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Establishing Factors Influencing Building Maintenance Practices: Ghanaian Perspective

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Abstract
The study was to establish factors influencing the decision to carry out building maintenance practices. The paper reviews the existing literature on building maintenance, types of maintenance, causes of maintenance, stages of maintenance and specific factors influencing the decision to carry out maintenance. The study utilized a structured questionnaire, which was administered on the residents of the private house owners called Landlords and Landladies in the study area. Data analysis indicated that, common factors and agent which are fundamental to deterioration of building components included ageing stock of building, obsolescence of building, environmental or climate issues, moisture, selection of materials, and design maintainability. Misuse of building after completion, faulty designs, and unavailability of skilled labour to undertake maintenance operations and poor financial support for maintenance work were also identified as the major factors inducing the decision to carry out maintenance work. Replacement and conditioned-based types of maintenance were also established as often undertaken. The paper in conclusion makes recommendations for consideration of maintenance during the early phase of construction and must be done with the highest quality in term of professionals and materials and components, hence, the need for engaging professionals from design to construction stage at least and create public awareness on the danger of lack of maintenance and the advantages of good maintenance practices.
Keywords: Maintenance Practices, Agent of Deterioration, Private, Landlords and Landladies

1. Introduction

Building maintenance is an important program for the sustainability of infrastructural development. It plays a central role among other activities in the building operations (Zulkarnainet al., 2011) cited in Baba, & Buba, (2013). Maintenance according to BS 3811(1984) 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. Work carried out in expectation of failure is referred to as preventive maintenance, and those carried out for restoring after failure is referred to as corrective maintenance according to Baba, & Buba (2013). It is a well-known fact that the primary objective of building maintenance is to preserve buildings in their initial functional, structural and aesthetic states (Adejimi, 2005). Maintenance program in Nigeria for instance, according to Ahmed (2000) and Odediran et al., (2012) has not received much attention in the past as the emphasis is on the development of new properties. Kunya et al., (2007) also observed that there is apparent lack of maintenance culture in Nigeria, and that emphasis is placed on the construction of new buildings and neglecting the aspect of maintenance which commences immediately the builder leaves the site. This is also endorsed by Olagunju (2012) who opined that there is lack of maintenance set up in Nigeria that can sustain the current inadequate housing provision in the country. Olagunju (2012) further stated that lack of appropriate tool for predictive maintenance of the existing buildings can have a detrimental effect on future housing development. Zubairu (1998) stated in his study that the country does not have a maintenance policy which resulted in the persistent problems of building maintenance.

Non- empirically, it has observed that the execution of maintenance work in Ghana is left mostly for unqualified professionals to handle as most building professionals prefer to work on new project or contract. This is directly in line with Kian, (2001); and Colen & De Brito, (2002) who reported that building maintenance technology is currently vastly underrated and ignored by owners, occupants, and building professionals. Adejimi (2005) observed that building defects arise through inappropriate or poor design, specification and poor construction as well as insufficient attention given to building. Considering the fact that the construction sector in Ghana is quite similar to that of Nigeria, it may be posited that similar constraints persist in Ghana. This paper therefore, focuses on the establishment of factors influencing building maintenance practices, types of maintenance and factors influencing the decision to carry out maintenance work in Atwima Nwabiyagya District in Ashanti region, Ghana.

2.0 Literature Review

2.1 Building Maintenance

Maintenance of the built environment affects everyone continually, for it is on the state of our homes, offices and factories that we depend not only for our comfort, but for our economic survival (Smith, 2003) in Siyanbola et al

(2013). Building maintenance has until recently been a neglected field of technology. It possesses little glamour and is unlikely to attract very much attention (Baba, & Buba, 2013; Oladapo, 2004). Neglect of maintenance has accumulative results with rapidly increasing deterioration of the fabric and finishes of a building. Buildings are too valuable assets to be neglected this way. The efficiency, convenience, life span, economic viability and appearance of any building can be affected by decisions taken and actions performed at any point in time in the history of the building. Maintenance starts the day the builder leaves the site. Design, materials, workmanship, function, use and their interrelations determine the amount of maintenance required during the life time of the building (Olagunju, 2012). Effective building maintenance requires the correct diagnosis of defects, and implementation of the correct remedial measures, all based on sound technical knowledge (Seelay, 1987). It is highly desirable but hardly feasible to produce buildings that are maintenance free, although much can be done at design stage to reduce the amount of subsequent maintenance work.

2.2 Stages of Maintenance

Maintenance of building can be viewed from different perspectives and is based on the objectives of maintenance. Maintenance can be done at different stages. Each stage will have different characteristics. Liska (1988) in Al-khatam (2003) defined those stages as follows:

2.2.1 Planning and Design Stage: Liska (1988) was of the view that the planning and designing of a facility should be based on the identified function and be as maintenance free as possible. At this stage, a lot of money can be saved with the proper plan and design. For this reason, the building manager and maintenance personnel should be consulted during the early stages of the building design.

2.2.2 Construction Stage: In order to achieve minimum level of maintenance during the building life, work performed during the construction phase must be done with the highest quality in term of workmanship. As a result, expert contractor should be selected to perform the project (Liska, 1988).

2.2.3 Maintenance Stage: At this stage, maintenance is performed after the building has been constructed and occupied. Nevertheless, building maintenance becomes more difficult according to age of the structure and this depends on the quality of the original building components and workmanship coupled with the rate of maintenance of the structure.

2.3 Types of Maintenance

BS3811 subdivides maintenance into planned and unplanned with their sub-aspect indicated

Under planned maintenance, there are several strategic possibilities available to management, and many alternative decisions to be considered. Planned maintenance specifically is a type of maintenance organized and carried out with forethought, control and the use of records to a scheduled (Streifel, 2002). There is, for example, the possibility of reducing the demand for maintenance by addressing the actual cause of failure and identifying its consequences. It may also be for instance, necessary to decide whether to repair or replace a component, or carry out periodic maintenance at fixed intervals or simply to respond to the requests of the users. The four most predominant maintenance types under planned maintenance are: preventive; corrective; scheduled and condition-based maintenance.

2.3.1 Preventive Maintenance: Also referred to as time-based maintenance or cyclic maintenance are performed in accordance with a predetermined plan at regular, intervals, which may be based on operating time. Such a strategy is frequently applied to external or internal paint work (Smith, 2003).

2.3.2 Schedule Maintenance on the other hand is a type of preventive maintenance that takes place at predetermined interval of time whereas corrective maintenance is the simplest type of maintenance strategy, where an element in a building is used until it breaks down or defects. It covers all activities, including replacement or repair of an element that has failed to a point at which it cannot perform its required function (David & Arthur, 1989). Corrective maintenance is sometimes referred to as failure-based or unplanned maintenance.

2.3.3 Condition-based maintenance: Condition-based maintenance is defined as: “maintenance carried out in response to a significant deterioration in a unit as indicated by a change in monitored parameter of the unit condition or performance” (Kelly and Harris, 1978). The condition-based maintenance concept recognizes that a change in condition and/or performance of an item is the principal reason for carrying out maintenance. Thus, the optimal time to perform maintenance is determined from a condition survey used to establish the actual state of each constituent item in a building. Condition assessments can vary from simple visual inspections to more advanced inspections using a variety of condition monitoring tools and techniques. Unplanned Maintenance on the other hand, is a type of maintenance that takes place at no predetermined plan. It is also referred to as semi-emergency maintenance. The three most major types of unplanned maintenance are include; emergency maintenance, corrective maintenance and unpredictable maintenance.

2.3.3.1 Emergency Maintenance: This is a type of maintenance carried out in order to avoid serious

consequences. This is sometimes referred to as day-to-day maintenance.

2.3.3.2 Unpredictable Maintenance: This is a work resulting from unforeseen breakdown or damage to a facility due to external causes.

2.3.3.3 Corrective Maintenance: This is the work required to rectify failures caused by incorrect design, incorrect installation or use of faulty materials.

2.4 Causes of Building Maintenance

Maintenance work in buildings is generated by a whole range of number of factors as exposed in **Figure 1** according to Ogunmakinde et al., (2013), hence, the need for proper understanding of the causes and agents of building deterioration in order to curtail the occurrence of these defects in buildings.

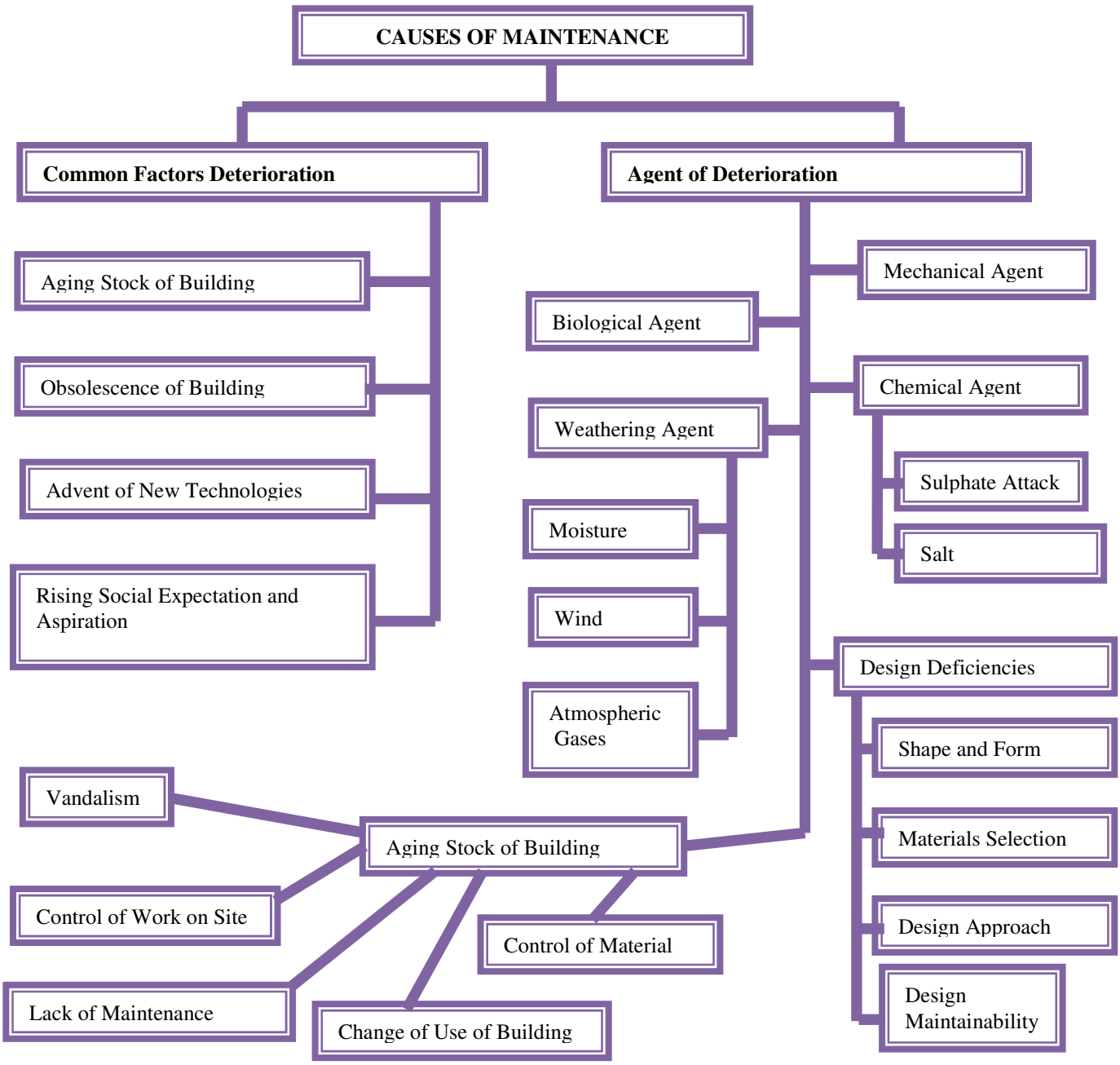

Fig. 1 Causes of maintenance

Source: Modified from Ogunmakinde et al., (2013)

2.5 Other Factors Influencing the Decision to Carry out Maintenance Work

2.5.1 Design Complexity: Building should be designed in such a way to be simple in maintenance. Design complexity will prevent maintenance work to be carried out easily, quickly and economically (Smith, 2003). Major replacement can often be avoided if regular cleaning and minor repair are carried out without difficulty. For example, maintenance requires some tools to be used for the execution. Failure for the designer to allow enough clearance to get the tools in and out, this minor problem will get bigger and become. In addition, major problem designer should always avoid is permanent fixing of an elements, which need continuous maintenance, e.g. such as lamp, carpets (Mills, 1980) in (Smith, 2003).

2.5.2 Faulty Design: It includes all defects that were caused during the early stage of design particularly in the structural design; for instance, when designer ignores the spacing for contraction and expansion movement, such movement causes cracking of the structure, which eventually will result in fractures in pipes or joint failure (Al-Shiha, 1993).

2.5.3 Low Concern to Future Maintenance: Maintainability is the effort that provides customers with products that can be maintained by satisfactory balance of a short time, low cost and minimum expenditure of support resources, without adversely affecting the product's performance or safety characteristics (Al-Khatam, 2003). It must be involved in the total design process. In the planning stage, maintainability requirements are defined and translated into design criteria. The design characteristics are measured to verify quantitative goals and then translated into improvement of design of the system. By not considering maintenance analysis during design stage of building, grievous problems can be caused regarding function, performance, and safety of the system. This can cause a total replacement of the system or an item might necessitate Patton, (1988) cited in Al-Khatam, (2003).

2.5.4 Unfamiliarity with Local Conditions and Site Conditions: The designer should have an idea about the building location and type of plants and insects existing in the area. The designer should specify the treatment method if existing in the design drawings. This is because such biological factors can harm the building and lead to continuous maintenance (Liska, 1988) in Streifel, (2002).Also the designer should be familiar with buildings site condition such as soil condition. Ignoring variation in soil condition will cause setting, which will cause cracking of structural elements (Al-Khudair, 1988)

2.5.5 Unavailability of Skilled Labours: Skilled labours are important for maintenance work and they should be available to perform job and utilize equipment. It is because they perform work according to their past experience and their skills. Employing labour with the requisite skills will assist to improve the quality of work, minimizing cost and reduce work time span (Al-Khudair, 1988) in Sohet et al (2004).

2.5.6 Materials Selection Does Not Comply with Client's Activities: Materials selection should meet the performance requirements expected. Using bad quality of materials will cause failure of the materials, which will require replacement, correction or more maintenance works in the future. Selection of inferior materials during the construction stage will cause more problems during the maintenance stage (Merritt, 1975) expressed in Kolawole (2002). Therefore, selection of materials should be in compliance with the performance specification requirements in order to minimize future expenses during maintenance stage.

2.5.7 Basic Physical and Chemical Properties of Materials: One of the major causes of building deterioration and other unsatisfactory features of many buildings is the bad understanding of the nature and behavior of materials. The failing to make allowance for the differing thermal and moisture movements of materials in combination will adversely affects building functional performance or appearance (Lee, 1995).

2.5.8 Unqualified Maintenance Contractors: The specialized and well-experienced maintenance contractors are important to perform maintenance work effectively. A good maintenance contractor is a solid performer who knows the costs and knows what he can or cannot do, and realizes that his regulations are built upon his past performance (Ahmed 2002).

2.5.9 Lack of Local Productivity Standard and Specification: The specification and standards are document that clearly and accurately describe the essential technical requirement for materials. This determines the performance requirements to be met. Such documents may include performance, support, preservation, packing, and making requirements (Patton, 1988).Standard and specification documents are extremely important to building maintenance, as it constitutes a schedule of instructions to the contractor and prescribes the materials and workmanship requirement. Projects and facilities are to be constructed as per standard and specifications. Having a uniform specification and standards will ease the construction process as well as maintenance work (Seeley, 1987).

2.5.10 Lack of Building Maintenance Manuals: The objective of the manual is to provide all building users with a common system of maintenance information recording and retrieval for the proper guidance of maintenance operatives, building owners, maintenance involving operatives, costing, and general maintenance. This would act as a common part of the building process and not as a series of isolated events that takes place after the completion of the building (Mills, 1980).

2.5.11 Not Using Building after Completion: Non-use of building after completion would make the owner not to give enough attention to the maintenance work. Facilities which have not been used for a long time could rapidly be deteriorated. However, if no maintenance has been performed on idle components and items, they may require emergency maintenance which will cost more and require more manpower. Hence, if facilities are not in use, they should be maintained in order to avoid future unplanned costly maintenance (Turrell, 1997).
2.5.12 Poor Financial Support for Maintenance Work: It is very important that building owners, when preparing their annual budgets, include enough financial allocation for maintenance work, as it is a critical and needed function. In the absence of financial support for maintenance work required, the building will not be maintained properly (Al-Sultan, 1996).
2.5.13 User Does Not Understand Importance of Maintenance Work: Building users often pay little attention in keeping their building in good working order. It has already emphasized that buildings start to deteriorate from the day they are completed. The length of time this process of decay takes depends on the care taken in: firstly, the design, secondly the construction, and thirdly the upkeep or maintenance.
2.5.14 Misuse of Building after Completion of the Construction: When building construction is completed, owners must be using their buildings and its components in proper way. The misuse of components will result in their damage and need for repair, which would be costly (Mahmoud, 1994).
2.5.15 Not Using Preventive Maintenance: Neglect of preventive maintenance such as checking the efficacy of rainwater gutters and servicing mechanical and electrical installation causes more extensive periodical maintenance and, in the long run, major repair or restoration which could have been avoided or postponed (Fattani, 1998).

3.0 Research Methodology

The study adopted quantitative survey approach and utilized primary data. This primary data was obtained through field survey and relied on questionnaire as an instrument. The study area for this research was Atwima Nwabiagya Distric, Ashanti Region of Ghana. The targeted group was private house owners. This targeted population was chosen because of their ease of accessibility, willingness to provide the information needed for the study and interest they had in putting up their own buildings. A comprehensive list of Association of Landlords and Ladies was obtained from the association leaders in the study area and contained a total population of 796 private house owners. A selection of one hundred and sixty (160) representing 20% of the identified group was done using simple random technique. This technique was used to give an equal chance of all listed private house owners within the study area an equal opportunity to take part in the study. Data for the study was collected using structured questionnaire. The questionnaires were of closed type and consisted of items on building maintenance factors. A total number of 108 out 160 completed questionnaires were received making a response rate of 67.5%. The statistical software called Statistical Package for Social Science version 16.0 (SPSS version16.0) was used in analyzing the data in order to provide accurate and realistic results obtained from the respondents. Descriptive statistical analysis tools were employed. Data were also summarized using tables for interpretation. Statistics were based on frequencies, percentages and mean scores. The results were ranked and remarked.

4.0 Data Analysis

This section of the paper presents the result and analysis of the data obtained from the questionnaires distributed.

4.1 Age Range of the Buildings

Table 4.1 Age Range of the Buildings

Age range of building	N	%
1-10	42	38.9
11- 20	24	22.2
21-30	38	35.2
over 30yrs	4	3.7
Total	**108**	**100**

Source: Author's field survey, September, 2015.

It revealed in Table 4.1 that, 42 respondents representing 38.9% said the age of their buildings ranges between 1-10 years while 24 representing 22.2% responded that theirs is between the ages 11-20 years old. 38 of house owners representing 35.2% also responded that their buildings' age is between 21-30 years old while only 4 representing 3.7% said their buildings are over 30 years of age.

4.2 Periodic Inspection of Buildings

Table 4.2 Periodic inspection of buildings to determine its maintenance needs

Item	N	%
Yes	78	72.2
No	30	27.8
Total	**108**	**100**

Source: Author's field survey, September, 2015.

In ascertaining whether the building owners have been inspecting their buildings periodically to determined its maintenance needs or not, the result was quite apparent from Table 4.2 that majority (72.2%, N=78) responded yes to the question while 30 representing 27.8% declined. This was done to verify from the owners the extent of period to which inspection of their facility is being done.

4.3 Stages for Planning of Maintenance over Building

Table 4.3 Stages for planning of maintenance over building

Item	N	%
Planning and Design Stage	8	7.4
Construction Stage	20	18.5
Maintenance Stage	80	74.1
Total	**108**	**100**

Source: Author's field survey, September, 2015.

It was discovered in Table 4.3 that, more than half (N=80, 74.1%) of respondents do plan for maintenance work at the maintenance stage while 20 representing 18.5% consider for future maintenance during construction stage. However, 8 representing 7.4% consider maintenance at the planning and designing stage. The result obtained is directly related to the findings by Al-khatam (2003) who reported that maintenance can be viewed from a different perspective and can also be done in different stages. He further attested that at the maintenance stage, maintenance is performed after the building has been constructed and occupied.

4.4 Types of Maintenance

For Table 4.4, the following approach is used to explain the results using the means: 1-1.5= never, 1.6-2.5= not often, 2.6-3.5= often and 3.6- 4.0= very often.

Table 4.4 Type of maintenance usually done

Item		Mean score	Rank	Remark
Planned maintenance	Condition-base Maintenance	2.74	1	Often
	Corrective Maintenance	2.57	2	Often
	Preventive Maintenance	2.39	3	Not often
	Scheduled Maintenance	2.19	4	Not often
Unplanned maintenance				
	Emergency Maintenance	2.61	1	Often
	Unpredictable Maintenance	2.41	2	Not often
	Corrective Maintenance	2.31	3	Not often

Source: Author's field survey, September, 2015.

Table 4.4 apparently revealed that, conditioned-based and corrective maintenance remarked **often** done with mean scores **2.74** and **2.57** respectively and therefore ranked **1st** and **2nd** while preventive and scheduled maintenance remarked **not often** with mean scores **2.39** and **2.19** and eventually ranked **3rd** and **4th** under planned maintenance. Condition-based maintenance concept recognizes that a change in condition and or performance of an item is the principal reason for carrying out maintenance (Kelly and Harris, 1978). Neglect of preventive maintenance such as checking the efficacy of rainwater gutters and servicing mechanical and electrical installation causes more extensive periodical maintenance and, in the long run, major repair or restoration which could have been avoided or postponed (Fattani, 1998). Work carried out in expectation of failure is referred to as preventive maintenance, and those carried out for restoring after failure is referred to as corrective maintenance (Baba, & Buba 2013). Preventive maintenance tasks according to Smith (2003) are performed in accordance with a predetermined plan at regular interval.

Similar trend was observed against unplanned maintenance. Emergency maintenance observed mean score **2.61** and therefore ranked **1st** with remarked **often**. However, unpredictable and corrective maintenance observed **not often** with mean scores **2.41** and **2.31**and therefore ranked **2nd**and **3rd** respectively. Emergency type of maintenance is carried out in order to avoid serious consequences. This is sometimes referred to as day-to-day maintenance.

4.5 Common Deterioration Factors of Building

For tables 4.5 and 4.6 the following approach is used in explaining the results using an average means score: 1-

1.5= Strongly disagree, 1.6-2.5= Disagree, 2.6-3.5= Agree and 3.6- 4.0= Strongly agree.

Table 4.5 Common Deterioration Factors of Building

	Items	Mean score	Rank	Remarks
Common Deterioration Factors of Building	Ageing Stock of Building	3.11	1	Agree
	Obsolescence of Building	2.83	2	Agree
	Environmental Issues	2.57	3	Agree
	Rising Social Expectations and Aspiration	2.48	4	Disagree
	Advent of New Technology	2.28	5	Disagree
	New Legal Development	2.25	6	Disagree

Source: Author's field survey, September, 2015.

From Table 4.5, ageing stock of building, obsolescence of building and environmental issues have been established by the respondents as major causes or common factors affecting building deterioration with mean scores **3.11, 2.83**, and **2.57** hence ranked **1st**, **2nd** and **3rd**.

Conversely, respondent disagree that rising social expectations and aspirations, advent of new technology and new legal development are the common factors of building deterioration with mean scores **2.48**, **2.28** and **2.25** and eventually ranked **4th, 5th** and **6th**.

4.6 Agents of Building Deterioration

Table 4.6Agent of Building Deterioration

	Items	Average mean	Rank	Remarks
Agents of Building Deterioration	Moisture	3.04	1	Agree
	Selection of Materials	2.98	2	Agree
	Design Maintainability	2.93	3	Agree
	Chemical Agents	2.89	4	Agree
	Driving Rain	2.87	5	Agree
	Design Deficiencies	2.81	6	Agree
	Wind	2.74	7	Agree
	Weathering Agents	2.74	7	Agree
	Approach to Design	2.72	8	Agree
	Mechanical Agents	2.69	9	Agree
	Biological Agents	2.69	9	Agree
	Atmospheric Gases	2.69	9	Agree
	Building Shape and Form	2.50	10	Disagree
	Solar Radiation	2.46	11	Disagree

Source: Author's field survey, September, 2015.

From Table 4.6, similar trend of response was observed on the agents of building deterioration. Results became obvious that moisture, selection of materials, design maintainability, chemical agents, driving rain, design deficiencies, wind and weathering agents, approaches to design, mechanical agents, biological agents and atmospheric gases were distinguished as the main agents causing building deterioration with mean scores **3.04, 2.98, 2.93, 2.89, 2.87, 2.81, 2.74, 2.72**, and **2.69**, hence ranked **1st, 2nd, 3rd, 4th5th, 6th** and **7th,8th** and **9th** consecutively. Respondents agree that building shape and form and solar radiation are the least agents of building deterioration with mean scores **2.50** and **2.46** and were ranked **10th** and**11th**.It is imperative to note that, the above findings is openly consistent with the study done by Siyabola et al., (2013) as captured in the review of literature. There is therefore the need for proper understanding of the common causes and agents of building deterioration so as to reduce its occurrence and thus discovering appropriate means of solving them.

4.7 Factors Influencing the Decision to Take Up Maintenance Work

For the purpose of explaining the results from Table 4.7 the following range is used using the means score: 1-1.5= Not important, 1.6-2.5= Important, 2.6-3.5= Very important and 3.6- 4.0= Most important.

Table 4.7 Factors Influencing the Decision to Take up Maintenance Work

Item	Mean score	Rank	Remark
Misuse of Building after Completion of the Construction	3.17	1	Very important
Faulty Design	3.11	2	Very important
Unavailability of Skilled Labour	3.04	3	Very important
Poor Financial Support for Maintenance Work	2.98	4	Very important
Not Using Preventive Maintenance	2.96	5	Very important
Unqualified Maintenance Contractors	2.94	6	Very important
User Does Not Understand Importance of Maintenance Work	2.85	7	Very important
Not Using Building after Completion	2.78	8	Very important
Basic Physical and Chemical Properties of Materials	2.76	9	Very important
Low Concern to Future Maintenance	2.70	10	Very important
Lack of Local Productivity Standard and Specification	2.69	11	Very important
Lack of Building Maintenance Manuals	2.56	12	Important
Materials Selection Does Not Comply with Client's Activities	2.52	14	Important
Design Complexity	2.52	14	Important
Unfamiliarity with Local Conditions and Site Conditions	2.50	15	Important

Source: Author's field survey, September, 2015.

From the analysis in Table 4.7, majority of the respondent remarked the following items as **very important** factors influencing the decision to carry out maintenance work and therefore ranked accordingly; misuse of building after completion, faulty design, unavailability of skilled labour, poor financial support for maintenance work, not using preventive maintenance, unqualified maintenance contractors, user does not understand importance of maintenance work, not using building after completion, basic physical and chemical properties of materials, low concern to future maintenance, lack of local productivity standard and specification, and lack of building maintenance manuals with their mean scores; **3.17, 3.11, 3.04, 2.98, 2.96, 2.94, 2.85, 2.78, 2.76, 2.70,2.69** and **2.59** hence ranked **1st** to**12th** respectively. Other items that were remarked **importance** included materials selection does not comply with client's activities, design complexity and unfamiliarity with local and site conditions with their mean scores **2.52**, and **2.50**and eventually ranked**14th** and **15th** respectively.

5.0 Discussion

Relatively, the findings of this study have been more of reaffirmation of what was reviewed in the literature though from different environment. Most responses revealed that, most house owners consider maintenance work at the maintenance stage instead of the design and construction stage; hence, condition-based and emergency type of maintenance has been prevailing and dominant. This however makes building maintenance more difficult according to age of the structure and depends on the quality of the original building components and workmanship coupled with the rate of maintenance of the structure (Al-khatam2003). Obsolescence, aging stock of building and environmental issues was observed as the common causes of building maintenance.

Major agents of building deterioration according to the findings included moisture, material selection, design deficiencies, chemical agent, weathering agent, biological agent, and mechanical agent. The designer should specify the treatment method if existing in the design drawings. This is because such biological and other factors can harm the building and lead to continuous maintenance as reported by Liska, (1988) in Streifel, (2002). Also the designer should be familiar with building site conditions such as soil condition as ignoring variation in soil condition according to Al-Khudair, (1988) can cause setting, and eventually leads to cracking of structural elements. Bad quality of materials causes failure and requires replacement, correction or more maintenance works in the future. Selection of inferior materials during the construction stage will cause more problems during the maintenance stage (Merritt, 1975) expressed in Kolawole (2002). Therefore, selection of materials should be in compliance with the performance specification requirements in order to minimize future expenses during maintenance stage.

Misuse of building after completion, faulty designs, unavailability of skilled labourers and unqualified maintenance contractors, poor financial support, and not using preventive maintenance have been revealed as the major decisions influencing maintenance work. Misuse of components result in their damage and need for repair, which would be costly (Mahmoud, 1994). Skilled labours are important for maintenance work. Employing labour with the requisite skills assists in improving the quality of work, minimizing cost and reduce work time span (Al-Khudair, 1988) in Sohet et al (2004). A good maintenance contractor is a solid performer and knows the costs and what he can or cannot do, and realizes that his regulations are built upon his past performance (Ahmed 2002). Neglecting of preventive maintenance such as checking the efficacy of rainwater gutters and

servicing mechanical and electrical installation causes more extensive periodical maintenance and, in the long run, major repair or restoration which could have been avoided or postponed (Fattani, 1998).

5.1 Conclusion and Recommendations

The study has revealed the various causes of maintenance works, types of maintenance, common factors of building deterioration and the decision to carry out maintenance operations. The study discovered that, misuse of building after completion, faulty designs, and unavailability of skilled labour to undertake maintenance operations as well as poor financial support for maintenance work are the major factors influencing the decision to carry out maintenance work. Factors and agents of building deterioration according to this study included ageing stock of building, obsolescence of building and environmental or climatic issues, moisture, selection of materials, design maintainability seem predominant. It was again revealed that condition-based, corrective and emergency types of maintenance have been prevalence. Replacement and servicing types of maintenance seem quite persisting.

It was recommended that; planning and designing stage of every building should be based on maintenance consideration since it almost impossible to produce maintenance free structures. Work performed during and after construction phase must be done with the highest quality in term of materials and professionals. Finally, association of industries and government should engineer action towards more advocacy, policy and awareness on the essence of maintenance in general and dangers associated with when neglected.

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