KWA ME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

COLLEGE OF ARCHITECTURE AND PLANNING

FACULTY OF ARCHITECTURE AND BUILDING TECHNOLOGY

DEPARTMENT OF ARCHITECTURE

COMPUTER ASSEMBLY PLANT- TEMA

A THESIS REPORT SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE FACULTY OF ARCHITECTURE AND BUILDING TECHNOLOGY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF

POST GRADUATE DIPLOMA (PGDip) IN ARCHITECTURE DEGREE

BY

KWAME OFORI

May, 2009

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

DECLARATION

I, Kwame Ofori, hereby declare that, except for references made to other people's work which have been duly cited, this work is the result of my own original research and that this thesis has neither in whole or in part been presented for another degree elsewhere.

..... 22-09-09

KWAME OFORI Date

(Student)

KNUST

I declare, that this dissertation herein submitted was written under my supervision and I confirm that the student has my permission to present it for assessment.

Certified by:

..... 22ND SEPT. '09

MR. CHARLES ESSEL Date

(Supervisor)

Certified by:

....

PROF. G.W.K. INTSIFUL Date

(Head of Department)

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

DEDICATION

This thesis work is dedicated to my parents, Mr. and Mrs. Ofori, my siblings, Afua, Abena and Kwadwo for their inspiration, motivation and unwavering support.

KNUST

ACKNOWLEDGEMENT

I am most grateful to the Almighty God who protected and sustained me throughout this study. Without His grace this work would not have been a reality.

I also wish to express my gratitude to my supervisor, Mr. Essiel for taking pains to go through my work. I appreciate his constructive criticism, suggestions and the encouragement he offered me throughout my course of study.

My sincere thanks also go to other lecturers of the Architectural Department for their concern, advice and suggestions.

Again my profound gratitude goes to Arc. Tony Asare of Tekton Consults for his immense support.

Finally, to all who have contributed in one way or the other, before and during the compilation of this thesis.

ABSTRACT

Computers and ICT have changed the way people live and work. This global phenomenon has transformed the economies of many countries, increasing computer literacy rates or for that matter ICT knowledge base of a nation have proven to boost economic growth but this unfortunately is not the case for many developing countries such Ghana which has a low Computer literacy rate. Accordingly there is the need for improved computer literacy rate.

The main objective of this thesis project is to document and design a Computer Assembly plant which would produce affordable computers in Ghana for both the Ghanaian and West African markets. This Assembly plant would not only cater for the just the assembly of computers but also IT training and job creation for the youth.

The Computer Assembly plant would make use of the serial assembly process which is more commonly known as an assembly line where the process is broken into individual steps, and completed by different assemblers in a specific sequence. The Computer Assembly plant would not only have a factory for assembling computers but also other facilities such as a Training centre, a Research lab and an After-sales servicing centre all in the quest to develop the ICT knowledge base of the country.

Having Computer Assembly plants would help in the realization of the economic and technological advancement of Ghana through making of computers affordable and also easily available and accessible to the people thereby increasing the computer literacy rate.

TABLE OF CONTENTS

TITLE *PAGE*

Declaration.....i

Dedication.....ii

Acknowledgement.....iii

Abstract.....iv

Table of content.....v

List of figures.....xii

CHAPTER ONE: INTRODUCTION

1.0 Preamble.....1

1.1Problem Statement and Justification.....2

1.2 Objective.....3

1.3 Scope.....3

1.4 Target Groups.....4

1.5 Clients.....4

1.6 Sources of Finance.....4

1.7 Clients Brief.....4

1.8 Location.....5

1.9 Methodology.....5

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

TITLE *PAGE*

CHAPTER TWO: LITERATURE REVIEW

2.0 Overview.....6

2.1 History of Computers.....6

2.2 Types of Computers.....9

2.2.1 Analogue computers.....9

2.2.2 Digital computers.....10

2.2.3 Types of digital computers.....11

2.3 Computer Hardware.....14

2.3.1 Central Processing Unit.....14

2.3.2 Case.....14

2.3.3 Power supply.....15

2.3.4 Motherboard.....16

2.3.5 RAM.....17

2.3.6 Floppy Disk Drive.....17

2.3.7 Hard drive.....18

2.3.8 Cd rom.....18

2.3.9 Peripherals.....18

2.3.9.1 Display device.....18

TITLE *PAGE*

2.3.9.2 Speakers.....19

2.3.9.3 Mouse.....19

2.3.9.4 Keyboard.....19

2.4 How to Assemble and Build A PC.....20

2.5 Use of computers.....27

2.6 The Assembly Process.....28

2.6.1 Parallel Assembly.....29

2.6.2 Serial Assembly.....29

REFERENCES 30

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Overview.....31

3.1 Methods used in data collection.....31

3.1.1 Interviews.....32

3.1.2 Personal observation.....32

3.1.3 Case studies.....32

3.1.4 Archival research.....32

TITLE *PAGE*

CHAPTER FOUR: FINDINGS AND DISCUSSIONS

4.0 Overview.....33

4.1 Case Study I: Omatek Computers (Ghana) Limited.....33

4.2 Activities in Omatek.....34

4.3 Specification.....36

4.3.1 Spatial Organization.....36

4.3.2 Services.....37

4.3.3 Security.....38

4.4 Lessons from the Study.....38

4.4.1 Merits.....38

4.4.2 Demerits.....39

4.5 Case Study II: Dell Assembly Plant Penang (Malaysia).....39

4.6 Specification.....40

4.6.1 The Structure.....40

4.6.2 Parking.....41

4.6.3 Services.....42

4.7 Lessons from the study.....43

4.7.1 Merits.....43

4.7.2 Demerits.....43

TITLE *PAGE*

4.8 Technical Studies.....47

4.8.1 Environmental control.....47

4.8.2 Electricity.....48

4.8.3 Lighting.....48

4.8.4 Fire Control.....48

4.8.5 Security.....49

4.9 Special Studies.....49

4.9.1 Photo Voltaic Power Generation.....49

4.9.2 Atrium Designs.....51

4.9.3 Conveyors.....53

4.9.3.1Types of Conveyor.....54

4.10 Site Selection Criteria.....57

4.11 Site Location.....57

4.12 Site inventory and analysis.....58

4.13 Vegetation.....59

4.14 Geology.....59

4.15Topography.....60

4.16 Site climate.....61

4.17 Peripheral studies.....63

TITLE *PAGE*

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.0 Design evolution.....66

5.1 Developed brief.....66

5.2 Accommodation Schedule.....67

5.3 Philosophy and concept.....71

5.4 General Functional Relationship.....73

5.5 Conceptual Site Planning.....74

5.6 Zoning.....76

5.7 The design.....79

5.8 Services.....81

5.8.1 Electricity.....81

5.8.2 Information and Communication systems.....83

5.8.3 Lighting.....83

5.8.4 Ventilation.....84

5.8.5 Fire protection.....85

5.8.6 Water.....85

5.8.7 Security monitoring.....86

5.8.8 Waste Disposal.....86

5.8.9 Drainage.....87

TITLE *PAGE*

5.9 Construction Technology.....87

5.9.1 Structural system.....88

5.10 Cost Estimates.....88

5.11 Conclusions.....89

BIBLIOGRAPHY.....91

APPENDIX (Architectural Drawings).....92

KNUST

LIST OF FIGURES

Fig 2.1: Installing a CPU

Fig 2.2: Installing the heat sink

Fig 2.3: Installing the RAM

Fig 2.4: Installing the power supply

Fig 2.5: Installing the video card

Fig 2.6: Installing the hard drive

Fig 2.7: SATA cable

Fig 2.8: Installing optical drive.

Fig 2.8: Installing optical drive.

Fig 2.9: Connecting various port cables

Fig 4.1: Frontage of Omatek Ghana Limited

Fig 4.2: Some products of Omatek

Fig 4.3: Spatial relationship/organization of the factory

Fig 4.4: Storage racks for storing components

Fig 4.5: Workers in testing area

Fig 4.6: Workers assembling system units

KNUST

Fig 4.7: Shows ongoing computer assembling process

Fig 4.8: Layout of the factory

Fig 4.9: Front view of Dell assembly plant (Penang)

Fig 4.10: Entrance gate to Dell plant

Fig 4.11: View of the showroom

Figure 4.12: Workers undergoing training

Fig 4.13: View showing production hall

Fig 4.14: Testing/Installation area

Fig 4.15: Control centre; this also serves as a customer service centre

Fig 4.16: Packaging Materials

Fig 4.17: Hot/Wet

Fig4.18: Warm dry

Fig 4.19: Belt conveyor

Fig 4.20: Roller conveyor

Fig 4.21: Map of selected site

Fig 4.22: View of area from above

Fig 4.23: Picture showing vegetation on site

KNUST

Fig 4.24: A representation of site conditions and analysis

Fig 4.25: Section through the site

Fig 4.26: Temperature chart for the year 2008

Fig 4.27: Chart showing average relative humidity levels for the year 2008

Fig 4.28: Chart showing annual total rainfall between 200mm and 18000mm

Fig 4.29: The land is bounded to the north western periphery by the Accra-Aflao road

Fig 4.30: The main entrance to the Tema Export Processing Zone

Fig 4.31: To the south eastern periphery of site is a textile producing factory.

Fig 4.32: Water storage tank also located to the south eastern portion of the site

Fig 4.33: To the south western periphery of land is a cocoa processing factory

Fig 5.1: Initial Site planning (zoning)

Fig 5.2: Initial site planning

Fig 5.3: Initial Option A

Fig 5.4: Option B

Fig 5.5: 3D initial sketches

Fig 5.6: 2D Initial sketches

CHAPTER ONE

INTRODUCTION

1.0 PREAMBLE

Information and communication technology (ICT) has transformed many economies and lives the world over, resulting in the world becoming a global village. Since the early 1990s, ICT applications and systems have become a critical means of achieving both social and economic development in many nations. The positive economic feedback generated by most ICT innovations has stimulated many global economies.

It is in this view that the government of Ghana has invited ICT companies worldwide to invest in Ghana as the Government is providing the requisite impetus by producing vibrant ICT policies and strategies for the country. The policy is aimed at ensuring that ICT capabilities are harnessed, replicated, and adapted in both formal and informal setups to help boost the economy of Ghana and the continent of Africa as a whole.

ICT systems such as computers have revolutionized the relationship between economic production and technological advancement, becoming a critical learning and economic productivity tool for consumers and industry alike.

Given the economic and technological challenges that awaits Ghana and the rest of Africa, having a computer assembly plant would help in the realization of the economic and technological advancement of Ghana through making of computers affordable and also increase the computer literacy rate.

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

1.1 PROBLEM STATEMENT AND JUSTIFICATION

The Government of Ghana having realized the important role that Information and communication Technology play in the socio-economic development of its nation has responsively launched the National ICT Policy and Plan. These measures are not only aimed at fostering technological growth but also job creation and employment of the youth.

Furthermore, having a computer assembly plant in Ghana will help make computers affordable thereby making them available to all.

This thesis work seeks to propose a design scheme for a Computer Assembly plant to be located in Tema. This proposed facility will cater not only for the Assembly of computers but also the aftersales servicing of the computers and training of the all who wish to become pc literate and learn more about computers; all in the quest for the socio-economic development of the country through Information and Communication Technology.

1.2 OBJECTIVES

The general objective of this project is:

- To come out with a proposed design scheme to cater for assembly and after-sales servicing of computers with the aim of producing affordable computers in Ghana and across the West African sub-region.

The specific objectives of this project are:

- To conduct research into computers and associated technology in the IT industry
- To help improve upon the socio-economic well-being of the people by assembling computers which are affordable to all.
- To help bridge the gap between people with effective access to digital and information technology and those without access.

1.3 SCOPE

- The various technicalities associated with the provision of Information and Communication Technology.
- Design an assembly plant complete with

1. Production unit
2. Welfare unit
3. Maintenance unit
4. Training centre
5. Aftersales service center
6. Administration
7. Security post

1.4 TARGET GROUPS

The target groups for this facility are all categories of people across Ghana and the West African sub-region.

1.5 CLIENT

The client for the project is Dell Inc. As part of its mission to expand its market base in Africa

KNUST

1.6 SOURCE OF FINANCE

- The project will be financed by the Dell Inc.

1.7 CLIENT'S BRIEF

The clients developed their brief after observation from other already existing facilities that have been developed in the country. They mentioned

- Offices
- Workshops
- Laboratories
- Computer laboratories
- IT / digital library
- Canteen
- Reception
- Car park
- Store rooms

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

- Exhibition hall/Sales Outlet
- First Aid Room
- Training Centre

1.8 LOCATION

The Computer Assembly plant would be located in the Export Processing Zone in Tema in the Greater-Accra region of Ghana.

KNUST

1.9 METHODOLOGY

The methodology to be employed can be identified in six main areas as;

Survey and Data collection - this will involve the collection of all relevant data, that is general reading and subject matter, discussions, visual surveys and pictures taking, collection of statistical data and measured drawings,

Analysis and synthesis - this includes the probing of data collected with respect to the site, activities/operations, technical and statistical dimensions and the co-ordination of the analyzed data.

CHAPTER TWO

LITERATURE REVIEW

2.0 OVERVIEW

A computer can be described as a device for processing, storing, and displaying information. Computer once meant a person who did computations, but now the term almost universally refers to automated electronic machinery.

2.1 HISTORY OF COMPUTERS

The first adding machine a precursor of the digital computer was devised in 1642 by the French Scientist, Mathematician, and Philosopher, Blaise Pascal. This device called the Abacus employed a series of ten tooled wheels, each tooth representing a digit from 0 to 9. The wheels were connected so that numbers could be added to each other by advancing the wheels by a correct number of teeth.

Also in the 19the Century, the British Mathematician and inventor Charles Babbage worked out the principles of the modern digital computer. He conceived a number of machines, such as the Difference Engine, that were designed to handle complicated mathematical problems. Many historians consider Babbage and his associate the true pioneers of the modern digital computer. One of Babbage's designs, the Analytical Engine, had many features of a modern computer- "a store" for saving data, a "mill" for arithmetic operations and a printer that made a permanent record. Babbage however failed to put this idea into practice, though it may well have been technically possible at that date.

Modern computing can probably be traced back to the 'Harvard Mk I' and Colossus (both of 1943). Colossus was an electronic computer built in Britain at the end 1943 and designed to crack the German coding system - Lorenz cipher. The 'Harvard Mk I' was a more general purpose electro-mechanical programmable computer built at Harvard University with backing from IBM. These computers were among the first of the 'first generation' computers.

First generation computers were normally based around wired circuits containing vacuum valves and used punched cards as the main (non-volatile) storage medium. Another general purpose computer of this era was 'ENIAC' (Electronic Numerical Integrator and Computer) which was completed in 1946. It was typical of first generation computers, it weighed 30 tonnes, contained 18,000 electronic valves and consumed around 25KW of electrical power. It was, however, capable of an amazing 100,000 calculations a second.

The next major step in the history of computing was the invention of the transistor in 1947. This replaced the inefficient valves with a much smaller and more reliable component. Transistorized computers are normally referred to as 'Second Generation' and dominated the late 1950s and early 1960s. Despite using transistors and printed circuits these computers were still bulky and strictly the domain of Universities and governments.

The explosion in the use of computers began with 'Third Generation' computers. These relied on Jack St. Claire Kilby's invention - the integrated circuit or microchip. The first integrated circuit was produced in September 1958 but computers using them didn't begin

to appear until 1963. While large 'mainframes' such as the I.B.M. 360 increased storage and processing capabilities further, the integrated circuit allowed the development of Minicomputers that began to bring computing into many smaller businesses. Large scale integration of circuits led to the development of very small processing units, an early example of this is the processor used for analyzing flight data in the US Navy's F14A `TomCat' fighter jet. This processor was developed by

Steve Geller, Ray Holt and a team from Air Research and American Microsystems.

On November 15, 1971, Intel released the world's first commercial microprocessor, the 4004. Fourth generation computers developed, using a microprocessor to locate much of the computer's processing abilities on a single (small) chip. Coupled with one of Intel's inventions - the RAM chip (Kilobits of memory on a single chip) - the microprocessor allowed fourth generation computers to be even smaller and faster than ever before. The 4004 was only capable of 60,000 instructions per second, but later processors (such as the 8086 that all of Intel's processors for the IBM PC and compatibles is based) brought ever increasing speed and power to the computers. Supercomputers of the era were immensely powerful, like the Cray-1 which could calculate 150 million floating point operations per second. The microprocessor allowed the development of microcomputers, personal computers that were small and cheap enough to be available to ordinary people. The first such personal computer was the MITS Altair 8800, released at the end of 1974, but it was followed by computers such as the Apple I & II, Commodore PET and eventually the original IBM PC in 1981.

Although processing power and storage capacities have increased beyond all recognition since the 1970s, the underlying technology of LSI (large scale integration) or VLSI (very large scale integration) microchips has remained basically the same, so it is widely regarded that most of today's computers still belong to the fourth generation.

2.2 TYPES OF COMPUTERS

Two main types of computers are in use today, analogue and digital. Analogue Computers exploit the mathematical similarity between physical interrelationships in certain problems, and employ electronic or hydraulic circuits to stimulate the physical problem.

Digital computers solve problems by performing calculations and by dealing with each other digit after digit.

Installations that posses elements of both digital and analogue computers are called hybrid computers. They are usually used for problems in which large numbers of complex equations known as time integrals are to be computed. Data in analogue form can also be fed into a digital computer by means of an analogue-to digital converter.

2.2.1 ANALOGUE COMPUTERS

Analog computers use continuous physical magnitudes to represent quantitative information. At first they represented quantities with mechanical components but after World War II voltages were used; by the 1960s digital computers had largely replaced them. Nonetheless, analog computers, and some hybrid digital-analog systems, continued in use through the 1960s in tasks such as aircraft and spaceflight simulation.

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

One advantage of analog computation is that it may be relatively simple to design and build an analog computer to solve a single problem. Another advantage is that analog computers can frequently represent and solve a problem in "real time"; that is, the computation proceeds at the same rate as the system being modeled by it. Their main disadvantages are that analog representations are limited in precision—typically a few decimal places but fewer in complex mechanisms—and general-purpose devices are expensive and not easily programmed.

2.2.2 DIGITAL COMPUTERS

KNUST

In contrast to analog computers, digital computers represent information in discrete form, generally as sequences of 0s and 1s (binary digits, or bits). The modern era of digital computers began in the late 1930s and early 1940s in the United States, Britain, and Germany. The first devices used switches operated by electromagnets (relays). Their programs were stored on punched paper tape or cards, and they had limited internal data storage.

2.2.3 TYPES OF DIGITAL COMPUTERS

Main frame computers

During the 1950s and '60s, Unisys (maker of the UNIVAC computer), International Business Machines Corporation (IBM), and other companies made large, expensive computers of increasing power. They were used by major corporations and government research laboratories, typically as the sole computer in the organization. In 1959 the IBM 1401 computer rented for $8,000 per month (early IBM machines were almost always

leased rather than sold), and in 1964 the largest IBM S/360 computer cost several million dollars.

These computers came to be called mainframes, though the term did not become common until smaller computers were built. Mainframe computers were characterized by having (for their time) large storage capabilities, fast components, and powerful computational abilities. They were highly reliable, and, because they frequently served vital needs in an organization, they were sometimes designed with redundant components that let them survive partial failures. Because they were complex systems, they were operated by a staff of systems programmers, who alone had access to the computer. Other users submitted "batch jobs" to be run one at a time on the mainframe.

Such systems remain important today, though they are no longer the sole, or even primary, central computing resource of an organization, which will typically have hundreds or thousands of personal computers (PCs). Mainframes now provide high-capacity data storage for Internet servers, or, through time-sharing techniques, they allow hundreds or thousands of users to run programs simultaneously. Because of their current roles, these computers are now called servers rather than mainframes.

Super computer

The most powerful computers of the day have typically been called supercomputers. They have historically been very expensive and their use limited to high-priority computations for government-sponsored research, such as nuclear simulations and weather modeling. Today many of the computational techniques of early supercomputers are in common use in PCs. On the other hand, the design of costly, special-purpose processors for supercomputers has been supplanted by the use of large arrays of commodity processors (from several dozen to over 8,000) operating in parallel over a high-speed communications network.

Mini computer

Although minicomputers date to the early 1950s, the term was introduced in the mid-1960s. Relatively small and inexpensive, minicomputers were typically used in a single department of an organization and often dedicated to one task or shared by a small group. Minicomputers generally had limited computational power, but they had excellent compatibility with various laboratory and industrial devices for collecting and inputting data.

One of the most important manufacturers of minicomputers was Digital Equipment Corporation (DEC) with its Programmed Data Processor (PDP). In 1960 DEC's PDP-1 sold for $120,000. Five years later its PDP-8 cost $18,000 and became the first widely used minicomputer, with more than 50,000 sold. The DEC PDP-11, introduced in 1970, came in a variety of models, small and cheap enough to control a single manufacturing

process and large enough for shared use in university computer centres; more than 650,000 were sold. However, the microcomputer overtook this market in the 1980s.

Micro computers

A microcomputer is a small computer built around a microprocessor integrated circuit, or chip. Whereas the early minicomputers replaced vacuum tubes with discrete transistors, microcomputers (and later minicomputers as well) used microprocessors that integrated thousands or millions of transistors on a single chip. In 1971 the Intel Corporation produced the first microprocessor, the Intel 4004, which was powerful enough to function as a computer although it was produced for use in a Japanese-made calculator. In 1975 the first personal computer, the Altair, used a successor chip, the Intel 8080 microprocessor. Like minicomputers, early microcomputers had relatively limited storage and data-handling capabilities, but these have grown as storage technology has improved alongside processing power.

In the 1980s it was common to distinguish between microprocessor-based scientific workstations and personal computers. The former used the most powerful microprocessors available and had high-performance colour graphics capabilities costing thousands of dollars. They were used by scientists for computation and data visualization and by engineers for computer-aided engineering. Today the distinction between workstation and PC has virtually vanished, with PCs having the power and display capability of workstations.

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

2.3 COMPUTER HARDWARE

2.3.1 CENTRAL PROCESSING UNIT

The CPU (Central Processing Unit) is the 'brain' of the computer.

It's typically a square ceramic package plugged into the motherboard, with a large heat sink on top (and often a fan on top of that heat sink).

All instructions the computer will process are processed by the CPU. There are many "CPU architectures", each of which has its own characteristics and trade-offs. The dominant CPU architectures used in personal computing are x86 and PowerPC. x86 is easily the most popular processor for this class of machine (the dominant manufacturers of x86 CPUs are Intel and AMD). The other architechtures are used, for istance, in workstations, servers or embedded systems CPUs contain a small amount of static RAM (SRAM) called a cache. Some processors have two or three levels of cache, containing as much as several megabytes of memory.

2.3.2 CASE

Most modern computers have an "ATX form factor" case in which ATX-compatible power supplies, Mainboards and Drives can be mounted.

The Mini-ITX is much different in important ways unlike its relatives the Micro-ATX and the Flex-ATX. The mainboard size can be up to 170mm x 170 mm which is smaller than the Flex and Micro-ATX can be. Usually at less than 100 watts, the Mini-ITX PSU

is energy efficient. The Mini-ITX is also backward-compatible with the Flex/Micro-ATX models.

During the 1980's and 1990's almost all cases were beige, even Apple's Macintosh line. A few rare exceptions to this were black. Only recently have computer case designers realized that there was a worthwhile market for other colors and designs. This has led to all sorts of modifications to the basic design of a computer case. Now it is easy to find cases with transparent windows and glowing lights illuminating their insides.

2.3.3 POWER SUPPLY

All computers have some sort of power supply. This converts the supply voltage (AC 110 or 220V) to different voltages such as DC 5V, 12V and 3.3V. These are needed inside the computer system by nearly every component inside the computer.

There will be a bunch of connectors coming off of the supply, called Molex connectors. They come in varying sizes, meant for different applications, such as the motherboard (usually the largest of the connectors), the hard and optical drives (a bunch of medium-sized connectors), as well as the floppy drive (a relatively small connector, also saw usage among videocards in 2004). As newer standards come out, the types of connectors have changed. Many power supplies now come with power connectors for Serial ATA hard drives. These are smaller and are "hot-swappable", meaning they can be removed and plugged in again without fear of data loss or electrical problems. The power supply also has an exhaust fan that is responsible for cooling the power supply, as well as

providing a hot air exhaust for the entire case. Some power supplies have two fans to promote this effect.

It is important to buy a power supply that can accommodate all of the components involved. Some may argue that it is the most important part of a computer, and therefore it is worth spending the money to get a decent one.

2.3.4 MOTHERBOARD

The Motherboard (also called Mainboard) is a large, thin, flat, rectangular fiberglass board (typically green) attached to the case. The Motherboard carries the CPU, the RAM, the chipset and the expansion slots (PCI, AGP - for graphics -, ISA, etc.).

The Motherboard also holds things like the BIOS (Basic Input Output System) and the CMOS Battery (a coin cell that keeps an embedded RAM in the motherboard -often NVRAM- powered to keep various settings in effect).

Most modern motherboards have onboard sound and LAN controller, some of them even have on-board graphics. These are adequate for standard office work and system sounds. But dedicated sound and graphics cards plugged into the expansion slots offer much better quality and performance

The expansion slots (PCI, PCI-e, PCI-X, AGP, ISA, etc.) allow additional functions.

2.3.5 RAM

Random Access Memory (RAM) is a memory that the microprocessor uses to store data during processing. This memory is volatile (loses its contents at power-down). When a software application is launched, the executable program is loaded from hard drive to the RAM. The microprocessor supplies address into the RAM to read instructions and data from it. RAM is needed because hard drives are too slow to operate with the speed of a microprocessor.

Some of the types of RAM are SDRAM, DDR RAM, Rambus RAM, SIMM, DIMM.

2.3.6 FLOPPY DISK DRIVE

8" Floppy Disk: In the late 1960s IBM invented the 8-inch floppy disk. This was the first floppy disk design. Used in the 1970s and as a read-only disk it had storage-write restrictions to the people it was distributed to. However, later on a read-write format came about. In today's modern society it is rare to find a computer that uses the 8-inch floppy disk.

5.25" Floppy Disk: This disk was introduced some time later, and was used extensively in the 1980s.

3.5" Floppy Disk: This is the one the oldest and more commonly used storage media listed here. Floppy disks hold from 400KB up to 1.44 MB. 720K(low-density) and 1.44 MB(high-density) with a 3.5" disc are usually the average type found. Floppy disks have

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

largely been superseded by flash drives as a transfer medium, but are still widely used as backup storage.

2.3.7 HARD DRIVE

A hard drive consists of one or more magnetic platters or disks and a read arm with two electromagnetic coils for each disk. Each hard disk is divided into many sectors, each containing a certain amount of data. As of now, it is the cheapest and most common way to store a lot of data in a small space.

KNUST

2.3.8 CD ROM

Compact Disc Read Only Memory (CD-ROM) is a standard format for storing a variety of data. A CD-ROM holds about **700 MB** of data. The media resembles a small, somewhat flexible plastic disc. Any scratch or abrasion on the data side of the disc can lead to it being unreadable.

2.3.9 PERIPHERALS

They are components which allow humans to interface with computers.

2.3.9.1 DISPLAY DEVICE

Includes computer monitors and other display devices. CRTs and LCDs are common. LCDs are a more recent development, and are gradually replacing CRTs as they become more affordable. LCD's in addition to being lighter also use less energy and generate less heat.

2.3.9.2 SPEAKERS

Includes internal or external speakers and headphones.

2.3.9.3 MOUSE

A user interface device that can enable different kinds of control than a keyboard, particularly in GUIs. It was developed at the Xerox PARC (Palo Alto Research Center) and adopted and made popular with the Apple Mac. Today, nearly all modern operating systems can use a mouse. Most mice (sometimes the plural is 'mouses' to prevent confusion with the rodent) are made from plastic, and may use a ball to track movement, an LED light, or a laser. Today you can get a wireless mouse that allows you to easily give a presentation without being tied to a desk. These mouses are usauly LED or Laser based tracking.

2.3.9.4 KEYBOARD

A keyboard is an input device which is connected to a computer and used to type instructions or information into the computer. Typically, a keyboard has about 100 or so keys.

- Keyboards differ between languages. Most English-speaking people use what is called a QWERTY layout. This refers to the order of the top row of keys. Some foreign languages (i. e. German) use QWERTZ, where the Z and Y are switched.
- Many laptop computers do not include a number pad. (There is sometimes a function on the keyboard to enable a numpad-like mode.)

- Modern keyboards sometimes have extra controls such as volume, and keys that can be programmed to bring up programs of the user's choice.

2.4 HOW TO ASSEMBLE AND BUILD A PC

Step 1: Installing the motherboard

Make sure you have all the components in place and a nice, clean and big enough place to work with.

Put your antic-static wrist strap on to prevent your components from getting affected. Make sure your hands are clean before starting. First we will be installing the motherboard which is a piece of cake to install.

- Open the side doors of the cabinet
- Lay the cabinet on its side
- Put the motherboard in place
- Drive in all the required screws

Tip: Most motherboards come with an antistatic bag. It is advisable to put the motherboard on it for some time and then remove it from the antistatic bag before placing it in the cabinet.

Step 2: Installing the CPU

CPU is the heart of a computer so make sure you handle it properly and do not drop it or mishandle it. Also try not to touch the pins frequently so that they do not get dirty. Get hold of your motherboard and CPU manual. You need to place the CPU on the dotted white patch of the motherboard in a particular fashion for it to fit properly. There is a golden mark on the CPU to help you assist. Consult both your motherboard and CPU manual to see which position it fits exactly or you could also use try all the 4 positions.

KNUST

- Lift the CPU lever on the motherboard
- Place the CPU properly on the motherboard
- Pull down the lever to secure the CPU in place

Fig 2.1: Installing a CPU

Got the thermal compound? Now is the time to use it. Take small amount of it and carefully apply it on the top surface of the processor. Be careful not to put it on the neighboring parts of the motherboard. If you do so clean it immediately using the cloth.

Tip: Thermal compounds should be changed once every six months for optimal performance.

Step 3: Installing the heat sink

After installing the processor we proceed to installing the heat sink. There are different kinds of heat sinks that are bundled with the processor and each has a different way of installation. Look into your CPU manual for instructions on how to install it properly.

Fig 2.2: Installing the heat sink

- Place the heat sink on the processor
- Put the jacks in place
- Secure the heat sink with the lever

After this you will need to connect the cable of the heat sink on the motherboard. Again look into the motherboard manual on where to connect it and then connect it to the right port to get your heat sink in operational mode.

Step 4: Installing the RAM

Installing the RAM is also an easy job.

Fig 2.3: Installing the RAM

The newer RAMs ie. DDR RAMs are easy to install as you don't have to worry about placing which side where into the slot. The older ones, SDRAMs are plagued by this problem.

If you want to use dual channel configuration then consult your manual on which slots to use to achieve that result.

- Push down the RAM into the slot
- Make sure the both the clips hold the RAM properly

Step 5: Installing the power supply

We will now install the power supply as the components we install after this will require power cables to be connected to them. There is not much to be done to install a PSU.

Fig 2.4: Installing the power supply

- Place the PSU into the cabinet
- Put the screws in place tightly

Tip: Some PSU have extra accessories that come bundled with it. Consult your PSU manual to see how to install them.

Step 6: Installing the video card

First you will need to find out whether your video card is AGP or PCI-E. AGP graphics cards have become redundant and are being phased out of the market quickly.

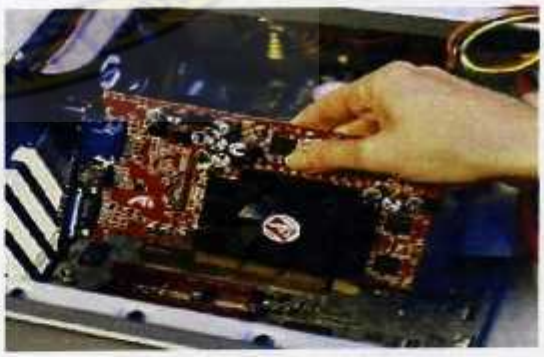


Fig 2.5: Installing the video card.

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

So if you bought a spanking new card it will certainly be a PCI-E.

- Remove the back plate on the cabinet corresponding to the graphics card
- Push the card into the slot
- Secure the card with a screw
- Plug in the power connection from PSU (if required)

High-end graphics cards need dedicated power supply and if your graphics card needs one then connect the appropriate wire from PSU into the graphics card.

Step 7: Installing the hard disk

Hard disk is another fragile component of the computer and needs to handled carefully.

Fig 2.6: Installing the hard drive

- Place the hard drive into the bay
- Secure the drive with screws
- Connect the power cable from PSU
- Connect the data cable from motherboard into the drive

If your hard drive is a SATA one then connect one end of SATA cable into the motherboard and other into the SATA port on the hard disk. If your hard disk is PATA type then use the IDE cable instead of the SATA cable.

Fig 2.7: SATA cable

Tip: If your PSU does not support SATA power supply then you will need to get a converter which will convert your standard IDE power connector to a SATA power connector.

Step 8: Installing optical drive

The installation an optical drive is exactly similar to a hard drive.

- Place the optical drive into the bay
- Drive in the screws
- Connect the power cable and data cable

Fig 2.8: Installing optical drive.

Tip: When installing multiple optical drives take care of jumper settings. Make sure you make one as primary and other slave by using the jumper. This is not applicable if the drives are SATA drives.

Step 9: Connecting various cables

- First we will finish setting up internal components and then get on to the external ones. You will need to consult your motherboard manual for finding the appropriate port for connecting various cables at the right places on the motherboard.

Fig 2.8: Installing optical drive.

- Connect the large ATX power connector to the power supply port on your motherboard
- Next get hold of the smaller square power connector which supplies power to the processor and connect it to the appropriate port by taking help from your motherboard manual
- Connect the cabinet cables for power, reset button in the appropriate port of the motherboard
- Connect the front USB/audio panel cable in the motherboard
- Plug the cable of cabinet fans

You are done with installing the internal components of the PC. Close the side doors of the cabinet and get it upright and place it on your computer table. Get the rest of the PC components like monitor,

keyboard, mouse, speakers etc.

which we will connect now.

- Connect the VGA cable of the monitor into the VGA port

Fig 2.9: connecting various port cables

- If mouse/keyboard are PS/2 then connect them to PS/2 ports or else use the USB port
- Connect the speaker cable in the audio port
- Plug in the power cable from PSU into the UPS
- Also plug in the power cable of the monitor

Step 10: Installing the OS and drivers

We are done with the hardware part. Now get your favorite OS disks ready and the CD that came with your motherboard.

- Set the first boot device to CD/DVD drive in BIOS
- Pop in the OS disk
- Reboot the PC
- Install the OS
- Install drivers from motherboard CD (applicable only to Windows OS)

2.5 USE OF COMPUTERS

People use computers in many ways. In business, computers track inventories with bar codes and scanners, check the credit status of customers, and transfer funds electronically. In homes, tiny computers embedded in the electronic circuitry of most appliances control the indoor temperature, operate home security systems, tell the time, and turn videocassette recorders (VCRs) on and off. Computers in automobiles regulate the flow of fuel, thereby increasing gas mileage, and are used in anti-theft systems. Computers also entertain, creating digitized sound on stereo systems or computer-animated features from a digitally encoded laser disc. Computer programs, or applications, exist to aid every level of education, from programs that teach simple addition or sentence construction to programs that teach advanced calculus. Educators use computers to track grades and communicate with students; with computer-controlled projection units, they can add graphics, sound, and animation to their communications.

Computers are used extensively in scientific research to solve mathematical problems, investigate complicated data, or model systems that are too costly or impractical to build, such as testing the air flow around the next generation of aircraft. The military employs computers in sophisticated communications to encode and unscramble messages, and to keep track of personnel and supplies.

2.6 THE ASSEMBLY PROCESS

Most of the value that is added to the product in the industry under discussion occurs in the assembly process. While the assembly process generally takes less time than loading software or testing the machine, it is arguably more valuable to the end customer. Customers can and will load software, but choose not to assemble their machines from individual components.

Since the value of the assembly process makes it essentially the *raison d'être* of the factory, one of the first decisions to be made in designing the factory layout will be the structure of the assembly process. This decision must include how the assembly process will be broken up in time and in space, and what portions of the process will be completed by what part of the workforce.

In a factory such as a computer final assembly plant, the assembly process development can be broken into two decisions. First, the team must decide whether the assembly process will be parallel or serial. Issues pertinent to this decision include the variability of the product assembly process, quality concerns, and demand volume. Once this decision has been made, the team must determine how different products or variations will be assembled. Dedicated

lines or stations can be setup for each distinct product or product family, or a single line or generic station can be used at which all of the different products will be assembled.

2.6.1 PARALLEL ASSEMBLY

In a parallel assembly structure the entire assembly process is completed at a single station, with stations replicated based on cycle time in order to meet demand quantities. One or a small group of assemblers is responsible for the entire assembly process for units scheduled at their station.

KNUST

2.6.2 SERIAL ASSEMBLY

A serial assembly process is more commonly known as an assembly line. The assembly process is broken into individual steps, and completed by different assemblers in a specific sequence. Demand quantities are met by increasing the number of steps in the process, and thereby decreasing the cycle time at each individual step. As throughput requirements are increased, the amount of work on an individual unit performed by each assembler decreases.

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY

REFERENCES

1. "Computer," *Encyclopaedia Britannica Ultimate Reference Suite,* Chicago, Encyclopaedia Britannica, 2009
2. Snyder, Timothy Law, "Computer," *Microsoft Student Encarta Encyclopaedia,* Redmond, WA, Microsoft Corporation, 2008.
3. Furey M. Thomas, *Decision Elements in the Design of a Consumer Electronics Assembly Plant,* Massachusetts, Massachusetts Institute of Technology, 1999
4. Wikipedia Encyclopaedia
5. http://www.bdir.sourceforge.net/binnyva
6. http://www.bnet.com
7. http://www.ehow.com

KNUST

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 OVERVIEW

This chapter outlines methods used in gathering the required information for this project. The sources of data in this project have been categorized into:

- Primary sources: These are the sources from which first-hand information were obtained. They include personal observation from walkthroughs, interviews and photographs.
- Secondary sources: These are sources of information obtained from works done by other people in the past. They include data gathered from books, journals, articles and electronic media (web links) relevant to the topic.

3.1 METHODS USED IN DATA COLLECTION

The methods adopted include:

- Interviews
- Personal Observation
- Case Studies
- Archival research

3.1.1 INTERVIEWS

Interviews with the staff of Omatek Ghana limited to know more about the spatial organization and various spatial requirements for a computer assembly plant. Also to learn about the Computer assembly process.

3.1.2 PERSONAL OBSERVATION

I personally went to Omatek Ghana limited in Accra to observe various problems faced due to the design of the facility. The sort of materials used for the finishing of the interior spaces. Photographs were also taken about technical things observed during the walkthroughs to help better explain the issues addressed in the research.

3.1.3 CASE STUDIES

Two Computer assembly plants were studies they are, Omatek Ghana limited which is a local assembly plant and a foreign plant which is Dell Penang assembly plant located in Malaysia. The main purpose for these studies was to learn about the computer assembly process, the spatial organization and the sort of machines used within the plants.

3.1.4 ARCHIVAL RESEARCH

The background information needed for this research was obtained from archival sources such as books, journals, articles and web links. The information obtained provided the precedence needed for this research.

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

CHAPTER FOUR

FINDINGS AND DISCUSSIONS

4.0 OVERVIEW

The findings and discussions in this chapter are based on data collected from the field survey, interviews and case studies.

4.1 CASE STUDY I: OMATEK COMPUTERS (GHANA) LIMITED

Established in September of 2007, Omatek computers limited produces locally assembled computer cases,speakers, flat screens and home entertainment speakers from completely knocked down (CKD).

Location: Omatek Ghana limited is located within Ridge (Accra) with proximity to the trade centers in Accra, the capital city of Ghana. This case was studied to understand the various spaces, facilities and the activities associated with the assembly of computers.

Fig 4.1: Frontage of Omatek Ghana Limited

4.2 ACTIVITIES IN OMATEK

OMATEK is the pioneer and the only factory on the African continent involved in the production of Computers, Casings and Speakers from Completely-Knocked-Down (CKD) components out of its Nigeria and Ghana factories. Operating at 50% capacity utilisation, the OMATEK Computer factory in Nigeria rolls out annually:

72,000 fully-built PCs (6,000 PCs a month)

150,000 Casings and150,000 Speakers.

Selling of Factory Production Capacity to various system builders forms the core of the OMATEK factory business model.

The factory is involved in the following:

(a) Assembly of OMATEK brand of Computers for OMATEK Ventures Distribution Limited.

The Factory produces for OMATEK Ventures Distribution Limited the OMATEK brand of products ranging from:

- Desktops
- Notebooks and
- Servers
- Power Back-up Systems
- Home Entertainment Systems

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

(b) Assembly of OEM brands for other brand builders such as :

- Foreign OEM Builders
- Local OEM Builders

The OMATEK factories assemble OEM brands for other brand builders. These brands are customized in the OEM brand names. The net effect of this is the generation of employment for over 300 Nigerians and 75 Ghanaians in these assembly lines.

(C) Assembly of OCL Brand for the Channel and Export markets and Omatek Casings.

The OMATEK factories are also into the assembly of the OCL brand of Casings and Speakers for the Channel and Export markets.

Fig 4.2: Some products of Omatek

4.3 SPECIFICATION

4.3.1 SPATIAL ORGANIZATION

The Omatek Ghana Limited factory is housed in a small single storey structure with very limited parking space for seven cars in front of it. Upon entering the facility the first point of call is the reception area which has a small area for showcasing some finished products and also a small waiting area for visitors. Immediately after this space comes an office for logistic which is partitioned from the reception area. After this space is a small corridor which leads directly into the production hall where the real work or assembling of the computers is done in a fully air conditioned space with artificial lighting employed for optimal vision within the space.

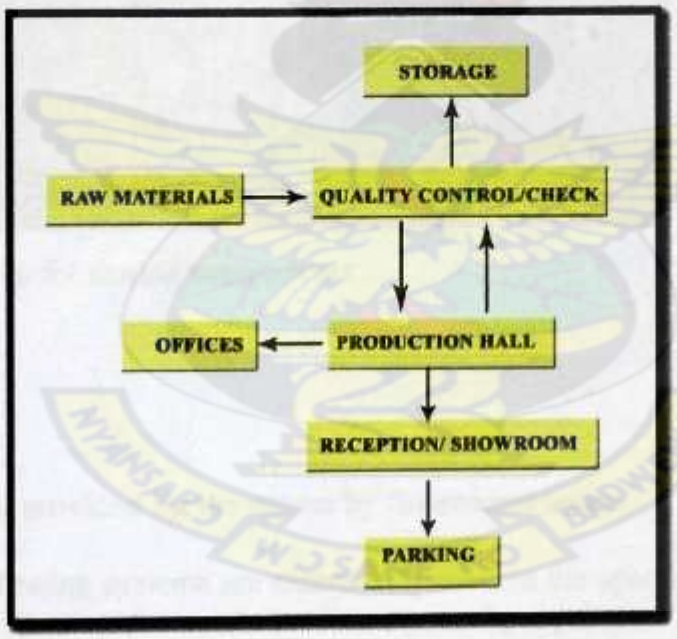


Fig 4.3: Spatial relationship/organization of the factory. (Source: Personal Observations)

Within this same production hall is a space for storage of the raw materials for assembling of the computers. A space after the production hall is the quality control area where the finished goods are checked/inspected and coded before being taken to the

space allocated for the storage of finished products, which happens to be immediately after the quality control room. Testing and packaging of finished products all takes place within the production hall.

The factory also has some offices allocated within the facility for the administration of the plant.

The access for both the finished products and raw materials is through the back of the structure though at times through the front.

Fig 4.4: Storage racks for storing components

4.3.2 SERVICES

Artificial lighting is provided for the spaces by fluorescent lamps.

Split unit air conditioning systems are extensively used in the spaces to keep the indoor temperatures at acceptable values.

4.3.3 SECURITY

For the security of its factory Omatek Ghana limited employs the services of well trained security personals to cater for the overall monitoring of activities within the production area and also the other areas of the facility where needed to ensure the smooth operation of the factory.

Fig 4.5: workers in testing area

Fig 4.6: workers assembling system units

4.4 LESSONS FROM THE STUDY

4.4.1 MERITS

- The use of air conditioning within the production hall to ensure a dust free environment and also the right temperature for pc components.
- The strategic location of the factory makes it easily accessible to ready market that is, trading centers in and around Accra.

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

4.4.2 DEMERITS

- The facility has in adequate space for parking of cars and o repair facility in place to service and maintain computers.
- Absence of changing facilities for Staff/ Clean lobbies before entry into production area
- Excessive use of artificial lighting in most of the spaces.
- Lack of adequate exits in case of fire outbreak.

Fig 4.7: shows ongoing computer assembling process

4.5 CASE STUDY II: DELL ASSEMBLY PLANT PENANG (MALAYSIA)

This computer assembly facility is located at Bayan Lepas in Penang which is a Malaysian island. This assembly plant is strategically located benefiting from its close proximity to an air port and a shipping harbour which facilitates fast and easy transportation of both raw materials and finished products.

Fig 4.8: Layout of the factory (shown edged red). Source: Google Earth

4.6 SPECIFICATION

4.6.1THE STRUCTURE

All facilities are located in one big structure that houses the administration, production hall among other facilities. The administration is located in the front portion of the structure, with the main production area and other facilities behind it, all under one roof. This two story building's massive structure is built primarily of reinforced concrete and block work with extensive glazing on the frontage of the building. The architecture of the building depicts features of the post modernist style of architectural design.

Fig 4.9: Front view of Dell assembly plant (Penang)

4.6.2 PARKING

This plant boasts of two extensive car parks, one on the main facility and the other about 50 meters away from the main plant area. The parking around the facility include a service parking which caters for both loading and offloading of raw materials and finished products, a parking for employees and also a visitors parking.

This assembly plant has two security check points one for monitoring employees and visitors and the other for monitoring the service trucks that use the facility.

Fig 4.10: Entrance gate to Dell plant

4.6.3 SERVICES

The engineering services are extensive; they ensure comfort, energy efficiency and safety. The indoor environment is controlled by a central air-conditioning system. This air conditioning system regulates the indoor temperature at values acceptable for both human and computer safety and performance. Apart from the power tapped from the Normal Electricity, a standby generator is in place which ensures uninterrupted supply of power for the facility. Cables for the powering of computers are laid in false floors and in the ceiling.

Fire safety extinguishers are in place at vantage points in the building.

4.7 LESSONS FROM THE STUDY

4.7.1 MERITS

- Provision of adequate parking for all
- This assembly plant has well defined accesses
- Adequate security is provided
- Strategic location making delivery of raw materials and finished products easier and faster
- The use of air conditioning within the production hall to ensure a dust free environment and also the right temperature for pc components.

4.7.2 DEMERITS

- The deep nature of structure makes it almost impossible to make use of natural lighting within the space.
- Lack of adequate soft landscaping may lead to increased solar radiation.

Fig 4.11: View of the showroom (Source: http://www.zdnet.com)

Figure 4.12: Workers undergoing training. (Source: http://www.zdnet.com)

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

Fig 4.13: view showing production hall. (Source: http://www.zdnet.com)

Fig 4.14: Testing/Installation area. (Source: http://www.zdnet.com)

Fig 4.15: Control centre; this also serves as a customer service centre

Fig 4.16: Packaging Materials. (Source: http://www.zdnet.com)

4.8 TECHNICAL STUDIES

4.8.1 ENVIRONMENTAL CONTROL

Computer systems require a fairly high level of environmental control for their optimum functioning. Many peripheral units like terminals, visual display units and printers, can operate in normal air-conditioned environments. However, the more complicated machines like disk, tape drivers, central processors, etc, require a higher level of environmental control. Most machines have a range of acceptable environmental conditions, within which efficient functioning is assured.

Air conditioning thus provides the most suitable methods of environmental control in terms of temperature and humidity. Acceptable environmental values are as follows;

Temperature: 16°-27° C, at a maximum rate of change of 2.7^{o} C/Hr.

Humidity: 35% - 65% (condensing) at a maximum change rate of 10% /Hr.

Air purity: General requirements are 96 % efficiency at 5 micron punticle. Normal Industrial Filtration - (1 micron = 1×10^{-6} meter)

Dust control is very important, and must be considered in the choice of materials. Audible and visible looming devices should be installed to control impending environmental changes.

It is also recommended that the air conditioning plant for a computer room be separated from that for other parts of the building, due to its widely defined units.

4.8.2 ELECTRICITY

Since computers operate on electricity and process data by means of electronic signals, the quantity and quality of electricity is critical. Where the power supply from the main is not up to the required voltage, step up transformers must be used, and where supply is liable to fluctuation, it is essential to have a 100% standby generator for simultaneous connection.

Electrical power requirements vary according to machine types, size and configuration, but generally are of two basic ranges.

240/415 v _+ 6% at 50 cycles/second _+ 1% or

220/380 v + 6% at 50 cycles/second _+ 1%

Electricity must come from a clean source, which is from a main fuse box.

4.8.3 LIGHTING

Lighting should be very bright and shadow less. The general lighting level should be about 30-35 ft, Candles (1) (322.92 lux – 376.74 lux)

4.8.4 FIRE CONTROL

To ensure safety and efficiency of the computer installation, fire should be well considered. Fire and smoke detection devices located in air conditioning ducts are suitable and these may switch off machine above a certain volume of smoke.

Suitable carbon dioxide (CO^2) appliances must be provided in computer rooms. Preferred systems of detection and fighting are

- Combustion detectors in the computer rooms, ceilings, floors, air conditioning ducts, etc.
- Flow alarm switches, sprinkler systems, and hose lines.

There must be a control panel, on which all critical parts of the building are easily located so that appropriate action can immediately be taken in times of crisis.

4.8.5 SECURITY

Access to the computer installation should be as restricted as possible and staff of the centre must be holders of appropriate identification. Security devices are thus to be installed in the complex to efficiently check any undesirable entry.

Personnel are to be posted to check identification and carry out searches where necessary at vantage points into the building. By such means, it is hoped that security will be enhanced and maintained.

Data security is provided by programming and consists of a series of hierarchical code possession which entitles a user to be able to assess certain level of information.

4.9 SPECIAL STUDIES

4.9.1 PHOTO VOLTAIC POWER GENERATION

The facility will not only depend on electricity from the national grid but also on power generated from photovoltaic cells. Photovoltaics (PV) or solar cells as they are often referred to are semiconductor devices that convert sunlight into direct current (DC) electricity.

Sizing a Photo Voltaic System

The size of a photovoltaic system depends upon two factors: the electrical requirements of the devices (loads) relying on the system and the amount of sunshine available to power the system. A current photo voltaic panel of dimension 500mm x 900mm generates energy of 50 peak watts, 21.4-17v.Energy required for a normal P.C. (computer) is 150 watts.

How Photovoltaic Systems work

Solar energy received by the photo voltaic panel is converted to electrical energy. This goes to a charge controller to regulate the power supply, then to a battery (cell) for storage. This then goes to a distribution board, to an invertor to change power from D.C to A.C, then finally to equipment.

Where to install

Photo Voltaic modules are usually installed on special ground or pole mounting structures away from shade especially during the prime sunlight hours of 9.am to 3pm. Modules may be mounted on rooftops provided that proper building and safety precautions are observed.

Tilt for maximum exposure. The annual energy production is high when the array is tilted at the latitude angle. The latitude for Tema is 6.72° N, therefore for maximum energy production; the array should be tilted 6.72° up from the horizontal. The best possible tilt for a module is one that puts it at right angles to the noontime sun.

Special Requirements

- Area for display of photo voltaic panels
- Battery Bank to house battery (cells), distribution boards and other equipment.

4.9.2 ATRIUM DESIGNS

Suggested by its Latin meaning as "heart" or an open courtyard of a Roman house, the term atrium as used today is a protected courtyard or glazed garden placed within a building. Atriums are generally incorporated in design schemes for purposes of natural cooling, heating, lighting etc. In this thesis work however, it was considered for its cooling and lighting effects.

Natural cooling

- In the design of an atrium for natural cooling, solar heat gain must be minimized through the sun shading of the atrium.
- Use the atrium as an air plenum in the mechanical system of the building. The great advantage is one of economy, but heat recovery options and ventilation become most effective when the natural air flow in the atrium is in the same direction and integrated with the mechanical system.
- To facilitate natural ventilation, create a vertical "chimney" effect by placing ventilating outlets high (preferably in the free flow air stream well above the roof)

and by providing cool "replacement air" inlets at the atrium bottom, with attention that the air stream is clean, that is, free of car exhaust or other pollutants.

- The inlet air stream can be cooled naturally, such as accessed from a shaded area. Passing the inlet air over water such as an aerated fountain or landscape area is particularly effective to create evaporative cooling.
- Allowing the atrium to cool by ventilation at night is effective where summer night time temperatures are lower than daytime (greater than 15F difference), in which case the cooling effect can be carried into the next day by materials such as masonry (although, as a rule, if the average daily temperature is above 78F (25.5°C), thermally massive materials are disadvantageous in non-air-conditioned spaces because they do not cool as rapidly as a thermally light structure).
- The ideal location for a sun shading screen is on the outside of the glazing, where it can be wind-cooled.
- When the outside air ranges about 80F (26.7°C), glass areas even if shaded admits undesired heat gain by conduction. In warm climates like Ghana, a minimum size of glazed aperture should be used to prevent undesired heat gain, in which case the small amount of glazing should be placed where it is most effective for day lighting. Heat-absorbent or heat-reflective glass, the common solution solar heat gain, also reduces the illumination level

Day lighting

In predominantly sunny sites, atrium geometry can by based upon heating and/or cooling solar orientation principles.

To maximize light, window or skylight apertures should be designed for the predominant sky condition

In a predominant sunny sky condition, orient the glazing according to heating and/or cooling design requirements. Provide sun-and-glare control by geometry of aperture, surface treatment, color, and adjustable shades or curtains

KNUST

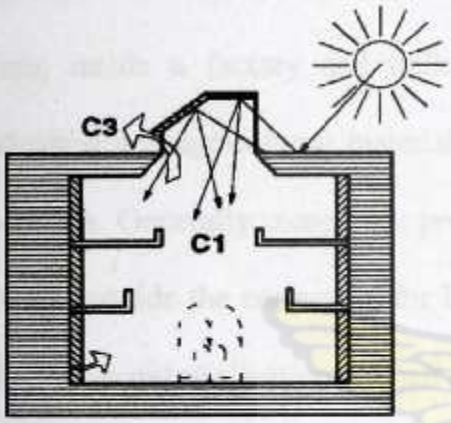


Fig 4.17: Hot/Wet

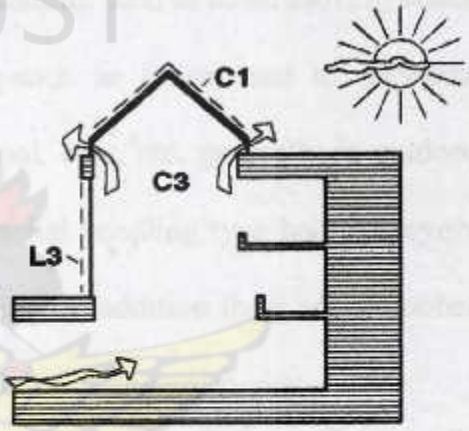


Fig4.18: Warm dry

4.9.3 CONVEYORS

Conveyors are used as components in automated distribution and warehousing. In combination with computer controlled pallet handling equipment this allows for more efficient retail,wholesale, and manufacturing distribution. It is considered a labour saving system that allows large volumes to move rapidly through a process, allowing companies to ship or receive higher volumes with smaller storage space and with less labour expense.

4.9.3.1 TYPES OF CONVEYOR

Conveyor belt

A **belt conveyor** consists of two or more pulleys, with a continuous loop of material - the conveyor belt - that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport industrial and agricultural materials, such as grain, coal, ores, etc. generally in outdoor locations. Generally companies providing general material handling type belt conveyors do not provide the conveyors for bulk material handling. In addition there are a number of commercial applications of belt conveyors such as those in grocery stores.

The belt consists of one or more layers of material they can be made out of rubber. Many belts in general material handling have two layers. An under layer of material to provide linear strength and shape called a carcass and an over layer called the cover. The carcass is often a cotton or plastic web or mesh. The cover is often various rubber or plastic compounds specified by use of the belt. Covers can be made from more exotic materials for unusual applications such as silicone for heat or gum rubber when traction is essential.

Material flowing over the belt may be weighed in transit using a beltweigher. Belts with regularly spaced partitions, known as *elevator belts*, are used for transporting loose

materials up steep inclines. Belt Conveyors are used in self-unloading bulk freighters and in live bottom trucks. Conveyor technology is also used in conveyor transport such as moving sidewalks or escalators, as well as on many manufacturing assembly lines. Stores often have conveyor belts at the check-out counter to move shopping items. Ski areas also use conveyor belts to transport skiers up the hill. A wide variety of related conveying machines are available, different as regards principle of operation, means and direction of conveyance, including screw conveyors, vibrating conveyors, pneumatic conveyors, the moving floor system, which uses reciprocating slats to move cargo, and roller conveyor system, which uses a series of powered rollers to convey boxes or pallets.

Gravity Skate Wheel Conveyor: It is extensively used in shipping/loading and moving of lightweight items over short distances.

Gravity Roller: It is similar to gravity skate wheel conveyor but more useful in movement of heavy items.

Zero Pressure Accumulating Conveyor Roller: It is the automated version of gravity roller. It is especially useful in avoiding the pressure buildup that normally occurs when product accumulates at a stationary operation.

Flexible Conveyor Roller: It is portable, expandable and easy to use. It is used extensively in shipping/receiving operations for package handling; flexible conveyor is usually anchored at one end to the automated conveyor allowing the other end to be expanded for loading and unloading.

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

Fig 4.19: Belt conveyor

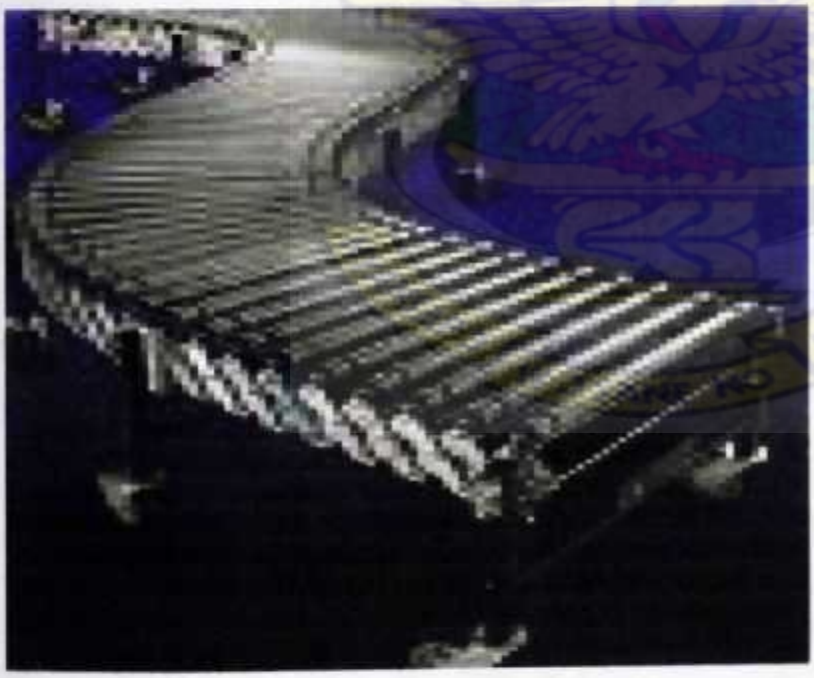


Fig 4.20: roller conveyor

4.10 SITE SELECTION CRITERIA

- Proximity to source of raw materials
- Proximity to ready market
- Availability of infrastructural services
- Proximity to Ghana's largest sea port that is the Tema harbour
- Future expansion

4.11 SITE LOCATION

The site is located in the Tema Export Processing Zone off the Accra-Afloa main road.

The site is about 5 minutes drive from the Tema end of the Accra-Tema motorway.

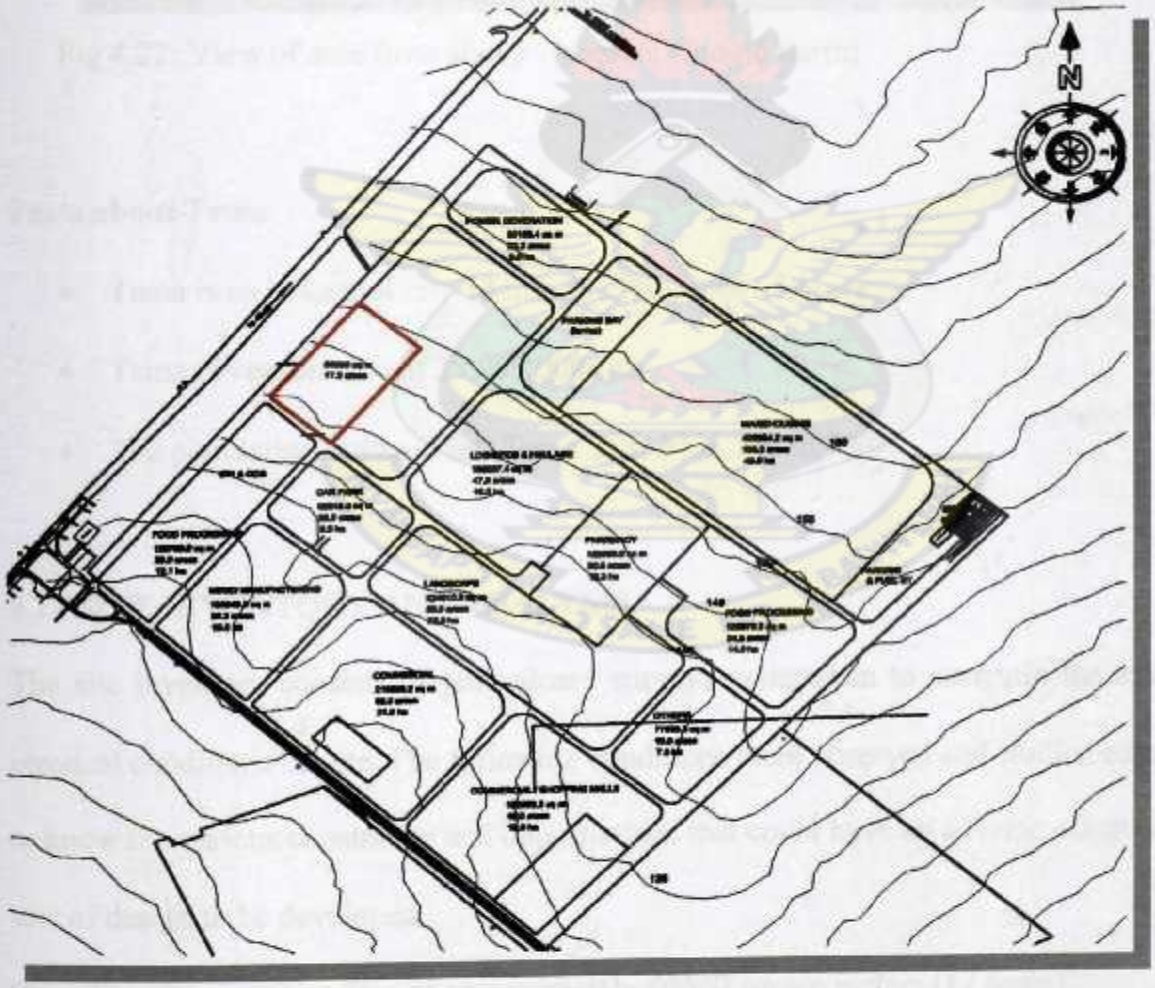


Fig 4.21: Map of selected site (area to be used in red) source: Free zones board, Accra.

Fig 4.22: View of area from above (source: Google Earth)

Facts about Tema

- Tema is an industrial city 18 miles (29km) east of Accra.
- Tema covers an area of 39,959,000sqm
- The population estimate for Tema as at 2005 was 209,400

4.12 SITE INVENTORY AND ANALYSIS

The site inventory consists of preliminary surveys undertaken to ascertain the existing physical conditions on site. The following conditions were observed and studied carefully to know the various constraints and opportunities that could have an adverse effect on the sort of design to be developed.

Size: The site covers an area of approximately 60000 square meters (17 acres)

4.13 VEGETATION

The area has two predominate vegetations comprising of coastal shrubs and grasslands. This site falls within the coastal savannah zone of Ghana. It has the capability of plant support to some extent.

Fig 4.23: Picture showing vegetation on site.

4.14 GEOLOGY

The location of the site is within an area well known for its metamorphic rocks mainly consisting of granite and schist. The soil type comprises of a mixture of clay in certain portions, sand and stones on other parts of the site.

4.15 TOPOGRAPHY

The general topography of the site can be described as fairly flat, as indicated by contours on site.

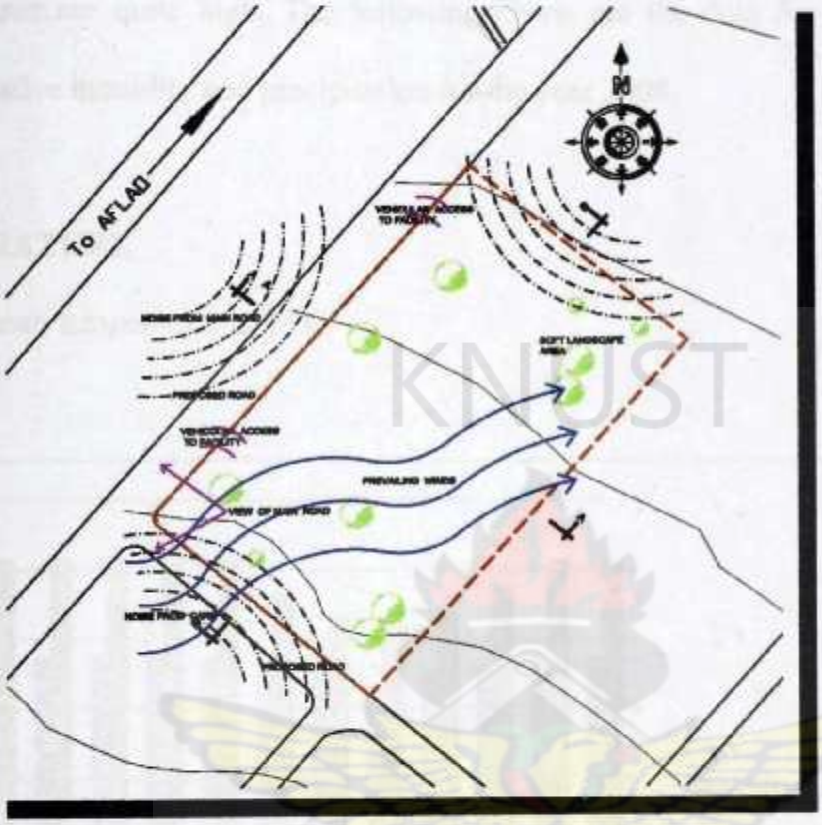


Fig 4.24: A representation of site conditions and analysis

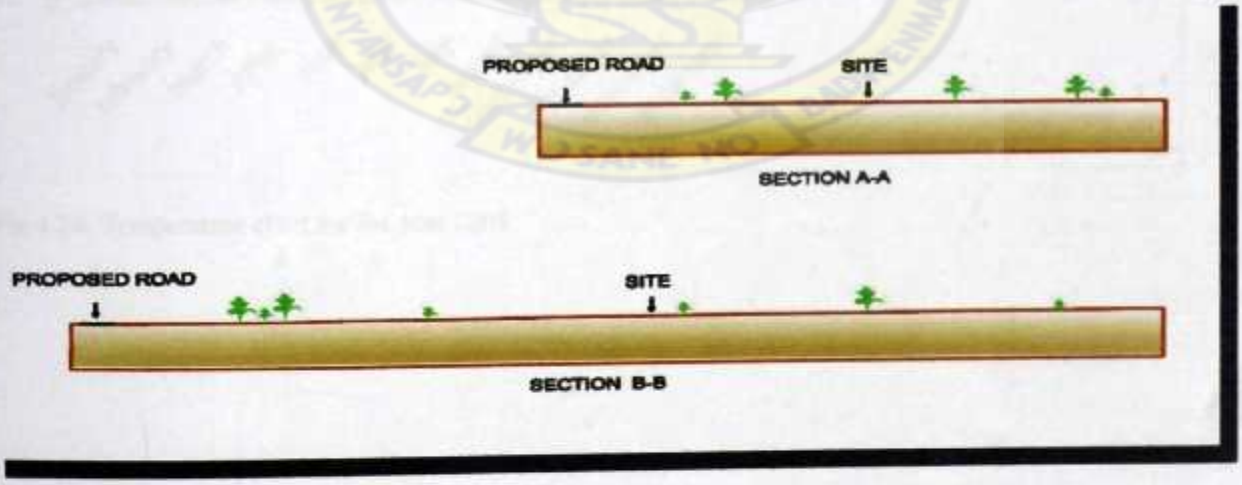


Fig 4.25: Section through the site

4.16 SITE CLIMATE

The sites location within the dry coastal savannah region of Ghana is characterized by dry climatic conditions with an average annual rainfall of about 790mm. All year round temperatures are quite high. The following charts are the data for temperature, wind speed, relative humidity and precipitation for the year 2008.

TEMPERATURE

Annual mean temperature is 27°C

KNUST

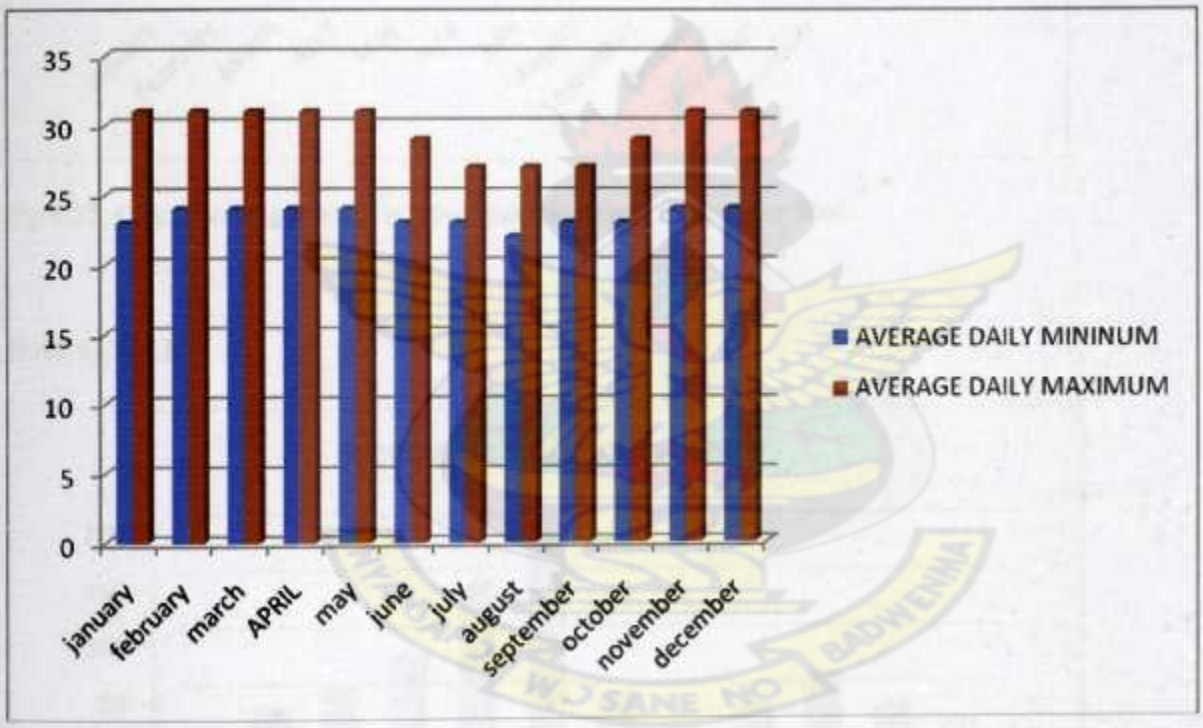


Fig 4.26: Temperature chart for the year 2008

RELATIVE HUMIDITY

The relative humidity for this site is quite high between 75% and 92%. This is shown in the chart below.

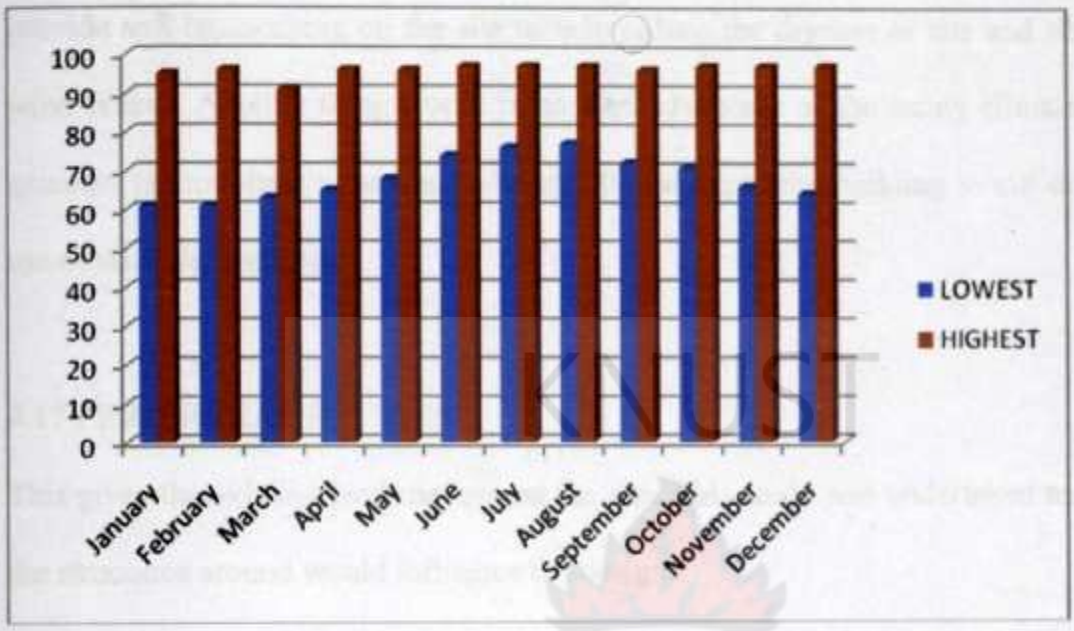


Fig 4.27: Chart showing average relative humidity levels for the year 2008.

RAINFALL

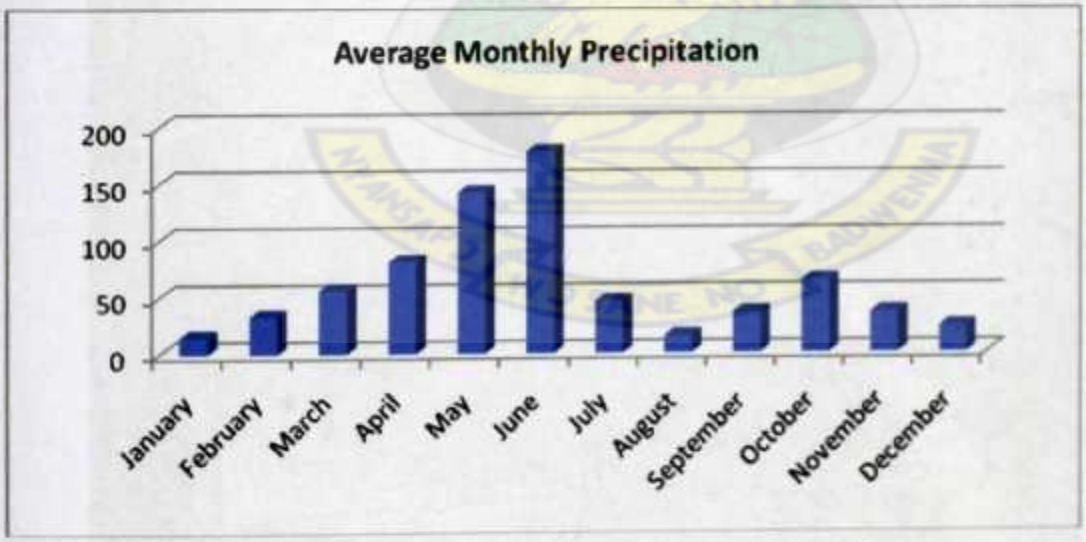


Fig 4.28: Chart showing annual total rainfall between 200mm and 18000mm.

RESPONSE

The need to provide air conditioning systems to keep both the indoor temperature and humidity at acceptable levels for occupants and computer components. Also the need to provide soft landscaping on the site to help reduce the dryness of site and also serve as wind brakes. Another thing would be to take advantage of the sunny climate on site to generate photovoltaic power and also sky lighting into the building to cut down on the use of artificial lighting.

4.17 PERIPHERAL STUDIES

This gives the existing land use around the site. This study was undertaken to know how the structures around would influence the design.

Fig 4.29: The land is bounded to the north western periphery by the Accra-Aflao road

Fig 4.30: The main entrance to the Tema Export Processing Zone also located on the north western periphery of site.

Fig 4.31: To the south eastern periphery of site is a textile producing factory.

Fig 4.32: Water storage tank also located to the south eastern portion of the site.

Fig 4.33: To the south western periphery of land is a cocoa processing factory

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.0 DESIGN EVOLUTION

The design of the computer assembly plant developed out of the results in the preceding content of this chapter as well as in accordance with the clients brief.

5.1 DEVELOPED BRIEF

Administration

The spaces within the administration include: An Entrance hall, Reception, Boardroom, Offices, Conference room, Visitors lounge, Staff room and a showroom/sales outlet.

Production unit

The following spaces are found within the production unit: A raw material storage, finished goods storage, changing area, rest area, first aid room, offices and security checks.

Canteen

The spaces within the canteen are an eating area, kitchen, kitchen yard, changing rooms, matrons office, storage.

Aftersales service centre

The following spaces are in the aftersales service centre, they are a reception area, waiting area, office and store.

Educational facility

The spaces are a workshop, Training centre, office, maintenance and a research lab.

Parking

Parking space for the customers, staff and service yard.

5.2 ACCOMMODATION SCHEDULE

The accommodation schedule gives an idea about the sizes of various spaces within the facility.

This accommodation Schedule did not only consider the clients brief but also the needs of various users of this facility and the various space requirements of such a facility.

KNUST

Canteen

Space	Area(Sq. meters)
Kitchen	58
Eating area	310
Kitchen yard	20
Matrons office	16
Cold/dry store	14
Changing rooms/sanitary	20
Refuse room	4
subtotal	**440**

Administration

Space	Area(Sq. meters)
Entrance hall	250
Reception	17
Boardroom	20
Showroom/sales outlet	130
General Offices	288
Security monitoring room	22
Visitors lounge	19
Switch room	12
Store room	11
Staff room	24
Conference room	54
Sanitary areas	48
Subtotal	**755**

Parking area

Space	Area(Sq. meters)
Service yard	1390
Staff parking	1000
Customer parking	2500
Subtotal	**4890**

Educational facility

Space	Area(Sq. meters)
Workshop	250
Training	78
Office	14
Sanitary	16
Maintenance	76
Research lab	78
Tools room	10
Subtotal	**554**

After Sales Service

Space	Area(Sq. meters)
Enquires/waiting area	60
Spare parts room	30
Offices	14
Repairs / After sales servicing	60
Sanitary area	14
store	10
Subtotal	**188**

Production unit

Space	Area(Sq. meters)
Raw material storage	325
Quality control	190
Trolley and tools room	80
Main assembly hall	1250
Managers Office	22.5
Security/ clock in	35
Supervisors office	22.5
Battery/ electrical room	22.5
Entrance lobbies	30
Final testing area	320
Packaging area	320
Finished products storage	280
Changing rooms/sanitary	90
subtotal	**3650**

KNUST

5.3 PHILOSOPHY AND CONCEPT

The philosophy behind this work is "transforming lives through technology". Knowledge is power and in this age of information and communication technology (ICT) advancement, people in developing countries are still underprivileged to access or even own a computer, hence a low computer literacy rate. The world is now literally powered by ICT, moving the economies of many Nations. It is therefore necessary to come out with measures to help increase the pc literacy rate in Ghana and across Africa as a whole. One such measure which will help boost the ICT levels in Africa will be the establishment of computer assembly plants to produce computers at affordable prices so as to improve the socio economic well-being of the African people.

The concepts for my design are intelligence, speed and accuracy.

Intelligence: This will be achieved through the use of Hi-tech Architectural theories where structural systems and services are not completely hidden but exposed for some aesthetic effects will be inherent in the design. Similarly, steel and glass which are the chief materials used in hi tech construction will also be employed in several phases to the design scheme to give it a Hi-tech effect, automated doors systems, high-tech security monitoring systems and also photovoltaic systems.

Speed and Accuracy: The computer age through the application of computer technology enables tasks to be undertaken at very high speeds and at great accuracies. This has brought a lot of efficiency into the system of operations and life in general.

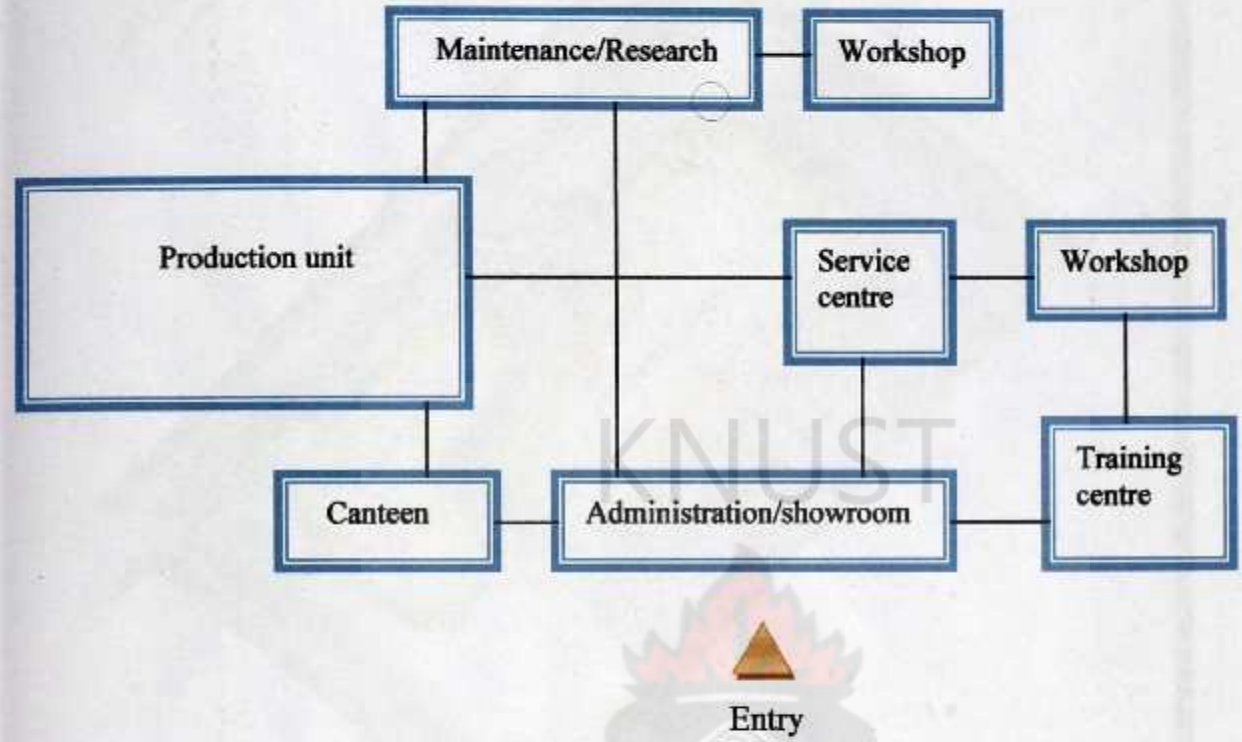
LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

Architecturally, to ensure high speed of operations in the building, spaces have been organized in such a way that there is openness, not too many sharp corners that can hinder the easy movement of people within the facility. Spaces are also well defined .Staircases have also been strategically located so that they could easily be identified and assessed. This will ensure that activities are carried out effectively at a very fast rate within the facility.

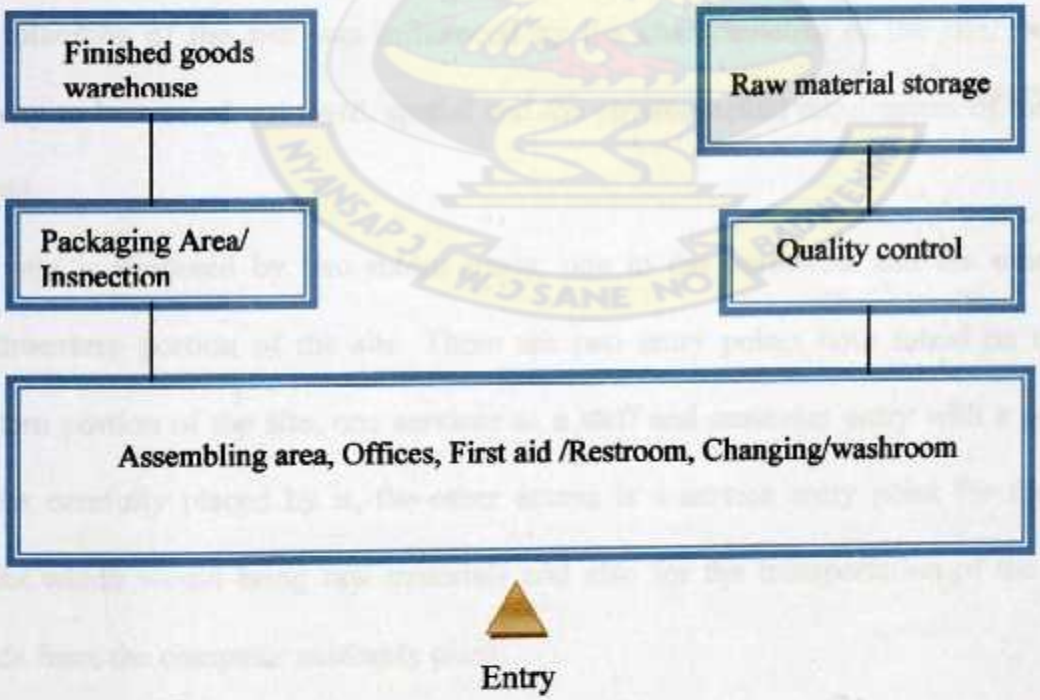
Also the production process speed is of great importance since the greater production rate the less the cost of production in the long run. Employing a design that will foster fast movement of the production process will go a long way to increase productivity levels. Also the use of machines such as conveyors among others will help reduce production time.

The use of appropriate methods of production and also putting in place correct supervision measures in place.

5.4 GENERAL FUNCTIONAL RELATIONSHIP



Production Unit (Functional relationship diagram)



5.5 CONCEPTUAL SITE PLANNING

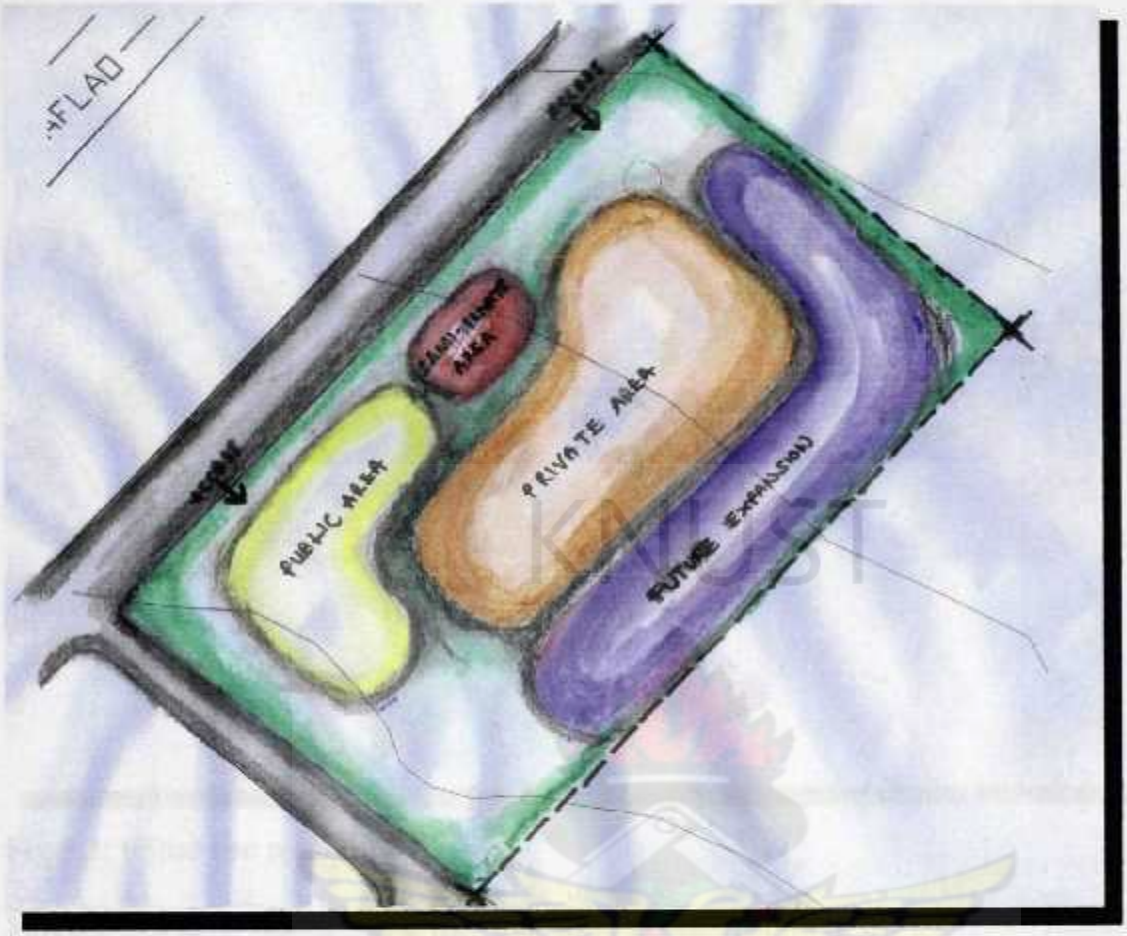


Fig 5.1: Initial Site planning (zoning)

The planning of the site was influenced by the characteristics of the site, the sort of activity to be carried out there, spatial and the environmental requirement of the various spaces.

The site is bordered by two minor roads, one to the northwest and the other to the southwestern portion of the site. There are two entry points both found on the north western portion of the site, one services as a staff and customer entry with a pedestrian access carefully placed by it, the other access is a service entry point for the service trucks which would bring raw materials and also for the transportation of the finished goods from the computer assembly plant.

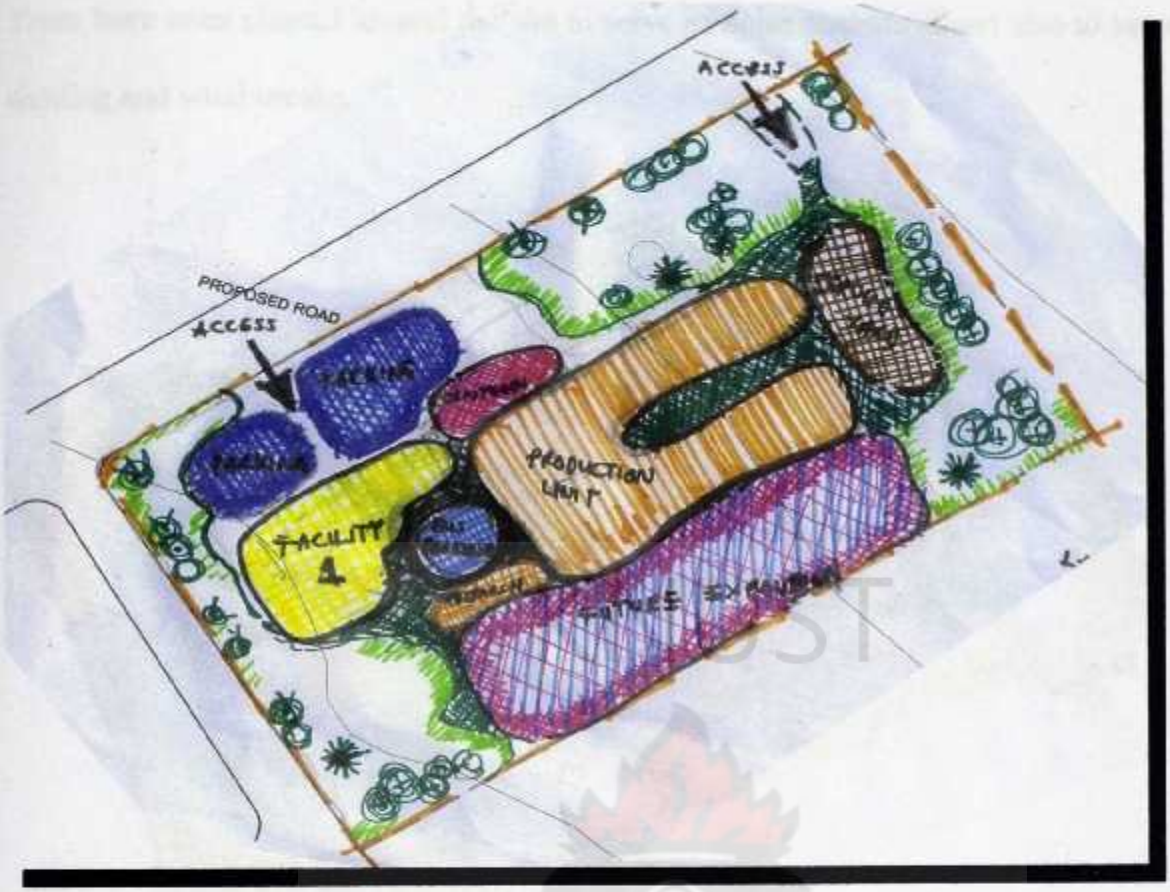


Fig 5.2: Initial site planning

Parking has been planned in a way that there is segregation of the customer parking from the staff parking. Parking for customers has specifically been located just by the entry point of the site so that customers do not have to drive several meters on the site in search of the parking lot. It is also close to the communal entrance of the Administration so that customers can easily make out the entrance themselves after parking. The separation of customer parking from staff parking is for security reasons, the two parking areas are separated by an appreciable distance with landscaping.

The service entry for this facility serves not only service yard for production but also services the canteen area. The service entry is strategically located to the northeastern portion of the site and is quite out of view from the public.

Trees have been planted around the site to serve as noise abatement and also to serve as shading and wind breaks.

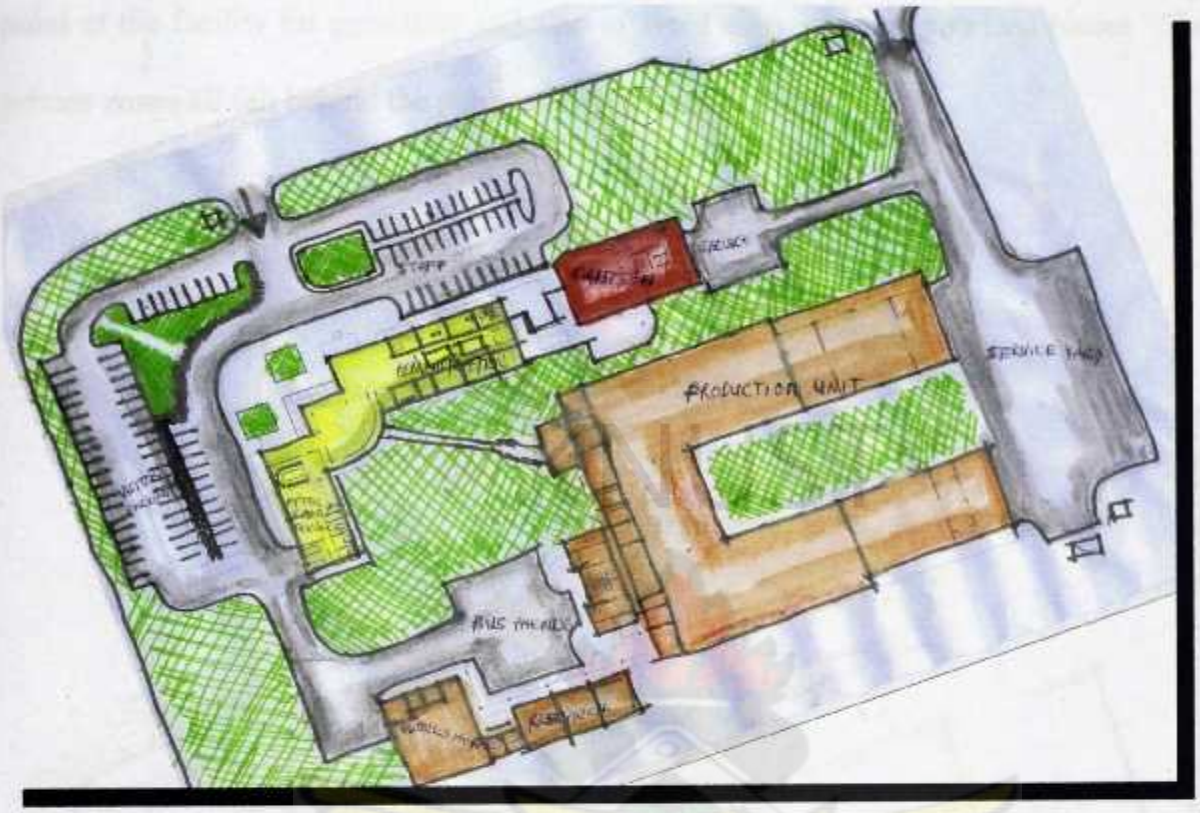


Fig 5.3: Initial Option A

5.6 ZONING

This facility is zoned into three areas, the public areas the semi private areas and the private areas. This has been done because some of the facilities would be mostly accessed by the public, while the private areas are for the employees. The public zones such as the Administration, aftersales servicing centre, the conference room, showroom/sales outlet are all located close to the parking area for easy accessibility by the general public. The semi private areas include the canteen which would be accessed by both workers and visitors who wish to use this facility. The private zones such as the production hall, changing areas for the workers, the research labs, maintenance unit, the material storage

LIBRARY
KWAME NKRUMAH UNIVERSITY OF
SCIENCE AND TECHNOLOGY
KUMASI-GHANA

area and the service yard for the off loading of raw material and loading of finished products are all out of sight of the public. The public areas are zoned close to the entry point of the facility for proximity and also to avoid entry into unauthorized places. The private zones all fall behind the public and semi public zones.

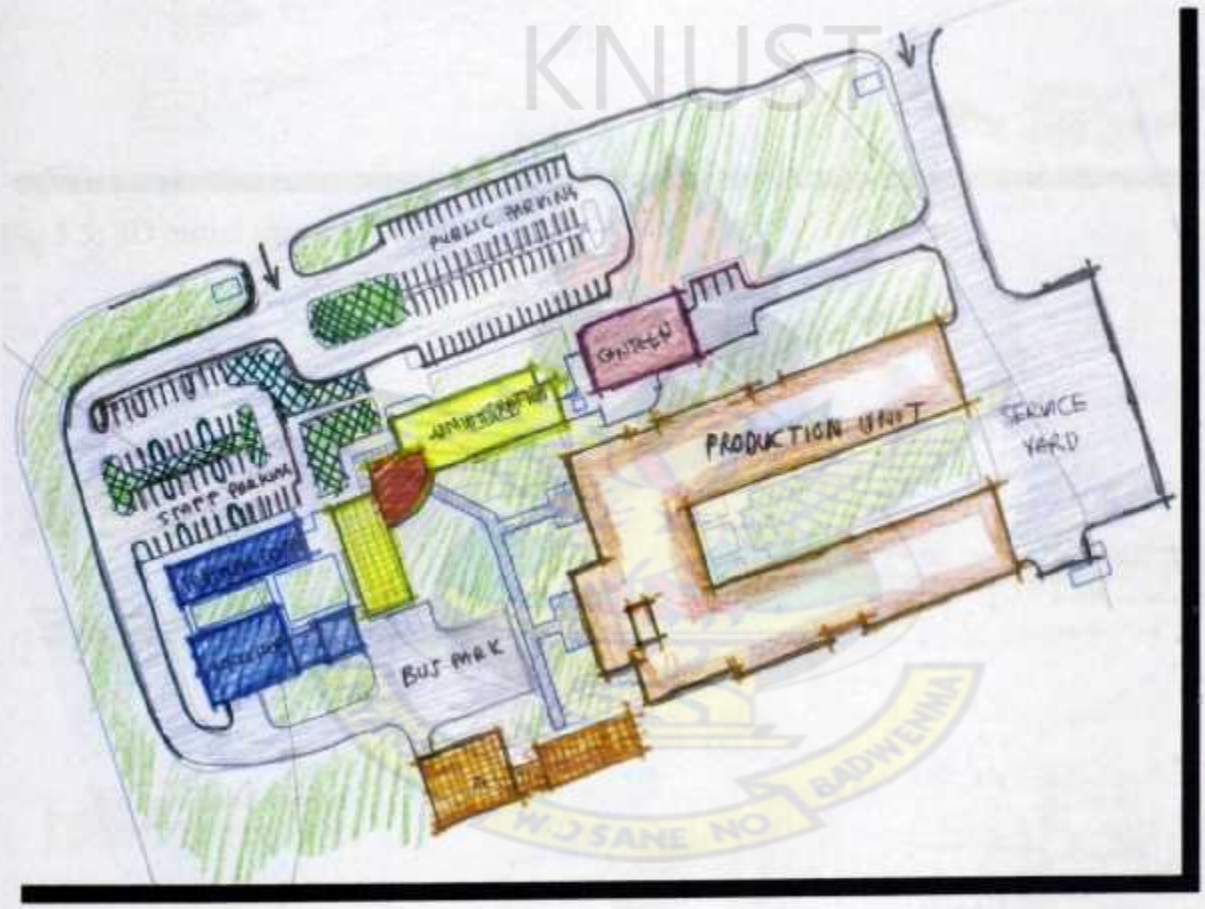


Fig 5.4: Option B

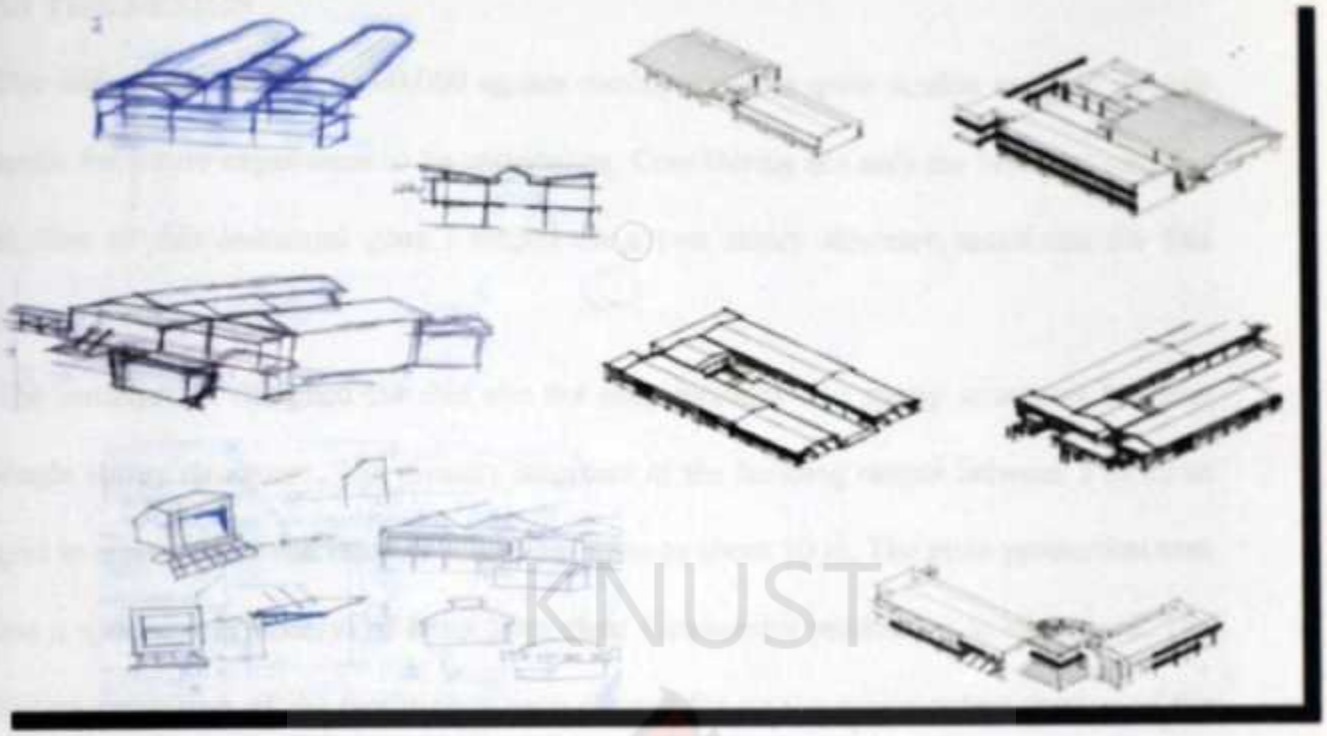


Fig 5.5: 3D initial sketches

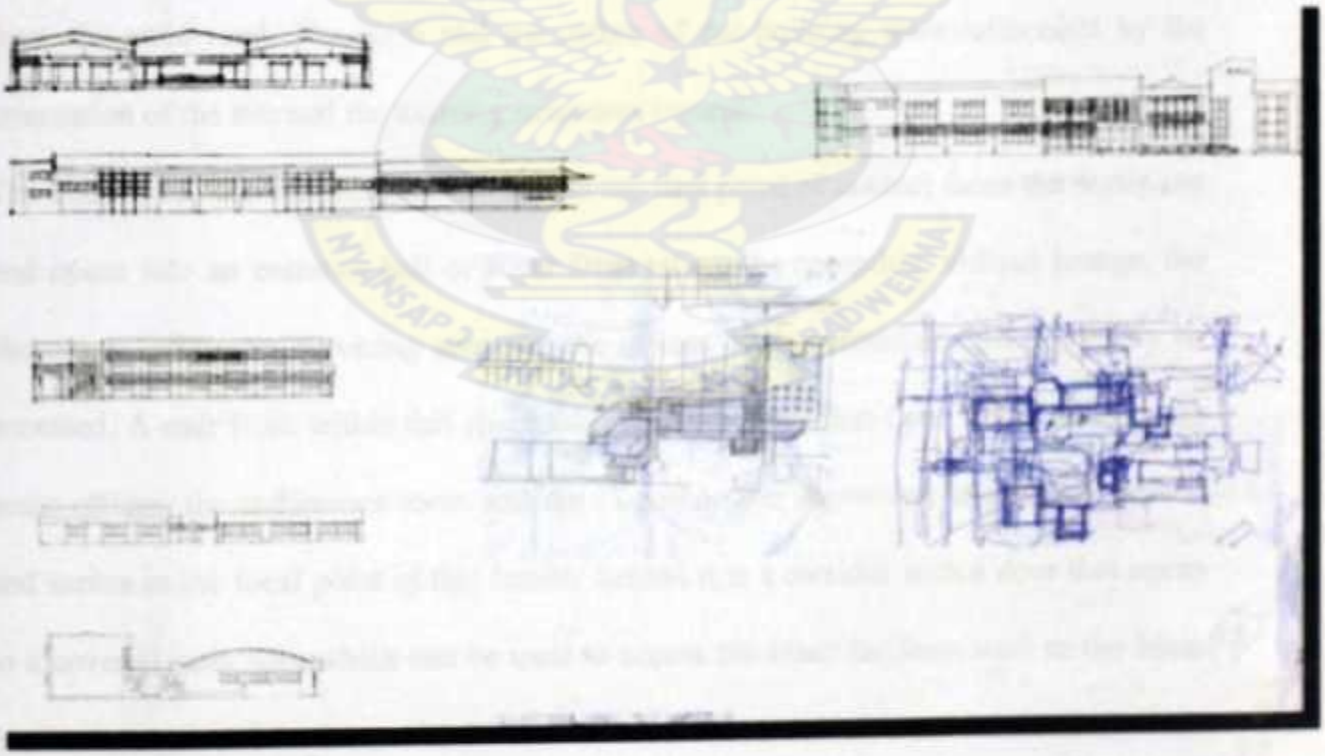


Fig 5.6: 2D Initial sketches

5.7 THE DESIGN

The site covers an area of 60,000 square meters which is quite sizable and has enough space for future expansions to be undertaken. Considering not only the brief but also the skyline of this industrial zone I settled on a two storey structure maximum for this project.

The structures I designed for this site not only includes two storey structures but also single storey structures. The primary structure of the building ranges between 5 m x5 m grid in some places and in other places stretches to about 10 m. The main production area has a special grid interval of 8m x 20m clear distance for production to take place. The Future expansion of the facility has been catered for on the southwestern portion of the site. The front façade of the public areas such as the Administration, the showroom and the training centre all face North West and are therefore parallel to the Accra-Aflao road which also faces the northwestern portion of the site. This enhances the view of the site from the main road. The form and the nature of the building were influenced by the orientation of the site and the existing structures around.

The entrance to the administration which is the first point of contact faces the northwest and opens into an entrance hall or foyer from where the reception, visitors lounge, the showroom, aftersales servicing area and the offices of the administration can easily be accessed. A stair from within this space takes you up to the first floor which also houses some offices, the conference room and the IT room. The showroom is centrally located and serves as the focal point of this facility behind it is a corridor with a door that opens to a covered walk way which can be used to access the other facilities such as the Main production area and the research labs.

This design makes good use of courtyards not only for ventilating the various spaces but also to introduce lighting into the interior spaces. These courtyards are also soft landscaped to add to the aesthetic value and also bring some freshness to the place.

Spatial disposition has also been done in a way that busy areas such as the main production hall, canteen, showroom and the aftersales servicing area are all found on the ground floor with the less busy areas such as the IT and conference room all on the first floor.

The training centre has been strategically located beside the aftersales service centre to share a common workshop so that as fixing of machines are being carried out in the workshop students can also learn from the aftersales service technicians.

Sanitary facilities in the various facilities are mostly sandwiched with changing areas, grouped and located at corners of the building for minimal use of drainage pipes in order to save cost. All the pipes are accordingly housed in ducts.

The main production hall has the changing/sanitary areas, first aid room and rest rooms all attached to it for easy accessibility. The storage areas for both the raw materials and the finished goods area also attached to the main production hall for easy accessibility, which would make production faster and also due to the nature of the components being handled. The main production hall has two main accesses for the workers with clock in areas and security checks to ensure the smooth running of activities in the production hall. The main production area also has a mezzanine floor with offices for the supervisors and managers. This mezzanine floor has been design to help keep an eye on factory workers, with the offices of the various managers overlooking the production floor. The factory floor is intentionally designed in a u-shape to make the production flow of the

various computer assembly processes not only easy but also introduce a high amount of natural lighting into the production hall through the windows around it. The soft landscaped courtyard also helps to keep dust in the production area at a minimum.

Aside the two entrances for workers other emergency exits have also been provided in event of a fire outbreak. Ramps have also been provided to make movement of components easier and faster.

Note: Refer to appendix for Architectural drawings

KNUST

5.8 SERVICES

Services planning must be made as flexible as possible to take into consideration, so that in future changes in the system are is easily carried out. Electrical connections and telecommunication modes should be in modular forms.

5.8.1 ELECTRICITY

Since electricity plays a crucial role in the assembly process and running of computers, it is therefore critical that quantity and quality of electricity being supplied is checked and other alternatives such as stand-by generators added to ensure a constant supply of power. This provision is intended to prevent loss of data and also damaging of computer components due to power outages and fluctuations.

This computer assembly plant's electric power is tapped from the National Grid to a transformer in a generator set house on the site for an automatic power switch in case of any power outage. This is then sent to the distribution board in the switch room. There is

also the use of power generated from photovoltaic cells to supplement the power from the national grid. The electrical cables in the production hall would be housed in false floors, floor trunking and above in the ceiling.

Electrical connections are of a modular nature to allow future changes in the system to be catered for.

Electrical power supply vary according to the sort of machines being used, and their sizes, but generally are of two basic ranges.

- 240/415 v + 6% at 50 cycles/seconds + 1%
- Or 220/380 v + 6% at 50 cycles/seconds + 1%

Photo voltaic power generation

Solar energy received by the photo voltaic panel is converted to electricity energy. This goes to a charge controller, to regulate power supply, then to a battery (cell) for storage. This then goes to a distribution board, to be inverted or changed from D.C. to A.C. then finally to the equipment or machine.

Photo voltaic power depends on the solar peak period. The solar peak period also varies with regions. The solar peak period for Tema is between 5 to 6 hours.

A current photovoltaic panel of a dimension 500mm x 900mm generates energy of 50 peak watts, 21.4 – 17v.

Energy requirement for computers range between 250-400 watts, hence an appreciable space should be considered for the display of the photo voltaic panels.

5.8.2 INFORMATION AND COMMUNICATION SYSTEMS

Communication lines are also tapped from Ghana telecom lines close to the site and also the use of radio and satellite phones as a means of communication. Another form of communication used within the facility would be the PABX (private automated branch exchange) system for internal communication within the assembly plant. Such communication systems help save time and money. Communication cables are housed in floor trunking and false floors.

Information systems are the software and hardware systems that support data-intensive applications. Information systems such as the internet, radios and television among others are used to provide both the workers and customers with needed information and news. There is the incorporation of various avenues of sources of information such as call rooms, cyber cafes and bulletin boards in the design to foster the spread of information.

5.8.3 LIGHTING

Adequate lighting is provided to ensure adequate vision for factory workers to work. For such a space where computers are assembled or used the lighting requirement should fall within 600 **lux** (55.74 foot candles) and 900 **lux** (83.61 foot candles).

Lighting for the assembly plant is partly natural and artificial. Natural lighting systems have been explored to bring Natural Sunlight Indoors, enabling the assembly plant to cut costs on lighting. Courtyards have been incorporated in the design to effectively bring day lighting into the various spaces requiring them.

5.8.4 VENTILATION

This assembly plant makes use of both natural and artificial ventilation. Computer systems require a fairly high degree of environmental control for optimum functioning. Many peripheral units such as disk drives, memory (RAM), central processing unit mother board or main board all require higher levels of environmental control. Air conditioning does not only control the temperature and humidity within the interior spaces, but also help regulate dust and other impurities from entering the spaces where the computers are. Dust and dirt can have adverse effects on the computer components so therefore the need to control ventilation in such places. For places such as the canteen natural ventilation is employed.

Recommended ranges are:

Temperature: -16°C – 27°C, at maximum rate of change of 2.7°C /Hr.

Humidity: -35% - 65% (condensing), at a maximum rate of 10%/Hr.

Air purity: general requirements are 96% efficiency at 5 micron pentacle,-Normal industrial filtration (1 Micron = 1×10^{-6} meter).

Dust control is of great importance here and measures such as the use of appropriate materials for both the interior and exterior environment. Both audible and visible looming devices are incorporated to ward of any impending environmental changes by recommended limits.

5.8.5 FIRE PROTECTION

Fires can be devastative and therefore measures must be put in place to ensure all fire outbreak are brought under control. Hence the provision of powder hydrants and extinguishers within the main production area and also adequate fire alarm systems such as smoke detectors, provision of fire rated walls and emergency exits at strategic locations to protect lives and property in the event of a fire outbreak. Fire extinguishers and hydrants are provided for all the other facilities also. The hydrants are also provided around the various facilities and in the courtyards to serve as precautionary measures precautionary.

5.8.6 WATER

Water will be tapped from the mains to the site via a 150mm diameter PVC pipe into an underground water tank. It will then be pumped into overhead storage tanks with pneumatic pumps and then redistributed by gravity to the various facilities of the assembly plant.

5.8.7 SECURITY MONITORING

The word security is derived from the Ancient Greek "Se-Cura" and literally translates to "without fear". 'Security' is therefore the state of being secure, or the actions employed to achieve that state.

This assembly plant will employ the services of qualified security personnel to manage its security affairs and also employ sophisticated electronic security systems such as the use of CCTV (close circuit television), cameras which will be placed at strategic points to

monitor activities within the assembly plant. The provision of security checks at vantage points and also security monitoring rooms to monitor what goes on in and around the production area. Security locks which require secret codes will also be employed to help control theft.

The provision of adequate security lambs at vantage points around the computer assembly plant to ensure optimum security, enhance night vision and help control theft.

5.9.8 WASTE DISPOSAL

A central waste disposal septic tank is in place which will store all the solid wastes from the various facilities until they are emptied.

Soil waste either solid or liquid will be piped through ducts and a series of manholes into a septic tank to be located on site.

There will also be a refuse room to house wastes from the assembly plant and another one provided solely to cater for waste from the canteen. Trash containers will also be installed at strategic points around the various facilities to ensure a clean environment.

5.8.9 DRAINAGE

There will be the provision of both covered and open drains to carry waste water and also rain water from the site. Both covered and open drains such as gutters are employed in this facility.

5.9 CONSTRUCTION TECHNOLOGY

The type of materials used for the plant need to be carefully considered to ensure a high degree of suitable conditions for the activities not only within the production area but also the other spaces.

5.9.1 STRUCTURAL SYSTEM

The structural systems are in steel and concrete. Concrete has a high fire rating ratio.

The structural frame system used for the various facilities, are based on post and beam construction with reinforced concrete columns, tied with beams. Non-load bearing walls are used to partition the various spaces.

Roofing: Steel trusses are used for all the facilities accept for the Main production hall which makes use of I-section portal frame system. Portions of some of the facilities are roofed with reinforced concrete slabs which also happen to serve as solar slabs.

Walls: The walls are of made up of static-free materials, which will not flake or attract dust and must also have sound absorbent properties.

The partition walls in the facility are of clipboard with anti scratch lamination finish. This finish is resistant to dust and scratches on walls with pens and other materials which are very common in most training institutions. Computer systems are thus well protected while partition walls of habitable rooms in the facility will require less maintenance.

The curtain walls are made of Zinc coated Aluminum oxide heat reflecting glass which reflects about 70% of the solar radiation incident on it and converts the remaining 30% into a red bias light. The red bias light is very good for computer fitted rooms since it does not create glare.

Ceiling: A false roof of about 1200mm depth is used to conceal service ducts for electrical cables, lighting and air conditioning fittings. The ceiling material is a sound absorbent material and also has static free properties. Other cabling connections are housed in the false floors of the facility.

Flooring: The type of flooring depends on type of activity required to be carried out on it. False flooring of thickness of between 200mm - 350mm thick are used to house most of the cabling connections in the production area and other parts of the computer assembly plant. Flooring materials such as non slip terrazzo which is dust free, resilient has therefore been specified for the assembly area. Other areas like the reception and entrance foyer is finished with polished granite tiles.

5.10 COST ESTIMATES

The preliminary cost estimate is based on the prevailing market rate of GH¢340 per square metre.

The approximate estimation method was used to calculate the estimates for the cost of this project. With this method, the unit cost per floor area and the probable total cost of the facility is then obtained by multiplying the total floor area by the calculated rate.

The costing is also aimed at giving the client a fair idea about the financial investment the project will need.

Based on the current market trends a unit of GH¢340 per square metre was used for the calculation.

Facility	Area m^2	Cost per m^2 (GH¢)	Cost of total area (GH¢)
Administration	755	340	256700
Canteen	440	340	149600
Production unit	3650	340	1241000
Service centre	378	340	128520
Education facilities	554	340	188360
		Total cost	**1964180**

Total cost estimate of the structure for the proposed project is **GH ¢1,964,180**

5.11 CONCLUSION

Information and communication technology has served as a catalyst in the Rapid globalization and liberalization of the world economy. It is therefore crucial for a computer and information based economy to be encouraged in developing countries since it is a sure way of boosting their economies.

Awareness about the importance of ICT skills for empowering developing countries in the global economy should be emphasized and encouraged, not only that but also policies and developmental initiatives aimed at promoting information and communication

technology would therefore be a step in the right direction. Also ways of making computers affordable and accessible to all should be exploited.

This thesis work however highlights the significance of ICT and how the much needed infrastructure can be developed, all in the quest to improve the socio-economic well-being of developing countries across the West African sub-region.

KNUST

BIBLIOGRAPHY

1. Chilton John- Space guide Structures (Architectural press, Butterworth- Heineman, 2000

2. Hall F- Essential Building Service and Equipment (Butterworth-Heineman Limited, 1935)

3. Ernest and Peter Neufert, Architects Data, third edition

4. Neufert, Neufert Architects Data, Alden press ltd, 1998

5. Egan M. David & Olgyay, Architectural Lighting, Betsy Jones, 2002.

6."Computer," *Encyclopaedia Britannica Ultimate Reference Suite,* Chicago, Encyclopaedia Britannica, 2009

7. Snyder, Timothy Law, "Computer," *Microsoft Student Encarta Encyclopaedia,* Redmond, WA, Microsoft Corporation, 2008.

8. Furey M. Thomas, *Decision Elements in the Design of a Consumer Electronics Assembly Plant,* Massachusetts, Massachusetts Institute of Technology, 1999

9. Wikipedia Encyclopaedia

10. http://www.bdir.sourceforge.net/binnyva

11. http://www.bnet.com

12. http://www.ehow.com

13. http://www.zdnet.com

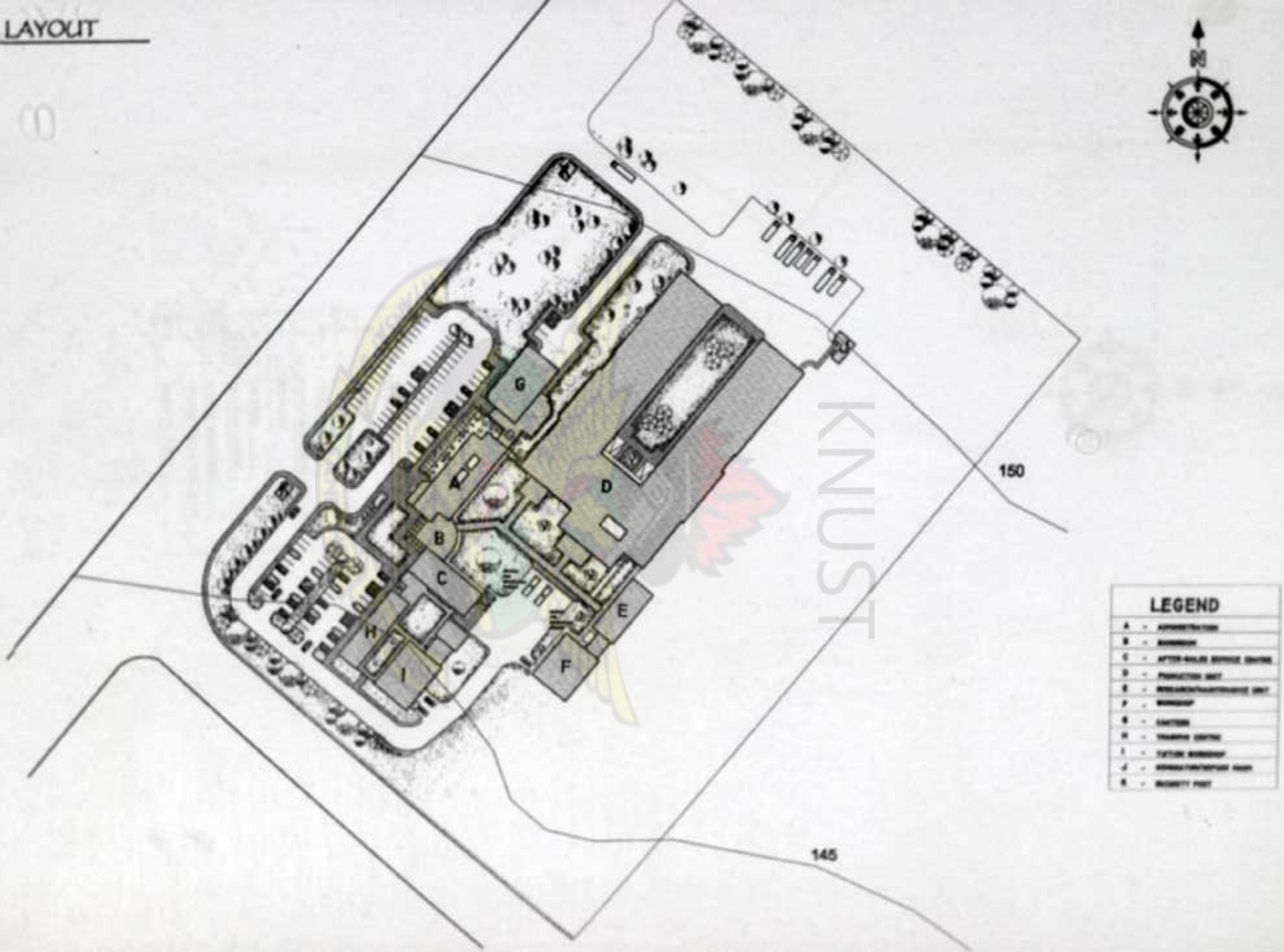
KNUST

APPENDIX

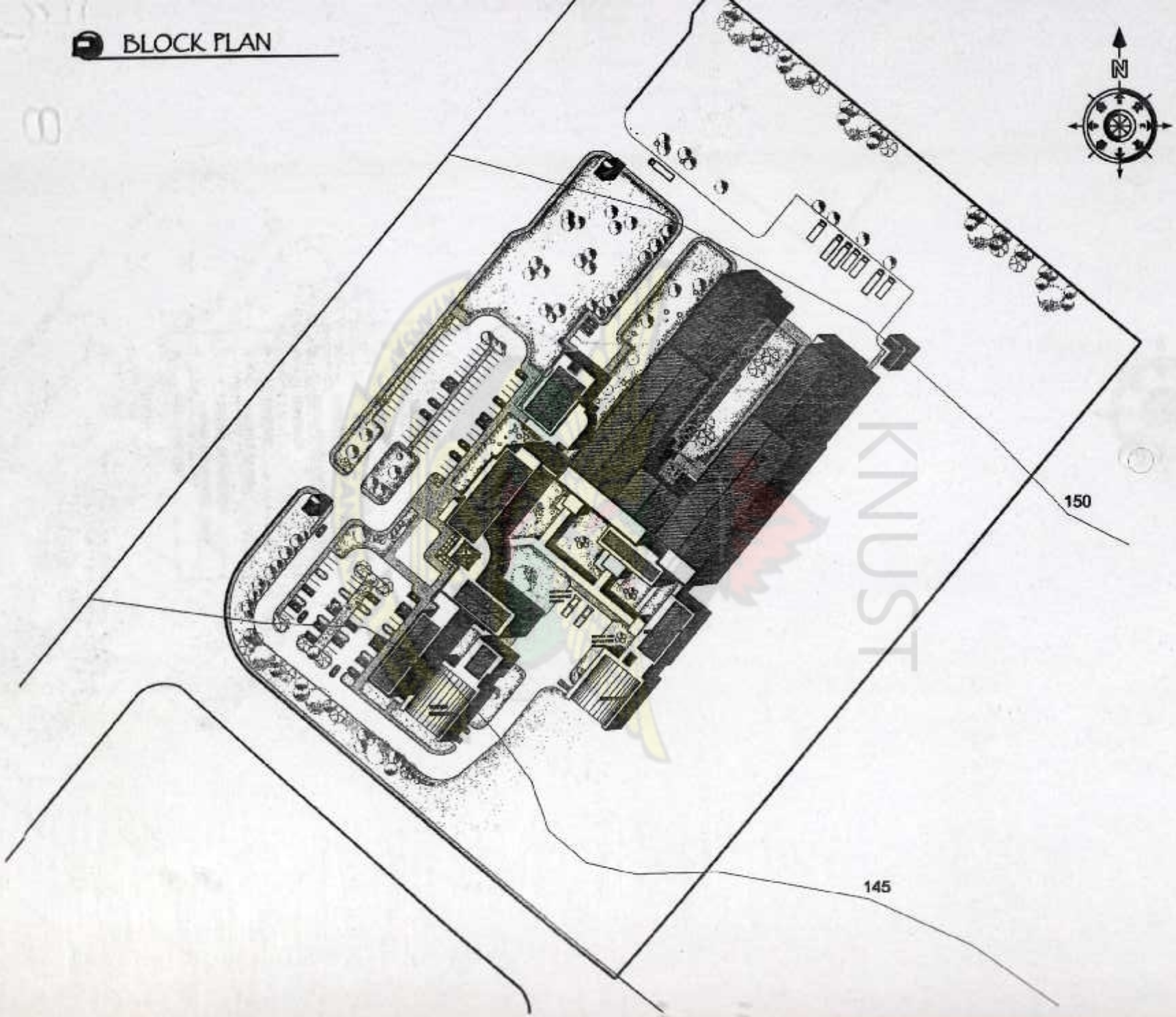
ARCHITECTURAL DRAWINGS

KNUST

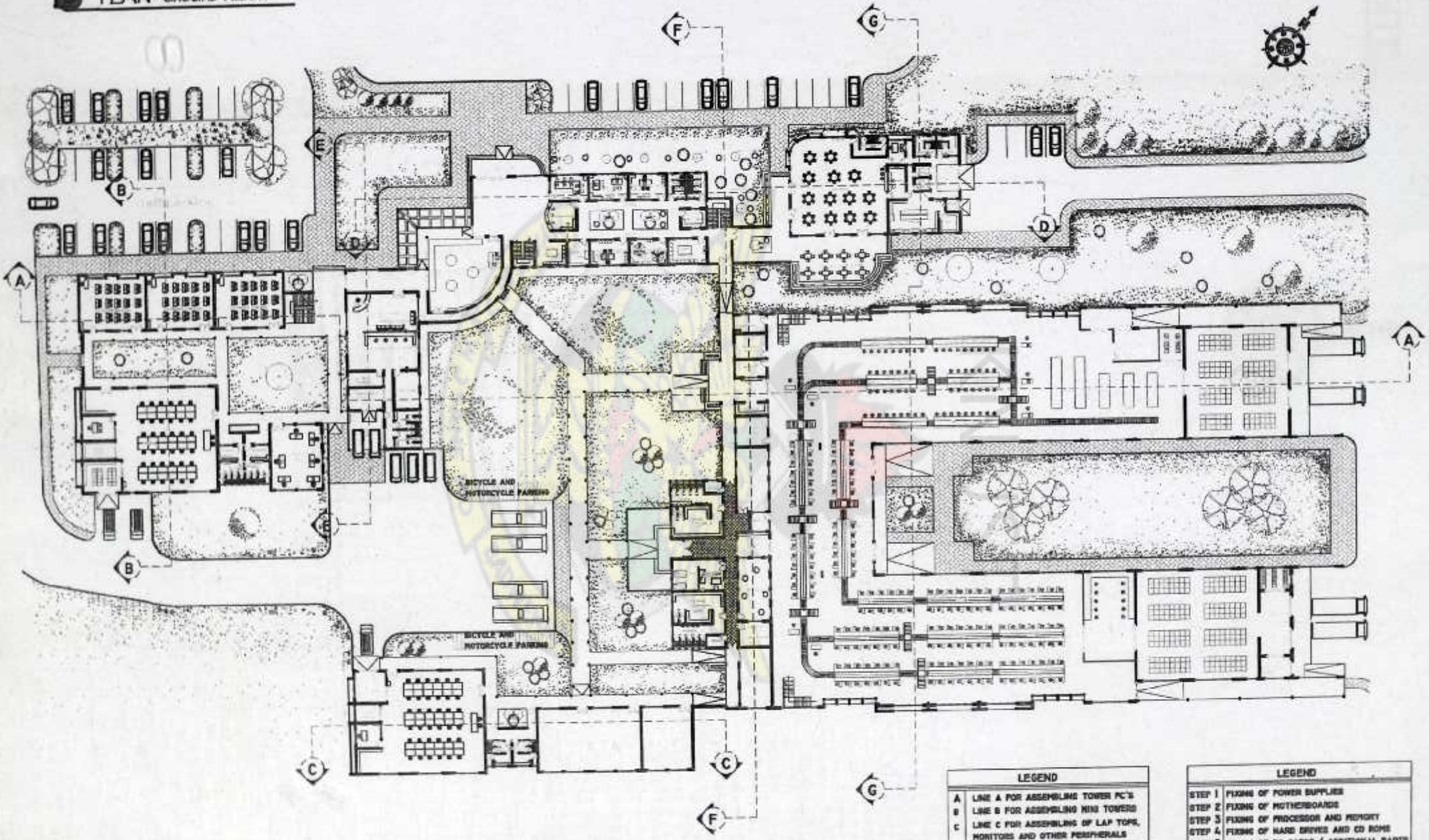
SITE LAYOUT



BLOCK PLAN



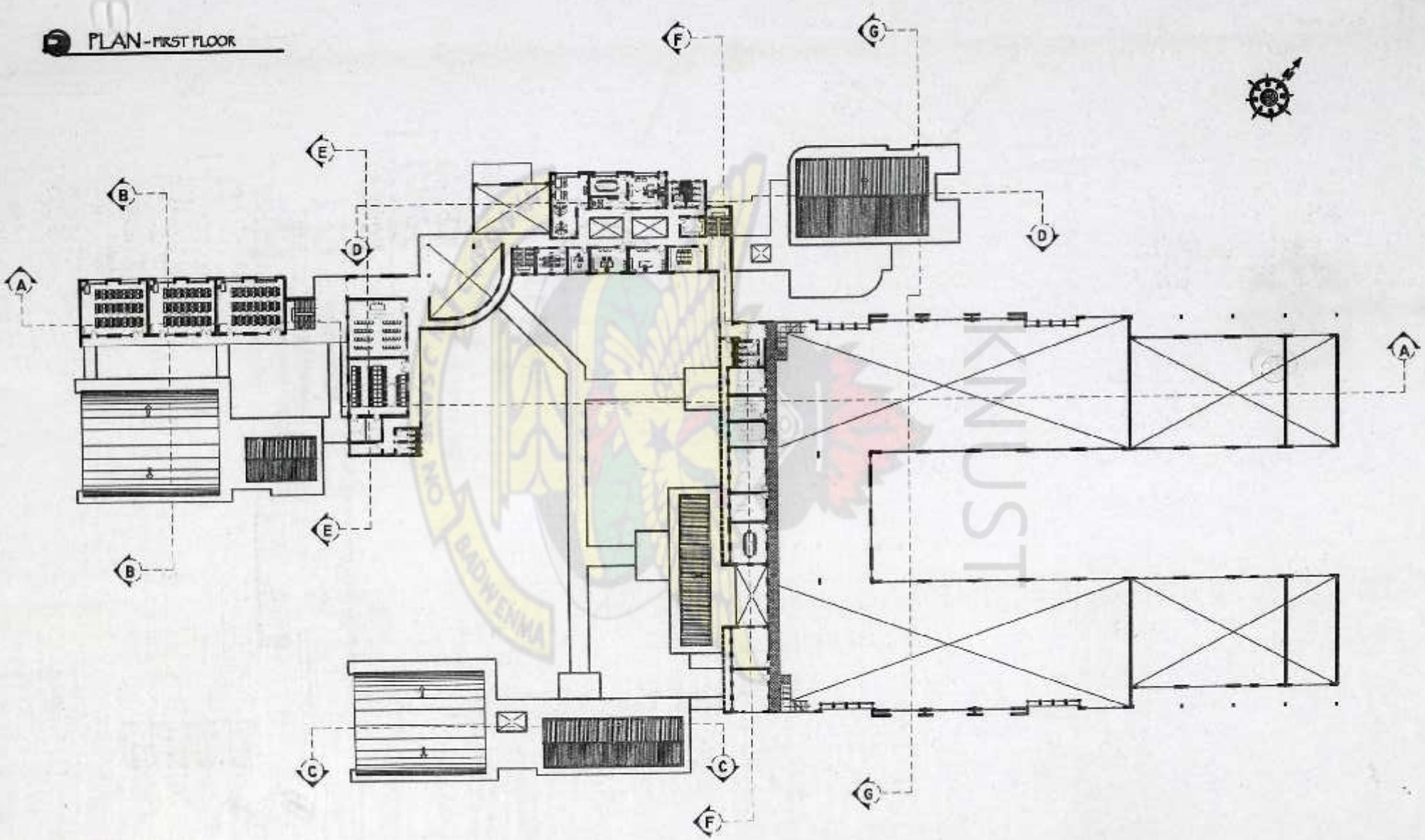
PLAN - GROUND FLOOR



LEGEND	
A	LINE A FOR ASSEMBLING TOWER PC'S
B	LINE B FOR ASSEMBLING MINI TOWERS
C	LINE C FOR ASSEMBLING OF LAP TOPS, MONITORS AND OTHER PERIPHERALS

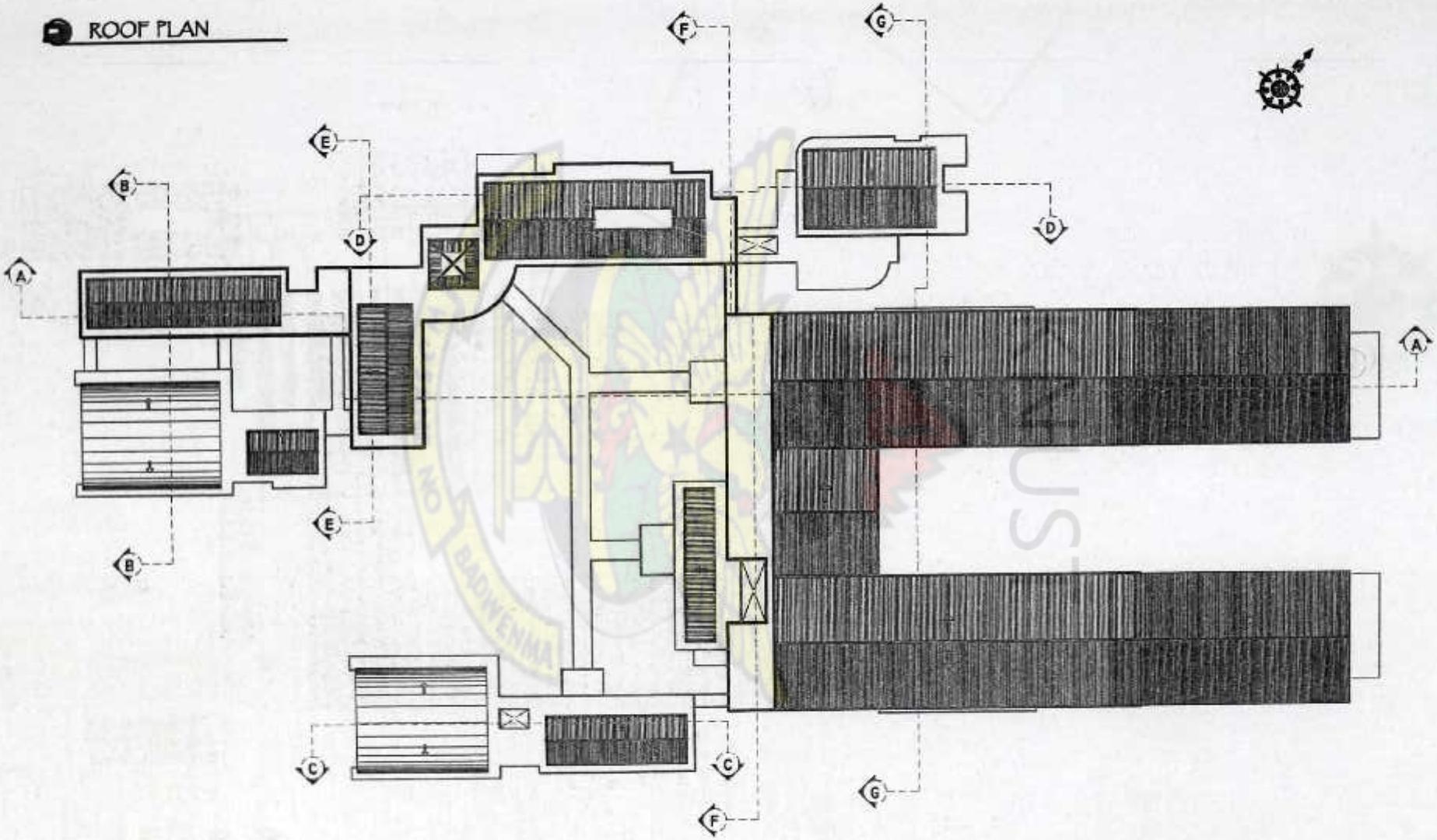
LEGEND	
STEP 1	FIXING OF POWER SUPPLIES
STEP 2	FIXING OF MOTHERBOARDS
STEP 3	FIXING OF PROCESSOR AND MEMORY
STEP 4	FIXING OF HARD DRIVES AND CD ROMS
STEP 5	FIXING OF PC CARDS / ADDITIONAL PARTS

PLAN - FIRST FLOOR



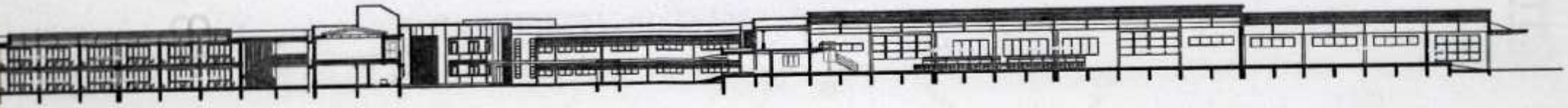
KNUST

ROOF PLAN

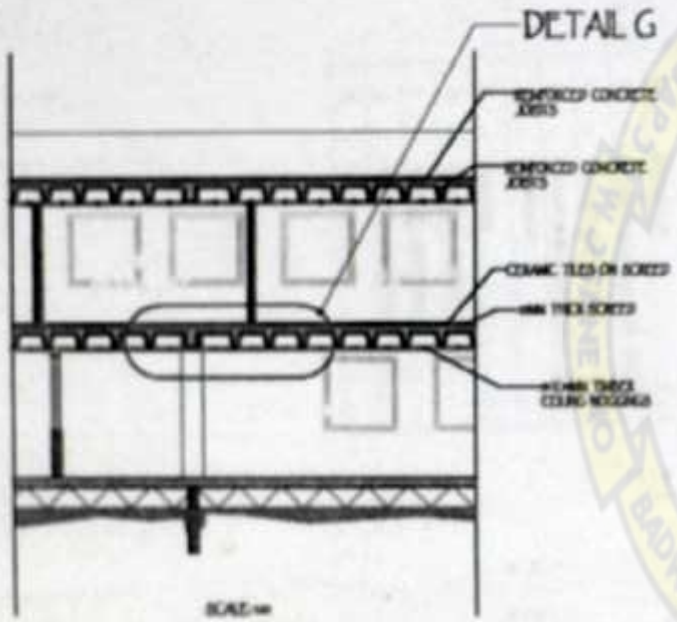


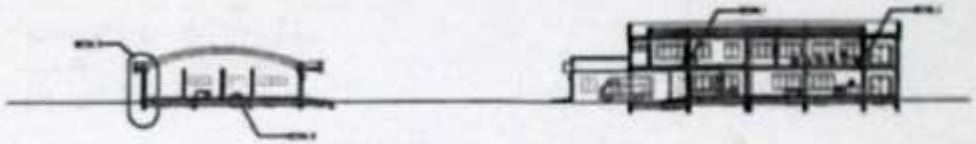
SECTIONS

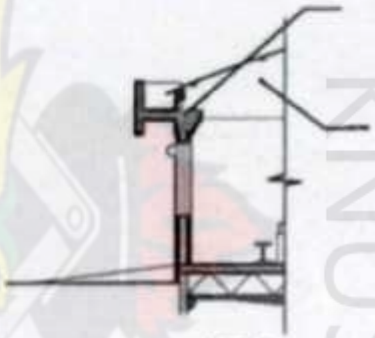
KNUST

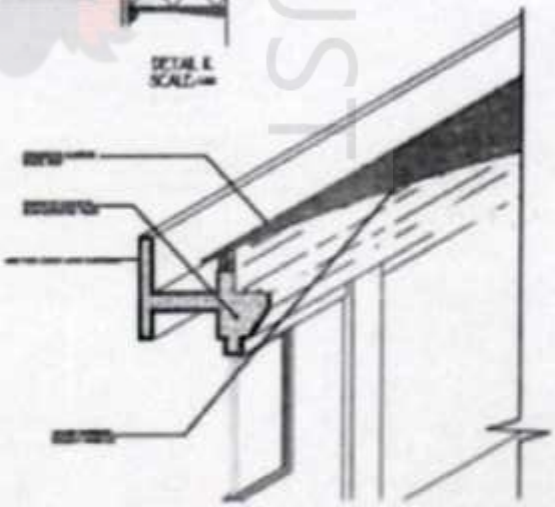


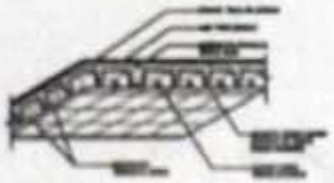
DETAILS







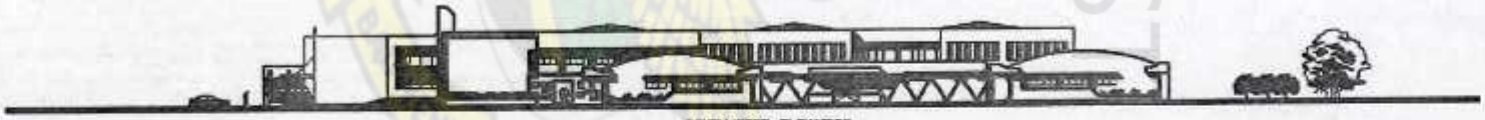




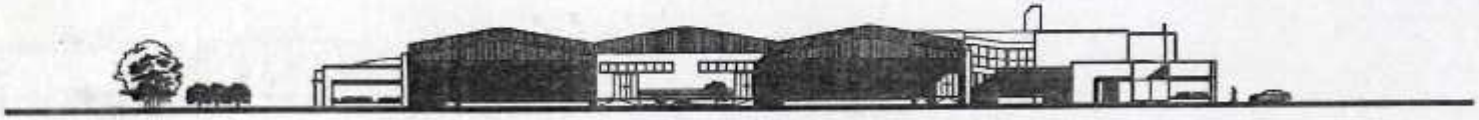
ELEVATIONS

NORTH-WEST ELEVATION

SOUTH-EAST ELEVATION

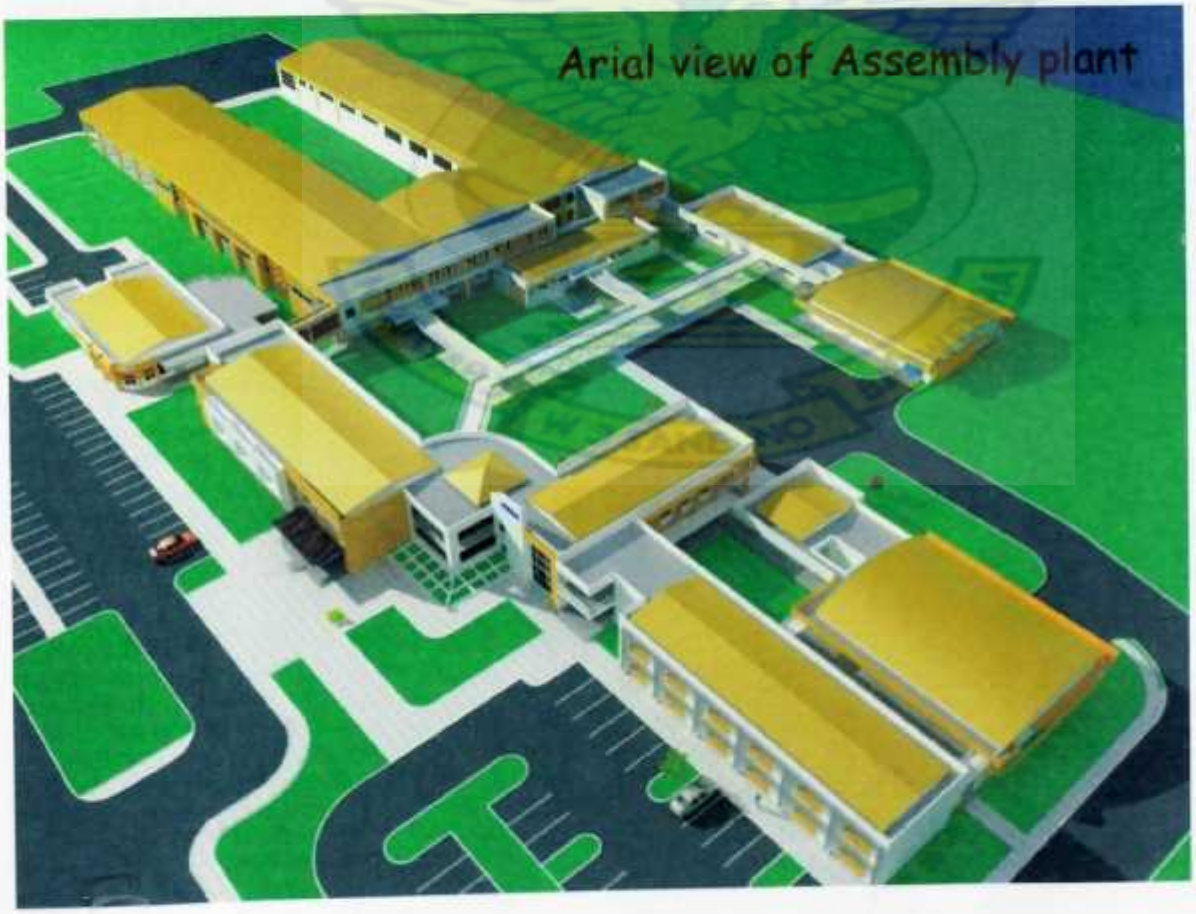


SOUTH-WEST ELEVATION



NORTH-EAST ELEVATION

Block plan


Arial view of Assembly plant

Administration

Administration

KNUST

Service Centre

Service centre

Training Centre

Dell Computers
Training Centre

Training/Service Centre

Production Plant

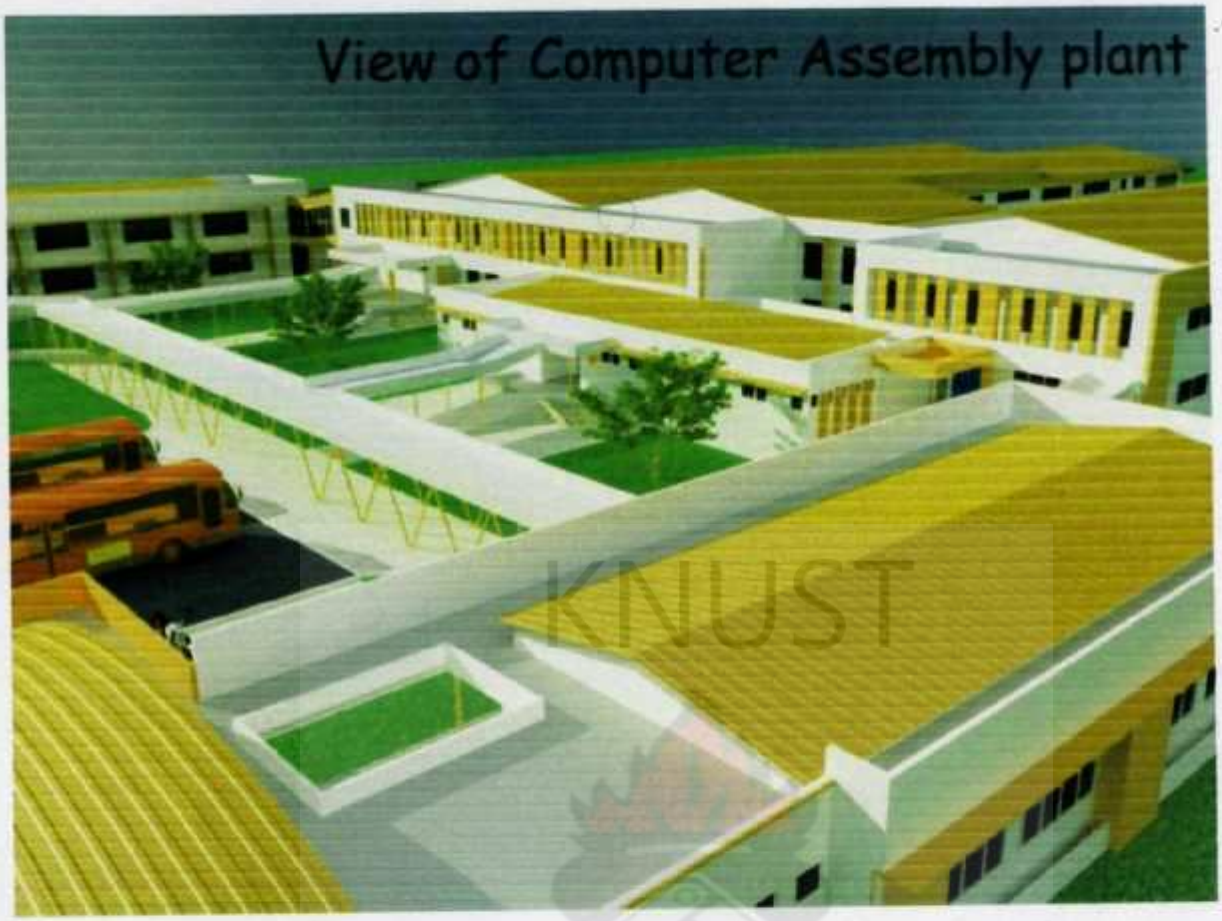
Production unit

Parking Area

Production Unit

Service Yard

KNUST



KNUST