

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

COLLEGE OF ARCHITECTURE AND PLANNING

FACULTY OF ARCHITECTURE AND BUILDING TECHNOLOGY

DEPARTMENT OF ARCHITECTURE

KNUST

TITLE: HERBAL DRUG PRODUCTION FACILITY

**THIS DRAFT THESIS REPORT IS PRESENTED TO THE DEPARTMENT OF
ARCHITECTURE AS PARTIAL FULFILMENT OF THE REQUIREMENT OF POST
GRADUATE DIPLOMA OF ARCHITECTURE DEGREE IN ARCHITECTURE**

ROSEMARY SARFO - MENSAH

JUNE 2009

DECLARATION

I hereby declare that this submission is my own work towards the PG-DIP and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

ROSEMARY SARTO-MENSAH 18th SEPTEMBER 2009

Student Name and

ID Signature

Date

KNUST

Certified by:

ERMAN A. BOZUMU

[Signature]

18th Sept 2009

Supervisor(s) Name

Signature

Date

Certified by:

Head of Dept. Name

Signature

Date

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

DEDICATION

This design thesis is dedicated to the Almighty God who gave me strength to go through the six years of architectural education and to my parents Mr and Mrs Sarfo Mensah and to my siblings Kofi Boamah Mensah , Rexford Sarfo Mensah Jr and Mrs Ruth Sarfo Mensah Kankam for their support throughout my stay in the university.

KNUST



ACKNOWLEDGEMENT

I am very grateful to the Almighty God for His love, grace knowledge and protection throughout my six-year stay on KNUST campus and for knowledge and strength He gave me to finish this project successfully.

My heartfelt appreciation also goes to Mr. Samuel O. Afram, my studio master for his enormous contributions during the interim juries.

My next profound gratitude also goes to my supervisor, Mr Botchway for his contributions, guidance and patience.

My appreciation also goes to my family especially my father Mr & Mrs. Sarfo Mensah for their prayers his words of encouragement

My deepest appreciation goes to the following personalities who helped in making the design thesis a reality:

Mr Alhassan (MADAM CATHERINE HERBAL CENTER)

Mr Boakye (MADAM CATHERINE HERBAL CENTER)

Finally, to all my colleagues who helped in one way or the other to make this project a success, I am very grateful.

ABSTRACT

PREAMBLE

“Dr Ibrahim Samba, Africa’s regional director, world health organization (WHO), explains that even though African traditional medicine (herbal drug) has been stigmatized as backwards practice during colonialism, it has continued to thrive because it is culturally accepted and more than 80% of Africans use it.”

Their popularity is a result of their availability. According to the World Health Organization, traditional medicine has a central role to play in the 21st century since the orthodox medicine is no longer sufficient. In Ghana this discernible fact is due to lack of inappropriate infrastructure and inadequate mechanisms which has not been put in place. Herbal drugs are mostly on demand when all orthodox medicine has failed. Herbal drugs are not processed under the right means and mechanisms. The government has therefore found it prudent to add herbal drugs to the list of drugs under the national health insurance scheme which will reduce the demand on orthodox medicine and serve as an alternative medicine. It is in this view that Fralena want to put up a structure to cater for this since it product is been considered. Herbal medicine will go a long way to improve the primary health care system in the country since it is already accepted. Herbal medicine today is being used by lot of people; about 80% have used or are still using herbal drugs. The thesis design seeks to address this topic to elaborate on the necessity of the herbal drug industry.

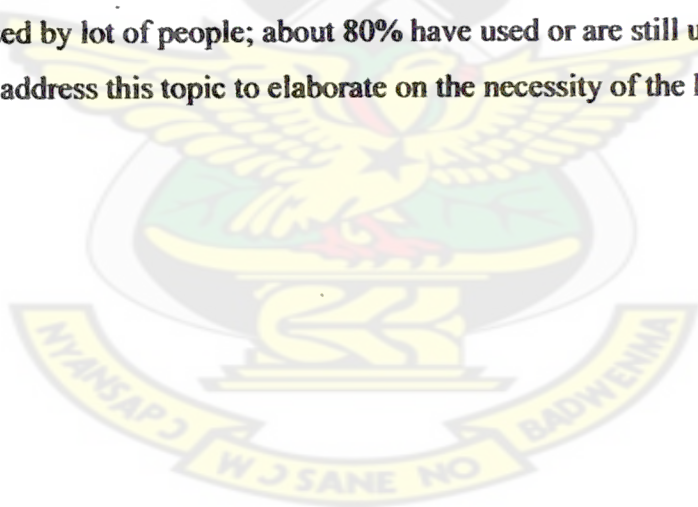


TABLE OF CONTENT

CONTENT	PAGES
Title page.....	i
Declaration.....	ii
Dedication.....	iii
Acknowledgements.....	iv
Abstract.....	v
Table of content.....	vi
List of figures.....	vii
 CHAPTER ONE.....	 1-7
1.0 INTRODUCTION.....	1
1.0.1 Definition.....	1
1.1 Problem Statement.....	2
1.2 Justification.....	3
1.3 Objectives.....	3
1.4 Client.....	3
1.5 Financiers	3
1.6 Scope.....	4
1.7 Target group.....	5
1.8 Clients brief.....	5
1.9 Location and site.....	5
1.10 Research Tools.....	6
 CHAPTER TWO.....	 8-21
2.0 Literature Review	8
2.1 History of herbal drug.....	8
2.2 Herbal medicine in Ghana.....	11
2.3Statistics.....	11
2.4 Traditional forms and production process of herbal drugs.....	12

2.5 Environmental quality requirements.....12

2.6 Forms of herbal medicine.....13

2.6.1 Primary form.....13

2.6.2 Secondary forms.....13

2.6.2.1 Mechanical form.....13

2.6.2.2 Chemical process.....13

2.7 Examples of herbal forms.....14

2.8 Forms of finished products.....14

2.9 Traditional production process.....17

2.10 Modern trend in production.....18

2.11Problems in the herbal industry.....19

2.12 Solutions.....20

CHAPTER THREE.....22-39

3.0 Case Studies.....22

3.1 Madam Catherine herbal center.....22

3.1.1 Location.....22

3.1.2 Architectural character.....22

3.1.3 Structure.....23

3.1.4 Services.....23

3.1.5 Process of production.....23

3.1.6 Facilities.....24

3.1.7Advantages.....24

3.1.8 Disadvantages.....25

3.2 Fralena herbal center25

3.2.1 History.....25

3.2.2 Location.....26

3.2.3 Architectural character.....26

3.2.4 Structure.....26

3.2.5 Services.....26

3.2.6 Process of production.....	27
3.2.7 Facilities.....	27
3.2.8 Advantages.....	27
3.2.9 Disadvantages.....	28
3.3Precedences studies	28
3.3.1 Location.....	28
3.3.2Architectural character.....	29
3.3.3 Structure.....	29
3.3.4 Services.....	29
3.3.5 Production process.....	29
3.3.6 Conclusion of case studies and precedence studies.....	29
 <i>CHAPTER FOUR</i>	 32-38
4.0 Site Selection.....	32
4.1 Factors considered for site selection.....	33
4.1.1 Accessibility.....	32
4.1.2 Source of raw materials.....	32
4.1.3 Size.....	32
4.2 Site 1.....	32
4.2.1 Location	32
4.2.2 Advantages.....	33
4.2.3 Disadvantages.....	33
4.3 Site 2.....	34
4.3.1 Advantages	34
4.3.2 Disadvantages	34
4.4 Site 3.....	34
4.4.1 Activities around the site	35
4.4.2 Site justification and considerations.....	35
4.4.3 Climatic conditions.....	35
4.4.3.2 Rainfall.....	36
4.4.3.3 Relative humidity	36

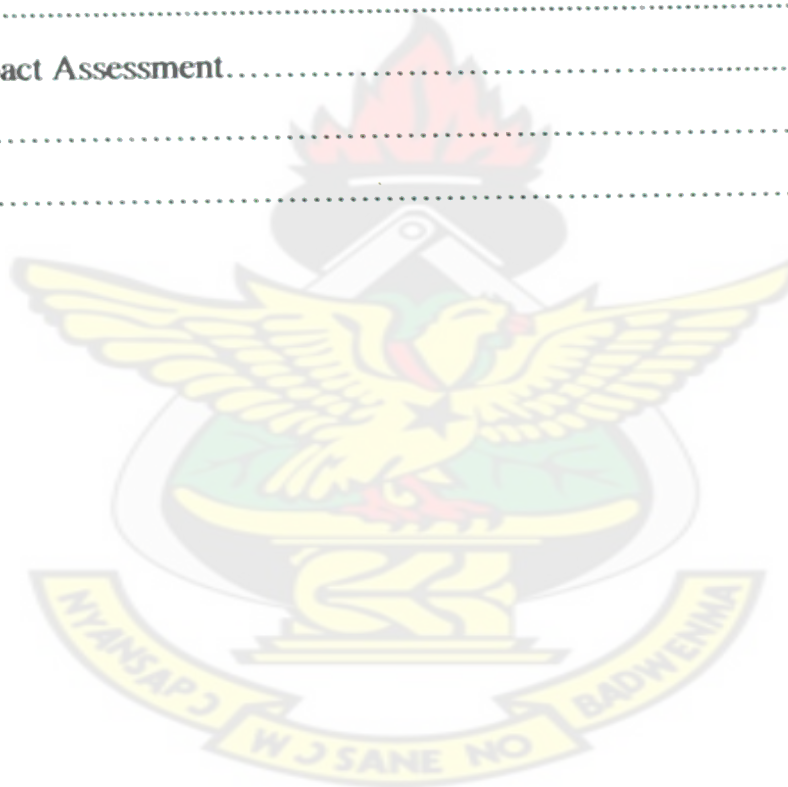
4.4.3.4 Air circulation	37
4.4.4 Responses	37
4.4.5 Geology	37
4.4.6 Topography.....	37
4.4.7 Vegetation.....	37
4.4.8 Existing Structures	38
4.4.9 Swot analysis of selected site	39
4.4.9.1 Strengths	38
4.4.9.2 Weakness	38
4.4.9.3 Opportunity	38
4.4.9.4 Threats	38

CHAPTER FIVE.....39-64

5.0 Design Philosophy and Concepts.....	39
5.1 Concept.....	40
5.3 The spaces considered.....	41
5.3.1 Administration.....	41
5.3.2. Production unit.....	41
5.3.3 Ancillary	42
5.4 Technical studies.....	43
5.5 Special studies.....	44
5.6 Environment and services study.....	45
5.7 Functional Diagram.....	46
5.8 Accommodation schedule	46
5.9 Conceptual Site Planning.....	49
5.10 Option 1.....	49
5.10.1 Advantages.....	49
5.10.2 Disadvantages.....	50
5.11 Option 2.....	50
5.11.1 Advantages.....	50
5.11.2 Disadvantages.....	50

5.12 Option 3	51
5.12.1 Advantages	51
5.12.2 Disadvantages	51
5.13 The design.....	51
5.13.1 General design	52
5.13.2 Orientation	53
5.13.3 Ventilation.....	53
5.14 Materials (Wall, Ceiling and Floor Finishes).....	54
5.14.1 Floors	54
5.14.2 Ceiling	54
5.14.3 Wall	54
5.15 Cabinetry.....	55
5.16 Odour.....	55
5.17 Drains.....	55
5.18 Lighting	55
5.19 Parking.....	55
5.20 Phasing.....	55
5.20.1 Phase 1	56
5.20.2 Phase 2.....	56
5.20.3 Phase 3.....	56
5.21 Services.....	56
5.21.1 Water supply.....	56
5.21.2 Electricity	56
5.21.3 Lighting and ventilation.....	56
5.21.4 Emergency exit	57
5.21.5 Telecommunication	57
5.21.6 Fire detection	57
5.21.7 Fire fighting installation.....	57
5.21.8 Fire hydrant.....	57
5.21.9 Waste management.....	58
5.21.10 Landscaping.....	58

5.22 Block plan.....	59
5.22 Plans.....	60
5.22 Ground floor.....	60
5.22.2 First floor	61
5.22.3 Roof plan.....	62
5.22.4 Elevation.....	63
5.22.5 Section.....	64
5.23 Structure and Form.....	66
5.24 Cost.....	66
5.25 Environmental Impact Assessment.....	68
5.26 Conclusion.....	69
Bibliography.....	70



LIST OF FIGURES	Pages
Figure 2.1 Herbal plant.....	8
Figure 2.2 Herbs.....	9
Figure 2.3 Syrups.	14
Figure 2.4 Ointments.....	14
Figure 2.5 Tablets.....	15
Figure 2.6 Capsules.....	16
Figure 2.7 Tinctures.....	16
Figure 3.1 Front view of the administration block.....	22
Figure 3.2 Wooden windows	23
Figure 3.3 Honey comb walls	25
Figure 3.4 Administration.....	25
Figure 3.5 Exterior view	26
Figure 3.6 Drains	28
Figure 3.7 Landscape	29
Figure 3.8 Security cameras	30
Figure 4.0 Site (Abora Dunkwa).....	33
Figure 4.1 Bui	33
Figure 4.2 Nkoransa	33
Figure 5.1 The Heart	39
Figure 5.2 The Digestive system	40
Figure 5.3 Production Flow.....	43
Figure 5.4 Raw material storage.....	44
Figure 5.5 Vehicles.....	44
Figure 5.6 Tableting machine.....	45
Figure 5.7 Functional Diagram	46
Figure 5.8 Conceptuals	49
Figure 5.9 Conceptuals	50
Figure 5.10 Conceptuals.....	51

TABLES	Pages
Table 2.1 Enviromental quality requirement.....	12
Table 2.2 Primary form	13
Table 2.3 Forms of herbs.	14
Table 4.0 Temperature	36
Table 4.1 Rainfall	36
Table 4.2 Relative humidity	37
Table 5.1 Adminstration block.....	46
Table 5.2 Canteen	47
Table 5.3 Production Block	48
Table 5.4 Sick bay... ..	48
Table 5.5 Maintenance unit.....	48



LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

CHAPTER ONE

1.0 INTRODUCTION

Under the impact of industrialization and urbanization, western medicine has displaced indigenous medical systems in many areas, in the process leaving many without any health care. Traditional medicinal knowledge is rapidly disappearing, owing to cultural change and declining access -in both urban and rural areas- to sources of natural medicinal products. Herbal medicine in Ghana today is currently going through renaissance in recent years due to the over prescribing pharmaceutical drugs. Countries like china and India have been fairly well established in the traditional medicine and have gained worldwide acceptance and are being practiced alongside modern medicine where as in countries like Bulgaria, Poland and other African countries are recognized as major exporters of plant –based medicinal products and raw materials for overseas medicinal plant industries. All these are been hampered greatly by the absence of the essential infrastructure to process the raw materials into finish products consumable by human. Human health cannot be considered in isolation for it depends highly on the quality of the environment which includes the infrastructure in which drugs are manufacture. This will go a long way to ease pressure on modern medicine and therapies

1.0.1 DEFINITION

Herbal drug refers to the health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral base medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illness or maintain well being whereas an industry is a facility that caters for the production of goods and service.

Herbal drug industry is therefore the facility where plant, animal and mineral base medicines are manufactured through manual and mechanical means to provide treatments, diagnose and prevent illness as well as provide for the well being of humanity medically. The herbal industry could also provide spiritual therapies and knowledge about the herbs.

The World Health Organization has estimated that In Ghana about 60% of the people have used herbal drug before or are still using it. These herbal drugs are well accepted by most indigenous people irrespective of the conditions under which it's been produced. Patronage has increased

since it was added to the list of drugs under the national health insurance scheme (NHIS) but much is yet to be done about the production facilities and its surrounding conditions.

Currently, Ghana is collaborating with China and India to promote the manufacture and market of herbal drugs in West Africa which means that there is the need to improve on the production and efficacy of herbal drugs in order to be recognizable like most orthodox medicines and gain international recognition like most herbal drugs from China and other places in the world.

The herbal drug industry is also the bases for further research into the treatment of other illness with herbal drugs.

1.1 PROBLEM STATEMENT

The use of natural medicinal products in modern medicine as complementary and alternative therapy medicine is on the increase globally. More so in developing and third world countries where the cost of research and developing of synthetic drugs is prohibitive and technological facilities as well as expertise are lacking. These coupled with the crumbling health care management systems in many of such countries make herbal medicine an attractive alternative. With the increasing popularity, there is the need for the process of the abundance of these herbs. About one third of the world's population still lacks access to essential drugs and the figure is believed to be rising to over 50% in the poorest parts of Africa and Asia. A traditional medicine industry therefore offers a major source of distribution and supply of herbal medicine and continues to play an important role in health care management in countries like Ghana. Herbal medicine also remains the most easily available and affordable form of medicine and therapy in low income countries. In most developed countries the average cost of developing a new pharmaceutical drug exceeds \$800 million which is very unlikely for a third world country to have that amount to develop a new drug. This therefore calls for a herbal drug industry where the process and formulas are already known. Synthetic drugs today have largely supplanted and surpassed the popularity of the herbal medicine due to the skyrocketing cost of these synthetic agents, lack of easy accessibility to the common man and new advances in natural products. There is resurgence in the use of these natural products and there calls for a much more larger and equipped industry to handle this than the old or traditional ways of processing since it has become an integral component of the herbal pharmaceutical industry

1.2 JUSTIFICATION

In Ghana today, herbal medicine stands amount some of the best drugs used for treatment of various sickness and illness in the country. It is also yet to enter into another phase of its existence. This is because after much neglect, it has now been realized that, it can be used as a substitute or an alternative drugs especially in most rural areas where access is very difficult and also the fact that has increased and the provision of drug has not increase. It is in this vein that herbal drug industries have to be setup and to modern standards to ensure this alternative or supplementary primary health care is accessed in larger quantities and produced under safe and hygienic conditions for the welfare of the people. This will go a long way to ease the pressure on orthodox drugs which is on the medium, widely supplied in Ghana. The herbal industry will not only avert the pressure on orthodox medicine but also reduce the money involved to produce an orthodox drug rather than the traditional or herbal drug.

1.3 OBJECTIVES

1. To create a more appropriate, safe and hygienic infrastructure for the preparation of herbal drug.
2. To produce more herbal drugs to supplement orthodox medicine to increase primary health care.
3. To provide the necessary facility for the production of unprocessed herbs for local consumption and export for further use.

1.4 CLIENT

The client is the Fralena Health Center in collabration with the Ghana health service.

1.5 FINANCIERS

The decision to allow the herbal industry to undertake place was taken after a meeting by the Management and workers of Fralena health center after various consultations and international forums. The concessionaire is required to inject capital, improve productivity and quality of service at a competitive rate and lower the cost of primary health care in the country. The objective of this new industry is to enhance the value of herbal medicine by putting them to their

best and valuable use. Currently, the company has quite some money to begin with and are seeking funds too from donor pharmaceutical companies like Roche pharmaceutical industry.

1.6 SCOPE

The industry will encompass an administrative area, a production area and other ancillary areas.

In administrative area

- ❖ Offices
- ❖ Reception lounge
- ❖ Canteen
- ❖ Washroom

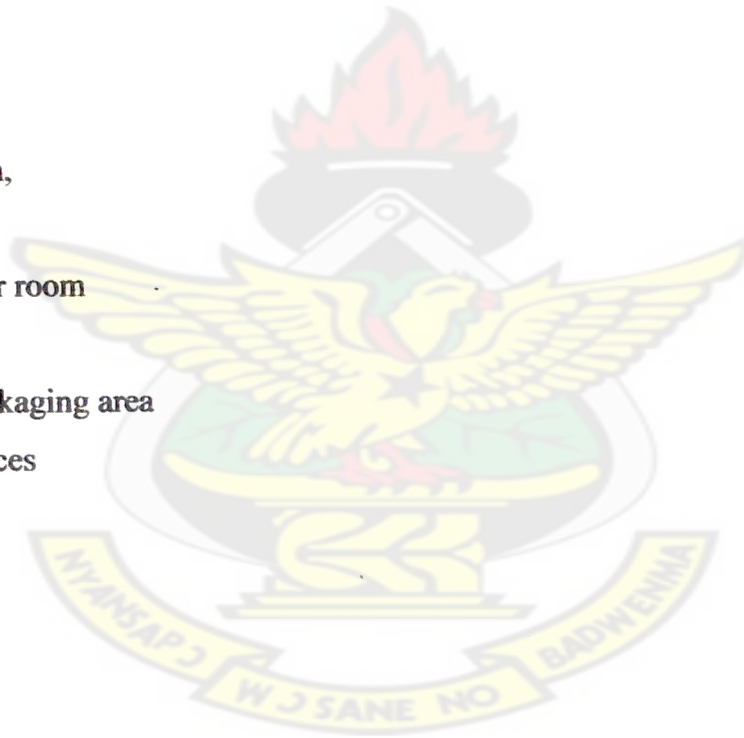
The production area

- ❖ Storage rooms,
- ❖ Tableting room,
- ❖ Granulation room,
- ❖ Bottling area
- ❖ Plant or generator room
- ❖ Boiling area
- ❖ Labeling and packaging area
- ❖ Supervisor's offices
- ❖ Capsule room
- ❖ Coating room

The ancillary

- ❖ Maintenance
- ❖ Workshop area
- ❖ Changing room
- ❖ Washroom
- ❖ Research and development laboratory
- ❖ Security check point,
- ❖ Janitor's room

KNUST



- ❖ Parking space
- ❖ Farming area.

1.7 TARGET GROUP

The target group of the facility will include hospitals, clinics, pharmacy shops, licensed chemist shops, importers, and registered herbalist centers

1.8 CLIENTS BRIEF

The brief provided by the client includes;

- ❖ Production area
- ❖ Parking
- ❖ Administrative area
- ❖ Storage
- ❖ Offices for various heads of department
- ❖ Washroom
- ❖ Quality control laboratory
- ❖ Accounts department

1.9 LOCATION

The site is located at Nkoransa in the Ashanti region, Ghana.

1.10 RESEARCH TOOLS

The information used to write this thesis was acquired through the adoption of a number of tried and tested research methodologies. These methods of research made the attainment of information quite easy. The information gathered was cautiously evaluated to ensure that only the one that would aid the execution of the task was collected. Interviews, Journals, magazines and literature reviews, taking of photographs, measurement of buildings, personal observations, photographic recordings, case study and internet café as well as the World Wide Web research were the research methods employed.

❖ Literature Reviews

Published and unpublished literature on the topic was reviewed. This involved the reading of written material such as books and journals. A lot of literature was also gathered from various web sites associated with Plant medicine and pharmaceutical design.

❖ Internet Searches

The searching of information on the internet was extensive used in the research. It provided some of the answers and clues to some problems and question which was difficult to find.

❖ Case Study

Local and foreign buildings were studied to have much knowledge about the scheme. It also helped the author to draw conclusions on decisions about the scheme.

❖ Photographic Recordings

Significant photographs of important facilities and activities that will aid the completion of the project were taken.

❖ Interviews

People with a lot of knowledge on pharmaceuticals were interviewed to know what is expected in a herbal drug industry. Workers at the industry where the case study was conducted were also interviewed to know what they expect, the advantages and disadvantages of the place.

Interviews with the clients and developers of the project – Fralena health service and the Ghana Health Service -to know their policy direction with respect to the project and brief development was also done.

❖ Personal Observations

Some of the information used came about through vigilant personal observations made by the author. This was important because the taking of photographs was not allowed in some areas visited.

1.11 LIMITATIONS

The project was done with some constrains such as the unavailability of published literature reviews, no precise standard parameters of the Ghana herbal medicine industry which made the studies arduous. Others include wrong answer given through data collection and interviews,

access which was not granted to certain areas like the director's office, accounts office as well as pictures. Measured drawings too were not allowed. Some were through visual observations.

KNUST



CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 HISTORY OF HERBAL DRUG

Long before the recorded of history, herbal drug or medicine has been the indigenous ways for treating ailments. It was found out by the prehistoric man that some plant foods were to repair damages and correct some abnormalities in the human system. The prehistoric man had observed sick animals like the chimpanzees, chickens, dogs and sheep in their way of treating their sickness as they change their food preferences to nibble at bitter herbs they would normally reject. This was the evolution of plant or herbal medicine.



Fig 2.1 Herbal plant

People on all the continents have used hundreds and thousands of indigenous plants for the treatments of ailments since prehistoric times. The first generally accepted use of plants as healing agents was depicted in cave painting. In Asian countries like China and India, herbal medicine has more than 5000 years of history as a system of medicine that is based on nature and philosophical concept of balance. They also relied so much on culture for healing sickness as concoction made from plants and animals, protective amulets and healing prayers were used.

In Europe, herbal medicines have more than 3000 years of history behind them as system of medicine based on natural philosophies as well. Folk healers passed on their knowledge from master to apprentice and were more accessible to peasant or labourers. In ancient Greece, they placed great emphasis on a good diet and healthy life style to restore equilibrium; drugs were used more to support healing than cure diseases. In Rome herbal drugs were limited to basic use of plant materials, prayers and incantations, the Romans brought with them a vast preparatory of herbal treatments and introduced to the concept of the hospital as a centralized treatment center. During the catholic and the protestant witch-hunt from the fourteenth centuries to the seventeenth centuries, the activities of traditional folk healers were severely curtailed and knowledge was often lost as it existed only as an oral tradition. The wide spread emigration from Europe to North America in the eighteenth centuries included both the knowledge of herbalism and some of the plants themselves. This was combined with Native American medicine and then re-imported to the U.K. where it re-integrated with the surviving herbal traditions to evolve as today's herbalism

In Africa, herbal medicine has been with the people since time immemorial. It was passed on from generation to generation, herbalist to apprentice to apprentice. Some of the concoctions were also learned from family and family friends. The village herbalist was the only one to inquire about one's health and they treated people from their ailments with concoctions and prayers. Herbal drugs in Africa were viewed from the religious context as part of spiritism being practice by the herbalist through divination and prayers. Some ailments were believed to be of the spiritual realm than physical, only the herbalist could see it.

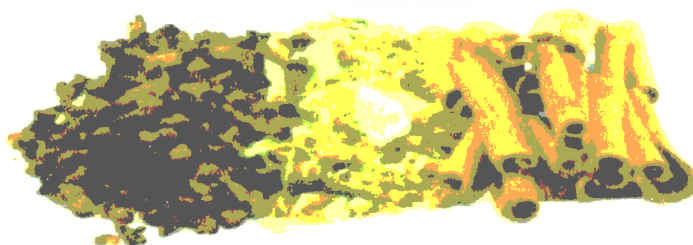


Fig 2.2 Herbs

As man developed in the areas of science, and Christianity, alchemist realized that plants which were considered to be a drug, only a component or part of it was responsible for the treatment of an ailment. The scientist then began to separate the active ingredients from the inactive ones. These active components were synthesized into producing conventional medicine. About 40% of all orthodox medicines are synthesized based on the active components of plants. The rapid developments of chemistry and physical science led increasingly to the dominance of chemotherapy chemical medicines as the orthodox system of the twentieth century. Three quarter of the plant that provide active ingredients for prescription drug came to the attention of researchers because of their use in traditional medicine.

Over the years it has become very clear that most useful drugs cannot be synthesized but can only be got from the plant in its natural form. Many drugs commonly used today are of herbal origin. Indeed, about 25% of the prescription drugs dispensed today contains at least one active ingredient derived from plant material. Example Salicylic acid, a precursor of aspirin, was originally derived from white willow bark and the meadowsweet plant. Cinchona bark is the source of malaria-fighting quinine. If so, then why has it been stigmatized as backwards in Ghana?

1. Because the mode of operation has not been changed, herbal medicine does not look attractive as compared to orthodox medicine.
2. Herbal medicine was associated with spiritism because herbalist has shrouded their profession with prayers and incantations instead of drugs to earn more money and recognition.
3. The plant and material for the preparation of drugs have been left in the hands of primitives and uneducated people who lack the technology.
4. Education and religion condemned herbalism to be demonic and therefore making people pay more attention to the orthodox medicine.
5. Herbal drugs are sometimes prepared under unsafe and unhygienic conditions which make it very hazardous to the human health.

Due to this unfortunate attitude, society's views on herbal medicine is that is unsafe and unhygienic but recent years have proven that they are one of the best and not just an alternative.

drug with examples from China and India who are leading in the world of plant medicine. Natural medicine still stands the best of times.

2.2 HERBAL MEDICINE IN GHANA

Herbal medicine in Ghana has been curing quite a number of diseases therefore making patronage beginning to go higher. An example is Echinacea extracts may limit the length and severity of rhinovirus colds and lemon grass can lower cholesterol. It is culturally accepted and respected. Before there were no industries to produce more drugs, all drugs were produced using manually applications which could only feed a handful of people and neither could they be preserved or produced in larger quantities. As the country began to explore more and population increases and demands for drugs go higher, there was the need to expand in production. This also calls for equipments and room spaces making up the industry.

In Ghana today, herbal medicine has been added to the list of drugs under the national health insurance scheme. In the remote areas where accessibility to medicines is very difficult, the uses of herbal medicine are extensively used and are far cheaper than orthodox medicine. In Ghana today, every 1 traditional healer attends to approximately 200 patients, while 1 doctor attends to approximately 20,000 patients in a year according to Erick Gbodosou and his associates.

2.3 STATISTICS

From the Ghana health service, these are the estimated population results;

Estimated population for 2009----- 24,252,438

Estimated population for 2010----- 24,943,759

Out of this population, 80% of the people are confined to the rural areas

40% of this population have access to hospitals but are not able to afford expensive orthodox medicines which do not fall under the national health insurance scheme.

60% of the population have no access to the hospitals or orthodox medicines but rely on the cheap and available herbal drugs.

50% of the people in urban areas cannot afford the expensive orthodox medicines.

About 70% of the gross health budget every year is used to import drugs which are accessible to only 20% of the total population.

2.4 TRADITIONAL FORMS AND PRODUCTION PROCESS OF HERBAL DRUGS

Africa has a long and impressive list of medicinal plants based on local knowledge. In Ghana, the herbalist, who is mostly the village priest and doctor is responsible for the health status of the community. The herbalist is considered to be the custodian of knowledge of the healing powers of the herbs.

The herbalist gathers herbs from the village and surrounding village forest and brings it to the shrine where the production takes place. This was mostly done at night to add mystic to it and prevent people from abusing the herbs. He is mostly assisted by someone who the herbalist trains and reveals all the secrets about the herbs to. The assistant takes over after the death of the herbalist.

2.5 ENVIRONMENTAL QUALITY REQUIREMENTS

Accommodation	Temperature °c	Humidity levels
Store (raw materials)	Normal room temperature	Low 50 %
Sorting and preparation	-ditto-	Normal 75%
Quality control	25	50%
Tableting room	-ditto-	50%
Capsuling room	-ditto-	50%
Packaging room	25	50%
Store (finished products)	25	50%
offices	Normal room temperature	50%

Table 2.1 environmental quality requirement

2.6 FORMS OF HERBAL MEDICINE

There are basically two forms of herbal medicine production. The two forms are the primary and the secondary form of production.

2.6.1 PRIMARY FORM

FORM	DESCRIPTION
Leaves	Part of a plant that grows from the branches
Seeds	A small dry hard fruit inside a bigger fruit
Tree bark	The outer layer of a tree
Fruits	The edible part of a plant
Stem	Part of a plant that does not bear leaves and fruits

Fig 2.2 Forms of herbs

2.6.2 SECONDARY FORMS

The secondary forms of drugs are either chemical or mechanical process.

2.6.2.1 MECHANICAL FORM

- ❖ Crushing
- ❖ Grinding
- ❖ Separation
- ❖ Mixing and blending

2.6.2.2 CHEMICAL PROCESS

- ❖ Boiling
- ❖ Leaching
- ❖ Fermentation
- ❖ Mixing

2.7 EAMPLES OF HERBAL FORMS

PLANT	PLANT PART	USES
1. Cassia didymobotria L.	Leaves	Anemia, Anthelmintic, laxative

2. <i>Ficus stuhlmanii</i> Walp.	Stem bark	Treats chronic wounds
3. <i>Harrisonia abyssinica</i> Oliv.	Roots	Bilharzia, chronic wounds
4. <i>Terminalia serica</i> Burch.	Roots	Diarrhea, vomiting, stomach problems
5. <i>Securidaca longipendunculata</i>	Roots	Treats infertility in both men and women
6. <i>Euphorbia quadrangularis</i> pax	Arial parts	General body weakness

Table 2.3 forms of herbs

2.8 FORMS OF FINISHED PRODUCTS

❖ Syrups

Syrups are made from concentrated extracts and a sweetener is added to taste , they are frequently used for sore throats and coughs.

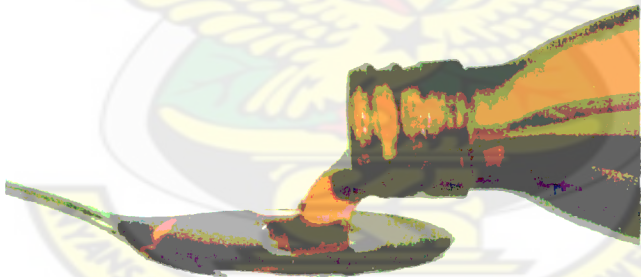


Fig 2.3 syrup

❖ Ointments

Oils are extracted from plants and often used as rubs for massage

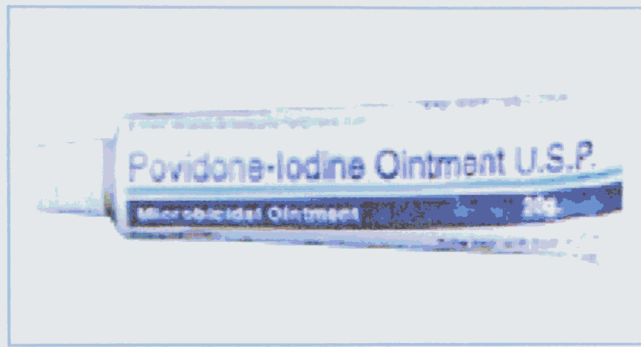


Fig 2.4 ointment

❖ Tablets

An extracted form and is the most concentrated form of an herbal product



Fig 2.5 tablets

❖ Capsule

a small cylindrical soluble container enclosing a dose of medicine, or the container itself



Fig 2.6 capsule

Tinctures

Tinctures and liquid extracts are solvents (usually water, alcohol, or glycerol) that contain the active ingredients of the herbs. Tinctures are typically a 1:5 or 1:10 concentration, meaning that one part of the herbal material is prepared with five to ten parts (by weight) of the liquid. Liquid extracts are more concentrated than tinctures and are typically a 1:1 concentration.



Fig 2.7 tinctures

❖ Tea

Teas are simply dried herbs left to soak for a few minutes in hot water, while other teas are the herbs boiled in water and then strained for consumption.

2.9 TRADITIONAL PRODUCTION PROCESS

The traditional way of production is mostly by manual means. In recent years a few of the industries have changed their production process from manual to a little more upgraded status by adding a few machines to the manual process but majority are still using manual means. The basic steps are as follow

a. Gathering of herbs.

Herbs are been collected by specialists who have knowledge about plant parts. These experts move around in the forest to gather herbs for production.

b. Storage of raw materials

Raw materials are brought in from the forest and the herbalist inspects them to be sure of what he has and is kept mostly in the court yards because of lack of storage spaces.

c. Preparation

At this level the production begins by

1. Sorting

The raw materials are sorted to separate between good raw materials and disformed ones based on their physical forms, for example un fresh leaves. Sorting is also done to separate foreign materials possibly found in the raw materials, such as dirt or waste.

2. Washing

The herbs or raw materials are cleaned from dust and other impurities

3. Drying

This is usually done in the open space and is due to lack of space for drying. Drying is normally done on cemented plate form or wooden plate form.

d. Crushing

Crushing is done by using pestle and mortar or the grinding stone to break the raw materials into small or soluble substances

e. Boiling

To get the decoction, the crushed substance is boiled to extract the needed part of it. Boiling is done in big pots using firewood

f. Packaging

Decoctions are packed into bottles while powder is packed into leaves, leather and pouches. The rest are packed or wrapped into leaves and leather especially the raw materials like seeds.

2.10 MODERN TREND IN PRODUCTION

In order to have effective process, physical and chemical data is required of the local herbs. At present very little knowledge is available of such parameters such as solubility, partition coefficient and heat transfer coefficients. The production process is as follows

a. Raw material Storage

Plants and herbs are collected from different sources and brought to the industry. It is been stored and used as the need for it arises.

b. Sorting and weighing

The raw materials are been separated into good and bad ones, different plant and part. It is then weighed into its right qualities for the drugs.

c. Washing and drying

Raw materials are washed with warm water and dried in industrial ovens.

d. Boiling

Boiling begins to take place in boilers within required temperatures.

e. Granulation

Having been boiled, the raw materials are ground in a grinding machine that is activated by a moving machine. The types and sizes of knives in the grinding machine should be different

between those used for leaves and those for roots. These knives must be replaced with the new ones every three months to ensure that the raw materials are ground into required fineness. In terms of financial calculation, it is assumed that there is always a knife that needs to be replaced with a new one every month for a different grinding machine because there are more than one grinding machines (the knives for different grinding machines are not replaced at the same time).

f. **Tableting and liquids cream**

Tableting is broken into finished products and they are film coating and sugar coating. The liquids and creams have a separate end product.

g. **Packaging**

Herbal medicine is packed with tableter sachet, steamed bottles and others. Every ten sachet's are packed in a bigger box pack. Several types of herbal medicine are not packed in a sachet but in kilogram in a bigger plastic packaging and finally into cartons

h. **Finish goods Storage**

Finished products are store within room temperatures in store rooms

2.11 PROBLEMS IN THE HERBAL INDUSTRY

a) **Standardization of herbal medicine:**

Herbal drugs as at today do not have the requisite standards to binds them. Most herbal production centers do not have license to operate. Production in such areas is very questionable. Such places do not have the right structures and equipments to produce. A condition under which it is being produced is not safe and hygienic. There are variations and irregularities which do not conform to the rest.

b) **Lack of institutional support, strategies and programmes for production and dissemination of key species for cultivation.**

There is not much support coming from the government and internationally which makes it very difficult to organize programmed among themselves to upgrade their statues. The distribution of information about production is not effective.

c) Lack of the latest technological know how

The educational level of most of the practitioners and employees are generally low. Basically the production relies on human experience and depends on manual methods and paper to operate business with little or no computer – based information technology

d) Sociological and religious believes

Herbal medicine has been stigmatized as backwards and associated with traditional religion, because of that most people will prefer the orthodox medicine rather than the herbal. This prevents the other religious people from buying because it is associated with traditional religion.

e) Poor packaging

The finish product that comes out at the end of the day has no attraction as compared with the orthodox or imported drugs. The herbal drugs turn to look inferior because of the way it's been packaged. The orthodox drugs then over shadow the herbal drug.

f) Quantity of products

The methods of production takes a lot of time to produce more therefore production methods cannot cope with the demand of the society. As the population increases, the demand of the people begins to move higher. Most of the production methods have proven to be wasteful.

i. Lack of research and Development on products and process development.

Research into new plant medicine is still not making a head way. Much has not been researched into, the same old drugs are still been produced under the same building conditions and procedures. There is not enough room to learn more develop new ways.

2.12 SOLUTIONS

a. Common standards among producers.

The binding documents that can bring products to the same level of operation or same standards running through the process can bring about some form of uniformity.

b. Government support for the industry

The government can organize seminars and workshops for producers to acquire more knowledge on the production and the current issues surrounding it..

c. Effects of the introduction of technology

a. Quality of product

Consumer's turns to go in for the best therefore meeting their demand is what is needed.

Packaging can be different and attractive.

b. Quantity

There is the need to produce more to meet the market demand and it comes in to relation with facilities available. The needed floor spaces to accommodate more machinery and to produce more. There is also the need to improve circulation pattern avoid conflict to increase speed to produce more,

c. Improve Packaging

The attraction of a product sometimes is what people use to judge a product and this packaging has to stand out to market itself. The right environment should be provided for the packaging staff to make a better package

CHAPTER THREE

3.0 CASE STUDIES

3.1MADAM CATHERINE HERBAL CENTRE

3.1.1 LOCATION

Madam Catherine herbal centre is located at Boadi in the Ashanti region in Ghana about a few kilometers from the kwame Nkrumah University of science and technology.

3.1.2 ARCHITECTURAL CHARACTER

The style of the building is basically Islamic architecture. The building is a two storey block in an l shape. The roof form is gable, hidden inside a parapet wall with Islamic symbols on them.



Fig 3.1 Front view of the administration and production block

The building is formed around a courtyard which also serves as a parking area for both trucks and saloon car. The building is clad with stones. The fenestration is made of wood and glass. There are glass windows for the research lab and the wooden windows for the storage areas. The doors are predominately wooden.

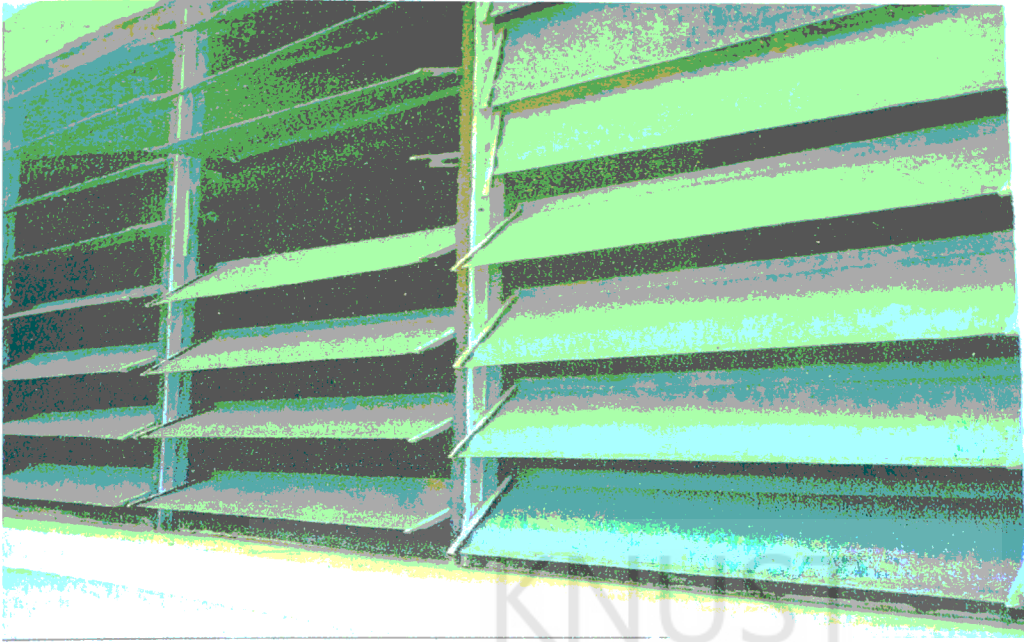


Fig 3.2 wooden windows

3.1.3 STRUCTURE

Reinforced concrete floor slabs supported by concrete columns and beams of varying sizes with post and beam form of skeletal frame.

3.1.4 SERVICES

There is a wide use of honey comb walls around the building which brings in more light and ventilation; this is to maximize the use of natural ventilation. Other inner rooms are supported by electric fans and extractors. There's the presence of a 230 KVA standby generator to supplement the electricity provided by ECG to ensure that electricity supply is constant. There is 10,000 liters poly tanks located at the centre ensures that water supplied by GWCL can be stored in large quantities to help in maintaining regular supply. Provision for outbreak of fire was not catered for. Waste generated from the industry was carried kept in big plastic bag and sent to the main rubbish dump which is not on the site.

3.1.5 PROCESS OF PRODUCTION

1. Sorting
2. Washing

3. Drying
4. Crushing
5. Boiling
6. Packaging

3.1.6 FACILITIES

These are the provisions made at the centre:

1. Clinic
2. Herbarium
3. Arboretum
4. Canteen
5. Research Laboratories
6. Administrative offices
7. Production warehouse
8. Production unit
9. Car park
10. Storage shed for water tanks
11. Administrative offices

3.1.7 ADVANTAGES

1. Maximum use of artificial lighting
2. A Courtyard to facilitate air flow
3. A security post to reduce theft
4. Maximum use of natural ventilation

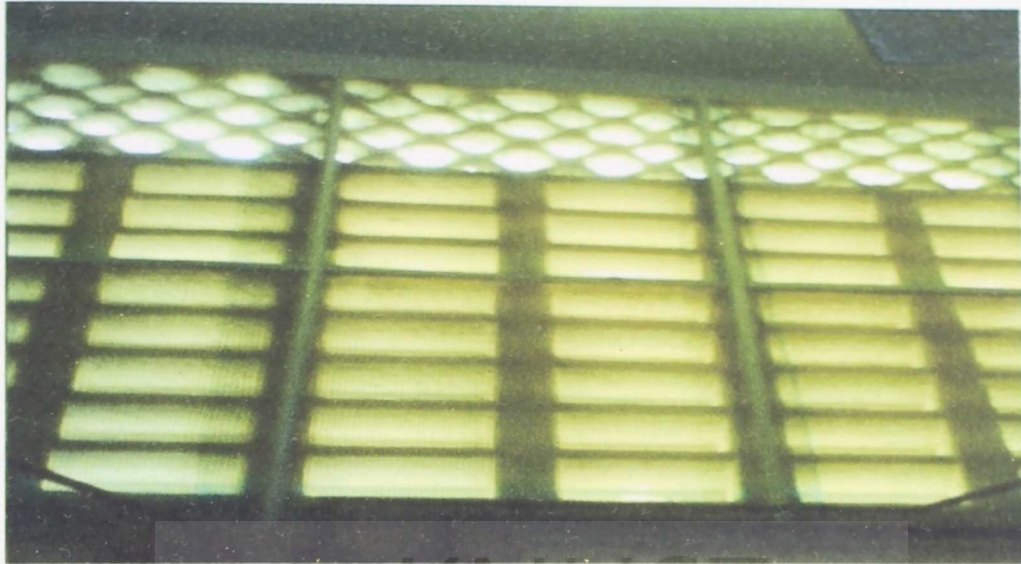


Fig 3.3 Honey comb wall

3.1.8 DISADVANTAGES

Administration block cannot accommodate all the heads of the various departments.



Fig 3.4 Administration

1. Administration block needs refurbishment
2. Lack of soft landscape
3. No proper arboretum
4. Undemarcated parking space

- 5. Workers do not have changing rooms

3.2 FRALENA HERBAL CENTER

3.2.1 HISTORY

The company started its operations from a kitchen in 1992 and has presently grown and is exporting products. Fralena was started by a business man whose father was a herbalist but unfortunately could not learn much from the father but studied under one Jean Claude Girardeau, a Frenchman, who was into alternative medicine practice. A shop was setup at Obuasi in the Ashanti region to sell drugs to treat an outbreak of cholera that was the beginning of Fralena herbal centre.

3.2.2 LOCATION

Fralena herbal is located at Ahenema kokoben in Kumasi, in the Ashanti region.

3.2.3 ARCHITECTURAL CHARACTER

The building is four storeys with one single storey attached to it and this represents the international style of architecture. The building is made up of glass windows and glass sliding doors at the entrance. There is both soft and hard around the building.



Fig 3.5 Exterior view

3.2.4 STRUCTURE

Reinforced concrete floor slabs supported by concrete columns and beams. The uses post and beam form of skeletal frame

3.2.5 SERVICES

The industry has drainages around the site to cater for the water. most of the rooms have electric fans. There is a standby generator of 230KVA capacity to supplement the electricity from the electricity company of Ghana. Water is been supplied from the Ghana water company limited. There is provision for shortage of water and that is the underground tank for prevention mechanisms like extinguishers were put in place at vantage points

3.2.6 PROCESS OF PRODUCTION

1. Sorting
2. Washing
3. Drying
4. Crushing
5. Boiling
6. Packaging

3.2.7 FACILITIES

1. These are the provisions made at the centre:
2. Clinic
3. Herbarium
4. Arboretum
5. Canteen
6. Research Laboratories
7. Administrative offices
8. Production warehouse
9. Production unit
10. Car park
11. Storage shed for water tanks



3.2.8 ADVANTAGES

- 1 The use of glass windows bring in day lighting therefore reducing the amount of natural lighting used
- 2 There is the use of soft landscape to reduce the intensity of the sun
- 3 Drainage at the factory was included by having pipes embedded into the exterior floor pavements



Fig 3.6 Drains

3.2.9 DISADVANTAGES

The use of sun shading devices were not employed which makes the rooms quite hotter without electric fans

The Façade design is not suitable for the tropics

The boundary of the industries is not clearly defined

The different floor levels bring about segregation in work at the industry therefore breaks the flow of work and co-ordination among staff.

3.3 PRECEDENCE STUDIES

GLENMARK PHARMACEUTICAL COMPANY

3.3.1 LOCATION

The Glenmark pharmaceutical industry is located in Mumbai, India

3.3.2 ARCHITECTURAL CHARACTER

The building is a two storey structure with glazing covering a wider part of the wall as windows. The entrance is circular in shape celebrating it whiles the other parts are rectangular in shape. There is the use of soft landscape to give the industry some aesthetic appeal. There is the use of hard landscape to demarcate parking and pavement areas.



Fig 3.7 Landscape

3.3.3 STRUCTURE

The building is made up of the sandcrete and steel members' whiles some of the partition walls are made of wood.

3.3.4 SERVICES

There are security cameras placed at strategic points to check stealing and unauthorized people from coming into the site. Cctv cameras are also used to check what is going on at various places in the

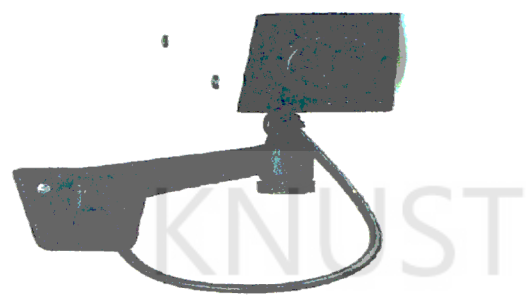


Fig 3.8 Security camera

industry. There is an additional supply of power from a generator to ensure constant electricity. Water treatment plant has also been put in place to give the industry the purest of water supply since water is a crucial issue in the industry. There is storage of water in an underground water storage tank.

3.3.5 PRODUCTION PROCESS.

1. Washing
2. Soaking
3. Drying
4. Milling
5. Extraction
6. Grading
7. Purification
8. Atomizing
9. Coating

3.3.6 CONCLUSION OF CASE STUDIES AND PRECEDENCE STUDIES

- ❖ A herbal drug industry follows the basic principles of any pharmaceutical production process with a few variations. Most machines used here are the same with the machines use in the pharmaceutical industry.
- ❖ Provision of ancillary facilities like the canteen and the sick bay prevents workers from at the industry from going outside during break therefore spending so much time outside.
- ❖ The provision of offices for supervisors or herbalist facilitates supervision and efficiency at work since the industry is dealing with drugs for human consumption.
- ❖ The study also points outs the need for a research laboratory for conducting test on drugs and research into new plant medicine

Basically the studies were conducted to understand the basic principle behind herbal industry and their relation to spaces.



CHAPTER FOUR

4.0 SITE SELECTION

4.1 FACTORS CONSIDERED FOR SITE SELECTION

The choose of site for the herbal industry selected was influenced by the following

4.1.1 ACCESSIBILITY

The site location should be within the area of the target group for easy transportation and marketing. The closer it is to the people the more the people use it. The accessibility should include less traffic to the site and good roads.

4.1.2 SOURCE OF RAW MATERIALS

The source of raw materials is very necessary. The source of the materials should be closer to the site for easy transportation. This will reduce the cost of production facilitate movement of the materials since the distance is not long.

4.1.3 SIZE

The size of the land should be able to accommodate the various units of the facility. The size also has to be bigger enough for future development and to develop an arboretum.

4.2 SITE 1

4.2.1 LOCATION

The first site is located at Abura Dunkwa in the central region. The site is bounded in the east by the Kumasi road and on the west by the cape coast road.

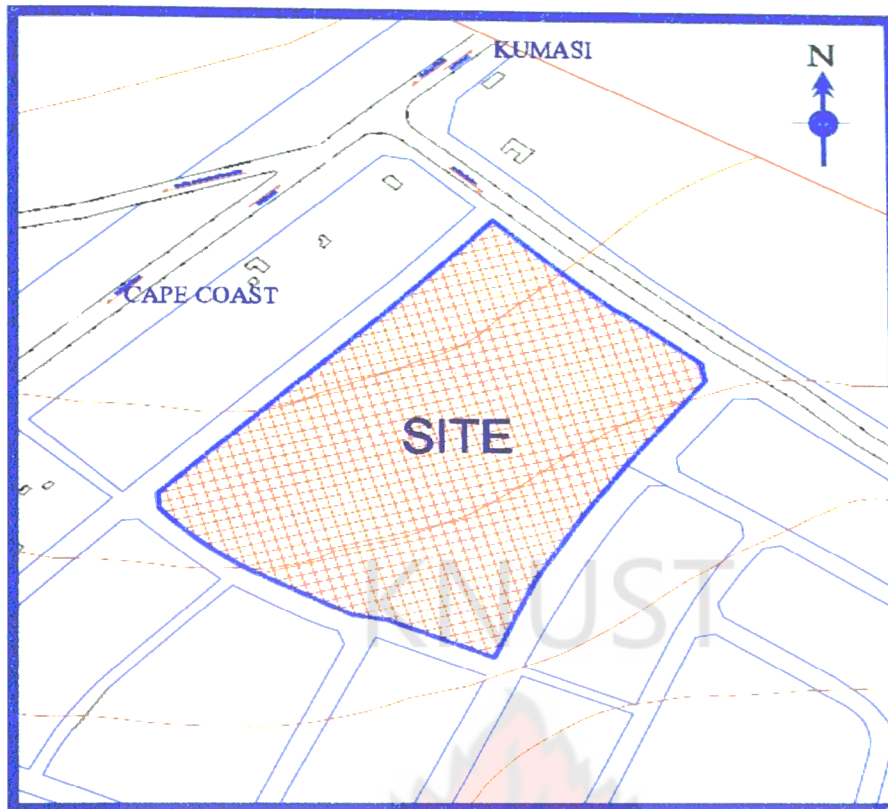


FIG 4.0

4.2.2 ADVANTAGES

1. Access to the site is good
2. The site is closer to the main road
3. The soil is good for growing herbs

4.2.3 DISADVANTAGE

1. The source of raw material is not close to the site
2. Transportation of materials and labour will bring additional cost.

4.3 SITE 2

The second option is located at Bui in the light industrial zone. The site is bounded on the north by the community center site and on the south by a water body. On the east is bounded by cultural facilities and on the west by commercial farming.



Fig 4.1 Bui

4.3.1 ADVANTAGES

1. The site is already located for light industrial.
2. There is a proposed farming area next to the site which will make it easier to get raw materials.
3. The site is a link between the southern and the northern part of Ghana.

4.3.2 DISADVANTAGES

1. The existing villages are far away from the site therefore transportation cost of labours will be higher.
2. There is no supporting facilities close by like the school of herbal medicine at the Kwame Nkrumah University of Science Technology.

4.4 SITE 3

The site is located on the Obuasi – Sanatasi road hence the site has no traffic on the way



Fig 4.2 Nkoransa site

4.4.1 ACTIVITIES AROUND THE SITE

In order to integrate the development seamlessly into the environment, the activities around the site were taken into consideration. The site is mainly of natural vegetation. Housing surrounding the site is quite far. There is a poultry farm on the east heading towards Obuasi. On the west are kiosks, a carpentry shop and houses which is about 120m far. On the north is natural vegetation.

4.4.2 SITE JUSTIFICATIONS AND CONSIDERATION

1. The site at Nkoranza was chosen out of the three for the following reasons.
2. The site is closer to the source of raw materials than the rest.
3. The size of the land was suitable for the industry
4. The site was chosen in Kumasi so as to take advantage of the Kwame Nkrumah University of Science and technology, school of herbal medicine.
5. There is also the presence of infrastructural services such as electricity, water and telephone
6. The land is fertile enough to support the growing of an arbore

4.4.3 CLIMATIC CONDITIONS

4.4.3.1 TEMPERATURE

Average minimum and maximum temperatures are 22°C and 35°C respectively.

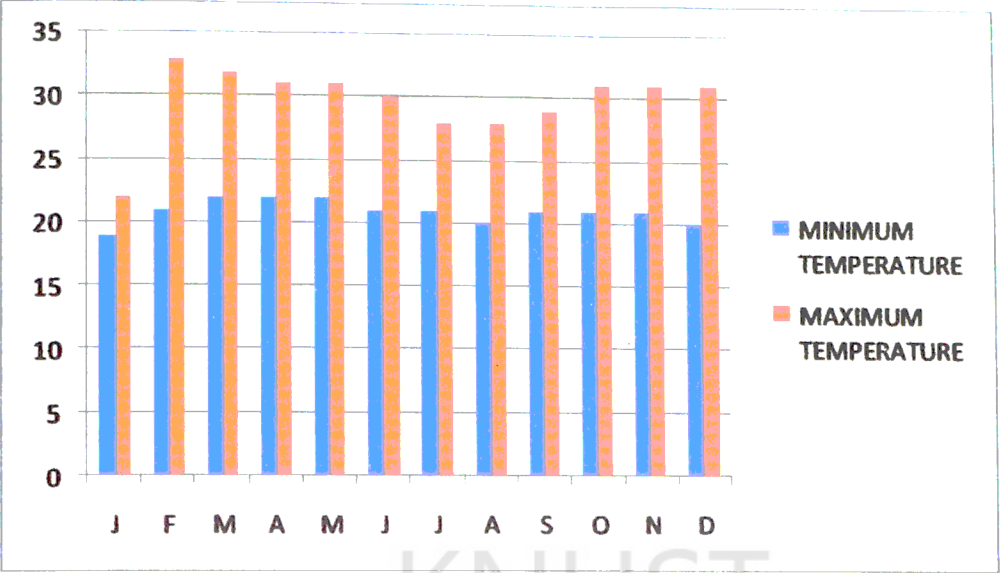


Table 4.0 Temperatures

4.4.3.2 RAINFALL

Rainfall is high throughout the year with an annual total rainfall between 890mm and 1500mm.

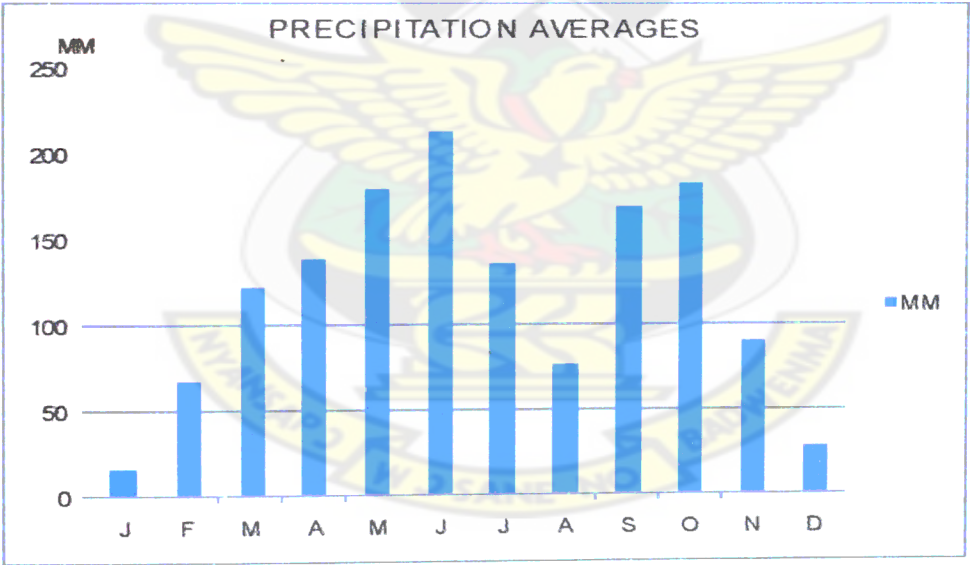


Table 4.1 Rainfalls

4.4.3.3 RELATIVE HUMIDITY

Relative humidity is falls between 75% and 85%. The chart shows relative humidity values of 2008.

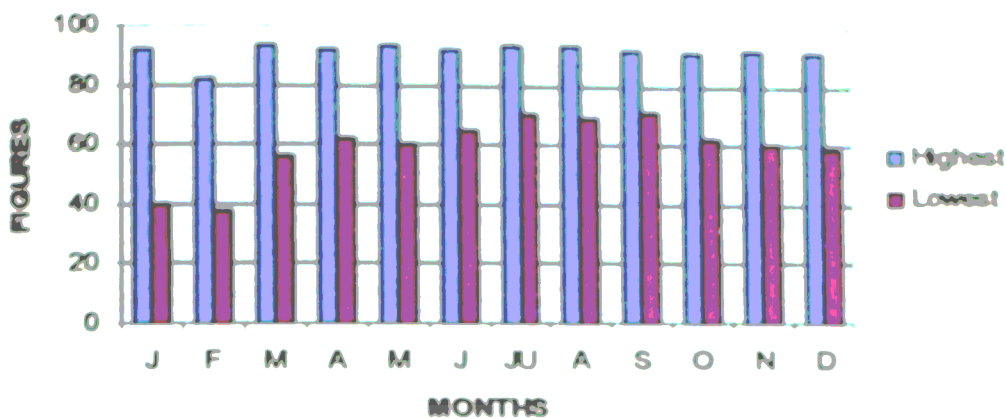


Table 4.2 Relative humidity

4.4.3.4 AIR CIRCULATION

Air velocity of 6.6 m/s with a prevailing south western direction

4.4.4 RESPONSES

Drainage problems will be solved by constructing drains on the site to cater for rain water. Plants and grass will be grown to check erosion. Most buildings will be orientated with the longer side facing the north. Sun shading will be provided on the east and west to help keep temperatures at comfortable levels for occupants, materials and finished goods. All proposed roads around the site will have to be developed to enhance accessibility.

4.4.5 GEOLOGY

Sandy loam soil with good load bearing capacity within the forest ochrosols zone of Gihana

4.4.6 TOPOGRAPHY

Site slopes downwards towards the western part gently

4.4.7 VEGETATION

Site supports plant life. Existing plants on site includes grass, shrubs and trees

4.4.8 EXISTING STRUCTURES

The entire site is covered with vegetation.

4.4.9 SWOT ANALYSIS OF SELECTED SITE

4.4.9.1 STRENGTHS

1. *Access to the site is easy.*
2. *There is enough of land for future development.*
3. *The land is sizable for such a facility enough to support such a facility.*
4. *There is the absence of vital human activities.*
5. *The site has good soil for arboretum and landscape*
6. *The site is easy to locate.*

4.4.9.2 WEAKNESS

1. *Service lines are not well laid out for use*
2. *The road around the site is untarred.*
3. *Currently the site is accessed through a foot path*
4. *The site does not slope making it difficult for drainage*

4.4.9.3 OPPORTUNITIES

1. *Trees on site could be preserved and used as part of the landscaping.*
2. *Soil supports good landscaping.*
3. *The nature of the site gives room innovation in design*

4.4.9.4 THREATS

1. *Surrounding towns are few meters away from site which means willtake some time for workers to get to work*
2. *Land close to the site is currently not developed*

The site was principally chosen because its strengths, potentials and opportunities far outweigh its threats and weaknesses.

In addition, the threats can be solved and used as a benefit for the site.

CHAPTER FIVE

5.0 DESIGN PHILOSOPHY AND CONCEPT

The philosophy used for the design is “the industry as the human anatomy” The philosophy evolved out of the case studies, precedence study and technical studies conducted. These studies referred to the industry as place that inter relates to each other, they depend on each other.

The human body consists of biological systems made up tissues, cells and organs. These systems do not work in isolation. They depend on each other for effective end results. Just the industry, all the separate entities depends on each other for support. Example is the tableting machine cannot work alone if the material has not gone through granulation. Without one the end product cannot be achieved.

The concept of the design is functionality. The human body system has to function to make the body work. The heart beats and pumps blood to the other components of the body. Life depends on this.

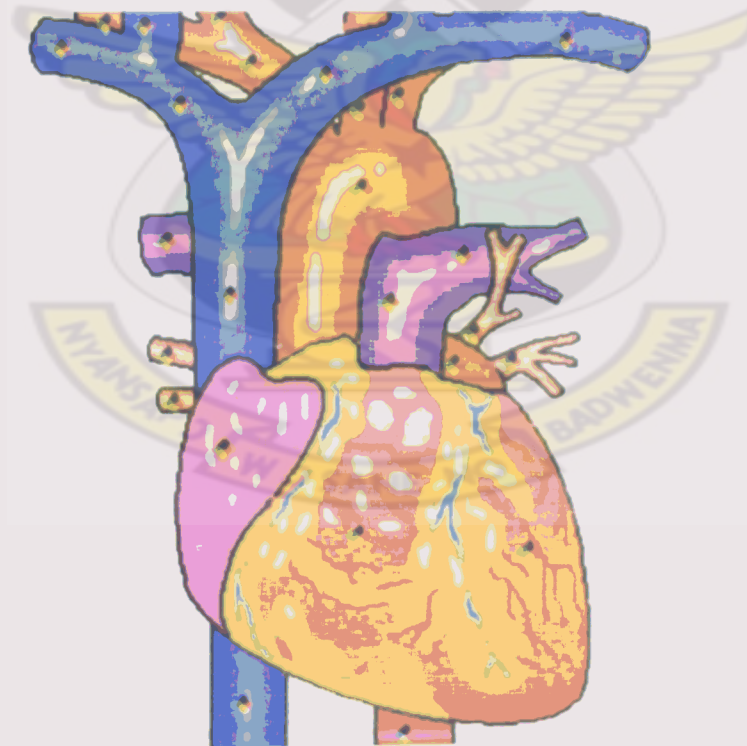


FIG 5.1 THE HEART

Just like the industry, the administration is the start point of the industry. If the heart beat of the human being stops, life ends. If the administration also stops then the industry can no longer be managed.

The digestive system also breaks down food and absorb nutrients likewise the production area, it breaks down the raw materials and turns it into finish products.



FIG 5.2 THE DIGESTIVE SYSTEM

The defecation of food then becomes the end product which is the finished and packaged drugs

5.1 THE CONCEPT

1. Linking the administration to the production unit for effective co-ordination between production unit workers and the top executives
2. The changing rooms, the maintenance unit and the research laboratory are close to the production unit for easy access and maintenance and repairing of machines. Workers after changing do not have a choice but to enter the production unit and start work immediately
3. The canteen is linked to all the major facilities on the site for easy movement and protect against the harsh weather.

Thus the planning of the design evolved based on this philosophy and concept

5.3 THE SPACES CONSIDERED

From the case studies and the precedence studies, the proposed herbal industry has the following spaces in it to facilitate activities and production process

5.3.1 ADMINISTRATION

1. C.E.O. office
2. C.E.O. Secretary
3. Board room
4. Production managers office
5. Marketing managers office
6. Sales and exhibition office
7. General manager’s office
8. Personnel managers office
9. General office
10. Accounts office
11. Sanitary areas
12. Archives
13. Reception
14. Kitchenette

5.3.2 PRODUCTION UNIT

1. Ware house
2. Raw materials store
3. Sales point
4. Finnish goods store
5. Special goods store
6. In between stores
7. Clock in area
8. Quality control laboratory



9. Tableting room
10. Capsules room
11. Sterilization room
12. Herbalist/ supervises office

5.3.3 ANCILLARY

❖ CANTEEN

1. Servery
2. Store
3. Kitchen yard
4. Kitchen
5. Eating area
6. Changing rooms
7. Sanitary

❖ PARKING

1. Staff parking for administration
2. Public parking for administration
3. Off loading parking
4. Loading parking
5. Trucks parking

❖ SICK BAY

1. Nurse's station
2. Recovery room
3. Sleeping area
4. Sanitary

❖ MAINTENANCE UNIT

1. Office
2. Store
3. Working area

❖ CHANGING ROOMS

1. Locker room



2. Sanitary areas

❖ RESEARCH AND DEVELOPMENT UNIT

1. Common room
2. Store room
3. Animal store
4. Sanitary
5. Phytochemistry laboratory
6. Microbiology laboratory

5.4 TECHNICAL STUDIES

The workability of an industry depends highly on the production flow process. They should flow together from one unit to another unit in sequence.

② Production process flow

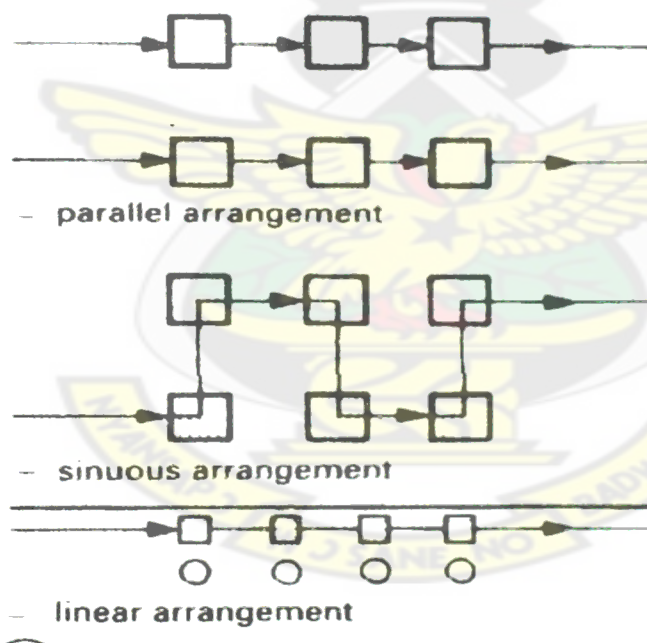


Fig 5.3 Production flow

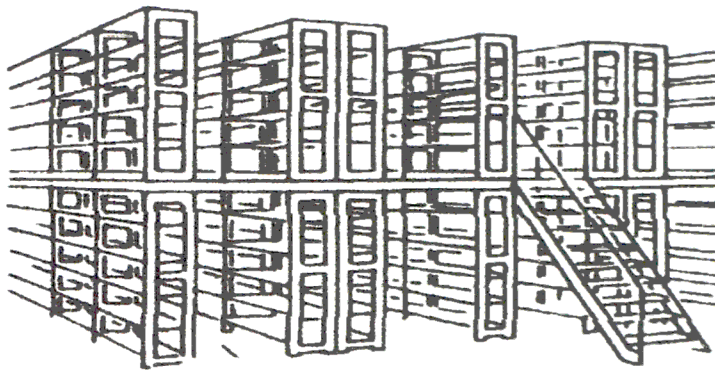


Fig 5.4 Raw material storage

The technique of storing materials in the store rooms brings about the need to go in for a double volume to store more. These are mostly stored on top of racks to avoid the materials coming into contact with the bare cold floor.

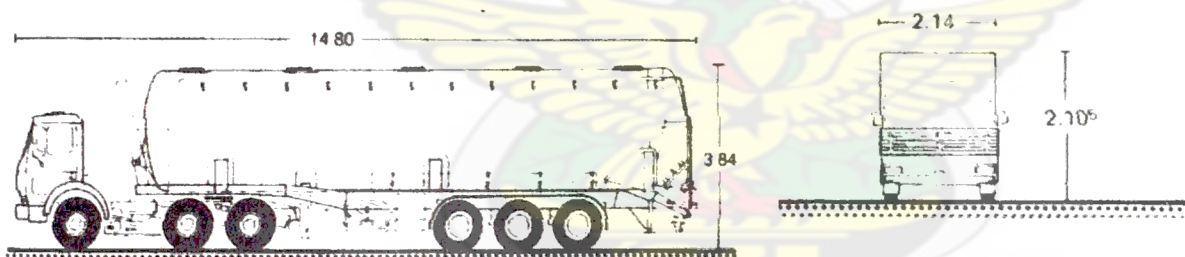


Fig 5.5 Vehicles

Studies were conducted on the various cars which will be coming to the facility, their length width and breath for the design of parking spaces.

Others include mechanism for the movement of goods in the production unit and turning angles of trucks at the industry.

5.5 SPECIAL STUDIES

Special studies were done on the type of machine and their various sizes used in the production unit. This was used as a check for room height and floor spaces.

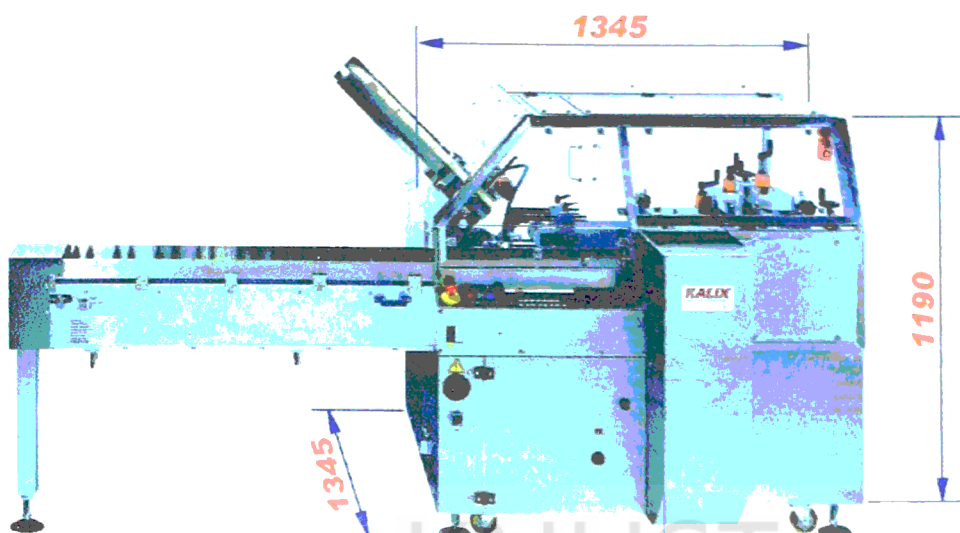


Fig 5.6 Tableting machine

Special studies on these machines were also conducted on the process of drugs flow and their arrangement on the floor space. The arrangement of the machines makes cleaning much easier and faster. There are in between stores for storage of in between materials like bottles and labels. Special rooms were provided for tableting and capsules, others include cloak in rooms and sterilization rooms.

5.6 ENVIRONMENT AND SERVICE STUDY

Temperature, lighting and ventilation is a crucial issue in a pharmaceutical industry. Some areas do not need artificial ventilation, an example is the laboratory. There is the use of extractors and electric fans well as honey comb walls for maximum ventilation. The honey comb walls also serves as a medium of lighting aside the supply of electricity from the electricity company of Ghana. There is also the use of LPG gas for fueling the boilers. Water supply is considered here very important. The purest of water is need in an industry like this. Water treatment plant is put in place to ensure the best of water and constant water supply. There are off head tanks to supply water during shortages. Waste .will be divided into two, one for fertilize and the other taken care of by a waste management company

5.7 FUNCTIONAL FLOW DIAGRAM

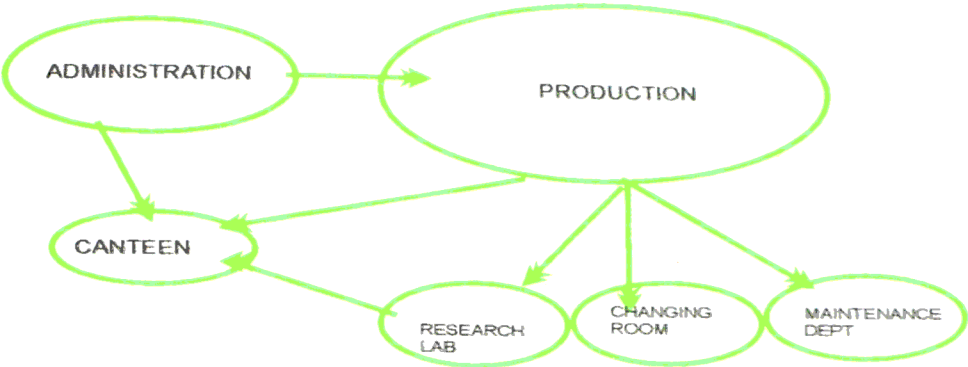


Fig 5.7 Diagram

5.8 ACCOMODATION SCHEDULE

ADMINISTRATIION BLOCK

SPACE	AREAS (SQUARE METRES)
1. CEO office	37.5
2. CEO secretary	12
3. General office	25
4. Personnel managers office	25
5. Production manager	25
6. Accounts office	25
7. Sales managers office	25
8. Archives	36
9. kitchenette	42
10. Sanitary	40.96
11. Board room	80
12. Reception lounge	45
13. Sales and exibition	25
14. Marketing manager	25

Table 5.1 Adminstration block

CANTEEN

<u>SPACE</u>	<u>AREAS (SQUARE METRES)</u>
1. SERVERY	64
2. Store	12
3. Kitchen yard	20
4. kitchen	36
5. Eating area	105
6. Changing rooms	36
7. Sanitary	9.6

Table 5.2 Canteen

PARKING

<u>SPACE</u>	<u>AREAS (SQUARE METRES)</u>
1. Staff parking	305
2. Public parking	900
3. Off loading parking	450
4. Loading parking	450
5. Trucks parking	450

PRODUCTION UNIT

<u>SPACE</u>	<u>AREAS (SQUARE METRES)</u>
1. Ware house	105
2. Raw materials store	105
3. Sales point	4
4. Finnish goods store	150
5. Special store	105
6. Inbetween store	36
7. Cloak in	16
8. Quality control room	16

9. Tableting room	35
10. Capsules room	35
11. Sterilization room	16
12. Herbalist / supervisor office	20

Table 5.3 Production unit

SICK BAY

<u>SPACE</u>	<u>AREAS (SQUARE METRES)</u>
1. Nurses station	105
2. Male sleeping area	105
3. Female sleeping area	4
4. Sanitary	81

Table 5.4 Sick bay

MAINTENANCE UNIT

<u>SPACE</u>	<u>AREAS (SQUARE METRES)</u>
1. Office	6.9
2. Store	15
3. Working area	138.75

Table 5.5 Maintenance unit

CHANGING ROOMS

<u>SPACE</u>	<u>AREAS (SQUARE METRES)</u>
1. Locker room	6.9
2. Sanitary areas	41.25

5.9 CONCEPTUAL SITE PLANNING

With careful examination of the conceptual site planning, site planning considerations for the layout were as follows:

1. Orientation of buildings
2. Interrelationship of spaces
3. User requirements of the various spaces
4. Parking areas
5. Service areas
6. landscaping

5.10 OPTION 1



Fig 5.8 Conceptual

These observations were made

5.10.1 ADVANTAGES

1. Visitors parking is close to the exit.
2. Good location of the administration block
3. Staff parking is behind the administration

§10.2 DISADVANTAGES

- 1 Philosophy is not too clear
- 2 Pocket of various buildings on the site are not linked to each other
- 3 Parking space for offloading goods will create problem for loading of goods

§11 OPTION 2



FIG 5.9 CONCEPTUAL

§11.1 ADVANTAGES

- 1 The production unit is placed in between the production unit and the ancillary
- 2 Access to the site is taken from the secondary road

§11.2 DISADVANTAGES

- 1 Farm office is too far from the administration
- 2 The cude- sac will create conflict between vehicle from the production unit and the service cars since the loading car barks out into the street

5.12 OPTION 3(SELECTED OPTION)



Fig 5.10 Concetpual

5.12.1 ADVANTAGES

1. Good access to the site.
2. Good soil for the growing of the arboretum
3. services road to take care of the ancillaries

5.12.2 DISADVANTAGES

- ❖ Administration quite far from the arboretum

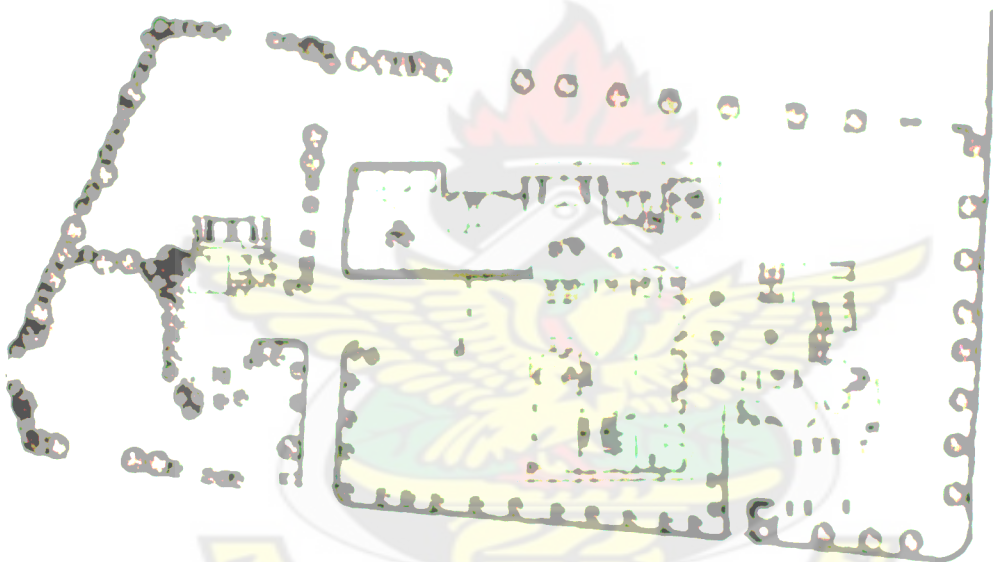
The option three was selected because of the strong advantages it has over the other two options.

5.13 THE DESIGN

The design tries to portray as much as possible an industrial set up. A pharmaceutical industry is not distinct in appearance from other industries. They do not dwell much on aesthetic but on functionality of the place. The various facilities are allocated around the administration and the

arboretum and future expansion at the other end of the site. The variable size of the site and the activities of various spaces influenced the decision to go maximum two floors.

The primary structure of the building varies from 5m x 5m grid for the administration block and 10m x 10m for the research block and production unit. The industry is set away some few meters away from the road. There are two entrances, one as services road and one as an access to the administration. The administration is faced with the public parking in front and the staff parking at the side since they leave the premises at the end of the day there will be no interference. The production unit is next to the administration for effective supervision and coordination among workers. The maintenance unit and the changing rooms are located behind the production unit. This makes it closer to the production unit and the service road.



5.13.1 GENERAL DESIGN

The first thing at the site is there are two roads entering the site. Before entry to the site there are two security posts whose duty is to check all the people and goods that comes and leave the factory. The first from the Obuasi - Kumasi road leads to the private and staff parking. They are excluded from the others due to proximity to the administration and the canteen. The second one is the services road which links all the services on the site. The administration is linked to the

factory and the canteen. The administration is entered through the reception via the entrance pouch and could also take you to the canteen or production hall. . There are two floors at the administration and single floor at the canteen area. The canteen has a single storey. The idea of the open space around the canteen is to create an environment that gives a feel of change in surrounding. This is to help relieve the built up stress in workers during non working hours.

The distance around the production block from the rest is to reduce any probable noise generated from the production block. The changing rooms are closer to the production block for easier access by workers. The wash rooms are separated from production block because of contamination since hygiene is a critical issues in the pharmaceutical industry the sick bay is closer to the production hall and the service road in other to use both in times of need when a worker needs to get to the hospital, the ambulance use the services road at the back to take the person away whiles it's easier to move the person from the production hall to the sickbay.

The power house is created at the other end for easy access to the transformer and the service road whiles it's attached to the water treatment. It is next to the maintenance unit for easy servicing and maintenance. The roof was influenced by the usual barrels that depicts more of an industrial setup.

5.13.2 ORIENTATION

The layout lends itself to easy orientation with the longer sides facing the north and south whiles the shorter side faces the east and west. This is to minimize the solar ingress and maximize views and allow the best of prevalent wind to create the desired comfort levels indoors.

1.13.3 VENTILATION

Sufficient ventilation has been provided by the usage of more windows. The velocity of air flow and its directions which determine the cooling effect of natural ventilation has been exploited very well by the structure and form employed.

5.14.MATERIALS (WALL CEILING AND FLOOR FINNISHES)

There is particular attention paid to floor finishes and walls in an industrial designs and construction, interior finishes and treatment are among the important considerations too. This is because of the nature of worker been done there and the thing that goes with it like water.

5.14.1 Floors

Floor materials in an industry are very vital due to the choice of finishes. They are subject to constant abuse and maintenance due to the sort of activities required in the spaces for example the chemicals used to prepare the drugs, water and spillages of all sorts.

For the choice of materials for the floor, these were taken into consideration

- ❖ Durability
- ❖ Non slipping
- ❖ Life span
- ❖ Easy to clean
- ❖ Choice of colour

Floor are finished some parts are non polished to avoid slipping while some parts are polished. Walkways will be treated with terrazzo because of the constant use of the space to prevent wearing and tearing. In doors will be treated with different materials depending on what happens in the space. Production areas will be treated with epoxy coating to resist splashes of chemicals.

5.14.2 Ceiling

There will be no ceiling at the production floor areas, roofs will be exposed. At the other areas like the administration and canteen, will have colored ceilings which will add to the luminance of the spaces.

5.14.3 Walls

The exterior walls are plastered smooth and painted green with white at some parts to depict herbs and greenery. The interiors are painted in different light colours to brighten up the individual spaces.

5.15 Cabinetry

Worktops in the laboratories are also finished with vitreous tiles and other areas will be finished with plastic laminate or wood (good quality) pre-manufactured with wide selection of styles.

Plastic laminate (better) pre-manufactured with exceptional accessories.

5.16 ODOR

Sanitary areas are outside the production due contaminations which might affect the drugs.

Disinfectants too are to be provided in the wash rooms to reduce the odor whiles in the administration block such areas which normally provide odor is designed to be inbetween the administration and the canteen. The production unit floor will also be washed regularly with disinfectant to remove odor.

5.17 Drains

Polymer concrete; prefabricated sections with grate pre-sloped and easily cleaned.

PVC not pre-sloped but inexpensive.

5.18 LIGHTING

There is maximum use of natural lighting and artificial lighting used as complementing lighting and alternative lighting where necessary. A lot of large openings have been designed to improve on the admittance of light from the natural source. There are devices like honey comb walls to admit more light.

5.19 PARKING SPACES

Each of the three sectors has its own clearly defined parking areas for trucks in the facilities and for visitors as well. The administration area which is also opened to the public has the highest number of parking spaces in the facility with a maximum walking distance of about 10m.

5.20 PHASING

The brief of design shows that the project when is undertaken will require extensive planning and financial management, thus the construction will be put into three phases as follows:

5.20.1 Phase 1

The first phase will comprise of the production and the administration block to be constructed. Work on the vehicular access, car park and fencing would be done.

5.20.2 Phase 2

During this phase the sick bay, canteen and the maintenance unit would be put up as well as landscaping and pedestrian walkways.

5.20.3 Phase 3

The final phase would comprise the construction the farm house and the arboretum.

5.21 Services

Services provided for the facility include water supply, electricity, lighting, ventilation, security controls, telecommunication facilities, gas supply, refuse disposal and fire fighting.

5.21.1 Water supply

Water to the facility would be from the mains along the Santasi – Obuasi road. Hot water would be provided.

5.21.2 Electricity

Power will be tapped from the mains along the Santasi – Obuasi road and stepped down by a 500KW transformer before being sent to a switchboard and then distributed to the panel boards. A standby generator set with automatic switches will be provided and would be part of the distribution cable which will be loaded.

5.21.3 Lighting and Ventilation

Due to the peculiar nature of the machines in certain spaces in industries like the production unit, natural ventilation is utilized with the exception of the capsules and the tableting rooms where specific room temperatures are required. Air conditioning system is used in the administration block and the laboratories in the research and development unit.

5.21.4 Emergency exits

Emergency exits have been provided for escape routes. Fire alarm call points and firefighting equipment have also been used.

5.21.5 TELECOMMUNICATIONS

Every unit has communications requirements that need to be connected to the administration block. These communications requirements encompass not only basic telephone service, but local area network/data communications (LANs), video/television, paging, and security and fire sensing and alarm systems. Separate, dedicated telecommunications space will be provided to satisfy the immediate and planned future telecommunications needs.

5.21.6 FIRE DETECTION

The fire alarm system shall be an automatic 1-24 zone single loop addressable fire detection and alarm system, utilizing conventional detection and alarm sounders. Detection shall be by means of optical and heat detectors located throughout the facility.

5.21.7 FIRE FIGHTING INSTALLATION

Fire fighting measures such as the use of portable fire extinguishers will be located at fire-prone areas. Automatic fire suppression system shall be proposed for the labs. The suppression means shall be harmless, effectual and environmentally friendly.

5.21.8 FIRE HYDRANTS

Fire hydrants of the type BS 750 comprising a cast iron key operated sluice valve complete with a socket adapter, a duck foot bend and an outlet adaptor or approved equal will be provided. The adaptor shall have a standard Belfast Pattern Outlet with the female thread protected by a brass cap and chain. The hydrant fitting shall be tee off from the mains. Each hydrant shall be provided with a heavy duty cast iron hinged hydrant box to BS 750 with the words fire hydrant cast on the cover. The top of the hydrant box shall be painted red.

5.21.9 WASTE MANAGEMENT

Drainage in soil and wastewater will be through pipes to septic tanks located in the lowest foot of the site. Refuse and litter bins would be placed at vantage points

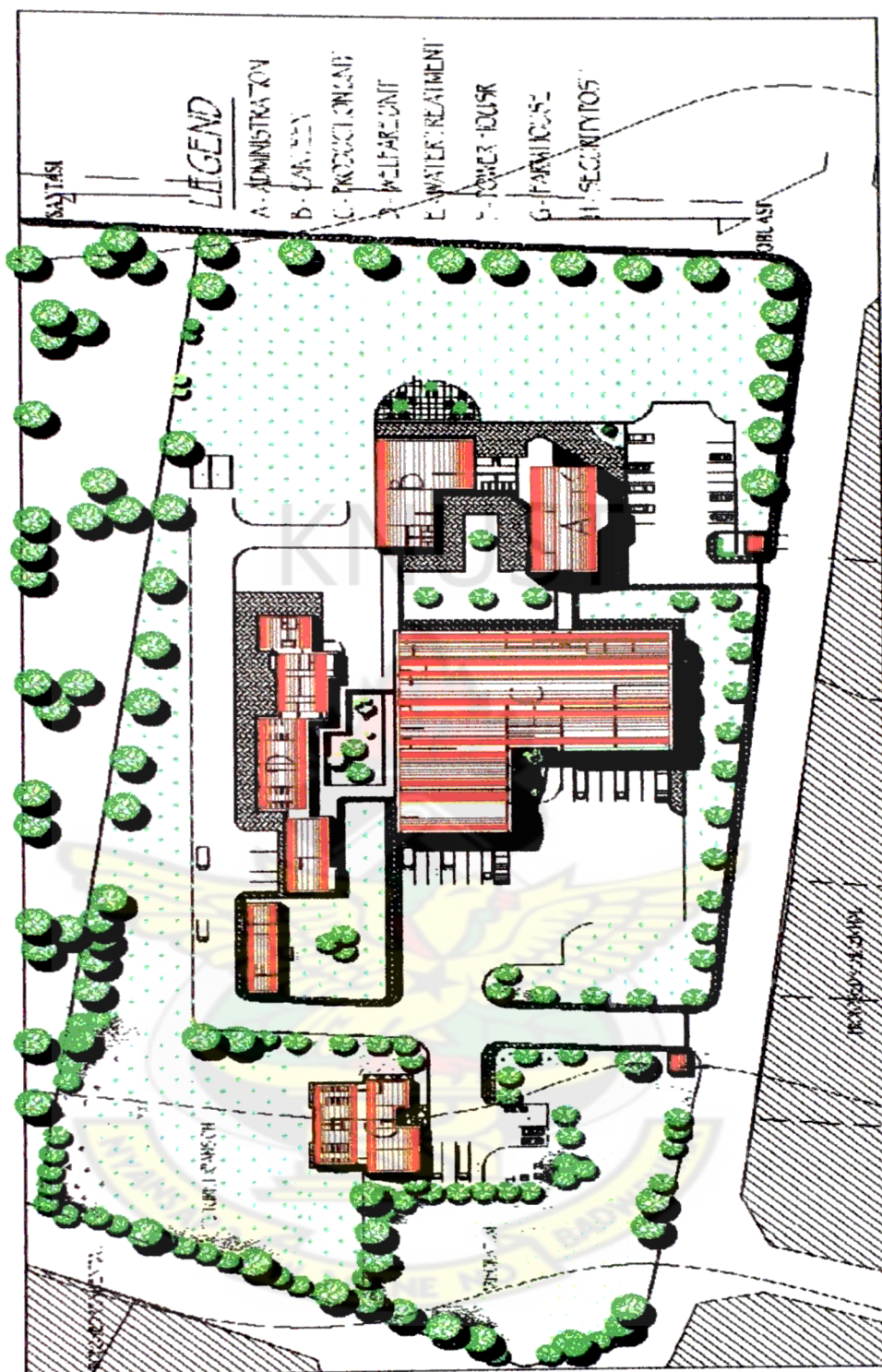
5.21.10 LANDSCAPE

Easy maintenance, durability and aesthetic appeal shall be considered in the landscaping of the facility. Soft landscape will be used to enhance the needed beauty and to create a microclimate against the harsh weather conditions. The few trees on the site shall be incorporated into an overall landscape with the introduction of more greens. The road net work will be lined with royal palm trees. Open spaces will also be landscaped with lawns and avenue trees. The arboretum will be filled with special specimens for research into new drugs and drugs to treat ailments. The frontage of the administration is enhanced with a small garden to give it an aesthetic appeal. This will help easy workers of tension psychologically whiles they are on break.

Hard landscape will be used to define walkways and roads. Pedestrian walkways shall be finished with interlocking concrete paves interspersed with grass. The pavers shall blend with the rest of the landscape in both color and texture. This is aimed at reducing heat loads, glare and by the principle of rhythm and repetition to achieve a better design. The driveways shall be surfaced with asphalt.

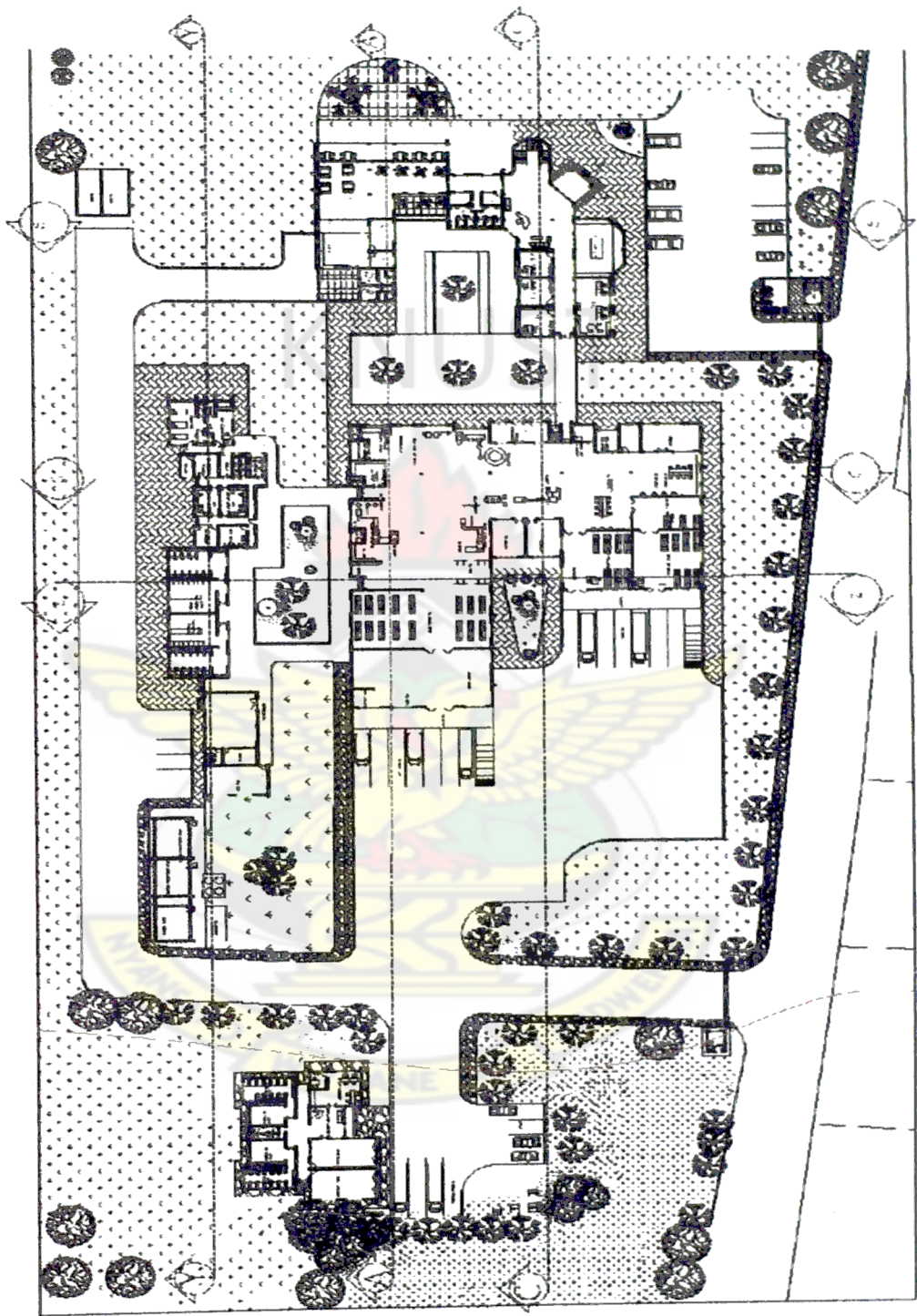
5.22 BLOCK PLAN

The facility sits on about 60% of the site with the remaining used for landscape and arboretum. The soft landscaped is used to break away from the rigidity of the hard landscape. The administration, production unit and the arboretum have parking spaces in front of them to service the facility with the administration having both private and public parking. Barrel roofs were employed to give it an industrial look.

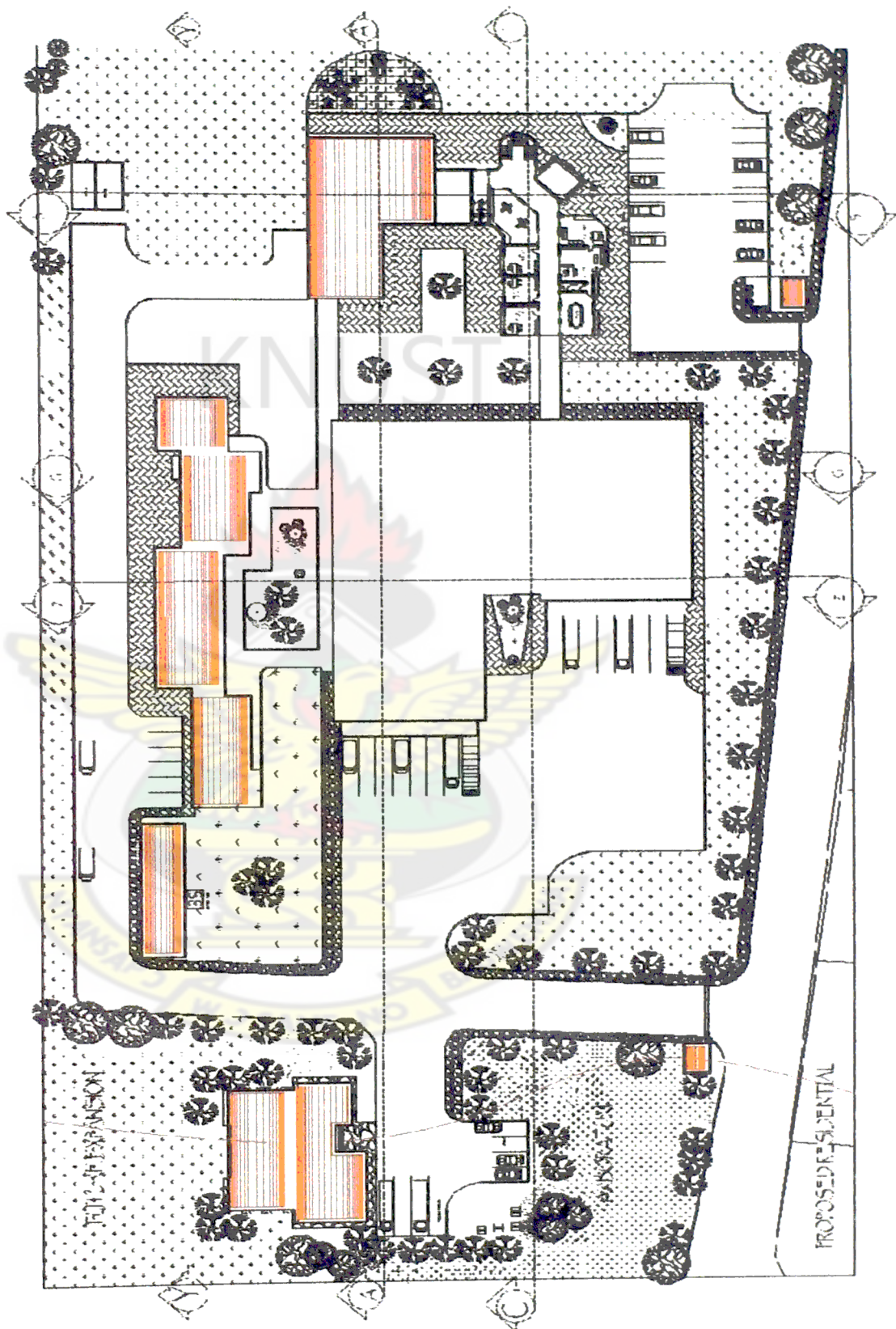


5.22 PLANS

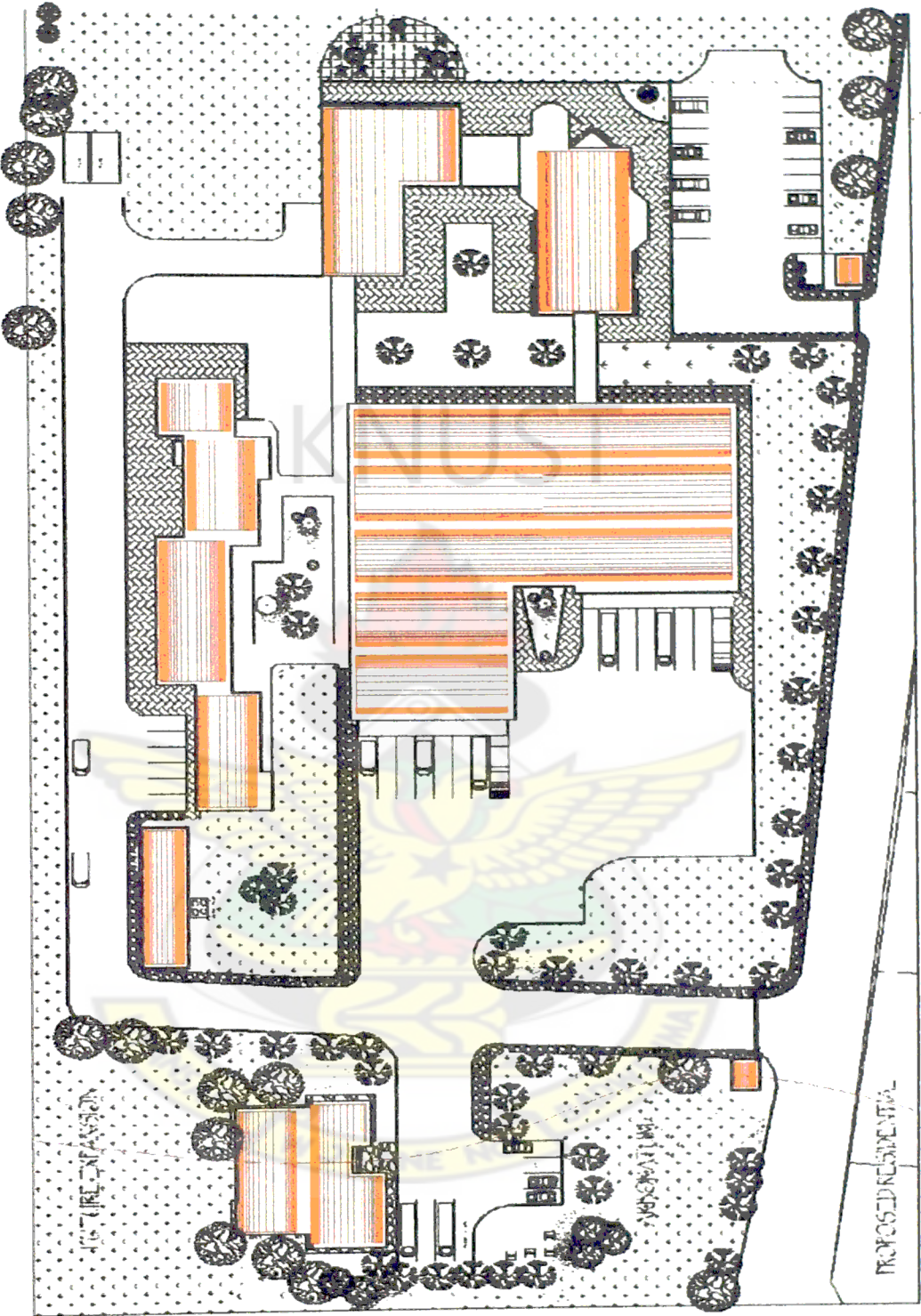
5.22.1 GROUND FLOOR PLAN



5.22.2FIRST FLOOR PLAN



5.22.3 ROOF PLAN



5.22.4 ELEVATIONS

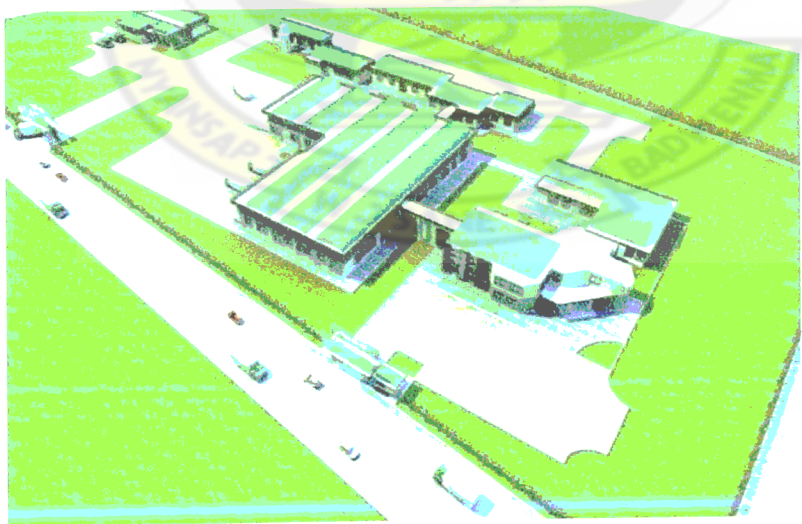


5.22.5 SECTION



5.23 STRUCTURE AND FORM

The structural system employed here is the load bearing post and beam system. There are different levels in height with the production unit being the tallest due to the nature of machines to the used. The second tallest is the administration block which has two floors, while the rest are single storey. Series of barrel roof were employed to depict an industrial setup. the administration block is supported with steel truss whiles the rest production unit and the other ancillary facility are self supporting. The longer sides of the buildings are oriented north and south to reduce the amount of solar received. The western and eastern facades have been carefully and consciously planned with recess to cater for the solar ingress.



5.24 Cost

All the phases put together shall cost a total sum of 160,000,000Ghana cedis. This is based upon the cost per unit area calculation of 250-350 Ghana cedis per unit area.

5.25 ENVIRONMENTAL IMPACT ASSESSMENT

The impact of an industry has both positive and negative on the immediate environment and as such measures should be taken to address any imminent situation. Environmental impact assessment is an activity that is designed to identify and predict the impact on the physical environment and on the human's life. A brief summary of such an impact by the design and planning can be outlined as follows:

❖ Impact on Air Quality

Air pollution would be caused by dust during the construction stage through site clearance, excavation works, delivery and use of cement and aggregates.

❖ Impact on flora and fauna

The clearing of vegetation cover and removal of topsoil during site preparation would result in the following:

1. degradation of plant cover
2. ii Destruction of the natural habitat of fauna on site

5.26 CONCLUSION

With the rapid population growth of Ghana, a substitution medicine has become a very crucial issue to deal with for the country to survive medically. The herbal drug production facility ceases this opportunity to create the avenue for this substitute therefore increasing the availability of medicine. This is also to promote the use of herbal drugs in the country and to create the awareness of how modernized the herbal industry has grown to be in recent times through the architectural design. The smooth preparation of drugs has also been provided in this facility. Therefore, in pursuance of the aims and objectives of the design summarized above, it is hoped that the Herbal Drug Production Facility to be located in Nkoranza, Kumasi will gain the full support of the Ghana Association of Traditional Medicine Practitioner in conjunction with the

Ministry Of Health, the World Health Organization (WHO), Food and Drugs Board and the Ghana Standard Board to make it a reality.

The concerns raised are best achievable by the active participation of all stakeholders. In the construction process; from inception to completion, all procedures must be followed to the letter. With a philosophy of Regionalism being a key factor, the natives must be made to feel a greater part of the process.

Also, it shall be recommended that, the project be carried out in phases;

KNUST



BIBLIOGRAPHY

1. World Health Organization . 2008-www.google.com
2. Ghana National Association of Traditional Healers. 2008-www.google.com
3. Journal Ethnobiol Ethnomedicine. 2007; 3: 14. 2007
4. Houghton Mifflin, the American Heritage ® Medical Dictionary Copyright© 2007.
5. Traditional Medicine Strategy Document who/edm/trm/2002.1. 2002-2005.
6. Neufert Ernst, *Blackwell Scientific Publication 1980*, Architects’ Data
7. Chudley R., 1996, *Construction Technology, Vol.4*, Second Edition
8. Allen, Edward, *Fundamentals of building construction, materials and methods*1990.
9. <http://medlibrary.org/medwiki/Herbalism>
10. Ghana National health policy documents
11. Dos Santos-Neto LL, de Vilhena Toledo MA, Medeiros-Souza P, de Souza GA. The use of herbal medicine in Alzheimer's disease-a systematic review. *Evid Based Complement Alternat Med*. 2006;3(4):441-5
12. www.pharmaasia.com/article-7542-earlydetectionindrugproduction-Asia.htm.2009

