KANO ABATTOIR COMPLEX

BY

ALI, SANI MUHAMMAD
B.Sc.(Arch.) A.B.U. Zaria.

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Department of Architecture
Faculty of Environmental Design
Ahmadu Bello University
Zaria, Nigeria.

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D E D I C A T I O N

I dedicate this work whole-heartedly to my loving parents for their endless support materially and spiritually.

A C K N O W L E D G E M E N T S

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CHAPTER ONE

1:0 GENERAL INTRODUCTION

1:1 INTRODUCTION

Vegetarians claim that food of animal origin, such as meat, fish, eggs and milk, is not essential for adequate nourishment. This claim is valid in that vegetarian diets can be satisfactory if they are carefully selected to provide all necessary nutritional elements. But the danger in a purely vegetarian diets is that either through ignorance or poverty the necessary amino acids will not be supplied in sufficient amounts to meet the dietary needs. Meat due to its compactness, and a source of easily digestible proteir from animals, is of utmost importance in the human diet.

In protein-deficient areas of the world, meat is not a simple food, such as cassava or banana, or other cereals, but is a life and health giving component of the physical and mental health of a nation. The crippling effects of clinical and subclinical protein deficiences are well known: high infant mortality inability to learn in the case of School children, low working efficiency, diminished resistance to disease, apathy, lethargy, are factors to be taken into consideration when discussing the role of meat and meat products.[1]

But meat as a highly efficient source of multifarious proteins of the animal body, is however, a perishable commodity and its poor handling daily exerts great public health hazards and economic toll.

1 Mann, (1984).

This problem is more acute in the third world countries, where the factor of low technical knowhow and very low per capita income, plus a tropical environment and a population with low sanitary standards, all combine to make the provision of clean and healthy meat to the general public a difficult task.

Thus, it is against this background, that the Federal Government planned to give the issue of provision of improved food supply to its populace a priority, among the steps taken is the construction of modern and hygienically acceptable abattoirs throughout the country. The Federal Government also directed the various state governments to build standard slaughter slabs and slaughter house in their villages and townships respectively.

The then Northern Nigerian towns like Kaduna, Kano Bauchi, Nguru, Maidugri, Sokoto and Makwa, were provided with standard modern hygienically acceptable abattoirs, with the minimum of daily throughout standing at about one hundred (100) livestock units. Kano State Government in response to the Federal Government appeal by 1976 had about thirty eight (38) slaughter slabs and slaughter-houses throughout the state.

1:2 THE PROBLEM

The 1970-73 Sahelian drought greatly influenced the quantity and quality of livestock produced and slaughtered, hence the supply of meat from within the country did not meet the internal demand, therefore the margin had to be

bridged with imported chilled and frozen meat especially from the Americas. This trend continued even after the draught, which continued to drain our foreign exchange earnings.

In view of the above the then governor of Kano State late Alhaji Audu Bako, decided to build an ultra modern export oriented abattoir to supply the Southern parts of the Country with fresh meat instead of the traditional way of transporting the livestock alive to these areas. This brought the number of abattoirs to two in Kano-metropolis. But as the new abattoir is solely designed for external market, the old abattoir is allowed to operate alongside the new one to cater for the internal market, that is the whole of Kano metroplis.

But the old abattoir is under pressure from the encrouching town development, because of its location in a residential zone, as a result expansion land is lacking. As it operates over its designed capacity, some activities even take place outside the slaughter hall, public conveniences are almost absent, workers have no proper provision nor for whole sale- meat market. These, and other reasons raise some doubts on the quality of the meat produced there.

In view of this a negotiation is going on between the Kano State Government, the Federal livestock-Department (FLD) and the Butchers' Copperative- Society on transfering both the livestock market and the old Abattoir to a more

adequate and more convenient site.

1:3 THE PROPOSAL

The thesis, therefore, is aimed at planning this new environment so as to prevent further- spread of zoonotic and meat borne diseases in both humans and animals, whilst keeping it free from Pathogens of animal origin; and to achieve increased and improved meat production and handling hygienically.

With this in mind the following objectives are formulated to achieve the above goal:

i. Bringing together the marketing of livestock, the livestock feeds, the abattoir and a wholesale meat market under one umbrella, to ensure efficient and coordinated meat business;

ii. to broaden the economic activity of the trade through the reduction in losses in meat by-products;

iii. employing the use of simple facilities with a hybridized technology for hygienic slaughtering and handling of meat;

iv. to humanize the environment with more emphasis laid on the worker rather than on the machinery, this ensures more job satisfaction and improved efficiency.

Reference:

1. Mann, I. (1984), Guidelines on Small Slaughterhouses and Meat Hygiene for Developing Countries. WHO Publication, Geneva. pp. 46 - 48

CHAPTER TWO

2:0 METHODS OF SLAUGHTER

2:1 SLAUGHTERING PRACTICES IN NIGERIA

Nigeria probably possesses and utilizes one of the most interesting ranges of abatoir facilities to be found anywhere in the world. It ranges from the comparatively sophisticated ones to the uterly primitive ones and includes the examples of degeneration from higher grades to lower ones. In studying the various types of slaughtering facilities it is obvious that the evolution and development ofabattoir system in Nigeria is completely interwoven with traditional methods of trading and commerce and dictated to no small extent by cultural and religious beliefs and practices. It is equally apparent that some of these requirements in the cause of time have become distorted and entrenched by vested interests. Before discussing further the various grades of slaughter facilities, their weaknesses and probable causes, it is necessary to mention first, the trends in the meat business today.

The butchers are divided into about three to four categories; there are those who have got nothing to do with the abattoir or meat and its products, but attach themselves to the livestock market, they are referred to as the livestock-dealers. This groups move about from this village market to another buying the animals, then summons them to the city

livestock market, where they sell them for slaughter or keep them there before transporting them to the Southern parts of the country. The second group buys the stock from village markets or from the city livestock market, but relatively smaller in number when compared to the first group, the livestock bought are meant only for slaughter in the abattoir. This same group slaughters and prepares the animals for sale on a wholesale basis. The third group is that which buys the prepared meat from the wholesale meat market for resale to the public at retail prices. The fourth group may include those people buying and selling stomaches, viscera, head and legs, hide and skin and are called the slaughtermen.

The system is perpetuated by lack of capital and is characterized by a complicated credit system that exist to keep the small butchers in operation. Large scale butchers and various middle men and traders provide the credit facilities, thus forming the link between the cattle traders (say th Fulanis) and the butchers. The small- butcher may also undertake his own slaughter and for this purpose employs three to four slaughtermen who carry out all operations from flaying to butchering with the exception of the acutal killing, which is reserved for the Malams, who ensure that killing is done according to Islamic law.

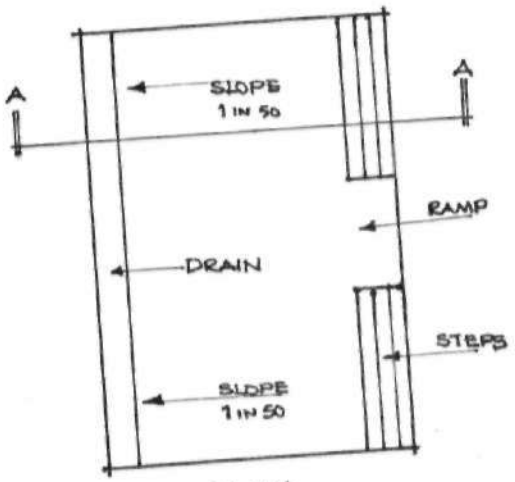
Attempts to overcome these serious defects were made by designing the slaughter slab in such a way that the concrete hard cover on which all operations take place now got some plat forms on which the operations are done instead of the floor; and the concrete floor is sloped into an open drain intended to carry away the waste from the slaughter operations. It has also got a protective-parapet wall and a lockable door. However, the problem of drainage blockages are enminent as its slaughter capacity is exceeded.

Continuous efforts at improving the slaughter slab led to the evolution of an advanced typed of slaughter slab known as the slaughter-house. The basic concept behind this design is the separation of the killing operations from the rest of the of the enclosure of the slab in side a building. This is further provided with hoisting and overhead track transporting facilities, which convey the carcass into the main hall where flaying, eviseration and dismembering take place.

In practically every case of slaughterhouse, the designers' intentions are defeated, because the numbers of the livestock handled are considerably in excess of the design capacity, with the result that slaughter operations revert to open slab system, but now in a building completely inappropriate to the operations being carried out. See figures 1 and 2.

FIG. 1 OLD AND IMPROVED SLAUGHTER SLABS

a- OLD SLAUGHTER SLAB

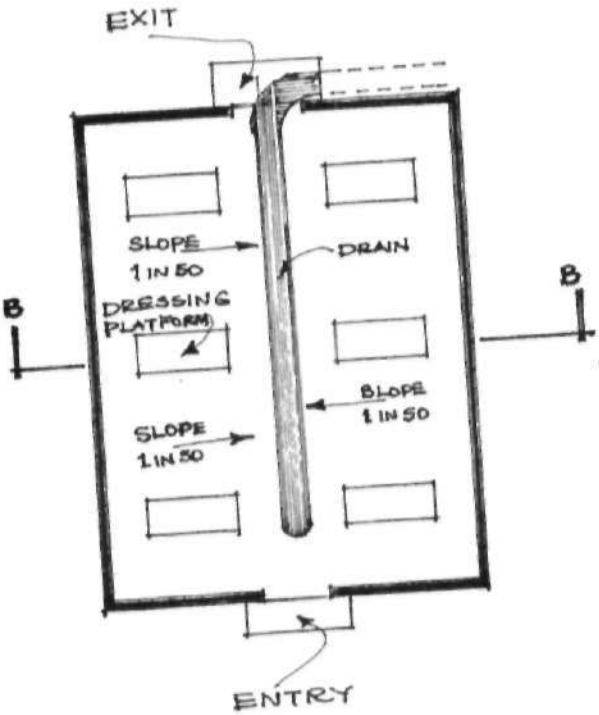


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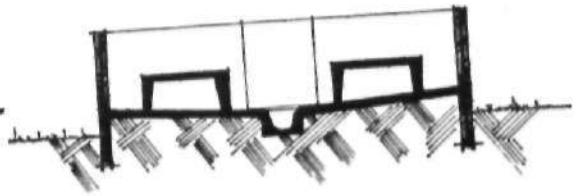


SECTION A-A

b- IMPROVED SLAUGHTER SLAB



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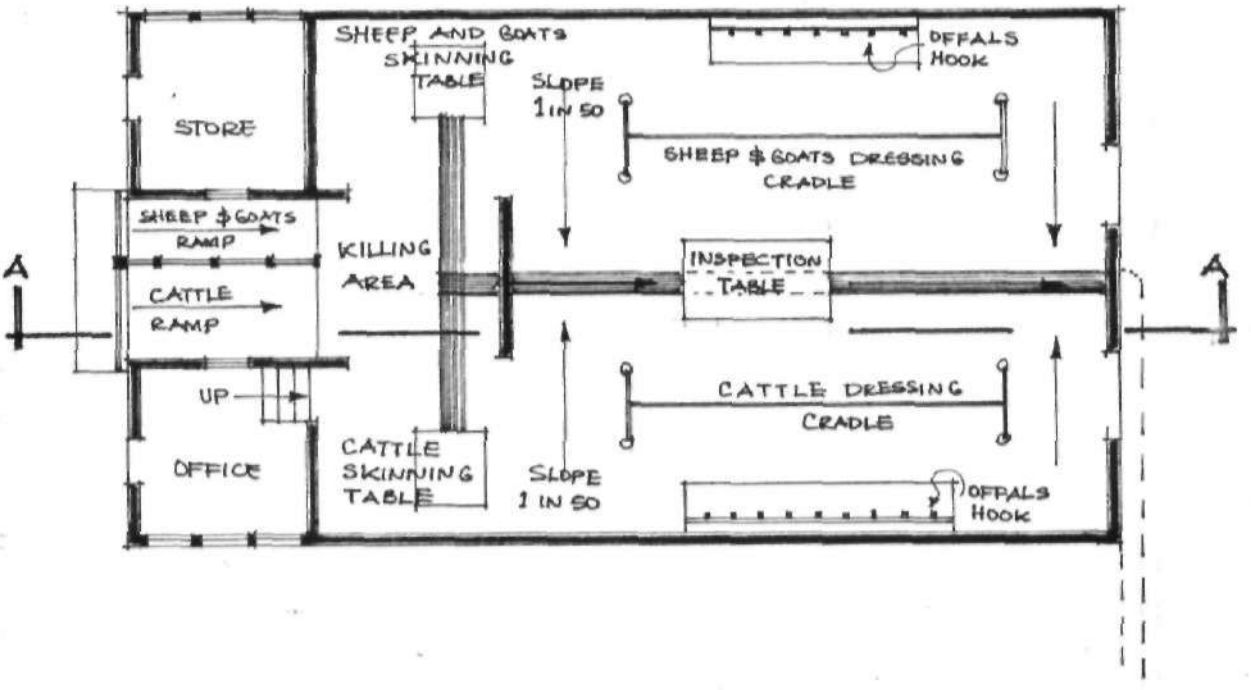
SECTION B-B

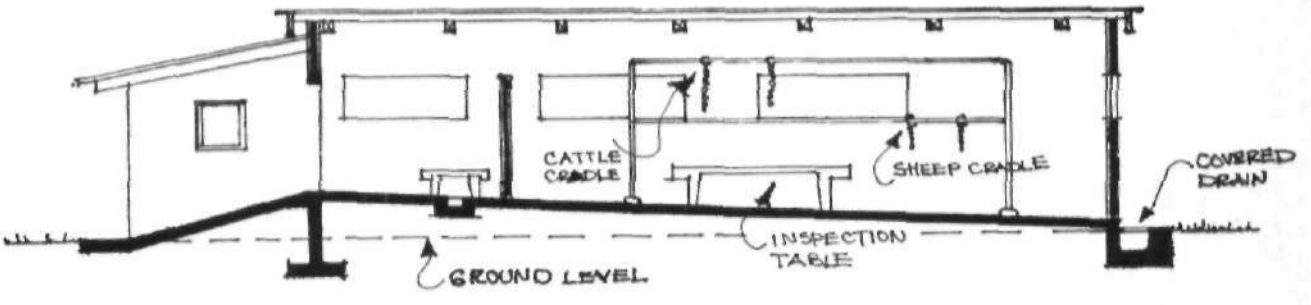
NB
THESE ARE SCHEMATIC NOT TO SCALE

FIG. 2

A TYPICAL SLAUGHTER HOUSE

PLAN





SECTION A-A

NB
NOT TO SCALE

The last stage in the evolution of slaughter facilities in the country is the modern in-line dressing system. In this system the animal is hoisted to an over-head track, after being stunned or casted and struck, then flaying and the removal of head, and legs take place. The carcass is then transfered from this bleeding rail to a lower rail where it is dehided, opened up the stomach, intestines and offals removed, inspected and conveyed away for cleaning and storage in chilled room or frozen room.. Examples of these are to be found in Kaduna, Kano, Bauchi and Mokwa to mention a few, but in all these- cases the intention of the designers is being misused. The most Comman faults to be found are:-

(a) Carrying out the slaughtering and bleeding operations on the floor instead of making use of the bleeding rails By this practice animals' flesh is not only contaninated by the blood and excreta of the preceeding one slaughtered, but also actual bleeding is incomplete.

(b) Several animals are slaughtered at once without reference to the speed at which the next operation takes place. In this way many animals are left lying about in filth unattended;

(c) Misuse of the over head track, which is designed with the animal suspended clear off the ground while the back flaying and evisceration operations are to be carried out.

In Kaduna the animal is only partially raised, while in other abattoirs the carcasses are attended while lying on the floor once again under slab conditions,

(d) Tethering live animals in the same place as that intended for slaughter:

(e) Inhuman treatment of live animals while awaiting slaughter in the holding pens.

Most of the examples of misuse of modern equipment resulted from the subconcious attempts to revert to slab conditions and were brought about by the same conditions, that is the need to identify all parts of the carcass as the property of the individual butcher and the insistence of the butchers on carrying out their own flaying and dressing with their own staff.

Marketing of beef as well as its products has been left in the hands of the butchers. Apart from gathering statistics and providing vetinary public health inspection at the abattoirs and the slaughter slabs and houses, government has not interfered very much with the system. Solutions to the problems of meat trade must necessarily be sought out as it never satisfy the expectations of both the producers and the consumers.

2:2 MUSLIMS METHODS OF SLAUGHTER

According to the Islamic law, all animals that are allowed as food must be slaughtered in such a manner that blood flows out completely. The approved method is to cut off the windpipe, the oesophagus and the two external jagular veins.

The idea underlying this particular manner of slaughter is causing the blood to flow so that the poisons contained in it should not form part of the food. The same appears to be the reason for the prohibition of blood for food.

It should be noted that, when an animal is slaughtered it is necessary that the name of God should be invoked. The following words are being pronounced when slaughtering an animal: "Bismillahi Allahu Akbar"- In the name of Allah, Allah is the Greatest of all, should a man forget to say these words when slaughtering an animal, the flesh of the animal is allowed, but if he omits the words intentionally, there is a difference in opinion as to the validity of that flesh.

Animals can be slaughtered in two ways. The first is "dhabh" that is when the gullet and the jagular veins are severed together through- applying the pressure of the knife once only. The other method is "nahr" which is more usual with a camel: and consists of spearing it in the hollow of the throat near the back bone. In the Hausa language "dhabh" is always translated as "Yanka" while 'nahr' is always translated- as "suka".

Cattle are to be killed, either for the purpose of sacrifice or for the purpose of eating the flesh for food, in the ordinary way by the type of slaughter known as "dhabh". But if they are killed by the type of slaughter known as "nahr" they are nevertheless eaten.

Camels, an the other hand, are to be killed by the type of slaughter known as "nahr"if killed by the type of slaughter known as "dhabh" they are not to be eaten. However, there are conflicting views amongst the muslim jurists, about the lawfulness of eating their flesh, if killed by the type of slaughter known as "dhabh".

Sheep and goats are to be killed by the type of slaughter known as "dhabh". If killed by the type of slaughter known as 'nahr' their flesh must not be eaten. Again there is divergence of views among muslim jurists about the lawfulness of eating their flesh, if killed by the type of slaughter known as "nahr".

Once again the method of slaughtering animals for sacrifice and other purpose is to cut through the gullet and the jagular veins, anything short of this is not sufficient. If a person who undertakes to slaughter a victim withdraws his hand after cutting only a part of those things mentioned and then applies the knife once again, and finishes off the slaughter, the flesh of the animal thus slaughtered shall not be eaten. If on the other hand, he continues to apply pressure until he cuts off the head completely what he did is detestable but the flesh of the animal then slaughtered may be eaten. If the person slaughtering an animals begins from the nape, the flesh of the animal thus slaughtered shall not be eaten.

The precise instructions in the traditions of the prophet shows that animals should be slaughtered with utmost despatch, carcasses should be- completely bled to ensure good quality meat, also only healthy animals should be slaughtered, and all injured animals cannot be slaughtered and their meat eaten by muslims, if the injuries they sustained are such that they can not survive. None of these conditions differ from the teaching of the modern meat hygiene.

2:2:1 OBSERVATIONS

i. The food of the followers of the Book (Jews and Christians) is expressely allowed in the Quran; 'And the food of those who have been given the Book is lawful for you, and your food is lawful for them' (5:5). A muslim may therefore invite them to his own table and he may eat at their table.

ii. Animals must be fully alive; thus animals in extremis from disease or accident can not be used; nor can stunning be practiced, which would result in death before the actual slaughter, if improfer voltage is used.

iii. Quick slaughter; the method used is to cast the animal so that it lies on its side, with its head towards the north while it faces the east

(towards the Qibla) and with its neck stretched out uppermost, the throat is cut by a single stroke by a sharp instrument which severes transversely the trachea, oesophagus and the large blood vessels.

iv. Complete bleeding of the carcass, this is very desirable, particularly in the climatic condition prevailing in most muslim countries, to ensure good quality of meat. By severing the large blood vessels in the neck while the heart continues to beat and the animal continues to breath, the fullest bleeing is assured.

v. Islam regards the pig as unclean. Therefore the consumption of pork is prohibited, as well as the meat from other animals which came in contact with live or dead pigs, their organs, blood or manure. It is not acceptable therefore to slaughter pigs under the same roof as cattle, sheep, goats or camels.

2:2:2 EQUIPMENT FOR MUSLIM SLAUGHTER

Difficulties often arise when methods of slaughter, humane by Western standards, are introduced into muslim communities. Because of the different schools of thought and different interpretations of the precise methods of acceptable slaughter, a single solution for universal application is not possible. The muslim is often gravely-suspicious of new slaughterhouses fitted with unorthodox equipment, and positions have actually been reached when new abatoirs have been boycotted by the muslim community.

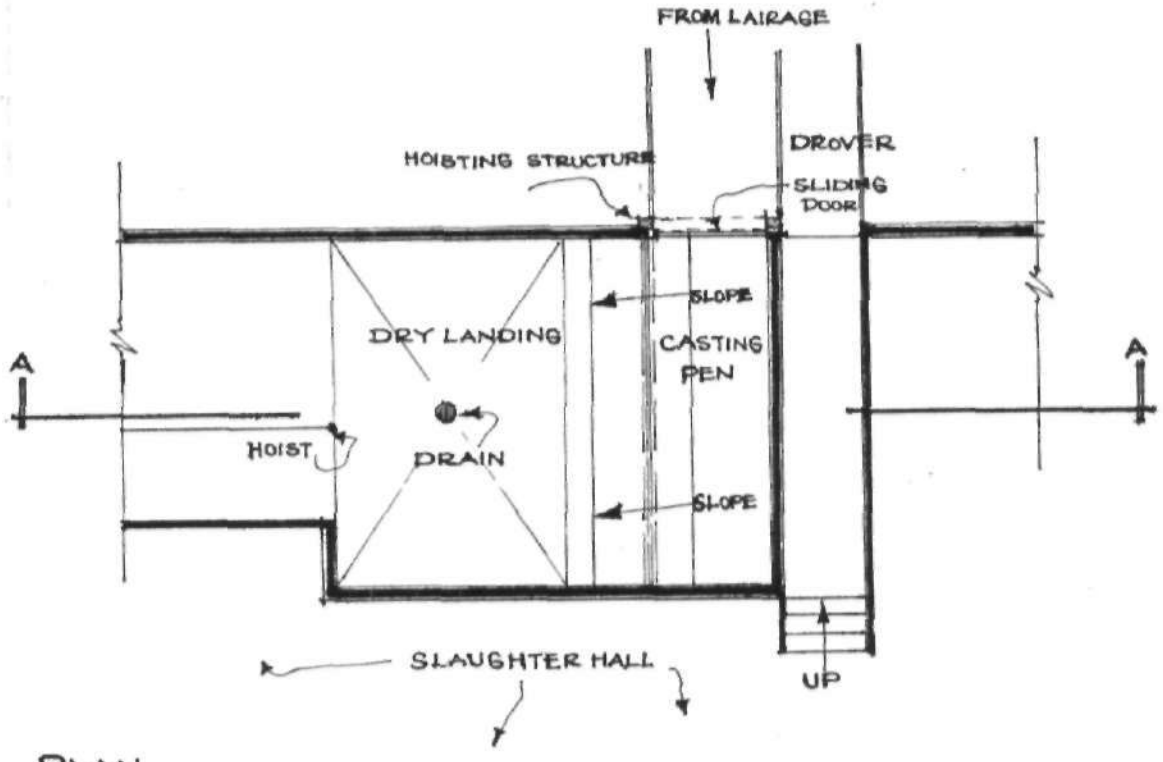
When new slaughter houses are to be built in a muslim community, they must be designed to fulfil all the religious requirements. The two main problems posed by Islamic teaching are a quick and effective method of casting prior to slaughter and an acceptable method of dispatch.

In large American abattoirs where slaughter for both Muslims and Jews were incorporated, a kind of casting pen is used whereby the animal entering the pen can be shackled through the lower opening of the gate, which is then lifted completely. The shackle is attached to the hook of the bleeding hoist and the animal is pulled out and up the hoist, so that it lies on its shoulders on the floor with its hind quarters suspended from the hoist. The head is secured to prevent movement while a muslim severes the neck. See figure 3.

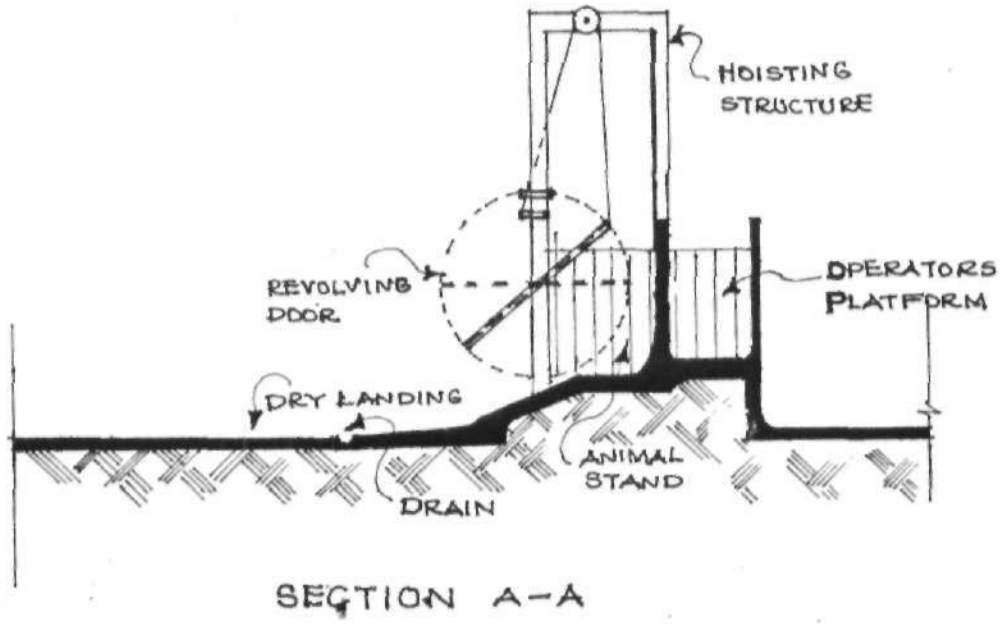
The principal objective of the casting pen and the hoist is to bring the animal humanely on to the killing floor while shackling it. The rapid hoisting of the animals hindquarters while the head is on the ground causes a temporary influx of blood to the brain, leading to partial unconciousness and blurred vision, so that the senses are numbed without the cause of machanical stunning.

A casting pen can therefore replace the stunning pen. The time taken in stunning is quite shorter than that for casting; therefore two or more such pens may be necessary to handle a large number of animals.

FIG. 3 CASTING PEN



PLAN



SECTION A–A

This casting pen allows the animal to enter the slaughter hall without seeing other animals being slaughtered and prevent bruising and slipping, its use makes the slaughtering operation safe and easy.

2:3 MODERN METHODS OF SLAUGHTER

Slaughter, in modern context, implies putting on animal to death and subsequently preparing the carcass and organs for human food. Meat, in a broad sense, refers to all parts of the carcass that are fit for human food; in its restricted sense, it includes the skeletal muscles and the accompanying body tissues (i.e, connective tissue, fat, tendon, bone, and blood-vessels).

Emergency slaughter is used for sick or injured animals. It is designed to save the meat for human food, wherever possible. Emergency slaughter should always be carried out in a special sanitary slaughter pen, and in such cases, the meat should be subjected to bacteriological examination-before final judgement is passed.

As a general rule, food control regulations prohibit the sale for human consumption of the carcass of an animal that has died from natural causes; in the case of an animal killed by accident, however, the carcass may be prepared in the ordinary way.

Experience has shown that blood is peculiarly open to contamination; hence, bacteria are more liable to penetrate and multiphly rapidly in a tissue full of blood.

Expert slaughter therefore aims at effecting as complete bleding of the animal as possible, the obvious- advantage being that this improves the keeping quality of the meat. The chief methods of slaughter in use are all directed to this end to secure maximum bleeding of the animal.

2:3:1 METHODS OF SLAUGHTER

The three chief methods are:-

(a) Slaughtering without previous stunning,

(b) Puncturing the back of the neck prior to bleeding (Pitching);

(c) Stunning prior to bleeding.

(a) SLAUGHTERING WITHOUT PREVIOUS STUNNING:-

This may be carried out by a stab in the chest or throat, or by cutting the animals throat. Large blood-vessels in the anterior thorax may be severed by a stab and the animal bleeds to death relatively quickly, but bleeding from the throat is the most generally used method. After fettering the animal, the throat is cut so as to severe the carotid arteries and the throat veins. In so doing, the oesophagus is frequently damaged or even severed.

(b) PUNCTURING THE BACK OF THE NECK PRIOR TO BLEEDING PITCHING:-

To pucture the neck, a knife is inserted between the first cervical vertebra and the occipital bone. The medulla oblongata is damaged and the animal at once callapses and remains motionless even during the subsequent bleeding.

Breathing and heart action are greatly reduced, because the centre of these functions lies in the part of the central nervous system which is injured. There is no doubt that a well performed neck puncture makes an animal insensible below the slab, but it does not appear to produce immediate unconsciousness.

(c) STUNNING PRIOR TO BLEEDING:-

Immediately prior to bleeding, the animal is rendered unconscious by one or other of these means:-

i. A striking instrument,

ii. A pistol (with bolt or bullet),

iii. Electricity

iv. gas.

i. A STRIKING INSTRUMENT:

A club or maul may be used as a striking instrument for stunning. The blow must be dealt with precision and force so that the roof of the skull is smashed at the outset, thus causing the animal to loose consciousness-immediately. In cattle the aiming point is the intersection of the lines drawn from the base of the horn on one side to the inner corner of the eye on the opposite side. At this point the brains is directly the thinnest portion of the cranium, and the blow has the greatest effect. In sheep and goats the brain is more readily reached from the back of the neck. Pigs have a well developed frontal cavity, which makes it difficult to affect the brain by a frontal blow, and in these animals the blow should be aimed one fingers-breadth above a line drawn

between the animal's eyes.

This method of stunning should not be used unless the head of the animal has been secured, as otherwise the risk of the blow missing the right spot, with consequent unnecessary suffering to the animal, is high. Use of the pole-axe also requires precision and force; it should be aimed at the same sports as the maul. The pole-axe is an iron pick, generally fixed to a wooden handle. If properly applied, the axe is driven in to the cerebrum and the animal loses consciousness; it is not frequent, however, for the blow to miss the right spot.

ii. A PISTOL (WITH BOLT OR BULLET):-

In many Countries striking instruments have been replaced by pistols discharging a free bullet, of which are a number of different kinds. Usually these are fired by a gentle blow with a hammer which projects the bullet into the brain. Such pistols should be handled with great care as accidents are not uncommon, some due to misdirected shots and some to the bullet's having passed through the animal's head and ricocheted into the slaughter-hall.

To eliminate such risks, pistols have been designed where the bullet is replaced by a bolt which, after firing, is returned to its original position either by the exhaust-gas or by a spring. Firing is done by pressing the tigger with the same hand that holds and directs the instrument. In consequence, the pistol is easy to handle and very suitable for stunning shy animals, particularly

horses. One disadvantage is that the bolt may get stuck in the fired position and become damaged before it can be freed from the animal.

iii. ELECTICITY:-

In the past years the above stunning methods have been increasingly supplanted by electrical stunning. This is a method based on observations made in 1902 by a French physiologist, Leduc, who showed that it was possible to bring about complete narcosis in animals by leading a weak direct current through their bodies. Leduc's method was not directly applicable to slaughter, where the purpose is to stun momentarily, for this reason. Muller, a German, used an overdose of alternating current together with direct current at a tension of 45-60 volts. The type of instrument in use looks like a pair of tongs. The electrodes are fastened to the Jaws of the tongs and the heads for the current pass through the handles. The electrodes are furnished with a sponge dipped in salt solution to enable the current to pass more easily through hair and hide. They are placed on the temples of the animal for the current to pass through the brain. As a rule, alternating current at 70-90 volts is used for calves five seconds suffice and for pigs 10-20 seconds. The longer time required for pigs is necessary on account of the greater resistance offered by the skull of the pig, and because preparations for pig slaughter take longer time.

The moment the current passes through, the animal is seized with muscle spasms. These top 10-20 seconds and the head drops towards the floor, at the same time the legs execute reflex walking movements. If the animal is left undisturbed it regains consciousness in three to five minutes when it behaves as though nothing had happened. Electrical stunning thus produces mere lack of consciousness for a short period, whereas stunning by machanical methods causes fatal injury to the animal. It is there-fore important for bleeding to be carried out as soon as possible after electrical stunning. If the animal should regain consciousness during bleeding, this indicates that the method has not been properly applied, not that it is imperfect.

Stunning by electric shock is a method that has now been in use for a number of years, but a new type of apparatus has recently been perfected in the Netherlands. This again originated in human medicine, where electric shock is utlized in the treatment of certain psychoses. For slaughtering purposes, a special apparatus has been devised, known as the "Elter-apparatus". This consists of stunning tongs similar to those used in ordinary electrical stunning, together with a device for adjustment of current to the watt-seconds desired, all built in to a special portable case and ready for connexion to the regular power supply. The power per second required for successful stunning is estimated as follows:

1. Small animals - 198 watts
2. Cattle and horses - 285 watts,
3. Bulls - 420 watts.

When the current is applied, the animal immediately looses consciousness and falls down with legs contracted and head bent forward. Nystagmus and cessation of breathing and of reflex action are observed, after which the legs, are finally stretched out to full. When the throat is cut, bleeding is effected very rapidly, helped by the return of the breathing. All- reports confirm that more complete bleeding is achieved by this method than after stunning by any other means. If left untouched, the animal will invariably regain consciousness and be quaite normal again in some 10-15 minutes; no histopathological changes of the brain have been found.

Stunning by electric shock has a number of further advantages over other methods. First, the resultant state of unconsciousness is very deep; secondly, the strength and duration of the current may be adjusted exactly to suit the kind of animal; and, thirdly, complete unconsciousness is- invariably produced. The captive-bolt pistol, for instance, does not always succeed in giving third result; it may fail by reason of a very large or abnormally shaped head in the animal. Thus from the stand-point of protecting the animal, the electrical method is infinitely to be preferred, and so far it has worked without a hitch where it is in use. By eliminating the pistol shot or blow on the head, it has greatly contributed to more

humane practices in slaughtering and it is to be hoped that the method will be studied closely to ascertain its validity in Islamic law so that it could be used in the Islamic world.

iv. GAS:

This is an anaesthetic preslaughter stunning method successfully used with carbon-dioxide on pigs only. In an apparatus called "oval tunnel" pigs are admitted singly through a hand operated gate to a conveyor belt which is divided into ten (10) Compartments. The conveyor transports each pig through the oval tunnel which contains amixture of 62-70% carbon-dioxide in atmospheric air, and on exposure to the gas the pigs become anaesthetized. The pigs, as removed from the chamber and the conveyor belt, are then skackled mechanically by the leg on to the-bleeding rail where they are stuck and bled.

CHAPTER THREE

3.0 GENERAL PRINCIPLES ON:

'Siting And Organisation Of An Abattoir'

It was quite usual for an abattoir to be erected near a cattle market so that animals were not diven long distance, through the strees before reaching the slaughter house. This requirement recognizes the fact that animals should rest enough at the slaughter house before slaughter. It also offered the butchers the opportunity to purchase their stock and within a short time get their prepared carcasses ready for sale, as the question of retaining the animals at lairage for the period of 24 hours did not hold. This also reduced the usually large area being kept aside for lairages. Going side by side with the siting of an abattoir close to a cattle market is the question of whether grazing land should be provided contiguous to an abattoir, for accommodation and feeding of cattle and sheep, is a matter of opinion, though it is contended that animals settle better on grazing land than in an-enclosed lairage.

Another area which is worth noting is the question of including a meat market within the premises of an abattoir. Where a large proportion of the meat to be produced at any proposed new slaughter house would be owned by wholesalers there would be need for a meat market where the carcasses could be displayed for selection and purchase by retailers.

by retailers. In such cases the site selected should enable the market to be established adjacent to the slaughter house and the accommodation should provide facilities for meat to be run on rails direct from the meat loading bank of the slaughter-house into the meat market, thus avoiding the loading and unloading operations that would otherwise be involved in the carriage of the meat from the slaughter house to the market.

3.1 SITE-CONDITION

Abattoirs may be sited in urban, rural or nominated industrial sites and each has both advantages and disavantages. But as the advantages of a rural site generally out weigh those of the other sites it is recommended that a rural location be chosen where possible. The tendency to build only one abattoir for as large as possible a group of towns or villages should be strongly encouraged, as this reduces operating costs. Public abattoirs should consist of one storey buildings, a though in certain circumstances multi-storey constructions are to be recommended, especially if available space is limited and the price of the land is high, it should also be pointed out here that this type of building has its drawbacks. For example, frequent and costly maintenance is necessary to prevent the deterioration of ceilings through contact with waste products, blood, urine, acids, etc.

Abattoir's should be readily accessible both to users and to livestock, by road, and by rail. The distance from workroom to butcher's establishments should be as short as possible. Any slaughter house situated near a river should be accessible by water as well as rood and rail.

Special attention should be paid to the facilities for waste-water disposal. From this point of view, the ideal site would be on a hill, near a water course or lake, in to which it would be possible after a simple purification precedure, to discharge wastes, such as the contents of the animals digestive tract, blood, etc.

Supplies of drinking water, which are indispensable, do not as a rule constitute a problem of any magnitude. It must always be borne in mind that abundant water is essential if the abattoir is to be kept impeccably clean. Water for washing should be recovered from the water used in the refrigeration process if water is used.

Public health acts and regulations are often applicable to the erection of a slaughter house. Where legislative measures do not exist, there are certain considerations which should always be observed.

These are:-

i. Slaughter houses should be sited away from dwellings and in planning their erection the future growth of the town should be taken into consideration.

ii. The road leading to the slaughterhouse should not pass through residential areas.

iii. Proximity of dwellings should be very carefully considered, to obviate nuisance to the human population and to prevent contamination entering the slaughterhouse from the neighbourhood.

iv. Consideration should be given to the direction of the prevailing wind. Abattoirs should be constructed neither to the leeward nor windward sides of the town.

v. The land could be landscaped and planted with trees, to provide wind breaks, shade and shelter, if not to make the building more attractive.

vi. Special attention should be given to an adequate water supply and arrangements for drainage.

vii. Easy access for livestock by road, rail or waterway and proximity to supplies of power and light should receive attention.

viii. In erecting an abattoir in the vicinity of a market, or even in a market area, consideration should be given to the problem of congestion, containation and-confusion which would probably arise from such siting.

ix. Rather than build an abattoir large enough to deal with the periodic kill peaks, it is considered advisable for the authority to make it only large enough to deal with average daily kills and to permit extended hours of slaughter during peak periods.

3.20 ORGANISATION

A modern abattoir is a factory in which cattle and other livestock are slaughtered for conversion into meat. It must cease to be a mere aggolmeration of primitive buildings and sheds, unhygienic both for the men who work in them and for the housing of animals and the preparation of carcasses.

The design of an abattoir is primarily a functional problem of which the solution, so simple at first sight, is in-fact extremely complex. The design varies from country to country, with different usage and custom, and even from town to town, but as a guiding principle it should be borne in mind that every abattoir should render the greatest possible service at the lowest possible cost.

In general, an abattoir must be functional, compact in space, and designed for economical throughput in-relation to the capital and operating costs. There must be-satisfactory working conditions, safe equipment and-provision for the highest sanitary standards. Internal communications should be such that there is efficient and sanitary flow of the work. There must be facilities for-meat inspection and easy removal of diseased carcasses or orgains. The whole structure must fit in with the-serrounding country and suit local climatic conditions.

There are some common features which apply to the layout of any abattoir, irrespective of its size or design.

They are:-

3.21 Pre-Slaughter:

When it is expected that livestock will reach the abattoir by rail or truck. Provision has to be made for an off-loading ramp. It should be of sufficient lenght to accommodate the arriving vehicles and of adequate height to off- loading. The surface, wherever possible, should be of concrete and nonslippery. Satisfactory preslaughter accommodation is essential so that animals may rest and recover from a journey, they may be fasted and reach the abattoir in a condition favourable to the production of meat of good keeping quality. This accommodation or lairage must allow for easy inspection of the animals and should include provision for the isolation of diseased stock. A supply of wholesome water should be provided.

3.22 Humane Slaughtering:

There should be direct and unobstructed entrances from the lairage to the stunning pens so that the animals may be stunned without seeing bleeding operations or-partially dressed carcasses. Where available, electric power should be used to stun animals, where the socio-religious culture of the people permits this.

3.23 Division Between Clean And Dirty Operations:

The live animals should enter at one end of the building and the dressed, inspected, fresh or chilled carcasses leave at the opposite end.

The arrangement should be such that the carcasses move in one direction and the dirty offal (hides, feet, tripe, guts) in another, without any risk of contaminating the meat.

3.24 Meat-Inspection:

An over head rail enables the inspector to make the necessary examinations without holding up the other operations. The provision of hooks on which to hang the offal opposite the dressed carcass assists in its identification. A meat inspectors office should be provided, together with accomodation for keeping records, specimens and laboratory equipment.

3.25 Passed, Detained and Condemned Meat:

No animal should be slaughtered for the production of meat or meat products unless it has been inspected before slaughter and found healthy by qualified persons. Animals showing signs of sickness should be separated from all others and must be slaughtered seperately. Having been inspected, the carcasses of diseased animals, those unfit for human consumption may be separated from passed carcasses.

3.26 Hanging Rooms:

The primary aim of providing chilling facilities is to protect carcasses against infection by micro-organisms which could result in surface slime formation or bone taint in the deep muscle.

Refrigeration also gives a measure of protection against other forms of meat deterioration during storage, such as oxidation of the fat, adverse changes in the colour of the superficial tissues and their undue desiccation. However, the risk of infection and deterioration of carcass meat is less likely when consumned rapidly after slaughter, say within 24-36 hours, as happens in many of the rural areas and townships served by abattoirs with low animal throughputs. It is therefore essential, especially in the tropics, to provide refrigeration to any new abattoirs to be built.

3.27 Triperies:

It is necessary in under-developed countries, to provide large triperies to deal with the offal for - human consumption.

3.28 By-Products Plants:

An abattoir should also include a plant for the processing of by - products, such as blood, bones, inedible offals and also hides and skins. But edible by-products should be sold fresh to avoid the expense of processing; because it is much more profitable to sell the by-products fresh or preserved than when it is processed as meat-meal.

3.29 Supplies of Steam and Hot Water:

Besides the supply of ample, portable and well distributed water throughout the premises under adequate pressure and in quantities sufficient for all operation needs, supplies of both hot and cold water must be available. At this jucture the size of the producing boiler will depend upon whether a by-products plant is planned.

3.210 Welfare Facilities:

There must be provided for the use of all staff employed on the premises:-

a. adequate lavatory accommodation;

b. adequate dressing room accommodation;

b. adequate hand washing basins with hot and cold water supplies.

d. a suitably equipped first aid box or cabinet;

e. a suitable mess room for boiling water and cooking of meals.

3.211 Accommodation For Meat Inspectors:

Adequate office accommodation and dressing room with a working laboratory suitably located in the abattoir should be provided for the meat inspectors.

3.3 Accessibility

3.31 EXTERNAL TRANSPORTATION

Animals may be moved from one place to another by any one of the following means:

i. driving on the hoof;

ii. road transport;

iii. rail transport;

iv. Sea transport.

Moving animals, whether by driving on hoof or transporting by rail or by any other means, will cause a change in their physical condition. This change is always evidenced in the quality of the meat. Fractures, bruises, and such like injuries may be incurred, and suffocation is a further risk with which all transportation systems are characterized. Furthermore no consigner of cattle overlooks the loss of weight that is caused by transportation, whatever its nature.

This loss of weight in livestock during transport depends upon various factors, including:

i. the condition oftheanimals at the time of loading andthe kind of treatment received during the drive to the place of loading;

ii. the length of time between thelast feed and loading;

iii. the kind of food animals are given before loading;

iv. the weather conditions prevailing at the time of loading and during transportation.

v. the kind of transport to the market;

vi. the kind of treatment during halts at stations in transit;

vii. the time of arrival at the market. (The loss of weight will be considerable if the animals have to cover a great distance on the hoof after arrival at night).

3.32 Internal Transportation

Considerable space is required for the movement and parking of vehicles on the site, and this should be appreciated at the time of site selection. Separation of traffic should be thought much early in the preparation of planning the abattoir. Heavy trucks, for example, which are mainly used for transporting of live animals to and from the complex, should have a separate route and a separate parking lot. This should be followed by small and light vehicles route, cars and light vans, the former belonging to the staff and customers while the latter is used for transporting of meat outside the complex. Finally pedestrian walkways should have short and direct-accesses to thevarious sections of the complex.

3,33 Meat Transportation

The recommendations made concerning pre-slaughter care, slaughter slabs, slaughter-houses, abattoirs, meat inspection and handling of offals have one aim that is to ensure that inspected and stamped meat derived from healthy, properly slaughtered animals reaches the consumer clean, unspoiled and in a wholesome state, free from danger of infection or intoxication.

Great care should be exercised in the methods used for transporting meat from the place of slaughter to the place of sale. Unhygienic transport, exposing the meat to heat, dust and bacterial contamination can nullify all the measures taken at the most hygienic slaughter facility and properly constructed and operated butcher's shop.

Unhygienic practices create favourable conditions for bacterial contamination of meat, leading not only to spoilage, but also contribute to the spread of meat borne infections and intoxication to the consumer. It is essential, therefore, that strict regulations be applied to the method of meat transport.

The following factors should be looked into - quantity of meat to be transported, distance between slaughter place and butchers' shops, time needed for

the transportation, the pre-vailing socio-economic factors and the cost of the proposed system.

Where the throughput is large, special meat-carrying motor vehicles, in-sulated, metal lined and if possible equipped with hooks for hanging the meat are recommended.

For small quantities of meat, closed aluminium or-galvanized tin containers may be used which can be carried or special tricycles or on ox-carts. For short distances, the metal meat containers should be provided with two hamdles-enabling them to be carried in a sanitary way.

Where abattoir is operated in conjuction with an adjacent wholesale meat market there should be facilities to enable the carcasses to be run on rails direct into the market.

3.4 SERVICES TO THE SITE

3.41 Water Supply

i. Water must be ample in quantity, potable and subject to the standards, and tests, laid down by the authority of public health;

ii. Distribution throughout the works must be under adequate pressure;

iii. Chlorination is essential, providing a minimal one part per million residual chlorine, and storage facilities permitting at least a 20 minute contact period for normal lethal effect;

iv. Hot and cold water, and steam must be provided both in slaughter and edible product handling accommodation. Hot water storage must be available to meat peak demands;

v. Steam points conveniently located are necessary for sterilisation and cleansing purposes, wherever edible products are handled.

vi. Many authorities demand 'on site' water storage sufficient for one day's normal consumption. The recommended basis of calculation is 100 gal/day/pig, 60 gal/day/cattle, 10 gal/ day/sheep; 25% should be added to the total.

3.4.2 Drainage

Internal drainage shall be carefully planned, particularly for all wet operation areas.

i. Drainage slope of floors shall normally be 1 in 50 though 1 in 100 will suffice for dry working areas, with the fall uniformly made to avoid flat spots which collect liquids.

ii. The use of either open channels or valleys, provided metal gratings or checker plates are installed, or drainage lines or pipes, is acceptable.

iii. Drainage pipes shall be a minimum of 10cm in diameter for normal purposes being constructed for use within the works, of cast iron or galvanized metal.

iv. Open channels from unclean areas shall not pass through clean areas.

v. Where drainage pipes are used, at least one inlet shall be provided for each 40 sq.m. of floor,

vi. Where dressing rails are provided, drainage channels or valleys below the rails, are essential.

vii. Each floor drain or channel must be equipped with a solid trap , and properly vented to the outside air.

viii. Drainage pipes from wash basins or other equipment shall not be permitted to drain on the workroom floor.

External Drainage:

Plan shall ensure direction of all effluent pipes or drainage channels away from- edible product handling premises, with adequate storm water provision to avoid flooding into any buildings. as with internal drainage, open channels shall be covered wherever movement- occurs in close proximity to buildings.

It is recommended that whenever possible all by-products accommodation, catch basin etc, shall be sited downward of the edible products department where a natural slope exists.

3.43 WASTE DISPOSAL:

i. Wherever municipal sewerage facilities are available, and such effluent can be accepted by the municipality, such facilities should be utilized if permitted.

ii. Effluent disposal systems in the absence of municipal facilities must be carefully planned in regard to the surroundings, being discussed with the local Health Authority, whose approval must be obtained.

iii. Catch basins, setting tanks for recovery of grease, and other matter must be suitably located away from edible product accommodation or loading facilities.

iv. Where any effluent discharges into a running stream or river, there shall be sufficient flow volume to carry the effluent away at all times of the year, without causing a nuisance, constituting a menace to the health of persons using such water for domestic purpose, or interfering with other industrial users.

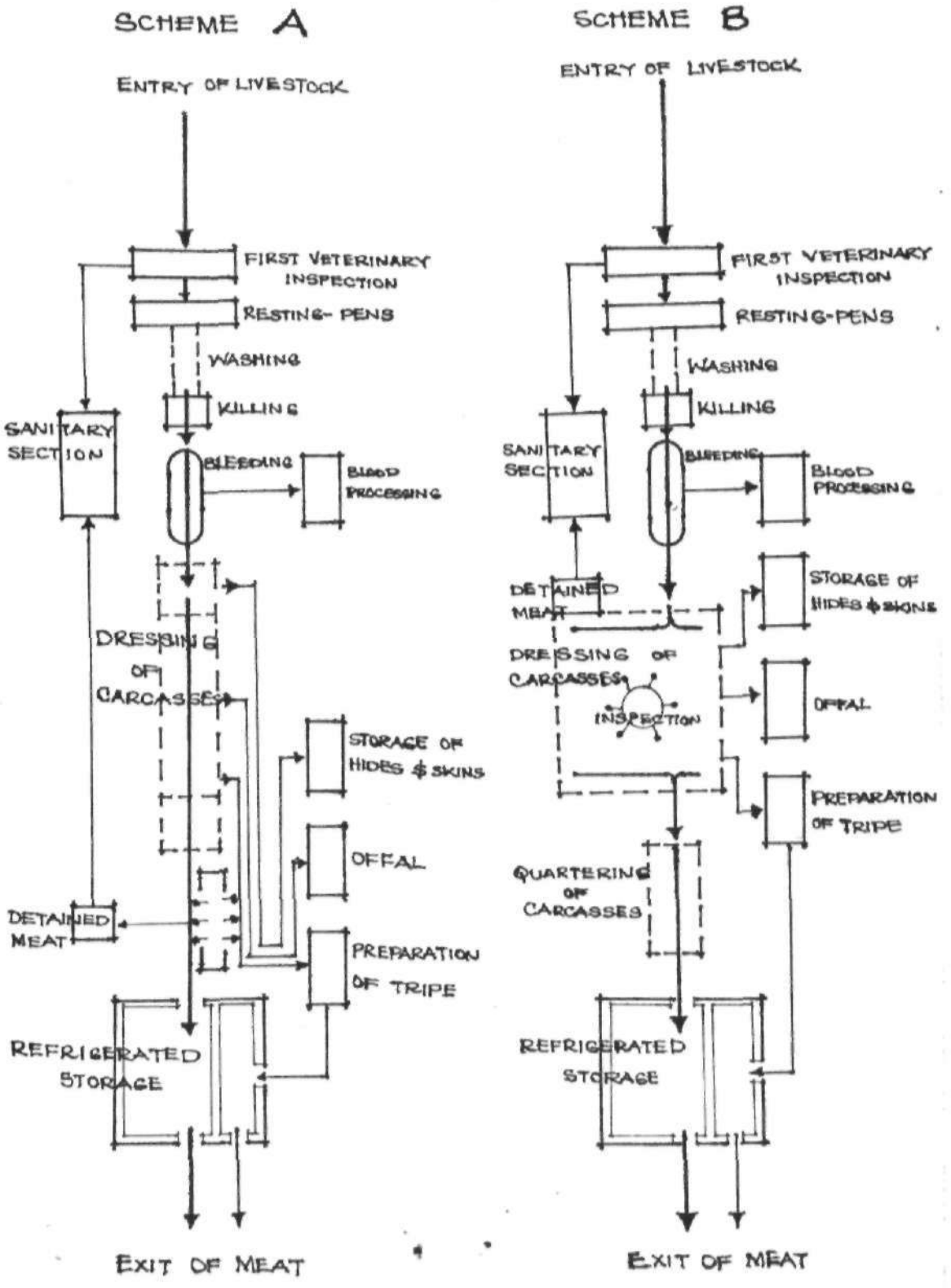
3.4 SOLID WASTE:

Materials such as paunch contents, pen manure, blood (if no by-products recovery) rubbish, etc must be disposed of, without creating objectionable conditions, and the specifications must indicate how this will be done.

3.5 SANITATION

In the new slaughterhouses with the most modern technical arrangements, there is a cycle of successive-operations. This cycle starts at killing pens, after which the carcass passes a long a continuous conveyer rail. The succeeding operations may be carried out according to two different systems (fig. 4); in scheme A, the carcass moves a long a conveyor chain from which the secondary circuits for the by-products branches off in scheme B, the chain is interupted at the place where the principal operations are carried out, the circuit continues after after this and subdivides in the normal way.

FIG. 4 ALTERNATIVE CYCLES OF OPERATIONS IN ABATTOIRS



It is evident that the 'B' circuit enables the veterinary inspectors to maintain more careful supervision, in view of the fact that the inspection covers all phases of the work. Above all, this system allows for immediate seizure and consignment to the condemned section of any infected carcass or offal. With the continuous chain 'A', on the other hand, the carcasses are already dressed before inspection, which means that the sanitary inspectors have less material at their disposal on which to base judgment. Morever, it renders co-ordination with the inspectors on the visceral circuit extremely difficult, since it is often very hard to identify the organs from a suspect carcass. The difficulty is in finitely harder in so far as the skin and blood are concerned. It is also manifestly impossible to prevent all contact with other meat and with the utensil in use. However seizure causes interruption in the chain of operations and, hence, loss of time, and this is the cheif disadvantage of the 'A' layout.

Since surface area and space in workrooms have been reduced in the new establishments, certain new measures are essential in order to ensure hyginic conditions. The Chief of these is provision for the machanical renewal of of the atmosphere in the slaughterhouse. The installation of a proper ventilation system with air-ducting, and possibly air- conditioning, is therefore highly desirable.

By constructing multiple-block establishments with natural roof-lighting, a considerable economy in installation and production costs would be possible, while at the same time the principles of hygiene would be respected.

The new operational systems are based on the wides spread use of up-to-date machanical installations, which offertwo advantages from the point of view of hygiene; first, a reduction of the time during which carcasses are exposed to the atmosphere and, secondly, a diminution in manual handling. On both these counts, electric quartering appliances, circular and band saws for the halving and cutting-up of carcasses, and automatic classification and weighing appliances, merit unqualified approval. Such appliances should be periodically disinfected throughout the day, however, and treated with detergents at the end of each day's work.

Electric windhes, placed at specific points in the work circuit, should take the place of the old hand models. The overhead single rail has become such an important feature of the circulation equipment that, in practice, it is part of the chain of operations. For this type of conveyor, the simplest and lightest appliances should be chosen, and the rail should be attached directly to the ceiling, to keep it free from dust and facilitate cleaning and disinfection, while not obstructing light.

It is essential that adequate space should be reserved for the ordinary installations (hot and cold water, steam, electricity, drainage of waste water, etc.), since their efficient functioning is indispensable for cleanliness and hygiene.

As a rule, sanitary inspection is carried out in two stages. The first is the examination of the live animals, which takes place at the time they enter the abattoir yard. Any animal which is considered unacceptable at the first examination must be immediately destroyed and rendered. Those only suspected to be unacceptable are conducted to the 'quarantine shed whence, after an adequate period of observation, they may be passed to:

a. The condemned slaughter room, for destruction and rendering, if found to be diseased;

b. The 'quarantine' slaughter room, if found partially usable; or

c. the normal circuit, if found to be satisfactory.

The second stage is the inspection carried out during the operations that follow the actual slaughter. There are three or four separate items to be inspected and where a chain system of operations is in use in the abattoir these are effected at the specified points in the circuit for the principal operations. Inspection covers chiefly the head and abdominal cavity opening, the viscera, the halved carcass, and finally, the dressed carcass. Whichever of the two chain systems is used, carcasses or part of carcasses that are judged unacceptable must be taken out of the circuit immediately and removed

to the appropriate section of the sanitary premises for destruction and rendering. Seized meat thus passes into same circuit as condemned aminals.

The sanitary premises, divided into condemned and suspect sections, can as a rule be organised on normal slaughterhouse lines, since no important inovation has been introduced into their traditional functions. Incidentally, both sections should have self-locking devices fitted to the doors to prevent free passage of unauthorized personnel.

The plant for the destruction and rendering of unsound or dangerous meat should always be located in the condemned section, so there must be access to it from the suspect section. The latter is economically justifiable only when it has cold- chambers and the equipment necessary for processing conditionally acceptable meat.

The veterinary inspector, by virtue of his position as the technical and sanitary director of the slaughter house, is responsible for control of the establishment at every stage of operations. Accordingly, any new construction on modern lines should include a special room for his use, from which he can exercise the maximum supervision and intervene as rapidly as possible when required.

Another problem is simplified under the new system of working in modern establishments that of the hygiene and cleanliness of personnel.

The additional premises for the use of personnel that are now considered indispensable for keeping contamination to a minimum and maintaining a healthier atmosphere should be placed in close proximity to the workrooms and should be well ventilated and lit.

Finally, there is the choice of construction materials and, in particular, of the materials to be used for floor and wall coverings. It is, of course, obsolutely essential that walls and floors of workrooms, cold chambers, and other premises should be easy to wash, clean and disinfect.

The question of the further installations and, in particular, of the circulation equipment is equally important. The importance of rapid removal of skins and other contaminating matter from the principal circuit as a prerequisite for safeguarding the hygienic condition and quality of meat has already been demonstrated. Removal is generally effected through vertical shoots (in the case of multi-storey arrangements) into a well or by means of sloping counters to take this detached material are definitely to be preferred, since they are easier to clean, either by sluicing or with detergents or disinfectants. Stainless steel is the most suitable material for this type of equipment, which has to be subjected to vigorous cleansing. Stainless steel should also be used for receptacles, such as trolleys and boilers for cooking meat. The cost of stainless steel is reasonable, particularly when its durability is compared with that of other usable alloys.

CHAPTER FOUR

4.00 TECHNICAL REQUIREMENTS

4.10 Livestock Market:

This is an environment where the marketing of livestock takes place. Shelters that will alter or modify the environment are provided, they should normally buffer the extremes of climate to reduce 'stress' on the animals. Two types of animal shelters exist:

Conventional Barns:

This is the kind of housing in which the animals are confined together on a platform and secured at necks by stachions or neck chains. This is roofed and completely walled with windows wide enough to show part of the animals. The animals are fed on individual basis or in little groups.

Loose Housing:

This keeps the animals loose on an open paddock or pasture throughout the day and night. The open paddock is-provided with shelter along one side under which the animals can retire when it is very hot or cold or during rains. A common watering tanks is provided and fodder is fed in common manger, its advantages include;

a.- the ability to house and manage all types of livestock;

b.- cheaper to construct, easier to expand and flexible in utility;

c. feeding is easier because of common feeding and watering arrangements;

d.- animals are more comfortable as they move freely.

Whatever its type, animal shed should;

i- be located with long axis north to south, to get direct sun light and yet face away from the direction of prevailing winds, whenever possible;

ii.- orientation and spacing of animal shed should be so arranged that they are nearer to and easily accessible from grain, hay and straw stores, fodder chaffing yards and pastures

iii- be far apart so that fire will not spread easily from one building to another;

iv- trees should be planted a little away from the sheds to act as wind breaks and as sheds.

Spacial Requirements

Type of animal	Covered area(m^2)	Open area	No/Pen	Heights of sheds at caves
Cattle	$3.5m^2$	$7.0m^2$	50	3.00m
Sheep/goats	$1.0m^2$	$1.0m^2$	60	2.20m
Camels	-	$10.5m^2$	30	-

Walls:

These should be constructed of tubular steel, so as to facilitate easy cleaning, and this should be of sound-construction.

Roofs:

These should cover only that area meant to be a shelter for the livestock in the times of extreme weather conditions, or during the rainy seasons. Roof coverings should preferably be of asbestos because of its less heat transmission quality, and light steel roof trusses is a suitable form.

Floors:

Should be of impervious non-slip material, 10cm mass concrete over 15cm hardcover makes a good floor. This should be laid with a fall of 25cm in 3m to the sides of the pen.

Drainage:

Floor drainage should be channelled to the sides of the pen where a ditch gutter, of about 30cm to 50cm deep, covered with slabs and opened at intervals with exapnded metal coverings, drains both the floor and storm water from the roof, to a nearby stream or pond.

Water Supply:

For the purpose of watering the livestock and for constant cleaning of the pen, water points should be adequately provided in each individual pens.

Fodder:

Provision should be made for the storage of fodder in close proximity to the pens, and each individual pen should have feeding and drinking troughs for the animals within it.

4.20 Lairage

Access:

Lairage should be readily accessible. There should be access from the grazing land or the adjacent livestock market so that stock may be driven easily into the lairage. There should also be good access by roadways or rail roads depending upon whether the abattoir is served by both roads and railroads.

Stockways And Gates:

Stockways and gates should not be less than 1.2m wide, and it is best to standardize, all doors and gates of this wideth. These should also be double swing as this gives good control of stock. The final passage leading to the stunning pen should be 80cm-90cm wide. The pen divisions are best constructed of tubular steel and gates should be of the same material. This gives better ventilation; is more hyginenic and also takes up less space.

Scale Of Lairage Provision:

The amount of accommodation required will depend on the daily throughput, the size of the hanging space, whether refrigeration is provided and to what extent. Generally speaking, sufficient covered lairage to accommodate one day's kill is all that is - necessary and up to 2 day's kill is desirable. About 0.6Sq m of floor space per sheep or goat is generally allowed and 2.8 sq.m for cattle and camels. Pens of about 28sq.m to hold 10 cattle or 10 camels or up to 50 sheep are a useful size.

Walls:

Walls should be constructed of tubular steel to a height of at least 1.2m to facilitate cleaning and should be of sound- construction. They should be coved 10cm radius at their junction with the floor.

Floors:

Floors should be of impervious non-slip material. 5cm granolithic screed and 10cm mass concrete over 15cm hardcore makes a good floor. Floor should be laid with a fall of 25cm in 3m to a central channel outside the pen.

Water Supply:

For the purpose of watering the livestock and for constant cleaning of the pen, water points should be adequately provided in each individual pens.

Fedder:

Provision should be made for the storage of fodder in close proximity to the pens, and each individual pen should have feeding and drinking toughs for the animals within it.

Drainage:

Floor drainage should be by channels to 30cm deep trapped gullies with silt basket, preferably outside the building.

Roof:

Light steel roof trusses carying a light asbestos roof is a suitable form.

Hydrant Points:

Hydrant points should be provided in the lairage building to facilitate frequent cleaning.

Fodder:

Provision should be made for the storage of fodder in close proximity to the lairage.

Isolation Lairage:

This is preferably provided in conjuction with a small emergency slaughter house, nothing more than a small two room block is necessary-lairage about 3m x 3.5m and slaughter hall-3.5m x 3.5m.

In the small slaughterhouse working on a line system the best solution would be to provide a high walled pen or pens for isolation purposes in the main lairage. Carcasses likely to contaminate the equipment could be dealt with at the end of the days' run. This is only second best, the first alternative should be aimed at.

4.30 SLAUGHTERHALL

Construction:

The slaughterhall should be a steel framed building-constructed on the bay principle. The structural steelwork can then be designed to carry the roof, itself and wind loading, the machanical handling equipment and the maximum potential load of carcasses on the equipment. The walls are nerely curtain walls and can be arranged as desired. They should be of concrete or brick.

Height:

The height from the floor to beef carcasse rails should be 3.5m plus 0.50m making a total height of 4m to the under side of the cross beams. The height from bleeding channel to cattle bleeding rail should be 4.5m plus 0.50m for attachments making a total of 5m

Walls:

Walls should be constructed of sound materials and finished with durable smooth impervious surface. Bricks or concrete blocks rendered to smooth finish with Portland cement to which has been added water proofing agent such as 'Selocrete', and painted with approved chlorinated rubber paint is satisfactory. Stanchions or inner walls should be filled in solid and not simply boxed in by rendering on exapanded metal. Slaughterhouse walls should be rendered to the full height of the wall. All walls should be coved 15cm radius at their junction with the floor.

Floors:

Improved hygiene and easier working can be achieved by careful variation of floor levels. The surface of the floor should be hard, impervious and non-shlip. Grooved tiles, ridged sandstone slabs and bricks are the usual materials. Sandstone is excellent. A good jointless finish in a 5cm granolithic screed treated with carborundum on 10cm mass concrete over 15cm good clean hard core.

Drainage:

If blood is to be collected a bleeding trough draining to a specially formed storage tank should be provided. Compressed air apparatus is required to remove the blood from the tank and agitators are needed in the tank. This outlay is hardly worth while except in large abattoirs with heavy throughput. The best arrangement for the small slaughterhouses is 1.2m wide bleeding channel 15cm below the general floor level at its heighest point falling to 30cm below at the outlet. If this is arranged across the width of the slaughterhall the-bleeding area is suitably cut off from the cleaner area where dressing operations take place. The floors of the slaughterhall should fall towards the bleeding channel and the bleeding channel itself should slope from the slaughterhall floor level to 15cm below in the 1.2m across the bleeding channel.

The bleeding channel outlet should be carried through the wall to discharge over the grating of a 30cm diameter deep trapped gully fitted with a strainer basket. This works satisfactorily if the streiner basket is cleansed frequently.

Doors and Openings:

The doors and openings should be standardized at 1.2m. This gives ample working room, and enables barrows etc. easily to pass through. Doors should be of the metal sliding type where possible.

Hatchways to gut rooms or hide stores may be provided if the layout is suitable for such treatment. These should be top hinged and the flaps constructed of metal. If by coincidence the ground level of the gut room is about 0.9m below the level of the slaughterhall floor, it is convenient to have a hatchway delivering the guts direct on to a gut table.

Windows:

Windows should be at high level and on the north facing wall of the slaughterhall. All windows should be of galvanized metal framed construction. They should be of the top hung type and openable. This type has the advantage that the openable portion may be protected against fly entry by copper gauze which is not possible with the centre type although the latter may be more advantageous from a ventilation point of view in hot weather.

Ceiling and Roof:

Asbestos sheets form a light, durable roof covering and have the advantage that a hyienic ceiling or undersurface can be formed by the use of flat asbestos sheets under-neath. The resultant air space also improves the insulation of the roof. The asbestos sheet should not be painted. If a more attractive ceiling finish is desired, stipple glaze, or 'Eterint' should be considered. The joints between the flat sheets are sealed by the use of anodized aluminium strips.

Lighting:

Natural lighting can be provided on sufficient scale without recourse to roof lighting, if the building is designed on an east-west axist and the width of the slaughterhall is restricted to about 9m and the steel frame form of construction is used. As the walls are curtain walls, the whole of the wall above the level of the lean-to buildings can, if desired, be of glass.

Artificial lighting needs careful consideration. An overall incnsity of 50 foot candles at floor level is required in areas where meat inspection is carried out. Warm- white De Luxe lamps should be used in in slaughterhall and cooling room, while warm white lamps are best used in less important areas such as offices, dining room, boiler- house etc.

Ventilation:

Again restriction of the width of the building to about 9m and the use of steel frame construction on an east- west axis assists ventilation. On the south wall, longitudinal slots restricted in height to the thickness of wall may be provided up to at least half the length of the wall.

A second form of parmanent ventilation can be obtained by continuous ridge ventilators which are readily available in asbestos.

Water Supply:

It is a foundamental neceissity that the slaughter house should be provided with a pure water supply, copious in volume and available at good pressure. This means that the service pipe from the mains should be designed on the assumption that all the draw off points will be in use at the same time. Nothing is more irritating to operatives and inimical to hygiene than an inadequate trickle of water where a forceful jet is needed.

Multiple water supply points both hot and cold should be situated in the slaughter hall as close to the site of operations as possible, $\frac{3}{4}$" diameter or larger pipes should be used. The aim should be to provide the operative with a bucket of water from a quick operating tap close at hand, in less time than it takes him to walk to a static tank and fill his bucket by dipping.

If these conditions are achieved, the insanitary static tank of which slaughtermen are so fond of, could be banished from the slaughterhall with resultant gain of a pure water supply and a clean floor.

Wash Basin:

A stainless steel or vitreous China wash basin with hot and cold water supply should be provided in the slaughterhall.

4.40 COLD STORE

Construction

The construction of the cooling hall should be the same as the slaughterhall which is already described.

Height:

The height from the floor to the high level beef rails should be 3.5m plus 0.5m for attachments, making a total height of 4m to the underside of the cross-beams.

Floors:

The floor of the cooling room should be on the same general level. The surface of the floor should be hard, impervious and non-slip. Grooved tiles, ridged sandstone slabs etc. are the common materials. Sandstone is excellent. A good jointless finish is a 5cm granolithic screed treated with carborundum on 10cm of mass concrete over 15cm good clean hard core.

Drainage

The floor should slope at 25mm in 3m to open drainage channels at least 15cm wide. These should discharge outside the building over the grating of 30cm diameter deep trapped gullies fitted with strainer baskets.

This works satisfactorily if the strainer baskets are cleansed frequently.

Doors And Openings:

The width of doors and openings should be standardized at 1.2m. This gives ample working room. Doors should be of the metal sliding type wherever possible.

Windows:

Windows should be at high level on the north facing wall of the cooling hall. All windows should be of galvanized-metal framed construction. They should be of the top hung type and opened at intervals. This type has the advantage that the openable portion may be protected against fly entry with copper gauze.

Ventilation:

This is as described for slaughter hall. It may be necessary to supplement the ventilation by the use of extra fans in hot weather conditions.

Water Supply:

The cooling hall should be provided with hydrant points both hot and cold as it is essential to maintain a high standard of hygiene in this room.

Wash Basin:

A stainless steel or vitreous china washbasin with hot and cold water supply should be provided in the cooling room.

Walls, Ceiling and Roof, Lighting:

These should all be as described for the slaughter hall.

4.50 BY-PRODUCTS UNIT

4.51 Condemned Meat Room:

The condemned meat room is located off the main slaughter line and is connected to the slaughterhall by covered linkages 5.0m wide. Condemned meat is brought to this zone by stainless steel trucks in sealed containers.

This Isolation reduces the risk of contamination of passed carcass in the slaughterhall and facilitates the maintenance of the division between the clean and dirty aspects of the slaughter operations. An area of 4.5m x 5.0m has been allocated for the storage of condemned carcasses of two to three days kill.

Walls:

The walls should meat the same requirements as those laid down for the slaughterhall.

Floors:

The floor should be of hard, impervious and of non-slip finish. A 5cm granolithic screed treated with carborundum would provide an appropriate finish.

Drainage:

This should meet the same requirements as those laid down for the cold store.

Doors

These should be standardized at 1.2m wide, with metal sliding doors fitted to the inlet and outlet openings. Secure locks should be fitted to these doors.

In the case of the roof, lighting, ventilation and water supply, requirements should be the same as those for the slaughterhall.

DETECTION

4.52 Room:

This is an area set aside for the examination of suspected carcass and must be of sufficient size to accommodate an unexpectedly large number of carcasses. It must be located near the main inspection area to facilitate the easy removal of the suspected carcasses from the main slaughterline. This room should also be accessible to the condemned meat room for the easy removal of carcasses confirmed unhealthy for human consumption.

Walls, Floors, Ceilings:

The requirements should be as those laid down for the cold room in the event that a separate room is built to accommodate this function. On the other hand, an area within the slaughter hall could be used for this function.

Ventilation and Lighting:

These should also meet the same requirements as those for the chilling rooms if a separate room is used for this function. If an area within the slaughter hall is used, then this problem does not arise since it has already been-solved in the slaughter hall.

4.53 Offal Rooms:

These rooms are used for the cleaning of offal and is connected directly to the slaughter hall by covered linkages and offals are brought to these rooms either by the use of conveyor belts or in stainless steel containers reserved for that function alone.

General space has been allocated for this function in view of the fact that it handles large amount of offal, since within the tropics, the animal offal forms part of the edible products and is an important source of - food. Separate rooms have been provided for the handling of offals from cattle, sheep, goats and those from camels or pigs respectively.

Walls, Floor And Drainage:

These should all meet the requirements laid down for the slaughter hall.

Doors:

Doors should be of the metal sliding type with widths standardized at 1.2m.

Lighting:

Natural lighting should be sufficient throughout these rooms and working conditions within the gut rooms are improved by the placing of gut tables alongside windows. Where natural lighting is not sufficient, artificial lighting in the order of 50 foot candles should be supplied over the tables while about 20 foot candles are supplied throughout the rooms.

Water Supply:

There should be a constant supply cold and hot water to the gut rooms, and the supply points should be easily accessible to the gut tables. Hydrants points and steam jets should be provided here in order to maintain a high standard of cleanlines within this zone.

For the improvement of the workers hygiene, a wash basin with hot and cold water taps should be provided in the gut-room for the workers personal use.

4.54 Hide And Skin Preparation And Storage:

These should be large enough to accommodate 2 days kill. Cattle hides are best stored on a platform about 15cm high, after being treated and dried, while the sheep and goat skins may be hung on rails or simply spread out on the floor. Sheep skins should be well serated so that the animal heat is quickly dissepated.

4.55 Blood Processing Unit:

Depending upon the scale of production, this unit should have an ample space for the drying and then storage of both raw blood and dried blood products. In the case of walls, floors, roof, ceilings, doors, windows, lighting, ventilation and drainage, requirements, should be the same as those for the hide and skin preparation and storage, because they should be under the same roof.

4.60 WHOLESALE MEAT MARKET:

The main aim of any meat market is to ensure a convenient method of exposing meat for sale hygienically to purchasers to make their selection. A wholesale meat market is a specialized market where meat is sold and purchased on a whole sale basis. Carcasses having been dressed are then transported using an overhead railing system direct from the cold room to the whole sale meat stalls, which are also provided with hooks on which carcasses are displayed. Another railing system transports the purchased carcasses to the loading bay from the stalls.

RECOMMENDATIONS

- The stalls should be concentrated in one place to facilitate efficient supply and despatch of the carcasses:
- Every effort should be made to see that meat market is not located in the most dusty and overcrowed place, but rather in a place where the movement of animals, goods and vehicles is minimal;
- It is advisable that all the stalls should be fly-proof; the counters and the backdoors should be equipped with weld mesh and covered with mosquito gauze;
- It is recommended that all the stalls should drain towards a central passage, covered with expanded metal so that any effluents, whether from the stalls or passage, are automatically removed;

- Efforts should be made to provide the butchers with facilities such as lavatories, wash hand basins, showers, changing- rooms and lockers. The butchers should wear clean white overalls and shoes while at the stalls;
- Name plates clearly indicating the name (s) of the butchers should be displayed on each shop to enable the buyer to identify the source of meat in case of a complaint or disease outbreak.

Walls:

They should be of hard, smooth, non-flaking and-washable material. Wooden walls should be given at least one or two coats of white or cream coloured oil paint.

Heights:

Under tropical conditions high buildings are cooler, are easily ventilated, are less humid and are generally less dusty than low structures. The distance from the ground to the eaves should be at least 4m and screened ventilating ridges should be incorporated in the roof design as well as under it.

Floors And Drains:

To achieve Sanitary conditions, smooth, impervious floors are essential, these should slope by not less than 7.5cm and not more than 12.5cm per 1.0m, towards a round section drain which should have traps and screens and should run along the back wall of the shops.

Counter Tops:

Glazed tiles are recommended, as they provide good protection against chemical damage, improve the appearance of shops and are easier to clean.

Roofing:

Roofing material should preferably be non-corrosive; asbestos gives the best protection from excessive heat. Aluminium sheeting is a good choice because of its reflective quality.

Water Supply:

Wash hand basins should be included in the individual shops, hot water is desirable and therefore construction of a hot water boiler should be considered.

CHAPTER FIVE

5.00 CASE STUDIES

5.10 OLD KANO ABATTOIR

History:

Kano abattoir is among the seven abattoirs established in 1963 by the then Northern Nigerian Government. Others include those in Kaduna, Sokoto, Mokwa, Bauchi, Maiduguri and Nguru. It was established adjacent to the famous Kano livestock market, so as to boost the trade. It is designed to handle up to 200 livestock units a day.

Siting:

The site of the abattoir, that is, Kofar Mazugal is also the same site for the livestock market, had been choosen on the ground that, it was an isolated site, quite spacious and adequatly enough to contain both the abattoir and the livestock market. This choice did not take into cognisance the potentials existing within ancient city of Kano to expand. As of now the abattoir can roughly be said to be in the heart of Kano metropolitan, exactly in between the old city and the new settlements of Fagge, Sabon Gari and Yan Awaki.

Thus its presence there poses a serious health hazards and a source of pollution to its immediate vicinities. Having realized this fact the government of Kano State proposed its immediate removal from that site and marked the whole of the site as commercial activity zone.

See figure 5.

Organisation:

The first buildings to come up were the slaughter halls, the cold rooms killing and stunning pens, guttery room, Bone meal, Blood Meal, Boiler room and Engines room. Others include the administrative block, and the lairages. All other buildings on site were an after thought, they include the bone crushing room, the Union building, open Wholesale Meat Market, Butchers changing room, "Sarkin Pawas" office and the dispensary. These additions combined with the original buildings choked up everything, and hence the subsequent lack of expansion spaces especially for the lairages and the loading space. See figure 6.

Architecture:

Having been built at different times, the whole abattoir now resembles a public building which has been abondoned for years. It is due to this lack of proper coordination in planning that the whole buildings are non proportional in themselves. This creates that feeling of utilitarianism which is detestable in every factory design. More emphasis is put on production and the worker is neglected. Not much thought have been given to the treatment of elevations. The saw tooth roof of the slaughter halls dominated everything, and all other buildings elevations look just projected from their plans. See plates 1 and 2.

FIG. 5 SKETCH OF KANO MASTER PLAN

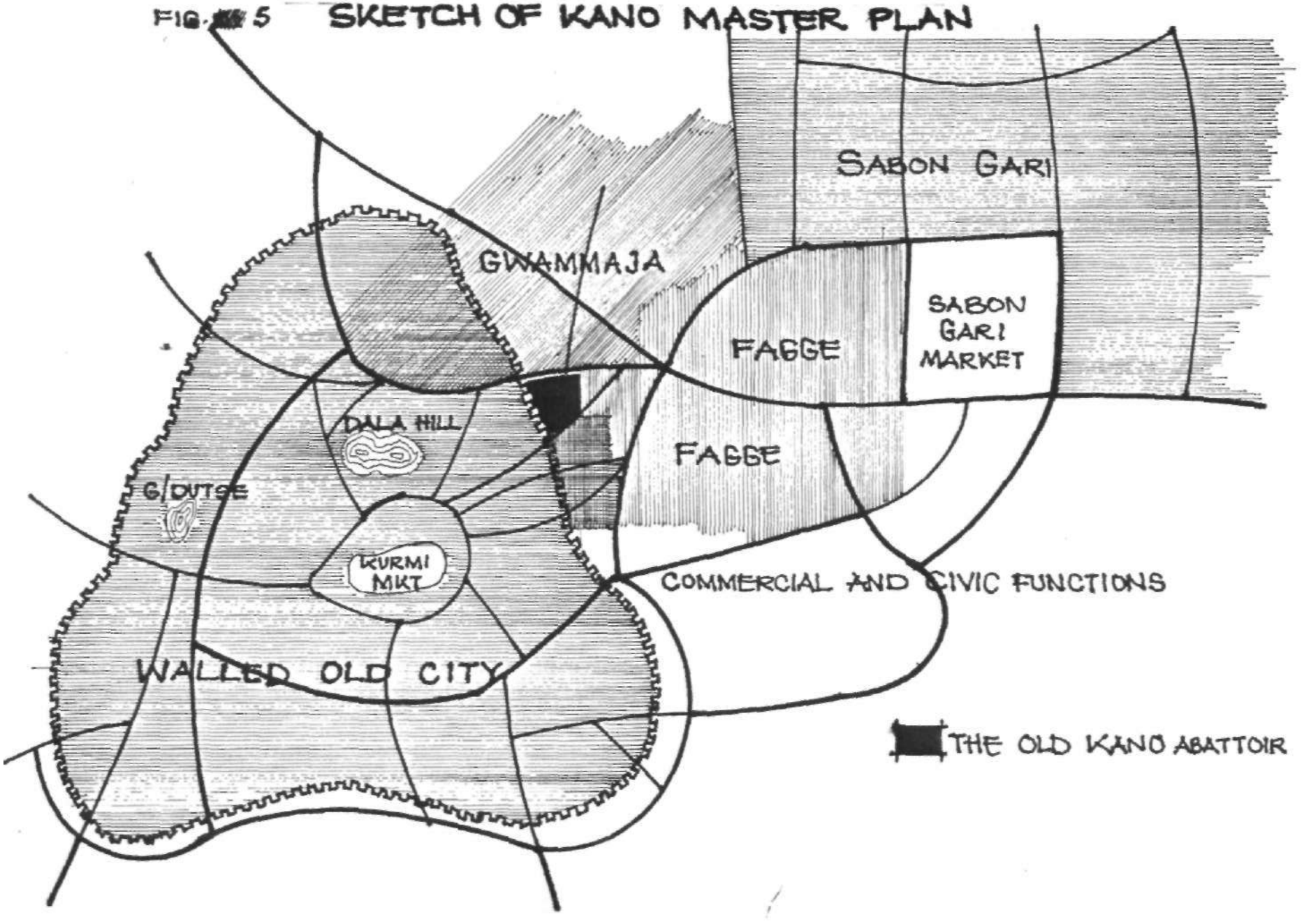


FIG. 6 OLD KANO ABATTOIR

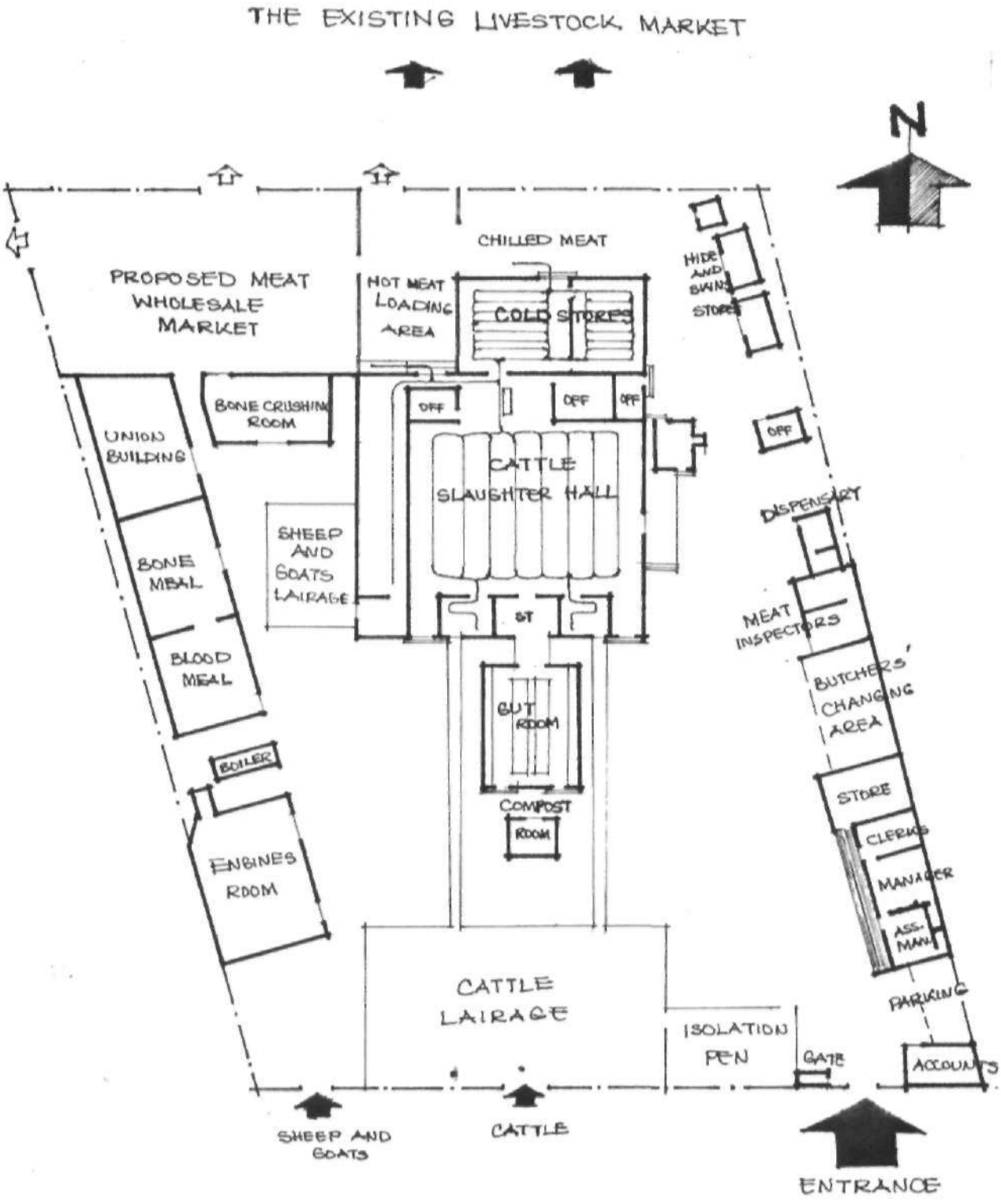




PLATE 1. OLD KANO ABATTOIR
VIEW OF THE SLAUGHTER HALLS



PLATE 2. OLD KANO ABATTOIR
VIEW OF ADMINISTRATIVE BLOCK



PLATE 3. KANO LIVESTOCK MARKET
CATTLE FOR SALE



PLATE 4. KANO LIVESTOCK MARKET
CAMELS FOR SALE

5.20 NEW KANO ABATTOIR

History:

The new Kano Abattoir otherwise known as "Nigerian Meat And Associated Products Limited Kano", is a limited liability Company owned by the Kano State Government, Federal Livestock Department and some individuals. Construction of the abattoir started long from the time of late Alhaji Audu Bako, the then governor of the State, and finished in 1980 during the civilian regime.

It is an ultra-modern and highly sophisticated complex with efficient operational facilities for the processing of blood, unwanted bones and inedible by-products, has large cold storage facilities and a very good waste disposal system. It is established for the preparation of meat and meat products for Commercial and export purposes. This is to be operated on the owner-user basis, whereby the State buys the stock, slaughters, dresses and prepares them for sale to the Southern parts of the Country and some neighbouring West African States.

At full capacity the abattoir can handle the following stock per shift:

Cattle - 800 heads

Sheep/Goats- 960 Heads

Camels - 40 heads

Meat by-products production stands at:

Bonemeal- 0.54 ton per shift

Blood-meal - 1.64 tons per shift

Meat-meal - 2.73 tons per shift

Siting And Organisation:

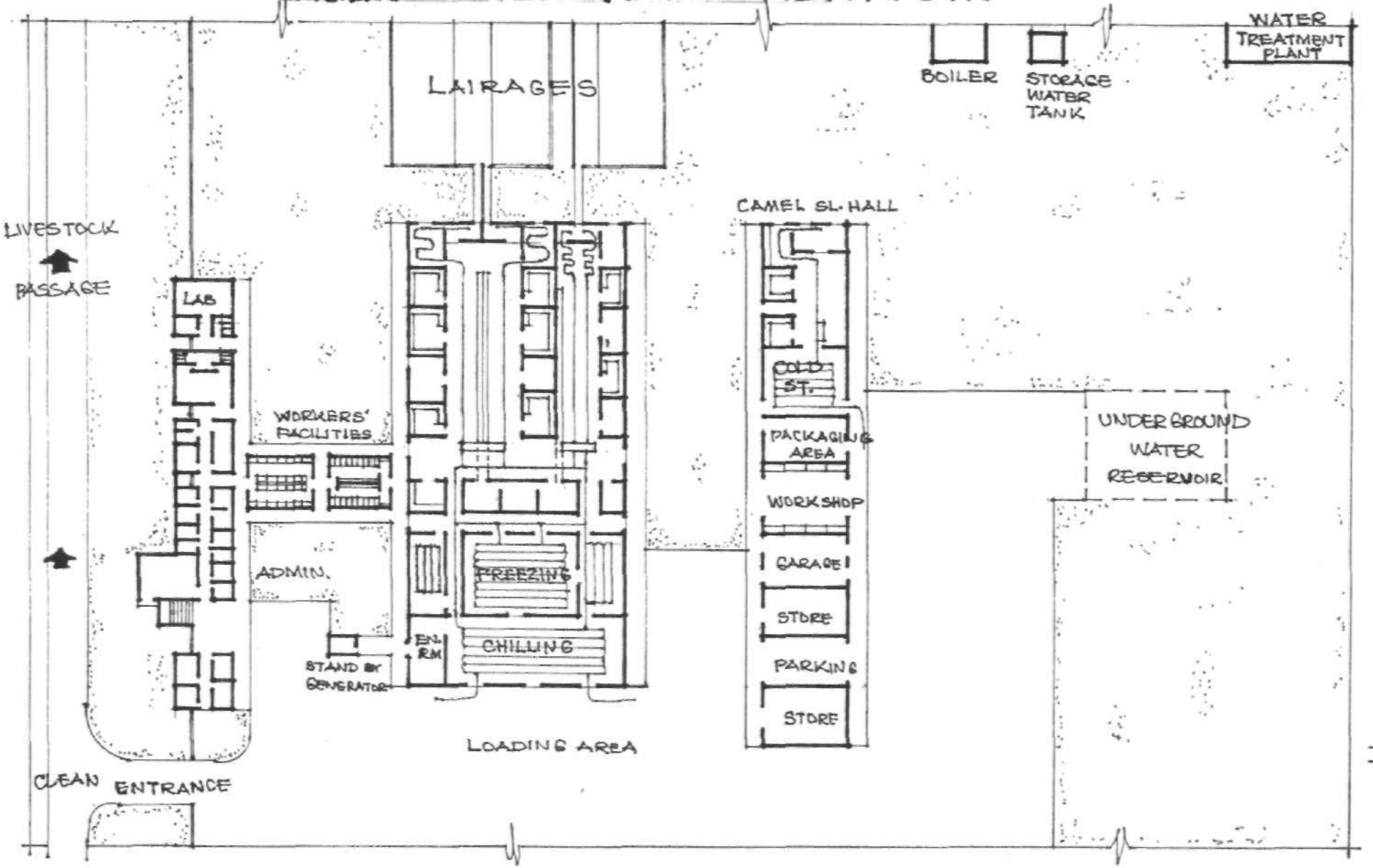
The abattoir is sited about 12km South-West of Kano City very close to town of Panshekara. The abattoir is readily accessible by road, the main road linking-Panshekara and the Kano water Works Stations to the City. The water pipes Serving the whole of Kano Metropolis passes along this road hence the abattoir has no water problem at all, electricity is also available within reach, also a standby generator is installed.

The abattoirs is organised functionally in a way that all related functional spaces are located reasonably close to each other. Good relation exists between the Administrative block and the main entrance, one does not have to go far in to the complex before reaching it, when one has no business to do with the other parts of the abattoir. Also there exists some harmonious relationship between the workers facilities and the work area. The way the boiler and the overhead storage tank is related is good, but the boiler is unnecessarily far from where it is dearly needed, that is the slaugher halls.

Architecture:

Although the different buildings of the complex are spread and some how dotted, this dipicts the different functions that take place within them, and an attempt is done in the way the street elevation is harmonized and

FIG. 7 NEW KANO ABATTOIR



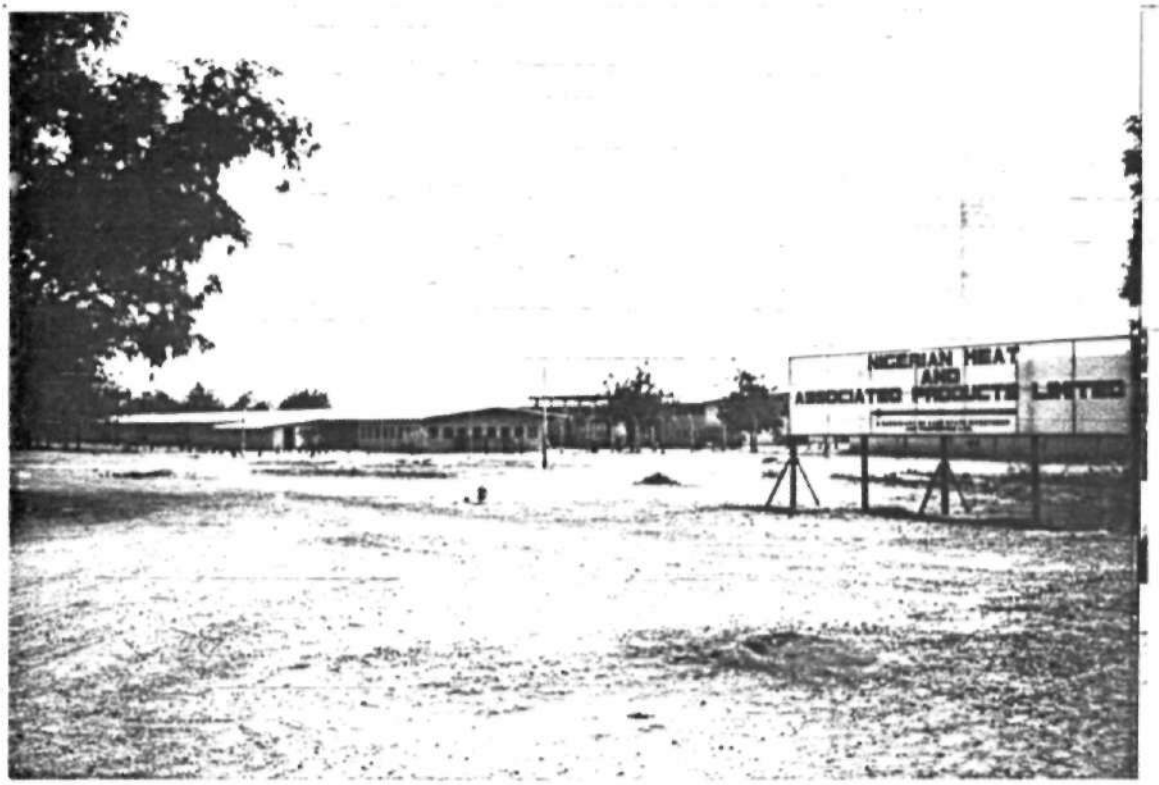


PLATE 5. NEW KANO ABATTOIR
GENERAL VIEW



PLATE 6. NEW KANO ABATTOIR
SIDE VIEW OF THE
SLAUGHTER HALL

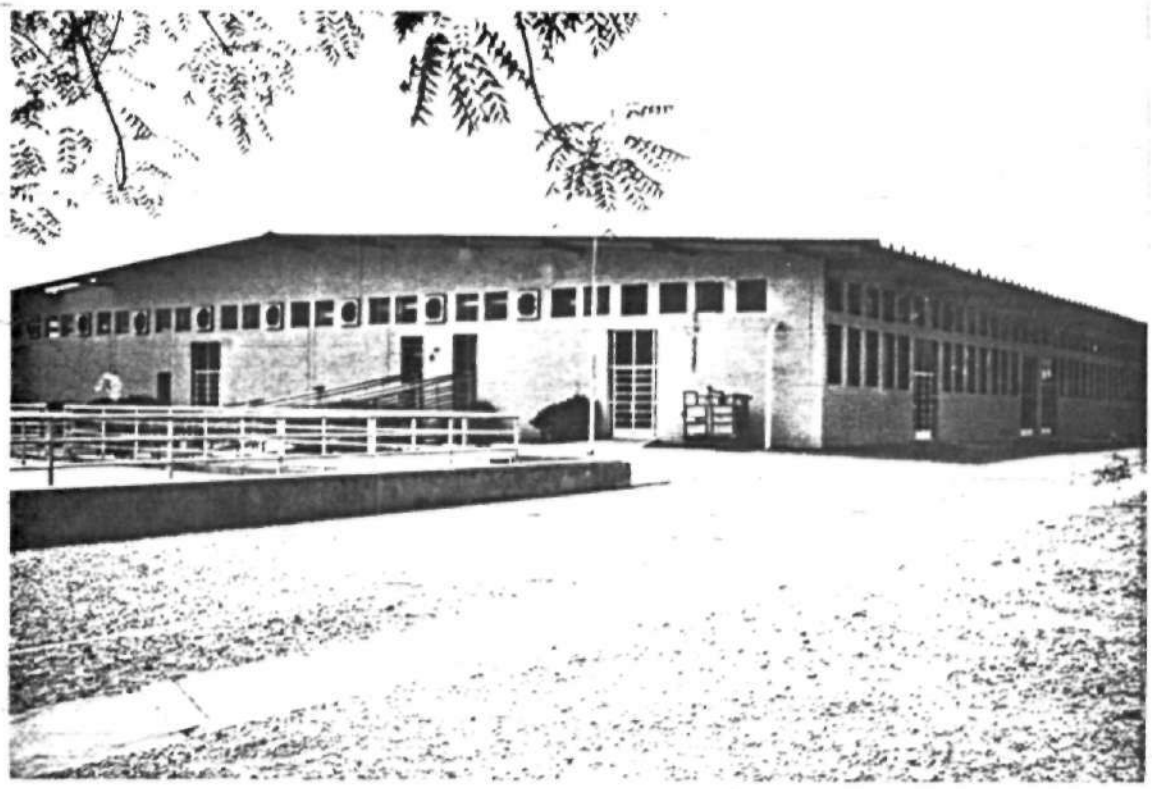


PLATE 7. NEW KANO ABATTOIR
VIEW OF SLAUGHTER HALL FROM
THE LAIRAGES



PLATE 8. NEW KANO ABATTOIR
WORKSHOPS AND GARAGES

some form of proportion attained. The rythem in which the designer expressed the-means of penestration in to his buildings shows the maturity attained in design. Windows puncture the building envelop in dual mythem both vertically and horizantally.

In the planning of the complex reliance more upon artificial means of ventilation and lighting is seen, instead of employing the courtyard kind of planning to exploit the abundant natural gift we have in this part of the globe. Also more use of landscappping elements should have been- employed to relieve the sight of the worker and to reduce stress, thus ensuring more job satisfaction.

5.30 LAUSANNE TOWNSHIP ABBATOIR:

Description:

The Lausanne Township Abattoir, as described by BENOIT in his book "MEAT HYGIENE, W.H.O. Publication, 1957", is extremely functional in design and lawns, trees and flowers all exist to help in relieving the utilitarian character. The slaugher halls, triperies, cold storage rooms, cloak rooms, Canteens and service rooms open on to a spacious high ceiling main corridor. This main corridor links the slaughtering halls with the cold storage rooms, and also serves as an intermediate place of storage where the meat can drain off for two or three- hours before being place in the pre-cooling rooms

where it is kept for 48 hours. If meat has to be collected hot it is conveyed along covered passages to the meat depot situated infront of the cold storage room. Bacteriological, paristological, physical and chemical examination is carried out on the premises. Commodious cloak room facilities exist.

Observation:

i. There exists a clear demarcation beween dirty and clean zones;

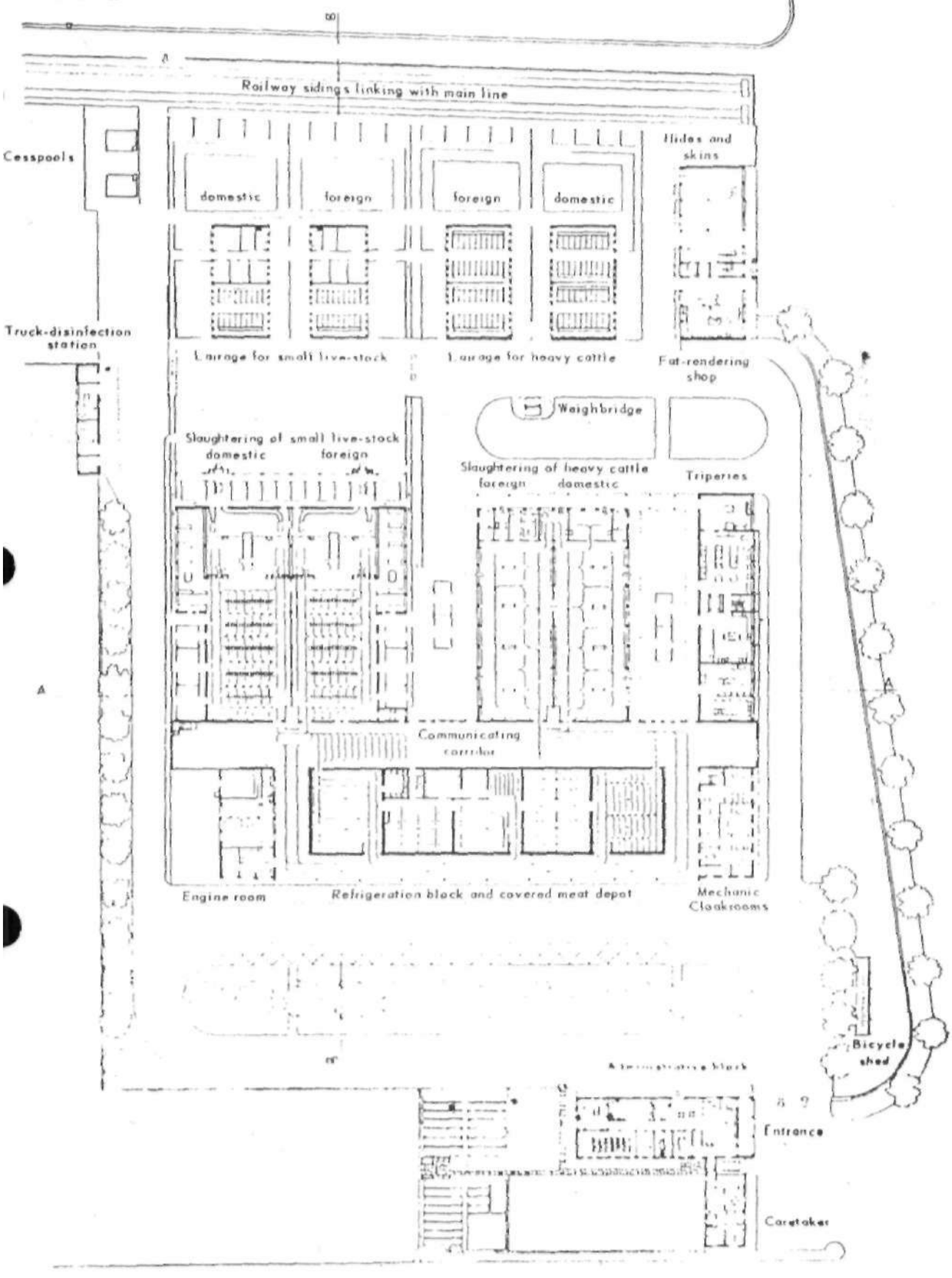
ii. Successful sepearation of small stock from heavy livestock is seen in the laivages, slaughter halls and in the cold storage rooms;

iii. Although the abattoir is a local one, it is expected to contain the usual by-products processing department, like blood and bone meals; unless some processing factories which use these by-products are haerby;

iv. Also there should be a provision for emergency-slaughter of diseased animal;

v. Workers facilities should be wel-defined, adequate and situated near to the working areas, in the-case of Lausanne Abattoir the cloak room provided is grossly inadequate for the numerous workers. Above all the Lausanne Township Abattoir depends wholly on machanical means for supplying both cold and super-heated water. Ventilation system and even the in-line system uses electrical-Conveyor system.

FIG. 8 LAUSANNE TOWNSHIP ABATTOIR



This makes it incompatible to tropical environment, more so to a developing country like Nigeria.

Nevertheless the spatial arrangements of the functional areas and the way lawns, trees, flowers and gardens are employed to reduce the stress exerted by the tedious work characterised by industrial establishments, are worth considering.

5.40 CONCLUSION:

Having studied a number of abattoirs, some common faults have been noticed to be recurring in each case. The followings are however more pronounced:

a. tethering live animals in the same place as that intended for slaughter;

b. carrying out the slaughter and Bleeding Operations on the floor instead of making use of the bleeding rail facilities. By these practices the animals are not only contaminated by blood and excreta of preceding slaughter but actual bleeding is incomplete.

c. several animals are slaughtered at once without reference to the speed at which the next operation takes place. In this way many animals are left lying about in filth at all times.

Some possible explanations to all these problems have been sought and are as follows:-

i. The attitude and outlook of the butchers, livestock meat and hide traders is not encouraging, they constitute a conservative group, hostile to anything

new which they consider to be a nuisance or-
which is intended to tighten control over their-
industry, check their revence or increase their
looses through condemnations, while forcing them
to accept centralized slaughter and to work
according to a strict hygienic routine;

ii. the butchers and the majority of consumers lack the necessary knowledge on simple hygiene this is another big obstacle, hence they have not seen the justification of such a change being introduced:

iii. laxity on the part of the veterinary inspectors to enforce the use of the railing system;

iv. the way and manner the abattoirs are managed also adds impetus to the problem; the system is that every Tom, Dick and Harry can enter the abattoir to have his own carcass prepared himself;

v. the spaces provided offer the butchers the chances of reverting back to the slab condition.

Improved slaughtering is the important concern of health authorities, Livestock producers, butchers and consumers; their cooperation is necessary for the success of any plan of improvent. The following suggestions might help:

The authority concern should give all the necessary encouragement and powers to the vetinary departments so that the reputations of meat inspectors will be-restored in the eyes of both the butchers and the-

Consumers. This will give them the impetus to see that all laws are adhered to in every slaughter-houses and abattoirs.

The improvement of slaughtering facilities and the hygienic handling of meat need continuous use of tact and persuasion, and the creation of a conviction in the mind of the butchers and the consumers such that the demand for-improvement is coming from them rather than it being superimposed on them by the authorities.

The authority should reconsider its carefree attitude of allowing everyone into the slaughter halls to take care of his slaughtered beast, should rather adopt an alternative system, whereby the staff of the abattoir slaughter and prepare the carcasses while the owners are only allowed into the loading area to collect their carcasses.

The problem of identification of ones carcass is tackled by the use of a tag system.

CHAPTER SIX

6.0 THE PROPOSAL

6.1 SITING THE COMPLEX

6.1.1 The Site

The complex is to be sited along Challawa/ Panshekara road about 6km South-West of Kano City, just before crossing the railway line. The Site spreads up to 1.62km along the railway line and about 1.6km perpendicular to it, and all-together the- Site reaches about 300 lectres.

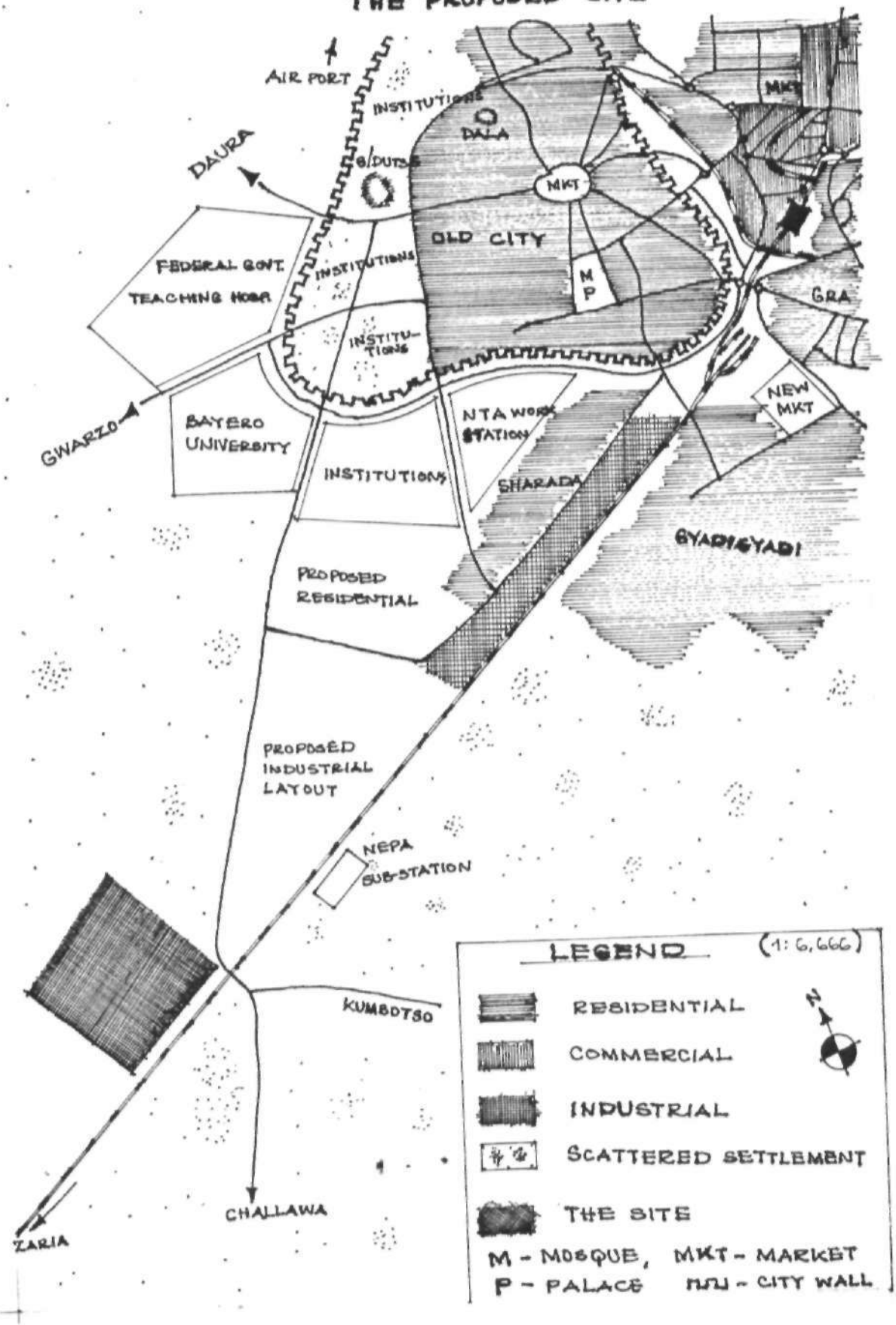
The site is located at the periphery of the- proposed Challawa industrial zone, thus the location of the site is ideal being both away from settlements and other functional zones.

In the realization of the abattoir the following are considered:-

6.1.2 Population To Be Served:

Kano the largest City of the Sudan Region and the third largest in Nigeria, which is to be served by the abattoir has an area of about 678.43 sq km (1.6% of the State's total), has an approximate population figure for both urban Kano and its immediate sorrounding villages of over one million (1m) (Kano State Gazette, 1986).

FIG. 9 KANO LAND USE MAP SHOWING THE PROPOSED SITE



6.1.3 Raw Materials (Livestock):

There is no reliable population figure for cattle in the State, but estimates from the Federal Livestock Department (F.L.D. 1980) put the cattle population of Kano at about 1,000,500 heads, with an annual increase rate of 3% and annual extraction rate of 7.75%. Like cattle, sheep and Goats in Kano State are estimated to stand at about 1,800,000 and 4,050,000 heads respectively, according to FLD survey carried out by Coffman in 1980. This estimate also revealed that Kano State had the highest concentration of sheep and goats in the country, immediately followed by Kaduna State while Rivers and Lagos States had the least.

6.1.4 Climate:

The climate of Kano is some what arduous with relatively wide and rapid changes in temperature and humidity and is largely influenced by two major factors:

a. Extreme values in temperature occuring during the dry season which ranges from as low as 13°C in January to as high as 40°C in April. More moderate temperature with less extreme values, but coupled with high humidity, occur during the wet season.

b. Wind currents which cause the two climatic seasons.

FIG. 10 CATTLE POPULATION

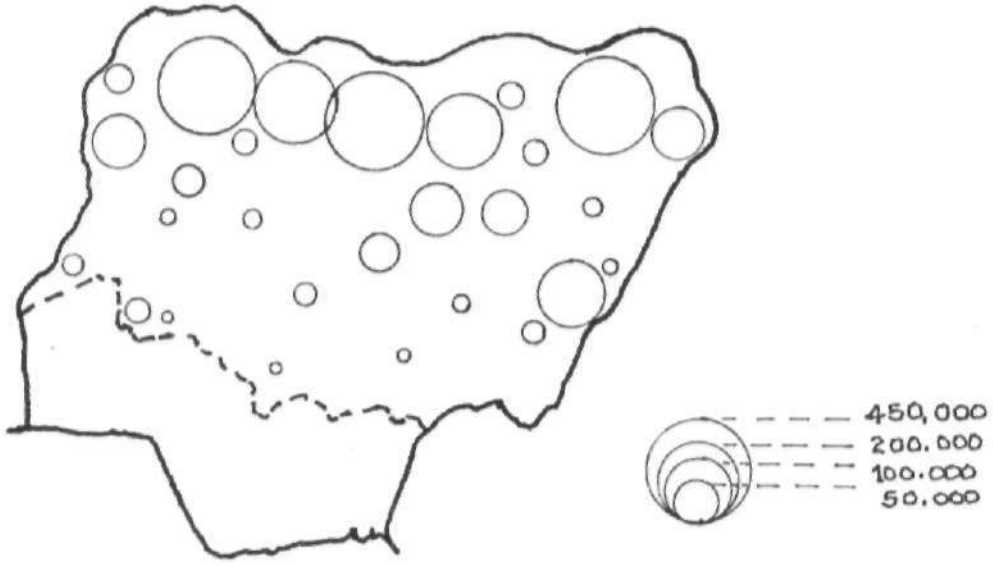


FIG. 11 RATIO OF CATTLE TO POPULATION

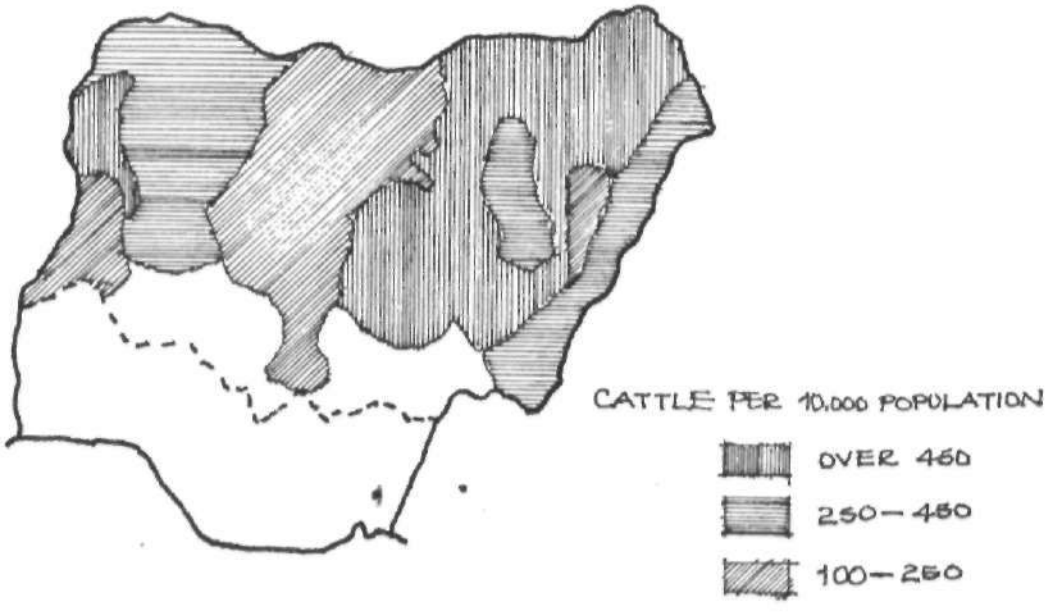
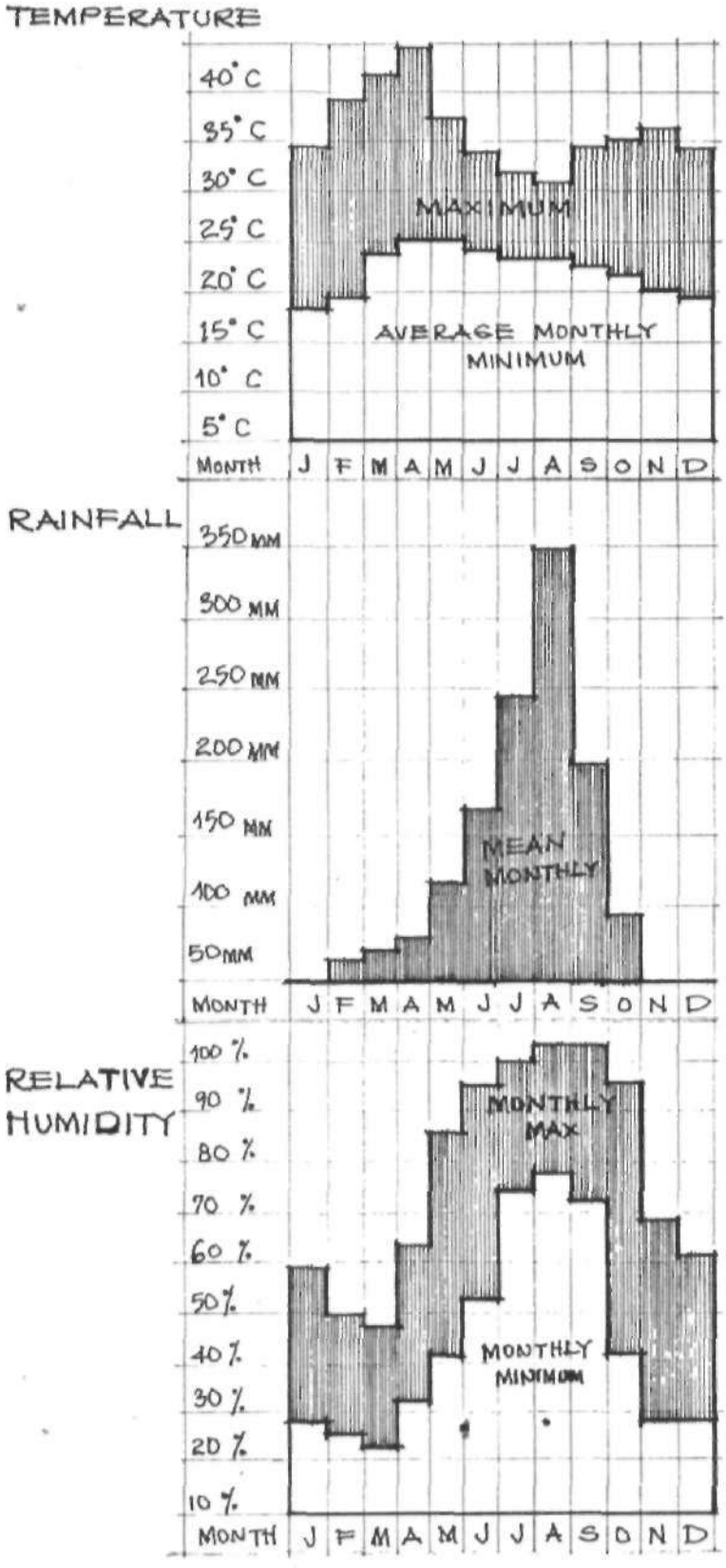


FIG. 12 CLIMATIC DATA



i. The dry season (October-April) is characterized by the tropical continental Sahara winds (Harmattan) from the North-East.

ii. The Wet season (May-September) is characterized by South-Westerly Maritime winds which carry warm and humid air.

The mean annual rainfall amounts to 862mm and occurs mainly between May and September with a peak in August. From November to February hardly any rainfall occur.

Similarly, humidity is fairly high during wet season (60-80%) and remains around 30% during the dry season, leaving its daily maximum at 70% in the morning and its minimum at 30% in the afternoon.

6.1.5 Transportation

Proximity to roads and a railway is a major factor in the selection of the site because the cost of extending-either facility for any great distance will be considerable. Thus the location is accessible to both users and to the livestock by road and rail and for easy- evacuation of meat and meat products.

6.1.6 Services

a. Water

Challawa happens to be the water works- station for metropolitan Kano, and is in close proximity with the site. Presently the site has already been connected to the Water mains which feed the metropolis.

b. Electricity

Power supply shall be from the municipal supply system which is the National Electric Power Authority (NEPA). The NEPA sub-station is located along the rail towards Kano just about 1km away from the site. Nevertheless, a standby generator should be installed to supplement the National grid.

c. Waste Disposal

Due to the existing regulation specify that waste water meant for discharge in to municipal sewers must have pollution load not exceeding that of domestic sewage and coupled with the absence of any municipal sewer within a reasonable distance, necessitate the provision of a purifying plant for the complex.

The stream on the site can simply be supplied with the partially prurified water.

6.2 DESIGN BRIEF

6.2.1 The Brief

The complex will consist of the following:-

i. Livestock market for marketing of cattle, sheep, goats and camels.

ii. Lairage or reception for cattle, sheep, goats and camels before slaughter.

iii. Slaughterhalls for both normal and emergency slaughter and cold stores.

iv. Whole sale meat shops

v. Administration and social welfare

vi. By- products processing unit and maintenance.

In the three slaughterhalls for cattle, small stock and camels respectively, line system of operation, in which the slaughtered animals are transported on a gravitationally activated rail from one working position to another, is suggested. This system is the most compact and economical of all the systems. Being the simplest in design there is less chance of serious breakdowns with consequent loss of production.

6.2.2 CAPACITY

i. The livestock market is to be designed to hold the following livestock at any given time:

Cattle	-	2,000 heads
Sheep	-	3,000 heads
Goats	-	3,000 heads
Camels	-	200 heads

ii. The Abattoir

The population of Kano metropolis is projected to about 1.35 million by the year 2,000 using the National growth rate of 2.5% per annum and 1986 population figure of 1m as the base for calculation. Within the period in question the per capita meat consumption figure in Kano will increase by 1.0%, according to Food and Agricultural Organization (FDA 1980) findings. Therefore the per capita meat consumption rate by the year 2000 will stand at about 23.06kg per annum, with per-centage supply from each livestock type as follows:

Cattle- 64%

Sheep - 8%

Goats- 16%

Camels- 12%

According to the above analysis daily slaughter figure will be: Cattle - 281 heads

Sheep - 334 heads

Goats - 445 heads

Camels - 44 heads

Having noticed serious fluctuations in the slaughter figures for the past seven years (see table 1); a safety factor is adopted in the form of percentage increase as follows:

Cattle - 25%, sheep- 5%, Camels- 36%

The abattoir is therefore to be designed to handle the following stock:-

Cattle - 350 heads per shift

Sheep - 350 heads per shift

Goats - 445 heads per shift

Camels - 60 heads per shift

6.2.3 Schedule Of Accommodation

A. Livestock Market

- Cattle pen $9,504m^2$
- Sheep/Goats pen $8,640m^2$
- Camels pen $1,296m^2$
- Control post $36m^2$
- Retirement shelter $366m^2$
- Fodder storage $1,490m^2$

TABLE I

ANNUAL SLAUGHTER FIGURES IN KANO

YEAR/LIVESTOCK	CATTLE	SHEEP	GOATS	CAMELS	
1980	129.445	44.363	149.725	9.328	
1981	129.588	44.817	123.410	15.411	
1982	13.796	64.435	148.253	21.786	
1983	142.759	50.502	129.913	24.554	
1984	118.837	53.404	135.808	35.036	
1985	106.943	96.966	137.338	49.001	
1986	67.043	66.507	112.460	22.500	
TOTAL	702.391	400.994	936.907	179.616	
CARCASS WEIGHT IN TONS	140.478·2	10,024·9	23,422·7	19,075·5	TOTAL 203,001·3
PERCENTAGE COMPOSITION	64 %	8 %	16 %	12 %	100 %

SOURCE:

DATA..... KANO ABATTOIR LIMITED.

ANALYSIS... AUTHOR.

B. Lairage (With Capacity of 1½ days slaughter)

- Cattle pen 1,944 m^2
- Sheep/Goats pen 1,272 m^2
- Camels pen 432 m^2
- Isolation pen 720 m^2

C. Cattle Slaughterhall

- Casting/sticking area 56 m^2
- Bleeding Area 36 m^2
- Head and offalroom 180 m^2
- Hide room 60 m^2
- Legroom 126 m^2
- Emergency Slaughter hall 270 m^2
- Detained meat room 168 m^2
- Condemned meat room 144 m^2
- Cold rooms 138 m^2
- Slaughter hall 1080 m^2

D. Sheep/Goats Slaughter Hall

- Casting/sticking area 40 m^2
- Bleeding area 24 m^2
- Head and offal room 108 m^2
- Skin area 48 m^2
- Slaughter hall 648 m^2

E. Camel Slaughter Hall

- Casting/sticking area 60 m^2
- Bleeding area 24 m^2
- Leg room 24 m^2
- Head room 32 m^2
- Skins store 32 m^2
- Offal room 24 m^2

	. Detained Meat room	32 m^2
	. Slaughter hall	324 m^2
F.	Administration	
	. Managing Director/Secretary	72 m^2
	. Assistant Managing Director	80 m^2
	. Secretary	40 m^2
	. Accountant	48 m^2
	. Welfare Officer	48 m^2
	. Maintenance Officer	48 m^2
	. General Office/Store	96 m^2
	. Accounts Clerk	48 m^2
	. Board Room	112 m^2
	. Reception	48 m^2
G.	Meat Inspectors	
	. Chief livestock supritendant (CLS)	48 m^2
	. Assistant CLS	42 m^2
	. Changing and Resting room	96 m^2
	. Livestock supritendant	72 m^2
	. Meat Technologist	72 m^2
	. Laboratory	60 m^2
	. Medicine Store	30 m^2
	. Sanitary Engineer	40 m^2
H.	Butchers Union	
	. Sarkin Fawa (Chief of butchers)	48 m^2
	. Sarkin Shanu(Traditional title)	48 m^2
	. President/V.P .	58 m^2
	. Secretary/Ass. Secretary	56 m^2
	. Treasurer/Financial Secretary	56 m^2
	. Other Officials room	64 m^2

I.	Worker's Facilities	
	. Changing room	162 m^2
	. Lavatory	78 m^2
	. Clinic	96 m^2
	. Cafteria/Kitchen/Store	236 m^2
	. Laundary	66 m^2
	. Equipment Store	48 m^2
J.	Ancillary Services	
	. Boiler room	80 m^2
	. Stand by generator	64 m^2
	. Work shop/store	96 m^2
	. Over-head storage tank	36 m^2
	. Waste treatment plant	72 m^2
K.	By-Product Processing Unit	
	. Blood Meal/Store	120 m^2
	. Bone Meal/Store	160 m^2
	. Hide and skin salting	96 m^2
	. Hide and skin store	80 m^2
	. Guttery	104 m^2
	. Compost bunker	72 m^2
L.	Wholesale Meat Shops	
	. Beef shops	480 m^2
	. Mutton shops	200 m^2
	. Goat Meat Shops	280 m^2
	. Camel meat shops	120 m^2
	. Viscera shops	120 m^2
	. Head and leg shops	120 m^2
	. Deboning room	72 m^2
	. Changing room	132 m^2

- Lavatory 120 m^2

6.2.4 Labour Force

Personnel

• Lairages	9
• Slaughterhalls/cold rooms	90
• Cleaners	15
• Administration	18
• Meat Inspectors	16
• Kitchen	6
• Laundary	4
• Clinic	3
• Ancillary	8
• By-Product processing Unit	15
• Wholesale Meat shop	66

6.3 THE DESIGN

6.3.1 CONCEPTUAL DEVELOPMENT

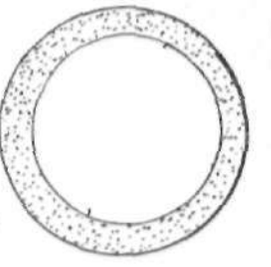
"The development of organisational patters for design program begins with the observation of the characteristic activity patterns of the users. This reveals a hierarchy in frequency of the use."[1]
The physical design is generally the result of a - combination of three concepts:

- The characteristics of the construction site; its shape, the sorrounding environment, accessibility etc. lead to a specific design form.
- the use of the functions of the structures as form generators
- Accommodating the program in an arbitrarily pre-determined spatial form.

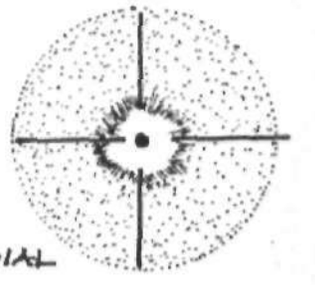
It is obvious that the best organisational solution is a combination or product of all the concepts. However, majority of Architects employ their own distinct alphabet of archetypal forms within which they have developed their spatial skill of visualization and design.- Some of these models are the rigid, the star and the ring. Each of these basic forms favours a spatial form of organisation that is flexible or rigid, open ended or finite, centralised or divergent etc. they include the following:-

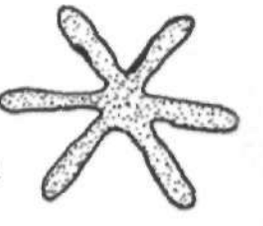
1. Kemper (1979)

i. The Ring:
- very closed and rigid, expansion can only be by complete repeatition
- promotes interactions in the central core
- Suitable for small organisation only

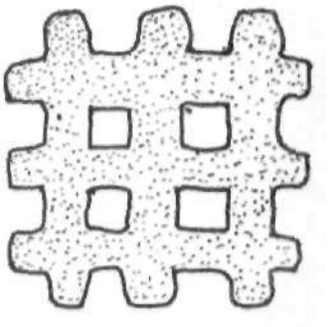

RING

ii. Radial or star patterns:-
- these are appropriate where all functions and activities have their orgin or destination in a central core
- instead of flexibility radial design offers simplicity in organisation
- encourages interactions of all kind.

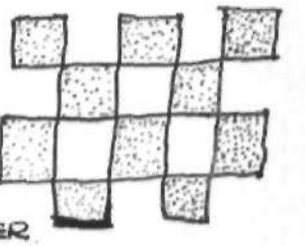

RADIAL


STAR

iii. The Grid, Net or Checker Patterns:-
- offers greatest flexibility
- because of its modular structure
- it can be extended and changed without interupting the whole organisation.
- It is easy to work with
- complex organisations respond well to these patterns but may had to monotony and lack of identity.

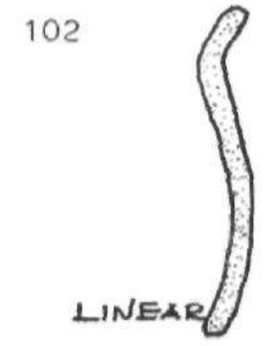

NET

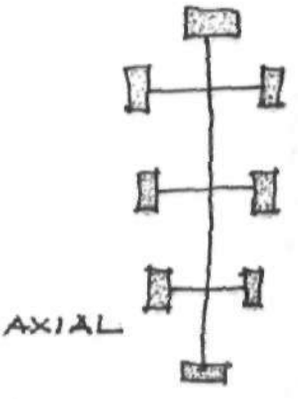
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CHECKER

iv. Linear and Axial Patterns:

- Linear pattern has a single spine along which all elements are organised and which determines the direction of growth, but eventually the spine may become overloaded
- the axial pattern gives more of a focus than the linerar pattern, and can be developed in phases. Most urban projects follow the axial pattern.





Going by the above mentioned three concepts: those of site character determinant functional approach and arbitrarily pre-determined spatial form, the complex in question has been conieved on the basis of its functional organisation and the character of the site.

The functions of the complex follow a horizantal-linear-organisational flow, with the livestock feeds unit feeding the livestock market, while the Abattoir is supplied with raw materials from the livestock market and the wholesale meat market is fed by the Abattoir, with the administrative unit being the coordinating organ of the complex.

The site poses the greatest limitations, due to its widespread nature large acreage and difficult immediate sorroundings, this led to the difficulty of

identifying a natural point of ingress to the site. The only possible natural ingress is towards the eastern part of the site close to the crossing point of the rail line and the road. This means that the administrative section is best located towards the- eastern side of the site close to the ingress point. Next to it is the Wholesale Meat Market which is the most frequented by customers. While the livestock market is sited towards the western part of the site closer to the source of feeds supply, that is the farm.

Out of the above mentioned organisational patterns, the Net or Checker Pattern best suits the pattern of the complex. This is because of its ability to expand easily without disrupting the- remaining organisation, it is easy to work with, and offers greater flexibility which is an important pre-requisite in any industrial complex planning.

6.3.2 SPATIAL ARRANGEMENT OF FUNCTIONS:

In general, a complex of this nature must be functional, compact in space, and designed for economical throughput in relation to the capital and operating costs. There must be satisfactory working conditions, safe equipment and provision for the highest sanitary standards. Internal communications should be such that there is efficient and sanitary flow of the work.

Livestock Market

It is assumed that livestock will reach and leave the complex by trucks and/or driven on hoof, as such provision for their reception is made. A provision for loading and off-loading of the beasts is made, with a waiting area for the trucks. An inspection station is provided with arrangement for disinfecting the beasts in Dipping pools for both heavy and small stocks. A seriously infected animal is separated before reaching the pool., while others are led through the pool to a waiting area before sending them to their respective sheds.

Three different kinds of sheds are provided, for cattle, camel and for small stocks respectively. Cattle are placed closed to the reception area because of their cumbersome nature compared to other stocks, the camels shed are placed next to that of cattle, while small stock are placed further inwards. Fodder storage, control post, security offices, resting shelters, and toilet facilities are also provided to ensure a well-secured and convenient environment.

Lairage

There exists an ample unobstructed passage between the livestock market and the lairage. The lairage is divided into four (4) separate pens for the each livestock type, cattle, camels and small stock, while the fourth one is meant to keep the infected animals

for further examination and care and is called Isolation pen. Further sub-divisions are made for the separation of restive animals, long-horned and weak ones- inorder to ensure sufficient and undisturbed rest. It is also designed with walkways in between the pens for smooth undertaking of ante-morten examination.

The Abattoir

In the design of the abattoir a clear division between clean and dirty operations is achieved, whereby the live animals enter through one end of the building, that is from the lairage, while the dressed, inspected, fresh or chilled carcasses leave through the opposite end, towards the wholesale meat market. The arrangement is in such a way that the carcasses move in one direction towards the cold rooms and the dirty offals (hides, feet, guts etc) in another direction without any risk of contamination.

An overhead rail enables the meat inspector to undertake the necessary post-mortem examination without holding up other operations. Infected or suspected carcasses are removed from the main rail and are led to Detention room. Further- examination is carried out in the Detention room, from there the carcasses are moved into condemned meat room when found to be unfit for human consumption or trnasfered to the cold room when fit for human consumption.

The Boiler House, stand-by Generator room, Gut-scrapping room, Hide and skin salting and storage, Blood processing and Bone Meal Unit form a separate unit from the main building, and are conveniently sited for easy transfer of products to be dealt with. Distances from workrooms to workers facilities are minimized.

Whole-Sale Meat Market

This is supplied with fresh meat directly from the slaughter halls or from the cold rooms, using the over-head rail. Two systems of corridors are provided, one meant for the supply of fresh meat to the various meat shops, while the other one, which is wider is meant for purchasing and laoding of the carcasses unto the meat vans. An ample- space is allowed for the vans to manoeuver in the Loading Bay for the supply of meat to various consuming centres, and awaiting area is also allowed for them.

Administrative Unit

This is situated in a more or less central position and within a walking distance from the main entrance for the benefit of pedestrians. Vehicles are to be parked in a centralized position between the adminitrative block and the whole sale meat market, up to-date toilet and dressing accommodations are provided. First aid rooms or more precisely a small clinic with a trained industrial Nurse is also provided.

A staff canteen with provision for both senior and junior staff is provided.

6.3.3 Compposition

"The plan being an architectural conception can not be considered as an independent entity for it is directly related to sections and to the elevations."[2] A spectator who examines a picture or a facade of a building, is able, generally speaking to see and grasp the composition as a whole. But in the case of the plan which is not limited by obstructing walls and floors, and his perception can only grasp the whole conception by travelling round the building and examining each room inturn. By reason of this limitation the various elements of a plan cannot be compared with each other and considered together from quite the same point of view as it the case with an elevation.

With this notion in mind, the layout of the complex is composed of a multiple repetition in various proportions of a single element, the U-shaped form, being obtained by arranging and massing the units to agree with the general purpose of the whole complex. The nature of the program, the general requirements of functions, character, and site dictate the formation of this kind of composition. Furthermore, the courtyard pattern attained is in response to the arduous climite persisting in the region.

Architectural design is essentially three dimensional in character, of which elevations are only a mere envelope to the internal forms and which the later express some degree of influence on the former. The degree to which this influence is expressed is a matter for the architect to determine, and this depends on the impression the building is desired to convey and upon the interest and worthiness of the various internal elements to obtain recognition externally.

Under these conditions, one of the primary determining factors in the design of the elevations will undoubtedly be the desire to convey a definite expression of the purpose of the building, and secondly that of sheer abstract beauty in design.

The expression in the elevations of the main slaughter halls, in the complex, rising above the roofs of the subsidiary plan elements shows clearly the desire for monumental effect. And generally an effort is made in endeavouring to blend this expression of purpose towards production of beauty of form.

6.3.4 DETAILS

Walls

All walls are designed in such a way that they are easy to clean and disinfect, and are made up of simple and sound construction. In both the livestock market and the lairages, the walls are made up of

galvanized tubular steel, whereas the walls of Administrative section are made up of load bearing sandcrete block walls rendered to smooth finish with concrete mortar. In both the slaughter halls and in the wholesale meat the walls are of sandcrete blocks finished with durable smooth impervious white tiles up to a height of about 1.8m from the floor.

Floors:

With the exception of the floors in the offices all others are made up of hard, impervious non-slip material laid to fall into a central drainage system. In the slaughter halls specially hard impervious and non-slip grooved tiles are used, and with careful variation of floor levels improved hygiene and easier working is to be ensured.

Roofs:

In the livestock market lattice steel portal frames carrying light asbestors roof is used. While in the slaughter halls lattice tubular steel trusses of 18m span at 6m centre to centre carrying light asbestoes roofing sheets with flat smooth soffit to act as ceiling are used. In the case of Administrative block, By-product section and the whole sale meat shops a 10cm mass concrete treated with 2cm granolithic screed finished with 3 coats of reflective bituminous felt is used.

Drainage:

Floor drainage in both the livestock market and the lairages are by channels 30cm deep covered with perforated metal outside the pens. In the slaughter halls the floors are carefully varied in levels so as to facilitate easy and quicker cleaning operations; on each level the floor is laid to fall towards a drainage out-let at the centre. Blood is not allowed to gain access to these gullies, as it congeals and quickly block the drains, it is rather collected in shallow trays 50cm diameter and 10cm deep at the bleding area.

Orientation

Generally the longer axes of the buildings are oriented east-west, with longer sides facing North and south, with minimum openings towards the western and eastern elevations, thus avoiding the effect of direct sun rays. And where they are found an effective shading device is employed to reduce the effect of the direct sun rays.

Ventilation

Ventilation is better achieved and dust percolation is reduced when windwo openings are obligue to the direction of the prevailing winds. (Oyelowo 1977). In the light of the above notion, the configuration of most of the building is obligue to the prevailing North-East and south-west winds.

Also the courtyard system of planning adopted creates some kind of micro-climate which supplements the natural ventilation and accelarates the removal of offensive odour. Due to the humiditive nature of the slaughter, the slaughterhalls are provided with roof ventilators and exhaust fans to quicken the removal of the saturated air out.

Lighting

Natural lighting through the side windows couldn't suffice, due to the wide spread of the slaughter halls, therefore roof lighting is employed as supplementary. The combined intensity of natural and aritificial lights of 20foot candle power is suggested, except where isnpection takes place, where it shall not be less than 50 foot candles.

Circulation:

The circulation is based on the principles that live animals enter through one side of the Abattoir building and leave as dressed carcasses on the other side. The animals are brought to the complex by being driven on hoof or by vehicles and are received in the lairages through the livestock market. From the lairages, animals are driven into the slaughter halls for slaughtering and dressing, and the stored in cold rooms before final dispatch to the meat shops.

Attempt has been made to ensure that the workers do not cross the production lines, this is achieved by the provision of an over head bridge linking the slaughter halls. Also an efficient circulation between the slaughter halls and the by-products unit by the use of roofed walkways are provided. This forms the basis of an efficient and free circulation throughout the whole complex.

Landscaping

Untill recently landscaping in factories was negelected and considered as a diversion from work and a waste of money. But recent studv shows that, more job statisfaction and overal output are recorded in highly landscaped factory environments as compared to neglected ones. This justifies the planing of trees and shrubs as well as careful planning of courtyards adopted in this scheme.

6.3.5 Slaughter Hygiene

The production of wholesome meat with good storage qualities and the reduction to a minimum the risk of meat borne diseases in any meat production plant, as a rule, must follow certain sanitary conditions, as follows:

1. Only healthy, clean and rested animals should be slaughtered;
2. Slaughter staff suffering from infected wounds, sore throat or diarrhoea should not participate

in any slaughter operation or handle meat,

3. daily routine cleaning should include, lairages, slaughter halls, guttery, hides and skins sheds, lavatiories and all ancillary structures;

4. hides and skins, legs and all intestines and any other dirty organs should be speedily removed from the slaughter halls;

5. drains and the whole effeluent system must be checked daily and kept in good working order;

6. rodent and insect control must be routinely carried out;

7. all mobile equipment such as hide puller, dirty removal carts, head and feet wheel barrows and son on, should be subjected to thorough disinfection daily;

8. all waste water disposal should lead directly into the main drainage system, after all solid material has been screened and removed;

9. pathways leading to guttery, compost bunker, hides and skin shed, condemned pit and other ancillary structures should be paved so as to avoid bringing earth or mud into the slaughter areas;

10. through cleanliness of the whole fenced area-should be ensured from time to time.

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CHAPTER SEVEN

7.0 Conclusion And Recommendations

7.1 Conclusion:

Apparently the thesis has been a demanding one full of inherent difficulty in finding ready-made materials and appropriate standards applicable to our ow situation. Some of these standards had to be established physically with the help of a veterinarian in old Kano Abattoir, standards like the confinement area for camels in both livestock market and in lairages are-established, this also include the appropriate height required to house the camels.

Another problem is the aspect of the appropriate technology to be employed in the abattoir. Out of the four know methods of slaughter operations, only one has been recommended for our own use, being what we are. Dr. Kwaga has suggested the use of gravitational rail system, for its simplicity in manupulation, lower in cost and very low chances of break down and quite suitable for use in any slaughter house with throughput of up to 60 slaughters per hour.

Quite a lot therefore has to be done on this subject with view of establishing appropriate standards and technology that are applicable to our own situation here.

7.2. Recommendation

The primary purpose of meat hygiene among many things is to ensure that meat is made wholesome and safe to members of the public. There are severa; diseases caused by bacteria and parasites that can be transmitted from animal to man through meat.

Unhygienic slaughtering, processing, transport and sale of meat contribute to the contamination of meat in addition to the infections present in animals before they are slaughtered.

Fortunately the Authorities con-cerned are aware of this fact for a long time, and made a positive step in constructing, modernizing and developing a number of slaughter houses in the country, as well as for revision of meat handling procedures. They really deserve full praise for such an action. However, these plans usually apply only in urban areas or to plants producing meat for export, whereas most slaughtering still occurs in rural areas where there is an urgent need for improvement in meat and slaughter hygiene.

This is the best area the Directorate of Foods Roads and Rural Infrustructure (DFRRI) should have started with. I suppose no scheme will be a success without the people present to put it into practice, instead of roads which do not normally serve their purpose before they become destroyed, peoples health and safety should be ensured. The existing hospitals, clinics and their staff have been orientated towards curative- medicines, giving little attention to preventive medicine. In the rural areas where there is no pipe borne water, the best approach to medication should be the preventive care.

Finally the provision of and centralizing the slaughtering activities and slaughter facilities with trained meat inspectors in both our urban and rural areas is a cheap and an important tool in the attainment of the goal of "health for all by the year 2000".

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