COCOA PROCESSING INDUSTRY IBADAN

BY

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(B.Sc(Hons) ARCH.. A.B.LI.)

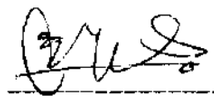
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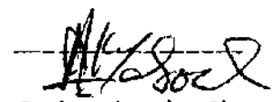
JULY 1998.

DECLARATION

I. OYELEKE, GABRIEL ADEBAYO of the Department of Architecture, Faculty of Environmental Design, A. B. U., Zaria, hereby declare that this thesis work has been a personal academic undertaking executed by me and that all quotations and information utilized and their sources have been fully acknowledged by means of references.



Student's Sign



Supervisor's Sign

Head of Dept's sign

CERTIFICATION

This thesis entitled' COCOA PROCESSING INDUSTRY IBADAN (Architectural Solutions to Hygiene Problems in Food Processing Industries); meets the regulation governing the award of the degree of masters of science in Architecture (M. Sc. Arch) of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary Presentation.

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Chairman, Supervisory Committee	Date
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Member, Supervisory Committee	Date
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Member, Supervisory Committee	Date
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Head of Department	Date
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Dean, Post Graduate Schol	Date.

DEDICATION

This thesis is dedicated to my deceased parents, Mr & Mrs J. O. Oyeleke, to God, the Almighty Father who created all things and spared my life; and also to the Lord Jesus Christ who saw me with his grace through this course, praise be to his name!

ACKNOWLEDGEMENT

Several people have in various ways contributed in no small way to the success of this thesis report, it is true that all names cannot be listed, I am thanking you all.

The priceless advices and critics of Prof. H. T. Saad, Arc. Mas'ud Abdulkasim, Head of Department, my supervisor Arc. A. K. Yeboah and that of others are all appreciated.

ABSTRACT

All food processing industries including that of cocoa require hygienic environments to enable them to perform excellently well: the site, the buildings and all the personnel connected with the processing of cocoa should therefore be of sound hygiene.

Although it is the practice of many industrialists who own these industries to ignore the human values of their wotkers (i.e: psychological and physical needs so as to maximize profits technically, and financially), yet these industrialist forgot that these gains could not be realised if the basic problems remained unsolved.

The existing situations of the sites visited were that buildings were erected randomly, without proper planning and orientation. In some cases, workers' facilities were inadequate, while in others, it was the obstruction of both vehicular and pedestrian movements.

Open spaces which are part of the comprehensive development were used as storage for both raw and finished products thereby the whole place looked more of an eye sore than a normal industrial process.

One needs to take a visit to most of the industries to see for himself their deteriorating hygienic conditions: atmospheric pollution, rodents/insects infestation, poor drainage, etc, the architect has a great role to play in ensuring that his design is hygiene-oriented by properly zoning the various activities that take place within the factory.

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CHAPTER ONE

1.0 INTRODUCTION

The importance of cocoa and other cash crops as main source of revenue for this nation before the discovery of crude oil cannot be over - emphasized. The Nigerian cocoa used to be exported to Canada, United States of America, Japan, the United Kingdom and the other Western European countries. What Nigeria got back as an exchange was in the form of manufactured goods which when critically examined was found to be of the same standard with, or of lower standard to those locally made. The challenge then arose that if this nation's wealth must be conserved, jobs provided for the teeming young school leavers and abundant food provided for the people, the industries that manufacture these goods must be set up locally.

During the cocoa boom days, the development that was attained from the revenue accrued must be mentioned. One of them was the Cocoa House. The edifice which was regarded as the tallest building in West Africa still stands today towering over other buildings in the heart of Ibadan. It helped the local farmers who grew cocoa to earn their living and placed Nigeria second after Ghana in the list of 'Who is Who' of the countries that grew Cocoa in West Africa. It is a glaring truth that the revenue that was earned from Cocoa and other commodities fast disappeared due to mass importation of commodities no mater whether they were essential or not. Now that the 'oil boom' days are over, the Federal Government placed a total ban on the exportation of the Nigerian raw cocoa. This was one of the steps taken to ensure that the nation could attain industrial growth if the raw materials were properly taken care of.

Although the oil boom era isn't long behind us, industries can give another boom if proper and adequate steps are taken to ensure that non-contaminated goods are provided for consumers. This could be realised if the workers are hygienic. One needs to go round our industries and see the condition under which the workers are performing. How then could good hygiene of the workers of our industries be realised through architectural design? This is the intention of this design.

1.1 Aim and Objectives

Some points to bear in mind are:

- The practice of good hygiene should be mandatory for all workers in our industries especially those in the cocoa processing.
- To make sure that workers safety is mandatory for all industrialists who own them (i.e all the industrial buildings).
- To ensure that the environment and the equipment are always improved upon.
- To ensure that all the industries put up meet the international standard set up by the advanced industrial community.
- To ensure that steady means of foreign exchange earning is encouraged.

1.2 Design Scope

The thesis will include the setting up of an industrial set-up comprising:-

i. An administration building
ii The production hall
iii Worker wing
iv Gate House
v Car park
vi Lorry park
vii Water tanks (overhead and underground)
viii Generator House

ix Broiler House

x Silos

xi Open storage.

1.3 Site: Ibadan, Oyo State

Client: Oyo State Government

Users: Cocoa farmers in particular and the Nigerian Community in general

Methodology: Existing set-up and literature review.

Limitations

The amount of information allowed out of the existing industries as case studies dictated the extent of the design but the international standard met. These industries did not permit their staff to release any information to any prospective designers who, in their opinion, may use such information to set up a rival improved industry and then push them out of business. Firstly, standard spaces would be created for the machines, then conducive environment for the workers and circulation comfort of the customers and the goods.

1.4 A Factory

What this project is all about is clearly defined, only when the function of an industry is totally known. Then the question may be asked, what is a factory? The answer is not far fetched. It is an organised space where the materials and energy are brought together in order to produce certain end- products (Are 1974).

1.5 Cocoa Industry

During the 1997 Agric show, the Administrator of Oyo state lamented over the over-production or (under-utilisation) of industrial raw materials in his state. These, according to

him, were the only source of revenue to the local farmers who produce them. It is lamentable that cocoa happened to be one of these raw materials under-utilised. No wonder a three or four-year old cocoa beans were found in the store of one of the producing factories due to under - utilisation!.

This is where the plan to set up a cocoa industry was hatched. If the over produced cocoa was converted, there would be a steady source of earning for the local farmers who produce them, the industries that process them and food for those that consume them. As a matter of fact, cocoa thrives well only in developing countries due to their location within the tropics of Cancer and Capricorn. Then the developed countries buy the cocoa, process and sell them. If the analysis is broken down further, it shows that it is the countries of Nigeria, Ghana, Brazil, Cameroon and Ivory Coast that produce about 80% of the world's cocoa output. It is lamentable that only 30% of Nigeria's total output, is used locally and the remainder exported. The best way out of the present shortage of food supply is to establish more industrial projects that can convert the raw materials into food. Fig 1.1 shows cocoa producing area of Nigeria.

1.6 WHAT IS COCOA?

Before we know the product of this proposed industry, we must know that Cocoa is. It is the fruit of the tree otherwise known as COCOA' and which is used for both the plant and the friot. Cocoa then is the botanical name of the tree, the pods and also the seed i.e; the infermented beans contained in the pod. But Cocoa is the name always used the manufactured goods being the product of the raw material cocoa. They indlude the powder sold as beverages and other food drinks. Recently it is used to describe the bulk of the beans that are yet to be fermented.

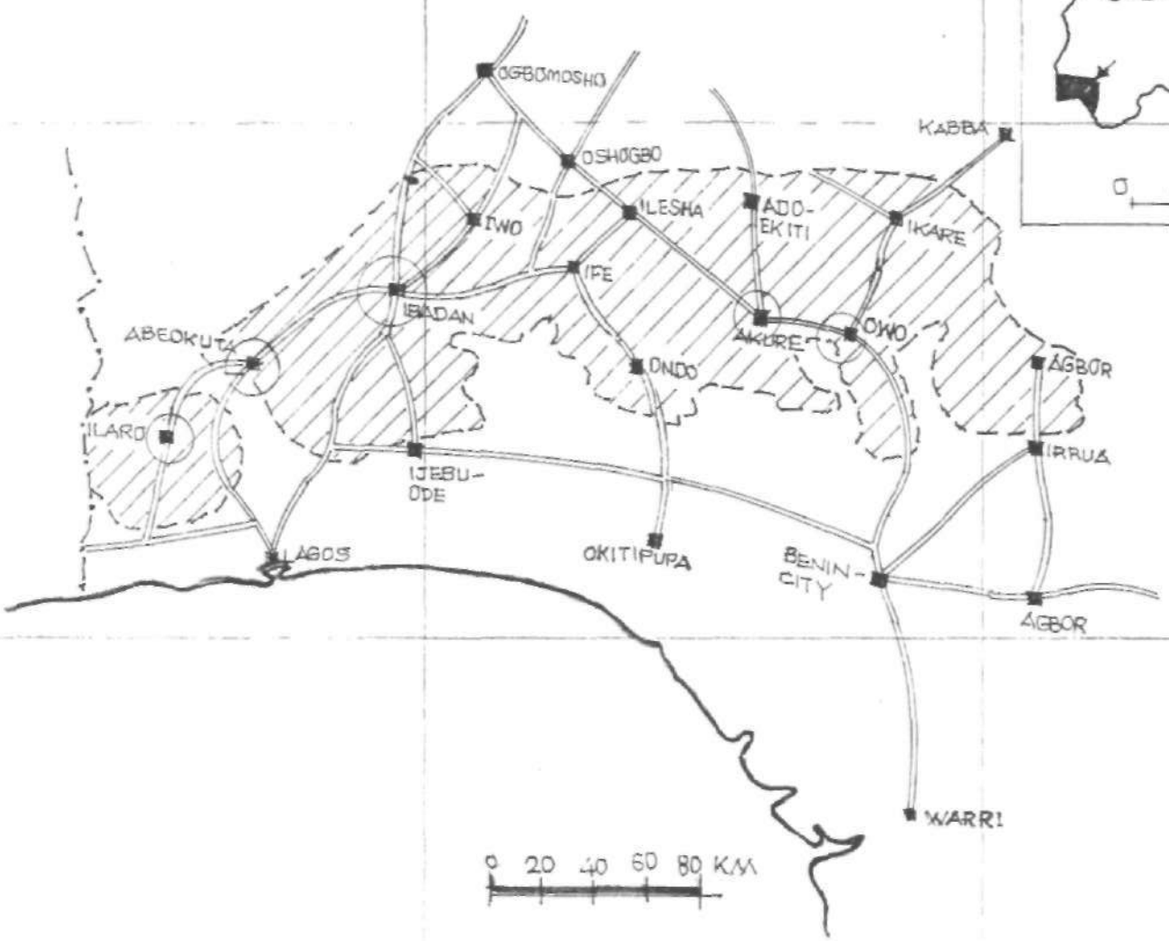


Fig.1.1 THE COCOA PRODUCING AREA OF NIGERIA. (Are, 1974)

The type of cocoa that are of commercial value are the seeds of the specie theobrama cacao L. This also has about thwenty species of small trees and bushes. Fig 1.2.1.3, and 1.4 show the cocoa tree, flowers and yong pods; and section of cacao pod. The only type that is of commercial value is T. Cacao. It also has two main groups, which are :

(i) "Criollo" C. Cocoa- the seed has no colour.

(ii) "Forastero" C. Cocoa - this specie has the seed that is purple cotyledon; although there is the third type which is a breed of the two types earlier mentioned - it is called "Trinitario".

Forastero constitutes about 85% of the commercial type, 5% is the Trinitario and Criollo is rated for 2% - 2 1 2%. The tree is of a height of between 5-8 metres. When young, it is necessary to give it shade by larger trees i.e the plantain. After a period of a year, the seedling attains a height of 1-2.5 metres, then, it forms about 4-6 branches.

The flowers are about 1.5 centimetres formed in small groups on the trunk and on the lower main branches as well. These flowers which are bisexual have their agent of pollination from the specie 'Cero topogonedae' - this is a very small midge. Although initially many flowers are produced but pollination reaches a few - the rest wilt and drop off when they were of the age of between 6-7.5 months.

The pod is a berry of about 10-20 cm long and 8-10 cm diameter .Averagely, it contains 18 to 42 seeds which are surrounded by a mucilaginous pulp by the time the pod is fully ripe. The process of harresting is plucking because the pods don't open or scatter. Nigerian farmers first know about Cocoa around the year 1874. It was alleged that a handful of pods were brought by some Nigerian labourers and African slaves returning home from



Fig. 1.2 DRAWING OF CACAO TREE SHOWING PODS ON TRUNKS AND BRANCHES.

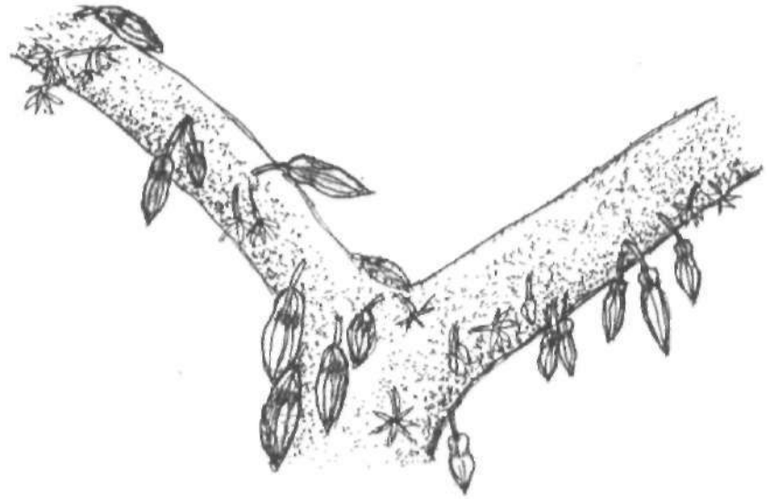


Fig. 1.3 FLOWERS AND YOUNG PODS ON TRUNKS OF CACAO TREE.

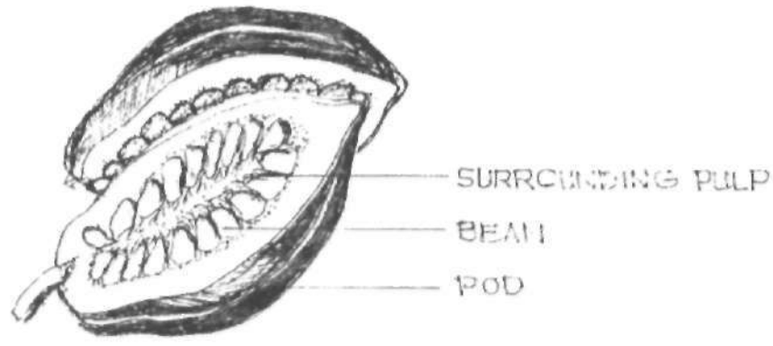


Fig. 1.4 DRAWING OF SECTION OF CACAO POD SHOWING BEANS & SURROUNDING PULP.

Fernando Po. One Chief Squiss Ibaningo, according to records planted the seeds at Bonny in the year 1874. Expansion was due to plantations organised by the Royal Niger Company at Asaba and other riversides of Onitsha around 1887 and 1898. Later on, the government took over these estates and converteddd them into agricultural centres so that the distribution of cocoa could be possible (Are 1974).

Many of the early plantations were said to have failed because there were no buyers of the fruit and the famers had to cut them off so that they could grow the famous crops. Included also was the problem of being ignorant of what tree cocoa was, i.e: the type of soil that supports its growth, the problem of growing it economically and so also how it could be consumed locally. The Nigerian farmer was then left to solve these problems alone since there was no Agricultural departments. By the end of the 19th century, 'cacao' spread to the Yoruba area - this is around Ibadan of the Western Region. Early products were chocolate and milk chocolate. They were the product of the Swiss industrialists who bought raw cocoa and used them for these products. Other companies include Cadbury Schweppes, Fry and Rowntree of Britain and also Nestle and Peters of Switzerland. Later on there was the increase in the order placed by these companies on the purchase of Cocoa.

In order to boost the farmers' morale of growing more cocoa so as to meet the demand, a company named Messrs Patterson Cochonis & Co. Which was based at Ibadan around 1895 was alleged to be paying farmers fives pounds no mater the quantity of Cocoa to be sold and in addition a piece of Velvet plust two other pieces of 'Craydon'. Clothes (Are 1974).

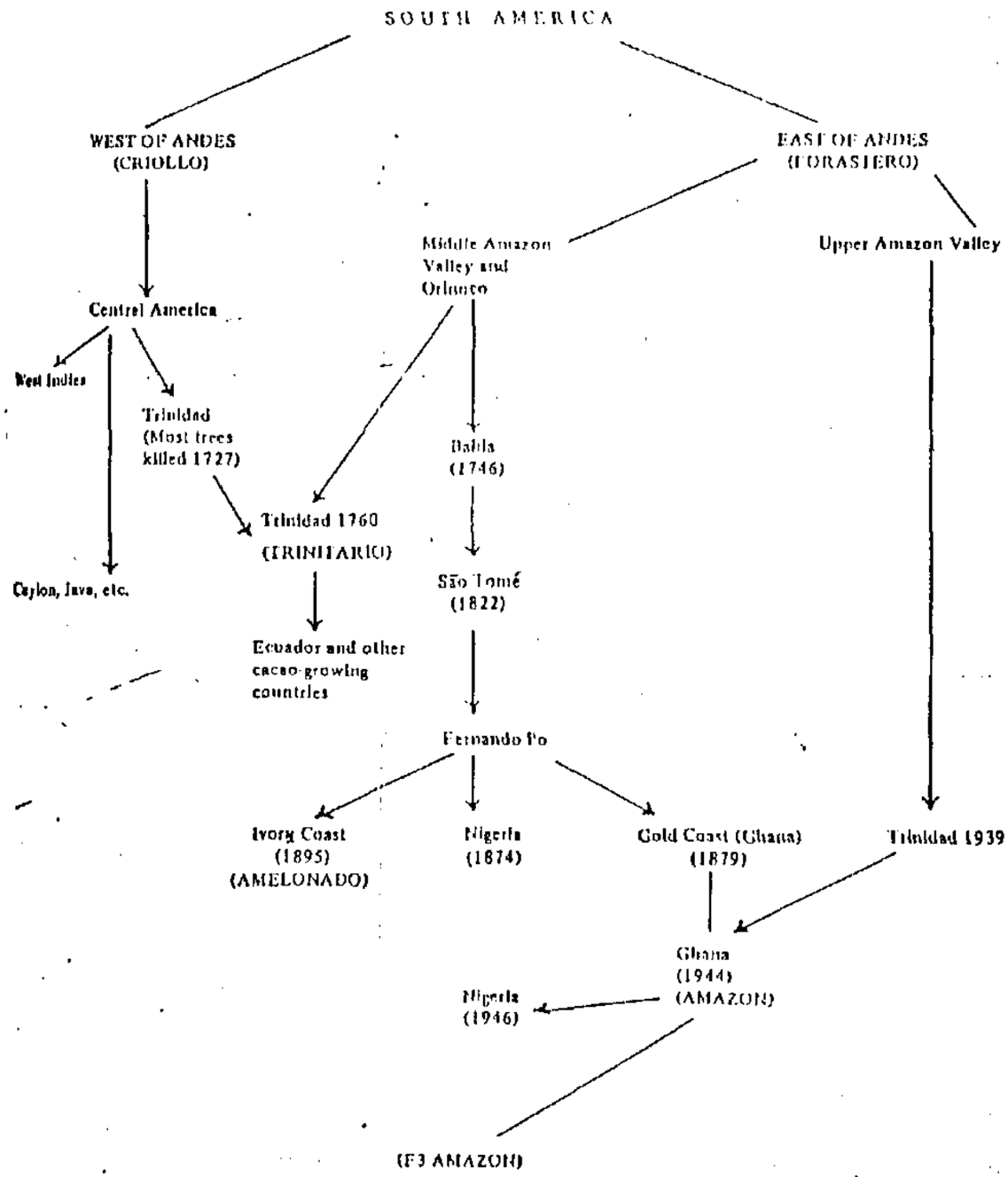


Fig 1.5 COCOA PRODUCING DIAGRAM & COUNTRIES OF ORIGIN

Table 1

Distinguishign Characters of Different Types of Cocoa

Distinguishing Characters	Cocoa Types		
	Criollo	Amazonian Forasteros	Trinitario
Fruit Colour Unripe	Red, green	Green	Red or purple
Ripe	Yello, orange	Yello	Orange
Apex	Conspicuous	Round ended but with small definite point	
Bottleneck	Distinct		
Pod surface	Warty, conspicously furrowed	Inconspicuously furrowed, not warty. Thick and woody	Hybrid swarm of Forastero
Fruit wall	Thin, easy to cut	Thick and woody	Criollo stocks. Quite heterogenous
Seeds	Plump	Flat	
Cotyledons	White or pale vilet	Dark purple	

(Arc. 1971)

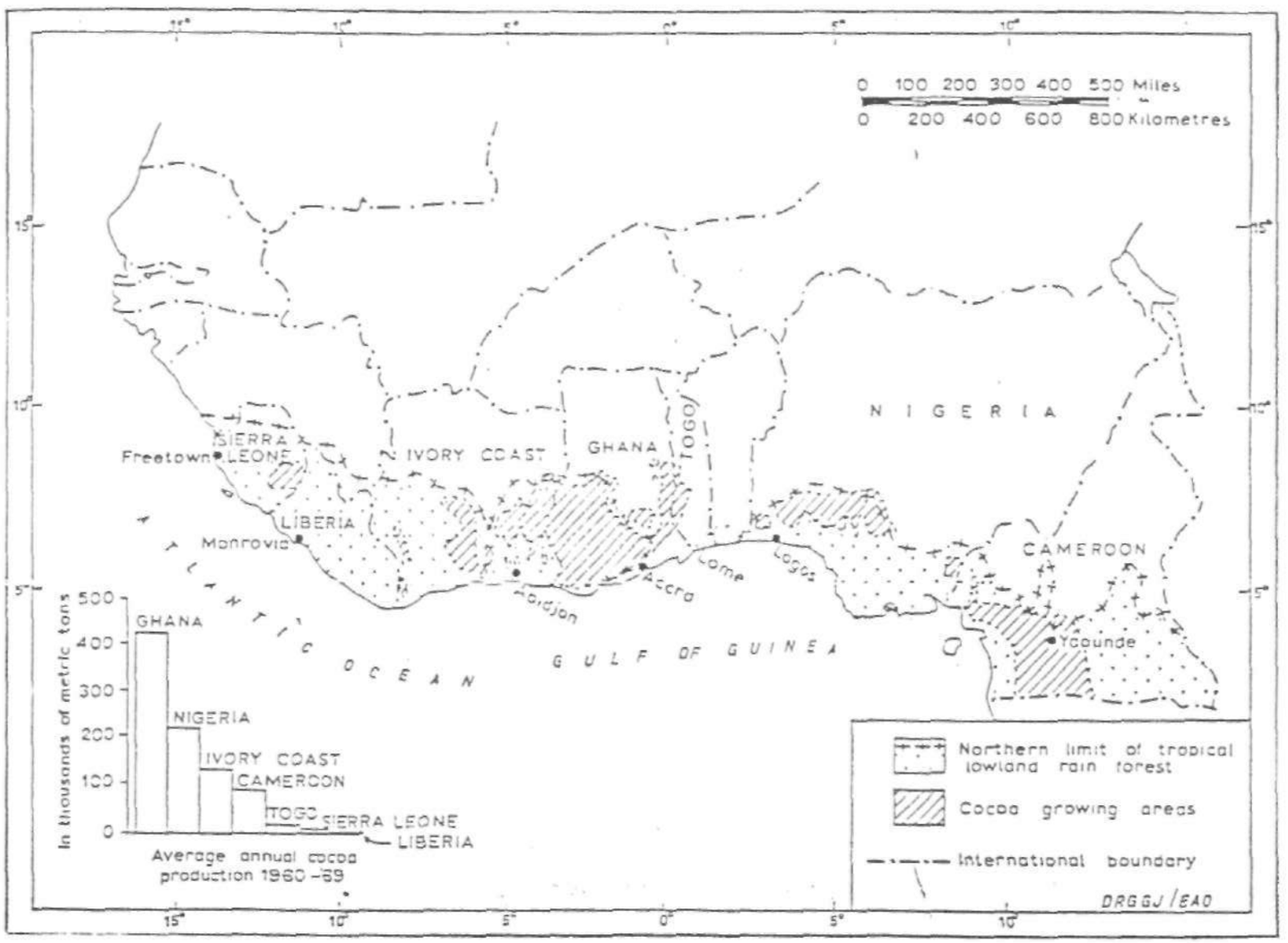
Cocoa production i.e. growing and processing of its fruits in Nigeria was a sort of family business. A farmer is assisted by his sons. During the harvesting, it is the farmer himself who does the harvesting of the pods. Extra care was taken to make sure that the tree stems were not damaged. The pods are now carried to a central breaking point, it is the children who do these. The pods are broken here, the seeds are removed and fermented. The women now participate in this and they help in carrying the dried beans to the buying stations. Hired carriers were paid for large quantity because of the distance from the farm to the buying station.

Because of the incentive, cocoa became famous within a short period in the western part of the country. In the eastern part of the country around Ikom, it was also tried by the then Eastern Nigeria Development Corporation, planting about 3,327h (8,000 acres). The exportation of processed cocoa beans started in Nifgeria around 1890 with 304 kilograms but it had reached 21.3 metric tons by the year 1895 (Are 1974). It rose sharply around 1960 when Nigeria was number two on the producers' list and now the quantity is around 200,000 metric tons annually. Nigerian farmers known for their 'trial and error' unorthodox methods of doing things earned fame for themselves for being relaible for the supply of the amount of cocoa needed by the importers. Although the support given by the government agents are commendable. Organisations like the Cocoa Research Institute of Nigeria (CRIN) and the Nigerian Cocoa Marketing Board (NCMB) played their own role.

These organisations carry out research on the cultivation, growth, and development i.e marketing of cocoa. These are achievements in the right direction, but there is still much to be done. Then the emphasis of this write-up is on the processing level even at the factory

level. This is in line with the federal government policy of processing all her raw materials locally before sending them into the world market. As earlier mentioned, the under-utilisation of cocoa beans or its over-production was as a result of low prices offered by the countries that import them. It is surprising that going by Nigeria's level of development, there are only three processing industries in the country. The government has therefore shown her concern in this trend and has placed a ban on the exportation of all her raw materials. This has brought relief from exploitation and low price for the commodity. What the existing processing centres produce are commodities like Cocoa Powder, Cocoa Cake and Cocoa Butter. The cocoa food manufacturing companies of Food Specialities Limited, Cocoa Industries Limited and Cadbury Nigeria Limited buy these processed commodities and use them to produce products like Bournvita which is a wet cocoa mix and Vitalo which is a dry Cocoa mix just to mention a few. Some problems facing the cocoa industry as at moment include (i) insect attack (ii) diseases (iii) rodent attach (iv) low price on the finished products. All these, coupled with lack of agricultural loan lead to limitations on the expansion of Cocoa industry. It is now reasonable to expect that once all these are overcome there will be an automatic success in the cocoa industry (processing/manufacturing). Fig. 1.5 shows the countries of West Africa that grow cocoa.

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1.6

Fig. 1.6 MAP SHOWING THE COUNTRIES OF WEST AFRICA THAT GROW COCOA.

When the seed has been weaned from the nursery stage, it is transplanted at about 2m - 2.5m spacing. Great attention is required in the early stage of the tree against weeds and pests. A tree that receives the normal care should commence fruit bearings as from the age of three years and fruit bearing lasts to a period of nine to ten years producing an average of 25-35 pods annually. If fermented, and dried, it weights 2 lbs in for example West Africa, but in other regions like Papua and New Guinea it weights about 7 lbs. This means that if the average production per year per acre in Nigeria weight 200 lbs it can weigh at high as 700 lbs in New Guinea.

Harvesting lasts for a period of several months, because of the way the trees bear fruit i.e. the flowering, growing of pods and maturity of fruits occur simultaneously. This means that harvesting can occur on a tree that flowers and has maturing pods. After harvesting, the pods are carried to a central point where they are cut open, the beans are then removed and fermentation process takes place.

1.8 Diseases

The major notorious disease affecting the Cocoa tree are the black pods, the swollen shoot, witches broom and Moniala - these affect the shoots and roots. Mosaic is the disease associated with the leaf. To forestall and cure these diseases, insecticides must be used systematically. Also to be used is the copper fungicides which wits off the infected part and leads to breeding of resistant strains.

1.9 Pests

The most damaging pests of Cocoa tree are Capsids. They are about 1 centimetre long. They attack the young shoots and pods by injecting a poisonous saliva into them while

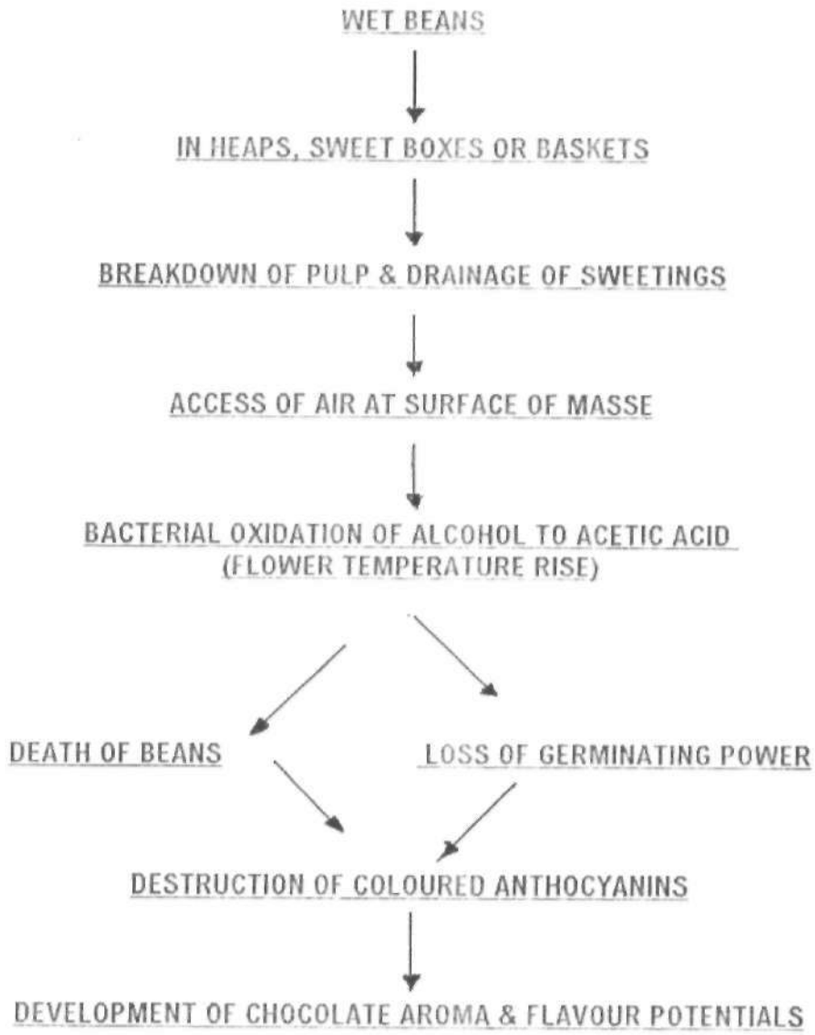


Fig. 1. 7 COCOA MASSE & CHOCOLATE PRODUCTION FLOW DIAGRAM.

they are feeding on the sap, therefore cause lesions to be affected by fungi and the shoots are killed. This is a continuous process whereby a tree affected weakens and finally dies. In order to control this, a spray known as BHC spray is sprayed by sprayers or engine machines.In the finer nib fractions, the germ is largely pods by injecting a poisonous saliva into them while they are feeding on the sap.

1.10 Fermentation and Drying

The process fermentation is by cutting the pods from the trees, transferring them to heaps, boxes or baskets for fermentation, which occurs by developing a temperature of between 32-50° C and lasts for about 5 - 6 days. While drying the beans, they must be mixed occasionally in order to aerate them. Dryness depend on the availability of sunshine, this is not a problem in West Africa because enough sunshine is available. But in other countries that grow cocoa and don't have sufficient sunshine, the beans are dried using dryers. What determines the development of good chocolate flavour is good fermentation, during, storage of the beans and of course, controlled process of manufacture. This is represented diagramtically:

CHAPTER TWO

2.1 PRODUCTION OF COCOA POWDER FROM COCOA BEANS

The details of cocoa powder production are as follows:

(i) Cleaning

The cleaning machine comprises of (a) series of brushes.

(ii) Roasting

It is the roasting that develops flavor and aroma. It also reduces the moisture content and loosens the shell so that removal of shell is easy during winnowing. Sufficient heat is supplied for a reasonable period of time so that removal of shell is easy during winnowing. Sufficient heat is supplied for a reasonable period of time so that steady penetration is achieved without burning the shell. All this is according to the type of beans and what the roasted bean is to be used for. In general, roasting time is between 20 to 75 minutes depending on the type of machine, the grade of flavor required and the size of the batch (See Fig. 2.1 for a typical batch roaster diagram and fig. 2.2 for the principle of air flow diagram).

(iii) Winnowing

Nib is the most valuable part of cocoa and the shell is a waste material which when completely separated from the nib is used as animal feed.

Nib - 87.10%

Shell - 12.00%

Germ - 0.90%

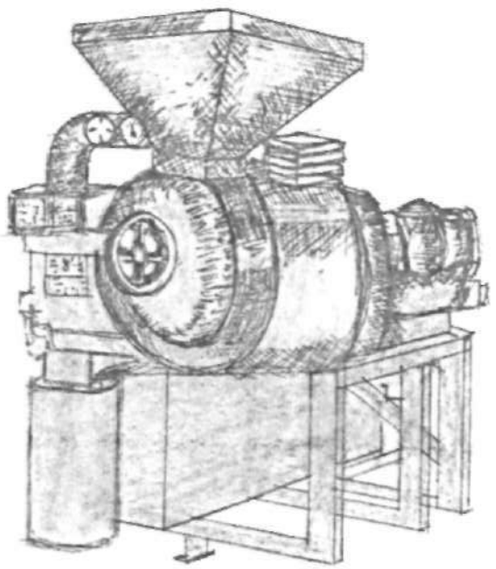


Fig. 2.1 A TYPICAL BATCH ROASTER
This is a typical batch roaster diagram which relies on the principle of drawing hot air through the cocoa beans, and reducing the risk of burning of the outer shell. This type of roaster may be heated by gas or oil burners or a coke furnace. In order to catch dust, cyclones are usually attached.

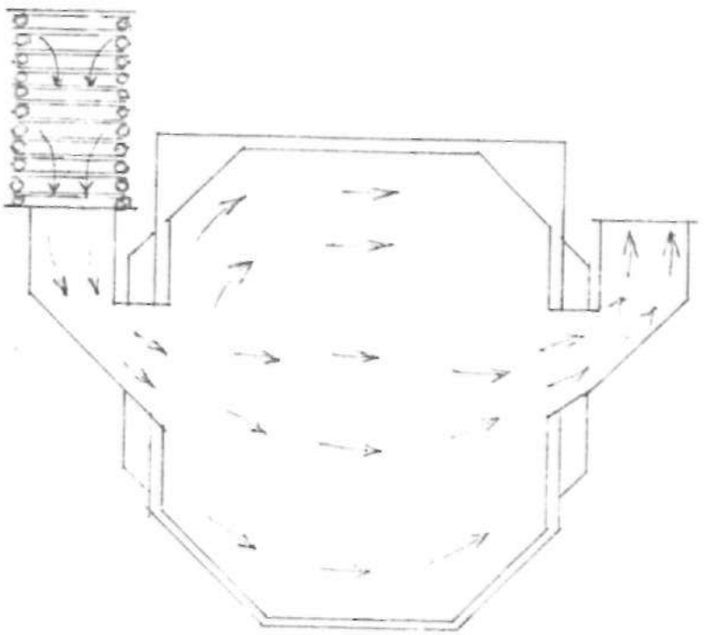


Fig. 2.2 DIAGRAM OF AIR FLOW

All these are obtained only if hand is used for the separation, machines never give them, due to the fact that fine particles are formed from the nib and also, there are shells that are not easy to be separated. Some points to note are that a bean rarely yields a nib that exceeds 82-83% no matter how large because shell will be up to 15% removed; both germ and shell are difficult to grind these are the sedimentations we see in cocoa drinks. The method of winnowing adopted depends on the density of shell and nib, which are normally separated by the combined action of sieves and air elutriation. The roasted beans are passed through toothed breaking rolls which crush them in order that it is only the large pieces of nib and shell that are produced with minimum dust.

The mixture then enters a rotating cylindrical sieve that has a graded mesh along its length. During rotation, mixtures of nibs and shells of varying particle sizes that correspond with the mesh diameter are discharged into a number of chutes which are arranged side by side. The discharged mixture of nib and shell now meets a flow of air in each chute and the shell is removed with some of the lighter dust. The large nibs practically free from shell are collected at one end of the system and large shells at the other. (See Fig. 2.3 for a diagram of the section through a winnowing machine).

(iv) Uses of Products of Winnowing

This is a breakdown of how the products of Winnowing are used: clean large nibs (the clean pure cotyledon of the beans) - used for best quality chocolate and cocoa drink.

Small nibs (mixed with large nibs) - used for 2nd grade chocolate drink but is often used in blends for expeller pressing for cocoa butter. Although nib dust is not suitable for use in chocolate drink manufacture yet it can be used in blends for expeller pressing for cocoa

butter. It has to be noted that shell dust is not good for human consumption, it can only be used for in blends for expeller pressing for cocoa butter. The large shell is used as a fertilizer because it contains nitrogen.

2.2 Cocoa Powder

The three main methods of cocoa powder production are:

(a) liquor Process (b) Dutch Process and (c) Extrusion/Dutch Process this is the detail of how they are made:

(I) Liquor Process:

This is a process whereby the nib is ground hot to a dark-brown fluid known as "liquor" or "mass". On cooling, the liquor settles and it could be yielded. Then the hydraulic pressing (before or after alkalization) influences cocoa butter content to be reduced from about 55% to 12 - 15%. The solid compressed mass is called "Cocoa Cake" it is ground and sieved to give cocoa powder.

(ii) Dutch Process

In this process the nib is soaked in warm alkali solutions until the nib particles have totally absorbed the solution. The wet nib is then dried and ground to liquor and it is subjected to hydraulic pressing to reduce cocoa butter. The Cocoa has much darker and redden colour.

(iii) Extrusion or Dutch Process

Here, the roasted nib is subjected to steam treatment which softens the nib but doesn't wet it. The steamed nib contains 5-6% moisture and is fed into the 'expeller press' where the fat content is reduced. The cake issuing is in the form of thick flakes and they are grinded to produce fine powder. Alkalization is mainly to improve the flavour and colour and the process

consists of treatment of the liquor, nib or powder with solutions or suspension of alkali which is usually in the form of Potassium (K) or Sodium Carbonate (Na_2CO_3).

2.3 Cocoa Fineness

After producing the cocoa cake, it is necessary to reduce the cake to fine powder. This process is a situation whereby cocoa is subjected to the combined of two dises in the grinding mill. One of the dises rotates at a high velocity. The dises are fitted with grinding pins which are made of special steel and are arranged in such a way that small particles of cocoa cannot escape their grinding action. The mill is housed in such a way that it can incorporate hollow walls to ensure efficient cooling system.

After the grinding process, the cocoa is delivered by air steam into the cooling pipes. About a third of the length of the pipe is before the grinding mill for air cooling and also the cooling of the cocoa delivered inside the pipe. The long distant delivery is to temper the powder and also to fix the colour of the cocoa powder. A terminal cyclone is introduced to separate the finished product from the air (See Fig. 2.4 - Cocoa Powder Plant Type 1 PC/1000).

2.4 ANALYSIS OF NECESSARY MACHINES

After the Data Collection on one's design proposal especially industrial, the next chapter to write is the analysis of necessary machine. This is to enable us to know the size and capacity and of course, the nature of the machines to be employed (Bavermeister, 1987).

(iii) WINNOWER (Fig. 2.3)

Function - It is used to crash raw, roasted or kiln -dried cocoa beans and also to separate the shells from the nibs. The expected product is the one that has an absolute minimum number of shells.

Here is the type and Dimensions:

Type : Br G2 (Product of Bavermeister Co.)

Load : 16KW
Length : 415 mm
Width : 1800 mm
Height : 4636 mm
weight : 4300 kg

(iv) BEATER BLADES

Function - Continuous grinding and subsequent vaccaum processing of pre-dried or roasted cocoa nibs as well as other raw materials that have a high oil content i.e ; groundnut.

Roasting is not necessary again after grinding because sufficient cooling was attained within the mill.

Dimensions

Length	7320 mm
Width	1550 mm
Height	3180 mm
Weight	1850 mm

Connected Load 48.61 kg.

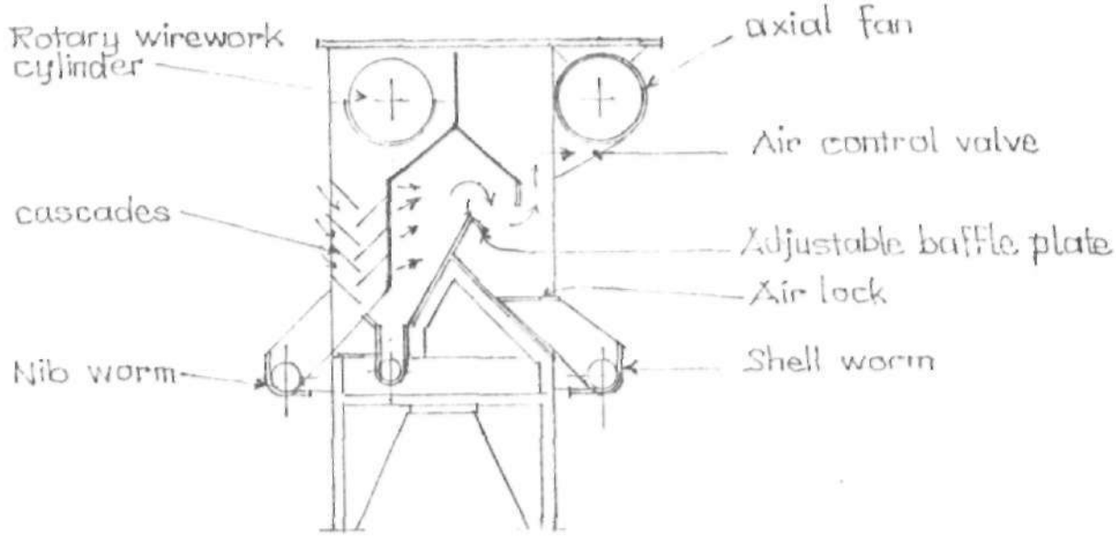


Fig. 2.3 SECTION THROUGH A WINNOWING MACHINE SHOWING THE PRINCIPLE OF OPERATION.

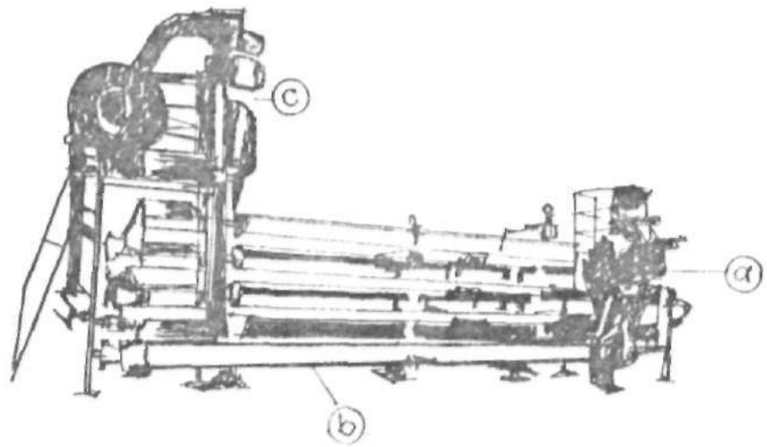


Fig. 2.4 COCOA POWDER PLANT TYPE 1 PC/1000

(a) Pin mill pulverizer
(b) Hollow wall pipes containing cooling liquids
(c) Cyclone separator

(v) Agitator Ball Mill

Function - There are balls that are moved by the agitator. It is these balls that grind the liquor that is feal into the mills the groud liquor is then pumped out below and by liquor pump.

Dimensions

Length	-	7780mm
Width	-	1580mm
Height	-	4250mm

(vi) Vaccum Mixer

Function - Its function is to mix the quantity of pre-set qater quantity to be treated. A rapid eliminatij of added humidity is attained by condensing the vapours and discharging them by means of vaccuum pump.

Type - the most popular type is Mode PMY3. It has a shaft mixer and a filling capacity of 3,000 litres.

Dimensions

Length	-	5600mm
Width	-	1500mm
Height	-	5090mm

(vii) Press

Function - As the name implies, it squeezes the butter content out of the cocoa masse. It then presses down to 10% the residual fat in the masse.

Type - Schule Presse J.

Area occupied 11.6 square metres.

(Viii) Powder Plant

Type 1 PC/1000 (Fig. 2.4)

Function - The function of the powder plant is to grind the crushed cake into powder for packaging and distribution.

Caution

All these machines are simple sources of fire out-break, therefore adequate fire prevention and control must be taken. Methods of fire prevention/control include the fixing of fire extinguishers (hand operated and also, Fire Pumps (engine operated) at every 15 metres in the Production Hall.

CHAPTER THREE

FACTORY PRODUCTION PROCESS

3.1 The Design

In designing a building, a lot of people regard aesthetics as the only means of expression, that is,how beautiful it is. But the technological property of the materials used plays a vital role in how the goal for which the project is put up is achieved. What then could we say is the real definition of design? We can pick one of these, that says, it is a purposeful plan before creative activity. It is very important to know the technology of the materials used so that any industrial building could be successfully constructed. In other words, the design of any industry and the technological process of its products are regarded as partners in any meaningful creative activity that is three-dimensional in shape. It is then important for any designer to put at the back of his mind this relationship even though they are not equal partners.

3.2 The Production Process

The study of the production process of this proposed industry and that of its structural composition are paramount in its design. There are two basic issues to be decided when planning an industry: is the layout to be based on production or on a process?

(i) Layout based on production: If a factory produces a large quantity of a few products.
(ii) Layout based on a process: if a factory produces a great number of products.

The proposed factory design based on product layout i.e it will be involved in the production of Cocoa Powder. It is this cocoa powder that other cocoa based product factories purchase as their raw materials Fig. 3.2 shows the details of technical flour and machine layout.

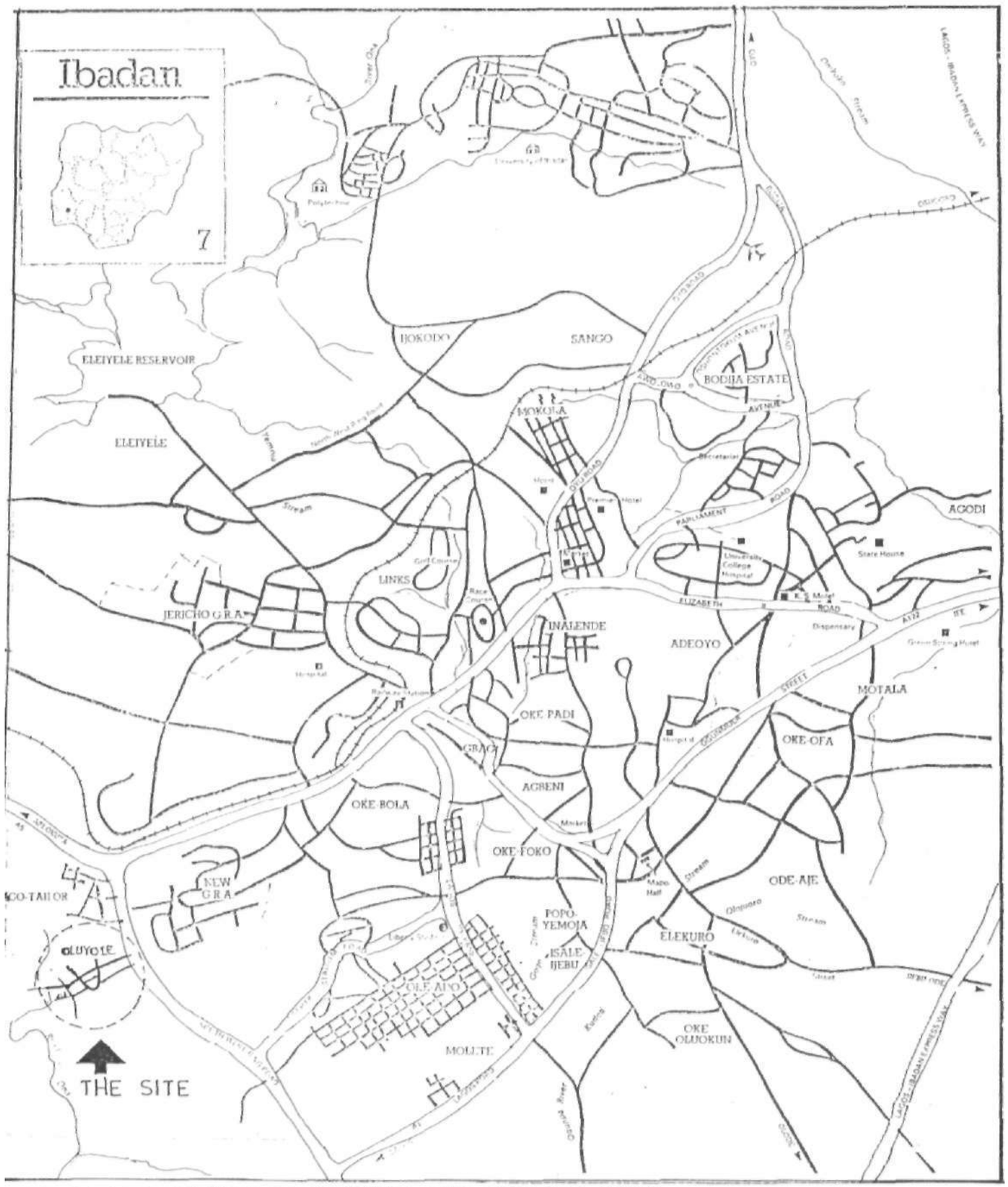


Fig. 3.1 MAP OF IBADAN SHOWING THE SITE LOCATION

It is a well known fact that there are two basic classes of raw materials used in industrial processes. They are:

(i) The unprocessed raw material and (ii) the semi-processed raw material (this is the type of raw material that has undergone some industrial processes from its crude form).

In this proposed industry, the unprocessed raw material is the Cocoa bean which hasn't undergone any mechanical process. Its only process undergone is the Fermentation and Drying which had been described on page ..... These dried cocoa beans are brought into the factory in clean jute bags of 50kg in which are then sewn up. The sacks are immediately transported to the port where they are shipped to avoid a situation whereby the climatic humidity will affect it after storage for a very long time.

3.3 Transport

In Nigeria today, transportation has been revolutionised by the rehabilitation of major and rural roads especially these days of P.T.F that has included the railways in its operation. The harbours have also been rehabilitated.

3.4 Outline of Processing for Cocoa Masse and Chocolate Manufacture

At the initial stages, the process of manufacture of Cocoa and Chocolate are the same. The process starts from cleaning, roasting and shelling and reducing the kernels to Cocoa masses and chocolate after grinding.

Cocoa Powder is obtained by pulverising the cake which remains when part of the fat (Cocoa butter) is removed from the liquor by pressure.

Chocolate is made by mixing chocolate liquor, sugar and cocoa butter after the product has undergone further refining processes (Fig. 3.4) shows the details of all Cocoa Processing methods).

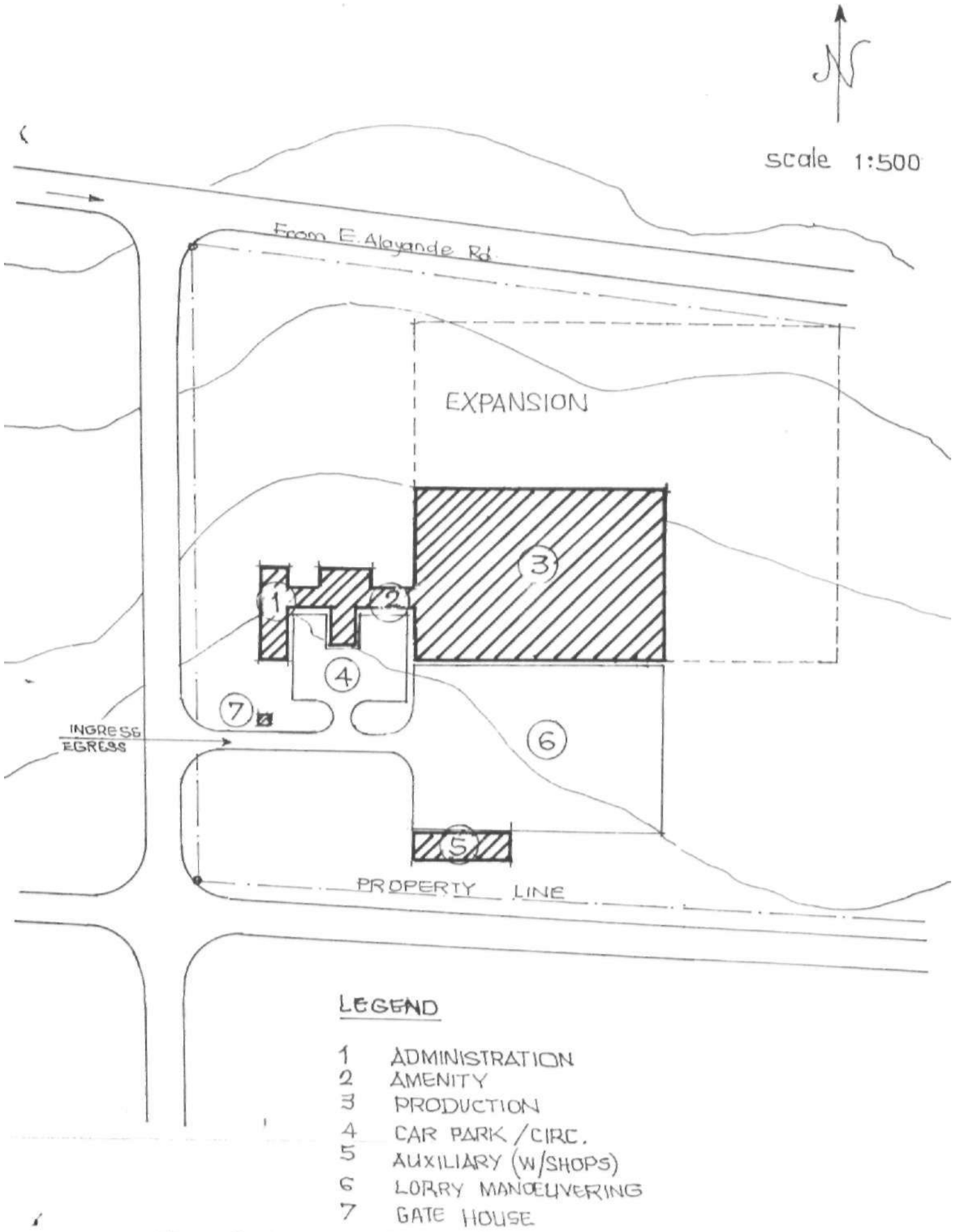


Fig.3.2 THE SITE PLAN

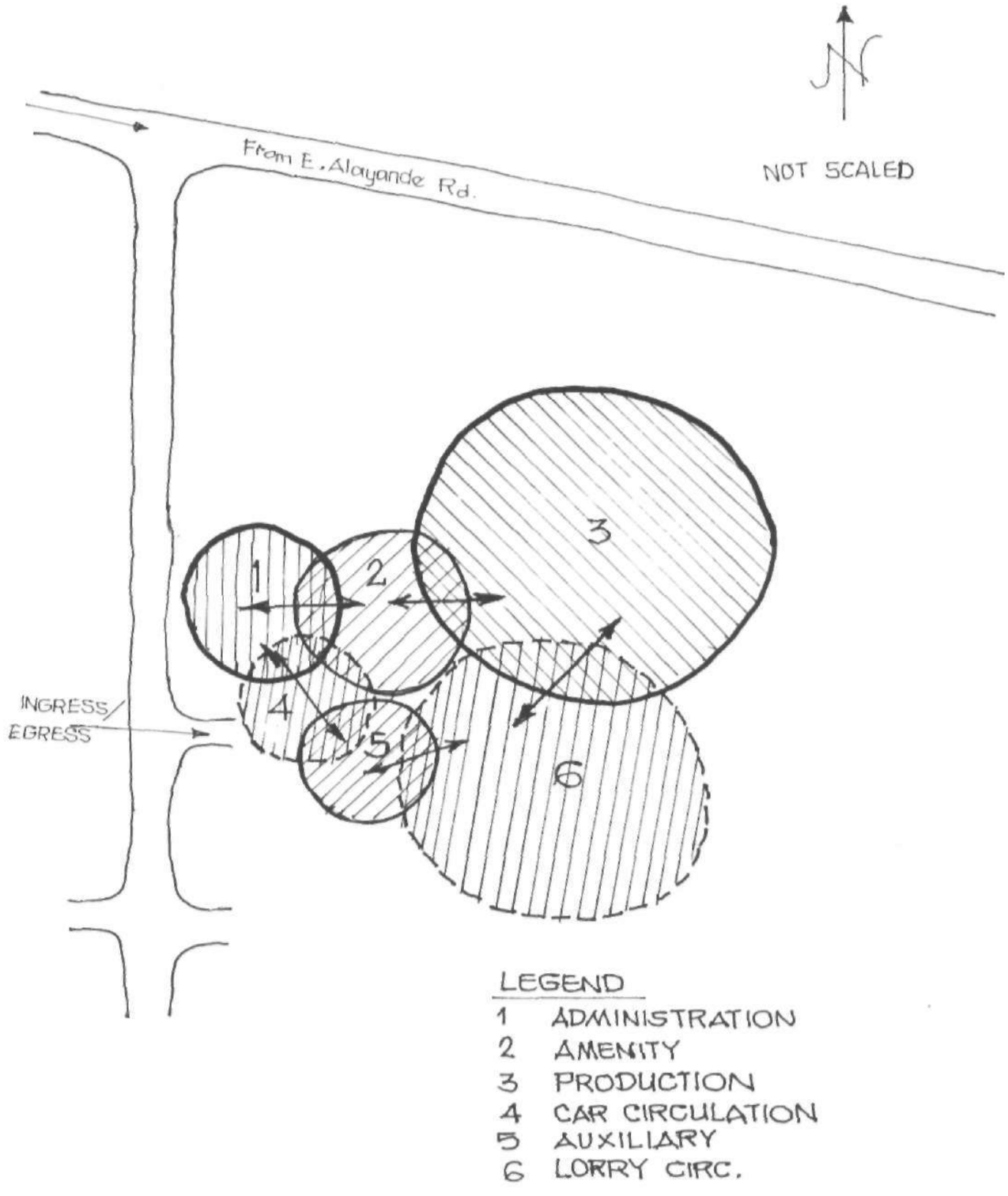
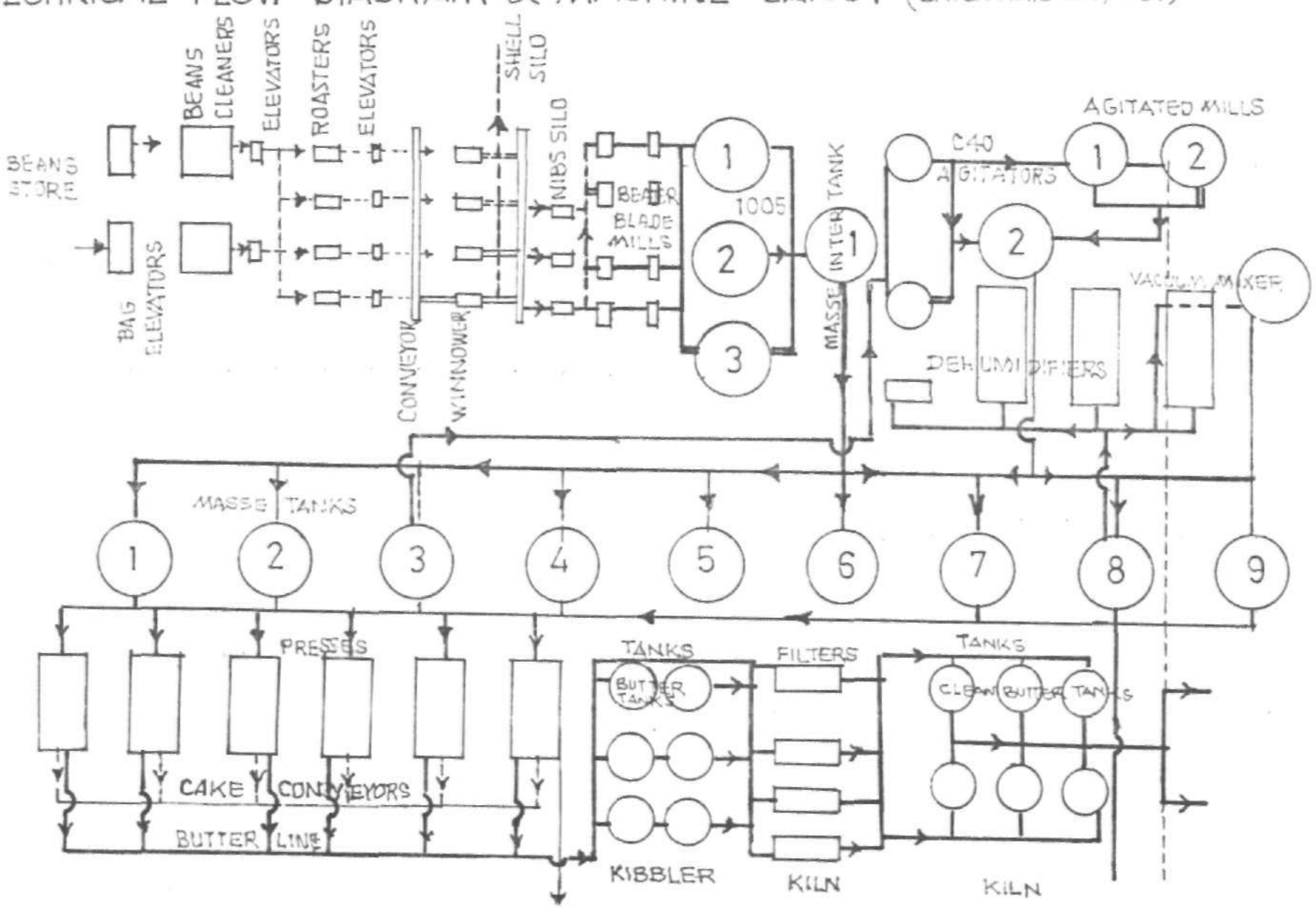


Fig.3.3 ZONING CONCEPT

Fig. 3.4 TECHNICAL FLOW DIAGRAM & MACHINE LAYOUT (BAVERMAISTER, 1987)



The raw materials are brought to the factory by trailers, they off-load them and then they are fork-lifted into the various stores. Among the factory staff is the Time-keeper who keeps the records of all the delvieries and issuings. A diagram that shows this process is shown below (Fig. 3.5). Another method is a delivery in bean/grain tankers. The beans are off-loaded in grain pits, from there, the bucket conveyor fork-lifts them into various silos from where they are freely let into the raw material store as the need arises.

In the factory, the process the raw material undergoes were fully described starting from: cleaning, roasting, winnowing, and the products of the process. The Nib, the Shell (the waste) masse or liquor, the cocoa cake, the cocoa butter, cocoa powder and plain chocolate. All these are the products of the proposed industry. This is what other Cocoa based factories use to produce Dry Cocoa Mix and Wet Cocoa Malt mix.

The Cocoa powder is stored in paper or cellophone bags and enclosed in cartons or tins. In order to achieve proper filling, large containers are placed on a shaking table and small containers are also placed to undergo the same process but shaking is regulated to give controlleld delivery of the correct weight.

3.5 ACCOMMODATION BRIEF

Labour Force

In industry or agricultgure or any other set-up that requires a high number of workers for profitable performance, the workers are referred to as the labour force. It refers generally to both skilled and unskilled worker. The skilled workers are those trained and specialising in one trade or the other. On the other hand, an unskilled person did not train and specialise in any trade. The number of workers to be employed in any set-up has to be known so as to calculate the space required to accommodate such workers just as calculating the capacitgy of machines density of materials and energy of engines are necessary. For this factor therefore the break down is as follows:

(i)	the Production Staff	300
(ii)	the Administrative, accounting and sales staff	75
(iii)	the Auxiliary and maintenance staff	30
(iv)	the Workers' facilities welfare staff	25
	Total number of workers	430
	Female staff number	90
	Male Staff number	340

SCHEDULE OF ACCOMMODATION

The ability of a designer to accurately calculate the space required for convenient performance of workers is a pointer to the quality and efficiency of such design. The clients' brief is a valuable guide in calculating the right square meter area of net usable space and also

to be able to allocate to every activity the right amount of space. It is now seen that these values of spaces are very essential to the production processes inside the factory. The 28m²/person for industrial and 17.5 28m² /person for administrative is adopted (Neufert's Architects' Data).

The proposed factory has four main sections, namely:

(i) Administrative Section
(ii) Workers' Facility Section
(iii) Production Section
(iv) Auxiliary

1. ADMINISTRATION SECTION

The Administrative Section manages the factory to a smooth and profitable level, therefore the required space is closely attached to the type of business organisation, the number of pieces of furniture and also, the degree of partitioning reflecting on the work - places. Below is the space allocated for officers/workers and the roles and of course the furniture:

Accommodation	Area (m^2)	Remarks
Reception Lobby	52	Working space for 2 receptionists a show/display cabinets for the finished products, a waiting room for guests a toilet and circulation space .
Secretary	36	Working space, 2 visitors' Sofa 2 file cabinets and a book shelf.
General Office	54	Working spaces for 2 clerks, 3 typists and 2 messengers, 4 file cabinets and circulation space.
General Manager	54	A large working space, 4 visitors sofa with a coffee table, 2 file cabinets, 1 book shelf and cirulation space.
General Manager's Secretary	36	

Sales Manager	18	Working space, 2 visitors sofa, 2 file cabinets and circulation space.
Sales Manager's Secretary	36	Working space, 1 file cabinet and circulation space.
Purchasing Manager	36	Working space, 1 file cabinet, visitors' sofa and circulation space.
Sales Office	36	Working space, for 3 sales clerks and 1 messenger, 4 file cabinets and circulation space.
Cash Office	36	Working space, for 1 cashier, a large safe, 1 file cabinet and circulation space.
Accountant	18	Working space, a large safe, visitors' chairs, bookshelf, 2 file cabinets and circulation space.
Account's Office	36	Working space for 1 secretary and 2 account's clerks, 2 file cabinets, visitors waiting circulation space.
Training Coordinator Supery.	22	Working space, bookshelves and circulation space.
Library	54	Working space for 1 librarian enough space to accommodate 500 volumes of books and journals, reading space for about 8 people at a sitting, a small store and circulation space.
Telephone Exchange	21	Telephone exchange machines, cables and telex, working spaces for 2 operators, waiting room and circulation space.
Conference Room	157	Large conference table for 46 people at a sitting, and circulation space.

Accommodation	Area (m^2)	Remarks
Coffee Roomer	18	Wash hand basin, a fridge, cabinet to store tea cups and saucers, worktop and circulation space.
Gate House/weighing		3 security attendants, weighing eqipment
2. WORKERS FACILITY SECTION Staff Canteen	 156	. Enough dining space for 80 people at a sitting, serving spce and cirulation space.
Kitchen	40	For ppreparation of worker's food
Pantry	10	For non perishable goods
Store	10	For perishable goods
Toilet and Showers/Changing Room	25	Changing space with lockers for the production staff who need to change.
Bicycle shed	Ample	
First-Aid Firs-Aid/ Treatment Room	84	A medical officer's working space., Examination bed, wash hand basin, book shelf and circulation area.
Ambulance Park	Ample	
3. AUXILIARY Engineering Manager's Office		Working spaces for 3 Production Managers and circulation space.
Carpentry Workshop	84	Sufficient space for machines, workbench, adequate storage room working spaces for 2 carpenters and circulation space
Electrical Workshop	84	Enough space for the machines, worktop, storage room, working spaces for 2 electricians and cirulation space
Mechanical Workshop	84	Ditto, but working space for 4 mechanical technicians
Scrap Store	48	Storage of broken down equipment and furniture
Generator House		To accommodate a 2 No. 250Kv Generators and Switch Room.
Fuel tank		For 3,000 litres of fuel

Water tank (overhead underground		For 3,000 litres of water
Boilelr room		To accommodate a boiler of 500Kw and circulation space.
Fire Station	Ample	Hose reel or fire extinguisher mounted on walls of Production Hall at every 15 metres.
Sewage Treatment Plant		.
Incinenrator	8	
4. PRODUCTION HALL What determines the size of any production hasll is the sizes of the machines equipment it accommodates.		
1. Raw materials storage/ weighing room		For storage of cocoa beans circulation space for both workers and fork lifts and store-keeper
2. Delivery bay	Ample	Enough space for delivery buffer where trucks stay for clearance during deliveiry.
3. Silos		For storage of dried cocoa beans
4. Packaging		Stapling machines, shrink wrap machine and circulation space
5. Finished products storage	Ample	
6. Dispatch bay		Enough space for a dispatch buffer where dispatch vans are loaded

CHAPTER FOUR

PROCESSING AND HYGIENE

4.1 Introduction

The nourishing property of any food, such that when eaten is easily acquired cannot be over-emphasized. To obtain such property, the hygiene that accompanies it is a thing of paramount concern to any family that wishes to obtain health and welfare it promotes. One of the industries that require high hygienic standards in its operation is Cocoa Processing Industry. It is well known that cocoa is not a mere tree, but the one that has a high nutritive value. Growers, manufacturers and everybody involved in cocoa processing industry are duty bound to maintain high hygienic and quality standards.

All who have carried out research on Cocoa tree have all declared that cocoa is a tree-crop with a lot of challenges for each category of specialities. There is therefore a glaring challenge facing the Architects in the design of a befitting factory. The factory like an envelope in its function for man and machinery to work in, needs the experience of a designer for a suitable environment where the practice of good hygiene is created and maintained. Such designs must therefore be the foundation of a huygienic system of production, consumption and exportation.

4.2 Possible Sources of Contamination of Cocoa Processing Industries

Before the goal of having the industry and products that are completely hygienic, there is the need to ensure the non-contamination of both the raw materials and finished products. What actually are the forms and sources of contamination? What, in this design are the steps taken to prevent or solve a situation where they have existed? In the cocoa processing

industry it is actually the beans that are processed. How then could the beans have been contaminated? The main sources are that of (a) processing and (b) storage of the beans and the finished products (as mentioned earlier).

4.3 Sources of contamination during Storage

The stages the beans undergo before processes are very importoant i.e. well grading, proper drying and curing. Even when all these have been observed, long storage in the tropics, that are the home of these beans, constitute one of the contamination sources. A study revealed that the major sources are:

(a) storage of the beans
(b) processing
© Insect and rodent infestation
(d) Mould growth due to increase in humidity
(e) Absorption of foreign matter and offensive odours that are as a result of fat content in the beans

Formerly, insect and rodent infestation and that of mould growth already stated were the most frequent sources of contamination. Details are:

(a) Storage of the beans/silos

The silos are made of aluminium:

- To prevent infestation and in order that good storage hygiene be maintained, and effective pest control be carried the floor be constructed sufficiently above ground level and should incoreporate a water vapour-barrier such as bitumen. The building should have a concrete floor and walls of brick or concrete blocks.
- In order to ensure pest control measures, stacks of wood or concrete should be built away from the walls so as to allow for smooth passage.
- There is the need for complete ventilation control, because ventilation of the storage is

important to prevent mould growth. Ventilation opening sshould be fitted with non-corrosive materials. Fix mesh screening capable of excluding flying insects (Wood, 1995).

- Steps should be taken to control infestation by insects and rodents by using suitable rodent insect proof construction.
- The floor, walls and roof structure of storage premises should be such that can be cleaned, brushed, washed and sprayed with insecticide at suitable time

(b) **Processing**

During processing, cocoa beans must have been infested through improper zoning and layout of equipment which the factories contain. If it occurs that shells are found in the finsihed products, automatically, such products are unfit for human consumption. All alone, improper zoning of machines and that of the activities that take place in the industry contribute to contamination. Example is when inadequate ventilation occurs in the industry, workers will face among other things, perspiration which in some cases, they cleaned with their aprons/uniforms.

(c) **Insect and rodent infestation**

Apart from the economic value loss of cocoa beans through the consumption by insects and rodents, the cocoa beans pose as source of human health through the insects/animals that die or pass excreta in them. No matter how long the case is narrated, the most important information is that generally, the organisms of food poisoning, poliomyelitis and a type of meningitis can be easily contacted to man through eating the food, that had been contaminated with the excreta of rats. Forestalling these calls for a befitting environmental design by the designing Architect.

(d) **Mould Growths**

Due to the climatic characters of the tropics, i.e high temperature and humidity, there is rapid development and spread of mould and also that of insects on stored products. It is then recommended that certain beans are to be stored in the tropics for any length of time precautions must be taken to ensure that beans are not contamainated or have their equality

deteriorated through mould grow.

(e) Foreign Odours

Close proximity to odorieferous non-food products cause cocoa beans serious absorption of the foreign odours. This may lead to serious damage and sometimes contamination to the product.

4.4 Sources of contamination through processing

There are a quite number of ways in which cocoa beans and products can be contaminated. It is true that cocoa factories are highly mechanised but it requries proper zoning and arrangement of equipment and machines to prevent contamination in the form of unwanted materials. For instance, cocoa shell is an unwanted material, unfit for human consumption, but quite often due to poor zoning arrangement or improper segregation of activities in the whole set-up., it finds its way into the finished-products.

The machines used for the operaitons emit heat which make the enclosed place hot. Because of the heat, the workers in order to cool their body from profuse sweating and sometimes droplets of these sweat find their ways into the products especially when they are being conveyed by conveyor belts at the early stage of processing and also, when being packaged.

In the process, some cocoa butter squeezes out and quite often litter the ground. But because inadequate provision for disposal of waste, or by-products the by-products of processing used to make the whole factory site filthy.

4.5 Architectural Response, Provision and Requirement

From the literature review, architectural provisions and requirements to solving hygienic problems i.e. changing rooms, zoning/segregation of operations; Quality Control and

Pest Control department, silos; waste disposal, goal clearance, Platforms and Floor finished, Adequate ventilation and lighting are treated below.

4.6 Changing Rooms

The changing rooms must be well equipped and detached from the main production hall, but close to the workers' entrance. In this case, the basis for personal cleanness is established. Handling of equipment with dirty hands is avoided.

4.7 Zoning/Segregation of Operations

The important roles of good zoning and layout of the factory is very necessary so as to clearly segregate dirty zones from clean zones both outside and within the production area. The main purpose is to encourage the removal of dirts and wastes. A tidy and clean environment will leave no room for easy dirts and wastes. Also, rats, insects, flies, etc will have no room for invasion.

4.8 Quality Control and Pest Control Department

Laboratory plays a paramount importance in the setting up of any factory, which apart from maintaining of the set-up standard, also monitors the intermediate stages of production. In addition, it should see to the control of pests such that personnel hygiene and public health of all personnel, i.e production workers and the good house-keeping in and about the plant is secured.

4.9 Silos/Warehouse

The silos are made of aluminium:

- To prevent infestation and in order that good storage hygiene be maintained, and effective pest control be carried the floor be constructed sufficiently above ground level and should incoreporate a water vapour-barrier such as bitumen. The building should have a concrete

floor and walls of brick or concrete blocks.

- In order to ensure pest control measures, stacks of wood or concrete should be built away from the walls so as to allow for smooth passage.
- There is the need for complete ventilation control, because ventilation of the storage is important to prevent mould growth. Ventilation opening sshould be fitted with non-corrosive materials. Fix mesh screening capable of excluding flying insects (Wood, 1995).
- Steps should be taken to control infestation by insects and rodents by using suitable rodent/insect proof construction.
- The floor, walls and roof structure of storage premises should be such that can be cleaned, brushed, washed and sprayed with insecticide at suitable time

4.10 Waste Disposal

All the wastes which are result of the materials that enter the site should leave as in form of finished goods, accumulate as waste or leave it as effluent. It is a known fact that the accumulate of waste can contaminate products and even impair the efficiency of the process and as time goes by become hazardous. Then, there is the need to design provision for waste disposal, Some of the points to be considered include: proper consultation with the health and regulation officials in matters relating to waste disposal when necessary.

4.11 Good Clearance

Easy accessibility should be made to all surfaces for scrubbling, enough space could be created in-between platforms to ease cleanaing problems. Such floor surfaces should be sloping and free from depressions that do not drain quickly and completely. This is desirable for floors in the processing areas (Benard, 1979).

4.12 Plat-Forms and Floor Finishes

In designing production halls, adequate and well located platforms in which machines

are raised for easy cleaning of the hall without disturbing the machinery operation and to prevent rusting of machine. This also is another source of contamination to floors and wall finishes. They should be such that when cleaned washed or brushed will not easily wear away.

4.13 Adequate Ventilation and Lighting

All ventilation openings in the production hall need to be provided with fine non-corrosive mesh along the walls. The ventilation which is from clean air is essential not only to avoid undesirable odours but also to reduce objectionable moisture in the atmosphere (Arthuele 1978) and the thermal comfort. Where necessary, mechanical ventilators should be encouraged. Adequately, light should be provided for proper cleaning such that it is not obstructed when cleaning exercise is carried out.

Dark places, moist and unclean places attract rodents, ants, flies, all these have no place to hide under sufficient lighting (Bernard, 1979).

CHAPTER FIVE

5.0 ARCHITECTURAL INTERPRETAIONS

The main focus under this chapter is the design of a factory in general and that of cocoa processing in particular. Also taking into consideration are: the site, the machine layout, structural concept, as well as ventilation and lighting so also are fire protection and dust control mechanism.

5.1 Design Elements

Before discussing anything of any importance, in all industrial buildings, the different methods used in transporting materials in any of the factories from one end to another come first. Such methods are:

(i) **Pneumatic tubes** - for granular substances i.e grains, fine powders,

Operation: The operation is carried out by effectively causing a current of air to flow along the tube. It is this air current in tube that causes the articles to be transported to float along its journey. Where a steady air velocity of around 750 metres/minute is used, then a movement of load of up to 20 tonnes/hour is feasible.

(ii) Alternate compression and release of a flexible, tube. This is in the same way as the pneumatic method, since it is the alternative method to it.

(iii) Screw conveyors and elevators: Both method is mostly used in flour mills to convey both the granular and powdered materials. This is a kind of helical metal end encased in a metal trough. Method of conveyance is such that the item to be moved is flown along the contours of the helix. Popular helix diameters range from 160 to 400 mm.

(iv) Gravitational Elevators The gravitatinal force is a very iumportant source of motive power

used mostly in flour mills. This power is very cheap because it is always available. The operations cover slides, chutes, roller conveyors and ball tables.

CAUTION

Adequate care must be taken in order that manpower, being flexible is not used extravagantly. Workers used for production should not be used for moving materials or vise versa.

There are conveyor belt systems of various types that can be used for transporting materials nowadays.

5.2 Structural Concept

The structural concept is based on the principle of using gravity in the transportation in the processing plant. This is the reason why for flour/bean processing plants, the machines manufactured for the procession is based on the concept of free-for-all fall of the gravity.

The Beam has a depth/span ration of 1/30. Columns are for production 30 x 60. The grid of 36 metres and a proportion of 2:3 (breadth length) is maintained.

5.3 Ventilation

When treating ventilation generally in industries we refer to

(i) The product and/or process requriements

(ii) The personnel confort requirements

(iii) The Industrial exhaust requirements

(a) Product and or process requirements are Installation of machines in industrial buildings are determined by so many factors out of which is the need that they form a safe division so that they can conveniently contain the heat releases efficiencies. In brief, the ventilation requirements in the processing industry of 60-65° F (15-18°C) is maintained in the production departments, while a relative humidity of about 60% is considered for the processing section.

but butter section has a low temperature.

(b) Personnel confort requirements are in the conditions usually maintained in the comfort range with close limits on the range and not the temperature and humidity in themselves. While maintaining the ventilation requirements, the two basic kinds of heat releases that affect the comfort of the personnel are: (i) a hot-day heat that gives relief by means of evaporation of body sweat and (ii) a warm-moist heat which prevents evaporation of sweat; these releases are controlled in different ways. The role played by the climate and orientation of the area is very vital especially in the Heating, Milling areas. Where too much heat is released, artificial devices like hoods, air-jacketing and pneumatic tubes are provided.

(c) Industrial exhaust requirements. In the processing industry, there is more dust in cleaning and sieving sections; there may even be the need to construct as already state above, the use of devices where necessary.

There is need to control the heat that is produced in industrial sites, one of these is by proper insulation at the heat source, insulation at the machine location, air-conditioning or by enclosing the entire process in a hood and drawing off the heat.

5.4 Lighting

Lighting referes to the day lighting, which is a form of great concern to architects as far as design with nature is concerned. Carrying along is the changing positions of the sun due to changing in seasons.

To allow for adequate and active lighting in this industry, the production hall is large enough to allow in enough light in the working places. Windows from both sides have been designed with both adequate widths and heights so as to receive the maximum amount of light. Since the north lighting system used, it has been rated for day lighting (at max. 17% and 5% min).

5. 5 Orientation

The buildings are oriented in the North-South direction due to the climatic considerations and also to utilize the North light roof system for the production hall. Low and

High level windows have been provided for all the sides so that clear working place and adequate ventilation is provided. Taking into consideation are: (i) variations in the amount and direction of the incident light during the day time (ii) variaiton and (iii) Effect of local terrain, landscaping and the nearby buildings on the path of the available light. The building depends solely on the function of the architectural design for daylight supply the fenestration, the decoration and furnishing or otherwise of the interior. Example is the windows where clear glalss is recommended also, good spacing and order of installation within the production hall and also befitting furniture in the administration block.

5.6 **Services**

(a) Each unit is provided with separate 415V 3-phase supply. For main production hall provide:

(i) Main distribution board of adequate capacity for normally anticipated unit need 70KVA fitted with fused switchboard.

(ii) Lighting circuits to be provided within offices and lavatories in appropriate locations.

(iii) Power socket outlets to be provided in offices.

(iv) Fused switchboard socket outlets should be provided in laboratories where electric heaters are used.

(v) Lighting wiring should follow likely office sub-division and should finish with fluorescent fitting but in lavatories and closets should be batten ceiling type fitting.

(vi) Flood lighting should be provided at the back of building over service door, wired to each individual unit to illuminate rear service area. This may be supplemented by street lighting where layout permits.

CHAPTER SIX

6.0 CASE STUDIES

6.1 The need for Case Studies

The need to carry out case studies when one is designing a project could not be over - emphasized. The need include:

i. To study the principles involved in the design of the particular project.

ii To be conversant with the method of translating into action all the principles involved in the construction.

iii To analyse the problems that may be contained in the design of a certain project and avoiding such problems in the design of the proposed project.

6.2 The Comparative Analysis of Case Studies

While embarking on the case studies, these sites were visited and the analysis of their situations were noted:

i. Cocoa Industries Limited

ii Cadbury Nigeria Limited

iii Food specialities Nigeria Limited.

The comparative analysis of these sites were:

i. Site/Location

ii Zoning

iii Production flow

iv Provision for hygiene

v Expansion potential

vi Services

vii Landscape

6.2.1. Site /Location

(i) Cocoa Industries Limited

The factory is located in the Ikeja Industrial Estate, Ikeja Lagos State. It is a member of the Odua group of companies. It commenced operation in 1965 after being incorporated as a liability company in the same year. The present factory was constructed and occuppied in 1975.

(ii) Cadbury Nigeria Ltd

The factory is located along Lateef Jakande Road, Agidingbi, Ikeja. It was established in 1956, then it was a subsidary of the Cadbury Fry Export Limited. Lateron it become autonomous in 1965 and it was then known as Cadbury Nigeria Limited. The development of the present site started in 1981.

(iii) Food Specialities (Nig) Ltd

The Factory is located at the Agbara Industrial Estate of Ogun State and the Administrative Wing in the Ilupeju Industrial Area Lagos State. The present site development started in 1982. The industry has among its products: MILO" - a kind of wet cocoa malt mix.

6.2.2. Zoning

(i) Cocoa Industries Nig Ltd.

The car park are arranged in such a way that the visitors parking is before the gate and defined parkings for various types of workers in the factory. At the entrance to the factory are the Reception Hall/Waiting Room. Also at the front is the Administrative Block, while at the rear are the generator house and the Sewage Treatment Plant. These are noisy and dirty

Zones respectively. The training school which ought to have been a quiet zone is erroneously sited very close to the generator house, a very noisy zone. The deafening noise from this zones led the workers to wear ear puffs.

(ii) Cadbury Nigeria Ltd

This site has a defined vehicular and pedestrian routes with concrete kerbs and shrubs. The factory produces items like "BOURNVITA - a kind of dry cocoa drink.

iii Food Specialities (Nig) Ltd

Thee factory is properly landscaped. It has a well maintaned lawn in the frontage with the side shrub-guide. The roads and parking are demarcated with concrete kerbs. A well drained and trimmed lawn demarcates the Administrative Block from the Production Hall.

6.2.3. Workers Facilities

Facilities available in all the sites include:

Staff Canteen (Senior and Junior staff), Cloakrooms/Toiles, clinics, Training schools (conference rooms) first-Aid for emegency cases.

6.2.4. Services

i. Cocoa Industries Nigeria Ltd.

Services include a laundry for washing of overalls. Wastes are disposed of by the Lagos State Waste Disposal Board every other day by cans. There is a fire station on the site in case of any fire incident, but fire insulated materials were used for the construction of likely inflammable materials.

ii Cadbury Nigeria Ltd

The laundry waste water drains into open gutter after treatment. Fire extinguishers are hung on the walls of the production Hall every 15 metres.

iii Food Specialities

The laundry waste water is disposed of by water containers which is finally treated by the Agbara Estate sewage plant. Other solid waste are disposed of by incinerators. Scraps are kept in a scrap store where the public buy them. Other services include fire extinguishers, fire hydrants and fire fighting pumps.

Workers on essential services are trained fortnightly.

6.2.5. Colour Impact

All the industries have very good colour impact. i.e. Colours of machines, services pipelines, walls, ceilings and storage tanks. They are complimentary to one another.

CHAPTER SEVEN

MAINTENANCE

7.1 Need for Maintenance Department

To emphasize the importance of a maintenance department in a factory is saying the right thing at the appropriate time. The type of maintenance therefore depends on the production processes carried out in each factory and the type of machines used. In many of the factories visited, it became a tradition to set up a maintenance department which simply consists of metal works section, carpentry and electrical section. In the process of setting up a maintenance section for any Cocoa Industry, there is the need for the Pest Control Unit. As an agro-based factory, the cocoa beans should be properly protected from the 'invading' rodents and insects.

The quality control section takes care of the standard of the in-coming raw materials (cocoa beans) and the out-going finished products: Cocoa Powder, cake and butter. These products must have undergone so many stages before finally loaded 'out' , therefore the need for the monitoring of intermediate stages of the product in the making.

(a) Pest Control

In any food processing industry, there is the need to set up a pest control unit to avoid wastes and contamination. No wonder pests like Rats, Cockroaches, Moles, etc are found in food stores i.e; Raw material store.

The solution to all these is to have a pest control section that takes care of:

(i) Personal hygine and public health of all personnel especcially the production workers.

(ii) The wastes being properly and quickly disposed off

(iii) Good housekeeping in and about the factory

(iv) Food spillages and broken pieces immediately removed

(v) Blocking unnecessary holes to avoid them acting as breeding holes for rats/insects.

(vi) Setting up of traps with food pieces as baits

(b) Waste Disposal

Fermentation and Drying

The development of good chocolate flavour depends on good fermentation, drying and storage of the beans together with controlled processes of manufacture:

Wet Beans

In heaps, Sweat boxes or baskets

Breakdown of pulp and drainage of sweatings

Access of air at surface of mass

Bacterial oxidation of Alcohol to acetic acid

(Further temperature rise)

Death of Beans — Loss of germinating power

Destruction of coloured anthocyanins

Development of chocolate aroma and flavour potentials

Simplified flow diagram of Cocoa fermentation

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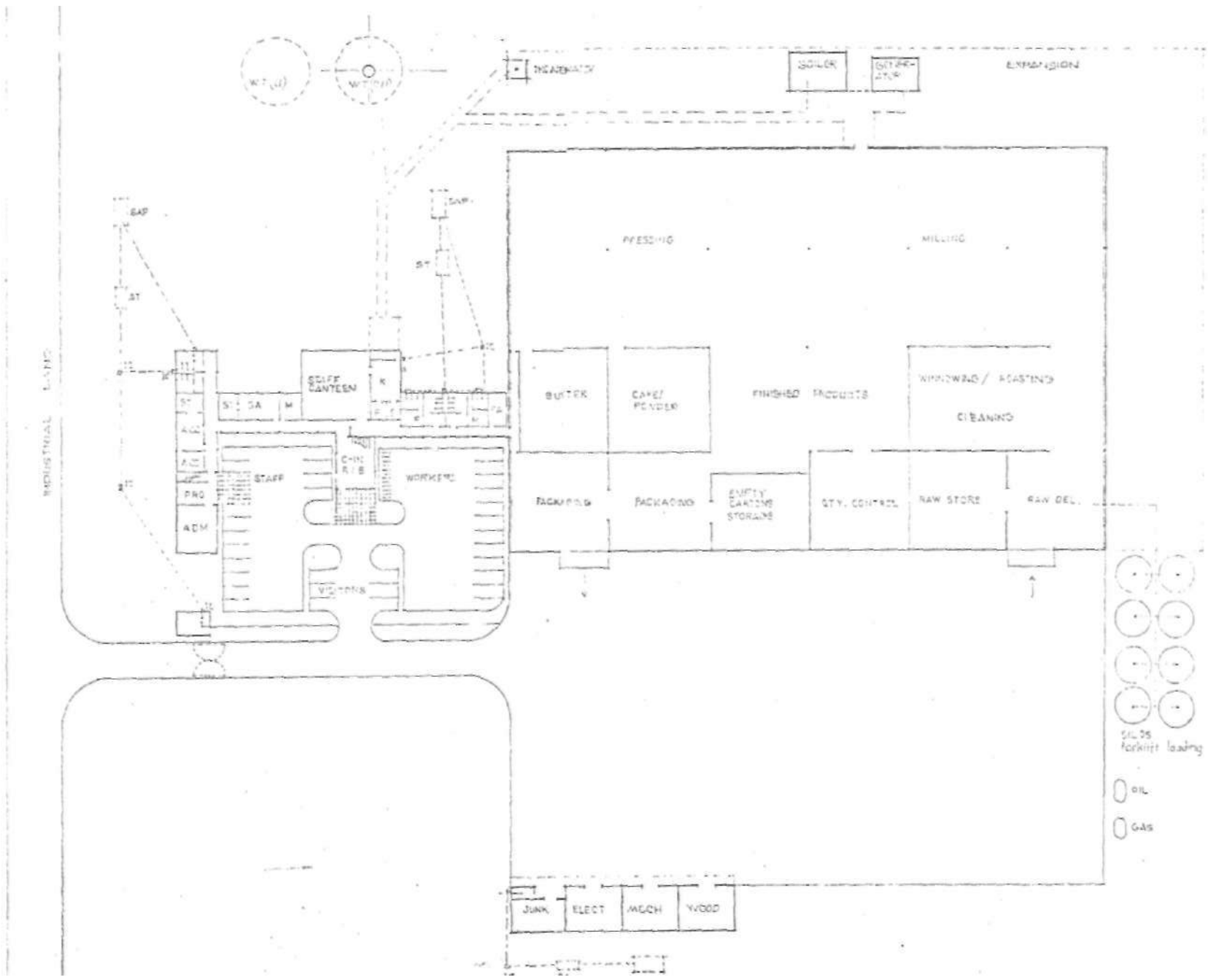


Fig. 7. 1 GROUND FLOOR PLAN

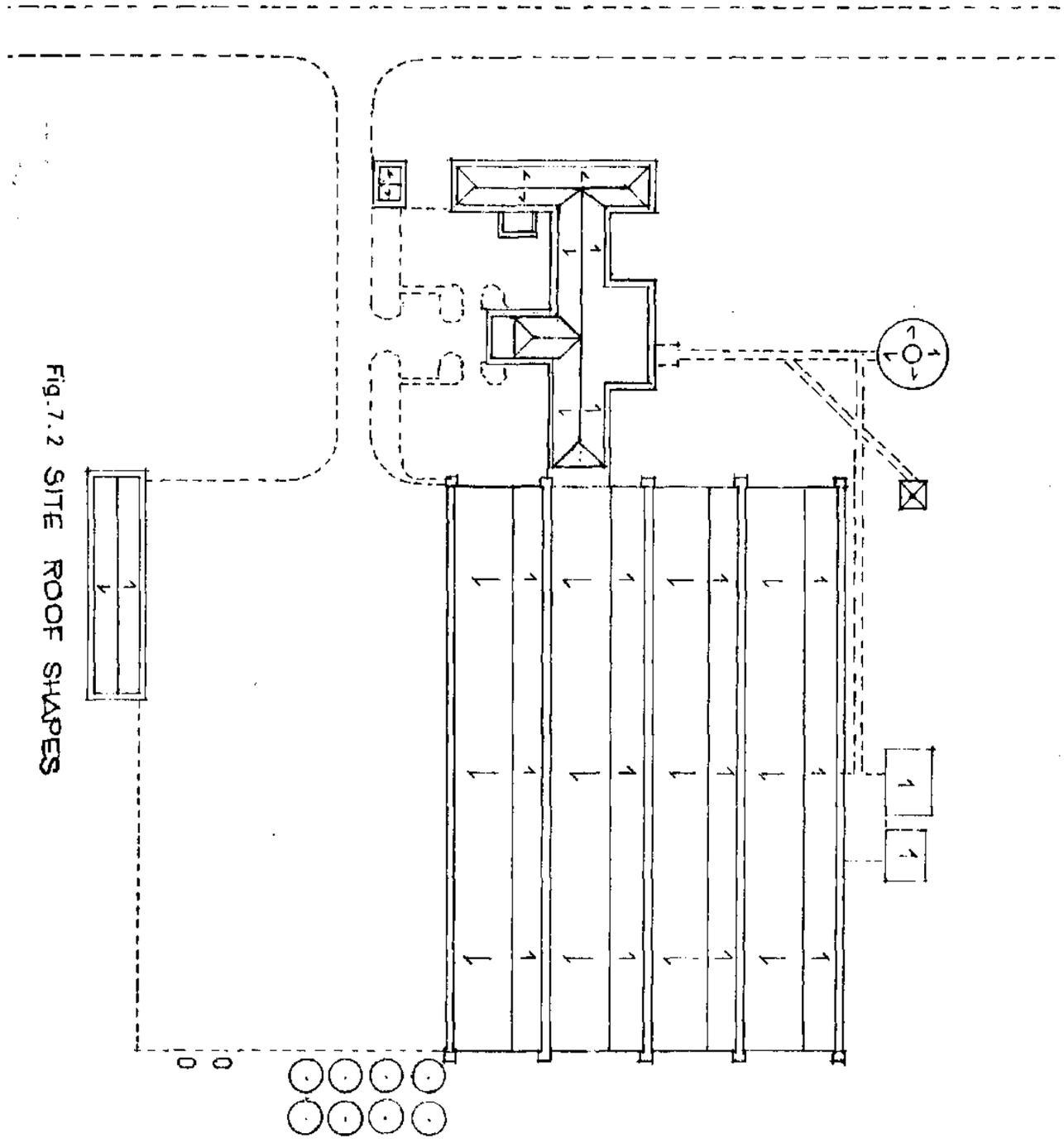


Fig.7.2 SITE ROOF SHAPES

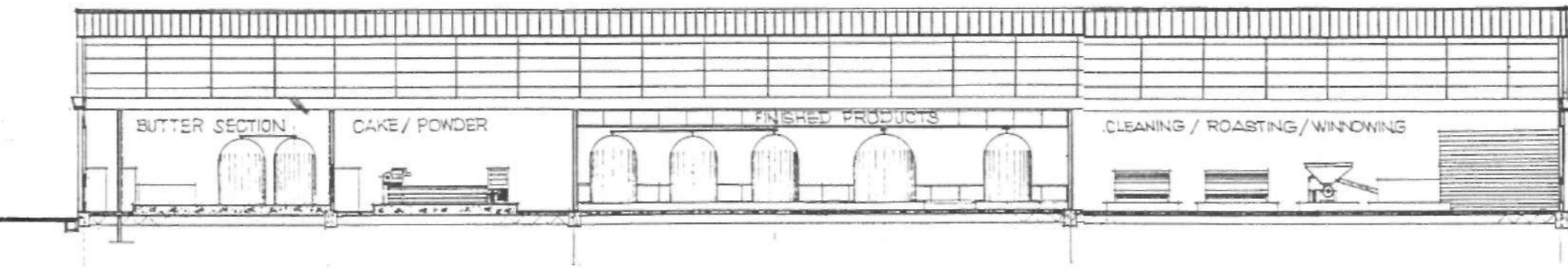


Fig 7.3 SECTION A—A

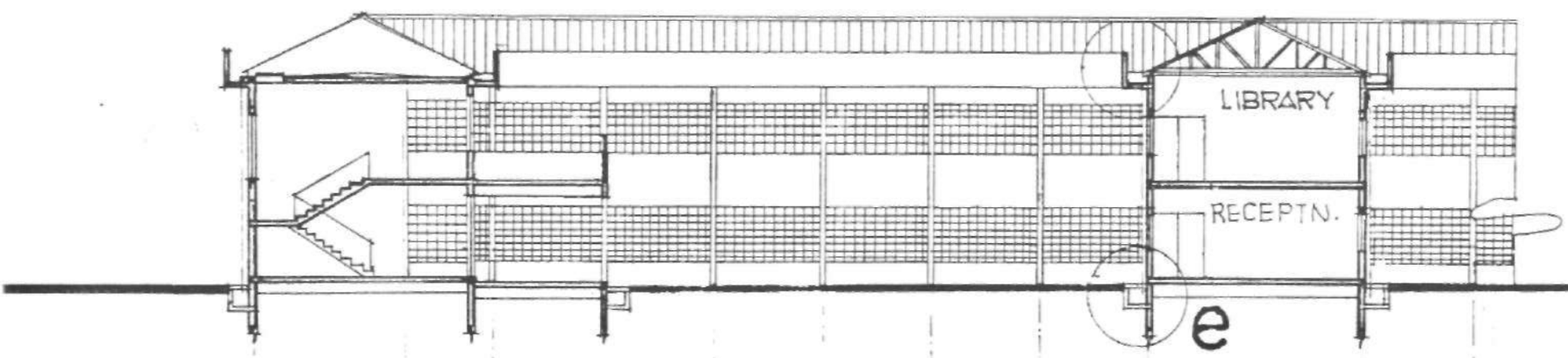


Fig. 7.4 SECTION B—B

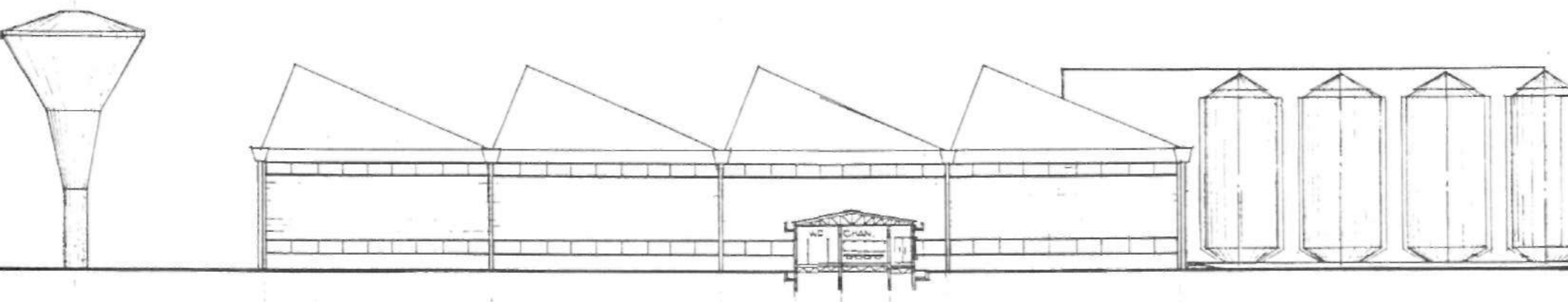


Fig. 7. 5 SECTION C-C

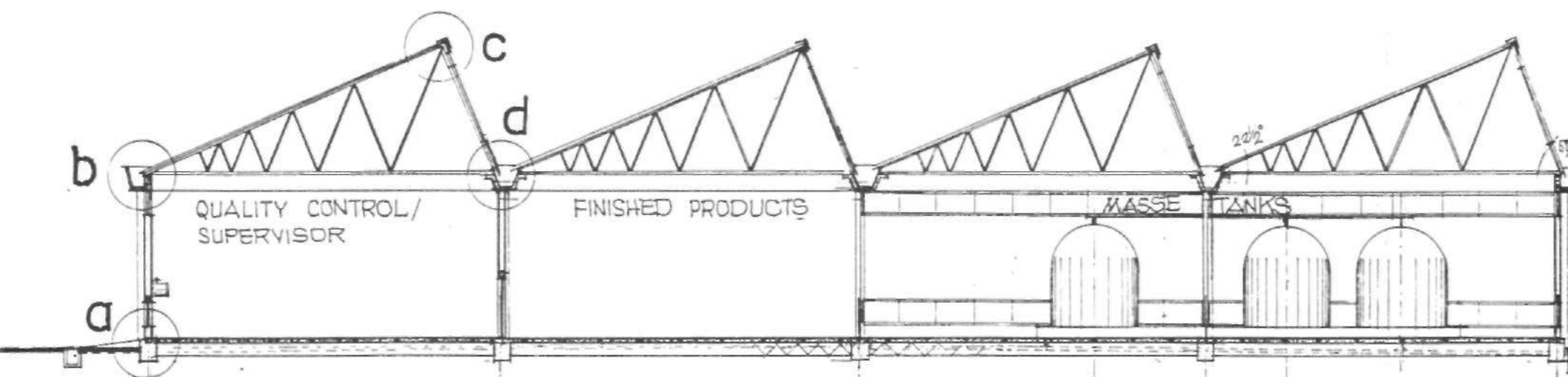


Fig. 7. 6 SECTION D-D

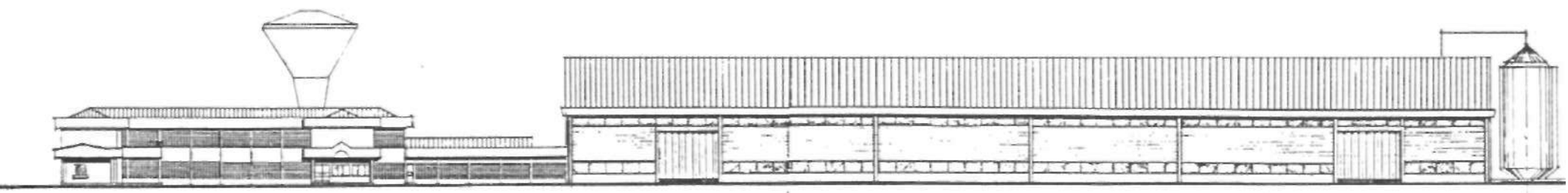


Fig. 7. 7 SOUTH ELEVATION

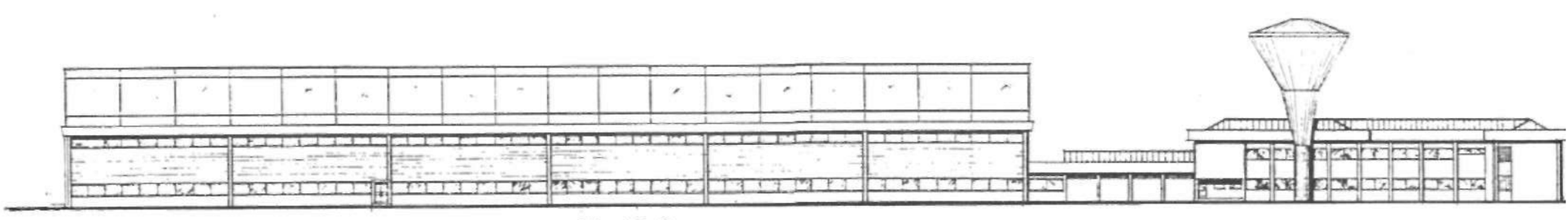


Fig. 7. 8 NORTH ELEVATION

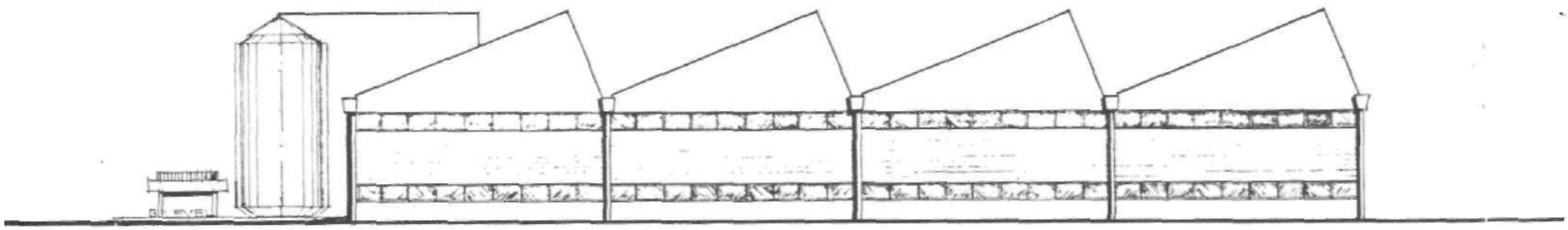


Fig. 7.9 EAST ELEVATION

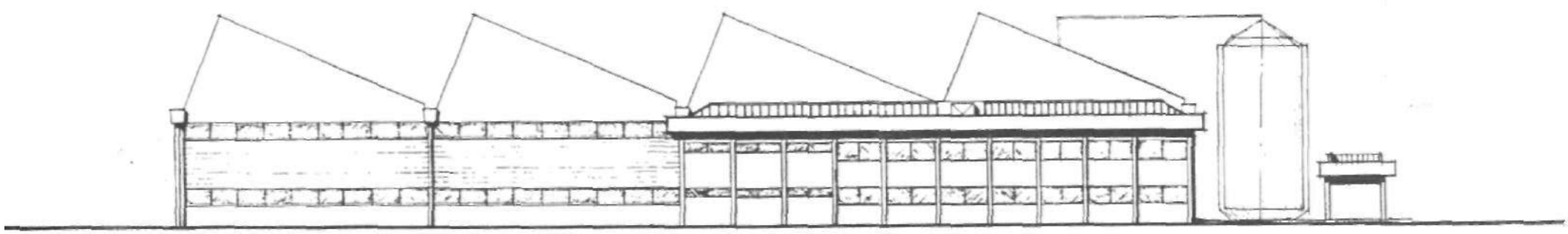


Fig. 7. 10 WEST ELEVATION