Ashesi University College

Investigating the incorporation of "Green Design" in the design of Ashesi University's campus at Berekuso.

By

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DECLARATION

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: …….

Candidate's Name: ……

Date: …….

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by Ashesi University College.

Supervisor's Signature: ……

Supervisor's Name: …….

Date: ……

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ABSTRACT

Global warming has become a major problem to countries around the world. This is usually caused by greenhouse gases emitted into the atmosphere. The main cause of these emissions is through human activities such as mining, building construction and manufacturing. These gases are considered to be harmful because it contributes to the increase in temperatures around the world. Research has proven that, the construction industry contributes about 40% of the overall greenhouse gases emitted. Thus there is the need to prevent or reduce these carbon emissions. Building construction, which is one such human activities, can reduce its carbon emissions by adopting sustainable building methods: the construction of green buildings.

Green buildings have been known to have a positive impact on the environment as compared to the traditional forms of building. It can be classified under various aspects including green architecture, green design amongst others. This study focuses on green designs and how it can be incorporated into the real estate development process. It is described as the use of environmentally friendly products or designs in a building which reduces its negative impact on the environment.

This research investigates the incorporation of Green Design in the design of Ashesi University's campus at Berekuso. Firstly, it establishes if green designs were incorporated into its design and seeks to find out how these green designs have been incorporated. The research also sought to rate the building under study using the Building Research Establishment Environmental Assessment Method (BREEAM).

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Chapter 1:

Introduction

1.0 Introduction

Human activities like manufacturing, energy production, food production, transportation and building operations consume fossil fuels hence contribute to the rapid increase in carbon emissions resulting in global warming (Fischer, 2010). The direct connection this emerging phenomenon has with human activities indicates that greenhouse gases which cause global warming can be reduced if more careful methods are used or indeed abandoned altogether. Despite the fact that global warming is still a belligerent issue among global powers, advocates of this phenomenon acknowledge that buildings are substantial greenhouse gas emitters. As was found for the case of Germany in a research study by Dipl.-Wirtsch-Ing, (2010) about 40% of the overall greenhouse gas emissions are produced by real estate.

While mega carbon emitting nations like China, India and the USA blame each other, smaller and internal institutions within these countries have instituted measures and standards for stakeholders (Gray, 2011). Some of which is used as a vindicating tool for corporate social responsibility to support 'greenery' projects (Gray, 2011). The processes involved in construction of a building such as water consumption, waste disposal and energy usage have all been said to increase carbon emissions.

This is an admission that the processes in building have a negative impact on both humans and environment thus increasing world global warming in the same manner as large factories and manufacturing plants. Also, scholars such as

Patnaikuni (2009), acknowledges the role of housing in voluminous greenhouse emissions in developed countries. According to the author, an effective response to rapid climate changes is to address emissions from the housing sector through sustainable alternatives. Thus, there is the need for real estate developers to adopt green construction as a way of reducing greenhouse emissions.

This study discusses this issue by investigating how a special purpose real estate in Ghana, the Ashesi University College campus at Berekusu, has incorporated green designs in its development. The study further attempted to rate the campus according to internationally established rating methods and make recommendations as to how the rating can be improved in future developments.

1.1 Background

Green construction can be described as a method of integrating building practices that considerably reduces the environmental footprint of buildings in comparison to standard practices (Fischer, 2010). Green construction helps save costs on energy because, for example, the use of simple cross-ventilation design in rooms helps reduce the use of air-conditioners, which emit carbon gases. Also, the use of green construction in a building sustains the building, which reduces the maintenance cost of the building by cutting off constantly burned fuels like gas, oil, and wood.

Green design (also known as sustainable design or environmental design) is the concept of construction built with principles of economic, social, and ecological sustainability (Brumback, 2010). Green design deals with using environmentally sustainable designs and processes in a building which reduces

pollution. Some designs considered to be green are; long and narrow buildings which maximize the use of natural lighting, growing trees to shade building roofs and storm water harvesting to reduce the risk of flooding. Ashesi's buildings will also have to be proven to reduce pollution as well as waste in the environment, making the products healthier. This study focuses on green designs at Ashesi University College.

In observing the topic within a local context, a news article published by the Ghana News Agency reports that government is putting in place measures to check global warming in the country, since it could affect its marine resources in the near future (Ghana News Agency, 2011). These measures include conscious efforts to promote reforestation programs and the formulation of a comprehensive Forest and Wildlife Policy aimed at conserving the country's forest and wildlife resources. These efforts by the government were a way to protect the environment from global warming, which could affect the country's marine resources.

Ghana's dependence on foreign aid and its tight operational budget leaves a lot to be desired when managing carbon emissions. Recently, it was found out that Ghana has become an e-waste dump site for most developed countries (Ghana: Digital Dumping Ground, 2011). Some private individuals and institutions have also taken up such sustainable methods at their expense. In fighting global warming, incorporating sustainable buildings in a country will help reduce emissions while increasing survival of living things. Developers need to adopt and use sustainable methods and designs in construction to help reduce global warming in the country. This will also help sustain the environment and buildings.

1.2 Problem statement

"Housing, like food and water, is a basic need and a necessity for the existence of man hence there is the need for individuals to acquire their own private accommodation" (Mahama & Antwi, 2006). This need, realized by Ghanaian private real estate developers, responds to the tastes and preferences of these individuals. Tastes and preferences should be in line with building sustainable structures that last long and have a positive impact on the environment.

A news article by Joy News stated, "climate scientists at the Colombia-based International Centre for Tropical Agriculture, CIAT, reported that expected increasing temperatures will lead to massive declines in cocoa production by 2030" (JoyNews, 2011). The warmer it gets, the more difficult it is for cocoa trees to get enough water to grow. The increasing temperature affects cocoa production in the country hence, the need to address this condition of global warming. Cocoa is one of the leading commodity exports in the country and contributes about 41% of GDP in the country (Mhango, 2010). This figure could decrease if measures are not put in place to reduce temperatures in the area. One way is by designing sustainable buildings and structures.

Carbon emissions cause temperatures to rise which has become a major worry for cocoa farmers as well as the government. The problem is how carbon emissions can be reduced so as to reduce temperatures. Human activities causes carbon emissions to increase and examples of such human activities include burning of fossil fuels, cement manufacture amongst others.

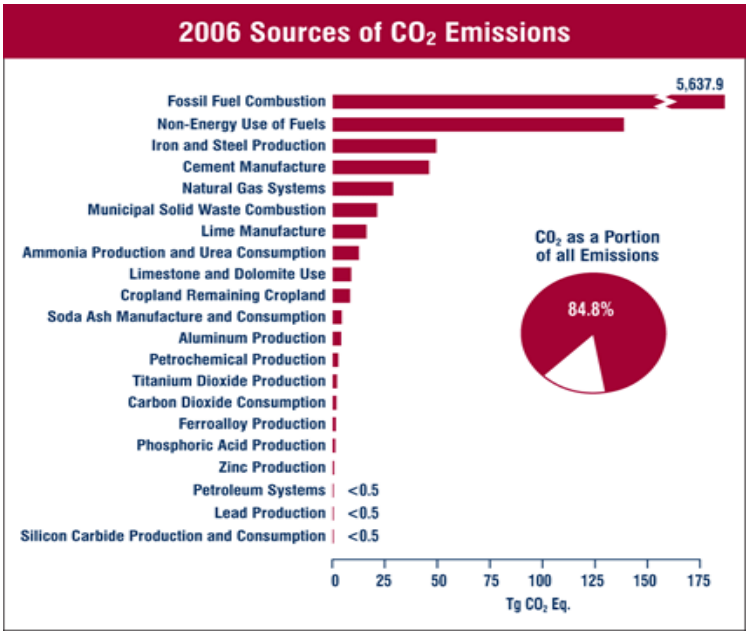

Figure 1.1: Green House Gas Emissions

Source: U.S Greenhouse Gas Emissions Inventory (2006)

The table above demonstrates the sources of carbon dioxide emissions with the y-axis being the teragrams of carbon dioxide. Fossil fuels recorded the highest or largest source of carbon dioxide emissions such as petroleum and natural gas which are produced by humans.

1.3 Research Question

1 What green designs has Ashesi University College incorporated?

2 How has Ashesi University College incorporated green designs in its construction?

3 How can Ashesi University College be rated on its green designs?

4 What recommendations can be made to Ashesi University College about its green design rating?

1.4 Aim/ Main Objective

The aim or main objective of this research is to examine how green design has been incorporated by Ashesi University College in its structures and to rate Ashesi University based on the green designs adopted.

1.4.1 Specific Objectives

1. To define what green design is.
2. To identify the green designs incorporated by Ashesi University College in the design of its campus at Berekuso.
3. To rate Ashesi University College based on an established rating system.
4. To recommend possible ways of improving its future designs.

1.5 Scope of the study

This study was a case study on how Ashesi University College incorporates green designs in its developments. It looked at the current school campus buildings at Berekuso.

1.6 Research Method

This study used a qualitative approach and it required the use of both primary and secondary data. The target population was the developer and development partners who are individuals who have knowledge about the processes used in construction of Ashesi University College's campus at Berekuso. The snowball technique was adopted to aid in identifying the development partners.

1.7 Justification / Impact

The research established if green design has been incorporated into the designs of Ashesi University College's new campus at Berekuso. There is the

need for the right methods to be used to reduce carbon emissions in the air (weather), in plant life and even in water bodies (where they exist). This need is created from the fact that there are increasing temperatures and global warming in the world. This means that if the right methods are used in building they will have a positive impact on the environment and the world as a whole. This research will benefit end users as well as developers by creating a healthy environment for people to live and work in.

1.8 Thesis outline

Chapter 1: Introduction

The introductory chapter provides an overview of what the report is about. It outlined the various sections, which the research covered and introduced the reader to the study. It also covered the aims and objectives of the report as well as the relevance of the study.

Chapter 2: Literature Review

This chapter discussed what scholars have said about green design. It allowed the researcher to critique written literature and identified the gaps in literature.

Chapter 3: Methodology

This chapter discussed the methods the researcher used in gathering data, both primary and secondary, for the study. It looked at the research approach and methods, techniques, sample size, as well as some analytical tools used in the data analysis.

Chapter 4: Data Analysis and Discussion

This chapter presented findings of the research, which are represented, in the form of charts and diagrams in order to communicate the findings of the

study. Discussion of findings as well as Ashesi University's ratings was done in this chapter.

Chapter 5: Summary, Conclusions and Recommendations

This chapter summarised, made recommendations and concluded based on findings from the survey and literature search.

Chapter 2

Literature Review

2.1 Introduction

This chapter reviewed existing literature on green construction and then narrowed down to green design to form the theoretical basis of the research. This provided the basis for comparison and achievement of the aim of the study.

2.2 Green Construction

There has been much concern on human activities affecting the environment and these activities, such as manufacturing and construction, have increased greenhouse gases in the environment (Human- Related Sources and Sinks of Carbon Dioxide, 2011). "The construction industry plays an important role in the economy, and the activities of the industry are also vital to the achievement of national socio-economic development goals of providing shelter, infrastructure and employment (Anaman & Osei-Amponsah, 2007)." It also contributes the most to greenhouse gases. Due to the increase in greenhouse gases the world is facing, there is the need for the real estate industry to incorporate environmentally responsible building practices (Roper & Beard, 2006). One way of addressing these bad practices is by adopting green construction.

Green construction methods were not regarded as a means of construction because they were not feasible to most people and merely considered as interesting experiments (Lockwood, 2006). Currently however, there has been a major change in the way people think of green construction for a number of factors. One such factor is the financial advantages associated with green construction. Raw materials used in green construction have become

relatively cheaper than their "non-green" alternatives since they are now more widely available (Lockwood, 2006). In Ghana however, these green raw materials are available in smaller quantities but many people are not aware of the fact that they are sustainable green alternatives. These alternatives are considered as a widening stock of construction materials which are costly due to its low supply. In addition to that, some developers do their work as a result of lack of regulation thereof. This will benefit the developer since the costs incurred in purchasing the materials will be cheaper than traditional buildings.

A second factor is the creation of building-ratings and performance measurement systems, which has raised the need for green construction in the world (Lockwood, 2006). Building-ratings helps give a building an international recognition and boosts the reputation of the building or institutions involved. The development team could also be recommended for other kinds of green construction. These referrals sometimes end up as financial benefits for the developments firms. These ratings also give awards to owners of some buildings which will help increase awareness amongst developers in the world. One of such ratings is the Leadership in Energy and Environmental Design (LEED) in the U.S.A and Building Research Establishment's Environmental Assessment Method (BREEAM) which evaluates and analyses buildings in critical areas such as design and innovation (Dapaah et al., 2009).

In the 1990's the modern practice of green building began which led to the formation of the committee on the Environment within the American Institute of Architects (AIA). As such, many other green building movements were formed to increase growth and diversity in other countries but there has

not been any specific meaning for green building. This is because many people have different practices along which they define green building.

A few years later, the U.S Green Building Council and other organizations were founded; the most prominent federal green building project was the "greening of the White House" (Fischer, 2010). In May 2010, nineteen African countries (represented by builders and stakeholders), gathered in Nairobi Kenya, to commit themselves to promoting reduction in greenhouse gases as well as increasing environmentally friendly building practices (UN Habitat, 2011). This was done in order to promote green building practices in Africa as well as have green building councils.

Green Building councils were set up in different countries so as to develop and promote the use of local rating tools such as the LEED in the United States or the Green Star which measure or rate how friendly the environment is. According to the UN Habitat (2011), green building councils were to help advance greener building by sponsoring professional developments about such developments. In a news article by Matt Smith (2011), the writer confirms that the Empire State Building was awarded a gold certification after a retrofit model was created. This retrofit model reduced energy consumption by more than 38% and the improvements also reduced carbon emissions by 105,000 metric tons; thus, it was concluded that the building is a carbon-neutral building (Smith, 2011).

With this, such buildings gain international recognition which includes the development partners involved in its construction. This then gives them an upper hand over other building consultants since they are known for constructing sustainable buildings. This also increases the market value of the

companies involved in constructing these buildings because they would be sought after. These recognitions and awards raise awareness to the whole world which in turn increase green construction. In 2010, during the Green Building Rating conference in Africa, there were 20 fully established green building councils worldwide and another 40 in various stages of development (UN Habitat, 2011). Presently, Ghana has a Green building council which seeks to develop a building rating tool recognized and acceptable internationally (Ghana Green Building Council, 2010) .

According to Hoffman and Henn (2009), a structure is classified as a green building by encompassing strategies, techniques, and construction products that are less resource-intensive or pollution-producing than regular construction (Hoffman & Henn, 2009).

In Ghana, some conventional construction products used in construction include cement blocks or concrete, corrugated metal sheets, slates or asbestos while non-conventional materials include mud or mud bricks, thatch, palm leaves, bamboo and wood (UN-HABITAT, 2004). These conventional materials require higher amounts of energy for their production and in the maintenance of the buildings as well thus increasing greenhouse gas emissions. For example, producing a ton of cement, one ton of carbon dioxide releases into the atmosphere (Patnaikuni, 2009).

In producing one brick, 24.5MJ of energy is required, this emits 1.5kg of carbon dioxide. This over a 50-year life cycle of about 10% to 20% of total energy used is absorbed in initial construction (Patnaikuni, 2009). That is to say, constructing buildings with conventional materials can be very expensive and energy consuming as well as harmful to the environment. Raw materials used in

green construction on the other hand, are recycled products or renewable products which would not harm the environment.

2.3 Benefits of Green Buildings

The benefits of green buildings will be discussed along these lines; economic, social and environmental in the sub sections that follow.

2.3.1 Economic Benefits

Dapaah et al. (2009) argue that going green increases property value by "lower running costs and risk, gains in productivity and reduced construction cost and financial incentives" Wasiluk (2007) explains that, a sustainable commercial building has a competitive advantage over traditional commercial buildings because they attract higher profile tenants; dominate market rentals and capital values. Also, with the introduction of rating systems such as the LEED and BREAM, green buildings dictate premium through honours which gives the property that value. Thus a green building can be argued to have more value than traditional buildings due its ratings. Miller et al. (2008) concluded that Energy Star-rated buildings as well as LEED-certified buildings in the United States have a competitive advantage (in terms of occupancy level and attractiveness) over the non-rated buildings.

Secondly, energy efficiency in green buildings render increases in net operating income and capital value as well as lowering costs incurred in operations as compared to traditional buildings (Roper & Beard, 2006). With green buildings, although the cost of adopting such practices might be high, the end is beneficial. An example is the cross-ventilation method which incurs lower operational costs. But it will increase capital value since the building does not

wear out quickly hence increasing operating incomes of developers and property owners.

Thirdly, construction costs are reduced. Lucuik et al (2005) explain that savings through eradicating unnecessary items or economizing of systems through better systems balances increased costs which are as a result of more advanced systems. Hydes and Creech (2000) describe construction costs savings, as arising from taking advantage of the site's natural features such as sunlight and landscapes. An example is using the natural method of hardening or strengthening concrete: which is using rainwater as a means of making it hard rather than wetting the concrete manually. There have been concerns raised from the comparison of construction costs to the performance of the building.

Davis Langdon (2004) argued that construction costs of a sustainable building as opposed to traditional buildings tend to be on the same level or exceed it slightly. This is to say that there is no significant and or a slight difference between the traditional and green buildings. Thus, although green building construction costs are cheaper than traditional buildings, the performances of the buildings are fairly on the same level. Shiers (2000) argues that one cannot make any meaningful comparison with regard to construction costs because the performance of buildings can differ in age, design and functional characteristics. This therefore debates the link between construction costs and the performance of a building. In conclusion, the economic benefits green buildings give out are long run benefits and this reduces costs.

2.3.2 Social Benefits

According to Shiers (2000), green buildings provide healthier working environment as well as an improved indoor air quality which will help reduce

health safety risks to occupants from Sick Building Syndrome (SBS) and Legionnaires Disease. Fisk (2002) explains that the prevalence of respiratory symptoms associated with asthma are increased by 20% to 100% among occupants of houses with moisture. In effect Fisk (2002) implies that elimination of this moisture would diminish symptoms by 17% to 50% in these occupants. Thus the need to adopt green practices that will help reduce this moisture in a room.

Also, Paevere and Brown (2008) acknowledge that green buildings can be a source of employee benefit to attract and retain workers. This means that most of the workers employed in that firm will help boost the competitive advantage of the firm. Green Buildings create the avenue for workers to work well under healthy and hygienic conditions. Turban and Greening (1996) stated that "scholars suggest that an applicant's initial attraction to a firm is based on perceptions of the firm's image, which is believed to be subjective by the firm's corporate social performance". An example is where companies like IBM, General Motors amongst others send out brochures to prospective applicants thus promoting the firm's philanthropic and environmental programs (Dapaah, Hiang, & Yen, 2009). It influences a person's perception about a particular company once the firm incorporates green designs.

In addition, improved health and productivity in green buildings cannot be quantified thus there is no certainty (Roper & Beard, 2006). This therefore makes it difficult to measure and define what a buildings performance and sustainability is. Consumers do not have a clear understanding as to what constitutes a Green Building thus making it difficult to quantify and measure. To conclude, green buildings help to improve the working environment which leads

to an increase in productivity from workers. This stresses the fact that green buildings provides user or occupants of this building a healthy working environment leading to increase in productivity.

2.3.3 Environmental Benefits

The real estate or building sector as mentioned in Section 1.0 is a major contributor to greenhouse gases. The use of natural resources will help reduce energy consumption and improve environmental quality. Roper and Beard (2006) explain that proper management and rational use of natural resources will help save the scarce resources we have thus reducing energy consumption and improving quality of the environment.

Adopting green buildings help the environment by conserving the scarce resources in the world. This, in the long run, preserves the natural renewable resources. To conclude, the benefits associated with green design will be beneficial in the long run although it might be costly in its construction. Therefore adopting green construction will help reduce carbon emissions in the sky and also save scarce resources.

2.4 Green Design

Green design, also known as sustainable design or environmental design, is the concept of construction built with principles of economic, social, and ecological sustainability (Brumback, 2010). With the fast growing real estate industry in Ghana, there is the need to practise and adopt green design, with the aim of reducing greenhouse emissions from building operations. There is the need to distinguish green design from just using natural resources such as wood and clay for construction but rather emphasizing on healthy resource recycling.

Hence it is not just the minimal extraction of natural resources in a way that is harmless to the environment and living things.

According to Fullerton and Wu (1998), the U.S. Office of Technology Assessment defines green design as a 'process in which environmental attributes are treated as design objectives'. The purpose is to reduce pollution as well as avoid waste.

2.5 Green Rating Systems

There has been the introduction of worldwide rating systems such as Building Research Establishment Assessment Method (BREAM) from the United Kingdom, the Leadership in Energy and Environmental Design (LEED) in the United States and the Green Globes and Green Mark in Singapore. The introduction of rating systems has helped to promote sustainability of Real Estate Development among countries in the world as well as encouraging green building. Green buildings or designs can be used interchangeably with sustainability to mean the same thing. "These rating systems, with virtually similar objectives, are pushing the green agenda by encouraging environmentally and socially responsible building practices, and distinguishing between sustainable real estate and conventional properties by awarding 'badges' for buildings' different degrees of 'green' (Dapaah, Hiang, & Yen, 2009)."

In addition, the evolution of these ratings has helped develop a consistent pattern on how buildings can be measured (Jackson, 2010). The flaw with these rating systems is the fact that there is no consensus on the relative weights of the various categories. Therefore it does not fulfill the purpose of it being able to promote environmentally friendly buildings (Jackson, 2010). This means that the different green rating systems have different values for each of the categories

that have been outlined. In effect, different countries would have different weights for their buildings thus making it difficult to be used in other regions.

2.6 Building Research Establishment's Environmental Assessment Method (BREEAM)

It is an environmentally sustainable assessment method used in rating buildings in the world (Breglobal, 2008). It is the world's leading assessment method which is widely used with over 115,000 buildings certified and nearly 700,000 registered (Breglobal, 2008). It measures environmental performance in nine areas; management, health and well-being, energy, transport, water, material, waste, land use and ecology, pollution. Each area is graded after which they are all added to get one grade. The overall score is on a scale of Pass, Good, Very Good, Excellent and Outstanding. Their aim is to alleviate the impact of buildings on the environment as well as recognising buildings which are environmentally sustainable and friendly (Breglobal, 2008).

The following sub-sections describes what the BREEAM standard categories expects in a building. It will look at how to evaluate designs within the subsection.

2.6.1 Management

This section recognises and encourages construction sites which are managed in an environmentally friendly manner in terms of resource use, energy consumption and pollution. It also looks at the provisions made for new users so they can understand and operate in an efficient manner. Management section looks at how policies have been co-ordinated to ensure optimum performance under occupancy conditions.

2.6.2 Health and Well-being

This section recognises and encourages a healthy environment within the rooms in Ashesi University College through the installation of appropriate ventilation, equipment and finishes. This looks at how well the rooms in the building are ventilated such as cross ventilation as opposed to air-conditioners. It also looks at how appropriate thermal comfort designs have been put in place to maintain comfort in the rooms as well as the requirements for sound insulation in the building. Also, the health and well-being section looks at the designs put in place for safety measures as well as reducing risks in the use of the building.

2.6.3 Energy

Discussed under this sub-theme are the various ways through which energy is conserved within the university campus. It addresses efficiency related issues and touch on how energy is managed as well as alternatives put in place. This considers other sources of energy aside hydro-electric power. It looks at:

- The alternatives put in place with respect to energy efficiency.
- Minimal energy usage or consumption as well as reduction in carbon dioxide gases.
- Usage of energy-efficient light fittings, equipment and refrigeration systems.
- Installation of sub-meters which allows to measure and monitor energy consumption.

2.6.4 Transport

Transport looks at how well the building is situated close to public transport networks, local amenities, and alternative means of transport to the building other than a private car. Also, transportation looks at the provision of cyclist

facilities which reduces the use of cars emitting harmful gases. The range of travel options for users of the building so as to reduce reliance on environmentally harmful forms of travel.

2.6.5 Water management

Water management looks at how water consumption can be monitored and consumed efficiently, as well as detection equipment for leakages to save potable water. The main aim is to reduce the use of potable water for sanitary use in buildings while increasing the use of water efficient components and recycling systems. It looks at the ways in which water can be managed so as to reduce the cost; that is both rain water and on-site water. Water efficiency or management could be in the form of rain water harvesting as well as the management of waste water. The measures that have been put in place to solve problems is also addressed.

2.6.6 Materials

Materials category looks at materials used in construction that has a low environmental impact throughout the buildings' existence. It addresses the lifecycle of the materials used and if they are within the required specifications. Materials section evaluates how an exposed part of the building is protected so it need not be replaced frequently.

2.6.7 Waste

Waste management checks how efficiently and effectively waste is reduced so as to protect the environment. Under waste, the rating system considers how recycling has been incorporated into the buildings waste disposal process. It also looks at the storage facilities for the waste generated in the buildings and how it is managed to prevent environmental pollution.

2.6.8 Land use and Ecology

It looks at the effective use of land and how it affects the environment. Land use encourages the use of previously developed land rather than virgin lands so as to protect ecological features during site preparations. It recognises the efforts made to maintain and enhance the sites' ecological value in the long term.

2.6.9 Pollution

Pollution seeks to check the amount of greenhouse gases emitted from refrigerants from the building. Also pollution looks at how to reduce the disposal of rain water to public watercourses which minimises flooding and other environmental damages. Pollution will ensure that the external lighting is put in the right place in order to reduce energy consumption and light pollution. Pollution will seek to know how the different forms of pollution is being managed by the building efficiently.

2.7 Elements of BREEAM Rating

There are four elements used in determining the BREEAM rating. It includes the BREEAM rating benchmarks, BREEAM environmental weightings, minimum BREEAM standards and BREEAM credits for innovation.

2.7.1 BREEAM Rating Benchmarks

The BREEAM rating benchmarks are categorized under different sections such as new buildings, major refurbishments and fit-out projects. The 2008 BREEAM rating benchmarks is as captured in the table below.

Table 2.1: BREEAM rating benchmarks

BREEAM Rating	PERCENTAGE SCORE
UNCLASSIFIED	<30

PASS	≥30
GOOD	≥45
VERY GOOD	≥55
EXCELLENT	≥70
OUTSTANDING*	≥85

Source: BRE Global 2008

2.7.2 BREEAM Environmental Weightings

BREEAM ratings have been divided nine different categories. These categories include; management, health and wellbeing, energy, transport, water, materials, waste, land use and ecology and pollution. Each one of them has a credit weight assigned to it based on the type of building.

Table 2.2BREEAM 2008 Environmental Weightings

Categories	**Credit Weightings**
Management	12
Health and Wellbeing	15
Energy	19
Transport	8
Water	6
Materials	12.5
Waste	7.5
Land Use & Ecology	10
Pollution	10

Source: BRE Global 2008

2.7.3 Minimum BREEAM Standards

In order to achieve a BREEAM rating, the minimum percentage score required in that particular category must be achieved (Breglobal, 2008). The minimum standard, which is the number of credits attainable in each category, must be complied with as well.

2.7.4 BREEAM credits for Innovation

This is a special rating developed to provide additional recognition for a building. This innovation category recognises a sustainable performance beyond the level that is currently being recognised. It gives an additional one percentage (1%) score to such buildings in the respective categories. The maximum number of credits allocated is 10.

To conclude, building ratings if developed will help protect the environment as well as introduce the construction of green buildings and designs. The main aim now is to decide on a common measurement tool which will make a green building standardized everywhere in the world. This will help countries grade each building based on the requirements and measurements of the laws.

"Green preservation can and should be an ideal protocol for the continuous use, enjoyment, and improvement of historic and older homes as well as an important protocol for green stewardship of houses, neighbourhoods, and planets" (Jackson, 2010).

Chapter 3

Methodology

This chapter focuses on the methods employed in the study as well as the instruments used in gathering the information. It describes the population and procedures used in investigating how Ashesi University College incorporated green design in its structures. It outlined the research strategy, design strategy, sampling strategy and the methods or procedures.

3.1 Research Strategy

The research strategy used was exploratory research. In research there are different kinds of research strategies; explanatory, descriptive and exploratory (Blanche, Durrheim, & Painter, 2006). An exploratory research helps one to learn more about a problem in order to gain a definite understanding of it (McKenzie & Danforth, 2009). Explanatory research seeks to build theories that explain and predict natural and social events (McNabb, 2008). It usually explains a cause and effect relationship between two or more variables (McNabb, 2008).

Descriptive research describes a phenomena accurately which can be done through a narrative description (Blanche, Durrheim, & Painter, 2006). Exploratory research was used because it is best for finding out about green designs and the designs Ashesi University has incorporated. This will be done through experience surveys and secondary data analysis.

3.2 Research Approach

Out of the two kinds of research approaches, quantitative and qualitative; this study took a qualitative study. The use of a case study and its narrowing on

a single sample in the form of Ashesi University College informs this approach. Qualitative research focuses on exploring in as much detail as possible, thus aiming for depth rather than breadth (Hughes, 2006).

Qualitative research helps the researcher get an in-depth understanding of a particular problem or information. Thus, the study gained an understanding of the particular designs Ashesi used and the underlying reasons and motivations. It does not involve the use of numeric but rather to understand a particular phenomenon hence making the researcher part of the research process and also very dynamic (Key, 1997).

Another reason why qualitative research will be preferred over the quantitative research is that, quantitative research seeks to find a precise or exact measurement while qualitative is subjective using the researcher's interpretation of results. In addition, qualitative seeks to find reasons for a particular situation while as opposed to quantitative which deals with statistics. Also, Qualitative research looks for interpretation of certain ideas or results and not précised measurements. This study sought to find reasons about a particular situation hence was not interested in the numerical values but its subjectivity.

The qualitative research will know the green designs Ashesi University College has adopted and the reasons for adopting those particular designs.

3.3 Research Design

The research was structured as a case study on Ashesi University College. "Case studies are detailed investigations of individuals, groups, institutions or other social units (Key, 1997)". An advantage of using a case study is that it generates empirical data and information, while a disadvantage is that it cannot be generalized for a wider population. This particular case study provided a

detailed exploration of green designs practised at Ashesi University College, Berekuso.

3.4 Research Methods

The research methods employed were surveys and secondary data analysis. Surveys in the form of observations and interviews were used in the study. Experience surveys in the form of interviews will involve talking to individuals with knowledge or insight about the problem (McKenzie & Danforth, 2009). These individuals are mainly the development partners who understand what went into the designs, as well as industry's best practices.

In accordance with this, experience surveys were used to find out first-hand information from developers and the partners of Ashesi University on how green design was incorporated into the development process. The development partners play a major role in how Ashesi University College incorporated green design. Development partners include the developer or the idea generator and the team members who help the developer in making his idea a reality. The team included architects, the structural engineers, the mechanical and electrical engineers and the developers.

The interviews were semi-structured in nature and the guide used is contained in Appendix 1 - 5 of this report. Interviews are mainly to help find out what people think about a particular problem or situation. There are three types of interviews; structured, semi-structured and unstructured interviews. Structured interviews on the other hand, follow a particular pattern (Britten, 1995). The unstructured interviews are also ones that do not follow a particular pattern but questions evolve during the interview process.

"Semi structured interviews are conducted on the basis of a loose structure consisting of open ended questions that define the area to be explored, at least initially, and from which the interviewer or interviewee may diverge in order to pursue an idea in more detail" (Britten, 1995). Semi-structured interviews were employed because they allow for other questions to emerge in the course of the interview.

The interviews were face-to-face conducted with members of the development team beginning with the architect and developer who will recommend other members of the development team to be interviewed. This is known as the snowball technique. The face-to-face interviews helped confirm what had been observed. Some interview questions addressed the green designs Ashesi University College had employed in its buildings, the reasons for adopting such designs and to find out if the designs they adopted were considered green.

Participant observation was also carried out in collecting primary data for this research. Observation is a method where the researcher observes a particular situation within a particular time (Trochim, The Research Methods Knowledge Base, 2006). This will form the descriptive part of the study as and will be communicated using pictures and diagrams. The observations supplemented the interview findings.

In meeting the study's third objective, which is to use the BREEAM rating system to rate Ashesi University, secondary data analysis will be considered. The BREEAM was chosen because; most of the buildings in Ghana use the British standard, and it has a British origin.

3.5 Sampling Strategy

The sampling techniques used in a research are probability sampling and non-probability sampling methods. Probability sampling involves the use of random samples; which assure that the different units in a population have an equal chance of selection (Trochim, The Research Methods Knowledge Base, 2006). Non-probability sampling does not involve random selection and does not necessarily mean the population was not represented well as compared to the probability sampling method (Trochim, The Research Methods Knowledge Base, 2006). Non-probability sampling was used in the study. Also as compared to probability sampling, non-probability sampling selection is much easier to use.

Under non-probability sampling, there are six main types: haphazard, quota, purposive, snowball, deviant case and sequential samples. The snowball sampling technique was adopted for this study. "It is a method for identifying and sampling the cases in a network which begins with a few people or cases and spreads out on the basis of links to the initial cases" (Neuman, 2007). The snowball sampling will help recommend other experts in the field of study. The two main people the interview covered was the architect and the developers after which they recommended other people.

The population for this study will be the development partners. The development partners include the architect, engineers, contractors, developer amongst others who were involved in the development process from inception to management after construction. The snowball sampling helped determine the sample population by selecting individuals required for the study which represented the population. The sample population will aid in answering the research questions and objectives.

3.6 Operational Definition of Variables

This study will be looking at concepts such as green design and construction and how it affects the real estate development process. It looked at the definitions and meanings of concepts pertaining to the study. These variables are the main areas the study explored.

3.6.1 Green design or sustainable design

It is the use of environmentally friendly materials or designs in constructing a building. Under green design the study will look at sustainable architecture. Sustainable architecture tries to reduce environmental impacts during construction as well as production of materials as well as after construction. Under this there is alternative energy such as solar energy, rain water harvesting for washing, and ventilation. The study will look at these three main aspects of green designs.

3.6.2 Ashesi University College

A special purpose building specifically an educational facility which represents a modern university campus constructed on the outskirts of Accra, Berekuso.

Chapter 4

Data Analysis and Discussion

The data analysis and discussion section presented findings from the research conducted. The data analysis method used was content analysis. Content analysis is "any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings" (Patton, 2002). It described what had been observed and presented interviews conducted. This was represented in pictures to communicate relevant information. Thus helped in the analysis of the findings and answering of the research objectives and questions.

4.1 About Ashesi

Ashesi University is a liberal arts college that has currently moved to its permanent campus at Berekuso. The school is situated on the hill of Berekuso with beautiful scenery. Ashesi began on 4th March 2002 with a student population of 30 offering a four year bachelor degree program in Business Administration, Computer Science and Management Information Systems. Ashesi University College promotes critical thinking and ethical behaviour and this is embedded in their mission and vision statements.

The **mission** of Ashesi University is *to educate a new generation of ethical, entrepreneurial leaders in Africa; to cultivate within our students the critical thinking skills, the concern for others, and the courage it will take to transform their continent*. The **vision** of Ashesi University: *An African Renaissance driven by a new generation of ethical entrepreneurial leaders*. Such

a high standard set by the University challenged its leadership to construct an organization that matches the innovations and characteristics it hopes to potray.

4.2 The Development/Property

Ashesi's development is located in the eastern region of Ghana, specifically Berekuso. This structure was completed after eighteen months of commencement and its structures make the property unique. The university has five lecture halls, a library, faculty and staff offices, two computer science laboratories and a housing facility which houses about 300 students.

4.3 Structures and Designs in Ashesi University College

The purpose for the structures and designs at Ashesi was influenced by the climate and weather in the locality, Berekuso in the Eastern Region of Ghana. The school is located in a tropical area where there is a heavy rainfall pattern, resulting in a non-reliance on air-conditioners. The philosophy of Ashesi was to make sure the buildings fit into the environment; a good example is the stones on the walls that were gotten on site before construction. Instead of disposing off the stones that were obtained from the landscape, Ashesi incorporated it into the building thus recycling the natural resource that would have destroyed the bare land wherever it was dumped.

Figure 4.1 The stones incorporated into the walls.

The architect, in an interview, explained the structure as a natural balance facility because, the artisanship in the area was not good hence used the stone as a fading to protect the building from rain splashing. This however adds to the aesthetic requirements of the buildings. According to the architect, the choice of plants was aimed at fitting into the general environment and natural landscape of the area.

Figure 4.3 The plants and flowers adopted

Figure 4.4 The landscape of the School.

The use of greenery gives a good carbon dioxide and oxygen balance which is aesthetic and calming. The colour and texture of the roofs was also chosen because of the inevitable algae that will grow which serves as a covering. The roofs have wider eaves than normal for shade and to enhance the important part of the design. This is also aimed at aiding rain water harvesting. The rain catchment area includes eaves all around each of the buildings. Not only do the wider eaves prevent rain from hitting the wall directly and save re-painting during the raining, but feeds the underground tank which is about 50,000 litres.

Figure 4.5 The wider roof eaves and pipes

It can be concluded that Ashesi University is mindful of its environment because most of the designs were aimed at defining and enhancing the site and location of the school.

Ashesi adopted the courtyard system or the 'village concept' existing in Ghana. The courtyard system is large space surrounded by different houses in a rectangular shape and it depicts a form of belongingness. One of Ashesi's developers identified it as being a purely cultural decision because the courtyard system shows a sign of communal living and belongingness and these form part

of Ashesi University's culture. It also emphasizes the concern for others (as well as each other's property) embedded in Ashesi's mission.

From the findings above, it can be concluded that the area in which the school is situated, the environment and the developers' ideas on going green, influenced its designs.

Figure 4.6 Ashesi University's Courtyard System

4.4 Health and Well-being in the Lecture Halls and Dormitories

Observations conducted for this research, demonstrated that, Ashesi University adopted green design in its structures. One method of green design adopted was cross or natural ventilation. This is a method "where air is supplied and vented through operable window" (Diamond, Feustel, & Matson, 1996).

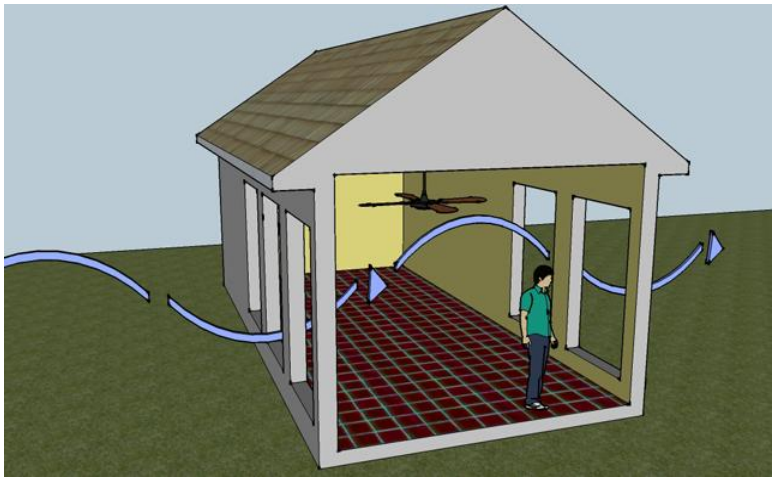

Figure 4.7 Cross-Ventilation Picture

Source: http://ecohomeresource.com/images/cross-ventilation.jpg

The illustration above, the concept of cross-ventilation and how it works in a building is demonstrated. This method makes air circulation in the room efficient and comfortable for inhabitants. In Ashesi's lecture halls and dormitories, the cross-ventilation method has been adopted. The dormitories have two sets of windows in opposite directions. This means that air comes in from one side and leaves through the other making rooms airier. This is illustrated in Figure 4.8 below. This picture illustrates the cross-ventilation concept. The air comes in from one side and leaves through the other window. Figure 4.9 also shows the vertical cross ventilation, this is where the windows or air inlets and outlets are directly opposite. All these are methods of cross-ventilation which was adopted in the University.

Figure 4.8 Cross ventilation in the dormitories

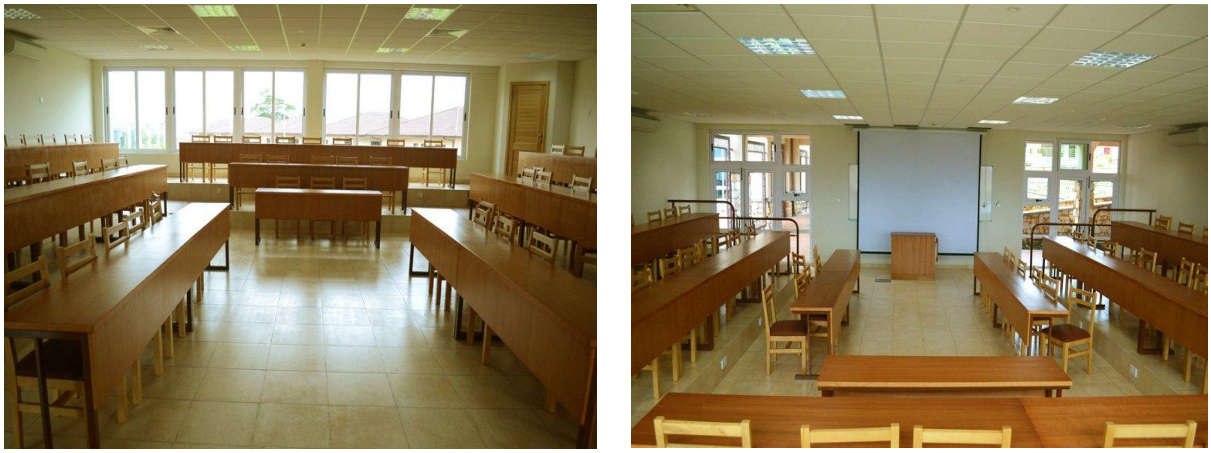

Figure 4.9 Cross-ventilation in the lecture halls

According to the interviews, the main reason for such a design in the dormitories and lecture halls was for air-circulation or ventilation thus less use of air-conditioners. In addition, Ashesi took advantage of the environment and adopted these designs. Air-conditioners were installed in the event of high temperatures.

4.4.1 Energy usage

Ashesi has tried to minimize the use of artificial lighting so as to save energy. It has done so by maximizing the amount of natural lighting and

minimizing artificial lighting. This meant that natural lighting is used during the day and then artificial lights during the night which helps save energy. In addition, reliance on unstable electric power from the main grid is minimized, driving costs lower.

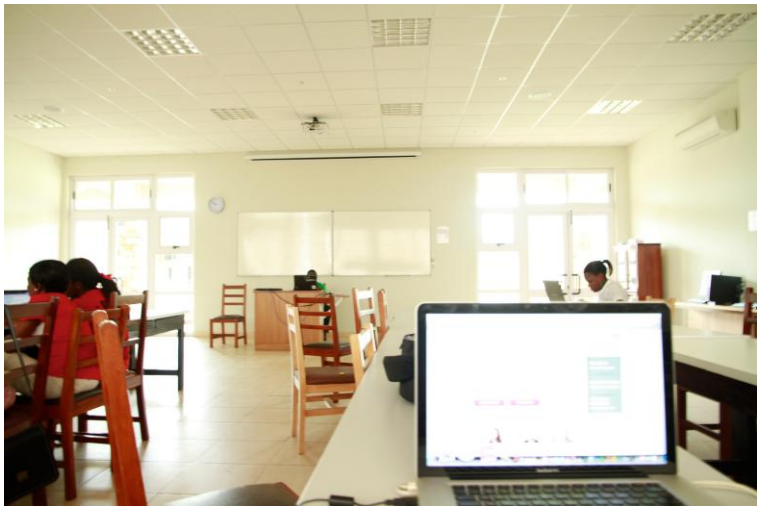

Figure 4.10 Use of Natural Lighting in Rooms

4.4.2 Fire Safety

Ashesi has three main fire safety methods; detection, suppression and fighting. Detection is where an electrical equipment is installed to detect fire. Suppression on the other hand, is a way in which fire is suppressed to prevent spreading. Fighting fire are the methods used in fighting fire, which has been put in place for both experts and non-experts. The most important and desirable are hose reels which have been installed at various points for untrained individuals to fight small fires and heavier hydrant systems for experts. To do that, Ashesi has a dedicated pump and water tank for firefighting and this is from the untreated rain water. Nonetheless, not all fires can be subdued with water and in accordance with BREEAM standards, other methods were needed.

Figure 4.11 Fire extinguishers and hose reels provided at various points

The detection equipment used in included lightning arresters and earthed electrical equipment's. Lightning arresters have been installed on all the buildings to prevent lightning strikes. Also, all electrical equipment's have been earthed into the ground to prevent any human or material contact.

With suppression of fire, Ashesi's engineers have installed fire suppression equipment which created a positive pressure in the building to suppress the spread of fire. Ashesi has installed fire extinguishers that aid in fighting small and large fires which is the carbon dioxide and dry powder extinguishers. The source of fire could be different hence the different extinguishers. Some sources of fires include electrical faults, paper or wood. However, the carbon dioxide fire extinguisher cannot be used if there are people around hence alternative dry powder extinguishers.

Ashesi University has a two-storey structure for its residence halls. This was adopted for safety measures. Anything above a two-storey structure will mean, in an emergency people will find it difficult to get to the ground floor.

4.5 Legal Requirements

The interview responses showed that Ashesi did not employ such designs because of some regulations they had to follow except for the residence halls. There were no legal requirements by the government or lands commissions but rather it was because the developers wanted to adopt such designs. With energy, Ashesi uses the British standard and the IEE regulations in its designs. It was a requirement by the International Finance Corporation (IFC) as part of fulfilling their loan requirements, for Ashesi to construct a two-storey structure in the residence halls. To go beyond the two-storey structure meant the University needed to install automatic sprinkler systems instead of the hose reels for fire-fighting.

4.6 Management Policies

Ashesi University has a maintenance protocol that is being followed and the operations department in the school heads this. Maintenance schedules for the building, generators, treatment plants, offices and lecture halls have been put in place. The Environmental Impact Assessment Report; which gives details about environmental conservation is being used. The operations department sees to it that the policies under water, energy and materials usage are managed efficiently and effectively. Ashesi is required by the International Finance Corporation (IFC) to submit a policy book as part of their loan conditions to build the dormitories. This policy book shows how Ashesi intends to manage the physical environment and the community of Berekuso.

4.7 Green Designs

4.7.1 Waste Management

Through observations conducted, it was realized that, Ashesi University has adopted a good waste management system. The waste management systems include the biogas system, the recycling of waste water and recycling of rubbish. The waste water is in two parts; black water and grey water. The black water comes from urine and faecal waste which is used for our biogas system. Grey water on the other hand, is generated from domestic activities such as washing and bathing which is recycled for irrigation purposes. The grey water is easier to recycle and less harmful to the environment as compared to the black water. This is because the grey water contains less contaminant as against the black water. It is also not safe for drinking or cooking hence its restricted use for irrigation.

The black water is very difficult to recycle because of the amount of pathogens it contains. In recycling black water, it produces a harmful gas known as methane gas. This gas in the bio-gas system is trapped and collected for cooking purposes. This system helps to reduce the impact of these gases on global warming. The trash or rubbish generated in the school is also congregated in collection for recycling. They are grouped in categories such as plastic waste, paper waste and organic waste (the degradable materials). The paper and plastic are recyclable which helps preserve the environment and can be re-used. Organic waste is biodegradable hence it can be used as manure for the plants. This helped to reduce the litter.

4.7.2 Water Management

Generally water is important for habitation wherever it is and water is gotten from all kinds of sources like boreholes, rainwater, rivers, lakes and the water works (Brouwer, Hoevenaars, & Bosch, 1992). Ashesi is situated in a remote area where water from the water works is not available thus there was a need to identify other alternatives. One alternative was to do underground water harvesting which is referred to as the borehole system. The water gotten from the borehole is not treated water hence cannot be used for cooking and drinking and during the dry season the water could dry out. The borehole water did not meet World Health Organisation (W.H.O.) requirements in terms of certain parameters so Ashesi had to find another alternative.

The school thus resorted to a more portable water treatment plant to treat this water to meet the requirements of W.H.O. The school thence adapted rainwater harvesting in which the architect used the slope in the topography of the area. Huge tanks were placed at the lower side of the slope to store the rainwater. These tanks can be found underneath the hostel and the administration block. There are four underground tanks located at block B of the student hostel. Each tank's capacity is about 47,430 litres which totals 189,720 litres available for the hostel. There is also an underground tank underneath the administration block with a capacity of 50,000 litres.

Unplasticized Polyvinylchloride (UPVC) pipes are largely used for water and waste but there are different classifications (C, D, B, O) depending on the pressure or volume of flow of the water.

Figure 4.12 UPVC Pipes

Source: http://www.narmadapipes.com/images/pvc_ring_fit.gif

The mechanical engineer identified these types of pipes to be resistant to almost all types of corrosion, either chemical or electrochemical in nature. The HDPE pipes are used for pumping water into tanks. The rainwater is collected through HDPE pipes and stored in the reservoir underneath the buildings. It is then treated for cooking and sanitary purposes. After, it is pumped back into the treatment tanks, then the water is fed to the buildings by gravity.

Also, there has been a significant amount of investment in the landscape and buildings so there is the need to take care of them. The plants which add to the look of the place needs water in order to survive hence the waste water generated is recycled to water the plants instead of using the clean water for such purposes. This design was also adopted to take care of the plants and garden during the dry season when there is shortage of water.

The school has installed water meters at various points to regulate the amount of water being used. The total amount of water used by a person in a day is 90metres or 20 gallons of water. For the hostel the total population of students is about 300 hence a total of 6000 gallons (approximately 27,277

litres) is consumed in a day. If the meter goes above this threshold then it means water is being used excessively and or wasted hence a need for it to be checked. The best time, according to the mechanical engineer, for such a cause to be investigated is at night when less water is used.

Also, the sanitary appliances installed have a dual flashing system; this system has two knobs. One uses less and the other more water in flushing the toilet, hence a particular knob will be used based on the amount of water required to be able to flush the content. The knob that uses less water is used in flushing urine while the other is used for faecal purposes. The toilet bowls have also been designed in such a way that it flushes very quickly hence a gallon of water can be used to flash for faecal purposes as opposed to the regular two gallons in some regular water closet systems. This is an efficient flashing systems aimed at controlling the use of water.

Ashesi has adopted these designs as a way of efficiently using water, which is a natural resource and a way of preserving and conserving water. Below is an illustration of the dual flush system and the smaller toilet bowls Ashesi has incorporated.

Figure 4.13 The dual flush system and the smaller toilet bowls

Source: http://rvanburen.files.wordpress.com/2010/07/denton_dual_flush.jpg

4.7.3 Energy Conservation

In terms of energy conservation, Ashesi has been able to manage its energy quite efficiently. It has put in place mechanisms, which aids in managing energy efficiently. A dedicated transformer of 500 Kilovolts Amperes (KVA), switch, panel boards and distribution boards (to feed the computers and UPS) have been installed at multiple sections in the building to improve flow of energy. The transformer is used step the high voltage received from the national down to an amount usable. A total percentage of 30 of the 500KVA (150 KVA) is used by the school which was revealed through the loads analysis test done. The generator is an interface between power supply and load. Ashesi currently has 3 generators with total kilovolts amperes of 300 for the whole school. The hostel has 80KVA, 100KVA for parts of the administration and the remaining 120 for the lecture halls and other parts of the administration block.

In an interview with the electrical engineer, Ashesi used armoured cables in its wiring. An armoured cable is "an electrical cable formed from aluminium or steel alloys with a thin strip of metal being formed into a spiral with an overlap between each strip" (Fortin & Marois, 1995) The armoured cables range between $1.5mm^2$ to $240mm^2$, the $1.5mm^2$ used for lighting fixtures, $2.5mm^2$ used for the sockets, $4mm^2$ used in wiring air conditioners, $16mm^2$ from the distribution boards to the panel boards (depending on the length), and the 70, 120 and $240mm^2$ used for the panel board depending on the load screen for each board.

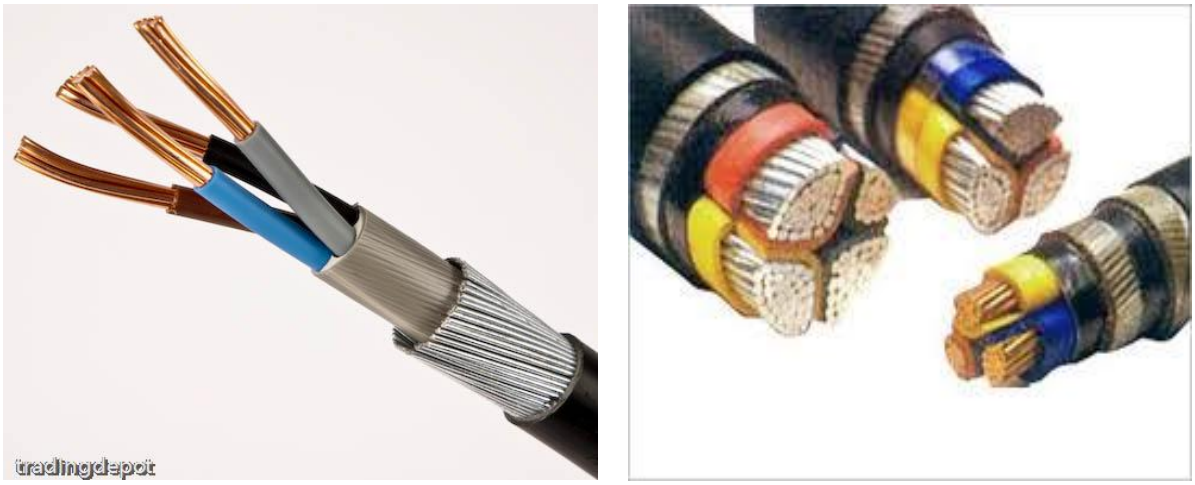

Figure 4.14 The Armoured cables

Source: http://4.bp.blogspot.com/-IGNTK1udPoc/TjFifKtR7KI/AAAAAAAAACI/-8Y1YpLkcQs/s1600/Armoured-Cables.jpg /

These form part of the British and Institute of Electrical and Electronics Engineers (IEEE) requirements.

For the lighting system, Ashesi has ensured that most of the areas (the lecture halls, libraries and residence halls) were given compact fluorescent lights. Compact Fluorescent Lights (CFL) are considered green among many of the worldwide ratings because they contain less mercury than traditional bulbs, tend to last ten times longer and use one-fourth the energy of traditional bulbs (U.S Department of Energy, 2012). Also, the design of the rooms or lecture halls does not require artificial lighting during the day helps conserve energy.

In each lecture hall, there are about 20 square lights and in each square there are 4 different bulbs each carrying 18 watts of power. The lecture halls have been zoned into 3 different zones which is switched on separately. Thus it was done in such a way that light switches on the periphery of the room were on a separate switch. They are turned as and when it was needed thus the lights at

the periphery of the room are switched on as you move along. Twin sockets (2 plugs) have been provided in each lecture hall with each one having 300 watts. The school uses a demand factor of 0.5 which gives each a total load of 600 watts which is not fully consumed.

In the hostels however, there are two rectangular fluorescent with each having two bulbs. Each of the bulb produces 36 watts so in the rectangular fluorescent it uses a total of 72 watts hence the room uses a total of 144 watts per person. It has four twin sockets each carrying 300 watts. The offices have also been provided with additional sockets to make provisions for fridges and other gadgets. A data and telephone port has also been provided.

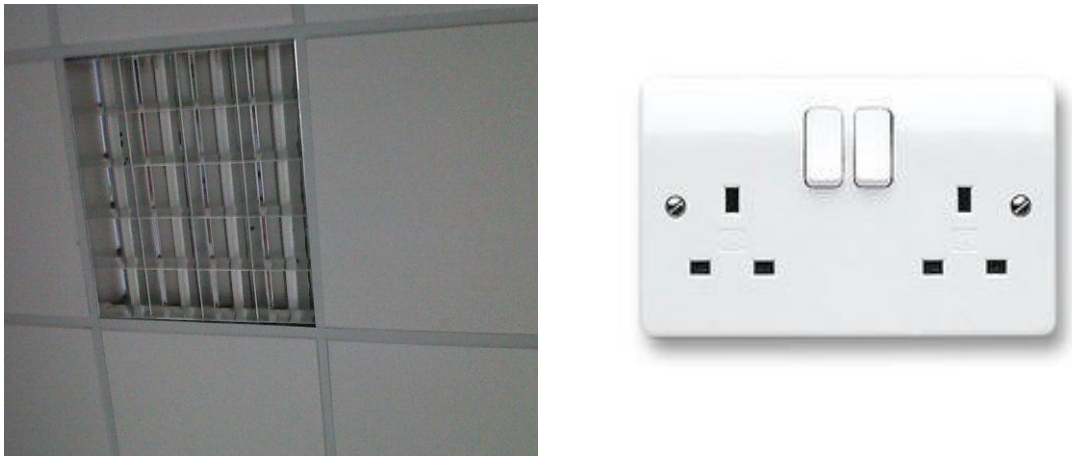

Figure 4.15 The fluorescent bulbs and twin sockets

Source: http://jstechnical.co.uk/images/twin%20socket.jpg

Currently, Ashesi has no alternate energy sources but there might be plans to adopt other alternatives in the future.

Alternatives considered include solar energy, which could help support the lighting systems like heating water, power computers, run a server room or even keep the Internet running. Solar energy can be applied to general tasks such as

heating; cooling and generation of electricity and these tasks consume a lot of energy (Brown, 1988). In heating, solar energy is considered good for heating water and rooms while cooling is more expensive because it requires a lot more energy (Brown, 1988).

Solar energy can also generate electricity for usage and this is known as Photovoltaic cells (Brown, 1988). "Photovoltaic cells, by their very nature, convert radiation to electricity and the maximum theoretical efficiency for a photovoltaic cell is only 32.3%3" (Brown, 1988). With this efficiency, electricity generated is very economical while other forms of electricity generation are at a lower efficiency than this (Brown, 1988). Among the renewable resources, only solar power has the potential to supply adequate energy.

Another option that was considered was the use of wind in generating energy but this required a certain amount of speed to generate energy. A wind gauge or anemometer is used to measure the speed of wind hence the faster the wind blows, the faster the shaft spins to generate energy (The Need project, 2011). Wind energy cannot be used if the speed of wind is too low in that area hence it does not generate enough energy.

The university adopted photocell to power its external lights like the security lights. The security lights are either automatic, night sensors or manually set by day. This is another way of conserving energy. There is also a manual override just in case something happens and it has to be turned off. These are the energy saving methods which Ashesi University has adopted in its designs and these designs are considered green.

4.7.4 Materials and Land Usage

Most of the materials used in Ashesi are cement based. Concrete, a mixture of sand, stone and cement and iron rods, is the dominant material. This particular building material was used because of the cultural orientation of Ghanaians with respect to the preferred choice of building materials for construction. In Ghana, most buildings are constructed using either sandcrete (which is a mixture of sand and cement), blocks and concrete while in other parts of the world there is the use of bricks and steel. Also plastics were used in the manufacture of the roof cladding hence can be recycled easily.

The pipes used in plumbing works are the UPBC pipes and they are largely used for water passage and waste passage such as the grey water. In selecting pipes for fire fighting purposes, steel pipes were selected for those above ground level. The purpose was to prevent them from melting in case there is a fire outbreak. Copper pipes were used for smaller irrigation systems. The most important thing is that, the type of pipe used should be able to withstand the pressure it is receiving.

Super Multi split air-conditioners were used. A super multi-type air conditioning system is one that has 'multiple' evaporator units (fan coils) connected to one external condensing unit (Bhatia). Both the indoor and outdoor units are connected through copper tubing and electrical cabling and the indoor part (evaporator), pulls heat out from the surrounding air while the outdoor, condensing unit, transfers the heat into the environment (Bhatia).

Figure 4.16 The super multi split air-conditioner

Source:http://image.made-in-china.com/2f0j00fCsEvtPyZWkj/R1-Multi-Split-Air-Conditioner.jpg

This outdoor unit is connected to six indoor units, which reduces the gas it releases into the air as compared to what one outdoor unit to one indoor unit would have produced. The University is yet to introduce automatic motion sensors, which will switch lights and air-conditioners on and off automatically. Instead of turning off the indoor unit with a remote, there will be a sensor to detect when a person leaves and enters a room. These are economical designs regulating the use of energy.

4.8 Ashesi University College Rating

The BREEAM assessment rating method was used in rating Ashesi University. This was divided into nine categories; management, health & wellbeing, energy, transport, water, materials, waste, materials, waste, land use & ecology and pollution. Each section had a minimum amount of credits for grading. Some of the sections had higher credits than others; management had the highest number with 22 credits while waste had the least number of credits of 7. Ashesi had a final BREEAM score of **67.56%**, which is rated as a **Very**

Good. In Appendix 6, the various credits received under each of the nine categories have been provided. These credits was awarded on the basis of observations and interviews conducted, these were subjective to the researcher.

BREEAM Section	Credits Achieved	Credits Available	% of Credits Achieved	Section Weighting	Section Score
Management	5.00	22	22.73	0.12	2.73
Health and Wellbeing	10	10	100.00	0.15	15.00
Energy	16.5	30	55.00	0.19	10.45
Transport	8	9	88.89	0.08	7.11
Water	8	9	88.89	0.06	5.33
Materials	7.5	12	62.50	0.125	7.81
Waste	5	7	71.43	0.075	5.36
Land Use & Ecology	5	10	50.00	0.1	5.00
Pollution	7.5	13	57.69	0.1	5.77
Innovation	3	10	30.00	0.1	3.00
Total score					67.56
Final BREEAM Score					67.56
BREEAM Rating					Very Good

Table 4.14 Ashesi University College's BREEAM Rating

4.9 Conclusion

From the findings, it can be concluded that Ashesi has incorporated green designs in its structures and these include; cross-ventilation in lecture halls and dormitories, recycling of waste water, green landscape and efficient sanitary equipment's have been fixed. Ashesi was rated with the BREEAM rating in which it received a 67.56% that is considered a 'Very Good'.

Chapter 5

Summary, Conclusion and Recommendations

5.1 Introduction

This section summarises the research and makes recommendations and concludes based on findings from interview and available literature. Also, this section recommends good and affordable practices of green designs for Ashesi University College.

5.2 Summary of Findings

It was learned from the study that, Ashesi University had incorporated green designs which were mainly influenced by the developers' initial plan for the school. Many of the designs included simple structural elements like the cross ventilation in the lecture halls and residence halls, and the use of natural lighting rather than artificial lighting (which takes up more energy) or the use of energy-saving fluorescent bulbs.

The first specific objective of this research was to define what green design is, and the extent to which Ashesi pursued sustainable features via the review of existing literature. The findings showed that, basic green design used environmentally friendly designs and materials to enhance the beauty of the building and sustain the environment. These were the pivot features of Ashesi's design project hence future developments will have more depth to the whole campus.

The second objective identified the green designs incorporated by Ashesi on its campus at Berekuso. The green design variables, identified included,

rainwater harvesting, the use of energy-saving bulbs, designs that promote the use of natural lighting, cross ventilation amongst others.

The third objective was to rate Ashesi on an established rating system. The rating system used was the BREEAM by the British Building Council and this was chosen because of similarities in the Ghanaian building requirements. Ashesi when rated received a 67.56% which is described as Very Good. The main objective has been attained by confirming Ashesi's amalgamation of green designs and identified the kinds of green designs incorporated.

The findings also included conservation methods like rain water harvesting through wider eaves of the roofs which at the same time provide shade in the rooms. To even more complex designs like water treatment plants and biogas plants that encouraged minimal usage of energy and reduced dependence on the national grid. The obvious incorporations included specific plants and gardens that created a balance of carbon dioxide and oxygen. Recycling of waste water for irrigation and the efficient use of materials and resources can all be considered sustainable methods. Ashesi had a rating of 67.56% which under BREEAM is considered a 'Very Good'.

5.3 Recommendations

The fourth specific objective was to recommend possible measures that the University can employ in enhancing its existing designs and lessons for future developments. These recommendations will be grouped into short and long-term measures that can be adopted.

5.3.1 Short-term Measures

These recommendations can be used immediately to solve some design problems which are as a result of existing designs. Many of them are cost-effective and general measures that will support the main design objectives.

5.3.1.1 Education and awareness

The study revealed challenges with excessive use of utilities. Utilities in terms of electricity and water were mismanaged because there was little education or knowledge for users of the structures. Hence, there was the need for Ashesi to educate users about the various designs. Students and lecturers can raise blinds when the projector is not in use to bring more natural light into the rooms. In addition, when projectors are in use and the blinds are brought down, the lights should be turned off to conserve energy. Water usage was very high increasing utility bills hence defeating the purpose of green designs.

Seminars and demonstrations could be organised for users to get familiar with these designs which can reduce costs in the long term. One developer addressed the need for more education and environmental awareness. Apart from the informational benefits, it will also create a sense of ownership amongst users and donors of this project.

5.3.1.2 Sustainability Guidelines

The university can create a system that measures and quantifies the benefits associated with green design. This will help Ashesi in justifying further investments through its measurable objectives. The operations department in Ashesi University could create a book which lists guidelines on how to preserve and sustain the facility. This book will help the school carry out routine check-

ups and inspections to improve on its existing infrastructure. Also, there should be frequent updates of the guideline book once every semester to help improve it.

5.3.2 Long-term Recommendations

This looked at long-term recommendations for Ashesi University College. These recommendations will help address and solve long-term issues.

5.3.2.1 Additional renewable energy sources

Ashesi would also need to consider implementing additional renewable energy sources which could support their current energy. This could be solar energy generation sources to power lighting and heating systems which reduce energy usage. It will require a thorough evaluation of the best available technology that thrives in this part of the country and acquire the adequate funding for it. Also, it will mean looking for additional funding to install such capital intensive machines.

5.3.2.2 Partnerships

If Ashesi collects and measures its data well, it could also partner with Environmental Protection Agency, land administrators and even chiefs within this community to encourage green design. The University's campus model can help inform regulations to require green designs among developers before land is sold to prospective buyers and real estate developers. The university could also work hand in hand with state officials and state leaders like the Mayor to identify programs and funding opportunities for individuals and companies that adopt green designs when building.

5.3.2.3 Support Green Design Programs

Ashesi can incorporate green design as part of its design curriculum and also support existing public or private programs that are dedicated to going green. This encourages the creation of such designs in the long run. Ashesi can work hand-in-hand with Ghana Green Building Council (GGBC) to develop ratings for Ghana to evaluate green designs. These ratings if developed could help give buildings in the country international recognition. This serves as a form of education and awareness for people who have no idea about green design. It will also outline the benefits associated with green designs.

5.4 Limitations

1. Absence/ inaccessibility of similar buildings or projects for comparison.

2. Absence/Lack of institutions in Ghana associated with green rating. – This would have made rating Ashesi more appropriate to the local context.

3. Challenges in meeting interviewees. Some of the categories under the BREEAM could not be addressed due to lack of information.

4. Undeveloped measures (within Ashesi) to assess the effectiveness of the incorporated green design methods.

5.5 Recommendations for further research

1. Research into more local rating methods which can be used.
2. Research into appropriate institutions required for the study.

These recommendations could help Ashesi University College improve on its Green designs it has incorporated.

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APPENDIX

Appendix 1: Interview Questions for Developers

1. What is the idea behind the kind of structures and designs Ashesi has?
2. Is there a particular reason for the glass windows in the lecture halls?
3. Is there a reason for the way the windows have been structured in the dormitories and lecture halls? Why?
4. Can the design of the window be linked with air circulation in the rooms and lecture halls? Did you have this in mind when designing the building?
5. Is there a reason for adopting rain water harvesting and recycling of waste water?
6. What other alternative energy sources do you have?
7. Why that particular alternative? Are you thinking of other alternatives? Do you have plans to adopt solar energy as an alternative?
8. Did you employ such designs because of some regulations or legal requirements? Why?
9. Does the location play a part in the design of the schools structure?
10. Do you consider these designs to be green? What do you know about green design?

Appendix 2: Interview Questions for Architects

This interview is to find out more on green designs that Ashesi University College has incorporated into its designs.

1. What factors did you consider in designing structures in Ashesi? What influenced those factors?
2. Is there a particular reason for the glass windows in the lecture halls? Why?
3. Is there a reason for the way the windows have been structured in the dormitories and lecture halls? Why?
4. Can the design of the window be linked with air circulation in the rooms and lecture halls? Did you have this in mind when designing the building?
5. Is there a reason for adopting rain water harvesting and recycling of waste water?
6. Was it part of the plumbing work or the initial drawings? Why was it considered?
7. Did you employ such designs because of some regulations or legal requirements? Why?
8. Does the location play a part in the design of the schools structure?
9. Do you consider these designs to be green? What do you know about green design?

Appendix 3: Interview Questions for Electrical Engineer

1. What kinds of materials were used in electrical wiring and installations?
2. Was it due to some regulations you had to follow?
3. Are there any energy policies put in place for Ashesi?
4. Is there any equipment(s) used to control carbon dioxide emissions or are the ways adopted to minimize carbon dioxide usage?
5. Are the streetlights solar powered?
6. Have safety measures been put in place to control faults?
7. Are there any alternative energy sources? Are there plans to adopt any other alternative energy sources?
8. What do you know about green design? Do you consider these designs to be green?

Appendix 4: Interview Questions for Structural Engineer

1. What is the idea behind the kind of structures and designs Ashesi has?
2. What materials were used in designing the structure of the building?
3. Are the materials used environmentally friendly? Did the building use any recyclable materials?
4. Do these materials emit any harmful substances?
5. What do you know about green design? Do you consider these designs to be green?

Appendix 5: Interview Questions for Mechanical Engineer

1. What materials were used in the sewage and plumbing system? Are they environmentally friendly?
2. How is the water being regulated or monitored?
3. Is there a way to reduce water being used?
4. Are there equipment's used to detect water leakages?
5. Why did Ashesi use air-conditioners and not ceiling fans?
6. What do you know about green design? Do you consider these designs to be green?

Appendix 6: BREEAM Categories

Energy	
Sections	**Credits Achieved**
Ene 01	6
Ene 02	1
Ene 03	1
Ene 04	2
Ene 05	1
Ene 06	2
Ene 07	1
Ene 08	2
Ene 09	1
Total	**17**

Pollution	
Sections	**Credits Avhieved**
Pol 01	2
Pol 02	-
Pol 03	4
Pol 04	1
Pol 05	1
Total	**8**

Transport	
Sections	**Credits Achieved**
Tra 01	2
Tra 02	2
Tra 03	1
Tra 04	2
Tra 05	1
Total	**8**

Innovation	
Hea 01 Daylighting	1
Mat 01 Material Specification	1
Wat 01 Water Consumption	1
Total	**3**

Waste	
Sections	**Credits Achieved**
Wst 01	3
Wst 02	1
Wst 03	1
Wst 04	1
Total	**5**

Management	
Sections	**Credits achieved**
Man 01	1
Man 02	2
Man 03	-
Man 04	2
Man 05	-
Total	**5**

Health and Wellbeing	
Sections	**Credits Achieved**
Hea 01	3
Hea 02	2
Hea 03	1
Hea 04	1
Hea 05	1
Hea 06	2
Total	**10**

Water	
Sections	**Credits Achieved**
Wat 01	5
Wat 02	1
Wat 03	1
Wat 04	1
Total	**8**

Materials	
Sections	**Credits Achieved**
Mat 01	3
Mat 02	1
Mat 03	3
Mat 04	-
Mat 05	1
Total	**8**

Land use and Ecology	
Sections	**Credit Achieved**
Le 01	-
Le 02	1
Le 03	2
Le 04	2
Le 05	1
Total	**5**