

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

COLLEGE OF ARCHITECTURE AND PLANNING

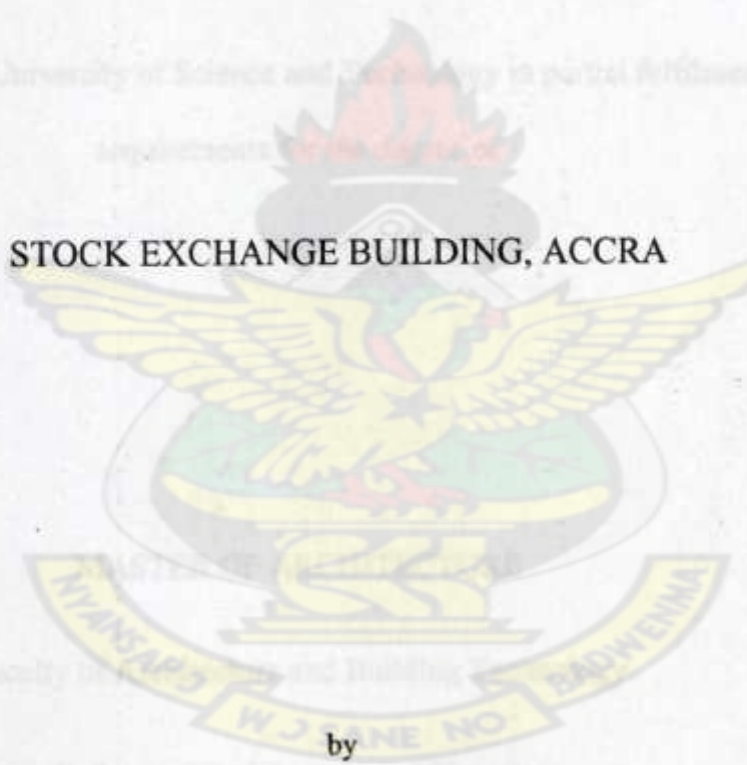
FACULTY OF ARCHITECTURE AND BUILDING TECHNOLOGY

DEPARTMENT OF ARCHITECTURE

B. Sc. (Hons.) Architecture

KNUST

STOCK EXCHANGE BUILDING, ACCRA



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B. Sc. (Hons.) Architecture

AUGUST, 2009

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KUMASI
AUGUST, 2009

STOCK EXCHANGE BUILDING, ACCRA

by

AMINA NANA EKUA QUAINOO

B. Sc. (Hons.) Architecture

This Thesis Report submitted to the Department of Architecture,

**Kwame Nkrumah University of Science and Technology in partial fulfilment of the
requirements for the degree of**

MASTER OF ARCHITECTURE

Faculty of Architecture and Building Technology

College of Architecture and Planning

AUGUST, 2009

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DECLARATION

I declare that I have wholly undertaken the study reported herein under the supervision of Dr. Victor Kootin-Sanwu and that except portions where references have been duly cited, this report is the outcome of my research.

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Signature

Date

Certified by:

Head of Dept. Name

Signature

Date

DEDICATION

I dedicate this design thesis to the Almighty God who gave me strength to go through the six years of architectural education, to my family and guardians for their support throughout my stay in the university and to the loving memory of my parents, Sheikh Ahmed Kojo Quainoo and Mrs. Zainab Aba Quainoo.

KNUST



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Mr. Ekow Afedzie, General Manager, Ghana Stock Exchange, Accra

Mr. Theodore Kanyi, Architect, Accra

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ABSTRACT

Apart from the Nigerian stock exchange and the BRVM of West African Monetary Union (WAMU), most national stock exchange buildings in Africa were not planned and design for securities and stocks trading. As a result installation of new technologies and other relevant infrastructure in these buildings has become almost impossible.

The Ghana Stock Exchange is one such institution. It is housed in the Cedi House in Accra, facilities within which are becoming old and even obsolete in the face of new trends in the workplaces especially in the fast changing financial industry. This was made evident in the fire which destroyed the exchange's new refurbished trading floor.

This design thesis seeks to explore current trends in the design of modern workplaces and office buildings and to produce a design that satisfies international standards in line with other stock exchanges elsewhere in the world while taking into consideration the surrounding environment and architecture in context.



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TABLE OF CONTENTS

CONTENT	PAGE
DECLARATION.....	ii
DEDICATION.....	iii
ACKNOWLEDGEMENT.....	iv
ABSTRACT.....	v
TABLE OF CONTENT.....	vi
LIST OF FIGURES.....	ix
 CHAPTER ONE.....	 1
1.0 Introduction.....	1
1.1 Preamble.....	1
1.2 Problem Statement.....	1
1.3 Analysis and Evaluation.....	2
1.4 Proposals.....	3
1.5 Objectives.....	4
1.6 Scope.....	4
1.7 Target Group.....	4
1.8 Client.....	5
1.9 Funding.....	5
1.10 Client's Brief.....	5
 CHAPTER TWO.....	 6
2.0 LITERATURE REVIEW.....	6
2.1 Definition of stock exchanges.....	6
2.1.1 Function and purpose of stock exchanges.....	7
2.2 Historical development of stock exchanges.....	8
2.3 Emergence of stock exchanges in Africa.....	9
2.3.1 Historical background of the stock exchange in Ghana.....	11
2.4 The Commercial building.....	12
2.4.1 Development of the modern office building.....	13
 CHAPTER THREE.....	 16
3.0 RESEARCH METHODOLOGY.....	16
3.1 Introduction.....	16
3.2 Method of Data Collection.....	16
3.2.1 Primary Sources of Data.....	16
3.2.2 Secondary Sources of Data.....	17
3.3 Method of Data Analysis.....	17
3.4 Ethics.....	17

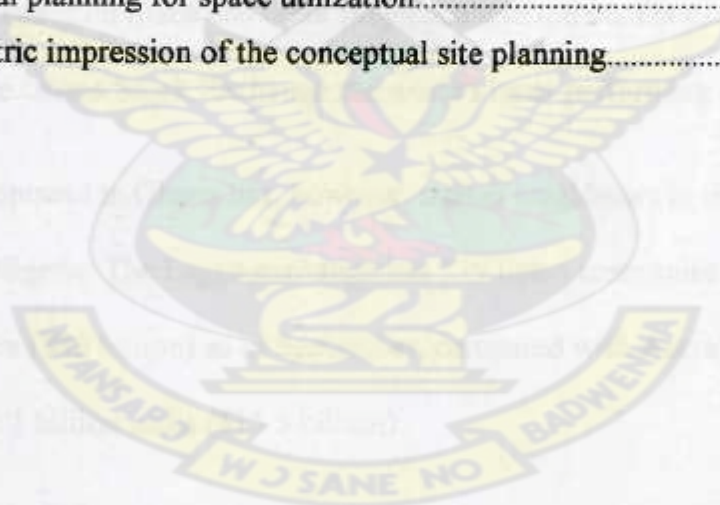
CHAPTER FOUR.....	18
4.0 FINDINGS AND DISCUSSIONS.....	18
4.1 Introduction.....	18
4.2 The Ghana Stock Exchange.....	18
4.2.1 Site Location.....	18
4.2.2 Reasons for study.....	19
4.2.3 Composition of Spaces.....	19
4.2.4 Architecture.....	21
4.2.5 Building Envelope.....	22
4.2.6 Workspace Planning.....	23
4.2.7 Structure.....	23
4.2.8 Services.....	23
4.2.9 Circulation.....	24
4.2.10 Security.....	24
4.2.11 Merits and Demerits.....	25
4.3 The London Stock Exchange.....	26
4.3.1 Background.....	26
4.3.2 Site Location.....	26
4.3.3 Composition of Spaces.....	27
4.3.4 Building Features.....	28
4.3.5 Merits and Demerits.....	28
4.4 Technical Studies.....	29
4.4.1 Office Space.....	29
4.4.2 Building Concepts.....	30
4.4.3 Service Cores.....	32
4.4.4 Circulation Spaces.....	33
4.5 Special Studies.....	35
4.5.1 Sustainable Design.....	35
4.5.2 Trading Floors.....	36
4.5.3 Vertical Circulation.....	37
4.5.4 Structural systems for multi-storey buildings.....	37
4.6 Conclusion.....	38
4.7 Site Studies.....	39
4.7.1 Site Selection Criteria.....	39
4.7.2 Site Location.....	39
4.7.3 Site Option 1.....	41
4.7.4 Site Option 2.....	43
4.7.5 Site Option 3.....	44
4.7.6 Conclusion – The Selected Option.....	45
4.8 The Selected Site.....	46
4.8.1 Site Topography.....	46
4.8.2 Site Inventory: Existing Site Conditions.....	47
4.8.3 Site Inventory: Peripheral Studies.....	48
4.8.4 Site Inventory: Utilities.....	50
4.8.5 Site Analysis.....	51

CHAPTER FIVE.....	52
5.0 CONCLUSION.....	52
5.1 Planning and Design.....	52
5.1.1 Developed Brief.....	53
5.2 Accommodation Schedule.....	54
5.3 Design Philosophy and Concepts.....	56
5.3.1 Design Philosophy.....	56
5.3.2 Design Concepts.....	57
5.4 Conceptual Site Planning.....	57
5.4.1 Option 1.....	58
5.4.2 Option 2.....	59
5.5 Description of the Design Essentials.....	61
5.6 Site Planning and Layout.....	62
5.6.1 General Description of the Design.....	62
5.7 Structure and Form.....	63
5.8 Materials and Finishes.....	63
5.9 Lighting.....	64
5.10 Services.....	64
5.10.1 Water Supply.....	65
5.10.2 Electricity.....	65
5.10.3 Lighting.....	65
5.10.4 Ventilation.....	65
5.10.5 Emergency Exits.....	66
5.10.6 Telecommunications.....	66
5.10.7 Fire Detection.....	66
5.10.8 Fire Fighting Installation.....	66
5.10.9 Fire Hydrants.....	66
5.10.10 Drainage – Waste and Surface Water.....	67
5.10.11 Soft Landscaping.....	67
5.10.12 Hard Landscaping.....	68
5.10.13 Other Landscaping Elements.....	68
5.11 Costing.....	68
5.12 Conclusion and Recommendations.....	69
6.0 REFERENCES.....	70
7.0 APPENDICES.....	71

LIST OF FIGURES

CONTENT	PAGE
Figure 4.1 The Cedi House – Home of the Ghana Stock Exchange.....	18
Figure 4.2 The GSE offices on the 5 th floor of the Cedi House.....	20
Figure 4.3 The GSE offices on the 6th floor of the Cedi House.....	20
Figure 4.4 Facade treatment of the Cedi House showing the horizontal elements of the composition of the facade.....	21
Figure 4.5 The Cedi House in its entirety showing a combination of vertical and horizontal composition, typical of tropical architecture.....	21
Figure 4.6 Carpeting in office areas.....	22
Figure 4.7 Glass partitions in the visitors' lounge.....	22
Figure 4.8 The ceiling system with light fixture and air-conditioning supply and return outlets.....	23
Figure 4.9 The air-conditioning ducts.....	23
Figure 4.10 Vertical circulation areas.....	24
Figure 4.11 CCTV cameras.....	24
Figure 4.12 Electronic door locking system.....	24
Figure 4.13 The Paternoster Square, London – Home of the London Stock Exchange.....	27
Figure 4.14. "The Source", a commissioned artwork which marks the start and finish of each day's trading.....	28
Figure 4.15 Floor plans since 1950 (Source: Neufert).....	29
Figure 4.16 Types of offices (Source: Neufert).....	31
Figure 4.17 Service core at the front (Source: Neufert).....	32
Figure 4.18 Service core to one side within the building (Source: Neufert).....	32
Figure 4.19 Service core at interior corners (Source: Neufert).....	32
Figure 4.20 Service core at the end of a passage (Source: Neufert).....	33
Figure 4.21 Service core between corridors next to a light shaft. (Source: Neufert).....	33
Figure 4.22 Fire safety considerations (Source: Neufert).....	34
Figure 4.23 A photovoltaic module.....	36
Figure 4.24 Example of a trading floor – Frankfurt Stock Exchange Trading Floor.....	37
Figure 4.25 Location map for Ridge, Accra.....	40
Figure 4.26 Site option 1 shown hewn in red.....	41
Figure 4.27 A view of the site conditions present.....	41

Figure 4.28 Another view of the present site conditions.....	41
Figure 4.29 The site's main access.....	42
Figure 4.30 Site option 2 shown hewn in purple.....	43
Figure 4.31 A view of the site conditions present	44
Figure 4.32 Another view of the present site conditions.....	44
Figure 4.33 Site option 3 shown hewn in blue.....	44
Figure 4.34 A view of the warehouse.....	45
Figure 4.35 A view of the University of Ghana Business School.....	45
Figure 4.36 Location map showing contour lines in red and proposed site line-hatched.....	46
Figure 4.37 Pictorial representation of existing site conditions.....	47
Figure 4.38 The existing building massing in the area under consideration.....	48
Figure 4.39 Some buildings situated on the periphery of the site.....	49
Figure 4.40 Map showing utility lines.....	50
Figure 4.41 Map showing site analysis.....	51
Figure 5.1 Conceptual site planning - Option 1.....	58
Figure 5.2 Conceptual site planning - Option 2.....	59
Figure 5.3 Conceptual planning for space utilization.....	60
Figure 5.4 An isometric impression of the conceptual site planning.....	60



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CHAPTER ONE

1.0 INTRODUCTION

1.1 Preamble

Since its inception in July, 1989, the Ghana Stock Exchange (GSE)'s performance has varied considerably. In 1993, the GSE was the 6th best index performing emerging stock market, with a capital appreciation of 116%. In 1994 it was the best index performing stock market among all the emerging markets, gaining 124.3% in its index level. 1995's index growth was a disappointing 6.3%, partly because of high inflation and interest rates. As of October 2006 the market capitalization of the Ghana Stock Exchange was about (\$11.5bil) 111,500bil cedis. As at December 31 2007, the GSE's market capitalization was 131,633.22bil cedis. In 2007 the index appreciated by 31.84%.¹ An offshore-oil discovery, rising commodity prices and government spending on roads and other projects drove the market to a 64 percent gain this year, making the Ghana Stock Exchange the world's best- performing bourse.²

Stock-market development in Ghana has, however, trailed neighbours in the West African sub-region such as Nigeria. The Lagos exchange has 219 listed companies and a valuation of about 10 trillion naira (\$80 billion) as of September, compared with Accra's 34 listed companies worth 18.1 billion cedis (\$15.5 billion).

1.2 Problem Statement

Stock exchanges and the other financial services are the major economic transformational entities in a nation. The establishment of stock markets is seen as beneficial for a variety of

¹ http://en.wikipedia.org/wiki/Stock_exchange. Accessed 23rd November, 2008

² Kew, J. & Bowers, E., www.bloomberg.com/apps/news?pid=newsarchive&sid=aa.ukPc0.vlu 30th October, 2008

reasons including their ability to attract foreign investment portfolio, boost domestic savings, and improve the pricing and availability of capital for domestic investment. However, the present Stock Exchange is outmoded in terms of present trends in the design of such facilities. Lack of adequate workstation hinders the growth of the Stock Exchange including the ability to attract foreign investment portfolio and the inability to boost domestic investment. The stability of the GSE Index reflects a lack of trading due to lack of educational programmes for the public and stakeholders. The Ghana Stock Exchange facility is not planned and designed in accordance with international standard and therefore cannot serve as a central point for an integrated or consolidated market.

1.3 Analysis and Evaluation

Exchanges face new imperatives – to find greater efficiencies, build faster and cheaper trading systems, diversify products to create new revenue streams. At the same time, as more countries embrace globalization and embrace open competitive markets, equity cultures have proliferated. So the number of people globally owning stock has soared from 100 million following World War II to over a billion today. Today, more investors can send more capital to where it is wanted most and treated best.

All of this has created two new realities. First, global markets are more liquid with smaller markets growing fastest. For example, while overall market capitalization in the United States grew by about 4% from 2001-6, markets abroad grew faster. London grew by nearly 10%, Euronext and Borsa Italiana grew by over 10%, Tokyo by 14%, Australia by over 19%, and Hong Kong by 20%, San Paolo by 25%, and Korea and Johannesburg by over 30%. Five years ago, it would have been impossible for China Construction Bank to raise \$9 billion in Hong Kong and now they can.

The second new reality is consolidation. Markets are aligning themselves within regions, within asset classes and globally. For example, the NYSE has aligned itself with the Archipelago and is on track to merge with Euronext. NASDAQ bought Instinet and maybe London. In Chicago, the CBOT and the CME are hoping to combine. And investment banks have invested in smaller exchanges in the United States, Philadelphia and Boston in particular, and they're potentially creating new exchanges that have trading platforms in Europe.³

Apart from the Nigerian stock exchange and the BRVM of West African Monetary Union (WAMU) most the national stock exchange building were not planned and design for securities and stocks trading. As a result installation of new technologies and other relevant infrastructure in these buildings have become almost impossible. The thinness and the illiquidity of these exchanges make them unattractive investment destination in the scale of world economy. There is therefore the need for the establishment of new and functional offices (a regional stock exchange) within the sub-region which will be commercially successful and will respond to all the requirements of a modern working environment.

1.4 Proposals

Consolidation of markets in the ECOWAS sub-region, specifically those of the Anglophone countries, will enhance efficiency and liquidity of the market and remain competitive. This would create a pool of information and reinforce economic integration within the different countries. Information on companies would be easy to obtain, and increase the trust of investors from around the world.

³ Thain, J. A., C.E.O. NYSE Group, Inc. Lecture presented at the China-Europe International Business School.

The integration of exchanges will be manifested in a physical building shaped by architecture to serve as the central exchange building for the consolidated West African market which will be functional and respond to all the requirements of a modern working environment.

1.5 Objectives

The above-mentioned proposal will seek to pursue the following objectives:

- The stock exchange building which will primarily provide facilities for stockbrokers and members of the exchange such as the trading floors, offices for brokerage firms as an avenue to boost Ghana's financial market and its economy on the world's market.
- The design will also include the provision of a training academy for potential stockbrokers and members of the general public to acquire knowledge about the stock exchange and its operations and create a learning environment for the human resource base of West Africa.
- The design aims to provide an avenue for the younger generation, the young speculators of tomorrow, to become more familiar with the stock market.

1.6 Scope

The design thesis will involve the detailed architectural design of a stock exchange building and all its ancillary facilities in international standards. With the needs of the occupants as a focus, this thesis project will explore new ways to use architecture to achieve a commercially successful stock exchange which will respond to the requirements of a modern working environment in an urban setting.

1.7 Target group

The target group of the project includes the general public, all stockbrokers of ECOWAS sub region.

1.8 Client

The clients are the Ghana Stock Exchange, West African Stock Exchanges and the Securities and Exchanges Commission.

1.9 Funding

The project will be jointly sponsored by the ECOWAS Bank for Investment and Development and the Ghana Stock Exchange.

1.10 Client's brief

- Administrative spaces
- Trading floor or hall
- Library and research centre
- Offices for brokerage firms
- Training academy
- Conference halls
- Canteen and recreational area, gymnasium
- Offices spaces for rent to financial institutions

CHAPTER TWO

2.0 LITERATURE REVIEW

2.0 Introduction

The stock market is one of the most important sources for companies and countries to raise money through investments. This literature review examines various papers from a variety of sources. These include research presented at the China-Europe International Business School lectures and from various journals and articles written on related topics.

The categories of literature review that are most relevant to this research are: 1) A discussion on the definition, function and purpose of stock exchanges; 2) Historical development of stock exchanges; 3) Emergence of stock exchanges in Africa; and 4) A discussion on the commercial building.

2.1 Definition of stock exchanges

A stock exchange, securities exchange or (in Europe) bourse is a corporation or mutual organization which provides "trading" facilities for stock brokers and traders, to trade stocks and other securities. Stock exchanges also provide facilities for the issue and redemption of securities as well as other financial instruments and capital events including the payment of income and dividends. The securities traded on a stock exchange include: shares issued by companies, unit trusts and other pooled investment products and bonds.⁴

A stock exchange can also be defined as the physical central market for the issuance and trading of common stocks of listed securities, regularly carried out by qualified members. Usually there is a central location at least for recordkeeping, but trade is less and less linked to such a physical place, as modern markets are electronic networks, which gives them advantages of speed and cost of transactions.

⁴ http://en.wikipedia.org/wiki/Stock_exchange. Accessed 23rd November, 2008

2.1.1 Function and purpose of stock exchanges

The stock market is one of the most important sources for companies to raise money. This allows businesses to be publicly traded, or raise additional capital for expansion by selling shares of ownership of the company in a public market. The liquidity that an exchange provides affords investors the ability to quickly and easily sell securities. This is an attractive feature of investing in stocks, compared to other less liquid investments such as real estate.

History has shown that the price of shares and other assets is an important part of the dynamics of economic activity, and can influence or be an indicator of social mood. An economy where the stock market is on the rise is considered to be an upcoming economy. In fact, the stock market is often considered the primary indicator of a country's economic strength and development. Rising share prices, for instance, tend to be associated with increased business investment and vice versa. Share prices also affect the wealth of households and their consumption. Therefore, central banks tend to keep an eye on the control and behaviour of the stock market and, in general, on the smooth operation of financial system functions. Financial stability is the *raison d'être* of central banks.

Exchanges also act as the clearinghouse for each transaction, meaning that they collect and deliver the shares, and guarantee payment to the seller of a security. This eliminates the risk to an individual buyer or seller that the counterparty could default on the transaction.

The smooth functioning of all these activities facilitates economic growth in that lower costs and enterprise risks promote the production of goods and services as well as employment. In this way the financial system contributes to increased prosperity.⁵

⁵ <http://www.articlesbase.com/investing-articles/function-and-purpose-of-stock-market-582881.html> Accessed 21st April, 2009

2.2 Historical development of stock exchanges

Historically, stock exchange first started in Africa. According to historian Fernand Braudel, in Cairo in the 11th century, Muslim and Jewish merchants had already set up every form of trade association and had knowledge of many methods of credit and payment. The history of stock exchanges can be traced to 12th century France, when the first brokers are believed to have developed trading in debt and government securities. In 11th century France, the 'courtiers de change' were concerned with managing and regulating the debts of agricultural communities on behalf of the banks. As these men also traded in debts, they could be called the first brokers.

Generally the origin of the stock exchange is traced back to the stock exchange in Antwerp (1460). Close to the Town Square lies the 'Hofstraat'. In the middle of the street an alley leads to a small inner yard. The house which occupies a large part of the yard is called 'Den Rhijn', better known as the 'Old Stock Exchange'. It was here that the Antwerp Stock Exchange was situated until 1533. Architect Domien de Waghemakere renovated it in 1515.

In 1531 a new Stock Exchange was built in Antwerp (again by Domien de Waghemakere). This building is located off the Meir Street (Israëlietenstraat, or Twaalfmaandenstraat). It was the first building in the world designed as stock exchange and trade exchange.

Unofficial share markets existed across Europe through the 1600s, where brokers would meet outside or in coffee houses to make trades. The Dutch later started joint stock companies, which let shareholders invest in business ventures and get a share of their profits—or losses. In 1602, the Dutch East India Company issued the first shares on the Amsterdam Stock Exchange. The Amsterdam Stock Exchange, created in 1602, became the first official stock exchange when it began trading shares of the Dutch East India Company (Verenigde Oostindische Compagnie or called VOC) that issued the first shares on the Amsterdam Stock

Exchange. It was the first company to issue stocks and bonds. . It was later renamed as the Amsterdam Bourse and was the first to begin trading in securities. These were the first company shares ever issued.⁶

By the early 1700s there were fully operational stock exchanges in France and England, and America followed in the later part of the century. Share exchanges became an important way for companies to raise capital for investment, while also offering investors the opportunity to share in company profits. The early days of the stock exchange experienced many scandals and share crashes, as there was little to no regulation and almost anyone was allowed to participate in the exchange.

Today, stock exchanges operate around the world, and they have become highly regulated institutions. Investors wanting to buy and sell shares must do so through a share broker, who pays to own a seat on the exchange. Companies with shares traded on an exchange are said to be 'listed' and they must meet specific criteria, which varies across exchanges. Most stock exchanges began as floor exchanges, where traders made deals face-to-face. The largest stock exchange in the world, the New York Stock Exchange, continues to operate this way, but most of the world's exchanges have now become fully electronic. There are now stock markets in virtually every developed and most developing economies, with the world's biggest markets being in the United States, Canada, China (Hong Kong), India, UK, Germany, France and Japan.

2.3 Emergence of stock exchanges in Africa

Africa, particularly Sub-Saharan Africa, has seen rapid growth in the number of stock exchanges and a stock market capitalization boom over the last fifteen years. There has been

⁶ <http://www.advfn.com/StockExchanges.html>. Accessed 23rd November, 2008

a considerable development in the African securities markets since the early 1990s. Prior to 1989, there were only 8 stock markets in the entire continent of which 3 were in North Africa and 5 in sub-Saharan Africa. Today there are over 22 stock exchanges operating in the continent. Two decades ago, there were only five in sub-Saharan countries and 3 in North Africa. The phenomenal growth was registered particularly in Sub-Saharan Africa, excluding the older markets in South Africa (Johannesburg Stock Exchange) and Egypt, established in the 1880s.

Along side the rapid expansion of stock markets in the continent, there has also been a significant growth in market capitalisation and the number of listed companies. The market capitalisation for the entire continent was only about US\$569 billion in mid 2005. However, the market capitalisation of JSE of South Africa, the biggest stock exchange in the continent, alone grew to US\$886 billion during the fourth quarter of 2007. The market capitalisation of Egyptian stock exchange, the second largest in the continent, and the Nigerian stock exchange, the third largest, was respectively US\$150 billion in February 2008 and US\$82 billion at the end of 2007. Together the three biggest stock exchanges in the continent have a combined market capitalisation of over US\$1.118 trillion in early 2008.

At present, over 50% of the 54 countries in the continent have formed securities exchanges. In recognition of the importance of stock markets in economic development, several African countries launched stock exchanges during the past two decades. The combined number of listed companies for all stock exchanges in the continent grew from about 1786 in 2005 to over 2000 in 2008. Rapid expansion of stock exchanges in the continent contributed to economic development in various ways. These are, among others, facilitating the privatisation process, diversifying the financial services, facilitating long term capital mobilisation, provision of alternative investment opportunities, attracting foreign capital inflows and serving as a signal of overall macroeconomic performance.

In an effort to promote regional cooperation, individual African securities exchanges established an African Securities Exchange Association (ASEA) in 1993. The ASEA was incorporated in Kenya in the same year. The basic objective of the ASEA is to provide a formal framework for the mutual cooperation of stock exchanges in the African continent. Its functions include exchange of information and provision of material, human and other assistances in the development of the member exchanges.

However, most African stocks exchanges are still at early stage of development and face several constraints. The main challenges are: political instability in some economies, high volatility in economic growth, macroeconomic uncertainty, liquidity constraints, limited domestic investor base, underdeveloped trading and settlement structures, and limited market information.⁷

2.3.1 Historical background of the stock exchange in Ghana

The idea of establishing a Stock Exchange in Ghana lay on the drawing board for almost two decades prior to its implementation. In February 1989, the issue of establishing a stock exchange moved a higher gear when a 10 - member National Committee, under the Chairmanship of Dr. G.K. Agama, then Governor of the Bank of Ghana, was set up by the Government.

The work of the committee was to consolidate all previous work connected to the Stock Exchange project and to fashion out modalities towards the actual establishment of the Exchange. As a result of the work of the committee, the Stock Exchange was established in July 1989 as a private company limited by guarantee under the Companies Code, 1963. It was given recognition as an authorized Stock Exchange under the Stock Exchange Act of

⁷ Dr. Wolassa L. Kumo, *Stock Exchange in Africa: Prospects and Challenges*, September 25, 2008

1971 (Act 384) in October 1990. The Council of the Exchange was inaugurated on November 12, 1990 and trading commenced on its floor the same day. The Exchange changed its status to a public company limited by guarantee in April 1994.

2.4 The Commercial Building

Within the context of architectural classification, stock exchanges fall within the categories of commercial buildings. Space for commercial transaction, primarily, the office, developed from several sources including the ancient Egypt, the Roman Empire, and part of the Western Europe. In ancient Egypt, specific space was set aside for scribes to keep written accounts of such essential items as grain as it was being stored. Small clay funerary models of a granary and its adjacent office for the scribes were later found in the tomb of Meketre XI dynasty 2130 B.C.

The Italians were also known to have developed their own offices for the administration of the supplying of food to Rome. Ostia, the port city of ancient Rome has remains of an office complex known as the square of the corporation (before 12 B.C.). The square of corporation was a large complex of seventy offices that housed the commercial association of this organization, a sort of stock exchange or chamber of commerce of the ancient Roman world. The offices were a series of identical simple interior spaces linked together to form three sides of the square. These offices were linked to warehouses.

The relationship between offices and ware house continued throughout the commercial history of Western Europe, becoming architecturally evident in the 16th and 17th centuries in the Netherlands as the Dutch at the time leading merchants of Europe.

2.4.1 Development of the modern office building.

Government offices became the first offices to develop as a singular building type in the late 12th century in Italy as towns acquired independent status. Uffizi, Florence (1560-1571) designed by Giorgio Vasari for cosimo de Medici.

In the nineteenth century, however architectural independence allowed the development of the singular commercial office building type without the warehouse. This event occurred in London in 1819 when Robert Abraham designed the County Fire Office as part of John Nash's classical Regent Street development. Following that, insurance offices such as the Westminster, Life and British Fire Office, London, the Sun Fire Office, London and the Liverpool office were designed by C.R. Cockerell.

All these buildings used neoclassical elements such as elaborated cornices and classical orders for the columns on exteriors. The use of ornamentation made them similar in appearance to palaces. Their windows also were relatively small, so the interior were dark. However, as new materials such as iron and glass became more available, improvement in office buildings occurred. Peter Ellis enlarged the window openings in the Oriel Chambers by using metal framework between slender stone columns in 1864. The interior now were becoming more generous in size and natural lighting. The next structural breakthrough that affected the office was the development of the iron skeleton frame, first featured in the Home Insurance Building in Chicago (1884 now demolished) by William Le Baron Jenney. It was a ten storey office building, a first of its kind in term of height and therefore accredited as the first skyscraper ever built. This realization was also dependent upon the invention of the elevator, by Elisha Otis.

Although these new office building were structurally innovative, the interior remained dull and standardized particularly the actual workspace. In the Larkin Company Administration

building, Buffalo (1903, demolished), Frank Lloyd Wright introduced new ideas to enhance office design for human activities. The interior of the five-story office was centred around a light court which went the full height of the five levels allowing natural light to reach all parts of the interior through double glazed skylights at the top. Vegetation was also introduced into the workspace while heating and ventilation including air-purifying and cooling equipment guaranteed a consistent comfortable environment regardless of external weather.

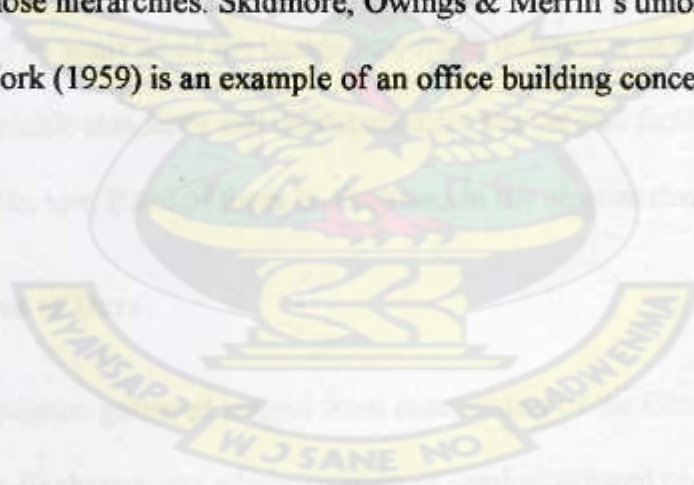
In 1930 George Howe and William Lescaze designed a high-rise office building for the Philadelphia Saving Fund Society. Their design was the departure from the traditional approach of using historical style to clothe a contemporary commercial building. Influenced by structural rhythm, ribbon windows and absence of applied ornament of European modernism, they produced the most advanced office building for its time.

New materials have led to the transformation of the office buildings. The use of glass and steel came to replace iron which was used earlier. In 1958 Mies Van Der Rohe designed the Seagram Building employing a structural and service core enclosed by a glass curtain wall. Because the principles of the concept were highly efficient and economical, this building became the standard for office buildings during the fifties and sixties in urban America. Despite the efficiency the resulting effects on the workspace were deficient. Monotonous and predictable interiors became the order of the day. The ubiquitous fluorescent light, combined with dropped ceilings integrated with air-conditioning systems ensured the monotony. This phenomenon also had its social effect on the workers and their productivity.

In reaction to the desensitized office environment of uniformity and efficiency of the 1950s and 1960s, Roche, Dinkeloo and Associates designed a garden atrium office building for the Ford Foundation (New York, 1966-1967). The Cor-Ten steel and glass square structure contains office along the north and west sides, which overlook a ten-story-high atrium. The

multilayered garden is landscaped with mature trees, shrubs and flowers, creating the essential link between humanity and nature. Sliding glass doors permit the office to physically connect to this oasis allowing the staff to moderate their personal environment. The Ford Foundation Building was a turning point in humanizing the office environment by unifying the entire staff through a common space, which metaphorically represented the philanthropic goal of the foundation itself.

One short fall the humanization of the office space was cost. The concept was so expensive at the time such that most organizations were not ready to invest into this concept just for the comfort and convenience of their employees. The quest for efficiency in large office complexes led to a coordinated systems approach. With this system the layout of the office is based on module system compatible with the building architecture. The spatial size and arrangement of offices could reflect current corporate hierarchies and be easily altered to express changes in those hierarchies. Skidmore, Owings & Merrill's union Carbide Headquarters New York (1959) is an example of an office building conceived with the module concept.



CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

There are indispensable or fundamental research procedures to be followed in order to come out with a creative research work. Depending on the type or topic of research, the procedures vary from assumptions, statistical, scientifically to a lot more. This chapter seeks to adore how diverse methodologies were employed to document and analyse the relevant data to achieve the aims and objectives of the research stated before.

3.2 Method of Data Collection

A qualitative research approach was employed. The methodology used in this design research was developed by carefully examining specific aspects of designing a stock exchange building. These are: a) an analysis of the design and space utilization of two case studies b) identification of acceptable standards and dimensions for the various facilities in the design, and c) an analysis of the site. Each of these is discussed in the chapter that follow.

3.2.1 Primary Sources of Data

The category of information gathered ranged from case studies of the Ghana Stock Exchange and the London Stock Exchange, the administration of semi-structured questionnaires to an excursion through the facilities of the Ghana Stock Exchange to observe and experience every detail in the facility. There are also photographs taken to capture significant areas in the facility.

3.2.2 Secondary Sources of Data

These sources of data include

- a) Internet: - information from the internet was very useful in bringing out the research topic.
- b) Microsoft Encarta 2007:- this also helped with vital information and diagrams.
- c) Journals and Handbooks: - Pictures and information from architectural journals also contributed to the research.

3.3 Method of Data Analysis

Site surveys and analyses were used to compile, arrange and interpret the collected data for precise conclusions and proposals to be made.

3.4 Ethics

The research is purely academic and the findings will be used solely for the purpose for which this research was carried out to define requirements for designing a stock exchange building. The participants were made aware of this basic understanding. The information gathered will be presented as a basis to the architectural design of a stock exchange building.

CHAPTER FOUR

4.0 FINDINGS AND DISCUSSIONS

4.1 Introduction

The proposals used in this design were developed by carefully examining specific aspects of designing a stock exchange building. These are: a) an analysis of the design and space utilization of two case studies b) identification of acceptable standards and dimensions for the various facilities in the design, and c) an analysis of the site. Each of these is discussed in the sections that follow.

4.2 The Ghana Stock Exchange

4.2.1 Site Location

The Ghana Stock Exchange is located on the fifth and sixth floors of the Cedi House in Accra. The building is found about one hundred metres away from the National Theatre in the northern direction along the Liberia Road.



Fig. 4.1 The Cedi House – Home of the Ghana Stock Exchange

The strategic location of the building alongside other prominent high-rise buildings has earned the district its status as the financial district of Ghana. The financial district is made up mostly of banks and other financial institutions which are potential clients of the stock exchange.

4.2.2 Reasons for study

The decision to study the Ghana Stock Exchange with the purpose of designing a stock exchange building in Accra was influenced by the following reasons:

- It is the only institution in Ghana involved with regulating and controlling shares and stock trading.
- The type and pattern of work carried out within a stock exchange is worth studying to understand the requirements for designing a stock exchange building.
- The facilities, equipment and space requirements for the various activities of a stock exchange are worth studying.

4.2.3 Composition of spaces

The GSE occupies a total floor area space of 184. 44 square metres of the fifth and sixth floors of the Cedi House housing the different departments of the exchange. On the 5th floor are the Administration and Finance departments with the main reception. It has the trading floor grounds with galleries overlooking from the floor above. There are 2 visitor lounges at the reception. The 6th floor houses the Public relations, Listings, Research and Special Studies departments. The old trading room on the 6th floor is currently the location for trade due to the fire outbreak soon after the automation of the trading floor. Other departments include Accounts and Education.

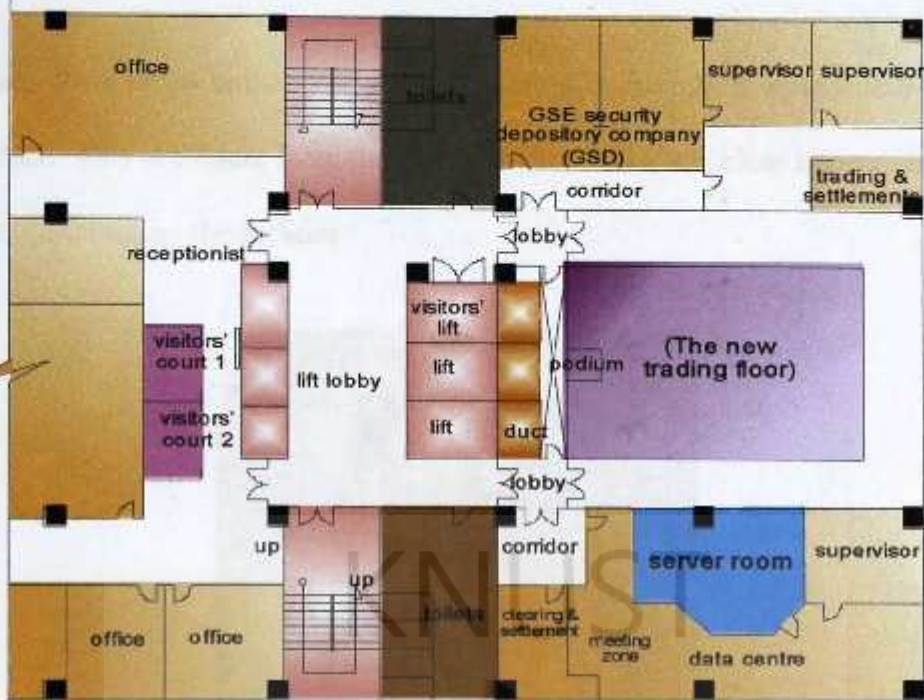


Fig. 4.2 The GSE offices on the 5th floor of the Cedi House

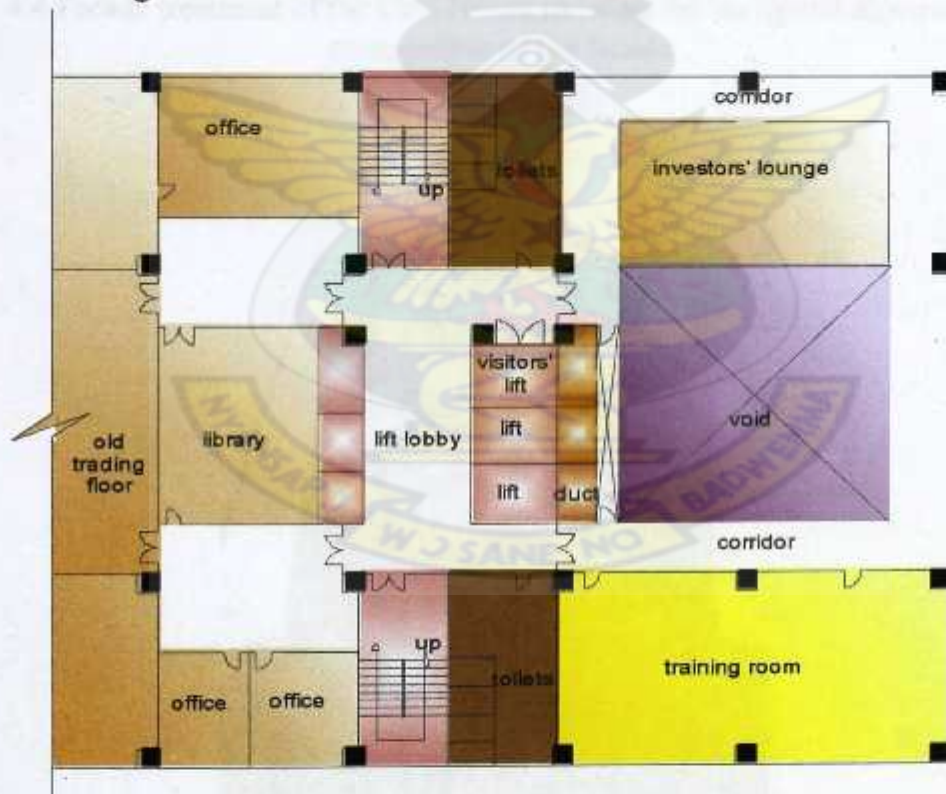


Fig. 4.3 The GSE offices on the 6th floor of the Cedi House

4.2.4 Architecture

The design and form of the building employs modernist architectural style which is simple, direct and robust. This is evident from the simple and minimalistic clear horizontal and vertical bands constituting the facades.



Fig. 4.4 Facade treatment of the Cedi House showing the horizontal elements of the composition of the facade



Fig. 4.5 The Cedi House in its entirety showing a combination of vertical and horizontal composition, typical of tropical architecture.

The ceiling is finished with mineral fibre ceiling tile on steel suspension grid system. Floors are finished with a combination of non-slip ceramic and porcelain tiles in the circulation areas. However, office areas and the old trading floors are carpeted. Specially designed glass partitions, about 1.8m high, are used for partitioning office spaces and visitors' lounges.



Fig. 4.6 Carpeting in office areas



Fig. 4.7 Glass partitions in the visitors' lounge

4.2.5 Building Envelope

The building employs a double-skinned envelope. The first skin is the actual walls demarcating the internal floor area of the building. The walls are made of sand cement block work with large panes of sliding windows spanning the distance between the massive structural columns on all the facades. The windows allow in natural ventilation and light into the interior of the building. The second skin comprises of the sun-shading devices offset outwards from the walls. The sun-shading devices on the north-east and south-west facades are vertical and horizontal devices are fixed on the north-west and south-east facades. The shading devices are used to emphasis the rectilinear shape of the building and the rhythmic appearance of all the building elements. This is typical of tropical architecture with a combination of vertical and horizontal composition.

4.2.6 Workspace planning

The GSE workspace is designed as a simple rectangular open space divided into two separate blocks by the services and utilities core of lift shafts, service ducts, staircases and sanitary areas. The administrative and trading areas which are the two blocks are linked by a lift lobby and horizontal access. The blocks are unified by the trading floor mezzanine which allows visual communication between the two floors. The trading floor is the common space and focus accessible from the fifth and sixth floors.

4.2.7 Structure

The building uses the post and beam structural system with massive columns and deep beams within which the internal spaces are defined. The columns are planned on a 7.5 x 6 metre grid system. Ceiling system consists of mineral fibre ceiling tile on steel suspension grid system. The room height is 3.7 metres high with 150-millimetre thick concrete floor slabs.

4.2.8 Services

All service infrastructures are carried in a 700mm x 7700mm duct system which is centrally located in the building. A suspended ceiling system is used to house overhead electrical conduits and air conditioning ducts. Fire standpipe zones and hoses with a separate water reserve are installed on the staircase landings on each floor of the building.



Fig. 4.8 The ceiling system with light fixture and air conditioning supply and return outlets



Fig. 4.9 The air-conditioning ducts

4.2.9 Circulation

Vertical circulation in the building is achieved by the use of lifts and staircases. Horizontal circulation is achieved by corridors.



Fig. 4.10 Vertical circulation areas

4.2.10 Security

Turnstiles are installed at the entrance of the building where visitors are searched before leaving the lift lobby. Electronic door locking system is used to automatically regulate public and private access. Close circuit television cameras are fixed at vantage points within the building to enable surveillance of movement within the building.



Fig. 4.11 CCTV cameras



Fig. 4.12 Electronic door locking system

4.2.11 Merits and Demerits

Merits

- The strategic location of the facility in the financial district makes it easily accessible to potential clients and brokers.
- Sun shading devices and large windows employed admit light and encourages ventilation while reducing solar heat gain.
- Transparent partitions facilitate easy supervision and make the layout flexible and adaptable for future adjustments.

Demerits

- Fire protection facilities are inadequate. This was evidenced when fire broke out at the Cedi House on the 26th of November 2008 at 11:00 am, affecting the 5th and 6th floors which house the Ghana Stock Exchange offices.
- The facility lacks social facilities where employees can meet and discuss issues and ideas informally.
- There is no room for future expansion of the GSE as the Cedi House was not designed and planned for stock trading.

4.3 The London Stock Exchange

4.3.1 Background

The London Stock Exchange is one of the world's oldest stock exchanges and can trace its history back more than 300 years. Starting life in the coffee houses of 17th century London, the Exchange quickly grew to become the City's most important financial institution. Over the centuries following, the Exchange has consistently led the way in developing a strong, well-regulated stock market and today lies at the heart of the global financial community.

4.3.2 Site Location

The former Stock Exchange Tower, based in Threadneedle Street/Old Broad Street was opened by Queen Elizabeth II in 1972 and housed the Trading Floor where traders would traditionally meet to conduct business.

This became largely redundant with the advent of the *Big Bang* on 27 October 1986, which deregulated many of the Stock Exchange's activities. It eliminated fixed commissions on security trades and allowed securities firms to act as brokers and dealers. It also enabled an increased use of computerised systems that allowed dealing rooms to take precedence over face to face trading.

In July 2004, the London Stock Exchange moved from Threadneedle Street to Paternoster Square, an urban development close to St Paul's Cathedral, still within the "Square Mile" (the City of London).

It was officially opened by Queen Elizabeth II once again, accompanied by The Duke of Edinburgh, on 27 July 2004. The new building contains a specially commissioned dynamic sculpture called "The Source", by artists Greyworld.



Fig. 4.13 The Paternoster Square, London – Home of the London Stock Exchange

4.3.3 Composition of Spaces

The contrast between the two buildings, the former Stock Exchange Tower on the Threadneedle Street and the new Exchange on Paternoster Square, underlines just how much the London Stock Exchange has changed in the last thirty years. The open-plan layout enables employees to work in new ways and gives the Exchange the flexibility needed to continue development as a commercial enterprise.

The Media and Business Complex is the Exchange's purpose-built, broadcast and event venue. It is situated on the first floor of our premises in Paternoster Square. The Media Complex offers both companies and media a dynamic environment for conducting effective business communications. The new Media and Business Complex is being used for a huge variety of meetings and events, with the constant flow of communication and ideas putting the Exchange firmly at the heart of the City.

The interior of the new London Stock Exchange building at 10 Paternoster Square was designed by Gensler, with a brief to create a flexible work space and emphasise the Exchange's place at the centre of London's financial markets.



Fig. 4.14 "The Source", a commissioned artwork which marks the start and finish of each day's trading.

4.3.4 Building Features

The building employs the use of vertical and horizontal elements incorporating shading devices and smaller windows and no curtain walls. Concrete is prominently used.

In four specially-designed studios, a variety of global broadcasters report on the day's business and market news. Companies can also benefit from media services and utilise the studios for filming corporate videos, media training or interviews.

4.3.5 Merits and Demerits

Merits

- The exchange is located in the heart of London.
- the building is multi-purposed with facilities including a business and media centre that has conference room facilities to host business meeting and conferences and also a TV and FM studios for business news, filming corporate videos, media training, etc.

Demerits

- The exchange does not have a trading floor.

4.4 Technical Studies

The technical study is made up of dimensions and standards for the various facilities in the design of a purposely built office building for the Ghana Stock Exchange.

4.4.1 Office Space

Types of office space

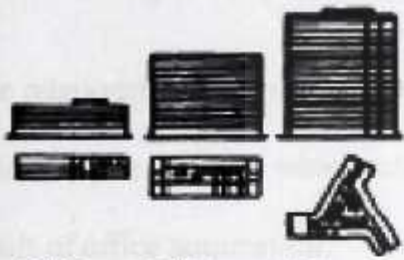
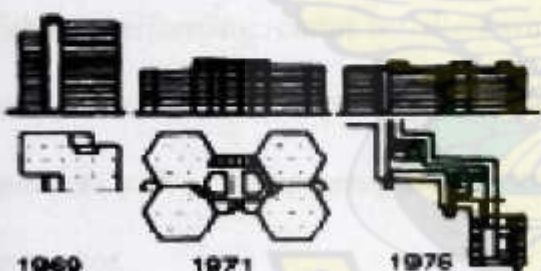
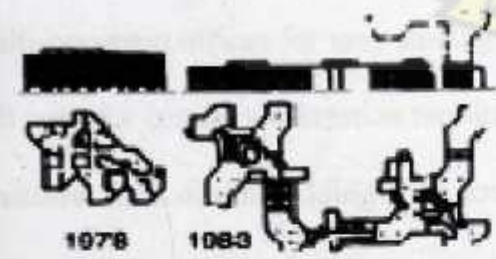
influence of function and ...	equipment	preferred locations
 <p>1958 1961 1963</p> <p>typical layout</p>	<p>mechanical type-writers and calculators telephone files pneumatic tube system</p> <p>1950 – 1965</p>	<p>city centre and adjacent area</p>
 <p>1969 1971 1975</p> <p>organisational flexibility</p>	<p>electric typewriters filing central data processing</p> <p>1965 – 1975</p>	<p>business parks city edge</p>
 <p>1978 1983</p> <p>differentiated working environment</p>	<p>data display terminals communications technology</p> <p>1975 –</p>	<p>city edge country</p>

Fig. 4.15 Floor plans since 1950 (Source: Neufert)

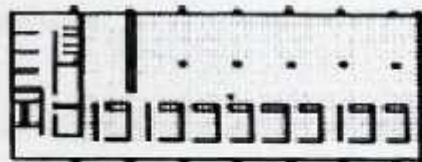
The layout of office space has changed dramatically since the 1950s. Working methods are always closely linked to available technology, and the working structure of earlier years is

being expanded by modern information technology and office automation. As a result, new forms of floor plan are being generated. The orientation of a new office building will depend on location. Where possible, the building should be orientated to admit useful daylight while avoiding glare and solar heat gain. It is easy to use canopies to block the sun from the south. However, if the primary axis runs north-south, the sunlight can reach every room. In the northern hemisphere, north-facing rooms are justifiable only when the building does not have a corridor.

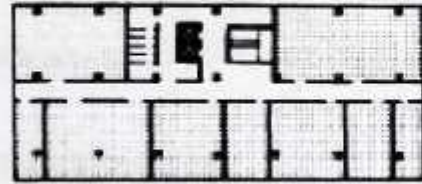
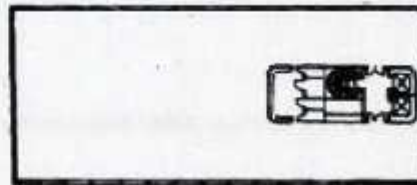
4.4.2 Building Concepts

The relationships between office organisation and spatial design have been classified in a field study in the USA which provided a benchmark for changes in office structures as a result of office automation.

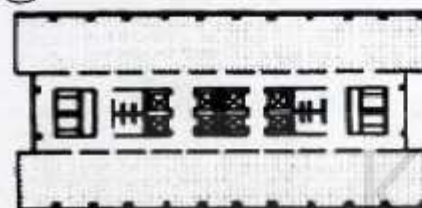
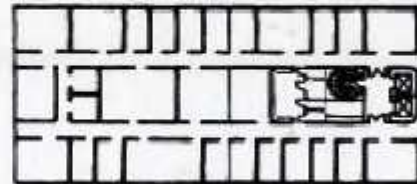
- Open-plan offices are suitable for large groups of employees with a high degree of division of labour, performing routine activities with a low level of concentration. The concept was developed in the 1960s to provide efficiently organised, multipurpose areas, based on arguments such as transparency and clarity of working processes, and the development of a group spirit.
- Separate offices are suitable for independent work requiring concentration, and also for multi-occupant offices for very small groups constantly exchanging information. They are still used for certain workstation requirements, and in multi-storey office buildings where the structural form of the building is so dominant that it determines the spatial and organisational features of the workstations.



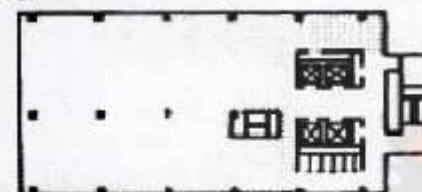
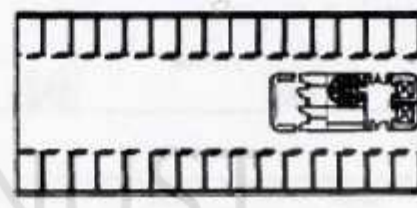
③ Economical one-row layout:
very deep offices



④ Double row layout



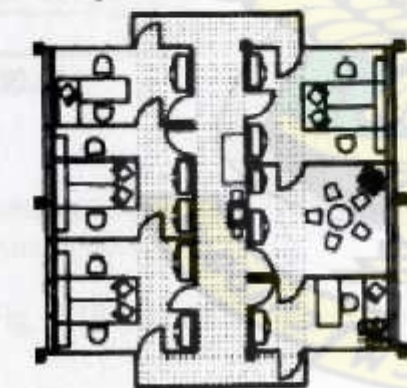
⑤ Three-row layout



⑥ Layout without corridor



⑦ First design, combined office:
ESAB HQ, Tenbom Arkitekt AB,
Stockholm. Various internal
arrangements: open-plan, group,
separate and combined offices



⑨ Separate office



⑩ Combined office

Fig. 4.16 Types of offices (Source: Neufert)

4.4.3 Service Cores

Large office buildings are usually multi-storey structures with moveable internal walls.

Service cores, containing plumbing, staircases, elevators etc., are generally located at the maximum distances specified by building regulations. Service cores can be placed

1. at the front of the building,

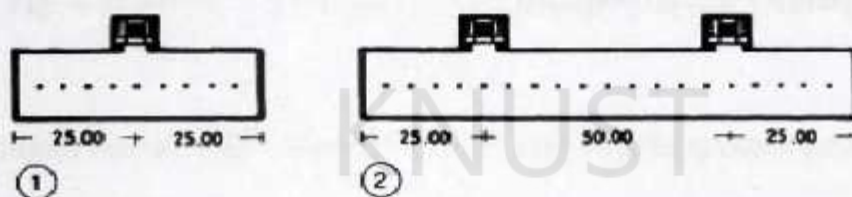
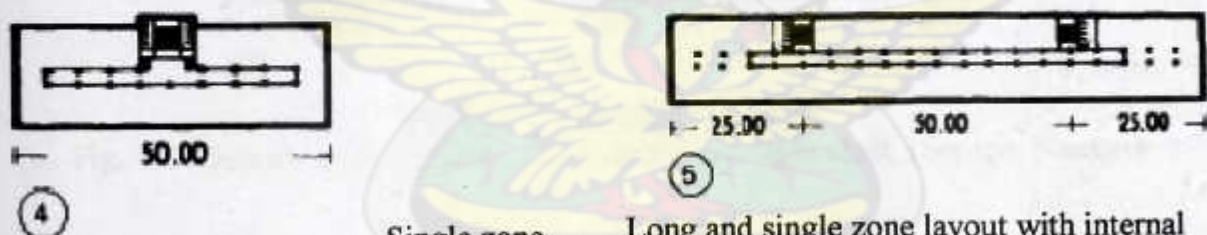


Fig. 4.17 Service core at the front (Source: Neufert)

2. to one side within the building,

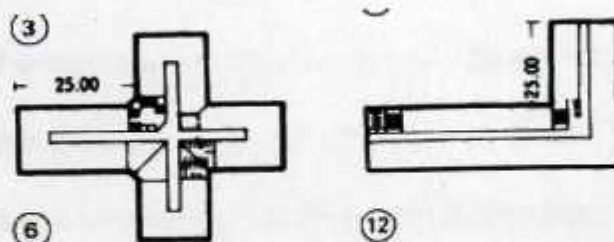


Single zone layout in a compact office with facilities arranged around a corridor.

Long and single zone layout with internal corridors and offices placed on either side of corridor. The two service cores are located in accordance with office building regulations.

Fig. 4.18 Service core to one side within the building (Source: Neufert)

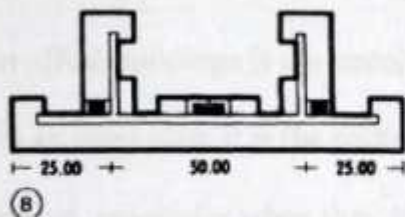
3. at interior corners,



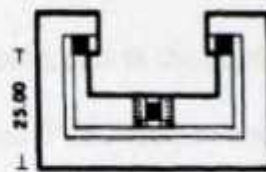
Double zone layout of facilities

Fig. 4.19 Service core at interior corners (Source: Neufert)

4. at the end of a passage



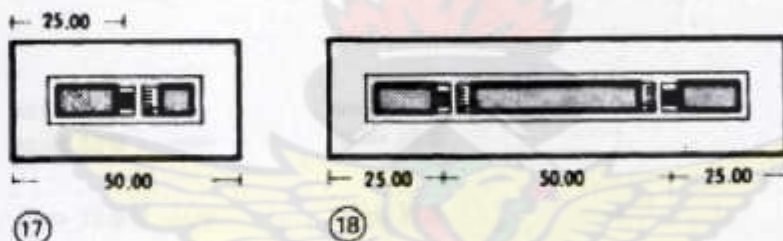
Single zone layout in which rooms are located on one side of a corridor. This planning is relatively expensive as compared to double and triple zone layouts.



Double zone layout of facilities.

Fig. 4.20 Service core at the end of a passage (Source: Neufert)

5. between corridors next to a light shaft, in order to maintain the greatest possible length and continuity in working spaces.



Double zone layout of facilities.

Fig. 4.21 Service core between corridors next to a light shaft. (Source: Neufert)

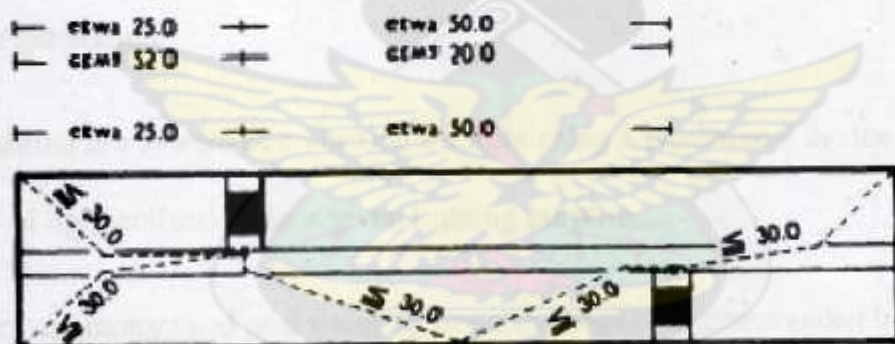
4.4.4 Circulation Spaces

- A simple central row of columns allows for a corridor on one side or the other according to space requirements. A double row of columns corridors may be lit directly by high-level windows and/or by glass doors in the corridor wall.

- Daylight in the corridor may be provided economically by overhead skylights in buildings with wings and those that are short, angled, T-shaped or U-shaped. Lateral illumination of corridors by recesses is less economical. On deep, expensive sites it is best to locate corridors, service rooms, archives, toilets and cloakrooms on interior courts or atria.

- Elevators and toilets can be located at the interior corners of stairwells. Dark rooms, strong rooms and storage rooms should be in dark areas. The area required to connect functional spaces in office buildings is the circulation area. In a closed plan, this is the corridors between rooms; in an open plan, it is the paths through the workstations. Path widths need careful consideration, especially when they are part of an escape route.

- Disability access considerations include the width of doors and circulation routes, wheelchair turnaround clearances, and the slope and length of ramps, etc. Fire safety is a primary consideration in the planning of circulation routes, and should be considered at an early stage. The main considerations are the width of escape routes, the distance to be travelled, and the provision of alternative escape routes and the avoidance of dead-end corridors. The plan must comply with local statutory safety requirements.



- ②① According to building codes, there must be escape stairs no more than 30m from any point in a non-work room. It is best to calculate the distance of the staircases as 25m from the site boundary and the distance between staircases as 50m → ① - ②①

Fig. 4.22 Fire safety considerations (Source: Neufert)

4.5 Special Studies

4.5.1 Sustainable Design

Sustainable architecture is the design of sustainable buildings. Sustainable architecture attempts to reduce the collective environmental impacts during the production of building components, during the construction process, as well as during the lifecycle of the building (heating, electricity use, carpet cleaning etc) This design practice emphasizes efficiency of heating and cooling systems, alternative energy sources such as solar hot water, appropriate building siting, reused or recycled building materials, on-site power generation (solar technology, ground source heat pumps, wind power), rainwater harvesting for gardening and washing, and on-site waste management such as green roofs that filter and control storm water runoff.

i) Solar power generation

Active day lighting is a system of collecting sunlight using a mechanical device to increase the efficiency of light collection for a given lighting purpose.

Active trackers use motors and gear trains to direct the tracker as commanded by a controller responding to the solar direction. Active two-axis trackers are also used to orient heliostats - movable mirrors that reflect sunlight toward the absorber of a central power station. As each mirror in a large field will have an individual orientation these are controlled programmatically through a central computer system, which also allows the system to be shut down when necessary.

Light-sensing trackers typically have two photo sensors, such as photodiodes, configured differentially so that they output a null when receiving the same light flux. Mechanically, they should be omnidirectional and are aimed 90 degrees apart. This will cause the steepest

part of their cosine transfer functions to balance at the steepest part, which translates into maximum sensitivity.

Since the motors consume energy, the heliostat is moved in discrete steps instead of a continuous motion. Also, if the light is below some threshold there would not be enough power generated to warrant reorientation. This is also true when there is not enough difference in light level from one direction to another, such as when clouds are passing overhead. Consideration must be made to keep the tracker from wasting energy during cloudy periods.

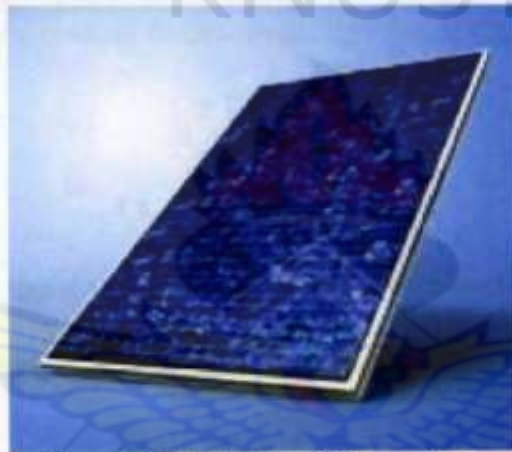


Fig. 4.23 A photovoltaic module

4.5.2 Trading floors

The trading floor marks the scenery of the stock exchange. The trading floor is a physical trading facility where traders make bids and offers via open outcry or the specialist system.

The design has to do justice to this prominent role and clearly communicate the brand message. The high-class, distinct structure translates the corporate identity into architecture.

Ergonomic broker barriers, display boards are some distinctive elements that help in shaping the floor.



Fig. 4.24 Example of a trading floor – Frankfurt Stock Exchange Trading Floor

4.5.3 Vertical Circulation

Office buildings, especially multi-tenant ones, are open environments by nature so it is vital that the flow of all people into, through, and out of the building is controlled effectively.

KONE Elevators™ are stylish space saving elevator solutions for office environments. They feature machine-room-less elevators. Their benefits for office environments include:

- precise floor levelling
- safe in use
- vibration free
- low noise levels

4.5.4 Structural systems for multi-storey buildings

Design and construction of a structure are intimately related and the achievement of good workmanship depends, to a large degree, on the simplicity of detailing of the members and of

their connections and supports. In earthquake-resistant foundation design, the following two main (basic) guidelines should be borne in mind: first, select a foundation layout and substructure system as simple as possible; and second, tie together the different elements of the substructure. When the surface soils are very soft and/or can liquefy, piles can be used to advantage. The pile caps should be tied together with tie beams or a reinforced concrete slab that can work in tension and compression so that the foundation can act as a unit (assuring the integrity of the foundation). Bearing, rather than friction piles, should be used if the foundation materials might liquefy. The piles should be able to carry not only axial but also shear and bending forces (which can be developed due to relative horizontal displacements between different layers in the soil deposit). Therefore, in the case of concrete piles, these should not only be longitudinally reinforced but also confined by suitable lateral reinforcement, particularly immediately below the pile cap.

4.6 Conclusion

The studies above were primarily carried out to know and understand the facilities needed in a stock exchange. It was also carried out to understand the basic operation of a stock exchange and the future demands of its users.

1. The most important aspects of architectural design and construction of stock exchanges are emphasized on layout plans, structural principles, external wall construction and principles of ventilation, heating and energy.
2. The result of the need for achieving an optimum working environment led to the open plan system.
3. The Stock Exchanges of the last century were simple structures of stone and timber; the present stock exchanges are so far of structural fabric elaborately designed.

4.7 Site Studies

4.7.1 Site Selection Criteria

One of the major influences and contribution to the efficiency of the existing offices of the Ghana Stock Exchange is its presence in the financial district of Accra, the capital city of Ghana. Another influence is its proximity to potential clients and brokers. Thus, the new and dedicated offices of the Ghana Stock Exchange should be located according to the following criteria:

Location: Location is of primary importance. Most stock exchanges are located in the heart of the city. Ghana's stock exchange can in the financial district.

Transport: Easy access to public transport is a vital requirement for siting a stock exchange. The site should have access to good public transportation route. This is to enable people to access the site by public transport.

4.7.2 Site Location

Three sites were chosen, all located in the financial district of Accra. The financial district of Accra is situated in one of the low density residential areas in Accra known as Ridge. It lies to the south of Accra and very close to Accra Central. It is part of the Central Business District of Accra. The Independence Avenue is the main arterial road in the neighbourhood. This road offers Accra the prospects of redevelopment into an International competitive business thoroughfare. This is because it is the only corridor within the Central Business Area with the requisite land supply capacity.

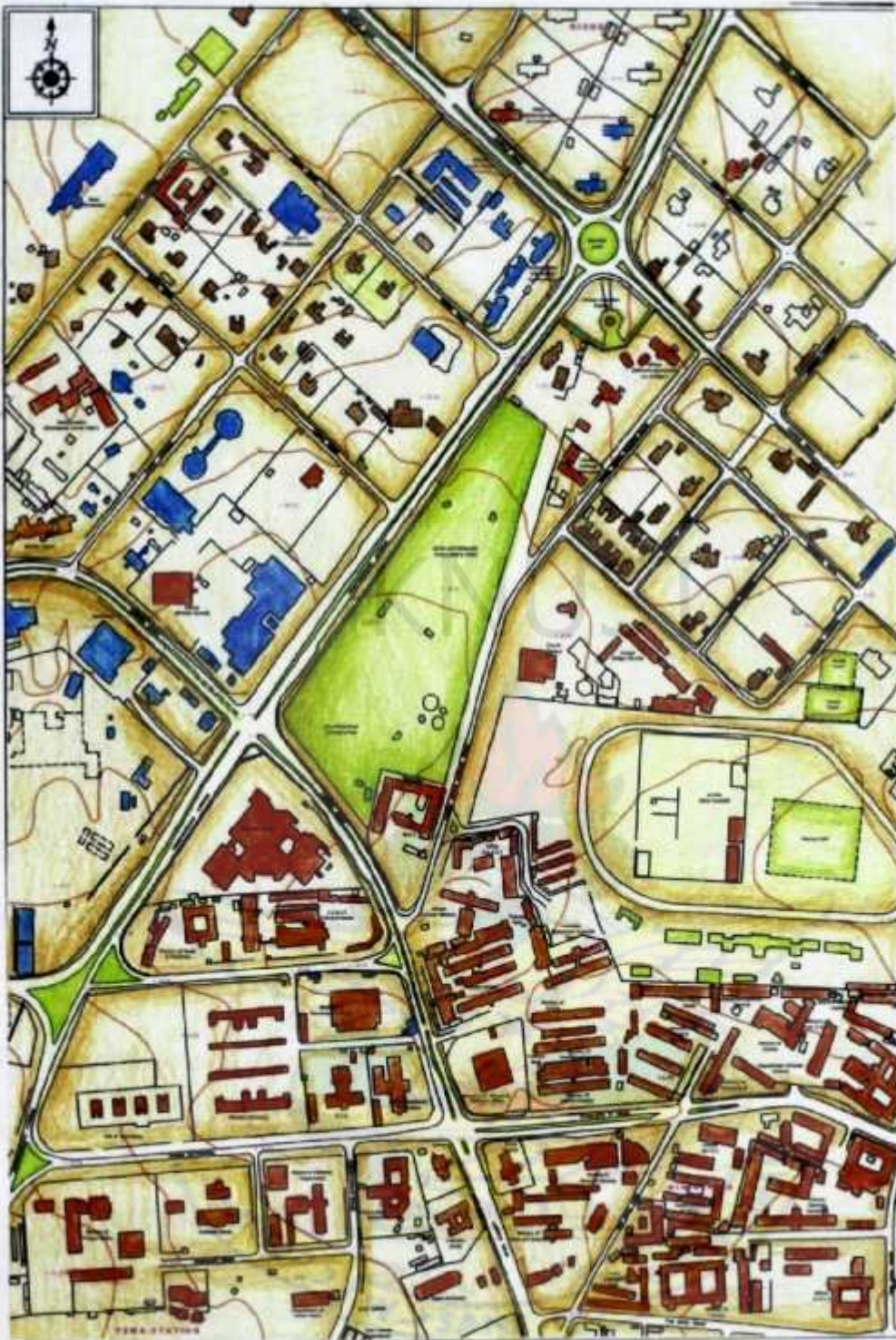


Fig. 4.25 Location map for Ridge, Accra

4.7.3 Site Option 1

Site location: The site is located at West Ridge opposite the Unilever Training Centre and behind the VALCO Trust House on the Castle Road. It is located in close proximity to the Ridge Hospital, Accra.



Fig. 4.26 Site option 1 shown hewn in red

Site Characteristics: The site is currently the manufacturing and building materials storage site of the TAYSEC Construction Company for the construction of the SSNIT multi-storey car-park. The site also houses the site office for the above mentioned construction. The site measures approximately 4.99 acres.



Fig. 4.27 A view of the site conditions present



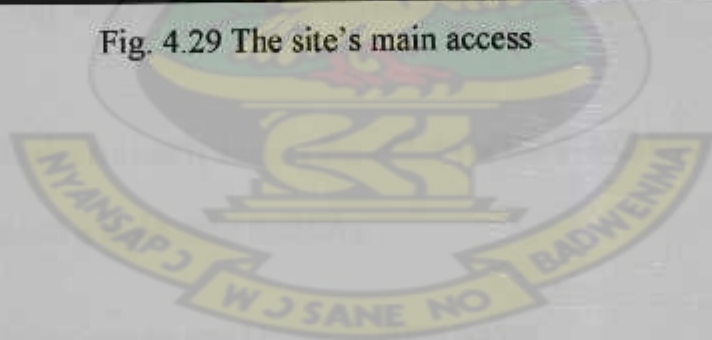
Fig. 4.28 Another view of the present site conditions

Site strength: The site has access to good transportation routes: on its eastern side it fronts the Castle road, one of the ceremonial routes in the metropolis; the three other routes are the Sudan road on its western side, the 7th Avenue on its northern side and the 6th Avenue on its southern side.

Site weaknesses: The site has limited site access on the peripheral roads. Intense vehicular traffic at the periphery of the site does not allow for easy access.



Fig. 4.29 The site's main access



4.7.4 Site Option 2

Site location: The site is located on the 51st Liberation Road, African Liberation Circle, in West Ridge, Accra, adjacent the 7-storey building under construction for Ministry of Water Resources, Works and Housing.



Fig. 4.30 Site option 2 shown hewn in purple

Site characteristics: The site currently houses the offices of the Public Utilities and Regulatory Commission and a residential building.

Site strength: The site has access to good transportation routes.

Site weaknesses: The site has limited site access on the peripheral roads. Intense vehicular traffic at the periphery of the site does not allow for easy access.



Fig. 4.31 A view of the site conditions present



Fig. 4.32 Another view of the present site conditions

4.7.5 Site Option 3

Site location: The site is situated on the Libya Road, adjacent the V. Morrison building and behind the Home Finance Company (HFC) building.



Fig. 4.33 Site option 3 shown hewn in blue

Site characteristics: The site currently houses the University of Ghana Business School and is also being used as a wholesale point.



Fig. 4.34 A view of the warehouse



Fig. 4.35 A view of the University of Ghana Business School

Site strengths: The site has access to good transportation routes. It is situated in the emerging financial district of Accra. The site is already ear-marked for office development. The site is in close proximity to the existing stock exchange offices.

Site weaknesses: The site has limited site access on the peripheral roads.

4.7.6 Conclusion – The Selected Option

Considering the strengths and weaknesses of the three sites, option number three was chosen for the proposed stock exchange for the following reasons:

1. The Stock Exchange must be sited in a financial district as in the commercial centre.
2. Architectural and spatial organisation of stock exchanges are not identical and their parameters are based on the functional relationship and operation.
3. The ICT requirement varies depending on the mission of the clients.

4.8 The Selected Site

An appropriate design responds positively both to its site and climate. The designer therefore has to get an intimate knowledge of both the site and the climate prevalent in the area for which he is designing. The correct selection of the site for the project or design is paramount and crucial to the optimum performance of any facility.

The site covers an area of approximately 12,951.47 square metres. The site currently houses the University of Ghana Business School and is also being used as a wholesale point.

4.8.1 Site Topography

The site slopes gently toward the south-western side. Below is a site map showing the contour lines, spot heights and sections to indicate the slope of the site.



Fig. 4.36 Location map showing contour lines in red and proposed site line-hatched

Soil type: Soil on the site is mostly clayey loam.

Vegetation: Vegetation is sparse on the south of the site; maize plants grow in the south-east. In the north-west of the site, however, ground cover is at a height 500mm with irregularly spaced trees.

4.8.2 Site Inventory: Existing Site Conditions

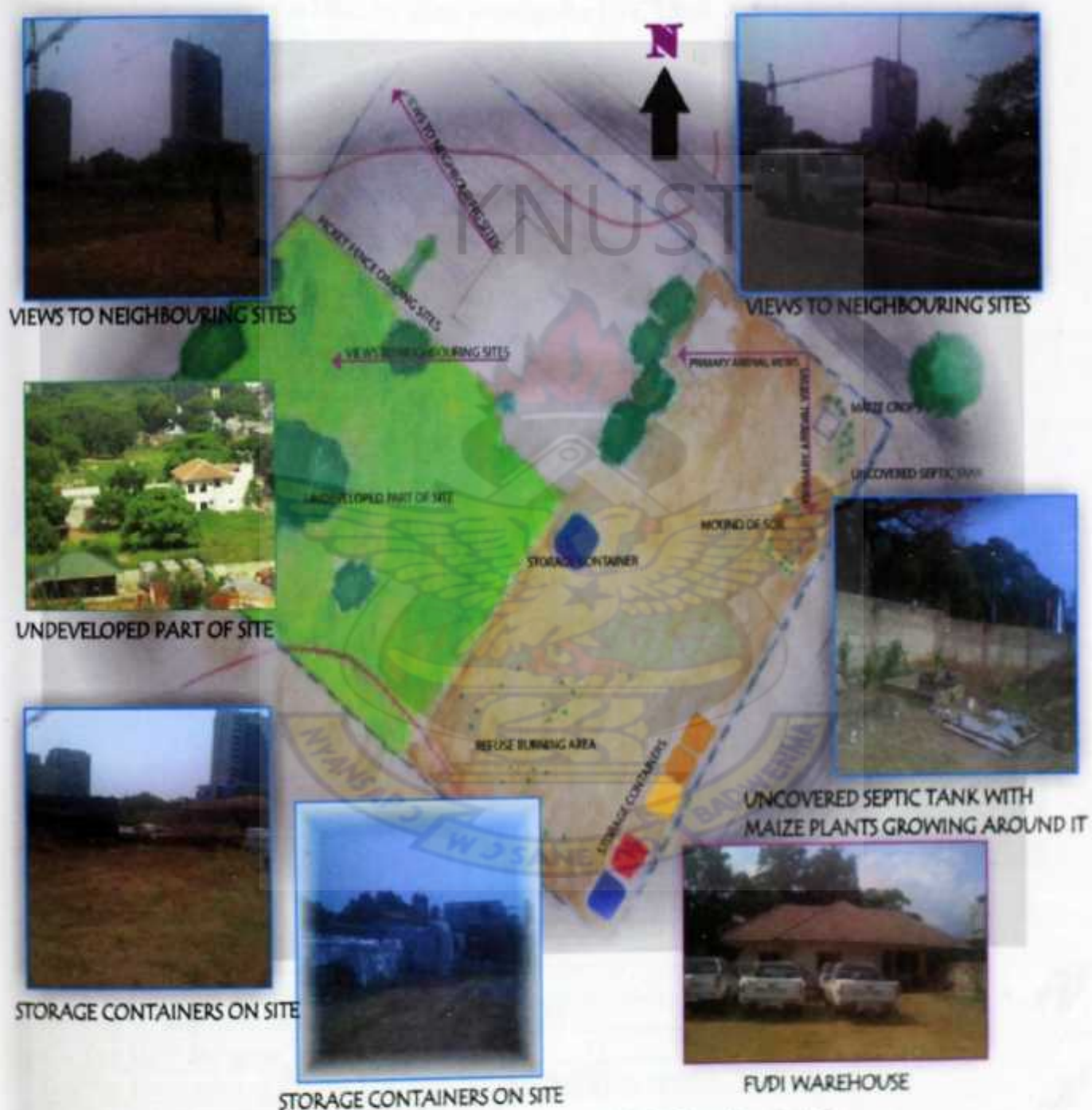


Fig. 4. 37 Pictorial representation of existing site conditions

4.8.3 Site Inventory: Peripheral Studies

The site has certain prominent building flanking it or within a few meters away from it. These buildings will have a direct or indirect effect on the proposed stock exchange.

- Financial buildings, namely, the Heritage Tower, a 14-storey tower, which houses the UBA financial institute and the HFC building housing the HFC Bank, form periphery buildings on the north-west of the site.

- The V. Morrison Building, a 12-storey tower, is located on the south-west.

- The site is bounded by the Independence Avenue on the south-east and the Libya Road on the north-east.



Fig. 4.38 The existing building massing in the area under consideration.
Refer to legend below.

LEGEND

A - The Heritage Tower, approx. 42m high

B - The V. Morrison Building, approx. 36m high

C - The HFC Building, approx. 9m high

D - The University of Ghana Business School Building, approx. 6m high

E - The FUDI warehouse, approx. 4m high

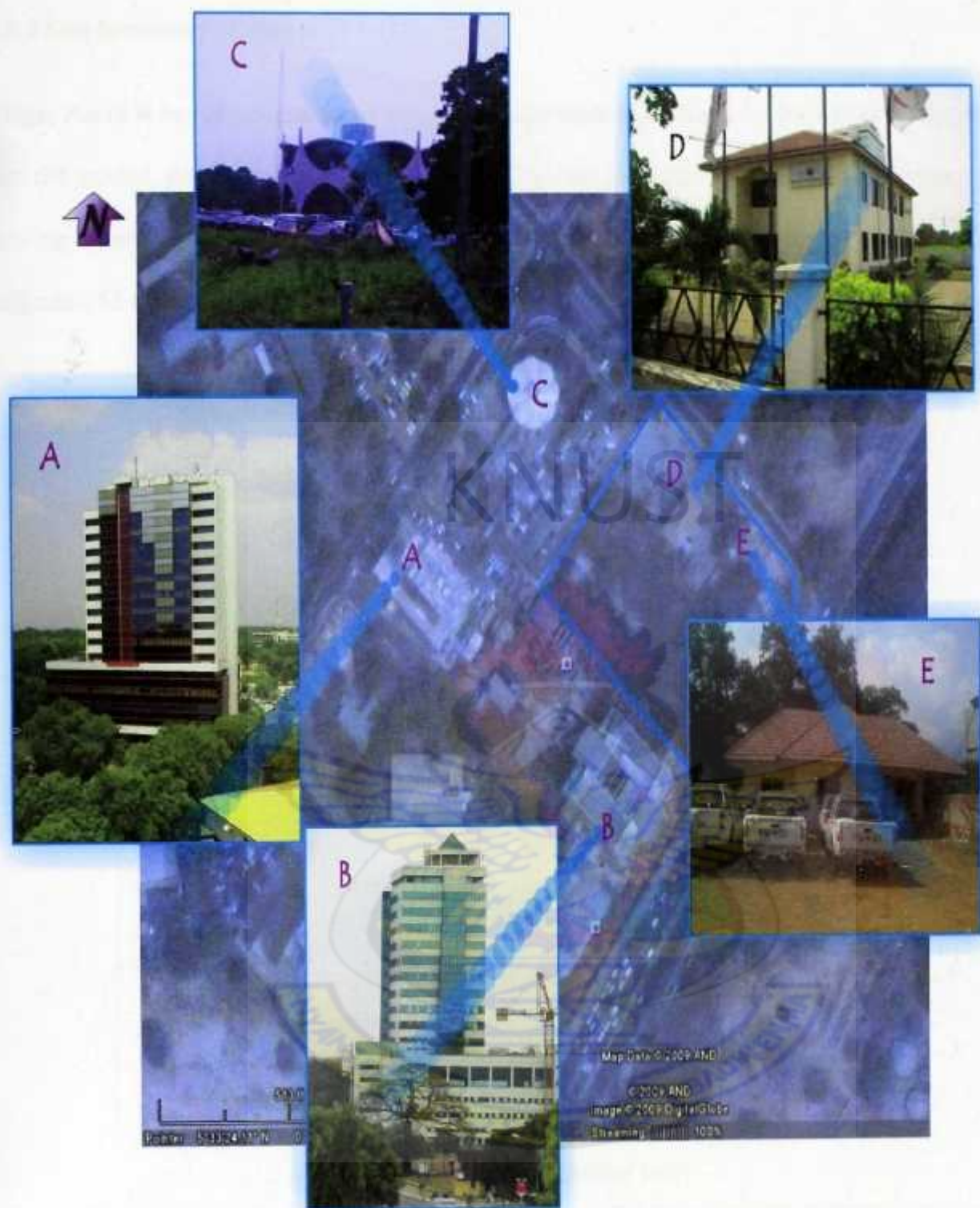


Fig. 4.39 Some buildings situated on the periphery of the site

LEGEND

A - The Heritage Tower, approx. 42m high

B - The V. Morrison Building, approx. 36m high

C - The HFC Building, approx. 9m high

D - The University of Ghana Business School Building, approx. 6m high

E - The FUDI warehouse, approx. 4m high

4.8.4 Site Inventory: Utilities

Ridge, Accra is an earthquake prone area. The water table is between 6 - 10 metres of digging into the ground, depending on the site. A sewer line runs along the Independence Avenue moving towards the High Street, Accra. The land in this area is valued at approximately \$1.5 millions - \$2 million per acre. Below is a map that shows utility lines in and around the site.



Fig. 4.40 Map showing utility lines

LEGEND	
	GT. DUCT ROUTE
	EXISTING 11kv U/G CABLE
	TELEPHONE POLE
	GT. INSPECTION CHAMBER
	TRANSFORMER- EXISTING 11/0.4kv SUBSTATION
	STAND PIPE
	INSPECTION CHAMBERS
	BOUNDARY OF PROPOSED SITE
	GT. EXISTING AERIAL CABLE
	DRAIN LINES
	SEWER LINES
	UNCOVERED MANHOLE
	TRAFFIC LIGHT
	STREET LIGHT
	ELECTRIC POLE

CHAPTER FIVE

5.0 CONCLUSION

5.1 Planning and Design

Brief Development

The establishment of new and functional offices (regional stock exchange) within the sub-region which will be commercially successful should respond to all the requirement of a modern working environment. The offices should enhance services for both the customer and the workers occupying the space. From the research and case studies undertaken, a well equipped and modern stock exchange should also stimulate users for the activity for which the facility is intended. The developed brief was based on the following:

- Site location in Accra: The site is located in the city centre; hence the developed brief should aim at taking advantage of this and produce a design that would be economically viable in such a location.
- Activities around the site: In order to integrate the development seamlessly into the urban fabric, the brief took into consideration, the activities around the site. The site is in a low density residential area. The neighbourhood is gradually assuming commercial characteristics as demonstrated by the redevelopment in the area. Pegasus House, one of the prime commercial properties in Ghana is one of such development. There are quite a number of residential houses, which have undergone refurbishment while few others are being redeveloped.

5.1.1. Developed brief

As a design measure to primarily provide the functional and commercially successful offices for the Ghana Stock Exchange, the proposal will seek to provide the following:

1. Administration: This will include:

- Reception areas
- Offices for the Ghana Stock Exchange, Securities and Exchange Commission
- Trading floors
- Offices for registered stockbrokers

2. Educational facilities: This will include:

- Training rooms for the Ghana Stock Exchange
- Offices for the University of Ghana Business School
- Lecture rooms for the University of Ghana Business School
- Visitors' centre for the education of visitors to the exchange
- Child care facilities
- Library and research facilities

3. Recreational facilities

- Multi-purpose recreational areas
- Seminar rooms
- Gymnasium

4. Ancillary facilities

- Business centre
- Media centre
- Travel bureau
- Health care facilities
- Executive (residential) suites
- Restaurants
- Security facilities
- Maintenance facilities
- Car parks for employees and visitors
- Service yards

5.2 Accommodation schedule

1. Administrative spaces

Managing director's office - 35m ²	Finance & administrative department – 70m ²
MD's secretary's office - 15m ²	Legal & secretariat department – 80m ²
Waiting area/reception - 5m ²	Trading & settlement department – 60m ²
General manager's office - 25m ²	Information technology department and server room – 105m ²
GM's PA/Dept. Mgr/HRM's office - 20m ²	Education/library department – 55m ²
Marketing/public relations department –	Research/special department – 60m ²

60m ²	
Main reception area - 20m ²	Drivers & dispatch department – 25m ²
Conference room - 35m ²	Meeting rooms - 25m ²
	TOTAL 960m ² for an average of 35 persons

Securities & Exchange Commission - TOTAL approx. 600m ² per office capacity of 25 persons	Registered Stockbrokers – Average floor area - 600m ² per office capacity of 25 persons TOTAL approx. 650m ² including meeting rooms and visitor lounges
The Trading Floor Average floor area - 900m ² per capacity of 25 persons with circulation Visitors' gallery - 20m ² TOTAL approx. 920m ²	

2. Educational facilities

Training centre - approx. 145m ²	University of Ghana Business School
Library / research centre - approx. 125m ²	TOTAL approx. 800m ² for lecturers' offices and a 100-seater capacity lecture room
Child care centre - approx. 70m ²	

3. Recreational facilities

Restaurant and kitchen – approx. 600m ²	Seminar rooms – approx. 200m ²
Gymnasium – approx. 430m ²	Meeting rooms – approx. 300m ²

4. Ancillary facilities

Business centre – 100m ²	Visitors' centre – approx. 200m ²
Travel bureau – 45m ²	Executive suites – approx. 80m ² per room
Media centre – approx. 600m ²	Maintenance and service yards – approx. 500m ²
Security (internal & external) – approx. 250m ²	Health care facility – approx. 150m ²
Car parks – approx. 4850m ²	

5.3 Design Philosophy and Concepts

5.3.1 Design Philosophy

“Architecture is a public art and can have a far reaching effect on its surroundings. This concern for physical context produces projects which are sensitive to the culture and climate of their place” - Sir Norman Foster.

As land becomes more valuable, building high becomes more attractive. The skyscraper provides a solution to the need for more offices on smaller sites. The philosophy for the design is therefore derived from the postmodern architectural style by communicating meanings with ambiguity, and sensitivity for the building's context. Taking inspiration from the philosophy of the architect above, the idea is to design a stock exchange that will respond

to its surrounding environment and architecture in context, and help to give the financial district its character as the financial centre of Ghana. The shapes and spaces of the exchange will have to nurture rather than hinder social interaction.

5.3.2 Design Concepts

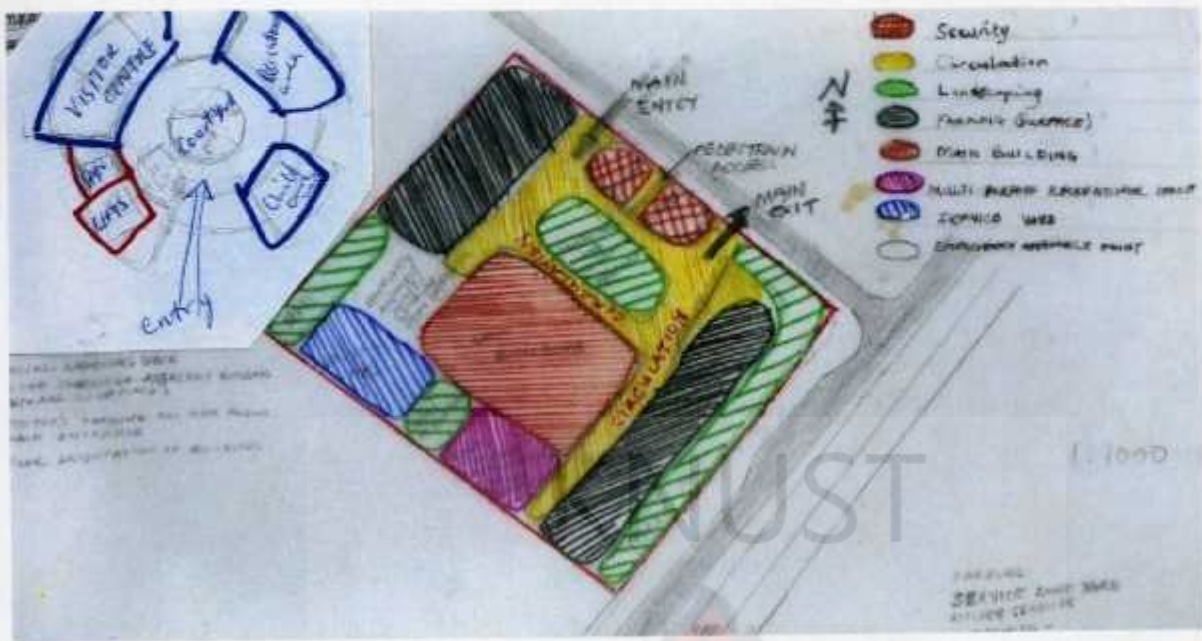
To illustrate the design philosophy the design will incorporate courtyards to create spaces for interaction and also gardens for visual interest and impressions.

- The use of transparent partitions to facilitate easy communication and supervision in the workplace will be employed.
- The open-plan layout will be employed to facilitate team work and supervision.
- A building envelope that allows in natural lighting and ventilation will be designed to create the feeling of being outside (bring the outside in).
- The employment of a tower block rising over the skyline of Ridge as a corporate symbol and improve the skyline and the urban setting.

5.4 Conceptual site planning

The conceptual layout arises from a careful analysis and consideration of the relationships between facilities. The size and shape of site and nature of surroundings influenced the arrangements of facilities.

5.4.1 Option 1



LEGEND








	Surface parking		Security
	Landscaping		Service yards
	Main building		Circulation
	Multi-purpose recreational space		

Fig. 5.1 Conceptual site planning - Option 1

Merits

- Good direct access to building.
- Green areas will aid in the prevention of heat islands.

Demerits

- Multi-purpose recreational space is poorly located. It is in the shadow of the adjacent building. Security supervision is limited.
- Visitors' parking is too far from the entrance. Security supervision is limited.

5.4.2 Option 2

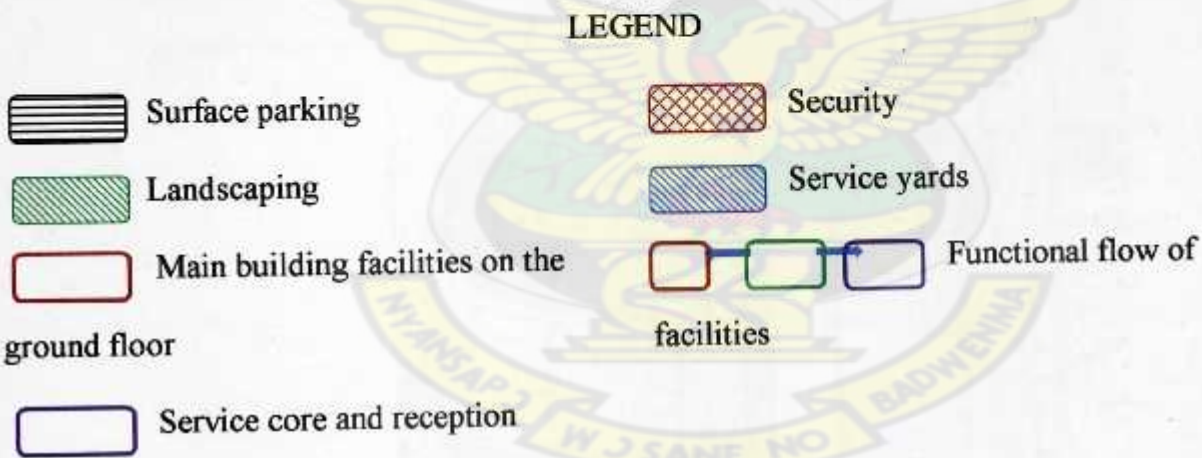
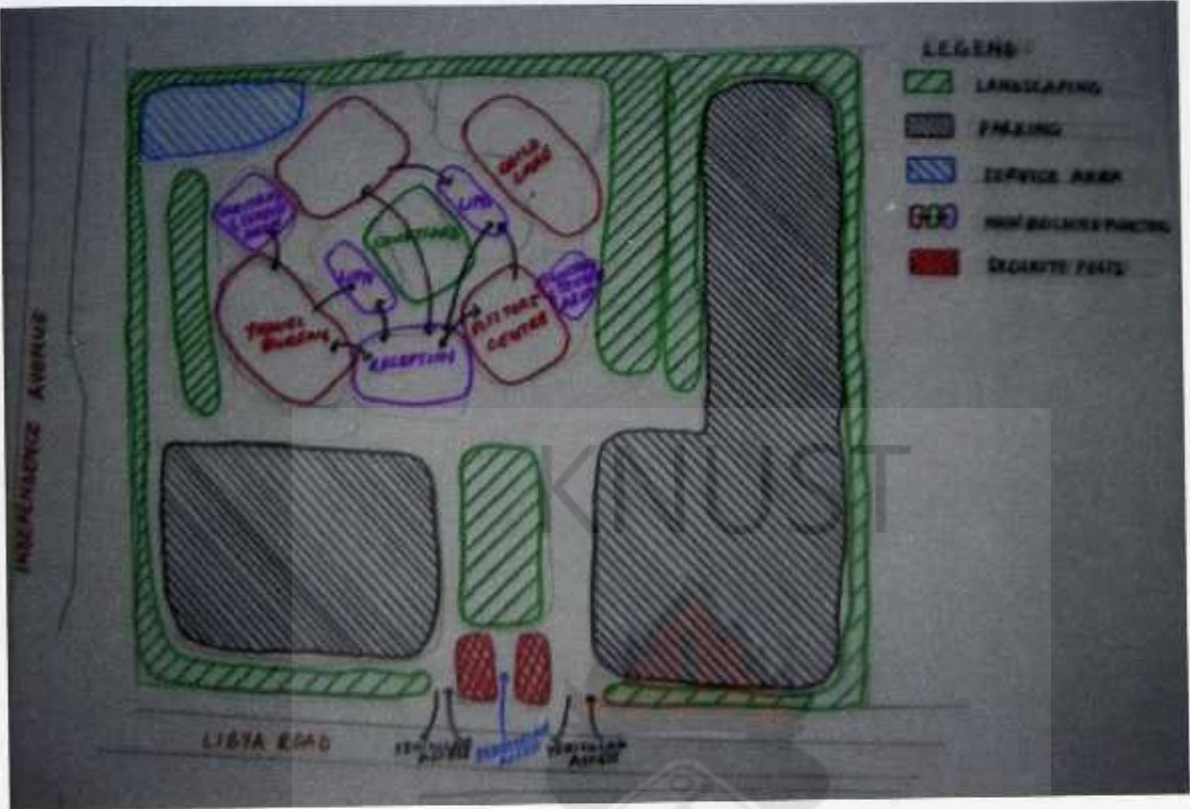


Fig. 5.2 Conceptual site planning - Option 2

Merits

- This layout employs the use of the courtyard system necessary to the design.
- Facilities are within the building. This integrates social interaction into the design.
- Clear supervision of visitors' activities can be achieved.
- Parking areas close to entrance.
- Separate entrance and exit points for both visitors and employees.

Option 2 was adopted and developed further. As described earlier, the choice of this option is mainly influenced by its numerous merits and contribution to design philosophy and concepts.

5.5 Description of the design essentials

With the philosophy and concepts of the design as guidance, the building forms were influenced by taking into consideration the functional and spatial requirements of office facilities by researching and analyzing standards on office designs. The design process involved the arrangement and positioning of the desired spaces within an envelope in close proximity or remote from other related and unrelated spaces. As part of the design concepts applied, consideration was also given to the circulation, accesses and general views to and from the site (both wanted and unwanted). The planning configuration and orientation of buildings was carefully done to enhance natural ventilation, reduce solar heat gain, and maximize day lighting to reduce energy cost.

5.6 Site planning and layout

With careful analysis of the conceptual site planning, site planning considerations for the layout were orientation of buildings, interrelationship of spaces, user requirements of the various spaces, parking areas, service areas and landscaping.

5.6.1 General description of the design

Two segregated vehicular accesses are provided for the facility from the road on the north-eastern boundary, one for employees and the other for visitors to the facility. Pedestrian access is also provided at the eastern boundary. A four-storey car parking facility is provided for employees in the north eastern part of the site with a capacity for two hundred and sixteen cars. Executives of the Stock Exchange and the Securities Exchange Commission have a separate parking facility in the basement of the building. An eighty-capacity visitors' car park is provided in the south east of the site.

The main entrance to the building faces the main arterial road, Independence Avenue. Here, the economic information of the market is displayed on the underside of a glass canopy for visitors to the facility. Motorists and pedestrians on the Independence Avenue can see stock information displayed on the south eastern facade.

The building is designed into compartments, mainly public, semi-public and private spaces. A double volume entrance hall is introduced at the entrance from which the public facilities and offices in the facility are accessed. The public spaces are located on the ground and first floors. These spaces are the multi-purpose recreational areas on the ground and first floors, convenience store, visitors' centre and a child-care centre on the ground floor; a gymnasium, business centre, travel bureau, forex bureau and a health-care unit are situated on the first floor. Semi-public spaces are the lecture and seminar rooms for the University of Ghana

Business School, library, lecturers' offices and lounge. The visitors' gallery to the Stock Exchange and media facilities also serve as semi-public spaces. The private spaces refer to the offices involved in the running of the stock exchange, offices of the stock brokers and the rentable office spaces. Executive suites provided for business executives on the 23rd to 26th floors are also considered as private spaces.

A courtyard is incorporated in the design to create a space for social interaction. Seating is provided in this area with landscaping employed. Socially, the courtyard helps to break down the scale of the building and help regulate the internal climate. Fresh air is drawn in into the space with the help of open gardens and sitting areas which are located generously about the building perimeter. Refer to Appendix A for drawings with reference to descriptions in this section and other sections that follow below.

5.7 Structure/Form

The structural system employed in the design is a load-bearing post and beam system. The building is further stiffened using the elevator enclosures as shear walls in the centre of the design.

The size of site could not support the needed space for the proposed design on the ground level and therefore different floor levels were introduced, a total of twenty-six levels. This also helps in compartmentalization of the spaces as described in section 5.6.1 above.

5.8 Materials and Finishes

In office building designs and construction, interior finishes and treatment are important considerations. This is because both interior and exterior finishes add to the whole environment. The choice of finish for interior walls was dependent on the location and use of the space. Timber slats that provide shade are well treated to last longer and finished in high

gloss lacquer. Horizontal shading devices are covered with translucent films which serve as solar panels.

Floor finish: A raised floor or access floor system is to be used in the facility to provide accessibility and flexibility in the placement of desks, workstations, and equipment. The under floor space is used for the installation of electrical conduit, and cables for computer, security and communication systems.

Ceiling: A suspended ceiling system is to be used to provide a concealed space for mechanical ductwork, electrical conduit, and plumbing lines. Acoustical ceiling tiles are to be used. These are removable for replacement or for access into the ceiling space.

Walls: Interior partitions to subdivide the space will be used and finished to provide the necessary acoustical separation.

5.9 Lighting

As much as possible natural lighting has been used and complemented by artificial lighting where necessary. A lot of large openings have been designed to improve on the admittance of light from the natural source. Because of the size of the buildings, voids and pockets of openings have been made part of the design to help with lighting spaces.

5.10 Services

Services provided for the facility include water supply, electricity, lighting, ventilation, security controls, and telecommunication facilities, refuse disposal, storm water drainage, waste soil drainage, fire fighting and air-conditioning facilities.

5.10.1 Water supply

Water to the facility would be from the mains along the Libya road. Rain water is also harvested by means of rain gutters from the roof.

5.10.2 Electricity

Power will be tapped from the mains along the Libya road and stepped down by a 500KW transformer before being sent to a switchboard and then distributed to the panel boards. A standby generator set with automatic switches will be provided and would be part of the distribution cable which will be loaded. In order to reduce the building's dependence on the national grid, other power generation systems were employed. Solar energy is being harnessed by means of solar panels installed on the facades of the building and on the flat roof of the building.

5.10.3 Lighting

The courtyard is designed to provide natural lighting and ventilation. The central courtyard provides adequate natural lighting within the various facilities.

5.10.4 Ventilation

Natural ventilation is encouraged with the introduction of operable windows in all facades of the building. Adequate spaces were left in-between buildings to aid in natural ventilation and lighting. A split air conditioning system is also used in the building to provide thermal comfort and cool computers and other equipment used in the building.

5.10.5 Emergency exits

Emergency exits have been provided for escape routes. Fire alarm call points and fire fighting equipment have also been provided. Emergency exits are enclosed and have pressurized air volumes to prevent fire and smoke into these enclosures.

5.10.6 Telecommunications

Every facility has communications requirements that need to be connected to the information infrastructure. These communications requirements encompass not only basic telephone service, but local area network/data communications (LANs), video/television, paging, and security and fire sensing and alarm systems. Separate, dedicated telecommunications space will be provided to satisfy the immediate and planned future telecommunications needs.

5.10.7 Fire detection

The fire alarm system shall be an automatic 1-24 zone single loop addressable fire detection and alarm system, utilizing conventional detection and alarm sounders. Detection shall be by means of optical detectors and heat detectors located throughout the building with break glass units on the corridors. Fire door assemblies are also utilized.

5.10.8 Fire Fighting Installation

Fire fighting is to be effected by the use portable fire extinguishers located at fire-prone areas. Sprinkler systems will be installed.

5.10.9 Fire Hydrants

Fire hydrants shall be of the sluice valve type to BS 750 comprising a cast iron key operated sluice valve complete with a socket adaptor, a duck foot bend and an outlet adaptor or approved equal. The adaptor shall have a standard Belfast Pattern Outlet with the female

thread protected by a brass cap and chain. The hydrant fitting shall be tee off from the mains. Each hydrant shall be provided with a heavy duty cast iron hinged hydrant box to BS 750 with the words fire hydrant cast on the cover. The top of the hydrant box shall be painted red. A 300 by 200 indicator plate of aluminium construction shall be provided with an inscription of "fire hydrant". The plate shall be supported at 600mm high above ground level by channel steel support. Both plate and support shall be painted in red colour and installed about 1,000m from the hydrant.

5.10.10 Drainage – Waste and Surface water

Surface drainage is generally underground in covered drains with the provision of grills intermittently to take away rain water. The lawns have also been provided with subterranean drain pipes to help drain it effectively. Sewerage is channeled through outlets at manholes provided at maximum at 9-metre intervals and at every change in direction. From the manholes the sewerage and waste water will be channeled to the main sewer line on the Independence Avenue.

5.10.11 Soft landscaping

The site shall be landscaped to enhance the needed beauty and to create a microclimate against the weather conditions. The few trees on the site shall be incorporated into an overall landscape with the introduction of more greens. The road net work will be lined with royal palm trees with lawns on the sides of the pedestrian walkways. The courtyard would be landscaped to a garden effect with plants as well as seating. Open spaces will also be landscaped with lawns and avenue trees. Parking areas would be provided with shady trees as well.

5.10.12 Hard landscaping

Easy maintenance, durability and aesthetic appeal shall be considered in my choice of hard paving elements. The driveways shall be surfaced with asphalt. The car park and pedestrian walks shall be finished with interlocking concrete paves interspersed with grass. The pavers shall blend with the rest of the landscape in both colour and texture. This is aimed at reducing heat loads, glare and by the principle of rhythm and repetition to achieve a better design.

5.10.13 Other landscaping elements

These shall include sculptured pieces, garden lamps and ponds which shall be incorporated into the complete landscape design.

5.11 Costing

This is an estimate that gives the client an overview of the cost of the project. The cost per square meter of high rise buildings with a high level of finish is estimated to be \$1500 in Ghana as at September 2009.

Hence,

$$\begin{aligned} \text{Basement (2 levels)} & \text{-----} 8702.2\text{m}^2 \times \$1500 \\ & \text{= } \$13,053,300 \end{aligned}$$

$$\begin{aligned} \text{Ground Floor – 2nd Floor} & \text{-----} 9750\text{m}^2 \times \$1500 \\ & \text{= } \$14,625,000 \end{aligned}$$

$$\begin{aligned} \text{3rd – 18th Floor} & \text{-----} 45128\text{m}^2 \times \$1500 \\ & \text{= } \$67,692,000 \end{aligned}$$

$$\begin{aligned} \text{19th – 22nd Floor} & \text{-----} 11090\text{m}^2 \times \$1500 \\ & \text{= } \$16,635,000 \end{aligned}$$

23rd – 26th Floor -----9246.8m² x \$1500

= **\$13,870,200**

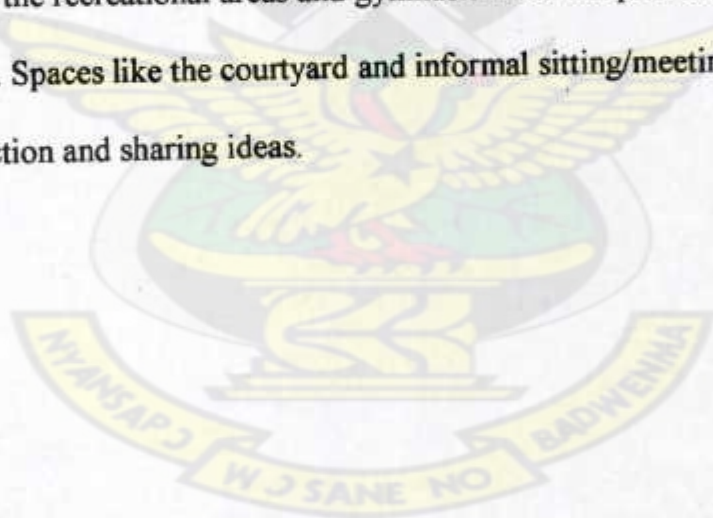
Grand Total-----83917m² x \$1500

= **\$125,875,500**

The project put together shall cost a total sum of **\$125,875,500**. This is based upon the cost per unit area calculation of \$1500 per unit area.

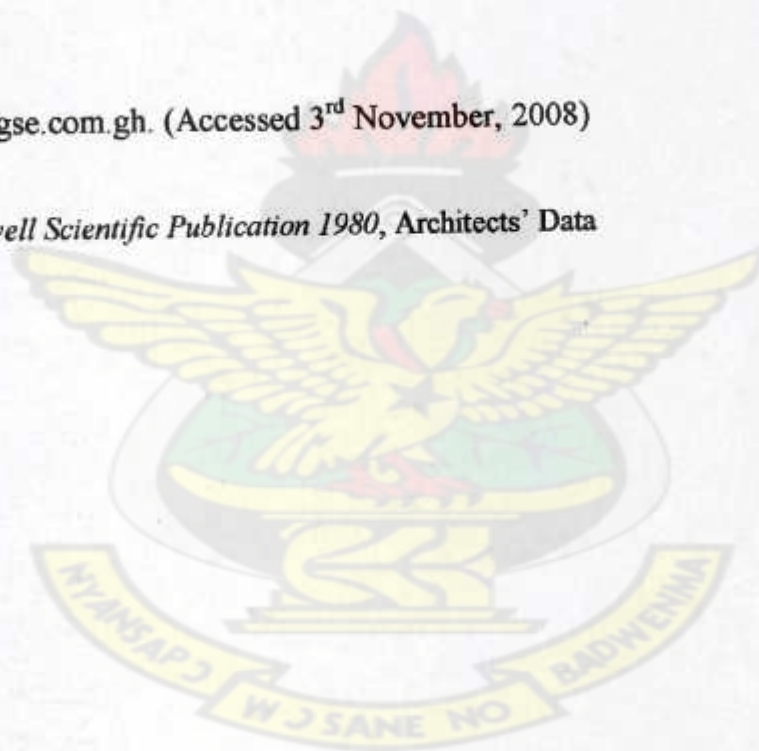
5.12 Conclusion and Recommendations

In conclusion, this proposed stock exchange building will create a space with a distinct character for the Ghana Stock Exchange and for the financial district of Accra as a whole. The building is designed to nurture rather than hinder social interaction. This will be achieved by providing spaces like the recreational areas and gymnasium for the public and employees of the facility to interact. Spaces like the courtyard and informal sitting/meeting areas can serve as areas for interaction and sharing ideas.



6.0 REFERENCES

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APPENDIX A

This shows the block plan, site layout, plans, sections, elevations and exterior and interior impressions of the proposed Stock Exchange building.

KNUST



BLOCK PLAN

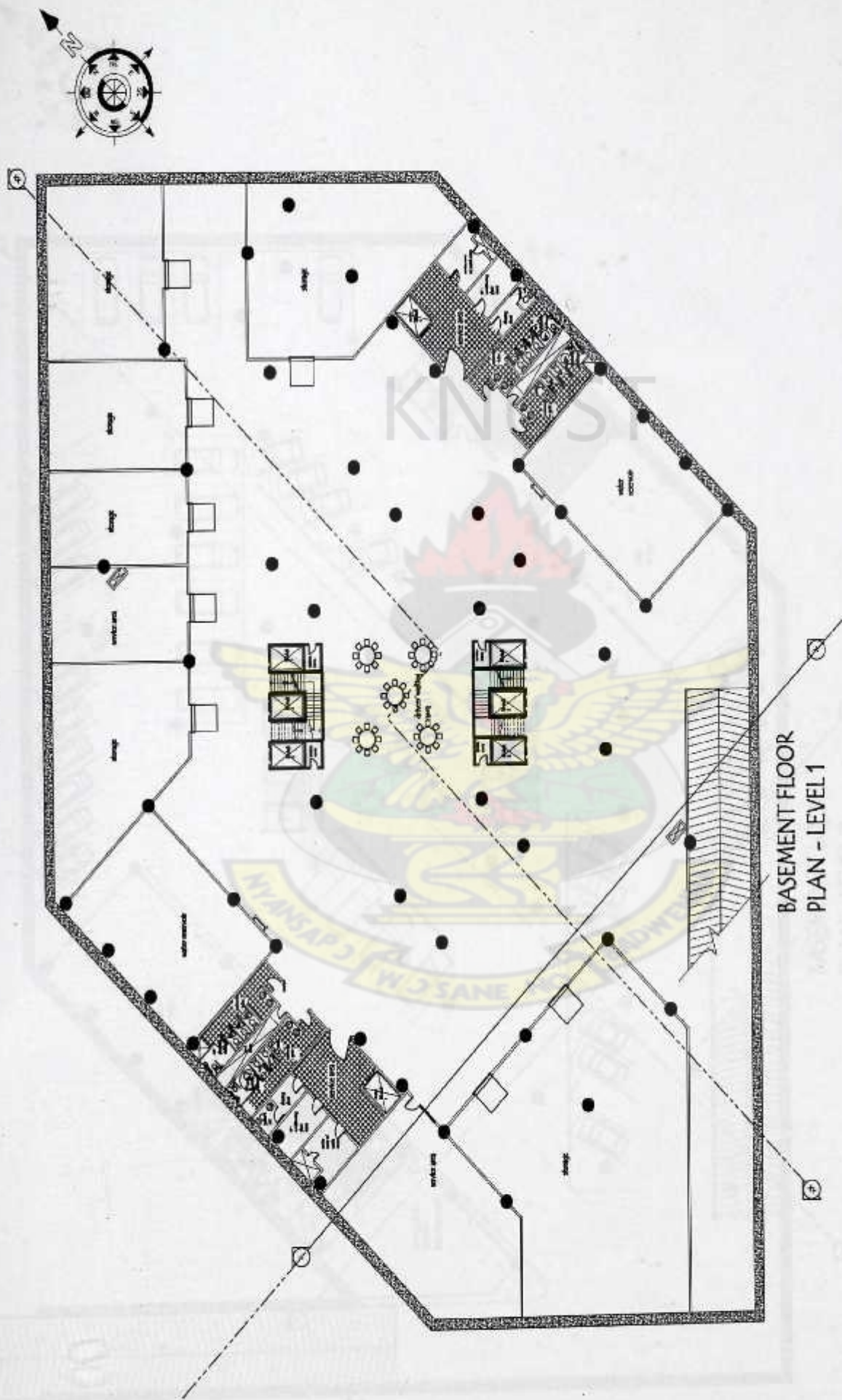


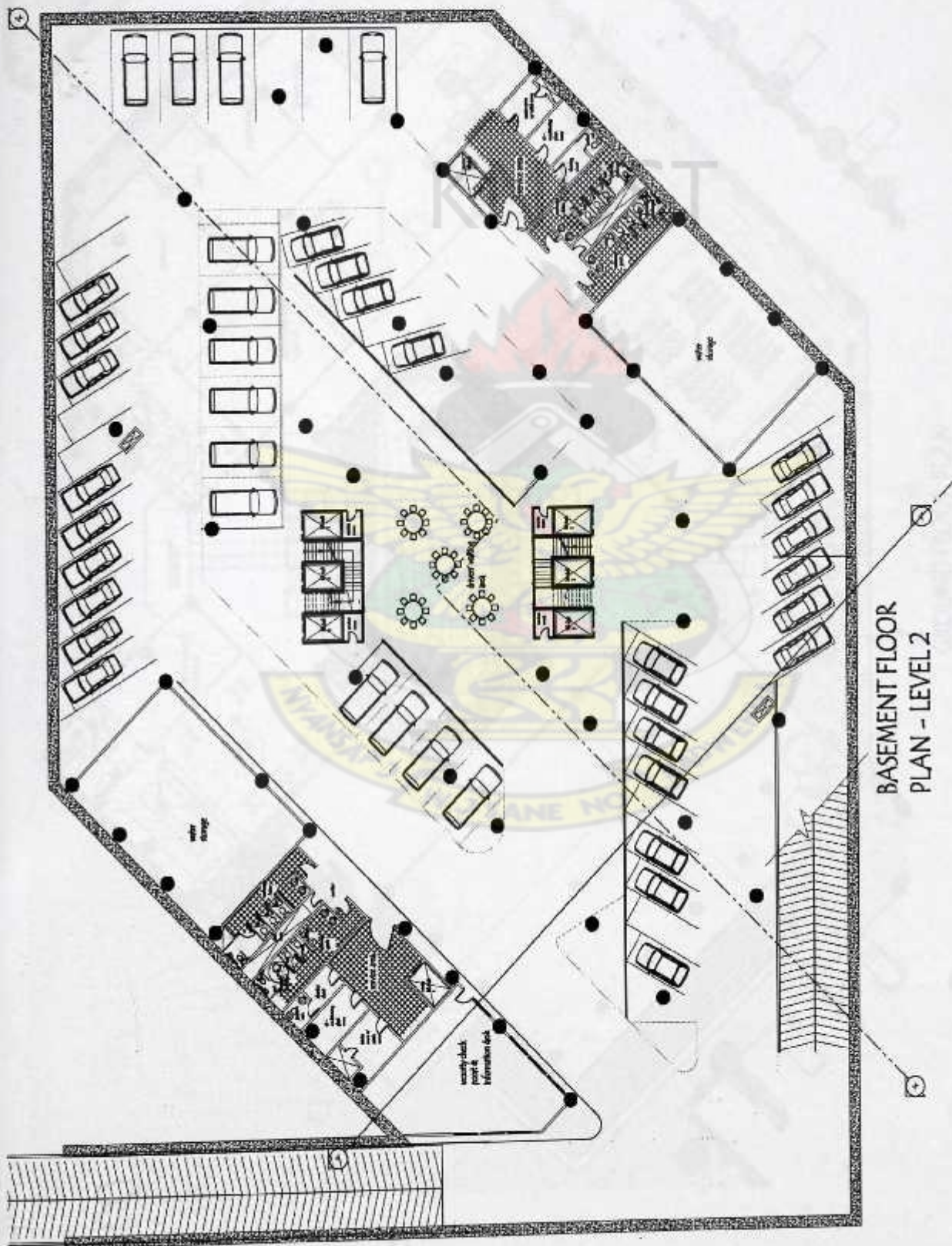
SITE LAYOUT

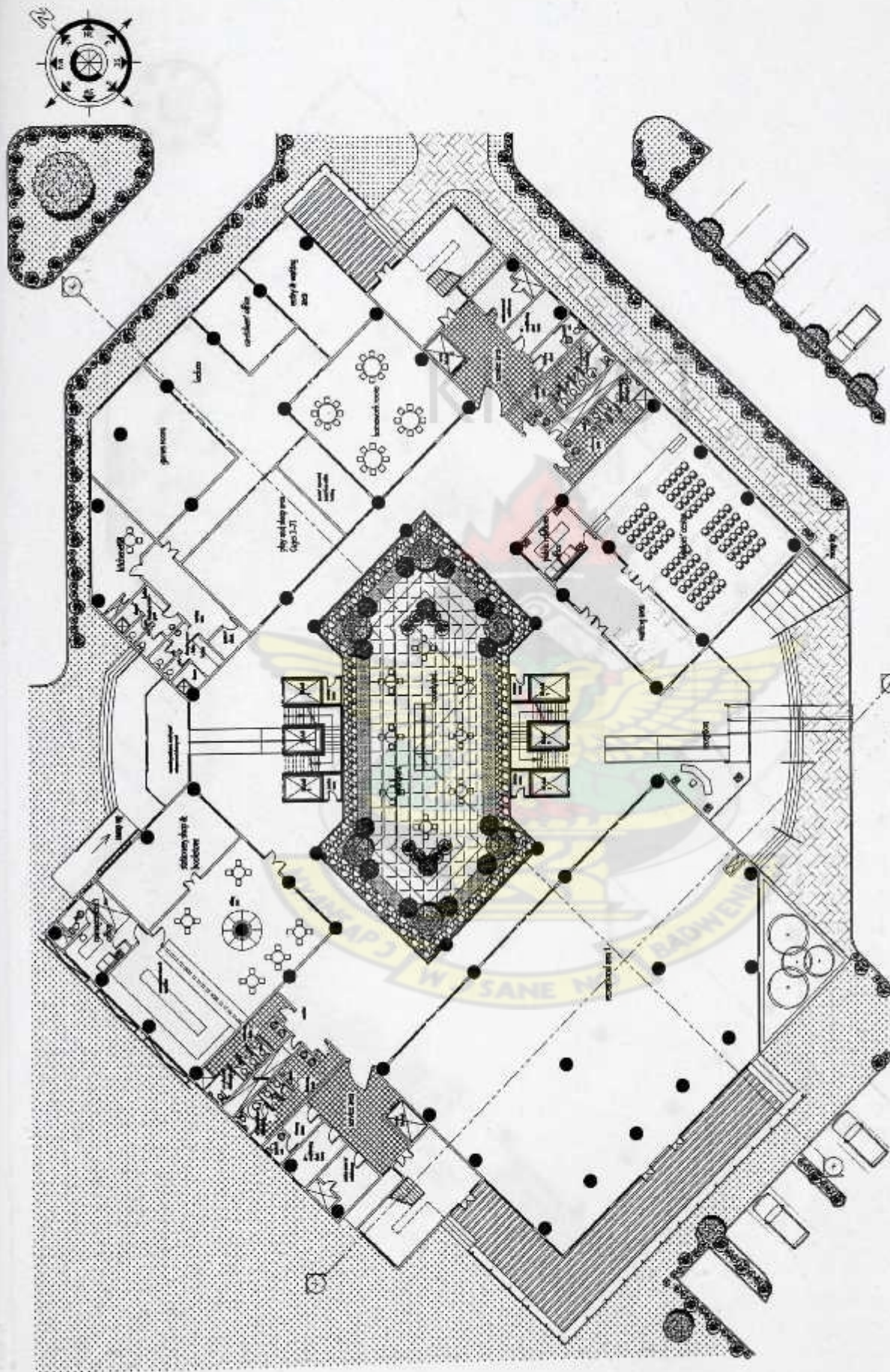


SCALE: 1:250

PLANS



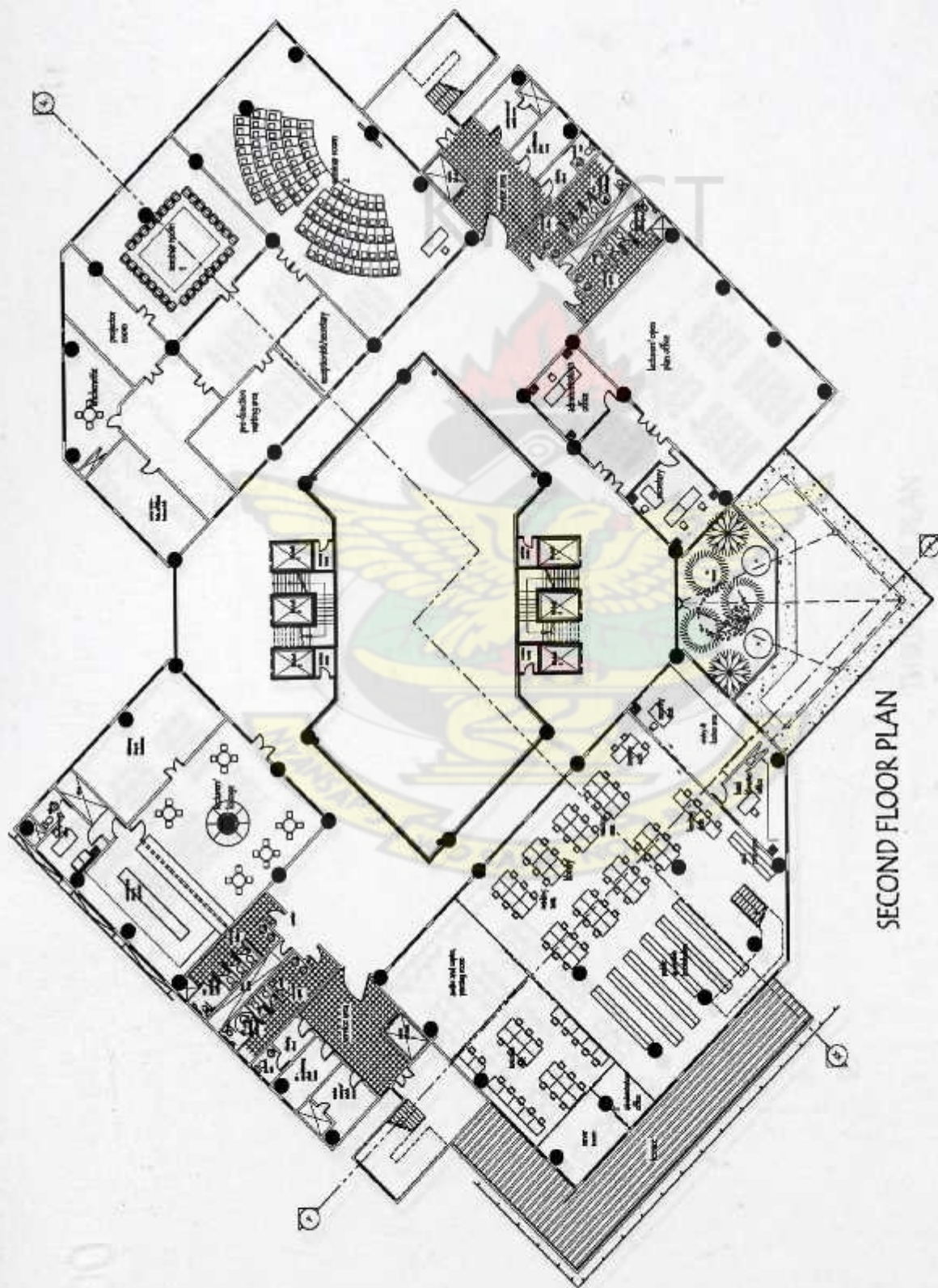




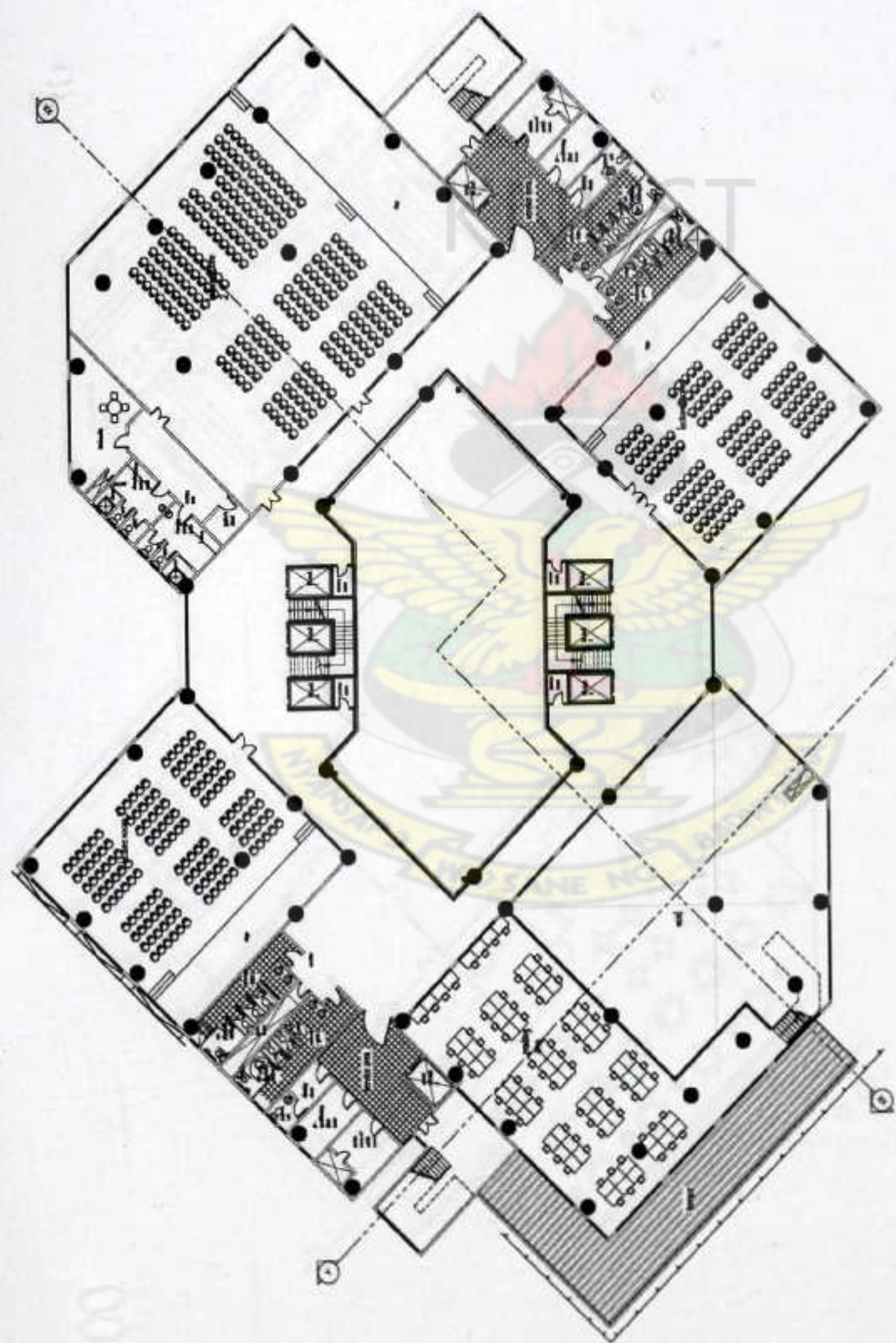
GROUND FLOOR PLAN



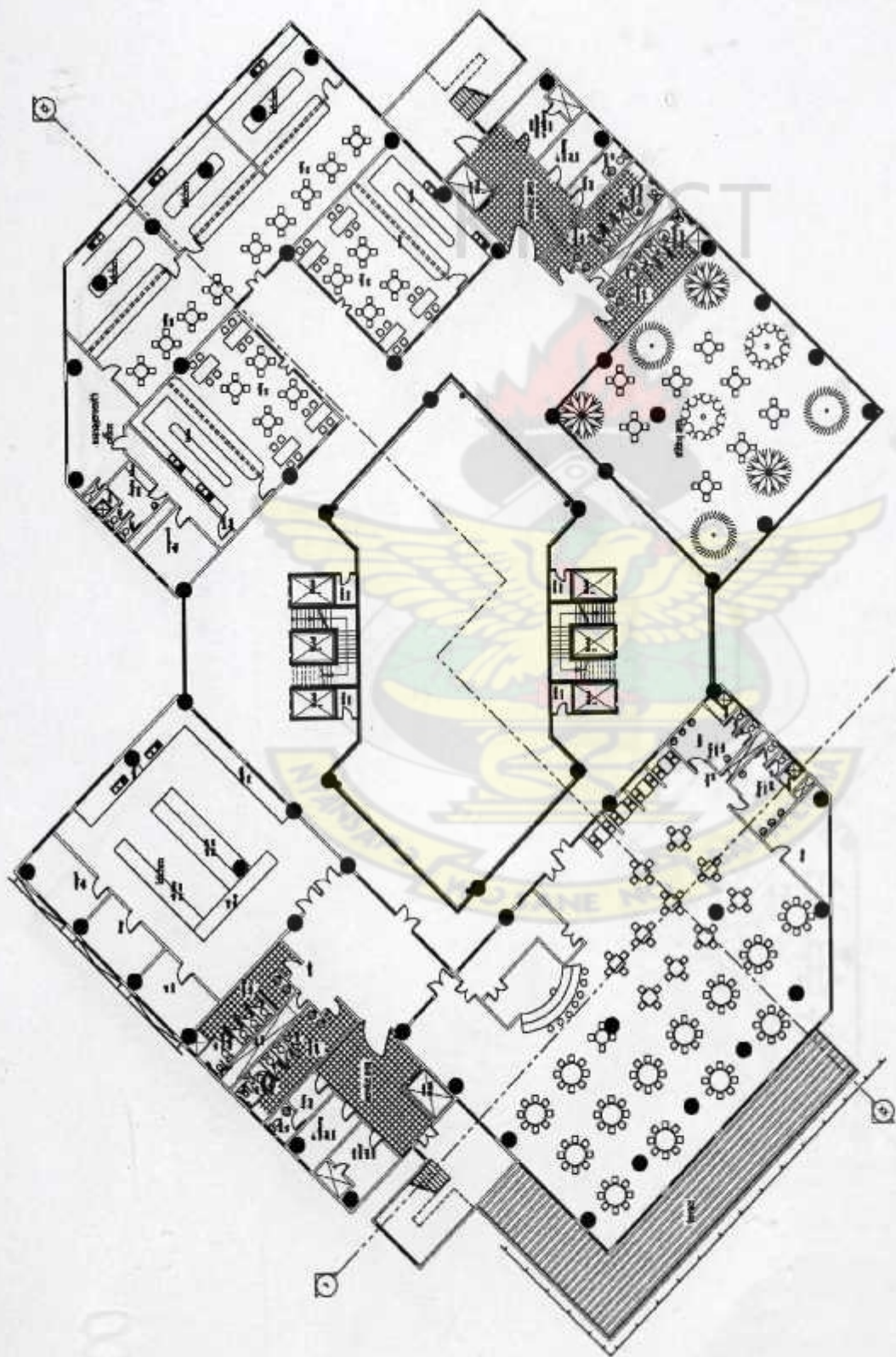
FIRST FLOOR PLAN



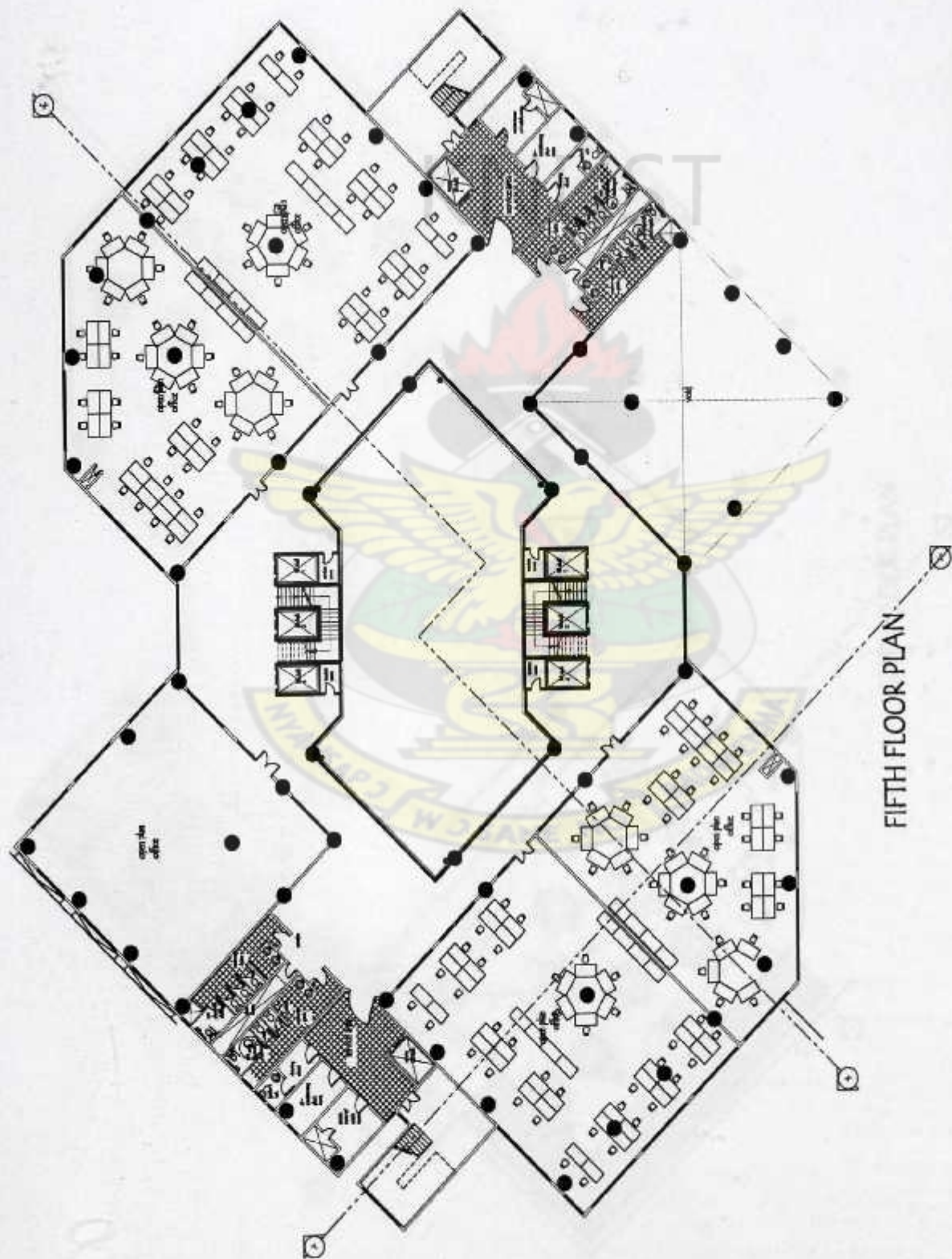
SECOND FLOOR PLAN

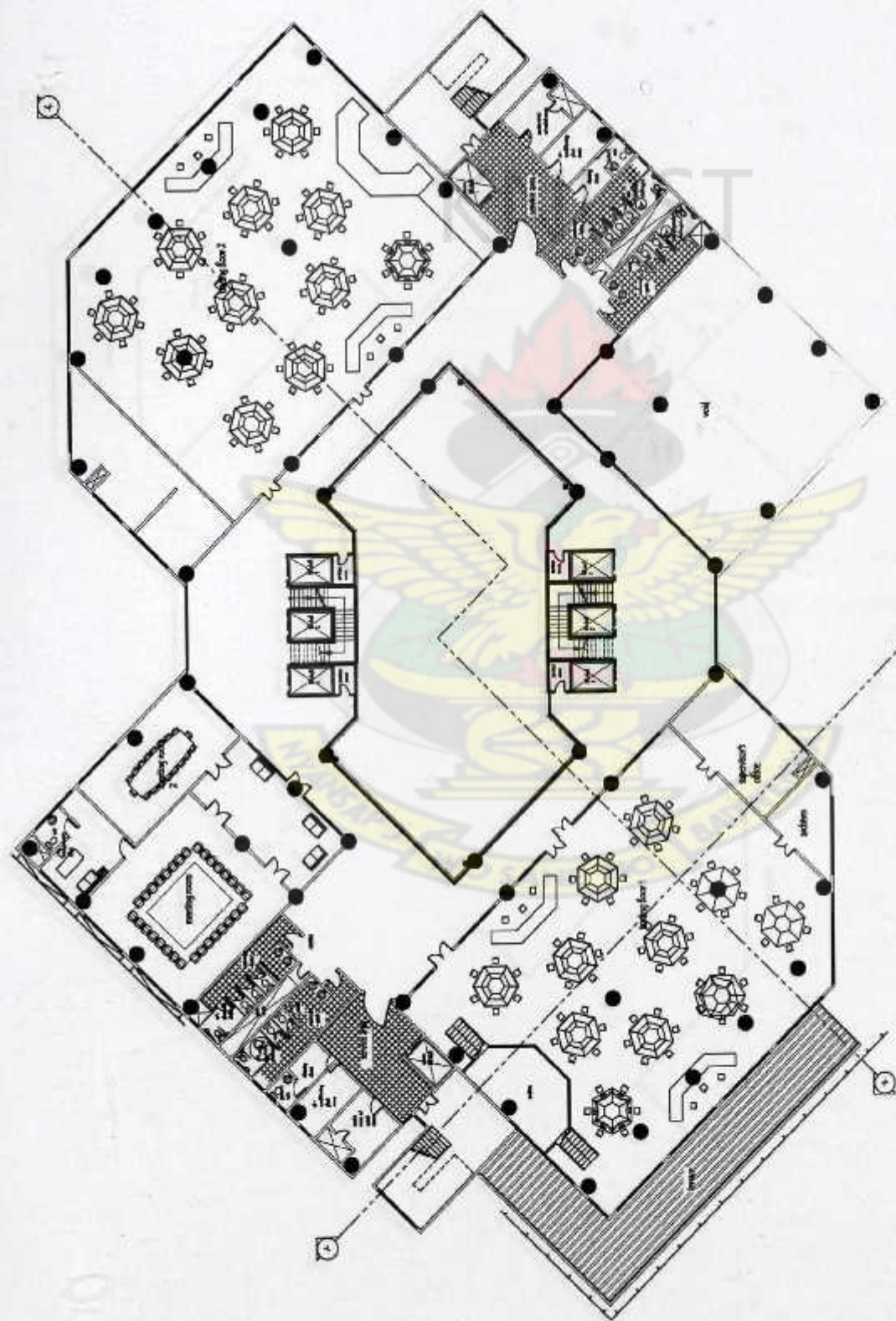


THIRD FLOOR PLAN



FOURTH FLOOR PLAN





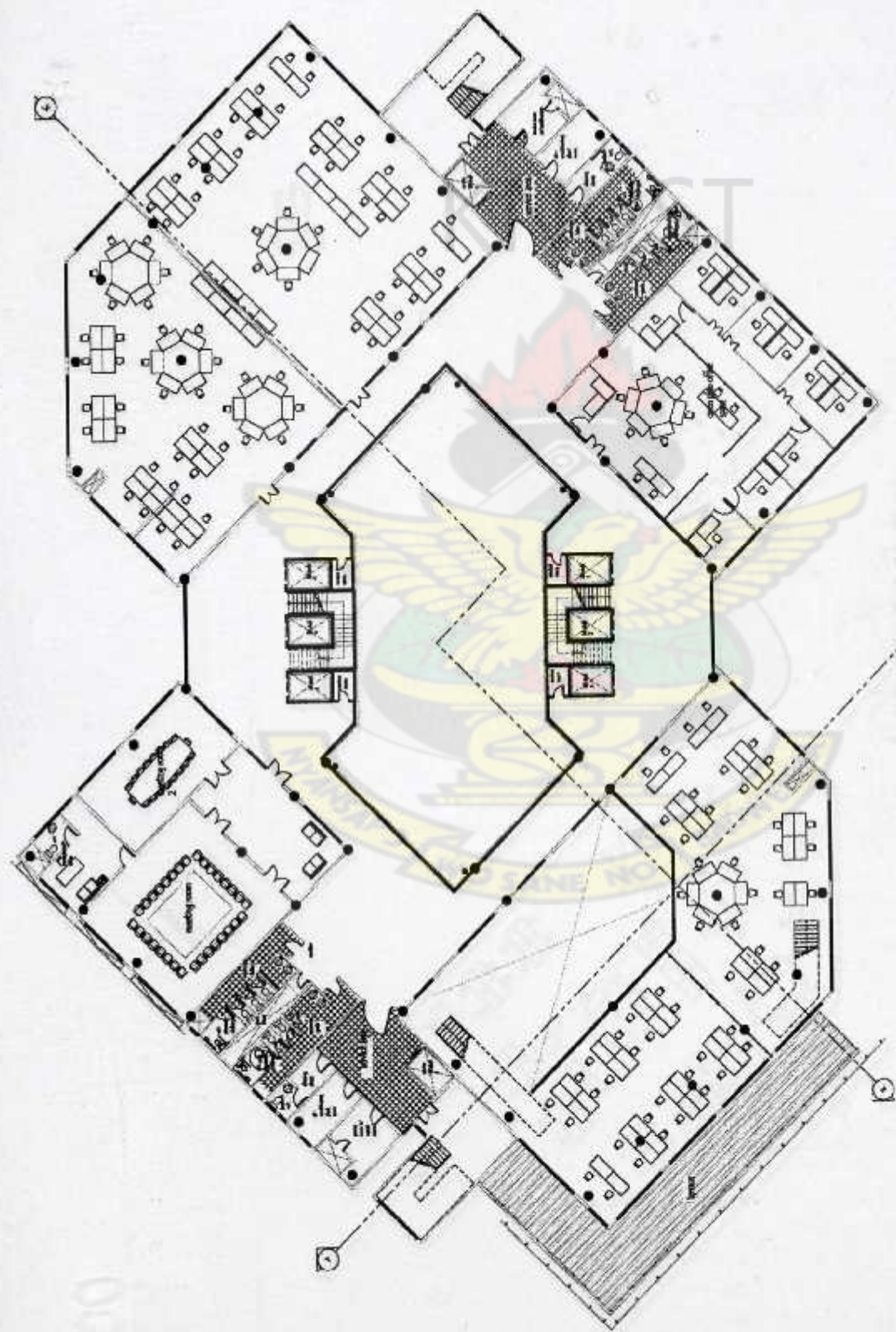
SIXTH FLOOR PLAN



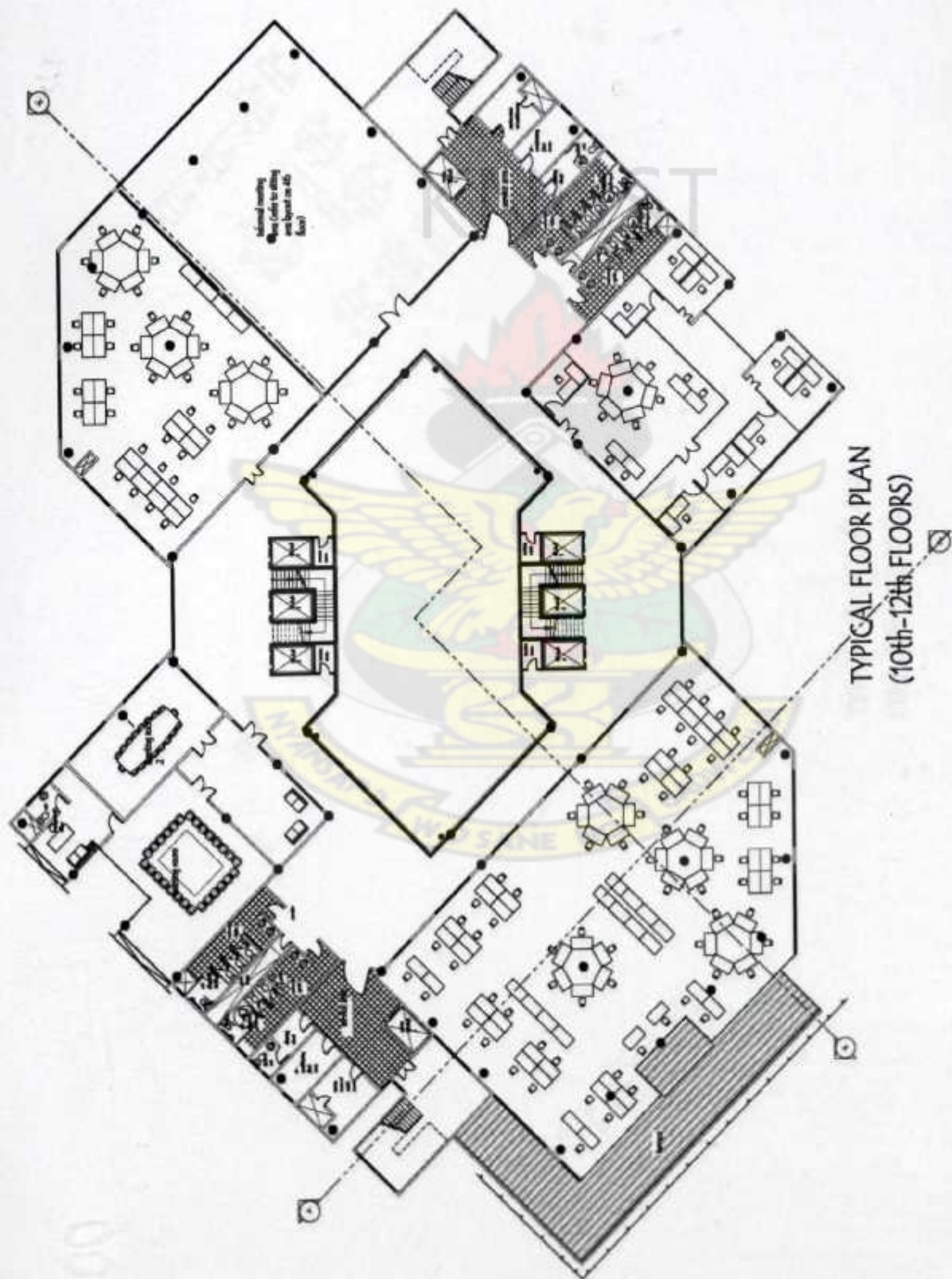
SEVENTH FLOOR PLAN

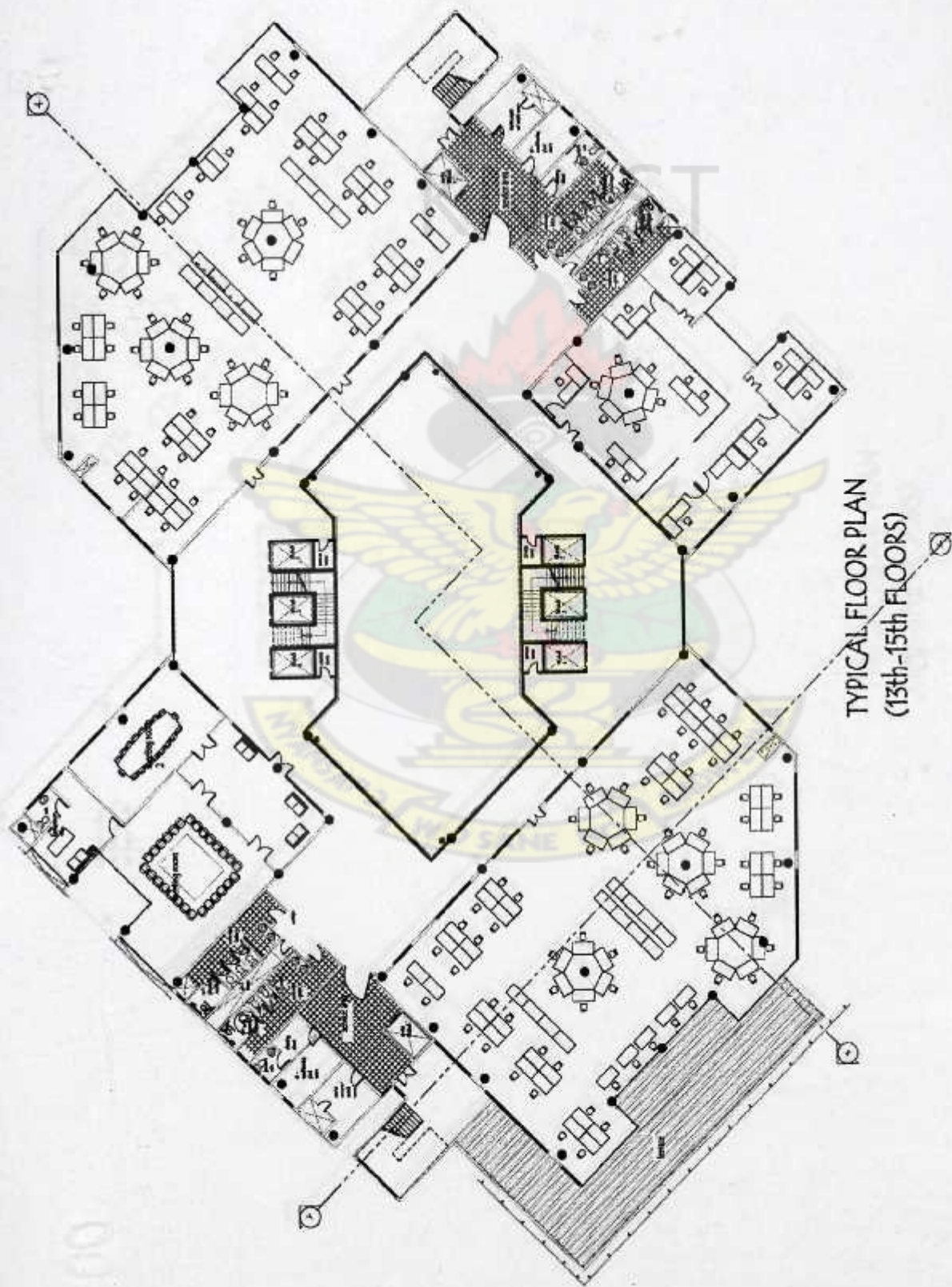


EIGHT FLOOR PLAN



NINTH FLOOR PLAN



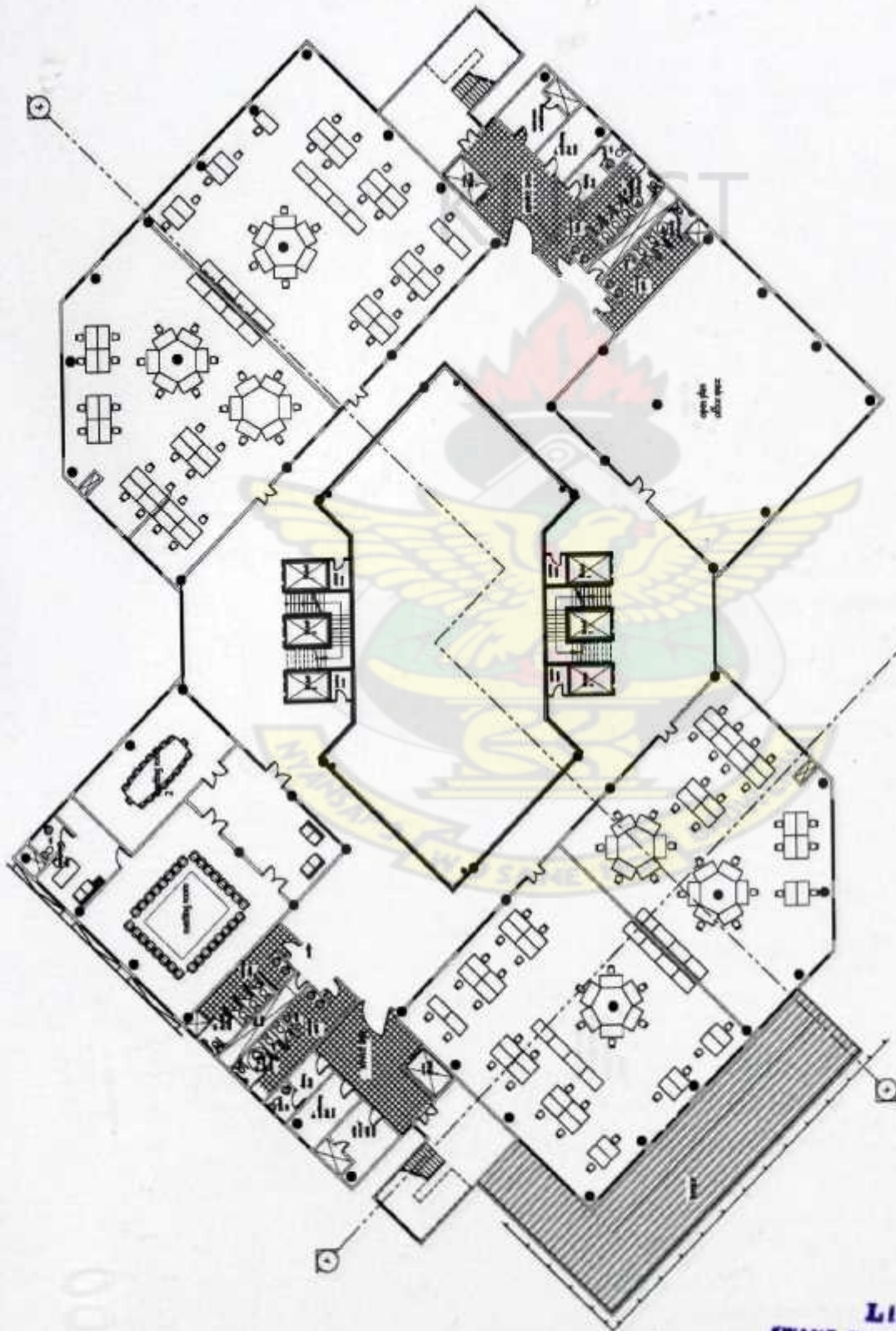




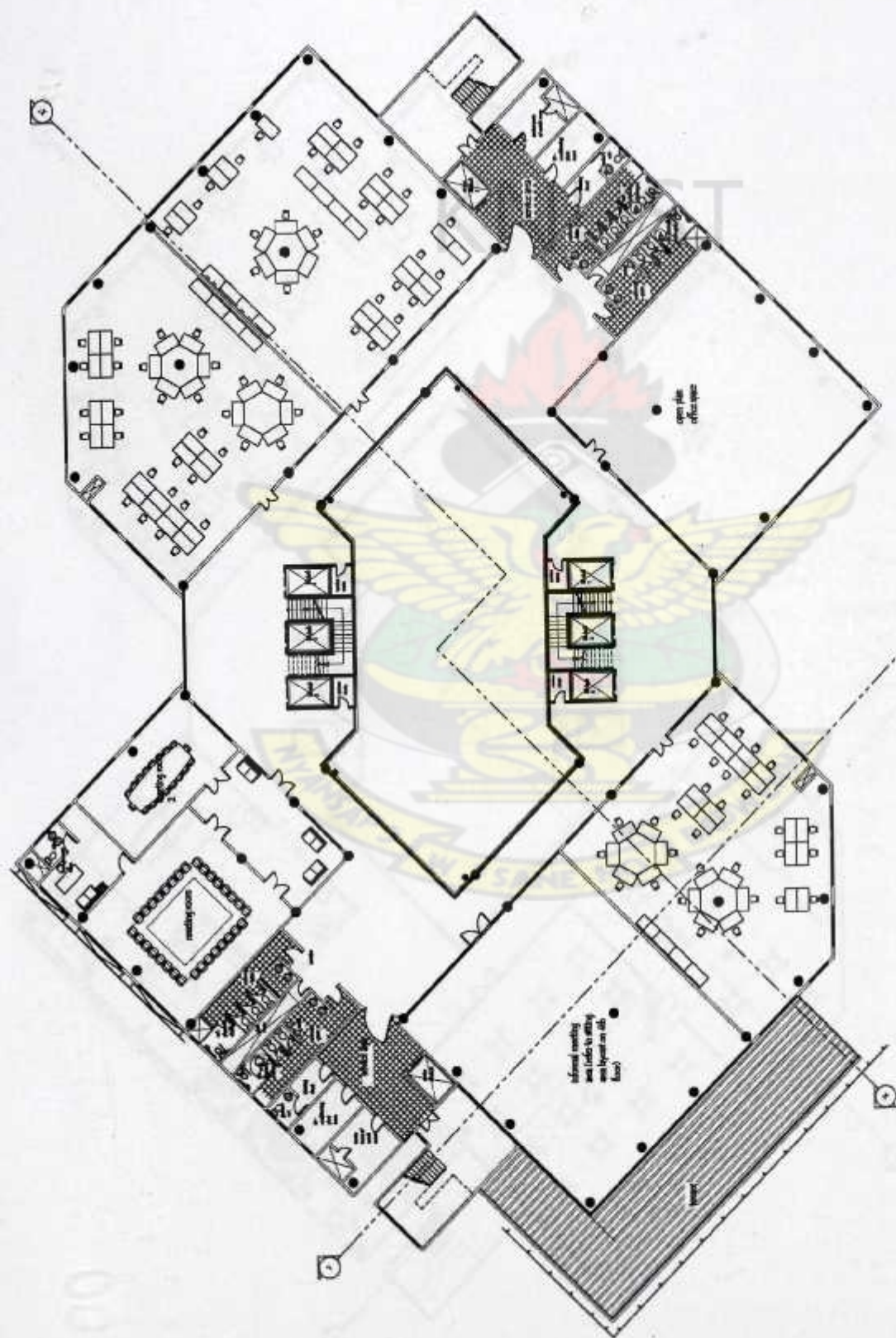
TYPICAL FLOOR PLAN
(16th-17th FLOORS)



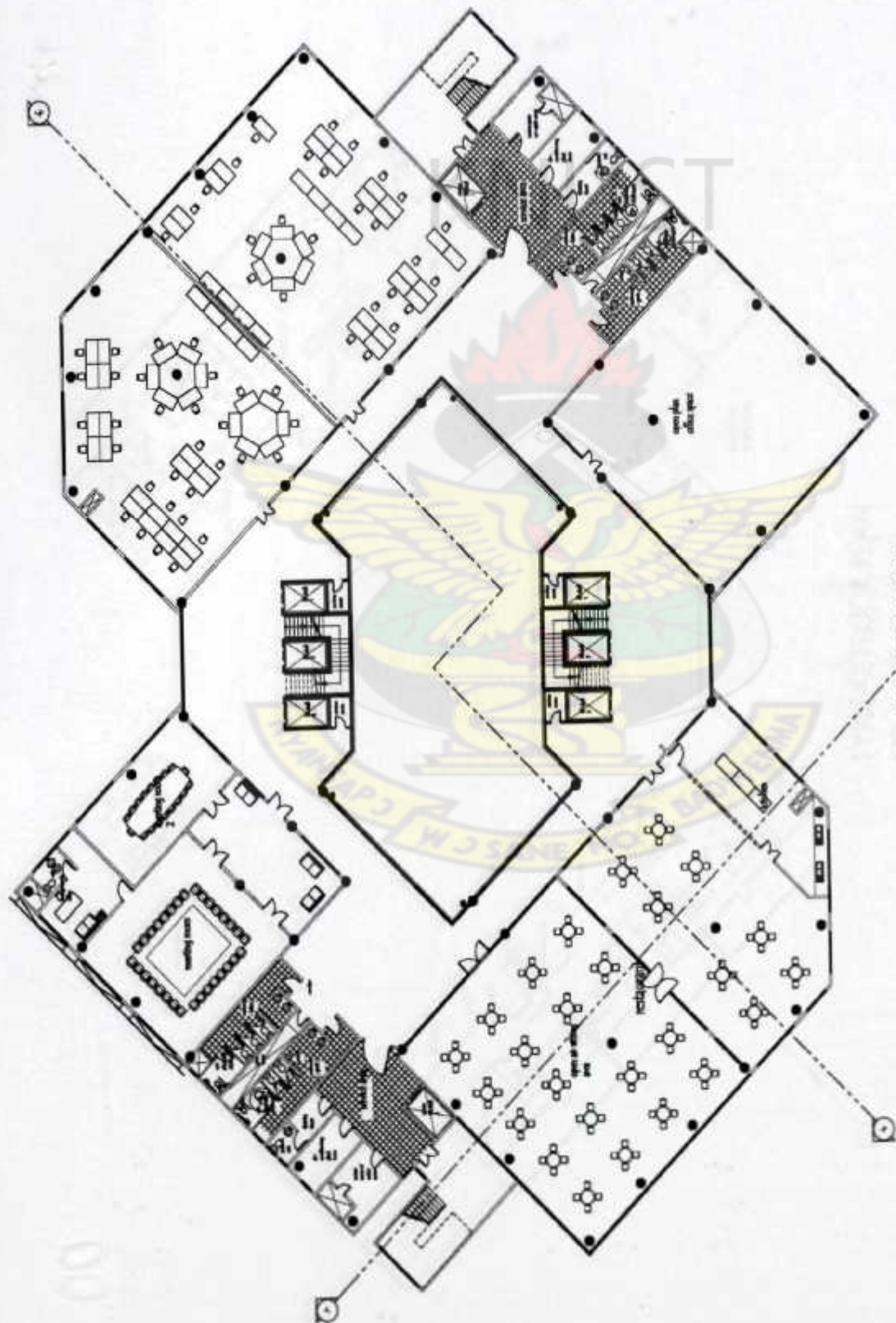
18th FLOOR PLAN



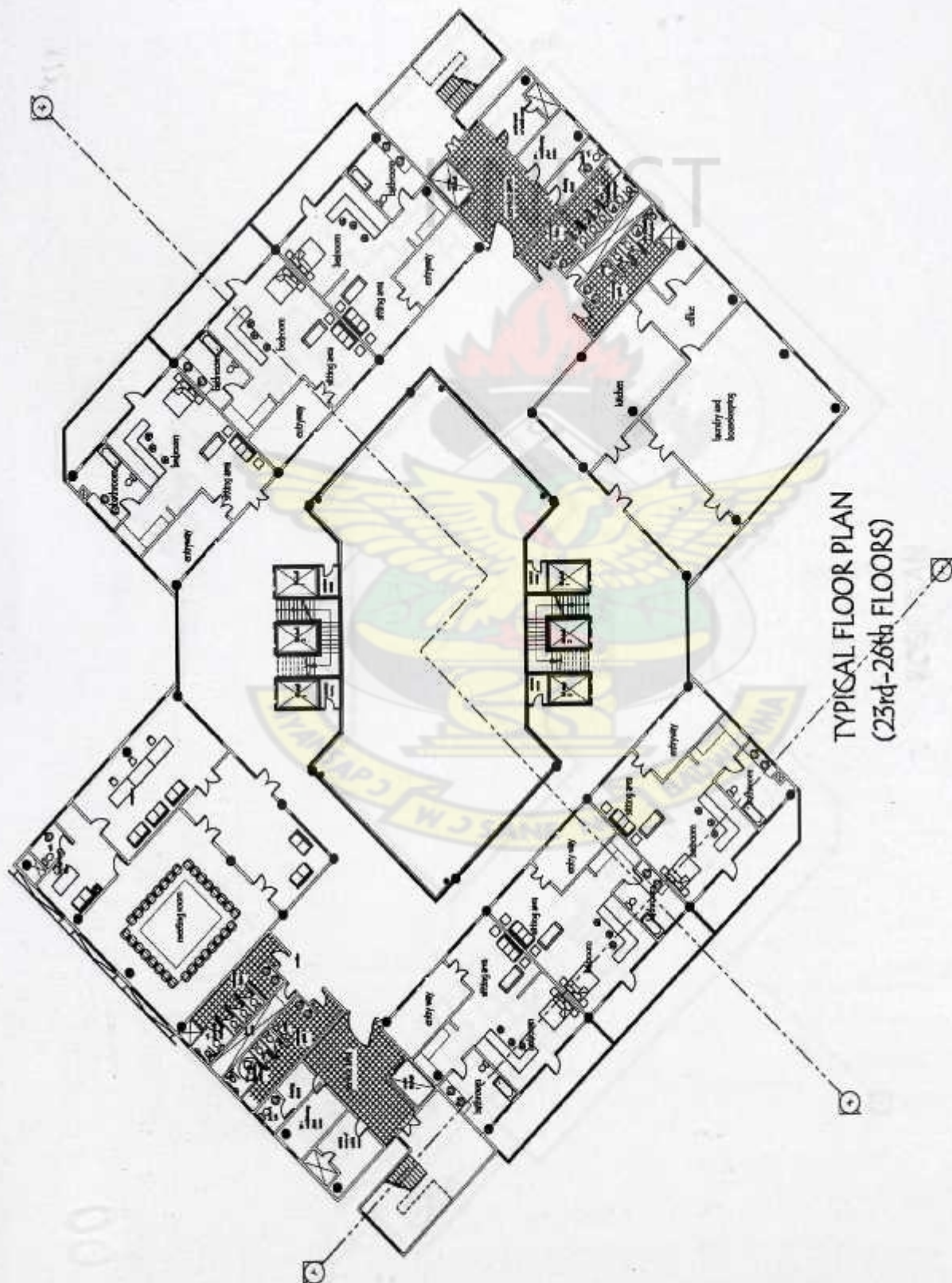
TYPICAL FLOOR PLAN
(19th-20th FLOORS)



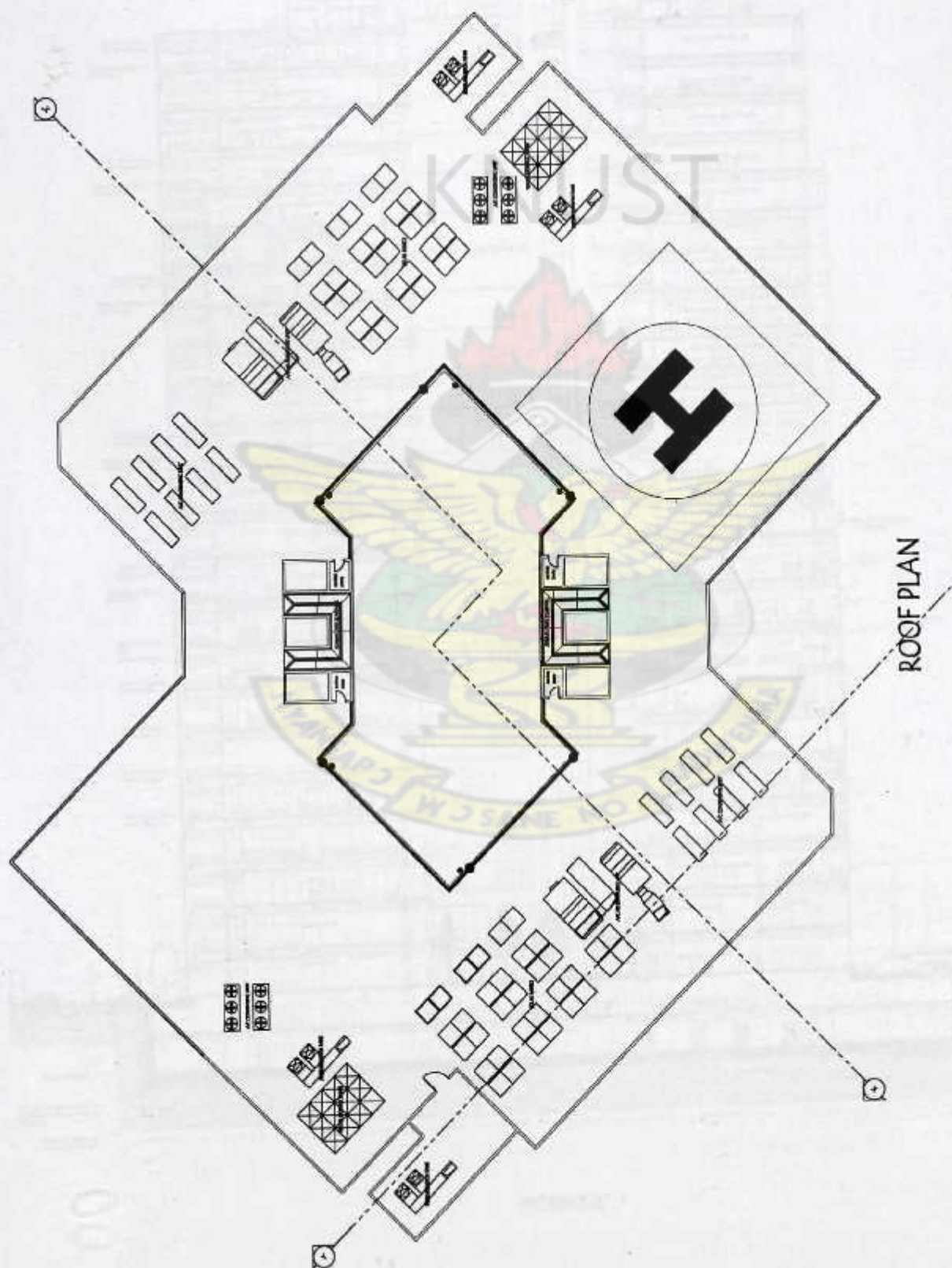
21st FLOOR PLAN



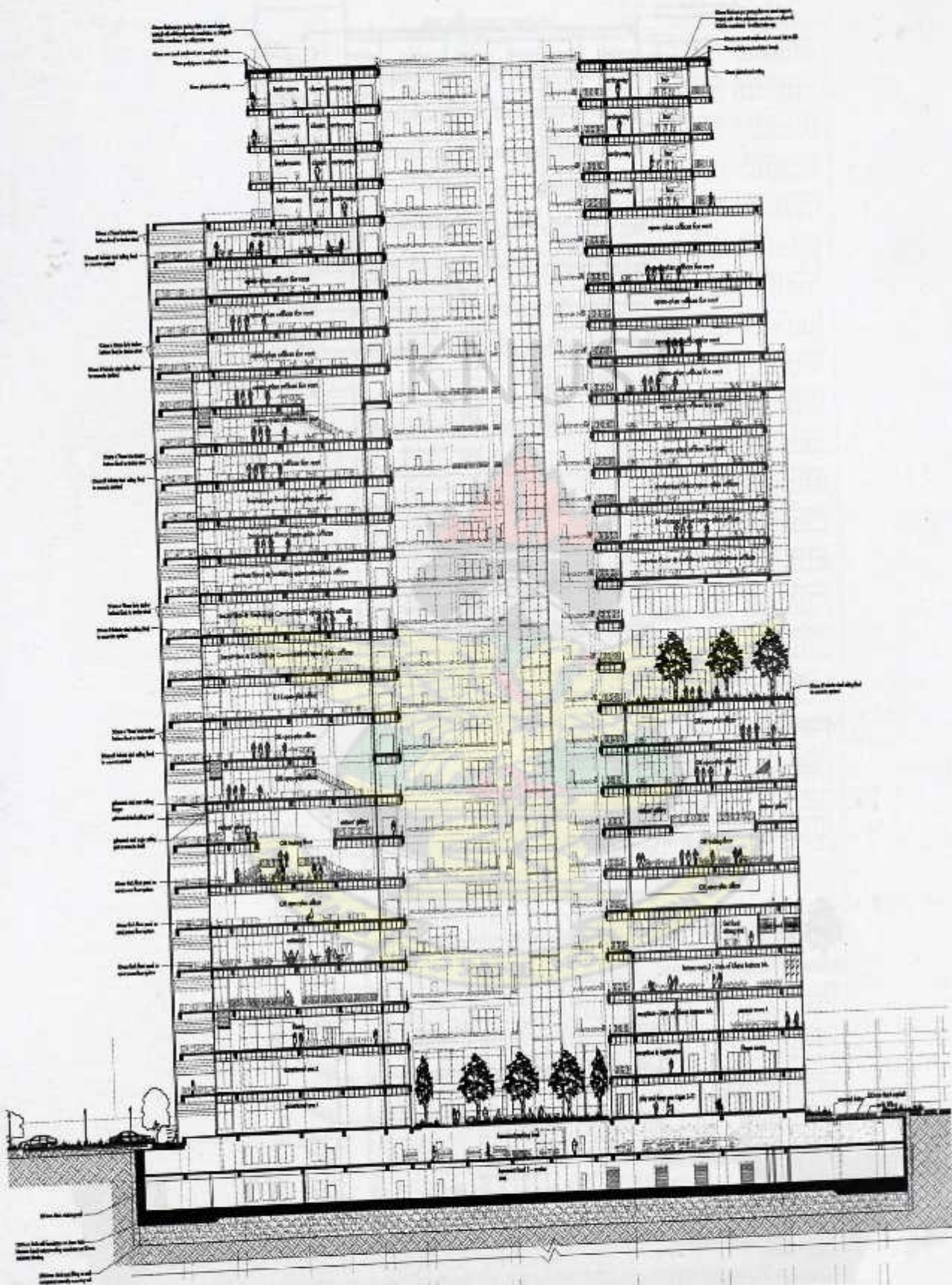
22nd FLOOR PLAN



TYPICAL FLOOR PLAN
(23rd-26th FLOORS)



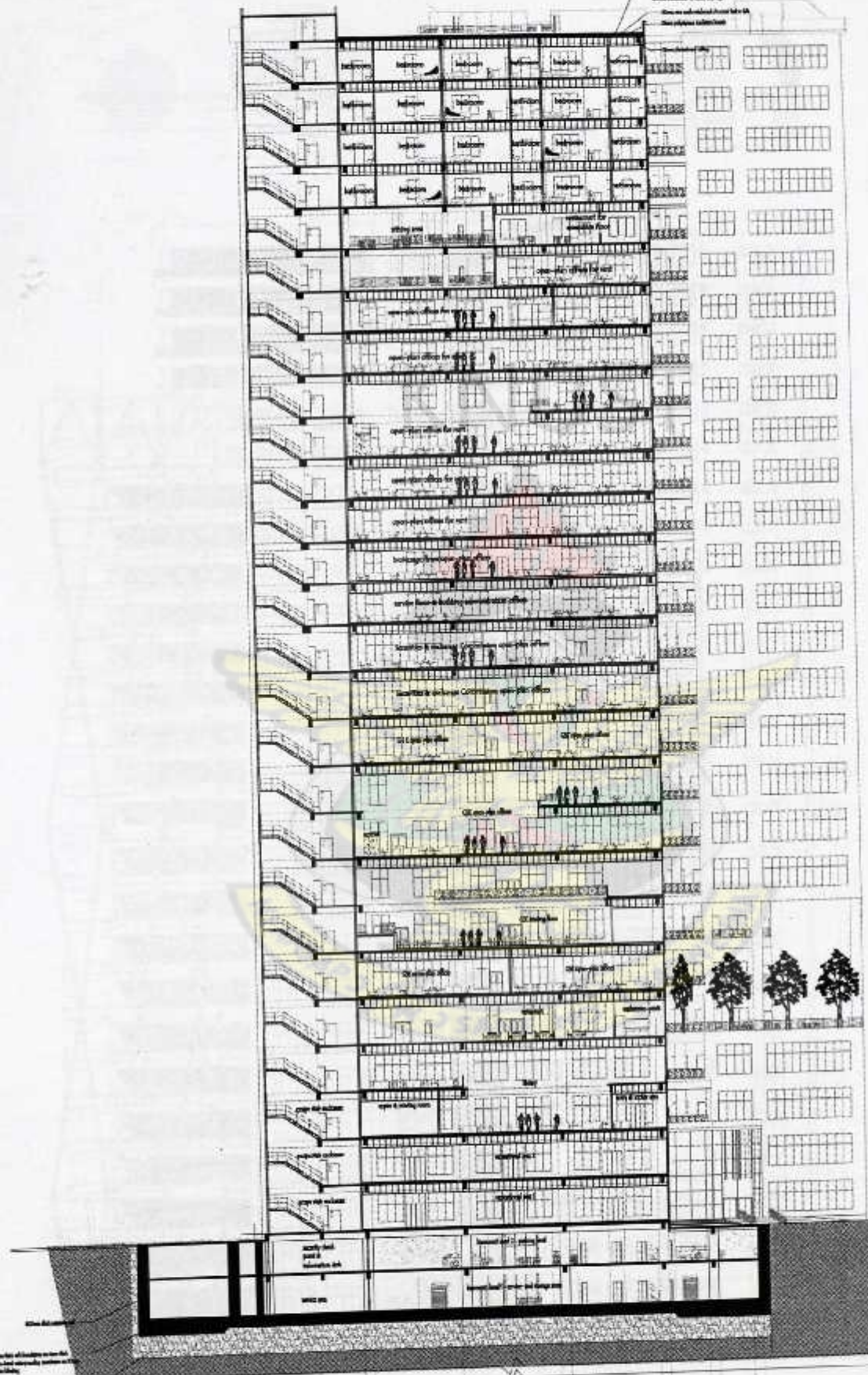
SECTIONS



SECTION X-X'

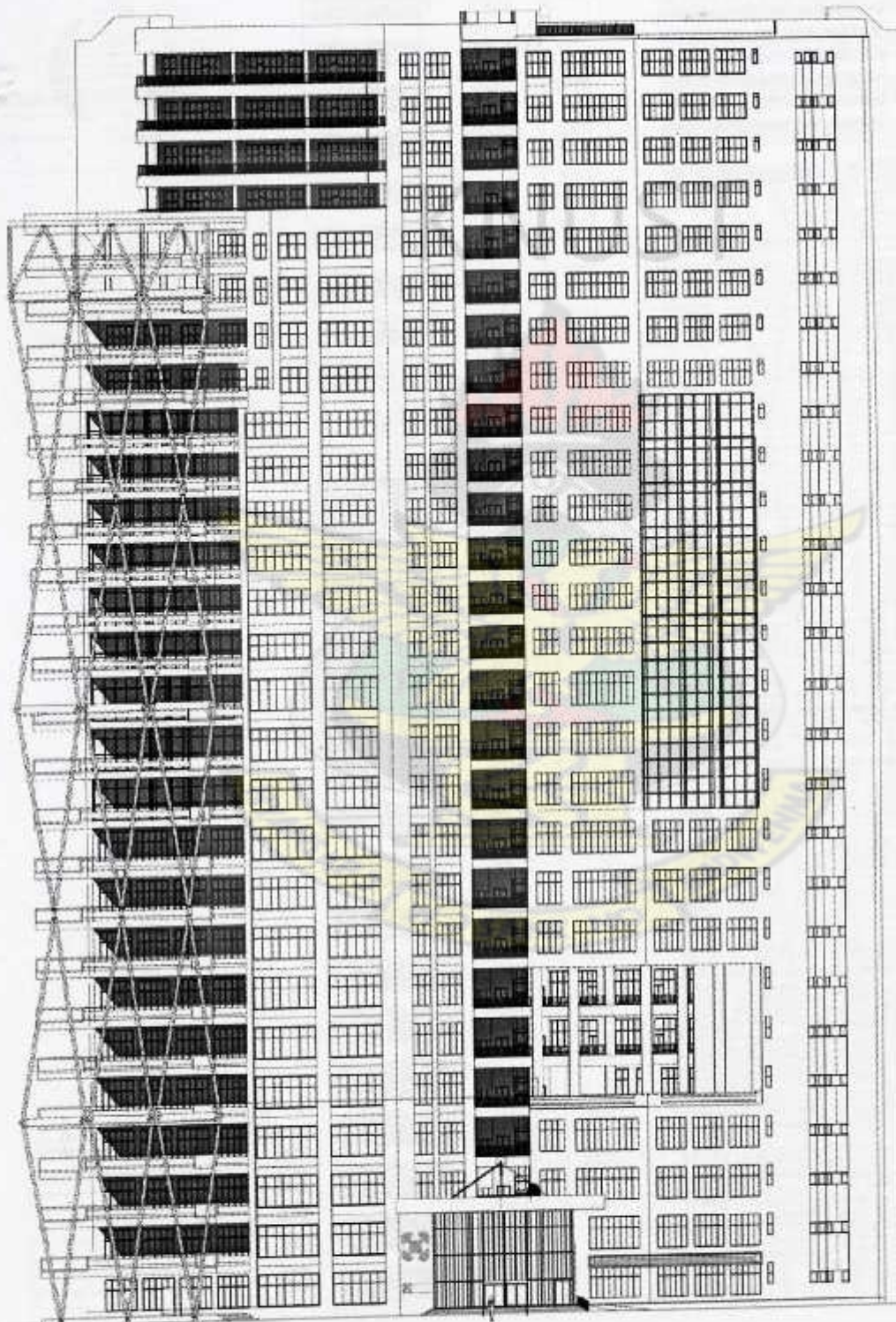
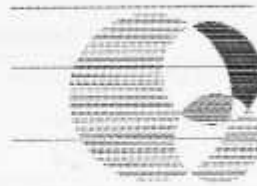
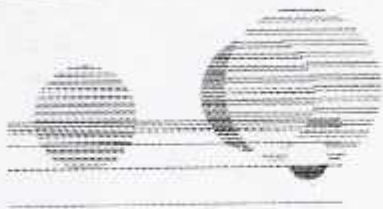
ELEVATIONS

How floors are numbered and spaces
How the building is divided into
How the building is divided into
How the building is divided into

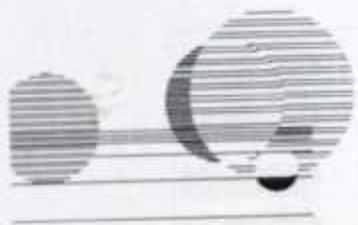


SECTION Y-Y'

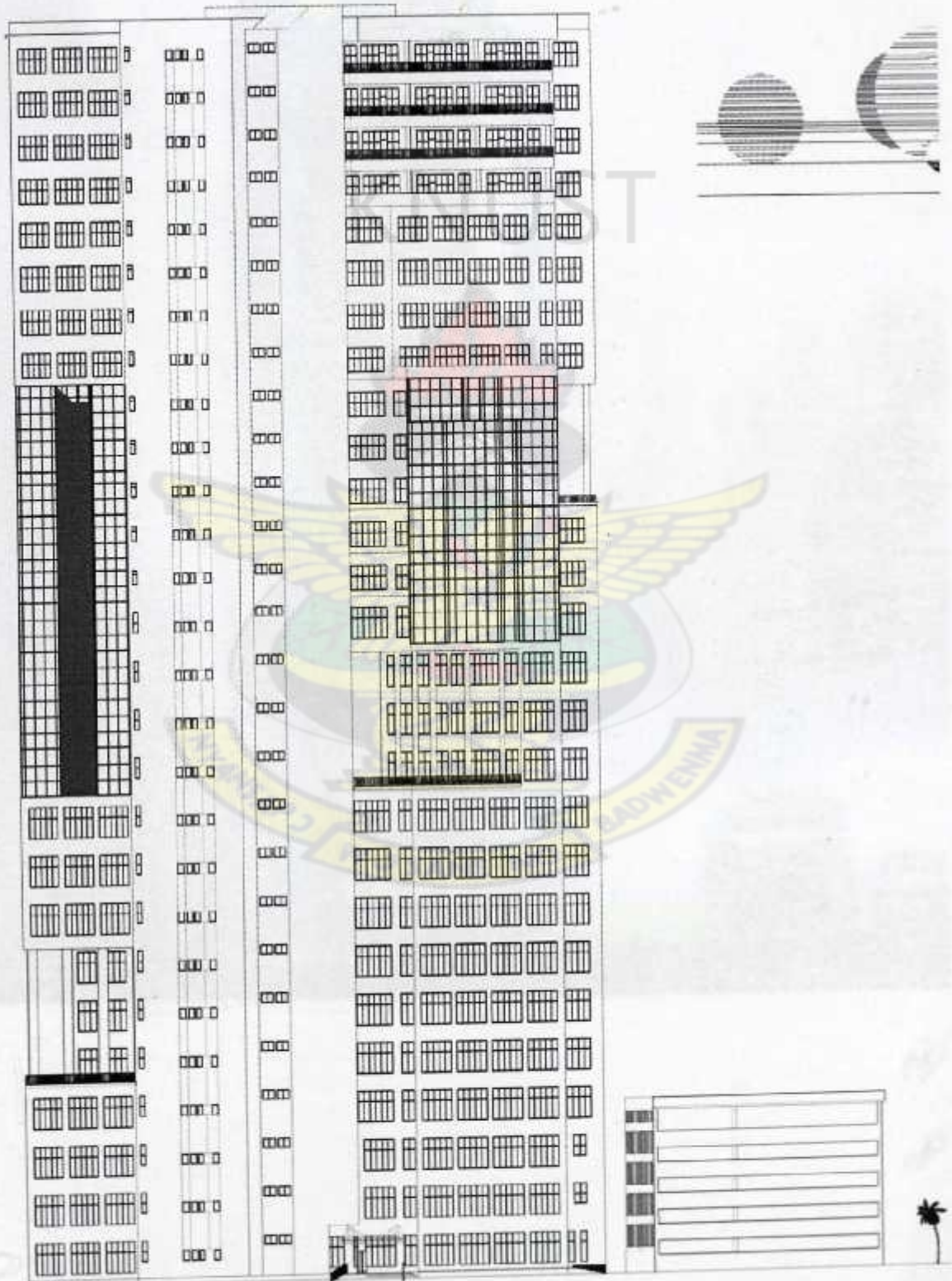
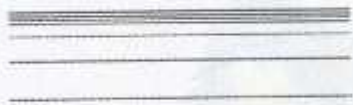
ELEVATIONS



SOUTH EAST ELEVATION



SOUTH WEST ELEVATION



NORTH EASTERN ELEVATION

A 3-DIMENSIONAL EXTERIOR IMPRESSION OF THE DESIGN



INTERIOR IMPRESSIONS OF THE RECEPTION AND COURTYARD AREAS



Main Reception



Courtyard(Aerial)



Courtyard

