"A MODERN BAKERY, UMUNYA, OYI L.G.A. ANAMBRA STATE"

UMUNYA, OYI L.G.A

ANAMBRA STATE

M.Sc. (ARCH) THESIS REPORT

BY

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CERTIFICATION

I, OKAFOR , VITALIS NONSO, a postgraduate student of the department of architecture, university of Nigeria, with registration number **PG/M.Sc./07/46830** has satisfactorily completed the requirement for the course and research work for the degree of master of science in architecture. The work embodied in this report is original and has not been submitted in part or full for other diploma or degree of this or any other university.

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DEDICATION

This thesis is dedicated to Mrs Gloria Okafor and Miss Ukonze Uchenna Mirian, whose immense effort has brought me thus far.

PREFACE

The choice of this topic was not made arbitrarily, but was made after much observation of the bakery industries today. It was clear to me that the bakeries were in trouble and that the masses were going to suffer if nothing was done to either change the bakery business in this country or improve its activities through careful planning and legislation. People have started to experience hardship. Many people complain of poor environmental sanitation of the bakeries and low quality of their products. It was in sympathy with those masses that I decided to have my thesis on this topic - Modern Bakery.

Sources of information were personal interviews with some bakers, retailers, consumers, and the general public. On the spot record and appraisal from magazines, catalogues, journals, periodicals and books.

This report comprises basically the history of the development of bakery industry in Nigeria, the process of baking bread, the most common and most acceptable baked products in this country. Some foreign and local case studies were also analysed in this report. It is from these case studies that I had to arrive at my own design.

My design is generally in six parts. These are the administration, staff amenities, factory (production area), research unit and small training school, repairs and maintenance workshop and utilities/services, parking spaces are also adequately provided for in the design. Of special interest in the design are the research units, the plant for the conversion of burnt bread and unsold bread into animal feeds.

The research unit will enable research work be carried out on the possibilities of using local raw materials in baking bread and other baked products. It should be noted that wheat is the main raw material for producing flour and it's imported into this country from U.S.A Thus the scarcity of this commodity has affected both quality and price of baked products. Besides, finding an alternative local raw material will reduce the huge foreign exchange, the importation of wheat costs to the government. For according to Tell magazine' report (20th August, 2008), Nigeria spends more than N3,000,000,000 (three billion naira on the importation of raw materials for flour production annually

The conversion of spoilt bread into animal feeds will help to reduce the cost of animal feeds and thus the final product of such animal farms.

Also, the addition of space for quality controller will ensure a high quality standard of the baked products. A broad knowledge of the entire report and the design proper will manifest itself after going through this manuscript.

ACKNOWLEDGEMENT

This work is the result of many years of struggle, the fruitful realization of which could not have bean accomplished without the immense and selfless contribution of many people.

Though, it is hard to mention all of such people, my special thanks and gratitude go to my mum Mrs. G. Okafor whose financial support gave me the courage to vigorously pursue my studies.

ABSTRACT

The efficiency of production depends on how well the various machines; production facilities and employee's amenities are located in a factory. Only the properly laid out factory can ensure the smooth and rapid movement of material, from the raw material stage to the end product stage. Factory layout encompasses new layout as well as improvement in the existing layout.An ideal factory layout should provide the optimum relationship among the output, floor area and manufacturing process. An efficent factory layout is one that aims at achieving various objectives like efficient utilization of available floor space, minimizes cost, allows flexibility of operation, provides for employees convenience, improves productivity etc.The entrepreneurs must possess the expertise to lay down a proper layout for new or existing plants. It differs from one factory to another. But basic principles to be followed are more or less same. From the point of view of factory layout, we can classify small business into three catagories i.e.

(a) manufacturing units

(b) trades

(c) services establishments.

Designing of layout is different in all above three categories e.g. manufacturing unit may follow one of product,process and fixed position or combined layout,as the case may be.

Traders might go either for self-service or full service or special layouts whereas service establisments such as motels, hotels, and restaurants

must give due attention to customer convenience,quality of service, efficiency in delivering the service etc. While deciding for layout for factory or unit or

store, a small entrepreneur has to consider the factors like the nature of the product, production process,size factory building, human needs etc.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 INTRODUCTION

Baking business is fast growing in this country since its existence in early nineteenth century. A sample survey conducted showed that baked products especially bread is eaten by most families in this country daily. This necessitates a continuous supply of bread and other baked products to all parts of the federation.

The problem however is that most factory (bakery) buildings are substandard, dirty and without any formal design. Most of the buildings were suitable for our needs earns decades ago but are almost certainly inadequate for the present and future needs. This is true when one realizes that fast technological changes are taking place, the result of which is the development of computer techniques in industry and commerce, the expansion of mass production into new fields and the extension of industrial automation. It is certain therefore that the entire work pattern for many people in industry and commerce will be completely changed with different form of work, new working hours and different conditions of work which will affect not only their working lives but their leisure activities as well. These changes are however geared towards greater efficiency and higher productivity.

Without stressing the obvious, I hasten to say that factory buildings with an ideal Landscaping play an important part in promoting industrial efficiency. It is therefore not enough for buildings in which people work to be a shell designed around a production flow diagram. The production flow in a modern factory and the work pattern in an office may be

of vital importance but the environment in which workers carry out their task is oven more important; for human beings will always be necessary to control, operate and maintain the hardware of industry and commerce.

The project — MODERN BAKERY UMUNYA is therefore aimed at providing an ideal shelter for the production of bread products. In the design proper, special consideration is taken to provide a conducive internal and external environment for the workers; smooth and correct merging of the workers and machines which inevitably will result in efficient management, effective machine operations and declining machine depreciations.

Again, we all know that food is the most vital and indispensable need of man. The apparent food shortage currently being experienced in the country has more than ever before heightened the need to accelerate efforts directed at tremendously increasing food production to meet the demand of the ever increasing population. This does not mean that there is scarcity of baked products. The fact is that the standard of bakeries in this country is low and may not meet the demand for baked products in the nearest future if left in its present state. It is in cognizance of these facts that I had to embark on this project.

1.2 STATEMENT OF PROBLEMS

Most bakeries presently in the country are manual bakeries (hand craft). A few however, are mechanized but mostly with obsolete machinery which drastically affects the quality of

their products. Also, the rate at which human beings handle bread is alarming from the raw material stage, through production, retailers to the consumers. One therefore cannot ever stress the need for automation in baking industry.

Poor and unhealthy bakery buildings which are of no architectural interest abound everywhere. These undersigned buildings are sited even between residential houses. Thus constituting a nuisance through production of noise, and also becoming a fire hazard.

The shortage of raw materials and manpower are other problems facing bakeries in the country. Shortage of raw material causes increase in the price of baked products while manpower shortage affects its quality.

1.3 PURPOSE OF THE STUDY

It is hoped that the result of this study, based on the material collected locally and from other parts of the world through magazines, journals, correspondence will be of value to those who build baking factories and offices in the future and those who design them. By so doing, the buildings they erect may not only be efficient and valuable aids to improved productivity, but also provide a humane environment for the workers who spend a large part of their lives within the bakery walls.

1.4 BASIC ASSUMPTIONS IN RESEARCH

The underlisted assumptions were taken in respect of research work, it is assumed that

1. Poor shelter and inhumane environment for bakery factories affects its products and productivity. The quality of bakery products is being affected by the filthy nature of the factories.

2. Shortage of raw materials brings the high cost bread and other bakery products.

4. Absence of qualified food technologists to factories brings down the quality of bread.

5. The use of hand craft production results in number of personnel and man-hours wasted in such industries. Thus the price of the baked products is increased.

1.5 MOTIVATION –NEED AND SIGNIFICANCE OF STUDY

There is an urgent need for a better and comfortable atmosphere for producing bread and other baked products, considering especially that most of these everyday food items have hitherto been prepared in undersigned filthy places.

Like we all may know, uncleanliness in the preparation of food can have an indirect effect on its nutritious value. The climate in Nigeria supports the development of micro-organisms which require warmth, food and moisture to develop and multiply. When they are growing and while they are being handled by people, foods can become contaminated by these organisms. Flies often contaminate food when they alight on it, as they are carriers of disease. Often a time that is what happens in many bakeries. Baked products (bread) are left exposed to flies and other diseases. Sand/stone is usually found in most loaves.

There is also the need to raise the quality of bread and other baked products in the country today through research into various methods of improvement by employing specialists Food technologists. In addition, the controller to be provided in the bakery of this nature will ensure the provision of certain percentage protein, fat, sugar etc. to better the quality of the products making them more palatable and digestible.

The study will create an avenue where different local materials will be tried through the research unit. The successful utilization of local raw materials will certainly reduce the price of the final products. It is also hoped that it will be a training ground for those who are interested in the act of baking.

The project will be a source of revenue for the government and to many Nigerians who will be employed into such organized system of production. This study will also ensure the safety and comfort of workers through the provision of a relaxed and interesting landscape. It would also promote imagery as an architectural form i.e. having a structure that translates its function

1 .6 LIMITATIONS

(a) **Finance:**-This is the most important factor that hinders the smooth execution of this project or study.

There was limited amount from the researcher (student) which was not enough to cover the entire country. Even the initial idea to travel overseas for some useful information could

not be implemented. Also my research has to be limited to some selected towns in three states of the federation. These are Lagos, Anambra, Abia and Enugu state.

(b) **Human Factor:**-Many of the human resource managers were reluctant to give out information about their bakeries because of the substandard nature of these bakeries. To worsen the situation, the demand for the photocopy of the plan of the bakeries aroused suspicion from the human resource managers. They doubted or questioned the intentions of such project. They feared I could be a government agent and was scared of NAFDAC invading their bakeries.

(c) **Foreign Case Studies:** This is another area where the I met obstacle. It took me to other libraries and to engage in correspondence with friends overseas. Although, the internet was of immense aid.

1.7 AREAS OF SURVEY

The study is designed to investigate critically the present status of bakery industries in Nigeria. However for the purpose or this research, the areas covered include Enugu, Anambra, Lagos, and Abia State. Others include some bakeries in some neighbourhood.

Although there are many small scale bakeries in these towns, only few of them were selected as case studies. Others were served with the questionnaires which they filled and returned to me. The selection of those written on as case studies was based on the availability of sufficient information on them.

Bakeries visited include the following:

(1) BUTTERFIELD BREAD …….Lagos

(2) UTC BREAD……. Lagos

(3) LEVENTIES FOODS LTD……Lagos

(4) HIGHLIFE BREAD INDUSTRY …..Aba

(5) ALLIANCE BAKERY ……Onitsha

(6) CHITIS BAKERY……Enugu

1.8 RESEARCH

Research Method

The research method for this study was questionnaire and interviews. After a comprehensive study of relevant literature, journals, periodicals and researches carried out by some scholars, the researcher was able to draw up the questionnaire.

The questionnaire contained simple questions and sentences. Proper answer to these questions provided the researcher with information necessary for modern bakery design. Some of the questions however needed specialties.

Administration Method

The researcher visited each bakery in person. On arrival, the researcher was directed to the executive director or the proprietor to whom I explains my mission along side with a letter of introduction issued by the Department of Architecture, University of Nigeria, Enugu Campus.

The questionnaires were giving to the Executive Director or Proprietor who in most cases asks that me to come for collection the following day. This they say is necessary to enable them have a proper look at the questions. The proprietors were assured that the purpose of the exercise is purposefully for a research project, that it is not designed to expose their faults thereby making their industry vulnerable to attack by government agencies. They were guaranteed of absolute confidence in the information they would give.

The consumers' questionnaire is designed to seek the opinion of the public as regard the baked products around them especially bread. It was also aimed at determining the consumption rate of broad in the area of project location. These questionnaires were distributed by some friends to different families. However, to ensure a fair percentage of correct returns, I personally administered some of the questionnaire to some families.

CHAPTER TWO

LITERATURE REVIEW

2.1 EARLY BAKERIES

In ancient history, the first evidence of baking occurred when humans took wild grass grains, soaked them in water, and mixed everything together, mashing it into a kind of broth-like paste. The paste was cooked by pouring it onto a flat, hot rock, resulting in a bread-like substance. Later, this paste was roasted on hot embers, which made bread-making easier, as it could now be made anytime fire was created. Around 2500 B.C., records show that the Egyptians had bread, and may have learned the process from the Babylonians. The Greek Aristophanes, around 400 B.C., also recorded information that showed that tortes with patterns and honey flans existed in Greek cuisine. Dispyrus was also created by the Greeks around that time and widely popular; was a donut-like bread made from flour and honey and shaped in a ring; soaked in wine, it was eaten when hot. The first evidence of stone ovens was in Italy, where they made pizza and pasta.

Baking flourished in the Roman Empire. In about 300 B.C., the pastry cook became an occupation for Romans (known as the pastillarium). This became a respected profession because pastries were considered decadent, and Romans loved festivity and celebration. Thus, pastries were often cooked especially for large banquets, and any pastry cook who could invent new types of tasty treats was highly prized. Around 1 A.D., there were more than three hundred pastry chefs in Rome, and Cato wrote about how they created all sorts of diverse foods, and flourished because of those foods. Cato speaks of an enormous amount of breads; included amongst these are the libum (sacrificial cakes made with flour), placenta (groats and cress), spira (our modern day flour pretzels), scibilata (tortes), savaillum (sweet cake), and globus apherica (fritters). A great selection of these, with many different variations, different ingredients, and varied patterns, were often found at banquets and dining halls. The Romans baked bread in an oven with its own chimney, and had mills to grind grain into flour.

Eventually, because of Rome, the art of baking became known throughout Europe, and eventually spread to the eastern parts of Asia. Bakers often baked goods at home and then sold them in the streets. This scene was so common that Rembrandt illustrated a work that depicted a pastry chef selling pancakes in the streets of Germany, with children clamoring for a sample. In London, pastry chefs sold their goods from handcarts. This developed into a system of delivery of baked goods to households, and demand increased greatly as a result. In Paris, the first open-air café of baked goods was developed, and baking became an established art throughout the entire world.

Grown in Mesopotamia and Egypt, wheat was likely first merely chewed. Later it was discovered that it could be pulverized and made into a paste. Set over a fire, the paste hardened into a flat bread that kept for several days. It did not take much of a leap to discover leavened (raised) bread when yeast was accidentally introduced to the paste.

Instead of waiting for fortuitous circumstances to leaven their bread, people found that they could save a piece of dough from a batch of bread to put into the next day's dough. This was the origin of sour-dough, a process still used today.

In Egypt, around 1000 BC, inquiring minds isolated yeast and were able to introduce the culture directly to their breads. Also a new strain of wheat was developed that allowed for refined white bread. This was the first truly modern bread. Up to thirty varieties of bread may have been popular in ancient Egypt.

It was also during this time that bread beer was developed. The bread was soaked in water and sweetened and the foamy liquor run off. Beer was as popular in ancient Egypt as it is in America today.

The Greeks picked up the technology for making bread from the Egyptians; from Greece the practice spread over the rest of Europe. Bread and wheat were especially important in Rome where it was thought more vital than meat. Soldiers felt slighted if they were not given their allotment. The Roman welfare state was based on the distribution of grain to people living in Rome. Later the government even baked the bread.

Through much of history, a person's social station could be discerned by the color of bread they consumed. The darker the bread, the lower the social station. This was because whiter flours were more expensive and harder for millers to adulterate with other products. Today, we have seen a reversal of this trend when darker breads are more expensive and highly prized for their taste as well as their nutritional value.

In the middle ages bread was commonly baked in the ovens of the lord of the manor for a price. It was one of the few foods that sustained the poor through the dark age.

Bread continued to be important through history as bread riots during the French Revolution attest. The famous quotation attributed to Marie Antoinette that if the poor could not get bread for their table then "let them eat cake," became a famous illustration of how royalty had become ignorant of the plight of the lower classes. Actually, Marie Antoinette never said this and was merely being slandered by her detractors.

Still thought of as the "staff of life", for centuries bread has been used in religious ceremonies. Even the lord's prayer requests of God to "Give us this day our daily bread" - meaning not merely loaves, but moral sustenance.

Today, even with the competition of a growing variety of foods, bread remains important to our diet and our psyche. It has a prominent place in at the local market, in our cupboards, and even in our language. The word "bread" is commonly used as a slang term for money. It connotes importance as when we say that some aspect of our work is "our bread and butter". In many households bread is still served with every meal.

Bread has a long history for a reason. It is a healthy and nutritious food that fills the stomach as well as the soul.

Bread is one of the oldest prepared foods, dating back to the Neolithic era. The first bread produced was probably cooked versions of a grain-paste, made from ground cereal grains and water, and may have been developed by accidental cooking or deliberate experimentation with water and grain flour. Yeast spores are ubiquitous, including the surface of cereal grains, so any dough left to rest will become naturally leavened. There were multiple sources of leavening available for early bread. Airborne yeasts could be harnessed by leaving uncooked dough exposed to air for some time before cooking. Pliny the Elder reported that the Gauls and Iberians used the foam skimmed from beer to produce "a lighter kind of bread than other peoples." Parts of the ancient world that drank wine instead of beer used a paste composed of grape juice and flour that was allowed to begin fermenting, or wheat bran steeped in wine, as a source for yeast. The most common source of leavening, however, was to retain a piece of dough from the previous day to use as a form of sourdough starter.

A major advance happened in 1961 with the development of the Chorleywood Bread Process, which used the intense mechanical working of dough to dramatically reduce the fermentation period and the time taken to produce a loaf. The process, whose high-energy mixing allows for the use of inferior grain, is now widely used around the world in large factories.

Recently, domestic breadmakers that automate the process of making bread have become popular in the home.

2.2 DEVELOPMENT OF BAKERY INDUSTRY IN NIGERIA

The art of baking was brought into Nigeria by some freed Negroes who were wall established as independent artisans in various trades. These Negroes educated and Christianized settled first in Lagos where baking was carried out in their homes until about 1900. Then, commercial bakeshops began to spring up. This was energized by the growth of the we learning urban population. The eating of bread which was the main baked product at that time disseminated first along the coastline (ports) Warn, Calabar, Port-Harcourt, and then inland Onitsha etc. In 1910, flour imports amounted hundred weights.

Inspite of thin rapid growth, baking was entirely by hand. The ingredients were hand mixed and kneaded, and were baked in mud ovens. The use of mud brick ovens is still widely practiced. The final product was sold directly to the consumer.

The wide spreading of the bakery industry was carried out by mostly non—indigenous Africans in 1915. Amos Stanely Wyntor Schackle—ford a West Indian was among those who pioneered commercial baking along the coastline — Schackleford brought two major innovations into Nigeria baking industry. He introduced the dough brake. This is a kneading device. The use of the dough brake was a well risen, smooth, even tenured bread. Schackleford also initiated the wholesale system. Independent vendors were appointed and commission paid to them (the vendors). This wholesale system permitted large scale

production. Schackleford bakery flourished mightily; consequently, shares issued initially at £50 each were later sold as much as £3,000. However, one major problem in baking business at this period was the absence of reliable fermenting agent. Palm wine which was used as fermenting agent produced poor results.

In 1920's and early 1930's, there grew three other fairly mechanized bakeries. Two of these (African Home and Foreign Industries, Sterling Brothers Baking Company) were Owned by best Indians while third was by a Nigerian — Mrs. Phibean Coker. By 1950, the first government sponsored trainee returned from England where he had secured his city and Guide Certificate in baking. Between 1946 and 1952 twelve Nigerians were at the United Kingdom to study the science of baking on private sponsorship. Indeed, these ware among the first Nigerians to go abroad far the purpose of pursuing industrial skills. Bakers associations were among the earliest in Nigeria. These were a measure of profit in baking industry. However no proprietor thought it wise to provide an ideal shoulder and environment far the production of this highly demanded product.

From about 1953 onward, competition in the principal urban areas intensified rapidly. Competition was also manifested in product innovations. Newsprint bread wrappers gave way to cellophane bags which in turn yielded to sealed wax paper wrapping. The slicing of bread was introduced. New types of baked products adaptations of basic bread formula came into the market Sugar bread, salt bread biscuits etc.

The bakery industry also advanced in the technical part, In 1954, E.g. Idowu, designed and built the first Nigerian made dough brake. The Idowu brake sold at L55 plus another £60 for power unit and installation as compared with £600 for the imported ones had marked effect in the growth of the industry. The drastic reduction of the price of the brake enabled many bakers to go mechanized. Thus Idowu's innovation hastened the decline of the hand baker. Besides, it made the products cheaper and of improved quality.

The continued growth of the bakery industry necessitated the establishment of flour mill in Nigeria by the Nigerian government. The mill which commenced production in 1962 had its main raw material (wheat) for continued existence imported from North America. The local production of hard wheat was hindered by poor soil and bad climatic conditions.

2.3 THE EFFICIENT FACTORY LAYOUT

A factory layout can be defined as follows; Factory layout refers to the arrangement of physical facilities such as machinery, equipment, furniture etc. with in the factory building in such a manner so as to have quickest flow of material at the lowest cost and with the least amount of the finished product.

According to Ringgs, "the overall objective of factory layout is to design a physical arrangement that most economically meets the required output-quantity and quality".

According to J.L.Zundi, "Factory layout ideally involves alloction of space and arrangement of equipment in such a manner that overall operating costs
are minimized".

This involves the installation or planning of the physical arrangement of the various industrial activities, usually includes mainly the space needed for:

* Operating equipment or machinery

* Personnel

* Material movement

* Storage of raw materials and finished products

* Indirect labour

* Other supporting activities and services.

The need for organised arrangement in modern industrial (buildings) is as a result of

- Improved mechanized equipment
- neatness and orderliness in the production areas specialization of labour
- improved and efficiently mechanized material handling techniques between major operations.

2.3.1 TYPES OF LAYOUT:

There are four main types of layout classified in accordance with the behaviours of the three basic elements of production — material, machinery and men.

(a) **Layout by Fixed Position**

In this layout, the material or the major component remains in a fixed position until the finished product, while the machinery and men work e.g. ship building industry. The major product being produced is fixed at one location. Equipment labour and

components are moved to that location. All facilities are brought and arranged around one work center. This type of layout is not relevant for small scale entrepreneur

(b) **Layout by Process**

Here all materials move while men and machinery are fixed. All similar processing functions are grouped in the same and one area. Example, in a pottery, all firing, glazing, and decorating are done in their respective group areas. In this type of layout machines of similar type are arranged together at one place. E.g. Machines performing drilling operations are arranged in the drilling department, machines performing casting operations be grouped in the casting department. Therefore the machines are installed in the plants, which follow the process layout. Hence, such layouts typically have drilling department, milling department welding department, heating department and painting department etc. The process or functional layout is followed from historical period. It evolved from the handicraft method of production. The work has to be

allocated to each department in such a way that no machines are chosen to do as many different job as

possible i.e. the emphasis is on general purpose machines. The grouping of machines according to the process has to be done keeping in wind the following principles:

a) The distance between departments should be as short as possible for avoiding long distance movement of materials

b) The departments should be in sequence of operations

c) The arrangement should be convenient for inspection and supervision.

(c) **Layout by Product or the Linear Production Layout**

Here the material moves and man and machines are fixed in a sequence of operations such that material from one operation is immediately picked up by the next. This type of layout seems to be an ideal one for the automated baking plant and hence will be adopted. Under this, machines and equipments are arranged in one line depending upon the sequence of operation required for the product . The materials move form one workstation to another sequentially without any backtracking or deviation. Under this, machines are grouped in one sequence. Therefore matereals are fed into the first machine and fineshed goods travel automatically from machine to machine, the output of one machine becoming input of the next, e.g. in a paper mill, bamboos are fed into the machine at one end and paper comes out at the other end. The raw material moves very fast from one workstation to other station with a minimum work in progress storage and material handling. The grouping of machines should be done keeping in mind the following general principles:

a) All the machine tools or other items of equipments must be placed at the point demanded by sequence of operations.

b) There should no points where one line crossed another line.

c) Materials may be fed where they are required for assembly but not necessarily at one point.

d) All the operations including assembly, testing packing must be included in the line.

(d) **Combined layout:**

Certain manufacturing units may require all three processes namely intermittent process the continuous process and the representative process combined 3 process. In most of industries, only a product layout or process layout process or fixed location layout does not exist. Thus, in manufacturing concerns where several products are produced in repeated numbers with no likelihood of continuous production, combined layout is followed. Generally a combination of the product and process layout or other combinaion are found, in practice, e.g. for industries involving the fabrication of parts and assembly, fabrication tends to employ the process layout, while the assembly areas often employ the product layout. In soap, manufacturing, plant, the machinery manufacturing soap is arranged on the product line principle, but ancillary services such as heating, the manufacturing of glycerin, the power house, the water treatment plant etc. are arranged on a functional basis.

2.4 ADVANTAGES OF FACTORY LAYOUT

Factory layout is an important decision as it represents long-term commitment. An ideal factory layout should provide the optimum relationship among output, floor area and manufacturing process.It facilitates the production process, minimizes material handling, time

and cost, and allows flexibility of operations, easy production flow, makes economic use of the building, promotes effective utilization of manpower, and provides for employee's convenience safety, comfort at work, maximum exposure to natural light and ventilation. It is also important because it affects the flow of material and processes, labour efficiency, supervision and control, use of space and expansion possibilities etc.

2.4.1 ESSENTIALS

An efficient factory layout is one that can be instrumental in achieving the following objectives;

a) Proper and efficient utilization of available floor space

b) To esure that work proceeds from one point to another point without any delay

c) Provide enough production capacity

d) Reduce material handling cost

e) Reduce hazards to personnel

f) Utilise labor efficiently

g) Increase employee morale

h) Reduce accidents

i) Provide for volume and product flexibility

j) Provide ease of supervision and control

k) Provide for employee safety and health

l) Allow ease of maintenance

m) Allow high machine or equipment utilization

n) Improve productivity

2.5 FACTORY FLOW

Factory FLOW is a graphical material handling system that enables engineers to optimize layouts based on material flow distances, frequency, and costs. Factory layouts are

analyzed by using part routing information, material storage needs, material handling equipment specifications, and part packaging (containerization) information.

The Shortest Distance Between Two Points

Factory FLOW uses aisle network information to find the shortest distance between any two points to identify the closest incoming dock and storage area to a part's point of use. Material flow studies are performed on alternate layout configurations and automatically compared to determine which layout is better. Factory FLOW can also be used to compute material handling equipment requirements and optimized tugger (milkrun) routes. Users can also use the available container information to auto-populate containers and bins on storage areas and racks in order to create operator walk paths. Factory layout information is stored in a Factory FLOW database. Factory FLOW uses this information to help engineers develop layouts that facilitate the manufacturing process. Factory FLOW generates Euclidean (point-to-point) material flow diagrams, actual path flow diagrams, aisle congestion diagrams, and quantitative reports so engineers can compare layout options and improve production efficiency.

The Competitive Advantage

A typical factory layout or engineering effort includes layout considerations and capacity, utilization, throughput, and resource constraint analysis. Factory FLOW can stand alone in situations where the layout is the focus of the project. In situations where there are capacity or process issues, Factory FLOW adds significant value to the simulation effort and

improves the quality of the overall engineering work. Here are the key benefits you can expect from Factory FLOW:

¬Create initial layouts easily

¬Improve layout productivity by determining the best location of machines and departments

¬Reduce material handling needs and storage requirements

¬Design workcell layouts on the process plan

¬Optimize layouts based on qualitative factors such as noise, dirt and supervision needs

¬Diagram material-flow intensity

¬Calculate material handling costs and requirements

¬Flow charts: The flow chart feature allows you to develop material routings using standard process symbols. You can elect multiple activity points and move arrows in the flowchart for mass routing change. Also, there is a capability to cut, copy, and paste multiple activity points for rapid editing of the material routing file.

¬Data templates and equations: Factory FLOW provides data templates that contain standard information to enable you to compute and track micro-activities such as the amount of time spent on cutting open cardboard boxes or walking.

¬Material flow calculations: Factory FLOW checks the data to verify that the proper devices are being used, and notifies you when material handling devices are under- or over-utilized, so that you can track the use of your operating assets.

¬Material Handling Equipment Utilization: Factory FLOW provides tools to assess the requirements for material handling equipment such as fork-lifts and tuggers. The analysis

can create a variety of reports including the type of equipment, number of trips by route and material, and the level of utilization. This information is a key to understanding where savings could be made in equipment requirements by adjusting aspects of the factory layout.

¬Container Packing: The container placement routines automatically place containers on the shop floor as well as on racks, using an optimum container packing routine.

¬Activity points: Activity points allow Factory FLOW to determine exact work center locations when material flow diagrams are created.

¬Walk Path generation: Factory FLOW also has intelligent walk path creation algorithms that allow you to see the effect of material placement in a work cell almost immediately.

¬Reports: Besides color-coded flow diagrams and graphs, Factory FLOW allows you to create many types of detailed reports on the layout, material flow, time, and cost saving comparisons.

2.6 FACTORY ACTS

Laws to regulate conditions of employment of factory workers. In Britian two early Acts of Parliament in 1802 and 1819, which aimed to protect children and apprentices, failed because they could not be enforced. The Factory Act of 1833 banned the employment of children under 9, restricted working hours of older children, and provided for the appointment of factory inspectors. Legislation in Britain (1844 and 1847) extended protection of workers into mines and other industries and reduced the working day to ten hours. A Factory Act (1874) consolidated the ten-hour day and raised the age of children in employment to 10, this being further raised to 12 in 1901 and 14 in 1920. In the 20th

century a complicated structure of industrial law developed. It was to counter the problem of child labour and the exploitation of factory workers, particularly women, that the International Labour Organization (ILO) was formed by the League of Nations (1919). Despite such initiatives, the exploitation of Third World women and children in such trades as the garment industry remains a matter of serious concern. In Britain workers have been further protected by such legislation as the Employers' Liability (Compulsory Insurance) Act (1969), the Health and Safety at Work Act (1974), and the Employment Act (1989).

The long series of Factory Acts, culminating in the home secretary's bill of the present session (1878), constitutes one of the most important chapters in the history of modern English legislation. The Acts assert the right of the state to control the industrial organizations which depend upon the labour of women and children. As yet the freedom of the adult male labourer has been held sacred from the interference of the legislature, but it is necessarily involved, to some extent, in the protection exercised over persons whose co-operation is necessary to his work. The gradual rise of the important principle that, in the interests of the moral and physical well-being of the community, the labour of women and children should be restricted by law within reasonable limits may be seen by a glance at the Factory Bills introduced in parliament since the beginning of the century.

In 1802 an Act was passed "for the Preservation of the Health and Morals of Apprentices and others employed in Cotton and other Mills, and Cotton and other Factories.' The immediate cause of passing this bill was the fearful spread throughout the factory district of Manchester of epidemic disease, which made dreadful havoc among the youthful

labouring population on account of their scanty mode of living and peculiar way of working.1 Pauper children from the agricultural districts of the south were sent to the northern counties to work in the factories which sprang up there in consequence of their superior supply of water-power. Their long hours of labour, the wretched accommodation provided for them, and the over-crowding of workmen in mills and factories, caused the alarming epidemic fevers of those times and districts. The Act of 1802 subjected all mills employing three or more apprentices, or twenty other persons, to the rules and, regulations of the Act. The walls were to be washed with quicklime and water; a sufficient number of windows was to be provided; the apprentices were always to have two suits of clothing, one to be new every year. The most important regulation, however, was that which fixed the hours of work at twelve per day, and prohibited work altogether from 9 o'clock at night to 6 in the morning. This Act, being intended to meet the evils of the apprentice system, did not extend to factories where children residing in the neighbourhood were employed. The use of steam-power had meanwhile caused the growth of factories in populous town districts. In 1819 an Act was passed for the regulation of cotton mills : children were not to be admitted before the age of nine, and between that age and sixteen were restricted to twelve hours a day, exclusive of an hour and a half for meal-time.

In 1825 Sir John Cam Hobhouse's Bill was passed, which established a partial holiday on Saturday, and provided penalties for offences against the Act. An amending Act was passed (10 Geo. IV. c. 51), and in 1831 (by the 1 and 2 Will. IV. c. 39) night work in the cotton factories was prohibited for persons between nine and twenty-one years of age ; the working day for persons under eighteen was to be twelve hours, and on Saturdays nine.

This was the time of the great political movement which brought about the Reform Act of 1832, and the factory question entered into and to some extent complicated the purely political issues. In the wool districts the unions of the working men clamoured for a restriction of non-adult labour in factories to ten hours a day, and their demand was supported by the Conservative and country party, out of opposition to the manufacturers, who were for the most part keen supporters of the Reform Bill. The wool factories had not been touched by the recent legislation, and the sufferings of the over-worked children appealed powerfully to the imagina-tion of the public. After much discussion in committees and commissions, the Act of 1833 (3 and 4 Will. IV. c. 103) was passed. Night work (between 8.30 p.m. and 5.30 a.m.) was prohibited to persons under eighteen in cotton, wool, worsted, hemp, flax, tow, and linen spinneries and weaving mills; children from nine to thirteen were not allowed to work more than 48 hours a week ; and young persons from thirteen to eighteen were restricted to 68 hours a week. In silk factories children might be admitted under nine, and children under thirteen were to be allowed ten hours a day. Provision was also made for school attendance and for the appointment of factory inspectors to watch over the working of the law. The manufacturers, dreading the economical results of the loss of children's labour, subsequently induced the Government to propose that chil-dren over eleven should be allowed to work the full time of 69 hours a week, but in the face of the agitation for greater restrictions this amendment was not persisted in.

The extension of the Factory Acts to unprotected industries now engaged the attention of philanthropists. A Mining Act (5 and 6 Vict. c. 99) was passed, which pro-hibited under-

ground work to children under ten and women. In 1844 the Factory Act, 7 Vict. c. 15, was passed. Children from eight to thirteen might be employed in textile industries for not more than six hours and a half per day, but in factories where "young persons" restricted to ten hours a day were employed, children might also be employed for ten hours a day on alternate days. Children so employed had to attend school during the "half time." Adult women were brought under the same rules as "young persons." Lord Ashley's2 Printworks Act followed in 1845. A Ten Hours Bill was at last carried in 1847 (10 Vict. c. 29). Women and young persons were restricted to ten hours a day, and the legal working day was fixed from 5.30 a.m. to 8.30 p.m. By employing protected persons in relays, manufacturers were enabled to keep their works going during the whole of the legal day; and to meet this evasion, as it was deemed to be, of the factory legislation a uniform working day was fixed, 13 and 14 Vict. c. 54. Young persons and women were allowed to work only between 6 a.m. and 6 p.m.—an hour and a half being allowed for meal-time. No protected person was to work on Saturday after 2 p.m. By the 16 and 17 Vict. c. 104, children were limited to a legal day beginning at 6 a.m, and ending at 6 p.m. Bleaching and dyeing works were subjected to similar restrictions by Acts passed in 1860 and 1862, calendering and finishing works in 1863 and 1864. Lace factories were placed under the regulations of the Factories Acts by 24 and 25 Vict.c.117. Night work in bakehouses was prohibited to young persons under eighteen, by 26 and 27 Vict. c. 40. After the report of a commission, a new Factory Acts Extension Act was passed (27 and 28 Vict.c. 48), which brought manufactories of earthenware, percussion caps, lucifer matches, and cartridges, paper-staining, and fustian-cutting within the scope of the factory legislation. In 1867 a

distinction was drawn in legislation between factories and workshops. The Factory Acts Extension Act of that year applied to all furnaces, iron and copper works, machine manufactories, metal and guttapercha factories, paper-mills, glass-works, printing offices, and bookbinders' shops, and to all establishments in which over 50 persons are employed for a period of a hundred days. Special modifications, however, were introduced to suit the requirements of the different trades. In the same year the Workshop Regulation Act was passed, for small trades and handicrafts, fixing the working day for children at 6 am. to 8 p.m., and for young persons and women from 5 a.m. to 9 p.m. Printing, bleaching, and dyeing works were brought under the general law by the Factory and Workshop Act 1870. In 1871 another Act with the same title was passed, which, inter alia, subjected Government factories to the general law. The Factory Act of 1874, the last of the series, raised the minimum of age in children to ten.

By these various enactments the state has emphatically taken under its protection the whole class of children and young persons employed in manufacturing industries. It has done this in the name of the moral and physical health of the community. The slow but steady advance of the principle of interference may be traced in the titles of the successive statutes. It is needless here to discuss the wisdom of the policy, which has now received en bloc the stamp of legislative approval. The substantive law of the Factories Acts has been re-enacted in a measure laid before parliament in the present session, which has already (May 1878) passed both Houses. In the debates in the Commons the only question of principle seriously raised was whether the freedom of adult women ought to be curtailed

by legisla-tive interference. Mr Fawcett's motion in the negative was rejected by a large majority.

The main objective of any industrial building is the efficient housing of the manufacturing process and the operations. Apart from control of the locations of factories and their ancillary services under the Town and Country planning, act 194 the principal legislation affecting industrial buildings is contained in the Nigerian factories' Act 1958.

The regulations are to guide against poor working conditions or atmosphere for factory operation. It also give control of different types of pollution.

2.7 BASIC PRINCIPLES OF FACTORY DESIGN

In summary, it must be noted that factory buildings must be designed round purely basic requirements, and the architect must discuss the general layout with the owner so as to fully understand the processes and their sequence. Every factory has its own problems and consequently, there are only a few basic principles which apply to all schemes.

(1) The line of production from the entrance or raw materials to the dispatch of finished products must be continuous and direct,

(2) Cross traffic from one process to another must be avoided.

(3) Provision must be made for possible changes in the manufacturing process.

(4) Planting and natural light is essential for most departments and good ventilation should be studied if satisfactory working conditions are to be provided.

(5) Plans should be simple and not influenced by a desire to produce elevations of symmetrical or otherwise preconceived character.

(6) Clean open spaces should be aimed at for freedom in every direction.

(7) Unnecessary roof and ceiling supports must be eliminated of unit planned.

(8) Re-arrangements of land and future expansions must be visualized as far as possible at the initiation of every scheme

CHAPTER THREE

THE PROCESS OF BAKING BREAD

3.1 PREAMBLE

Though there are many baked products, only the process of baking bread the most common, most demanded of the products will be discussed in detail.

Bread the earliest baked product is a mixture of flour and liquid which is raised or leavened' by the addition of a growing plant called yeast, giving it its characteristic texture and flavour.

3.2 PRINCIPLES OF BREAD MAKING

It is designed to give the fundamental principles and science behind the baking rules and recipes most bakers, technologists, and students are accustomed to.

Functional properties of ingredients and interactions occurring during each step in the baking process are presented in straightforward chemical and physical terms understandable to anyone with a background in baking. The knowledge gained will allow for the optimization of recipes and processes of all types of bread, including pre-baked breads and frozen doughs.

It describes the chemistry and basic physics behind a recipe, what happens with ingredients during mixing, the pros and cons of dough temperatures, conditions for fermentation and proof, and handling of the dough throughout the process. It also describes the transformation of dough into the final product in the oven in terms of heat transfer to the

dough and heat transport in the product. By covering the functionality of unit operations and raw materials at this level, the reader is given the foundation needed to optimize recipes and the production process.

It provides detailed, critical descriptions of the processes involved in creating prebaked breads and frozen doughs. The chapter on prebaked breads discusses cooling, ambient storage, chilled storage, frozen storage, storage in a modified atmosphere, and the rebaking process. Moisture migration, solubility of gases, diffusion of gases, yeast, and drying and condensation are discussed in a chapter dedicated to frozen doughs. Both chapters also include sections on optimizing procedures and recipes.

It is an essential troubleshooting reference for bakers, food technologists, product developers, millers, ingredient suppliers, and newcomers to the bakery business and related industries.

3.3 RAW MATERIALS

Bread is made with three basic ingredients: grain, water, and bakers' yeast. The harvested grain is ground according to the type of bread being made. All grains are composed of three parts: bran (the hard outer layer), germ (the reproductive component), and endosperm (the soft inner core). All three parts are ground together to make whole wheat and rye breads. To make white flour, the bran and the germ must be removed. Since bran and germ contain much of the nutrients in grain, the white flour is often "enriched" with vitamins and minerals. Some white flour has also been fortified with fiber and calcium.

The grinding takes place at grain mills, which sell the grain to bakeries in bulk. The bakeries keep the grains in storage sacks until they are ready to be used. In the baking factory, water and yeast are mixed with the flour to make dough. Additional ingredients such as salt, fat, sugar, honey, raisins and nuts are also added in the factory.

3.4 RECIPES

Officially a recipe is the amount of ingredients and the processing method. The best method of writing down a recipe is to have the flour at 100%. It means that whatever the amount of dough, the ratio of other ingredients will remain the same. For example:

	A	B
Flour	100%	100 %
yeast	1%	1,5%
salt	1%	1,5%
sugar	1%	2 %
fat	1%	2 %
water	60%	56 %

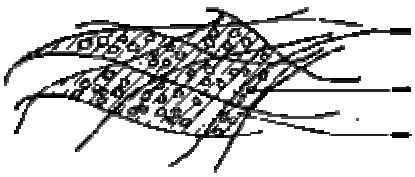
Table 3.4 bread ingredients percentage ratio (**Source:** www.answers .com)

Now both recipes can be asily compared. Recipe B has more yeast(0,5%), more salt(0,5%), more sugar(1 %), more fat(1%) and less water. An experienced baker knows what kind of bread he can expect out of recipe B. The recipes for bread differ all over the world because of the availability , the price and the quality of the ingredients. The amount of salt differs because of the legislative requirements and local taste. The amount of water varies dependant on the quality of the flour and the processing method.

3.5 PROCESSING

Dough kneading is the mixing and kneading of the raw materials in a way that a good quality bread can be obtained. The dough kneading:

- scaling flour and other ingredients
- sieve the flour to remove impurities
- activated yeast, dissolve yeast in water and add
- instant yeast, add dry yeast to the flour
- add other ingredients like salt, sugar, milk powder, fat etc.
- avoid direct contact between yeast and salt and/or sugar
- switch on the dough kneader
- mix the ingredients
- the kneading can start, the formation of the gluten network which surrounds all other ingredients



gluten network

starch grains free water with yeast, salt and sugar

DOUGH CELLS

During dough kneading air is incorporated which is the basis for the structure of bread. Although strenuous work dough kneading can be done manually. Dough kneaders can be classified into two different groups:

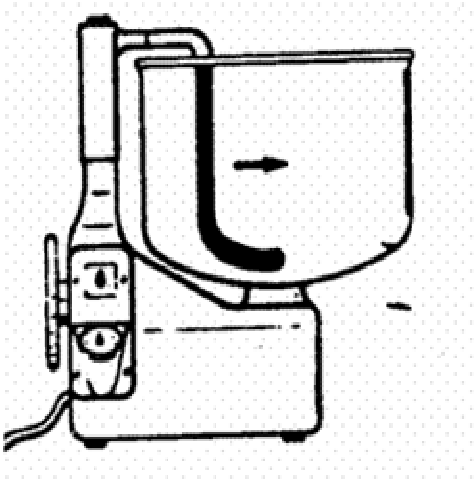
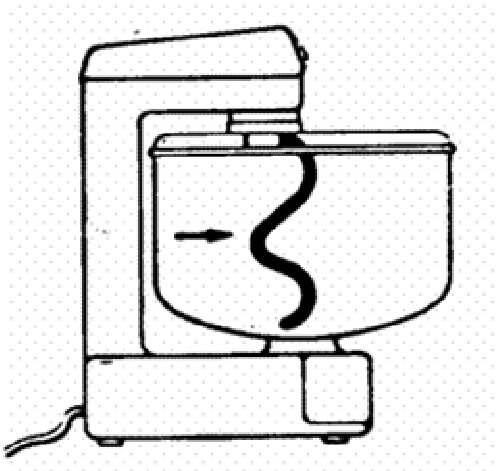
fast kneader kneading time 2- 12 minutes 	medium kneader kneading time 12-20 minutes 

Plate 3.5 Dough Kneading (**source:** www.wikipedia)

During kneading frictional heat causes the rise of the dough temperature. To control the desired dough temperature the water temperature has to be adjusted. When the ingredients are thoroughly mixed and the gluten network is sufficiently elastic and extensible the dough is ready. When a piece of dough is stretched up to a thin film without breaking it shows that the dough is ready for further.

3.6 BREADMAKING PROCESS

Mixing and kneading the dough

• 1 The sifted flour is poured into an industrial mixer. Temperature-controlled water

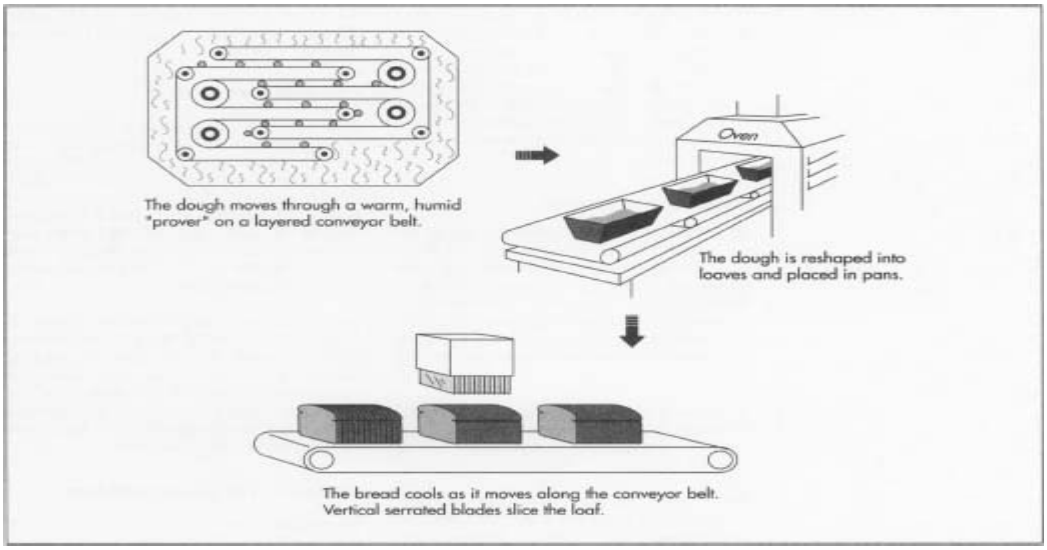


Plate 3.6 Baking Process **Source :** (www.bake.com)

is piped into the mixer. This mixture is called "gluten" and gives bread its elasticity. A pre-measured amount of yeast is added. Yeast is actually a tiny organism which feeds off the sugars in the grain, and emits carbon dioxide. The growth of the yeast produces gas

bubbles, which leaven the bread. Depending on the type of bread to be made, other ingredients are also poured into the mixer. Modern mixers can process up to 2,000 pounds (908 kg) of dough per minute.

• 2 The mixer is essentially an enclosed drum that rotates at speeds between 35 to 75 revolutions per minute. Inside the drum, mechanical arms knead the dough to the desired consistency in a matter of seconds. Although modern bread production is highly computerized, the ability of the mixing staff to judge the elasticity and appearance of the dough is critical. Experienced personnel will be able to determine the consistency by the sound of the dough as it rolls around the mixer. The mixing process takes about 12 minutes.

Fermentation

• 3 Three methods are used to ferment the dough. In some plants, the high-speed machinery is designed to manipulate the dough at extreme speeds and with great force, which forces the yeast cells to rapidly multiply. Fermentation can also be induced by the addition of chemical additives such as 1-cysteine (a naturally occurring amino acid) and vitamin C. Some breads are allowed to ferment naturally. In this instance, the dough is placed in covered metal bowls and stored in a temperature-controlled room until it rises.

Division and gas reproduction

• 4 After the dough has fermented, it is loaded into a divider with rotating blades that cut the dough into pre-determined weights. A conveyer belt then moves the pieces of dough to

a molding machine. The molding machine shapes the dough into balls and drops them onto a layered conveyer belt that is enclosed in a warm, humid cabinet called a "prover." The dough moves slowly through the prover so that it may "rest," and so that the gas reproduction may progress.

Molding and baking

• 5 When the dough emerges from the prover, it is conveyed to a second molding machine which re-shapes the dough into loaves and drops them into pans. The pans travel to another prover that is set at a high temperature and with a high level of humidity. Here the dough regains the elasticity lost during fermentation and the resting period.

• 6 From the prover, the pans enter a tunnel oven. The temperature and speed are carefully calculated so that when the loaves emerge from the tunnel, they are completely baked and partially cooled. While inside the tunnel, the loaves are mechanically dumped from the pans onto shelves. The baking and cooling process lasts approximately 30 minutes.

Slicing and packaging

• 7 The bread continues to cool as it moves from the oven to the slicing machine. Here vertical serrated blades move up and down at great speeds, slicing the bread into consistently sized pieces.

• 8 Metal plates hold the slices together while picking up each loaf and passing it to the wrapping machine. Pre-printed plastic bags are mechanically slipped over each loaf. At

some bakeries, workers close the bags with wire twists. Other plants seal the bags with heat.

3.6.1 BAKER PERCENTAGE

sometimes called **formula percentage**, is a way of indicating the proportion of ingredients when making bread. The "percentage" is in fact a ratio where the mass of the ingredients are expressed in terms of the mass of the flour used (that is, the unit mass). For example, if a recipe calls for 10 pounds of flour and 5 pounds of water, the corresponding percentages will be 100% and 50%.

Common formulations for bread include 100% flour, 60% water/liquid, 1% yeast, 2% salt and 1% oil, lard or butter.

In addition, the baker percentage enables the user to more accurately compare recipes (i.e. which is drier, saltier, sweeter, etc.).

Bread recipes are more conveniently expressed in this manner, using mass instead of volume measurements. The uncertainty in using volume measurements follows from the various ways flour is ground, how it occupies the measuring cup etc.

3.6.2 QUALITY CONTROL

Commercial bread making is held to strict government guidelines regarding food production. Further, consumer preferences compel bread producers to maintain a high quality standard of appearance, texture, and flavor. Therefore, quality checks are

performed at each step of the production process. Producers employ a variety of taste tests, chemical analyses, and visual observation to ensure quality.

Moisture content is particularly critical. A ratio of 12 to 14% is ideal for the prevention of bacteria growth. However, freshly baked breads have a moisture content as high as 40%. Therefore it is imperative that the bakery plants be kept scrupulously clean. The use of fungicides and ultraviolet light are two popular practices.

3.7 METHODS OF BREAD PRODUCTUON

Each method should be able to create a structure of gas bubbles which is capable of expansion,, produce carbondioxide and produce dough which is able to retain gas and expand. The sponge and dough method and the straight dough method are widely used.

Sponge and dough method

A sponge can be considered as a slack dough. Mixing a proportion of the flour, the yeast, some, or all of the salt, but sometimes none at all and some or all of the water makes it up. The amount of yeast, the amount of salt and the consistency and the temperature of the sponge control the fermentation speed of the sponge. The amount of flour used in the sponge gives its name e.g. a quarter sponge is made with 25% of the flour. It is very important to have a very well fermented sponge otherwise the further fermentation will become very slow.

Sponge	50% flour, 1% yeast and 40 to 50% water
sponge fermentation	60 minutes
Mixing	all remaining ingredients and sponge
Scaling	
Rounding	
Moulding	
final fermentation	60 minutes
Baking	20 minutes

Table 3.7.1; The amount of flour used in the sponge (**Source :** www.google.com)

Advantages:

- more tolerance during processing
- a weaker, cheaper flour can be used
- less yeast is required
- long sponge fermentation and short processing time
- fermentation in a bowl is very easy

- a well developed gluten
- a good taste

Disadvantages:

- more bowls for the sponges are necessary
- more space is needed for storage
- difficult planning

Straight dough method

Ingredient Mix

mixing	15 minutes
first bulk fermentation 30 minutes	these can be combined into one period of 50 minutes
knocking back	other changes can be made as long as the total production time remains the same
second bulk fermentation	20 minutes
scaling and	

moulding	
intermediate proof	25 minutes
final moulding	20 minutes
baking	20 minutes

Table 3.7.2. Ingredient mix (**Source:** www.google.com)

Advantages

- the process is short
- good quality bread with a fine structure
- easy planning
- less space required
- less bowls needed

Disadvantages

- labour intensive
- skilled bakers needed
- intermediate prover required
- temperature and humidity control in provers
- less tolerance

3.8 THE FERMENTATION SPEED

Yeast produces carbon dioxide out of the sugars present in the dough. Baking powders also produce carbon dioxide but will not produce the typical bread taste.

SUGAR:

Sugar will affect the fermentation speed , the colour and taste. Amounts up to 3% will increase carbon dioxide production. More sugar will reduce the fermentation speed and will give a noticeable sweeter taste.

SALT:

Salt will slow down the fermentation speed and harden the gluten. In common bread doughs 1-2% salt is added.

YEAST:

Because of the various yeast types always follow the instructions of the manufacturer. More yeast produces more carbondioxide and the dough will be "faster". Less yeast will make the dough slower.

OTHER INGREDIENTS:

Ingredients like fat (bread improver), milk powder, malt etc. will require more yeast to maintain the same level of carbon-dioxide production.

3.8.1 Dough temperature

In general a dough temperature between 25 º- 30 º Celsius is advisable. A higher dough temperature hardens the gluten and the gluten becomes too tough to process it. A high dough temperature also requires increased processing speed, which is not always possible.

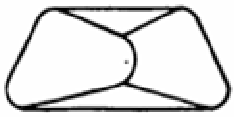
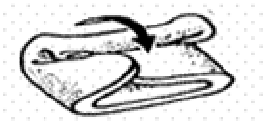
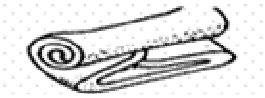
3.8.2 Scaling and weight

The weight of the final bread product is controlled by law(Food and Drugs Act). Sometimes the production date and the weight has to be mentioned on the wrapping paper. When a bread product has to weigh 500 g after baking, 550 g of dough is necessary.

3.8.3 Proofing time and dough handling

During the bread making process the dough is given several fermentation periods interrupted by dough handling, to get a nice bread of a good volume, fine structure, good taste and good digestibility. The effect of the different proofing periods is an increased carbon dioxide development, a better dough development resulting in increased gas retention ability. The following proofing periods can be identified: sponge fermentation, 1st bulk fermentation, 2nd bulk fermentation, intermediate proof, and final proof and oven spring. The effect of all dough handling is to stop temporarily the stretching of the gluten by pressing out the gas, to get an equal distribution of the dough cells throughout the dough and to increase the number of dough cells causing a fine structure. The fermentation time is influenced by the quality of the flour, the dough temperature, the type of product, the bakery temperature and humidity, the stiffness of the dough, the amount of yeast added, the amount of other ingredients in the recipe and the activity of the enzymes.

3.8.4 The final moulding

	After the intermediate proof the dough piece is turned upside down, the carbon dioxide removed and the gas bubbles are divided into more by flattening the dough.
	
	The dough piece is stretched, the ends are folded inside and pressed in a way that a trapezoid shape is obtained.
	
	The dough will be rolled up, making thicker ends and putting it with the lock downwards. The thicker ends will give a straight product after baking.
	

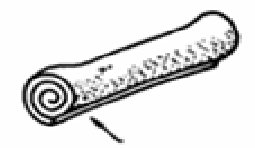
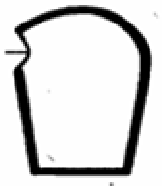
	

Table 3.8.4 dough moulding (**source :** www.google.com)

3.8.5 Mistakes in moulding

Too tight. The gluten will break and sometimes you will get a loose top crust.	
Too loosely moulded. Holes are inside because the layers do not stick together.	
Too much dusting flour. Holes and white lines can be seen after baking	

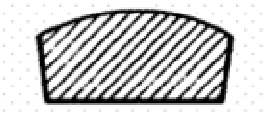
No thick ends. The loaf is not straight but has sloping sides.	

Table 3.8.5; mistakes in moulding (**source:** www.google.com)

3.8.6 Carbon dioxide and gluten development

The whole process is based on an optimum carbon dioxide and gluten development. The dough temperature, baking temperature and humidity, the amount of sugar and the amount of water affect carbon dioxide production. Gluten development is affected by the flour quality, the kneading time, the stiffness of the dough and the amount and type of bread improver. An optimum carbon dioxide and gluten development results in a good quality great with a high volume and a fine structure. A smooth oven spring proves a good processing of the dough. When the fingers are pressed into the dough feeling very little resistance, the bread is ready for baking.

3.9 THE BAKING PROCESS

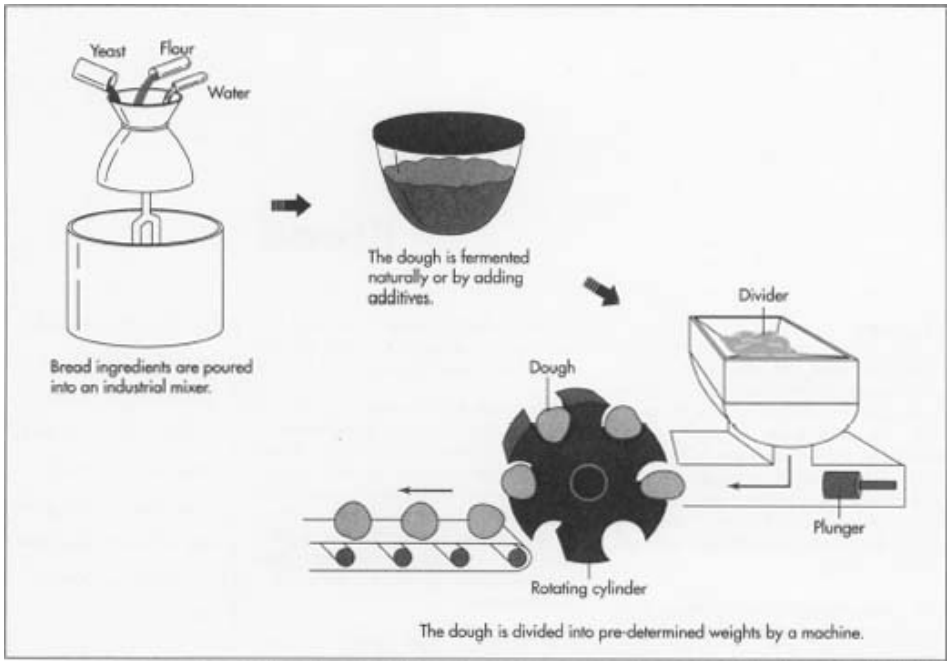


Plate 3.9. Baking process (**Source**: www.google.com)

During baking the dough will be changed from a pliable shape into a fixed shape, the taste will be developed and the crust will be formed. When bread is put into the oven, water will evaporate from the crust. The crust formation will start after the loaf has reached its maximum volume. The yeast has died at 50º C and the gelatinization of the starch begins. At 70º C the protein coagulates releasing water which will be absorbed by the starch. The volume increases, the skin will crack as well as the cell walls. The water starts evaporating, the protein is coagulated, the starch gelatinises, the structure and shape fixed. At 110º C the crust becomes thicker, the temperature increases and colouring starts. During baking the oven temperature and baking time are very important. In general small products have to be baked at a high temperature for a short period, big products have to be baked at a lower temperature for a longer period. The heat is penetrating small products much faster than

big products. The type of bread, the addition of other ingredients like sugar and milk powder are other factors influencing the baking temperature and time. The stiffness of the dough, the amount of fat and the filling are just minor factors. During baking steam will be developed by the evaporation of water from the dough and will give bloom to the crust. Some products like crispy bread require the addition of steam before baking to increase the volume and make the crust crispy.

3.10 CHARACTERISTICS OF GOOD BREAD

To define a good loaf, one must have some knowledge of the desirable qualities of a particular type of bread and how these qualities are produced. The desirable features of a good loaf can be listed under two headings, external and internal.

EXTERNAL	INTERNAL
evenness of bake	crumb clarity and elasticity
volume	colour
symmetry of shape	structure
bloom	sheen, texture
crust colour	flavour and aroma
Cleanliness	Cleanliness

oven break	moistness

Table 3.10; characteristics of good bread (**Source:** www.bake.com)

A good loaf is the result of:

- good quality ingredients
- good processing
- good workmanship

Volume

A fair volume with a structure, which is not too open, is required for common bread.

Symmetry of shape

The dictionary defines it as a beauty resulting from right properties, or a harmony between the parts. lt is brought about by correct dough fermentation and moulding.

Bloom

Natural bloom is the glow that denotes excellent fermentation, the use of good raw materials and fine workmanship.

Crust colour

The right baking temperature, good raw materials and correctly fermented dough will obtain the right colour. Pale dull coloured bread is mainly caused by the absence of sugar.

A harsh red-brown colour is caused by an under fermented dough. A dried out skin will give a poor crust colour.

Evenness of bake

Depends on the quality of the oven and the way the oven is operated like loading, heating etc.

Oven break

Properly processed dough will "break" properly during the first period of the baking process. When an oven break is not required give the dough a longer final proof.

Internal Colour

The type of flour used and the structure of the crumb influence the colour. The right fermentation, manipulation and proving and baking conditions cause a fine regular crumb structure.

Structure

The structure of an ordinary tin loaf should have round fairly small dough cells and they should be regularly and evenly distributed. First class raw materials and good processing of the dough achieve this.

Sheen and Texture

The way a cut surface reflects light will indicate the condition on the structure, which is called sheen. Over fermented dough will give a "woolly" and tight dough will give a "drummy" texture.

Flavour And Aroma

The use of yeast, proper processing and baking will give a well-developed flavour and aroma. Longer fermentation processes will give a fuller taste, short processes are characterised by a flat taste.

Crumb Clarity and Elasticity

The crumb, when pressed, should return when the pressure is raised, this is called elasticity.

Moistness

The water content, the fermentation, the salt, other ingredient like fat and malt and the baking conditions determine the moistness of a loaf.

3.11 BREAD FAULTS

Bread faults are not easy to diagnose, because they can arise from so many causes. The causes can be grouped into five main categories:

- Raw materials
- Equipment
- Processing conditions
- Recipe
- Care after baking

External	Possible causes

bread faults	
lack of volume	• poor flour • too much-salt • over or under kneading • too low a dough temperature cooling down of dough during processing • too short a final proof • wrong humidity during fermentation and baking • too big a tin size • too high an oven temperature
excessive loaf volume	• too little salt • too much developed dough over proofing • too small a tin • low oven temperature
pale crust colour	• not enough sugar • too much fermentation • too high a dough temperature • dry skin during final proof • low oven temperature • too short a baking time

dark crust colour	• too much sugar • too short-a-fermentation time high-oven temperature too much top-heat over baking • leaking oven
thick crust	• low sugar content • crusting during final proof low oven temperature • too long a baking time
shell top (flying top)	• stiff dough • under developed--dough • too short a final proof leaking oven • skinning during final proof
no oven break	• poor flour • under or over developed dough • not enough fermentation • high oven temperature • dry oven

Internal faults	**Possible causes**

grey crumb colour	• too much malt • too much fermentation • high dough temperature • low oven temperature
streaky crumb	• poor dough kneading • excessive dusting flour • crusting before final moulding • too much divider oil • poor moulding • old dough pick up during final moulding • crusting of sponge • too much greasing oil
coarse grain	• poor flour • stiff doughs • soft doughs • over kneading • young doughs • poor moulding • too little dough for tin size too low an oven temperature
poor texture	• stiff doughs poor mixing

	• skinning at all stages • too high a temperature during intermediate and final proof • over fermentation • too little dough for tin size • too low an oven temperature
poor flavour	• poor raw materials • too low or too high a salt percentage • unbalanced recipe • poor storage conditions • over fermentation • under fermentation • unsanitary plant conditions • old pan grease • absorption external odours
poor keeping qualities	• unbalanced recipe • low sugar content • poor raw materials • oven fermentation • low baking temperature

	• poor bread cooling
holes in bread	• weak flour • too short a kneading time • stiff doughs • too much fermentation • poor moulding • too much dusting flour • too much divider oil • too high a fermentation temperature • flashy ovens

Table 3.11; Bread Faults **(Source:** www.google.com)

3.12 LIKELY PRODUCTS FROM A MODERN BAKERY

Challah

Four loaves

Pain au Levain, a French bread

Breads and Bread rolls at a bakery

Tin Vienna bread

Bread in a traditional oven

Pre-sliced bread

Bread rolls

A cereal grain

Close up of sourdough bread slice

A selection of breads

Crustless bread covered by a mold

Homemade rye bread

A variety of breads at the Boudin Bakery.

Sourdough breads

A chef in India prepares *Rumali Roti*

Bread-seller in front of a bakery, Damascus, 1910.

A variety of bread in Stroud Farmers' market,

Slice of French Bread.

Table 3.12; Bakery Products **(Source:** www.bakeryproducts.com)

3.13 BAKERY EQUIPMENT

Plate 3.1 Flour-Dressing Machines (**Source:** www.googleimages.com)

Plate 3.2 Dough-Mixing Machines (**Source:** www.googleimages.com)

Plate 3.3 Dough Dischargers **(Source:** www.googleimages.com)

Plate 3.4 Airfree Dough Dividing Machines **(Source:** www.googleimages.com)

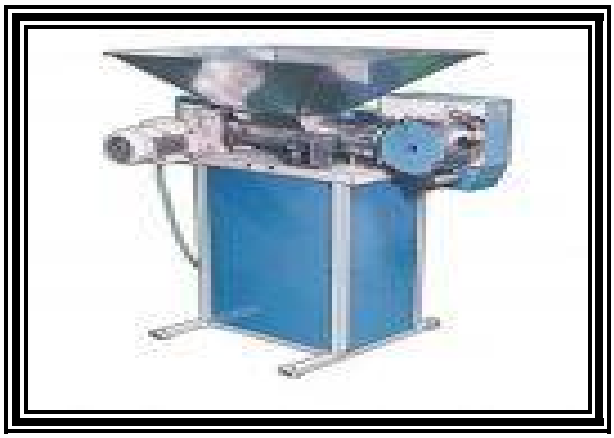


Plate 3.5 screw, Hydraulic Dough Dividing Machines **(Source:** www.googleimages.com)

Plate 3.6 Dough Divider & Rounder **(Source:** www.googleimages.com)

Plate 3.7 Dough Rounder **(Source:** www.googleimages.com)

Plate 3.8 Overhead Proof Chambers **(Source:** www.googleimages.com)

Plate 3.9 Dough Forming Machines **(Source:** www.googleimages.com)

Plate 3.10 Moulding Machine **(Source:** www.googleimages.com)

Plate 3.11 Final Proofer **(source:** www.googleimages.com)

OVENS

Plate 3.12; Bakery Equipment **Source;** www.googleimages.com

CHAPTER FOUR

CASE STUIES

4.1 THE BAKERY SQUARE, PITTSBURGH P.A.

In 1918 the Nabisco Bakery was built in the East Liberty neighborhood of Pittsburgh as part of a nationwide expansion by the National Biscuit Company. The Regional Industrial Development

Corporation (RIDC) bought the plant in 1999 after Nabisco closed the plant's doors. RIDC leased the building to Atlantic Baking Company. During the peak of production, the company had seven plants and 1,300 employees. It was eventually taken over by the Bake-Line Group.

A developer, Walnut Capital, came forward with plans for redevelopment. Walnut Capital dubbed the project "Bakery Square," recognizing the site's history in the production of baked goods.

Plate 4.1 Bakery Square **(Source:** the Strategic Investment Fund)

4.1.1 LOCATION: Pittsburgh, PA

SIZE: 6 acres

FEATURES: proximity to downstream

OWNER: walnut capital

CONTAMINANTS: asbestos, PCBs, and lead-based paint

TOTAL ACTUAL COST: $113 million

4.1.2 TOPOGRAPHY

The Bakery Square development resides in Pittsburgh's East End and is less than six miles from the heart of downtown Pittsburgh.

Plate 4.1.2; Topography of Bakery Square (**Source**: Google Earth)

4.1.3 MARKET CONDITIONS

This area, the East Liberty neighborhood of Pittsburgh, is densely populated with 350,000 people residing within a 5-mile radius of the site; 575,000 within 7 miles. This consumer base is affluent (100,000 people in the trade area have an average household of $81,774/year.), young (the average age is 35.5 years.), and educated (52% of the population within a 1-mile radius are college educated or above.).

This development plans to address the area's bakery demand. The site also sits across the street from Mellon Park on Penn Avenue, and less than a block from the major urban commuting avenues, Fifth Avenue and Washington Boulevard.

4.1.4 SITE ASSEMBLY AND CONTROL

This site passed through many hands before it reached Walnut Capital for redevelopment. For the majority of the 20th Century, the Nabisco Company owned the factory. When the East Liberty location closed in 1998, the RIDC took over and leased the property to Atlantic Baking Company. The factory was eventually leased to the Bake-Line Group of Oak Brook.

Plate 4.1.3 Site Assembly (**Source:** www.bakerysquare)

4.1.5 ENVIRONMENTAL PROBLEMS

The site received a $1 million grant from the state Department of Environmental Protection towards environmental remediation. The property was found to contain asbestos, PCBs, underground storage tanks (UST), and lead-based paint. The RIDC held an environmental site assessment before Walnut Capital entered the picture, and they dealt with the removal

of drums of hazardous materials and USTs. The RIDC contributed an additional $335,000 towards the clean-up.

Walnut Capital updated that site assessment in May 2007 and, with $1 million, capsulated the asbestos and lead paint. After the contamination was abated, another site assessment was taken. The site was cleaned up according to state regulations.

Plate 4.1.4; perspective view **(Source:** www.bakerysquare)

4.1.6 SOCIAL/COMMUNITY INFRASTRUCTURE

Walnut Capital contacted the community before redeveloping the former Nabisco factory, specifically council members and East Liberty Development, Inc. (ELDI).

4.1.7 PHYSICAL INFRASTRUCTURE

The developers deemed road access improvements vital to the redevelopment. One-way traffic along most of East Liberty's Penn Circle is one of the biggest barriers of growth in the area. The project of rerouting East Liberty for two-way traffic is expected to cost $2.8 million. Of that, $2.5 million will be financed with new tax revenue from Bakery Square. The rest of the $10 million in tax increment financing (TIF) is used to pay property taxes, and improve traffic signals.

In 2007, the news reported negotiations with the Port Authority to establish a bus station opposite the development. Bakery Square plans also include a 932-vehicle garage in addition to the 99 surface parking.

4.1.8 COSTS & ECONOMIC INFRASTRUCTURE

The total cost for Bakery Square is projected to be between $105 and $125 million. This amount includes a mix of private and public funding; however, over 90% of the total cost is sponsored by private sources. The development received historic tax credits, $10 million state loans in tax-exempt financing, and money from the Urban Redevelopment Authority. The state's Commonwealth Financing Authority approved the loan under the Building PA program. The project's TIF funds will be used to help finance the parking garage and infrastructure improvements. Also, the DEP contributed $1 million for remediation.

Plate 4.1.5 A view of bakery square **(Source:** www.bakerysquare.com)

4.1.9 ECONOMIC/COMMUNITY IMPACT

Since the spread of suburbanization in the 1960's, East Liberty had been on a decline. Nearly twenty years passed before the creation of a nonprofit community development corporation, ELDI.

Their efforts in the 1980's are gradually pulling East Liberty out of this descent; ELDI attracted approximately 200 new businesses and over $80 million in new investment since the 1980's, including this development.

The state expects Bakery Square to create 1,600 jobs. Of those, 200 are office jobs and 1,400 will go towards the bakery industry that will be created at the site.

Plate 4.1.6; Aerial View of Bakery Square **(Source:** www.bakerysquare)

4.1.10 APPRAISAL

Walnut Capital was able to keep the factory as part of its development and add a tower, while only demolishing a section of the site's three-story structure. The rest was refurbished. Three or four buildings on the site are to be devoted to baked products and one is designated to handle other confectionary. The bakery square was planned as part of a joint venture with locally-based bakery.

This development has also pursued LEED green building certification. It has been separated into two projects: one using the existing Nabisco factory building and the other encompasses all the adjacent newly constructed retail buildings. While the latter targets a

LEED Certification, the former targets a LEED Silver or better because of its adaptive reuse of the building. Its architect, Astorino, has a sustainable design strategy that includes the use of on-site renewable energy technologies such as photovoltaic panels and roof-mounted wind turbines, a green roof, and recycled building materials.

Along with sustainability design, public funds took a major role in this development. A representative from the Urban Redevelopment Authority said that without financial backing from TIF, the project would have been one-tenth the size.

4.2 NIGERIA BAKERIES

Although, baking business started a long time ago in Nigerian, we are still backward in industrial mechanism of the baking process. Hence bread production and that of other baked products are cumbersome and crude.

This is because the government, corporate bodies, and big-time businessmen pay less attention to baking business. Even the proprietors, who earn huge profit, are not prepared to re-inject such profit for the improvement of the backhouses. Residential houses and other improvised buildings or extension of kitchens, st6ores etc. are in most cases used as bakeries. The result is an unorganized baking environment-machines, utensils etc. and people move at random. These give rise to uncontrolled quality and quantity.

In general, use is made of low quality and antiquated machines are in use. In short the entire set-up is very unhygienic. Even the workers are very dirty. A visit to most bakeries

in this country whether the ones in towns or villages would discourage one from consuming bread. It should however be noted that every few bake houses (bakeries) scattered all over the country are being well machined and the environment kept tidy. The research also shows that automated bakeries are infinitesimally few in this country.

In any case, I am of the hope that this project will go a long way in helping to bring Nigerian bakeries in line with what is obtainable in developed countries.

4.3 FOOD CONCEPT

The company whose product goes by the brand-name "butterfield bread" was incorporated in June 2002 after several years of preparatory work which began in 1999. Its products is said to have received very wide acceptance. Its basic aims are to provide high quality bread produced under a most hygienic condition at the lowest possible price. Besides it is also to provide job opportunities for the youths.

4.3.1 LOCATION

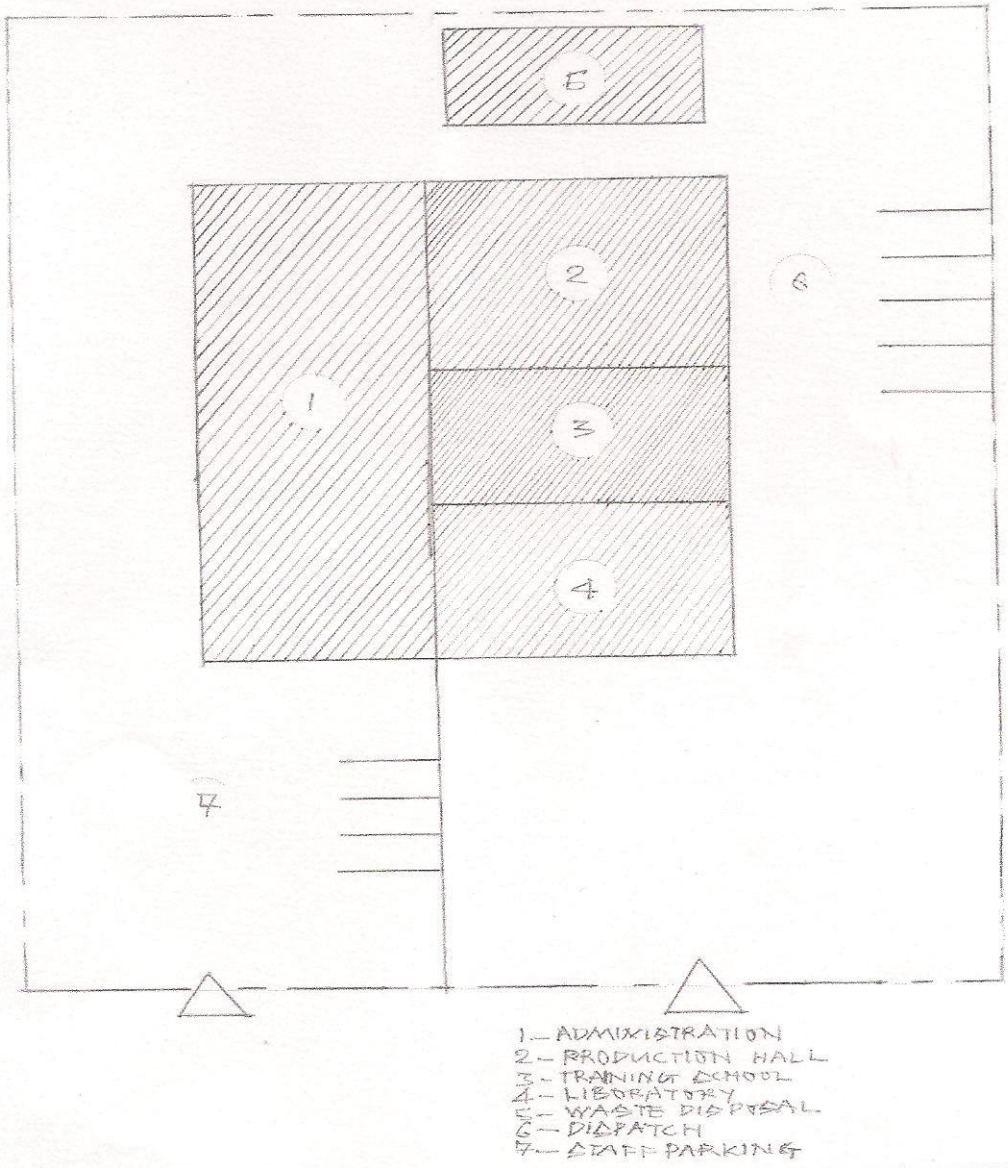
This Company's (Bakery) plant is situated at #2, jagal close, off ikosi road, oregun, ikeja, lagos state

Plate 4.3.1 Front Elevation **Source:** Author(2009)

4.3.2 SITE

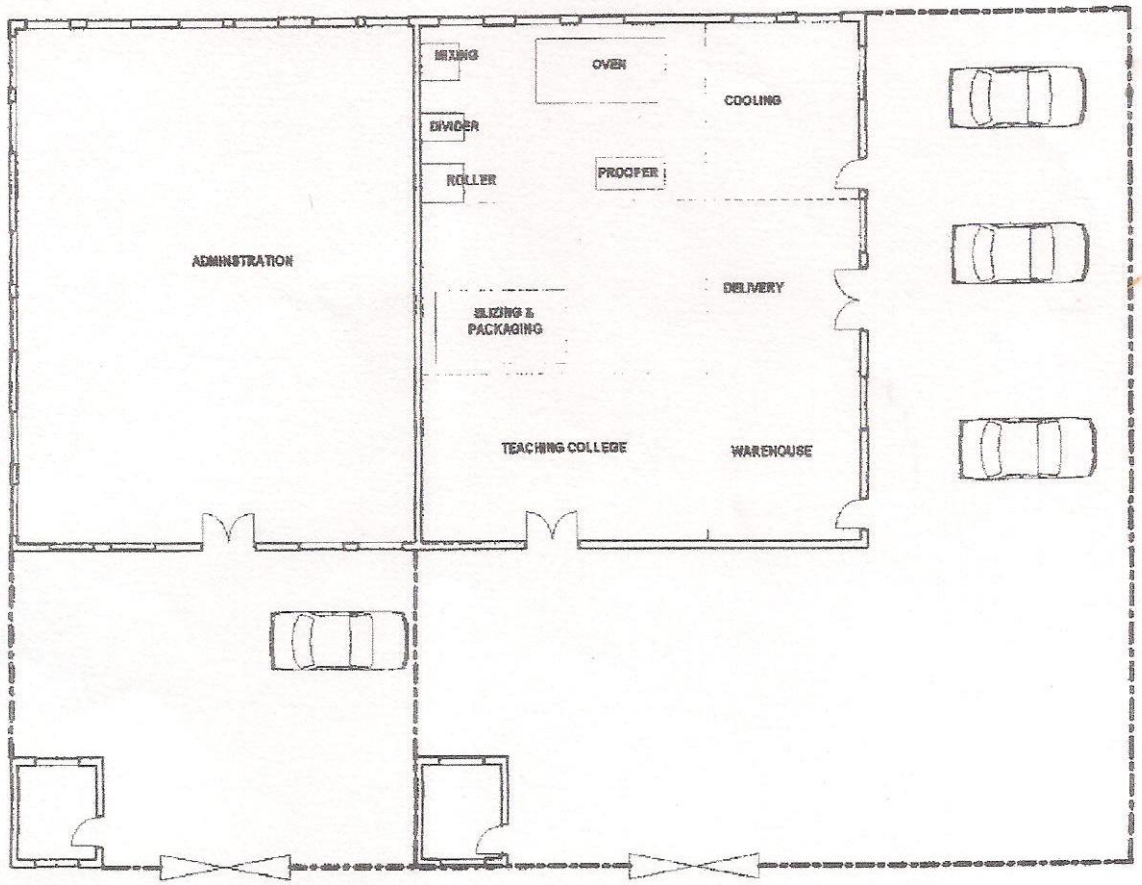
The site is chosen for the following reasons availability of land (200m x100m), accessibility, nearness to raw materials, availability of water, and large market to patronize the finished products.

Though there is extension of power to this area, it is said that the plant relies on the power from its own 250KVA generator as the Power holding company of Nigeria (PHCN) voltage generator current cannot carry the plant. This is because (PHCN) has not been able to install a transformer that will provide the required voltage/current capable of carrying the company's high level equipment.



SITE LAYOUT OF BUTTERFIELD BAKERY

Fig 4.1 **Source:** Author (2009)



Floor Plan

Fig 4.2 **Source:** Author (2009)

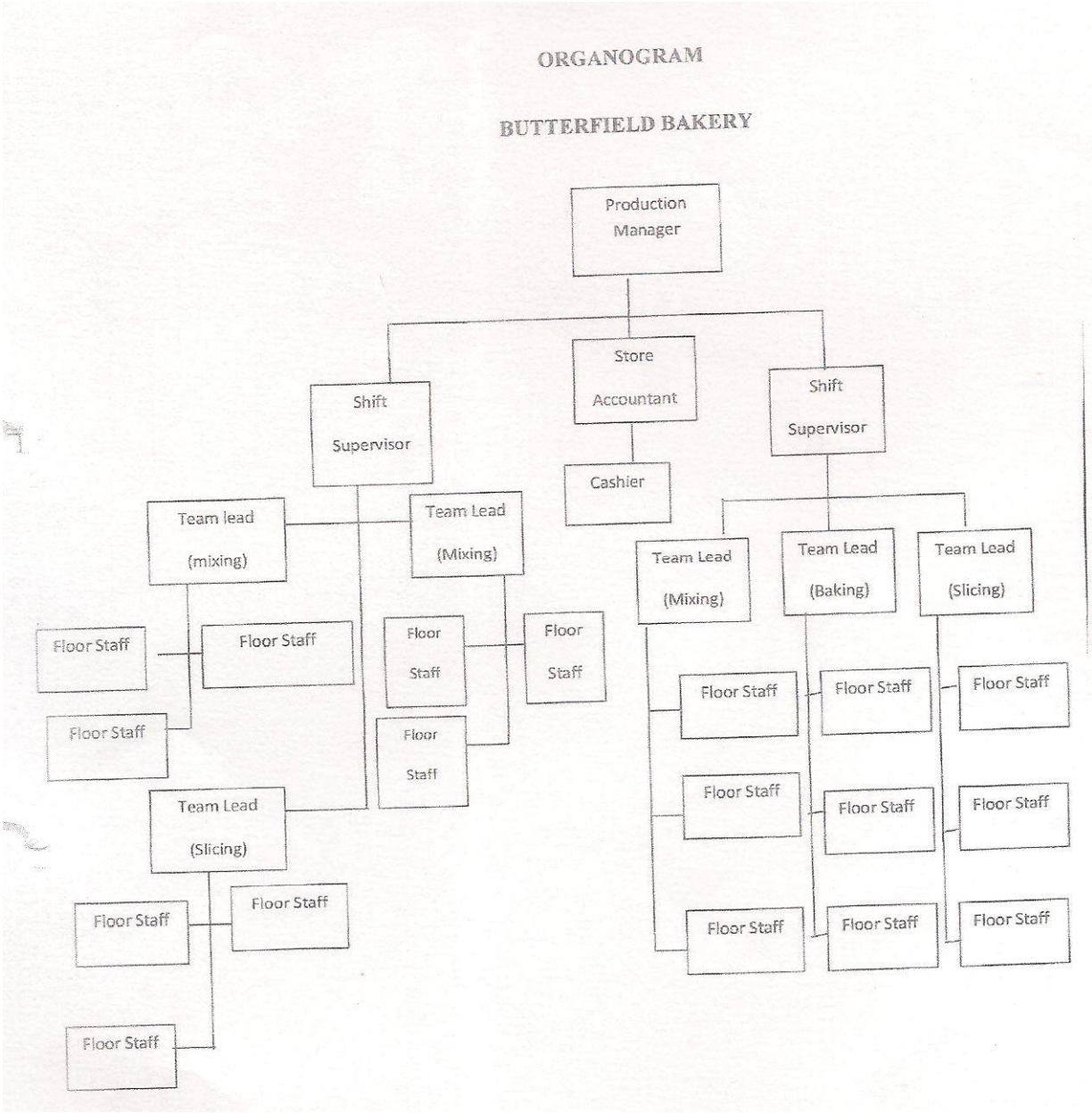


Fig 4.3 **Source:** Author (2009)

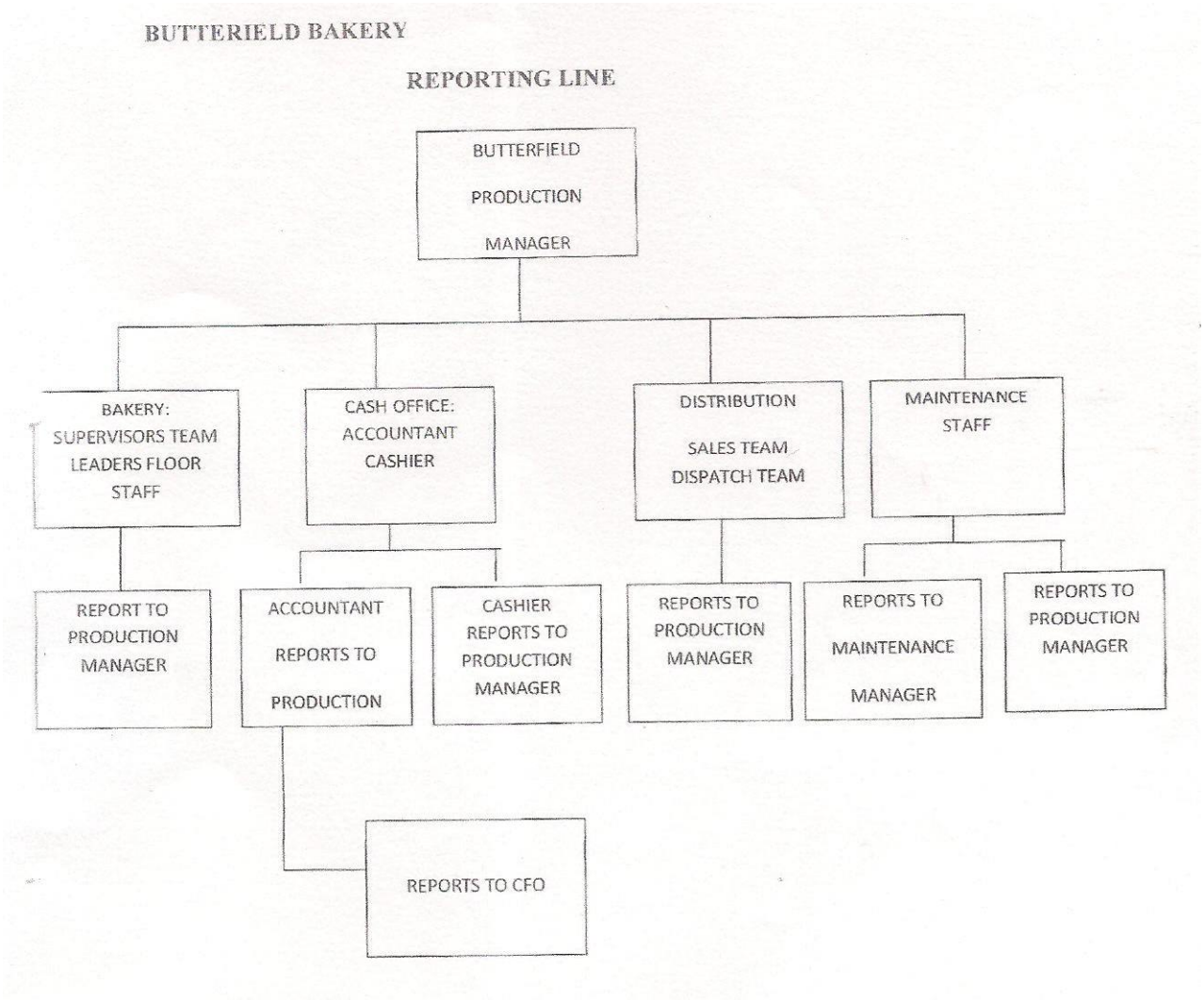


Fig 4.4 report line **source:** Author (2009)

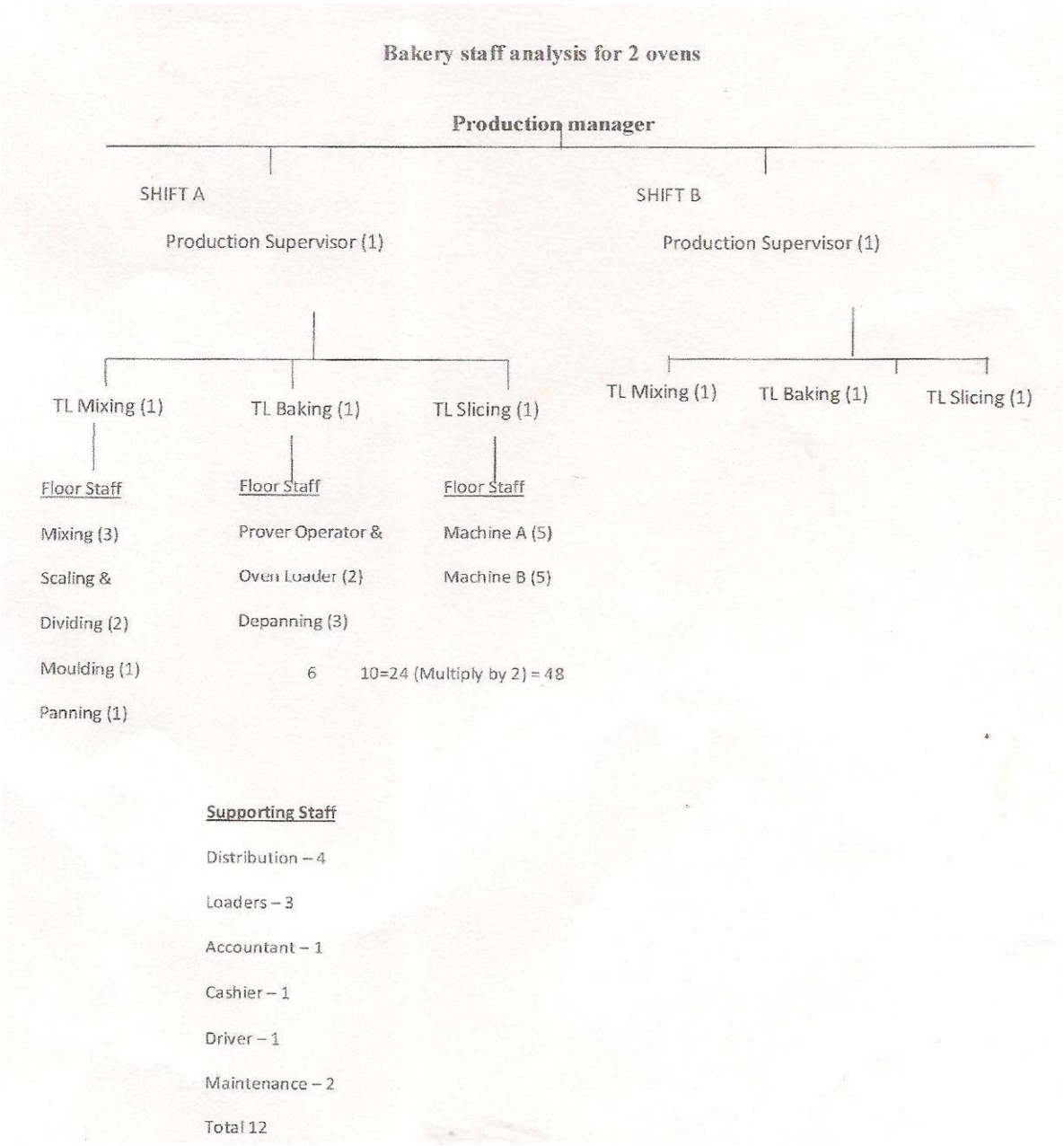


Fig 4.5 bakery staff analysis **Source:** Author (2009)

4.3.3 PRODUCTION CAPACITY

Production is automatic. It has a capacity of producing 10, 000 per hour at the optimum production.

4.3.4 PRODUCTS PRODUCED

At present, only bread is being produced by the company. Plan is however on the way to start producing other baked products such as cakes and biscuits.

The bread produced here are free from external bodies like sand, mud, flies and other dirt which are common to some other bread produced under crude and manual methods where fermentation is done over-night with the flour exposed. Even the finished products are stored in well made counters with wire note cover to prevent entry of insects and flies

4.3.5 SALE OF THE PRODUCTS

No direct sales to the retailers are made at the factory side. The showroom and sales depot is at the headquarter where the public could go and purchase any number of loaves at reduced prices. The company has also fleet of distribution vehicles and recruited will trained and powerful sales agents.

Plate 4.3.2 Despatch **Source;** Author (2009)

4.3.6 ESSENTIAL EQUIPMENT IN THE FACTORY

Some of its automatic devices include: flour sifting machine, watering mixing and metering units. Heavy-duty high speed mixers, lifting and tilting device, dough hopper, multi-pocket divider, cone rounder, double reversing intermediate proofer etc.

Others are the control panel, universal wire band oven, and pan conveyor plant with cooling channel. Slicing machine, wrapping/packing machine, low pressure steam boiler, fan ventilator and water cooling unit, water chiller (a cooling device) and air compressor

The company has also provided the plant with a giant 250KVA stand-by generating plant as well as a water tank capable of storing 5,000 gallons of water.

Dough Mixer

Dough Divider

Slizing Machine

Proofer

Oven

Plate 4.3.3 Bakery Equipment **Source;** Author (2009)

4.3.7 SPACE/FUNCTION

The factory has a large baking hall of about 30m x 72m. This hall houses all the important machines use for baking. They are all arranged sequentially in rows according to the various stages of production.

Offices are also included in the factory house: chairman/managing Director's office, executive Director, master bakers' reception, Changing Room, Workshop, stores for raw materials etc. in addition, at the other side is the boiler and Air Compressor's room, and the Chiller with the generator inclusive.

Production hall

Cooling area

Despatch hall

Store

Plate 4.3.4 Spaces in A Bakery **Source;** Author (2009)

4.3.8 LANDSCAPING:

Though there are no amenities for relaxation of workers, the large compound is well planted with some beautiful flowers.

4.3.9 PARKING:

There are no formal parking spaces in the factory premises. However, cars are packed indiscriminately in the compound is large and only few cars come and leave the premises.

Plate 4.3.5 Parking Spaces **Source;** Author (2009)

4.3.10 CONSTRUCTION:

The major materials used are steal, block and aluminum sheets. The choice of these materials is influence by readily availability and cost of the materials. The floor finishes is cement-sand screed.

The workshop has no external door. Thus whatever is coming into and out of the workshop will have to pass through the baking hall. This could introduce some foreign matter into the dough being left ready in the bowl for onward transfer into the dough hopper.

It should however be noted that the bakery plant is a very standard one.

The factory is properly ventilated with high level fan light. There are also roof lights at 3.0m intervals. Besides, there are fans in some of the offices. It should however be noted that in spite of all these, the factory is not yet well ventilated considering the intense heat produced during the baking process.

4.3.11 APPRAISAL:

The automatic industrial bakery plant which is a private enterprise seems to be one of the largest in Nigeria. Though it is being underutilized due to shortage of raw materials. The company has actually answered the call by the Federal and State Governments for improved environmental sanitation.

The position of the canteen is not suitable. Apart from the noise that may disturb the Chairman/Managing Director in his office, there is no kitchen where food could be

prepared. In short, one of the major problems facing the company is that of lack of welfare amenities for the workers.

4.4 HIGH LIFE BAKERY LTD

LOCATION: # 65 Ibere street, off ngwa road, Aba, Abia State.

Plate 4.4.1 Offloading Of Flour **Source;** Author (2009)

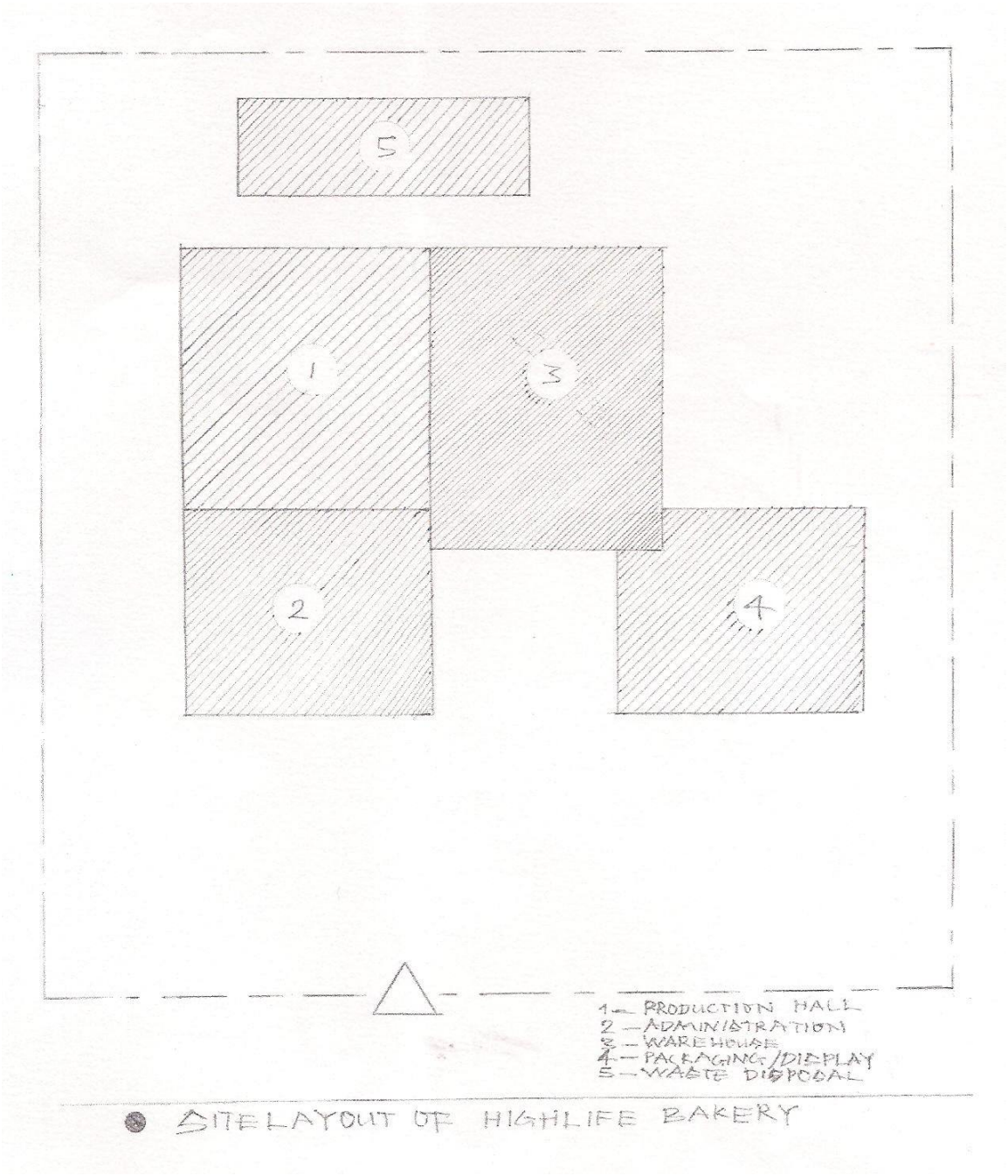


Fig 4.6 site layout **Source ;** author (2009)

The choice of site is purely based on financial reason. The proprietor having thought of the huge sum of money that may be involved in constructing a separate building for the bakery simply decided to use one part of his four flats storey building. This is quite astonishing for the bakery has been in existence over a decade now and huge profit is recorded monthly.

Other reasons that may have influenced the choice of site could be availability of electricity and water, wide market, nearness to raw materials.

In any case, it should be noted that electricity and water supply in this area are regular. Hence it became necessary that the factory should have a stand-by generator.

NUMBER OF EMPLOYEE: 51

4.4.1 PRODUCTION CAPACITY:

The factory on optimum production uses sixty bags of flour of 50kg per bag per day.

Method of production:

The factory is semi-mechanized. Production is not automatic. Hence is time is wasted in transferring raw materials from one stage to the next through manual labour.

Items Produced: Only bread of assorted sizes (weights) is produced.

Marketing of the finished products:

Sales take place at the premises as could be seen in one of the photographs. The company has two shops in the centre of the tow where sales to wholesalers, retailers and consumers are being affected.

In addition, four distribution vehicles are available for distribution to near and far places.

4.4.2 SOURCES OF RAW MATERIALS:

Most often, the raw materials are bought in the open market. Allocation is also gotten from flour mills especially Life Flour Mill, Aba. It is said that the raw materials bought from the open market almost doubles the price of the ones bought by allocation.

Plate 4.4.2 Offloading of Raw Material **Source;** Author (2009)

4.4.3 STORAGE FACILITIES:

Flours are stored in creates. Leaving the flour directly on the floor results in quick caking of the materials. The flour and sugar are stored in the same manner. Milk and eggs are stored in cold room.

Plate 4.4.3 warehouse **Source;** author (2009)

Ventilation:

Natural ventilation through the provision of windows, fans are used in the office rooms.

Fire protection:

Fire extinguishers are fixed at strategic points.

Drainage/sewage disposal:

Dust bins, soak away pit.

Plate 4.4.4 Waste Disposal **Source;** Author (2009)

4.4.4 CONSTRUCTION:

Concrete blocks for the walls and partitions. Zinc roofing sheets and metals for extension walls. Reinforced concrete upper floor properly rendered acts as the ceiling to all the room except the production hall. Timber doors and glass Louvre windows are used.

4.4.5 SPACE/FUNCTION:

The bakery consists mainly the production hall, flour and other raw materials store, sales manager, production Manager, Cashier and storekeeper's office. The offices are generally very small. Even the production hall and fermentation room are so congested that movement is always disturbed.

Warehouse

Preparation Room

Dividing and Scaling

Proofers

Oven

Interior space

Cooling area

Slizing And Packaging Section

Show Room

Packaging Hall/ Show Room

Sales Spot

Plate 4.4.5 Spaces/Function **Source;** Author (2009)

4.4.6 APPRAISAL:

The highlife bakeries ltd is a private enterprise. Though profit is high since the commencement of production, no effort has been made to provide or create a sound architectural environment for the production of the baked product. Rather, the factory is very congested. No formal way of arrangement of equipment and movement of people are unorganized.

Besides, the employees have not been provided with basic facilities such as canteen, rest rooms etc. it should be noted that facilities of this sort are necessary for high efficiency of the workers.

The landscape is nothing to write home about and the environment looks uninteresting and unattractive. The boredom this creates could result in low production.

In summary of interest with high environmental sanitation is recommended for this bakery.

CHAPTER FIVE

GENERAL DESIGN PRINCIPLES AND CONSIDERATIONS

5.1 INDUSTRIAL DESIGN

General Industrial Designers are a cross between an engineer and an artist. They study both function and form, and the connection between product and the user. They do not design the gears or motors that make machines move, or the circuits that control the movement, but they can affect technical aspects through usability design and form relationships. And usually, they partner with engineers and marketers, to identify and fulfill needs, wants and expectations.

In Depth "Industrial Design (ID) is the professional service of creating and developing concepts and specifications that optimize the function, value and appearance of products and systems for the mutual benefit of both user and manufacturer." According to the IDSA (Industrial Design Society of America)

Design, itself, is often difficult to define to non-designers because the meaning accepted by the design community is not one made of words. Instead, the definition is created as a result of acquiring a critical framework for the analysis and creation of artifacts. One of the many accepted (but intentionally unspecific) definitions of design originates from Carnegie Mellon's School of Design, "Design is the process of taking something from its existing

state and moving it to a preferred state". This applies to new artifacts, whose existing state is undefined and previously created artifacts, whose state stands to be improved. According to the (Chartered Society of Designers) design is a force that delivers innovation that in turn has exploited creativity. Their design framework known as the Design Genetic Matrix determines a set of competences in 4 key genes that are identified to define the make up of designers and communicate to a wide audience what they do. Within these genes the designer demonstrates the core competences of a designer and specific competences determine the designer as an 'industrial designer'. This is normally within the context of delivering innovation in the form of a three dimensional product that is produced in quantity. However the definition also extends to products that have been produced using an industrial process.

According to the ICSID, (International Council of Societies of Industrial Design) "Design is a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life-cycles. Therefore, design is the central factor of innovative humanization of technologies and the crucial factor of cultural and economic exchange"

5.1.1 PROCESS OF DESIGN

Although the process of design may be considered 'creative', many analytical processes also take place. In fact, many industrial designers often use various design methodologies in their creative process. Some of the processes that are commonly used are user research, sketching, comparative product research, model making, prototyping and testing. These

processes can be chronological, or as best defined by the designers and/or other team members. Industrial Designers often utilize 3D software, Computer-aided industrial design and CAD programs to move from concept to production. Product characteristics specified by the industrial designer may include the overall form of the object, the

location of details with respect to one another, colors, texture, sounds, and aspects concerning the use of the product ergonomics. Additionally the industrial designer may specify aspects concerning the production process, choice of materials and the way the product is presented to the consumer at the point of sale. The use of industrial designers in a product development process may lead to added values by improved usability, lowered production costs and more appealing products. However, some classic industrial designs are considered as much works of art as works of engineering: the iPod, the Jeep, the Fender Stratocaster, the Coke bottle, and the VW Beetle are frequently-cited examples.

Industrial design has no focus on technical concepts, products and processes. In addition to considering aesthetics, usability, and ergonomics, it can also encompass the engineering of objects, usefulness as well as usability, market placement, and other concerns such as seduction, psychology, desire, and the sexual or affectionate attachment of the user to the object. These values and accompanying aspects on which industrial design is based can vary, both between different schools of thought and among practicing designers.

Product design and industrial design can overlap into the fields of user interface design, information design and interaction design. Various schools of industrial design and/or

product design may specialize in one of these aspects, ranging from pure art colleges (product styling) to mixed programs of engineering and design, to related disciplines like exhibit design and interior design, to schools where aesthetic design is almost completely subordinated to concerns of function and ergonomics of use (the so-called *functionalist* school).

Also used to describe a technically competent product designer or industrial designer is the term Industrial Design Engineer. The Cyclone vacuum cleaner inventor James Dyson for example could be considered to be in this category

5.2 INDUSTRIAL DESIGN RIGHTS

Industrial design rights are intellectual property rights that make exclusive the visual design of objects that are not purely utilitarian. An industrial design consists of the creation of a shape, configuration or composition of pattern or color, or combination of pattern and color in three dimensional form containing aesthetic value. An industrial design can be a two- or three-dimensional pattern used to produce a product, industrial commodity or handicraft. Under the Hague Agreement Concerning the International Deposit of Industrial Designs, a WIPO-administered treaty, a procedure for an international registration exists. An applicant can file for a single international deposit with WIPO or with the national office in a country party to the treaty. The design will then be protected in as many member countries of the treaty as desired

5.3 DESIGN CONSIDERATIONS AND GEOGRAPHICAL DATA

(a) Climate

For a good design the architect must have a good knowledge of the climate where the project is to be sited. This project is sited at umunya which is in the rain forest vegetation. It has a dark-green vegetation all the year round with one dry and one wet season. Rainy season starts roughly from middle of May and stops at October ending, while dry seasons starts November and ends April. It has mean annual minimum temperature of 72^0F and mean annual maximum temperature of 90^0F. There is no drought or frost or major damage by wind.

(b) Temperature

The daily air temperature is usually between 35^0F and 90^0F but this may fall below 8^0F during the rainstorm. The shade or vegetation temperature is up to 15^0F below the temperature of the external surface during the day. Temperature is the degree of hotness or coldness of the weather Good knowledge of this temperature condition will help good conditions of comfort for the occupants in the enclosure. Devices such as air-conditioning can be used to provide special conditions of temperature and humidity for various industrial processes and for storage and manufacture of a wide variety of materials.

MEAN MONTHLY TEMPERATURE (2005-2009)

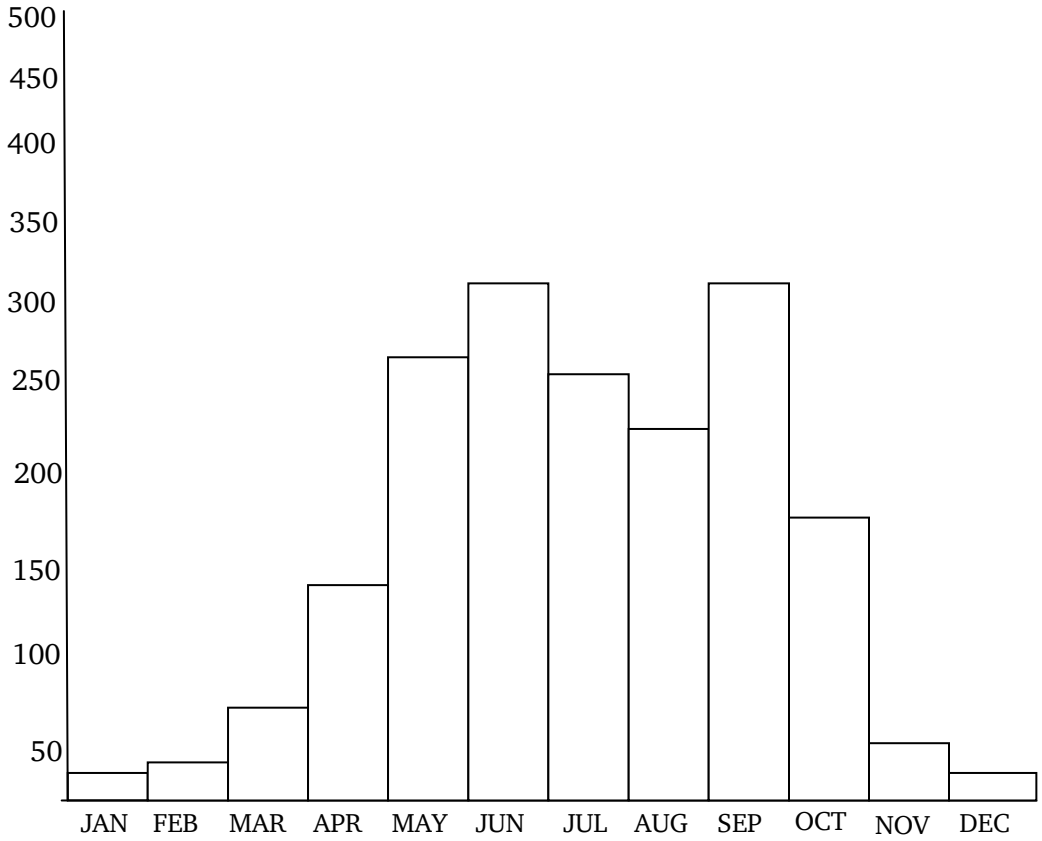


Fig. 5.1

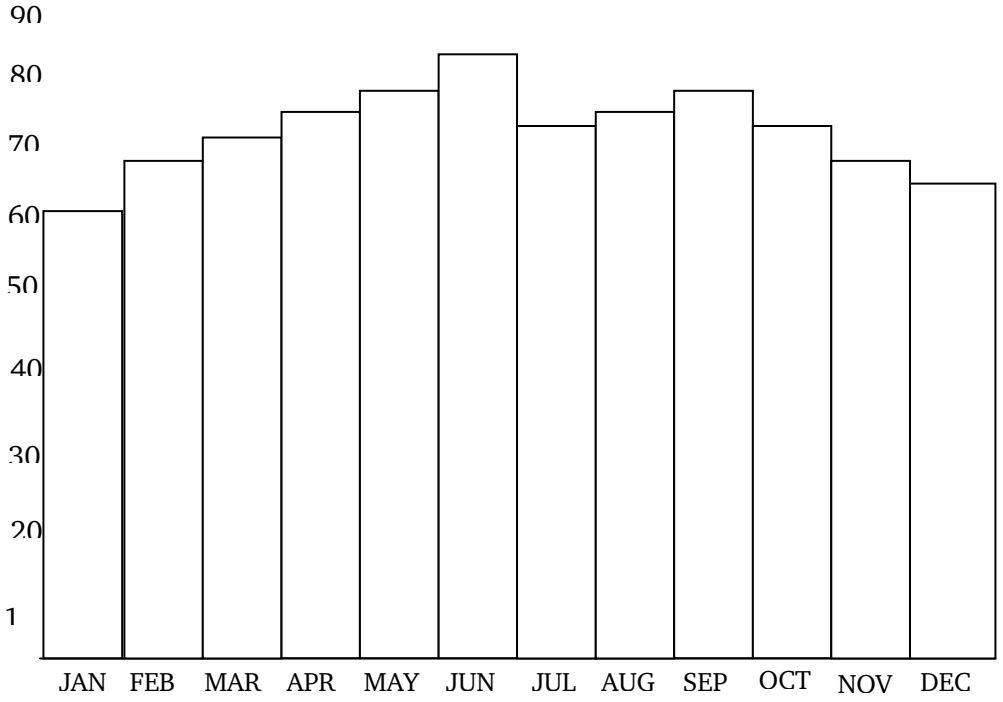
MONTHS

Source: Nigerian meteorological services, Awka

(c) Atmospheric Humidity

Average humidity varies between 80% and 85%. Highest humidity is usually witnessed in the morning when it can be up to 90%. A theoretical analysis shows that relative humidity could be within certain degrees. This makes one believe that thermally acceptable condition can be achieve at certain temperature and relative humidity.

MEAN MONTHLY ATMOSPHERIC HUMIDITY (2005-2009)



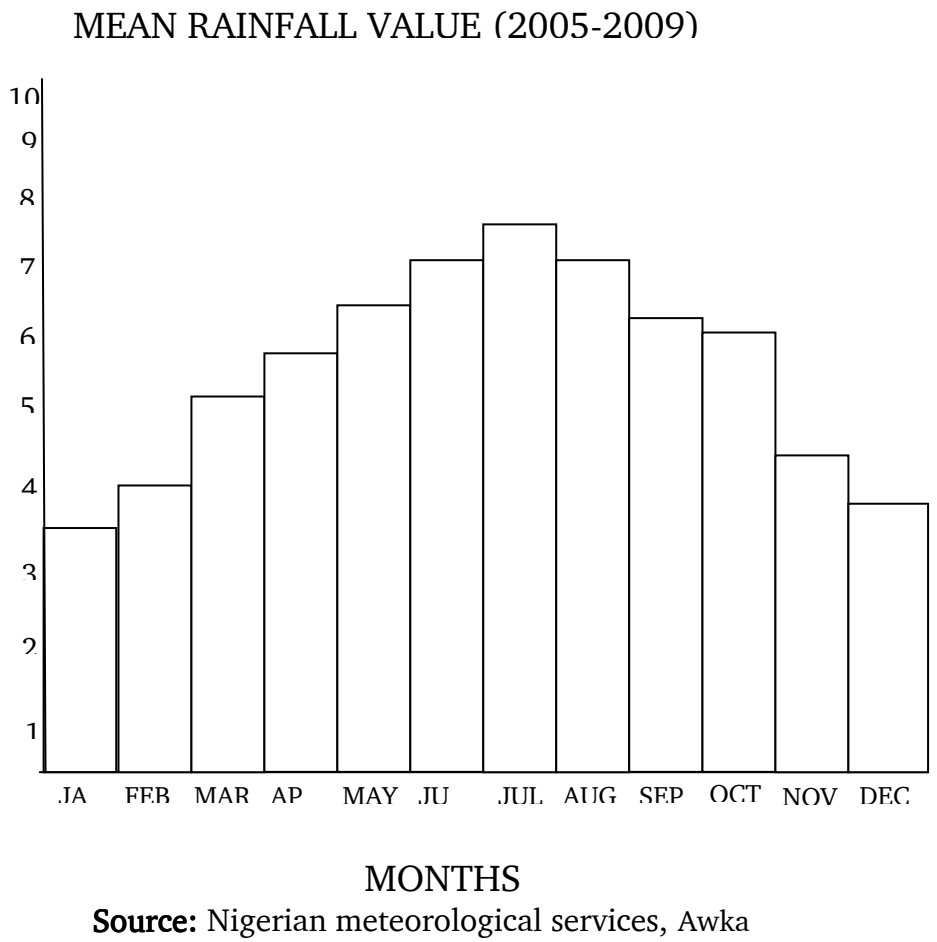
MONTHS

Source: Nigerian meteorological services, Awka

Fig. 5.2

(d)Rainfall

Umunya has a fairly heavy rainfall of up to 78 inches per annum. The average rainfall during the rainy season is about 45 inches and during dry seasons about 1.5 inches. There are occasional heavy down pours during the dry season. Hence there is the need to drain water through underground gutters.



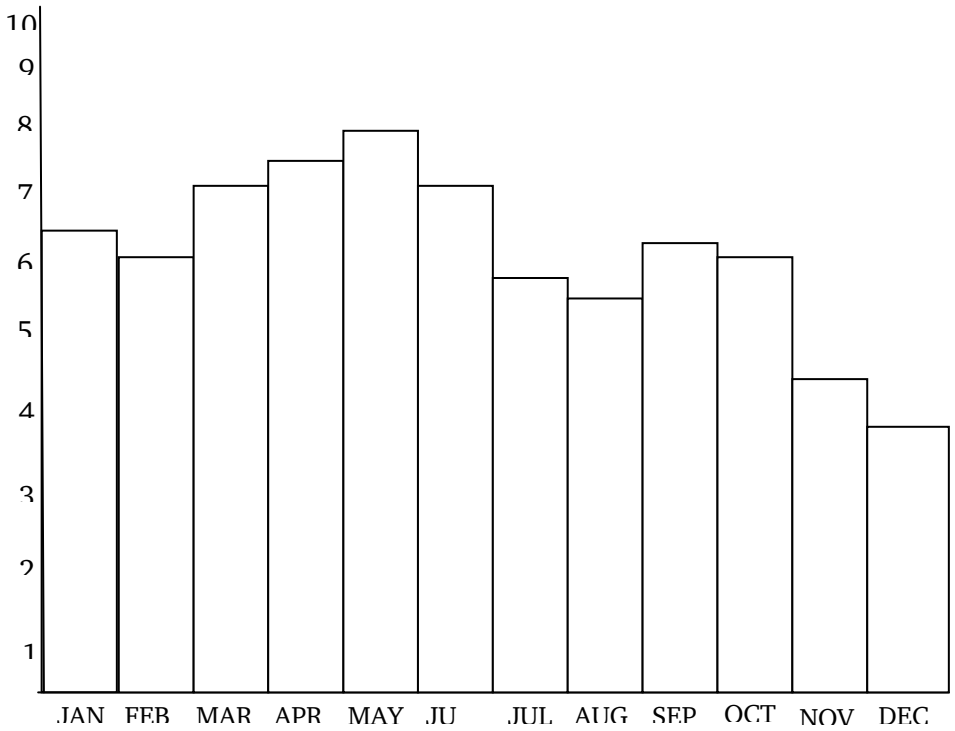
Source: Nigerian meteorological services, Awka

Fig. 5.3

(e) Wind

Wind affects the shape and appearance of the building. Nigeria is a tropical country affect by the N. E. and S. W. Trade Winds. The South West Trade Wind comes from the coast, while the North East Trade Wind comes from the Sahara. The South Western Winds are usually cool and clear, but N. E. which brings 'harmattan' is cool and dry. No several damages are done except that it dries to skin and carry dust.

MEAN VALUES OF HIGHEST WIND FORCE OBSERVED (2005-



MONTHS

Source: Nigerian meteorological services, Awka

Fig. 5.4

5.4 IDEAL WEATHER CONDITIONS INSIDE A BAKERY

(a) Humidity Control and Vegetation

The factory Act demands compulsory effective ventilation in factories. Therefore a good Architect would try to ensure thorough and satisfactory ventilation in a bakery house realizing that intense heat is released during baking and thus fast replacement of internal air with external fresh air (thermal ventilation) is very necessary.

Ventilation may be produced by mechanical means through fans or be produced by temperature differences. In this latter case, air as it becomes warmer expands and becoming lighter tends to rise installation of ducts in rooms at ceiling level will allow warm air to pass out while cold air is drawn to replace it through ducts located near ground level. Window could also be used provided they are made so that no direct in draught is allowed, this being diverted by means of a board or movable section of the window.

The walls of the bakery house should be built of brick or stone since these materials retain effectively.

Glazed tiles bonded by means of cement will not only produce a fine building which can be kept clean but the walls not being porous will enable the heat to be retained in the bakery house itself. Corrugated iron sheets are unsuitable, since they are good conductors of heat and consequently loose it quickly. Slate is one of the best roofing agents, but wood covered with some of the special roofing felts and asbestos tiles can be recommended.

They keep the bakery house warm, since both substances are poor conductors and so return much of it after absorption.

Air conditioning is a term used to indicate the more scientific control of ventilation, for it is realized that something more than the removal of foul air is required by ventilation. The following factors are essential especially in bakery:

(i) Air movement since this is essential for life and reduction of fatigue

(ii) Humidity

(iii) Purity of air

(iv) Freedom from dust and smoke

(v) Temperature

While the control of these is difficult in small bakeries, in large modern buildings, consideration before design is important.

In a bakery, complete conditioning of air is not necessary as different conditions re required in different departments of a bread making plant. Hence the better thing is that each section of the production department and bread store should be considered separately.

(b) Humidity Control

The relative humidity in this country is very variable, differing daily and even making remarkable changes within an hour as exemplified by the formation and clearance of fogs.

The relative humidity decreases with increase in temperature, a factor which is important in bakery design.

(c) Variation and Measurement of Humidity

It is known that in some days dough will skin much more than on others by an amount which depends on the relative humidity of the air in the dough room or bakery house. The amount of aqueous vapour in the atmosphere is very variable, but the maximum quantity which a given volume of air can contain is equal to the mass of the vapour this volume will contain when filled with saturated water vapour at the given temperature. An instrument to use in showing the variations which occur is the wet-and-dry bulb hygrometer.

(d) Humidity in flour stores

Flour is susceptible to changes in the humidity of the atmosphere and when stored in dry atmosphere rapidly looses moisture and therefore weight, but after some time weight losses stops ad equilibrium is established. It is interesting to record that the drier the flour the greater the amount of heat which is developed in the dough during mixing.

(e)Humidity of dough room

For regular fermentation of the dough room temperature must be controlled. This will help reduced dough at correct temperatures and ensure its maintenance during fermentation.

Air conditioned dough room are extensively used in America because of extreme temperature conditions which prevail in winter and summer.

(f) Proving Cabinets

Where fancy breads and fermented small goods are produced on a large scale, it is the practice to have large proving cabinets or 'presses' installed, heated by steam coils and generally humidified by steam or a unit such as the Bahnson humidifier.

(g) Bread cooling and storage

To prevent or minimize crust stalling and case hardening of bread a temperature of 70-80^{0}F and relative humidity of 75% are required during cooling of bread. Specially designed rooms could be provided for this purpose; same room to be used for slicing and wrapping as they require almost same conditions.

(h) Humidity and storage of material

Recommendation may be summarized as follows:

Product or Place	Storage Temperature	Humidity
Sugar	70	65
Yeast	28-40	60-75

Flour	60-80	60-75
Fats	40	60
(a) Dough fermentation Rm (b) Intermediate Prover (c) Final Dough-proving chambers (d) Bread cooling Room (e) Cake Bakeries	80 75 80 70 70	80 60 85-95 65-70 65-70

Table 5.1 Humidity and storage of material **Source;** www.bakery.com

5.5 ESSENTIAL CONSTRUCTIONAL CONSIDERATIONS

(a) VENTILATION

The ventilation conditions inside a building are among the primary factors determining human health; comfort, and well-being. They have a direct effect on the human body

through the physiological effect of air purity and motion, and an indirect effect through their influence on the temperature and humidity of the indoor air and surfaces.

Proper ventilation is essential in buildings especially in a bakery. Very intensive heat is produced in bakeries during production processes. The result is that the workers become very uncomfortable and may even run out for external fresh air if nothing is done to alleviate their sufferings.

Thus, ventilation serves to maintain the quality of the air in a building above a certain minimum level by replacing indoor air, vitiated in the process of living and occupancy by fresh outdoor air.

It also provides thermal comfort by increasing the heat loss from the body and preventing discomfort due to moist skin.

Ventilation cools the structure of a building when the indoor temperature is above the out-of-doors.

The relative importance of each of these functions depend on the climatic conditions prevailing in different seasons and regions, and each involves air flows of different orders of magnitude and their satisfactory use sometimes calls for different design details.

In hot regions such as Benin, proper ventilation will be required to provide thermal comfort through air motion past the body. This should be sufficient to provide adequate cooling and rapid sweat evaporation, especially under hot humid conditions. In the evenings air motion

is required to reduce the indoor air temperature and to offset the effect of the warm internal surfaces.

A number of factors affect ventilation;

1. Type of structure or building;
2. Number and size of openings;
3. Window orientation with respect to wind;
4. Climatic variations.

It should be noted that better ventilation conditions are obtained when the air stream has to change direction within a room or space than when the flow is direct from inlet to outlet.

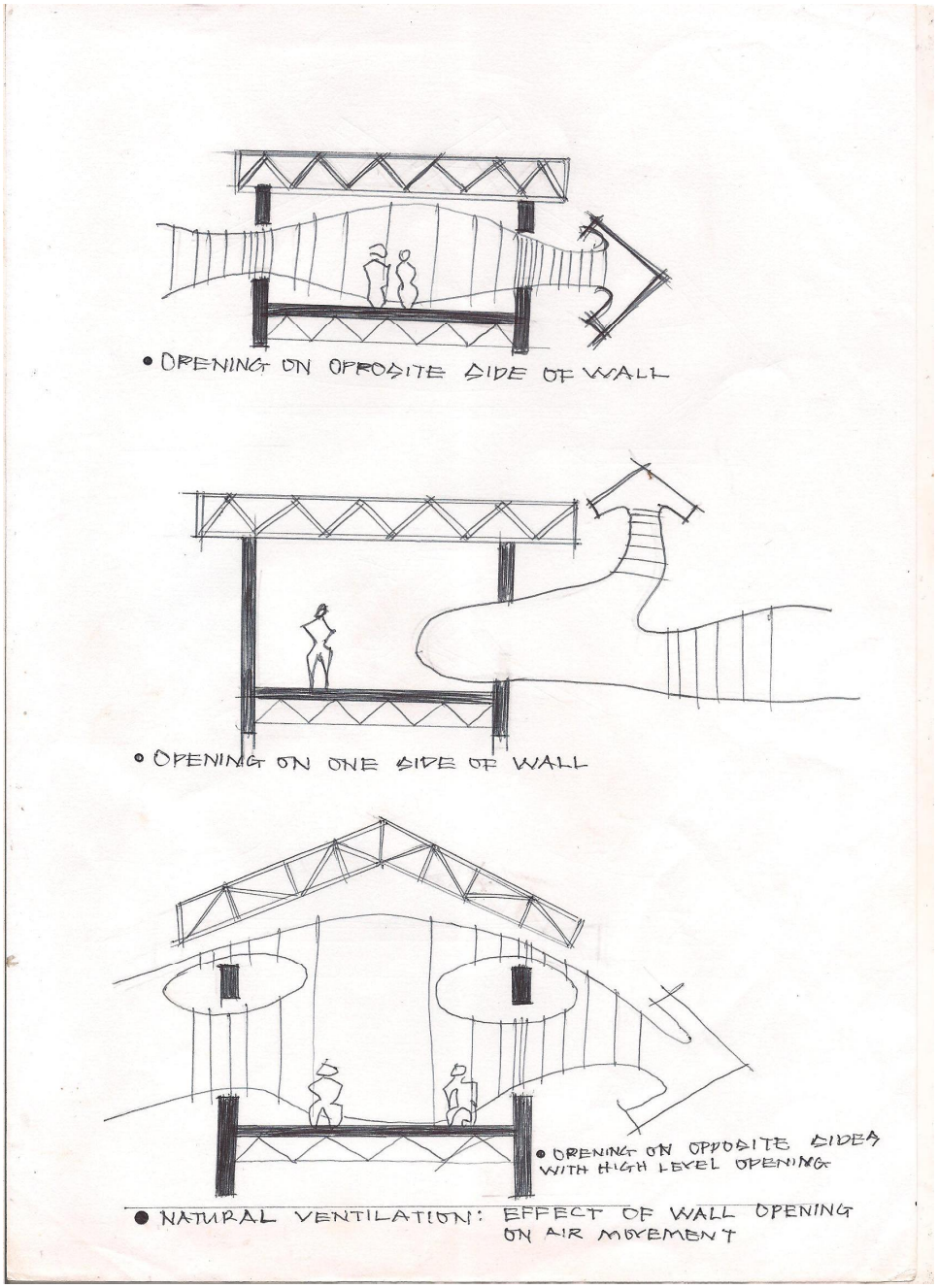


Fig 5.3 Effect of Opening **source;** Author (2009)

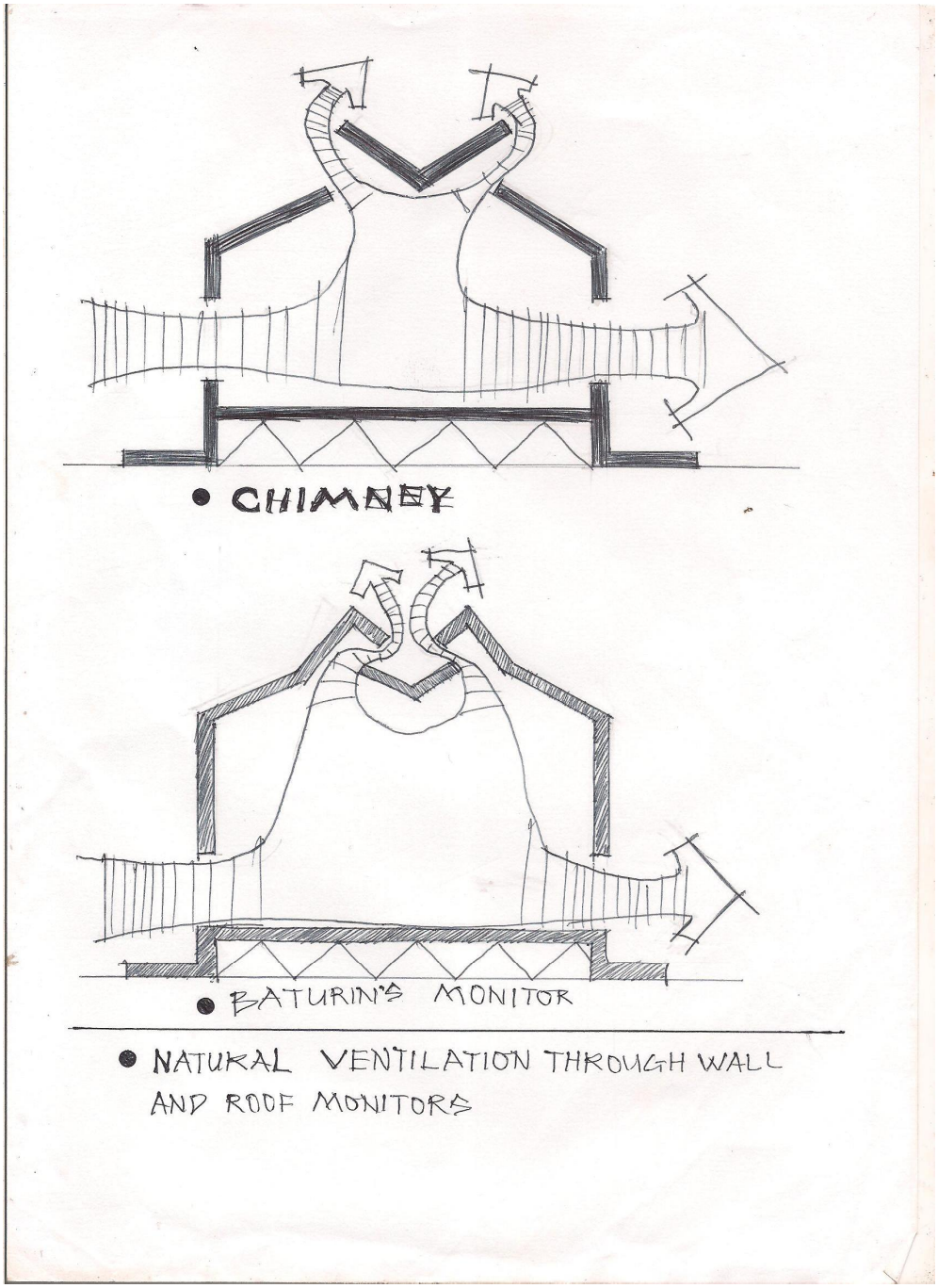


Fig 5.4 Ventilation **source**; Author (2009)

(b) LIGHTING

The universal use of electricity for artificial illumination and the improvement of light sources through the development of the fluorescent tube, which not only improves the quality of artificial light but also reduces the cost, have resulted in the raising of illumination levels in industrial and commercial buildings.

Work spaces with deep internal areas have become logical and a building envelope designed as a solid block offers considerate advantages. This type of building is more economical in erection costs than a building with a narrow plan, and offers greater flexibility in terms of internal layout and more efficient use of available floor space. Under such circumstances, a totally artificial and fully controlled internal environment is a practical and economic solution.

Artificial lighting at any level produces heat; all lighting systems produce heat at the rate of 3.41 BTU per hour for every watt of electrical input. People at work machines and equipment also generate heat and this must normally be removed by ventilation or cooling system and ejected to the outside air.

It is however necessary that maximum use be made of natural ventilation bearing in mind the irregularity of electricity supply, the tropical nature of our climate etc. Hence in my design a combination of both natural and artificial ventilation is used. The offices have

window floor ratio of at least 1:6. Some illustrations with self-explanatory note will help to show the effect of light in a space.

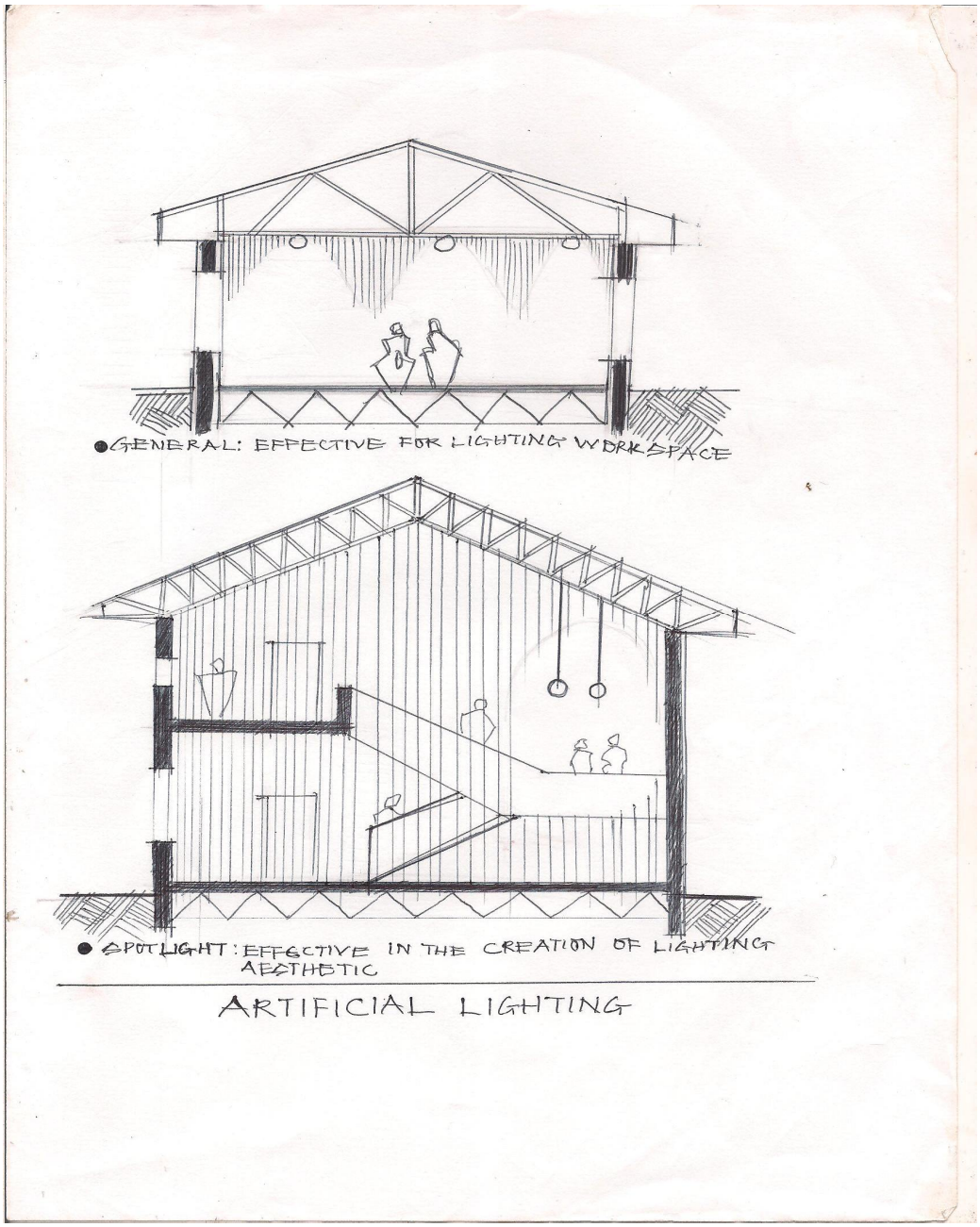


Fig 5.5 Lighting **Source;** Author (2009)

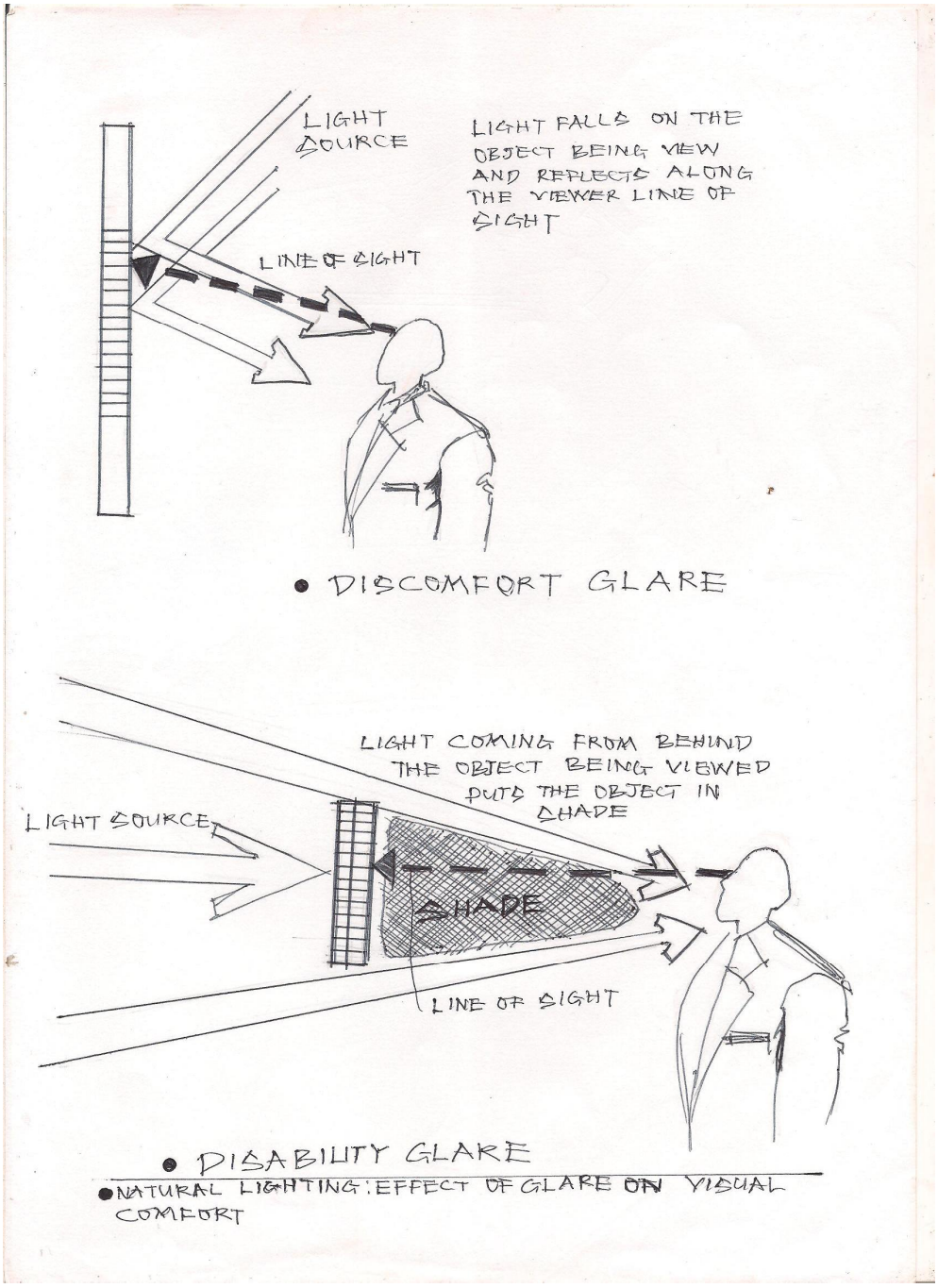


Fig 5.6 Glare **Source:** Author (2009)

(c) FIRE PROTECTION

Among the many responsibilities placed upon the architect by society and more particularly by the state from which he receives his license to practice, is the protection against loss of live by fire. The preservation of the structure and its contents against fire damage or destruction is of serious concern to owners and others having financial interest in property.

Fire protection is very important in bakeries. Locally, much of the fire/heat needed in bakeries is produced using fire-woods as could be seen in fig. 8.B4. The modern bakeries consume much gas or electricity.

Wood or timber is very vulnerable to fire. Unprotected steel is subject to rapid collapse if attacked directly by fire or superheated air and therefore is subject to limitations. It is therefore necessary for adequate care to be taken against the eruption or spreading of fire.

Effort will be made to reduce the use of timber in the construction for my design. Steel will be protected either by fire resistant plaster or imbedded in masonry. Reinforced concrete and protected steel are usual components of the most fire safe buildings.

Some of the many protective measured items that must be considered are as follow;

a. Suitable form of construction;

b. Suitable planning of the building internally and in relation to adjacent buildings;

c. Satisfactory planning and construction of means of escape – it should be ventilated to the open air in all storey;

d. Installation of fire-fighting equipments like fire extinguishers and automatic sprinkler systems;

e. Protection against fires caused by defective electrical systems;

f.Protection against fires caused by lightning;

g. Detection and alarm systems;

h. Standpipe and hose systems within and near buildings.

Construction against Fire Spread

Fire resistance depends on the way in which materials e used in an element and not solely on whether they are combustible or not.

(i) Concrete

The behavioural of concrete under fire depends largely upon the type of aggregate used. Hard stone gravel expands greatly and causes spalling of the concrete, but clay brick and slag do not cause spalling. Examples of non-spalling aggregates are: foamed flag, pumic, blast-furnace slag, crushed brick and burnt clay products, expanded clay and crushed limestone. Additional protection can be given to reinforced cement or steel members by increasing the concrete cover.

To this effect, crushed limestone from neighbouring towns is used as the coarse aggregate in all the concrete works in the factory. The reinforced concrete columns will be covered with 50mm concrete cover, which gives a fire rating of two hours.

(ii) Timber

Timber is a highly combustible material but some species such as peak and iroko are highly resistant to fire. The degree of combustibility of timber can be reduced by treatment with a fire-retardant. Pressure impregnation gives better results than brush applications.

(iii) Cladding

Combustible linings are potentially more dangerous when there are air spaces behind them. This occurs in factory buildings where the inner insulating lining is separated from the outer cladding by the structural framing. To avoid continuous air space, it should be filled with a non-combustible material e.g. wood wool.

(iv) Decking

Where a decking is used, as in the first floor of the factory building, a non-combustible material should be placed below it in order to protect it from fire below, for example wood slab.

5.6 THERMAL CONSIDERATION

Due to excessive heat during the dry season in the tropical environment, solar radiation presents some problems. Heat gain emitted from machines should be taken care of. If this combines with high humidity working conditions may become intolerable. For these to be taken care of mechanical ventilation is less effective and control measures help to bring the condition down to a tolerable state. This can be achieved through:

a. Orientation and use of industrial fountain;

b. Incorporating reflecting finishes and surfaces to roofs and walls (use of bright coloured paint on say the external walls of the buildings);

c. The use of special glazing;

d. Making best use of ventilation either natural or mechanical.

Note that the control of heat in bakeries is essential due to the much heat produced during baking. However, care should be taken since rate of fermentation is being affected by the temperature of the fermentation area which may likely be part of the baking hall.

5.7 NOISE AND VIBRATION CONTROL

Noise and vibration control is a vital issue in the design of factories. The works should be able to work in an atmosphere free from deafening noise. To this effect, the walls and floors should be well-insulated from noise.

For an acoustically satisfactory building, consideration must be given to mechanical services installations and technical equipments which may cause structure-borne noise and vibrations. The following measures are adopted:

i. Provision of floating floors where need be;
ii. Provision of acoustic mountings to all noise producing installations;
iii. Provision of insulation materials to the walls and ceiling.

It is important that insulating material should not be bridged by solid parts. Elastic mountings must be able to function freely and where used in conjunction with machines, they should only be allowed to compress by a small part of their static loadings.

Further noise insulation will be achieved by use of tree baffles, which absorb mainly air-borne noise.

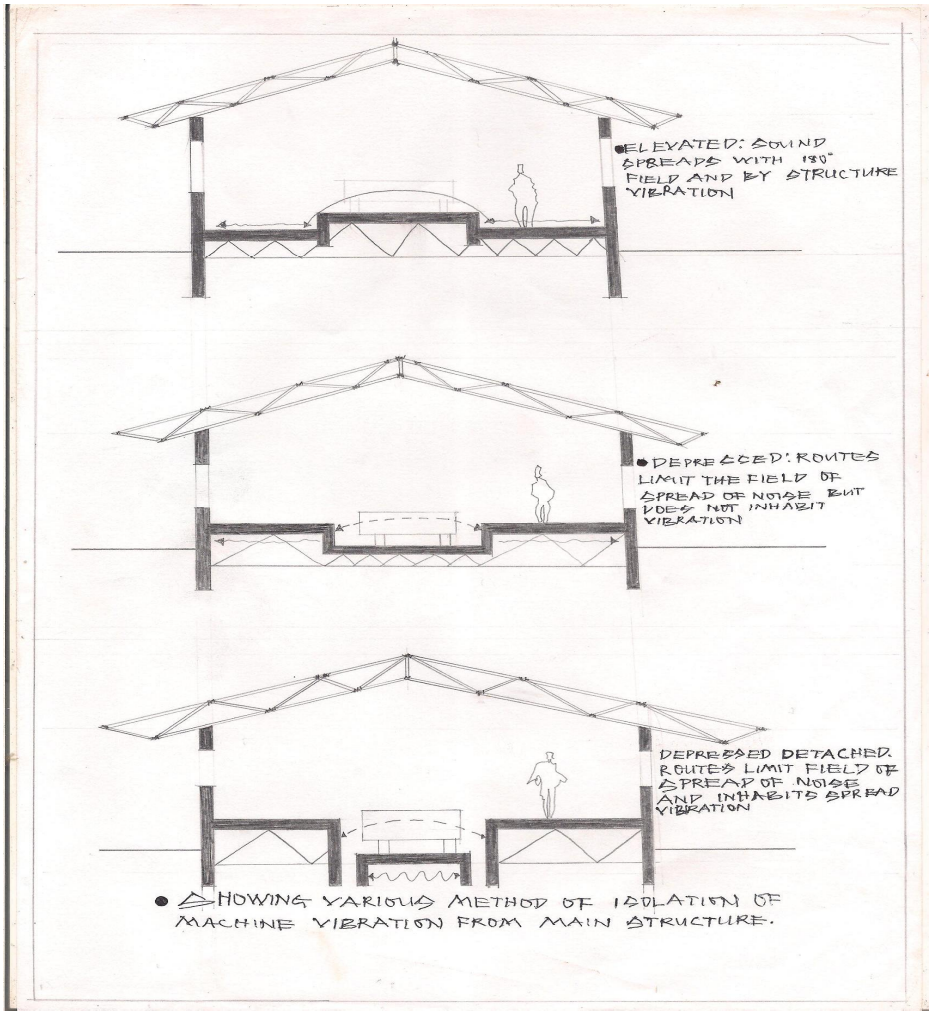


Fig 5.7 Insulation **Source;** Author (2009)

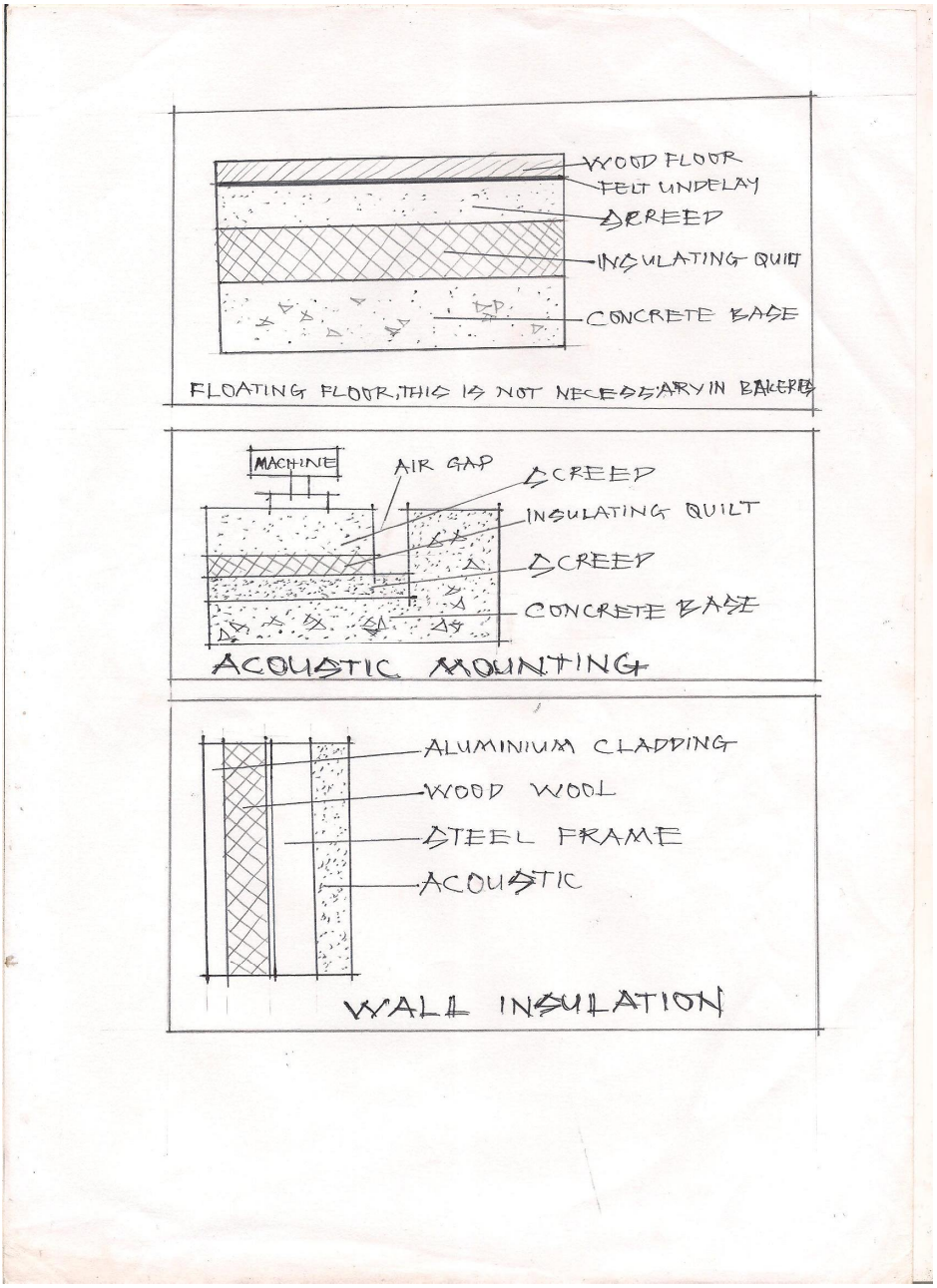


Fig 5.8 Noise Control **Source:** Author (2009)

Generally in any well automated bakery, the sound produced due to production is very minimal. People could work in bakeries without suffering permanent disability – deafness and other defects. Considering noise alone therefore, one may say that residential houses could be built close to bake houses. This could account to why people in this country live in the same buildings with bake houses.

5.8 UTILITIES/SERVICES

The development of new techniques of power supply, environmental control, automation, materials and information storage and retrieval, together with the use of the electronic equipment and automatic plant, means that the services required by industry and commerce can no longer be catered for by simple ducts or pipe runs slung from ceilings or buried beneath the floors of a building.

Complicated circuits of ductwork for air conditioning, pipework for conveyance of liquids and gas, electrical wiring for the operation for machines, computers and other equipments are necessary for the operation of the various types of plant, machinery and equipment needed by modern industry. All thee services must be readily accessible for servicing, maintenance and modification. Because of the continuous nature of much of the running of the equipment, plant, etc. this servicing must be capable of being carried out at any time during the day or night and must preferably be carried out without interference to the operation of the plant or without interference to adjoining plant or equipment.

Based on these facts, effort will be geared towards the provision of service zones devoted entirely to the supply lines. This and the proper planning of both internal and external

circulation will produce smooth functioning, efficient and economical system without bottlenecks and waste of space.

It is important to know that electrical installations are normally subjects to codes and regulations which lay down standards in the interest of safety. Conditions for connection to mains supplies, including the testing of installations will also be laid down by the utility undertakings concerned.

Also, there will be two entrances into the factory premises. While one will be used by the public, the other will be mainly a service entry. It could be used by staff. A separate pedestrian path will be provided. This is a great advantage.

Besides, there is the need for standby generator to ensure continuous production during times of power cut by Power Holding Company of Nigeria (PHCN).

Since water supply in many of our cities is irregular, I propose the provision of an independent water supply source or a water reservoir tank. This is because the bakery industry needed much water for its operation. Steam and cold water are needed for efficient run of the plant. It is therefore my intention to provide a water tank reservoir of 5,000 litres capacity. This calls for:

a. Water borehole or treatment room

b. Electricity plant

5.9 POLLUTION

The fact that 1970 was designated as World Conservation year led to much discussion and deliberation on the problems of the living environment and particularly the problems of pollution arising from new developments in industry and commerce. Many of these problems are uncontrolled side effects of technological advance; the pollution of air and water, the creation of noise to an unbearable level, the inadequate disposal of domestic refuse, trade refuse and industrial effluent, all ad to the pollution of the natural environment.[2]

Pollution of our country's rivers and streams has, as a result of our rapid population, and industrial growth and change, reached alarming proportions. This situation is not only serious, it is also urgent, for we continue to pollute the atmosphere on which we depend for our life at our peril. Industries must therefore be designed with a serious concern not only for the well-being of the people who work inside the buildings, but for those who live around them.

Plant and equipment can be made smokeless and fumes can be treated so that they are harmless when discharged into the air. Modern building materials and techniques enable noisy plant and machinery to be physically isolated so that they create fewer disturbances and improved design can often eliminate the basic cause of the trouble. These therefore will be at the back of my mind while designing this thesis project – Modern Bakery.

It should be noted that pollution is not harmful to man and his environment, it is also wasteful and uneconomical.

In bakery industries, waste is usually produced during production. This is in form of the empty bags of flour and sugar, the condemned pans, empty tins of vegetable oil. Drops of dough and other raw materials on the floor must be washed away and the contaminated water should be properly drained. Other areas where waste could occur in bakeries are the washing rooms, WC's, urinals, meat pie preparation rooms, workshops and the wrapping sections.

The solid wastes are packed and deposited either in dust bins or special area provided for same purpose for the final discharge by the local authority. The liquid wastes will be run into pipes and drain into a soak away pit.

The indiscriminate discharge of sewage and industrial wastes into bodies of water is a health hazard and a menace to wild life. Surface water picks up organic matter on the ground as it flows. These decaying matter are sources of dangerous pollution. In the light of this, I propose that all droplets within and outside the factory be removed into dust bins placed at strategic places within the premises. The sewage is discharged as discussed later in this chapter. The unsold baked products will be converted into animals feeds. The company sells part of the feeds while the rest will be used by the company to feed its animal farms.

Pollution of the air by smoke is caused mainly by the incomplete combustion of fossil fuels which emit carbon monoxide, fine carbonaceous particles and tiny droplets. Air contamination by smoke and other forms of pollutants are detrimental to health and damaging to vegetation, buildings and materials. It often has serious effects on the respiratory system and can sometimes be lethal on a considerable scale when combined with certain humidity and temperature conditions to produce smug. Smoke has an injurious effect by obscuring natural light and depriving people of sunlight. This has inevitable psychological and social consequences.

The deposit n vegetation of various chemical sis often poisonous, while it corrodes the stonework of buildings and accelerate decay. This increasing building maintenance cost.

Apart from air cleaning in air-conditioning systems, smoke abatement ordinances often control and density of discharges from stacks. Dry centrifugal, wet scrubber, etc. are some dust collectors used to extract dust particles from the air.

It should be noted that the effect of smoke is more pronounced in bakeries where firewood or coal is used in baking. In modern bakeries, this is less of a problem. All these problems discussed here will be given due attention when designing in order to reduce their effects.

Concrete drains will be provided along all building sides to drain off storm water. The drains will also run along all the roads with a gradient of 1 in 60 toward a general direction.

The drains will be at least 750mm deep and 450mm wide and will be covered with concrete slabs of not less than 50mm thick.

Bearing in mind that this area experiences heavy rains, discharge of storm water into sanitary sewers is objectionable because the large flows interfere with effective wastewater treatment and increase treatment costs.

As said earlier in this chapter, foul water will be drained into a small sewage – treatment plant – the septic tank. The resulting purified liquid will then be discharged to a nearby river or adjacent land. For efficient operation; the sludge will be collected from the bed of the septic tank by the local authority at regular intervals. It is carted away or used as fertilizers.

5.10 LANDSCAPING/AESTHETICS

It is clear that even with the reduced working hours that modern technology is making possible for many; most people still spend a very high proportion of their working hours at their place of work. A well-designed working environment includes not only suitable lighting, heating and ventilation, and comfort standards, but also the tangible and intangible amenities which can convert discontent and boredom into interest and a sense of participation. Among these amenities is the landscaping of offices.

Landscaping brings the nature closer to the factory and give man who spends most of his life in an office a more habitable environment. It creates aesthetically impressive spaces that soften the harshness of the large production building springing up.

The more grass and vegetation, the more shade, the less hot pavement or earth, the less light glaring surfaces. Air is cooled by the growth of vegetation to create deep shade. Shade is an object of intrinsic beauty.

5.11 COLOUR

Apart from the improvement in standards of cleanliness and appearance, the right use of colour can help to increase production, reduce accidents, and improve the morale of workers. The days of drab colour schemes for factory building are past, and although the value of colour I offices and welfare buildings is now widely appreciated, the application of scientific colour schemes to workshops is still in its infancy. Good sight is a priceless asset and should be preserved at all costs. The correct use of colour in conjunction with a good standard of lighting, both natural and artificial, can reduce eye strain, glare, and visual discomfort, thus assuring the best possible working conditions and at the same time reducing the risk of accidents to minimum.

It is therefore my intention to use bright colours in any areas of the design. Gloss oil paint will be used on the internal walls of the production hall and workshops to waterproof them and facilitate cleaning and hygiene.

CHAPTER SIX

SITE LOCATION AND ANALYSIS

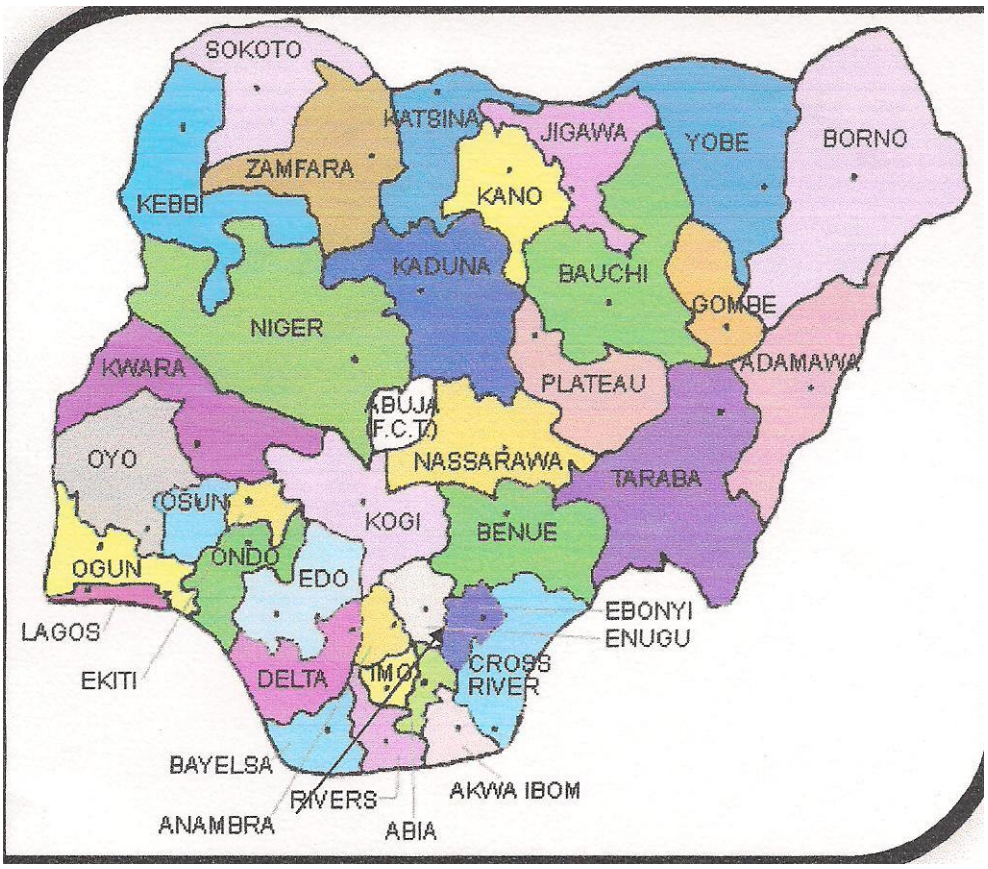


Fig. 6.1 Map Of Nigeria **Source;** microsoft encarta

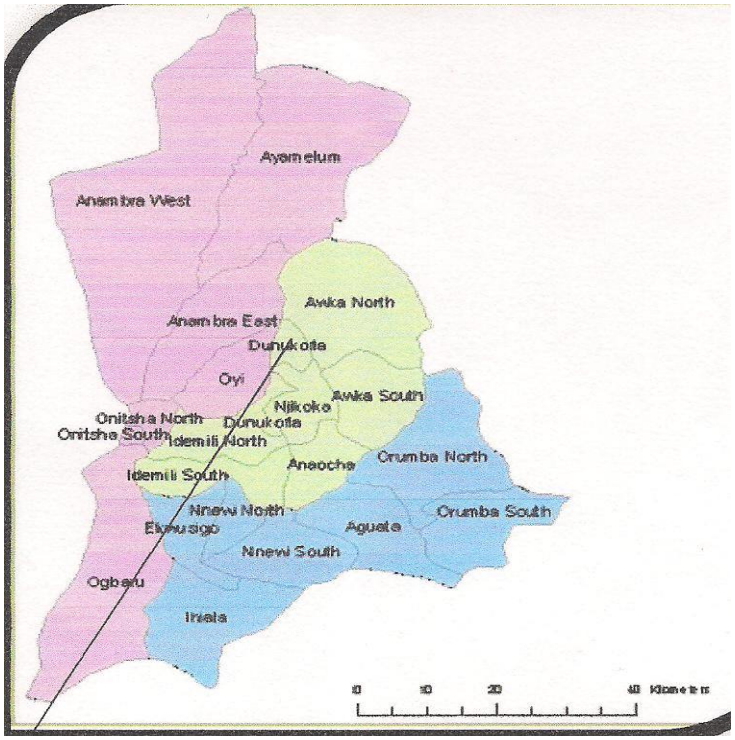


Fig 6.2 map of anambra state showing Oyi L.G.A **Source:** www.anambrastate.com

6.1 SITE LOCATION.

Fig 6.3 Proposed Site **Source;** Google earth

Oyi L.G.A is in the Anambra North Senatorial Zone and it is centrally located between Onitsha the commercial nerve centre of the state and Awka, the state capital. It has an area of 500 Sq. kms. Oyi L.G.A. share boundaries with Anambra State. L.G.A idemili North L.G.A Dunukofia L.G.A, Niikoka L.G.A all in Anambra State

6.2 A BRIEF HISTORY

Fig 6.4 Showing Proposed Site and Environs **Source**; Google earth

Oyi Local Government Area came into being in 1989. It was carved out of former Anambra Local Government Area. It is compose of five communities in Awkuzu, Ogbunike, **Umunya,** Nkwelle, Ezunaka, and Nteje as the Headquarter. It derives its name from the Oyi River.

Social Life

The people of Oyi Local Government Area are culturally inclined; they are famous throughout the State for their Egwu Ekpili (A special brand of Traditional Music). Naturally an average Oyi person does not give into worries because after the days work, he will relax in a Palm wine Party-stream and listen to his Egwu Ekpili. Besides, he loves eating and would always express his joy for the quantity of food he has taken by publicly rubbing his stomach. No wonder a number of festivals take place annually to mark the

beginning of farming season, the interval between cultivation and harvest and the harvest itself. Notable among these include the Opot by Awkuzu, Ijaw by Nteje, lsigu by Umunya, lme Nwafor by Ogbunike and Eme-mmilii by Nkwelle-Ezunaka. Above all, they are very hospitable. On the Political Scene, Oyi Local

Government Area since its creation has had fifteen (15) chairmen/sole Administrators. It is made up of fifteen Wards and five communities. Nteje is the Headquarters.

Elections in Oyi have generally been peaceful and devoid of maiming, killing and senseless hooliganism that have characterized Nigerian politics in recent years. It has made its mark on both National and State politics. The Local Government has its fair share in Ministerial appointments and it is well and ably represented in both National and State Houses of Assembly. When it comes to the appointment of Commissioners in Anambra State, Oyi has not been left out.

Economically, Oyi Local Government is essentially Agric-based. It is reputed as one of the food baskets of the State. It has wide arable land. Yam tubers, Yam seeds, Rice, Cassava, Cocoyam, Palm Oil and Fruit etc are produced in commercial quantity. Palm and Raffia Wine are available so much that it can be harvested for industrial use and even for export. The people of Oyi are also well known for hunting.

In the area of commerce and industry, the privileged proximity of Oyi L.G.A to Onitsha the commercial nerve centre of Anambra State has boosted the growth of (SME), Small and Medium Enterprises, Ultra modern markets have been developed such as Nkwo Awkuzu, Oye Olisa Ogbunike. Eke Igwe Nteje, Afor Umunya, Nkwo N/Ezunka and

Plastic market at Ogbunike. Large quantity of finished goods easily find their way to the Oyi Local Government Area, while primary products are transported to Onitsha thus making Oyi L.G.A one of the reliable sources of raw materials for industries.

The availability of Electricity, though with its constraints has enhanced the growth of small and medium scale industries.

The Oyi people, population and society

Plate 6.1 Oyi L.G.A Headquater **Source:** Author(2009)

Oyi Local Government Area came into being in 1989 at first it was composed of eight (8) Communities from former Anambra local government, which included Awkuzu. Umunya. Nkwelle-Ezunaka, Ogbunike, Nando, Nsugbe. Igbariam, Nteje and Eight communities detached from Uzo-Uwani Local Govt. which include Anaku, Igbakwu, Umueje Omasi, Ifite Ogwar, Umerum, Umumbo and Omor with the Headquarter at Nteje. In October 1996, another Local Govt Area which composed of the eight communities earlier detached

from Uzo-Uwani was created as Ayamelum Local Govt Area. And Nando. Igbariam and Nsugbe were taken back to old Anambra Local Got Area. (Now Anambra East Local Govt). following this development. Oyi Local Govt. as we know it today is composed of Awkuzu, Ogbunike Umunya, Nkwelle Ezunaka and Nteje as Headquarter it derived its name from the Oyi River.

The people of Oyi are predominantly farmers. They are so inclined to their culture, little wonder they are famous for their Egwu Ekpili, Akwunechenyi and Igba Ijele (Traditional brands of Music).

The 2006 estimated population of over 126, 445 for Oyi Local Government (projected from the 1991 National Population Census) makes Oyi one of the Local Governments Area with high population growth rate in Anambra State. The male population of 47.26% is less than the female population of 52.74%.

The five (5) communities of Oyi L.G.A Awkuuzu, Ogbunike, Umunya, Nkwelle Ezunaka and Nteje as the head Quarter have been designated by the Anambra State Government as Urban Communities hence making Oyi an Urban Local Government Area. At the moment 20.629 (40.690) of Oyi total population is of primary school age while 52.74% and 47.26% constitute female and male population respectively. Women of reproductive age 15.49 years, constitute about 26% of the entire population of Oyi L.G.A

The population distribution and proportion of the Target group in Oyi Local Area makes it extremely important matters concerning development, participation, protection and survival will be made the focal points of Oyi Local Economic Empowerment Development Strategy (LEEDS). All these will accelerate all our e towards poverty reduction, employ generation and wealth creation.

2006 POPULATION ESTIMATES GROUPS

Community	Total	Percentage (%)
Awkuzu	41095	32.5%
Nteje	33003	26.1%
Ogbonike	19473	15.4%
Nkwelle/Ezunaka	16563	13.1%
umunya	16311	12.9%

Table 6.1 2006 Population Estimates Group **Source**; NPC Anambra State,1991

Geography

Oyi local government area which is located south west of Awka, the capital of Anambra state and east of river Niger, occupies a land area of about 500 sq kms, with predominantly

a vegetation of flat grassland. Of the five autonomous communities of the local government area, the largest ones are Awkuzu and Nteje.

Socio-Economic Institutions

Oyi Local Government Area has the opportunity to boast of a number of big industrial Establishments functioning in its various communities, some of them are:-

- The Niger Delta Flour Mills, Umunya
- The Akulueuno Nail Industry, Awkuzu
- Anolac Industry Limited, Ogbunike Kengraphic, Ogbunike
- Ginpat Aluminum, Ogbunike
- The Pamob Ind. Ltd., Ogbunike
- Franklin Marble, Ogbunike
- Nwakobi Plastics Ind., Nkwelle-Ezunaka and others.

There are also many Block Industries in the area with the growth of business and activities pursued by the people of the Local government Area, the need to encourage the people to make use of banking system has given rise to a number of Commercial Banks in the area Such banks include Nigeria Agricultural Cooperative and Rural Development Bank (NACRDB) Nteje, First Bank Nkwelle Ezunaka, Community Bank Umunya and Awkuzu etc.

Infrastructure:

(i) Most roads in the L.G.A. owned by F.G, State or L.G are in bad condition and unmotorable.

(ii) Roads connecting the agricultural communities are either unbarred or in bad state of disrepair.

(iii) The state of the farm roads are such that evacuation of farm produce through these roads is virtually impossible. Harvested crops are lost in the farm as a result

list of rural roads in oyi local government area nteje community

- Oddokwe-Amuda-Eziagu Omeleora Road-(5km)
- Eziagu-Umuebo-Nsugbe Road – (8km)
- Jaga-Okachamma Road- (4km)
- Eke Igwe-Achalla-Uno Road (9km)
- ABC Onwuagana-Achalla Uno Toad (4km)
- PWD road Camp-Achalla Uno Road (km)

awkuzu community

- Akaezi-Nkwo Awkuzu-Ozu village Amapa-Igbu road (5km)
- Ekeatu-Okonkwo-Onitsha Express Road (5km)
- Maternity-Ukpomachi-Obinetiti Road (8km)

- Llozue Road-Obidike-Umudunu Road (9km)
- Awkuzu Town hall Road (3km)
- Obinetiti Dusogu, Lfite Awkuzu Road (10km)

umunya community

- Nengo-Odumodu – Aforochi Road-7(km)
- Aleluya – Eke-Umudioka Road (6km)

ogbunike community

- Okolomesike-lloomenu Road (5km)
- Umuoba-Ituma-Oyeolisa Road (10km)
- Hon Nwike-Akukwu Road (2km)

nkwelle-ezunaka community

- Ugwu Ogboito Amenyi – UNDP Amauche Road (8km)
- Oze-Mechanic village – 1 Bank Road (7km)

electricity

* All the five Communities in Oyi L.G.A are connected to the National Grid.

* Supply of power is at best epileptic and with uncertain durations.

* Electricity supply is most critical for economic activities in the L.G.A especially for artisans, mechanics, electricians, welders etc.

* The populace rely mostly on the expensive procurement running and maintenance of generators with its attendant noise, danger and uncertainty.

water supply

Generally, the main sources of water supply in the five communities of the Oyi L.G.A are streams, wells/Bore-holes and rainfall especially during rainy season.

* There is no community in Oyi L.G.A today that can boast of a functional public water supply. For example

* Nteje: This Community has six (6) public borehole which only one is

functional, and others have since been out of use because of lack of maintenance. Although there are private bore-holes, they are, few and do not serve water need of the villagers. The owner also charge exorbitant prices. There are some streams where people fetch water and also wash clothes.

Awkuzu: There is only one existing bore-hole in this community but is not functional. There are two uncompleted bore-holes project which have been abandoned halfway. The Awkuzu water works has since broken down. There are other private bore-holes , wells although some are not functional while those functional are very expensive. There are equally some naturally streams but they are at substantial distances from the population and are hardly used these days expect in extremely difficult situation.

The situation is basically same and applicable to the other three remaining communities (Ogbunike, Urnunya and Nkwelle-Ezunaka).

The ground water supply is limited in number and at considerable distances from the population centres thereby limiting the use except under extreme \circumstances. Even some of the streams have been contaminated by silt from erosion.

6.3 SITE SELECTION AND REASONS FOR CHOOSING THE SITE

In the selection of a suitable site, I have taken into consideration the importance of the underlisted factors:

a. Accessibility of the site to the main services – gas, water, electricity and drainage. It should also be accessible to vehicles and pedestrians.

b. There should be ample space for movement of transport by separate entrance and exit so that all vehicles can be kept moving in a steady flow without any congestion.

c. There should be room for parking facilities.

d. The availability for adequate space to accommodate the present programme and future expansion.

e. Proximity of the site to the centre of the city.

f. Availability f suitable labour.

g. Market, they should be large market to patronize the finished goods.

h. Proximity to source of raw material.

Although, proximity to the centre of the city is an essential factor to be considered, the non-availability of land in and around the centre resulted in the project being sited some sight kilometers away from the centre of the city. This does not mean that people cannot go there to buy bread. In short, there are many taxicabs and buses plying the area.

Plate 6.2 Showing Niger Delta Flour Mill **Source;** Author (2009)

The site is between Awka, Onitsha and Nnewi, which are the target markets. The site is slightly opposite the Niger Delta Flour Mill (NDFM) at umunya. The only known amalgamated bakery material international market at ogidi, is few kilometers away from the proposed site. Besides, people from the western and southern part of the country do pass through Enugu-Onitsha express road when going to parts of Western Nigeria and southern Nigeria through Anambra State. Thus, the factory will be self advertising since it

is located by this express road. Enough customers will also be able to call-in and buy any of the products baked by the factory. Accommodation for workers will not be much a problem since the site is located few kilometers from Onitsha.

Plate 6.4 Amalgamated Bakery Material International Market, Ogidi **Source;** Author (2009)

Apart from these reasons, there are sufficient infrastructures such as water, electricity in this area. The area is being proposed to be used as an industrial layout. That the majority of the people are still in low income bracket give credence to this project since the products will be cheap and easily made available to the masses under high hygienic conditions.

6.4 SITE ANALYSIS

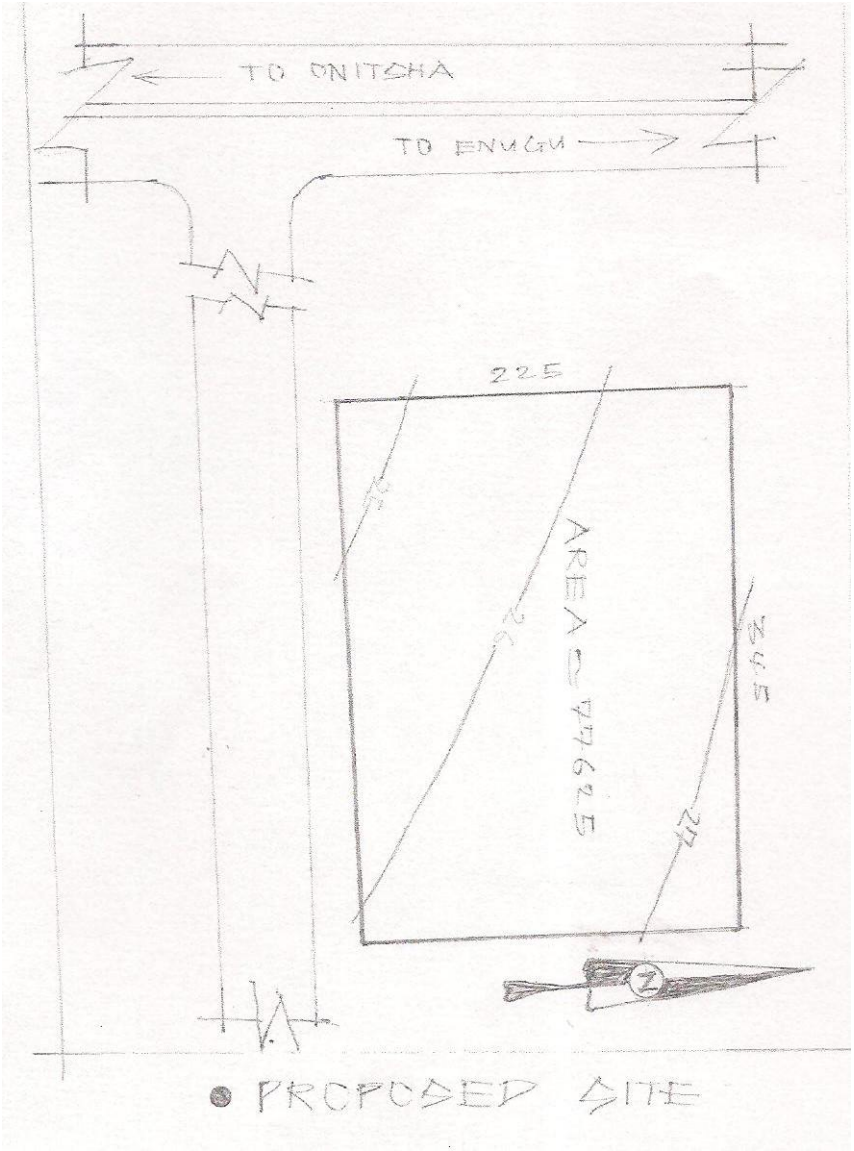


Fig 6.5 Site Analysis on Proposed Site **Source:** Author (2009)

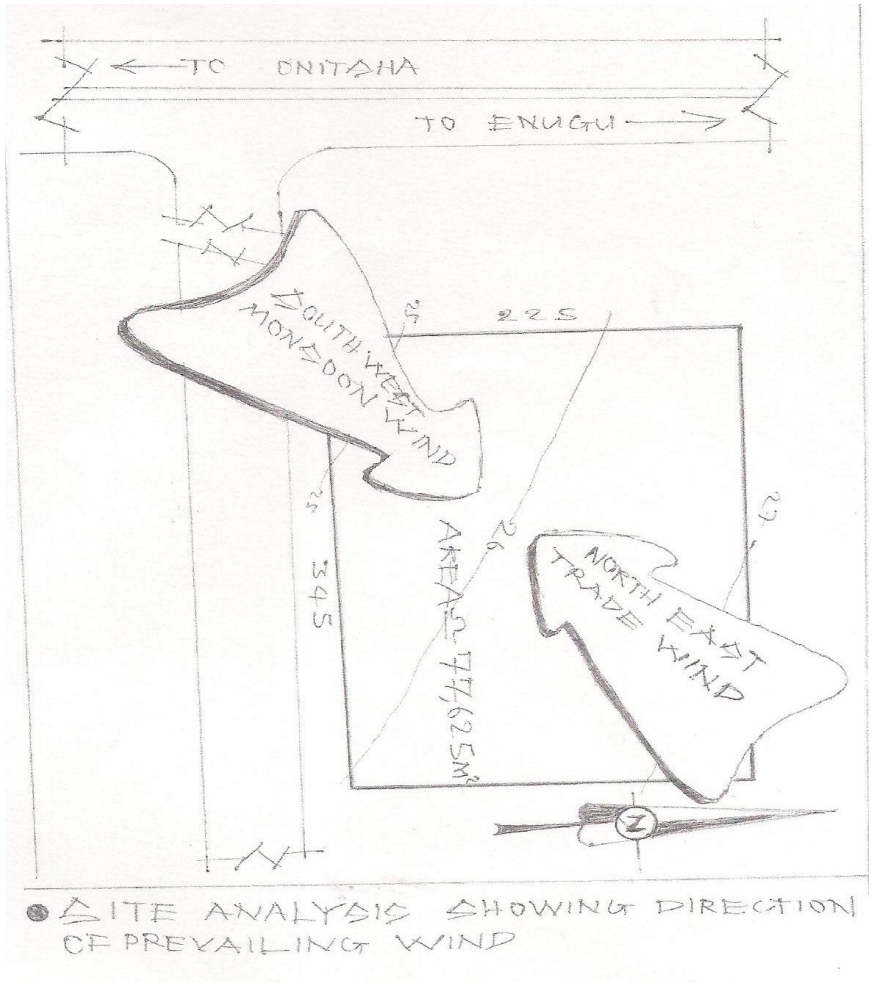


Fig 6.6 Site Analysis Showing Wind Direction **Source;** Author (2009)

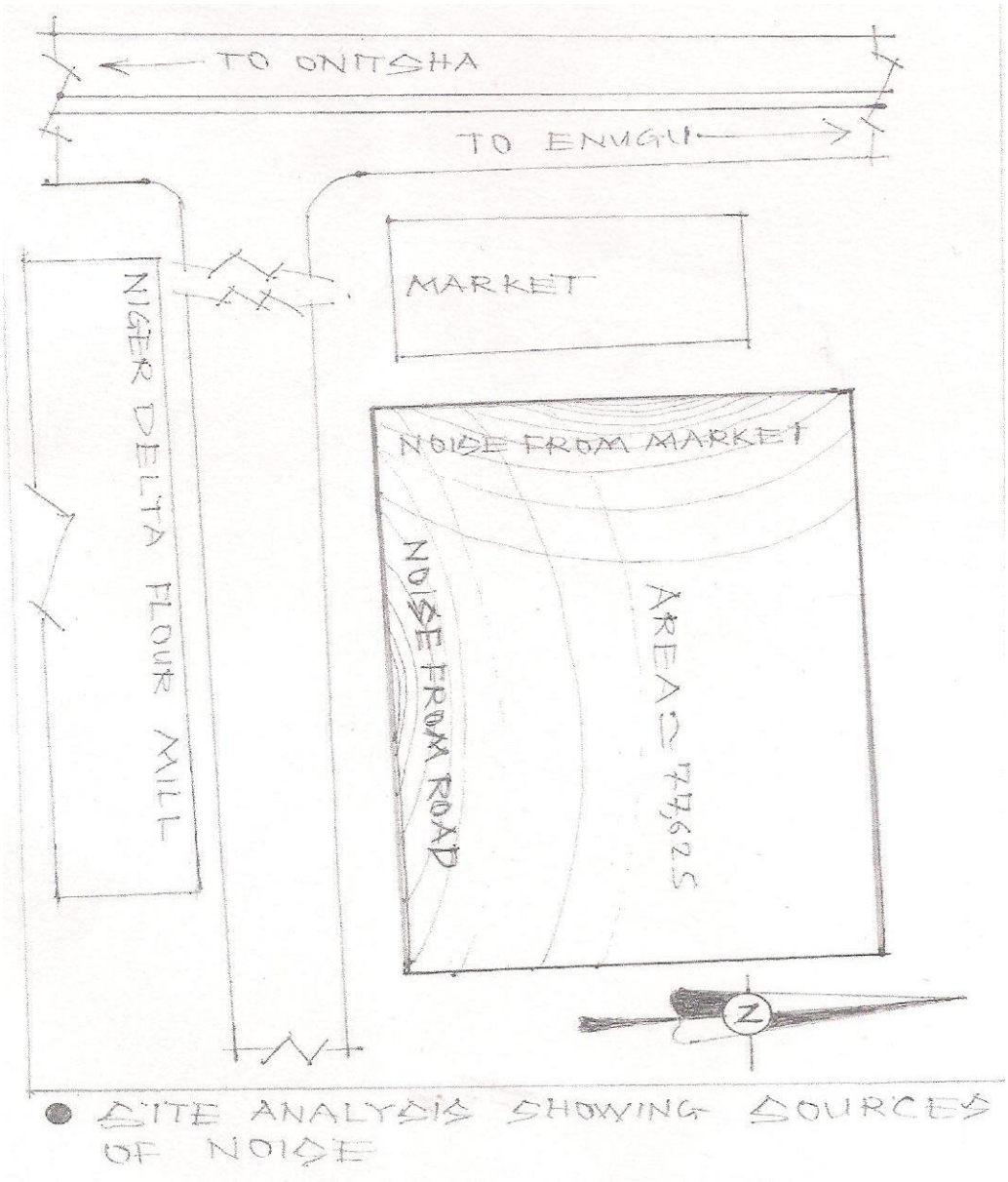


Fig 6.7 Site Analysis Showing Noise Source **Source:** Author (2009)

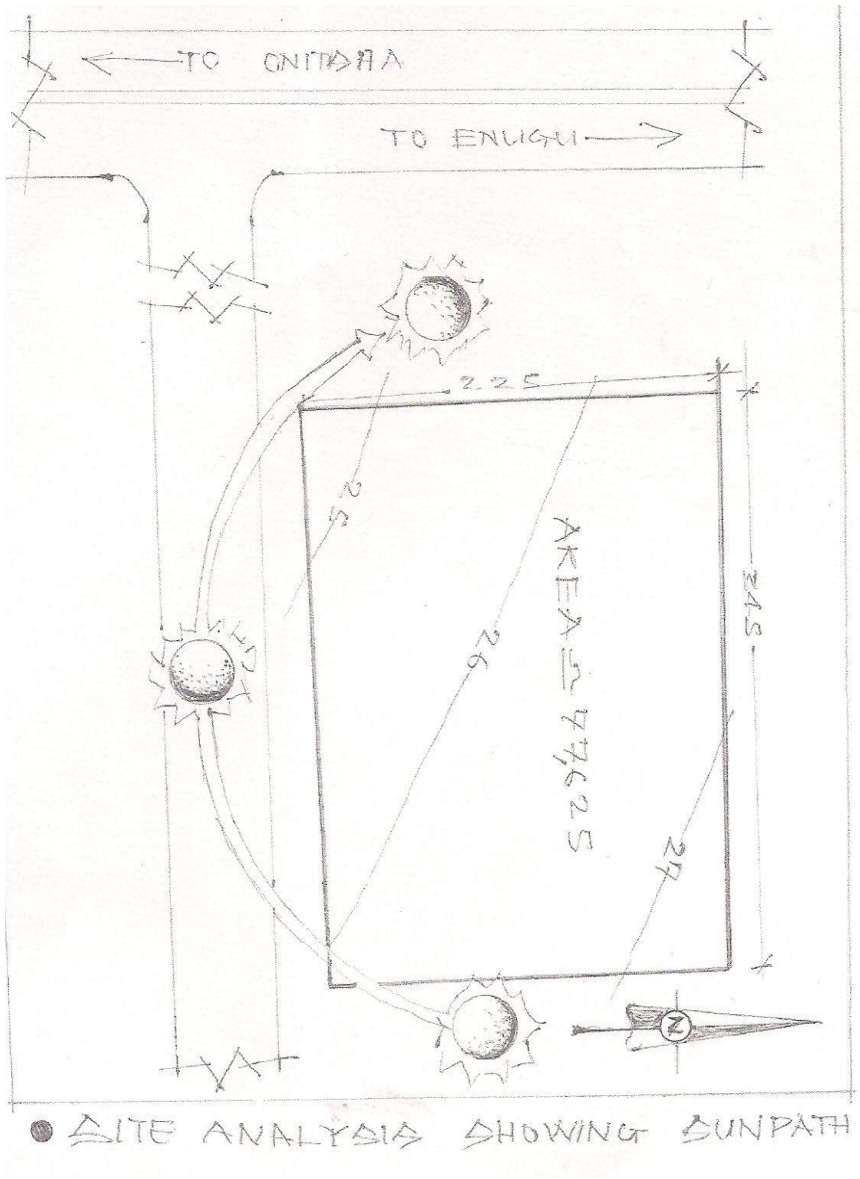


Fig 6.8 Site Analysis Showing Sun Path **Source;** Author (2009)

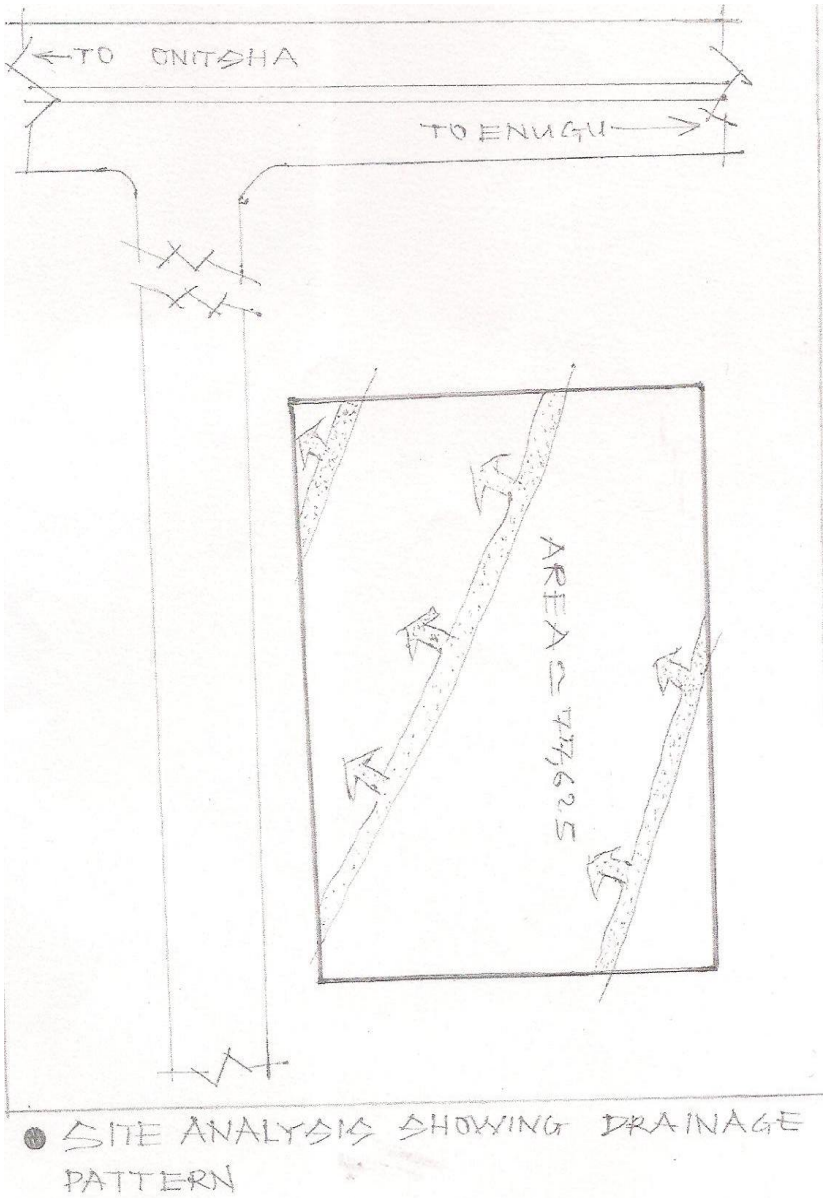


Fig 6.9 Site Analysis Showing Drainage Pattern **Source;** Author(2009)

The climate data of umunya has already been given. The bakery complex is being sited at industrial layout mapped out and designed by Oyi Local Government.

In selecting this site, thoughts was given to the industrial layout and it is of interest that the bakery house will not be consumed in the layout as special consideration was taken to ensure that it get a good location in the layout. It is has got such a form composition that if the design has its own character and boldness and therefore stand to dominate other buildings which will be sited there. This is because the other industries will not get sufficient plot for real development and expansion.

Also its location is such that it is self advertising. It is close to the enugu-onitsha express road. In the industrial layout they are some other factories that will render some industrial services to the bakery complex. For example, the Niger delta floor mill.

ACCESS ROAD LEADING TO SITE

UMUNYA BUS STOP ALONG ENUGU-ONITSHA EXPRESSWAY

Plate 6.3 Access View To Site **Source;** Author (2009)

CHAPTER SEVEN

THE PROJECT

7.1 Concept

The concept is aimed at creating a conducive, healthy and clean environment for the production of baked products. It is an answer to various governments' call for environmental sanitation.

These will be achieved through the utilization of simple forms and simplified construction techniques, the provision of adequate staff amenities to encourage them into doing nice job.

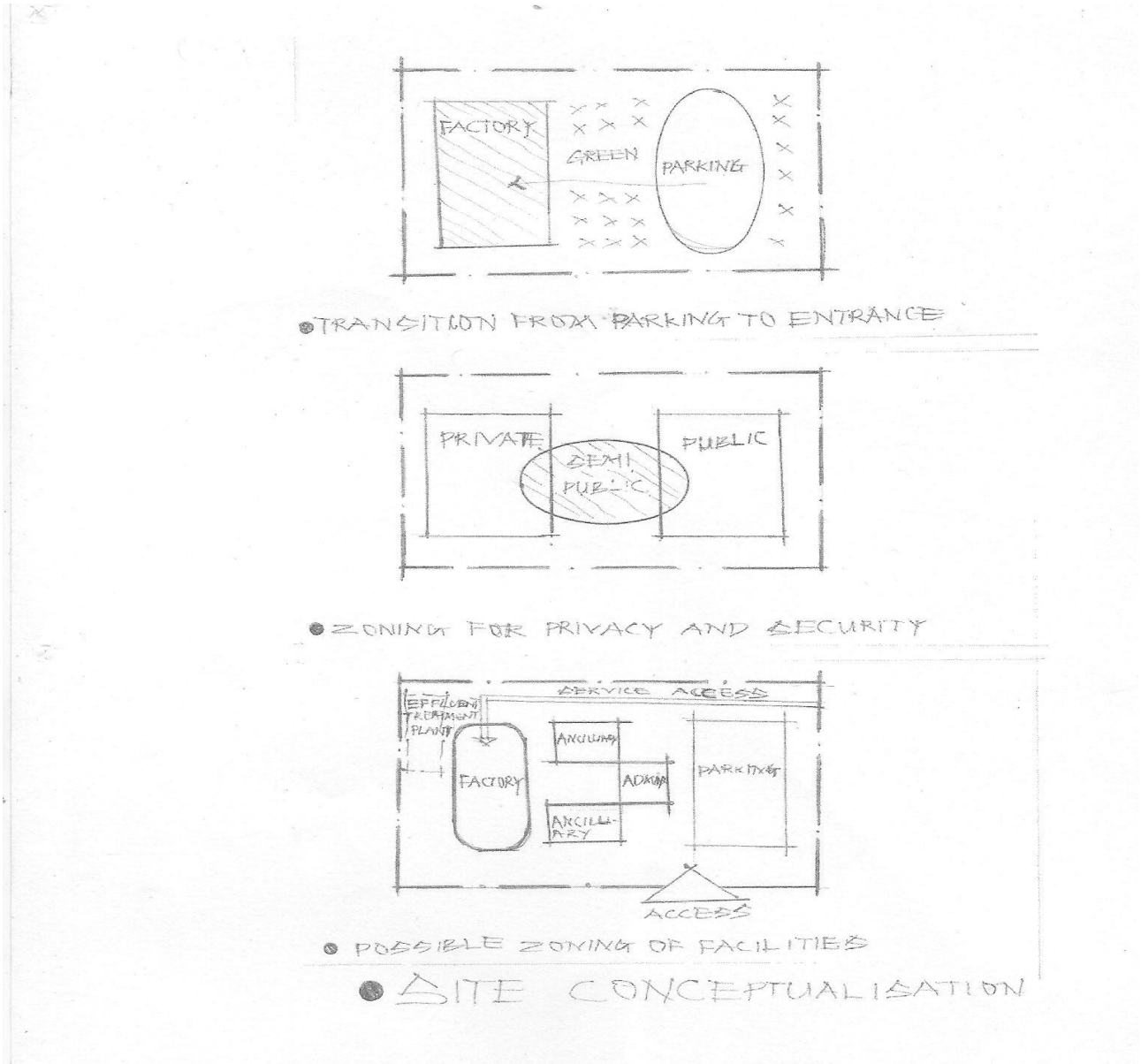


Fig 7.1 Site Conceptualization **Source:** Author (2009)

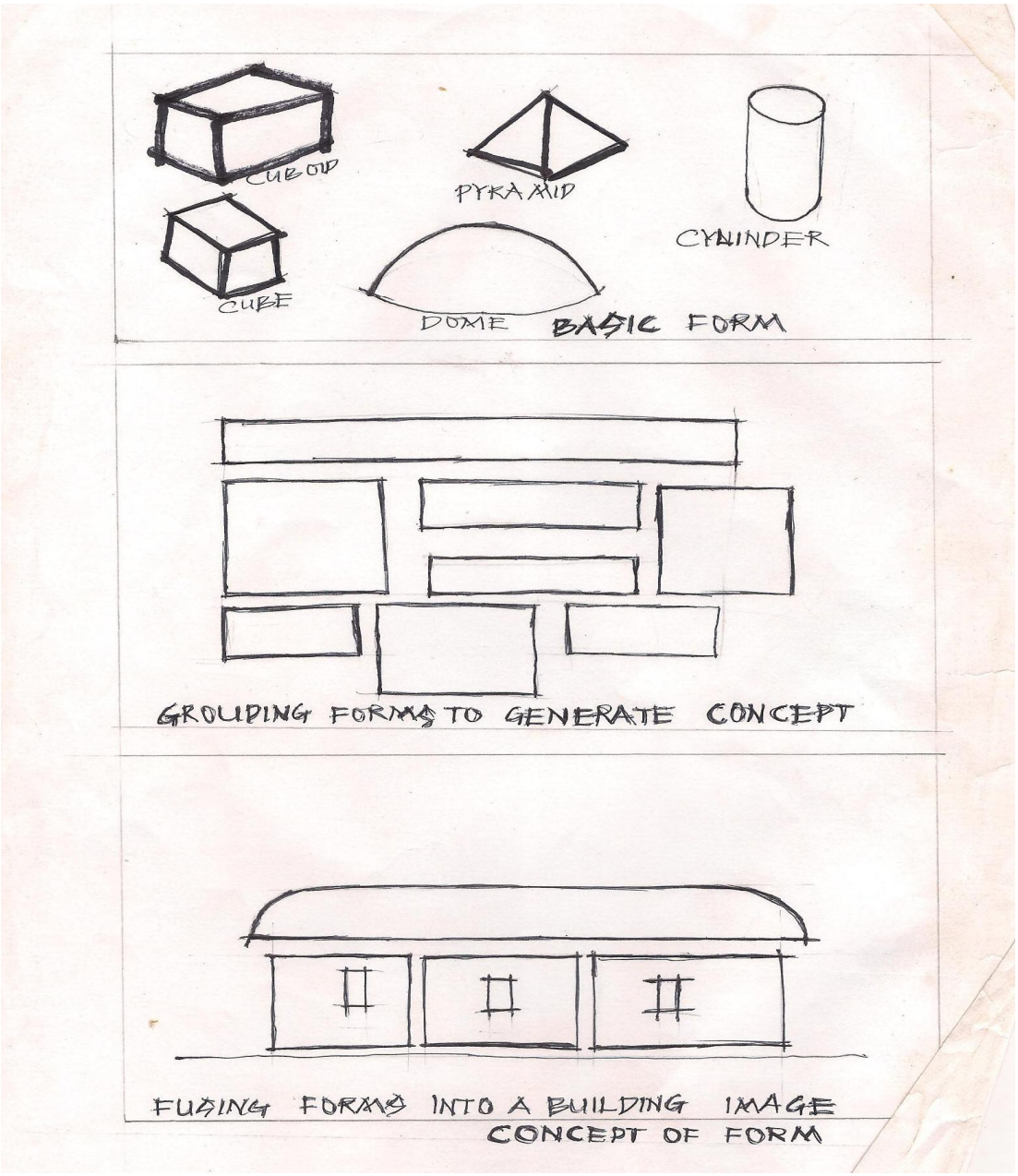


Fig 7.2 Concept of Form **Source:** Author (2009)

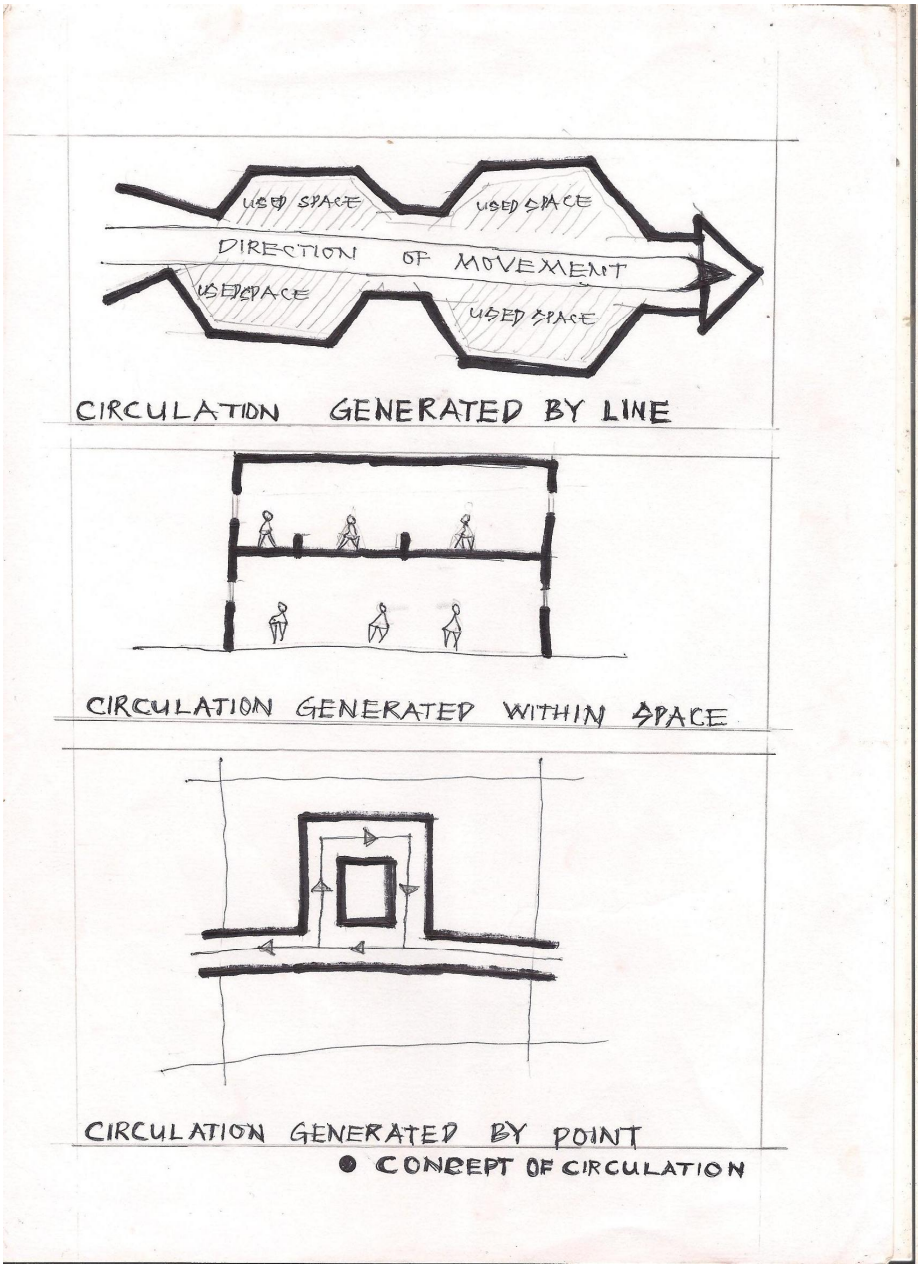


Fig 7.3 Concept of Circulation **Source;** Author (2009)

7.2 SCOPE/CAPACITY OF THE PROJECT

This project is planned to be a large one. When fully automated, a two number working shift will be adopted.

The project is also going to be a BATCH BAKERY type. It will be capable of producing more than thirty assorted bread products.

This bakery will be capable of producing 3,500 loaves per hour of 450gm per loaf at optimum production. It's capacity is 112t of bakery products per 24 hours.

Since it is going to be completely mechanized, less number of people than what may be expected will be employed. At least a total of 150 workers will be absorbed.

7.3 ADOPTED PLANNING PRINCIPLES

There are two main planning principles adopted.

These are:

a. Batch Baking: This principle makes it possible for a wide variety of bread to be handled in an organized sequence while at the same time ensuring a better quality.

b. Full Automation: Automation steps up productivity in some industries by nearly 400%. The principle of automation reduces the number of staff and detects inconsistency.

In a normal industrial process, a machine performs either one or more operation in the chain of production activities and then the article which is being manufactured is passed on

to the next stage of processing, the movement being by hand or mechanical means. The result is a long production line rather like a string of breads with much wasting of time between operations, as opposed to a continuous automated production line which is more economical in time and labour.

The first step therefore, in automation is the co-ordinating of the processing and handling of the product at all stages to provide a uniform production flow and a simplified control. One of the important factors that influence the detailed design of the automated factory is the engineers' production flow which determines the movement of goods and materials around the building shall through the production line by means of the machinery and equipment.

While automation may mean fewer works, one important factor to be noted is that in order to be economically viable such factory must run continuously. This means that in many cases 10 hours a day operation with maintenance facilities built in to reduce the risk of breakdown. This changing work pattern demanded by non-stop plan and equipment will necessitate a very much higher standard of amenities for those controlling the machines.

In the design of factories, adequate flexibility must be built into the envelope to allow for future technological advance.

7.4 DESCRIPTION OF THE DESIGN OR PLANNING LAYOUT

The thesis design will be made up of the following basic components:

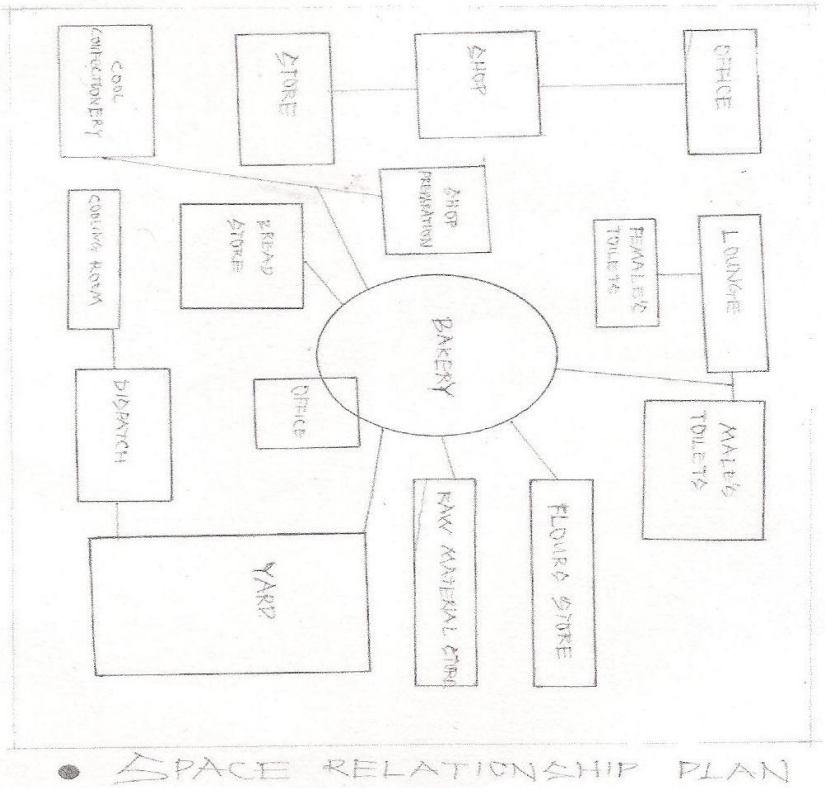


Fig 7.4 Space Relationship **Source;** Author (2009)

- Administration

- Staff Amenities
- Production Area
- Research Unit and Training School
- Repairs and Maintenance Workshop
- Utilities/Services
- Parking Spaces.

7.4.1 Administration

The administrative block will be located away from the more noisy zones. Hence, it will be at some distance from the factory and workshops. It will face the main entrance for proper liaison with the public.

Research Unit

The research unit will be incorporated into this design is charged with the responsibility to research into the utilization of local materials for producing baking raw materials.

The main material currently used for the production of baking main raw material (the flour) is wheat. This is because wheat has a special type of protein called the gluten. By this protein wheat is different from the other cereals. The viscous – elastic property of the gluten makes the bread to rise. It was also gathered that a composite of wheat and our local cereals like soya beans, cassava, etc. will at a certain proportion be capable of rising.

This research unit is intended to work hand in hand with various research institutes in Nigeria. Besides, its inclusion in this design is in cognizance of the importance of the governments call for privately owned companies to go into research on the various ways of using our local raw materials for some finished products.

The quality control section of this unit takes care of the quality of the products. It helps to bring to the government standard all the baked products. This is unlike now when the government does not exercise some form of control on the quality of baked products especially bread.

Consequently, most of our baked products today are homes of foreign matter or particles such as sand, stone, flies, etc.

Training School

The training school will be the centre where newly employed factory workers will be trainee. Interested public could also be allowed to attend the school on payment of agreed fees. Hence the training school will yield some money.

The research unit and training school are located close to the production area to allow for easy communication between the workers in the production area and the trainees. To gain practical knowledge, the trainees has to pay regular visits to the production area. Spaces proposed for this unit will include among others space for:

- Laboratory
- Library

- Quality control manager's office
- Senior laboratory attendants
- Head of the school
- Class-rooms
- Offices
- Stores
- Changing rooms
- Toilets.

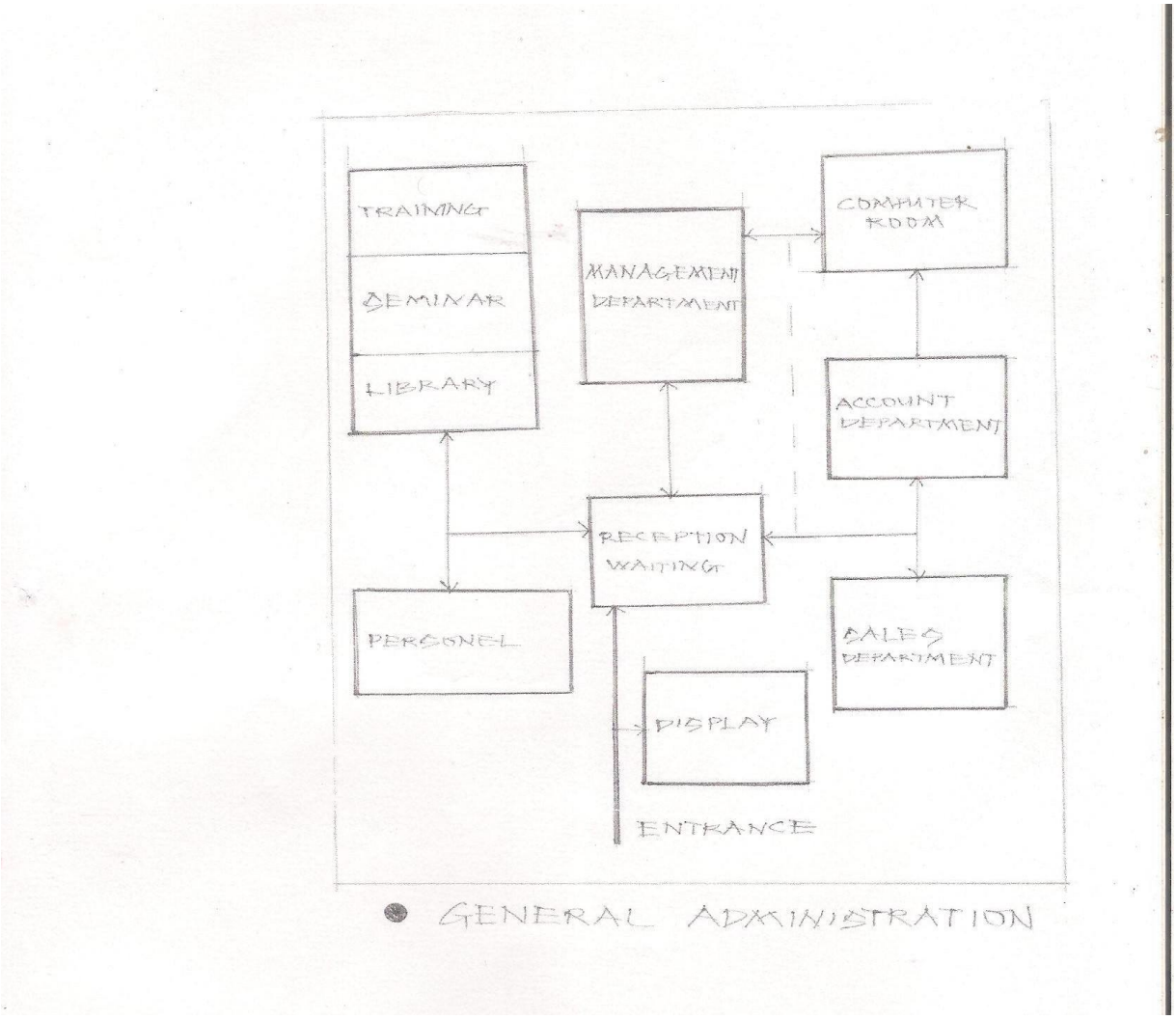


Fig 7.5 General Administration **Source;** Author (2009)

7.4.2 Staff Amenities

Special consideration will be given to the provision of improved working conditions for the employees as this increases worker's productivity and attracts those skills required to

operate and complex machines. It should be noted that both the quantity and quality of the product depend not only on the sequence, precision, and efficiency of the factories, tools, and machines, but on the proficiency, prides and fitness – both mental and physical of the personnel.

The facilities that are to be included here should be near the work space. This is to save time in getting back and forth the work area. It should however be insulated from the sights and sounds of the work area so that a real change of scene is provided. The staff amenities section will comprise:

- Kitchen and dining rooms
- Medical unit
- Stores
- Lounge
- Lockers
- Changing rooms
- Toilets
- Recreation areas

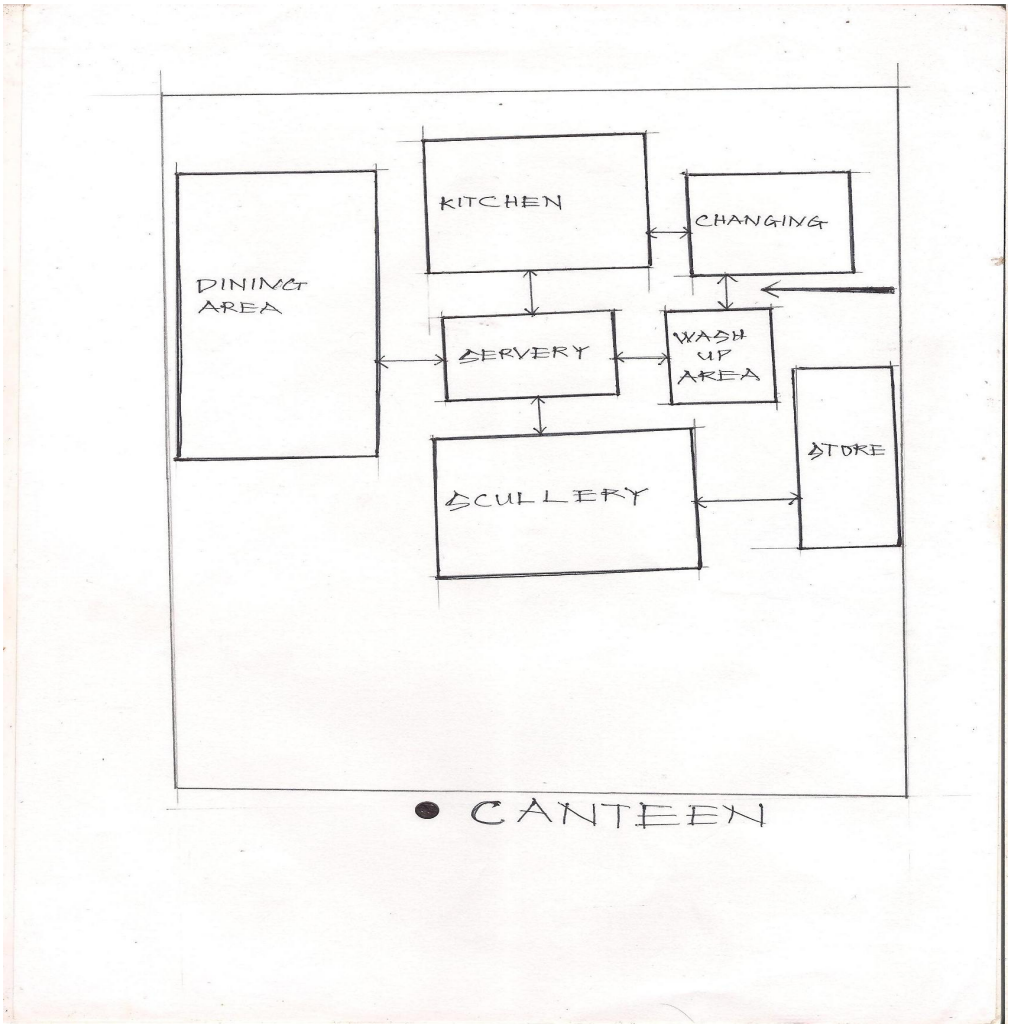


Fig 7.6 Canteen **Source;** Author (2009)

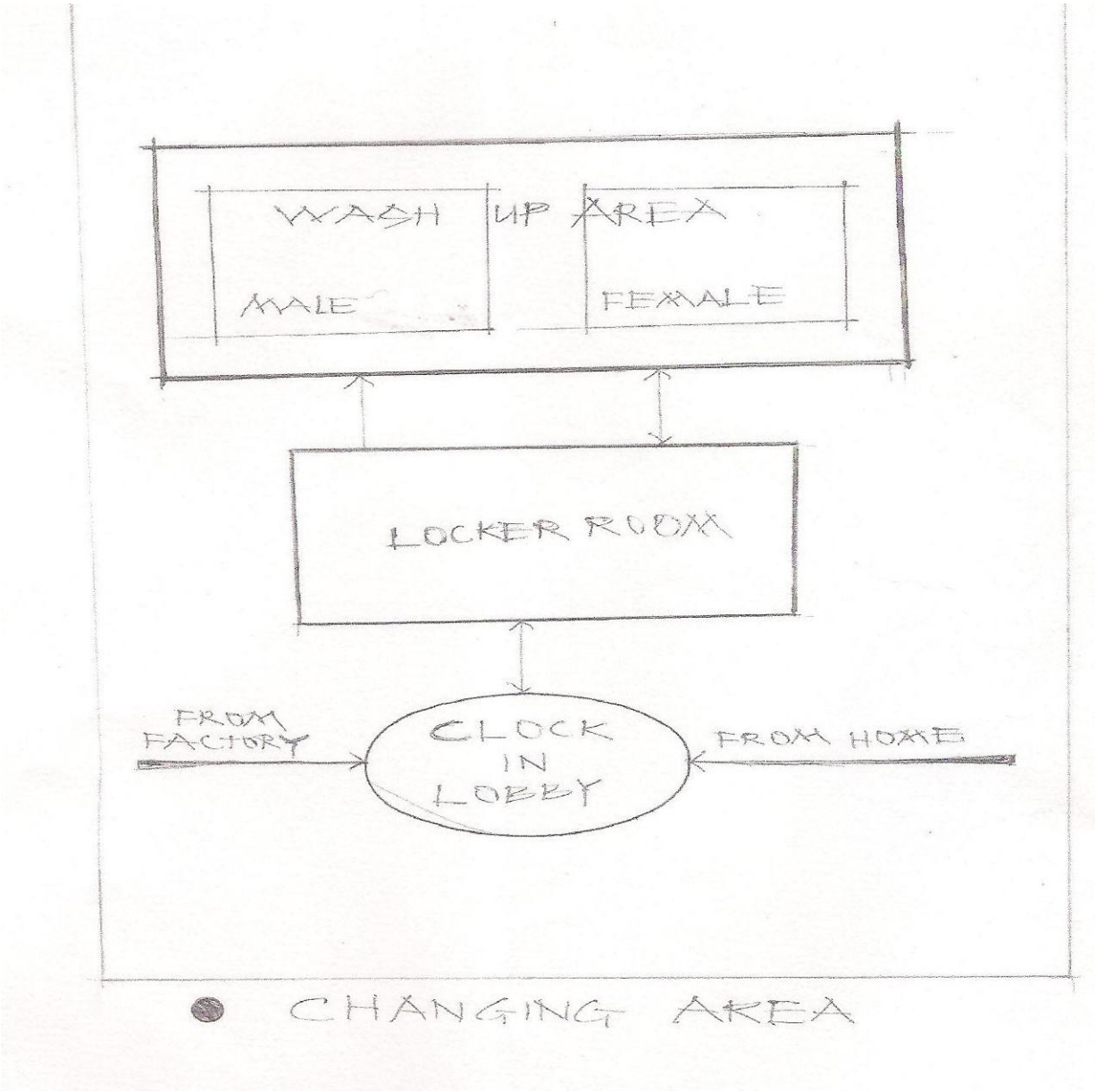


Fig 7.7 Changing Area **Source;** Author (2009)

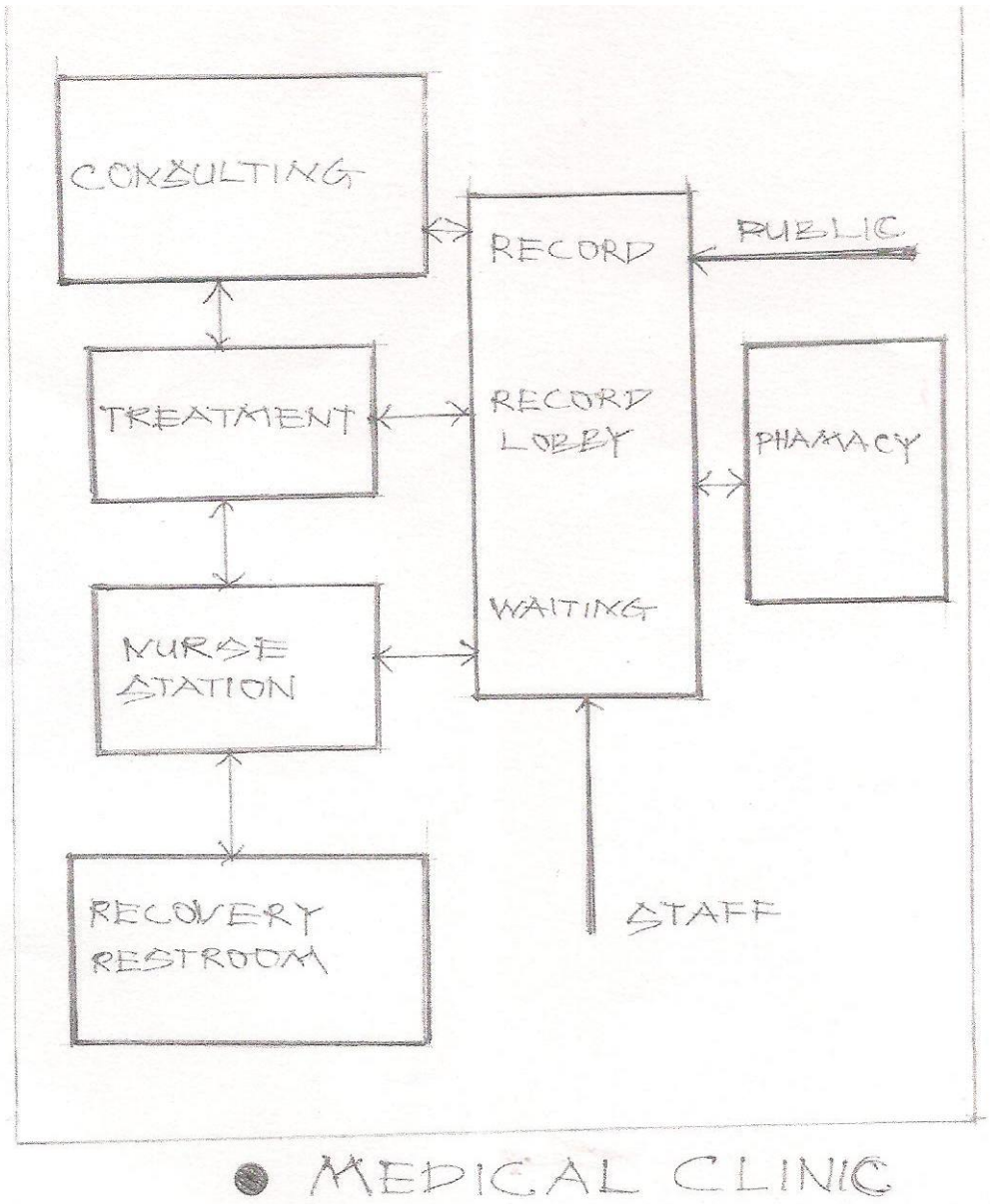


Fig 7.8 Medical Clinic **Source;** Author (2009)

The recreation rooms will afford the workers an opportunity of relaxation during break. This will certainly reduce the boredom that could arise due to monotony of the automatic system of production and also act as relief to the effect of heat produced during production. The games likely to be provided for include among others, table tennis, cards, scrambles, monopoly, etc.

Provision will be made for a medical unit for prompt medical attention to minor accident cases and staff. But all complicated medical cases must be referred to nnamdi azikiwe teaching hospital, umunya very close to the company.

7.4.3 Production Area

This is the core of the design. It will house the machines and will cater for all aspects of the production process. It should be located very near the power supply for economy in piping and insulation.

The plan and section will follow strictly the flow diagram on the manufacturing process. Provision will be made for the following spaces:

- Production hall
- Stores for both raw materials and finished products
- Offices

- Changing rooms
- Laundry
- Toilets.

For details of the components, check accommodation schedule or space allocation.

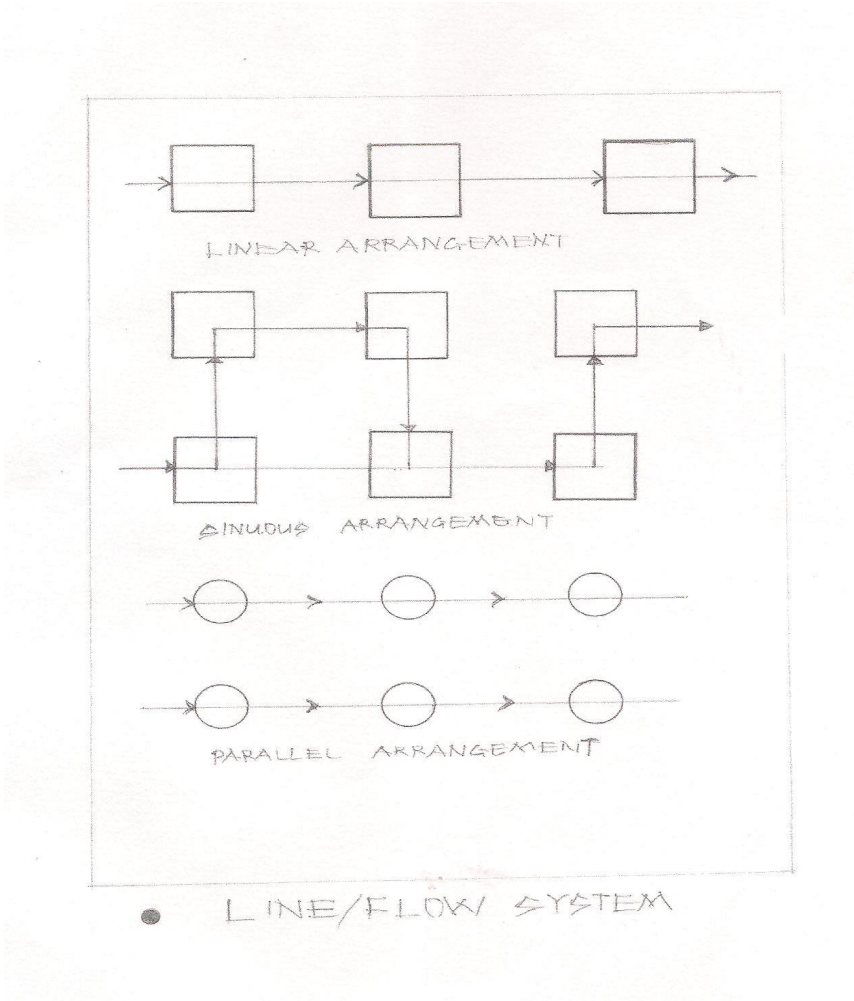


Fig 7.9 Line/Flow System **Source;** Author (2009)

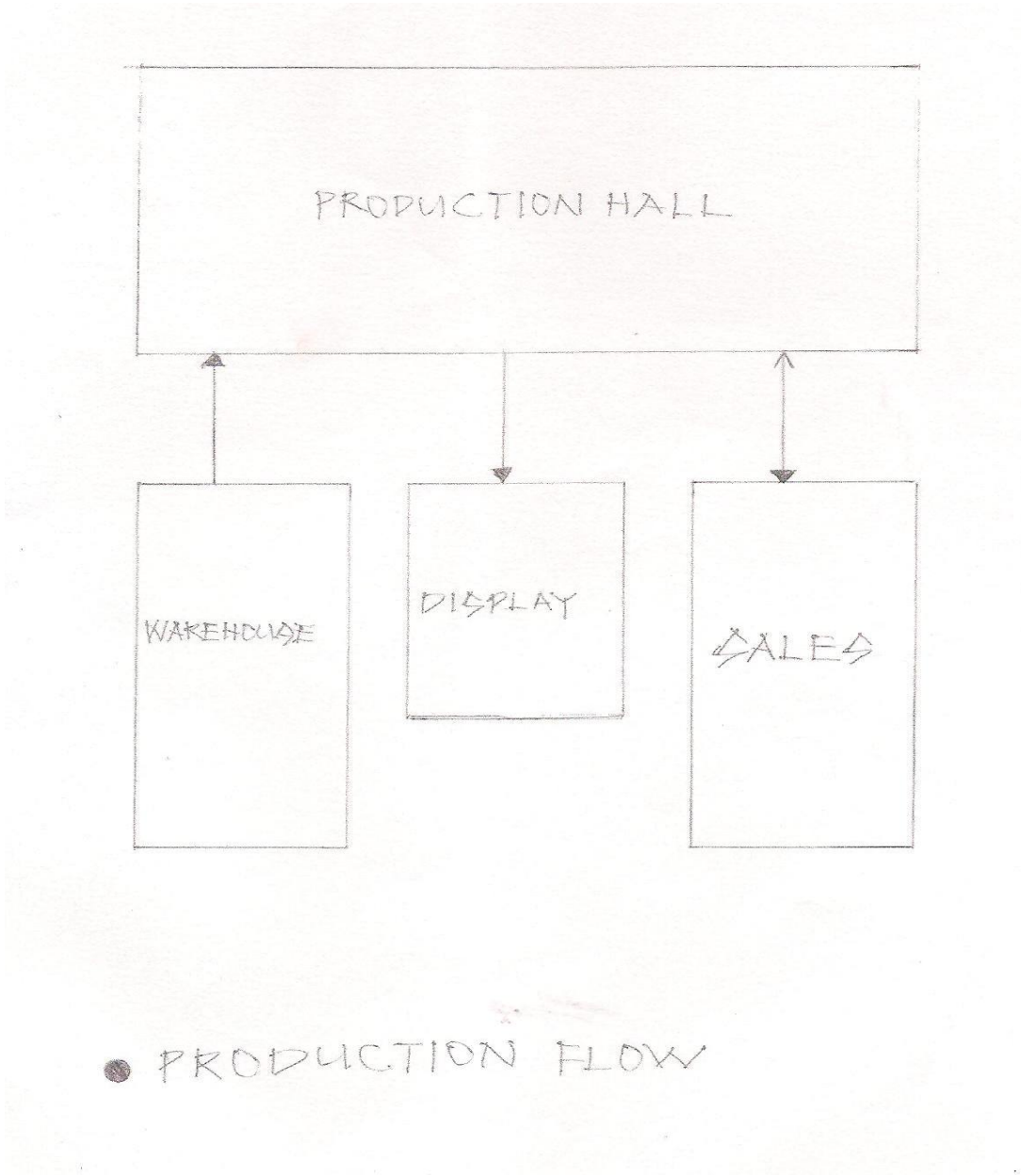


Fig 7.10 Production Flow **Source;** Author (2009)

7.4.4 Repairs and Maintenance Workshop

This will cater for the repairs and maintenance of plant equipment and vehicles. Spaces included here are:

- Mechanical workshop
- Electrical workshop
- Carpentry workshop
- Offices
- Changing room
- Stores
- Toilets.

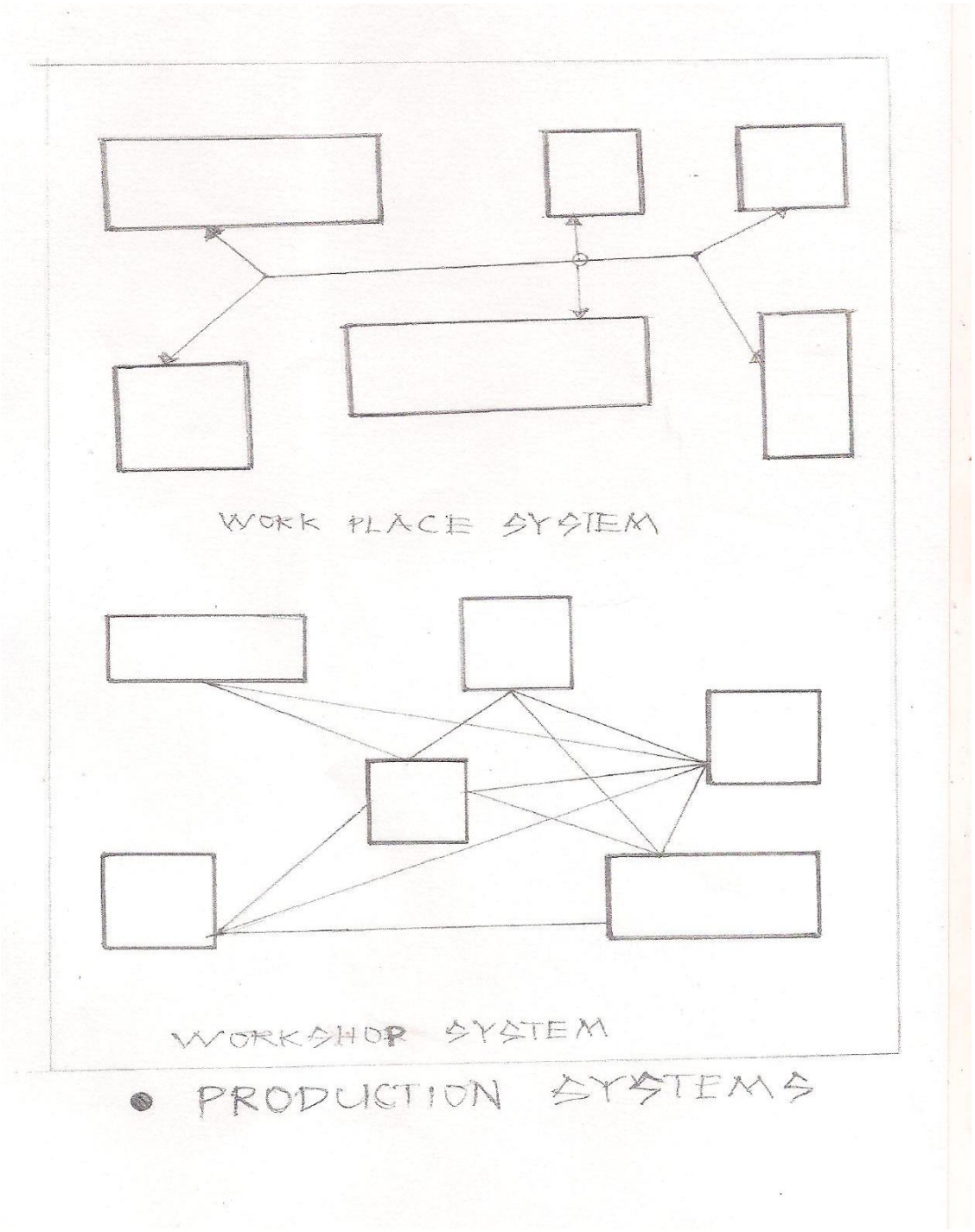


Fig 7.11 Production System **Source;** Author (2009)

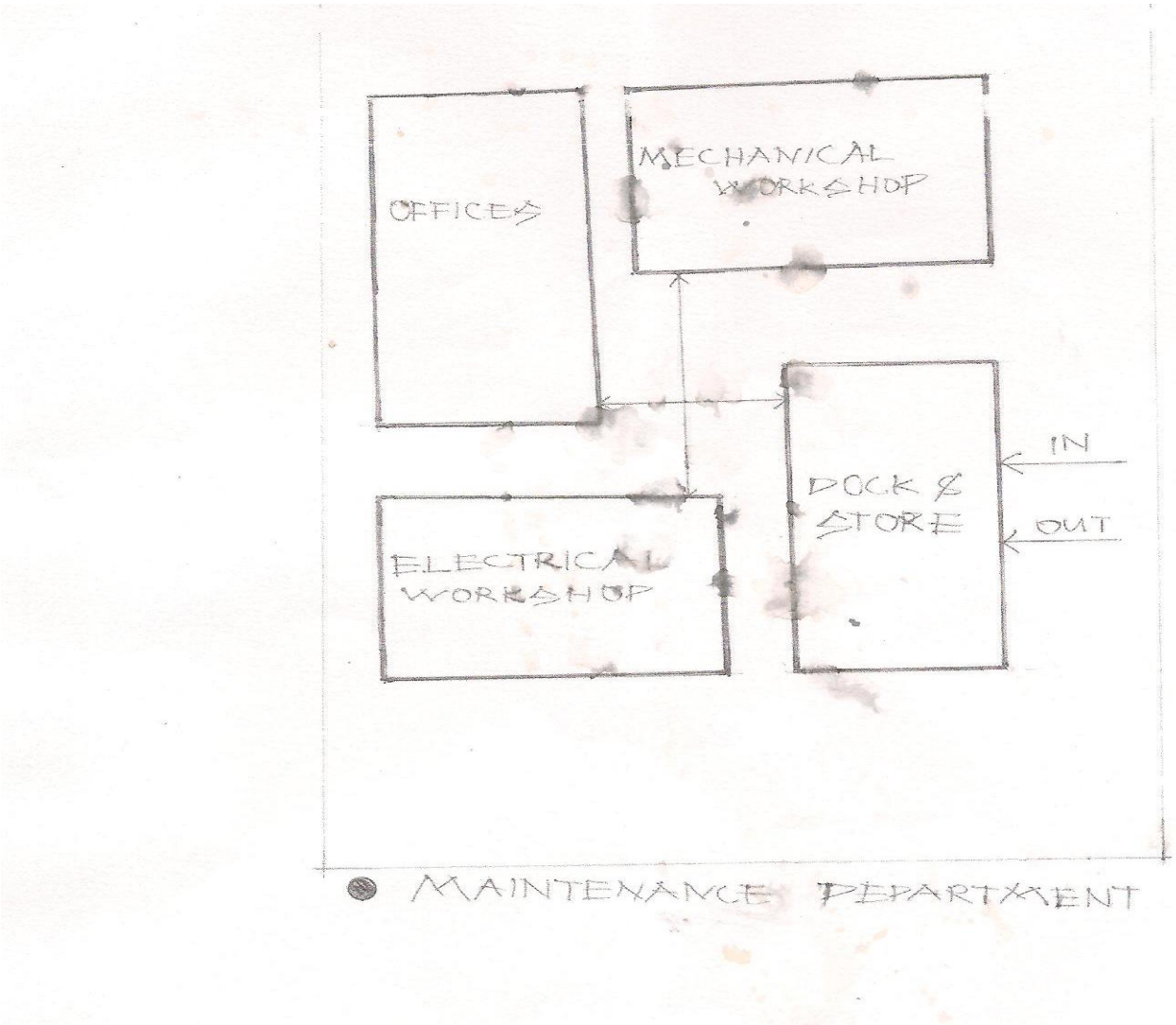


Fig 7.12 Maintenance Department **Source;** Author (2009)

7.4.5 Parking Spaces

Provision will be made for staff, visitors' and customers' parking. There will be car, motor cycle and bus parking spaces. Trucks and Lorries will also be provided for, but mostly near the production area.

The number of parking spaces will be determined by assuming that every senior or executive staff is entitled to a car. For every other 25 staff, a car space will be provided. Consideration will also be given to the number of company vehicles and their various uses. It is also being assumed that at pick hours, not more than 10 visitor's vehicles and 20 customer's cares will be parked at the site.

The number of motor cycle parking spaces will depend on the number of junior staff and labourers with few provision for the public. A total of 30 car parking spaces will therefore be provided for future expansion.

7.5 EXPANSION

The expansion will be in two ways – adding machines to the existing ones in order to step-up production and building entirely new factory. To this and, enough floor area will be provided to fit in more machines. Moreover, a portion of land will be earmarked for the construction of another factory unit.

7.6 ORGANIZATION OF PERSONNEL

The personnel here are mainly those working in the production area. People who work here should have good or sound knowledge of baking process.

The Production Manager: Will be responsible for all the production of the bakery, the efficient operation of the plant, the quality of the product, the economic use of labour and development of new lines in the production.

Assistant Production Manager: Will assist the production manager in the day to day activities of the factory.

Quality Control Manager: Will be a food technologist or a chemist. He will be responsible for the quality and chemical content of the goods baked.

Foreman/Supervisor: He will be responsible to the production manager for all the work done during his shift.

Dough Maker: Makes regular dough by proper weighing, shifting, and blending of flour correct sealing of all ingredients, flour, yeast, salt, water improvers, etc.

Assistant Dough Maker: Gives assistance to the dough maker.

Flour Runner: He keeps the flour blender supplied with necessary flour from the lofts in accordance with the production manager's instruction.

Divider Man: He controls the feeding of the dough into the divider and see that it is working accordingly.

Final Prover Feeder: The proper timing of the dough results in good shape and appearance.

Oven Cleaner: Responsible for the cleaning of the entire oven.

Bakers and Table Handlers: These are workers mainly engaged in the operation of moulding, sealing and handling of dough or feeding an oven or clearing the oven of full or empty pans.

Oven Man: Mainly concerned with the operation of peal or draw plate oven or certain type of travelling ovens where various types of products are being baked.

Store Keeper: Takes care of the warehouse or stores and keeps record of the inventory.

Salesmen: Are responsible for the sale of the finished goods. They are directly under the supervision of the sales manager.

Advertising Manager: See to the wide publicity of the company's products.

Personnel Officer: Is responsible for the recruitment and welfare of the staff, keeping personnel records and training of new apprentices.

Economic Adviser: Studies the market situation and offers expertise advise to the company. He may decide that the company should increase or reduce production rate.

Legal Adviser: Takes and advises the company on all legal matters.

7.7 SPACE SCHEDULE/ ALLOCATION

The following assumptions will be sued to calculate the area of each space required in this project.

Offices	-	10 – 12m^2 per person (10 – 12m^2/p)
Board room and Union hall	-	1.5m^2/p
Dining	-	1.2 – 1.5m^2/p
Kitchen	-	50% of total area of dining
Changing rooms	-	2.0 – 2.5m^2/p
Toilets	-	0.3m^2/p
Locker	-	1.5m^2/p

Library, laboratory and medical unit will depend on the number of users. The size of the production area will depend on the capacity of the factory, whether raw materials will be stored for a long period and also the quantity of finished products to be stored and for how long.

Below are list of spaces/function to be provided for in the design.

(a) Administration

General Manager (G.M.)

Secretary/Waiting

Assistant General Manager (AGM)

Secretary/Waiting

Conference/Board room

Personnel Manager

Public Relation Officer

Advertising Manger

Economic Adviser

Legal Adviser

Secretary/Typists (2)

Chief Accountant

Account's Clerks (2)

Sales Manager

Chief Security Officer

Assistant Security Officer

General Office

Showroom/Sales Room

Snack Bar

Wholesale Room

Stationary Store

Changing Rooms

Toilets

(b) Staff Amenities

Dining Room

Kitchen

Union Hall

Union President

Secretary/Typist

Medical Unit

Stores (4)

Changing Rooms

Toilets

(c) Production unit

Production Hall

Raw Material Store without Flour

Flour Store or Warehouse

Store for Finished Goods

Store for Condemned Goods

Pans Store

Condemned Loaves and Confectionary Conversion Plant Area

Production Manager

Assistant Production Manager

Master Bakers (6)

Foremen/Supervisors (4)

Pans Washing Room

Dispatch Area

Lounge

Changing Rooms

Lockers

Toilets

(d) Research Unit/Training School

Quality Control Manager

Research Officers (3)

Laboratory

Library

Librarian

School Co-ordinator

Classrooms (2)

Stores

Changing Rooms

Toilets

(e) Repairs and Maintenance Workshops

Engineers (2)

Mechanical Workshop

Electrical Workshop

Carpentry Workshop

Stores

Changing Rooms

Toilets

(f) Utilities/Services

Standby Generator

Boiler

Chiler

Compressor

Fire Protection Room

Water Treatment Room

Total area for the officers – 650m^2 using the assumption 10m^2/p.

7.8 CONSTRUCTION AND CHOICE OF MATERIALS

The proposed bakery could be divided into two main groups of buildings. These are the industrial buildings comprising the administration, staff amenities, research unit and the training school buildings.

The choice of materials and construction will be briefly discussed under these headings: floor, walls and roofs. Choice of materials is guided, among other factors by the availability, durability, and cheapness of the materials.

(a) Foundation

The soil is good. It is a laterite with enough bearing capacity to withstand the load of the buildings. However due to the flatness of the site, with resultant flood during the rainy seasons, it is advisable that the foundation be strong enough to resist the effect of expansion and shrinkage of the soil.

Thus, the industrial buildings will be erected with steel or concrete structures. The buildings will be long spanned. Steel stanchions carry al the loads. Pad foundation made of reinforced concrete will be used to connect the stanchions.

The steel will be protected using plaster casings. Plaster casings has excellent fire protection and sufficient mechanical strength against all but the hardest knocks. Regular painting and the use of concrete to cover the steel members where possible will reduce corrosion.

The service buildings will be erected of concrete structures with reinforced concrete columns and beams bearing and transferring loads. Normal strip foundation will be used for single storey structures while reinforced strip foundations will be used for two storey buildings.