

MAINTENANCE PRACTICES FOR STRUCTURAL INTEGRITY OF PUBLIC BUILDINGS IN AKWA IBOM STATE, NIGERIA

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ABSTRACT

Purpose: This study aimed at evaluating the effectiveness of maintenance practices commonly adopted for public buildings in Akwa Ibom state, Nigeria, in a view to preserving the structural integrity of these buildings.

Design/methodology/approach: The study adopted a survey research method. The study population comprised registered construction professionals practising in Akwa Ibom State. A total of 308 registered professionals listed in the directory of state chapters of respective professional bodies. With the Taro Yamane formula, a sample size of 262 was calculated, with which questionnaires were randomly distributed. Data gotten from questionnaires were analysed using simple percentage and mean.

Findings: Results showed that there was a “Moderate” level of implementation of maintenance practices by building professionals in the study area. The study also indicated that roof leaks, wall cracks, concrete deterioration and foundation problems were common structural issues in the study area. Structural defects had a moderate effect on structural integrity of buildings and maintenance practices adopted to mitigate them were effective.

Research limitations/Implications: Findings from the study were limited to the perceptions of practising professions who manage properties, tender and execute maintenance projects in the study area. End users of these properties may have differing perceptions on the defects, their effects on structural integrity and the effectiveness of maintenance practices.

Practical implications: The study recommended the establishment of standardized maintenance protocols, incentives for maintenance investments amongst other measures, for effective maintenance management towards securing the structural integrity of public buildings.

Originality/value: Though several studies exist on maintenance practices for buildings, this study relates maintenance practices to the structural integrity of public buildings in Akwa Ibom State, which is an area not well investigated in literature.

Keywords: Akwa Ibom State; Maintenance practices; Nigeria; Public buildings; Structural integrity.

1. INTRODUCTION

In the realm of urban development, the integrity of buildings stands as a cornerstone of safety, functionality, and sustainability. Across the globe, cities contend with the challenge of maintaining the structural soundness of their built environments, ensuring the safety and well-being of their inhabitants. Maintenance and structural integrity are

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closely interconnected aspects in maintaining the safety and functionality of buildings. Maintenance refers to the systematic inspection, upkeep, and repair of various building components before they deteriorate significantly. On the other hand, structural integrity relates to the ability of a building to withstand external forces and loads without experiencing failure or collapse. Proper maintenance plays a crucial role in preserving the structural integrity of a building over its lifespan. According to Wikstan and Jonansson (2006), effective maintenance can reduce the consequences of failure and extend the life of a system.

In Nigeria, building maintenance is a recurring topic because of the steady growth of dilapidating facilities in the country. Structures degrade with time requiring attention to maintain good appearance, efficient operation and safety to users and passers-by. Neglect of maintenance has accumulated consequences aiding the rapid increase in the deterioration of the building fabric and accompanied by a harmful effect on the inhabitants.

Most buildings in Nigeria, public and private, undergo these maintenance challenges. In a typical facility, major maintenance problems are 15% electrical related, 28% plumbing related, 26% cracks related, 10% of painting works related, 5% floor works and 16% covering elevator maintenance (Reddy, Reddy and Asadi, 2018). Other issues are hygiene issues, water leakage, elevator stops, and humidity. It must be emphasised that defects in buildings that may not be structural in nature could lead to future structural consequences if not promptly corrected. Plumbing faults could lead to dampness and corrosion of embedded steel reinforcement and faulty drainages could lead to scouring of foundations.

Many public structures are not well maintained. The components of such buildings such as floors, ceilings, doors and windows frequently express evidence of nonexistence of maintenance and repair. Nurul and Azree (2014) submitted that defective materials and poor workmanship are causes of infrastructural decay. They noted that some office and residential buildings of public institutions experienced no major maintenance since their construction. Such structures were in a dilapidated state and some of them had been totally abandoned. Thus, lack of regular maintenance of these facilities, by occupants and authorities, regularly resulted in the reduction of the structural integrity of the buildings (Talib *et al.*, 2014).

This study aimed at evaluating the effectiveness of maintenance practices commonly adopted for public buildings in Akwa Ibom state, towards preserving the structural integrity of these buildings. The following specific objectives were adopted to realize this aim.

- i. Evaluate the application of maintenance practices on public buildings, in Akwa Ibom State.
- ii. Evaluate the effectiveness of maintenance practices applied to public buildings in Akwa Ibom State.
- iii. Assess the barriers to effective application of maintenance practices on public buildings in Akwa Ibom State.

The study illuminates the connection between maintenance practices and preservation of structural integrity, offering profound implications for various stakeholders and the general society. By identifying common structural issues and evaluating the effectiveness of current practices, the research seeks to improve the understanding of maintenance and enable the implementation of appropriate practices. Ultimately, the proposed recommendations will support the development of sustainable and resilient buildings that ensure the safety and well-being of occupants.

2. LITERATURE REVIEW

2.1. Concept of Building Maintenance

Maintenance for building can be defined as the process where the building is kept usable at a pre-determined standard, for the use and benefit of its occupants or user (Opara *et al.*, 2019). Building maintenance has become the significant part of work on a building, to keep it usable for the occupants (Ahmad, 2006). According to Dardengo (2010), building maintenance has a fundamental importance for the safety, soundness and functionality of any type of building. It consists of a set of activities that are necessary to guarantee satisfactory performance over time, realisation of users' needs and modernization of aspects of the building, in order to meet expected performance requirements. Maintenance is a tool to maintain the building functionality and it can be characterized as any and all interventions made on the property and its parts, with the purpose of preserving or recovering its functional capacity (ABNT, 2012).

2.2. Maintenance practices for structural integrity

Maintenance strategy is a planned way to upkeep devices, which contains actions such as "identification, researching and execution of many repairs, replace and inspect decisions". Implementing the strategy requires executable, tactical plans (Velmurugan & Dhingra, 2015). According to Shafiee & Sørensen (2017), a maintenance strategy "includes a set of policies and actions (practices) that are used to "retain" or "restore" equipment as well as the decision support system in which maintenance activities are planned". Another definition states that maintenance strategy "is an integrated system that is needed by corporate management to highlight the significance of a particular piece of equipment that impacts particular types of maintenance work" (Rani *et al.*, 2015). Choice of a maintenance strategy is dependent on the strategic objectives of company.

Strategies are practises based. Many authors have classified maintenance practices in different ways. Mikler (2011) and Teixeira and Junior (2016), presented the development of maintenance, where three generations in maintenance practise were distinguished. Firstly, presented was corrective maintenance, where all actions were concentrated on repairing, for which time was mainly until the Second World War. Secondly was preventive maintenance, defined as tasks based on planning and scheduling. It was developed up till the seventies. Both generations are connected with the use of a profile, describing frequency of failures, called "bathtub", for equipment life cycle of profiling. The third generation, involved predicting and preventing activities, named "the reliability centred maintenance culture". This third generation of maintenance techniques included issues such as condition monitoring, hazard studies, multitasking and teamwork; as well as reliability and maintainability (Teixeira and Junior, 2016).

Basic maintenance practices presented in (Lee and Scott, 2009; Shin and Jun, 2015) are preventive (PM), corrective (CM) and condition-based maintenance (CBM). General maintenance policies integrate the mentioned approaches to build tools for maintenance personnel. In Horner, El-Haram and Munns (1997), the same three practices as above were presented, alongside their advantages and disadvantages. Corrective maintenance is pointed out as the simplest method, however quite expensive, because is used as a reaction to breakdowns and all consequences of this incident.

Building maintenance practices provide options to make a decision on which maintenance strategy will be carried out. They should ensure that those alternative decisions are available to management in maintaining a building. They are dependent on the failure elements condition, prior to decisions being made on the maintenance strategy, to repair or replace. To choose the best maintenance strategy, it must be put into consideration, which strategy is more efficient.

2.2.1 Planned Maintenance

Planned maintenance is defined as the maintenance work that has been planned, organized and carried out with foresight, control and the use of records to a predetermined plan (Horner, El-Haram, and Munns, 1997). Besides that, planned maintenance can be used to avoid the disadvantages of corrective maintenance and urgent maintenance. Planned maintenance includes preventive maintenance.

2.2.2 Preventive Maintenance (PM)

In preventive maintenance strategy, the building components, elements, facilities and services are exposed to a systematic schedule of maintenance tasks, such as cleaning, inspections, adjustments, and others (Basri, *et al.*, 2017). The maintenance tasks are executed at fixed intervals to minimize building deterioration and to ensure that the building is in good condition.

2.2.3 Condition-Based Maintenance

Condition-based maintenance is geared towards minimizing the total maintenance cost by collecting and compiling condition data of critical and other building systems (Au-Yong, Ali and Ahmad, 2013). This maintenance strategy is in accordance to an acceptable defect in a unit as it shows by a change monitored parameter of the unit's condition or performance. The purpose for executing the maintenance work is due to the condition of building elements that has been change or failed. The optimal time to execute maintenance works is determined by observing the current state of the building or building element, its performance or other condition parameters. Its concept recognizes that the main reason for carrying out maintenance is due to change in condition or performance of an item.

2.2.4 Unplanned Maintenance

Unplanned maintenance works are carried out without fixed planning. In this strategy, the maintenance work is executed after a failure has taken place already (Weidner, 2023). The unplanned maintenance work is to reset an item to functional and acceptable condition through replacing, renewing and correcting damaged parts (Lind and Muyingo, 2012). Unplanned maintenance is more costly while planned maintenance is less costly. Unplanned maintenance includes corrective and urgent maintenance.

2.2.5 Corrective Maintenance

Corrective maintenance is the easiest of existing maintenance strategies. This only occur when the building is used, till it is no longer functionable (Weeks and Leite, 2022). It concealed all activities, including replacement, repair and renovating of building elements that have failed. This maintenance strategy is executed after a failure or occurrence of defects. It is planned to restore an item to an acceptable state, to perform its required function.

2.3. Structural Integrity and structural issues in buildings

Structural integrity refers to the ability of a building to withstand various loads, resist deformations, and maintain its stability and safety over its intended lifespan. It is the ability of a structure to resist loads and deformations while maintaining its original form and functionality. It ensures that a building or infrastructure remains stable, safe, and reliable, even under the influence of external forces such as wind, seismic activity, or live loads. The significance of structural integrity lies in its direct impact on the safety of occupants, economic implications, and overall sustainability of a structure (Melchers, 2018).

Several factors influence the structural integrity of buildings and infrastructure. These include material properties, design considerations, construction techniques, environmental conditions, and maintenance practices (Angst *et al.*, 2017 and Razaqpur *et al.*, 2019). Advancements in technology and research have led to the development of new materials,

monitoring techniques, and computational tools that advance the understanding and assessment of structural integrity. Studies such as Bamonte *et al.* (2021), have explored the integration of artificial intelligence and machine learning in structural integrity evaluation, enabling more accurate predictions and optimized maintenance practices.

Buildings face various structural issues over time due to factors such as age, design flaws, environmental conditions, and inadequate maintenance. These issues can have severe consequences on the structural integrity, safety, and functionality of the building. Identifying and addressing these problems early is essential to prevent further damage and potential risks to occupants. Structural issues in buildings include, foundation problems, wall cracks, roof leaks, corrosion and rust, concrete deterioration, wood rot and decay, settling and uneven settlement, insufficient lateral stability, improper load distribution, inadequate maintenance, wall tie failure, inadequate insulation, masonry issues, under-designed or overloaded floods, rotted wood, termite or pest infestation (Kenechi, 2021; Ogundele, Obamoh and Akah, 2023).

2.4. Maintenance Practices and Structural Integrity

Moghaddam and Usher (2010) opined that maintenance involves, maintenance tasks such as inspection, monitoring, cleaning, lubrication, adjustment, alignment, repair, replacement and maintenance of building and systems' components before failures or system breakdowns occur. Meanwhile, preventive maintenance is based on component reliability characteristics and aimed to reduce the probability of component failure, as well as to minimize the system. To maintain the integrity of a structure, Wireman (1990), recommended that the following types of maintenance practices may serve as a progressive method of implementing a comprehensive maintenance program.

- i Routine – lubrication, cleaning, painting, inspections, and others; aimed at taking care of small problems before they cause equipment failures.
- ii Proactive replacements; replacement of deteriorating or defective components before they can fail.
- iii Scheduled refurbishing; during a shutdown or outage, all known or suspected defective components are replaced.
- iv Predictive maintenance; an advanced form of routine inspections, using technologies like vibration analysis, and spectrographic oil analysis.
- v Condition-based maintenance; maintenance based on “real-time” inspections through sensors installed on the equipment.
- vi Reliability engineering; design engineering studies performed to discover possible modifications of the equipment to prevent failures from occurring.

By implementing well-thought-out practices, building owners and managers can proactively address potential issues and avoid costly repairs or replacements in the future. Maintenance practices summarized from literature (Abd Elghaffar, 2007; Panchdhari, 2003; Bortolini and Forcada, 2018; Ahluwalia, 2008; Bijen, 2003; Hauashdh *et al.*, 2022) include;

- i. Regular Inspection: Conduct routine inspections to identify signs of wear, damage, or potential structural issues. This includes examining walls, floors, ceilings, foundation, and support structures. Inspections should be carried out by qualified professionals, such as structural engineers or certified maintenance personnel.
- ii. Maintenance schedule: Developing a comprehensive maintenance schedule that outlines the tasks, frequency, and responsible parties for each activity. Schedule should cover everything from checking for cracks and leaks to inspecting electrical systems and HVAC equipment.

iii. Cleaning and debris removal: Keeping the building clean and free from debris, as accumulated dirt and debris can cause structural damage over time. Regularly clean gutters, downspouts, and drainage systems to prevent water accumulation and potential water-related issues.

iv. Moisture control: Addressing moisture-related problems so as to maintain structural integrity. Fixing leaks promptly, sealing cracks, and properly ventilating areas prone to excess humidity, as moisture can lead to mold growth, wood rot, and weakening of building materials.

v. Roof maintenance: Regularly inspecting and maintaining the roof to prevent leaks and water intrusion. Replacing damaged or missing shingles, and ensuring that roof flashing and seals are in good condition.

vi. Foundation maintenance: Solid foundations are vital for structural stability. Monitoring and repairing any foundation cracks or settling promptly is important. Implement proper drainage solutions to prevent water from pooling around the foundation.

vii. Structural repairs: Addressing identified structural issues promptly. Engaging qualified professionals to assess and recommend appropriate repairs or reinforcement techniques.

viii. Pest control: Regularly inspecting for pest infestations and taking proactive measures to control them. Pests can cause damage to building materials, compromising structural integrity.

ix. Fire safety measures: Ensuring fire safety systems, such as fire alarms, sprinklers, and fire extinguishers, are in proper working condition. Regularly testing and maintaining these systems to protect the building from fire-related damages.

x. Elevator and lift maintenance: Regularly servicing and maintaining elevators and lifts to ensure their proper functioning and prevent accidents or malfunctions.

xi. Electrical and plumbing systems: Regularly inspect and maintain electrical and plumbing systems to prevent potential hazards and structural damage resulting from electrical faults or leaks.

xii. Exterior maintenance: Maintaining the building's exterior, including walls, windows, and façade, to protect it from weathering and potential structural deterioration.

By implementing these maintenance practices, building owners can significantly enhance the structural integrity of their properties, prolong their lifespan, and ensure the safety and well-being of occupants. Regularly scheduled inspections, prompt repairs, and proactive measures are key to avoiding costly structural issues and preserving the building's value over time.

2.5. Barriers to the Implementation of Maintenance Practices

Implementation of maintenance practices in buildings is essential for enhancing structural integrity and ensuring the safety and longevity of structures (Culp, and Schramm, 2018). However, several barriers hinder the effective adoption and execution of maintenance practices (Yan and Kamaruzzaman, 2016). Understanding these obstacles is crucial in finding solutions to overcome them and promoting a proactive approach to building maintenance. This Barriers include;

i. Budget constraints: One of the primary barriers to implementing preventive maintenance is limited financial resources. Building owners and managers may perceive preventive maintenance as an additional expense and prioritize other budgetary needs over maintenance activities (Kadhim and Altaie, 2023). This often leads to deferred maintenance, which can result in more significant issues and costly repairs in the future.

ii. Lack of awareness: Some building owners and managers may not fully understand the importance of preventive maintenance or the potential consequences of neglecting it. They might underestimate the impact of regular maintenance on the building's structural integrity, safety, and overall operational efficiency.

iii. Short-term focus: Many stakeholders tend to focus on short-term cost savings rather than long-term benefits. This short-sighted approach can lead to a reactive maintenance mindset, where maintenance actions are taken only after a problem becomes evident, rather than preventing it from occurring in the first place.

iv. Time constraints: In busy building environments, finding time for preventive maintenance activities can be challenging. Owners and facility managers may prioritize immediate operational needs over maintenance tasks, postponing necessary inspections and repairs.

v. Lack of qualified personnel: Implementing effective preventive maintenance requires skilled and knowledgeable personnel. Finding and retaining qualified maintenance staff, especially in specialized areas, can be difficult, particularly in competitive job markets.

vi. Resistance to change: Some stakeholders may resist adopting preventive maintenance practices due to a preference for traditional reactive maintenance methods or fear of disrupting established routines. Overcoming this resistance requires effective communication and highlighting the benefits of preventive approaches.

vii. Complexity of buildings: Larger and more complex buildings may pose logistical challenges for preventive maintenance. Accessing hard-to-reach areas or coordinating maintenance efforts across various systems and components can be daunting tasks.

viii. Lack of standardization: In some cases, there might be a lack of standardized guidelines or protocols for preventive maintenance in buildings. This can lead to inconsistency in maintenance practices and may make it challenging to benchmark the effectiveness of preventive measures.

ix. Perceived low impact: Some building owners or managers may believe that their buildings are relatively new or in good condition, leading them to overlook the necessity of preventive maintenance. However, even newer buildings require regular inspections and maintenance to detect and address potential issues before they escalate.

x. External factors: Economic downturns, changes in building regulations, or unexpected events (e.g., natural disasters) can divert attention and resources away from preventive maintenance efforts, leaving buildings vulnerable to potential structural issues.

Overcoming these barriers requires a multi-faceted approach, including increasing awareness of the benefits of maintenance, allocating sufficient budgets for maintenance activities, providing training and education for maintenance staff, and developing standardized guidelines for maintenance in buildings.

3. METHODOLOGY

A survey was carried out which comprised a population of registered construction professionals practising in Akwa Ibom State. A total of 308 professionals were considered for the population of the study (Architects: 63, Builders: 42, Engineers: 70, Estate valuers: 80, Quantity surveyors: 53). Each number was obtained from the state chapter of the respective professional body. Stratified random sampling technique was adopted to determine the sampling size, with each profession considered a stratum. A sample size of 262 was calculated (Architects: 53, Builders: 38, Engineers: 59, Estate valuers: 66, Quantity surveyors: 46), using the Taro Yamane formula, shown in Equation 1.

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where: n is the sample size; N is the finite population; e is the margin of error, and 1 is unity.

A Structured questionnaire was developed and administered randomly to the selected professionals. Variables identified in the literature review, were adopted into the questionnaire. Respondents were requested to rate, on a five-point Likert scale (1 = Very low, 2 = Low, 3 = Moderate, 4 = High and 5 = Very high), variables to be evaluated. Questionnaires were validated by administering 30 copies of the test questionnaires to some professionals within the construction sector. This enabled the researcher to identify the strengths and weaknesses as well as errors inherent in the questionnaire and make amends before sending out to the actual target population. Cronbach Alpha test score of 0.82 was obtained for the instrument. This is an acceptable value as it exceeds 0.7 which is the recommended threshold value. Percentages and mean scores were computed using the Statistical Package for Social Sciences (SPSS) version 25.

4. PRESENTATION AND DISCUSSION OF RESULTS

4.1. Questionnaire Distribution Analysis

Table 1 shows Analysis of distributed questionnaires, 150 questionnaires (100%) were distributed, while 120 questionnaires (80%) were retrieved for Analysis.

Table 1: Questionnaire Distribution Analysis

Description	Total number	Percentage (%)
Questionnaire Distributed	150	100
Questionnaire Returned	120	80

4.2. Respondents Characteristics

Table 2 shows that 101 (84.2 %) of the respondents were male Professionals, while 19 (15.8 %) were female. The respondents ages indicated that 3 were within the age range of 18 - 30years (2.5 %), 106 were within the range of 31 - 59 years (88.3 %) and 11 (9.2 %) were 60 years and above. This indicated that the professionals were within their active years of service. The Table further showed that all respondents were Nigerians. This implies that they possess adequate knowledge about the Nigeria construction sector. As such, being within the research study area, information obtain can be relied on.

Positions occupied by professionals as shown in Table 2 indicated; 21 (17.5 %) project managers, 10 (8.3 %) production managers, 39 (32.5%) project architects, 23 (19.2 %) project Quantity surveyor, and 27 (22.5 %) project structural Engineer. It implies that, respondents are highly placed in key positions in the project section. Thus, they are highly knowledgeable and information gotten from them can be relied on.

Professionals who responded were; Architects 39(32.5 %), Builders 25(20.8 %), Quantity surveyors 23(19.2 %), Estate Valuer 6(5.0 %) and Civil Engineers 27(22.5 %). This shows a fair distribution of the questionnaire to the various professionals in the construction industry. Qualifications of the various professionals shows; HND 4 (3.3%), B.SC 56 (46.7%), M.SC 57 (47.5 %) and PhD 3 (2.5 %). This indicates that the respondents are qualified and well educated to the subject matter, therefore information obtain are valid. Affiliation from table 2 indicate, 39 (32.5%) respondents were from NIA, 25 (20.8 %) NIOB, 27 (22.5%) NSE, 23 (19.2%) NIQS and 6 (5.0%) for NIESV this shows that professionals in this study are all registered members of their various professional bodies.

Table 2: Respondents characteristics

Respondent's characteristics		Frequency	Percent	Valid Percent	Cumulative Percent
Sex	Male	101	84.2	84.2	84.2
	Female	19	15.8	15.8	100.0
	Total	120	100.0	100.0	
Age	18-30years	3	2.5	2.5	2.5
	31-59 years	106	88.3	88.3	90.8
	60years and above	11	9.2	9.2	100.0
	Total	120	100.0	100.0	
Nationality	Nigerian	120	100.0	100.0	100.0
Position	Project manager	21	17.5	17.5	17.5
	Production manager	10	8.3	8.3	25.8
	Project architect	39	32.5	32.5	58.3
	Project Q\S	23	19.2	19.2	77.5
	Project structural Engineer	27	22.5	22.5	100.0
	Total	120	100.0	100.0	
Profession	Architect	39	32.5	32.5	32.5
	Builder	25	20.8	20.8	53.3
	Quantity surveyor	23	19.2	19.2	72.5
	Estate Valuer	6	5.0	5.0	77.5
	Civil Engineer	27	22.5	22.5	100.0
	Total	120	100.0	100.0	
Qualification	HND	4	3.3	3.3	3.3
	B.SC	56	46.7	46.7	50.0
	M.SC	57	47.5	47.5	97.5
	PhD	3	2.5	2.5	100.0
	Total	120	100.0	100.0	
Affiliation	NIA	39	32.5	32.5	32.5
	NIOB	25	20.8	20.8	53.3
	NSE	27	22.5	22.5	75.8
	NIQS	23	19.2	19.2	95.0
	NIESV	6	5.0	5.0	100.0
	Total	120	100.0	100.0	
Membership	Technician Licentiate	4	3.3	3.3	3.3
	Associate	19	15.8	15.8	19.2
	Graduate	13	10.8	10.8	30.0
	Corporate	84	70.0	70.0	100.0
	Total	120	100.0	100.0	
Regulatory	ARCON	39	32.5	32.5	32.5
	CORBON	25	20.8	20.8	53.3
	COREN	27	22.5	22.5	75.8
	ESVARBOM	6	5.0	5.0	80.8
	QSRBN	23	19.2	19.2	100.0
	Total	120	100.0	100.0	
Practice	1-5years	2	1.7	1.7	1.7
	5 -10years	51	42.5	42.5	44.2
	11-15years	47	39.2	39.2	83.3
	16-20years	20	16.7	16.7	100.0
	Total	120	100.0	100.0	

Also, for membership the result shows that 4 (3.3%) were Technician Licentiate, 19 (15.8%) Associate, 13 (10.8%) graduate members while 84 (70.0) were corporate

members. Regulatory bodies indicate ARCON 39 (32.5%), CORBON 25 (20.8 %), COREN 27 (22.5%), ESVARBOM 6 (5.0%), and QSRBN 23 (19.2%). This implies that the study was an all-inclusive one and that professionals in this study are all members of their various regulatory bodies.

Table 2 shows Practice of the respondents, 2 (1.7%) have 1 – 5 years of experience, 51 (42.5%) have 5 – 10 years of experience, 47 (39.2%) have 11 – 15 years of experience, 20 (16.7%) have 16 – 20 years of experience. This implies that the majority of the respondents are well experienced, have worked in the construction industry and supervised maintenance of public building projects for more than 5 years; hence their opinions could be relied upon.

4.3. Level of Implementation of Maintenance Practices by Building Professionals in Akwa Ibom state

Table 3 is a representation of findings on level of implementation of maintenance practices by building professionals in Akwa Ibom State. Results show that maintenance practices such as, cleaning and debris removal (MS = 4.60), have very high level of implementation by building professionals in Akwa Ibom State. More so, other maintenance practices have the following; electrical and plumbing systems (MS = 4.00), exterior maintenance (MS = 3.75), moisture control (MS = 3.75), all have a high level of implementation by building professionals in Akwa Ibom State. However, pest control (MS = 3.24), roof maintenance (MS = 3.08), regular inspection (MS = 3.00), maintenance schedule (MS = 2.84), have moderate level of implementation. Fire safety measures (MS = 2.15), foundation maintenance (MS = 2.00), elevator and lift maintenance (MS = 1.91), and structural repairs (MS = 1.91), were maintenance practices with low levels of implementation by building professionals in Akwa Ibom state. An average mean of (MS) of 3.02, implied that there was a moderate level of implementation of maintenance practices by building professionals in Akwa Ibom state.

Table 3: Assessment of the level of implementation of maintenance practices by building professionals in Akwa Ibom State.

Maintenance Practices	N	1	2	3	4	5	Sum	Mean	Rank	Remark
Cleaning and Debris Removal	120				48	72	552.00	4.6	1	Very High
Electrical and Plumbing Systems	120			31	58	31	480.00	4.0	2	High
Exterior Maintenance	120	15	7	10	48	40	451.00	3.8	3	High
Moisture Control	120	15	7	10	48	40	451.00	3.8	3	High
Pest Control	120		42	25	35	18	389.00	3.2	5	Moderate
Roof Maintenance.	120	9	23	50	25	13	370.00	3.1	6	Moderate
Regular Inspection	120	19	13	50	25	13	360.00	3.0	7	Moderate
Maintenance Schedule.	120	11	19	68	22		341.00	2.8	8	Moderate
Fire Safety Measures	120	53	27	15	18	7	259.00	2.2	9	Low
Foundation Maintenance	120	44	45	20	9	2	240.00	2.0	10	Low
Elevator and Lift Maintenance	120	54	35	20	9	2	230.00	1.9	11	Low
Structural Repairs	120	54	35	20	9	2	230.00	1.9	11	Low
Average Mean								3.0		

4.4. Identify Common Structural Issues Faced by Buildings in Akwa Ibom state and their Impact on the Structural Integrity

Table 4 is a representation of findings on common structural issues faced by buildings in Uyo and their impact on the structural integrity. Results show, roof leaks (MS=5.00), wall cracks (MS = 4.91), concrete deterioration (MS=4.84), foundation problems (MS=4.51). Findings show that, professionals all agreed that the above structural issues have very high level of impact on structural integrity. Meanwhile, inadequate maintenance (MS = 3.84) and settling and uneven settlement (MS = 3.75), had high levels

of impact on structural integrity. Inadequate insulation (MS = 3.35), masonry issues (MS = 3.24), corrosion and rust (MS = 3.24), termite or pest infestation (MS = 3.08), under-designed or overloaded floods (MS = 3.08), wood rot and decay (MS = 3.08), rotted wood (MS = 3.00), improper load distribution (MS = 3.00), all have moderate levels of impact. Insufficient lateral stability (MS = 1.91), and wall tie failure (MS = 1.00), have low and very low levels of impact respectively. This implies that respondents are very much aware of the various impact these structural issues cause. An average mean of 3.43 shows a moderate level of impact of the various structural issues on structural integrity.

Table 4: Common structural issues faced by buildings in Akwa Ibom state and their impact on the structural integrity

Common Structural Issues	N	1	2	3	4	5	Sum	Mean	Rank	Remark
Roof Leaks	120					120	600.00	5.0	1	Very High
Wall Cracks.	120				10	110	590.00	4.9	2	Very High
Concrete Deterioration.	120				19	101	581.00	4.8	3	Very High
Foundation Problems	120			18	22	80	542.00	4.5	4	Very High
Inadequate Maintenance	120		5	37	50	28	461.00	3.8	5	High
Settling and Uneven Settlement	120		14	31	45	30	451.00	3.8	6	High
Inadequate insulation	120		28	39	35	18	403.00	3.4	7	Moderate
Masonry issues	120		42	25	35	18	389.00	3.2	8	Moderate
Corrosion and Rust	120		42	25	35	18	389.00	3.2	8	Moderate
Termite or pest infestation	120	2	24	60	30	4	370.00	3.1	10	Moderate
Under-designed or overloaded floods	120	2	24	60	30	4	370.00	3.1	10	Moderate
Wood Rot and Decay	120	2	24	60	30	4	370.00	3.1	10	Moderate
Rotted wood	120	12	14	60	30	4	360.00	3.0	13	Moderate
Improper Load Distribution	120	12	14	60	30	4	360.00	3.0	13	Moderate
Insufficient Lateral Stability	120	53	28	35	4		230.00	1.9	15	Low
Wall tie failure	120	120					120.00	1.0	16	Very Low
Average Mean								3.4		

4.5. Assessment of the Challenges and Barriers to the Implementation of Maintenance Practices in Buildings in Akwa Ibom state

Table 6 shows result from assessment of the challenges and barriers affecting the implementation of maintenance practices in buildings in Akwa Ibom state. It can be seen from the table that factors such as, lack of standardization (MS = 4.75), budget constraints (MS = 4.67) and time constraints (MS = 4.60), have very high levels of influence on the implementation of maintenance practices in buildings in Akwa Ibom state.

Table 6: Assessment of the challenges and barriers to the implementation of maintenance practices in buildings in Uyo

Barriers	N	1	2	3	4	5	Sum	Mean	Rank	Remark
Lack of Standardization	120			1	27	92	571	4.8	1	Very High
Budget Constraints	120			1	37	82	561	4.7	2	Very High
Time Constraints	120				48	72	552	4.6	3	Very High
Lack of Qualified Personnel	120		14	13	62	31	470	3.9	4	High
Resistance to Change	120		14	31	45	30	451	3.8	5	High
Lack of Awareness	120		42	25	35	18	389	3.2	6	Moderate
External Factors	120	10	32	25	35	18	379	3.2	7	Moderate
Short-Term Focus	120		40	60	20		340	2.8	8	Moderate
Complexity of Buildings	120	9	31	60	20		331	2.8	9	Moderate
Perceived Low Impact	120	47	45	25	25		312	2.6	10	Moderate
Average Mean								3.6		

Lack of qualified personnel (MS = 3.91), resistance to change (MS = 3.75), both have high levels of influence from professional's view point. However, other factors such as lack of awareness (MS = 3.24), external factors (MS = 3.15), short-term focus (MS = 2.83), complexity of buildings (MS = 2.75), and perceived low impact (MS = 2.60), have moderate levels of influence on the implementation of maintenance practices in buildings in Akwa Ibom state. Average mean value of 3.62, shows respondents all agrees that these factors on a general bases have high level of influence on the implementation of maintenance practices in buildings in Akwa Ibom state.

4.6. Discussion of Results

The findings presented in Table 3 offer a comprehensive insight into the level of implementation of various maintenance practices by building professionals in Akwa Ibom state. Notably, cleaning and debris removal emerged as the most executed practice, with a mean score of 4.60. This suggests that respondents perceive a very high level of implementation in this maintenance practice.

Electrical and plumbing systems, exterior maintenance, and moisture control practices also exhibited commendable performance, each scoring relatively high with means of 4.00, 3.75, and 3.75, respectively. The results imply that building professionals in Akwa Ibom state place significant emphasis on these maintenance practices, reflecting a proactive approach to managing electrical and plumbing systems, as well as addressing exterior and moisture-related concerns.

The study, however reveals a moderate level of implementation for pest control, roof maintenance, regular inspection, maintenance schedule, with mean scores ranging from 2.84 to 3.24. This is an improvement from the findings of Talib *et al.* (2014) that regular maintenance of public buildings is lacking. Though, these practices are recognized and addressed, there is room for improvements in their execution. Building professionals should pay particular attention to regular inspection of buildings to spot defects and other potential problems at the earliest possible phases of their development.

The findings also point to challenges in implementation of fire safety measures, foundation maintenance, elevator and lift maintenance, and structural repairs, as these practices were lowly ranked with means between 1.91 and 2.15. These areas show a lower priority or possibly indicate a need for increased awareness and investment in these crucial aspects of building maintenance.

The overall average mean of 3.02 implies a moderate level of implementation across all maintenance practices considered in the study. This suggests that while some aspects are well-addressed and maintained at a high level, others lag, contributing to an overall moderate rating. It would be beneficial for building professionals in Akwa Ibom state to assess and address low-scoring practices to elevate the overall maintenance standards in the region.

In conclusion, the findings from Table 3 underscore the need for a balanced and comprehensive approach to building maintenance in Akwa Ibom state. The strengths and weaknesses identified across various practices provide valuable insights for stakeholders to prioritize and enhance maintenance practices, ultimately contributing to the longevity and sustainability of buildings in the region.

Table 4 encapsulates a comprehensive exploration of prevalent structural issues faced by buildings in Akwa Ibom state, delving into their respective impacts on structural integrity. Notably, roof leaks emerge as the foremost concern, garnering unanimous agreement among professionals. This was closely followed by wall cracks and concrete deterioration. Foundation problems also feature prominently, underscoring the widespread recognition of their potential to compromise structural stability. However, a nuanced perspective arises in the assessment of inadequate maintenance and settling, where a slightly lower mean score suggests some variability in professional opinions. Within the moderate impact category, various issues, including inadequate insulation,

masonry issues, corrosion, rust, termite infestation, and others, collectively contributed to a complex landscape of structural challenges. In contrast, insufficient lateral stability and wall tie failure were relegated to low and very low impacts, respectively. An average mean score of 3.43, indicating a consensus among respondents that there exists a generally moderate level of impact caused by these structural issues on the integrity of buildings in Akwa Ibom state. Results are in line with Kenechi (2021) and Ogundele, Obamoh and Akah (2023), that such defects are common place among buildings in the study area. This collective awareness underscores the importance of targeted interventions and proactive maintenance practices to ensure the enduring structural soundness of buildings in the region.

Table 6 presents a comprehensive analysis of the factors influencing the implementation of maintenance practices in buildings in Akwa Ibom state. The Mean Scores (MS) assigned to each factor provide valuable insights into the perceived impact from professionals involved in the assessment.

Firstly, Lack of standardization emerges as a significant challenge with a high mean score of 4.75. This suggests a consensus among respondents that the absence of standardized procedures and guidelines poses a substantial hindrance to the effective implementation of maintenance practices in Akwa Ibom buildings.

Budget constraints and time constraints closely follow with mean scores of 4.67 and 4.60, respectively. These findings underline the financial and temporal challenges faced in the maintenance processes. The high scores indicate a shared recognition among professionals that limitations in budgetary allocations and time availability pose substantial barriers.

Moving to factors with a high level of influence, lack of qualified personnel and resistance to change both receive notable mean scores of 3.91 and 3.75, respectively. These scores signify that professionals acknowledge the pivotal role of having skilled personnel and the need for a proactive approach to change management in overcoming implementation challenges.

Shifting focus to factors with a moderate level of influence, lack of awareness, external factors, short-term focus, complexity of buildings, and perceived low impact presented mean scores ranging from 2.60 to 3.24. While these factors may not be as pronounced as the high-level influencers, their moderate scores suggest that they still contribute significantly to the challenges faced in the implementation of maintenance practices.

The collective agreement among respondents, reflected in the average mean value of 3.62, reinforces the overall consensus that these identified factors exert a high level of influence on the implementation of maintenance practices in buildings in Akwa Ibom state. This consensus indicates a unified perspective among professionals regarding the multifaceted challenges in ensuring effective maintenance processes.

In conclusion, the findings from Table 6 shed light on the nuanced landscape of challenges and barriers impacting the implementation of maintenance practices in Akwa Ibom state. Results of the study agree with those of Odediran, Opatunji and Eghenure (2012), that technical and budgetary constraints are the key barriers to implementation of effective maintenance practices in the study area. The identified factors collectively underscore the need for a comprehensive and strategic approach to address these challenges for the sustainable upkeep of buildings in the region.

5. CONCLUSION AND RECOMMENDATIONS

This study focused on maintenance practices for structural integrity of public buildings in Akwa Ibom State. Findings indicated that there was a “Moderate” level of implementation of maintenance practices by building professionals in Akwa Ibom state. The study also found out that, common structural issues faced by buildings in the study

area included, roof leaks, wall cracks, concrete deterioration, and foundation defects. However, the impact of these issues on structural integrity was “Moderate”. Finally, the study showed that effectiveness of current maintenance practices in Akwa Ibom state, were effective.

Based on these findings, the following recommendations are made.

- i. Specialized Training Programs: Develop training courses specifically targeting common structural issues, equipping building professionals with specialized skills to identify and address problems like roof leaks, wall cracks, concrete deterioration, and foundation issues.
- ii. Regular Structural Audits: Mandate regular structural audits for buildings in Uyo, conducted, to systematically assess and address potential vulnerabilities.
- iii. Collaboration with Materials Industry: Foster collaboration between building professionals and the construction materials industry to ensure the availability of high-quality, durable materials suitable for Uyo's environmental conditions.
- iv. Continuous Professional Development: Encourage continuous professional development for building experts by organizing seminars and workshops focused on the latest advancements in structural maintenance techniques and technologies.
- v. Research on Localized Solutions: Invest in research to identify region-specific materials and construction techniques that can better withstand the local climate and environmental conditions, reducing the occurrence of common structural issues.
- vi. Public Awareness on Maintenance Importance: Launch a public awareness campaign emphasizing the significance of routine maintenance in preserving the structural integrity of buildings, with a focus on educating homeowners and tenants.
- vii. Incentives for Maintenance Investments: Introduce tax incentives or financial rewards for building owners who proactively invest in structural maintenance and improvements, encouraging a preventive approach.
- viii. Standardized Maintenance Protocols: Develop standardized maintenance protocols specifically tailored to the prevalent structural issues in Uyo, providing a clear guide for professionals to follow.
- ix. Early Detection Systems: Implement advanced monitoring systems to detect structural issues at an early stage, allowing for timely intervention and preventive measures.
- x. Establish Emergency Response Teams: Form specialized teams equipped to respond swiftly to structural emergencies, minimizing the impact of sudden issues such as foundation problems or severe roof leaks.

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