KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

KUMASI

COLLEGE OF ARCHITECTURE AND PLANNING

DEPARTMENT OF ARCHITECTURE

THESIS:

INTERPRETING INDIGENOUS ARCHITECTURE IN THE DESIGN OF A SCHOOL OF ARCHITECTURE IN LOHO WA, THROUGH CRITICAL REGIONALISM

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(BSc. ARCHITECTURE)

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A THESIS REPORT SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE OF THE KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER OF ARCHITECURE DEGREE

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June 2011

DECLARATION

I hereby declare that this thesis dissertation has been undertaken solely by me and is an original and not a duplicate or plagiarized work. It has resulted from thorough research and logical analysis and synthesis under department staff supervision.

..... 4TH March, 2013

Kunko Karol Augustine Date

(Student)

I hereby declare that this work is an original research undertaken by my student and has been done under my supervision

..... 4th March, 2013

Dr. V. Kodtin-Sanwu Date

(Supervisor)

I hereby declare that this work is an original research undertaken by the student under the supervision of his supervisor

....

Prof. G.W.K Intsiful Date

(Head of Department)

DEDICATION

To the Lord God Almighty, I dedicate this written piece for his guidance, protection, love, direction and grace. To my parents, Mr. Charles Kunko and Mrs. Monica Kunko and my siblings: Beatrice, Vivian, Juliet, Isaac and Theresa for their immense support throughout my education.

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Table of Contents

Table of Contents Continued

page number

LIST OF FIGURES ..... page number

LISTS OF APPENDIX

APPENDICE ..... Page Number

CHAPTER ONE

INTRODUCTION

1.0 OVERVIEW

The vernacular architecture of all the countries within the tropics has been long referred to as a sustainable architecture (Laar and Grimme, 2002). These hot and dry tropical regions with hot days and cold nights developed over centuries, a perfect balance of shading and day lighting as well as natural ventilation and heat storage to in a bid to maximize indoor comfort conditions. The Upper West Region of Ghana and the specific town of Loho which falls within the tropics is no exception with regards to the sustainability of its vernacular architecture. Preliminary survey has however revealed that, most building constructions use block and concrete as opposed to the mud and timber as was the vernacular architecture, and that the functioning of interior spaces are purely without regard to the traditional practices of the people of Loho. This thesis seeks to address the later through an interpretation of the vernacular architecture of Loho, in the design of a School of Architecture in Loho through the critical regionalist philosophical approach.

Geographically, Loho is located in the Upper West Region, between Wa Township and Kaleo Township, less than 8km drive from Wa the capital town. Inhabitants are predominantly Dagaaba and practice a building culture common to the traditional architecture of North Western Ghana.

An Architecture School is a specialized school established to provide training to students to become eligible architects. In the past architecture training was offered in the form of apprenticeship but with time training of architects became formal in institutions of higher learning as universities and also specialized institutes of architectural excellence like the Bauhaus in Germany, Ecole des Beau Arts in France, and Arizona School of Architecture in the USA were established for formal education in architecture training (Stevens, 2001). The architecture school should stimulate developmental growth in Loho and offer an opportunity for artisans and professionals in the construction industry and other related disciplines to upgrade and learn new and sustainable methods of executing their various disciplines to enhance their practice and the services that they provide.

This thesis adopts critical regionalism as a guiding philosophy in the design of the School of Architecture in Loho. The term Critical Regionalism was first coined by Alex Tzonis and Liane Lefaivre in 'The Grid and The Pathway', 1981. Kenneth Frampton in 'Modern Architecture - A critical history,' further elaborated it 1938. Frampton describes Critical Regionalism as"...a term that was not intended to denote vernacular, as it was spontaneously produced by the combined interaction of climate, culture, myth and craft but rather to identify, to reflect and serve, in a critical sense, the limited constituencies in which they are grounded". Frampton agrees that ". . . while aiming at fostering local character and identity, critical regionalism constantly remains open to and selectively accepts elements and ideas from sources other than its own. It is open to interpretation of global perspective, that is to say it does have the capacity to stimulate other cultures and influence the thinking and perception of other people. It returns to the source and approaches tradition by the way of probing into them and challenging them and only by doing so it is able to reinscribe them in a new and contemporary 'form'". No documentation exist of an attempt to translate the vernacular of architecture of Loho, this thesis therefore will set the precedence for further studies and attempts at other modern translations of the relevant aspects of the indigenous architecture of Loho and the Upper West region at large.

1.1. PROBLEM STATEMENT

Over the years builders and designers have lapsed in interpreting the cultural and climatic essence of the local traditional architecture of the people of Loho, Wa in Upper West Region, Ghana. There has been a shift from mud and timber to sandcrete blocks and concrete construction. But most importantly, there is no literature to suggest that designers are making an effort at interpreting the culture of the people of Loho, in recent constructions. This lack of translation, results in a continuous deterioration of the indigenous cultural interpretation of buildings. Thus, the basic function of space and the interrelation between the cultural practices and special division within the typical indigenous house have been lost in recent buildings. To a large extent, the use sandcrete and concrete as opposed to mud and timber has also resulted in a negative influence on natural cooling of the buildings. That is to say mud brick generally has thick walls (approximately 300 mm) and high thermal mass. When outside temperatures

fluctuate above and below comfort temperatures, the high thermal mass of mud bricks considerably reduces heat transfer, performing particularly well in harmattan as compared to sandcrete and concrete with lower thermal mass. This thesis is aimed at finding a way of interpreting the vernacular architecture of Loho in the construction of a School of Architecture as a model for the cultural interpretation of Loho's vernacular architecture.

1.2. JUSTIFICATION

There is a need to preserve the age old vernacular architectural practices of the Loho, since it is largely considered as sustainable architecture. The lapse in interpreting the traditional needs of buildings in Loho results in an ultimate break down of the various aspects of this sustainable architectural practice like, hierarchical layout of the community, the relation and interdependence that exists between specific builds and within buildings as well. An interpretation of the sustainable vernacular architecture is therefore an effort at improving and sustaining the culture of the people of Loho.

1.3 OBJECTIVES

1. To establish the existing vernacular building culture of Loho
2. To analyze the traditional building typology as well as the spatial interrelation and composition of Loho through the case study approach
3. To provide a design which reflects a rendition of the indigenous architecture of Loho in the design of a School of Architecture

1.4. RESEARCH METHODOLOGY

The qualitative research method was adopted for this thesis. The aspect of qualitative research adopted for this thesis is commonly known as foundational research; it examines the foundations for a science, analyzes the building culture, and develops ways to specify how a knowledge base should change in light of new information.

1.5. SCOPE

This thesis underlines the building culture as well as, the climatic aspects of the indigenous buildings in Loho with respect to surrounding environmental factors and parameters associated with the buildings.

This thesis concentrates on discussions based on the aforementioned areas to cover the layout (micro community dwelling) as well as the building configuration (form and structure) of some specific buildings as part of the architecture school design.

The influences are then relayed on the design of a school of architecture evolved to concentrate on three major aspects of operation namely; Bachelor of Science in undergraduate architecture, refresher courses and practical apprentice programmes, post graduate and other advanced graduate programmes in specific areas of interest.

1.6. LIMITATIONS

There is little or non-existing literature on the spatial composition and inter relations between human activity and building form with specific regards to Loho.

Observation as adopted as a data collection technique could influence behaviors of participants, thus the inhabitants of Loho

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

It could be argued that thermal comfort in the tropics can be achieved at much higher ambient temperatures and humidity levels because of occupants acclimatization, however, the vernacular understanding of optimum designs in hot dry environments combined with present day technological advances and 'knowledge' should only be advantageous (Bezemer, 2008).

2.1 CLIMATE

Climate encompasses the statistics of temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological elemental measurements in a given region over long periods. Climate can be contrasted to weather, which is the present condition of these elements and their variations over shorter periods (Wikipedia, 2011)

Dwellings in rural areas of the developing countries do not have artificial systems of cooling or heating. These buildings, especially in hot-dry climate, are provided with natural cooling systems. (Ahuja and Rao, 2005)

2.2. CLIMATE AND VEGETATION OF UPPER WEST REGION, GHANA

The climate is tropical equatorial, which prevails throughout the northern part of Ghana. Temperatures are high all-year, ranging between 15cº-45cº. The temperatures are lowest in December/January, while the highest occur in March /April. The average annual and average monthly temperatures are 21cº and 38cº respectively (Anladong, 2010). The Harmattan, characterized by cold, dry dusty wind with occasional haze occurs between November to April yearly. The district has a single rainfall regime from May-October. The average annual rainfall averages between 750 mm and 1050 mm (30–40 in), about 1,200mm/year and they are torrential, erratic and stormy (Anladong, 2010). The single rainfall regime does not make farming all year round possible. Most farmers therefore become redundant during the long dry

season, from November to May. There is therefore the need for irrigation facilities in the district to provide employment opportunities during this period (Wikipedia, 2011).

The region is located in the guinea savannah vegetation belt. The vegetation consists of grass with scattered drought resistant trees such as the shea, the baobab, dawadawa, and neem trees. The heterogeneous collection of trees provides all domestic requirements for fuel wood and charcoal, construction of houses, cattle kraals and fencing of gardens. The shorter shrubs and grass provide fodder for livestock (Anladong, 2010). Over 30% of the natural vegetation has been destroyed by annual bush burning, inappropriate farming practices, indiscriminate cutting of trees for wood, charcoal and poor animal husbandry practices. The consequence of these human practices is that the district is faced with a serious problem of environmental degradation (Wikipedia, 2011).

2.3. INDIGEOUS ARCHITECTURE IN HOT AND DRY REGIONS

Providing optimum cooling and heating of residential buildings of hot and dry regions, so far has been according to the relations of ecology, so that using architectural methods based on climate, local materials and also culture has damaged the environment as little as possible.(Salehipoor et al.,2005)

According to Salehipoor et al., (2005), traditional architecture has been generated from a climate and the situation which has grown on it, so that all existing spaces of these regions such as urban spaces of passages, yards, and buildings are protected against the atmospheric factors especially undesirable winds, and using desirable winds and the sun's radiation are done according to some special arrangements. In order to recreate the least sun light and heat, outer parts of building walls of urban texture of these regions are condensed to each other and the houses are thickly joined to each other. The lanes are thin and disordered and sometimes they are covered with quite high walls, it is believed that while these situations create a shadow against the sun's radiation they control the speed of the winds.

Yasrebi (2005) wrote that, the idea of court yard in the houses of hot and dry regions has been formed according to the climatic factors, so that construction of courtyard houses of these regions with the indicators such as thick walls of porches, basements, wind catchers, arches and domes show that architects had an explicit concept of environmental conditions. Seasonal usage of spaces, concentration and attention to courtyard and making suitable use of roof are the very functional ways of planning which is in accordance with hot-arid regions. Lastly, we can say that the traditional architecture is a constant and sustainable architecture, because with a stable indicator it is able to answer its ecological matters after the passage of so many years.

2.4 CRITICAL REGIONALISM

The concept of regionalism is nothing new because Vitruvius discussed regional variations in architecture in his ten books and the Romans propounded picturesque regionalism during the nineteenth and early twentieth century's (Wu, 2006). Wu further states however that, regionalism is seen in a new light against the backdrop of the dominance of modernism and the artistic scenography of postmodernism, both of which were thought to have failed to address the human condition in their extreme stances towards historicism. Thus demanding the question, "how to become modern and but return to sources?"

The term Critical Regionalism was first coined by Alex Tzonis and Liane Lefaivre in 'The Grid and The Pathway', 1981. Norberg Schulz, in 1975, in his book 'Meaning in Western Architecture', describes the same as Pluralist Architecture. Thus, Critical Regionalism is not a regionalism in the sense of vernacular architecture, but is, on the contrary, an avant-gardist, modernist approach, but one that starts from the premises of local or regional architecture.

Frampton asserts that- "Critical Regionalism is a dialectical expression. Hence the fundamental strategy of critical regionalism is to mediate the impact of universal civilization with elements derived indirectly from the peculiarities of a particular place. In other words, mediation between construction technology and techniques with elements derived the culture of Loho.

It depends upon maintaining a high level of critical consciousness. Although critical of modernism, it adopts the emancipator progressive aspect of modern architecture.

Later in 1990, Bontand Bognar reviews the theory of critical regionalism as prepared by Kenneth Frampton. He agrees that ". . . while aiming at fostering local character and identity, critical regionalism constantly remains open to and selectively accepts elements and ideas from sources other than its own. The philosopher Paul Ricoeur (1965) has advanced the thesis that a hybrid "world culture" will only come into being through across-fertilization between rooted cultures on the one hand and universal civilization on the other.

Several architects have used the critical regionalist approach to achieve remarkable results. For example, architect Alvaro Siza seems to have been able to ground his buildings in the configuration of a given topography and in the fine-grained specificity of the local context. To this end his pieces are tight responses to the urban fabric and marine scape of the Porto region where he largely practiced. Other important factors are his extraordinary sensitivity towards local materials.

Like Aalto's Jyvaskyla University (1957) all of Siza's buildings are delicately layered and inlaid into their sites. His approach is patently tactile and materialist, rather than visual and graphic.

In addition to Aalto and Utzon, the following architects have used Critical Regionalism (in the Frampton sense) in their work: Studio Granda, Mario Botta, Mazharul Islam, B. V. Doshi, Charles Correa, Alvaro Siza, Jorge Ferreira Chaves, Rafael Moneo, Geoffrey Bawa, Raj Rewal and Tadao Ando.

2.5 CASE STUDIES

2.5.1 INTRODUCTION

This study adopted a descriptive case study approach. This is used to explore reason in order to find underlying principles. Criteria are established and cases fitting the criteria are included as they become available and two cases were selected. The criteria mainly depended on the design philosophy adopted as well as the climatic zone within which the construction was executed

The School of architecture for the Chinese university of Hong Kong and the Waterloo School of architecture, Ontario, Canada were considered as case studies.

The l Chinese university of Hong Kong because it is a design intervention for a similar design problem in Hong Kong and the Waterloo School of Architecture, Ontario, Canada, because it is a working case study. Both cases met the criteria for selection as they are found within similar climatic zoning as Loho, they are also both School infrastructure meaning similar uses with the Proposed School of Architecture. And most importantly, they both were designed using the critical regionalist philosophical approach.

2.5.2 SCHOOL OF ARCHITECTURE FOR THE CHINESE UNIVERSITY OF HONG KONG

The new architectural school building by "Ida and Billy" sits on the edge of the hilly campus with a scenic view of the Tolo harbour. They proposed an architecture which takes the form of a mass pierced diagonal shape to preserve the view of the sky. This also continues the uphill movement from the railway station, to the 'acropolis route' up to the architectural school building and to the outer edge of the site (Ridhika, 2009). The form has large openings to capture the campus' topology and views of Tolo Harbor, "giving an infinite boundary to architectural thinking and design."(figure 17, Cilento 2009).

Figure 1. *View of the school (Source: Cilento, 2009)*

Figure 2. *View of the school's critic and gallery space (Source: Cilento, 2009)*

The 'acropolis route'as mentioned by Ridhika(2009), goes from the public gallery path, internal street, through the studios, up to the open lawn and upper internal lawn. Metal grill panels of varying degrees of openings complete the concrete facade, while enabling light and air to enter (Figure 19).

Figure 3. *The school's multi-purpose circulation lobby (Source: Cilento, 2009)*

The open spaces of school, such as the large public gallery space near the entry (Figure 3), provide ample room to display students' work and hold large critique discussions. Large pivot

joint metal blackboards double as partitioning doors to include or exclude the corridor spaces as desired. The gallery can even be extended into the gallery path and the external timber deck in the woods. Studios and office centers are organized around an upper internal lawn with hanging ivy, while additional informal green learning areas weave in and out of the upper level rooms.

BUILDING CONFIGURATION: The form's diagonal mass creates a breezeway through the building, enabling cross ventilation and penetration of natural light to all levels (Cilento, 2009).

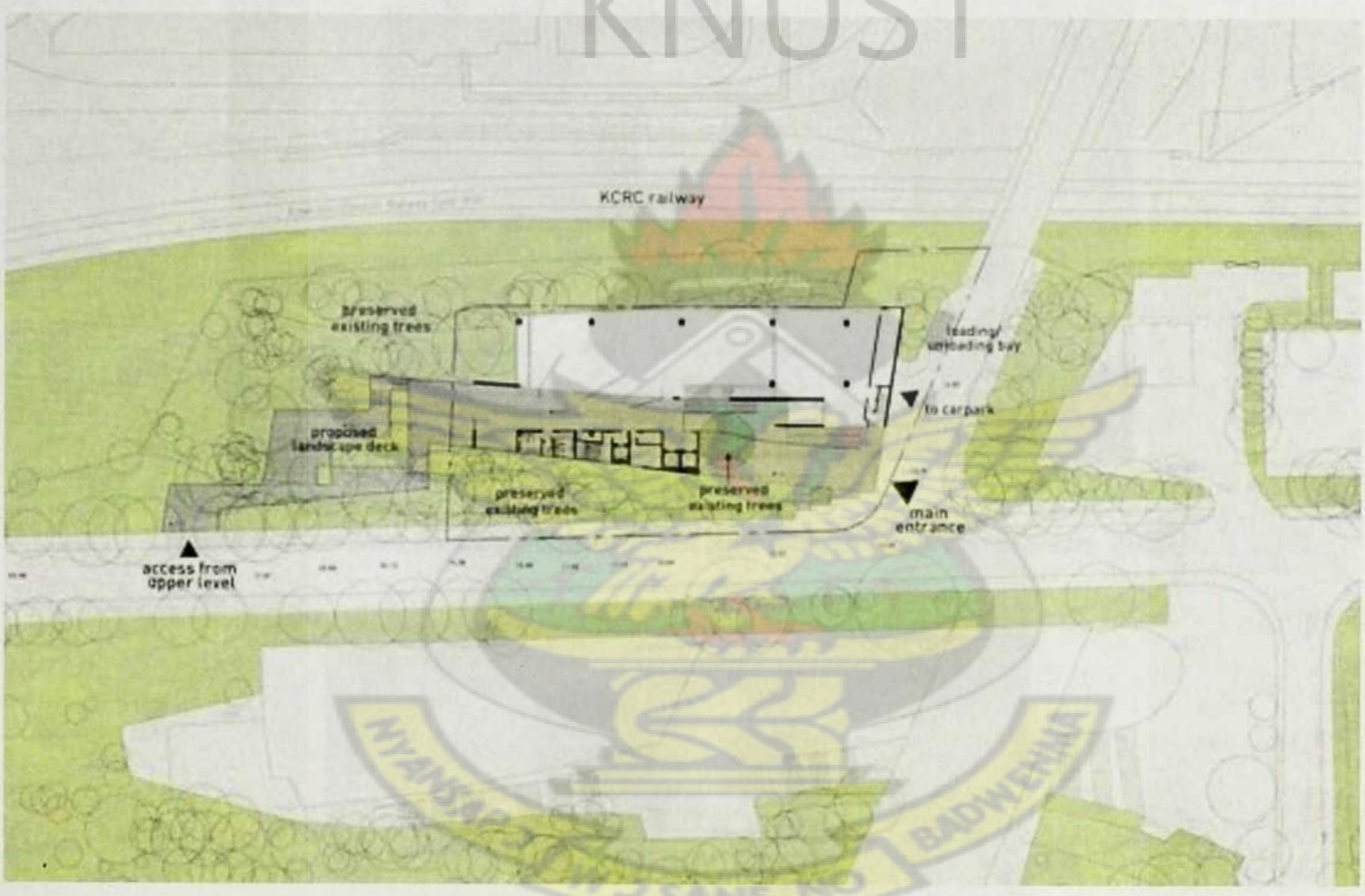

Figure 4. *The school's layout (Source: Ida and Billy, 2009)*

Metal grill panels of varying degrees of openings complete the concrete facade, while enabling light and air to enter.

Refer to appendix 5 for details of other floor plans of school of architecture for the Chinese university of Hong Kong.

BUILDING STRUCTURE AND MASSING: The building has a series of recesses and voids opening into a central courtyard. The air flow is therefore efficient and convenient for indoor and outdoor activity. Ida and **Billy's** sections in figures 21 and 22 illustrate the air circulation that results from the design intervention. The various thicknesses of the directional arrows signify the various volumes of air directed (*Cilento, 2009).*

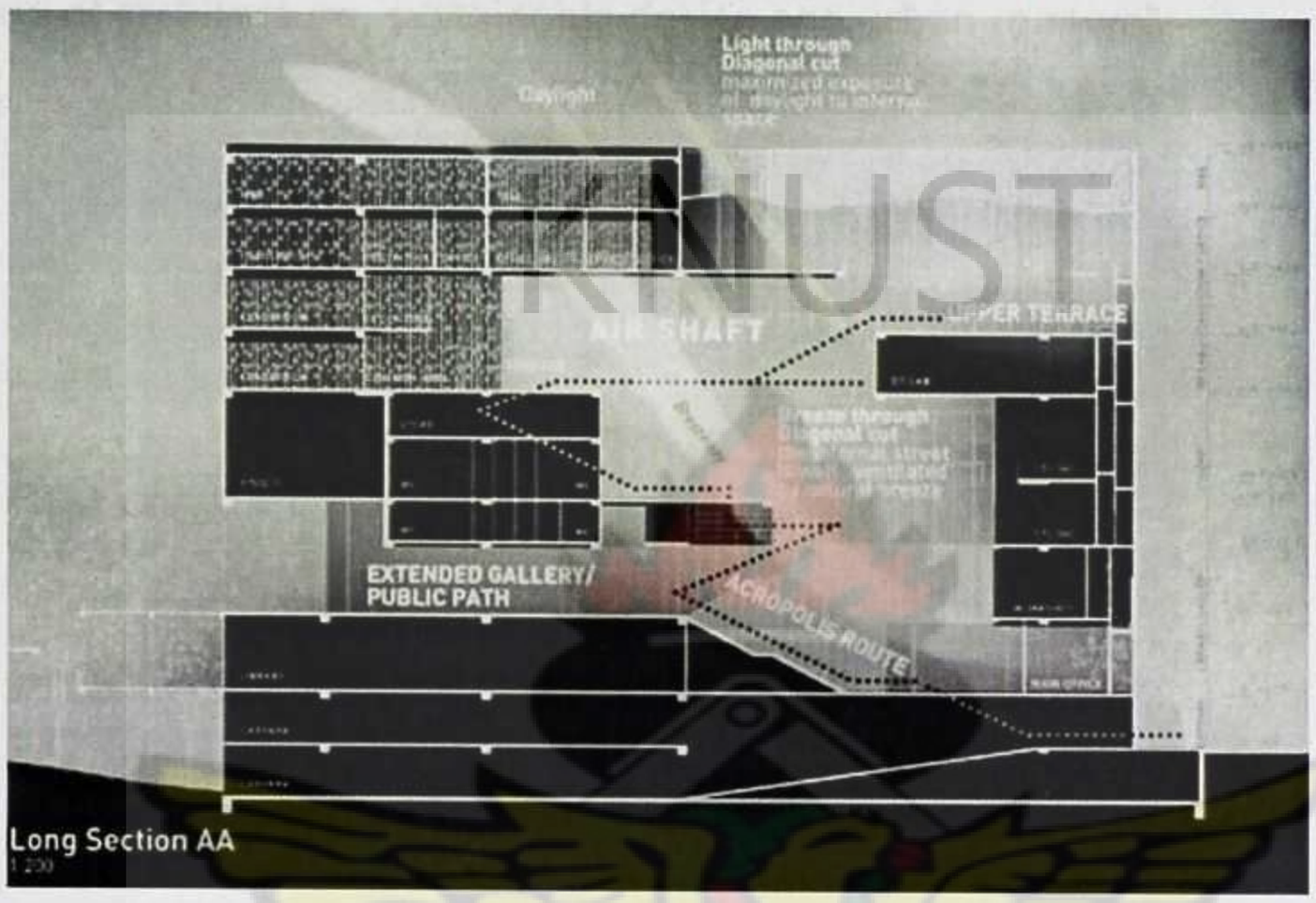

Figure 5.*A section through the Architecture School (Source: Cilento, 2009)*

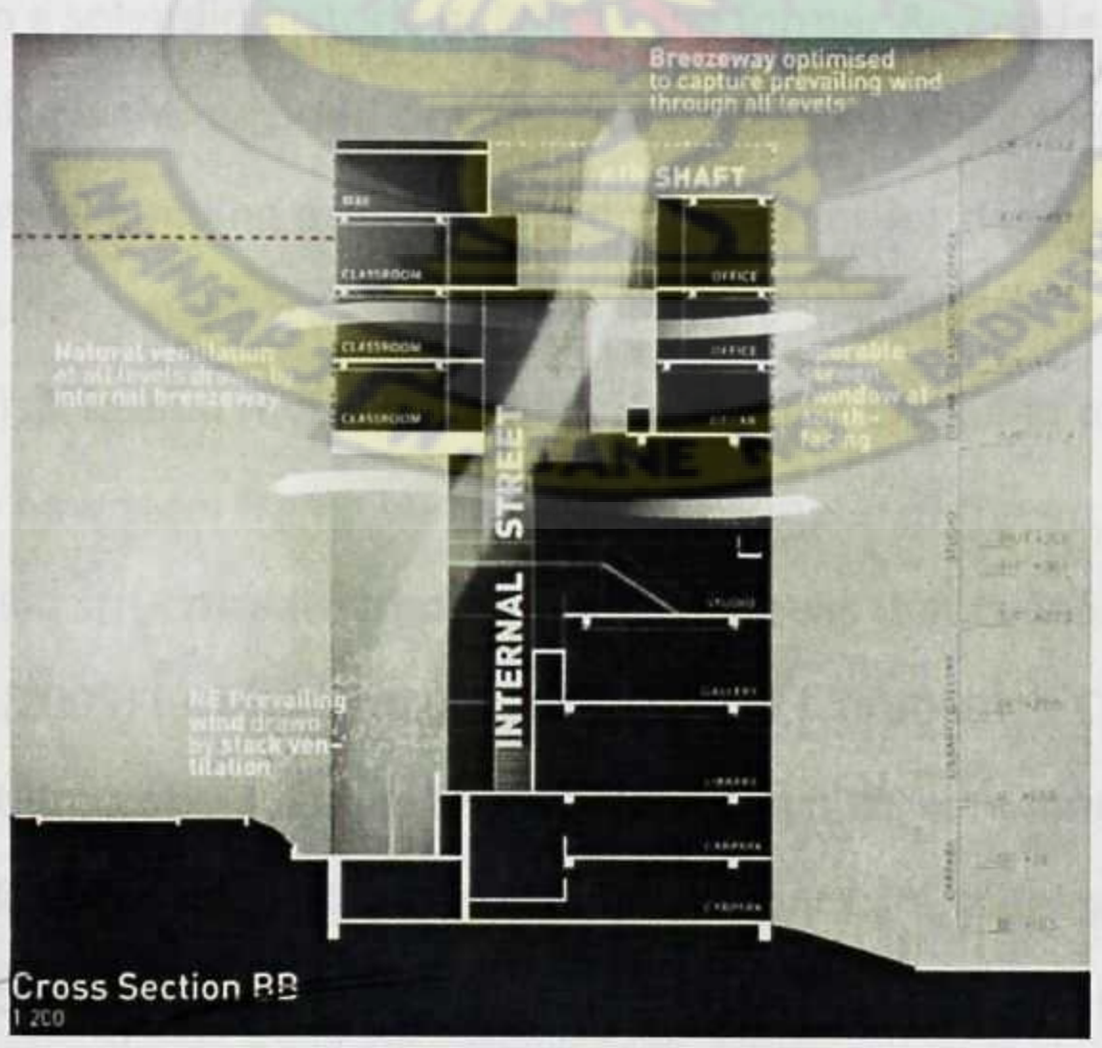

Figure 6.*A section through the Architecture School (Source: Cilento, 2009)*

2.5.3 WATERLOO SCHOOL OF ARCHITECTURE, ONTARIO, CANADA

The Waterloo school of architecture designed by Levitt Goodman Architects was completed in 2004 and is located at Cambridge, Ontario, Canada. The school Project covers an Area: 7,897sqm. Relocating from the University of Waterloo campus to the century-old Riverside Silk Mills in Cambridge Ontario, the new School of Architecture has repositioned itself as a model for the instruction of architecture, sustainable design and urban renewal.

Figure 7, *Water Loo School of Architecture (Source: Ben Rahn, 2009)*

The School is located in a splendid historic building - the former Riverside Silk Mill - located in the heart of the old Galt neighbourhood of Cambridge. Situated along the banks of the Grand River, the former industrial building provides wonderful spaces for design studios, labs, and classrooms. It also includes a superb design library, exhibition galleries, public auditorium, and café (Cambridge, 2011). A formal rhythm between the regular brick and masonry piers of the historic façade and the new steel frame windows is emblematic of the architectural strategy of re-presenting the existing structure with contemporary details that redefine the building (figure 26) (Nico, 2009). Nico (2009) further states that the school has enabled Cambridge to remediate a prominent Brownfield site, extend its downtown core, reconnect its "Riverwalk" promenade and provide the public with access to a riverfront café, a design gallery and an auditorium that hosts community functions. A formal rhythm between the regular brick and masonry piers of the historic façade and the new steel frame windows is emblematic of the

architectural strategy of re-presenting the existing structure with contemporary details that redefine the building. Funded by local businesses as well as all levels of government, the project is a model for public-private partnerships. It augments the University's facilities and serves as an instrument of knowledge and experience for the profession. It has enabled Cambridge to remediate a prominent brownfield site, extend its downtown core, reconnect its "Riverwalk" promenade and provide the public with access to a riverfront café, a design gallery and an auditorium that hosts community functions. The staff and students have instantly invigorated the local economy and since the school operates day and night, it continuously animates the City.

BUILDING CONFIGURATION: By design, the School of Architecture is a didactic model of building assembly. The architects carved out a central atrium that establishes an airy, three-storey hub punctuated by blackened-steel cantilevered staircases, providing sweeping views of the river and the surrounding activities (figure 25). Even bathroom stalls are fabricated from pin boards. Distinctive spaces such as the auditorium and the library are elevated by employing finer material and craftsmanship.

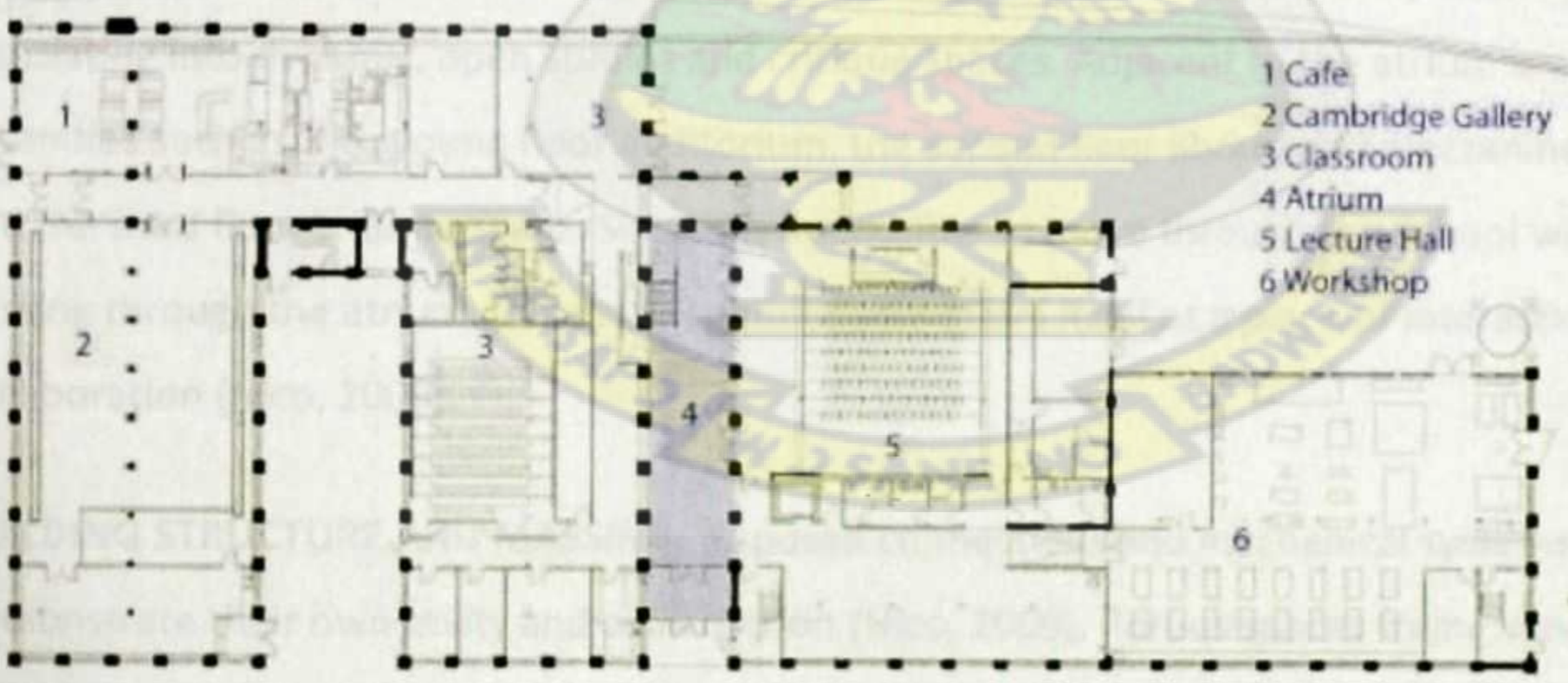

Figure 8, Ground floor plan of Waterloo School of Architecture (*Levitt Goodman Architects, 2009)*

Refer to appendix 5 for architectural details of Waterloo School of Architecture, Ontario, Canada.

Figure 9.*The hallway of* Waterloo School of Architecture *(Source: Rahn, 2009)*

Levitt Goodman Architects on the interior maintained the former factory's expansive floor plate translating into dynamic, open studios and critique spaces. Adjacent to the atrium are key amenities such as the ground floor auditorium, the second floor library and mezzanine lounge and the third floor critique space. Since it is impossible to move through the School without passing through the atrium, this space continuously offers itself as a place of interaction and collaboration (Nico, 2009).

BUILDING STRUCTURE AND MASSING: Exposed connections and mechanical systems demonstrate their own utility and construction (Nico, 2009). Porous spaces frame views of things being made. A conscious decision "not to design too much" renders most surfaces raw and durable, suited to exhibition, intervention and creativity (Levitt Goodman Architects, 2004).

Figure 10, *Exterior view of school (Source: Rahn, 2009)*

Waterloo's emphasis on the craft of architecture is highlighted though select details such as the custom-designed glass canopy over the main entrance that casts the word "ARCHITECTURE" underfoot and along the old masonry wall, the reverse treads cut into the feature staircases that emphasize a sense of descending into the sunken auditorium and the new fenestration and concrete panel exterior at the river face.

SUSTAINABILITY: Practicality and sustainability were driving factors for all design and material selections aimed at reinforcing the notion that quality design can no longer be skin deep. This also minimized the amount of new material required and construction waste produced. A schedule of 14 months was dedicated to design and construct, whiles establishing a "maximum reuse" architectural party, allowing construction to begin immediately while the design was still underway (Levitt Goodman Architects, 2004).

2.6 INDIGEOUS ARCHITECTURE OF THE UPPER WEST REGION

In the dry and northern half of Ghana the traditional building methods in mud are still followed throughout the region, mainly in the rural areas. This region has rectilinear structures of interconnected cellular spaces, built with flat mud roofs (Schreckenback, 1983). Schreckenback (1983) further discusses that, houses have internal courtyards; walls are laid out rectilinear to enclose interconnecting spaces. Schreckenback also explains that wall are moulded in layers with wet mud balls or with sun-dried mud bricks or in some cases also with dried mud clods from old, broken down buildings.

The walls are however, thicker (average 400mm). The separate layers, if built with mud balls, are clearly recognizable, since the next layer overlaps the previous layer so that the external appearance (the inside walls are plastered and finished smoothly) is that of an exaggerated horizontal feather-edge boarding

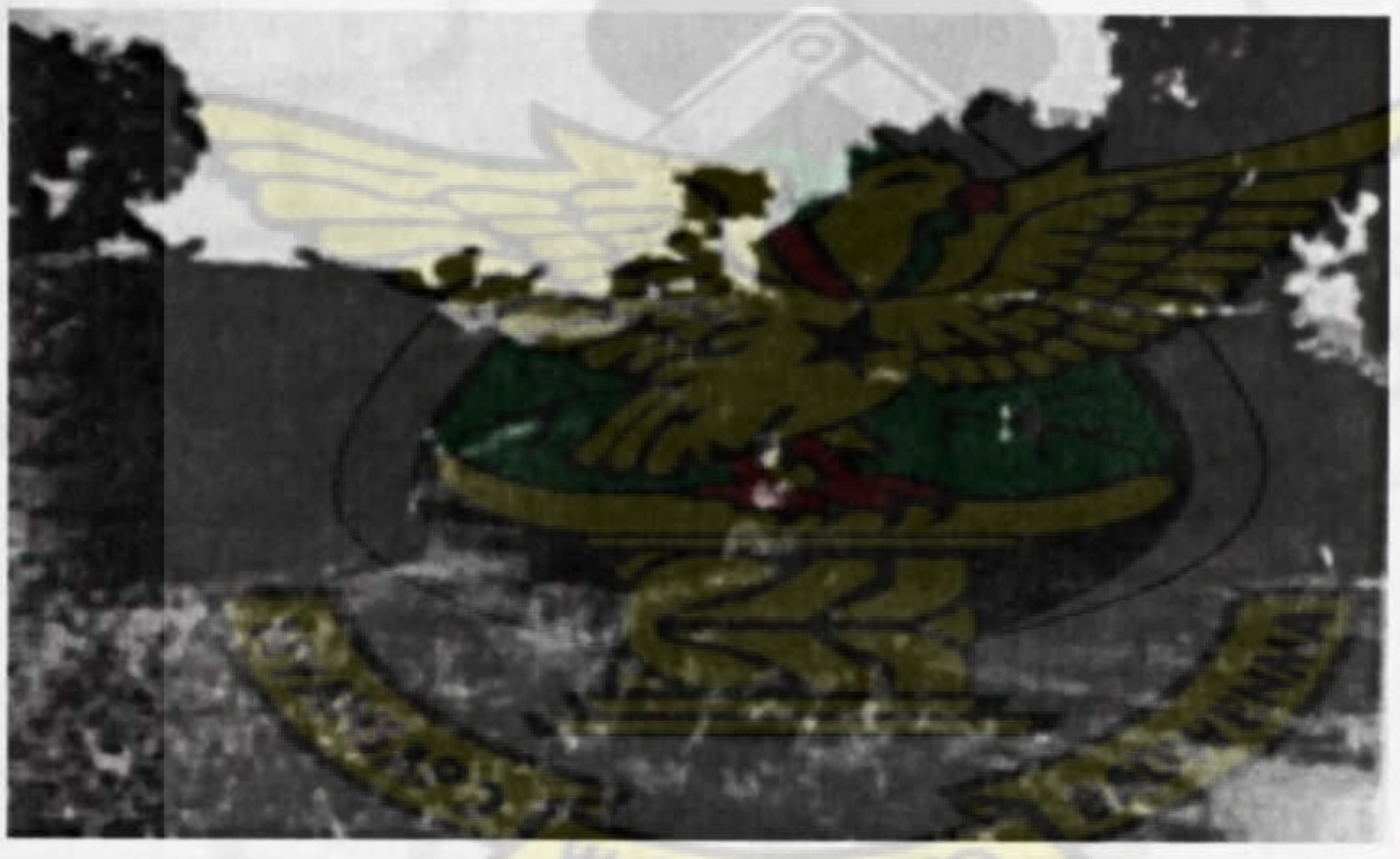

Figure 11, *View of "mud ball wall"* ***(****Source:* Schreckenback, 1983***)***

The flat mud roof is supported entirely with a post and beam arrangement thus; the walls are therefore non load bearing. Room widths do not exceed 2.5 to 3 meters (Schreckenback, 1983). Each room is in itself an independent structural entity, as can be seen from the part-plan of a typical house (figure 27).

It is easy to understand the internal layout of such a house when one stands on the flat roof. The non-load bearing walls project in the form of parapets (about 250 to 300mm high) beyond the roof surface. The flat mud roof is supported on walls with its beams and rafters bedded into the mud of the wall. Corners of such buildings, unless reinforced cannot transmit the forces to which the walls are subjected. Early deterioration is the result (Schreckenback, 1983).

The rooms are built using a simple post-and-beam system. Each room is an independent structural entity, with a series of forked timber posts along its perimeter which carry the supporting beams for a dense layer of rafters, as a solution to the scarcity of long timber members (Intsiful, 1984).

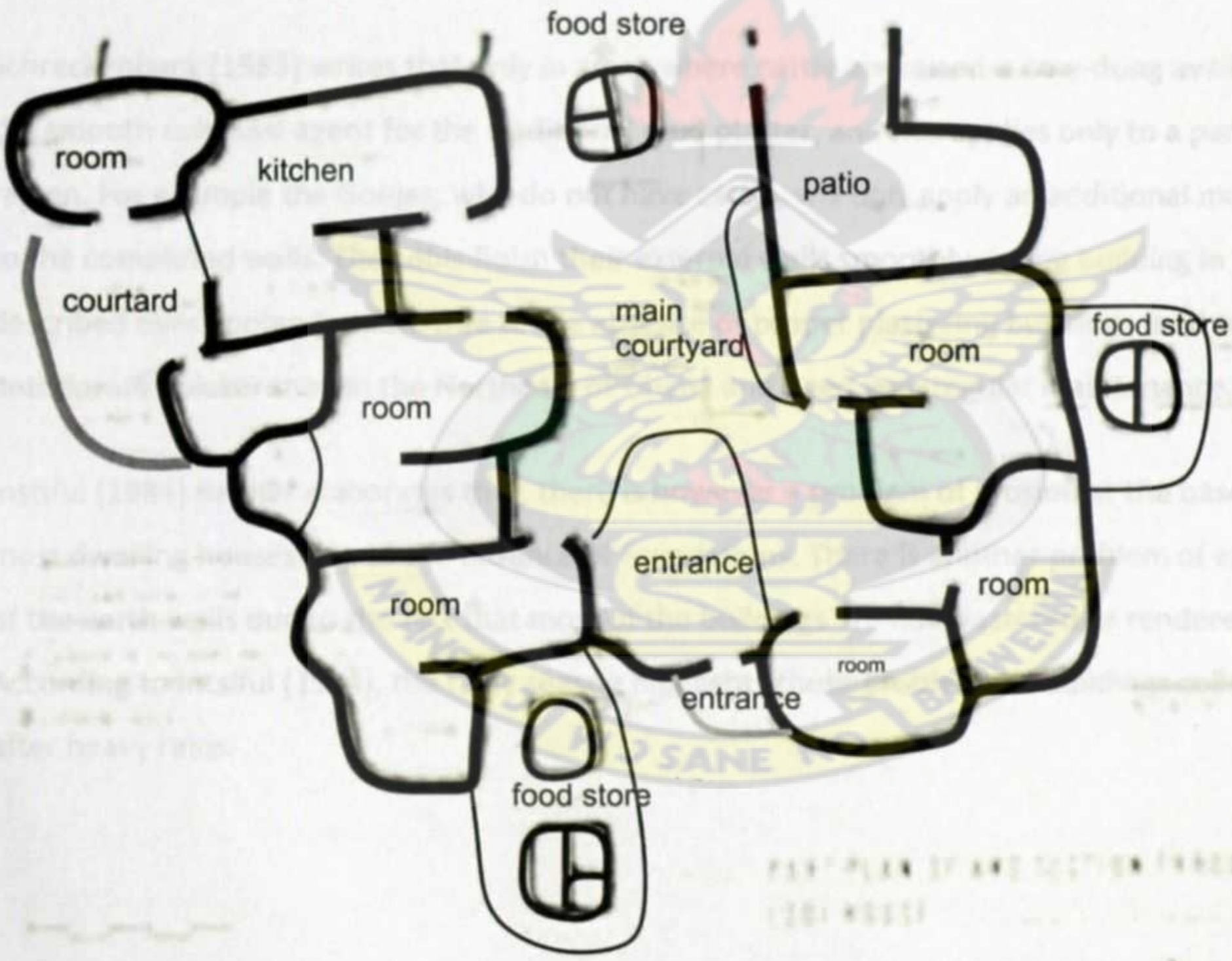

Figure 12, *Layout of typical vernacular house in upper west region (Source:* Schreckenback, 1983*)*

The mud roofs are built with a supporting bush pole substructure of posts and beams or beams and rafters from the Shea butter tree bedded into the mud wall. The posts have forked ends at the top and carry the beams. Across these are laid smaller poles (rafter) at the distance of 100mm apart in two layers. Over these follows a layer of crosswise arranged, closely laid twigs or small split poles. A layer of about 200mm thick well kneaded mud or clayey soil is put on top of this. A finish of a mixture of mud, cow-dung, sand and the residue from Shea butter during extraction is applied to the mud layer and a pot without bottom is inserted into the mud roof in places to let in light or for extraction of smoke. The mud roofs are laid such that they drain off rainwater easily through spouts let into the small parapet wall which normally surrounds the roof.

Schreckenback (1983) writes that only in areas where cattle are raised is cow-dung available as the smooth cohesive agent for the traditional mud plaster, and this applies only to a part of the region. For example the Gonjas, who do not have cattle, will only apply an additional mud coat to the completed walls. The Lobis finish their external walls smoothly during building in the described overlapping fashion. Due to the absence of proper plastering buildings tend to deteriorate quicker than in the Northeast of Ghana and need very regular maintenance.

Instiful (1984) further elaborates that, there is however a problem of erosion at the base of most dwelling houses due to the absence of foundations. There is another problem of erosion of the earth walls due to the fact that most of the buildings are not plastered or rendered. According to Intsiful (1984), the rainy season highlights these problems as buildings collapse after heavy rains.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 INTRODUCTION

This research sought to find out and understand vernacular architecture in Loho in response to the design of an architecture school. The aim is to find appropriate measures to improve the environment and maintain the cultural identity of Loho.

In an effort to conduct an inquiry into the current prevailing situation concerning the vernacular architecture, it was realized that, the influences were mainly surrounding environmental factors and the parameters that bordered on the buildings themselves. The later concerns were the vegetation pattern, water bodies, landform and orientation as well as open spaces and built form. The former concerns were the building configuration and the building orientation. This chapter outlines the methods used in the study.

3.1 RESEARCH FRAME WORK

This research applied the use of the qualitative research methodology in seeking to explore a phenomenon, that is; vernacular architecture of Loho and subsequently design a critically regionalist school of architecture. This method will help obtain information which will eventually be used to describe and to examine the vernacular architecture.

Methods such as case studies, interviews, documentation review and observation were essential methods of data collection for this thesis.

A careful study of documentation on climate and architecture in hot and dry climates was conducted and aspects of climatic influence on the vernacular architecture of such places were noted and analyzed. The Chinese school of architecture, Hong Kong and the Waterloo school of Architecture were chosen as case studies. A study of the building configuration, material as well as building structure and massing was discussed. Careful observation and documentation on site also presented essential influences bordering on the topic.

3.2 RESEACH DATA

Qualitative research data are forms of information gathered in a nonnumeric form. Data collected from case studies, interviews, documentation review and observation, on the phenomenon informed a critical analysis of the topic. In deciding the particular cases to study, the climatic location and philosophy of the schools were the parameters of selection.

Documentation of construction methods and material were gathered from literature and reviews published on the vernacular architecture of north western Ghana.

Aspects of daily circulation patterns and activity with respect to the building spatial organisation and spatial configuration were documented based on participant observation.

3.3 PROCEDURE

Firstly, documentation reviews were conducted on the climate and vegetation of the study area with respect to the vernacular architecture and the influences on such.

Secondly, documentation reviews and analysis on the indigenous architecture of the study area to reveal construction culture and techniques as well as material and craftsmanship of such were conducted.

Thirdly, careful observation helped in documenting and analyzing the circulation and spatial organisation in respect to the study. This also helped to verify and confirm initial documentation and material bordering on the topic as reviewed from other authors.

Fourthly, after a critical literature review and participant observation and documentation, the influences bordering on the topic were then categorized into two broad headings, thus, surrounding environmental influences and the parameters associated with the building itself.

Fifthly, these influences were then critically analyzed and the results influenced the design decisions towards the outcome of this research.

The discussions try to explain the relationships between the layout of the study area and the circulation patterns of the inhabitants. In addition, relationship between activity and spatial organization as well as climate and building culture are also discussed.

Further discussion on circulation trends, spatial organisation is carried out from the findings.

3.4 THE ADVANTAGES OF THIS METHOD TO THIS STUDY

An advantage of the qualitative methodology in this research is that; use of observations and probing gives the opportunity to respond in the author's own words, rather than limited choices from fixed responses, as in the case of quantitative methods research.

Another merit of the qualitative method to this study is that, it also enabled a focus on investigating the "*why*" and "*how*" of the topic under discussion. Why vernacular architecture and how was it achieved, as well as; why critical regionalism and how will it be achieved.

CHAPTER FOUR

FINDINGS AND DISCUSSIONS

4.0 INTRODUCTION

This chapter relates directly to the interpretation of the principal concepts and influences on the choice of vernacular architecture and not specific materials and techniques as reviewed in chapter two. The layout of Loho is discussed in this chapter as an introduction to the village's physical character.

The discussions in this chapter bring to board relevant findings and discussions of the outcome of the methodology adopted for this study. These include a study of, climate and vegetation, circulation pattern and spatial organisation and aspects of indigenous architecture of Loho. The discussions on climate and vegetation centered on climatic features and vegetation characteristics that directly informed the choice of the vernacular architecture practiced in Loho and the interpretation of these influences on the design of a School of Architecture in Loho. Further discussions on the circulation pattern and spatial organisation also emphasizes the function and use as well as the inter relation between the two, within the context of a typical vernacular type building. The discussion further outlines the relevance of such interpretation on the School design. The discussion on aspects of the indigenous architecture centered on two broad categories, thus; the influence of surrounding environmental factors and the influence of parameter associated exclusively with the buildings. Both aspects are accessed to establish the motive for the choice of indigenous architecture and later interpreted through a critical regionalist approach in the design of the School of Architecture.

4.1 LAYOUT

The layout of Loho is quite simple, apart from the main high way cutting across the study area of Loho, every other vehicular circulation route remains un-tarred, and thereby generating dusty micro environments within the inhabited areas. Travelling to major economic activity areas is done on foot and along foot paths evolved over time. Paths to farms and other

occupational areas are also along foot paths, a kilometer or more away from their homes (Appendix 1a). Entering Loho from the southern direction, that is from the regional capital Wa, one notices the catholic church retreat centre to the right occupying an over two acres of land and walled on all sides. Opposite this huge compound are regular local businesses such as carpentry and motor mechanics, along the road. But further inland are residential buildings of the mud and typical to the vernacular architecture of the Loho. Less than a minute drive away from this a junction serving the inner town of Loho and further through to Cheria Village. This road connecting from the West is the only other vehicular access road; all others are short drives to specific buildings and motor paths to houses and farms. On the East of the major Wa to Kaleo Road are several residential buildings, most of which do not the vernacular architecture concept. The site for the Architecture school is located east of the road and further away from the local residential buildings.

4.1 CLIMATE AND VEGETATION

Loho is characterized by two main climatic seasons, the rainy season and harmattan season. Temperatures are high all-year, ranging between 15cº-45cº resulting in mud as an appropriate walling material and usually constructed 400mm thick up to about 2100mm high. However maintenance should be annually before the rainy season and no special treatment is given to stabilize the mud before or after construction. Stabilized mud brick have been effectively to construct buildings both residential and offices, examples of such can be found in Kumasi on the campus to the Kwame Nkrumah University of Science and Technology. However for the purposes of a critical regionalist approach to interpreting the results of these adverse temperatures, the double walling system of construction is adopted. Unlike cavity walling, a void is created between these walls to suction the heat transfer from the outer wall surface. Thus, double walls 150mm and 100mm with a void of 900mm between the outer and inner walls respectively.

The harmattan is characterized by cold, dry dusty wind and occurs between the months of November to April. These conditions result a vernacular choice of few and small size windows

on the exterior wall. The doors opening into the courtyard are almost always opened to let in light and better the ventilation conditions in doors. Small size windows are also adopted in the design of the Architecture school, as a critical response to the interpretation of this vernacular construction character. How the windows are however patterned and dressed with several color features to give its appearance an esthetic appeal. Courtyard developments

The rainy season is characterized by torrential, erratic and stormy rains. This has resulted in an annual culture of maintenance of the local buildings. The rooms are built using a simple post-and-beam system with teak "Y" shaped posts at every corner of the rooms supporting a teak beam. This structure holds the roof in place whiles the 400mm thick mud wall support itself against the stormy winds. This character of construction is interpreted vividly in the "Y" shaped columns adopted for the double volume gallery and exhibition space provided under the studio block of the Architecture school. The School design also adopts a regular post and beam system as main structural support. Storm drains are also provided in the services layout to cater for the occasional torrential pour of rain.

Loho falls within the guinea savannah vegetation belt of Ghana. Vegetation cover is grass with scattered drought resistant trees such as the shea, the baobab, dawadawa trees. The natural vegetation is been destroyed by seasonal bush burning, inappropriate farming and hunting practices and indiscriminate cutting of trees for charcoal. The vegetation cover has very little influence on improving the micro climatic conditions of the site but could be harnessed to the benefit of the Architecture school as a critical regionalist response. The "Ba Kpeng" stream is a good opportunity to harness and collect water for drought season benefit such as planting, grey use and industrial uses at the laboratories. Underground water is also alternative to the drought water shortage for services and planting purposes. Teak is a good choice for dust shielding and heat adsorption especially during the harmattan season.

4.2. TYPICAL CIRCULATION PATTERN AND SPATIAL ORGANISATION IN LOHO

Upon return to the homes, there is a first court outside the main building popularly referred to in the local parlance as "daa par" (under the tree) and its design of strapped teak logs laid

across "y-shaped" stumps, serves several functions including, resting to catch your breath after a long day's activity and receiving visitors that don't have any business inside the house, some other uses of this culturally essential space include, monitoring children's outdoor activities, large gathering for traditional naming ceremonies and wake keeping during funeral activities. A visitor, if allowed, subsequently arrives within the entrance lobby through a gated entry point into the first court thus, the regular activity court yard. Where activities such as, laundry and drying of certain food are done. Important cultural activities such as, marriage ceremonies and family meetings are also conducted within this courtyard. This court also serves as a reception point for an allowed group of visitors, such as, close friends, family allies and in-laws.

A third court yard exists where the house elder resides generally referred to as the "patio". That's where he receives important guest as well as dine and rest when he is not out of the house. That's also where hobbies and trades of the family are thought, for example, xylophone repairs and crafting as well as drum repairs and crafting in some cases. Smock weaving and sowing are also thought in other instances. One very essential use of this space also is that toddlers and babies are confined to play within this court so they can be monitored thoroughly from the second court and by the landlord.

In a bid not to divert from the norm of creating a hierarchy of court yards as dominating within the local indigenous architecture, the school of architecture as interpreted exhibits a series of court yards to create and control a micro climate that favors the uses of the various spaces (Appendix 4a).

These courts occur both in layout and massing of the architecture school, thus both vertical and horizontal compositions as illustrated in appendices 4a and 4c.The School creates a series of court yards within which users are ushered into the facility. The courts steam form the more public general parking into the semi-private ceremonial court, the auditorium and schools administration offices. In similar light, the workshop court yard is open to customers of the production and fabrication units. Other courtyards created for more private use, are the studio or exhibition foyer leading into a more private student Centre court, then further into the

residential courts for a total privacy (Appendix 4a). This practice is an essential part of the vernacular architecture of Loho.

4.3. INDIGINEOUS ARCHITECTURE OF LOHO, WA

Two main parameters that influence the indigenous architecture of Loho are; surrounding environmental factors and the Parameters associated with the buildings.

Surrounding environmental factors include landform and its orientation, vegetation pattern, water bodies, open spaces and built form.

Parameters associated with the buildings include building configuration and building orientation, ventilation control and roofing systems.

Both categories particularly influence the cooling and ventilation of such buildings and are essential for the interpretation of the vernacular architecture.

4.3.1 INFLUENCE OF SURROUNDING ENVIRONMENTAL FACTORS

These are influences bordering on the vernacular architecture of the study area that directly relate to the environment and site character either than the buildings composition. These influences however, can affect the buildings composition.

4.3.1.1 Landform and its orientation

In the case of Loho, the ground is undulating but predominantly sloped towards the northern "Ba Kpeng" stream valley which within the hot-dry climate is an advantage when constructing a building in the depression. This is due to the relatively lower air temperature that collects in the depressed land areas. As a result, cool air being heavier than hot air, tends to settle down in depressions while hot air rises. Similarly while making a building on slopes, leeward side is preferable. Nevertheless, hot winds would be minimum on either slope. In Loho, a north slope is preferable as it would receive least direct radiation. This is however true only if the slope is steep enough to shade the building. Farming practices within the immediate environs of the settlement also contributes to erosion. As a result and in an attempt at representing the hierarchy of courtyards established, a rather modern approach is instituted to create a more climate-responsive environment to climate change and the green building theory (Appendices

2y and 2.1a). On the contrary, the spaces opened within and outside the immediate environs of the local houses are cultivated and farmed on, coursing rill erosions areas on the affected areas within the environment and exposing the ground to a non-favorable climatic intent.

4.3.1.2 Vegetation pattern

Vegetation and trees in particular effectively shade and reduce heat gain. They increase humidity level. They also cause pressure differences thereby increasing and decreasing air speed or directing air flow as well as shading from dusty winds. The few plants, shrubs and trees that grow on the study area, absorb radiation in the process of photosynthesis. As a result they actually cool the environment where they exist. This lack of trees however increases heat gain as well as allowing the penetration of the hot and dusty breezes of the north-east trade winds during the relatively long dry season. Lack of vegetation and trees also effectively reduce shade and humidity level.

4.3.1.3 Water bodies

The "Ba Kpeng" stream however small or seasonable serves a relatively essential role in the micro climate of Loho. The water absorbs relatively large amount of radiation. It also allows evaporative cooling.

As a result, during day time areas around water bodies are generally cooler. At night, however, the water body releases relatively large amount of heat to the surroundings. The steam therefore can be used both for evaporative cooling as well as minimizing heat gain. Taking into account wind pattern and vegetation, cool breeze can be made to enter into the house.

4.3.1.4 Open spaces and built form

Open spaces have to be seen in conjunction with the built form. Together they allow for free air movement and increased heat loss or gain. Open spaces in this context are inevitable. After all, any built mass will modify the microclimate. Open spaces gain heat during the day.

The ground is hard and building surfaces are brown in colour, which makes much of the solar radiation to be reflected and a little portion, absorbed by the surrounding buildings. However, during the rainy season when the grounds are tilled and is soft and green, then less heat is reflected. In hot-dry climates, compact planning with little or no open spaces would minimize both heat gain as well as heat loss.

When the heat production of the buildings is low, compact planning minimizes heat gain and is desirable. This is how the indigenous settlements are.

4.3.2 INFLUENCE OF PARAMETERS ASSOCIATED WITH THE BUILDINGS

These are influences bordering on the vernacular architecture of the study area that directly relate to the buildings composition. These influences affect the users and function of the spaces so are therefore necessary for an accurate interpretation of the vernacular architecture.

4.3.2.1 Building configuration

It is desirable to lower the rate of temperature rise of the interior during day time in harmattan season. To achieve this, the building should preferably be compact. The surface area of its external envelope should be as small as possible, to minimize the heat flow into the building. The ratio of the building envelope's surface area to its volume or ratio of floor area to its volume determines the relative exposure of the building to solar radiation. The best layout is that of a patio or a courtyard surrounded by walls and thus partially isolated from the full impact of the outdoor air as practiced as a key element of the vernacular architecture. As discussed in the spatial organisation of the Architecture school, the courtyard is a major determining factor in the interpretation of the vernacular architecture of Loho. In the instance of the typical vernacular architecture there are none or little openings into the courtyard to allow for free cross flow of ventilation. The architecture school's configuration however, exhibits a series of "U" shaped courts to allow for controlled circulation and ventilation within the court yards. The vertical configuration of spaces also allows for controlled circulation and comfortable use of the indoor spaces. Refer to appendix 4C

4.3.2.2 Building orientation

The main objective in deciding upon a given orientation in Loho is to minimize the impact of the sun on the buildings especially during the harmattan. The amount of solar radiation on different walls also results in a clear preference for north-south orientation of the main facades.

However the effects of the long existent dusty dry winds calls for a careful orientation to benefit both solar heat gain on exposed walls and dust gathering on openings, especially of the windows. In light of that, a north west, south east orientation could also be suggested. In the case of the School of Architecture, emphasis is however, drawn to the solar radiation influences and effects either than the gathering of dust on window openings and other such openings on the exposed façades. In similar vein the double walling system will adequately serve as a buffer and trap for the dusty winds blowing from the north east direction of the site. Similarly north south orientation enables easy and in expensive shading of the southern window in the harmattan. The heating effect of solar radiation on walls can further be minimized by choosing reflective colors of the walls. On the other hand an orientation due to influences of dusty winds and their accompanying effects will result in shading on all walls and facades since all façades will be exposed to the suns radiation. Obviously, the North West, south east orientation option will be more costly in construction, every other thing being equal, than the south north orientation. The Architecture school therefore adopts the north south orientation predominantly for building configuration. Refer to appendices 3B, 4B and 4M for details

4.3.2.3 Ventilation Control

Warm air from within the more enclosed rooms is sucked out by pressure movement of air. An occurrence due to small sized openings on exterior facades coupled with wider openings within the court yard, thus, creating a more rapid exchange of air between interior and exterior spaces (Appendix 4M). The small sized openings are typical of the vernacular architecture and advantageous to the climate. A critical interpretation of this system of ventilation reestablishes the building culture. In a similar vein, the dust and heat gain from the immediate environment of the buildings in Loho, also influences the vernacular choice of window sizes for exposed

exterior walls. Typical window sizes for the vernacular architecture of Loho are averagely 900mm by 900mm.

4.3.2.4 Roofing System

The vernacular architecture of Loho is mostly flat roofs constructed with several layers of rammed earth on a bed of waffle sticks and straw. During the harmattan, the inhabitants sleep on the roofs of their houses due to the heat generated indoors. They also dry food crop and cereal harvested from their farms on this flat roof when the need arises. Similarly, in response to the many issues of services that confront the design of a sustainable architecture school in Loho Wa, the design adopts a parapet flat roof system; some green and others paved to accommodate the numerous services of solar farming and above ground water storage for use within the facility (Appendices4.1b and 4.1d). The use of the flat terrace on top of the studio block relays to the generally flat roofs exhibited in the indigenous architecture. The design and use of this flat roof also improves the lifestyle of the students as does in the local setting (Appendices 3Bi, 4C, 4K and 4M)

4.4 APPLICATIONS OF FINDINGS TO DESIGN

4.4.2 Conceptualization

Some decisions were made based on the initial case study conducted on both the case studies of both Chinese School of architecture and Water Loo School of Architecture. Aspects of building interrelation, building connectivity, building heights, building composition in terms of the design brief and last but not least the accommodation schedule, all were greatly informed from the case studies conducted.

Several sketch attempts were made at site planning before the eventual outcome of the School design. Four such attempts are discussed below. The fourth option was adopted as the concept idea for the design of the School of Architecture

4.4.2.1 SITE PLANNING OPTION ONE (1)

The major merit of this option is that, the open court yards create a micro-climate appropriate for locality. Some major demerits of option one includes;

Firstly, building orientation for this initial option is predominantly East –West orientation and is largely influenced by the prevalent wind direction. This choice however is not favorable for indoor conditions since the buildings are oriented facing the solar axis where there is much solar heat gain on the exterior walls. Secondly, there are as many as seven vehicular routes within the entire layout of the School of Architecture as compared to the entire Loho settlement with two major vehicular circulation routes. It is therefore prudent to reduce the vehicular access routes but still maintain access to all parts of the layout.

Refer to appendix 2A for sketch site conceptual planning option one

4.4.2.2 SITE PLANNING OPTION TWO (2)

Some major merits of this second attempt at translating the vernacular layout of Loho in the design of the School Architecture include, Firstly, there exists a large vegetated courtyard facing the west façade of the buildings which could be used prudently to shade the buildings west facing facades. Similarly, the plantings at the North-eastern direction can advantageously, redirect unfavorable harmattan winds from the development. Secondly, large central green court is very appropriate for good ventilation. The large central green court between the buildings will help ventilated the buildings in terms of air exchange between indoor and outdoor conditions. Thirdly, less vehicular circulation routes as compared to the initial attempt in option one. This option presents a loop form of vehicular circulation with connections to a central point of convergence on the layout. Fourthly, a predominant North-south building orientation is advantageous for as it reduces heat gain on most of the buildings external walling. That is, making indoor conditions much more favorable as compared to the East-west orientation that is predominant with option one.

On the other hand, some major demerits of option two include; Firstly, the loop circulation due to long length of continuous curved road will be uncomfortable for drivers and users of the

road. On a lighter side, it could help reduce traffic speed on the campus. Also connection angles from main loop access to the central circulation point on the layout will be in appropriate since the loop curves along the junction. Secondly, the building interrelations and inter connections in this attempt could be improved. Thus, the buildings could be connected such that, pedestrians can walk through the campus without necessarily being discomforted by the unfavorable atmospheric conditions, especially exposure to the heat from the sun's radiation.

Refer to appendix 2B for sketch site conceptual planning option two

4.4.2.3 SITE CONCEPTUAL PLANNING OPTION THREE (3)

This option adopts the two merits of option three of the site layout as discussed above. Thus, the advantage of providing a large green courtyard and the further benefits of the green buffer on the west is good for shading intentions. Another merit of this option is that, there is adequate access for both service and regular vehicular routes. Thus, there are two major accesses on to the layout, the service access and the main vehicular access to the layout. A diversion from the main access through to the staff area and back around to link the main access makes it three main options of access on the layout. This layout however has pedestrian connections as the predominant circulation patterns which will create a better appreciation of the vernacular layout as interpreted. The vehicular accesses also apply to motor cycle access. Also, advantageous is the fact that the vehicular circulation ways are clearly defined and outlined, making the layout legible. In addition to the aforementioned merits, the building interrelations and connections are a lot more appropriate for the users as compared to option two above. Walkways and building connections provide adequate shading for users of the School of Architecture.

Demerits of option three include;

The layout is disadvantaged for purposes of future developments since the only possible direction of future development is towards the main access road. There are three buildings

located south- east of the layout designated for staff use. These could be put together into several floors of vertical arrangement. This saves space for softer landscaping within the layout.

Refer to appendix 2C for sketch site conceptual planning option three

4.4.2.4 SITE CONCEPTUAL PLANNING OPTION FOUR (4)

Option four exhibits all the merits of the aforementioned options of layout, thus, an extensive green courts are very appropriate for good ventilation, a green buffer on the west is good for shading intentions, adequate access for both service and regular routes as well as clear vehicular circulation routes on layout. Other merits as discussed above include; good building interrelations and connections and the building functions are condensed into adequate vertical extensions instead of sprawling horizontally on the site. Last but not least, the layout allows for appropriate future expansion. Thus, the layout offers flexibility for future expansion projects of the School of Architecture. This is evident in the open spaces provided south, east and west of the development.

A major demerit of this option, however, is that, the services access was not concealed adequately and could be addressed by moving the route behind the studio block so as to conceal it from public view.

Refer to appendix 2D for sketch site conceptual planning option four

For conceptual design sketches showing sketches of courtyard intent, functional relationship with spaces, roofing intent for workshop and building connectivity refer to appendix 3. The design choices were basically informed by the vernacular architecture with the intent of a translation through critical regionalism. To further improve the vernacular architectural representation of space and volume, aspects of the building are raised to create shading and to direct wind flow and pressures to specifically designated areas such as the exhibition and visitor courts (Appendices 4A, 4B and 4C). A variation in building massing also allows for shading and heat absorption reduction on the east and west facing facades (Appendix 3Biii and 4D).

4.4.1 Layout

The layout is built to interpret various aspects of the local indigenous architecture of the locality. From an open court of parking to a semi-public court of exhibition and production supply at the workshop and service points to a more private students court, comprising of the amphitheater and student hostel courts. In the light of this, the auditorium and administrative office, as well as, the reception and business offices at the workshop and production unit are the first point of call for people coming into the school architecture at Loho. Refer to appendix 4B for detailed Layout of the School design as interpreted.

4.4.3 Site Layout

There two main accesses into the facility, the main administrative entrance and the services access, both accessed from the Wa Loho road bounding the site to the west. Refer to appendix 4C and appendix 4D

The main administrative access leads to the auditorium, administration areas, exhibition areas and connecting to the residences and other facilities. The minor services access leads to the workshop and production units as well as the development office and other facilities. The minor access also connects through the entire facility for service delivery. Parking and drop off areas for vehicles as well as motor cyclist have all been catered for at appropriate locations for students and staff alike as well as visitors to the facility. Pedestrian pavements are provided under shaded or covered areas for comfort and security against the weather and other traffickers around the school (Appendix 4B).

4.4.4 Orientation

The facilities used regularly have been strategically oriented to reduce solar ingress into the spaces and maximize the prevalent wind into these spaces to make them as comfortable and habitable as possible. To reduce the intensity of heat in the building, most of the spaces, especially, the teaching and learning areas have been oriented in the north- south (appendix 2d). The series of courtyards expressed in the school also helps to create a conducive micro environment within the school. This is done in principal by orienting the courtyards south-west

to maximize the cool winds blowing from the coastal region of the country and to also cut lots of hot and dusty north east winds from the desert north of the country. Refer to appendices 4B and 4C).

4.4.5 Structure/ Form

The school structure is expressed in post and beam construction. The studio and classroom are typically reinforced concrete post and beam with waffle floor slabs. The library and auditorium is built on composite floor systems, thus, steel I-section beams under a plate of corrugated metal with a layer of concrete. Refer to appendices 3c, 4L, 4M and 4N for details of structure.

The form is expressed in a series of connected courtyards occurring in at different levels with diverse volumes, helping to ventilate and cross ventilate the entire school. Areas of specific interest such as the studio court is opened into the exhibition area and connected to the auditorium foyer under a raised portion of the library and art building. The canteen and classroom of the workshop block are raised cross the courtyard which is connected to the studio courtyard through the laboratories area. The openings on the external walls of the school from the north-eastern direction are predominantly smaller in size to the openings within the courtyards and towards the southwestern direction of the school. This in effect controls the heat gain (minimal) and heat loss (great) in the direction of flow of the wind, making both enclosed and semi-enclosed spaces within the school climatically conducive and comfortable. The height variations of adjacent and adjoin buildings also creates a shade within open areas for outdoor activity.

4.4.6 Materials

The materials adopted for the construction of the school of architecture in Loho, are basically heat and impact resistant materials for the interior floors and walls, thus high resistant timber panel floors for the studio and classroom areas. The outdoor circulation and activity areas are paved slightly apart with stampcrete allowing for vegetation to grow within the pavement. This

reduces heat gain and loss on the floors. Vegetated areas are planted strategically to enhance the ventilation and heating on the buildings.

4.4.7 Detailed design proposal

Refer to Appendix 4 for details of design proposal.

CHAPTER FIVE

CONCLUSION

5.0 CONCLUSION

Architecture of this region is an expressive sample of culturally ecological architecture. In addition to this, all traditional buildings of Loho, both in architectural and constructional fields, are planned in a way to have maximum of shade during harmattan, to use natural ventilation and to provide comfort for the users.

Traditional architecture of Loho is formed with extreme respect to site, climate and culture. It is noticed that houses do not have equal sizes and dimensions and also in some cases, do not have a clear geometric form. In this region the creation of court yard in the middle of buildings increases ventilation in building environment and the mud-brick walls, which are made thick to act like a thermal condenser, decrease the variance of temperature during day and night.

With regards to this paper however, the character of the vernacular architecture, its influences and effects studied and discussed, helped to design the School of Architecture through a critical regionalist point of view. In light of this success, several recommendations can be made with regards to interpreting the vernacular architecture of Loho and such principal and concepts could be applied to a study area of similar character to achieve similar results.

5.1 RECOMMENDATIONS

The following conclusions are drawn from the study

i. To interpret the vernacular architecture in a critically regionalist approach, it is essential to give climatic and cultural considerations for designing buildings, as discussed in chapter four and interpreted in the school design (Appendix 4b).

ii. For a building to function in co-ordination with the environment there should be a relation between the interior and exterior environment, orientation, building form, and material application. In the case of an Architecture school, large openings onto vegetated courtyards, with orientation emphasis on the north and south facing facades with small openings. The building form being relevant and supportive of function and

use as envisaged and material application that allows for controlled heating and cooling of the interior spaces as well as the micro climate of the school. Refer to Appendix 2b

iii. Landscaping should be improved as a passive energy saving technique. Referring to site analysis, the final design layout and the landscaping plan in Appendices 2b and 2x respectively. Thus, the landscaping controls wind, solar radiation and temperature extremes of climate. Places of high intended traffic are paved with grass grouting to reduce heat gain on the surface of the pavement. Drought resistant tresses such as teak planted across the path of the north east trade winds that blow with dust and heat, to divert and absorb where possible the dust and heat respectively thereby regulating the effects of the trade winds on the micro climate of the School.

iv. When buffer spaces are provided between exterior and interior spaces, heat from outside dissipates before entering interiors. Non-habitable rooms such as toilets, stores and galleries can be provided as heat barriers in the worst orientations on the outer periphery of the building. Refer to design sections in Appendix 2.1b, 2.1c and 2.1d for diagrammatical representation and explanation of this recommendation.

v. Provision of a central courtyard is preferable which helps in achieving shaded spaces, natural light in most of the places and better circulation of air without providing many openings on the exteriors surfaces. Coupled with the hierarchy of movement established in relation to the courtyard, there is therefore a direct representation of the vernacular architecture of Loho. These courtyards reflect and accommodate use as envisaged and provide protection for macro climatic conditions of the site. These courtyards open toward the south west orientation to collect the favorable monsoon winds whiles redirecting and repelling dust and heat from the north east trade winds. the Refer to ground floor plan and section in Appendices 2d, 2.1c and 2.1d respectively

vi. Thick walls create thermal time-lag, thus creating comfortable conditions. However in trying to achieve better time lag between heat transmitted from heat gaining west and east walls, the double wall system as referred to in Appendix 2.1d is adopted. This provides a void to dissipate heat going through the outer wall and reduces time lag of heat gain massively. Pressure from the opposite inner courtyard direction also pushes this heat inflow up and out of the inner spaces due to the fact that cool air settles whiles warm air rises. However in places where this cooling system is not relevant such as in the bathrooms and changing rooms, regular single walling is adopted.

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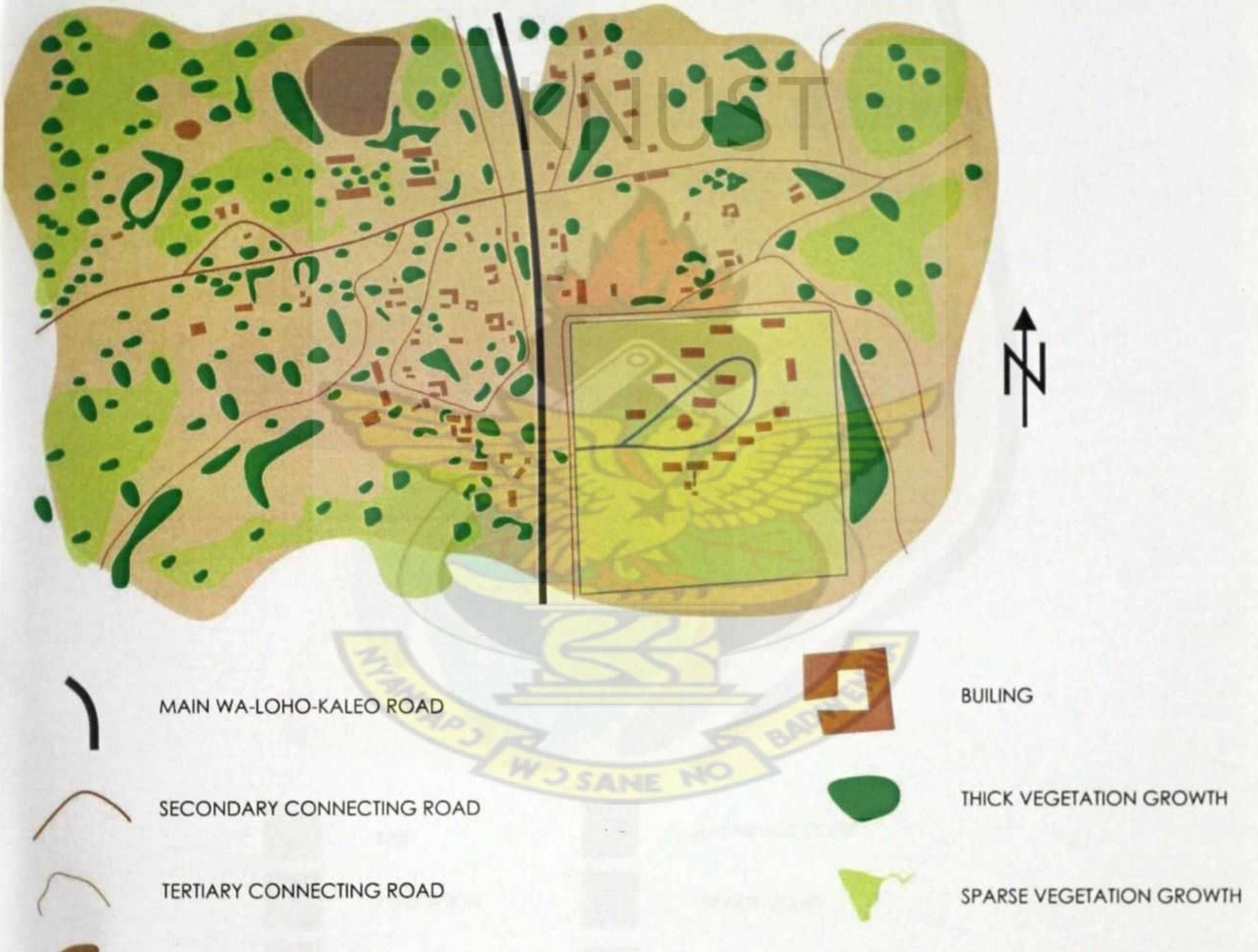
APPENDICES

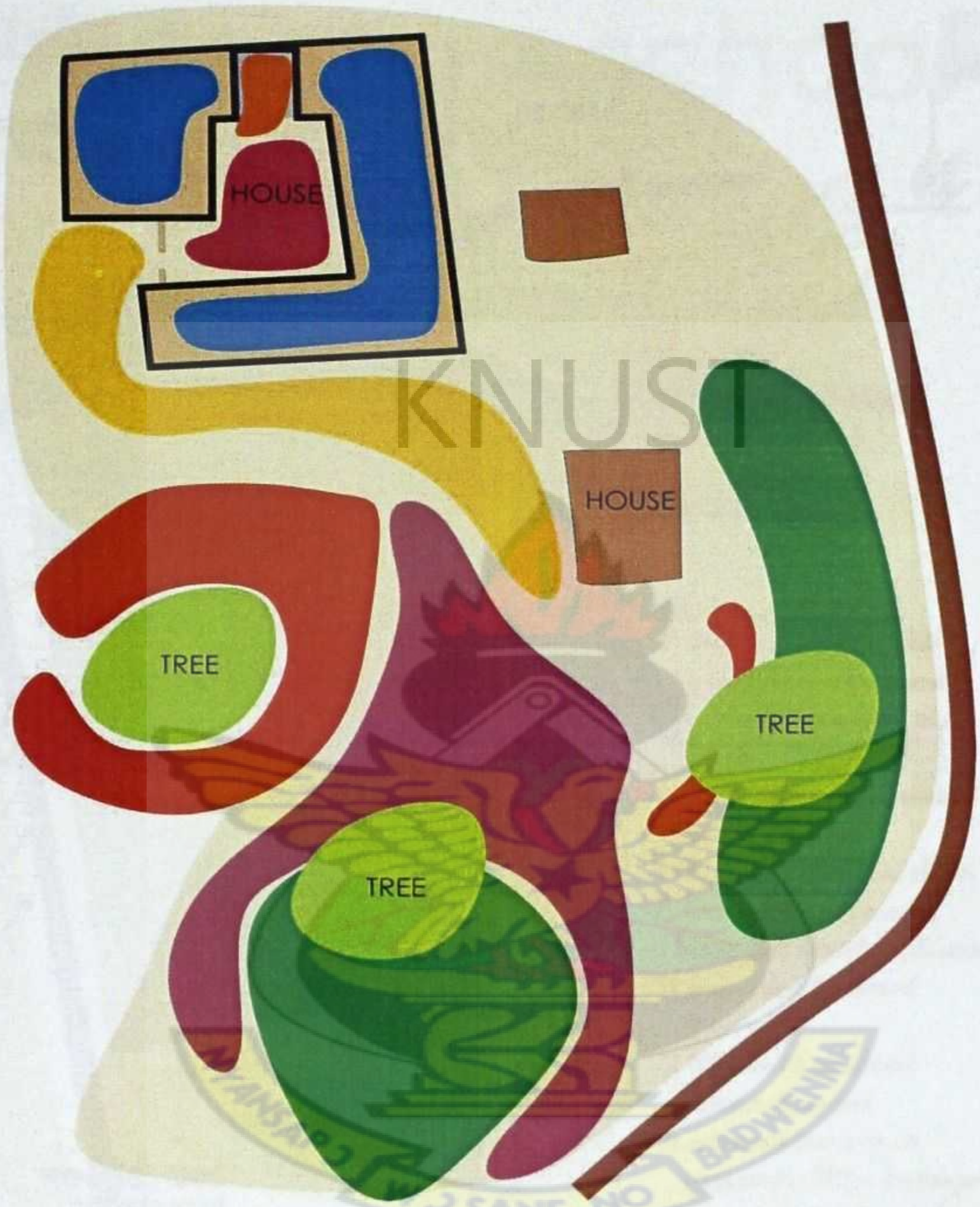
APPENDIX 1

1a.



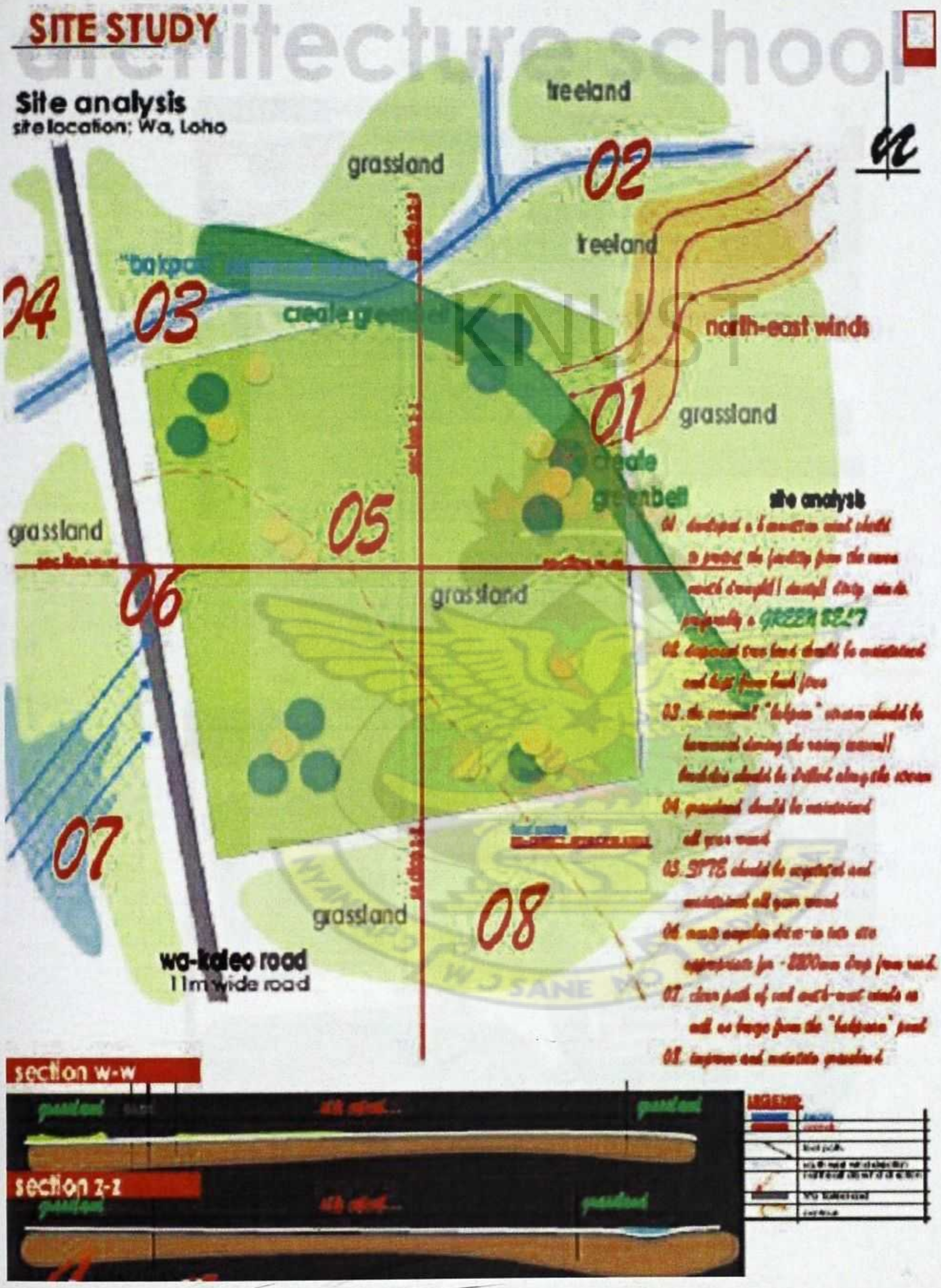
LAYOUT OF LOHO *(AUTHOR, 2011)*

1B



TYPICAL HOUSE LAYOUT *(AUTHOR, 2011)*

1C



SITE INVENTORY *(AUTHOR, 2011)*

APPENDIX 2

2A

SITE CONCEPTUAL PLANNING OPTION 1 *(Author, 2011)*

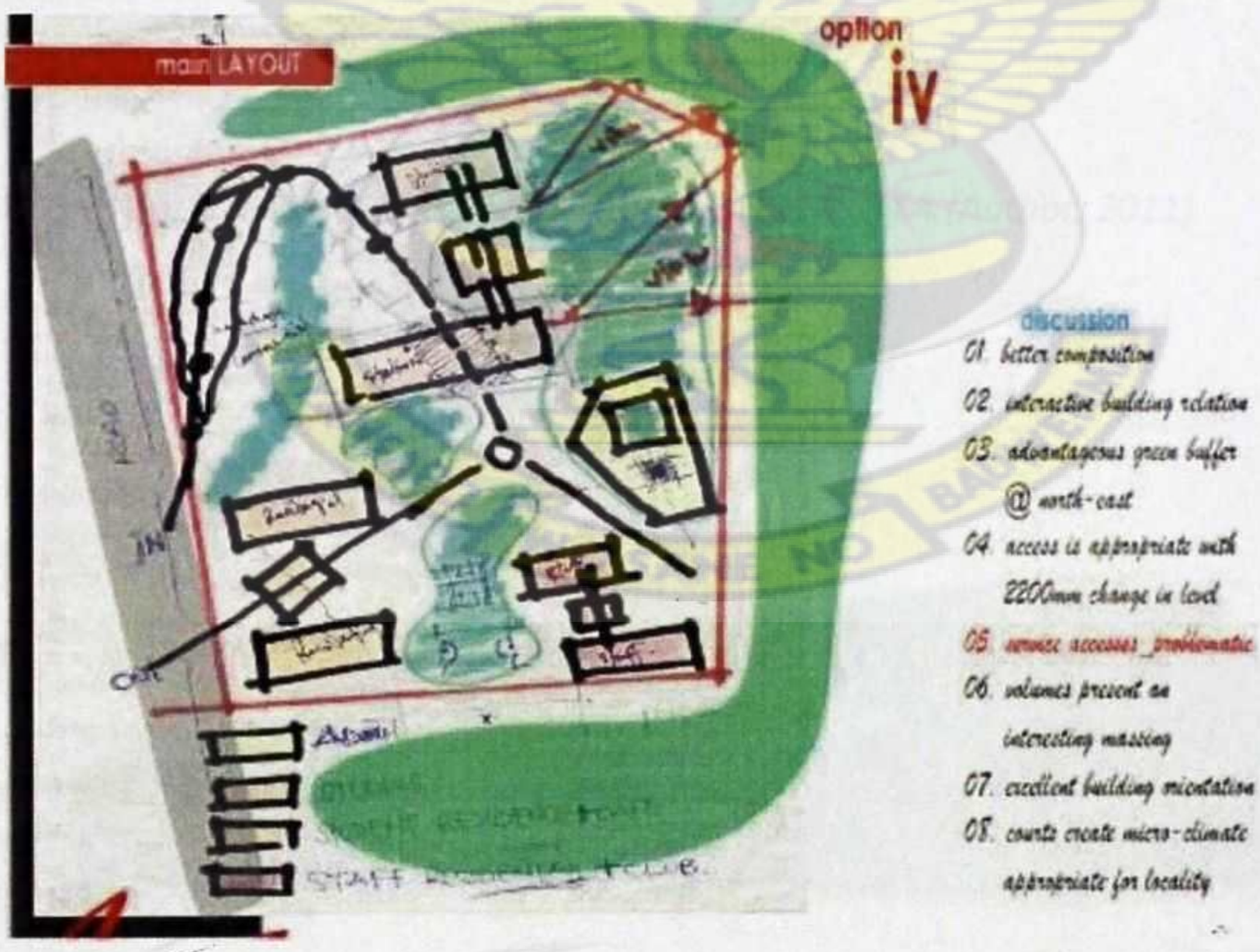
2B

SITE CONCEPTUAL PLANNING OPTION 2 *(Author, 2011)*

2C

SITE CONCEPTUAL PLANNING OPTION 3 *(Author, 2011)*

2D



SITE CONCEPTUAL PLANNING OPTION 4 *(Author, 2011)*

2A

THREE DIMENSIONAL SITE CONCEPTUAL PLANNING OF OPTION 4 *(Author, 2011)*

2B

THREE DIMENSIONAL CONCEPTUAL PLANNING OF OPTION 4 *(Author, 2011)*

2C

THREE DIMENSIONAL CONCEPTUAL PLANNING OF OPTION 4 *(Author, 2011)*

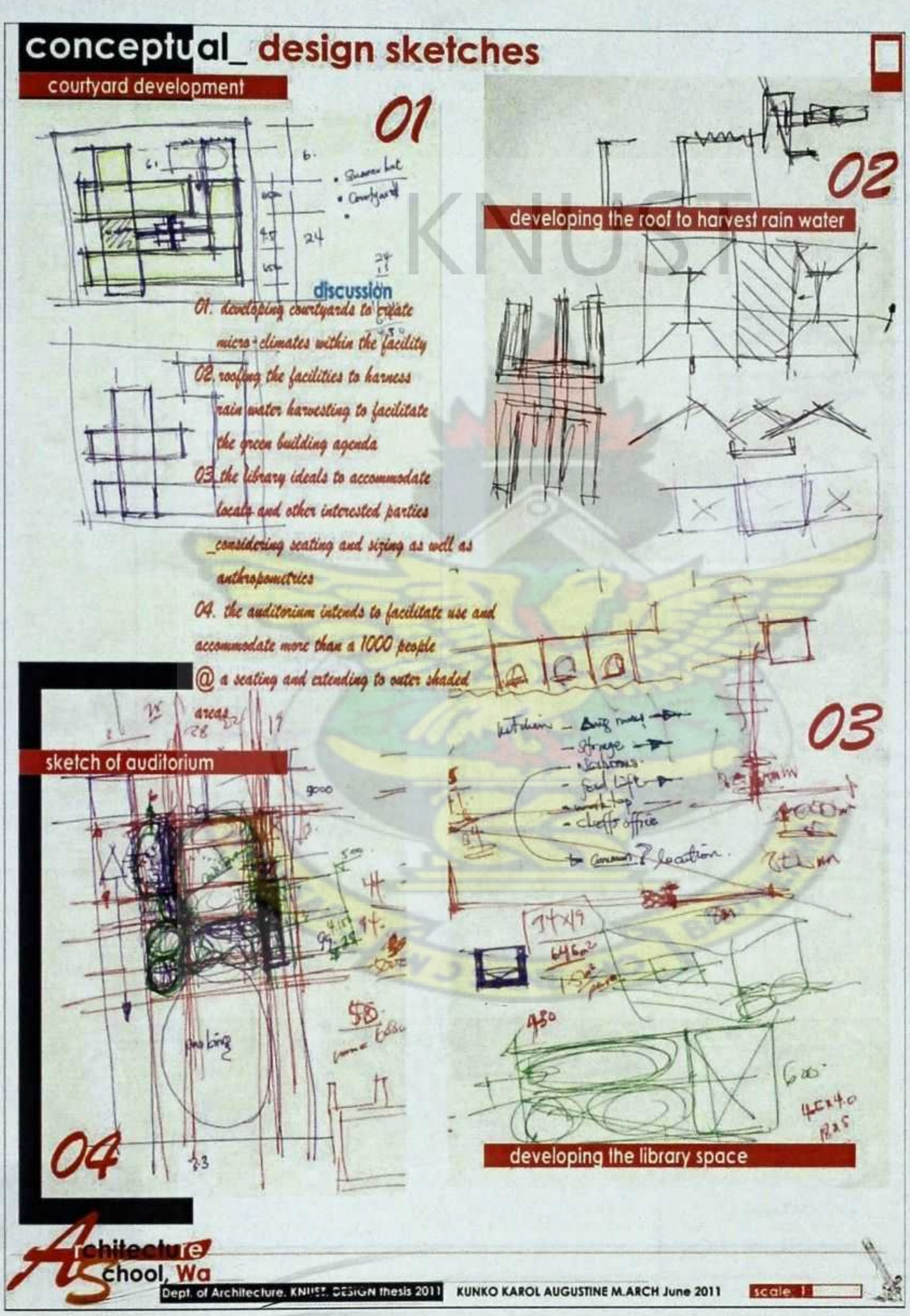
2D

THREE DIMENSIONAL CONCEPTUAL PLANNING OF OPTION 4 *(Author, 2011)*

APPENDIX 3

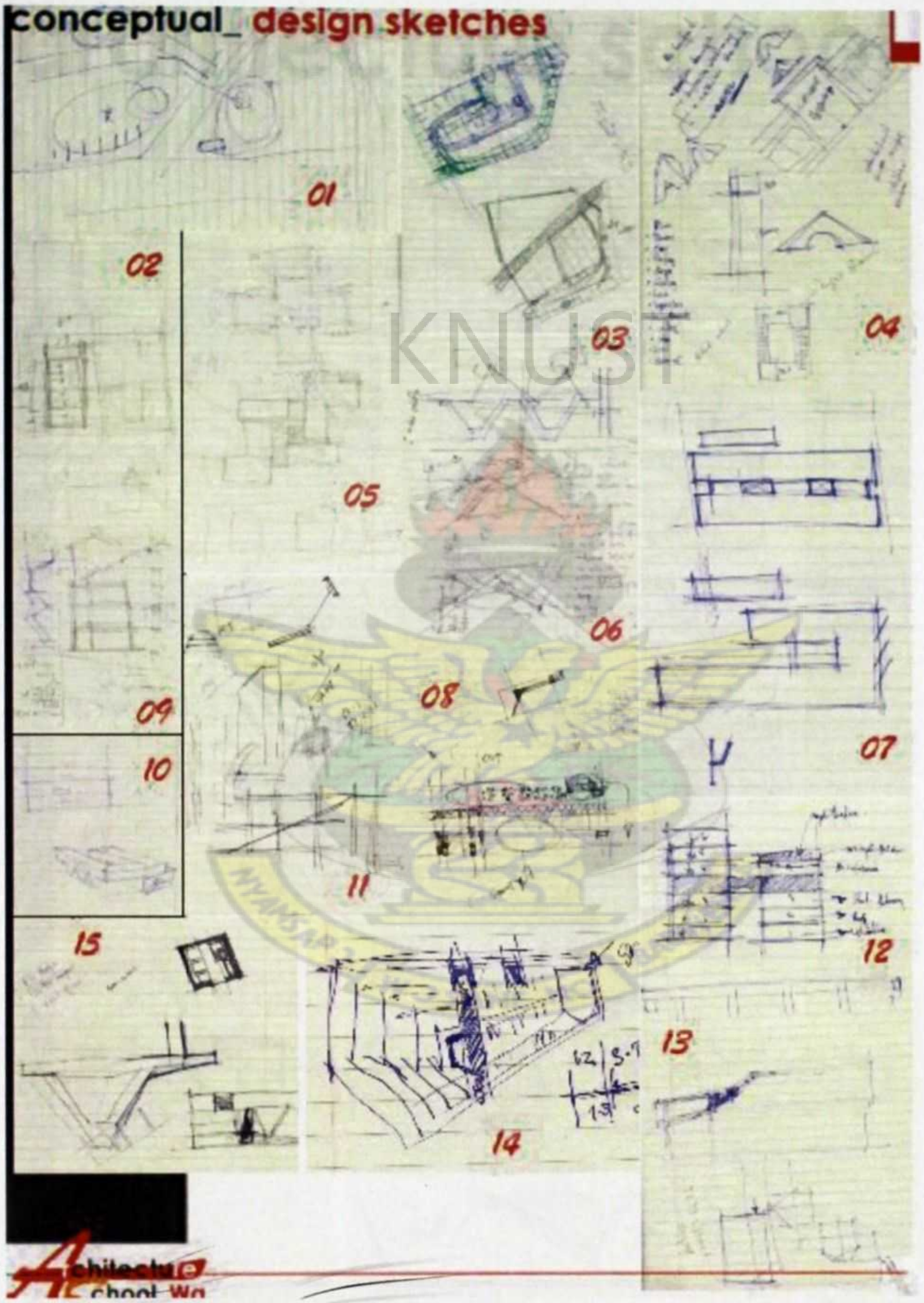
3A CONCEPTUAL DESIGN SKETCHES SHOWING SKETCHES OF COURTYARD INTENT, FUNCTIONAL RELATIONSHIP WITH SPACES, ROOFING INTENT FOR WORKSHOP AND BUILDING CONNECTIVITY

3Ai



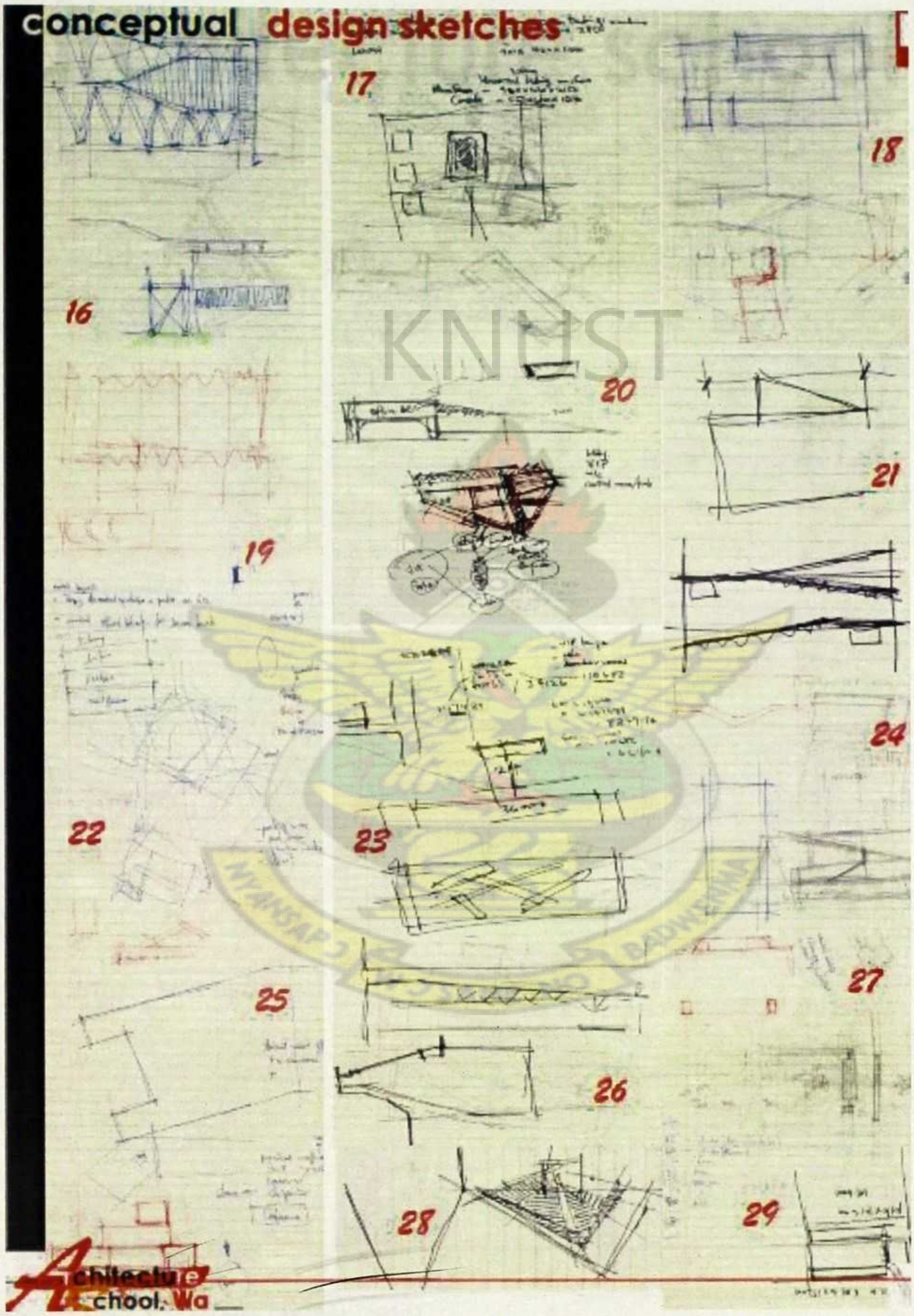
CONCEPTUAL DESIGN SKETCHES (Author, 2011)

3Aii



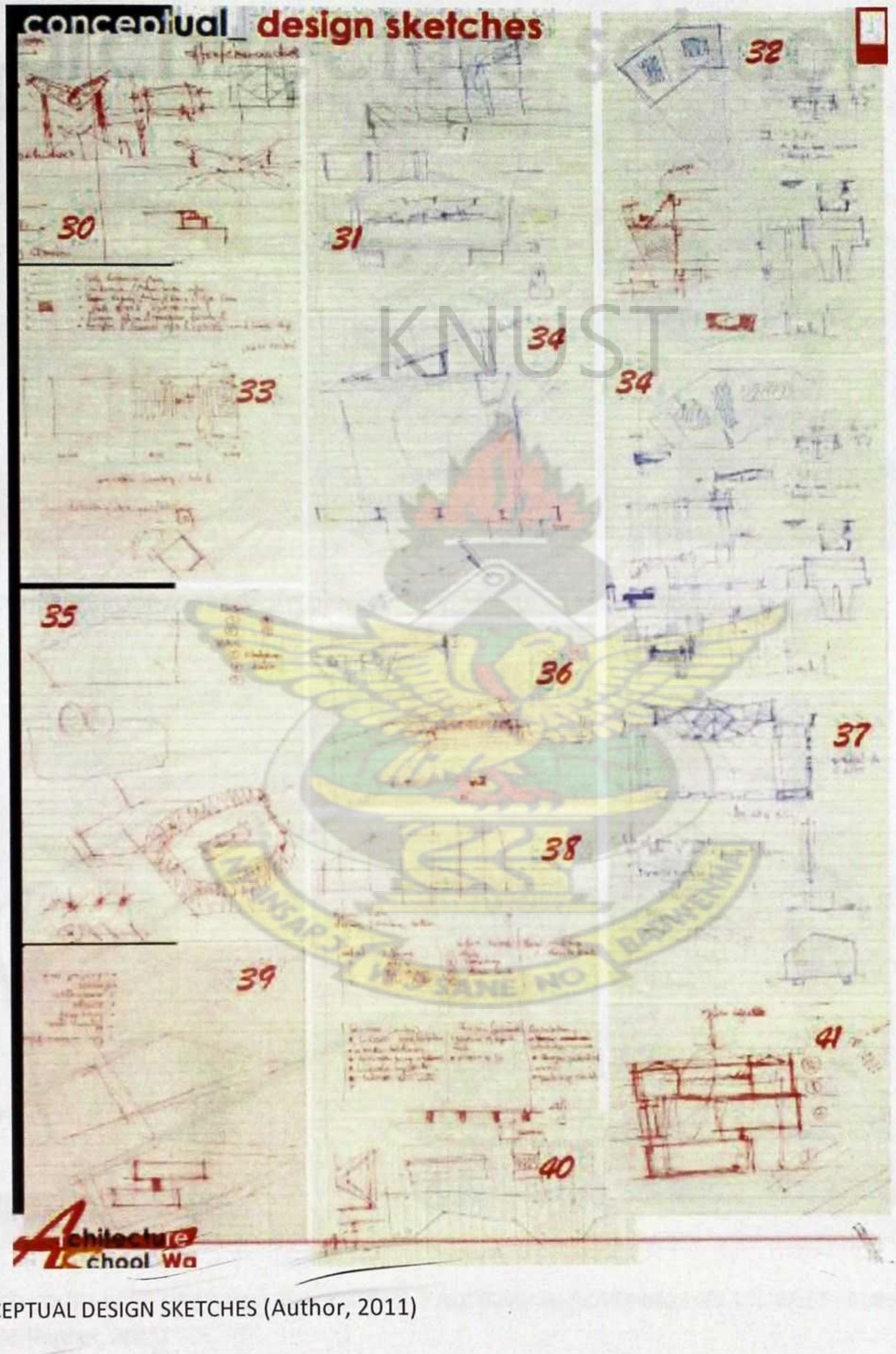
CONCEPTUAL DESIGN SKETCHES (Author, 2011)

3Aiii



CONCEPTUAL DESIGN SKETCHES (Author, 2011)

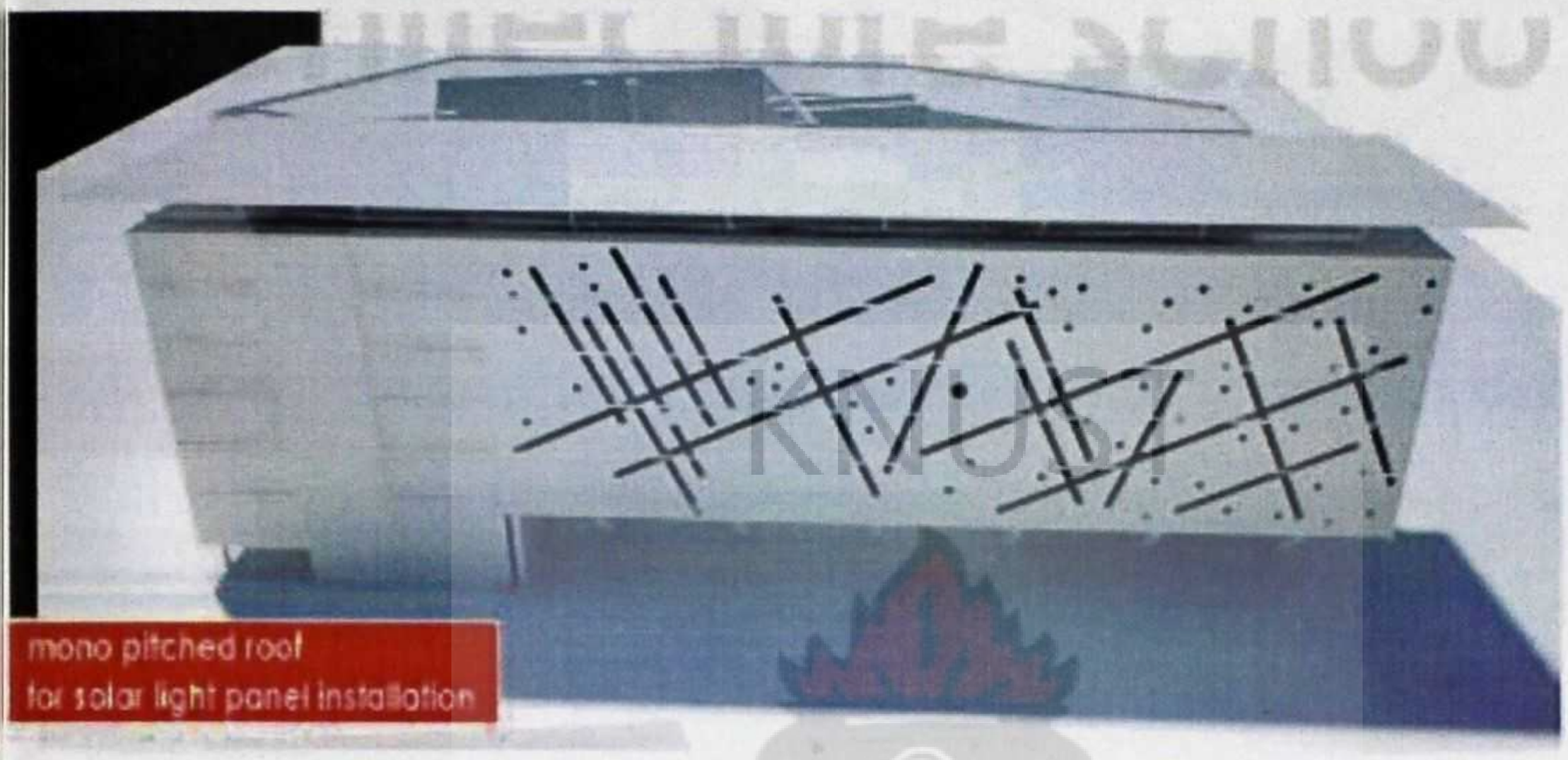
3Aiv



CONCEPTUAL DESIGN SKETCHES (Author, 2011)

3B CONCEPTUAL DESIGN OF STUDIO BLOCK

3Bi



FLAT CONCRETE ROOF AS TRANSLATED FROM THE VERNACULAR ARCHITECTURE (Author, 2011)

3Bii

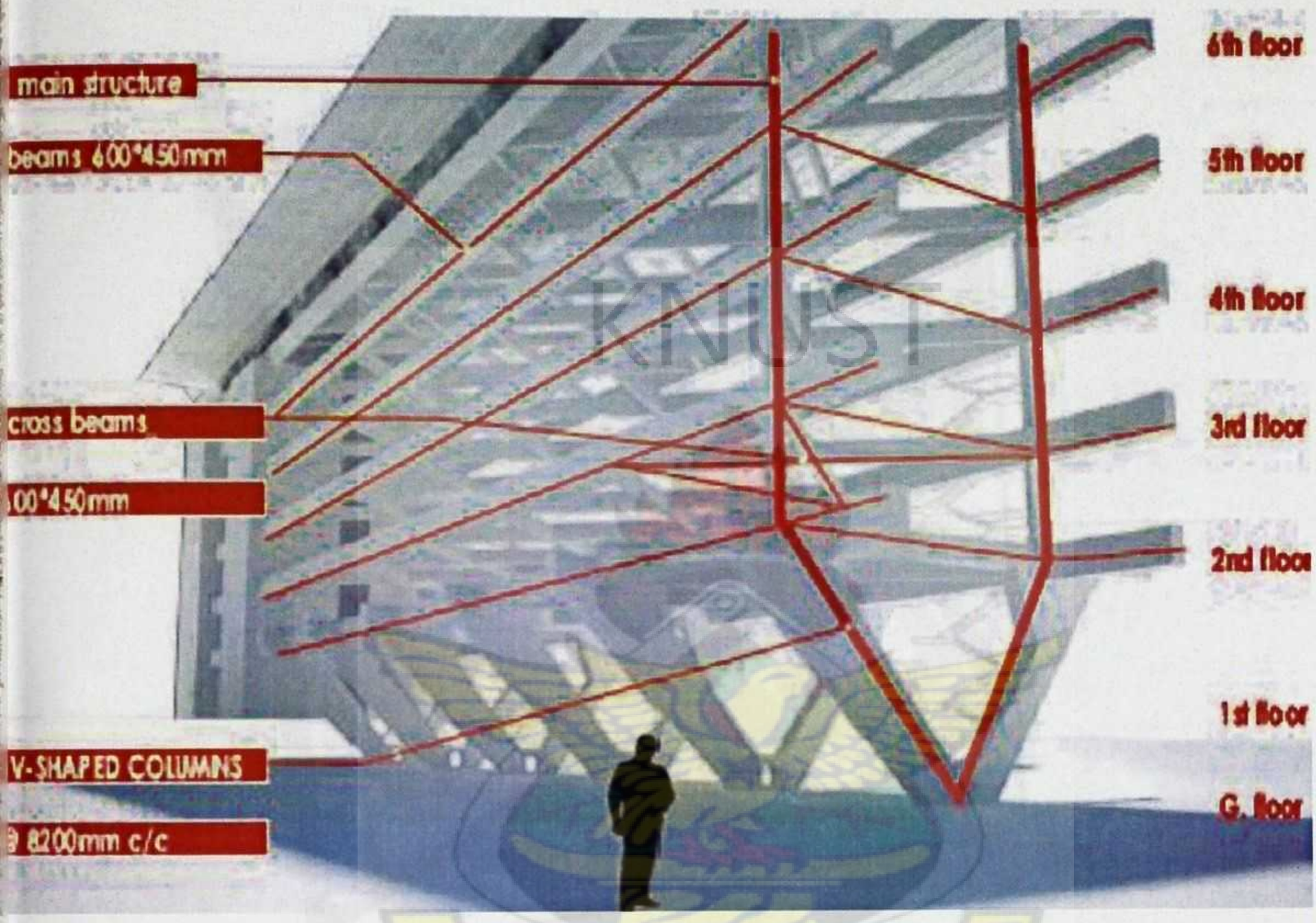
SHADED COURT YARD OF STUDIO BLOCK AND SLIT RECTANGUALR OPENINGS ON THE WEST FACING FAÇADE (Author, 2011)

3Biii

EAST END OF STUDIO BLOCK FURNISHED WITH LITTLE OPENINGS AND CEALED FROM COURTYARD (Author, 2011)

3Biv

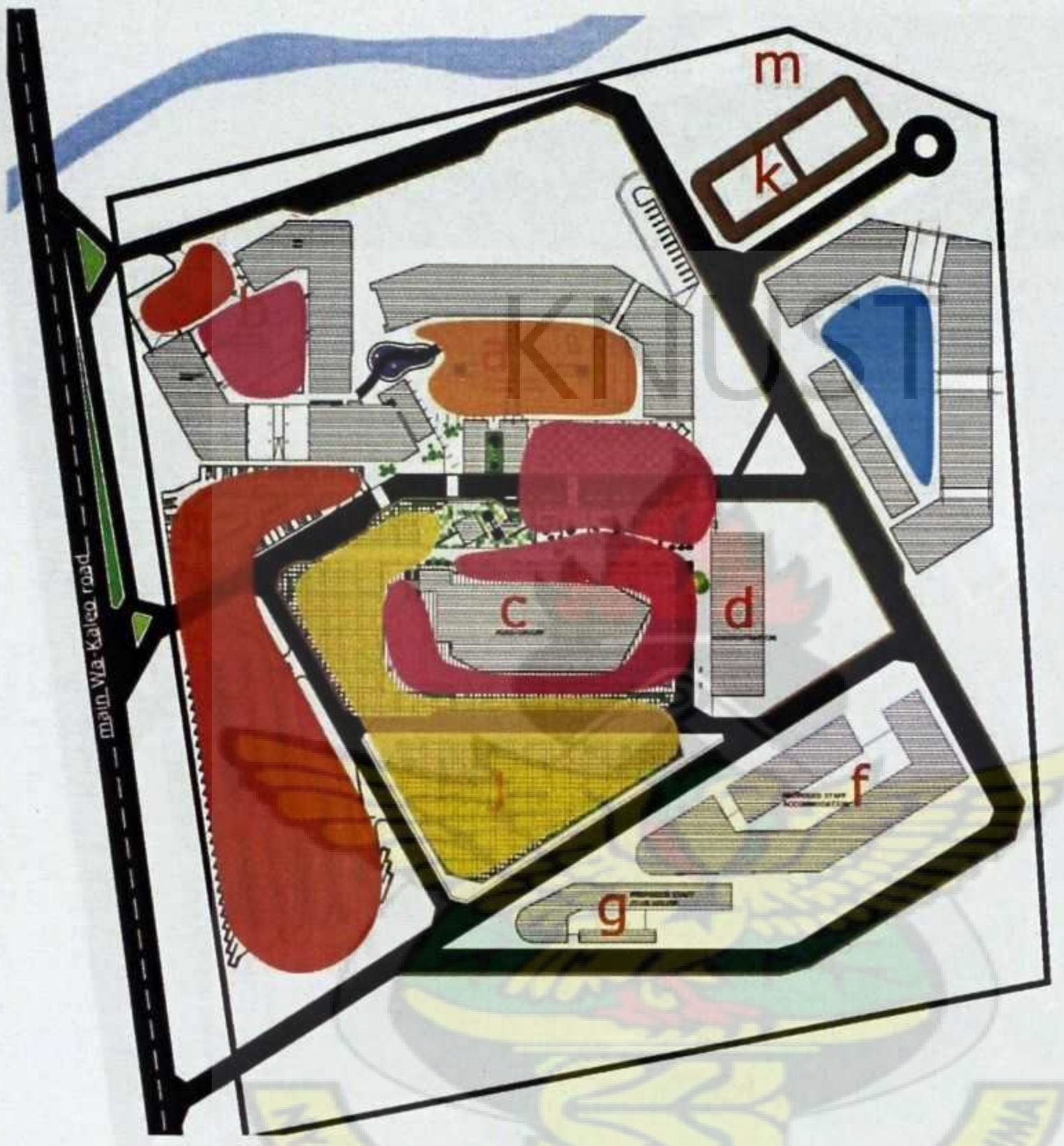
A CONCEPTUAL FAÇADE DESIGN OF STUDIO BLOCK WITH A TRANSLATION OF THE SMALL SIZED VERNACULAR OPENINGS INTO SLITS OF LINE AND CIRCULAR OPENINGS *(Author, 2011)*



CONCEPTUAL STRUCTURE OF STUDIO BLOCK SHOWING THE POST AND BEAM CONSTRUCTION WITH CROSS BEAM BRACING. THE "V" SHAPED COLUMNS ARE INSPIRED BYY THE "Y" SHAPED POST USED FOR THE VERNACULAR CONSTRUCTION. *(Author, 2011)*

APPENDIX 4

4A



MORE PUBLIC COURT

SEMI PUBLIC COURT

SEMI PRIVATE COURT

PRIVATE COURT

MORE PRIVATE COURT

HIERACHY OF COURTYARDS *(Author, 2011)*

4B

Legend

a	STUDIO BLOCK//STUDENT CENTRE DEVELOPMENT& PRACTICE OFFICE
b	WORKSHOPS//LABORATORIES// MARKETING DEPARTMENT
c	AUDITORIUM//CONFERENCE //LIBRARY//LECTURE THEATRES//
d	AMPHITHEATER// SCHOOL OFFICES// SYNDICATE ROOM//STAFF LOUNGE
e	PROPOSED STUDENT RESIDENCE
f	PROPOSED STAFF RESIDENCE
g	PROPOSED STAFF CLUB HOUSE
h	PARKING
J	CEREMONIAL COURT

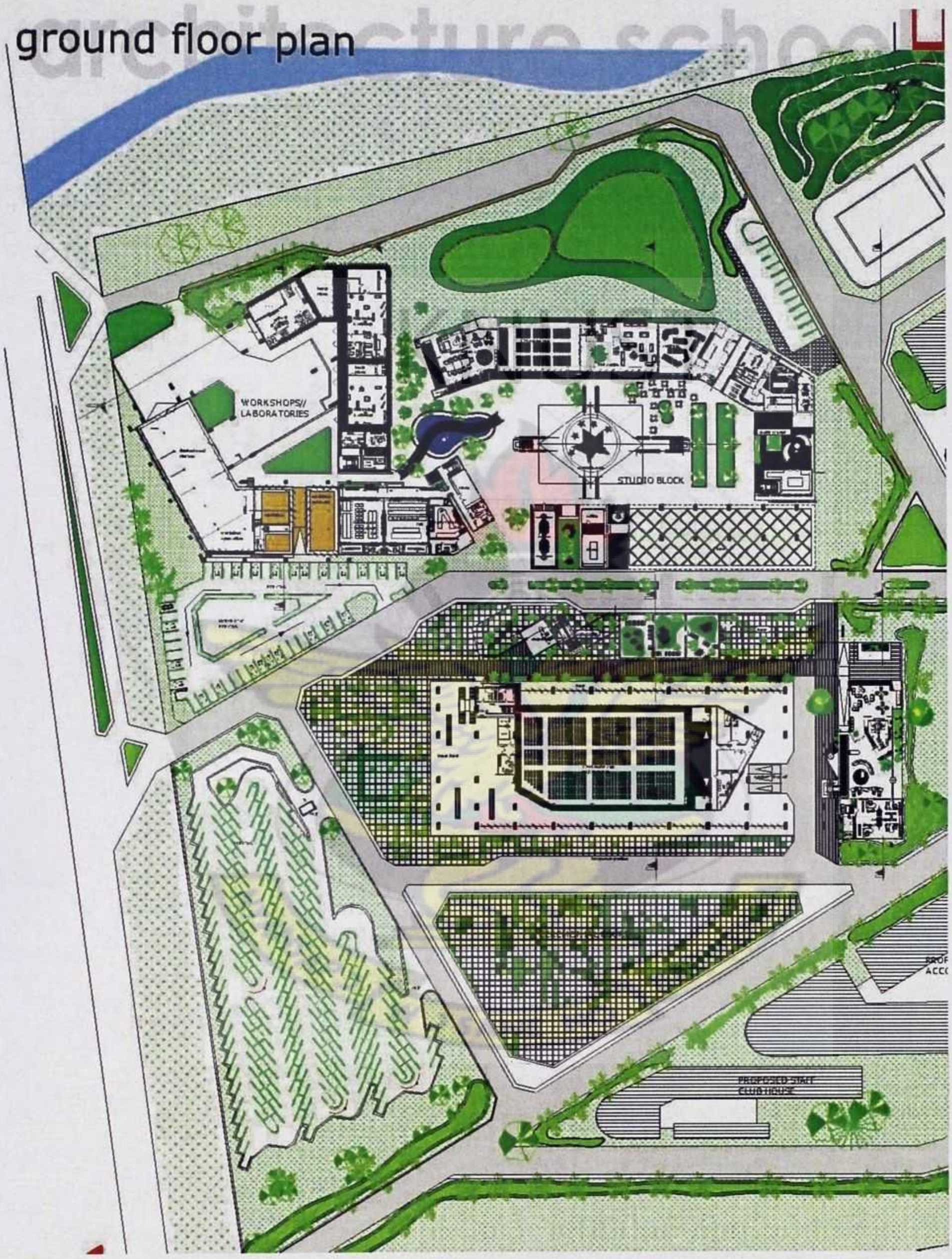
SITE LAYOUT *(AUTHOR, 2011)*

legend

a	STUDIO BLOCK//STUDENT CENTRE DEVELOPMENT& PRACTICE OFFICE
b	WORKSHOPS//LABORATORIES// MARKETING DEPARTMNET
c	AUDITORIUM//CONFERENCE //LIBRARY//LECTURE THEATRES//
d	AMPHITHEATER// SCHOOL OFFICES// SYNDICATE ROOM//STAFF LONUGE
e	PROPOSED STUDENT RESIDENCE
f	PROPOSED STAFF RESIDENCE
g	PROPOSED STAFF CLUB HOUSE
h	PARKING
J	CEREMONIAL COURT

BLOCK PLAN *(AUTHOR, 2011)*

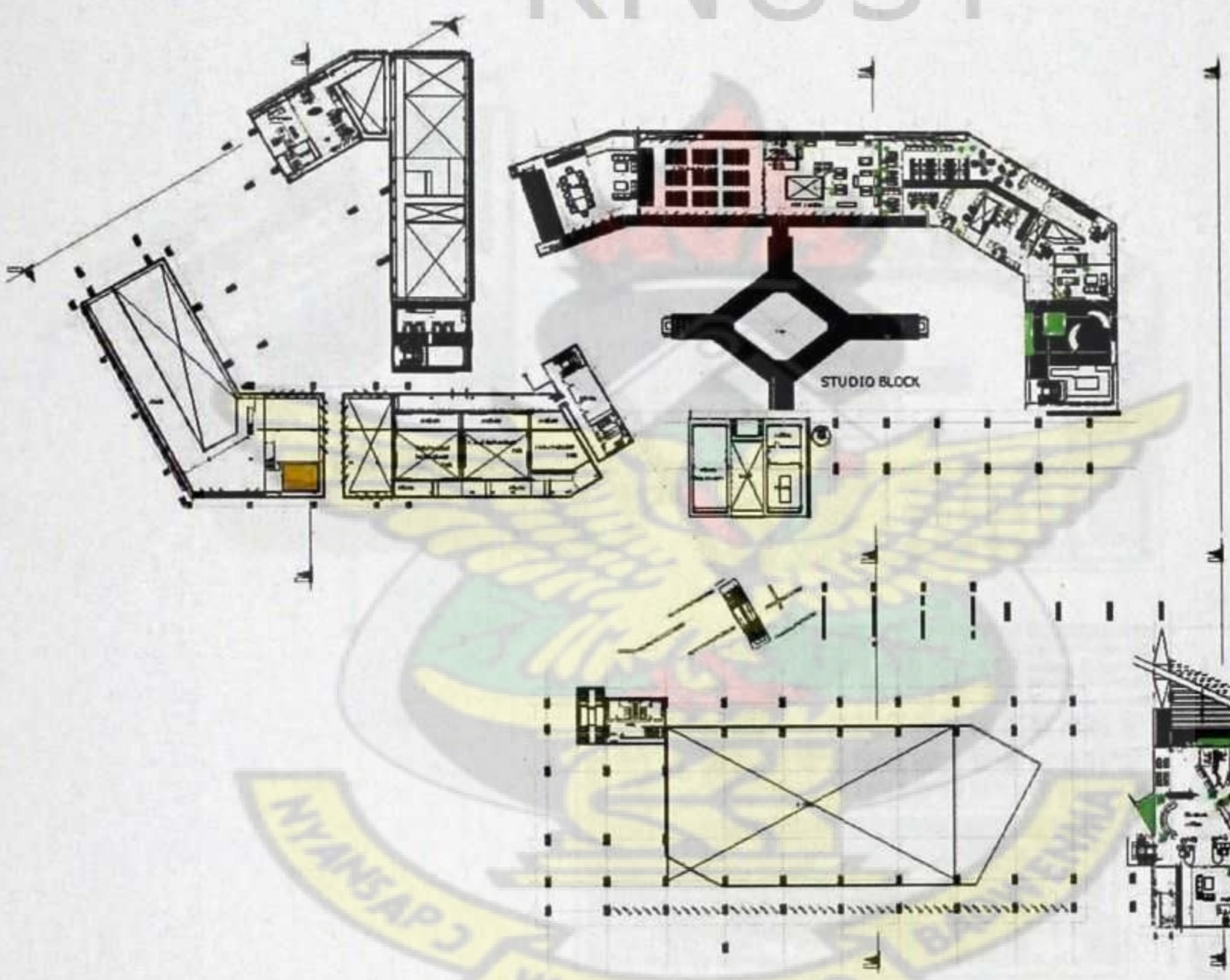
4D



GROUND FLOOR PLAN *(AUTHOR, 2011)*

4E

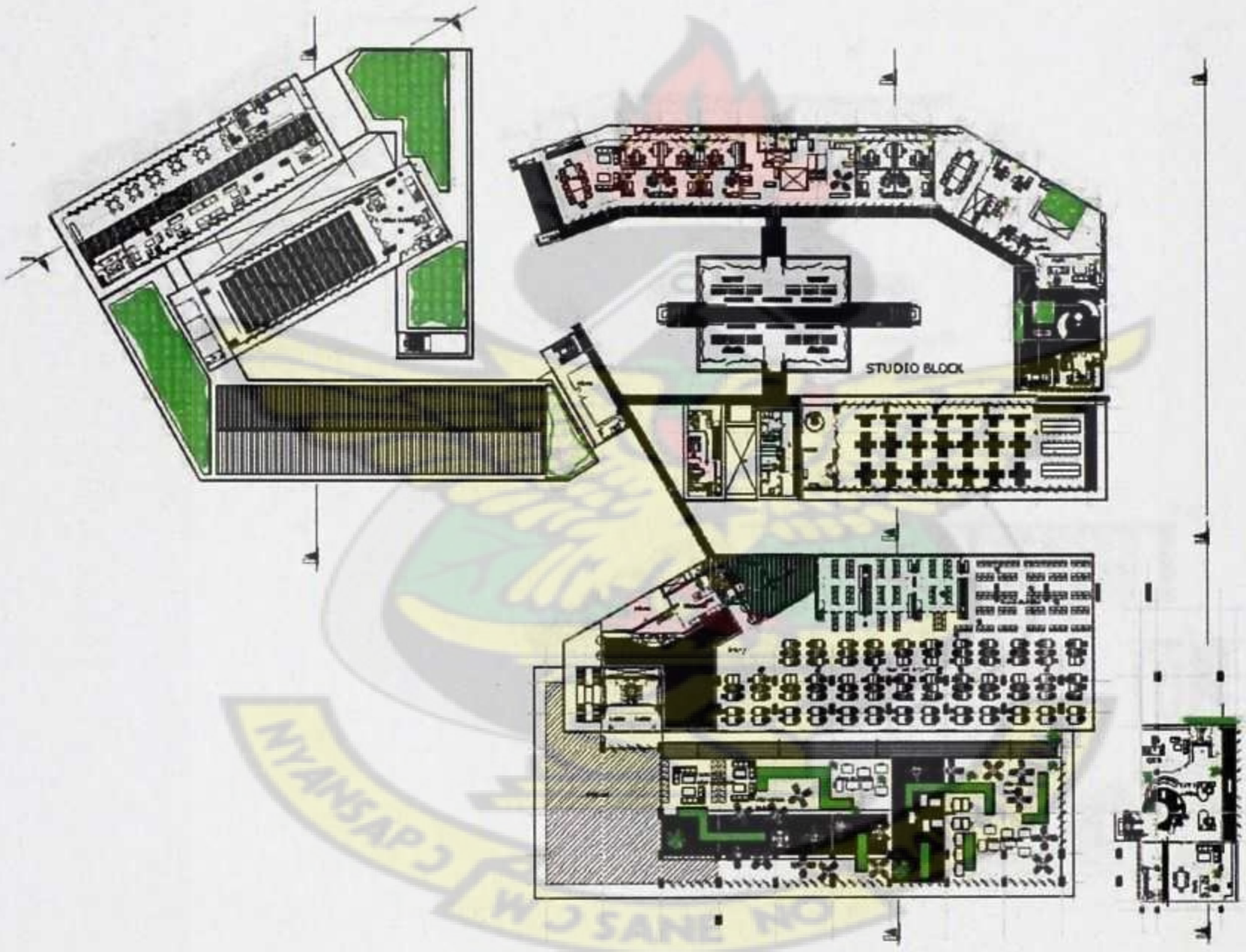
first floor plan



FIRST FLOOR PLAN *(AUTHOR, 2011)*

4F

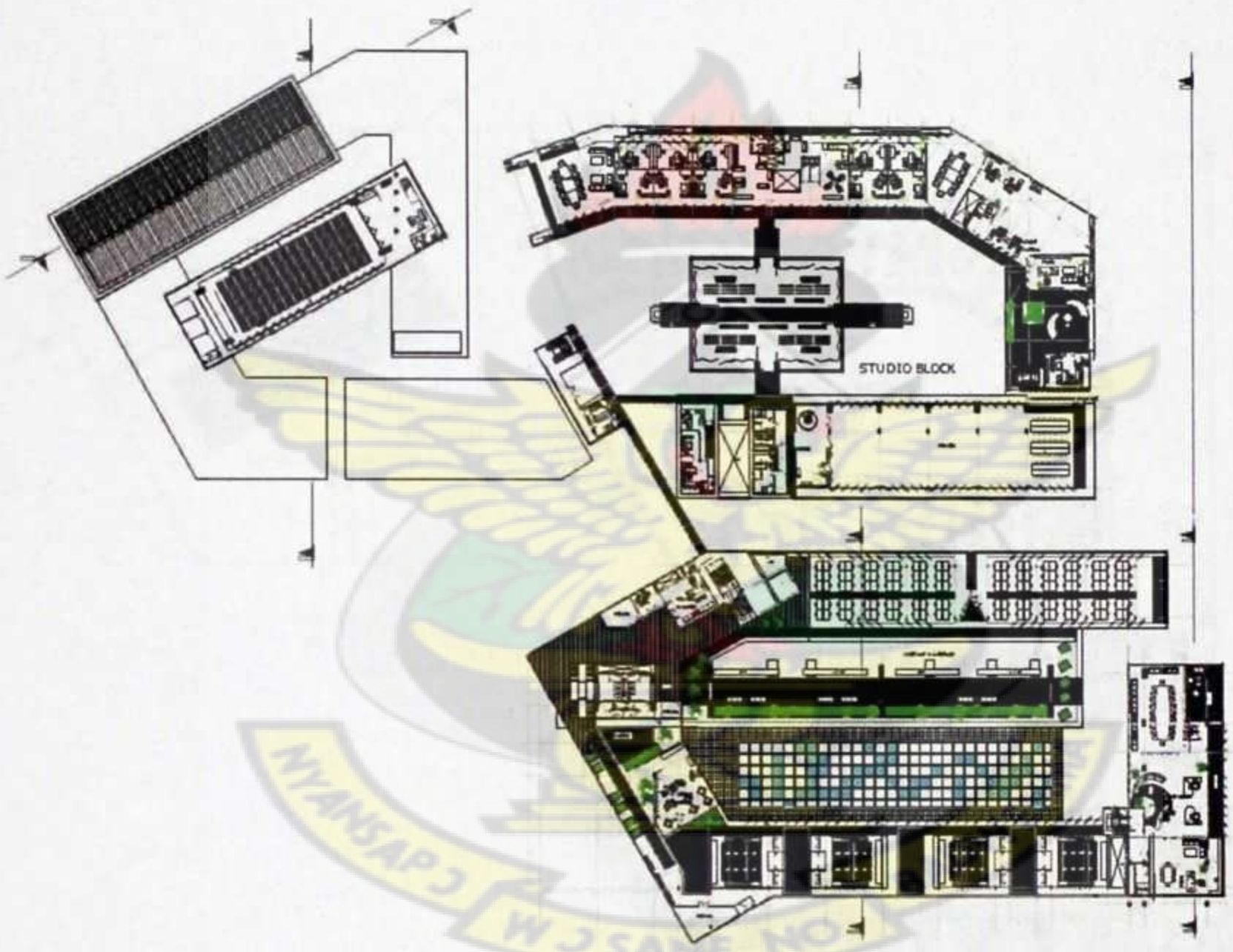
second floor plan



SECOND FLOOR PLAN *(AUTHOR, 2011)*

4G

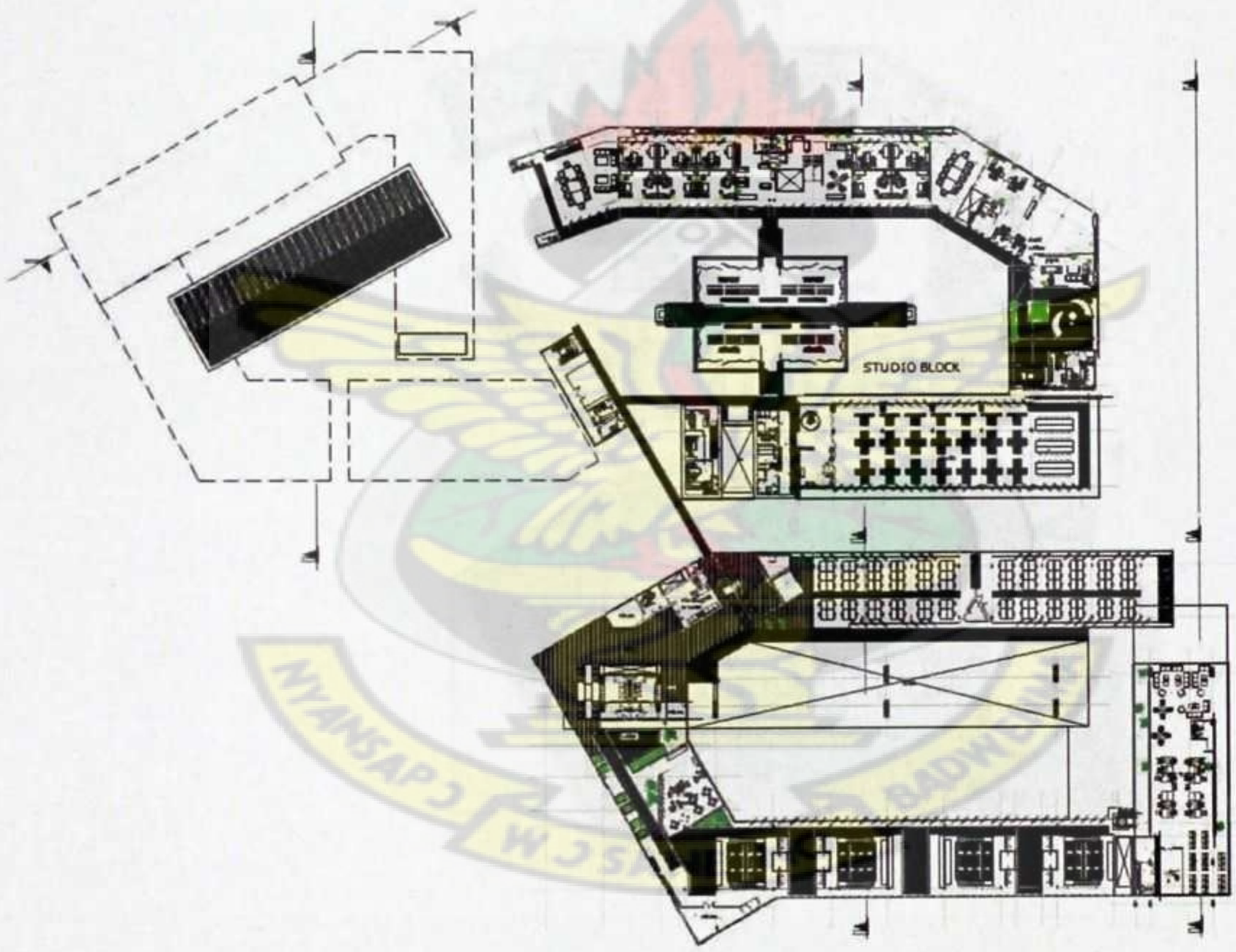
third floor plan



THIRD FLOOR PLAN *(AUTHOR, 2011)*

4H

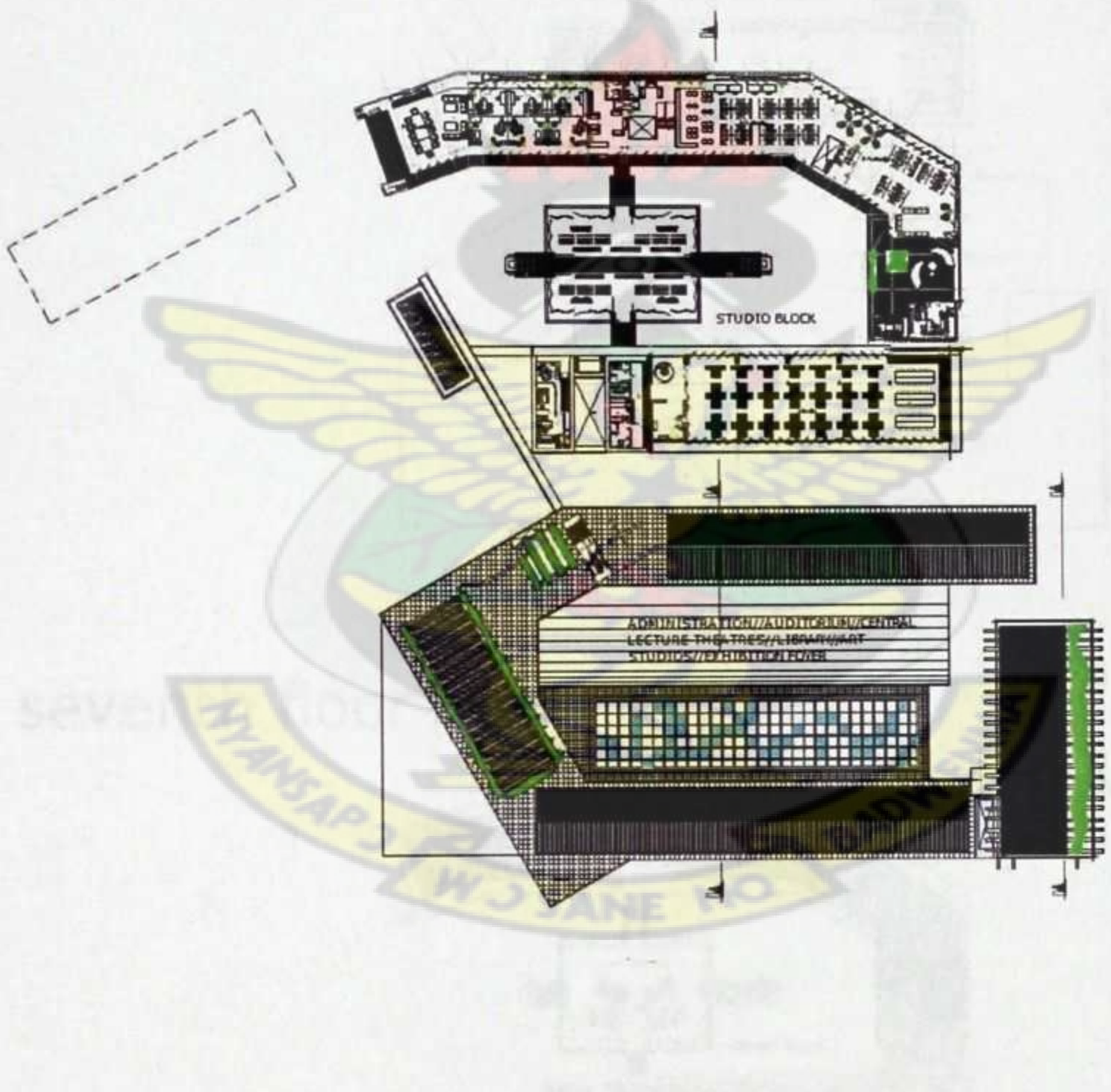
fourth floor plan



FOURTH FLOOR PLAN *(AUTHOR, 2011)*

4i

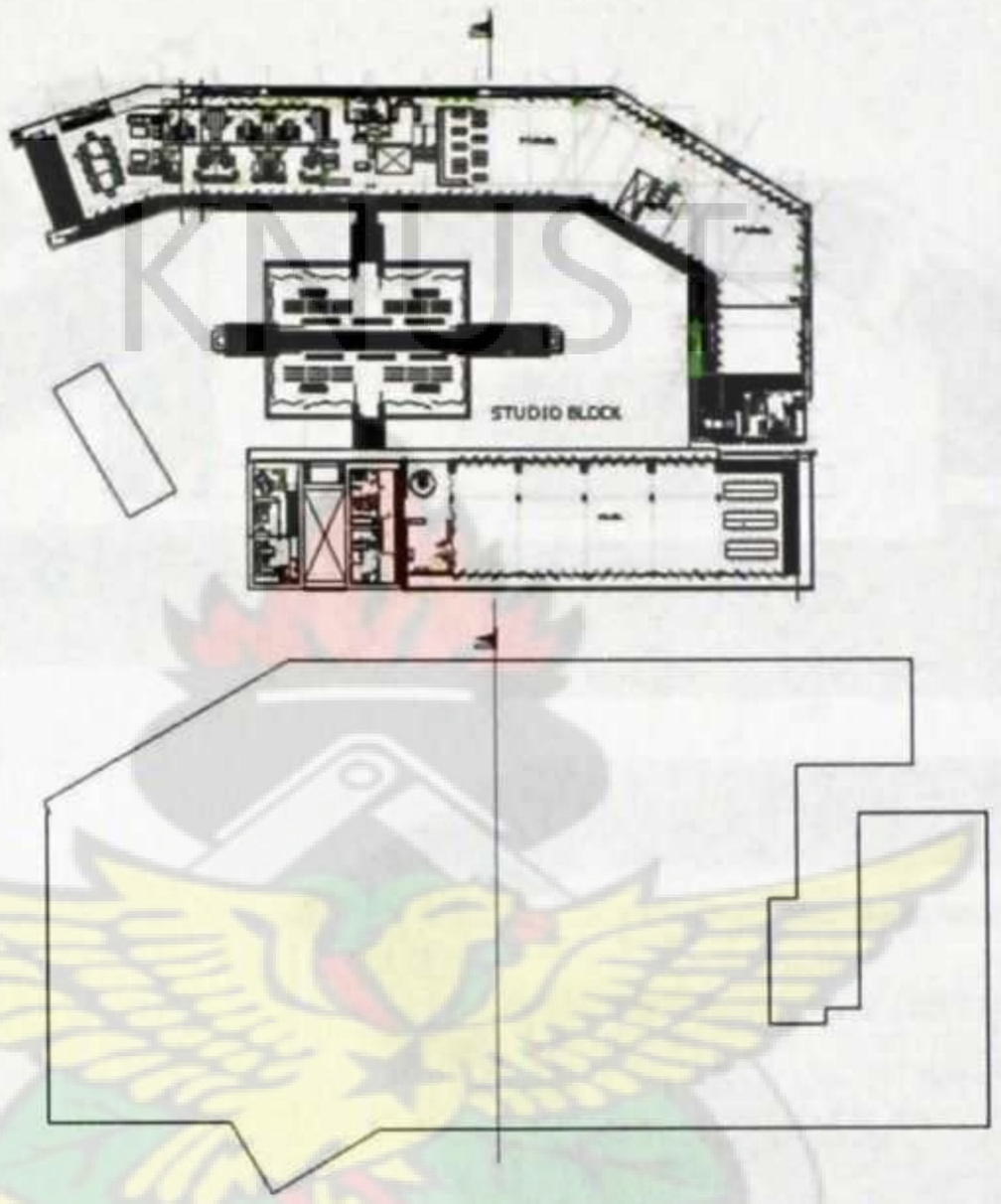
fifth floor plan



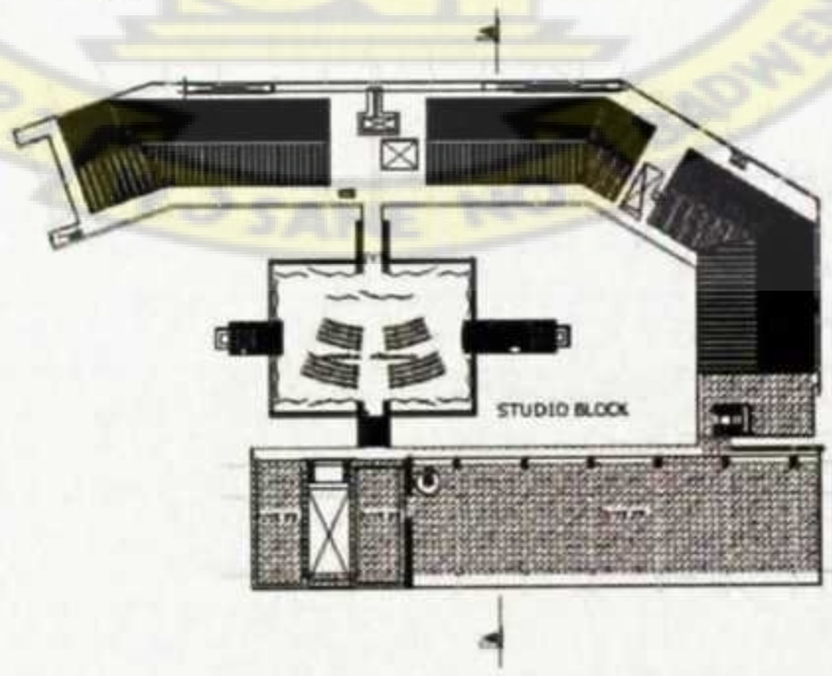
FIFTH FLOOR PLAN *(AUTHOR, 2011)*

sixth//seventh floor plans

sixth floor plan



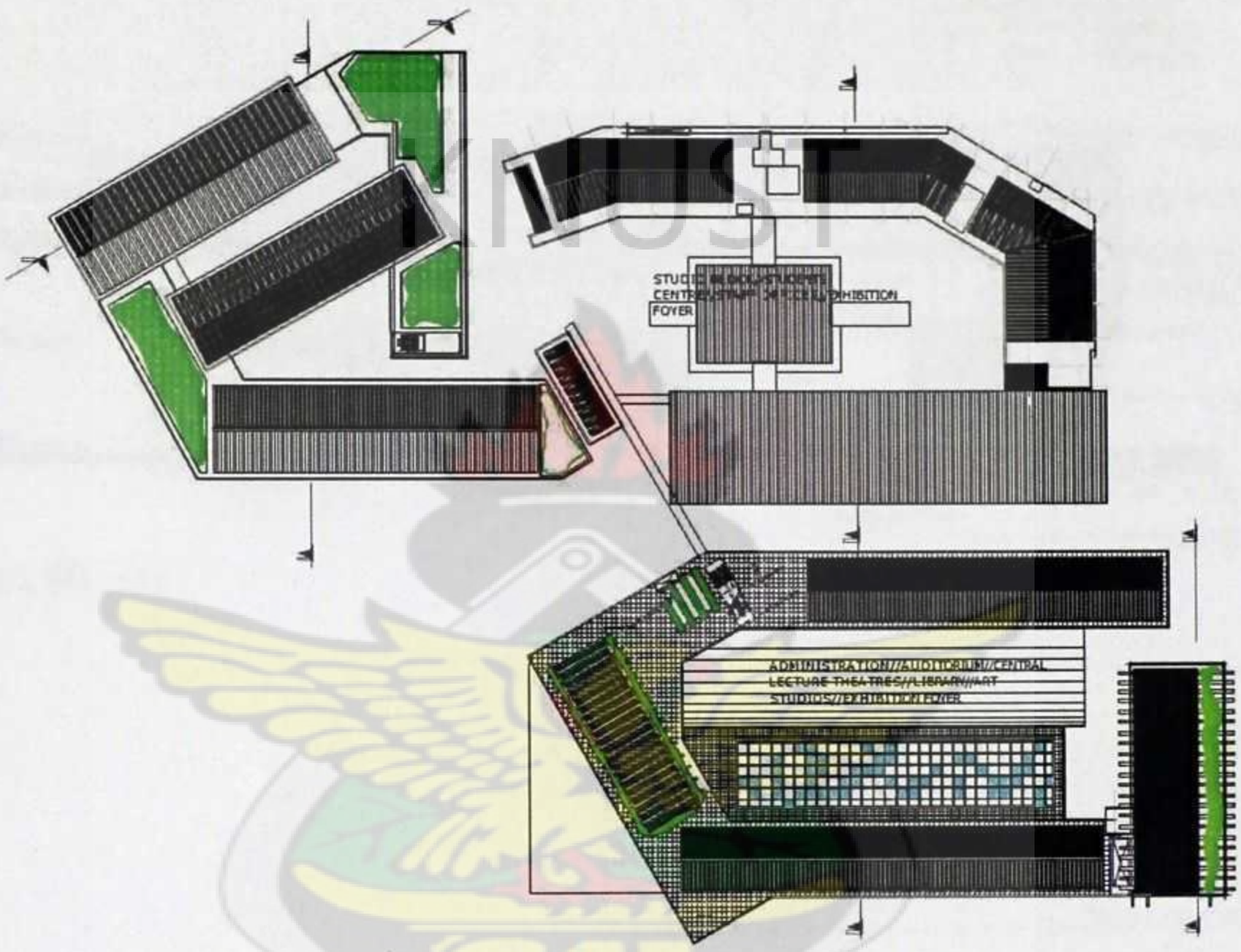
seventh floor plan



SIXTH AND SEVENTH FLOOR PLANS *(AUTHOR, 2011)*

4K

roof floor plan



ROOF FLOOR PLAN *(AUTHOR, 2011)*

auditorium//administration detail :sections

section 01-01

section OF-OF

SECTIONS OF AUDITORIUM AND ADMINISTRATION BLOCK *(AUTHOR, 2011)*

4M STRUTURE AND SECTIONS STUDIO AND WORKSHOP

4Mi

studio detail :section

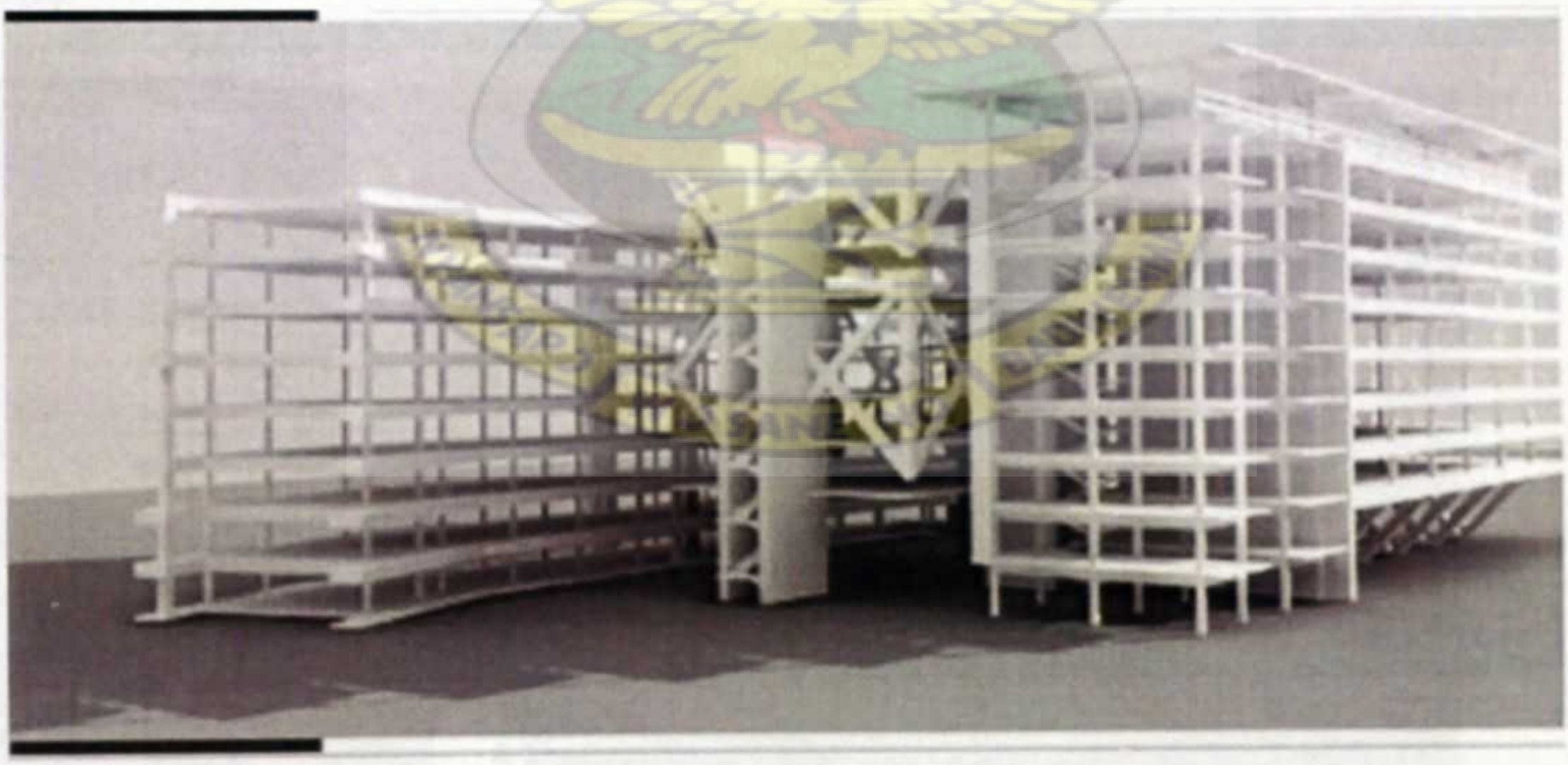
section 01-01 *continued*

SECTION OF STUDIO BLOCK *(AUTHOR, 2011)*

4Mii

STRCUTURAL MODEL OF STUDIO BLOCK; VIEW OF COURTYARD *(AUTHOR, 2011)*

4Miii



STRCUTURAL MODEL OF STUDIO BLOCK; VIEW FROM SOUTH-WEST *(AUTHOR, 2011)*

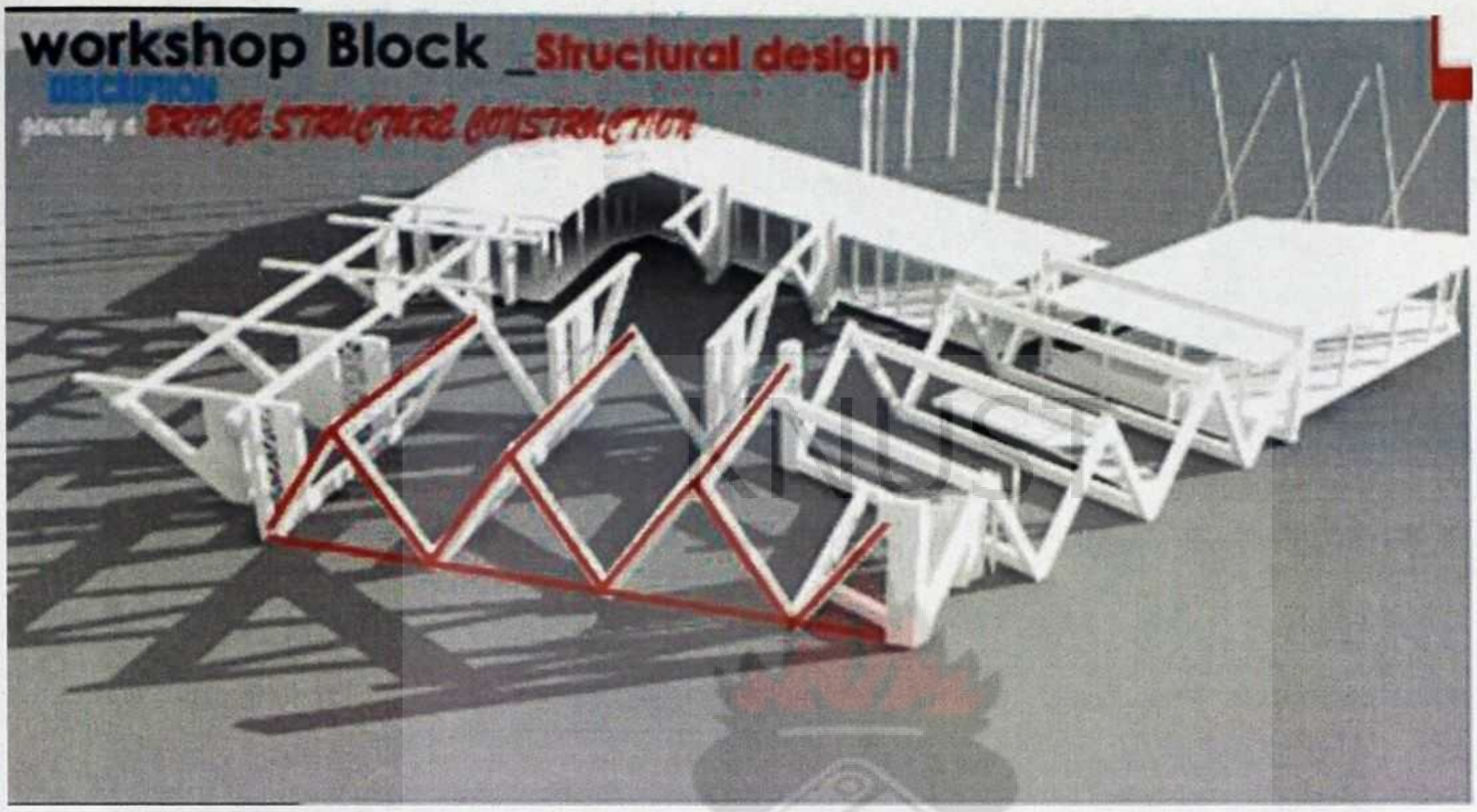
4Miv

STRCUTURAL MODEL OF STUDIO BLOCK *(AUTHOR, 2011)*

4Mv

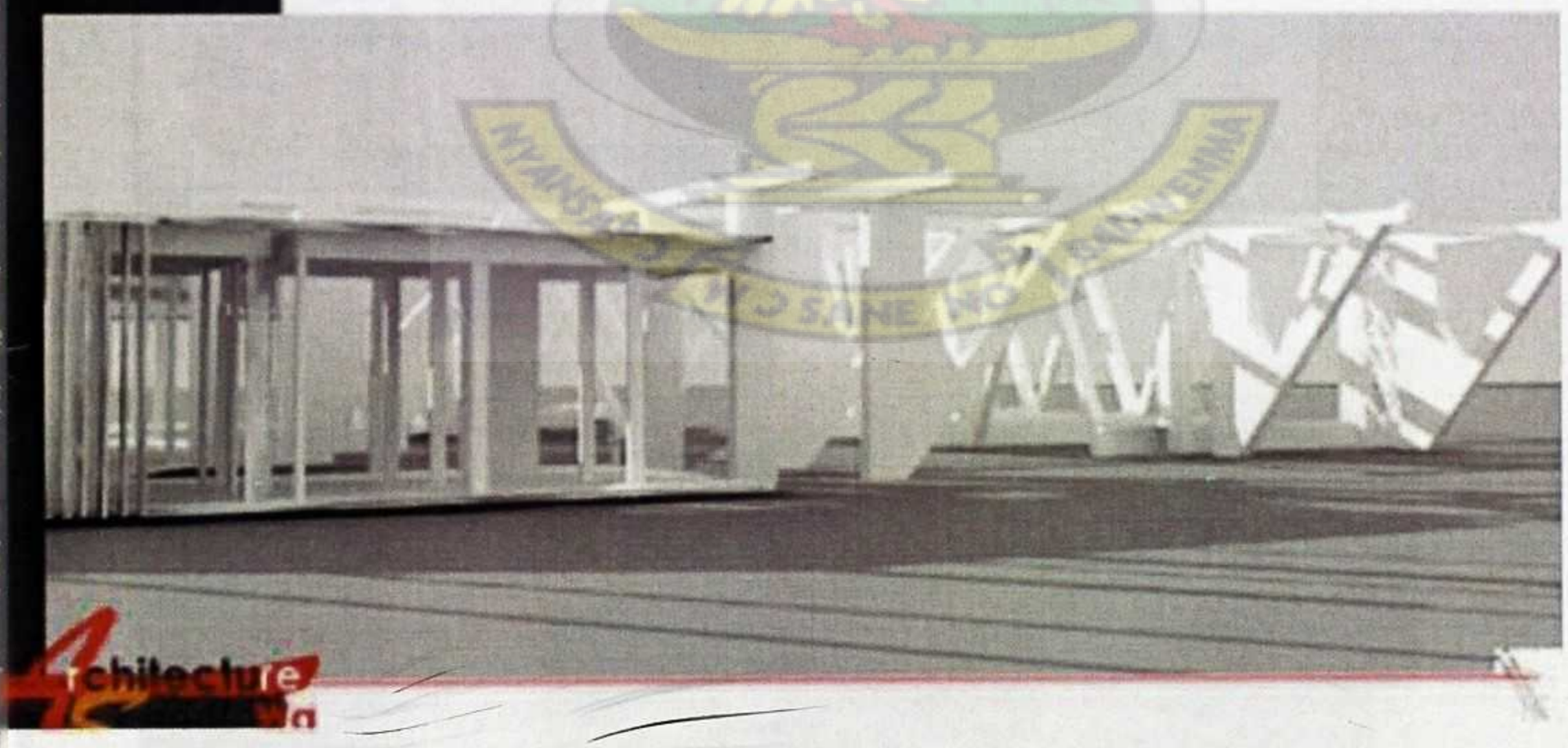
STRCUTURAL MODEL OF STUDIO BLOCK; CROSS BRACING OF CRITIQUE BLOCK *(AUTHOR, 2011)*

4Mvi



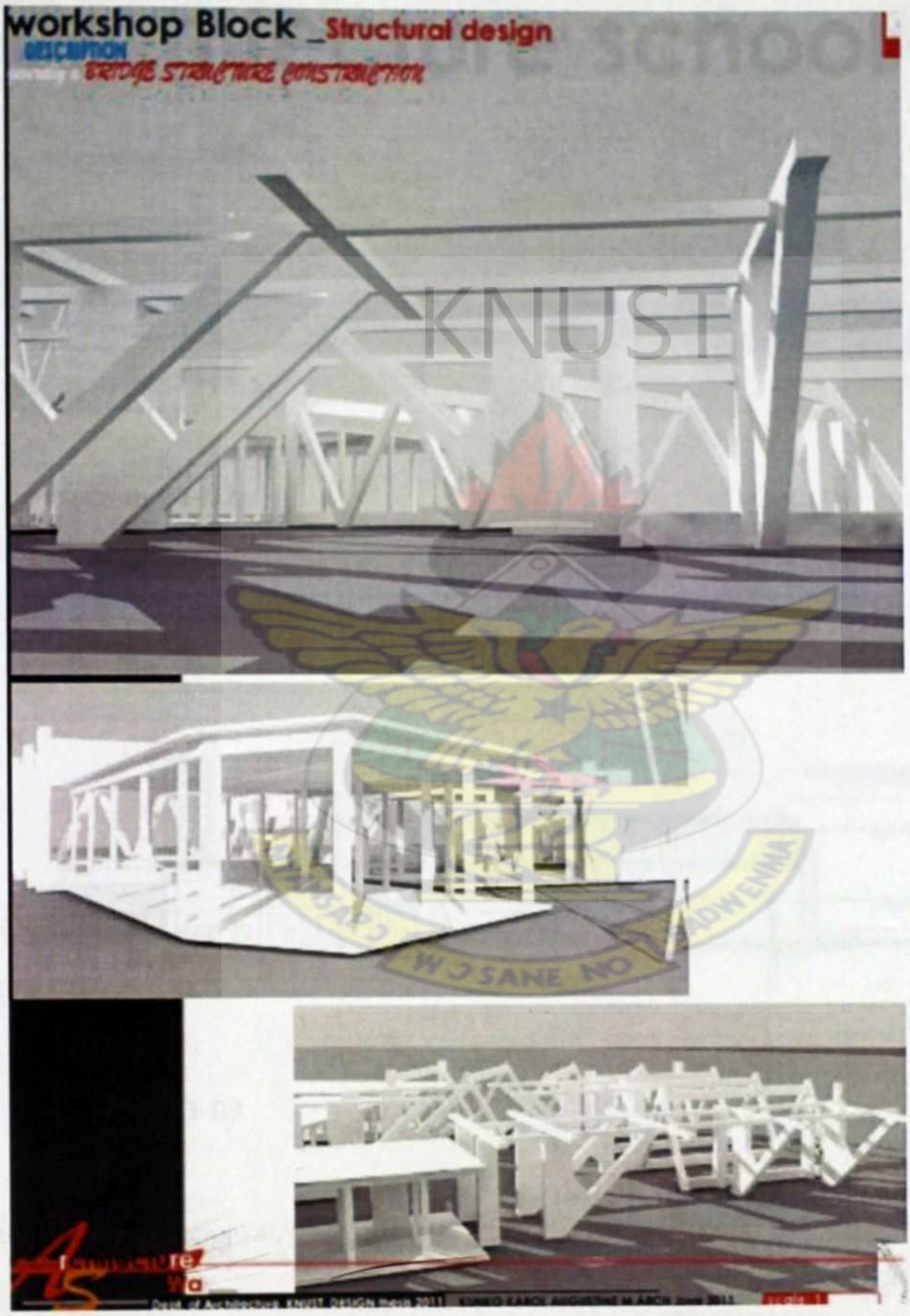
STRCUTURAL MODEL OF WORKSHOP BLOCK *(AUTHOR, 2011)*

4Mvii



STRCUTURAL MODEL OF WORKSHOP BLOCK *(AUTHOR, 2011)*

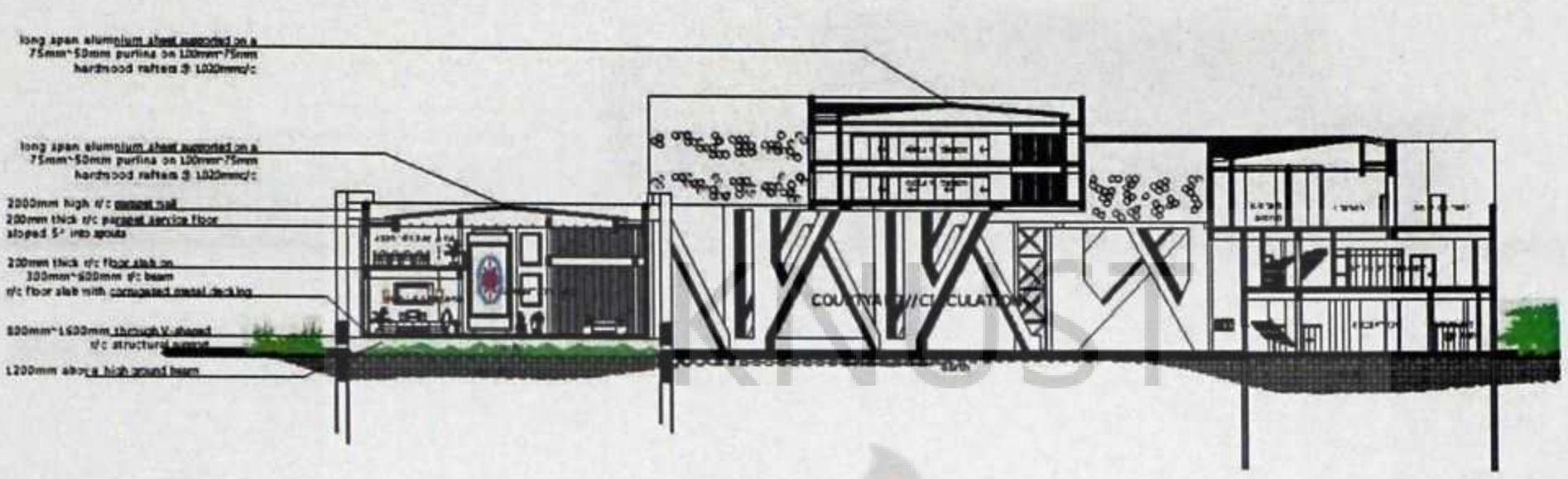
4Mv



STRCUTURAL MODEL OF WORKSHOP BLOCK *(AUTHOR, 2011)*

4N

workshop:sections

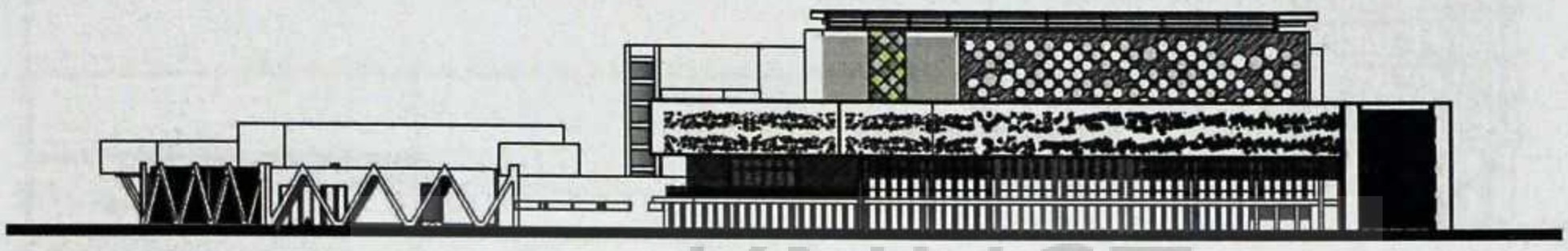


section 02-02

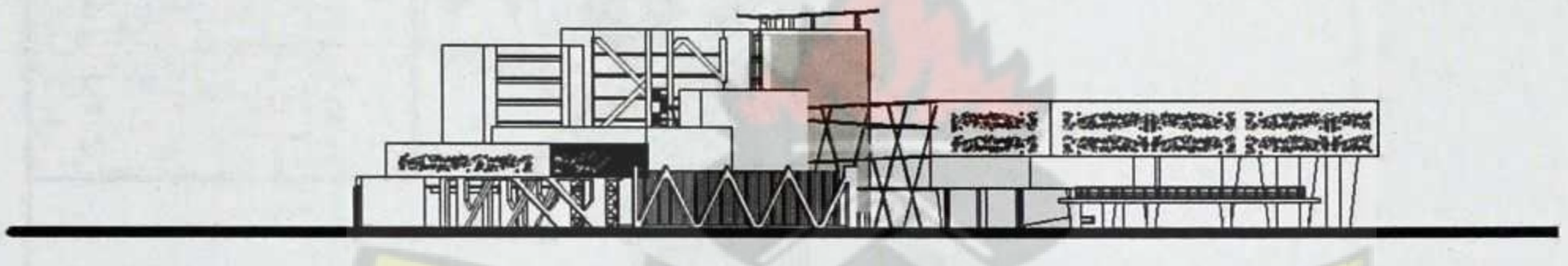
section 03-03

SECTIONS OF WORKSHOP *(AUTHOR, 2011)*

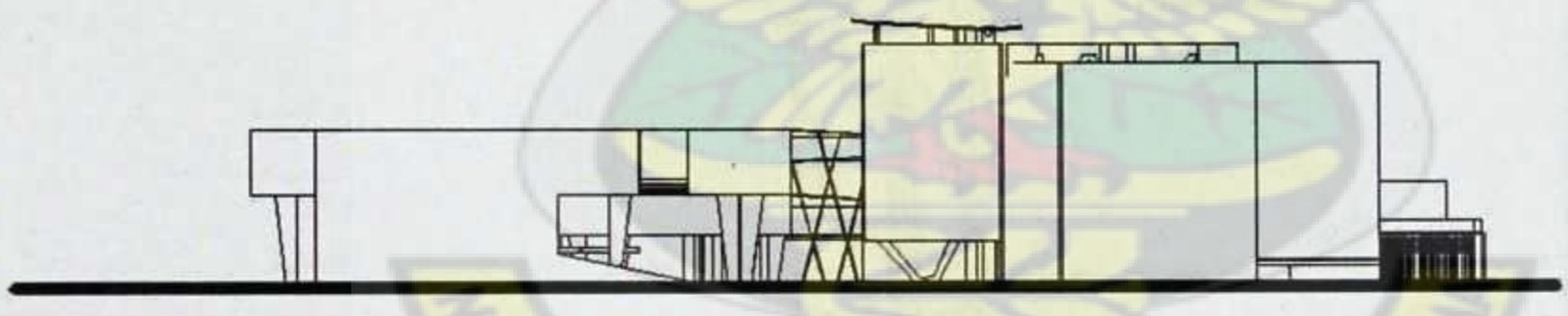
elevations..



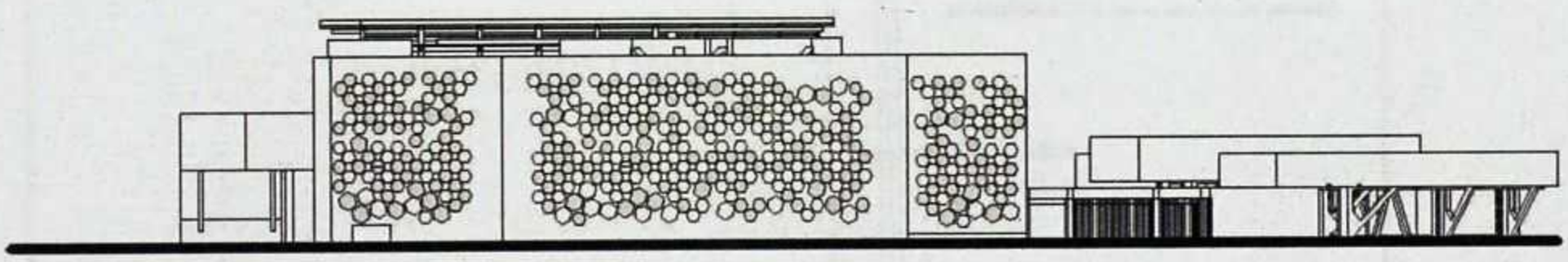
south elevation



west elevation



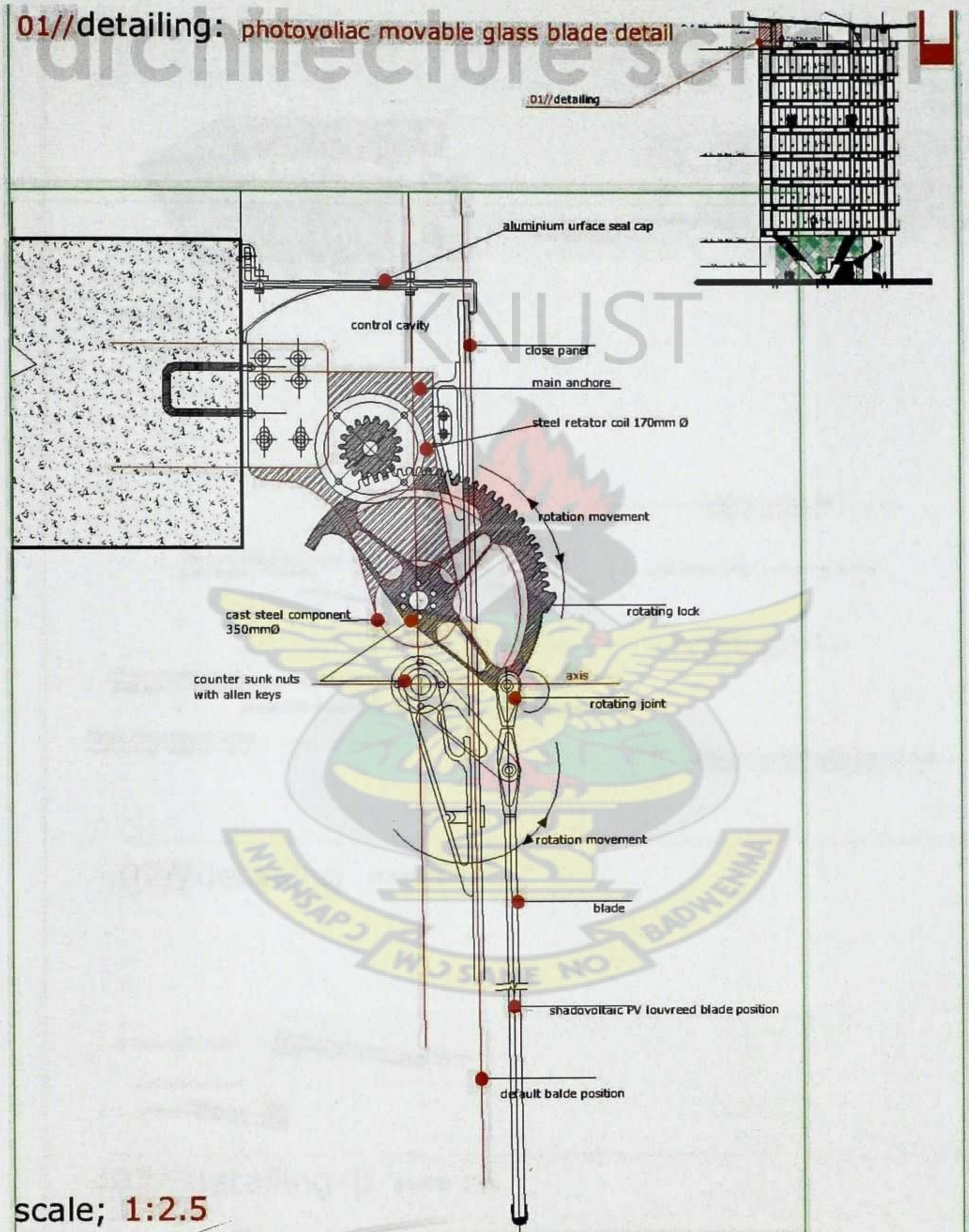
east massing



north elevation

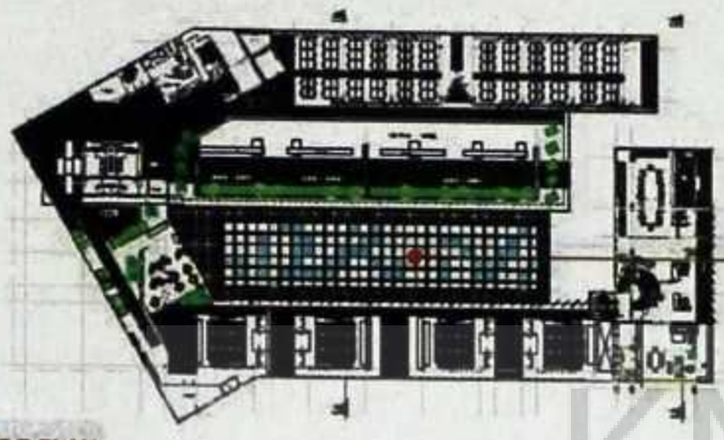
ELEVATIONS *(AUTHOR, 2011)*

4P

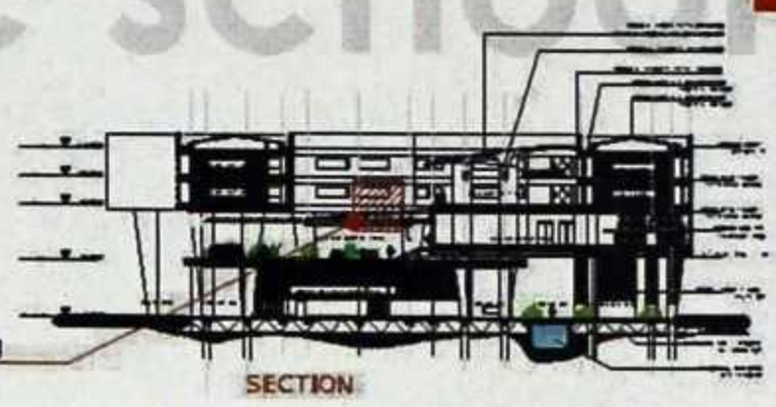


CONSTRUCTION DETAILING *(AUTHOR, 2011)*

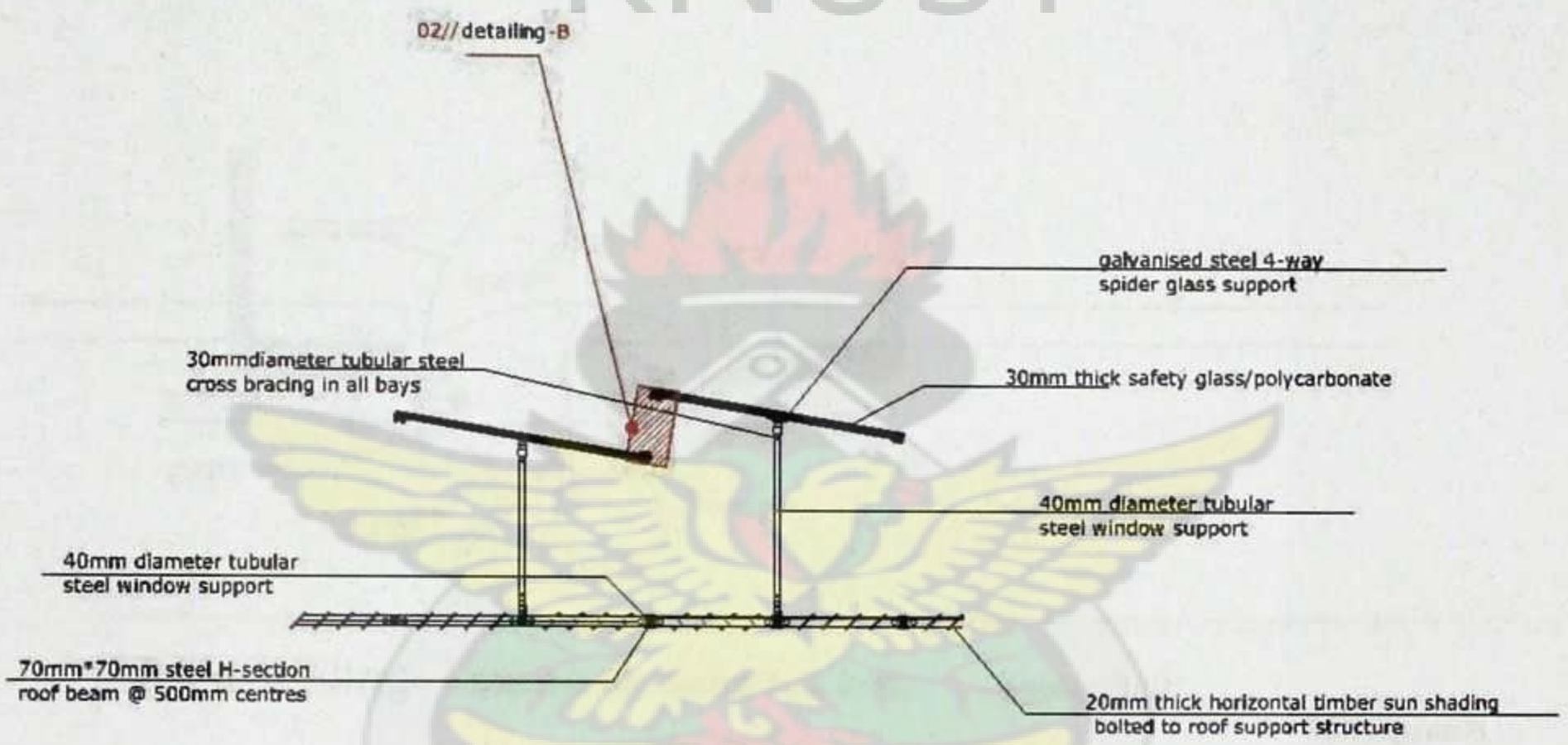
02//detailing: ETFE adjustable automated roof



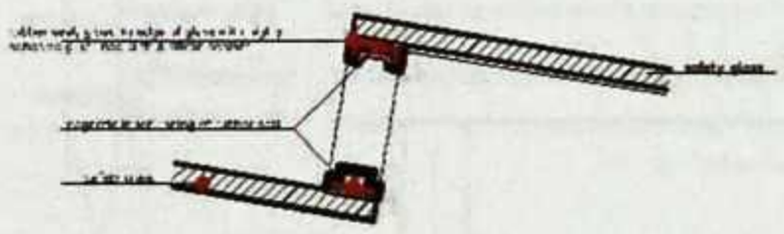
ROOF PLAN



SECTION



02//detailing scale; 1:25

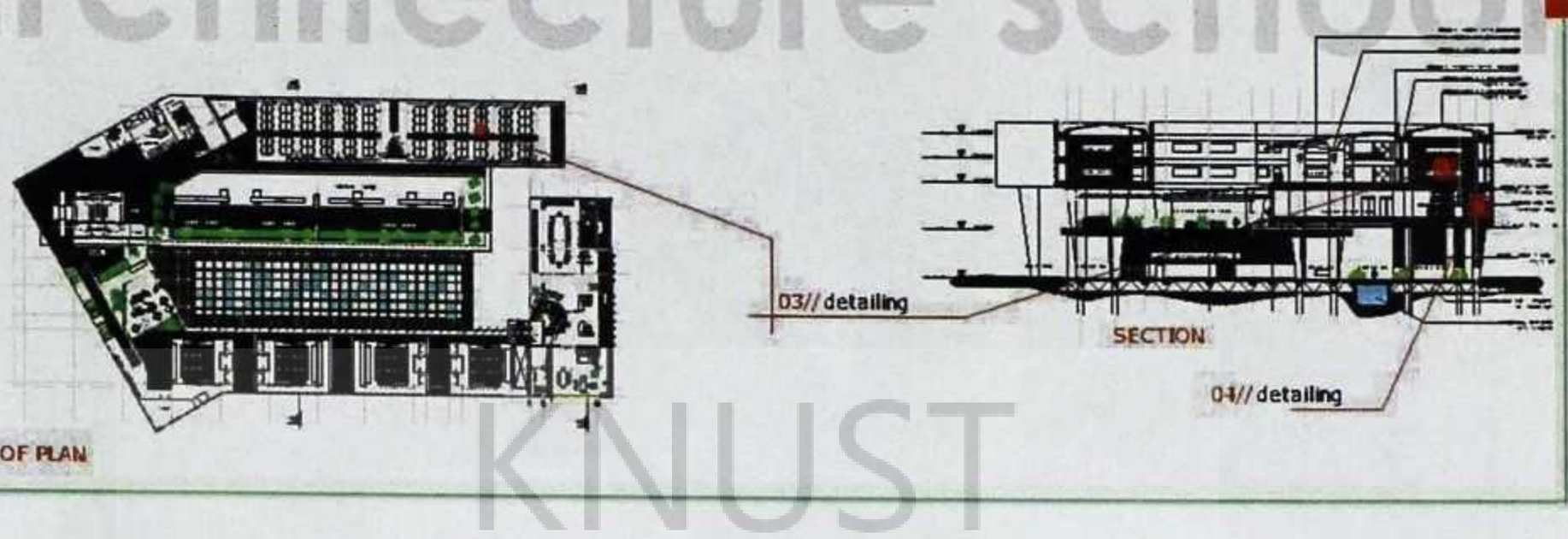


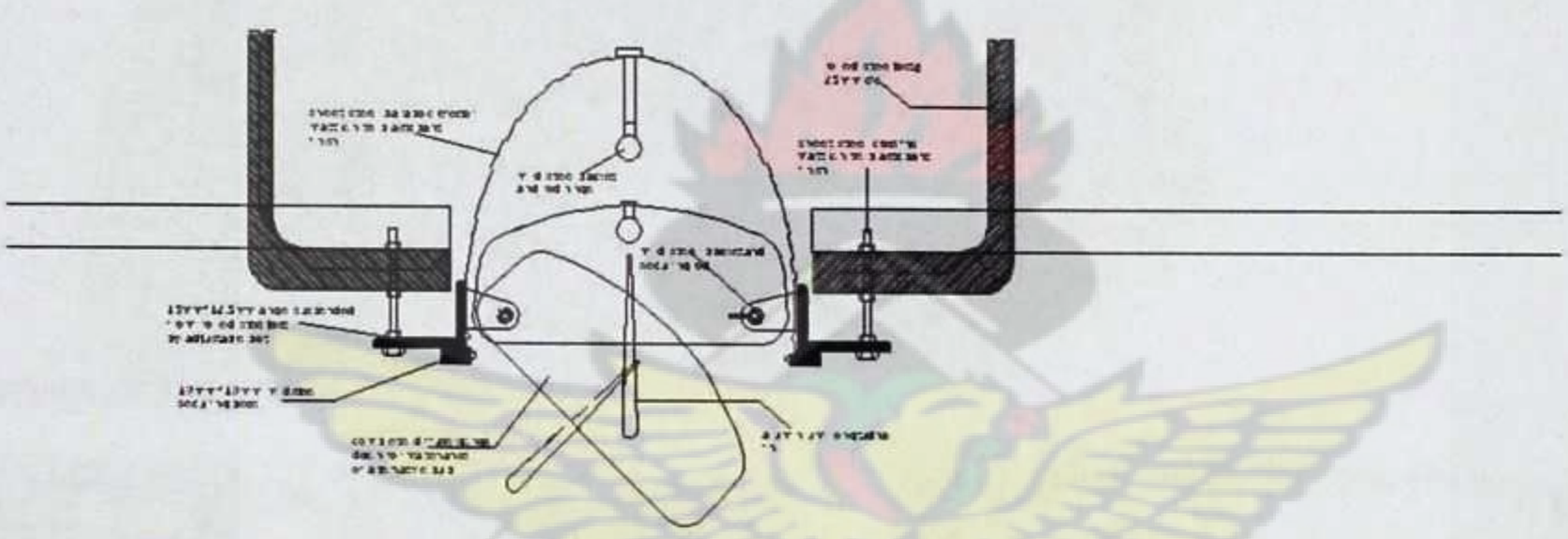
02//detailing-B scale; 1:5

COSTRUCTION DETAILING *(AUTHOR, 2011)*

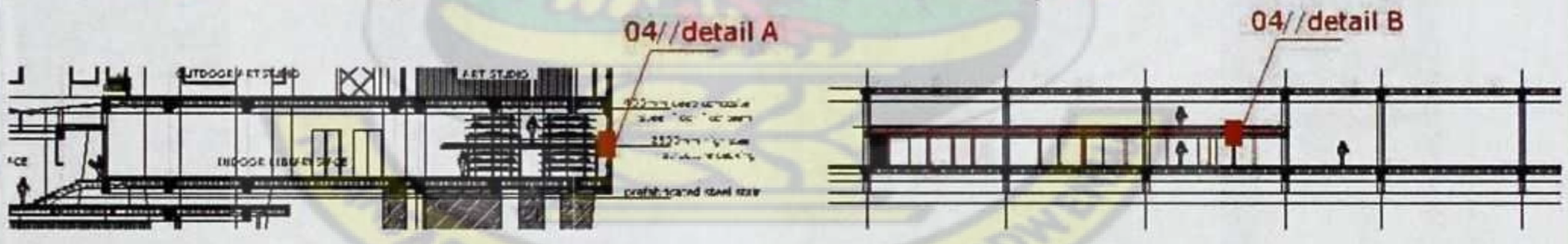
4V

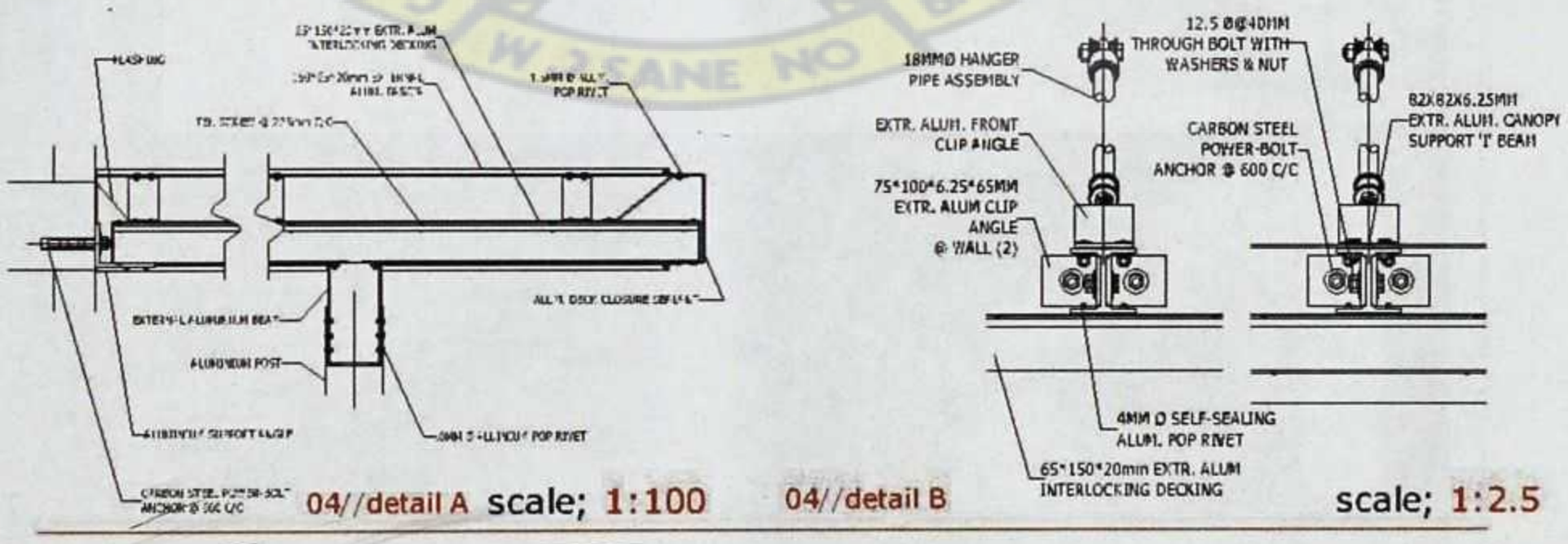
03//detailing: Adjustable two duoble bulb lamps





03//detailing Adjustable two duoble bulb lamps scale; 1:2





04//detailing Raised floor detail

CONSTRUCTION DETAILING *(AUTHOR, 2011)*

4W

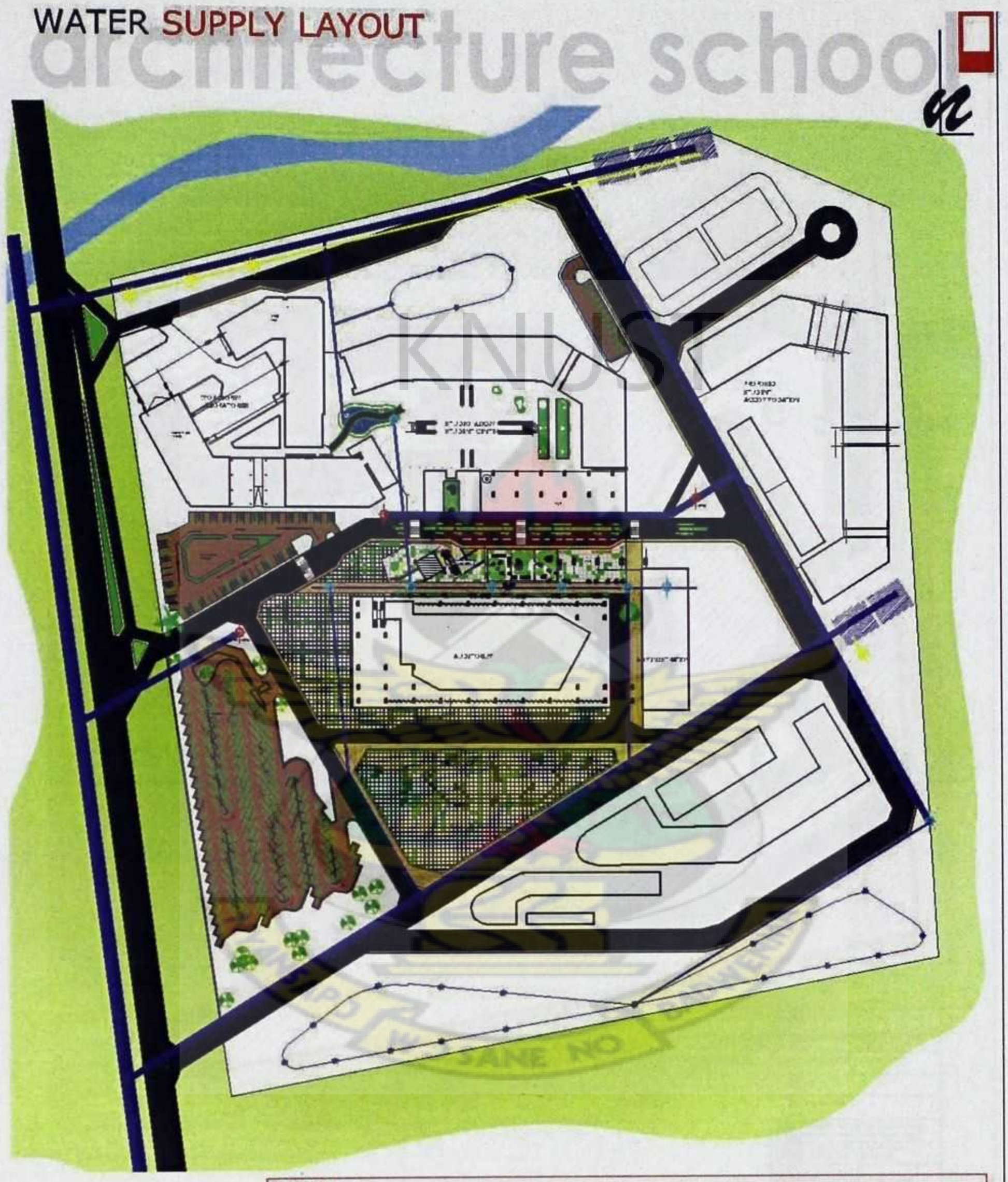
SERVICES LAYOUT: CIRCULATION LAYOUT *(AUTHOR, 2011)*

4X

LANDSCAPING LAYOUT

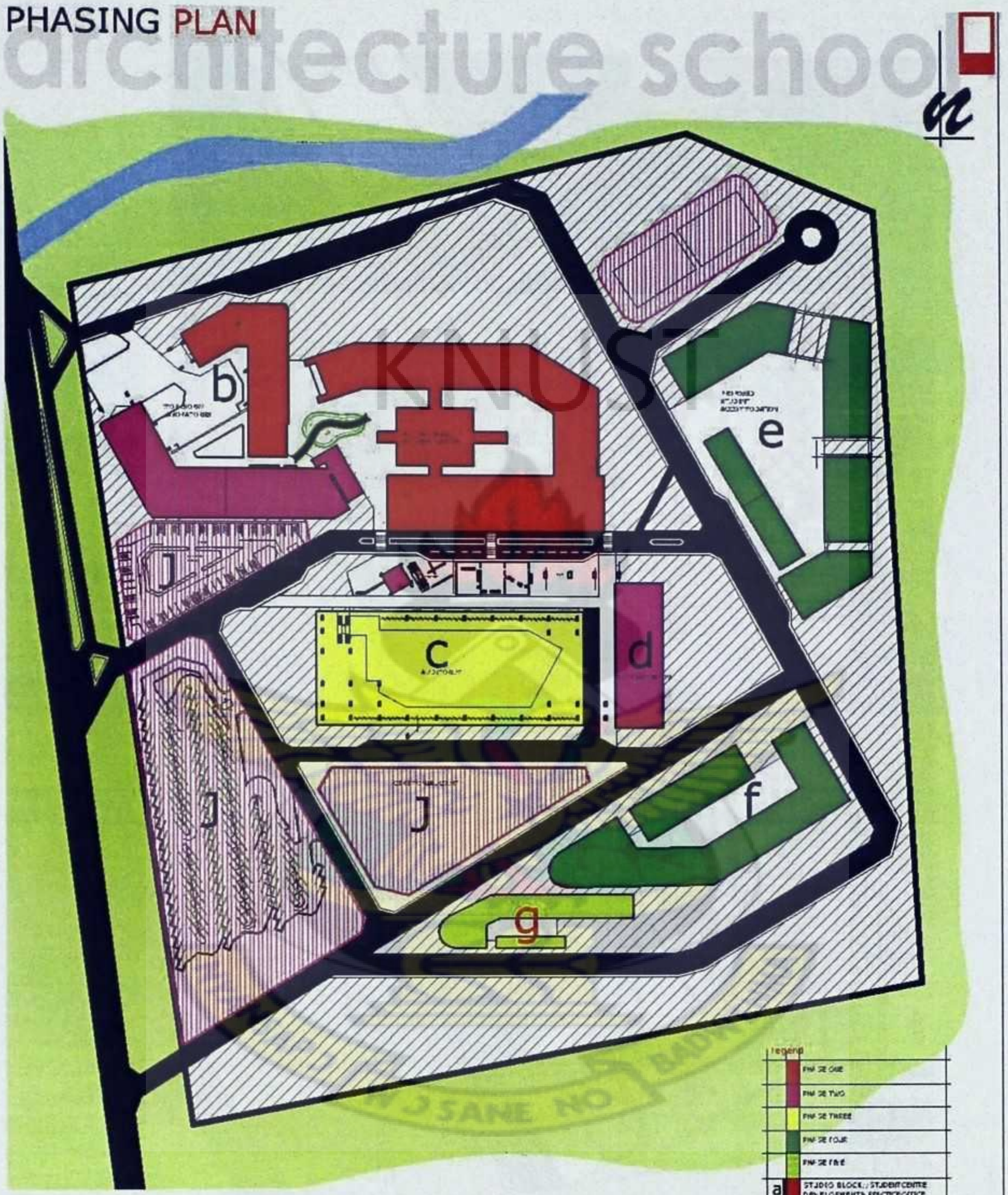
SERVICES LAYOUT: LANDSCAPING LAYOUT *(AUTHOR, 2011)*

WATER SUPPLY LAYOUT



SERVICES LAYOUT: WATER SUPPLY *(AUTHOR, 2011)*

PHASING PLAN



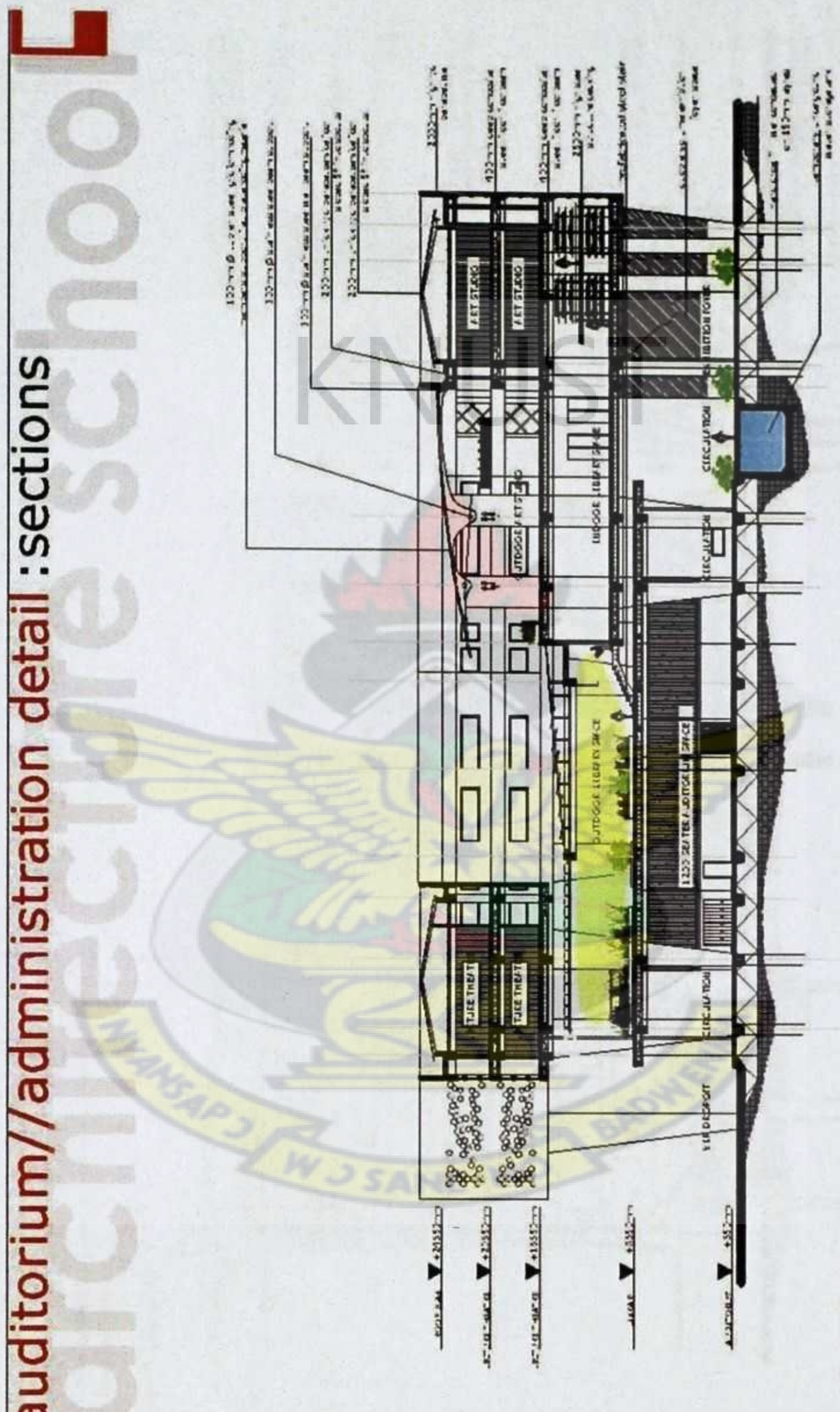
Architecture

SERVICES LAYOUT: PHASING LAYOUT *(AUTHOR, 2011)*

4.1A

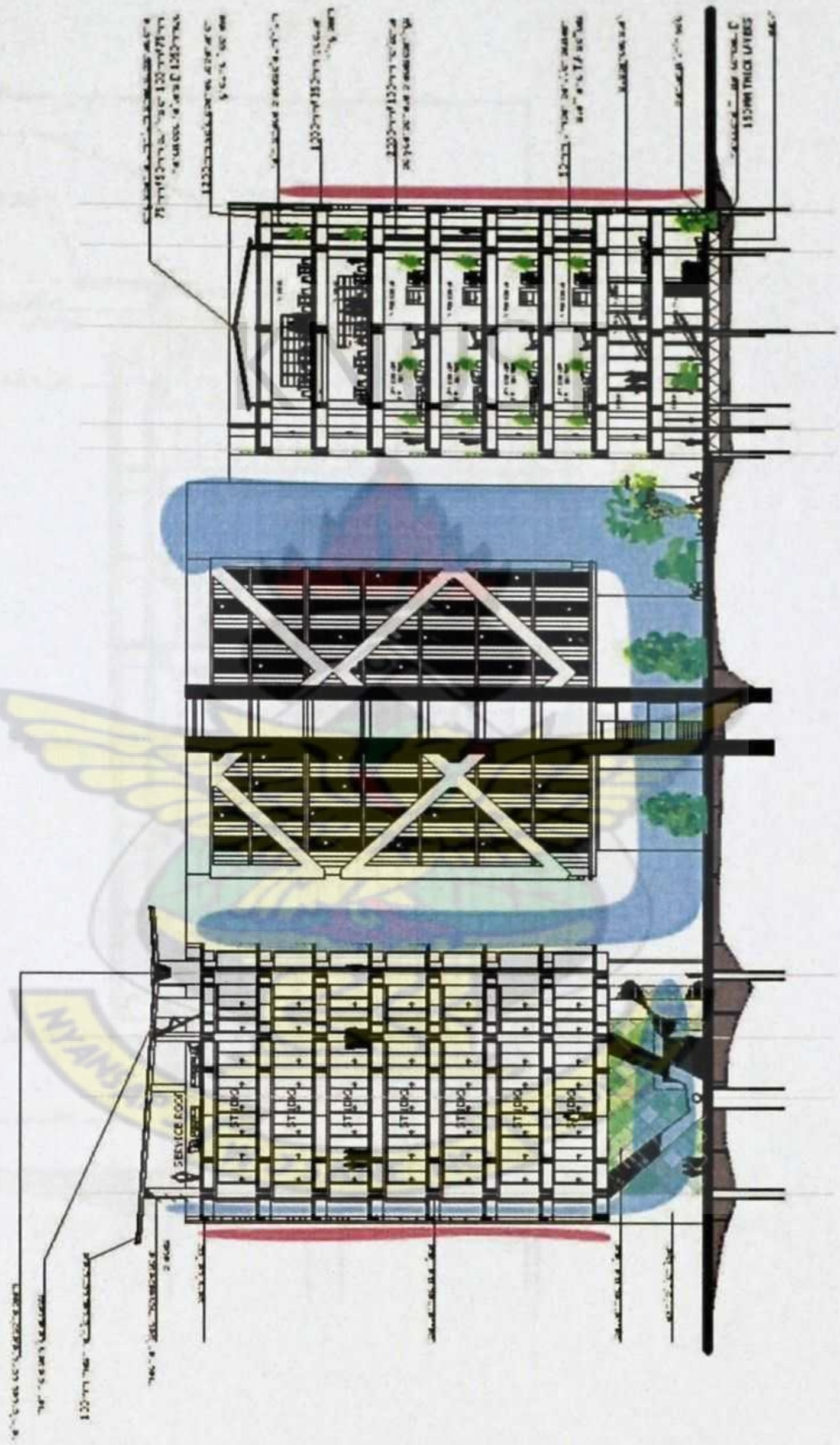
GROUND FLOOR PLAN (STUDIO BLOCK AND WORKSHOP BUILDING) *(AUTHOR, 2011)*

4.1B



SECTIONS OF AUDITORIUM BLOCK *(AUTHOR, 2011)*

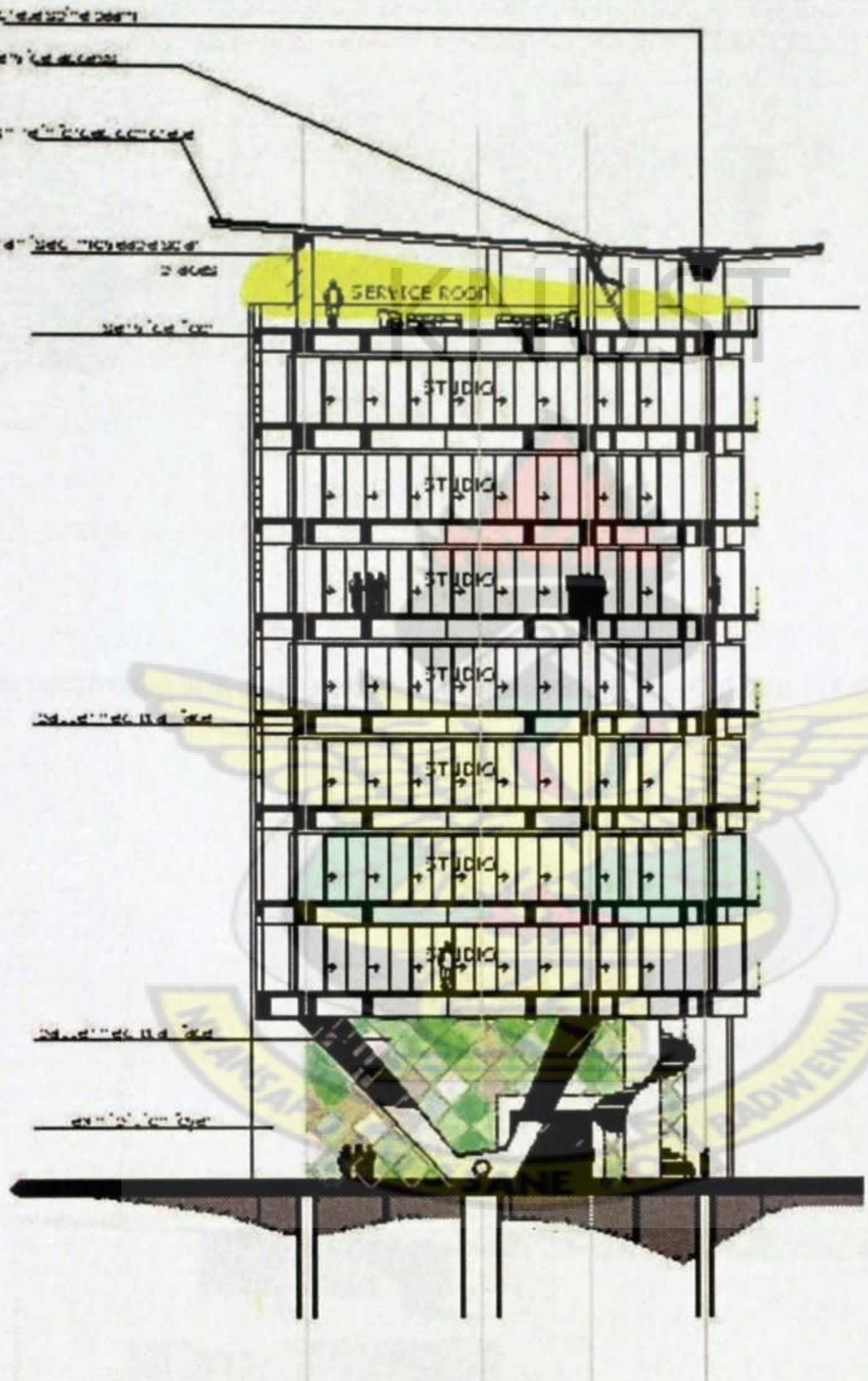
4.1C



section 01-01 continued

ANOTATED SECTION OF STUDIO BLOCKS *(AUTHOR, 2011)*

4.1D

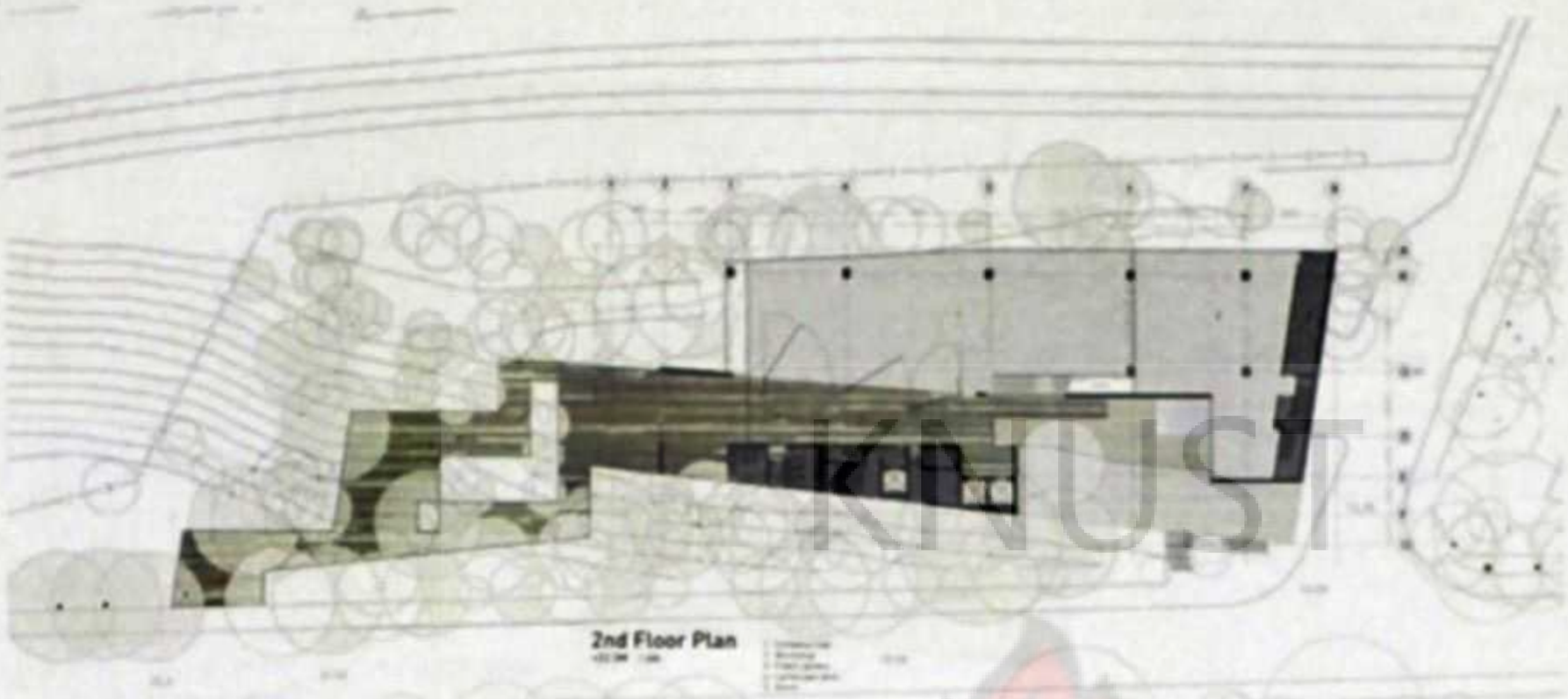


section 01-01 *continued*

DETAILED SECTION OF STUDIO BLOCK: FLAT ROOF *(AUTHOR, 2011)*

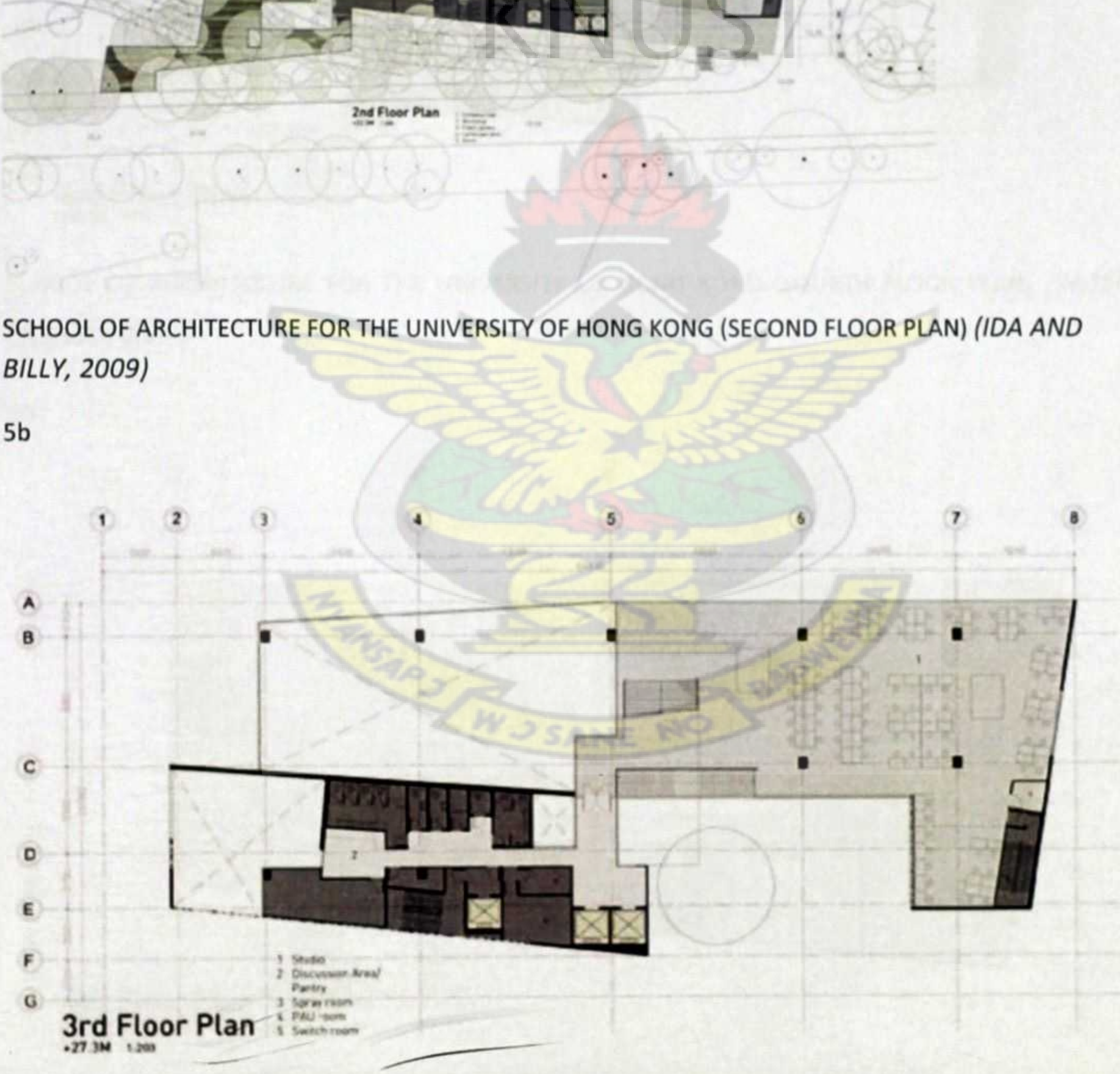
APPENDIX 5

5A.



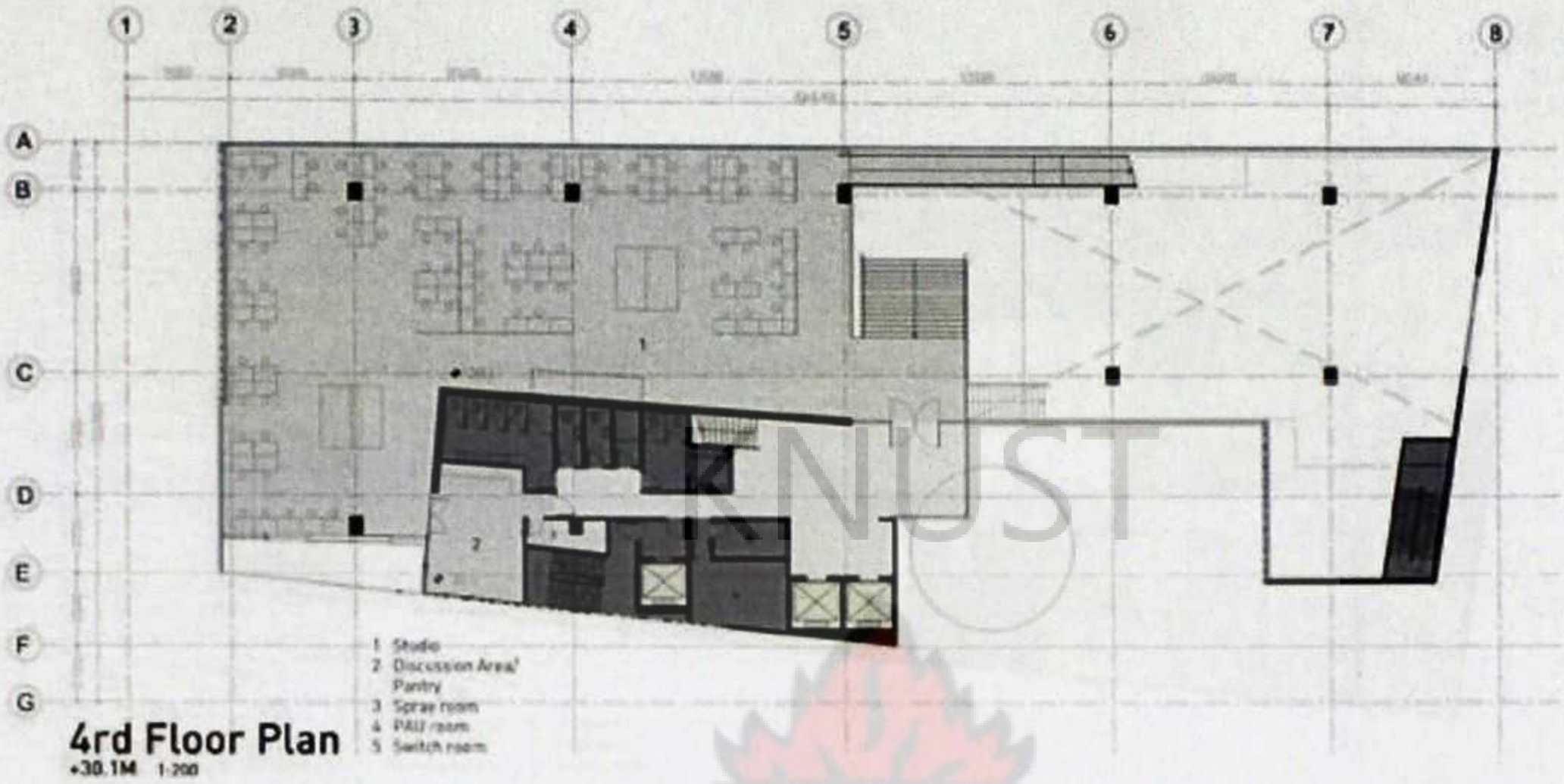
SCHOOL OF ARCHITECTURE FOR THE UNIVERSITY OF HONG KONG (SECOND FLOOR PLAN) *(IDA AND BILLY, 2009)*

5b



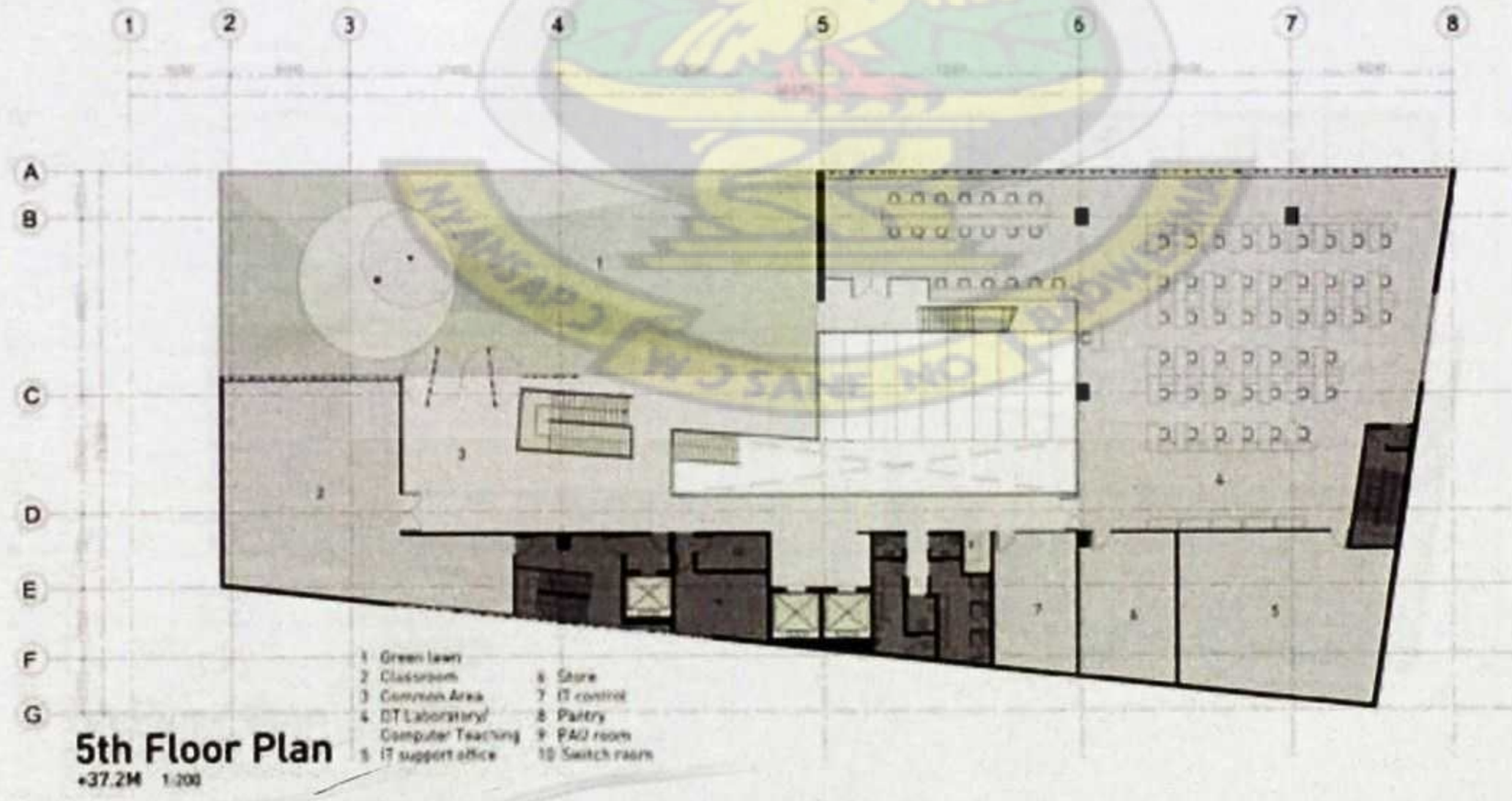
SCHOOL OF ARCHITECTURE FOR THE UNIVERSITY OF HONG KONG (THIRD FLOOR PLAN) *(KAREN CILENTO, 2009)*

5C



SCHOOL OF ARCHITECTURE FOR THE UNIVERSITY OF HONG KONG (FOURTH FLOOR PLAN) *(KAREN CILENTO, 2009)*

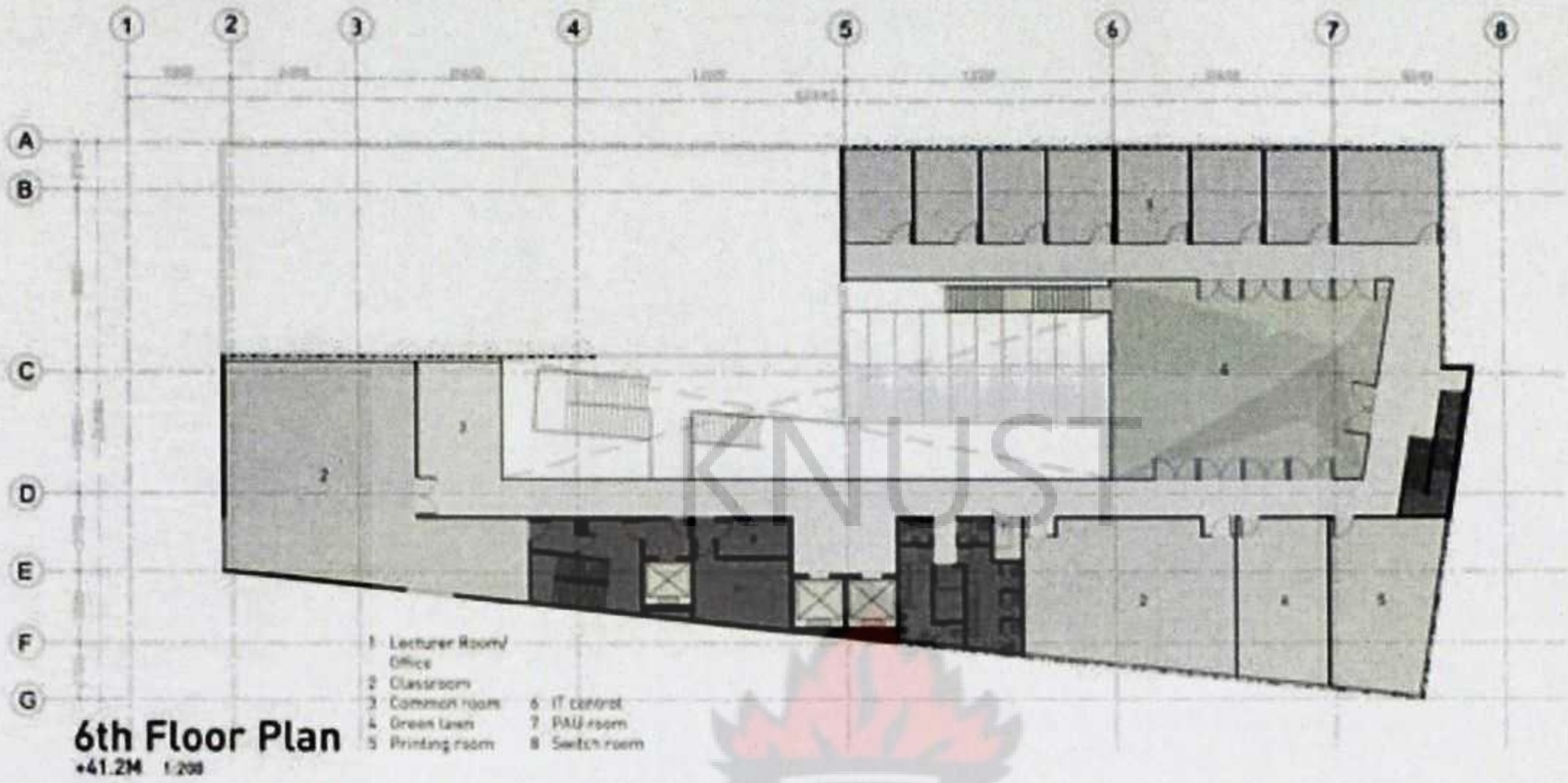
5D



SCHOOL OF ARCHITECTURE FOR THE UNIVERSITY OF HONG KONG (FIFTH FLOOR PLAN)

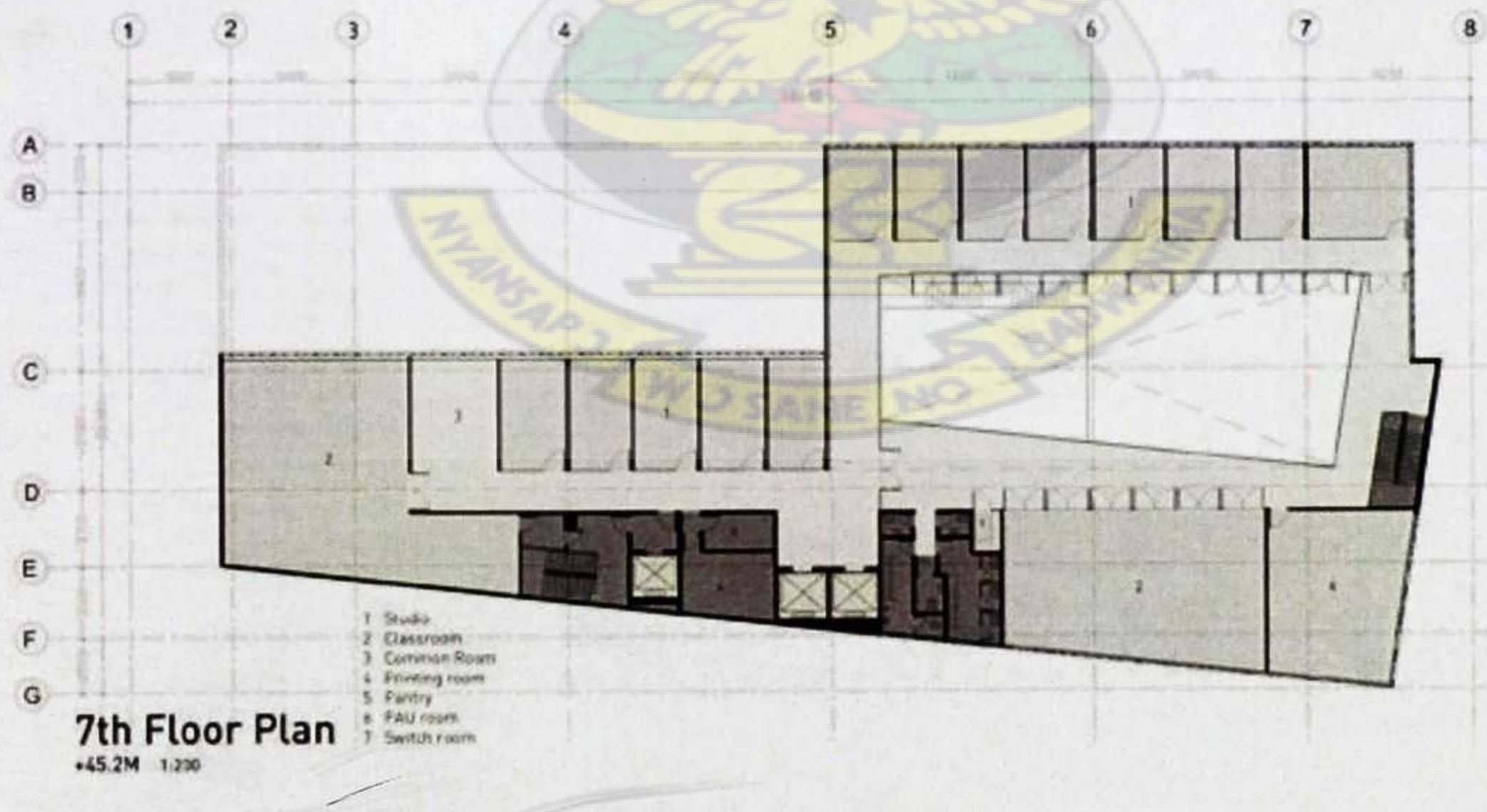
(KAREN CILENTO, 2009)

5E



SCHOOL OF ARCHITECTURE FOR THE UNIVERSITY OF HONG KONG (SIXTH FLOOR PLAN) *(KAREN CILENTO, 2009)*

5F

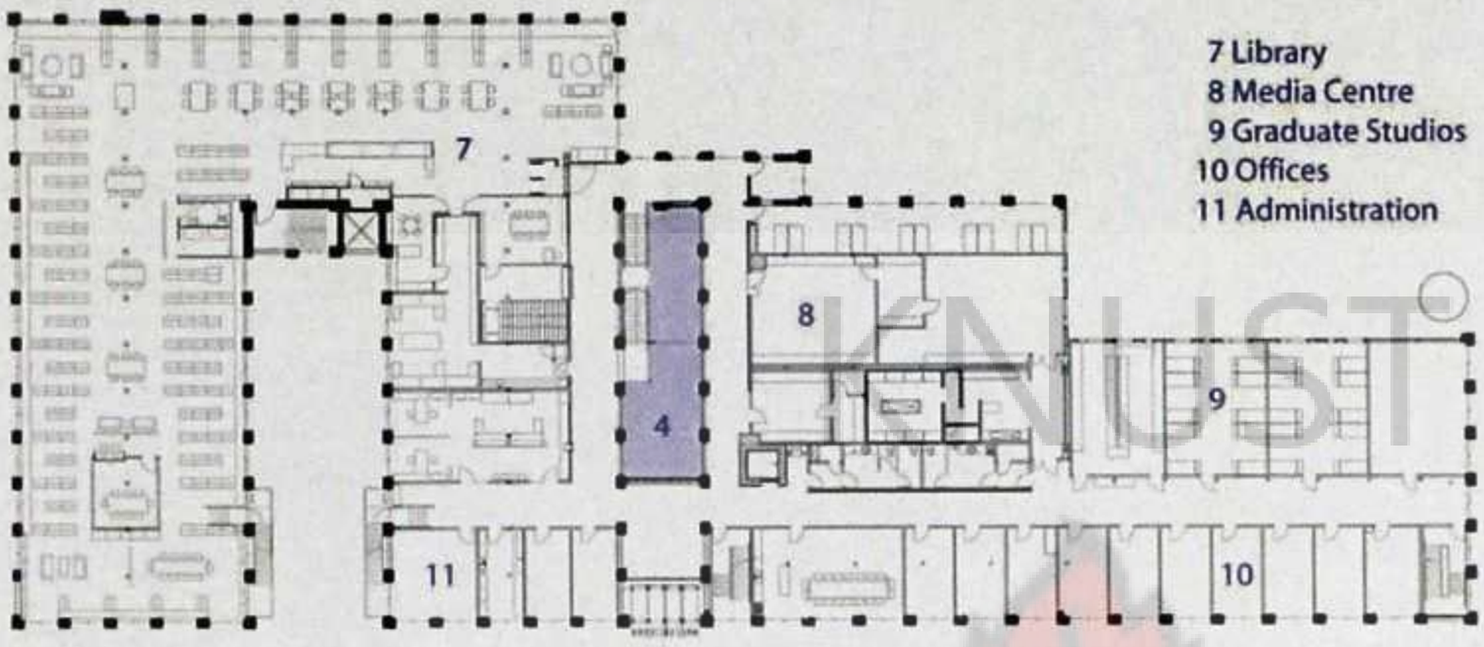


SCHOOL OF ARCHITECTURE FOR THE UNIVERSITY OF HONG KONG (SEVENTH FLOOR PLAN)

(KAREN CILENTO, 2009)

APPENDIX 6

5A

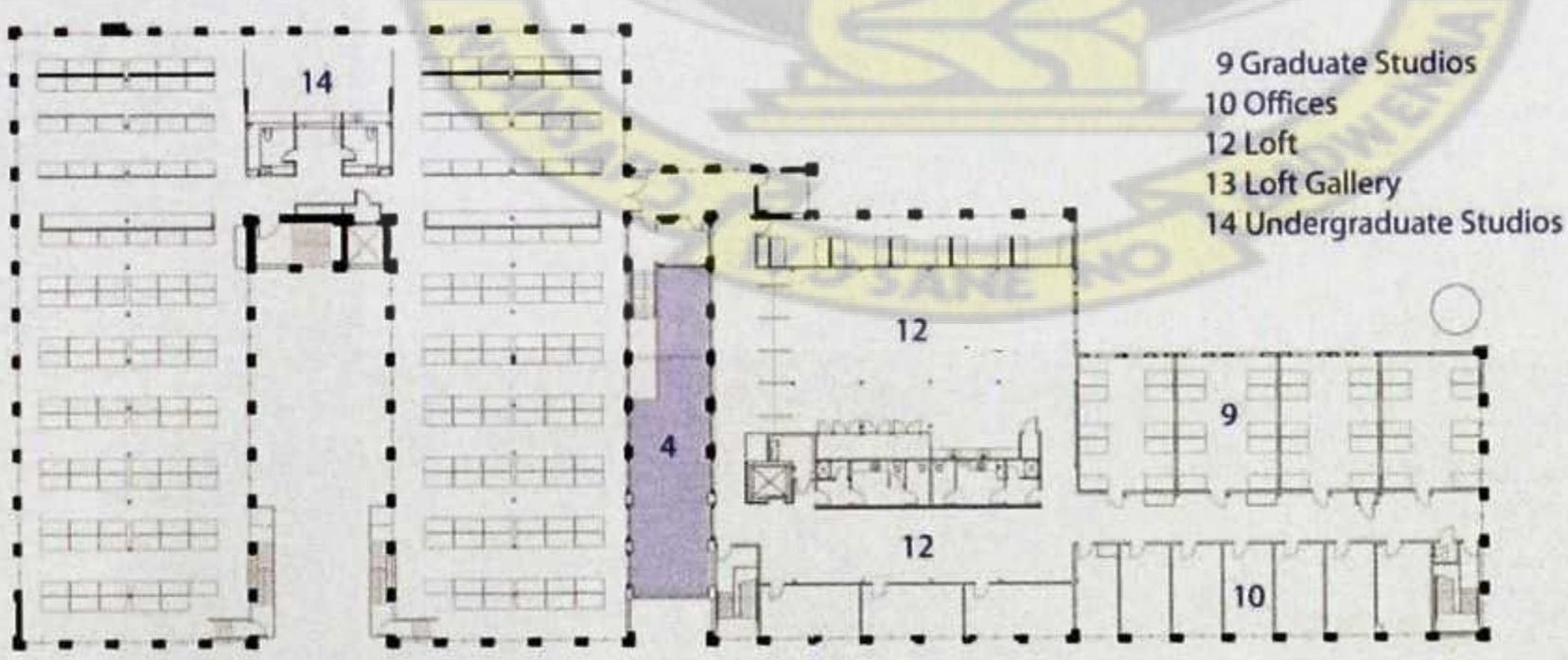


Second Floor Plan

WATERLOO SCHOOL OF ARCHITECTURE, ONTARIO, CANADA (SECOND FLOOR PLAN)

(*BEN RAHN, 2004*)

5B



Third Floor Plan

WATERLOO SCHOOL OF ARCHITECTURE, ONTARIO, CANADA (THIRD FLOOR PLAN)

(BEN RAHN, 2004)