

A THESIS

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BY
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on
METALWOOD FURNITURE FACTORY IN ZARIA
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DEDICATION

This Thesis is dedicated to:-

My Uncle Mallam Ibrahim Sambo Galadima,

My Brother Alh. Sani Aliyu

My Wife Rakiya Aliyu Bammali

My Mother, Dad and the whole humanity for
educating our youth and administering our
great nation to glory.

BE KIND TO THOSE PEOPLE YOU MEET ON YOUR WAY TO
THE TOP. YOU MAY MEET THEM ON YOUR WAY TO THE
BOTTOM

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ABSTRACT

This thesis is intended to investigate and explore the various architectural problems and the processes involved in Furniture Making and to provide some suitable solutions. Basically, the programme is aimed at covering up the design of a furniture factory for the production of school and office furniture to be sited at the light Industrial area of Zaria,

The choice of Zaria as a site for locating the factory is not accidental. All necessary facilities needed for such an industry such as good roads, railways and railsiding are available and this will ease the problem of transporting both the starting materials and the products. The site itself is dominated by similar light industries and ensures the availability of necessary services that the factory will require.

The principal starting materials are Ace Metal and Timber which are abundant in the country. With commissioning of Ajaokuta Steel Factory in 1983 and booster given by some states governments in the country for wood plantations, the starting materials will be readily available.

Considering the rate of unemployment in the country, the potentials of steel and timber production and the obvious need for a system of distribution to the ever increasing demand, the important role which an industry of this nature will play in providing employment and distribution system for steel, Timber and their products in the country needs not be over emphasised.

As the 1980 is seen as an industrial development era in the country and being a Nigerian, I am of the opinion that this project will expose me to the problems of industrial design generally and that of furniture industry in particular; thus, enabling me to contribute my quota to the industrial development of the nation.

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INTRODUCTION

Furniture is a household name that everybody is so familiar with to the extent that it hardly needs any description. When one sets off thinking about amenities that facilitates man's inevitable struggles for existence, or to bring in more comfort for the inhabitants, or raise the standard of living of the people generally, the one thing among others, that comes to mind is furniture. Furniture come in different shapes and kinds and also for different purposes. It could be made of plastic on metal frame or wood on metal frame or an all metal furniture. It could also be for the home, the office, the school the garden, the factory and a host of other places.

However, the proposed ZARIA FURNITURE FACTORY, whose product will be of either all wood or all metal or wood on metal frame, will in the main produce office and school furniture. But it can also produce home furniture on special request. The need to provide such an industry is apparent. One only needs to look around and one will see a lot of mushroom workshops where furniture of unskilled workmanship are produced. Two things are clear from this. One is the great demand for furniture and knowing what Nigeria of today is, Nigerians want nothing but the best and they are now forced to buy what is readily available. Those who can afford to travel all the way to Lagos, Benin, Kano e.t.c. to purchase such items. Secondly, it shows the availability of labour. That labour is available is considered while designing the factory that is why a separate training division was not provided.

Looking around one will find that most of the workshops produce home furniture in the main while other types are secondary. That is why today most or all of our furniture on the A.B.U. campuses and other

schools of higher learning are brought from Kano or other places and with the request for creation of more local governments coupled with the possibility of breaking Kaduna State into New Kaduna and Katsina States, many new Administrative headquarters are coming up. With education getting lion shares in all or most of the northern states budgets, many new schools are going to be built. For smooth operation in these areas a factory that will supply them with their needs is appropriate.

The development of any nation depends upon quite a number of factors among which is industrialization. The road to industrialization is the establishment of small scale industries. Due to our governments wrong priorities, the small scale industrial sector of our country's economy has been the most neglected but the later governments realize the importance of industrialization and the priorities today are geared towards creating good and cheap working space for indigenous entrepreneurs. Consequently, the rapid growth of industries is a manifestation of the Third National Development Plan of the country. While agro-based industries have priority, industries that thrive on our natural resources receive due attention. With an economy that relies very much on oil, it will be proper to propose an industry that will make use of other abundant natural raw material. The use of timber in the country can be divided into two major groups, first in the building industry and secondly in furniture production. Other uses include packing finished goods for transportation to customers and the like. Metal, the other raw material the factory requires is also used in the building industry, furniture production, vehicle body building and a host of others.

Timber and ~~the~~ metal which are the major raw materials in the furniture production are available in abundance in some parts of the country and with the good roads and railways that link the areas where the raw materials exist and the other parts of the country, a factory sited at a right position anywhere in the country is sure of raw material supply.

CHAPTER 1

RAW MATERIALS

1.10

AVAILABILITY OF RAW MATERIALS

Wood is one of the major components in furniture production. Unless wood of species suitable for furniture production is available at reasonable cost and also in adequate volume, production will not be possible. Nigeria's timber areas lie mostly in the southern part of the country known as Rain Forest Zone. These forest are part of Nigeria's natural resources, that is, they were not originally planted by anyone. To prevent extinction, these timber supplying areas are looked after by the Federal Forestry Department, it supervises commercial concessions and the afforestation of areas where logs have been extracted. For the proposed Himma Furniture Factory, supply of wood is expected to come from Bendel State.

1.11

TIMBER SPECIES IN NIGERIA

Today there are over fifty two species of timber on commercial scale in Nigeria, and out of this number, Seventeen species are suitable for furniture production. After careful screening and survey of the species readily available, the following have been suggested for use in the proposed factory. The species are:-

<u>TRADE NAME</u>	<u>BOTANICAL NAME</u>
African Walnut	Lowoa Trichiloides
Afrormosia	Afrormosia Olata
Agba	Gossweillerodendron Balsamiferum
Black Afara	Terminalia Ivoreasis
Canwood	Pterocarpus soyauxii
Cedunohop Mahogany	Entandrophragma Angolense
Iroko	Clitorophora excelsa

Mansonia	Mansonia Altissima
Opepe	Nauclei DiFerrichii
Sapele Magogany	Entandrophragma cylindricum
Mogogany Utile	Entandrophragma Utile

The African Timber and plywood company at Sapele, in B. ^Ndel State, produces and supplies all the sawn timber and plywood both for the need of furniture industry in the country and for the export market. The same company supplies most of the Nigerian timber species and it can supply the proposed factory with the required quantity, dimensions and in a well seasoned state, according to specifications.

1.20

ACE METAL

The other major component in the production of furniture is ace metal. Its availability is essential for the possibility of production. Like wood metal deposits in Nigeria are also found in the southern part of the country on commercial scale. Presently only ace metal or light metal is produced in the country. This type of metal is used for furniture manufacture and in making light containers such as water tanks, buckets and the like. Meanwhile, heavy metal is imported into the country. This type is used in the building industry as well as vehicle body building but when the Nigeria's steel complex at Ajaokuta starts operating around 1983, Nigeria will join the wagon of world's leading steel exporters.

George Kohen/Lagos one of the leading metal distributors in the country will supply the proposed factory through its branch office, Brossette, which is located at Kaduna.

1.21

ACE METAL TO BE USED

For furniture production only, few sections are required for frame work in addition to press metal for tops and some metal drawers for the office. The following will be required in the proposed factory:-

- i. Angle Iron
- ii. Steel pipes
- iii. Sq. pipes
- iv. Press metal

1.30

SECONDARY MATERIALS

In addition to Metal, Sawn timber plywood and Veneers, other important materials required for furniture production are:- Hardware, Adhesives, Finishing materials and Upholstery materials.

1.31

HARDWARE

The items under this category are:-

Handles, Knobs, Hinges, Pulls, Drawer Guides, Screws and Nails.

The above items are now locally manufactured in the country and could be purchased with ease from the local distributors. For the High quality furniture that the proposed factory will produce, only high quality specially designed handles and pulls will be purchased so that they will match the furniture produced.

1.32.

ADHESIVES

Adhesives are the materials used in bonding together two or more

pieces of wood or wood and other materials. An efficient adhesive is one that maintains an adequate bond between the wooden elements under the condition of exposure that the joints has to withstand. There are many well known substances which, when dissolved or melted and applied to wood, will, on drying or cooling or by chemical changes act as adhesives. Of such substances, the ones of Chief interest to furniture industry are the so called animal glues, vegetable glues casein, blood albumin and the resins of Urea and phenolic groups, which act according to definite chemical changes.

In addition to the qualities of adhesives enumerated above, other factors are also considered before choosing the adhesive. The factors include fast setting, colour and moderate moisture resistance. The following glues, having satisfied the above conditions, particularly for their special quality of non-staining of work will be recommended for use in the proposed factory:-

1. Animal glues
2. Synthetic polyvinyl Resins
3. Urea Resins
4. Contact Adhesives.

1.33

FINISHING MATERIALS

To achieve the desired variety of colours and textures, furniture manufacturers require a number of different types of finishing materials. There are fillers, to accommodate woods with different porosity; sealers to accommodate woods with different absorbencies, stains to achieve the final colouring with differing natural wood shading, and lacquars, varnishes, oils, and waxes to achieve a

wide range of gloss, texture and durability in the final finish.

Most of these are now manufactured in the country and regular supplies from dealers whose products attains the desired quality can be arranged.

1.40

UPHOLSTERY MATERIALS

The use of upholstery materials will be restricted to super executive chairs and desks, swivel chairs, arm chairs and chairs on semi-straight back.

Today, all the upholstery materials used in the furniture industry for quality production are manufactured in Nigeria. Fabrics such as cotton sheeting drill, baft shirting and twill will be made use of. Another locally produced cotton sheeting called "GWADO" will be used. This types of materials is presently used in local chair production that is used for lying down. It is very durable and can be produced in different patterns.

The foam rubber now readily available in the country will be made use of in the proposed factory.

CHAPTER 2

2.00 PLANNING OBJECTIVES.

2.10

OBJECTIVES

The facilittating of the manufacturing processes ranks high in the 1 list of layout objectives such objectives are:-

1. The planning is done in such away as to provide increased productivity efficiency and this increasing the manufacturing capacity of a given floor space;
2. The space allocated for machines, equipments and work areas are such that materials flow smoothly in as straightline as possible with a minimum back trackling
3. Spaces are economically and generously allocated to all functions so that there is enough room for trolleys to be conveying the materials for processing
4. The lines of travel are kept as short and direct as circumstances p permit.
5. The planning is done in a flexible manner so as to allow for extension of the production and storage section without hindering theoperation of the plant during construction.
6. Columns are generously spaced as far apart as economically possible in order to allow for free location of machines and also to ensure smooth transportation of materials.

2.20

MATERIALS AND MATERIAL HANDLING

For conversion of raw materials into finsihed product, the would-be

movement of either materials, man or machine. In most industrial processes it is the materials that move instead of man or machines.

The materials can be in any form - gaseous liquid or solid. Material handling has traditionally been broken down according to the various equipment classifications but recently an effort has been made to subject matter into functional activities. The materials handling handbook classified these functional areas as follows:-

1. Bulk handling
2. Unit handling
3. Industrial handling
4. Ware housing
5. Carrier handling
6. Handling operation analysis.

Material handling is a means of supporting and simplifying a manufacturing process. It is used to minimize cost, not just the local cost of handling. Improved working condition can be met by better material handling in the following ways:-

- i. provide safer working conditions
- ii. reduce workers fatigue
- iii. improve personnels confort
- iv. up-grade employees to productive work.

2.21

MATERIAL HANDING EQUIPMENT

The following basis have been suggested for classifying material handling equipments:-

1. CONVEYORS - all types of conveyors including Belt, Chain, Cable, roller screw, Pipeline and Vibrating
2. CRANES, ELEVATORS AND HOISTS - all types of cranes, elevators and hoists including fixed, travelling and portable cranes elevators, cable-ways, hoists, winches and auxilliary crane equipments
3. INDUSTRIAL VEHICLES - includes power trucks, hand-trucks, industrial tractors, trailers, industrial cars, and locomotives, bulk handling vehicles and other special vehicles.

Selection of handling equipments boils down to two types of problems viz:-

- i. Economic Problem
- ii. Technical Problem

Technical problems that generally arise call for knowing the following information about the handling systems under consideration:-

- i. floor space required
- ii. vertical height required
- iii. source of power for movement
- iv. path of movement
- v. direction of movement
- vi. form of material to be moved.

2.22

HANDLING EQUIPMENTS TO BE USED IN THE FACTORY

After careful consideration with regard to the above discussions, the following handling equipments have been suggested for use in the factory:-

(i) LIGHT DUTY CRANE

This machine lifts and lowers goods from one area to the other. It will be installed in the ace metal store where it will be used in off-loading and in positioning of the metal brought to the factory.

(ii) FORK LIFTS

This type of factory vehicle will be used in the timber yard for off-loading and also in stucking the timber in the yard as well as in the timber shade. Two such vehicles will be used in this while another one will be used in off-loading and conveying chemicals, paints and upholstery materials to the appropriate places.

(iii) TROLLEYS

It is my intention to use the available cheap labour around for conveying material from one stage of production to the other by using trolleys which will be manually instead of the usually used conveyor belts. This will help in cutting the initial cost as well as the running cost. Three will be used in the ace metal line, two in the wooden line while three will be used in the final processing hall.

2.30

THE DEPARTMENTS OF THE INDUSTRIAL COMPLEX

The industrial complex is made up of four different departments that are independent of one another but whose zoning and planning allow for smooth running of the complex. The departments are as follows:-

- i. production and storage department
- ii. administration department
- iii. welfare department
- iv. maintenance division

The functions of each of the various departments are analysed in the next chapter which deals with the analysis of the different sections of the industrial complex.

2.40

DETERMINATION OF THE PRODUCTION CAPACITY OF THE FACTORY

Various factors are responsible for the determination of the production capacity of a factory. Among other factors are the salary paid to the workers, incentives, the interest envisaged by the authority of the factory and also the factory design. Design wise, every effort is made through good zoning, generous and economical allocation of spaces and the positioning of different parts of the factory in the best possible way so as to provide an excellent relationship between one point of production and the other on one hand and between the departments on the other hand, all in effort to facilitate optimum production capacity.

The high demand for furniture of good quality in the state in particular and in the country in general needs not be emphasised. The right step at the right direction is the mass production of the best quality through mechanised method of production so as to meet the demand at a reasonable cost.

The number of schools and administrative set ups in the state to be primarily served by the factory is very large. For the factory to serve the state effectively, taking into account the competition that exists, it should be able to produce an average of 65 items a day, with an annual production average of about 20,000 items.

2.41

ITEMS TO BE MANUFACTURED IN THE FACTORY

From my investigation, the out-put/demand indicated that school furniture make-up of about 75% of the total calient demand. The factory will be expected to produce the school and office furniture in the ratio of 3.1 respectively. The items to be manufactured in the factory will be:-

ITEMS FOR SCHOOLS AND INSFITUTIONS OF HIGHER LEARNING

- i. Desks
- ii. Chairs
- iii. writing chairs
- iv. benches
- v. cushion chairs
- vi. dining tables
- vii. dining chairs
- viii. furniture for libraries
- ix. clothing lockers.

ITEMS FOR THE OFFICE

- (i) senior and junior executive desks
- (ii) clerks tables
- (iii) typist desks
- (iv) chairs
- (v) half and full sized cupboards
- (vi) 2,3 or 4 - drawer filing cabinets
- (vii) shelving systems
- (viii) cardex units
- (ix) map/plan cabinets
- (x) clothing lockers

Provision will also be made for the manufacture of Bedroom and living room furniture for the home on special request. The items to be produced are as follows:-

- (i) sofa-bed with continental headboard
- (ii) dressing table
- (iii) upholstery dressing stool
- (iv) 3 doors wardrobe
- (v) chest of drawers
- (vi) coffee tables
- (vii) upholstery arm chair

METHOD OF STARTING MATERIAL SUPPLY

The supply of starting materials to the factory will be by road. Although Zaria is linked to source of supply by railways, I favour supply by road due to the inconsistency of the rail service. Seasoned timber and ace metal enough to last three month will be supplied initially and it will be increased to last upto 6 months in future. Hence, the provision of enough ace metal store and an adequate timber yard in addition to a timber shade.

2.50

PROPOSAL ON THE RUNNING OF THE INDUSTRY

Although the project is a medium scale type, large sum of money has to be invested at the initial stage.

- (i) It involves the building of the industrial complex
- (ii) the purchase of the machinery
- (iii) the maintenance and management of the factory

Due to the magnitude of the project, the proposal for the running of the project is to be done by the Zaria Local Government, private individuals, the Industrial Development Bank and the Kaduna State Government. The proposal of their shares is as follows:-

(i) Zaria Local Government	-	40%
(ii) Kaduna State Government	-	25%
(iii) Private individuals	-	20%
(iv) Industrial Development Bank	-	15%

Ultimately, Zaria Local Government is expected to buy the shares of the Industrial Development Bank while private individuals buy that of the State Government. When the time is ripe the private individual could be the owners of the factory after buying the local government shares.

2.60

MARKET PROSPECTS FOR FINISHED PRODUCTS

With a sound processing technique that allows for mass production in addition to a highly improved machinery that ensures higher quality for furniture, the factory can therefore afford to reduce existing selling prices to the public and still be making gains through increased sales.

Distributing centres will be opened at Katsina, Funtua, Kaduna, Kafanchan and Zaria at the initial stage and later on similar but may be smaller centres will be opened at all the other local government headquarters in the state. When the need arises, such centres may be opened in some neighbouring states.

CHAPTER THREE

THE INDUSTRIAL COMPLEX

3.00

ANALYSIS OF DIFFERENT SECTIONS OF THE INDUSTRIAL COMPLEX

The proposed Himman Furniture Factory, Uaria, will have two separate production lines, one for wood and the other for the Ace Metal section. The two lines will meet at the semi-finished product storage area. From this point, production will continue as illustrated in the previous chapter. The initial separation of the two lines is necessitated by the fact that it will not be possible to have wood, which is highly flammable and metal whose welding produces sparks under the same roof. Doing that will raise the factory's fire risk while separating the two greatly lowers the fire risk.

3.10

THE TIMBER YARD

The timber yard is a large open place where the timber brought to the factory are stocked. The area is provided so that all the timber that the factory will require for use up to six months will be stored there so as to prevent cut in production due to delay in supply of timber. The area is spacious enough to allow for recording of species and dates of arriving. Stacking the timber outside may during the rainy season affect the seasoning of timber by aiding the addition of its moisture contents. To take care of this, a shade is also provided adjacent the open yard. This allows for air seasoning under the shade.

3.11

KILN

It is possible that by the time the wood will be needed in the covered store, the moisture contents of the timber is not suitably air-seasoned under the shade. In order to ensure a right moisture

content in the timber a small artificial Kiln is provided between the timber shade and the covered timber store. It is expected that all timbers arrive at the factory site satisfying the given specifications particularly with regards to regularity of supply of species, quality, limit of permissible defects, method of conversion and degree of seasoning - which should be 18 - 22 percent moisture content. To maintain standard output and quality of products and reduce wear to machinery, all timbers must be further Kiln - seasoned to a 15 - 12 percent moisture content.

3.20

RAW MATERIAL STORAGE

There are two raw material stores, one for the timber and the other for the ace metal. All are located just before the cutting machines so as to avoid waste of time in bringing the raw material to the cutting machines. This short coming is observed in most of the workshops as the storage of raw materials is done away from the processing hall. This shortcoming is eliminated this proposed factory.

A crane is provided in the ace metal store so as to ease off loading of trucks that bring raw material to the factory. Provision is made for trucks to off-load while inside the ace metal store since the crane moves only within.

3.30

THE PROCESSING HALLS

The processing halls house all the machines and equipments needed in processing the raw materials. The machinery layout in the processing halls strictly obey the production process. This is of vital importance as the layout plays an important roll in the output of the factory. This ensures that the workers spend most of the time working instead of moving up and down before they reach one stage of production. Tool boxes are also provided close to workers so as to facilitate production.

3.40

SEMI-FINISHED PRODUCT STORE

For a factory that produces different types of products and a large

quantity, it is ideal for such a factory to have a semi-finished parts store. As mass production is the aim of the factory, it is not possible for all the various parts processed in a day to be completed on the same day. This store will also serve as a bulk store for storing accessories such as hardwares, adhesives, finishing products (materials) and upholstery material, otherwise known as secondary materials.

3.5

VARNISHING HALL

This the area where semi-finished parts are either sprayed, painted or polished and also a provision is made for an area within the same hall where such parts are allowed to dry before proceeding to the next process of production. Also provision is made for simple storage of items that are needed in the hall for immediate use.

3.60

ASSEMBLY AREA

Various parts of the furniture are joined, glued, screwed or any of such aspects the need may be. It is in this area that the metal and the wooden part are assembled. The parts that moved to the upholstery area are also brought back to this area for assembling.

3.61

UPHOLSTRY AREA

Some of the items that are produced in the factory have to pass through this area for upholstery. Items such as executive chairs and tables that need be upholstered are treated here. Storage facilities are also made available here for immediate use while the bulk is in the semi-finished parts store.

3.62

PACKING, LEVELLING AND CONTROL AREA

Finished products are checked, levelled and packed here before taking them to the product store. As standard has to be maintained, it is the duty of this section to see that products attain high standard and they are done according to specification.

3.63

THE PRODUCT STORE

After passing through all the necessary processing, the lastly, the finished furniture arrives at the product store where it stays for a while. At this stage, the furniture is ready for use, so when customers bring their receipts of purchase, their supplies are given to them or the factory vehicles can load for onward delivery to the customers.

3.71

THE TECHNICAL AUXILIARY SECTION

Every factory, no matter how small, needs maintenance. It is however advisable to have maintenance division that can carry out simple service jobs. These are usually geared towards maintenance requirements that might be peculiar to that particular industry. For most factories maintenance workshops consists of metal works section, carpentry and electrical departments. These trades require mainly workshops that are peculiar to their particular practice, with necessary auxiliary fittings. Some factories might include a civil works department but this is rare.

In a furniture factory, only the metal works section is required to take care of the factory machines and also sharpen saw-teeth in case of wear.

3.71

SAWDUST SIRO

For the disposal of shavings and saw-dust, silo needs be installed. All the initial processing machines, the cutters, planers, thicknessers, routers and sanders are supplied complete with internal ducting system which suck away any shavings and dusts that follow during operations. The silo, otherwise known as extracting tower, houses the machinery that performs this sucking effect and gives the sucked-up materials the initial processing after which the materials re-appear distinctively as shavings and saw-dust.

This shavings and saw-dust is an essential raw material that can be put to some good use. Mixed with portland cement, woodwork slabs can be obtained. Unfortunately, there is no such factory around that could use it as such it could be sold to poultry ^{farmers} who use it. In future, it might be used as a component for a new source of manure as research to that effect is underway at the Agricultural Research Institute of Ahmadu Bello University, Zaria.

3.80

THE ADMINISTRATIVE BLOCK

This block houses all the sections of the establishment connected with the day-to-day running of the factory. This building serves as a link between the outside and the factory as such its positioning calls for taking great care to make sure that it can be easily be identified. This has been achieved in the design as it is made to be the only storey block and is located at the fore-front of the complex closer to the way of approaching the factory.

This block accomodates offices for keeping records of accounts,

production, all purchases and sales, advertisements and other important documents necessary for the efficient functioning of the factory. The entrance to the block, that is, customers entrance, is well treated to portray reception and this helps in identifying the block to an approaching customer.

3.81

SHOW ROOM

The administrative block also houses the show-room. It is positioned facing the parking space so that customers arriving on vehicles are made to pass it on their way to the reception. Those customers or visitors who may use other means of transport come into contact with the show-room while at the reception. This is of great importance for advertisement purposes.

3.82

PARKING SPACE

Parking spaces are apportioned to customers and a separate one for the administrative workers. The segregation of the two parking spaces was found to be appropriate as the customers are linked with the show-room.

A bicycle shade is also provided at a separate place nearer to the workers entrance because most of the factory worker will come to work either on motor-cycle or bicycle while the rest use commercial transport, which the factory will provide at subsidised rates.

3.90

THE COMMON FACILITIES

The modern industrialist now accepts the fact that to be able to reach the maximum output and maintain it, he has to incorporate in

his project a sound welfare programme to at least maintain if not promote the health of his staff. It is expected that the services of a medical Doctor will be made available to the need patients once a week. It is to be arranged that the medical Doctor will be in the factory clinic every Wednesday between 9 - 12.00 noon. Also incorporated in the medical programme is the services of two nurses and one dispenser throughout the working hours every day.

3.91

CANTEEN

In business time means money and incentives given to workers promote productivity. Considering the distance of the site from the town, there is a high need for designing a feeding area for the workers and it is expected that standard food will be sold to the workers at subsidised price. This will ensure that the workers could have a quick and cheap meal without leaving the factory complex.

3.92

CHANGING AND COMMON ROOMS

A common room attached to the changing room is provided where workers on shift who ^{carried} before their time is due could relax and wait for their turn. They can also use it during break. Workers who bring their break-fast or any other meal can take it their, in which case, they do not have to go to the canteen.

Lockers, showers, toilets and washing facilities are made available for the use of factory workers. The changing room is so placed such that is very close to the factory building so that factory workers can ease themselves without wasting time.

3.93

WORKERS ENTRANCE

A separate workers entrance and clocking is provided so that workers do not have to wait on the road i.e. by the gate-house and clock there. This is considered unfit for a modern factory design. The entrance is so provided such that a direct line of movement for the factory workers is achieved.

3.94.

GATE HOUSES

The gate-house in the factory, two in number, is so positioned as to allow a proper control of in-coming and out-going vehicles, staff and also the public.

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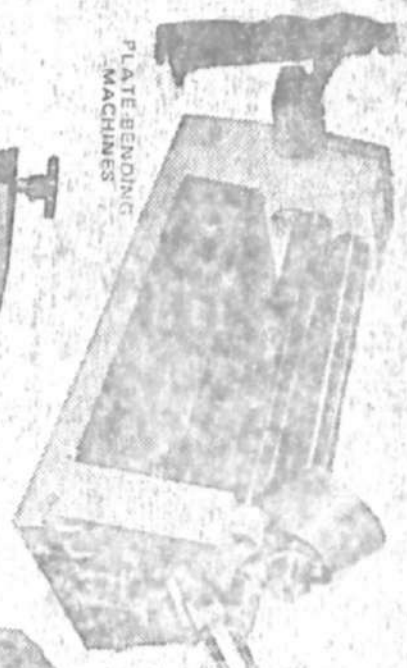
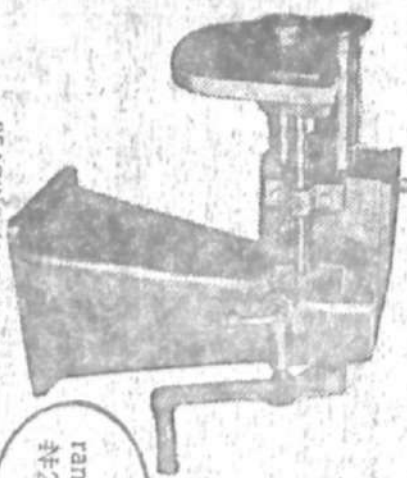


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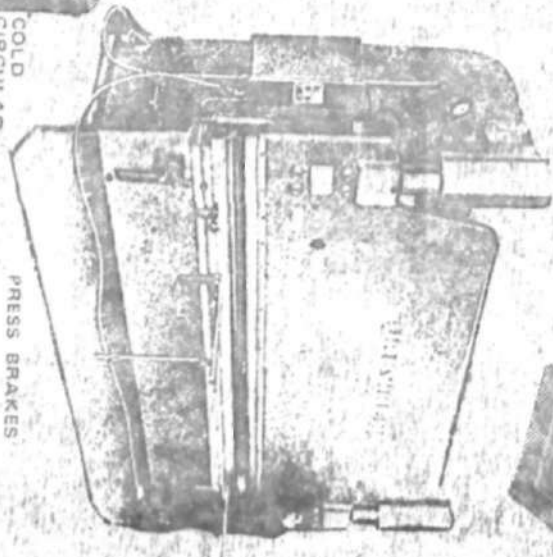
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CHAPTER FOUR

4.00 CONCEPTUAL ANALYSIS *

4.01

DESIGN CONCEPT

The site layout. The industrial complex is situated on a slightly slopy land which gives the factory section the advantage of using the difference of levels. To this end, the provision of loading for the finished products is not necessary. The workers from Zabi, Muchiya and other areas around will gain access to the factory through the road network ^{that} exist in the industrial area.

The planning of the site layout is influenced by the following concepts.

- (i) the grouping of the different sections in accordance with their functions
- (ii) the need to emphasize the interdependence of different sections.
- (iii) the intergration of different sections (which work together to keep the factory going) into a unified complex. The different sections are compactly integrated as much as functionally and safely possible.
- (iv) creation of interaction between the staff of different sections and departments of the complex.

4.02

CIRCULATION

There are two major circulations in the complex. These are:-

- (i) the vehicular movements
- (ii) the pedestrian movements.

The only other movement in the complex is that of fork lifts that operates within the timber yard. In planning the circulation, the following are achieved:-

- (i) reduction of the working distances between different parts of the complex as much as possible with due consideration to the functions of these sections. The major walk-away which links the worker

entrance hall and the production area is provided with covered walkway to protect the workers from sun and rain.

ii. Segregation of the pedestrian movements from that of the vehicular, one, and also that of the movements of workers and customers where separate entrances are provided. These two achievements are necessary for the safety of pedestrians and the decongestion of the entrance hall.

iii. two separate gates are provided for the intake of raw materials which is considered as a dirt gate and the other a clean one where products are taken out. The latter also serves as the workers and customers access to the complex. The two gates are linked with an internal road which provides access in case of eventualities.

4.03

STRUCTURE

The factory section is the largest block. Due to involvements of machines with heavy vibrations and movements of men and processing materials, wider spacing of columns was found to be most suitable. Therefore, a structural grid of 12m centre to centre is chosen for column spacing. The columns, beams and the folded plates for the roof are all precast elements. Prefabrication aids speedy erection with less labour force than in situ construction. None load bearing walls are provided in the starting material store and the product store. The other areas of the factory section have curtain wall up to two metre high from the floor followed by complete glazing throughout up to four and a half metres from the floor and finally a cladding wall complete the external walling system.

The determination of any particular structural system for the factory building as enumerated above is chosen in connection with the following factors:-

- i. flexibility in planning as regards to extensions and alterations;
- ii. the nature of work handled in the building
- iii. good economy
- iv. general aesthetics of the building.

4.04

WALLS

For partition inside the factory wardrobes with sliding doors are provided for storing tools and other items like the upholstery materials for easy reach in order to facilitate the production works. Sandcrete blocks are used and the height is about two metres, just below the window level. The wardrobes are not provided everywhere in the processing hall but only where they are necessary.

4.10

SERVICE DUCTS

Service ducts are provided in the timber processing hall where all the machines in this area are provided with ducts that suck away the shavings of the wood. This ensures not only a clean production process but also a healthy working place for the workers. With the use of such machines the factory will be a pollution free factory. All the shavings will be sucked down to the ducts that are located under the floor of the production hall. The shavings could be sucked not only by deducting under the floor but also through the roof. Ducting under the floor is prepared to that through the roof because the difference of levels on the site will be made use of.

4.20

LIGHTING

Good factory lighting facilities facilitates work without straining. As many windows as possible are provided in this factory. The importance attached to lightening is evident in the design as up to about one-third of the external wall of the factory is glazed. In addition to this artificial lightening in form of flourescent lighting will be used in case it is needed on days the weather is dark. The orientation of the buildings is in North-south direction. This orientation will help eliminate glaring effect of the sun as much as possible without using sun shading devices.

4.30

VENTILATION

Cross ventilation is provided throughout the factory complex. The adoption of folded plates for roofing system in the production halls in addition to the limitless openings provided enhanced both ventilation and lightening. Artificial ^{ventilation} is not considered necessary in the production halls and other areas except in the administrative block where air conditioners will be provided.

4.40

FLEXIBILITY - Extensions and Alterations

In the factory designs, the word flexibility brings a lot of confusion. Flexibility does not, for instance, mean that the factory manager will one morning decide to turn the processing hall into a show-room or visa-versa. Should that happen, the architect would have failed his propotion for this will indicate that enough thought was not given at initial stage, to specific functions of the required accomoda-tions atleast to stop the said manager from reversing an already working

process.

However, in this project, flexible means "adaptable to new conditions" It is a fact that the products from this factory are to be type of standard for particular items, and it is also an open secret that in the furniture industry only the fittest survive. It is of paramount importance that the financier must be alert to the fashion and tastes of the day - in the light of new techniques of production and modern way of advertisement. Spaces for extension has been provided.

4.50

FIRE RESISTANCE

Steel is more susceptible to fire than concrete. This accounts for the use of concrete columns and beams, and of sandcrete blocks which will offer effective and long resistance to the out-break of fire. Unlike oil refinery, the risk of fire hazard in the Zaria factory is very low for the following reasons:-

- (i) All the shavings and saw-duct are sucked away to an extraction tower where they are processed and sold to customers
- (ii) All employees are warned not to throw lighted cigarette heads or other naked lights into those areas where dried timber, veneer and combustible chemicals are stocked, while the factory workers are prohibited from smoking in the factory areas. Smokes will be allowed some few minutes to go to their common room to smoke which is situated very close to the factory.

4.51

OTHER MEANS OF FIRE RESISTANCE

It is also necessary to provide fire fighting equipment and such equipment as would automatically become active as a direct result of temperature rise. These measures may be summarised as follows:-

- (i) sprinkler systems, fire hydrants and fire extinguishers should be made available;
- (ii) electrical lines and equipments should be surrounded in their adjacent quarters by incombustible materials.
- (iii) Good factory house keeping
- (iv) Provision of direct link to the Zaria Fire Service station.

CHAPTER FOUR

5.00 SITE CONSIDERATION

278993



LOCATION

Industries however, small they may be if not located at a well planned area within the master plan, will lead to urban decay, the disease that turned most advanced countries into hot beds of violence delapidation, overcrowding and very soon people will move to leave desolate areas. After taking care of this unhealthy situation, other factors that influence selection of a site for locating an industry are looked into. Some of those factors include:-

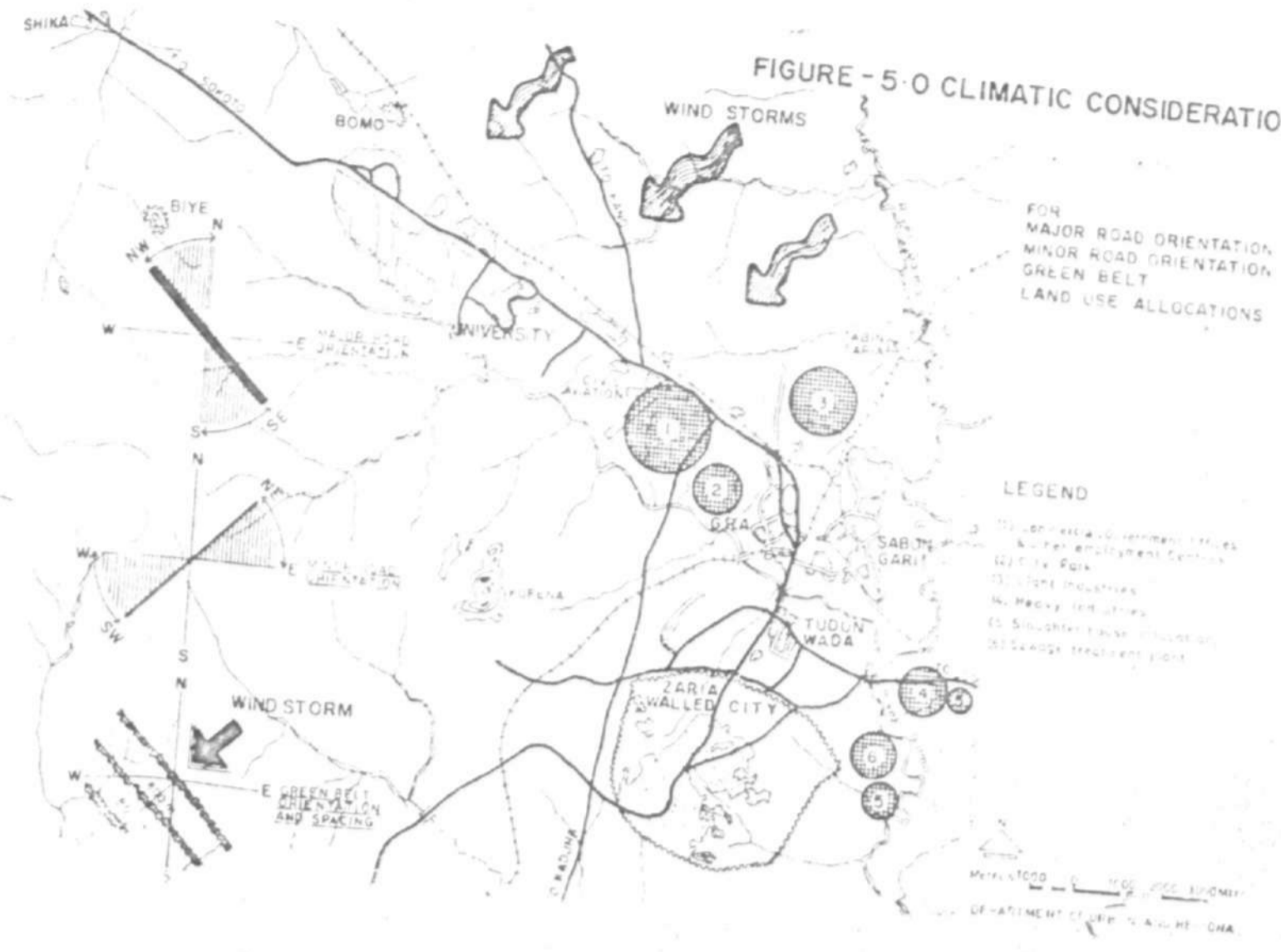
- (i) proximity to source of raw material
- (ii) availability of suitable land with required acreage
- (iii) availability of good road and other access facilities
- (iv) availability of necessary industrial services and required labour
- (v) amiable climatic conditions

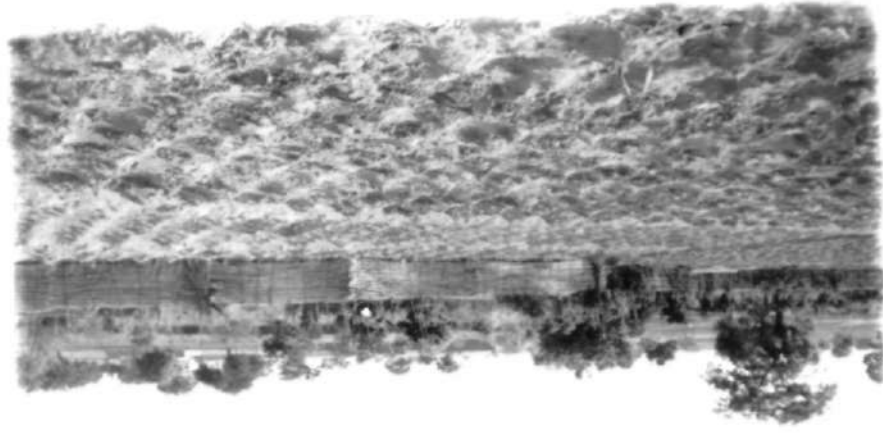
The site of the proposed factory is located in the proposed Zaria Light Industrial Area as planned in the Land-use map of Zaria township. This area housed similar light industries such as the Zaria Oil Mills, Cadbury and the A.J. Seward. The area is suitable for siting such an industry since there will be conformity to the other kinds of industries around it as they pose less problems of industrial waste hazards in that their waste can easily be disposed of. The position of Zaria offers an advantage as it is about the heart of the major traffic arteries that link the major Northern states towns such as Kano, Katsina, Sokoto, Jos and Kaduna. This means that distribution of the finished products will be easy and this will ensure quick delivery.

FIGURE - 5.0 CLIMATIC CONSIDERATIONS

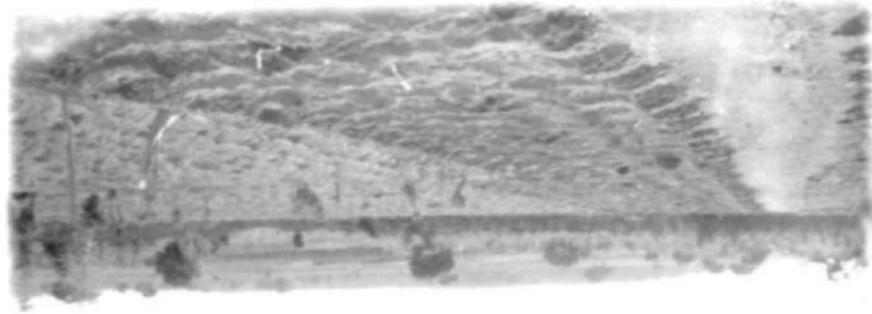


FIGURE - 5.0 CLIMATIC CONSIDERATIONS





THE SITE: Bounded by a small stream on the North, the access road on the South and other plots on the Western and Eastern sides.

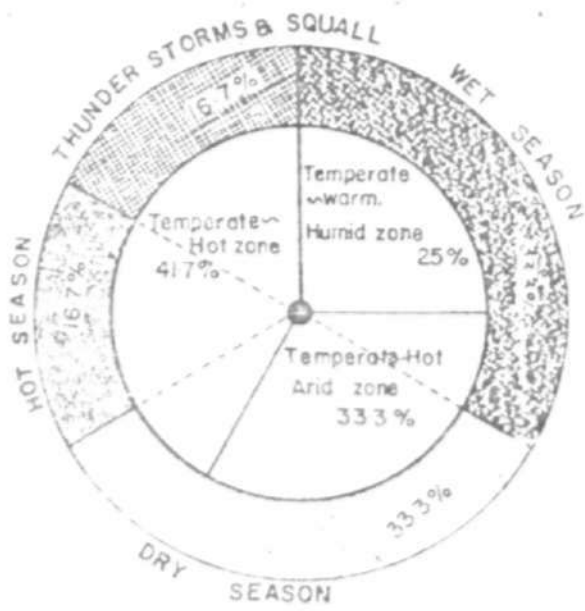


SITE CLIMATE

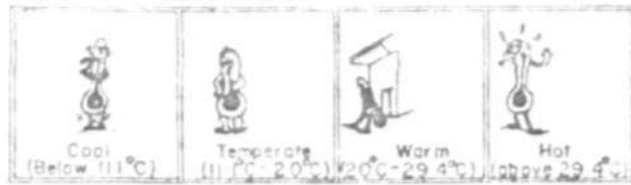
The climatic conditions of Zaria provide an amiable working conditions for most part of the year if not throughout the year. Basically, the climatic conditions of Zaria fall into the following four seasons:-

- (i) Dry season (winter and harmattan period) November to February
- (ii) Hot season - March to April
- (iii) Thunder storms and squals - May to June
- (iv) Rainy season - July to October

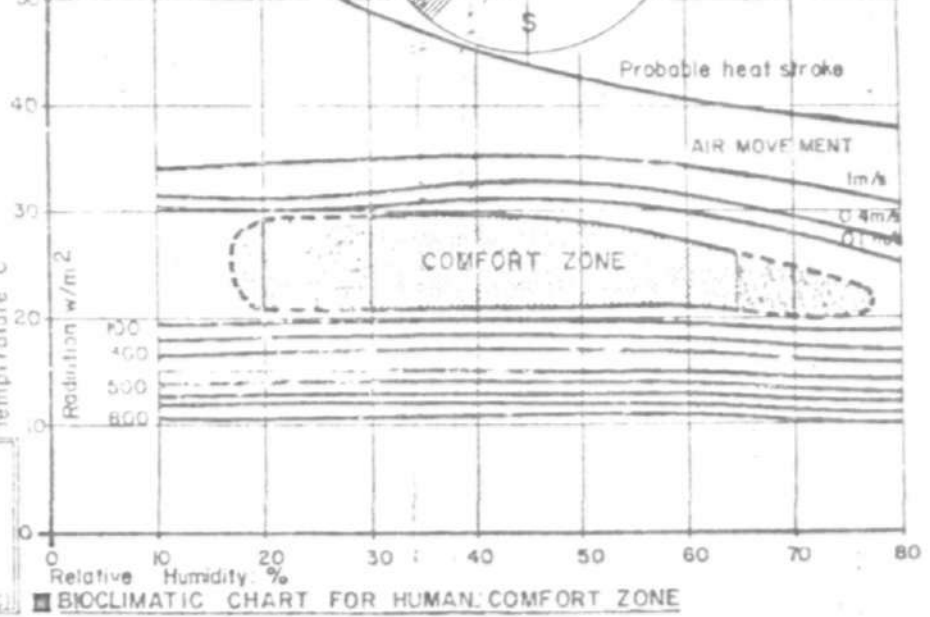
The charts below shows a tabulation of the various characteristics of the climatic conditions throughout the year.



ANNUAL AVERAGE CLIMATIC CONDITIONS & CORRESPONDING SEASONS AT SAMARU



PREVAILING WIND DIRECTION & AVERAGE WIND SPEED, AT SAMARU



5.20

SITE ANALYSIS

Various factors have contributed to the choice of the site. Beside the suitable climatic conditions already referred to in the discussion above, there are also specific considerations that apply to this site in particular.

5.21

VIEWS AND VISTAS

The site has high potentials of good views with excellent vistas at least in three major directions which if fully utilized will not only provide the viable working environment for the workers but also a beautiful scenery for people to walk around. This will be of particular importance for commercial and advertisement purposes.

5.30

SERVICES

This area is dominated by some industries as such most of the services meant for industrial use are already existing. To this end services like power supply, railsiding, access road, water and telephone services can easily be tapped or improved for the use of the proposed factory.

The site has slope of about 4% which can serve as natural drainage. Coupled with the advantage of a small stream which now serves as a main drainage for the existing factories as well as waste disposal point.

5.40

ACCESSIBILITY

Access to the site has already been developed leading to the adjacent industries and to the small village over the banks of the stream. Moreover, the factory is sited close to the major access road to the industrial area so that it is clearly located and is straight forward for easy location. Another important aspect of the site is the fact that a good linkage could be made as already proposed in the new Land Use map to the new Kane road thereby making it easier to connect to any other part of the country for distribution of goods to customers. Rail services are also very well developed for any goods transportation.

5.50

SITE IMPROVEMENT

Although the site sounds perfect it has its short-comings and special attention was given to such areas.

Pedestrian movements - Pedestrian access needs he developed as presently no separated pedestrian walk ways exist rather, the vehicular access also serves as the pedestrian access. It is therefore necessary that a provision is made for the safety of the pedestrians. Along with this problems is that of access by lined buses and taxis. I have therefore proposed a bus stop to cater for the taxis and buses that will convey some of the factory workers.

CHAPTER SIX

6.00 GENERAL

SCHEDULE OF ACCOMMODATION

ACCOMMODATION	AREA REQUIRED M2
(1)	(2)
<u>INITIAL PROCESSING</u>	
<u>WOOD PRODUCTION</u>	
Open Timber Yard	2304.0
Covered Timber Shade	468.0
Timber Kiln	108.0
Timber Plywood and Veneers Store	288.0
Marking Out	36.0
Sawdust Silo	36.0
Processing Hall	756.0
Tools Storage	50.0
<u>METAL PRODUCTION</u>	
Acc Metal Store	432.0
Sizing and Straightening	108.0
Processing Hall	900.0
Workers' Passage	106.0
Smoking Room	18.0
Foremens Offices	24.0
Semi-Finished Products Store	335.0
Sub-Total	5,968.0

1	2
<u>FINAL PROCESSING HALL</u>	
Painting Area	46.0
Spraying Booth	46.0
Polishing Area	46.0
Drying Area	198.0
Assembly of Metal and Wooden parts	216.0
Upholstery Area	162.0
Control, Levelling and Packing Area	162.0
Product Store	324.0
Maintenance Division	<u>288.0</u>
	7,456.00
<u>TOTAL AREA OF PRODUCTION SECTION</u>	
<u>SOCIAL FACILITIES</u>	
<u>CLOACKING ROOM</u>	
Toilets (including duct)	67.0
Showers	53.0
Changing Room	143.0
Common Room	71.0
Covered Walkways	218.0
	<u>5,52.0</u>
Sub-Total	

1	2
SEWER	
Veranda	27.0
Store	19.0
Cold Store	8.0
Cooking Area and Store	100.0
Outdoor Cooking Area	25.0
Males Changing Room	18.0
Females Changing Room	19.0
Showers	12.0
Toilets	12.0
Piling Area	200.0
PLUMBING DIVISION	
Waiting Card Room	8.0
Doctor/Infirmary Room	16.0
Examination Room	16.0
Treatment Room 2	8.0
Male Toilets	8.0
Female Toilets	8.0
Lobby	8.0
Sub-Total	512.0

1	2
<u>WORKERS' ENTRANCE</u>	
Reception	16.0
Clocking In and Out	28.0
Waiting Area	16.0
<hr/>	
<u>TOTAL AREA OF SOCIAL FACILITIES</u>	1,124
<hr/>	
<u>ADMINISTRATION SECTION</u>	
<u>GROUND FLOOR (Minus Welfare Division)</u>	
Main Entrance And Waiting	16.0
Reception (Telephone/Enquiries)	8.0
Show Room	56.0
Sales Office	24.0
Accounts Office plus Cashier	32.0
General Office	40.0
Technical Drawing Office	32.0
Stationery Store	24.0
Store	8.0
Stair Case (2)	24.0
Men's Toilets	12.0
Women's Toilets	8.0
Corridor	72.0
Sub-Total	356.0
<hr/>	

1	2
<u>FIRST FLOOR</u>	
Lobby	16.0
General Manager (plus Toilet)	32.0
Secretary and Waiting	16.0
Deputy General Manager	24.0
Secretary and Waiting	16.0
Production Manager	24.0
Sales Manager	24.0
Secretary and Waiting	16.0
Deputy Production Manager	24.0
Company Secretary/Accountant	24.0
Secretary and Waiting	16.0
Electrical and Mechanical Engineer	16.0
Conference Room	40.0
Coffee Room	8.0
Store	16.0
Utility Room	8.0
Males Toilet	12.0
Females Toilet	8.0
Corridor	80.0
	420.0
Sub-Total	420.0
TOTAL AREA OF ADMINISTRATION SECTION	776.0

1	2
<u>OTHERS</u>	
Generator House	35.0
Garages	108.0
Bicycle Shade	30.0
Customers Car Park	30.0
Workers Car Park	18.0
Sub-Total	222.0
TOTAL AREA OF OTHERS	222.0
<u>SUMMARY</u>	
Production Area	7,456.0
Special Facilities	1,124.0
Administration Section	776.0
Others	222.0
GRAND TOTAL	9,578.0

DESCRIPTION (A)	QUANTITY (B)
<u>TIMBER YARD</u>	
Fork Lift	2
<u>TIMBER KILN</u>	
Heater with Steam	
Pipes and Spray jets	1
Fan	1
Motor	1
Metro	1
6M wide Track	1
<u>WOOD PROCESSING HALL</u>	
Cross Cutting Machine	2
Circular Saw	4
Band Saw	4
Surface planner/Thicknesser	6
Knot Nail Drill	2
Planners	2
Milling Machine	2
Tononing -"-	2
Framing Press	2
Belt Sanders	2
Hot Plates	2
Vaneer Press	2
Capenters' Work Benches	6

A	B
<u>ICE METAL STORE</u>	
3-ton Cranes	1
<u>ACE METAL PROCESSING HALL</u>	
Power Saw	4
Hand Lever Shears	4
Pipe Benders	8
Electric Arc Welder	4
"- Spot -"	1
Mobile Acetylene Welder	1
Grinder	3
Vices	3
Power Drill	4
<u>VARNISHING SHOP</u>	
Spirit Varnishing equipment	2
Hand Spray Compressors	2
Polishing Tools	2
Painting Pit with Accessories	1
<u>ASSEMBLY OF METAL & WOODEN PART</u>	
Work Benches	20
<u>UPHOLSTERY HALL</u>	
Workbenches	5
Cutting Shears	5
Fatiguing Automat	3

A	B
<u>UPHOLSTERY HALL COMTD.</u>	
Riveting Gun	5
Plastic Foam Cutting/Welding equipment	1

A	B
Sewing Machines	4
Workbench with cloth setting press	1
<u>MAINTENANCE HALL</u>	
Bandsaw Brazing clamp	2
Knife Grinder	1
Saw Sharpener	1
Workbench	4
Tool Grinder	1
Knife loppine Machine	1
Machine for make items like screws, spindles, knots etc.	1
<u>OTHERS</u>	
Vehicles	6
Generator	1
Silo Sawdust	1
Water Tank	1

	DEPARTMENT	ESTIMATED LABOUR FORCE	PERCENTAGE
1.	Production	128	62%
2.	Administration	35	17%
3.	Maintenance	8	4%
4.	Welfare & Social Establish- ments	14	7%
5.	Others	10	5%
	Total	195	95%
	Safety Margine 5%	10	5%
	Grand Total	205	100%

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