

**UNIVERSITY OF EDUCATION, WINNEBA**  
**COLLEGE OF TECHNOLOGY EDUCATION, KUMASI**

**ASSESSING MAINTENANCE PRACTICE OF PUBLIC RESIDENTIAL  
BUILDINGS IN GHANA, A CASE STUDY OF GHANA FIRE SERVICE AND  
GHANA HEALTH SERVICE BUILDINGS IN BOLGATANGA  
MUNICIPALITY OF GHANA**



**AYOAKATENG EUGENE SALAM**

**SEPTEMBER, 2016**

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**AYOAKATENG EUGENE SALAM  
(7141190010)**



**A Dissertation submitted to the Department of CONSTRUCTION AND WOOD  
TECHNOLOGY EDUCATION, Faculty of TECHNOLOGY EDUCATION,  
University of Education, Winneba, in partial fulfilment of the requirements for  
the award of the Master of Technology (Construction) degree**

**SEPTEMBER, 2016**

## DECLARATION

### STUDENT'S DECLARATION

I, Ayoakateng Eugene Salam, declare that this Dissertation, with exception of quotations and references contained in published works which have all been identified and dully acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE .....

DATE.....

### SUPERVISOR'S DECLARATION

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

NAME OF SUPERVISOR: MR. MICHAEL K. TSORGALI

SIGNATURE:.....

DATE:.....

## **DEDICATION**

To my beloved wife, Diana Musa, mum, Mmaa Akunlie Adeenze and the entire family.



## ACKNOWLEDGEMENT

The Lord God Almighty deserves all the praises and thanks for helping me to accomplish this feat. Without Him, this enormous task would not have been possible.

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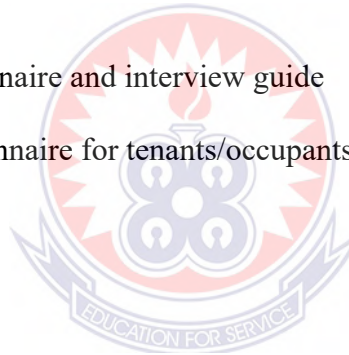
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## ABSTRACT

Wear and tear in buildings and other fixed equipment is inevitable; for this reason periodic attention is required to keep them in good state so that they can continue to perform their required functions. One of the ways to achieve this is the adoption of maintenance as essential practice. Due to the neglect of maintenance of buildings in the country a lot of public and private sector buildings are in very deplorable conditions. The aim of the study is to evaluate the maintenance practice of the public residential buildings in Bolgatanga Municipality. The field investigations focused on 58 out of 68 residential buildings of GFS and GHS nurses' quarters. Opinions of maintenance officers and tenants were solicited. These officers were purposively selected and questionnaires administered to them. The data collected were analysed using descriptive statistics. The survey revealed that the most prevalent maintenance problems with respect to the building elements are dirty paint, crack/peeled off floors, leaking roofs, cracks in walls, exposed foundation, and partly broken windows and doors. Also, majority of the facilities in the households are in fairly good conditions and thus need attention. The study also established the following factors as being responsible for the poor maintenance of the public buildings surveyed: Lack of maintenance culture, Inadequate funds and high maintenance cost, Pressure on building facilities by number of users, The age of the buildings, Frequent transfer of occupants, Apathy and lack of patriotism on the part of some public employees occupying government bungalows, and lack of preventive maintenance plan, absence of a national maintenance policy. The study concludes that management of public institutions' buildings surveyed should embrace preventive maintenance practice as a high priority; also occupants of the public residential buildings who exhibit poor maintenance should be strictly sanctioned.

## CHAPTER ONE

### INTRODUCTION

This chapter gives a brief introduction into the background of the study, statement of the problem, purpose of the study, aim and objectives of the study, research questions, scope of the study, the significance of the study, limitation of the study, and the organisation of the study.

#### 1.2 Background of the Study

Maintenance is the combination of all technical and associated actions intended to retain an item or restore it to a state in which it can perform its required function (BS 3811, 1984). Work carried out in anticipation of failure is referred to as preventive maintenance and those carried out for restoring after failure is referred to as corrective maintenance (<http://www.shepherd.co.uk/building-consultancy>). Adejimi (2005), stated that the primary objective of building maintenance is to preserve buildings in their initial functional, structural and aesthetic states. Cripps (1984), further described building maintenance as the regular inspection of all parts of the building and the execution of work necessary to keep the structure, finishes and fitting in a proper and acceptable state of repair, including decoration both internally and externally.

Essentially, building maintenance programme sustains infrastructural development. Every country's socio-economic development largely depends on the contribution of infrastructure. Sustainable capital investment for any nation remains a critical dialogue the world over with special reference to developing countries and their infrastructural development which is still at the infancy. The cause for this could not be far-fetched. The focus of most of government expenditures and investments

has been on infrastructural development in the areas of road, power, water and housing. In the developed nations, the challenges could be attributed to sustainability. One way by which there could be sustainability is the maintenance of the existing stock of infrastructural facilities and services (Journal of Emerging Trends in Economics and Management Science, 2012).

In general, buildings must provide safe and conducive environment for various human activities (Odediran et al., 2012). For that matter, when a building starts to deteriorate, it is only proper that measures are taken to make sure that the characteristics of that facility which gives safety and conservancy are maintained. Government's worldwide aim at providing suitable accommodation of high standard and quality that is also affordable to meet the social, economic and political desires of the citizenry. Should this desirable social objective be fulfilled, it will become a key component of sustainable development and a measure of the people's well-being (Ibem & Amole, 2010).

Housing, as considered by Leong (2009), is one major factor which has impact on the health, safety, socio-economic and political life of respective occupants. As a matter of fact, housing impacts all aspects of human endeavour. For that matter, the state of housing and its environment becomes an indicator of the level of development and state of the citizenry.

Housing plays a vital role in a nation's socio-economic development as far as the lives of the people are concerned. However, greater number of public housing is in a state of dilapidation as a result of long period of lack of maintenance. Olatubara and Fatoya (2006), postulated that public residence, unlike private housing estates, lacks basic infrastructural facilities and respective maintenance meant to preserve the building. Blome (2010), opinionated that housing standards become deplorable and

their physical environmental conditions deteriorated as a result of problems of society such as poverty, poor academic performance, poor health, riots and high crime rates prevalent in our society. According to Brennan (2000), a living accommodation of poor quality, will give a negative impact on the physical and mental health of the resident of the public building.

In recent years there have been complaints and criticisms in the media and published literature of the conditions and performance of public buildings in Ghana. Studies show that the face of public structures in Ghana is at a very deplorable state (Afranie & Osei Tutu, 1999; Cobbinah, 2010 & Isshaku, 2013). According to Cobbinah (2010), lack of maintenance of some police buildings including police cells in recent times have resulted in jailbreaks in some police stations in the country leading to the escape of hardened criminals in custody also some educational institutions especially basic schools hold classes in the open air at the mercy of the weather because their buildings are not in an optimally operable condition.

Public buildings consist of both dwelling (residential accommodation) and non-dwelling (office accommodation) which are prone to defects due to their permanent and lengthy usage. As revealed by (Committee on Building Maintenance, 1972 as cited in Cobbinah, 2010), all elements of buildings deteriorate at a greater or lesser rate depending on materials and methods of construction, environmental conditions and the use of the buildings. Nevertheless, new buildings are springing up now and then without paying much attention to old existing structures that need maintenance (Ahmed, 2000; Odediran et al., 2012).

## 1.2 Statement of the Problem

In recent years there have been complaints and criticisms in the media and published literature of the deplorable state of public buildings in Ghana. The deplorable state of some public buildings in Ghana including police cells in recent times have resulted in jailbreaks in some police stations in the country leading to the escape of hardened criminals in custody. Also, some educational institutions especially basic schools in the Upper East Region hold classes in the open air at the mercy of the weather because their buildings are not in an optimally operable condition. Vital documents in some of these public institutions have not been spared due to poor or non-maintenance of the buildings. An interview conducted by the researcher revealed that the deplorable state of public institution buildings is due to lack of awareness creation of maintenance practices, policies, manual and the perception that maintenance of public buildings is the sole responsibility of government.

Similarly, the self-evident state of disrepair and deterioration of public residential buildings in Bolgatanga, such as the Nursing, and Fire Service quarters is of great cause for concern; there is presence of cracks on some of the foundations, floors and walls, peeling off of plastered walls, faded painting, defective door hinges as well as broken windows and leaking roofs. This has left the properties of most of the occupants at the mercy of the weather. Disrepair of these buildings does not only lead to reduce lifespan of these buildings but also impact negatively on the physical and mental health of the residents. These problems arising out of the present situation as far as maintenance of buildings in the public sector is concerned no doubt affects productivity levels in hospitals, schools, and offices. It is against this background, that



this study is conducted to evaluate the maintenance management practices of public residential buildings in Bolgatanga Municipality.

### **1.3 Aim of the Study**

The aim of the study is to evaluate the maintenance management practice of the public residential buildings in Bolgatanga Municipality with a view to recommending most efficient maintenance management strategy.

### **1.4 Specific Objectives**

The specific objectives of this study are;

- i. to assess the current conditions of public residential buildings in Bolgatanga.
- ii. to identify the reasons that have accounted for the poor maintenance management of public residential buildings in Bolgatanga.
- iii. to devise maintenance strategies for public institutions in Bolgatanga.

### **1.5 Research Questions**

The research questions that will guide the study are:

- i. What is the current condition of public residential buildings in Bolgatanga?
- ii. What are the reasons that have accounted for the poor maintenance management of public residential buildings in Bolgatanga?
- iii. What maintenance strategies are required for public institutions in Bolgatanga?

## 1.6 Significance of the Study

- The study will contribute to good maintenance practice in the public residential buildings in Bolgatanga, Ghana. This is because the study will attempt to find out the present state of non-maintenance of public residential buildings; some of which have been abandoned due to its state of deterioration and recommend appropriate remedial actions to be taken.
- Furthermore, the study will assist managers of public institutions in Bolgatanga to become aware of the current state of their building infrastructure and its effect on the safety and health of personnel and also to put in place adequate innovative measures to prevent new buildings put up to suffer deterioration which ultimately lead to increased cost in restoring these buildings to their original state.
- It will provide a critical and analytical perspective for appreciating the factors affecting the decisions to carry out maintenance. In addition, the study will bring to the fore the major inhibiting factors in the maintenance of public buildings in Bolgatanga, Ghana.

## 1.7 Scope of Study

Contextually, the study examined the current condition of public residential buildings in the Bolgatanga Municipality, identified the reasons that have accounted for poor maintenance management of public residential buildings, devise maintenance strategies for the public institutions and the capacity of human resource of their maintenance department, and assessed the factors responsible for good maintenance management practices on public residential buildings. Geographically, the study was limited to residential buildings of the Ghana Fire Service, and the Ghana Health

Service Nurses quarters in the Bolgatanga Municipality of the Upper East Region of Ghana.

### **1.8 Limitation of the Study**

Enough effort has been put to exhaust the scope aforementioned but skill for gathering the primary data, meeting with staff involved following some protocol, sample technique, access to current statistical tools for analysing the data and current literature constraint relative to the magnitude of maintenance problems are the major forms of limitations for the total achievement of the study objectives. In addition records keeping was a problem for all the institutions surveyed such that in some situation researcher had to collate the number of buildings himself.

Notwithstanding the above limitations, the study results have not been affected and thus are credible, reliable and useful for any purposes of evaluation and feedback.

### **1.9 Organisation of the Study**

The study has been organized under five chapters. Chapter one, covers the introductory part and it includes the problem statement, aim and objectives, research questions, significance of the study, the scope and the limitations. The second chapter deals with the review of relevant literature on the subject. Thus, ideas of some researchers and authors have been reviewed.

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 presents a summary of the key findings, conclusion, and recommendations.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter reviews in-depth literature on issues relating to the concept of building and the importance that is attached to the maintenance of buildings. It covers secondary materials related to the conceptual issues as well as definitions and other factors affecting maintenance of buildings.

#### **2.2 The Concept of Building**

##### **2.2.1 Definition of Building**

A building is an assemblage that is firmly attached to the ground and that provides total or nearly total shelter for machines, processing equipment, performance of human activities, storage of human possessions, or any combination of these (Frederick S. Merritt & Jonathan T. Ricketts, 2001). However, according to Nickolas D. and Erkki (2008), building is any permanent structure which provides shelter, encloses space and can be occupied by people, animals, goods or services. In the world all over, people spend 90% of their lives in buildings (Issshaku, 2013). This therefore makes them a very important and valuable asset to be neglected.

##### **2.2.2 Lives of Buildings**

Seeley (1987 as cited in Cobbinah, 2010), asserts that buildings generally have a substantial life in the order of fifty (50) to sixty (60) years. A building may be demolished before the end of this period to permit a more profitable use of the site, or because it is found more economical to clear and rebuild rather than to adapt the

building to meet changed requirements, because of physical or technical obsolescence.

The life of a building can be categorized into ‘structural life’ and ‘economic life’. The structural or physical life is the period which expires when it ceases to be an economic proposition to maintain the building, while economic life is concerned with earning power and it is that period of effective life before replacement (Isshaku, 2013).

### **2.3 Current State of Residential Buildings**

A study published by the African Journal of Applied Research (2016), opined that there are several needs of society that buildings serve; some buildings serves as housing to suit climatical conditions in general and living space to provide privacy. Notwithstanding that, a site visit and interviews of some occupants and estate officers in the Bolgatanga municipality revealed that most of the public residential buildings in the municipality such as; Fire Service and Nursing staff quarters were in a very deplorable state. There is evidence of rust roofing sheet causing serious leakage, crack on walls and floors, exposed foundation, rotten wooden members, i.e. doors and windows, missing louver blades, faded painting, and naked electricity cables, faulty fittings, poor plumbing systems and so on due to lack of maintenance.

However, according to Smith (2003) and Sani et al. (2011) the state of public residential buildings lack maintenance due to privatization which has no correlation with systematic changes in maintenance and management issues. The obvious case is the grave condition of the housing stock disorder so far as financial, economic, administrative and social issues are concerned. There is also the issue of how much the occupants of the housing facilities are supposed to pay to make it possible for

prompt maintenance. The poor maintenance culture is the cause of the current terrible state of public buildings in Ghana (Abdul-Manan, 2011). The deplorable state of public buildings in Ghana is, therefore, too much worrying. Kindred (2004) argued that a building's structural life is when it has expired. This means that it no longer becomes economically viable for maintenance. However, the building's economic life has to do with its earning power and the effectiveness of replacement. Buildings which lack maintenance affect the comfort, performance and productivity of occupants who live or work in such buildings.

#### **2.4 The Concept of Building Maintenance**

Hackman and Osei Tutu (2008), opined that if buildings are regarded as assembly of components and parts, then it follows that these parts may be replaced as they continue to wear and tear. In fact there may come a time when the building will fail to function if continuing servicing and maintenance is not carried out at regular periods.

It appears that in Ghana the neglect of maintenance of our housing stock has resulted in much public concern as in some cases defect/failure have occurred in relatively new buildings. Some of the problem is lack of concern shown by clients and users as well as poor design habits.

RICS (2009), states that building maintenance has for many years been regarded as the "Cinderella" of the building industry, with little attention paid to innovation and "free thinking" in the delivery of its service. However, it should be pointed out that building maintenance is not only a key to sustaining the built environment, but its value in terms of employment and expenditure in the economy is also significant. Maintenance, according to the British Standard (BS 3811) is defined

as “a 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 actions referred to are those associated with initiation, organization, and implementation. It envisages two processes retaining, i.e. work carried out in anticipation of failure, referred to as “preventive maintenance” and “restoring”, i.e. work carried out after failure, referred to as “corrective maintenance”. There is also the concept of an “acceptable standard” which may be construed as acceptability to the person paying for the work, to the person receiving the benefit or to some outside body with the responsibility for enforcing minimum standards.

The committee on Building Maintenance defined “acceptable standard” as quoted in the first edition of BS 3811, as “one which sustains the utility and value of the facility” and this is found to include some degree of improvement over the life of a building as acceptable comfort and amenity standards rise. Furthermore, the British Standard (B. S. (3811) 1974, as cited in Hackman & Osei-Tutu, 2008), identified maintenance as work undertaken in order to keep or restore every facility (i.e. every part of the site, building and content) to an acceptable standard and cost:

- To keep here means that defects are prevented from developing
- To restore means that minor defects, if they are allowed to occur, are then corrected;
- Acceptable standard and acceptable cost indicate that maintenance work is tailed to suit individual needs and conditions.

## 2.5 Identifying the Maintenance Needs

RICS (2009) in identifying the needs of maintenance indicated that it involves collecting and assimilating information from:

- Regular condition surveys of the building stock;
- Pre-acquisition surveys prior to any building purchase;
- The existing planned maintenance programme (or profile);
- Faults and repairs notified by the building users;
- Feedback from works of servicing, repairs and improvements in progress;
- Relevant legal requirements either from statute law or from lease and rent and repair covenants and any changes/updating of legislation;
- Existing building and service records; and
- Older buildings, which may be affected by legislation that came into effect after they were constructed. Legislation necessitates asbestos surveys and management plans, DDA assessment and fire risk assessment amongst other requirements.

Keeping track of all the required information in maintenance management requires careful handling to avoid errors, omissions or excessive bureaucracy. Similarly, Zulkarnain et al. (2011), in considering maintenance needs emphasised that it is highly desirable but hardly feasible to produce buildings that are maintenance-free, although much can be done at the design stage to reduce the amount of subsequent maintenance work. All elements of buildings deteriorate at a greater or lesser rate depending on material and methods of construction, environmental conditions and the use of the building. A prime aim of maintenance is to preserve a building in its initial stage, as far as practicable, so that it effectively serves its purpose. The main purposes of maintaining buildings are:



- Retaining value of investment.
- Maintaining the building in a condition in which it continues to fulfil its function.
- Presenting a good appearance.

## 2.6 Types of Maintenance in Construction

BS 3811 categorizes building maintenance by means of the following terms and definitions.

- **Planned Maintenance:** “The maintenance organized and carried out with forethought, control and the use of records to a predetermined plan.”
- **Unplanned Maintenance:** “The plan carried out to no predetermined plan.” It refers to work necessitated by unforeseen breakdown or damages. For example, the ripping-off of a building, through the action of a storm, and its remedial action constitute unforeseen damages. It can also be termed unexpected and unavoidable maintenance.
- **Preventive Maintenance:** “The maintenance 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.”
- **Corrective Maintenance:** “The maintenance carried out after a failure has occurred and intended to restore an item to a state in which it can perform its required function.”
- **Emergency Maintenance:** “The maintenance which it 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 gate damage.

- **Condition-based Maintenance:** “The preventive maintenance initiated as a result of knowledge of the condition of an item from routine or continuous monitoring.”
- **Scheduled Maintenance:** “The preventive maintenance carried out to a predetermined interval of time, number of operations, mileage, etc.”
- **Running Maintenance:** “Maintenance which can be carried out whilst an item is in service.”

### 2.6.1 Planned Maintenance in Construction

Maintenance organized and carried out with fore thought, 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., n.d). Furtherance to this, Zulkarnain et al., (2011), also identified 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. Planned maintenance consists of preventative, statutory, and condition-based maintenance. RICS, (2009), in other words explained planned maintenance as the process of periodically undertaking routine tasks necessary to maintain plant (lifts, boilers, etc.) in a safe and efficient operating condition.

## 2.6.2 Preventive Maintenance

According to Stilemachinery (2012), preventive maintenance is the care and servicing by qualified personnel for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects. Maintenance, including tests, measurements, adjustments, and parts replacement, performed specifically to prevent faults from occurring. Preventive or Pre-Planned Maintenance is used as means to deal with the disadvantages of corrective maintenance, for that matter it reduces the likelihood of failure of an element. Preventive maintenance tasks are carried out in accordance with a regular plan of fixed intervals. The advantages of preventive maintenance over corrective maintenance according to Sai Kung District Council (2011) are:

- i. Maintenance tasks can be planned ahead and performed when convenient to building user/operator;
- ii. Maintenance costs can be reduced by avoiding the cost of consequential damage and use of emergency resources;
- iii. 'Down time' (the time that an element of the building or whole building is out of service) can be minimised so the occupancy and income of the building is maintained and can be increased;
- iv. Health and Safety of user and operator can be improved.

However, there are some disadvantages to consider with preventive maintenance:

- i. Planned maintenance will be performed irrespective of the condition of the item/element (i.e. some tasks will be performed on elements that may have remained in a safe/acceptable operating condition for a longer period of time).

- i. Planned maintenance tasks can be more costly in terms of spare parts and labour costs if it is carried out without control or when not required.

### 2.6.2.1 The Value of Preventive Maintenance

A well-planned preventive maintenance is advocated for its effects on improving equipment's operating efficiency, preventing premature replacement of components, and avoiding interruptions for building occupants. Preventive maintenance is widely thought to reduce long-term costs by maximizing the operating capacities of equipment, minimizing downtime, and avoiding breakdowns that would otherwise lead to higher repair costs later (Cobbinah, 2010).

Preventive maintenance may indirectly affect occupants' productivity and health. For example, a study of public school conditions in the District of Columbia found that, while controlling for other factors, students in schools with excellent building conditions had higher standardized achievement scores than students in schools with fair building conditions and even higher scores than students in schools with poor conditions. Certain preventive maintenance can improve the quality of indoor air, and insufficient preventive maintenance can be detrimental to it. For instance, lack of preventive maintenance may result in roof leaks, creating conditions for mold growth and potentially affecting some users' respiratory systems.

According to Cobbinah (2010), successful preventive maintenance programs should achieve these goals:

- **Preserve taxpayers' investments in public buildings.** Preventive maintenance can extend the life of building components, thus sustaining buildings' value and the significant tax dollars they represent.

- **Help buildings function as they were intended and operate at peak efficiency, including minimizing energy consumption.** Because preventive maintenance keeps equipment functioning as designed, it reduces inefficiencies in operations and energy usage.
- **Prevent failures of building systems that would interrupt occupants' activities and the delivery of public services.** Buildings that operate trouble-free allow public employees to do their jobs and serve the public. Because preventive maintenance includes regular inspections and replacement of equipment crucial to operating a building, maintenance staff reduces the problems that might otherwise lead to breakdown in operations.
- **Sustain a safe and healthful environment by keeping buildings and their components in good repair and structurally sound.** Protecting the physical integrity of building components through preventive maintenance preserves a safe environment for employees and the public.
- **Provide maintenance in ways that are cost-effective.** Preventive maintenance can prevent minor problems from escalating into major system and equipment failures that result in costly repairs. In avoiding costs of major repairs, preventive maintenance creates efficiencies. Increasing preventive maintenance can reduce time spent reacting to crises, which is a more cost-effective way to operate buildings. Deferring preventive maintenance can generate higher costs over the long term.

### 2.6.3 Proactive Maintenance

Proactive maintenance is a highly structured practice that uses information from analysing equipment to identify origins, not just symptoms, of equipment

problems. Proactive maintenance would, for example, identify whether excessive wear resulted from defective installation, unsuitable design, or some other cause. Proactive maintenance is maintenance work performed in order to avoid failures or to identify defects that could lead to failure. It includes routine preventive and predictive maintenance activities and work tasks identified from them (Corrosionpedia, 2016). Maintenance work has also been categorized as ‘predictable’ and ‘avoidable’. Predictable maintenance is regular periodic work that may be necessary to retain the performance characteristics of a product, as well as that required to replace or repair the product after it has achieved a useful lifespan. Avoidable maintenance is the work required to rectify failures caused by poor design, incorrect installation or the use of faulty materials.

With building services, minimal neglect can result in potential danger. ‘Appropriate condition’ could be interpreted as the maintenance of building in a state, which allows them to be used for the purpose for which they were provided for the minimum capital expenditure. The appropriate condition will be influenced by many factors, including the function of the building, its public image, or even national prestige. The prime aim of building maintenance should be to obtain good value for money spent on maintenance.

## **2.7 Significance of Building Maintenance**

In Seeley (1985) the committee on Building maintenance asserted that building maintenance was of great significance to the economy not only because of the scale of expenditure involved but also because it was important to ensure that the nation’s (Great Britain) stock of buildings born as a tractor of production and of accommodation, was used as effectively as possible. The committee saw no early

prospect of restoring, let alone keeping, a majority of buildings to an acceptable standard. It emphasized that more rather than less maintenance work is necessary if the value and amenity of the nation's buildings stock is to be kept at present levels.

## **2.8 Nature of Maintenance**

According to the British Standard Institution (1993), the nature of building maintenance encompasses many aspects of work depending on the condition of maintenance. It may be divided into four components namely; Servicing, Rectification, Replacement and Modernization:

### **2.8.1 Servicing**

This is essentially a cleaning operation. The frequency of cleaning varies and is sometimes called day maintenance e.g. floors are swept daily, windows washed monthly and painting done every 3-5 years. As more sophisticated is introduced so more complicated service schedules become necessary.

### **2.8.2 Rectification**

This work usually occurs fairly early in the life of the building and arises from shortcomings in design, inherent faults in or unsuitability of components, damage of good in transit installation and incorrect assembly. Rectification represents a fruitful point at which to reduce the cost of maintenance, because it is avoidable. All that is necessary to ensure that components and materials are suitable for their purpose and are correctly installed.

### **2.8.3 Replacement**

Replacement problems involve items that degenerate with use or with the passage of time and those that fail after a certain amount of use or time. Items that deteriorate are likely to be large and costly (e.g., machine tools, and home appliances). Non-deteriorating items tend to be small and relatively inexpensive (e.g., light bulbs, vacuum tubes). The longer a deteriorating item is operated the more maintenance it requires to maintain efficiency. Furthermore, the longer such an item is kept the less is its resale value and the more likely it is to be made obsolete by new equipment. If the item is replaced frequently, however, investment costs increase. Thus the problem is to determine when to replace such items and how much maintenance (particularly preventive) to perform so that the sum of the operating, maintenance, and investment costs is minimized (BSI, 1993).

### **2.8.4 Modernization**

This is concerned with alteration, addition and enhancement to existing buildings, on both small and large scale. It also includes all work designed either to expand the capacity of a facility to perform some new functions.

## **2.9 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 relate 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

### **2.9.1 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.

### **2.9.2 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.

### **2.9.3 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.

#### **2.9.4 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.

#### **2.9.5 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.

#### **2.9.6 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.

#### **2.10 Challenges of Maintenance Management Practices**

Three considerations for developing maintenance policy are building maintenance objectives, benefits and policies (Armstrong, 1987 cited in Issahaku, 2013). The main purpose is to obtain benefits with integration of adequate maintenance policies. It concerns with proper procedures for planning building maintenance activities. Alner and Fellows (1990), summarise that safety is the primary concern for the planning of maintenance strategy to ensure building and associated services are in safe condition, fit for use and comply with the law and all statutory requirements. Maintenance work is carried out to maintain the value of the

physical assets of the building stocks and quality. Thus, these factors are considered important for development of maintenance policy. However, apart from the value consideration, Burns (1997) argued that there should be ground rules for the allocation of maintenance resources available to management.

Maintenance policies are beneficial to the organisation as a whole, it must relate to the cost involved for getting maintenance funding. Maintenance strategy is adopted in order to extend the life cycle of buildings and its fittings services. Maintenance personnel choose different maintenance strategies depending on the allocation maintenance of resources. The maintenance policy is the integration of different strategic approaches, which include corrective, preventive and condition-based maintenance (Horner et al., 1997).

Ollila and Malmipuro (1999) identify that the main categories of maintenance consisted of reactive, preventive, predictive and proactive maintenance. However, Coetzee (1999), revealed that the maintenance strategies should be based on the detailed design of the maintenance cycle for different types of organisations. Chan et al (2001) split this into five types of maintenance strategy, including time-based, performance-based, breakdown-based, renovation-based and integration-based. Furthermore, Tse (2002) is of the opinion that most of the maintenance practices are failure-driven, time-based, condition-based, reliability-centered and predictive.

The basic maintenance strategies include preventive, corrective and condition-based maintenance. According to Chan et al (2001), the time based, performance-based, breakdown-based, renovation-based and integration-based are also developed from the three basic maintenance strategies. Planned Preventive Maintenance (PPM) has been described as the most effective maintenance strategy against the frequency of breakdown (Seeley, 1976).

However, PPM is considered an ineffective solution because it makes too early and unnecessary replacement (Spedding, 1987). The argument of this maintenance strategy is becoming the focus of economic downturn, resulting in cutting operation cost to organisations. Moreover, the study about the effectiveness of PPM with empirical data to support its efficiency is limited (Horner et al., 1997). Wood (1999) introduces just-in time theory developed from the production industry applying to building maintenance. From the strategic perspective, there is little understanding about the relationships of PPM with the core business objectives (Loosemore & Hsin, 2001).

On the contrary, it is recommended for the better use of the PPM in order to optimise maintenance resources (Shen & Lo, 1999). Tse (2002), argues that maintenance practices in Hong Kong concentrate on time-based and failure-driven strategies, but without adopting a comprehensive maintenance approach, and that maintenance is still in a primitive stage. From the technological perspective, most of the studies focus on the study of technology application to condition-based maintenance and performance-based maintenance with centered reliability maintenance, and forward maintenance and predictive maintenance are all based on the condition surveys (Pitt, 1997).

## **2.11 Other Maintenance-Related Concepts and Definitions as related to Housing**

According to Hackman and Osei-Tutu (2008), other maintenance-related concepts and definitions as related to Housing are as follows:

Prevention; this 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.

Consolidation; this 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.

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.

Repair; this 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.

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 (Hackman & Osei-Tutu, 2008).

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.

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

## **2.12 Technology of Maintenance**

The technology of maintenance is concerned with all the factors that influence and cause the need for maintenance work. The occurrence of defects in the fabric of a building can result from many unrelated design decisions- unsuitable material,

incorrect assessment of loads, inadequate appreciation of conditions of use and inadequate assessment of exposure. Exposure is influenced by rainfall, direction of prevailing winds, microclimate, atmospheric pollution and aspect and height of building. The durability of the building material also influenced by frost action, crystallization of salts, sunlight, biological agents, abrasions and impact, chemical action and corrosion and incompatibility of modern building material (Cobbinah, 2010).

Cracks in building normally result from failure or defective construction and are invariably unacceptable to occupants. If severe, they may result in loss of stability. Furthermore, cracks frequently give rise to air infiltration, heat loss and reduced sound insulation all of which cause reduced efficiency in buildings. Cracking is generally caused by tensile stresses; in excess of the tensile strength of the material, produced by externally applied loads or internal movements arising from temperature or moisture changes.

Other important concept of the maintenance can be illustrated by reference to roof construction. A good roof which is well maintained should last the life 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 within the building. A leaking roof apart from causing considerable inconvenience to users can 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 installation. Traffic over a roof should be kept to a minimum and where it is essential, appropriate walkways and access ladders must be provided. To ensure that roofs are adequately maintained, they should ideally be inspected every three (3) years or alternatively one-third each year (Cobbinah, 2010).

### **2.13 Economic and Social Significance of Maintenance**

According to Alan, C. BCIS Report, (2015), revealed that it is important that building owners, operators and facilities managers manage their existing buildings efficiently. Furthermore, clients and their design teams and contractors, must consider the whole life performance of a building when constructing and refurbishing a property, taking into account not just the capital costs of elements and components but their maintainability and longevity.

Maintaining the physical structures of a property ensures that investments made does not only yield the highest possible returns over the life of the property but also fulfils the ultimate responsibility of providing the needed human satisfaction and comfort.

A house according to Dave (2002), as cited in (S. Afranie and E. Osei-Tutu, 1999), 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. In effect, the primary aim of maintaining a building is to preserve it in its original state as practicable as possible so that it effectively serves that purpose. As a rule, the capital asset of a building is so valuable and is often appreciating so that in practice, maintenance should frequently be directed to prolong effective life. Therefore the purpose for maintaining a building are; retaining the value of investment, maintaining the building in a condition in which it continues to fulfil its function and presenting good appearance.

Studies show that the condition and quality of buildings reflect public pride, the level of prosperity in the area, social values and behaviour and all the many influences both past and present, which combine to give a country its unique characteristics (Cobbinah, 2010).

## **2.14 Aims of Maintenance**

The primary aim of maintaining a building is to ensure that the building continue to serve the purpose for which it was put up. The purposes for which maintenances are undertaken include:

- a) To maintain the value of a 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 in the determination of value (Afranie & Osei-Tutu, 1999).
- b) To ensure optimum use of buildings- good maintenance should allow buildings to be used to their full potential
- c) To create or maintain suitable appearance- this can make a positive contribution to external environment and social conditions. Dilapidated buildings can contribute to social deprivation and badly maintained services and facilities, waste energy and resources and can affect the environment
- d) To maximize the life of main components and materials- maintenance can reduce cost of subsequent maintenance by extending periods between repairs and replacements;
- e) To ensure that buildings do not detract from surroundings and also maintain a suitable appearance.

## **2.15 Factors Influencing Decision to Undertake Maintenance**

Miles and Syagga (1987 cited in Cobbinah, 2010), identify the following factors as influencing the decision to carry out maintenance on a building:

- Inadequate finance-it is generally acknowledged that inadequate finance is a major constraint on effective property management, partly because



maintenance budgets are the easiest to cut when money is scarce. According to him, maintenance expenditure can be absorbed more easily in commercial and industrial organizations where it may account for as little as 0.5% of turnover, but even in these cases maintenance is taken for granted except when it threatens production or profitability. However, the situation is more serious in the public sector where damaging effects of poor maintenance are less immediately obvious. Also in the case of housing estates, it is common for organizations to emphasize the provision of new houses, with little funding provided for maintaining existing stock. Not are day-to-day repairs neglected, but efforts at improvements and rehabilitation are considered lower priority than new construction. This problem of inadequate finance indeed result in rapid deterioration of existing stock resulting in increases in the demand for new houses because poorly maintained houses are not only unpopular; but they soon reach the stage where the structure itself deteriorates and rebuilding has to be considered.

- Bad management- refers to the idleness and waste among maintenance personnel.
- Poor building design- it is not uncommon to find that buildings are inherently expensive to maintain because of inappropriate priorities applied during the design phase. Poor detailing and the specification of unsuitable components and materials are common complaints. In addition, construction errors arising from inadequate drawings and specifications, coupled with poor workmanship because of contracts awarded to incompetent contractors are frequent causes of rapid physical deterioration in buildings. Good design should allow

accessibility and adequate working space for essential maintenance such as cleaning, and minor repairs to pipes, ducts and cables.

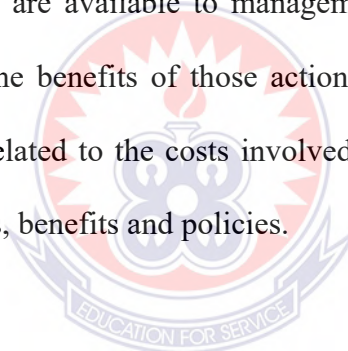
- Stapleton (1994 in Afranie & Osei-Tutu, 1999), relates that the decision to carry out maintenance is affected by many factors, among which are:
- Cost- investors would want to have the most economic method for carrying out maintenance work whether, corrective or preventive, thus they look at actual 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.
- Availability of physical resources- the availability or non-availability of physical resources affects decisions 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;
- Urgency of work- this also affects decisions on maintenance in that investors consider whether delayed work 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.

- Interference with activities carried out in the building.

Seeley (1993) on the other hand according to Afranie and Osei-Tutu (1999), summarizes the principal criteria which could influence the decision to carry out maintenance briefly as, cost, age and condition of property, availability of adequate resources, urgency, future use and sociological considerations.

## **2.16 Maintenance Policy**

BS 3811, Defines maintenance policies as a strategy within which decisions on maintenance are taken. Alternatively, it may be defined as the ground rules for the allocation of resources (men, materials and money) between the alternative types of maintenance actions that are 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 costs involved. Issues under consideration in a policy include; objectives, benefits and policies.



## **2.17 Physical Causes of Poor Maintenance in Residential Buildings**

The physical causes of maintenance problem refer to all the natural/physical factors that negatively affect the durability of the building. The durability of a built facility is a measure, in an inverse sense, of the rate of deterioration of a material or component (Afranie & Osei Tutu, 1999). According to Afranie and Osei Tutu (1999), the British Standard Institution (BSI) Code of Practice defines durability as the quality of maintaining a satisfactory appearance and performance of required functions. The code measures this parameter in terms of the minimum number of years of satisfactory life. The three major causes of deterioration and hence maintenance problems are, age or period of construction, environmental and location factor.

Newly constructed houses are observed to be in relatively better condition as compared to older houses. Environmental factors such as extreme moisture content (too high and too low), high and fluctuating temperature and salt laden winds among others have effects on the building (Afranie & Osei Tutu, 1999). In areas of continuously high humidity, some materials retain more moisture sufficient to have deleterious effects while in drought zones, some materials may deteriorate or fail to develop their potential properties because of hydration. Fungal and insect attack of organic materials and the corrosion of metals are encouraged in very moist conditions. The components of buildings, which are found to be more affected are the wooden members, the cement based parts and the roofs, especially the corrugated iron sheets (Afranie & Osei Tutu, 1999).

The location of a building has a direct effect on the maintenance problem. The location refers to the exact location of the building. Thus location is influenced by the terrain of the environment, soil, nature of social and seismic movement, salt laden winds and salty water effects as well as high temperatures and drastic temperature changes.

## **2.18 Organisation of Maintenance Department**

The maintenance department in an organization is managed by a maintenance manager. 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 would be a separate group of people solely responsible for maintenance.

### 2.18.1 The Functions of the Maintenance Department

According to Cobbinah (2010), maintenance department among other things performs the following basic functions.

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 time 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 facing 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 requirements 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. **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.

**3. Control functions:** 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 input:** Identifying the extent of work necessary to achieve the required standards within the constraints laid down. The processes involved would include planned inspections, appraisal of user requests and assignment of priorities.
- **Time of execution:** Programming the workload so that the 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 latent defects
- **Cost:** Budgetary control system including estimating resource requirements 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.

**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 fire-fighting equipment, Refuse disposal, cleaning, grounds etc.

### **2.19 Factors that are Responsible for the Deterioration of a Building**

According to Cobinnah (2010), property owners all too frequently endeavor to keep maintenance expenditure to a minimum, ignoring or misunderstanding the adverse long-term effects of such a policy. Neglect of maintenance has accumulative

results with rapidly increasing deterioration of the fabric and finishes of a building accompanied by harmful effects on the contents and occupants.

The usage of a building result in wear and tear; and exposure to natural forces cause deterioration of building. Human activities responsible for the deterioration/decay of building are: failure to clean and carry out routine maintenance, ignorance of the causes of deterioration and decay, failure to promote awareness of maintenance needs by all who use the building and adopting a negative attitude of waiting until emergency measures are required,. Other factors that are responsible for the deterioration of building are presence of chemical, fire, faulty design, construction, materials and systems as well as vandalism. This deterioration can however be avoided or rectified through maintenance of the building. Maintenance (planned and unplanned) can make the necessary impact only if the financial regulator of the building through correct diagnosis of defects ensures that funds are made available for such a purpose. Failure to undertake maintenance of a building will ultimately result in reducing the life span of the building and consequently result in demolition. Maintenance of the building will however ensure that the building is restored to its initial status and also increase the life span of the building.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Introduction

This chapter deals with how the research was conducted. It describes and explains the methods and process that were used to collect data for the study. The chapter is presented under the following sections namely; introduction, research design, population, sampling technique and sample, criteria for selecting the study areas, piloting of questionnaire, questionnaire, interview and observation, variables of the study and data analysis.

#### 3.2 Research Design

The study made use of the single case study approach but a combination of quantitative and qualitative methods comprising, questionnaire, interview and personal observation. Qualitative research employs inductive approach to raw data and emphasizes developing insights and generalizations out of the data collected. According Neuman (2000), quantitative research on the other hand employs deductive approach and ‘‘uses statistical analysis to show findings. They follow strict set of rules to make them as objective as possible’’. Therefore, the design adopted for the research was descriptive and analytical. It is appropriate to use quantitative and qualitative sample survey because it is one of the best design that describes all aspects of the targeted population under study. In view of this, the researcher designed questionnaire, interview and carried out personal observation to collect data on the concept of building maintenance as applied in public institutions in Ghana with particular reference to the following public residential buildings in Bolgatanga



Municipal: Ghana Fire Service bungalows, and the Ghana Health Service nurses quarters.

### **3.3 Research Population**

For the purpose of this research, the population consisted of sixty-eight (68) tenants and five (5) estate department staff responsible for maintenance of the buildings of the selected public institutions in the Bolgatanga municipal. The main reason for using this category of people is that their activities directly or indirectly have a bearing on maintenance management practices of the selected public residential buildings.

### **3.4 Sampling Technique and Sample Size**

The sampling method used for data collection was quota and purposive sampling technique. The sampling was done to ensure that there was no bias or subjectivity in the selection process. Due to the large number of the public institutions in the Bolgatanga municipality, it helped the researcher to work with reasonable size of public residential buildings since it was difficult to do so with the entire public institutions in the Upper East Region. The sample size of seventy-three (73) was used for the study. The sample representation comprises: sixty-eight (68) tenants, forty-two GHS quarters and twenty-six GFS quarters as shown in table 3.1 & 3.2 and five (5) estate department responsible for maintenance of the buildings of the selected public institutions in the municipal.

**Table 3.1: Sample Frame**

Institution	House Type				Total
	Detached		Semi-detached		
	Three bedroom	Three bedroom	Two bedroom	One bedroom	
GFS	4	22	-	-	26
GHS	-	-	27	15	42
Total	4	22	27	15	68

Source: Author's Field Survey, 2016

**Table 3.2 Sample size for institution**

Institution	House Type				Total
	Detached		Semi-detached		
	Three Bedroom	Three Bedroom	Two Bedroom	One Bedroom	
GFS	4	17	-	-	21
GHS	-	-	24	13	37
Total	4	22	24	13	58

Source: Author's Field Survey, 2016

### 3.5 Criteria for Selecting the Study Areas

The researcher considered the following to purposely select the two public institutions for study:

- The Ghana Fire Service was selected due to the state of dilapidation of their residential buildings and the system of administration. The services' residential accommodation has a combination of detached type of buildings, and semi-detached bungalow. It however has a centralized system of administration with total reliance on the state for funds for its operations. The bungalows are occupied by the Senior Fire Officers' (SFO) while the semi-detached houses are occupied by the Junior Fire Officers (JFO).

- The nurses' quarters on the other hand consist of both one bedroom and two bedroom semi-detached buildings which showed a defects such as exposed/hanged foundations, cracked walls and floors leaked roofs etc. Its administrative system though centralized, has options of internally generating funds to support some of its activities.

### **3.6 Data Collection Techniques**

Data was collected using techniques like; questionnaire, interview and personal observation for the study.

#### **3.6.1 Piloting of Questionnaire**

The questionnaire was field tested by the researcher to assess the relevance of the questions, the understanding of respondents, identify any ambiguities, as well as the general availability of the various categories of information needed. The field testing also provided hands on experience in the administration of the questionnaire. The researcher piloted the questionnaire on a group of households of the two public institutions and their contributions were then incorporated in the final questionnaire by way of a review based on the information gathered.

#### **3.6.2 Questionnaire Administration**

Preliminary contacts with potential respondents and information from the literature review served as a basis for questionnaires design for the different respondents. The questionnaire was developed and administered to twenty-six (26) tenants of Ghana Nation Fire Service personnel and forty-two (42) Ghana Health Service Nurses as in table 3.1. Issues captured were based on maintenance practice of

public residential buildings of selected institution as in table 3.3. A series of questions that are easy and convenient to answer but can describe the intended practices or behaviours was formulated into a questionnaire. Shao (1999) defines a questionnaire as a formal set of questions or statements designed to gather information from respondents that accomplish research objectives. The questionnaire may have either structured, semi structured or unstructured questions. For the purpose of this research, the questionnaire contained structured questions. The structured questions are convenient easy and take less time to answers because options are available to the respondents from which they tick options that best describe their practices, opinions or attitudes.

**Table 3.3: Issues of Maintenance of Public Residential Building**

<b>Housing Elements and Facilities</b>	<b>Issues</b>
Roofs	Leakage, rusty, partly ripped off, completely ripped off.
Windows and Doors (wooden members)	Partly broken down, completely broken down, no problem
Painting	No Painting, faded painting, dirty, well painted
Walls	Partly broken down, develop cracks, peel – off, tilted
Foundation	Exposed, hanging, weak
Age of the Building	Old ( above 50 years) medium aged (20-50 years) and younger buildings (less than 20 years)
Housing type	Detached, semi-detached
Housing facilities(toilet, water, bathroom, kitchen, electricity)	Good, fairly good and bad

Source: Cobbinah (2010) and Issahaku (2013).

### **3.6.3 Interview Guide**

The researcher developed a well-structured interview guide for estate managers/maintenance officers of the institutions and stakeholders in the provision of public buildings such as PWD

The structured interview for the maintenance and estate departments was to enable the researcher to assess the capacity of these departments to maintain buildings of their respective institutions and the type of maintenance activities that go on in these institutions. The questions covered the variables necessary to measure maintenance of buildings. This included the age of buildings, the components that decay and the design of the buildings and its effect on maintenance.

### **3.6.4 Observations**

In order to support evidence of the information gather for the research, the researcher undertook physical field observation and photographs of buildings in the selected institutions in terms of walls to determine the nature or state of the coated surface-check for cracks and fungi infestation. Other things looked out for were the floor screed, broken windows and doors, non-functional electrical fittings, faulty sewerage and broken down drains, exposed/hanged foundation and ripped off/ rusty/ leaking roofs amongst others in arriving at a conclusion.

### **3.7 Data Analysis**

Analysis of the data was done using both qualitative and quantitative analytical techniques. Tables, percentages and textual write-ups of the data gathered among others were used in the case of the quantitative technique, while descriptions and pictures were used in the case of the qualitative analysis.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1 Introduction

This chapter presents the results, analyses, and discussions of the data collected. Analysis of responses was done according to the research objectives. It examined the present state and condition of the residential buildings of the following public institutions in Bolgatanga: Ghana Health Service Nurses quarters and the Ghana Fire Service, the causes of maintenance problems in public institutions and the maintenance policy and practices of these institutions. Simple percentages were used for the discussions and analyses.

#### 4.2 Results and Discussion of Questionnaires

##### 4.2.1 Results of Questionnaires from Tenants

##### Background Information of Tenants

This section of the study presents the background information of the tenants of the bungalows of the Ghana Fire Service and Ghana Health Service Nurses Quarters. Some of the major factors considered included tenant type, type of building, years of staying in the building, age of building, and others. These questions were to assess the nature and state of the buildings occupied by tenants of the bungalows of the Ghana Fire Service and Ghana Health Service Nurses Quarters. The results of the section are presented in Table 4.1.

Personnel of the surveyed public institutions reside in two main house types, namely; bungalows (detached and semi-detached) for senior staff, and 1&3 bedroom (semi-detached) for junior staff. From Table 4.1, out of the total tenant surveyed (n=58), the majority were junior staff numbering (31) representing (53%). The

dominant type of buildings of the surveyed tenants was 1&2-bedrooms (semi-detached) type of buildings numbering (31) represented by 53% of the respondents; while 27 representing 47% of the respondents held 3-bedroom houses (detached and semi-detached) buildings. The majority numbering (58) representing (90%) of the tenants have stayed in these buildings between 1 and 10 years. Furthermore, the age of most of the buildings as indicated by the majority of (43) representing (74%) of the tenant respondents was above 15 years. The majority numbering (45) representing (78%) of the respondents took inventory of the state of the buildings before occupancy. Regular inspection is not taking of the state of the buildings as indicated by the majority of (35) representing (60%) of the respondents. However, where inspection is conducted, the inspection on the state of the buildings is often done annually. Public Works Department (PWD) section of the Municipal Assembly is the organisation responsible for the maintenance of the buildings as indicated by (36) representing (62%) of the tenants. It often takes more than 6 months for maintenance request to be responded to by the Municipal Assembly (PWD section). The majority numbering (50) representing (87%) of the tenants believed that the maintenance conducted by the Authority is poor.

**Table 4.1: Background Information of Tenants**

<b>Background Information</b>	<b>Frequency (n=58)</b>	<b>Percentage</b>
<b>Tenant type</b>		
Senior staff	27	47
Junior staff	31	53
<b>Type of building</b>		
3-Bedroom House	27	47
1&2- Bedroom House	31	53
<b>Years of staying in the building</b>		
1-5 years	22	38
6-10 years	30	52
11-15 years	4	7
16-20 years	2	3
<b>Age of building</b>		
Below 10 years	3	5
Between 10-15 years	12	21
Above 15 years	43	74
<b>Took inventory of state of building before occupancy</b>		
Yes	45	78
No	13	22
<b>Undertaking of regular inspection of the building</b>		
Yes	23	40
No	35	60
<b>If yes, how often is it done</b>		
Quarterly	5	19
Annually	18	69
Bi-annually	3	12
<b>Persons responsible for building maintenance</b>		
Self	22	38
Municipal Assembly	36	62
<b>Period taken for maintenance request to be responded to</b>		
Less than a month	4	7
1-5 month	12	21
6-12 months	16	27
More than 12 months	26	45
<b>Perception of maintenance concerning building condition</b>		
Very Good	2	3
Good	6	10
Poor	34	59
Very Poor	16	28

Source: Author's Field Survey: June, 2016



## **The Present State/Condition of the Buildings**

### **The Availability of Domestic Facilities and Services in the Public Buildings**

Domestic facilities and services in the building namely toilet, kitchen, water, electricity and bath among others are basic and necessary requirement to make the building habitable and ensure the comfort and safety of occupants. They form an integral part of housing design and construction and are therefore required to be incorporated in the design of buildings before approval is given by city authorities upon application. These facilities have been described as being in good condition, fairly good condition and bad condition. Facilities described as being in good condition are those that are well maintained and operational in most of the times. Those that have served many years of useful life and are fairly maintained but have some problems with its functionality, and yet operational are described as being in a fairly good condition while facilities that are not well maintained and are either not operational or operational for limited periods of time due to maintenance problems are said to be in bad condition. The study therefore sought to assess the state of these facilities in residential buildings of the Ghana Fire Service, and the GHS Nurses quarters in Bolgatanga.

### **Condition of Domestic Facilities and Services**

All the institutions surveyed had the full complement of the following domestic facilities services: toilet, kitchen, water, electricity and bath. The single unit buildings (1- Bedroom semi-detached) however, have their toilet, kitchen, water and bath separated from the main buildings. In addition, each of these domestic facilities and services are shared by two households or housing unit. Pipe borne water is the main source of water supply to the households and the toilet facility used was mainly

water closet (52) and a few pan latrines (6 for GHS Junior Staff). Table 4.2 shows details of the condition of these domestic facilities and services in the various institutions.

The state of water, bathroom, toilet, kitchen, and electricity shown by table 4.2 depicts that, total number of; 23 representing 40 percent, 34 representing 58 percent and 2 percent of the water facility among households of public institutions surveyed were in good, fairly good and bad condition respectively. This means that about 35 buildings of both institutions representing 60 percent of the water facility of the public buildings surveyed requires some form of maintenance.

In terms of institutions, GFS had 8 buildings representing 38 percent of the water facility in good condition, with 12 buildings representing 57 percent in fairly good and 1 representing 5 percent in bad condition, while GHS which had none of its surveyed buildings with its water facility in bad condition; but with only 15 buildings representing 41 percent and (22) representing 59 percent in good and fairly good respectively, the situation is depressing and needs some maintenance attention. The condition of the facility has been associated with the following problems according to the various institutions surveyed: There is irregular flow of water and frequent breakdown of the taps, especially, with the single unit building of the GHS where pressure on the facility is high due to the number of users.

For a house to become a home for man, there is the need for a bathroom to be incorporated in the main design. This facility should have a smooth floor and wall to prevent water from seeping through into the foundation. It was essential to take a look at the state of the bathroom of occupants of the public buildings. From Table 4.2, total number of 45 representing 78percent and 13 representing 22 percent of respondents surveyed indicated that the facility was in good and fairly good condition

respectively. Therefore, 13 representing 22 percent of public buildings surveyed require some maintenance.

However a look at the facility according to institutions revealed that, total number of 17 representing 81 percent and 4 representing 19 percent of buildings surveyed in the GFS have their bathrooms in good and fairly good condition respectively while the GHS had 28 represented by 76 percent and 9 represented by 24 percent respectively. The major maintenance problems with the bathrooms are: presence of cracks on the floor and wall, peeling off of the plastered walls, and too many users particularly in the case of single unit houses.

The results revealed that the toilet facility used by the respondents are water closet and pan latrine. From Table 4.2, total number of 10 representing 17 percent of the toilet facility is in good condition, while 44 representing 76 percent and 4 representing 7 percent are in fairly good and bad condition respectively. The state of the toilet facility in the GFS shows that 2 buildings representing 10 percent of households surveyed had their toilet facility in good condition while 15 representing 71 percent and 4 representing 19 percent were in fairly good and bad condition respectively. The situation with GHS was much better with a number of 8 representing 22 percent of respondents having their facility in good condition, and 29 representing 78 percent in fairly good condition. The state of the condition of the toilet facility for the two institutions emanates from the problem of leakages from the septic tanks and inspection chambers, thus emitting very bad odour. According to the residents, the septic tanks have been in existence for decades, i.e. from the 1950s when the buildings were put up. Also, most of the junior staff quarters are still using the pan latrine system which is unhygienic.

The kitchen facility was analysed by looking at the nature of ventilation, the size of the kitchen and the number of users as well as its location in the building. The bungalows of the GFS and GHS senior nurses quarters have their kitchens located within it, spacious and well ventilated and used by one occupant. The situation is different when it comes to the single unit houses of the GHS Junior staff quarters, where the facility is located in front of the building, poorly ventilated, small in size and shared by two households. The pressure on the kitchen facility for the single houses has resulted in deterioration of the floors, the walls, windows, doors and the electrical gadgets such as sockets, switches and plugs. Table 4.2 shows that, about a total number of 26, 28, and 4 representing 45 percent, 48 percent and 7 percent of kitchens in public buildings surveyed are in good, fairly good and bad condition respectively. This is an indication that, about 32 representing 55 percent of them need maintenance works. A number of 12, 21 and 4 representing 32 percent, 57 percent and 11 percent of respondents from the GHS nurses quarters had their kitchen facility in good, fairly good and bad condition respectively. The situation is however better with the GFS which had about 67 percent of the kitchen facility in good condition and 33 percent in fairly good condition.

Electricity was available in all buildings surveyed. The electrical facilities in the buildings were also analysed to establish the functionality of the entire wiring system of the building, the state of the fixtures (sockets, switches), fans/air-conditioners if available and provided by the institution. Respondents complained of frequent power cuts due to the wiring system which they intimated are overaged. Some of the fans and fluorescent fittings are faulty, rusty and non- functioning. The electricity facility was described as being in good condition by about 11 representing 19 percent of respondent, while a total number of about 41 and 6 representing 71

percent and 10 percent responded that the facility was fairly good and bad respectively. However, 6 and 15 representing 29 percent and 71 percent of respondents from the GFS indicated that the electrical facility was good and fairly good respectively. The situation for GHS nurses quarters were 5 and 28 representing 13 percent, 76 percent and 11 percent in good, fairly good and bad condition respectively. Generally, the surveyed houses had problems with their electricity facility and therefore needed urgent attention to protect the building and property of occupants.

**Table 4.2: Condition of Domestic Facilities and Services**

Institution	Water							
	Good		Fairly Good		Bad		Total	
	No	%	No	%	No	%	No	%
Ghana Fire Service	8	38	12	57	1	5	21	100
Ghana Health Service	15	41	22	59	-	-	37	100
<b>Total</b>	<b>23</b>	<b>40</b>	<b>34</b>	<b>58</b>	<b>2</b>	<b>-</b>	<b>58</b>	<b>100</b>
			<b>Bathroom</b>					
Ghana Fire Service	17	81	4	19	-	-	21	100
Ghana Health Service	28	76	9	24	-	-	37	100
<b>Total</b>	<b>45</b>	<b>78</b>	<b>13</b>	<b>22</b>	<b>-</b>	<b>-</b>	<b>58</b>	<b>100</b>
			<b>Toilet</b>					
Ghana Fire Service	2	10	15	71	4	19	21	100
Ghana Health Service	8	22	29	78	-	-	37	100
<b>Total</b>	<b>10</b>	<b>17</b>	<b>44</b>	<b>76</b>	<b>4</b>	<b>7</b>	<b>58</b>	<b>100</b>
			<b>Kitchen</b>					
Ghana Fire Service	14	67	7	33	-	-	21	100
Ghana Health Service	12	32	21	57	4	11	37	100
<b>Total</b>	<b>26</b>	<b>45</b>	<b>28</b>	<b>48</b>	<b>4</b>	<b>7</b>	<b>58</b>	<b>100</b>
			<b>Electricity</b>					
Ghana Fire Service	6	29	15	71	-	-	21	100
Ghana Health Service	5	13	28	76	4	11	37	100
<b>Total</b>	<b>11</b>	<b>19</b>	<b>41</b>	<b>71</b>	<b>6</b>	<b>10</b>	<b>58</b>	<b>100</b>

Source: Author's Field Survey: June, 2016

## **Present Condition of Building Elements**

This section examines the current general maintenance situation of the residential buildings of the two public institutions in the Bolgatanga Municipality in relation to the building elements. A building is made of several elements with each performing specific functions. The effective functioning of these elements determines the condition of a building. All the elements have well defined and distinct functions irrespective of the design of the building, its specifications and construction. The maintenance condition of the buildings was done by assessing the following elements: the foundation/substructure, the roof, the floor, the wall, painting, and wooden members (windows and doors).

### **Foundation of buildings**

A foundation is the solid base of a building that transmits the load of the structure onto a firm soil. Primarily, it is the foundation upon which the building's strength resides. A weak sub-structure/foundation cannot support any super structure no matter how well the building is constructed. The foundation of a building represent between 20-30 percent of the cost of any built environment (Afrane & Osei Tutu, 1997). The defective foundations were detected through a site visit as shown in appendix I

Table 4.3 reveals that, total number of about; 6 and 9 representing 10 percent, and 16 percent of all buildings surveyed had problems with their foundation. The results revealed that, about 2 representing 10 percent of the buildings of the GFS have their foundation developed deep cracks, while 3 representing 14 percent have their foundation exposed or hanging. Similarly, GHS had 4 representing 11 percent of their foundation developed deep crack, while 6 representing 16 have their foundation

exposed or hanging. This indicates that the buildings need urgent attention. It was observed that the problem of exposed foundation is as a result of intensive erosion as most of the surroundings of the buildings have no vegetation cover to reduce the rate of erosion.

**Table 4.3: Present Condition of Foundation Element**

Institution	Foundation							
	Deep Cracks		Exposed/Hanging		No Defect		Total	
	No	%	No	%	No	%	No	%
Ghana Fire Service	2	10	3	14	16	76	21	100
Ghana Health Service	4	11	6	16	27	73	37	100
<b>Total</b>	<b>6</b>	<b>10</b>	<b>9</b>	<b>16</b>	<b>43</b>	<b>74</b>	<b>58</b>	<b>100</b>

Source: Author's Field Survey: June, 2016

### Condition of Roofing Elements

Roofing element constitute about 15-20 percent of the cost of any housing project (Afranie & Osei Tutu, 1997). The roof cover of any building forms an important component of that building. The roof of a building must be in place before it can be habitable. The predominant roofing material identified in the study area was the asbestos roof, aluminium and iron sheet. A leaking roof of a building has a multiplier effect of causing damage to the building structure itself as well as the property of occupants.

Table 4.4 shows that, total number of 25 representing 43 percent of all buildings surveyed had problems with their roofs. It was recorded that, a total number of 14 and 9 representing 24 percent and 16 percent of all surveyed houses had their roofs either leaking or rusted respectively while 2 representing 3 percent had their roof partly ripped off. The problem of roof leakage was more pronounced in buildings of GFS where about 6 representing 29 percent of buildings surveyed had leaking

roofs. This situation needs urgent attention to prevent damage to the properties of the occupants.

**Table 4.4: Condition of Roofing Element**

Institution	Leaking		Rusty		Partly Ripped Off		No Defect		Total	
	No	%	No	%	No	%	No	%	No	%
Ghana Fire Service	6	29	4	19	-	-	11	52	21	100
Ghana Health Service	8	22	5	14	2	5	22	59	37	100
<b>Total</b>	<b>14</b>	<b>24</b>	<b>9</b>	<b>16</b>	<b>2</b>	<b>3</b>	<b>33</b>	<b>57</b>	<b>58</b>	<b>100</b>

Source: Author's Field Survey: June, 2016

### Present Condition of Flooring Elements

The floor of any building is an area that experiences a lot of activity due to the movement of occupants and as such undergoes both imposed and natural stress; hence the rate of wear and tear is more pronounced. Majority of the buildings surveyed had problems with their floor. Only 27 representing 47 percent of the houses surveyed had their floors in good condition. In addition to the floors developing cracks and peeling off, there were sections of some floor exhibiting indentation due to the peeling off with respect to the concrete floor.

**Table 4.5: Present Condition of Flooring Element**

Institution	Flooring Element						Total	
	Develop Cracks		Peeled-off Defect		No Defect		No	%
	No	%	No	%	No	%	No	%
Ghana Fire Service	8	38	3	14	10	48	21	100
Ghana Health Service	16	43	4	11	17	46	37	100
<b>Total</b>	<b>24</b>	<b>41</b>	<b>7</b>	<b>12</b>	<b>27</b>	<b>47</b>	<b>58</b>	<b>100</b>

Source: Author's Field Survey: June, 2016



## Wall Elements of Buildings

Wall element is for enclosing of space. It is one of the most substitutable elements of the building and it is basic to all buildings. Table 4.6 depicts the condition of the walling elements of buildings surveyed.

The results indicated that the commonest problem with the wall is the development of cracks. From Table 4.6, a total number of 13 and 12 representing 22 percent, and 12 percent of the walls of all public buildings surveyed have either developed cracks or peeled off respectively. However, the situation is more pronounced on GFS that had 5 representing 24 percent of their walls developed cracks and 3 representing 14 percent of their walls peeled off.

**Table 4.6: Present Condition of Wall Element**

Institution	Wall Element							
	Develop Cracks		Peeled- Defect		off No Defect		Total	
	No	%	No	%	No	%	No	%
Ghana Fire Service	5	24	3	14	13	62	21	100
Ghana Health Service	8	22	4	11	25	67	37	100
<b>Total</b>	<b>13</b>	<b>22</b>	<b>7</b>	<b>12</b>	<b>38</b>	<b>66</b>	<b>58</b>	<b>100</b>

Source: Author's Field Survey: June, 2016

## Painting of Buildings

Painting on a building adds up to the beauty of any built environment and protects the buildings as well against the vagaries of the weather. It also prolongs the lifespan of the building. Painting as a finishing material is an aesthetic variable as far as the building fabric is concerned. Table 4.7 shows the data in terms of painting by institution.

Table 4.7 indicates that, a total number of 18 representing 31 percent of all buildings surveyed were well painted. However, a total number of 40 representing 69 percent had various forms of painting-related problems as follows: faded paint 4 representing 7 percent, and 36 representing dirty 62 percent. This is an indication that buildings of these public institutions need urgent attention in terms of painting. Relatively the GHS had the highest well painted number of 9 buildings representing 43 percent, while the GFS had the highest number of 24 dirty buildings representing 65 percent. There is therefore the need to ensure that buildings are regularly painted due to the aesthetic and protective value of painting.

**Table 4.7: Present Condition of Painting Element**

Institution	Painting							
	Faded Painting		Dirty		Well Painted		Total	
	No	%	No	%	No	%	No	%
Ghana Fire Service	4	11	24	65	9	24	37	100
Ghana Health Service	0	0	12	57	9	43	21	100
<b>Total</b>	<b>4</b>	<b>7</b>	<b>36</b>	<b>62</b>	<b>18</b>	<b>31</b>	<b>58</b>	<b>100</b>

Source: Author's Field Survey: June, 2016

### **Maintenance Condition of Windows and Doors (Wooden Members)**

Windows and doors are purposely put in place to regulate the amount of air and sunlight penetration into a building. It also ensures that properties of occupants are safe and secure. Table 4.8 shows the general maintenance condition of windows and doors with respect to the institutions.

Table 4.8 shows that a total number of 13 representing 23 percent of buildings surveyed had defective wooden members. This implies that about 23 percent of all buildings surveyed need to have their windows and doors repaired because they are partly broken down. The partly broken wooden members had some doors with their

hinges defective as well as part of the doors especially the bathroom doors rotten due to lack of coating or painting to prevent the doors from absorbing water. The major problem with the windows was broken louvre blades which impact negatively on day and night room temperatures and indoor air quality.

**Table 4.8: Present Condition of Windows and Doors Element**

Institution	Windows and Doors Element							
	Partly Broken down		Completely Broken down		No Defect		Total	
	No	%	No	%	No	%	No	%
Ghana Fire Service	5	24	-	-	16	76	21	100
Ghana Health Service	7	19	1	3	29	78	37	100
<b>Total</b>	<b>12</b>	<b>21</b>	<b>1</b>	<b>2</b>	<b>45</b>	<b>77</b>	<b>58</b>	<b>100</b>

Source: Author's Field Survey: June, 2016

### General Maintenance Condition of Buildings of the Institutions Surveyed

In sum, the assessment of maintenance conditions of residential buildings of public institutions surveyed has revealed that the houses are not well maintained. The most poorly maintained elements of the building are the painting, roofing, and flooring. Only 31 percent, 42 percent, and 47 percent of the painting, roofing and flooring elements respectively were well maintained and in good condition. Major defects identified on the buildings include the following: cracked and exposed foundation, rusty and leaking roof, cracked peel-off and dusty floors, faded and dirty painting of buildings, broken down windows and doors, damaged door locks, missing hinges, as well as loose screws and bolts on doors. Additionally, most of the junior staff quarters are still using the pan latrine system which is unhygienic.

The ineffectiveness of the building maintenance by the Ghana Fire Service and Ghana Health Service is supported by literature that indicates that building maintenance has until recently been a neglected field of technology, being regarded as a “Cinderella” activity (RIC, 2009). It possesses little glamour and is unlikely to attract very much attention and is frequently regarded as unproductive.

### **Causes of Maintenance Problems in Public Buildings**

Governments since independence have put up buildings for use by public institutions. Some of these properties even date back to the colonial administration. Public institutions are therefore expected to have the natural tendency to preserve, protect and maintain these properties. This section of the study assesses the factors responsible for poor maintenance management of the surveyed public institutions. The tenants were given 12 factors to choose between least and highest, regarding the factors responsible for maintenance problems in the public buildings surveyed. The variables were ranked with the aid of the mean responses of the surveyed participants/respondents. The result is presented in Table 4.9. The results revealed that the five most critical factors responsible for maintenance problem of the public institutions surveyed as opined by the tenants and estate/maintenance staff were:

- Lack of maintenance culture
- Inadequate funds and high maintenance cost
- Pressure on building facilities by number of users
- The age of the buildings
- Frequent transfer of occupants

However, the least ranked factors for poor maintenance management included inadequate training and development of maintenance personnel, inflation of the cost

of maintenance by the operatives, and lack of skilled personnel in maintenance department in that order.

### **Lack of Maintenance Culture**

Respondents pointed out that the authorities or management of the institutions, after having acquired these properties, do not show much eagerness towards their maintenance. According to them, Estate and Maintenance Managers do not undertake regular inspection of the building to ascertain its condition neither do they undertake routine and periodic maintenance on the buildings. Some of the GHS respondents indicated that even though they pay rent as a company policy for the buildings they occupy, external maintenance works which are to be carried out by the institution are either not done or take a long time for reported complaints to be attended to thus creating a lot of inconvenience for occupants. It also came to light that the fire service personnel and GHS occupants of the junior staff quarters do not pay rent.

Expressing their views on lack of maintenance culture by the individuals, the maintenance staff had this to say; “majority of the occupants feel it’s not their permanent/personal abode and therefore would not like to spend money on renovation.” The respondents (tenants) however, had this to say; “Central Government withholds rent deductions at national level without setting anything aside for maintenance”. They also indicated that in situations where maintenance request are put in by occupants according to the policy of the institutions, they hardly receive prompt attention. Some of the tenants however intimated that the estate committee does not enforce occupants to maintain their quarters periodically by law. In short, negligence on the part of public officers in maintaining buildings point to the fact that maintenance culture is very poor.

### **Inadequate Funds for Maintenance**

Most of the maintenance staff opined that funds from central government to carry out maintenance of buildings is not adequate. The tenants also opined that they do not have sufficient funds for maintenance. This is how one tenant remarked “occupants are too much burdened with high cost of repairs from their low remuneration”. In short, occupants’ inability to maintain their buildings is being attributed to high cost of maintenance in respect of cost of materials such as cement, wood, paint, nails etc and labour. As a result of this, respondents felt reluctant to sacrifice or increase spending towards the proper maintenance of their building which at the end of the day creates a lot of problems for the occupants in terms of their comfort and safety. Moreover, what is less considered is that, maintenance problems become more expensive when not attended to in time.

In spite of the above, respondents maintained that they contribute substantially to the external maintenance of their building else the maintenance situation would have been worse. Majority of the respondents numbering (44) representing (75%) indicated that they spend between GH¢ 250.00-800.00 annually on maintenance of their buildings while 25 percent indicated that, they cannot cost the amount they spend on maintenance of their buildings.

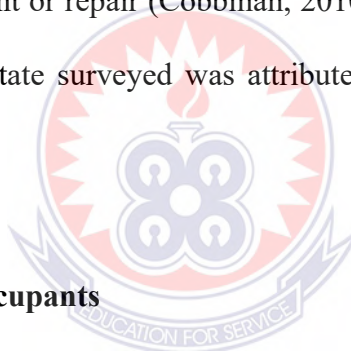
### **Pressure on building facilities by number of users**

The number of people occupying or living in a house is also seen to have a bearing on the maintenance conditions. Generally, the higher the number of people in a house the more pressure there is on the use of facilities which are in common use such as water, bathrooms, toilet, and kitchen facilities. From the survey, it came out that maintenance seems to suffer especially with single unit houses where the above

facilities are shared by large number of occupants living in this house. According to the respondents, the minimum number of people that occupy their buildings are three (3).

### **Age of the buildings**

According to the 4 staff interviewed, the ages of most of the public buildings surveyed (79%) are more than 50 years. Houses deteriorate with age since the lifespan of most buildings are constructed to last for at least sixty (60) years but may exceed this period if the building is well maintained over time. Above 60 years, most houses exhibit serious maintenance problems which will demand at least major renovation, rehabilitation, replacement or repair (Cobbinah, 2010). The present state of the public buildings in fairly bad state surveyed was attributed to the age of the buildings by some of the respondents.



### **Frequent transfer of occupants**

The study results revealed that both tenants and maintenance staff believe that frequent transfer occupants is one of the most critical factors attributable to maintenance problems of the surveyed institutions. “I believe that the frequent change of occupants in the building is responsible for the present state of the building” remarked a tenant.

**Table 4.9: Factors Responsible for Maintenance Problem in Public Buildings**

Factors	Tenant	SD	Rank	Staff	SD	Rank	Overall Mean	R
Inadequate funds for maintenance job	3.76	0.54	2	3.92	0.45	1	3.84	2
Frequent transfer of occupants	3.44	0.48	5	3.26	0.54	5	3.35	5
Persistent breakdown through indiscipline and ignorance factors of building users	2.95	0.52	8	2.85	0.52	6	2.90	8
Natural deterioration due to age and environment	3.58	0.56	4	3.48	0.60	4	3.53	4
Inadequate training and development of maintenance personnel	2.78	0.50	11	2.46	0.54	9	2.52	10
Inflation of the cost of maintenance by the operatives	2.58	0.54	12	2.36	0.48	10	2.47	11
Non-response to maintenance	3.38	0.58	6	2.54	0.50	8	2.96	6
Frequent shortage of materials and spare parts due to absence of efficient inventory system	2.78	0.50	9	2.34	0.56	11	2.56	9
Lack of skilled personnel in maintenance department	2.24	0.56	10	2.18	0.53	12	2.21	12
Lack of maintenance culture	3.86	0.52	1	3.84	0.52	2	3.85	1
Pressure on facility/building due to number of occupants	3.68	0.55	3	3.76	0.56	3	3.72	3
Bureaucratic reporting process	3.05	0.54	7	2.82	0.58	7	2.94	7

Source: Author's Field Survey: June, 2016

### 4.3 Results and Discussions of Interview

#### 4.3.1 Results of Interview from Maintenance Staff

##### Background Information of Maintenance Staff

From Table 4.10, out of the total maintenance staff (5) interviewed, the majority (3) possess BSc degree; four (4) have had more than 5 years experience as maintenance staff. The majority (4) of the interviewed staff were also senior staff officers in the maintenance department. The interviewed staff of the Ghana Fire Service and Ghana Health Service believed the institution has maintenance policy. The maintenance arrangement is mostly periodic. The maintenance of the buildings is often necessitated by knowledge of state of the buildings after inspection and also upon occupancy of new tenants. It often takes 6 to 12 months for the Ghana Fire



Service, and Ghana Health Service to respond to maintenance request from occupants or tenants as indicated by 4 (80%) of the surveyed respondents. 79 percent of the buildings are above 50 years.

**Table 4.10: Background Information of Maintenance Staffs**

<b>Background Information</b>	<b>Frequency (n=5)</b>	<b>Percentage</b>
<b>Highest Qualification</b>		
Master's degree	1	20
BSc	3	60
HND	1	20
<b>Years of experience as a maintenance staff</b>		
Less than 5 years	1	20
5-10 years	4	80
<b>Status of staff in the maintenance department</b>		
Senior	3	60
Intermediate	2	40
<b>Presence of maintenance policy in the institution</b>		
Yes	5	100
No	-	-
<b>Type of maintenance arrangement</b>		
Periodic	4	80
Routine	1	20
Preventive	-	-
<b>What necessitated maintenance on the building</b>		
Upon inspection	3	60
Upon request	-	-
Upon occupancy of new tenant	2	40
<b>Period taken for maintenance request to be responded to</b>		
Less than a month	-	-
1-5 month	1	20
6-12 months	4	80
More than 12 months	-	-
<b>Age of the buildings</b>		
Less than 20 years	-	-
20-50 years	12	21
above 50 years	46	79

Source: Author's Field Survey: June, 2016

## **Maintenance Policy and Practices of Public Institutions**

Ghana at present has no National Maintenance Policy to regulate or control preventive maintenance of buildings of public institutions. However, the survey revealed that the Estate departments of the institutions have developed maintenance policy to ensure that there is regular maintenance of buildings allocated to personnel. The maintenance policy of the institutions does not however take care of preventive maintenance which is a regularly scheduled inspection, testing, and repair of building components intended to prolong a building's life and restore components' efficiency.

The institutions adopt a centralized approach in handling preventive maintenance. This responsibility for building maintenance rests largely with one office i.e. the Estate and Maintenance office that oversees maintenance for most or all buildings owned by the institution. The institutions are responsible for the external maintenance of the buildings including: painting, replacement of wooden members and net, roof, electricity, sewerage, and plumbing. Occupants on the other hand are responsible for the internal maintenance of the building such as:

- Replacement of all burnt-out bulbs, lost keys or locks and broken louver blades.
- Keeping service or institutional properties and the surrounding thereof in good sanitary condition, by weeding around and disposing of refuse regularly to avoid any nuisance.
- Fumigation of the internal portions of dwelling units to get rid of ants, mosquitoes, cockroaches, flies etc.
- Occupants not causing or permitting anything to be done to their dwelling units which will alter the external walls or allow any renovation to be done to any part of the premises without the written consent of the institution.

### **Mode of Access to the Building and its Maintenance**

The buildings are allocated to the personnel by the Estate Officer in consultation with the accommodation committee. The Estate department is to ensure that an inventory of the building is taken and signed by both the officer and the would-be occupant. Similarly this procedure must be followed before occupant vacates the building. The study revealed on the contrary that occupants take occupancy of the building without signing any inventory form. This has arisen largely because of the urgency with which personnel move in to take over the building on retirement or transfer of previous occupant without recourse to the laid down rules. In the case of the GFS, respondents claimed they take over the accommodation of the relieved after service vehicle have brought them in without necessarily consulting the Estate Department due to the room being virtually empty. They further indicated that the practice of inventory taking is not in existence. This development makes it difficult for the institutions to surcharge occupants who refuse to undertake internal maintenance of their building for the period of their occupancy. Also, the bureaucratic reporting process prevents occupants from reporting maintenance needs of their buildings unless in emergency situations such as ripping off of roof, emptying of septic tanks and major electrical faults.

### **Funding of Maintenance Activities of Public Institutions**

Maintenance includes daily maintenance, minor repairs, and major system replacement requiring huge capital outlay. Public institutions rely on central government funds to cover maintenance expenses. The survey revealed that personnel occupying public buildings are charged rent based on government rent policy which currently is 10 percent of gross salary. The situation is however different in the case

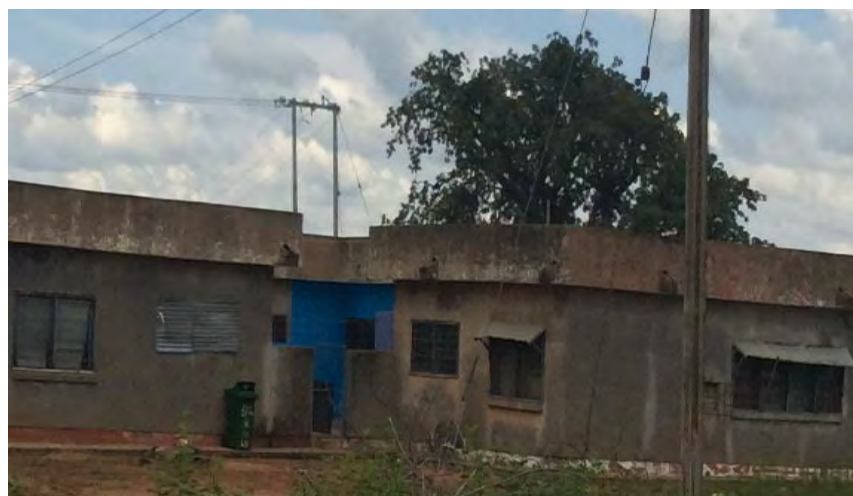
of the GFS where only the senior officers do pay rent on their bungalows. The rent paid on public buildings is not paid into the institutions account but rather to the Consolidated Accounts of the government.

#### **4.4 Results of the Field Observations of the Residential Buildings in the Surveyed Institutions**

The photographs below show the building types and the maintenance problems of the public residential buildings of GFS and GHS in Bolgatanga.



**Figure 4.1:** Two Bedroom (GHS SSQ) & One bedroom semi-detached (GHS JSQ)



**Figure 4.2:** Three Bedroom Bungalow (GFS SSQ)

Figure (4.1 &4.2) indicates the type of residential buildings surveyed in Bolgatanga municipality. It was observed that, most of the Ghana Fire Service junior staff quarters were in a very deplorable state and needed urgent maintenance and repairs to bring the buildings back to good condition and functionality. However, the observation also revealed that, GFS senior staff bungalows and the Nurses quarters are of great cause for concern. There is the presence of faded and dirty painting, leaking roof, faulty electrical fittings etc. which need urgent attention to make the buildings habitable.



**Figure 4.3:** Exposed/hanged foundation due to erosion



**Figure 4.4:** Weak foundation/substructure

Figure (4.3 & 4.4) indicate the exposed/hanged and weak substructure/foundation. It was observed that most of the GFS junior staff quarters had weaker foundations/substructure as shown in figure 4.4 while most of the Nurses quarters had exposed/hanged foundations as shown in figure 4.3. This situation as shown is serious and needs urgent attention to prevent any future calamity.



**Figure 4.5:** Missing louvre blades and weak wooden members (door & window frames) due to poor maintenance practice.

Figure 4.5 indicates missing louvre blades and weak wooden members. The observation revealed that most of the GFS junior staff quarters had missing louvre blades and weak wooden members as shown. This situation needs urgent attention to make the buildings habitable.



**Figure 4.6:** Pan Latrine and Non-functional water closet facility

Figure 4.6 indicates pan latrine and non-functional water closet facility. It was observed that till date some of the GHS junior staff quarters use pan latrine and non-functional water system which is unhygienic. This gives rise to open defecation especially when the pan latrine is full and the right soil carriers are not ready to work.



## **CHAPTER FIVE**

### **SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Introduction**

This chapter presents summary of findings, conclusion and recommendations of the study.

#### **5.2 Summary of Finding**

The following are findings of the study:

- The study has revealed that, most of the public residential buildings of the Ghana Fire Service and Ghana Health Service surveyed in Bolgatanga municipality are old and more than 50 years. These buildings have not been maintained especially the GFS junior staff quarters since they were constructed and therefore, most of the facilities such as toilet, bathroom, kitchen and electricity are out of use and very dangerous for users.
- The study has shown that, some of the Ghana Health Service junior staff quarters still use pan latrine system which is unhygienic. This situation has promoted open defecation especially when the pan latrine is full.
- The study further revealed that, electrical and water systems, bathrooms and kitchens are in deplorable state. The reasons for this current state of the facilities is partly attributable to the limited attention given to maintenance by the occupants. The institutions on the other hand, attribute the situation to inadequate fund to carry out periodic maintenance.
- The study further indicated that, all the building elements of the two public institutions are defective especially, foundations, floors, roofs and walls and



have never been maintained since inception. However, the study also showed that, windows and doors are the only elements that have somehow been maintained since their inception.

- The study showed that, there is generally lack of maintenance culture on the part of both the institutions (GFS & GHS) and the occupants, thus resulting in deferred maintenance of the buildings. This situation is also evident in the lack of preventive maintenance plan by public institutions for their buildings. Occupants also exhibit apathy towards maintaining their buildings holding the view that it is a government property and not their permanent abode.
- The study revealed that, funds for maintenance works are inadequate. Furthermore, there is delay in releasing the funds. These have contributed significantly to the present state of the two public buildings surveyed. The situation has also been worsened by the high cost of building materials in the municipality.
- The study also revealed that, the two state institutions in Bolgatanga municipality, their major setback is lack of effective maintenance policy, laws and regulations. This implies that, nothing compel both managers of public institutions and occupants to undertake maintenance work on the buildings hence the continuing deterioration of public residential buildings in the municipality.

### **5.3 Conclusion**

The study has confirmed that, maintenance is very crucial to the sustainability of the structure and exposure of various inefficiency in maintenance could be said to have contributed to rapid deterioration of the buildings, hence the study's findings and

recommendations would go a long way to ensure the sustainability of the buildings. With an increasingly and rapidly changing nature of buildings, the onus falls on both management and tenants to improve their attitude toward maintenance practice thereby ensuring efficient use of public resources. In conclusion, management of public institutions (GFS & GHS) in Bolgatanga needs to embrace preventive maintenance practice as a high priority. Also, the occupants of the public residential buildings who exhibit poor maintenance practices should be strictly sanctioned such as surcharging them with cost of damage caused as well as eviction from the premises.

#### **5.4 Recommendations**

To address the findings, the following recommendations are made:

- The estate/ maintenance officers in charge of maintenance of these institutions in Bolgatanga municipality should ensure that all the overaged public residential buildings which are not maintainable or repairable are demolished immediately and replaced with modern ones to avoid sudden collapse of buildings on occupants.
- The estate/maintenance officers should make sure that, all existing pan latrines currently in use by some of the Ghana Health Service junior staff quarters should be converted to water closet system to curb open defecation in the municipality.
- To address the old age situation of most of the residential buildings in the municipality, it is recommended that, most of the electrical and plumbing system should be changed to modern system to make the buildings habitable.

- For this problem to overcome, all defective elements of the public residential buildings should immediately be given the needed attention by carrying out serious repair works to avoid sudden collapse.
- To curb this problem, occupants of government buildings should also shed off their apathy in terms of ownership and maintenance of such property and rather exhibit high sense of patriotism. This can be done through public education and sensitization and strict application of sanctions.
- To have a sustainable maintenance plan, it is recommended that, a National Maintenance Fund be set up similar to that of the Road Fund to mobilize adequate funds to meet maintenance needs of public institutions. In addition, there is the need for the review of the current rents paid by tenant of public buildings to reflect current economic trends and to generate enough funds to undertake maintenance works on these buildings.
- There should be a state regulation to affect state maintenance of specific building systems. A state building and maintenance code should govern building construction and remodeling. It should also affect accessibility, electricity, energy, fire protection, and plumbing.
- In order to ensure good maintenance practice by occupants, the government should improve the conditions of service of public employees in terms of salary to ensure that tenants are able to do their own maintenance on the buildings.
- For this situation to overcome, a National Maintenance Policy should be formulated as part of the National Housing Policy to compel people to undertake maintenance on the buildings they occupy to avoid the situation

where huge sums of taxpayers' money go down the drain through deterioration of public buildings due to lack of maintenance.

- It is recommended that, further research could look into the maintenance practices of other public institutions such as teachers' bungalows, SSNIT and Estates housing, Metropolitan/Municipal/District assembly residential buildings.



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## APPENDIX I

### PHOTOGRAPH OF MAINTENANCE PROBLEMS OF PUBLIC RESIDENTIAL BUILDINGS (GFS & GHS)



Painting; Dirty and Faded walls



Peeled-off plaster & Crack on walls due to old age and poor maintenance of buildings



Roof: Partly ripped off



Weak floor & foundation due old age & lack of maintenance of buildings weak structure



Weak substructure

**APPENDIX II**

**QUESTIONNAIRE AND INTERVIEW GUIDE**

UNIVERSITY OF EDUCATION, WINNEBA KUMASI CAMPUS

FACULTY OF TECHNOLOGY EDUCATION

DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY

**INTERVIEW SCHEDULE FOR ESTATE / MAINTENANCE OFFICERS AND  
PUBLIC WORKS DEPARTMENT SECTION**

This interview is strictly to provide information regarding a research work on improving maintenance practice of public residential buildings in Bolgatanga Municipality.

You are assured of full confidentiality of all information provided please.

Please tick (✓) or write your responses where appropriate.

Thank you.

1. What is your highest academic qualification, please? [ ] Master's degree [ ] BSc Degree [ ] HND [ ] CTC [ ] Other (please specify) .....

2. What is your position, job description, please? .....

3. What is the role of Estate Officer/PWD in the provision of residential buildings?  
.....

4. What building types do you put up for public residential?  
.....

5. What is the age of your buildings? .....

6. Are occupants charged for their occupancy of the building?  
.....

With reference to the above, who determines the rent Payable?  
.....

7. Do you have a maintenance policy in place for the building in your area / location?

YES [ ] NO [ ]

If yes, who developed the policy?  
.....

8. Does the government have a maintenance manual used when performing preventive maintenance, managing emergency situation?

YES [ ] NO [ ]

9. Do you have an annual maintenance plan for public residential buildings?  
YES [ ] NO [ ]
10. Who is responsible for allocating of public residential buildings to public workers? .....
11. What type of maintenance arrangement do you have in place?  
Periodic [ ] Routine [ ] Preventive [ ]  
Other (please specify).....
12. Do you inspect the building periodically to determine its maintenance needs?  
YES [ ] NO [ ]  
If yes how often and if no please assign reasons.  
.....
13. Who is ultimately responsible for the maintenance of the residential buildings?  
.....
14. What is the responsibility/role of the occupants towards the maintenance of the buildings?  
.....
15. How long does it take to respond to maintenance request/needs of tenants?  
[ ] less than a month [ ] 1-3 months [ ] 6-12 months [ ] More than 12 months  
[ ] other please specify .....
16. Does the institution take inventory of the state of the building on occupancy of new tenant/personnel? YES [ ] NO [ ]
17. How does the institution treat any incidence of negligence in maintenance of the building when tenant/personnel are moving out?  
.....
18. How is maintenance funded? .....
19. What necessitates the carrying out of maintenance on the buildings?  
[ ] Upon inspection [ ] Upon request [ ] Upon occupancy of new tenant  
[ ] Other (Specify) .....
20. How is request for maintenance by occupants on the building handled by your department?  
.....  
.....
21. Do technicians and managers receive training on how to conduct the assessments of the condition buildings? YES [ ] NO [ ]

22. Is there a plan to reduce deferred/delayed maintenance that includes a list of major deferred maintenance projects ranked by level of severity and urgency? YES [ ]

NO [ ]

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

.....  
 .....  
 .....

24. Have building conditions in public institutions improved or stayed at acceptable levels from year to year? YES [ ] NO [ ]

25. How will you consider the current state of the buildings in terms of the following elements and facilities? Please tick (√) appropriate.

KEY NOTE: G – GOOD, FG – FAIRLY GOOD, FB – FAIRLY, B - BAD

Element/Facility	Current State			
	G	FG	FB	B
Roof				
Walls				
Windows/Doors				
Painting				
Floors / floor finish				
Foundation				
Toilet/Bathroom /Bathroom				
Kitchen				
Plumbing system / Drains/gutter system				
Electrical fittings				

26. What will be your comment on the general perception to the view that Public Buildings are not well maintained?

.....  
 .....  
 .....

### APPENDIX III

UNIVERSITY OF EDUCATION, WINNEBA KUMASI CAMPUS  
FACULTY OF TECHNOLOGY EDUCATION  
DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY

#### QUESTIONNAIRE FOR TENANTS/OCCUPANTS OF THE BUILDING

This questionnaire is strictly to provide information regarding a research work on improving maintenance practice of public residential buildings in Bolgatanga Municipality

You are assured of full confidentiality of all information provided please.

Please tick (✓) or write your responses where appropriate.

Thank you.

#### PART I Maintenance of Building

Name of Institution.....

1. What is your highest academic qualification, please? [ ] Master's degree [ ] BSc Degree [ ] HND [ ] SHS [ ] Other (please specify) .....

2. How long have you stayed in the building? .....

3. How many people occupy this building? .....

4. Did you take inventory of the state and facilities in the building before taking occupancy?

YES [ ] NO [ ]

Please assign reason(s) for your response

.....  
.....

5. Do you pay any rent for occupying the building? YES [ ] NO [ ]

If Yes how much do you pay? .....

6. If No please attempt an explanation for non-payment of rent

.....

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

YES [ ] NO [ ]

If yes, how often is it done? [ ] Quarterly [ ] Annually [ ] Biannually

[ ] other (please specify).....



8. Who is responsible for the maintenance of the building? Self  Landlord   
PW   other please specify .....

9. How long does it take for maintenance request to be responded to?  
 less than a month  1-3 months  6-12 months  More than 12 months  
 other please specify .....

10. In your opinion is the building well maintained?  YES  NO.

Please give reason(s) for your answer

.....  
.....

11. Please indicate in your opinion the reasons/factors responsible for the present state of your building.

.....  
.....

12. How does the current state of your building affect your stay/business in the building?

.....  
.....

13. What role do you play in the maintenance of your building?

.....  
.....

14. How much do you spend annually if any on maintenance of your building? .....

## **PART II General Condition of Building Elements**

Please tick (✓) appropriately how you consider the state of the following elements of your building.

15. Condition of the foundation  cracks developed  exposed/ hanging  
 weak  no problem

16. Roof  leakage  rusty  partly ripped off  completely ripped off  
 No problem

17. Floor screed  cracks  peeled-off defect  no defect

18. Wall  partly broken down  develop cracks  peel – off  tilted

19. Painting  no painting  faded painting  dirty  well painted/no problem

20. Windows and Doors  no problem  partly broken down  completely broken down

21. Electrical installations  no problem  non-functioning  faulty

22. Plumbing/water             no problem    leaking                     broken down

23. What type of toilet facility do you use?

Water closet    KVIP    Pan Latrine    other please

specify.....

24. Toilet /Sewerage    no problem    leaking    broken down    non-functioning

25. What will be your comment on the general perception to the view that Public Buildings are not well maintained?

.....  
 .....  
 .....

**Conditions of the Facilities**

26. Please how do you consider the conditions of these facilities in the building? Tick (✓) appropriately.

Element / Facility	Current State			
	Good	Fairly Good	Bad	Very Bad
Water				
Bath				
Toilet				
Kitchen				
Electricity				

**PART III Major Cause of Non-Maintenance of Public Building**

27. How will you rank the following as the major cause of non-maintenance of public buildings if it is so? Please rank from 1<sup>st</sup> to 7<sup>th</sup>, with first being the major reason and seventh being the least reason. Tick (✓) appropriate.

Causes of Maintenance Problem	Rank						
	1	2	3	4	5	6	7
Lack of maintenance culture							
Inadequate funds							
Bureaucratic reporting process							
Pressure on facility/building due to number of occupants							
Poor work done on building							
Non-response to maintenance request							