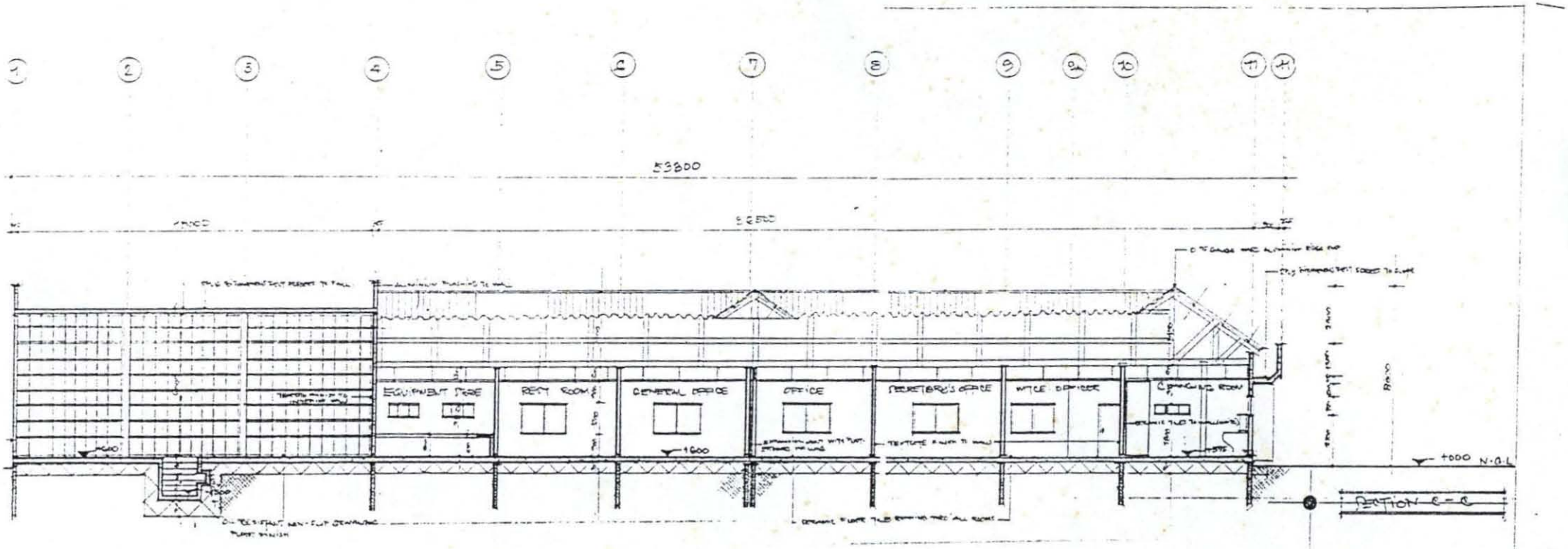
DETAIL AT D; 1:10

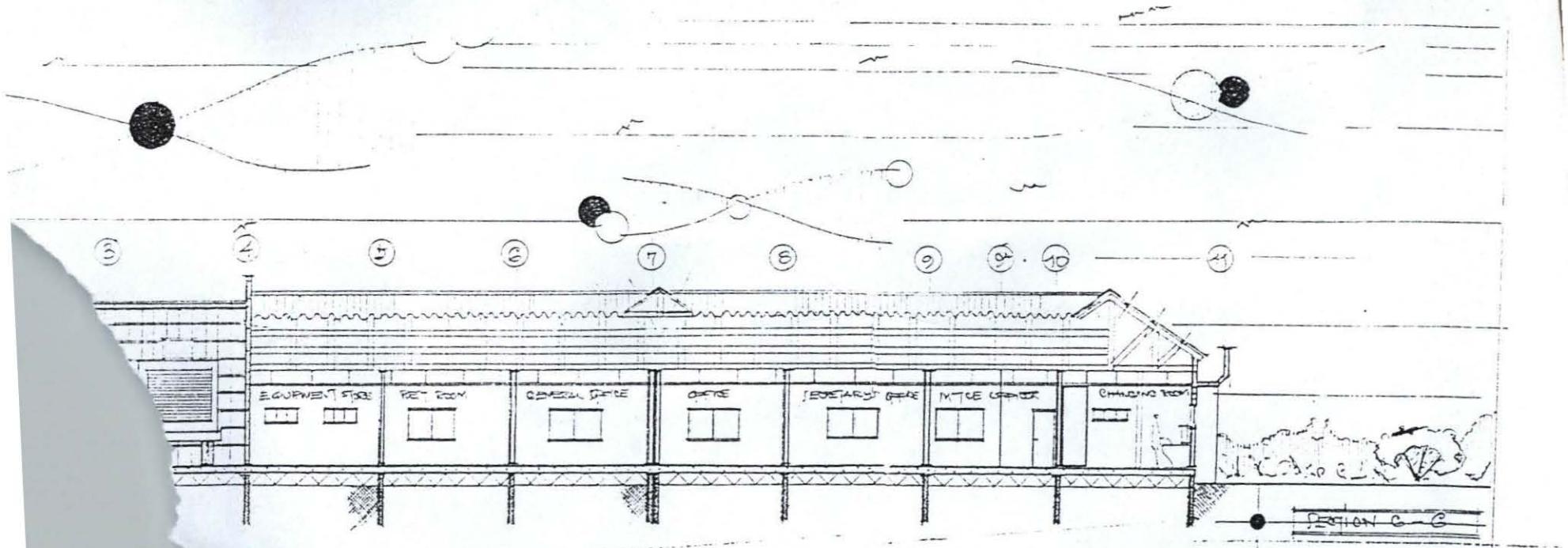


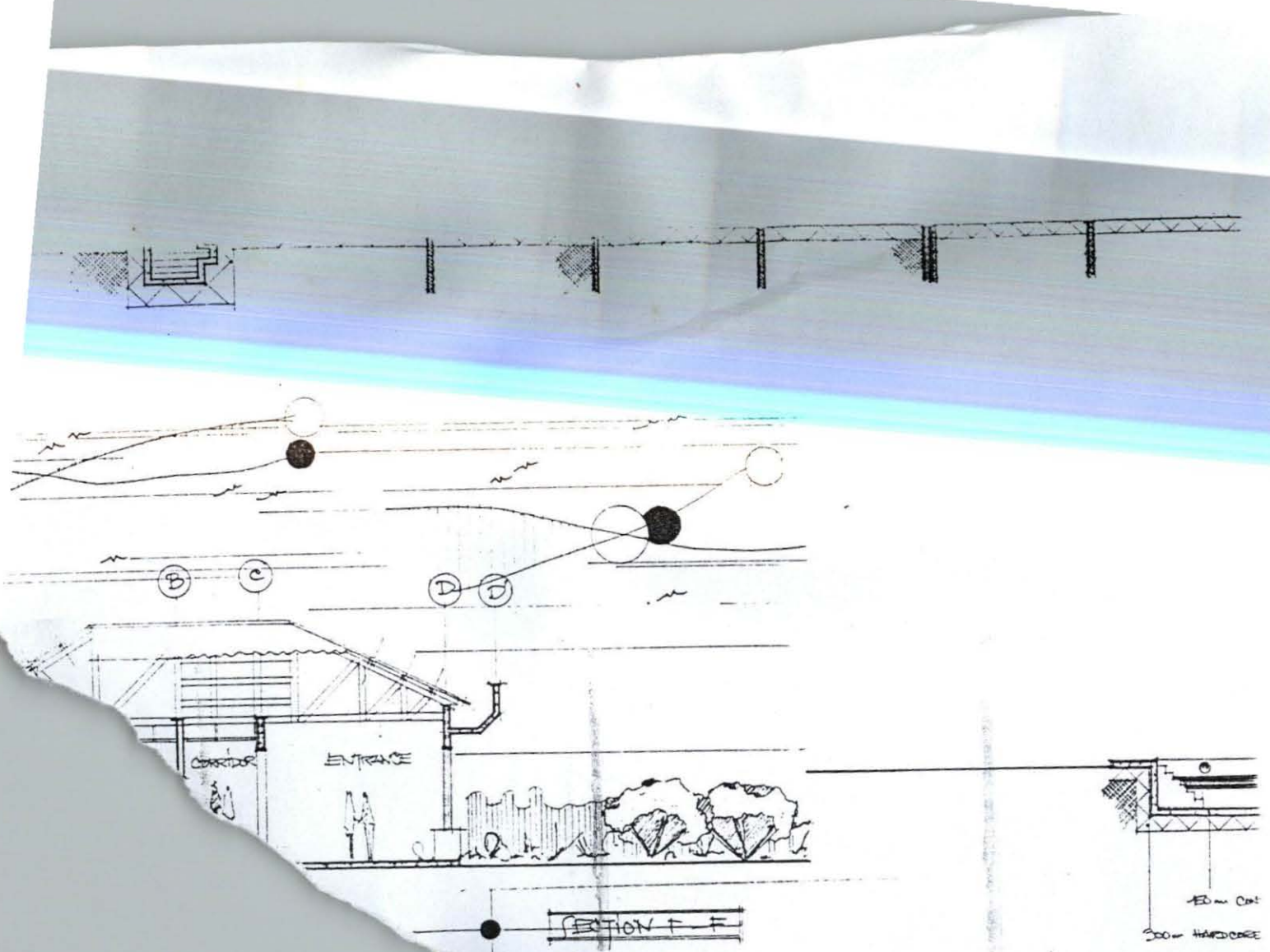
DETAILS-3


6mm DIAMETER FEED PIPE TO POND FROM STORM-WATER COLLECTING CHANNEL
225mm CONCRETE WALL
225m FOUNDATION WALL FILLED WITH MASS CONCRETE
300m HARDCORE
150m SLAB SCREED TO SLOPE
CERAMIC TILES LAID TO FOLLOW SLOPE AND TO MAKE POND CLEANING EASY.
DETAIL AT E; 1:10


SERVICE BAY
+450
STORE
+600
EQUIPMENT
ROOM
GENERAL
OFFICE
CERAMIC TILES
FLOOR FINISH
SECRETARY'S
OFFICE
MAINTENANCE
OFFICER
CORRIDOR
+600
CEMENT SCREED
FLOOR FINISH
+000
+575
ALUMINIUM FIXED LANAI USED
TO FACE TOILET WALLS AND
COVER DUCT PIPING
15500


1
2
3
4
5
6
7
8
9
10
11
12
53800
EQUIPMENT STORE
REST ROOM
GENERAL OFFICE
OFFICE
SECRETARY'S OFFICE
MTCE OFFICER
+600
+000 N.G.L
SECTION C-C
A
B
C
D
D'


EQUIPMENT STORE
CHANGING ROOM
SECTION C-C

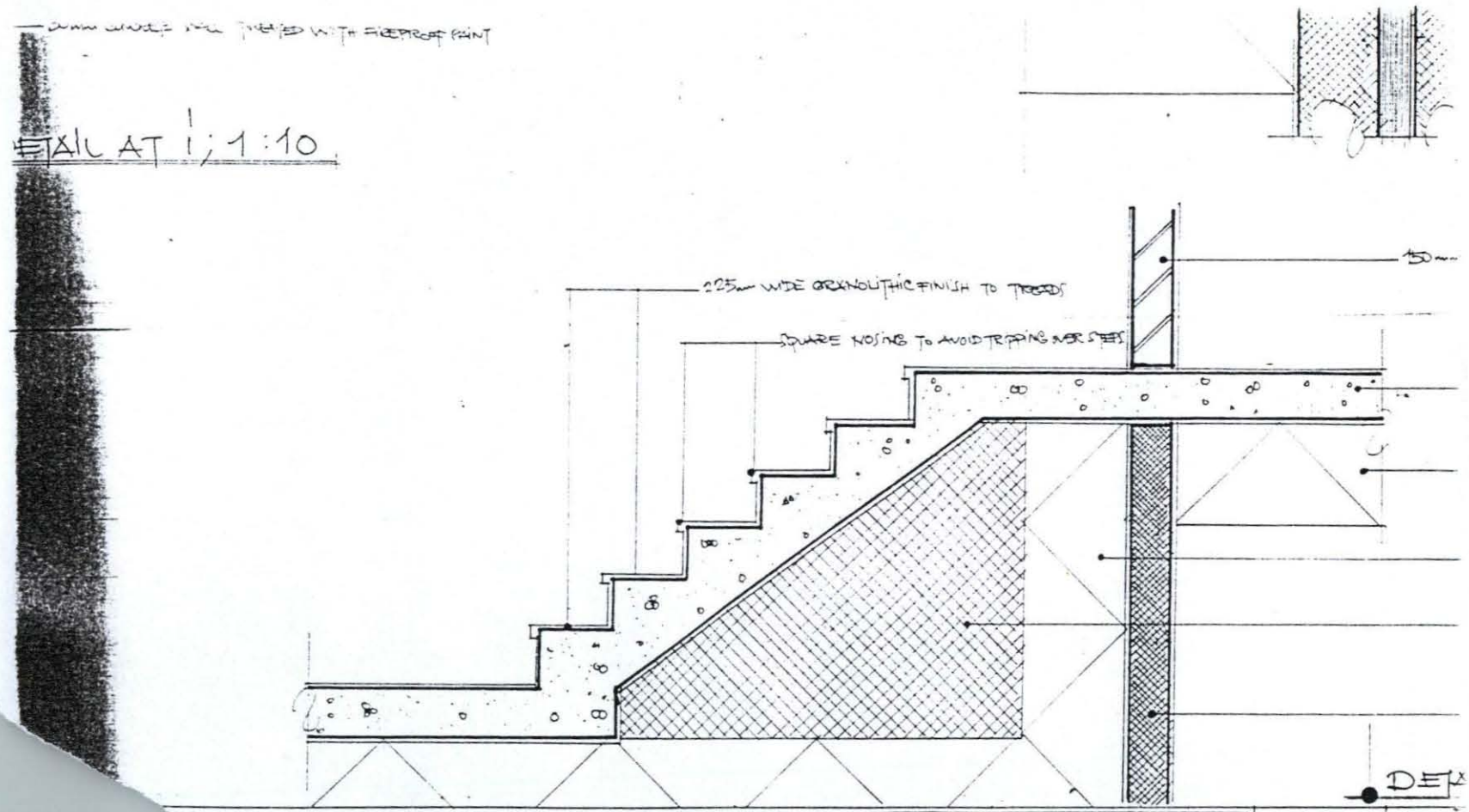


ERN FIRE SERVICE STATION,

RE SAFETY IN BUILDINGS. **2**

TRA - MODERN

SIS ON FIRE



DETAIL AT 1; 1:10

...OR ULTRA - MODERN FIRE SERVICE STATION,
...EMPHASIS ON FIRE SAFETY IN BUILDINGS.

SHEET NO 31

NAME
REG NO
DEPT.
LEVEL

...POSAL FO...
...WITH E...

ECTING POND

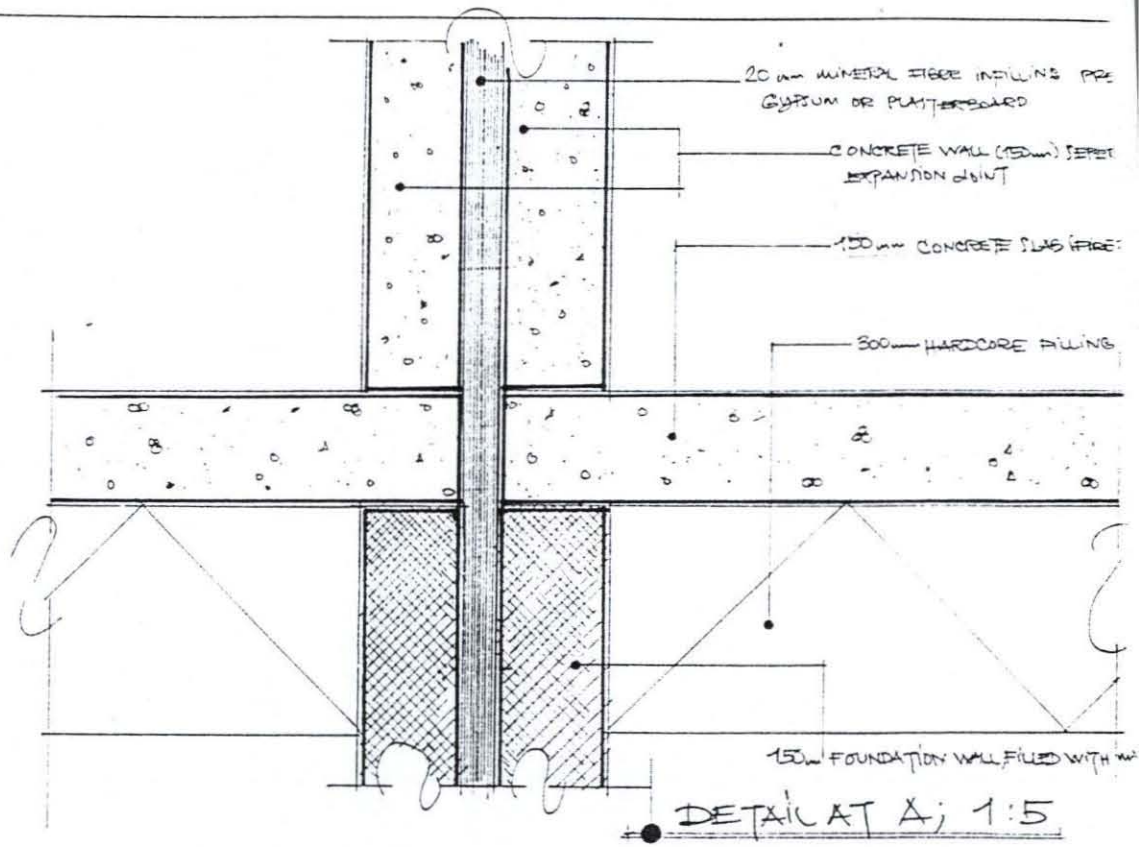
— 10mm BOLTS USED TO FIX STEEL TRUSSES TO RAFTERS AND MAIN TIE

-SECTION PURLINS BOLTED TO CLEAT

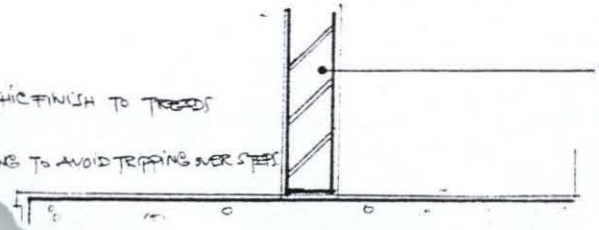
EJ BOLTED TO ROOF MEMBERS

M.E RAFTER AT 4500 C/C

N TIE AT 4500 C/C

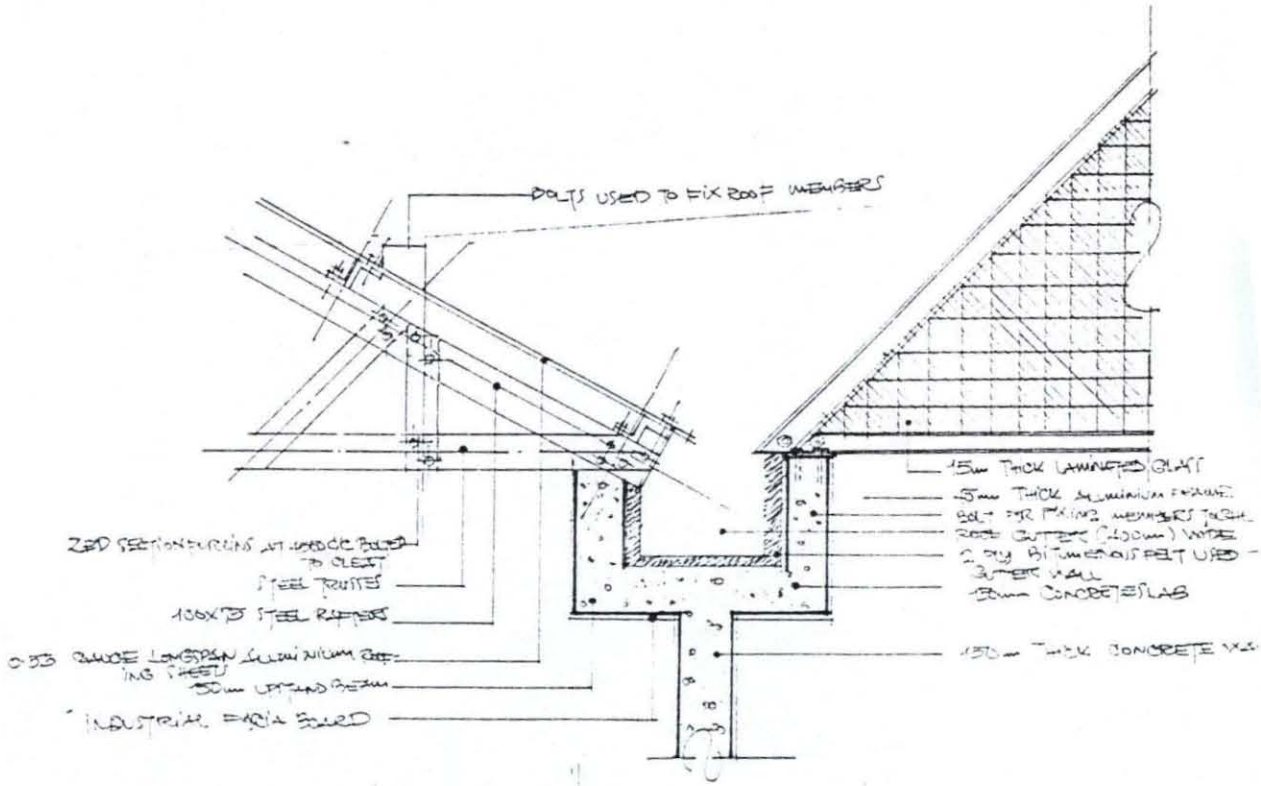


DETAIL AT A; 1:5



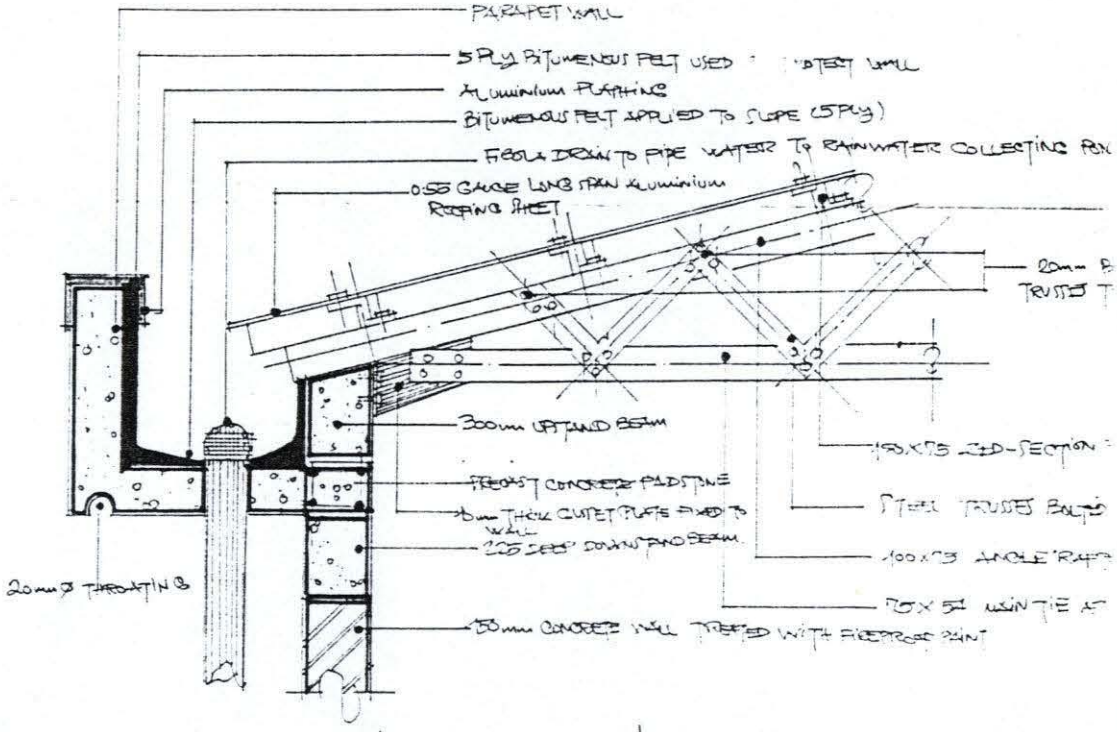
E GRANOLITHIC FINISH TO TREADS

NOSING TO AVOID TRIPPING OVER STEPS

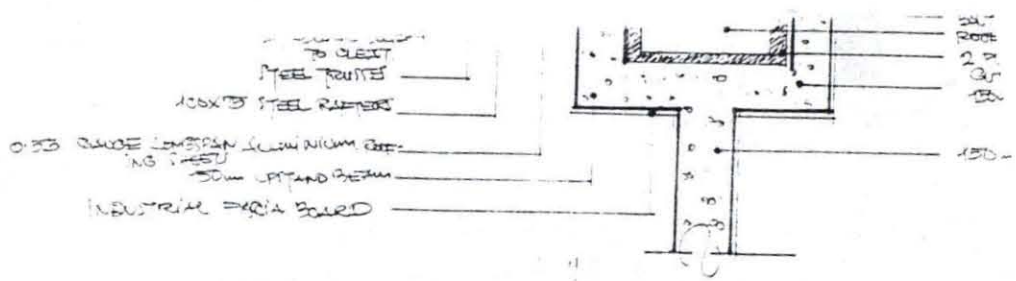


DETAIL AT D; 1:10

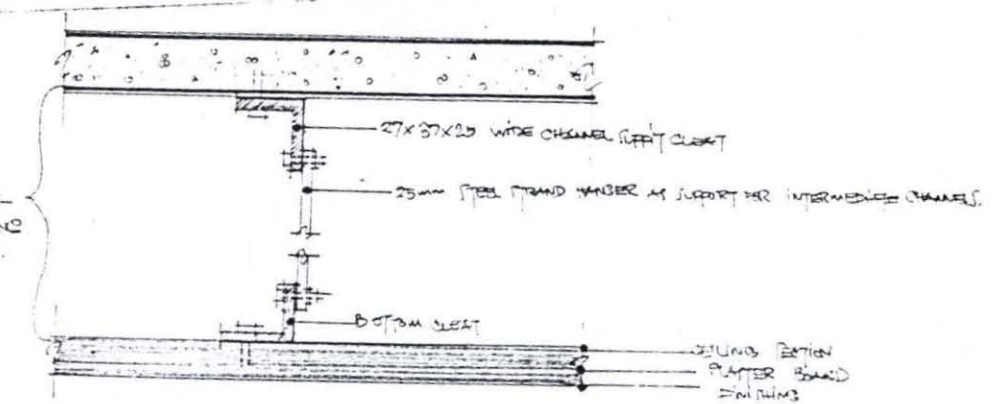
DETAILS-1



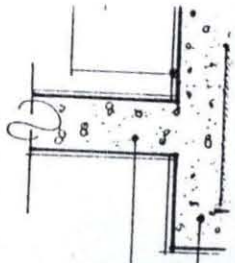
DETAIL AT 1; 1:10



DETAIL AT D; 1:10

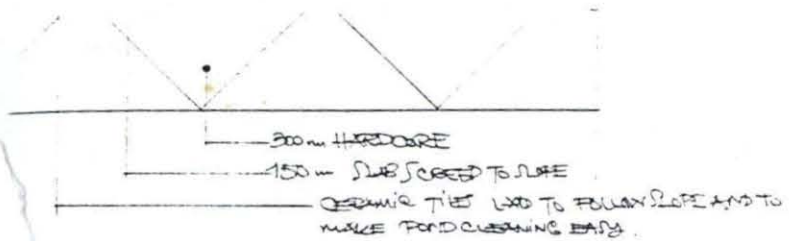


DETAIL AT d ; 1:10

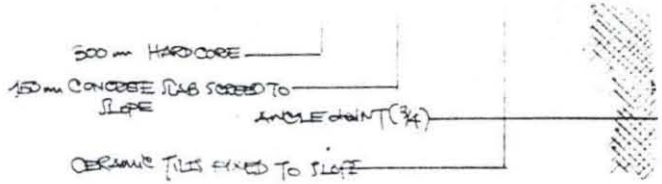


DETAIL AT D; 1:10

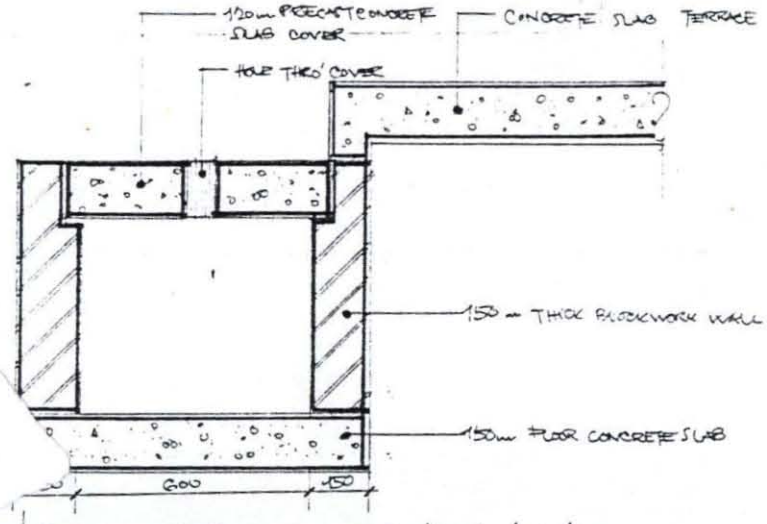
DESIGN PROPOSAL FOR ULTRA - MODE
ABUJA, NIGERIA, WITH EMPHASIS ON F



ATE; 1:10



DETAIL AT F; 1:10



COVERED GUTTER DETAIL ; 1:10

...LTRA - MODERN FIRE SERVICE STATION, ...ASIS ON FIRE SAFETY IN BUILDINGS.

SHEET NO.	NAME	OKON, V...
33	REG. No.	M.TECH/SE...
	LEVEL	900
	DEPT	ARCHI...