A COMPARATIVE STUDY OF INDUSTRIAL AREAS IN NORTHERN NIGERlA
CASE STUDY OF KADUNA AND KANO

BY

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Dedication

This work is dedicated to the memory of (Alhaji) Dr. Ahmed Rufai Bukar, in whose untimely death we have lost a modest and devoted family elder.

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ABSTRACT

Industrialization has been regarded by many developing countries as a key towards rapid socio-economic development Many governments have thus bean persuing various policies aimed at promoting industrial development,, The policy instruments used include the provision of certain incentives and inducements. It also involved the establishment of industrial areas in some principal towns. These industrial areas **offer** improved land, utilities and services and the advantage of economies of scale to the clustering industries. In Nigeria, most of the existing manufacturing industries in our large urban centres have been established on industrial areas and estates. Some of the industrial areas have been planned with good designs, layout and have adopted high standards of roads, setbacks, site coverage and plot sizes others have not and are consequently faced with layout, design and environmental problems. The aim of this thesis therefore, is to study the existing design characteristics *of* industrial areas in Kaduna and Kano with a view to identifying principles and standards for industrial area planning

Data for this thesis was collected through the administration of questionnaires on industrialists and industrial employees. Information was also collected from assessment of layout plans of the industrial areas, town planning maps and. aerial photographs.

It has been discovered that the industrial areas in Kaduna and Kano have same good design attributes and some problems which will give a good basis for formulating principles and standards for the design and layout of industrial areas.

The good attributes of these industrial areas are

(i) All the industrial areas in Kaduna and Kano have location with respect to direct access to transportation networks roads and railway lines; availability of Utilities and services such as water, electricity and effluent dispersal points and site or topographic conditions.

(ii) modular approach to plot size and phasing of development have been adopted in most cases to provide flexibility to the layout.

(iii) There is a defined hierarchy of roads.

(iv) High standards have been adopted for road widths, setbacks, site coverage and plot sizes.

Despite these good attributes, the industrial areas have some shortcomings in layout and design, For example there is the lack of integrated pedestrian routes, vehicular and pedestrian traffic segregation and inadequate communal facilities. Others include the lac!'. of defined criteria and basis of grouping industries, poor visual quality due to lack of landscaping and the wasteful use of land.

Based on the analysis of the industrial areas some, principles and standards for industrial area planning were proposed. The standards have been proposed in the light of the existing situation and the present conditions and needs of the industries. Principles on location, design, layout and grouping of industrial units have been proposed. Standards have also been derived on those aspects for which

principles were derived. Standards were based on land requirements, intensity of development of land for particular industries and their scale of operation. Performance standards that is standards for measuring external nuisances produced by industries have also been proposed.

The application of the principles and standards proposed has been demonstrated in 1ayout of an industrial area in Kaduna.

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CHAPTER 1

INTRODUCTION

1.10 PROBLEM DEFINITION AND JUSTIFICATION

Industrialization brings about social and economic benefits to a city, a region or a nation. These benefits facilitate a rapid socio-economic development of any nation or part of it. As a result many governments in developing countries are persuing vigourously industrialization policies and programmes in order to promote a rapid socio-economic development. In Nigeria, the government is directing greater efforts towards encouraging and promoting the industrial sector of the economy. This has been considered necessary in order to diversify the economy and reduce the country's dependence on revenues from crude oil and exports of primary products. As a result of these efforts, many manufacturing and processing industries have come to be established in many of our urban centres. Most of these urban centres are thus experiencing a quick transition from traditional crafts to manufacturing and processing industries. Many cities in Nigeria, notably Lagos, Ibadan, Jos, Port Harcourt, Kano and Kaduna have become important centres of industrial activities.

It should be pointed out that the development of the industrial sector of the Nigerian economy started

late compared to housing and other public sectors. This late start could be attributed to the colonial economy at the pre-independence period when our urban centres were used as warehouses for exported agricultural products and imported manufactured goods. Large scale manufacturing in Nigeria, started in the southern part of the country, particularly in Lagos in the late 1940s, while industries in the Northern part of Nigeria were established in the late 1950s.

In order to accomodate industries coming to the urban centres and attract more in the future the Federal and the then Regional Governments established industrial areas in some major commercial and administrative centres. Many industrial areas and estates have been developed over the last thirty years in some cities in Northern Nigeria, and quite a number of them have been expanded in recent years. New industrial areas and estates have been established recently in most of the new State capitals of the Federation. These industrial areas provide industrial sites and services such as roads, railway siding, telephone services, water and electricity supply.

Modern industrial development in Nigeria, came after the construction of railways and the establishment planning and zoning regulations, as a result most of the industries were established on planned industrial zones. These industrial areas were located on the

fringes of the urban areas where huge tracts of land was always available and where locational factors such as rail-road access and the direction of the prevailing wind were considered. Nevertheless, the existing industrial areas in Nigeria have been associated with many environmental and other problems. These problems include:

(a) Pollution of water courses as untreated liquid and inorganic wastes are drained directly into streams and rivers which inturn become polluted.

(b) Air pollution and foul smell from stinking industrial effluents are experienced in areas adjacent to industrial areas of many Nigerian cities.

(c) There is in many cases, the lack of planned relationship between industrial and residential areas. This creates accomodation problems of employees within walking distance from home to work.

Other important problems highlighted by Vagale and Adekoya shows that existing industrial areas suffer from several shortcomings in design, layout and operation.[1] The following are the shortcomings.

(i) Most of the industrial layouts do not conform to the industrial subdivision regulations.

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1. Vagale, L.R. and Adekoya, O.C. (1974), p. 79.

(ii) There is no functional classification and grouping of industries on the basis of performance and nuisances.

(iii) There is the mixing of incompatible industries.

(iv) Winding roads, hard to use angular plots and poor drainage conditions.

(v) Low industrial densities and high costs of development resulting from the inefficient use of the industrial land.

(vi) Lack of facilities and services such as underground sewarage.

(vii) There is often no rational relationship between industrial, commercial and transportation landuses.

From the above problems, it is evident that planning principles and standards are required to guide the design and layout of industrial areas in future.

1.20 AIM AND OBJECTIVES

1.21 Aim: The aim of this thesis is to make a comparative study of the existing design characteristics of industrial areas in Kaduna and Kano with a view to identifying principles and standards for industrial area planning.

1.22 Objectives:

1. To review policies and principles of industrial area planning in general and in Nigeria in particular.

2. To select and define indicators for comparison of the design and layout characteristics of industrial areas in Kaduna and Kano.

3. To study industrial development in Kaduna and Kano and to compare the industrial areas of these cities based on (2) above.

4. To derive principles and standards for industrial area planning.

5. To design an industrial layout in Kaduna using the derived principles and standards in (4) above.

1.30 SCOPE AND LIMITATIONS

This study is concerned with the analysis of planned, manufacturing industrial landuse in Kaduna and Kano. Household/crafts industries and the informal industrial sector are excluded. Also, single industrial complexes and mixed industrial landuses are excluded from the study.

Since the study is limited to the location of industries within urban centres, regional theories of industrial location may be mentioned but will not be treated in detail.

1.40 THE BASIS OF THE SELECTION OF STUDY AREAS

Northern Nigeria with a vast land surface area and with about 53.5% of the total population of the country accounts 26% of the industrial employment and

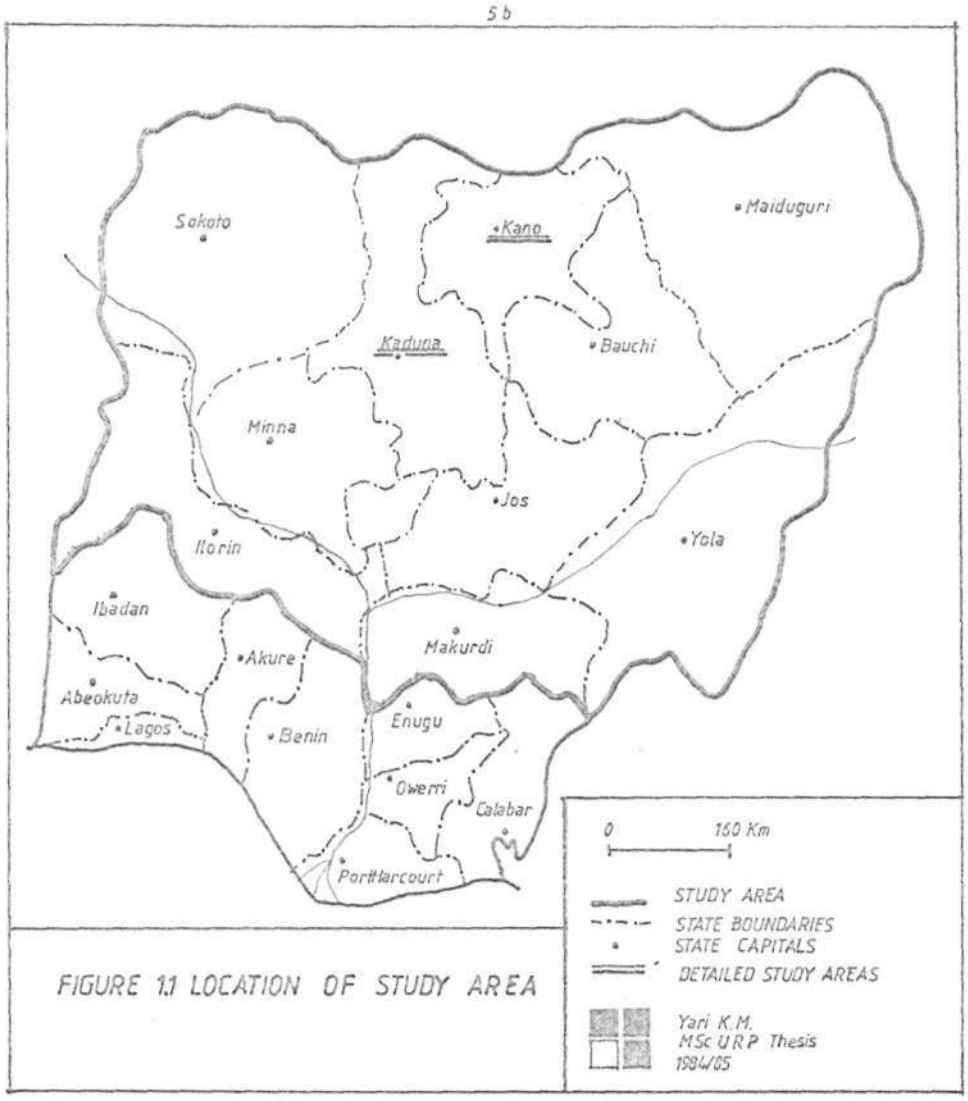


FIGURE 1.1 LOCATION OF STUDY AREA

27% of the Nigeria's industrial establishments. Its national share of the industrial output is only 20%[2]. This evidence shows that Northern Nigeria is lagging behind in industrial development. Despite this, some centres notably Kano, Kaduna, Zaria and Jos have emerged as centres of modern industrial activities. It is the Northern part of Nigeria that forms the basis of this study - See Fig. 1.0.

Kano and Kaduna have been selected for the study because they formed the most important part of the so-called industrial triangle in Northern Nigeria (Fig. 1.1). Kano is the largest industrial city in Northern Nigeria and is second to Lagos in Nigeria. In 1960, there were fourty-nine industrial establishments in Northern Nigeria, out of which thirty two or (62%) were located in Kano. The city has three well established industrial area accomodating about 200 manufacturing industrial establishments and covering about 495 hactres of land.

Kaduna is the second industrialized city in Northern Nigeria and the third in Nigeria. In 1965 there were about fourty-four industrial establishments in Kaduna employing about 9,217 people. There are two industrial areas in Kaduna covering over 800 hactres of land.

The selection of these two cities would give a general picture of the design principles and standards used in the layout of industrial areas in Northern

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2. Teriba, O. et. el (1981) p. 71.

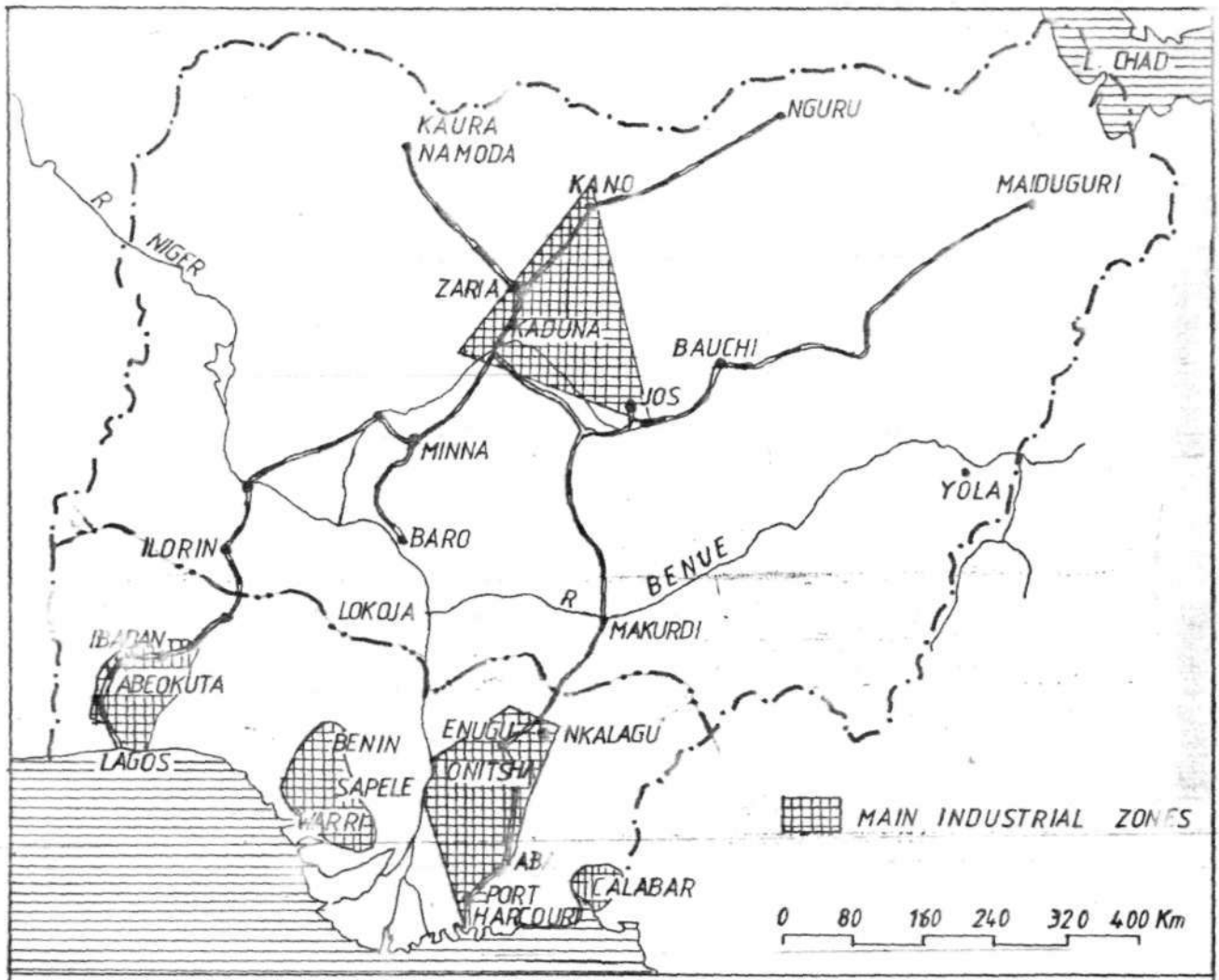


FIGURE 1.2 LOCATION OF INDUSTRIAL ZONES IN NIGERIA.

Source Ajaegbu H I (1976)

Yari K M
MSc URP Thesis
1984/85

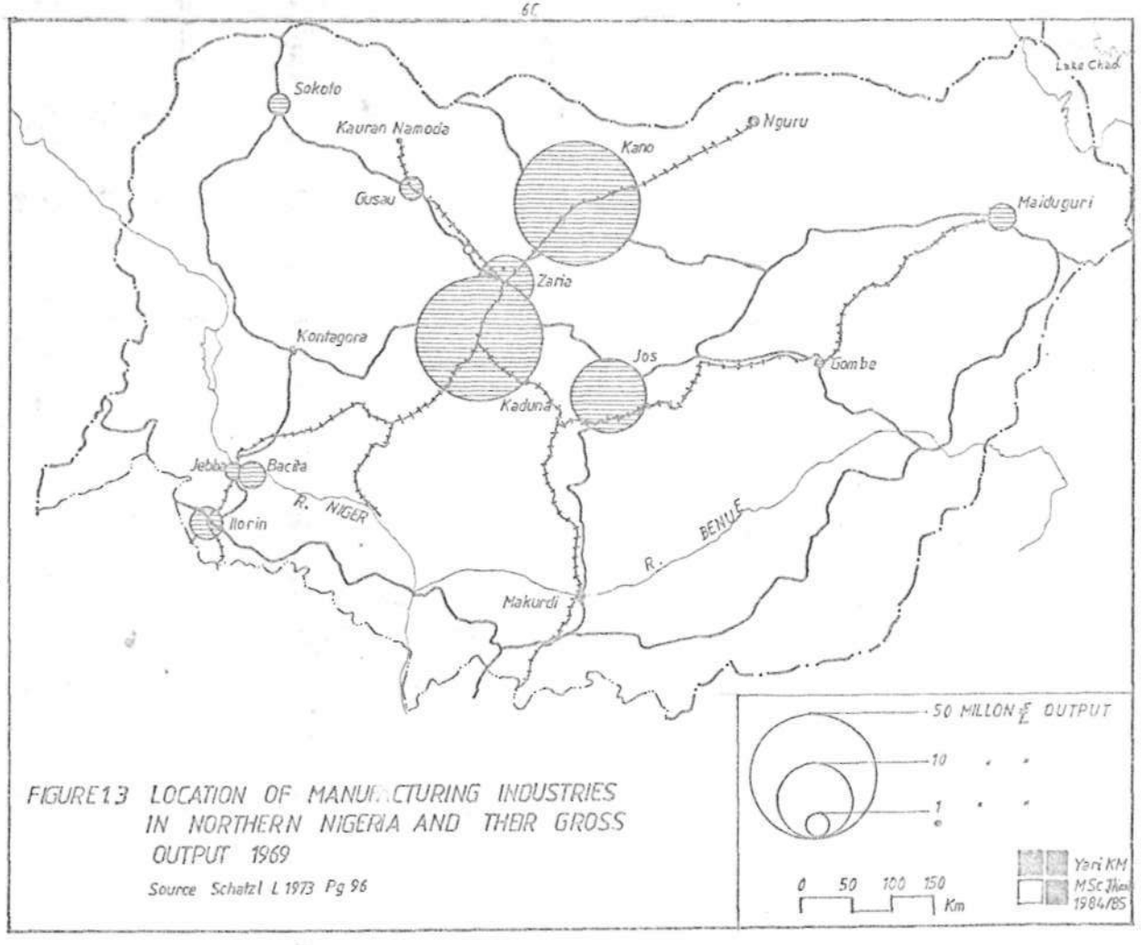


FIGURE 13 LOCATION OF MANUFACTURING INDUSTRIES IN NORTHERN NIGERIA AND THEIR GROSS OUTPUT 1969

Source Schatzl L 1973 Pg 96

(3)

Nigeria. Since the two cities have all been experiencing extensive industrial development resulting in the development of new industrial areas, it is assumed that the comparison would shed some light on the similarities and differences in the design of industrial areas in Northern Nigeria in particular and Nigeria in general.

1.50 RESEARCH METHODOLOGY

Methods of Data Collection

Data was collected through the administration of questionnaires in the field and also from secondary sources of information.

Three different questionnaires were prepared and administered. They include:

(i) a questionnaire for the industrial establishments,

(ii) industrial employees and

(iii) questionnaire for those living near or adjacent to the industrial areas.

Documents were collected from relevant ministries and agencies concerned with industrial development. The documents collected are:

(i) Existing landuse maps of Kaduna and Kano.

(ii) Town Planning maps at a scale of 1:2000 was collected from Kano Urban Development Board.

(iii) An ortho-aerial photograph at a scale of 1:2000 and flown in 1980 was collected from the Kaduna State Water Board.

(iv) Layout of all the industrial areas in Kaduna and Kano.

(v) Statistical and other infirmation were collected from ministries of Economic Development and that of Industries.

1.60 DEFINITION OF TERMS

Industry - An industry here refers to modern manufacturing or processing establishments, using modern advanced tools and techniques of production and management and producing "new" types of goods. These are distinguished from handicraft, artisan and cottage industries because the later depend to a large extent on traditional process, equipment and products.

Industrial Area - This refers to an area zoned and planned for industrial use. The land is provided with utilities and services such as water, electricity, sewers, roads, railway sidings and some other basic facilities. Industrialists are provided with plots of varying size and each industrial enterprise construct its own factory buildings and structures to suit its requirements. Industrial areas generally accomodate medium and large scale manufacturing concerns that have some capital for constructing factory building and for purchasing equipment.

Industrial Estate - This is a corporate development which provide standard factory accomodation to

industrial entreprenuers at an economic rate at rental basis or hire purchase system. In addition, common facilities provided on the estate are shared by its occupants e.g creche, canteen, dispensary, etc.

1.61 Classification of Industries: Industries may be classified into various categories for the purpose of planning.

(a) Classification of Industries by Industrial Process

This is one of the simplest methods of classification by which industries are classified as primary, secondary and tertiary.

Primary industry is concerned with the extraction of materials direct from the earth and do not involve the processing into finished product. Primary industries are raw materials oriented. Examples Agriculture, lumbering and quarry working.

Secondary industry - This is concerned with the processing or manufacturing of products. It involves the conversion of raw materials or the assembly of parts to form a finished or semi-finished products. Examples are textiles, metal engineering, vehicle assembly, etc. Secondary industries are the subject matter of this thesis.

Tertiary Industry - This consist of service and repair works. Tertiary industry covers a variety of enterprises such as printing and binding, repair industries and other specialized fields like banking and insurance.

(b) Classification by types of Products

In this classification industries are categorised on the basis of their products. This type of classification is accepted by the United Nations, the Federal and State Governments in Nigeria. On the basis of available and published statistical and factual information regarding industrial establishments this method when used with other methods could be very appropriate for planning.

A classification recommended by the Western State Manual of space standards will be adopted for this study. Industries in the study area will be classified as follows:

(i) Flour and Vegetable Oil Milling.

(ii) Beverage and Food Industry.

(iii) Timber and Furniture Industry.

(iv) Metal working and metal products industry.

(v) Plastic and Chemical Industry.

(vi) Textiles and Apparels Industry.

(vii) Clay, Ceramics and Building Materials Industry.

(viii) Electrical Engineering and Electrical Goods Industry.

(ix) Manufacture of Stationary and Paper Products.

(x) Automobile Assembly, Servicing and Repair Industry.

(xi) Tannaries, Leather and Leather Products.

(xii) Other Industries.

(c) Classification by Intensity of Landuse

Another approach to industrial classification is based on intensity of landuse. Some industries use land more intensively than others. The intensity of landuse here is measured interms of the number of people per gross hactre of factory land. Three sub-classes are commonly identified as follows:

(i) Intensive Industries: These are industries that employ about 125 or more industrial employees per gross hactre. Examples include Textiles and confectionary manufacture.

(ii) Intermediate Industries - These indusstries are those that are intermediate between the extensive and intensive industrial categories. They generally employ about 75 industrial employees per gross hactre.

(iii) Extensive Industries - These industries require a vast amount of land. They usually employ about 50 or less industrial employees per gross hactre. Examples are blast furnance, saw milling and grease manufacture. It should be noted that the recent trend is that of the development of extensive industries. This is as a result of the advances in technology and the level of automation in the modern industries.

(d) Classification of Industries by Environmental Effects: Most industrial plants produce various types of wastes, pollution and hazards. The type and extent of this depends upon the type and size of industry and the methods and processes involved. Industries can thus be classified on the basis of their hazards and nuisances. Hazards will include traffic, fire and explosion risks and nuisances will include noise, smells, waste products and smoke. The system of classification is largely based on tests of the degree of hazards and nuisance produced by an industry or its 'industrial performance.' Usually certain minimum acceptible standards are set for the production of nuisances and hazards. All industries that conform to the established stadards are regared as clean and harmoneous and those industries that do not conform to the minimum standards are regarded as obnoxious. A list of obnoxious industries in given in appendix 1. This classification gives a basis for determing the effects of industry on its neighbours within the industrial area and on neighbouring non industrial landuses. This classification is used in zoning industries to particular zones and classes within the industrial area.

This classification will be used in conjunction with classifications based on landuse intensity and types of products.

CHAPTER 2

BASIC POLICIES AND PRINCIPLES OF INDUSTRIAL AREA PLANNING

2.10 BASIC POLICIES OF INDUSTRIAL AREA PLANNING.

Most governments have been encouraging industrial development through various measures which include the provision of incentives to industrialists such as grants and tax reliefs. In most countries specific policies of industrial area planning have been adopted. These include fiscal measures as policy incentives for the location of industries at the regional level and legislative measures which include policies on standards and planning controls, byelaws and specific policies of permitting industries into the industrial areas.

2.11 Location Policies (Regional): In some developed and developing countries, industries tend to concentrate in a few urban centres. This leads to overcrowding of industries in these few areas and stagnation in the other disadvantaged areas. Regional location policy thus seeks to decentralise or disperse industries from overcrowded areas to under developed areas. Industries are thus encouraged through fiscal policies to locate in certain areas or to move away from over-concentrated areas. The most important instrument used in persuading industries include - fiscal incentives such as tax grants, rate reductions, tax reliefs and

the provision of government loans. Another important measure is the establishment of industrial areas/estates in the backward areas in order to attract industries.

Fiscal policy is currently being applied in Nigeria to encourage the dispersal of industries throughout the country. Special incentives such as differential land rent charges, industrial development income tax relief, pioneer status and custom draw back are given to industrialists. Land rents charged per hactre of industrial land vary between areas of differential industrial growth. The charges are lower in areas with little industrial growth. Industries that locate in remote areas of the country are granted an income tax relief usually for an initial period of five years.

Another important location policy is the use of industrial estates as tools of achieving the objective of balanced regional industrial development. Many developed and developing countries notably the United Kingdom, India, Italy and Brazil have utilized the establishment of industrial estates as tools for attracting industries to depressed or backward areas. These estates are usually located in regions with very low industrial growth. Inducements are given to industrialists to locate in these areas. This policy has recently been receiving attention in Nigeria. To achieve a rapid industrial development and a fair dispersal of industries, the Third National Development Plan

proposed an industrial estates programme. Under the programme, one model industrial estate/area was to be established in each State of the Federation. The sum of sixty million naira was earmarked for the projects by the Federal Government. The projects have not been implemented.

Another policy measure used in Nigeria is the provision of basic infrastructure facilities such as roads, railways, water, electricity and serviced industrial sites so as to attract industries to these areas.

2.12 Legislative Policies: At the city level the location policy is more of control rather than encouragement. Planning legislative policies of zoning, development control and bye-laws relating to standards are used. These measures are used in order to bring industries to locate where they can provide the greatest benefits or cause least environmental damage and also to create a safe working environment free from hazards and nuisances.

Zoning regulation is enacted inorder to create and encourage a healthy environment between landuses. It ensures that industrial areas are in harmony with other urban landuse zones. Zoning is also undertaken within the industrial areas to separate obnoxious industries from others. These regulations are enforced

through development control measures and the issuance of planning permits. Development control ensures that unauthorized development is regulated and approval has to be obtained for any extension of building, demolition or structural change of any factory. area.

2.13 Policies on Principles and Standards: Principles and standards have been established in many countries to guide in the designing and planning of industrial areas and estates. These standards are usually issued by government ministries, parastatals or government research institutions. For example in the United States, the National Industrial Zoning Committee issues guidelines on principles and standards for industrial area planning. In Nigeria, academic institutions with government authority and assistance have developed such guidelines and standards. The Polytechnic, Ibadan, prepared a manual of space standards for the use of Western State Government. This document/guideline is widely used in all parts of the country as a basis and guide for designing industrial layouts. The standards are also used for approving layout plans of individual factories.

Standards are meant to create an environment which is free from any health hazard and which conforms to acceptable standards of confort and efficiency necessary for the well being of members of the community. They are thus meant to create a confortable and safe environment free from hazards and nuisances.

Minimum acceptable standards are usually set by the planning authority and these are expected to be followed. The standards are applied to:

(i) the design and layout of the industrial areas. These relate to space, utilities, facilities and services.

(ii) The designing of factory plot layout and factory buildings.

(iii) Performance standards regarding the emission of measurable external nuisances such as noise, smoke, fumes, smells and waste products.

Adherence to these standards would provide a safe environment both for the employees and the adjacent landuses.

2.14 Admission Policy: This refers to the policy of industrial selection for industries wishing to establish factories on the industrial areas. Specific rules and regulations are drawn and used as pre-conditions for approving applications for the establishment of industries in the industrial area. These ensure that all industries admitted into the industrial area have satisfied performance and other standards of the industrial area development. The specific regulations and bye-laws established ensure that the original planning and aesthetic standards established in the industrial area are maintained. The regulations focus on refuse and effluent disposal, preservation of

natural landscape and nuisance control. Admission policy is more effective in the developed countries and is successfully applied by private industrial area/estate developers to check compliance to standards.

2.20 PRINCIPLES OF INDUSTRIAL AREA PLANNING

There are some basic principles that govern the planning of industrial areas. These principles are broadly categorised below as follows:

2.21 Locational Principles: Location of industrial areas within the city is considered from the following important aspects: accessibility, climatic considerations, site requirements, landuse considerations and the availability of utilities and services on or near the site.

(a) Accessibility: Good access is a primary requirement of industrial areas. Good links with the main transportation facilities including highways, major city roads, railways and other terminal facilities is very essential. Where it is possible, accessibility by water ways is desirable on account of low transportation cost. Highways or major city roads are important for easy products distribution, employee movement to work and an efficient linkage with other parts of the city and the region. The importance of railway service in the industrial areas is, however diminishing due to its inefficiency. Never-the-less, its availability provides an additional measure fo flexibility.

Air cargo transport is becoming very important to industrial developments particularly in areas where some of the raw materials especially the perishable ones are either imported or transported by air. In this case industries should be located near airports to reduce transport cost.

(b) Climatic Considerations: Industrial areas should be located considering wind direction and existing and future spatial extend of the city. They should always be located in the lee ward side of the city considering the prevailing wind directions to avoid blow back of pollutants into the city. This will help to reduce the incidence of industrial pollution in the city

Where an industrial area has to be located on a windward side of the city or other landuses, industrial areas must be separated from other developments by the use of a buffer zone in the form of green belt.

(c) Site Requirements: Industrial areas require a reasonably flat or very gently sloping land which cover extensive areas. The slope should not be more than 5% and should be capable of being graded without huge expense. In addition, the soil must have a high load bearing capacity and should be sufficiently stable to support heavy and vibrating machinery.

Industrial sites should also be well drained and naturally free from flooding. This calls for a

location at a safe distance from streams and away from flood plains.

(d) Utilities and Services: Industrial areas require an adequate supply of water, electricity power and sufficient waste removal facilities. Industrial areas should therefore be located on or near sites where adequate and regular supply of utilities and services are available.

Water supply for industry is a controlling factor in the location of industrial areas. It influences the location of industrial areas as well as determine the type of industrial activities that can be carried out. Industrial areas should therefore be located near high capacity water mains, rivers or lakes for easy supply. Other elements such as electricity power supply are also important because where that is not available near the site, it has to be provided at an additional cost.

(e) Landuse Considerations: Industrial areas should be located in convenient proximity to residential areas. This is important inorder to facilitate commuting of employees to their places of work. Industrial areas should also have a good locational relationship and efficient linkage with the city centre and other leisure or recreational areas of the city.

2.23 Principles of Layout and Design:

Internal circulation systems sufficient land must be allocated for the provision of roads. There must also be a defined hierarchy of roads of suitable width designed for the volume of traffic anticipated. The road junctions should be of 'T' form and junctions must be designed to permit easy manoeuver for trucks. Wide radius on curves is therefore necessary.

Where railway sidings are provided industries should be grouped together and be provided with it. Efforts should be made to reduce the number of level crossings.

An integrated system of footpaths should be provided within the industrial areas. Where possible, shade trees should be planted along the footpaths. As much as possible footpaths should be designed to provide short acts to bus stops and car parks.

Offstreet parking, loading and unloading facilities should be provided for all vehicles which come to the industrial establishment. Curb parking should not be allowed in an industrial area because that will cause traffic hazards and reduce the capacity of the roads.

Industrial factories, sites, should be provided with employee and visitors parking spaces on their plots. They should also be provided with loading and unloading facilities for delivery trucks.

Facilities and Serivces!

Facilities necessary for the mental and physical well-being of the industrial employees should be provided in the industrial area or estate. These include clinics, canteens, convenient shops, fire fighting facilities and post offices. It is more convinient and economical to provide these facilities on a communal or shared basis.

Flexible and Functional Design:

The design of an industrial area should be such that it is flexible, economical, functional and aesthetic. Industrial layout must be flexible to accomodate industries with different land and building requirements. Economy in design could be achieved by adopting a simple design and also by reducing the size of streets to minimum.

Functionality requires that all the elements within the industrial area should be well interconnected. The industrial area should be landscaped to evolve relieving environment for the workers.

CHAPTER 3

SELECTING AND DEFINING INDICATORS FOR COMPARISON

3.10 THE NEED FOR INDICATORS

In a comparative study, there is the need to establish certain guidelines or indicators to be used as a basis for comparison. This is necessary in order to have uniform and organised sequence of assessment.

3.20 THE INDICATORS

The following indicators have been selected to provide the basis for comparison of the design and layout of industrial areas in Kaduna and Kano.

3.21 Locational Characteristics: The physical location of industrial areas is one of the most important factors of significance in industrial area planning. Certain locational requirements have to be fulfilled for the industrial area to function efficiently and economically. The important elements to be considered are:

(i) Accessibility - Accessibility refers to the location of industrial areas in relation to transportation routes - roads, railways, seaport and water ways and airports. It is not the location of the industrial area near these routes that is important but the efficient linkage to them.

Industrial areas require direct access to commercial and transportation facilities to convey raw materials to the factories, distribute finished products to the urban and regional markets and also to facilitate easy movement of labour.

(ii) Site factors - These are concerned with the physical and topographic characteristics of industrial sites. Industries require a flat or very gently sloping well-drained land with high load-bearing capacity. This is necessary because factory areas cover large expense of land and use heavy and vibrating machinery. When sites with high slope values are used, they have to be graded at an additional cost.

(iii) Climatic Considerations - This refers to the location of industrial areas in relation to climatic factors particularly the direction of the prevailing wind. This is important because the city and neighbouring landuses have to be protected from industrial pollution such as smoke, odour, dust and noise. Industrial areas therefore need to be located with special regards to the direction of the prevailing wind so that wind borne industrial pollution can be kept at a minimum level.

(iv) Utilities and Services - Utilities and services are important to the industrial area for successful industrial activities. Adequate and reliable supply of water is needed for both human consumption and for industrial processes. The industry also need sufficient power supply to drive machinery.

Services add to the efficiency and management of industrial areas. For example good drainage is needed for the disposal of storm water and industrial effluents. Utilities and services as elements of location require that industrial areas be located at sites that are in close proximity to such necessities such as near water pipelines, rivers and reservoirs.

(v) Landuse Considerations - This refers to the location of industrial areas in relation to other landuses. Industrial areas need to be located in convenient proximity to residential areas to facilitate easy movement of industrial employees to work. There is also the need to locate industrial areas in relation to commercial areas of the city.

3.22 Types of Industries: This refers to the type of industry and the industrial process carried out in an industrial area. Industrial areas usually accomodate

a wide range of industrial activities each with different processes and space requirements. To satisfy land requirements and control landuse within industrial areas industries are classified into groups. The layout and design of industrial areas in Kaduna and Kano will be compared considering different types of industries in these places.

3.23 Landuse of Industrial Area

(i) Landuse Structure is concerned with the allocation of land to various categories of uses. In an industrial area the category of utilities, facilities and services. Land allocation to these uses depend on the types of industrial process carried out, the intensity of landuse by the industries and aesthetic considerations.

(ii) Landuse Intensity - This is concerned with the industrial density i.e number of employees per gross hactre of industrial activity. This will be used for the comparison.

3.24 Transportation Network: A good transportation is very essential for the efficient functioning of the industrial area. For all the elements in an industrial area to be functionally connected and integrated, a well designed network of roads, streets, parking spaces, loading and unloading facilities are required. When these are provided, easy movement of goods, services and people will be facilitated.

A good transportation network would enable individual factories to have a direct vehicular access to delivery and evacuation trucks, private vehicles of managerial staff and visitors. Railway siding may also be required by some heavy industties with bulky raw material and finished goods.

A comparative analysis of the application of the principles and standards used for the layout of transportation network i.e street pattern, road hierarchy, road width, layout of railway siding, pedestrian routes and parking facilities will be made.

3.25 Factory Plots: This refer to the layout of factory plots and the planning controls imposed on them. These include plot sizes, plot coverage and set-back lines. In this case certain standards are usually applied.

Planning controls are legislative instruments to guard orderly arrangement of industrial buildings on sites and to allow adequate space to accomodate on site parking, loading and unloading facilities and provide attractive landscaping within the factory. The standards used for these controls in the industrial areas will be studied.

3.26 Communal Facilities: These are some facilities provided in the industrial area for the mental and physical development of the industrial employees.

The type and number of facilities provided depends upon the size and population of the industrial area. Generally canteens, banks and fire services are provided in industrial areas. The study, will investigate the provision of communal facilities in the industrial areas of Kano and Kaduna.

3.37 Landscaping: This refers to the planting of trees and the provision of green areas within an industrial area. Landscaping gives an industrial area an attractive scenery, serves as buffer zone and also protect the environment from erosion. The landscaping of the strips between the street pavement and property lines is customary. Individual factories normally take care of landscaping their factory areas. An attempt will be made to make a comparative assessment of the types of landscaping in the industrial areas of Kaduna and Kano.

3.38 Grouping of Industrial Units: This refers to the basis of locating industries close to each other. This is important because undesirable neighbours may cause problems in the industrial areas. In planning, industries are grouped together so as to enhance economy of scale and increase efficiency. Industries with similar requirements are thus grouped together.

These indicators selected will be used in the next chapter to compare the industrial areas of Kaduna and Kano.

CHAPTER 4

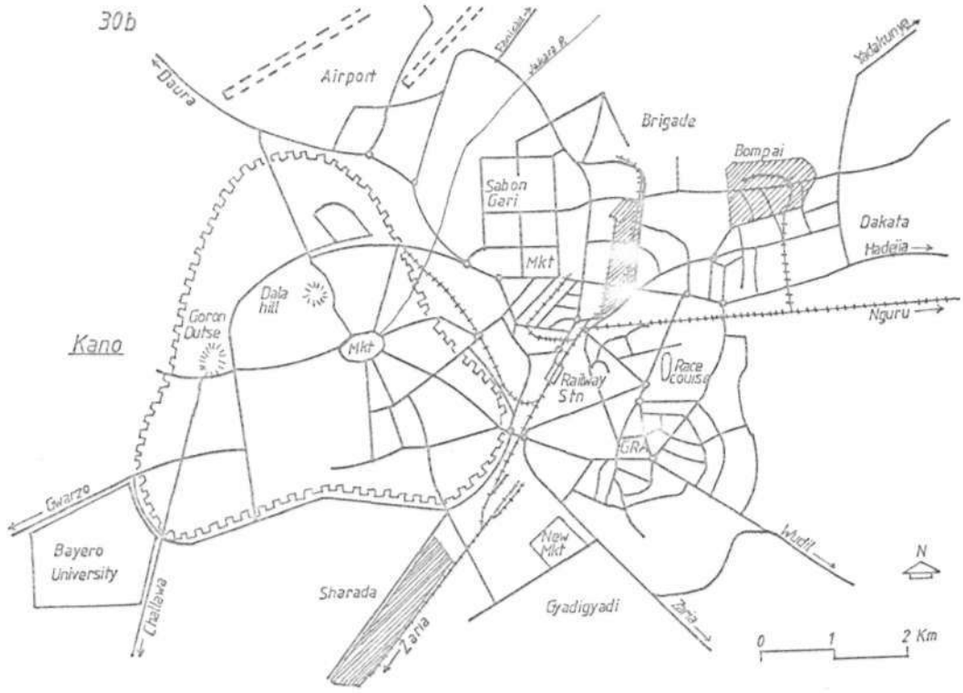
COMPARATIVE STUDY OF INDUSTRIAL AREAS IN KADUNA AND KANO

4.10 LOCATION

(a) Accessibility

Industrial areas in Kaduna are effectively served by rail and good road network (see Fig. 4.2). Kaduna South Industrial Area is served by both regional and township roads. These include Kachia Road, which lies on the eastern boundry of the industrial area and the western bye-pass which links the industrial area with many regional roads namely Lagos, Abuja and Kachia. These two important roads also link the industrial area with the city centre and other parts of the city. Kaduna South Industrial Area therefore enjoys a direct access to the regiona and the city. The industrial area is also accessible by the Kaduna-Lagos railway line.

Kudenda Industrial Area is adjoining a major highway - the western bye-pass. This gives the area a very easy accessibility especially to trucks conveying raw materials from Lagos. The industrial traffic doesn't have to pass through the city. All industrial areas in Kano have good road and rail access. However, the road access to Bompai industrial area is poor, routes from other parts of the city being indirect and all with numerous intersections and



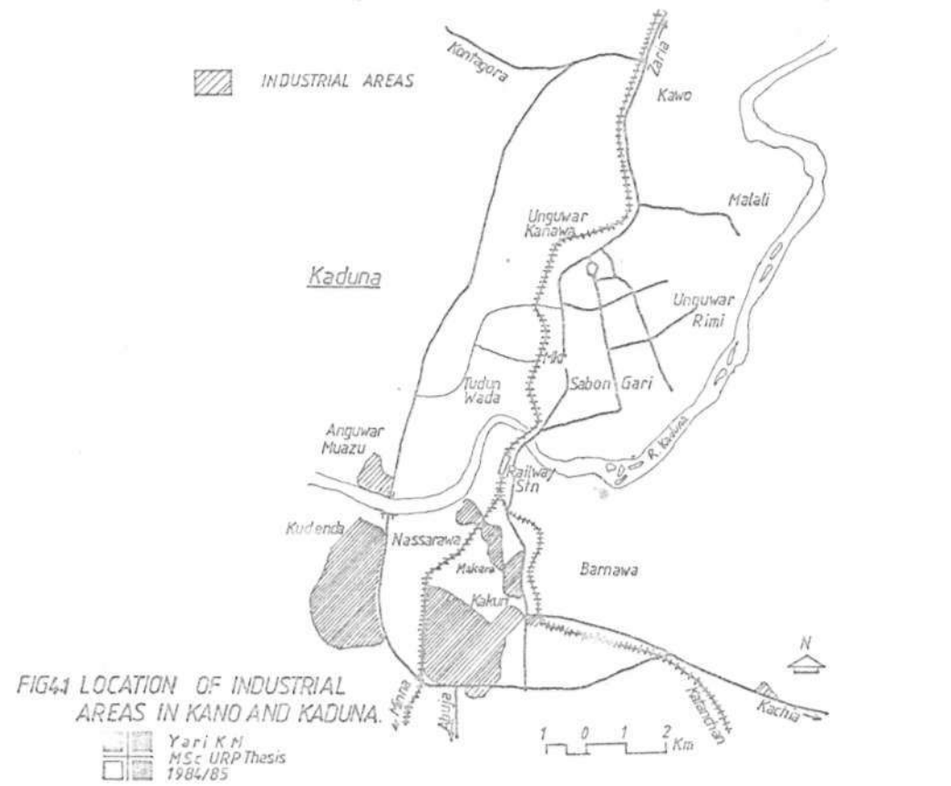


FIG41 LOCATION OF INDUSTRIAL AREAS IN KANO AND KADUNA.

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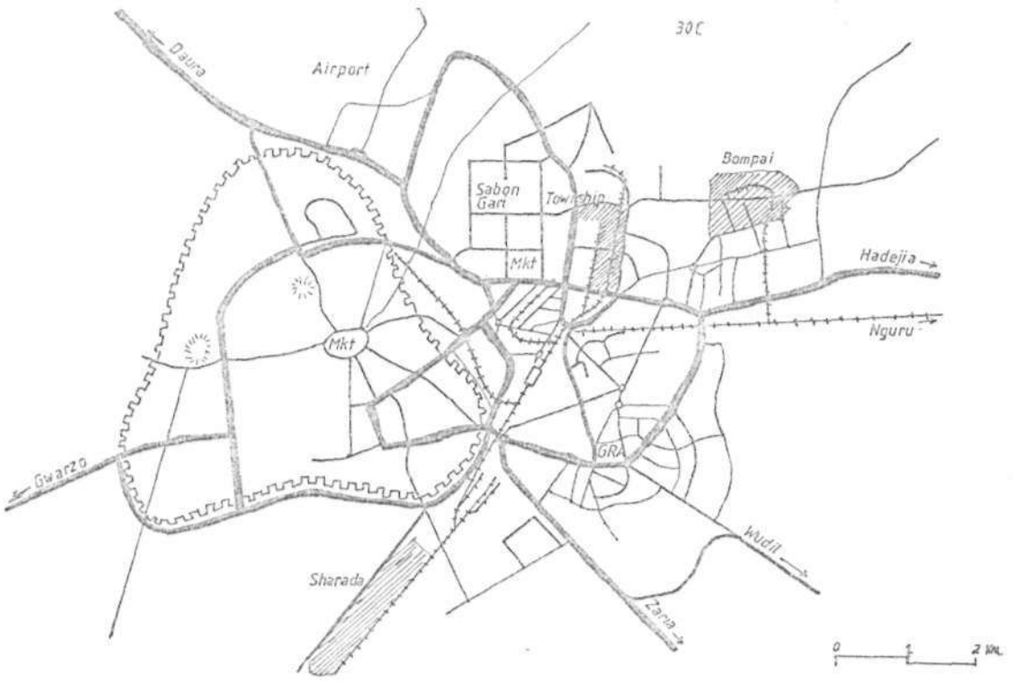


FIG 4.2 KANO: LOCATION OF INDUSTRIAL AREAS IN RELATION TO HIGHWAYS - AND RAILWAY LINES.

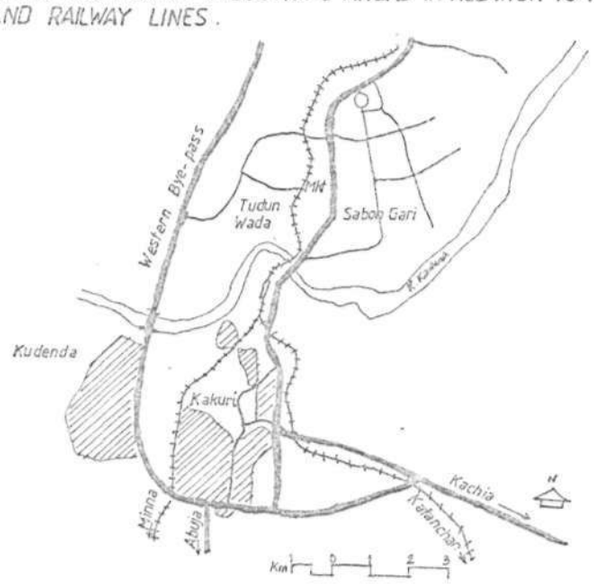


FIG 4.3

KADUNA: LOCATION OF INDUSTRIAL AREAS IN RELATION TO HIGHWAYS AND RAILWAY LINES

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outlets restricting free flow of industrial traffic (see Fig. 4.3). The township industrial area in Kano is located very near the city centre and to the east of Airport Road - an important city highway. Being located near the city centre the industrial area enjoys good accessibility offered by major city roads.

Sharada Industrial Area is located on the south western edge of Kano urban area, along Kano-Kaduna railway line. The area is served by a major road from Bayero University bye-pass which is an important highway. Plans are under way to link the industrial area with Challawa - a site of new industrial development. When this is achieved the area will have additional accessibility.

(b) Site Factors

Industrial areas in Kaduna are located on flat or very gently sloping and well drained sites. A stream with a fairly wide valley has however come up at the south western edge of the Kaduna south industrial area. This section is undulating and not suitable for industrial use. Kudenda industrial area in Kaduna has a fairly flat site but it is disected in the northern part by two stream valleys which are tributaries of Kaduna river.

All the industrial areas in Kano have a very flat or gently sloping topography. They are well drained. Sharada industrial area has a stream or valley

which separates the developments in phase I and II. The valley is a narrow one and does not very much affect the topogtaphy of the site.

(c) Climatic Considerations

An important climatic consideration is location of industrial areas in relation to prevailing wind direction and the city. There are two dorminant prevailing winds in Northern Nigeria - the north east winds and the south west winds. The north east dry wind blows from the West African interior towards the Southern Coast and the South-West winds are warm and humid blowing from the Atlantic towards the interior. The north-east wind is the predominant wind in Northern Nigeria blowing for about seven months of the year, that is, from October to March. Being dry and strong winds, the North East Trades can spread pollution easily. The south-west wind on the other hand blows for about five months of the year. This wind may cause acid rain if it carries alot of gaseous pollutants.

Industrial areas in Kaduna are located on the leeward side of the city with respect to the direction of the predominant prevailing wind (see Fig. 4.4). The city is therefore free from wind-blown industrial pollutants. However, some neighbouring landuses in Kaduna especially the workers residential settlements of Nassarawa and Makera, which lie between the industrial areas, suffer from wind borne industrial pollution.

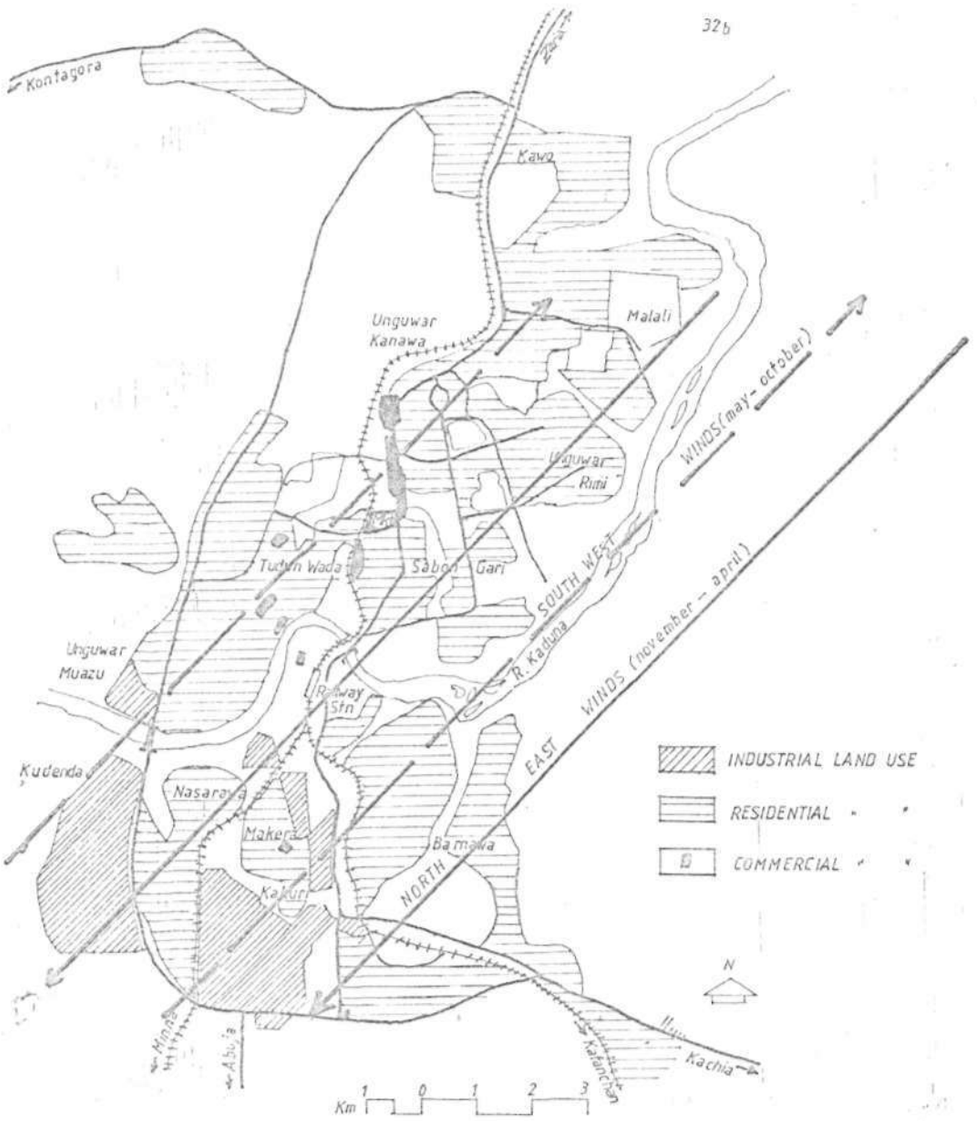


FIGURE 4.4 LOCATION OF INDUSTRIAL AREAS WITH REGARDS TO WIND DIRECTION IN KADUNA.

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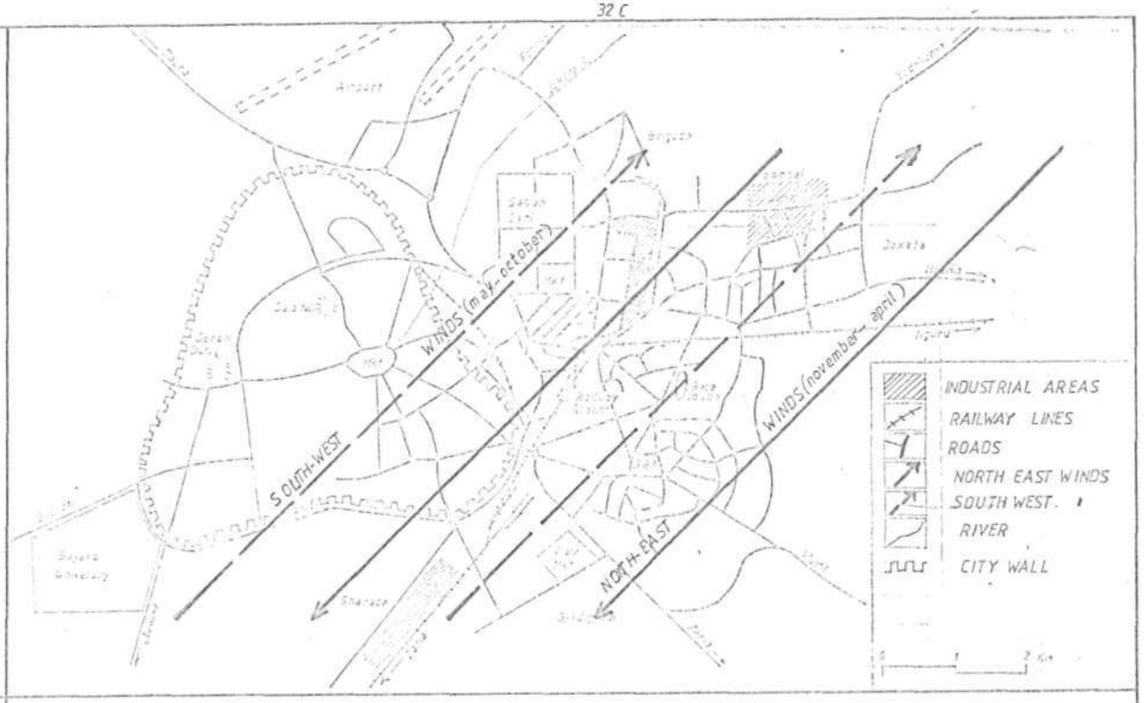


FIG4.5 LOCATION OF INDUSTRIAL AREAS WITH REGARDS TO WIND DIRECTION IN KANO

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It should be pointed out that Nassarawa village is an unplanned settlement and grew up spontaneously to provide the much needed accomodation for low income industrial workers who could sacrifice a decent and planned residential environment in order to save daily costs of transportation to and from work.

Fig. 4.5 gives the location of industrial areas in Kano in relation to the wind direction. It could be seen that Bompai and Township industrial areas have been poorly located with respect to the dominant prevailing wind direction. These industrial areas are located on the windward side of the city. The city centre and other parts of Kano are therefore prone to industrial pollution.

Sharada industrial area is, however, located on the leeward side of the city. This makes the city free from pullution from the industrial estate.

(d) Utilities and Services

The industrial area in Kaduna south is located both near the source of water supply, the Kaduna River and the water treatment works - Kaduna South Water Works (see Fig. 4.6). The area is also located near a high tension national eletric supply line and a power sub-station, availability of these essential utilities offer the site advantages of cost reduction or economy. It means the utilities could easily be extended to the site.

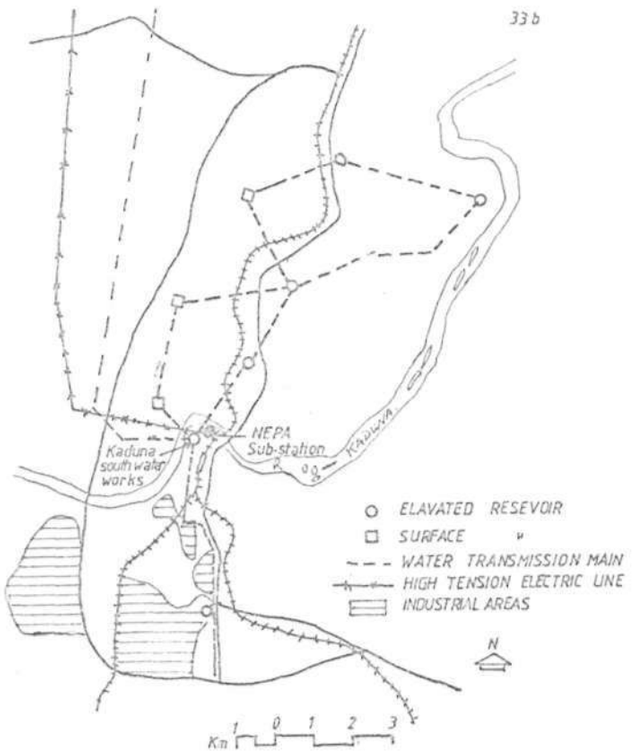


FIG 4.6 LOCATION OF INDUSTRIAL AREAS IN KADUNA AND UTILITY LINES
Source Field work 1984

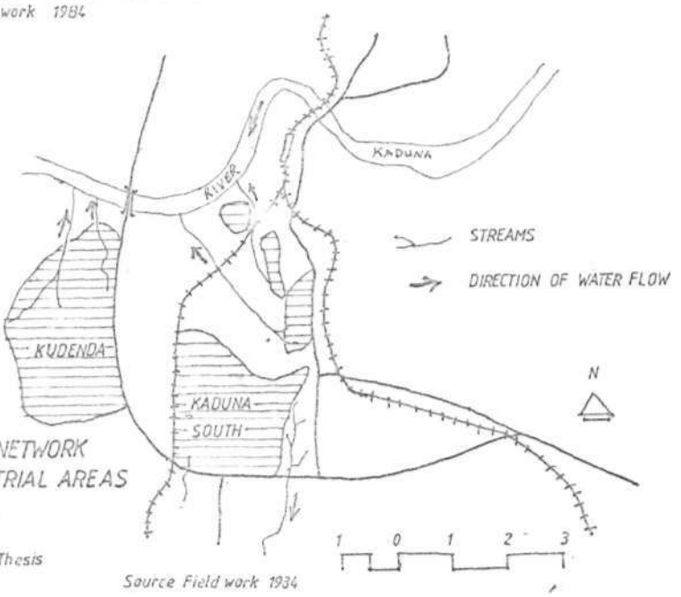


FIG 4.7 NATURAL DRAINAGE NETWORK FOR INDUSTRIAL AREAS IN KADUNA.

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Source Field work 1934

Proximity to Kaduna river also made it possible for some factories that consume large amount of water to make supplimentary provision. Industries presently using the river to suppliment their water supply include Nigeria Breweries Ltd., United Textiles Ltd., and the Federal Super-phosphate Fertilizer Company.

The Kaduna river and its tributary streams within the Kaduna South Industrial Area provide the area with good drainage network for the disposal of trade effluents and storm water (Fig. 4.7). Industrial waste water is thus easily disposed off through the river. It should be noted that the industrial area is located down stream of river Kaduna. This ensures that the city is not affected by river pollution.

Kudenda industrial area in Kaduna is located near the river too. This provides the area with advantages of water sources and effluent disposal. Presently a factory - Berec Nigeria Ltd, is solely dependent upon the river for its water supply. All the factories that produce effluents discharge them to the river. It has been observed that eventhough the two industrial areas in Kaduna are located near river Kaduna, they are all located at a safe distance i.e away from the river's floodplain.

The industrial areas in Kano have been located near high capacity water mains. The new industrial area at Challawa is located near the main water

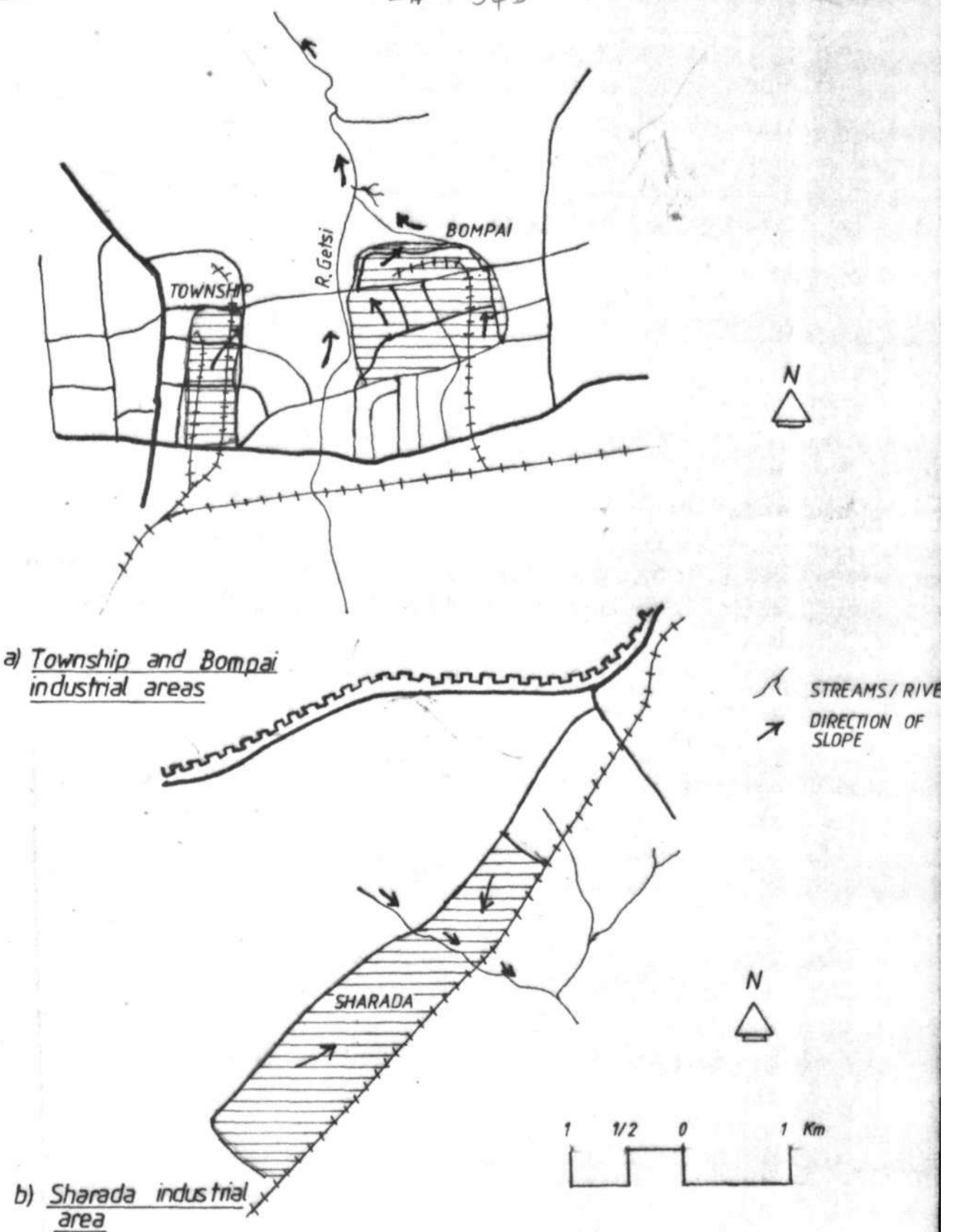


FIGURE 4.8 NATURAL DRAINAGE NETWORK FOR INDUSTRIAL AREAS IN KANO

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pipeline coming from the Challawa water works.

Bompai and Sharada industrial areas are located near some streams (see Fig. 4.8). These streams are used for disposing industrial effluents.

(e) Landuse Considerations

In Kaduna, the Kaduna south industrial area is bounded by residential areas of Kakuri, Makera and Nassarawa. Another important neighbouring area is Unguwar Television. These areas provide residential accommodation for about 80% of the low income industrial workers. The industrial area in Kaduna south is about seven kilometres from the city centre but lies close to some important recreational areas - such as the Local Government Park near Kaduna river and Ahmadu Bello Stadium.

Kudenda industrial area is located at the edge of the city but lies close to some residential areas of Nassarawa, Unguwar Muazu and Tudun Wada - which are located opposite the industrial area. The two industrial areas in Kaduna are located close to each other and are linked by an efficient transportation system (Fig. 4.9).

Bompai industrial area in Kano is also surrounded by industrial workers residential areas namely - Dakata, Tudun Wada (Brigade) and Gwagwarwa (see Fig. 4.10). Township industrial area is bounded by commercial landuse by the west and by police barracks in the east. This police barracks is the development that separates

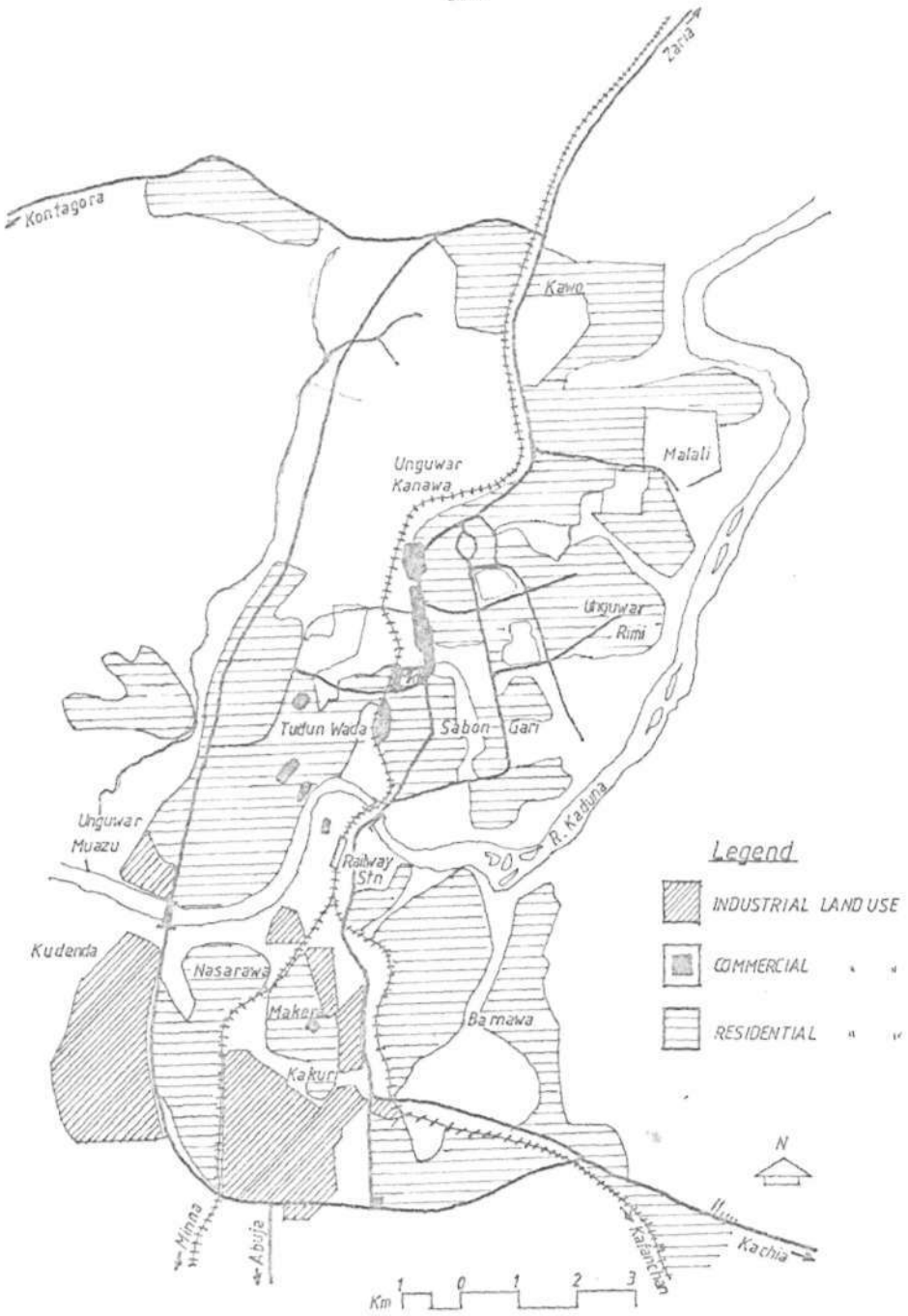


FIGURE4.9 KADUNA: RELATIONSHIP BETWEEN INDUSTRIAL AND OTHER LAND USES Source: Kulshresthal 1984) P 76

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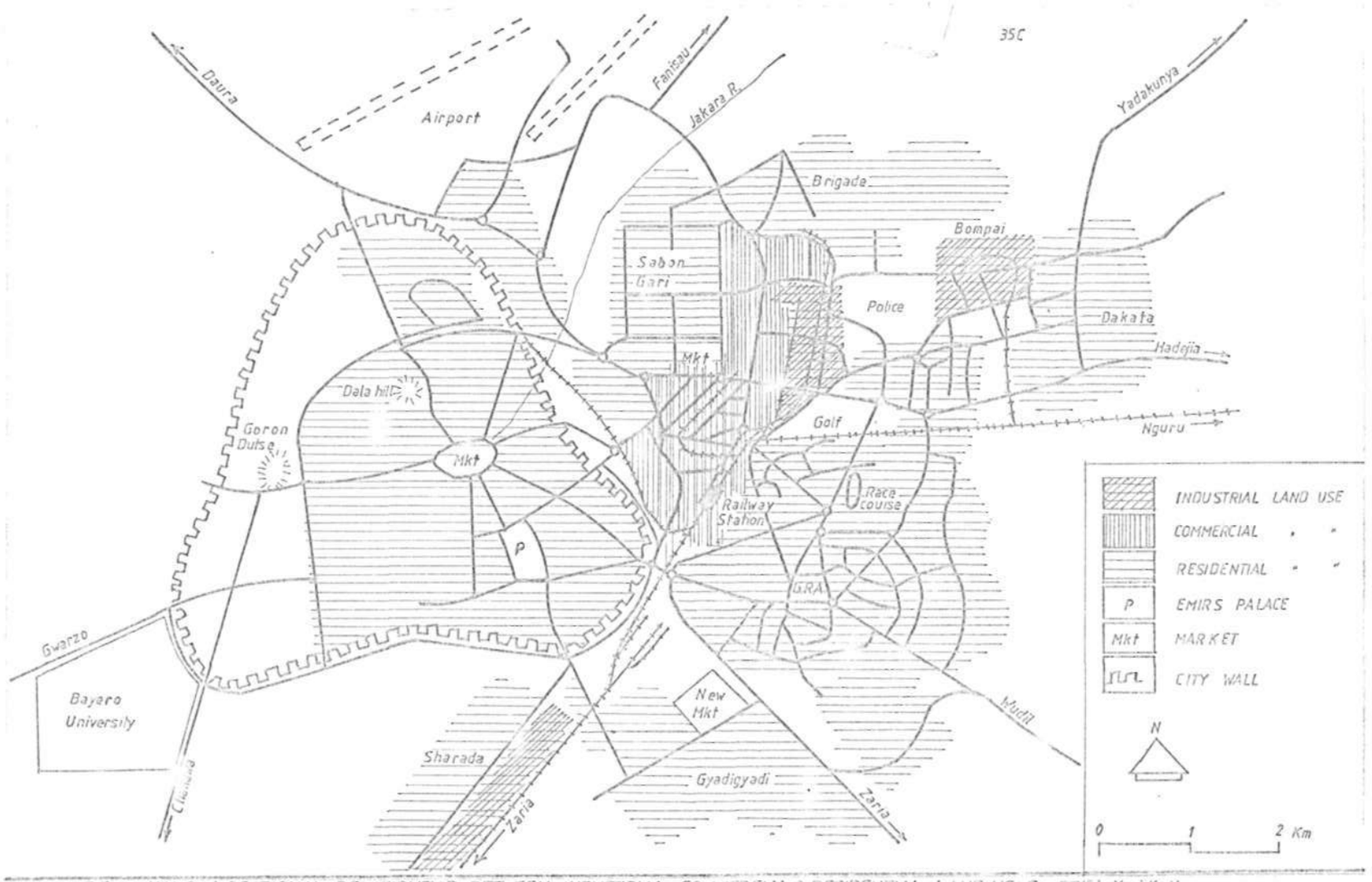


FIG.4.10 KANO: LOCATIONAL RELATIONSHIP BETWEEN INDUSTRIAL, COMMERCIAL & RESIDENTIAL LAND USES
Source: Urban Devt. Board, Kano

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the township with Bompai industrial areas. The two industrial areas are efficiently linked and are all located in close proximity to the city centre and major recreational landuses in Kano namely - Cinema theatres (Elderado and Queen Cinema) and the Township Staium in Sabon Gari.

Sharada industrial area is bounded on both sides by residential areas. To the west it is bounded by Sharada village, which is separated from the main industrial area by a main road. The village has been expanded to accommodate people displaced from the present factory sites. The industrial area is bounded by Tukuntawa resettlement village to the east and lies across the Kano-Kaduna railway line. About 60% of the industrial workers in Sharada reside in these neighbouring residential areas.

4.20 TYPES OF INDUSTRY

The industrial areas of Kaduna and Kano accommodate different types of industries. All the industrial areas are therefore diversified and not specialized.

Fig. 4.11 shows that the most predominant industries are metal working and metal products followed by chemical and plastics industry and textiles. Other important industries are the manufacture of beer and carbonated water. Other very important factories are the car assembly and a defence factory. Kudenda Industrial Area in Kaduna has just been established and

only a few industries have been fully developed. The important industries that have come up are grain processing, beer and carbonated water and textiles.

The industrial areas in Kano contain almost the same type of industries. There is however, some spacialization in some industrial areas compared to others. The township industrial area for example specialisedin vegetable oil milling, confectionary manufacture and metal working and metal products (see Fig. 4.11). Vegetable oil mills and tanneries are only found in Kano.

Industrial areas in Kaduna south are big interms of employment size. All the textile mills employ a labour of 1000+ employees (Fig. 4.12).

In Kano the industries employ a moderate size of workers and none of the industries in Kano (located in industrial area) employs a labour of 1000+ employees.

4.30 LANDUSE OF INDUSTRIAL AREAS

Landuse Structure

The landuse structure of industrial areas in Kaduna and Kano are given in Table 4.1.

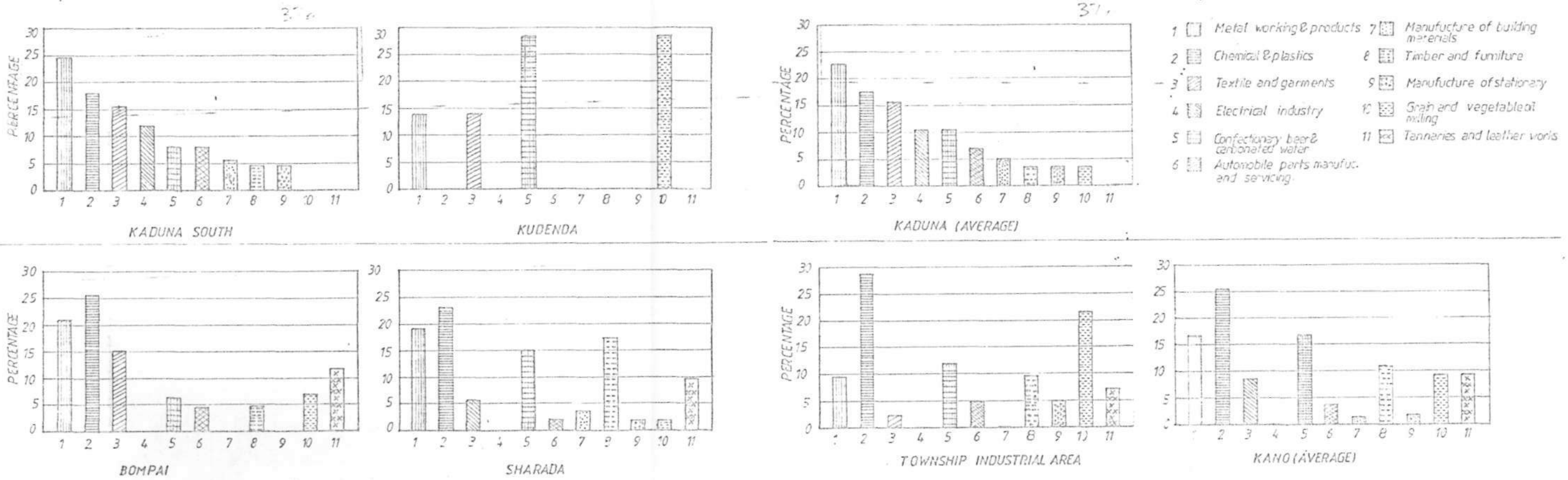
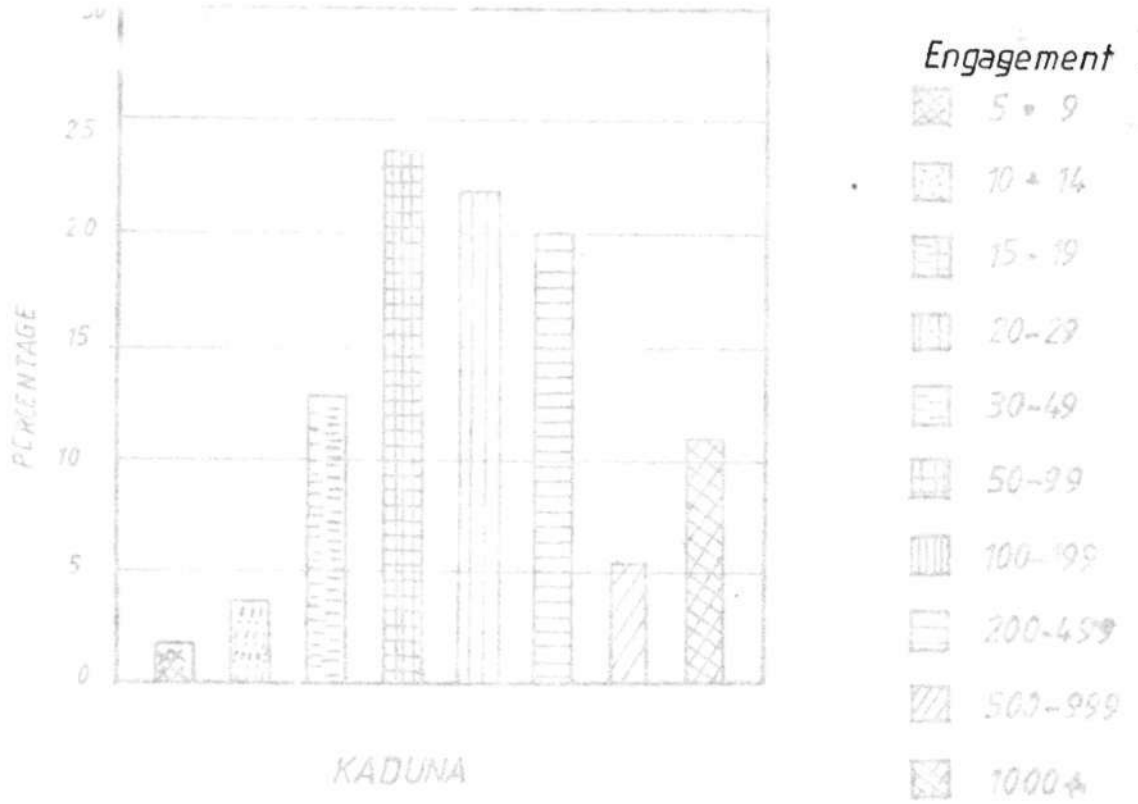


FIGURE 4.11 ANALYSIS OF INDUSTRIES BY TYPES OF PRODUCTS

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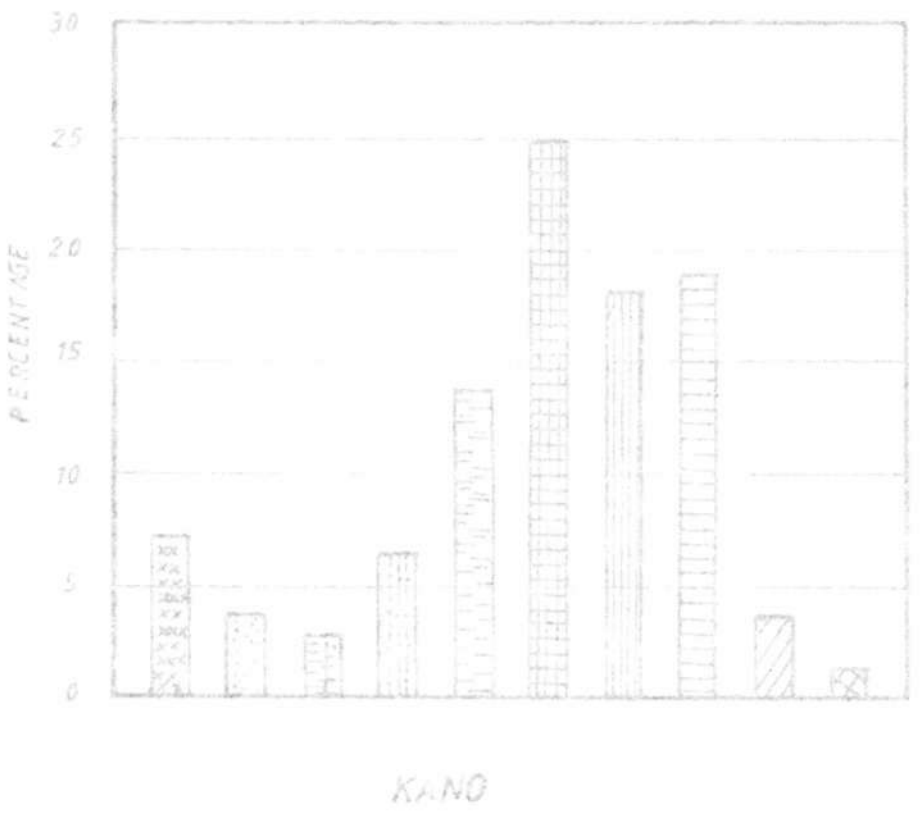


FIGURE 4-12 CLASSIFICATION OF INDUSTRIES BY ENGAGEMENT SIZE.

Table 4.1: LANDUSE STRUCTURE OF INDUSTRIAL AREAS IN KADUNA AND KANO.

Land Allocation in Percentage	Kaduna	Kano		
	Kaduna South	Bompai	Sharada	Average
Factory Plots	69.30	57.24	53.20	55.22
Roads, Parking lots and railways	21.80	35.85	36.37	36.12
Open Spaces	4.20	3.60	6.58	5.09
Facilities and Services	2.62	2.26	1.05	1.65
Other uses	2.08	1.03	2.80	1.92
TOTAL	100	100	100	100

Source: Field work.

In Kaduna, the land allocation for open spaces and facilities seem to be inadequate. This is because there are no organised open spaces in the industrial areas.

In Sharada and Bompai Industrial Areas in Kano, a large proportion (36.37% and 35.8%) of the land is taken by roads and internal circulation. This comes as a result of provisions for both roads and railway sidings. The amount of land allocated to facilities is very low in Sharada because the industrial area is just being developed. The percentage will be greater than this when the industrial area is fully developed.

Landuse Intensity

The intensity of landuse has been measured interms of industrial density. This refers to the number of industrial employees per gross hactre. The industrial density for Kaduna is 37 workers per hactre and a density of 73 workers per hactre was obtained in Kano. This shows that industrial land is used more intensively in Kano than in Kaduna.

4.40 TRANSPORTATION NETWORK (INTER CIRCULATION)

Kaduna South Industrial Area has a modified grid iron layout. There are four distinct road hierarchies in the industrial area (see Fig. 4.13). Railway sidings have also been provided on the industrial area. Two methods were used for laying the railway siding. In the first method railway siding to run parallel to the main road and sidings were provided through factory frontages. In the second method the railway lines run along the rear of the factory plots (see Fig. 4.14).

There is no planned and integrated pedestrian routes but natural desire lines have come up in the industrial area (see Fig. 4.13). Kudenda Industrial Area has a modified grid iron layout and there are three hierarchies of road. The area has no provision for railway siding. Table 4.2 gives the standards used for road widths in Kaduna.

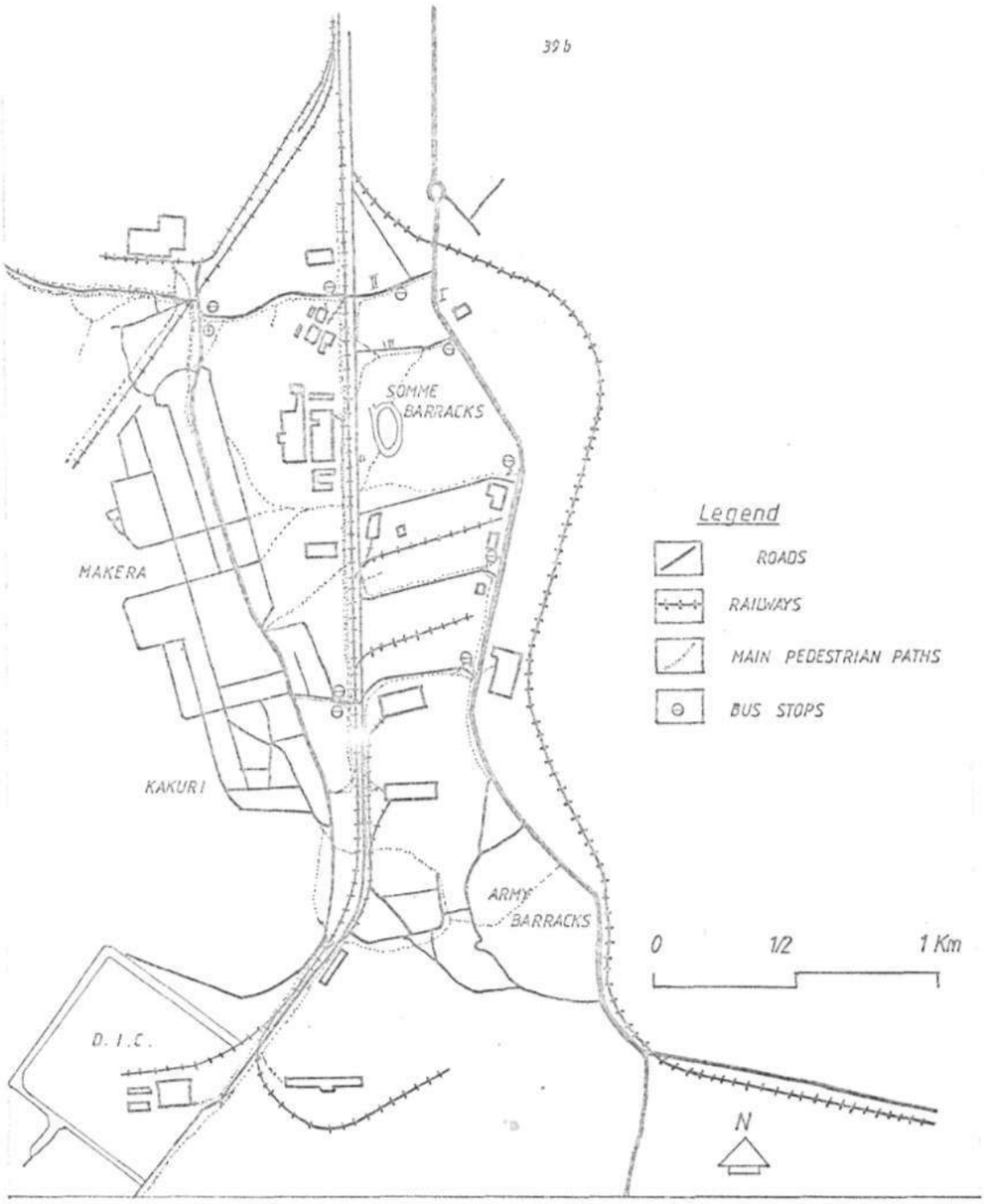


FIGURE 4.13 KADUNA SOUTH INDUSTRIAL AREA : TRANSPORTATION NETWORK

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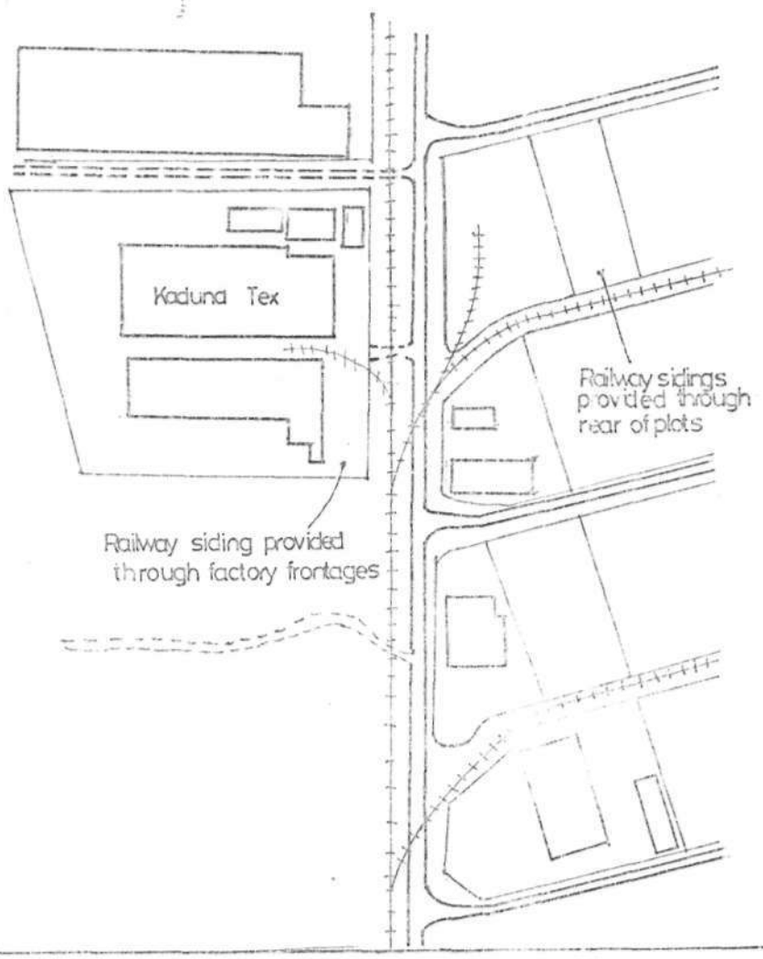


FIG 4.4 METHODS OF RAILWAY SERVICE PROVISION IN KADUNA SOUTH INDUSTRIAL AREA

Dompai and Township Industrial Areas in Kano have a grid iron layout. They both have three hierarchies of road (see Fig. 4.15 and 4.16). The two industrial areas have provision of railway sidings which have been provided through the rear of the factory plots. However, in all the two areas railway lines cross major and minor roads at many points. An integrated system of footpaths has not been incorporated in the layout plans.

Sharada Industrial Area has a grid iron layout. Road junctions are all "T" junctions. Attempt has been made in the layout to segregate vehicular and railway traffic. All the roads approaching the railway line have ended in culde-sacs and this has eliminated rail/road interference (see Fig. 4.17). Industries requiring rail service have been grouped together and provision were made to provide the rail service from the rear of the factory plots.

The standards used for road widths in the industrial areas in Kano is given in Table 4.2.

2.22 Grouping of Industrial Units: For the purpose of grouping on site, industrial units are divided into two broad categories - non-obnoxious industry and the obnoxious industry. Obnoxious industries are those that pollute the environment and cause nuisance to their adjoining landusers. Planning aims at locating these industries such that their side effects could be minimised. This could be done by locating such industries in relation to the direction of the prevailing wind as was earlier discussed.

Industries should be grouped functionally and on the basis of their performance standards and requirements. Performance standards provide a criteria for testing the degree of hazards or nuisances produced by industries. This should be the basis of determing the location of different industries in a particular zone in the industrial area. Functionality refers to the functional linkage between industries. For example leather industries - tanning, and foot wear should be located in the same zone. This enhances external economies of scale.

Industries should be grouped in relation to their plot size requirements and road hierarchies. This means that large plots be located on higher order road hierarchies.

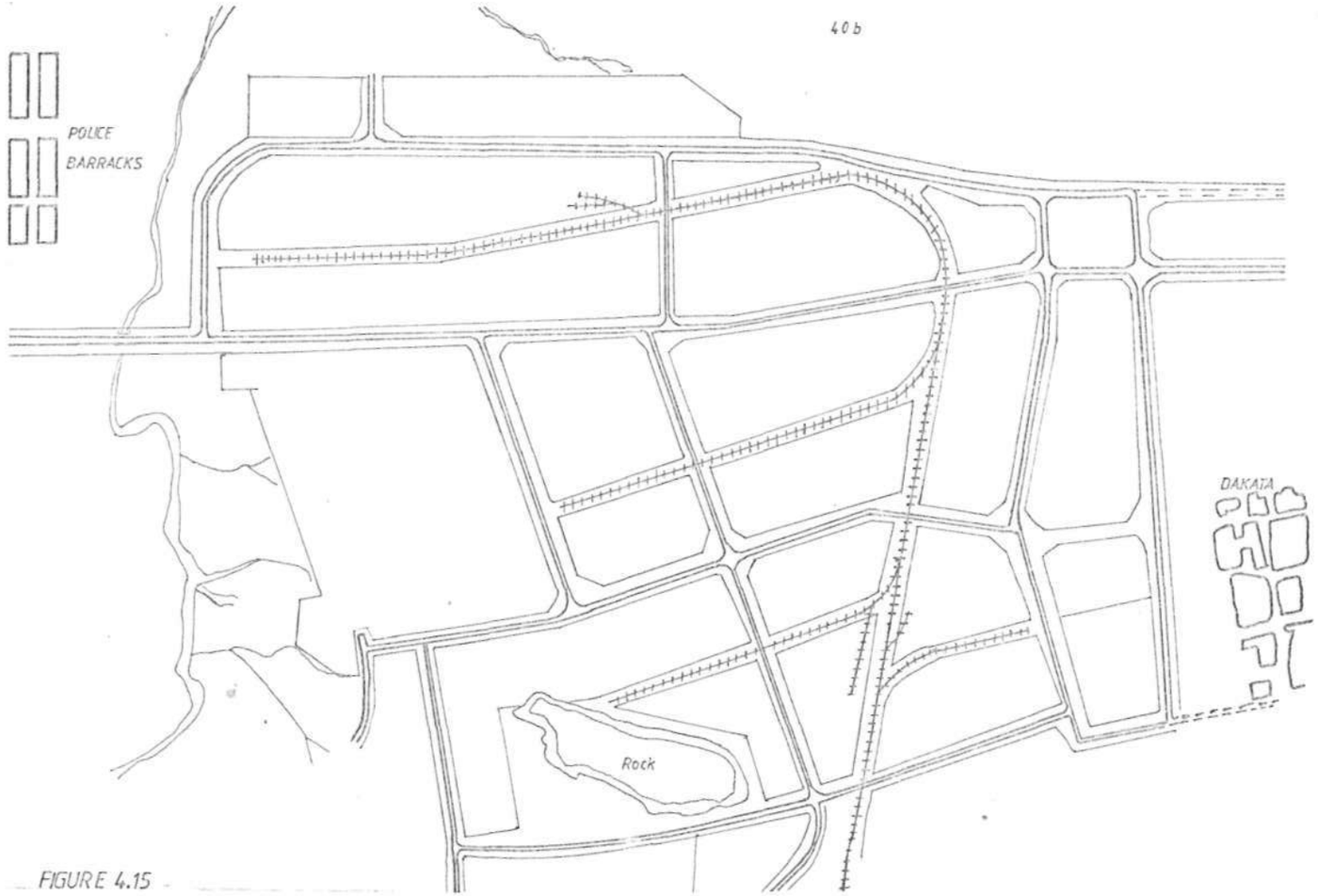


FIGURE 4.15
BOMPAI INDUSTRIAL AREA KANO: RAILWAY AND ROAD LAYOUT

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FIGURE 4.16 TOWNSHIP INDUSTRIAL AREA KANO
ROAD AND RAIL LAYOUT

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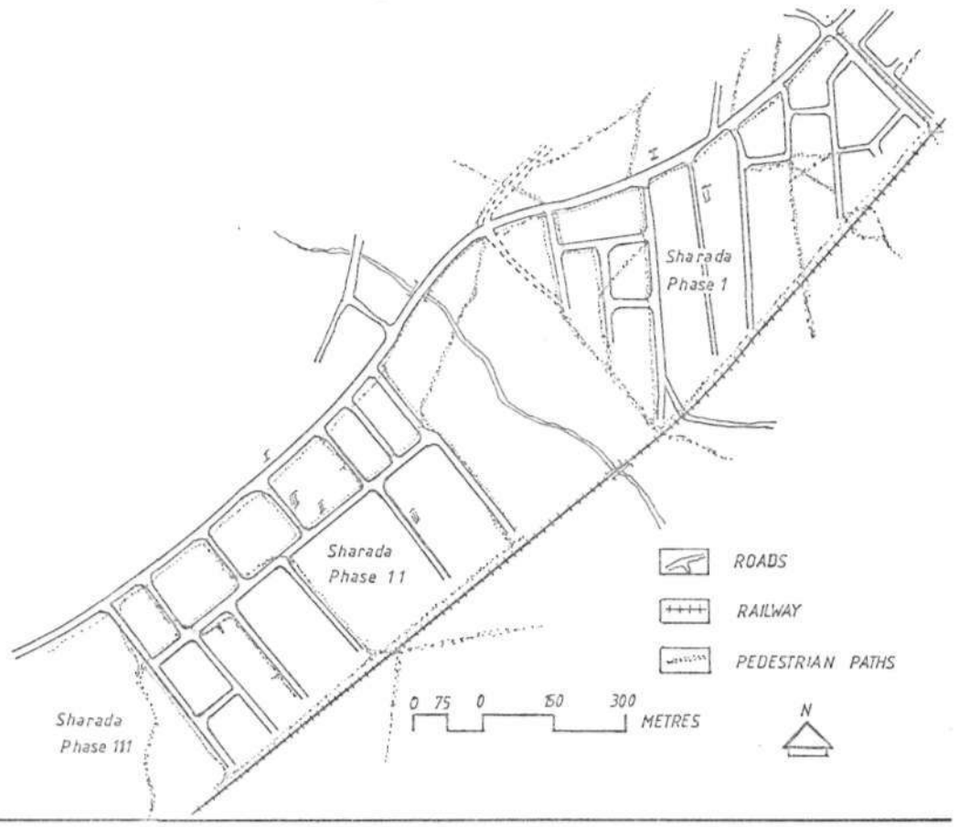


FIGURE 4.17 SHARADA INDUSTRIAL AREA KANO
TRANSPOTATION NETWORK

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Table 4.2: ROAD DIMENSIONS IN INDUSTRIAL AREAS OF KADUNA AND KANO.

A. WIDTH OF METAL PORTION.	KADUNA			KANO			
ROAD HIERARCHY (DIMENSIONS IN METRES)	Kaduna South	Kudenda	Average	Bompai	Sharada	Township	Average
High ways	18	18	18	18	18	18	18
Major Roads	8	10	9	8	8	7	7.7
Collector Roads	6.5	7	6.75	6.5	6.5	6.5	6.5
Access Roads	6	-	6	6	6	6	6
WIDTH OF RIGHTS OF WAY IN METRES							
Highway	50	50	50	50	50	50	50
Major Roads	35	30	32.5	30	30	30	30
Collector Roads	25	25	25	25	25	25	25
Access Roads		20	20	20	20	20	20

Source: Field Work.

4.50 FACTORY PLOTS

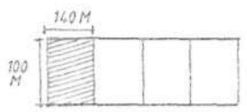
In all the industrial areas, a modular approach in the size and layout of the factory plots has been used. In Kaduna South Industrial Area there is a variation in the plot sizes between the older part of the industrial area and the new layouts - the areas that have been laidout recently - 1980. In the old layout the modular plot size has been 1.40ha while in the new layout the average modular plot size is 1.38 ha

In Kudenda Industrial Area the plot sizes adopted are bigger The average modular size however are shown in Fig. 4.18.

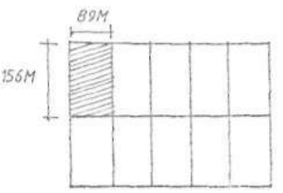
Fig. 4.19 shows the layout of Kaduna South Industrial Area and gives an idea of how the modular plot sizes are combined with the general plot sizes. In Kano the plot sizes vary in both width and depth - between the industrial areas (see Fig. 4.15). In Bompai two modular plot sizes have been identified. They include a big plot of 1.72 ha (132 x 130m) and 0.87 ha (139 x 62.4m) plot sizes of similar dimensions - 0.79 ha and 0.80 ha. There is one modular plot size in the Township Industrial Area. It has an area of 0.54 hactre (90 x 60m). Figures 4.20 and 4.21 show how the modular plot sizes are arranged and combined by industrialists in Township and Sharada Industrial Areas respectively.

KADUNA

Kaduna South



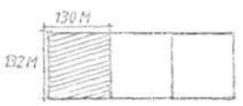
MODULE A
14.0 × 100 M = 1.40 HACTRES



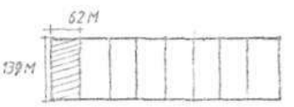
MODULE B
156 × 89 M = 1.39 HACTRES

KANO

Bompai Industrial area

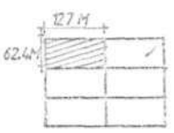


MODULE A
130 × 132 M = 1.72 HACTRES

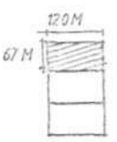


MODULE B
139 × 62 = 0.87 HACTRES

Sharada



MODULE A
127 × 62.4 M = 0.79 HACTRES



MODULE B
67 × 120 M = 0.80 HACTRES

Township



MODULE
90 M × 60 M = 0.54 HACTRES

FIGURE 4.18 MODULAR PLOT SIZES IN INDUSTRIAL AREAS OF KADUNA AND KANO. Source Field work 1984



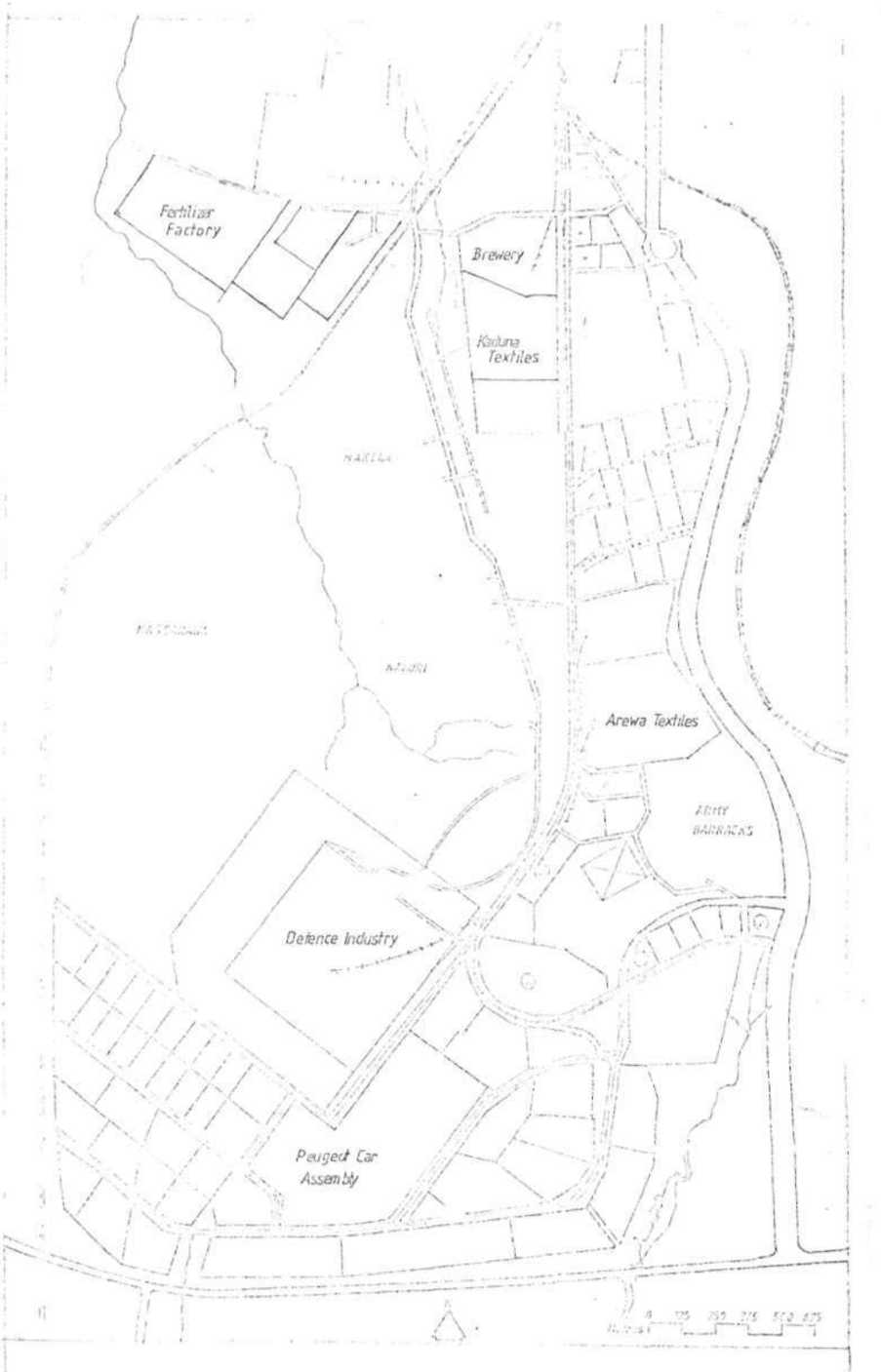


FIGURE 4.19 LAYOUT OF KADUNA SOUTH INDUSTRIAL AREA

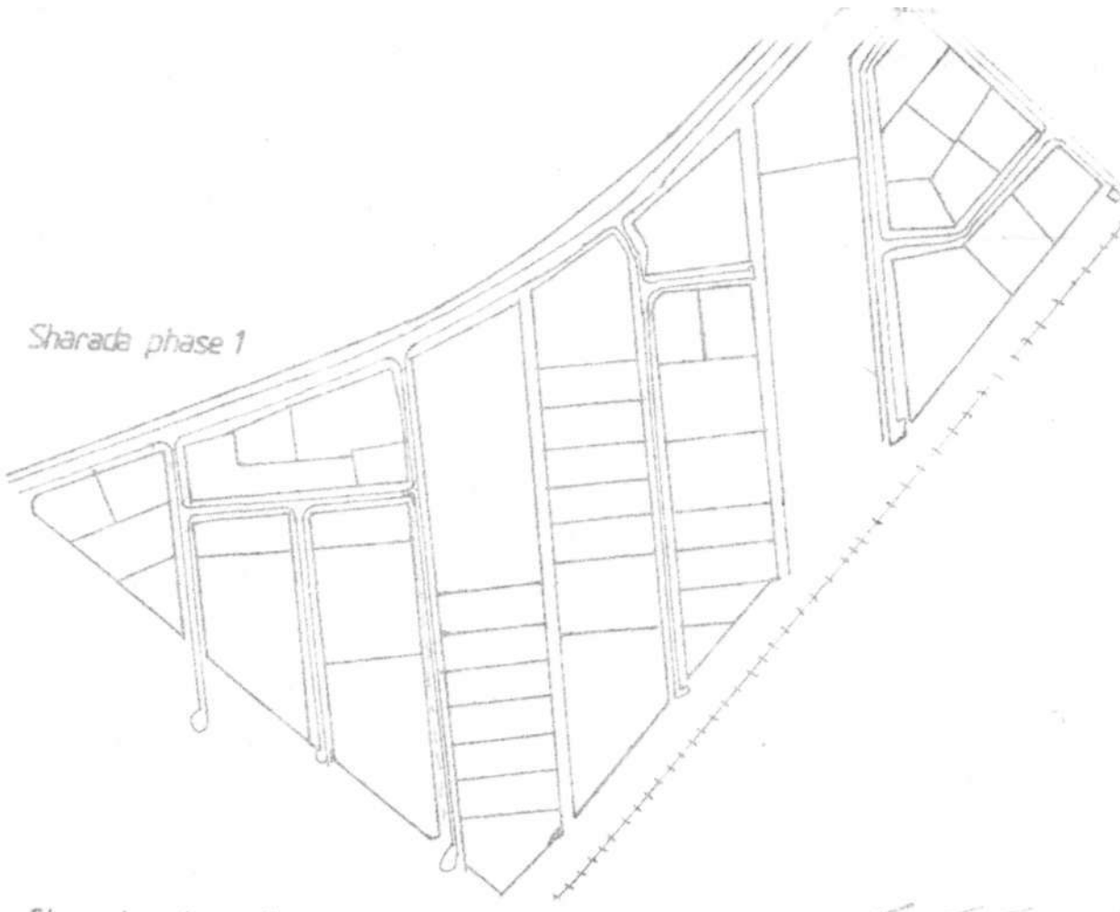
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FIG 4.20 LAYOUT OF TOWNSHIP INDUSTRIAL AREA

Source Urban Devt Board Kano.

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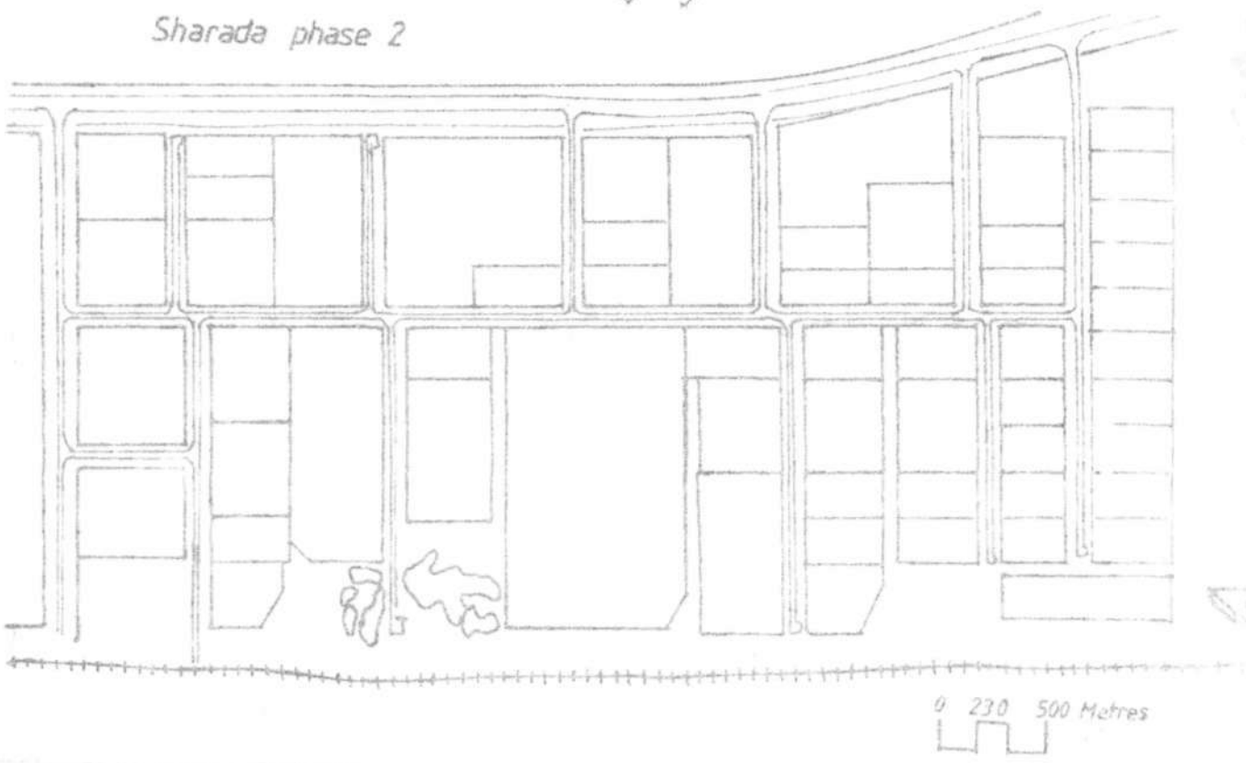


FIGURE 4.21 LAYOUT OF SHARADA INDUSTRIAL AREA.
Source: Kano Urban Dev. Board.

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Standards used for planning controls vary between individual factories and between the industrial areas. Plot coverages in Kaduna range from 10% to 55% the average being 30% for Kaduna South Industrial Area. In Kano , the average plot coverage are 32%,26%, and 31% for Bompai, Sharada and Township Industrial Areas respectively.

The setbacks used in the industrial areas appear to be related to the road hierarchy and plot sizes. The setback used in the industrial areas of Kano and Kaduna is shown in Table 4.3.

Table 4.3: STANDARDS USED FOR SETBACKS IN THE INDUSTRIAL AREAS OF KADUNA AND KANO.

Set-back in Metres from Centre line of the road	Kaduna	Kano
Highway	25	27
Major Road	20	21
Collector Road	15	15
Access Road	12	12

Figures 4.22, 4.23 and 4.24 illustrate the existing situation - site coverage,- set back lines and other developments on individual factory plots in industrial areas of Kaduna and Kano.

4.60 COMMUNUAL FACILITIES

Communal facilities available in the Kaduna South Industrial Area include banks, a cinema and a hospital·

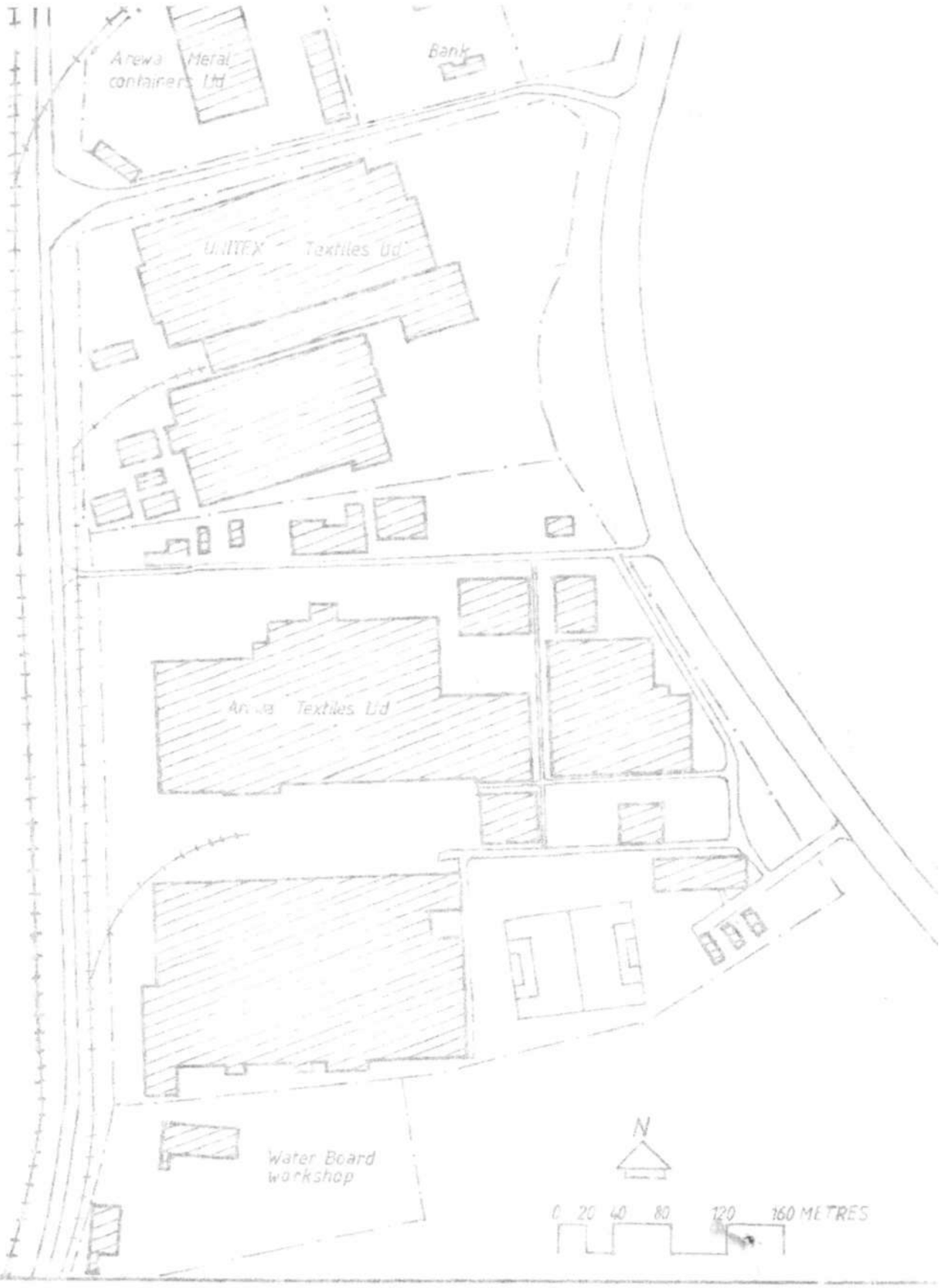


FIGURE 4.22 PART OF KADUNA SOUTH INDUSTRIAL AREA SHOWING EXISTING DEVELOPMENTS

SOURCE 1980 Aerial photo flown for Kaduna State Waterboard sheet 153 Map reduced by half & field survey 1984

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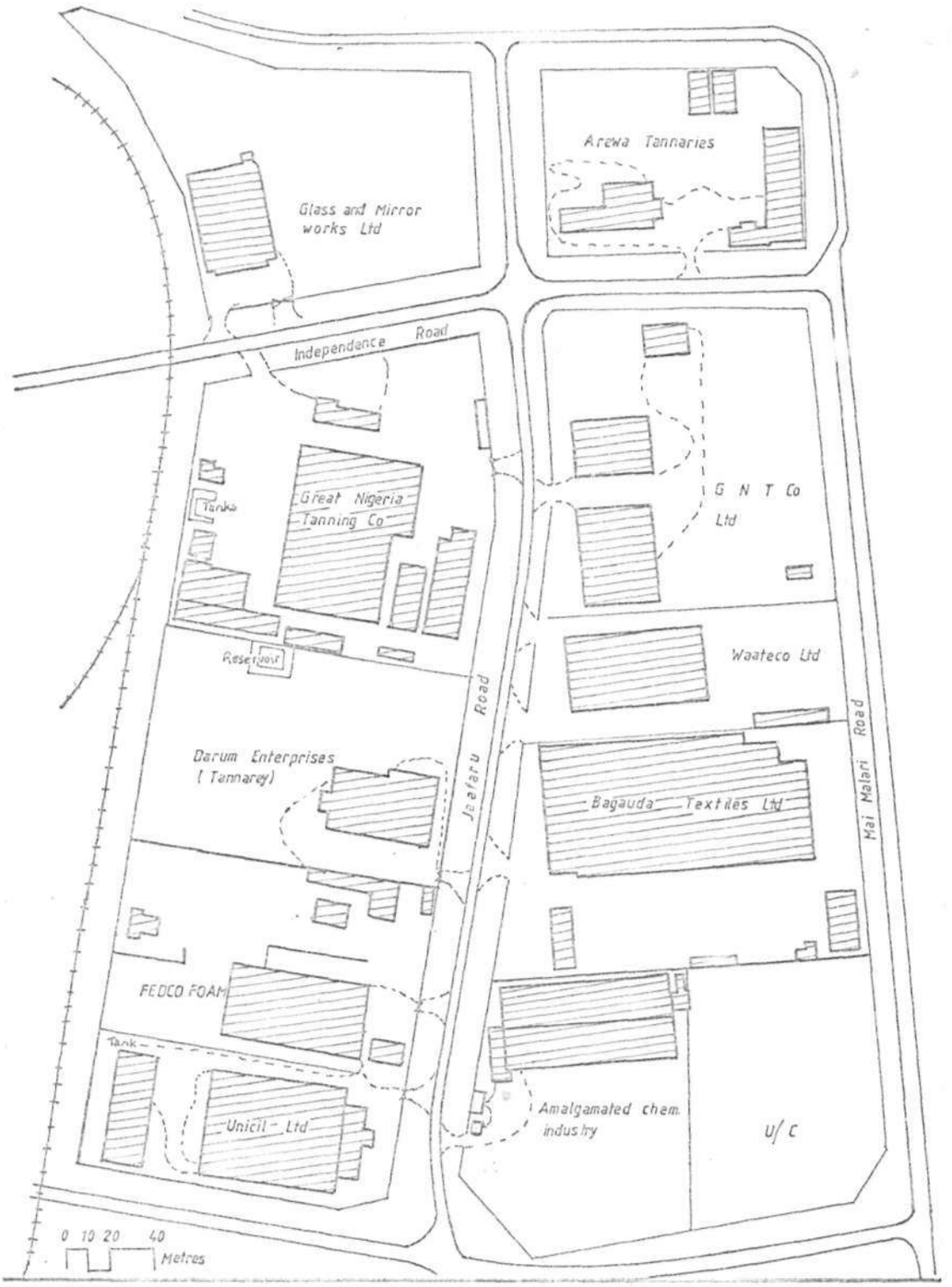


FIG.4.23 PART OF BOMPAI INDUSTRIAL AREA SHOWING EXISTING DEVELOPMENT. SOURCE Kano sheet 453/1326 NW 8 field work 1984

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FIGURE 4.24

TOWNSHIP INDUSTRIAL AREA KANO
EXISTING DEVELOPMENT- NOTE ABUTTING FACTORY WALLS

SOURCE: Kano sheet 451/1326 NW& Field work 1984

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In addition some temporary and substandard buildings have come up as "canteens" providing cheap meals to industrial workers. It should be noted that these facilities have not been provided in an integrated nature and their locations have been haphazard. Other facilities such as recreation facilities, fire services and convenient shops have not been provided on the industrial area (see Fig. 4.25). Kudenda Industrial Area is just being developed and is therefore too early to assess this aspect of its development.

In Kano some facilities like banks and post offices have been provided in the industrial areas. Small open air mosques have also come up near those industries that employ a large number of people. Figures 4.26 and 4.27 show the distribution of the available factory facilities on industrial areas in Kano. The location and adequacy of these facilities however, leaves alot to be desired. Table 4.4 gives an idea of facilities provided by individual industries.

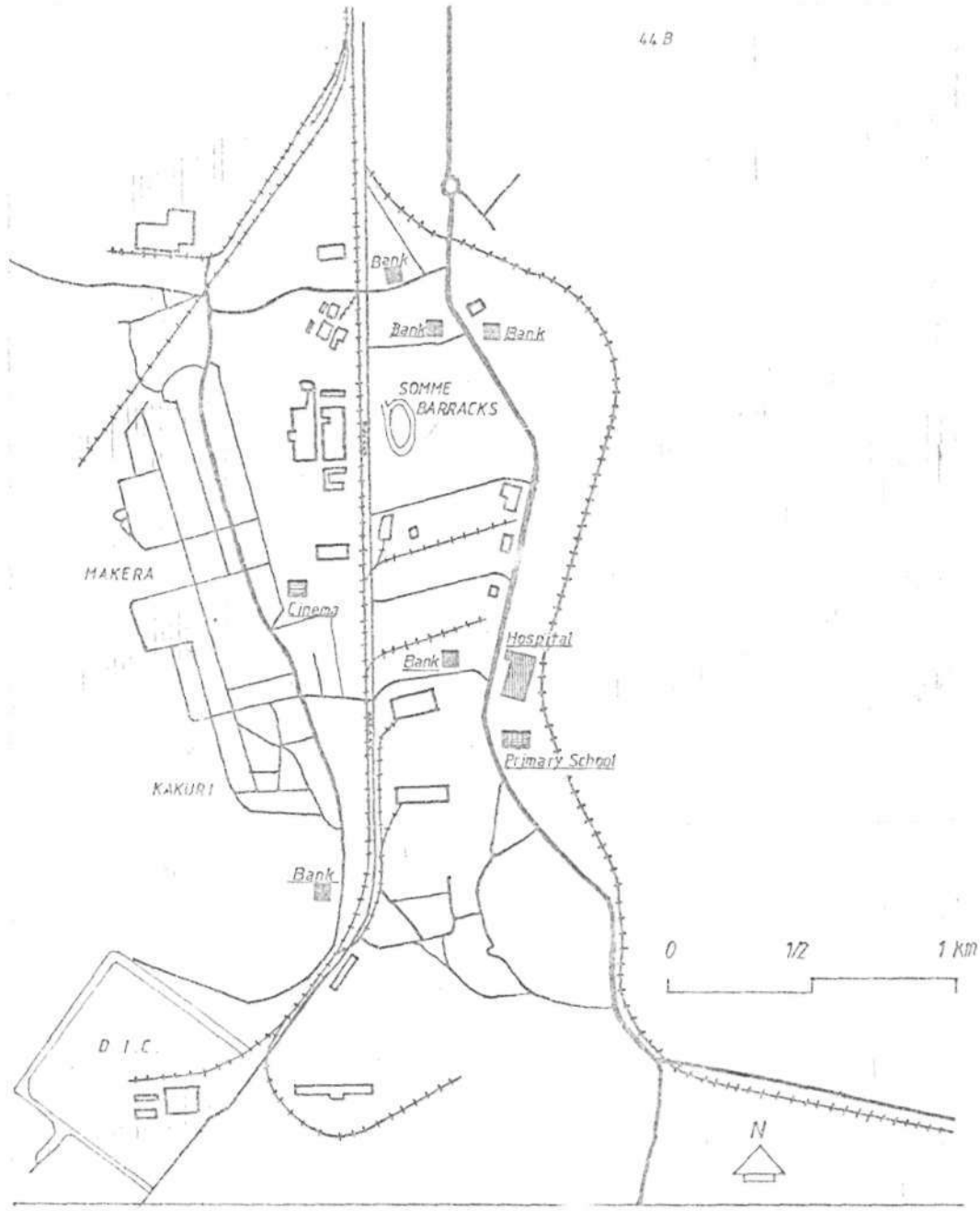
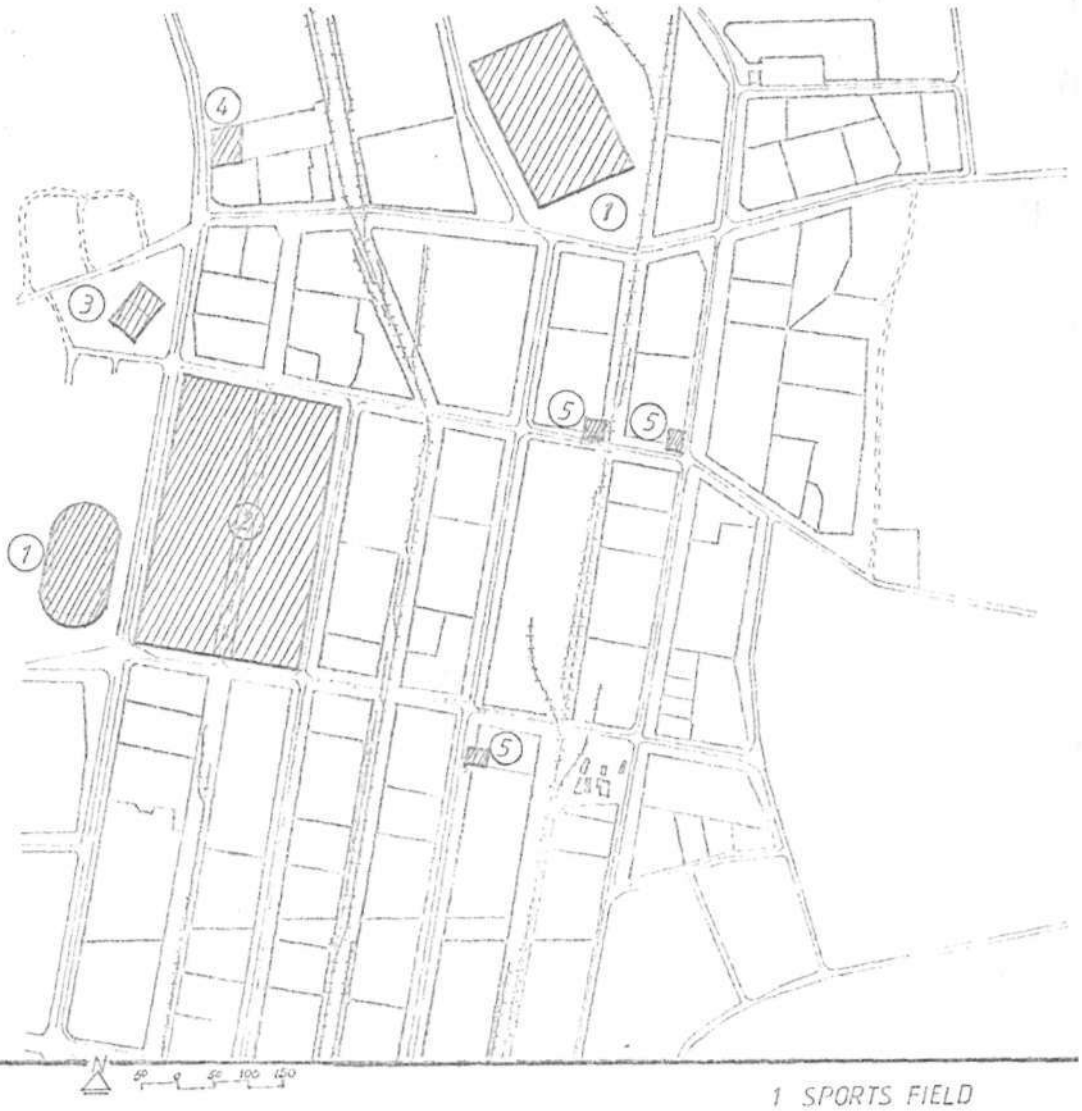


FIGURE 4.2 KADUNA SOUTH INDUSTRIAL AREA : FACILITIES ON SITE.

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1 SPORTS FIELD
2 HOSPITAL
3 CINEMA
4 FILLING STATION
5 MOSQUE

FIG.4.26 TOWNSHIP INDUSTRIAL AREA: FACILITIES

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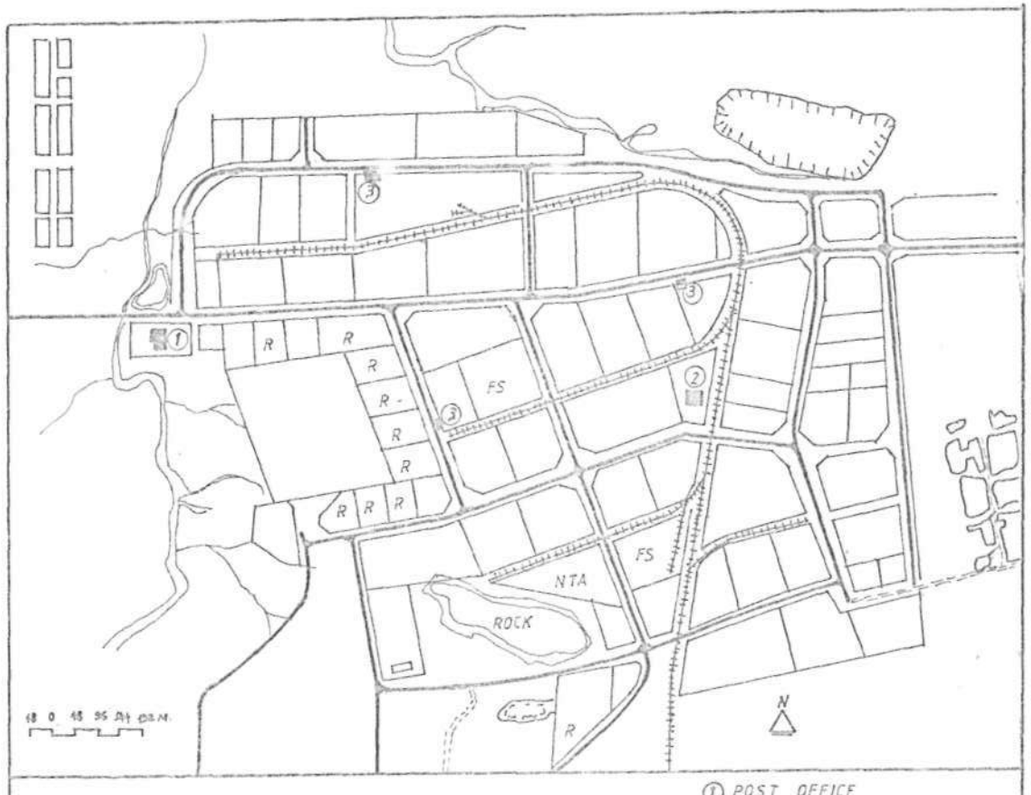


FIG.4.27 BOMPAI INDUSTRIAL AREA: FACILITIES.

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① POST OFFICE
② BANK
③ MOSQUE
Ⓡ RESIDENTIAL
FS FILLING STATION

Table 4.4: FACILITIES PROVIDED BY INDIVIDUAL FACTORIES

Percentage of factories providing facilities	Kaduna South	Bompai
Canteen	45%	48%
Clinic/First Aid	88%	78%
Shower/Dressingroom	36%	38%
Indoor recreation	30%	19%
Outdoor recreation	45%	43%

Source: Field work 1985.

4.70 LANDSCAPING

The industrial area in Kaduna have left much to be desired in the area of landscaping. There has not been any deliberate attempt to provide landscaped open spaces in the industrial areas of Kaduna and Kano. The areas between the property lines and road reservations have been left bare without any landscape treatment. However, in Bompai and Township Industrial Areas trees have been planted along the major roads of the estate,

4.80 GROUPING OF INDUSTRIAL UNITS

In Kaduna South Industrial Area, large factory plots have been located on a high order road hierarchies and those factories that produce trade effluents have been located near the streams or valleys for easy waste disposal. There is no attempt to locate industries on the basis of their functional linkage.

In Bompai Industrial Area, the tannaries have been grouped and located at the edge og the industrial area and near a stream for easy effluent disposal, this trend was also observed in Sharada Industrial Area.

In all the industrial areas factories that need railway sidings are grouped together and provided with the utility.

CHAPTER 5

RECOMMENDED PRINCIPLES AND STANDARDS FOR INDUSTRIAL AREA PLANNING

5.10 PRINCIPLES OF INDUSTRIAL AREA PLANNING

The comparative study of industrial areas in Kaduna and Kano has provided the basis of recommending principles for industrial area planning. The good attributes of design and layout have been adopted and some methods of correcting their shortcomings have been proposed.

5.11 Locational Principles: There are some basic principl which govern the location of industrial areas. These principles are generally concerned with important issues such as economy, convenience, health and safety of the community. Economic considerations refer to cost reduction measures which could be achieved without sacrificing efficiency. In chosing a site for an industrial area, the economy of bringing some utilities and services to the site has to be considered. Health and safety requirements require that, industrial areas should not be sited where they will injurisouly affect the community through pollution. Convenience considerations relate to other issues such as amenity and functional linkage between industrial and other land uses. Detailed locational principles are given below:

(i) Accessibility:

(a) Industrial areas should be located near a good transportation network preferably

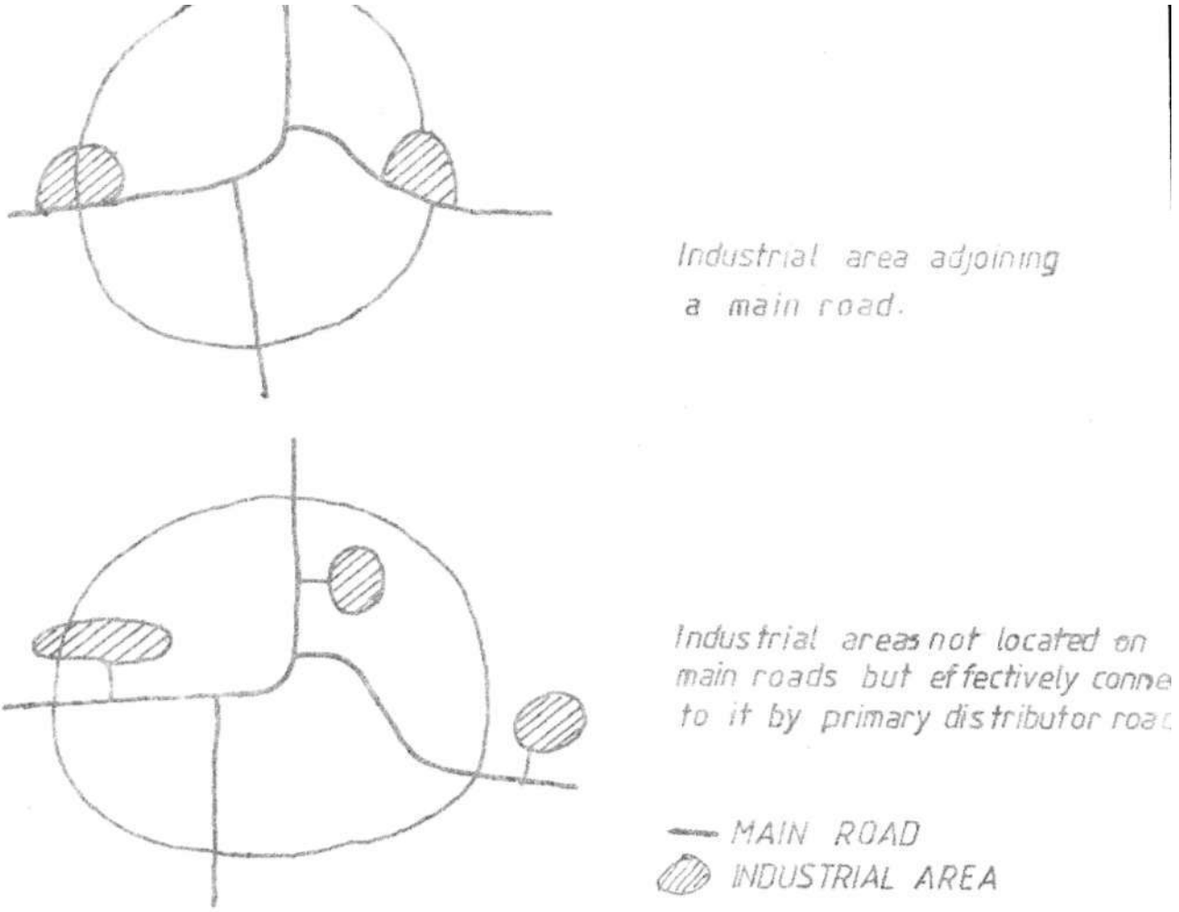


FIGURE 5.1 LOCATION OF INDUSTRIAL AREA IN RELATION TO MAJOR ROADS.

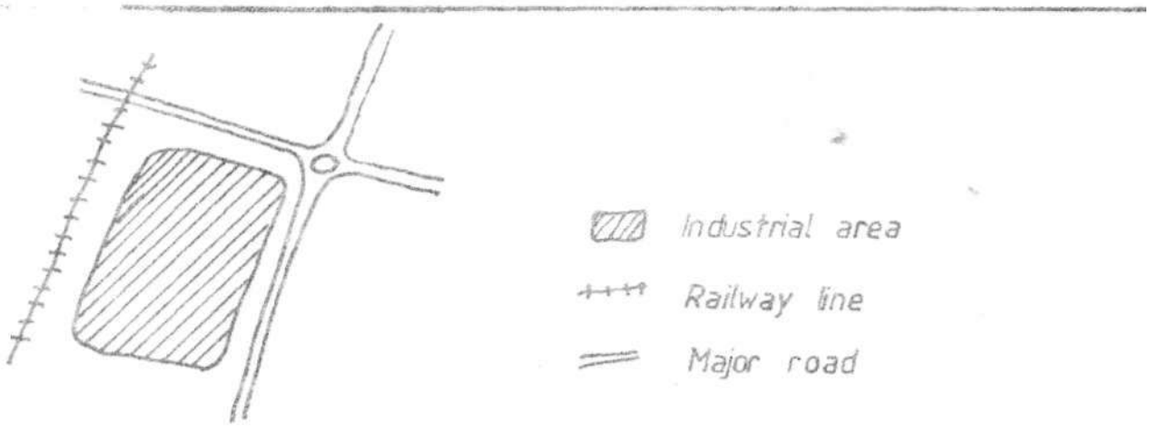


FIGURE 5.2 LOCATION OF AN INDUSTRIAL AREA NEAR RAIL LINE AND A MAJOR ROAD

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regional roads/highways and major city roads. This is important because accessibility determined the value and succuss of a planned industrial area. It is possible to construct new road to the industrial area but this will be costly and time consuming.

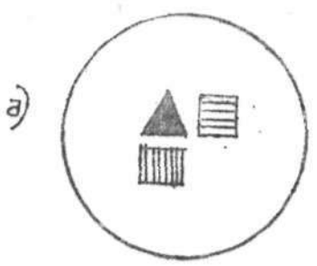
(b) If the industrial area is to accomodate heavy industries, then it must be located near an existing railway line. A site near both a railway line and a major road will be great assets.

(c) Industrial areas should not be located in the same area with other landuses that generate large amount of traffic such as city centres, shopping centres, universities and administrative centres (Fig. 5.3).

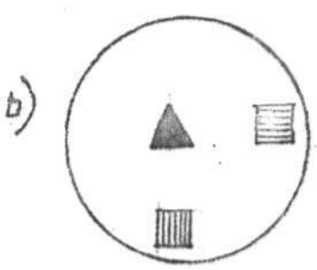
(ii) Site Factors: Industrial areas should be located on reasonably flat or gently sloping and well drained sites. In addition, the soil must have a high load bearing capacity and should be sufficiently stable to support heavy and vibrating machinery. The location of industries in a deep valley should be avoided.

(iii) Climatic Considerations:

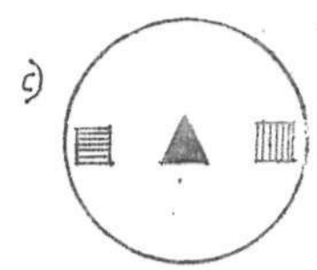
(a) As much as possible industrial areas should be located on the leeward of the city. This is important in order to protect the city



a) Land uses located in the same area - poor



b) In b and c landuses that generate ~~traffic~~ are located in different areas - good



c)

- City centre
- Industrial areas
- Landuses that generate large volume of traffic

FIGURE 5.3 LOCATION OF INDUSTRIAL AREAS AND OTHER LAND USES THAT GENERATE TRAFFIC

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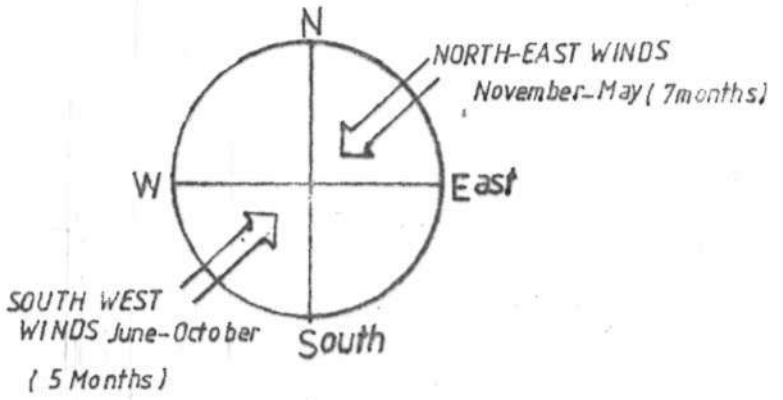
from wind borne industrial pollution. In Norther Nigeria there are two dominant prevailing winds - the east wind and south west wind (Fig. 5.4). The principle emphasises the location of industrial areas on the leeward side of the maximum prevailing wind of maximum duration. This means industrial areas in Northern Nigeria should be sited on the southern edges of the cities. Figure 5.4 illustrates the possible locations of industrial areas with respect to pollution winds directions.

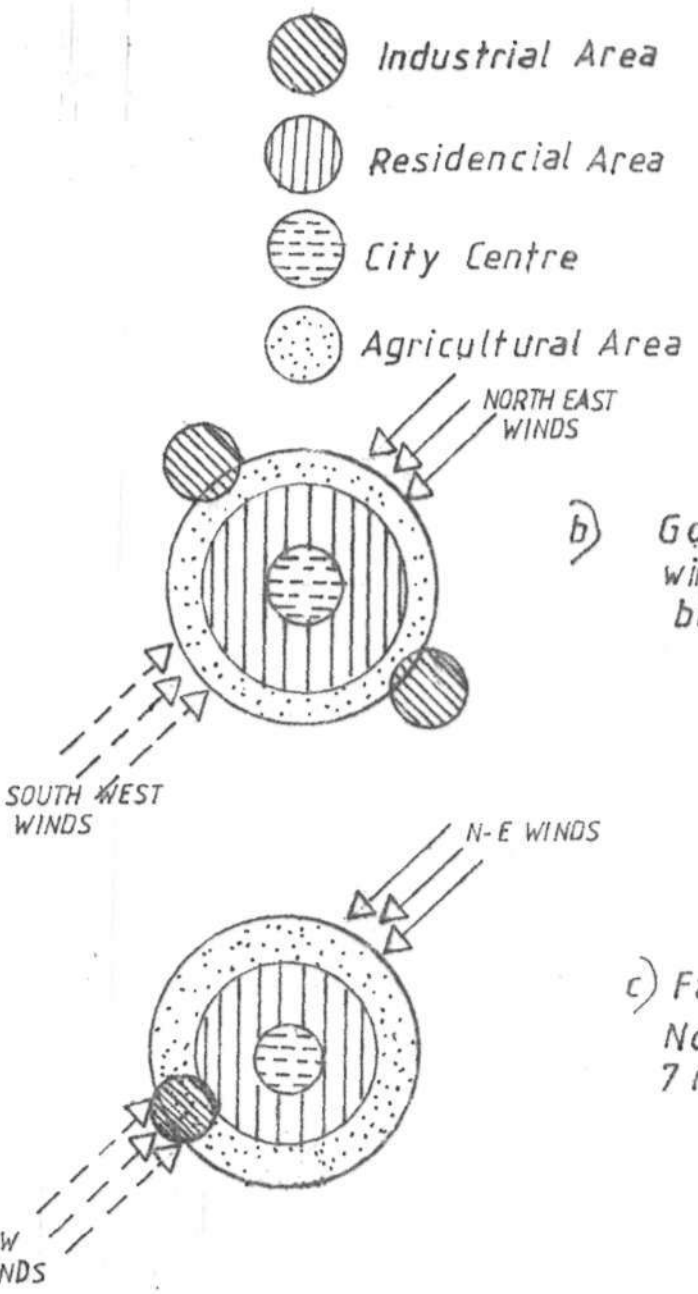
(b) Where industrial areas have to be located on the windward side of the city or residential areas, factories must be separated from other developments by the use of a buffer zone in form of open space or green belt.

(iv) Utilities and Services: Industrial areas should be located on or near sites where adequate utilities and services are available such as electricity, water supply and waste disposal facilities.

Electricity - industrial areas should be located near high tension electricity lines or sub-stations. Location with regard to electricity lines may not be considered in cases where power can be generated in or near industrial areas for the use of the industrial establishments.

a) Prevailing wind directions in Northern Nigeria.





b) Good location
wind from industrial areas not blown over the city

c) Fair location
North east winds prevail for 7 months of year

FIGURE 5.4 LOCATION OF INDUSTRIAL AREAS IN NORTHERN NIGERIA

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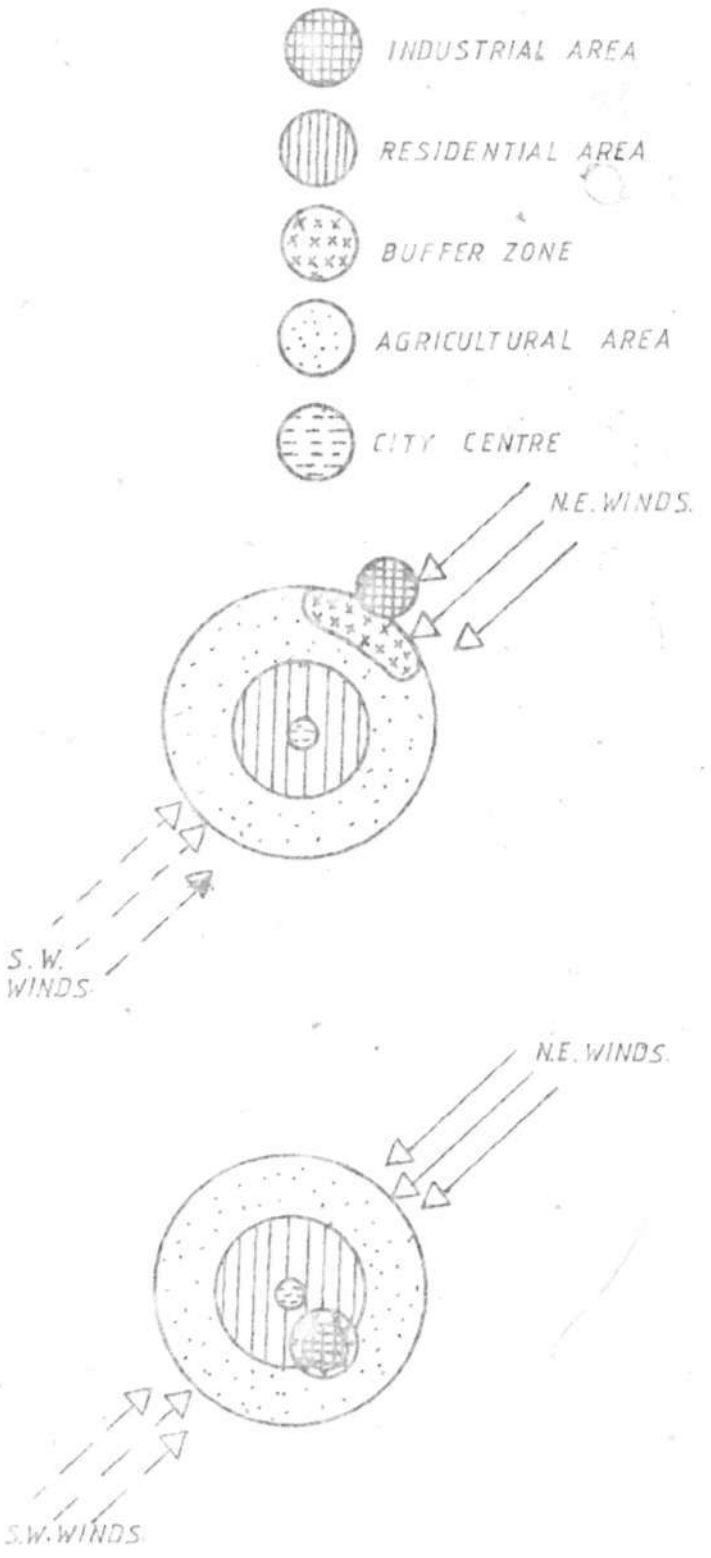


FIGURE 5.5 PROVISION OF BUFFER IN AN INDUSTRIAL AREA.

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Water - As for water supply this may be a determining factor. If the industrial is to get water from the public, then the nearer the site is to the main water supply pipeline the better. In cases where other sources are used, industrial areas should be located near such water sources i.e rivers, lakes dams and reservoirs.

Effluent disposal - Industrial areas should have good drainage and waste removal facilities. They should therefore be located near an existing sewage lines. In places like Nigeria where there is no central sewage system, proximity of the industrial area to suitable disposal points (sea, rivers or land areas for treatment) is very important. It is also important to locate industrial areas with regards to the natural drainage of the city. They should be located in such a place that effluents discharged by the industries are drained away from the city (Fig. 5.6).

(v) Landuse Considerations:

(a) Industrial areas should be located in close proximity to residential areas. However, this may not be applicable in all cases because health and safety considerations may override the reason of locating industries near residential areas.

(b) Industrial areas should be located conveniently and efficiently linked with the city centre.

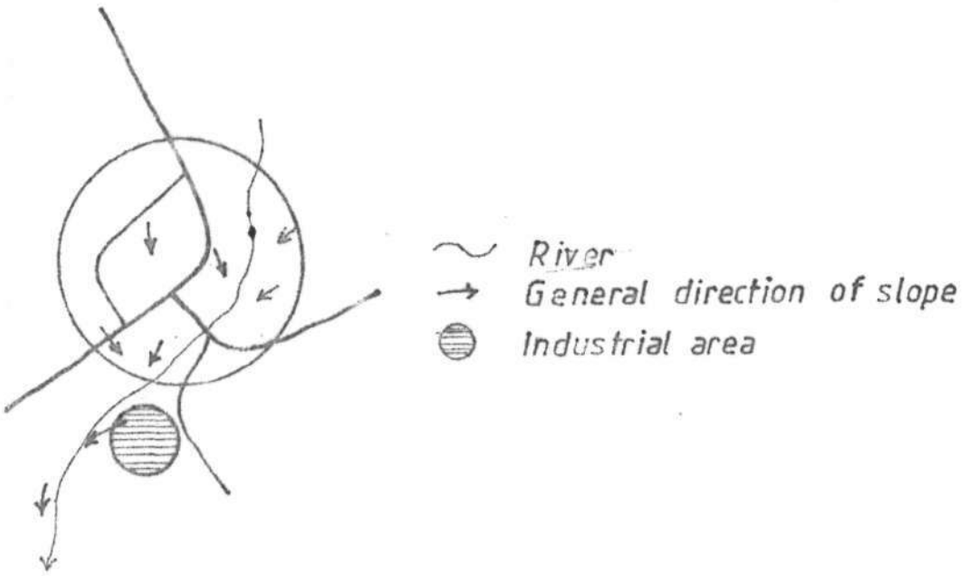


FIGURE 5.6 LOCATION OF INDUSTRIAL AREA IN IN RELATION TO EFFLUENT DISPOSAL AND DRAINAGE

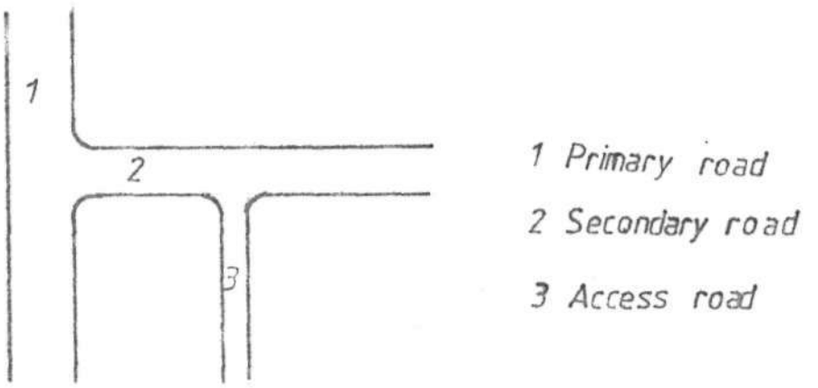


FIGURE 5.7 ROAD HIERARCHIES IN INDUSTRIAL AREAS

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5.12 Transportation Network (Internal Circulation):

(a) Roads should not pass through an industrial area, i.e through fares should be avoided.

(b) There should be a marked hierarchy of roads in an industrial area.

(c) Road layout must be simple and should avoid cross-junctions and insufficient safe site distance (Fig. 5.8).

(d) If railway sidings are to be provided in the industrial area, railway users should be grouped together and railways sidings provided to avoid unnecessary rail-road crossings.

(e) Attempt should be made to segregate traffic i.e rail/road and vehicular/pedestrian.

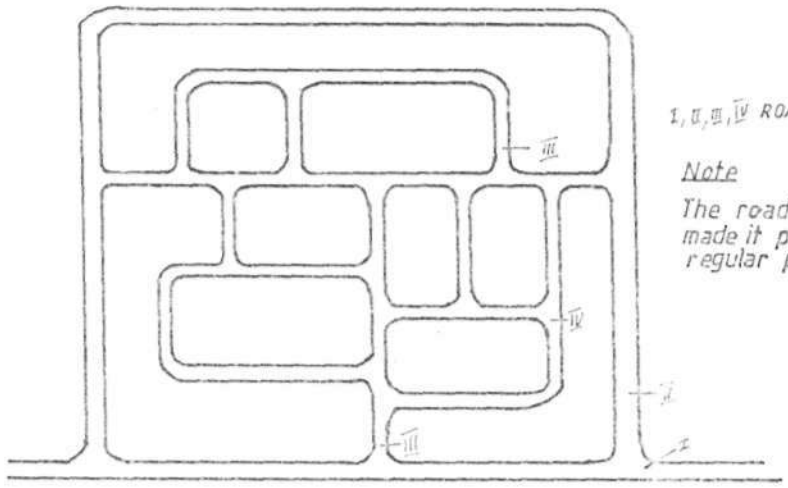
(f) For industrial areas adjoining highways or regional roads provision of service roads must be made. This separates fast moving long-distance traffic from the slow traffic dominated by long trucks.

(d) Footpaths should be well integrated in an industrial area.

5.13 Factory Plots:

(a) Locational Arrangement

The three functional areas of a factory - administration, service area and the factory building should be functionally arranged or integrated. The administration block should be located close to the entrance to have an effective linkage with the outside world. The services and factory areas



I, II, III, IV ROAD HIERARCHIES

Note

The road layout has made it possible to have regular plot sizes.

FIGURE 5.8 LAYOUT OF ROADS IN AN INDUSTRIAL AREA

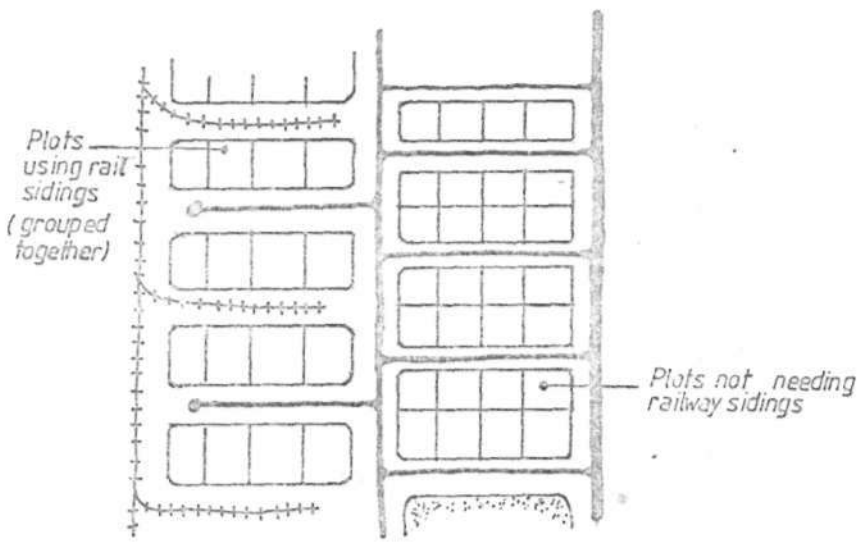


FIGURE 5.9 SEGREGATION OF ROAD AND RAILWAY TRAFFIC IN AN INDUSTRIAL AREA.

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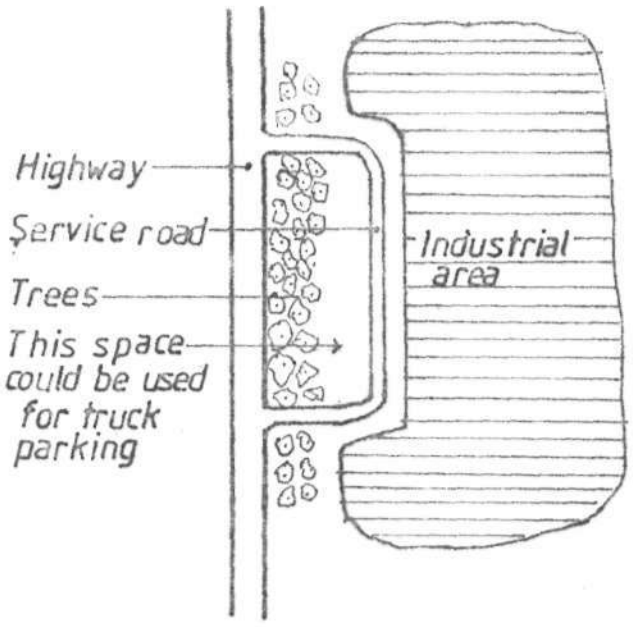


FIG. 5.10 PROVISION OF SERVICE ROAD TO INDUSTRIAL AREAS ADJOING HIGHWAYS

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should be accessible to the evacuation and delivery vehicles. (Fig. 5.11). If possible movement of goods should be separated from the movements of people.

(b) Factory buildings should be located at the back to remove it from the public.

(c) The position of the factory building should be such that 100% future expansion is provided to avoid additional future cost of expansion (see Fig. 5.12).

(d) Parking facilities for employees and visitors should be provided on the factory plots. In addition loading and unloding bays with adequate facilities for vehicle turning should be provided on each factory plot.

5.14 Principles of Grouping Industries: Grouping of industries should be based on performance standards and industrial processes (Fig. 5.13).

(b) Big plots should be placed on higher order hierarchy roads and small plots in smaller order roads and vice versa.

5.15 Communal Facilities: Communal facilities such as the followings should be provided in the industrial areas: police station, fire service, post offices, banks and canteens. Others are display facilities and training centre for workers. These should be located

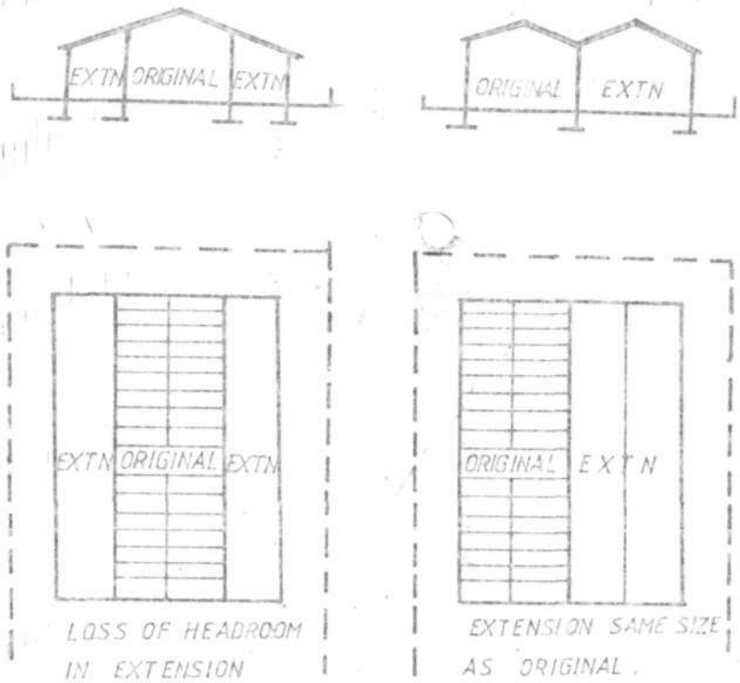


FIG. 5.12 LOCATION OF FACTORY AREA TO ALLOW FUTURE EXPANSIO

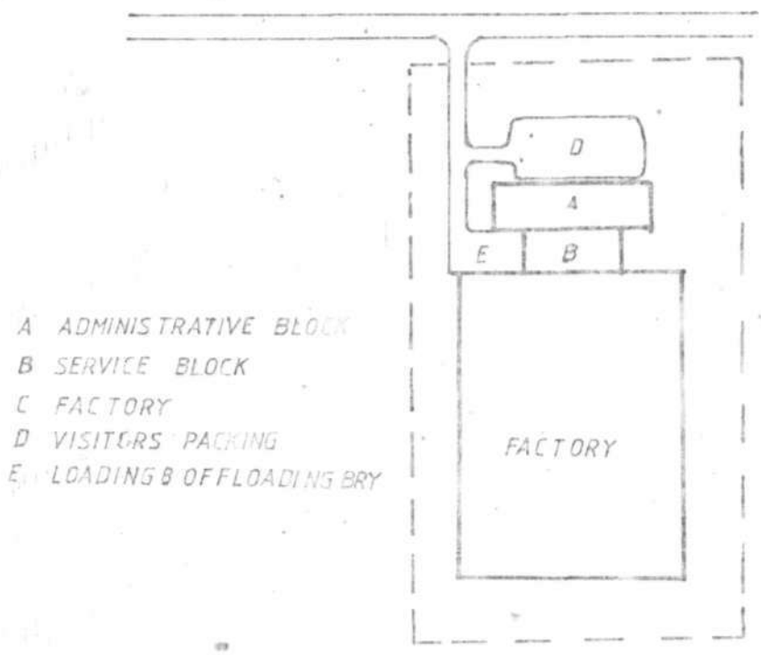
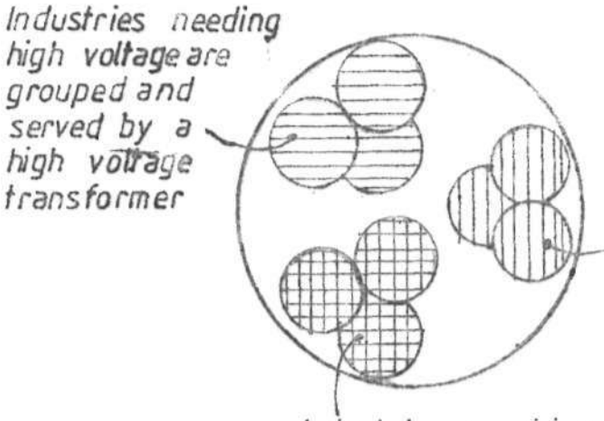
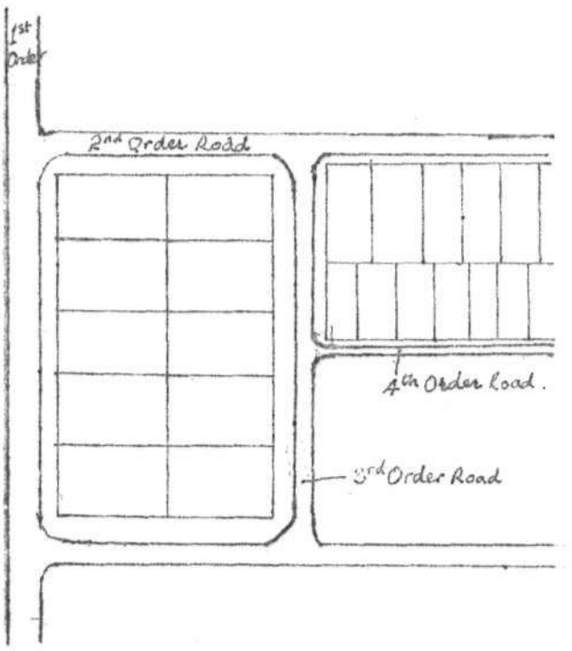


FIG. 5.11
LAYOUT OF A FACTORY PLOT

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5·13 SUGGESTED METHODS FOR GROUPING OF INDUSTRIES



Bigger plots are placed on higher order roads

5·14 RELATIONSHIP BETWEEN PLOT SIZE AND ROAD HIERARCHY

centrally, so that they could be shared by all the industries.

5.16 Environmental Considerations:

(a) Raw or untreated wastes must never be discharged into sewage systems or disposal points such as rivers and lakes. Industries producing such wastes should treat them at the source before disposal.

(b) A central sewage treatment plant should be provided in an industrial area.

(c) Distance factor should be used to locate some obnoxious industries that cause nuisance to neighbouring landuses. In other words obnoxious industries should be located at a safe distance (given in standards) from residential and other landuses.

5.17 Principles of Design and Layout: The design and layout of an industrial area should contain the following elements:

(a) Flexibility.

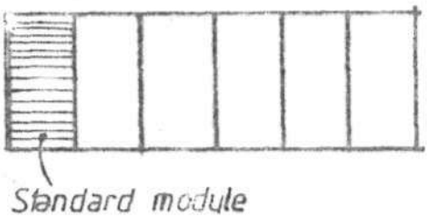
(b) Economy

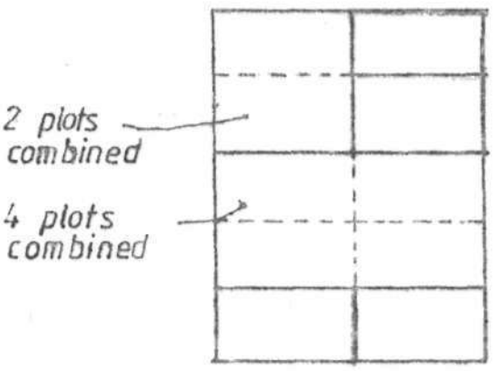
(c) Functionality

(d) Aesthetic appeal.

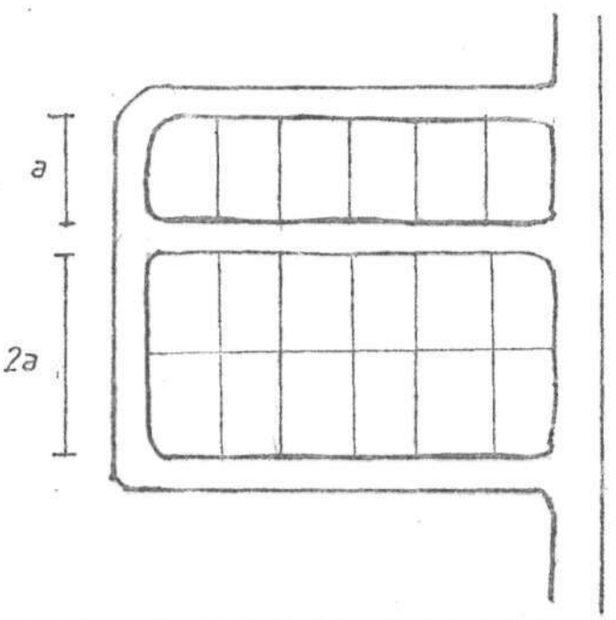
(e) Accessibility.

(a) Flexibility is an essential feature of industrial area planning. Industrial layouts must be flexible because space requirements of different industries vary enormously and





Possible plot combinations



Variation of plot depths to give flexibility

FIG 5.15 FLEXIBILITY IN INDUSTRIAL LAYOUTS USING MODULAR PLOTS

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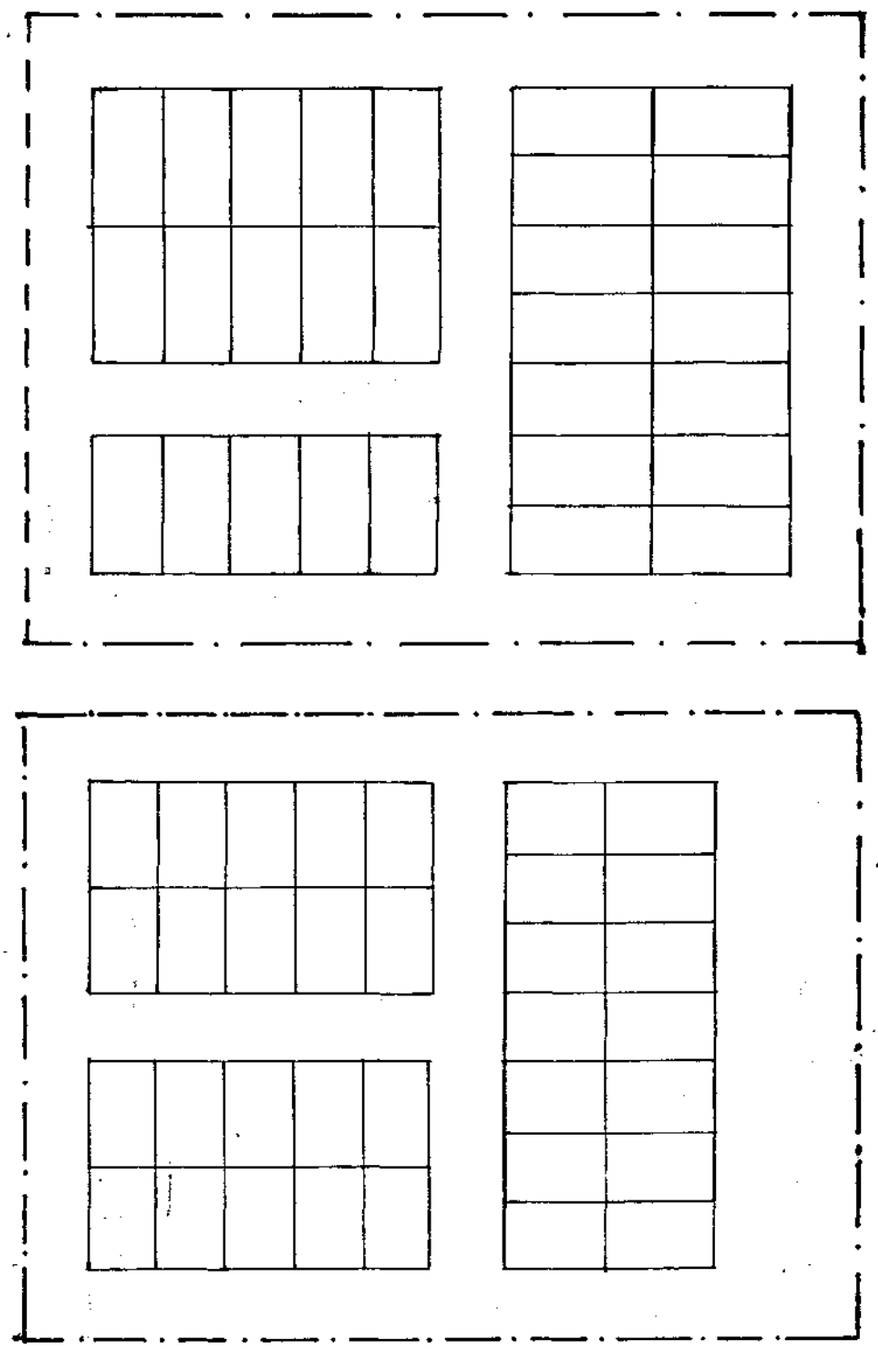
is quite difficult to foretell the kinds of industries that will be established in the industrial area. Flexibility can be achieved by adopting the following methods

(i) Modular plot size

(ii) Phase development

(i) Modular plot size - Adopting a modular plot size brings some measures of flexibility to the industrial area. This is because those industrialists that need more than the standard module could combine two or more plots depending on the space needs of the industry (Fig. 5.15). Another measure complimenting the modular plot, is to vary the plot depth. This will give plots of various dimensions and at the same time permit plot sizes to be made larger or smaller (through plot combinations) as the demand reveals itself.

(ii) Phasing Development - Under this the development of the industrial area is carried on in stages or "instalments". Thus utility extensions, street construction and other site improvements are carried out in stages and not all at the same time. In other cases,



A.
Big plot depth small area goes to streets

B.
Smaller plot depth more area goes to streets

FIG 5·16 RELATIONSHIP BETWEEN PLOT DEPTH AND STREET SPACE.

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particularly where large sites are to be developed, the development is carried out in phases - commencement of next phase being dictated by the completion and occupation of existing site. Phasing enables the initial costs of development to be kept down and allows the future flexibility of the layout to be retained.

(b) Economy: Industrial layout plans should be designed with a view to minimising the development costs. This could be achieved by using simple designs and also by keeping street areas, utility extensions and rail sidings to a minimum without sacrificing service or efficiency. To achieve this plot depths should not be shallow because the shallower the plot depths the more the area devoted for streets and rails rights of way.

(c) Functionality: All elements in the industrial area must be functionally related to each other. This means that the plots have to be located in relation to their functional relations. Communal facilities and open spaces must also be related to the industrial area. Parking spaces loading and unloading

facilities must be located in the right places and must be related to the functions of the area.

(d) Aesthetics: There must be some landscaping in our industrial areas to improve the visual environment. In addition trees should be planted along the main roads to provide shade and screen some parking areas and loading and unloading areas too.

5.20 RECOMMENDED STANDARDS

5.21 Need for Standards: Standards give measurement units or quantitative expressions of the terms appearing in the statement of planning principles. In other words, principles of planning give broad statements while standards supply the quantitative or measurable units of such statements. Standards proposed in this chapter are based on the recommended principles.

In a developing country like Nigeria, standards are essential in providing a healthy, efficient and satisfying environment for the individual and the community. This is more crucial in some portions of the city like the industrial areas where lots of hazards and nuisances are produced. Standards for the design, layout and development of industrial areas are necessary in order to:

(i) ensure that industrial environment is conducive and does not pose any health hazards.

(ii) provide a convenient, efficient and functional access to and circulation around industrial establishments.

(iii) ensure efficiency, economy of amenities in the industrial areas.

(iv) ensure optimization in the use of land and other resources.

The standards proposed are based on the findings of this study. They are therefore emperical and indegeneous.

5.22 Landuse Structure: The allocation of land in an industrial area depends on certain considerations such as the type of industries, the size of the industrial and land values in that community. A general recommendation is given below in Table 5.1.

Table 5.1: RECOMMENDED LAND ALLOCATION FOR INDUSTRIAL DEVELOPMENTS IN NORTHERN NIGERIA.

Landuse Category in Percentage	Existing		Western Nigeria	Recommended
	Kaduna	Kano		
Factory	69.30	55.22	45-50	55
Internal Circulation	21.80	36.12	10-15	25
Open Spaces	4-20	5.09	20-25	5
Utilities Facilities and Services	2.62	1.65	15-20	10
Other uses	2.02	1.92	5-10	5
Total	100	100		100

5.23 Plot Size: Plot sizes have been categorised into small, medium and large. This is based on the type of industry, its scale of operation and factory floor area requirements. Appendix II gives the types of industry, where the plot sizes are applicable.

Table 5.2: RECOMMENDED PLOT SIZES.

Plot size in metres/scale of operation	Existing		Western Nigeria	Recommended
	Kaduna	Kano		
Small	1.39	0.54	0.4-0.8	0.4 - 0.6
Medium	2.78	1.08-1.4	0.8-1.2	, 1.2
Large	3+	2+	1.2-1.6	2+

The recommended plot ratio is 2:1.

5.24 Plot Coverage: Good coverage is essential to give enough space for circulation, open spaces, parking, loading and unloading facilities within the factory plot.

Table 5. 3: SUGGESTED PLOT COVERAGE

Plot size/ percentage coverage	Existing		Western States	Recommended
	Kaduna	Kano		
0.4-0.6m	-	-	30-35	40
1.2m	31	20-39	"	35
2+m	28	22	"	35

5.25 Plot Area Ratio: The following has been recommended as the floor area ratio standards.

Table 5. 4: RECOMMENDED FLOOR AREA RATIOS

Plot Size	Plot Coverage	Floor Area Ratio (FAR)
0.4-0.6	40	40
1.2	35	35
2+	35	35

5.26 Setback Lines: Setback lines provide for easy movement of people, vehicles and installation of utilities and services. The distance to be reserved as setback is determined by many factors such as the intensity of landuse, plot size, height of building and the hierarchy of road. Table 5.25 gives the recommended setback lines. This is based on the size of factory plot and road hierarchy.

Table 5. 5: RECOMMENDED SETBACKS FOR INDUSTRIAL ESTABLISHMENTS.

Plot size/ Setback in Metres	Existing						Delhi			Recommended		
	Kaduna			Kano								
	F	R	S	F	R	S	F	R	S	F	R	S
0.4-0.6m	-	-	-	-	-	-	6	5	5	6	5	5
1.2	12	10	5	16	15	5	15	15	6	15	10	6
2+	15	15	5	10	10	6	15	15	6	15	15	10

F = Front

R = Rear

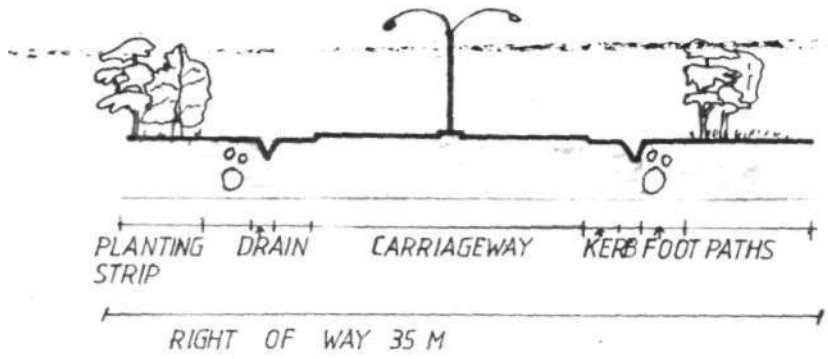
S = Side

5.27 Road Width: Roads in industrial areas should be designed to convey not only pedestrians and vehicles but also other utilities like electricity cables, drainage runs and water pipes. The recommended road widths for carriage way and rights of way are given below. The basis for the carriage way width is the size of each lane and the number of lanes to be provided. For highway and major roads provision has been made for a central verge.

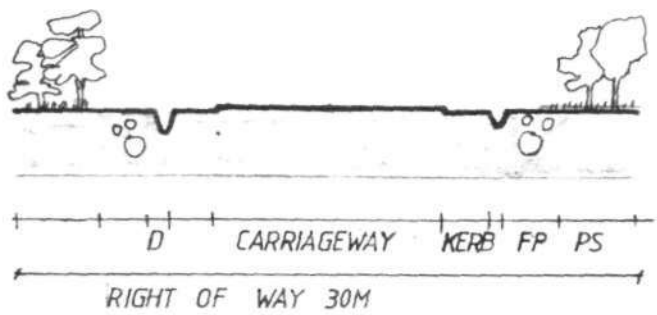
Table 5. 6: RECOMMENDED CARRIAGEWAY WIDTHS IN INDUSTRIAL AREAS.

Road Hierarchy/ Width in metres	Existing		Western Nigeria	Recommended
	Kaduna	Kano		
Highway	18	18	18-21	18-4 lanes each
Major Road	8	7.7	15-18	16-4 lanes 3.5m each
Collector Road	6.5	6.5	12-15	12-3 lanes 4m each
Access Road	6	6	9-10	7-2 lanes 3.5m each

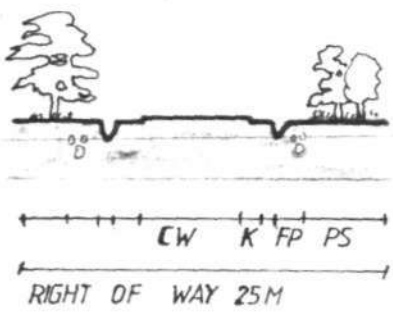
The streets right of way is determined by the dimension adopted for the widths of carriageways, curbs, side walks, drains and the planting strip (see Fig. 5.17).



MAJOR ROAD



COLLECTOR ROAD



ACCESS ROAD

Scale 1:500

FP Footpath
PS Planting strip
D Drainage
K Kerb
CW Carriageway

FIG. 5.17 PROPOSED ROAD SPECIFICATIONS AND SECTIONS.

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Table 5. 7: RECOMMENDED RIGHTS OF WAY WIDTH IN INDUSTRIAL AREAS.

Road Hiearchy/ Rights of Way in Metres	Existing		Proposed
	Kaduna	Kano	
Highway	50	50	50
Major Road	35	30	35
Collector	25	25	30
Access Road	20	20	20

5.28 Industrial Density: This is a measure of the intensity of the use of land in an industrial area. Industrial density depends on the type of industry and its processes i.e whether labour intensive or capital intensive and land values in a particular area. It is recommended that the land should be used judiciously. On this basis and on the basis of the need to provide more employment to the people, the following densities are proposed (Table 5.28). On a general note a density of 75 employees per gross hactre is recommended.

Table 5. 8 RECOMMENDED GROSS INDUSTRIAL DENSITIES BY TYPES OF INDUSTRIES (Persons per Hactre)

Types of Industry	Existing		Western Nigeria	Proposed
	Kaduna	Kano		
Small Scale	246	129	61-74	160
Medium	73	58-110	37-61	60
Large	55	32-56	24-37	40

5.29 Vehicular Parking: Two methods can be used for provision of parking spaces in an industrial area.

(a) The standard may be based on plot area. It is recommended that 15% of an industrial plot be devoted to vehicular parking of both visitors and factory employees. Another method is to provide one car parking space for each 93-186 square metre (1,000-2,000 sq. ft.) of factory space.

(b) Another method is based on the number of people employed.

A standard of 1 car parking space for every 15-20 employees, plus one parking space for each managerial staff. Visitors parking space should be provided at one visitor parking space for every 10 managerial personnel.

5.30 WATER SUPPLY

(a) The provision of water to an industrial area depends on the type of industry and its water requirement. Generally standards may be recommended based on water use of employee per day.

Table 5. 9: RECOMMENDED QUANTITY OF WATER SUPPLY TO INDUSTRIAL AREAS (In litres/employees).

Existing			
Kaduna	Kano	Western Nigeria	Recommended
138	105	91-114	120

Source: Field work (1984).

(b) Another standard recommended by Vagale and Adekoya (1974, p. 74) is the provision of 20,000 to 25,000 litres per hactre of industrial activity.

(c) The United Nations recommended standards to be based on water demand per kilogram of product (Table 5.30). This means the water demand of industries established in the industrial area could be accurately calculated.

5.31 Facilities:

(a) A standard canteen is recommended for each industry. This should be based on the cost to the employees.

(b) Toilets - 1 WC for every 9-10 persons giving room for visitors.

5.32 Performance Standards: Industrial establishements produce various types of wastes, pollutions, nuisances and hazards. These are in the form of air pollution, water borne and noise pollutions. To ensure a pleasant working environment the intensity of pollution must be kept to acceptable levels of tolerance from physiological and psychological points of view. This could be achieved by the use of performance standards. This standards are based on measurable external nuisances and usually a standard of acceptability is set. Industries that conform to the standard are said to be compatible and those that do not conform are incompatible or obnoxious and may require special location. Standards have been recommended for some sources of pollutants below.

Table 5.10: TYPICAL WATER DEMAND IN LITRE/KG OF INDUSTRIAL PRODUCT.

No	Industrial Product	Water Litre/kg of Product
1	Aluminium Smelling	1350
2	Baking	3
3	Brewing	15
4	Buttler	11
5	Cheese	20
6	Sulphonic Acid	10
7	Synthetic Fibres	200
8	Vegetable Canning	100
9	Concrete Component	1000
10	Oil Refining	10
11	Paper	160
12	Steel	45
13	Sugar	9
14	Glass	70
15	Laundering	30
16	Coal Mining	4
17	Fruit Canning	20
18	Wall-board	100

Source: Abdu, M.S. (1981).

(a) Noise

Noise is defined as any unwanted sound. To protect workers and neighbouring land uses from pollution, the following standards are recommended.

Table 5. 1: RECOMMENDED NOISE LEVELS TOLERATED IN INDUSTRIAL AREAS IN (dBA) DECIBLES

	Night	Day
Basic noise levels	55 dBA	55dBA
Maximum	70 dBA	80dBA

Source: Vulcan and Stephenson (1967) p. 965

(b) Air Pollution

Air pollution has tremendeous effects on human health. Many countries have enacted legislation on environmental standards to be adhered to in industrial premises. Sources of air pollution are smoke, dusts, fumes and gases. The maximum permissible ranges of concentration of air contaminants for safety and comfort are given below.

Table 5.12: STANDARDS OF COMFORT AND SAFETY FOR WORK ENVIRONMENT WITH REFERENCE TO AIR CONTAMINANTS

No.	Air Contaminants	Maximum Allowable Concentration
1	Gases	
	Sulphur dioxide	10.0 ppm
	Carbon tetrachloride	25.0 ppm
	Benzal	35.0 ppm
	Turpentine	100.0 ppm
	Naphtha (coal tar)	200.0 ppm
	Carbon dioxide	5,000.0 ppm
2	Toxic Dusts and Fumes	
	Cadmium	0.10 mg/cu.m
	Lead	0.15 mg/cu.m
	Mercury	0.10 mg/cu.m
	Zinc oxide	15.0 mg/cu/m

Source: Vagale and Adekoya(1974, 66).

(c) Distance Standards

Distance standards are recommended to separate industrial from residential zones depending upon the extent of the emission of fumes and smoke and the limits of allowable in residential areas and cities.

Table 5.13: RECOMMENDED DISTANCES BETWEEN SOURCES OF POLLUTION AND RESIDENTIAL AREAS.

Source of Pollution	Distance in Metres
Printing Works, Bakery	45
Brewers, distillers, machine works furniture makers, building trades, chemical clearers, cigaratte factory	100
Saw mills and joineries, firms making, agricultural machinery, brick works, French polishers	200
Gear-cutting works	350
Iron Foundary	400
Boiler makers	500
Battery manufacture	800
Blast furnace, manufacturers of Cellulose and paper	2,000

Source: Grandjean, E. and Gilgen, A. (1966) Environmental Factors in Urban Planning, Taylor and Francis Ltd., London.

The above recommended principles and standards for industrial area planning would be applied in the next chapter to design of an industrial layout for Kaduna.

CHAPTER 6

DESIGN OF AN INDUSTRIAL LAYOUT FOR KADUNA

6.10 Schedule of Requirements: This chapter is undertaken to demonstrate the methodology of applying principles and standards in the planning of industrial areas. The standards and principles recommended in the previous chapter will be applied to design an industrial layout for Kaduna.

Kaduna has experienced a boom in the industrial establishments especially the period between 1971-1980. This attributed to the economic situation of the country at the time. The economic situation currently prevailing in the country i.e economic recession has however slowed down the trend of industrial establishment. This situation is expected to be temporary. A survey and analysis conducted revealed that industrial activities in Kaduna will continue to grow.[1]

6.11 Number of Industries: According to projections by the Kaduna Master Plan review and proposals for the year 2015, industrial employees would reach 59,300 by the year 1995. It also revealed that the average employment in the industries is 404 employees per industry. From this two figures the number of industrial establishments likely to be established can be calculated.

---

1. Kulshrestha, S.K. (1984) Kaduna Master Plan: Review and Proposal for 2015, p. 84.

$$\text{Number of establishments to be established by 1995} = \frac{\text{Industrial employees (1995)}}{\text{Average employees}}$$

$$= \frac{59,300}{404}$$

$$= 146 \text{ Industrial Establishments.}$$

This means by the year 1995, (146-65) = 81 industrial establishments employing 5 and more workers will be established in Kaduna (65 is the number of existing industrial establishments,, 1985).

6.12 Land Requirements: The Kaduna Master Plan review showed that by the year 1995, industrial density in Kaduna would be 50 industrial employees/hactre. This is considered to be low compared with the recommended density of 75 industrial employees per hactre; therefore the recommended will be adopted with a view to making a more economic use of the land. The projected industrial land requirement for Kaduna will therefore be:

$$= \frac{\text{Projected employment}}{\text{Industrial Density}}$$

$$= \frac{59,300}{75}$$

$$= 791 \text{ hactres}$$

It is therefore necessary to develop (791-480) about 311 hactes in the next ten years (480 ha is the amout of developed industrial land presently).

6.13 Types of Industries: Kaduna is famous for textile manufacturing, car assembly, petroleum refining and metal products. It is envasaged that some small and medium industries likely to be related to the above industries will come up. Others are engineering industries - electrical and electronics, metal working and other assembly plants - this is due to the presence of steel mills in the country. With the governments campaign of back to the land and increased agricultural output agro allied industries such as flour mills, corn flakes factories are expected in Kaduna.

6.20 Site Selection

The existing industrial areas in Kaduna are established south of the Kaduna river. This is as a result of the efforts by the planning authority (KCDB) to mitigate the effects of environmental pollution from industry especially wind and water pollution. Considering all factors of location - good access, site factors, climate, utilities and services and need for future expansion four sites have been identified as suitable sites for industrial establishments.

(i) Along Lagos Road just at the edge of the present built up area.

(ii) Western bye-pass near Lagos road junction.

(iii) Abuja Road junction near western-bye pass.

(iv) An area near the Kaduna Refinery along Kachia road.

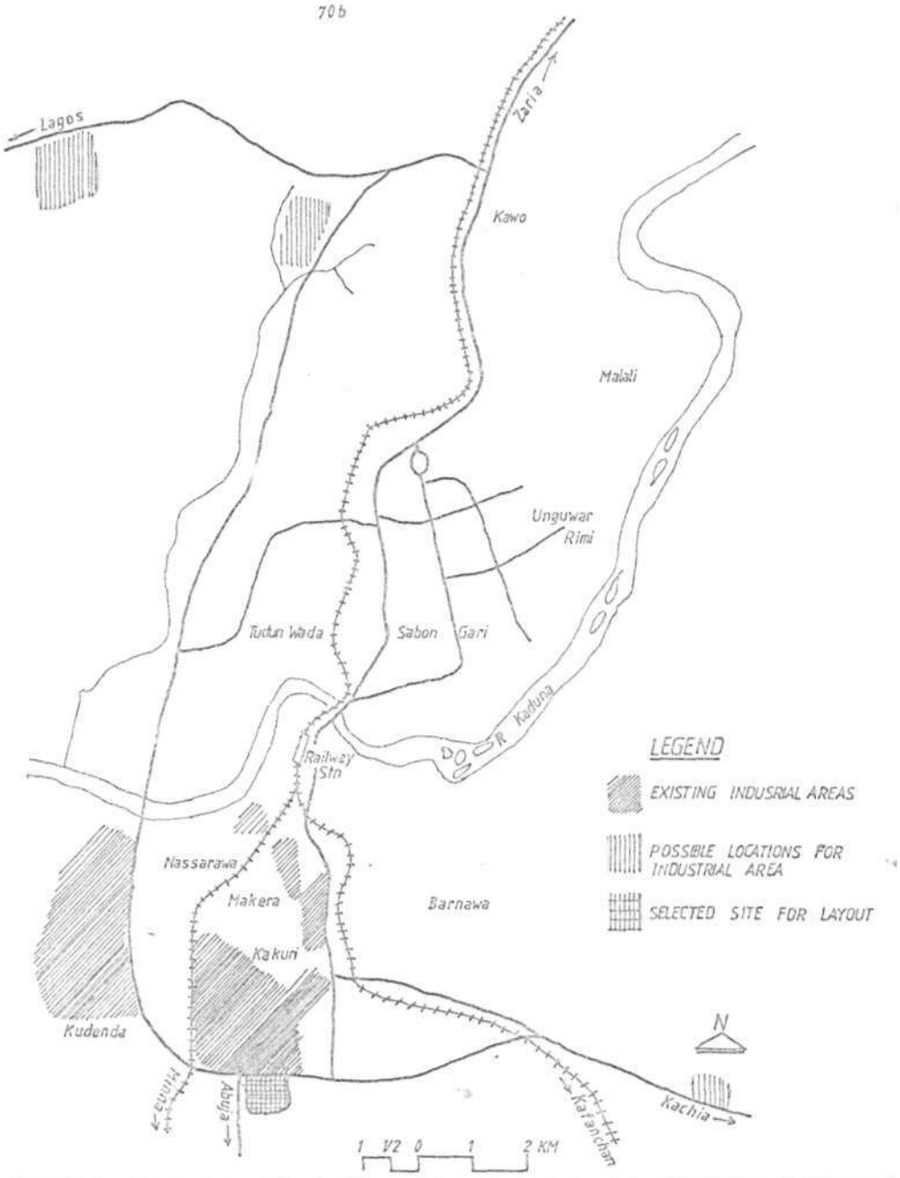


FIG.6.1 LOCATION OF SITE FOR LAYOUT IN KADUNA

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All these areas identified are suitable for industrial areas consisting of industries that do not produce liquid waste or noxious trade effluents. Of these industrial areas Abuja road junction site was chosen because the Kaduna State Department of Lands and Survey, Town Planning Division are preparing a new layout for this area. This layout may be regarded as a contribution towards such efforts because it will demonstrate to the ministry and government officials the application of the findings and recommendations of this thesis.

6.30 Site Analysis

The selected site is about 120 hactres. It is bounded on two sides by important roads - the western bye-pass and the Abuja road. At the southern edge, the site is bounded by a stream which could be used for effluent disposal.

A railway line - Lagos-Kaduna railway line is located about 800m west of the site. Utilities lines - water and electricity lines have reached the site boundary and can be brought to the site at the cheapest rate.

6.40 Landuse Proposals

The following allocation has been made in the industrial area.

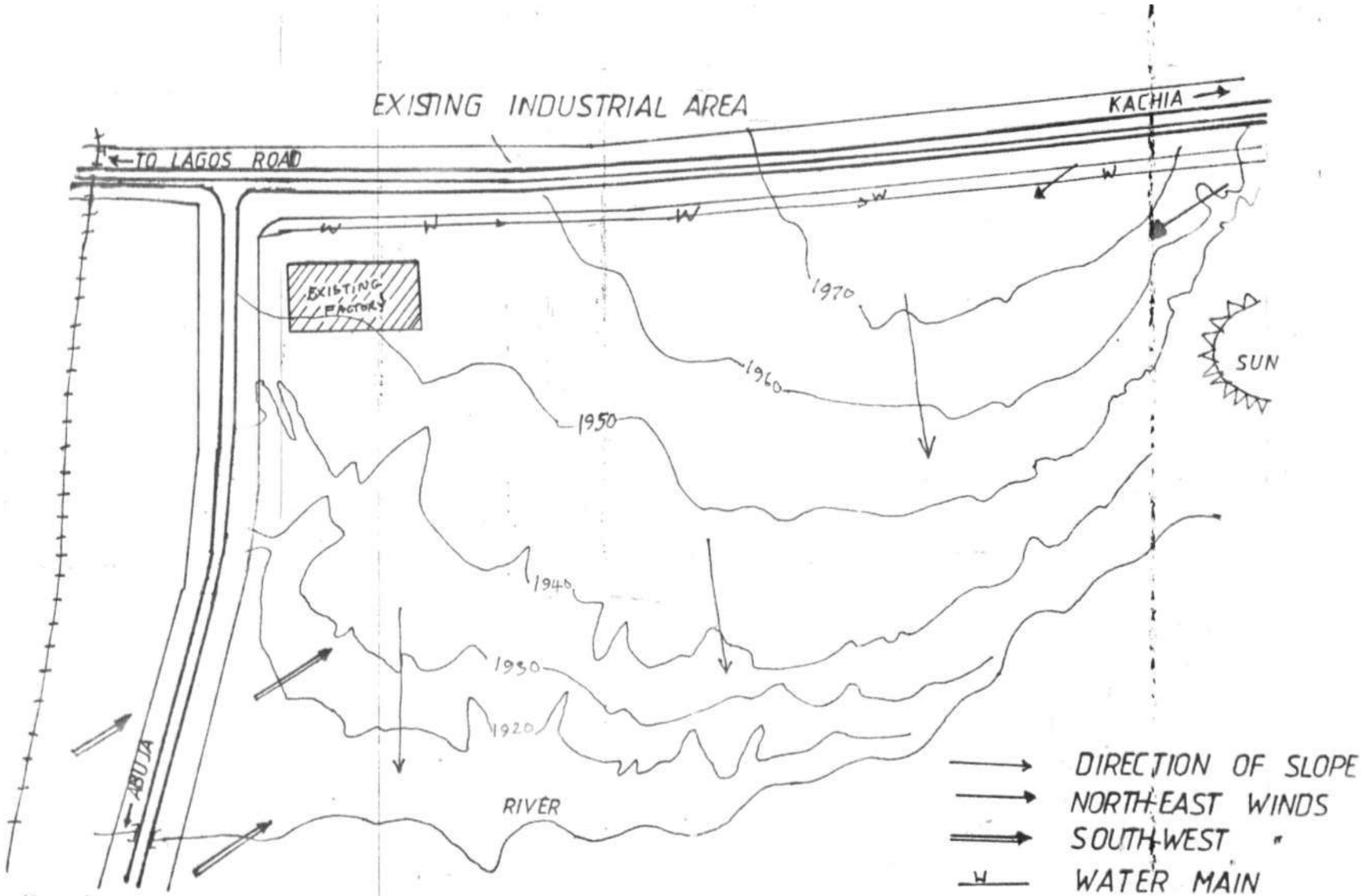


FIG. 6.2 SITE ANALYSIS.

Table 6.1: LANDUSE STRUCTURE OF THE PROPOSED INDUSTRIAL LAYOUT

Landuse	Area in Hactres	Percentage
Factory Plots	66	60
Internal Circulation	28.6	26
Open Spaces	4.4	4
Facilities and Services	7.7	7
Others	3.3	3

6.50 Transportation System

This is very important for the success of an industrial area. The following have been demonstrated.

(i) Functional classification of the road into hierarchies each with an appropriate carriage way and rights of way.

(ii) Road pattern is simple and regular no cross junctions and intersections have sufficient safe site distance.

(iii) Provision of pedestrian footpaths and a service road.

(iv) All industries are accessible by road system.

6.60 Grouping of Plots

Plots have been located according to the road hierarchy. Small plots have been located at lower hierarchy roads and large plots at higher order hierarchy of roads.

Plots have been grouped according to performance standards and needs of the industries. Those industries requiring waste disposal have been located near the stream for easy disposal of effluents.

6.60 Facilities and Services

Some facilities have been provided on communal basis. These include fire service, clinic, canteeens, post office and convenient shops. The facilities have been located centrally to facilitate easy access to all industries.

6.70 Landscaping

There is a proposal for planting trees on major roads and collector roads. Landscaping of the stream side has been proposed to give good site scenery and recreation facilities.

6.80 Flexibility

Some measures have been adopted to achieve flexibility in the layout. Modular plot sizes of 0.4 and 0.6 hactres have been adopted. These could be combined in various ways to give to larger plots of 1.2 and 2 and above hactres. This is a measure of flexibility. In addition the plot depths have been varied so as to have variety of plot sizes in order to meet the varied needs of different industrialists.

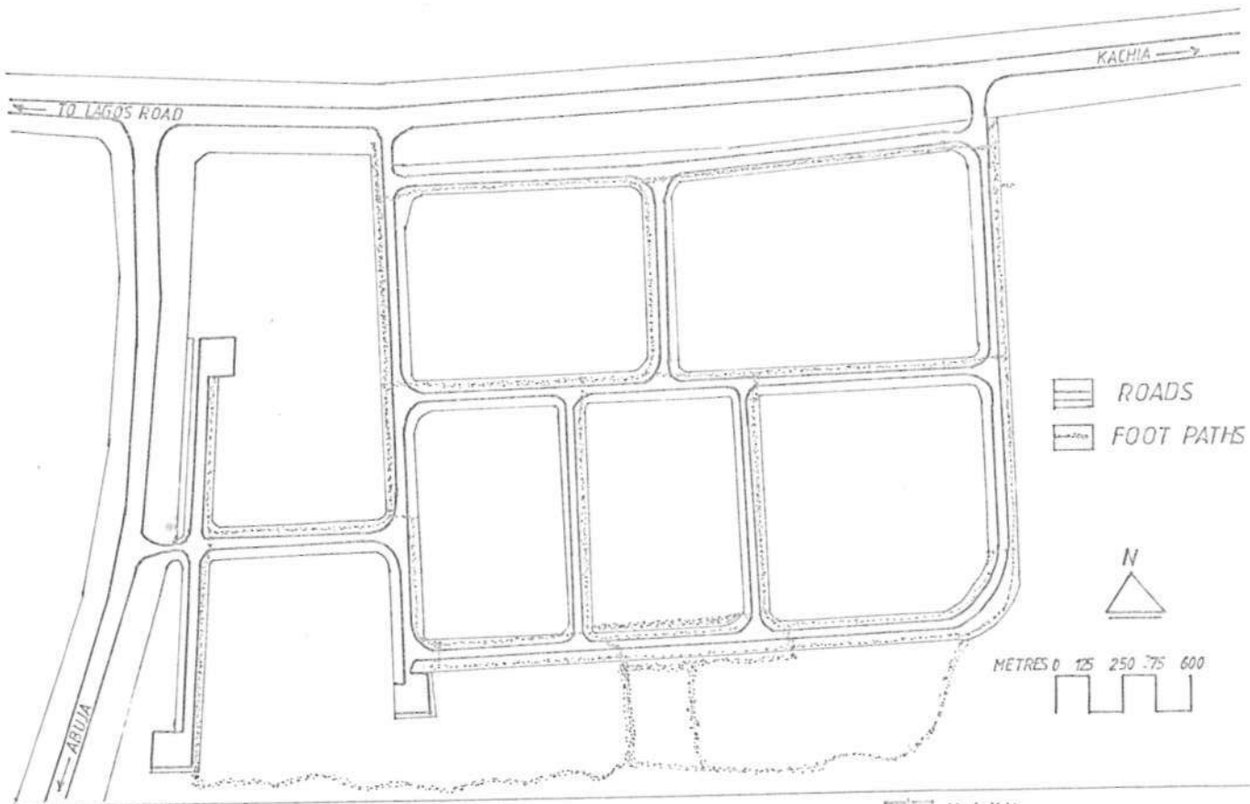


FIG 6.3 PROPOSED INTERNAL CIRCULATION

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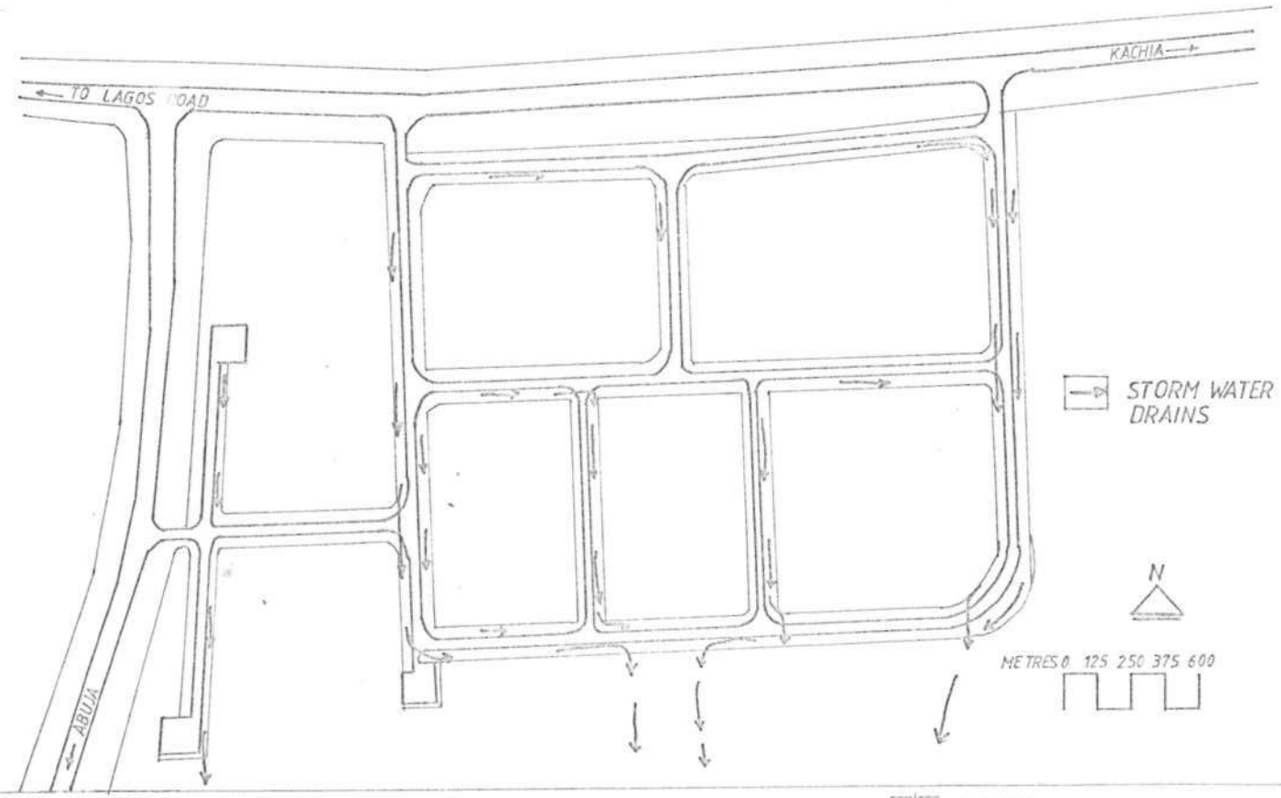


FIG 6.4 PROPOSED DRAINAGE NETWORK

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6.90 CONCLUSION

The study attempted to look at the existing design and layout characteristics of industrial areas in Kaduna and Kano. Some elements which are essential for the successful planning, design and layout of industrial areas were identified and used as indicators for comparism.

The study revealed that the industrial areas have some good attributes of location, design and layout. Industrial areas have been located near regional roads/ highways and railway lines. These facilitate the provision of both road and railway sidings at a very economic rate. Industrial areas in Kaduna and Kano are all located on flat sites or gently sloping land with good natural drainage like rivers and streams which allow for easy disposal of industrial liquid effluents. All the industrial sites are located near existing utility lines such as water mains and electricity lines.

The layout of the industrial areas has adopted high rather generous standards for road width, set backs, site coverage and plot sizes. These standards are similar in both Kaduna and Kano. Modular plot sizes are adopted in all the industrial areas. Plot sizes used in Kaduna and Kano vary. The plots are on the average, larger in Kaduna and smaller in Kano. However, there are striking similarities in the use

of space for factory areas especially in industries of the same type and scale of operation.

In the industrial areas of Kaduna and Kano the roads have been defined into hierarchies. However, the definition is not clear in some industrial areas such as Kaduna south industrial area. The newer industrial areas such as Sharada, the layout separated vehicular traffic from rail traffic thereby elininating multiple level crossings found in the older areas of Bompai and Township.

There are some problems related to the layout and design of the industrial areas. In Bompai, Township and Kaduna south industrial areas, there is multiple rail/road crossings and lack of vehicular and pedestrian and vehicular traffic segregation. There are no planned and integrated pedestrian routes in all the industrial areas studied. There is also the lack of organised open spaces and landscaping in the industrial areas. Communal facilities in the industrial areas are also found to be inadequate. It has also been found that the land in the industrial areas is not used economically and there is the wasteful use of land especially in Kaduna where low standards of industrial density and site coverage are adopted.

Based on the findings - the good attributes and problems, some principles and standards for industrial area are proposed. These include principles on locating

an industrial area in urban centres and the means of mitigating the environmental hazards of industrial areas located on the windward side of the city such as Bompai and Township industrial areas in Kano. Others include principles on grouping of industries, internal circulation systems, landscaping and the provision of communal facilities.

Standards have been recommended for landuse within the industrial areas, plot sizes and coverage, road width and industrial density. Performance standards, setting the maximum allowable limits of discharge of some environmental pollutants have been recommended. The basis of the standards has been the actual needs of the industries and current economic situation - i.e economic use of resources available.

The study finally demonstrated how some of those principles and standards proposed could be applied. This was done by designing an industrial layout in Kaduna.

This study will be of some benefits to the State's Ministries of Lands and Town Planning Authorities responsible for planning industrial areas. Experience has shown that well designed industrial areas are not only visually pleasing but will increase worker productivity and provide a healthy working environment as well as helping to achieve a habitable urban environment.

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APPENDIX I

OBNOXIOUS INDUSTRIAL BUILDINGS

The following industries have been regarded as obnoxious.

Blood boiling

Bone boiling

Tallin melting

Fat meting or extracting

Soap boiling

Fellmongering

Skin curing

Leather dressing

Tanning

Glue making

Fish curing

Fish oil manufacture

Brick and tile burning

Malt making

Yeast making

Candle making

Rubber latex co-agulating

Cement and line manufacture

Sintering of sulphur-bearing materials

Cocoa butter manufacture

Source: Cla, C.S. Town and Country Planning Law in Nigeria.

APPENDIX II

INDUSTRIES AND PLOT SIZES

The list of industries that would occupy the three types of plots proposed is given below. It should be noted that that some industries could fit into the whole 3 groups depending upon thier scale of operation and intensity of landuse. In amy case an industry may combine two or more plots depending on its needs.

Small Plots

(a) 0.40 hactres

This will be able to accomodate these industries.

- Furniture works
- Steel and Metal works
- Cosmetics
- Chemical Industries (Match Making)
- Shoe Factories

(b) 0.6 hactres

- Tannaries
- Apparels Industries
- Car Repairs
- Confectionary
- Electrical Appliances assembly
- Bicycle accessories

Medium Plots (1.2 hactres)

- Carbonated water factories
- Plastics Industries
- Cotton lint manufacture
- Brass and Ornaments
- Tyre sole manufacture
- Metal working
- Packing materials and stationary

Large Plots 2+ hactres

- Flour Milling
- Brewing
- Textiles
- Fertilizer Manufacture
- Asbestonic Building Materials.