DAIRY PRODUCTS FACTORY BARAKIN LADI

HYGIENE IN DAIRY PRODUCTS FACTORY

M.Sc. (ARCH) THESIS

By

DAMULAK AHMADU

FEBRUARY, 1992

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DECLARATION

I DAMULAK Ahmadu do declare that this work is the product of a research project undertaken by me under the supervision of my mentor, Architect Nabade. It has not been submitted for the award of a degree elsewhere in whole or in part. Works quoted have been acknowledged by means of references.

Damulak Ahmadu

CERTIFICATION

This thesis entitled DAIRY PRODUCTS FACTORY, BARAKIN-LADI: Hygiene in Dairy Products Factory, by DAMULAK, Ahmadu meets the regulations governing the award of the degree of Master of Science in Architecture (M.Sc. Arch.) of the Ahmadu Bello University, Zaria Nigeria. It is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This project is dedicated to my parents Mr. and Mrs. Muhammadu Damulak for all the care and concern they showed while bringing me up, my family members, relations, and most especially to God.

ACKNOWLEDGEMENT

With gratitude to my FATHER and MOTHER for their unending love and mercy, and to GOD for giving me life and knowledge, I would like to thank the following for making my stay in Zaria worthwhile. My parents for your support,

My Brothers and Sisters - for continued support
Arch Madusalumo - for good assistance
Arch Nabaa - for good guidance
Tony Onaji - for general assistance
Sirajo Zumi - fellow crasher
Yakubu Aku - for encouragement
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Pamela, Sakyan, Gladys, Odugbesan, Rhoda, Afobs, Valerie, Mrs. Gyang, "Lizzy", Robert, Mathew, Nana

Thank you all.

ABSTRACT

The dairy industry is that, which specialises in the production, processing, and marketing of dairy products.

After the advent of the oil boom, there was a general neglect on agro-based or related industries, due to this neglect on these agro type industries, there has been a decline in productivity and standards of such type industries, attention was de-emphasized.

The country for example, relies on importation of foreign powdered milk for most of the supply of raw materials in dairy factories.

Hygienic standards in these factories are very poor, which are often harmful to consumers.

To keep citizens in line with the presents government emphasis on industrialization and agricultural development, as the prime area of concern, and to uplift the hygienic standards of these type industries, this project was selected with this keen interests in mind.

Hygienic standards will be arrived at through a total sealing or exclusion of factory manufacturing processes from outside activity, raw material supply, and evacuation, so that a higher grade or standard of product can be produced.

The solution will include, incorporations thorough considerations of Architectural factors in the design. They include considerations of the following; architectural, environmental considerations, construction, health and other general design consideration.

This will be done through design manipulation or considerations of these factors.

This approach is justifiable in order to raise the sanitary standards of such factories.

Hygiene is of paramount importance in food processing industries. Thus, adequate thought most be given to potential sources of contaminations, and other design criteria through a thorough study of considerations affecting the sanitary standard. Contamination in food processing plants could be microbial or non-microbial.

The thesis titled "Hygiene in Dairy Products Factory", is to investigate ways of solving santary problems in such factories and thereby present a design proposal for a dairy products factory, Barakin-Ladi.

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CHAPTER ONE

INTRODUCTION AND PREAMBLES

1.1. INTRODUCTION

Hygiene is of paramount importance in food processing plants. Good sanitary standards contribute to better quality, and better keeping characteristics. Hygiene may be defined by "Lopez Parker and Lithfield" as, the systematic control of environmental conditions during the transportation, storage and processing of foods, so as to prevent contamination."[1] Contamination could be by insects, microorganism, rodents or other pests. These contamination sources could be microbial or non-microbial.

The role of the architect in the design of food installations cannot be overemphasized, but he usually serves as an adviser, of the general design programme in the design of any food installation. It is very important for architects to consult hygiene specialists, in order to have proper allowance for higie... Good sanitary standards can be arrived at, by only thororgh sanitary considerations, in the planning of the total building operation.

The purpose of this study is to find out or propose a design solution, for a hygienic or bacteria free environment in a dairy products factory.

---

1 Source: Lopez Parker and litchfield June 1973

It is intended to find out how certain architectural design aspects or considerations can be carefully applied, manipulated, selected or made to conform to certain sanitary levels inorder to prevent contamination.

1.2. THE DAIRY INDUSTRY:

The dairy industry is that which specializes in the production, processing and marketting of dairy products.

A dairy factory is however, an individual unit which undertakes such activity. Milk production does not however have to be carried out by an individual factory carrying out milk processing, but could be collected from other collection centres.

The primary phase in a dairy industry is milk production, whilst the secondary phase is milk processing.

A dairy cow, is the basic unit in the milk production system. Production of milk is that function, which is performed by the milk production system.

The second activity in the dairy industry, which is carried out in the dairy, is milk processing. The raw milk is processed to a number of products which includes; powdered milk, butter, ice cream, pasteurised and other dairy products.

The dairy industry in Nigeria, is an area whereby, although it has been given due attention by government, it has been neglected for quite some time now, and is saddled with a number of problems. These problems includes; that of poor management, genetic limitations of milk producing cattle and ingridients in cattle feeds, and a general lack or inadequacy of products produced in the country so as to meet up with consumer demand, due to high costs.[2]

In dairy factories, whereby milk production is done, usually rely on importation of powdered milk from places like Netherlands, Denmark, West Germany, Holland etc. Dairy factories are evident in Nigeria, in our towns such as Kaduna, Funtua, Minna, Jos, Kano, etc.

Dairy factories on the other hand exist in places such as; Agege, Jos, Ibadan, Shika, etc. The farms are all generally small, and are integrated. An integrated dairy farm is a unit or factory that serves or performs a combined role of dairy farming and processing.

From the data by the World Health Organisation, it has been found out that the nutritional requirements of a greater percentage of the Nigerian population, mostly the low income group is very unsatisfactory.[3]

2,3 Newswatch, August 27, 1990

This is because the availability of such types of nutritional foods is not enough, and where it exists, it is of a high cost.

About 76% of agricultural output, is from farm crops and 50% animal products, of which meat is highest.

Cattle population in Nigeria is about 12 million, of which 93% are in Northern Nigeria.[4] A large available local supply of cattle, is present in the country.

1.3. DAIRY FARMING:

Dairy farming has been one of the most profitable and stable farming type in the world. The weekly or monthly income from sales has been of important financial aid to farmers. Milk which has very high nutritive value in the human diet.

Future Trends:

Dairying all over the world now, has a brighter future than it did during the 1930s and 40s. The trend is towards large commercial herds.

Modern machines and methods have taken most of the drudgery out of this farming type.

Modern advances in science and veterinary medicine have greatly reduced losses and risks caused by disease.

---

4 A New Geography of Nigeria by N.P. Iloje:

Successes are usually attached to persons or companies who have a genuine liking for dairy animals.

Dairy cattle are numerous and of various species. Dairy breeds include high yielding European breeds which include the following; Friesian-Holstein, Friesians, Brown Swiss, Jerseys, Guernseys, Ayrshires. High yielding Zebu cattle breeds include; Sahivoals, Red Shindhi and European breeds. Holsteins when combined with Zebu breeds have a high t yield because of a combination of the potent factors.[4] These factors include that of climatic and local resistance.

REPRODUCTION:

European breeds calve at 2 - 2½ years, while Zebu cattle calve at 3 - 4 years. The cow produce about one calf a year.

MEAT:

Veal calfes are ready for slaughtering at 150-200kgs, or otherwise fattened as bulls up to 400-500kgs. Castrated males can be fattened up to 500kgs. Growth rate varies. from 0.5 to 1.25kg per head regular cattle yields are up to about 55 percent of liveweight.

---

4 Animal Science and Industry, June 1963

MILK YIELD:

Average milk yields under good management are below:

Table 1:3:4

	Kgs/Milk	Fat %
Friesians	5,000 - 7,000	4.0
Holstein Friesians	5,000 - 8,000	3.8
Brown Swiss	4,000 - 6,000	4.2
Jerseys	3,500 - 4,500	5.5
Guernseys	3,500 - 4,500	5.0
Ayrshires	4,000 - 6,000	4.0
Sayhival	1,000 - 2,000	4.5
Red Shindi	1,000 - 2,000	4.5
Cross breeds	1,500 - 3,000	3.5 - 5.0

Source Handbook for dairy men 1963

Protein content of milk varies from 3 - 3. 5 percent. Lactation periodic lengths are about 280 - 320 days.

1.4 MOTIVATION

Motivation for this study arose from my keen interest in industrial design, and the need for identifying myself in development trends and the countries future aspirations, in industrial design development and architecture.

1.5. DESIGN PROPOSAL/PROBLEM DEFINITION

The aim of the design project is to produce a dairy factory, which will engage in the processing of raw milk into dairy products, such as; powdered milk, yoghurt, butter, cheese, ice-cream. The aim is to produce an ideal design which will cater for dairy activity.

1.6. DESIGNER'S AIM:

The project design is indeed very technical, as clearly seen in most industrial design projects. The thesis attempt, will be on investigation into ways for the creation of a hygienic work place environment, in a dairy products factory. The main aimsis summarized below

(a) Achievement of a hygienic workplace environment by means of effective planning, so that products produced are free from contamination, and are of a high quality, fit for human consumption.

(b) Achieving a design with an efficient and effective integrated spatial organization for best operational results.

(c) A design which gives constructional and operational flexibility.

(d) A design reflecting to high degree of workers' interest and production processes.

(e) To design a factory which gives a conducive occupational environment, as it applies to dairy factory so as to ensure psychological and physical comfort, and safety.

A hazard free environment through design considerations and solutions should be arrived at.

- To give employment to people in the area
- Development of an appropriate planning scheme so as to achieve effective spatial organization.
- To create a market whereby the potentials for a particular agricultural product exist, thus stimulating production.
- To increase the net income of the population dependent on dairy products, or other factories associated or related to dairy products either vertically or laterally.
- To conserve and eventually earn foreign exchange in the long term.

1.7. RELEVANCE TO NIGERIA:

The project is in line with the government's emphasis on:

- Rural industrialization
- Reviving agriculture
- The use of local, available, raw materials for our industries.
- Diversifying the economic base of the country.

The second motivation factor is because of the unaffordable high prices of dairy products, such as milk; for breakfast, and for babies, has started to cease, due to the unaffordable high prices. Such commodities are of a great necessity even in this structural adjustment period.

The final motivation factor is that at this critical period, these projects types should be geared up, so as to upgrade the living standard and unaffordable high prices. Emphasis should be given to agriculture or agriculturally related factories.

It is good attempt to try and solve these problems now in school theoritically, so that one can aquaint and equip himself with expert solutions, on ways of solving, or handling such problems, incase one meets these kinds of problems later on in life. Emphasis on agriculture or agrorelated goods is the governments' prime area of concern or focuss area nowadays.

1.8. SCOPE OF DESIGN:

The project will cover the following:

- Milk processing(dairy plant)
- Administration building
- Staff facilities
- Auxillary facilities
- Warehouse
- Generator house.

1.9. RESEARCH METHODOLOGY:

The project entails a detailed knowledge of dairy products, and production processes, from the issue of type,, raw materials and for specific production, and peculiarities involved in the production.

Knowledge was aquired through visitation of existing dairy product factories in the country, through site visits and conduction of a field research.

Case studies of three existing factories and two foreign factories from existing literature were carried out or studied.

Knowledge also was aquired from academicians related to dairy production ie. (Veterinary Medical students, Home Economics students, and Medical students).

Site visitation of interesting industrial or architectural examples of existing factories were studied in the quest for favourable aesthetics or other architectural design solutions.

1.10. SOURCE OF DATA:

Data sources included literature review of existing journals or magazines, past project works, professional design reports on seminar papers and also a review of past notes, textbooks or other brochures relating to this area of design specialization.

Personal and informal interviews were carried out for this design which provides an ever increasing market. Dairy cattle are very efficient converters of grains and forages into food for human consumption.

The dairy industry usually consist of two main parts. The production of milk on one hand and the processing and distribution of milk and other dairy products.

There are over 600 million domestic cows in the world today in almost every country.[5]

There has been a slow but definite trend towards larger herds in dairying. Capital requirements are higher, standards under which products are produced and marketted are higher. Competetion in dairying is higher. Advent of milking parlours, loose housing systems, cow pools, bulk handling system and strict sanitary regulations have made this farming type more competetive.

Dairy products which are very essential and are necessary to promote and maintain life. Requirements for human diet nutritional value have been on the increase worldwide.

---

5 Handbook for dairy men June, 1963

DISADVANTAGES:

Dairying although very profitable, is not left out with a number of disadvantages. Dairy cows require better feeding and care than most other farm animals.

As the work becomes larger and more specialized, problems of arranging work schedules and securing interested and dependable people is often a problem.

1.11. ARCHITECTURAL SIGNIFICANCE:

It has hoped that this thesis work will be a inspirational source for investors, and serve as a working model for architects who intend to find out or get information about food processing factories.

The factory will promote industrial development in Plateau State, and also provide job opportunities for people residing in the area. It is hoped, that the factory products will be exported so as to generate foreign exchange.

Finally, it is intended that it will be a major contribution in industrial design architecture.

1. News watch, August, 1990

2. Acker D. H. (1963) Animal Science and Industry, Prentice Hall Inc, Englewood Cliffs, V.S.A

3. Makolm E. and Watkins P. (1979) The principles of dairy farming, Faber and Faber Ltd., V.S.A.

4. Shead D. (1980) Dairy Farming, Arahitects journal volume 35, July edition.

5. Nigerian export promotion council Newsletter (1984) No. 20.

CHAPTER TWO

THE FOOD PROCESSING INDUSTRY

2.1. INTRODUCTION

The food processing industry has been in existence, and practiced all round the world, for quite some time now. Technological advances after the outbreak of the first world war, caused an impetus in this industry, because an abundant supply of vegetables, had to be arranged for members of the armed forces.

The food processing industry nowadays places a lot of emphasis on mass production, modern processing techniques, conveiency of products, and a general control over product quality. Advances in this industry includes innovations such as the use of mechanical harvesters, bulk handling methods and automation. These have a resultant effect of a reduced production cost and a higher product quality and quantity.

Large increases of food supplies are necessary to keep up with the rapid increase in world population. The United Nations estimates, stated that the population growth rate, grows by 2.2% every year, and at present, with the world population of 3.5 billion. 35 years are needed for an additional 3 billion if world growth rates do not decline.[1]

---

1 Acker D (1963) Animal Science and Industry

Data from the United Nations Food and Agriculture Organisation have continually sounded alarms or indications to third world countries, to increase their agricultural food production requirements. These third world countries have a grossly inadequate supply of food and there is the presence of malhutrition and hunger in these regions.

2.1.1. DEFINITION

Food processing, refers to all industries, involved in the handling of foods at the time it is grown on the farm to the preparation, processing, transportation, and before consumers investments could be large and capital requirements and competition have increased in these such type industries in the last few years.

2.1.2. OBJECTIVES

Main objectives of food processing plants include the following:

a) Improvement of product quality, through addition of nutritive components to ensure a balanced diet.

b) For ensuring a more or less uniform and adequate food supply constantly.

c) Ensurance of large scale requirements for the food supply.

d) Reduction of bulk produce to smaller convenient sizes, which are easier to purchase and transport by consumers.

e) Improvement of storage requirements or other properties, so as to prevent losses.

f) To ensure monetary gains from product sales

g) For provision of employment to people residing in areas where these industries are located.

2.1.3. REQUIREMENTS FOR SETTING UP A FOOD FACTORY

Requirements prior to the establishment of any food processing industry include the following:

- Adquate supply of basic raw material
- Good and efficient management
- A good supply of working capital
- There must be a ready, assured market for the products
- The industry or factory must assure production of high quality or grade of products which will not be harmful to consumers.

2.2. THE DAIRY AS A FOOD PROCESSING INDUSTRY

The dairy may be defined as that food processing industry specially concerned with the production, processing and marketting of milk and other dairy products. It constitutes both milk production and milk processing.

Raw milk is processed into recogniable products, such as pasteurized or standardized milk, yoghurt, butter, cheese, icecream etc. Skimmilk, buttermilk, and whey, are the associated byproducts of this industry, and are used in the production of miscellaneous products in the dairy and other industries.

The dairy primary production phase is the production of raw milk, but however, this thesis is only concerned with the secondary phase whereby the raw milk is processed into various prudcts.

2.2.1. THE DAIRY INDUSTRY IN NIGERIA

The Dairy Industry in Nigeria has been in existence for quite some time. But major problems or bottlenecks facing this industry include the following:

a) Inability to meet consumer demand
b) Poor management
c) Genetic limitations of indigineous cattle
d) Rapid or high intrest rates and depreciation of the naira which reflect in the unaffordable high prices of these products.[2]

Dairy farms abound or exist in places like Agege, Ibadan, Shika, Mushin and Jos.

---

2 Newswatch, August 27,1990

Research studies and experimental stations have been set up, but no major mass production steps have been set up to increase the production of these products. Factories which have been set up usually rely on imported dry milk, from countries like Denmark, Holland or West Germany.

2.2.2. MAJOR OBJECTIVES OF NIGERIAN DAIRY INDUSTRY

The major objectives which the governments intends for the industry includes the following;

1) Measures for increasing the raw milk supply at farm level. This is achieved by the following:-
   (a) This is by development of indigineous breeds
   (b) Good cattle feeding programmes
   (c) Crossbreeding local breeds with foreign breeds.

2) Measures for establishing modern marketting systems. This inculde the following:-
   (a) Improvement in storage properties or methods
   (b) Organization of the milk collection systems.

3) Provision of credit facilities for milk produces.

4) Effecting pricing policy.

---

1 Newswatch, August 27 1990

These measures or steps if taken will clearly increase the output, product quality and viability of this industry. Because for quite some time now, there has been a neglect on this industry. As a result many factory have stopped production or do not produce enough products to meet up with consumer demand. In most cases, the products, when sold in the market, are sold at prices which are out of the reach of the average earning income of most Nigerians. It was due to these problems that promoted the urgency of the need to set up a number of experimental stations, and wide extensive research studies into this type of agriculture is being carried out by government, so as to increase the raw milk supply and product quality. This is to ensure the mass production of these products. However, the resultant effect of these studies were not taken to a level to meet up with the general consumer demand of the country so far, but rather, they just met up with local needs in the areas where these farms or stations were set up. An example of one of these is at the National Animal Production Reseach Institute (NPRI), Shika Zaria.

References

1. Newswatch, August 1990

2. Collertti A. (1963) Handbook for dairymen, Iowa State University Press, Annes, Fowa U.S.A.

3. Acker D. (1963) Animal Science and Industry Prentice Hall Incs Engle wood Cliffs, U.S.A.

CHAPTER THREE

HYGIENE IN THE FOOD PROCESSING INDUSTRY

3.1. INTRODUCTION

Hygiene is of paramount importance in any food processing plant because of public health, good appearance of products, better quality and better keeping characteristics of processed foods.

The architect plays a very important role of performing the task or creating such an environment, so as to achieve effective sanitation inorder to prevent contamination of the finished products. This is achieved based on a thorough study of sanitary or hygienic requirements of factory design principles. The architect performs this task upon consultation with a food technologist, so that the best , most economical and effective design can be arrived at.

Hygienic requirements are usually very high for food processing factories as compared to other type factories.

The importance of design of plant have shown that large plants have invariable proven to be the cleanest or best laid out. Smaller plants usually have more hygienic problems, because sanitation was not consided in total planning of the whole operation.

3.2. HYGIENIC PROBLEMS IN FOOD PROCESSING INDUSTRIES

The food industry has faced a wide range at problems, especially that due to poor hygienic standards of products.

A wide number of deaths of people due to food poisoning have occured in the country. (Table 3.2.3) shows the reported cases and deaths due to food poisoning in Nigeria from 1917 - 1976.

Table 3.2.1: Food Processing Plants in Nigeria, 1962

INDUSTRY	NUMBER
Meat processing	9
Fruits and Vegetable processing	8
Grain milling	10
Confectionaries	4
Vegetable and animal oil	62
Dairy	7
Bakeries	41
Breweries	5
Soft drink manufacturing	20
Miscellaneous	14
TOTAL	180

Source: Federal Institute of Research Oshodi Lagos 1970.

A number of entrepreneurs have no doubt established modern plants for the manufacture of various food products, but considering the great scope which exists for the

development of the industry, the pace of progress is not as fast as it should be. The Nigerian Institute of Food Science and Technology, Ikeja and the Federal Institute of Industrial Research, Oshodi, both in Lagos, are striving hard to find solutions for the problems which stand in the way of the development of the dairy industry.

However, in recent times, some entrepreneurs and State governments have established modern canning plants for the manufacture of various canned food items which include; fruits, vegetables, juices, fish and sea foods, meats, soups. In 1971, over N277,000.00 worth of processed food items were destroyed because of contamination.[1] These are losses which can be avoided if sanitation in food plants is given adequate consideration.

Sanitation therefore, in food plants is necessary for the prevention of food poisoning and to stop or reduce food spoilage. The main factors affecting this are biological, and others such as chemical and physical factors also contribute.

---

1 Source Federal Institute of Research Oshodi Rented Lagos 1970

Table 3.2.3 Reported cases and deaths of food poisoning in Nigeria from 1971 - 1976.

Year	Number of Cases	Deaths
1971	919	18
1972	815	5
1973	977	20
1974	1389	9
1975	1829	10
1976	829	3
TOTAL	6758	65

Source: Statistics Division Federal Ministry of Health, Lagos.

3.4. CONTAMINATION SOURCES DUE TO POOR SANITATION

Contamination in food processing factories may be as a result of either microbial or non-microbial contamination. It could occur during handling, preparation, processing or pakaging of the final product.

MICROBIAL CONTAMINATION

This is contamination from micro-organism which resut result in food processing and food spoilage, thereby causing diseases. These diseases includes; cholera, almonelloses, cholistidhum botolimum poising, and physical poisoning etc.

NON-MICROBIAL CONTAMINATION

Non-microbial contamination is due to mostly foreign bodies, flavours or odours. These arrive mostly due to poor factory or machinery design.

Foreign body contamination could be from the following; dirt, insects, metal, plastic, human hair, oil, string glass, paper dough, cigarrettlas oven blacks etc.

Table 3.2.4 Unwholesome food items destroyed by Food and Drug Administration Inspectorate in 1977.

Food Items	Quantity	Cost(N)
A. Beverages		
Alcoholic		
i) Canned beer (hectolitres)	3.8x10	44,500
ii) Bottled beer "	0.36x10	2,500
iii) Cider "	36.00	500
Non-alcoholic		
i) Soft drinks (hectolitres)	4.2x10	350
ii) Cocoa/malt based beverage(kg)	21.5	150
B. Meat Products		
i) Chilled meat (kg)	3,000	4,500
ii) Canned meat (kg)	11,500	23,000
C. Fish Products		
i) Sardines (kg)	3.1x10	42,000
ii) Stockfish (kg)	750	27,000
iii) Frozen fish (kg)	-	-
D. Milk Pdroducts		
i) Evaporated milk (kg)	6.3x10	44,000
ii) Powdered milk (kg)	42	150
iii) Infants milk food (kg)	260	800
E. Fat and Fatty Products		
i) Domestic margarine (9kg)	165	6,500
ii) Cheese (kg)	22.5	50
F. Sugar and Sugar confectionery		
i) Granulated sugar (kg)	12,000	5,000
ii) Toffee, sweets, etc. (kg)	65	150
G. Vegetables, Cereals, Flours, other commodities (kg)		
i) Rice	20,500	25,000
ii) Yam flour	175.0	450
iii) Vegetable casserole	660	2,000
iv) Chicken pies	205	750
v) Butter beans	480	800
vi) Corn flakes	48.5	125
vii) Pickle	10.0	15
viii) Custard powder	1.5	2.5
ix) Dates	415	1,350
x) Vegetable soups, etc.	6.6x10	50,000
H. Salt	-	N0.2777million

Source: Inspectorate Division of Food and Drugs Administration
Federal Ministry of Health, lagos.

References

1. Modern milk production (1979) Faber and Faber Ltd. V. SA, 1979.
2. The principles of dairy farming (1980) Farming Process Limited, U.S.A.
3. Nigerian export promotion council Newsletter No 20.
4. New watch, August, 1990.

CHAPTER FOUR

4.1. MILK PROCESSING SYSTEM

The programme concerned with the necessary production and marketing of milk and other dairy products, is referred to, as the milk processing system. Steps involved are numerous, and are discussed below:

Milking Process:

Milk undergoes a number of processes before it leaves the factory for sale.

Milk is brought to the factory from a nereby farm or from other individual collection centres. It is collected usually in bulk storage containers known as the milk vat. The tanks or refridgerated vats are usually of 10 gallons capacity.

The milk undergoes a number of successive processes, before being used for production. Such processes include; grading, sampling, recording, storing, valueing, testing, detection, separation, clarification, final filteration, pasteurization and finally cooled before it is used for any production venture. They are discussed thoroughly below. Adequate thought of space anea requirements and sanitary considerations for these processes, are important to serve as a grade for the architect.

Grading: Tests for quality are next carried out. Smelling is done as a final check for milk purity.

Sampling: Milk samples are laid out in order to determine the butterfat content. Tests or scientific activity as the Babcock test, bacterial plate count, microscopic examination and composite samples precede.

Recording: The total amount of milk received each day is recorded for further calculations on production output, or variations in output.

Storage: Milk is stored in a cold storage room of about $40^{\circ}F$ in gallons or cans.

Valueing: A very important process, whereby the milk content is multiplied by the butterfat, so as to get the milk value. (fig41 and fig42 show the milking process flow diagram.

FLOW DIAGRAM FOR MILK PREPARATION

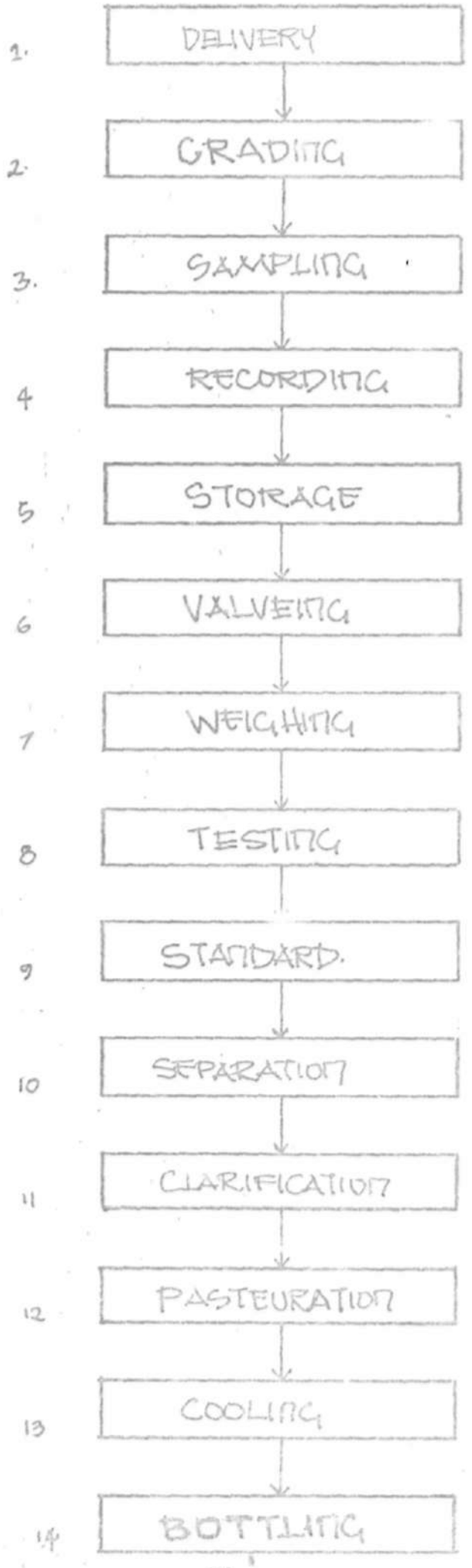


Fig. 4:1

4.2. MILKING PROCESS

This process occurs after the initial stage of milk production. The steps involved in the major operations include the following:

Milk Reception: The milk flows in 60 litres containers.

Filtering: A step carried out so as to remove impurities.

Pasteurization: A very important step whereby it is heated up to 71°7C for 15 seconds or 62.5°C/74°C ~~if you~~ using use a plate heat exchanger for 30 minutes. It is then cooled after coming out at 30°C.

Addition of Additives and Stirring: Additives are then added, stirred and kept at 40°C.

Standardization: This is maintainance of fat content by addition of skimmed milk.

Separation: Removal of butterfat from the milk, is done at this stage. The cream must be made to contain the following;

18 - 22% coffee cream

32 - 36% whipping

65% plastic cream.

Milk is separated, to produce butter and ice cream. Milk separation can be done, either by hand skimming, or with use of separator.

Clarification and Filtering: The milk is subjected to whirling, and the heavier portion called skimmed milk is thrown to the outer edge with sediments. Sediments are them removed by filtering, through a heavily fleeced cotton cloth.

Pasteurization: This is a process whereby the milk is heated to a temperature which is sufficiently high so as to destroy all bacteria present and in order to keep milk quality without any alteration in its physical, chemical or nutritive processes. Processes include three main processes which are as below:

4.2.1. SOFT CHEESE

These are of two types or varieties; a) Neufchatel
b) Cream cheese

The methods of manufacture are however very similar but very only in the milk composition.

Neufchatel is made from whole milk containing 3½% to 4% butterfat.

Cream cheese however is that to which cream has been added so that it has 6% - 9% butterfat.

Renetting - It is done for 40 minutes.

Cuttings - This precedes and for a small factory.

Raking - This step takes about 22 minutes.

Draining - The first whey is drained.

Cooking: - This precedes after draining.

Drainig - This is the next step in the cheese making process.

Scoping - Is an important step.

Cutting - This is done so the cheese can be prepared for sale.

Moulding - Required so as to give it shape.

Pressing - For final compaction.

Removal - Required in order to remove it from mould.

Brining - Addition of brine to the cheese.

Drying - It is next allowed to dry for one day.

Vaccum packing - Done so that the cheese can be prepared for sale.

(Fig 43) Showsthe flow diagram for the cheese making process.

PROCESS FLOW DIAGRAM [COTTAGE INDUSTRY]

A COTTAGE CHEESE [SHORT TIME] PROCESS

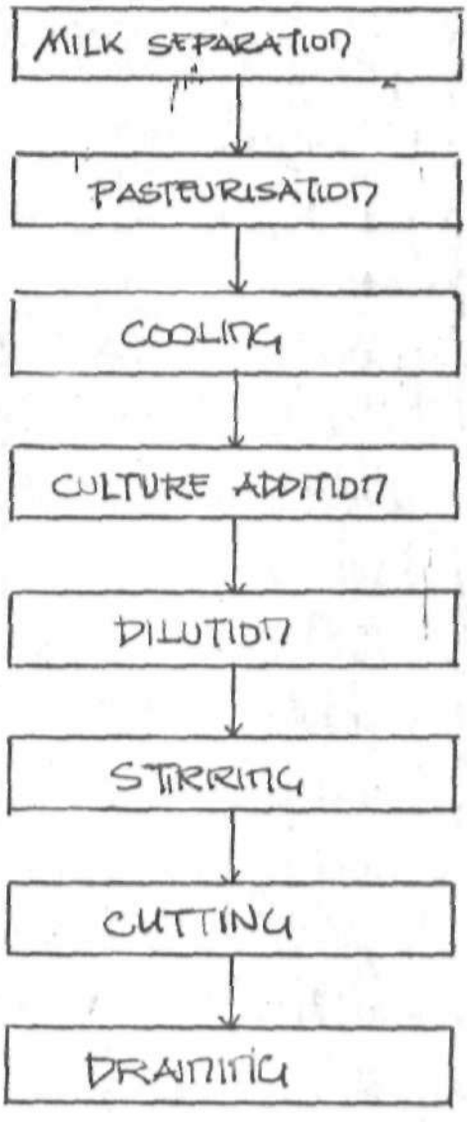


Fig. 4.3

4.3. YOGHURT MAKING PROCESS

This is a process which flows sequentially in any dairy factory after milk production and pasterurization has been carried out.

The process of incubation is done in a cheese vat. But in yoghurt preparation, no scooping is done. A pasteurizer that is a cooler of not more than 10°C is utilized. The yoghurt is then passed into a cooling tank, not a cold store because of temperature requirements of about 34°C.

(10°C Max) (34°C Max)

Pasteurization - Incubation - cooling

(Cheese Vat) (Cooling Tank)

Consideration for these process must be thought of, and planned aqueduately by the architectinorder to have a hygienic design.

4.4. BUTTER MAKING PROCESS

This is a product derived as a result of fat seperation. Successive fat is used for bulk separation.

Equipment required include a fat separator and a working machine. This working involves conversion of cream to fat.

4.5. ICE CREAM MAKING PROCESS

In this process, a blast freezer is incorporated to air and freeze the ice cream mix. The architect has to consider dimensions and standards or specifications concerning blast freezer and packing machines.
(Fig46) show the Ice cream making flow diagram.

4.6. DAIRY PROCESSING PLANTS TYPES/CONSIDERATION

Dairy processing plants considerations include; major considerations for appearance, sanitation, safety, working conditions and effeciency.

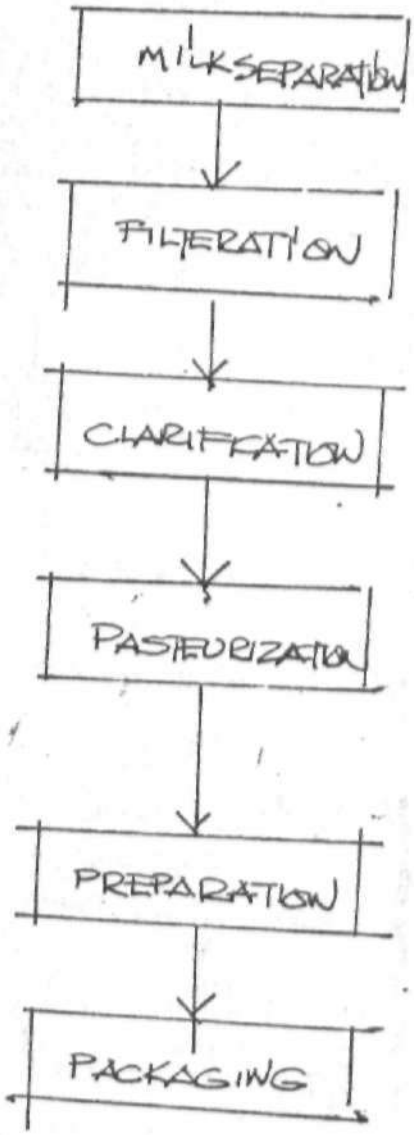
4.7. PLANT TYPE SELECTION FACTORS

The trend in dairy design, is for plant design with a single floor. Basement construction is not necessary.

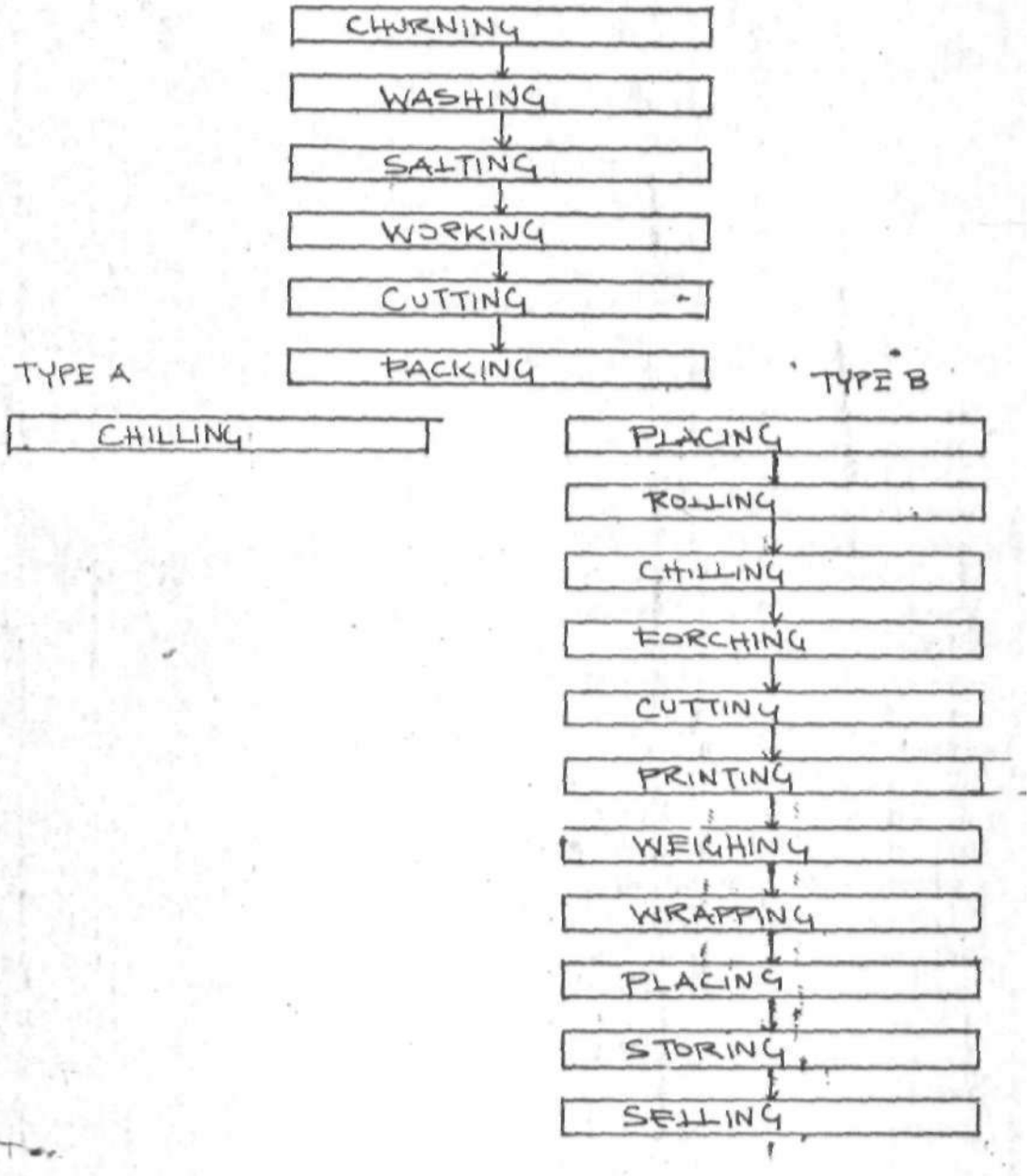
a) Single Story Plant: This type is mostely adopted. Attention is to be paid for this type in the design. It has qualities for easier ventillation and lighting incorporation. Better lighting and ventillation increases hygienic standards. Production flow is easily achieved. It has a lighter wall construction at a low cost. Drainage poses no problems because drains may be planned conveniently. Access from driveway is achieved at any point. Leakage problem is obvioated and movement of equipment around the building is easy.

b) Multi Storey Plant: These however, occupy a big land floor space. Gravity flow eliminates pumping for products manufacture of such items as cream or cultured milk. Roof construction and maintainance is less.

YOGHURT FLOW DIAGRAM



Fig,4.4



FLOW DIAGRAM (BUTTER MAKING)

Fig 4.5.

ICE CREAM FLOW DIAGRAM

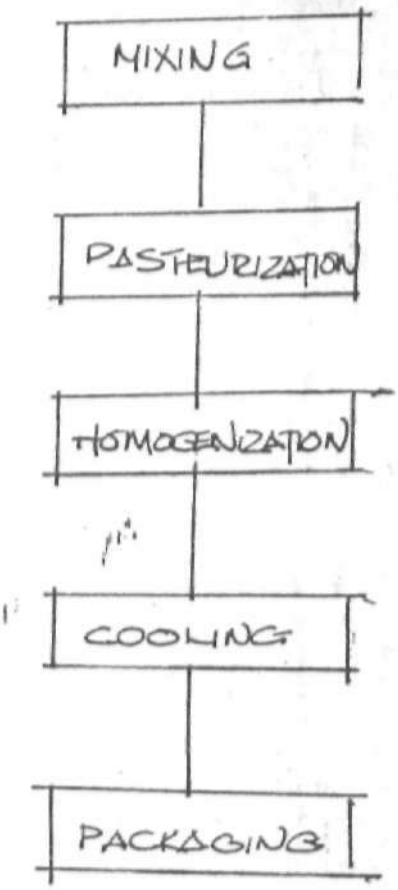
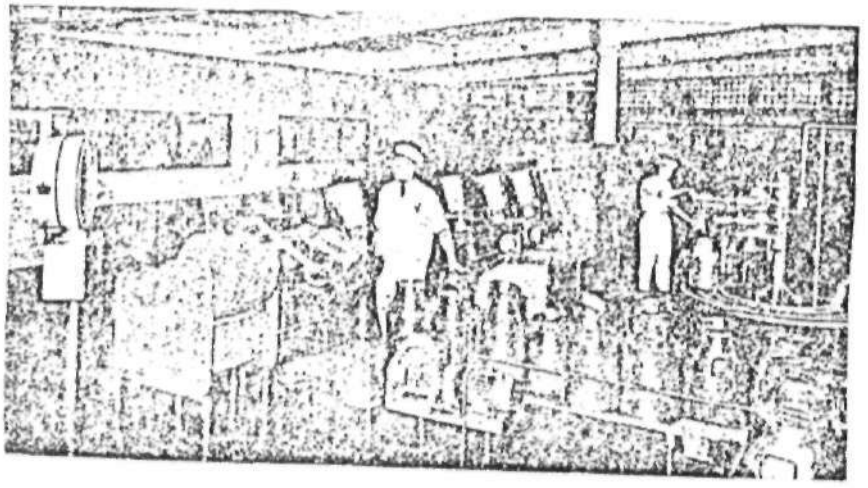


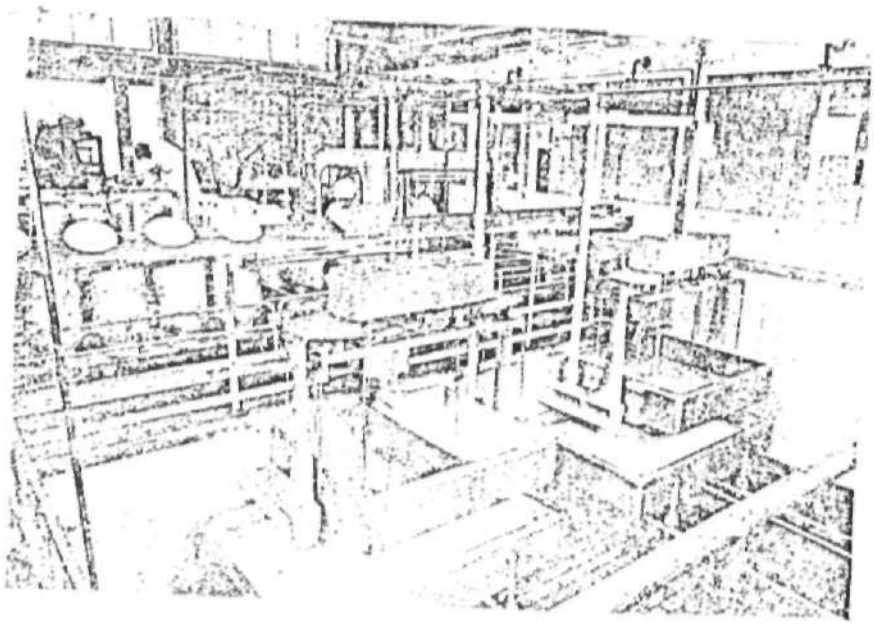
Fig. 4.6

Plate I



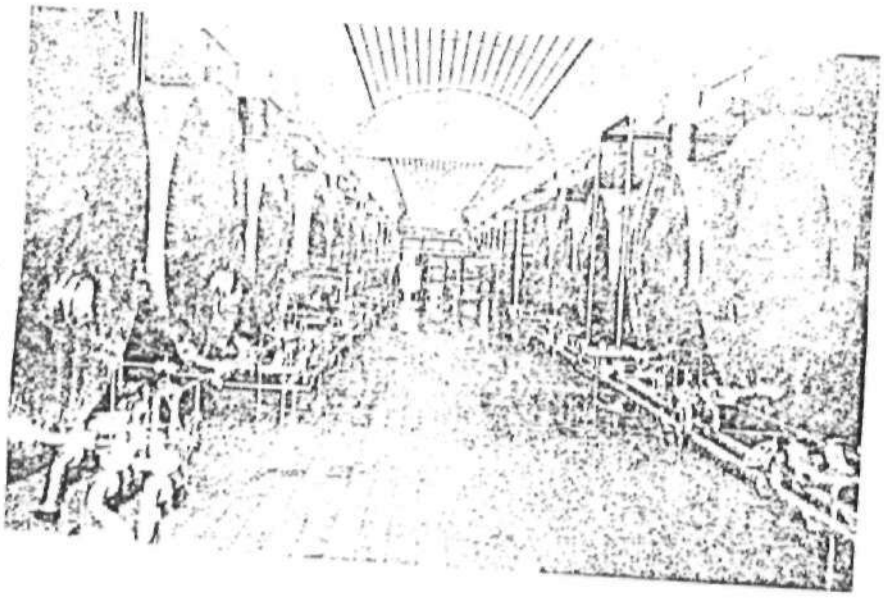
Milk weighing with dump tank in pit

Plate II



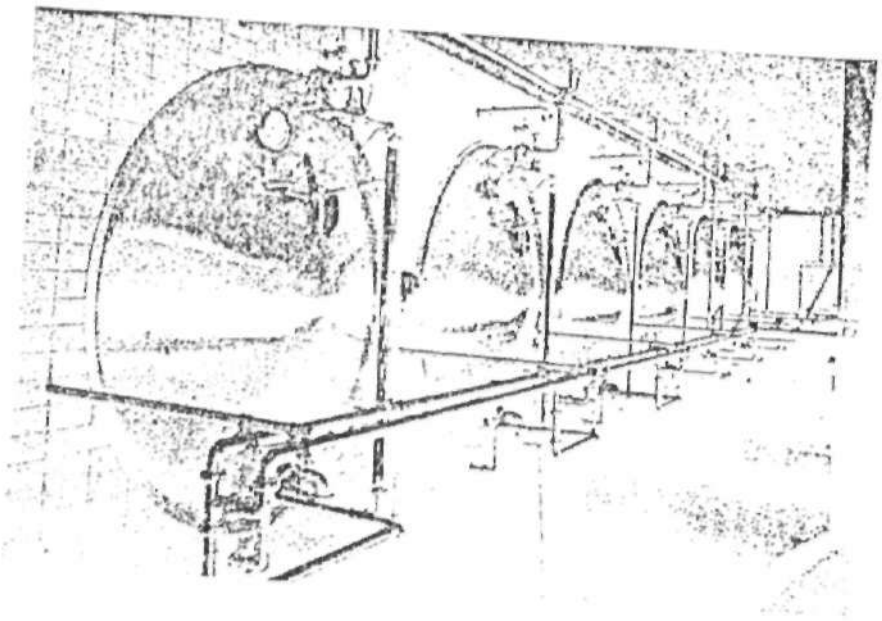
Tipping and weighing

Plate III



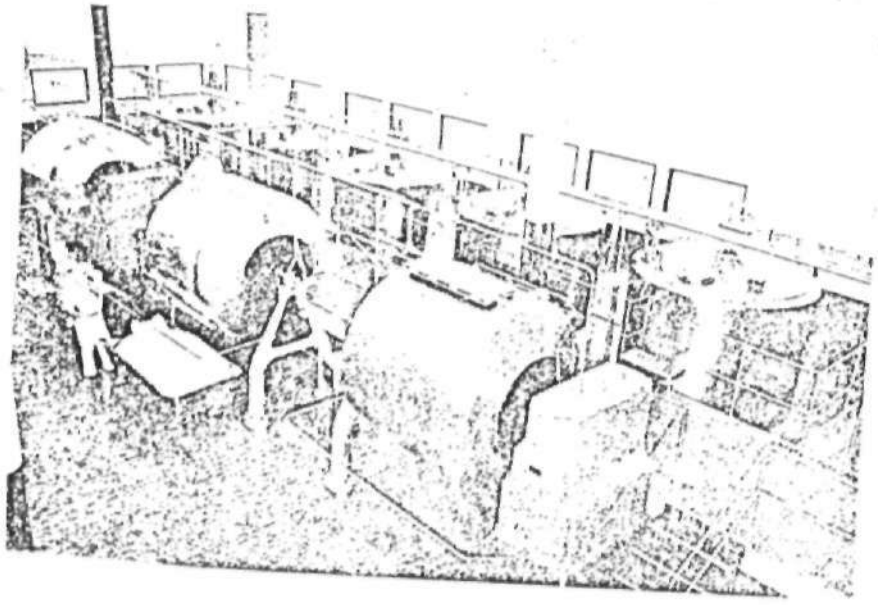
Milk storage tanks

Plate IIIb.



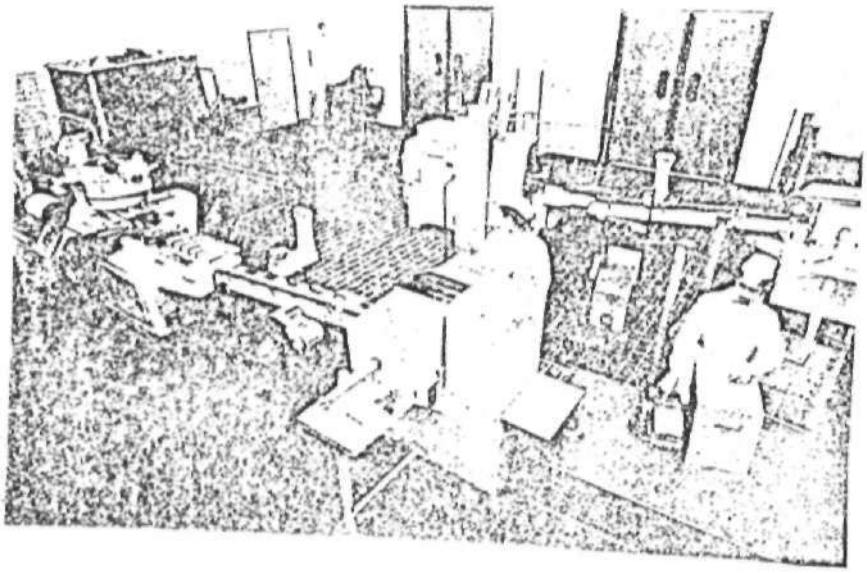
Milk Storage Tanks.

Plate IV.



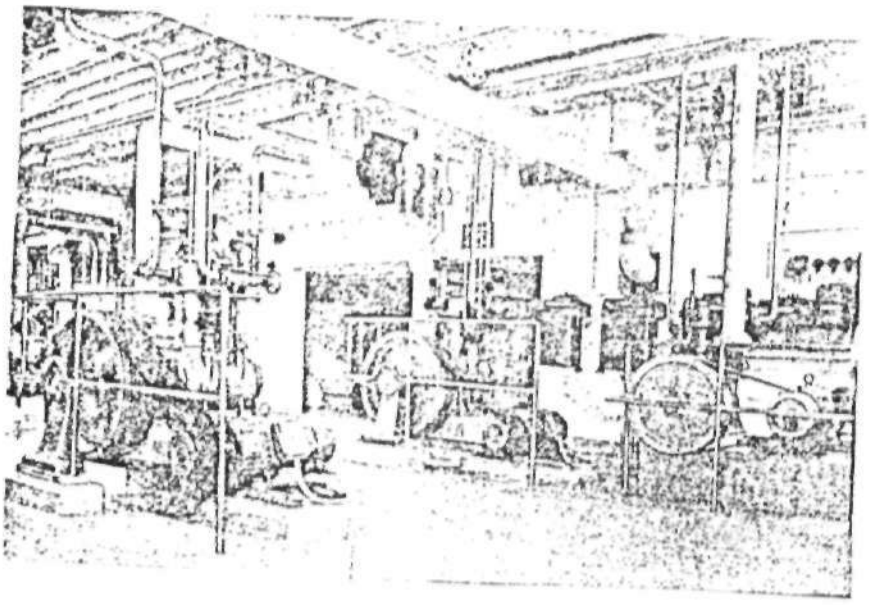
Butter-making room.

Plate V.



Butter packing.

Plate VI.



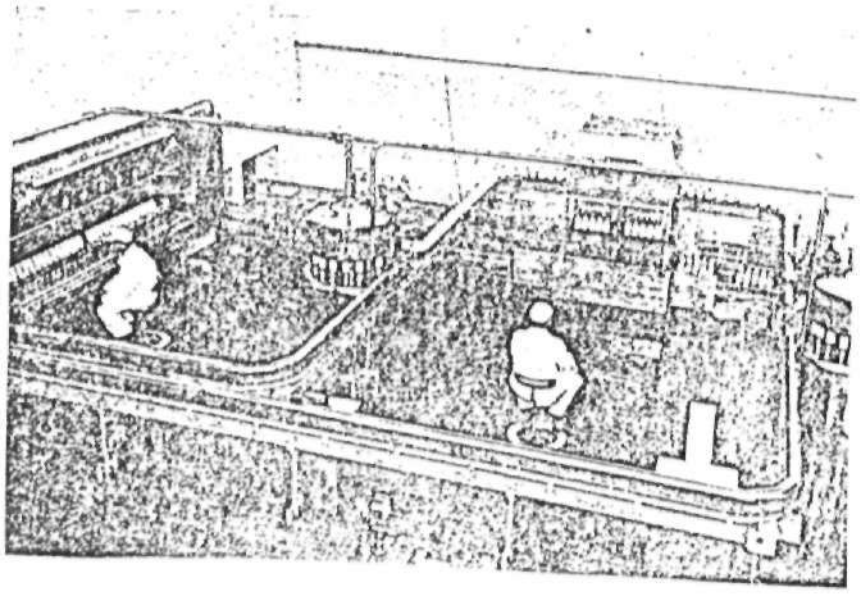
Refrıdgeration Compreesor room.

Plate VII



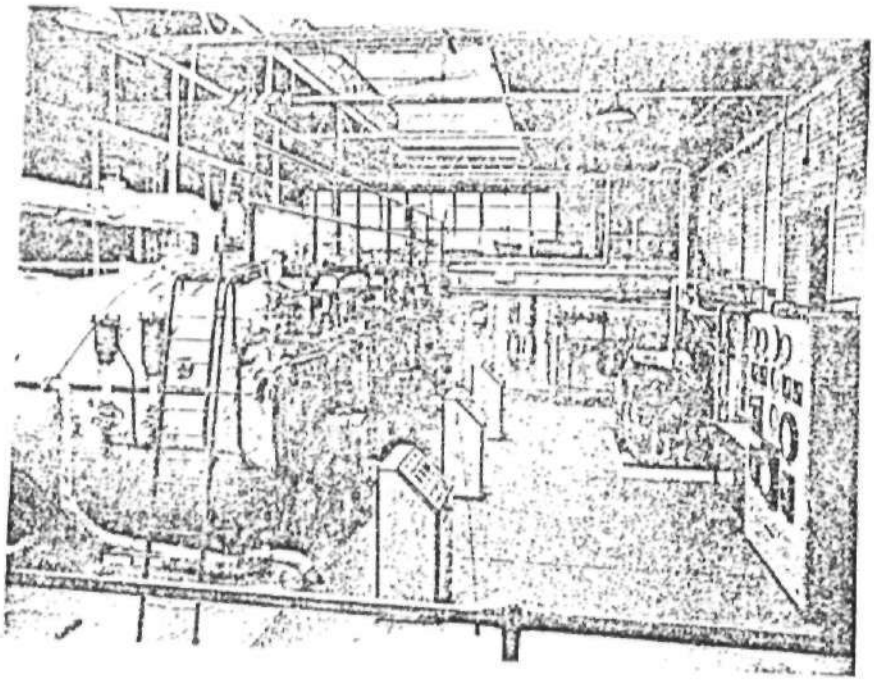
Milk pipe hangers

Plate VIII



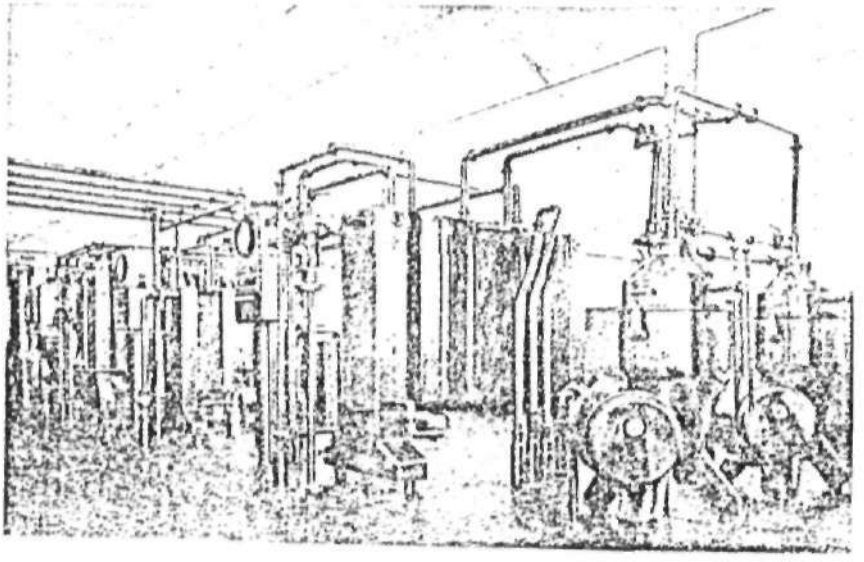
Milk pipe on floor and wall support.

Plate IX



Boiler house.

Plate X.



Room for pasteurizers and separators.

CHAPTER FIVE

CASE STUDIES

5.1. INTRODUCTION

For projects of this nature, case studies are necessary for an examination of the problems involved, and to see how our predecessors tackled such problems.

In the light of this, three existing dairy producing factories were visited and studied. They are as follows:

- Integrated Dairy Farm, Vom.
- Northern Dairies, Funtua.
- W. A. M. C. O. Lagos.

5.2. INTEGRATED DAIRY FARM, VOM

Location: This is located within the premises of the National Veterinary Research Institute in Vom, Plateau State.

Layout: The design is very mature. Also, zoning of areas is very functional. The administrative area is separated from the production area.

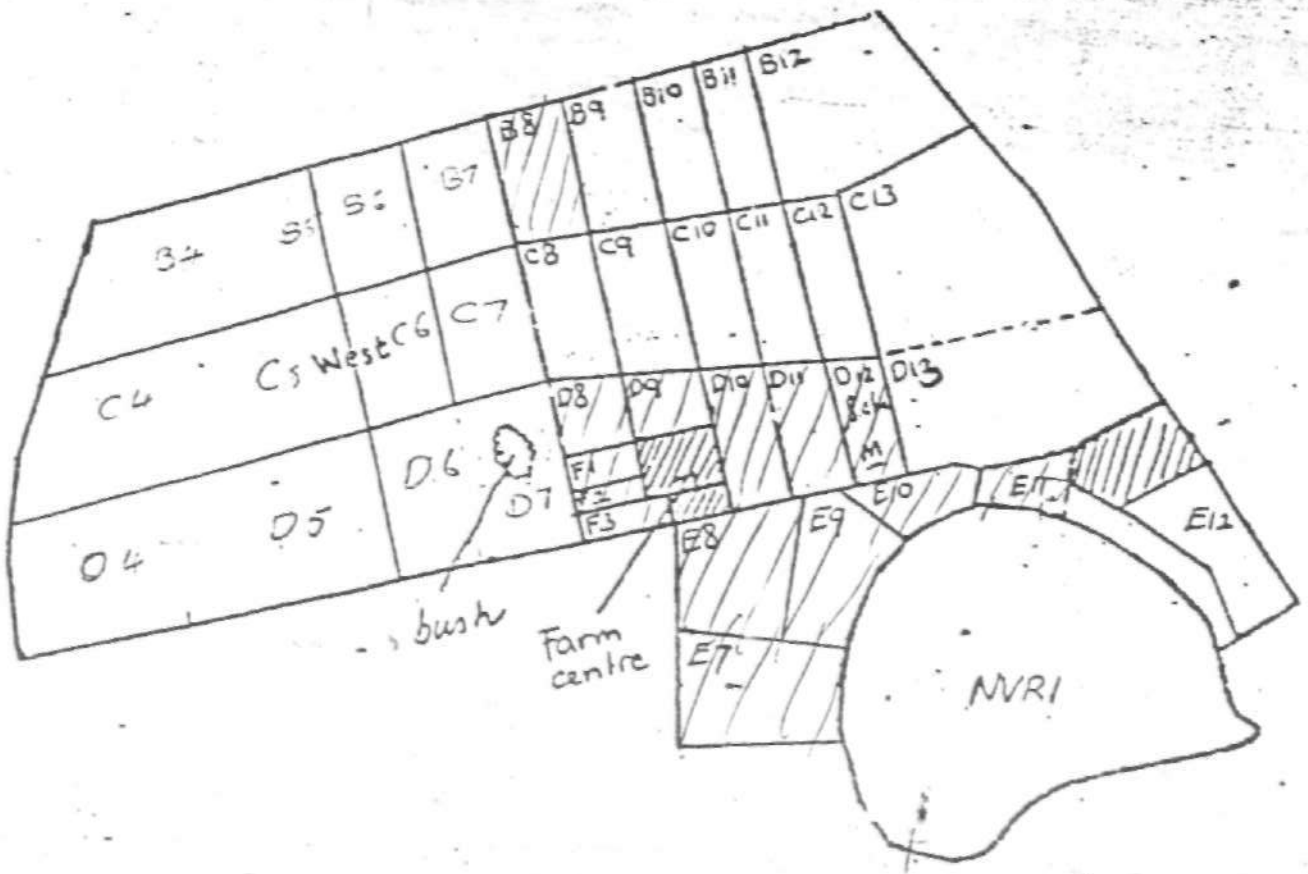
The paddocks have been separated from the main production area.

Space: The functions are all adequately housed, to cater for individual specific requirements.

Fig. 5.1

Integraked Dairy Farm

Aproximak Farm Layout



1cm = 250 m

SKETCH FLOOR PLAN OF IDF (VOM) PROCESSING ~~AREA~~



Staff Facilities: They have a changing room and a clinic.

Products: They produce milk and cheese. These include; Fresh milk, and Gouda Fresh Cheese.

Functional Relationship: The production flow is good, but however the arrangement of the flow is too compact.

Lighting: Lighting is provided, by high level windows. Artificial lighting is by means of flourescent tubes. The lighting is not very adequate, considering the fact that the processing requires high precision, for good sanitary standards, or health requirements.

Circulation: The circulation is good, with the administration, car parking and vehicle or truck maintainance area dearly defined. Trucks parking area is segregated.

Observation: The production hall was not of a very high sanitary standard. There was no pest proofing also the arrangement was compact. The entry of bacteria or other micro organisms was not effectively tackled or catered for in the design because there was no pestproofing. Water and other fluids were apparent on the floor, which looked messy.

Structure: The production hall is constructed of steel trusses. Clear height of the hall is about 3.5 metre. Concrete is used on the floor, with non slip ceramic floor tiles. The bull and female cows and calve pens are also of concrete. The roof is constructed with the use of steel frames.

Farm Composition and Quantity: The farm possesses about 24 cows, which comprise of both local and foreign cows. (Fig 52) Shows a sketch of the site lay out.

5.3. NORTHERN DAIRIES, FUNTUA

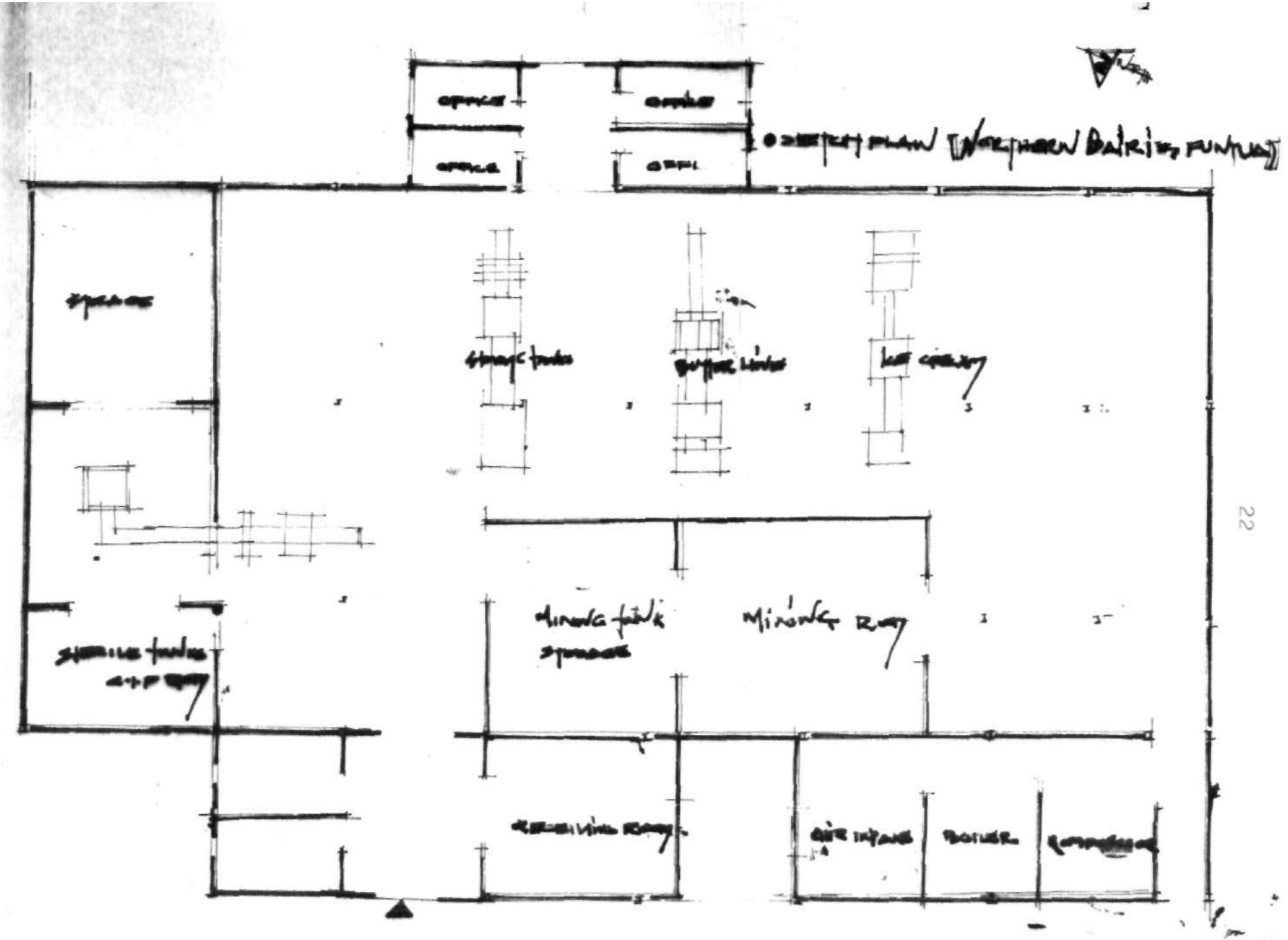
Location: This is located along the Bakori Bye Pass in Funtua, Katsina State.

Staff Facilities: They have changing rooms, toilets, canteen, laundry, etc.

Products: They produce Ice Cream, Sweet Yoghurt, Whole Milk, Orange Ice Lolly, Juices such as Pine Apple or Straw Berry or Orange Juice.

Structure: The production hall structure and other blocks are all of prefabricated aluminium/steel products. The floor is of concrete covered with ceramic floor tiles.

Raw Materials: The raw materials involves in the production include; skimmed powdered milk, water, stabilizers, sugar, butterfat in 200kg barrels, flavours, colours and also local milk from fulani cattle.



Layout: The design is very mature. Site zoning is very functional. Functional spaces have been clearly outlined, zoned and linked up with one another. A major site environment problem was that the site consisted of some unpleasant scenery, due to scattered storage racks which lie open, in front of the complex. The approach was very beautiful but also the cattle grazing area was undefined so cows could roam about the factory complex. The hygienic situation of the surrounding landscape was thus poor, which could lead to infilteration of the factory products.

Space: All functions are adequately housed.

Lighting: Lighting has been provided for by high level windows and flourescent tubes. This is however a bit inadequate for a factory requiring high sanitary or health standards.

Observations: The raw material storage area accomodated rats, which were contaminating the raw materials.

Also areas were noted on the ground, with water and other fluids scattered around within the complex.

The storage of raw material products are quite far away from the production or processing area. The windows do not possess nettings.

The production is entirely mechanical, only during washing of floors or equipments whereby hand washing is employed.

Material Movements: This in the design comprises of water for mixing chemicals, for cleaning, and steam for the boiler processing line. It contains about 15 free paddocks, and 18 paddocks for grazing. There are also areas designated for growing of maize, soyabeans and other grains. This covers an area of about 700 land acres.

Output: They produce 475kg (Full Gouda Cheese and Powdered milk.

Farm Land (Area Coverage): It covers 450 hectares. 100 hectres for pastureland, 350 hectres for maize and soya beans.

Lighting: Lighting is not very adequate in the main production hall, although provision has been made for both natural and artificial lighting.

Circulation: The circulation on site is good and allows for good or easy movement.

Observations: The production area posseses some water drippings scattered all over the place.

The production flow is not very organized, and was haphazardly arranged.

Raw materials are just dropped anyhow, and were not really given thorough consideration or special attention in the design. Doors open wide during production. This can cause contamination.

Structure: The buildings clear height is about 4 metres, covered with steel roofing frames and has a concrete floor and ceramic floor tiles which are acid resistant.

5.4. WAMCO, IKEJA LAGOS

Location: This is located within the industrial belt area in Ikeja, Lagos State. The location is along the Acme Road, off Ogba Road.

Layout: The design is very mature, and zoning of areas is also very well done. The administration and other areas are separated from the main production area. A shortcoming however is that lanscaping, has not been effectively tackled or taken care of.

Staff Facilities: These are available on the site. They include; changing rooms, canteen and clinic.

Space: The spaces are adequately housed.

Products: They produce Peak milk, Frisocream and Frisolac which are baby foods.

Output: They produce the following output weekly:

1230 cartons peak milk.

875kg full cream powdered milk.

92 kg full cream baby food.

9kg frisolac baby food.

Observations: The production areas posses water drippings, areas of scattered concentrations.

The production flow arrangement has been haphazardly implemented in the design. Raw materials consideration was a not adequantely catered for.

Raw materials are just dropped anyhow, and actual placement or stacking was not given thorough consideration.

Production area doors, open to the outside during production, and open up directly to the outside sprroundings which causes food contamination.

5.5. GENERAL OBSERVATION

Material for liguid movement is by use of pipes.

Materials through pipes are:

Cool water

Chemicals (NaoH)

Steam

Hot water

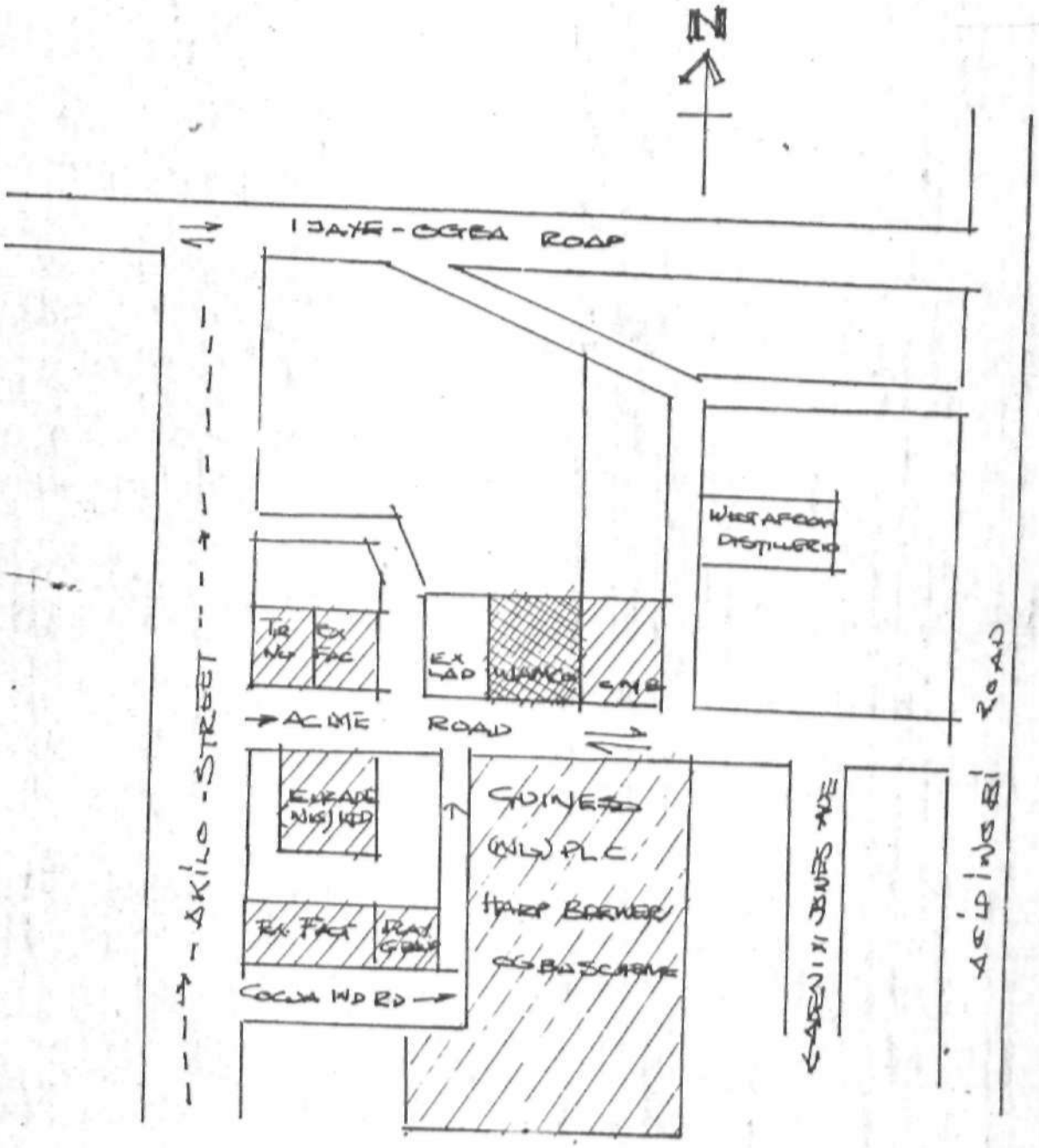
Materials through conveyors are:

Products during processing.

Other Observations:

- Forklifts are mostly employed in arranging products in the stores.
- Ground floor is made of concrete, and are constructed with steel roofs.
- Exhaust fans were used for extraction of dust in certain ones.

Fig. 5.2
Sketch layout of W.A.M.C.O., Ikeja, Lagos.



CHAPTER SIX

THE SITE AND ENVIRONMENT

6.1. THE SITE

6.1.1. Location: Heipang is located within Barakin Ladi Local Government Council Area of Plateau State. The site is approached through a laterite access road, linking up with a Federal highway, which is main regional road. The site is therefore stategically located.

6.1.2. Labour Force: About 67% of the full time workers are engaged in the agricultural sector.

Other workers in the area are engaged in the tertiary sector, which include; manufacturing and construction.

6.1.3. Economic Base: Barakin Ladi is an agricultural town, it has important commercial functions. There is an airport, and has some other small scale industries.

Trading activities are carried out in the market. Buyers and sellers come from other areas, with crops and food stuffs for exchange. These are all exchanged in the traditional market.

There are several shops along the main road, which cater for the area and other sorrounding area.

6.1.4. Agriculture: Most of the population derive their livelihood from agriculture. Crops grown include; potatoes, vegetables, and other cereal. Cattle rearing activities are also evident in the area.

6.1.5. Industrial Development: The area consists of some abandoned forestry activities. The twon has potentials for the existence of a food processing industry.

6.2. Choice of Site:

6.2.1. Regional Consideration

Barakin Ladi is located within the tsetsefly free zone or the middle belt ofNigeria. This zone permits the survivability of cattle, becasue of the absence of tsetseflies.

It is also a noted area or cattle zone, because of permittance or survivability and the seasonal movement, or North - South migration of cattle.

This zone also permits a vavourable or nice environment for the survivability of foreign friesien cattle breed, known as the hosteins. It also provides a conductive environment for milk production. Milk must not be left at a maximum temperature of 4% otherwise it will spoil.

6.2.2. Macro-Locational Factors

Barakin Ladi is located within Plateau State. It is a bordered in the North by the Bassa and Jos Local Government areas. At the southern end it is borded by the Bokkos Local Government Council. The Western end is Mangu Local Government area.

The central location of Heipang can be viewed based on raw materials supply and distribution of the finished products.

Cattle can survive well within this tsetselly free belt, and there is an abundance of cattle in this region. It is linked to the north with a major highway going to Bokkos and the other towards Jos.

There is also a rail line linking up the area, which could be utilized for transportation of finished goods. The Jos airport is also located at Heipang which could serve as the conecting link from other airports.

6.2.3. Micro-Locational Factors:

At first insight, the aim is to integrate the factory with some of the old dilapidated units on site. There is aboundant land for expansion on the site. The coverage is very large, and extensive.

The factory will thus be integrated with the main federal highway road which is connected by a laterite road. The nearby rail line could also be utilized and linked with the factory for transportation.

The chosen site is at Kpang. This is about 3km from the main Federal road.

The Advantages of the site include:-

- Accessibility: It is linked along the main Federal highway.
- Ease of transportation: It is near an existing railline.
- Ownership: The land ownership already belongs to Government.
- Accessibility: It is near the airport.
- Land: The land is very extensive.
- Expansion: There is free expansion in all directions.
- Agricultural and Water Supply: There exists a stream at the end portion of the site.
- Topography: The slope is very gentle in the South-West direction.

6.2. SITE ANALYSIS

Location: The project site is located, off Airport Road. The site is more or less rectangular in shape, and is very extensive. It is free to expand in all directions, except around the area near the stream.

Fig.6.1

Barkin Ladi, showing its position in relation to ther local governments.



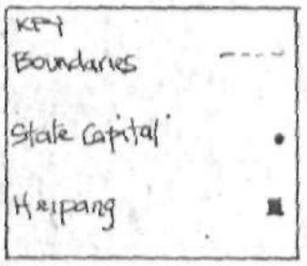
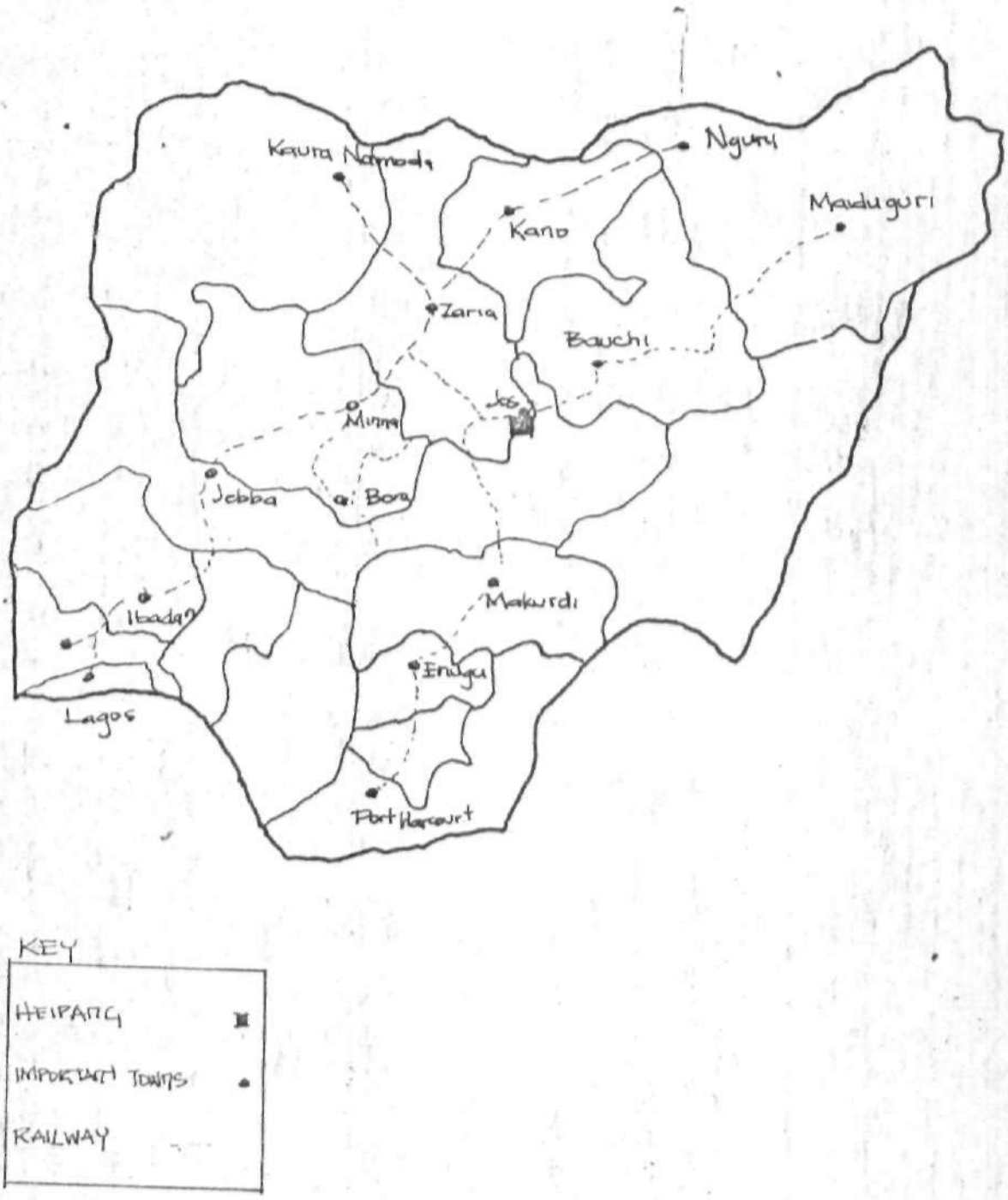


Fig.6.2

Map of Barkin Ladi, showing the Rail Network.



Slope: The site slopes gently towards the North. The gradient is about 2%.

Vegetation: The site is covered with scattered short grasses, and some trees. The vegetation is that of montane vegetation.

Geology Soil: With particular reference to the project site, the top level is covered with a layer of sedimentary felsic soil. The underlaying rock is also of lateritic or sedimentary origin. It is a layer of felsic light minerals.

Climate: The area has a tropical savannah climate wirh montane effects due to attitude.

There are two main seasons which are from May to October, and the dry seasons is from November to April.

During the wet season, south-westerly winds blow from the equatorial rain-forest belt. In the dry season, a dusty dry laden wind, known as the harmattan blows from the north-east.

Temperatures decrease during the wet season, with a corresponding increase in relative humidity.

The dry season is characterized by high temperatures. February to April are the hottest periods.

The harmattan however reduces the effect off the relative humidity, at the beginning of the rainy season.

Flash storms occur during the wet season, thus an efficient water drainage system is required to take care of peak flows.

Utilities: Heipang has been supplied with electricity, water and telephone services. Utilities occur along the main federal highway road where the project site is. The industry will rely on these for electricity, and will rely on water from boreholes initially. A generator will be provided as standby as a temporary measure.

Other Infrastructures: The site access road links with a very nice federal highway road. This road links the Barakin Ladi L.G.C, with the Jos L.G.C.

There exists a stream in the site extreme, which can be utilised for water supply into the site, or for discharge of effluents.

The project site is also in close proximity to the Jos airport at Heipang.

The factory can take advantages of these infrastructures for procurence of raw materials supply, transportation of finished goods, evacuation to the markets or other potential market areas.

CLIMATIC DATA FOR YELWA LAWNSON IN : E/PANG DISTRICT (BARAKIN LADI)

TEMPERATURE AND RELATIVE HUMIDITY 1967-81

MONTH OF THE YEAR	Daily Max. Temp Mean °C	Daily Max. Temp Absolute °C	Daily Min Temp Mean °C	Mean Rel Hum at 7:00 Gmt %	Rel Humid at 12:00 Gmt %
JANUARY	27	34	8	30	14
FEBRUARY	29	35	10	30	13
MARCH	31	36	12	49	17
APRIL	31	35	14	79	35
MAY	29	33	14	90	54
JUNE	27	33	12	89	61
JULY	24	31	13	95	70
AUGUST	26	31	13	95	71
SEPTEMBER	28	31	14	92	60
OCTOBER	28	31	13	82	40
NOVEMBER	27	33	10	42	19
DECEMBER	27	32	7	33	14

Table 6.2.1

SOURCE. Department of Meteorological Services Jos

6.4. SITE FEASIBILITY AND VIABILITY

6.4.1. Site Views: The site is bounded in the North-West corner by a belt of forest or trees. In the South-East, there is the presence of a small stream.

6.4.2. Ingress and Egress: The site bounded by two roads. One has a linkage with the main feaeral highway road. The roads can be freely for entry or exit from the site.

6.4.3. Topography: The site slope is a very gentle one. There will not be much problem, for any extra construction cost. Existing plants should be spared as much as possible.

6.4.4. Potential Built up Zone: This is the area, whereby after careful observation of factors that govern the site viability is drawn out a structure can be errected. Generally, for any industrial area the visitors parking is done outside the site.

CHAPTER SEVEN

DESIGN CONTENT AND CONSIDERATIONS

7.1 PROJECT CONTENT

7.2 SOURCE AND EXTENT OF RAW MATERIAL

7.3 HYGIENIC DESIGN CONSIDERATIONS

7.4 DESIGN BRIEF AND SCHEDULE OF ACCOMODATION

7.1 PROJECT CONTENT:

The design consists of a dairy plant which carries out milk processing. Products to be produced includes: cheese, butter yoghurt pasteurized milk, and ice cream.

The factory comprises of the following units;

- Gate house
- Workers facilities
- Administration
- Main production area
- Auxilliary and maintainance area

These are discussed briefly below;

Gate house area:

This unit checks vehicular movement entering and leaving the premises. Goods leaving or entering are checked.

- Workers Facilities block:

Within this unit, facilities exist which cater for workers welfare. They include; dining areas, recreation area, and clinic.

- Administration

For handling of managemental affairs, purchasing, material supply, record keeping and general personnel affairs, this, is handled in the administration.

- Main production unit:

This is where the main processing activity is to take place. Milk is to be processed into other dairy products, such as cheese, butter or ice cream.

- Auxilliary and Maintainance:

Supporting facilities for the factory are to be located here. These include; the boiler room, compressor area, and the trucks maintainance area.

- Storage facilities

For general storage of items, such as; packaging material and other raw main materials.

7.2 SOURCE AND EXTENT OF RAW MATERIALS

The raw material which is to be used is mainly milk. Milk is to be aquired from a separate, collection centre or other centres located in this region.

Cows thrive well within this tse-tsefly free zone, known as the middle belt. High milk producing cattle such as the friesien or other local breeds when cross breeded with the foreign breeds yield a large amount of milk. The cattle breed, in this area include the local bunangi or zebu cattle breed.

It is of paramount importance for the architect to note that, the milk collection centres should be separated from the main processing or plant area, for best sanitary standards, but should be within the processing zone so as not to increase production cost due to transportation movement, of raw materials to the main processing or plant area.

7.2.3 PRODUCTION CAPACITY

It can thus be clearly seen that with the abundance supply of raw materials, the local fulani cows, and if an additional expenditure is spent on the purchase of some foreign holstein cows, and are cross breeded in this region, in the near future, which possess good climatic requirements for this to take place, the project in this area justifies the need or establishment of a dairy products factory for large scale manufacture of dairy products.

7.2.4 FINANCIING:

The diagram below shows how the porject is to be financed.

FGN - 60%	PLSG = 60%
PLSG - 40%	PRIVATE- 40%
At the initial phase.	At the final phase.

The ownership will next be sold out to the Plateau State Government, then later passed finally to private individuals who may be interested.

7.3 HYGIENIC DESIGN CONSIDERATIONS

This include methods, ways or special considerations which the architect is to consider through design solutions, options or manipulations. They are all combined to give or produce a hygienic free workplace environment in dairy product factories. These checks or measures, are not only considered dunning the production process only, but also before and after the production processes, so as to produce a bacteria free product,

which is fit for human consumption. These considerations include the following.

- Architectural planning design considerations
- Environmental Considerations
- Safety measures
- Constructional considerations
- Health considerations

7.3.1 Architectural Planning Design Consideration

General Planning

Factory planning should consist of an open planning arrangement, Compartmentation creates comers, which complicate the cleaning process. Prefabricated partition walls where necessary are utilized because of their ability, for ease of erection, and minimization of fire hazards.

Waste Disposal

Waste disposal locations should be carefully planned and integrated with the design. They are linked by short and direct routes because they should not bypass the main production area for good hygienic or sanitary purpose. Drainage channels are properly positioned and placed so to that they connect with the main services drain for onward transmission.

Factory site requirement

The site selected for the factory should be easily drained, siting and construction of waste collection areas, effluent treatment, and incinerators, should be carefully done.

- The sorroundings of the site, must be properly landscaped
- The site selection must be done carefully so that waste material or soot from other factories do not interfere, or contaminate the factory products.
- Facilites for factory waste disposal should be provided.
- There should be a scope for an orderly expandion procedure.
- The area should be clean and free from any debris.
- The growth of feeds or other debris should be controlled.

The site area must permit easy cleaning or maintenance

- The area coverage of the site must be large enough to accomodate freely all plant and labour requirements without restraint.

Location of Amenities

Amenities are to be placed at a very considerable distance from the main production area, however they are to be linked to them. These include places such as smoking zones, toilets and washrooms etc.

Production Area

Major considerations in this area, is to be given for drippage, spillage, leakage etc or other effluent discharges.

Material finishes which require minimum maintenance and good finishes are the best requirement by a food plant.

Washable tiles, in areas where equipments are to be located, are recommended.
These tiles are usually light in colour and are smooth. Painting must be done or controlled to avoid tainting of products. Walls should be kept painted regularly, so that they will present a clean fresh surface.

The production floor must drop with the flow of product. Concrete is best required for these type of factory floors. The concrete floor is covered with grandithic concrete convered with non slip brick floor tiles.

Floor attack from spillage, drippage or other processes is achieved by gently sloping the floor, and provision of a floor drain.

Areas should be fully designated for workers washing of hands, or equipment should be carefully done and separated from the main processing area, so that this activities do not contaminate the products.

Storage Areas

All main stores, should be isolated or detached from the main production area. This is very important, because these areas are usually high-risky sanitary zones. Stores housing raw materials, before could contaminate products, due to contact with germs or other particles during t nsportation, or delivery. If products deteriorate or spoil, when kept in these stores, they will not contaminate the products while the processing is going.

The main actual floor space where storage is to be done, should be raised so as to provide restraint for the entry of rodents, pests, or other harmful micro-organisms. These increase the sanitary standards of such type factories. The products should be placed at specific heights from the ground if they are to be placed on shelves, and should not be indirect contact with any external wall. External walls, which are in contact with products encourage the penetration and even entry of micro-organisms, insects, or other rodents into these products.

Location of Amenties

Amenties are to be placed away from the production area, but linked to them. These include places such as smoking zones, toilets and washrooms etc.

Service fittings

The production area should posses minimum overhead service fittings. This minimization of service fittings, reduce contaimination of finished products. A complex network of service fittings cause problems of maintenance. They provide difficulty in cleaning and encourage the roosting of birds. These problems can be remedied by providing a separate service floors which will house all these services.

Pasonal Hygiene

Adequate thought and consideration must be given to this factor by the architect. This is achieved by the architect, by good placement or positioning of workers hand washing area, or other simple utensils or equipments which are to be use in the food plant. This area should be screened, easily accessible, and within

the main processing area.

Cold storage Areas:

These areas should be located, as close as possible to the production area, and the architects design should ensure that these areas are airtight, so that the temperature conditions can be maintained Good adequate space requirements for products, which are to be placed at spefic heights, and -should not be in direct contact with any external wall, because of penetration by rodents or other insects or micro-organisms.

Factory Structure:

The design should have good considerations for placement of equipment, fittings, lighting, and ventillation provisions. Windows are to be large enough to accommodate enough lighting as required by sanitary plants. Fittings area to be concealled, so as to prevent contamination of products.

Service areas

These areas are to be considered carefully in any food plant design service areas must not bypass any of the main processing area. This is so as to minimize any accidents, spillage, or the spread of contamination of these areas to the main production area. Handwashing and cleaning areas must be large enough, and screened from the main processing activity.

Raw Materials

This factor is of paramount importance. Screened raw material must be prevented from any further contamination by dispensing them in very good controlled areas.

Packaging material or other cans are to be separated from these raw materials, and kept in other separate areas so as to avoid any further contamination.

Good antropometric space requirements for human activity or use of machanical aids such as; milk vats, forklifts etc. should be given attention, so as to produce a good hygienic environment.

Quality Control Areas

The Architect, in the design of any food plant, must provide accommodation for the quality control department. This department sets up adequate and relevant control programme, so as to ensure that the products are maintained, or comply with gove nments regulations of santary standards. This department maintains or imporves the quality grade, and reduce possibility of spoilage and other hazards which might affect the consumer.

7.3.2 CONSTRUCTIONAL CONSIDERATION

These are methods, or measures to be applied in the design of a dairy factory, so as to present an improved sanitary or hygienic standards.

Walls

In dairy design careful consideration is to be made for wall surfaces. The wall materials finishes should permit minimum maintenace in any food plant. Washable tiles should be used in areas where the main processing activity or equipments are housed. The wall surface should be smooth and light in colour. Where painting is done, this area can be reduced by using plastic food boarding.

Cealings

The ceilings of any food processing plant must be washable and have sealed joints. This application prevents moisture condensations on the ceiling. This condensation causes contamination in food plants.

Floors

In dairy factory design, the floor design is very important for good hygienic results. The floor material must be resistive to acid, derived during milk spillage. The floor must also be resistive to washing detargents, and should not contain high odour materials. In order to achieve this, a suitable concrete floor is used, covered with non-slip brick floor tiles. The floor attack is reduced by a gently slope of the floor, and provision of suitable floor drains properly positioned.

Where floor drains are used in dairy design, these should flush with the floor to prevent pooling. The best position for the siting of drains is under the plant equipment, or whereby spillage or any other discharge is likely to occur.

Foundations

The foundation should be brought to at least 600 - 900mm to present rodents or any other micro-organisms from encroaching into the factory.

Doors

The doors incorporated in the design, will be incorporated with self desing mechanisms, overlapping with heavy- duty plastic strips or double door construction, incorporating a dobby with an electrical trapping device or vapourizer.

Windows

· The use of pest proofing, or wiremesh is to be incorporated in the design, where windows are positioned Operable doors and windows are screened with wiremesh so as to provide restraint for the entry of insects, redents or other micro-organisms.

Roofs

In dairy design, careful attention must be paid to the roof design for best results. Roofing material such as corrugated, painted longspan aluminum roofing sheets is utilized. This material or roof considerations for heat insulation, expansion, and good non-corrosive solar tendencies is best as a long term lasting solution in food plants for best hygienic results.

Ceilings

The celing design should posses qualities for good reflectivity and should be coated and polished. Aluminium is a good material painted white for good reflectivity.

Service Fittings

Pipework services, [illegible] duty and other openings should be concealed and flush wuth the overall factory design. This serves to avoid areas of potentialities for dust or other particles accumulation.

Factory Structure

This could be single storey or multi-storey. But the single storey is best prefered due to reduced cost of erection, maintenance and for improved hygienic results.

Multi-storey factories cause a lot of hygienic problems due to increased wall surface corners, connections, joints etc.

Floor drainage

The overall plant floor drainage is of paramount importance to a designer: All floor slopes and services drains must be properly postiioned or arranged so that the gravity flow of material derived due to spillage or during production work is organised, or good positioning of drains and slope.

Health Considerations

7.33 Health Consideration

in dairy factory design, the trend is for a production flow which is uninterrupted. This obviates human contact for a change, or movement from one production sequence to another. Thus in the design, a linear uninterrupted flow is adhered so as to minimize human contact or movement of materials from one place to another, which could pose as a source for contamination.

Definition of spaces

For best health results careful consideration is to be made for storage spaces.

Screened raw material must be prevented from further contamination by dispensing them in properly controlled areas storage spaces must be clearly defined, and separated clearly from the main processing area or sanitary sensitive zone. Storage spaces must thus be defined seperately from the processing area.

Health Requirements

The dairy design must conform to total sanitary or hygienic requirements of organization, such as the Food Drug and administration (F.DA) acts, to avoid any seizure or other action. The architect must check and see that his design conforms to such health requirements. These requirements are many, and vary from one food plant type to another. The designs was took cognisance of this factor in mind, to active such a hygienic or bacteria free environment.

7.3.4 SAFETY CONSIDERATIONS

The factory, should be designed so as to minimise spillage, accidents, or contamination of products from one processing activity to another.

Safety measures is achieved by the following techniques or ways in the design.

1. Maintenance clear space

There should be an adequate amount of space on the same root for movement, simple repairs or maintenance, and a corfortable working environment.

2. Definition of processing area

The various processing areas of the various products are clearly outlined defined, separated and screened from each other in the des gn for best hygienic results, so as to prevent contamination from one processing activity to another through infiiteration.

7.3.5 ENVIRONMENTAL CONSIDERATION

1. Ventilation:

Ventilation is of paramount importance in the design. It consists of both natural and artificial ventilation. Mechanical ventilation is achieved by use of air-conditioner or fans in the factory.

2. Lighting:

Lighting must be very adequate, and also sunshading so as to regulate the light entry, is to be provided.

For adequate lighting, colums could be used as main structural and load bearing structure, so as to provide a free wall surface for lighting.

3. Biological consideration:

Harmful organisms and bacteria culd enter or penetrate through the building hence causing contamination of the milk being produced. In order to prevent or disallow this, wiremesh is placed on the window and exteriors.

4. Storage spaces

These must be carefully selected, in neat areas and should b ery distinct.

Milk powder and sugar are kept in one storage section while butter cans, powdered milk etc in other sections.

5. Mechanical aids:

Spaces should be designed so as to permit the use of mechnical aids such as forklifts.

5. Flow/Circulation:

Production flow and movement flow should not be

interuppted in the design.

7.4 DESIGN BRIEF AND SCHEDULE OF ACCOMMODATION

.4.1 DAIRY PLANT ACCOMMODATION

The will engage in the processing of milk into six different products namely: yoghurt, milkpowder, pastuerized white milk, butter and ice cream. Milk requirements are based on milk capacity of 200,000 litres. Equipments include those for packaging and filling. Other equipments include; boilers, refridgeration devices, compressors and auxillary facilities. Incubation and hardening rooms are also necessary.

ACCOMODATION SCHEDULE

ACCOMODATION	AREA(M^2)
Whole milk processing	$432m^2$
Butter processing	$432m^2$
Cheese processing	$288m^2$
Ice cream processing	$432m^2$
Milk powder processing	$432m^2$
Yoghurt Processing	$432m^2$
Row milk reception and storage	$360m^2$
Quantity control lab.	$144m^2$
Milk laboratory	$108m^2$
Incubation room	$108m^2$
Hardening room	$144m^2$
Generator room	$108m^2$
Maintainance section	$360m^2$
Plant workshop	$72m^2$

Retail store room	$288m^2$
Control room	$72m^2$
Supervisors' offices (8)	$64m^2$
Engine room	$144m^2$
Cold room	$504m^2$
CIP room	$54m^2$
UHT/Dry room	$504m^2$

Personnel requirements for the plant include the following:

Plant (Staff)	(Number)
Junior workers	40
Tech, Assistants	10
Supervisors	8
Drivers	6
Mantenance workers	12

Administration requirement consists of data processing equipment and other office equipment.

Administrative Staff	N°
General Manager	1
Gen. Manager Secretary	1
Dairy production Manager	1
Personnel Manager	1
Personnel Manager's Secretary	1
Finance and Admin. Manager/ Secretary	1/1
General office staff	8

. Cashiers	3
Accounts clerks	5
Accounta ts	2
Receptionist	1
Computer experts	2

STAFF FACILITIES	N°
Toilets/showers	
changing rooms	-
Kitchen/kitchen yard	-
Canteen	-
Clinic	-

PARKING SPACE

(Description)			(No)
Visitors	-	car parking spaces	
Staff	-	Car parking space	-

Includes staff busses.

There is provision for company and customers' truck parking.

Staff Requirement Estimate		
Production Hall and Storage	-	76
Tech. Auxillary facilities	-	12
Admin. facilities		30
Total		106

NOTE:

Facilities are designed taking the shift with maximum number of workers into account.

In the dairy farm however there are two shifts.

CHAPTER EIGHT

ARCHITECTURAL SOLUTIONS

8.1 FROM CONCEPT

8.2 DESIGN CONCEPT

8.3 DESIGN OVERVIEW

8.4 EVALUATION

8.5 CONCLUSION

8.1 FORM CONCEPT.

The form concept used for the building facades, is that of the typical fulani homadic traditional hut.

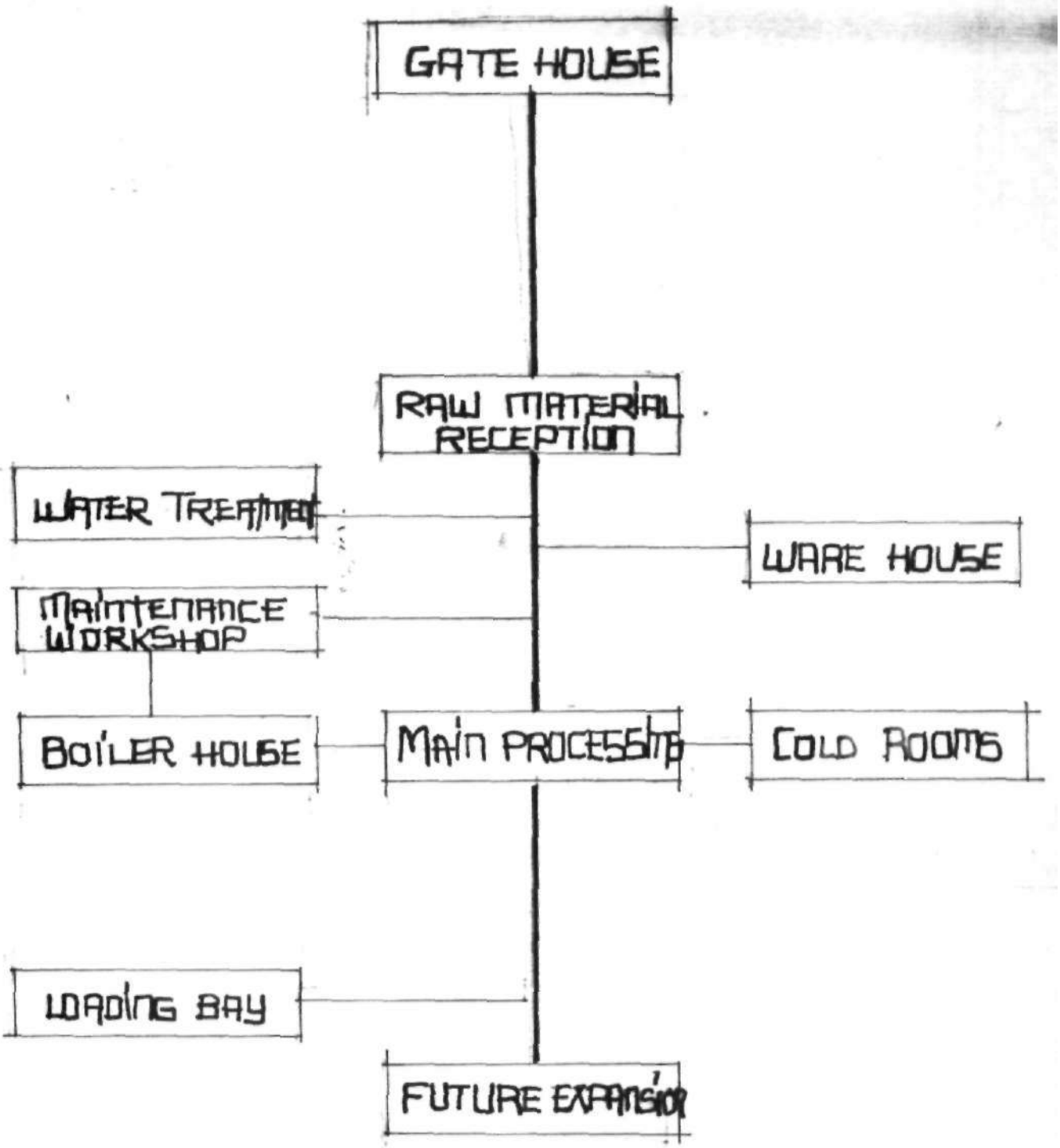
The tradictional hut is more or less, trangular in shape. This shape or motiff is strikingly seen, at the main entrance or approach of the factory administrative building. It provides a very fanciful and strikingly beutiful piece of architecture.

8.2 DESIGN CONCEPT

The resultant plan form is due to a merger of three architectural concepts of privacy, noise and function.

Zoning by privacy is whereby the units are arranged based on privacy. Three categories exist in this grouping, we have public functions, semi-public and private functions. Public functions include, administration or services open to general public. Private functions ecompass the main production area. Whereas semi-public functions houses the workers facilities block.

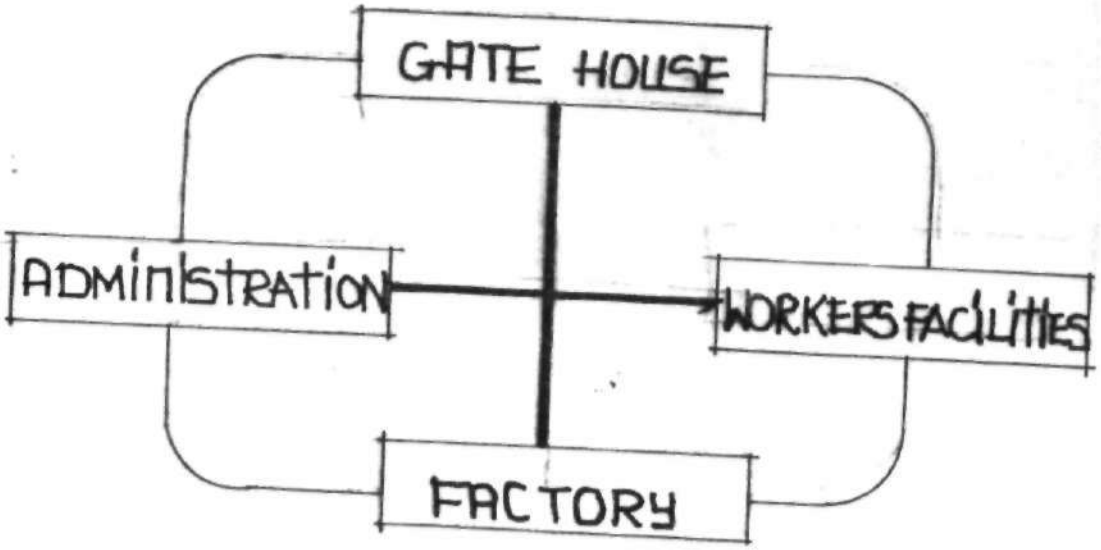
Zoning by noise is that category where the site is zoned accordingly by noise intensities. With three distinct categories of a noisy semi-noisy and quiet zone. The noisy zone houses the production area. While the quiet



THE FACTORY

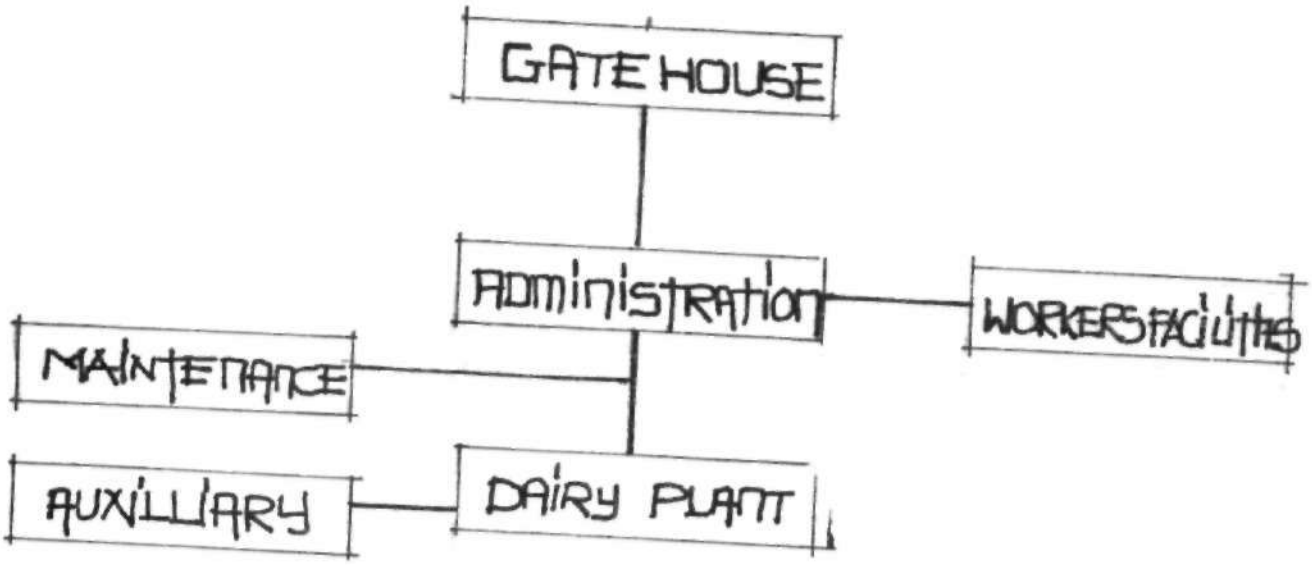
FUNCTIONAL RELATIONSHIPS

Fig.8.9



THE MAIN SITE

Fig.8.2a



THE UNITS
FUNCTIONAL RELATIONSHIPS

Fig.8.2b

zone accomodates quiet functions, such as offices etc. The workers facilities block accomodates the semi-noisy functions.

The last case is whereby the site is zoned upon consideration of the other two concepts, into functions. Four broad categorizations are outlined. These are administration, workers facilities, main production and service area.

The resultant plan form is thus a merger of the above concepts.

8.3 DESIGN OVERVIEW

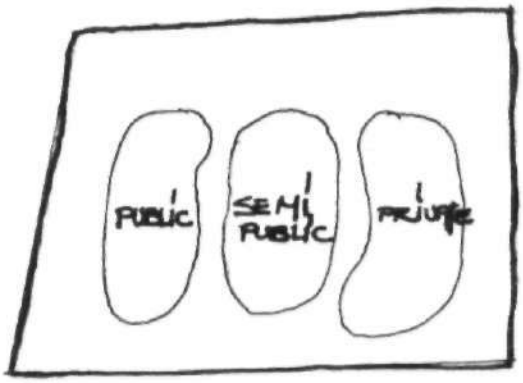
8.3.1 Site plan

The site plan is a basical simple, and functional design. All buildings have been oriented, taking into cognisance of the solar radiation. The short sides of all buildings face the East and West axis of solar radiation, whilst the shorter sides face the North and South position of solar radiation. The building floor is made of reinforced concrete. The roofing material is made of timber, with a covering of long span aluminium.

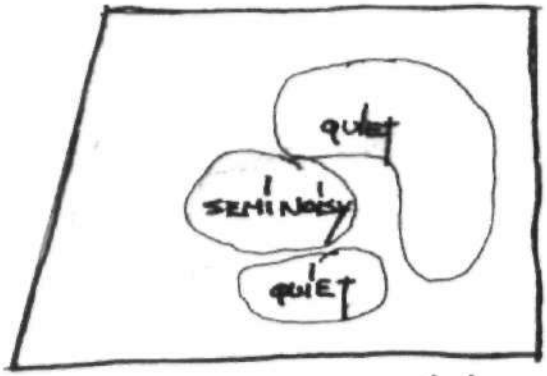
Circulation routes are finished with the use of granolithic concrete tiles. All walls are rendered smooth and painted with sand textured paint

8.3.2 Maintenance Area

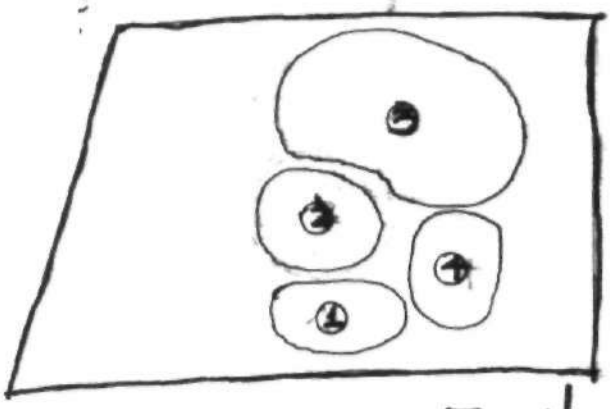
This is a place where repairs servicing and other works are carried out. It contains a tools area, spare parts section and store area. Space is provided for the repair of tractors and an iron - gate is provided for security purposes.



PRIVACY



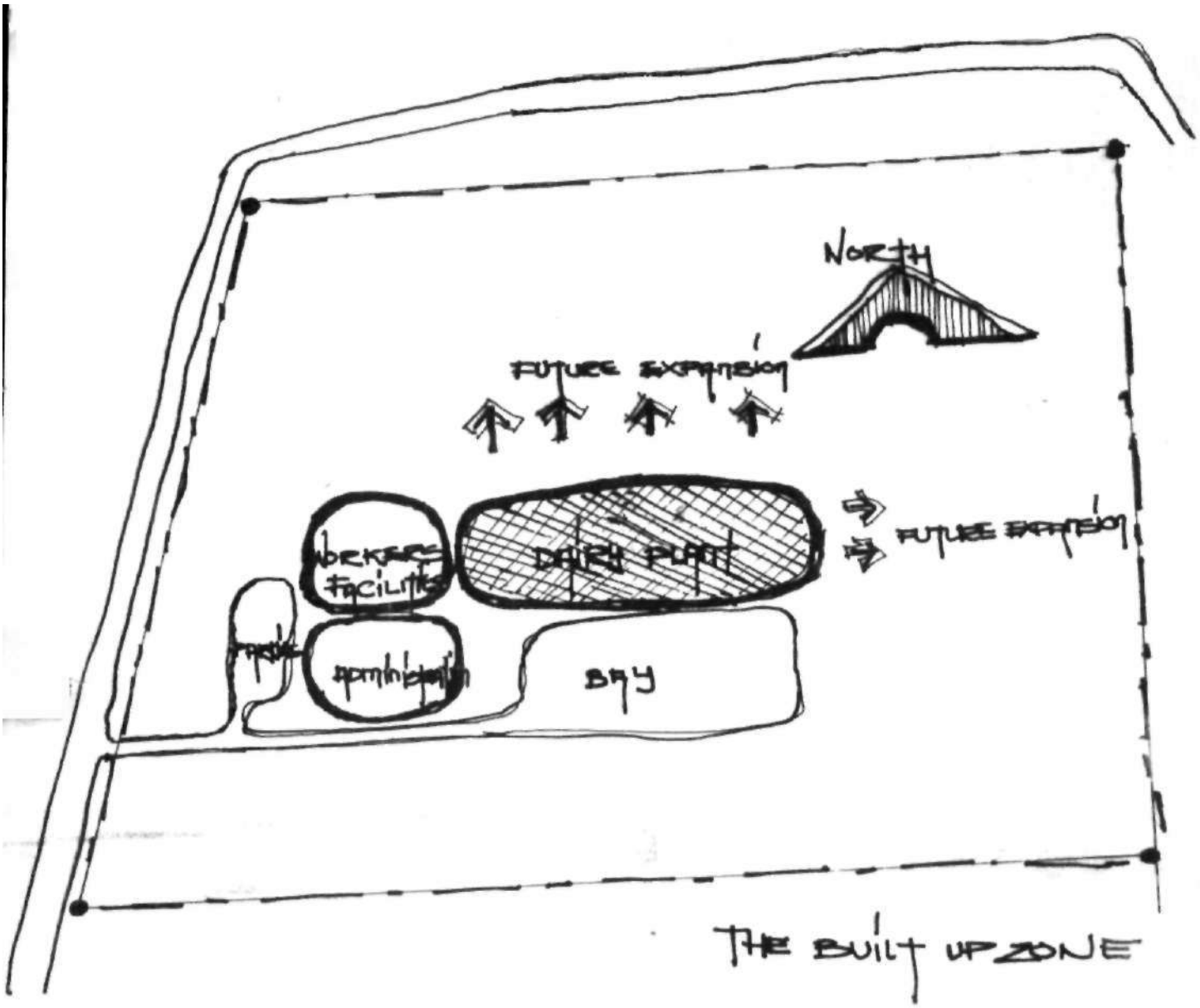
NOISE



Function

KEY
1) ADMINISTRATION
2) WORKERS FACILITIES
3) PRODUCTION AREA
4) SERVICE AREA

SITE ZONING CONCEPTS



SITE CONCEPT

Construction

The structural system of the buildings here, is the use of mild tubular, steel columns, with a steel truss for the roof.

Machines in the workshop were mounted on pads, for noise reduction. The infilling wall panel is with use of hollow concrete blocks at low level, then finally covered with long span aluminium roofing sheets.

Floors of any workshop should be resistant to chemical attacks, easy to clean, maintain, and have a high resistance to abrasion. For such a purpose, there is, the incorporate of the use of in-situterrazzo finishes.

For best hygienic results and good cross ventilation, the buildings have been inclined to the direction of the prevailing wind.

Future expansion of the mainprocessing hall of the factory has also been considered.

Access into the site is by a single gate for security purposes and effective control.

There is the provision of segregation of light and medium sized parking and manovering space, with that of heavy vehicles.

8.3.3 Administration and workers Facilities Block

PLANNING:

This block comprises of both the administration and workers facilities. They are linked together by a corridor. This building block is a simple bad bearing structure, made of sandcrete block, infills. Offices are single banked, and a courtyard space is provided for good cross

ventiliation.

The administr tion block is the first block, easy accessible from the main access. The workers facilities block is further inwards, to the left of the administrative block.

This block is a single storey building. The administrative block comprises of offices, toilets, entrance and reception areas etc.

Factory Building

In the factory building, there was the use of steel portal frames. Modular courdination of the 6m x 6n grid was used.

The production hall is a very simple design. This is square in shape with the processing lines all linearly arranged with a screen wall to separate each process storage spaces both for raw material and cold storage are all clearly defined, separated and arranged so that they do not interfere with any of the processing activity.

The production area comprises also of the auxilliary area, which houses the boiler house. The main production hall contains all production operations, and none of the operations is exposed so as to provide restraint for the entry of any disease causing air-borne micro-organisms.

The boiler house is located close to the main production hall, but separated so as to minimise st transfer which causes heat gains into the factory building.

The production area thus comprises of the mainproduction, auxilliary services such as the equipment store, generator room, boiler house, and water treatment plant.

EV ALU ATION

Hygienic a considerations are very important, as in the design of food factories, such as the dairy.

Standards must be taken to a very satisfactory standard so as to avoid products contamination. These contamination sources could be microbial or non-microbial.

In order to have a good and hygienic factory environment. The architect must make a through study, selection and incorporation of hygienic materials and procedures.

This hygienic environment is achieved, only by a thorough consideration of the following factors or design principles.

- Architectural planning design consideration
- Environmental considerations
- Constructional considerations.
- Safety measures
- Health and other considerations.

The proper utilization of the basic considerations or measures will thus produce a very hygienic or bacteria free environment, which will conform to health standards as recommeded by food plant requirements such as the . Food, Drugs and Cosmetics Acts - FDA), so as to minimize losses or damage of products or cause illnesses, to consumers.

8.5 CONCLUSION

Development in agricultural practices such as dairying, are crucial and important at this structural adjustment period.

The thesis, however is concerned with the solving of the associated sanitary problems which are envisaged in this factory type.

The upgrading of quality and increasement of product standards will upgrade the quality of products and safeguard the health of consumers.

The realisation of this project will go a long way in reinforcing the emphasis of the Government's empasis on agricultural or agro-related activites. This will boost agricultural production of these products, and at a price affordable to customers. It will ensure consumers health and justify the vialability and future of such a project.

The designer is optimistic that this will be beneficial to Nigeria, not only as a source of food, but if exported will generate foreign exchange.

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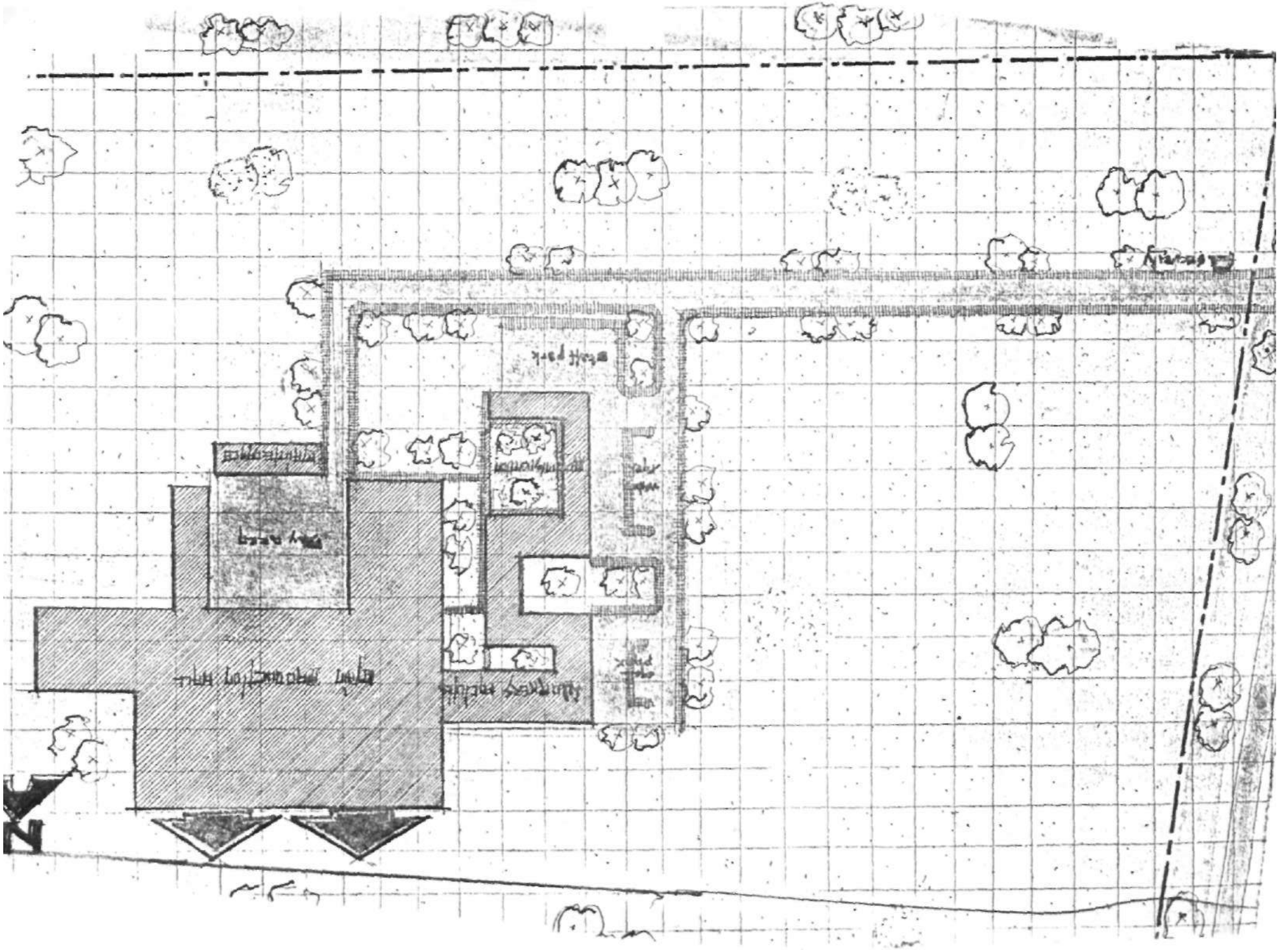
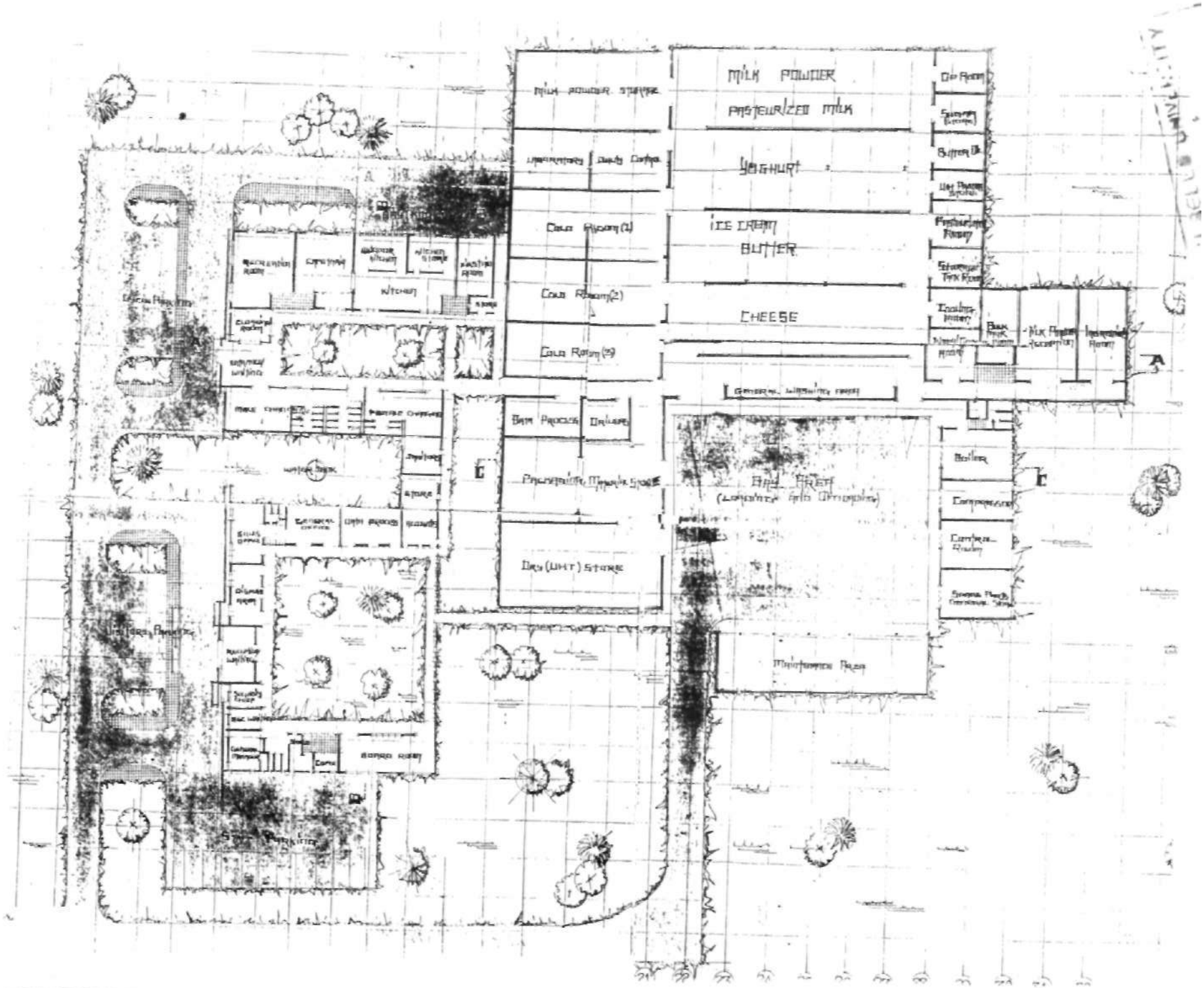
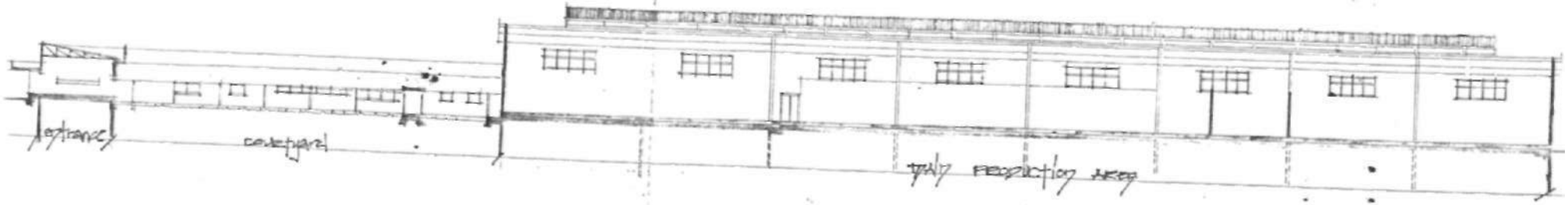
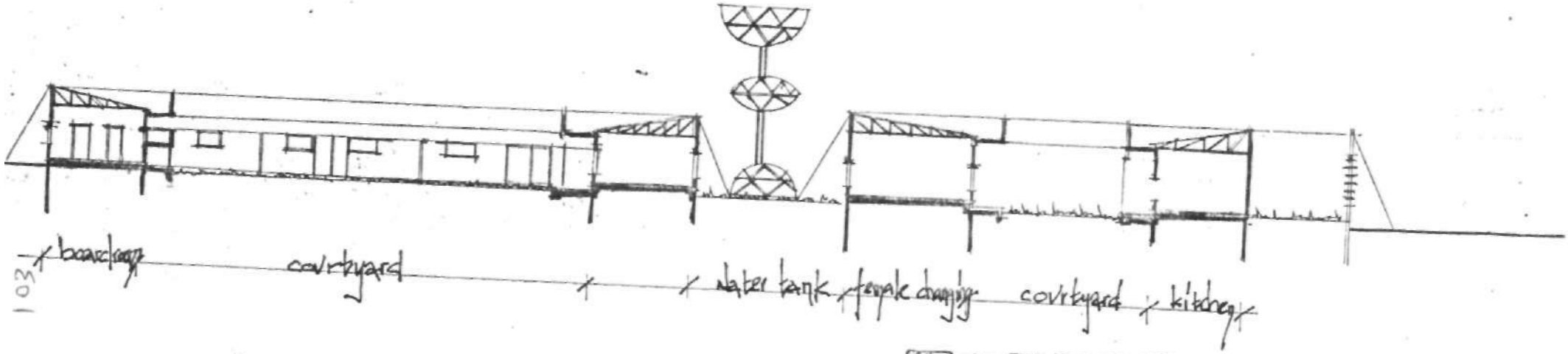



MILK POWDER
PASTEURIZED MILK
YOGHURT
ICE CREAM
BUTTER
CHEESE
Cold Room (1)
Cold Room (2)
Cold Room (3)
Bay Area
Dry (UHT) Store
Boiler
Compressor
Control Room
Maintenance Area
Kitchen
A
C



SECTION A-A


boarding
courtyard
water tank
temple dwelling
courtyard
kitchen

SECTION B-B

APPROACH FACADE

RIGHT SIDE FACADE