INTEGRATED COCOA PROCESSING CENTRE
IBADAN

BY

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Department of Architecture

Faculty of Environmental Design

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DECLARATION

I, Olagunju O.K. of the Department of Architecture, Faculty of Environmental Design, Ahmadu Bello University hereby declare that this thesis work has been a personal academic undertaking executed under the supervision of my mentor, Arc. A.A. MBINA of the Department of Architecture, Ahmadu Bello University, and that all quotations and information utilized and their sources have been duly acknowledged by way of references.

Student's Signature

Mentor's Signature

CERTIFICATION

This thesis entitled Integrated Cocoa Processing Centre Ibadan, by Olagunju Oladele Kit meets the regulations governing the award of the degree of Master of Science in Architecture (M.Sc. Arch) of Ahmadu Bello University, and is approved for its contribution to knowledge and library presentation.

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Dean, Post - Graduate School — Date: _____

TO EVERYTHING THERE IS A SEASON AND A TIME

TO EVERY PURPOSE UNDER THE HEAVENS.

ECC. 3.1

DEDICATION

TO LAGUNJU'S FAMILY ESPECIALLY MY MOTHER WHO COULDN'T DENY SOME RESPONSIBILITY.

ACKNOWLEDGEMENT

Firstly, I am very grateful to my Heavenly Father for giving me grace, strength, wisdom and knowledge to succeed. Without him things might have taken a different course.

I am also indepted to members of my Family for their financial and moral supports they have given me in all my academic endeavours.

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I am also very grateful to all my other friends too many to mention for everything they have done for me.

ABSTRACT

The three basic essentials of life are food, shelter and clothing in their order of priority. The indispensability of food further makes it a very high priority area in the development of any nation.

It is "because of the importance of food and the very high priority accorded food industries in the national development plan that the author decided to concentrate this thesis on this area

Moreover, the importance of agricultural industrialisation cannot "be over-emphasized especially with the rapid declining situation of the economy of Nigeria, the over-reliance on importation of food items and high rate of unemployment all over the country.

However, cocoa "being one of the most important cash crops in Nigeria and especially in Oyo State, that is produced in abundant quantities can reliably support a processing factory using cocoa beans as the primary raw material.

THESIS TITLE:- INTEGRATED COCOA PROCESSING CENTRE

TOPIC; An architectural re-appraisal of the agric sub-sector as a means of enhancing economic development.

AIMS AND OBJECTIVES:

The project is aimed at undertaking a comprehensive re-appraisal of cocoa production within the context of economic development and also to architecturally enhance the process of production to complement exisiting facilitis in Ibadan at present that is (C.R.I.N) Cocoa Research Institute of Nigeria and (C.P.U) - Cocoa Development Unit.

DESIGN SCOPE:- The thesis will include the design of a processing plant that will have production and marketing ties with the existing facilities in Ibadan, Workers facilities, the administrative and auxilliary facilities

SITE:- The Owode industrial layout Ibadan is selected due to proximity raw materials and marketing of the industrial products.

Client:- Federal Government of Nigeria and Co-operative Farmers Society of Nigeria.

ARCHITECTURAL SIGNIFICANCE OF PROJECT

The design of industries in widest sense, is at least receiving great attention from architects. Not only do they set the problem of designing a suitable envelop for man and machinery to work in, but they must also achieve a satisfactory relationship between various elements involved and harmonise the often conflicting demands of several specialities. The architect must provide for the workers a high standard of creative comfort with efficient working conditions in the best possible environment. All these should be done within a cost manageable by the factory owners who always seem reluctant about workers comfort. The architect is faced with two seemingly uncompromising tasks; that of compromising the difficult to compromise. A proper investigation into the design of processing plant will, therefore, go a long way towards better planning of future industrial building in the country.

It therefore becomes imperative that the design of any industrial building be extremely flexible, because when industrial building is planned it is impossible to foresee what will be its ultimate development due to high rate of technological growth all over the world.

Flexibility, however can be of two types:- the general type or the specific type. In the general type of flexibility a facility is designed to be adaptable to any function e.g. industrial, recreation e.t.c.

In the specific type of flexibility on the other hand, provision is made only for changes with the defined category of functions; say industrial function.

The kind of flexibility of importance in this proposal, however, in the specific type. By careful planning of main design elements, by dimensional co-ordination of major building elements, changes in internal functions and easy future expansion would be facilitated.

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CHAPTER ONE

(i) HISTORY OF FACTORY DEVELOPMENT

(ii) CLASSIFICATION OF ENGINEERING WORKSHOPS

(iii) PLANNING A FACTORY

(iv) INDUSTRIAL DEVELOPMENT IN NIGERIA
(MANUFACTURING INDUSTRIES)

- Causes of industrial growth
- The tendencies in industrial investiment
- Strategy of industrial development
- Government control of industry
- Factors affecting location of industries
- Problems of industrial Growth
- Objectives of industrialisation
- Industrial policies
- Conclusion

CHAPTER ONE

(i) HISTORY OF FACTORY DEVELOPMENT

The history of factory development particularly that of the industrial development, in turn, has been one of continually changing requirements following improvements in production equipment, mechanical handling and motive power associated with shifts of philosophy from individual craftmanship to soulless production line. The latest inovation is soon outdated, and the buildings designed to accommodate it are often obsolete before they are commissioned.

(ii) CLASSIFICATION OF ENGINEERING WORKSHOPS

Engineering workshops can be classified into light, medium or heavy process.

Light process workshops.

These includes:-

(i) High precision work in laboratory - like conditions.

(ii) Small - scale craft workshops as are now being encouraged in both urban and rural areas.

Design of this type of workshops will depend on circumstances, but will tend to approximate to laboratory or office type design.

MEDIUM PROCESS WORKSHOPS

These workshops can be subdivided into:-

(i) Light - medium:- Small scale engineering, clothing factories, paint shops.

(ii) General - medium:- batch production of components for other industries, medium sized printing e.t.c.

(iii) Heavy - medium:- for industries requiring intensive use of buildings and services as in mass production.

Heavy process workshops:- Workshops such as steel-making and ship building require spaces (not necessarily enclosed) designed around the work or mechanical plant.

Traditionally, it is difficult to build adaptable structures, but modern handling techniques enable loose - fit buildings to be designed.

Planning A Factory

In the design of factories, the sizes of spaces are usually determined by the shape, size and number of machines, rigs or pieces of equipment rather than by the numbers of workplaces. There are no universal standards and as such areas must be assessed on an ad-hoc basis.

INDUSTRIAL DEVELOPMENT IN NIGERIA
(MANUFACTURING INDUSTRIES)

The government has taken a good step towards industrial development, hence the encouragement of skilled man-power through various training systems (in-service and other educational encouragements). Financially, there are various generous incentives for investors both foreign and local.

It can be said that the general trend of industrial development in Nigeria has followed a developing pattern from the history of craft industry of the villages, through the colonial local industries to the present stage of industrialisation in the country.

The history of Nigerian industrialisation can be traced to the last four decades when in 1946 the first development plan was launched when only about £300,000 (₦600,000) was provided for the department of Commerce and Industry.[1] This was for the acceleration of the tempo of industrial development in Nigeria by every possible means, scale and method for the achievement of maximum participation of Nigeria in industrial enterprises and also to secure a larger share of the world trade for Nigeria as well as a larger share of Nigeria trade for Nigerians.

Causes of Industrial Growth

The rise of both the volume of industrial investment and of industrial production since 1957 is a result of the following four reasons:

1. The increasing consciousness of the government after 1951, which can be understood from the 1952 "Aid to Pioneer Industries Ordinance" passed to encourage industrialization. It was to assist new industries to operate in the country with provision of incentives allowances and protection from initial problems. The most important of this include:
   (a) The Industrial Development - Import Duties Act 1967.
   (b) The Industrial Development - Income Tax Relief - Act 1958.
   (c) The Customs Duties (Draw-back) Regulations 1958.
   (d) The Income Tax (Amendment) Act, 1958[2].

   These were improved upon over the years through amendments to encourage the realisation of the various government policies. Moreover, land for the establishment were provided cheaply.

2. Foreign investors were appealed to and encouraged to invest in Nigeria in all types of industries except the public utilities - transportation, electricity, water and communication services. This was jointly agreed by the then three regional governments of the federation in August, 1957 and thus, the policy statement backing this up, That "The Government of the Federation of Nigeria of the Northern, Eastern and Western Region and of the Southern Cameroons" recognises that Nigeria

will for many years to come need overseas capital and managerial and technological skills, if her resources are to be developed to the extent which the government and the people of Nigeria desire. They realised that overseas investors will be reluctant to lend (and invest) their capital unless they can be assured that such investment and the skilled overseas personnel which may be necessary to make it successful will be welcomed. The purpose of this investment is to give such assurance and to assure foreign investors of the rejection of Nationalisation of private enterprise and guaranteed adequate compensation, should occasion call for Nationalisation".

3. The 1955 - 1962 Development Programme of both Regional and Federal Government which laid emphasis on industrialisation and provision of infrastructures that can induce industrial growth like high level man-power, electricity, transportation, communication and water supply.

4. Development of Finance Corporations to encourage new industries like Nigeria Industrial Development Bank (N.I.D.B.) and the directorate of employment for young graduate to establish small scale industries.

The Government realising the role of industrialisation in the imporovement of Nation's economy thus, encourage the setting up of industries that can use both local raw materials and man-power.

This in essence is to provide employment opportunities for Nigerians and to increase technical and managerial skills as well as to improve the market for local raw materials.

5. The present ban on importation of raw materials and emphasis laid on use of local materials so as to conserve our foreign earnings.

6. Cheap labour in the country due to the present economy glut.

The Tendencies in Industrial Investment

The influence of the foreign investors can be recognised from the 1962 - 1968 Development Plan when they were supposed to contribute one-sixth of the total capital formation which shows clearly the entrusting of the Nation's Economy in the hands of outsiders. This was corrected with the promulgation of the indigenisation decree of February, 1972;

- To maximise the local retention of profit.
- To increase the level of capital formation at both intermediate and higher levels.
- To create good opportunities for Nigerian indegenous business men.

Strategy of Industrial Development

The most import policy of Nigeria is to develop her industry as a means of promoting rapid economic growth.

Hence its industrialisation process is based on an INWARD LOOKING IMPORT SUBSTITUTION until recent years when some of these goods have been banned. The strategy recognises four basic sources of growth:

i. Growth in final consumer demand for the end products of manufacturing industries.

ii. Growth in intermediate demand, that is the increase in use of the domestic industries products (processing plants) for further productions in other domestic industries.

iii. Growth in export demand, to create an improved market for locally made products, e.g. Cocoa Cakes and Cocoa butter.

iv. Growth in the substitution of import by domestic production - import substitution.

Government Control of Industry

The influence of the government on the course of industrialisation process can be recognised from the initial minimal control during the rapid expansion and diversification of industry in 1950 through the time of the colonial government to the period between 1972 and now when the "Indigenisation Decree" among others was promulgated.

The major types of control include:

(a) Direct Control

By Acts, Regulation and Decree which stipulate specific regulation, operation and ownership of industries with penalties for non-compliance.

(b) Indirect Control

Schemes which induces individual companies and industries to operate their business in conformity with government policies and objectives.

(c) Physical Control

Law stipulating the conditions for the formation and operation of business within government influences.

(d) Financial Control

Ways of controlling money invested, spent and shared between share holders.

(e) Control of Entrepreneurs and Management

Conditions and term of employment of foreigners and indigenes.

(f) Control of Foreign Exchange

Conditions under which money can be sent into the country or invested out of the country and the amount.

(g) Control of Labour and Product

Quality and condition of service including the standard minimum quality of products for the market.

Factors Affecting Location of Industries

The factors affecting location of industries include social, economic, political and geographic factors and can be understood from the following:

- Availability of abundant raw materials.
- Availability of local labour both skilled and unskilled to be used in the industries.
- Availability of essential infrastructure ; water supply, electricity, good road and communication systems.
- Availability of land for development purposes.
- Availability of large market for the manufactured products.
- Availability of capital for financing it.
- There must be political stability to encourage the expansion and free working atmosphere.
- Availability of man-power both skilled and unskilled for the operations of the industry.

Problems of Industrial Growth

1. Infrastructural Constraints

   This is the lack of good transportation and communication system, water and electricity supplies.

2. Shortage of skilled technical man-power and relative shortshightedness of manufacturing industries to indigineous businessmen.

3. Difficulities of getting feasibility studies data to aid future/anticipated development.

4. High share of foreign capital and high degree of dependence on foreign entrepreneurs.

5. Scarcity of willing and competent foreign partners.

6. Restrictive industrial policies or administrative bottle-neck that exists within Nigerian systems.

Objectives of Industrialisation

The most important objectives of industrial development in Nigerian include:

- Creation of a greater and dynamic economy.
- Creation of an egalitarrian and just society.
- Creation of a free and democratic society.
- Provision of bright and full opportunities for all citizens..

Industrial Policies

- To ensure rapid expansion and diversification of the industrial sector of the economy.
- To increase the income realised from manufacturing activities.
- To create more employment opportunities.
- To promote even development and fair distribution of industries in all parts of the country.
- To promote the establishment of industries which cater for overseas markets in order to

earn foreign exchange.

- To expand the programme of import substitution as well as raise the level of intermediate and capital goods production.
- To initiate schemes designed to promote indigeneous man-power development in the industrial sector.
- To raise the proportion of indigenous ownership in aggregate industrial investments in Nigeria.

Conclusion

The underutilized natural resources of Nigeria can be exploited to the brim and the industrial sector expanded to the maximum if the abundant local natural resources including both human and material as well as the large domestic market due to large population efforts can be exploited and fully encouraged.

Hence with improved enlightenment, better education, the future of industrial development in Nigeria is very bright.

CHAPTER TWO

(I) INTRODUCTION

(II) COCOA - THE RAW MATERIAL

(III) COCOA BEANS PROCESSING

CHAPTER TWO

I. INTRODUCTION

(a) - Introduction

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II. COCOA - THE RAW MATERIALS

(a) - Maintenance of Cocoa Farm

(b) - Harvesting, Fermentation and Drying of Cocoa

(c) - Cocoa Beans Quality

(d) - Cocoa Production History

III. COCOA BEANS PROCESSING

(a) - Beans Cleaning

(b) - Roasting

(c) - Winnowing

(d) - Grinding or Milling

(e) - Pressing of the Cocoa Liquor

CHAPTER TWO

I. INTRODUCTION

(a) Introduction:-

Like rubber, cocoa production went into decline at the height of the oil boom. Nigeria's cocoa yield potentials were either under-developed or abandoned outright for more lucrative import trade and government contracts.

Plantations that remained in production sold their produce to Nigeria Cocoa Board at a pittance.

Cocoa's bounce back to the limelight as a major export commodity was aided by two factors. The oil glut which necessitated the return of agro-based alternatives to oil, and the scrapping of the commodity board which had erstwhile enjoyed the monoply of export trade in cocoa.

Farmers and businessmen alike suddenly realised the new potentials in cocoa trade. Business adventurers and speculators joined in the scramble and price of cocoa at the form level soared. Nigerian farmers enjoyed a boom like never before. For many exporters cocoa has not only become a status symbol, but a means of repatriating money overseas.

Today, cocoa ranks second only to oil as foreign exchange earner, thus becoming the nation's soaring grace in face of economic decline. In the 1986/87 season, alone, the total production figures rose to 88,000 metric tonnes.

Projected figures for the current season is put at approximately 140,000 metric tonnes[1].

Due to cocoa's new position as a valuable export commodity, a three man team from the International Trade Centre (IIC) an arm of UNCTAD, Geneva, educated Nigeria Cocoa farmers and exporters on the technicalities of cocoa production and trade, at the Cocoa Dissemination Seminar just ended in Lagos (Jan. 1988).

According to the experts, Gill and Duffus cocoa market report, Nigeria cocoa rates as one of the best in the world market. This good reputation became slightly tarnished at onset of the cocoa scramble when cocoa export trade became an all comers market following the scrapping of the Commodities Board.

The Nigeria cocoa rated by the experts as slighly lower than Ghana cocoa is used in blending most other cocoa beans for the production of chocolate and other cocoa products for improved flavour. But the Cocoa Association of Nigeria (CAN) sees this allegation as blackmail and international consipiracy to force down the price of the Nigerian Cocoa since the genetic and productional quality of Nigerian cocoa is not in doubt.

(b) Discovery

Since the discovery of mild cocoa plant by the Americans, the production and use has spread across the world. In regions where cocoa did not thrive, the crop was consumed in one or several of its processed form. Chocolate is

particularly favoured in temperate countries because of its low melting point. Chocolate which solidifies after melting loses its eating value.

The world's total cocoa production for 1986/87 period was put at about 1,957,000 tonnes. Of this, Africa produced 55.6 percent, America 29.5, Asia and Oceania 12.4 percent and West Indies 2.5 percent.(2)

For the same period Western Europe consumed 37.1 percent of cocoa grindings followed by Americas at 33.3 percent Eastern Europe 13.5, Asia 8 percent and Africa 8.2 percent.(3)

Only very few crops are as versatile as cocoa. From the discarded pods to the shells of the cocoa beans, every item is useful. While pods and shells may be considered as waste in some countries, others have found various uses for such waste.

The cocoa beans is the most valuable part of the crop. The harvested cocoa crop is processed for the beans which are fermented before inn-drying to reduce its moisture content. It takes the beans about three months from farm level to world market at the earliest.

The fermented and well-dehydrated beans is pressed into cocoa liquor (paste). This pure cocoa mass contains about 55 percent cocoa butter, and 45 percent cocoa cake ground into powder.

When pressed 250 metric tonnes of cocoa beans gives about 95 tonnes of Butter, 105 tonnes of cocoa powder(4).

The rest is waste, made up of shells and moisture loss in production.

Cocoa beans sell at a much lower rate than butter. While the cake is the cheapest product.

But Nigerian exporters find it is easier to export cocoa butter as this fetches high revenue and reduces complications arising from food and drugs regulation of the various importing states and spoilage in transit.

(c) Uses

The use of the cocoa beans are diverse and numerous. The butter is used in confectionery, pharmaceutical and cosmetic industry. Chocolate is obtained from the cocoa mass, while the powder is utilised in dairy and confectionary industry.

With such versatile range of use, the cocoa trade is not only lucrative but essential. But as with export commodities, the danger of over-production is always very near its economic successes.

(d) Problems

On the home front, problems facing the farmers have been that of disease, high cost of pesticides labour and other overheads. Price fluctuations also make long-term planning or other economic capitulating meaningless. As of now, the farmers are at the mercy of world market prices which hikes or depresses in the asking price.

Since 1946, the cocoa trade has been characterised by sharp fluctuations, with prices hitting rock bottom at the peak of production. To maintain fair market level, over expansion should be curtailed while increased home consumption by the producer nation is expedient.

II COCOA - THE RAW MATERIAL

Cocoa is the botanical name and refers to the tree, the pods, and the infermented beans from the pods, cocoa refers to the manufactured product that is, the powder sold as beverages and for food manufactured but of recent has been used to describe the fermented beans in bulk.

Cocoa beans of commerce are the seeds of tree species theobram Cocoa 1 (indigenous to South America) which consists of twenty species of small bushes and trees.

Types:- T cocoa is the only one of commercial value and is divided into main groups namely "Criollo" C Cocoa seed without colour and "forasters" C cocoa seed with purple cotyledon but there is a third group known as "Trinitario" which is a breed between the former two.

Forasters is the most important commercial type, Trinitario constitute about 5% of the world's production with criollo less than 1%.

The cocoa tree grows to an average height of 7-10 meters and requires some shade from larger forest trees. From the time the seedling reaches a height of 1-2 meters, it throws out 3-5 fan branches.

(a) MAINTENANCE OF COCOA FARMING

The maintenance of a cocoa farm is an all-year programme embracing various operations at different periods of the year. The operations vary with factors such as climates fertility of the soil, age and vigour of cocoa trees and method of establishment of the cocoa farm. If the maintenance is correctly and adequately carried out; diseases and weeds will be less of a problem and their control can be achieved far more efficiently and effectively through weeding, mutching, shade management pruning, regeneration, replacement of dead trees.

(b) HARVESTING, FERMENTATION AND DRYING OF COCOA

HARVESTING: Pods are removed from the trees by cutting clearly through the stalk, care must be taken to avoid damage to cushions, since such damage can reduce bearing and permit entry of fungi. Knives are used to remove pods within arm's length and hooks for those in upper reaches of trees.

Ripe pods assume a distinctive coloury, green pods turning yellow, red pods and orange shade.

To keep farms clean of waste materials a pontential source of disease, fermentable pods are conveyed to the fermentary and hiks are remove there.

FERMENTATION AND DRYING OF COCOA:

Fermentation and drying of cocoa is done in the fermentary. The beans with pulp removed and transferred to heaps, boxes or baskets for fermentation to take place which lasts for about 5-6 days with the

temperature increasing from 32-50°C[5]. It is important to give occasional mixing to earate the beans. After fermentation, the beans are placed in shallow trays or mats to try. In West Agrica where the sun is hot enough, the beans are sun-dried while in places like South America, dryers such as chula, samoon, and mechanial dryers are used.

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

FLOW DIAGRAM OF COCOA FERMENTATION

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

death of beans

loss of germinatory power

Destruction of coloured anthocynains

Development of chocolate aroma and flavour potentials

(c) COCOA BEANS QUALITY

The importance of a consistently high standard of quality in cocoa beans cannot be over emphasised. The bulk of the World's cocoa is used in the manufacture of chocolate the quality of which depends solely on the quality of the cocoa beans processed. Chocolate is food. It is paramount therefore for growers, manufacturers and everybody else involved in the cocoa industry to be conscious of the cocoa beans quality and to strive to maintain high quality standards.

The grade standards as laid down by the World's standard bodies such as the cocoa Association of London (CAL), the Association Francaise du Commerce des Cacao (AFCC), the United States Cocoa Merchants Association (CMA) and the codex Alimentarius commision are shown in the table below.

TABLE I:- COCOA BEANS GRADE STANDARDS(6)

	% Slatey	% Mouldy	% Other defects
GRADE I	3 Max counted	3 Max counted	3 Max counted
GRADE II	8 " "	4 " "	6 " "
NO GRADE	78	74	76

Slatey:- Beans are characterised by grey slate colour and cheesy texture.

Mouldy:- Appearance of visible moulds.

Other defects:- Coerminated, flat smoky.

The Cocoa Beans are also classified as Main Crop or Light Crop (Lic) depending on the beans size and informity % shell content and % fat content.

Finally, it is pertinent to say that normal manufacturing process will not improve the defective state of a consignment of cocoa beans particularly in respect of defects relating to flavour, so Grade I main crop (M.C) beans should be used.

(d) COCOA PRODUCTION HISTORY

Cocoa as a commodity crop is produced in 32 countries of the world in varying degrees of intensity. Prominent amongst World producess of reput are in major countries that account for about 72% of total World production as follows[7].

Ivory Coast	=	29.6%
Brazil	=	19.3%
Ghana	=	11.2%
Malaysia	=	6.5%
Nigeria	=	6.2%
Cameroun	=	6.1%

It is an undisputable fact that cocoa is a political crop and as such plitical decisions are always made in cocoa producing countries to reflect the thinking of the leaders of those countries.

III. COCOA BEANS PROCESSING

Cocoa beans processing involves the following stages of operation in sequential order.

(a) BEANS CLEANING

The beans are cleaned to remove foreign matter such as stones or pebbles, twigs, strings, metallic objects etc. Uncleaned or poorly cleaned beans will lead to
- damage to machine parts
- poor quality of finished products.

(b) ROASTING:

The cleaned beans are roasted to:
- develop the inherent chocolate flavour derived in the finished product.
- reduce moisture level
- make the shell loose and easy to remove.

The roasting stage is critical to the quality of the finished product. It is during roasting of the cocoa beans that the chocolate flavour most desired by the manufacturer and the consumer of the finished product is developed. This operation therefore calls for skillful and careful handling. Here the beans size and uniformity are of vital importance as nonuniform size beans will not roast evenly. Here also attention is paid to quality. Highly slaley and highly mouldy beans will be expected to produce off flavours.

The level of moisture in the roasted beans is expected to be less than 2%.

Higher level of moisture will be attended by process problems such as poor flow of the liquor along the process lines. Good roasting will give rise to good grading and easy release of fat from the cocoa solid.

Typical composition of roasted cocoa beans[8].

Nibs 87.1% containing about 55% fat

Shell 12%

Germ 0.90%

(c) WINNOWING

Winnowing is the process of breaking the roasted beans followed by the seperation of the shell from the flesh (cotyledon or cocoa rib). Complete seperation of the shell from the ribs is not possible but the level of shell in ribs or ribs in shell is usually kept below 0.5%. Excessive level of shell in ribs poses difficulty in grinding while excessive level of ribs in shell results in lowering of yeild of product.

(d) GRINDING OR MILLING

In the process of grinding, the roasted cocoa ribs are transformed into a paste or fluid cocoa called cocoa masse or cocoa liquor. During the grinding process the cocoa fat is released in the heat that accompanies the mechanical process. Thus in the liquor or masse the cocoa solid swims in the sea of its own butter or fat. No water is added.

The degree of finess of the liquor or masse depends on.

- The type of mill used. There are various types of mills designed for different stages or grinding. We have mills for primary, secondary or tertiary grinding.
- The number of stages of grinding.
- The desired level of finess of the finished cake or powder as specified by the customer or end user.

The two grade of finess commonly requested for by the end user of the cocoa cake or powder are:

- less than 2.0% residue on 200 mesh sieve
- less than 10.0% residue on 200 mesh sieve

(c) PRESSING OF THE COCOA LIQUOR

Pressing is the process of compressing the cocoa masse or liquor to the extent that the free and available butter sips out of solid cocoa.

Prior to pressing, the cocoa liquor is held or stored in tank at specified temperature and for specified period to mature. During this period the moisture level of the cocoa liquor is brought down to a level desirable (below 1.5%) for easy pressing. Also during the heating process the level of bacteria in the material is brought down to a tolerable level. The heating is controlled to prevent overheating and subsequent damage to the cocoa butter.

The amount of butter pressed out of the cocoa liquor depends on:

- the level of fat required in the residual cocoa solid (cake) as specified by the user.

We have low fat (10-12% fat) cake as well as high fat (20-22%) cake.

- The efficiency of the presses.

The cocoa butter pressed out of the presses is passed through hydraulic press fillers to remove the cocoa solids in it. The filtered butter is then tempered and packed in corrugated craft paper cartons in units of 25kg weight. The butter flows out of the tempering machine chilted and fluid but soon solidifies inside the cartoon. The butter is stored in an air conditioned room of 22°C prior to shipment. It takes about 2 weeks for the solidified butter to mature.

The melting point of cocoa butter is 34°C and will therefore remain solid under normal ambiant room temperatures. The residual cake is discharged from the press in form of discs each weighing about 8-9g. These are fed into kibblers which break down in manageable pieces (kibbled caked). The kibbled cake is packed in poly propylene bags lined with nylon in unit weights of 40kg for export.

The cocoa cake is referred to as Natural/ordinary cake if no chemical has been added to the cocoa during processing while the cocoa cake is called Alkalised cake if an alkali (e.g. sodium or potasium carbonate) has been added. The process of adding solution to the cocoa ribs or cocoa liquor is called Alkalization or simply the Dutch process.

The Alkalised cocoa cake is usually pulverised into cocoa powder for use in beverage manufacture.

A yield of 80% is expected in cocoa processing. That is for every 100 tons of cocoa beans processed 80 tons of butter and cake are expected. And of the 80 tons cocoa cake portion is expected to give + 45 tons while the butter portion will be + 35 tons.

The overall yield may in fact be less than 80% if the starting raw cocoa beans contain a lot of fat beans or high percentage of shell.

The cocoa butter and cake are immediate products which are further processed to produce other products.

NOTES

1. SUSANNAH O. - "COCOA".
   DAILY TIMES, FEB 9 1988
   P7

2. Ibid, P7

3. Ibid, P7

4. ADVISORY PAMPHLET No 1 - "COCOA"
   COCOA RESEACH INSTITUTE OF NIG.
   MAY 1986 P4.

5. ADVISORY PAMPHLET No 6 - HARVESTING, FERMENTATION AND DRYING OF COCOA
   COCOA RESEARCH INSTITUTE OF NIG.
   MAY 1986 P1

6. Ibid P10

7. YESUFU T.A. - COCOA
   A PAPER PRESENTED AT A COCOA CONFERENCE AT AKURE (ONDO STATE)
   Organized by the Nigeria Export Promotion Council (NOV. 1987) P1

8. Ibid P2.

9. Ibid P3.

CHAPTER THREE

CASE STUDIES

(1) COCOA INDUSTRIES LIMITED, IKEJA, NIG.

(2) COCOA PRODUCTS FACTORY, TAKORADI, GHANA

CASE STUDIES

The purpose of carrying out case studies when designing a factory are:

(a) To examine the principles involved in the design of such factory.

(b) To see how the predecessors translated these principles into reality.

(c) And to analyse the problems as per the design of the factory so that the proposed factory will be devoid of these problems.

Research work for the purpose of case study has been carried out on 2 major cocoa industries in West Africa, namely:

(1) Cocoa Industries Limited, Ikeja, Nigeria.

(2) Cocoa Products Factory, Takoradi, Ghana.

Geographically, these two industries are situated in the Southern part of West-Africa hence they share in common sc many factors affecting industrial goods and service production e.g. climatic condition etc.

THE COMPARATIVE ANALYSIS OF CASE STUDIES

(a) Site

1. C.P.F. Takoradi Ghana

56 Arces (22.7 Hectares) South of city centre in area designated for both residential and industrial development site is prominent. Site on undulating ground and adjacent to valley which is public open space.

As impact of project on adjacent residential community would be considerable landscaping assumed exceptional significance client mounted exhibition to explain project to local community groups.

(ii) C.I.L. IKEJA NIG.

A member of C'dua group of companies is located in Ikeja industrial estate in Lagos State of Nigeria. It was incorporated in 1965 with commercial operations commencing in 1967 and expanded in 1975. The present factory covers an area of 14 acres in industrial area.

(b) GENERAL INFORMATION

1. C.P.F. TAKORADI

DESIGN TEAM:- SOM + PRT GHANA

ARCHITECTS:- SOM + PRT GHANA

STRUCTURE:- Felix J. SAMUEL & PARTNERS

SERICES:- STEENSEN Varm harm & Partners

QUANTITY SURVEYORS:- Gleeds

LANDSCAPE:- Kenneth Booth

SOUND CONTROL:- The Wolfson Unit.

Project Team

W.D & H.O. Wills project group materials handling consultants modern materials management and design team.

Building Team

Constructed by thyssen stahlunion of Dusseloorf in 1963, GHANA.

(d) Zoning

(i) C.P.F. TAKORADI

The factory is not properly zoned. The administrative block is in front of the production Hall. The workers facilities are to the side a little far back. The auxilliary facilities and loading bays are behind the production hall. The security blocks are by the two gates. See fig.

(ii) C.I.L. IKEJA

The noisy and dirty zone of the factory (for example production hall, maintenance workshop) are sited at the hall while the quiet and lean zone (for example admin block, framing school) are infront but the fuel tank and one of generators are also infront which give the factory an unsightly impression. The workers facilities like canteen and clinic are close to the administrative block while the maintaince workshop is close to the production hall. There is a well defined loading bay front of the production hall. The laundry and fire station which are less often in use are a bit on the far side of the factory. The visitors car park outside the factory, while only the executives have a defined car park in the factory, the other workers just park anywhere as long as you are not obstructing the road. There is a gate house with clock-in facility by the gate. See fig.

(c) WORKERS FACILITIES

(i) C.P.F. TAKORADI

Workers facilities available are senior and junior canteens, clinic Training School, changing rooms and toilets common rooms and library.

(ii) C.I.L. IKEJA

Some are above excluding common rooms and library.

(f) Interior Design

(i) C.P.F. TAKORADI

In the two factories, there are good colour impact where the colours of the machines, services pipelines, wall and floors are complementary to each other for good working conditions.

(g) Services

(i) C.I.L. IKEJA

There is laundry where all the overalls are washed weekly. Waste dispose by the use of dust bins. Apart from fire in sulating materials used in construction of the buildings there is fire station on site in case of any fire outbreak, good sanitary conditions for high standards of hygiene.

(ii) C.I.F TAKORADI

Same as above including fire extinguishers in the production hall while there are fire fitting fighting pumps and hydrants with a radius circulation of 25meters outside the hall.

(h) PRODUCTION FLOW

C.I.L. IKEJA

The processing is orthodox in the sense that the high graded beams are subjected to the traditional sequence of processing involving bean cleaning

roasting winnowing, rib grinding pressing, clarification, tempering and pàcking of cocoa butter. The production flow is a straight line.

(ii) C.P.F. TAKORADI

Same as above. But the production flow is "u" shaped

(I) Flexibity

They all have flexible production halls, that is without major changes, building can be used for new production technology or for different activities of the factory.

(J) Future Expansion

(i) C.P.F, TAKORADI

Has vast land behind the factory fence for future expansion, not appropriate and well planned.

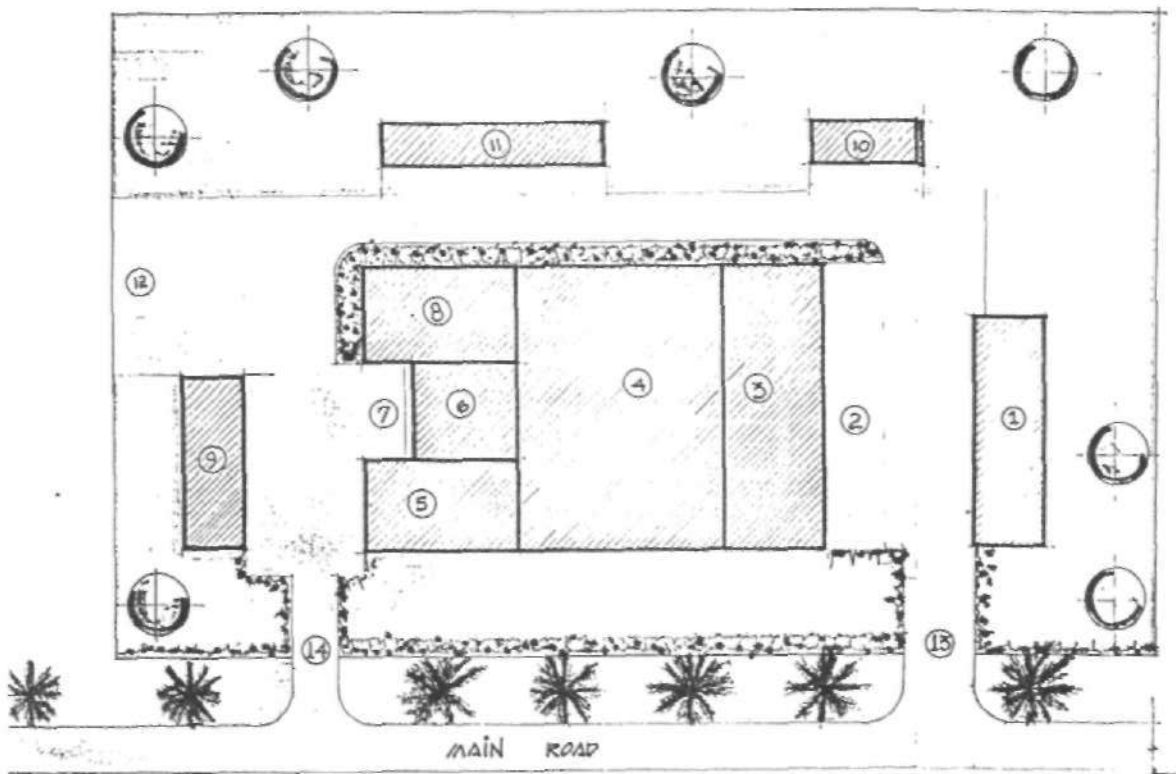
(ii) C.I.L, IKEJA

Has very little land for future expansion.

Findings

- Use of high building to house some machines due to special function is needed to be performed by the machines -
- Farness of changing rooms.
- Inadequate office accommodations.
- Use of manpower for intermediate flow during processing reduces production.
- Adequate land needed due to technological growth.
- Best production flow is u-shaped.
- Good zoning needed.

case study 2
cocoa products factory takoradi 'GHANA'



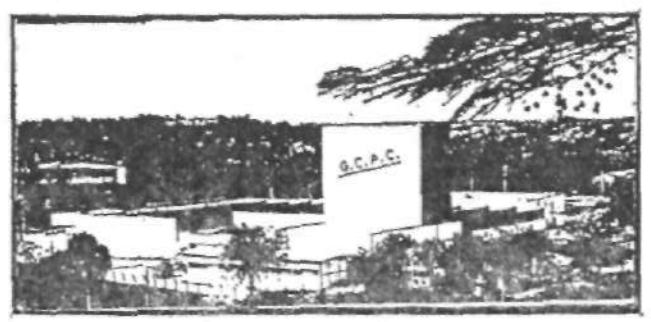
key

1 ADMIN BLOCK.
2 CAR PARK.
3 PROCESS FUNCTION
4 PRODUCTION HALL
5 RAW MATERIAL STORE
6 OFFICES
7 LOADING BAY.
8 PACKING AND STACKING OF FINISHED PRODUCTS
9 AUXILIARY BLOCK.
10 BOILER HOUSE
11 CATEEN, CLINIC, EDUCATIONAL CENTRE
12 ENTRANCE FOR LORRIES
13 ENTRANCE FOR CARS.

SITE

56 ACRES (22·7 HECTARES) SOUTH OF CITY CENTRE IN AREA DESIGNATED FOR BOTH RESIDENTIAL AND INDUSTRIAL DEVELOPMENT. SITE IS PROMINENT SITE ON UNDULATING GROUND AND ADJACENT TO VALLEY WHICH IS PUBLIC OPEN SPACE. AS IMPACT OF PROJECT ON ADJACENT RESIDENTIAL COMMUNITY WOULD BE CONSIDERABLE LANDSCAPING ASSUMED EXCEPTIONAL SIGNIFICANCE CLIENT MOUNTED EXHIBITION TO EXPLAIN PROJECT TO LOCAL COMM

layout



SITE PERSPECTIVE

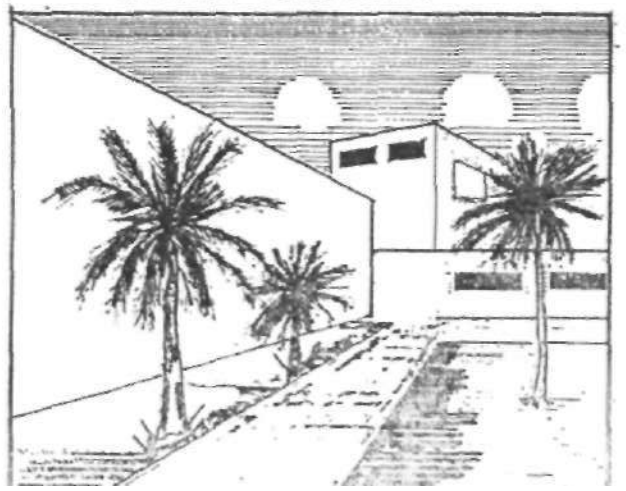
DESIGN TEAM.
ARCHITECTS: GAM + PRT GHANA
STRUCTURES: FELIX J. SAMUEL & PARTNERS.
SERVICES : STEENSEN VARIA HAAN & PARTNERS
QUANTITY SURVEYORS: GLEEDS.
LANDSCAPE: KENNETH BOTH.
SOUND CONTROL: THE WILFSON UNIT.

PROJECT TEAM.
W.D & H.O WILLS PROJEC GROUP MATERIALS HANDLING CONSULTANTS. MIDEKN MATERIALS MANAGEMENT, AND DESIGN TEAM.

BUILDING TEAM.
CONSTRUCTED BY THYSSEN STAHLUNION OF DUSSELDORF IN 1968.

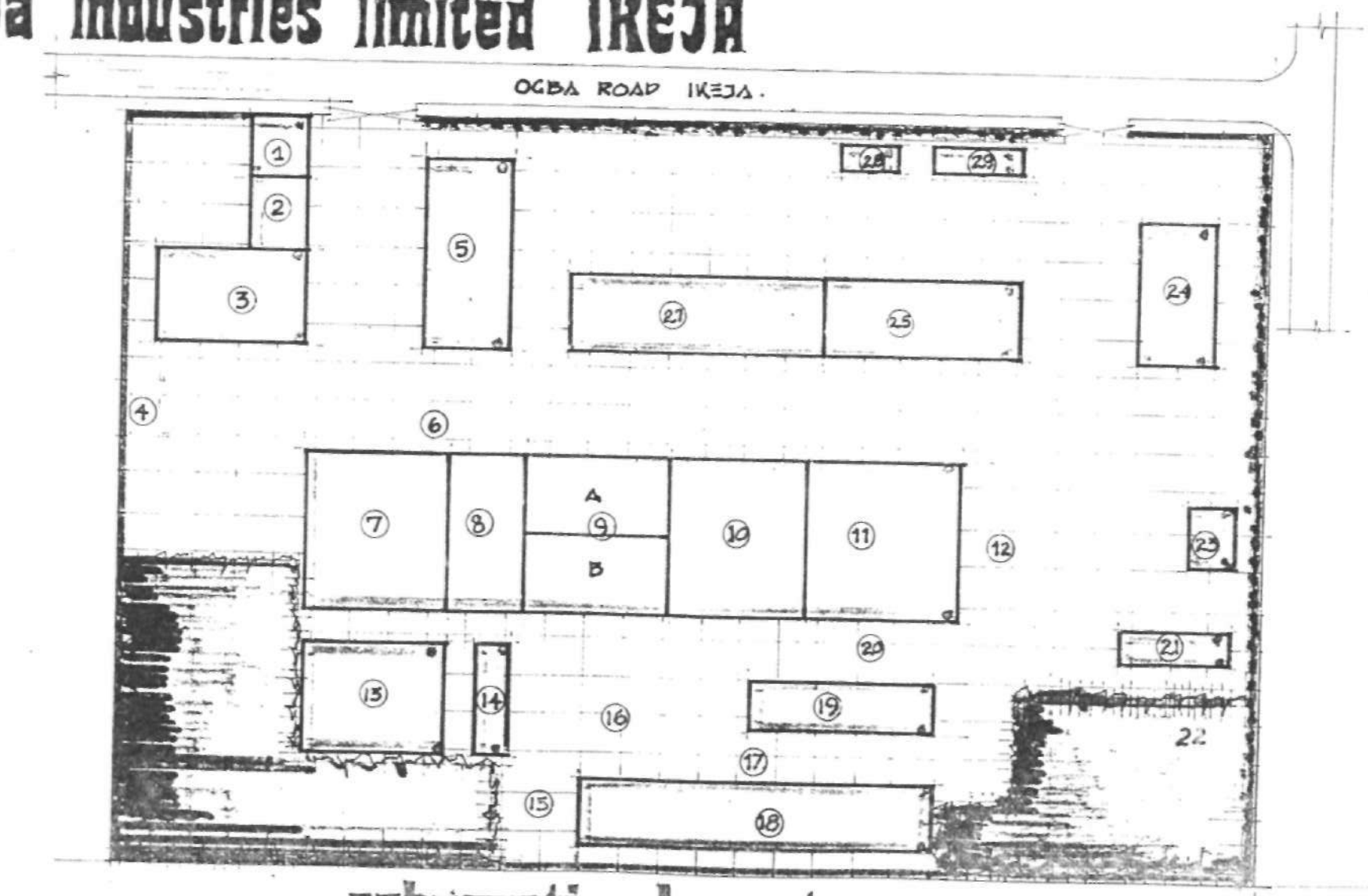
CLIENT.
OPERATED BY THE GHANA COCOA MARKETING BOARD.

INTERIOR PERSPECTIVE



case study 2

cocoa industries limited IKEJA



schematic layout

key

1 GATE HOUSE.
2 CLOCK-IN.
3 ADMIN / ACCOUTS.
4 CAR PARK - STAFF.
5 PERSONNEL & TRAINING MANAGER/CLINIC
6 LOADING BAY.
7 VITALO PRODUCTION HALL.
8 FINISHED PRODUCT STORE.
9 COCOA POWDER AND BUTTER 'P' HALL.
10 PRODUCTION HALL.
11 COCOA BEANS STORE AND PROCESSING
12 OFF LOADING BAY.
13 FACTORY EXTENSION.
14 MARKETING / PRODUCTION STAFF.
15 WORKERS CAR PARK.
16 CARPENTERS WORKSHOP.
17 CAR PARK.
18 AUXILLIARY WORKSHOP/OFFICES.
19 WATER TREATMENT PLANT.
10 WASTE PRODUCT
21 MAINTANENCE CAR PARK.
22 MAINTANENCE YARD.
23 FIRE STATION.
24 QUALITY CONTROL DEPARTMENT.
25 CANTEEN.
26 CANTEEN.
27 KITCHEN.
28 FUEL TANK.
29 GENERATOR HOUSE.

SITE.

A MEMBER OF ODUA GROUP OF COMPANIES IS LOCATED IN IKEJA INDUSTRIAL ESTATE IN LAGOS STATE. IT WAS INCORPORATED IN 1965 WITH COMMERCIAL OPERATIONS COMMENCING IN 1967 THE PRESENT FACTORY WAS BUILT IN 1975. CIL MAKES DRY COCOA MIX NAMELY 'VITALO' AMONG OTHER THING.

BUILDING TEAM.

JOHN LAING CONSTRUCTION (MANAGEMENT CONRACTORS) WILLS PROJECT GROUP AND DESIGN TEAM.

SITE:

14 ACRES. IN INDUSTRIAL AREA.

CHAPTER FOUR

(I) FACTORY PRODUCTION PROCESS

(II) PRODUCTION FLOW DIAGRAM AND TECHNOLOGICAL LAYOUT

(III) ANALYSIS OF NECESSARY MACHINES

(a) The dry stoner

(b) Continous convectional beans roaster

(c) Winnower

(d) Beater blade mill

(e) Agitator ball mill

(f) Vacuum mixer -

(g) Presses

(h) Cake crusher

(i) Powder plant

(j) Pressurized cooler with Pre-cooler cocoa butter

(I) FACTORY PRODUCTION PROCESS

For many people, design as an expression conjures up a concern with aesthetics, that is to say, an appreciation of the beautiful. On the other hand, technology, is regarded as being concerned with the technical means of achieving a given goal. The former seems very much a theoritical and abstract approach while the latter is a pratical down-to-earth business.

There are many definitions of design, but a useful one is, a purposeful plan before creative activity. However, without some understanding of the technology of material in which one is working, it is impossible to design effectively especially for an industry. There is little doubt that the design of an industry and the technological process of its products are very close partners in any creative activity of a three-dimesional nature. This close relationship, although they are not always equal partners, should become established in the designer's mind.

It is in the light of the fore said that detailed study of the production process and technology of the proposed factory was undertaken.

A factory either has a layout based on production or on a process. If a factory produces a large quantity of a few products, then the design is functioned on

production layout while if a factory produces a great number of products, each relatively small, run by similar processes, then the design is functioned on a process layout. The proposed factory design is based on product layout since only 4 products of large quantity are to be produced.

There are 2 basic classes of raw material used in industrial processes namely:

(a) The unprocessed raw material.

(b) The semi-processed raw material: This is the raw material that has already undergone some industrial process from the crude form.

In this industry, the unprocessed raw material is the cocoa beans. A foresight into production process is available in (Chapter 2 page).

There are 4 finished products to be produced by this factory are:

(a) Cocoa powder

(b) Cocoa cake

(c) Cocoa butter

(d) Shell

These raw material (cocoa beans) are brought to the factory by trailers and vans which offload the goods in the delivery bay from where they are transported by forklifts to the store. The store keeper keeps records of all deliveries and issuings.

From this the cocoa beans goes into processing through the following sections as discuss in Chapter 2.

(1) Bean roaster/Winnower section.

(2) Beater blade/Refinery section

(3) Press section

(4) Cake section

(5) Powder section

(6) Cocoa butter section

(7) Packing section.

See production flow diagram fig. over leaf.

(II) PRODUCTION FLOW DIAGRAM AND TECHNOLOGICAL LAYOUT[1]

(III) ANALYSIS OF NECESSARY MACHINES

(a) The dry stoner (cleaning machine)[2]

- Function - To remove stones and other particles from the cocoa beans and discharge them through the stone outlet.
- Type Range

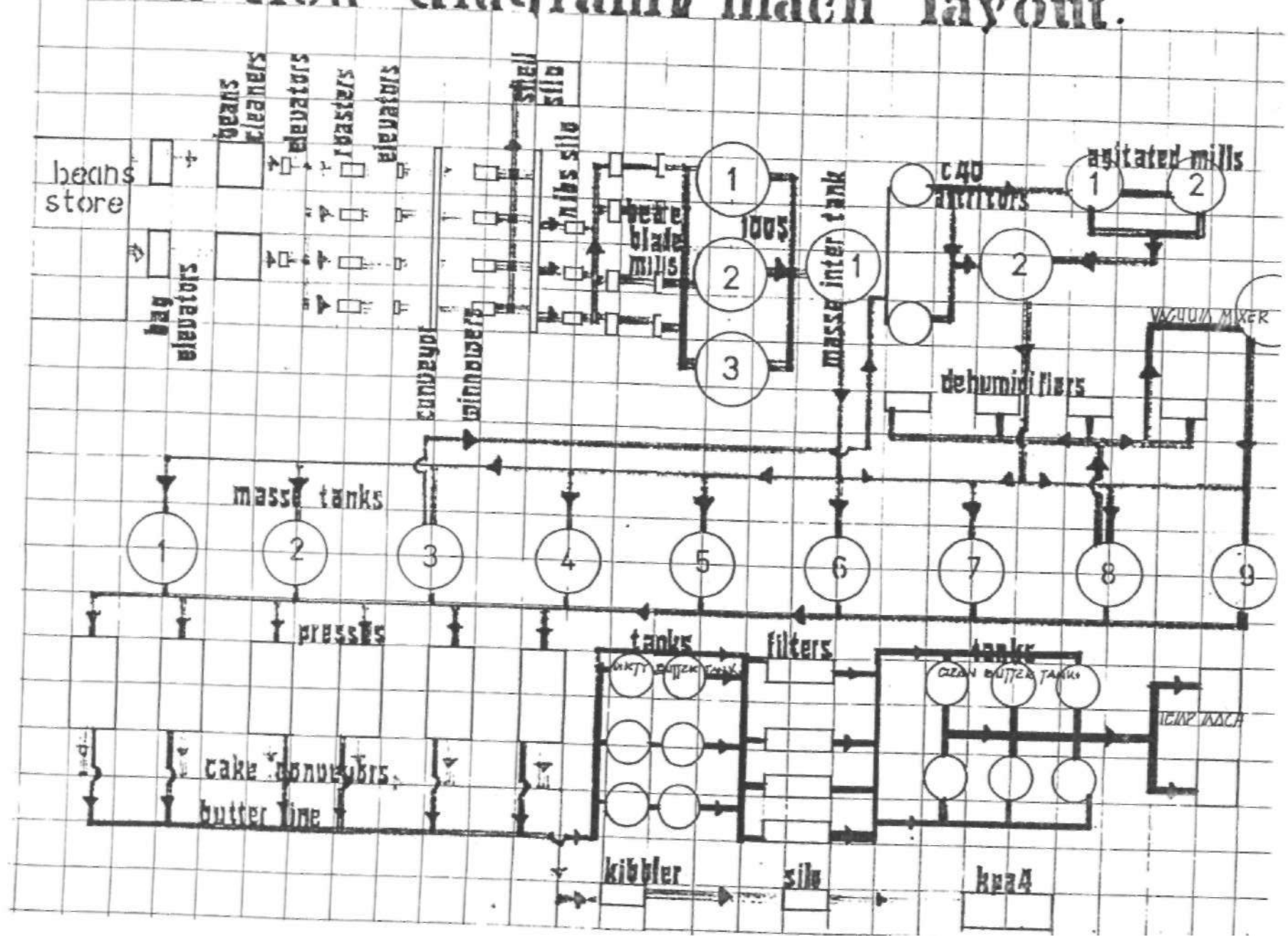
  three dry stoner sizes are available

  1) MTSB - 50 = $0.5m^2$ Area of sep plate
  2) MTSB - 100 = $1.9m^2$ " " " "
  3) MTSB - 150 = $1.5m^2$ " " " "

  All the 3 sizes can be supplied in reinforced design for abrasive products.
- Erection

  level lenght and width of substructure in horizontal position with the aid of a sprit level and both to the fixing holes in the bottom.

tech' flow diagram & mach' layout.



(b) Continous Convectional Beans Roaster[3]

The machines uses cheap gas to roast the cocoa beans thus preparing it for easy breaking for further processing.

(c) Winnower[4]

- Function:- The machine serves to crush raw, roasted or Kiln - dried cocoa beans and to subsequently separate the shells from the nibs, thus obtaining a product with an absolute minimum number of shells.
- Type

BR 62 - made by Bauermeister Company

Connected load KW 16

Air thoughput M^3/m 3780

length	mm	4150
width	mm	3300
height	mm	2.636
weight	kg	4300

(d) Beater Blades[5]

- Function - for the continous grinding and subsequent vacuum processing of pre-dried and roasted cocoa nibs as well as other raw materials with a high oil content.
  No after - roasting during the grinding due to sufficient cooling within the mill.
  Smooth product handling achieves optimum floor properties.

- Type

Vacuum Veater Blade Mill SMM 800V

Throughput	Kgs/h	up to 1000	
Sieves	mm	0.15 - 0.5	
		mill vacuum unit	
Connected load		48.61	4.25
length	mm	2320	1550
Width	mm	1460	900
Height	mm	2180	2410
Weight	Kgs	1850	200

- Floors

There will serve all floors resisting to more than 800Kg/m^2. Bases are required only if the height of 355mm for the product discharge is not sufficient, or if an easier maintenance of the v-belt shall be secured.

The dymanic load of the floor is low and must not be taken into consideration. It is very important that the machine is perfectly levelled across the conveying direction of the dooring apparatus.

e) Agitator Ball mill(6)

- Function - The liquor fed into the mill is ground by the balls moved by the agitator and pumped out from below by liquor pump. The ball are retained by the sieve in the chamber below.

- Type

Weiner 100s typer rated to do 1.5tonnes/hr

lenght - 2180mm

width - 1180mm

height - 2250mm

- Subsoil and foundation

  Special foundation not required. If the mill has no calotte feet the subsoil must be horizontal and plain, in order to guarantee a perfect resting of the base plate of the lower part of the mill on the floor. If the floor bearing capacity is not significant, the doubt of the supports must be increased by placing steel plates underneath it.

- Special requirement for Operation and Maintainance

  On all sides, the mill should be at distance of at least 1000mm from the neighbouring machines or building. Height of the room should not be less than 3.200mm.

(f) Vacuum Mixer - Type PMV 3[2]

- function:- The machine intensively mix a pre-set water quantity with the product to be treated so as not to easy dissolutions. Afterwards, the added humidity is again rapidly eliminated by condensing the vapours and discharging them by means of vacuum pump.

- Type PMV 3

  The model PMV3 is one-shaft mixer with a filling capacity of 3000 litres.

- Dimensions

  lenght - 2.60m

  breadth - 1.50m

  height 0.90m

(g) PRESS[8]

- function - The press serves to squeeze out the butter content of the cocoa masse. It presses down to 10% residual fat in the masse. The butter from there is pumped into settling tanks for further processing while the cake goes to the crusher via the conveyor belt.

(h) Cake Crusher[9]

- function - The crusher serves to reduce the cocoa cake into nut sizes. The amount of fires in the kibbled cake is made as low as possible. The crusher has too distribution lines one leading the Kibbled cake to the scale for weighing and parking for marketing while the other goes to the powder section.

(i) Powder Plant[10]

The powder plant grinds the crushed cake into powder for packaging, and distribution. It is an inflammable machinery thereby necessitating provision of both automatic cooling plant for the engine as well as fire fighting machines to combat fire outbreak.

(j) Pressurized cooler with Pre-cooler (Cocoa butter)[11]

The cocoa butter is aspirated by the pump out of the storage tank. At the 3-way cock (G) the butter can be conducted directly to the cooling unit (IX) or through the pre-cooler (UK) and then to the cooling unit, which uses ammonia gas (NH3) for cooling.

NOTES

1. Bauermeister - "the experts for cocoa industry" Probat London May-1987. Pp 2-3.

2. (11) Ibid pp7 - 106

CHAPTER FIVE

(I) PRODUCTION CAPACITY

(II) LABOUR FORCE

(III) PRODUCTION HALL

(IV) WORKERS ZONE

(V) ADMINISTRATIVE ZONE

(VI) AUXILLIARY ZONE

(I) CAPACITY OF FACTORY

Capacity of the factory is determined by the capacity of storage and the secifications by the International Cocoa Organisation (ICCO).

ICCO specified 31,000metric tonnes of cocoa maximum that can be processed by any Industry in West-Africa due to the climatic conditions man power availability and market for finished products. The expected cocoa (raw material) that will be processed in this industry is 30,000 metric tonnes per year which can conveniently be supplied by the cocoa Research Institute of Nigeria and the Co-operative Farmers Society store of Ibadan. The storage capacity of the store is expected to be 90,000 metric tonnes which can serve the processing plant for 3 years in case of inadequate raw material supply.

(II) LABOUR FORCE OF THE PROPOSED FACTORY

Is the total number of people expected to work in the factory, that is both the skilled and unskilled.

Four production shifts (RED, BLUE, GREEN AND YELLOW) are expected to operate the factory continuously on a 4-shift system covering 24hours of each day, seven days of the week and fifty weeks in a year in the last to weeks of the year the factory will be shot down for intensive over haul. There are basically 4 categories of labour force.

		NO REQUIRED
(a)	The Production staff	440
(b)	The Administrative and Sales staff	100
(c)	The Auxilliary and Maintenance staff	60
(d)	The Workers facilities staff	50
	Total number of staff	650
	Number of femal staff	90
	" " Male "	460

(III) SHEDULE OF ACCOMMODATION

The allocation of the right amount of space to every activity and function in a programme greatly determines the quality and efficiency of a design. The Architect at this point of programming process needs to translate the clients ideas into square meter area of net usable space as well as into square meter of space required for services and circulation. For a factory, these values relates to the production process inside the factory.

The proposed factory will comprise 4 main zones namely:

(a) PRODUCTION ZONE

(b) WORKERS FACILITY ZONE

(c) ADMINISTRATIVE ZONE

(d) AUXILLIARY ZONE

(a) PRODUCTION ZONE

The size of the production halls depends largely on the sizes and number of the various machines, which depends largely on the capacity of the proposed factory.

Total Operational hours = 8400HRS = 50 WEEKS

To know the number of machines required per unit, the efficiency of the machines is required. To calulate the space requirement for production halls, these variables are used. Considering all machines working at maximum efficiency and if all variables are positive.

$$\text{No of machines required} = X = (T)\ \frac{\text{Production capacity}}{E \times 8400}$$

Where T = 30,000 Tonnes per year

E = Efficiency of machinery

8400 = Total operational hours per year

TYPE OF MACHINERY	Efficiency (E)	NO REQ.	AREA OCCUPIED PER 1 (m^2)	TOTAL AREA REQ' + CIRCULATION AREA (m^2)
VERTICAL BEAN ELEVATOR	10 tonnes/hr	1	1	1.5
BEAN CLEANING MACH' BUHLER TYPE	3.5 tonnes/hr	3	17.84	60
Bean roasting mach' Probat type	1 tonne/hr	5	12	70
Bean winnower	2.2 tonnes/hr	5	14.5	45
Bauermeister beater blade mills model smm 800	0.8 tonnes/hr	8	2.5	25

TYPE OF MACHINERY	Efficiency (E)	NO REQ.	AREA OCCUPIED PER 1 (m^2)	TOTAL AREA REQ' + CIRCULATION ARE. (m^2)
Ball mills C-40 type	0.5 tonne/hr	6	2	15
Dehumidifiers B-type	2 tonnes/hr	6	4	30
Vacuum Kneader B-type	2 tonnes/hr	1	3.9	3.9
Presses B-type	2presses/hr	6	5	36
Cake Kibbling Mach'		2	2.5	6
Schule press fitters	1 tonne/hr	1	3	4
Butter fitter mach.	0.8 tonne/hr	2	5	12
Tempering mach'	2 tonnes/hr	1	3.5	5
Powder plant for Cocoa powder 1-pin-disc Mill-B' type KPA4	1 tonne/hr	1	30	35

WORKERS FACILITIES

ACCOMMODATION	No of Rooms	Area Req/1 Room m^2	Total Area m^2	R E M A R K S
Senior Staff Canteen	1	50	50	Enough space for dinning of 40 people at a sitting serving space and circulation space
Junior Staff Canteen	1	90	90	Enough space for the dinning of 100 people at a sitting serving and circulation space
Caterers Office	1	12	12	Working space, 1 1 file cabinet and circulation
Kitchen	1	70	70	
Pantry	1	Ample	Ample	For non-perishable goods
Wet Store	1	Ample	Ample	For perishable goods
Common Room	3	45	135	Each for 15 people at a time
Toilets and Showers	2	15	30	For Catering Workers
Changing Rooms			200	With lockers for all the production wo workers who need to change
Bicycle Shed	1	Ample	Ample	
Training School	2	30	60	15 Students each
Clinic	1			
Examining Room	1	20	20	Doctors working space examination bed, wash hand basin, book shel shelf and circulatio space

ACCOMMODATION	No of Rooms	Area Req/1 Room m^2	Total Area m^2	R E M A R K S
Waiting room	1	25	25	For 8 persons at a time, working space for a nurse and circulation space.
Dispensary	1	20	20	Working space for a dispenser.
Card room	1	15	15	Working space for 1 attant, shelves for cards and clati space.
Store	1	Ample	Ample	For drugs and Clinical Equipments.
Toilets	2	3	6	For the medical personnel and patients
Ampulance park	1	Ample		

V. ADMINISTRATIVE ZONE:- The need for administrative department of any factory is to ensure smooth management of the factory. The space needed depends largely on the type of business organisation, number of pieces of furniture and the degree to what work-places are partitioned.

ACCOMMODATION	NO OF ROOMS	AREA REQ PER ROOM (m^2)	TOTAL AREA (m^2)	R E M A R K S
Reception lobby	1	80	80	Working space for 2 receptionists, a show room for display of products, a waiting room for visitors, toilets for visitors and circulation space.
Public Relations Officer	1	25	25	Working space, 2 visitors sofa, 2 file cabinets and a book shelf.
General Office	1	130	130	Working spaces for 6 clerks, 3 typists and 2 messangers, 4 file cabinets and circulation space.
General Manager	1	36	36	A large working space, 6 visitors sofa around a coffee table, 2 file cabinets, book shelves and circulation.
Gneral Manager's Secretary	1	25	25	4 file cabinets, working space, visitors waiting area, coffee mailing area, messenger's seat and circulation space.
Personnel Manager	1	25	25	Working space, 2 file cabinets, book shelf and circulation spac
Personnel Office	1	30	30	Working space for 3 personnel staff, 4 file cabinets and circulation space.
Personnel Office Secretary	1	20	20	Working space, 4 file cabinets, Coffee making area, visitors waiting area and circulation area.
Sales Manager	1	25	25	Working space, 12 visitors sofa, 2 file cabinet and circulation space.

ACCOMMODATION	NO OF ROOMS	AREA REQ PER ROOM (m^2)	TOTAL AREA (m^2)	R E M A R K S
Sales Manager's Secretary	1	20	20	Working space, 4 file cabinets visitors waiting area and circulation space.
Assistant Sales Manager	1	20	20	Working space, 1 file cabinet visitors waiting area and circulation space.
Purchasing Manager	1	25	25	Working space, 1 file cabinet, visitors sofa and circulation space.
Sales Office	1	65	65	Working spaces for 5 sales clerks and 1 messenger, 4 file cabinets and circulation space
Cash Office	1	50	50	Working space for 2 cashier a large safe, 2 file cabinets an good circulation space.
Accountant	1	25	25	Working space for 1 person, a large safe visitors chairs, book shelf, 2 file cabinets and circulation space.
Accounts Office	1	30	30	Working space for 1 secretary 2 accounts clerks, 2 file cabinets, visitors waiting and circulation space.
Research Market Analyst	1	20	20	Working space, a computer, 1 file cabinet and circulation space.
Training Co-ordinator	1	20	20	Working space, book shelves and circulation space.
Cleaners Room	1	10	10	
Transport Office	1	15	15	Working space for 1 transport clerk and 6 drivers and circul tion space.
Library	1	110	110	Working space for 1 Librarian, space for 500 books, and Journals, reading space for about 20 people plus the circulation space.

ACCOMMODATION	NO OF ROOMS	AREA REQ PER ROOM (m^2)	TOTAL AREA (m^2)	REMARKS
Telephone exchange	1	18	18	Telephone exchange machines, cables and Telex, working spaces for 2 operators waiting room and circulation space.
Technical Drawing Office	1	30	30	Working space for 2 draights men cabinets to store drawing equipment, worktop photo copying machine, book shelves.
Conference Room	1	40	40	Large conference table for 15 people at once, toilet and circulation space.
Coffee Room	1	8	8	Wash hand basin, a fridge, Cabinet to store tea cups and saucers, worktop and circulation space.
Stationery Store	1	Ample		
Store Keeper	1	6	6	
Gate house	2	12	24	4 Security attendants enough room for temporary detaining of suspects and circulation space.

For primary circulation which is essential to provide access and means of work place area, a 20% of net usuable area is taken and added to net required area.

(VI) AUXILLIARY ZONE:

ACCOMMODATION	NO OF ROOMS	AREA REQ PER ROOM (m^2)	TOTAL AREA (m^2)	R E MAA R K S
Production Managers Offices	2	18	36	Working spaces for 2 product managers and circulation spa
Engineering Manager's Office	1	24	24	Working space for 2 engineer and circulation spaces.
Welfare Officer	1	12	12	Working space and circulatio space.
Carpentary Workshop	1	50	50	Enough space for the machine work top. Adequate storage room. Working spaces for 3 carpenters.
Electrical Workshop	1	50	50	Enough space for the machine worktop storage room workin spaces for 2 electricians a circulation space.
Mechanical Workshop	1	70	70	Same as above including working space for 4 mechani technicians
Scrap Store		Ample		
Quality Control Lab	2	35	35	Working spaces for 2 labora technicians, apparatus worktop, storage space and circulation space.
Maintenance Garage	1	130	130	for broken down forklifts trucks and buses
Generator House	2	50	50	To accomodate 2, 250kv generators and a switch roo for 2900 litres of fuel.
Water tank	1			For 2,000 litres of water.
Boiler Room	1	100	100	To Accommodate boiler of 500KV and circulation space
Laudry	1	Ample		
Fire Station	1	50	50	
Sewage treatment plant and incinerator				

CHAPTER SIX

FACTORS AFFECTING PLANNING OF INDUSTRIES

6.00 Comfort requirements

6.10 The site

6.1.1 Site location

6.1.2 Site selection

(a) Natural factors

(b) Cultural factors

(c) Aesthetic factors

6.1.3 Site factors

The macroclimate

The moocon

The harmattan

Temperature and relative humidity

Air movement

Precipitation

Duration of sunshine

Evaporation

Geology

Topography

Land forms

Hydrology

Soil

Vegetation

6.2 Vegetation and Cross ventilation

Vegetation

Cross ventilation

6.3 Conclusion