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**Symposium on the Prospects for Industrial  
Meat Processing in Developing Countries**

Vienna, Austria, 13 - 17 October 1975

**AN AFRICAN MEAT PLANT - A CASE STUDY<sup>✓</sup>**

**S. Liptay-Wagner\***

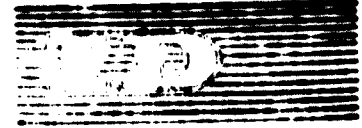
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Summary

AFRICAN MEAT PLANT - A CASE STUDY<sup>1/</sup>

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Organisation des Nations Unies pour le développement industriel

Colloque sur les perspectives du traitement industriel  
de la viande dans les pays en voie de développement  
Vienne (Autriche), 13-17 octobre 1975

RESUME

UNE USINE DE TRAITEMENT DE LA VIANDE EN AFRIQUE - ETUDE DE CAS<sup>1/</sup>

par  
S. Liptay-Wagner\*

La viande étant une des principales sources de protéines, une attention spéciale doit être accordée à sa production et à son traitement, c'est-à-dire à l'élevage du bétail, d'une part, et à la construction d'abattoirs et d'installations de traitement de la viande, d'autre part.

<sup>1/</sup> Les vues et opinions exprimées dans le présent document sont celles de l'auteur et ne reflètent pas nécessairement les vues du Secrétariat de l'ONUDI. Le présent document est la traduction d'un texte anglais qui n'a pas fait l'objet d'une mise au point rédactionnelle.

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... of the ... .. has to be paid ... .. production, ... ..

In this case ... .. - taking into account ... .. plant ... .. level. ... .. to find the optimal solution. ... .. in advantageously the ... .. products.

Taking the local circumstances into account, the basic principles of acet processing, separation and collection and strict hygiene prescriptions, etc., were applied in a consistent way. This technology applied enables not only the production of the required products but also the utilization of all the by-products.

The degree of mechanization was chosen mainly so that job opportunities would be provided for local inhabitants, at the same time, for schooling and training skilled workers.

The construction is in conformity with the local codes, raw materials and building habits. More than half of the total costs was completed by a local contractor. This solution was advantageous for many reasons

By summarizing this practical experience, the case study demonstrates that the complex of questions dependent of the local circumstances, demands and their fulfilment may be solved under African circumstances to the satisfaction of everybody concerned and without special efforts, if a logical sequence of activities is followed during planning and construction.

Cette étude d'une usine africaine de traitement de la viande montre qu'il est possible, en tenant compte des conditions et des paramètres locaux, de mettre en place des installations techniquement satisfaisantes pour les activités prévues. La solution optimale n'a pu évidemment être trouvée que grâce à quelques légers compromis, mais ces compromis ne nuisent ni au bon fonctionnement des installations ni à la qualité des produits.

Les principes fondamentaux du traitement de la viande - séparation entre les zones propres et les zones polluées, strictes précautions d'hygiène, etc. - ont été appliqués systématiquement en tenant compte des conditions et des besoins locaux. La technologie employée permet, non seulement de fabriquer les produits voulus, mais aussi d'utiliser tous les sous-produits.

On a choisi le degré de mécanisation en tenant compte des deux objectifs suivants : création d'emplois pour la main-d'oeuvre locale et, en même temps, formation d'ouvriers qualifiés.

Les bâtiments sont conformes aux règlements locaux et ils ont été construits avec des matières premières locales et suivant les techniques locales. Une part importante des travaux, représentant environ la moitié des coûts totaux de construction, a été exécutée par un entrepreneur local. Cette solution était avantageuse pour de multiples raisons.

En décrivant cette réalisation, l'étude démontre que l'ensemble des problèmes posés par les conditions locales et les besoins locaux peut être résolu par les moyens locaux à la satisfaction de tous les intéressés et sans efforts spéciaux, si les activités de planification et les travaux de construction se déroulent suivant un calendrier bien ordonné.

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## CONTENTS

<u>Chapter</u>	<u>Pages</u>
Introduction .....	1
I. The requirement .....	2
II. The project site and the plant units .....	2
A. Selection of the site of the project .....	2
B. Plant units .....	3
III. Slaughtering, processing and cooling: .....	4
A. Slaughtering of cattle and sheep and processing of the meat and by-products .....	4
B. Pig slaughtering .....	6
C. Cooling .....	6
IV. Labour utilization .....	6
V. Construction of the plant .....	7
VI. Cost breakdown .....	9
VII. Conclusions .....	10



## INTRODUCTION

It is well known that although certain countries are self-sufficient with respect to their meat supply, the demand for meat and meat products is continuously increasing and meat shortages can be observed in the world economy. In the developing countries it is necessary to make efforts not only to increase livestock production but also to establish adequate slaughtering and processing capacities, so that meat, a basic protein source, can reach consumers with the least possible loss in the forms required and so that all hygienic requirements can be fulfilled during the whole slaughtering-processing-transporting process.

Since meat consumption is of the same age as humanity itself, a great deal of experience and knowledge has been collected in connexion with slaughtering and processing livestock. However, local circumstances and demands may not be neglected; their fulfillment is essential for the successful operation of a meat plant. The present paper is a case-study of how local conditions and parameters were fulfilled in the case of an African meat plant. It describes the site of the plant, its various units, the processing technology applied and the construction of the plant. Other questions, such as the training of skilled workers and the composition of investment costs, are also discussed.

### I. THE REQUIREMENT

The meat plant that is the subject of this case-study was built near a town of half a million inhabitants, where an old, non-mechanized low-capacity public abattoir for private slaughterers was in operation. There was a need for an up-to-date plant working one shift, with the following capacities, based on the quantity of livestock available:

Slaughtering (hourly):	100 cattle
	120 sheep
	15 pigs
Pre-cooling:	25% of the daily production
Freezing:	4 - 5 tons every 24 hours
Cold-storage:	45 - 50 tons
By-products:	complete utilization

As is clear from these specifications, the original purpose of the plant was primarily fresh-meat and by-products processing. There is, however, a possibility of expansion, since another shift could be worked and an additional processing unit (for sausage making or canning) could be built.

With the establishment of the plant, the technical and personnel nucleus of an up-to-date meat industry was created.

## II. THE PROJECT SITE AND THE PLANT UNITS

### A. Selection of the site of the project

If the problem of selecting the site of a project such as the meat plant described here could be formulated mathematically, it would be called a multi-variable optimization programme, since several factors influence the total investment cost. Naturally, the aim is to attain the given targets at the smallest possible cost.

Since the livestock and meat products had to be transported by truck, the project was built on one of the main roads to the town.

The project was situated near to the town mainly to save the cost of infrastructure investments for water, electricity and sewage disposal. Water is supplied from the municipal main, i.e. it was not necessary to lay down an extra line. Significant savings are assured this way, the total demand being 1600 m<sup>3</sup> of potable water at a pressure of 4 kg/cm<sup>2</sup> during an eight-hour shift. Electricity is supplied from the 11-kv line adjacent to the plant. A transformer station of 1000 kVA was built, the maximum electrical power demand amounting to 850 kW. Sewage is discharged, after the necessary treatment, into the municipal sewer.

There are also a number of other factors to be taken into account in site selection, e.g., the prevailing wind direction. Although the project was not expected to cause any air pollution, a certain smell could possibly

be driven by the wind towards the town. That possibility was eliminated by the suitable choice of the site.

Having the plant near town is also advantageous from the point of view of labour availability and the existence of land for later expansion.

### B. Plant units

In planning the interconnexion of the units within the plant, the following aspects were taken into account:

- Separation of "clean" and "unclean" zones and related traffic
- Movement of personnel
- Straight, smooth flow of materials

The plant layout is shown in figure I, in which truck routes through the plant are marked with dotted lines. One can see how the plant is divided into clean and unclean zones and how the truck routes are separated accordingly. The building for slaughtering and processing cattle and sheep is the main unit of the plant, and the connected livestock pens and service units are situated around it.

The pig slaughter-house is a separate building for religious regions. The pig-pen and the extra changing rooms and social facilities for the personnel who work in this slaughterhouse are in the same building.

In the boiler-house are two oil-fired boilers each producing 4 t/h of steam. Two tanks, each holding 50m<sup>3</sup>, serve for the storage of fuel oil. The repair workshop, placed in a separate building, is where the machinery is repaired and the livestock-transporting trucks are washed with high-pressure water.

The bicycle racks, administration building, canteen, changing-rooms and laboratory share a common roof. The changing-rooms are divided into clean and unclean zones with compulsory showers; arriving personnel leave their clothes in the unclean zone and have to pass under showers to get to the clean zone, where they put on their working-clothes. The changing-rooms are connected directly to the main building.

A booster-house assures a steady supply of water at a stable pressure. In addition, two separate H<sub>2</sub>O-tanks hold water for fire-fighting in case the regular water supply is cut off.

As can be seen, the main flow of materials—livestock reception, slaughtering, processing, shipping is unbroken and is not disturbed or crossed by the operation of the service units.

### III. SLAUGHTERING, PROCESSING AND COOLING

The main target of processing was to utilize all the by-products. Only end-products leave the plant, either meat or processed by-products. Straight slaughtering lines were established, with the by-product processing departments adjacent to them. The by-products go to the processing departments directly from the slaughtering lines (Figure II). Quick, hygienic, easily installed pneumatic transport facilities are used.

#### A. Slaughtering of cattle and sheep: and processing of the meat and by-products

After a rest in the pen, the animals are driven through race-ways directly to the electrical stunning unit. (The rest improves meat quality). Stunning is followed by sticking and cutting up of the carcasses. The blood is collected and pumped to the inedible materials rendering department for blood-meal production. Since only veterinarian-inspected livestock may enter the plant, a separate sanitary slaughter-house is not provided. If a sick animal is found in the pen, it is taken to a special room where it is separately, milked and delivered to the incinerator or the inedible materials rendering plant through a blow tank.

Two parallel cattle slaughtering lines with a capacity of 50 cattle/h each, have been installed. That not only meets the capacity specification but also allows the possibility of working at partial capacity and training workers at the same time. (This latter question will be discussed in detail in chapter IV). Having two lines is a compromise, as the specific costs of a slaughter line of larger capacity may be lower. However, the advantages of having undisturbed trailling line compensates even the disadvantage that guts from one of the slaughter lines crosses over the other line. Although the guts are transported

hygienically in a closed system, the procedure is not in accordance with prescribed practice in the USA. Except for that, the project complies with all the US rules (e.g., a hot-water-network is provided for the sterilization of tools)

Although exportation of meat products to the United States is not the main purpose of the plant, its products would certainly be acceptable there, as all kinds of contamination are excluded in plant operation.

The sheep-slaughtering line is also straight. The advantage of these "straight" lines is that the conveyor systems are simpler because curves are eliminated, fewer guide-wheels are used and less energy is needed to run them. In addition, the departments that process by-products may be situated adjacent to the slaughter lines so that the by-products go direct to the departments without the use of any mechanical facilities.

Cattle heads are boned out, the meat from them is sold, and the rest is used to make bone-meal. Sheep heads are prepared for human consumption by moving inedible material and sending it to the rendering department. In the leg-treatment department, hoof-oil is produced as well. There is a department adjacent to the line for trimming cattle hides from which they are dispatched direct. Sheepskins line are prepared from dispatch in a separate room adjacent to the sheep-slaughtering line.

Cattle guts go by chute to the guts processing hall. The processing of sheep guts takes place in the same hall. After cleaning, the casings are not used for sausage-making as is usual elsewhere, but for direct human consumption. After veterinarian inspection, the edible offals are put into the offal cooling room where, after appropriate packing, they remain ready for dispatch. Edible fat is melted and stored in tanks until dispatch.

The inedible material rendering department is noteworthy. All the condemned materials from the sanitary slaughter room and the cooler room, as well as blood (through a blot-tank system), arrive in this department. The carcasses arriving from the cooler after veterinarian inspection are crushed. All materials are cooked and packaged, meat-meal and blood-meal in bags, inedible fat in tanks.

Since the machine lines have provision for vertical feeding, there is a part in this spec that is 4.20 m lower than the average floor level. The main slaughter-house is a one-floor building.

There are separate departments for melting bone fat and producing bone-meal. Thus, all inedible by-products may be utilized for industrial and feeding purposes, these latter assuring the reuse of inedible protein and providing a feed base for developing livestock production.

### B. Pig slaughtering

The floor-plan and arrangement of the slaughtering line of the separate pig-slaughtering building are shown in figure III. The slaughtering procedure is standard. There are facilities for storing the processed casings. The capacity of the precooler is 10% of the daily production. Cold-storage capacity is 2-days' production.

### C. Cooling

In establishing the capacities of the coolers, the dispatch of fresh meat was taken into account. In accordance with the slaughtering technology used, the pre-coolers, storage coolers, freezer and large dispatching room are equipped with overhead rails.

Although the expansion of the plant by the establishment of an additional meat-processing factory (sausage-making or canning) is planned, for the sake of the more secure operation of the present plant it would be advantageous to have larger cooler capacities now. It is true that the instalment of coolers is relatively expensive, but in the case of such a large project it is false economy to save money at this point. Naturally, with well-organized and scheduled deliveries and with a sufficient number of adequate refrigerator vans, any kind of problem can be avoided. A careful study of the whole question needs to be made.

## IV. LABOUR UTILIZATION

The staff of the plant consists of 200 persons, of whom 20 are involved in administration of the plant. That means that the plant is well mechanized, with medium automation; heavy physical work is eliminated. It would not have been a good idea to establish a more highly automated plant that employed fewer persons; the creation of employment opportunities is also important in the developing countries. The relatively higher costs and the complicated repair of highly automated facilities would also cause problems, and the savings in labour

would not counterbalance economically the relative cost increase. On the other hand, the application of machines or control equipment instead of people obviously has to be considered when there is a question of product quality, safety or reliability of operation. The frequency of possible failures and the loss resulting from them have to be estimated when deciding on automation. The fact that fewer hands contacting the meat means less contamination in the final product cannot be ignored either, cheap labour is not always more advantageous than costly mechanical equipment.

There is, perhaps, a similarity between the operation of a slaughter-house and meat-processing plant and the operation of a machine assembly line, but there is also an important difference: a meat plant processes organic material, which, because of the possibility of the spontaneous occurrence of biochemical processes, may be more sensitive than a machine component. The rhythm of the "disassembly" line of the meat industry has to be controlled more carefully.

Having a good supply of skilled workers and foremen in a plant is an obvious necessity and that is one of the reasons for the existence of two slaughtering lines. The speed of one of the lines may be decreased in accordance with the skill of the workers, the second line provides the place and opportunity for training skilled workers.

The availability of skilled workers is the key to success of many industrial projects in developing countries. A base of skilled workers for developing a meat industry can be created when the possibility for schooling and training has been considered in advance. That does not mean that there is no need for schools and that totally unskilled persons would work near a slaughter line operating with full capacity. But it should be possible to accommodate oneself flexibly to the needs, taking into account the different points of view. It is feasible to give the task of providing training and work supervision to the companies carrying out the construction, since these firms are well acquainted with the installed machines and equipment and are also experienced with training. That was done in the case of this meat plant.

#### V. CONSTRUCTION OF THE PLANT

In constructing the plant the aim was to utilize as far as possible local possibilities for saving costs and time and also so that the structures built and incorporated in the plant would not be too unfamiliar to the local personnel.

The buildings are of the single-floor type (figure IV). The load-carrying metal structure and the roof are on reinforced concrete columns on 6 and 9 m centers. More space between columns would have made it easier to arrange the machinery but would also have increased the cross-sections and, consequently, the cost of the load-carrying structure. The roof is self-supporting with wide overhangs for shade. The walls are made of sandcrete blocks fabricated on the site and the floor is made of a concrete called "bernit". It is not slippery and does not need any under-insulation. The local conditions, especially the rather frequent occurrence of dust-storms, had to be taken into account. To protect against these, swinging windows, which are in common use in the area, and forced-air ventilation were installed.

The local standards were followed. Thus, all the fittings for electricity, water etc. were of local origin, authorization for their use was obtained without difficulty and assembly did not and repair will not, cause any problem.

The reason for choosing such a building is that the related expenses are lower in consequence of the following points:

- (a) There is no need for load-carrying ceilings, the insulation of which could easily be damaged;
- (b) A later expansion of the building can be carried out without difficulties;
- (c) Material transport can be solved easily and quickly with available technical means; no stairs and lifts, which are costly and create bottlenecks, are needed; and the connexions between the processes can be easily controlled;
- (d) The structure is simple and can be built quickly.

As was already mentioned, the plant complies with the strictest hygienic prescriptions; vessels and appliance in contact with the meat and other edible material are made of non-corrosive steel, an 82°C water-system is installed etc. Satisfying the strictest hygienical demands is not an end in itself. One should also think of exporting, which could be economically advantageous. The modification of an already existing plant to meet specifications purposes would be very costly, perhaps impossible. Naturally, the creation of export possibilities is not the main argument in this case, but the protection of the health of the people who will be consuming the meat and meat products from this plant.



## VI. COST BREAKDOWN

The investment for the plant took place on a turn-key basis. This current popular solution offers many advantages. The most important is given perhaps from the investor's point of view. The investor has only one partner, namely the main contractor, who is responsible for the good quality and scheduled completion of all tasks fixed in the contract so that the plant should meet design specifications, yield the required output. The main contractor has to organise and manage the project and engage local subcontractors if necessary.

Taking the cost of the whole turn-key project as 100%, the breakdown of the total is as follows:

Construction (i.e., the buildings themselves, including lighting, water, electricity, ventilation and air conditioning systems)	45%
Planning and design	5%
Installation of machines and equipment	10-15%
Machines and equipment	35-40%

In the present case the construction and the major part of the installation -together accounting for about 55% of the total cost - was done by a local contractor.

In addition to enjoying the advantage of a turn-key project, the investor may pay either partly with local currency or only with foreign currency, in which case a part of the capital flows back to his country. In that way the amount of foreign currency required is reduced and local labour is employed. The advantages for the foreign main contractor are also obvious; the local contractor provides the labour force and the major part of the raw material, thus saving transportation and storage costs. He is also well acquainted with local conditions and can promote the work of the main contractor.

Reference was made in the preceding chapter to the adaptation of the solution on this project to the local conditions. These solutions were made possible because of the fruitful co-operation established with the local experts.

## VII. CONCLUSIONS

It is obvious that the capacity for slaughtering and processing has to be established in parallel with the development of livestock production in the developing countries.

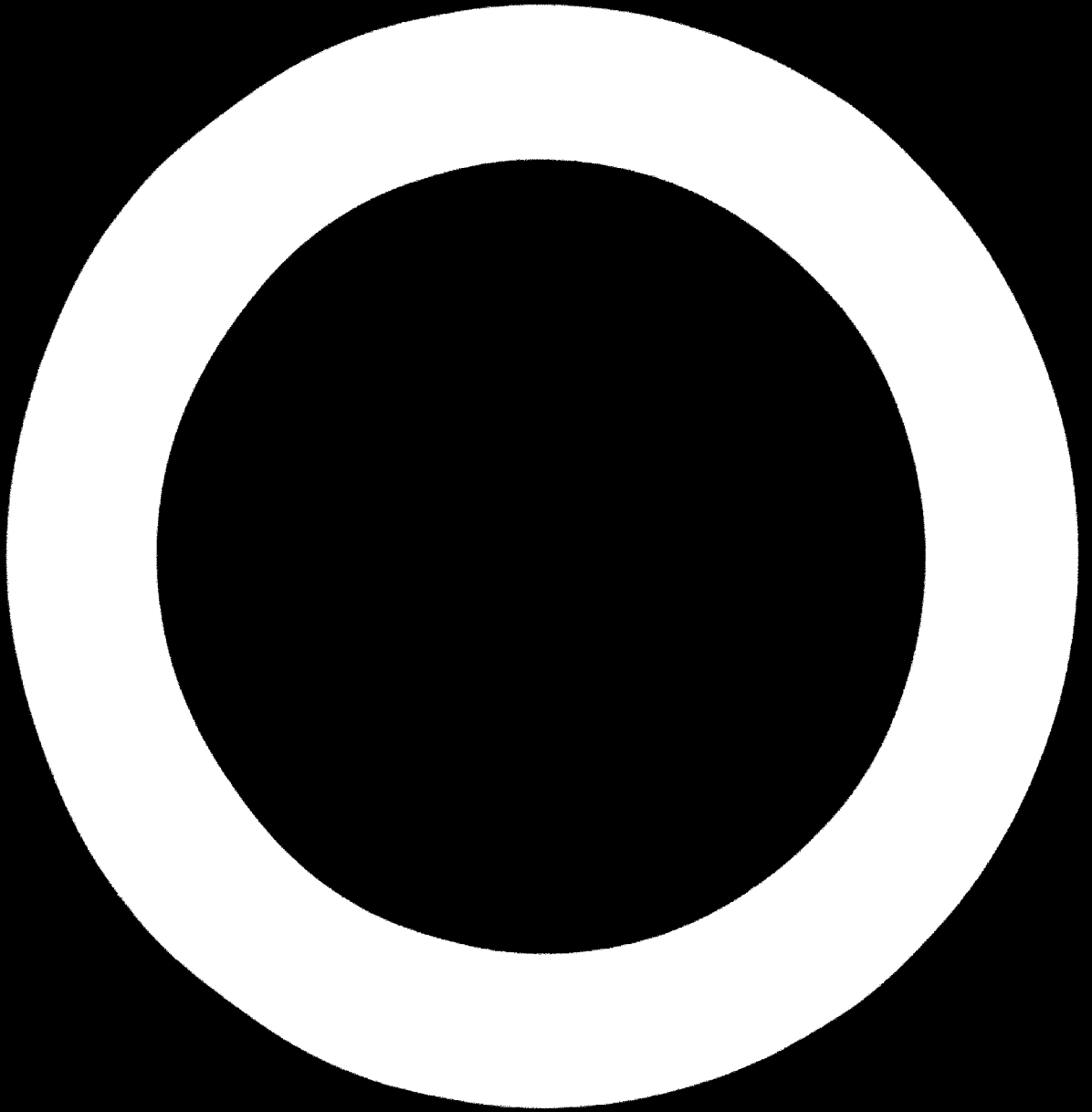
Although a detailed presentation of the technological solutions, and theoretical explanations has not been given for want of space, it is quite clear that the questions concerning local circumstances and needs of this African plant were complex. However, all of the problems were solved by the harmonious activity of the co-operating partners to the satisfaction of everyone concerned. The compromises applied will not result in any disadvantage.

The establishment of a new meat plant in Africa requires no special efforts if the well-known logical steps are followed during planning and construction.

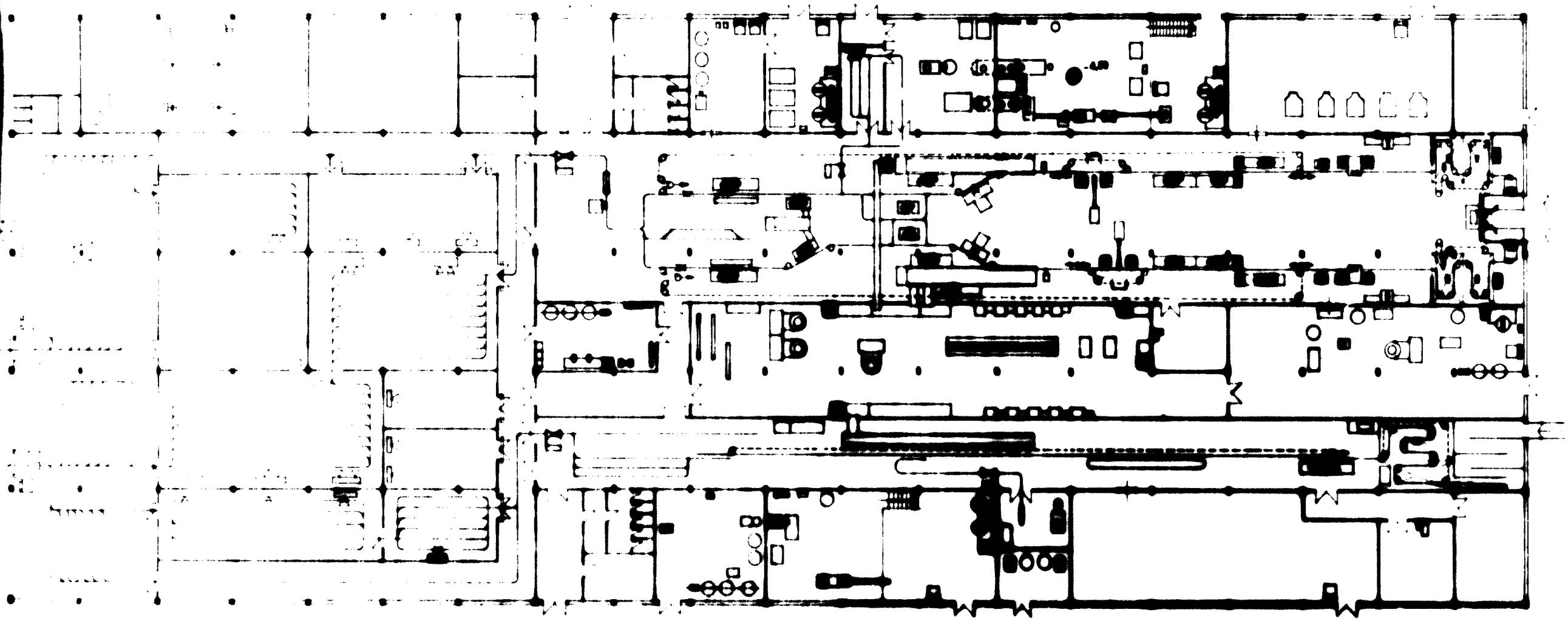
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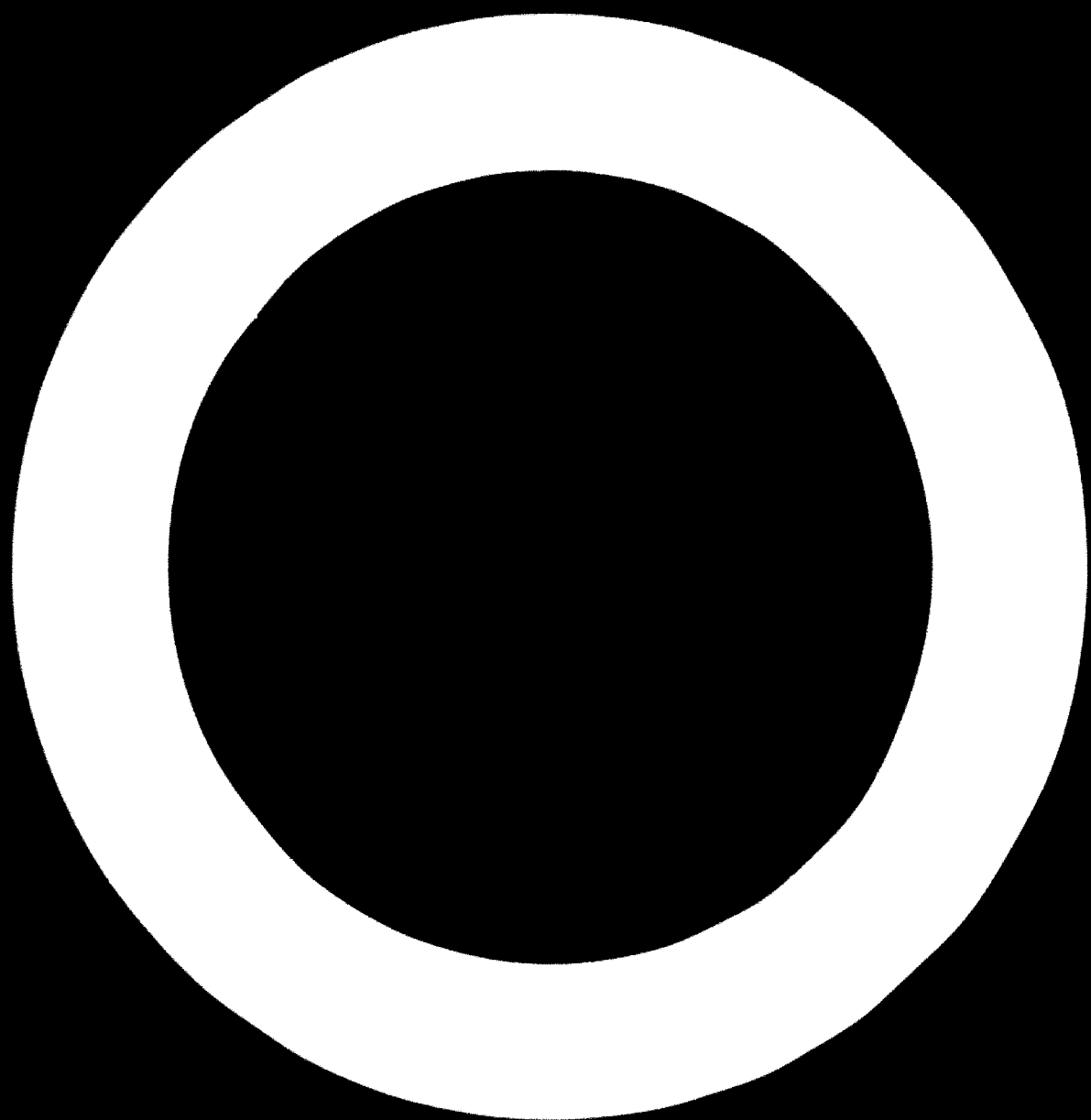
- 1 cattle and sheep slaughtering and processing building
- 2 cattle-pen
- 3 sheep-pen
- 4 pig slaughter-house
- 5 boiler-house
- 6 repair workshop
- 7 gate for goods and staff in the clean zone
- 8 bicycle racks
- 9 administration building
- 10 canteen
- 11 changing-room for women
- 12 laboratory
- 13 changing-room for men
- 14 gate for goods in the unclean zone; transformer station; diesel generator
- 15 evaporative condenser
- 16 manure-collecting basin
- 17 gate
- 18 booster house
- 19 softened-water storage tank, 200 m<sup>3</sup>
- 20 fire-fighting water storage tank, 100 m<sup>3</sup>
- 21 central grease-trap
- 22 sewage pumping station
- 23 screen
- 24 clean-zone truck park
- 25 unclean-zone truck park
- 26 car park
- 27 sterilizing basin
- 28 fence





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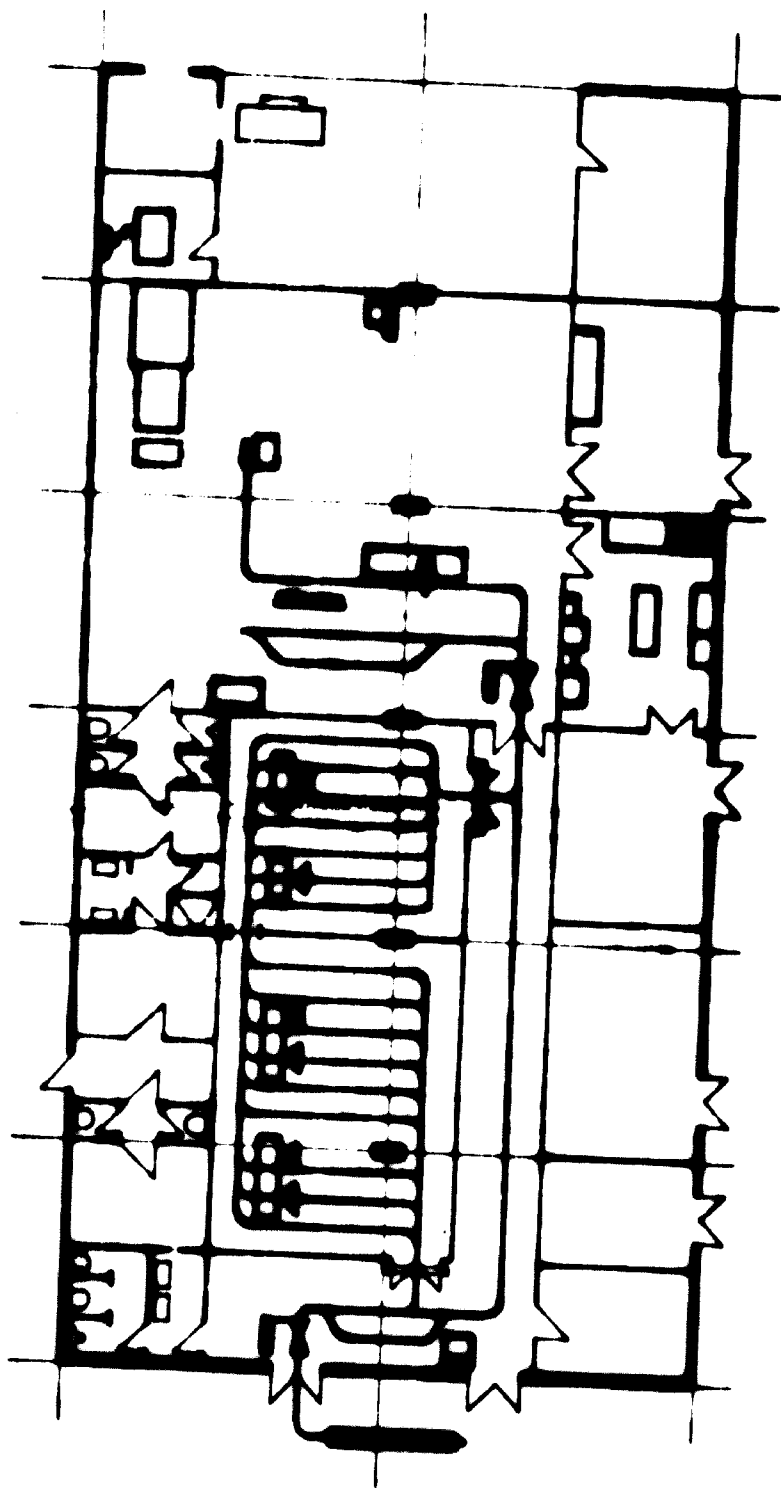


Figure III. Floor-plan of the pig-slaughtering building



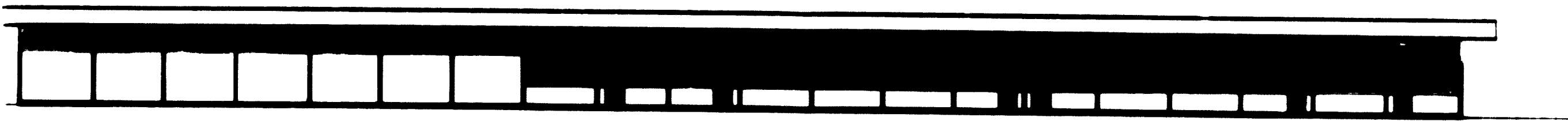
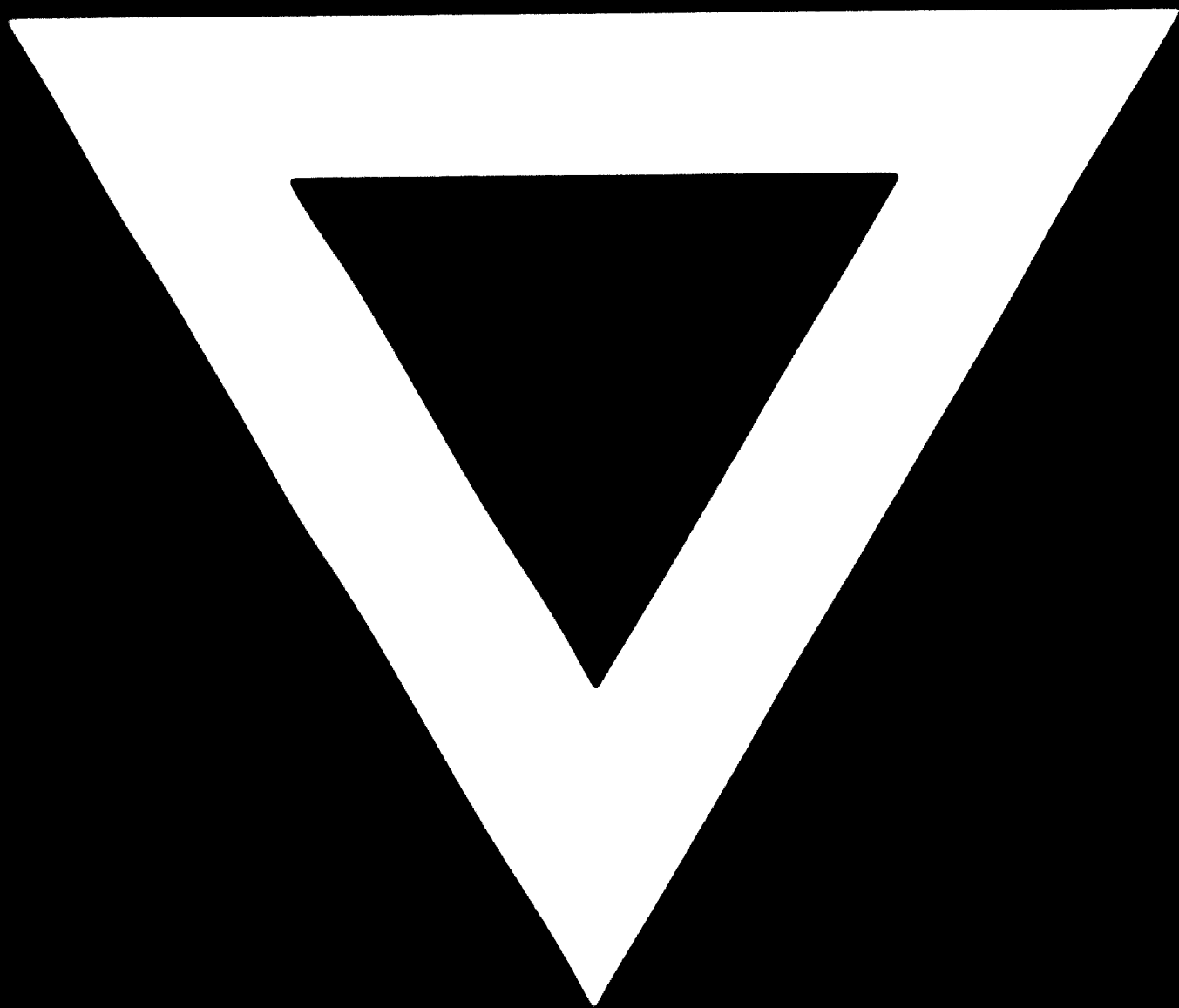


Figure IV. Elevation of main building





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