

# Common Defects of Buildings in Tertiary Institutions in Nigeria

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**Abstract:** Building maintenance problems are a breakdown in a building's performance, function, and user requirements. Moreover, these problems can be in its structure, services, and other facilities. These problems primarily manifest as defects and should be rectified immediately; otherwise, they would result in a higher maintenance cost, hinder operational efficiency, and even reduce lifespan. At the same time, poor building performance and inadequacies due to these maintenance defects have been known to cause unproductivity of building users and even illnesses. Therefore, it is pertinent to investigate these defects to create maintenance solutions for them. However, even though studies abound on university building maintenance in Nigeria, its issues, and the factors affecting it, there is still the need to explore the common maintenance defects affecting buildings in public universities. Few studies have been conducted on common building maintenance defects; however, these defects have been well-researched in this study. Therefore, this paper illustrates the findings from assessing the common defects in six selected higher education institutions in the country. This study embraced a quantitative approach, and data were gathered from maintenance managers, supervisors, and technicians working in the Works Departments of the selected public institutions. Data collected was analyzed using descriptive statistics such as percentile and factor analysis. Findings revealed that the most common defects affecting university buildings are joinery infestation and fittings, substandard finishes and cracks, deterioration and leakages, and rusting and installation issues.

**Keywords:** Maintenance, Building Maintenance, Maintenance Defects, Higher Education Institutions

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## 1. Introduction

People carry out building maintenance activities to repair, replace, and service the structural members and electrical and mechanical components of a building to enhance its habitability and usability for a specific period. Building assets change in value according to their quality and quantity of maintenance work [2]. Therefore, various building maintenance systems improve buildings' value and return them to their functional state to continue performing their

initial functions. Maintenance includes routine, preventive, predictive, emergency, and corrective maintenance.

Knowledge and skills acquired through education are the bedrock of human capital development in any nation [4]. In Nigeria, by law, mid-level technicians and graduate employees are Higher Education Institution (HEI) products [4]; captains of industries, future leaders, engineers, managers, scientists, and entrepreneurs are all products of

educational buildings. Studies have posited that the condition of educational buildings is crucial to students' learning effectiveness, behavior, and academic performance [20, 31]. University buildings should be maintained to create an atmosphere that promotes learning, teaching, research, and innovation [1]. Therefore, effectively managing the maintenance of university buildings is crucial to accomplishing these primary goals.

In Nigeria, learning, teaching, academic research, and innovation are indoor activities; therefore, provision is made for lighting and air conditioning systems in these indoor spaces to preserve and protect the teacher's and student's health and safety [4]. These provisions will also improve their comfort and facilitate the learning process. Past studies on the maintenance management of buildings and their health benefits by Abisuga *et al.*; Leung and Fung [4, 20] revealed factual evidence that the physical state of facilities in HEIs and the effective maintenance of these buildings contributes significantly to the well-being of staff and students of these institutions.

Therefore, an efficient maintenance management strategy is pertinent to prevent building assets from depreciating. In most cases, the ineffective or total absence of a maintenance management system encourages building defects, thereby depriving it of fulfilling the purpose for which it was constructed. Pheng and Wee [28] further pointed out that building defects characterized as flaws in the function, performance, and conditions result from the absence of a sound building maintenance management strategy. These defects can also be viewed as the deterioration of certain buildings' structural, mechanical, and electrical services, ultimately halting the institutions' day-to-day learning activities.

In a study by Olagunju [25], he identified a few maintenance issues and building defects plaguing public buildings. These defects were categorized into roof components, discharge of wastewater components, wall finishes condition, electrical and switches condition, and toilet facilities. Thus, it is obvious that the discussions around maintenance defects affecting university buildings cannot be avoided considering the effect of buildings and facilities on the quality of education. Therefore, assessing these defects affecting structures in Nigerian institutions is essential. Based on this background, this study evaluated the common defects plaguing public tertiary institution buildings in southwest Nigeria, with a vision to create a compendium or record of the most occurring and common defects affecting their structures. This would help to have a proper financial plan and procurement schedule to cater to these defects and issues. This would point university management and maintenance departments in the right direction regarding the defects affecting buildings and adequate maintenance measures to cater to them.

## 2. Literature Review

Sound and conducive buildings are pertinent to conducting

the operations of HEIs. These buildings offer value to the university and the university community at large. Some studies by Lavy and Bilbo and Leung and Fung [19, 20] have ascertained the positive connections between the well-being of educational buildings and the value of the education they facilitate. Even though these studies have generally focused on school buildings, university buildings are not exempted; they also influence students' and faculty members' performance. Bagdiya and Wadalkar [9] emphasized that maintenance issues during the occupancy stage are pivotal to building performance. Therefore, any shortfall in the performance of these buildings due to maintenance issues will substantially affect the efficiency of universities [2].

Tan *et al.* [32] posited that all buildings would develop maintenance issues over time. This view has been widely propagated in the media in Malaysia in the past few years. The media further illustrated that these maintenance issues and problems regularly occur in Malaysia. Various studies have been conducted on common building defects and problems; these maintenance defects have been well-researched in this study. Building maintenance issues such as wall cracks, roof damage and leakages, steel corrosion, defective door and window, dampness, fungi growth, discoloration, and faulty electrical systems have been documented [15, 33-34]. Kamal *et al.* [18] posited that HEI buildings in Malaysia are prone to maintenance defects due to a lack of maintenance policies, maintenance care, technical knowledge, and the high cost of maintenance repairs. A study on maintenance issues affecting HEIs in Malaysia by Wahab and Hamid [34] indicated that leakage problems, steel corrosion, rainwater penetration, and wall cracks are endemic. They further touched on several types of damages revealed in their investigation. These cracks were mainly on the external walls, causing water seepage and dampness on the walls and finishes.

Various studies have documented several common maintenance issues battling higher education buildings in Brazil. According to the survey conducted by Forcada and Bortolini [14], it was deduced that wall and floor cracks, water seepage problems, and foundation settlements were common maintenance issues affecting buildings. Hovde and Moser [17] also mentioned water damage problems in a building. They stated that maintenance issues such as moisture movement in a building structure could be critical and cause structural damage. They also emphasized the need to monitor cracks and spalling in a building as they are delicate maintenance problems. Likewise, the research carried out by Pérez-Bella *et al.* [27] identified water movement, cracks, and deterioration of finishes as the most critical building maintenance issues in Latin America.

According to Ochien'g [23], in Nigeria, despite the government's assurances towards university building maintenance, these buildings are not effectively maintained, resulting in defects and issues. These defects have been investigated to be mostly wall and floor cracks, leakages, vandalized fittings, blocked drains, broken glass panes, damaged joinery, damaged electrical and mechanical fittings,

and wall dampness. Likewise, the study carried out by Abisuga et al. [4] revealed that defects such as dampness, plumbing leakages, cobwebs, and dust are common in higher institutions in Lagos. Ochien'g [23] posited that these defects have become rampant in higher institution buildings, necessitating their proper management in terms of scope and cost.

Abdul-Lateef [1] defined a defective building as being unable to fulfill its functional, aesthetic, and economic needs as designed and constructed. He further clarified that defects are responsible for the unserviceability and poor performance of a building. His investigation of higher institution buildings revealed that faulty electrical and mechanical fittings and appliances, roof leakages, door locks and knobs, wall dampness, and cracks were common. Furthermore, Kamal et al. [18] highlighted the frequent occurrence of wood decay, paint leaking, steel rust, and broken glass panels as defects affecting university buildings in Nigeria. Likewise, Bagdiya and Wadalkar [9] posited that inspection revealed that roof defects were also common, such as blocked gutters, pipe leakages, roof leakages, broken roof tiles, and fascia boards. The common building maintenance issues and defects mentioned above have been found to plague higher institution buildings in Nigeria. This is a testament to the need for a comprehensive maintenance strategy to combat these defects.

### 3. Research Methodology

The study assessed the common defects affecting buildings in public tertiary institutions in southwestern Nigeria. The survey approach adopted was the quantitative approach. Research data were collated through questionnaires presented to maintenance managers, supervisors, and technicians working in the Works Departments of the six selected public universities. The study adopted a structured questionnaire in tandem with information from the review of related literature. The questionnaire entailed two sections, A and B. Section A consisted of background information questions to gain insights into personal information such as academic qualifications and respondents' years of experience. This section of the research instrument offers quality checks to the data from the other section. Section B presented questions to identify the common maintenance defects affecting these institutions. The study adopted a 5-point Likert scale. Out of 165 questionnaires sent out to the various maintenance departments of the target institutions, 107 were received and ascertained fit for analysis, representing about a sixty-five percent (65%) response rate.

Cronbach's alpha coefficient was adopted as it is the most used indicator of internal consistency. According to Pallant [26], the preferable values are 0.8 and above, but values above 0.7 are acceptable. This method measures the reliability of the questionnaire's each field and the mean of the whole field. Between 0.0 and +1.0 is the typical range for

Cronbach's alpha; the greater the value, the higher the internal consistency. For the common defects affecting the buildings in the selected institutions, the Cronbach alpha value of 0.642 was determined. To analyze the respondents' demographic data, percentile was used; nevertheless, Factor Analysis was used to analyze the prevalent maintenance issues and defects impacting HEI buildings.

## 4. Findings and Discussions

### 4.1. Background Information of Respondents

The result of the respondents' background information shows that (47.2%) have either a bachelor's or a master's degree, while about (9.4%) are Ph.D. holders. This indicates that most respondents (56.6%) are well-educated professionals. Most of these respondents (65.1%) have acquired between 5 and more than 15 years of experience working with the maintenance unit. This indicates that most of the personnel in these institutions' works/maintenance departments are highly qualified. They are mostly bachelor's and master's degree holders. Furthermore, these staffs are equally experienced, most of whom have spent between six and 15 years maintaining their university buildings.

### 4.2. Common Defects Affecting Buildings in Higher Education Institutions

In assessing the common building defects affecting university buildings, factors identified from the literature review were presented to respondents to rank them according to their frequency of occurrence. The data were subjected to factor analysis (FA) to examine and classify the discovered factors into larger, more manageable groups. The acquired data's suitability must be established first for this to be done effectively. Correlation matrix assessment reveals the presence of values greater than 0.3. The sampling acceptability KMO metric reached a value of 0.570. This value exceeds the minimum value of 0.5 [29]. Bartlett's sphericity test established the correlation matrix's factorability and was statistically significant ( $<0.05$ ).

Principal component analysis (PCA) with varimax rotation was used to conduct FA after it was determined that the data collected complied with all requirements. Four (4) factors with eigenvalues greater than one were extracted with the eigenvalues stationed at the conventional high value of 1. The PCA's final statistics and extracted components accounted for about 70% of the total cumulative variance. This satisfies the requirement that the factors account for at least 50% of the variation [31]. The four extracted components and the factors loading on them are displayed in Table 1. According to Spector [30], a variable has a distinct component structure when it has a significant factor loading (loading  $> 0.50$ ) on just that component. As a result, factors with 0.5 and higher are significant and are discussed under each primary component.

**Table 1.** Component Matrix/Rotated factor matrix.

Factors	Components Numbers			
	1	2	3	4
Wood decay and termite infestation	0.847			
Mould and fungi infestation	0.814			
Joinery and fittings	0.746			
Cracking of walls		0.834		
Mechanical installation problems		0.674		
Finishes problems		0.622		
Roof deformation and leakages			0.882	
Damp penetration into the building			0.870	
Corrosion				0.797
Electrical installation/fittings problems				0.751

### 4.3. Discussion of Extracted Factors

#### *Joinery Infestation and Fittings Defects*

The first principal component accounts for 25.731% of the variance explained and has three factors loading. These factors include; wood decay and termite infestation, mold and fungi infestation, and joinery and fittings. Considering these factors' descriptions, the component was therefore named "Joinery Infestation and Fittings defects."

Kamal et al. [18] highlighted the frequent occurrence of wood decay, paint leaking, steel rust, and broken glass panels as defects affecting university buildings in Nigeria. Also, the study by Bhargava, Ratnamala and Asadi [10] in India corroborated the wall cracks, revealing that plumbing issues, electrical fittings problems, faded wall paintings, and lift maintenance existed. Similarly, Mohd Isa [22] posited that most building maintenance issues are architectural, particularly faulty doors and finishes. Additionally, Forcada et al. [15] researched maintenance issues of academic buildings at the post-completion stage. The study revealed that inadequate tile grouting and improper toilet fittings are the most common issue.

Furthermore, paint peeling was detected and was due to insufficient coat application. Macarulla et al. [21] also posited that maintenance issues and defects in Brazil were mainly mold growth in walls causing sick building syndrome. Furthermore, through their research, Abisuga et al [4] found nine common defects in university buildings in Nigeria: faulty joinery and fittings were part of them.

These maintenance problems indicate that they are universal; they have become a global menace.

#### *Substandard Finishes and Cracks Defects*

The second principal component accounts for 16.378% of the total variance explained. The factors under this component include; cracking of walls, mechanical installation problems, and finishes problems (deteriorated floor finishes, faded paints on façade, walls, beams, and columns, and broken and chipped wall and floor tiles). This component was then named "Substandard Finishes and Cracks Defects" based on the attributes of its factors.

Various studies have been conducted on common building maintenance defects and problems; these defects have been well-researched in this study. Building maintenance issues such as wall cracks, steel corrosion, and

discoloration have been documented [15, 34-35]. Likewise, the study by Abd-Wahab et al. [3] alluded to wall and floor cracks as some of the defects they uncovered plaguing university buildings. According to the survey conducted by Dahal and Dahal [13] in Nepal, the most predominant building maintenance defects are wall and floor cracks, tile breakages, and wall finishing deterioration.

Furthermore, Kamal et al. [18] highlighted the frequent occurrence of wood decay, paint leaking, steel rust, and broken glass panels as defects affecting university buildings in Nigeria. Likewise, Mohd Isa [22] posited that inspection revealed that crack and discoloration defects, such as broken roof tiles and fascia boards, were also common.

#### *Deterioration and Leakages Defects*

The third principal component accounts for 14.198% of the total variance explained. The factors under this component include; roof deformation and leakages and damp penetration. This component was then dubbed "Deterioration and Leakages Issues" based on the attributes of its factors.

The findings of this study are consistent with the conclusions and findings of Babatope, Akinsola et al. and Ofide et al. [5, 8, 24]. Some of the pressing maintenance issues highlighted in the research above also ranked highest in the respondents' opinions: damp penetration, roof deformation, and leakages. A study by Choka [12] in Ethiopia showed that issues with leaking pipes, water seepage from walls and concrete, roof leakages, and mechanical problems were rife. Zakariyyah et al. [36] traced the causes of dampness in tertiary institution hostels in Lagos State (southwest) Nigeria to increased underground water during rainy seasons, condensation, and pipe leakage. Zakariyyah et al. [36] recommended further investigation by building surveyors to determine other causes of dampness in hostel buildings and proffer remedial solutions.

#### *Rusting and Installation Defects*

The last principal component extracted contains two loading factors, accounting for 13.362% of the variance explained. These factors are corrosion and electrical installations/fittings. Considering the underlying characteristics of these factors, this component was subsequently named "Rusting and Installation Issues."

Forcada et al., Wahab et al. and Raftery and Walker [15, 34-35] have all investigated the common defects affecting buildings in various regions worldwide. Their study revealed

the most noticeable defects of steel corrosion, defective door and window, and faulty electrical systems. Also, in the study on residential buildings carried out by Chew [11] in Singapore, it was deduced that concrete spalling, corrosion of pipes, and faded and peeling paint were the maintenance issues they were battling with. Similarly, according to Alves and Casado [6], a study in Brazil showed that most of their maintenance problems were related to mechanical and electrical building installations, plumbing, and sanitary problems. Dahal and Dahal [13] observed these same maintenance issues in their study; they posited that maintenance problems affecting sanitary ware, such as leakages in sinks, showers, and taps, were rampant in Nepal. These defects are universal; therefore, maintenance managers must identify these issues to take necessary actions to stem their effects.

## 5. Conclusion and Recommendations

This study aimed to assess the common defects affecting public university buildings in Nigeria. The study determined the qualification and experience of the personnel in the maintenance units of these institutions by using a survey approach with quantitative data gathered from maintenance officers, supervisors, and technicians within six selected public tertiary institutions. This gave credence to their ability to participate in the survey and their knowledge about the issues discussed. The study also investigated the common defects of buildings in these tertiary institutions.

Findings revealed that most of the personnel in these institutions' works/maintenance departments are highly qualified. They are mostly bachelor's and master's degree holders. Furthermore, these staffs are equally as experienced, most of whom have spent between six and 15 years maintaining their university buildings. The defects affecting university buildings are classified as joinery infestation and fittings, substandard finishes and cracks, deterioration and leakages, and rusting and installation defects.

The idea of HEIs was to create an institutional infrastructure and environment favorable to the development of the human mind, meaning the gradual formation of the human character through education through the quest for knowledge imparted through teaching and learning [7]. Akinsola et al. [5] attributed the pathway to global economic growth, productivity, and competitiveness to the advent of technology in higher education. Therefore, if the idea behind an HEI is to be realized to become a pathway to growth, HEI infrastructures should be well maintained to actualize the responsibilities for which they were built.

It is, therefore, incumbent upon the higher institution managements and maintenance departments by extension, to defeat the defects assessed in this study, to insist on contracting only professional services and having experienced maintenance managers, technicians, and forepersons at their disposal to tackle infestation and leakages adequately. Also, the empirical study reveals that these experienced technicians are needed to repair leaky

plumbing and pipes in buildings as soon as they are discovered. They are to watch for condensation and wet spots and to eliminate them by removing the water source or increasing air circulation with ventilation. Maintenance considerations should also be incorporated during design to ensure foundation vents are open and unobstructed and adequate cross ventilation exists. Additional vents should be installed if necessary.

It is also recommended that institutions orientate their students and building users on embracing a maintenance culture to preserve the good working condition of their building facilities. Severe penalties should also be meted out to vandalism defaulters to deter future potential offenders.

The findings of this study will contribute significantly to the knowledge about the most common defects affecting university buildings. This will help maintenance units on the appropriate area of focus. More research can still be conducted to investigate other defects not captured in this study affecting university buildings, especially in the country's northern region. This is necessary because of the climatic difference between the north and south regions. This will give a broader view of maintenance issues and their corresponding solutions.

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