KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ARCHITECTURE AND PLANNING

FACULTY OF ARCHITECTURE AND BUILDING TECHNOLOGY

DEPARTMENT OF ARCHITECTURE

TOPIC: MEAT PROCESSING FACTORY- UPPER-EAST REGION (ZUARUNGU)

A THESIS REPORT SUBMITTED

TO THE DEPARTMENT OF ARCHITECTURE, KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF POST GRADUATE DIPLOMA IN ARCHITECTURE,

BY

CAMILLA FYNN

DATE: JUNE 2009.

DECLARATION

"I hereby declare that where references have been duly cited, I have personally undertaken this Design Thesis report under due supervision."

FYNN CAMILLA ADJOA

Signature ..... **Date** 18/09/09

I declare that this design thesis report was written under my supervision and that the candidate has been interacting with me for my guidance and therefore confirm that the student has my permission to present it for assessment.

MR. S.O.AFRAM

Signature ..... **Date** 18/09/09

CERTIFIED BY

PROF. G.W.K. INTSIFUL
(HEAD OF DEPARTMENT)

Signature ..... **Date** .....

DEDICATION

This work is dedicated to God Almighty and my parents and siblings for their immeasurable support throughout my life. "To you all, I say a big thank you".

ACKNOWLEDGEMENT

To the Almighty God who has being my strength, guide and a great provider each day of my life. I give Him all the praise.

To my family, especially my parents, thank you for their support, prayers and encouragement that has brought me this far.

I also want to thank the entire staff of the Kumasi Abattoir, Mr. J.B. Derry (Accountant of Bolgatanga Meat Factory), Mr. Bruce (Premiere Meat Products), Charles (Divestiture Implementation Committee). This Project would not have been successful without your help.

Also, I want to thank all the lecturers of the department Of Architecture who took time off their busy schedules to give advice to the success of this project.

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CHAPTER 1

1.0 INTRODUCTION

The Ghana meat industry which started as far back as in 1960's produced meat and meat products with the aim of satisfying both domestic and foreign markets. However, this aim was not fully achieved as a result of three major reasons:-The severe drought during 1980's in the savannah and Sahel region which dwindled the supply of livestock to the Ghana meat industry, High importation of meat and meat products from global leaders in Europe and South America to substitute the local sources of meat, and political instability[1].

Irrespective of these mishaps, The Ghana Meat Industry still poses potentials of producing and supplying livestock and processing them into various meat products for domestic and foreign consumption. If calculated measures are taken into consideration and acted upon with diligence, the Ghana Meat Industry can be revived and transformed into a sustainable industry to create employment and wealth.

1.1 PROBLEM STATEMENT

1. Lack of scientific method of livestock farming the country.
2. Ghana continues to import meat and meat products indicating that meat production in Ghana is poorly supported by both government and the private sector.
3. The material base for the supply of raw materials is not well developed.
4. There is lack of adequate human resource (meat technologist) and middle level personnel.
5. Indigenous way of slaughtering and dressing meat for public consumption is unhygienic and poses health problem for the country.
6. Lack of policies and programme to support the meat industry by the government.

1.2 AIMS / OBJECTIVES

This design programme is intended:

- To improve and expand the business of processing meat and meat products.
- To ensure good hygiene and quality meat product

- To ensure excellent environmental sanitation for slaughtering and processing meat and meat products.
- To create opportunities to export and import meat products.
- To create a facility to process animal by-products.
- To create employment
- To create a facility that is 100% energy autonomous in the event of power outage and must respond automatically.
- To create a facility that responds to the tropical climate.
- To create a facility that is user friendly.
- To determine the general principle of design of meat processing factories based on modern situations and the perspective development in the area of meat processing industry.
- To conduct an organizational and strategic analysis of the meat processing factory that identifies the current situation, current problem in a new design.
- To evaluate the strengths, weaknesses, opportunities and threats of the existing factory and propose key success factors to provide the desired changes in the proposed design.
- To evaluate the relevance of skill training (human resource) to sustainable operation of meat processing factory in Ghana.

1.3 SCOPE

The scope of this design thesis is to

- Combine an abattoir with a meat processing centre.
- The factory must be able process cattle, hog, sheep and goat.
- The factory must also have an area for receiving dressed chicken.
- The factory should also be able to produce about 40 tons of processed meat (i.e) Sausages, Burger meat, bacon, cooked ham, meat loaf and corned beef.
- The Factory should be able to process animal by products such as the hide, blood and bones.

1.4 GOALS OF THE CLIENT

The goals of the clients are:

- To revive the meat processing factory at Zuarungu.
- To generate employment and to develop skills in meat processing.
- To participate in socio-economic development.
- To facilitate demand and supply to needy populations.

1.5 SITE

The selected site is located at Zuarungu, Bolgatanga in the Upper East region. It's an existing site for the Ghana meat industry.

1.6 JUSTIFICATION

It is very important to put up a meat processing factory for the Ghana meat industry in the Upper East region – Zuarungu due to these imperative reasons:

The site for the factory is already available at Bolgatanga Meat factory, but now a defunct site. The site is a 34 acre land well fenced and secured.

It is close to the source of raw material, i.e. livestock farming area. It has basic infrastructural facilities such as water supply, electricity, telephone.

Land is available for expansion and there is the need to revamp the Bolgatanga meat factory into a modern industry.

Also, it is necessary to provide animal protein to the population to reduce malnutrition and improve the health of our people.

To bridge the gap between imports of meat and meat product and local production.

1.7 CLIENT

Ghana Government

1.8 CLIENT BRIEF

The client brief is directly related to the element spelt out in the scope above.

1.9 FINANCIER

The Ghana Government

1.10 TARGET GROUP

Domestic and foreign market.

1.11 RESEARCH METHODOLOGY

The research methods employed in this design thesis report are:

- Questionnaire administration.
- Interviews.
- Literature review.
- Photography.
- Data collection.
- Personal observation.

REFERENCES

1. GIHOC Sales Memorandum (2005)

CHAPTER 2

2.0 LITERATURE REVIEW

2.1.0 THE GHANA MEAT INDUSTRY IN PERSPECTIVE

2.1.1 GHANA LIVESTOCK POPULATION AND DISTRIBUTION

Even though livestock rearing is undertaken throughout the country, concentration of some species occurs in certain region. The three northern regions (Northern, Upper East and Upper West) and the Volta Region have historically dominated the rearing of ruminants and pigs through the 1980s and 1990s. While the three northern regions appear to dominate cattle production, the Volta Region had the highest and second highest population of sheep and goats respectively, in the 1990s [1].

2.1.2 OVERVIEW OF BOLGATANGA OPERATIONS

The Bolgatanga Meat Processing factory and ancillary buildings are located on a well secured and fenced parcel of land which covers 34 acres is located at Zuarungu in the Upper East region. The construction of the factory began in 1962 and production subsequently began in 1965. The design of the factory was by the German Firm Martin Sturcken & Co. Gmbh of Bremen. The factory was well equipped. However, production stopped in 1992 due to lack of tin cans for the production of Corned beef [1].

From 1965 to 1968, the production of the company was 100 cattle and 20-50pigs per day, 40-50 sheep and goats per week. The Slaughtering of pigs, goats and sheep was based upon demand and varied [1].

Approximately 50% of the slaughtered cattle were used for the production of Volta corned beef 50% sold as raw meat to the public [1].

Before the collapse, the company produced 4000-5000 tins of corned beef per day comprised 80% with other products such as sausage, bacon, luncheon meat, beef loaf, smoked beef accounting for the remaining 20% was produced [1].

The company also produced some by-products such as cow hide for a tannery in Kumasi, bone meal for poultry feed, and technical fat [1].

Currently, security is provided to secure the site to avoid encroachment.

2.1.3 OVERVIEW OF TEMA OPERATIONS

The Tema Branch originally served as head office for all the operations: - Tema, Kumasi, and Bolgatanga. It was later moved to Bolgatanga.

The Tema operation is located on an 8 acre land.

Meat was processed by the Bolgatanga meat factory and sent down to Tema for storage and subsequent distribution. With the virtual collapse of the Bolgatanga business, Tema suspended the sale of these products to its clients.

During this period to 1992, the company went into agreement with a local entrepreneur (SOTREC) to process meat. Under this arrangement, the entrepreneur bought meat from the company and processed it for distribution [1].

2.1.4 MEAT PROCESSING COMPANIES IN GHANA

There are few meat processing companies processing meat into sausages, ham, bacon, frankfurters, luncheon meat e.t.c currently, the dominant company is SOTREC Meat Company Limited and Premier Meat Products which are all in Accra.

Their monthly production is about 8 tons of meat and 5tons of meat products respectively.

The supply of meat and meat products by the company is handicapped by inadequate raw materials and inability of the factory to process large volume of meat due to its size- a small scale enterprise facility.

Ghana is a net importer of processed meat products (both animal and animal products).

Apart from live cattle imported from Burkina Faso, most livestock products are imported in a dressed or processed form.

2.2.0 WHY THE MEAT INDUSTRY MUST BE REVIVED.

The meat industry must be revived to produce quality meat to feed the population

It would encourage people to go into livestock farming as the meat industry will facilitate demand for meat processing.

The meat industry is both a foreign exchange and cedi earner. This will reduce the amount spent for the importation of meat.

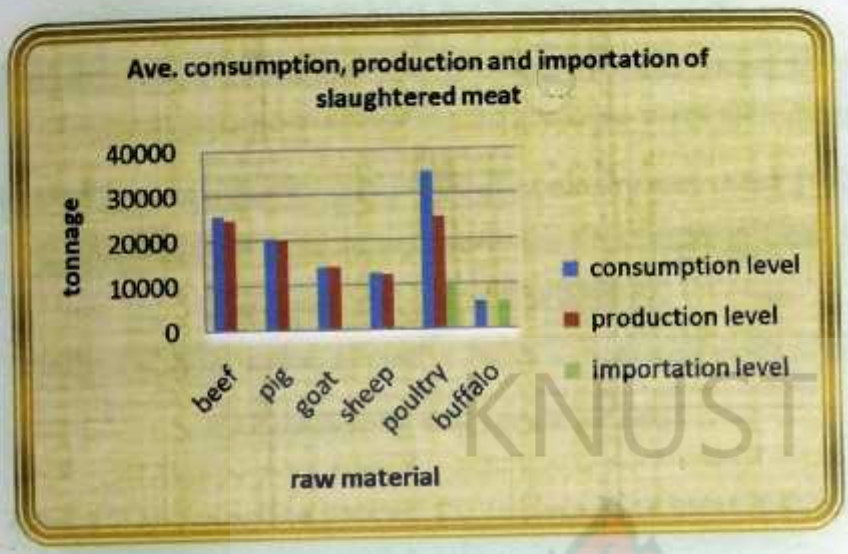
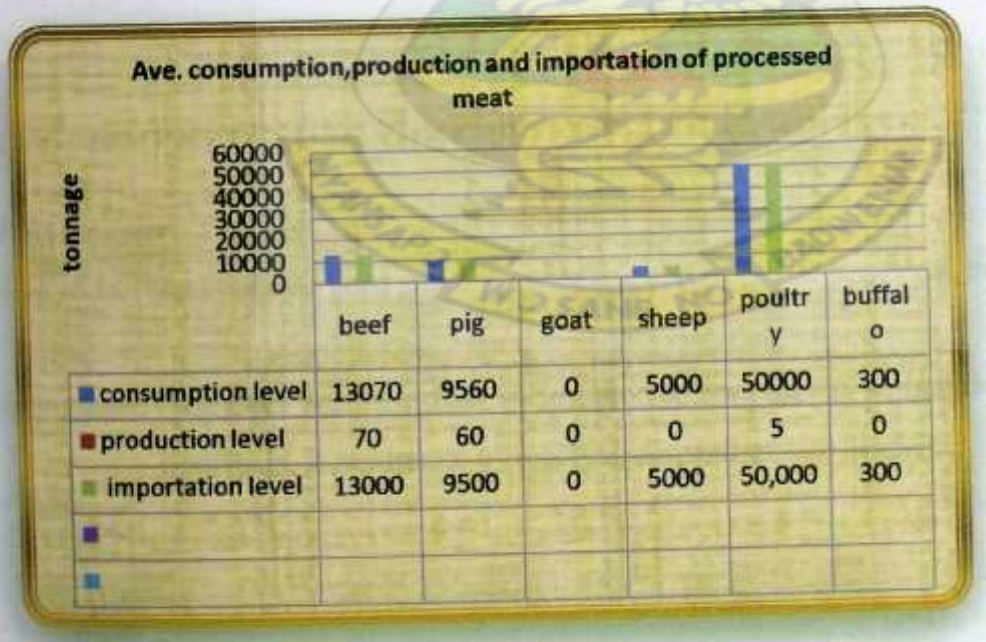


Chart. 2.0 Chart showing the average consumption, production and importation of slaughtered meat per year (2000-2005). Source: FAO Database and Veterinary Office Ghana.



	beef	pig	goat	sheep	poultry	buffalo
consumption level	13070	9560	0	5000	50000	300
production level	70	60	0	0	5	0
importation level	13000	9500	0	5000	50,000	300

Chart. 2.1 Chart showing the annual average consumption, production and importation of processed meat. (2005-2008). Source: FAO Database and Veterinary Office Ghana

2.3.0 SOLUTIONS FOR REVIVING THE GHANA MEAT INDUSTRY

Government investment and dedication to the meat sector

↓

Establish irrigational facilities in the savannah and sahel regions

↓

Provide good subsidies for livestock farming

↓

Encourage livestock farmers to produce more by giving them incentives

↓

Create educational centers for training meat technologist

↓

Establish and operate quality and efficient abattoirs and meat processing company

↓

Create employment especially for the people of Ghana

↓

Distribute meat within Ghana

↓

Reduce imports and export Ghana's meat and meat product

↓

Save money and create wealth

Fig 2.2 Diagram showing the process for reviving the meat industry

2.4.0 MACHINES USED IN MEAT PROCESSING

The equipment used in a meat processing factory varies in each production line that is cattle production line, hog production line, sheep and goat and the meat products processing factory.

2.4.1 EQUIPMENT USED IN THE CATTLE PRODUCTION LINE

Beef Restrainer: The beef restrainer is designed to hold the animal in a quiescent upright position to facilitate the overhead stunning with a speed over 100 heads per hour [3].

Stunning Box: The Beef Stunning Box is designed to restrain the animal during the stunning operation. It is capable of reaching a speed of 120 heads/hr.

Fig 2.3 Stunning box. (Source: www.google.com – Riopel equipment)

Beef hoist: The hoist is used to bring stunned and shackled cattle to the bleeding rail. It is used with an automatic Lander and 1 shackle trolleys various speeds and automatisms are available to meet the operation speed c/x 120 heads/hr.

Fig 2.4 Beef hoist (Source: www.google.com – Riopel equipment)

Bleeding Table: This motorized bleeding table is designed to stick hogs and kill cattle and other livestock easily and safely with the possibility to collect the blood in a collecting pan.

Fig 2.5 Bleeding table (Source: www.google.com – Riopel equipment)

Hide puller: The Hide Puller is designed to remove hides from beef carcasses up to 50 heads/hour keeping maximum quality in hide removal. It can be operated by people working each side of a central chain to pull down the hide following two rollers end anchored to the floor roller equipped with chains. Front feet of the carcass being priory peeled and attached, they shackle front feet hide to the roller chains, rolling and pulling up hide until complete removal. If head is on, pneumatic platforms are used each side of the roller to allow workers following the hide removal.

Fig2.6 Hide puller (Source: www.google.com – Riopel equipment)

Beef Carcass Cabinet: The circular Beef Carcass Cabinet Sterilizer draws carcasses to be sterilized by a steam jet, as a way to fight bacteria, all side of the beef carcass are continuously sprayed by the steam jet at the same time. The cabinet will be conceived according to your speed of operation [3].

Final washing Cabinet: The automatic carcass washing cabinet is designed to wash carcass sides before cooling, while they are traveling on an overhead rail conveyor. This equipment is designed to avoid excesses of water consumption.

Fig 2.7 Final washing cabinet (Source: www.google.com – Riopel equipment)

2.4.2 EQUIPMENT USED IN THE HOG PRODUCTION LINE

Restrainer: This conveyorized hog restrainer is used for any size of hogs. The walkway slopes downward, so that the hog can be wedged by the flights which propel it toward the discharge end. Since the hog loses footing, stunning probe is easily applied. Two restrainer conveyors with plastic flights mounted on the same galvanized base can be installed in series for higher operation speed. They allow more space between hogs, easing the stunning and shackling operations and avoiding any electric transfer from one hog to another.

Fig 2.8 Restrainer (Source: www.google.com – Riopel equipment)

Angular Hoist: This hoist is designed to lift hogs and other small animals such as lamb, sheep, goat, etc. and bring it to the bleeding rail. The chain is supplied with hook attachments to convey shackle trolleys to the bleeding rail [3].

Bleeding Table: This motorized bleeding table is designed to stick hogs and kill cattle and other livestock easily and safely with the possibility to collect the blood in a collecting pan.

Fig 2.9 bleeding table (Source: www.google.com – Riopel equipment)

Scalding tank: This scalding is specially designed for small (100 per hour) and high (800 per hour) capacity hog slaughterhouses where pull trough conveyorized bleeding and scalding system is used. Many configurations are possible to fit in your own application. A high volume of water is circulated against the hog to keep pressure on it, bring back to the suction point any possible floaters and keep the same temperature in the whole tank. The surface is maintained with a maximum of steam to fill the surface with natural foam assuring a better condition for workers and a perfect scald

Fig 2.10 Scalding tank (Source: www.google.com – Riopel equipment)

In these machines, hogs, sheep and goats of all sizes are supported on "U" bars and cleaned by hogs scrapers bolted on two shafts assuring their rotation. We recommend installing one de-hairing machine for an operation of 200 hogs per hour and less or for higher speed. We also suggest installing two de-hairing machines in series with opposite rotations to scrap hogs on both sides equally. A minimum of warm water is required to drop hair in the hair removal conveyor. Outside, heavy duty bearings insure an easy maintenance and doors are installed to facilitate the washing period. The exit doors are hydraulically operated to control the dehairing time. Scrapers and U-bars are installed like a screw to allow hogs to go through the machine naturally.

Fig 2.11 Dehairing machine (Source: www.google.com – Riopel equipment)

Washing Cabinet: The automatic carcass washing cabinet is designed for washing the splitted hog carcasses, while they are travelling on and overhead rail conveyor. This equipment is designed to convey the operation speed desired and avoid over water consumption.

Fig 2.12 washing cabinet (Source: www.google.com – Riopel equipment)

Hog Carcass dryer: This machine is designed to prevent wet hair from sticking to the skin surface before being singed to obtain a better result.

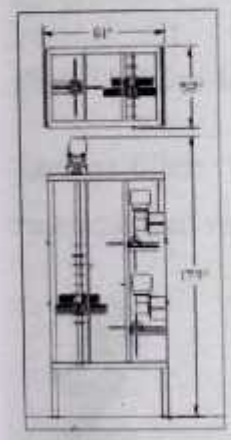


Fig 2.13 hog carcass dryer (Source: www.google.com – Riopel equipment)

Singer Cabinet: The Singer cabinet is designed for automatic singeing of hog carcass as they travel on conveyorized slaughter line. Natural gas or propane fuel can be used.

fig. 2.14 Singer cabinet (Source: www.google.com – Riopel equipment)

NOTE: However, these machines are also used for sheep and Goat Slaughtering.

2.4.3 EQUIPMENT USED IN A MEAT PRODUCT PROCESSING FACTORY

The main equipment used in a meat processing factory are:

Cutting tools (Knives, band saws) ,Grinders , shredders, mincers, cutting and mixing bowl, brine injectors , tubs, burger making machine, sausage filler , slicers, vacuum machine, rotational ovens , autoclave cooker , smokers , tumblers , trolleys and carts .

Brine Injectors:

Brine injectors are used in making bacons. Brine is injected into the meat by the use of this machine. In small factories, it is normally done manually.

Fig 2.15 Brine Injector. (Source: www.springer machinery.com)

Sausage filler: this machine is used in filling minced and spiced meat into intestines with recommended weight and size.

Fig 2.16 Sausage filler (Source: www.springer machinery.com)

Mixers and tumblers: this machine is used for mixing meat and spices for further processing. They can be manufactured in different shapes and size

Fig 2.17 Mixers

Fig 2.18 Tumbler

Grinders : Like the mincer, grinders grind chunks of meat into minced meat form.

Fig 2.19 Grinder (Source: www.springer machinery.com)

Rotational ovens: This is normally used for roasting, baking, and smoking meat products.

Fig 2.20 Rotational oven (Source: www.springer machinery.com)

Vacuum machine: This is used in the packaging room to seal rubber packages,

Fig 2.21 Vacuum machine (Source: www.springer machinery.com)

REFERENCES

1. **GIHOC Sales Memorandum (2005)**
2. **www.google.com – Riopel equipment**
3. **www.springer machinery.com**

CHAPTER 3

3.0 RESEARCH METHODOLOGY

As stated in Chapter one (1.11) the following research methods were applied to obtain both qualitative and quantitative information : Interviews, literature reviews which includes internet search, taking of photographs, measurement of buildings, personal observations, photographic recordings and case studies .

- Interviews

Experts as well as people with a lot of knowledge on meat processing were interviewed. A meat technologist from Premiere meat product, the foreman, production and engineering manager of the Kumasi abattoir, old workers as well as the accountant (Mr. J.B. Derry) of the Bolgatanga meat processing factory where the case studies were conducted were also interviewed to ascertain their response.

Interviews with the public relations officer of the Divesture Implementation Committee were made to know their policy direction with respect to this project from which the brief development was also done.

- Literature Reviews

Published and unpublished literature on the topic was reviewed. This involved the examination of written material such as books, journals and video recordings. A lot of literature was also gathered from various web sites associated with meat processing.

- Internet Searches

Extensive information was acquired from the World Wide Web and was greatly used in the research. It provided answers and clues to some problems encountered whilst undertaking the project.

- Photographic Recordings

Photographs of critical and important facilities and activities that will aid the completion of the project at hand were taken.

- Measured Drawings

Existing Abattoirs and meat processing factories whose drawings were not available had to be measured to enable the author draw comprehensive conclusions.

- Questionnaires

Questionnaires were developed in order to attain both qualitative and quantitative information from the experts in the field of meat processing.

- Personal Observations

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

- Case Study

Local and foreign cases related to meat processing were undertaken and studied to enable the author draw conclusions on design decisions to be taken in tackling the scheme.

Chapter 2 focuses more on the literature review and internet searches.

Purpose

This Chapter is focusing on case studies, measured drawings, photographs and personal observation.

Bolgatanga Meat Factory, Kumasi and Tema Abattoir, premier meat Products and other foreign meat processing plants around the world were Case studies undertaken in order to identify both positive and negative effects of design on allocation of space in meat factories and abattoirs resulting from different environmental variables in the development of those facilities, looking for quality of space, in the objective of which to reach an environment that is good for users and optimization of operational aspects of all stakeholders .

3.1.0 CASE STUDY ON BOLGATANGA MEAT PROCESSING FACTORY

Reasons for the study

The Bolgatanga Meat Factory was chosen as a case study because of the following reasons:

- To gain experience that could be used in designing a meat factory in the country in the future.
- It was study mainly to know the production process of a meat processing factory.
- To understand the principles underlying the design of space.
- To identify the positive aspects of the design resulting from environmental variables in the development of meat processing factory.

Main architectural features

- Almost all Buildings are in rectangular form with the long side facing north with the exception of the maintenance block.
- Windows of all the buildings on site are of one style. They are all air tight fixed windows.
- Materials used mainly are concrete for walls and some roof beams, steel for roof members and asbestos as roofing sheet.

3.1.1 SPATIAL ORGANISATION OF THE SITE

The Bolgatanga Meat Factory site has the following spaces and facilities.

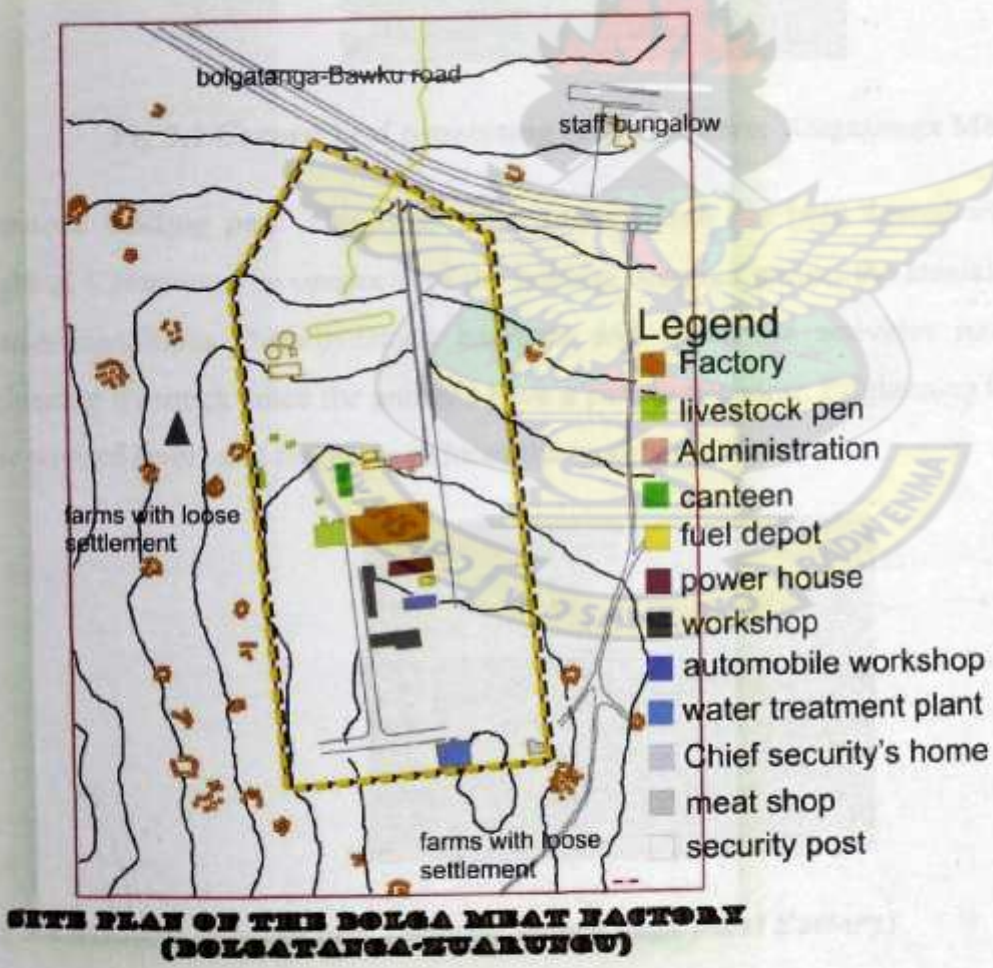


Fig.3.0 Spatial organization of the site of the Bolgatanga meat factory. (Source: Bolgatanga Meat Factory)

3.1.2 DESCRIPTION OF THE VARIOUS FACILITIES

Factory: It is semi-mechanized and uses electricity powered winches which are currently not operational because of mechanical problems. Other machinery as scales, grinders, cutters and cookers are very obsolete. The factory is made up of the slaughter floor, cold and freezing rooms, cutting and deboning room, cooking room, corned beef processing roof and a finished good departure room on the ground floor and a hide drying area, spices storage, animal feed storage and archives on the first floor on the first floor. The hide drying area has a floor area of 500msq and a room height of 2.3meters.

Fig 3.1 Corned beef processing room (Source: Bolgatanga Meat Factory)

Livestock holding pen: This is an open space which has been fenced with steel bars at a height of 1.2meters. The openness of the holding does not protect the animals from the various weather conditions. Non-livestock handlers and other site activities have a tendency of frightening livestock since the animals have a panoramic view. Frightening livestock increases their cortisol levels and therefore reduces the quality of meat.

Fig 3.2 livestock holding pen. (Source: Bolgatanga Meat Factory)

Bone milling room: This is attached to the power block .The room has equipment for extracting technical fat from the bones before the bones are milled. Machines are also not in operation. Movement of bones from the factory to the bone milling area makes the production line cumbersome and unhygienic.

Power block: The power block consists of the power house and the boiler house. The power house functions perfectly well and can power both the factory and the workers bungalow.

Fig 3.3 power block

fig 3.4 picture of power house

(Source: Bolgatanga Meat Factory)

Boiler house: This had two diesel fired boilers. The area boiler room is about (10 * 15) meters with a height of approximately 3.5meters.

Fig. 3.5 boiler house (Source: Bolgatanga Meat Factory)

Water treatment plant: The water treatment plant is roofed. It has sand filters, water pumps and tanks for both treated and untreated water. The capacity is 228,300 gallons (223,300 gallons untreated water and 5,000 gallons treated water). The whole system is in perfect condition except a small portion of the roof which leaks.

Fuel Depot: The fuel depot has about 3.5meters dug out diesel oil storage tank which is used for powering the boilers

Fig 3.6 fuel depot house (Source: Bolgatanga Meat Factory)

Automobile workshop: This is a 15 by 30 m automobile workshop. As a result of long distances travelled, the meat factory needed an onsite automobile workshop to service the trucks before and after every travel.

Apart from a system for lifting there is no equipment currently installed in this area. The workshop has a vehicle inspection pit.

Fig 3.7 Automobile workshop (Source: Bolgatanga Meat Factory)

Stores and workshops: These are mainly engineering and carpentry workshop.

Laundry: In order to ensure all workers dress appropriately and neatly before entering the factory, the meat factory had a laundry to clean workers uniforms after every working day. The workers laundry has washing machines and dryers which are not in operation.

The laundry is quite a distance away from the factory which is inefficient.

Fig 3.8 laundry room (Source: Bolgatanga Meat Factory)

Workers Canteen: As a result of workers working in an enclosed space with no fresh air, the canteen was designed open to liberate workers from the artificial air in the factory during their break time. The workers canteen is currently dilapidated.

Fig 3.9 Workers canteen (Source: Bolgatanga Meat Factory)

Loading Bay: There is no specific place for a loading bay. It competes with the administration, customer car park and road for space.

Fig 3.10 loading bay, administration car park and customer car park (Source: Bolgatanga Meat Factory)

Incinerator: The incinerator is mainly used for burning condemned animals from the factory .The location of the incinerator will increase the spread of contamination since it is far from the factory.

Administration: The administration is made up of the Managing Director, Deputy Managing Director, Production and Engineering Managing Directors with their Deputies respectively, Accountants and a Financial Controller, Marketing and Auditing Personnel and Public Relation Personnel. The administration is just one storey and does not have space for all the members of the administration

Fig 3.11 Administration. (Source: Bolgatanga Meat Factory)

Security post: The security post is situated at the entrance of the facility beside the meat shop

It is no device for checking loaded and unloaded trucks. The security men make use of only a torch light.

Fig 3.12 security post (Source: Bolgatanga Meat Factory)

Chief security officer's home: This is located at the extreme end of the site. The chief security man is to stay there permanently to guard the site and its' asset, especially with the facility at that end which is far from the main security post.

Fig 3.13 chief security officer's home (Source: Bolgatanga meat factory)

Staff bungalow: The Bolgatanga meat factory has a large underdeveloped staff bungalow site which is 100 meters away from the factory site.

3.1.3 SPATIAL ORGANISATION OF THE FACTORY BLOCK

The factory has a dimension of 30m (width) by 60m (length).

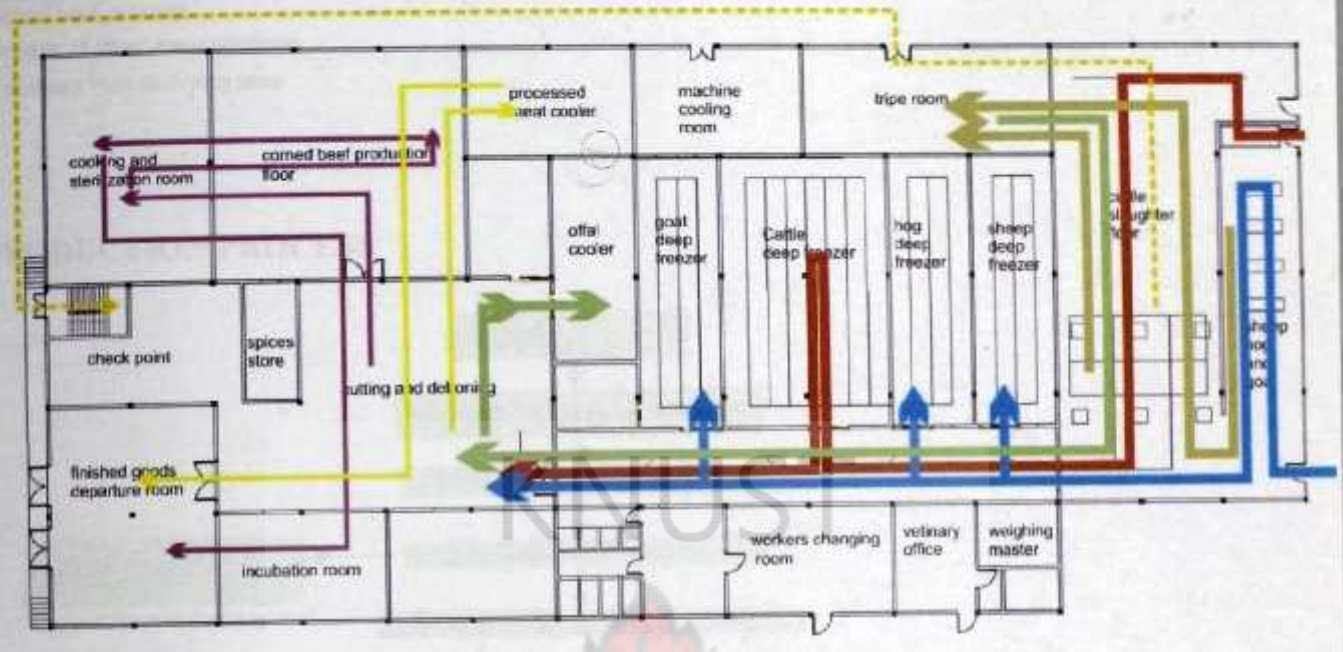


Fig 3.14 Ground floor plan (Source: Bolgatanga meat factory) – (Existing)

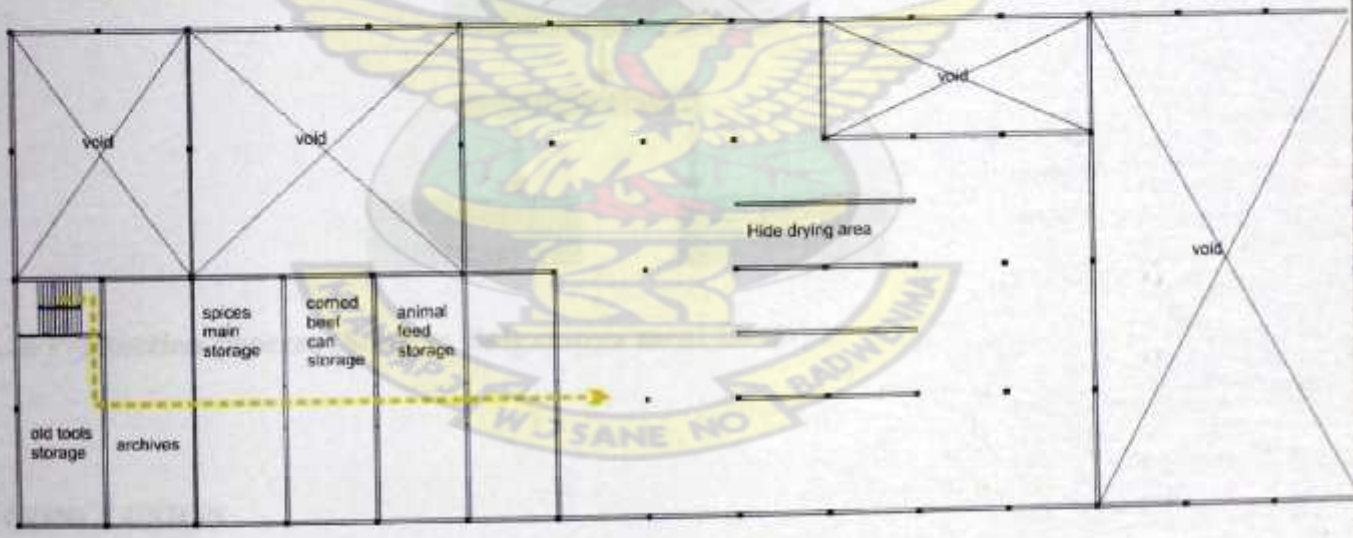


Fig 3.15 First floor plan (Source: Bolgatanga meat factory) – (Existing)

LEGEND
- cattle processing
- sheep goat and hog processing
- offal and trip process
- washed offals
- corned beef process
- process of other meat products
- movement hide to drying area

3.1.4 PRODUCTION PROCESS

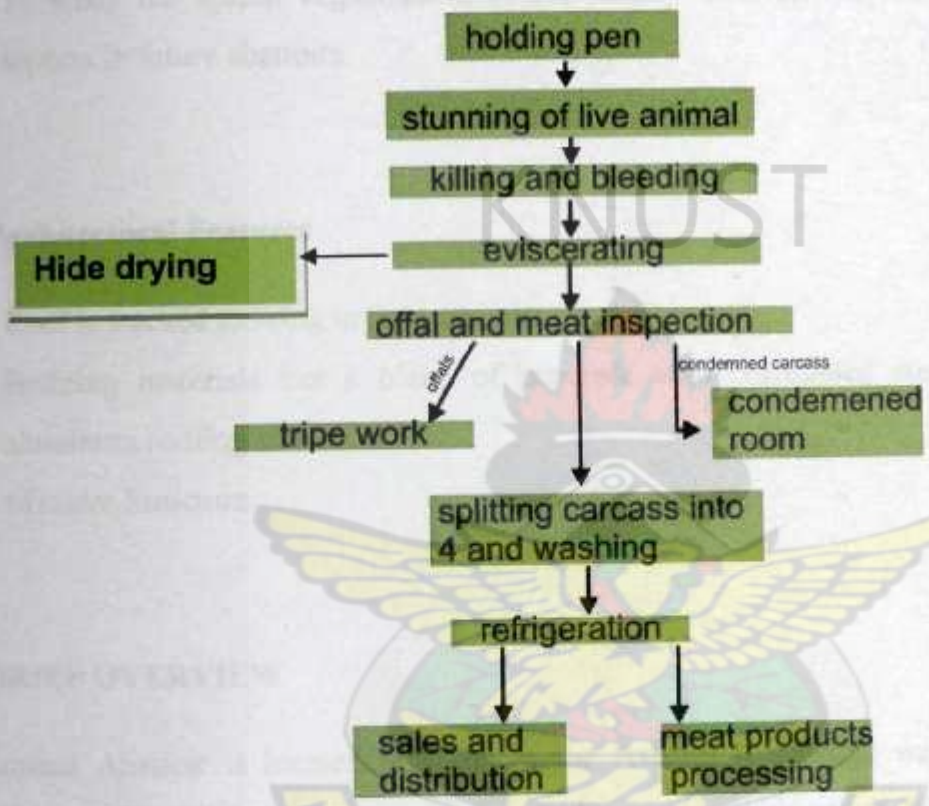


Fig 3.16 Production process (Source: Bolgatanga meat factory)

3.1.5 CONCLUSION

The Bolgatanga meat factory seemed to have had good facilities and equipment for a meat processing. However, the factory is deteriorating as a result of neglect. The equipment are also damaged as a result of lack of maintenance.

Also the Spatial organization of the site as well as the factory seems to be badly planned since new methods, procedures and technicalities have come up in designing a meat processing factory.

3.2.0 CASE STUDY (2) KUMASI ABATTOIR

Reasons for the study

- The Kumasi abattoir was studied because it is one of the designed abattoirs in Ghana apart from the Accra Abattoir in Community 18 which was also designed by the same architectural firm (Canadian International Development Agency).
- It has an upgraded processing technique as compared to the Bolgatanga Meat factory.
- To study the spatial organization of the facility with an aim of using the positive aspects in future abattoirs.

Main Architectural Features

- Roof is stacked to bring in light and air.
- Building materials has a blend of concrete with corrugated steel plate walls and aluminum roofing sheet.
- Massive Structure

3.2.1 BRIEF OVERVIEW

The Kumasi Abattoir is located at Kaasi in the Ashanti Region. It was designed by The Canadian international Development Agency and was commissioned in 1992. It was designed to slaughter 240 cattle, 120 hogs, 120 goats and 120 sheep per shift per day. However, as a result of low supply of raw material (livestock) and high transportation cost, the abattoir is now being used as a service provider for slaughtering carcass for individuals.

3.2.2 SPATIAL ORGANISATION OF THE SITE

Facilities on the site includes

- The main Factory
- The Administration
- Waste reactor
- Sludge Lagoon

- Paddocks
- Livestock holding pen
- Waiting area

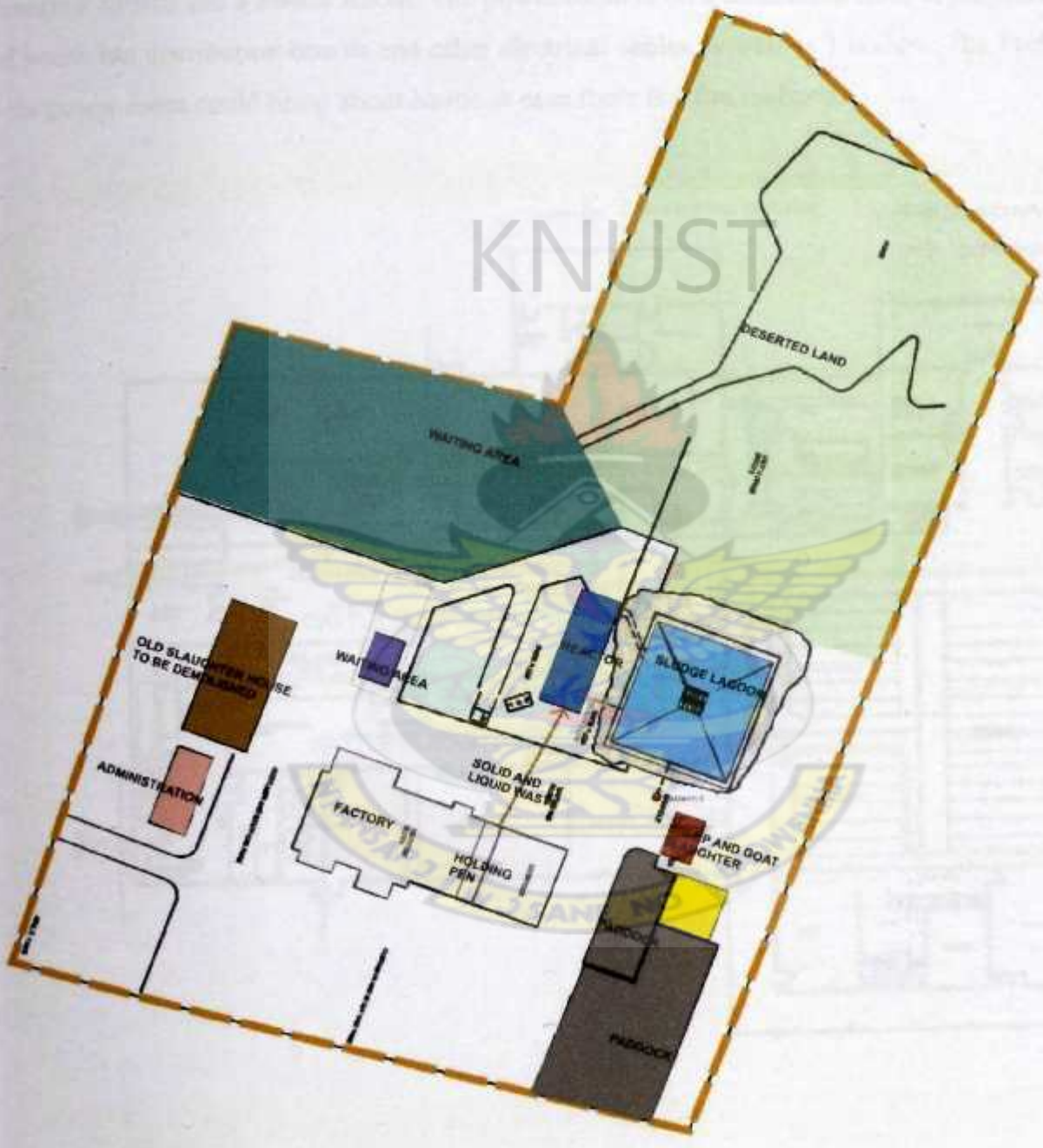


Fig 3.17 Sketch of the spatial organization of the facilities on the Kumasi Abattoir site (Source: Kumasi Abattoir)

3.2.3 DESCRIPTION OF THE VARIOUS FACILITIES

Factory: It occupies an area of 2729msq .The abattoir process cattle, pigs, sheep and goats. However, the processing of sheep and goat is currently being done outside the abattoir. Attached to it is a holding pen for all the livestock. In the abattoir there is the slaughter floor, Tripe room, Inspection table, Inedible room, Chillers and Coolers, First Aid Room, Production Managers' Office and a Power Room. The power room is on a mezzanine floor at the entrance and house has distribution boards and other electrical cables as well as 3 boilers. The Position of the power room could bring about havoc in case there is a fire outburst.

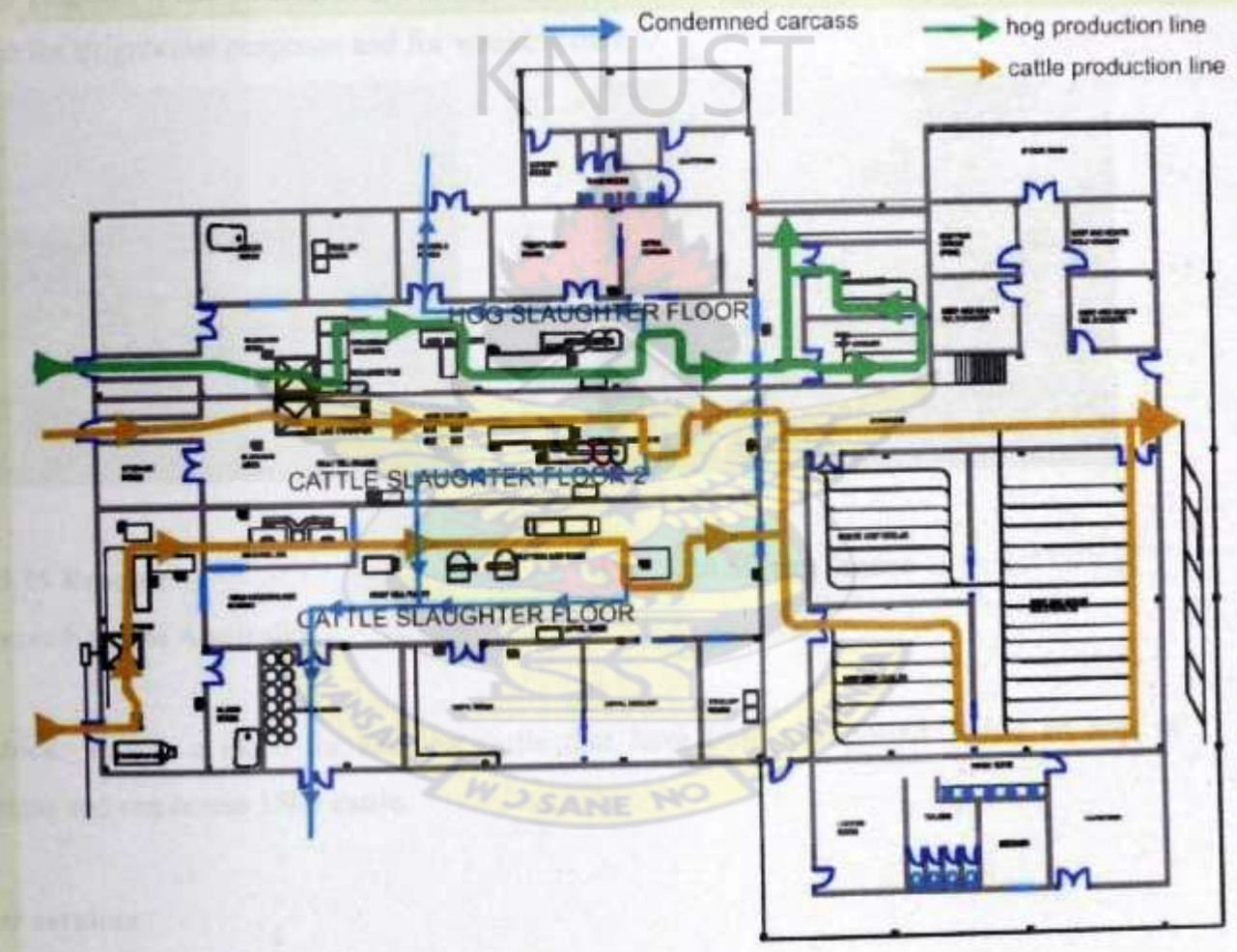


Fig. 3.18 The schematic sketch showing the spatial organization and production flow of the factory floor of the Kumasi Abattoir. (Source: Kumasi Abattoir)

Administration: The administration is made up of the Managing Directors' Office, Deputy Managing Directors' Office, Production and Engineering Managing Directors' Offices, Accountants' Office and, Marketing and Auditing Personnel Office, a reception and a conference room.

Waste treatment plant: It is made up of a reactor and a sludge lagoon.

Reactor: The reactor has an area of 546msq. It is the first point for waste collection. The solid waste is separated from the liquid waste by the reactor. The solid waste (fecal matter) is sold out as manure. The liquid waste is oxidized and aerated before it is pumped and filtered into the sludge lagoon.

Sludge Lagoon: it has an area of 2500msq. The waste water at this stage is odorless and clean enough for irrigational purposes and for washing cars.

Fig. 3.19 Reactor

(Source: Kumasi Abattoir)

Fig .3.20 Sludge lagoon

Paddock: This is a place for keeping cattle that have been transported. It has an area of 2891msq and can house 1500 cattle.

Other services

The Kumasi abattoir has the following

- Water storage
- Ventilation

Water storage: the abattoir does not have a water treatment plant .It has a bore hole and water tank on site. Not having a water treatment plant can increase meat contamination. The factory consumes 44,000 gallons of water from the Ghana Water Company and 21,000 gallons of

water from the bore hole. The factory consumes a lot if water because of the obsolete machines that are being used and poor maintenance of pipes.

Ventilation: The abattoir uses natural ventilation. This increases the entry of dust and other contaminants. It also attracts vultures since they have a strong sense of smell for animal blood and wounds.

3.2.4 TYPICAL PRODUCTION PROCESS AT THE KUMASI ABATTOIR

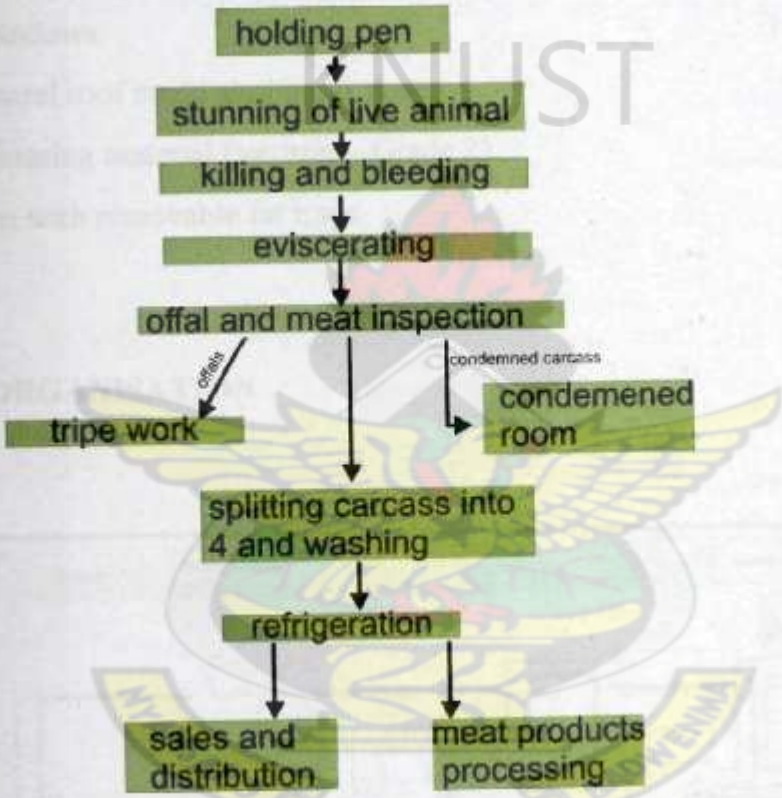


Fig 3.21 Production Process at Kumasi Abattoir (Source: Kumasi Abattoir)

3.2.5 CONCLUSION

The Kumasi Abattoir is absolutely an upgraded abattoir compared to the Bolgatanga meat factory. However, their equipment are also obsolete.

From the brief overview, it tells us that abattoirs should be located near or within livestock farming area.

It also means that there was lack of planning during the process of the design.

It also tells us that transportation is a factor in meat factory and abattoir planning.

The site has a large land which is being underutilized. If this site is re-designed again, it could have a meat processing company as well as an abattoir.

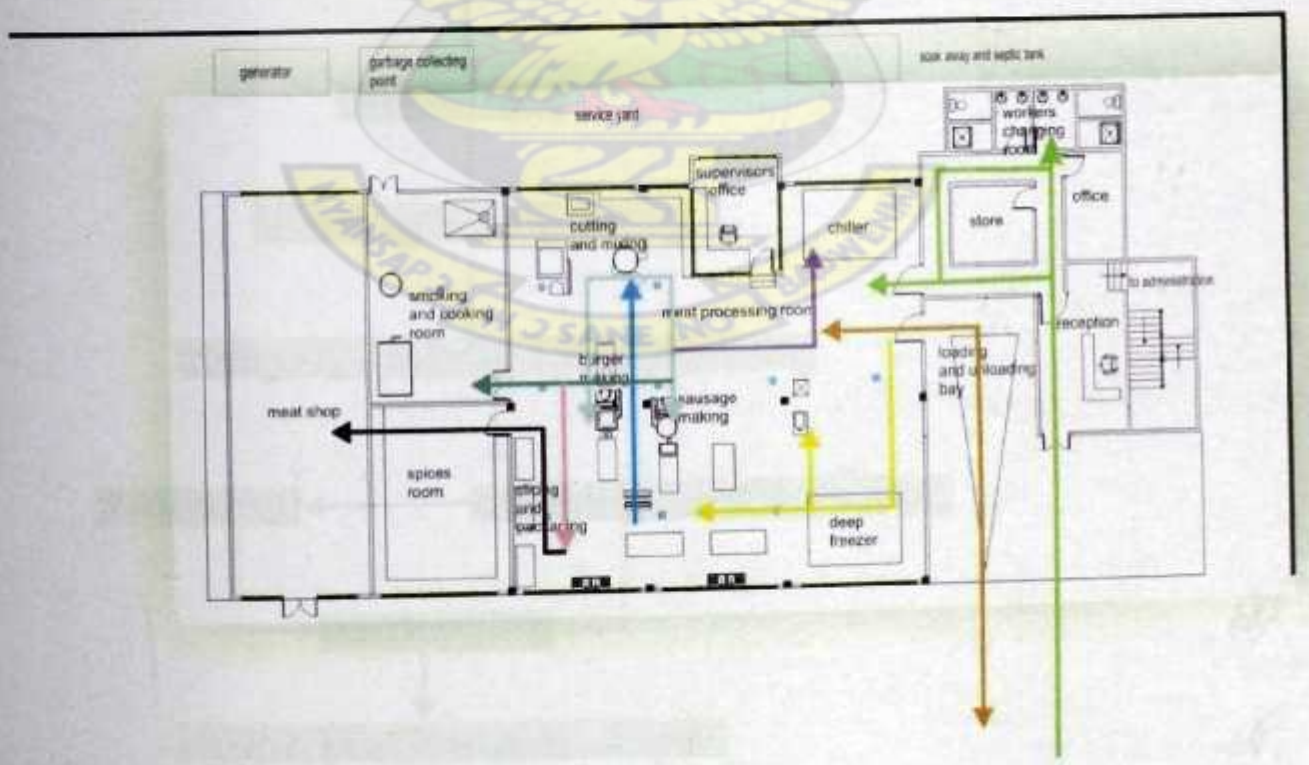
3.3.0 CASE STUDY 3 – PREMIER MEAT PRODUCTS.

Introduction: Premier meat products is a meat processing company located at Tema Round About. It is a small meat processing company but one of the largest in Ghana apart from SOTREC. It's been in operation since the year 2002. The factory operates for 10 hour a day produces 5 -6 tons of processed meat monthly. The factory has a capacity of producing more than what is being produced currently but the supply of raw material is a challenge.

Main Architectural Features

- White Tiled interior walls up to 2 meter from the ground.
- Air tight windows.
- Series of barrel roof made aluminum sheets.
- Non-Slip flooring material (terrazzo –Grade 2).
- Floor drains with removable fat traps.

3.3.1 SPATIAL ORGANISATION



LEGEND

- Raw meat from cold van
- Workers entry and exit
- Frozen meat to be deboned
- Deboned meat to be minced
- minced meat for further processing
- to cooking room
- to chiller
- packaging

Fig. 3.22 Spatial organization of premier meat products (Source: Premiere meat products)

3.3.2 GENERAL PROCESS OF MEAT PRODUCTS PROCESSING

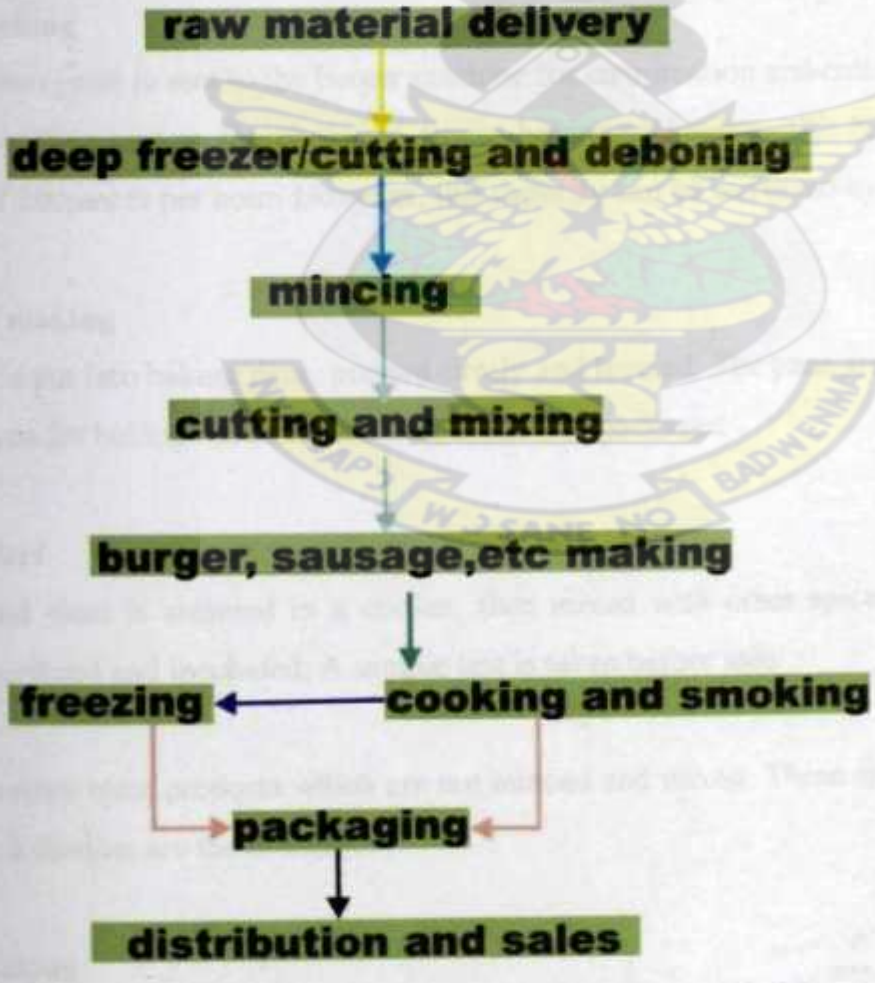


Fig 3.23 General process of meat products processing

3.3.3 PROCESSING OF VARIOUS MEAT PRODUCTS

Sausages

Emulsion / paste from the cutting machine is transferred into the filler to be filled into intestines. Sizes differ depending on the recipe. After, they are hanged on a trolley and put into the oven for the following processes

- Drying- using the oven
- Redding – meat is taken to the coloring room
- Smoking- using the smoking machine
- Cooking- Using cookers or autoclaves
- Drying – Using the oven

After drying it is cooled down in the chiller for 12 hours or more before packaging and distribution.

Burger making

The Emulsion paste is sent to the burger machine for compression and cutting into flat round pieces. It is then sent to the chiller to freeze before packaging. The burger machine has a capacity of 200pieces per hour. However, this capacity can be increased by the manufacturer.

Meat loaf making

The paste is put into baking pans, pressed firmly and leveled. The pans are put on a trolley and into the oven for baking. After it is cooled, sliced and packaged.

Corned Beef

The minced meat is steamed in a cooker, then mixed with other spices in a mixing bowl, canned, sterilized and incubated. A sample test is taken before sale.

There are other meat products which are not minced and mixed. These are Bacon and Cooked ham. The following are the processes

Bacon making

With bacons and cooked ham, mainly pork is used.

Well trimmed Pork legs and shoulders are selected, brine is injected into the meat and marinated in a tank of brine solution and kept in a chiller for 5 days. Nowadays, more sophisticated equipment make marinating of pork legs and shoulders within a day.

After marinating in brine solution, rinse in clean water and hang on bar and on trolley for the following process with different length time at each stage;

- Drying
- Smoking
- Drying
- Smoking
- Drying
- Smoking
- Drying

It is cooled down in the cooling room and then sliced for packaging.

Cooked ham making

Pork legs are selected rinsed in clean water, phosphate is rubbed in the legs. The legs are fix on ham forms and cooked in a boiler. It is then cooled and sent to the chiller overnight before packaging.

3.3.4 SERVICES

Waste management: as a result of the small size of the factory, waste water is expelled by the use of soak away. The factory has floor drains within the factory to discharge waste water and blood to the soak away

Electricity and lighting: the factory makes use of both artificial and day lighting during production hours. It also has a stand-by generator.

Ventilation: Air condition is always used during working hours and maintenance period to minimize the entry of dust and other contaminants

3.3.5 CONCLUSION

As a result of the long distance from the abattoir and other sources of raw material (meat), supply of meat is irregular and inadequate with high transportation cost, hence increasing the price of the end products.

3.4.0 CASE STUDY (4) - FOREIGN CASES

The foreign case study comprises of element from different meat factories all over the world.

Reasons for the study

- Foreign cases were studied to know the new trend of a meat processing factory.
- Other countries around the world especially the European, American and Scandinavian countries are far advanced in the meat industry and therefore know the rights and wrongs of a meat factory.

Cattle chute/ corral

According to Temple Gradin, curved corrals or chute as shown in the above left corner picture building are intended to reduce stress in animal being led to the slaughterhouse.

Vowels and Hollier (1982) also said, "a curved chute Reduces the time spent moving a cattle by up to 50%.

Fig. 3.24 Curved cattle chute (Source: "Slaughterhouses", Global Action Network, accessed March 18, 2008.)

Carousel or pen

All species of livestock have wide –angle panoramic view (Prince 1977). As a result of this, modern practice experience has shown that the use of solid sides on ramps, corals or chutes and crowd pen is preferred.

Fig. 3.25 Carousel. (Source: www.google.com – Riopel Equipement)

Meat processing handling equipment

The modern meat processing factory incorporates the use of sophisticated equipment that ensures good sanitary methods, speed and efficiency.

Examples of such equipment are bucket lift, hoist and conveyors.

New equipment for cutting and deboning has weighing scales and knife sterilizers to them attached to them.

Fig 3.26 picture of bucket lift, hoist and other conveyors

(Source : www.leebooth partners .com)

Fig. 3.27 cutting and deboning table

CHAPTER FOUR

4.0 REASEARCH FINDINGS AND DISCUSSIONS

4.1.0 PRINCIPLES OF DESIGNING A MEAT PROCESSING FACTORY

The basic facilities and site location are the basic principles to note in designing a meat processing factory [1].

The facilities are divided into a series of 'modules' which can be combined as required to suit a particular location.

The following modules are included:

a. Production Modules

Fig 4.0 Function relationship of production modules

b. Service Modules

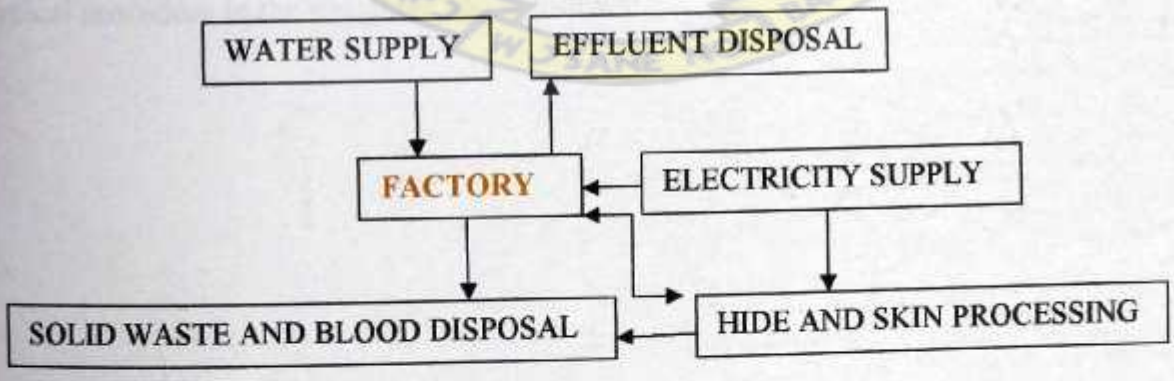


Fig. 4.1 Functional Relationship of service modules

4.2.0 DETAILED DESCRIPTION OF THE PRODUCTION AND SERVICE MODULES

4.2.1 PRODUCTION MODULES

1. Lairage and Holding pen

Lairage areas are open areas where livestock are kept before slaughter.

Holding pens are usually enclosed areas for keeping livestock a night before slaughtering.

Pen areas required for each species are as follows [1];

Species	Area
Cattle	$1.7m^2$/head
Pigs/Sheep	$.35m^2$/head
Goats	$.25m^2$/head

2. Slaughter Floor

The slaughter house process differs by species and region and may be controlled by civil law as well as religious laws [1]. In Ghana, it is a tradition that the animals as well as the butcher face east before the animal is killed.

Typical procedure in the slaughter house follows:

- **Cattle production process**

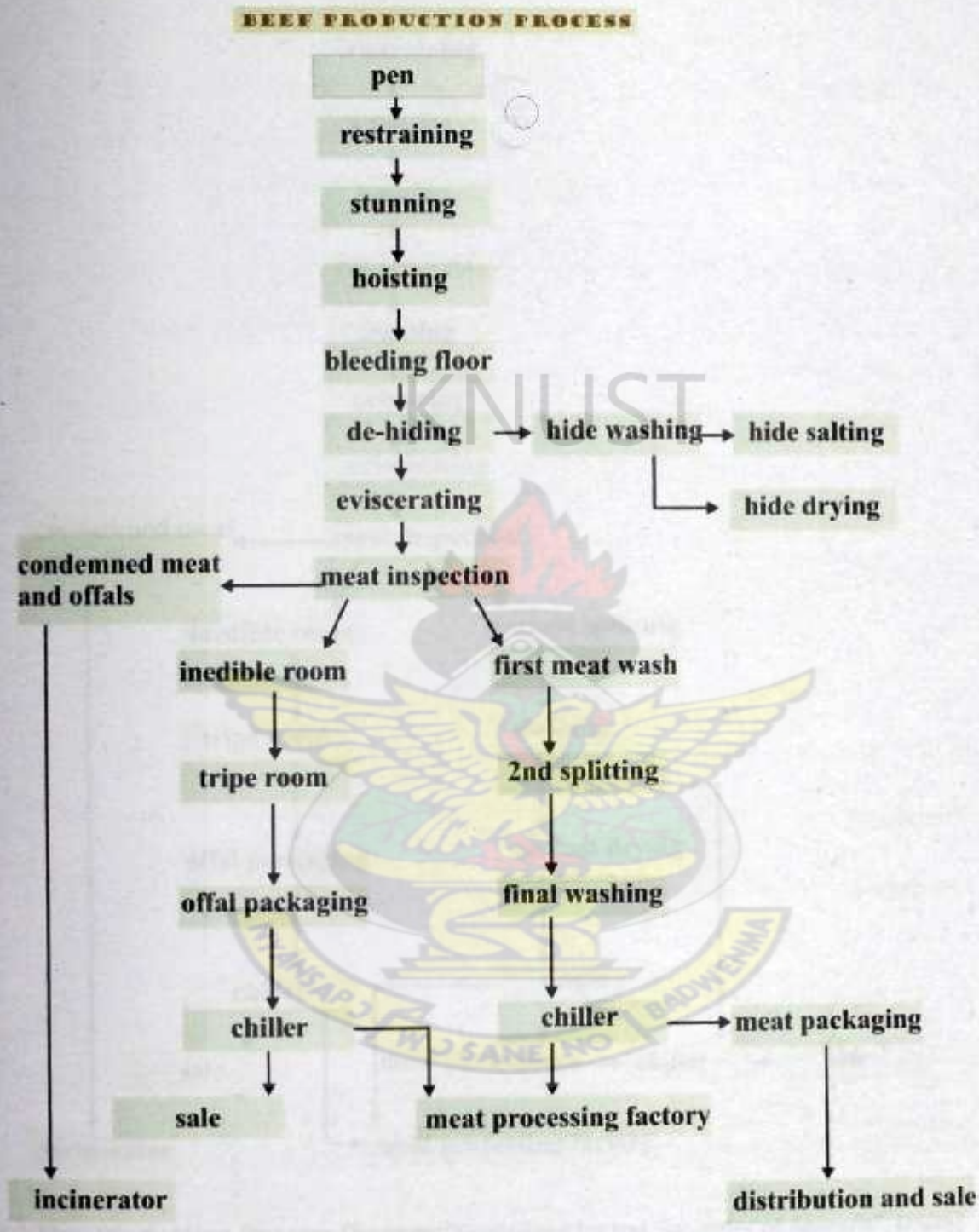


Fig 4.2 Beef production process (Source:"Guidelines for the Slaughter of Animals". USDA)

- **Hog Production Process**

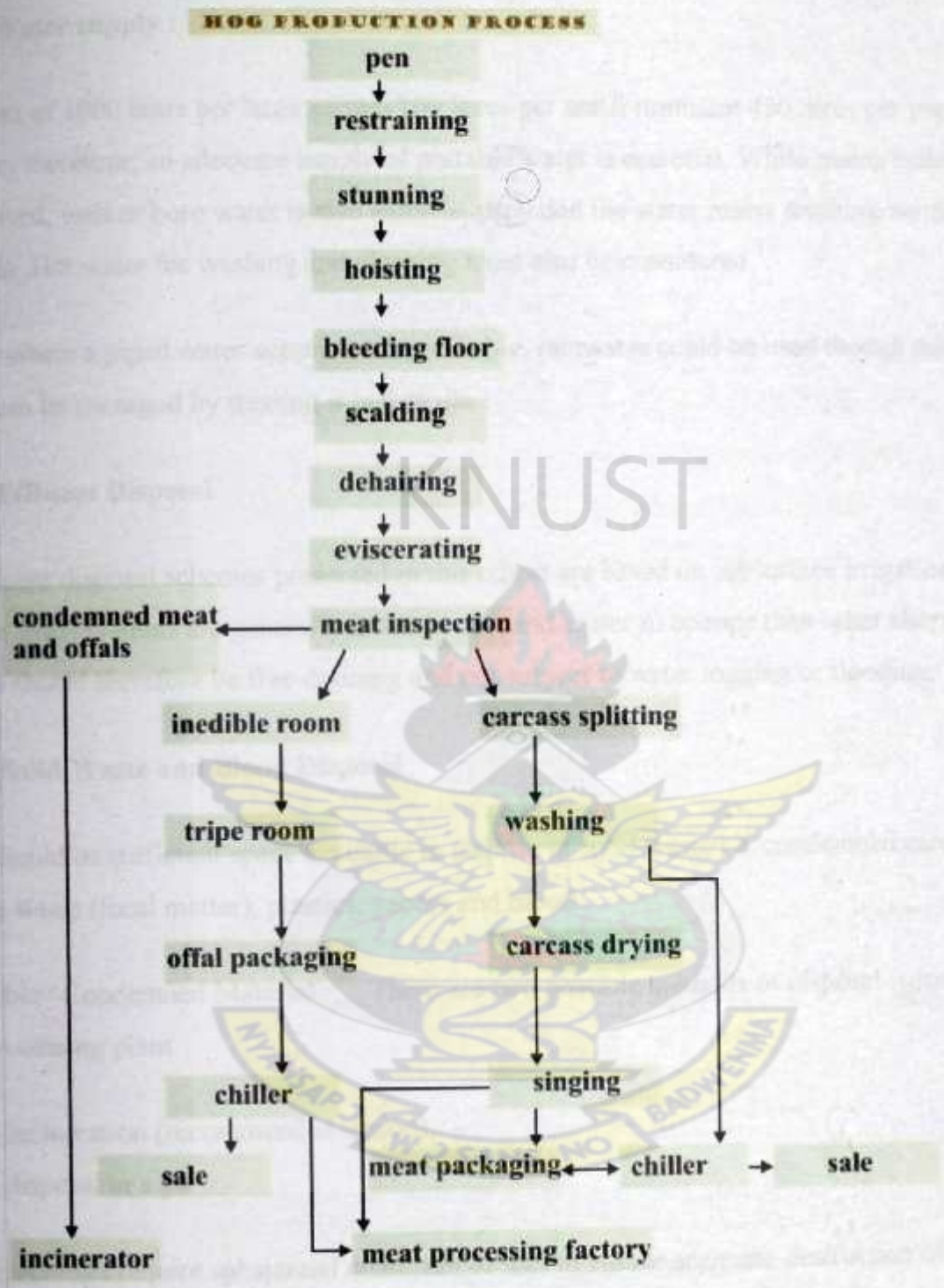


Fig 4.3 Hog Production Process (Source: "Guidelines for the Slaughter of Animals". USDA)

- **Sheep and Goats**

These could be slaughtered and dressed in a similar manner to hogs or cattle depending on the factory's regulations.

4.2.2 SERVICE MODULES

a. Water supply :

Quantities of 1000 liters per large animal 100 litres per small ruminant 450 litres per pig are desirable; therefore, an adequate supply of portable water is essential. While mains water is to be preferred, well or bore water is also suitable, provided the water meets drinking water standards. Hot water for washing and cleaning must also be considered [1].

In areas where a piped water supply is not available, rainwater could be used though not the best; it can be managed by treating it before use.

b. Effluent Disposal

The effluent disposal schemes presented in this report are based on subsurface irrigation and soakage. Such systems are generally lower in cost and easier to operate than other alternatives. The site should therefore be free draining and not subject to water logging or flooding.

c. Solid Waste and Blood Disposal

There should be sufficient space available to dispose of solid waste i.e. condemned carcass, inedible waste (fecal matter), plastics, papers and blood.

1. Inedible / Condemned Material : There are two possible methods of disposal suitable for a meat processing plant

a. Incineration (recommended option).
b. disposal in a pit

Incinerators require substantial quantities of fuel to ensure adequate destruction of meat and offal; however it reduces the spread of contamination within the factory premises and it is most suitable for a large factory. Incineration is therefore recommended.

2. Blood : Blood is a valuable source of protein. It should not be diverted into the effluent system since it will quickly clog up the screens and disposal trenches.

By using the following treatments blood can be incorporated into stock feed.

a. Fresh Blood: Where pigs and poultry are kept nearby, fresh blood can be directly incorporated into bran, cassava or other stock food. This represents the simplest and most efficient means of disposal. With this method it is essential that the resulting meal be fed out the same day as it has no keeping properties.

b. Treated Blood: Where a somewhat longer life for the feed is required approximately 1 % of unslaked (burnt) lime can be added to the blood container and stirred in as the fresh blood is added. The hardened product will keep for up to one week. It should be used as described for fresh blood.

c. Dried Blood: Where it is not possible to directly add fresh blood to pig or poultry feed, it may be mixed with bran or cassava as described under (a) and dried in the sun, on either a concrete floor, or matting. Drying will generally be complete in three days. (The drying area will need to be covered in the event of rain). During rainy periods it would be necessary to dry the mixture on corrugated iron trays placed over a copra dryer or similar fire. Because of the additional cost of drying this method is only recommended where the methods described above cannot be used [1].

d. Hides and Skins Processing

Three alternatives exist for the disposal of hides and skins:

- Burial
- Drying and sale
- Salting and sale.

The quantity and quality of hides and skins will determine whether or not it is worth saving and marketing the hides and skins produced.

However as a general guide, the export of less than 100 cattle or 500 goat skins per annum is unlikely to be economic and could be disposed of by burial or incineration [1].

Drying: Suspension drying can be carried out using locally made equipment and needs no other materials. Normally a simple a roofed area should be provided for washing and fleshing hides prior to stretching on drying frames. Drying frames for cattle hides should be approximately 3 meters square and can be made of bamboo or small round timbers lashed together at the corners.

Salting should be considered only when production reaches the equivalent of 30 hides per week.

e. **Electricity**

Connection to a public electricity supply is desirable especially since chilling of carcasses is considered or on site water pumping is required

4.3.0 ALTERNATIVE ENERGY SOURCES FOR A MEAT PROCESSING FACTORY

- **Biogas**

With the availability on site of raw material in the form of animal wastes and the requirement for hot water for processing, the generation of biogas should be considered.

- **Solar Heating**

Solar panels could be used to provide warm water for amenities and for washing in the meat processing factory.

- **Solar Lighting**

Where electric power is not available or during early morning slaughter, the use of solar cells in conjunction with storage batteries and low voltage fluorescent lamps could be used to reduce cost on electric power from the mains.

4.1.1 THE IDEAL LOCATION AND SITE FOR A MEAT FACTORY

The following are points to consider in selecting a suitable site for a meat processing factory:

The locality for the meat processing factory should be established based on sources of stock supply, location of markets, and taking into account transport methods , infrastructure availability (water supply , electricity supply) and availability of space for waste disposal.

A minimum site area of 1800 square meters will be required to accommodate all modules[1].

The Industry should be located in a rural setting among livestock farming areas to facilitate accessibility.

Meat processing is considered to be one of heavy industry. From the town planning point of view, you cannot locate them in an urban set-up.

The factory should be located not far from a major road.

4.4.0 THE PROPOSED SITE

The site is a defunct site owned by Ghana Meat Processing Company. It is located at Zuarungu in the Upper East Region and surrounded by large farm land with loose organic settlements and staff Bungalows for the meat factory.

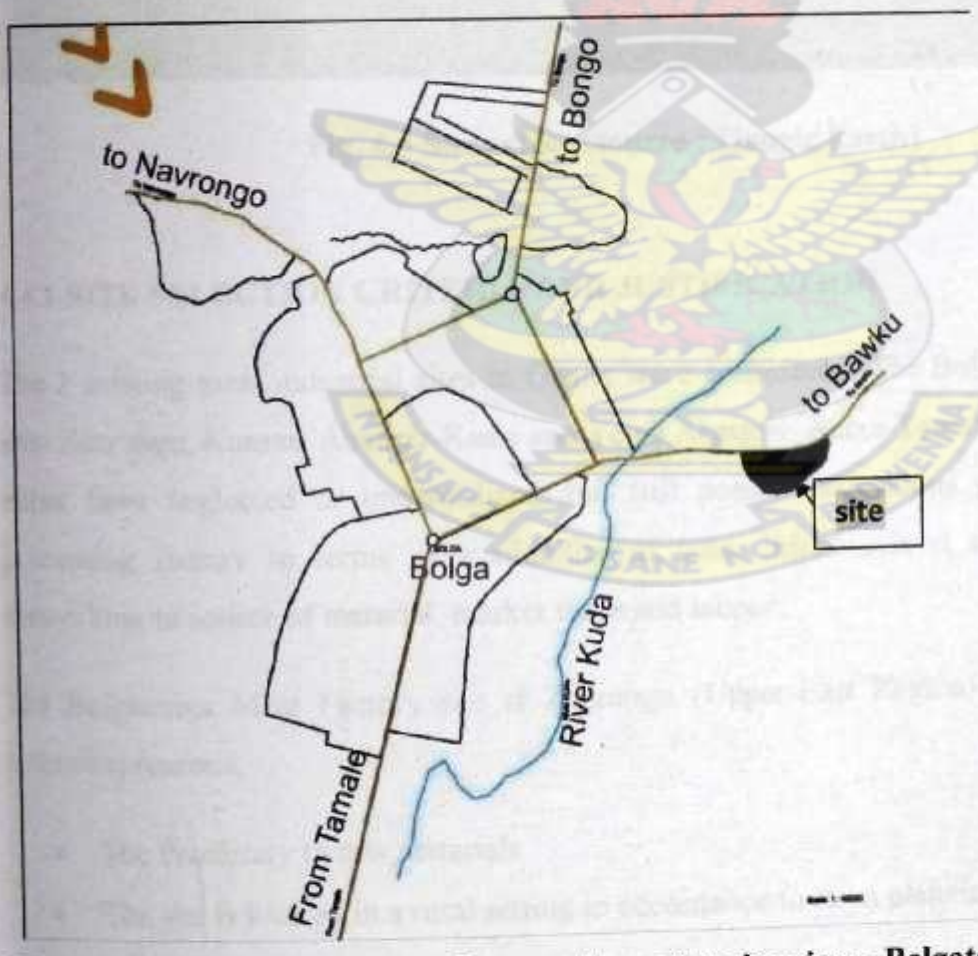


Fig. 4.4 Site Key map (source : Town and country planning – Bolgatanga)

Fig. 4.5 Site extent (source : Google Earth)

4.4.1 SITE SELECTION CRITERIA AND JUSTIFICATION

The 3 existing meat industrial sites in Ghana were considered: The Bolgatanga Meat Factory site- Zuarungu, Kumasi Abattoir-Kaasi and Tema Abattoir- Accra-Tema) since these sites have either been neglected or underutilized and still posses tremendous potentials for a meat processing factory in terms of availability of land, infrastructural services, location and networking to source of material, market force and labour.

The Bolgatanga Meat Factory site at Zuarungu (Upper-East Region) was selected for the following reasons:

- The Proximity to raw materials
- The site is located in a rural setting in accordance to town planning requirement.
- It already has infrastructural services on site.

4.4.2 EXISTING SITE CONDITIONS

The site is a well fenced 34 acre piece of land. Facilities on the site include the following,

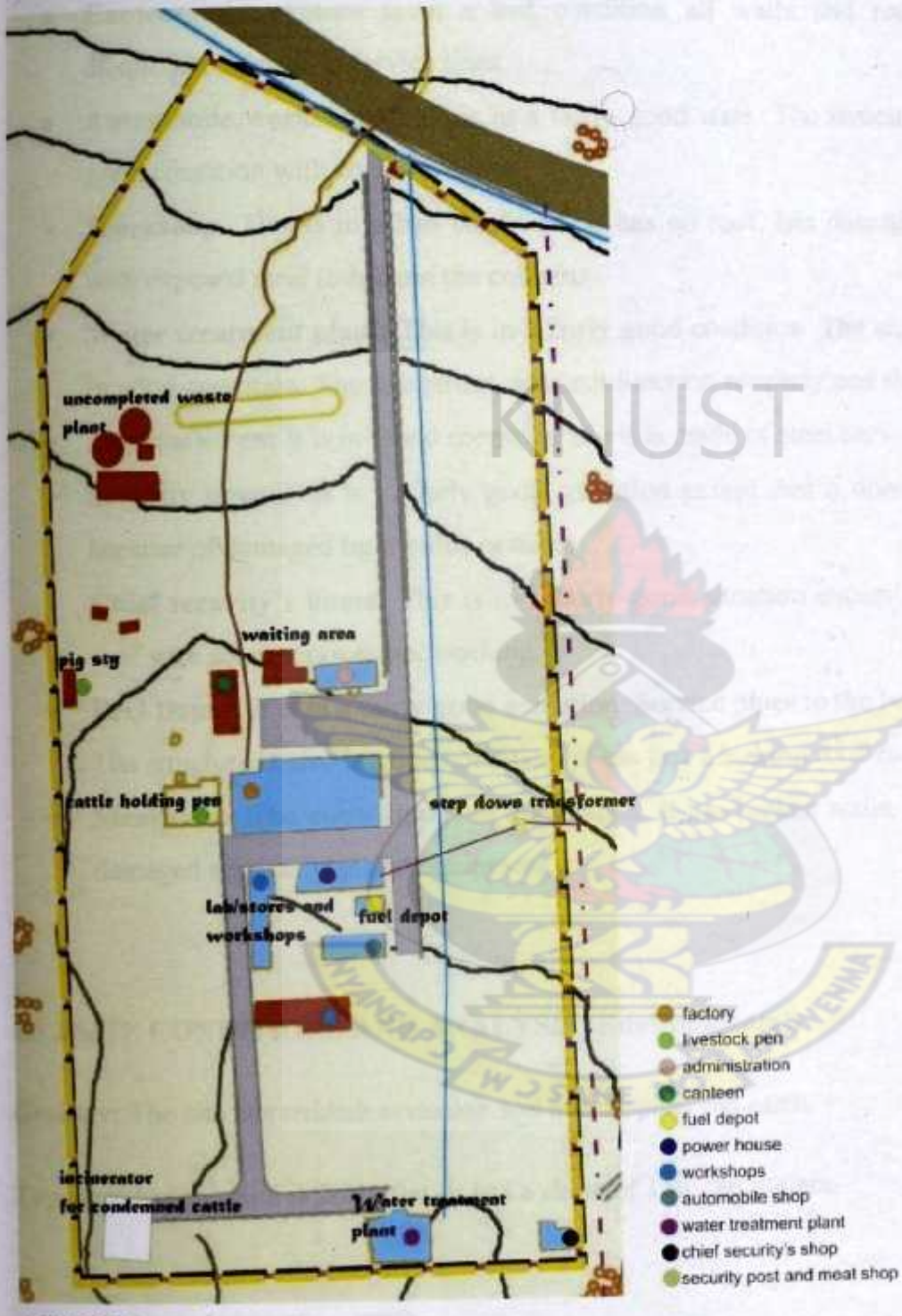


Fig.4.6 Site plan of the Bolgatanga meat factory showing the existing building conditions

(source: Bolgatanga Meat Factory)

- **Factory:** The factory is in a fairly good condition. The structure is strong and good with some east walls in a bad condition. However, all service pipes are damaged.
- **Administration:** this is also in a fairly good state but has all service lines destroyed.
- **Canteen:** the canteen is in a bad condition all walls and roofing members are dilapidated as well as service lines.
- **Automobile workshop:** This is in a fairly good state. The structure and walls are in good condition with no service lines.
- **Workshop**: This is in a bad condition. It has no roof, has damaged and broken wall with exposed steel rods from the columns.
- **Water treatment plant:** This is in a fairly good condition .The structure and walls are in good condition. The equipment does not function properly and the roof leaks.
- **Livestock Pen:** It is in Good condition and it is made of steel bars.
- **Security post:** This is in fairly good condition except that it does not have electricity because of damaged light bulbs or tubes.
- **Chief security's home:** This is in a fairly good situation except that it has a leaking roof with some services not working.
- **Fuel Depot:** It is in a fairly good condition. Service pipes to the boiler works perfectly. The structure is also in good condition. It has just a leaking roof and dirty walls.
- **Meat shop:** The meat shop is in a bad state. It has broken walls, dilapidated roof and damaged service lines and equipment.

4.3.2 SITE CONDITIONS AND ANALYSIS (Environmental)

Geology: The site has reddish savannah soil and tropical red earth.

Topography: the land is fairly flat. It has a slope of 1 in 188 meters.

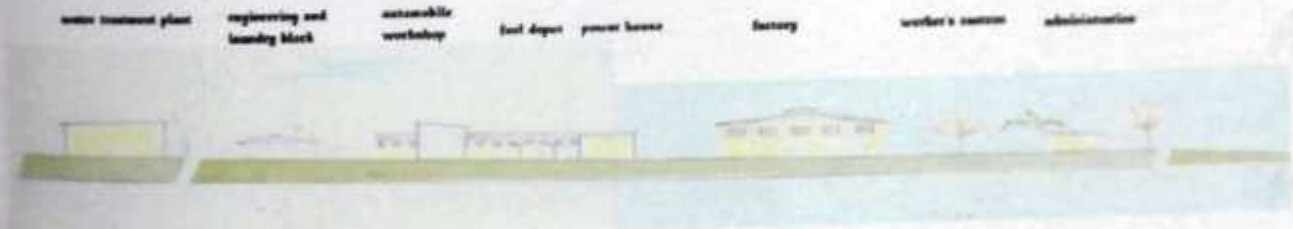


Fig 4.7 Site section A-A' (source : Authors field survey)

Climate: The site experiences the savannah climate which is hot and dry. It has temperatures ranging from 19-40 C. It is therefore advisable to use materials with low U- values especially for the roof. Planting drought resistance grass and plants would also be suitable for this climate.

Vegetation: The vegetation is an example of tropical Savannah with low trees and bush. It has dry brown grass with few baobab, mango and teak trees

Services: The site has access to all the utility services including water, electricity and telecommunication.

Even though most of the buildings on site are in fairly good condition, and comparing it to its case study, only three will be maintained :- the factory's structure , the water treatment plant and the chief security's home.

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CHAPTER 5

5.0 RECOMMENDATION AND CONCLUSIONS

This chapter highlights mainly the design recommended for the meat processing factory project at Zuarungu – Upper East Region.

5.1.0 DESIGN PHILOSOPHY AND CONCEPT

The following philosophies and concept were derived to aid in achieving the set objectives in Chapter one.

Philosophy: Revitalizing and transforming the Ghana Meat Industry with the use of efficient and sustainable methods in production.

Concepts:

REVITALIZATION

- Locate the facility close to the source of material and on a defunct site
- Incorporating the existing facility with the new design.

TRANSFORMATION

- By creating a two in one facility. (i.e.) combining an abattoir and a meat processing plant.

SUSTAINABILITY

- Incorporate the use of biogas system to recycle waste
- Use solar panel systems to generate electricity.

EFFICIENCY

- Provide sophisticated handling equipment such as conveyors, pulleys and lifts to speed up operations.
- Adapt the use of hi –tech meat equipment that ensure good sanitation in order to produce quality meat to meet international standards.

5.2.0 DESIGN EVOLUTION

5.2.1BRIEF DEVELOPMENT

The final brief agreed upon by the designer and the client (GIHOC –MPC) is spelt below.

General brief

- **Factory**
- **Engineering and metal works workshop**
- **administration**
- **automobile workshop**
- **canteen**
- **animal care unit**
- **waste management system**
- **water treatment tank**
- **Power house**
- **security post**
- **meat shop**

Detailed brief

- **Factory:** An abattoir together with a meat processing centre that can produce at least 40tons of processed meat ,loading bay, staff parking and changing room.
- **Engineering and metal works work shop:** this must consist of the working space, spare parts store and changing rooms
- **Administration:** Must have the Managing directors offices, deputy managing directors office, secretary's office, production and engineering managers with their deputies, Accounts office, marketing and auditor's office , public relations office , reception, washroom, MD's kitchenette and car park.
- **Automobile workshop**: consist of parking slot with inspection pits, spare parts room and body works work shop.
- **Canteen**: Eating area, kitchen, kitchen yard, staff changing room, supervisor's office.
- **Animal Care units:** Consist of the veterinary office and animal health care, animal pen; hide drying area, animal feed storage.
- **Waste Management system**: biogas cylinders, aerobic ditches.
- **Water treatment tank**: one big room to contain tanks.

- **Power house**: contains a boiler room, electrical room (generators and switch boards), air pressure room, dwarf engine room (equipment for generating electricity from the biogas plant.
- **Meat shop/ meat market:** consist of a meat products shop, butchers shop, butchers changing room, chillers, a hide processing ('wele') shop and a vehicular car park.

5.3.0 TRAFFIC NEEDS AND RESPONSES

Bicycles and motor cycles are the most used vehicles Bolgatanga.

Anticipated range of vehicle likely to access the facility.

- Cold truck/ vans
- Trailers for transporting livestock
- Service trucks
- Other company trucks and vans
- Private cars
- Taxis
- Bicycles
- Motor cycles

5.4.0 PLANNING AND DESIGN

5.4.1 ALLOCATION OF SPACE

Space allocation and size was based on the capacity of the facility, the size of machines, case studies and the work force.

Planning of the site and other facilities especially the Factory was based strictly on production flow and environmental health.

5.4.2 CAPACITY DETERMINATION AND SPACE ALLOCATION OF THE ANIMAL HOLDING PEN

The Factory is to process the following: Cattle, Sheep, Goats and Hogs.

The factory is also supposed to produce at least 40 tons of meat products daily.

The factory should be able to process enough carcasses to feed itself as well as the Tema abattoir.

50% of the carcasses to be used by the Bolgatanga meat factory would be used in processing meat products (sausages, bacon, burgers e.t.c) the remaining 50% will be sold to butchers.

5.4.2a Capacity determination of animal pen

The following are the ideal average dead and live weight for each animal ready for slaughtering.

Animal	live weight (kg)	Dead Weight (kg)
cattle	350	175
Sheep	70	35
Goat	60	30
Hog	100	50

Table 5.0 ideal dead and live weight of livestock

Cattle

If 1 cow = 175 kg dead weight

250cattle= 43750kg =43.75 tons

Therefore the cattle holding pen should be able to hold 500cattle to serve both Tema abattoir and the Bolgatanga meat processing factory that is 250 cattle for each.

50% of the 250 cattle which is = 21.875tons will be used in processing meat products.

Hog

Normally a higher percentage of pork is used in processing meat products.

If 1 hog = 50kg

X = 40000kg=40tons

Therefore x= 800hogs

50% of 40 tons of pork = 20tons (amount need for processing meat products)

Sheep and Goats

Since Volta Region and Western Region dominate in the production of sheep and Goat in Ghana, it is ideal that majority of the sheep and Goats is processed in those regions than in the Northern belt since they may have to transport large quantities of sheep and goats to feed the factory.

Based on this, only 200 sheep and 200goats will be slaughtered on a daily basis which is equivalent to 7tons of mutton and 6tons of goat meat.

5.4.2b. Space Allocation of the animal pen

According to FAO Corporate document repository, the following are the ideal pen size for each species.

Species	Area (m2)
Cattle	1.7msq/head
Sheep and Goats	.25msq/head
hogs	.35msq/head

Table 5.1 Ideal Size of livestock pen (source: Standard design for small-scale modular slaughterhouses... – FAO CORPORATE DOCUMENTATION REPOSITORY. Originated By : Agriculture and consumer protection.)

Therefore Space needed for a cattle holding pen

1cow=1.7msq

Therefore 500 cattle = 850sqm

Space needed for hogs

1hog = .35msq

Therefore 800 hogs = 280msq

Space needed for sheep and goat

.25msq * 200 = 50msq each

5.4.3 ACCOMODATION SCHEDULE

ADMINISTRATION

Refined brief	area (unit)m^2	unit	Total ($m^{2)}$
Managing Directors Office and conference room	10*5	1	50
Deputy Managing Directors office	5*5	1	25
production managers Office	2*4	2	16
Engineering managers Office	2*4	2	16
Accounts office(for 5)	6*6	1	36
Auditors office (for 4)	4*4	1	16
Marketing office (for 2)	3*4	1	12
Public Relations Office (for 2)	3*4	1	12
Reception	5*4	1	20
Secretary's office	3*3	1	9
TOTAL			**212**

WELFARE

Refined brief	area (unit)m^2	No. Of workers	Total ($m^{2)}$
Canteen	10*35	150	50
Laundry	6*5		30

2 First aid rooms	3*4		24
Changing room	(10*10) 4	300	400

ANCILLARY

Refined brief	**area (unit)m^2**	**unit**	**Total ($m^{2)}$**
Automobile workshop	15*30	1	450
Engineering workshop	6*6	1	36
Metal works workshop	6*5	1	30
Meat shop	10*10	1	100
Traditional meat market	15*15	1	36
TOTAL			**752**

PRODUCTION FLOOR

Refined brief	**area (unit)m^2**	**unit**	**Total ($m^{2)}$**
Cattle lairage	-	-	6000
Cattle holding pen	(25*30)	1	850
Hog holding pen	(20*14)	2	560
sheep holding pen	(5*10)	1	50
Goat holding pen	(5*10)	1	50

SLAUGHTERING FLOOR

Refined brief	area (unit)m^2	unit	Total ($m^{2)}$
cattle	30*10	1	300
hog	25*10	1	250
sheep	25*10	1	250
goat	20*10	1	200
Tripe room	6*6	5	180
Inedible room	5*5	2	50
Meat inspection room	10*10	3	300
Cattle holding cooler	10*10	1	100
Cattle drip cooler	10*10	1	100
Hog chiller	10*10	1	100
Sheep chiller	10*10	1	100
Goat chiller	10*10	1	100
Offal cooler	7*7	1	49
Meat packaging	10*10	2	200
TOTAL			**12289**

MEAT PROCESSING FLOOR

Refined brief	area (unit)m^2	unit	Total ($m^{2)}$
Cutting and deboning	30*30	1	900
Corned beef unit	5*5	2	50
Other meat production	50*60	1	3000
Meat packaging unit	10*15	1	150
Chillers	10*40	1	400
Supervisors office	4*4	1	16

Spices store	5*5	1	25
OTHERS			
Bone milling	7*7	1	49
Hide drying	10*10	2	200
Chemical lab	4*4	1	16
Microbiological lab	4*4	1	16
TOTAL			**4822**

SERVICES

Refined brief	**area (unit)m^2**	**unit**	**Total (m^2)**
Power house	40*10	1	400
Water treatment meat plant	20*20	3	1200
Biogas plant	30*40	1	1400
Solar hot water tank	10*40	1	400
Waste treatment plant	70*100	1	7000
Workers vehicular parking	30*20	1	600
Customer parking	30*40	1	1200
Loading Bay	40*100	1	4000
TOTAL			**16200**

5.5.0 CONCEPTUAL DEVELOPMENTS AND PLANNING

5.5.1 FUNCTIONAL DIAGRAM

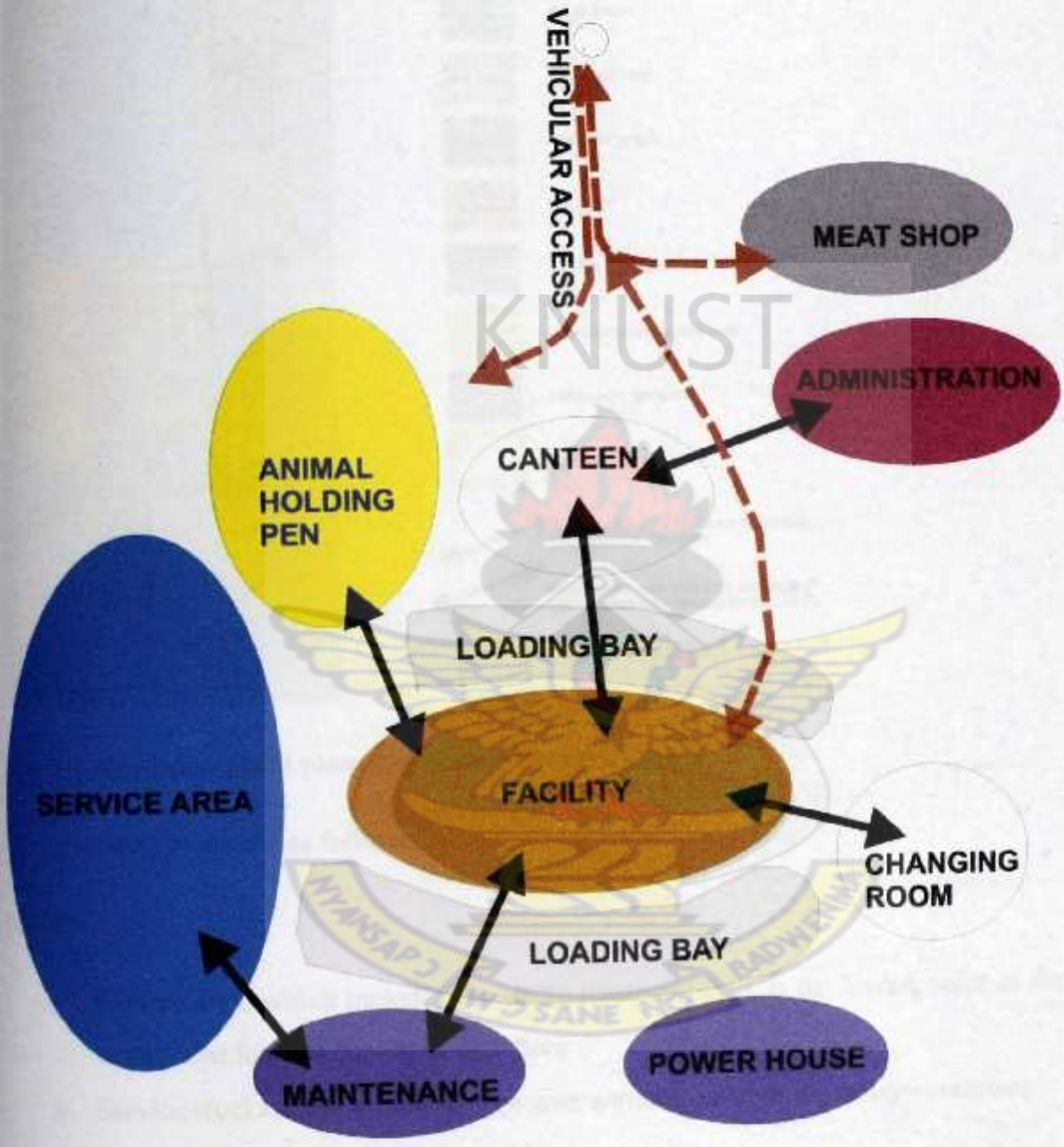

Fig 5.0 Functional Relationship diagram

5.5.2 CONCEPTUAL SITE PLANNING

OPTION 1 – Alternative 1

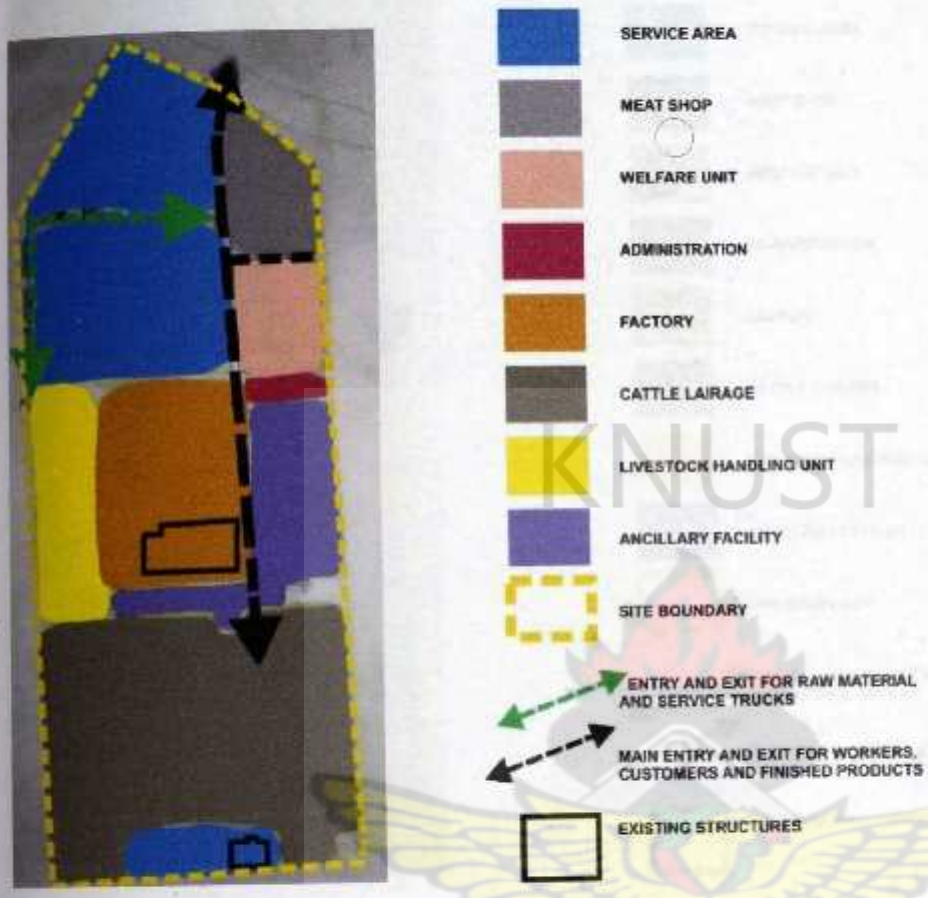

Fig 5.1 Site conceptual planning option 1 ,alternative 1

Observations made are as follows:

Merits

- Service area, which includes the waste treatment area, is the lowest point of the site. It would cost less channeling waste there
- Service trucks could access service area without entering the factory premises
- Cattle lairage will not be disturbed by passers- by.

Demerits

- One entry and exit for both raw materials and finished good as well as entry for staff workers and customers could increase contamination on site.
- One entry and exit would bring about congestion and could reduce working efficiency.
- The service area at the entrance is not welcoming as one enters the site.
- Disjointed service area

OPTION 1 – Alternative 2

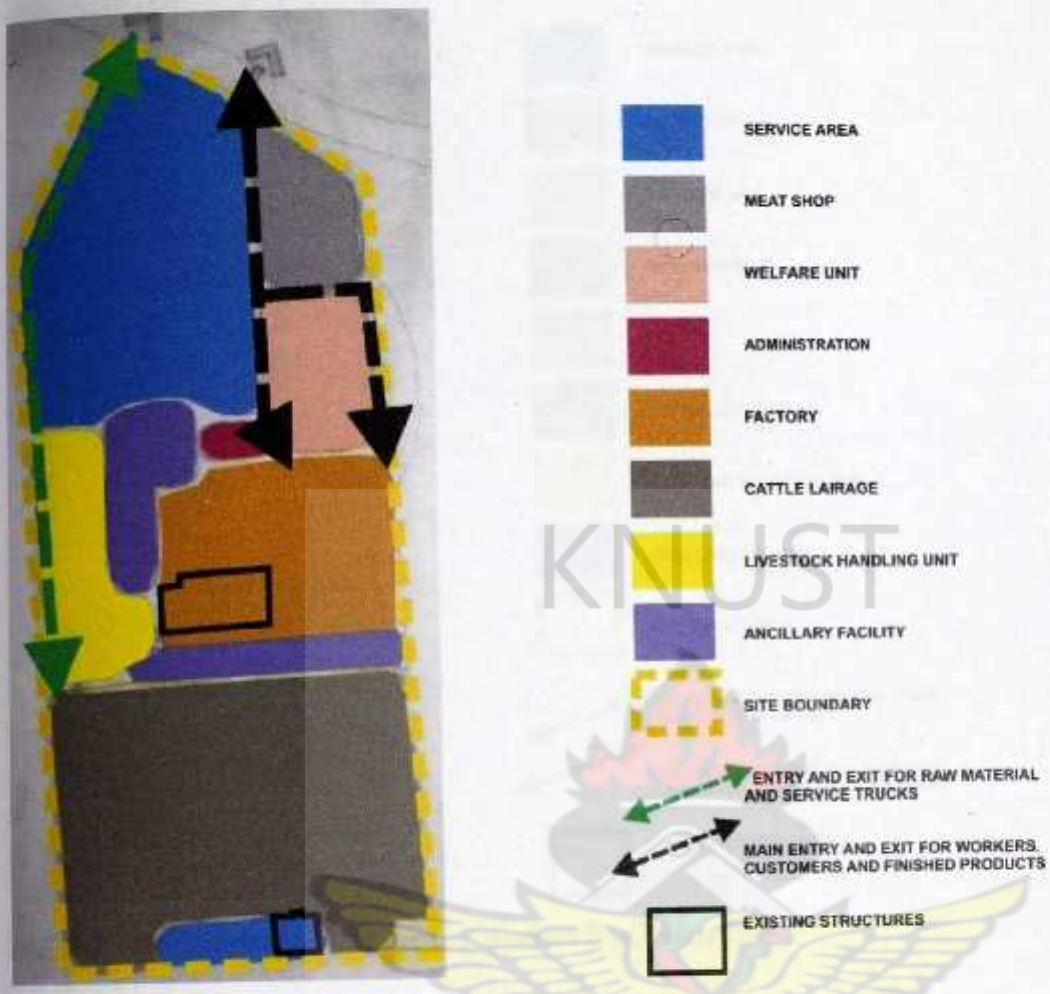

Fig 5.2 Site conceptual planning option 1 ,alternative 2

Merits

- The site has a gentle gradient for waste management planning.
- Service trucks could access service area without entering the factory premises
- Has a well planned and segregated entry and exits points

Demerit

- The service area at the entrance is not welcoming as one enters the site.
- Disjointed service area

OPTION 2

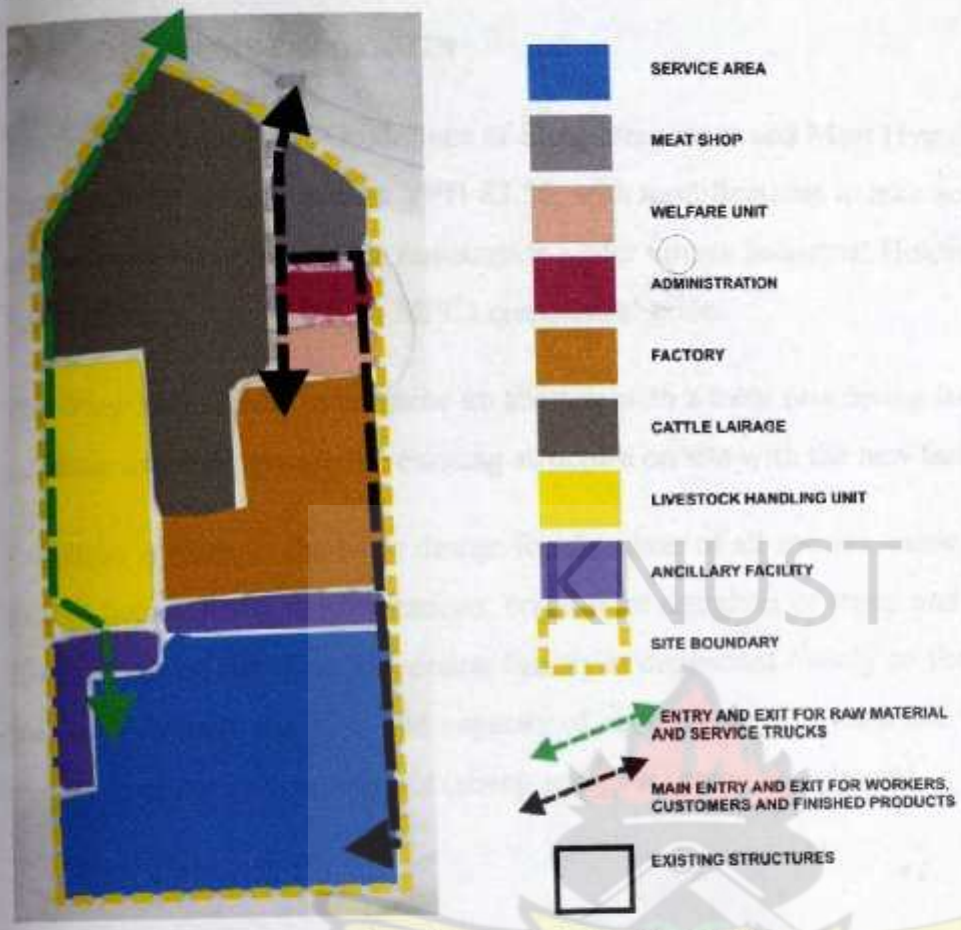

Fig. 5.3 Site conceptual planning option 2 ,alternative 1

Merits

- Service trucks could still access service yard without interfering with factory activities
- Cattle Lairage at the entrance is more welcoming than the waste treatment plant at the entrance.
- Has 2 entry points: One for raw materials and the other for finished goods and workers
- The service area is whole and not disjointed like the other options
- Waste treatment plant is hidden from customers and other road users.

Demerits

- Cattle Lairage could be disturbed by passers-by.
- Location of the waste treatment plant will need expensive construction since; it is at the highest point.

Option 2 was selected because, it blends the two options above and it resolves most of the basic problems and issues of designing a factory.

5.6.0 THE DESIGN

5.6.0a THE BASIS OF DESIGN

The design is based on "Guidelines of Slaughterhouses and Meat Hygiene for Developing Countries" WHO publication VPH 83.56, with modifications to take account of the likely mix of stock and according to the registration under Ghana Industrial Holding Corporation- Meat Products Company (GIHOC-MPC) companies' code.

The design also seeks to combine an abattoir with a meat processing factory. It also seeks to maintain and incorporate the existing structure on site with the new facility.

Provision is made in the basic design for slaughter of all species, cattle, sheep, goats and pigs though because of space limitations, concurrent slaughter of sheep and goat is not possible. The capacity of the meat processing factory is dependent mainly on the space available for holding livestock, the type and capacity of equipment being used and the working skill of workers and the mix of animals (sheep and goat) being slaughtered .

5.6.0b GENERAL DESIGN (Refer to drawings in appendix)

Based on the process flow of a meat processing factory, the philosophy and concept, the design process involved the arrangement and positioning of the desired spaces within an envelope in close proximity or remote from other related and unrelated spaces. As part of the design concepts applied, consideration was also given to the circulation, accesses with hygienic but profitable ways of eliminating waste.

PLANNING

The facility sits on about 49% of the site with the remaining used for landscape (Soft and hard landscape). The size of site used for the facility is approximately 34acres.

At main entrance (North-Eastern corner) of the site) is a security post, a meat shop and a traditional meat market. These were position there to prevent customer from entering the factory premises. This facility has its own access in order not to conflict movement with the factory's cold vans.

At the North western corner of the site is another entry point with a security post for entry and exit of raw materials (cattle, sheep, goat and pig).

Behind the meat shop and traditional meat market is the administration and 2 security post : one for the administration and the other for checking and weighing the factory's cold vans and staff vehicles.

The Canteen which located behind the administration is centrally located and has a relationship with most of the buildings on site.

To the west of the site is the animal care unit which receives newly transported livestock, cares for livestock by feeding and medicating them. It also discharges packaged animal-by products to other companies who receive them on a weekly or monthly bases.

Centrally placed is the factory .It is influenced by the existence of the old structure. The abattoir has been crafted into the old structure and connected to it is the meat processing factory. The workers laundry, changing and clock in room is attached to the factory to reduce the contamination of meat and meat products from the workers clothing.

The factory has an automobile work shop which checks the condition of the vehicles before every working period. The existence of the automobile workshop increase efficiency of delivery service for the factory since the delivery vans have to travel long distances.

As a result of the amount of waste (water and solid) expelled from the factory a biogas system, a manure room, ash collection room and a main waste disposal room has been provided on site to efficiently and safely eliminate waste.

The site already had a water treatment plant with a holding capacity of 228,300 gallons of water (223,300gallons of untreated water and 5000gallons of treated water) which was used in slaughtering 100 cattle a day, 40-50 sheep and goat a week and 50 pigs a day. According to the FAO standards and case studies, a volume of 10,400m^3 of water which is equivalent to 2,747,360 gallons of water has been provides onsite. This includes solar hot water tanks and another water treatment plant. Apart from this two bore has been created to as a water supply backup.

Lastly is a fuel depot where underground storage tank has been provided to store oil for the boiler in one chamber and compressed gas from the biogas plant in another chamber.

Orientation: A meat processing factory located in the Upper East Region, an area that experiences high temperatures of the day buildings have been aligned and orientated such that the long side of the building faces north with blank walls on the east and west except on

facades that have wash rooms and other wet areas facing east or west. This is to minimize the solar ingress into working spaces and maximize solar sanitization in wash rooms and wet areas.

Ventilation: Ventilation in a meat processing factory is solely artificial (air – conditioning). In an abattoir an extractor fan with dust filter could be used. This is to reduce dust and other unwanted particles in the air which could easily contaminate meat. As a result of this air tight windows have been used in this design to bring in light and not air.

5.7.0 BUILDING STRUCTURE

The structural system employed here is the load bearing Post and Beam System of Construction.

The existing structure of the Bolgatanga meat Factory has a structural grid of 4m x 5 m. The new design has a structural grid of 5m x 12m. The columns are made of reinforced concrete. The roofing members are made of laminated curved wood truss with I –section steel purlin.

5.8.0 MATERIALS (WALL, CEILING, FLOOR AND OTHER FINISHES)

In the design of a meat factory, interior finishes and treatment are among the important considerations. This is because both interior and exterior, add to the safety and sanitation of the whole environment.

(a) Walls

Exterior: Most of the exterior walls are finished in soothing coloured- paints such as the cream emulsion paint which was the colour of the existing facility with brick and fur faced finishes on some facades. The Exterior walls are composed of sandcrete blocks.

Interior: The choice of finish for interior walls was dependent on standard of designing a meat factory.

All interior walls in the factory except the storage areas and refrigerator has been tiled with white 20*20 wall tiles up to 2 meters high

The untiled parts of the factory have been painted with white emulsion paints for hygienic purposes and also to brighten up the factory.

The interior walls of the other facilities have been painted with colours with tints of white

(b)Floors

The most critical choice of finishes in a meat factory is the choice of floor finish. They are subject to constant abrasion and maintenance due to the sort of activities required in the spaces for instance spillages of blood, faeces and water, the use of antimicrobial chemicals in cleaning floors after every working period and the movement of trolley carts and workers.

Wet floor cause workers to slip, therefore when selecting the flooring materials, the following factors were taken into consideration: wearing surface durability, joints (in seams and at wall intersections), slip resistance, stain resistance, scratch resistance, life cycle, color selection, substrate requirements, and clean ability. The material chosen for the factory floor and traditional meat market is polymer concrete or reinforced plastic fiber floor material which is mostly used in modern meat factories and eve changing rooms of sports stadia.

The floor of the animal pen and workshops has been finished with terrazzo tiles, the power house, water treatment plant automobile workshop have been finished with cement screed.

The floor of the administration, meat shop, butchers shop and security post has been finished with non-slip ceramic tiles

(c) Ceiling

White wooden ceiling boards in a meat factory also add to the luminance of the spaces.

(d) Other finishes

Cabinetry: Worktops in the chemical and microbiological laboratories are also finished with vitreous tiles.

Pre-manufactured White Plastic laminate would be used for water hose cabinets in the factory.

Drains: PVC pipes have been connected to polymer concrete gutters that have been covered with a removable fibre grating and a fat trap.

5.9.0 ACOUSTICS

Noise control is very essential in the animal care unit since animal paddle and balk in noisy area.

Foam has been stuffed in the ceiling of the animal pen to prevent noise from entering the pen from the hide drying area.

5.10.0 LIGHTING

As much as possible natural lighting have been used and complemented by artificial lighting. However some areas have high intensity light in order to execute the task safely and efficiently such spaces are the meat inspection room, cutting and deboning room and meat packaging room.

5.11.0 SERVICES

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

(a) Water supply

Water to the facility would be from the mains along the Bolgatanga –Bawku road. Hot water would be provided by using the solar water tanks on site as well as bore water.

(b) Electricity

Power will be tapped from the mains along the eastern side of the site 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. Electricity will also be generated by the use of solar panels. The biogas system will also be used to generate electricity.

(c)Lighting and Ventilation

Due to the sensitivity of meat processing factories, ventilation is solely artificial to prevent dust and other dangerous air particles to contaminant the meat.

Courtyards and north lighting have been provided to admit natural lighting into working spaces.

(d)Emergency exits

Emergency exits have been provided for escape routes with pressure lock doors. Fire alarm call points, fire extinguishers and firefighting equipment have also been used.

(e)Telecommunication Facility

The Factory has P.A systems to facilitate easy communication to all workers.

(f)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 factory building except in the cooking rooms and incineration rooms with break glass units on the corridors.

(g)Fire Fighting Installation

Fire fighting is to be effected by the use portable fire extinguishers located at fire-prone areas. Automatic fire suppression system shall be proposed for the labs. The suppression agent shall be safe, effective and environmentally friendly.

(h) Fire Hydrants

Fire hydrants shall be of the sluice valve type to 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. 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.

A 300 by 200 indicator plate of aluminum construction shall be provided with an inscription of "fire hydrant". The plate shall be supported at 600mm high above ground level by channel steel support. Both plate and support shall be painted in red color and installed about 1,000m from the hydrant.

(i) Security lighting

To ensure safety and security in and around the factory premises day and night, security lighting would have to be provided at some vantage points.

(j)Telephone

The private branch exchange (PBX) telephone system is been used to facilitate communication at the centre. The PBX actually handles the processing of all calls within it. It also has all the built in features such as, Forwarding, Conferencing, Call Pick up Groups, Intercoms, and Transferring just to name a few.

The administration will have both intercom services and regular land lines.

(k)Air conditioning

Air- conditioning is vital and needed in these areas: - the meat processing floor, cutting and deboning room and packaging areas, administration block, meat shop and veterinary office. Extractor fans with filters is also vital in the abattoir, animal care unit and power house. All other facilities would use ceiling fans. The factory space will be served by a central air-condition plant and the others by split air condition system.

(l)Waste management and disposal

Solid waste such as papers and cartons would be treated in an incinerator on site, at the service area.

Refuse and Solid and liquid wastes from the animal pen, the factory and the workshop area have been connected to a biogas plants with an inspection chamber provided at every change in direction. The faeces are converted to gas and the liquid is filtered and used to water gardens and surrounding farms. Some of the water is further filtered in sand beds and used for cleaning the animal pen.

Liquid and solid waste from the administration, meat shop and canteen is connected to a soak away.

Incinerators have been placed in the factory to burn all inedibles (condemned carcass and offal)

Odor: The best way to reduce odors is to keep all areas in and around the factory clean. Use a high-pressure sprayer with a disinfectant to wash away waste and bacteria that cause odors, and use a floor-drain system.

Litterbins would be placed at vantage points in and around the factory.

5.12.0 LANDSCAPING

The built area of the site occupies about 49% of land, 26% for soft landscape and 26% for hard landscape. The main aim the soft landscaping is to,

- Modify climate
- Add to the aesthetic appeal of the facility and
- To create serenity

The nature of the northern belt climate restricts the type of plants to be used. As a result of the hot dry climate special plant species that are drought resistance were chosen.

The plants used include the following:

- Buffalo grass
- Magnifera Indica (Mango tree)
- Spurge species
- Kalanchoe species
- Cactus species
- Ice plant (hedge)

Water loving plants have been used at areas around the aerobic ditch.

The plants to be used include:

- Fern Species
- Banana trees

Hard landscaping is made up of asphalt for the loading bays and services areas, and clay pavement tiles for the walkways ways.

Streetlights have also been placed around the facilities at an interval of 5m

5.13. 0 COSTING

COSTING

The cost of the facility is an estimation to give the client a fair idea on the financial investment of the project.

The cost per square meter of construction is $350, that is GH¢490

(a)Factory

Ground floor ----------7200 m² x GH¢490 = **Gh¢3,528,000**

First floor ----------4800m² x GH¢490 = **Gh¢2,352,000**

TOTAL = GH¢5,880,000

(b)Administration

Floors ----------300m² x GH¢490 = **GH¢147,000 *3 floors**

TOTAL = GH¢441,000

(c)Animal care unit

First floor----------5000 m² x GH¢490 = **GH¢2,450,000**

(d)Canteen

Ground floor----------600 m² x GH¢490 = **GH¢294,000**

(e)Meat shop

Ground floor----------600 m² x GH¢49 = **Gh¢294,000**

(f) Workshop

Ground floor----------750 m² x GH ¢490 = **GH¢367,500**

(g) Power House

Ground floor .....600 m² x GH ¢490 =**GH ¢294,000**

(h) Automobile workshop

Ground Floor.....825 m² x GH ¢490 = **GH ¢ 404250**

(i) Water Treatment Plant

Ground floor plan.....2500m² * GH ¢490 = **GH ¢ 1,225,000**

TOTAL FOR BUILDINGS = GH ¢ 10,988,250

Biogas plant ..... $30,000,000 = GH ¢ 42,000,000

Equipment..... $ 10,000,000 = GH ¢ 14,000,000+

TOTAL FOR OTHERS = GH ¢ 57,470,000

GRAND TOTAL = GH ¢10,988,250 + GH ¢57,470,000 = GH ¢ 68,458,250 +

5.14.0 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:

Phase 1

The first phase will comprise of breaking down the existing structures that are not to be maintained, breaking down of unwanted parts of the buildings to be maintained, refurbish and fix all major service lines, setting out the new buildings.

Phase 2

During this phase the waste treatment plant will be built as well as the other facility beginning with the factory whiles the others are built along side.

Phase 3

The final phase would comprise of all landscaping elements

5.15.0 CONCLUSION

In conclusion, meat processing factories functions better when the abattoir and the meat product processing factory are close to each other. However, it is best when they are designed as one facility because it would reduce transportation cost and also reduce the rate of contamination.

The principles of designing a meat process factory should never be underestimated; the service modules are very essential- the absence of one service module would render the process futile.

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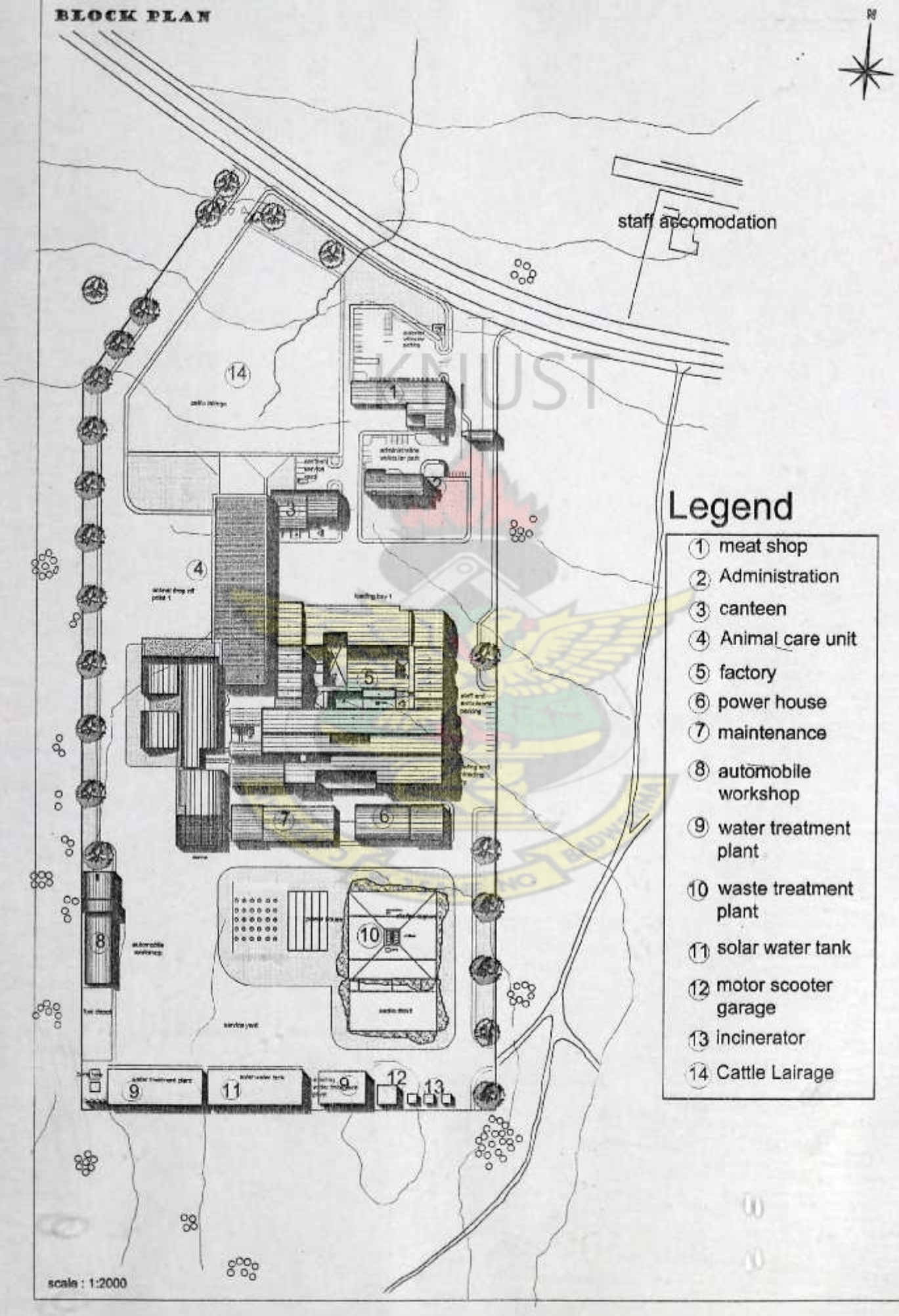
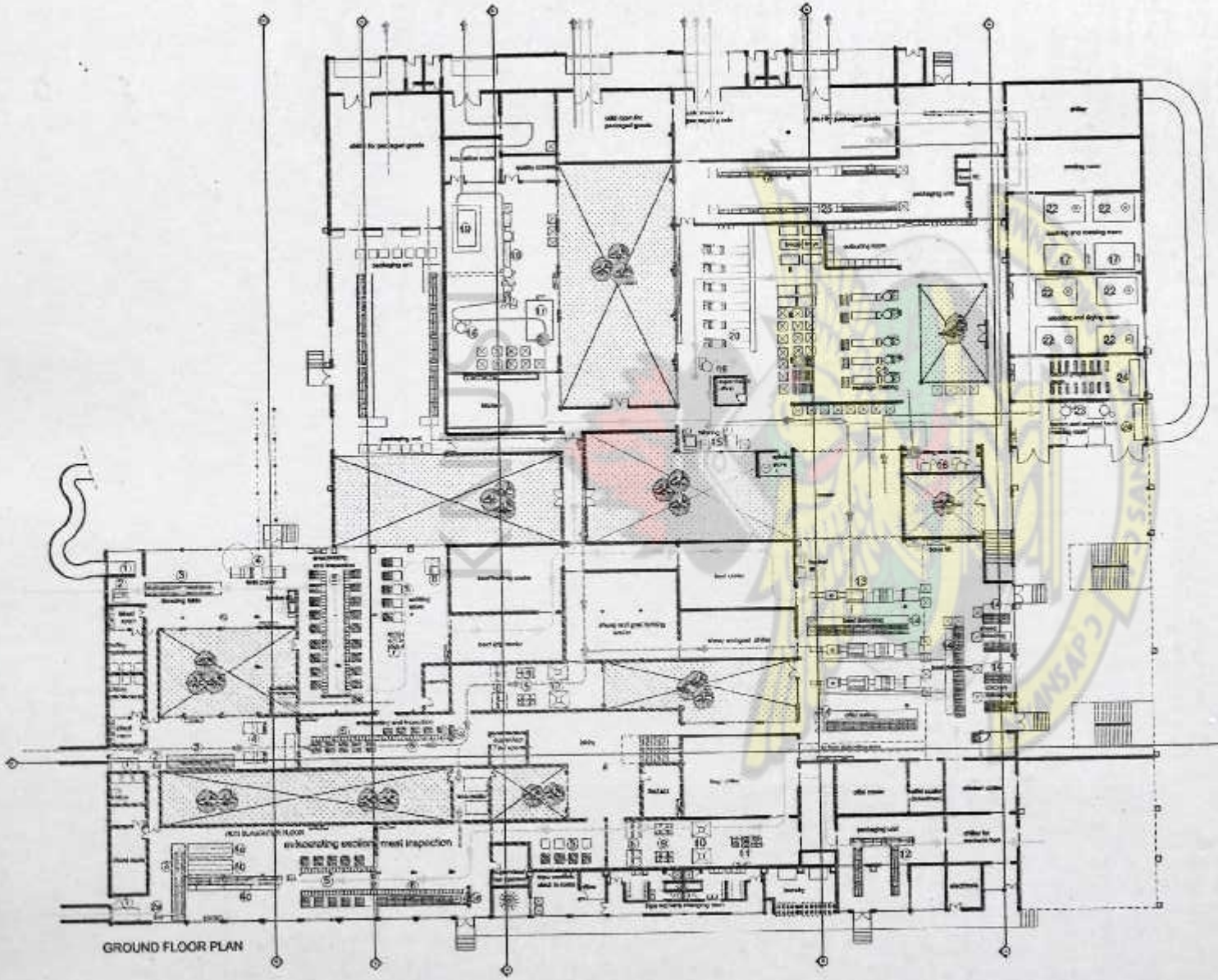
BLOCK PLAN


staff accomodation
Legend
1 meat shop
2 Administration
3 canteen
4 Animal care unit
5 factory
6 power house
7 maintenance
8 automobile workshop
9 water treatment plant
10 waste treatment plant
11 solar water tank
12 motor scooter garage
13 incinerator
14 Cattle Lairage
scale : 1:2000

SITE PLAN SHOWING CIRCULATION

scale : 1:2000

FACTORY - PROCESS FLOW AND EQUIPMENT

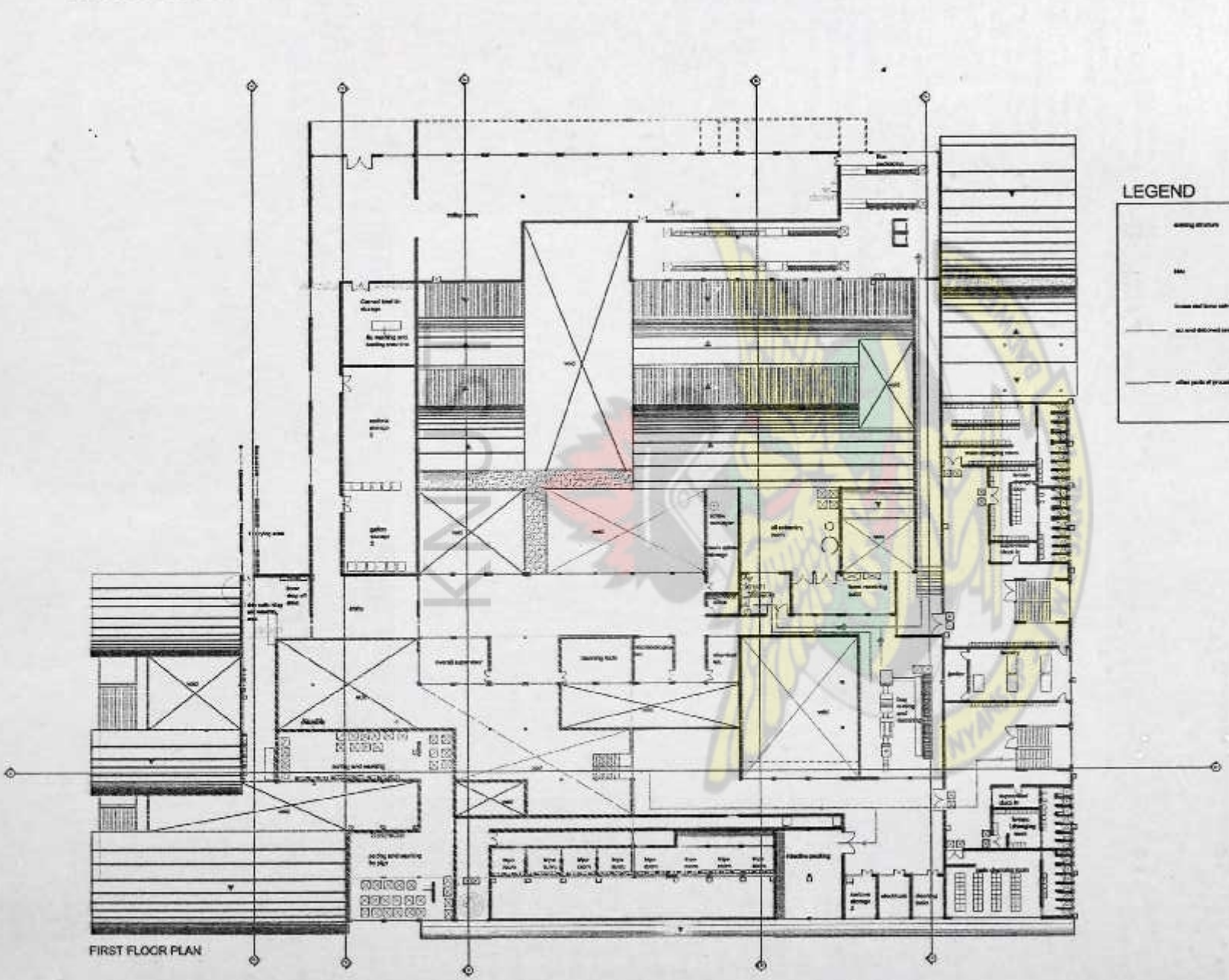


GROUND FLOOR PLAN

LEGEND

scale : 1:500

FACTORY- PROCESS FLOW AND EQUIPMENT

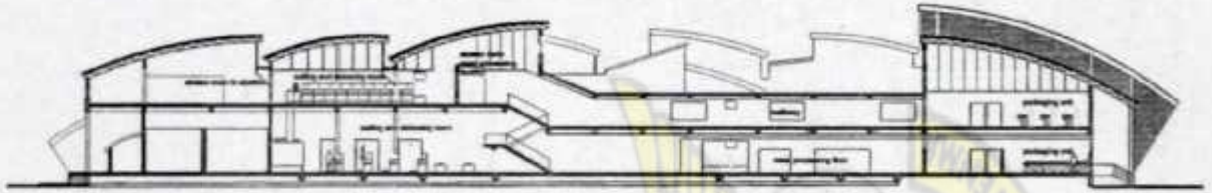


LEGEND

FIRST FLOOR PLAN

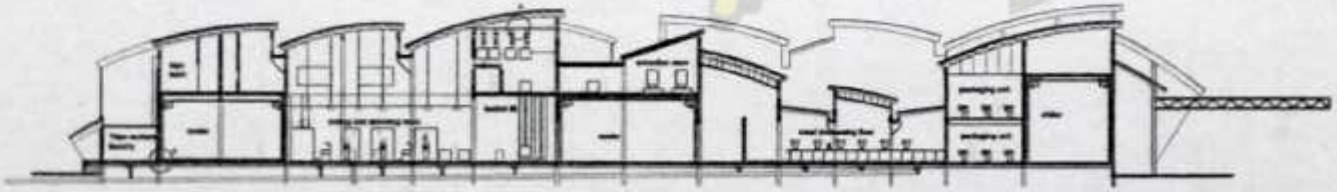
scale : 1:500

FACTORY- SECTIONS



SECTION A-A'

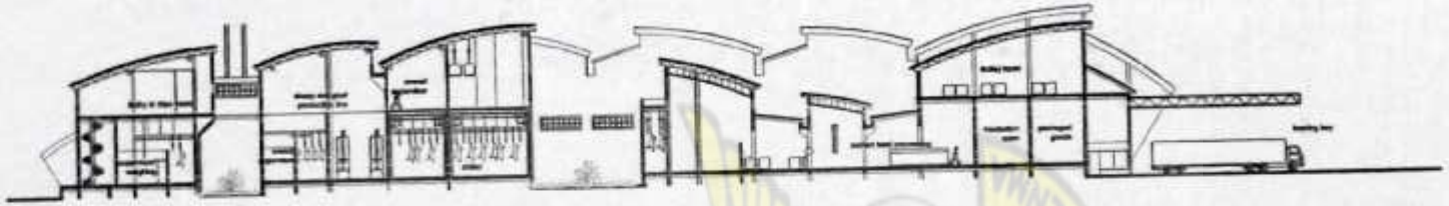
SECTION F-F'



SECTION B-B'

scale : 1:500

FACTORY- SECTIONS



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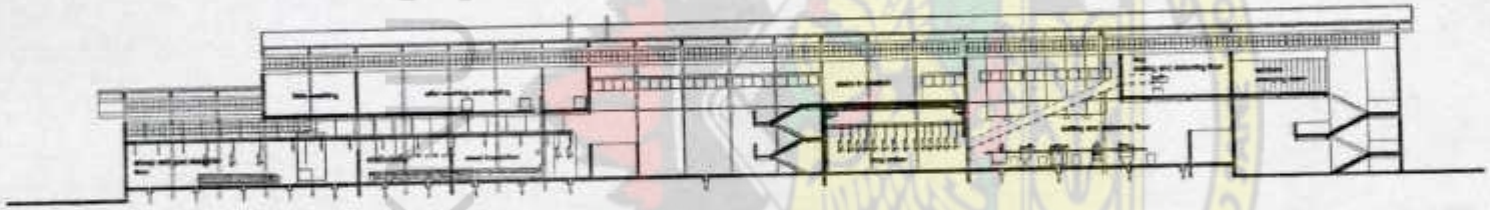

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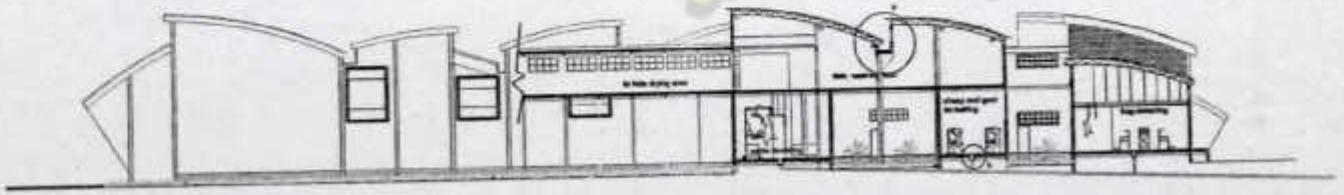
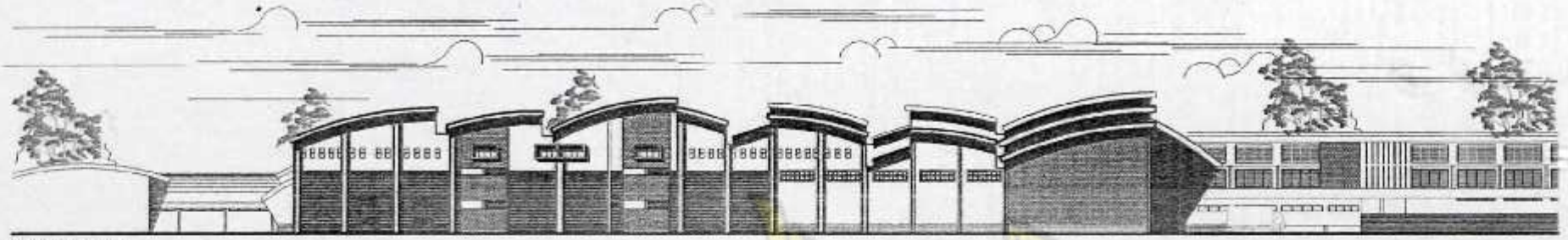


SECTION E-E'

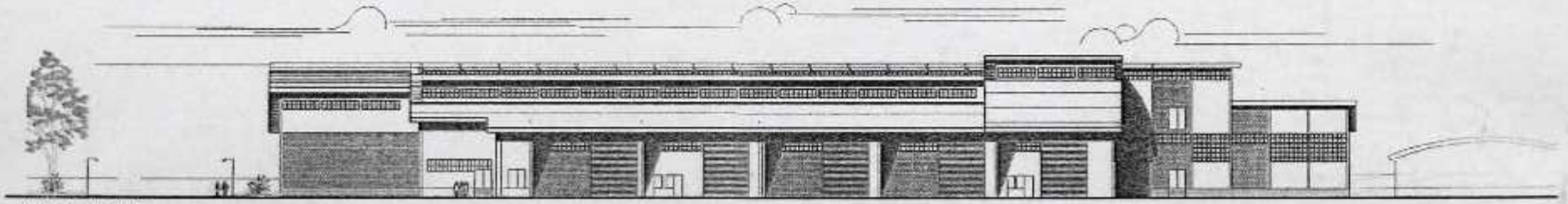
FACTORY- ELEVATIONS



EAST ELEVATION

WEST ELEVATION

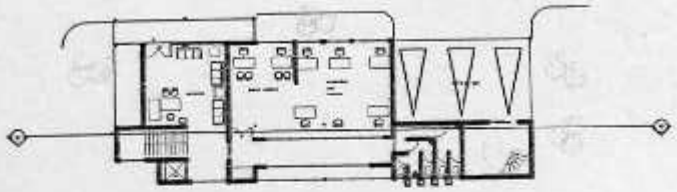
SOUTH ELEVATION



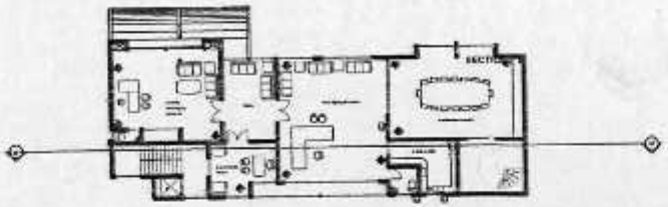
NORTH ELEVATION

scale : 1:500

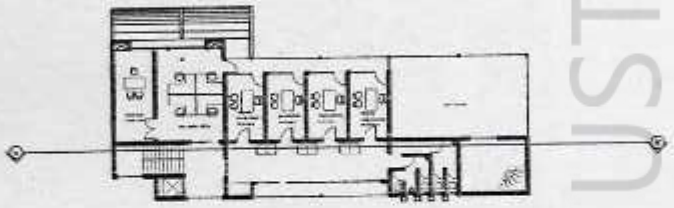
DESIGN OF THE ADMINISTRATION



GROUND FLOOR PLAN

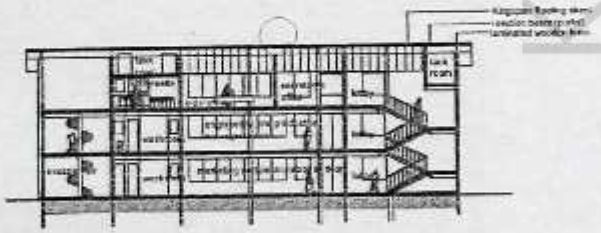


SECOND FLOOR PLAN



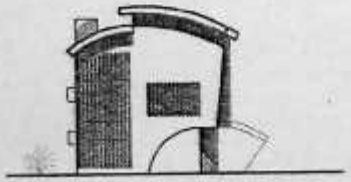
FIRST FLOOR PLAN

ROOF PLAN



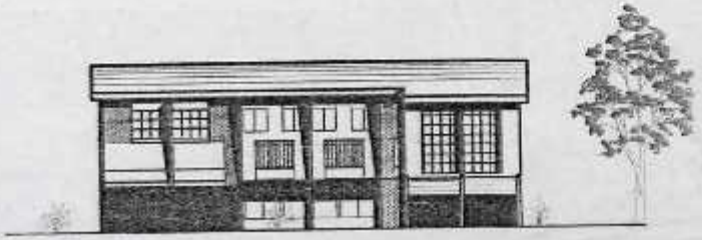
SECTION U-U'

SOUTH ELEVATION



EAST ELEVATION

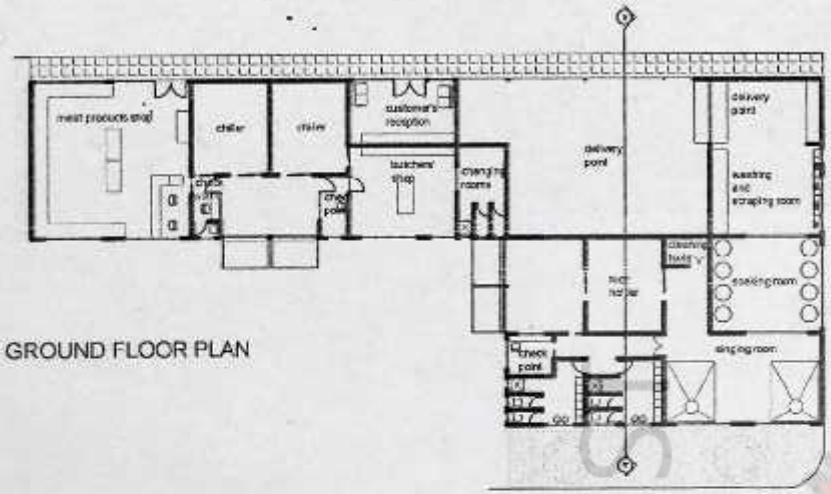
WEST ELEVATION



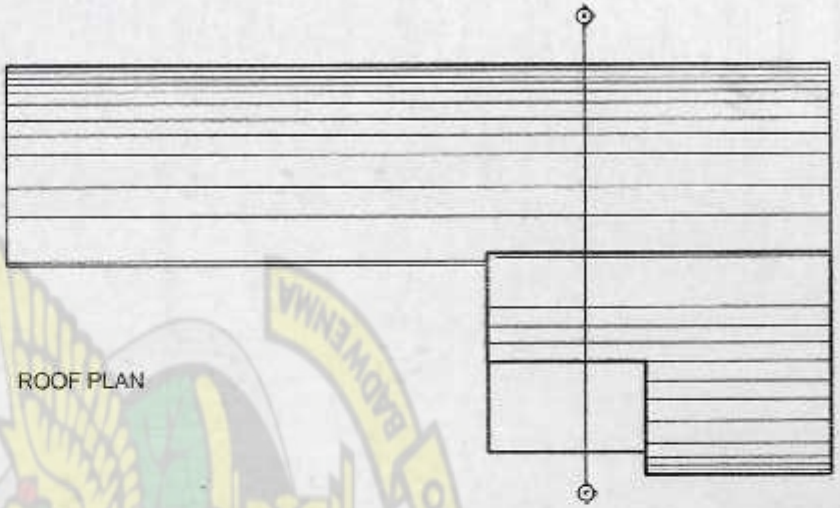
NORTH ELEVATION

: 1:400

DESIGN OF THE MEAT SHOP

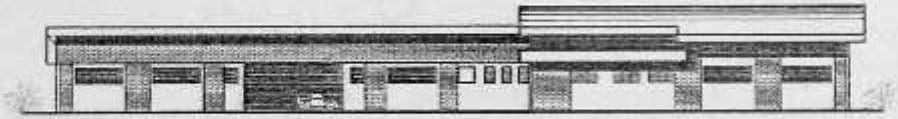


GROUND FLOOR PLAN

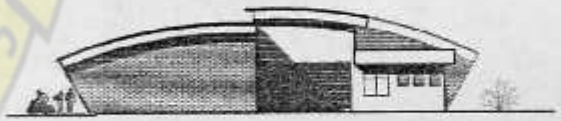


ROOF PLAN

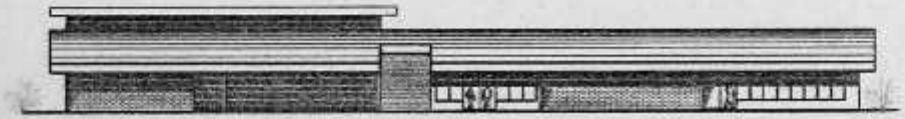
SECTION X-X'



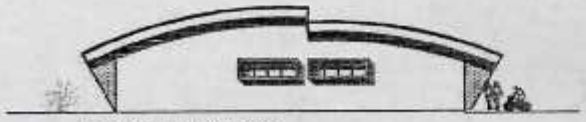
SOUTH ELEVATION



WEST ELEVATION



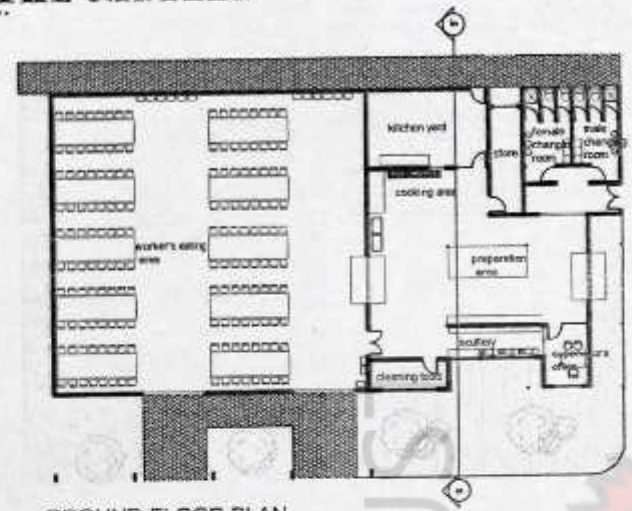
NORTH ELEVATION



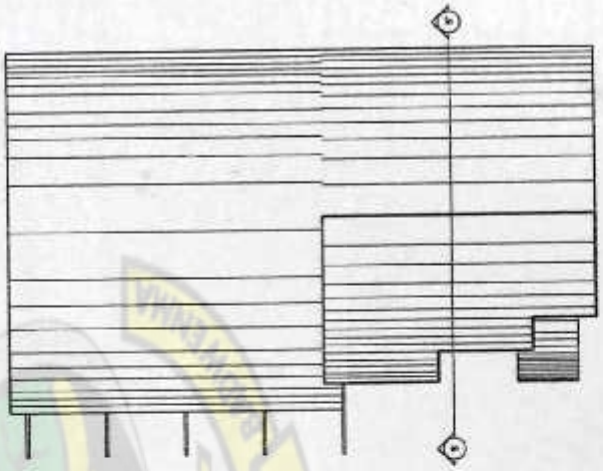
EAST ELEVATION

scale : 1:350

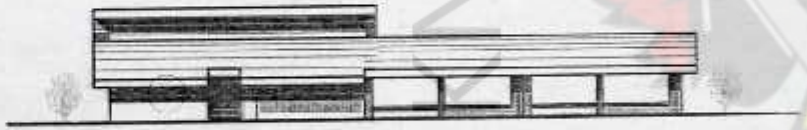
DESIGN OF THE CANTEEN



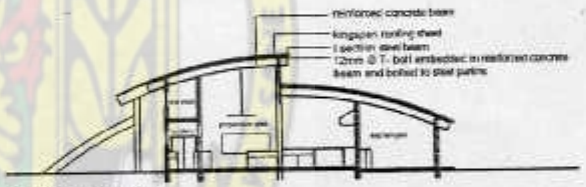
GROUND FLOOR PLAN



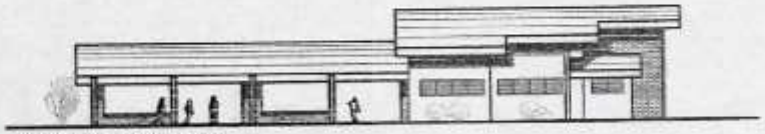
ROOF PLAN



NORTH ELEVATION

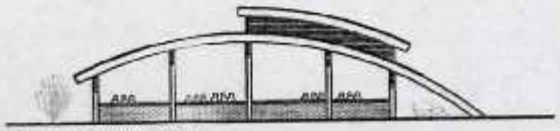


SECTION S-S'



SOUTH ELEVATION

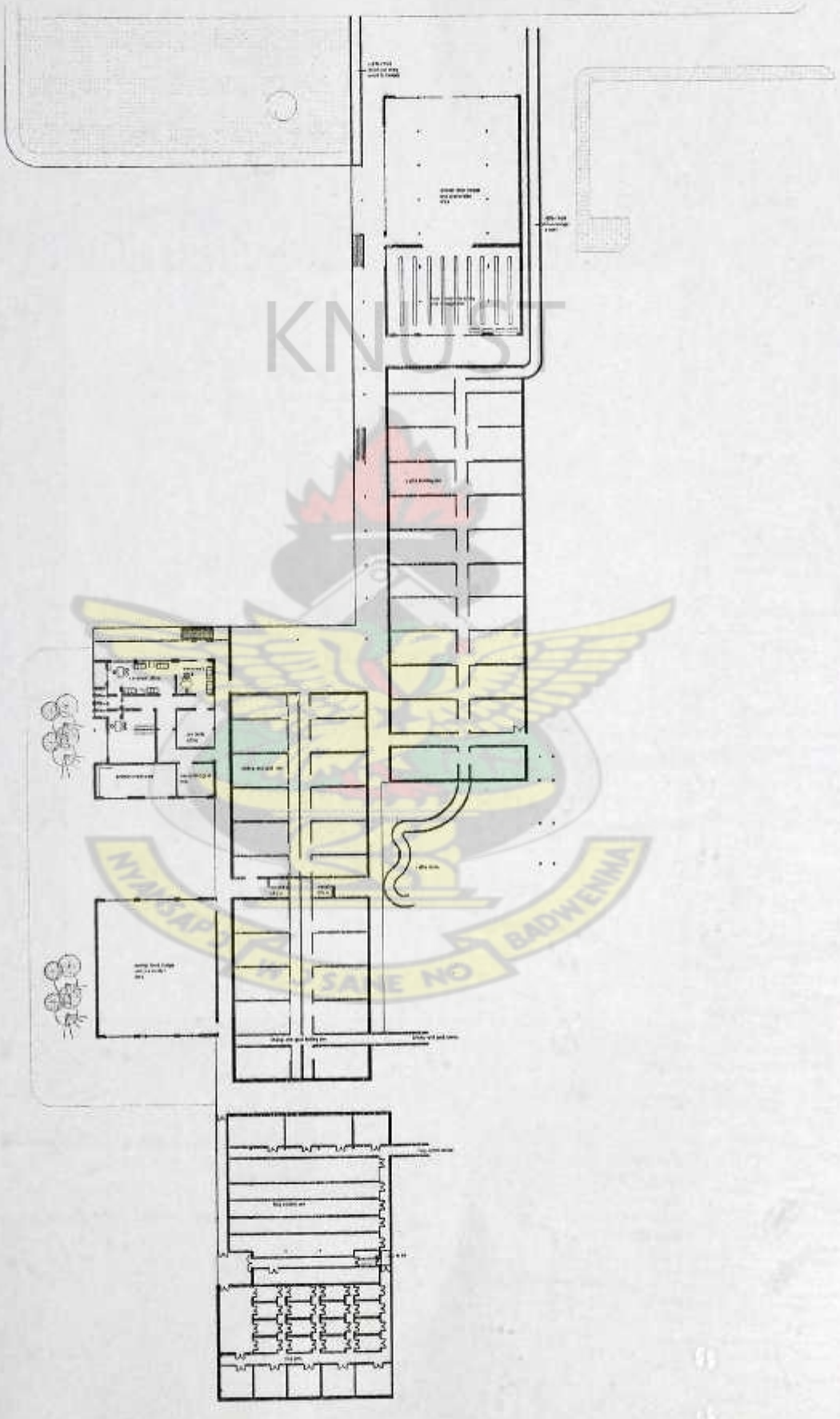
EAST ELEVATION



WEST ELEVATION

scale : 1:350

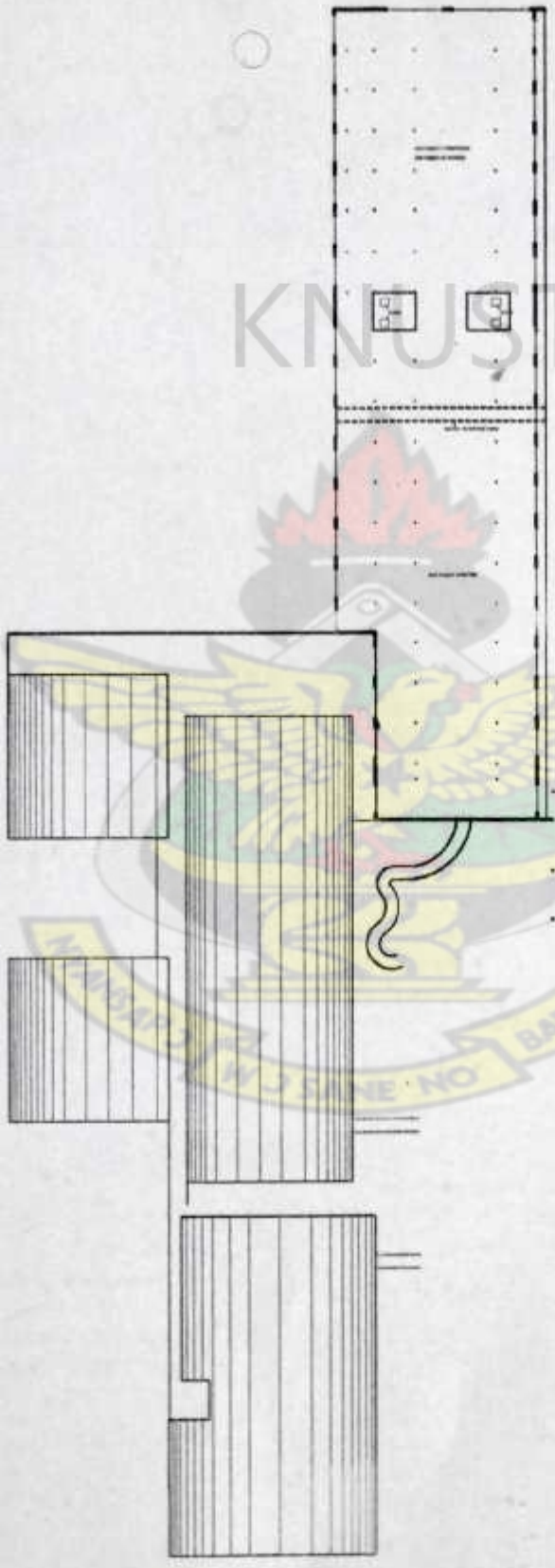
DESIGN OF THE ANIMAL CARE UNIT



GROUND FLOOR PLAN

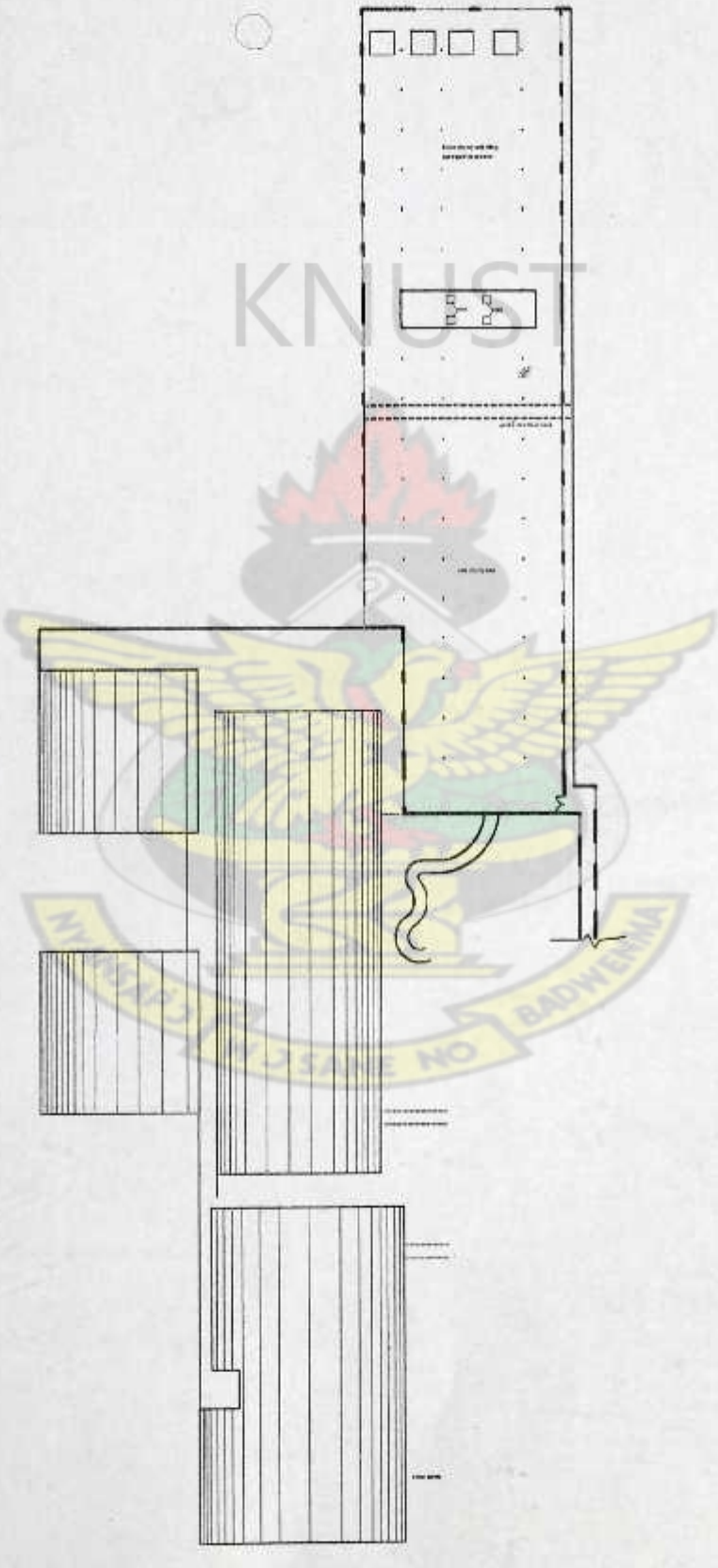
SCALE : 1:650

DESIGN OF THE ANIMAL CARE UNIT



FIRST FLOOR PLAN

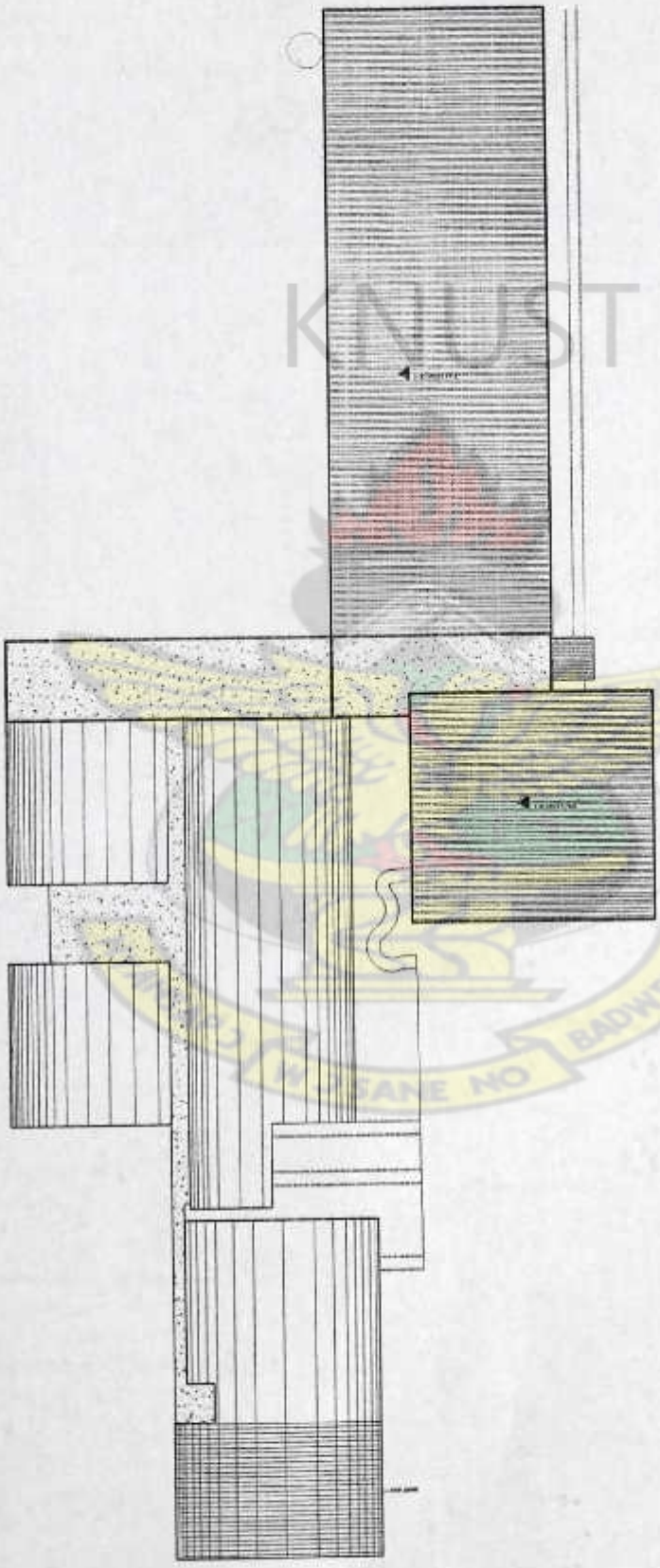
DESIGN OF THE ANIMAL CARE UNIT



SECOND FLOOR PLAN

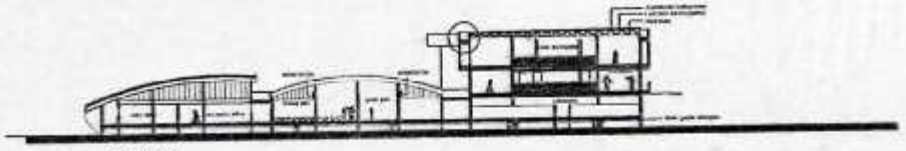
scale : 1:500

DESIGN OF THE ANIMAL CARE UNIT



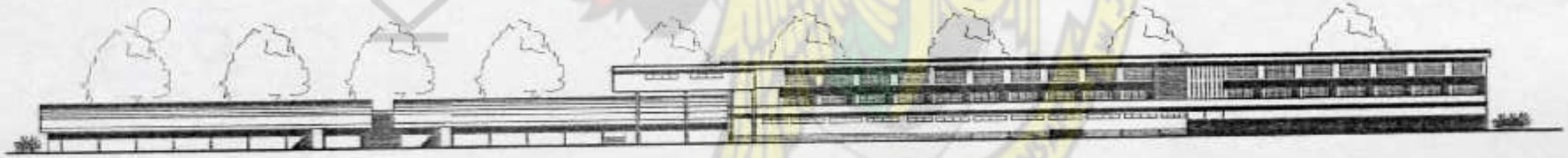
ROOF PLAN

DESIGN OF THE ANIMAL CARE UNIT

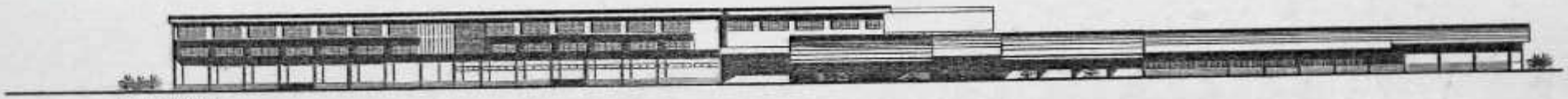


SECTION Z-Z'

SECTION E2 - E2'



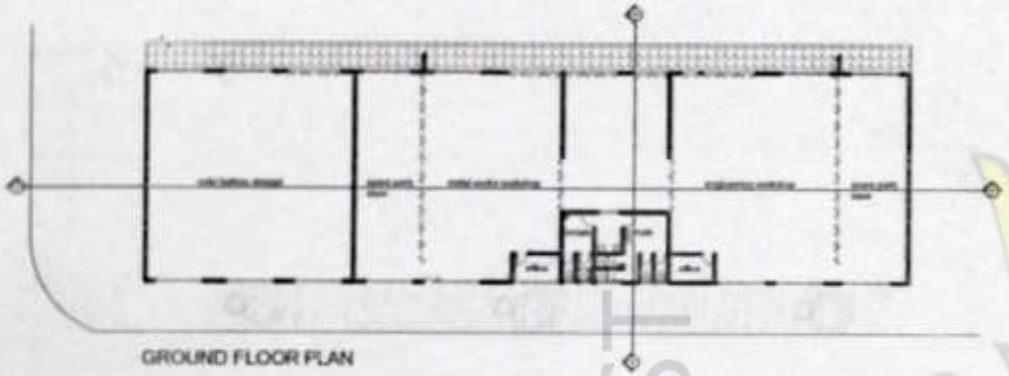
EAST ELEVATION



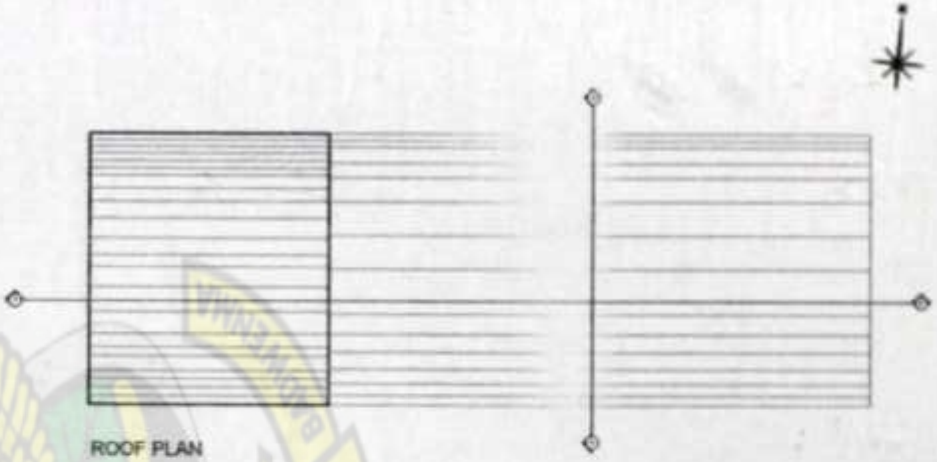
WEST ELEVATION

scale : 1:650

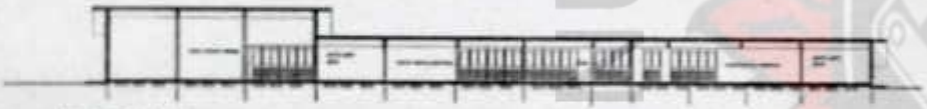
DESIGN OF THE MAINTENANCE BLOCK



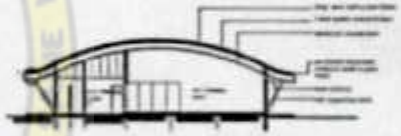
GROUND FLOOR PLAN



ROOF PLAN



SECTION Y-Y'



SECTION V-V'

SOUTH ELEVATION

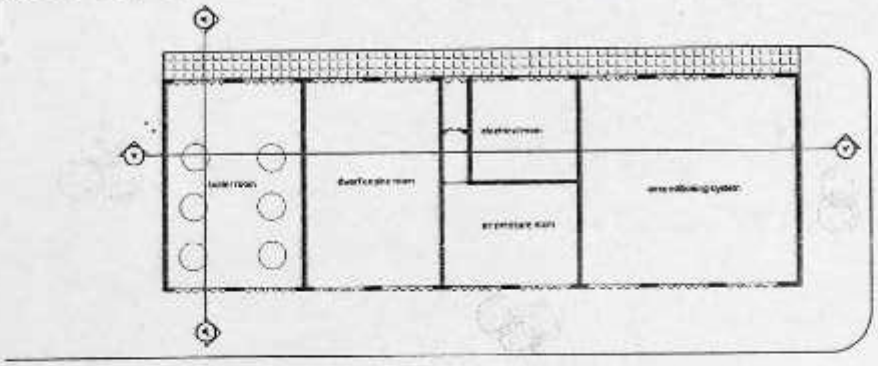
EAST ELEVATION

NORTH ELEVATION

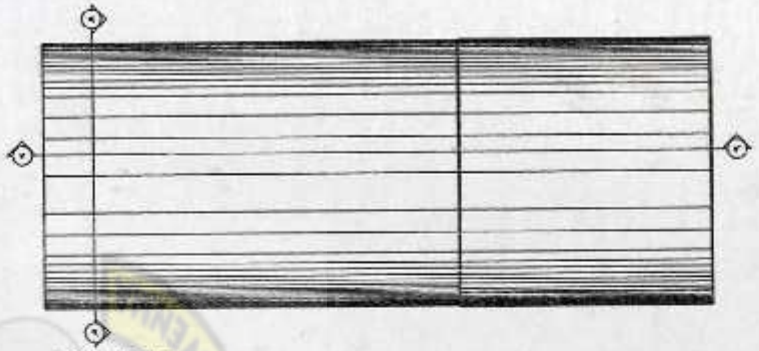
WEST ELEVATION

Scale : 1:400

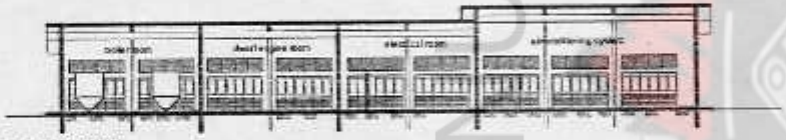
DESIGN OF THE POWER HOUSE



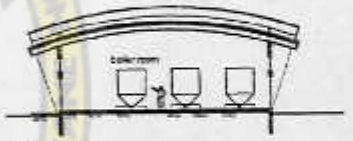
GROUND FLOOR PLAN



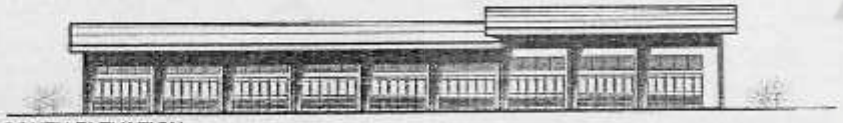
ROOF PLAN



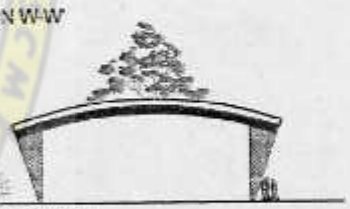
SECTION V-V'



SECTION W-W

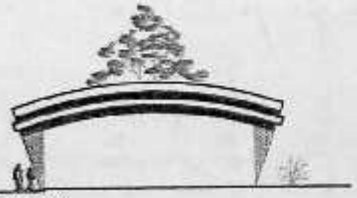


SOUTH ELEVATION



EAST ELEVATION

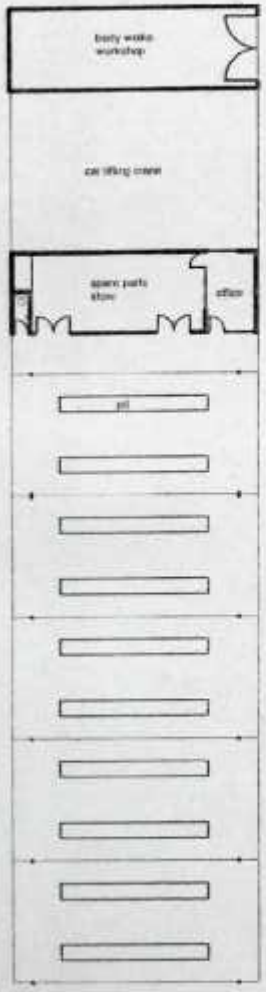
NORTH ELEVATION



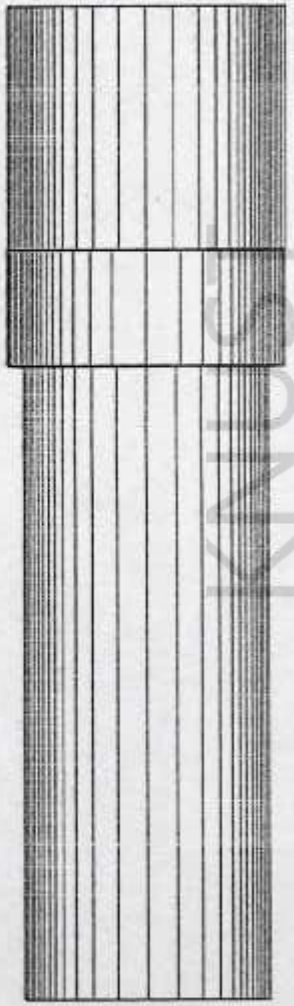
WEST ELEVATION

Scale : 1:400

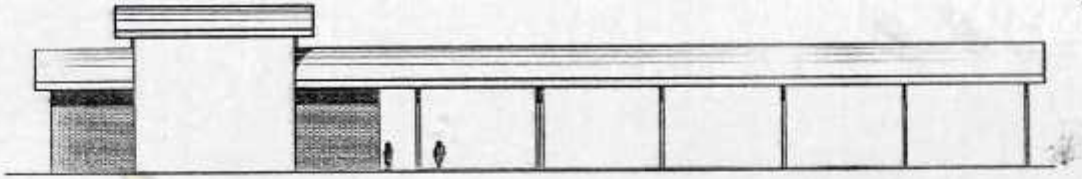
DESIGN OF THE AUTOMOBILE WORKSHOP



GROUND FLOOR PLAN



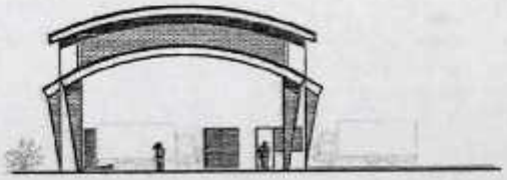
ROOF PLAN



WEST ELEVATION

EAST ELEVATION

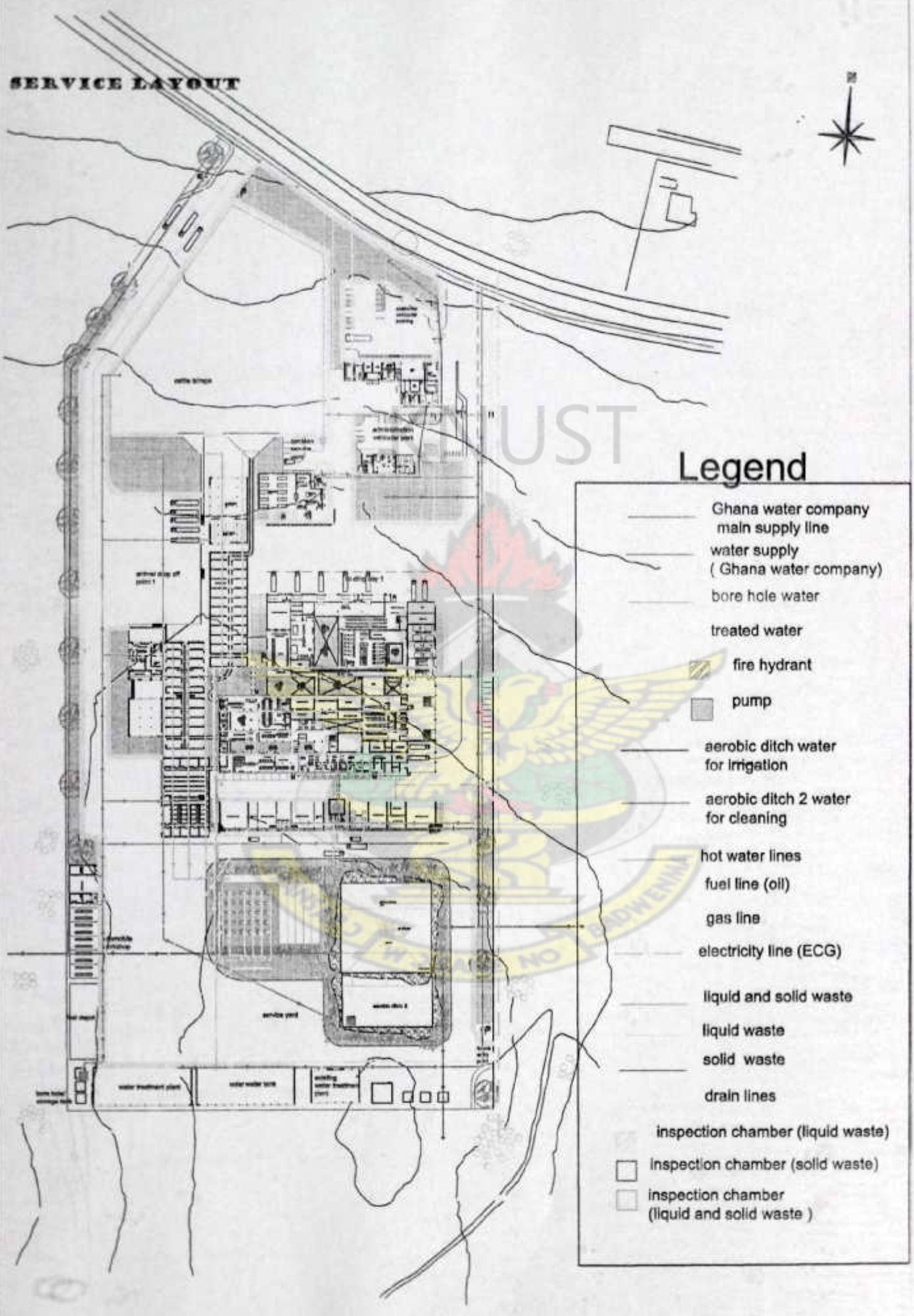
NORTH ELEVATION



SOUTH ELEVATION

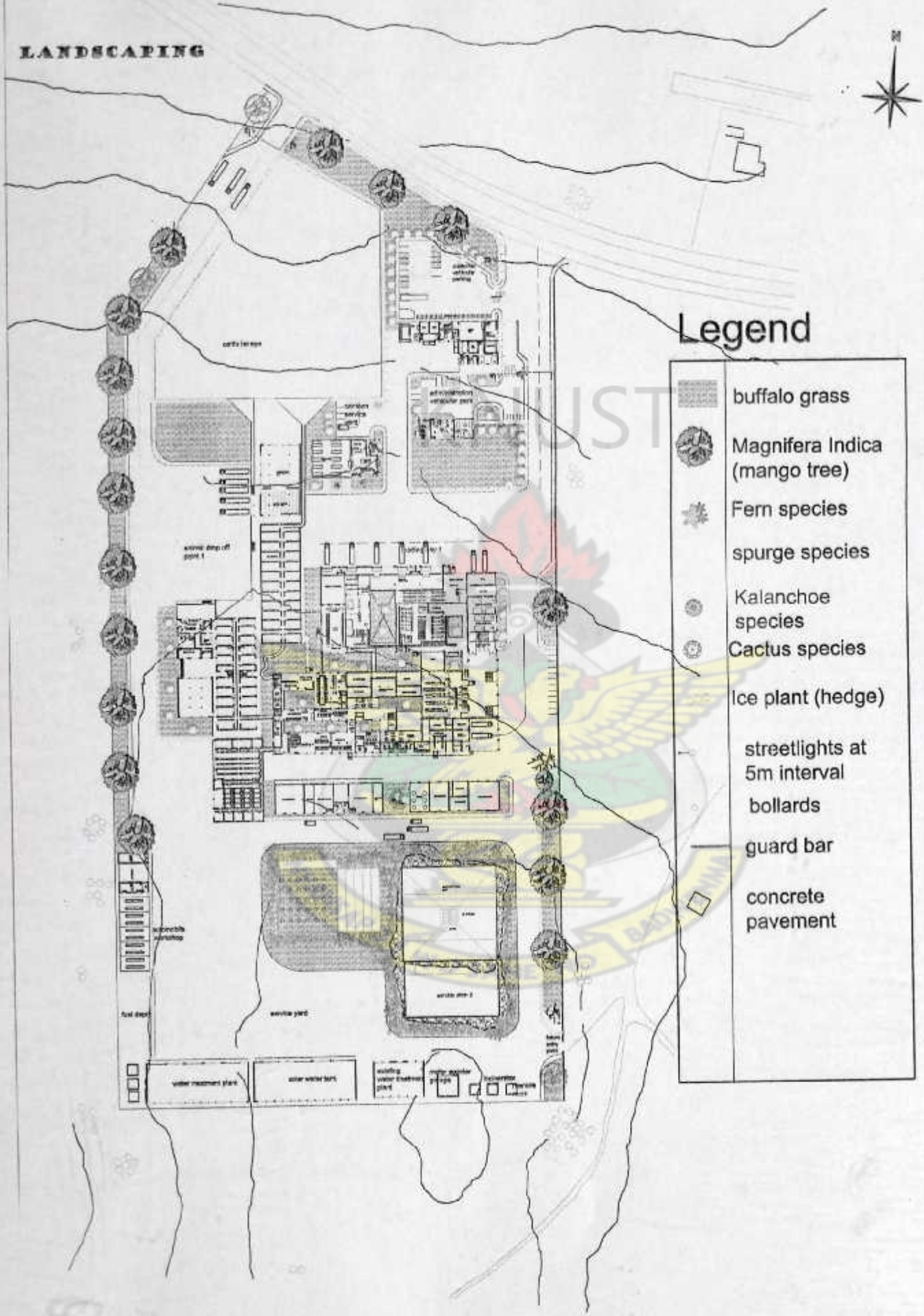
scale : 1:350

SERVICE LAYOUT



scale : 1:2000

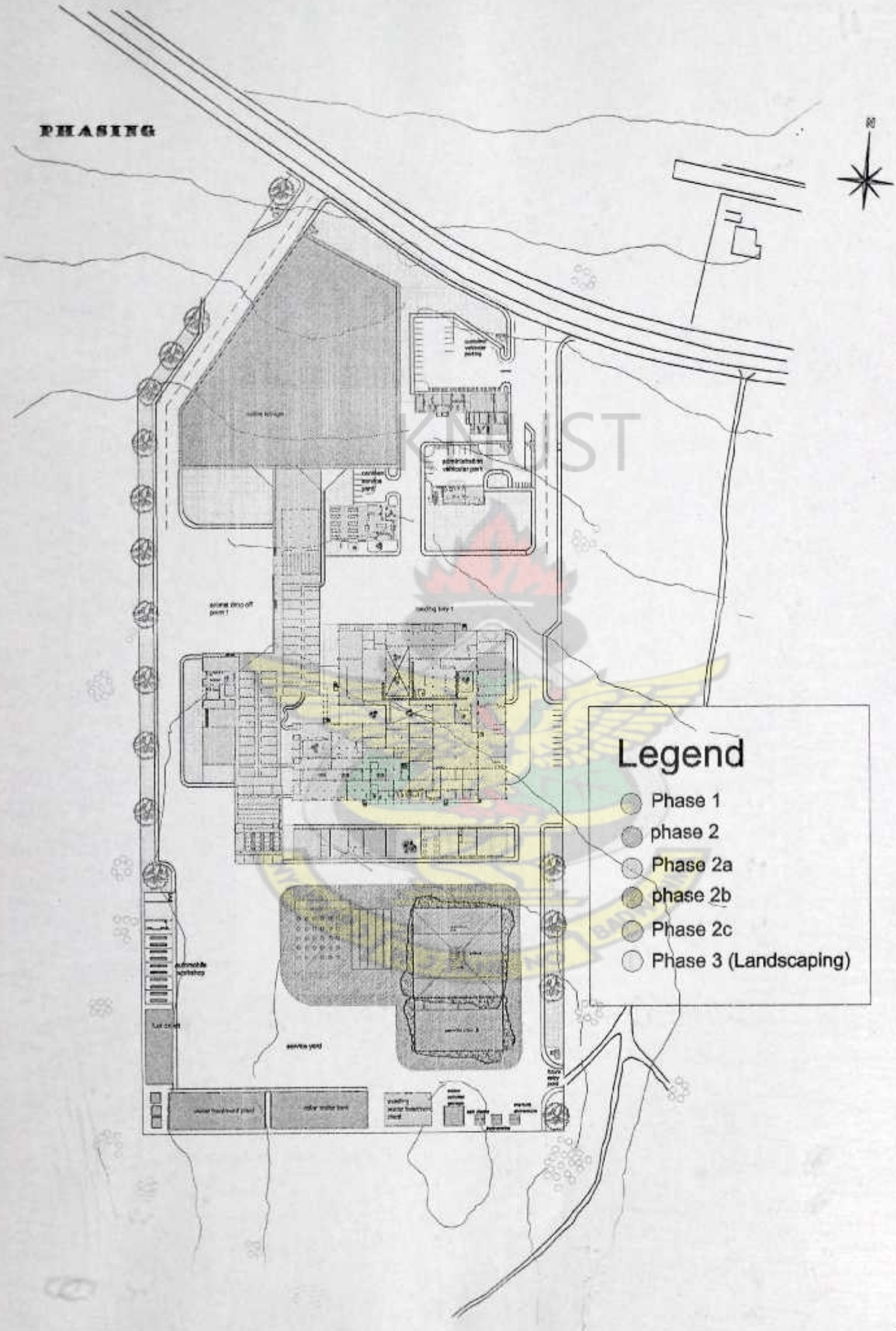
LANDSCAPING



scale : 1:2000

xx

PHASING

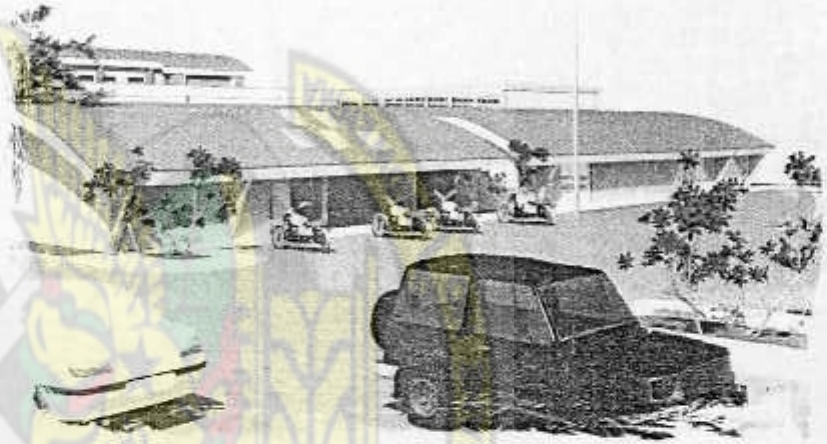


scale : 1:2000

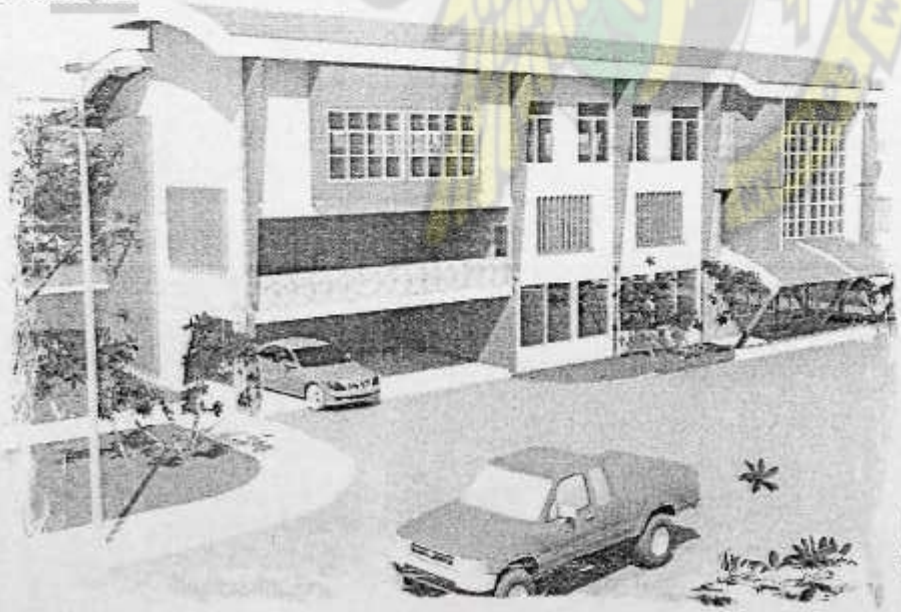
EXTERIOR PERSPECTIVE

1 MEAT SHOP AND MEAT MARKET

View of the main entry and exit point for finished goods and workers



North east view of the meat shop and traditional meat market



2 ADMINISTRATION

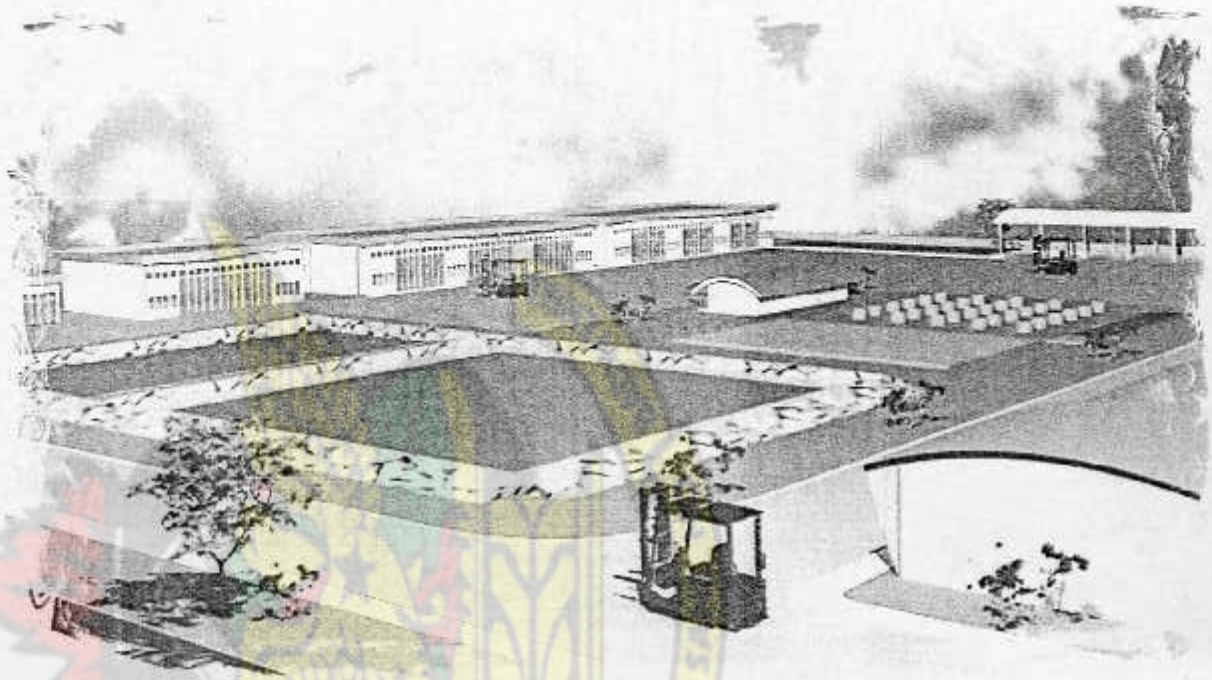
North east view of the administration

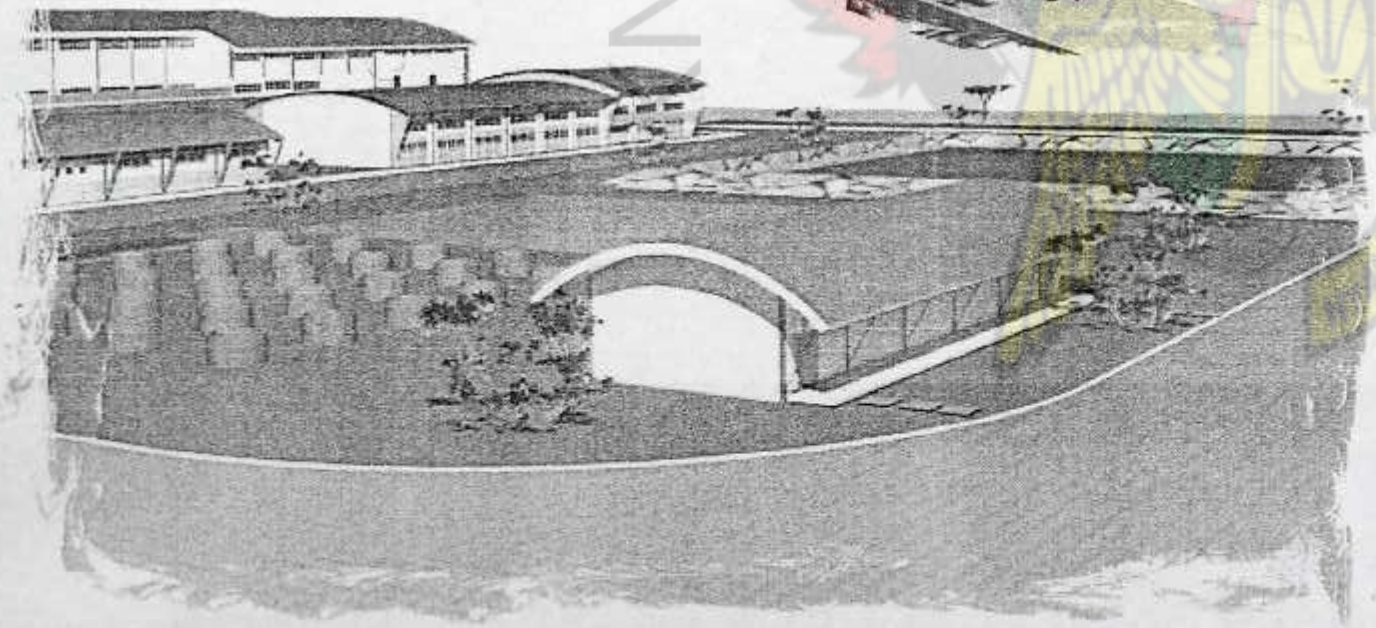
EXTERIOR PERSPECTIVE

10 WASTE TREATMENT AREA (BIOGAS PLANT)

This biogas plant can produce 240000litres of gas a day . This is amount is enough to t generate electricity for a community as well as supply gas.

The sum of the volume of the aerobic ditches is 10700m3 which is equivalent to 2,720,972 gallons of water. This is the factorys weekly water usage.





MEAT PROCESSING FACTORY

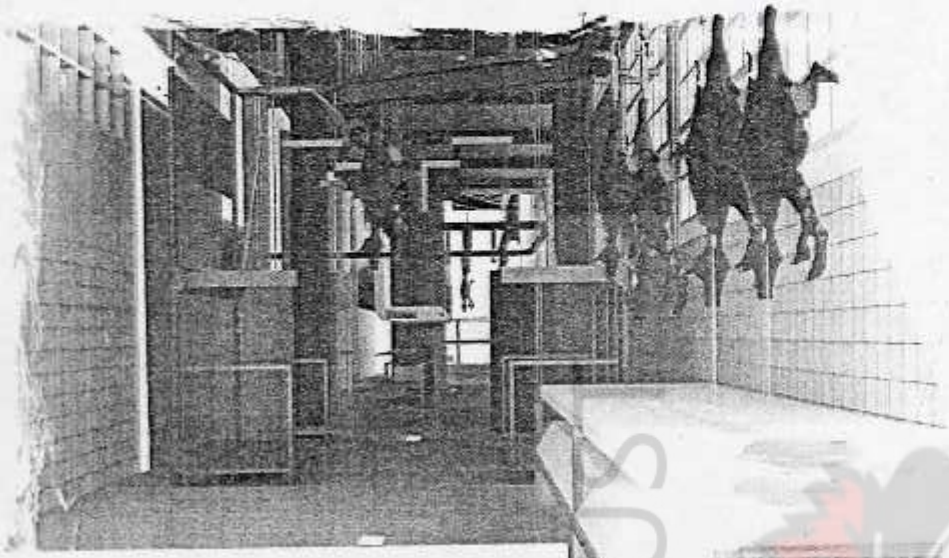
ZUARUNGU (BOLGA)

AUTHOR - FYNN CAMILLA ADJOA
DEPT. OF ARCHITECTURE (KNUST)
POST GRAD. ARCH. 3

DATE: JAN. MAY, 2009

SCALE:

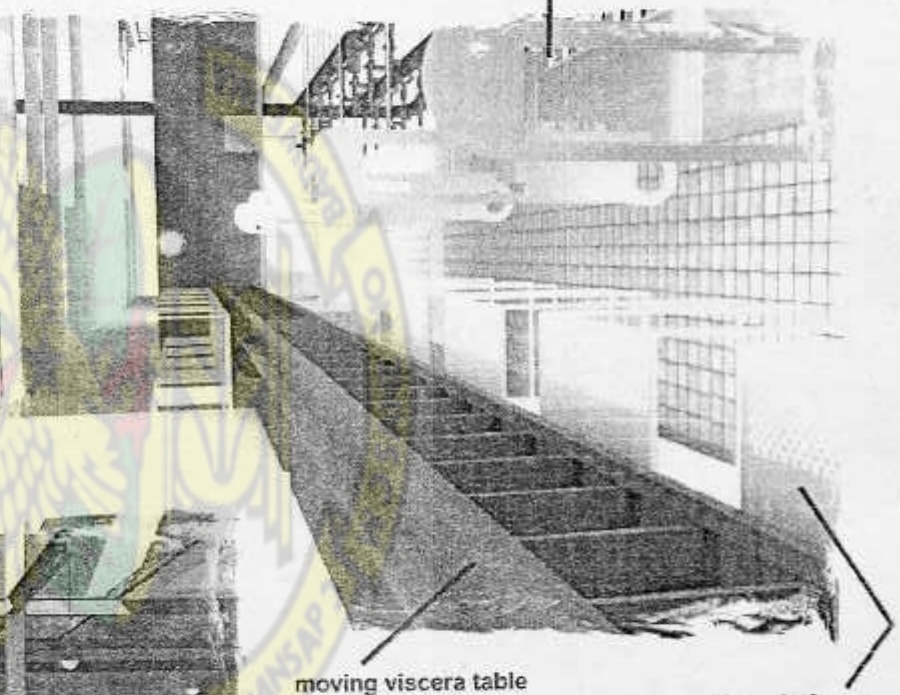
INTERIOR PERSPECTIVE



bleeding table

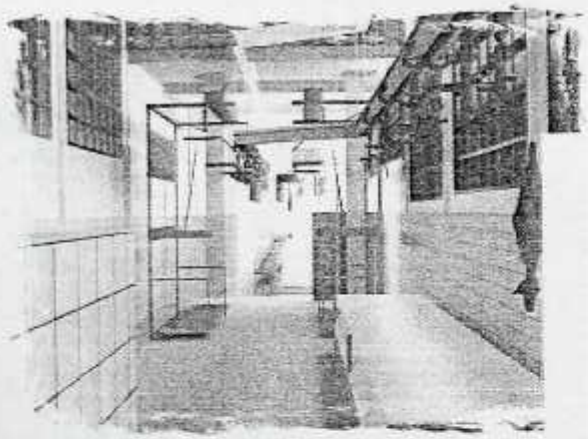
View of the eviscerating and inspection room

splitting saws hanging from overhead beams



moving viscera table

working platforms



view of the sheep and goat slaughter floor

View of the deboning room

MEAT PROCESSING FACTORY

ZUARUNGU (BOLGA)

AUTHOR: FUNK CAMILLA ADJOA
DEPT. OF ARCHITECTURE (KNUST)
POST GRAD. ARCH. I
COURSE: DESIGN THESIS

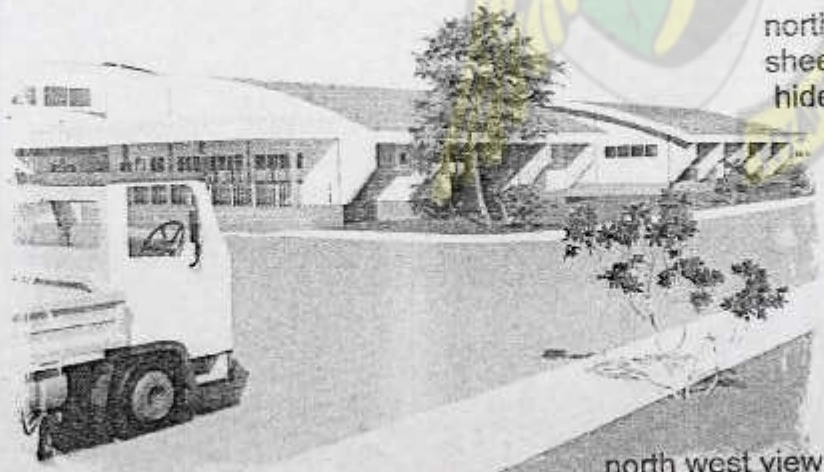
DATE: JAN.-MAY, 2009

SCALE:

4 ANIMAL CARE UNIT

south west view of the animal pen showing
The hog drop of point.

north west view of the animal pen showing
sheep , goat and cattle drop off point and the
hide drying area.



north west view of the animal pen showing
The veterinary office.

AUTHOR : FYAN DAMTHA ARTOA
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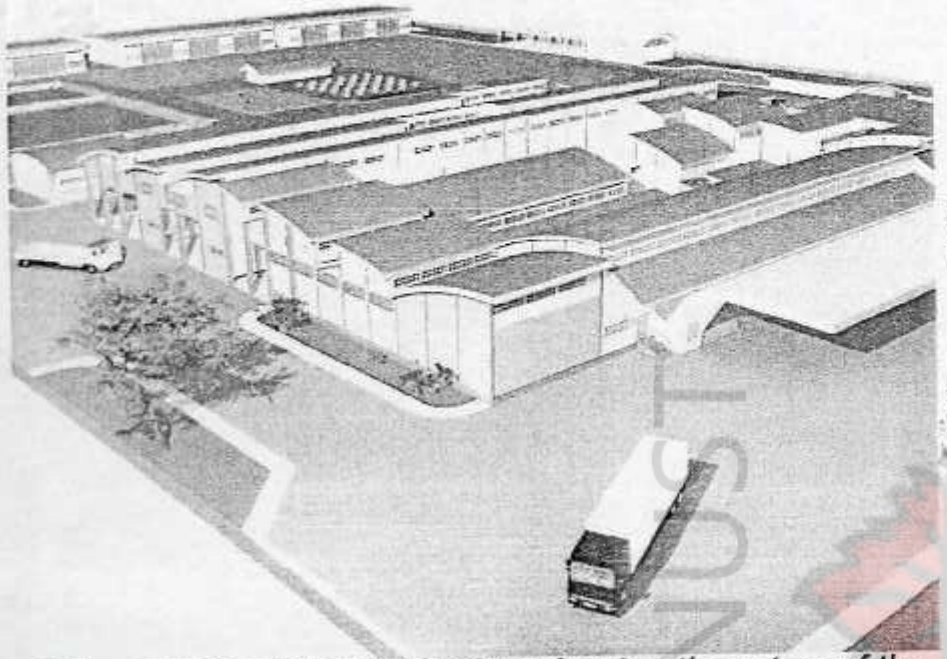
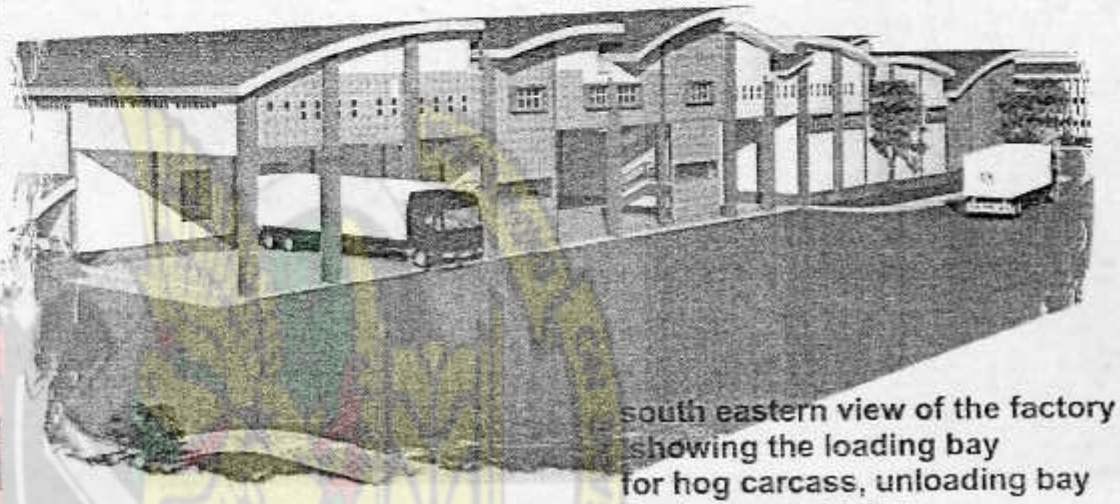
POST. GRAD. ARCH. I

DATE: JAN. MAY 2009
SCALE:

EXTERIOR PERSPECTIVE

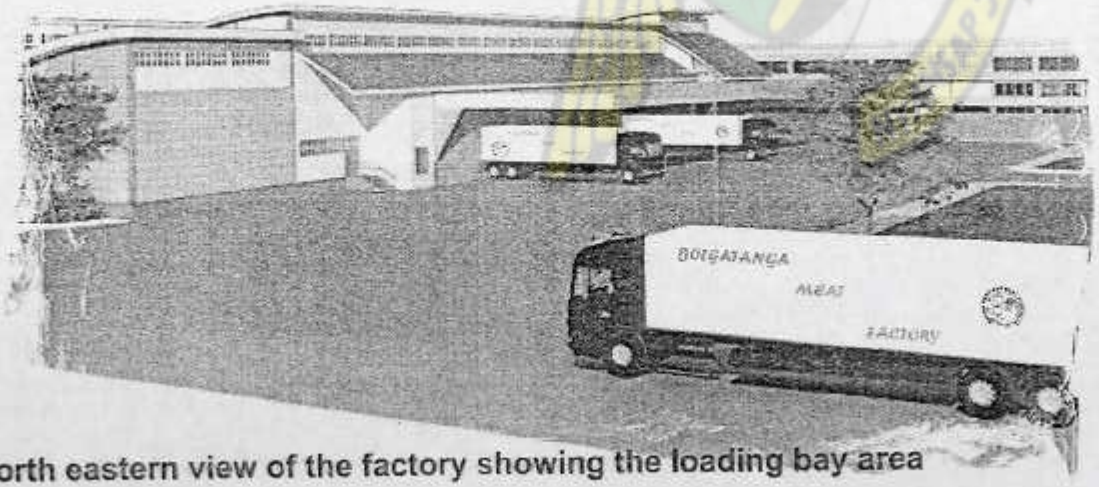


Orthographic view of the factory showing the nature of the roof



south eastern view of the factory showing the loading bay for hog carcass, unloading bay for dressed chicken and staff workers drop of point.

5 FACTORY



North eastern view of the factory showing the loading bay area

MEAT PROCESSING FACTORY

ZUARUNGU (BOLGA)

AUTHOR : LYNN CAMILLA ADJOA
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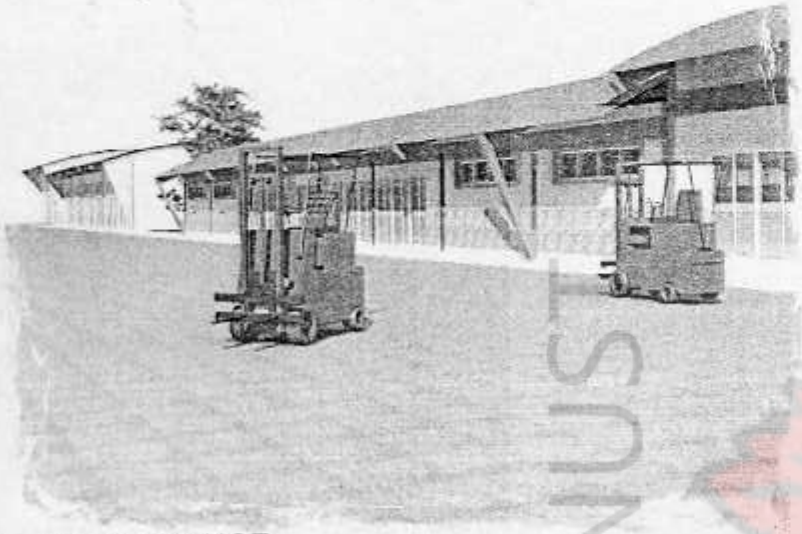
POST GRAD. ARCH 1
COURSE: DESIGN THESIS

DATE: JAN - MAY 2009
SCALE:

EXTERIOR PERSPECTIVE



7 MAINTENANCE BLOCK

3 CANTEEN

The Canteen has enough space to house 150 workers

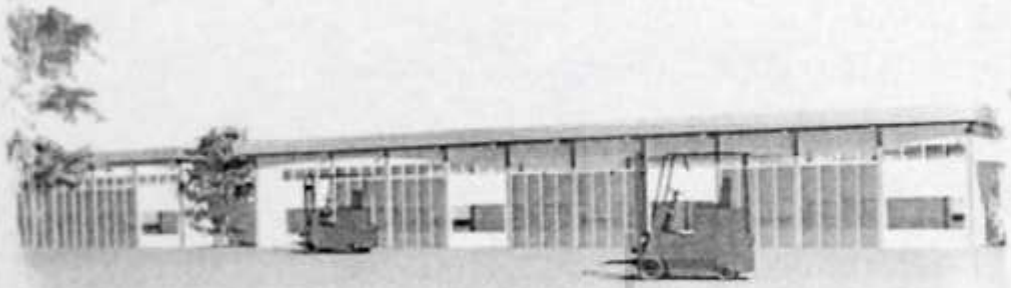
6 POWER HOUSE

The power house consist of the boiler house, pressure room, dwarf engine room, air-conditioning plant, electricals and power distribution room

MEAT PROCESSING FACTORY | **ZUARUNGU (BOLGA)**

AUTHOR : FUNN GAMZIIA ABJOA

EXTERIOR PERSPECTIVE



9 WATER TREATMENT AND STORAGE AREA

This water treatment plant can store 1141500gals of water which is enough to keep the factory running for 3days without water.

8 AUTOMOBILE WORKSHOP

The automobile workshop has solar panels to capture the east and west sun to generate electricity

- a manure room
- b main incinerator
- c ash damp room

MEAT PROCESSING FACTORY | **ZUAKUNGU (BOLGA)**