

Assessment of Wall Defects in Student Hostels at Federal Polytechnic Damaturu: Causes and Remedial Measures

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Abstract

This study investigates the causes and remedies of wall defects in student hostels at Federal Polytechnic Damaturu, Yobe State, Nigeria. Using an observational and survey-based approach, data were collected through condition surveys and interviews in 24 randomly selected blocks across five hostels. Findings reveal that chemical agents (28.7%), mechanical agents (21.8%), and occupant-related factors (22.9%) are the primary causes of defects, with common issues including cracks, dampness penetration, peeling paint, and efflorescence. These findings align with existing literature, emphasizing the role of moisture, poor construction practices, and user behavior in wall deterioration. Recommendations include enhancing maintenance practices, educating users about responsible behavior, employing durable materials, and adapting designs to local climatic conditions.

Keywords: Wall Defects, Hostel Buildings, Deterioration, Preventive Maintenance, Chemical Agents, Mechanical Agents.

Introduction

Buildings are constructed to serve as shelters and these facilities must be carefully planned, designed, and erected to meet various human needs and activities. Effective planning and design are crucial to ensure that buildings fulfill their intended purposes efficiently and sustainably (Sysoevam *et al.*, 2023; Rashidi *et al.*, 2022; Hai *et al.*, 2022; Novak *et al.*, 2023; Harshavardhan *et al.*, 2023; Misbach and Aman, 2023; Kor *et al.*, 2022). However, despite these expectations building defect remains significant challenge that affect their performance and longevity. These defects can be categorized into those impacting structural performance and those affecting appearance. They may also involve legal violations of building codes or standards (Lambers *et al.*, 2023; Mydin *et al.*, 2024; Wardach *et al.*, 2023; Oppedal and Kvande, 2024; Alomari, 2022; Alencastro *et al.*, 2023). Defects in buildings can arise from a variety of factors, including mechanical, electromagnetic, thermal, chemical, biological agents, and user actions. These defects can significantly

impact the building's functionality, safety, and economic value (Mydin *et al.*, 2024; Sandanayake *et al.*, 2021; Faqih *et al.*, 2020; Hauashdh *et al.*, 2021; Milion *et al.*, 2021). Water is a significant factor in the deterioration of building materials, affecting their physical, chemical, and biological integrity. It can lead to various forms of damage, such as structural weakening, fungal growth, and efflorescence (Jucienė *et al.*, 2023; Rabat *et al.*, 2020; Náhunková *et al.*, 2024; Soulios *et al.*, 2020; Charola and Wendler, 2015; Feng and Janssen, 2021; Arpaci *et al.*, 2023). Generally, institutions in the Nigeria are faced with shortage of funds to construct new and to maintain the available hostel buildings to accommodate the ever-increasing number of students in their institutions. Thus, prior to defect maintenance; the condition as well as the causes and measures to address thus defects must be carefully investigated for optimum benefit. Therefore, this study aims to identify the primary causes of wall defects in student hostels at Federal Polytechnic Damaturu in Nigeria and propose appropriate remedial measures. The findings of this research will contribute to improving maintenance practices and enhancing the durability of building structures. According to previous studies, inadequate artisan skills are a significant contributor to defects in buildings, while cracks are among the most frequent types of defects observed (Paton-Cole & Aibinu, 2021). Additionally, poor maintenance culture has been identified as a critical factor accelerating building deterioration (Olanrewaju *et al.*, 2022).

Literature Review

Building defects and deterioration are significant concerns in the construction industry, affecting both the functionality and lifespan of structures. This literature review focuses on recent studies that have explored the causes, types, and remedial measures for building defects, particularly wall defects, with an emphasis on student hostels and similar institutional buildings.

Causes of Deterioration and Defects

Recent studies highlight several factors contributing to building defects and deterioration. According to Van Den Bossche *et al.* (2023), demographic, geographical, and climatological factors significantly influence the occurrence of building defects in Belgium. Their study emphasizes that environmental conditions such as heavy rainfall and fluctuating temperatures can accelerate the degradation of building materials, particularly walls. Similarly, Talebi *et al.* (2021) identified tolerances in construction practices as a major cause of defects, especially in low-rise residential buildings. These findings align with earlier observations that inadequate workmanship and poor-quality materials contribute to structural failures.

Gurmu *et al.* (2021) developed a fuzzy-stochastic model to assess defects in low-rise residential buildings, revealing that chemical agents, such as moisture and salts, are among the primary causes of wall defects. Moisture penetration, in particular, was found to be a critical factor leading to issues like efflorescence, cracking, and peeling paint. Furthermore,

Gurmu *et al.* (2022) conducted a scientometric analysis of building defects research, concluding that mechanical agents (e.g., ground movement) and human actions (e.g., misuse by occupants) also play significant roles in causing wall defects.

Types of Wall Defects

Wall defects manifest in various forms, including cracks, dampness penetration, peeling paint, and efflorescence. Sandanayake *et al.* (2022) investigated residential building defects in Victoria, Australia, and reported that cracks were the most common type of defect observed. Cracks often result from foundation settlement, thermal expansion, or shrinkage of building materials. Additionally, Faqih and Zayed (2021) highlighted the importance of condition assessments in identifying early signs of wall defects, which can help prevent more severe damage.

In hospital buildings, Olanrewaju *et al.* (2022) noted that wall defects frequently arise due to poor maintenance practices and inadequate supervision during construction. Their study underscores the need for routine inspections and timely repairs to mitigate these issues. Similarly, Jesumoroti *et al.* (2024) examined defects in Malaysian hospital buildings and found that chemical reactions, such as sulfate attack on concrete, were prevalent causes of wall deterioration.

Remedial Measures

Effective remediation requires understanding the root causes of defects. Carretero-Ayuso *et al.* (2021) explored the interrelations between different types of damages and their original causes, emphasizing the importance of targeted interventions. For instance, addressing water infiltration through improved drainage systems and waterproofing can significantly reduce dampness-related issues. Moreover, Paton-Cole and Aibinu (2021) suggested that disputes over defects could be minimized by implementing robust quality control measures during construction and adopting standardized inspection protocols.

Recent advancements in repair techniques have also been documented such as using durable materials and advanced sealing technologies to enhance the longevity of repaired structures. In addition, regular maintenance schedules to prevent minor defects from escalating into major problems. These strategies include repainting walls, applying water repellents, and ensuring proper ventilation to combat dampness.

Summary of key Findings from Existing Literature

The reviewed literature reveals that wall defects in buildings, including student hostels, are primarily caused by; Chemical agents such as moisture penetration, salt crystallization, and sulfate attack. Mechanical agents such as ground movement, foundation settlement, and structural overload. Building users attitude including misuse, lack of awareness, and inadequate maintenance practices. To address these issues effectively, researchers recommend;

- i. Employing skilled personnel during construction and maintenance.

- ii. Using high-quality, durable materials resistant to environmental stresses.
- iii. Implementing routine inspections and preventive maintenance programs.
- iv. Educating occupants about responsible usage and reporting potential problems promptly.

Methodology

This study employed a systematic approach to investigate the causes and remedies of wall defects in student hostels at Federal Polytechnic Damaturu, Yobe State, Nigeria. The methodology involved both qualitative and quantitative data collection techniques, ensuring comprehensive analysis of the identified issues.

Research Design

The research adopted an observational and survey-based design. This approach allowed for direct observation of the physical condition of the buildings and the identification of specific types of wall defects. Additionally, interviews with key stakeholders shed more light into the underlying causes of these defects. The primary objective was to assess the condition of the walls in selected student hostels/halls, determine the most common types of defects, and identify their root causes. Data were collected using checklists for building condition surveys and oral interview score sheets, which helped in systematically documenting the findings.

Population and Sampling

The population for this study consisted of the student hostels within Federal Polytechnic Damaturu. Blocks across the five hostels; Modibbo Adama, Bubayero, Dabo Aliyu, Nazargamu Hall, and El-Kanemi Hall, were identified as part of the study population (Table 1). From this population, samples were randomly selected for detailed inspection.

Data Collection Instruments

Two main instruments were used for data collection:

- i. Building Condition Survey Checklist: This checklist was designed to document various types of wall defects observed during site visits. It included categories such as cracks, dampness penetration, peeling paint, efflorescence, and other visible signs of deterioration.
- ii. Oral Interview Score Sheet: Semi-structured interviews were conducted with maintenance personnel, hostel supervisors, and students to gather information about the perceived causes of defects and existing maintenance practices.

Data Collection Procedure

Fieldwork involved visiting each selected hostel block to conduct visual inspections and record observations using the building condition survey checklist. Interviews

complemented the field observations by providing contextual details regarding the usage patterns, maintenance schedules, and any previous repairs carried out on the structures.

Data Analysis

Data collected from the field surveys were analyzed quantitatively using descriptive statistics. Results were presented in tabular form and visually represented through charts for clarity. For example: Table 1 presented the complete results of defects identified in all the representative hostels. Similarly, Figures 1 through 6 provided detailed analyses for the remaining hostels, highlighting variations in the prevalence of different defect causes.

Limitations of the Study

While the methodology ensured a thorough investigation of wall defects in the selected hostels, certain limitations must be acknowledged:

- i. Due to time limitations, the study could not cover all blocks comprehensively.
- ii. Some defects may have been subjectively assessed during visual inspections, potentially introducing bias.
- iii. The study focused exclusively on student hostels, which may not fully reflect the broader range of building defects across the entire campus.

Results and Discussions

Results

The results of this study were derived from the field survey conducted on the student hostels at Federal Polytechnic Damaturu, Yobe State, Nigeria. Data were collected using a building condition survey checklist and oral interviews with key stakeholders, including maintenance personnel and hostel occupants. The analysis focused on identifying the types of wall defects, their causes, and their prevalence across the selected hostels.

Frequency and Percentage Analysis of Wall Defect Causes

Table 1 present the frequency and percentage distribution of the identified causes of wall defects in the surveyed hostels.

Table 1: Summary of causes of wall defects across hostels (Source: Authors Field Work)

Cause of Defects	Observed Frequency						Observed Percentage (%)					
	Modibbo Adama Hall	Bubayero Hall	Dabo Aliyu Hall	Nazargamu Hall	El-Kanemi Hall	Overall	Modibbo Adama Hall	Bubayero Hall	Dabo Aliyu Hall	Nazargamu Hall	El-Kanemi Hall	Overall
Mechanical Agents	14.0	6.0	7.0	9.0	5.0	41.0	35.0	16.7	13.9	22.5	13.9	21.8
Electromagnetic Agents	1.0	1.0	0.0	1.0	0.0	3.0	2.5	2.8	0.0	2.5	0.0	1.6
Thermal Agents	2.0	5.0	2.0	2.0	3.0	14.0	5.0	13.9	8.3	5.0	8.3	7.4
Chemical Agents	10.0	9.0	12.0	12.0	11.0	54.0	25.0	25.0	30.6	30.0	30.6	28.7
Biological Agents	3.0	2.0	2.0	5.0	2.0	14.0	7.5	5.6	5.6	12.5	5.6	7.4
Building Users	7.0	10.0	9.0	8.0	9.0	43.0	17.5	27.8	25.0	20.0	25.0	22.9
Earth Movement	3.0	3.0	4.0	3.0	6.0	19.0	7.5	8.3	16.7	7.5	16.7	10.1
Total	40.0	36.0	36.0	40.0	36.0	188.0	100.0	100.0	100.0	100.0	100.0	100.0

From the results presented in Figure 1, it is evident that chemical agents, mechanical agents, and building users were the primary causes of wall defects in the student hostels. Chemical agents accounted for 28.7% of the defects, followed by mechanical agents (21.8%) and building users (22.9%).

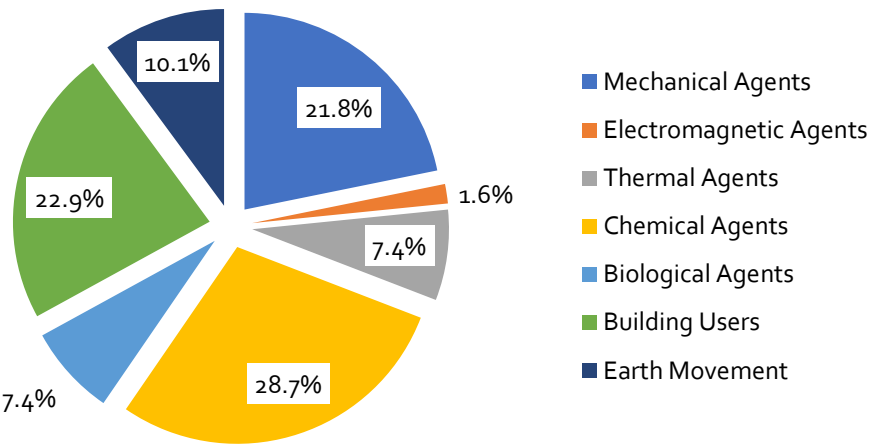


Figure 1: Overall Summary of Causes of Wall Defects Across Student Hostels (Source: Authors Field Work)

Results of Causes of Defect for Each Hostel

The following tables provide a detailed breakdown of the causes of wall defects in each hostel; In Modibbo Adama Hall, mechanical agents were the leading cause of defects, accounting for 35.0% of the total defects observed as presented in Figure 2.

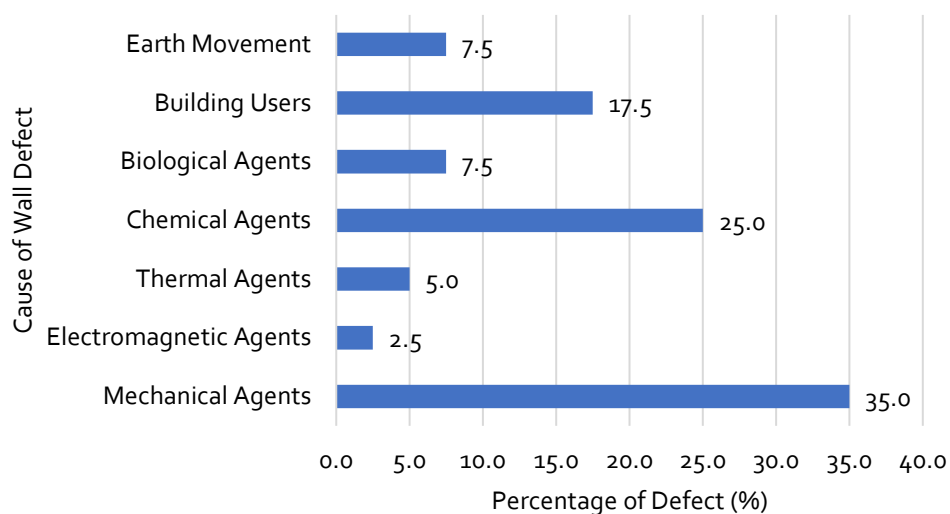


Figure 2: Causes of Wall Defects at Modibbo Adama Hall (Source: Authors Field Work)

For Bubayero Hall (Figure 3), building users emerged as the primary cause of defects, contributing 27.8% of the total defects.

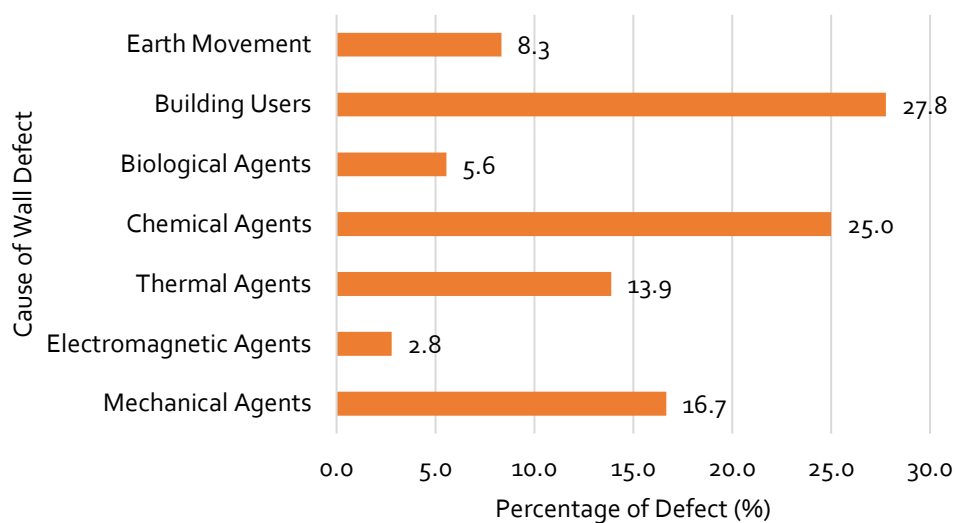


Figure 3: Causes of Wall Defects at Bubayero Hall (Source: Authors Field Work)

Similarly, Figure 4 presents the results of the assessment of the causes of defects in Dabo Aliyu Hall, from which chemical agents emerged as the prevalent cause of defects, contributing 30.6% of the total defects.

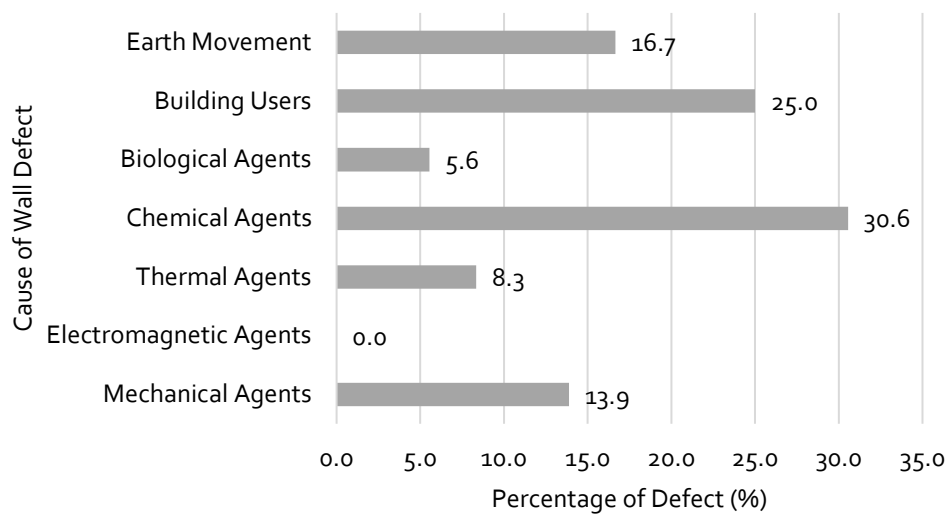


Figure 4: Causes of Wall Defects at Dabo Aliyu Hall (Source: Authors Field Work)

Also, Figure 5 presents the results of the causes of defects in the “Nazargamu Hall”, from which chemical agents is the dominant cause of defects in the hostel, contributing 30.0% of the total defects.

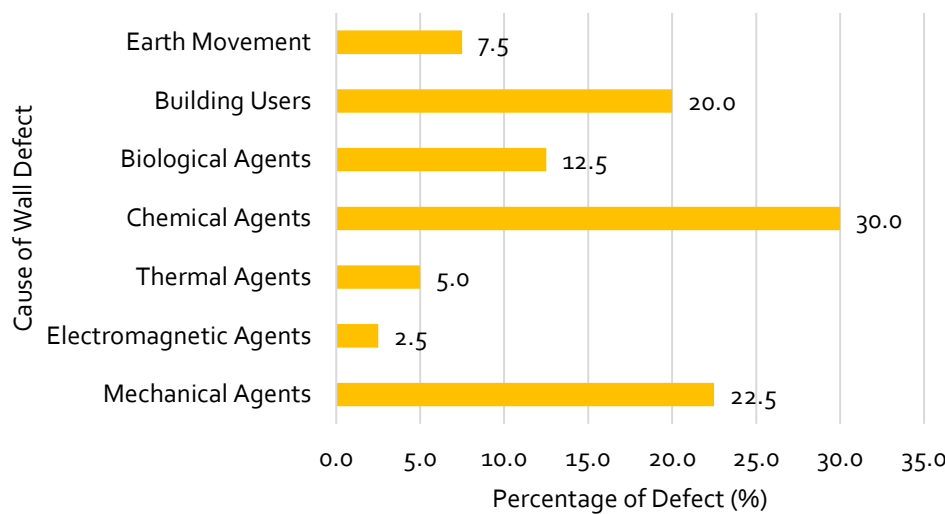


Figure 5: Causes of Wall Defects at Nazargamu Hall (Source: Authors Field Work)

For El-Kanemi Hall, presented in Figure 6, chemical agents were the dominant cause of defects, contributing 30.6% of the total.

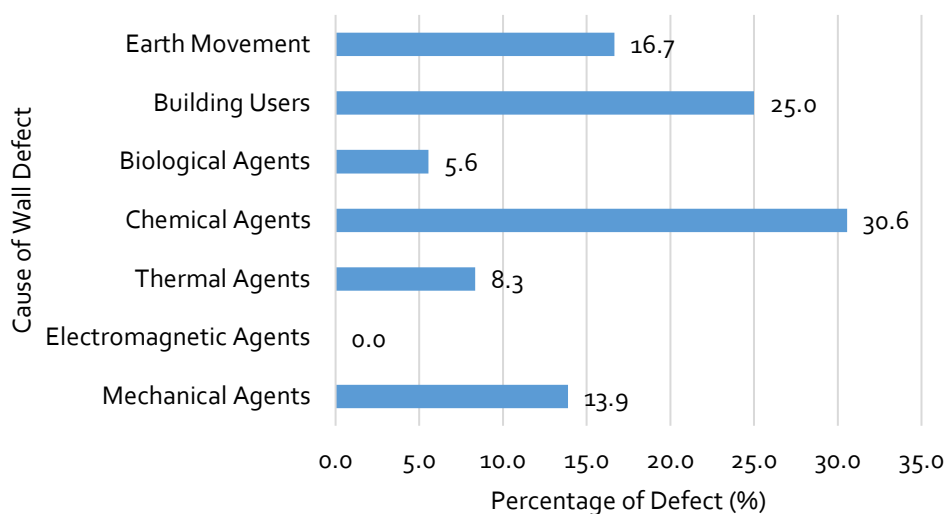


Figure 6: Causes of Wall Defects at El-Kanemi Hall (Source: Authors Field Work)

Common Wall Defects Observed

The following defects were commonly observed during the field survey:

- i. Cracks: Vertical, diagonal, and horizontal cracks were prevalent, particularly in areas affected by ground movement and chemical reactions.
- ii. Dampness Penetration: Water infiltration through walls was a recurring issue, often caused by leaking gutters, poor drainage systems, and high moisture content in the soil.
- iii. Peeling Paint: Exposed walls showed signs of peeling paint due to water leakage, inadequate surface preparation, and exposure to harsh weather conditions.
- iv. Efflorescence: White salt deposits were observed on walls, indicating moisture migration through masonry materials.

Summary of Key Findings

- i. Chemical agents (e.g., moisture, sulfate attack) were the most common cause of wall defects, affecting approximately 29% of the structures.
- ii. Mechanical agents (e.g., ground pressure, vibration) and building users (e.g., misuse, lack of maintenance culture) were also significant contributors, accounting for 21.8% and 22.9%, respectively.
- iii. The most frequent types of defects included cracks, dampness penetration, peeling paint, and efflorescence.

Discussion of Results

The findings of this study align with and extend existing research on the causes and remediation of wall defects in buildings, particularly in student hostels. The results indicate that chemical agents, mechanical agents, and building users are the primary contributors

to wall defects in the student hostels at Federal Polytechnic Damaturu. This discussion explores these findings in light of recent studies and provides insights into their implications for practice.

Chemical Agents as a Major Cause of Wall Defects

Chemical agents, particularly moisture, were identified as the most significant cause of wall defects, accounting for 28.9% of the observed issues. This finding is consistent with the literature, which highlights water as one of the most pervasive chemical agents affecting building materials (Gurmu *et al.*, 2021). Water penetration can lead to efflorescence, corrosion of reinforcing steel, and degradation of masonry materials. For instance, Talebi *et al.* (2021) noted that sulfate attack on Portland cement products is a common issue in low-rise residential buildings, while Faqih and Zayed (2021) emphasized the importance of condition assessments to detect early signs of moisture-related damage. In the context of student hostels, high humidity levels and inadequate drainage systems exacerbate the problem of dampness penetration. As reported by Olanrewaju *et al.* (2022) maintenance practices accelerate building deterioration, especially in institutional settings like hospitals and educational facilities.

Mechanical Agents and Structural Instability

Mechanical agents, such as ground pressure and vibration, accounted for 21.8% of the defects observed in this study. These findings corroborate earlier research indicating that structural instability caused by mechanical forces is a prevalent issue in buildings with ground movement due to soil instability or changes in stress-state frequently cited as a contributing factor. For example, Van Den Bossche *et al.* (2023) demonstrated how demographic, geographical, and climatological factors influence building defects in Belgium, highlighting the role of soil conditions in causing cracks and other forms of structural failure. Cracks, both vertical and diagonal, were commonly observed in the surveyed hostels. According to Paton-Cole and Aibinu (2021), cracks often result from foundation settlement, thermal expansion, or shrinkage of building materials. In some cases, tree roots penetrating near the foundations were identified as a source of uneven settlement, further supporting the observations made during this study.

Building Users and Human-Induced Defects

Building users emerged as another significant cause of wall defects, contributing 22.9% of the total issues identified. This aligns with previous studies that emphasize the impact of human behavior on building performance. For instance, Ahmad and Abdul Rahman (2010) attributed many defects in developing countries to occupant-related factors, such as hanging heavy objects on walls or damaging finishes through neglect. Similarly, Carretero-Ayuso *et al.* (2021) highlighted the interrelations between user actions and building damage, emphasizing the need for education and awareness programs to promote responsible usage.

The findings also reflect the importance of fostering a culture of maintenance among building occupants. Due to the fact that deliberate ill use, such as vandalism, and unintentional actions, like condensation caused by cooking or heating appliances, can accelerate deterioration. Therefore, educating students about the consequences of their actions and encouraging them to report defects promptly could help mitigate these issues.

Remedial Measures and Maintenance Practices

Effective remediation requires addressing the root causes of defects rather than merely treating surface symptoms. The principles of repair outlined in the literature emphasize the importance of analyzing the underlying causes before implementing solutions. Often regular inspections and timely interventions is recommended to prevent minor defects from escalating into major problems. Repainting walls, applying water repellents, and ensuring proper ventilation are practical measures that can significantly reduce the incidence of peeling paint and dampness penetration. Furthermore, employing skilled personnel and using durable materials during construction and maintenance are critical to minimizing defects. Gurmu *et al.* (2021) developed a fuzzy-stochastic model to assess defects in low-rise residential buildings, concluding that inadequate workmanship and substandard materials are major contributors to building failures. By adopting proven techniques and preserving original design features, institutions like Federal Polytechnic Damaturu can enhance the longevity and functionality of their structures.

Comparison with Previous Studies

This study findings aligned with those of Sandanayake *et al.* (2022), who investigated residential building defects in Victoria, Australia. They reported that cracks were the most frequent type of defect observed, often resulting from foundation settlement or thermal movement. Additionally, Jesumoroti *et al.* (2024) examined defects in Malaysian hospital buildings, identifying chemical reactions, such as sulfate attack, as a leading cause of wall deterioration. These parallels underscore the universality of certain defect types and their underlying causes across different regions and building types. However, there are notable differences in the prevalence of specific agents. For example, electromagnetic agents played a minimal role in the current study, accounting for only 1.6% of the defects.

Implications for Practice

Based on the findings, the following recommendations were made to improve the condition of student hostels:

- i. Routine inspections and preventive maintenance should be prioritized to address minor defects before they worsen.
- ii. Programs aimed at raising awareness among students about responsible usage and the importance of reporting defects can foster a proactive maintenance culture.
- iii. Ensuring the use of high-quality materials and skilled labor during construction will reduce the likelihood of defects occurring in the first place.

- iv. Considering the climatic and geological characteristics of Yobe State when designing and constructing buildings can mitigate the impact of environmental factors on building performance.

Conclusions and Recommendations

This study investigated the causes and remedial measures of wall defects in student hostels at Federal Polytechnic Damaturu, Yobe State, Nigeria. The findings revealed that chemical agents, mechanical agents, and building users were the primary contributors to wall defects, accounting for 28.7%, 21.8%, and 22.9% of the identified issues, respectively. Common types of wall defects observed included cracks, dampness penetration, peeling paint, and efflorescence.

The research emphasizes the importance of addressing both external environmental factors and internal user behavior to mitigate wall defects effectively. Inadequate maintenance practices, substandard materials, and improper usage by occupants were significant contributing factors. To improve the condition of the student hostels, the following recommendations are proposed:

- i. Enhanced Maintenance Practices: Regular inspections and timely repairs should be prioritized to prevent minor defects from escalating into major problems.
- ii. User Education: Programs aimed at raising awareness among students about responsible usage and the importance of reporting defects can foster a proactive maintenance culture.
- iii. Improved Construction Standards: Ensuring the use of high-quality materials and skilled labor during construction will reduce the likelihood of defects occurring in the first place.
- iv. Adaptation to Local Conditions: Considering the climatic and geological characteristics of Yobe State when designing and constructing buildings can mitigate the impact of environmental factors on building performance.

Author(s) Contributions

The authors confirm contribution to the paper as follows:

Yahaya Saleh: Study conception and design, field data collection, extraction and analysis.

Ahmad Batari: Study conception, Data analysis, manuscript writing, and proofreading.

Buhari Mohammed Ardo: Proofreading and Manuscript editing.

Abubakar Usman Baraya: Field data collection and processing.

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Conflict of Interest

The authors declare no conflict of interest.

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