AIRPORT '88

- the development of Kaduna International Airport

BY
OLADAPO BABATUNDE ADELEYE

A thesis submitted to the Postgraduate School, Ahmadu Bello University, Zaria, as a partial fulfillment of the requirements for the award of the degree - MASTER OF SCIENCE (ARCHITECTURE)

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

July, 1988

DECLARATION

I, ADELEYE Oladapo Babatunde, hereby declare that this is my authentic work under the guidance of Architect Fred Addo, and the chronological sequence of texts in the compilation and edition of this write-up remains solely the achievement of the author.

No part of this work may be produced, stored in a retrieval system, or transmitted in any form, or by any means except in the case of quotations without the prior permission of the Department of Architecture, Ahmadu Bello University, Zaria, Nigeria.

Signature

22nd Aug., 1988
Date

CERTIFICATION

This thesis entitled AIRPORT '88 - the development of Kaduna International Airport by ADELEYE, Oladapo Babatunde meets the regulations governing the award of the degree of Master of Science (Architecture) of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

Chairman, Supervisory Committee _____

Member, Supervisory Committee _____

Member, Supervisory Committee _____

Head of Department _____

Dean, Post-Graduate School _____

DEDICATION

God gave me a precious gift
A gift beyond compare
For he gave me to a gracious mother
Of love, tender and care.

This work is specially dedicated to my mother,
Chief (Mrs) R. A. Adeleye.

In the begining was the word
The word was with GOD
And the word was GOD
Through him all things were made
And without him nothing was made.

Thankfully dedicated to him without whom nothing would have been possible.

ACKNOWLEDGEMENT

I am indebted to Arc. Fred. Addo for his thorough supervision of my work and other members of my supervisory committee for their constructive criticism. They include Dr F. Schwerdtfeger, Arc. (Mrs) Altine Mohammed and Arc. O. Ogunsote.

I am grateful to the entire staff of Nigerian Airport Authority (N.A.A), Kaduna particularly Engr. Saleh Dunama and Mr Kehinde Ogunleke; the Airport Managers and their staff, N.A.A. Jos and Port-Harcourt; Alhaji Sule Abdul, the Resident Engineer, Aminu Kano International Airport, Kano; the Nigeria Airways Station and Duty Managers at Kaduna International Airport; the Manpower Development Officer and the Librarian of Nigeria Institute of Transport Technology, Zaria; the Co-ordinator, and ..; the Library staff of Nigeria College of Aviation Technology, Zaria; and Dr I. C. Ogwude, a senior research fellow, of the transport research section at the Centre for Social and Economic Research, A.B.U. Zaria for their co-operation and willingness to help.

I wish to extend my gratitude to certain individual who had at one time or the other made considerable impact on me as an architect-trainee. They include Professor E. A. Adeyemi, Professor Shim Adesina, Dr O. Solanke, Arc. Czernewski, Arc. Akin. Odeyemi and Arc. Yinka Obotosho. They made me realise that the frontiers of architecture knows no limit.

I thank my parents, brothers and sisters for what they have been able to give. Momsie, your love had always been overwhelming.

I wish all my numerous friends success in all their endeavours.

Finally, I am thankful to GOD for giving me life abundantly.

ABSTRACT

Architecture is that field of human, endeavour that concerns itself with man's essence of being, in a comfortable environment. Architecture can only foster enjoyable experience and consequent appreciation if its commitment is total. Man has failed to recognise the fact that the architectural vocation of any particular place should be governed by the culture of the inhabitants and the nature of the place. By recognising human and social needs, and by application of suitable strategies and techniques of design, all the complex requirements of architecture can be reconciled and integrated into structures which are both humane and efficient.

The effectiveness of a transportation system in commonly measured in terms of its ability to efficiently process the transported unit, and the performance of an airport system is dependent upon the individual components which comprise it.

Kaduna International Airport requires sequential utilisation of several facilities and as such its overall efficiency had been limited by the characteristic of the least efficient component which is the passenger and baggage handling facility.

AIRPORT *88 is an attempt at providing an ideal passenger terminal system that responds to passenger comfort and convenience requirements; that provides a favourable atmosphere fo airline operators and airport management; that satisfies the peculiar nature of Kaduna International Airport as regards domestic and occasional international flight operations; and that will accommodate possible organisational, economic or technological changes.

Development is the act of growing, increasing, becoming more complete and thus paving way for economic possibilities. Essential facilities that are required for the technical competency of Kaduna Airport are available in serviceable condition. Put lack of a proper passenger terminal system hinders its commercial viability. Thus, the end product of this research is a contribution to the development of Kaduna International Airport.

"For me aviation has value only to the extent that it contributes to quality of the human life it serves".

Charles A. LINDBERGH, 1972.

New concepts in airport planning, aerodrome and terminal design has to replace obsolescence in airport thinking and new independent growth and design philosophy should be fostered in total airport design.

New concepts in airport terminal designs such as variable geometrics, flexible modular extrusions, both on airside and landside airport airport design as well as renewed thinking in vertical extension is overdue ----------

William F. Shea

Whatever space and time mean, place and occasion mean more.
For space in the image of man means place, and time in the image of man means occasion ----------

Provide that place, articulate the inbetween ----------
Get close to the shifting centre of human reality and build its counter form - for each man and all men.

Van Eyck

TABLE OF CONTENTS

		PAGE
	Abstract	v
1.	Introduction	1
1.1.	Problem Statement...	4
1.2.	Motivation	4
1.3.	Goal	4
1.4.	Objectives...	5
1.5.	Scope	6
1.6.	Architectural Significance	6
1.7.	Constraints	6
2.	The Development of Air Transportation in Nigeria.	7
2.1.	Man's quest for better transportation	8
2.2.	The history of air transportation in Nigeria ...	9
2.3.	The role of the government in the development of air transportation	11
2.4.	Commercial flight operation in Nigeria... ...	14
2.5.	An appraisel of air cargo	18
2.6.	Problems and opportunity	23
3.	Issues	26
3.1.	Air traffic control	42
3.2.	The passenger terminal system - a worldwide overview	27
3.3.	The passenger terminal building - I.C.A.O. recommendations	34

		PAGE
4.	Program Study	45
4.1.	Checklist of basic planning ojectives	46
4.2.	Checklist of detailed design requirements	51
4.3.	Space determination	67
4.4.	Evaluation of alternative concepts	73
5.	Case Study	85
5.1.	Dulles International Airport...	86
5.2.	New York International Airport	89
5.3.	Jos Airport	92
6.	Site Study	98
6.1	Kaduna	99
6.1.2	Location and History	99
6.1.3	Physical Features	100
6.1.4	Services	102
6.2	Airport Site Selection	102
7.	Design Report	111
7.1	Reflections on the Nigerian Transport Industry - the views of the N.A.A. officials	112
7.2	Brief	117
7.3	Brief Development	117
7.4	Schedule of Accommodation	118
7.5	Sketch Design	
8.	Sumary and Conclusion	124

LIST OF TABLES

1. Distribution of Domestic Passenger Traffic in Nigeria 1979

2. Growth Rates 1971 - 1978 Passenger, Freight and Mail Traffic Nigeria Airways.

LIST OF FIGURES

3 - 1	Hand Baggage Regulations
4 - 1	Passenger/Year Relationship Models
4 - 2	Typical Blast Deflector Fences (Metal)
4 - 3	Typical Blast Deflector Fences (Concrete)
4 - 4	Sattelite and Pier Terminal Concepts
4 - 5	Linear and Transporter Terminal Concepts
4 - 6	Vertical Distribution Concepts
5 - 1	Plan, Dulles International Airport Terminal Building
5 - 2	Section, Dulles International Airport Terminal Building
5 - 3	Plan and Section, United Airline Terminal Building New York International Airport
6 - 1	Map of Nigeria Showhing 21 states and available airports
6 - 2	Mean Monthly Rainfall in inches for Kaduna
6 - 3	Mean Relative Humidity for Kaduna
6 - 4	Mean Daily Air Temperature for Kaduna
7 - 1	Components of the airport system
7 - 2	Components of the passenger terminal systems
7 - 3	Flow plan diagram

chapter 1

introduction

M.SC. THESIS

architecture dept.
ahmadu bello university
zaria.

july, 1988

adeleye, o. b.

airport '88

the development of ....

KADUNA
international
AIRPORT

KASHIM IBRAHIM LIBRARY
AHMADU BELLO UNIVERSITY
ZARIA, NIGERIA.

An airport is a quasi-city devoted to dynamic movement. It comprises of varied structures that facilitate passenger and cargo movement, maintenance and aircraft control, and structures that provide auxilliary support services.

Architects who regard airport as opportunity are correct in that a sense but often they are unaware of its full implications. There has never been a field where the basic skills of architecture had been more necessary or have met more negative constraints.

Air travellers must have encountered the consequences of those constraints: bleak and confusing terminals; exhausting delays on ticket lines; more hikes on foot with heavy luggage, traversing unreasonable distances mandated by convenience and configuration of machines; demands upon traveller's time and person, serving no purpose but the proprietary image of airlines; shrinkage and withering of the quality of life, subservient to the economy of the machines and to the monstrous conditions they create. But here and there, there had been fragmentary victory by architects on behalf of people - so logical and so expensive.[1]

Foxhall (1973) said "But the airlines, not the travellers, are the essential clients of architects in this arena. So terminal design are for airlines, not travellers. Architects, whatever their social consciences must either deal with the goals of the client or pass along to those who will".

In the 1960s , a discussion on airport terminals would invariably lead to the question, is it big enough? The growth of the aviation industry was turbulent then: the rise in consumerism, a

devastating airline recession, an awakening to our responsibility to the environment, all had their effects. Airplanes too have become larger. Airline growth has stalled many cities. Noise which remained a problem now seems solvable.

One element that affects terminal planning which has remained constant is the passenger. Passengers still want to use the terminal easily, without confusion and with a sense of dignity.

Why Kaduna?

Kaduna International Airport was essentially established to serve a dual purpose. Firstly to fulfil the regulation of the International Civil Aviation Organisation (I.C.A.O., a specialised agency of the United Nations Organisation) which stipulates that a reliever airport of international standard must be situated not too far from an international airport so as to provide alternative landing facility in case there should be any difficulty. In this regard, the airport serves as an alternate to Aminu Kano International Airport, Kano.

Secondly, though the aeronautical demand of Kaduna metropolis warranted the establishment of an airport for domestic flight operations, Kaduna airport was planned with a bias on cargo. Peugeot Automobile of Nigeria (P.A.N.) used to air lift its automotive components from France through the airport in Kano. It was considered reasonable and promising economically to develop necessary air cargo facilities in Kaduna airport so as to enable P.A.N. (which is based in Kaduna) utilise it. Unfortunately, this idea was overtaken by events because P.A.N. now employs sea and rail

modes of transport.

1.1 Problem Statement

Despite the fact that Kaduna airport has its average annual passenger volume put over half a million, originates international flights and is viable for domestic flight operations; a proper passenger terminal system is lacking. This constitutes a hinderance to the commercial viability of the airport and causes a great deal of inconveniency to its user groups, namely the passengers and operating airlines.

1.2 Motivation

The effectiveness of a transportation system is commonly measured in terms of its ability to efficiently process the transported unit, and the performance of an airport system is dependent upon the individual component which comprise it. As in the case of Kaduna International Airport where the use of the whole system requires the sequential utilization of a group of facilities the overall efficiency had been limited by the characteristics of the least efficient component - passenger and baggage handling facility.

1.3 Goal

The aim of this thesis is an attempt in providing an ideal passenger terminal system by designing a passenger terminal complex within the context of Kaduna airport master-plan being the concept of its ultimate development. The purpose of this system is to provide the necessary interface between the passenger and the airport access mode, to process the passenger for the origination or termination of an air transport trip; and to convey the passenger and baggage to and

from the aircraft.

1.4 Objectives

Passengers (USER - GROUP 1)

1. Responsiveness to the needs of people relative to convenience comfort and personal requirements.
2. Provision of effective passenger orientation through the use of concise, comprehensive graphics.
3. Separation of enplaning and deplaning traffic routes to ensure maximum operational efficiency.
4. Provision of convenient access to public employee parking facilities, rental car areas and auxilliary facilities.

Airline Operators (USER GROUP 2)

1. Accommodation of existing and future aircraft fleets with maximum operational efficiency.
2. Provision of direct and efficient means of passenger and baggage flow for all groups of passengers, be it domestic, international, originating, terminating or transfer passengers.
3. Provision for economic, efficient and effective security.
4. Provision of facilities which will embrace the latest conservation measures (in terms of energy and manpower)

Airport Authority (SPONSOR)

1. Maintenance of the existing terminal operation, access system, runway system and other facilities during all stages of construction.
2. Provision of facilities which generate maximum revenues.
3. Provision of facilities which minimise maintenance

and operating expenses.

1.5 Scope

The passenger terminal complex shall comprise of

1. the passenger and baggage handling facility
2. the air traffic control facility
3. the Nigerian Airports Authority Office Accommodation.

1.6 Constraints

1 For security reasons, as being claimed by the offices that were consulted, information on several possible local case studies were not made available.

2 Available statistics are not adequate

3 Site selection is restricted to the area mapped out for terminal building in the master plan.

1.7 Architectural Significance

1. Designing a building that will respond positively to the personal requirements of individuals within each user group.
2. Designing a building in which the architecture expresses the specialness of air travel and relates the human scale to that of the aircraft. And thus, architecture that will reveal the terminal, not as static enclosure of space, but a place of movement and of transition.

chapter 2

the development of air transportation in Nigeria

M.SC. THESIS

architecture dept.
ahmadu bello university
zaria.

July, 1988

adeleye, o. b.

airport '88

the development of ....

KADUNA
international
AIRPORT

2.0 Man's Quest For Better Transportation

The history of man's progress through the ages is linked among others, with the development and improvement of transportation. It is vital not to underestimate the importance of man's being able to develop social, economic and political relationships with his neighbours. No community in isolation can develop to the full extent otherwise possible. History is filled with records of races and nation that florished briefly and then, because of lack of exchange of ideas and absence of external competition quickly faded and vanished from the scene.

Technology is the life blood of transportation which is the medium of infusing new breadth into the individual and into the nation. Before man discovered the wheel, he used sledges. The steam age, beginning in the early 19th century, freed man from dependence upon human and animal transport power, and vastly increased his movement capability over land and sea. In the last years of the 19th century, the invention of the internal combustion engine and the automobile provided man with flexible rapid transport over land, free of fixed routes required by rail rights-of-way and water channels.[1]

Greater speed meant fuller life - the sensation of speed itself had always had a great attraction. By travelling faster, man could see more of the world, could exchange ideas and goods with people far away and could develop a higher culture. Man watches the flight of birds with great admiration and dreamt of vehicles capable of carrying him through the air smoothly. His first efforts were in lighter-than-air balloons. He kept trying, and eventually succeded in accomplishing a powered flight of heavier-than-air machines.

On December 17, 1903, in the sand dunes of Kitty Hawk, North Carolina, two bicycle mechanics, Willbur and Orville Wright achieved the first sustained flight of an airplane powered with an internal combustion engine.[2] It lasted 12 seconds and travelled a ground distance of 40 metre. This epochal historical event that ushered in the air age was witnessed by only five people.

Following the Wright brothers' flight, development of aircraft and power plants was quite rapid. However, it is noteworthy that the greatest forces behind the development of the aviation industry has been the two world wars and fear of a third one. As early as January, 1914, the first rudimentary scheduled airline service in the United States started over 32 kilometre route linking Tampa and St. Petersburg in Florida. It did not last for long. Between 1914 and 1918, World War 1 accelerated the development of aircraft engines in terms of dependability and load-carrying capability. After the war, between 1919 and 1920, scheduled airline services started in Europe linking Paris and London.[3] In recent times, man has been able to move faster than even the boldest scientist would have dared to predict. Now in use are Supersonic Jets, like Jumbo Jet, Boeing 747, which is the heaviest commercial jetliner in history having a payload as high as 490 passengers at speeds well over 960 Km/h.

2.1 THE HISTORY OF AIR TRANSPORTATION IN NIGERIA

In the 1920's, several flights were made to Nigeria by the British Air Force Squadron based in Sudan. The first civil aircraft to land in Kano was a light aeroplane of De Havilland (DH) 'Moth' variety, privately owned, which was flown from Lagos to Kano in 1930.

No commercial flying took place until six years later when the Imperial Aircrafts inaugurated the first international airline service to Nigeria. The airline operated lights in four-engined DH 86 biplanes through Khartoum in Sudan connecting Cairo - Kisume route. The Lagos airport, as at then, could best be classified a landing strip on the fore-shore of Lagos - Island. During World War 2, the American Airforce Captioned "Allied Nations" operating under the West African Frontier Force built the airport at Ikeja for their use. At the end of the war, it was phased into civil use.[4]

Similarly, there was no airport facility in Kano for the first airline services to Nigeria. The Imperial Airways was using the polo ground in the north of the walled city, which had a maximum length of 400m. Later, the Public Works Department constructed two runways, - the main one running 1000m though extensible to 1500m in the direction of the prevailing wind, and the secondary one 800m long for use when cross winds were experienced on the main one.[5] The runways were later improved during the second world war. Taxiways were also constructed to build up the speed of military aircraft.

In 1946, the West Africa Airways Corporation (W.A.A.C.) was established to operate in the British West African Territories. The airline had its headquarters in Lagos and, operate regular domestic air services in both Nigeria and Ghana (then Gold Coast) and internationally to Dakar (in Senegal) and Kartoum (in Sudan). Her fleet of aircraft comprised of De Havilland Doves (DH 104), Bristol Way Farers and Freighters (B 170). Accra (in Ghana) was the actual base of the Way Farers and Freighters while the Doves were

handled in Lagos. There were very few private operators and one foreign owned general aviation aircraft which specialised in carrying out aerial photography and surveys. As at 1950, ten DH Doves and Bristol 170's belonging to W.A.A.C, one Piper belonging to Sudan Interior Mission and one Tiger Moth belonging to Mr Malcolm Brown were on the Nigeria register.

In 1960, Nigeria Airways was incorporated following the break-up of W.A.A.C. Most co-owners had to relinquish their partnership after their independence. The Nigeria Airways is a national airline charged with the responsibility of operating commercial flight services both domestically and internationally.

2.3 THE ROLE OF THE GOVERNMENT IN THE DEVELOPMENT OF AIR TRANSPORTATION

The oil boom of the early 70's sparked a boost in several of the country's industries, the aviation industry inclusive. The enhanced level of socio-economic development, resulting from oil boom, led to a rapid increase in the quest for air travel among the citizenry. Consequently, available airport structures and facilities became overstretched by an unprecedented upsurge in passenger and cargo traffics. The Federal Military Government saw a massive aerodrome development project as the solution to this problematic situation and subsequently conceived the idea of setting up an automonous body, the Nigerian Airports Authority (N.A.A) to implement the envisaged solution. This body was charged with the responsibility of developing and surbsequently managing airport and necessary supporting facilities through out the country.

In 1976, the Federal Military Government promulgated Decree 45 designated Nigerian Airports Authority Decree formally establishing the authority as a corporate and statutory body. However, it was not until July 11, 1977 that N.A.A. came into effective existence with the inauguration of a 10-man board of directors, to manage the affairs of the authority. Before then, the responsibility of developing and managing airports was under the direct jurisdiction of the then Federal Ministry of Civil Aviation. The N.A.A. had been endeavouring to achieve their purpose of establishment by ensuring the sustenance of and a steady improvement of airport facilities, some of which were designed to serve long haul intercontinental jets for international services and medium haul jets for domestic services as the case may be. A good number of airports including Ibadan, Port-Harcourt, Yola, Sokoto, Calabar, Jos and Akure airports have been commissioned since then. Presently, there are fifteen commissioned airports in Nigeria. Others include Lagos, Kano, Kaduna, Abuja, Enugu, Benin, Ilorin and Maiduguri.

At the inception, the Nigeria Airports Authority inherited a total of 2,000 workers from the then Ministry of Civil Aviation in the areas of engineering, administration, accounting and fire services. At that time, the authority did not have a clearcut organisational structure. There were five principal divisions namely technical development, personell, commercial, finance and operations. The legal, public relations, internal audit and training departments were later incorporated into the set-up. After sometime, the organisation was rejuvenated for greater administrative convenience and to reflect the commercial orientation of the authority.

The principal functions of the authority as laid down in the Decree 49 of 1976 are as follows:

- To develop and maintain at airports all services and facilities necessary for the safe operation of aircraft, excluding navigational aids.

- To provide accommodation and other facilities necessary for the effective handling of passengers and cargo.

- To provide and develop facilities for surface transportation.

- To carry out at airports, either directly or in partnership with either person or groups, such economic activities that are relevant to air transport.

- To formulate regulatory modalities for the development of air transport and supporting services in the most economic and efficient manner.[6]

The authority has since inception, established certain commercial subsidiaries purposely for revenue generation and operation rationalisation in the airports. They include

1) Nigeria Aviation Handling Company (NAHCO) - This is a joint venture between the N. A. A. and some foreign airlines in which the N. A. A. owns 60 percent equity shares. This company is one of the two empowered by the government to undertake aircraft handling operation at Nigerian airports.

2) Nigerian Airports Commercial Ventures (N. A. C. V.) - This is solely owned by the N. A. A., and its activities

spread from snack bars to restaurant services.

3) International Airport Consultancy (I.A.C.) - This offers consultancy service in aviation and transport related issues. It enjoys patronage of some African countries.

At this juncture, it would be necessary to mention other organisations that are connected with air transportation in Nigeria. The Civil Aviation Department of Ministry of Aviation is responsible for providing navigation aids and air traffic control services, while the Meteorological Department of the same ministry provides weather forecast required for effective flight operation.[7]

2.4 COMMERCIAL FLIGHT OPERATIONS IN NIGERIA

For the past three decades, the local air transportation industry has focussed primarily on the movement of people. Air cargo has been given a secondary role, only employed to fill available space on the passenger flights as belly cargo. Therefore, only the relevant aspects of civil aviation shall be discussed. These are Business Flying and Air Taxi Service. Business flying refers to that aspect of aviation being operated by companies and individuals who own and use their aircraft for transporting people and property in normal business operations. Some large companies and well meaning Nigerians own and operate multi-engined and well-equiped aircrafts. At one time the question "Why the business aircraft" was often asked. Why should airlines not serve companies? Today, the trial period has ended, and the

answers to those questions are ready and sound. It has been said that "having the right men, the right tools and the right equipment at the right place at the right time plays a vital role in the economic of modern business."[8] This saying explains why the aeroplane has become a logistical tool in modern business.

Air-taxi service concerns with transportation for hire by qualified individuals and companies who supply service on a contract or charter basis. There are quite a good number of air-taxi operators in Nigeria. The scheduled airlined among them are the national airline, Nigeria Airways and other privately established ones like Okada, Kabo and Gas airlines. Others like Skypower Express, Flash Airways, Imani Aviation and so on are non-scheduled carriers.

As at the time of writing this paper, the fleet of a serviceable aircraft belonging to the national airline comprises of eight Boeing 737, three Boeing 707, one Boeing 747, one Dc. 10 and four A310 air buses. Totalling seventeen in all. The Boeing 737 aircraft have the smallest passenger seating capacity which varies from 103 - 130 seaters. Two among the three Boeing 707 are cargo aircraft, while the only Boeing 747 is half cargo and half passenger seater. The national airline operates domestically in twelve out of the fifteen commissioned airports in the country. Ibadan, Ilorin and Akure are not operational as at now because of their non-viability. Their passenger volume is too low.

There are several international airports. Lagos, Kano and Port-Harcourt international airports actually originate international flights. Other international airports are Calabar for originating

non-frequent flights to the West Coast; Kaduna, Sokoto, Maiduguri and Ilorin for originating flights of Hajj Pilgrims.

Besides, Kaduna, Ilorin and Enugu are serving as alternate international airports for Kano, Lagos and Port-Harcourt respectively. An alternate airport is a reliever airport that should be established near an international airport to provide an alternative landing facility in case any difficulty should arise, and must be of similar standard in terms of facilities. Abuja international airport is peculiar in the sense that it rarely originates international flight but is located in the Federal Capital Territory. The remaining airports are meant solely for domestic flights operations. They include Benin, Jos, Yola, Ibadan and Akure.

Table 1 DISTRIBUTION OF DOMESTIC PASSENGER TRAFFIC IN NIGERIA BY AIRPORT, 1979

Airport	% of Passengers	Rank
Benin	10.5%	(2)
Calabar	2.9%	(7)
Enugu	8.0%	(6)
Ibadan	0.8%	(15)
Ilorin	0.9%	(12)
Jos	1.9%	(9)
Kaduna	8.9%	(5)
Kano	9.5%	(3)
Lagos	42.8%	(1)
Maiduguri	2.5%	(8)
Port-Harcourt	9.0%	(4)
Sokoto	1.1%	(11)
Yola	1.3%	(10)
TOTAL	100.0%	

Source: Nigeria Airways, as reported in the Statistical and Economic Abstract of the Nigeria Airports Authority.

Table 2 GROWTH RATES 1971 - 1978 PASSENGER, FREIGHT AND MAIL TRAFFIC NIGERIA AIRWAYS

	Average Annual Growth Rate
Passenger carried	35.2%
Passenger Kms	32.0%
Mail-tons	4.7%
Mail-ton-Kms	4.6%
Freight-tons	6.5%
Freight-ton-Kms	9.9%
Aircraft Kms flown	20.9%

Source: Nigeria Airways, as reported in the Statistical and Economic Abstract of the Nigeria Airports Authority.

2.5 AN APPRAISAL OF AIR CARGO

In Nigeria, the opportunity that is being offered by the air-cargo sub-industry is not being fully exploited. This might have been a result of non-awareness. With so many forms of transport, such as road, rail and water available, persons engaged in the movement of goods from place to place might ask 'why use air cargo?'.

There are several good reasons for using aircrafts to carry goods; there are also reasons which can preclude the use of aircraft under certain circumstances from the carriage of certain commodities, the decision wheather or not to use air-cargo would depend upon all the factors involved, particularly the 'unit value' and the over all cost.

The unit value is based on a comparison of the value of articles to be dispatched with their weight. For example, a carton of watch-pieces of ₦4,000.00 worth and having a gross weight when packed for dispatch, of two kilograms, is a cargo of high unit value. Conversely, a bag of cement at a value of ₦10.00, is a cargo of low unit value.

All goods which travel from the point of manufacture to a point of sale for consumption must include in the selling price the cost of transport. Therefore, the basic value of ₦4,000.00 would be increased by the amount of the freight paid for carriage to destination.

Assuming that both specimen consignments are flown from the same point of origins to the same destination, over the same route. Taking the freight rate to be ₦4,000.00, at two kilogram gross weight will incure a total freight of ₦8.00. The selling price will therefore be ₦4,000.00 plus the freight charge of ₦8.00, a total of ₦4,008. The freight equals 0.02 per cent of the basic value of the watches and such an increase would be acceptable. In this case, air cargo should be an obvious method of dispatch. The cement valued at ₦10.00 and weighing 50 kilogram will include a total freight of 50 x 4.00 - ₦200.00. In this instance, the selling price would be ₦210.00. The freight charge of ₦200.00 represents 200 per cent or 20 times the basic value of the cement. Such an increase in the cost of an article could never be accepted under normal circumstances. Therefore air cargo would not be an acceptable method of dispatch.

The above examples show that goods with a high unit value are more suitable as air-cargo that goods that has low unit value. The same applies to perishable agricultural produce that could be in high demand in their destinations. For example, in Nigeria there is a relative potential in the production of certain agricultural goods. Vegetables like tomato grow better in the north while fruits like oranges grow better in the south.

Some advantages that could be enjoyed by sending goods by air are discussed below.

1. Speed: The speed of the conveyance, that is the aircraft is obvious. The aircraft convey from one place to another more rapidly than any other forms of transport. The speed of handling, the air-craft convey less cargo than ships and consequently can load and discharge more quickly. Because of the speed of aircrafts, they can return for further loads more frequently.

2. Less costly Packing: As cargo carried in aircraft is handled and stored in a different manner from that of ship. It is possible to use less robust materials, and methods of packing. These light-weight materials usually cost less. Some countries even impose custom duties on gross weight of a consignment. In that sense, this could result in some savings.

3. Lower Insurance Preium: With greater speed of transit, the reduced handling and the more rapid movement through the transit sheds, the goods are subjected to less loss, damage or pilferage, for a greatly reduced period of time. This reduction in risk has resulted in lower insurance premium.

However, the fact that aircargo can offer certain advantages to many shippers does not mean that it can replace other forms of transport. Air cargo is a useful and very necessary supplement to those means of transport which has existed for long, and as such, certain demerits that disqualify air-cargo from replacing other forms of transport are discussed below.

1. <u>High freight rates in relation to value (low-unit-commodities)</u> this is basically the main disadvantage. The variation between air-cargo rates and surface transport rates is less critical when goods are to be conveyed between towns and cities which are not a great distance apart. The greater the distance, the less favourable is the rate of air-cargo.

2. <u>Restriction on the size of indivisible load</u> the limitation of the lifting equipment is closely associated with the type of location in which the airport is situated. If an airport is mainly used for handling passengers with only small 'feeder' type of aircrafts, it is not likely to have equipment that can handle heavy single pieces of cargo. The very type of aircraft normally using the airport governs the average pieces of cargo which can be handled.

3. Severe restriction imposed on certain cargoes which are of harzadous nature. Manufacturers of some commodities may agree that their products are of sufficiently high unit value to use air cargo economically. They may be able to gear up their marketing program to rapid delivery by air instead of bulk stocks held at depots overseas. Unfortunately they may be deprived of such benefits as are available to others, by the very nature or content of the product. Certain goods of harzadous nature are restricted, and others prohibited from being carried by air. Similar cargoes may be subjected to special conditions when they are conveyed by other forms of transport, but none is likely to be as strict as those imposed for carriage by air.

2.6 PROBLEMS AND OPPORTUNITIES

It is not the intention here to make predictions for the future. There is, however, some purpose in looking into possible ways in which the expansion of air cargo may ease the transportation of goods in Nigeria. The aeroplane has been said to make the world a smaller place, it has certainly enabled many of the ordinary people of the world to meet their opposite numbers in other countries. A great understanding of the world is becoming possible by more people through air travel.

Nonetheless certain problems and opportunities that are existent in the present state of the air transport system are highlighted below:

Capacity Constraints:

Only a few of Nigerian airports are equiped for night or instrument operations. This makes it more difficult for domestic airports to achieve satisfactory aircraft utilization rate, as they must terminate operations on many routes by early evening. in order to avoid night time operations.

Economic Problems:

In spite of booming demand, domestic aviation in Nigeria is not viable in economic terms. The industry appears to be a net drain in Nigeria's national resources and unnecessarily so. In particular, the industry is subsidized by public funds. The fact that aviation requires costly imports makes this drain of resources a serious concern.

i. - The operating costs of aviation infrastructure are not covered by user charges.

In fact, most of the operating costs of the airports, terminals, navigation and communications system are out of general government revenues. Of these costs the navigation, meterological and communications services are not susceptible to imposition of user charges, and consequently are usually considered a legitimate government expense.

ii. - Air transport service is furnished primarily by a government financed parastal, Nigeria Airways. The public company looses money in a market that should be generating substantial economic and financial profits.

iii. - Pricing is another serious problem of Nigerian domestic air transport. In the past, domestic air fares have been held down. Even, if private competitors had been allowed in the market in the past, uneconomically low air fares would have hamper free market mobilization of capital holding down net operating revenues. Higher air fares would both reduce a drain on public resouces and encourage air increase in aviation service by better enabling the private sector market entrants to earn money on their operations.

Air Fleet Considerations:

The need to expand the domestic service on certain routes is evident. Three options exist: purchase of the new aircraft which best serves the needs of the routes; purchase of the best available

used aircraft taking advantage of its reduced price; or wet lease from other operators. If the decision is to purchase new equipment, current production models should be considered to forestall obsolescence and rapid depreciation. The current model of the Boeing 737 should be preferred to the new model which is being modified with suphisticated and expensive equipment, unnecessary under Nigeria domestic operating condition. Other aircraft worthy of consideration are the B-757, B-767 and A-310 Airlines. In spite of high initial costs these aircraft may provide advantages in the short to medium haul domestic service.

Smaller craft of the air commuter type may prove advantageous in two ways. By collecting small passenger enplanements at remote or lightly used airports and transporting them to regional airports, the cost per passenger kilometre would be reduced, or expanded service could be provided without increasing total operating cost. Secondly, if the larger aircraft did not lose time in servicing these small airports it would be possible to change schedules so as to better utilize every daylight hour.

chapter 3

issues

M.SC. THESIS

architecture dept.
ahmadu bello university
zaria.

July, 1988

adeleye, o. b.

airport '88

the development of ....

KADUNA
international
AIRPORT

3.1 THE PASSENGER TERMINAL SYSTEM - A WORLDWIDE OVERVIEW

On one side of an airport terminal building passengers are coming and departing by land modes of transport namely road and rail. On the other side they are arriving and departing by air. It may not therefore, be immediately clear that the signs 'Arrivals' and 'Departures' are refering to the passengers situation on the ourside of the building. The terminal building is usually designed in such a way that passengers who are begining a journey by air are completely separated from those who have completed a journey by air, and the sign 'Departures' is used throughout the building to guide passengers who are joining a flight.

3.1.1 Departures

There are usually enough porters available for passengers who want their baggage carried from the vehicle in which they arrive to the check-in desk. In some countries porters charge for carrying baggage in accordance with a published tarriff, usually so much a piece. They may then expect a gratuity proportionate to the total charge. In other countries the charge is not prearranged and it is settled between porter and passenger. In others, porters are paid a fair wage and there is no real need for passenger to pay any extra for the service. They will probably have to make a substantial constribution anyway in an airport service charge. If a porter does take a passenger's baggage he will ask for the name of the airline the passenger is flying by and the destination, they will guide the passenger to check-in desk where that flight is dealt with. So, besides carrying baggage, porters provide a valuable secondary

service as guides.

With or without the help of a porter the passenger must find his way to the right check-in desk. Sometimes, this means locating a section occupied by

the operating carrier on whose aircraft the passenger is flying. Sometimes it means locating a section occupied by an airline acting as handling agent for the operating carrier. Sometimes all or most of the flights from an airport are handled by the national carrier who acts as agent for all other carriers. At some airports all flights are handled at all check-in points. At others each check-in point deals with a particular flight. A passenger not employing a porter does well to spend a few seconds looking at the signs above the check-in counters to sum up the whole situation rather than immediately joining the shortest queue.

The check-in desk, or passenger agent, or whatever the official at a check-in counter is called, likes to see a passenger's ticket before discussing any details. The ticket is a complete record of the contract between an airline and a passenger. Because the ticket contains all the facts, passenger clerks are naturally reluctant to begin talking without seeing it. If the passenger has not obtained his ticket he often has to be refered to a separate ticket reservation counter, which is another reason why the check-in clerk does not want to become involved until he has seen the ticket. If several people are travelling together the clerk will usually ask to see all the tickets at once. Sometimes an irregularity in the ticket of say one member of a family travelling together may call for changes in the travel arrangements of the whole family.

When the check-in clerk has verified the ticket he will begin to complete it. Baggage is weighed, number of pieces are noted and details recorded on the ticket. Labels are attached and counterfoils clipped to the ticket. The baggage is then taken away and held until it is loaded on the aircraft. The clerk will want to see and weigh any hand luggage the passenger wishes to carry with him into the passenger cabin.

Some airlines ask the passengers to mark all baggage including what they take with them into the cabin, with their names and addresses in case an article is mislaid. Special labels may be provided for this purpose yet. Baggage should contain personal effects only but commercial samples may be carried provided customs regulations are complied with. Baggage taken into the cabin is usually limited either by weight or dimension, but in general includes items such as typewriters, nightbags, brief-cases, ladies vanity cases and large cameras. Under the regulations of the International Air Transport Association these items have to be included as part of free baggage allowance.[1]

Passengers are advised to avoid putting certain types of articles into baggage into the aircraft hold. These include fragile and perishable articles, money, jewellery, silverware, negotiable papers, securities and other valuables, samples or business documents. Bottles containing liquids should have screw caps and should be firmly closed. State regulations prohibit the carriage on aircraft of a number of articles including inflammable or explosive material, and passengers are reminded that they may not carry with them or in their baggage things such as cylinders of

HAND BAGGAGE REGULATIONS OF THE INTERNATIONAL AIR TRANSPORT ASSOCIATION

PLEASE DO NOT ASK OUR PERSONNEL TO EXCEED THESE FREE ARTICLES IN ANY WAY AS THEY ARE NOT AUTHORIZED TO COMPLY WITH SUCH A REQUEST.

A LADY'S HANDBAG, POCKETBOOK OR PURSE, WHICH IS APPROPRIATE TO NORMAL TRAVELING DRESS AND IS NOT BEING USED AS A CONTAINER FOR THE TRANSPORTATION OF ARTICLES WHICH WOULD OTHERWISE BE REGARDED AS BAGGAGE.

AN OVERCOAT, WRAP OR BLANKET.

AN UMBRELLA OR WALKING STICK.

A SMALL CAMERA AND/OR A PAIR OF BINOCULARS.

A REASONABLE AMOUNT OF READING MATTER FOR THE FLIGHT.

INFANT'S FOOD FOR CONSUMPTION IN FLIGHT.

INFANT'S CARRYING BASKET.

A FULLY COLLAPSIBLE INVALID'S WHEEL CHAIR AND/OR A PAIR OF CRUTCHES, AND/OR BRACES OR OTHER PROSTHETIC DEVICE FOR THE PASSENGER'S USE; PROVIDED THAT THE PASSENGER IS DEPENDENT UPON THEM.



For your air trip the above articles when retained in your custody will be carried free over and above the free baggage allowance, except that infant's carrying basket, a fully collapsible invalid's wheel chair and or a pair of crutches may be carried in the passenger or cargo compartment of the aircraft. However, overnight bags, briefcases, typewriters, personal radios, ladies' vanity or cosmetic cases, hat boxes and large size cameras —all other articles— are weighed together with all other baggage and are subject to excess baggage charges if total weight is in excess of free baggage allowance.

Fig. 3-1

compressed gas for picnic or camping sloves, cylinders of compressed air for use with aqua lungs and under-water equipment, containers of lighter fuel and explosives, including blank catridges.[2] Matches and cigaretts are not allowed in the checked baggage but may be carried for use on board.

On international journeys (including domestic sectors forming part of an international journey) the free allowance for each adult or child paying adult fare is, at the time of writing, Tourist or Economy Class 20kg, and First Class 30kg. There is no free baggage allowance for infant carried at 10% adult fare, but infants food for consumption en route and an infant carrying are carried free of charge.[3]

The use of cameras in aircraft is subject to restriction over some countries and passengers wishing to take photographs from the air are asked to consult the steward before doing so. Passengers may use hearing aids, heart pacemakers, portable dictating machines or tape recorders provided these are not used for playing music through a loud speaker. The use of all other of portable electronic equipment, including radio sets, is not allowed, because of possible interference with aircraft navigational aids.[4]

After dealing with baggage the clerk may ask the passenger to pay an airport service levy. A receipt for the payment will usually be clipped to the ticket then after all appropriate entries have been made on the ticket and some coupons have been removed the remainder of the ticket will be handed back to the passenger.

In return for the flight coupon which has been removed he will receive a Boarding Card coloured green for enonomy class travel and red for first-class travel. The boarding card will show date and flight number.

Equipped with his boarding card, passport, visas and whatever other official documents he requires, the passengers may then go through the various controls carrying his own hand baggage. Porters are rarely allowed to assist passenger through controls.

It is the passenger's responsibility to ensure that the documents necessary for travel are in order, and carriers do not accept any liability for loss occuring because of an irregularity in a document. Certain countries require valid certificate of inoculation and/or vaccination and passengers should enquire well in advance whether any such certificates are needed for their journey. It may be too late to deal with these matters at the airport just before departure.

Once through the controls the passenger will find himself in the pre - departure assembly lounge. Here, he may sit quietly and attentively awaiting the announcement of the depatures of his flight, or he may join the throngs at the duty free shops. If he buys anything at the duty free shops he will probably be allowed to pay in any reputable currency but may be required to show his passport and boarding card to prove he is a bona fide traveller. The articles purchased will be specially wrapped and sealed and must not be opened until the passenger is airborne.

3.1.2 Arrivals

Passengers whose journey is not yet over and are travelling further by air are called transit passengers and are directed to wait in the transit lounges which is normally a portion of the international section. They remain their until it is possible for them to connect their further flights.

However, passengers who have got to their destination are processed through the usual control facilities. Passengers who have only hand luggage could immediately for customs examination. While those awaiting baggage will proceed to the baggage reclaim hall. Having collected their baggage, they go into the customs hall for clearance. In some airports, self-service trolleys are always made available.

After the customs examination, passengers are free to join their friends who may be waiting for the concourse. They may either carry their baggage or ask a porter to send it down to the exit. Porters may not move bags without any instructions. Passengers who are unfamiliar with the car-hire system may enquire from information counters possible lot to board a car, taxi or taxi to the metropolis as the case may be.

As such, the passenger terminal system essentially provides a necessary interface between land and air modes of transport.

3.2 PASSENGER TERMINAL BUILDING - I.C.A.O. RECOMMENDATIONS

3.2.1 What is I.C.A.O.

The International Civil Aviation Organisation is a specialised agency of the United Nations concerned with airport development.[5] The objectives of I.C.A.O. as stated in its charter are to develop the principles and techniques of international air transportation so as to:

1. Ensure the safe and orderly growth of internationally civil aviation throughout the world.
2. Encourage the arts of aircraft design and operation for peaceful proposes.
3. Encourage the development of airways, airports and air-navigation facilities for international aviation.
4. Meet the needs of the people of the world for safe, regular, efficient, and economical air transport.
5. Prevent economic waste by unreasonable competition.
6. Ensure that the rights of contracting states are fully respected and that every contracting has a fair opportunity to operate international airlines.
7. Avoid discrimination between contracting states.
8. Promote safety of flight in international air navigation.
9. Promote generally the development of all aspects of international civil aeronautics.

3.2.2 Recommendations

Although the design of each building on airport presents its particular problems the Terminal Building is probably the most complex and is worthy detailed considerations of the factors involved.

Design General

The Building should be designed to cater for the volume of traffic anticipated at least ten years after it is complete and adequate provision must be made for future extensions.
The building size and layout will be dictated by peak-hour aircraft. movements, their size and the resultant number of peak-hour passengers, the methods of aircraft parking, and the use of the building by Domestic or International passengers or a combination of both.

Site Restrictions

The building size may also be limited by the site available, and by the height restriction imposed by flight clearances, and by the preservation of a satisfactory line of sight from the Control Tower.

Car Parking

The parking of cars passengers, visitors and staff is a major problem at most large airports. Adequate space for ground level or multistorey car parks must be provided as near the terminal building as possible.

Rail Access

With the continuing growth of traffic and of the possible space limitation of car parks, the possibilities of direct rail or monorail links from town to terminal should be considered.

Entrances

To avoid congestion at the landside, several entrances and exi with adequate road length must be provided for cars taxis and coaches. It may be necessary to provide elevated access to the departure concourse.

Public Concourse

The entrance concourse must be large enough for greetings or farewells between passengers and friends. In some parts of the world friends outnumber passengers by 5 to 1.

Check-in Counters

Airlines generally favour the provision of individual airline check-in counters. The counters should be located reasonably close to, and be visible from the entrance doors, if possible.

Baggage Flow

After check-in, conveyors should transport baggage directly to the sorting area. In reverse the baggage from the aircraft should be speedily conveyed to a distribution centre for passenger claiming and onward handling through the custom area.
Alternative methods of baggage transportation should be provided against the possibility of electrical or mechanical failure.

Passenger Flow

The routes of passenger flow must have simplicity and give ease of movement, with minimum walking distance and changes of level particularly while passengers may be carrying their baggage.

Separation of Domestic From International Passengers

The formalities of customs, health and immigration inspections are unnecessary in dealing with domestic passengers, and it is normal to separate and direct flow channels to be provided for this category of passenger.

Passenger Information

The information of passenger needs should be readily available either from information desks in the concourse or from easily readable and internationally understandable signs.
Flight information should be provided in all public areas of the building either by closed circuit television or by manual or mechanically operated signs.

Public Address System

Supplementary to the sign system there is the need for loudspeaker announcements. These should be reduced to the minimum and be localised whenever possible by restrictions in the number of microphone inputs and by the use of special restrictive circuits.

Catering

Restaurants and bars should be provided in or near all public rooms where passenger must wait. There must be a separate "service" access for goods and staff to the centralised or separate kitchen which may also be designed to prepare in-flight meals.

Canteens should be provided for staff and airport workers in or near the terminal.

Concessions

As well as providing a service to the public, concessions provide an important revenue for the airport authority. An international terminal should have the following facilities:

Bank and Currency Exchange

Post Office

Telephone and Cables Despatch

Hotel Reservation

Car Hire Service

Baggage Lockers

Book Shop

Gift Shop

Duty Free Shop

Barbers and Hairdressers Shops

Lost and Found Store

Flight Insurance Machines

Hotel Rooms

It is often desirable to provide hotel rooms, for transit or delayed passenger and crews.

First Aid

A first aid room possibly combined with isolation facilities, will be necessary for both passenger and airport staff.

Children Nursery

Mothers in transit with young children have the need for a nursery room with simple cooking and sanitary facilities.

Spectators

It is essential, in order to avoid congestion in the entrance concourse, that separate stairways or escalators to the observation areas be built. Restaurant and snack bar facilities may be provided for spectators.

V.I.P. Rooms

Provision must usually be made for the reception of V.I.P's (often of varying importance) by the allocation of space for military guards of honour, and special waiting and reception rooms.

Press and Television Rooms

Coupled with the above, space may also be required for Press Radio and T.V. interviews.

Helicopter Platforms

Provision may be necessary for a heliport. Passenger and baggage flow arising from this must be considered.

Access to Aircraft

The various alternative methods of moving passengers from terminal to aircraft and vice versa by means of fingers with satellite lounges, mobile lounges, buses or telescopic access ways from fingers directly into the aircraft or simply by walking must be considered.

Sound Proofing

Consider the need for and methods of noise suppression by the use of double glazing on the airside or by the use of carpets, rubber flooring and acoustic tiled walls or ceilings.

Jet Blast

Provide jet blast deflecting screams where necessary.

Office Accommodation

In addition to the main facilities which must be provided for passengers, offices and operational spaces must be provided for a number of other function including the followings:

Airport Management

Administration

Accounting

Maintenance

Operations and Public Relations

Government Functions

Immigration Control

Health Control (including possibly quarantine area)

Customs Control

and possibly for

Post Office Department

Communication Facilities

Meteorological Service

Air Traffic Control

Airline Operations

Check - in counters, with adjacent airline office space information counters, flight operations, for weight computations, and preparation of aircraft documents flight and Ground Crew Rest Rooms.

It will normally be found necessary to restrict office accommodation to those functions essential to the administration and operation of the terminal and even then only to those elements of airport management, airline operation, Customs, Health and Immigration whose presence in the building is necessary. At a large airport separate administrative and terminal buildings may have to be built.

Building Maintenance and Utilities

The space allocated to heating, air-conditioning, electrical plant, communications systems, fire alarm systems, cleaning services and to air, cable and heating ducts must be adequate and allow for future expansion.

3.3 Air Traffic Control

An indispensable element in the operation of a modern aircraft terminal is the existence of the air traffic control system. Without the airport control tower and radar approach and departure control facility, the capacity of the airport to handle traffic would be significantly reduced when the weather in worse than that permitted for visual flight operations.

The airport traffic control tower is the facility which supervi es, directs, and monitors the traffic at the airport and in the immediate airspace, arrivals and departures, up to 8km from the airport. The tower is responsible for issuing clearances to all arriving and departing aircraft, providing pilots with information on wind, temperature, barometric pressure, as well as for operating conditions at the airport and the control of all aircraft parking positions, called the ramp area.

The International Civil Aviation Organisation (I.C.A.O.) prescribes two basic types of flight rules of air traffic. These are known as visual flight rules (V.F.R.) and intrument flight rules (I.F.R.). In general, V.F.R. means that the weather conditions are such that the aircraft can maintain safe separation by visual means. On the other hand, I.F.R. conditions prevail when the visibility or the ceiling falls below those prescribed under V.F.R. In I.F.R. conditions, safe separation between aircraft is the responsibility of air traffic control personnel, while in V.F.R. conditions it is the responsibility of the pilot. Thus, in V.F.R conditions there is essentially very little air traffic control, and aircraft are allowed to fly on a 'see and be seen' principle.

Air traffic control monitors flights under V.F.R, and intervenes only when apparent conflicts between aircraft develop. This is passive control. Positive traffic control is exercised only when I.F.R. applies. Essentially these rules require the assignment to specific routes and altitudes and maintenance of minimum separations between aircraft.

As the speed of aircraft and the density of air traffic in the airspace increased, there was more concern over the possibility of midair collisions. This concern was substantiated by the occurence of several such collisions involving many lives.[6] Accordingly, in certain parts of the airspace, IFR has been prescribed regardless of weather conditions. This is refered to as positive control airspace, it usually encompasses the airspace where high speed jet air operate. Therefore, it can include the airspace in the vicinity of the airports called the terminal control area. Conformity with IFR requires that, prior to departure, the pilot file with the air route traffic control centre a flight plan which indicates the aircraft destination, the desired routes and altitudes. This centre is responsible for controlling the movement of en-route aircraft along the airways and other parts of the airspace. The flight plan is continuously updated as the flight progresses.

Airport Control Tower service begins when the pilot operating under V.F.R. first radios in from about 24km to 32km away. If he is flying under I.F.R, and therefore under the control of an air routes traffic control centre. The first call is made when the centre controller transfers to the approach controller in the tower. After the tower controller acknowledges the airplane, he

radios certain instructions to the pilot, principally direction and altitude of landing pattern, the active runway (the one to use based on wind direction), wind direction and velocity, weather data and altimeter setting. The pilot is then directed to a position in the landing sequence. After landing, he is given taxing instructions.

The trend of air traffic control operations is toward more positive control necessary to ensure safe operation, especially in those areas where high speed aircraft operate.

chapter 4

program study

M.SC. THESIS

architecture dept.
ahmadu bello university
zaria.

july, 1988

adeleye, o. b.

airport '88

the development of ....

KADUNA
international
AIRPORT

4.1 CHECKLIST OF BASIC PLANNING OBJECTIVES

4.1.1 Land Transport

The main aim is to provide fast efficient public and private transport facilities between the terminal and transport networks/centres of population and between separate terminals. Each interchange with each mode of transport should be in close proximity to the terminal and routes should be easily intelligible to the first time user. Particular importance of kerbside length and car parking capacity should be considered.

4.1.2 Passenger Convenience and Safety

The passenger is primarily concerned with moving between one mode of transport (land) and another (air) with the minimum of inconvenience and in shortest time.

Main aims: The route should involve as short a walking distance as possible, preferably unencumbered by baggage, be easy to follow, especially for the first time user; have the minimum number of changes in level and direction; be protected from the weather and be safe (protected from vehicles and aircraft). Particular importance of young or invalid passenger, late departing passengers and their baggage, meeting or leaving visitors access to amenities en route and organisation of necessary control points to cause minimum delay.

4.1.3 Security and Its Effect Upon Flow Planning

National Security

Main aims: to control the movement of unathorised persons

and commodities into or out of a country (international terminals only). Passengers are technically considered to have entered or left a country at a point within terminal known as the airside landside barrier. All passenger access to and from aircraft is prohibited excepted by crossing this barrier points controlled by government agencies.

Control over departures is generally less comprehensive than over arrivals, applies to passengers only (permitting baggage to be checked in independently at any conveniently location, landside or airside) and involves two barrier controls, immigration and customs.

Control over arrivals applies to passengers and their baggage necessitating the following sequential organisation before crossing the barrier: health control (locate as close to arrival aircraft as practicable to minimise risk of infection); immigration control; baggage reclaim; customs control. (Note: crossing of the airside - landside barrier by employees and terminal facilities serving both areas require special security controls. Note also that domestic passengers and passengers from countries having reciprocal agreements may not require processing as above and should have separate and secure routes to by-pass these controls.

Terminal And Airline Security

Main aims - to prevent weapons (including explosive) from being carried on board or through the terminal either directly (on the person indirectly (by transfer from the person or baggage of arrivals, transit or transfer passengers to departure passengers prior to boarding. To achieve this, consider:

- complete and secure separation of arrival and departure routes at all stages from gate position to landside/airside barrier
- airport controlled security checks on passengers and hand luggage at the transit-transfer crossover points to departure areas; and on departing and arriving at the airside - landside barrier.
- security chacks on luggage prior to distribution to aircraft and baggage reclaim facilities.
- optional airline checks at gate positions.

Where separation of routes as above cannot be achieved it is generally impractable to mount airport controlled security checks on passengers and hand luggage at all arrival gate positions, therefore protection is restricted to the most vulunerable areas only (the public concourse and departure lounge). The concourse is protected by a check on arriving passengers and their baggage at the airside-landside barrier; the departure lounge by separating it from arrival areas and by checking all passengers and their hand luggage on entry to it; that is, at the airside-landside barrier and at transit-transfer points. Though this will not prevent weapons transfer in other airside areas (and consequent risk to aircraft), therefore provision would have to be made for airlines to install their own security facilities at the departure gate position, as it may be required.

4.1.4 Baggage Handling

Departing Passengers - the system must free them if heavy baggage at the earliest opportunity, to weight, identify, sort, security check and dispatch the baggage to the appropriate aircraft safely, reliably and in synchronisation with the flight departure time.

The system may also accept occasional baggage arriving too late for normal processing.

Arriving Passengers - the system must make provision for unloading baggage from aircraft, dispatching to the terminal, sorting, security checking (if required) and distribution to a baggage reclaim area for presentation to and convenient identification and retrieval by passengers. This must be achieved safely, reliably and in synchronisation with the movement of passengers from aircraft to baggage claim. For passenger convenience, baggage should be located as close to the landside transportation facilities as possible - for international arrivals, immediately prior to customs check at the airside landside barrier.

Transfer Passenger - provision must be made for baggage to be either sorted and transfered direct across the apron or to follow arriving baggage to the sorting point for transfer to departure.

4.1.5 Extensibility And Adaptability

Technological, organisational and economic developments can, and invariably will effect considerable changes in terminal operations. These cannot be forecast with accuracy, but within the contraints of economic feasibility an inbuilt capacity for extensibility and adaptability should be aimed for, capable of implementation without disruption to normal terminal operations. Areas of particular concerns: car parking kerbside; concourse; pre-flight assembly; baggage reclaim and sort; aircraft parking stand arrangements; small increamental increases in the number of stands; security control techniques.

41.6 Basic Administrative Requirements

Airport Management

Main aims - to reconcile all the conflicting requirement of users and operators within a cost effective design.
Particular concerns: capital cost; running cost (importance of making maximum effective use of staff should be considered); user appeal (to airline operators, passengers and visitors - importance of passenger convenience, general amenities, V.I.P. facilities, etc. should be considered); income generation (in addition to landing fees) the increasing importance of concessionaries being a major source of revenue should be considered.

Airline Operators

Main aims - to provide fast, efficient and attractive service to customers which is both competitive and economic.
Particular concerns: passenger convenience; passenger facilities; aircraft security; maintenance and servicing; maximum utilisation of staff and equipment; minimum turn round time of aircraft on the ground.

Government Agencies

The main agencies are health, immigration, customs and police.
Main aims - to administer and enforce government legislation affecting international travel, general law enforcement, traffic control.

Aircraft Control Operations

Main aims - to control local aircraft movements both in flight and on the ground; to provide facilities and equipment for the maintenance of security and safety of aircraft in the air and on the

ground to international standards.

4.2 DETAILED DESIGN REQUIREMENTS

4.2.1 Passenger and Visitor Facilities (Landside)

Transport between terminal and centres of population. Private vehicles - consider vehicle circulation (one-way: airport entrance direct to car parking and kerbside(s) thence to exit); to and from car parking and kerbsides.

Consider separation and control of airside - landside vehicular routes; passing lanes adjacent to kerbsides; effect of right - hand - drive on terminal layout.

Car Parking - consider extensibility; weather protection (cars and persons; check-in facilities; local parking standards; segregation by user (passenger - arrivals and departures, visitors, employees), by usage (long-term and short-term parking); location.

Adjacent to terminal on opposite side of access roads - consider the problem of pedestrain/vehicular segregation and effect of mezzamine bridge link between two-level access road on terminal floor heights.

Adjacent to terminal ends on same side of access road - consider the problem of terminal extensibility, walking distances.

Above the terminal - consider expense, ramping, extensibility, vertical access to concourses.

Underground - consider expense, extensibility, ramping, orientation problems.

Public Transport - consider:

tracked systems (note terminus and tracked requirements proximity to terminal, protected passenger access.

bus-coach (note operators' requirements - airline, charter bus company.

kerbside loading and unloading requirements, parking and if large numbers involved consider separate terminus.

- taxi-hire cars (note ranks, upstream arrivals curbside drivers facilities, car-hire parking and office close to terminal.

- helicopter (note special transportation and security requirements between landing point and terminal if crossing of the airside-landside barrier is involved.

- fuelling point for public vehicles.

4.2.1.2 Kerbside Areas

Consider - weather protection, baggage check-in facilities, baggage trolley and wheel chair availability, safety for vehicle loading and unloading.

4.2.1.3 Concourse Areas

Passenger Facilities - departures

Consider: general concourse area, baggage check-in facilities, airline counters and offices, cashiers' desk, porters' room and amenities, baggage trolley and wheel chair availability, departures information board, common facilities.

Passenger Facilities - arrivals

Consider: general concourse area (preferably with separate visitors' area), airline counters and offices, taxi and hotel reservation facilities (desk or direct telephone), entertainment and tourist information agencies porters room and amenities, baggage trolley and wheel chair availability, message board, arrivals information board, common facilities.

Common Facilities (departures and arrivals)

Consider: 24 hour banking and currency exchange, public toilets, catering (restaurant, buffet, bar, coffee lounge) public telephones, post office and telegraph facilities, airline and club lounges, V.I.P. facilities, nursery, generally sitting and waiting areas, first aid medical facilities, car rental office, lost property room, place of worship or meditation rooms (quiet room), press facility, airport information desk, writing desks, public address system, clocks and direction signs, concessionaires (hairdresser, newsagent, tobacconist chemist, florist, shoe repair and shine, sonvenirs, vending machines, advertising etc.)

Visitors' Facilities

In addition to the above facilities consider - visitors viewing galleries and lounges.

Possible security controls and revenue generating potential should be considered as well.

4.2.1.4 Check-in Facilities

This is the point at which departing passengers have their flight generally their seat numbers confirmed, their baggage weighed and distributed to aircraft. Consider location (landside - in town centre, car park, kerbside, or departures concourse; airside - at departures gate or holdroom.

- separation of airline information and sales counters from check-in to maximise throughput.

- individual airline requirements (document storage, power and telephone, electronic data processing facilities with links to other check-in position and central control, coupon conveyors, baggage weighing methods.

- flight number and airline signboards.

- provision for out-of-gauge baggage and staff offices.

4.2.2 Passenger Amenities and Processing Facilities

4.2.2.1 Departing Passengers

Immigration and Customs Control

This is generally a combined facility with immigration control and call-upon customs control when required.

Consider: Immigration desks and associated offices, secure store and amenities.

Preflight Assembly Areas - departure Lounge

Consider: general waiting and seating areas; possible separation of international - domestic passengers, concessionaires (restaurant, buffet, bar, coffee lounge, duty free shop and store, book stalll, other shops, public toilets; departure indicator board airline information desks, V.I.P. facilities; security control on transit - transfer access, public telephones.

Pre-flight Assembly Areas - hold rooms

This is supplementary to departure lounge for handling high capacity aircraft. Located adjacent to aircraft boarding gates.

Consider - general waiting and seating areas
separation of arrivals - departures
late check-in and baggage handling facility
divisibility and extensibility (to accommodate segregated boarding procedures larger passenger load factors, alternative aircraft stand arrangement.
airline information desk.
Facility for airline [illegible] control.

NOTE - no public toilets should be provided after security control.[1]

[illegible]ARY

4.2.2.2 Arriving Passengers

Health Control: consider -

pre-control waiting and hold areas, public toilets, health desks, examination rooms, doctor and nurses rooms, X-ray, vaccination and quarantine rooms, staff amenities, secure access to ambulance bay.

Immigration Control: consider -

waiting area, immigration desks, offices, interview rooms, detention rooms, security officers rooms, dark room, store and staff amenities.

Baggage Reclaim: consider

separation of domestic from international preclaim waiting with toilets and seating arrangement baggage reclaim hall, flight indicator boards, out-of-gauge facility, unclaimed baggage store, staff amenities, baggage handling equipment.

Customs Control: consider

'red - green' chanelling (declare, non-declare) customs desks and/or beaches, duty rooms, search rooms - male and female, interview rooms, goods search room, cash office, general offices, customs enquiry office (accessible from landside arrivals concourse), staff amenities and air-crew controls.

.2.2.3 Transit and Transfer Passengers

Consider - airline and/or transit-transfer information desks close to arrival gates, segregate transit passenger

facilities access to pre-flight assembly areas (note security controls).

4.2.2.4 V.I.P. Passengers

Consider - separate lounge, bar and general amenities in pre-flight assembly areas.

4.2.2.5 Methods of Connection to Aircraft

Open Apron Approach

(bus and/or walking across the apron)

Consider - passengers safety and convenience (weather protection, possible changes of level - down steps to tarmac - upsteps to aircraft, risk from aircraft blast and vehicles, time to load - unload bus and walk.

Passenger Transport Vehicle

Consider relationship to airport - airline operations, effect apron terminal planning.

Loading Bridge (air-bridge, jetway) Provide a direct connection at first floor level between aircraft doors and gate position for use with pier, satellite and linear configurations.

Consider - maximum gradient of bridge to sill height of aircraft 1:10 ever short distance, minimum clearance below for airside vehicles - 4.5m, bridges preferably provided to portside doors only to leave starboard side clear for aircraft servicing, wide-bodied aircraft generally require two bridge connections.

4.2.3 General Terminal Facilities

4.2.3.1 Baggage Handling System

This is the single most important mechanism in a terminal and it may involve complex automatic handling equipment. The mechanics of a typical relatively simple system are as follows.

At the departures check-in point baggage is weighed, labelled and transfered to the primary conveyor for distribution via an X-ray security check (if required) to the baggage hall. The primary conveyor may feed direct onto a straight line or circulating accummulator for sorting, or have provision for multiple sorting by visual or electronic identification of labels on a series of secondary straight line feeds related to specific flights. Baggage is then normally transfered manually to wheeled container dollies or baggage carts, for grouping into trains for lowing to the appropriate aircraft parking stand. Containers will be hosted direct, baggage carts will require loading out mobile conveyors, for stowage within the aircraft baggage hold.

For arrivals, a separate but basically similar process carries the baggage to the reclaim area.

In developing the system, consider - individual airline preferences versus advantages of single consolidated system, degree of automation related to need and cost effectiveness (note fail safe requirement), alternative baggage reclaim facility using self-selection direct from containers, synchronisation of system with passengers processing times, flexibility and extensibility of system, safety and reliability (aim to reduce number of handling operations, changes in level and direction, and apron congestion),

provide for weather protection and accessibility to all parts of the system for rapid maintenance in use, storage facilities for early departures and unclaimed or unaccompanied baggage, security against loss in transit, facilities for out-of-gauge and late-arriving departure baggage facilities for transfer baggage processing and cart storage.

4.2.3.2 Catering

Main catering facilities are related to public concourse areas (landside) but additional facilities required for airside departure lounge, V.I.P. areas and for employees. Consider -
alternative facilities for delayed passengers
meal service on board of aircraft
serving in-flight type meals within terminal
common servicing of airside-landside facilities (subject to security control); delivery, receiving and storage areas; liquid stores; food preparation, kitchen and serving facilities, staff amenities (dining, changing, lockers and showers).

4.2.3.3 Security

Note additional requirement: to deny access to persons carrying weapons into areas overlooking airside operations (may require airport controlled security on visitors entering viewing galleries, car parking areas etc; to prevent loss of property or damage to facilities and equipment within the terminal and in airside-landside areas. (Note protection of goods in transit, vulnerability of aircraft, control tower, etc: need for extension of airside-landside barrier outside terminal and security checks at all crossing points).

4.2.3.4 Administrative and General Support Facilities

Airport Administration

Consider - offices, conference rooms, overnight accommodation, airport police facilities (offices, detention rooms and amenities), porters rooms, engineering stores and workshops maintenance stores, cleaners rooms, general store rooms, baggage loaders' facilities (lockers, rest rooms and amenities), employees' canteen.

Airline Operators

Consider - offices in addition to those within the concourse areas, employees and aircrew accommodation and amenities (rest rooms, changing, canteen etc), computer facilities, operation and duty rooms.

4.2.3.5 Building Services

In addition to normal building service consider - air-conditioning, sound-proofing, public address systems, flight information boards control systems, telephone (internal, public and private), telex and computer facilities, pneumatic tube systems, sewage disposal, electricity substations and standby generators.

4.2.4 Aircraft and Apron Operations

4.2.4.1 Air Traffic Control (A.T.C.) Facilities

Control Tower

Main aims - to provide visual control of take-offs, landings and movements of all aircraft on the ground.

Consider - height related to distance from runways and angles of vision over local obstructions, location adjacent to

terminal but note possible constraint upon terminal extensibility.

Aeronautical Information Service (A.I.S.)
- meteorological and flight clearance facilities
Consider general planning (location adjacent to control tower). A.I.S. requirements (general office with clerical, copying and teleprinter facilities, senior officers room, sleeping cubicle and storage areas.
Meteorological requirements (general office with clerical, cartography wind indicator and barrograph facilities, copying, signals, teleprinter facilities, senior officers room, sleeping cubicle and storage areas.

4.2.4.2 Aircraft Parking Stand Arrangements.

The apron provides the connection between the terminal buildings and the air field. It includes aircraft parking areas, called ramps, and aircraft circulation and taxing areas for access to these ramps. On the ramp, aircraft park in the areas designated as gates or stands.

The size of a stand depends on the size of aircraft which it is to accommodate and on the type of parking used. The size of the aircraft determines the space required for parking as well as for maneuvering.

Aircraft parking type refer to the manner in which the aircraft is positioned with respect to the terminal building and to the manner in which aircraft maneuver in and out of parking positions. Aircraft can be positioned at various angles with respect to the terminal building line and can maneuver in and out of parking

positions either under their own power or with the aid of towing equipment. With aircraft towing, it is possible to reduce the size of parking positions. It is advisable, in adopting a parking type, to take into consideration the objective of protecting passengers from the adverse elements of noise, jet blast and weather, and the operating and maintenance costs of needed ground equipment.

Evaluation of aircraft - parking types -

Nose-in Parking

In this configuration, the aircraft is parked perpendicular to the building line, with the nose as close to the building as permissible, the aircraft maneuvers into the parking position under its own power. In order to leave the stand, the aircraft has to be towed out a sufficient distance to allow it to proceed under its own power. The advantages of this configuration are that it requires the smallest stand area for a given aircraft, causes lower noise levels as there is no powered turning movement near the terminal building, sends no jet blast near the building, and facilitates passenger loading as the nose is near the building. Its disadvantages include the need for towing equipment and the nose is too far from the building to effectively use the rear doors for passenger loading.

Angled Nose-In Parking

This configuration is similar to the nose in configuration, except that the aircraft is not parked perpendicular to the building. The configuration has the advantage of allowing the aircraft to maneuver in and out of the gate under its power. However, it requires a larger stand area than the nose-in configuration and causes a higher noise level.

Angled Nose-Out Parking

In this configuration the aircraft is parked with its nose pointing away from the terminal building. Like the angled nose-in configuration, it has the advantage of allowing aircraft to maneuver in and out of gate positions without towing. It does require a larger area than the nose-in positions but less than the angled nose-in. A disadvantage of this configuration is that the breakaway jet blast and noise are pointed toward the building when the aircraft starts its taxing maneuver.

Parallel Parking

This configuration is the easiest to achieve from the aircraft maneuvering standpoint. In this case, noise and jet blast are minimised as there are no sharp turning maneuvers required. It does require however, a larger stand position area, particularly along the terminal building frontage. Another advantage of this configuration is that both forward and aft aircraft doors can be used for loading and unloading passengers, although relatively long loading bridges may be required.

4.2.4.3 Jet Blast Considerations

Jet Blast becomes an item of consideration in the design of aprons when the velocity is sufficient to cause erosion of surface areas, damage to other aircraft, buildings, or equipment or be detrimental to the safety of persons in the apron area. Velocities above 48hr/hr are considered undersirable for passenger comfort and equipment operation on the terminal area. Exhaust from jet aircraft may bring about velocities many times greater than 48km/hr at considerable distances from the operating aircraft.

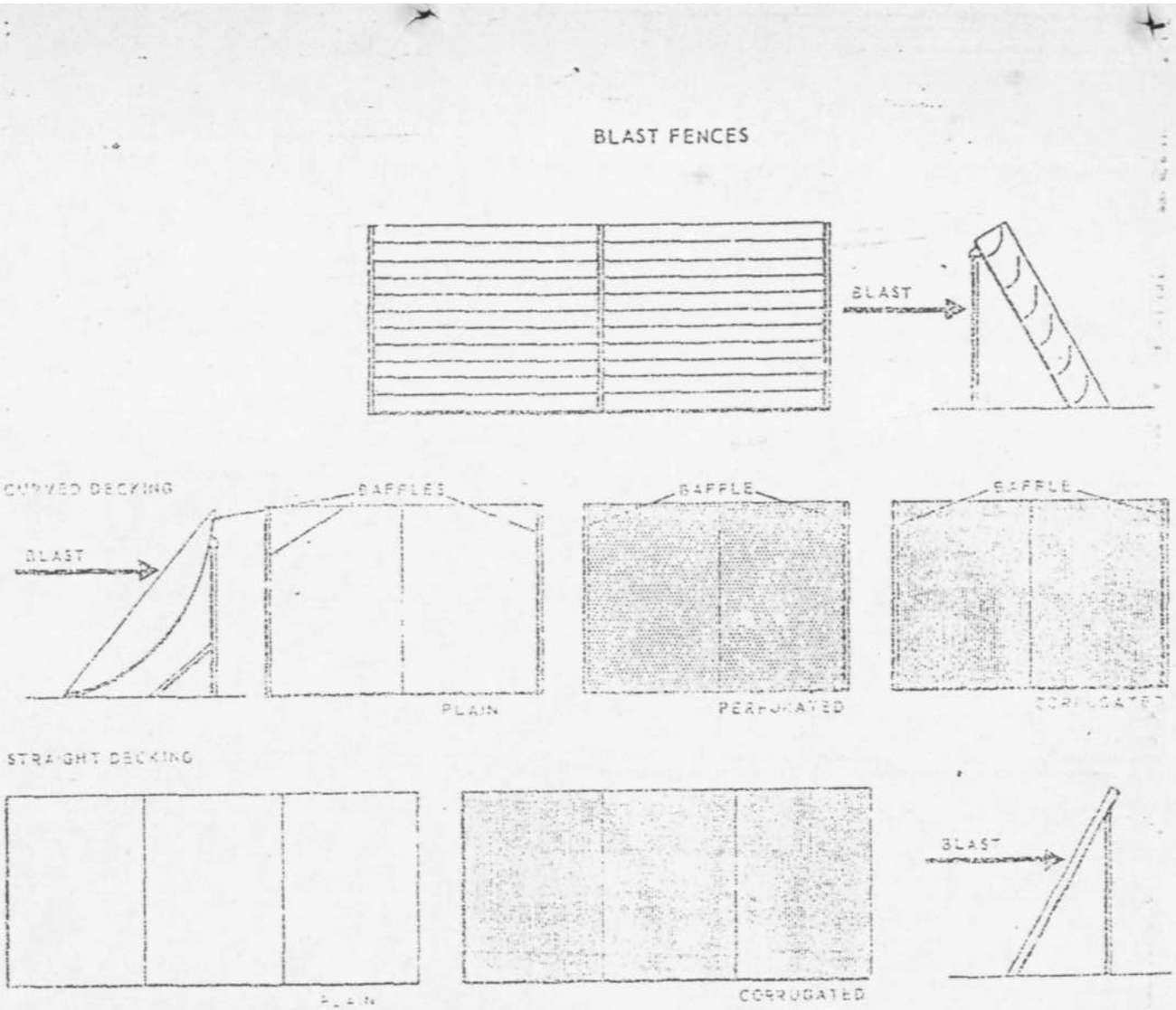
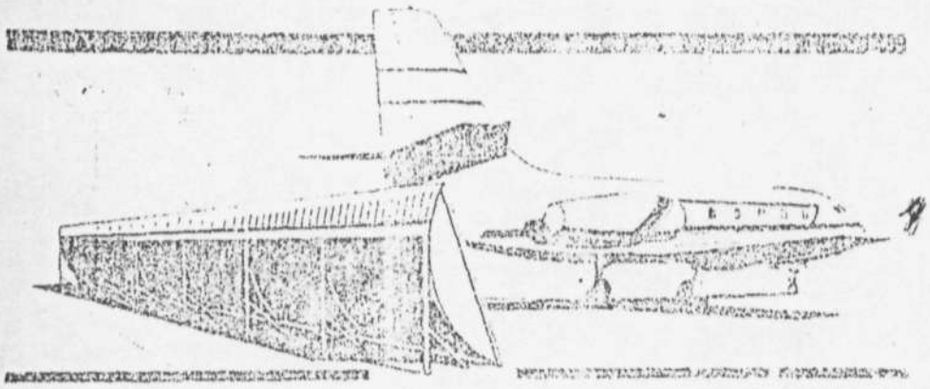
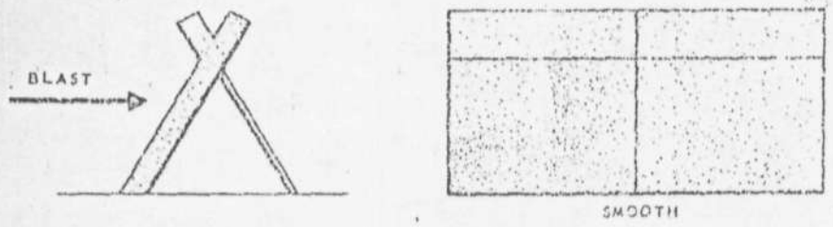


FIGURE 4-1 TYPICAL BLAST DEFLECTOR FENCES (METAL)

TYPICAL BLAST DEFLECTOR FENCES (CONCRETE)



SOLID SLAB SECTIONS



LOUVERED



FIGURE 4-2

Blast Protection -

Taxiway (for continuous movement of aircraft)

Dense turf 7.5m on each side of the taxiway. In geographical areas where a dense turf cannot be established, other treatments should be used instead of turf.

Taxiway (intersection and sharpturns)

Treated area of 7.5m on each side of taxiway and extending 90m from the intersection. An additional 7.5m of dense turf or other suitable treatment should be placed adjacent to the section.

Blast Fences

These are used to deflect and dissipate the energy of high velocity wakes of both propeller and turbojet aircraft. The type and size of blast fence to be used depends on the location and degree of protection desired. Generally, the closer the fence is located to the blast source the more effective it is, provided the extended centreline of the blast wake falls below the top of the fence. It is advantageous to place fences so that prevailing will blow over the top of them towards the aircraft. This helps eliminate disturbing effects of surface winds. Fences should be designed to dissipate the effects of blast to a safe velocity limit. Any obstruction, natural and man made could also afford some measure of protection. Tall hedges and bushes also help to attenuate sound to some extent as well as attenuate blast.

4.3 SPACE DETERMINATION

4.3.1 Projections for Year 2,000

Population Growth Projection

Year	1978	1985	1995	2005
Population	528,000	964,000	1,400,000	2,000,000

relevance:

the aeronautical demand of a given location usually maintains a linear relationship with the population of the locality.

Statistics of Annual Passenger Movement

Year	1983	1984	1985	1986
Departures	280,255	236,363	280,770	266,971
Arrivals	260,492	227,220	284,223	273,546
Transit	-	921,937	88,466	58,694
Total	540,747	556,520	653,459	599,211
Approximation	0.54	0.56	0.65	0.60

to the nearest million

Estimation of a Projectable Linear Model

Year	x	y	xy	x^2
1983	1	0.54	0.54	1
1984	2	0.56	1.12	4
1985	3	0.65	1.95	9
1986	4	0.60	2.40	16
Summation	10	2.35	6.01	30

Linear Equation: $y = \hat{\alpha} + \hat{\beta}x$

where $\beta = \dfrac{n\Sigma xy - (\Sigma x)(\Sigma y)}{n\Sigma x^2 - (\Sigma x)^2}$ and $\hat{\alpha} = y - \beta x$

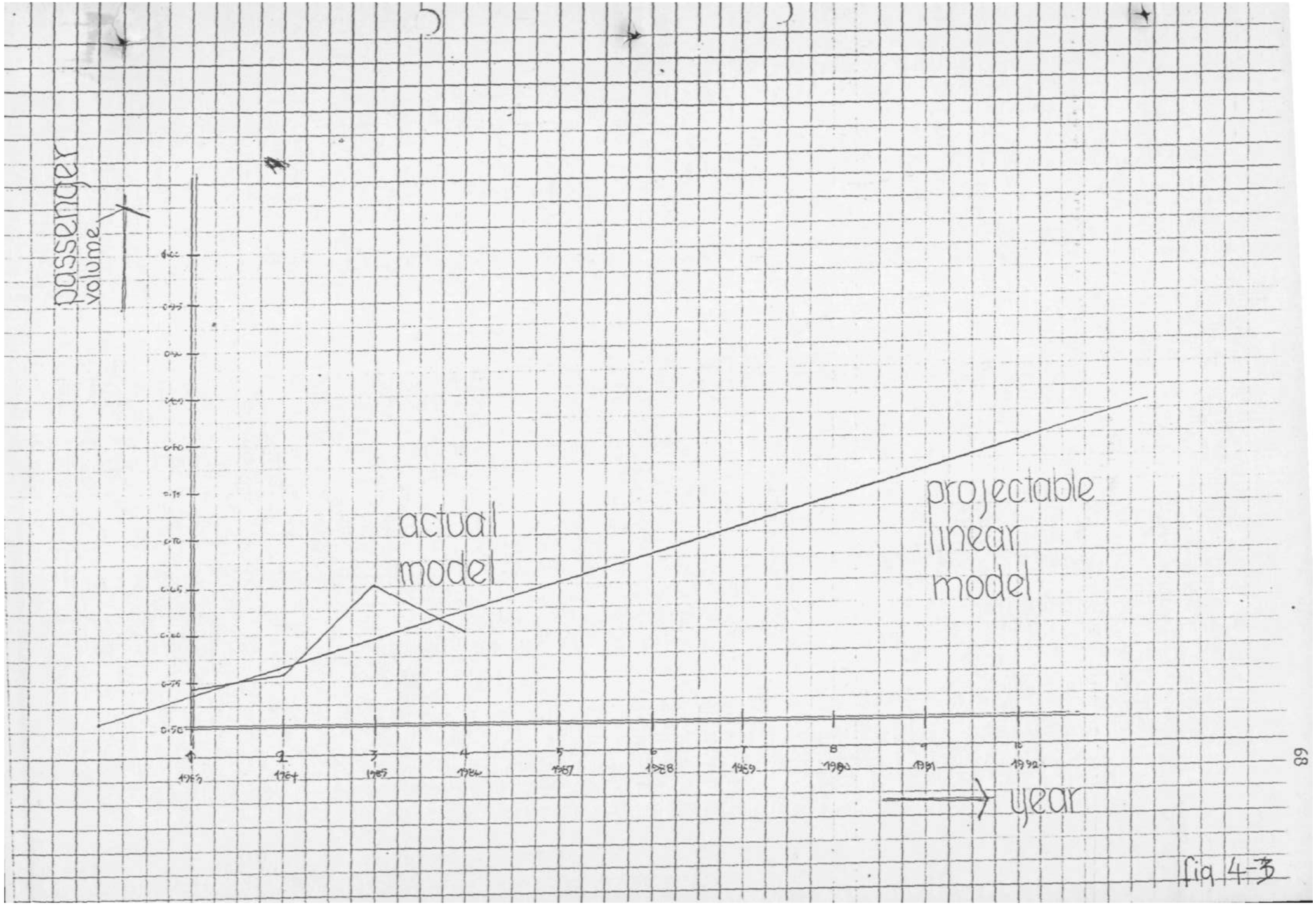

passenger volume
actual model
projectable linear model
year

fig 4-3

$$\hat{\beta} = \frac{4(6.01) - 10(2.35)}{4(30) - (10)^2}$$

$$= \frac{24.04 - 23.50}{120 - 100}$$

$$= \underline{0.027}$$

$$\hat{\alpha} = \bar{y} - \beta(\bar{x})$$

$$= \frac{\Sigma y}{n} - \left(\frac{\Sigma x}{n}\right)$$

$$= \frac{2.35}{4} - (0.027)\frac{10}{4}$$

$$= \underline{0.52}$$

Projectable linear equation, $y = 0.52 + 0.027(x)$

In year 2000, $x = ?$

1983, $x = 1 = 1983 - 1982$

1984, $x = 2 = 1984 - 1982$

2000, $x = 2000 - 1982$

$x = 18$

$y = 0.52 + 0.027\ (18)$

$= 1.006$ million (annual passengers).

Therefore, in the year 2000, one million and six thousand passengers are expected to travel through Kaduna International Airport.

4.3.2 Estimation of Peak Hour Passengers

The Federal Aviation Administration of the United States recommended certain relationships for the computation of peak hour passengers from the annual figures.[2]

total annual passengers	peak hour passenger (%)
20,000,000 and over	0.030
10,000,000 - 19,999,999	0.039
1,000,000 - 9,999,999	0.040
500,000 - 909,999	0.50
100,000 - 499,999	0.065
under 100,000	0.120

Peak Hour Passengers

$$= \frac{0.050}{100} \times 1,000,000$$

$$= 500 \text{ passengers}$$

4.3.3 Space Requirements

The design index (typical hour passengers) = 500 passengers

Car Parks

Allowing 70 - 90% of peak hour passenger

Assuming one car per person for total car parking

requirements $\frac{70}{100} \times 500 = 350$

$\frac{90}{100} \times 500 = 450$

350 - 450 parking lots.

Concourse Areas

Total area of both concourses (arrivals and departures) including common facilities (excluding check-in facilities and restaurants):

$2.5m^2 - 3.0m^2$ per passenger per design index

$3.0m^2 \times 500 = 1500m^2$

Check-in Facilities

Allowing $1.1m^2$ - $1.2m^2$ per passenger per design index

$1.2m^2 \times 500 = 600m^2$

Departing Passengers:

Immigration and Custom Control

$0.2m^2 \times 500 = 100m^2$

Departure Lounge

Allowing $0.7m^2$ per passenger per design index

$0.7m^2 \times 500 = 350m^2$

Due to delays, to accommodate accummulation of passengers

$1.0m^2 \times 500 = 500m^2$

Shops

$0.22m^2 \times 500 = 110m^2$

Holdrooms

Approximate area = total aircraft capacity x $1.0m^2$

(excluding toilets)

$= 350 \times 1.0m^2$

$= 350m^2$

Arriving Passenger:

Health Control - $0.08m^2 \times 500 = 40m^2$

Immigration Control - allowing 60% of peak hour passenger x $1.0m^2$

$$\frac{60}{100} \times 500 \times 1.0m^2 = 300m^2$$

Baggage Claim -

Pre - claim waiting area

allowing 30% of peak hour passengers per $1.0m^2$

$$\frac{30}{100} \times 500 \times 1.0m^2 = 150m^2$$

retrieval area

allowing 80% of peak hour passengers

$$\frac{80}{100} \times 500 \times 1.0m^2 = 400m^2$$

Customs Control

Allowing $0.4m^2 - 0.5m^2$ per passenger per design index

$$0.5m^2 \times 500 = 250m^2$$

Pedestrain Movements:

Ramps should not have greater gradient than 1:12

maximum distance Kerbside to Baggage Check-in or Reclaim = 20m

Furthest car park to baggage check-in or reclaim = 300m

Furthest gate position to " " " " = 330m

Gate to aircraft = 50m

Catering:

70% of total passengers, visitors and staff use facilities

in ratio:

65% use buffet/bar - $1.3m^2$ per person - 65% of $500 \times 1.3m^2 = 422.5m^2$

25% use grill/Coffe shop - $1.60m^2$ per person - 25% of

$500 \times 1.6m^2 = 200.00m^2$

10% use restaurants - $1.4m^2$ per person - $10\% \times 500 \times 1.4 = 10m^2$

$625.5m^2$

Inclusion of staff and facilities:

692.5 + (60% of 692.9) = 1,105m^2.

4.4 EVALUATION OF BASIC CONCEPTS

There are a number of ways in which the facilities of the passenger terminal system are physically arranged, and in which various passenger - processing activities are performed. Centralised passenger processing means that all facilities of the system are housed in one building and are used for processing all passengers using the building. Centralised processing facilities may be used to service a large number of aircraft gate positions.

Decentralised processing, on the hand, mean that passenger processing facilities are arranged in modular units and repeated in one or more buildings. Each unit is arranged around one or more aircraft gate positions and serves the passengers using those gate positions.

4.4.1 Horizontal Distribution Concepts

There are four basic horizontal distribution concepts, as well as many variations or hybrids which include combinations of these basic concepts.

Each can be used with varying degrees of centralisation.

These terminal concepts are discussed below. They include:

1. Pier or Finger Concept

2. Satellite Concept

3. Linear or Frontal Concept

4. Transporter, Open Apron or Mobile Conveyance Concept.

4.4.1.1 Pier or Finger Concept

The pier concept has an interface with aircraft along fingers extending from the main terminal area. Aircraft are usually arranged around the axis of the pier in a parallel or nose-in parking alignment. Each pier has a row of aircraft gate positions on both sides, with a passenger concourse along the axis which serves as the departure lounge and circulation space for both enplaining and deplaning passengers. This concept usually allows for the extension of the pier to provide additional aircraft parking positions without the expansion of the central passenger and baggage processing facility.

The chief advantage of this concept is its ability to be expanded in increamental steps as aircraft or passenger demand

warrant. It is also relatively economical in terms of capital and operating cost, its chief disadvantages are its relatively long walking distance from curb front to aircraft and the lack of a direct curb front relationship to aircraft gate positions.

4.4.1.2 Satellite Concept

The satellite concept consists of a building surrounded by aircraft, which is separated from the terminal and is usually reached by means of a surface, underground, or above ground connector the aircraft are normally parked in radially or parallel positions around the satellite. It often affords the opportunity for simple maneuvering and taxing patterns for aircraft, but requires larger apron area than other concepts. It can have common or separate departure lounges. Since enplaning and deplaning from the aircraft is accomplished from a common and often remote area, mechanical systems may be employed to transport passengers and baggage between terminal and satellite.

The main advantages of this concept lie in its adaptability to common departure lounge and check-in functions and the ease of aircraft maneuverability around the satellite structure.

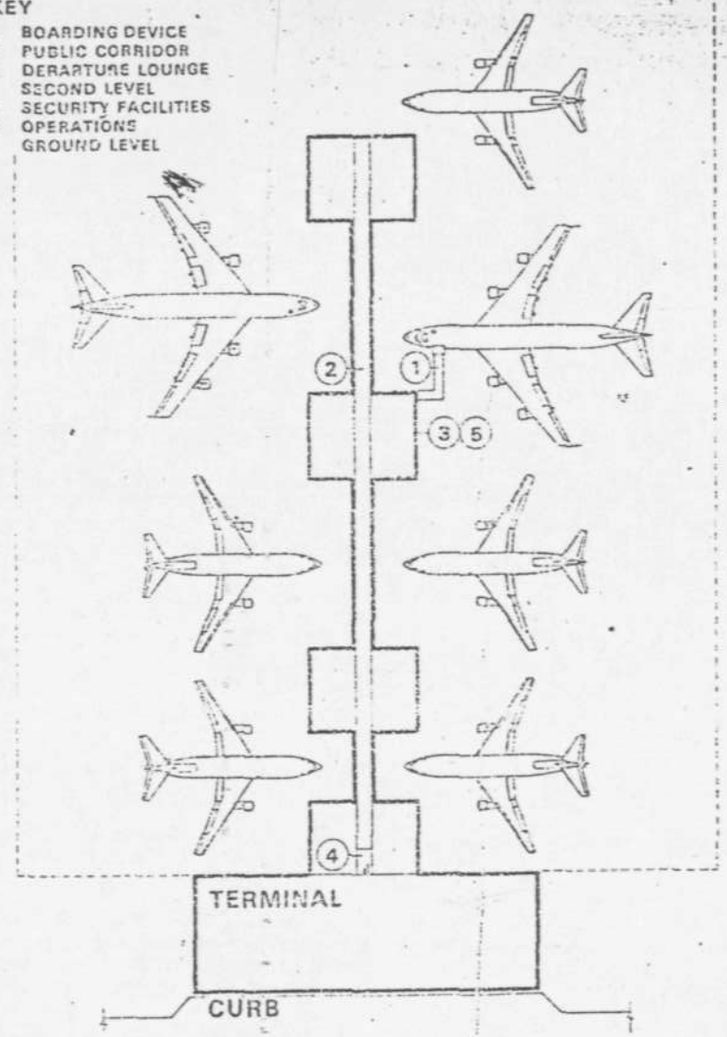


Fig. 4.4 Pier concept.

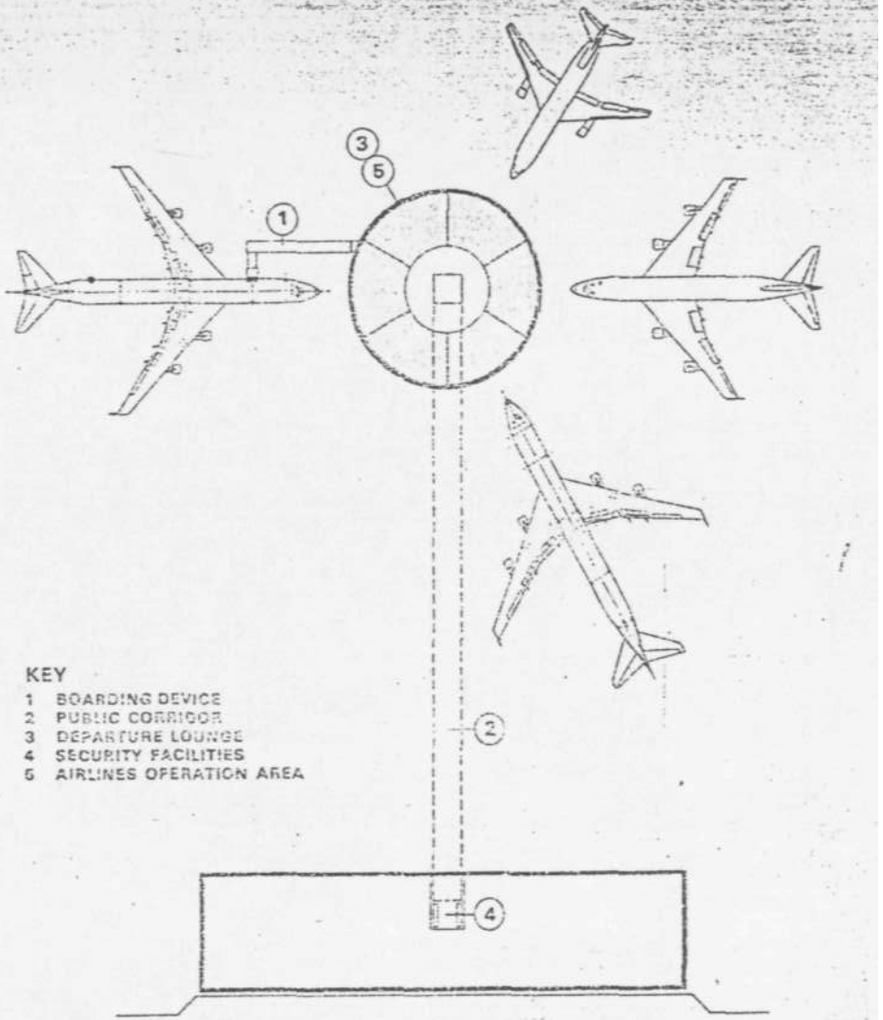


Fig. 4.5 Satellite concept.

However construction cost is relatively high due to the need to provide connecting concourses to the satellite. It lacks flexibility for expansion and passenger walking distances are relatively long.

4.4.1.3 Linear or Frontal Concept

The simple linear concept consists of a common waiting and ticketing area with exits leading to the aircraft parking apron. It is adaptable to airports with low airline activity which will usually have an apron providing close-in parking for three to six commercial passenger aircraft. The layout of the simple terminal should take into account the possibility of pier, satellite or linear additions for terminal expansion. Aircraft are parked along the face of the terminal building. Concourses connect the various terminal functions with aircraft gate positions. This concept offers ease of access and relatively short distances if passengers are delivered to a point near gate departure by vehicular circulation. Expansion may be accomplished by linear extension of an existing structure or by developing two or more terminal units with connectors.

These concept provide direct access from curb front to aircraft gate positions and afford a high degree of flexibility for expansion.

4.4.1.4 Transporter, Open Apron, or Mobile Conveyance Concept

Aircraft and aircraft-servicing functions in the transporter concept are remotely located from the terminal. The connection to the terminal is provided by vehicular transport for enplaning and deplaning passengers. The characteristics of the transporter concept include flexibility in providing additional aircraft parking positions to accommodate increases in schedules or aircraft size, the capability to maneuver an aircraft in and out of a parking positions under its own power, the separation of aircraft-servicing activities from the terminal, and reduced walking distances for the passenger.

The concept minimises the level of capital costs since the building efficiently uses minimal departure lounge space and has gate positions for transporters rather than aircraft. It offers high degree of flexibility in both operation and expansion. Aircraft maneuverability is very high, and a separation between

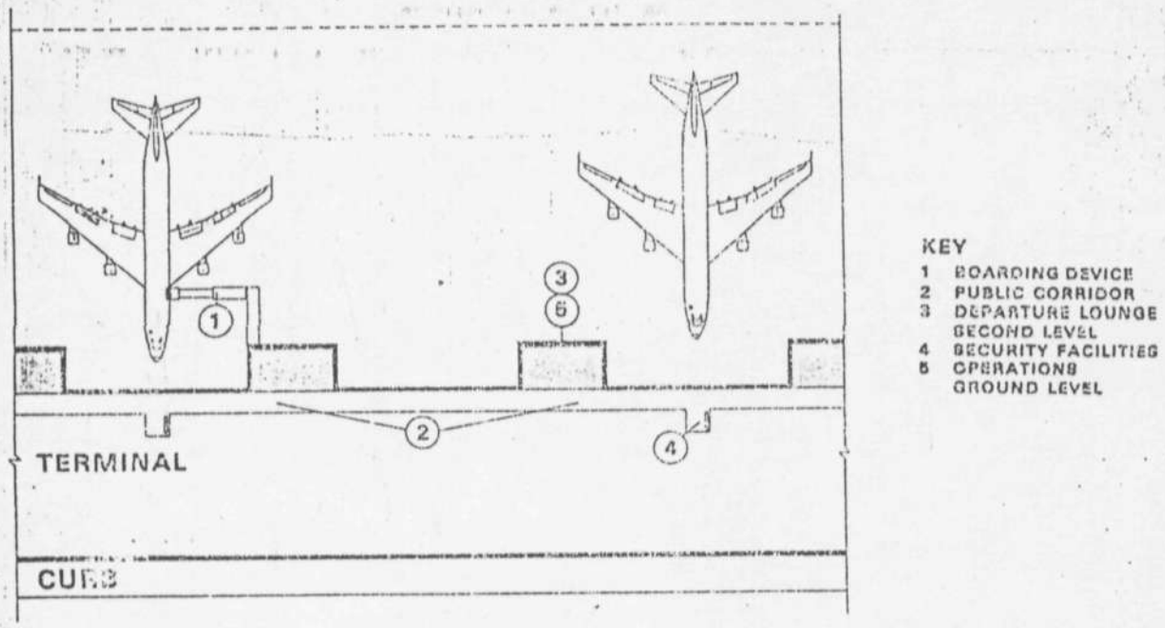


Fig. 3 Linear concept.

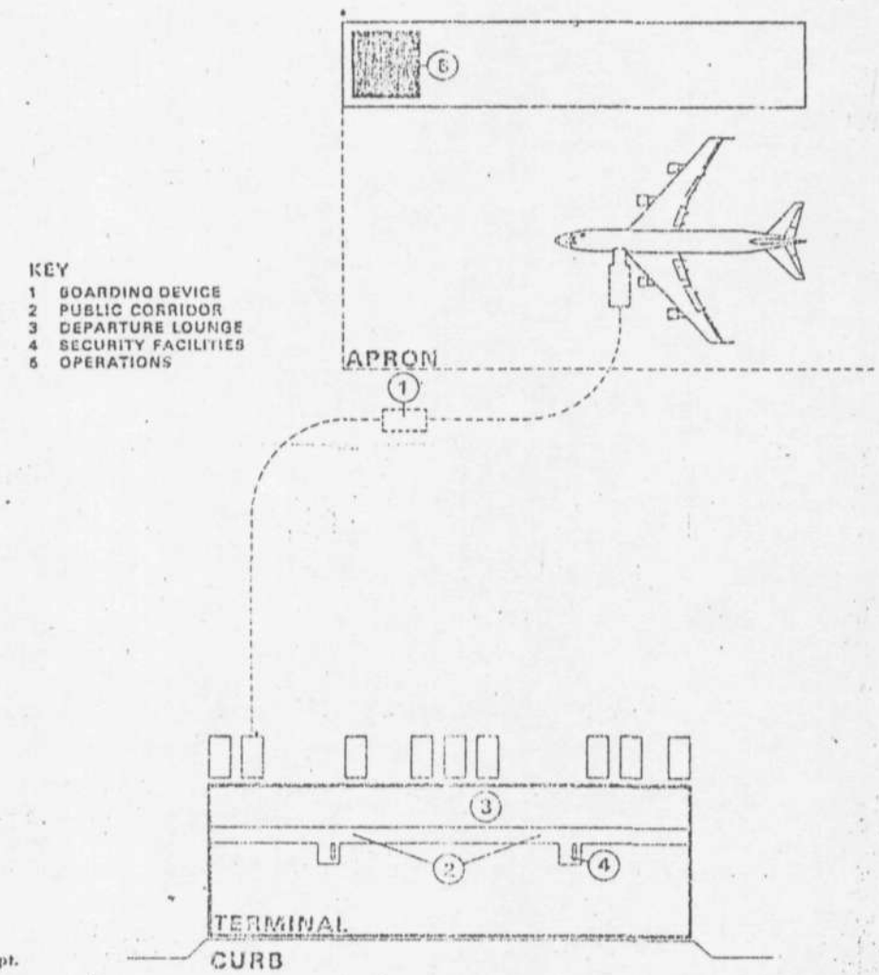


Fig. 4 Transporter concept.

fig 4-5

landside and airside is very obvious. The use of mobile lounges to convey passengers to and from aircraft can increase passenger-processing time, and unless scheduling is carefully coordinated, unnecessary delays may result.

Concept Combinations and Variations

Cominations of concepts and variations as a result of changing conditions experienced from the initial conception of the airport throughout its lifespan. An airport may have many types of passenger activity, varying from originating and terminating passengers using full range of terminal services to passengers using limited services on commuter or connecting flights.

Each requires a concept that differs considerably from the other. In time, the proportion of traffic handled by flights may change necessitating modification or expansion of the facilities. Growth of aircraft size or a new combination of aircraft types servicing the airport will affect the type of concept. In the same way, physical linutations of the site may cause a pure conceptual form to be modified by addition or combinations of other concepts.

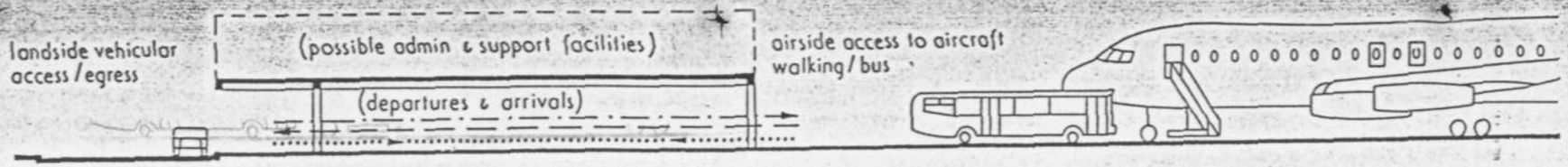
Combined concepts acquire certain of the advantages and disadvantages of each basic concept.

A combination of concept type can be advantageous where more costly modifications would be necessary to maintain the original concept. For example an airline might be suitably accommodated within an existing transporter concept terminal, while an addition is needed for a commuter operation with rapid turnovers which would be best served by a linear concept extension. In this situation, combined concepts would be desirable.

Vertical Distribution Concepts

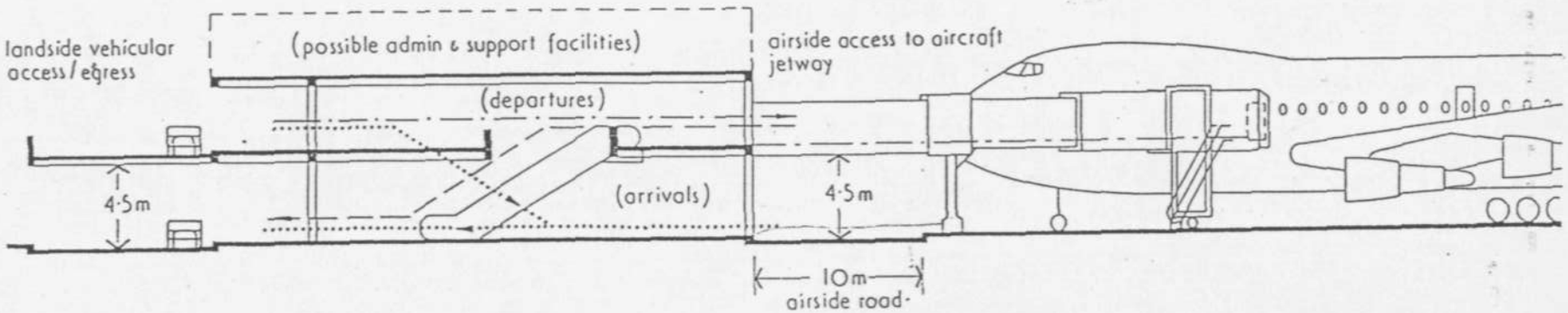
The basis for distributing the primary processing activities in a passenger terminal among several levels is mainly to separate the flow of arriving and departing passengers. The decision on the number of levels a terminal facility should have depends primarily on the volume of passengers and availability of land for expansion in the immediate vicinity. It may also be influenced by the type of traffic, such as domestic, international, or commuter passengers being processed, by the terminal area master plan, and by horizontal processing concept chosen.

With a single-level system all processing of passengers and baggage occurs at the level of the apron. Separation between arriving and departing passenger flows is achieved horizontally.

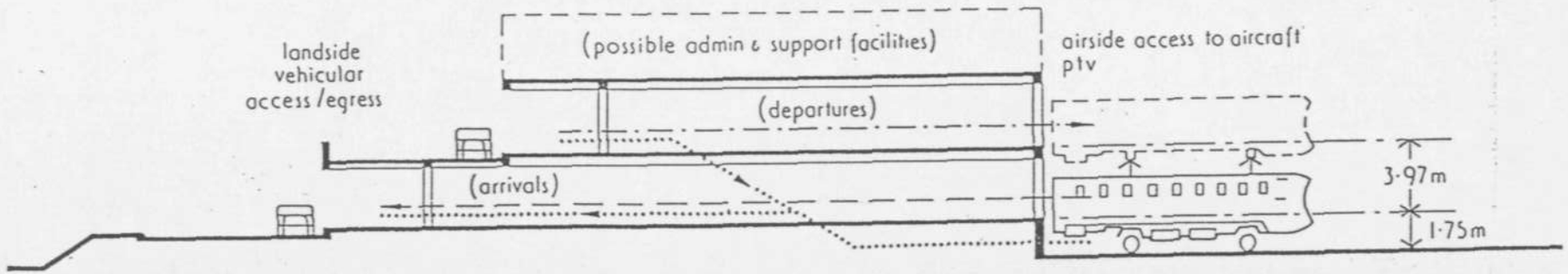


10.1 *Forms of typical terminals shown by cross-sections:*

a *Single level terminal, generally applicable to small or domestic terminals*
Arrival and departure routes split horizontally as flow plan diagram, **10.3**



b *Two-level terminal—jetway type*



c *Two-level terminal—transporter type. Two level terminals are applicable to larger international terminals,*
al routes split horizontally while

amenities, and administrative functions may occur on a second level. With this system, stairs are normally to load passenger on aircraft. This system is quite economical and is suitable for relatively low passengers.

Two-level passenger terminal systems may be designed in a number of different ways. In one type, the two levels are used to separate the passenger-processing and the baggage-handling activities occur at the lower apron level. The advantage of raising the passenger-handling level is that it becomes compatible with aircraft doorsill heights, allowing convenient interface with the aircraft. Vehicular access occurs on the upper level to facilitate the interface with the processing system.

Another articulation of the two level system separates the arriving and departing passenger streams. In this case departing passenger-processing activities occur on the upper level, and arriving passenger-processing including baggage claim occurs at the apron level. Airline operations and baggage handling also occur at the lower level. Vehicular access and parking occur at both levels, one for arrivals and one for departures, and parking

can be surface or structural.

Variations in these basic designs may occur when traffic volumes or the type of traffic so require. For example, for international airport terminals, a third mezzamine level may be needed for international passengers. Also, at large airports where intra-airport transportation systems operate, a special level may be needed to provide for these systems.

chapter 5

case - studies

M.SC. THESIS

architecture dept.
ahmadu bello university
zaria.

july, 1988

adeleye, o. b.

airport '88

the development of ....

KADUNA
international
AIRPORT

5.1 CASE STUDY ONE

5.1.1 DULLES INTERNATIONAL AIRPORT

Architect:	Eero Saarineu and Associates, Hamden, Connecticut, U.S.A.
Sponsor:	Metropolitan Washington Airport Authority
Situation:	7km North-West of Chantily, Virgina, Washington, D.C., U.S.A.
Built:	1958 - 1962
Reference Location:	Longitude 38° 56' 39" W Latitude 77° 27' 24" N
Elevation:	95m above sea level
Terminals:	Two level passenger terminal, separate general aviation terminal and three cargo buildings.
Airline Operators:	14 scheduled carriers and 2 commuter airlines

Traffic Volume:	1970	1975	1976	1977	1978
(Passenger Movement)	2,157,463	2,528,407	2,841,495	2,867,782	3,189,954

5.1.2 Historical Background

The need for a second airport to serve Washington, D.C. became apparent shortly after the close of the World War II. The second Washington Airport Act of September 7, 1950 as ammended by a congressional Act of July 11, 1958, approved for the construction, protection, operation and maintenance of a public airport in or within

the vicinity of the District of Columbia.

5.1.3 Architecture

A compact two level structure 180m long and 60m wide without fingers. It can be readily expanded to 360m in length by adding 90m extension to either end.

The public parking lot is slightly lower than the ground floor of the terminal. This permits a passenger flow that effectively separates enplaning and deplaning passengers.

A centrally located south concourse contains a passenger lounge area, a restaurant and an observation deck on the on the main floor. The lower floor contains offices.

5.1.4 Functionality

Enplaning passengers enter through one of the eight entrances located directly in front of the airline ticket counters and walk less than 70m to the mobile lounge. Enplaning passengers leaving cars in the public parking lot (lower level) ascend to the ground via a short ramp and an escalator to the main floor level.

Deplaning passengers descend through one of the two escalators directly in front of the mobile lounge doors and land in the centre of the baggage claim area. A short ramp links the baggage claim area to the public parking lot.

5.1.5 Structure

The roof is supported by a row of columns 12m apart, 20m high on the approach side, and 12m on the air field side. It is made of light suspension bridge cables between concrete panels of the

of the roof deck fit. The concrete pillars are sloped outward to counteract the pull of cables.

5.1.6 Concept

In order to minimise tremendous distance covered to, aircraft and to satisfy the increasing need for flexible interior space a transporter depature lounge was invented. The transporter departure lounge on wheels and stilts is a part of the terminal which detaches itself from the building and travels out to where the aircraft is conveniently parked or serviced.

5.1.7 Conclusion

The merits of the above case study are enumerated below:

- Commendable departure lounge that satisfies passenger convenience requirements.
- Effective separation of enplaning and deplaning passenger traffics.
- Lateral expansion possibility.
- Flexible interior space.
- Decentralised entrance system.
- Symbolic architectural expression.

Demerits Include

- Restrictive expansion possibility, expansion is only possible laterally.
- Uneconomic departure lounge system, operational cost is high but could be economically reasonable where there are highly scheduled peak traffic flows.

5.2 CASE STUDY TWO

5.2.1 NEW YORK INTERNATIONAL AIRPORT

Terminal Building for United Airlines

Architect:	Skidmore, Ownings and morell
Sponsor:	United airlines
Situation:	New York, United States of America
Built:	1958 - 1960
Reference Location:	Longitude 74° West
	Latitude 41° North

5.2.2 Architecture

This structure was designed for smooth and rapid handling of a large volume of visitor and passenger traffic. The passenger enters the terminal through one of several vestibules and after checking in proceeds by escalator to the upper level, where there are restaurants, new stands, wash rooms and spacious lounges. He continues through one of two glassed - in fingers with waiting rooms and over passenger bridges directly to board his plane.

The incoming passenger arrives on the upper level and rides down the escalator to the baggage claim area. The manual handling of baggage is reduced to a minimum by the fully automatic conveyor systems which operate under the building.

5.2.3 Structure

The main structure is crescent shaped and is adapted to the idlewild master plan. The apron finger differs from each other because of the variance in loading procedures of the United Airlines jets and those of its tenant, Delta Airlines.

The total length of the main structure is 210m; it is 36m wide in the centre and 30m at both ends. The roof cantilevers 8.4m along the side walk of the entrance wall and 4.0m at each end and along the apron side.

Aluminium - faced steel columns enclose large window areas of clear glass or black precast concrete exposed aggregate panels. The fascia consists of sheet aluminium and the soffits of the overhang are finished with cement plaster. The frame structure, staircases and fascias of the fingers, more exposed to jet exhaust, are painted black. The steel framing is fireproofed with vermiculite. The concrete slab ground floor, accommodating operational facilities, like the structure itself is supported on an extensive pile foundation system.

5.2.4 Concept

The pier concept of the terminal area has an interface with the aircraft along the fingers extending from the main terminal building. Each finger has a row of aircraft gate positions on both sides, with passenger concourse running along the axis of the pier which serves as the circulation route for both enplaning and deplaning passengers.

5.2.5 Conclusion

The merits of the above case study include:

- The structural system allows flexible manipulation of interior spaces.
- The^re is expansion possibility.
- Climate responsive design - adequate overhangs

meant for shading.

Service, Administration and Public spaces are well laid out.

Baggage handling system is operationally efficient.

Tenant Airline space is well carved out to ensure privacy.

Decentralised approach system to ease traffic.

The demerits are enumerated as well.

Possible congestion leading to an overstretch of passenger facilities e.g. common circulation routes along the piers meant for both enplaning and deplaning passengers.

Terminal concept requires passenger to walk a considerable distance and also requires a large expanse of apron area.

Restrictive expansion possibility.

5.3 CASE STUDY THREE

5.3.1 JOS AIRPORT

Architects:	Adenrele, Omisore, Adebanjo Associates
	9 Nnamdi Azikwe Street, Lagos.
Sponsor:	Nigerian Airports Authority
Situation:	31km off Jos Metropolis
Airline Operators:	Nigeria Airways, Okada Airline
Runway Dimension:	45m x 3000m
Elevation:	350m above sea level
Location:	Longitude 13° 01' East
	Latitude 05° 15 North

5.3.2 Functionality

5.3.2.1 User Group One - Passengers

An enplanning passenger drops along the curb, and enters the ticketing hall to check - in his baggage. He remains in this hall until he is issued a boarding pass. He proceeds to the departure lounge which leads to the apron through a 24m long finger structure.

The deplaning passenger enters the terminal building through a similar 24m long 'arrival' finger structure into baggage claim area.

Merit

- Effective separation of enplaning and deplaning traffics.
- Openness of connector elements.
- Space manipulation of centrally positioned functions such as V.I.P. lounge and restaurant.

Demerits

Ticketing hall not adequate for peak hour capacity. Inadequate seating facility to cope with possible congestion of departure lounge which may arise from the inability of operating airlines to meet their schedules.

5.3.2.2 User Groups Two - Operating Airlines

Nigeria Airways sells ticket and checks - in passengers in the ticketing hall. Its office accommodation lies behind the ticketing counters. The station managers and the general office along with air-crew rest room lie on one side while the duty officer and records personnel overlook ticketing and checking - in procedures from their offices on the other side.

Okada Airlines sells ticket and checks - in passengers in the same ticketing hall but has its administrative facilities along the corridor that leads to departure lounge.

Merits

The Nigeria Airways spaces by virtue of their location encourages operational efficiency, for instance, the station manager overlooks the aircraft parked on the apron.

Demerits

Tenant spaces meant for Okada Airlines hinder operational efficiency. Lack of first aid facility.

5.3.3 Structure

A system of columns and beams of varying dimensions.

The internal columns accommodate drain pipes running down their

heights. The walls are of masonry construction. The roofing system comprises of reinforced concrete (damp proofed) decks finished with screed. The foundation is of deep strip type with a system of underground beams running below load bearing vertical elements. The staircase is a dogleg type having risers of 17.5cm and treads of 25m finished with marble slabs of 27.5cm.

5.3.4 Finishes

The facade is stone-faced and other sides are smooth plastered and painted. Soffits are finished with acoustic tiles suspended on metal bearers. Floors are finished with regard to their functions: Polyvinyl Chloride (P.V.C.) tiles in offices, quarry tiles along corridors and passages, non - slip cement finish in the cargo hall, precast concrete slabs on concrete bed for both enplaning and deplaning curbn platforms.

5.3.5 Conclusion

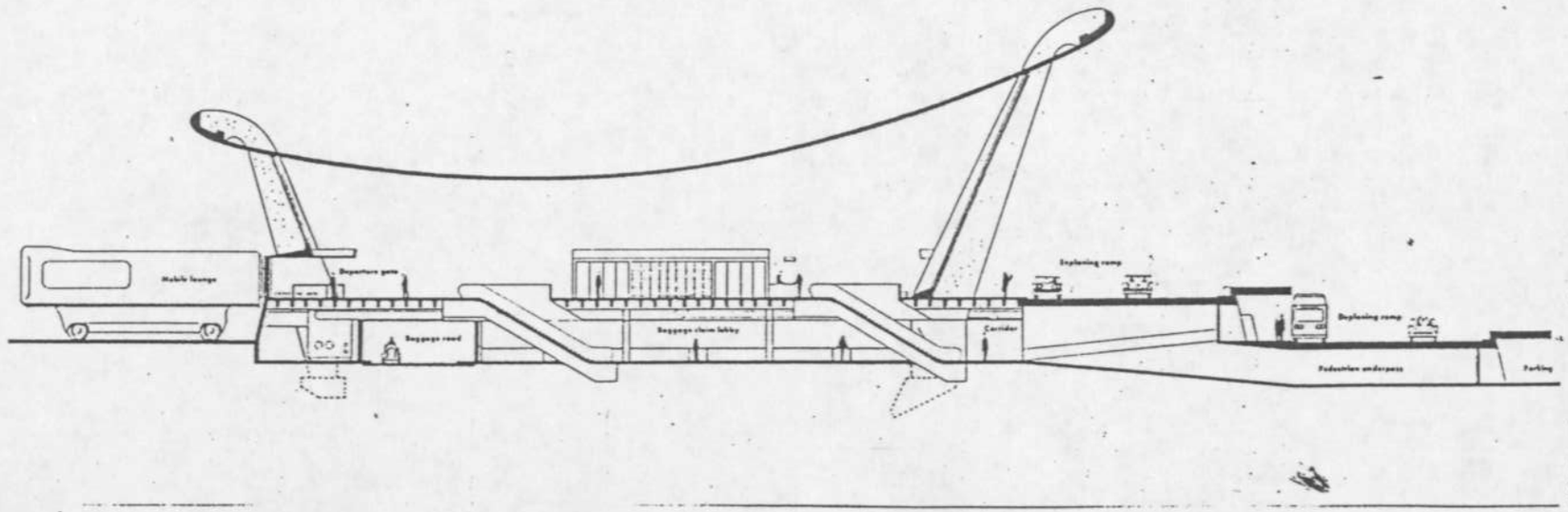
Merits

- Functional selection of finishes.
- Expressional effect of stone-facing along the main facade, it localises the entire architectural piece.
- Openings are wide enough to allow adequate daylight illumination.

Demerits

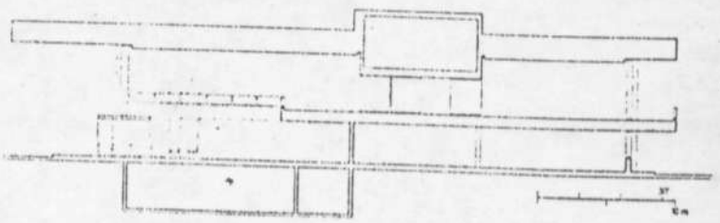
- Ineffective shading device for offices
- Drain running through columns constitute a menace to the structure.

PLAN DULLES AIRPORT



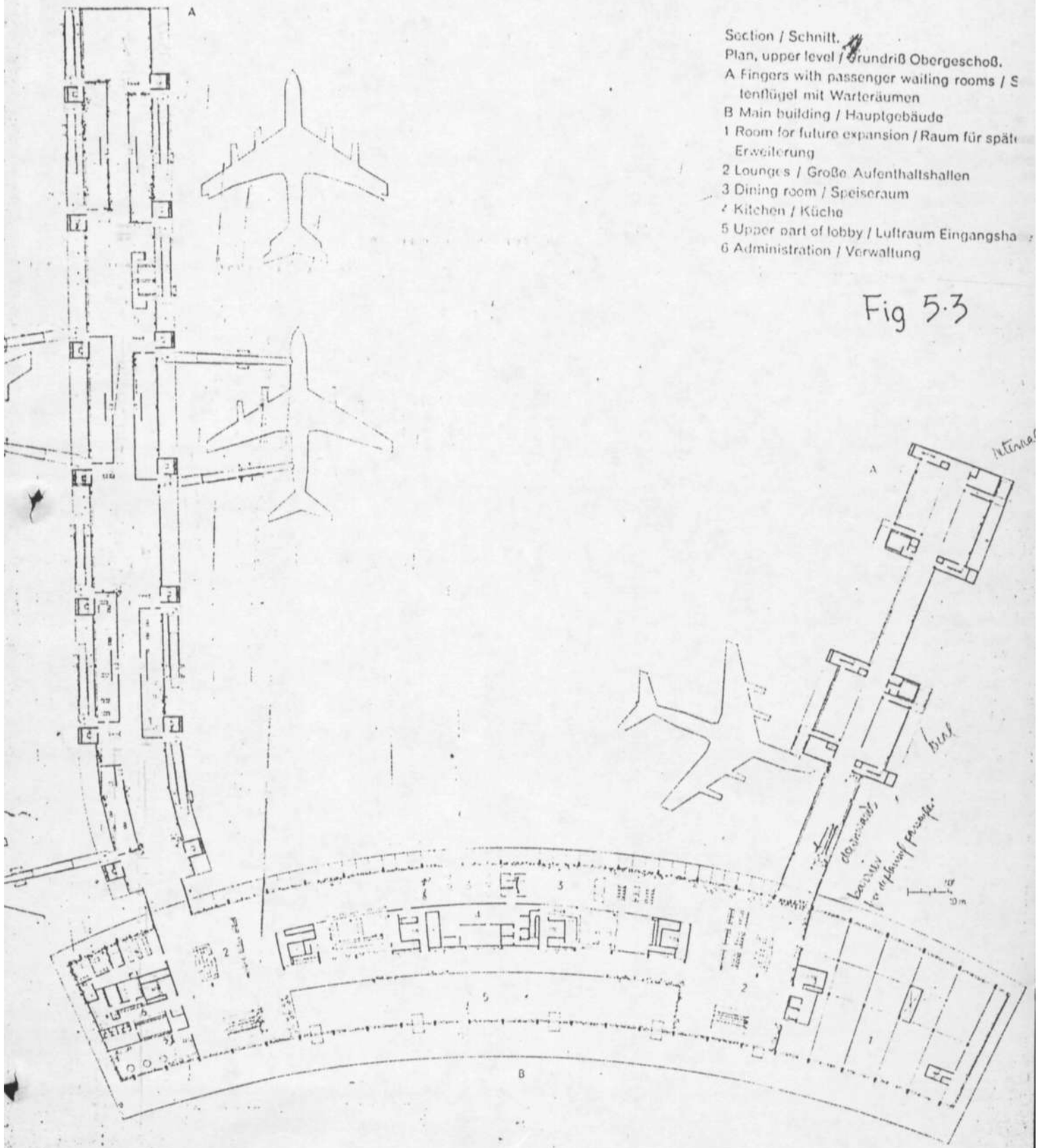
SECTION DULLES AIRPORT

Fig 5-2



Section / Schnitt.
Plan, upper level / Grundriß Obergeschoß.
A Fingers with passenger waiting rooms / S
tenflügel mit Warteräumen
B Main building / Hauptgebäude
1 Room for future expansion / Raum für späte
Erweiterung
2 Lounges / Große Aufenthaltshallen
3 Dining room / Speiseraum
4 Kitchen / Küche
5 Upper part of lobby / Luftraum Eingangsha
6 Administration / Verwaltung

Fig 5.3



united airlines terminal

Fig 5-3

chapter 6

site study

M.SC. THESIS

architecture dept.
ahmadu bello university
zaria.

july, 1988

adeleye, o.b.

airport '88

the development of ....

KADUNA
international
AIRPORT

6.1 KADUNA

Kaduna is one of the colonial towns of Nigeria, and had a population of 149,910 by 1963 census.[1] It was founded to serve as the capital of the Northern Nigeria. Upon the creation of states in 1967, it became the capital of the North Central State. In 1976, it became the capital of Kaduna State which was split in late 1987 into two - the north constituting Katsina State and the South remaining Kaduna State. Kaduna still remains the capital of the new Kaduna State. However, the loss of a substantial part of its administrative hinterland has not affected the growth of the city which is now experiencing shortage of office and housing accommodation. Industrial and Military establishments have immensely contributed to the continuing growth of the city.

6.1.1 Location and History

Kaduna is located on latitude 10° 30' N and longitude 7° 30' E at a distance of about 930 kilometre from Lagos.[2] The city derives its name, which means the place of crocodiles from the crocodile infested river which is its main physical feature. Its central position in the former Northern Region, ready accessibility by both road and rail and availability of a river were important considerations in the selection of the site for the capital city in 1917. Ten years later when the eastern railway mainline was tapped from Port-Harcourt, the city became a major rail junction and the biggest passenger exchange point for trains from Kano, Kaura Namoda, Port-Harcourt and Lagos.

Although Kaduna was originally built as an administrative capital, it was also to become an important industrial city and a

major military training centre. These functions have combined to make for its rapid growth. Two years after its foundation, Kaduna had a population of 3,000 which rose to 5,400 in 1921 and 10,620 in 1931. In 1952, there were 44,540 people and ten years later the population has increased to 150,000.[3] As at 1985, the population was projected at 964,000. The growing importance of Kaduna as an industrial centre has attracted more immigrants. Despite the fact that the administrative importance of the city and its labour force had been reduced due to the creation of several new states, the city has maintained a steady growth.

6.1.2 Physical Features

River Kaduna, one of the important tributaries of River Niger is by far the most dominating physical feature of the site of Kaduna which is built on a rolling plateau about 600 metre above sea level. The monotony of this grass land rolling country is broken in many places by solid granite inselbergs which rise a few hundred metre above the surrounding plain. Much of the plateau surface is dissected by broad shallow valleys, some of which are dry for most of the year. Apart from small forest reserves located in the West and North of Kaduna, these valleys are only areas of extensive woodland since the interfludes have been largely deforested by continuous cultivation and bush fires.

Kaduna district is underlain by granite rocks of the Basement Complex.[4] Over most of the area, these rocks have weathered to from deep layers of fine textured soil - which become water-logged when it rains and dry out cracking during the dry season. The heavy rainfall (127.5cm) has contributed to the incidence of gully

erosion along valley slopes; and the headward retreat of these gullies has left many flat topped lateritic capped residual hills.

6.1.3 Commerce and Industry

Kaduna is both an industrial and a commercial city. As at 1980, manufacturing was by far the largest employer of labour. Industrial growth has taken place mainly in Kaduna South which is mapped out as the industrial zone of the city. The largest category of industry is the textile industry. Kaduna Textile Company was established in 1958. By 1972, there were six textile factories in Kaduna namely, Arewa, United Nigeria, Norsprin, Nortex, Northern Nigeria and Kaduna Textiles. The location of Kaduna near the Nigerian Cotton belt has contributed immensely to this rapid growth of the industry.

Other industrial establishments include the ordinance of the Federal Ministry of Defence, Peugeot Automobile of Nigeria, Kaduna Refinery and several breweries. There is also a good number of medium and small scale industries such as printing, furniture and metal works.

310018

The main commercial centre of the city is located in Kaduna North and consists of the Central Market, the Central Business District along Ahmadu Bello Way and the principal thorough fares of Sabon Gari. Commercial activities have been expanding and consists mainly of retail and wholesale trade in a variety of commodities. Some of the bigger establishments are A. G. Leventis, K. Chellarams and Son, the United African Company (U.A.C.) and the United Technical Company (U.T.C.). These establishments played the dual role of agricultural produce buying agents and distributors of manufactures goods till the 1960s.

KASHIM IBRAHIM LIBRARY
AHMADU BELLO UNIVERSITY
NIGERIA.

Barely all of them have now established supermarkets which have been guaranteed protection by the enactment of the indigenisation decree. The central market provides a different category of shopping facilities, similar in some ways to the roadside traders who are found along the major streets in most of Nigerian cities.

6.1.4 Services

Educationally, there are several primary and post primary institutions in Kaduna belonging to both the government and the private sector. Other educational establishments are the Nigeria Defence Academy and the Airforce College.

Compared with other cities in Nigeria, Kaduna has a good number of health care delivery facilities. They include the National Eye Centre, a general hospital, a teaching hospital, a military reference hospital, an infections disease hospital and a psychiatric hospital and several private clinics.

Kaduna also has a good number of hotels, tourist attractions, recreational and sports facilities. Besides the aeronautical demand of Kaduna and its environs had warranted the establishment of a new airport along Mando Road, a few kilometre outside Kaduna metropolis. The old airport which served for both military and civil use was totally phased into military use having been replaced by a new one for civil use, located few kilometre from the old one.

6.2 Airport Site Selection

The individual who undertaken the selection of a site suitable for new airports must first establish certain outeria which will serve as a guide in the determination of its proper location and size. Most of these criteria are however applicable to the

expansion of existing airports. The location of an airport will be influenced by the following factors:[5]

1. Type of development of the surrounding area
2. Atmospheric and meteorological conditions
3. Accessibility to ground transport
4. Availability of land for expansion
5. Presence of other airports and availability of airspace in the area.
6. Surrounding obstructions
7. Economy of Construction
8. Availability of Utilities
9. Proximity to aeronautical demand

Type of Development of the Surrounding Area

This is an extremely important factor, since airport activities, particularly from the standpoint of noise, are often objectionable to the airport's neighbours. A study of current and prospective uses of land adjacent to Kaduna International Airport reveals their compatibility with airport activities. The airport is located several kilometre from the metropolis. Besides, the surrounding under-developed thick-forested area forms a buffer zone between the airport and the metropolis.

Atmospheric and Meteorological Conditions

The presence of fog, haxe and smoke reduces visibility and has the effect of lowering the traffic capacity of an airport, since the capacity when visibility is poor is less than when it is good. Fog has a tendency to settle into areas where there is little wind. Lack of wind can be caused by surrounding topography. Likewise, smoke and haxes are present in the vicinity of large

The present of site of Kaduna International Airport offers characteristics which are commensurate with aviation needs. It is located several kilometre from the industrial zone of Kaduna South.

Accessibility to Ground Transportation

Transit time from the point of origin to the ultimate destination for passengers and shippers of air freight is a matter of major concern. In many cases, the ground time exceeds the air time by a considerable margin. With the introduction of jet transports the margin has increased even more. For a journey of 640km between two large metropolitan areas, ground times can be as much as twice the air travel time.

Access to airports is required not only by air passengers but also by other users of the airport, such as employees, visitors, spectators, trucks hauling freight, and businesses dealing with the airport's tenants. Statistics have shown that the private automobile is the major form of access to the airport for both passengers and employees. It is expected that this trend will continue in the future despite greater availability of mass transit. Although air cargo is growing rapidly, truck traffic is not a major contributor to airport traffic. However, the number of trips by airport employees can be laeger than the numbered generated by airline passengers. This depends on the size of the airport and the presence of commercial enterprises or large maintenance facility at the airport.

In order to minimise delays and prevent congestion, the circulation of traffic in an airport should generally be one way and

counterclockwise. The road should be wide enough to permit passing. This is exactly the case in Kaduna International Airport.

Availability of Land for Expansion

In a field as dynamic as aviation it is necessary to acquire land in advance or to be able to acquire sufficient real estate in the future for expanding the airport plant. Historically, as the size of aircraft and the volume of traffic increased, runways have had to be lengthened, terminal facilities expanded, and additional support facilities provided. Sufficient real estate is available to accommodate possible new facilities in Kaduna International Airport.

Presence of Other Airports and Availability of Airspace

The operations at other airports in the area mus be carefully analysed when a site for a new airport is selected or when additional runways are provided at an existing airport. Airports should be located at a sufficient distance from each other to precent aircraft which are maneuvering for a landing at one airport from interfering with the movements of aircraft at other airports. The minimum distance between airports depends entirely on the volume and type of traffic and whether the airports are equipped to operate under poor visibility conditions.

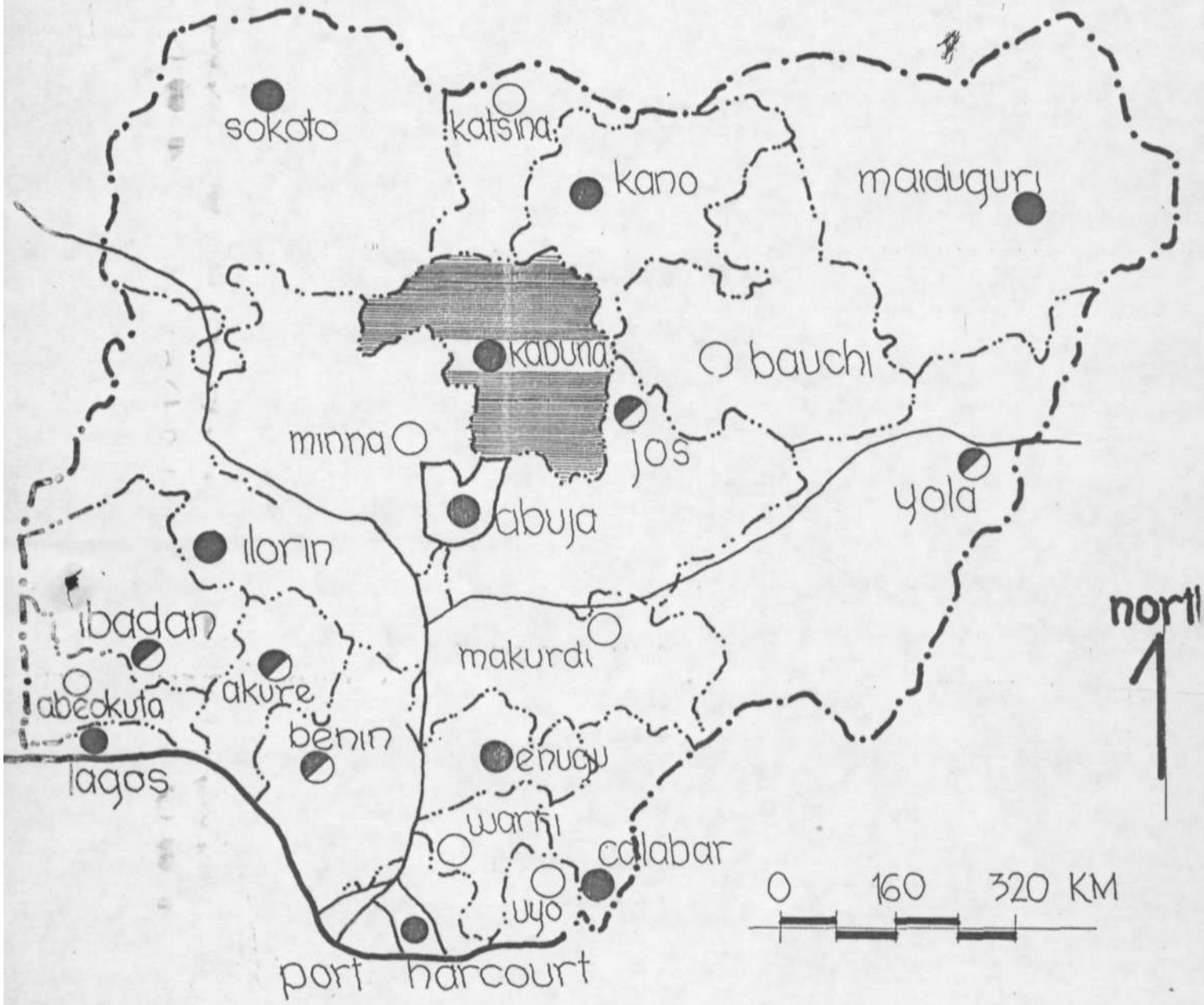
Maneuvering in the air is vastly more complicated during periods of poor visibility. Under instrument flying conditions, air traffic control segerates aircraft using the airways and maintains control until each in turn is cleared for an instrument approach to the airport.

The location of Kaduna International Airport is consistent with the overhead airway traffic patterns so as to prevent conflicts in traffic flow.

Surrounding Obstructions

Sites should be selected so that approaches necessary for the ultimate development of the airport are free of obstructions or can be cleared if obstructions exist. The provision and protection of adequate approaches to an airport will necessitate height restrictions in the airport turning zones and in line with runways. In Kaduna International Airport, the required clearances for the approaches to the runways and in the maneuver area directly above and adjacent to the airport have been respected.

map of nigeria showing the 21 states and available airports.

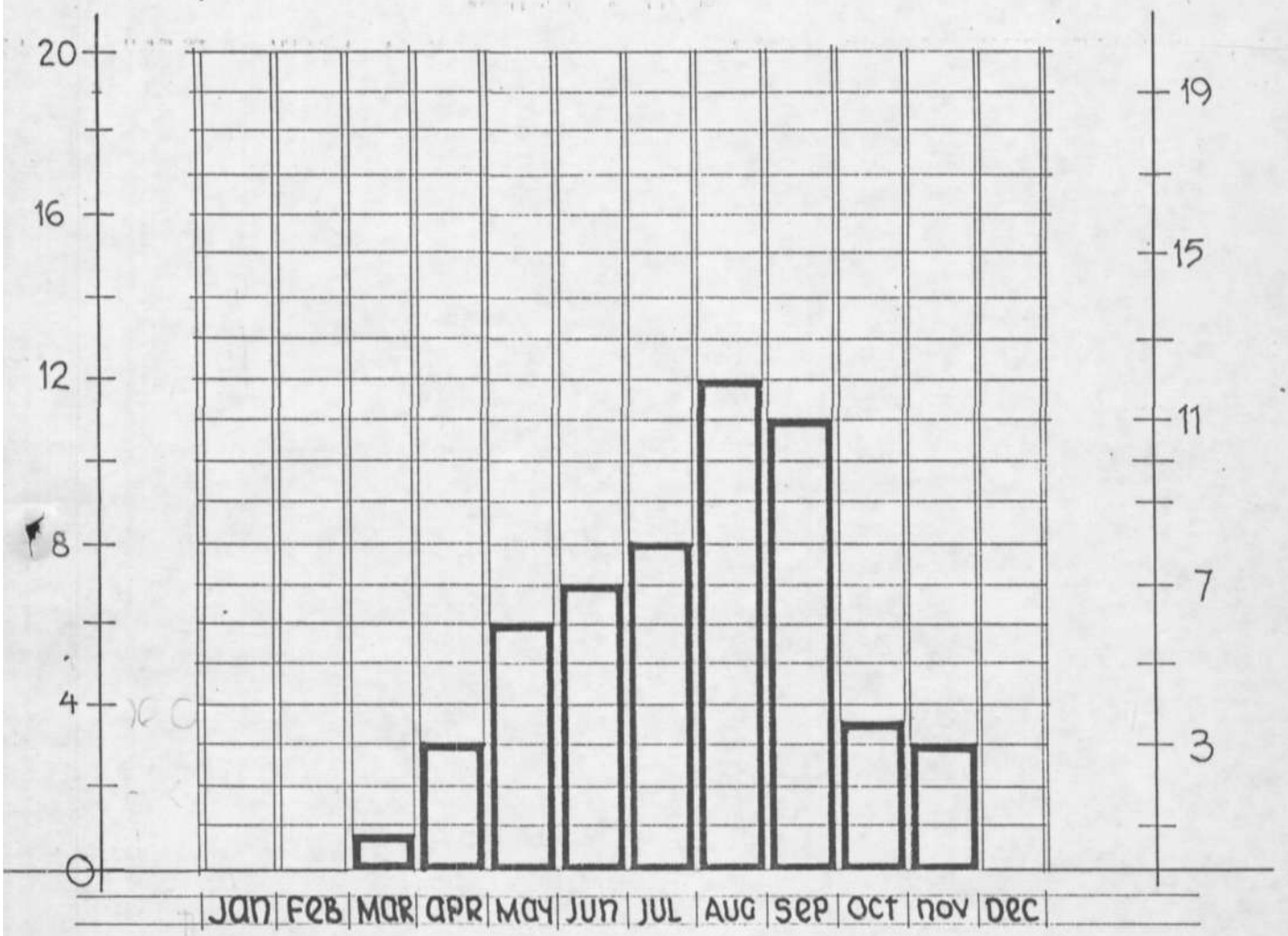


○ state capital
● facility for long haul aircraft
◐ facility for medium haul aircraft

fig 6-1

mean monthly **Rainfall** in inches

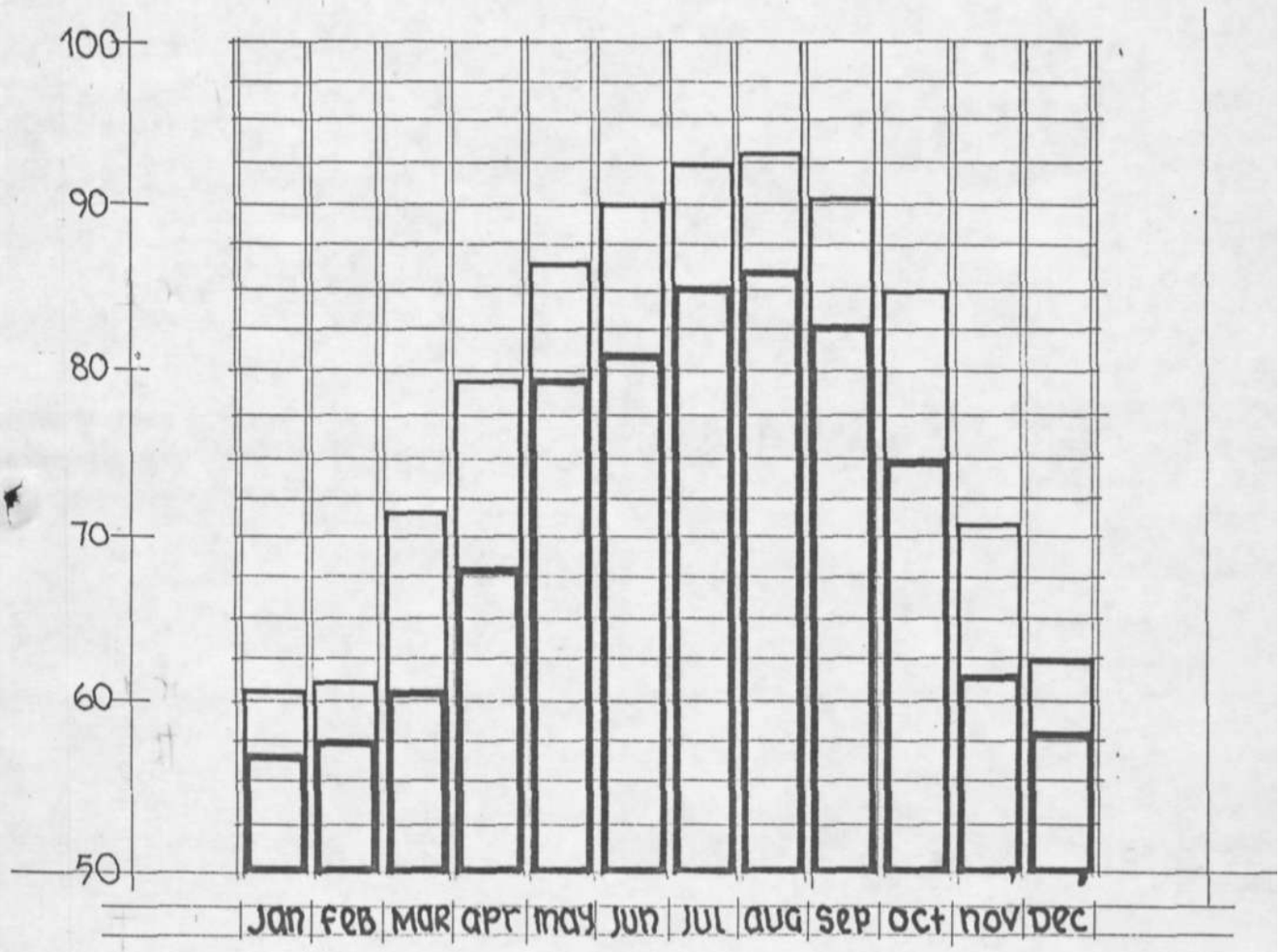
for KADUNA



purpose to determine need for special design responses

fig. 6-2

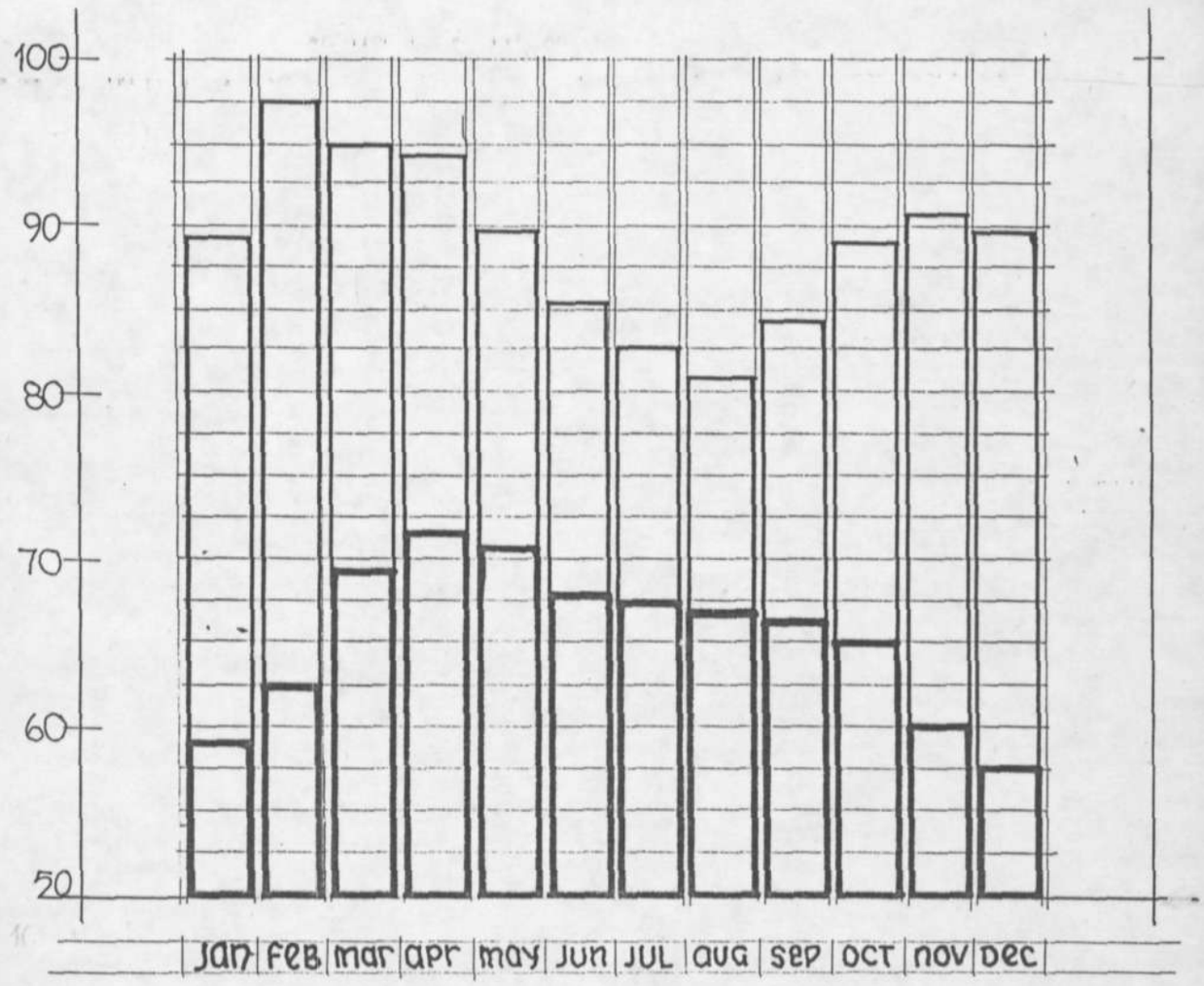
mean monthly **relative humidity**
at 10 hrs and 16 hours



purpose to determine the need for dehumidification or humidification.

fig 6-3

mean daily **air temperatures**



purpose

extremes by month to determine heating and cooling requirements

fig 6-4

chapter 7

design report

M.SC. THESIS

architecture dept.
ahmadu bello university
zaria.

july, 1988

adeleye, o. b.

airport '88

the development of ....

KADUNA
international
AIRPORT

7.1 REFLECTIONS ON THE NIGERIAN AIR TRANSPORT INDUSTRY

- the views of the N.A.A. officials

Airports are part of a complex economic and social system. Like highways and other forms of transport, they constitute important elements of the infrastructure of a nation. To the extent that they influence the pattern and speed of regional development, a purely technical approach to their design is inadequate. If transport planning is to be responsive to the aspirations of a country, it must be sensitive to prevailing cultural values and social desires. Subtle interactions exist between the public and the design of any airport. They will determine both the nature and demand of airport services and, consequently, the role, size and form of the airport itself. We will, therefore also learn how to model these economic and social forces, and how to anticipate and deal with their consequences.[1]

Personal interviews with various officials of Nigerian Airports Authority revealed some striking facts about the air transport industry in Nigeria. The Airport Manager, Jos Airport contended that the future of the industry is bleak. He claimed it is tied to the economy. In Nigeria, the purpose of travelling is solely business and not pleasure unlike in the advanced countries of the world. According to him, the remedy lies in the evolution of a national transport policy that links all modes of transport. Presently roads are over-utilised, rail is underequipped and inefficient while air transport is expensive. This is as a result of the recent reduction of government subvention and increasing cost aircrafts and their spare parts, and aviation fuel,

two basic commodities that are imported into the country at the present unfavourable foreign exchange rates.

With respect to congestion in airport terminal buildings, this arises from flight schedules not being strictly adhered to. It is not unusual for 7.00am flight to delayed till 11.00am, at which time passengers for the 11.00am would have arrived. Meanwhile, 1.00pm flight passengers are rushing down to check-in early for their flight. In effect at any one time there may be up to three batches of passengers in the terminal designed for just a batch.

The problems of the air-transport industry are not so different from those of other vital sectors of the economy like health. Inaccurate data remain the bane of these sectors. Faulty projections of airport users, in the words of the Head of Operations, Jos Airport have led to congestions which in turn resulted to an overstretching of existing facilities like toilets. Indeed, seats often become inadequate for passengers at peak periods while at other times, many may be unoccupied.

Airports in the developed world care so much about the welfare of their passengers. In Nigeria, this is not the case. Apart from the problem of congestion earlier identified, lack of flight information display systems, meditation rooms, indoor games for stranded passengers and nurseries for nursing mothers while at the terminal characterise most of our airports.

It is becoming increasingly difficult to understand the motive behind the establishment of airports in Nigeria. A pertinent question being asked is "Why are airports being

established — as a public utility or as a commercial venture? The answer to this question holds a judicious use of our airports. However, when one realises that staffers of the Nigerian Airport Authority cannot provide an answer to this question, then it seems for a long time to come our airports will continue to drift aimlessly as the basis for their establishment remains a wild guess. What is known is that there are airports that were established for political expediency.

There is also a need for airport users to develop a maintenance culture so as to keep running costs on airport facilities to the minimum. The airlines and the airport authority could possibly exploit related fields like tourism, internal cargo handling so as to boost their revenue generation.

There is an overriding need to match airport designs with the regional peculiarities of their location such as climate. Designs should take cognizance of the technological development and climatic status of the location of airports. In Nigeria, where power supply is erratic and thus unreliable, caution should be exercised in the incorporation of building services which are fully automatic and that might not be easily replaced in case of possible breakdown. An example is the split air-conditioning system in Port-Harcourt International Airport which has since broken down.

A case in view is the Kaduna International Airport. First operational in July 1983, the airport presently originates international flights in addition to its domestic flight operations. However, there is still controversy whether the airport is trully international or not.

In the words of the Public Relations Officer of the airport, what makes an airport an airport international is neither its size nor its annual average passenger volume, but the functions it serves and its facilities. According to him, Kaduna Airport enjoys the recognition of the International Civil Aviation Organisation (I.C.A.O.) as an international airport. To the credit of the airport are such facilities as 3-km runway capable of taking any of the Boeing - 747 series, control tower and a fire and rescue service facility. Although immigration and custom services are only made available when necessary. They could be summoned at short notice on a 24-hour basis. Deficiencies such as befitting terminal buildings and rental spaces are hindering its commercial viability.

Seasonal factors affect the viability of this airport. These include student vacations, festival periods, convocation ceremonies of institutions like Ahmadu Bello University, Kaduna Polytechnic, Nigerian Defence Academy and Command Staff College, Jaji. During these periods, there is a very heavy air traffic. The same is true of state visits which are usually accompanied by a considerable entourage. Other factors include the establishment of non-scheduled carriers namely KABO, GAS and OKADA airlines, and their recent promotion to the status of scheduled airline operators. The recent inception of transit flights in the airport has also added an economic viability of the airport, in the words of the Principal Airport Operations Officer, is very encouraging. The future seems bright if the required facilities are quickly developed. However, there is a need for airline operators to build up trust in the minds of the people. The level of economic activities of the people will also

contribute to the viability of the airport. Equally important is the catchment area of the airport, any reduction in this area as a result of the establishment of another airport nearby might affect its viability. Against this background, it is worth saying that the airports viability is not in doubt.

With the recent export drive, a bright future awaits the air-cargo sub-industry - an area that had been taken care by the airport land-use plan. The concentration of industries like the Defence Industries Corporation (a military ordinance company), the Refinery and Peugeot Automobile of Nigeria in Kaduna and in nearby towns like Zaria, and to the newly created state of Katsina, there is every hope that the air cargo industry will definitely pick up in the airport, in fact, as the sole one in the north Lagos presently boasts of the only well equipped cargo terminal. Furthermore, Kaduna, Kano and Katsina are important agricultural areas with recent concentrations of mechanized agricultural outfits. The products of these agricultural processes will also brighten the hope for a successful air-cargo industry.

The above points hold true for Kaduna due to its strategic location being a nerve centre of economic activities and its near central location. They may hold true for any other airport but caution should be exercised in applying them unguardedly.

7.2 BRIEF

The new Kaduna International Airport was forced into operation upon a predidential order to airlift hajj pilgrims to Jeddah, Saudi Arabia in July, 1983. Although demand had already outstretched the facility capacity of the old airport which was being shared with Nigerian Air Force, the basic technical facilities were barely ready as at the inception of the new airport.

Deficiency of certain facilities such as proper terminal buildings in the new airport is obviously hindering its commercial viability. A passenger terminal complex is to be designed for the airport. The complex must comform with the airport master plan being the concept of ultimate development.

7.3 BRIEF DEVELOPMENT

According to the International Civil Aviation Organisation, an international airport is that designated by the contracting state in whose territory it is situated as an airport of entry or departure for international traffic, where formalties incident to customs, immigrations, public health, animal and health quarantine and similar procedures are carried out. In essence, the function of an airport and its facilities make for its international status. International flights are occasionally originated from Kaduna. Despite its viability in domestic flight operations, it also serves as a reliever airport for both Kano and Abuja International Airports (that is providing an alternative landing facility for an approaching aircraft in case it should be difficult landing in their actual destination). The essential facilities that make for the technical competency of an international airport are available in

serviceable condition. They include the runway fire and rescue service facility and control tower. The runway can take the heaviest commercial aircraft — Boeing 747 series and other wide-bodied aircraft. Besides, government agencies required to facilitate and regulate international travel such as Customs, Immigration and Public Health departments could be summoned on short notice.

The terminal area is the major interface between the airfield and the rest of the airport. It includes the facilities for passenger and baggage processing, cargo handling, airport maintenance and operations, and administrative activities. Ideally, the passenger terminal system is the major connection between the ground access and the aircraft. The purpose of this system is to provide the necessary interface between the passenger and the airport access mode, to process the passenger for the origination or temination of an air transport trip and to convey the passenger and the baggage to and from the aircraft. However, site investigation revealed the temporary structure of the air traffic control tower and the wrong location of the airport authority office accommodation. So these two facilities shall constitute integral parts of the development scheme of the proposed passenger terminal complex.

7.3 SCHEDULE OF ACCOMMODATION

Airport Terminal Space Facility	Space Requirement/m^2
Car Park	10,000

Passenger Terminal -	
Concourse areas	1,500
Departure lounge	500
Shops	100
Holdrooms	350
Baggage claim: waiting area	150
retrieval area	400
Catering	1,100
Aircraft Information Service -	
Chief of Air Traffic Facility	30
Senior Air Traffic Controller	30
Senior Signals Officer	30
Meteorological Suprintendent	25
Computer Room (teleprinter)	25
Staff Rest Room	25
Signals Office	30
Equipment Room for Signals	25
Battery Room for Signals	25
Radar Stimulators and Apparatus	60
Meteorelogical Communication Centre	60
Met. Brieffing Office	30
Airport Management -	
Airport Manager	50
Public Relations	40
Airport Operation	40
Accounts	40
Personnel	40
General Office	80
Coffee Room	15

Conference	50
Building Maintenance	200
Airline Operations -	500
Office Accommodation	
Staff Lounge	
Aircrew rest room	
Government Agencies	200
Nigerian Air Force	
Customs	
Immigrations	
Public Health	

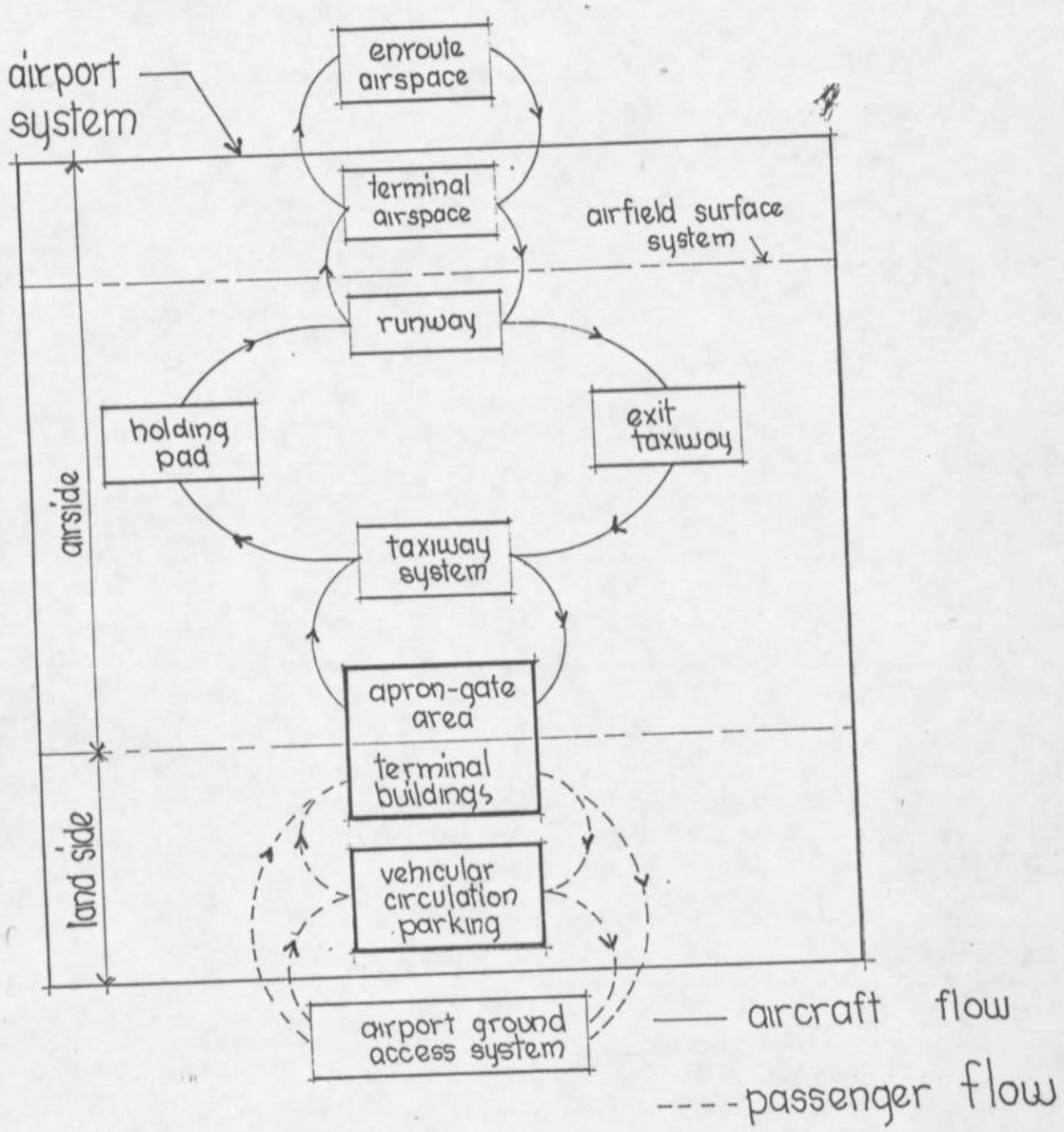


Fig 7-1 Components of the airport system

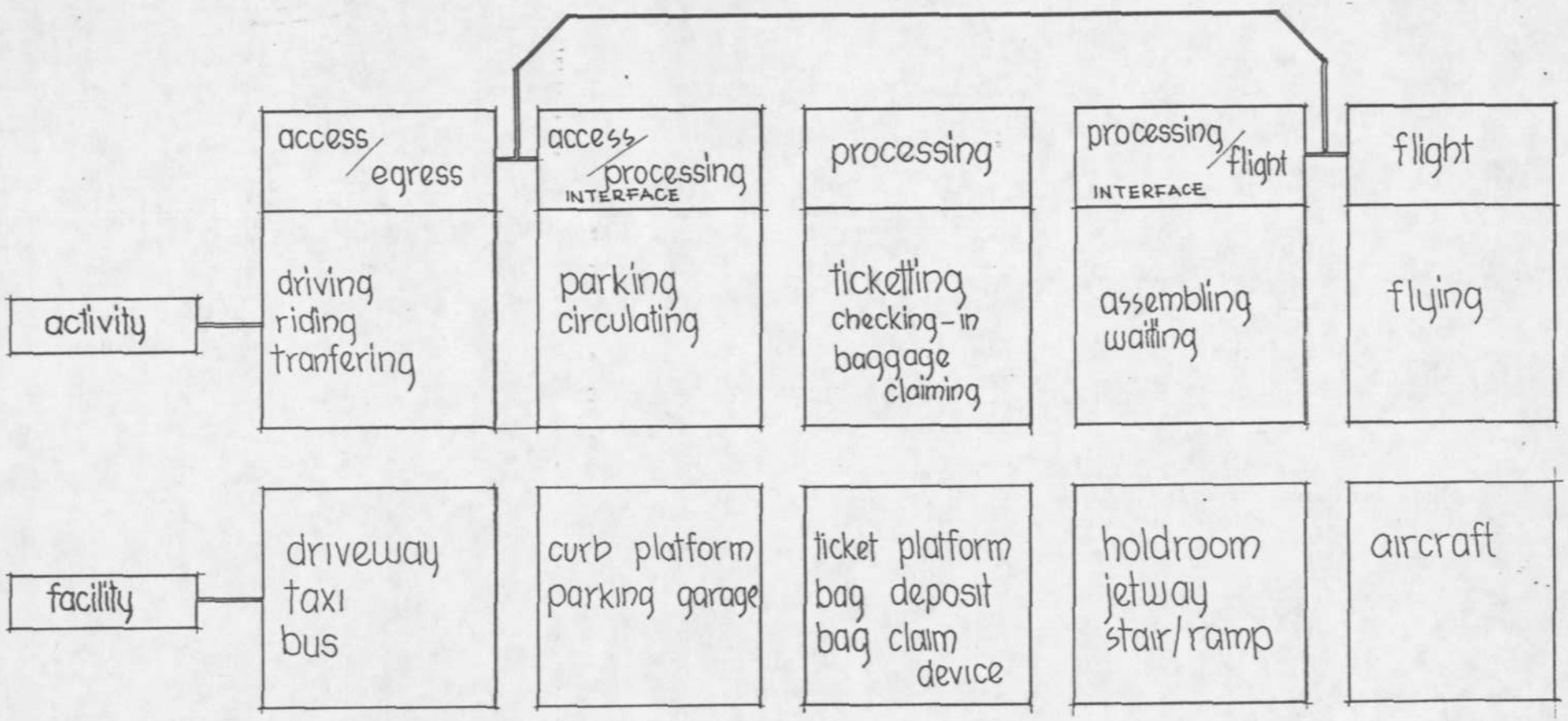
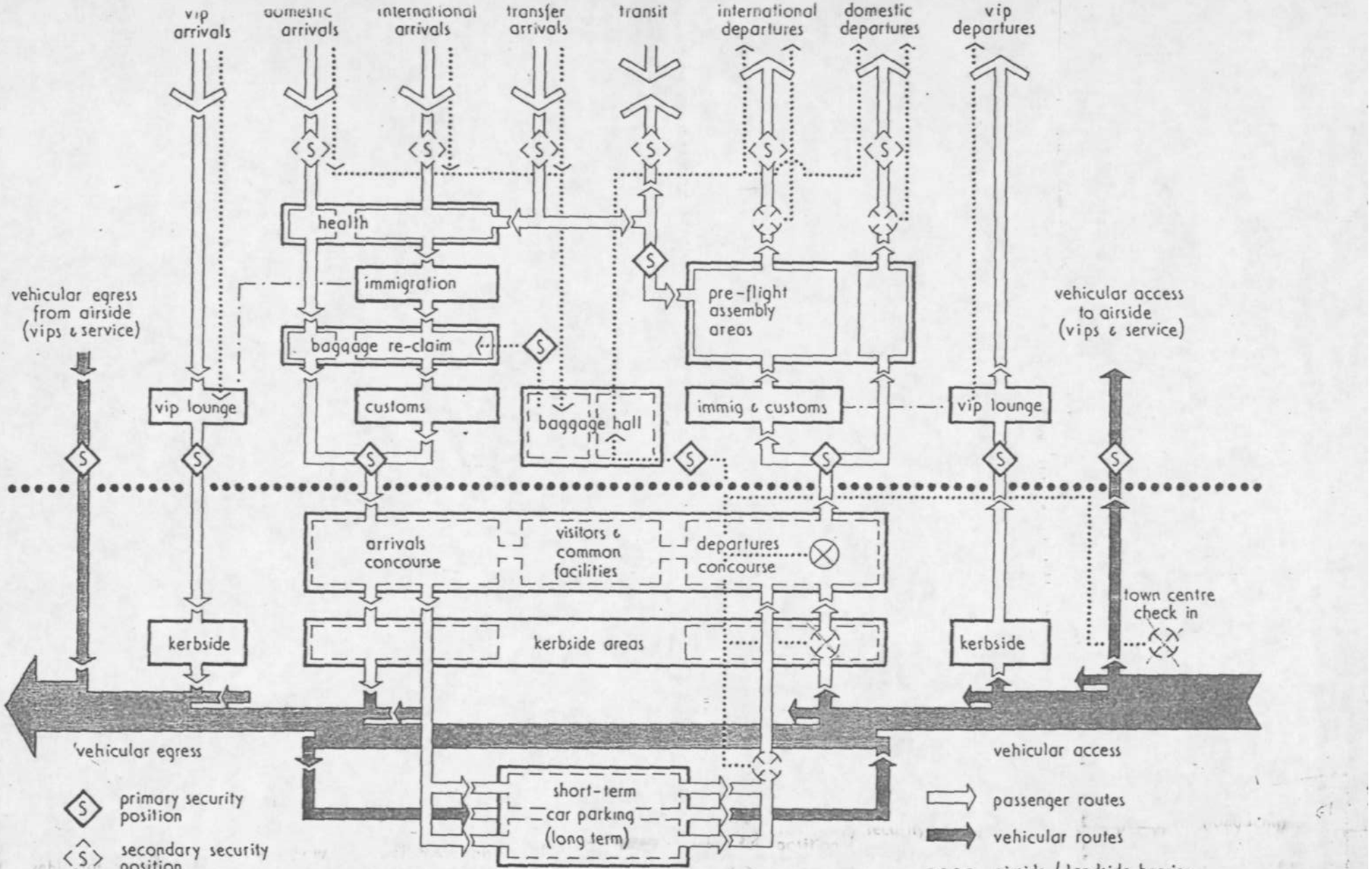


Fig. 7-2 Components of the passenger terminal system



7.3 *Flow plan diagram*

chapter 8

summary and conclusion

M.SC. THESIS

architecture dept.
ahmadu bello university
zaria.

july, 1988

adeleye, o. b.

airport '88

the development of ....

KADUNA
international
AIRPORT

SUMMARY

The whole write-up could be grouped into three by virtue of their context, namely, problem definition, problem study and design report. The first three chapters were introductory. They defined the research proposal, established a basis for its necessity and discussed relevant issues.

The following three chapters constituted the problem study. They include program study, case studies and site study. A comprehensive study of the program requirements, a survey of relevant case studies and a thorough investigation of the site were carried out respectively.

The relevancy of case studies:

1. Dulles International Airport. It is the only airport that adopts solely the transporter terminal area concept which is a kind of the two basic terminal layouts. The main challenges were maximum flexibility to cope with future possibility and, its symbolic and expressive architectural envelope.

2. New York International Airport, United Airlines Terminal. This terminal was designed to accommodate tenant airline (Delta Airlines) in addition to the main occupant. The Nigerian situation gives rise to the idea of the national flag bearer, Nigeria Airways as being main occupant and other airline operators as tenants. This case study also enabled a thorough study of the second kind of the two basic terminal layouts.

3. Jos Airport. This is typical airport designed by Nigerian Consultants. Its facilities were designed in a manner such that with a minor extension, international facilities could be accommodated. The main challenge was the building design with respect to the climate. This particular study enabled the author to have a feel of Nigerian Airport System.

Being a development scheme, the site study enabled a thorough investigation of the existing facilities and proposed ones. According to the Airport Resident Engineer. Mr. Dunama Saleh, the master plan proposals include developments like National Maintenance Centre, Hangars for certain airlines, a Technical Building Complex for the Nigerian Airport Authority as well as a mechanical workshop. All within the airport perimeter fence. Beyond the fence, a filling station and a motel are among the proposals. He claimed that the soil test of the terminal building area revealed that a reasonably hard subsoil exists near the surface and as such pad and strip foundation systems are recommended respectively for columns and load - bearing walls.

With respect to utilities, there are two boreholes capable of providing the airport with adequate water supply. There is no central sewage collection system so septic tanks are provided. The Fire and Rescue Service facility has a 50,000 litre underground water reservoir and there also two of 20,000 litre capacity at both ends of the runway. Power supply had not being a problem. Ther are two generating plants. of 200 kVA and

275 kVA capable of supplying alternative electricity reliably whenever the public supply fails. The Nigerian Airports Authority staff clinic had been planned to take care of accident victims, so, only a first aid medical facility is required in the terminal building. There is plan to phase the temporary terminal structures being used presently into a hajj camp. before the ultimate development of a cargo terminal.

The chapter on design report discussed the views of the N.A.A. officials as regards the Nigerian air transport industry. It includes the brief and brief development. Schedule of space requirements as obtained from space determination in chapter four was also listed. The last chapter is summary and conclusion.

CONCLUSION

This research had demostrated that the problems highlighted in form of objectives could be satisfactorily solved as presented in the design proposal of the entire passenger terminal complex. These objectives include passenger comfort and convenience, security and baggage handling, extensibility and adaptability. The enplaning and deplaning traffics had been properly separated and thus passenger processing operation is free of friction. Facilities for deplaning passengers are available in the ground floor. The next level accommodates the departures concourse. An extension of the departures concourse occupies half of the second floor. Several rooms had been provided to cater for the welfare of passengers. There is a first-aid medical facility in the security office. This is so because security men are always occupying strategic positions by virtue of their work. In case there should be accident they could easily help the victim. Besides, nursery had been provided for nursing mothers and meditation room for passengers that enjoys quietude. A press room is available to cater for possible press interview. There is also the usual V.I.P. lounge which is as a result of societal stratification. The safety of passengers is now guaranteed unlike what obtains presently in Kaduna Airport. The passenger go through a tube to the holdrooms where they wait to join their plane. They enplane with the aid of an air-bridge which connects the plane to the holdroom. They would no longer be exposed to jet blast. These holdrooms had been deliberately designed as an extension of the main structure. Being the interface between the passenger processing component and the aircraft, it is to a great extent vulnerable to aircraft characteristics.

Since it is difficult to predict what technology is emerging to alter aircraft characteristics in the near future, the holdrooms had been developed as a demountable structure of steel frames treated with vermiculite.

A peculiar operation in Kaduna is the use of the terminal facilities for occational international passengers. Ideally, two separate terminals are required in international airports. However, the author had succeeded in accommodating both operations within the single terminal facility.

The baggage handling procedure had been simplified. Mechanical sorting system had be adopted so as to minimise cost and because manual sorting becomes difficult when they are many people on a flight. As the baggage comes by belt from check-in to the sortation area, the destination label is visually inspected by a sorter. Baggage is then parked on baggage carts which are driven to the aircraft baggage hold, or is placed directly into baggage containers, which can be mechanically loaded into the aircraft.

The treatment of the arrivals is simpler. The aircraft is unloaded unto carts which are unloaded on a moving belt. The moving belt conve ys the baggage to the waiting passengers. For obvious security reasons, all points of access to the baggage hall had been designated control points. A short : television is installed in the baggage handling area to enable the security officials and airline operators oversee every cargo handling operation without being physically present. As part of necessary security measures, a checked-in baggage passes through a metal scanner and an x-ray explosive detector before being handled.

A safe and secured baggage handling procedure with an efficient flow is assured. Another mechanical break-through was the use of a dual-engined conveyor belt. The conveyor belt that collects checked-in baggage has two built-in tracks but with one working at a time. The moment one develops fault, the second can be put into operation. At no time will their be need for manual conveyance if the system is well maintained.

The study of airport buildings has revealed that changes in terms of technology, economy and organisation of airport operations could be unprecedented. Therefore, there is a strong requirement for the maximum flexible use of the interior space and expansion possibility to the adjacent areas. The structural scheme allows much unobstructed space and thus enables flexible use of the interior space for possible adaptations. The entire building could also extend in two opposite ways to house functions that might be closely related to the terminal operations.

The layout of building services had been simplified and integrated so as make room for an economic maintenance. The services core in the tower block houses the staircase, elevators, toilets and a central duct. The basement provides pit for servicing elevators and an underground water reservoir. The roof deck takes a smaller water reservoir and air-conditioning condensers which are placed on synthetic rubber mountings. The electric supply is connected from a step-down transformer. The surface water is collected in a perimeter drain system which joins the central drain network. Fresh water supply is collected in the underground reservoir and later pumped to the overhead reservoir which supplies the sanitary appliances and the sprinkler system (a fire proofing installation) under gravity.

A separate fresh water supply is connected to the kitchen. Foul water from the sanitary appliances is to be disposed into the septic tank - soak away system proposed on the site. But the waste water from the kitchen goes directly to the soak away via a grease trap. It had been discovered that washing detergent is hazardous to the bacteria which decomposes organic matter in the septic tank.

Having endeavoured to solve the basic problems, special consideration was also given to certain attributes of the scheme. Paul Rudolph, a celebrated architect based in the United States of America, once affirmed that architecture should go beyond the mediocrity of form and space - solids and voids, vertical thrusts, interecting planes and formal concerns of scale; but rather, form should be considered for its symbolic values and space as a felt experience. Professor Ivoh Smith of Scotland also believes that an an architectural piece should reflect its regional context and celebrate its purpose. One could now gather from these two personalties that the exterior form should be appreciated for expressing the purpose of a building and the interior space experienced as being suitable for the expected activities. The fact that a passenger terminal building is being regarded as a place of transition from one mode of transport to another calls for expression of movement.

Consideration of the regional context calls for localising the entire architectural piece so as to depict its identity for belonging to a certain place. Kaduna being centrally situated in the northern part of Nigeria — a part that boasts of groundnut pyramids. The pyramidal form is found to have been adopted as being

of symbolic value in the Northern Nigeria. The building envelop which tapers is symbolic despite being functionally suitable for shading solar radiation and screening jet blast.

Finally, it would be unethical for an architect to design in Nigeria, a building that will rely solely on artificial means for modifying the inclement tropical climate considering the nation's level of technology and peoples' level of maintenance culture. The use of courtyards has thus been employed to allow much daylight and ventilation as well as providing service spaces for areas that were centrally located.

On the whole, it becomes clear that the passengers and employees could use the terminal building comfortably and conveniently.

FOOTNOTES

Chapter 2

1. Wiley, J. R. (1981) Airport Administration, Eno Foundation for Transportation, Inc. West Port, Connecticut, U. S. A.
2. Ibid
3. Ibid
4. Deru, J. I. (1980), The Aviation Industry in Nigeria A paper presented at Nigeria College of Aviation Technology, Zaria.
5. Ibid
6. Supplement on Aviation and Tourism: Nigerian Airports Authority Vanguard, December 1, 1987.
7. Ibid
8. Bernado J. V. (1960) Aviation and Space in the Modern World. E. P. Dutton & Co., Inc. New York, U.S.A.

Chapter 3

1. Barry W. S. (1969) The Language of Aviation Chatto and Windus, London
2. Ibid
3. Ibid
4. Ibid
5. Horonjeff R. and McKelvey X (1983) Planning and Design of Airports. The King post Press, New York, U.S.A.
6. Ibid

Chapter 4

1. Tutt, P. and Adler, D. (1979) New Metric Handbook The Architectural Press, London.
2. Ashford, N. and Wright, P.H. (1979) Airport Engineering John Wiley & Son, New York, U.S.A.

Chapter 6

1. Federal Department of Survey (1978) The Administrative Atlas of Nigeria

2. Ibid

3. Ibid

4. Ibid

5. Horonjeff R. and McKelvey F. X. (1983) Planning and Design of Airports The Kingpost Press, New York, U. S. A.

Chapter 7

1. de Neufville R. (1980) Airport Systems Planning The MacMillan Press, London, Great Britain.

REFERENCES

1. Ahmed, A.T. (1981) Nigerian Airports Authority and the Development of Air Transportation in Nigeria. A seminar paper presented at the Nigerian College of Aviation Technology, Zaria.

2. Ashford, N. and Wright, P.H. (1979) Airport Engineering John Wiley & Son, New York, U.S.A.

3. Barry E. S. (1969) The Language of Aviation, Chatto and Windus, London, Great Britain.

4. Bernado, J.V. (1960) Aviation and Space in the Modern World E. P. Dulton & Co., New York, U.S.A.

5. Ching, F.D.K. (1975) Building Construction Illustrated Van Norstrand Reinhold Company, New York U.S.A.

6. de Neufille, R. (1980) Airport Systems Planning The Macmillan Press, London, Great Britain.

7. Burberry, P. (1979) Environment & Services, The Anchor Press, Essex, Great Britain.

8. Deru, J.I. (1980) The Aviation Industry in Nigeria A seminar paper presented at the Nigerian College of Aviation Technology, Zaria.

9. Foster, J.S. (1979) Structure and Fabric The Anchor Press, London, Great Britain.

10. Gniadzik, J.S. (1984) Structural Systems in Architecture, Ahmadu Bello University Press, Zaria.

11. Horonjeff, R. and McKelvey, F.X. (1983) Planning and Design of Airports. The King post Press, New York, U.S.A.

12. Neufert Ernst (1980) Architects Data Halsted Press, New York, U.S.A.

13. Nayler, J.L. and Owen, E. (1965) Aviation: Its technical development, Peter Owen/Vision Press, London, Great Britain.

14. Packard, R.T. (1981) Architectural Graphic Standards
John Wiley & Sons, New York.

15. Schmertz, M.F. (1979) Office Building Design
Mc Graw Hill Book Company, New York, U.S.A.

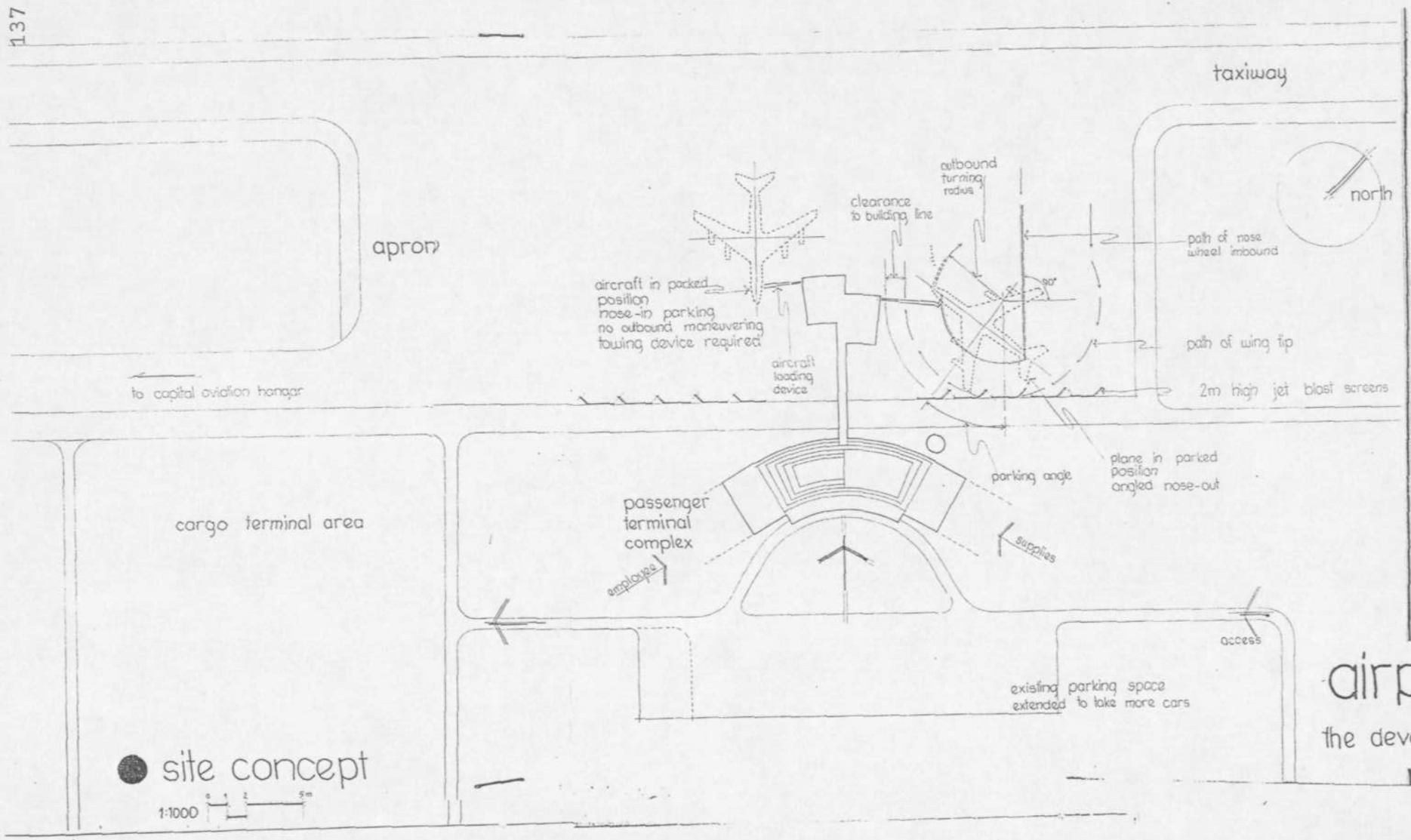
16. Siegel, C. (1961) Structure and Form in Modern Architecture
Crosby Lockwood & Sons, London, Great Britain.

17. Snyder J.C. and Catanese A.J. (1979) Introduction to
Architecture, McGraw Hill Book Company New York, U.S.A.

18. Taper H. (1967) Air Cargo, Cassell & Co, London.

19. Tutt, P. and Adler, D. (1979) New Metric Handbook
The Architectural Press, London.

20. Wiley, J.R. (1981) Airport Administration
Eno Foundation for Transport, Inc. West Port
Connecticut, U.S.A.



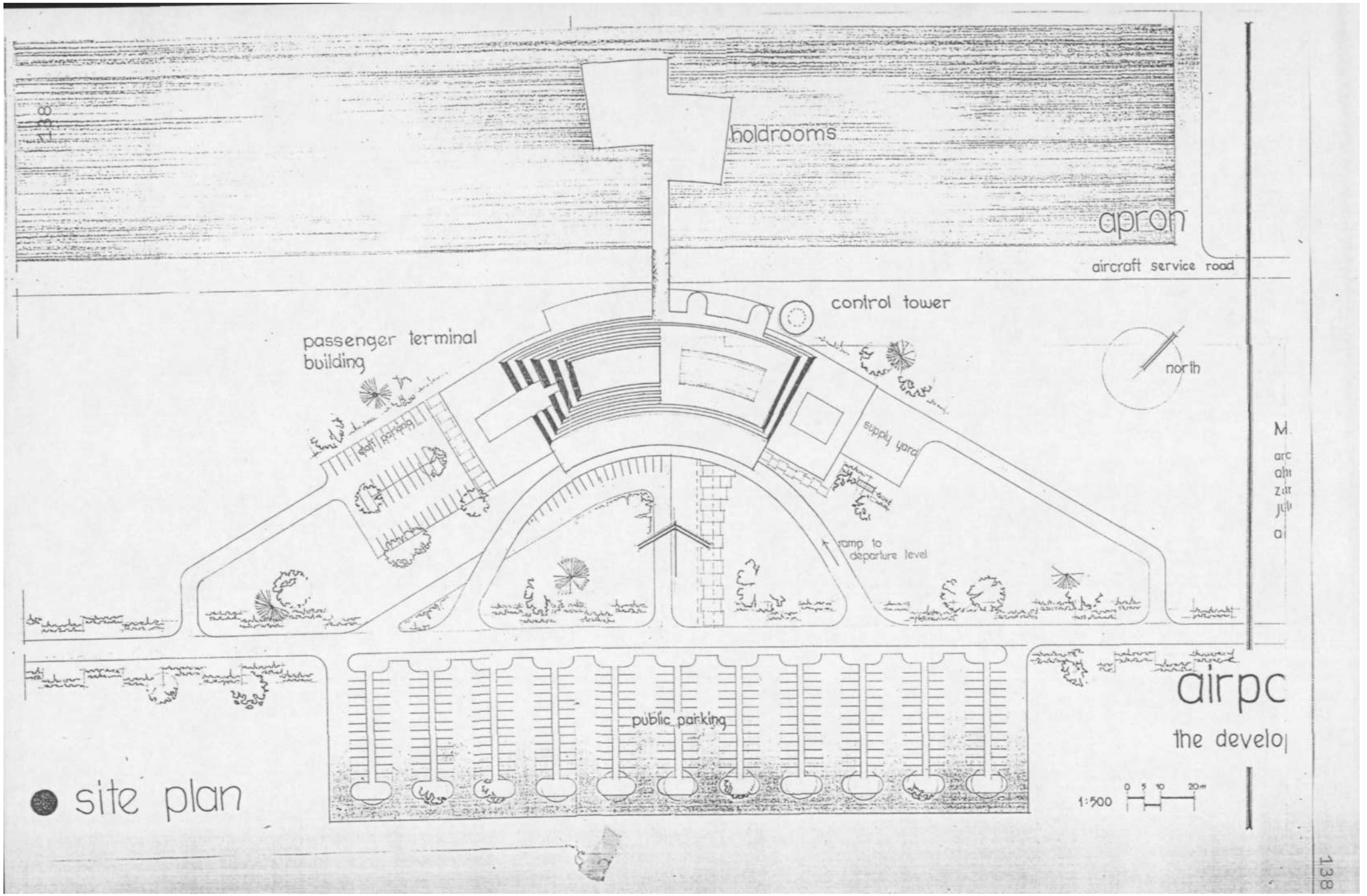
M.SC. T
architecture
ahmadu bell
zaria
july, 198
adeleye,

16

airport

the development

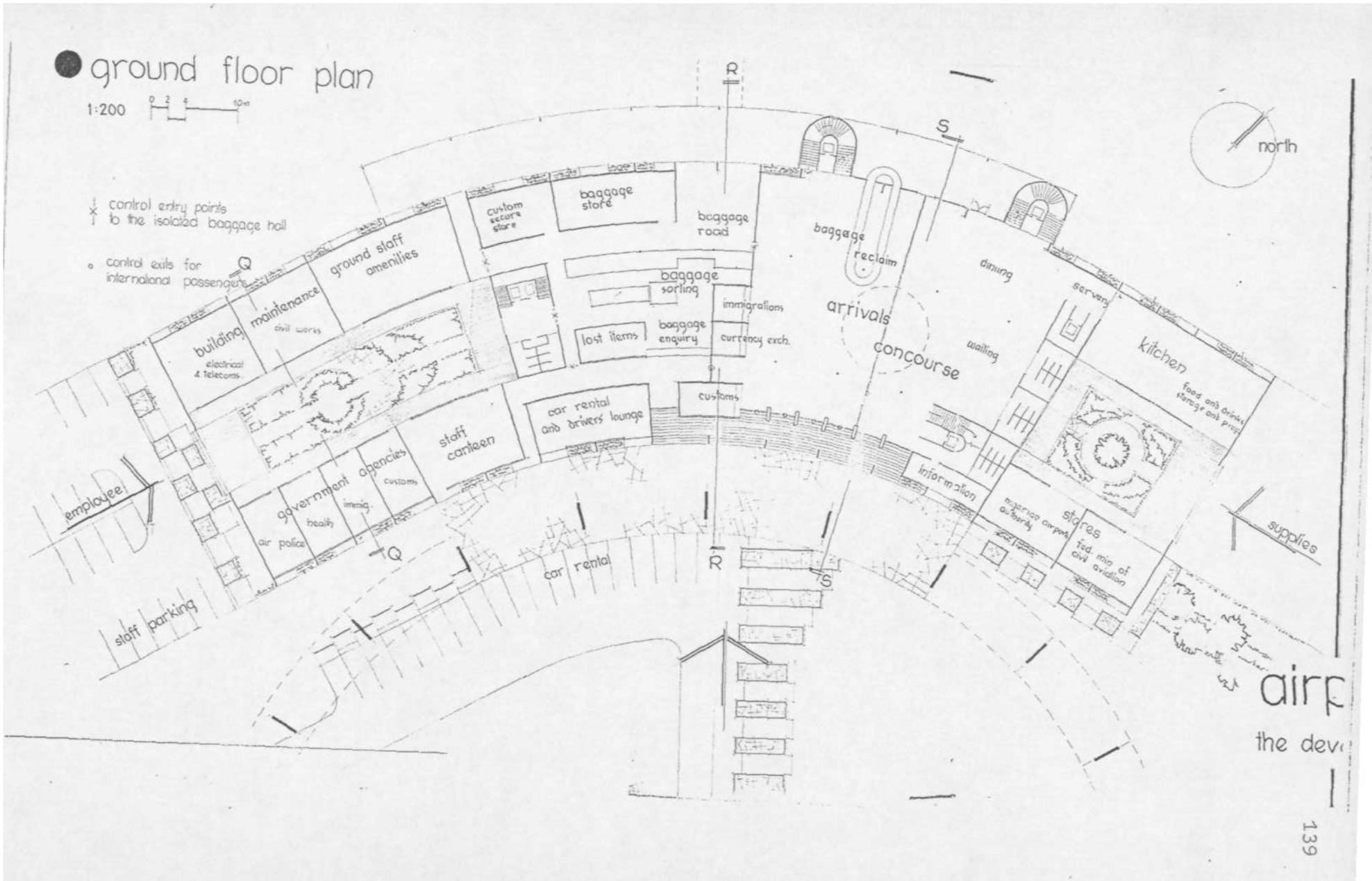
KA

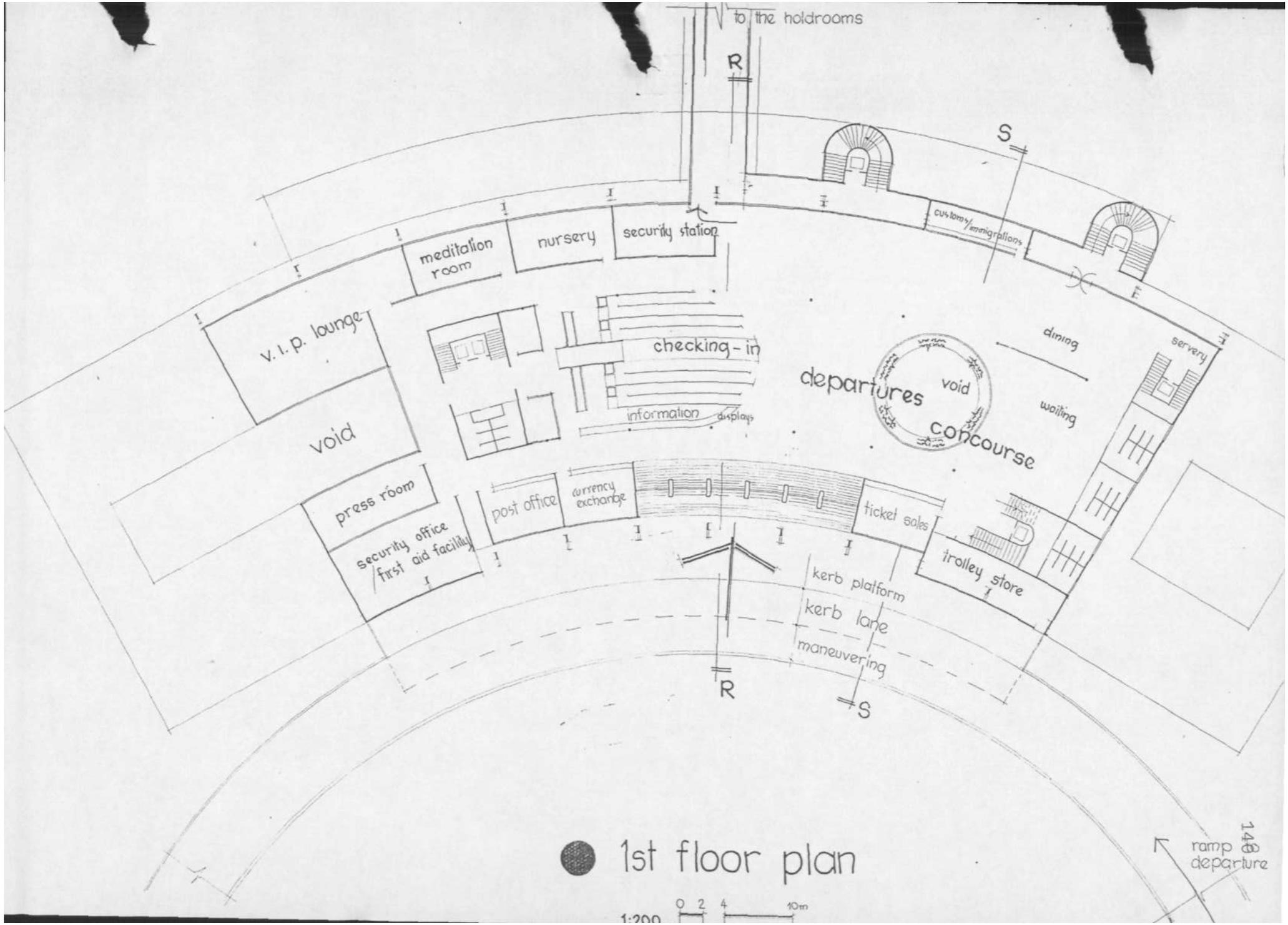


site plan

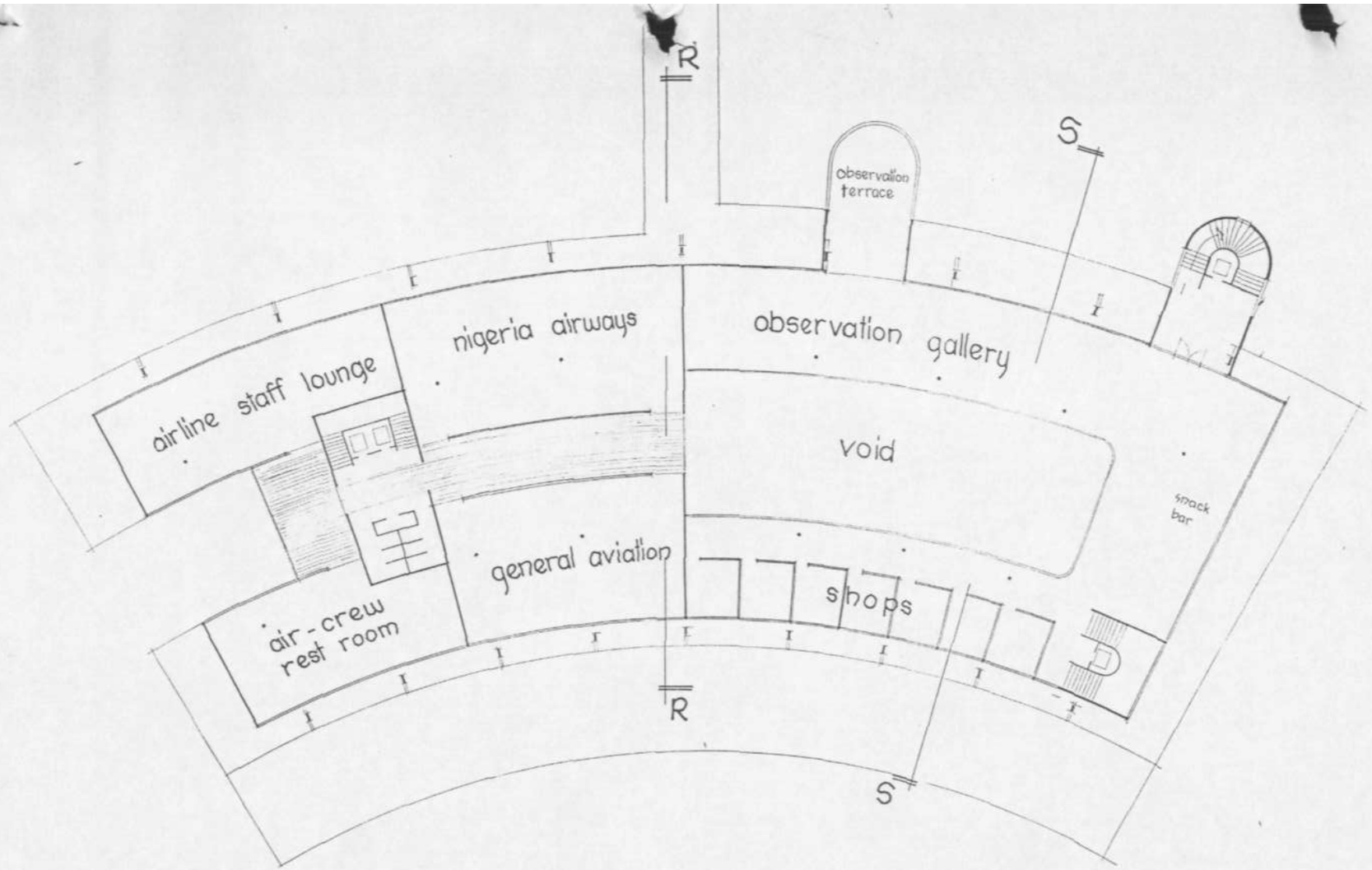
airpc

the develo


ground floor plan
1:200
control entry points to the isolated baggage hall
control exits for international passengers
north
baggage store
custom secure store
baggage road
baggage reclaim
ground staff amenities
maintenance
civil works
building
electrical & telecoms
baggage sorting
immigrations
lost items
baggage enquiry
currency exch.
arrivals concourse
dining
servery
waiting
kitchen
food and drinks storage and prep
car rental and drivers lounge
customs
staff canteen
government agencies
customs
immig.
health
air police
employee
information
nigerian airports authority
stores
fed. min of civil aviation
supplies
car rental
staff parking
Q
R
S
T



1st floor plan



2nd floor plan

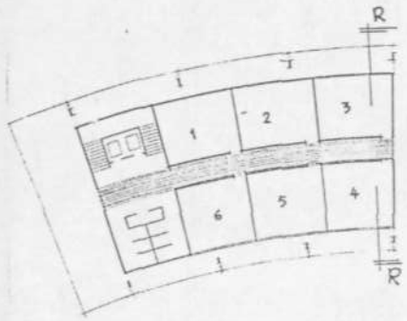
airline operations and
departures concourse extension

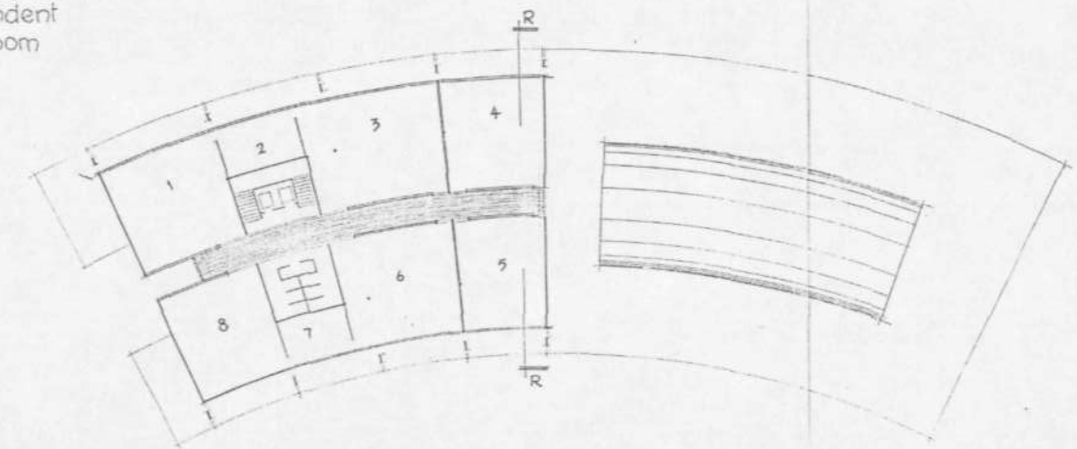
1:200

5th floor plan

A.I.S. principal officers

1 senior signals officer
2 senior air traffic controller
3 chief of air traffic facility
4 computer (teleprinter) room
5 met. supretendent
6 staff rest room



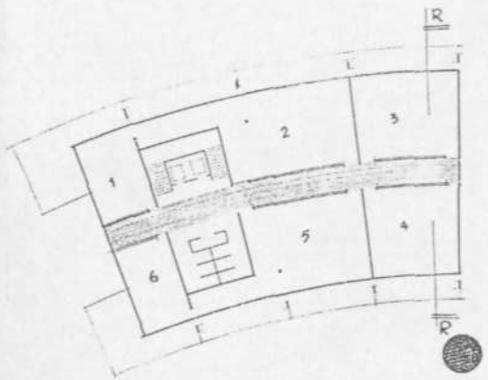


north

3rd floor plan

airport authority offices

1 airport manager
2 store
3 airport operations and public relations
4 accounts
5 personnel
6 general office
7 coffee room
8 conference room



4th floor plan

aircraft information service rooms

1 equipment room
2 radar stimulators and apparatus
3 signals office
4 meteorological briefing office

M. SC.
architecture
ahmadu bell
zaria, nig.
july, 1988
adeleye, (

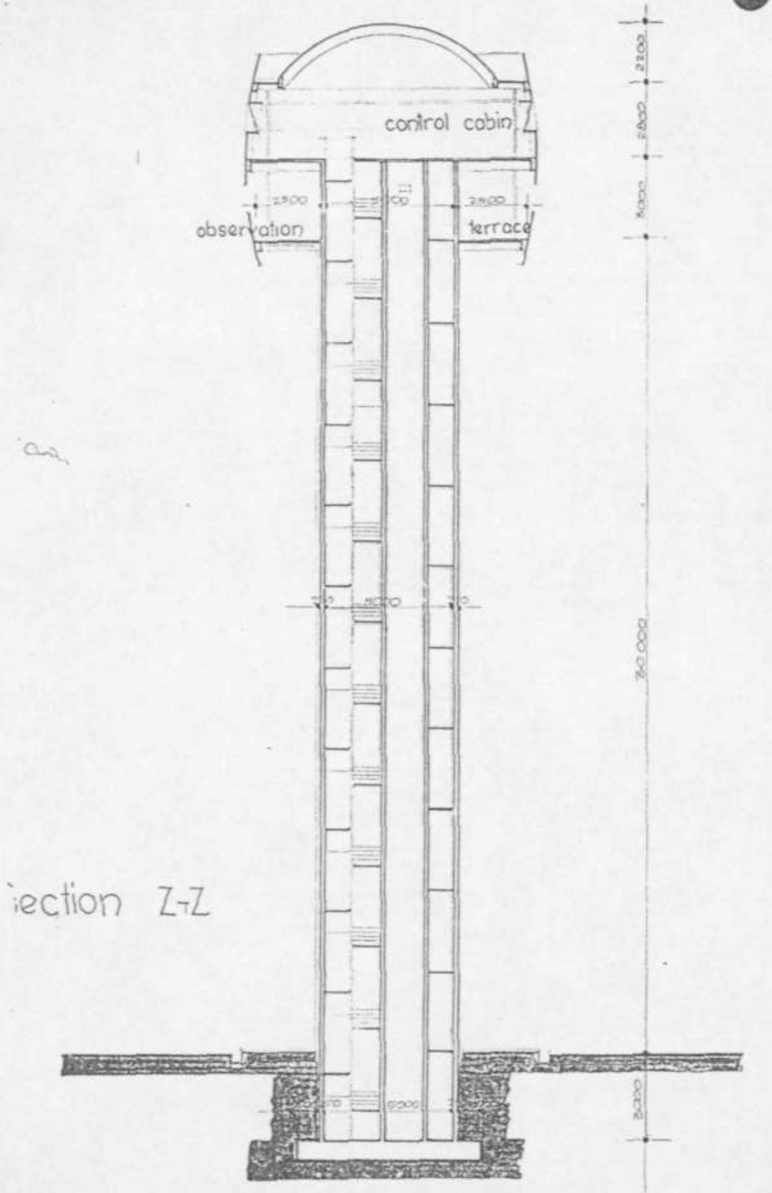
airport

the development

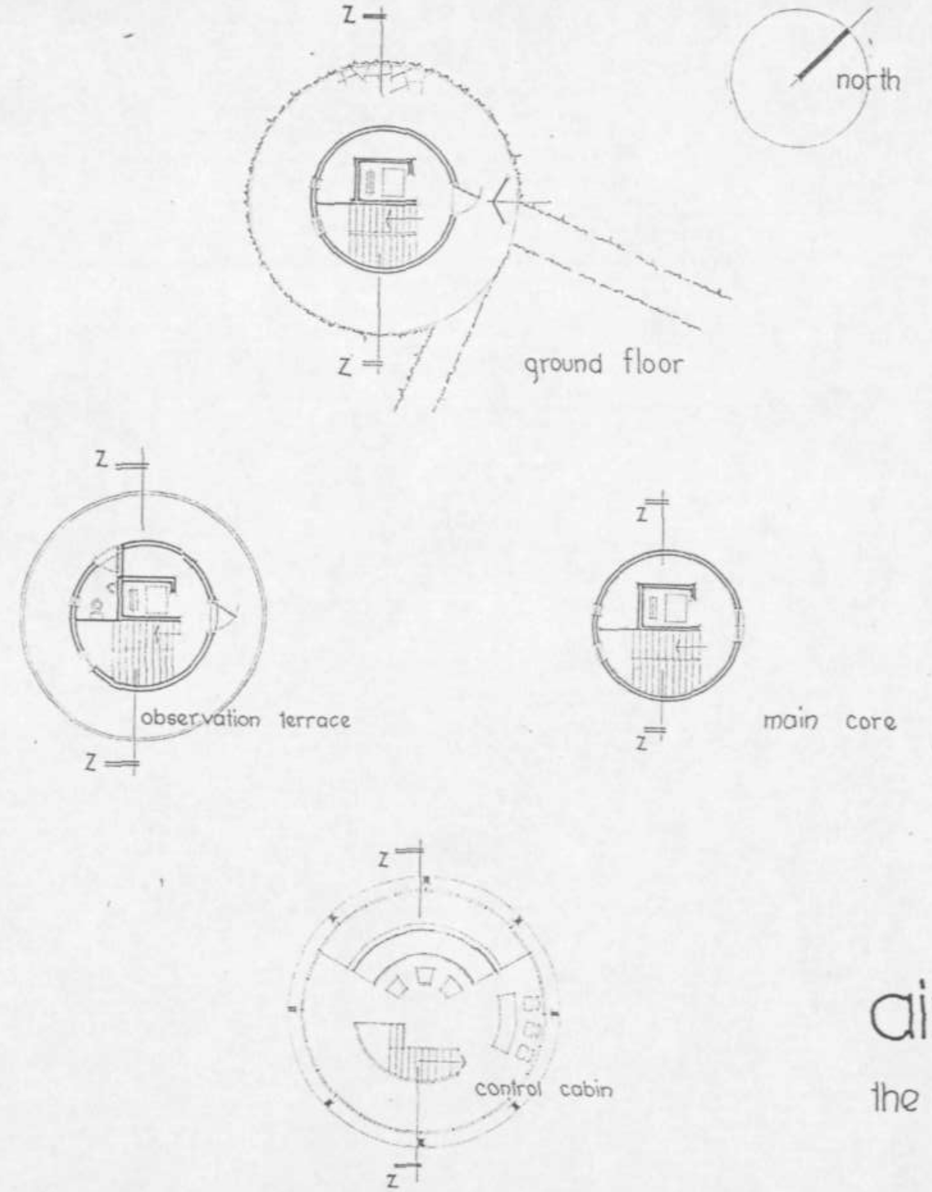
KADI
interr

control tower

1:100

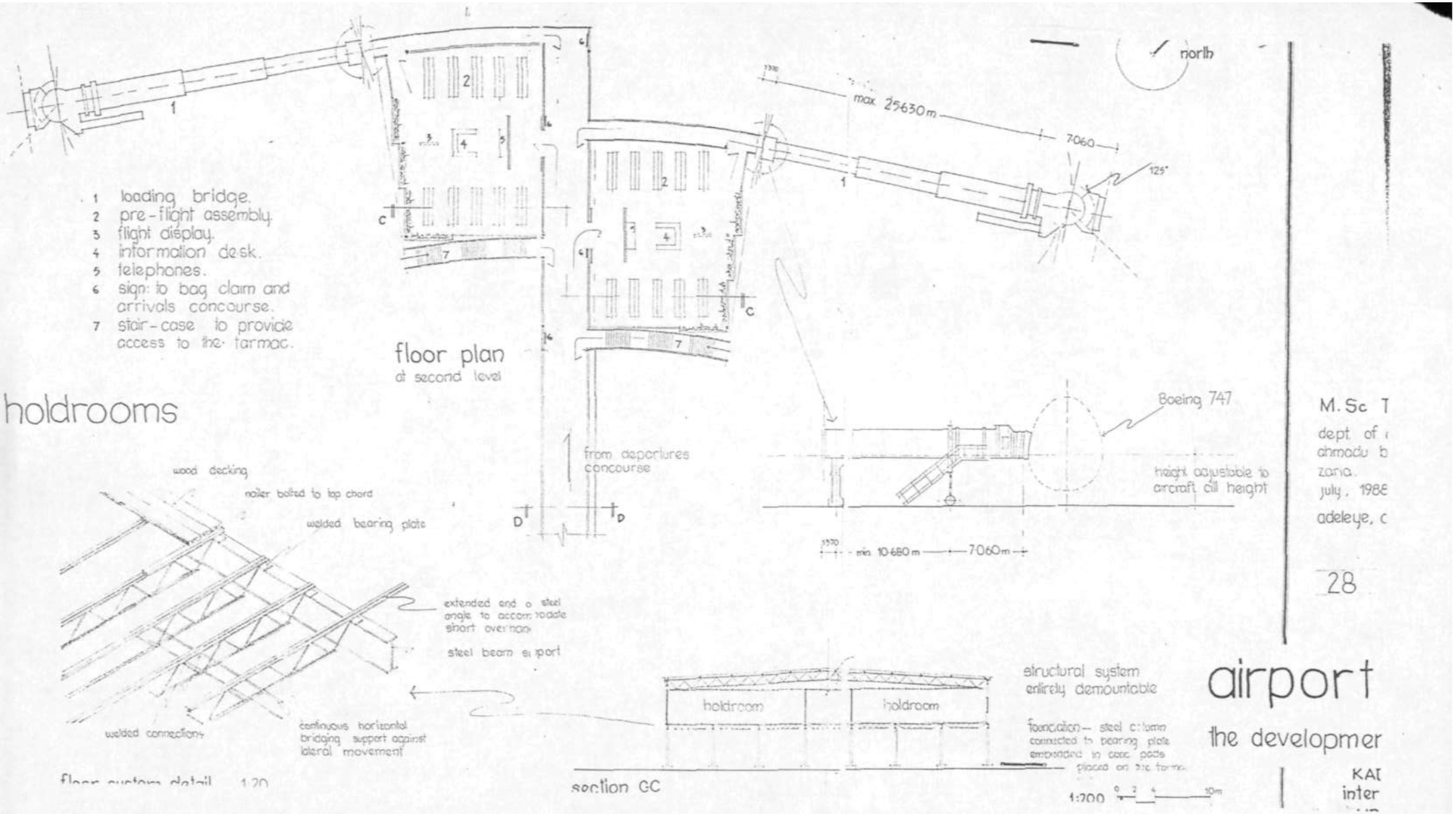


section Z-Z



airpo

the develo



M. Sc T
dept. of
ahmadu b
zaria.
july, 198
adeleye, c

28

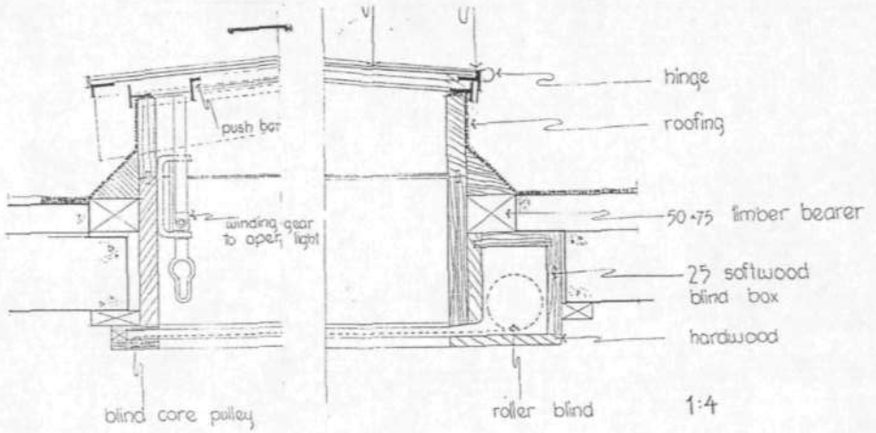
airport

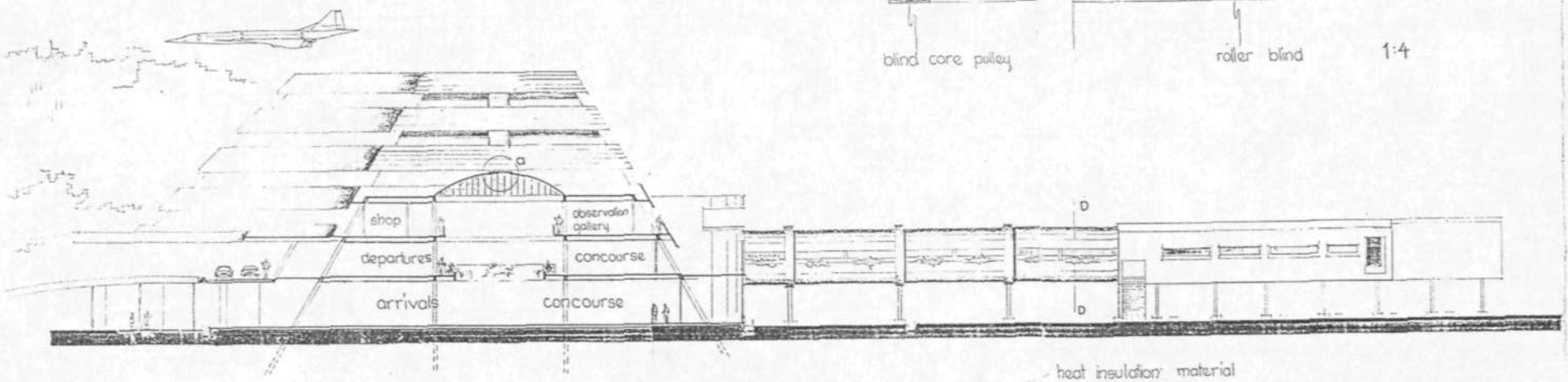
the developmer

KAI
inter

detail a

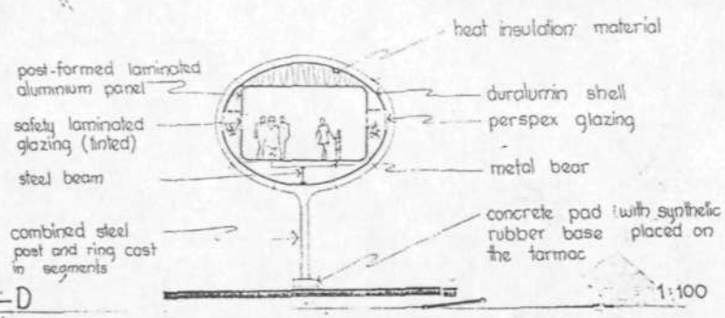
vertical section I through rooflight and blindbox





section S-S

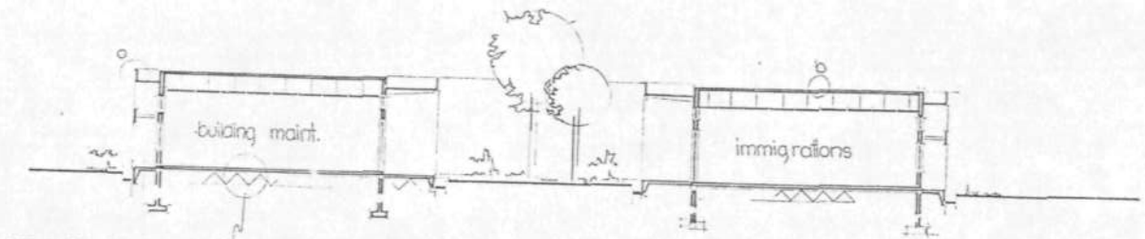
1:200

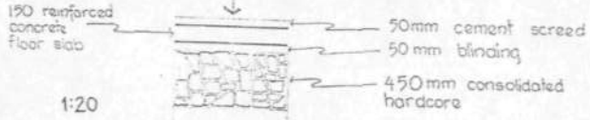


section D-D

section Q-Q

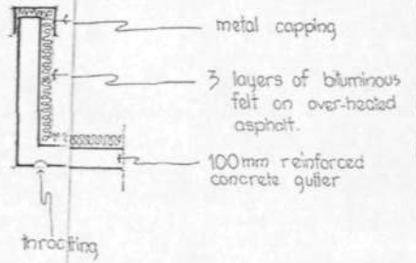
1:100



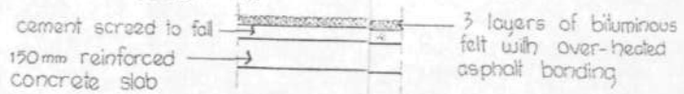


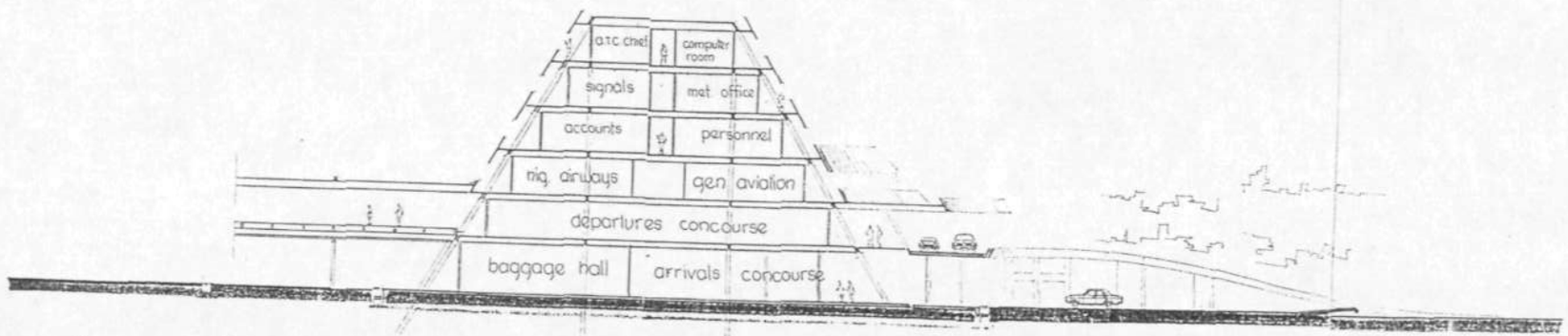
1:20

detail o



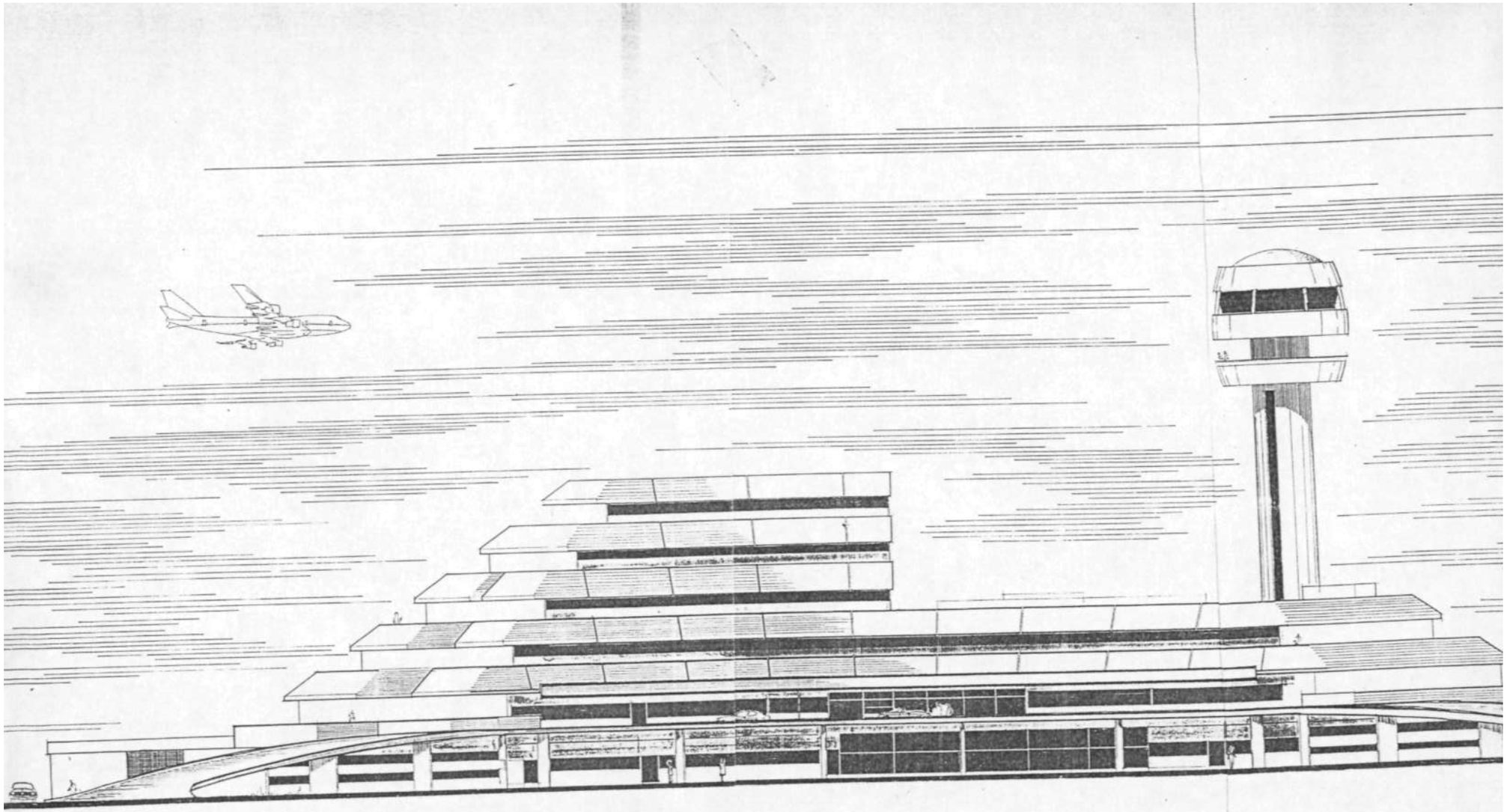
detail b





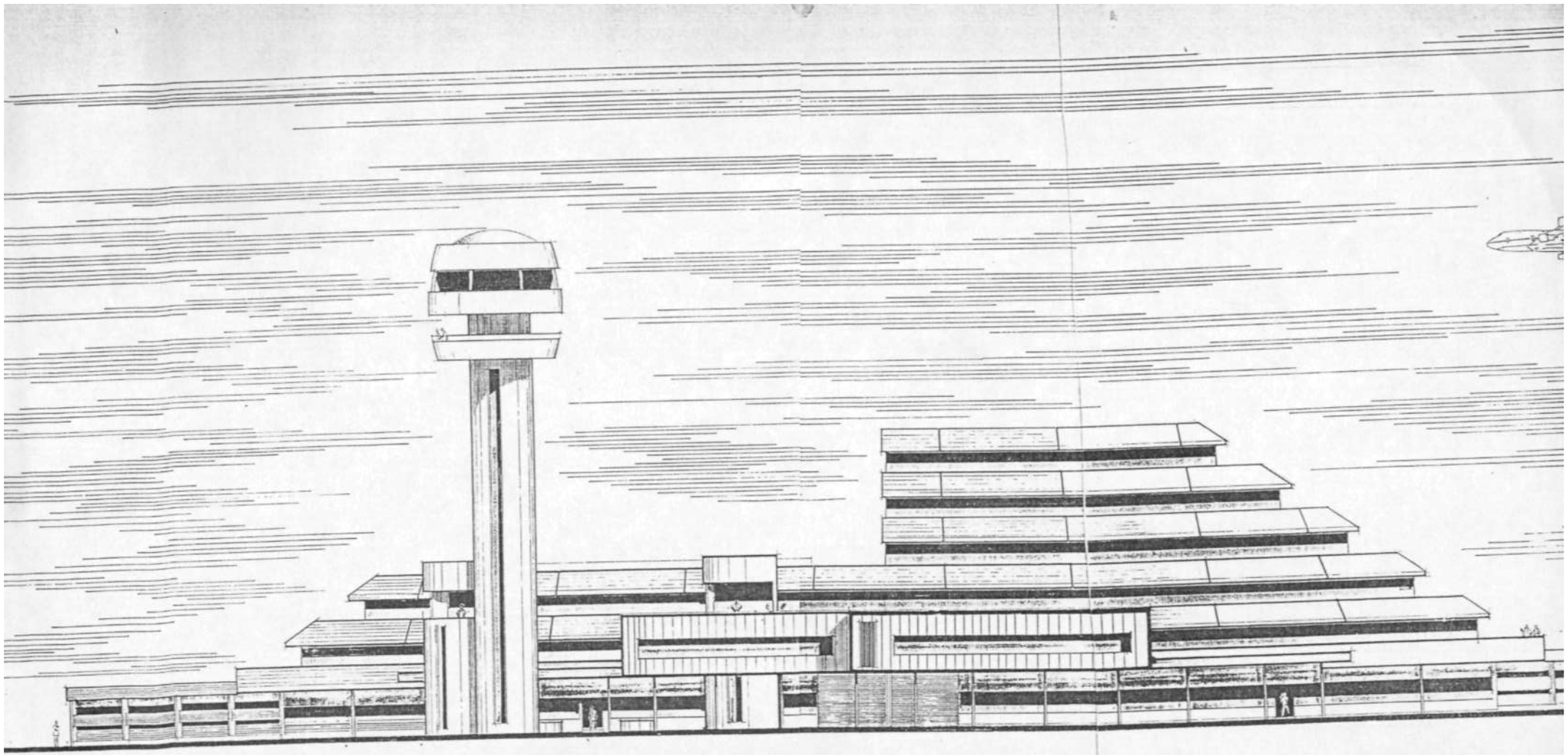
section R-R

1:200



south-east elevation

landside approach



north-west elevation

airside approach

KASHIM IBRAHIM LIBRARY
ABUBAKAR TAFAWA BALEWA UNIVERSITY
ZARIA, NIGERIA.