

UNIVERSITY OF EDUCATION, WINNEBA
COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

**ENHANCING EFFICIENT MAINTENANCE OF PUBLIC BUILDINGS IN GHANA: A
CASE STUDY OF SELECTED INSTITUTIONS IN THE TAMALE METROPOLIS**

FUSEINI SULE

AUGUST, 2018

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BY

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**A Project presented to the Department of CONSTRUCTION AND WOOD
TECHNOLOGY EDUCATION, Faculty of TECHNICAL EDUCATION, submitted to
the School of Graduate Studies, University of Education, Winneba in partial fulfillment
of the requirements for the award of Degree of Master of (Construction Technology
Education)**

AUGUST, 2018

DECLARATION

STUDENT'S DECLARATION

I, Fuseini Sule, declare that this dissertation, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for any other degree elsewhere.

Signature:.....

Date:.....

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of dissertation as laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: **Mr. M. K. TSORGALI**

Signature:.....

Date:.....

ACKNOWLEDGEMENT

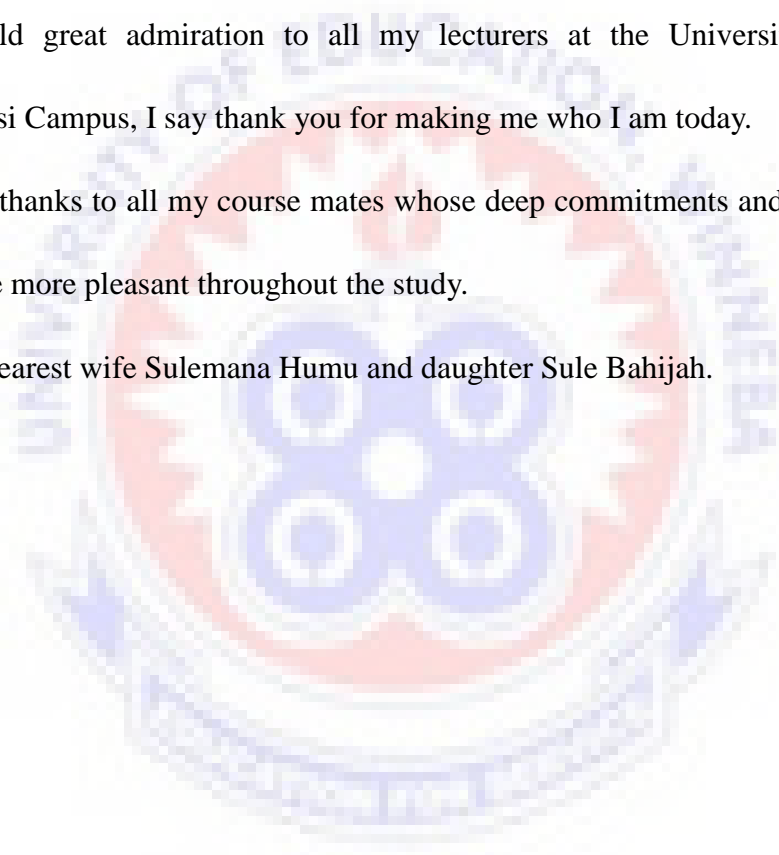
This project work might not have been correctly presented without the co-operative effort of some other people. I happily cherish the warm reception accorded me by such personalities.

First of all, I express my heartfelt thanks to my supervisor Mr. M. K. Tsorgali, for his concise direction, constructive criticisms and all the necessary guidance in going about the project work.

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More so, many thanks to all my course mates whose deep commitments and sharing of ideas made the course more pleasant throughout the study.

Finally, to my dearest wife Sulemana Humu and daughter Sule Bahijah.



DEDICATION

I dedicate this piece of work to the Almighty Allah the creator of the universe for His divine guidance, inspiration and direction which has made this report possible.

It is also dedicated to my lovely mother Madam Adisah Ziblim, my lovely father Afa Fuseini Moli, my lovely wife Sulemana Humu not forgetting my daughters Sule Bahijah and Sule Nakibah.



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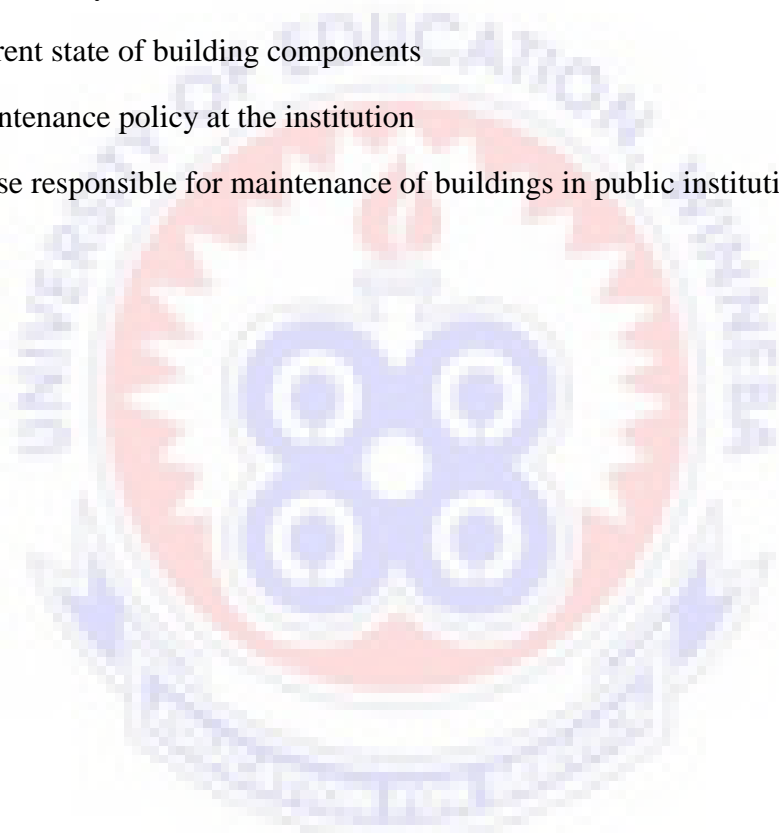
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ABSTRACT

Provision of adequate housing has remained a daunting challenge in the country particularly in urban areas following the high demand for housing. Most public residential buildings are characterized by a poor state of maintenance. Timely maintenance and proper management of buildings prevent their deterioration, provide a pleasant and comfortable living environment and uphold their value. This study seeks to enhance efficient maintenance of public buildings in Ghana, a case study of selected institutions in the Tamale Metropolis. The data collection instruments used for the study were questionnaires, interview and observation. The analysis of the respondents' responses was done through combined method system of tables and figures. The total population of 95 respondents were used and the sample size was 88 and was sampled as follows; Staff of Dabokpa Technical Institute 26, Students of Dabokpa Technical Institute 20, Workers of University for Development Studies 20, and Workers of Tamale Teaching Hospital 22. Simple random sampling technique was used to sample out the 88 respondents and were administered with questionnaires. Interview was conducted on maintenance managers and officers of Tamale Teaching Hospital. Observation was made on building components and services of all the three public institutions to gather data for the study. The objectives of the study were to; assess the current state of building components of public buildings, identify factors affecting maintenance of buildings of public institutions and device appropriate maintenance policies and practices for the maintenance departments of public institutions. The study revealed that the defective components of buildings in public institutions negatively affects the comfort of users and occupants. The defects identified included cracks on walls, faded painting, roof leakages, exposed foundations and choked drains. The study further revealed that public buildings deteriorate very early after their construction as a result of lack of maintenance culture and faulty design of buildings. The study recommends that; adequate funds should be made available for maintenance of public buildings and also the mentality of users and occupants of public buildings seriously needs to be addressed on the importance of maintenance culture through mass education and public campaigns. Also maintenance Log Book needs to be developed and implemented at the maintenance departments of public institutions for effective record keeping.

CHAPTER ONE

INTRODUCTION

This chapter discusses the background to the study, statement of the problem, purpose and objective of the study, research questions, significance of the study and scope of the study.

1.1 Background to the Study

Buildings in general perform a very important role in every aspect of human endeavor. Buildings are needed everywhere in the world for recreational, residential, industrial and commercial purposes. Ancient families were often represented as cave dwellers who lit fires at the entrance to keep out marauding enemies such as bears and wolves (Cook and Hinks, 1992). The original function of the building envelop was to isolate the inhabitants from the worst aspect of the natural environment such as draught, fire, snow and rain just to mention a few. As building technology has advanced coupled with an increase in population density, the isolating function has been broadened with modern architectural designs to meet the need of society. Ghana is a developing nation that is steadily rising to become a develop one in the distant future. Mother Ghana has indeed moved from where she was after her independence, into a very promising nation. Undoubted, Ghana which is the gateway to West Africa continues to be the shining example and star in the African Continent. However, one of the major problems confronting the development of this country is the poor attitude of its stakeholders towards rehabilitation and maintenance of its structures and facilities (Richard, 2008).

In fact, housing contributes towards poverty reduction through employment generation, raising incomes, improvement of health and increasing production of the labour force (Chirchir, 2006). Housing being a relatively labour intensive venture retains the highest employment generation potential in any developing country necessitating most countries to consider adequate housing as a priority national goal (Syagga and Aligula, 1993). One of the critical problems confronting the housing industry in Ghana is the poor maintenance practice (Afrane and Osei Tutu, 1999). The role of public institutions in national development cannot be over-emphasized. However, in spite of the heavy investment in public buildings, public institutions allow their structures to care for themselves without any suitable maintenance plan to preserve the quality of the buildings.

BS 3811 (1984), define maintenance as “the combination of all technical and associated administrative actions intended to retain an item in, or restore it to, a state in which it can perform its required function”.

The advance learner’s dictionary define maintenance as the process of protecting or preserving someone or something, or the process of keeping something in good condition.

Maintenance is the act of putting back device to its effective use after it has broken down.

Alagidede (2002), define maintenance as an action carried out by a group of persons to protect, preserve and maintain the systems, equipment and structures to ensure asset capability to function.

Neglect of maintenance has accumulated consequences with rapid increase in the deterioration of the fabric and finishers of a building, accompanied by a harmful effect on the

contents and occupants Seeley, (1987). Inadequate maintenance culture is a peculiar feature of almost every public building in Ghana.

According to Sam Afrane (2017), the poor maintenance culture plaguing our housing system in Ghana can be likened to a water tank with a perforated base. Although water flows regularly into the tank it never gets full because of the continuous outflows or discharge of water through the hole's underneath. He added that although efforts are being made over the years through public and private sector interventions to improve the housing situation in the country, these efforts are not yielding fruitful results because the housing stock continue to deplete or does not see much increase because little effort is made to keep them in good and livable conditions. It is said that housing and other landed properties in Ghana "take care of themselves". He further indicated that, although sustainable housing policy thrives on a balanced focus on new housing production and effective maintenance strategies, the orientation of housing policies and programs in Ghana manifest an unequal attention on the supply side of the housing equation.

According to Stephen (2002), public properties rarely perform as well as desired. The causes emanate from deficiencies in design, construction, commissioning and maintenance. He further said that all these could be planned for during the design stage. Maintenance problems though do manifest during the use of the building, their causes might be during the design stage. These made Dekker (2002), to assert that thinking on the maintenance should start in the design phase. According to Speight (2000), it is at the design stage that the maintenance burden can be positively influenced for better or for worse. Seeley (1997), also said that a

skillful design can reduce the amount of maintenance work and also make it easier to perform, since good maintenance begins on the drawing board.

The former Deputy Minister of Local Government and Rural Development, Mr. Elvis Afriyie Ankrah in 2010 noted at the launch of Operations and Maintenance manual for markets that, "As a country, we go to every length to raise taxes, secure loans and grants to invest in infrastructure such as roads, markets, schools and hospitals but fail to undertake the basic repairs or maintenance leaving them to deteriorate to complete disrepair." He called on the Metropolitan, Municipal and District Assemblies to mainstream infrastructure maintenance into their planning and budgeting process to ensure that maintenance scheduled were prepared (Nyarko, 2014). The German-born theoretical physicist, Albert Einstein said "not until the creation and maintenance of decent conditions of life for all people are recognized and accepted as a common obligation of all people and all countries not until then shall we with a certain degree of justification, be able to speak of humankind as civilized". Maintenance according to him is a pre-requisite for a civilized society (Nyarko, 2014).

1.2 Statement of the Problem

The importance of maintenance of buildings of public institutions cannot be overemphasized. Many public buildings located within Tamale Metropolis of which the research is being conducted have not seen significant maintenance or show little signs of maintenance since they were constructed. These has resulted in such buildings being in a dilapidated state with some being abandoned, which invariably defeat the purpose for which they were constructed. When the researcher visited the three public institutions in the Tamale Metropolis the

situation was abhorring in terms of maintenance. Some of the maintenance challenges observed at the Tamale Teaching Hospital were; cracks on walls and floors, ripped-off roofing due to rainstorm, non-functional electrical fittings at the nurse's quarters, broken down drainage systems and damaged ceilings. At the Dabokpa Technical institute the situation was not different. At the mechanical workshop of the school there were deep cracks on the building almost beyond repair. At the teachers quarters the painting on the walls of the buildings started to fade. Again, at the Dabokpa Technical Institute, the only toilet facility meant for students was badly deteriorated. Some of the students contacted by the researcher lamented that the toilet was now a death trap to them. Also, at the University for Development Studies Tamale Campus, the maintenance problems identified by the researcher included cracks on walls and floors, faded paints, fungal attack on roofing members, broken down sanitary appliances, non-functional electrical fittings, exposed foundation and broken-down doors and windows. The main challenges towards maintenance in the Metropolis was attributed to lack of maintenance plans, lack of funding and inadequate budgetary allocations to cater for maintenance activities. It is against this background that the current study sought to enhance the maintenance of public buildings in the Tamale Metropolis in order to improve upon the quality of maintenance in public infrastructure.

1.3 Purpose and Objectives of the Study

The purpose of this study is to ensure efficient maintenance of buildings of public institutions in the Tamale Metropolis.

The specific objectives of this study are to:

- Assess the current state of building components of public buildings in the Tamale Metropolis.
- Identify factors affecting maintenance of buildings of public institutions in the Tamale Metropolis.
- Device appropriate maintenance policies and practices for the maintenance departments of public institutions.

1.4 Research Questions

- What is the current state of buildings components of public buildings in the Tamale Metropolis?
- What are the factors affecting maintenance of buildings of public institutions in the Tamale Metropolis?
- What maintenance policies and practices are available in the maintenance departments of public institutions?

1.5 Significance of the Study

- The findings of the study will provide information on efficient housing maintenance in Ghana, and addresses challenges faced by government and other stakeholders in maintaining public housing.

- The study will provide empirical evidence on how to execute maintenance for institutional housing by first of all identifying the gaps and areas that require strengthening with existing frameworks.
- The study will be of use to academicians and researchers as it will open opportunities for further research in the area of public housing maintenance
- The study will provide a guideline for maintenance of public buildings.
- Finally, findings of the study will result in improving the living conditions of the beneficiaries who reside in public buildings.

1.6 Scope of the Study

The scope of this study focuses on areas such as: Classification of buildings, concept of building maintenance, importance of building maintenance, technology of maintenance, economic and social significance of maintenance, aims of maintenance, nature of maintenance, maintenance management, maintenance policy and funding of maintenance works in public institutions.

1.7 Limitations

A major limitation in the research was the respondents attitude towards the study. This would have been a barrier to accuracy of information in that, some of the respondents were suspicious about the objectives of the study. To minimize this, the researcher sensitized the respondents on the objectives of the study in advance to get them acquainted.

In addition, data gathering also suffered due to delay in getting responses from respondents as a result of their work schedule especially workers of Tamale Teaching Hospital. Notwithstanding the above limitations, the study results have not been affected and thus are credible, reliable and useful for any purpose of evaluation and feedback.

1.8 Organization of the Study

This research work has been organized under five chapters. Chapter one covers the introductory part and it includes the background of the study, statement of the problem, purpose and objective of the study, research questions, significance of the study, scope of the study, limitations and the organization of the study. The second chapter deals with the review of literature pertinent to the study as presented by various researchers, scholars and authors. Chapter three focused on the methodology adopted in undertaking the research. The analysis of the data gathered is dealt with in chapter four, whilst chapter five represents a summary of findings, conclusion, recommendations and suggestion for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature pertinent to the study as presented by various researchers, scholars and authors. The areas for discussion in this chapter include the classification of buildings, concept of building maintenance, types of maintenance, importance of maintenance, and technology of maintenance. Additionally, the chapter attempts to look at the economic and social significance of maintenance, aims of maintenance, nature of maintenance, maintenance policy, and the role of maintenance manager and funding of maintenance activities among other issues.

2.2 Classification of Buildings

According to International Building Code (2012), by Rob Aman, buildings can be classified in relation to age, type of construction and occupancy.

2.2.1 Classification of buildings based on Age

Ancient buildings are those that were built before the 19th century and conformed to no building regulation standard. Griffiths (1973), stated that, 19th century buildings were generally of poor technical standards. 20th century buildings were those build before 1945 to a minimum standard governed by building by-laws and those built after 1945 using modern techniques and materials with the minimum standards being governed by modern building regulations. Modern buildings are now better in terms of standard with present day materials and techniques with better services. According to Seeley (1985), the standard building

conformance criteria for modern buildings to be met include the following: Stability, weather resistance, comfort, noise resistance, durability, economy and ease of maintenance.

2.2.2 Classification of buildings based on construction

Thomas Britto (2011), classified buildings based on construction as follows:

- **Buildings with type 1 construction:** In these building the design and types of materials used in their construction are such that all structural components have about 4 hours fire resistance. In this type of construction, building elements are of non-combustible materials such as concrete, masonry and steel.
- **Buildings with type 2 construction:** In these building the design and types of materials used in their construction are such that all structural components have about 3 hours fire resistance. In this type of construction also building elements are of non-combustible elements such as concrete, masonry and steel.
- **Buildings with type 3 construction:** In these building the design and types of materials used in their construction are such that all structural components have about 2 hours fire resistance. In this type of construction, exterior walls are of non-combustible materials or fire-retardant wood framing and interior building elements are of any code permitted materials
- **Buildings with type 4 construction:** In these building the design and types of materials used in their construction are such that all structural components have about 1hour fire resistance. This type of construction is often referred to as heavy timber

construction and is characterized by the use of large dimension lumber of greater than 4 inches. Its exterior walls are of non-combustible materials and the interior building elements are of solid or laminated wood without concealed spaces.

2.2.3 Classification of buildings based on occupancy or use

Thomas Britto (2011), classified buildings based on occupancy as follows;

- **Assembly buildings (Group A)** - Places where people gather for amusement, recreation, social, restaurant, churches, theaters, stadiums etc. This group of buildings were found in almost all the three public institutions under the study. Restaurant and church buildings were found at the University for Development Studies. Dabokpa Technical Institute also had canteen and dining hall facilities. Tamale Teaching Hospital also had a restaurant
- **Business buildings (Group B)** - Places where services are provided, example; banks, insurance agencies, police stations, court, trade fair centre etc. Under this category, University for Development Studies had shops and offices, Dabokpa Technical Institute also had accounts office and Tamale Teaching Hospital had accounts unit and pharmacy unit.
- **Educational buildings (Group E)** - That is schools, day care centres, college offices etc. The dominant institutions with this group of structures were University for Development Studies and Dabokpa Technical Institute.
- **Hazardous buildings (Group H)** - Places involving production or storage of very flammable or toxic materials, example; refinery, molar plant etc. All the three institutions

had science resource centres of which these toxic materials were found with Tamale Teaching Hospital having X-ray unit in addition.

- **Institutional buildings (Group I)** - Places where people are physically unable to leave without assistance example; hospitals, nursing homes, prisons etc. Among all the three public institutions only Tamale Teaching Hospital was under this group.
- **Mercantile buildings (Group M)** -Places where goods are displayed and sold, example; shops, grocery stores, department stores etc. All the three institutions under the study had department stores and shops with Tamale Teaching Hospital only having a pharmacy.
- **Residential buildings (Group R)** - Places providing accommodations, examples; houses, apartment buildings, hotels, motels etc. All the three institutions had accommodation facilities.
- **Storage buildings (Group S)** - Places where items are stored, example; warehouses, parking garages, cold stores, marine terminals etc. All the three institutions had warehouses for storing their foodstuffs.

2.2.4 Building Types in Ghana

i Public Buildings

Van Baren (2013), define Public buildings as any type of building that is accessible to the public and is funded from public sources. Typically, public buildings are funded through tax money by the government, state or local governments. All types of governmental offices are considered public buildings. Public buildings generally serve the purpose of providing service

to the public. Many of these services are provided free to residents. This list includes public schools, libraries, courthouses, state bungalows and post offices. In other words, public building is a building, whether for single or multitenant occupancy, and its grounds, approaches, and appurtenances, which is generally suitable for use as office or storage space or both by one or more Government

Agencies or mixed-ownership Government corporations.

ii Residential Buildings

- **Detached Houses:** This refers to single-family homes that sit on their own lot without sharing any walls with another home or building. It is self-contained and may be made of two (2) to (5) bedrooms with a living room, bathrooms and toilets, store rooms and garages (Issahaku, 2013).
- **Semi Detached Houses:** This consists of pairs of houses-built side by side as units sharing a party wall and usually in such a way that each house's layout is a mirror image of its twin. Unlike the Detached houses, the Semi Detached, shares walls on both sides with another home (Issahaku, 2013).
- **Blocks of Flats:** This type of houses provides self-contained dwelling units of different sizes for single-households placed on multi-levels without any defined private courtyard space. Balconies are provided on the ground floor for the occupying households. In some cases, lockable garages and storerooms are provided on the ground floor for the occupying households (Cobbinah, 2010).

2.3 The Concept of Building Maintenance

2.3.1 Definition of Maintenance

Maintenance has no universal definition; however, different writers defined it from different perspectives.

Seeley (1993), define maintenance as the combination of all technical and associated administrative actions intended to retain an item in or restore it to a state in which it can perform its required functions to an acceptable standard. That is, it is maintained in an efficient state, in efficient working order and in good repair. Actions referred to are those associated with initiation, organization and implementation. Retaining means work carried out in anticipation of failure, while restoring means work carried out after failure.

A more functional definition by White (1969), is that maintenance is synonymous with controlling the condition of a building so that its components would lay within specified region. The word control suggests a positive activity which is planned so as to achieve a define result. The term 'specified region' presumably has a meaning similar to acceptable standards' and would be determined in a similar way. An interesting aspect of this definition is that it envisages a range of acceptability with upper and lower limits between which the condition of the facility must be maintained. Maintenance therefore is all the necessary work done to preserve a building with its finishes and fittings, so that it continues to provide the same or almost the same facilities, amenities and serves as it did when it was first built. It also includes the expenditure necessary to maintain the rental value of the property and involves:

- Day to day repairs such as leaking taps and electrical effects
- Periodic up-keep such as painting
- Major repair requiring heavy expenditure and the services of technical experts, for example foundation works and re-roofing, (S. Afrane and E. Osei- Tutu, 1999).

2.3.2 Types of Maintenance

The categorization of maintenance according to BS3811 as cited in Seeley (1987), is as follows;

- **Planned Maintenance**

This type of maintenance is organized and carried out with forethought, control and the use of records to a predetermined plan. The plan should be comprehensive and systematic encompassing both short and medium-term considerations. The program should be based on sound knowledge of the building with particular regards to: The life of the building, the standard to be achieved, the financial implications and the responsibility for maintenance (Aha et al, 2012). Furtherance to this, Zulkarnain et al. (2011), also identify planned maintenance as a maintenance that is organized and carried out with forethought, control and the use of records to a predetermined plan. Queensland Gov. (2012), similarly in defining planned maintenance referred to it as planned work executed at predetermined intervals to meet statutory, health and safety, technical or operational reliability considerations, and to preserve the asset and prolong its economic life (Issahaku, 2013). RICS (2009), explained

that planned maintenance is the process of periodically undertaking routine tasks necessary to maintain plant (lifts, boilers, etc.) in a safe and efficient operating condition.

- **Unplanned Maintenance**

Maintenance carried out to no predetermined plan. It refers to works necessitated by unforeseen breakdowns or damages, for example repairing of a ripped off roof after a torrent rainfall. The resources needed to carry out repair works may not be available at the time of breakdown because it is not anticipated and therefore planned for. It thus occurs when your preventive maintenance work has been neglected or over worked altogether and the result turn to be very costly (Moses, 2014).

- **Preventive Maintenance**

This type of maintenance is carried out at predetermined intervals or corresponding to prescribed criteria and intended to reduce the probability of failure or the performance degradation of an item (Cobbinah,2010). David and Arthur (1989), also stated that preventive maintenance tasks are performed in accordance with a predetermined plan at regular fixed intervals which may be based on operating time. RICS (2009), revealed that preventive maintenance is generally identified by a condition assessment and is planned to take place to suit the pattern of deterioration of a building and the availability of funds for the purpose.

- **Corrective Maintenance**

The maintenance carried out after a failure has occurred and is intended to restore an item to a state in which it can best perform its required functions (Cobbinah, 2010). Corrective maintenance is the simplest type of maintenance strategy where an element in a building is used until it breaks-down. It covers all activities, including replacement or repairs of an element that has failed to a point at which it cannot perform its required function. Corrective maintenance is sometimes referred to as failure based or unplanned maintenance. Corrective maintenance tasks often take place in an adhoc manner in response to breakdowns or user requests (David and Arthur, 1989). The most popular type of maintenance practice carried out at the three institutions was corrective maintenance. The authorities to carry out preventive maintenance normally wait for the component of the building to break-down before replacement and repair works are done.

- **Emergency Maintenance**

The maintenance which is necessary to put in hand immediately to avoid serious consequences. This is referred to as day- to -day maintenance, resulting from such incidents as gas leaks and gale damage. In such a situation, the maintenance has not been planned in advance but it is necessary to organize maintenance of the facility or equipment to avoid serious loss of production, major damage to the facility or cause of accidents to the personnel using the facility (Moses, 2014).

- **Condition - Based Maintenance**

The preventive maintenance initiated as a result of knowledge of the condition of an item from a routine or continuous monitoring (Issahaku, 2013). The condition- based maintenance concept recognizes that a change on condition or performance of an item is the principal reason for carrying out maintenance (Mobley, 2004). To gain the full advantages of applying condition - based maintenance, the condition of an item must be monitored to identify whether there is any evidence of change from a normal to an abnormal condition (David and Arthur, 1989). Monitoring buildings to know their conditions was not a regular practice at the various public institutions under the study.

- **Shutdown Maintenance**

This refers to maintenance which can only be carried out after the building is evacuated or out of service (Issahaku, 2013). This calls for the vacation of the occupants to pave way for the maintenance work to be carried out successfully. It should be noted here that the building under shutdown is not out of use or breakdown, yet it needs to be maintained to an acceptable standard as already scheduled (Moses, 2014). At the institutions under the study, the researcher was told that this type of maintenance practice normally happens once in a while.

- **Routine Maintenance**

This is in the form of servicing which include cleaning, checks and adjustments operations undertaken at regular intervals of varying frequency in the owner's manual or schedule maintenance under attention. The routine could be hourly, daily, weekly, fortnightly, monthly

or yearly cleaning, lubrication, polishing, painting etc. as a result of the effect of weather and atmospheric conditions in the components of the building (Moses, 2014). None of the three institutions of which the research is being conducted were committed to routine maintenance practices. Corrective type of maintenance practices was adopted by the institutions to restore the building components after failure has occurred.

2.4 Importance of Building Maintenance

Building maintenance is perhaps more important than building itself. It is costly to put a structure and leave it to deteriorate and fail. It is colossal loss of investment. Seeley (1985), indicated that recently building maintenance has been a neglected field of technology and has been regarded by many as a “cinderella” activity. (Anderson 1967), said that the prime aim of maintenance is to preserve a building in its initial state, as far as practicable, so that it effectively serves its purpose and sees the main purpose of maintenance of building. This will help to retain the value of investment. Maintenance has been neglected for far too long and therefore gives little to no merit in the Ghanaian Construction Industry. Anderson (1967), again indicated that building maintenance is very necessary for the following reasons:

- Retaining value of investment
- Maintaining building in good condition which will continue to serve or fulfill its functional requirements, that is, physically, economically, and up-dated functionally.
- Presenting good appearance in order to preserve and beautify the built up-environment.

Alzabaidi (1997), also identified some of the purposes of maintaining a building as follows:

- To preserve a building in its initial state as long as practicable so that it serves effectively the purpose for which it is built.
- To assist in the minimization of production cost
- To maintain an acceptable quality standard in terms of structural stability to meet the current taste and demand
- To keep down time and maintenance costs themselves to a minimum.
- To maintain and retain aesthetic value
- To improve the general condition of such buildings

According to Hamilton and Wan- Salleh (2001), a good maintenance system is also a good disaster mitigation system. Therefore, well operated system of building maintenance has the effect of being an effective disaster mitigation measure in terms of cost and facility usage. Marks and Pickard (1996), postulated that when buildings are neglected defects can occur and may result in extensive and avoidable damage to building elements. Poor maintenance has resulted in damages and deterioration to most public residential buildings in Ghana. Many of these buildings have not seen any significant maintenance after their construction. Evidence of lack of maintenance and repair are frequently demonstrated on roof, windows, doors, and other building elements and facilities.

2.5 Technology of Maintenance

The technology of maintenance is concerned with all the factors that influence and cause the need for maintenance work. According to Seeley (1987), the occurrence of defects in the fabric of a building could be due to a variety of unrelated design decisions, such as;

- Unsuitable materials
- Incorrect assessment of loads
- Inadequate appreciation of conditions of use
- Incorrect assessment of exposure.

According to Lee (1976), the amount of exposure of a building fabric is influenced by factors such as;

- Rainfall
- Direction of prevailing winds
- Micro-climate
- Atmospheric pollution
- Height of the building

The durability of the building materials is also influenced by Frost action, Crystallization of salts, Sunlight, Biological agents, Abrasions and impact, Chemical action and corrosion and Incompatibility of modern building materials. Lee (1976), stated that defects such as cracks

may occur from faults other than structural and may invariably cause inconvenience and discomfort to the occupants. Furthermore, cracks frequently give rise to air infiltration, heat loss and reduced sound insulation all of which could reduce efficiency in buildings. Cracks in general are caused by tensile stresses in excess of the tensile strength of material produced by externally applied loads or internal movement arising from temperature or moisture changes. Other important concept of the technology of maintenance can be related to roof construction. A good roof which is well maintained should last the life span of a building and it is false economy to save money on roof during construction, because if it ever requires replacement, it will cause serious dislocation of production, occupancy or other activities with the building. A leaking roof apart from causing considerable amount of inconvenience to users and occupants can also lead to accelerated deterioration of other parts of the building such as ceiling, floors and walls and can cause serious damage to decorations and electrical installations. To ensure that roofs are adequately maintained, they should be ideally inspected every three [3] years or alternatively one-third each year.

2.6 Economic and Social Significance of Maintenance

A well-maintained product/asset ensures the maximum utilization for the period of useful life especially when the product reaches the decline stage. Many writers on the economic and social significance of maintenance contend that the built environment expresses in physical form, the complex social and economic factors, which give structure and life of the community. Therefore, the condition and quality of buildings reflect public pride or indifference, the value of prosperity in the area, social values and behavior and all the many influences both past and present, which combine to give a country its unique characteristics.

Richard (2008), stated that, wealthy people are affluent because they have a considerable number of resources to the one they had in the time past. Likewise, a great nation's growth and development depend on the rehabilitation and maintenance of its structures all the time. He further argued that, maintaining both the old and new structures in a country go a long way to promote its advancement and therefore kindle the growth and development of the nation's economy Mr. Kwesi Ahwoi, the former minister for Food and Agriculture also added his voice on the economic and social significance of maintenance by saying that, the lack of maintenance culture in the country was causing the nation a great deal of money which could have been channeled in to development projects. To him the attitude of Ghanaians now is to build, neglect and rehabilitate instead of going by the axiom "a stitch in time saves nine". He contended that watching the infrastructure bequeathed by our forefathers to decay before looking for gargantuan funding to rehabilitate them was unpardonable, he noted, adding that this development has devastating effects on the economy. He remarked that, many analysts and African political leaders relate their poor economic performances to inadequate investment in infrastructure forgetting that without significant improvement in its maintenance culture, mere addition of more public and private infrastructure cannot result in the anticipated improvement in Africa's economic performance. Repair works and rehabilitation help government to redirect available funds to other economic sectors to solve the growing economic downturn the country is facing. Preventable damage caused to infrastructure and subsequent repairs is a financial lost to the state. I will be a happy Ghanaian if my political leaders draft policies that would ultimately compel us to adopt a maintenance culture (Nyarko, 2014). Seeley (1995), emphasized that, generally, there is an

inverse proportion between the initial cost and maintenance cost, that is the higher the initial cost the lower the maintenance cost. In combining the life of building with the initial cost or future maintenance emphasis should be laid on a choice of material to last the life of the building. A house is regarded as an economic asset, which must be maintained to ensure that it appreciates in value and results in a return either socially or economically to the owner.

2.7 Aims of Maintenance

Seeley (1987), stated that, the primary aim of building maintenance is to preserve the building in its initial state, as far as practicable while retaining, where appropriate, its investment values, and presenting a good appearance; so that it effectively serves its purpose. It is impossible to produce buildings which are maintenance -free, but maintenance work can be minimized by good design and proper workmanship carried out by skilled experts or competent craftsmen using suitable codes of installation, requisite building materials and methods. Afrane and Osei-Tutu, (1999), also identify the following to be the main purposes of maintaining buildings;

- To maintain the value of building: A better maintained building normally has greater value, however increased value may be marginal as location and size of site all play an important role in the determination of value.
- To ensure optimum use of buildings: Good maintenance should allow building to be used to their full potential.

- To create or maintain suitable appearance: Maintenance can make a positive contribution to external environment and social conditions. Dilapidated buildings can contribute to social deprivation and bad resources and affect the environment.
- To minimize the life of maintained services and facilities of the main components: Maintenance can reduce cost of subsequent maintenance by extending periods between repairs and replacement.
- To ensure that buildings do not detract from surroundings and also maintain a suitable appearance.

2.8 Factors Affecting the Decision to Undertake Maintenance

According to Stapleton (1994), the decision to carry out maintenance is affected by many factors, among which are:

(a) Cost: Investors would want to have the most economic method for carrying out maintenance work whether, corrective or preventive, thus they look at:

- Actual cost of maintenance of the building to the cost of maintaining similar buildings.
- Consideration of money spent to achieve acceptable standard at present.
- Cost of maintaining same standard in future and economies of replacing facilities, and
- Amount of work available and priority of work to be executed.

(b) Availability of physical resources: The availability or non-availability of physical resources affects the decision in that, when suitable materials for maintenance are not

available, it becomes difficult to undertake maintenance. Again, even if suitable materials are available but not in adequate quantities and the alternative materials are not available it will deter people from undertaking maintenance activities. The level of craftsmanship in terms of both skills and efficient numbers can also affect decisions to carry out maintenance.

(c) Urgency of work: This also affects decisions on maintenance in that investors consider whether delayed in the short run will require more expensive work at a later stage.

This usually takes into account:

- Safety of building users; and
- Possible damage to structure and finishes used in the building.

(d) Interference with activities carried out in the building.

2.9 The Maintenance Challenges in Ghana

The main challenges of maintenance of buildings in Ghana are lack of funds. The budgetary allocation does not cater for maintenance activities. As a result of that the District, Municipal and Metropolitan Assemblies are not resourceful enough to undertake maintenance activities periodically and regularly. Another problem is ownership of these buildings, where occupants and users regard it as not their own property but as a state property and handle it without due care. In some cases, occupants do not regard the buildings as their property and therefore have passive attachment in relation to the efficient use and maintenance of the building. In relation to occupants having passive attachment to state property, Ebenezer Banful (2004), stated that, it is important for Ghanaians to cultivate a maintenance culture. We need to

change our attitude to government property. Government and corporate property must be treated as if it were one's private property for it belongs to all the people and is held in trust by the government for all Ghanaians. He further challenged that, Ministers and Parliamentarians and those in positions of authority should set the example. They should use government property lawfully, appropriately and efficiently. According to Afrane (2017), maintenance challenges can be classified into two main groups, namely;

- **Physical Factors.** The physical factors include;
 - Age of building
 - Nature of terrain soil conditions
 - Seismic movements
 - High temperature variations.
- **Socio-economic Factors.** The main factors include;
 - Lack of maintenance culture among house owners and tenants
 - Lack of funds
 - Uneconomic rents
 - High maintenance cost
 - Lack of maintenance plans and budgets
 - Family ownership resulting in neglect

- Absentee landlordism

Also, a study conducted in 2016 by Quayson and Akoymah of the Department of Building Technology, Cape Coast Polytechnic suggested the following to be the principal causes of maintenance challenges in residential buildings in Ghana;

- Age of the building
- Lack of maintenance culture
- Funding for maintenance activities
- Apathy and ignorance of maintenance responsibility
- Capacity of the maintenance unit

2.10 Nature of Maintenance

It is highly desirable but hardly feasible to produce maintenance free buildings. Much work can however be done at the design stage to reduce the amount of subsequent maintenance work that will be done during the operation and maintenance life of a building (Faremi and Adenuga, 2012). Maintenance involves a considerable amount of work which Seeley (1987), has categorized into three separate components namely; Servicing, Rectification and Replacement.

- **Servicing** – Is essentially a cleaning operation undertaken at regular intervals of varying frequency and is sometimes termed day-to-day maintenance. Daily sweeping of floors, monthly washing and cleaning of windows and regular painting for decoration and

protection every four years are some examples of servicing. However as more sophisticated equipment is introduced so more complicated service schedules become necessary. Servicing becomes necessary as a result of constant use of facilities, the effect of the weather and atmospheric conditions on the components of the building.

- **Rectification**--- Usually occurs fairly early in the life of a building, but it can also occur sometime within the life span of the building. It arises from shortcomings in design, inherent faults in or unsuitability of components, damage of goods in transit or installation and incorrect assembly. Rectification represents a fruitful point at which to reduce the costs of maintenance, because it is avoidable. All that is necessary at any given rate in theory is to ensure that components and materials are suitably for their purpose and are correctly installed. Rectification work could be reduced by the development and use of performance specification and codes of installation (Lee, 1987). According to Stapleton (1994), rectification is the response to inherent defects in design, construction or installation stages of the building process. This provides an opportunity to ‘trade off’ current capital expenditure against future maintenance costs.
- **Replacement**--- Occur at all costs in building. This is because the extent of exposure of materials to the vagaries of the weather varies, and the weather in specific locations also varies while the capacity of elements of buildings in withstanding changes and different intensities of the weather also vary. This therefore becomes necessary as a result of material decay due to these differential rates of weather conditions. Physical breakdown of materials or elements as well as deterioration appearance may necessitate

replacements. However, this brings the problem of distinguishing between maintenance and improvement, which has not been resolved satisfactorily by many definitions. It is however, generally conceded that maintenance should include reasonable elements of improvement, for example the replacement of worn out components with up-to-date versions. Where the intention of work done is to increase efficiency in the use of the building by adding facilities, which were not previously present, the work should be classified as improvement. However, it is logical therefore to extend the meaning of maintenance to cover some localized improvement.

2.11 Other Maintenance Related Concepts and Definitions

2.11.1 Prevention

It entails protecting housing by controlling its environment, thus preventing agent of decay and damage from becoming active. It involves clearing schedule, good housekeeping and proper housing management.

2.11.2 Consolidation

Consolidation is the physical addition or application of adhesive or supportive materials unto the actual fabric of housing in order to ensure its continued durability or structural integrity.

2.11.3 Rehabilitation

It involves the modernization of aged building with or without adaptive alteration for use. It means the introduction of modern services into the building without changing its original use.

2.11.4 Repair

Repair is to revive housing to the original state so that it works as it was first put up or built.

It involves reactive responses to housing deterioration and it is essentially ad hoc in nature.

2.11.5 Renovation

It consists of work done to restore a structure, services and equipment by a major overhaul to the original design and specification or to improve on the original design. This may include substantial additions and extensions to the original structure and in the extreme re-building.

Renovation constitutes the interface with improvement and refurbishment. Renovation to some extent is unavoidable, since in replacing a fitting, such as a bath, the replacement will be of a new design.

2.11.6 Refurbishment

Refurbishment means in architectural sense, as involving replacement of missing parts or introduction of new decorative elements into a structure. In addition, it involves working on a housing to make it bright, clean and fresh again.

2.11.7 Extension

With respect to housing, it involves addition of parts to make housing wider or larger in response to what is required of it.

2.11.8 Conversion

Conversion simple refers to converting or changing the use of a building from one to another.

For example, converting a residential building to a church, or converting a lecture theatre to

an office complex. Seeley (1987), stated that prior to conversion the building must be thoroughly examined to determine its stability.

2.11.9 Alteration

Alteration simple refers to adjustment of initial design of a building to upgrade the building to a particular standard or aesthetics. These usually arise as a result of increase in taste of the occupant or tenant. A typical example is changing of louver windows to casement windows. Lateef et al. (2010) found out that alteration works are carried out by small contractors.

2.12 Causes for and Sources of Maintenance

The need for maintenance may be regarded as the inverse of durability and the latter is influenced by external and internal climate and in some cases by special man-made hazards other than internal climate. However, considerable amount of work of maintenance is due to decay and deterioration. These are termed (1) primary causes and (2) primary sources.

2.12.1 Primary Causes

These are causes, which will usually produce or contribute to deterioration, and call for maintenance work and include:

- a. **Faulty design-** A good design needs to provide suitable protection of proven materials by adequate detailing. A variety of unrelated design decisions may result in defects in the fabric of the building e.g. unsuitable materials, incorrect assessment of load, orientation of the building with regards to area and weather conditions can contribute to the faster deterioration of the building.

b. **Faulty execution of work-** This is usually due to bad workmanship and inadequate supervision. The quality of work may be reduced by the use of slip-shop methods and incorrect use of materials. The number and or quality of supervisors may lead to misinterpretation of design to workers. Thus, the intentions of the design may not be properly secured.

c. **Vandalism-** This is usually caused by intentional damage and disfigurement resulting in the natural life material or component being reduced. This also reduces aesthetics and increases maintenance cost.

2.12.2 Primary sources

Such sources are the originators of maintenance work and can only be reduced by correctly observing basic principles involved in construction. These sources are:

(a) **Corrosion of metals-** Two forms of corrosion of metals are:

- **Rusting-** which is caused by the oxidation of metals resulting in metal peel offs.
- **Electrolytic action** – It occurs when dissimilar metals are in constant contact in a conducting medium thus resulting in a short-circuited galvanic cell and in metals removing from anode and deposited on the cathode.

(b) **Biological agents-** Insects and plants can attack parts of buildings especially wooden parts and cause them to fall off. There are instances where roots of plants have caused walls of buildings to crack. These are usually corrected by: correct detailing, use of resistant materials and suitable pre-treatment of affected materials.

(c) **Abrasion and Impact-** These relate mainly to wall and floor finishes and doors. It is usually caused by:

- Pedestrian traffic (the grinding of dirt by feet and hands on the floor and walls)
- Vehicular traffic (vehicles colliding into walls)
- Dragging of furniture and equipment across floor areas.

2.13 Maintenance Management

The function in this area is mainly of a technical nature and concerned with the planning and control of construction resources to ensure that necessary repairs and renewals are carried out with maximum efficiency and economy. The major decision relates to the following as spelt out in BS 3811 cited in Seeley (1985);

- Determining Standard
- Planning Inspections
- Identifying and Specifying the work necessary
- Estimating the cost of the work
- Planning the work
- Organizing the executive of the work

2.13.1 Determining Standards

For this, it is necessary to have information on the overall objectives of the organization and of statutory and other external requirement so that compatible standards can be fixed. The

expression of these standards in qualitative and quantitative terms demands knowledge of the effects of varying degree of disrepair on user activities and levels of visual acceptance.

2.13.2 Planning Inspections

Fixing the periodicity of inspections requires knowledge of the rates of deterioration of the building elements so that defects are revealed before they reach critical stage. The minimum period will be determined by the inspection cost which should clearly not exceed the cost consequence of failure.

2.13.3 Identifying and Specifying the Work Necessary

This is achieved by compiling the information received on the condition of the building from inspectors and other sources with the standards laid down. It demands knowledge of the causes of defects and of the remedial measures which would be appropriate for the circumstance.

2.13.4 Estimating the Cost of the Work

As far as possible the estimates should be based on historic cost data obtained from within the organization for previous similar jobs, but in the absence of such data, cost from external sources and experienced budget have to be used.

2.13.5 Planning the Work

This is mainly in respect of fixing appropriate start and finish times for the individual jobs. It also requires information on the effect of the timing of the work on user activities, its agency, the availability of resources and the labour time required for each operation.

2.13.6 Organizing the executive of work

The major decision here is whether to employ labour directly for the purpose or to engage an outside contractor; for this, information will be required on the relative merits of these alternatives from the point of view of both cost and convenience.

2.14 Factors for Achieving Minimum Maintenance at Design Stage

In order to achieve minimum maintenance for a building at design stage, it is important for the parties involved in the project to consider the ease with which the property can be maintained during its use. The critical factors to consider during the design stage in order to minimize maintenance include:

- **Materials Selection-** Good maintenance depends on an understanding of materials and appreciation of their behavior in use is essential. Some materials are difficult to repair in case of damage. It is also important to consult manufacturer's recommendation for use.
- **Thermal effects-** Thermal expansion is often important to the design of buildings, and should be predicted as accurately as possible, in order that suitable expansion joints can be designed and incorporated into the structure. Thermal movement is responsible for much damage to buildings.
- **Design detailing-** Architects must be reminded continuously of the need for attention to weathering, throating, and expansion joints, tolerances and correct jointing between different materials to allow for movement.

- **Vandalism-** Vandalism is apparently an increasing problem in public places which are not under constant observation such as public toilets, libraries and entertainment halls. It is important to design such places to be well lit and visible in order to discourage vandals.
- **Cleaning-** Before selecting materials it is worth preparing a typical check list and considering the cleaning equipment, use, storage, service, outlet etc.
- **Legislation-** Both the architect and the contractor must take care to acquaint themselves with statutory requirements concerning building design and construction especially planning and building regulations.
- **Education** - Building maintenance must form part of the curriculum for architectural education with enough attention paid to life cycle costing, diagnosis of causes of building defects and strategies for repair and maintenance

2.15 Organization of Maintenance Department

The most appropriate organizational structure is that which is the best suited to meet the particular needs of the organization. The maintenance department in an organization is managed by a maintenance manager who manages and supervises the operations of other executives managing the various subdivisions comprising professionals like Electrical, Mechanical, Building and Civil among others. The maintenance manager is responsible for the planning and control of maintenance operations. In a small firm, the functions may be undertaken by a member of staff in addition to his other duties, while in a larger firm there will be a separate group of people solely responsible for maintenance. Ikpo (2006), asserted

that the organizational structure found in most maintenance organizations is pyramidal in nature showing a deep structure.

2.16 The Functions of the Maintenance Department

The maintenance department among other things performs several functions. Lee (1987) opined that maintenance department carries out a wide range of functions such as Advisory, Organizational, Control and Miscellaneous.

2.16.1 Advisory function:

This involves liaison with occupants and users and consultation with upper management on such matters as:

- The standards to be maintained and the effect on user activities of deviations from these standards.
- The relative merits of alternative maintenance policies and the extent to which it would be advantageous to employ operatives directly for executing the work.
- Clarification of any constraints in relation to limits of expenditure, desirable cash flow patterns acceptable delay times or restrictions on and method of carrying out work.
- Estimates of maintenance expenditure both long and short term, including, where appropriate, the cost of initially bringing up to the required standard and the possibility of phasing out any such backlog over a period of years.
- Provision of cost and other data to assist upper management in deciding whether to repair or renew.

- Technical requirement for minor works involving alterations or small additions to the building; although not strictly maintenance it is usual for the maintenance organization to assume full responsibility for this type of work.
- Advice on the maintenance implications of designs for proposed new buildings.

2.16.2 Organizational Function

This may be in relation to the central administrative and supervisory system or to the execution system whether by direct labour or contract.

2.16.3 Control Function

The control functions are dependent on the timely receipt of accurate information relating to the state of the system. The control functions operate in the following areas.

- **Work output:** Identifying the extent of work necessary to achieve the required standards within the constraints laid down. The processes involved would include planned inspections approval of user requests and assignment of labour force.
- **Time of execution:** Programming the work load so that carrying out of the work is timed in accordance with the needs of the user and the available labour force.
- **Quality:** Supervision of work during execution and by subsequent control inspections to detect lateral defects.
- **Cost:** Budgetary control system including estimating resource requirement in cost and performance terms for later comparison with actual cost and performance achieved.

- **Feedback:** This is an inherent feature of all the control functions and involves keeping such records as are necessary for the proper control of the operations.

2.16.4 Miscellaneous functions

The maintenance organization may have responsibility for other matters such as safety and security principally in relation to compliance with statutory fire precautions and the maintenance of firefighting equipment for refuse disposal, cleaning, etc.

2.17 Procedure for Carrying Out Maintenance

In order to carry out maintenance work effectively the following procedures normally must be followed:

- Identify the problem: this can be done, through examination of the building, critical observation and inspection.
- Study the problem and analyze it to identify possible cause; this will help find the solution.
- Plan the cause of action and list the various tasks that will be required in renovating the building (operational sequence)
- Estimate the cost of the maintenance work if it is an organization then write officially to the authorities for the maintenance work, which should include the problem and the cost of the maintenance work.
- Carry out maintenance work using appropriate skills and after the request has been approved and the necessary materials and funds provided.

- Test or evaluate the project
- Write a report

2.18 Maintenance Policy

B S 3811(1993), define maintenance policy as a strategy within which decisions on maintenance are taken, alternatively, it may be defined as the ground rule for the allocation of resources between the alternate types of maintenance actions available to management. In order to make a rational allocation of resources the benefits of those actions to the organization as a whole must be identified and related to the cost involved. Issues under consideration in a policy include; Objectives, Benefits and Policies. Closer examination further revealed that maintenance policy is influence by some criteria which occasionally could be conflicting. These are;

- **Social Criteria**-This involves providing a quick service to high standards of quality
- **Financial Criteria** -This involves investing funds in activities in the most efficient manner with due regard to the effects on debt charges subsidies and rent.
- **Technical Criteria** - This also deals with the maintenance of a property at a level deemed necessary after thorough and regular technical survey, to provide continuous employment for certain operatives within a fixed budget. Afrane (2017), stated that, the poor housing maintenance problems in Ghana has severe consequences and requires serious attention and concerted efforts from all stakeholders at all levels. In order to address these problems policies should be formulated to promote sustainable housing delivery system

that gives a balanced focus to a vigorous housing production and maintenance programmers in the country. He suggested five broad policy interventions to be used namely;

- **Prevention and cost reduction measures.** It deals with the use of appropriate building materials, application of relevant technology, and adoption of appropriate designs, proper location and quality control and training and certification of artisans.
- **Attitudinal change mechanism.** It focuses primarily on maintenance education and awareness creation aimed at addressing the root causes of the poor maintenance culture.
- **Maintenance compelling measures.** It deals with the institution of appropriate legal requirements, standard maintenance agreements, specification of maintenance responsibilities of landlords and tenants and drawing maintenance plans and budgets.
- **Maintenance regulatory framework.** This policy seeks to define the role of the central and local governments, private and public institutions in maintenance activities .It is recommended that the Public Works Department should be transformed in to National Maintenance Agency to provide public education and technical services to promote healthy maintenance behavior and attitudes in the country .The Building Inspectorate Division of the Metropolitan ,Municipal and District Assemblies should also be tasked to conduct regular monitoring and assessment of the state of maintenance of buildings in their areas of jurisdiction to enable authorities to enforce maintenance regulations .

- Incentives for the promotion of regular maintenance. There should be policy interventions to institute incentives and sanctions for the promotion of positive maintenance culture at all levels this should include various methods of fund mobilization and the institution of various awards and sanctions to encourage maintenance activities among property owners.

2.19 The Role of Maintenance Manager (Officer)

Lee and Yuen (1993), stated that, the maintenance officer should be able to draw the attention of management to items which are very expensive to maintain and those with persistent maintenance problems and organize training to improve the skills of members of the organization.

The functions of the maintenance manager include, he;

- Meets maintenance financial standards by providing annual budget information, monitoring expenditures, identifying variances and implementing corrective actions.
- Maintains safe and healthy work environment by following standards and procedures, complying with legal codes and regulations
- Accomplishes maintenance and organization mission by completing related results as needed
- Evaluates functionality and reliability of facility systems and associated equipment by conferring with departments, identifying problems and requirements

- Improves function and reliability of facility systems and associated equipment by studying performance results; identifying, recommending, implementing changes, expansions and additions
- Updates job knowledge by participating in educational opportunities and reading technical publications
- Meets maintenance operational standards by contributing maintenance information to strategic plans and reviews; implementing production, productivity, quality and customer-service standards, and resolving problems.

2.20 Funding for Maintenance Activities of Public Institutions

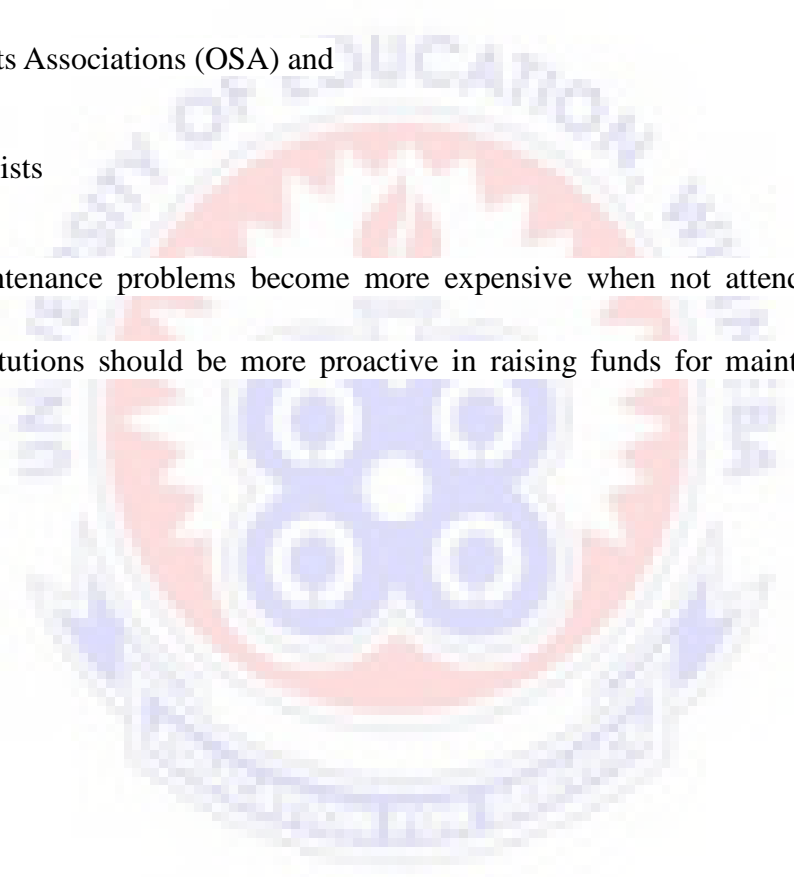
Funding is the act of providing financial resources, usually in the form of money, or other values such as effort or time, to finance a need, program, and project, usually by an organization or company.

Maintenance of buildings requires huge capital expenditure. Public institutions rely on central government funds to cover maintenance expenses. Maintenance expenditure is normally captured in the General Maintenance and Repair Fund and included in their annual budget submitted to the government. Government funding of maintenance activities in public institutions have been dwindling over the years of which public institutions in the Tamale Metropolis is no exception. In the case of Ghana Health Service, the fund is supplemented with part of its internally generated fund because funds from central government are usually woefully inadequate to meet the maintenance needs. In public sector such as schools and universities Ghana education trust fund (GET Fund) is also a source from which funds are

sought to maintain the existing structures in the country. Moses (2014) also listed the following to be the other sources of funding for maintenance works in public institutions in Ghana:

- Non-governmental Organizations (NGOs)
- Parent Teacher Associations (PTA)
- Old Students Associations (OSA) and
- Philanthropists

Generally, maintenance problems become more expensive when not attended to on time. Therefore, institutions should be more proactive in raising funds for maintenance of their buildings.



CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the research methodology of the study. The chapter is presented under the following sections namely; profile of the study area, research design, population, sampling techniques and sample size, data collection techniques and data analysis.

3.2 Profile of the Study Area

The Tamale Metropolitan Assembly is one of the 26 districts in the Northern Region. It is located in the central part of the Region and shares boundaries with the Sagnarigu District to the North-West, Mion District to the East, and East Gonja to the South and Central Gonja to the South -West. The Tamale Metropolitan Assembly was established by Legislative Instrument (L.I.2068). The population of the metropolis is 223,525 according to the 2010 Population and Housing Census. Of the total population, there are more females 112,143(50.2%) than males 111,109(49.8%), (Ghana Statistical Service, 2010).

3.3 Research Design

The descriptive case study design approach was used to investigate the concept of building maintenance as applied in public institutions in Ghana with particular reference to the following selected public institutions within the Tamale Metropolitan area, namely;

- University for Development Studies-Tamale Campus
- Ghana Health Service-Tamale Teaching Hospital

- Dabokpa Technical Institute-Tamale

Kumekpor (2002), stated that, a case study can be conceived as a method of investigation which aims at studying the facts of a particular case from all aspects and from all angles. It is thus a critical and systematic examination into the circumstances and factors that resulted in a particular condition or situation.

3.4 Population

The target population of this research include; buildings of the selected public institutions in the Tamale Metropolis, Workers of Ghana Health Service (Tamale Teaching Hospital), Staff and Students of Dabokpa Technical Institute (Dabotech) and Workers of University for Development Studies (UDS) Tamale Campus.

3.5 Sampling Techniques and Sample Size

The researcher used purposive sampling technique to select the three public institutions out of the many public institutions in the Tamale Metropolis. Simple random sampling was then adopted to select the occupants and users of public buildings of the three institutions in the Tamale Metropolis, namely; Workers of Ghana Health Service (Tamale Teaching Hospital), Staff and Students of Dabokpa Technical Institute and Workers of University for Development Studies. The simple random method was employed based on the fact that each member of the respondents could enjoy equal chance of being selected to err their views. The housing and building types identified in the institutions include:

- University for Development Studies (UDS) Tamale Campus; Lecture halls, hostels, offices, kitchen, clinic, workshops, bungalows/quarters, library, mosque, toilets and bathrooms.
- Dabokpa Technical Institute; Classroom blocks, dormitories, offices, workshops, toilet and baths, kitchen, library and mosque.
- Ghana Health Service (Tamale Teaching Hospital); Bungalows/quarters, offices, kitchen, toilets and baths, workshop, wards, consulting rooms and mosque.

The researcher administered a total of ninety-five (95) questionnaires to Teachers and Students of Dabokpa Technical Institute, Workers of University for Development Studies (UDS) and Workers of Tamale Teaching Hospital (TTH) / Ghana Health Service. Out of the total number of 95 questionnaires administered to the respondents 88 were retrieved representing ninety-two-point six (92.6) percent of the total population. The sample size of the study was 88 and distributed as follows: Staff of Dabokpa Technical Institute 26, Students of Dabokpa Technical Institute 20, and Workers of University for Development Studies 20 and Workers of Tamale Teaching Hospital/Ghana Health Service 22.

Table 3. 1 Building types in the three Institutions

Institution	Building types							
	Bungalow/ Quarters	Office	Dormitory	Classroom Block	Kitchen	Toilet	Library	Workshop
UDS-Tamale	15	10	8	15	2	4	1	1
Dabotech	4	6	4	10	1	2	1	5
GHS/TTH	12	8	-	-	1	2	-	1
Total	31	24	12	25	4	8	2	7

Source: Field Data, 2018.

3.6 Data Collection Techniques

The data collection techniques used by the researcher for this study are; Questionnaires, interviews and observation.

3.6.1 Questionnaires

Questionnaires were developed and administered personally to Workers of University for Development Studies-Tamale Campus, Workers of Ghana Health Service-Tamale Teaching Hospital and the Staff and Students of Dabokpa Technical Institute. Among the issues involved in the questionnaires were; the number of years the respondents stayed in their respective institutions, components that are attacked by fungi resulting in decay, design of the buildings and its effect on maintenance, cracks in buildings, faded paintings and its

associated maintenance problems, leaking of roofs, maintenance policies and practices of buildings in public institutions and funding of maintenance activities in the public institutions.

The researcher piloted the questionnaires on a group of management of the three public institutions and their conditions were then incorporated in the final questionnaire by way of a review based on the information gathered by the researcher.

3.6.2 Interview

The researcher interviewed maintenance Managers and Officers of Tamale Teaching Hospital of Ghana Health Service. Among the issues discussed were the state of building components of public buildings, ages of buildings, maintenance budget, factors impeding effective maintenance of buildings, attitude of users towards maintenance of public buildings, maintenance challenges in public institutions and funding of maintenance activities in public institutions.

3.6.3 Observation

The researcher undertook field observation to identify various defects on buildings in the selected public institutions in the Tamale Metropolis. The attributes, issues and maintenance challenges that were looked out for during the observation trip include; cracks on walls and floors, broken doors and windows, faulty sewerage systems, non-functional electrical and sanitary fittings, damaged ceilings, faded paints, leaking roofs and broken-down drains among other problems.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results and discussions from the questionnaires, interviews and observation conducted by the researcher.

4.2 Results of Questionnaires

4.2.1 Results of Questionnaires from Staff of Dabokpa Technical Institute

4.2.1.1 Background of respondents

Table 4. 1 Gender of the respondents

Gender	Frequency	Percentage (%)
Male	20	76.9
Female	6	23.1
Total	26	100.0

Source: Field Data, 2018

The results on the gender from the respondents indicated that, both males and females were captured in the study. This is because the views of both genders were needed to make fair conclusions on the issue of maintenance of public buildings in the Tamale Metropolis. Out of the 26 respondents, 20 respondents representing 76.9% were males while 6 respondents representing 23.1% were also females. This means that there were more males than females

Table 4. 2 Number of years in the institution

Number of years	Frequency	Percentage (%)
1-3 years	6	23.1
4-6 years	8	30.8
7-9 years	7	26.9
10 years and above	5	19.2
Total	26	100.0

Source: Field Data, 2018

Table 4.2 illustrate the number of years the respondents have stayed in the institution, 6 respondents representing 23.1% revealed that they have stayed in the institution for 1-3 years, 8 participants representing 30.8% said they have stayed for 4-6 years, 7 participants representing 26.9% indicated they stayed for 7-9 years and 5 respondents representing 19.2% also said they stayed for 10 years and above. The results indicate that majority of the respondents have worked in the institution for 4-6 years and hence have more knowledge on the maintenance situation in the institution.

4.2.1.2 Current state of building components

Table 4. 3 State of foundations of buildings

Responses	Frequency	Percentage (%)
Developed cracks	9	34.6
Exposed/hanging	9	34.6
No problem	8	30.8
Total	26	100.0

Source: Field Data, 2018

Table 4.3 outlined the state of building foundations in the institution. Out of the 26 respondents, 9 respondents representing 34.6% indicated that the foundations of buildings in their institution had developed cracks, another 9 respondents representing 34.6% indicated that their foundations were exposed/hanging while 8 respondents representing 30.8% also said their building foundations had no problem. The results showed that most of the building foundations had either developed cracks or exposed while some had no problems.

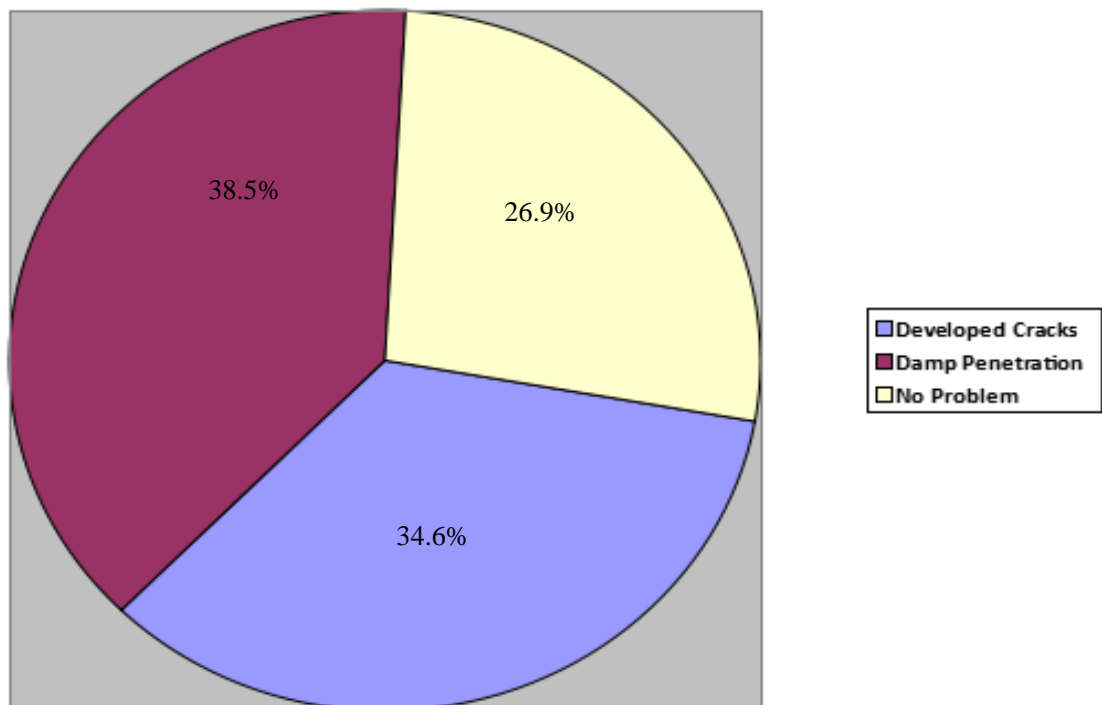


Figure 4. 1 Condition of Floor screeds of buildings

Source: Field Data, 2018

On the condition of floor screed of buildings in the figure 4.1 above, 9 of the respondents representing 34.6% said the floor screed of their buildings had developed cracks, 10 respondents representing 38.5% indicated that their floor screeds had damp penetration and 7

of them representing 26.9% also indicated that their floor screeds had no problem. This result means that most of the building floor screeds of the institution have developed dampness and cracks while few of them have no problem.

Table 4. 4 State of walls of buildings

Responses	Frequency	Percentage (%)
Develop cracks	11	42.3
Partly broken	4	15.4
Damp penetration	8	30.8
No problem	3	11.5
Total	26	100.0

Source: Field Data, 2018

From the results in table 4.4, there was considerable variation in the opinions expressed by the respondents with respect to the state of walls of buildings in the institution. 11 of the respondents representing 42.3% said the walls of their buildings had developed cracks, 4 of the respondents representing 15.4% indicated that their walls were partly broken, 8 of them representing 30.8% said their walls had damp penetration and 3 respondents representing 11.5% indicated that their walls had no problem. It is clear from the results that cracks and damp penetration were the major defects on walls and therefore needs maintenance.

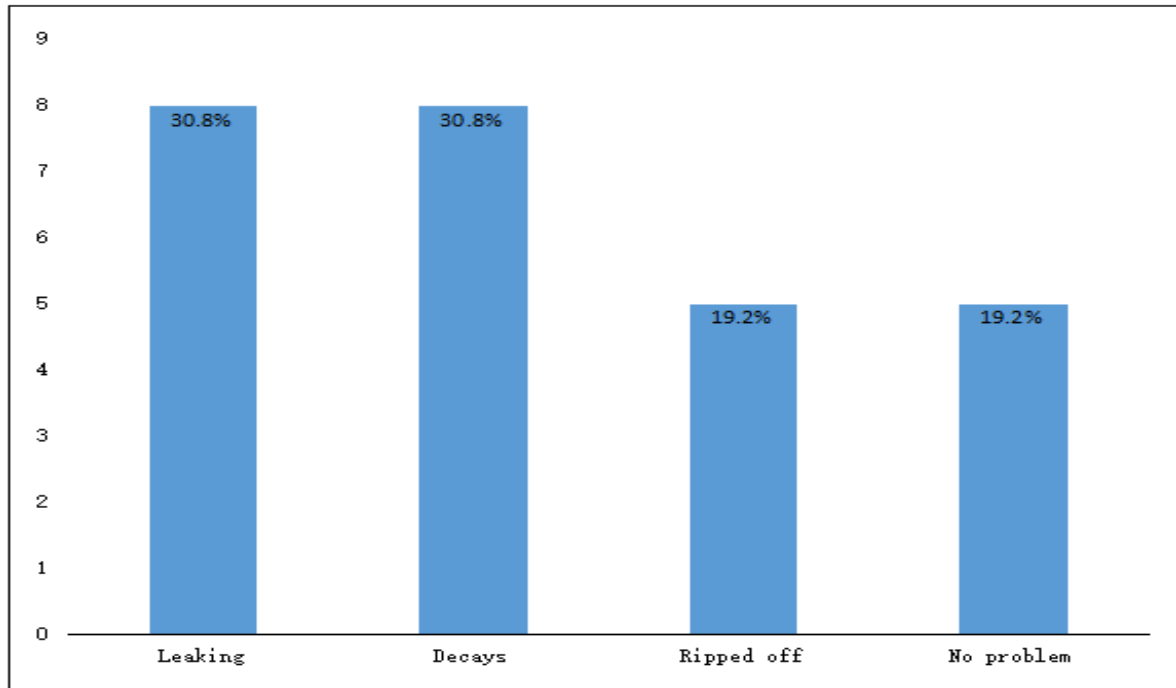


Figure 4. 2 Condition of roofs of buildings

Source: Field Data, 2018

Figure 4.2 displayed responses on the condition of building roofs in the institution. 8 of the participants representing 30.8% indicated that their roofs were leaking, another 8 of the respondents representing 30.8% said their building roofs decays, 5 respondents representing 19.2% said their roofs were ripped off by rain storm and the remaining 5 respondents representing 19.2% also indicated that their building roofs had no problem. The results revealed that the most challenging defects of building roofs were leakages and decay.

Table 4. 5 State of painting of buildings

Responses	Frequency	Percentage (%)
Peeled off	6	23.1
Faded	7	26.9
Discoloured	11	42.3
No problem	2	7.7
Total	26	100.0

Source: Field Data, 2018

Respondents were asked to indicate the state of painting of buildings in their institution. Statistically, results (table 4.5) have shown that, 6 respondents representing 23.1% indicated that their buildings paint had peeled off, 7 respondents representing 26.9% said their buildings had faded paintings, 11 respondents representing 42.3% indicated that the painting of their buildings have become discoloured and 2 respondents representing 7.7% also said their building paints had no problem. From the results, most of the participants observed that their buildings had discoloured, faded and peeled off painting respectively.

Table 4. 6 State of doors and windows

Responses	Frequency	Percentage (%)
Partly broken	12	46.1
Completely broken	8	30.8
No problem	6	23.1
Total	26	100.0

Source: Field Data, 2018

Table 4.6 outlined the state of doors and windows in the institution. 12 respondents representing 46.1% said their buildings doors and windows were partly broken, 8 of them

representing 30.8% agreed that their doors and windows were completely broken down and the remaining 6 participants consisting 23.0% also said the door and window frames of their buildings had no problem. This result indicates that, majority number of doors and windows of buildings of public institutions were not in good state.

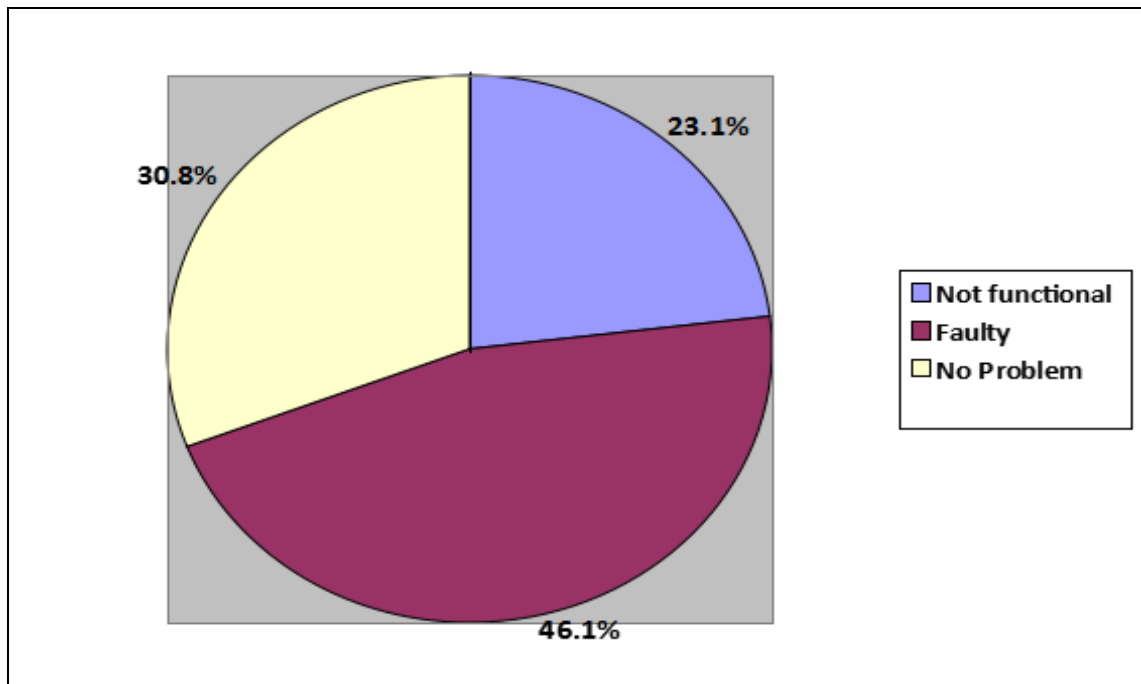


Figure 4. 3 Condition of electrical installations

Source: Field Data, 2018

Figure 4.3 displayed the condition of electrical installations of buildings in the institution. Out of the 26 usable questionnaires received from the respondents, 12 respondents representing 46.1 indicated that their electrical installations were faulty, 6 respondents representing 23.1% said their electrical installations were not functional and 8 participants representing 30.8% also indicated that their electrical installations had no problem. This result means that, majority of the electrical installations of the institution were faulty while a few had no problem.

Table 4. 7 Issue of drainage system

Responses	Frequency	Percentage (%)
Choked	10	38.3
Broken down	6	23.1
Leaks	8	30.8
No problem	2	7.7
Total	26	100.0

Source: Field Data, 2018

On the issue of drainage systems in public institutions, respondents were asked to state the appropriate conditions of their drainage systems. Out of the 26 valid questionnaires received, 10 respondents representing 38.4% said their drainage systems were choked, 6 respondents representing 23.1% indicated that their drainage systems were broken down, 8 representing 30.8% said their drainage systems were leaking while 2 of the respondents representing 7.7% said their drainage systems had no problem. These results show that majority of drainage systems of public institutions had maintenance challenges.

4.2.1.3 Factors affecting maintenance of buildings of public institutions

Table 4. 8 Factors affecting maintenance of buildings

Factors	Agree	Disagree	Neutral
Lack of maintenance culture	20(76.9%)	6(23.1%)	—
Inadequate funds	26(100.0%)	—	—
Bureaucratic reporting process	15(57.7%)	8(30.8%)	3(11.5%)
Pressure on the facility due to number of occupants	13(50.0%)	10(38.5%)	3(11.5%)
Poor work done on the building	18(69.2%)	6(23.1%)	2(7.7%)

Source: Field Data, 2018

The varying opinions of respondents were sought for in table 4.8 on factors affecting maintenance of buildings in public institutions. 20 participants representing 76.9% of the respondents agreed that lack of maintenance culture is a contributory factor affecting maintenance of public buildings, while 6 respondents representing 23.1% disagreed. In answering the question on whether inadequate funds were a factor affecting maintenance of public buildings, all the 26 respondents representing 100.0% unanimously agreed to the statement. Also, on the statement of whether bureaucratic reporting process was a factor affecting maintenance of public buildings, 15 of the respondents representing 57.7% agreed, 8 respondents representing 30.8% disagreed, while 3 respondents representing 11.5% remain neutral to the statement. On the issue of pressure on the facility due to number of occupants, 13 of the respondents representing 50.0% of the total number agreed, 8 of them representing 38.5% disagreed and the remaining 3 respondents representing 11.5% were also responded neutral to the statement. Finally, on whether poor work done on the building was a factor affecting maintenance of public buildings, 18 of the participants representing 69.2% agreed, 6 respondents representing 23.1% did not agree while the remaining 2 respondents representing 7.7% were neutral to the statement. The above discussions show that, lack of maintenance culture, inadequate funds, bureaucratic reporting process, pressure on the facility due to number of occupants and poor work done on the building respectively were the major factors affecting maintenance of public infrastructure as revealed by the respondents.

Table 4. 9 Those responsible for maintenance of buildings in public institutions

Responses	Frequency	Percentage (%)
Government	10	38.4
Users	8	30.8
Institutions	6	23.1
All of the above	2	7.7
Total	26	100.0

Source: Field Data, 2018

Table 4.9 displayed responses on the issue of those responsible for maintenance of buildings in public institutions. 10 of the participants representing 38.4% stated that government is responsible for maintenance of public infrastructure, 8 of the respondents representing 30.8% indicated that users of public infrastructure are responsible for its maintenance, 6 of them representing 23.1% were also of the view that authorities of public institutions are responsible for maintenance of its own infrastructure, and the remaining 2 respondent representing 7.7% also asserted that all the stakeholders mentioned have a role to play in the maintenance of buildings of public institutions. This result means that government is the major stakeholder in the maintenance of buildings of public institutions.

Table 4. 10 maintenance schedule at the maintenance department of public institutions

Maintenance schedule	Frequency	Percentage (%)
Monthly	--	--
Quarterly	2	7.7
Annually	10	38.4
Others	14	53.9
Total	26	100.0

Source: Field Data, 2018

The views of respondents were solicited on the type of maintenance schedule at the maintenance departments of public institutions. None of the respondents agreed that maintenance activities were carried out every month, 2 respondents representing 7.7% stated that maintenance activities were done quarterly, 10 respondents representing 38.4% indicated that maintenance activities were carried out annually and 14 of them representing 53.9% also indicated other maintenance schedules such as two to three years period and as and when funds were available. It can be deduced from the results that, majority of the maintenance activities were carried out as and when funds were available while some were done annually.

Table 4. 11 Funding for maintenance

Sources	Frequency	Percentage (%)
I.G.F	11	42.3
Budgetary allocation	6	23.1
Non-governmental organizations	2	7.7
GET Fund	4	15.4
Others	3	11.5
Total	26	100.0

Source: Field Data, 2018

The varying opinions of respondents were sought for in table 4.11 on the sources of funding for maintenance activities in public institutions. 11 participants representing 42.3% indicated internally generated funds (I.G.F), 6 participants representing 23.1% indicated annual budgetary allocation, 2 participants representing 7.7% said non-governmental organizations, 4 participants representing 15.4% indicated that maintenance works were funded by Ghana Education Trust fund (GET fund) and 3 participants representing 11.5% also indicated that

maintenance activities were funded by other sources. It is clear from the results that the major sources of funding for maintenance activities in public institutions were internally generated funds and government annual budgetary allocation to public institutions.

4.2.2 Results of Questionnaires from Workers of Tamale Teaching Hospital

4.2.2.1 Background of respondents

Table 4. 12 Gender of the respondents

Gender	Frequency	Percentage (%)
Male	16	72.7
Female	6	27.3
Total	22	100.0

Sources: Field Data, 2018

The results on the gender from the respondents indicated that, both males and females were captured in the study. This is because the views of both genders were needed to make fair conclusion on the issue of maintenance of public buildings in the Tamale Metropolis. Out of 22 respondents, 16 of them representing 72.7% were males while 6 respondents representing 27.3% were also females. This means that there were more males than females.

Table 4. 13 Number of years in the institution

Number of years	Frequency	Percentage (%)
1-3 years	4	18.2
4-6 years	6	27.3
7-9 years	9	40.9
10 years and above	3	13.6
Total	22	100.0

Source: Field Data, 2018

Table 4.13 outlined the number of years the respondents have stayed in the institution. 4 respondents representing 18.2% revealed that they have stayed in the institution for 1-3 years, 6 respondents representing 27.3% revealed that they have stayed for 4-6 years, 9 respondents representing 40.9% indicated that they have stayed for 7-9 years and 3 participants representing 13.6% also stated that they have stayed in the institution for 10 years and above. The results indicate that majority of the respondents have stayed in the institution for 7-9 years and hence have in-depth knowledge on the maintenance situation in the institution.

4.2.2.2 Current state of building components of buildings of public institutions

Table 4. 14 Current state of building components

Component	Current State		
	Good	Fairly good	Bad
Foundations	10(45.5%)	7(31.8%)	5(22.7%)
Floor screed	8(36.4%)	9(40.9%)	5(22.7%)
Walls	6(27.3%)	12(54.5%)	4(18.2%)
Roofs	1(5.9%)	7(31.8%)	2(9.1%)
Painting	7(31.8%)	10(45.5%)	5(22.7%)
Doors and windows	8(36.4%)	10(45.5%)	4(18.2%)
Electrical installations	9(40.9%)	9(40.9%)	4(18.2%)
Drainage systems	7(31.8%)	12(54.5%)	3(13.7%)

Source: Field Data

The views of respondents were solicited on the current state of building components in public institutions. Out of the 22 respondents, 10 of them representing 45.5% indicated that the foundations of buildings in their institution were in good state, 7 respondents representing

31.8% indicated that their building foundations were in fairly good condition while 5 respondents representing 22.7% also indicated that their building foundations were in bad state. On the state of floor screeds of buildings, 8 participants representing 36.4% revealed that the floor screeds of buildings in their institution were good, 9 participants representing 40.9% indicated that their floor screeds were fairly good and 5 participants representing 22.7% also stated that the floor screeds of their buildings were bad. On the state of walls, 6 participants representing 27.3% said good, 12 participants representing 54.5% said fairly good and 4 participants representing 18.2% also indicated bad. Finally, on the state of roofs of buildings, 13 participants representing 59.1% indicated good, 7 participants representing 31.8% indicated fairly good and 2 participants representing 9.1% also indicated that the roofs of buildings in their institution were in bad state. The data gathered shows that the general conditions of building components were fairly good while just a few were in bad state.

Table 4. 15 Factors contributing to early deterioration of buildings

Factors	Frequency	Percentage (%)
Faulty design	9	40.9
Faulty execution	10	45.5
Vandalism	3	13.6
Total	22	100.0

Source: Field Data, 2018

Table 4.15 outlined the factors contributing to early deterioration of buildings of public institutions. Out of the 22 respondents, 9 of them representing 40.9% affirmed that faulty design of buildings of public institutions is a contributory factor to its early deterioration, 10 respondents representing 45.5% indicated that faulty execution of building works is a

contributory factor to early deterioration of buildings of public institutions while 3 respondents representing 13.6% also believe that vandalism of buildings on the part of users was also a factor contributing to early deterioration of buildings in public institutions. The results show that faulty execution of building works in public institutions and faulty design were the major factors contributing to early deterioration of buildings in public institutions. Seeley (1997), emphasized that, a skillful design can reduce the amount of maintenance work and also make it easier to perform, since good maintenance begins on the drawing board.

Table 4. 16 Forms of maintenance

Forms	Frequency	Percentage (%)
Rehabilitation	1	4.5
Repairs	10	45.5
Renovation	7	31.8
Refurbishment	4	18.2
Total	22	100.0

Source: Field Data, 2018

From the results in table 4.16, there was considerable variation in the opinions expressed by the respondents with respect to the forms of maintenance practiced in public institutions. Out of the 22 respondents, 1 respondent representing 4.5% indicated they practice rehabilitation, 10 respondents representing 45.5% indicated repairs, 7 respondents representing 31.8% indicated renovation and 4 respondents representing 18.2% also indicated refurbishment. The study revealed that the most common forms of maintenance practiced in public institutions were repairs and renovation.

Table 4. 17 Types of maintenance

Maintenance types	Frequency	Percentage (%)
Planned	4	18.2
Unplanned	7	31.8
Corrective	9	40.9
Routine	2	9.1
Total	22	100.0

Source: Field Data, 2018

As indicated in table 4.17, participants were asked to state the type of maintenance practiced in public institutions. Out of the 22 participants, 4 of them representing 18.2% said planned maintenance, 7 respondents representing 31.8% said unplanned maintenance, 9 respondents representing 40.9% indicated corrective maintenance and 2 respondents representing 9.1% also indicated routine maintenance. The results clearly show that the most popular type of maintenance practiced in public institutions was corrective maintenance which is a type of unplanned maintenance.

Table 4. 18 Components of maintenance

Components	Frequency	Percentage (%)
Servicing	7	31.8
Rectification	5	22.7
Replacement	10	45.5
Total	22	100.0

Source: Field Data, 2018

In table 4.18, respondents were asked to state the components of maintenance practiced in public institutions. Out of 22 participants, 7 of them representing 31.8% indicated servicing, 5 respondents representing 22.7% indicated rectification and the remaining 10 respondents representing 45.5% also indicated replacement. It can be seen from the results that replacement and servicing were the major components of maintenance practiced in public institutions.

Table 4. 19 Types of residential buildings

Types of buildings	Frequency	Percentage (%)
Detached bungalow	5	22.7
Semi-detached bungalow	16	72.8
Blocks of flats	1	4.5
Total	22	100.0

Source: Field Data, 2018

Table 4.19 displayed response on the type of residential buildings occupied by respondents in public institutions. 5 respondents representing 22.7% indicated that they occupied detached bungalows, 16 respondents representing 72.8% indicated semi-detached bungalows and 1 respondent representing 4.5% also indicated blocks of flats. This result indicates that majority of the workers in public institutions were living in semi-detached bungalows.

Table 4. 20 Funding of maintenance

Options	Frequency	Percentage (%)
I.G F	10	45.5
Budgetary allocation	8	36.4
GET Fund	4	18.2
Total	22	100.0

Source: Field Data, 2018

On the funding of maintenance activities in public institutions, 10 respondents representing 45.4% indicated internally generated funds, 8 respondents representing 36.4% indicated annual budgetary allocation and 4 respondents representing 18.2% were also of the view that Ghana Education Trust Fund was the source of funding for maintenance works in public institutions. The results revealed that, the main sources of funding for maintenance activities in public institutions were internally generated funds from the institutions and the annual budgetary allocation from government to public institutions.

4.2.3 Results of Questionnaires from Workers of University for Development Studies

4.2.3.1 Background of respondents

Table 4. 21 Gender of the respondents

Gender	Frequency	Percentage (%)
Male	14	70.0
Female	6	30.0
Total	20	100.0

Source: Field Data, 2018

The results on the gender from the respondents indicated that, both males and females were captured in the study. This is because the views of both genders were needed to make fair

conclusion on the issue of maintenance of public buildings in the Tamale Metropolis. Out of 20 respondents, 14 respondents representing 70% were males while 6 respondents representing 30% were also females. This means that there were more males than females.

Table 4. 22 Number of years in the institution

Number of years	Frequency	Percentage (%)
1-4 years	7	35.0
5-8 years	10	50.0
9 years and above	3	15.0
Total	20	100.0

Source: Field Data, 2018

Table 4.22 outlined the number of years the respondents have stayed in their institution. 7 participants representing 35.0% revealed that they have stayed in their institution for 1-4 years, 10 participants representing 50.0% said they stayed for 5-8 years and 3 participants representing 15.0% also said they stayed for 9 years and above. The results indicate that majority of the respondents have worked in the institution for 5-8 years and therefore have more knowledge on the maintenance situation in the institution.

4.2.3.2 Current state of building components

Table 4. 23 Current state

Components	Good	Fairly good	Bad
Foundations	6(30.0%)	12(60.0%)	2(10.0%)
Floor screed	8(40.0%)	10(50.0%)	2(10.05%)
Walls	5(25.0%)	11(55.0%)	4(20.0%)
Roofs	6(30.0%)	12(60.0%)	2(10.0%)

Source: Field Data, 2018

Table 4.23 displayed responses on the current state of building components of buildings in the institution. On the state of foundations of buildings in the institution, out of 20 respondents, 6 of them representing 30.0% stated that the foundations of buildings in their institution were in good state, 12 respondents representing 60.0% indicated that their building foundations were fairly good and 2 respondents representing 10.0% also revealed that their building foundations were in a bad state. On the state of floor screed of buildings, 8 respondents representing 40.0% indicated that their floor screeds were good, 10 respondents representing 50.0% indicated that their floor screeds were fairly good and the remaining 2 respondents representing 10.0% also indicated that their floor screeds were bad. Also, on the state of walls of buildings, 5 respondents representing 25.0% said good condition, 11 respondents representing 55.0% responded fairly good and 4 respondents representing 20.0% also said their walls were in a bad state. Finally, on the state of building roofs, 6 respondents representing 30.0% said the roofs were in good state, 12 respondents representing 60.0% indicated that the roofs were in fairly good state and the remaining 2 respondents representing 10.0% also indicated that their roofs were in a bad state. The data gathered shows that the general conditions of building components were fairly good which is not entirely the best while just a few were in a bad state.

4.2.3.3 Factors affecting maintenance of building of public institutions

Table 4. 24 Factors contributing to early deterioration of buildings

Factors	Frequency	Percentage (%)
Faulty design	7	35.0
Faulty execution of work	7	35.0
Vandalism	6	30.0
Total	20	100.0

Source: Field Data, 2018

On the factors contributing to early deterioration of buildings in table 4.24, 7 participants representing 35.0% affirmed that faulty design of buildings is a contributory factor to early deterioration of buildings, another 7 respondents representing 35.0% believed that faulty execution of building works is a factor to early deterioration of buildings while 6 respondents representing 30.0% also affirmed that vandalism of buildings on the part of users and occupants is also a factor contributing to early deterioration of buildings of public institutions. The results show that faulty design, faulty execution and vandalism respectively were the major factors among others contributing to early deterioration of buildings in public institutions.

Table 4. 25 Factors affecting maintenance of public buildings

Factors	Frequency	Percentage (%)
Lack of maintenance culture	6	30.0
Inadequate funds	7	35.0
Unsuitable materials	3	15.0
High maintenance cost	4	20
Total	20	100.0

Source: Field Data, 2018

In determining the factors affecting maintenance of public buildings, 6 respondents representing 30% indicated lack of maintenance culture by building users, 7 respondents representing 35.0% indicated inadequate funds, 3 respondents representing 15.0% indicated unsuitable materials and 4 respondents representing 20.0% also indicated that high cost of maintenance is a factor affecting maintenance of buildings in public institutions. The statistics of the study shows that the major factors affecting maintenance of buildings of public institutions were inadequate funds, lack of maintenance culture and high cost of maintenance respectively.

4.2.3.4 Maintenance policies and practices of buildings in public institutions

Table 4. 26 Forms of maintenance

Forms of maintenance	Frequency	Percentage (%)
Rehabilitation	2	10.0
Repairs	10	50.0
Renovation	6	30.0
Refurbishment	2	10.0
Total	20	100.0

Source: Field Data, 2018

From the results in table 4.26, there was considerable variation in opinions expressed by the respondents with respect to the forms of maintenance practiced in public institutions, out of 20 respondents, 2 of them representing 10.0% indicated rehabilitation, 10 respondents representing 50.0% indicated repair, 6 respondents representing 30.0% indicated renovation, and 2 respondents representing 10.0% also indicated refurbishment. The study therefore revealed that the commonest forms of maintenance practiced in public institutions were repair and renovation.

Table 4. 27 Types of maintenance

Maintenance types	Frequency	Percentage (%)
Planned	2	10.0
Unplanned	6	30.0
Corrective	8	40.0
Routine	4	20.0
Total	20	100.0

Source: Field Data, 2018

As indicated in table 4.27, participants were asked about the type of maintenance practiced in public institutions, 2 participants representing 10.0% indicated planned maintenance, 7 participants representing 35.0% said unplanned maintenance, 8 participants representing 40.0% indicated corrective maintenance and 3 participants representing 15.0% also indicated routine maintenance. The results clearly show that the most prominent types of maintenance practiced in public institutions were corrective and unplanned maintenance.

Table 4. 28 Components of maintenance

Component	Frequency	Percentage (%)
Servicing	6	30.0
Rectification	3	15.0
Replacement	11	55.0
Total	20	100.0

Source: Field Data, 2018

From table 4.28, respondents were asked to state the components of maintenance practiced in public institutions, out of the 20 participants, 6 respondents representing 30.0% indicated that they practice servicing, 3 respondents representing 15.0% said they practice rectification and

11 representing 55.0% said they practice replacement. It can be seen from the results that replacement and servicing were the major components of maintenance practiced in public institutions.

Table 4. 29 Types of residential buildings.

Type of building	Frequency	Percentage (%)
Detached bungalows	4	20.0
Semidetached bungalows	14	70.0
Blocks of flats	2	10.0
Total	20	100.0

Source: Field Data, 2018

Table 4.30 displayed responses on the type of residential buildings occupied by respondents in public institutions. 4 of the participants representing 20.0% said their institution had detached bungalows, 14 of them representing 70.0% said their institution had semi-detached bungalows and 2 respondents representing 10.0% also indicated that their institution had blocks of flats as buildings for accommodation. This result indicates that majority of the workers in the institution were living in semi-detached bungalows as accommodation.

Table 4. 30 Funding of maintenance

Options	Frequency	Percentage (%)
I.G. F	12	60.0
Budgetary allocation	6	30.0
GET Fund	2	10.0
Total	20	100.0

Source: Field Data, 2018.

On the funding of maintenance activities in the institution, 12 respondents representing 60.0% indicated internally generated funds was their source of funding for maintenance activities, 6 respondents representing 30.0% said the source of funding for maintenance activities was through annual budgetary allocation by government and the remaining 2 respondents representing 10.0% were also of the view that Ghana Education Trust Fund (GET Fund) was the source of funding for maintenance works in public institutions. The results revealed that the major sources of funding for maintenance activities was through internally generated funds (I.G.F) and annual budgetary allocation.

4.2.4 Results of questionnaires from students of Dabokpa Technical Institute

4.2.4.1 Background of respondents

Table 4. 31 Gender of the respondents

Gender	Frequency	Percentage (%)
Male	12	60.0
Female	8	40.0
Total	20	100.0

Source: Field Data, 2018

The results on the gender from the respondents indicate that both males and females were captured in the study. This is because the views of both genders were needed to make fair conclusion on the issue of maintenance of buildings of public institutions in the Tamale Metropolis. Out of 20 respondents, 12 of them representing 60.0% were males while 8 respondents representing 40.0% were also females. This means that there were more males than females.

Table 4. 32 Number of years in the institution

Number of years	Frequency	Percentage (%)
1-2 years	9	45.0
3-4 years	11	55.0
5 years and above	—	—
Total	20	100.0

Source: Field Data, 2018

Table 4.32 outlined the number of years the respondents have stayed in the institution. 9 respondents representing 45.0% revealed that they have stayed in the institution for 1-2 years and 11 respondents representing 55.0% also said they have stayed for 3-4 years. The results tabulated revealed that majority of the respondents have stayed in the institution for 3-4 years and hence have knowledge on the maintenance situation in the institution.

4.2.4.2 Current state of building components of buildings of public institutions.

Table 4. 33 Current state of building components

Components	Good	Fairly good	Bad
Drainage	6(30.0%)	10(50.0%)	4(20.0%)
Floor screed	9(45.0%)	11(55.0%)	—
Walls	9(45.0%)	6(30.0%)	5(25.0%)
Painting	5(25.0%)	9(45.0%)	6(30.0%)
Roofs	8(40.0%)	8(40.0%)	4(20.0%)
Foundations	10(50.0%)	8(40.0%)	2(10.0%)
Doors and windows	7(35.0%)	10(50.0%)	3(15.0%)

Source: Field Data, 2018

The views of respondents were solicited on the current state of building components in the institution. Out of the 20 respondents, 6 of them representing 30.0% indicated that the drainage system in their institution was in good state, 10 respondents representing 50.0% indicated fairly good while 4 respondents representing 20.0% also said the drainage systems in their institution was in a bad state. On the state of floor screed, 9 respondents representing 45.0% indicated good and 11 respondents representing 55.0% also said the floor screed of buildings was in fairly good state. On the state of walls of buildings in the institution, 9 respondents representing 45.0% indicated that the walls were in good condition, 6 respondents representing 30.0% said the walls were in fairly good condition while 5 respondents representing 25.0% also indicated that the walls were in a bad state. On the state of painting of walls in the institution, 5 respondents representing 25.0% said good, 9 respondents representing 45.0% indicated fairly good while 6 respondents representing 30.0% also revealed that the painting of walls in their institution was in a bad state. On the issue of the state of roofs of buildings in the institution, 8 respondents representing 40.0% revealed that the roofs were in good state, 8 respondents representing 40.0% indicated that their roofs were in a fairly good state and 4 respondents representing 20.0% also said the roofs of buildings in their institution were in a bad state. Also, on the state of foundations of buildings in the institution, 10 respondents representing 50.0% indicated good, 8 respondents representing 40.0% also revealed that the foundations were in fairly good state while 2 respondents representing 10.0% also indicated that the foundations of buildings in their institution were in a bad state. Finally, the opinions of respondents were also solicited concerning the state of doors and windows of buildings in the institution, 7 respondents

representing 35.0% said the doors and windows were in a good state, 10 respondents representing 50.0% indicated that their doors and windows were in a fairly good state while the remaining 3 respondents representing 15.0% also revealed that the doors and windows of buildings in their institution were in a bad state. This result show that majority of the building components in the institution were in either fairly good state or in good state while some were in a bad state.

Table 4. 34 Maintenance policy at the institution

Options	Frequency	Percentage (%)
Yes	1	5.0
No	2	10.0
Not sure	17	85.0
Total	20	100.0

Source: Field Data, 2018

Respondents were asked to indicate whether their institution had a maintenance policy. Out of the 20 usable questionnaires received from the respondents, 1 respondent representing 5.0% indicated that the institution had a maintenance policy, 2 respondents representing 10.0% said their institution had no maintenance policy while 17 respondents representing 85.0% also indicated that they were not sure whether their institution had maintenance policy. The result means that the overwhelming majority of the respondents were not sure whether their institution had a maintenance policy.

Table 4. 35 Those responsible for maintenance of buildings in public institutions

Responses	Frequency	Percentage (%)
Government	10	50.0
Users	3	15.0
Institutions	4	20.0
Not sure	3	15.0
Total	20	100.0

Source: Field Data, 2018

Table 4.35 outlined the responses of the respondents on those responsible for maintenance activities of buildings in the institution. 10 of the participants representing 50.0% indicated that government is responsible for maintenance of buildings in the institution, 3 of the participants representing 15.0% indicated that users of buildings of public institutions were responsible for its maintenance, 4 of the respondents representing 20.0% indicated that the institutions themselves were responsible for maintenance of its buildings while 3 respondents representing 15.0% also indicated that they were not sure about those responsible for maintenance activities of buildings in their institution. The results imply that majority of the respondents asserted that maintenance activities at the institution was the responsibility of the government and the authorities of the institutions.

4.3 Results of interview

4.3.1 Results of interview from Estate Managers and Officers of Tamale Teaching Hospital

4.3.1.1 Position at the place of work

In all, the researcher interviewed four (4) estate managers and officers of the institution comprising one (1) female and three (3) males. On the issue of position at the place of work,

1(one) respondent indicated estate manager, another 1(one) also indicated senior estate manager and the remaining 2(two) said they were estate officers.

4.3.1.2 Number of years in the institution

On how long they had been in the institution, 2 of the respondents indicated 6 years, 1 respondent said 4 years and the last 1 stated that he was 7 years in the institution.

4.3.1.3 Current state of building components in public institutions

On the state of public building walls, 1 of the respondents indicated that the walls of buildings in the institution was good, 1 also said better and the remaining 2 said bad. Those who said bad further indicated that the walls of buildings in their institution developed cracks which were very difficult to control. On the roofing situation in the institution, the respondents indicated that most of the roofing members such as facial boards, ceiling joists and other parts of their building roofs were only better because some have decayed while others had leakages. On the state of public building foundations, 2 of the respondents revealed that their building foundations were better, the other 2 also indicated that their building foundations were exposed, developed cracks and therefore on a bad state. Touching on the state of floor screed of buildings in the institutions, 1 of the respondents stated that it was better. The other 3 also affirmed that the floor screeds of their buildings were peeled off, developed cracks, and had damp penetration especially during rainy seasons. They concluded by saying that something needed to be done to make their buildings habitable. When the researcher interviewed the respondents on the state of public building doors and windows in the

Metropolis, it was revealed that majority of the doors and windows were defective needing repair works on them.

The defects stated by the respondents included; broken louver blades, rotten frames, faulty locks and broken joints among others. Seeking the views of respondents on the ages of buildings in their institution, majority of them classified their buildings as medium aged(20-50 years) while other buildings were also being classified as young(below 20 years).No building in the institution was classified as old(above 50 years).The results further revealed that the youngest (below 20 years) buildings were found to be one year six months old and two years old respectively while the medium aged(20-50 years) buildings were also found to be about 42 years.

4.3.1.4 Factors affecting maintenance of buildings of public institutions

In finding out whether the maintenance department of the respondent's institution undertake regular inspections on maintenance needs of buildings, all the participants interviewed stated emphatically that, they do not undertake regular inspections on the buildings but rather they wait till when funds are available for maintenance activities. They all affirmed again that their department is not well resourced to undertake regular inspection of the buildings and therefore put the buildings at risk of deterioration. Respondents were also asked whether they had maintenance budget at the institution to take care of their maintenance needs. All the respondents agreed that they do have maintenance budget, but they added that funds are normally not given when the budget is being prepared. Again, respondents were asked to give their views on factors impeding the effective maintenance of buildings of public institutions.

All the respondents mentioned lack of adequate materials and logistics and lack of adequate funds to be some of the major factors hampering the effective maintenance of buildings in public institutions.

4.3.1.5 Maintenance policies and practices of buildings in public institutions

Respondents were asked to state whether their institution had maintenance policy to safeguard maintenance of buildings. 2 of the respondents categorically stated that there was a maintenance policy at the institution but were quick to add that the implementation of the policy was usually the problem. The other 2 also stated that public institutions in the Metropolis do not have maintenance policies. They revealed that public institutions adopt corrective maintenance practices. The views of the participants were sought to ascertain whether maintenance of buildings was necessary as far as public buildings were concerned. There was a unanimous agreement by the respondents that maintenance of buildings was necessary. To buttress their answer, they stated that when buildings are left to deteriorate before repairing them it turns to cost much more than planned preventive maintenance. Concerning the attitude of users towards maintenance of public buildings in the Tamale Metropolis, all the respondents indicated that the users have look warm attitude towards maintenance of public infrastructure with the reason being that public buildings belongs to the state and for that matter their maintenance should be done by the government. The views of the respondents were solicited on how maintenance was funded in public institutions in the Metropolis. 3 of the respondents said that maintenance activities were funded through internally generated funds (I G F) of the institutions, the remaining 1 respondent affirmed that maintenance was funded through annual budgetary allocation by central government. Last but

not least, respondents were asked to indicate whether they usual keep records of maintenance activities carried out in their institution. All the respondents bemoaned that record keeping for maintenance activities in public institutions was very poor. They indicated the importance of record keeping but said it was not normally beings practiced.

4.4 Results of observations

The results of the observations made by the researcher from various sites of the study area within the Metropolis to ascertain the true state of building elements are as follows.

4.4.1 Results of observation at Dabokpa Technical Institute

At the Dabokpa Technical Institute in the Tamale Metropolis, the following observations were made. Cracks on walls and floors of the following buildings; mechanical workshop, toilet facility, dining hall, classroom blocks and the old administration block. The teacher's quarters, classroom blocks and the girl's dormitory were also observed to have faded and discoloured paints on the walls. The louver blades of windows of some of the classroom blocks were also broken posing danger to students and teachers. Rotten facial board of the toilet facility and damp penetration on walls and floors were also observed to be a challenge to users.

Photographs of some of the maintenance challenges observed at the institution are shown in figure 4.4, figure 4.5, figure 4.6, and figure 4.7.



Figure 4. 4 Rotten Facial Board of toilet building at Dabokpa Technical Institute



Figure 4. 5 Discoloured Paint of teacher's quarters building at Dabokpa Technical Institute



Figure 4. 6 Crack on Wall of mechanical workshop at Dabokpa Technical Institute



Figure 4. 7 Defective floor screed of fashion one classroom at Dabokpa Technical Institute

4.4.2 Results of observation at Tamale Teaching Hospital

At the Tamale Teaching Hospital, the following observations were also made. Cracks on walls and floors, ripped off roofing members, non-functional electrical installations, faulty drainage systems, damaged ceilings, faded and discoloured paints on walls, faulty sanitary appliances and damp penetration on walls and floors were some of the maintenance problems posing security challenges to the users.

Photographs of some of the maintenance challenges observed at the institution are shown in figure 4.8, figure 4.9, and figure 4.10.



Figure 4. 8 Crack on wall of nurses' quarters No. 2 at Tamale Teaching Hospital.



Figure 4.9: Non- Functional Electrical Installation of garage of doctors at bungalow No.5 at Tamale Teaching Hospital.

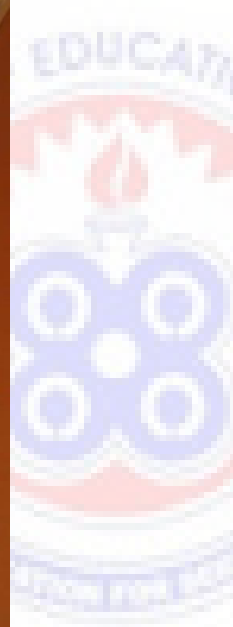


Figure 4.10: Exposed Foundation of nurses' quarters No. 1 Tamale Teaching Hospital.

4.4.3 Results of observation at University for Development Studies

At the University for Development Studies, the following observations were made. Faulty sanitary appliances, exposed foundations, broken doors and windows, cracks on walls and floors, rotten roofing members, faded paintings on walls, faulty hinges and locks of doors, faulty electrical installations and dampness of walls and windows were also observed to be the maintenance challenges at the institution.

Photographs of some of the maintenance challenges observed at the institution are shown on figure 4.11, figure 4.12, figure 4.13, and figure 4.14.



Figure 4.11: Broken Door of bungalow No. 2 at U.D.S Tamale Campus.



Figure 4.12: Choked Drainage System of Lecturers bungalow No. 3 building at U.D.S Tamale Campus.



Figure 4.13: Defective Ceiling of maintenance workshop at U.D.S Tamale Campus.



Figure 4.14: Broken-down Water Closet of students hostel at U.D.S Tamale Campus.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the main findings of the study, conclusion, recommendations, and suggestion for further studies.

5.2 Summary of findings

The following are the findings of the study;

- The study revealed that most of the building components of public institutions within the study area were not in good state. The most widespread maintenance problems identified included cracks on walls and floors, faded painting, partly broken doors and windows, exposed foundations, roof leakages, damaged electrical installations, choked drains, dampness on walls and floors and faulty electrical appliances.
- The study revealed that, the major factors that hinder the effective maintenance of buildings of public institutions in the Tamale Metropolis included lack of adequate funds for maintenance activities and lack of maintenance culture among users and occupants of public buildings.
- Finally, the study revealed that record keeping on maintenance activities at the departments of public institutions was not effective.

5.3. Conclusion

The study has established that housing maintenance is a real problem among public institutions in Ghana, with over 80 percent of all residential building components of public institutions surveyed having maintenance challenges.

Drawing of maintenance plans and schedules to guide maintenance departments to undertake regular inspection of buildings, respond promptly to maintenance request and to employ competent personnel to carry out maintenance works were all affected due to lack of adequate budgetary allocation solely for maintenance in public institutions.

Finally, misuse of facilities has also been identified as one factor that contributes greatly to the deterioration of public buildings, even though natural wear and tear over the years occurs on building components, some practices like wrong usage and poor constructional methods contribute in one way or the other to the generation of defects on these buildings.

5.4 Recommendations

The following recommendations are made to address the findings of the study;

- The study recommends that users and occupants of public buildings at the various public institutions should embrace preventive maintenance as a high priority to prevent the rate of deterioration of building components.
- The study recommends that adequate funds should be made available for maintenance of public buildings and make sure that such funds are judiciously utilized. The mentality of users and occupants of public buildings seriously needs to also be addressed on the importance of maintenance culture through mass education and public campaigns.
- The study also recommends that maintenance Log Book need to be developed and implemented at the maintenance departments of public institutions for the following reasons;
 - It records and keeps records which can be for future reference.
 - It can be used for future price determinations

- It shows the location and part of the building which has been repaired already
- It helps the maintenance officers to know the cost of maintenance done on past years.

5.5 Suggestion for further research

Future researchers can widen the scope of the research on maintenance to cover not only buildings in public institutions but all building types in the metropolis.



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APPENDIX A

QUESTIONNAIRES FOR STAFF OF DABOKPA TECHNICAL INSTITUTE IN THE TAMALE METROPOLIS

UNIVERSITY OF EDUCATION, WINNEBA KUMASI CAMPUS

DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY

PROJECT TOPIC: Enhancing Efficient Maintenance of Public Buildings in Ghana (A case study of selected institutions in the Tamale Metropolis)

This questionnaire is design to obtain data for a project work on maintenance of public buildings. The study is aimed at expanding the frontiers knowledge on this issue of maintenance of public buildings. Your participation in the exercise is absolutely voluntary, and your answers will be kept completely confidential. Kindly fill the questionnaire and make any additional comments you may like to make in the space provided. The information is for academic purpose only. **Thank You**

INSTRUCTION

Please answer the following questions by ticking []

Section A: Information about Respondents

1. Gender:

Male [] Female []

2. How long have you stayed in this institution?

1-2 years [] 3-5 years [] 6-8 years [] 9 years and above []

Section B: Current state of Building Components

3. What is the state of foundations of buildings in your institution?

Developed cracks [] Exposed/hanging [] No problem []

4. What is the condition of floor screed of buildings in your institution?

Damp penetration [] Developed cracks [] No problem []

5. What is the state of the walls in your institution?

Developed cracks [] Tilted [] Damp penetration [] No problem []

6. What is the condition of the roofs of buildings in your institution?

Leaking [] Decays [] Ripped off [] No problem []

7. What is the state of painting of the buildings in your institution?

Peeled off [] Faded [] Discolored [] No problem []

8. What is the state of doors and windows in your institution?

Partly broken [] Completely broken [] No problem []

9. What is the condition of electrical fittings in your institution?

Not functional [] Faulty [] No problem []

10. What is the issue of the drainage system in your institution?

Choked [] Broken down [] Leaks [] No problem []

Section C: Factors affecting maintenance of buildings of public institutions

11. To what extent do you agree or disagree with the following factors affecting maintenance of public buildings?

FACTORS	RESPONSES		
	AGREE	DISAGREE	NEUTRAL
Lack of maintenance culture			
Inadequate funds			
Bureaucratic reporting process			
Pressure on facility due to number of occupants			
Poor work done on the building			

Section D: Maintenance policies and practices of buildings in public institutions 12.

Who is responsible for the maintenance of buildings in your institution?

Government Users Institutions All of the above

13. What is the maintenance schedule at the maintenance department of your institution?

Quarterly Annually Biannually Others

14. What type of maintenance arrangement do you have in place?

Periodic Routine Preventive None

15. How is maintenance funded?

IGF Rent payment Surcharging Budgetary allocation

APPENDIX B

QUESTIONNAIRES FOR WORKERS OF TAMALE TEACHING HOSPITAL IN THE TAMALE METROPOLIS

UNIVERSITY OF EDUCATION, WINNEBA KUMASI CAMPUS

DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY

PROJECT TOPIC: Enhancing Efficient Maintenance of Public Buildings in Ghana (A case study of selected institutions in the Tamale Metropolis)

This questionnaire is design to obtain data for a project work on maintenance of public buildings. The study is aimed at expanding the frontiers knowledge on this issue of maintenance of public buildings. Your participation in the exercise is absolutely voluntary, and your answers will be kept completely confidential. Kindly fill the questionnaire and make any additional comments you may like to make in the space provided. The information is for academic purpose only. **Thank you.**

INSTRUCTION

Please answer the following questions by ticking []

Section A: Background of Respondent

1. Gender

Male [] Female []

2. How long have you stayed in this institution?

1-2 years [] 3-4 years [] 5-6 years [] 7 years and above []

Section B: Current state of building components

3. How do you consider the current state of these components and facilities of buildings in your institution? Please, tick appropriately

Component/Facility	Current State		
	Good	Fairly Good	Bad
Foundations			
Floor screed			
Walls			
Roofs			

Section C: Factors affecting maintenance of building in public institutions

4. Which of the following factors contribute to early deterioration of buildings in your institution?

Faulty design [] Faulty execution of work [] Vandalism []

Section D: Maintenance policies and practices of building in public institutions

5. Which of the following forms of maintenance does your institution practice?

Rehabilitation [] Repair [] Renovation [] Refurbishment []

6. Which type of maintenance does your institution practice?

Planned [] Unplanned [] Corrective [] Routine []

7 Which of the following components of maintenance does your institution practice?

Servicing [] Rectification [] Replacement []

8. Which of the following type of residential building existed in your institution?

Detached bungalow [] Semi-detached bungalow [] Blocks of flats []

9. How is maintenance funded?

IGF [] Budgetary allocation [] GET Fund []



APPENDIX C

QUESTIONNAIRES FOR WORKERS OF UNIVERSITY FOR DEVELOPMENT STUDIES IN THE TAMALE METROPOLIS

UNIVERSITY OF EDUCATION, WINNEBA KUMASI CAMPUS

DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY

PROJECT TOPIC: Enhancing Efficient Maintenance of Public Buildings in Ghana (A case study of selected institutions in the Tamale Metropolis)

This questionnaire is design to obtain data for a project work on maintenance of public buildings. The study is aimed at expanding the frontiers knowledge on this issue of maintenance of public buildings. Your participation in the exercise is absolutely voluntary, and your answers will be kept completely confidential. Kindly fill the questionnaire and make any additional comments you may like to make in the space provided. The information is for academic purpose only. **Thank you.**

INSTRUCTION

Please answer the following questions by ticking []

Section A: Background of Respondent

1. Gender

Male [] Female []

2. How long have you stayed in this institution?

1-2 years [] 3-4 years [] 5-6 years [] 7 years and above []

Section B: Current state of building components

3. How do you consider the current state of these components and facilities of buildings in your institution? Please, tick appropriately

Component/Facility	Current State		
	Good	Fairly Good	Bad
Foundations			
Floor screed			
Walls			
Roofs			

Section C: Factors affecting maintenance of building in public institutions

4. Which of the following factors contribute to early deterioration of buildings in your institution?

Faulty design [] Faulty execution of work [] Vandalism []

5. To what extent do you agree or disagree with the following as factors affecting maintenance of public buildings. Please tick appropriately

Factors	Responses		
	Agree	Disagree	Neutral
Lack of maintenance culture			
Inadequate funds			
Unsuitable materials			
High maintenance cost			

Section D: Maintenance policies and practices of building in public institutions

6. Which of the following forms of maintenance does your institution practice?

Rehabilitation [] Repair [] Renovation [] Refurbishment []

7. Which type of maintenance does your institution practice?

Planned [] Unplanned [] Corrective [] Routine []

8. Which of the following components of maintenance does your institution practice?

Servicing [] Rectification [] Replacement []

9. Which of the following type of residential building existed in your institution?

Detached bungalow [] Semi-detached bungalow [] Blocks of flats []

10. How is maintenance funded?

IGF [] Budgetary allocation [] GET Fund []

APPENDIX D

QUESTIONNAIRES FOR STUDENTS OF DABOTECH

UNIVERSITY OF EDUCATION, WINNEBA KUMASI CAMPUS

DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY EDUCATION

PROJECT TOPIC: Enhancing Efficient Maintenance Culture of Public Buildings in Ghana (A case study of selected institutions in the Tamale Metropolis)

This questionnaire is designed to obtain data for a project work on maintenance of public buildings. The study is aimed at expanding the frontiers knowledge on this issue of maintenance of public buildings. Your participation in the exercise is absolutely voluntary, and your answers will be kept completely confidential. Kindly fill the questionnaire and make any additional comments you may like to make in the space provided. The information is for academic purpose only. **Thant You**

INSTRUCTION

Please answer the following questions by ticking []

Section A: Information about respondents

1. Gender:

Male [] Female []

2. How long have you stayed in this institution?

1-2years [] 3- 4 [] 5 years and above []

Section B: Current state of building components

3. Please how do you consider the state of these components and facilities in the buildings of your institution? Tick appropriately.

Components	Good	Fairly good	Bad
Drainage			
Floor screed			
Walls			
Painting			
Roof			
Foundation			
Doors/windows			

Section C: Factors affecting maintenance of buildings of public institutions

4. How will you describe the general condition of your buildings?

Good [] Fairly good [] Bad []

Section D: Maintenance policies and practices of buildings in public institutions

5. Does your institution have a maintenance policy?

Yes [] No [] Not sure []

6. Who is responsible for the maintenance of buildings in your institution?

Government [] Users [] Institution [] Not sure []



APPENDIX E

**INTERVIEW SCHEDULE FOR ESTATE MANAGERS AND OFFICERS OF
TAMALE TEACHING HOSPITAL IN THE TAMALE METROPOLIS**

UNIVERSITY OF EDUCATION, WINNEBA KUMASI CAMPUS

DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY EDUCATION

**PROJECT TOPIC: Enhancing Efficient Maintenance Culture of Public Buildings in
Ghana (A case study of selected institutions in the Tamale Metropolis)**

The series of questions in this questionnaire are to obtain data for a project work on maintenance of public buildings. Please, answer the questions that follow by ticking the appropriate option (if provided) or writing unrestricted for open-ended questions. The information is for academic purposes only and will be treated with the strictest confidentiality.

Thank You.

Section A: Information about respondents

1. What is your position at your place of work?

.....

2. How long have you been in this institution?

.....

Section B: Current state of building components

3. How will you consider the state of these components in the buildings of your institution?

Components	Current State		
	Good	Better	Bad
Walls			
Roof			
Foundation			
Floor screed			
Doors/Windows			

4. How will you classify your buildings according to the period of existence as to whether they are old (above 50 years) medium aged (20-50 years) or young building (below 20 years)?

.....

Section C: Factors affecting maintenance of buildings of public institutions

7. Does the maintenance department undertake regular inspection of the building?

.....

8. Do you have maintenance budget?

.....

9. What factors in your opinion are impeding the effective maintenance of buildings in your institution?.....

.....

Section D: Maintenance policies and practices of buildings in public institutions

10. Does your institution have a maintenance policy?

.....

11. In your opinion, is maintenance of buildings necessary?

.....

.....

12. What is the attitude of users towards maintenance of buildings in your institution?

.....

.....

13. How is maintenance funded in your institution?

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