DESIGNING TO HEAL:

THE ROLE OF ARCHITECTURE IN PROMOTING HEALING IN THE LONG-TERM CARE SETTING

By

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DECLARATION

Candidate's Declaration:

"I declare that this thesis submission is my own work towards the M. Arch and that, to the best of my knowledge it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due and appropriate acknowledgement has been made in the text."

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ABSTRACT

Hospitals first appeared at the start of the Christian era to shelter sickor weary travelers and persons too poor or ill to be treatedat home, yet their dirty, crowded and dark environmentwere anything but hospitable. The change from this tothe present day hospitals has been metamorphic.(Shi, L., & Singh, D, 2001).

Hospitals are complex buildings containing many departments of different specializations where diagnostic or therapeutic activities take place, while other administrative, ancillary, or service units sustain, and support main functions, to compliment the health care process.

While healthcare functional aspects following the same medical trends have the same influence on hospital architecture all through the world, yet, cultural aspects form a dominant deviant influence in each country according to its different cultural trends following habits and traditions. Although sustaining patients' comfort is a universal demand, its application might warrant different methods.

This thesis therefore describes in detail the status and perspective of Ghanaian healthcare facilities with an analysis of emerging trends of healthcare facilities, the impacts hospital architecture has on patients and staff with an overall aim of improving design efficiency in healthcare facilities and improving patient and staff comfort healthcare facilities.

The study was carried out on a random sample of hospitals operating under government jurisdictions. Sample size was roughly restricted to the two main teaching hospitals in Ghana; Korle-Bu and Komfo Anokye and the Sunyani Regional Hospital. The material itself consisted of pictorial and technical data, as obtained from the archives of said institutions. Plan types of these institutions were examined and analysed with respect to functional classification of spaces constructed.

DEDICATION

This report is dedicated to the Almighty God for giving me the strength to undertake this design thesis.

Dedication of this report also goes to my father, Mr. John Serbe Marfo, my mother Mrs. Mary Marfo and all my siblings, for their enormous support and financial backing.

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To God for this provision

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APPENDIX A

SAMPLE QUESTIONAIRRE FOR HEALTHCARE STAFF

Name of Respondent:

Occupation (Institution):

Age: **Sex:**

1) How long have you been in your current employment? (…….)

2) Do you enjoy your job? (Y/N)

3) Do you find your work tiring? (Y/N)

4) What don't you find fulfilling about the environment in which you work? (……..)

5) What do you find fulfilling about the environment in which you work? (……..)

6) Do you look forward to coming to work every day? (Y/N)

7) Do you hope to continue working in your current environment? (Y/N)

8) Does moving between your workspace and other units or wards affect your performance? (Y/N)

9) How do you relate to the people you work with? (……..)

10) a. Do you find yourself making some errors at work? (……..)

10) b. What type of errors are they? (……)

11) a. Do you experience symptoms of drowsiness or headaches after long hours at work? (Y/N)

11) b. When do you experience these? (……)

12) What times of the day are you most tired? (…….)

13) What would you prefer to change about the physical environment in which you work? (……)

SAMPLE QUESTIONAIRRE FOR IN-PATIENTS

Name of Patient:

Occupation (Institution):

Age:

Sex:

1) How long have you been admitted? (……..)

2) Are you comfortable in your environment? (Y/N)

3) Do you find your recovery progressive? (Y/N)

4) What don't you find fulfilling about the environment in which you are admitted? (…)

5) What do you find fulfilling about the environment in which you are admitted? (……)

6) If you had the choice where would you prefer to be admitted? (…….)

7) Do you hope to continue your recovery in your current environment? (…….)

8) Does moving between your ward and other units or wards affect you? (……)

9) How do you relate to the people who tend to you? (……..)

10) Are you nostalgic? (……)

11) a. Do you experience symptoms of drowsiness or headaches which are not symptoms of your ailment? (……..)

11) b. When do you experience these? (…….)

12) What times of the day are you most tired? (…….)

13) What would you prefer to change about the physical environment in which you work? (……)

APPENDICES

CHAPTER ONE

1. INTRODUCTION

1.1PREAMBLE

“We shape our buildings; thereafter they shape us,” noted statesman and prime minister Winston Churchill ,1945.

Healthcare buildings are to be designed as living spaces for patients rather than warehouses for the sick. It has to be remembered that a hospital is not a factory in which the assembly lines dictates all aspects of design but is a community in which the patient is fundamental to the successful working of the whole. Needs and expectations of the patients have to be visualized, analyzed and fulfilled. The hospital building should provide the patients a sense of safety, comfort, dignity and repose. It should also provide pleasing spaces for patients, families and visitors as well as imbibe the cultural concerns of the community. (Kane, 2001) emphasized that the design of healthcare setting should welcome the patients family and friends, value human beings over technology and provide flexibility to personalize the care of each patient.(Shi, L., & Singh, D, 2001).

This thesis is therefore intended to elucidate on how to create a healing environment in light of growing health challenges in Ghana and the globe at large. The aim is to have a humanizing architecture that can positively contribute to the healing process. It should make the patient enjoy the best of bioclimatic comfort. Healthcare Design must also satisfy professional requirements.

The physical environment of the healthcare facility should firstly do no harm and secondly facilitate healing process.

1.1.1 HISTORY OF HEALTHCARE FACILITIES

The term hospital derives from the Latin word “hospitalis”, which relates to guests and their treatment.(Bartlett, 2007).The word reflects the early use of these institutions not merely as places of healing but as havens for the poor or for weary travellers. Hospitals first appeared in Greece as “Aesculapius”, named after the Greek god of medicine, Aesculapius. For many centuries they developed in association with religious institutions, such as the Hindu hospitals opened in Sri Lanka in the 5th century bc and the monastery-based European hospitals of the Middle Ages (5th century to 15th century). The Hôtel Dieu in Paris, a monastic hospital founded in A.D. 660, is still in operation today. (Bartlett, 2007)

The first hospital established in the United States was Pennsylvania Hospital in Philadelphia, which was chartered in 1751 with the support of Benjamin Franklin. Although other U.S. hospitals were created in the 1700s, most people were treated for their illnesses by neighbours and friends in their homes well into the 1800s. Hospitals changed radically after the Civil War—in the early years of the war no hospitals were available to treat the thousands of soldiers who were wounded or became ill, but by the war’s end in 1865, 200 hospitals with more than 137,000 beds had opened in the northern states. In addition to the military hospitals that emerged during the Civil War, many voluntary and public hospitals appeared in the 1850s.

Throughout the 1850s and 1860s it was far more dangerous to receive care in a hospital than at home because of poor sanitation. As many as 25 percent of patients died after surgery because hospitals of that era were overcrowded, poorly ventilated, and inadequately cleaned. The introduction of antiseptic techniques by British surgeon Joseph Lister in 1865 marked a turning point in the safety of hospitalization.

Patient care also improved as a result of the formal training of nurses at the first nursing schools, which were founded independently .The development of X rays and the clinical laboratory in the 1890s further improved the quality of care available to patients and prompted the opening of many new hospitals, including religious hospitals and hospitals that specialized in the treatment of women or children. The number of for-profit hospitals owned by doctors also increased between 1890 and 1920.

1.1.2 History of Healthcare Facilities in Ghana

The first Teaching Hospital in Ghana was, The Korle Bu Teaching Hospital, formerly known as the Gold Coast Hospital, it was opened at its present site, in the south-western part of the city of Accra, on October19, 1923 by the then Governor of the Gold Coast, Sir Gordon Guggisberg. At its inception, Korle Bu Hospital had less than 200 beds and treated up to 200 patients daily. At that time, Korle Bu was described as the finest hospital in Africa,on account of its impressive array of fine buildings and a cadre of competent staff,who provided excellent medical care to the population of Ghana, in general, and the city of Accra, in particular.

From its inception, hospitals such as Korle Bu has been used for the training of practicalnurses, nurse-anaesthetists, dispensers, midwives and other para medical staff. In1946, a Nurses Training College was opened at Korle Bu to train a higher level ofStaff Registered Nurses (SRNs) for the hospital, and for the entire country.

Throughout the 1920s, there had been a running debate among the medical establishment about whether the hospital should also be training doctors and medical assistants. In April 1963, this debate was permanently settled by a decision taken by the government to make Korle Bu Hospital the teaching hospital for the University of Ghana Medical School, until a medical center could be built at Legon (the main campus of the University of Ghana). The medical center in Legon never materialized, and, subsequently, the medical school was attached to Korle Bu hospital.

From 1957 onwards, a rapid development and expansion of Korle Bu's original design - aimed at modernizing the hospital - has taken place. The expansion of the hospital resulted in an increase in the number of beds to 1526 by 1972. Several specialties and sub-specialties, befitting the status of Korle Bu as the apex tertiary care center in Ghana, were added to the traditional departments of Medicine, Surgery, Pediatrics and Obstetrics and Gynecology.

Today, there are quiet number of healthcare facilities in Ghana from state of the art Private owned hospitals to small clinics with as little as a 4-bed capacity. Ghana adopted a number of policies to ensure an improved health sector. These included the

introduction of minimum fees paid by patients to augment state funding for health services and a national insurance plan.

1.1.3 HEALTHCARE IN GHANA

Modern medical services in Ghana are provided by the central government, local institutions, Christian missions (private non-profit agencies), and a relatively small number of private for profit practitioners. According to the United Nations, about 60.2 percent of the country's total population in 1995 depended on government or quasi-government health centers for medical care. Of the available health facilities represented in the 2000 census, about 62.9 percent were still described as government and quasi-government institutions. Mission hospitals represented a large percentage of the remainder, while private hospitals constituted less than 2 percent of modern medical care facilities (WHO 2005 Report on Global health standards)

The medical system in Ghana comes under the jurisdiction of the Ministry of Health, which is also charged with the control of dangerous drugs, narcotics, scientific research, and the professional qualifications of medical personnel. Regional and district medical matters fall under the jurisdiction of trained medical superintendents. Members of the national Psychic and Healers' Association have also been recognized by the government since 1969. Over the years, all administrative branches of the Ministry of Health have worked closely with city, town, and village councils in educating the population in sanitation matters.

Many modern medical facilities exist in Ghana, but these are not evenly distributed across the country. Ministry of Health figures for 2000 showed that there were 18,477 beds for the estimated national population of 22 million. (World Bank Annual Report on living Standards in Ghana 2005) figures showed that in 1965 there was one physician to every 13,740 patients in Ghana. The ratio increased to one to 20,460 in 1989. In neighbouring Togo, the doctor-to-patient ratio of one to 23,240 in 1965 improved to one to 8,700 in 1989; it was one to 29,530 in 1965 and one to 6,160 in 1989 for Nigeria, whereas in Burkina, the ratio of one to 73,960 in 1965 worsened to one to 265,250 in 1989. These figures show that while the doctor-patient ratio in Ghana gradually became less favourable, the ratio in neighbouring countries, with the exception of Burkina, was rapidly improving.(World Bank Annual Report on living Standards in Ghana 2005)

The ratio of nurses to patients in Ghana (one to 3,730 in 1965), however, improved to one to per 1,670 by 1989. Compared to Togo (one nurse to 4,990 patients in 1965 and one to 1,240 in 1989) and Burkina (one to 4,150 in 1965 and one to 1,680 in 1989), the rate of improvement in Ghana was slow. Nigeria's nurse-to-patient ratio of one to 6,160 in 1965 and one to 1,900 in 1989 was exceptional. A rapidly growing Ghanaian population was not the only reason for unfavourable ratios of medical staff to patients; similar population growth was experienced in neighbouring West African countries. Insofar as the Ghana Medical Association and the various nurses associations were concerned, better salaries and working conditions in Nigeria, for example, were significant variables in explaining the attraction of that country for

Ghanaian physicians and other medical personnel. This attraction was especially true for male and, therefore, more mobile medical workers, as shown by the arguments of various health workers' associations in 1990 during demonstrations in support of claims for pay raises and improved working conditions.(World Bank Annual Report on living Standards in Ghana 2005)

On the whole, however, Ghana's health conditions are improving. The result is reflected in the decline in infant mortality from 120 per 1,000 live births in 1965 to 86 per 1,000 live births in 1989, and a rate of overall life expectancy that increased from an average of forty-four years in 1970 to fifty-six years in 1993. (WHO 2005 Report on Global health standards)

To reduce the country's infant mortality rate further, the government initiated the Expanded Program on Immunization in February 1989 as part of a ten-year Health Action Plan to improve the delivery of health services. The government action was taken a step further by the Greater Accra Municipal Council, which declared child immunization a prerequisite for admission to public schools.

1.2 OBJECTIVE

Amongst other things, this research shall seek to achieve the following;

i. To promote the creation of a healing environment by research and design

ii. To enhance the smooth and efficient running of healthcare facilities by the provision of recommendations on creating a comfortable healthcare environment

iii. To provide a source of reference on design efficiency of healthcare facilities in Ghana

iv. To make an assessment of the physical form of the healthcare building and asses its response to enhanced patients' expectations

1.3. SCOPE

The study was carried out on a random sample of hospitals operating under government jurisdictions. Sample size was roughly restricted to the two main teaching hospitals in Ghana; Korle-Bu and Komfo Anokye and the Sunyani Regional Hospital. The material itself consisted of pictorial and technical data, as obtained from the archives of said institutions. The factors considered were (a) Location of Facility, (b) Departmental Inventory with respect to Facilities available(c) Functional relationship/circulation within the facility and (d) Specialised system Utilisation.

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1. Kane 2001. *Health care Manager*. Washington, DC: Federation of Nurses and Health Professionals.

2. Shi, L., & Singh, D. (2001). *Delivering health care in America: A systems approach* (2nded). Gaithersburg, MD: Aspen Publishers

3. Interviews with the Medical Superintendent of Brong Ahafo Regional Hospital, Dr. Daniel Asare, 13th February, 2007

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 DEFINITIONS

Health is a state of physiological and psychological well being. (WHO 2005 Report on Global health standards)

Definitions that have been given for a Hospital include;

"An institution that provides a broad range of medical services to sick, injured, or pregnant patients. Hospitals employ medical, nursing, and support staff to provide inpatient care to people who require close medical monitoring and outpatient care to people who need treatment but not constant medical attention."(Webster's Dictionary 2007, 7th Edition)

The role of the hospital is in transformation. The main parameters, which have impacted changes in hospital architecture, are: Enhanced patients' expectations, increased emphasis on ambulatory care, enhanced standards of care and Demographic and epidemiological changes.

2.2 HEALTHCARE FACILITIES TODAY

Present-day Hospitals comprise of a wide range of services and functional units. These include diagnostic and treatment functions, such as clinical laboratories, imaging, emergency rooms, and surgery; hospitality functions, such as food service and housekeeping; and the fundamental inpatient care or bed-related function. This diversity is reflected in the breadth and specificity of regulations, codes, and oversight

that govern hospital construction and operations. Each of the wide-ranging and constantly evolving functions of a hospital, including highly complicated mechanical, electrical, and telecommunications systems, requires specialized knowledge and expertise. No one person can reasonably have complete knowledge, which is why specialized consultants play an important role in hospital planning and design.

In addition to the wide range of services that must be accommodated, hospitals must serve and support many different users and stakeholders. Ideally, the design process incorporates direct input from the owner and from key hospital staff early on in the process. The designer also has to be an advocate for the patients, visitors, support staff, volunteers, and suppliers who do not generally have direct input into the design. Good hospital design integrates functional requirements with the human needs of its varied users.

The basic form of a hospital is, ideally, based on its functions, namely;

bed-related inpatient functions, outpatient-related functions, diagnostic and treatment functions, administrative functions, service functions (food, supply), research and teaching functions.

Physical relationships between these functions determine the configuration of the hospital. Certain relationships between the various functions are required—as in the following flow diagrams.

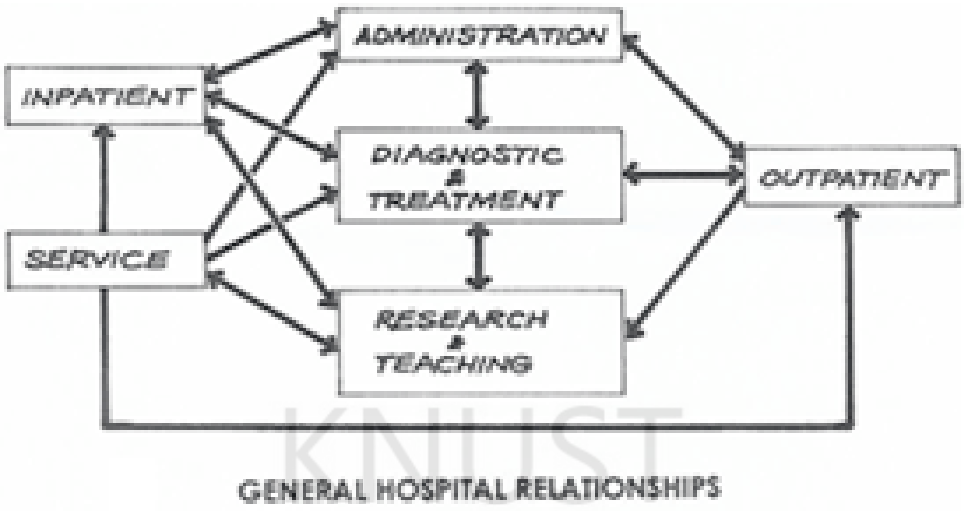

Fig 1; General flow diagram of the various units of a modern healthcare facility

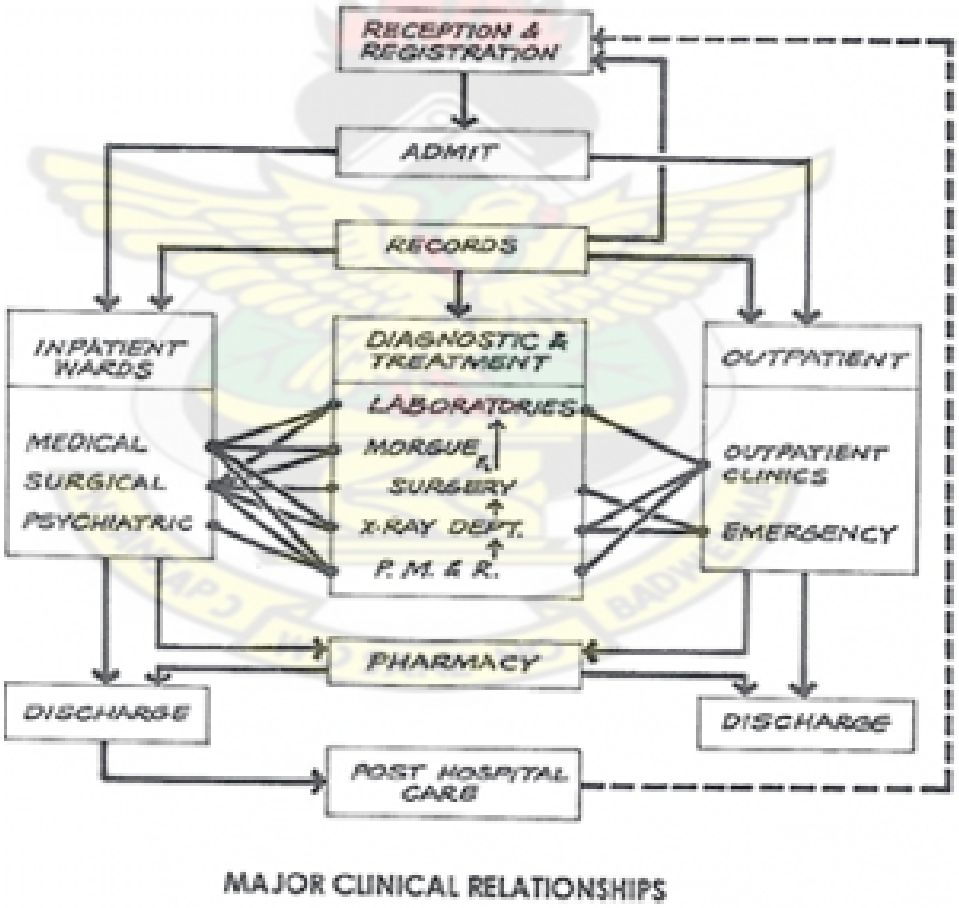

Fig 2; Major Clinical Relationships between the various units in a healthcare facility

These flow diagrams show the movement and communication of people, materials, and waste. Thus the physical configuration of a hospital and its transportation and logistic systems are inextricably intertwined. The transportation systems are influenced by the building configuration, and the configuration is heavily dependent on the transportation systems. The hospital configuration is also influenced by site restraints and opportunities, climate, surrounding facilities, budget, and available technology. New alternatives are generated by new medical needs and new technology.

2.2.1 Trends in Healthcare Facilities Today.

From the foregoing study, today's dynamic environment healthcare facilities are one of the fastest changing organizations. A hospital has to constantly adjust to variable work loads uncertainty and critical situations.

The study also makes evident that demand will also change in hospitals due to increase in life expectancy, health becoming a norm and healthcare focusing on prevention and intervention rather than treatment.

The healthcare facility should be eco friendly and designed to make use of renewable resources of energy such as solar and wind energy. Hospital stay is gradually being programmed only for high dependency inpatient care. The healthcare facilities must plan for day care/home care/ambulatory care facilities/wellness and fitness.

Use of natural light, high efficiency light sources, biogas technology and Aesthetics should also be incorporated in the planning and designing of hospitals so as to provide a quality and pleasure experience from the surroundings. These and many other positive elements from other studies shall form the pond of ideas from which my thesis shall stem.

Regardless of their location, size, or budget, all hospitals should have certain common attributes. (WHO Annual Report 2007). These are as outlined below:

2.2.1. a. Efficiency and Cost-Effectiveness

According to (World Health Design 2005.) An efficient hospital layout should:

1) Promote staff efficiency by minimizing distance of necessary travel between frequently used spaces

2) Allow easy visual supervision of patients by limited staff

3) Include all needed spaces, but no redundant ones. This requires careful pre-design programming.

4) Provide an efficient logistics system, which might include elevators, pneumatic tubes, box conveyors, manual or automated carts, and gravity or pneumatic chutes, for the efficient handling of food and clean supplies and the removal of waste, recyclables, and soiled material

5) Make efficient use of space by locating support spaces so that they may be shared by adjacent functional areas, and by making prudent use of multi-purpose spaces

6) Consolidate outpatient functions for more efficient operation—on first floor, if possible—for direct access by outpatients

7) Group or combine functional areas with similar system requirements

8)Provide optimal functional adjacencies, such as locating the surgical intensive care unit adjacent to the operating suite. These adjacencies should be based on a detailed functional program, which describes the hospital's intended operations from the standpoint of patients, staff, and supplies.

2.2.1. b. Flexibility and Expandability

Since medical needs and modes of treatment will continue to change, hospitals should:

1) Follow modular concepts of space planning and layout

2) Use generic room sizes and plans as much as possible, rather than highly specific ones

3) Be served by modular, easily accessed, and easily modified mechanical and electrical systems

4) Where size and program allow, be designed on a modular system basis. This system also uses walk-through interstitial space between occupied floors for mechanical, electrical, and plumbing distribution. For large projects, this provides continuing adaptability to changing programs and needs, with no first-cost premium, if properly planned, designed, and bid. This Building System also allows vertical expansion without disruptions to floors below.

5) Be open-ended, with well planned directions for future expansion; for instance positioning "soft spaces" such as administrative departments, adjacent to "hard spaces" such as clinical laboratories.

2.2.1. c. Therapeutic Environment

Hospital patients are often fearful and confused and these feelings may impede recovery. Every effort should be made to make the hospital stay as unthreatening, comfortable, and stress-free as possible. The interior designer plays a major role in this effort to create a therapeutic environment. A hospital's interior design should be based on a comprehensive understanding of the facility's mission and its patient profile. The characteristics of the patient profile will determine the degree to which the interior design should address aging, loss of visual acuity, other physical and mental disabilities, and abusiveness. (Interior Design Manual 2005.) Some important aspects of creating a therapeutic interior are:

1) Using familiar and culturally relevant materials wherever consistent with sanitation and other functional needs

2) Using cheerful and varied colours and textures, keeping in mind that some colours are inappropriate and can interfere with provider assessments of patients' pallor and skin tones, disorient older or impaired patients, or agitate patients and staff, particularly some psychiatric patients.

3) Admitting ample natural light wherever feasible and using colour-corrected lighting in interior spaces which closely approximates natural daylight

4) Providing views of the outdoors from every patient bed, and elsewhere wherever possible; photo murals of nature scenes are helpful where outdoor views are not available

5) Designing a "way-finding" process into every project. Patients, visitors, and staff all need to know where they are, what their destination is, and how to get there and return. A patient's sense of competence is encouraged by making spaces easy to find, identify, and use without asking for help. Building elements, colour, texture, and pattern should all give cues, as well as artwork and signage. (Signage Design Guide 2005)

2.2.1. d. Cleanliness and Sanitation

Hospitals must be easy to clean and maintain. This is facilitated by:

1) Appropriate, durable finishes for each functional space

2) Careful detailing of such features as doorframes, casework, and finish transitions to avoid dirt-catching and hard-to-clean crevices and joints

3) Adequate and appropriately located housekeeping spaces

4) Special materials, finishes, and details for spaces which are to be kept sterile, such as integral cove base. The new antimicrobial surfaces might be considered for appropriate locations.

5) Incorporating practices that stress indoor environmental quality (IEQ)

2.2.1. e. Accessibility

All areas, both inside and out, should:

1) Comply with the minimum requirements of the Disability Act (DA2005). (Source: Ministry of Health Codes 2006)

2) Ensuring grades are flat enough to allow easy movement and sidewalks and corridors are wide enough for two wheelchairs to pass easily

3) Ensuring entrance areas are designed to accommodate patients with slower adaptation rates to dark and light; marking glass walls and doors to make their presence obvious

2.2.1. f. Controlled Circulation

A hospital is a complex system of interrelated functions requiring constant movement of people and goods. Much of this circulation should be controlled.

1) Outpatients visiting diagnostic and treatment areas should not travel through inpatient functional areas nor encounter severely ill inpatients

2) Typical outpatient routes should be simple and clearly defined

3) Visitors should have a simple and direct route to each patient nursing unit without penetrating other functional areas

4) Separate patients and visitors from industrial/logistical areas or floors

5) Outflow of trash, recyclables, and soiled materials should be separated from movement of food and clean supplies, and both should be separated from routes of patients and visitors

6) Transfer of cadavers to and from the morgue should be out of the sight of patients and visitors

7) Dedicated service elevators for deliveries, food and building maintenance services

2.2.1. g. Aesthetics

Aesthetics is closely related to creating a therapeutic environment. It is important in enhancing the hospital's public image and is thus an important marketing tool. A better environment also contributes to better staff morale and patient care. Aesthetic considerations include:

1) Increased use of natural light, natural materials, and textures

2) Use of artwork

3) Attention to proportions, colour, scale, and detail

4) Bright, open, generously scaled public spaces

5) Homelike and intimate scale in patient rooms, day rooms, consultation rooms, and offices

6) Compatibility of exterior design with its physical surroundings

2.2.1. h. Security and Safety

In addition to the general safety concerns of all buildings, hospitals have several particular security concerns:

1) Protection of hospital property and assets, including drugs

2) Protection of patients, including incapacitated patients, and staff

3) Safe control of violent or unstable patients

4) Vulnerability to damage from terrorism because of proximity to high-vulnerability targets, or because they may be highly visible public buildings with an important role in the public health system.

2.3 National Alzheimer's Disease Centre, Madrid
A bioclimatic complex for saving energy

Fig 3; Aerial view of the National Alzheimer's Disease Centre, Madrid

The centre for sufferers of Alzheimer's disease in PAU de Vallecas (Madrid) is a multidisciplinary project whose objective is to create a model that can be applied in other regions. The structure of the complex is divided into four sections: the residence for 162 patients, the day centre, the research centre, and the training centre for health professionals. It consists of many low units with a common corridor running along the back. This acts as a link between the public and residential areas. A large ramp joins the different levels.

The building has also been designed with a carefully researched environmental strategy in place. The idea was to create a bioclimatic and energy-efficient structure, where doors and windows would play a fundamental role. Its design considered illumination and natural ventilation as well as solar protection or collection. The

southeast and southwest facing façades have large glass areas, so as to capture sunlight in winter. Because sunlight falls horizontally at that time of year, the window captures almost 90% of its rays, thus reducing heat and light consumption. On the other hand, in summer, sunlight is vertical, so the window captures only 29%. The northeast and northwest facing façades have less glass and are less protected, since they do not receive as much direct sunlight. Yet the most significant of all is the photovoltaic façade of the Research Centre, since this provides protection from the sun while at the same time generating energy.

All of the sheltered housing units are built around a number of courtyards which use WICTEC 50 curtain walling. These have been fitted with side-hinged windows from Technal's SaphirFXi range, which suit the project perfectly thanks to their excellent versatility. Titane PH doors have alsobeen fitted. However, on the external façades, large openings have been created and fitted with Technal Unicity tilt and turn windows with a visible aluminium profile of just 55 mm to make the most of the glazed area available.

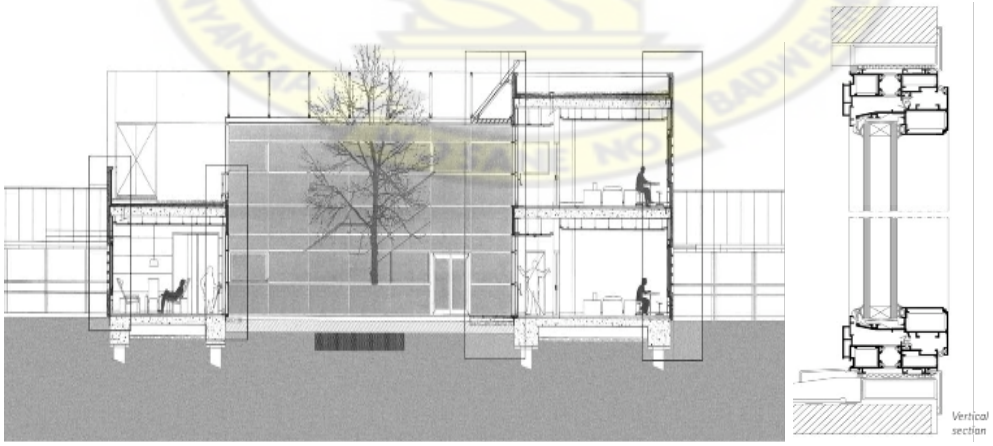

Fig 4; Cross Section of the National Alzheimer'sDisease Centre, Madrid

The different living units are built around the Centre's courtyards

Fig 5; Corridor view of the National Alzheimer's Disease Centre, Madrid

Fig 6; Courtyard view of the National Alzheimer's Disease Centre, Madrid

photovoltaic façade of the Research Centre, since this provides protection from the sun while at the same time generating energy. All of the sheltered housing units are built around a number of courtyards which use WICTEC 50 curtain walling.

The architectural proposal aims at achieving direct, easy user understanding of the building's organisation, in such a way that one knows where one is at all times. The layout and location of the work and patient rest areas have been key points in achieving these goals. Moreover, the predominance of horizontal instead of vertical relationships, and the organisation of the floors interspersed by the sequential

presence of interior garden-terraces, further simplifies comprehension of the spaces and their purpose.

The north façade has an acoustic screen for the area with heaviest, most intensive use such as operating theatres, the ICU and the casualty unit. The south façade, with its excellent exposure to the sun, lower acoustic impact and better landscape, has been employed to house the hospital wards. All in all, it is a building designed with a gradient of use intensity in mind.

CASE STUDIES

2.4 KORLE BU TEACHING HOSPITAL.

Korle Bu Teaching Hospital has nearly 1900 beds (2005 estimates). It functions as the teaching hospital for the Ghana Medical School, and has a staff component of more than one hundred and fifty doctors. Korle Bu Hospital serves as the ultimate referral institution for patients from all over the country. It is also a general hospital for the Greater Accra Municipality, which has an estimated population of 3.87 million (2010 projection from 2000).

The hospital belongs to, and is controlled by, the Ministry of Health, although moves have been afoot for thel ast few years to make it a fully autonomous institution within the Ministry of Health, under the provisions of Law 209.

Fig 7; A view of an early section of the Korle Bu hospital Administration, this section was completed in 1927

Fig 8; A view of a recently completed section of the Korle Bu hospital Administration, this section was completed in 2004.

As a teaching hospital, Korle Bu has three primary goals: the provision of high-quality medical care, teaching (including the training of students in medicine, nursing, pharmacy, and a variety of other para-clinical and technical disciplines), and research. The hospital has specialised units in Surgery, Medicine, Paediatrics, Obstetrics and Gynaecology, Dentistry, Ophthalmology, Ear, Nose and Throat, Orthopaedics, Pathology and Communicable Diseases. Within the surgery department, the main divisions are the Units of General Surgery; Oral, Dental and Maxillo-facial Surgery; Cardio-Thoracic and Vascular Surgery; Neuro-Surgery; Uro-genital Surgery; and Casualty. Similarly, within the medicine department, the main divisions are the Units of General Medicine; Infectious Diseases; Cardiovascular Diseases; Emergency Medicine; Endocrine/Genetic Diseases; Kidney Diseases; Neurology; and

Dermatology. The other large departments include Laboratory Services, the Blood Bank, Radiography, Physiotherapy, Occupational Health, and the Pharmacy department.

There are a number of other institutions, with links to the Ministry of Health, located at Korle Bu. These are:

The Nurses Training School, The Public Health Nurses Training School,The Midwifery Training School, The School of Hygiene,The Disease Control Division of the MOH,The Health Education Unit of the MOH, and The Center for Health Statistics of the MOH(Source: Korle Bu Hospital 1923-1973)

2.4. 1 Architectural Disposition of Korle-Bu Teaching Hospital.

Fig 9; A South-East view of a recently completed section of the Korle Bu hospital Administration, this section was completed in 2004.

At a cursory glance from the main Korle-High Street road, the most obvious impression on gets of the architectural disposition of Korle-Bu is one of a group of

buildings from different eras incoherently placed on the same site with no conscious effort to harmonize them.

Admittedly such a huge institution with a wide range of buildings serving various purpose would undoubtedly have various consultants working on it at various points in its history.

Nonetheless, a conscious attempt to let the buildings exude a common aura at least in terms of aesthetics is glaringly missing.

Fig 10; A view of an early section of the Korle Bu hospital Administration, this section was completed in 1920.

Early photographs of Korle-Bu Teaching Hospital from the 1920's to 1940's show an affinity for a colonial style of Architecture, which was overall harmonious, thoughtful and appealing.

This overall composition, seemed to however have been abandoned during the late 1950's and 1960's in preference for fair faced, linear structures, reminiscent of the International style and Modernism.

Fig 11; A view of a section of the in-patient wards completed in 1957

The styles of these different eras marked a drastic departure in terms of harmony since the sitting of the structures from various eras were sometimes placed next to each other, probably due to the lack of space or to optimize the use of resources and reduce the distances between the various hospital units.

The main reason for this is however unclear since the basis for these decisions were not adequately documented during the construction of the hospital.

Fig 12; A new section of the in-patient wards under construction, picture taken in April, 2009

In the last two decades the hospital has seen a lot of new structures been put up in response to the ever increasing demands on health care needs in the country.

Unfortunately, most of these new structures have a contemporary appearance without any conscious effort to synchronise these with any of the earlier styles used in constructing the hospital.

This has giving rise to an overall seemingly incongruous group of buildings, located close to each other with no common style, colour, skyline or texture.

2.4. 2Inferences from the construction of Korle-Bu Teaching Hospital.

The older sections of the Korle-Bu Teaching Hospital, circa (1920-1950), show a high degree of intricate detailing and craftsmanship reminiscent of the pre Gold Coast era.

This technique was however not duplicated in the 1960's due their non-suitability for the modernist style.

Fig 13; A skywalk detail of the old Korle Bu hospital Administration, this section was completed in 1920.

The response to building climatology of the colonial sections of the hospital seem to be more evident than the contemporary recent once. This was evident in the following:

1. The orientation of the earlier in-patient wards and administration was done in a strict north-south orientation to cut down on the incidence of solar ingress.
2. Intricate detailing of certain elements such as railings, architraves, cornices, spouts and the like was adopted to give the building an overall humanist touch.

3. Choice of fernestration and fernestration were done such that, natural ventilation was sufficient for most parts of the in-patient wards. To this end French windows with low sill heights of around 500mm were adopted.
4. Durable finishes that were easy to maintain such as terrazzo and granolithic screeding were adopted.
5. Where appropriate, oil paint was used in finishing walls of areas of high circulation where dirtying of walls would have contributed to nosocomial infections –Infections that take place within the healthcare environment.
6. High level glazing, and fanlights were adopted for most offices and circulation spaces, to enhance the illumination of circulation spaces by natural light. This was a noted positive for the energy efficiency of most of the buildings.source ((Boyce, Hunter, &Howlett, 2003)
7. Colour tones employed were mainly of mild shades. This was an aid to the healing of patients since they have a positive impact on the body's circadian rhythm. Source (Boyce, Hunter, &Howlett, 2003)

Fig 14; The main operating theatres, with mild shades for lessening anxiety in patients.

In spite of some these commendable features of the structures at the hospital that were built in the colonial style, a drawback to this was the use of as asbestos as a roofing fabric for most of these structures.

Asbestos has been classified as a carcinogen from the Stockholm Convention (Source US EPA, 2003 Municipal Solid Waste in the United States: 200. Data). See table 2 in appendix D.

Hence incidence of some cancerous developments and respiratory problems could be induced by the use of asbestos as a building fabric. It is therefore imperative that the hospital authorities take measures to replace all parts of the buildings where asbestos as a building fabric was used. In this regard the Ministry of Health at large should also ensure that a list of approved materials for construction of healthcare facilities in Ghana is generated and strictly adhered to.

In support of this recommendation on the choice of materials is a caption from (Boya, M.V. et al 1995).”Volatile organic compounds (VOCs) such as formaldehyde, acetaldehyde, naphthalene, and toluene are released into the air from particleboard, carpets, and other finish materials to be inhaled by patients and staff alike. Semi volatile compounds such as phthalates and halogenatedflame-retardants latch on to the dust and float into breathing spaces. The potential implications can be subtle but significant, including effects ranging fromlonger patient recovery times to more sick days for staff. The health effects from building materials reach farther than the occupants of the building, stretching into the broader community. Roof coatings and paints spread VOCs into the surrounding air contributing to smog. Particulates kicked up by construction and spewed with other carcinogens from exhaust pipes and smokestacks threaten the lungs of residents in the area.”

2.5 KOMFO ANOKYE TEACHING HOSPITAL

The Komfo Anokye hospital is located on a hill overlooking the city of Kumasi in the Ashanti region, and is built on the former site of the African and Europeanhospitals. The hospital was completed in 1954, and initially named the KumasiCentral hospital. This name was subsequently changed to Komfo Anokye, in honor of a legendary fetish priest of the Ashanti kingdom of the same name. On itscompletion, the hospital also took over the Nurses Training College (established in1945) and the Midwifery Training School (built in 1950), that had previously beenattached to the African and European hospitals.

Fig 15; The in-patient blocks at the KomfoAnokye Teaching Hospital

The Komfo Anokye Teaching Hospital, with just over 1100 beds (2003 figures), is the second largest hospital in this country. In 1975, in pursuance of an MOH policy to establish a second medical school in Ghana, Komfo Anokye was converted into a teaching hospital (and renamed Komfo Anokye Teaching Hospital). The medicalschool of the University of Science and Technology, Kumasi, was provided an attachment to the hospital, which was now required to provide the necessaryteaching facilities for medical students and other auxiliaries, in addition to patientcare. In addition, Komfo Anokye Teaching Hospital is also the referral hospital forthe Northern and Upper Regions, Brong Ahafo, and sometimes the Western andCentral Regions of Ghana.

The goals of Komfo Anokye, thus, are similar to those of Korle Bu: patient care, teaching, and research (in that order) are all considered central to the hospital's

mandate. The hospital has specialized units in Medicine, Surgery, Obstetrics, Gynecology, Pediatrics, Dentistry, Ophthalmology, Orthopedics, Ear, Nose and Throat, Pathology and Communicable Diseases. The other major departments include Pharmacy, Radiography, Radiotherapy, Physiotherapy and Occupational Health.

Like Korle Bu, albeit on a smaller scale, Komfo Anokye is host to other institutions attached to the Ministry of Health, and also has links with several autonomous institutions. These include:

The Nurses Training School, The Midwifery Training School, The Medical School of the University of Science and Technology, Kumasi, The Blood Bank, and The Health Laboratory Services.

2.5. 1 Architectural Disposition of Komfo Anokye Teaching Hospital.

Fig 16; The Environs of KomfoAnokye Hospital, towards the Kumasi C.B.D.

Sited on a hill close to the heart of Kumasi, The Komfo Anokye Teaching Hospital, makes an imposing edifice, however upon closer scrutiny of the architectural style adopted over the various eras,the obvious impression is one of a group of buildings from different eras incoherently placed on the same site with no conscious effort to harmonize them just like the case of Korle bu Teaching Hospital.

Even more apparent, is a lack of thoughtfulness in the site planning of these structures with no obvious organized circulation pattern between the buildings.

In this regard, conflict points between pedestrian and vehicles were observed in a number of areas, namely; the Administration and the O.P.D., the Medical School and Wards, etc.

Fig 17; The Administration blocks at the Komfo Anokye Teaching Hospital

The initial barrel roofing adopted for the early buildings of the hospital built around the 1950's -1960's had a stark industrial feel about them. This was however further highlighted by the building scale, which was quite imposing (15m-20m) high at certain portions.

Though a concern for effective use of land might have informed this building scale, the after effect has not helped the overall efficiency of the hospital with staff and patients alike not finding it to be welcoming as gathered from interviews with 15 staff and 35 out patients and 15 in-patients.

Fig 18; The Medical School block at the KomfoAnokye Teaching Hospital

The more recent buildings of the 1980's to 2000's, have a marked departure from the initial high volume structures of the 1960's.This is however though more appealing aesthetically not carried with due regard to the architectural style of the existing structures there.

Unfortunately, most of these new structures have a contemporary appearance without any conscious effort to synchronise these with any of the earlier styles used in constructing the hospital.

This has giving rise to an overall seemingly incongruous group of buildings, located close to each other with no common style, colour, skyline or texture.

Fig 19; The newly completed Accident and Emergency Centre at the KomfoAnokye Teaching Hospital

An appraisal of the recently completed Accident and Emergency Centre completed in early 2008 shows a further departure of Architectural style from the earlier hospital bulidings ofth 1950's in KomfoAnokye.

This however conformed to the initial colour scheme of shades of brown of the early hospital structures to maintain a sense of identity.

The main dominant features of this facility are its spiral ramps and wavy roof forms which seem to at least in roof form, synchronise with the earlier barrel roofs of the 1950's and 1960's.

The incorporation of the spiral ramp as part of the Accident and Emergency Centre design, aids efficiency in circulation and also enhances accessibility for the disabled and the aged. This is very commendable and care should be taken to employ this in all major hospitals in Ghana where funds can support this since it greatly enhances healthcare delivery.

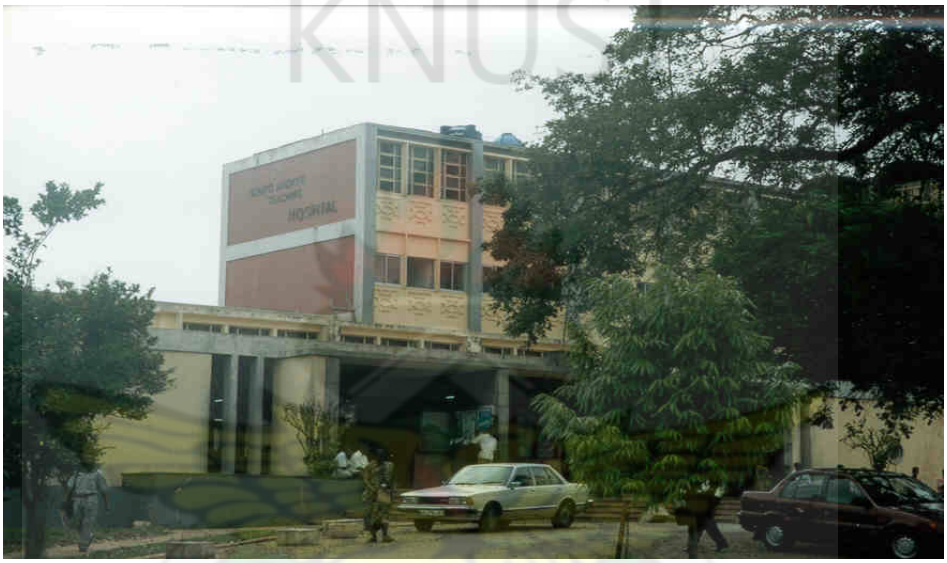

Fig 20; The Out Patient Department blocks at the KomfoAnokye Teaching Hospital

Landscaping in Komfo Anokye left much to be desired with an obvious neglect of trees and shrubs.

The advantage offered by landscaping elements as a therapeutic source of healing was not utilized. This is an area where much attention would need to be given.

An infusion of landscape elements such as aroma-therapeutic plants like *cinnamomumzeylanicum, Acacia auriculfiormis*, and xerophytic plants such as the *Araucaria imbricata* (monkey-puzzle tree) which is evergreen all year round are employed so that a general sense of greenery and life all year round is maintained.

This would greatly enhance the flora appeal of the hospital environment.

In addition, creating seating areas and providing features such as fountains and sculpture works would further aid in creating a serene atmosphere. This could also be complement by providing foliage trees that would adequately provide shades.

Fig 21; The In-Patient Wards at the KomfoAnokye Teaching Hospital

All the wards have cross ventilation with adequate lighting received for much of the day. Natural ventilation in the wards is made efficient by the adequate spacing between the wards. The laboratories and office are artificially ventilated however.

Noticeably however, overcrowding of most of the hospital wards has eradicated most of these commendable provisions. This brings to the fore the need for new spatial requirements that could complement the demand for space in the healthcare facilities in Ghana.

2.5.2Inferences from the construction ofKomfo Anokye Teaching Hospital.

The following inferences were made from the case study of the Komfo Anokye teaching hospital.

1. The orientation of most of the in-patient wards and administration was done without due regard for orientation to cut down on the incidence of solar ingress.
2. Intricate detailing of certain elements such as railings, architraves, cornices, spouts and the like was not adopted to give the building an overall humanist touch.
3. Choice of fenestration and fenestration were done such that, natural ventilation was sufficient for most parts of the in-patient wards. However, a conversion of some these spaces from their original intended purpose and a lack of expansion of some these facilities has eroded these gains.
4. Durable finishes that were easy to maintain such as terrazzo and granolithic screeding were adopted. This should be adopted for future developments.
5. Where appropriate, oil paint was used in finishing walls of areas of high circulation where dirtying of walls would have contributed to nosocomial infections –Infections that take place within the healthcare environment.
6. High level glazing, and fanlights were adopted for most offices and circulation spaces, to enhance the illumination of circulation spaces by natural light. This was a noted positive for the energy efficiency of most of the buildings.source ((Boyce, Hunter, & Howlett, 2003)

7. Colour tones employed were mainly of mild shades. This was an aid to the healing of patients since they have a positive impact on the body's circadian rhythm. Source (Boyce, Hunter, &Howlett, 2003)

2.6 BRONG AHAFO REGIONAL HOSPITAL

Fig 22; The Out Patient Department and main Administration of the Brong Ahafo Regional Hospital

Nightingale Associates was appointed architect for this 240-bed Regional Hospital in 1997 by the International Hospital Group. Their brief for this £14 million EU-funded project was to obtain the best possible long-term value for money for this remotely-positioned building.

The Brong Ahafo Regional Hospital, Sunyani, Ghana was completed in 2003 by the UK firm International Hospital Group (I.H.G.) The General character of the hospital

is a display of hip roofs at play with the floor volumes varying between two and three volumes. These hip roofs have unusually long overhangs ranging from 1.5m to 2m. The long overhangs have a positive impact on the general building climatology since it helps in cooling the interior spaces and walkways, thus enhancing the thermal comfort of patients.

2.6.1 Architectural Disposition of Brong Ahafo Hospital.

A response to this schemewas made by designing a hospital that maximised the use of local materials and minimised running costs and future maintenance. The extensive gently-sloping site, with consistent cooling breezes, facilitated a 'green' design approach in which air conditioning was restricted to operating facilities only, while all other areas were designed to take full advantage of natural ventilation. This was achieved by designing 'shallow plans' with cross ventilation via adjustable glass louvers.

The whole hospital is single storey, except for the administration offices designed above outpatients. There are no lifts to maintain and all engineering services have been designed as generic replaceable units to maximise choice in replacing components. The twin hospital streets serving the various departments were designed with open ends for future expansion. Computer modelling was used to ascertain the optimum distance between blocks, in order to maximise natural ventilation.

The Hospital became fully operational in 2003. In 2008, World Health Design, the quarterly magazine for the International Academy of Design and Health, commissioned a formal review of the hospital aimed at assessing the effectiveness of the low energy, low maintenance costs; design approach on clinical outcomes; and patient, staff and visitor satisfaction.

The review team found a thriving optimistic hospital that had grown to 300 beds and was seeing five times as many outpatients and maternity cases as originally envisaged. Despite the high levels of clinical activity, the fabric of the hospital was beautifully maintained, levels of hospital-acquired infections were extremely low and the evident popularity of the hospital was a testament to the high levels of patient satisfaction. The environmental and clinical success of the hospital has led to an unusually high level of staff retention in the Sunyani Regional Hospital, leading to a fourfold increase in doctor and nurse numbers in its five years of operation.

Fig 23; The Main entrance of the Brong Ahafo Regional Hospital, with special access for the invalid and the disabled

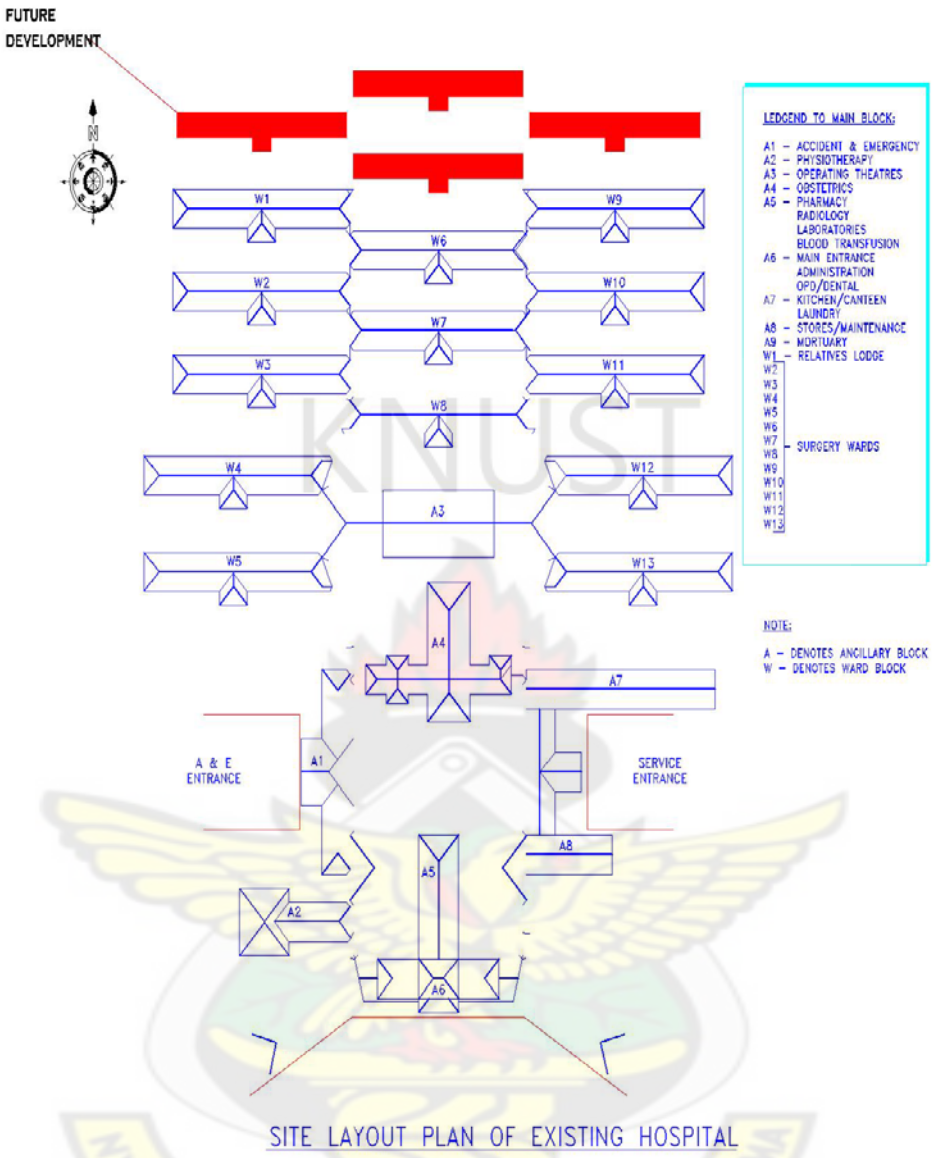

Fig 24; Site layout of the existing Brong Ahafo Regional Hospital

This layout assists in healthcare provision by offering interconnected units whilst simultaneously offering adequate lighting and ventilation of the spaces.

The adherence to a similar character throughout the Brong Ahafo Regional Hospital, which was not evident in Komfo Anokye and Korle Bu, was commendable.

Fig 25; Childrens' playroom at the Brong Ahafo Regional Hospital

The provisions of ancillary facility such as a children's playroom is quite thoughtful and worth replicating.

Fig 26; The landscaped courtyard between the in-patient wards.

Landscaping in the Brong Ahafo Regional Hospital is quite commendable. A conscious and cautious provision of flora in the courtyards, walkways and rooms was quite evident.

The advantage offered by landscaping elements as a therapeutic source of healing was well utilized.

An infusion of landscape elements such as aroma-therapeutic plants like, *Buxusmicophylla, plueria obtuse, lagerstroemia indica, roystonea. Sp,*,andxerophytic plants such as the *Araucaria imbricata* (monkey-puzzle tree) which is evergreen all year round are employed so that a general sense of greenery and life all year round is maintained. This has greatly enhance the flora appeal of the hospital environment.

In addition, creating seating areas and providing features such as fountains and sculpture works would further aid in creating a serene atmosphere.

Fig 27; The main triage and waiting area of the BrongAhafo Regional Hospital.

2.6.2 Inferences from the construction ofBrongAhafo Teaching Hospital.

The following inferences were made from the case sudy of the BrongAhafo teaching hospital.

1. The entire facility is designed in a typical tropical style with long overhangs and the buildings are orientated in a strict north-south manner with blank east-west walls. to cut down on the incidence of solar ingress.
2. Intricate detailing of certain elements such as railings, architraves, cornices, spouts and the like was not adopted to give the building an overall humanist touch, however.

3. Choice of fenestration and fenestration were done such that, natural ventilation was sufficient for most parts of the in-patient wards.
4. Durable finishes that were easy to maintain such as terrazzo and granolithic screeding were adopted. This should be maintained for future developments.
5. Where appropriate, oil paint was used in finishing walls of areas of high circulation where dirtying of walls would have contributed to nosocomial infections –Infections that take place within the healthcare environment.
6. High level glazing, and fanlights were adopted for most offices and circulation spaces, to enhance the illumination of circulation spaces by natural light. This was a noted positive for the energy efficiency of most of the buildings.source ((Boyce, Hunter, & Howlett, 2003)
7. Colour tones employed were mainly of mild shades. This was an aid to the healing of patients since they have a positive impact on the body's circadian rhythm. Source (Boyce, Hunter, & Howlett, 2003)
8. The courtyard has been enhanced to form a park like setting for patients and staff. The building is designed to be welcoming and of human scale enhanced by multiple interiors, rooftop gardens and extensive site landscaping.
9. The building environmentally responsive with a very good integration of the built and un built environment.
10. Adequate space for social interaction and leisure were provide especially in the staff lounges and cafeterias.
11. Solar energy could have been employed to supplement energy requirements and rainwater harvesting could have been incorporated into the design.

2.7 IMPLICATIONS OF FINDINGS AND INFERENCES FROM CASE STUDIES.

The health-care facilities under discussion are arguably some of the best in Ghana, however despite the concerns for patient, staff and environment whilst being economical in the design various issues come to the fore.

The absence of a play area for paediatrics in Komfo Anokye and Korle Bu is an area of obvious neglect which could have been addressed in the design. This could be further considered from an indoor and outdoor perspective, which were lacking in both facilities.

The design of the relatives ward in the BrongAhafo Regional Hospital though an innovative idea could have been more sensitive to the comfort of the relative.

The Sunyani Regional Hospital has a relatives ward designed morel like a dormitory than a hostel. Though cost could have been the primary reason for this the comfort of relatives should have been priority. The extent of landscaping is commendable and should be adopted as much as possible in the various healthcare centres in the country.

Local climate and customs are essential ingredients which must continue to be taken into consideration when planning and building hospitals. Locally-based traditions in particular should be taken into serious consideration. Many such traditions have proven to co-exist successfully with internationally recognized principles of modern medical science. Source (Kane 2001)

The natural environment is a significant contributor to recovery from illness. The modern hospital, with its artificial environment, which ultimately rendered the patient a little more than a machine cared for by the machines of the institution, lost this timeless aspect of care.

It is important to re-create true 'healing environments' in hospitals and related health facilities. As hospital buildings and engineering technologies are regarded as the ‘hard’ dimensions of healing environments, it is essential to improve the ‘soft’ dimensions of healing environments, encompassing such attributes as a positive, cheerful staff, clean rooms, and satisfying food. Without patient-centered philosophies, well-designed buildings and high-tech equipment cannot create a truly therapeutic healing environment. In this regard, the role of the Architect and the Facility Manager in hospitals will grow in importance in the coming years in Ghana and elsewhere.

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CHAPTER THREE

3.0 RESEARCH METHODOLGY

3.1METHODOLOGY

First, an extensive literature review was conducted to provide background information on the meaning and evolution process of Hospitals in general as well as the evolution processes of healthcare facilities in Ghana. This literature review includes research on the nature and design of some hospitals such as The Korle –Bu and KomfoAnokye hospitals andpublished work on design and architecture of the National Alzheimer'sDisease Centre, Madrid, Spain. Published work on the use of special glazing in intelligent building design, which would influence the outcome of the thesis.

In addition, research case studies were conducted on The Korle-Bu, Komfo Anokye and Brong Ahafo Regional hospitals. These were chosen and analysed and conclusions drawn. Case studies are frequently used in professions and fields of practical activities such as architecture, planning and environmental engineering. A case is a phenomenon of some kind, which emerges in a limited context and determined in social, spatial or temporal terms (Johansson, 2001).

Furthermore, on-site surveys and analysis are also conducted to give an indication of the location, weather conditions, and what exactly exists within the site, which would influence the outcome of this thesis.

3.2 DATA COLLECTION

Data triangulation was used to increase the reliability and validity of information collected. Data triangulation refers to using several sources to collect information/data about the same phenomenon (Johansson, 2001). The different methods used include:-

(i) Key person informal interviews

•Interviews with the Medical Superintendent of Brong Ahafo Regional Hospital, Dr. Daniel Asare and some Staff of the Hospital.

•Interviews with the Estate Officers of Sunyani Regional Hospital, Korle Bu Hospital and Komfo Anokye Hospital.

(ii) Archival records/documentation

•Various reports and documents on the Sunyani Regional Hospital, Korle Bu Hospital and Komfo Anokye Hospital.

•The 2007 World Bank Annual Report

•Published and Unpublished books and articles as well as information from the internet formed the basis of the discussion in the literature review section of the thesis.

(iii) Direct observations, on-site technical surveys, measurement and documentation of existing features of the existing hospitals studied.

(iv) Sketches, photographs and CAD produced data were also employed to give graphical evidence of the relevant information.

3.3 PROBLEMS ENCOUNTERED

Access to adequate information in Ghana, as in other developing countries, proved to be a big hurdle. Either the required information was not documented or getting official access by way of permissions from top officials proved to be rather bureaucratic and time consuming. Though this was evident from virtually every group encountered, I am grateful for the information that the following were willing to share: Medical Superintendent of Brong Ahafo Regional Hospital, Dr. Daniel Asare and some Staff of the Hospital, the Estate Officers of Sunyani Regional Hospital, Korle Bu Hospital and Komfo Anokye Hospital.

This is not to say that I did not encounter problems with the above. For instance, it was not possible to get documented technical details and specifications for certain areas of Sunyani Regional Hospital, Korle Bu Hospital and Komfo Anokye Hospital. Additionally, Time and financial constraints encountered by the author meant that the duration and extent of the thesis could not be increased. The author's intentions of supporting this thesis with 3-dimensional simulations and animations could not be achieved for this reason.

Also many of those contacted were willing to comment on general issues, but when it came to specifics, there were hesitations. Some areas within all the hospitals the author visited were considered restricted and accessible to only a few people. As such, there is limited information on these areas

However, despite these odds and problems encountered, the author has managed to get the information contained in this thesis. It will be interesting to compare the issues raised in this thesis with the results from further studies.

CHAPTER FOUR

4.0 FINDINGS AND DISCUSSIONS

4.1 INFERENCES AND IMPLICATIONS

As cited in literature (Boyce et al, 2003.), there exist several studies carried out on the design of hospitals such that healing is aided by the various architectural elements employed. such as light, materials, landscaping, colour etc.

The Korle –Bu and KomfoAnokyehospitals studied in Ghana showed a lack of conscious effort in responding to maintaining a general identifiable character for the healthcare facilities.This was however not the case with the Brong Ahafo Regional Hospital which maintained the same feature throughout all units of the hospital

Thus elements such as the building fabric of the Brong Ahafo Regional hospital is uniform throughout all units, thiswas also the case with colour, floorvolumes, building scale and landscaping.

The positive impact of this character in the Brong Ahafo Regional hospital is epitomized by this caption in the literature review" Despite the high levels of clinical activity, the fabric of the hospital was beautifully maintained, levels of hospital-acquired infections were extremely low and the evident popularity of the hospital was a testament to the high levels of patient satisfaction. The environmental and clinical success of the hospital has led to an unusually high level of staff retention in the Sunyani Regional Hospital, leading to a fourfold increase in doctor and nurse numbers in its five years of operation."(World Health Design 2008)

Statistics available indicate that the The Korle –Bu and Komfo Anokye hospitals have a relatively high occupancy rate even by global standards. Thus it is imperative that in-patient healthcare provision is complemented with efficient healthcare design.

In this regard, bioclimatic comfort of in-patients is paramount.

The low incidence of nosocomial infections in the Brong Ahafo Regional Hospital (source: World Health Design 2008) is evidence of how due diligence to the environment in which healthcare is given aids healing. To further enhance healthcare in Ghanaian hospitals, the environment of healthcare facilities such as landscaping, lighting levels and spatial configuration should be based on healthcare design standards. See Table 2.

The advantage offered to the healing process by landscaping elements as a therapeutic source of healing was not utilized in the Korle Bu and Komfo Anokye hospital. This is an area where much attention would need to be given.

An infusion of landscape elements such as aroma-therapeutic plants like *cinnamomumzeylanicum, Acacia auriculfiormis*, andxerophytic plants such as the *Araucaria imbricata*(monkey-puzzle tree) which is evergreen all year round are employed so that the flora appeal of the hospital environment is enhanced.

In a study by (Nagasawa 2007) of Japanese hospitals, 85 percent of a total of 35 hospitals that had more than half their unbuilt area extensively landscaped showed faster in-patient recovery times and lower cases of recurrent cases compared to those that had less than half their unbuilt area landscaped.

4.1 a. Plan Configurations

Aydın (2004), states that the size of nursing units are determined according to how many patients can be cared by the certain number of personnel. For this, the numbers expressed by the Ministry of Health is between 20 to 30, as the author mentions. Spaces excluding the patient bed rooms--such as nursing station, doctors and nurses' offices, toilets and baths-- have standard functions similar among hospitals except some specialistic units such as units for children, women and the units of maternity.

The observed sizes of nursing units in Korle Bu and Komfo Anokye ranged from 2-10 for most units. This evidently falls far below the recommended figures from the Ministry of health of 20-30.Thus the pressure on staff at these hospitals was immense.

Gainsborough and Gainsborough (1964) mention four types of nursing units as;(1) single-corridor wards with patient rooms are located along one main corridor (2) double-corridor wardswhere the whole area is separated into two spaces as interior and exterior. One of its disadvantages is its higher construction costs; however, its prime advantage is its high operational efficiency. Its advantages are stated as high observability of patient rooms, the flexibility in subdividing wards(in design), shorter distances between destinations, smaller perimeter, and higher amount of heat gain; (3) square wards which have the largest area compared to its perimeter ; (4) circular wards are also advantageous in terms of the largest area compared to its perimeter and observability from the central nursing area only if the proper diameter size is satisfied (Agron,1978).

Miller and Swensson (1995) also define triangular shaped units, where the distance between patient rooms and nursing stations is decreased together with construction and maintenance costs. Some generic plans of nursing unit forms are also presented as diagrams in Figure

In Komfo Anokye and Korle Bu the observed nursing units were mainly single-corridor wards with patient rooms are located along one main corridor. A drawback to

this type of layout in the healing process however is the high incidence of noise levels generated from the corridors by staff, visitors and patients alike.

4.1 b. Noise Levels

Studies by (Johnson, 2001) have focused on infants in (National Institute of Cardio-thoracic Unit) NICUs, finding that higher noiselevels, for example, decrease oxygen saturation (increasing need for oxygen supporttherapy), elevate blood pressure, increase heart and respiration rate, and worsen sleep.Apart from worsening sleep, there is strong evidence that noise increases stress in adultpatients, for example, heightening blood pressure and heart rate (Baker, 1992)

In Ghana, data available from the Komfo Anokye Teaching Hospital, Kumasi, The Korle-Bu Teaching Hospital, Accra and The Brong Ahafo Regional Hospital showed that day time noise levels at Komfo Anokye daytime levels ranged between a minimum of 80db to 135db,at Korle-Bu daytime levels ranged between a minimum of 85db to 145db and at The Brong Ahafo Regional Hospital daytime levels ranged between a minimum of 35db to 65db,(source: Ministry of Health 2007) thus making The Korle-Bu Teaching Hospital, the noisiest hospital and The Brong Ahafo Regional the least noisy.

World Health Organization guideline values for continuous background noise in hospitalpatient rooms are 35 dB, with nighttime peaks in wards not to exceed 40 dB (Berglund, Lindvall, & Schwela, 1999). These guidelines notwithstanding, many

studies have shownthat hospital background noise levels fall in far higher ranges. Background noise levelstypically are 45 dB to 68 dB, with peaks frequently exceeding 85 dB to 90 dB (Aaron etal., 1996)

In judging these noise levels, itis worth noting that the decibel scale is logarithmic; each 10 dB increase representsapproximately a doubling in the perceived sound level. A 60 dB sound, accordingly, isperceived as roughly four times as loud as a 40 dB sound. Medical equipment and staffvoices often produce 70 dB to 75 dB levels measured at the patient's head, whichapproach the noise level in a busy restaurant

A study by (Johnson, 2001) examinedthe effects of poor versus good sound levels and acoustics on coronary intensive-carepatients by periodically changing the ceiling tiles from sound-reflecting to sound absorbingtiles. When the sound-absorbing ceiling tiles were in place, patients sleptbetter, were less stressed (lower sympathetic arousal), and reported that nurses gave thembetter care. There were also indications in this study that the incidence of rehospitalizationwas lower if patients had experienced the sound-absorbing rather thansound-reflecting ceiling during their hospital stay.

4.1 c. Lighting

Whilst observed lighting levels in all the hospitals studied were adequate, patient responses showed they were much more satisfied with lighting conditions at the Brong Ahafo Regional Hospital (83% of respondents were satisfied with lighting

conditions at this hospital compared with 65% for Komfo Anokye and 57% for Korle Bu).

According to (Boyce,Hunter, &Howlett, 2003; Veitch&McColl, 1993).

Light impacts human health and performance by four main mechanisms:

• Enabling performance of visual tasks

• Controlling the body's circadian system

• Affecting mood and perception

• Facilitating direct absorption for critical chemical reactions within the body

Light controls the body's circadian rhythm, (which are responsible for synchronizing the body's internal clock to 24 hours. Studies show that it can have a negative impact on many healthcare workers, staff can feel drowsy, tired, and distracted. For example, for individuals working during night shifts, a 24-hour cycle that keeps most people awake and alert in the day and sleepy in the night would result in fatigue and a complete inability to perform during the night shift.

Exposure to outdoor daylight is a key factor in determining the phase of the circadian rhythm. According to Boyce and colleagues (2003), daylight provides a higher light level at the eye that is matched to the spectral sensitivity of the circadian rhythms than most electric-light sources. By controlling the circadian system, light—both natural and artificial—impacts many health outcomes among patients and staff in

hospitals such as depression, sleep, circadian rest-activity rhythms, as well as length of stay in the hospital.

4.1 d. Materials

The choice of material use in the hospitals studied brought to the fore one major issue, that whilst most the materials used in recent development projects were non-toxic, earlier buildings especially at Korle Bu still had certain materials such as asbestos in use.

Asbestos has been classified as a carcinogen from the Stockholm Convention (Source US EPA, 2003 Municipal Solid Waste in the United States: 200. Data). see table 2 in appendix C.

Hence incidence of some cancerous developments and respiratory problems could be induced by the use of asbestos as a building fabric. It is therefore imperative that the hospital authorities take measures to replace all parts of the buildings where asbestos as a building fabric was used. In this regard the Ministry of Health at large should also ensure that a list of approved materials for construction of healthcare facilities in Ghana is generated and strictly adhered to.

In support of this recommendation on the choice of materials is a caption from (Boya, M.V. et al 1995).”Volatile organic compounds (VOCs) such as formaldehyde, acetaldehyde, naphthalene, and toluene are released into the air from particleboard, carpets, and other finish materials to be inhaled by patients and staff alike. Semi

volatile compounds such as phthalates and halogenated flame-retardants latch on to the dust and float into breathing spaces. The potential implications can be subtle but significant, including effects ranging from longer patient recovery times to more sick days for staff. The health effects from building materials reach farther than the occupants of the building, stretching into the broader community. Roof coatings and paints spread VOCs into the surrounding air contributing to smog. Particulates kicked up by construction and spewed with other carcinogens from exhaust pipes and smokestacks threaten the lungs of residents in the area."

In addition, certain paints and adhesives especially of the brands by Azar Chemicals and Leyland and Leylac Paints were noted that, at least 21 days should be allowed before habitation of the healthcare spaces in which they were used is permitted.

CHAPTER FIVE

5.1 CONCLUSION

This research has come out with a proposal for a typical long term care setting. (Ref. Appendix D) The facility is designed to reflect contemporary tropical style. The courtyard has been enhanced with skywalks, fountains and seating areas for patients, staff and visitors. The building scale although large is designed to be welcoming and of human scale. This was partly achieved through the floor volume adopted and the elements employed in the design. The design is environmentally responsive to the tropics with its hip roof system, long overhangs and large courtyard. There is a very good functional relationship among the various units of the centre with adequate space for social interaction and leisure.

The design incorporates the use of solar energy to supplement energy requirements and rainwater harvesting for non- essential water demanding tasks.

5.2 RECOMMENDATIONS

It is recommended that future long-term healthcare settings for the treatment of chronic diseases take into account the role that various elements of the design as well as the physical environment has on the healing process of students. To this extent the above discussed factors namely: Light, Colour, Materials, Noise, Landscaping and the Layout employed should be considered and treated as separate yet interdependent factors in coming up with future healthcare designs.

The following recommendations are made for possible inclusion in future healthcare designs in the country:

i) That where possible the following form of glazing is adopted for bioclimatic comfort of in-patients in healthcare facilities.

This is a window with a hidden pane system and Thermal Bridge Break. The aluminium profile seen from outside is only 55 mm, whatever the configuration, with a design that reminds us of folded sheet metal work. It has excellent thermal transmittance (U=2.4) and acoustic insulation (44 dB). The possible designs include one- and two-leaf windows and balcony windows, with practical, tilt-and-turn and folding applications.

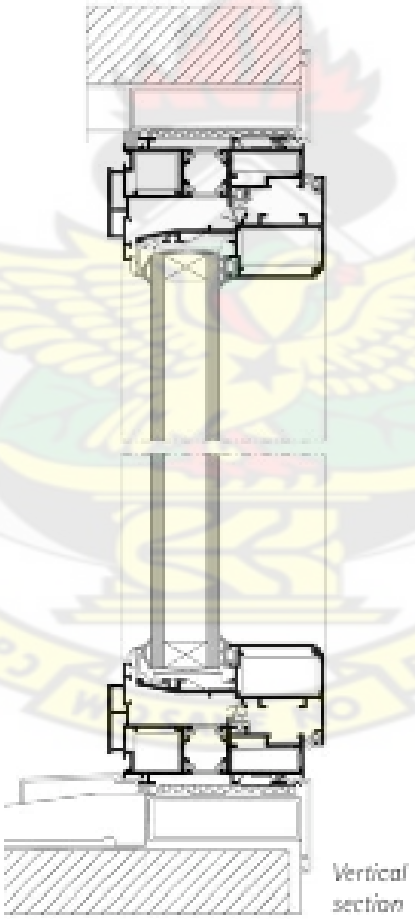

Fig 28; A vertical section of the proposed form of glazing.

ii)That the therapeutic properties of landscape elements such as scented foliage plants like *Acacia* sp. be employed along carefully designed seating areas where in-patients can seat and relieve stress. These should be appropriately shaded and create a relatively cool microclimate within the environs of the healthcare facility. Recommended outdoor temperatures for the immediate environs of the healthcare facility should range from 22-32 degrees centigrade.

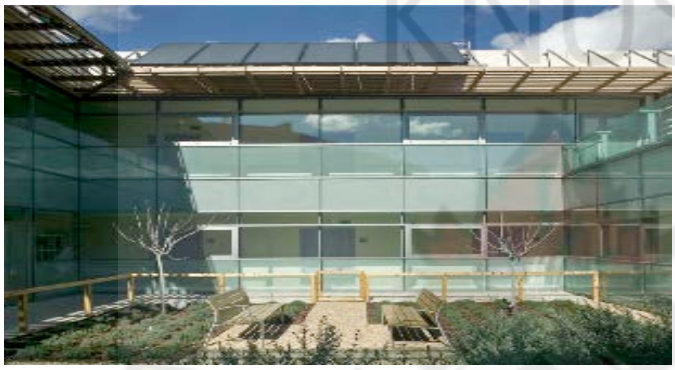

Fig 29; A proposal for the seating area in the courtyard of the healthcare facility that could be employed.

In addition, soft landscaping such as lemon grass and *Cythophera* sp. should be employed in much of the hospital environment to enhance bio-climatic comfort. This has been proven to reduce microclimatic temperature by as much as 10 degrees centigrade.

Fig 30; A proposal for the soft landscaping for the environs of the healthcare facility.

iii) That earthen colors which aid the healing process of patients by having a positive impact on the visual cortex and aiding stress relief as well as improving recovery times of patients be employed in the aesthetic treatment of healthcare facilities.

Fig 31; A proposal for the choice of earthen colors which aid the healing process of patients.

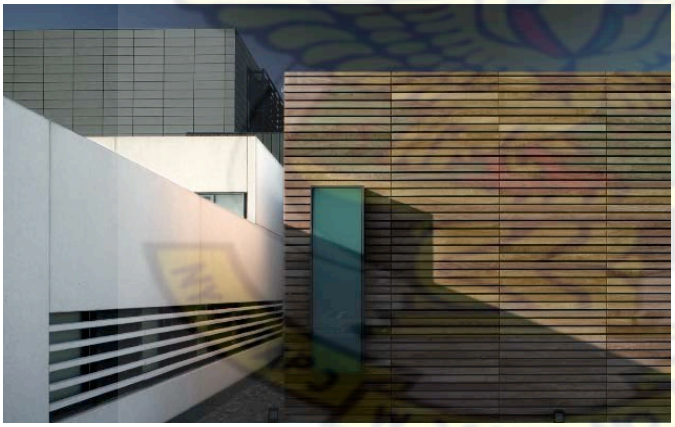

Fig 32; A proposal for the choice of earthen cladding for the building fabric.

In addition, only materials that have been certified as having non-toxic properties such as non-corrosive metals like aluminium, and timber based materials should be used for the cladding of the building fabric.

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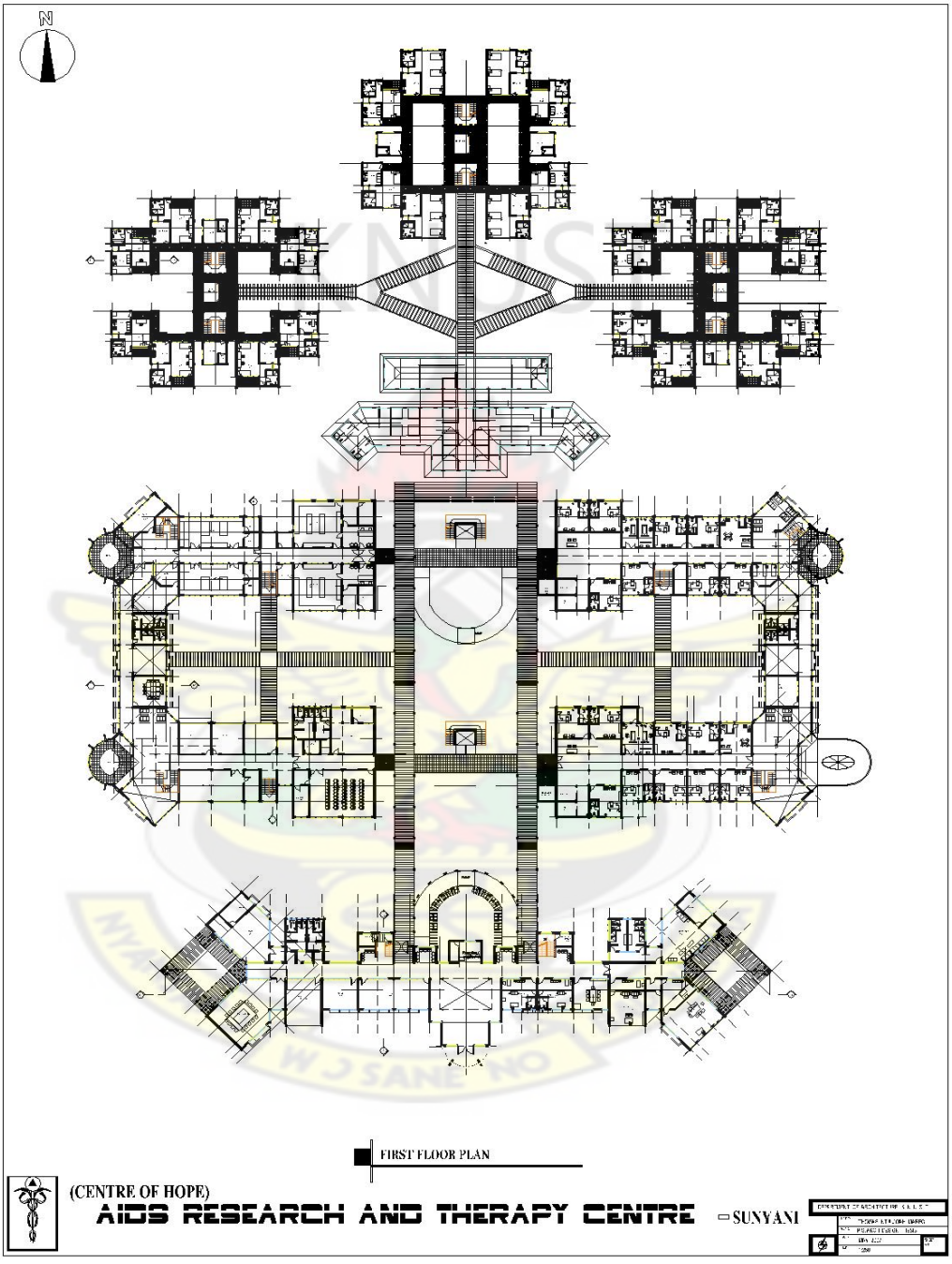
APPENDIX B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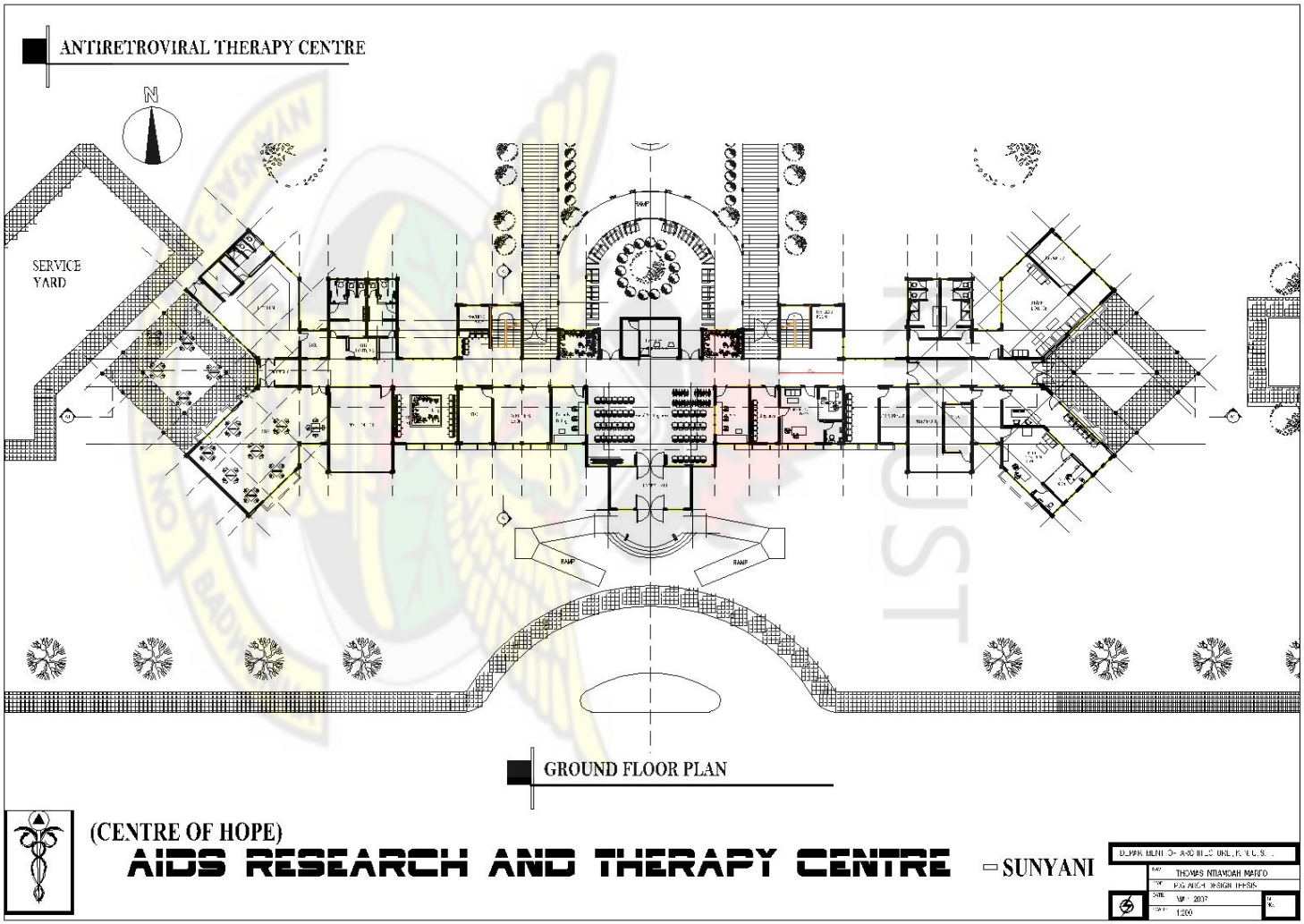
AIDS RESEARCH AND THERAPY CENTRE
SUNYANI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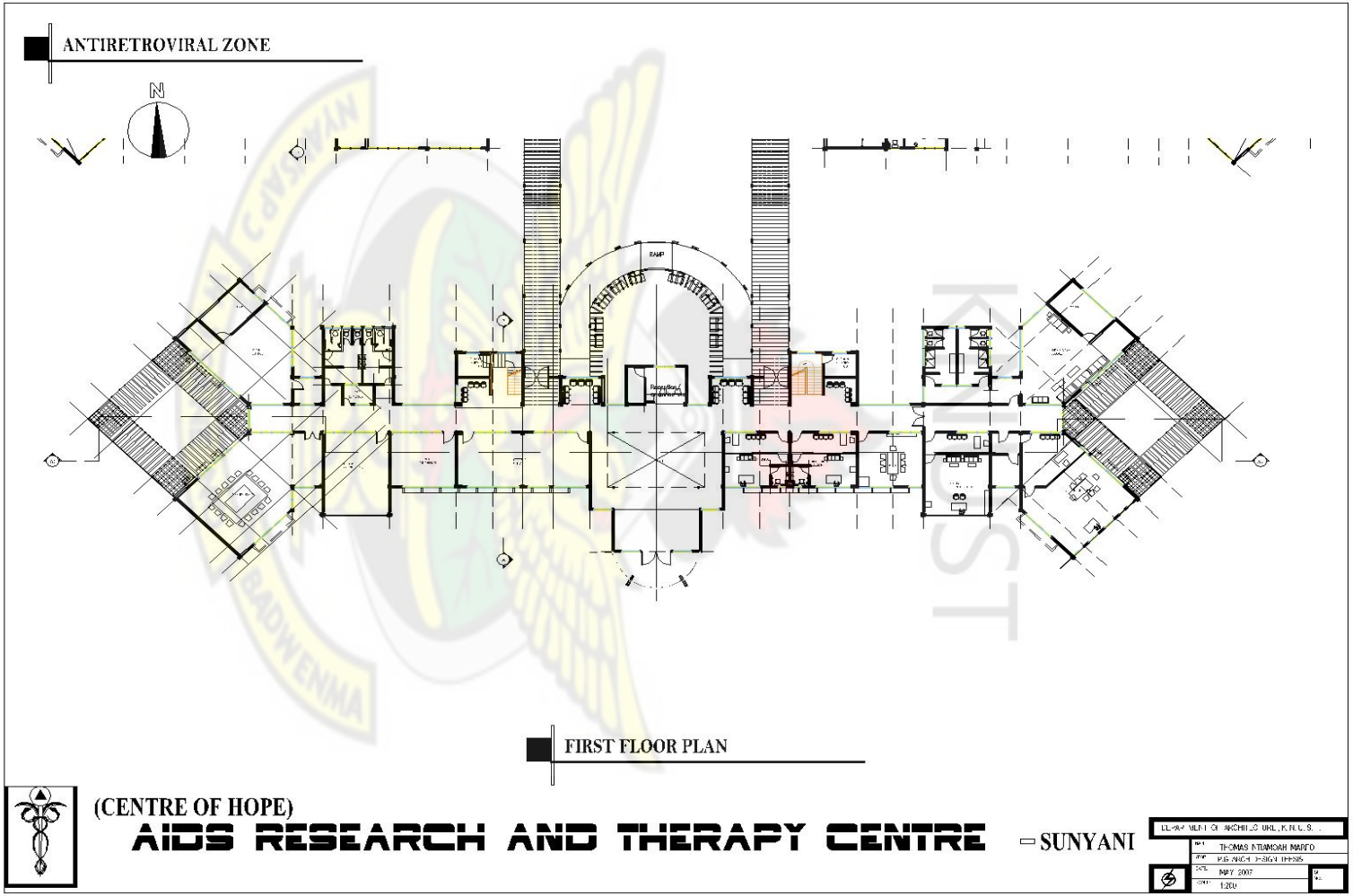
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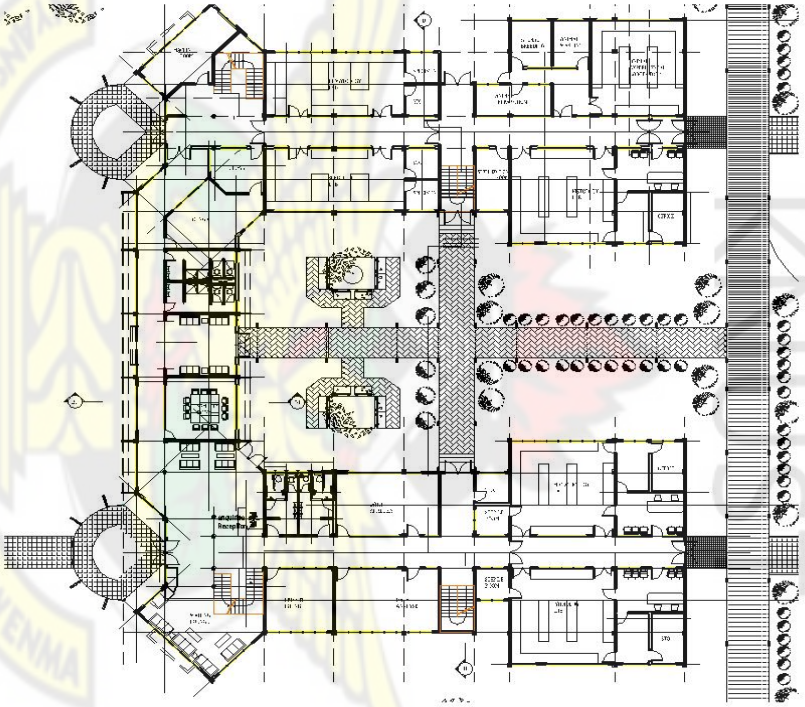

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AIDS RESEARCH AND THERAPY CENTRE – SUNYANI

DEPARTMENT OF ARCHITECTURE, K.N.U.S.T.

THOMAS NTIAMOAH AMPAFO

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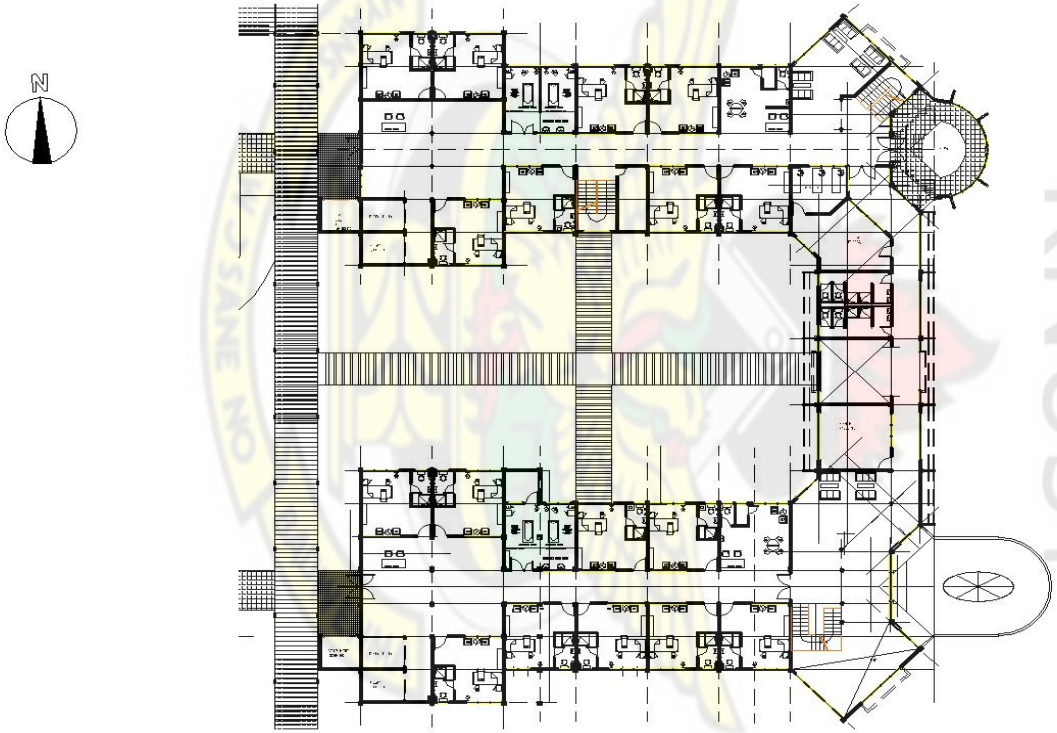

FIRST FLOOR PLAN

(CENTRE OF HOPE)

AIDS RESEARCH AND THERAPY CENTRE

SUNYANI

DEPARTMENT OF ARCHITECTURE, K.N.U.S.T.

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PROJ: F.C.ARCH. DESIGN THESIS

DATE: MAY 2007

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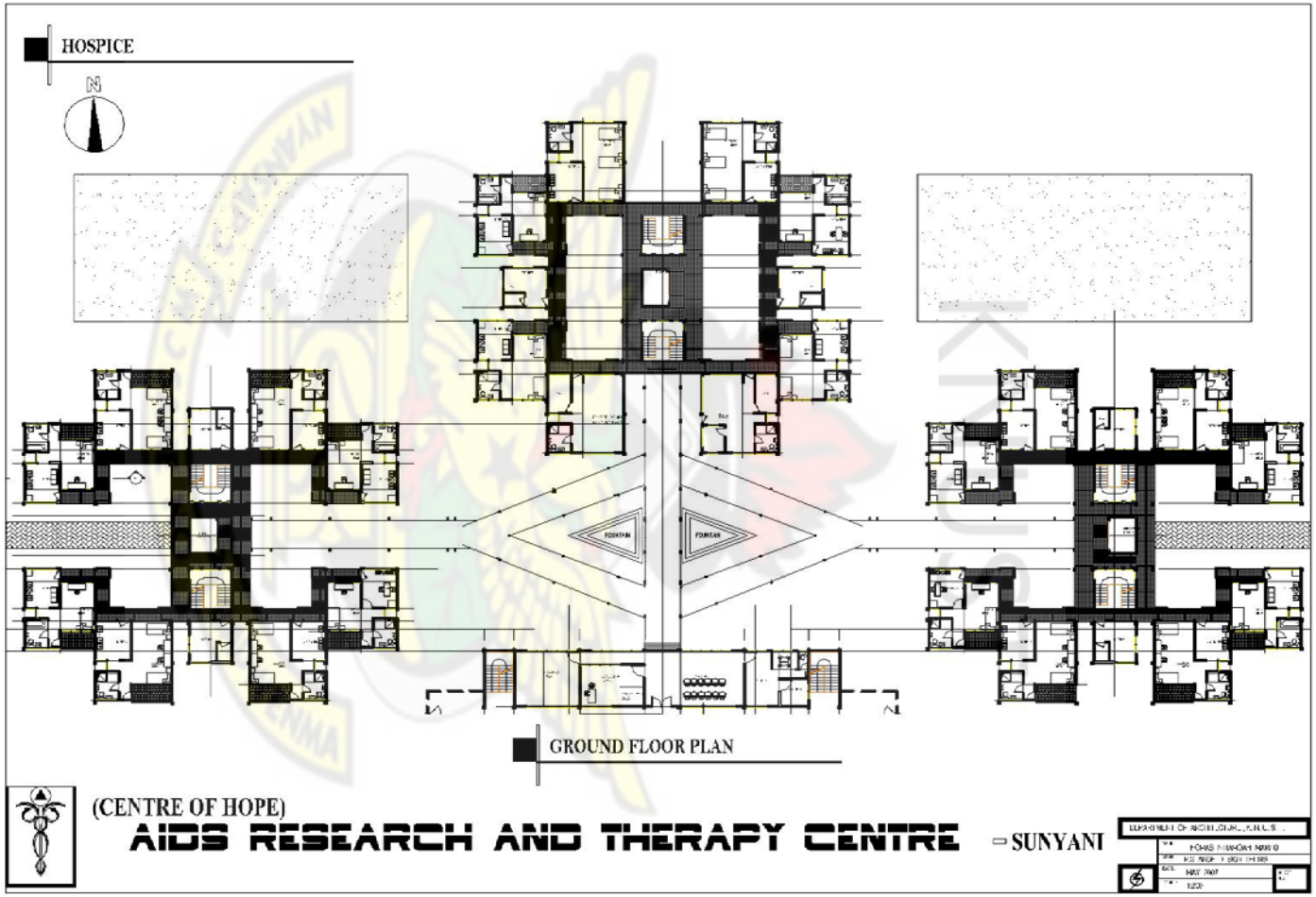
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AIDS RESEARCH AND THERAPY CENTRE
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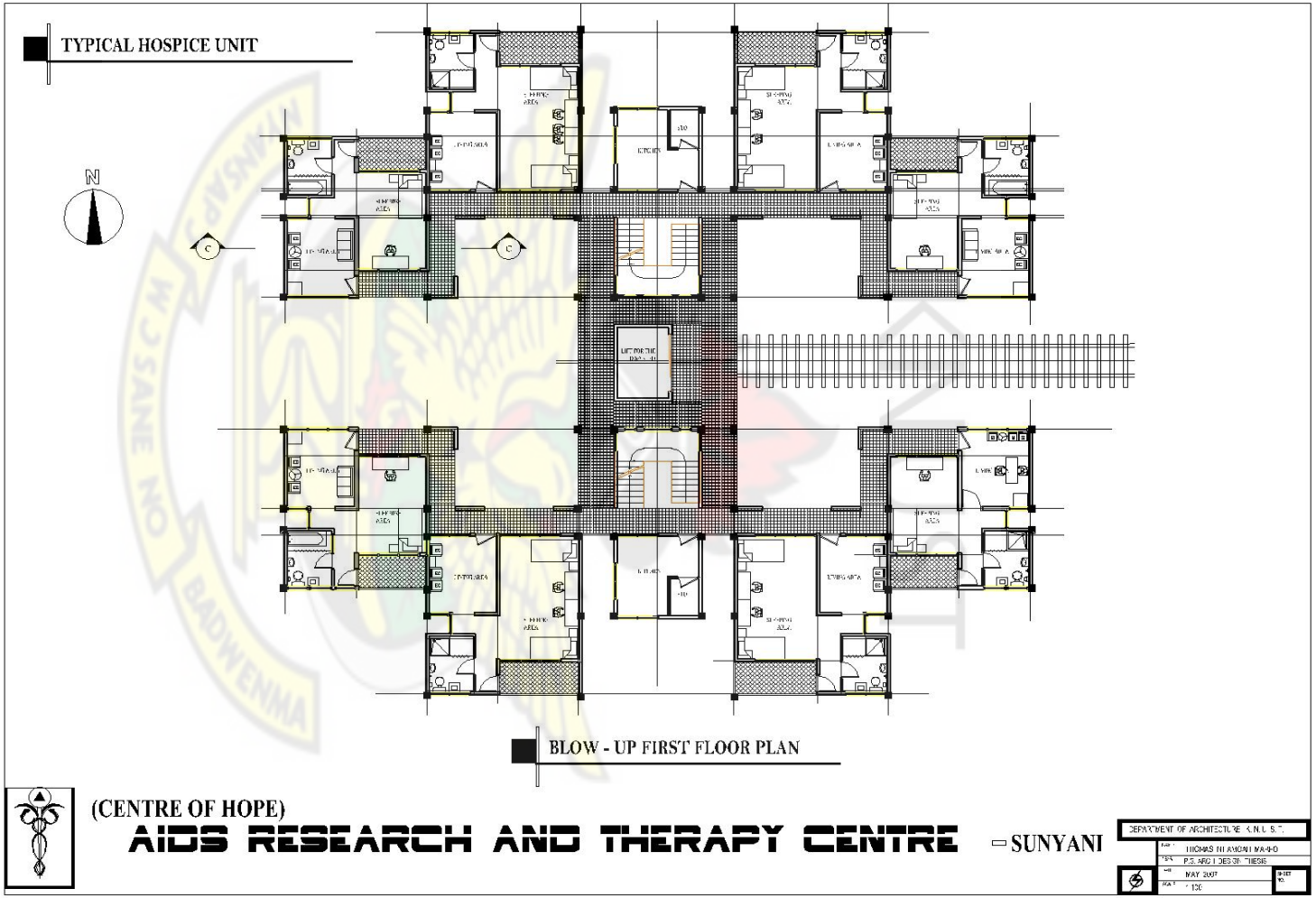
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THOMAS NII AYIKAI MA-HO
P.G. ARCHITECTURAL THESIS
MAY 2007

ELEVATIONS

(CENTRE OF HOPE)

AIDS RESEARCH AND THERAPY CENTRE

SUNYANI

DEPARTMENT OF ARCHITECTURE, K. N. U. S. T.

NAME: THOMAS NTIAMOAH WARE

P.G. PROF. DESIGN THESIS

DATE: MAY 2007

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ELEVATIONS

(CENTRE OF HOPE)

AIDS RESEARCH AND THERAPY CENTRE – SUNYANI

DEPARTMENT OF ARCHITECTURE, F.R.U.S.T.

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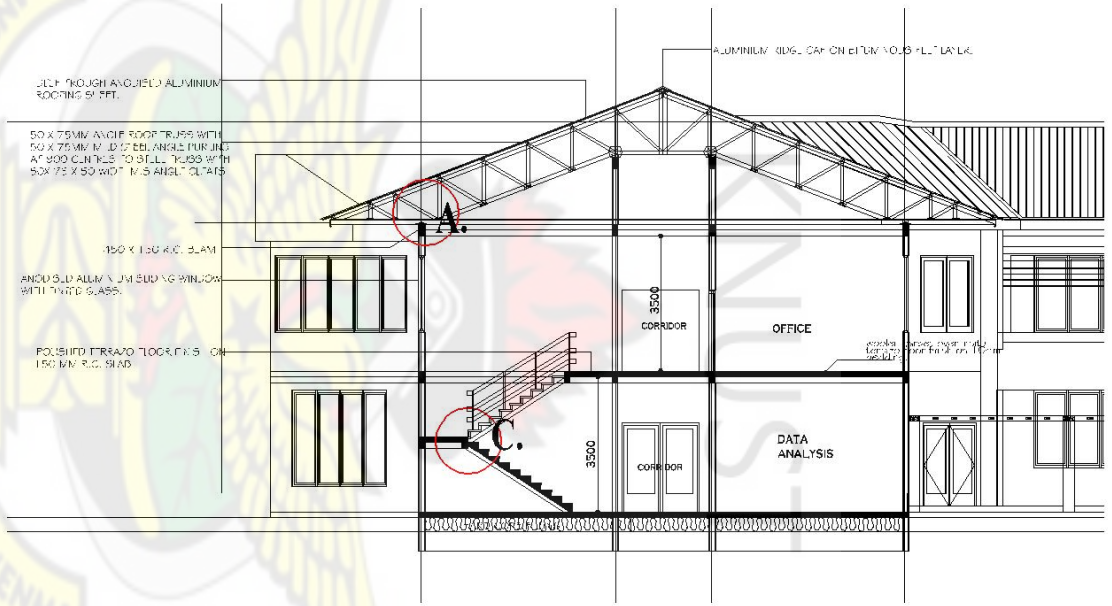

SECTION B - B (BLOW- UP)

(CENTRE OF HOPE)

AIDS RESEARCH AND THERAPY CENTRE

SUNYANI

DEPARTMENT OF ARCHITECTURAL STUDIES

NAME: THOMAS NTIAMOAH AMPEM

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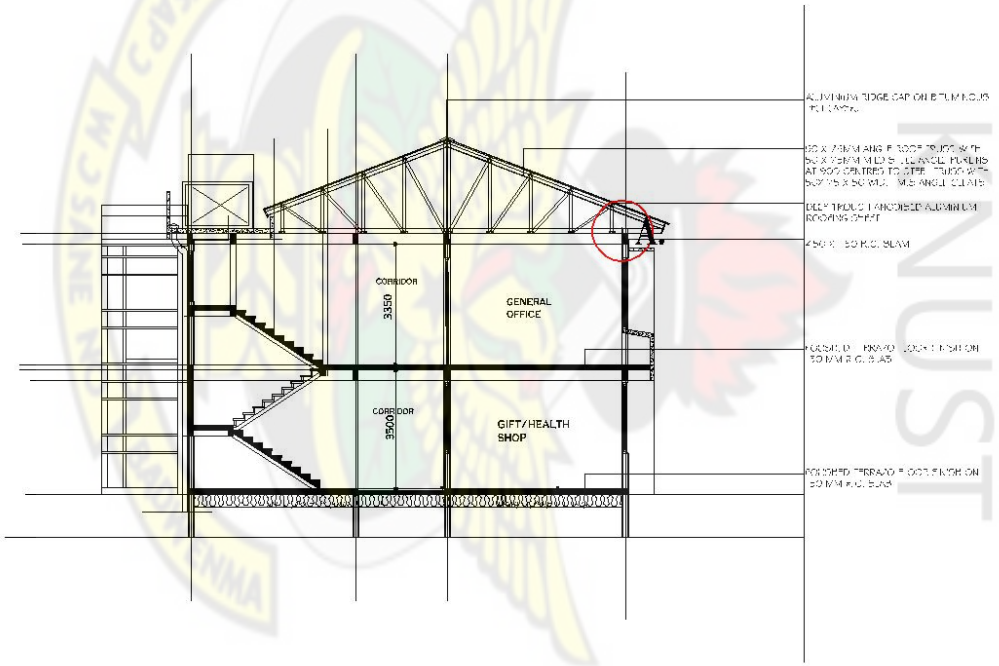
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SECTIONS

SECTION B - B

(CENTRE OF HOPE)

AIDS RESEARCH AND THERAPY CENTRE — SUNYANI

DEPARTMENT OF ARCHITECTURE, K.N.U.S.T.

NAME: THOMAS NTIAMOAH MARFO

DATE: MAY 2007

APPENDIX C

Criterion 1: Do not use materials that contribute to the formation of persistent organic pollutants (POPs) as defined by the Stockholm convention.

Criterion 2; Do not use materials that contain or emit highly hazardous chemicals,

Including;

a. Do not use material that contain

1) Presistent, bioaccumulatives, toxics (PTBs) or

2) verypersisten, very bioaccumulative (vPvB) chemicals

b. avoid materials that contain

1. Carcinogens
2. mutagens
3. reproductive or development toxicants
4. neurotoxicants
5. endocrine disruptors

c. Avoid materials that emit criteria level of VOCs.

Criterion 3: Use sustainably soured biobased or recycled and recyclable materials

a. Prefer sustainably produced biobased materials that are;

1. Grown without the use of genetically modified organism (GMOs)
2. grown without the use of pesticides containing carcinogens, mutagens, reproductive toxicants, or endocrine disruptors.
3. certified as sustainable for the soil and ecosystems
4. compostable into healthy and safe nutrient for food crops.

b. Prefer materials with the highest postcosumer recycled content

c. Prefer materials that can be readily reused or recycled into a similar or higher value product and where an infrastructure exists to take the materials back.

Criterion 4; Do not use materials manufactured with highly hazardous chemical including those described in criterion 2.

Table 2: Rational for Green Material Heirarchy for Healthcare

Criterion	Reasons for Action
1. Do not use materials that contribute to the formation of Stockholm Convention Persistent Organic pollutants (POPs).	• POP are highly hazardous • POPs circulate ad accumulate globally • Government have identified POPs as a top Priority for action and agreed to a global treaty for elimination (Stockholm Convention on POPs).
2. Do not use material that contain or emit highly hazardous chemicals.	• Government agencies have identified these as Priority health hazards • These highly hazardous chemical escape from materials in the healthcare environment • Patients and healthcare workers may be exposed to these chemical
3. Use sustainably sourced biobased or recycled and Recyclable materials.	• Create sustainable material supply systems. • Reduce environment impacts from virgin Materials production and from agriculture
4. Do not use materials manufactured with highly Hazardous chemicals.	• Reduce exposure of communities outside the hospital walls to high hazard chemicals • Improve eider community and ecological health.

Source US EPA, 2003 Municipal Solid Waste in the United States : 200. Data