# PALM PRODUCTS INDUSTRY
# "MODULAR CO-ORDINATION FOR FLEXIBILITY IN INDUSTRIAL DESIGN"

BY

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DEDICATION

This Thesis is dedicated to the Memory of my late mother, Mrs Ochoniya Edinoh who gave in so much to see that I became someone she could be proud of. How I wish you were here today.

## DECLARATION

I, Uwodi Edinoh Ebune, of the Department of Architecture, Faculty of Environmental Design, Ahmadu Bello University hereby declare that this Thesis work has been a personal Academic Understanding executed under the supervision of my mentor, Dr. C.S. John of the Department of Architecture, and that all quotations and information utilized and their sources have been duly acknowledged by means of references.

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CERTIFICATION

This project Report/Thesis/Dessertation entitled Palm Products Industry, Modular Coordination for Flexibility in industrial design, by Uwodi Edinoh Ebune meets the regulations governing the Award of the Degree of Masters in Architecture of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

Chairman, Supervisory Committee Date: .....

Member, Supervisory Committee Date: .....

Member, Supervisory Committee Date: .....

Head of Department Date: .....

Dean, Post Graduate School Date: .....

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The experience within the past few years has not been pleasant to me at all. But I regard them all as a phase in one's life; an experience which can prepare one for greater challanges. I would therefore give my first vote of thanks to the Almighty God for giving me the strenght to bear them all. His guidance is unending.

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Finally, I hate to but will take the ugly and unpleasant task of regestering my digust for the hostile attitude of some Nigerians to researchers. They should stop it.

# PALM PRODUCTS INDUSTRY
# MODULAR COORDINATION FOR FLEXIBILITY
# IN INDUSTRIAL DESIGN

M.Sc. THESIS ABSTRACT (1984/1985)

BY

UWODI EDINOH EBUNE

The oil palm is indinenous to West Africa and thrives in all the countries from Sierra Leone to the Zaire, wherever the average annual rainfall amounts to 150 cm distributed over not less than eight months of the year.

Palm oil and Palm kernel were important among the several exports from oil palm belt of Nigeria and used to be the most important commodities that the people produced for export and were their sole source of income before the oil boom in Nigeria.

Palm products output like any other agricultural product droped seriously after the advent of oil boom to the extent that we have become a major importer of palm oil now.

The present fall in petroleum price has made the Federal Government to look for a way of deversifying the economy, hence the present emphasis on industrialization and agricultural development.

To carry the citizens along with the agricultural programmes, there should be a ready market, and a good one for that matter, for any agricultural product right where it is produced or where the potentials for producing them exist thus stimulating the production. These will also serve a dual purpose of industrial and agricultural development.

This thesis topic was selected with this phyosophy in mind. The industry is to extract and refine palm oil and palm kernel oil for domestic and subsequent export market.

SCOPE

a) PRODUCTION HALLS
   - Palm oil mill
   - Palm kernel mill
   - Feed mill
   - Refinery

b) STORAGE FACILITIES

c) TECHNICAL AUXILIARY FACILITIES

d) STAFF FACILITIES

e) ADMINISTRATION.

UWODI EDINOH E.

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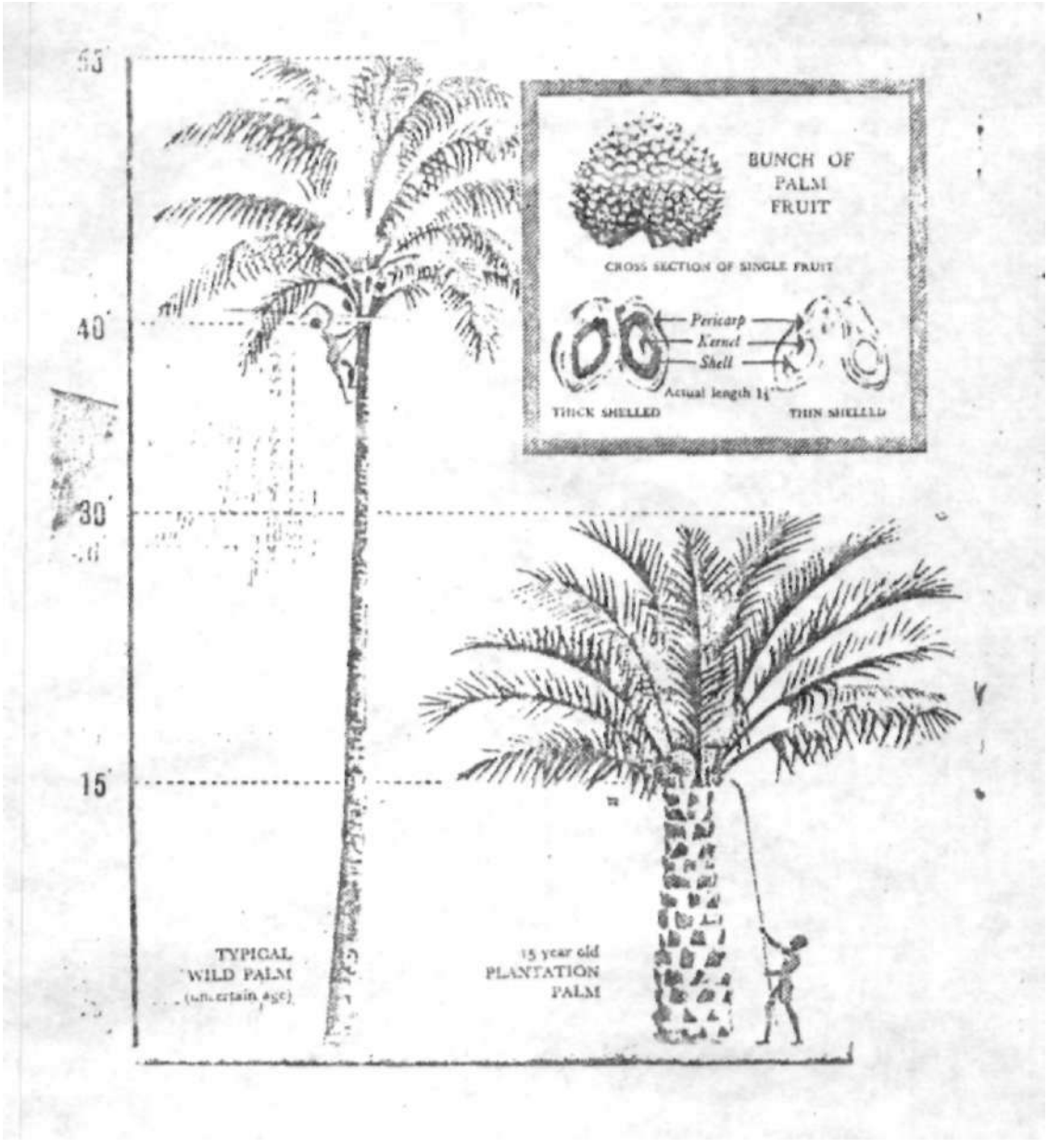

60'
40'
30'
15'
BUNCH OF PALM FRUIT
CROSS SECTION OF SINGLE FRUIT
Pericarp
Kernel
Shell
Actual length 1½"
THICK SHELLED
THIN SHELLED
TYPICAL WILD PALM
(uncertain age)
15 year old PLANTATION PALM

# CHAPTER ONE

## 1.0. INTRODUCTION:

Industrial investment have been devoted to projects for import substitution of imported luxury items such as cars, refrigerators, air conditioners etc. Little attention has been paid to simple, mass market items like edible oil, soap, pencils etc we have to remember that however simple an article may be, unless there is investment in its production we shall continue to import them. It is time now to deliberately orient our search for new industrial projects towards the production of many of the very simple but essential industrial products that we continue to import for consumption by the bulk of the population. And whose raw materials are not locally available.

The best market base for any industry is to produce goods for which there is a traditional mass market. Edible oil is a product which is indegenous and has been produced as traditional goods using local skills and raw materials. This product is produced by traditional methods which result in variable quality and sometimes in shortages. Opportunities therefore exist for new industries to be created to produce traditional products on a mass production basis. This combined with modern management techniques will bring down cost.

So, in the planning stage of an industrial project, opportunities should be sought for the utilization of local raw materials. The method of selecting the product to be made first, and thereafter, looking for the raw materials is not the best. Instead we should focus on selecting industrial projects whose products can be made from local materials. By so doing, we

stimulate the production of raw materials whose demand has been low. But which we have them in abundance or which we have the potentials of producing.

1.1. THE RAW MATERIALS:

Palm oil is derived from the front of the oil palm tree, which in appearance is rather like the data palm with a large head of pinnate feathery fronds growing from a study trunk, the fruit grows in bunches weighing 18.14kg to 22.68kg with 400 to 1500 individual fruits. The fruit consists of the outer pulp which is the source of the crude palm oil, an inner shell which is used as a fuel, and a kernel which is the source of palm kernel oil and meal.

A plantation - grown palm tree bears fruit when 3½ - 4 years oil; reaches its peak yield at about 10 years; produces about 136.07kg of oil per hectare; is replaced when about 30 to 35 years old when the fruit bunches are too high (13 metres) for economic harvesting. The wild palm probably takes three times as long as a plantation palm before it bears fruit; grows upwards at the expenses of grith, to rise above the undergrowth; so that the fruit can usually be reached only by climbing the trunk (plantation fruit is harvested by hand using either a chisel or a curved knife on a long pole depending on the height of the palm tree. Harvesting of the fruit is continous through the year with a seasonal peak between March - May.

The bunch is harvested from the palm tree by cutting through the bunch stem. The harvested bunch is then gathered together with any detached fruit and carried manually to road side to await

transport to the oil mill. The fresh fruit bunches are loaded into trucks, transported to the oil mill where they are dumped and beloaded into sterilizer cages. The extraction of palm oil from fruit is in four stages. The first stage is sterilization in which the fresh fruit bunches are subjected to live steam under high pressure for 50 - 75 minutes. The purpose of sterilization is to deactivate the enzymes responsible for the breakdown of oil into free fatty acid and to loosen the fruit from the bunches so that the oil can be recovered later. Great care is taken during sterilization to exclude air which interferes with the sterilization efficiency and may cause oxidation of the oil.

In the second stage of processing sterilized bunches of fresh fruit are then continuously fed into a rotary drum threshing or stripping machine which strips and separates fruit from the bunches. The fruit passes along channel bars running longitudinally along the drum while the empty bunches are eventually discharged at the end of the drum for incineration. After stripping, the fruit is fed continuously into a digester. Digestion converts the fruit into a homogeneous oil mash suitable for pressing. The digested mash is then fed into a press for extraction of crude oil under pressure which is applied either hydraulically or by means of a worm screw.

The nuts separated from the fruit pass through a polishing drum, the nuts are cracked and shells separated from the kernel in a hydroclone. The shells are mixed with the fibrous material for use as fuel for boiler. The kernels are pressed and solvent extracted to produce palm kernel oil and meal. The fruit bunch

produces 20% palm oil and 6% palm kernel for plantation oil palm while it is 10.6% and 7% respectively for wild palm groove.

For traditional methods, the fresh fruit bunches are left for some days so that the fruit can loosen up. Small axes are then used to shake off the fruit from the bunches. The fruits are then fed into drum, whose top have been removed with water on fire and allowed to cook for up to five hours. The fruits are then threshed in mortar by either pistol or by foot to form a paste. Water is added to this paste, the fibrous and the nuts are removed, whatever is left is poured into drum on fire, the oil comes to the surface and is then skimmed oof. The palm nuts are dried under the sun. Extraction of kernel is carried out manually by the use of stones.

These two materials, crude palm oil and palm kernel, forms the starting materials for this "palm products industry" and the sources are these oil mills and from the natives who employ this traditional methods of extraction.

1.2. THE VALUE OF THE OIL PALM:

Although the oil palm is best known for its commercial products, palm oil and palm kernel, it must be borne in mind, when considering it in its West African setting, that it is first and foremost a food crop. Large quantities of palm oil are consumed locally. While it is difficlt to get precise figures there is good reason to believe that in Nigeria more is consumed within the country than it was exported in the Ghana (Gold Coast) and Sierra Leone palm oil is also an important article of food, but in the letter country, the poorness of the fruit type and the difficulty of

expressing a reasonable amount of oil from it is no doubt a discouraging factor in determining its wide use. Palm oil besides contributing to a balanced diet by the provision of vegetable fat, has the added value of being rich in vitamin A. There is considerable scope for extending the consumption of palm oil throughout the tropics, with benefit to the health of the people.

Another important product of the oil palm is palm wine. While the consumption of the liquor is often condemned it is usually recognised as having a certain dietetic value because of its vitamin contect. In some parts of West Africa the production of palm wine is carried out on such scale that for all practicel purpose it may be regarded as equivalent to brewing industries of other countries.

The oil palm furnishes many other things which assume importance in the domestic economy of the people. The leaves may be used to make thatches which are often the only roofing materials available in certain areas. The leaf petioles or rachises may be used for fenching, or for protecting the tops of mud walls. The palm cabbage is occasionally eaten as vegetable, but this of course involves the destruction of the palm and is usually only done when a palm has been felled for some other purpose. Sometimes oil is expressed for making soap. The ash obtained by the burning of the refuse which remains after stripping fruit from the bunches when producing oil and kernels is very rich is potash and is therefore often used in soap making.

All this uses combine to make the oil palm a most valuable plant in the lives of the people in the regions in which it grows. With the possible exception of the coconut palm it is doubtful whether there is any other plant which is so important.

1.3. COMPETITORS: WORLD TRADE IN VEGETABLE AND OTHER OILS:

Hundreds of thousands of tons of palm oil and palm kernels enter into world trade every year. Although this sounds considerable it is an important fact to bear in mind when viewing the oil palm from the commercial angle that these quantities represent only a few percentage of the total world trade in vegetable oil. While it is true that each vegatble oil has its own special uses, there is a good deal of interachangeability which will undoubtedly increase as scientific research progresses. It will be seen, therefore, that in the world market the commercial products of the oil palm are up against a considerable amount of competition from other vegetable oils. This picture would not be complete without reference to the large quantities of oils and fats which are supplied to the market from non-vegetable sources like butter, lard and whale oil.

1.4. THE STRONG POSITION OF THE OIL PALM AS A PRODUCER OF VEGETABLE OIL:

Although the oil palm has many competitors its great strength lies in the very high yield of oil which it can give. Of the more important vegetable oil plants grown throughout the world the oil palm is easily the most efficient producer of vegetable oil judged by the yield of oil obtainable from an acre of land. This holds good even when the relatively low yields

produced under West African conditions are taken as the basis. When the much higher yields obtained in the plantations are taken into account the oil palm is well ahead of others. The oil palm only real rival, in fact, is the coconut palm, which when grown under the very best conditions can give yields of oil equivalent to those obtained from the oil palm when growing under the relatively unfavourable climate of West Africa.

Yield per acre is always an important factor in determining the successful cultivation of the crop. It is because of the high yields of which the oil palm is capable, even under relatively unfavourable climatic conditions, that it is in such a strong position therefore. But good yields are only obtained when the crop is well cultivated, and when modern methods are applied to the processing of the fruit.

1.5. THE NIGERIAN OIL PALM INDUSTRY - HISTORICAL DEVELOPMENT:

With the world-shortage of animal fats Western Europe has had to look more to the inter-tropics for vegetable substitutes. Margarine and matty soaps and cooking fats are manufactured from intertropical oils of which those expressed from the fruit and kernels of the oil palm form a large part. The trade dates balk to the beginiting of the nineteenth century, when less than 200 tons of palm oil were shipped annually from the Niger Delta. By 1834, when the McGregor Laird expedition was endeavouring to open up the Niger valley trade in order to provide an alternative to slave-traffic, it was estimated that over 13,000 tons of palm oil were exported to the United Kingdom alone. Demand grew as population densities in Western Europe increased. By 1890 the invention of oil

seed crushing machinery stimulated the export of palm kernels and by 1903 the hydrogenation process for de-odorising and solidifying liquid oils had been completed. South-Eastern Nigeria was aptly named the oil rivers protectorate. In 1953, palm produce formed 28% by value of Nigeria export amounting to 201,000 tons of oil and 403,000 tons of palm kernels. It is estimated that an additional 500,000 tons of oil was consumed in the producing area that same year.

1.6. WORLD TRADE HISTORY IN OIL PALM PRODUCTS - NIGERIA'S POSITION:

1.6.1. PALM OIL

World trade in palm oil increased steadily in the period between the two world wars, and although there was considerable dislocation during the second war the latest available returns show that it has reached, and may by now have surpassed, the pre-war level. The expansion of the trade was very largely due to the development of the plantation industry, firstly in the far East, and later in the Belgian Congo. The accompanying graph (Fig. 1.10) show the total world trade since the early nineteen - twenties, and the contribution to that trade by some of the more important producing contries. The graph is worth studying in some details, as the trends which it reveals have an important bearing on the situation in West Africa vis-a-vis Nigeria.

It will be seen first of all that at the beginning of the period for which figures are given export from the British West African territories made up the greater part of the total world trade, amounting to about two-third in fact. Towards the end of

the period they came to no more than about one-third of the total. For all practical purposes, it may be taken that the exports of palm oil from British West Africa are the same as those from Nigeria, as exports from the other territories of the group is negligible. From the point of view of Nigeria's development, therefore, it must be regarded as a little short of tragic that she was unable to take a greater share of the expanding world trade in palm oil. The principal reason is almost certainly the poor quality of the oil produced in Nigeria, but the absnce of plantation developments on any substantial scale, and the use of inefficient processing methods, most have been contributing factors.

The rise in production from countries which have come in for the plantation development of oil palms on a large scale is well brought out by the graph. Before the last war the most striking increase was from the Netherlands East Indies (now Indonesia), and when the war broke out production from that area was well ahead of that of Nigeria. It was this almost phenomenal increase within a relatively short period which gave rise to the expression "the sumatran menace" which was often used when the prospects of the Nigerian oil palm industry were being discussed. At one time the fears aroused by this "Menace" led to gloomy fore - boding regarding the future of the industry. Fortunately, because of the increasing world demand for palm oil, Nigeria was able to hold her own and was at least able to maintain her exports. Nevertheless the danger is still there, and with production from the plantation countries continuing to rise, and with increase

competion from other vegetable oils, Nigeria will be hard put to it unless her production methods are put on a sound basis.

As the graph shows the indonesian export trade in palm oil has been seriously disrupted as a result of the last war and of the political uncertainties that followed and was not able to reach its former level. Production from the Belgian Congo, on the other hand, has show an uninterrupted rise. Nigeria's exports of palm oil between 1926 - 1952 is shown in table.

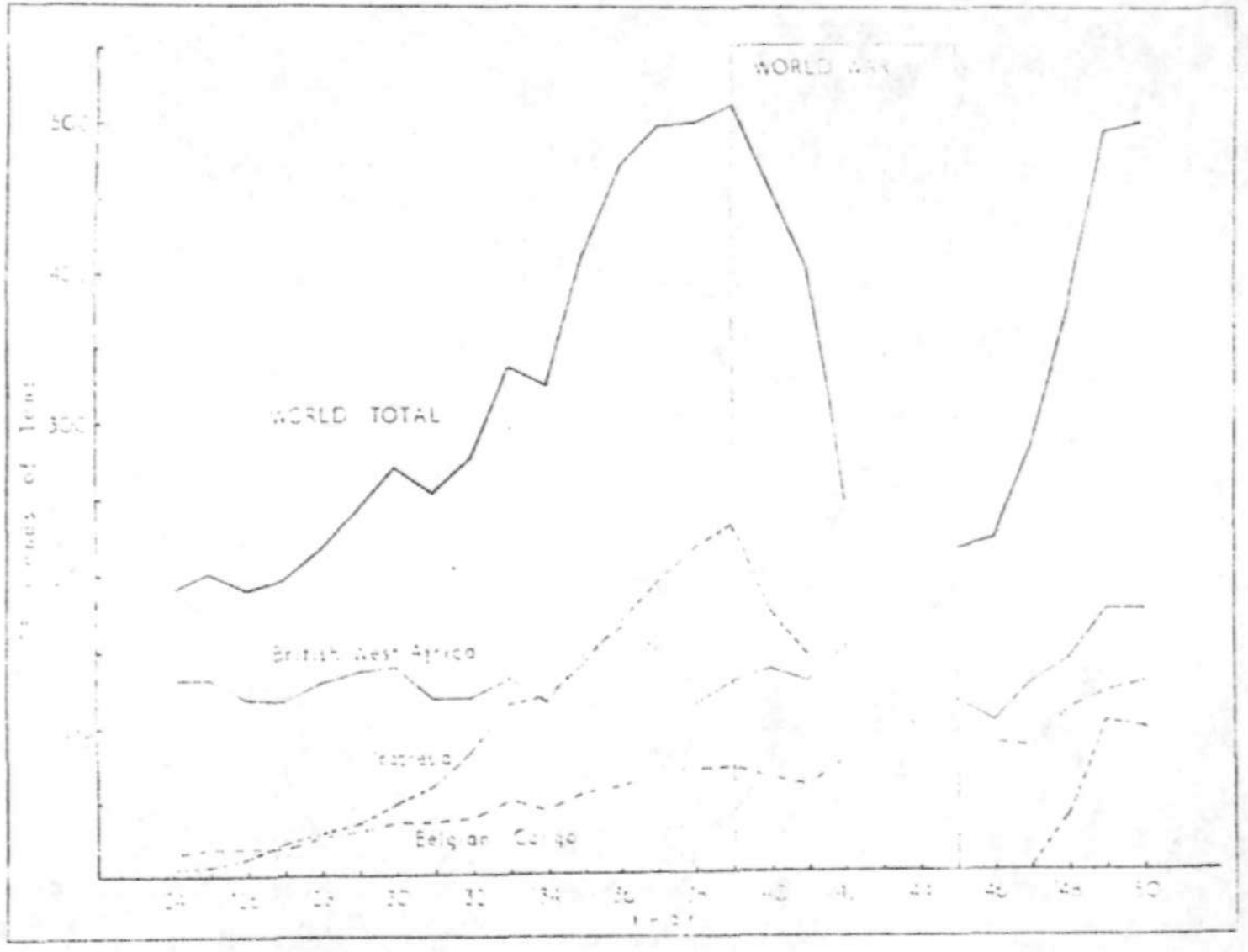
TABLE 1.10

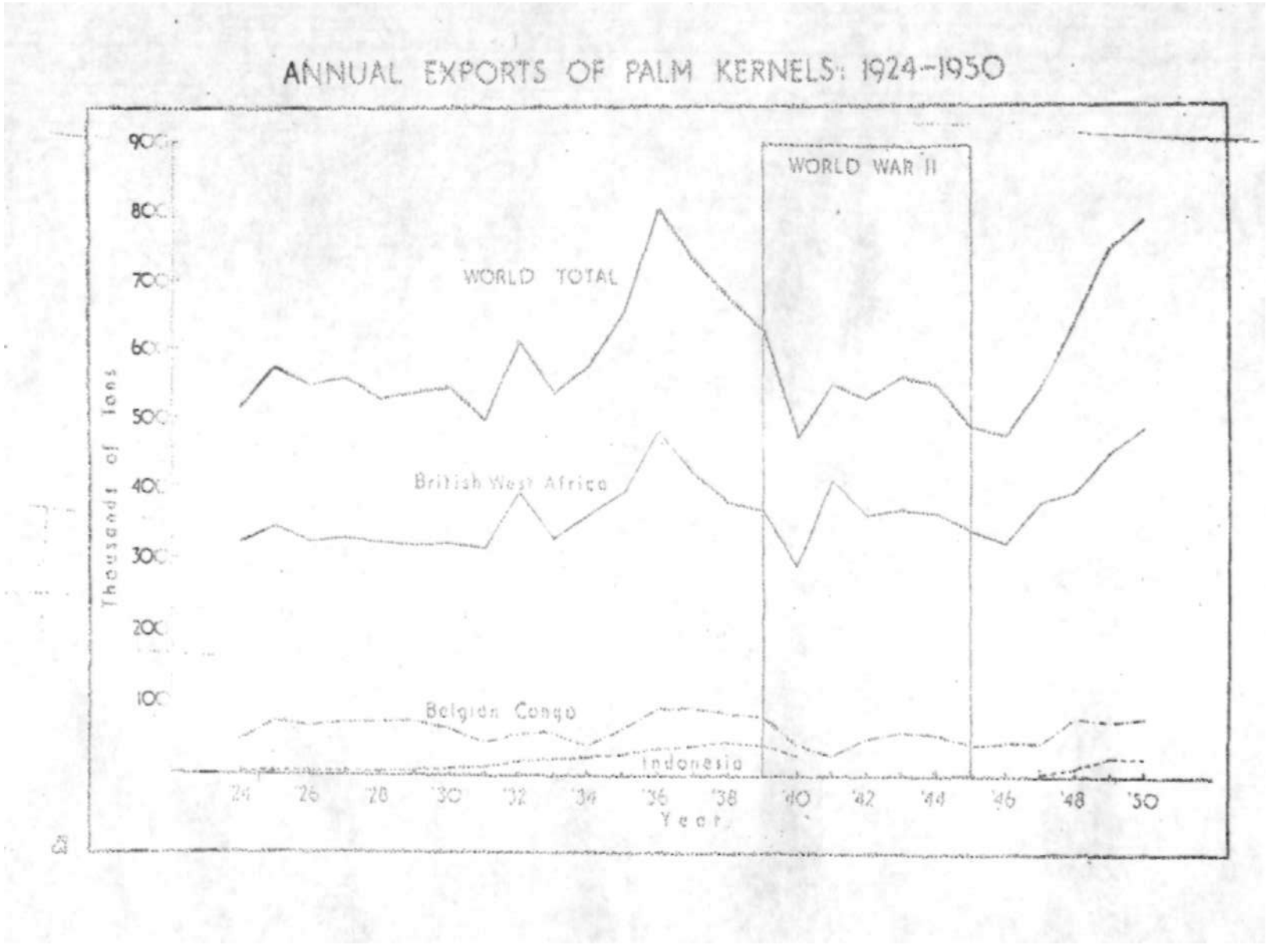
Annual Exports of Palm Oil from Nigeria (to Nearest Thousand Tons)

| Period | Export |
|---|---|
| 1926 - 1930 Average | 124,000 |
| 1931 - 1935 Average | 124,000 |
| 1936 - 1940 Average | 136,000 |
| 1941 - 1945 Average | 131,000 |
| 1946 - 1950 Average | 142,000 |
| 1951 | 150,000 |
| 1952 | 162,000 |

Source: Weifor: An Account of Inception and Activities.

# ANNUAL EXPORTS OF PALM OIL : 1924-1950.




ANNUAL EXPORTS OF PALM KERNELS: 1924-1950
WORLD WAR II
WORLD TOTAL
British West Africa
Belgian Congo
Indonesia
Thousands of tons
900
800
700
600
500
400
300
200
100
'24
'26
'28
'30
'32
'34
'36
'38
'40
'42
'44
'46
'48
'50
Year

1.6.2. PALM KERNEL

A very different picture emerges from a study of the world trade in palm kernels. The graph (fig. 1.20) shows the total world trade since the early nineteen - twenties, and the contribution to it by some of the more important producing countries. It can be seen that in normal times total exports have remained relatively steady at or around the five or six hundred thousand tons mark, but they rose to a peak of over 800,000 tons before the last war, probably as the result of stock - piling. Export from the British West African territories have always formed a substantial part of the whole, and as the graph shows the proportion has been remarkably constant at, on the average, a little under two-third of the total. Exports from the countries in which the oil palm has received extensive plantation development, namely, Indonesia and the Belgian Congo, have always been relatively low, and have shown no tendency to rise in keeping with the increase in palm oil exports. At first sight this will appear surprising, but the reason is that in the plantation countries the emphasis has always been on the production of palm oil at the expense of palm kernels, and this has been particularly the case in the field of plant breeding.

The fact that British West Africa has always had such a steady proportion of the total world trade in palm kernels is a reflection on the relative efficiency of its kernel industry in contrast to that of palm oil. The great bulk of the kernels exported from West Africa are obtained from wild trees and are produced by tedious method of cracking the nuts and extracting

the kernels by hand. This very primitive process is part of the social and economic tradition of the country, being carried out almost entirely by the women and children more or less as a hobby. Costs of production hardly enter into it therefore, and production is maintained even when prices are low. Moreover, the efficiency of extraction is as high as it is with machinery, and the quality of the product is often better. While such a primitive system is often deplored it will undoubtedly take many years to change, if, indeed, the people ever show any willingness to have it changed. In the plantation countries it is considered that because palm oil is so much more valuable than palm kernels, weight for weight, the kernel industry can safely be ignored. In West Africa, however, it is difficult to imagine a situation in which the kernel industry had been allowed to die out. It is felt that at this stage the kernel industry is of such importance that it cannot be neglected.

While Nigeria is by far the largest producer of kernels in West Africa the production from Sierra Leone is also quite considerable. Ghana (formerly Gold Coast) exports a few thousand tons every year, and even Gambia exports a small quantity annual exports from each territory are shown in table 1.20.

TABLE 1.20

Annual Exports of Palm Kernels from West Africa
(To Nearest Thousand Tons)

| Period | Nigeria | Sierra Leone | Ghana (Gold Coast) | Gambia |
|---|---|---|---|---|
| 1926 - 1930 Average | 153,000 | 63,000 | 7,000 | 1,000 |
| 1931 - 1935 " | 285,000 | 68,000 | 5,000 | 1,000 |
| 1936 - 1940 " | 314,000 | 70,000 | 7,000 | 1,000 |
| 1941 - 1945 " | 332,000 | 37,000 | 7,000 | 1,000 |
| 1946 - 1950 " | 342,000 | 64,000 | 4,000 | 1,000 |
| 1951 | 347,000 | 75,000 | 2,000 | 2,000 |
| 1952 | 374,000 | 76,000 | 6,000 | 2,000 |

Source: Waifor: An Account of Inception and Activities.

1.7. THE PLACE OF THE OIL PALM IN WEST AFRICAN ECONOMY:

While the total value of the products consumed or utilised locally must be very considerable, it is impossible to put a precise figure on it. When it comes to exports, however, their values can be computed with accuracy, and it is usually these figures which are in mind when discussing the place of the oil palm in the economy of the West African countries.

In Nigeria the total value of the exports of palm products was very nearly one-third of that of the total value of all domestic exports. From the export point of view the products of the oil palm were in fact more valuable than any other commodity.

TABLE 1.30

NIGERIA: Value of Exports of Oil Palm Products in Caparism with that of all Domestic Exports

| Year | Palm Oil | Palm Kernels | Total | Total Domestic Exports |
|---|---|---|---|---|
| 1948 | 9048260 | 11451097 | 204993.57 | 61165052 |
| 1959 | 11910091 | 16912575 | 288226.66 | 679201150 |
| 1950 | 12072052 | 16693636 | 287656.88 | 88487565 |
| 1951 | 12948743 | 20059297 | 330882.40 | 116613829 |
| 1952 | 14617372 | 20411981 | 350293.53 | 115897459 |

Source: **WAIFOR:** An Account of Inception and Activities.

1.8. BACKGROUND STUDY

Production of palm produce takes place largely in Rivers, Cross Rivers, Imo, Anambra, Bendel and Ondo States with marginal production in Oyo, Ogun, Lagos, Kwara, Benue and Gongola States.

Most of the production comes from the wild palm groves of Dura specie, but there has been a great break through in the replacement of this low yielding specie with a high yielding and fast mature tennera specie developed by the Nigeria Institute for oil palm research, Nifor, Benin.

From the data, (**Table 1.40**) supply shows a declining trend from 501,000 tonnes in 1982 to 533,000 in 1990. And there is an excess demand over supply throughout the period. The supply deficit grows from 132900 tonnes in 1982 to 570,000 tonnes in 1990.

TABLE 1.40

Demand for and Supply of Palm Oil in Nigeria 1982-1990

| Year | Estimated Population | Estimated Consumption/ Capital | Estimated Demand | Estimated Supply | Supply Deficit |
|---|---|---|---|---|---|
| | Millions | kg/year | Tonnes | Tonnes | Tonnes |
| 1982 | 81.40 | 8.77 | 713900 | 581000 | 1329000 |
| 1983 | 83.50 | 9.03 | 754000 | 575000 | 179000 |
| 1984 | 85.58 | 9.30 | 795900 | 569000 | 226900 |
| 1985 | 87.79 | 9.58 | 841000 | 563000 | 278000 |
| 1986 | 89.98 | 9.87 | 880100 | 557000 | 323100 |
| 1987 | 92.23 | 10.17 | 938000 | 551000 | 387000 |
| 1988 | 94.54 | 10.48 | 990800 | 545000 | 445800 |
| 1989 | 96.90 | 10.79 | 1045500 | 539000 | 506500 |
| 1990 | 99.32 | 11.11 | 1103400 | 533000 | 570400 |

Source: Feasibility study for the establishment of processing and refining mills. (BENUE STATE).

With the above, it could be adduced that the prevailing market outlook indicates that domestic production is incapable of meeting the consumption requirements of the country. This is because the oil palm industry has during and after the Nigeria civil war suffered total neglect of maintainance, rehabilitation and development due to the war and emergence of oil boom in the early 70's which attracted away labour from agricultural activities to non agricultural jobs which guarantee quicker and higher income opportunities away in urban areas that boast of essential amenities of life that are lacking in rural areas.

In fact before the war and for 15 years, 1950 - 1965, Nigeria was the world's largest producer and exporter of palm oil. The volume of export between 1960 - 1966 is as follows:

TABLE 1.50

| Year | Export(Tonnes) |
|---|---|
| 1960 | 186000 |
| 1961 | 167000 |
| 1962 | 121000 |
| 1963 | 128000 |
| 1964 | 136000 |
| 1965 | 152000 |
| 1966 | 146000 |

Source: Statistical publication by Lever Brothers.

The fall in export started in the civil war year of 1967 as most of the oil palm growing areas were in the geographical area declared as Biafra by the seccessionists. Export during the war years were as follows:

TABLE 1.60

| Year | Export(Tonnes) |
|---|---|
| 1967 | 17600 |
| 1968 | 3000 |
| 1969 | 8000 |

Source: Statistical publication by Lever Brothers.

Even though the civil war ended in 1970, the export volume was 7000 tonnes in that year and 8000 tonnes in 1971. The export never recovered to its pre-war level. Infact export of palm oil ceased from that year, 1971.

Production of palm oil suffered a great decline in the 70's. It declined from 490000 tonnes in 1970 to 200000 in 1974 but rising again to 300000 tonnes in 1977. But despite the decline between 1971 when the country last exported and 1976 when the production was still poor the volume of vegetable oil produced locally was nearly equal to the country's demand for industrial and domestic consumption. During this period, the country neither exported nor imported any quantity of vegetable oil.

Also despite the stoppage of decline in production of palm oil in 1975 as from 1976, Nigeria started to import vegetable oil in order to bridge the demand and supply gap. About 27,7000 tonnes, was imported in that year with the highest volume of import.recorded in 1979 at 420,000 tonnes.

TABLE 1.70

Import Between 1976-1983

| Year | Import (Tonnes) |
|---|---|
| 1976 | 27700 |
| 1977 | 231300 |
| 1978 | 258800 |
| 1979 | 420000 |
| 1980 | - |
| 1981 | 250000 |
| 1982 | 256000 |
| 1983 | 350000 |

Source: Statistical Publication by Lever Brothers

The 1980's saw remarkable revival of palm oil production in contrast to declining trend of 1970's. There has been a steady annual increase in the production which for the period 1980 - 1983 the volume is as follows:

TABLE 1.80

| Year | Production (Tonnes |
|---|---|
| 1980 | 520000 |
| 1981 | 535000 |
| 1982 | 550000 |
| 1983 | 600000 |

Source: Statistical publication by Lever Brothers.

Infact, the 1983 production was the highest in 23 years.

The remarkable revival of palm oil production could be attributable to massive investment by the Federal Government, the world bank and few private investors in the rehabilitation of old estates and establishment of new estates in the oil palm growing areas of the country. Also is use of the improved high yielding and quick mature tennera specie.

1.9. PRICES AND MARKETING OF PALM PRODUCTS:

The Nigeria produce board, a Federal Government Agency with Headquarters at Calabar, fixes prices for palm produce for any season. But there is also an open market price that is dictated by the demand and supply situation prevaling from time to time.

The Nigeria palm produce prices for 1984 season are as follows:

| | | |
|---|---|---|
| Special Grade Palm Oil | - | ₦495.00 Tonnes |
| Technical Palm Oil | - | ₦440.00 " |
| Palm Kernel | - | ₦230.00 " |

The open market prices of palm oil ranges between ₦1,000 - ₦1,200 per tronc. This high level of prices could be attributed to the excess demand which is associated with low level of supply and the cost of processing using traditional methods.

The Nigerian palm produce board is presently not patronised by oil palm processors because of its low prices. Most processors prefer to sell to the open market buyers, where they could obtain higher prices.

As for the palm kernel only the Nigeria palm produce price reigns and it is the board that is virtually the sole purchaser.

1.10. DESIGNER'S AIM:

- To design buildings which gives constructional and operational flexibility
- A design which reflects a high degree of involvement with both the workers' interest and the production processes.
- To humanise the factory environment
- To design an industry that will give a forceful image to the products.
- A design that will result in high workers' morale, job prestige which will encourage efficiency and personal identification by workers.

1.11. GOALS/OBJECTIVES

- To develop facilities which maximize available local resources
- To create market where the potentials for a particular agricultural products exist thus stimulating the production
- To increase agricultural and industrial development
- To use Nigeria's vast wild palm groves and plantation potentials to benefit the economy
- To increase the net income of that portion of the population dependent on oil palm produce production
- To give employment to the people
- To meet Nigeria's demand for fats and oil

- To conserve and eventually earn foreign exchange
- To help combat shortfall in the world's fats and oil situation.

1.12. RELEVANCE TO NIGERIA

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

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

1.13. THE CONCEPT OF RURAL INDUSTRIALIZATION

When rural industrialization is mentioned, what some people immediately think of is the use of village technology and active participation of the villagers. Although this notion cannot be discarded, there is another way of industrializing rural areas. One can go capital intensive. Whatever way one chooses, the most important thing is that the industry should have some social and economic impact on the people. For this thesis, the nature of production cannot allow one the luxury of village technology.

Any industry, or any commercial enterprise for that matter, which is situated in any area must have social and economic impact on the area and communities within the area.

Social benefits of the industry include direct employment of a large number of indigenous personnel for capital intensive project as well as peripheral employment and benefits arising from corresponding services and facilities supporting the industrial complex.

The benefits incorred by the utilisation of amenities supplied by the complex such as medical and educational facilities, electricity and pipe borne water are incalculable.

The siting of the industry and housing for staff in rural areas will enhance rural development. The need for skilled labour stimulates training opportunities and this leads to development.

It is also likely that this industry will stimulate the siting of auxiliary industries such as packaging industry with increasing opportunities.

The standard of living and purchasing power of the people in the area will be raised.

Nigeria is an agrarian society with about 75% of the population engaged in agriculture. At least 85% of this population live in rural areas. If such developments are brought to rural areas, it will have a positive effect on agricultural output. Minus that, people with skills in agriculture and other fields will be attracted to rural areas. If the conditions of living are improved thereby disconjesting our towns and cities.

1.14. SCOPE

The project will cover the following:

- Palm kernel oil extraction and meal handling mill
- Palm oil and palm kernel oil refinery
- Fatty acid and glycerine recovery and distillation
- Auxiliary facilities
- Administration
- Staff facilities.

The above are broken down into their respective components in the design brief. (Chapter 7).

1.15. THESIS MOTIVATION

Nigeria was the largest producer and exporter of palm produce between 1950 - 1965. For the various reasons which has been given already in this introductory chapter, Nigeria slumped. In recent years, the Federal Government has stepped up effort, an elaborate effort for that matter, towards the palm produce production. The 1980 - 1983 production (Table 1.8) has justified this effort; production is seriously on the increase. There is a spark of hope. It means that in the near future, and with this effort, we will start exporting again. But this time around we should export refined oil instead of crude oil and we should be able to refine the oil to meet our domestic, including industrial consumption. We will stand to gain more by refining the oil in this country. Some of this gain can clearly seen from the discussion so far. This is one major motivation.

The second motivation is my interest in industrial design and the need to identify myself with the trends of development and the aspiration of this country - industrial development.

# CHAPTER TWO

## 2.00. THE SITE

### 2.1. LOCATION

Anyigba is situated near the centre of Dekina Local Government Council Area at the junction of two main regional roads: The Dekina Ankpa Federal Highway A233 and the Anyigba Idah main regional road. The town is therefore strategically placed at the centre of the highway network.

### 2.2. LABOUR FORCE

Approximately 67% of the full-time workers are engaged in the agricultural sector, 27% in the tertiary sector 4% in the manufacturing and 2% in construction.

Part-time and casual workers, undoubtedly suffering from a certain amount of underemployment, who are considered to form a pool of casual labour for various job are assumed to represent about 14% of the total labour force.

The effective labour force is estimated to constitute about 38% of the total population, while the total labour force, full-time casual workers, constitute about 44% of the total population.

### 2.3. ECONOMIC BASE

Anyigba is a rapidly growing agricultural town which is also an important commercial centre in the region. Its manufacturing sector is composed mainly of small scale industries, such as furniture making, bakeries and crafts.

Traditing activities in Anyigba are carried out primarily in the traditional market which is held every 4 days. About 5050 buyers and sellers attend the market, approximately 55% of whom

come from Anyigba. The rest come mainly from surrounding villages. Crops and foodstuffs mainly maize, guinea corn, yam, cassava, beans, soup incredients, meat and fish constitute over 80% of the goods traded.

In addition to the traditional market, there are several shops along the main roads which cater for the daily needs of the towns inhabitants and the surrounding villages.

The average annual family income is probably about ₦200.00. This figure excludes income in kind which is believed to be relatively high in rural towns when traslated into monetary value.

2.4. AGRICULTURE

Most of the population of Anyigba derive their livelihood from agriculture the main crops grown include maize, millet, cassava and yam, with extensive areas of oil palm. Lumbering is practiced by some farmers.

2.5. INDUSTRIAL DEVELOPMENT

At present the manufacturing sector in Anyigbo, engages approximately 4% of the effective labour force and consists mainly of small scale timber and furniture industries and handicrafts. It is likely that the development of manufacturing industries will consist of food processing plants using local agricultural produce, crushing mills, furniture manufacture, bakeries and small-scale mechanical engineering, especially motor repairs on account of Anyigba's strategic position within the region, the town could develop as a storage and distribution centre for various trades and industries.




FIG A: LOCATION OF BENUE IN NIGERIA.




FIG B: OIL PALM GROWING AREA OF BENUE.

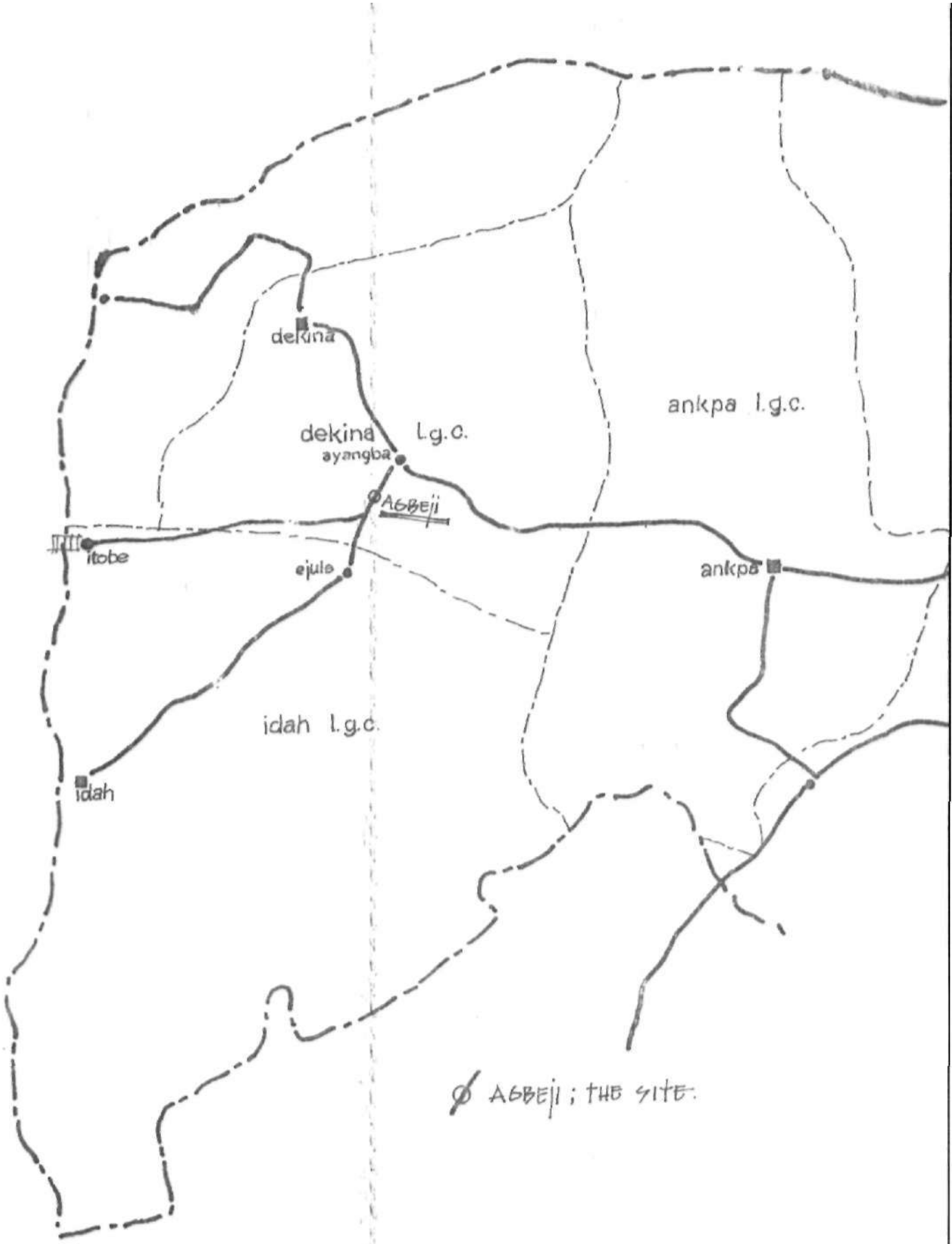



FIG.C : SITE LOCATION.

## 2.6. CHOICE OF SITE

### 2.6.1. REGIONAL CONSIDERATION

Although the data shows that equal amount of palm produce is obtained from the mills, it is just an average taken when it is broken down to actual figures, Benue West, which consist of Idah, Dekina, Bassa and Ankpa local government councils, is the major producer of this palm produce the amount obtained from the rest areas are megre. The oil palm exploitation activities is higher in Benue West. A pointer to this is the fact that five major private oil millers exist within this area compared to one in the rest of the producing areas of the state.

Apart from the petty industries like block industries, lumbering, vehicle servicing and repairs etc this region has no major industry. It will serve well for this industry whose major raw materials are found here to be located within this area.

### 2.6.2. MACRO-LOCATIONAL FACTOR

Anyigba happened to fall within the centre of the Benue West with the major highway from this local government areas converging there.

The centrality of Anyigba can also be viewed from the raw materials and distribution of finished products angle. Anyigba is linked directly to the North and South via the New Itobe Bridge. There are potential markets and sources of raw materials like chemicals. In the case of South, it is also linked to the Ports if the need for exportation arises.

2.6.3. MICRO-LOCATIONAL FACTORS

At first insight, the aim was to intergrate the industry with one of the oil mills. The two palm oil mills that falls within the centre of gravity of this oil palm producing area are Anyigba oil mill and Acharu oil mill. On the second thought, I decided against it because: in the case of Anyigba, the land is costly and there is no land for expansion.

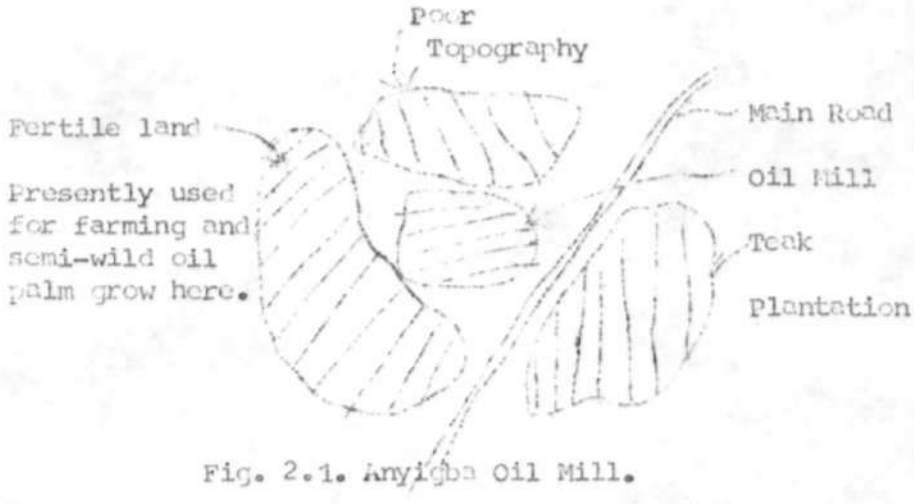



Fig. 2.1. Anyigba Oil Mill.

In the case of Acharu, the mill is located within the village. The land is also fertile with the villagers farming all around and semi-wild palm groove trees around. It is also a small village with laterite road so staff housing and transportation will be difficult.

With this in mind, I decided to chose an entirely new site to tap the advantages it offers.

The chosen site is at Agbeji, 5km from Anyigba town rotary along Idah and Itobe road. The advantages of the site are includes:

- It is along the Itobe Road
- It is an extensive barren land, free to expand in all direction
- The land is cheap
- It is very near to the propose Railway line.

2.7. SITE ANALYSIS

2.7.1. LOCATION

The project site is located about 5km from Anyigba round about along Idah road. The site is regular in shape and very extensive and free to expand in all direction except the side bounded by the major highway.

2.7.2. SLOPE: - The site slopes gently towards North. The gradient is about 3.5%

2.7.3. VEGETATION: The site is covered with tall grasses interspersed with trees characteristic of guinea savannah. The trees found here are decidous (photograph).

2.7.4. GEOLOGY - SOIL: With particular reference to the project site the top level of the site is covered with thin layer of clayey silty loam which is brown with exposed rock here and there. The underlaying rock is lateritic and is of sedimentary origin. On exposure, the rock can be very hard an indurated thus very impemenable to water flow and can be excavated for civil engineering structures like road construction and foundation.

Special foundation are not required for buildings on this site.

2.7.5. CLIMATE: In general Anyigba has a tropical savannah climate.

There are two main seasons: the wet season from May to October, and the dry season from November to April. Each is characterised by a particular type of wind. During the wet season, Southwesterly winds blow from equatorial rain belt, and during the dry season the harmattan, a dry dust-laden wind, blows from the Northeast.

Temperatures decrease slightly during the wet season with a corresponding increase in relative humidity. Tornadoes occur occasionally at the end of the wet season, destroying settlements and crops. The dry season is usually a period of high temperatures. Febuary to April is generally the hottest period. The harmattan often helps to reduce. The relative humidity at the beginning of the rainy season.

Due to the existence of 'flash' storms during the wet season, an efficient storm water drainage system is required to take peak flows.

2.8. UTILITIES

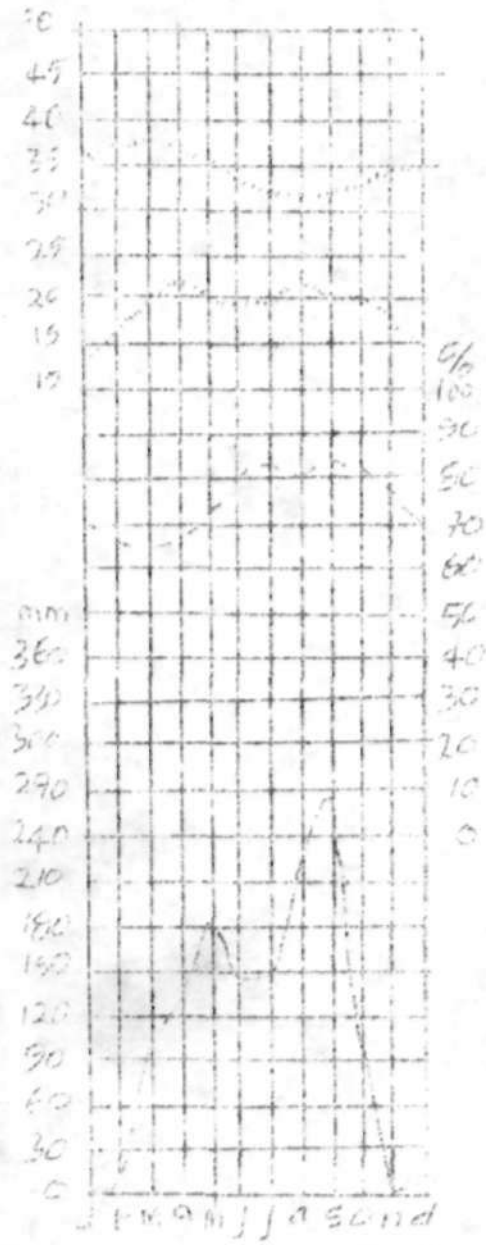
Although Anyigba is about the fifth lagest town in Benue State, it has not been supplied with water electricity and telephone services. However, the masterplan envisaged utility lines along the main road where the project site is. The industry will therefore rely on this for supply of electricity and water although a generator and bore holes will be provided as stand-by.

## 2.9. OTHER INFRASTRUCTURES

The site is along a good sub-arterial road. This road links the whole of the region to the heart of the North and South via the newly constructed Itobe bridge.

The proposed railway and the only railway line in the region, if built, is less than 1km from the site.

The industry can take advantage of these infrastructures for the procurement of some raw materials and the distribution of the finished goods to the heart of the market.



..... Average max. & min. temp

- - - - - Average relative humidity at 9.006mt

——— Rainfall

Fig. 2.2. Climatic Conditions

## CHAPTER THREE

### 3.0. FEASIBILITY STUDIES

### 3.1. SOURCES AND EXTENT OF RAW MATERIAL

The raw material which are fresh fruit bunches (FFB) are from the oil palm groove that are wildly grown mostly in the South and South Western part of the state.

The oil palm grooves in these areas are mainly of dura specie which is characterized with low yield of both palm oil and kernel. But there is a government owned plantation at Alloma where improved and high yielding tenmera specie is planted. Reasonable hectarage planted has reached production stage.

TABLE 3.1

Hectarage of wild palm grooves as derived from graded palm Kernel

| Division | 1975/76 | 76/77 | 77/78 | 78/79 | 79/80 | Total | Average |
|---|---|---|---|---|---|---|---|
| Ankpa | 51694 | 46924 | 44702 | 33275 | 39298 | 215893 | 43178.6 |
| Dekina | 15524 | 22282 | 18574 | 28670 | 21998 | 107048 | 21409.6 |
| Idah | 32883 | 23931 | 23266 | 32499 | 25532 | 138021 | 27604.2 |
| Otukpo/ Okpokwu | 20482 | 8693 | 12743 | 16642 | 13253 | 71813 | 14362.6 |
| Total | 120583 | 101830 | 99285 | 110996 | 100081 | 532775 | 10655.5 |

Source: Feasibility study for the establishment of processing and refining mills (Final Report II).(BENUE STATE).

PLANTATIONS

ALOMA - 5200 hectares envisaged, 485 hectares have been planted already

ACHARU - Approximately 0.70km$^2$ of palm plantation owned by Nifor

A.A.D.F. - Has pockets of plantations

B.P.F.B. - Plans on the way to establish plantations

PROPOSED - Three sites have been proposed by PGN

INDIVIDUAL - There are private plantations - extent not known.

TABLE 3.2

Yield from oil palm

| Yield | Wild | Plantation |
|---|---|---|
| Fresh fruit bunches (FFB) Ha | 2.5 tons | 10.0 tons |
| Palm Oil/FFB | 10.6 % | 20.0 % |
| Palm Kernel/FFB | 7.0 % | 6.0 % |
| Plam Oil/Ha | 0.265 tons | 2.0 tons |
| Palm Kernel/Ha | 0.175 tons | 1.2 tons |

Percentage of oil in palm kernels = 50%

REMARKS

- The hectarage of wild palm groves has been projected to 266367 by 1990
- With the present emphasis and encouragement; more wild groves will be rehabilitated; more individuals will go into plantation farming and the present ones will be expanded.

3.2. THE PALM OIL MILLS

Presently Benue State Government has proposed eighteen oil mills in the state. The mills proposed are not enough for the resources available because the feasibility studies didn't go further to explain what will happen to the surplus fresh fruit bunches (FFB) after the maximum production capacity of the mills has been reached. So more mills are recommended. A palm oil mill have been deliberately included in this thesis to give a proto-type design to the proposed ones.

Each mill will have collection centres where FFB will be weighed and bought from the farmers.

In addition to this, the mill will buy directly from the plantation farm and may undertake the fetching of the FFB from the palm tree.

The palm oil and the palm kernel from these mills will be sent directly to this "palm products industry".

3.3. PRODUCTION CAPACITY

From the above (source and extent of raw materials). It can be seen that there is abundant raw materials in this area presently and surplus in the near future to justify the establishment of a palm products industry.

It is not possible to fix a precise figure of the quantity of raw materials available. For this reason, the production capacity is not a direct derivative of the quantity of raw materials available but empirical.

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Palm oil mill = 1200kg/hr

One FFB weighs 18.4 - 22.68kg

assuming an average of 20kg/FFB and

16hour working time; =

$$\frac{1200kg}{20kg} \times 16 \text{ hours} = 960 \text{ FFB/Day}$$

Palm Kernel mill = 250 tons/Day

Palm kernel contains 50% oil

45% will be extracted, 5% will be left in the cake

oil extracted/Day = $\frac{45}{100} \times 250 = 112.5$ tons

cake obtained/Day = 250 - 112.5 = 137.5 tons

Oil Refinery = 400 tons/Day

400 tons of crude oil gives 300 tons of refined oil.

The 100 tons difference is the spent lye.

Free Fatty Acid/Glycerine Recovery and Distillation = 100 tons of spent lye/Day

Feed Mill = 1200 bags/Day for four production lines;

300 bags/line.

3.4. MARKET FOR THE PRODUCTS

Tables 1.40 and 1.70 shows the palm oil situation in Nigeria. It can therefore be seen that there is a huge market for the product of this industry in the country. This domestic market includes oil for domestic cooking and industrial use such as in the soap, margerine, buscuit factory and other industries with oil based products.

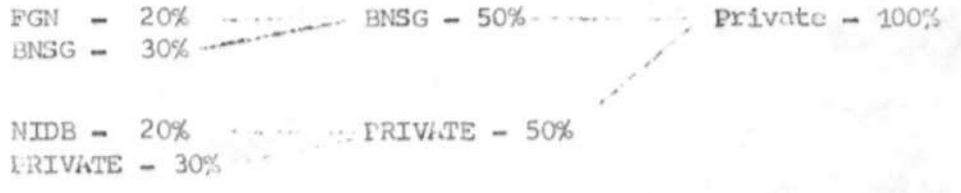
This domestic market can be supplimented in the near future by export market since the palm produce production is on the increase now as indicated by Table 1.80.

Glycerine can be sold to pharmacuetical industries and pure fatty acid will find market is soap, synthetic resin and paint industries.

The kernel cake will be sold to feed mills and organic fertilizer industries. The animal feeds produced here will be sold to livestock farmers.

3.5. FINANCING THE PROJECT

The diagram below shows how the project is going to be financed.




Initially, the four bodies will have shares in the project. Later, the state government will buy federal government's share and private will buy NIDB's share lastly the public will buy the share from the state government.

3.6. INFRASTRUCTURE

Water, electricity, telephone services, road and railway line has been discussed in section 2.8 and 2.9 of this thesis.

3.7. MAJOR IMPUTS

CAUSTIC SODA: It is being imported presently into the country but we have a lot of deposit in this country. A plant has already been proposed for Lagos.

HEXANE AND FUEL: This will be supplied by Petroleum Companies in the country

BLEACHING EARTH: Will be imported from North Africa and Europe.

Others like Phosphoric Acid, Sulphuric Acid will be supplied locally.

## CHAPTER FOUR

### 4.0. CASE STUDIES

In a project like this case studies are necessary to firstly examine the criterion involved in the design of such factory and secondly, to see how the predecessors translated this criterion into concrete structures.

In the light of this I decided to choose three existing adibe oil refinery namely:

- Noma Enterprises Limited, Kano
- Kano State Oil and Allied Industry
- Funtua Oil Mill

They will be discussed in turn.

### 4.1. NOMA ENTERPRISES LTD, KANO

The factory is located at Mission Road Kano in the Industrial Area.

They have good functional relationship. Although the BLDGS are not compact.

Landscape: The whole site is covered with tar macadam. Except at the back of administrative building.

Staff Facilities: The only facility provided for the staff is toilet. No clinic, no changing room, no carteen. The workers change their dress within the factory and they go out to eat during their one hour break.

Spaces: No loading and unloading facilities. There is no adequate storage since most of their stocks like cake, maize, fuller earth etc are stored in the open places and verandaits and are covered with tarpoline. There is enough space in the production hall since the production goes on conveniently. The offices are inadequate in the administrative section. A cabin has

been placed outside for some personnels.

Raw materials depot is about 3.5km from the site.

Lighting: Natural lighting is by roof glazing and high level windows, artifical by flourescence tubes. The roof glazing is covered by dust.

Capacity: 7 - 8 pre-press machines crush 27 tons of Soy-bean between 7am - 3pm 40tons of crude oil is refined/Day. This gives 30 tons of refined oil.

Products: Edible oil, livestock feed and cake which is sold to other feed mills.

Structure: The production hall is of steel structure at about 7m off centre with sandcrete blocks filled between. Clear hight is about 12m. For the oil mill the ground floor is in concrete. All other floors are constructed with steel.

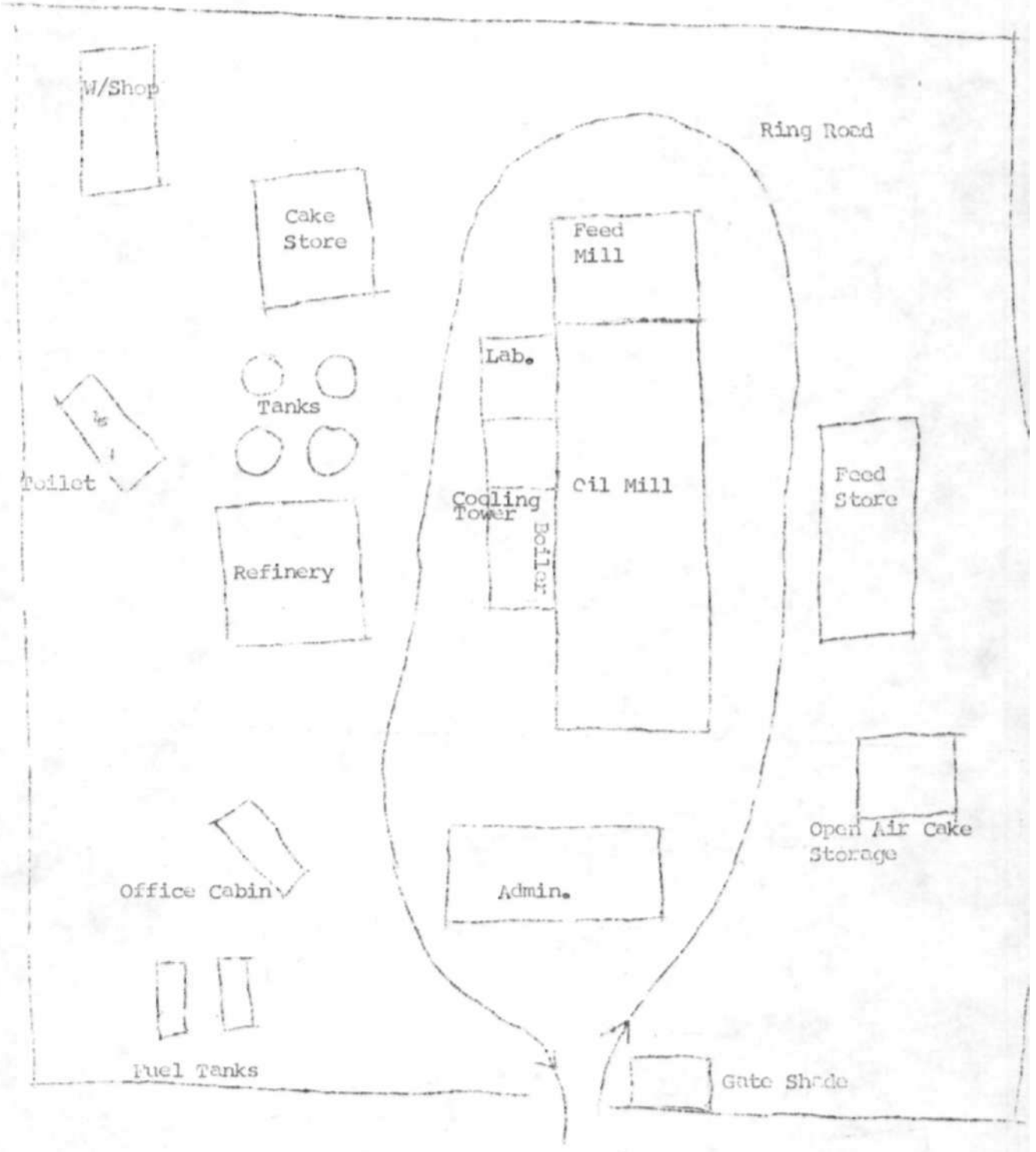



Fig. 4.1. Site Layout, Noma Enterprises Ltd, Kano

4.2. KANO STATE OIL AND ALLIED INDUSTRY

Location: The factory is also located at Mission Road, Kano. in the industrial area.

Layout: It is a mature design. The zoning is very functional. Noisy areas are completely gegragated from the administration and the staff facilities by warehouses. Functional use areas are properly related to one another. Despite all these the factory is not without its shortcomings: There is no provision for truck parking. Trucks park directly on the way blocking other coming trucks. Truck manaurvering is also difficult.

The laboratory is too far from the refinery. And the solvent extration plant where most samples are taken from.

Spaces: The functions are adequately housed. But the warehouses seems too large for its function.

Raw Materials: Soybean, cotton seed, rubber seed, groundnut,

Products: Edible oil and cake. The cake is sold to other feed mills but feed is not produced.

Functional Relationship: The production flow is good; One stage of production is effectively linked to the next one.

Landscape: Flowers are planted between the covered car park and the administrative office, and also at the back of the office. Apart from these, most part of the site is paved. Few trees are seen on the site.

Lighting: Natural lighting is provided by North light and roof glazing. This is supplemented by artificial lighting.

Structure: Steel portal frame is used in the expeller room and the warehouses. Sandcrete blocks are used up to a hight of about 2m and the rest is panelled with asbestos sheets. The solvent extraction and refinery are constructed with steel.

4.3. FUNTUA OIL MILL

The mill is located in the industrial estate at Funtua.

The site layout is poor. It gives the impression that the site was not planned and there is lack of compactness in the design. The staff changing room/toilet is attached to the administrative buildings and far from the production hall, from those who actually use it.

An attempt has been made to landscape the site but deserves more effort apart from trees planted here and there part of the site has been planted with mango, orange and guava. The rest is cultivated. There is a strip of tar along the truck route.

Staff Facilities: The only staff facility they have is the changing room/toilet. There is no clinic and no canteen.

Raw Materials: The major raw materials is the seed which are mostly cotton seed, soybean and maize.

Iroducts: They produce Edible oil, livestock feed and cake which they sell to other feed mills.

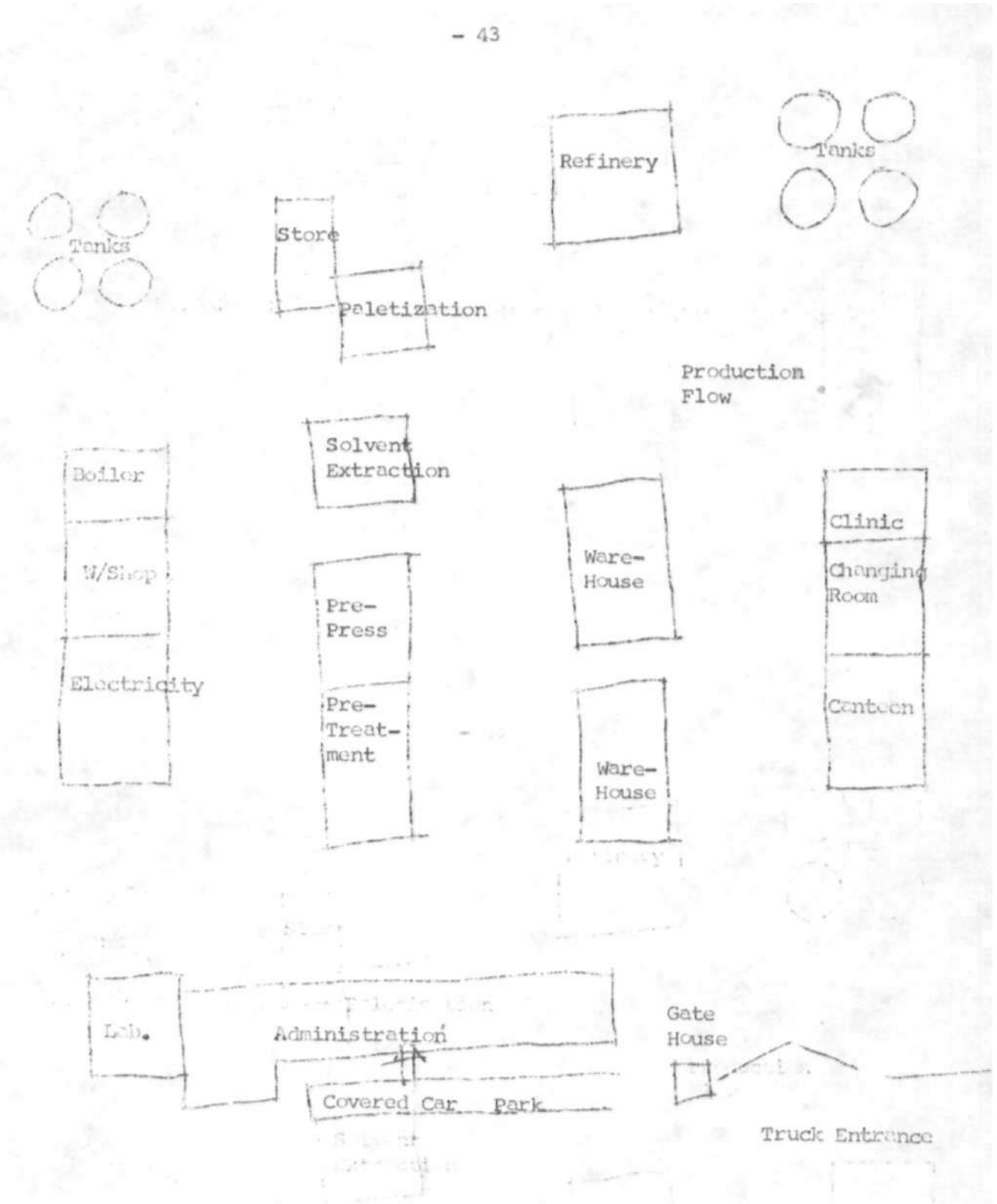



Fig. 4.2; Site Layout: Kano State Oil and Allied Industry

Lighting: Natural lighting is provided by trasparent plastic roof and wall glazing and high level windows. The roof glazing is covered with accumulated dust thus defeating the aim for which it is created. Articical lighting is provided by the use of flouresence tubes. The lighting is adequate, considering the fact that the nature of work does not require precision.

Functional Relationship: The production flow is good. The seed storage is effectively linked with the starting hall. The oil refinery is detached from the oil mill but since the transportation of crude oil is through pipe, it posses no difficulty to production.

Circulation: The circulation is good though not the best. Production hall has blocked sight line at one sharp corner on the site covered car park is provided at the front of the administration building with covered way to the corridor.

OBSERVATION: The production hall is dirty. The Administrative Office entrance is not pronounced. One has to ask before getting to the reception.

Structure: The production hall is constructed of steel portal frame at 6m off centres. Clear height of the hall is about 14m. The wall is raised up to 2m by sandcrete blocks and the remaining height is cladded by asbestos sheets.

Concrete is used on the ground floor. Steels is used at all other levels. The water tank is located on top of the refinery roof.

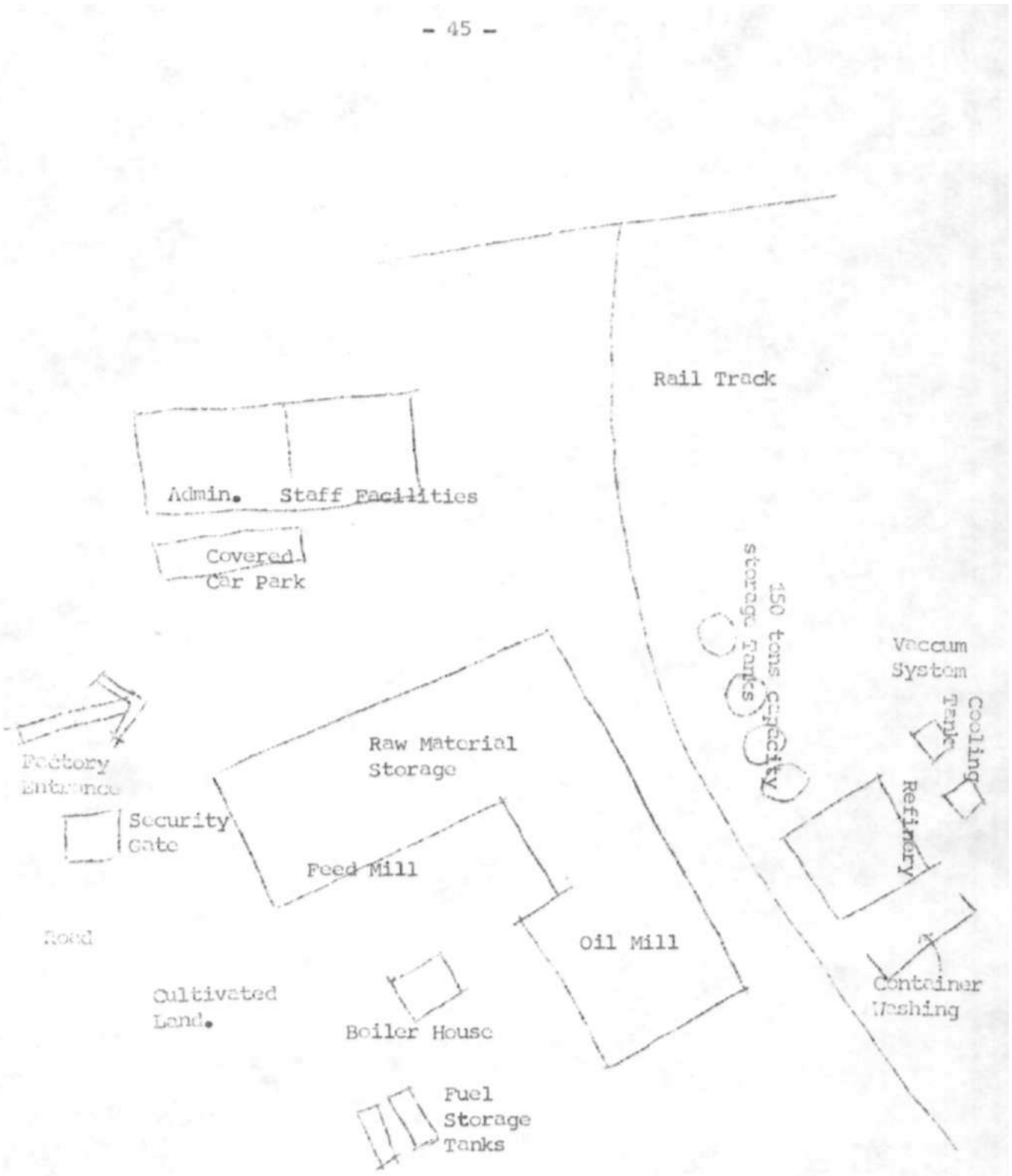



Fig. 4.3.; Site Layout; Funtua Oil Mill.

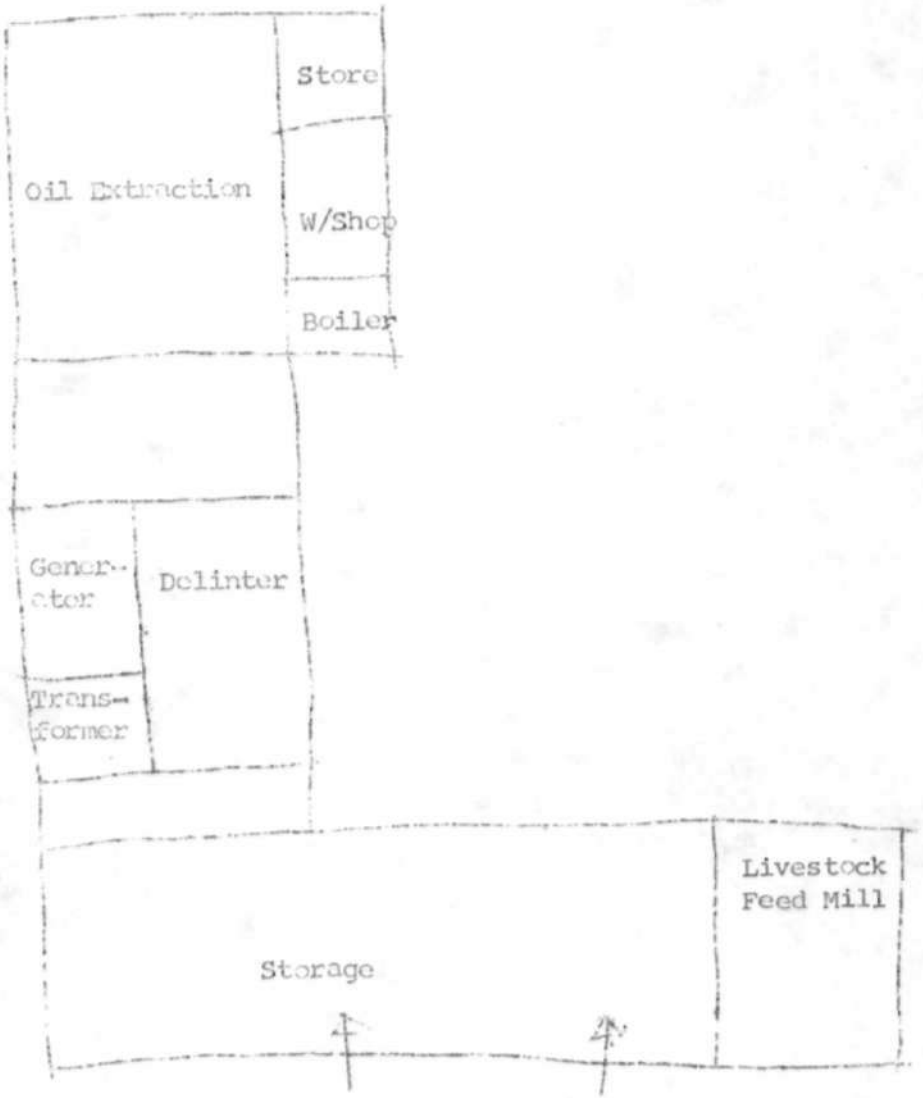



Fig. 4.4. Oil Extraction Mill

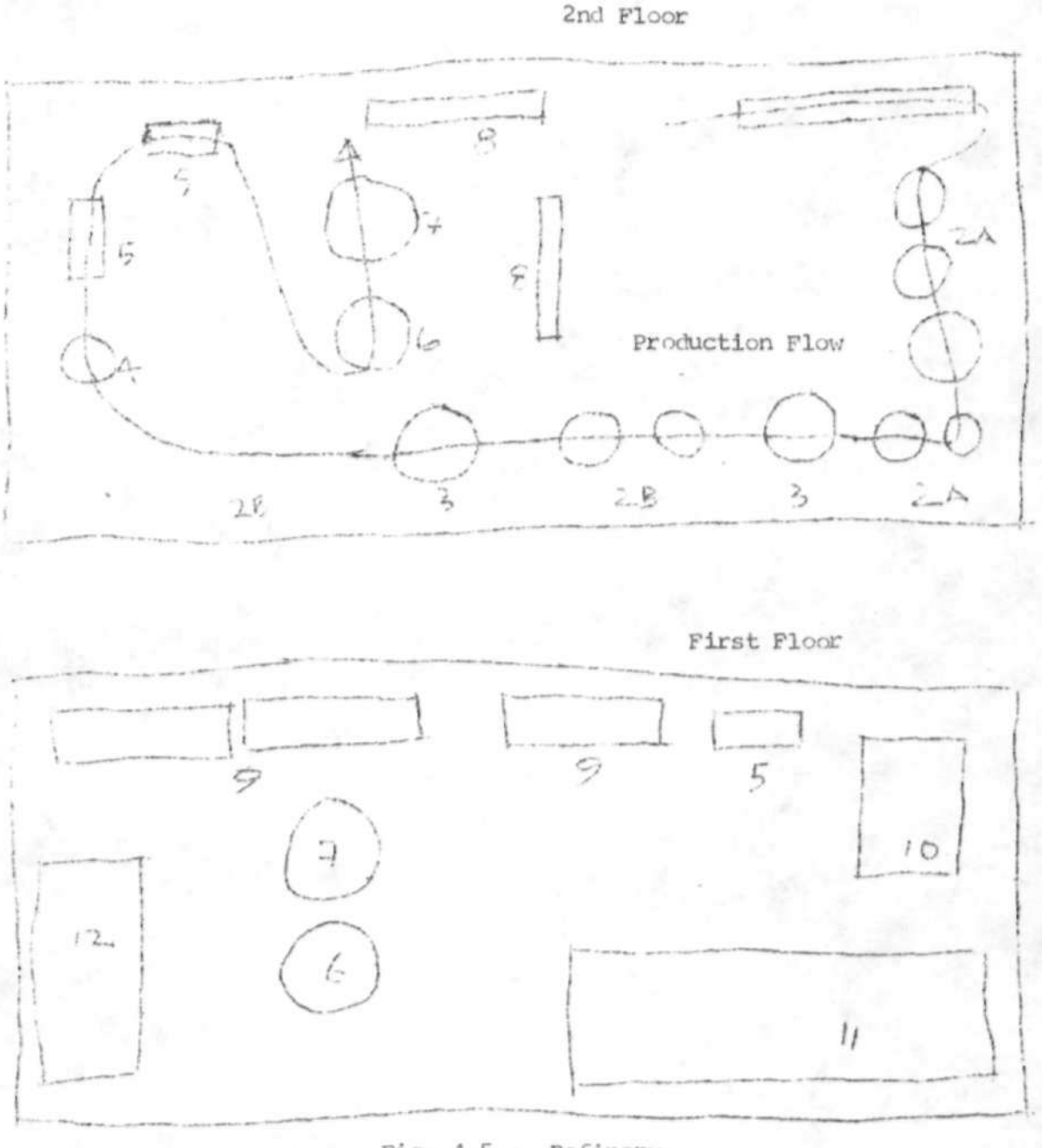
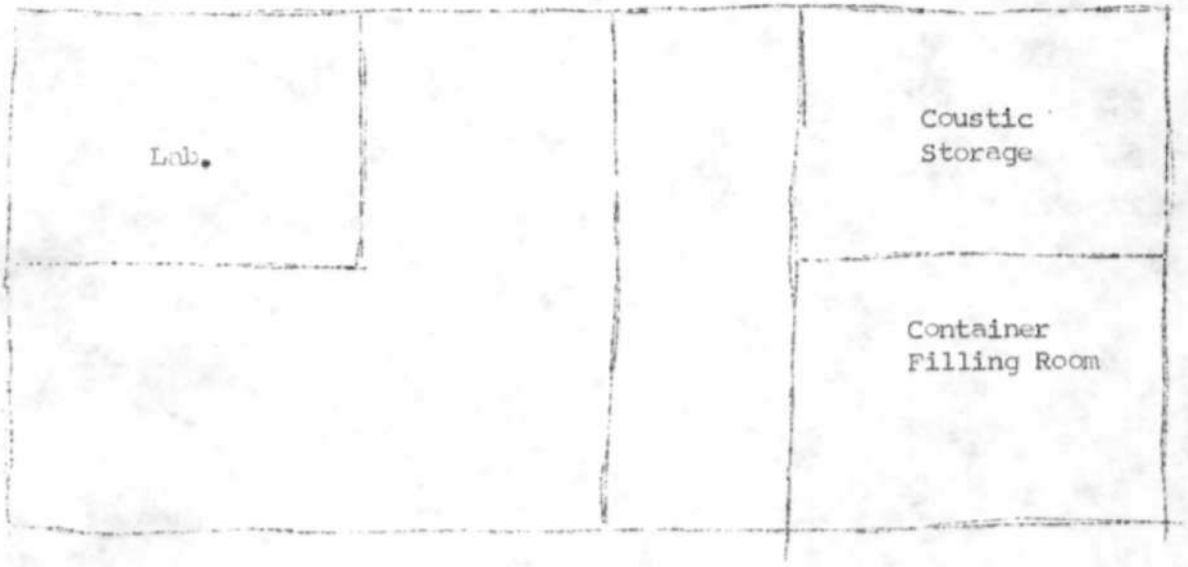



Fig. 4.5.: Refinery

| | | | | | |
|---|---|---|---|---|---|
| 1. | - | Heater | 8 | - | Control Board |
| 2A | - | Centrifuge (Coustic) | 9 | - | Coustic Tanks |
| 2B | - | Centrifuge (Water Wash) | 10 | - | Bleacher Tank |
| 3 | - | Discharge Tanks | 11 | - | Refined Oil |
| 4 | - | Vacuum Drier | 12 | - | Soapstock. |
| 5 | - | Filter | | | |
| 6 | - | Bleacher | | | |
| 7 | - | Deodorizer | | | |

GROUND FLOOR

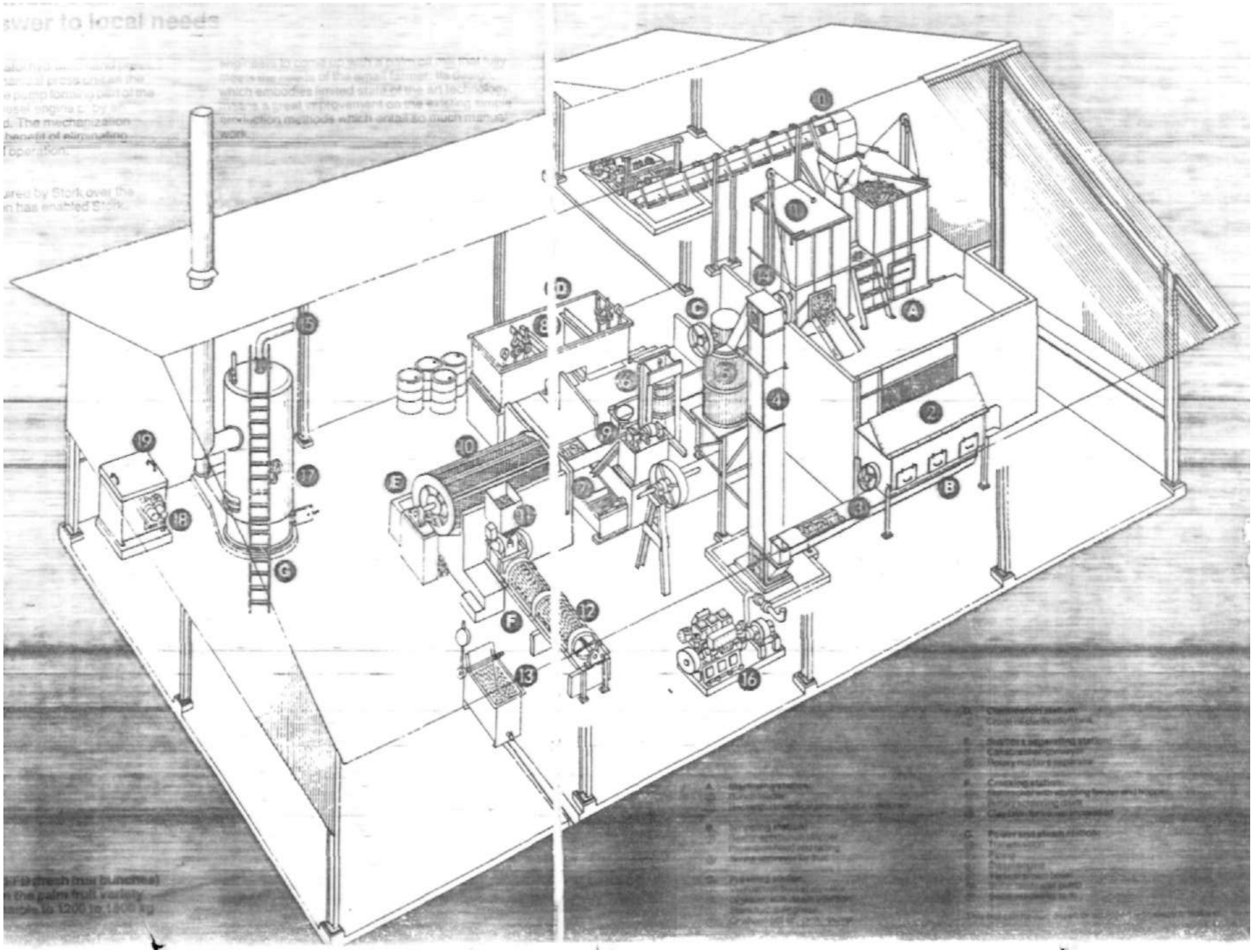



3.4. GENERAL OBSERVATION

Since most of the materials used are either in liquid or crew form, their movement is by the use of pipes conveyors, and elevayors.

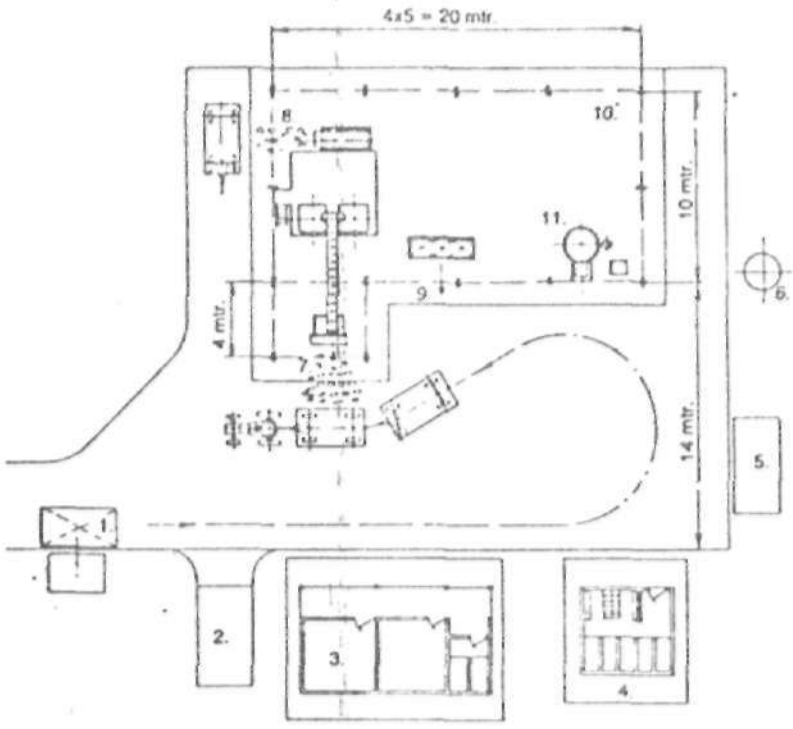
. Materials through pipes are:

- water
- chemicals (eg. caustic, phosptoric acid)
- steam
- crude oil
- refined oil



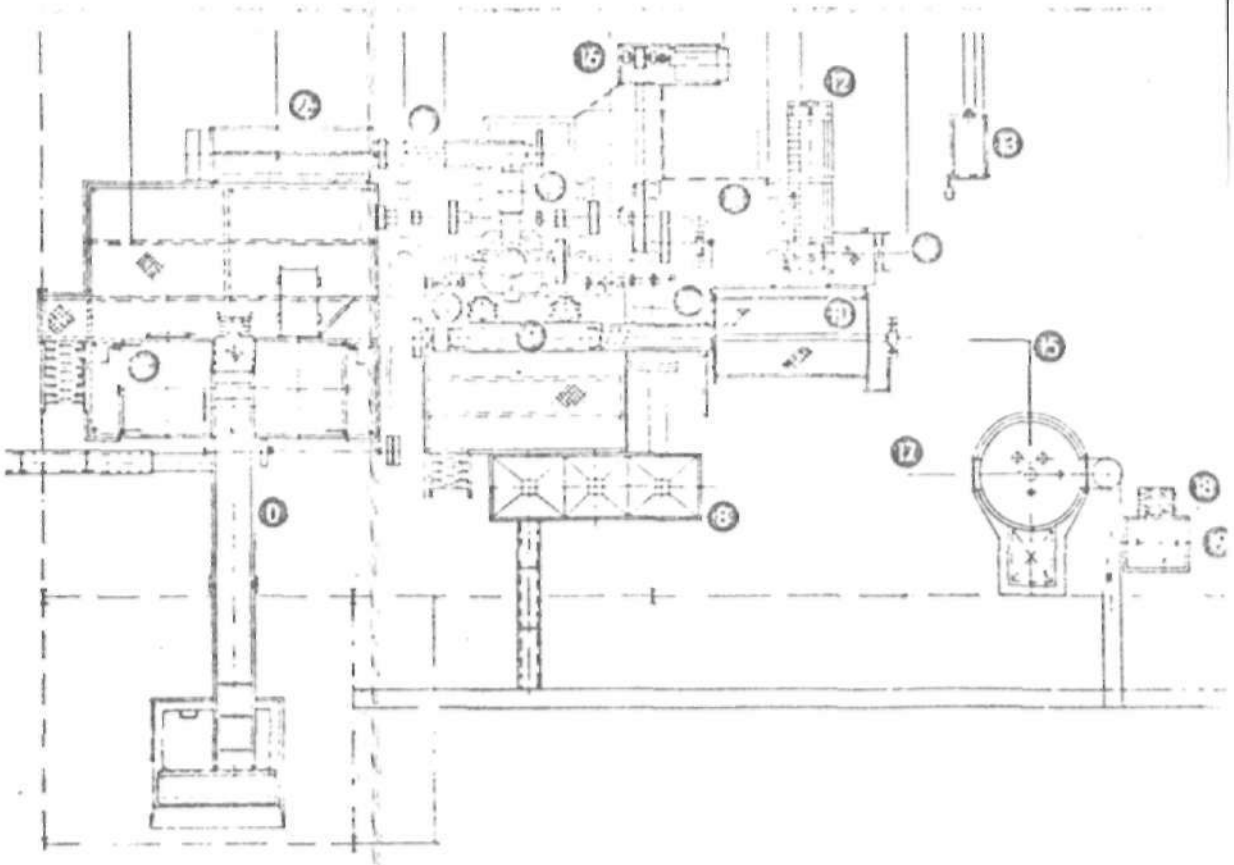
# Site layout of Stork Standard Junior Palm Oil Mill

-47C-




1. Weighbridge
2. Car port
3. Office
4. Toilet block + changing roor
5. Cycle parking
6. Water tower + water storage
7. Fresh fruit bunch reception
8. Empty bunch removal
9. Oil discharge
10. Kernel storage
11. Steam boiler

# Stork Standard Junior Mill lay out



② Bunch feeder
① Rectangular vertical atmospheric sterilizers
② Beater-arm bunch stripper
Protection hood and railing
③ Screw conveyor for fruit
④ Vertical fruit bucket elevator
⑤ Digester with steam injection
⑥ Stork hydraulic press
⑦ Crude oil gutter, tank, pump
⑧ Crude oil clarification tank
⑨ Cakebreaker-conveyor
⑩ Rotary nut/fibre separator
⑪ Nutcracker with vibrating feeder and hopp
⑫ Rotary screening drum
⑬ Clay bath for kernel separation
⑭ Transmission
⑮ Piping
⑯ Diesel engine
⑰ Vertical steam boiler
⑱ Boiler feed water pump
⑲ Boiler feed water tank

# Start up in the shortest possible time

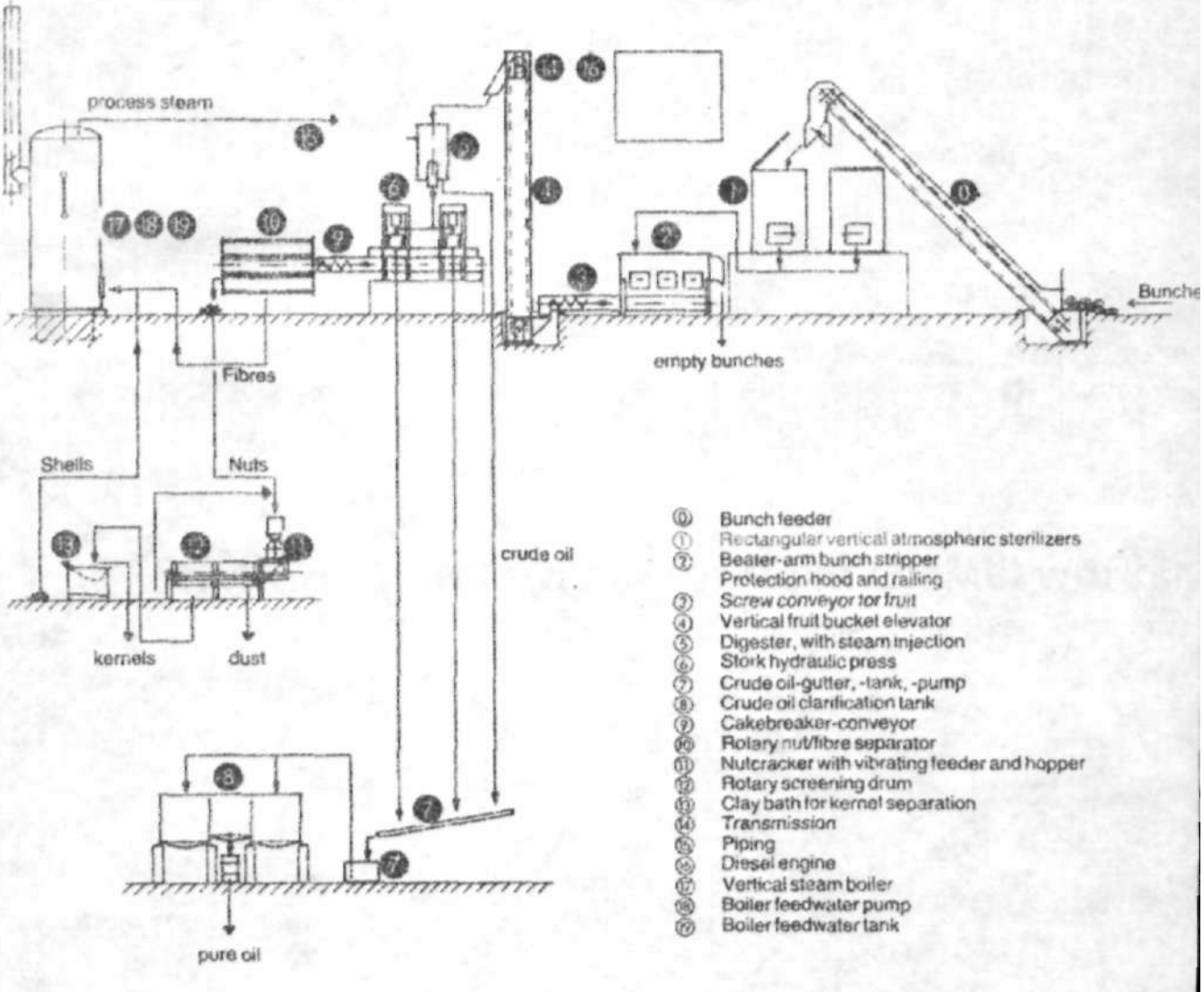
GS-47C-

Once the decision to purchase from us has been made, the following activities would normally apply:

| | | | |
|---|---|---|---|
| 1 making a financing arrangement | 2 months | 6 delivering the equipment | 6-7 mon |
| 2 performing a return-on-investment study<br>3 reaching an agreement with a bank<br>4 drawing up contracts with suppliers<br>5 constructing the plant building | 2 months | 7 importing and transporting the equipment<br>8 installing the equipment and making the various connections<br>9 commissioning the plant and training the operators | 5 mon |

Total time required for completion approx. 15 mont

# This is how a Stork Standard Junior Palm Oil Mill works



- Materials through conveyors and elevators are:
  - oil seeds
  - cakes
  - powders (eg. fuller earth)
- Fork Lifts are mostly employed in arranging things in the stores.
- Refineries are completely detached from the oil extraction mills
- Ground floors are concreted while mezzanine floors are constructed with steel.
- Exhausted fans are employed for extraction of dust from the production halls.

## CHAPTER FIVE

### 5.0. PRODUCTION PROCESSES

For many people design as an expression conjures up a concern with aesthetics, that is to say, an appreciation of the beautiful. On the other hand technology is regarded as being concerned with the technical means of achieving a given end. The former seems very much a theoretical and abstract activity, and the latter a practical down-to-earth business.

There are many definations of design and a useful one is, a purposeful plan before creative activity: However, without some understanding of the technology of the material in which one is working, it is impossible to design effectively. There can be little doubt that design and technology are very close partners in any creative activity of a three - dimensional nature. This close relationship, although they are not always equal partners, should become established in the designer's mind.

It is in the light of the afore-said that detailed study of the production process and the technology involved was undertaken. And will be discussed stage-by-stage.

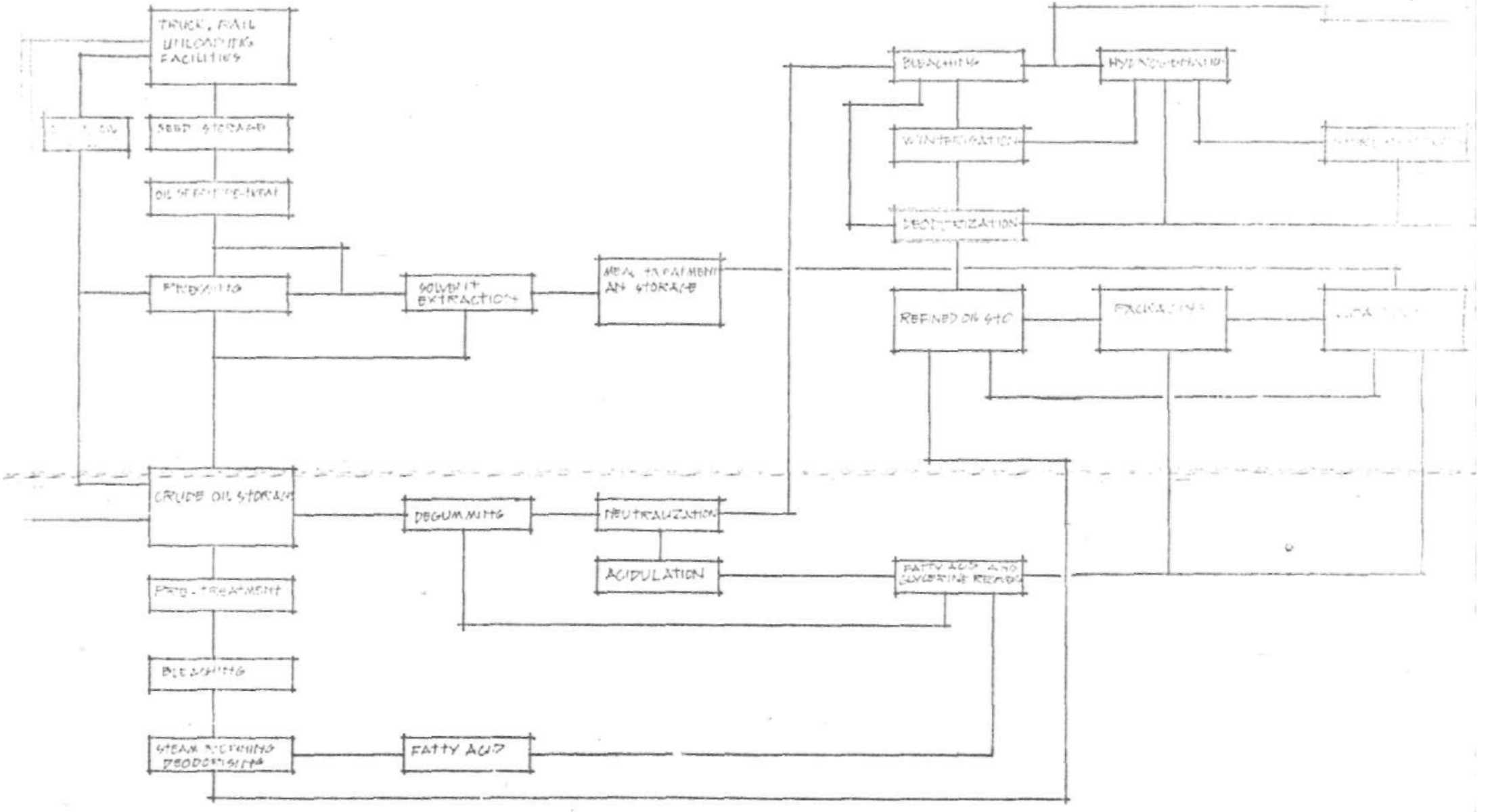
### 5.1. Oil Extraction from Fresh Fruit Bunches

This has been discussed already in section 1.1. of this thesis.

### 5.2. Oil Extraction from Palm Kernel.Pretreatment

- Roller Mills are used in the preparation line of oil seeds prior to expelling or direct solvent extraction
- Meat conditioner adjusts meats termperature and humidity to the most efficient point for flaking or pre-pressing.

# FUCTIONAL RELATIONSHIP.



Screw Pressing (Pre-Press)

This squezes the oil seeds. The oil from here is pumped to the settling tank. The oil cake is sent by screw conveyor to the flaking roll (Dia ).

Filteration

The expelled oil is settled in a tank and then filtered. It is then pumped to the crude oil storage.

Flaking Mills (Roll)

The conditioned meals or cake are squeezed, thus breaking down celular wall structure and exposing more surface area for solvent extraction.

Solvent Extraction

The meat flakes are sent to the pecolation extractor where the oil is extracted by solvent action. The cake and the solvent are pumped into the desolventizer where the solvent is distilled off. The oil is pumped into the settling tank. From there the oil is filtered and pumped into the crude oil storage tanks.

5.3. Refining

Three categories of refined oil will be obtained from this industry. In the light of this, three different refining processes will be employed. They are:

| Category | Refining Process |
|---|---|
| Oil for Export | Physical (steam) Refining |
| Oil for other Industries | Batch Refining |
| Oil for Domestic Cooking | Coustic Refining |

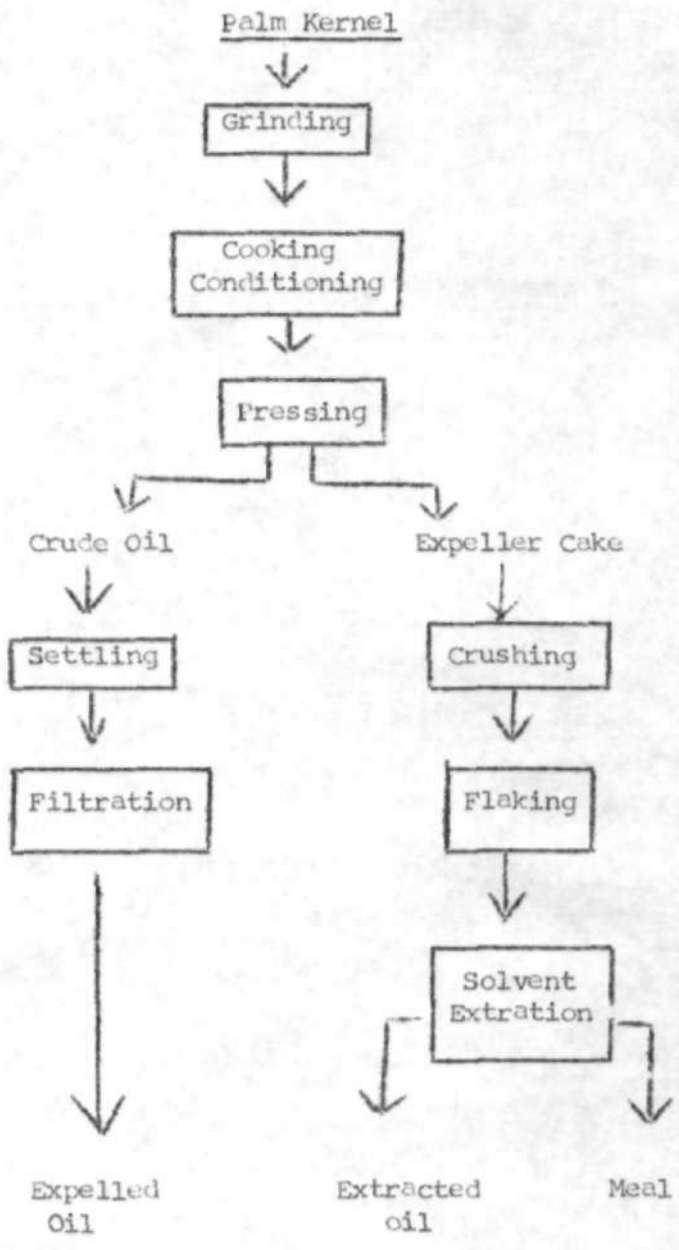



Fig. 5.1.: Oil Extraction.

The suitability of each process of refining to the respective category of refined oil will be mentioned in the course of discussing the processes.

GENERAL

Pre-Treatment (Degumming) Stage

This acid pretreatment process is designed to continuously acid-treat the crude oil to remove impurities that are not removable by steam stripping or that would be degraded by heat treatment. These include, in varying amounts, materials such as phospholipids and trace metals.

Fig. 5.2. crude oil is continously pumped under automatic control, through the crude oil heater(1) where it is heated to 190°. Matering pumps feed concentrated phosphoric acid and demineralized hot water(2) at controlled rates into a pipe where they combine to form a dilute phosphoric acid solution.

The heated crude palm oil and dilute phosphoric acid are combined in a pipeline and delivered to the treat tank(3) for thorough mixing.

The acid water serves to react with the trace metals and inactivate them and also hydrate the phosphatides.

The oil acid mixure is pumped to the centrifuge (4) where the hydrated gums are separated from the oil by centrifugal force and discharged into the waste water trap. The degummed crude oil passes to the oil dryer (5) where disolved moisture is removed under vacuum(6).

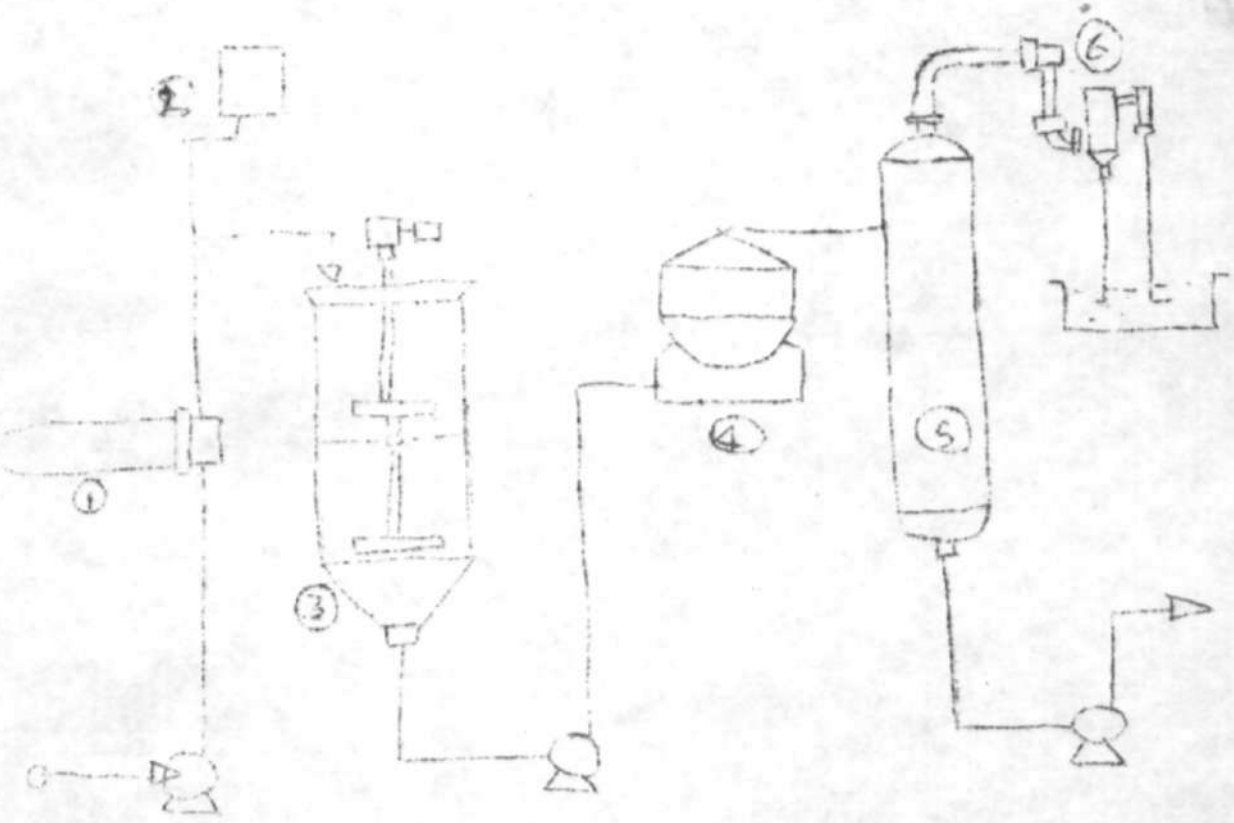



Fig. 5.2. Acid Pretreatment Process (DEGUMMING).

Acid Treatment Vacuvm Bleaching Process

The function of this stage is to reduce the colour of the fats and oil. The process consists of an acid treatment followed by an activated clay treatment under vacuvm.

Fig. 5.3 The crude oil is fed continously at a regulated rate into the treet tank (1) Along with a metered amount of phosphoric acid from the acid tank (2). The mixture is thoroughly agitated in two stages to obtain complete treatment, after which it is pumped to the slurry tank (3). Activated clay and filter aid are continuously fed from the clay bin (4) Into the slurry tank (3) at a controlled rate. Slurry of oil, clay, and filter aid is pumped continuously to the vacuum bleacher (5) and sprayed into the head space to obtain complete deaeration prior to heating.

The dearated slurry is heated to the desired bleaching temperature under automatic temperature control by internal steam coils; and the bleacher is mentained vacuum by a steam jet ejector system(7). The vacuum bleacher is compartmented to provide two stages of mixing for intimate contact and adequate time. The slurry is pumped from the vacuum bleacher through a cooler (6) and into one of the two filters (10), which are provided for alternate use.

When a filter reaches its cake capacity, the slurry flow is diverted to the other filter. The oil is discharged from the out-of-service filter; and the cake is blown with steam emptied into the cake chute (9) and conveyed to the discharge point.

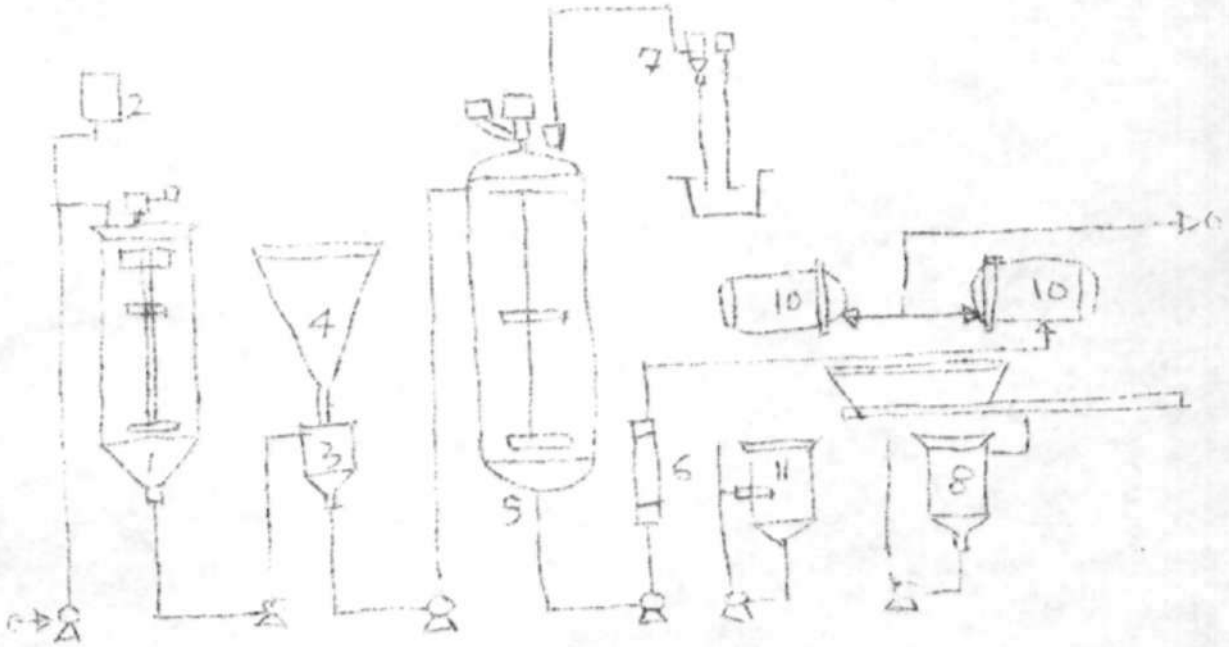



Fig. 5.3. Acid Treatment Vacuum Bleaching Process.

The filter then is precoated; using the precoat tank (11) and pump, in preparation for the next filter cycle. Steamings from the filter are collected in the steamings tanks (8) and reworked into the slurry tank (3).

Steam Refining and Deodorizing Fig. 5.4/5.5

In this process the pretrated oil is purified by three operations conducted under high vacuum at high temperature. First, the free fatty acids are removed by multistage counter-current contact with steam. Then, the pigments are converted to a colourless form by retention of the hot oil for the required reaction time. Finally the oil is deodorized by additional multistage counter current contact with steam.

Fig. 5.4 the pre-treated oil feedstock is continuously pumped through a filter (1) and sprayed into the deaerator (2) under vacuum to remove entrained and dissolved air. The deaerated oil is pumped to the refining deodorizer (3) in which it passes through coils in the heat recovery section and up into the heating section in the top of the deodorizer. In this section the oil is heated to the required processing temperature by coils, which are heated by vapor from dowtherm vaporizer (10). The oil then flows down to the refining section in which is passes over a series of trays countercurrent to the flow of stripping steam which is injected below the bottom tray.

The refined oil flows down to the holding section which provides the retension time required for heat bleaching of section. In this section the oil again passes over a series of

trays countercurrent to the ascending steam of stripping steam. The completely deodorized oil flows down through the heat recovery section to transfer its heat to the feedstock, and then flows down to the cooling section. In this section the oil is cooled to the required discharge temperature and is pumped out through a polishing ficter (7). Metered quantities of solution from the antioxidant tank (8) and nitrogen are injected as the oil is discharged to produce storage.

The vapors from the refinery deodorizer, consisting of distilate (fatty acids and volatile impurities) and steam, flow into the bottom of the distillate recovery tower (4) and up through a grid packing countercurrent to the deslending spray of cooled liquid distillate. The distillate vapor condenses and combines with the liquid distillate, flow out of the bottom of the tower, and is pumped through a distillate cooler (6) and recycled back to the top of the tower. The quantity of distillate recirculating in the system is maintained constant, and the recovered distillate is automatically discharged to storage. The temperature of the distrillate cooler is controlled by circulation of water from water tank (9) which is automatically maintained at temperature some what higher than the freezing point of the distillate. The steam from the top of the distillate recovery tower flows to the multistage vacuum system (5) which maintains the entire deodorizing system under vacuum.

The antioxidant is added to the deodorized oil and the deodorized oil is thoroughly saturated with nitrogen to protect its quality. This oil can be shipped to overseas and after being

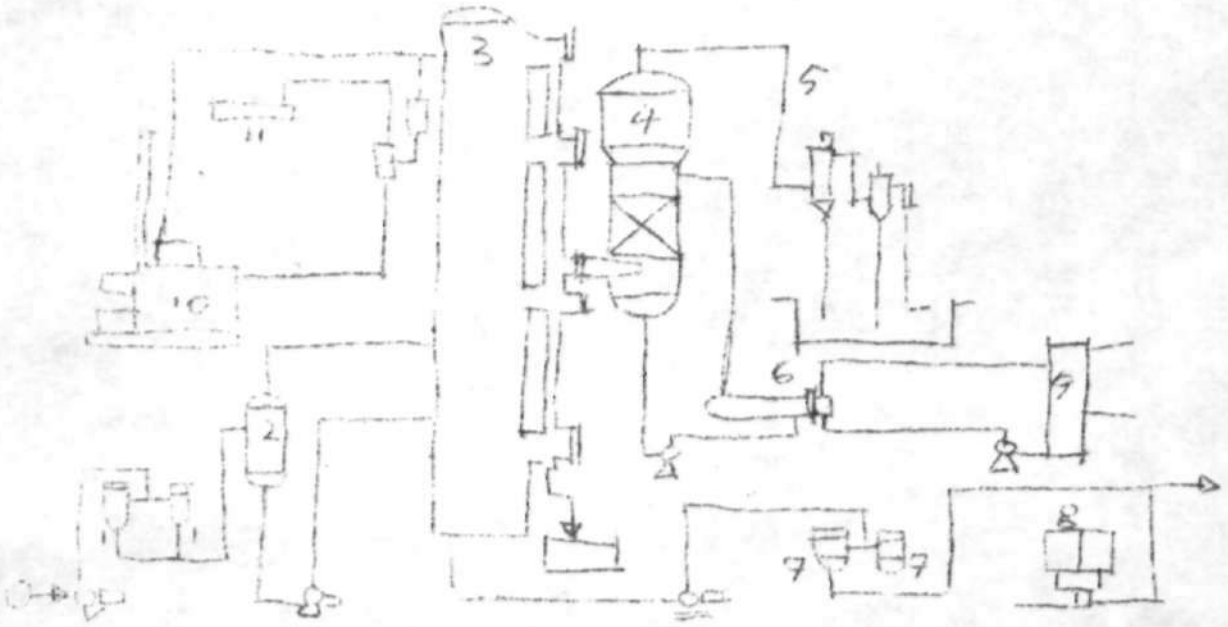



Fig. 5.4.: Steam Refining Deodorizing Flowsheet.

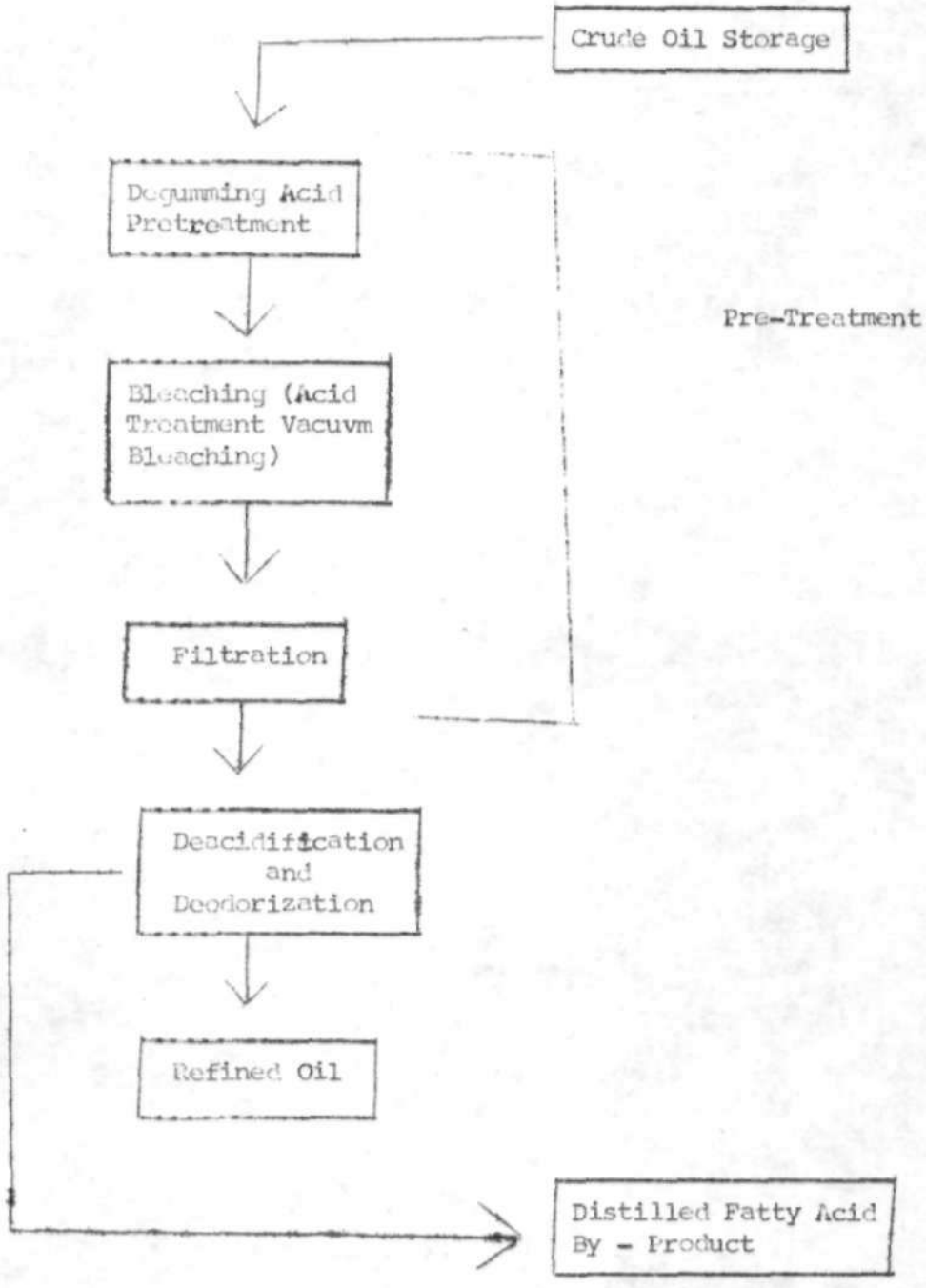



Fig. 5.5.: Steam Refining and Deodorizing Flow Diagram.

in transit for 60 - 90 days the oil can be bleached with acid activated bleach clay to reduce the yellow and red colour.

Batch (Chemical) Refining (Fig. 5.6).

The Batch Refining process consists of the following:

- initial refining (degumming, neutralization, bleaching and filteration).
- modification (hydrogenation, interesterification, fractionation)
- Final refining (neutralization, bleaching, filteration and deodorizing)

Initial Refining

Degumming and bleaching and filteration has been explained already.

In neutralization, the free fatty acids, which are inherently undesirable and which would oxidise to cause rancidity are disposed off. The principle is to combine the free fatty acids with an alkali, usually caustic soda to form a soap solution which can be separated from the oil by the centrifugal action of the centrifuge. When the soap has been separated, the oil is washed by 'wash centrifuge' and dried under vacuvm.

MODIFICATION

- Hydrogenation

Unsaturated oils melt at low temperatures. They are also unstable and more likely to deteriorate. Hydrogenation is a means of adding hydrogen in the presence of a catalyst (usually nickel), to make the oil less liquid (that is, having a higher melting point) and more stable. Hydrogenated oil may have melting points between $40^{\circ}$c and $60^{\circ}$c.

Hydrogenation is carried out in an enclosed tank. Approximately 0.05 - 0.2% of finely powdered catalyst is introduced and the usual temperature of the operation is up to 180°c. Afterwards, all traces of the catalysis are removed by filtération.

- Interesterification

This is a method of altering the melting point of fat or a mixture of fats by changing the positions of the fatty acids group in the glyceride molecules. Positions may be exchanged between groups of the same molecule (inter-molecular), or between the groups of different molecules (intrr-molecular).

The fat provided by this mixture will have a melting point somewhere between that of the original highly saturated oil and that of the highly unsaturated. By interestarification, oils and fats of specific characteristics can be produced which either cannot be obtained in nature or may be of short supply in their natural appearance.

- Fractionation

All fats are mixtures of solid and liquid glycerides. Fractionation is a means of altering the proportion of solid to liquid. Two fats are produced, one melting at a higher temperature than the other, and therefore harder. To fractinate a fat, it is first melted, then cooled under controlled conditions. The high melting glycerides crystalize first and can be filtered off.

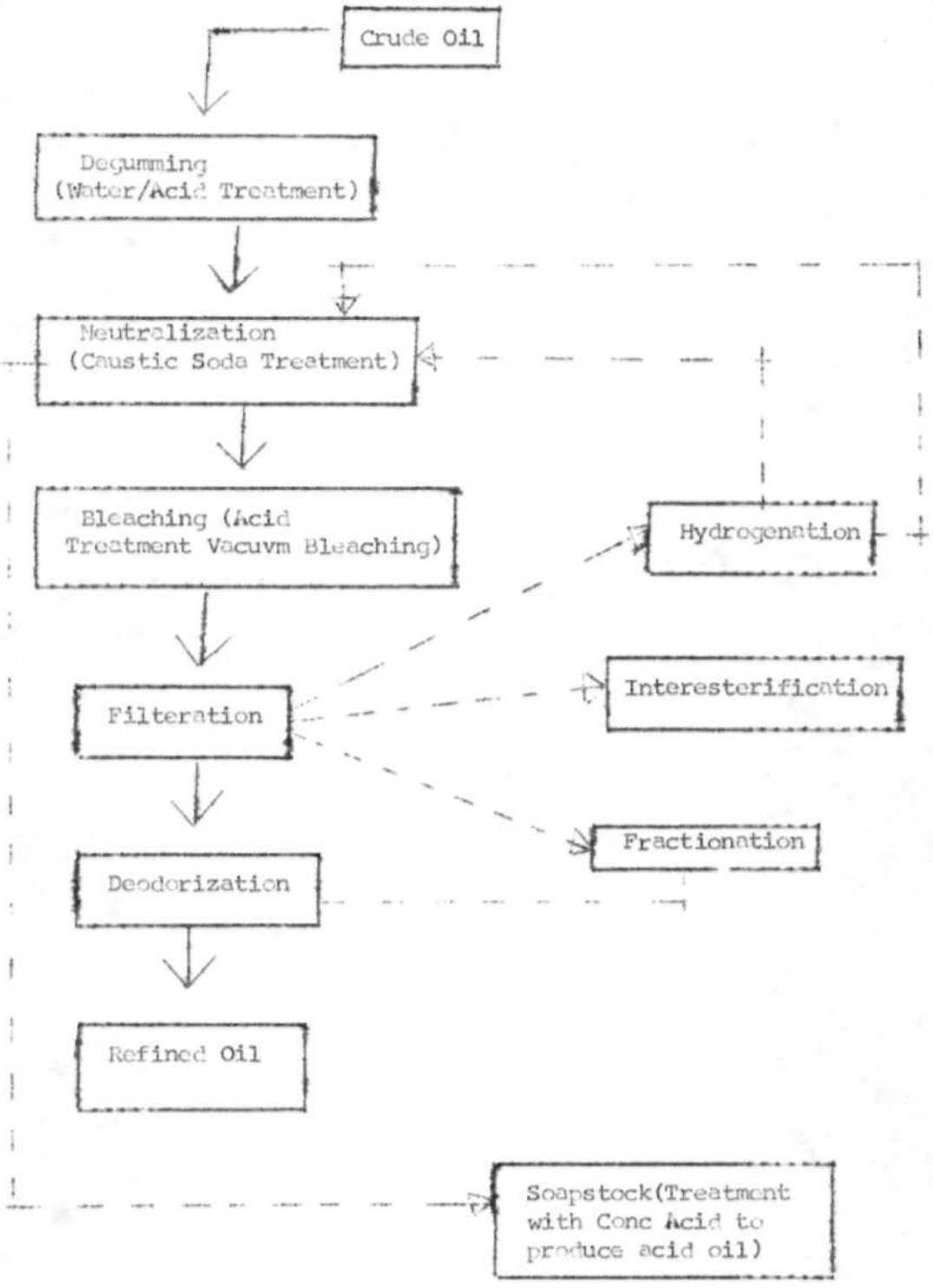
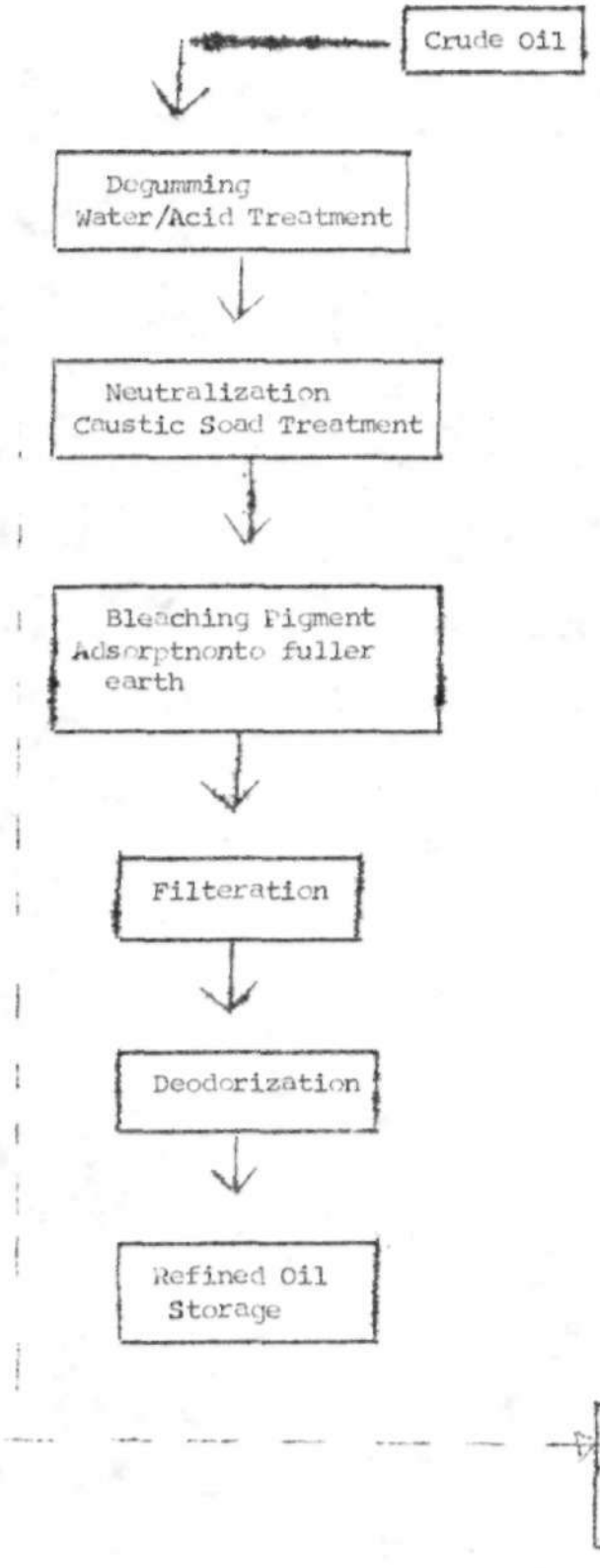



Fig. 5.6.: Batch Refining.




NOTE:

- Coustic Refining is essentially a batch refining process without modifications.
- The refined oil is good enough for domestic cooking.

Fig. 5.7: Caustic Refining flow diagram.

- Paletization

Paletization is the process whereby the meal is compacted into small ribbons of about 5cm long and 1cm diameter. This is to prevent the losses which will occur if left in powder form.

The mill is cooled first by meal coolers and then sent to the paletizer where it is palletized.

Fatty Acid and Glycerine Recovery and Distillation

This process is designed to process fats, oils and refining by products into fatty acids, glycerine and their derivatives. These plants enable materials sometimes of a low commercial value to be turned into high quality products suitable for special industrial applications. The distilled fatty acids obtained, which are of a high grade of purity can be used both in the soap industry and for the manufacture of synthetic resins and paints.

Glycerine is recovered from sweet water and spent lyes. The vacuum distilled and bleached glycerine should be able to meet the requirements of the important pharmacopoeia.

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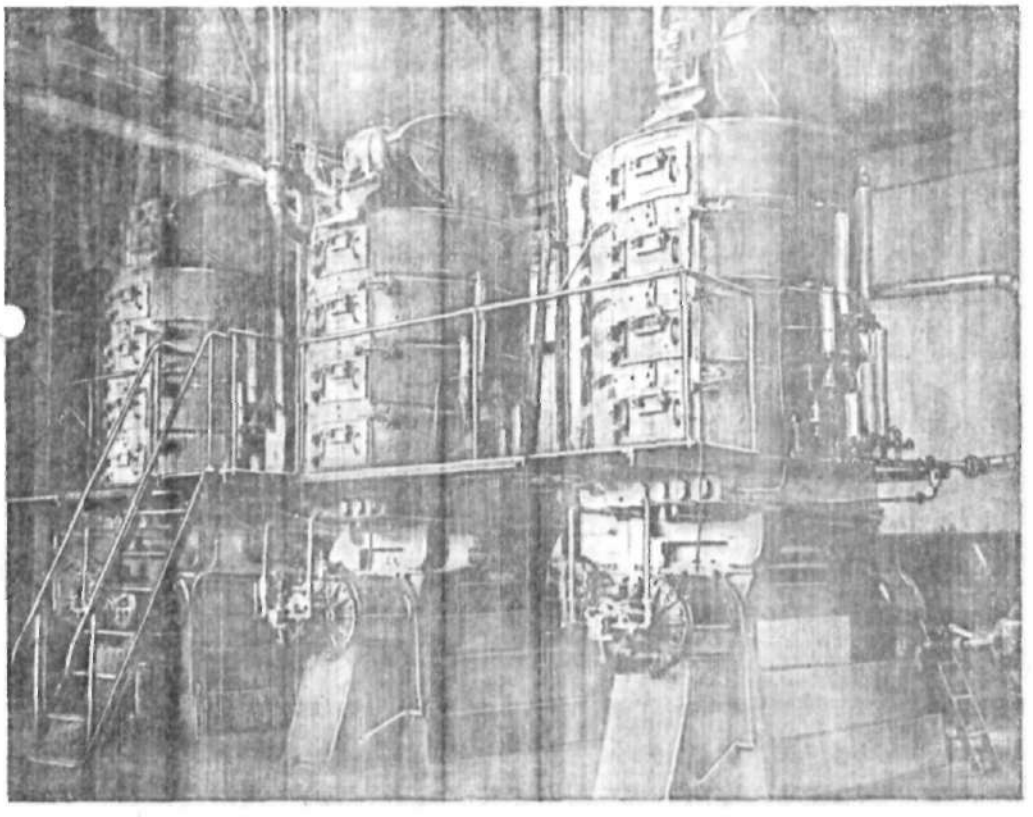
# OIL MILL ENGINEERS

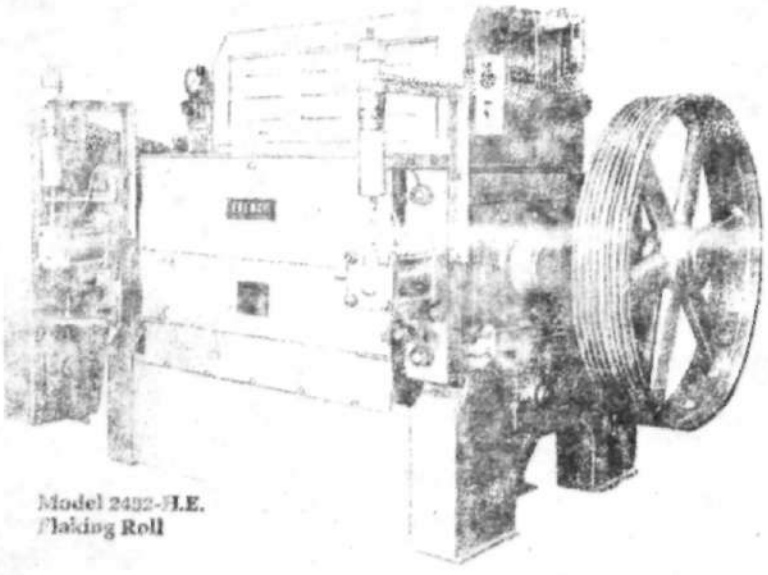
-63A-



## COMPLETE PLANT DESIGNS AND SPECIFICATIONS

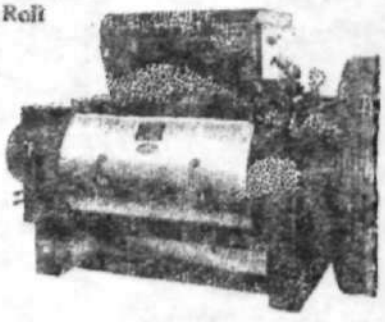


658



Model 2432-H.E.
Flaking Roll

Model 2069-H.E.
Flaking Roll





Model 1252
Cracking Roll

## cracking and flaking rolls

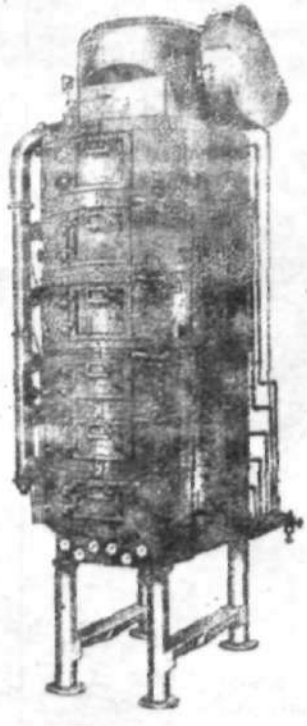
Constructed to meet the exceptionally rugged operational requirements of seed preparation in capacities up to 400 TPD soybeans, FRENCH cracking rolls, equipped with drives up to 50 H.P., perform the essential first step in both direct and indirect extraction by breaking raw materials into small, uniform pieces.

FRENCH flaking rolls, with capacities of up to 300 tons of soybeans per day, and with drives up to 150 H.P., squeeze the conditioned meats or cake into thin flakes, thus breaking down cellular wall structure and exposing more surface area for solvent extraction.

Front roll removal, vibrating feeder with instant cut-off and reset switch, v-belt differential drive and heavy duty shaft roller bearings are just a few of the features of FRENCH cracking & flaking rolls.

## meats conditioner

Featuring patented automatic level control gates, the FRENCH meats conditioner adjusts meats temperature and humidity to the most efficient point for flaking or pre-pressing. Units are designed up to 100 inch diameter, 12 kettles high with 100 H.P. overhead speed reducer drives.



Meats Conditioner

FRENCH

# preparation machinery

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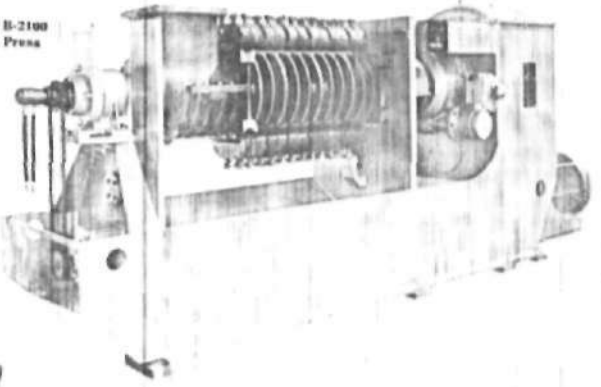
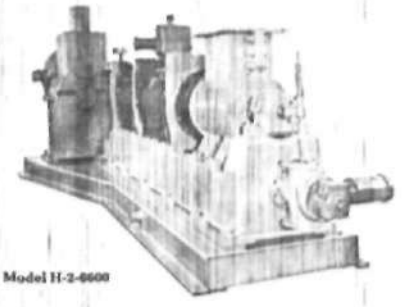
Model B-2100
Screw Press





Foot-Mounted
Main Drive



Model H-2-6600

## screw presses

Whether used for finish pressing or pre-pressing, FRENCH Mechanical Screw Presses offer many exclusive features that have earned them a reputation of being the world's most efficient, modern and heavy duty screw presses. For example, Full Press FRENCH Screw Presses can be modified in shaft arrangement and gearbox speed to obtain two to three times the straight pressing tonnage, if desired.

The Model B-2100 Press features a one-piece steel fabricated gearbox and frame, with quiet-running herringbone gearing and FRENCH's exclusive quick-opening clamp cage design for easy maintenance. The feed screw rotates in a 12" inside dia. feed hopper, with the four-section main cage incorporating a 10¼" inside diameter for a swept drainage area of approx. 2100 sq. inches. Pre-Press capacity of the B-2100 is approx. 100-125 tons of seed per 24 hours.

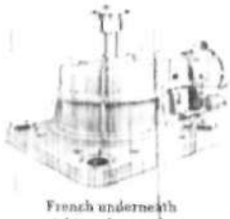
The H-2-6600 is an extra large capacity press with a 1000-h.p. H-2 gearbox normally supplied with a 600-h.p. motor. The feed screw is 16" in diameter and the main cage has a 14" inside dia. offering a swept drainage area of approx. 6600 sq. inches. Equipped with specially notched worms, the H-2-6600 will daily pre-press over 300 tons of whole flaxseed or screenings which can be solvent extracted to less than 1% oil content.

# machinery

65C



Patented automatic level control gates



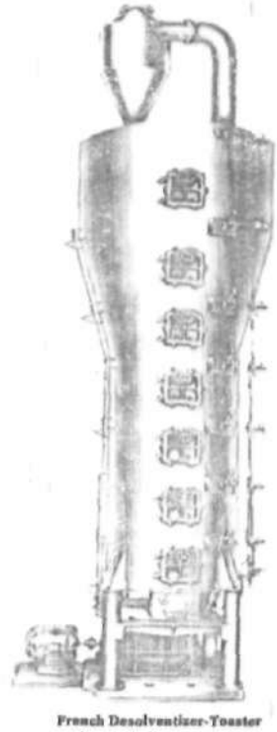
French underneath right angle speed reducer drive



**French Desolventizer-Toaster** with traditional ring bottom stacked design.



**Internal Vents** Vapors pass to the upper Kettles around the vertical shaft. Sparging steam lines are located on the sweeps as shown on this upper kettle installation.



**French Desolventizer-Toaster** with Uni-Shell construction.

## desolventizing toasters

Effective desolventizing and toasting are essential in producing the rich color, texture, nutritional value, & freedom from toxicity that mark a superior quality oil seed meal.

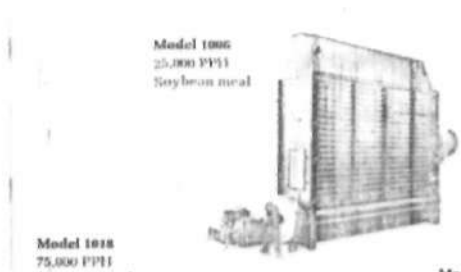
The FRENCH-patented Desolventizer-Toaster design has been universally tested and accepted for continuous dependability, economy and product quality. The FRENCH D-T employs sparging steam and jacket steam for vaporizing the entrained solvent with moisture created in the desolventizing process being utilized for the toasting phase. Solvent vapor release is accomplished through variable combinations of internal, external or grid venting to the vapor scrubbing system.

Exclusive FRENCH reliability features include automatic level controls and a specially-designed underneath D-T Reducer Drive for smooth, profitable performance. Models are available with a capacity of 50 TPD through 3,000 TPD.

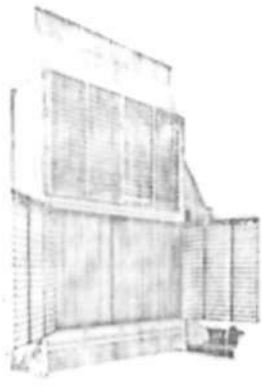
FRENCH

# meal handling machinery



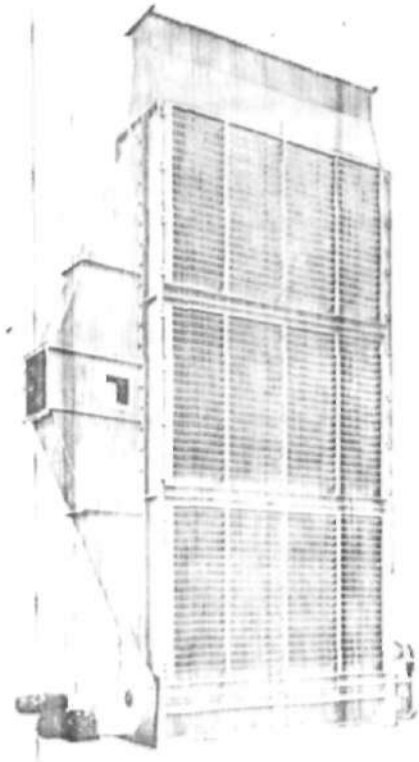


**Model 1006**
25,000 PPH
Soybean meal



**Model 1012**
50,000 PPH
Soybean meal

**Model 1018**
75,000 PPH
Soybean meal

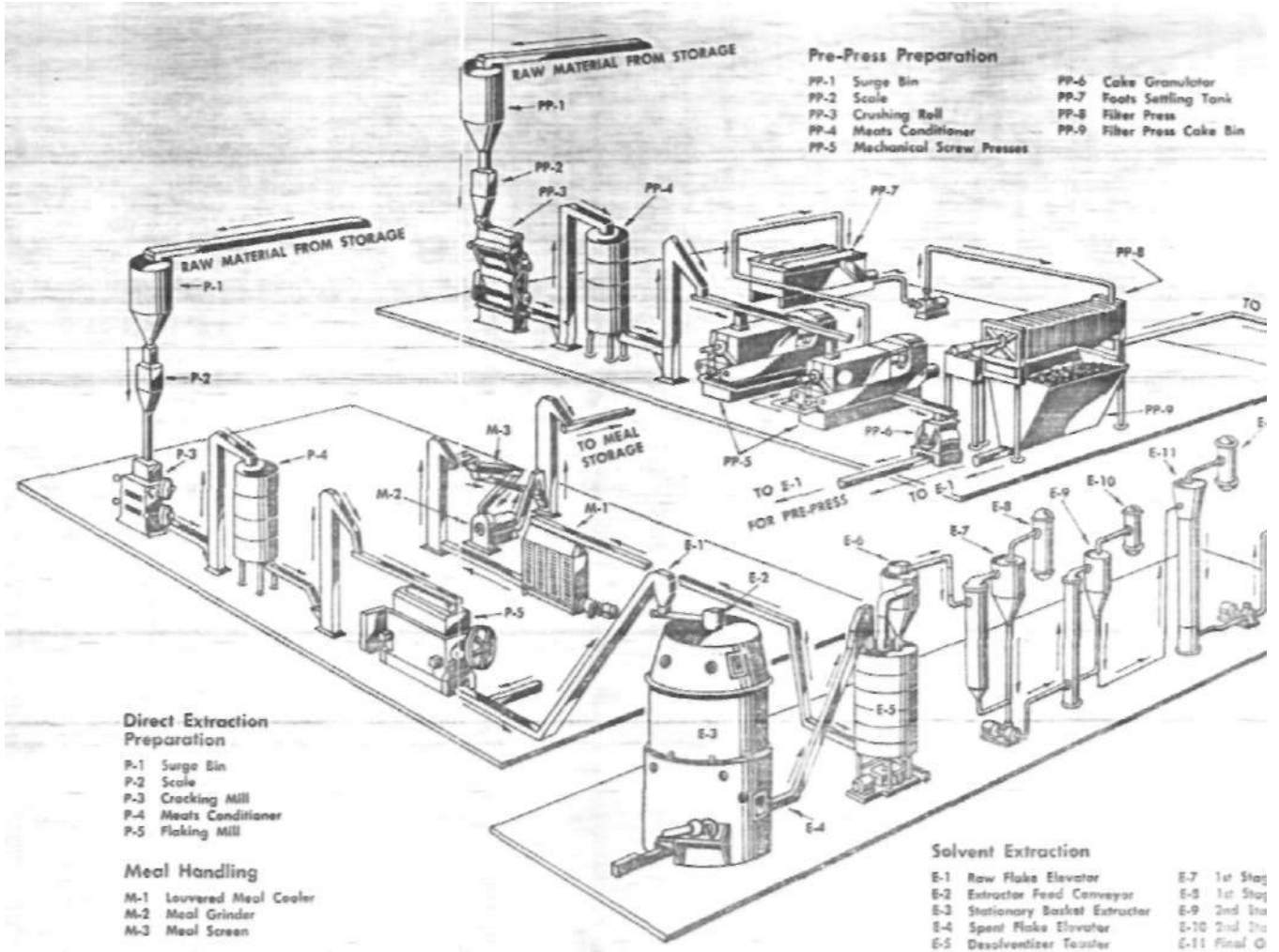


## meal coolers

Famous for their simplicity of design and low operating costs, FRENCH Stationary Louver Meal Coolers utilize the available outside air to cool up to 1200 tons of meal per day (soybean basis), providing clean, dust-free operation from gravity flow to discharge. Designed to offer maximum cooling capacity in a minimum amount of floor space, FRENCH meal coolers cool from temperatures of 220 degrees Fahrenheit down to 100 degrees, or 15 degrees above ambient whichever is greater, depending on the temperature and humidity of the surrounding air.

## auxiliary equipment

Meal grinders, screens, and conveying, weighing and storage components are also available, in applications and sizes to match your individual operation. Systems designed and engineered by FRENCH!




## Pre-Press Preparation

PP-1 Surge Bin
PP-2 Scale
PP-3 Crushing Roll
PP-4 Meats Conditioner
PP-5 Mechanical Screw Presses
PP-6 Cake Granulator
PP-7 Foots Settling Tank
PP-8 Filter Press
PP-9 Filter Press Cake Bin

## Direct Extraction Preparation

P-1 Surge Bin
P-2 Scale
P-3 Cracking Mill
P-4 Meats Conditioner
P-5 Flaking Mill

## Meal Handling

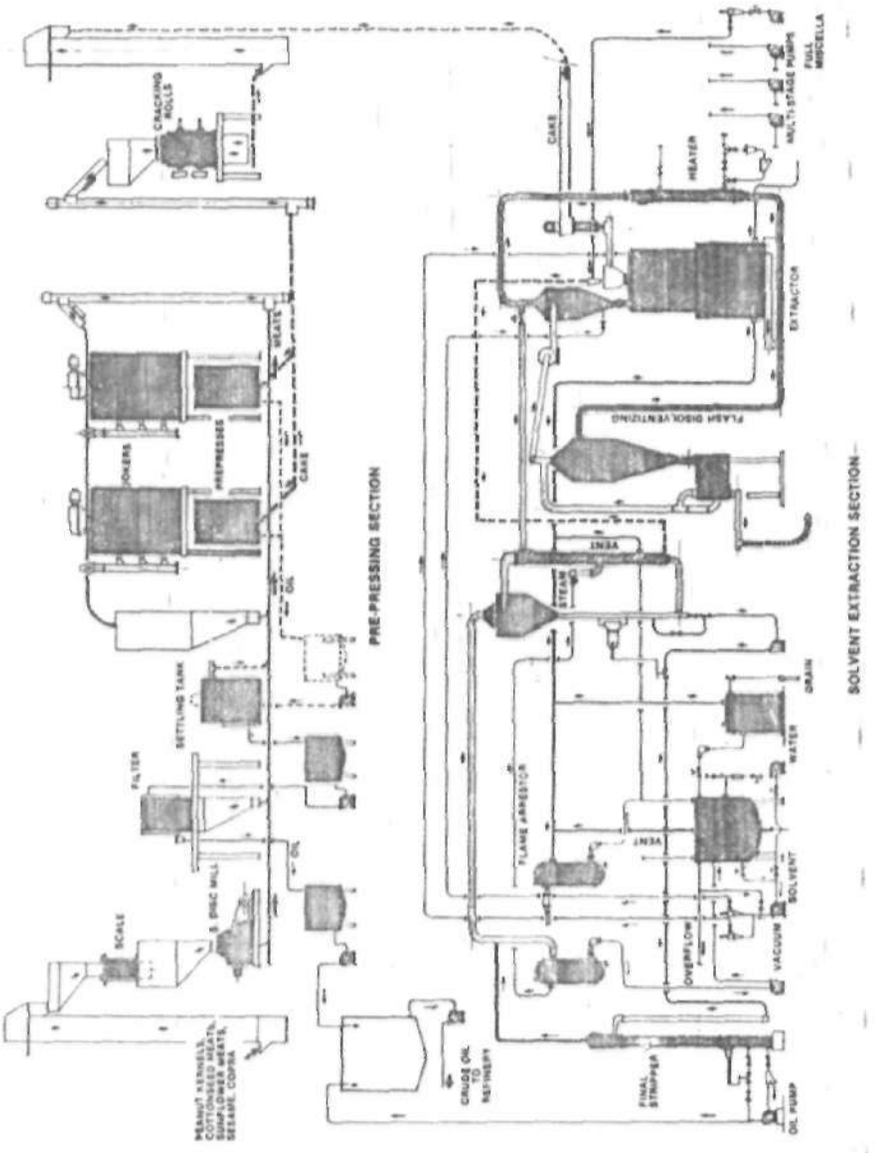
M-1 Louvered Meal Cooler
M-2 Meal Grinder
M-3 Meal Screen

## Solvent Extraction

E-1 Raw Flake Elevator
E-2 Extractor Feed Conveyor
E-3 Stationary Basket Extractor
E-4 Spent Flake Elevator
E-5 Desolventizer Toaster
E-6 Vapor Scrubber
E-7 1st Stag
E-8 1st Stag
E-9 2nd Sta
E-10 2nd Sta
E-11 Final C
E-12 Vacuum

Pre-Pressing may be required, depending on the oil content and handling characteristics of different seeds and raw materials. Some seeds, cotton seed and safflower for example, may be processed by both direct and pre-press methods.

# Neumunz Complete Vegetable Oil Mills



TO STORAGE
BAGGING AND SEALING STATION
DRUM APPLICATOR
SIZE CONTROL EQUIPMENT
DRYER-COOLER
FEED BIN
GRINDING EQUIPMENT
SIZE CLASSIFIER
RECYCLE
VACUUM PUMP
COOLER EXHAUST

654

# «TS-DL» MISCELLA REFINING

# «TS-DL» NEUTRALISATION EN PHASE MISCELLA

# «TS-DL» NEUTRALIZACION EN MISCELA

The «TS-DL» plant has been specially designed to neutralise high F.F.A. oils and fats with an almost theoretical loss factor.
This is possible only with our system.
The procedure is fully continuous and permits the production of an extremely pure neutral oil, which is then easily bleached and deodorised, and at the same time of crude fatty acids of a high F.F.A. concentration and easy to distill.

Notre procédé «TS-DL» permet de neutraliser, avec un indice de perte très bas, huiles et graisses ayant une teneur en acidité très élevée. Cela est possible seulement avec ce procédé qui est à fonctionnement tout à fait continu et permet d'obtenir des huiles neutres très pures, faciles à décolorer et désodoriser, et en même temps directement des acides gras bruts à haute concentration et faciles à distiller.

El sistema «TS-DL» hace posible la neutralización con perdidas mínimas en aceite neutro de aceites y grasas con acidez muy alta.
Todo esto puede alcanzarse solamente con este procedimento.
El proceso TS-DL, a funcionamiento continuo, permite obtener aceites neutros puros de más simple y mejor blanqueo y desodorización y, al mismo tiempo, ácidos grasos brutos de fácil destilación.

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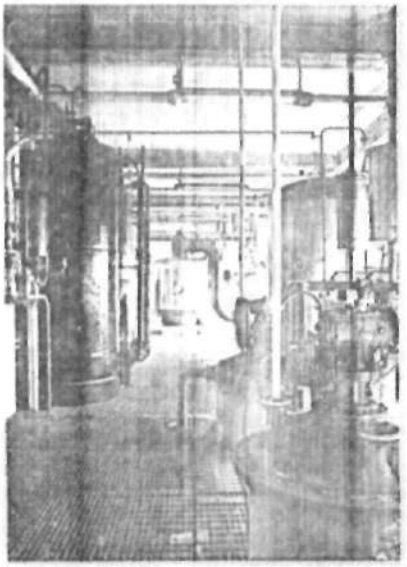

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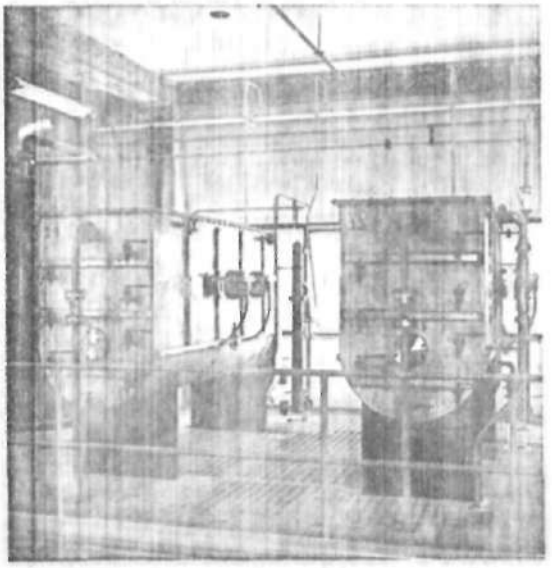

-65H-

# CONTINUOUS ALKALI NEUTRALISING

# NEUTRALISATION ALKALINE CONTINUE

# NEUTRALIZACION CONTINUA CON ALCALI

This fully continuous and automated process is the most widely used in the modern fats and oils refining cycles.
It encompasses three well-defined stages:
— degumming and neutralising
— re-refining
— washing and vacuum drying.
The plant is entirely pre-assembled at our works thus affording easy and quick re-assembly and start-up on site.

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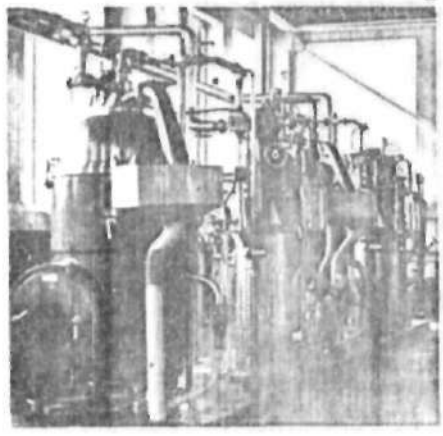

Ce procédé à fonctionnement continu et autorèglé est le plus employé dans les lignes modernes de raffinage des huiles et des graisses.
Il comprend trois phases bien distinguées:
— Dégommage et neutralisation
— Re-raffinage
— Lavage et séchage sous vide.
L'installation est complètement pré-assemblée dans nos ateliers ce qui permet un remontage et une mise en marche faciles.

Este procedimiento de funcionamiento continuo y autoregulado es el más empleado en los modernos ciclos de refinación de aceites y grasas.
Este comprende tres etapas bien distintas:
— desmucilaginación y neutralización
— re-refinación
— lavado y secado bajo vacio.
La planta es completamente premontada en fase de construcción en nuestros talleres y de fácil armado y puesta en marcha.

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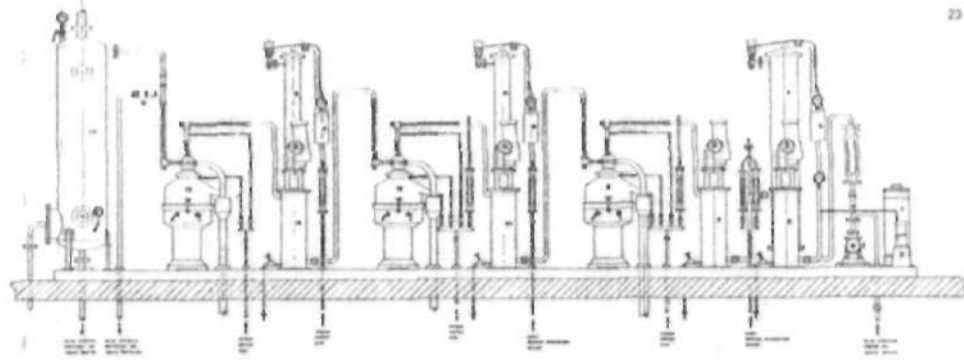
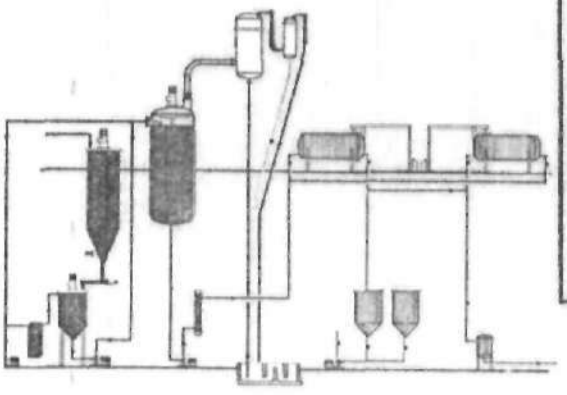


GBE 65 I

# BLEACHING
# DECOLORATION
# BLANQUEO

24



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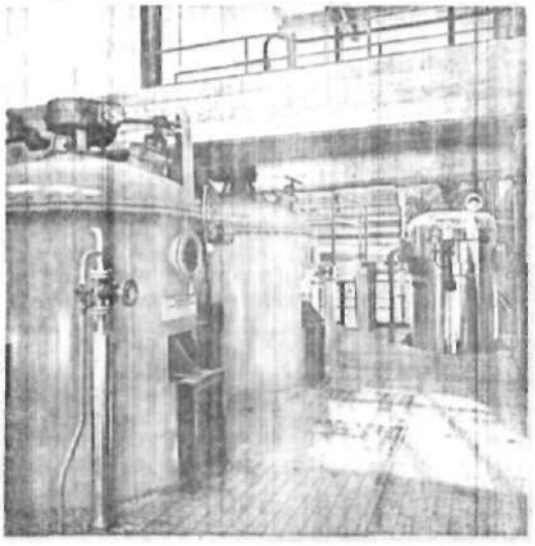


The special design of the C.M.B. continuous bleaching reactor affords maximum flexibility and optimisation of the entire process, which is carried out under the best time and temperature conditions. The latter are previously programmed based on the optimum oil-clay ratio which is maintained automatically constant.
This all-hermetic vacuum operating plant eliminates any risk of oil oxidation and its full automation minimises supervision by the operator.
C.M.B. also manufactures a special bleacher which makes it possible the combined degumming and bleaching of oils such as palm, palm kernel, etc. that are subsequently refined via physical means (steam refining).

La construction spéciale du décolorateur continu C.M.B. donne une très grande flexibilité et l'optimisation de tout le procédé qui a lieu dans les meilleures conditions de temps et de température. Celles-ci sont préalablement programmées sur la base du rapport optimal terres-huile qui est maintenu automatiquement constant.
L'hermèticité totale de l'installation C.M.B. à fonctionnement sous vide élimine tout risque d'oxidation de l'huile et son automatisation complète réduit au minimum la nécessité de contrôle.
La C.M.B. construit également un décolorateur spécial qui permet le dégommage et la décoloration simultanés d'huiles telles que l'huile de palme, de coco, etc. qui sont ensuite raffinées par voie physique.

La particular construcción del reactor de blanqueo en continuo C.M.B. permite la maxima flexibilidad y la optimización de todo el proceso que es conducido en condiciones óptimas de tiempo y temperatura preventivamente programadas y con la proporción ideal tierras/aceite mantenida automáticamente constante.
La hermiticidad de la planta, funcionante bajo vacio, elimina todo riesgo de oxidación del aceite y su completo automatismo reduce al mínimo la necesidad de control.
C.M.B. construye además un especial blanqueador que permite simultáneamente el desgomado y la decoloración de aceites como palma y coco que sucesivamente pueden ser sumetidos a refinación física.

## Filtering

To remove the spent clay from the bleached oil automatic filters are used which depending on the various requirements can be fitted with cloths fabricated in stainless steel, wire mesh or cotton fabric.
The oil retained by the bleaching cake is partially recovered by steam blowing. The spent bleaching earths are discharged automatically.

## Filtration

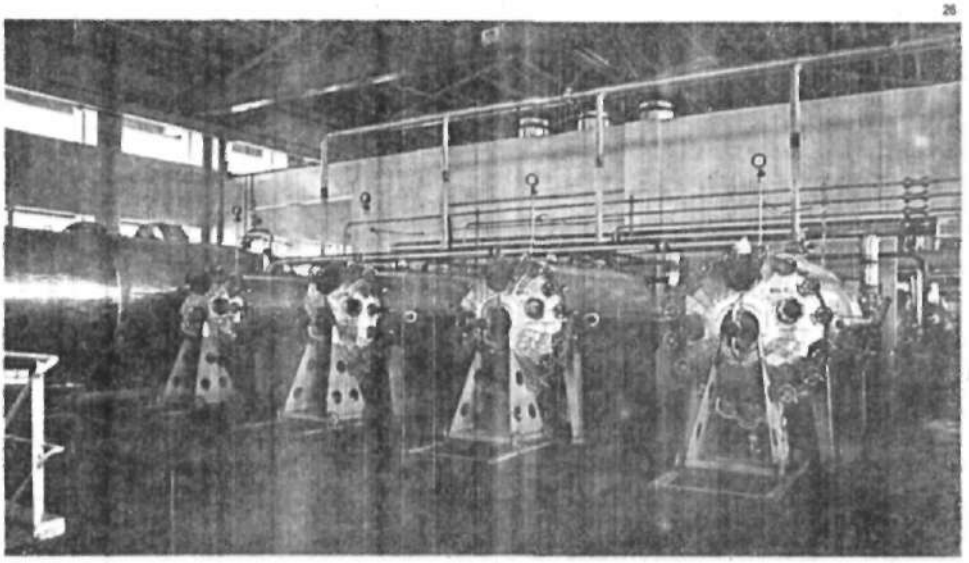
- 65J -

Pour séparer les terres épuisées de l'huile décolorée on utilise des filtres automatiques qui selon les diverses exigences sont pourvus de toiles en acier inox ou en coton.
Un système spécial de soufflage par vapeur permet la récupération partielle de l'huile absorbée par les gateaux de terre. Le déchargement des terres se produit automatiquement.

## Filtración

Para separar las tierras del aceite blanqueado se utilizan filtros automáticos según las diversas exigencias con telas de acero inoxidable o de algodón. Un especial sistema de inyección de vapor permite la parcial recuperación del aceite absorbido por las tortas de tierra. La descarga de las tierras se efectúa automáticamente.





## Filtering with Total Oil Recovery

In case it is necessary for the economics of the process to recover completely the oil contained in the bleaching cakes, C.M.B. supplies a special self-cleaning rotary filter where the retained oil is recovered by means of solvent. By this process the oil loss is reduced to practically nil.

## Filtration avec récuperation complète de l'huile

Dans le cas où serait nécessaire, pour des raisons d'économie du procédé, une récupération totale de l'huile contenue dans les gateaux, la C.M.B. fournit un filtre spécial rotatif à déchargement automatique qui récupère l'huile retenue par les terres à l'aide de solvant.
Ce procédé permet de réduire les pertes d'huile à des quantités insignifiantes.

## Filtración con recuperación completa del aceite

En el caso de que fuera necesaria para la economía del proceso la recuperación total del aceite contenido en las tortas, C.M.B. construye un filtro rotativo especial de descarga automática donde tiene lugar la filtración y la sucesiva extracción mediante disolvente del aceite absorbido. Este proceso permite reducir a entidades mínimas las pérdidas de aceite.

- 65K -

# DEODORISING - CONTINUOUS/SEMICONTINUOUS
# DESODORISATION - CONTINUE/SEMICONTINUE
# DESODORIZACION - CONTINUA/SEMICONTINUA

To better meet the various process requirements C.M.B. designs and manufactures deodorisers both continuous and semicontinuous.
C.M.B. deodorisers are fully made of stainless steel and are of the single or double shell design.
They operate in the optimum combination of the process variables, monitored and controlled in a centralized switch board, thus ensuring complete deodorisation of the feedstock and its full stability.
Quick feedstock changeover is accomplished with no substantial loss of operating time and with no risk of cross contamination.
A special system of internal and external exchangers allows for maximum heat recovery. Any pollution problem that might be caused by the condensing water is eliminated thanks to a vapour scrubber which is furnished as a standard accessory.

Pour mieux répondre aux diverses exigences de traitement la C.M.B. construit des désodoriseurs tant continus que semi-continus.
Construits entièrement en acier inox et du type à simple ou double «shell» ils opèrent en combinaison optimale des variables du procédé qui sont controlées par un tableau de commande centralisé et permettent d'atteindre une parfaite désodorisation de l'huile et une longue stabilité.
Le changement rapide de l'huile est effectué sans aucune perte substantielle de temps opérationnel et sans aucun risque de contamination. Un système particulier d'échangeurs intérieurs et extérieurs permet une récupération maximale de chaleur. Les problèmes de pollution causés par l'eau de condensation sont éliminés grâce à un laveur de vapeurs de désodorisation qui est fourni, comme accessoire standard.

Para responder mejor a las varias exigencias de trabajo, C.M.B. construye desodorizadores tanto continuos como semi-continuos.
Construidos completamente en acero inoxidable con diseño a camara doble o sencilla operan en la combinación óptima de las variables del proceso, monitorizadas y controladas en un tablero de mando centralizado y permiten alcanzar una perfecta y definitiva desodorización de los productos.
El cambio rápido del aceite puede hacerse sin alguna pérdida substancial de tiempo operativo y sin algún riesgo de contaminación de los aceites. Un particular sistema de intercambiadores al interior y al exterior del desodorizador permite la recuperación máxima de calor.
Todo problema de contaminación a causa del agua del condensador es eliminado, gracias a un lavador de vapores provisto como accesorio standard.

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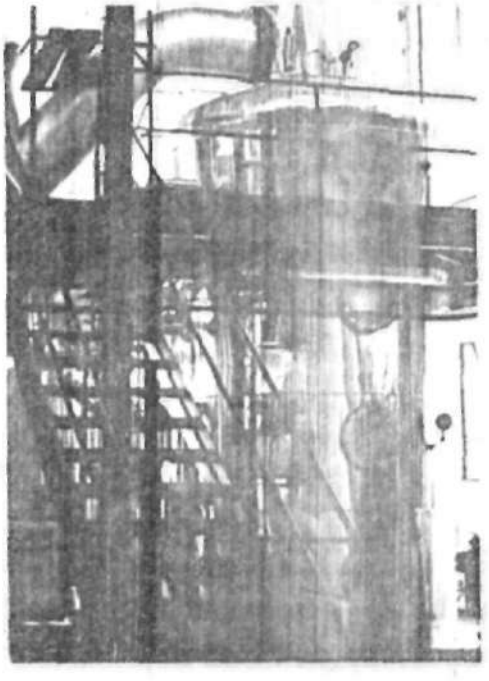

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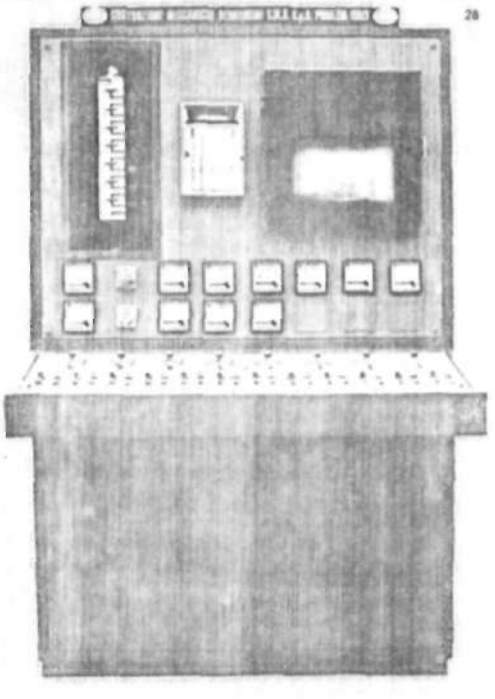

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## Dry Winterising

C.M.B. has developed a winterising system which lends itself to the processing of any type of oil according to the most suitable cooling curve and under the most *favourable conditions of temperature*, time and agitation. The latter factors are of primary importance for the formation and nature of the crystals.

Fully automatic filters are provided for the removal of the solid phase *from the crystallised mass*.

## Solvent Winterising

For some oils, and in case other *sections of the refinery make use* of solvent, it is advisable to install the C.M.B. solvent winterising plant, which offers the following advantages:

— fully continuous running
— high yield of liquid oil
— *better quality of the end products*
— stearine of a higher melting point
— reduced labour requirement.

## Wintérisation à sec

La C.M.B. a mis au point un système de winterisation qui s'adapte à traiter tous les types d'huile selon la courbe de refroidissement la plus appropriée dans la combinaison *optimale de température*, temps et agitation, facteurs qui sont fondamentaux pour la formation et la nature des cristaux. Des filtres à fonctionnement complètement automatique sont prévus pour la séparation de la phase solide *de la masse cristallisée*.

## Wintérisation par solvant

Pour certains type d'huiles et dans *le cas où d'autres sections de la* raffinerie utilisent du solvant, il convient d'utiliser l'installation de wintérisation par solvant C.M.B. qui offre les avantages suivants:

— marche continue
— rendement élevé en huile *fluide*
— meilleure qualité des produits finis
— point de fusion élevé de la phase solide
— main d'oeuvre réduite.

## Winterización convencional

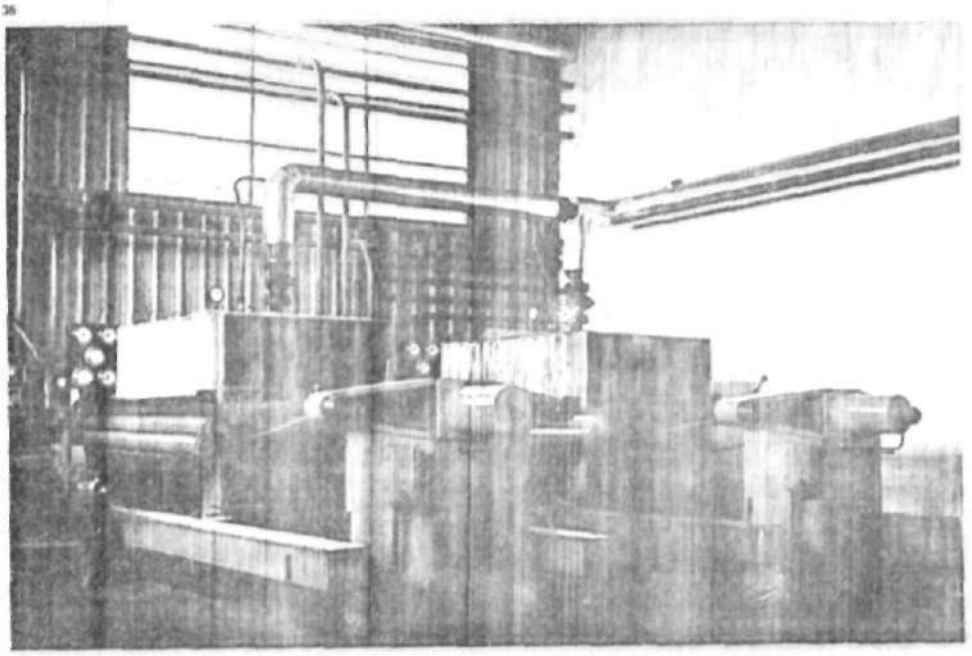
El sistema de Winterización C.M.B. tiene la flexibilidad de procesar todo tipo de aceite según la curva de enfriamiento la más idónea en la combinación *óptima de temperatura, tiempo* y agitación, factores fundamentales para la formación y la naturaleza de los cristales. Filtros de funcionamiento automático están instalados en la etapa de filtración.

## Winterización con disolvente

Para ciertos aceites y en el caso que *otras secciones de la refinería* utilicen disolvente es conveniente instalar la planta C.M.B. de winterización con disolvente. Las ventajas de este procedimiento son las siguientes:

— alto rendimiento de aceite *líquido*
— mejor calidad de los productos terminados
— estearina con alto punto de fusión
— menor empleo de mano de obra.





-65M-

# PHYSICAL REFINING
# RAFFINAGE PHYSIQUE
# REFINACION FISICA

The characteristics of some oils and fats such as palm, coconut, *palm kernel*, *sunflower*, *tallow*, etc. make it possible to remove the free fatty acids they contain by steam distillation carried out under high vacuum conditions.

This process has the following advantages vs. the conventional alkali neutralising procedure:

— combined neutralising and deodorising of the feedstock is carried out in a single step

— no loss of neutral oil due to entrainement in the soapstock

— direct production of distilled fatty acids and consequent elimination of soapstock disposal problems.

Of a fully continuous and automated design, the plant requires desultory supervision by a single operator who is also in charge of other sections.

Les caractéristiques de certaines huiles et graisses comme l'huile de *palme*, *coco*, *palmiste*, *tournesol*, suif etc. rendent possible la distillation des acides gras libres par voie physique au moyen de haute température et haut vide. Ce procédé présente les avantages suivants par rapport au système classique par alcali:

— neutralisation et désodorisation simultanées effectuées dans un seul appareil

— aucune perte d'huile neutre dans les pâtes de saponification

— production directe d'acides gras distillés et élimination des problèmes d'acidulation des soapstocks.

Le procédé «N.D.R.» complètement continu et automatisé demande la supervision irrégulière d'un seul opérateur qui est également chargé d'autres sections.

Las caracteristicas de algunos aceites y grasas como palma, coco, *palmiste*, *girasol*, sebo, *etc.* hacen posible la destilación de los ácidos grasos libres por via física por medio de alta temperatura y bajo alto vacio. Este proceso presenta las siguientes ventajas con respecto al sistema clásico con álcali:

— neutralizacion y desodorización combinadas y efectuadas en una sola unidad

— ninguna pérdita de aceite neutro en las pastas jabonosas

— producción directa de ácidos grasos destilados y consiguiente eliminación del procedimiento de descomposición de las pastas jabonosas.

Completamente continuo y automatizado el proceso N.D.R. requiere la supervisión mínima de un único operador disponibile simultáneamente para otras secciones.

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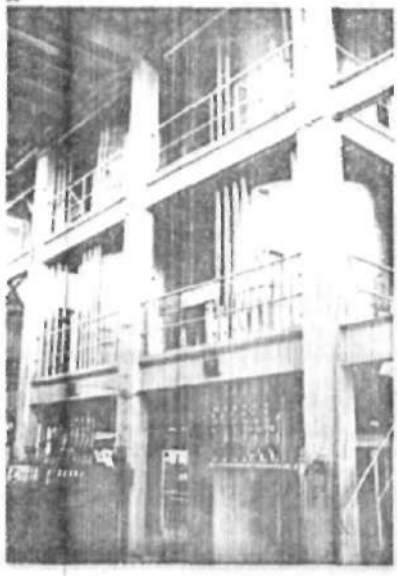

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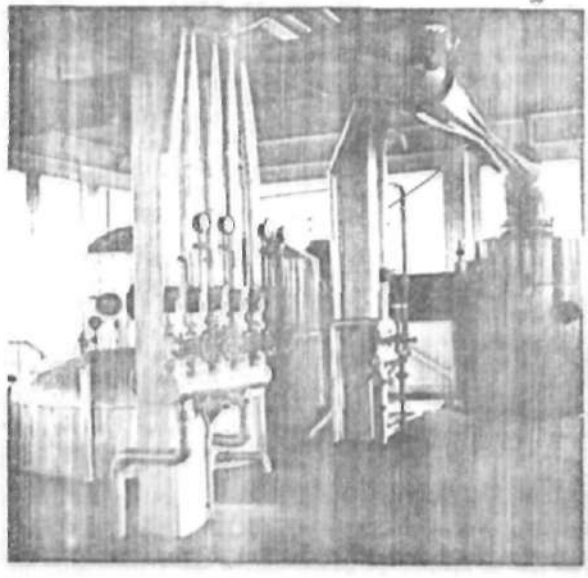

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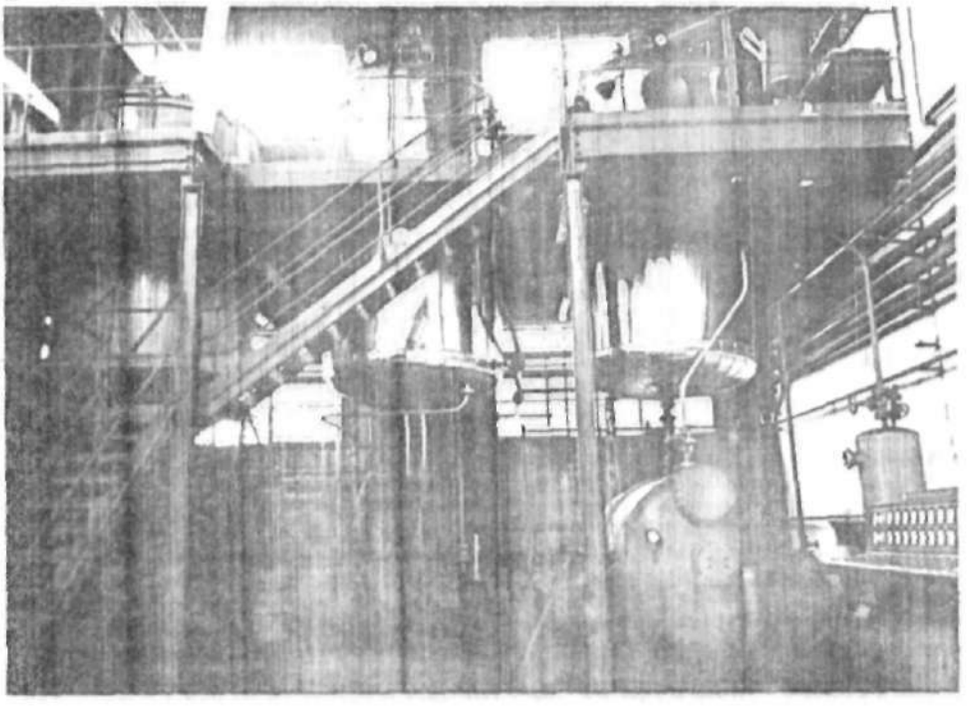
# BATCH TYPE REFINING
# RAFFINAGE EN DISCONTINU
# REFINACION DISCONTINUA

The batch type refining procedure is particularly suitable when small amounts of fats and oils are to be processed.
The plant is delivered complete with metal structure and is fully pre-assembled at our works so that re-assembly and installation on site is very simple and rapid.
The three steps of neutralising, bleaching and deodorising are accomplished in three separate vessels, which ensures a high grade end product.
Upon request the plant can be equipped with a centrifuge for soapstock separation.

Le système de raffinage à charges alternatives est particulièrement indiqué pour le traitement de petites quantités d'huile et graisses.
Notre installation est fournie complète avec charpente métallique et elle est tout à fait préassemblée dans nos ateliers, ce qui rend plus simple et rapide le re-montage et la mise en place de l'installation sur les lieux.
Les trois opérations de neutralisation, décoloration et désodorisation sont effectuées dans des appareils séparés ce qui permet d'obtenir un produit fini d'une très bonne qualité. Sur demande l'installation peut être équipée de centrifugeuses de séparation des soapstocks.

El sistema de refinación discontinuo es generalmente el más empleado para plantas de pequeña capacidad.
La planta está completa de armazón metálico y es enteramente premontada en fase de construcción en nuestros talleres para hacer más rapido y simple el armado y la puesta en marcha.
La tres secciones de neutralización, blanqueo y desodorización están completamente distintas el que permite obtener un producto terminado de calidad óptima.
La planta puede ser equipada de separador centrifugo para la separación de las pastas jabonosas.





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# FRACTIONATION
# FRACTIONNEMENT
# FRACCIONAMIENTO

## Solvent System

The C.M.B. continuous solvent fractionation plant differentiates from other systems thanks to its flexibility, which affords great selectivity in the separation of the liquid and solid fractions. This enables a wide range of products to be obtained by simply changing the oil-solvent ratio and the crystallising temperature.

Additional advantages:

— high yield of oleine
— better quality of oleine as hexane acts as a purifying medium
— possibility of fractionating crude oil.

The plant can handle, with no limitation, any type of oil and fat.

## Système par solvant

Le système de fractionnement par solvant C.M.B. se distingue pour sa flexibilité; ceci rend possible une selectivité considérable dans la production des fractions solide et fluide et l'obtention d'une vaste gamme de produits, en variant le rapport huile-solvant et la température de cristallisation.

Les autres avantages sont:

— haut rendement en oléine
— meilleure qualité d'oléine car le solvant a une fonction de purification
— possibilité de fractionner de l'huile brute.

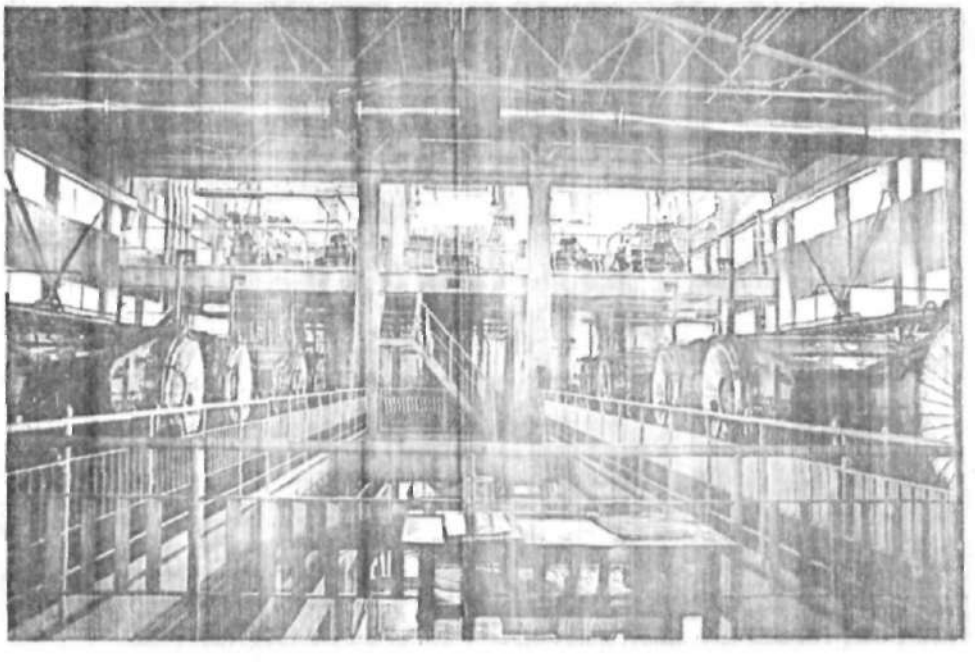
L'installation peut fractionner sans exception n'importe quel type d'huile et de graisse.

## Sistema con disolvente

El sistema C.M.B. de fraccionamiento con disolvente se distingue por su flexibilidad; esto hace posible una gran selectividad en la producción de las fracciones sólida y líquida y la obtención de una vasta gama de productos, variando la relación aceite-disolvente y la temperatura de cristalización. Otras ventajas son:

— alto rendimiento de aceite líquido (oleína)
— alta calidad de la oleína puesto que el disolvente hace función de agente purificador
— posibilidad de fraccionar, sin limitaciones, todo tipo de aceite y grasa.





# HYDROGENATION
# HYDROGENATION
# HIDROGENACION

-65R-

Thanks to its long experience in this field, C.M.B. designs and manufactures high-performance selective hydrogenation plants of complete reliability whose main advantages are:

— intimate contact between oil and hydrogen accomplished by a special stirrer
— perfect control of the hydrogenation rate (selectivity)
— possibility of obtaining in all successive batches products with constant characteristics as a result of a perfect control of the process parameters
— reduced catalyst consumption
— possibility of achieving very low iodine values (stearic acid production).

The special design of the C.M.B. convertor prevents any hydrogen leakage.

La C.M.B. grâce à sa longue expérience dans ce domaine, dispose aujourd'hui d'installations d'hydrogènation sélective très efficaces et d'une sécurité complète dont les avantages principaux sont:

— contact intime huile-hydrogène réalisé par un agitateur spécial
— controle parfait du degré d'hydrogénation (sélectivité)
— possibilité d'obtenir dans les différentes opérations successives des produits avec des caractéristiques constantes grâce au contrôle parfait des conditions opérationnelles
— consommation réduite de catalyseur
— possibilité d'atteindre des indices très bas (production d'acide stéarique).

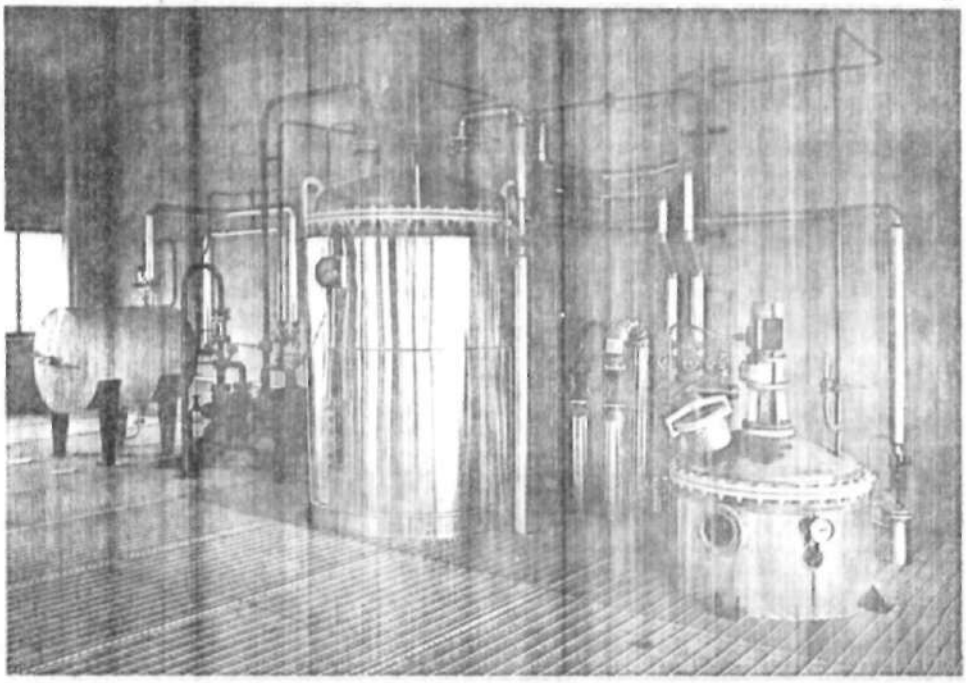
La construction particulière du réacteur rend d'éventuelles fuites d'hydrogène absolument impossibles.

C.M.B., gracias a su larga experiencia en este campo, dispone hoy de plantas de hidrogenación selectiva de alta eficiencia y completa confiabilidad cuyas principales caracteristicas son:

— intimo contacto aceite-hidrógeno realizado mediante un agitador especial
— control perfecto del grado de hidrogenación (selectividad)
— posibilidad de obtener en las varias cargas sucesivas productos con caracteristicas constantes gracias al perfecto control de las condiciones de proceso
— reducido consumo de catalizador
— posibilidad de alcanzar números de yodo muy bajos (estearinas).

El particular diseño del reactor hace absolutamente imposibles eventuales pérdidas de hidrógeno.





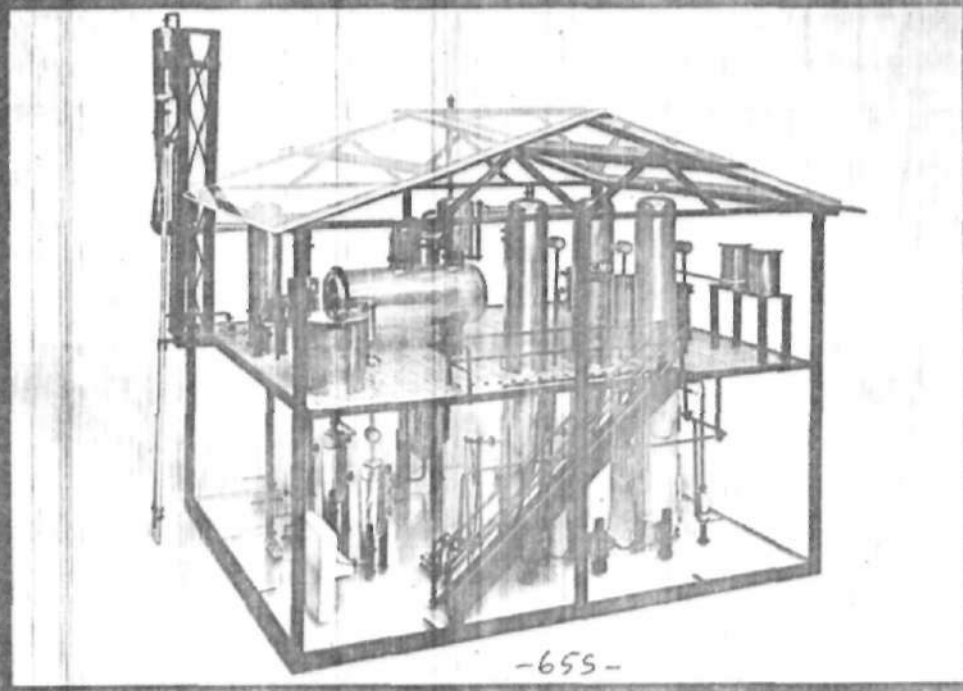
# FATTY ACIDS AND GLYCERINE

C.M.B. completes its wide range of manufacturing lines with plants designed to process fats, oils and refinery by-products into fatty acids, glycerine and their derivatives. These plants enable materials sometimes of a low commercial value to be turned into high quality products suitable for special industrial applications.

La C.M.B. complète ses lignes de production avec des installations pour la transformation d'huiles, graisses et sous-produits du raffinage en acides gras, glycérine et leurs dérivés.
Ces installations permettent une mise en valeur de produits, dans certains cas de faible valeur commerciale, en produits de qualité supérieure pour des usages industriels particuliers.

C.M.B. completa su linea de producción construyendo plantas para la elaboración de aceites, grasas y residuos de la refinación y su transformación en ácidos grasos, glicerina y sus derivados.
Estas plantas permiten una valoración de productos, en algunos casos de escaso valor comercial, en productos de calidad superior para particulares aprovechamientos industriales.





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# CHAPTER SIX

## 6.0. CONCEPT/DESIGN REPORT

To design any factory, the architect has to consider the following:

Production technology; structure, future expansion and climatic conditions, environmental factors like sufficient natural light and ventilation, thermal comfort and acoustical problems. Aesthetic aspects; colour scheme, interior, elevations and landscaping has to be considered too.

## 6.1. Site Layout/Zoning

The site layout has three main features:

Firstly, is the separation of the noisy area from the noise sensitive area by a buffer zone. The noisy area include the palm oil mill, the palm kernel mill, the feed mill and the technical auxiliary facilities; the buffer zone include the warehouse, the oil tanks, and the refinery; the noise sensitive area includes the staff facilities, the administration and the laboratory and classrooms.

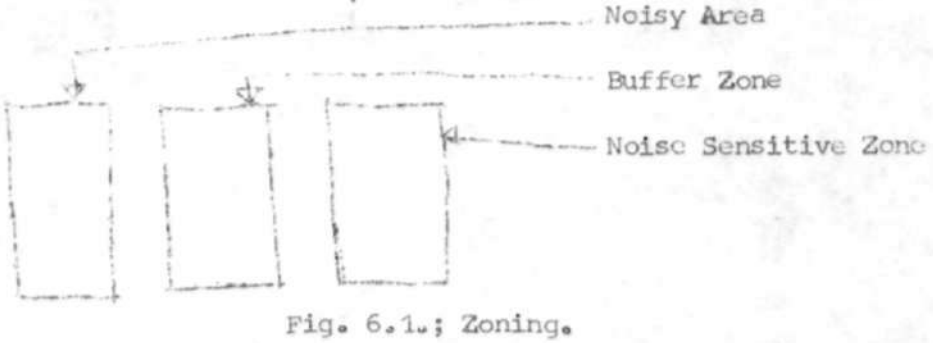
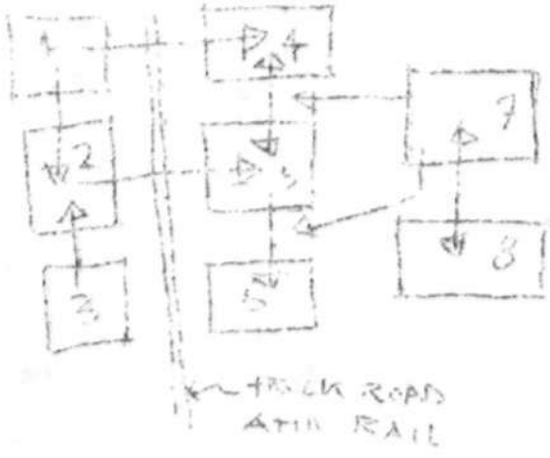



Fig. 6.1.; Zoning.

Secondly is the zoning of use areas that require common facilities.




1. Technical Auxiliary Facilities
2. Mills
3. Soils
4. Refinery
5. Oil Tanks
6. Warehouse
7. Workers' facilities
8. Administration

Fig. 6.2. Functional relationship

The arrows shows the relationship between the structures. The other common facility is the railway and the truck road. The offloading and the loading bays are effectively linked to the road and the rail line.

Thirdly is the segregation of traffic. Workers' entrance and good entrance and exit are seperated. Pedestrian and vehicular movement are also segregated.

The building are oriented of align with the main road and the neighbouring village setting. But the monitor lights are oriented in the North-South direction to reduce direct sun rays and to reduce glare.

The siting of the buildings are such that the production halls are located where there should be no obstruction to expansion thus they are located at the periferies.

Parking spaces are conviniently distributed on the site in isolated clusters to avoid one expanse of asphalt. This parking are intersparsed with green areas to give good environmental effect.

Particular attention was paid to an efficient flow pattern and most practical intergration of all departments, together with the most extensive use of automation and mechanization in production aids, as well as adequate storage capacity. The flow of materials was systematically planned right through from delivery of raw materials to the exit of finished products.

After the basic requirements of production flow had been worked out, the first thing to be ascertained was the actual space requirement of the building. The result is a production building which combines efficiency with congenial working conditions.

Industrial stores are usually designed to earn profits. Cost incurred are reflected in the production or distribution accounts, and are ultimately passed on to the consumer. Thus as the design of storage affects handling and storage costs, which help to fix commodity prices, the architect bears considerable responsibility to the public. For this reason, storage facilities were considered as part of the total distribution system from the onset.

The loading bay is the beginning and end of any production storage process and must be able to handle peak traffic flows, be adaptable to future conditions and operate in all weathers. If incorrect decisions are made, they will be magnified throughout the distribution system. Dimensions of bays, vehicles and equipment were taken into account.

6.2. INTERIOR DESIGN

To have a good factory interior it is not sufficient to have a good colour scheme for the walls, ceiling and floor, but the colours of machines, service pipe lines and the total effect was also considered. Colour scheme means a combination of colours which is harmonious and pleasing to the eye. Individual elements of the colour schemes are secondary and the total effect is more important - luminosity and lustre of colours, texture and spacing should be considered.

Colour is a powerful means of expressing the character of a building, emphasising materials and structure and influencing the mood of those who inhabit it. Colour is more immediate to human perception than form, according to psychologists. Colour is a subjective field and so the general population of workers and their attitudes has to be considered. It is not true that some colours are good and others are ugly. It is the right combination that is important. Some colours are warm and aggresive, viz red, orange and yellow and as such are not suitable for this factory which is likely to be hot. Cool colours like green, blue and violet are passive and their use will give a psychological effect of coolness. Strong colours look best if used for small areas and

when surrounded by large areas of complementary colours in soft shades. Colours have symbolic meanings and hence should be used carefully: red for danger; orange for giving warnings, white for cleanliness, blue or orange for relaxation.

Colour schemes for different units of a factory will vary, the colour scheme for production hall will be different from the scheme for stores or workers' facilities. A colour scheme may be of complimentary colours, that is colours opposite to each other on a colour circule, or may be of analogous colours, that is colours adjacent to each other on colour circule.

A colour scheme for a production hall should be complimentary to that of working material so as to provide a clear differentiation. The colour scheme should not be too bright so as to divert the concentration of workers nor so dull as to create a dark or floomy environment. Generally, for walls, pastel colours of green or blue should be used. For ceilings light colours should be used to give more reflected light. If dark colours are used it will create a psychological feeling of heaviness and workers will not feel secure and comfortable.

Colour schemes for flooring should give an impression of solidness and provide direction. For this separate colour should be used in gan-ways and in other circulation areas. Changes in floor level or in flooring material and surface texture should be made clear by using two distinct colours. This will also help to reduce accidents.

Colours for machines should harmonise with the surrounding colour-scheme and there must be a contrast between machine colour and that of working material. This will help to reduce accidents. Switches, operating levers and tool points should be painted in separate colours so that they can be seen clearly and operations are easy. For services like steam, electricity, hot water, cool water and materials pipes, different colours are used. This will not only make the interior interesting but will also make maintenance easy.

In hot places like the boilers room and generator room the use of blue will create a cooling effect. Colours in recreational units viz canteen, common room should be light and gay to relieve work tension, whereas in changing rooms and toilets white should be used for hygiene.

6.3. LIGHTING

Natural Lighting: In tropical countries there is sufficient natural light available almost all year, and it should be utilised fully. Good day light is essential for working for save movements and for feeling fresh and relaxed. This effect cannot be achieved by artificial lighting. Daylight factor, that is total internal illumination as a percentage of that available outside should be in general, 5 - 10%. For this openings should be approximately 20 - 30% of floor area.

Day lighting from side-windows is highest near to the window and is 20% though at a distance it is just 3%. Hence for this factory with large span production halls, this will not be sufficient and roof lighting is essential. Different types of roof lightings commonly used are:

1) North light roofing

2) Double pitch roof with glazing

3) Glazing in folded plate slabs or in shells

4) Monitor roof lighting

Before selecting any roof lighting system it must be checked thoroughly whether it is essential as it is expensive and maintainance is also difficult. The approach should be to use maximum natural light and, at the same time, minimise solar heat penestration. In view of these, the best orientation for minimizing glare and discomfort, considering solar movements, and glass area was checked.

Monitor roof - lighting which gives the highest compromise was chosen. It can give 6% day-light factor with 30% glazed area and lighting distribution is fairly uniform. Glare and discomfort are avoided as glazing is vertical and not facing direct to the sun.

Artificial Lighting: In addition to natural light it is essential to have artificial lighting for continuous working. The minimum general lighting in production halls is 400 lux. As this factory does not required precision work 600 lux will be adequate.

6.4. THERMAL COMFORT/VENTILATION

Excessive heat is always a serious environmental hazard in industries.

Apart from the internal heat produced, heat comes from outside in the form of solar heat penetration through openings and through the building fabric. The fabric of the buildings is designed as a first defence to control light, heat and sound problems. Where this is not sufficient, or not possible, artificial aids is used. If buildings are designed with large openings, then the problem of solar heat is greater, if designed with smaller windows to reduce heat a new problem arises as lighting and ventilation are not sufficient. Hence proper balance has to be achieved.

To ventilate the halls, the aid of a natural phenomena, convention is employed. A lot of heat is generated in the production hall. The heated air being light has the tendency to rise. Fresh air from below then replaces the hot one, hence the need for high and low level windows.

With this, the use of mechanical ventilation is highly reduced in the production hall. In the administration however, unit air conditioner are used.




Fig. 6.3.; Principle of Ventilation.

6.5. NOISE/VIBRATION

In industrial buildings, noise level is very important. High noise level will give physical disabilities like deafness. Noise and vibrations of machines are the main sources of noise and in addition to this other sources are vehicular movements, boiler and generator etc. Sound transmission is either direct or of the reflected air borne type and is reverberant or travels through ducts, flooring and structure. This will be reduced by the following methods: The machines vibrations will be reduced by using neoprene pads. Reduction of sound output at the source, machine, is beyond the scope of the architect.

All ducts and services passing through the walls will have flexible connections or be insulated with absorbent materials at the place of contact with the structure. Landscaping will also be used to absorb sound.

6.6. STRUCTURE

The factory production buildings consist of a steel-structure with non-load bearing walls of sandwich panels. Steel structure is easy and quick for erection, expansion and alterations are easy. It is less affected by climatic conditions.

Lattice girider are used for the roofs. This is most suitable for this pipes oriented industry.

6.7. FLEXIBILITY

Future expansion, additions and alterations due to changes in technology must be taken into consideration in the design. As technology changes today's machines and production processes will be outdated and will need to be replaced. But the life of the

building is more than this, and the building will become obsolate if proper consideration is not given at the design stage. The structure should be such that, without major changes, buildings should be able to be used for new production technology.

Modular coordination was considered as a good step towards achieving this flexibility.

6.8. MODULAR COORDINATION

Modular coordination is the name given to the dimensional coordination of building elements components and parts. In other words, it is a method of sizing building components so that they will fit together without having to be cut in the field. Conventional building practice is wasteful of both material and labour. Even the simplest building requires thousands of individual components. These manufactured products, which are completely unrelated in dimension, are assembled at the site, where they must be cut and fitted together by skilled workmen. Building components manufactured in modular sizes however, can be assembled (fig. 6.4) without the necessity of field cutting, and thus permit great savings in materials and labour. Equally important are the savings that result from simplified practices in the drafting room, estimating office and in the field.

International standard organisation has established 4" basic module for foot-inch countries and 100mm (almost 4") for metric countries.

BASIC METHODS

The basis of the modular method is joint - centreline to joint-centreline dimensioning for all the components, using multiple of 100mm module. The three drawings in fig. 6.5 illustrate the principle of joining different modular materials.

Material "A" represents a component produced in any multiple of 100mm, with sufficient manufacturing tolerance and joint clearance to permit installation without cutting. Material "B" represents another modularly dimensioned material or components. Different materials ordinarily have different point thickness requirements, but for all modular materials one-half the minimum joint thickness at any edge provides sufficient clearance for installation. The third drawing in fig. 6.5 illustrates the method of dimensioning modular materials or components to be joined. Materials "A" for example could be a window assembly, material "B" a frame wall, and material "C" a door unit. This method applies to all parts of a building and indicates the ease of assembly of modular materials.

Fig. 3 shows the principle of joint-centreline to joint-centreline. It also shows how the actual size of a modular components is determined.

MODULAR DRAFTING

If the advantages of modular coordination are to be realized, modular methods must be used in architectural drafting. And also by manufacturer. There is little gain in having building materials manufactured in modular sizes if modular methods are not used in the design of buildings. Fortunately, modular drafting

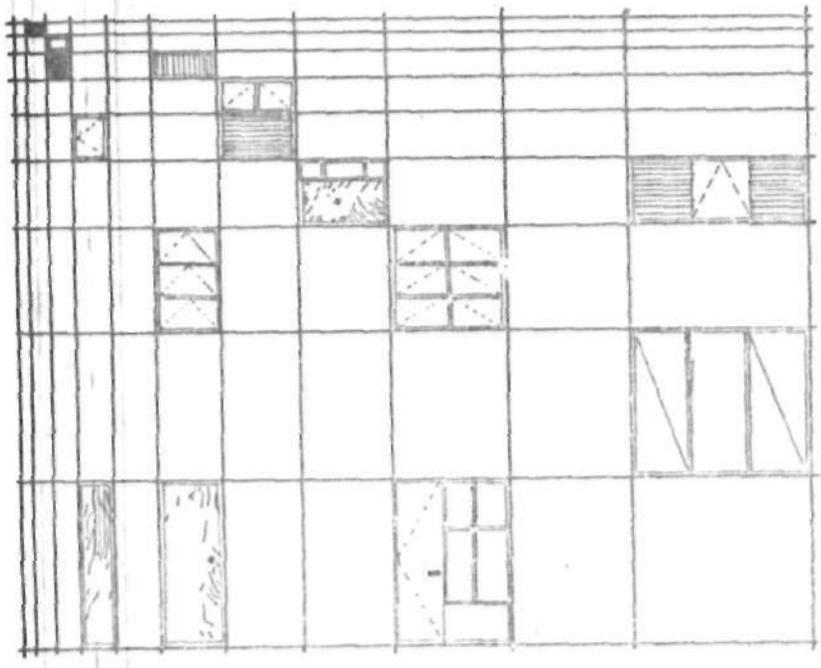


FIG 6.4: PRINCIPLE OF COORDINATED RANGE OF COMPONENTS.

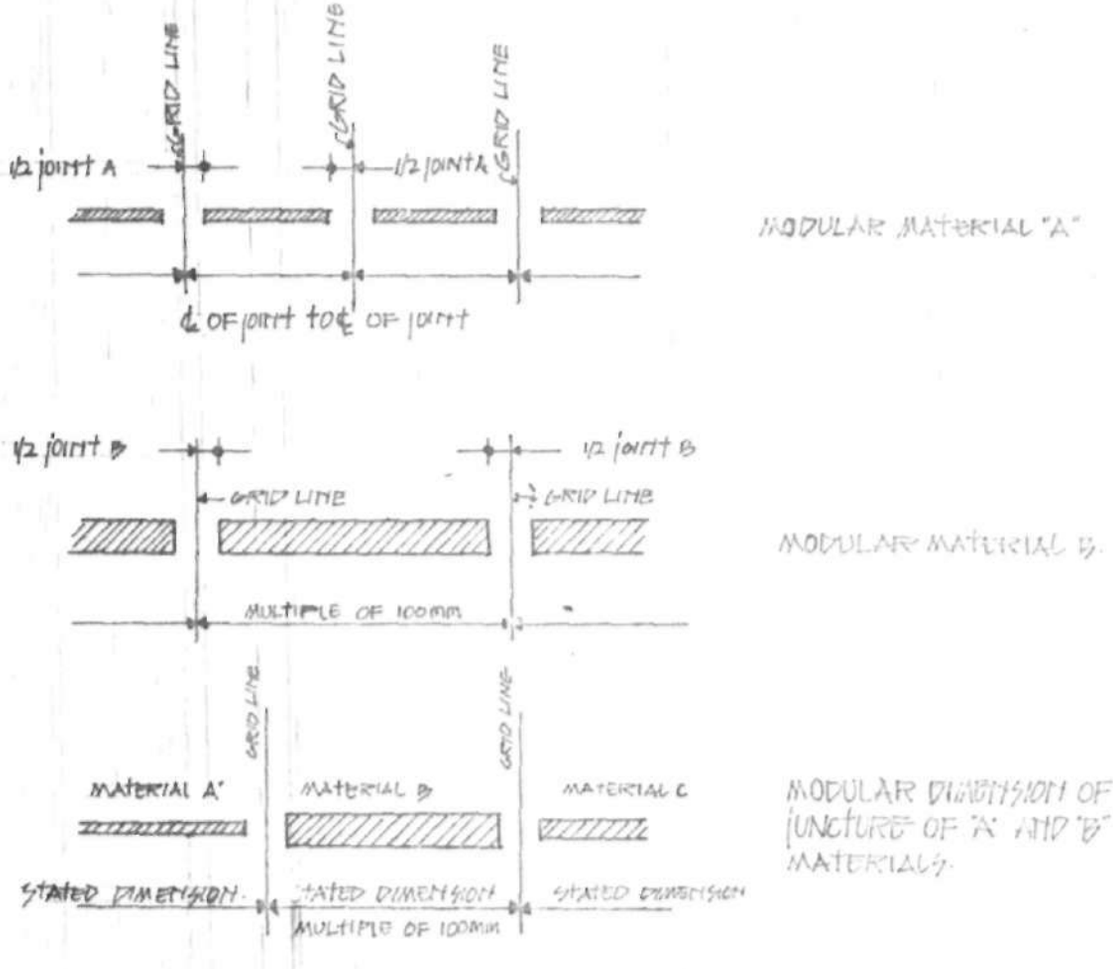



FIG 6.5: MODULAR JOINING PRINCIPLE.

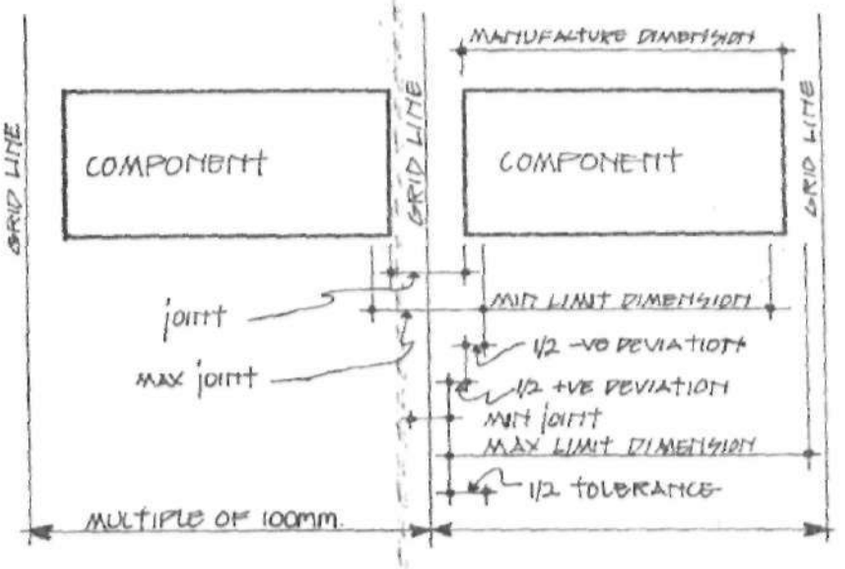
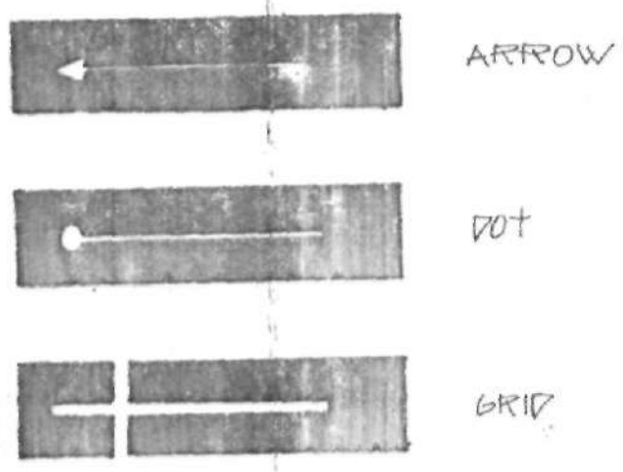



FIG 6.6 BASIS FOR SIZING A COMPONENT



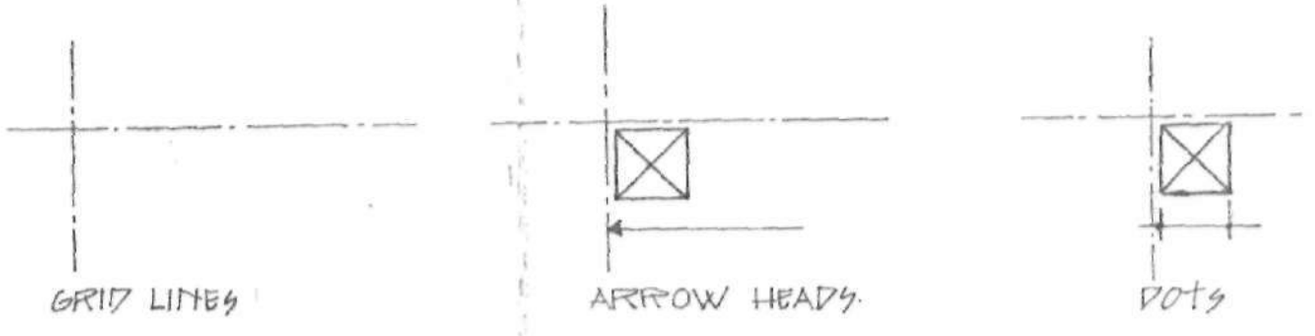




FIG 6.7 MODULAR DRAFTING CONVENTIONS

conventions are few and simple and are easily put into practice. The three basic conventions are the grid, the arrow head and the dot fig. 6.7A.

Fig. 6.7B: Gridslines are used to establish reference planes 100mm apart in all three dimensions. Grid lines are immaginary and can be thought of as dimensional egg-crates running throughout the structure. The grid lines are partially or entirely shown on large-scale details but will not be shown at all on small scale plans. Some large multiple of the 100mm module (principal grids) may be used as a planning grid and may also be shown on plan.

The arrowhead is used for all dimensions that originate or terminate on a 100mm grid line. Dots are used for off-grid dimensions - used only when essential to the clarity of the drawing.

Two observations can be made: Firstly, if only dots were to be used on a drawing, it would not differ from any "premodular" architectural drawing. And secondly, the fewer the number of dots and the greater the number of arrowheads, the greater the simplicity of the structure and the joining problems. Theoretically, if only arrowheads were used, the architect would enjoy the ultimate in drafting simplicity and the building would benefit from the ultimate in construction simplicity.

The use of basic drafting conventions throughout the dimensioning of all plans, elevations, and details obviates the need for most fractional dimensions on the drawings and the corresponding possibility of errows in the addition and subtraction

of series of numbers involving such fractions. The drawings are simpler to make and simpler to use, resulting in savings all along the line, preliminaries, working drawings, details, checking, estimating, field layout and supervision. In general, modular coordination is a dimensional reference system that encourages simplified construction details and takes advantage of the inherent dimensional qualities of modular building materials and components. It applies to any type of construction in which the plan and structural elements are in character.

Freedom of design is not undesirably affected by the use of modular coordination. Both designing and preparation of drawings on a modualr basis follow closely the conventional methods; the only important difference is the helpful discipline of a 100mm grid. The small size of the grid and the possibility of intergrating nonmodular -sized items permit as infinite a variety of plan and elevation solutions as the more traditional practice.

Overall dimensions for the entire structure, wall lengths, opening widths and heights, partition locations and the like should all be planed in multiples of 100mm to ensure agreement of plans with grid, and to eliminate unnecessary details. For the dimensional coordination of building systems and their components, a larger modular called the systems module (SM) has been established. The systems module is equal to 60 basic module, or 1SM = 60m = 6.0 metres. Preferred coordinating dimensions for components are 30m, 20m, 15m, 12m, 10m, 6m, 5m, 4m, 3m, or 1m. While primarily intended for use in the

horizontal plane, there is nothing to preclude applications in the vertical plane.

For the coordination of vertical dimensions, a multimodule equal to 4m has been established. The multimodule is to be used as a basic increament of vertical dimensioning. For dimensions exceeding 20m for components less than 20m, the preffered coordinating dimensions are 16m, 12m, 10m, 8m, 6m, 4m, 2m, or 1m. It should be noted that 10m, 12m, and 16m in some combination provie 20m and every dimension thereafter in 2m increaments. For components 20m or more, the preferred coordinating dimensions are 24m, 32m, and 36m. Where structural or economic factors prevent. Adherence to these coordinated dimensions, second preference should be the use of dimensions which are at least modular - that is, even multiples of the basic module. Where this is not possible, the nonconforming dimensions must be handled as an uncoordinated neutral zone and custom-dimensioned components must be specified. Their use will allow prefabrication of structural and nonstructural components and systems in a minimum number of sizes which will allow a maximum number of design and dimensioning alternatives.

# CHAPTER SEVEN

## 7.0. DESIGN REQUIREMENT/ARCHITECT'S BRIEF

7.1. Transportation - Major areas where vehicular access are required are the storage and administration zone for goods and personnel/visitors respectively.

Forklifts - Are used to arrange goods.

Pneumatic and screw conveyor - Transport material in granular form to storage (silos) and from storage to production halls into the daily production storage hoppers.

Within the production hall, overhead convenyors are used to distribute raw materials into machines and underground conveyors carry materials from one machine or group of machines to another; for example from pre-press room - solvent extraction - pelletization room.

Channel - Runs on the ground and carries oil to crude oil buffer storage.

Pipes - Convey fluids and steam.

7.2. Structures and Their Functions

Gatehouse/Weighbridge Reading Room - Check the vehicles leaving the premises. Goods entering and leaving the site are weighed and recorded.

Administration: Is responsible for management of the workers, purchasing of materials and equipments, sales of products and book/record keeping and accounts of the Company.

Storage Facilities. Used for storage of raw materials and finished products; silos for the storage of palm kernel, kernel cake and cereals; oil tanks for storage of crude oil

and refined oil. The warehouse is for the storage of sealed domestic cooking oil.

PRODUCTION HALLS

Palm oil mill - extraction of red palm oil from the fruits after removing the fruit from the fresh fruit bunches. Extraction of palm kernel from the nut is also carried out here.

Palm kernel mill - extraction of oil from the palm kernel and compressing the cake into pallets for storage.

Feed mill - Production of animal feeds.

Refinery - removing gum, odour, fatty acid, colour, metals and other impurities from the oil. Pure fatty acid and glycerine are also recovered from the spent lye.

Technical auxilliary facilities - provide support services for the industry; this includes provision of steam, hot water, cold water, water treatment and suppling of electricity when NEPA is off. Maintainance and repair services are also part of this department.

Staff facilities - this are the facilities for the welfare of the workers. This includes the clinic, dining and the changing room.

7.3. Accommodation Schedule

| Production Halls | Area ($m^2$) |
|---|---|
| Palm Oil Mill | 216 |
| Palm Kernel Mill | 504 |
| Feed Mill | 360 |
| Refinery | 1140 |
| **Storage** | **Capacity** |
| Ante Room | $66m^2$ |
| Silos | 16 x 500 tons |
| Oil Tanks | 12 x 850 tons |
| Warehouse | $540m^2$ |
| Water Storage | $500m^2$ plus three Bore - Holes. |
| **Technical Auxiliary Facilities** | **Area ($m^2$)** |
| Workshop | 168 |
| Boiler Room/Cooling Tower | 96 |
| Water Treatment | 96 |
| Laboratory | 66 |
| Security Gatehouse | 36 |

| Staff Facilities | Area ($m^2$) |
|---|---|
| Lobby | 64 |
| Changing Room | 150 |
| Kitchen/Kitchen Yard | 216 |
| Canteen | 216 |
| Clinic | 60 |
| Class Rooms | 312 |
| Toilet/Shower | 64 |

| Administration | Area ($m^2$) |
|---|---|
| General Administration | 160 |
| Purchase Department | 96 |
| Sales Department | 128 |
| Accounts Department | 144 |
| Social Welfare Department | 80 |
| Reception/Display | 72 |
| Conference | 80 |

PARKING SPACES

Visitors' - 20 car parking spaces

Staff - 33 car parking spaces including Comapny Staff Buses.

There is provision for Company and Customers' truck parking.

7.4. Staff Requirement Estimate

| Department | 8.00am-4.00pm | 4.00pm-12.00am | 12.00am-8.00am |
|---|---|---|---|
| Production Hall | 60 | 55 | 55 |
| Storage | 42 | 42 | 42 |
| Technical Auxilliary Facilities | 19 | 13 | 13 |
| Staff Facilities | 16 | 15 | 15 |
| Administration | 44 | - | - |
| Total | 171 | 125 | 125 |

NOTE:

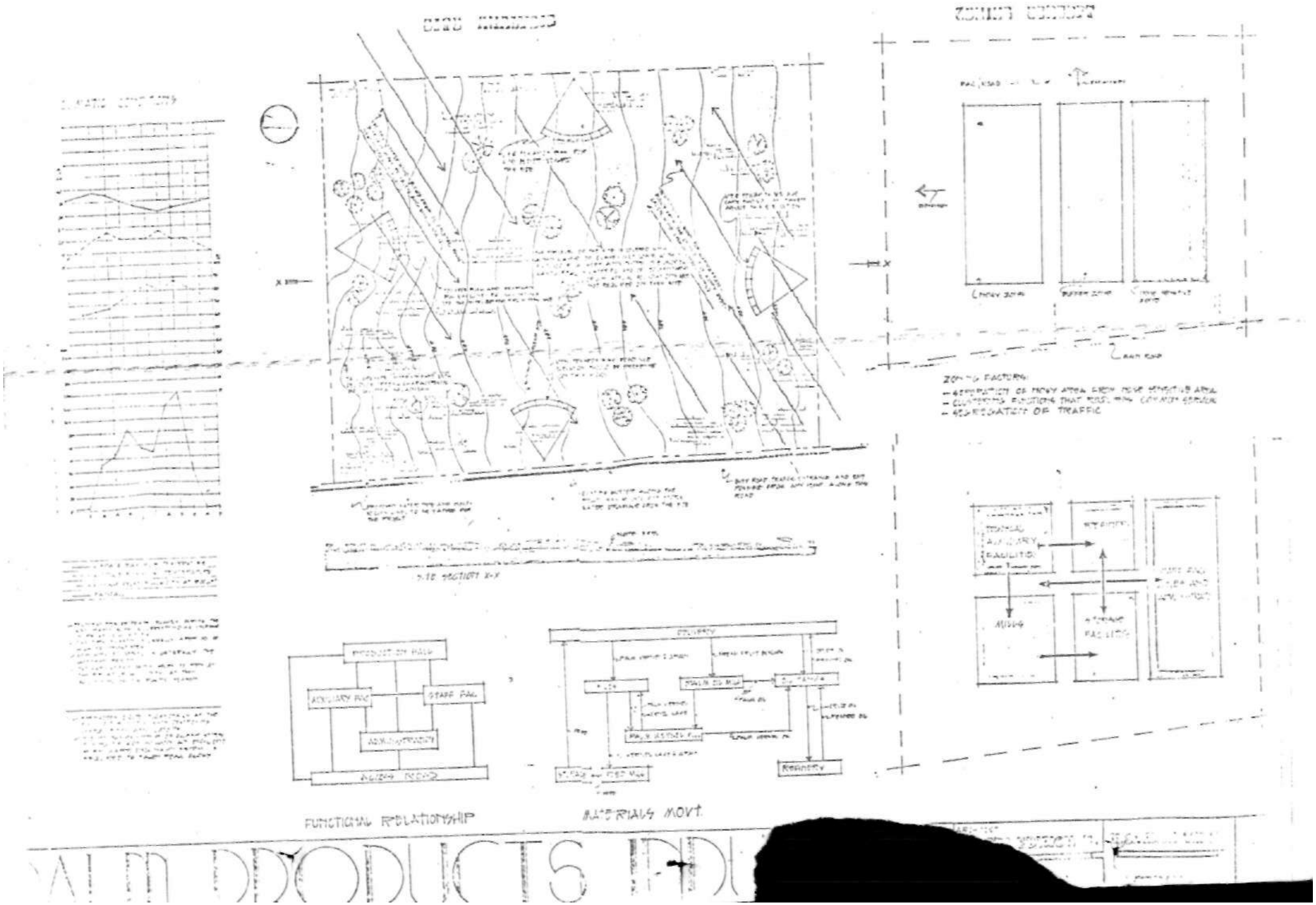
Facilities are Designed taking the shift with maximum number of workers into account.

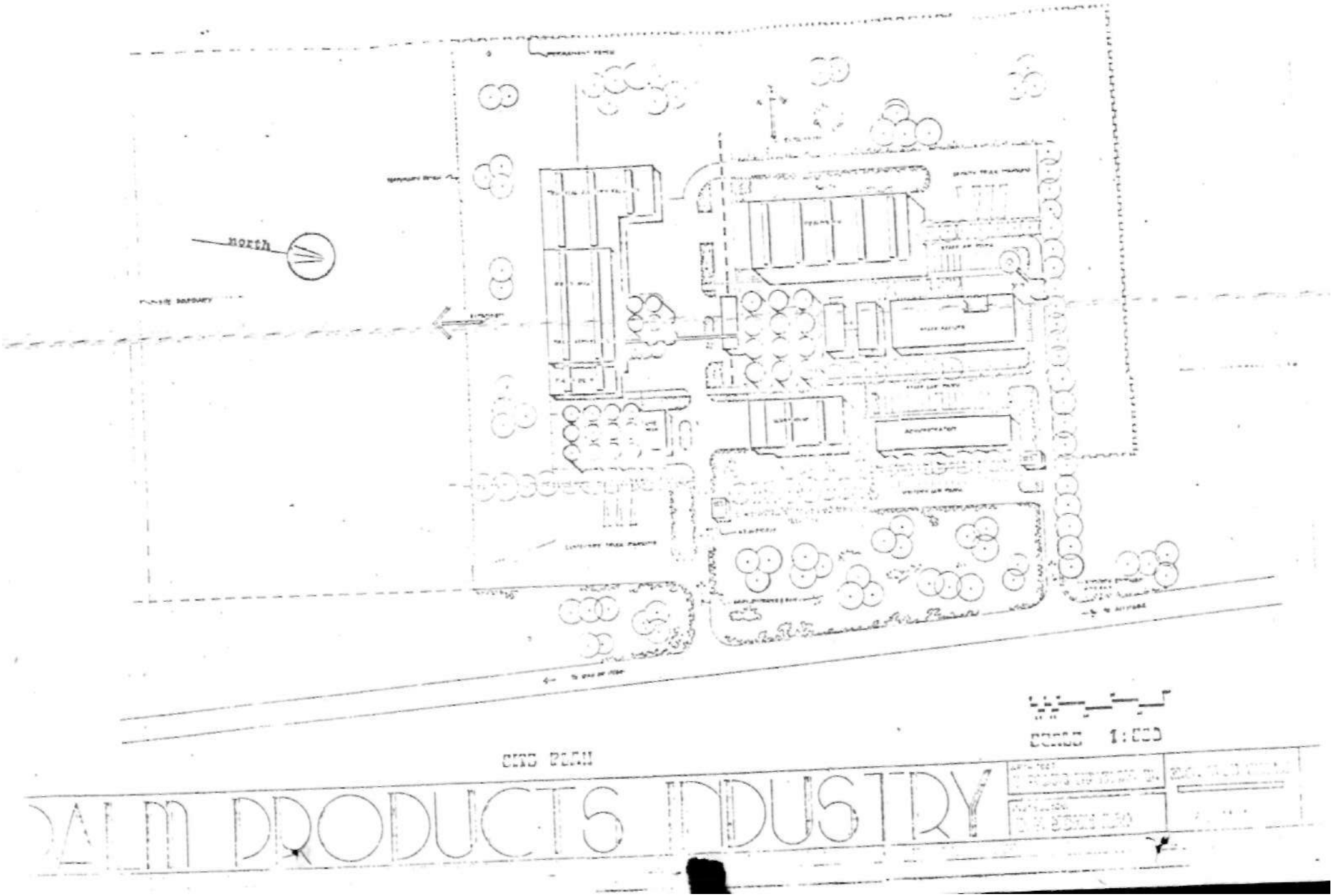
## CONCLUSION

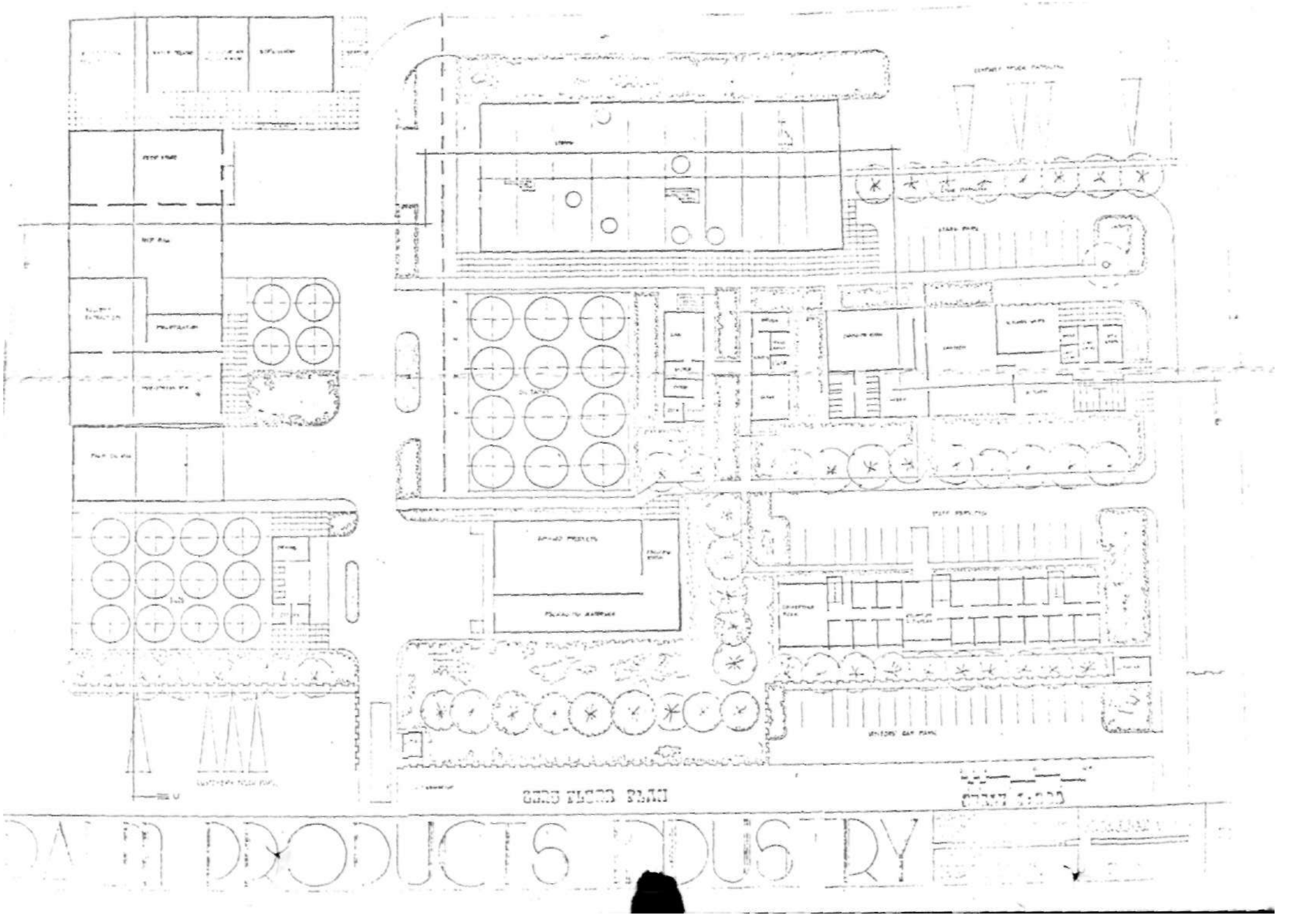
A country should specialize where she has the capabilities. This is the basis of international trade.

Nigeria is blessed with agricultural potentials. A lot of emphasis should therefore be put on agro based industries. These industries should be located where they can provide good market directly to the particular agricultural products available in the area. The difficulties in the way of finding and developing any big new industry in this area are very great. Thus the best way to safeguard the future of any particular agricultural product in Nigeria is to try to improve the industry rather than to try to replace it by a new one.

In pursuing such programme, we should not forget to improve the living standard of our villages where over 85% of the farmers live because this has a direct implication on the agricultural output.


ZONING FACTORS:
- SEPARATION OF NOISY AREA FROM NOISE SENSITIVE AREA
- CLUSTERING FUNCTIONS THAT REQUIRE COMMON SERVICE
- SEGREGATION OF TRAFFIC
SITE SECTION X-X
PRODUCTION HALL
AUXILIARY FAC
STAFF FAC
ADMINISTRATION
ACCESS ROAD
DELIVERY
REFINERY
FUNCTIONAL RELATIONSHIP
MATERIALS MOVT.


north
SCALE 1:500
SITE PLAN
DALM PRODUCTS INDUSTRY

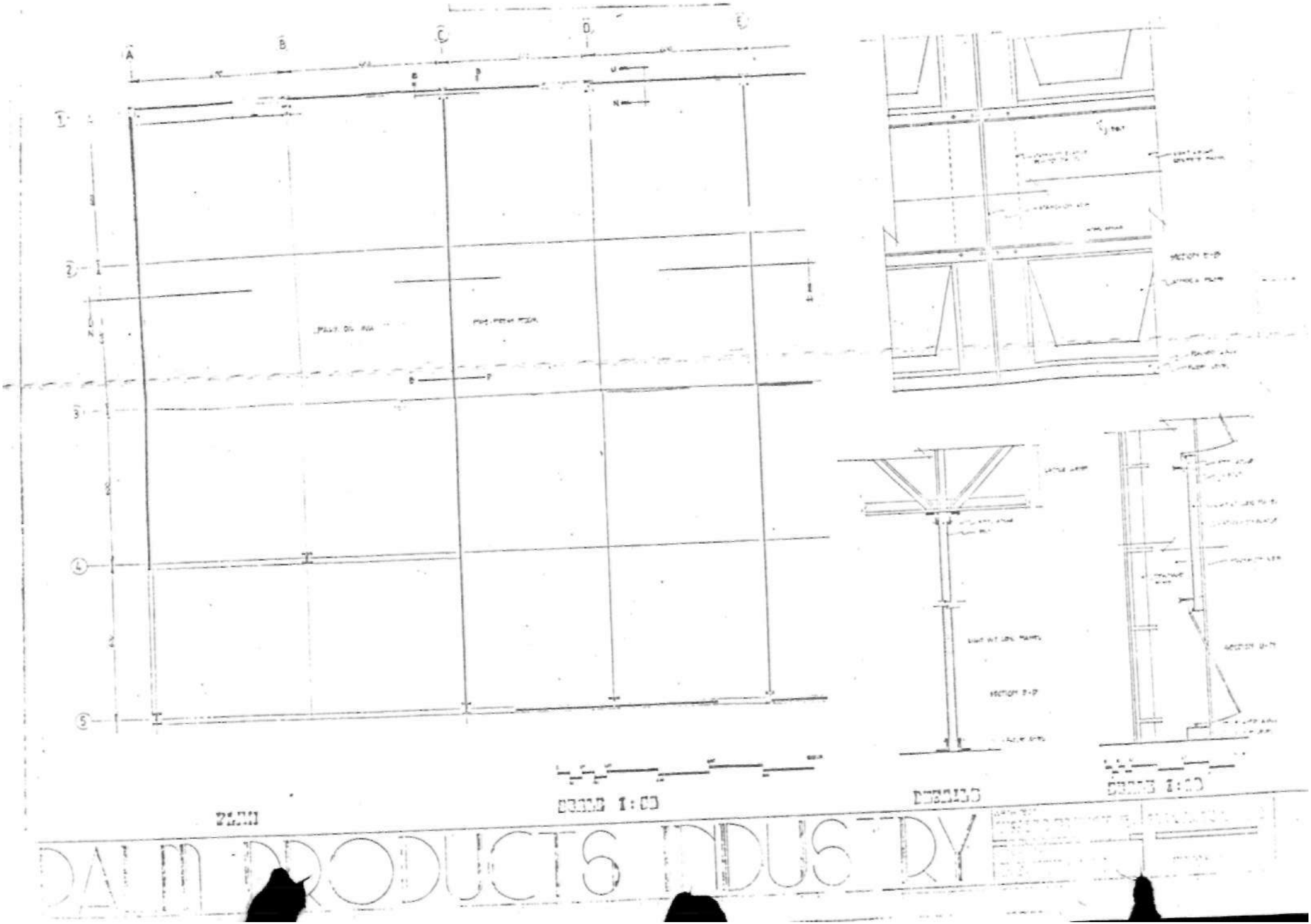

GERS FLOOR PLAN
DAIRY PRODUCTS INDUSTRY

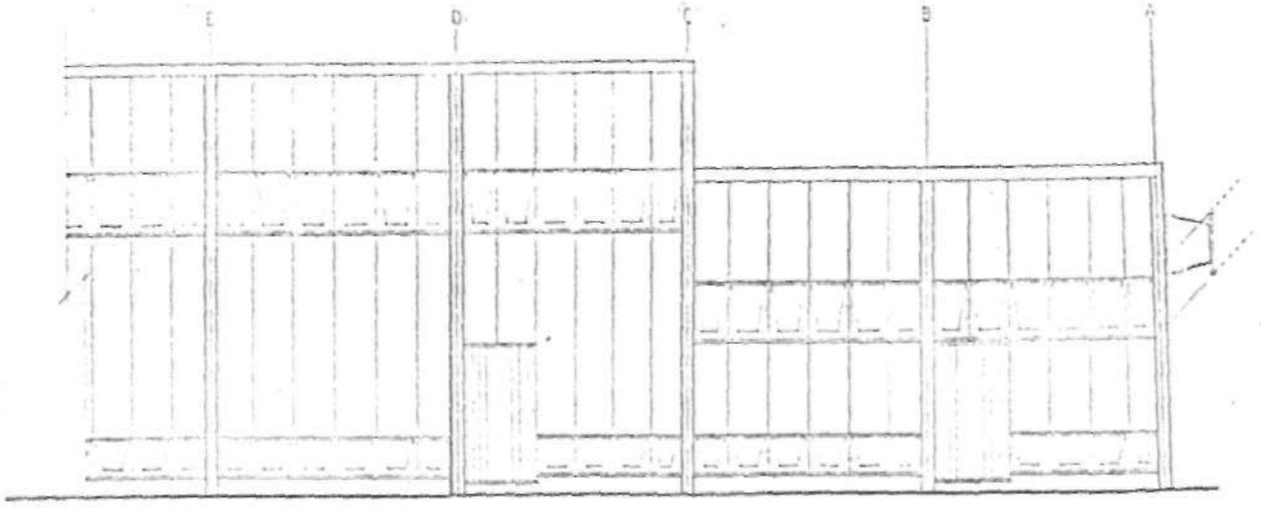
INDUSTRIAL

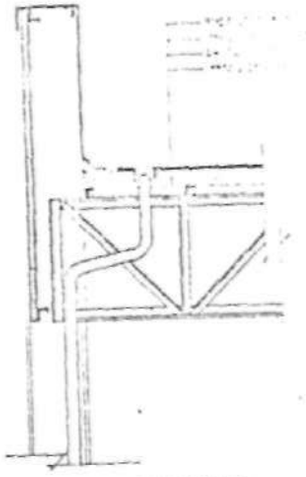
DAIRY PRODUCTS INDUSTRY

DAIRY PRODUCTS

AUTODESK VIZ 3D PRODUCTS

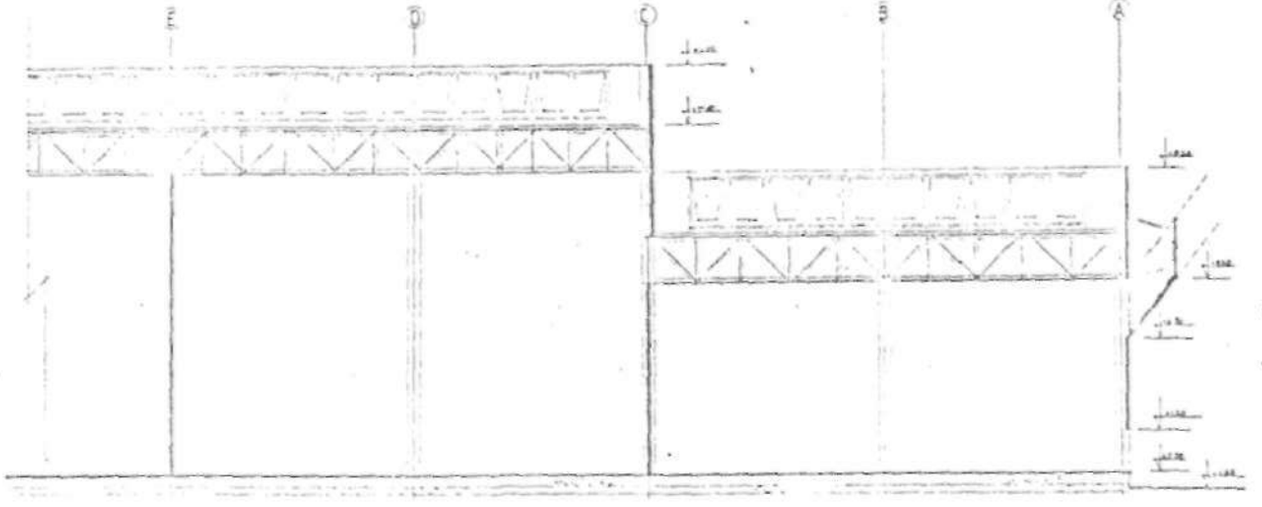

A
B
C
D
E
1
2
3
4
5
PLAN
SCALE 1:50
DETAILS
SCALE 1:10
DALM PRODUCTS INDUSTRY

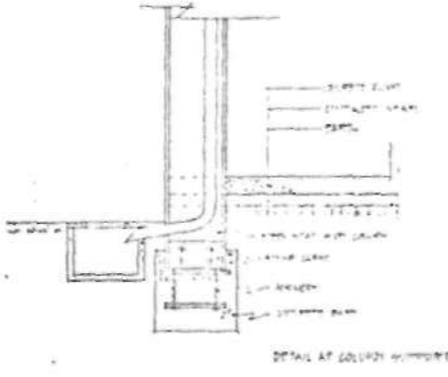


DETAIL AT BASE

BACK ELEVATION



DETAIL AT COLUMN

SECTION 11-11

SCALE 1:03

DETAILS

SCALE 1:03

PALM PRODUCTS INDUSTRY

10

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